



检测
CNAS L0579

SAR TEST REPORT

For

TITAN 2

Model Number: HS-7DTB25

FCC ID: 2AB9A-7DTB25

IC: 11937A-7DTB25

Report Number : WT148001119

Test Laboratory : Shenzhen Academy of Metrology and Quality Inspection
National Testing Center for Digital Electronic Products

Site Location : Bldg. Metrology and Quality Inspection, Longzhu Road, Shenzhen, Guangdong, China

Tel : 0086-755-26941599

Fax : 0086-755-26941545

Web : www.smq.com.cn

Test report declaration

Applicant : THINKMAX TECHNOLOGIES INC.
Address : 560 DENISON STREET, UNIT 5, MARKHAM,ontaria, L3R2M8
,Canada
Manufacturer : THINKMAX TECHNOLOGIES INC.
Address : 560 DENISON STREET, UNIT 5, MARKHAM,ontaria, L3R2M8
,Canada
EUT Description : TITAN 2
Model No : HS-7DTB25
Trade mark : **hipstreet**
Serial Number : : /
FCC ID : : 2AB9A-7DTB25

Test Standards:

IEEE 1528-2013 FCC KDB 865664 D01 v01

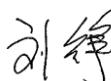
Canada's Safety Code 6 RSS-102

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.

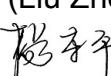
Project Engineer:



Date: Apr.28.2014

(Liu Zheng)

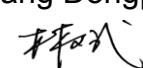
Checked by:



Date: Apr.28.2014

(Yang Dongping)

Approved by:



Date: Apr.28.2014

(Lin Bin)

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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

| Exposure Position | Frequency Band | Highest Reported 1g-SAR (W/kg) | Equipment Class | Highest Reported 1g-SAR (W/kg) |
|-------------------|------------------|--------------------------------|-----------------|--------------------------------|
| Hotspot(0m m Gap) | WLAN 2.4GHz Band | 0.228 | DTS | 0.228 |

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 | 802.11b&802.11g&802.11n-20&802.11n-40 : |
| | 2.4GHz |
| Modulation Mode | : 802.11b:DSSS |
| | 802.11g&802.11n-20&802.11n-40: OFDM |
| Antenna type | Fixed Internal Antenna |
| Battery Model | |
| Battery Specification | |
| Hardware Version | |
| Software Version | |

3.2. RF output power Tune up limit

| Maximum Target Average Power for Production Unit (dBm) | | | | |
|--|-------------|----|--------|--------|
| Mode / Band | IEEE 802.11 | | | |
| | b | g | n-HT20 | n-HT40 |
| WLAN 2.4 GHz Band | 14 | 12 | 11 | 10 |

3.3. Applied Standards

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 447498 D01 v05
- FCC KDB 648474 D04v01
- FCC KDB 248227 D01 v01r02
- FCC KDB 941225 D01 v02
- FCC KDB 941225 D03 v01
- FCC KDB 941225 D06 v01
- FCC KDB 865664 D01 v01
- FCC KDB 616217 D04v01
- Canada's Safety Code 6
- RSS-102

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:

$$SAR = \frac{d}{dt} \left(\frac{dW}{dm} \right) = \frac{d}{dt} \left(\frac{dW}{\rho dv} \right) \quad SAR = C \frac{\delta T}{\delta t} \quad SAR = \frac{\sigma |E|^2}{\rho}$$

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 ρ .

In the second equation, C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration.

The last equation relates to the electrical field, where σ is the conductivity of the tissue, ρ 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

For WWAN SAR testing, the device was controlled by using a base station emulator. Communication between the device and the emulator was established by air link. The distance between the EUT and the antenna of the emulator is larger than 50 cm and

the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT.

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 | ES3DV3 | SPEAG | SB6810/02 | 2013.10.31 | 1year |
| 3 | System Validation Dipole,835MHz | D835V2 | SPEAG | SB6810/04 | 2012.09.24 | 2year |
| 4 | System Validation Dipole,1900MHz | D1900V2 | SPEAG | SB6810/05 | 2012.09.21 | 2year |
| 5 | System Validation Dipole,2450MHz | D2450V2 | SPEAG | SB6810/06 | 2012.10.18 | 2year |
| 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 | 2014.01.16 | 1year |
| 12 | Power Meter | NRVD | R&S | SB3437 | 2014.01.19 | 1year |
| 13 | Call Tester | CMU 200 | R&S | SB3441 | 2014.03.30 | 1year |
| 14 | Data Acquisition Electronics | DAE4 | SPEAG | SB6810/01 | 2014.10.30 | 1Year |
| 15 | Software | DASY52 | SPEAG | SB6810/14 | -- | -- |

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 ES3DV3

| | |
|---------------|--|
| Construction | Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., butyl diglycol) |
| Calibration | Calibration certificate in Appendix C |
| Frequency | 10MHz to 4GHz (dosimetry); Linearity: ± 0.2 dB (30MHz to 4GHz) |
| Directivity | ± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in HSL (rotation normal to probe axis) |
| Dynamic Range | 5 μ W/g to > 100mW/g; Linearity: ± 0.2 dB |
| Dimensions | Overall length: 330 mm Tip length: 20 mm Body diameter: 12 mm Tip diameter: 3.9 mm Distance from probe tip to dipole centers: 2.0 mm |
| Application | General dosimetry up to 4 GHz Compliance tests of mobile phones 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.



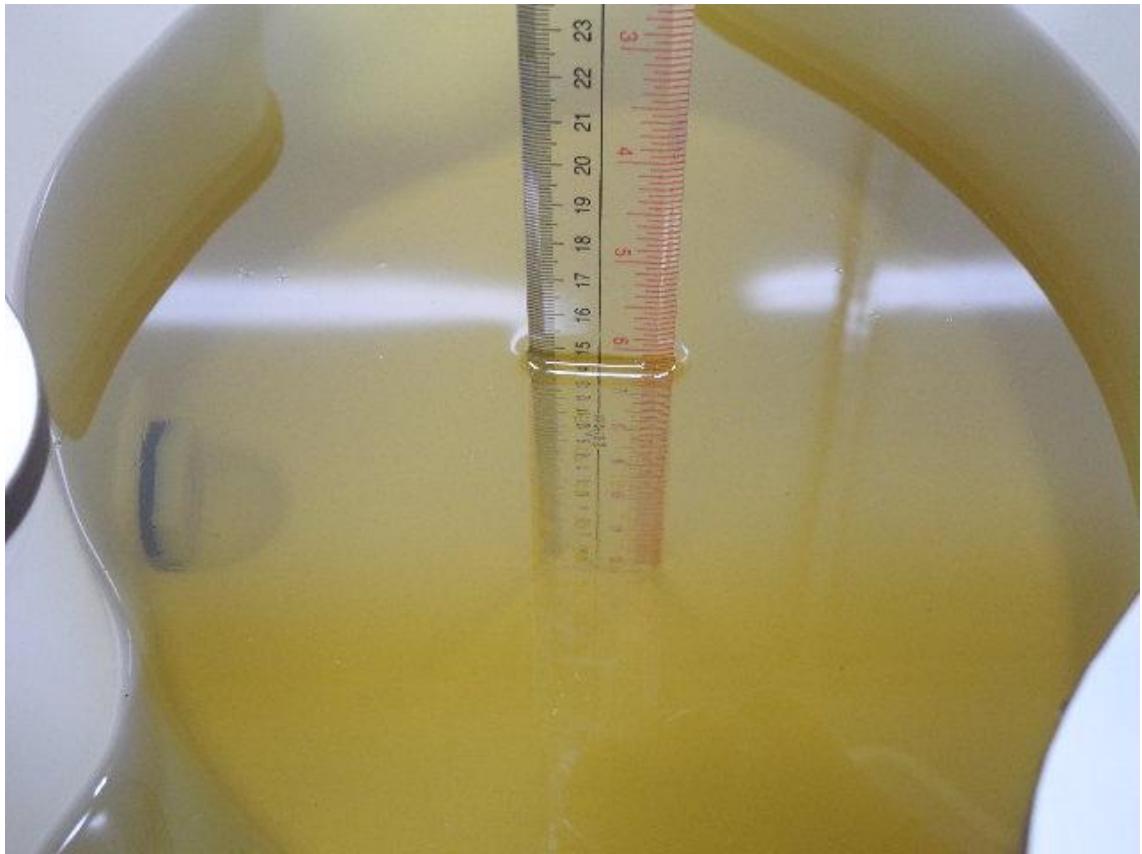
5.4. Tissue-equivalent Liquids

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 ± 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 (% 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 (% 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

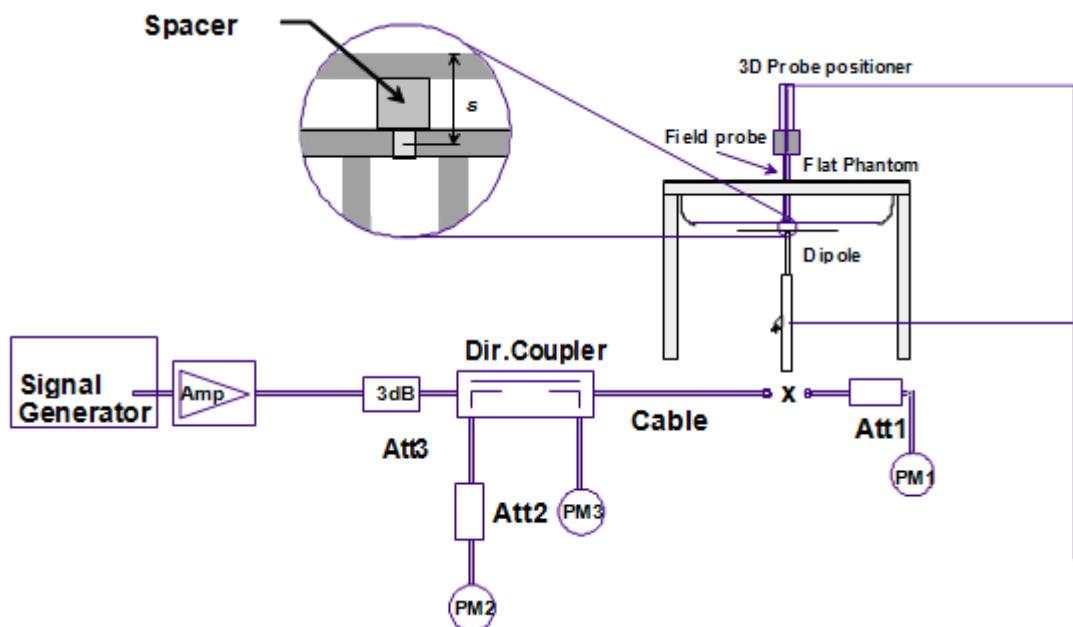
Dielectric parameters of the Tissue-equivalent liquids were measured before testing using the dielectric probe kit and the Network Analyzer. The measurement is carried out following the Agilent 85070 dielectric probe software instruction. A calibration of the probe open in air, probe with shorting block 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) |
|-------|-------------|------------------------|--------|----------|---------------|-----------|
| 2450 | 2014/4/28 | $\varepsilon_r = 51.4$ | 52.7 | -2.47% | ± 5 | 22 |
| | | $\sigma = 1.98$ | 1.95 | 1.54% | | |
| 2410 | 2014/4/28 | $\varepsilon_r = 51.1$ | 52.7 | -3.04% | ± 5 | 22 |
| | | $\sigma = 1.94$ | 1.95 | -0.51% | | |
| 2475 | 2014/4/28 | $\varepsilon_r = 51.3$ | 52.7 | -2.66% | ± 5 | 22 |
| | | $\sigma = 1.96$ | 1.95 | 0.51% | | |

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) |
|-------|-------------|------------------|--------|----------|------------------|--------------|
| 2450 | 2014/4/28 | 48.8 | 50.8 | -3.94% | ±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.

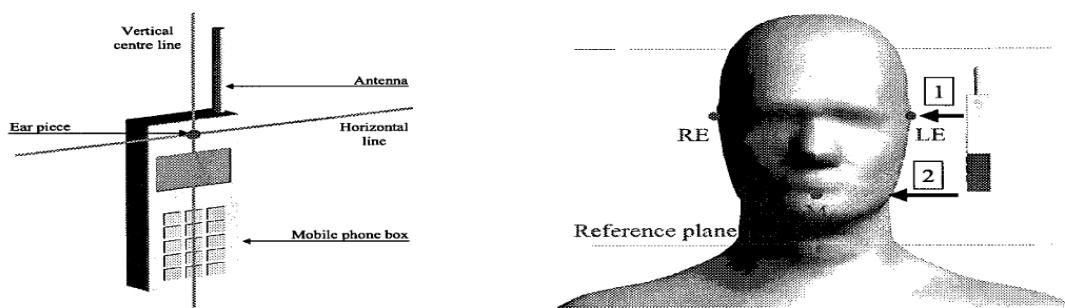
Define of the “cheek” position:

- 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

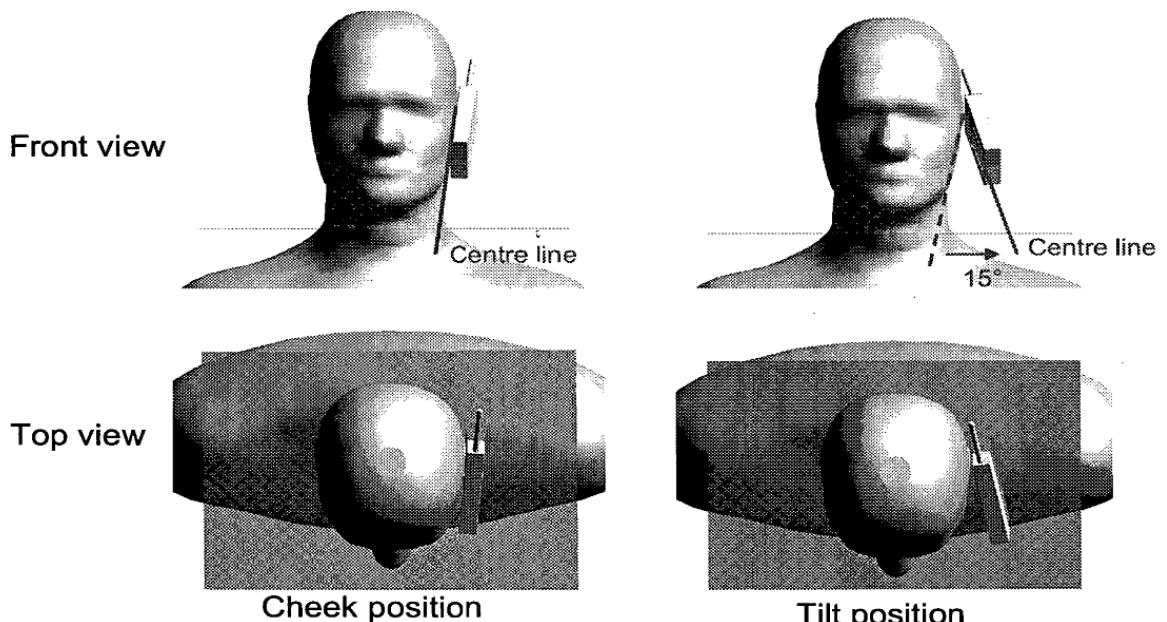
the cheek of the phantom or until contact with the ear is lost.

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



“ Cheek” and “ tilted” position of the mobile phone on the left side

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)³ (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 | ∞ |
| Test Sample Related | | | | | | |
| 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 | ∞ |
| Phantom and Tissue Parameters | | | | | | |
| 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 |
| Combined Standard Uncertainty | | | | | ±10.7 | 387 |
| Expanded STD Uncertainty | | | | | ±21.4 | |

6.2. Uncertainty for System Validation

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

7. CONDUCTED TEST RESULTS

WLAN 2.4GHz Band Conducted Power

| 802.11b Average Power (dBm) | | | | | |
|-----------------------------|----------------|-----------------|--------|----------|---------|
| Channel | Frequency(MHz) | Data Rate (bps) | | | |
| | | 1M bps | 2M bps | 5.5M bps | 11M bps |
| CH 01 | 2,412 | 13.53 | 13.41 | 13.36 | 13.25 |
| CH 06 | 2,437 | 13.64 | 12.9 | 12.43 | 12.98 |
| CH 11 | 2,462 | 13.6 | 13.9 | 12.96 | 13.5 |

| 802.11g Average Power (dBm) | | | | | | | | |
|-----------------------------|----------------|-----------------|--------|---------|---------|---------|---------|---------|
| Channel | Frequency(MHz) | Data Rate (bps) | | | | | | |
| | | 6M bps | 9M bps | 12M bps | 18M bps | 24M bps | 36M bps | 48M bps |
| CH 01 | 2,412 | 11.52 | 10.77 | 10.82 | 10.74 | 10.66 | 10.54 | 10.32 |
| CH 06 | 2,437 | 11.35 | 11.16 | 11.13 | 11.19 | 11.24 | 10.91 | 10.63 |
| CH 11 | 2,462 | 11.63 | 11.46 | 11.41 | 11.21 | 11.26 | 11.16 | 10.74 |

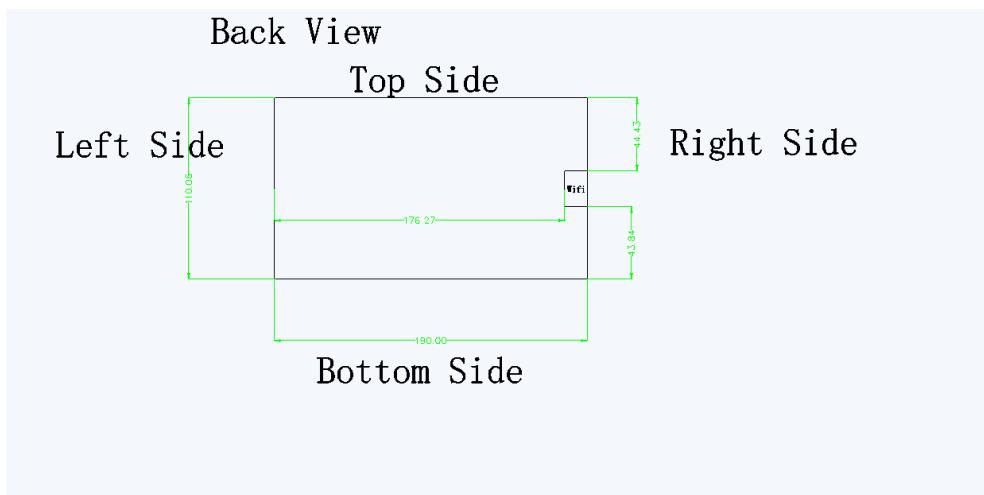
| 802.11n-HT20 Average Power (dBm) | | | | | | | | |
|----------------------------------|----------------|-----------------|-------|-------|-------|-------|------|------|
| Channel | Frequency(MHz) | Data Rate (bps) | | | | | | |
| | | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS7 |
| CH 01 | 2,412 | 10.45 | 9.75 | 9.69 | 9.63 | 9.5 | 9.28 | 9.16 |
| CH 06 | 2,437 | 10.66 | 10.25 | 10.55 | 10.39 | 10.29 | 9.93 | 9.84 |
| CH 11 | 2,462 | 10.27 | 10.06 | 9.83 | 9.95 | 9.82 | 9.49 | 9.36 |

| 802.11n-HT40 Average Power (dBm) | | | | | | | | |
|----------------------------------|----------------|-----------------|------|------|------|------|------|------|
| Channel | Frequency(MHz) | Data Rate (bps) | | | | | | |
| | | MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS7 |
| CH 03 | 2,422 | 9.76 | 9.71 | 9.28 | 9.09 | 8.25 | 7.7 | 7.35 |
| CH 06 | 2,437 | 9.86 | 9.82 | 9.55 | 9.4 | 8.56 | 8.09 | 7.77 |
| CH 09 | 2,452 | 9.57 | 9.58 | 9.34 | 8.75 | 7.98 | 7.43 | 7.14 |
| | | | | | | | | 7.06 |

Remark:

1. Per KDB 248227 D01 v01r02, choose the highest output power channel to test SAR and determine further SAR exclusion
2. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate. 2.4GHz WLAN SAR was tested on 802.11b 1Mbps.
3. Per KDB 248227 D01 v01r02, 11g, 11n-HT20 and 11n-HT40 output power is less than 1/4dB higher than 11b mode, thus the SAR can be excluded.

8. EXPOSURE POSITIONS CONSIDERATION



| Distance of the Antenna to the EUT surface/edge | | | | | | |
|---|--------|--------|----------|-------------|------------|-----------|
| Antennas | Back | Front | Top Side | Bottom Side | Right Side | Left Side |
| | | | ≤ 25mm | ≤ 25mm | >25mm | >25mm |
| WLAN 2.4GHz Band | ≤ 25mm | ≤ 25mm | >25mm | >25mm | ≤ 25mm | >25mm |

| Positions for SAR tests; Hotspot mode | | | | | | |
|---------------------------------------|------|-------|----------|-------------|------------|-----------|
| Antennas | Back | Front | Top Side | Bottom Side | Right Side | Left Side |
| | | | Yes | Yes | NO | NO |
| WLAN 2.4GHz Band | Yes | Yes | NO | NO | Yes | NO |

Remark:

- 1 According to KDB 447498 D01v05, for handsets the test separation distance is typically according to the smallest test separation distance required for the group of body-worn accessories with similar operating and exposure characteristics. Which is 0mm for head SAR, 0mm for body-worn SAR for the DUT.
- 2 For minimum test separation distance $\leq 50\text{mm}$, Bluetooth standalone SAR test exclusion power threshold is determined by: $[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where
 - $f(\text{GHz})$ is the RF channel transmit frequency in GHz
 - Power and distance are rounded to the nearest mW and mm before calculation
 - The result is rounded to one decimal place for comparison
 - 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

9. SAR TEST RESULTS

Remark:

1. Per KDB 447498 D01v05, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
Scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
Reported SAR(W/kg)= Measured SAR(W/kg)* Scaling Factor
- 2 Per KDB 447498 D01v05, for each exposure position, if the mid channel or highest output channel reported SAR $\leq 0.8\text{W/kg}$, other channels SAR testing are not necessary
- 3 Per KDB 941225 D06v01r01, when the same wireless mode and device transmission configurations are required for testing body-worn accessories and hotspot mode, it is not necessary to test body-worn accessory SAR for the same device orientation if the test separation distance for hotspot mode is more conservative than that used for body-worn

9.1. WIFI SAR results

WIFI Body
Distance 0mm

| Band | Mode | Test Position | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Scaling Factor | Measured SAR (W/kg) | Reported SAR (W/kg) |
|-----------|------|---------------|-----|-------------|---------------------|---------------------|----------------|---------------------|---------------------|
| WIFI 2.4G | 11b | Front | 6 | 2437 | 13.64 | 14 | 1.086 | 0.21 | 0.228 |
| WIFI 2.4G | 11b | Back | 6 | 2437 | 13.64 | 14 | 1.086 | 0.144 | 0.156 |
| WIFI 2.4G | 11b | Right Side | 6 | 2437 | 13.64 | 14 | 1.086 | 0.072 | 0.078 |

9.2. Repeated SAR results

Remark:

- 1 According to KDB 865664 D01v01, for each frequency band, repeated SAR measurement is required only when the measured SAR is $\geq 0.8\text{W/kg}$.
- 2 KDB 865664 D01v01, 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 0.8W/kg, repeated SAR is not required .

APPENDIX A: SYSTEM CHECKING SCANS

SystemPerformanceCheck-D2450 Body

Date: 2014.4. 28.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 – SN:818

Communication System: CW; Communication System Band: Not Specified; Frequency: 2450 MHz; Communication System PAR: 0 dB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.98$ mho/m; $\epsilon_r = 51.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

Probe: ES3DV3 - SN3203; ConvF(4.72, 4.72, 4.72); Calibrated: 2013. 10. 31.

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn876; Calibrated: 2013. 10. 31.

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 (81x81x1): Interpolated grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 18.3 W/kg

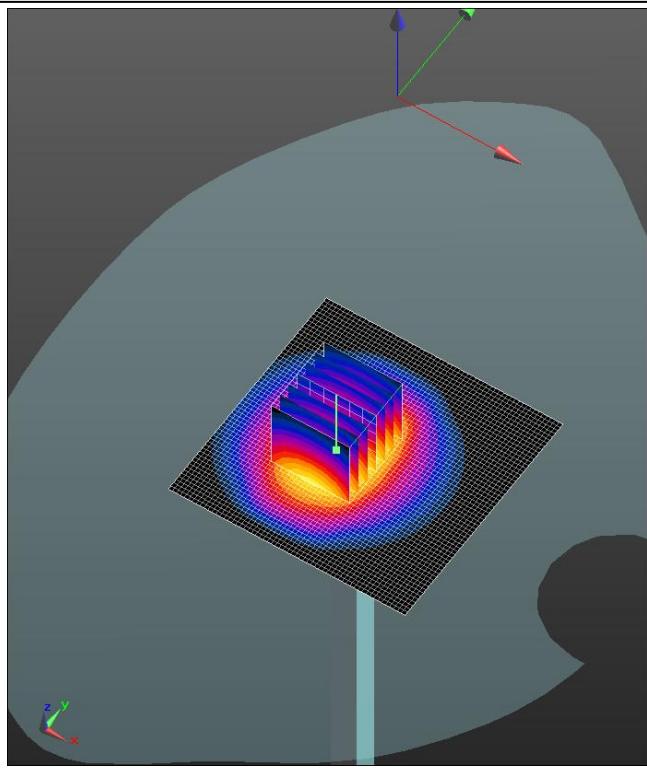
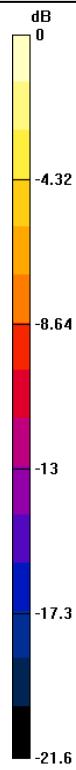
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 82.205 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 24.691 mW/g

SAR(1 g) = 12.2 mW/g; SAR(10 g) = 5.72 mW/g

Maximum value of SAR (measured) = 18.4 W/kg



0 dB = 18.4 W/kg

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 D01v01. 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 |
| 2013-11-16 | 3203 | 2450 | Body | Pass | Pass | Pass | OFDM | Pass | N/A |

APPENDIX C: MEASUREMENT SCANS

Test Laboratory: SMQ SAR Test

HS-70TB25 WiFi 802.11b Body Hotspot Front Mid

DUT: MID; Type: default; Serial: Not Specified

Communication System: 802.11b WiFi 2.4GHz (DSSS, 11Mbps); Communication System Band: 802.11b; Frequency: 2442 MHz; Communication System PAR: 3.599 dB

Medium parameters used (interpolated): $f = 2442 \text{ MHz}$; $\sigma = 2.011 \text{ mho/m}$; $\epsilon_r = 50.719$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3203; ConvF(4.72, 4.72, 4.72); Calibrated: 2013.10.31.;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn876; Calibrated: 2014.03.03.
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

802.11b-0mm/Faceup-Mid/Area Scan (71x101x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$

Reference Value = 10.211 V/m; Power Drift = 1.47 dB

Fast SAR: SAR(1 g) = 0.221 mW/g; SAR(10 g) = 0.114 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (interpolated) = 0.256 W/kg

802.11b-0mm/Faceup-Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

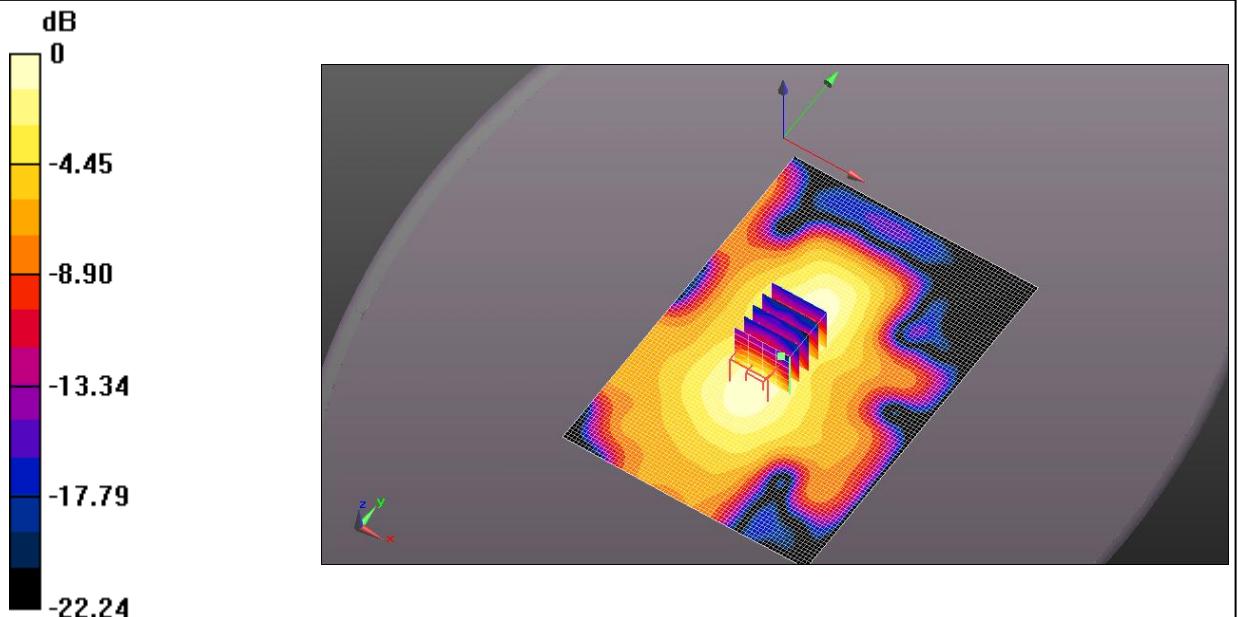
Reference Value = 10.211 V/m; Power Drift = 1.47 dB

Peak SAR (extrapolated) = 0.421 mW/g

SAR(1 g) = 0.210 mW/g; SAR(10 g) = 0.106 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.222 W/kg



$$0 \text{ dB} = 0.256 \text{ W/kg} = -11.83 \text{ dB W/kg}$$

Test Laboratory: SMQ SAR Test

HS-70TB25 WiFi 802.11b Body Hotspot Rear Mid

DUT: MID; Type: default; Serial: Not Specified

Communication System: 802.11b WiFi 2.4GHz (DSSS, 11Mbps); Communication System Band: 802.11b; Frequency: 2442 MHz; Communication System PAR: 3.599 dB

Medium parameters used (interpolated): $f = 2442 \text{ MHz}$; $\sigma = 2.011 \text{ mho/m}$; $\epsilon_r = 50.719$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3203; ConvF(4.72, 4.72, 4.72); Calibrated: 2013.10.31.;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn876; Calibrated: 2014.03.03.
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

802.11b-0mm/Facedown-Mid/Area Scan (71x101x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$

Reference Value = 6.465 V/m; Power Drift = 0.75 dB

Fast SAR: SAR(1 g) = 0.133 mW/g; SAR(10 g) = 0.073 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (interpolated) = 0.146 W/kg

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

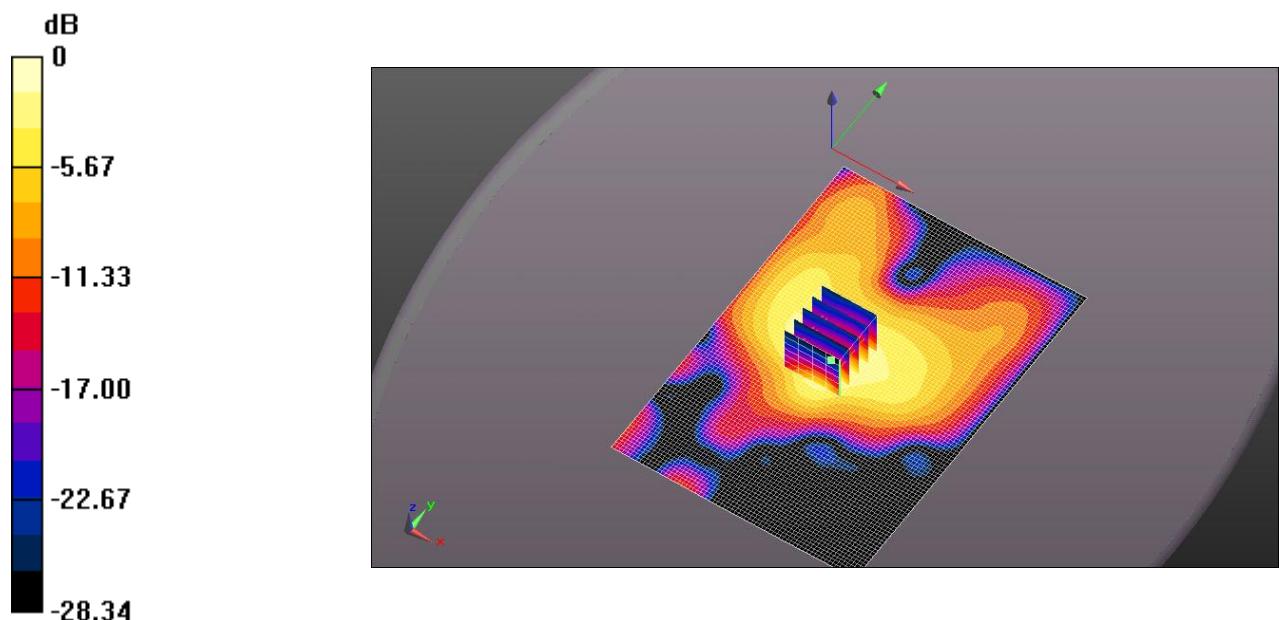
Reference Value = 6.465 V/m; Power Drift = 0.75 dB

Peak SAR (extrapolated) = 0.260 mW/g

SAR(1 g) = 0.144 mW/g; SAR(10 g) = 0.078 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.157 W/kg



$$0 \text{ dB} = 0.146 \text{ W/kg} = -16.72 \text{ dB W/kg}$$

HS-70TB25 WiFi 802.11b Body Hotspot Right Side Mid

DUT: MID; Type: default; Serial: Not Specified

Communication System: 802.11b WiFi 2.4GHz (DSSS, 11Mbps); Communication System Band: 802.11b; Frequency: 2442 MHz; Communication System PAR: 3.599 dB

Medium parameters used (interpolated): $f = 2442 \text{ MHz}$; $\sigma = 2.011 \text{ mho/m}$; $\epsilon_r = 50.719$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3203; ConvF(4.72, 4.72, 4.72); Calibrated: 2013.10.31.;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn876; Calibrated: 2014.03.03.

- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:xxxx
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

802.11b-0mm 2/right-Mid/Area Scan (71x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Reference Value = 4.920 V/m; Power Drift = 0.87 dB

Fast SAR: SAR(1 g) = 0.070 mW/g; SAR(10 g) = 0.039 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (interpolated) = 0.0770 W/kg

802.11b-0mm 2/right-Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

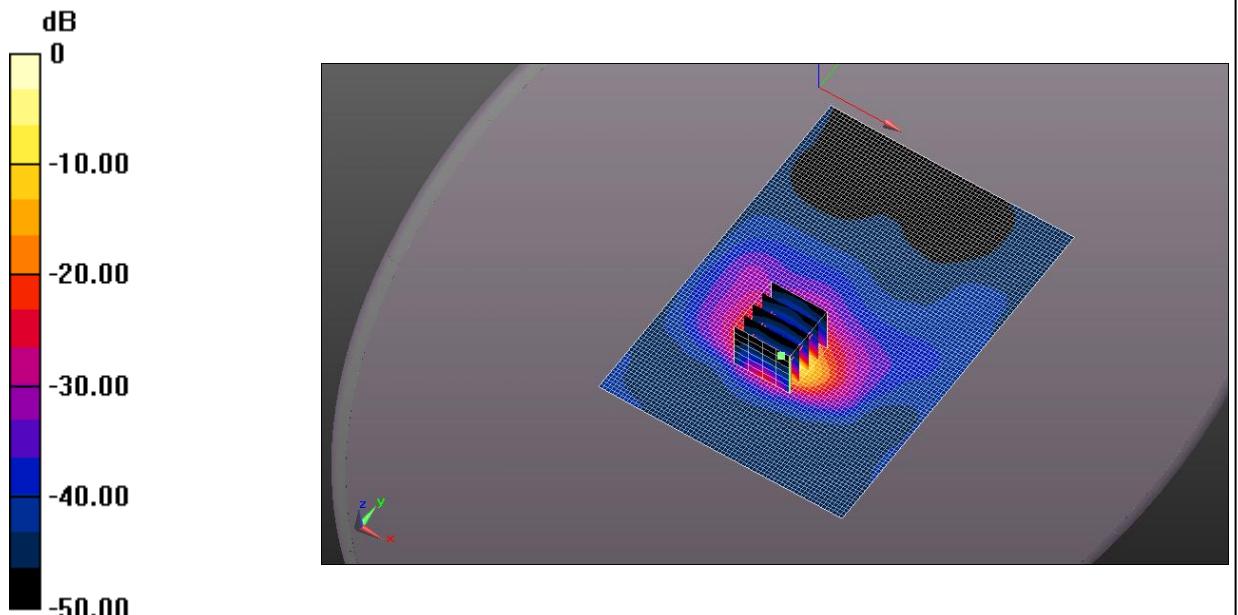
Reference Value = 4.920 V/m; Power Drift = 0.87 dB

Peak SAR (extrapolated) = 0.139 mW/g

SAR(1 g) = 0.072 mW/g; SAR(10 g) = 0.035 mW/g

Info: Interpolated medium parameters used for SAR evaluation.

Maximum value of SAR (measured) = 0.0811 W/kg



$$0 \text{ dB} = 0.0770 \text{ W/kg} = -22.26 \text{ dB W/kg}$$

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



**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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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 Http://www.emcite.com



CNAS L0442

Client

SMQ

Certificate No: J13-2-2921

CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3203

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

Calibration date: October 31, 2013

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-13 (TMC, No.JW13-044) | Jun-14 |
| Power sensor NRP-Z91 | 101547 | 01-Jul-13 (TMC, No.JW13-044) | Jun-14 |
| Power sensor NRP-Z91 | 101548 | 01-Jul-13 (TMC, No.JW13-044) | Jun-14 |
| Reference10dBAttenuator | BT0520 | 12-Dec-12(TMC, No.JZ12-867) | Dec-14 |
| Reference20dBAttenuator | BT0267 | 12-Dec-12(TMC, No.JZ12-866) | Dec-14 |
| Reference Probe EX3DV4 | SN 3846 | 03-Sep-13(SPEAG, No.EX3-3846_Sep13) | Sep-14 |
| DAE4 | SN 777 | 22-Feb-13 (SPEAG, DAE4-777_Feb13) | Feb -14 |
| Secondary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| SignalGeneratorMG3700A | 6201052605 | 01-Jul-13 (TMC, No.JW13-045) | Jun-14 |
| Network Analyzer E5071C | MY46110673 | 15-Feb-13 (TMC, No.JZ13-781) | Feb-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: November 4, 2013

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

Certificate No: J13-2-2921

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

Glossary:

| | |
|-----------------------|---|
| TSL | tissue simulating liquid |
| NORM _{x,y,z} | sensitivity in free space |
| ConvF | sensitivity in TSL / NORM _{x,y,z} |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A,B,C,D | modulation dependent linearization parameters |
| Polarization Φ | Φ rotation around probe axis |
| Polarization θ | θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i $\theta=0$ is normal to probe axis |

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 300MHz to 3GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\theta=0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: waveguide). $NORM_{x,y,z}$ are only intermediate values, i.e., the uncertainties of $NORM_{x,y,z}$ does not effect the E^2 -field uncertainty inside TSL (see below ConvF).
- $NORM(f)x,y,z = NORM_{x,y,z} * frequency_response$ (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- $DCPx,y,z$: DCP are numerical linearization parameters assessed based on the data of power sweep (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.
- $A_x,y,z; B_x,y,z; C_x,y,z; VR_{x,y,z}; A,B,C$ 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 $f \leq 800$ 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 valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORM_{x,y,z} * ConvF$ whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical Isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle*: The angle is assessed using the information gained by determining the $NORM_x$ (no uncertainty required).



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

Probe ES3DV3

SN: 3203

Calibrated: October 31, 2013

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)



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CALIBRATION LABORATORY

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 Http://www.emcite.com

DASY – Parameters of Probe: ES3DV3 - SN: 3203

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|-----------|
| Norm(μ V/(V/m) ²) ^A | 1.30 | 1.26 | 1.11 | ±10.8% |
| DCP(mV) ^B | 103.9 | 104.0 | 105.8 | |

Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB/ μ V | C | D dB | VR mV | Unc ^E (k=2) |
|-----|---------------------------|---|---------|------------------|-----|---------|----------|---------------------------|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 200.4 | ±3.5% |
| | | Y | 0.0 | 0.0 | 1.0 | | 184.0 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 184.4 | |

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

^A The uncertainties of Norm X, Y, Z do not affect the E²-field uncertainty inside TSL (see Page 5 and Page 6).

^B Numerical linearization parameter: uncertainty not required.

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



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DASY – Parameters of Probe: ES3DV3 - SN: 3203

Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] ^c | Relative Permittivity ^f | Conductivity (S/m) ^f | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 900 | 41.5 | 0.97 | 6.55 | 6.55 | 6.55 | 0.39 | 1.77 | ±12% |
| 1810 | 40.0 | 1.40 | 5.41 | 5.41 | 5.41 | 0.31 | 2.22 | ±12% |
| 2450 | 39.2 | 1.80 | 5.07 | 5.07 | 5.07 | 0.54 | 1.66 | ±12% |

^c 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.

^f At frequency below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



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E-mail: Info@emcite.com Http://www.emcite.com

DASY – Parameters of Probe: ES3DV3 - SN: 3203

Calibration Parameter Determined in Body Tissue Simulating Media

| f [MHz] ^c | Relative Permittivity ^f | Conductivity (S/m) ^f | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 900 | 55.0 | 1.05 | 6.75 | 6.75 | 6.75 | 2.14 | 0.90 | ± 12% |
| 1810 | 53.3 | 1.52 | 5.12 | 5.12 | 5.12 | 0.32 | 2.38 | ± 12% |
| 2450 | 52.7 | 1.95 | 4.72 | 4.72 | 4.72 | 0.64 | 1.49 | ± 12% |

^c 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.

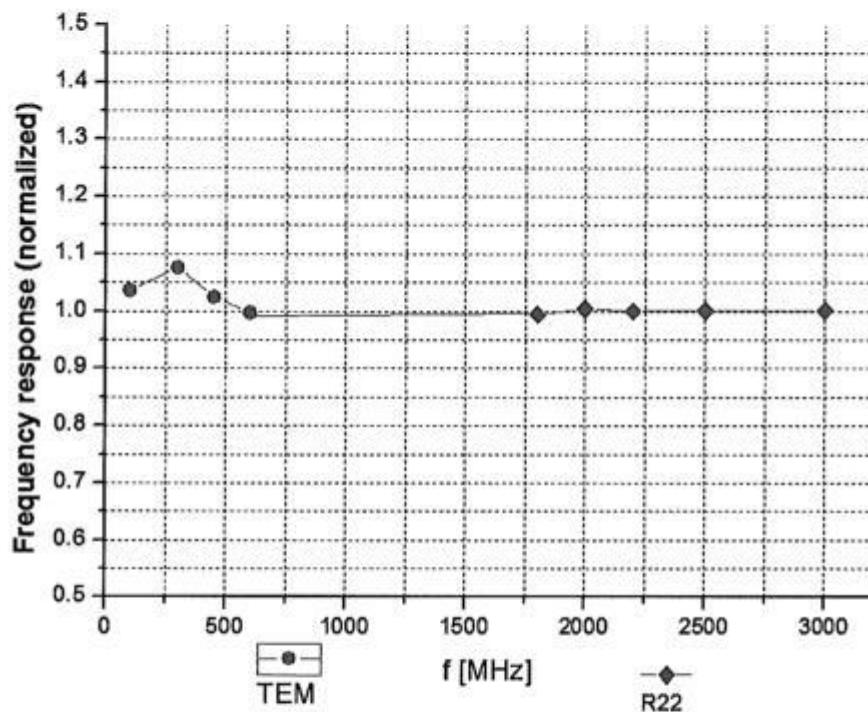
^f At frequency below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.



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



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

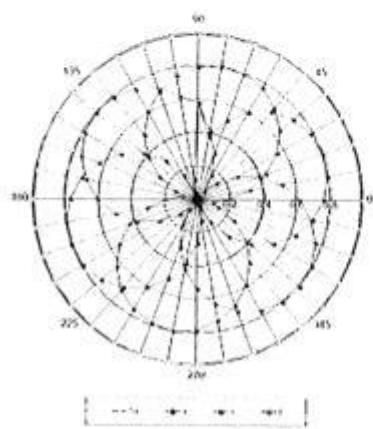


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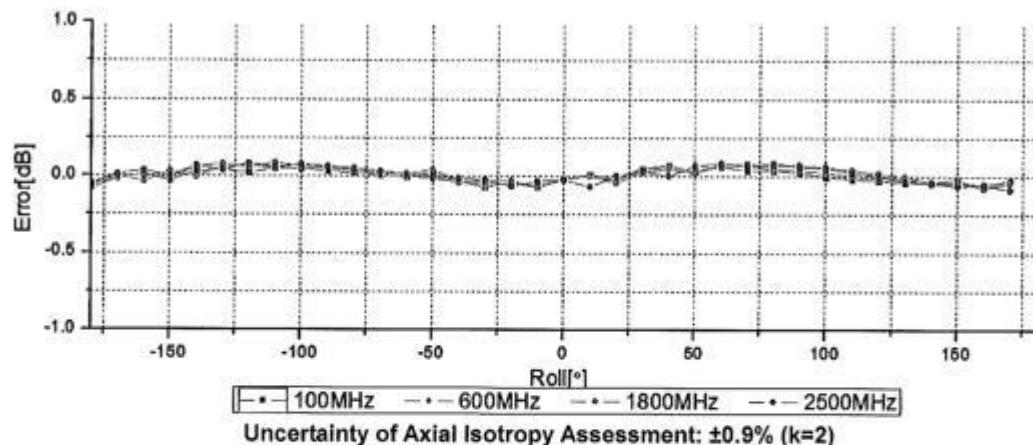
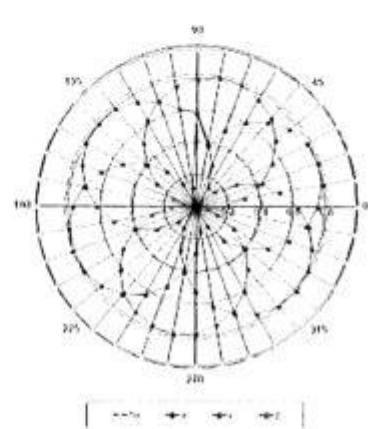
Add: No.52 Huayuanbei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: Info@emcite.com Http://www.emcite.com

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

$f=600$ MHz, TEM



$f=1800$ MHz, R22

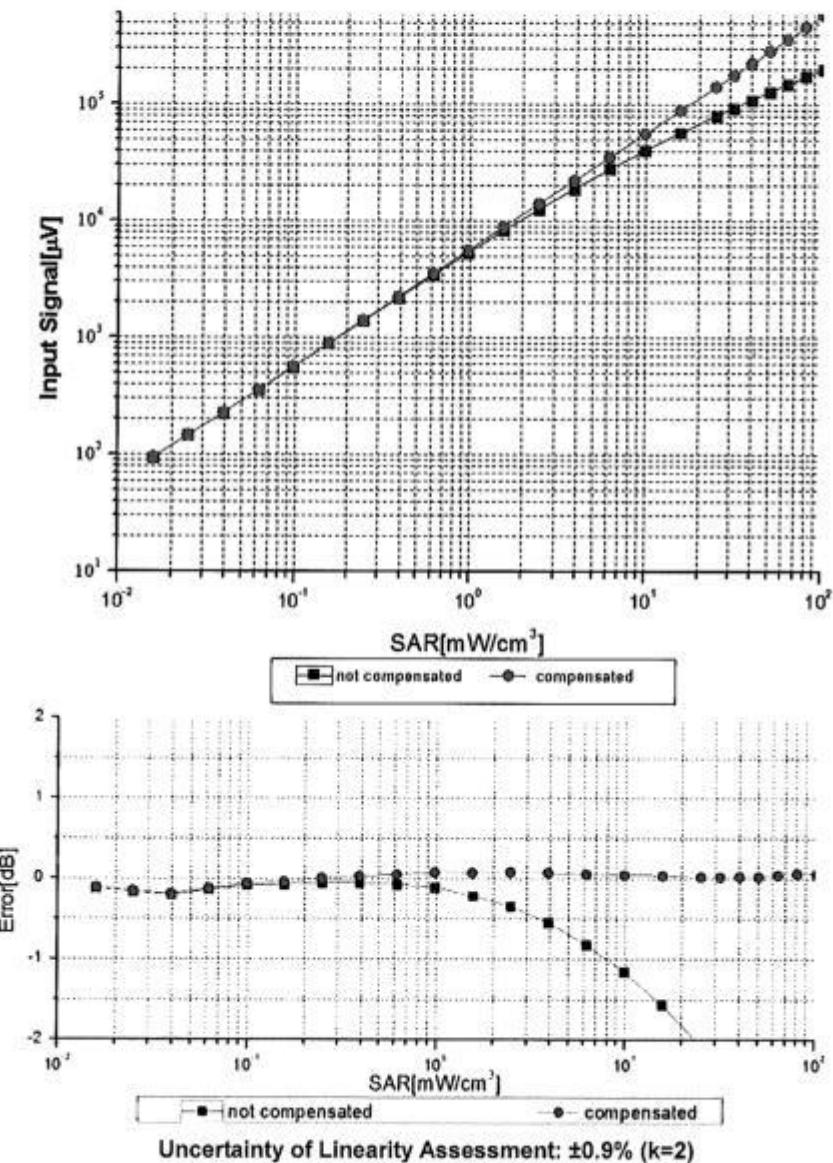




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Dynamic Range f(SAR_{head}) (TEM cell, f = 900 MHz)



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

Certificate No: J13-2-2921

Page 9 of 11

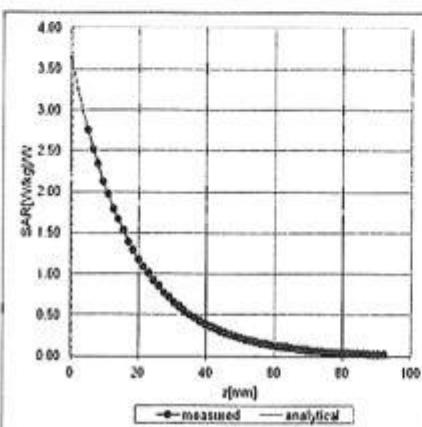


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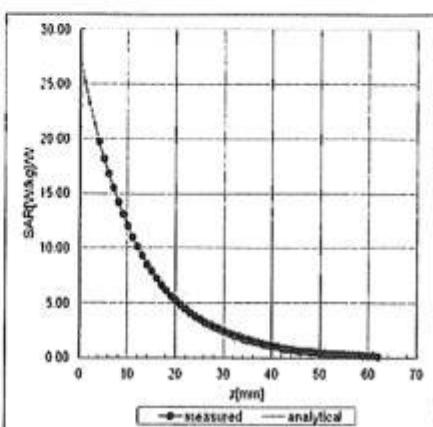
Add: No.52 Huayuanbei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: Info@emcite.com Http://www.emcite.com

Conversion Factor Assessment

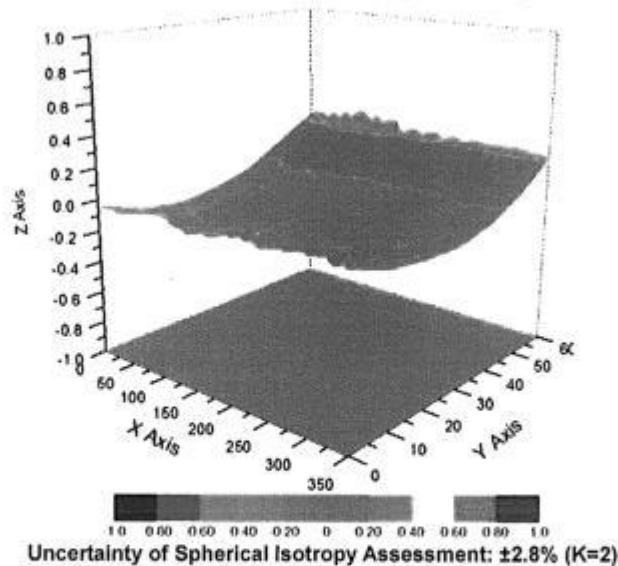
$f=900$ MHz, WGLS R9(H_convF)



$f=1810$ MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid





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DASY - Parameters of Probe: ES3DV3 - SN: 3203

Other Probe Parameters

| | |
|---|------------|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 175 |
| 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)

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: **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&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-12) | In house check: Oct-13 |

| | | | |
|----------------|-------------------------------|--|---------------|
| Calibrated by: | Name Israe El-Naouq | Function Laboratory Technician | Signature |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: October 18, 2012

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

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



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

Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 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:

- a) 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
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- c) 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:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

| | | |
|-------------------------------------|------------------------|-------------|
| DASY Version | DASY5 | V52.8.3 |
| 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 ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

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

SAR result with Head TSL

| | | |
|---|--------------------|---------------------------------|
| SAR averaged over 1 cm³ (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 ± 17.0 % (k=2) |

| | | |
|---|--------------------|---------------------------------|
| SAR averaged over 10 cm³ (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 ± 16.5 % (k=2) |

Body TSL parameters

The following parameters and calculations were applied.

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

SAR result with Body TSL

| | | |
|---|--------------------|---------------------------------|
| SAR averaged over 1 cm³ (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 ± 17.0 % (k=2) |

| | | |
|---|--------------------|---------------------------------|
| SAR averaged over 10 cm³ (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 ± 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/m³

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:

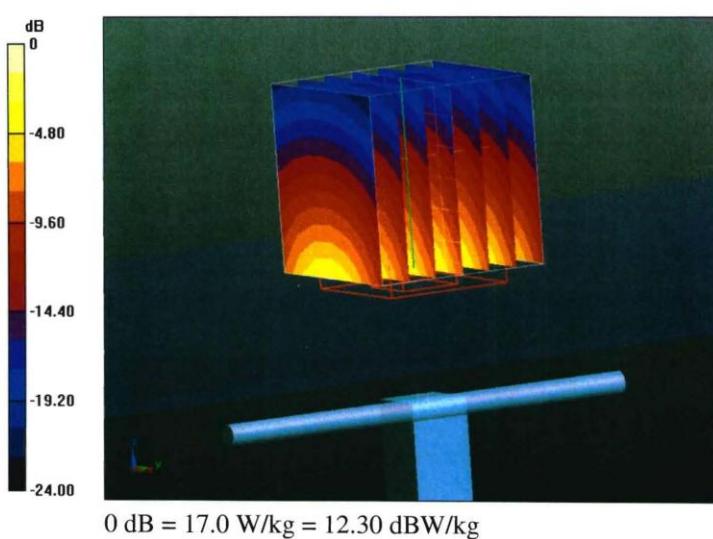
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

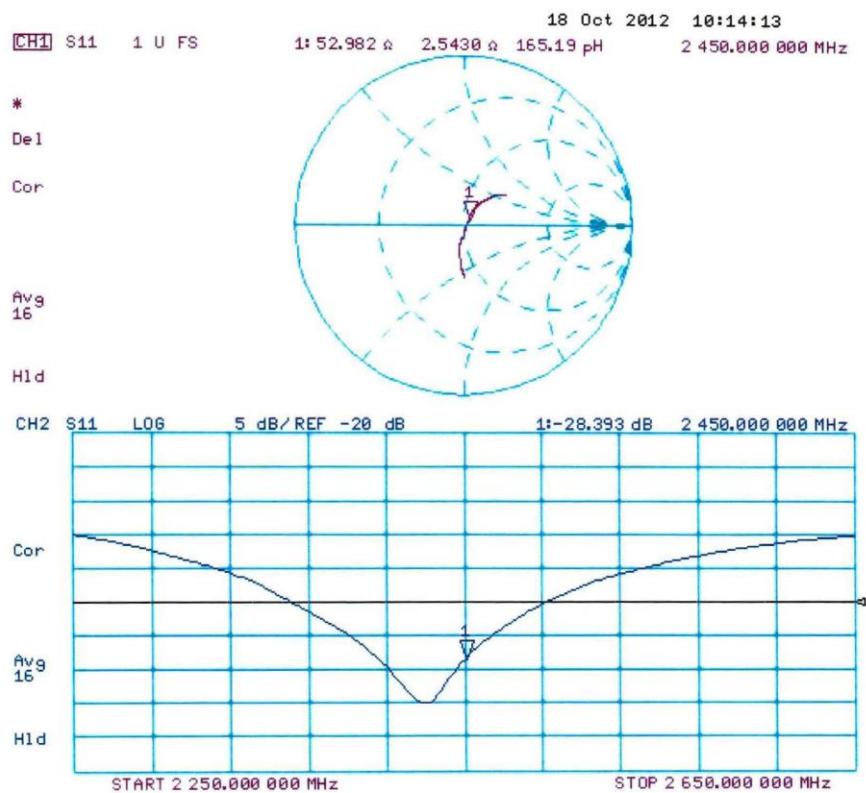
Peak SAR (extrapolated) = 27.4 W/kg

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/m³

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:

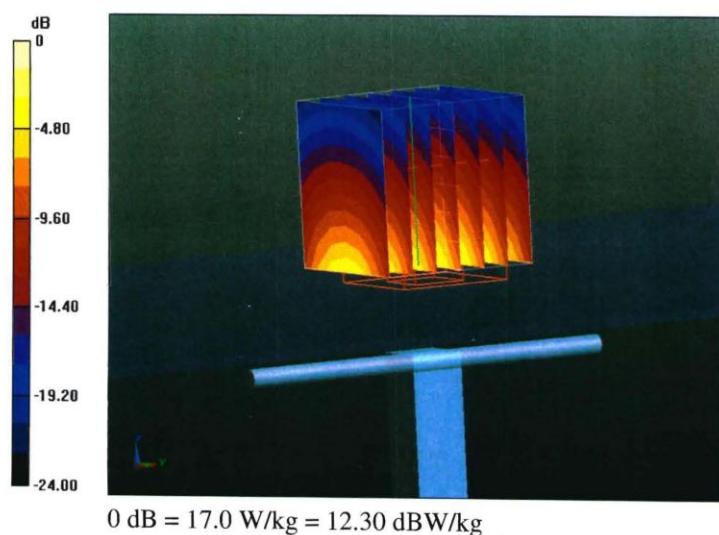
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

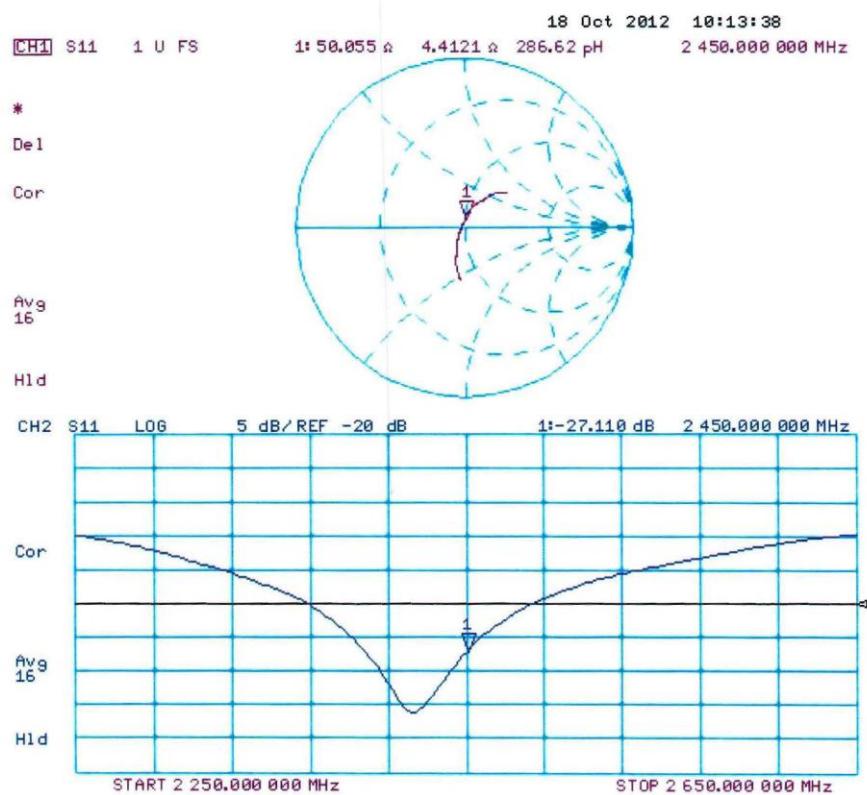
Peak SAR (extrapolated) = 26.9 W/kg

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



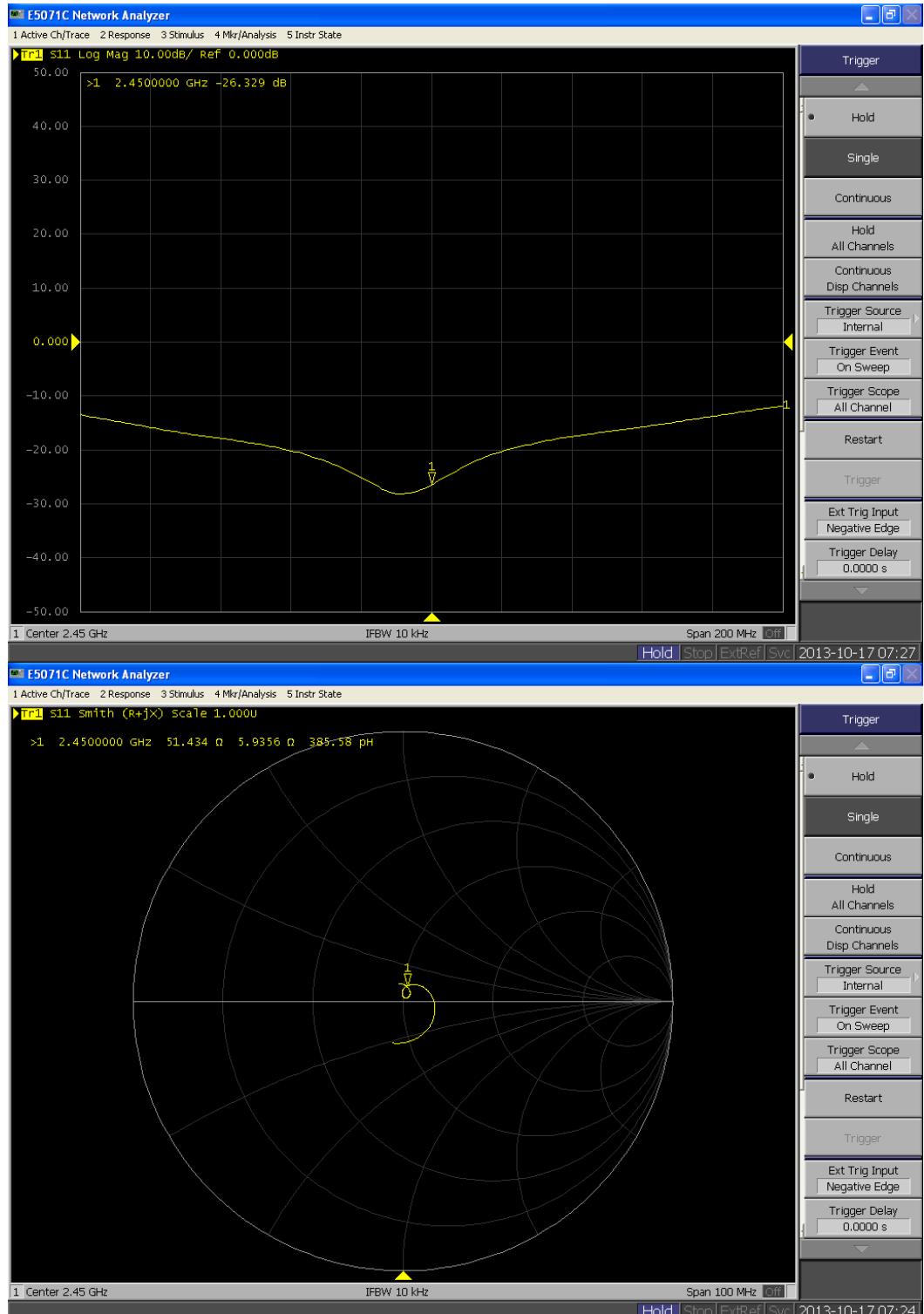
D2450V2, serial No. 818 Extended Dipole Calibrations

Referring to KDB 865664, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

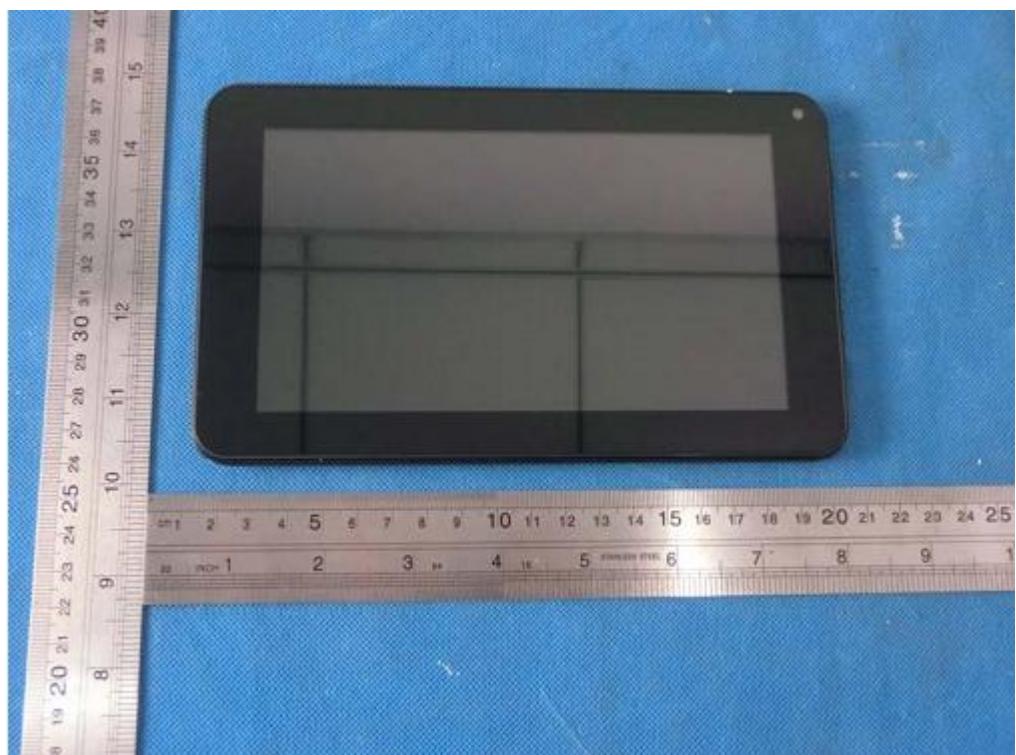
Justification of the extended calibration

| | 2450 Body | | | | | |
|------------|---------------------|----------|------------------------|----------------|-----------------------------|----------------|
| | Return-Loss (dB) | Delta(%) | Real Impedance(ohm) | Delta (ohm) | Imaginary Impedance(ohm) | Delta (ohm) |
| 2013-10-18 | -27.110 | | 50.055 | | 4.4121 | |
| 2013-10-17 | -26.329 | -2.88 | 51.434 | 1.38 | 5.9356 | 1.52 |

2450 Body



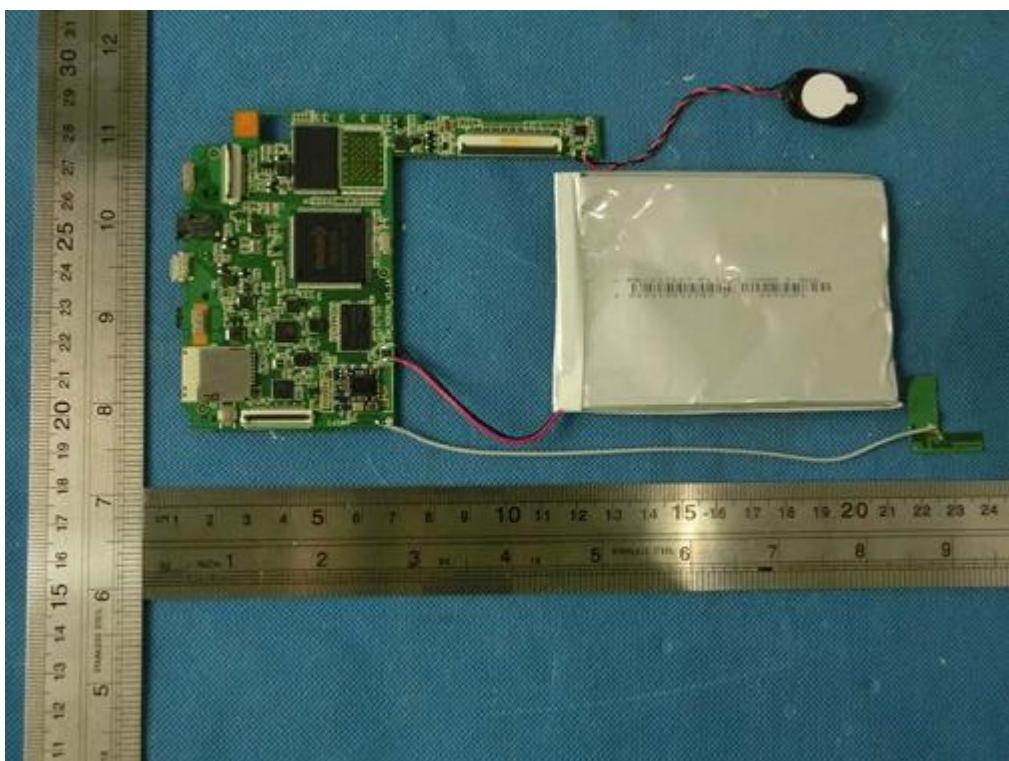
APPENDIX E: DUT Photos

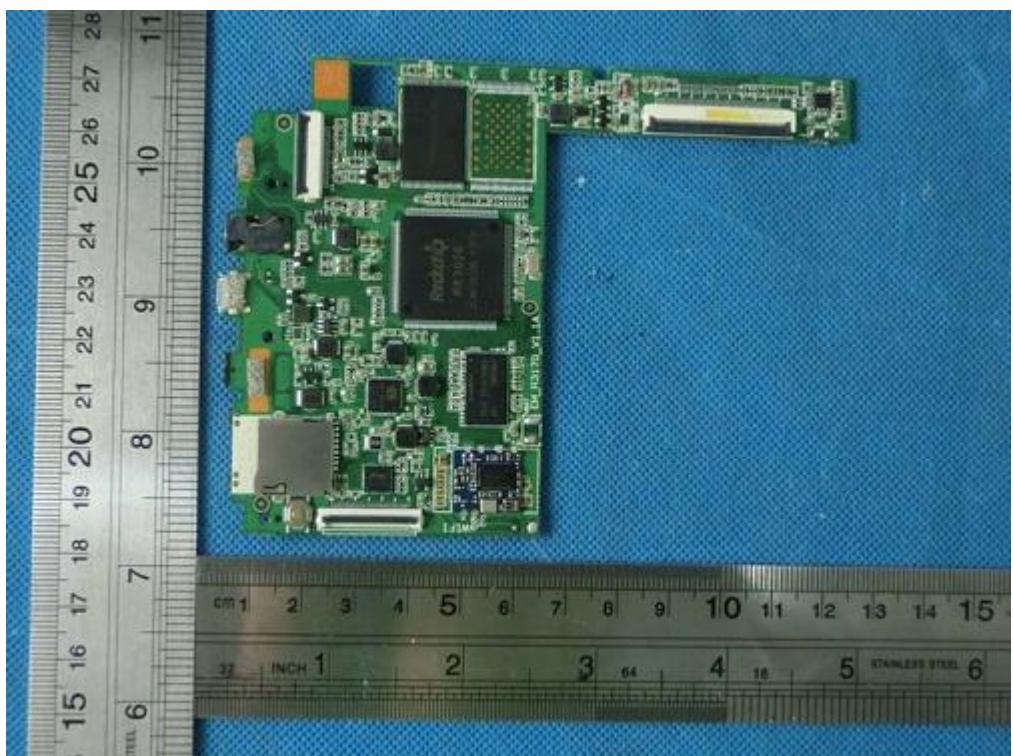


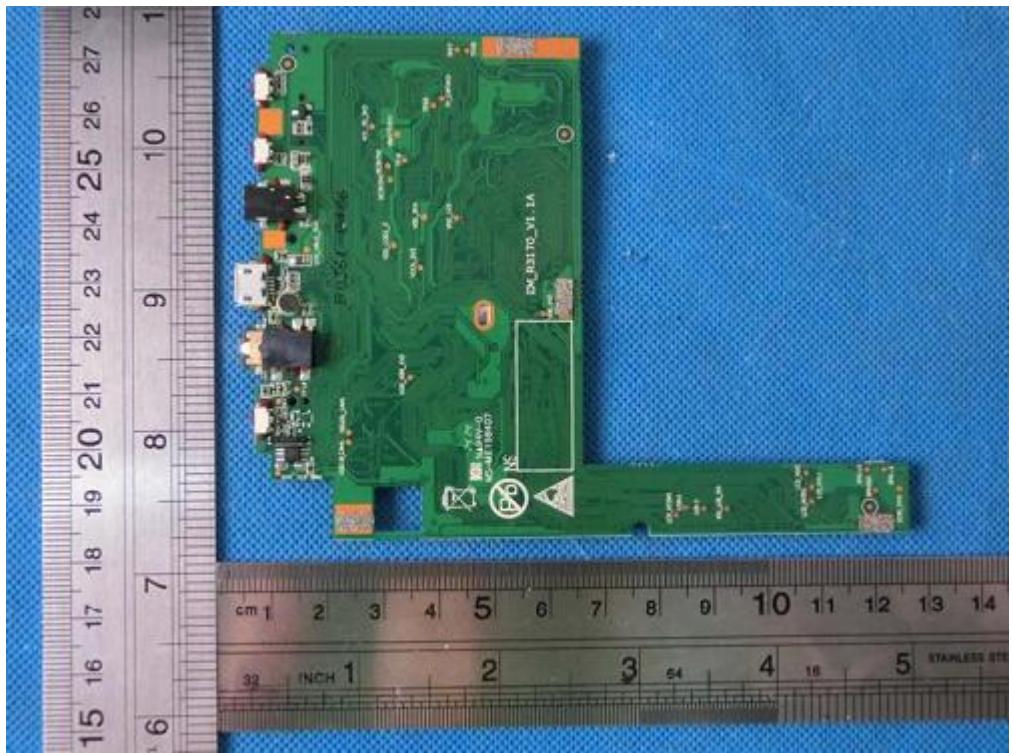


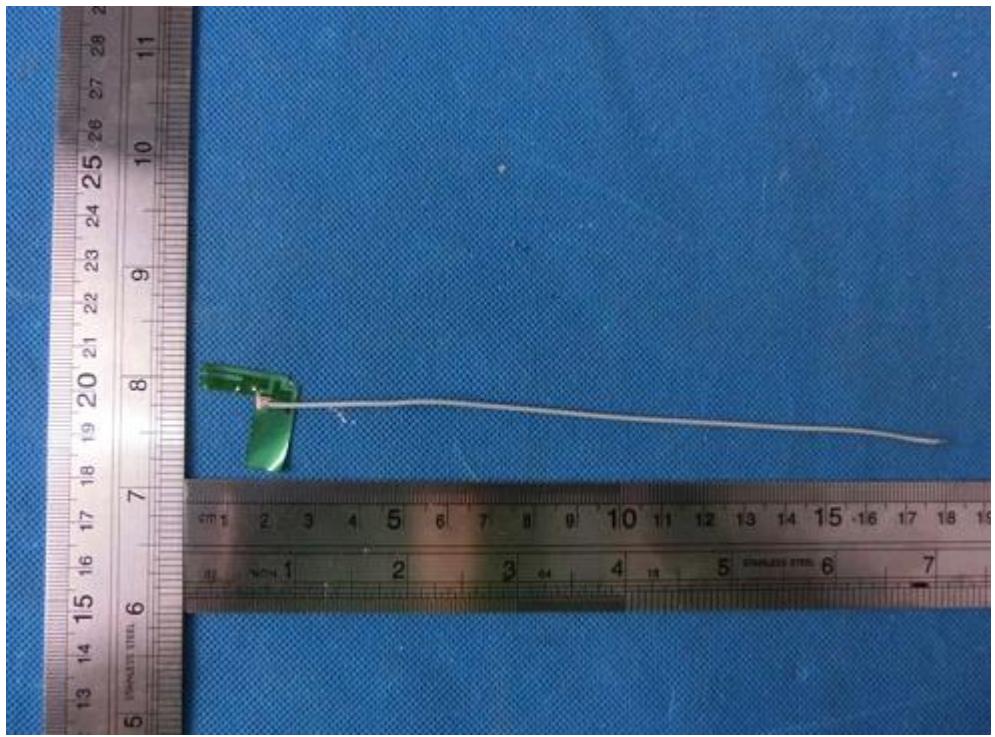












APPENDIX F: Test Position Photos

Faceup position 0mm



Facedown position 0mm



Right Side 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

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No.CNAS AL 2

0005789