

# SAR TEST REPORT

For

**Handheld Rugged Terminal**

**Model Number: HRT700 HRT500**

**FCC ID: SX3-HRT700**

**Report Number : WT158002175**

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## Test report declaration

Applicant : PRADOTEC CORPORATION SDN. BHD. (807780-P)  
Address : IRIS Smart Technology Complex, Technology Park Malaysia,  
Bukit Jalil, Kuala Lumpur, Malaysia  
Manufacturer : OPTIMA KLASIK SDN.BHD.(807783-T)  
Address : IRIS Smart Technology Complex, Technology Park Malaysia,  
Bukit Jalil, Kuala Lumpur, Malaysia  
EUT Description : Handheld Rugged Terminal  
Model No : HRT500,HRT700  
Trade mark :   
Marketing name : /  
FCC ID : : SX3-HRT700

### Test Standards:

#### IEEE 1528-2003 FCC KDB 865664 D01 v01r3

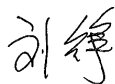
The EUT described above is tested by Shenzhen Academy of Metrology and Quality Inspection EMC Laboratory to determine the compliance of the applicable standards stated above.

Shenzhen Academy of Metrology and Quality Inspection EMC Laboratory is assumed full responsibility for the accuracy of the test results.

The results documented in this report only apply to the tested sample, under the conditions and modes of operation as described herein.

The test report shall not be reproduced in part without written approval of the laboratory.

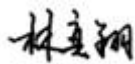
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Date: Jun.19.2015

#### Revision History

| No | Date       | Reason        |
|----|------------|---------------|
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## 1. REPORTED SAR SUMMARY

The maximum results of Specific Absorption Rate (SAR) found during testing are as follows.

### Highest Reported Standalone SAR Summary

HRT700

| Exposure Position      | Frequency Band | Highest Reported1g-SAR (W/kg) |
|------------------------|----------------|-------------------------------|
| Body-Hotspot( 0mm Gap) | GSM850         | 0.081                         |
| Body-Hotspot( 0mm Gap) | GSM1900        | 0.02                          |
| Body-Hotspot( 0mm Gap) | WCDMA V        | 0.048                         |
| Body-Hotspot( 0mm Gap) | Wi-Fi          | 0.005                         |

HRT500

| Exposure Position      | Frequency Band | Highest Reported1g-SAR (W/kg) |
|------------------------|----------------|-------------------------------|
| Body-Hotspot( 0mm Gap) | GSM850         | 0.021                         |
| Body-Hotspot( 0mm Gap) | GSM1900        | 0.123                         |
| Body-Hotspot( 0mm Gap) | WCDMA V        | 0.012                         |
| Body-Hotspot( 0mm Gap) | Wi-Fi          | 0.005                         |

## **2. GENERAL INFORMATION**

### **2.1. Report information**

This report is not a certificate of quality; it only applies to the sample of the specific product/equipment given at the time of its testing. The results are not used to indicate or imply that they are application to the similar items. In addition, such results must not be used to indicate or imply that SMQ approves recommends or endorses the manufacture, supplier or use of such product/equipment, or that SMQ in any way guarantees the later performance of the product/equipment.

The sample/s mentioned in this report is/are supplied by Applicant, SMQ therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture or any information supplied.

Additional copies of the report are available to the Applicant at an additional fee. No third part can obtain a copy of this report through SMQ, unless the applicant has authorized SMQ in writing to do so.

### **2.2. Laboratory Accreditation and Relationship to Customer**

The testing report were performed by the Shenzhen Academy of Metrology and quality Inspection EMC Laboratory (Guangdong EMC compliance testing center), in their facilities located at Bldg. of Metrology & Quality Inspection, Longzhu Road, Nanshan District, Shenzhen, Guangdong, China. At the time of testing, Laboratory is accredited by the following organizations:

China National Accreditation Service for Conformity Assessment (CNAS) accredits the Laboratory for conformance to FCC standards, EMC international standards and EN standards. The Registration Number is CNAS L0579.

The Laboratory is listed in the United States of American Federal Communications Commission (FCC), and the registration number are 446246 806614 994606 (semi anechoic chamber).

The Laboratory is registered to perform emission tests with Industry Canada (IC), and the registration number is IC4174.

TUV Rhineland accredits the Laboratory for conformance to IEC and EN standards, the registration number is E2024086Z02.

### 3. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

#### 3.1.DUT Description

|                       |  |
|-----------------------|--|
| Frequency Bands       | GSM850; GSM1900; WCDMA Band V  |
| Modulation Mode       | : GPRS: GMSK<br>EDGE: 8PSK<br>WCDMA: QPSK  |
| Antenna type          | RFID: Integrated Antenna 0dBi<br>BT: Chip Antenna 0dBi<br>WiFi: PCB Antenna 0dBi<br>GPS: Patch Antenna 0dBi<br>2G/3G: PCB Antenna 0dBi |
| Battery Model         | Lithium Polymer 3600mAh  |
| Battery Specification | 7.4V/3600mAh   |
| Hardware Revision     | V1.0   |
| Software Revision     | Windows CE 6.0   |

Remark: This product is prototype.



### 3.2. RF output power Tune up limit

#### **GSM/GPRS/EDGE850 (GMSK) :**

1TXslot: 31 dBm[-1dB~~+1.0dB]

2TXslot: 31 dBm[-1dB~~+1.0dB]

3TXslot: 31 dBm[-1dB~~+1.0dB]

4TXslot: 31 dBm [-1dB~~+1.0dB]

#### **EDGE850 (8PSK) :**

1TXslot: 25 dBm[-1dB~~+1.0dB]

2TXslot: 25 dBm[-1dB~~+1.0dB]

3TXslot: 25 dBm[-1dB~~+1.0dB]

4TXslot: 25 dBm [-1dB~~+1.0dB]

#### **PCS/GPRS/EDGE 1900 (GMSK) :**

1TXslot: 29 dBm [-1dB~~+1.0dB]

2TXslot: 29 dBm [-1dB~~+1.0dB]

3TXslot: 29 dBm [-1dB~~+1.0dB]

4TXslot: 29 dBm[-1dB~~+1.0dB]

#### **EDGE 1900 (8PSK) :**

1TXslot: 25 dBm [-1dB~~+1.0dB]

2TXslot: 25 dBm [-1dB~~+1.0dB]

3TXslot: 25 dBm [-1dB~~+1.0dB]

4TXslot: 25 dBm [-1dB~~+1.0dB]

### **The UMTS Band 5 power adjust procedure**

WCDMA: 22 dBm [-1dB~~+1dB]

HSDPA:

HSDPA Subtest 1: 21 dBm [-1dB~~+1.0dB]

HSDPA Subtest 2: 20 dBm [-1dB~~+1.0dB]

HSDPA Subtest 3: 20 dBm [-1dB~~+1.0dB]

HSDPA Subtest 4: 20 dBm [-1dB~~+1.0dB]

HSUPA:

HSUPA Subtest 1: 20 dBm [-1dB~~+1.0dB]

HSUPA Subtest 2: 20 dBm [-1dB~~+1.0dB]

HSUPA Subtest 3: 19.5 dBm [-1dB~~+1.0dB]

HSUPA Subtest 4: 21 dBm [-1dB~~+1.0dB]

HSUPA Subtest 5: 20.5 dBm [-1dB~~+1.0dB]

**BT Average Power:**

BT: 1dBm [-1dB~~+1.0dB]

**The Wi-Fi RF test procedure**

**WIFI**

Average Power:

11b: 11dBm[-1dB~~+1.0dB]

11g: 9dBm[-1dB~~+1.0dB]

### **3.3. Applied Standards**

- **FCC 47 CFR Part 2 (2.1093)**
- **ANSI/IEEE C95.1-1992**
- **IEEE 1528-2003**
- **FCC KDB 447498 D01 v05r02**
- **FCC KDB 648474 D04v01r02**
- **FCC KDB 248227 D01 v01r02**
- **FCC KDB 941225 D01 v02**
- **FCC KDB 941225 D06 v01**
- **FCC KDB 865664 D01 v03**
- **FCC KDB 616217 D04v01**

### **3.4. SAR Limit**

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

## 4. TEST CONDITIONS

### 4.1. Temperature and Humidity

|                           |       |
|---------------------------|-------|
| Ambient temperature (°C): | 21-22 |
| Ambient humidity (RH %):  | 59-60 |

### 4.2. Introduction of SAR

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for general public group.

SAR Definition:

$$SAR = \frac{d}{dt} \left( \frac{dW}{dm} \right) = \frac{d}{dt} \left( \frac{dW}{r dv} \right) \quad SAR = C \frac{dT}{dt} \quad SAR = \frac{\sigma |E|^2}{r}$$

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

In the second equation, C is the specific heat capacity,  $dT$  is the temperature rise and  $dt$  is the exposure duration.

The last equation relates to the electrical field, where  $\sigma$  is the conductivity of the tissue,  $\rho$  is the mass density of the tissue and E is the rms electrical field strength. However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

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

### 4.3. Test Configuration

#### GSM Test Configuration

The tests for GSM850 and GSM1900, a communication link is set up with a System Simulator by air link. The Absolute Radio Frequency Channel Number (ARFCN) is allocated to 128, 190 and 251 respectively in the case of GSM850, to 512, 661 and 810 respectively in the case of GSM1900. The tests in the band of GSM850 and GSM1900 are performed in the mode of GPRS/EGPRS function. Since the GPRS class is 10 for this EUT, it has at most 2 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslot is 5. The EGPRS class is 10 for this EUT, it has at most 2 timeslots in uplink, and at most 4 timeslots in downlink, the maximum total timeslot is 5. The device output power was set to maximum power level for all tests. Using CMU200 the power control level is set to "5" for GSM850, set to "0" for GSM1900.

#### WCDMA Test Configuration

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1 specification. The EUT supports power Class 3, which has a nominal maximum output power of 24 dBm (+1.7/-3.7).

|                        |                         |              |
|------------------------|-------------------------|--------------|
| WCDMA General Settings | Mode                    | Rel99        |
|                        | Subtest                 | ---          |
|                        | Loopback Mode           | Test Mode 1  |
|                        | Rel99 RMC               | 12.2kbps RMC |
|                        | Power Control Algorithm | Algorithm2   |
|                        | $b_c / b_d$             | 8/15         |

### WiFi Test configuration

For the 802.11b/g/n SAR tests, a communication link is set up with the test mode software for WiFi mode test. The Absolute Radio Frequency Channel Number(ARFCN) is allocated to 1, 6 and 11 respectively in the case of 2450 MHz. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. Each channel should be tested at the lowest data rate.

The distance between the DUT and the antenna of the System Simulator is larger than 50 cm. A fully charged battery was used for every test sequence.

For all the testing, measurements follow the EN 62209-1/-2 standards. The measurements were performed on the middle channel of both bands for each testing position. For the testing position with largest SAR result on each band, measurements of the lowest channel and highest channel were also performed.

The radiated output power of the device was measured by a separate test laboratory on the same unit(s) as used for SAR testing.

The tests shall be performed, which is illustrated in figure as below.

## 5. DESCRIPTION OF THE TEST EQUIPMENTS

### 5.1.Measurement System and Components

| No. | Equipment                            | Model No. | Manufacturer | Asset No. | Last Calibration Data | Period |
|-----|--------------------------------------|-----------|--------------|-----------|-----------------------|--------|
| 1   | SAR test system                      | TX60L     | SPEAG        | SB6810    | ---                   | ---    |
| 2   | SAR Probe                            | EX3DV4    | SPEAG        | SB6810/02 | 2014.07.22            | 1year  |
| 4   | System Validation Dipole,1900MHz     | D1900V2   | SPEAG        | SB6810/05 | 2012.09.21            | 3year  |
| 6   | Dielectric Probe Kit                 | 85070E    | SPEAG        | SB6810/12 | ---                   | ---    |
| 7   | Dual-directional coupler,0.10-2.0GHz | 778D      | Agilent      | SB6810/07 | ---                   | ---    |
| 8   | Dual-directional coupler,2.00-18GHz  | 772D      | Agilent      | SB6810/08 |                       |        |
| 9   | Coaxial attenuator                   | 8491A     | Agilent      | SB6810/09 | ---                   | ---    |
| 10  | Power Amplifier                      | ZHL42W    | Agilent      | SB6810/10 | ---                   | ---    |
| 11  | Signal Generator                     | SMR20     | R&S          | SB3438    | 2015.05.12            | 1year  |
| 12  | Power Meter                          | NRVD      | R&S          | SB3437    | 2015.04.16            | 1year  |
| 13  | Call Tester                          | CMU 200   | R&S          | SB3441    | 2015.01.07            | 1year  |
| 14  | Data Acquisition Electronics         | DAE4      | SPEAG        | SB6810/01 | 2015.03.09            | 1Year  |
| 15  | Software                             | DASY52    | SPEAG        | SB6810/14 | --                    | --     |
| 16  | Network Analyzer                     | E5071C    | Agilent      | SB9011/01 | 2015.04.23            | 1Year  |

The measurements were performed using an automated near-field scanning system, DASY5, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements was the “advanced extrapolation” algorithm.

## 5.2. Isotropic E-field Probe Type EX3DV4

|               |  |
|---------------|--|
| 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., butyl diglycol) |
| Calibration   | Calibration certificate in Appendix C  |
| Frequency     | 10MHz to 4GHz (dosimetry); Linearity: $\pm 0.2$ dB (30MHz to 4GHz)   |
| Directivity   | $\pm 0.2$ dB in HSL (rotation around probe axis)<br>$\pm 0.3$ dB in HSL (rotation normal to probe axis)  |
| Dynamic Range | 5 $\mu$ W/g to > 100mW/g; Linearity: $\pm 0.2$ dB  |
| Dimensions    | Overall length: 330 mm<br>Tip length: 20 mm<br>Body diameter: 12 mm<br>Tip diameter: 3.9 mm<br>Distance from probe tip to dipole centers: 2.0 mm   |
| Application   | General dosimetry up to 4 GHz<br>Compliance tests of mobile phones<br>Fast automatic scanning in arbitrary phantoms  |

## 5.3. Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).

System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.



SAM Twin Phantom

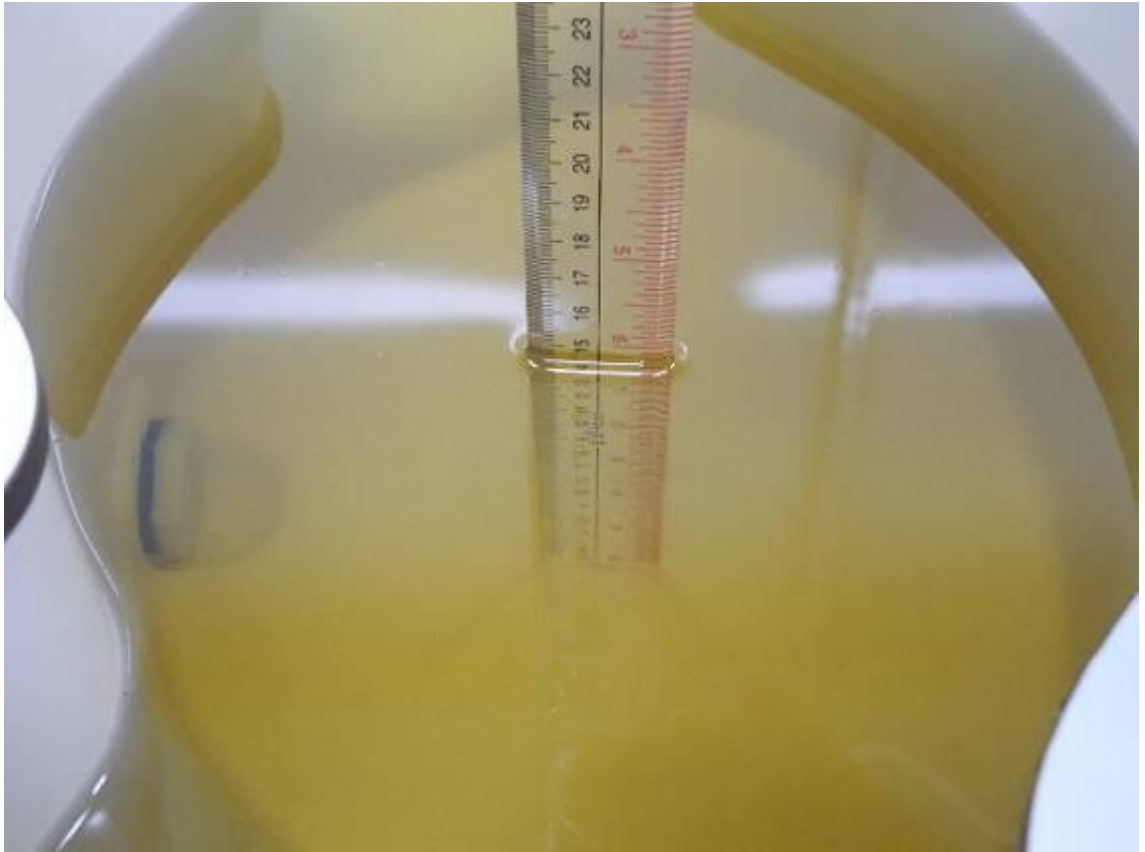
#### **5.4. Tissue-equivalent Liquids**

Tissue-equivalent liquids that are used for testing, which are made mainly of sugar, salt and water solution. All tests were carried out using tissue-equivalent liquids whose dielectric parameters were within  $\pm 5\%$  of the recommended values. All tests were carried out within 24 hours of measuring the dielectric parameters. The depth of the Tissue-equivalent liquid was  $15.0 \pm 0.5$  cm measured from the ear reference point (ERP) during system checking and device measurements.

Tissue-equivalent liquid Recipes

The following recipe(s) were used for Head Tissue-equivalent liquid(s):





| Ingredient<br>(% by weight ) | Frequency Band |           |         |           |
|------------------------------|----------------|-----------|---------|-----------|
|                              | 800-900        | 1800-1900 | 800-900 | 1800-1900 |
| Tissue Type                  | Head           | Head      | Body    | Body      |
| Water                        | 40.6           | 56.1      | 50.8    | 68.9      |
| Sugar                        | 58.2           | --        | 48.2    | --        |
| Salt                         | 1.0            | 0.03      | 0.9     | 0.1       |
| Preventol D-7                | 0.1            | --        | 0.1     | --        |
| DGMBE                        | --             | 43.87     | --      | 31        |
| Cellulose                    | 0.1            | --        | --      | --        |
| Ingredient<br>(% by weight ) | Frequency Band |           |         |           |
|                              | 2450           | 2450      |         |           |
| Tissue Type                  | Head           | Body      |         |           |
| Water                        | 54.8           | 68.4      |         |           |
| Sugar                        | --             | --        |         |           |
| Salt                         | --             | --        |         |           |
| Preventol D-7                | --             | --        |         |           |
| DGMBE                        | 45.2           | 31.6      |         |           |
| Cellulose                    | --             | --        |         |           |

#### Tissue-equivalent liquids used in the Measurements

Dielectric parameters of the Tissue-equivalent liquids were measured before testing using the dielectric probe kit and the Network Analyzer. The measurement is carried out following the Agilent 85070 dielectric probe software instruction. A calibration of the probe open in air, probe with shorting block and probe in water is performed before measurement. After calibration, Insert the probe into the tissue liquid, trigger a measurement on software interface and record the data.

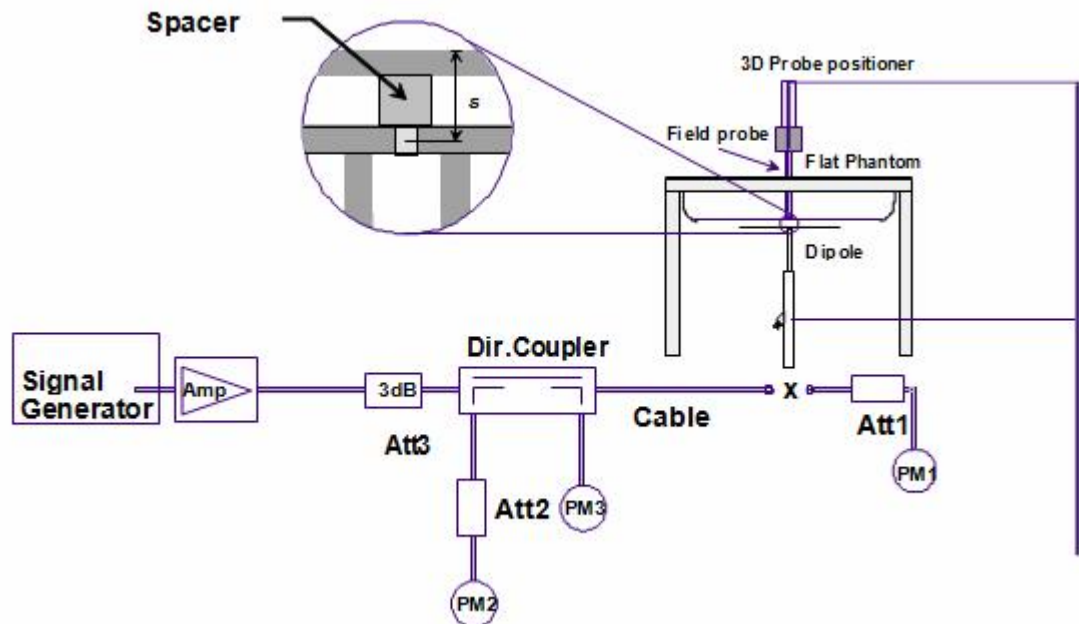
#### Body Tissue-equivalent liquid measurements:

| f/MHz | Date Tested | Dielectric Parameters | Target | Delta(%) | Tolerance (%) | Temp (°C) |
|-------|-------------|-----------------------|--------|----------|---------------|-----------|
| 850   | 2015/06/15  | $\epsilon_r = 55.87$  | 55.2   | 1.22     | ±5            | 22        |
|       |             | $S = 0.96$            | 0.97   | -1.04    |               |           |

|   |            |              |       |       |    |    |
|---|------------|--------------|-------|-------|----|----|
| 1900  | 2015/06/15 | $e_r$ =52.80 | 53.3  | -0.94 | ±5 | 22 |
|   |            | $S$ =1.45    | 1.52  | -4.61 |    |    |
| 2450  | 2015/06/15 | $e_r$ =52.74 | 50.71 | 4.0   | ±5 | 22 |
|   |            | $S$ =2.03    | 2.02  | 0.4   |    |    |
| $\epsilon_r$ = Relative permittivity, $\sigma$ = Conductivity |            |              |       |       |    |    |

## System Checking

The manufacturer calibrates the probes annually. A system check measurement was made following the determination of the dielectric parameters of the tissue-equivalent liquid, using the dipole validation kit. A power level of 250mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom.



The system checking results (dielectric parameters and SAR values) are given in the table below.

System checking, Body Tissue-equivalent liquid:

| f/MHz | Date Tested | SAR(W/kg), 1g | Target | Delta(%) | Tolerance (%) | Temp (°C) |
|-------|-------------|---------------|--------|----------|---------------|-----------|
| 835   | 2015/06/15  | 9.92          | 9.46   | 4.86     | ±10           | 22        |
| 1900  | 2015/06/15  | 40.8          | 40.7   | -0.25    | ±10           | 22        |
| 2450  | 2015/06/15  | 55.6          | 50.8   | 9.45     | ±10           | 22        |

Plots of the system checking scans are given in Appendix A.

## 5.5. 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

## 5.6. Test Position

### Against Phantom Head

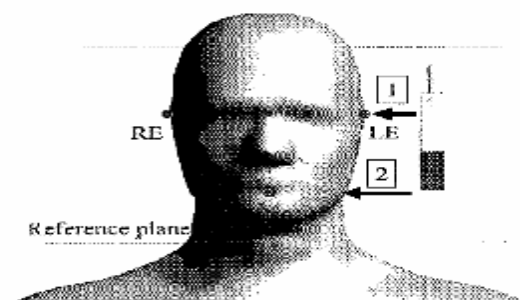
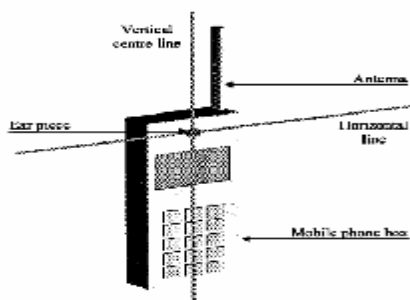
The Mobile phone shall be tested in the “cheek” and “tilted” position on left and right sides of the phantom.

Define of the “cheek” position:

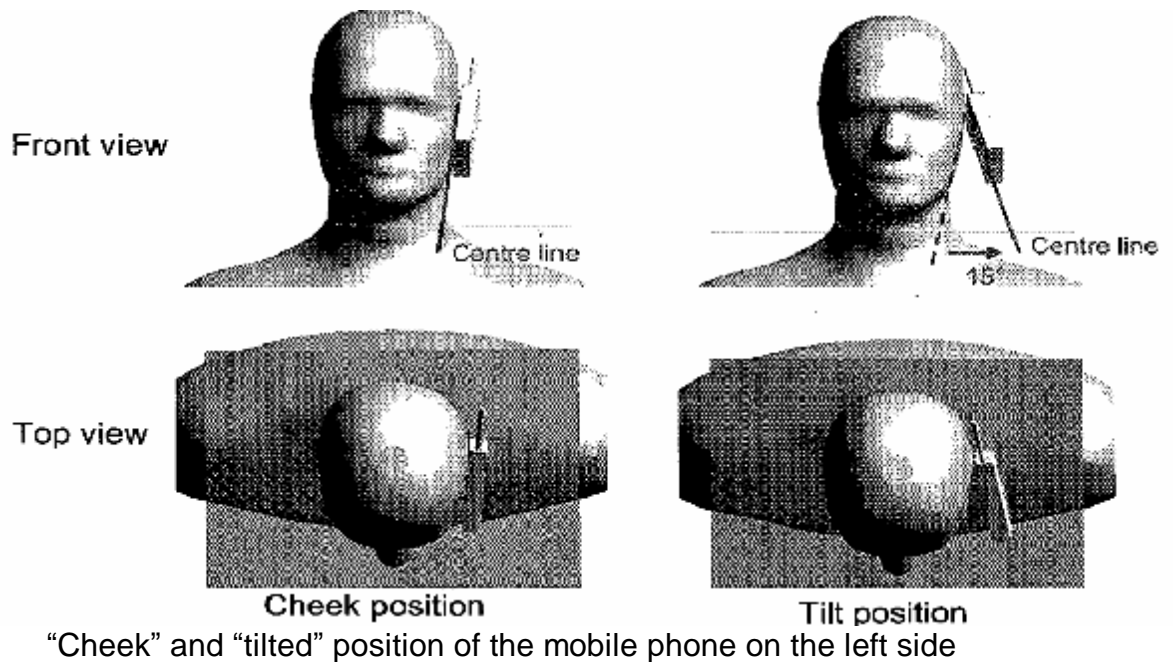
- a) Position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M, RE and LE) and align the center of the ear piece with the line RE-LE.
- b) Translate the mobile phone box towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost.

Define of the “tilted” position:

- a) Position the device in the “cheek” position described above.
- b) While maintaining the device the reference planes described above and pivoting against the ear, move it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost.



Define of the reference lines and points,  
on the phone and on the phantom and initial position



#### Body Worm Configuration

Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. Devices with a headset output should be tested with a headset connected to the device. The distance between of the device and the phantom was kept 15mm.

#### 5.7. Scan Procedures

First, area scans were used for determination of the field distribution. Next, a zoom scan, a minimum of 5x5x7 points covering a volume of at least 30x30x30mm, was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

#### 5.8. SAR Averaging Methods

The DASY5 software includes all numerical procedures necessary to evaluate the spatial peak SAR values. The base for the evaluation is a “cube” measurement in a volume of (30mm)<sup>3</sup> (7x7x7 points). The maximum SAR value was averaged over the cube of tissue using interpolation and extrapolation.

The interpolation, extrapolation and maximum search routines within Dasy5 are all based on the modified Quadratic Shepard’s method.

The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighbouring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.

In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

## 6. MEASUREMENT UNCERTAINTY

### 6.1. Uncertainty for SAR Test

Uncertainty Budget of DASY for frequency range 300 MHz to 3 GHz

| Uncertainty Component   | Tol. (%) | Prob Dist. | Div        | ci (1g) | ci.ui(%) (1g) | vi         |
|---|----------|------------|------------|---------|---------------|------------|
| Measurement System  |          |            |            |         |               |            |
| Probe Calibration   | ±5.9     | N          | 1          | 1       | ±5.9          | ∞          |
| Axial Isotropy  | ±4.7     | R          | $\sqrt{3}$ | 0.7     | ±1.9          | ∞          |
| Hemispherical Isotropy  | ±9.6     | R          | $\sqrt{3}$ | 0.7     | ±3.9          | ∞          |
| Boundary Effect   | ±1.0     | R          | $\sqrt{3}$ | 1       | ±0.6          | ∞          |
| Linearity   | ±4.7     | R          | $\sqrt{3}$ | 1       | ±2.7          | ∞          |
| System Detection Limits   | ±1.0     | R          | $\sqrt{3}$ | 1       | ±0.6          | ∞          |
| Readout Electronics   | ±0.3     | N          | 1          | 1       | ±0.3          | ∞          |
| Response Time   | ±0.8     | R          | $\sqrt{3}$ | 1       | ±0.5          | ∞          |
| Integration Time  | ±2.6     | R          | $\sqrt{3}$ | 1       | ±1.5          | ∞          |
| RF Ambient Conditions - Noise   | ±3.0     | R          | $\sqrt{3}$ | 1       | ±1.7          | ∞          |
| RF Ambient Conditions - Reflections   | ±3.0     | R          | $\sqrt{3}$ | 1       | ±1.7          | ∞          |
| Probe Positioner Mechanical Tolerance   | ±0.4     | R          | $\sqrt{3}$ | 1       | ±0.2          | ∞          |
| Probe Positioning with respect to Phantom Shell                                 | ±2.9     | R          | $\sqrt{3}$ | 1       | ±1.7          | ∞          |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | ±1.0     | R          | $\sqrt{3}$ | 1       | ±0.6          | ∞          |
| <b>Test Sample Related</b>  |          |            |            |         |               |            |
| Test Sample Positioning   | ±2.9     | N          | 1          | 1       | ±2.9          | 145        |
| Device Holder Uncertainty   | ±3.6     | N          | 1          | 1       | ±3.6          | 5          |
| Output Power Variation - SAR drift measurement                                  | ±5.0     | R          | $\sqrt{3}$ | 1       | ±2.9          | ∞          |
| <b>Phantom and Tissue Parameters</b>  |          |            |            |         |               |            |
| Phantom Uncertainty (shape and thickness tolerances)                            | ±4.0     | R          | $\sqrt{3}$ | 1       | ±2.3          | ∞          |
| Conductivity Target - tolerance   | ±5.0     | R          | $\sqrt{3}$ | 0.43    | ±1.2          | ∞          |
| Conductivity - measurement uncertainty  | ±2.5     | N          | 1          | 0.43    | ±1.1          | ∞          |
| Permittivity Target - tolerance   | ±5.0     | R          | $\sqrt{3}$ | 0.49    | ±1.4          | ∞          |
| Permittivity - measurement uncertainty  | ±2.5     | N          | 1          | 0.49    | ±1.2          | 5          |
| <b>Combined Standard Uncertainty</b>  |          |            |            |         | <b>±10.7</b>  | <b>387</b> |
| <b>Expanded STD Uncertainty</b>   |          |            |            |         | <b>±21.4</b>  |            |



## 6.2. Uncertainty for System Validation

| Uncertainty Component       | Uncert. value | Prob. Dist. | Div.       | (ci) (1g) | Std. Unc. (1g) | (vi) v <sub>eff</sub> |
|-----------------------------|---------------|-------------|------------|-----------|----------------|-----------------------|
| Probe Calibration           | ±6.55 %       | N           | 1          | 1         | ±6.55 %        | 1                     |
| Axial Isotropy              | ±4.7 %        | R           | $\sqrt{3}$ | 1         | ±2.7 %         | 1                     |
| Hemispherical Isotropy      | ±9.6 %        | R           | $\sqrt{3}$ | 0         | ±0 %           | 1                     |
| Boundary Effects            | ±1.0 %        | R           | $\sqrt{3}$ | 1         | ±0.6 %         | 1                     |
| Linearity                   | ±4.7 %        | R           | $\sqrt{3}$ | 1         | ±2.7 %         | 1                     |
| System Detection Limits     | ±1.0 %        | R           | $\sqrt{3}$ | 1         | ±0.6 %         | 1                     |
| Modulation Response         | ±0 %          | R           | $\sqrt{3}$ | 1         | ±0 %           | 1                     |
| Readout Electronics         | ±0.3 %        | N           | 1          | 1         | ±0.3 %         | 1                     |
| Response Time               | ±0 %          | R           | $\sqrt{3}$ | 1         | ±0 %           | 1                     |
| Integration Time            | ±0 %          | R           | $\sqrt{3}$ | 1         | ±0 %           | 1                     |
| RF Ambient Noise            | ±1.0 %        | R           | $\sqrt{3}$ | 1         | ±0.6 %         | 1                     |
| RF Ambient Reflections      | ±1.0 %        | R           | $\sqrt{3}$ | 1         | ±0.6 %         | 1                     |
| Probe Positioner            | ±0.8 %        | R           | $\sqrt{3}$ | 1         | ±0.5 %         | 1                     |
| Probe Positioning           | ±6.7 %        | R           | $\sqrt{3}$ | 1         | ±3.9 %         | 1                     |
| Max. SAR Eval.              | ±2.0 %        | R           | $\sqrt{3}$ | 1         | ±1.2 %         | 1                     |
| Dipole Related              |               |             |            |           |                |                       |
| Deviation of exp. dipole    | ±5.5 %        | R           | $\sqrt{3}$ | 1         | ±3.2 %         | 1                     |
| Dipole Axis to Liquid Dist. | ±2.0 %        | R           | $\sqrt{3}$ | 1         | ±1.2 %         | 1                     |
| Input power & SAR drift     | ±3.4 %        | R           | $\sqrt{3}$ | 1         | ±2.0 %         | 1                     |
| Phantom and Setup           |               |             |            |           |                |                       |
| Phantom Uncertainty         | ±4.0 %        | R           | $\sqrt{3}$ | 1         | ±2.3 %         | 1                     |
| SAR correction              | ±1.9 %        | R           | $\sqrt{3}$ | 0.84      | ±0.9 %         | 1                     |
| Liquid Conductivity (meas.) | ±2.5 %        | N           | 1          | 0.71      | ±1.8 %         | 1                     |
| Liquid Permittivity (meas.) | ±2.5 %        | N           | 1          | 0.26      | ±0.7 %         | 1                     |
| Temp. unc. -Conductivity    | ±1.7 %        | R           | $\sqrt{3}$ | 0.71      | ±0.7 %         | 1                     |
| Temp. unc. -Permittivity    | ±0.3 %        | R           | $\sqrt{3}$ | 0.26      | ±0.0 %         | ∞                     |
| Combined Std. Uncertainty   |               |             |            |           | ±10.1 %        |                       |
| Expanded STD Uncertainty    |               |             |            |           | ±20.1 %        |                       |

## MEASUREMENT RESULTS

**Result:**

**Passed**

Date of testing 2015-05-15  
 Ambient temperature : 20°C~22°C  
 Relative humidity : 50~68%

### 6.3. Conducted Power

For the measurements a Rohde & Schwarz Radio Communication Tester CMU 200 was used. SAR drift measured at the same position in liquid before and after each SAR test.

Note: CMU200 measures GSM peak and average output power for active timeslots. For SAR the time based average power is relevant. The difference in between depends on the duty cycle of the TDMA signal :

| No. of timeslots                                     | 1       | 2       | 3       | 4       |
|--|---------|---------|---------|---------|
| Duty Cycle   | 1:8.3   | 1:4.1   | 1:2.77  | 1:2.08  |
| Time based avg. power compared to slotted avg. power | -9.19dB | -6.13dB | -4.42dB | -3.18dB |

The signalling modes differ as follows:

| mode | coding scheme | modulation |
|------|---------------|------------|
| GPRS | CS1 to CS4    | GMSK       |
| EDGE | MCS1 to MCS4  | GMSK       |
| EDGE | MCS5 to MCS9  | 8PSK       |

Apart from modulation change (GMSK/8PSK) coding schemes differ in code rate without influence on the RF signal. Therefore one coding scheme per mode was selected for conducted power measurements.

### HRT700 GSM Conducted Power Measurement Results

| Band: GSM850                 | Burst Average Power (dBm) |       |       | Frame Average Power (dBm) |              |              |
|------------------------------|---------------------------|-------|-------|---------------------------|--------------|--------------|
| Channel                      | 128                       | 190   | 251   | 128                       | 190          | 251          |
| Frequency (MHz)              | 824.2                     | 836.6 | 848.8 | 824.2                     | 836.6        | 848.8        |
| GPRS/EDGE (GMSK, 1 Tx slot)  | 31.98                     | 31.81 | 31.39 | 22.84                     | 22.62        | 22.2         |
| GPRS/EDGE (GMSK, 2 Tx slots) | 31.93                     | 31.75 | 31.27 | 25.8                      | 25.62        | 25.14        |
| GPRS/EDGE (GMSK, 3 Tx slots) | 31.96                     | 31.68 | 31.30 | 27.54                     | 27.26        | 26.88        |
| GPRS/EDGE (GMSK, 4 Tx slots) | 31.89                     | 31.71 | 31.27 | <b>28.71</b>              | <b>28.53</b> | <b>28.09</b> |
| EDGE (8PSK, 1 Tx slot)       | 25.71                     | 25.16 | 25.16 | 16.52                     | 15.97        | 15.97        |
| EDGE (8PSK, 2 Tx slots)      | 25.63                     | 25.11 | 25.09 | 19.5                      | 18.98        | 18.96        |
| EDGE (8PSK, 3 Tx slots)      | 25.61                     | 25.09 | 25.13 | 21.19                     | 20.67        | 20.71        |
| EDGE (8PSK, 4 Tx slots)      | 25.67                     | 25.05 | 25.11 | 22.49                     | 21.87        | 21.93        |

### HRT500 GSM Conducted Power Measurement Results

| Band: GSM850                 | Burst Average Power (dBm) |       |       | Frame Average Power (dBm) |              |              |
|------------------------------|---------------------------|-------|-------|---------------------------|--------------|--------------|
| Channel                      | 128                       | 190   | 251   | 128                       | 190          | 251          |
| Frequency (MHz)              | 824.2                     | 836.6 | 848.8 | 824.2                     | 836.6        | 848.8        |
| GPRS/EDGE (GMSK, 1 Tx slot)  | 31.91                     | 31.74 | 31.34 | 22.72                     | 22.55        | 22.15        |
| GPRS/EDGE (GMSK, 2 Tx slots) | 31.81                     | 31.65 | 31.30 | 25.68                     | 25.52        | 25.17        |
| GPRS/EDGE (GMSK, 3 Tx slots) | 31.75                     | 31.61 | 31.28 | 27.33                     | 27.19        | 26.86        |
| GPRS/EDGE (GMSK, 4 Tx slots) | 31.73                     | 31.60 | 31.25 | <b>28.55</b>              | <b>28.42</b> | <b>28.07</b> |
| EDGE (8PSK, 1 Tx slot)       | 25.59                     | 25.09 | 25.11 | 16.4                      | 15.9         | 15.92        |
| EDGE (8PSK, 2 Tx slots)      | 25.55                     | 25.07 | 25.10 | 19.42                     | 18.94        | 18.97        |
| EDGE (8PSK, 3 Tx slots)      | 25.53                     | 25.06 | 25.09 | 21.11                     | 20.64        | 20.67        |
| EDGE (8PSK, 4 Tx slots)      | 25.52                     | 25.05 | 25.08 | 22.34                     | 21.87        | 21.9         |

Remark:

- 1) The conducted power of GSM850 is measured with RMS detector.
- 2) Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
- 3) Per KDB941225 D01v03, the bolded GPRS 4Tx mode was selected as the primary mode for SAR testing according to the highest frame- averaged output power table.

### HRT700 GSM Conducted Power Measurement Results

| Band: GSM1900                | Burst Average Power (dBm) |       |        | Frame Average Power (dBm) |              |              |
|------------------------------|---------------------------|-------|--------|---------------------------|--------------|--------------|
| Channel                      | 512                       | 661   | 810    | 512                       | 661          | 810          |
| Frequency (MHz)              | 1850.2                    | 1880  | 1909.8 | 1850.2                    | 1880         | 1909.8       |
| GPRS/EDGE (GMSK, 1 Tx slot)  | 28.90                     | 29.30 | 29.17  | 19.71                     | 20.11        | 19.98        |
| GPRS/EDGE (GMSK, 2 Tx slots) | 28.84                     | 29.15 | 29.06  | 22.71                     | 23.02        | 22.93        |
| GPRS/EDGE (GMSK, 3 Tx slots) | 28.85                     | 29.16 | 29.00  | 24.43                     | 24.74        | 24.58        |
| GPRS/EDGE (GMSK, 4 Tx slots) | 28.83                     | 29.17 | 29.09  | <b>25.65</b>              | <b>25.99</b> | <b>25.91</b> |
| EGPRS (8PSK, 1 Tx slot)      | 25.20                     | 25.71 | 26.01  | 16.01                     | 16.52        | 16.82        |
| EGPRS (8PSK, 2 Tx slots)     | 25.10                     | 25.55 | 25.98  | 18.97                     | 19.42        | 19.85        |
| EGPRS (8PSK, 3 Tx slots)     | 25.05                     | 25.60 | 25.89  | 20.63                     | 21.18        | 21.47        |
| EGPRS (8PSK, 4 Tx slots)     | 25.10                     | 25.55 | 25.98  | 21.92                     | 22.37        | 22.8         |

### HRT500 GSM Conducted Power Measurement Results

| Band: GSM1900                | Burst Average Power (dBm) |       |        | Frame Average Power (dBm) |              |              |
|------------------------------|---------------------------|-------|--------|---------------------------|--------------|--------------|
| Channel                      | 512                       | 661   | 810    | 512                       | 661          | 810          |
| Frequency (MHz)              | 1850.2                    | 1880  | 1909.8 | 1850.2                    | 1880         | 1909.8       |
| GPRS/EDGE (GMSK, 1 Tx slot)  | 28.87                     | 29.39 | 29.15  | 19.68                     | 20.2         | 19.96        |
| GPRS/EDGE (GMSK, 2 Tx slots) | 28.67                     | 29.37 | 29.13  | 22.54                     | 23.24        | 23.0         |
| GPRS/EDGE (GMSK, 3 Tx slots) | 28.65                     | 29.36 | 29.12  | 24.23                     | 24.94        | 24.7         |
| GPRS/EDGE (GMSK, 4 Tx slots) | 28.62                     | 29.34 | 29.10  | <b>25.44</b>              | <b>26.16</b> | <b>25.92</b> |
| EGPRS (8PSK, 1 Tx slot)      | 25.17                     | 25.80 | 25.99  | 15.98                     | 16.61        | 16.8         |
| EGPRS (8PSK, 2 Tx slots)     | 25.16                     | 25.67 | 25.85  | 19.03                     | 19.54        | 19.72        |
| EGPRS (8PSK, 3 Tx slots)     | 25.14                     | 25.63 | 25.77  | 20.72                     | 21.21        | 21.35        |
| EGPRS (8PSK, 4 Tx slots)     | 25.13                     | 25.60 | 25.67  | 21.95                     | 22.42        | 22.49        |

Remark:

- 1) The conducted power of GSM1900 is measured with RMS detector.
- 2) Frame-averaged output power was calculated from the measured burst-averaged output power by converting the slot powers into linear units and calculating the energy over 8 timeslots.
- 3) Per KDB941225 D01v03, the bolded GPRS 4Tx mode was selected as the primary mode for SAR testing according to the highest frame- averaged output power table.

## HRT700 UMTS Conducted Power Measurement Results

| Band               |       | WCDMA Band V |       |
|--------------------|-------|--------------|-------|
| Channel            | 4,132 | 4,182        | 4,233 |
| Frequency (MHz)    | 826.4 | 836.4        | 846.6 |
| RMC 12.2K          | 23.41 | 22.99        | 22.56 |
| RMC 64kbps         | 22.63 | 22.67        | 22.59 |
| RMC 144kbps        | 22.60 | 22.64        | 22.63 |
| RMC 384kbps        | 22.58 | 22.68        | 22.59 |
| HSDPA Subtest-1    | 21.76 | 21.65        | 21.42 |
| HSDPA Subtest-2    | 20.82 | 20.75        | 20.81 |
| HSDPA Subtest-3    | 20.76 | 20.75        | 20.59 |
| HSDPA Subtest-4    | 20.71 | 20.67        | 20.61 |
| HSUPA Subtest-1    | 20.82 | 20.96        | 20.80 |
| HSUPA Subtest-2    | 21.15 | 21.00        | 20.90 |
| HSUPA Subtest-3    | 20.16 | 20.13        | 20.06 |
| HSUPA Subtest-4    | 21.13 | 21.58        | 21.45 |
| HSUPA Subtest-5    | 21.09 | 21.23        | 21.12 |
| DC-HSDPA Subtest-1 | 21.33 | 21.28        | 21.36 |
| DC-HSDPA Subtest-2 | 20.73 | 20.78        | 20.76 |
| DC-HSDPA Subtest-3 | 20.46 | 20.52        | 20.46 |
| DC-HSDPA Subtest-4 | 20.36 | 20.22        | 20.26 |

## HRT500 UMTS Conducted Power Measurement Results

| Band               |       | WCDMA Band V |       |
|--------------------|-------|--------------|-------|
| Channel            | 4,132 | 4,182        | 4,233 |
| Frequency (MHz)    | 826.4 | 836.4        | 846.6 |
| RMC 12.2K          | 23.34 | 22.92        | 22.49 |
| RMC 64kbps         | 23.27 | 22.87        | 22.44 |
| RMC 144kbps        | 23.29 | 22.79        | 22.49 |
| RMC 384kbps        | 23.32 | 22.91        | 22.49 |
| HSDPA Subtest-1    | 23.32 | 22.84        | 22.44 |
| HSDPA Subtest-2    | 22.54 | 22.08        | 21.62 |
| HSDPA Subtest-3    | 21.96 | 21.47        | 21.05 |
| HSDPA Subtest-4    | 21.65 | 21.2         | 20.76 |
| HSUPA Subtest-1    | 22.37 | 21.89        | 21.44 |
| HSUPA Subtest-2    | 20.29 | 19.83        | 19.39 |
| HSUPA Subtest-3    | 21.22 | 20.76        | 20.34 |
| HSUPA Subtest-4    | 21.01 | 20.53        | 20.14 |
| HSUPA Subtest-5    | 22.46 | 22.02        | 21.56 |
| DC-HSDPA Subtest-1 | 21.33 | 21.28        | 21.36 |
| DC-HSDPA Subtest-2 | 20.73 | 20.78        | 20.76 |
| DC-HSDPA Subtest-3 | 20.46 | 20.52        | 20.46 |
| DC-HSDPA Subtest-4 | 20.36 | 20.22        | 20.26 |

Remark:

1) The conducted power of UMTS Band V is measured with RMS detector

- 2) Per KDB 941225 D01v03, When the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq 0.25$  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 adjusted SAR is  $\leq 1.2$ W/kg, SAR measurement is not required for the secondary mode.

#### HRT700 WLAN 2.4GHz Band Conducted Power

| Wi-Fi<br>2450MHz      | Channel  | Average Power (dBm) for Data Rates (Mbps) |       |       |       |      |      |      |      |
|-----------------------|----------|---|-------|-------|-------|------|------|------|------|
|                       |          | 1   | 2     | 5.5   | 11    | /    | /    | /    | /    |
| 802.11b<br>2.4G(DSSS) | 1(2412)  | 10.9                                      | 10.78 | 10.73 | 10.62 | /    | /    | /    | /    |
|                       | 6(2437)  | 11.9                                      | 11.66 | 11.49 | 11.24 | /    | /    | /    | /    |
|                       | 11(2462) | 11.82                                     | 11.71 | 11.46 | 11.30 | /    | /    | /    | /    |
| 802.11g<br>2.4G(OFDM) | Channel  | 6   | 9     | 12    | 18    | 24   | 36   | 48   | 54   |
|                       | 1(2412)  | 6.8                                       | 6.05  | 6.1   | 6.02  | 5.94 | 5.82 | 5.6  | 5.48 |
|                       | 6(2437)  | 9.3                                       | 9.11  | 9.08  | 9.14  | 9.19 | 8.86 | 8.58 | 8.43 |
|                       | 11(2462) | 9.7                                       | 9.53  | 9.48  | 9.28  | 9.33 | 9.23 | 8.85 | 8.71 |

#### HRT500 WLAN 2.4GHz Band Conducted Power

| Wi-Fi<br>2450MHz      | Channel  | Average Power (dBm) for Data Rates (Mbps) |       |       |       |      |      |      |      |
|-----------------------|----------|---|-------|-------|-------|------|------|------|------|
|                       |          | 1   | 2     | 5.5   | 11    | /    | /    | /    | /    |
| 802.11b<br>2.4G(DSSS) | 1(2412)  | 10.7                                      | 10.58 | 10.53 | 10.42 | /    | /    | /    | /    |
|                       | 6(2437)  | 11.7                                      | 11.56 | 11.49 | 11.04 | /    | /    | /    | /    |
|                       | 11(2462) | 11.42                                     | 11.43 | 11.36 | 11.09 | /    | /    | /    | /    |
| 802.11g<br>2.4G(OFDM) | Channel  | 6   | 9     | 12    | 18    | 24   | 36   | 48   | 54   |
|                       | 1(2412)  | 6.6                                       | 5.85  | 5.9   | 5.82  | 5.74 | 5.62 | 5.4  | 5.28 |
|                       | 6(2437)  | 9.1                                       | 8.91  | 8.88  | 8.94  | 8.99 | 8.66 | 8.38 | 8.23 |
|                       | 11(2462) | 9.5                                       | 9.33  | 9.28  | 9.08  | 9.13 | 9.03 | 8.65 | 8.51 |

#### HRT700 Bluetooth 2.4GHz Band Conducted Power

| BT<br>2450 | Average Conducted Power (dBm) |      |      |
|------------|-------------------------------|------|------|
|            | 0CH                           | 39CH | 78CH |
| DH1        | 1.5                           | 1.5  | 1.5  |
| DH3        | 1.4                           | 1.4  | 1.4  |
| DH5        | 1.2                           | 1.2  | 1.2  |
| 3DH1       | -2.7                          | -2.7 | -2.7 |
| 3DH3       | -2.9                          | -2.9 | -2.9 |
| 3DH5       | -3.2                          | -3.2 | -3.2 |

#### HRT500 Bluetooth 2.4GHz Band Conducted Power

| BT<br>2450 | Average Conducted Power (dBm) |             |      |
|------------|-------------------------------|-------------|------|
|            | 0CH                           | 39CH        | 78CH |
| DH1        | 1.4                           | <b>1.4</b>  | 1.4  |
| DH3        | 1.3                           | <b>1.3</b>  | 1.3  |
| DH5        | 1.1                           | <b>1.1</b>  | 1.1  |
| 3DH1       | -2.8                          | <b>-2.8</b> | -2.8 |
| 3DH3       | -3.0                          | <b>-3.0</b> | -3.0 |
| 3DH5       | -3.3                          | <b>-3.3</b> | -3.3 |

#### 6.4. GSM850 SAR results

##### HRT700 GSM850 Body

Distance 0mm

| Band   | Mode             | Test Position | Ch. | Freq. (MHz) | Burst Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) |
|--------|------------------|---------------|-----|-------------|---------------------------|---------------------|----------------|---------------------|---------------------|
| GSM850 | GPRS(4 Tx slots) | Front         | 190 | 836.6       | 31.71                     | 32                  | 1.069          | 0.0552              | 0.058               |
| GSM850 | GPRS(4 Tx slots) | Back          | 190 | 836.6       | 31.71                     | 32                  | 1.069          | 0.076               | 0.081               |

##### HRT500 GSM850 Body

Distance 0mm

| Band   | Mode             | Test Position | Ch. | Freq. (MHz) | Burst Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) |
|--------|------------------|---------------|-----|-------------|---------------------------|---------------------|----------------|---------------------|---------------------|
| GSM850 | GPRS(4 Tx slots) | Front         | 190 | 836.6       |                           |                     |                | --                  |                     |
| GSM850 | GPRS(4 Tx slots) | Back          | 190 | 836.6       | 31.6                      | 32                  | 1.096          | 0.0194              | 0.021               |

#### 6.5. GSM1900 SAR results

##### HRT700 GSM1900 Body

Distance 0mm

| Band    | Mode             | Test Position | Ch. | Freq. (MHz) | Burst Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) |
|---------|------------------|---------------|-----|-------------|---------------------------|---------------------|----------------|---------------------|---------------------|
| GSM1900 | GPRS(4 Tx slots) | Front         | 661 | 1880        | 29.17                     | 30                  | 1.211          | 0.00897             | 0.011               |
| GSM1900 | GPRS(4 Tx slots) | Back          | 661 | 1880        | 29.17                     | 30                  | 1.211          | 0.0163              | 0.02                |

##### HRT500 GSM1900 Body

Distance 0mm

| Band    | Mode             | Test Position | Ch. | Freq. (MHz) | Burst Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) |
|---------|------------------|---------------|-----|-------------|---------------------------|---------------------|----------------|---------------------|---------------------|
| GSM1900 | GPRS(4 Tx slots) | Front         | 661 | 1880        |                           |                     |                | --                  |                     |
| GSM1900 | GPRS(4 Tx slots) | Back          | 661 | 1880        | 29.34                     | 30                  | 1.164          | 0.106               | 0.123               |

## 6.6. WCDMA Band V SAR results

### HRT700 WCDMA Band V Body

Distance 0mm

| Band         | Mode | Test Position | Ch.  | Freq. (MHz) | Burst Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) |
|--------------|------|---------------|------|-------------|---------------------------|---------------------|----------------|---------------------|---------------------|
| WCDMA Band V | RMC  | Front         | 4182 | 836.4       | 22.99                     | 23                  | 1.002          | 0.0366              | 0.037               |
| WCDMA Band V | RMC  | Back          | 4182 | 836.4       | 22.99                     | 23                  | 1.002          | 0.0481              | 0.048               |

### HRT500 WCDMA Band V Body

Distance 0mm

| Band         | Mode | Test Position | Ch.  | Freq. (MHz) | Burst Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) |
|--------------|------|---------------|------|-------------|---------------------------|---------------------|----------------|---------------------|---------------------|
| WCDMA Band V | RMC  | Front         | 4182 | 836.4       | --                        | --                  | --             | --                  | --                  |
| WCDMA Band V | RMC  | Back          | 4182 | 836.4       | 22.92                     | 23                  | 1.019          | 0.0117              | 0.012               |

## 6.7. Wifi SAR results

### HRT700 Wifi 802.11b Body

Distance 0mm

| Band | Mode    | Test Position | Ch. | Freq. (MHz) | Burst Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) |
|------|---------|---------------|-----|-------------|---------------------------|---------------------|----------------|---------------------|---------------------|
| Wifi | 802.11b | Front         | 6   | 2437        | 11.9                      | 12                  | 1.023          | 0.00441             | 0.005               |
| Wifi | 802.11b | Back          | 6   | 2437        | 11.9                      | 12                  | 1.023          | 0.00502             | 0.005               |

### HRT500 Wifi 802.11b Body

Distance 0mm

| Band | Mode    | Test Position | Ch. | Freq. (MHz) | Burst Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) |
|------|---------|---------------|-----|-------------|---------------------------|---------------------|----------------|---------------------|---------------------|
| Wifi | 802.11b | Front         | 6   | 2437        | --                        | --                  | --             | --                  | --                  |
| Wifi | 802.11b | Back          | 6   | 2437        | 11.7                      | 12                  | 1.072          | 0.00502             | 0.005               |



## 6.8.Repeated SAR results

Remark:

1 According to KDB 865664 D01v01r3, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8\text{W/kg}$ .

2 KDB 865664 D01v01r3, if the deviation among the repeated measurement is  $\leq 20\%$  and the measured SAR  $< 1.45\text{W/kg}$ , only one repeated measurement is required.

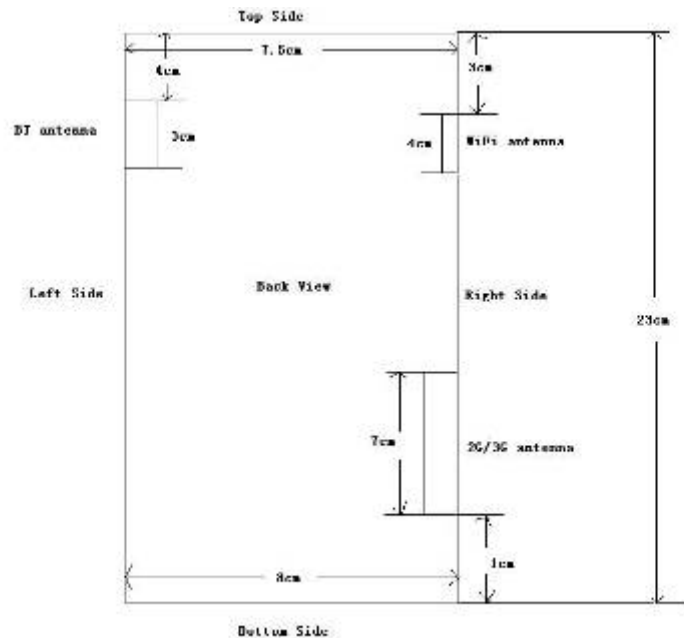
3 The variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

| Band | Mode | Test Position | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) | Ratio |
|------|------|---------------|-----|-------------|---------------------|---------------------|----------------|---------------------|---------------------|-------|
| --   |      |               |     |             |                     |                     |                |                     |                     |       |
| --   |      |               |     |             |                     |                     |                |                     |                     |       |

Measured SAR of all frequency band are lower than  $0.8\text{W/kg}$ , repeated SAR is not required .

## 7. EXPOSURE POSITIONS CONSIDERATION

### 7.1. Multiple Transmitter Evaluation



Hotspot Mode is not support, only Body-Worn test configuration is tested.

### 7.2. Stand-alone SAR test exclusion

Per FCC KDB447498D01v05, the 1-g SAR and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distances  $\leq 50$  mm are determined by:

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

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

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

| Mode | Position  | P <sub>max</sub><br>(dBm) | P <sub>max</sub><br>(mW) | Distance<br>(mm) | f(GHz) | Calculation<br>result | SAR<br>Exclusion<br>threshold | SAR<br>Test<br>exclusion |
|------|-----------|---------------------------|--------------------------|------------------|--------|-----------------------|-------------------------------|--------------------------|
| BT   | Body-worn | 0                         | 1                        | 5                | 2.45   | 0.08                  | 3                             | yes                      |

Table 1 standalone SAR test exclusion for BT

Note:

- 1) \*- maximum possible output power declared by manufacturer
- 2) Held to ear configurations are not applicable to Bluetooth for this device.

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

$$\left[ \frac{(\text{max.power of channel, including tune-up tolerance,Mw})}{(\text{min.test separation distance,mm})} \right] * [\sqrt{f(\text{GHz})}] \leq 3.0$$

$f(\text{GHz})/x] \text{W/kg}$  for test separation distances  $\leq 50\text{mm}$ , where  $x=7.5$  for 1-g SAR and  $x=18.75$  for 10-g SAR.

When the minimum test separation distance is  $<5\text{mm}$ , a distance of 5 mm is applied to determine SAR test exclusion

| Mode | Position  | $P_{\max}$<br>(dBm) | $P_{\max}$<br>(mW) | Distance<br>(mm) | f(GHz) | X   | Estimated<br>SAR(W/Kg)* |
|------|-----------|---------------------|--------------------|------------------|--------|-----|-------------------------|
| BT   | Body-worn | 0                   | 1                  | 5                | 2.45   | 7.5 | 0.611                   |

Table 2: Estimated SAR calculation for BT

- 1) \*- maximum possible output power declared by manufacturer
- 2) Held to ear configurations are not applicable to Bluetooth and therefore were not considered for simultaneous transmission.

### 7.3. Simultaneous Transmission Possibilities

The Simultaneous Transmission Possibilities of this device are as below:

| No. | Configuration             | Body-worn |
|-----|---------------------------|-----------|
| 1   | GPRS/EDGE(DATA)+ WiFi2.4G | N/A       |
| 2   | GPRS/EDGE(DATA)+ BT       | N/A       |
| 3   | UMTS(DATA)+ WiFi2.4G      | N/A       |
| 4   | UMTS(DATA)+ BT            | N/A       |

Table 3: Simultaneous Transmission Possibilities

Note:

- 1) Wi-Fi 2.4G and Bluetooth share the same Tx antenna and can't transmit simultaneously.
- 2) 2G&3G can't transmit simultaneously.
- 3) Held to ear configurations are not applicable to Bluetooth and therefore were not considered for simultaneous transmission.
- 4) Hotspot mode is not supported and WIF is not considered for simultaneous transmission.

**APPENDIX A:      SYSTEM CHECKING SCANS**

SystemPerformanceCheck-D835 Body

Date 2015.06.15.

DUT: Dipole 835 MHz D835V2; Type: D835V2;

Communication System: CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.96$  mho/m;  $\epsilon_r = 55.87$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3203; ConvF(6.2, 6.2, 6.2); Calibrated: 2014.12.19.;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn876; Calibrated: 2015.03.09.
- Phantom: SAM 1; Type: QD000P40CC; Serial: TP:1504
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Body/Dipole835/Area Scan (61x131x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 55.902 V/m; Power Drift = -0.52 dB

Fast SAR: SAR(1 g) = 2.55 mW/g; SAR(10 g) = 1.67 mW/g

Maximum value of SAR (interpolated) = 2.76 W/kg

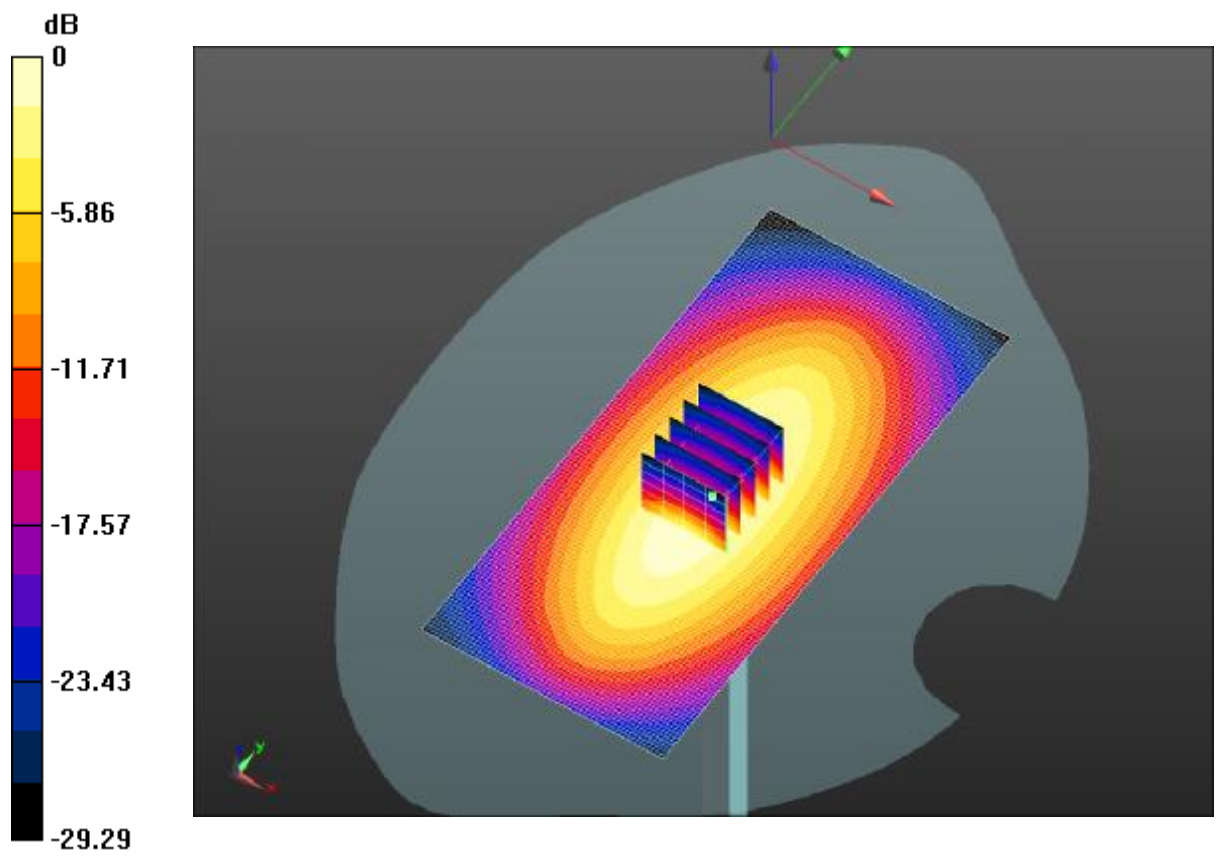
Body/Dipole835/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 55.902 V/m; Power Drift = -0.52 dB

Peak SAR (extrapolated) = 3.791 mW/g

SAR(1 g) = 2.48 mW/g; SAR(10 g) = 1.61 mW/g

Maximum value of SAR (measured) = 2.69 W/kg



0 dB = 2.76 W/kg = 8.82 dB W/kg

Test Laboratory: SMQ SAR Test

## SystemPerformanceCheck-D1900 Body

Date 2015.06.15.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d162

Communication System: CW; Communication System Band: Not Specified; Frequency: 1900 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.45$  mho/m;  $\epsilon_r = 52.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

### DASY5 Configuration:

- Probe: EX3DV4 - SN3881; ConvF(8.25, 8.25, 8.25); Calibrated: 2014.07.22.
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn876; Calibrated: 2014.03.03.
- Phantom: SAM 1; Type: QD000P40CC; Serial: TP:1504
- Measurement SW: DASY52, Version 52.8 (0); SEMCAD X Version 14.6.4 (4989)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 14.5 W/kg

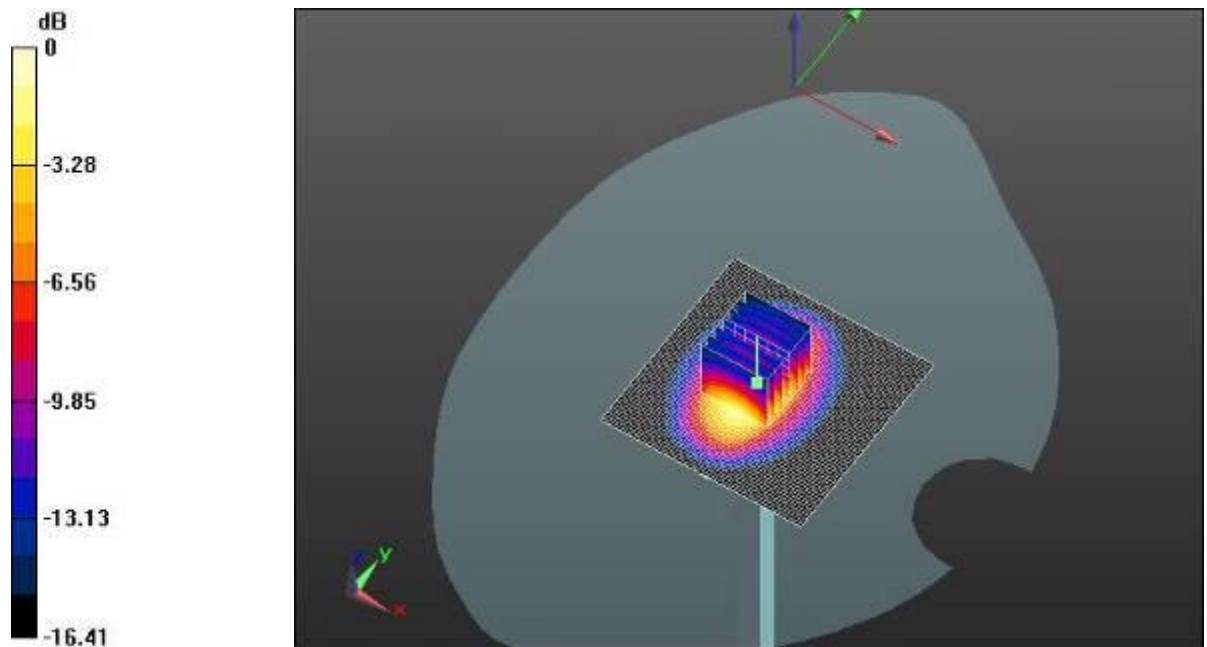
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 85.872 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.503 mW/g

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

Maximum value of SAR (measured) = 14.6 W/kg



$$0 \text{ dB} = 14.6 \text{ W/kg}$$

#### SystemPerformanceCheck-D2450-Body

Date: 2015.06.15

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2;

Communication System: CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450 \text{ MHz}$ ;  $\sigma = 2.03 \text{ mho/m}$ ;  $\epsilon_r = 50.74$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

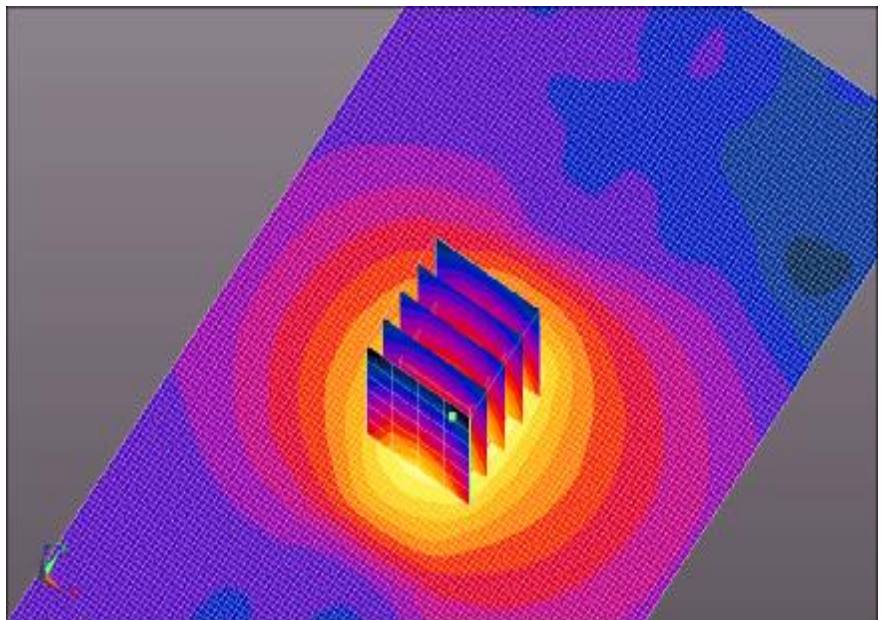
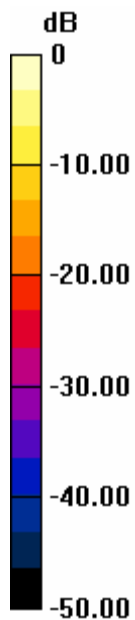
#### DASY5 Configuration:

- Probe: ES3DV3 - SN3203; ConvF(4.55, 4.55, 4.55); Calibrated: 2014.12.19.;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn876; Calibrated: 2015.03.09.
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)



Body/Dipole2450/Area Scan (91x161x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm  
Reference Value = 92.292 V/m; Power Drift = 0.01 dB  
Fast SAR: SAR(1 g) = 14.1mW/g; SAR(10 g) = 6.22 mW/g  
Maximum value of SAR (interpolated) = 17.3 W/kg

Body/Dipole2450/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 92.292 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 33.353 mW/g  
SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.29 mW/g  
Maximum value of SAR (measured) = 16.9 W/kg



0 dB = 17.3 W/kg = 24.78 dB W/kg

Test Laboratory: SMQ SAR Test

## APPENDIX B: System Validation

Per KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. SAR measurement systems are validated according to procedures in KDB 865664 D01v01r3. The validation status is documented according to the validation date(s), measurement frequencies, SAR probe and tissue dielectric parameters. When multiple SAR system is used, the validation status of each SAR system is needed to be documented separately according to the associated system components.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probe and tissue dielectric parameters are shown as below.

| Date       | Probe S/N | Tested Freq MHz | Tissue | CW          |           |          | Mod. Validation |             |                              |
|------------|-----------|-----------------|--------|-------------|-----------|----------|-----------------|-------------|------------------------------|
|            |           |                 |        | Sensitivity | Linearity | Isotropy | Mod             | Duty Factor | Peak to Average Power Ration |
| 2015.06.15 | 3881      | 1900            | Body   | Pass        | Pass      | Pass     | QPSK            | Pass        | N/A                          |
| 2015.06.15 | 3203      | 1900            | Body   | Pass        | Pass      | Pass     | QPSK            | Pass        | N/A                          |
| 2015.06.15 | 3881      | 850             | Body   | Pass        | Pass      | Pass     | QPSK            | Pass        | N/A                          |
| 2015.06.15 | 3203      | 850             | Body   | Pass        | Pass      | Pass     | QPSK            | Pass        | N/A                          |
| --         | --        | --              | --     | --          | --        | --       | --              | --          | --                           |

## APPENDIX C: MEASUREMENT SCANS

Date: 2015.06.15.

### HRT700 GPRS850 Body Back Side Mid

#### **Medium: MSL900**

Communication System: GPRS 4 Tx slots ; Communication System Band: GSM 850 (824.0 - 849.0 MHz); Frequency: 836.6 MHz; Duty Cycle: 1:2.08

Medium parameters used (interpolated):  $f = 836.6$  MHz;  $\sigma = 0.96$  mho/m;  $\epsilon_r = 55.87$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration: Probe: ES3DV3 - SN3203; ConvF(6.2, 6.2, 6.2); Calibrated: 2014.12.19.; Electronics: DAE4 Sn876; Calibrated: 2015.03.09.

GPRS 850\_Facedown/Mid/Area Scan (71x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 2.100 V/m; Power Drift = 2.58 dB

Fast SAR: SAR(1 g) = 0.100 mW/g; SAR(10 g) = 0.061 mW/g

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.124 W/kg

GPRS 850\_Facedown/Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

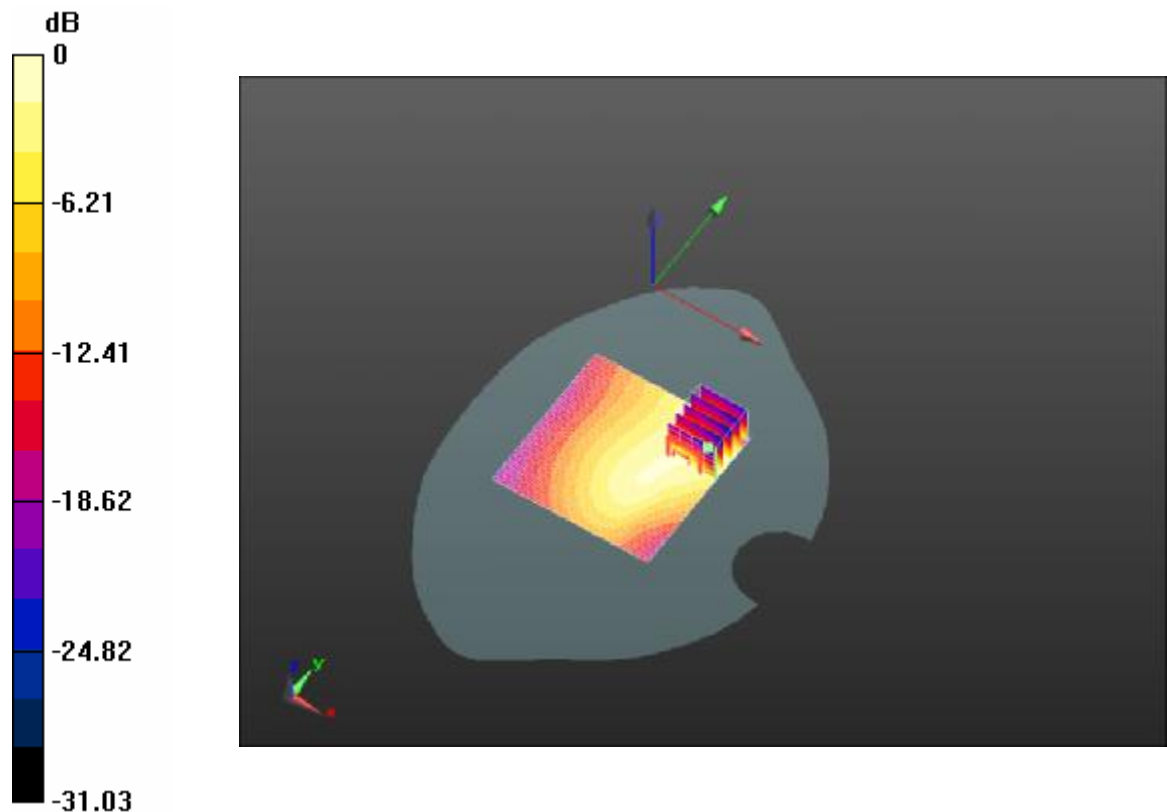
Reference Value = 2.100 V/m; Power Drift = -0.2 dB

Peak SAR (extrapolated) = 0.099 mW/g

SAR(1 g) = 0.076 mW/g; SAR(10 g) = 0.055 mW/g

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.0805 W/kg



$$0 \text{ dB} = 0.124 \text{ W/kg} = -18.12 \text{ dB W/kg}$$

Date: 2015.06.15.

### HRT500 GPRS850 Body Back Side Mid

#### Medium: MSL900

Communication System: GPRS 4 Tx slots; Communication System Band: GSM 850 (824.0 - 849.0 MHz); Frequency: 836.6 MHz; Duty Cycle: 1:2.08

Medium parameters used (interpolated):  $f = 836.6 \text{ MHz}$ ;  $\sigma = 0.96 \text{ mho/m}$ ;  $\epsilon_r = 55.87$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASYS Configuration: Probe: ES3DV3 - SN3203; ConvF(6.2, 6.2, 6.2); Calibrated: 2014.12.19.; Electronics: DAE4 Sn876; Calibrated: 2015.03.09.

GPRS 850\_Facedown/Mid/Area Scan (71x71x1): Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Reference Value = 3.689 V/m; Power Drift = 0.49 dB

Fast SAR:  $SAR(1 \text{ g}) = 0.016 \text{ mW/g}$ ;  $SAR(10 \text{ g}) = 0.011 \text{ mW/g}$

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.0177 W/kg

GPRS 850\_Facedown/Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

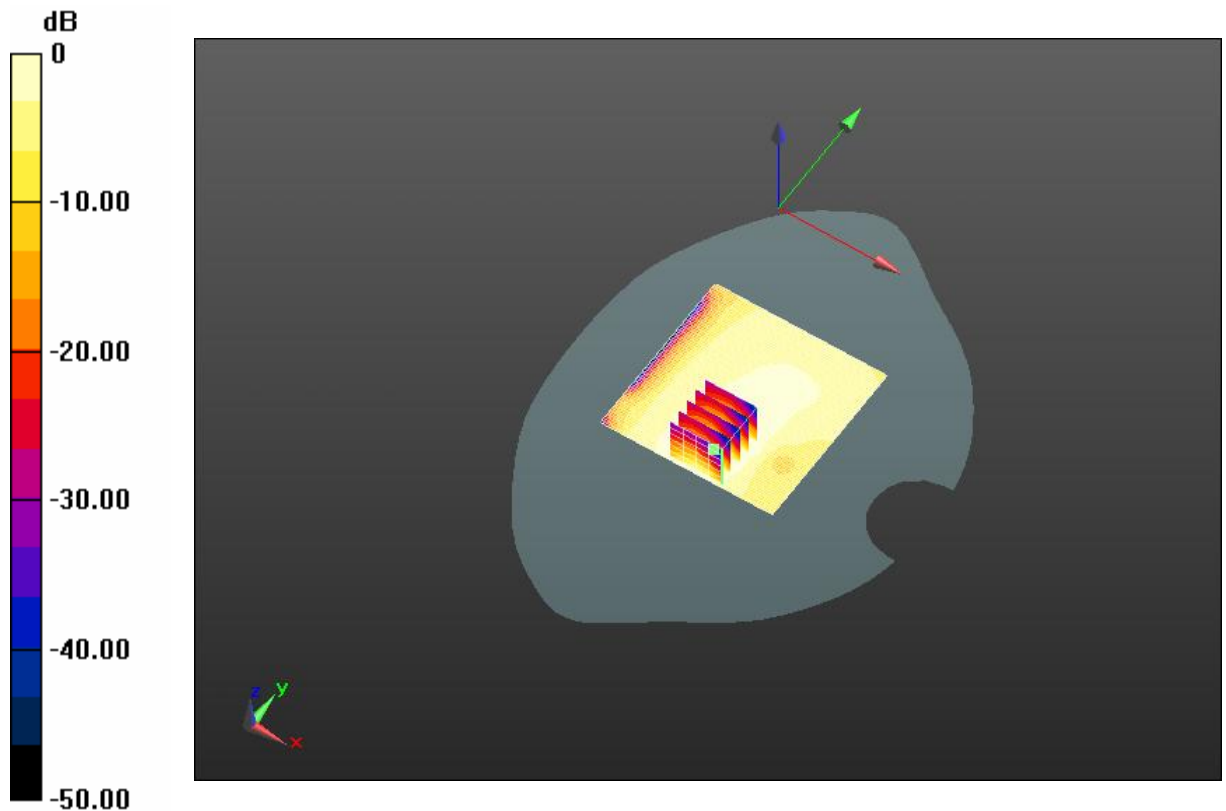
Reference Value = 3.689 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 0.025 mW/g

$SAR(1 \text{ g}) = 0.019 \text{ mW/g}$ ;  $SAR(10 \text{ g}) = 0.014 \text{ mW/g}$

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.0201 W/kg



0 dB = 0.0177 W/kg = -35.02 dB W/kg

Date: 2015.06.15.

## HRT700 GPRS1900 Body Back Side Mid

### Medium: MSL1900

Communication System: GPRS 4 Tx slots; Communication System Band: PCS 1900 (1850.0 - 1910.0 MHz); Frequency: 1850.2 MHz; Duty Cycle: 1:2.08

Medium parameters used:  $f = 1850.2$  MHz;  $\sigma = 1.45$  mho/m;  $\epsilon_r = 52.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration: Probe: EX3DV4 - SN3881; ConvF(8.25, 8.25, 8.25); Calibrated: 2014.07.22.; Electronics: DAE4 Sn876; Calibrated: 2015.03.09.

1900\_GPRS 0mm/GPRS1900 Back-Mid/Area Scan (71x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 1.185 V/m; Power Drift = 5.74 dB

Fast SAR: SAR(1 g) = 0.025 mW/g; SAR(10 g) = 0.014 mW/g

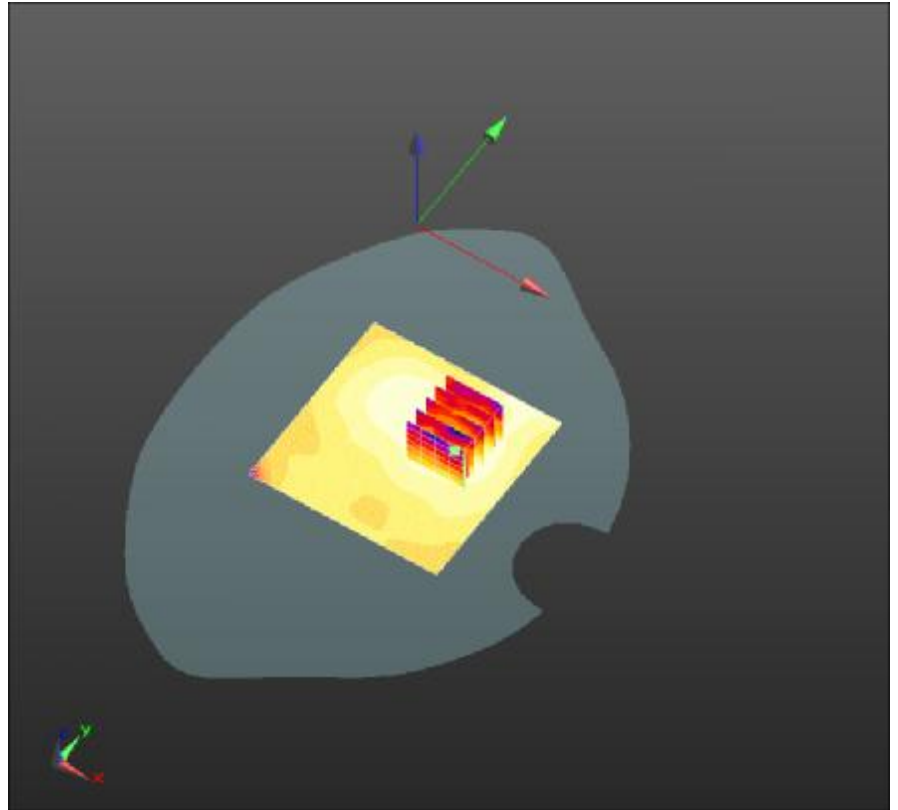
Maximum value of SAR (interpolated) = 0.0273 W/kg

1900\_GPRS 0mm/GPRS1900 Back-Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.185 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 0.043 mW/g

SAR(1 g) = 0.026 mW/g; SAR(10 g) = 0.016 mW/g  
 Maximum value of SAR (measured) = 0.0282 W/kg



0 dB = 0.0273 W/kg = -31.27 dB W/kg

Date: 2015.06.15.

## HRT500 GPRS1900 Body Back Side Mid

### Medium: MSL1900

Communication System: GPRS 4 Tx slots; Communication System Band: PCS 1900 (1850.0 - 1910.0 MHz); Frequency: 1850.2 MHz; Duty Cycle: 1:2.08

Medium parameters used:  $f = 1850.2$  MHz;  $\sigma = 1.45$  mho/m;  $\epsilon_r = 52.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration: Probe: EX3DV4 - SN3881; ConvF(8.25, 8.25, 8.25); Calibrated: 2014.07.22.; Electronics: DAE4 Sn876; Calibrated: 2015.03.09.

1900\_GPRS 0mm/GPRS1900 Back-Mid/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 4.336 V/m; Power Drift = 0.17 dB

Fast SAR: SAR(1 g) = 0.110 mW/g; SAR(10 g) = 0.063 mW/g

Maximum value of SAR (interpolated) = 0.125 W/kg

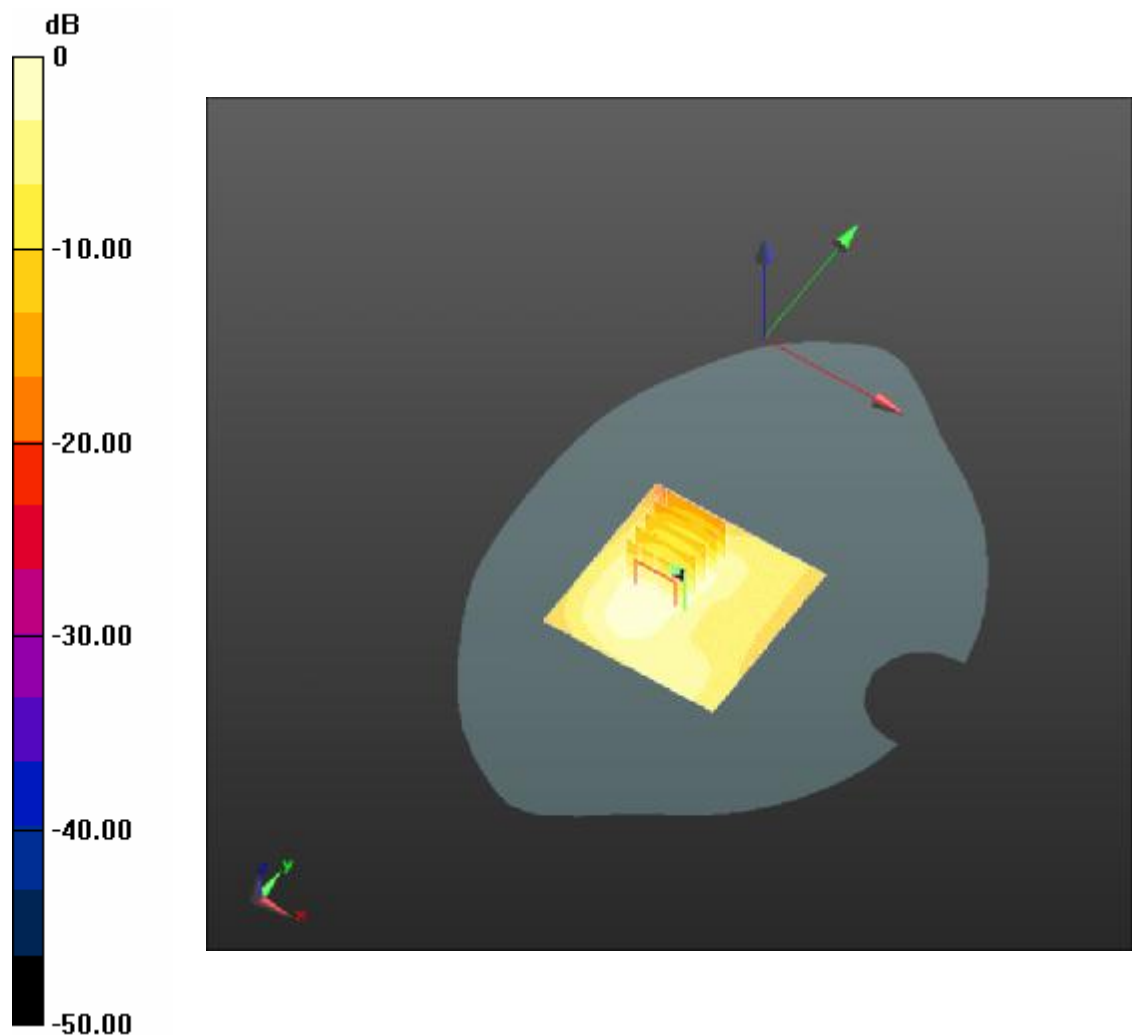
1900\_GPRS 0mm/GPRS1900 Back-Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.336 V/m; Power Drift = 0.17 dB

Peak SAR (extrapolated) = 0.168 mW/g

SAR(1 g) = 0.106 mW/g; SAR(10 g) = 0.065 mW/g

Maximum value of SAR (measured) = 0.115 W/kg



$$0 \text{ dB} = 0.125 \text{ W/kg} = -18.03 \text{ dB W/kg}$$

Date: 2015.06.15

### HRT700 WCDMA Body BAND5 Body Back Side Mid

#### Medium: MSL900

Communication System: UMTS-FDD; Communication System Band: Band 5, UTRA/FDD (824.0 - 849.0 MHz); Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 836.6 \text{ MHz}$ ;  $\sigma = 0.96 \text{ mho/m}$ ;  $\epsilon_r = 55.87$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASYS Configuration: Probe: ES3DV3 - SN3203; ConvF(6.2, 6.2, 6.2); Calibrated: 2014.12.19.; Electronics: DAE4 Sn876; Calibrated: 2015.03.09.

UMTS Band 5\_body Back/Mid/Area Scan (71x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm  
Reference Value = 6.582 V/m; Power Drift = -0.06 dB  
Fast SAR: SAR(1 g) = 0.048 mW/g; SAR(10 g) = 0.033 mW/g

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.0515 W/kg

UMTS Band 5\_body Back/Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

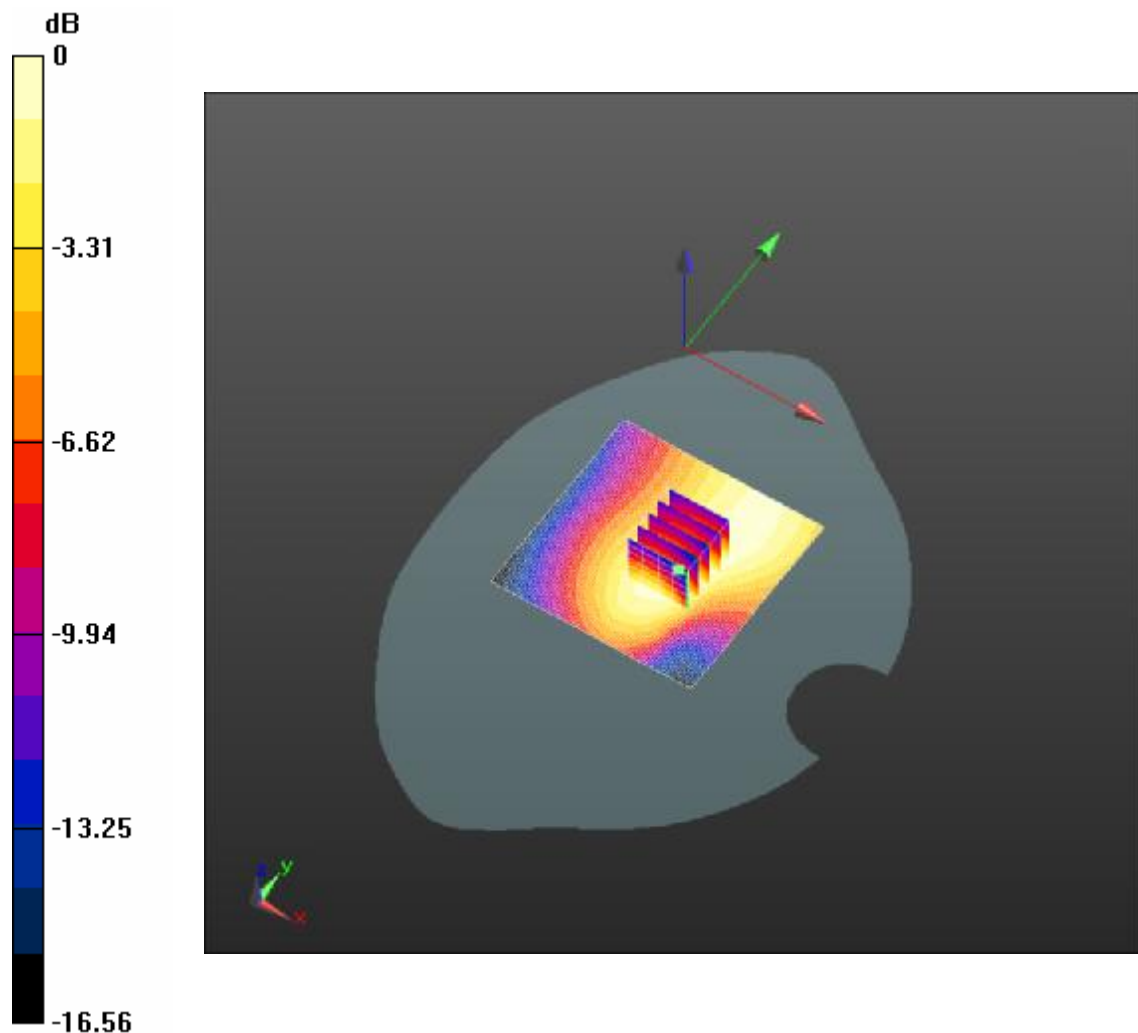
Reference Value = 6.582 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.062 mW/g

SAR(1 g) = 0.048 mW/g; SAR(10 g) = 0.035 mW/g

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.0509 W/kg



0 dB = 0.0515 W/kg = -25.76 dB W/kg

Date: 2015.06.15.

HRT500 WCDMA Body BAND5 Body Back Side Mid



**Medium: MSL900**

Communication System: UMTS-FDD; Communication System Band: Band 5, UTRA/FDD (824.0 – 849.0 MHz); Frequency: 836.6 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 836.6$  MHz;  $\sigma = 0.96$  mho/m;  $\epsilon_r = 55.87$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASYS Configuration: Probe: ES3DV3 - SN3203; ConvF(6.2, 6.2, 6.2); Calibrated: 2014.12.19.; Electronics: DAE4 Sn876; Calibrated: 2015.03.09.

UMTS Band 5\_body Back/Mid/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 2.956 V/m; Power Drift = 0.07 dB

Fast SAR: SAR(1 g) = 0.013 mW/g; SAR(10 g) = 0.0082 mW/g

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.0137 W/kg

UMTS Band 5\_body Back/Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

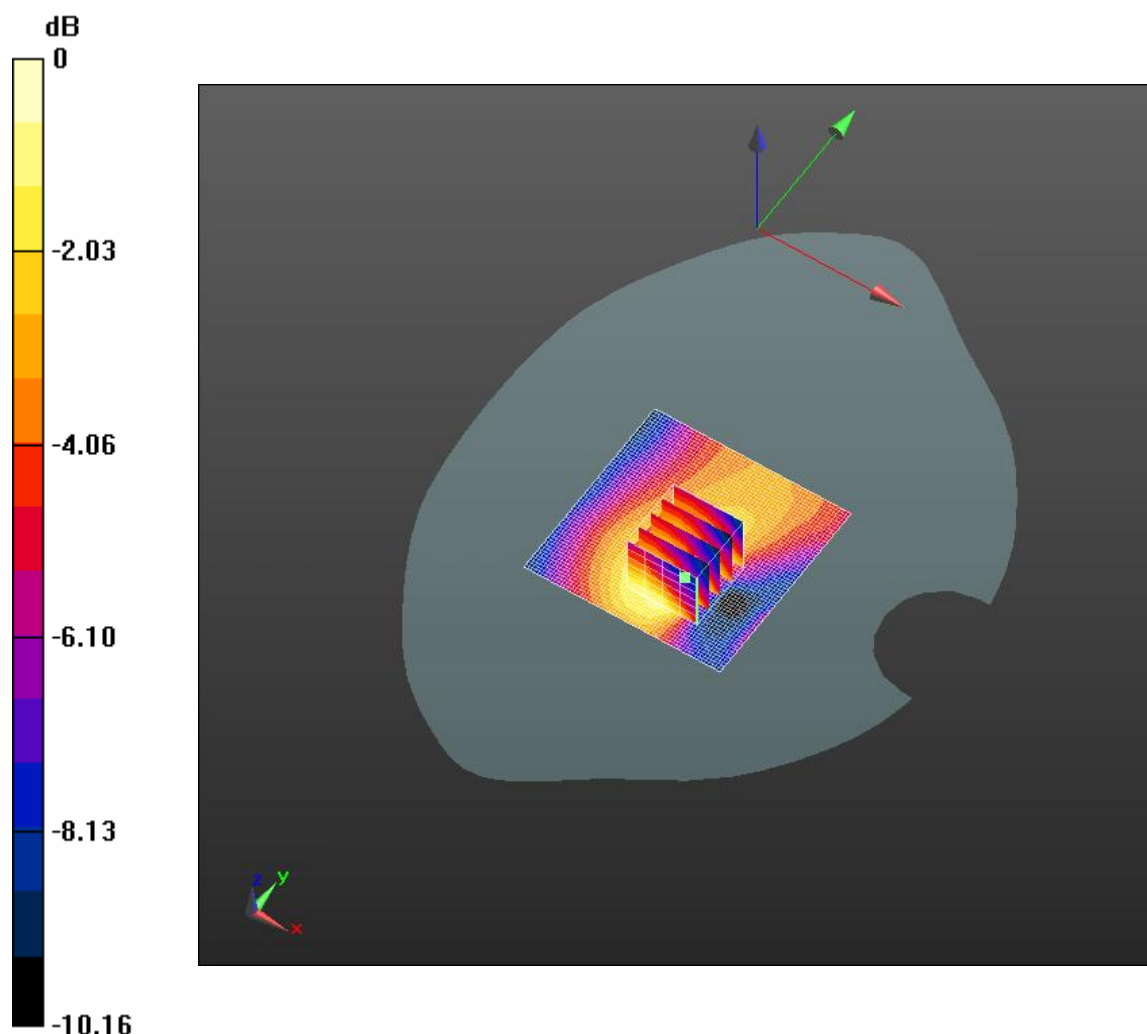
Reference Value = 2.956 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.015 mW/g

SAR(1 g) = 0.012 mW/g; SAR(10 g) = 0.00851 mW/g

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.0120 W/kg



$$0 \text{ dB} = 0.0137 \text{ W/kg} = -37.27 \text{ dB W/kg}$$

Date: 2015.06.15.

### HRT700 WiFi 802.11b Body Back Side Mid

#### Medium: MSL2450

Communication System: 802.11b Wi Fi 2.4GHz(DSSS, 1Mbps); Communication System Band: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2437 \text{ MHz}$ ;  $\sigma = 2.03 \text{ mho/m}$ ;  $\epsilon_r = 52.74$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration: Probe: ES3DV3 - SN3203; ConvF(4.47, 4.47, 4.47); Calibrated: 2014.12.19.; Electronics: DAE4 Sn876; Calibrated: 2014.03.03.

802.11b-Back/Back-Mid/Area Scan (61x61x1): Interpolated grid:  $dx=1.500 \text{ mm}$ ,  $dy=1.500 \text{ mm}$

Reference Value = 1.231 V/m; Power Drift = 0.25 dB

Fast SAR:  $\text{SAR}(1 \text{ g}) = 0.00429 \text{ mW/g}$ ;  $\text{SAR}(10 \text{ g}) = 0.0023 \text{ mW/g}$

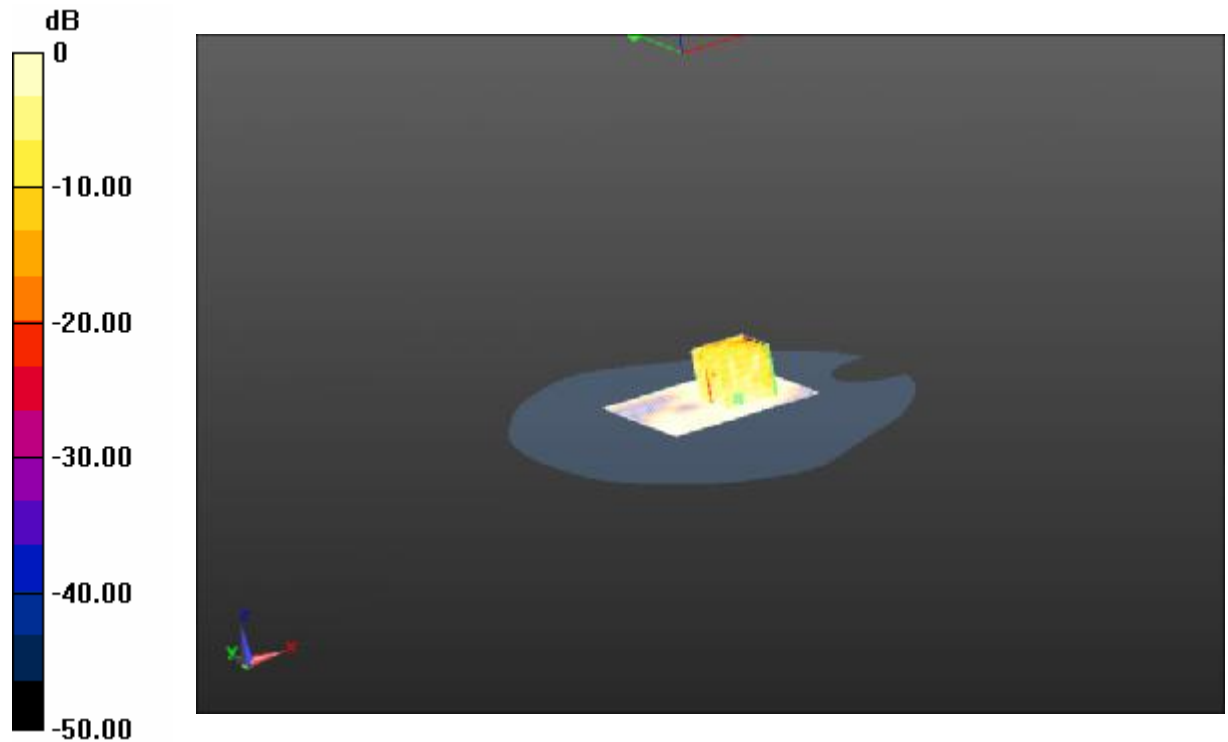
[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.00476 W/kg

802.11b- Back/Back-Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 1.231 V/m; Power Drift = 0.12 dB  
Peak SAR (extrapolated) = 0.00803 mW/g  
SAR(1 g) = 0.00502 mW/g; SAR(10 g) = 0.00299 mW/g

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.00560 W/kg



0 dB = 0.00476 W/kg = -46.45 dB W/kg

Date: 2015.06.15.

## HRT500 WiFi 802.11b Body Back Side Mid

### Medium: MSL2450

Communication System: 802.11b Wi Fi 2.4GHz(DSSS, 1Mbps); Communication System Band: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 2.03$  mho/m;  $\epsilon_r = 52.74$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY5 Configuration: Probe: ES3DV3 - SN3203; ConvF(4.47, 4.47, 4.47); Calibrated: 2014.12.19.; Electronics: DAE4 Sn876; Calibrated: 2014.03.03.

802.11b-Left Head/Back Cheek-Mid/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 1.231 V/m; Power Drift = 0.25 dB

Fast SAR: SAR(1 g) = 0.00429 mW/g; SAR(10 g) = 0.0023 mW/g

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.00476 W/kg

802.11b-Left Head/Back Cheek-Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

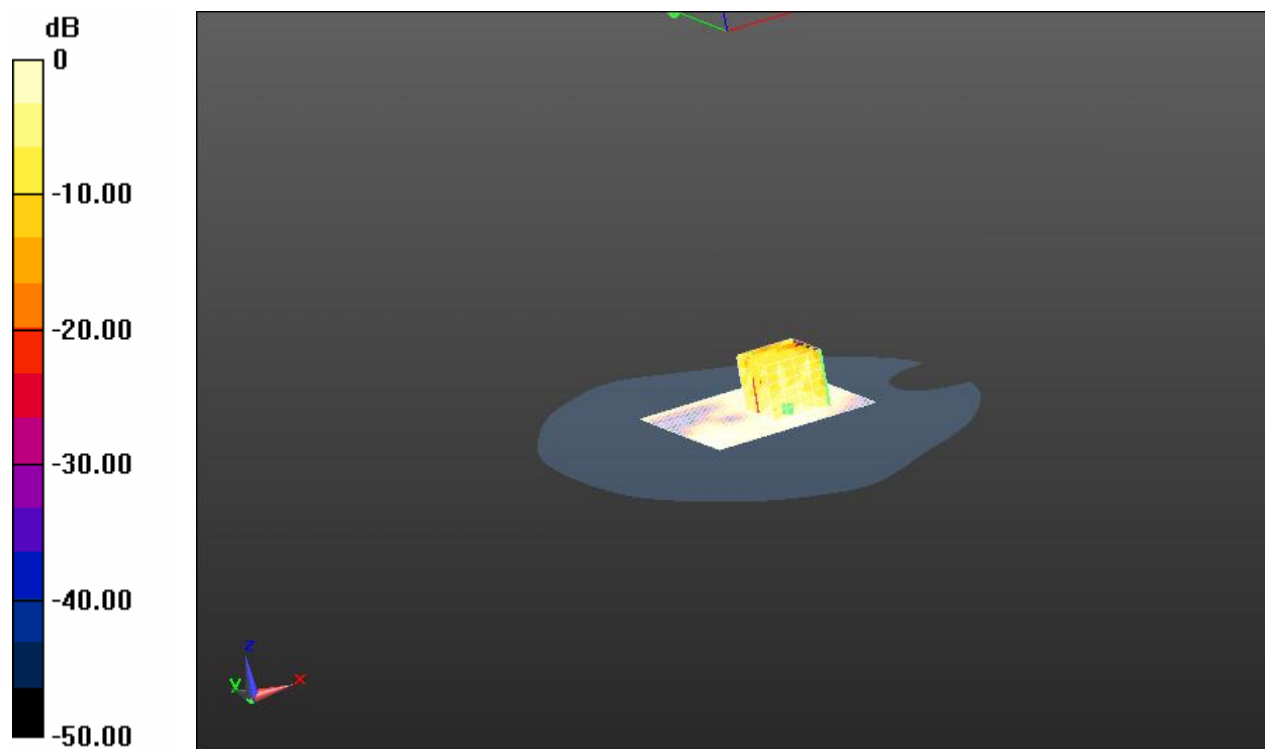
Reference Value = 1.231 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 0.00803 mW/g

SAR(1 g) = 0.00502 mW/g; SAR(10 g) = 0.00299 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.00560 W/kg



0 dB = 0.00476 W/kg = -46.45 dB W/kg

**APPENDIX D:      RELEVANT PAGES FROM PROBE CALIBRATION  
REPORT(S)**

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



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

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

Accreditation No.: **SCS 108**

Client **SMQ (Auden)**

Certificate No: **EX3-3881\_Jul14**

## CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3881**

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: **July 22, 2014**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards          | ID              | Cal Date (Certificate No.)        | Scheduled Calibration  |
|----------------------------|-----------------|-----------------------------------|------------------------|
| Power meter E4419B         | GB41293874      | 03-Apr-14 (No. 217-01911)         | Apr-15                 |
| Power sensor E4412A        | MY41498087      | 03-Apr-14 (No. 217-01911)         | Apr-15                 |
| Reference 3 dB Attenuator  | SN: S5054 (3c)  | 03-Apr-14 (No. 217-01915)         | Apr-15                 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 03-Apr-14 (No. 217-01919)         | Apr-15                 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 03-Apr-14 (No. 217-01920)         | Apr-15                 |
| Reference Probe ES3DV2     | SN: 3013        | 30-Dec-13 (No. ES3-3013_Dec13)    | Dec-14                 |
| DAE4                       | SN: 660         | 13-Dec-13 (No. DAE4-660_Dec13)    | Dec-14                 |
| 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-13) | In house check: Oct-14 |

|   |                |                       |                       |
|---|----------------|-----------------------|-----------------------|
| Calibrated by:  | Name           | Function              | Signature             |
|   | Jeton Kastrati | Laboratory Technician |                       |
| Approved by:  | Name           | Function              | Signature             |
|   | Katja Pokovic  | Technical Manager     |                       |
|   |                |                       | Issued: July 23, 2014 |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. |                |                       |                       |



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

Accreditation No.: **SCS 108**

#### 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 $\phi$      | $\phi$ 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

#### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  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<sup>2</sup>-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).

# Probe EX3DV4

## SN:3881

Manufactured: April 30, 2012  
Calibrated: July 22, 2014

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



## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3881

### Basic Calibration Parameters

|   | Sensor X | Sensor Y | Sensor Z | Unc (k=2)     |
|---|----------|----------|----------|---------------|
| Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup> | 0.18     | 0.37     | 0.53     | $\pm 10.1 \%$ |
| DCP (mV) <sup>B</sup>                                     | 96.5     | 100.9    | 101.1    |               |

### 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    | 133.4    | $\pm 4.1 \%$              |
|     |                           | Y | 0.0     | 0.0                          | 1.0 |         | 131.0    |                           |
|     |                           | Z | 0.0     | 0.0                          | 1.0 |         | 132.8    |                           |

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 NormX,Y,Z do not affect the  $E^2$ -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.

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3881

### 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) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 450                  | 43.5                               | 0.87                            | 10.60   | 10.60   | 10.60   | 0.18               | 1.80                    | ± 13.3 %    |
| 835                  | 41.5                               | 0.90                            | 9.41    | 9.41    | 9.41    | 0.49               | 0.70                    | ± 12.0 %    |
| 1900                 | 40.0                               | 1.40                            | 8.09    | 8.09    | 8.09    | 0.57               | 0.64                    | ± 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.

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3881

### 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) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 450                  | 56.7                               | 0.94                            | 10.75   | 10.75   | 10.75   | 0.10               | 1.50                    | ± 13.3 %    |
| 835                  | 55.2                               | 0.97                            | 9.34    | 9.34    | 9.34    | 0.30               | 1.03                    | ± 12.0 %    |
| 1900                 | 53.3                               | 1.52                            | 8.25    | 8.25    | 8.25    | 0.46               | 1.00                    | ± 12.0 %    |

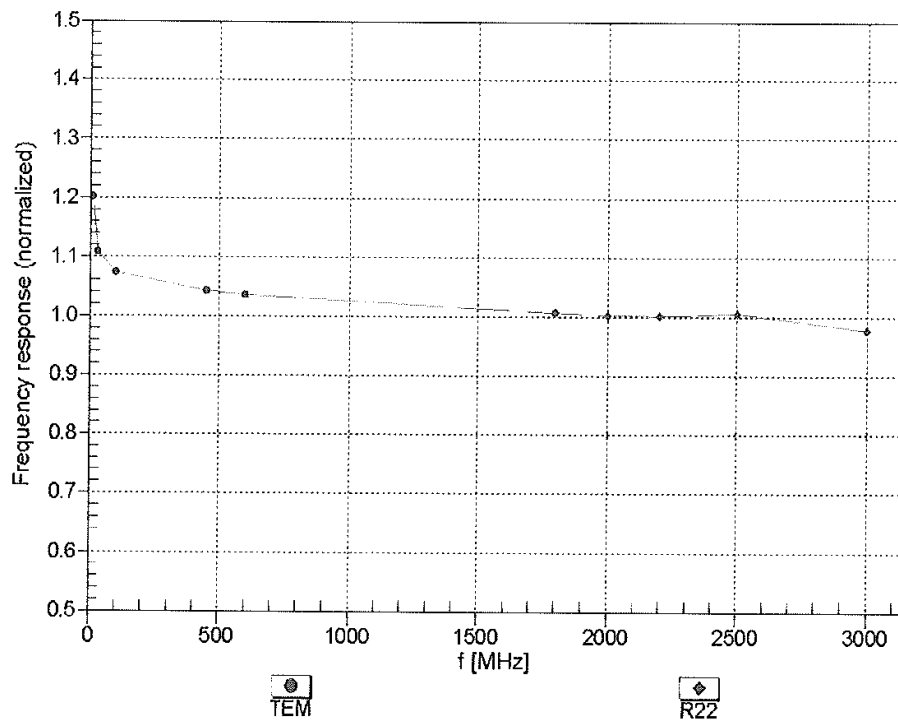
<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 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.

## Frequency Response of E-Field

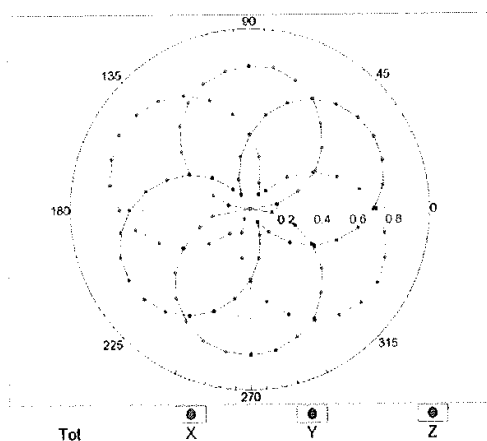
(TEM-Cell:ifi110 EXX, Waveguide: R22)



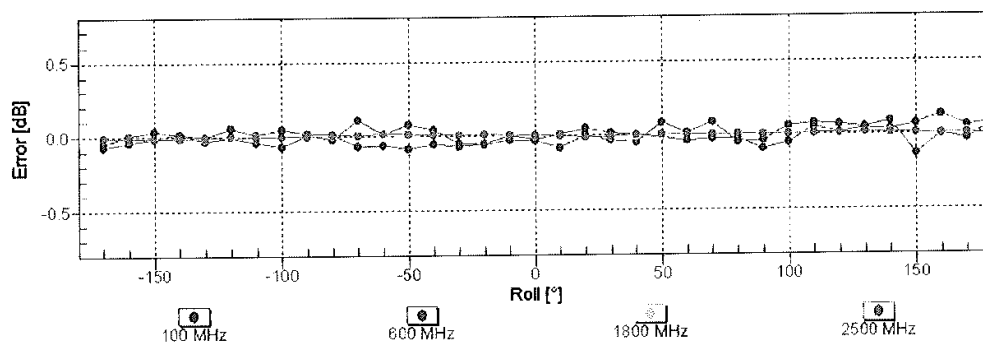
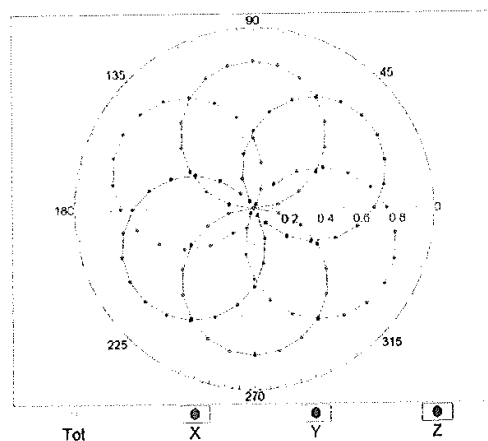
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

## Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$

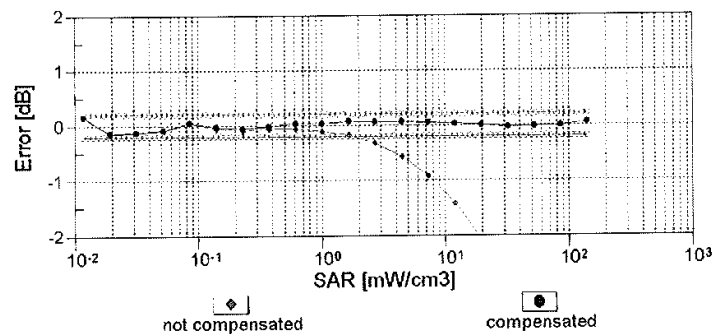
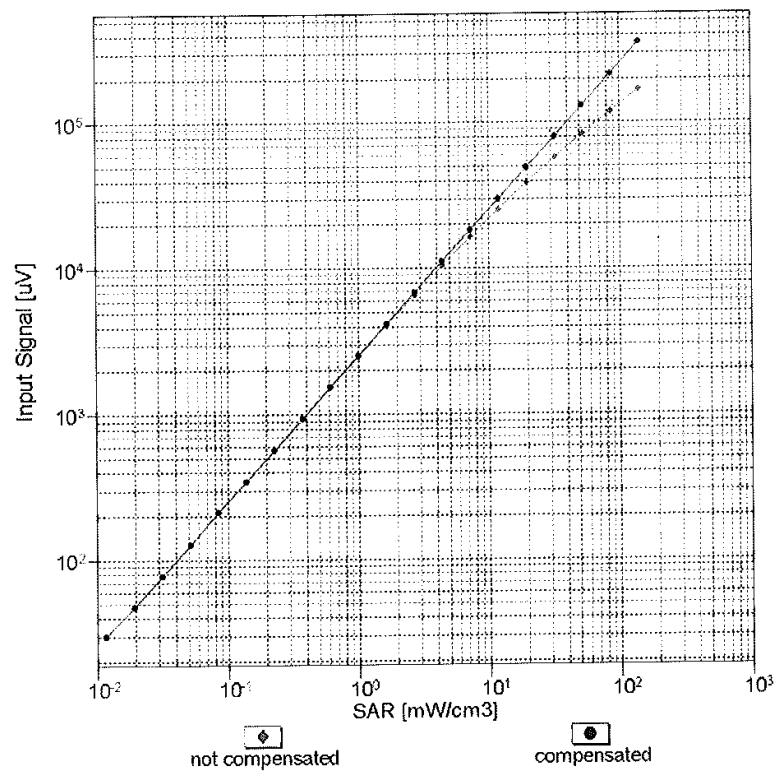
f=600 MHz,TEM



f=1800 MHz,R22

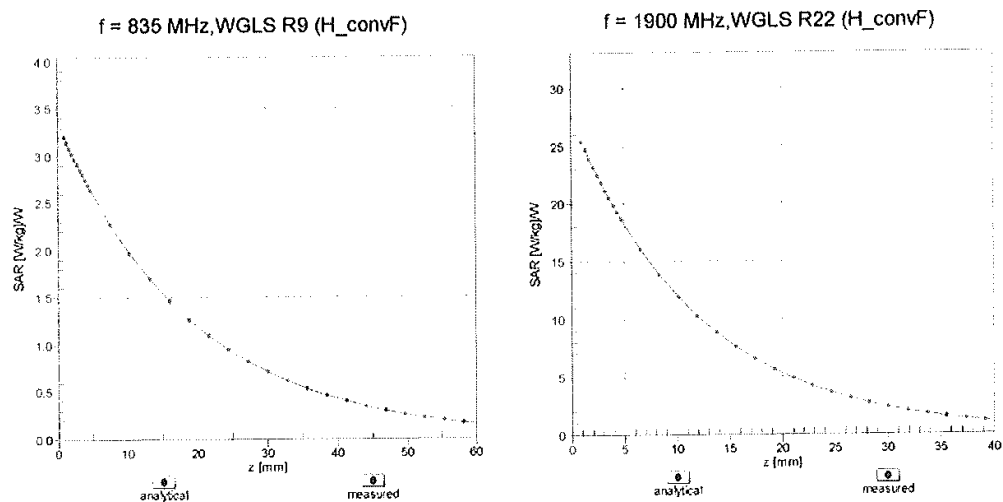
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

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



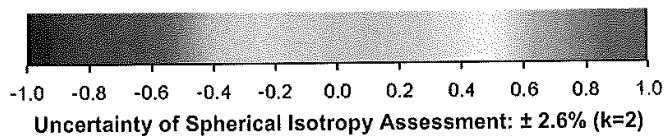
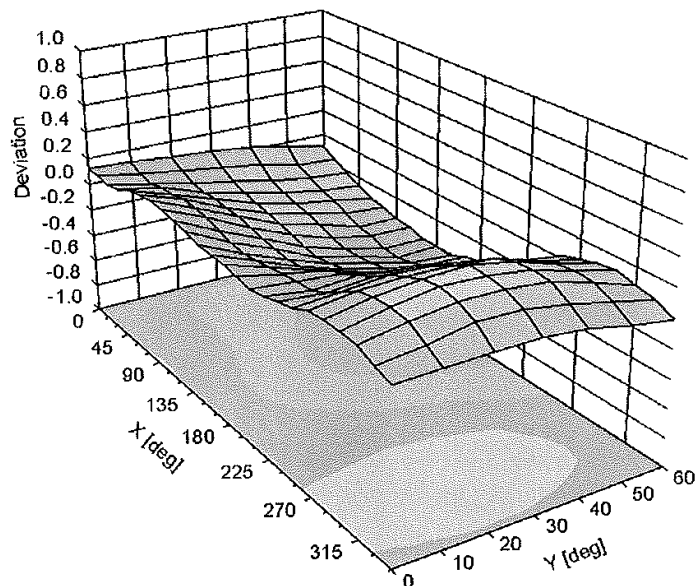
Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

## Conversion Factor Assessment



## Deviation from Isotropy in Liquid

Error ( $\phi, \theta$ ),  $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  ( $k=2$ )

**DASY/EASY - Parameters of Probe: EX3DV4 - SN:3881****Other Probe Parameters**

|   |            |
|---|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | -10.2      |
| 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     |



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

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by TMC (*Telecommunication Metrology Center of MITT in Beijing, China*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and TMC, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following.

- 1) The agreement established between SPEAG and TMC is only applicable to calibration services performed by TMC where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. This agreement is subject to renewal at the end of each calendar year between SPEAG and TMC. TMC shall inform the FCC of any changes or early termination to the agreement.
- 2) Only a subset of the calibration services specified in the SPEAG-TMC agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
  - a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
    - i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by TMC, are excluded and cannot be used for measurements to support FCC equipment certification.
    - ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics are handled according to the requirements of KDB 865664; that is, "Until standardized procedures are available to make such determination, the applicability of a signal specific probe calibration for testing specific wireless modes and technologies is determined on a case-by-case basis through KDB inquiries, including SAR system verification requirements."
  - b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
  - c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
  - d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the TMC QA protocol (a separate attachment to this document).
  - e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by TMC.
  - f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 or higher version systems.

- 3) The SPEAG-TMC agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by TMC under this SPEAG-TMC Dual-Logo calibration agreement are equivalent to the calibration services provided by SPEAG. TMC shall, upon request, provide copies of documentation to the FCC to substantiate program implementation.
  - a) The Inter-laboratory Calibration Evaluation (ILCE) stated in the TMC QA protocol shall be performed between SPEAG and TMC at least once every 12 months. The ILCE acceptance criteria defined in the TMC QA protocol shall be satisfied for the TMC, SPEAG and FCC agreements to remain valid.
  - b) Check of Calibration Certificate (CCC) shall be performed by SPEAG for all calibrations performed by TMC. Written confirmation from SPEAG is required for TMC to issue calibration certificates under the SPEAG-TMC Dual-Logo calibration program. Quarterly reports for all calibrations performed by TMC under the program are also issued by SPEAG.
  - c) The calibration equipment and measurement system used by TMC shall be verified before each calibration service according to the specific reference SAR probes, dipoles, and DAE calibrated by SPEAG. The results shall be reproducible and within the defined acceptance criteria specified in the TMC QA protocol before each actual calibration can commence. TMC shall maintain records of the measurement and calibration system verification results for all calibrations.
  - d) Quality Check of Calibration (QCC) certificates shall be performed by SPEAG at least once every 12 months. SPEAG shall visit TMC facilities to verify the laboratory, equipment, applied procedures and plausibility of randomly selected certificates.
- 4) A copy of this document, to be updated annually, shall be provided to TMC clients that accept calibration services according to the SPEAG-TMC Dual-Logo calibration program, which should be presented to a TCB (*Telecommunication Certification Body*), to facilitate FCC equipment approval.
- 5) TMC shall address any questions raised by its clients or TCBs relating to the SPEAG-TMC Dual-Logo calibration program and inform the FCC and SPEAG of any critical issues.

Change Note: Revised on June 26 to clarify the applicability of PMR and Bundled probe calibrations according to the requirements of KDB 865664.



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Client **AUDEN**

Certificate No: **Z14-97164**

## CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3203**

Calibration Procedure(s) **TMC-OS-E-02-195**  
**Calibration Procedures for Dosimetric E-field Probes**

Calibration date: **December 19, 2014**

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

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

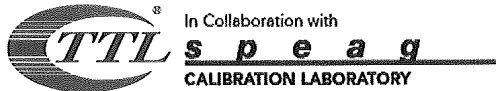
Calibration Equipment used (M&TE critical for calibration)

| Primary Standards       | ID #        | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|-------------|--|-----------------------|
| Power Meter NRP2        | 101919      | 01-Jul-14 (CTTL, No.J14X02146)           | Jun-15                |
| Power sensor NRP-Z91    | 101547      | 01-Jul-14 (CTTL, No.J14X02146)           | Jun-15                |
| Power sensor NRP-Z91    | 101548      | 01-Jul-14 (CTTL, No.J14X02146)           | Jun-15                |
| Reference10dBAttenuator | 18N50W-10dB | 13-Mar-14(TMC,No.JZ14-1103)              | Mar-16                |
| Reference20dBAttenuator | 18N50W-20dB | 13-Mar-14(TMC,No.JZ14-1104)              | Mar-16                |
| Reference Probe EX3DV4  | SN 3617     | 28-Aug-14(SPEAG,No.EX3-3617_Aug14)       | Aug-15                |
| DAE4                    | SN 1331     | 23-Jan-14 (SPEAG, DAE4-1331_Jan14)       | Jan -15               |
| Secondary Standards     | ID #        | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| SignalGeneratorMG3700A  | 6201052605  | 01-Jul-14 (CTTL, No.J14X02145)           | Jun-15                |
| Network Analyzer E5071C | MY46110673  | 15-Feb-14 (TMC, No.JZ14-781)             | Feb-15                |

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

Issued: December 20, 2014

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  |
| 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 $\Phi$   | $\Phi$ rotation around probe axis   |
| Polarization $\theta$ | $\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i<br>$\theta=0$ is normal to probe axis |

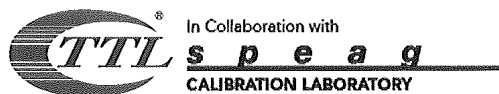
Connector Angle information used in DASY system to align probe sensor X to the robot coordinate system

#### 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 300MHz to 3GHz)", February 2005

#### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>:** Assessed for E-field polarization  $\theta=0$  ( $f \leq 900\text{MHz}$  in TEM-cell;  $f > 1800\text{MHz}$ : waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect 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 (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>; VR<sub>x,y,z</sub>:** A,B,C 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  $f \leq 800\text{MHz}$ ) and inside waveguide using analytical field distributions based on power measurements for  $f > 800\text{MHz}$ . The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued 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  $\pm 50\text{MHz}$  to  $\pm 100\text{MHz}$ .
- 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).



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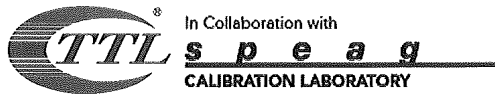
# Probe ES3DV3

## SN: 3203

Calibrated: December 19, 2014

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)



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## DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3203

### Basic Calibration Parameters

|  | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|--|----------|----------|----------|-----------|
| Norm( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup> | 1.39     | 1.37     | 1.19     | ±10.8%    |
| DCP(mV) <sup>B</sup>                                     | 103.9    | 100.8    | 104.3    |           |

### Modulation Calibration Parameters

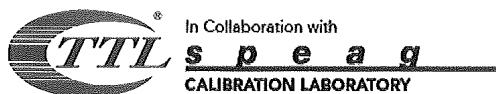
| UID | Communication System Name |   | A dB | B dB $\cdot\mu\text{V}$ | C   | D dB | VR mV | Unc <sup>E</sup> (k=2) |
|-----|---------------------------|---|------|-------------------------|-----|------|-------|------------------------|
| 0   | CW                        | X | 0.0  | 0.0                     | 1.0 | 0.00 | 298.4 | ±2.3%                  |
|     |                           | Y | 0.0  | 0.0                     | 1.0 |      | 292.8 |                        |
|     |                           | Z | 0.0  | 0.0                     | 1.0 |      | 272.7 |                        |

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

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



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## DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3203

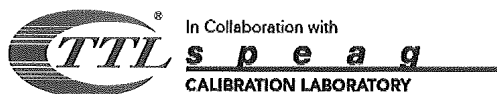
### Calibration Parameter Determined in Head Tissue Simulating Media

| 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) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 900                  | 41.5                               | 0.97                            | 6.55    | 6.55    | 6.55    | 0.32               | 1.66                    | ± 12%       |
| 1810                 | 40.0                               | 1.40                            | 5.20    | 5.20    | 5.20    | 0.67               | 1.27                    | ± 12%       |
| 2450                 | 39.2                               | 1.80                            | 4.55    | 4.55    | 4.55    | 0.90               | 1.10                    | ± 12%       |

<sup>C</sup> Frequency validity of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>F</sup> At frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



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## DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3203

### 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) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 900                  | 55.0                               | 1.05                            | 6.20    | 6.20    | 6.20    | 0.55               | 1.38                    | ± 12%       |
| 1810                 | 53.3                               | 1.52                            | 4.88    | 4.88    | 4.88    | 0.46               | 1.60                    | ± 12%       |
| 2450                 | 52.7                               | 1.95                            | 4.47    | 4.47    | 4.47    | 0.59               | 1.55                    | ± 12%       |

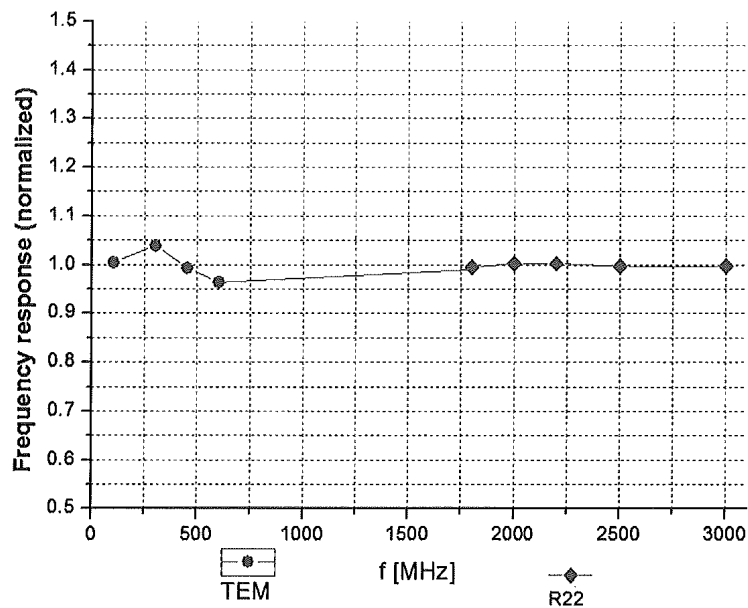
<sup>C</sup> Frequency validity of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>F</sup> At frequency 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.

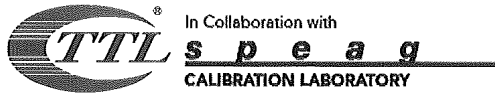
<sup>G</sup> Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



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



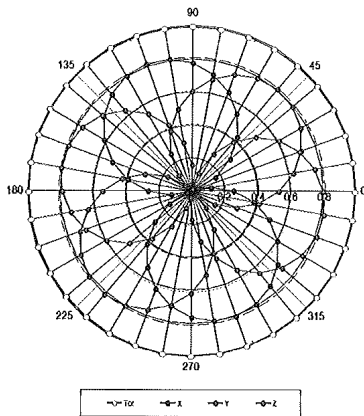
Uncertainty of Frequency Response of E-field:  $\pm 7.5\%$  ( $k=2$ )



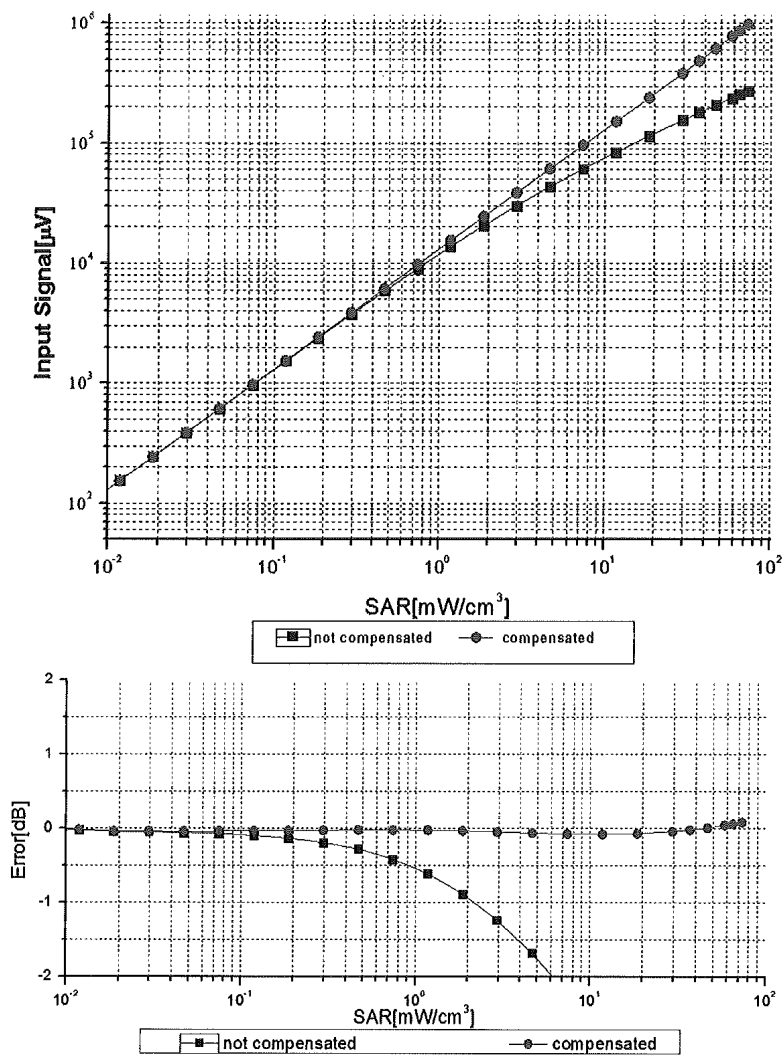
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## Receiving Pattern ( $\Phi$ ), $\theta=0^\circ$

**f=600 MHz, TEM**



## Dynamic Range f(SAR<sub>head</sub>) (TEM cell, f = 900 MHz)

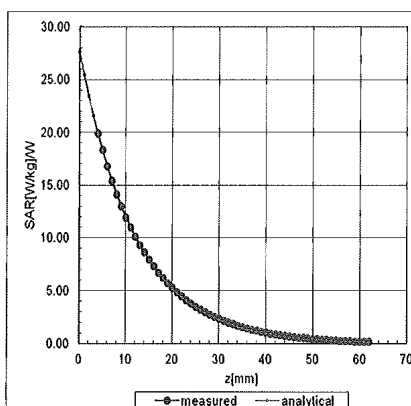
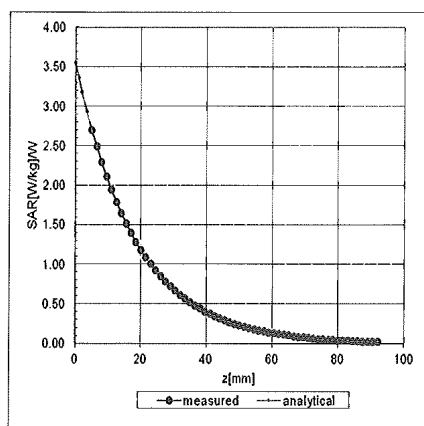


Uncertainty of Linearity Assessment:  $\pm 0.9\%$  ( $k=2$ )

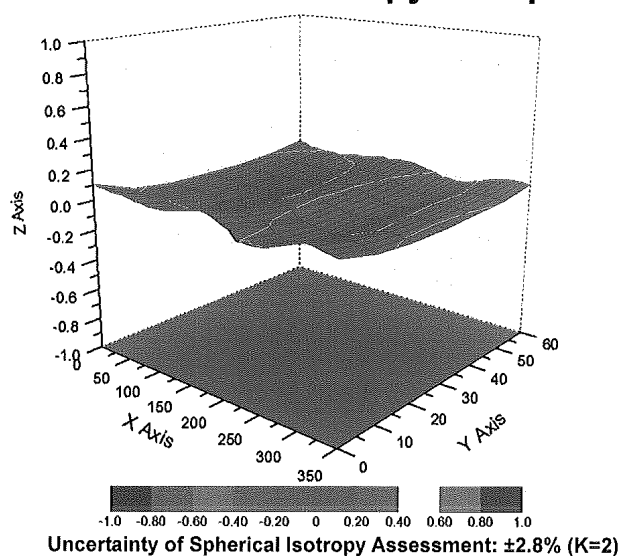
## Conversion Factor Assessment

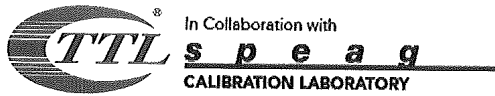
f=900 MHz, WGLS R9(H\_convF)

f=1810 MHz, WGLS R22(H\_convF)



## Deviation from Isotropy in Liquid





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## DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3203

### Other Probe Parameters

|   |            |
|---|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | 175.2      |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disable    |
| Probe Overall Length                          | 337mm      |
| Probe Body Diameter                           | 10mm       |
| Tip Length                                    | 10mm       |
| Tip Diameter                                  | 4mm        |
| Probe Tip to Sensor X Calibration Point       | 2mm        |
| Probe Tip to Sensor Y Calibration Point       | 2mm        |
| Probe Tip to Sensor Z Calibration Point       | 2mm        |
| Recommended Measurement Distance from Surface | 3mm        |

## APPENDIX E: RELEVANT PAGES FROM DIPOLE VALIDATION KIT

# REPORT(S)

DB 10364/01

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



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

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

Accreditation No.: **SCS 108**

Client **SMQ (Auden)**

Certificate No: **D835V2-4d141\_Sep12**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d141**

Calibration procedure(s) **QA CAL-05.v8**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **September 24, 2012**

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 (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)     | Scheduled Calibration |
|-----------------------------|--------------------|--------------------------------|-----------------------|
| Power meter EPM-442A        | GB37480704         | 05-Oct-11 (No. 217-01451)      | Oct-12                |
| Power sensor HP 8481A       | US37292783         | 05-Oct-11 (No. 217-01451)      | Oct-12                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 27-Mar-12 (No. 217-01530)      | Apr-13                |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 27-Mar-12 (No. 217-01533)      | Apr-13                |
| Reference Probe ES3DV3      | SN: 3205           | 30-Dec-11 (No. ES3-3205_Dec11) | Dec-12                |
| DAE4                        | SN: 601            | 27-Jun-12 (No. DAE4-601_Jun12) | Jun-13                |

| Secondary Standards       | ID #             | Check Date (in house)             | Scheduled Check        |
|---------------------------|------------------|-----------------------------------|------------------------|
| Power sensor HP 8481A     | MY41092317       | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06   | 100005           | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-11) | In house check: Oct-12 |

Calibrated by: **Israe El-Naouq** **Function**  
**Laboratory Technician**

Approved by: **Katja Pokovic** **Technical Manager**

Signature

Issued: September 24, 2012

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

Certificate No: D835V2-4d141\_Sep12

Page 1 of 8



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

Accreditation No.: **SCS 108**

**Glossary:**

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

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

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**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%.

### Measurement Conditions

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.8.2     |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 15 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 835 MHz $\pm$ 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 | 41.3 $\pm$ 6 % | 0.90 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

### SAR result with Head TSL

|   |                    |                                |
|---|--------------------|--------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                |
| SAR measured  | 250 mW input power | 2.34 mW / g                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 9.35 mW / g $\pm$ 17.0 % (k=2) |

|   |                    |                                |
|---|--------------------|--------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                |
| SAR measured  | 250 mW input power | 1.53 mW / g                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 6.12 mW / g $\pm$ 16.5 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 55.2           | 0.97 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 53.2 $\pm$ 6 % | 1.00 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

### SAR result with Body TSL

|   |                    |                                |
|---|--------------------|--------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                                |
| SAR measured  | 250 mW input power | 2.44 mW / g                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 9.46 mW / g $\pm$ 17.0 % (k=2) |

|   |                    |                                |
|---|--------------------|--------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                |
| SAR measured  | 250 mW input power | 1.60 mW / g                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 6.25 mW / g $\pm$ 16.5 % (k=2) |



## Appendix

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 52.6 $\Omega$ - 2.7 j $\Omega$ |
| Return Loss                          | - 28.7 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.1 $\Omega$ - 1.9 j $\Omega$ |
| Return Loss                          | - 34.6 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.391 ns |
|----------------------------------|----------|

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

|                 |                |
|-----------------|----------------|
| Manufactured by | SPEAG          |
| Manufactured on | March 27, 2012 |

## DASY5 Validation Report for Head TSL

Date: 24.09.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 835 MHz

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.9 \text{ mho/m}$ ;  $\epsilon_r = 41.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

### Dipole Calibration for Head Tissue/Pin=250 mW, $d=15\text{mm}$ 2/Zoom Scan (7x7x7)/Cube 0:

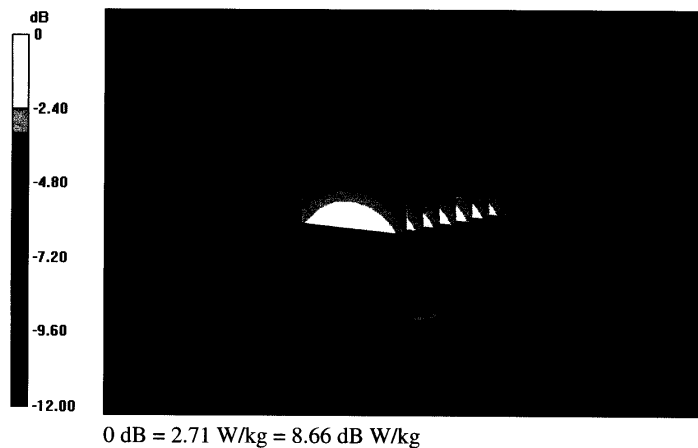
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 56.647 V/m; Power Drift = 0.03 dB

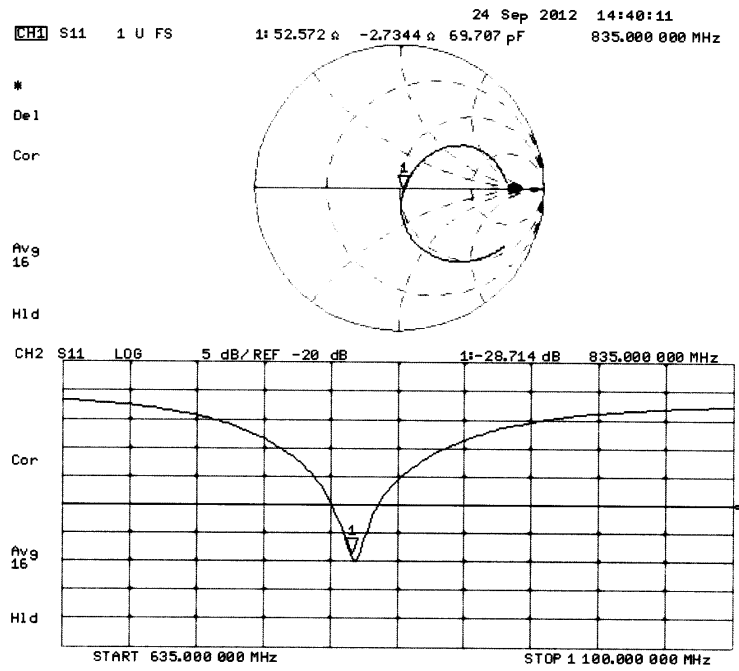
Peak SAR (extrapolated) = 3.447 mW/g

**SAR(1 g) = 2.34 mW/g; SAR(10 g) = 1.53 mW/g**

Maximum value of SAR (measured) = 2.71 W/kg



## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 24.09.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 835 MHz

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 1 \text{ mho/m}$ ;  $\epsilon_r = 53.2$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

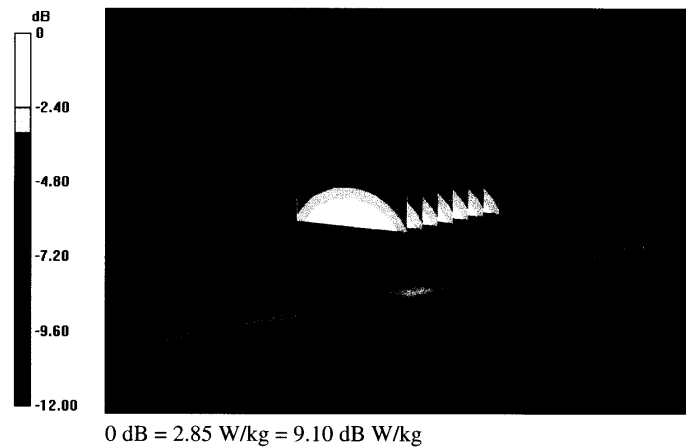
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 55.345 V/m; Power Drift = 0.02 dB

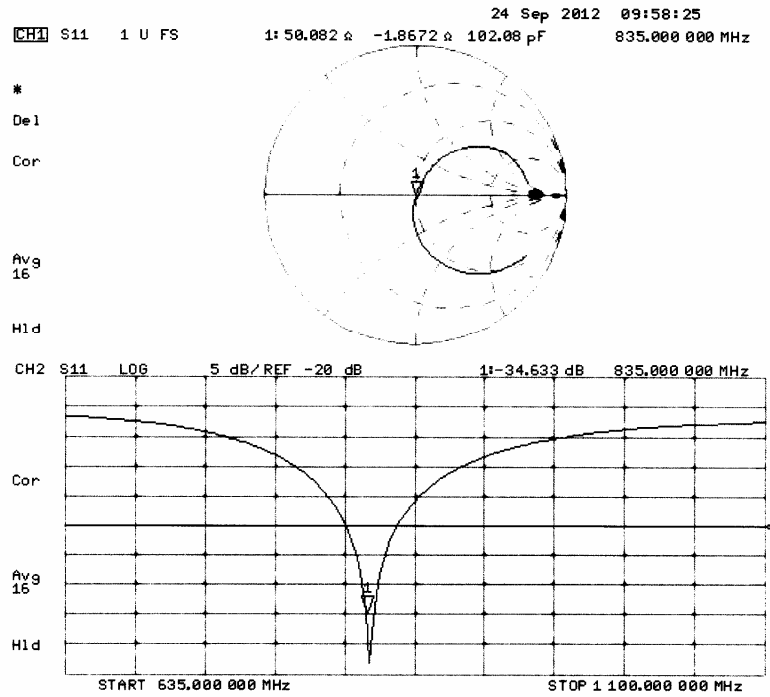
Peak SAR (extrapolated) = 3.541 mW/g

**SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.6 mW/g**

Maximum value of SAR (measured) = 2.85 W/kg



## Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **SMQ (Auden)**

Certificate No: **D1900V2-5d162\_Sep12**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d162**

Calibration procedure(s) **QA CAL-05.v8**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **September 21, 2012**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter EPM-442A        | GB37480704         | 05-Oct-11 (No. 217-01451)         | Oct-12                 |
| Power sensor HP 8481A       | US37292783         | 05-Oct-11 (No. 217-01451)         | Oct-12                 |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 27-Mar-12 (No. 217-01530)         | Apr-13                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 27-Mar-12 (No. 217-01533)         | Apr-13                 |
| Reference Probe ES3DV3      | SN: 3205           | 30-Dec-11 (No. ES3-3205_Dec11)    | Dec-12                 |
| DAE4                        | SN: 601            | 27-Jun-12 (No. DAE4-601_Jun12)    | Jun-13                 |
| Secondary Standards         | ID #               | Check Date (in house)             | Scheduled Check        |
| Power sensor HP 8481A       | MY41092317         | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RIF generator R&S SMT-06    | 100005             | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E   | US37390585 S4206   | 18-Oct-01 (in house check Oct-11) | In house check: Oct-12 |

Calibrated by: **Israe El-Naouq** **Function**  
**Laboratory Technician**

Approved by: **Katja Pokovic** **Technical Manager**

Signature

*Israe El-Naouq*  
*Katja Pokovic*

Issued: September 21, 2012

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Certificate No: **D1900V2-5d162\_Sep12**

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

**Glossary:**

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

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

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**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%.

### Measurement Conditions

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.8.2     |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 1900 MHz $\pm$ 1 MHz   |             |

### Head TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 40.0           | 1.40 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 40.6 $\pm$ 6 % | 1.37 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

### SAR result with Head TSL

|   |                    |                                |
|---|--------------------|--------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                |
| SAR measured  | 250 mW input power | 9.69 mW / g                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 39.4 mW / g $\pm$ 17.0 % (k=2) |

|   |                    |                                |
|---|--------------------|--------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                                |
| SAR measured  | 250 mW input power | 5.13 mW / g                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 20.7 mW / g $\pm$ 16.5 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 53.3           | 1.52 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 52.5 $\pm$ 6 % | 1.54 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ----           | ----                 |

### SAR result with Body TSL

|   |                    |                                |
|---|--------------------|--------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                                |
| SAR measured  | 250 mW input power | 10.3 mW / g                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 40.7 mW / g $\pm$ 17.0 % (k=2) |

|   |                    |                                |
|---|--------------------|--------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                |
| SAR measured  | 250 mW input power | 5.45 mW / g                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 21.6 mW / g $\pm$ 16.5 % (k=2) |



## Appendix

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 53.2 $\Omega$ + 4.0 j $\Omega$ |
| Return Loss                          | - 26.1 dB                      |

### Antenna Parameters with Body TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 49.2 $\Omega$ + 5.0 j $\Omega$ |
| Return Loss                          | - 25.9 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.197 ns |
|----------------------------------|----------|

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

|                 |                   |
|-----------------|-------------------|
| Manufactured by | SPEAG             |
| Manufactured on | December 20, 2011 |

## DASY5 Validation Report for Head TSL

Date: 21.09.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d162**

Communication System: CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.37$  mho/m;  $\epsilon_r = 40.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

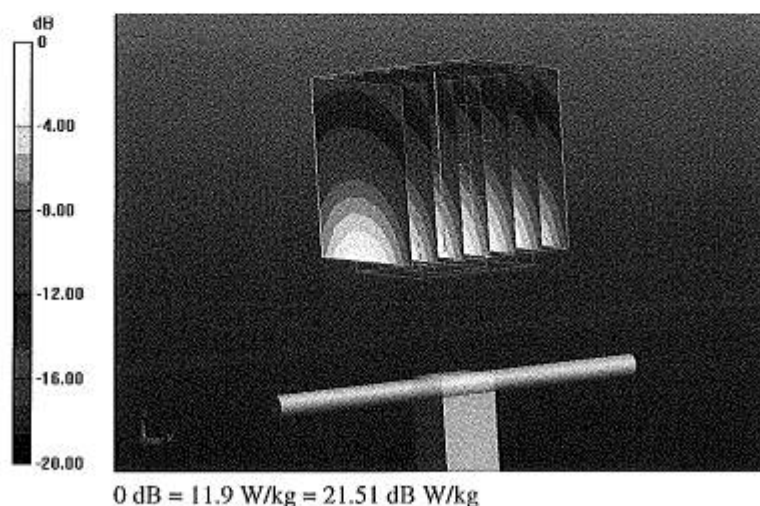
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.423 V/m; Power Drift = 0.04 dB

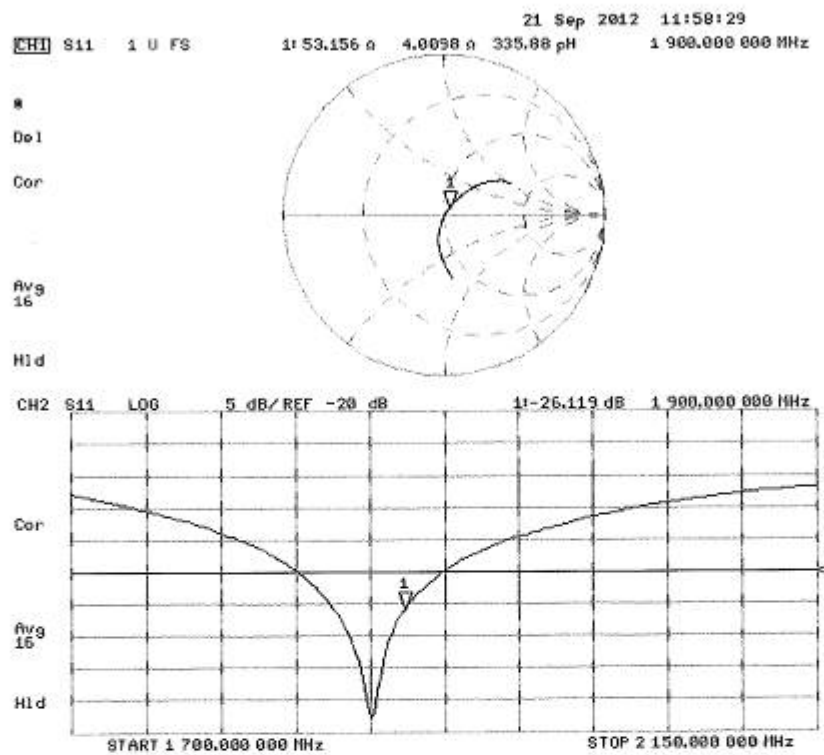
Peak SAR (extrapolated) = 17.236 mW/g

**SAR(1 g) = 9.69 mW/g; SAR(10 g) = 5.13 mW/g**

Maximum value of SAR (measured) = 11.9 W/kg



## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 21.09.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d162**

Communication System: CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.54$  mho/m;  $\epsilon_r = 52.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

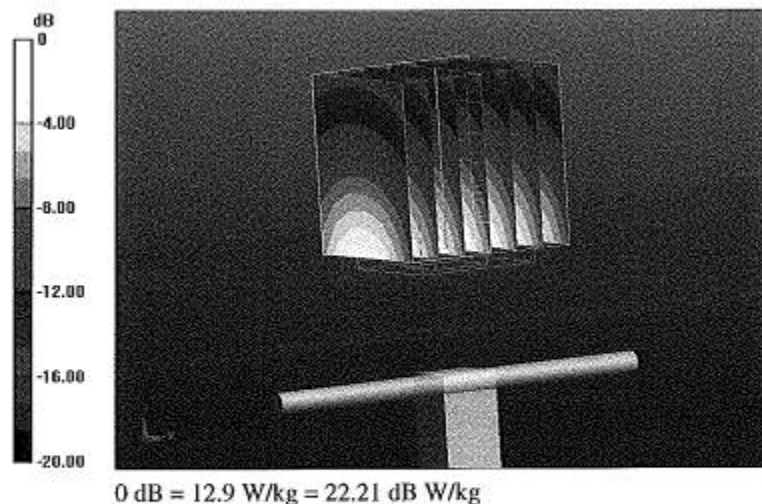
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.423 V/m; Power Drift = 0.02 dB

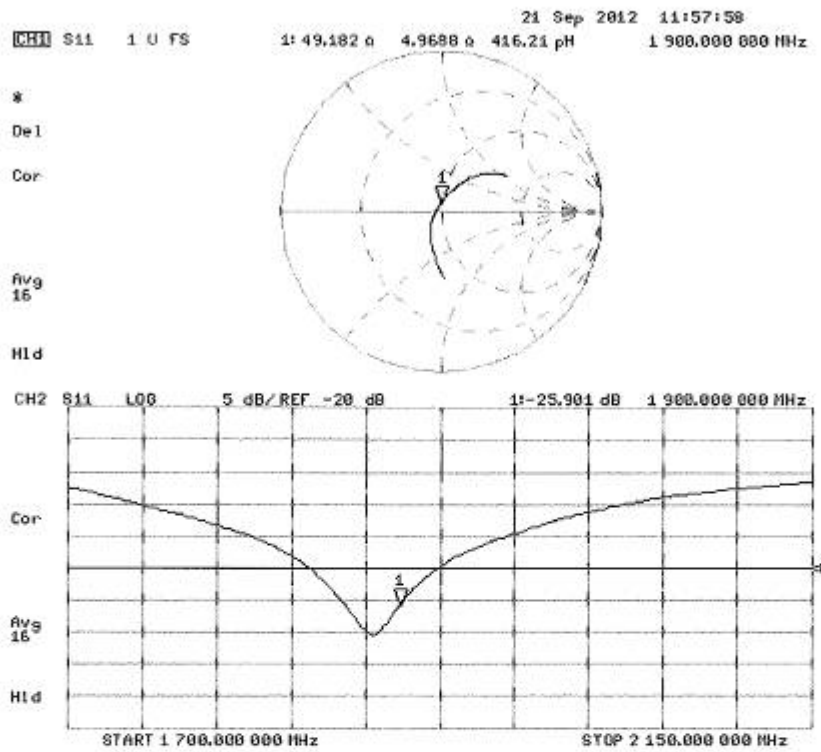
Peak SAR (extrapolated) = 17.979 mW/g

**SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.45 mW/g**

Maximum value of SAR (measured) = 12.9 W/kg



## Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **SMQ (Auden)**

Certificate No: **D2450V2-818\_Oct12**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 818**

Calibration procedure(s) **QA CAL-05.v8**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **October 18, 2012**

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 (M&E critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter EPM-442A        | GB37480704         | 05-Oct-11 (No. 217-01451)         | Oct-12                 |
| Power sensor HP 8481A       | US37292783         | 05-Oct-11 (No. 217-01451)         | Oct-12                 |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 27-Mar-12 (No. 217-01530)         | Apr-13                 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 27-Mar-12 (No. 217-01533)         | Apr-13                 |
| Reference Probe ES30V3      | SN: 3205           | 30-Dec-11 (No. ES3-3205_Dec11)    | Dec-12                 |
| DAE4                        | SN: 601            | 27-Jun-12 (No. DAE4-601_Jun12)    | Jun-13                 |
| Secondary Standards         | ID #               | Check Date (in house)             | Scheduled Check        |
| Power sensor HP 8481A       | MY41092317         | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06     | 100005             | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E   | US37390585 S4206   | 18-Oct-01 (in house check Oct-12) | In house check: Oct-13 |

Calibrated by: **Israa El-Nasouq** Name: **Israa El-Nasouq** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Name: **Katja Pokovic** Function: **Technical Manager**

Signature  
*Israa El-Nasouq*  
*Katja Pokovic*

Issued: October 18, 2012

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Accreditation No.: **SCS 108**

**Glossary:**

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

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

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**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%.

### Measurement Conditions

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

|                              |                        |             |
|------------------------------|------------------------|-------------|
| DASY Version                 | DASY5                  | V52.6.3     |
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 2450 MHz $\pm$ 1 MHz   |             |

### Head TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 39.2           | 1.80 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 38.4 $\pm$ 6 % | 1.85 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | < 0.5 °C            | ---            | ---                  |

### SAR result with Head TSL

|   |                    |                              |
|---|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                              |
| SAR measured  | 250 mW input power | 13.3 W/kg                    |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 52.3 W/kg $\pm$ 17.0 % (k=2) |

|   |                    |                              |
|---|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured  | 250 mW input power | 6.19 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 24.5 W/kg $\pm$ 16.5 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Body TSL parameters             | 22.0 °C             | 52.7           | 1.95 mho/m           |
| Measured Body TSL parameters            | (22.0 $\pm$ 0.2) °C | 51.0 $\pm$ 6 % | 2.02 mho/m $\pm$ 6 % |
| Body TSL temperature change during test | < 0.5 °C            | ---            | ---                  |

### SAR result with Body TSL

|   |                    |                              |
|---|--------------------|------------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                              |
| SAR measured  | 250 mW input power | 13.0 W/kg                    |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 50.8 W/kg $\pm$ 17.0 % (k=2) |

|   |                    |                              |
|---|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                              |
| SAR measured  | 250 mW input power | 6.03 W/kg                    |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 23.8 W/kg $\pm$ 16.5 % (k=2) |



## Appendix

### Antenna Parameters with Head TSL

|                                      |                               |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | $53.0\ \Omega + 2.5\ j\Omega$ |
| Return Loss                          | - 28.4 dB                     |

### Antenna Parameters with Body TSL

|                                      |                               |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | $50.1\ \Omega + 4.4\ j\Omega$ |
| Return Loss                          | - 27.1 dB                     |

### General Antenna Parameters and Design

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

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

|                 |                   |
|-----------------|-------------------|
| Manufactured by | SPEAG             |
| Manufactured on | December 11, 2008 |

## DASY5 Validation Report for Head TSL

Date: 18.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 818**

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.85$  mho/m;  $\epsilon_r = 38.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**

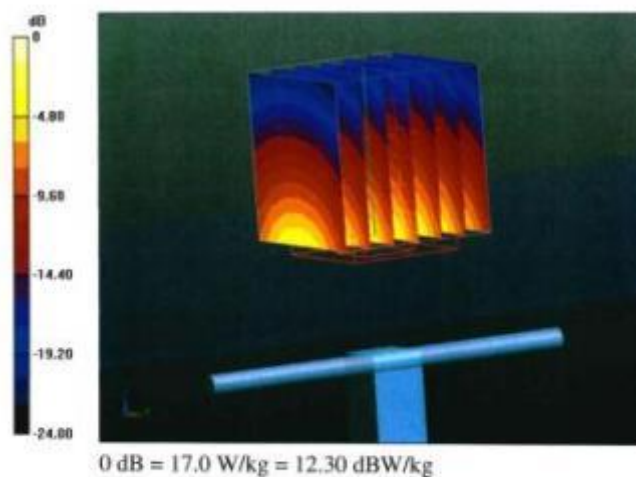
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.551 V/m; Power Drift = 0.07 dB

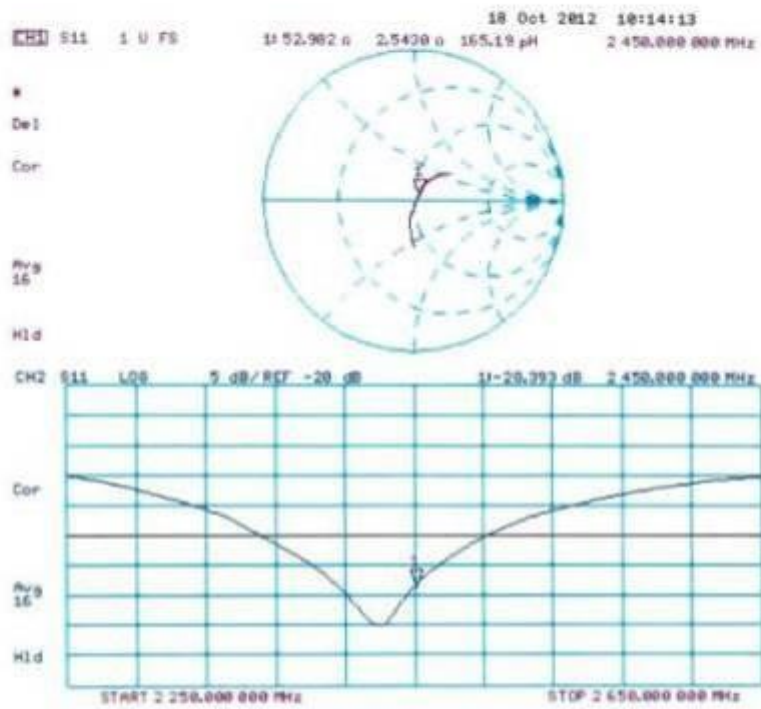
Peak SAR (extrapolated) = 27.4 W/kg

**SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.19 W/kg**

Maximum value of SAR (measured) = 17.0 W/kg



## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 18.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 818**

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.02$  mho/m;  $\epsilon_r = 51$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm 2/Zoom Scan (7x7x7)/Cube 0:

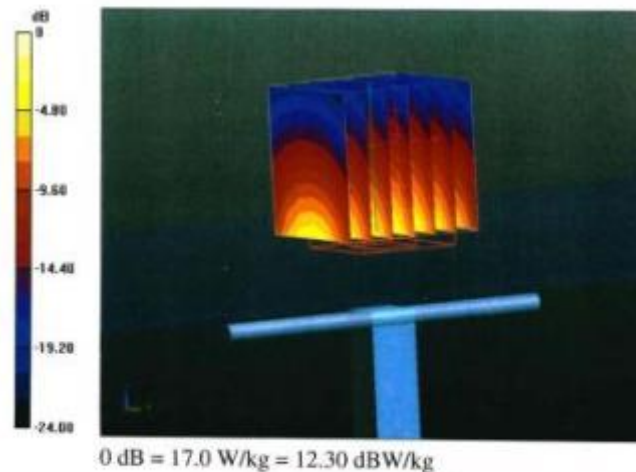
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.079 V/m; Power Drift = 0.02 dB

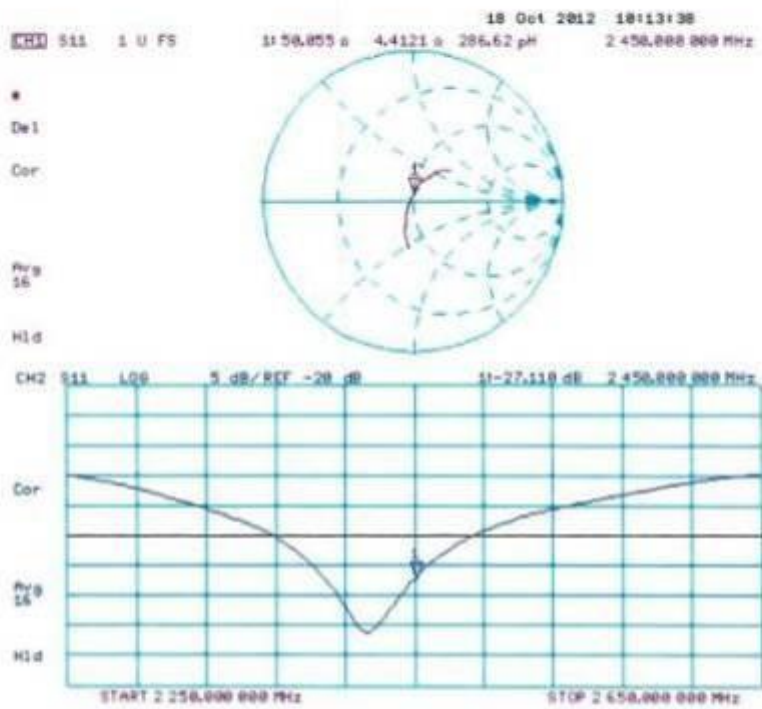
Peak SAR (extrapolated) = 26.9 W/kg

**SAR(1 g) = 13 W/kg; SAR(10 g) = 6.03 W/kg**

Maximum value of SAR (measured) = 17.0 W/kg



## Impedance Measurement Plot for Body TSL





In Collaboration with  
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**CALIBRATION LABORATORY**

ADD 0101-1

Add: No.52 Huayuanbei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [Info@emcite.com](mailto:Info@emcite.com) Http://www.emcite.com

Client : **SMQ**

**Certificate No: Z14-97008**

## CALIBRATION CERTIFICATE

Object **DAE4 - SN: 876**

Calibration Procedure(s) **TMC-OS-E-01-198**  
**Calibration Procedure for the Data Acquisition Electronics (DAEx)**

Calibration date: **March 03, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards                     | ID #    | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|---------------------------------------|---------|--|-----------------------|
| Documenting<br>Process Calibrator 753 | 1971018 | 01-July-13 (TMC, No:JW13-049)            | July-14               |

|                | 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: March 04, 2014

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

Certificate No: Z14-97008

Page 1 of 3



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Add: No.52 Huayuanbei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [Info@emcite.com](mailto:Info@emcite.com) [Http://www.emcite.com](http://www.emcite.com)

#### **Glossary:**

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

#### **Methods Applied and Interpretation of Parameters:**

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

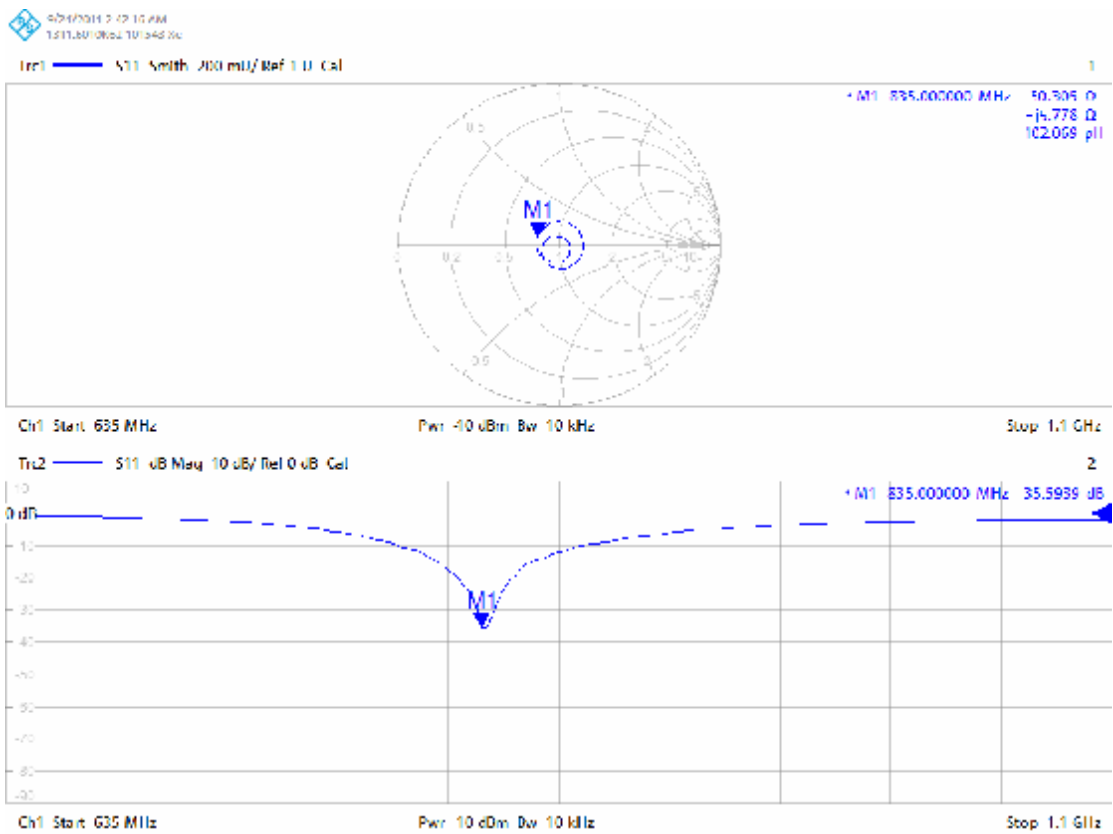
#### **Note:**

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 the following criteria at least on annual interval in Appendix D.

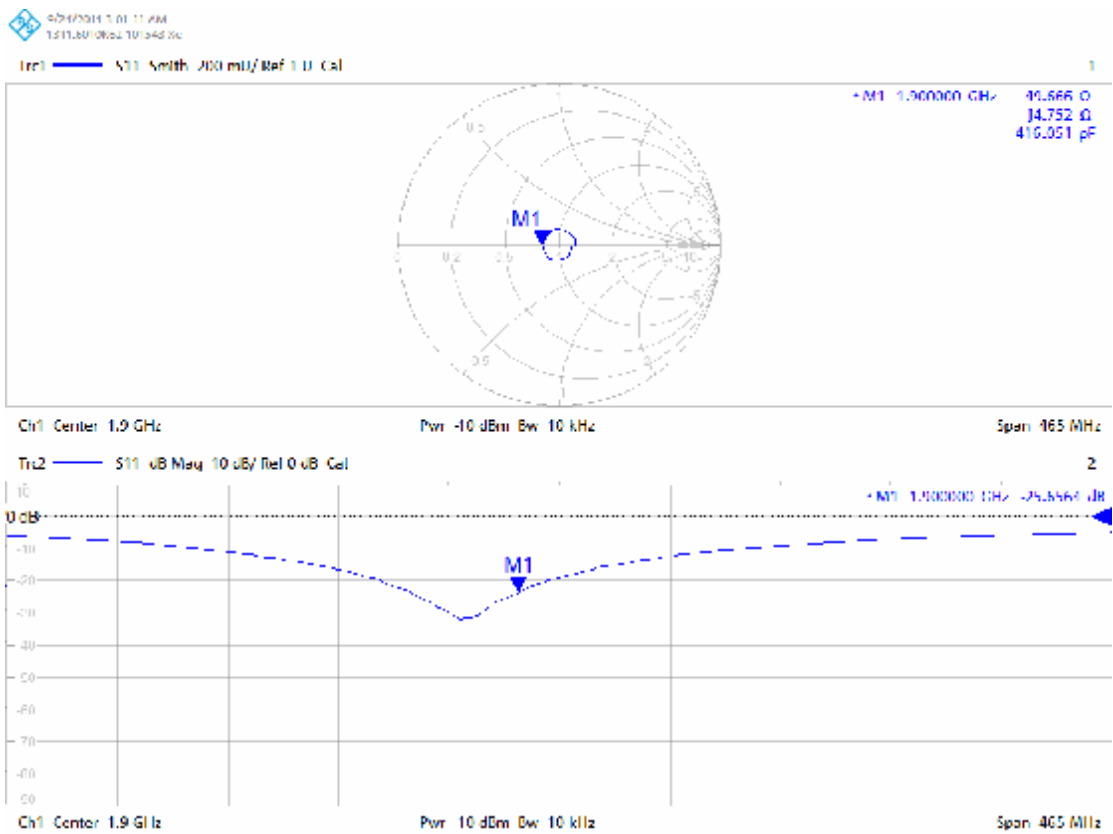
- a) There is no physical damage on the dipole;
  - b) System check with specific dipole is within 10% of calibrated value;
  - c) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement.
  - d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within  $5\Omega$  from the previous measurement.





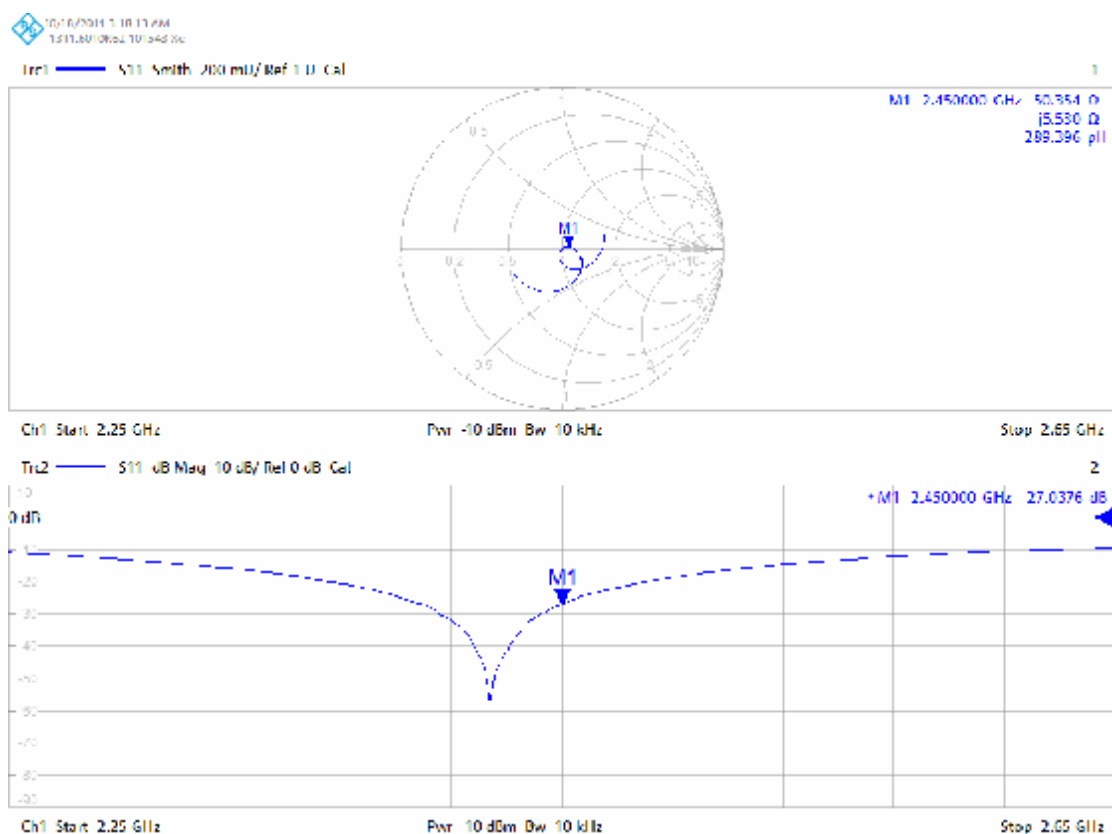
835MHz Dipole Body  
D835V2, serial No. 4d141 Extended Dipole Calibrations

|           | 835 Body            |          |                        |                |                             |                |
|-----------|---------------------|----------|------------------------|----------------|-----------------------------|----------------|
|           | Return-Loss<br>(dB) | Delta(%) | Real<br>Impedance(ohm) | Delta<br>(ohm) | Imaginary<br>Impedance(ohm) | Delta<br>(ohm) |
| 2012-9-24 | -34.633             |          | 50.082                 |                | -1.8672                     |                |
| 2014-9-24 | -35.594             | -2.70    | 50.305                 | 0.22           | -5.778                      | -3.91          |



# D1900V2, serial No. 5d162 Extended Dipole Calibrations 1900MHz Body

|           | 1900 Body       |          |                     |             |                          |             |
|-----------|-----------------|----------|---------------------|-------------|--------------------------|-------------|
|           | Return-Loss(dB) | Delta(%) | Real Impedance(ohm) | Delta (ohm) | Imaginary Impedance(ohm) | Delta (ohm) |
| 2012-9-21 | -28.393         |          | 52.982              |             | 2.543                    |             |
| 2014-9-24 | -25.656         | 0.11     | 49.666              | -3.32       | 4.752                    | 2.21        |

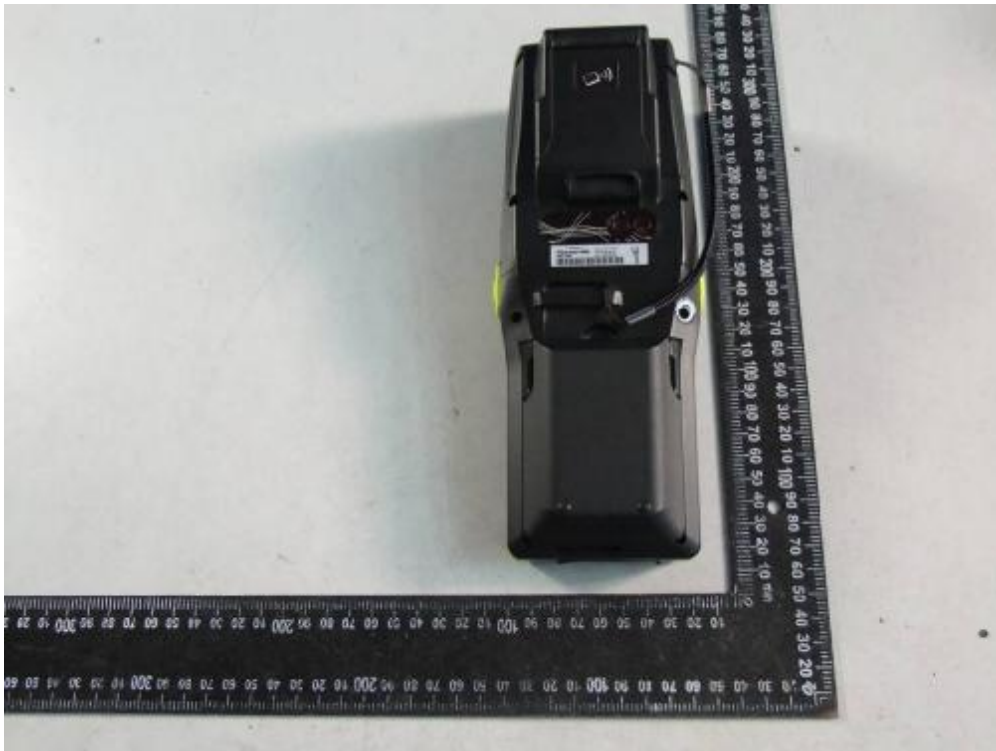


# D2450V2, serial No. 818 Extended Dipole Calibrations 2450MHz Dipole Body

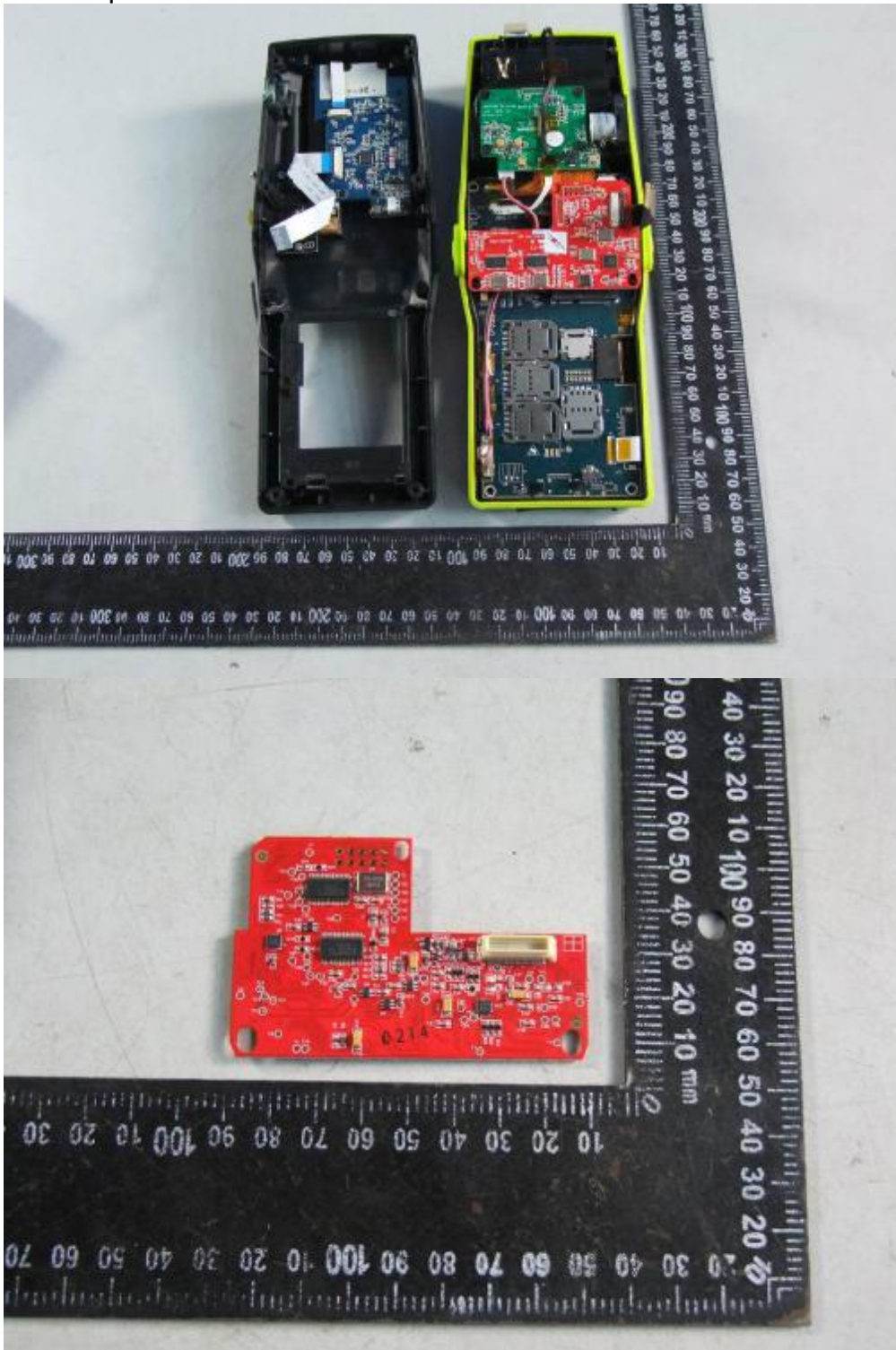
|            | 2450 Body           |          |                        |                |                             |                |
|------------|---------------------|----------|------------------------|----------------|-----------------------------|----------------|
|            | Return-Loss<br>(dB) | Delta(%) | Real<br>Impedance(ohm) | Delta<br>(ohm) | Imaginary<br>Impedance(ohm) | Delta<br>(ohm) |
| 2012-10-18 | -27.110             |          | 50.055                 |                | 4.4121                      |                |
| 2014-10-18 | -27.038             | 0.27     | 50.354                 | 0.30           | 5.530                       | 1.12           |

## APPENDIX E: DUT Photos

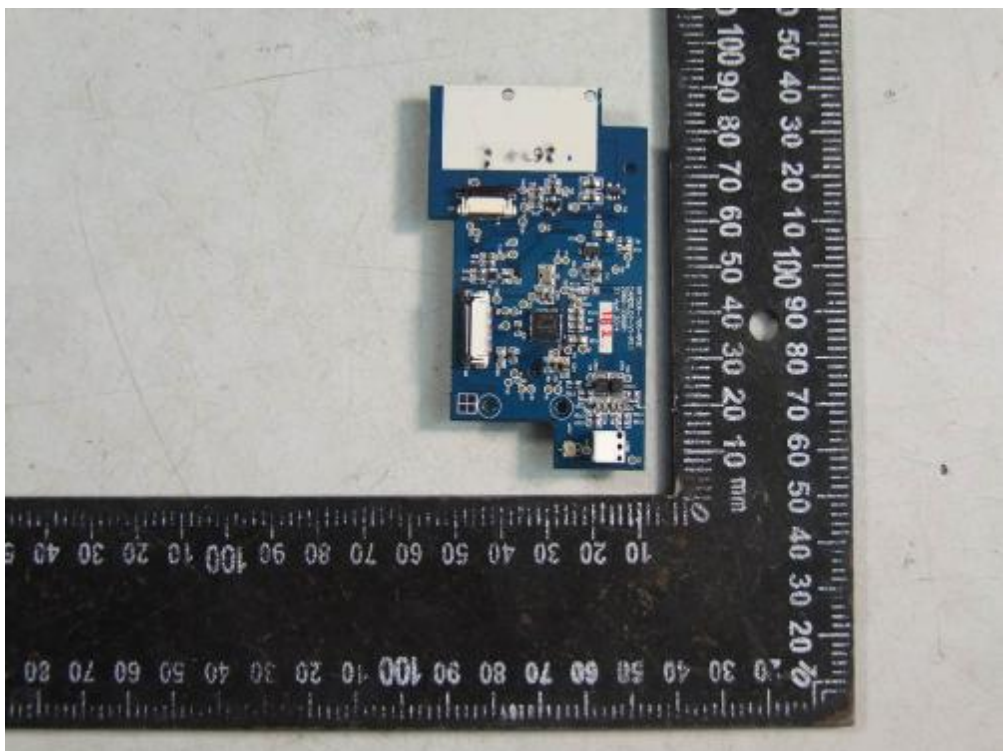
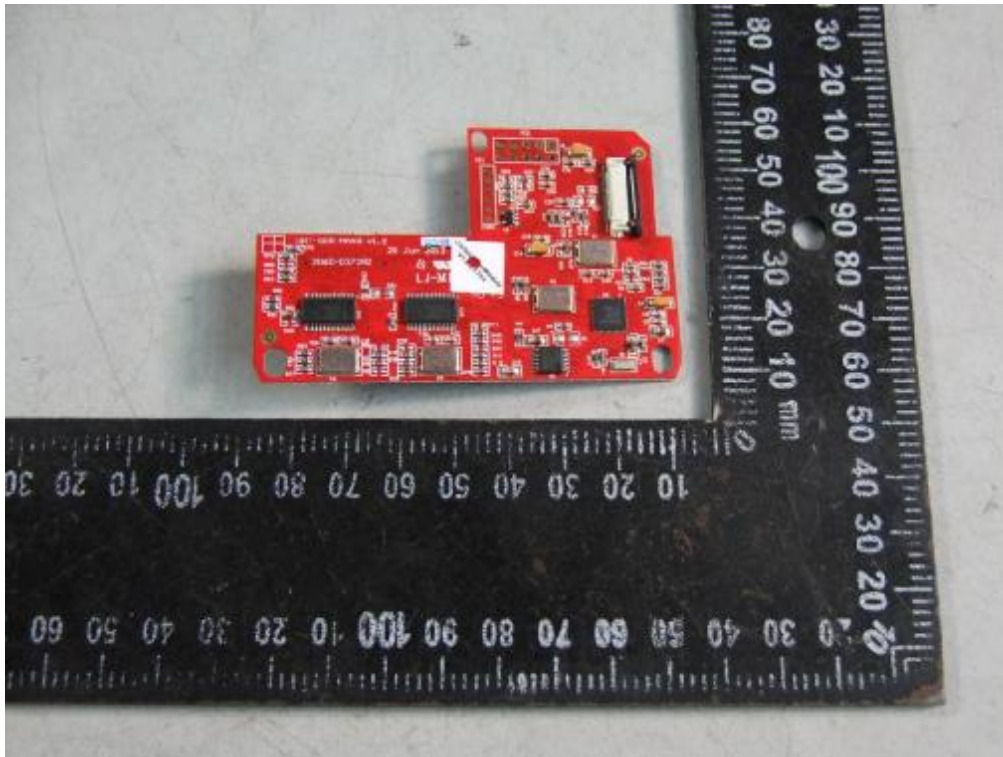
HRT700

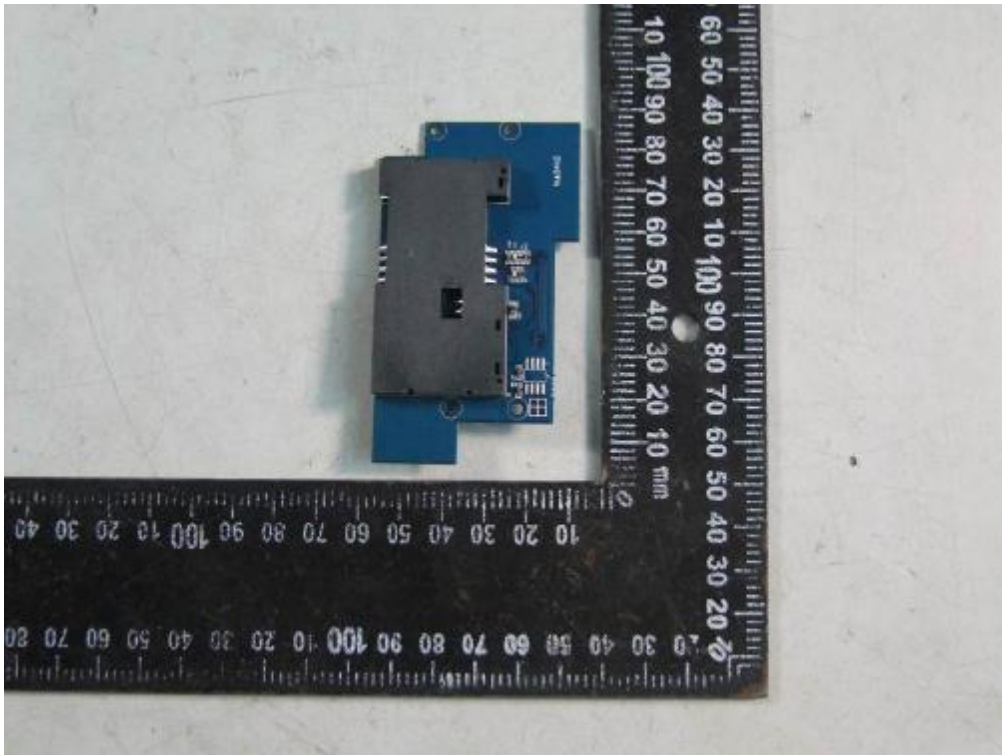


## Internal photos







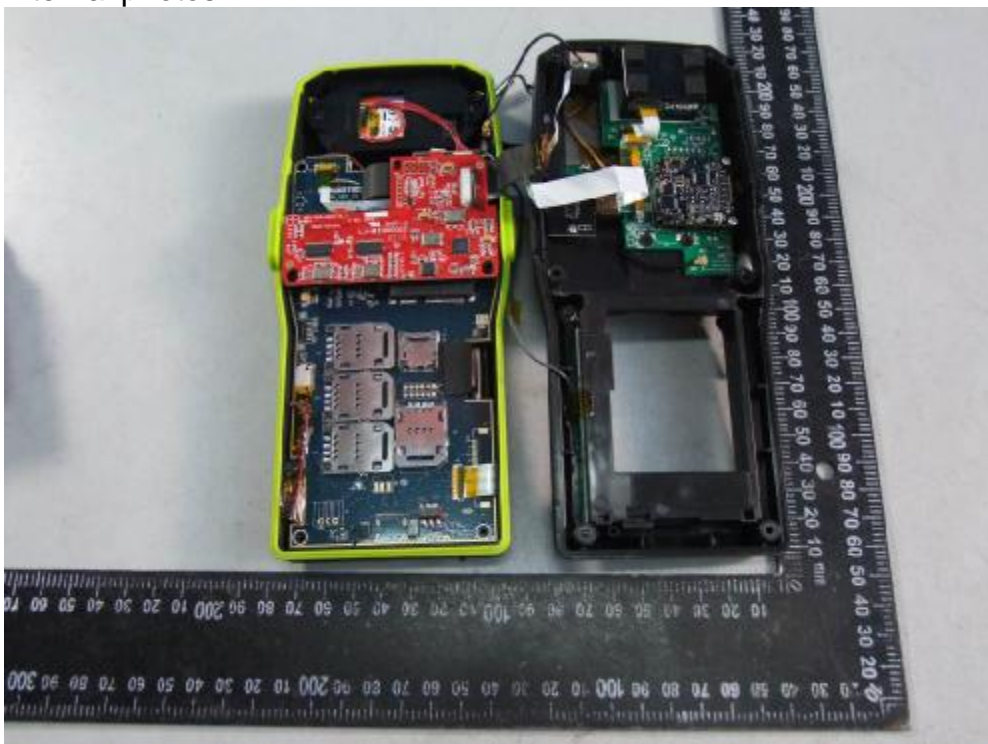


HRT500

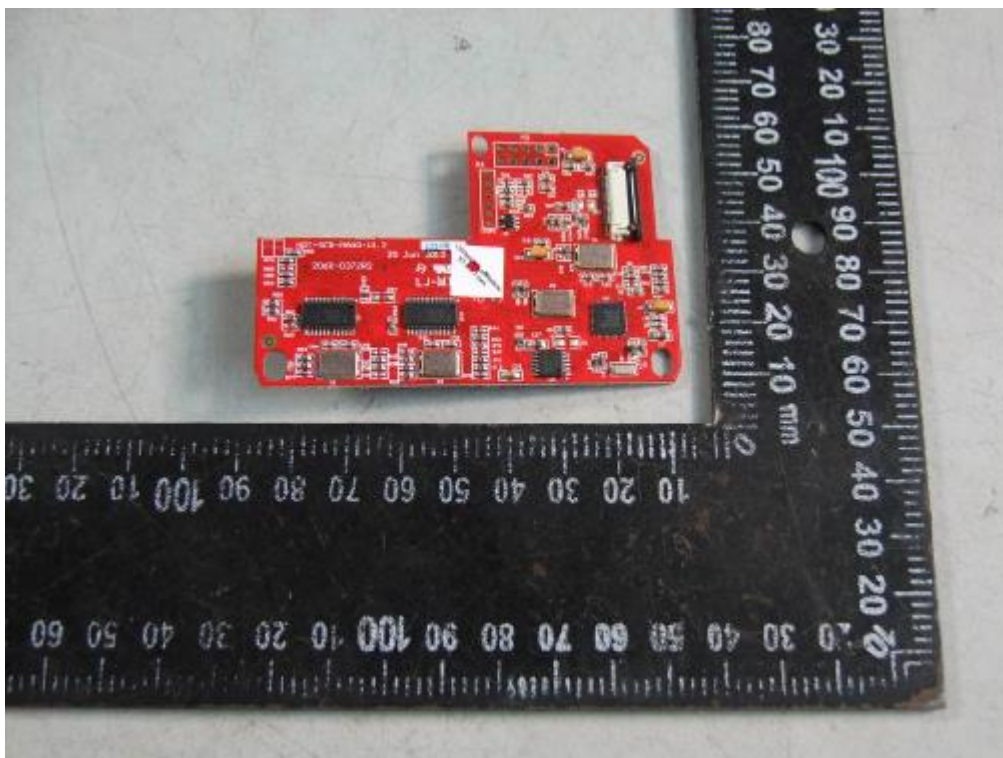
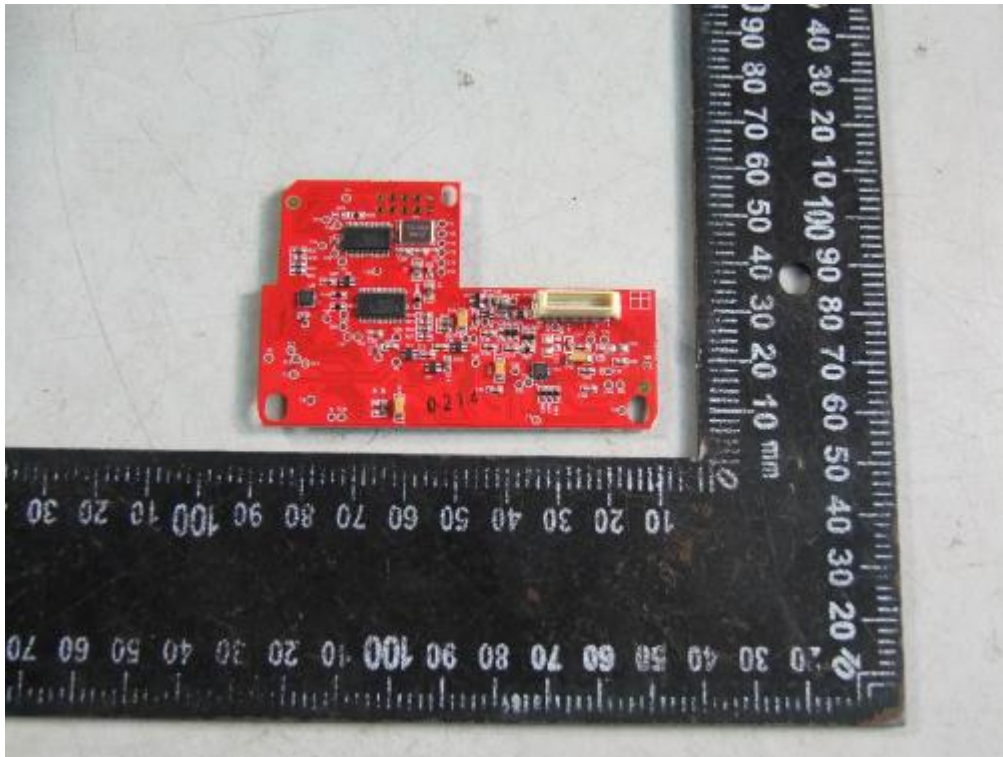


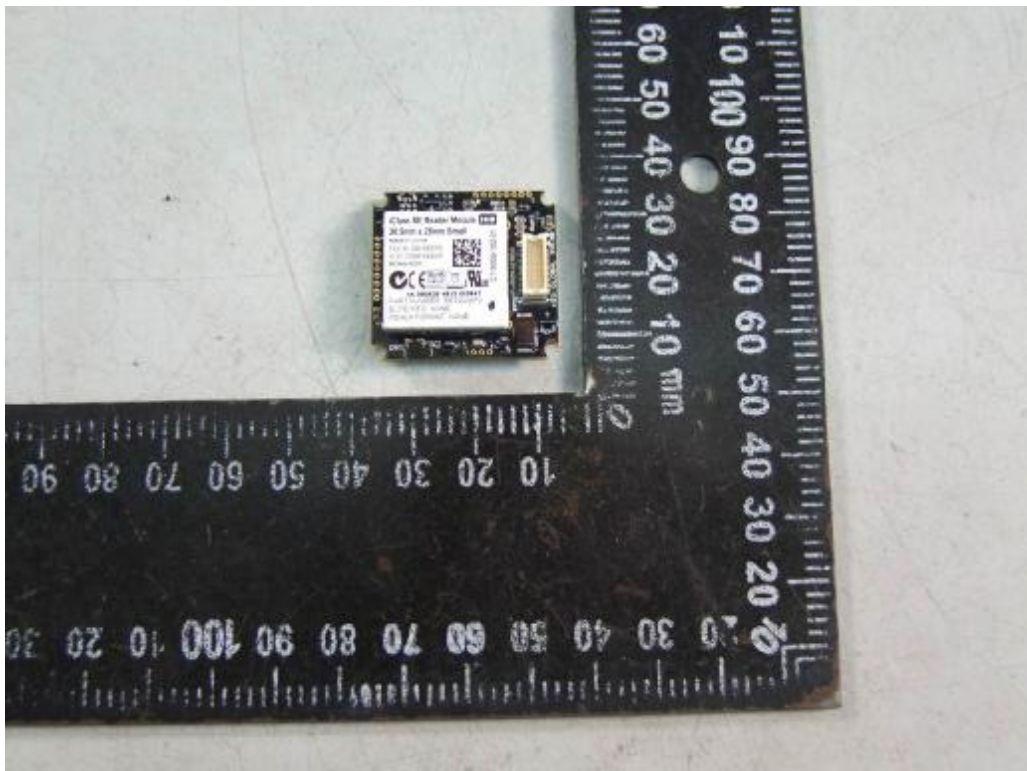
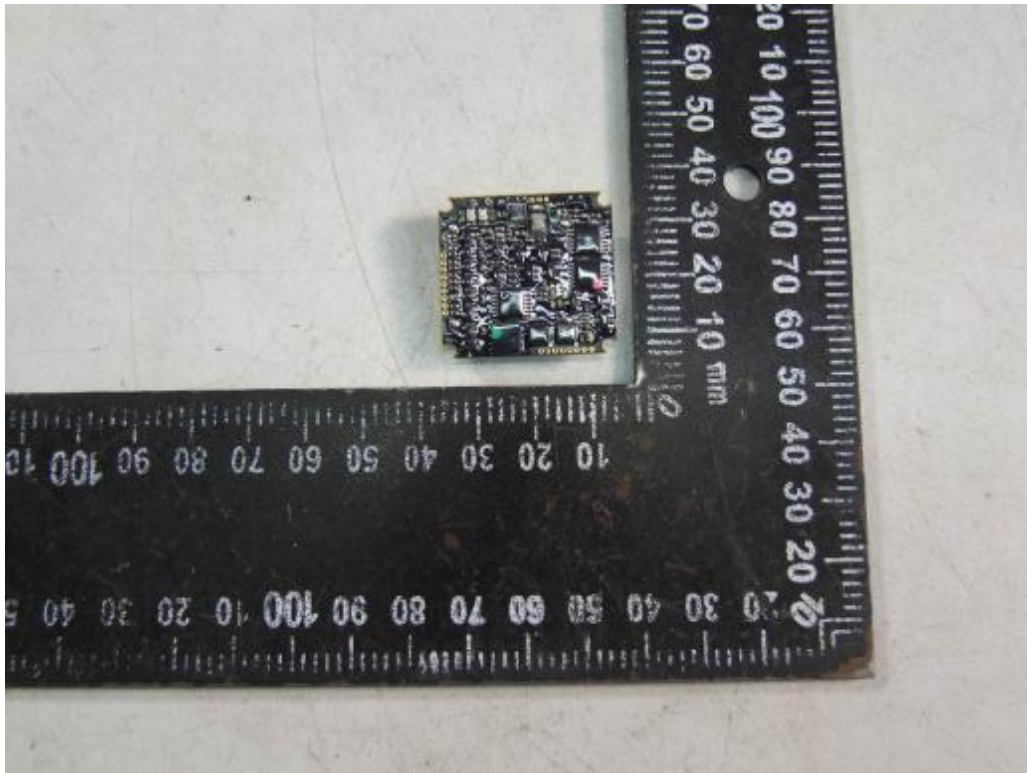


Internal photos

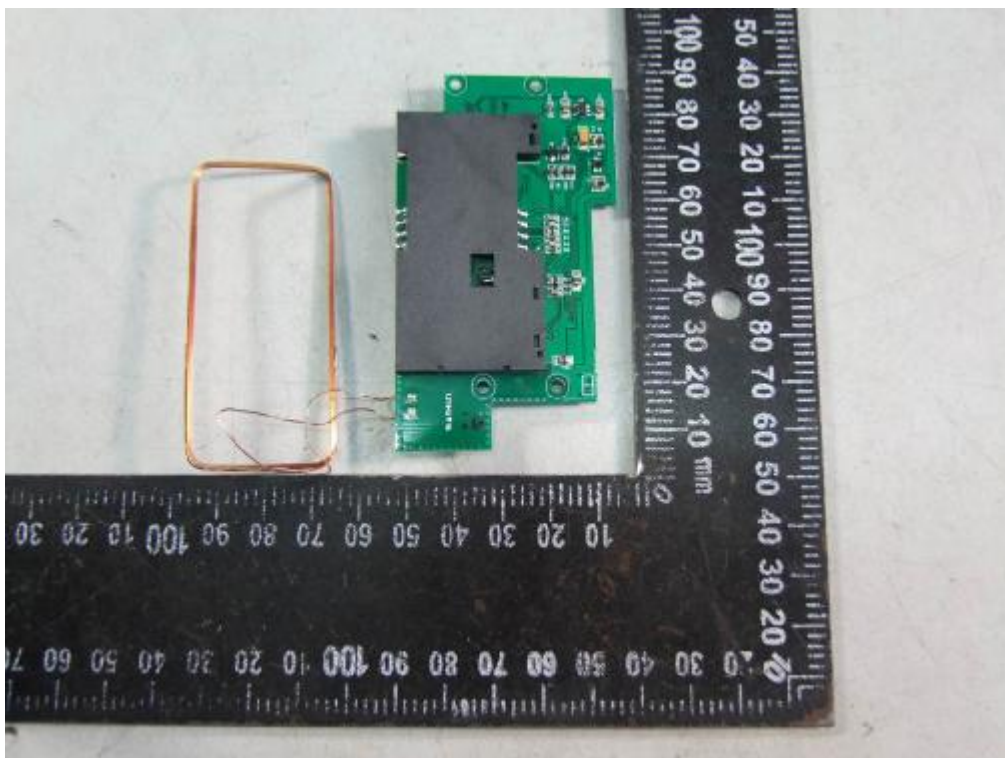
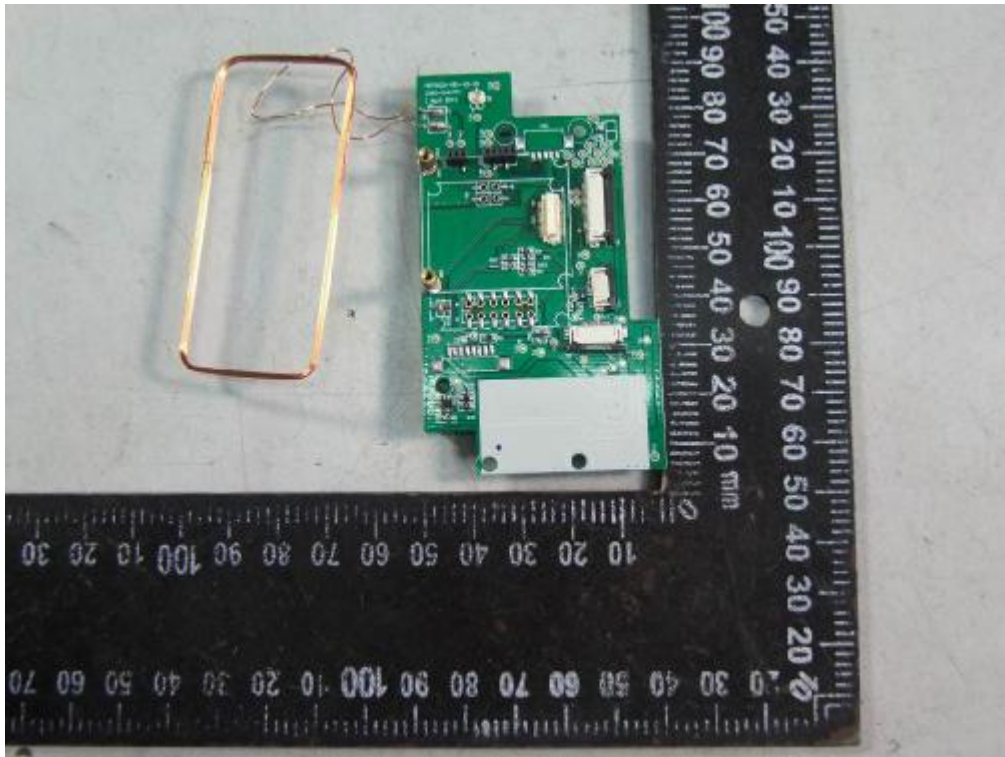


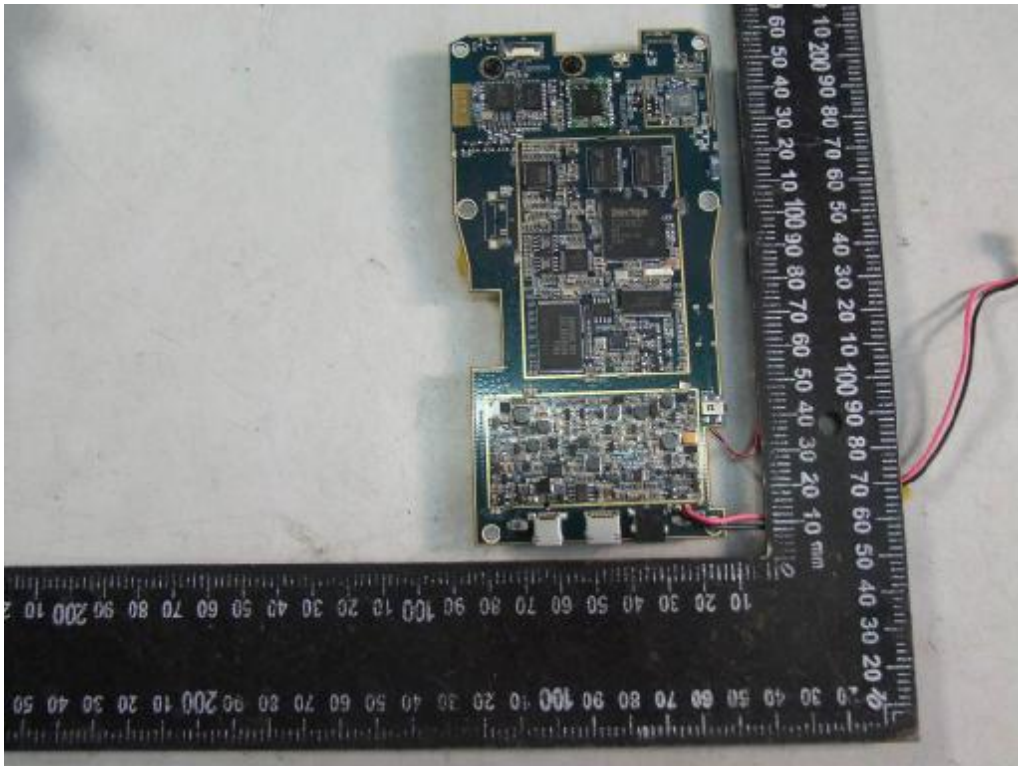






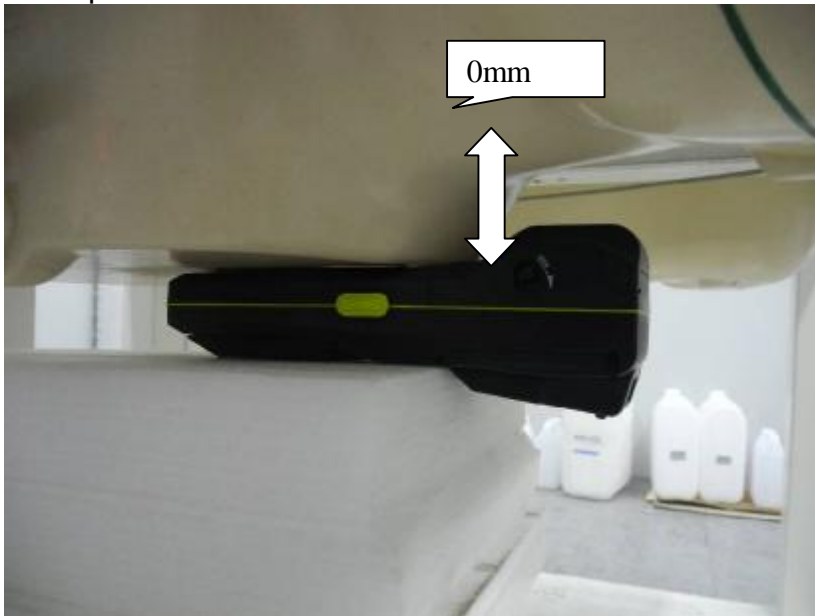






**APPENDIX F: Test Position Photos**

Front position 0mm

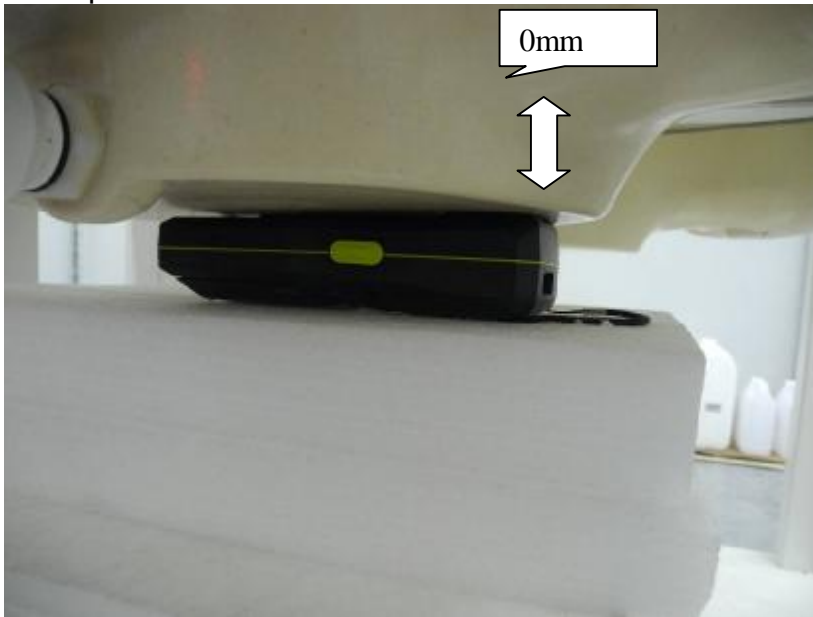


Back position 0mm

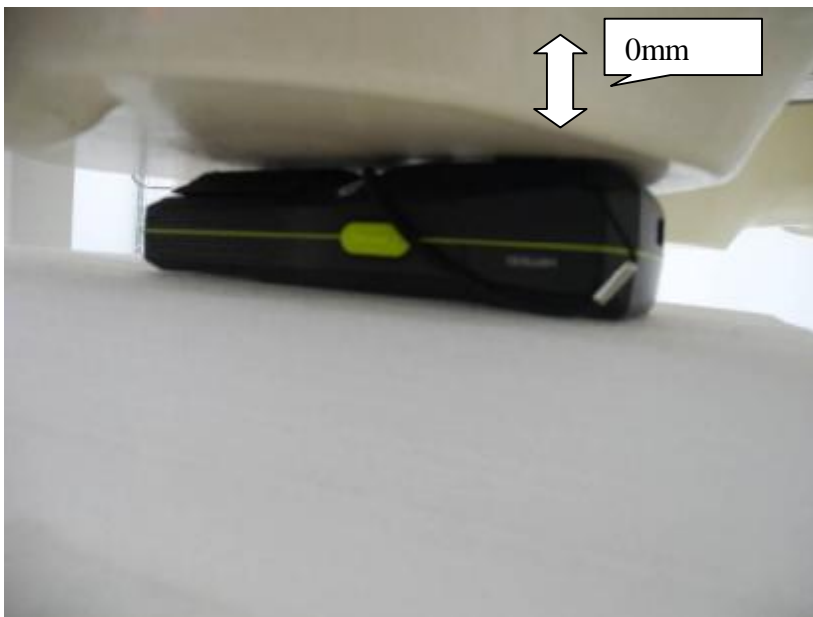


HRT500

Front position 0mm



Back position 0mm



**APPENDIX G: Laboratory Accreditation Certificate**





China National Accreditation Service for Conformity Assessment

**LABORATORY ACCREDITATION CERTIFICATE**

(Registration No. CNAS L0579 )

**Shenzhen Academy of Metrology & Quality Inspection**

Middle Section of Longzhu Avenue, Nanshan District, Shenzhen, Guangdong, China

*is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories(CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence of testing and calibration.*

*The scope of accreditation is detailed in the attached appendices bearing the same registration number as above. The appendices form an integral part of this certificate.*

Date of Issue: 2012-12-10

Date of Expiry: 2015-12-09

Date of Initial Accreditation: 1998-11-30

Date of Update: 2012-12-10

Signed on behalf of China National Accreditation Service  
for Conformity Assessment

China National Accreditation Service for Conformity Assessment (CNAS) is authorized by Certification and Accreditation Administration of the People's Republic of China (CNCA) to operate the national accreditation schemes for conformity assessment. CNAS is the signatory to International Laboratory Accreditation Cooperation Multilateral Recognition Arrangement (ILAC MRA) and Asia Pacific Laboratory Accreditation Cooperation Multilateral Recognition Arrangement (APLAC MRA).

No.CNAS AL 2

0005789