

# FCC SAR Test Report

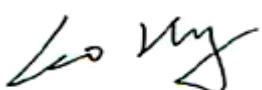
## FCC ID: QIST1-701W

**Project No.** : 1503C049  
**Equipment** : HUAWEI MediaPad T1 7.0  
**Model Name** : T1-701w  
**Applicant** : Huawei Technologies Co., Ltd.  
**Address** : Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District Shenzhen China

**Date of Receipt** : Mar. 16, 2015  
**Date of Test** : Mar. 25, 2015  
**Issued Date** : Apr. 07, 2015  
**Tested by** : BTL Inc.

**Testing Engineer** : 

( Super Jiang)

**Technical Manager** : 

(Leo Hung)

**Authorized Signatory** : 

(Steven Lu)

# B T L I N C .

No.3,Jinshagang 1st Road, Shixia,Dalang Town, Dongguan, China.  
TEL: +86-769-8318-3000FAX: +86-769-8319-6000

## **Declaration**

**BTL** represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with the standards traceable to National Measurement Laboratory (**NML**), or National Institute of Standards and Technology (**NIST**).

**BTL**'s reports apply only to the specific samples tested under conditions. It is manufacture's responsibility to ensure that additional production units of this model are manufactured with the identical electrical and mechanical components. **BTL** shall have no liability for any declarations, inferences or generalizations drawn by the client or others from **BTL** issued reports.

**BTL**'s reports must not be used by the client to claim product endorsement by the authorities or any agency of the Government.

This report is the confidential property of the client. As a mutual protection to the clients, the public and **BTL-self**, extracts from the test report shall not be reproduced except in full with **BTL**'s authorized written approval.

**BTL**'s laboratory quality assurance procedures are in compliance with the **ISO Guide17025** requirements, and accredited by the conformity assessment authorities listed in this test report.

## **Limitation**

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

Table of Contents	Page
<b>1 . GENERAL SUMMARY</b>	<b>6</b>
<b>2 . RF EMISSIONS MEASUREMENT</b>	<b>8</b>
<b>2.1 TEST FACILITY</b>	<b>8</b>
<b>2.2 MEASUREMENT UNCERTAINTY</b>	<b>8</b>
<b>3 . GENERAL INFORMATION</b>	<b>9</b>
<b>3.1 STATEMENT OF COMPLIANCE</b>	<b>9</b>
<b>3.2 GENERAL DESCRIPTION OF EUT</b>	<b>10</b>
<b>3.3 LABORATORY ENVIRONMENT</b>	<b>11</b>
<b>3.4 MAIN TEST INSTRUMENTS</b>	<b>11</b>
<b>4 . SAR MEASUREMENTS SYSTEM CONFIGURATION</b>	<b>12</b>
<b>4.1 SAR MEASUREMENT SET-UP</b>	<b>12</b>
<b>4.2 DASY5E-FIELDPROBESYSTEM</b>	<b>13</b>
<b>5 . SYSTEM VERIFICATION PROCEDURE</b>	<b>21</b>
<b>5.1 TISSUE VERIFICATION</b>	<b>21</b>
<b>5.2 SYSTEM CHECK</b>	<b>23</b>
<b>5.3 SYSTEM CHECK PROCEDURE</b>	<b>23</b>
<b>6 . SAR MEASUREMENT VARIABILITY AND UNCERTAINTY</b>	<b>24</b>
<b>6.1 SAR MEASUREMENT VARIABILITY</b>	<b>24</b>
<b>6.2 SAR MEASUREMENT UNCERTAINTY</b>	<b>24</b>
<b>7 . OPERATIONAL CONDITIONS DURING TEST</b>	<b>25</b>
<b>7.1 WIFI 2.4G TEST CONFIGURATION</b>	<b>25</b>
<b>7.2 TEST POSITION</b>	<b>26</b>
<b>7.2.1 TEST POSITION REQUIREMENTS</b>	<b>26</b>
<b>7.2.2 SAR TEST REDUCTION AND EXCLUSION GUIDANCE</b>	<b>26</b>
<b>8 . TEST RESULT</b>	<b>29</b>
<b>8.1 CONDUCTED POWER RESULTS</b>	<b>29</b>
<b>8.2 SAR TEST RESULTS</b>	<b>31</b>
<b>8.3 MULTIPLE TRANSMITTER EVALUATION</b>	<b>33</b>
<b>APPENDIX</b>	<b>34</b>
<b>1. TEST LAYOUT</b>	<b>34</b>
<b>2. SYSTEM CHECK PLOTS</b>	<b>36</b>

<b>Table of Contents</b>	<b>Page</b>
<b>3. SAR MEASUREMENT PLOTS</b>	<b>37</b>
<b>4. CALIBRATION CERTIFICATE</b>	<b>41</b>
<b>6. DAE4 CALIBRATION CERTIFICATE</b>	<b>60</b>
<b>5. EUT TESTING POSITION AND ANTENNA LOCATION</b>	<b>63</b>

**REPORT ISSUED HISTORY**

Issued No.	Description	Issued Date
BTL-FCC-SAR-1503C049	Original Issue.	Apr. 07, 2015

## 1. GENERAL SUMMARY

Equipment	HUAWEI MediaPad T1 7.0
Model Name	T1-701w;
Brand Name	HUAWEI
Manufacturer	Huawei Technologies Co., Ltd.
Address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C
Standard(s)	<p><b>ANSI Std C95.1-1992</b> Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz. ( IEEE Std C95.1-1991)</p> <p><b>IEEE Std 1528-2003</b> Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques</p> <p><b>IEEE Std 1528a-2005</b> IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques Amendment 1: CAD File for Human Head Model (SAM Phantom)</p> <p><b>KDB447498 D01</b> General RF Exposure Guidance v05r02  <b>KDB616217 D04</b> SAR for laptop and tablets v01r01  <b>KDB248227 D01</b> SAR meas for 802.11 a/b/g v01r02  <b>KDB865664 D01</b> SAR measurement 100 MHz to 6 GHz v01r03  <b>KDB865664 D02</b> SAR Reporting v01r01  <b>KDB690783 D01</b> SAR Listings on Grants v01r03</p>

Note: T1-701w and T1-702u Share The Test Results according to the differences between the models, shown in the following table.

	T1-720u	T1-701w
PCB	the same	the same
GPS	the same	the same
WIFI/BT 2.4G	the same	the same
GSM850/1900	support	Not support
WCDMA1900/850	support	Not support

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCC-SAR-1503C049) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO-17025 quality assessment standard and technical standard(s).

## 2. RF EMISSIONS MEASUREMENT

### 2.1 TEST FACILITY

The test facilities used to collect the test data in this report is **SAR room** at the location of No.3,Jinshagang 1st Road, ShiXia, Dalang Town,Dong Guan, China.523792

### 2.2 MEASUREMENT UNCERTAINTY

Uncertainty Component	Uncertainty Value	Probability Distribution	Divisor	$C_i$ (1g)	Standard Uncertainty $\pm 1\%$	$V_i$ or $V_{eff}$
<b>Measurement System</b>						
Probe Calibration ( $k=1$ )	5.9	Normal	1	1	5.9	$\infty$
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	$\sqrt{0.5}$	1.9	$\infty$
Hemispherical Iso rropy	9.6	Rectangular	$\sqrt{3}$	$\sqrt{0.5}$	3.9	$\infty$
Boundary Effect	1.0	Rectangular	$\sqrt{3}$	1	0.6	$\infty$
Linearity	4.7	Rectangular	$\sqrt{3}$	1	2.7	$\infty$
System Detection Limit	1.0	Rectangular	$\sqrt{3}$	1	0.6	$\infty$
Readout Electronics	0.3	Normal	1	1	0.3	$\infty$
Response Time	0.8	Rectangular	$\sqrt{3}$	1	0.5	$\infty$
Integration Time	2.6	Rectangular	$\sqrt{3}$	1	1.5	$\infty$
RF Ambient Conditions-Noise	3.0	Rectangular	$\sqrt{3}$	1	1.7	$\infty$
RF Ambient Reflections	3.0	Rectangular	$\sqrt{3}$	1	1.7	$\infty$
Probe Positioner Mechanical Tolerance	0.4	Rectangular	$\sqrt{3}$	1	0.2	$\infty$
Probe Positioning with respect to Phantom Shell	2.9	Rectangular	$\sqrt{3}$	1	1.7	$\infty$
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	1.0	Rectangular	$\sqrt{3}$	1	0.6	$\infty$
<b>Test Sample Related</b>						
Test sample Positioning	2.9	Normal	1	1	2.9	145
Device Holder Uncertainty	3.6	Normal	1	1	3.6	5
Output Power Variation - SAR drift measurement	5.0	Rectangular	$\sqrt{3}$	1	2.9	$\infty$
<b>Phantom and Setup</b>						
Phantom Uncertainty ( shape and thickness tolerances)	4.0	Rectangular	$\sqrt{3}$	1	2.3	$\infty$
Liquid Conductivity - deviation from target value	5.0	Rectangular	$\sqrt{3}$	0.64	1.8	$\infty$
Liquid Conductivity - measurement uncertainty	2.5	Normal	1	0.64	1.6	$\infty$
Liquid Permittivity - deviation from target values	5.0	Rectangular	$\sqrt{3}$	0.6	1.7	$\infty$
Liquid Permittivity - measurement uncertainty	2.5	Normal	1	0.6	1.5	$\infty$
<b>Combined standard uncertainty</b>		RSS	-	-	10.9	387
<b>Expanded uncertainty</b>		$k=2$	-	-	21.9	-

### 3. GENERAL INFORMATION

#### 3.1 STATEMENT OF COMPLIANCE

The maximum results of Specific Absorption Rate (SAR) found during testing for HUAWEI T1-701w are as below Table.

Band	Max Reported SAR(W/kg)
	1-g Body-worn (0 mm) *
WiFi 2.4G	0.666

Note:

The device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits according to the FCC rule §2.1093, the ANSI/IEEE C95.1:1992, the NCRP Report Number 86 for uncontrolled environment, according to the Industry Canada Radio Standards Specification RSS-102 for General Population/Uncontrolled exposure, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2003 & IEEE Std 1528a-2005.

### 3.2 GENERAL DESCRIPTION OF EUT

Tested Mode(s)	WiFi (tested),BT	
Test Modulation	WiFi(DSSS/OFDM)	
Operation Frequency Range(s)	Bluetooth	2400 ~2483.5
	WIFI	2400 ~2483.5
Test Channels (low-mid-high):	1-6-11 (WiFi)	
Battery Information	Model Name: HB3G1 DC 3.7V 4000mAh	
Adapter	Model Name: HW-050100U2W Rated Voltage: 5V1A	
Earphone	Model Name: HA1-3 Manufacturer: GoerTek Inc.	
Hardware	SH1T1701UM	
Software	T1-701wV100R001C001	

### 3.3 LABORATORY ENVIRONMENT

Temperature	Min. = 18°C, Max. = 25°C
Relative humidity	Min. = 30%, Max. = 70%
Ground system resistance	< 0.5Ω

Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards.

### 3.4 MAIN TEST INSTRUMENTS

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Data Acquisition Electronics	Speag	DAE4	1390	Sep. 15, 2015
2	E-field Probe	Speag	EX3DV4	3932	Jan. 30, 2016
3	Electro Optical Converter	Speag	ECO90	1151	N/A
4	SAMT win Phantom	Speag	SAM	1784	N/A
5	System Validation Dipole	Speag	D2450V2	919	Sep. 17, 2015
6	Power Amplifier	Mini-circuits	ZHL-42W	N/A	N/A
7	Power Amplifier	Mini-circuits	ZVE-8G	N/A	N/A
8	ENA Network Analyzer	Agilent	E5071C	MY46102965	Mar. 29, 2016
9	Dielectric Probe Kit	Agilent	85070E	2593	N/A
11	P-series power meter	Agilent	N1911A	MY45100473	Mar. 29, 2016
12	wideband power sensor	Agilent	N1921A	MY51100041	Mar. 29, 2016
13	Power Meter	Anritsu	ML2487A	6K00004714	Mar. 16, 2016
14	Power Meter Sensor	Anritsu	MA2491A	34138	Mar. 16, 2016
15	MXG Analog Signal Generator	Agilent	N5181A	MY49060710	Nov. 02, 2015
16	Low pass filter	Mini-Circuits	SLP-2950+	M108294	Mar. 29, 2016
17	Attenuator	Mini-Circuits	VAT-10+	31317-1	Mar. 29, 2016
18	Attenuator	Mini-Circuits	VAT-10+	31317-2	Mar. 29, 2016
19	Attenuator	MEB	300-affn-03	314	Mar. 29, 2016
20	Dual directional coupler	Agilent	777D	50208	Mar. 29, 2016
21	8960 Series 10 Wireless Com Test set	Agilent	E5515E	MY53211053	Jun. 13, 2015

Remark: " N/A" denotes no model name, serial No. or calibration specified.

All calibration period of equipment list is one year.

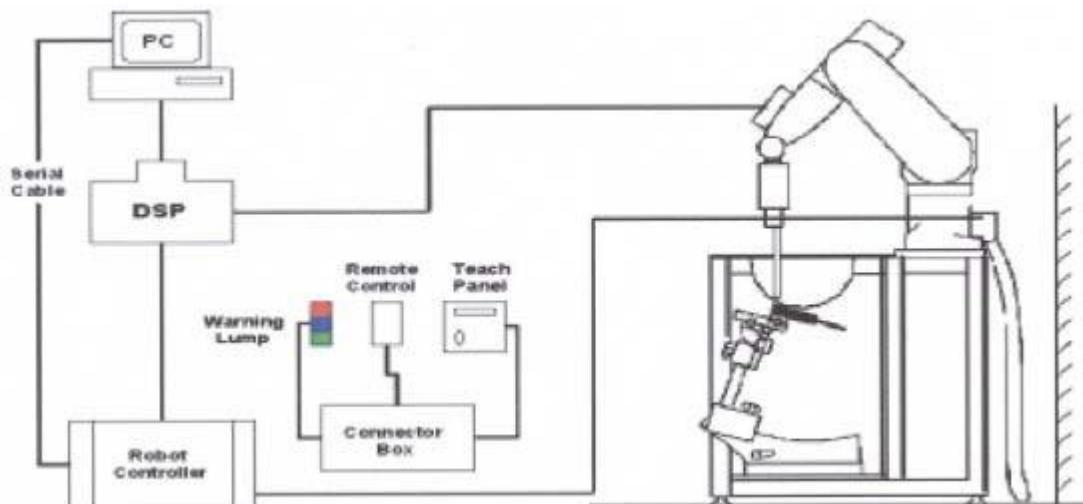
## 4.SAR MEASUREMENTS SYSTEM CONFIGURATION

### 4.1 SAR MEASUREMENT SET-UP

The DASY5 system for performing compliance tests consists of the following items:

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
2. A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
3. A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
4. A unit to operate the optical surface detector which is connected to the EOC.
5. The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.
6. The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 7
7. DASY5 software and SEMCAD data evaluation software.
8. Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
9. The generic twin phantom enabling the testing of left-hand and right-hand usage.
10. The device holder for handheld mobile phones.
11. Tissue simulating liquid mixed according to the given recipes.
12. System validation dipoles allowing to validate the proper functioning of the system.

#### 4.1.1 Test Setup Layout



## 4.2 DASY5E-FIELDPROBESYSTEM

The SAR measurements were conducted with the dosimetric probe EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

### 4.2.1 EX3DV4 PROBE SPECIFICATION

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available
Frequency	10 MHz to 6 GHz Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)
Directivity	$\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 $\mu$ W/g to > 100 mW/g Linearity: $\pm 0.2$ dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.0 mm



EX3DV4 E-field Probe

#### 4.2.2E-FIELD PROBE CALIBRATION

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than  $\pm 10\%$ . The spherical isotropy was evaluated and found to be better than  $\pm 0.25\text{dB}$ . The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a wave guide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$\text{SAR} = C \frac{\Delta T}{\Delta t}$$

Where:  $\Delta t$  = Exposure time (30 seconds),

$C$  = Heat capacity of tissue (brain or muscle),

$\Delta T$  = Temperature increase due to RF exposure.

$$\text{Or SAR} = \frac{|E|^2 \sigma}{\rho}$$

Where:  $\sigma$  = Simulated tissue conductivity,

$\rho$  = Tissue density ( $\text{kg/m}^3$ ).

## 4.2.3 OTHER TEST EQUIPMENT

### 4.2.3.1. Device Holder for Transmitters

**Construction:** Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices (e.g., laptops, cameras, etc.) It is light weight and fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin SAM, ELI4and SAM v6.0Phantoms.

**Material:** POM, Acrylic glass, Foam

### 4.2.3.2 Phantom

The SAM twin phantom is a berglass shell phantom with2mm shell thickness (except the ear region, where shell thickness increases to 6 mm). The phantom has three measurement areas:

- \_ Left hand
- \_ Right hand
- \_ Flat phantom

The bottom plate contains three pairs of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to cover the phantom during o-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on top of this phantom cover are possible.



**SAM twin Phantom**

#### 4.2.4 SCANNING PROCEDURE

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

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

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

- Area Scan

The “area scan” measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The standard scan uses large grid spacing for faster measurement.

Standard grid spacing for head measurements is 15 mm in x- and y- dimension( $\leq 2\text{GHz}$ ) , 12 mm in x- and y- dimension(2-4 GHz) and 10mm in x- and y- dimension(4-6GHz). If a finer resolution is needed, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation.

- Zoom Scan

A “zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous “coarse” scan. This is a fine grid with maximum scan spatial resolution:  $\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}} \leq 2\text{GHz} - \leq 8\text{mm}$ ,  $2\text{-}4\text{GHz} - \leq 5\text{ mm}$  and  $4\text{-}6\text{GHz} - \leq 4\text{mm}$ ;  $\Delta z_{\text{zoom}} \leq 3\text{GHz} - \leq 5\text{ mm}$ ,  $3\text{-}4\text{GHz} - \leq 4\text{mm}$  and  $4\text{-}6\text{GHz} - \leq 2\text{mm}$  where the robot additionally moves the probe along the z-axis away from the bottom of the Phantom. DASY is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in Appendix B. Test results relevant for the specified standard (see chapter 1.4.) are shown in table form in chapter 7.2.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2 mm steps. This measurement shows the continuity of the liquid and can - depending in the field strength – also show the liquid depth.

The following table summarizes the area scan and zoom scan resolutions per FCC KDB 865664D01:

Frequency	Maximum Area Scan resolution ( $\Delta x_{area}, \Delta y_{area}$ )	Maximum Zoom Scan spatial resolution ( $\Delta x_{Zoom}, \Delta y_{Zoom}$ )	Maximum Zoom Scan spatial resolution			Minimum zoom scan volume (x,y,z)
			Uniform Grid	Graded Grad		
	$\Delta z_{Zoom}(n)$	$\Delta z_{Zoom}(1)^*$	$\Delta z_{Zoom}(n>1)^*$			
≤2GHz	≤15mm	≤8mm	≤5mm	≤4mm	≤1.5* $\Delta z_{Zoom}(n-1)$	≥30mm
2-3GHz	≤12mm	≤5mm	≤5mm	≤4mm	≤1.5* $\Delta z_{Zoom}(n-1)$	≥30mm
3-4GHz	≤12mm	≤5mm	≤4mm	≤3mm	≤1.5* $\Delta z_{Zoom}(n-1)$	≥28mm
4-5GHz	≤10mm	≤4mm	≤3mm	≤2.5mm	≤1.5* $\Delta z_{Zoom}(n-1)$	≥25mm
5-6GHz	≤10mm	≤4mm	≤2mm	≤2mm	≤1.5* $\Delta z_{Zoom}(n-1)$	≥22mm

#### 4.2.5 SPATIAL PEAK SAR EVALUATION

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of 5 x 5 x 7 points( with 8mm horizontal resolution) or 7 x 7 x 7 points( with 5mm horizontal resolution) or 8 x 8 x 7 points( with 4mm horizontal resolution). The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting "Graph Evaluated".
- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.
- All neighboring volumes are evaluated until no neighboring volume with a higher average value is found.

#### Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

#### Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff ].

#### Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

#### Advanced Extrapolation

DASY5 uses the advanced extrapolation option which is able to compensate boundary effects on E-field probes.

## 4.2.6 DATA STORAGE AND EVALUATION

### 4.2.5.1 Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension “.DAE4”. The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm<sup>2</sup>], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

#### 4.4.2 Data Evaluation by SEMCAD

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

Probe parameters:	Sensitivity	Norm <sub>i</sub> , $a_{i0}$ , $a_{i1}$ , $a_{i2}$
	Conversion factor	ConvF <sub>i</sub>
	Diode compression point	Dcp <sub>i</sub>
Device parameters:	Frequency	f
	Crest factor	cf
Media parameters:	Conductivity	
	Density	

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multi meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot cf / dcp_i$$

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

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

$$\text{E-field probes: } E_i = (V_i / \text{Norm}_i \cdot \text{ConvF})^{1/2}$$

$$\text{H-field probes: } H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1}f + a_{i2}f^2) / f$$

With  $V_i$  = compensated signal of channel  $i$  ( $i = x, y, z$ )

$\text{Norm}_i$  = sensor sensitivity of channel  $i$  ( $i = x, y, z$ )  
[mV/(V/m)<sup>2</sup>] for E-field Probes

$\text{ConvF}$  = sensitivity enhancement in solution

$a_{ij}$  = sensor sensitivity factors for H-field probes

$f$  = carrier frequency [GHz]

$E_i$  = electric field strength of channel  $i$  in V/m

$H_i$  = magnetic field strength of channel  $i$  in A/m

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

$$E_{\text{tot}} = (E_X^2 + E_Y^2 + E_Z^2)^{1/2}$$

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

$$\text{SAR} = (E_{\text{tot}})^2 \cdot \sigma / (\rho \cdot 1000)$$

With  $\text{SAR}$  = local specific absorption rate in mW/g

$E_{\text{tot}}$  = total field strength in V/m  
= conductivity in [mho/m] or [Siemens/m]  
= equivalent tissue density in g/cm<sup>3</sup>

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{\text{pwe}} = E_{\text{tot}}^2 / 3770 \text{ or } P_{\text{pwe}} = H_{\text{tot}}^2 \cdot 37.7$$

With  $P_{\text{pwe}}$  = equivalent power density of a plane wave in mW/cm<sup>2</sup>

$E_{\text{tot}}$  = total field strength in V/m

$H_{\text{tot}}$  = total magnetic field strength in A/m

## 5. SYSTEM VERIFICATION PROCEDURE

### 5.1 TISSUE VERIFICATION

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within  $\pm 5\%$  of the target values.

The following materials are used for producing the tissue-equivalent materials.

Ingredients (% of weight)	Body Tissue
Frequency Band (MHz)	2450
Water	73.2
Salt(NaCl)	0.04
Sugar	0.0
HEC	0.0
Bactericide	0.0
TritonX-100	0.0
DGBE	26.7

Salt: 99+% Pure Sodium Chloride; Sugar: 98+% Pure Sucrose; Water: De-ionized, 16M + resistivity  
HEC: Hydroxyethyl Cellulose; DGBE: 99+% Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy)ethanol]  
Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue		Liquid Temp. (°C)	Test Date
		$\epsilon_r$ (+/-5%)	$\sigma$ (S/m) (+/-5%)	$\epsilon_r$	$\sigma$ (S/m)		
	2450	52.7 (50.07~55.35)	1.95 (1.85~2.05)	53.45	1.89	20.7	2015/3/25

Note:

- 1)The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2 °C of the conditions expected during the SAR evaluation to satisfy protocol requirements.
- 2)KDB 865664 was ensured to be applied for probe calibration frequencies greater than or equal to 50MHz of the EUT frequencies.
- 3)The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies. The SAR test plots may slightly differ from the table above since the DASY rounds to three significant digits.

## 5.2 SYSTEM CHECK

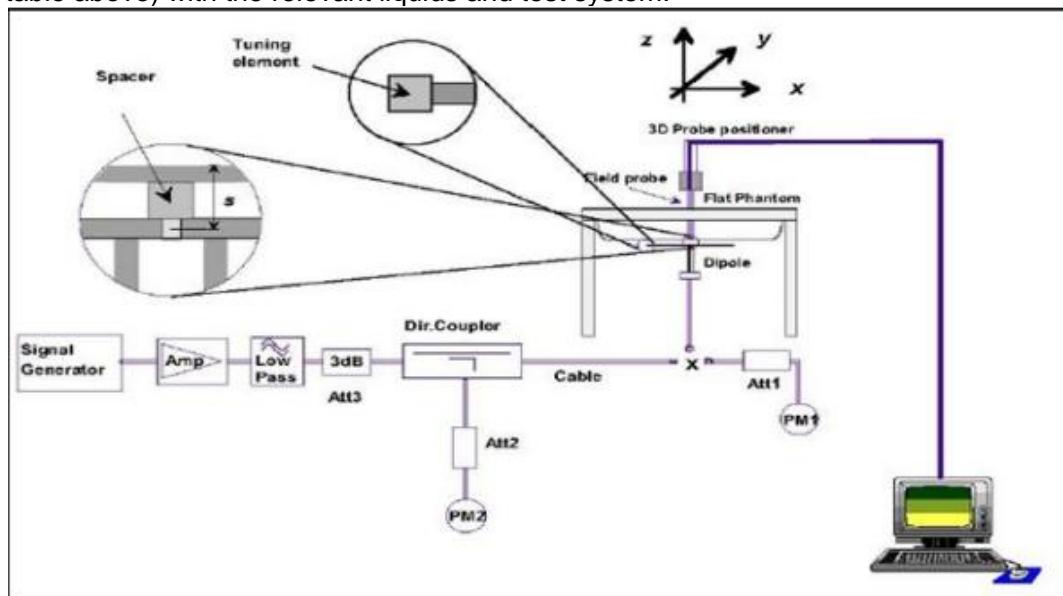
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system check is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows system check results for all frequency bands and tissue liquids used during the tests.

Frequency (MHz)	Test Date	Dielectric Parameters		Temp (°C)	250mW Measured SAR <sub>10g</sub>	1W Normalized SAR <sub>10g</sub>	1W Target SAR <sub>10g</sub> (±10% deviation)
		ε <sub>r</sub>	σ(s/m)				
2450B	2015/3/25	53.45	1.89	20.7	11.76	47.04	50.7 (45.63~55.77)

## 5.3 SYSTEM CHECK PROCEDURE

The system check is performed by using a system check dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a plexiglass spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 250 mW(below 5GHz) or 100mW(above 5GHz). To adjust this power a power meter is used. The power sensor is connected to the cable before the system check to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the system check to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test.

System check results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system.



## **6.SAR MEASUREMENT VARIABILITY AND UNCERTAINTY**

### **6.1SAR MEASUREMENT VARIABILITY**

Per KDB865664 D01 SAR measurement 100 MHz to 6 GHz v01r03, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

- 1) Repeated measurement is not required when the original highest measured SAR is  $< 0.80 \text{ W/kg}$ ; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is  $\geq 0.80 \text{ W/kg}$ , repeat that measurement once.
- 3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$  or when the original or repeated measurement is  $\geq 1.45 \text{ W/kg}$  ( $\sim 10\%$  from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5 \text{ W/kg}$  and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .

The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

The detailed repeated measurement results are shown in Section 8.2.

### **6.2SAR MEASUREMENT UNCERTAINTY**

Per KDB865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03, when the highest measured 1-g SAR within a frequency band is  $< 1.5 \text{ W/kg}$ , the extensive SAR measurement uncertainty analysis.

## 7. OPERATIONAL CONDITIONS DURING TEST

### 7.1 WIFI 2.4G TEST CONFIGURATION

For the 802.11b/g 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.

802.11b/g operating modes are tested independently according to the service requirements in each frequency band. 802.11b/g modes are tested on channel 1, 6, 11; however, if output power reduction is necessary for channels 1 and/or 11 to meet restricted band requirements the highest output channel closest to each of these channels must be tested instead.

SAR is not required for 802.11g/n channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

Mode	Band	GHz	Channel	“Default Test Channels”	
				802.11b	802.11g
802.11b/g	2.4 GHz	2.412	1#	✓	△
		2.437	6#	✓	△
		2.462	11#	✓	△

Notes:

✓ = “default test channels”

△= possible 802.11g channels with maximum average output ¼ dB the “default test channels”

# = when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

## 7.2 TEST POSITION

### 7.2.1 Test Position Requirements

The overall diagonal dimension of the display section of a tablet is 21cm>20cm, Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the Tablet touching the phantom. SAR evaluation for the front surface of tablet display screens are generally not necessary. The SAR Exclusion Threshold in KDB 447498 D01 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned adjacent the phantom and the edge containing the antenna positioned perpendicular to the phantom.

### 7.2.2 SAR test reduction and exclusion guidance

(1) The SAR exclusion threshold for distances < 50mm is defined by the following equation:

$$\frac{(\text{max. power of channel, including tune-up tolerance, mW})}{(\text{min. test separation distance, mm})} \cdot \sqrt{\text{Frequency (GHz)}} \leq 3.0$$

(2) The SAR exclusion threshold for distances > 50mm is defined by the following equation, as illustrated in KDB 447498 D01 Appendix B:

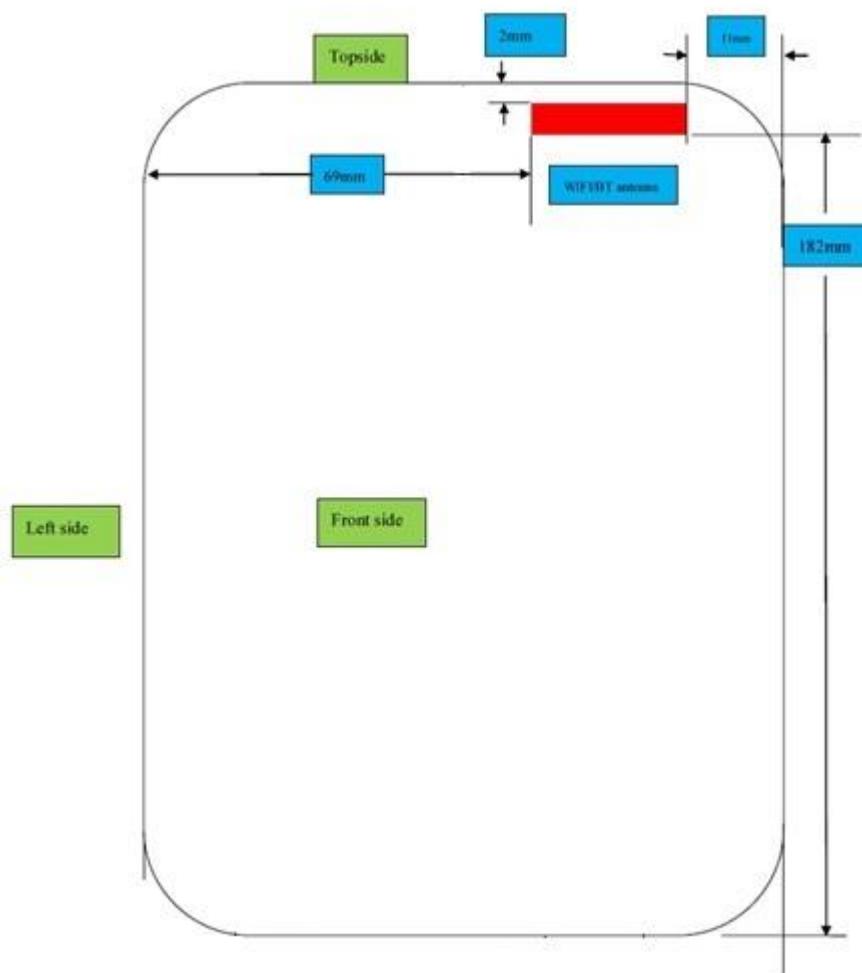
a) at 100 MHz to 1500 MHz

$$[\text{Power allowed at numeric Threshold at 50 mm in step 1} + (\text{test separation distance} - 50 \text{ mm}) \cdot (f_{(\text{MHz})}/150)] \text{ mW}$$

b) at > 1500 MHz and  $\leq 6 \text{ GHz}$

$$[\text{Power allowed at numeric Threshold at 50 mm in step 1} + (\text{test separation distance} - 50 \text{ mm}) \cdot 10] \text{ mW}$$

The location of the antenna inside EUT is as below.



**Test Position 1:** The back side of the EUT towards the bottom of the flat phantom.

SAR is required for WiFi antenna in this position.

SAR is not required for BT antenna in this position.

$$\text{Evaluation}_{(\text{BT})} = [10^{(2/10)} / 5] * (2.480^{1/2}) = 0.50 < 3.0$$

$$\text{Evaluation}_{(\text{WiFi})} = [10^{(15.5/10)} / 5] * (2.462^{1/2}) = 11.18 > 3.0$$

**Test Position 2:** The left side of the EUT towards the bottom of the flat phantom.

SAR is not required for BT/WiFi antenna in this position.

$\text{Evaluation}_{(\text{BT})}=96+(69-50)*10 =286\text{mW}=24.6\text{dBm}>2\text{dBm}(\text{max.power})$

$\text{Evaluation}_{(\text{WiFi})}= 96+(69-50)*10 =286\text{mW}=24.6\text{dBm}>14.98\text{dBm}(\text{max.power})$

**Test Position 3:** The right side of the EUT towards the bottom of the flat phantom.

SAR is required for WiFi antenna in this position.

SAR is not required for BT antenna in this position.

$\text{Evaluation}_{(\text{BT})}=[10^{(2/10)}/11]*(2.480^{1/2})=0.23<3.0$

$\text{Evaluation}_{(\text{WiFi})}=[10^{(15.5/10)}/11]*(2.462^{1/2})=5.08>3.0$

**Test Position 4:** The top side of the EUT towards the bottom of the flat phantom.

SAR is required for WiFi antenna in this position

SAR is not required for BT/GSM/UMTS antenna in this position.

$\text{Evaluation}_{(\text{BT})}=[10^{(2/10)}/5]*(2.480^{1/2})=0.50<3.0$

$\text{Evaluation}_{(\text{WiFi})}=[10^{(15.5/10)}/5]*(2.462^{1/2})=11.18>3.0$

**Test Position 5:** The bottom side of the EUT towards the bottom of the flat phantom.

SAR is not required for BT/ WiFi antenna in this position.

$\text{Evaluation}_{(\text{BT})}=96+(182-50)*10 =1415\text{mW}=31.5\text{dBm}>2\text{dBm}(\text{max.power})$

$\text{Evaluation}_{(\text{WiFi})}= 96+(182-50)*10 =1415\text{mW}=31.5\text{dBm}>14.98\text{dBm}(\text{max.power})$

## 8. TEST RESULT

### 8.1 CONDUCTED POWER RESULTS

#### 8.1.1 CONDUCTED POWER MEASUREMENTS OF WiFi 2.4G

WiFi 2.4G	Frequency (MHz)	Tune-up	Average Power (dBm) for Data Rates (Mbps)							
			1	2	5.5	11	-	-	-	-
802.11b	2412	15.50	14.97	14.93	14.82	14.68	-	-	-	-
	2437	15.50	14.98	14.97	14.95	14.72	-	-	-	-
	2462	15.50	14.98	14.92	14.84	14.69	-	-	-	-

WiFi 2.4G	Frequency (MHz)	Tune-up	Average Power (dBm) for Data Rates (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2412	12.60	11.96	11.95	11.88	11.62	11.51	11.15	10.82	10.78
	2437	12.60	11.98	11.96	11.95	11.85	11.66	11.34	11.05	10.88
	2462	12.60	11.94	11.9	11.87	11.72	11.56	11.13	10.85	10.73

WiFi 2.4G	Frequency (MHz)	Tune-up	Average Power (dBm) for Data Rates (Mbps)							
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
802.11n HT20	2412	11.80	11.33	10.98	10.91	10.75	10.43	10.05	10.04	9.91
	2437	11.80	11.33	11.26	11.01	10.82	10.54	10.32	10.28	9.94
	2462	11.80	11.30	11.02	10.86	10.73	10.39	10.14	10.01	9.92

Note:

- 1) The Average conducted power of WiFi is measured with RMS detector.
- 2) Per KDB248227, for WiFi 2.4GHz, highest average RF output power channel for the lowest data rate of 802.11b mode was selected for SAR evaluation. SAR test at higher data rates and higher order modulations (including 802.11g/n) were not required since the maximum average output power for each of these configurations is not more than 1/4dB higher than the tested channel for the lowest data rate of 802.11b mode.

### 8.1.2 CONDUCTED POWER MEASUREMENTS OF BT

BT 2450 MHz	Average Conducted Power (dBm)			Tune Up
	CH0	CH39	CH78	
DH5	-0.06	1.19	1.33	2
2DH5	-0.01	1.17	1.22	2
3DH5	0.45	1.12	0.62	2

BT 2450 MHz	Average Conducted Power (dBm)			Tune Up
	CH0	CH19	CH39	
BT (4.0)	-1.67	-0.45	0.04	2

Note:

- 1) The conducted power of BT is measured with RMS detector.

## 8.2 SAR TEST RESULTS

### **General Notes:**

- 1) Per KDB447498 D01v05r02, all measurement SAR results are scaled to the maximum tune-up tolerance limit to demonstrate compliant.
- 2) Per KDB447498 D01v05r02, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:  $\leq 0.8 \text{ W/kg}$  or  $2.0 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is  $\leq 100 \text{ MHz}$ . When the maximum output power variation across the required test channels is  $> \frac{1}{2} \text{ dB}$ , instead of the middle channel, the highest output power channel must be used.
- 3) Per KDB865664 D01v01r03, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8 \text{ W/Kg}$ ; 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.

### **WLAN Notes:**

Per KDB248227D01v01r02 and October 2012/April 2013 FCC/TCB workshop meeting notes:

- 1) For WiFi 2.4GHz, highest average RF output power channel for the lowest data rate of 802.11b mode was selected for SAR evaluation. SAR test at higher data rates and higher order modulations (including 802.11g/n) were not required since the maximum average output power for each of these configurations is not more than 1/4dB higher than the tested channel for the lowest data rate of 802.11b mode.

### 8.2.1 SAR MEASUREMENT RESULT OF WiFi 2.4G

#### 1. Body-Worn SAR test results of WiFi 2.4G

Test data with the battery 1# 0mm									
Mode	Test Position	CH	Freq.	Drift (dB)	Power(dBm)		SAR Value (W/kg)1-g	Reported SAR	Graph Results
					Tune up	Conducted			
802.11b	Back	6	2437	0	15.5	14.98	0.591	0.666	1
	Left	6	2437	0.09	15.5	14.98	0.039	0.044	2
	Right	6	2437	0.05	15.5	14.98	0.116	0.131	3
	Top	6	2437	0.01	15.5	14.98	0.475	0.535	4

## 8.3 MULTIPLE TRANSMITTER EVALUATION

### 8.3.1 About BT and WiFi antenna

WiFi antenna and BT antenna cannot transmit simultaneously, so the simultaneous SAR are not required for WiFi and BT antenna.

## APPENDIX

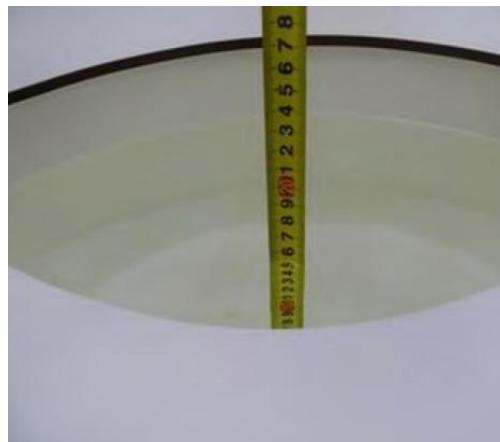
### 1. Test Layout

#### Specific Absorption Rate Test Layout



**Liquid depth in the flat Phantom ( $\geq 15\text{cm}$  depth)**

Body 2450MHz 15.3cm



## 2. System Check Plots

Date/Time: 03/25/2015 09:45:54

Test Laboratory: BTL Inc.

SystemPerformanceCheck-2450 Body

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:919

Communication System: UID 0, CW (0); Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.89$  S/m;  $\epsilon_r = 53.45$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3932; ConvF(7.60, 7.60, 7.60); Calibrated: 01/30/2015;
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 31.0$
- Electronics: DAE4 Sn1390; Calibrated: 09/15/2014
- Phantom: SAM 1; Type: SAM; Serial: 1784
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

System Performance Check at 2450MHz/d=10mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Area Scan (5x7x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 15.62 W/kg

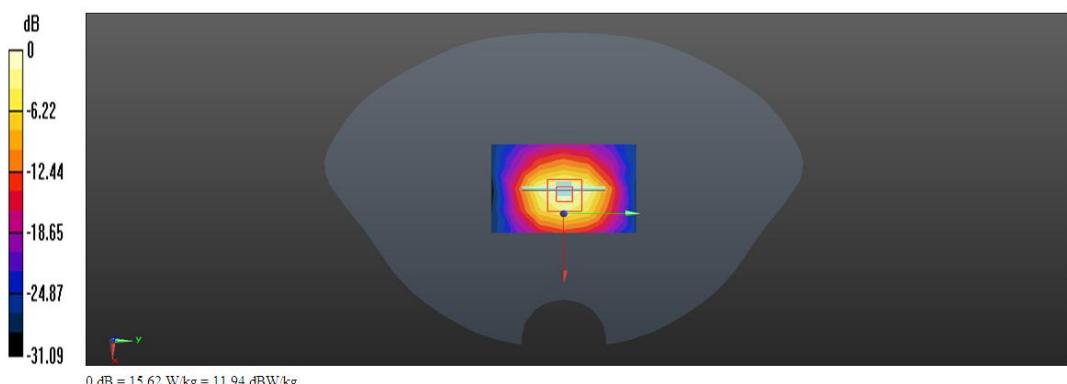
System Performance Check at 2450MHz/d=10mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.634 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 26.1 W/kg

SAR(1 g) = 11.76 W/kg; SAR(10 g) = 5.86 W/kg

Maximum value of SAR (measured) = 18.53 W/kg



### 3.SAR Measurement Plots

Date/Time: 03/25/2015 10:28:07

Test Laboratory: BTL Inc.

Smart phone Huawei T1-701w 802.11b 2437MHz CH 6 Body Back

DUT: Smart phone ; Type: T1-701w; Serial: NA

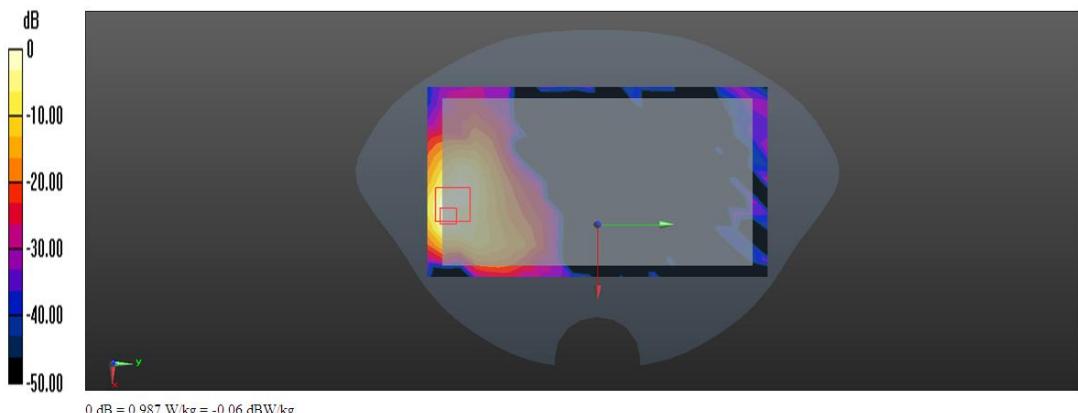
Communication System: UID 0, IEEE 802.11b WiFi 2.4GHz (DSSS, 1Mbps) (0); Frequency: 2437 MHz  
Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 2.013$  S/m;  $\epsilon_r = 50.739$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 – SN3932; ConvF(7.6, 7.6, 7.6); Calibrated: 01/30/2015;
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 31.0$
- Electronics: DAE4 Sn1390; Calibrated: 09/15/2014
- Phantom: SAM 1; Type: SAM; Serial: 1784
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Back Side 0mm/T1-701w/Area Scan (13x22x1): Measurement grid:  $dx=10$ mm,  $dy=10$ mm  
Maximum value of SAR (measured) = 0.987 W/kg

Back Side 0mm/T1-701w/Zoom Scan (7x7x7)/Cube 0: Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm  
Reference Value = 0 V/m; Power Drift = 0.00 dB  
Peak SAR (extrapolated) = 1.81 W/kg  
**SAR(1 g) = 0.591 W/kg; SAR(10 g) = 0.229 W/kg**  
Maximum value of SAR (measured) = 1.29 W/kg



Test Laboratory: BTL Inc.

**Smart phone Huawei T1-701w 802.11b 2437MHz CH 6 Body Left****DUT: Smart phone ; Type: T1-701w; Serial: NA**

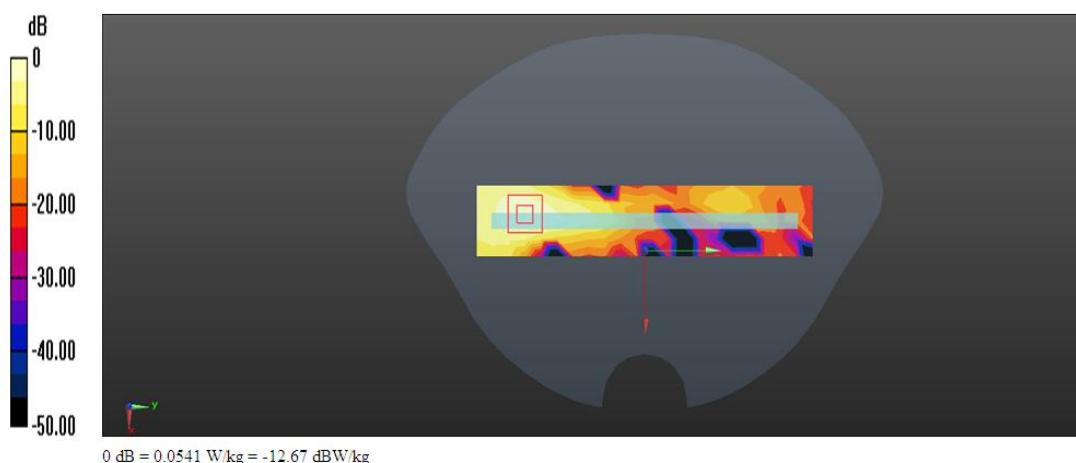
Communication System: UID 0, IEEE 802.11b WiFi 2.4GHz (DSSS, 1Mbps) (0); Frequency: 2437 MHz  
 Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 2.013$  S/m;  $\epsilon_r = 50.739$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3932; ConvF(7.6, 7.6, 7.6); Calibrated: 01/30/2015;
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 31.0$
- Electronics: DAE4 Sn1390; Calibrated: 09/15/2014
- Phantom: SAM 1; Type: SAM; Serial: 1784
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

**Left Side 0mm/T1-701w/Area Scan (5x22x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$   
 Maximum value of SAR (measured) = 0.0541 W/kg

**Left Side 0mm/T1-701w/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 0 V/m; Power Drift = 0.09 dB  
 Peak SAR (extrapolated) = 0.103 W/kg  
**SAR(1 g) = 0.039 W/kg; SAR(10 g) = 0.016 W/kg**  
 Maximum value of SAR (measured) = 0.0771 W/kg



Test Laboratory: BTL Inc.

Smart phone Huawei T1-701w 802.11b 2437MHz CH 6 Body Right

DUT: Smart phone ; Type: T1-701w; Serial: NA

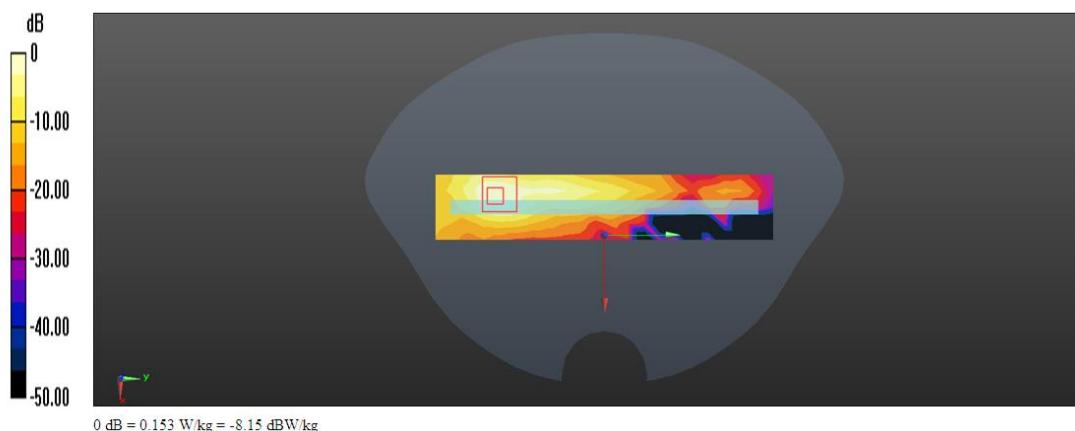
Communication System: UID 0, IEEE 802.11b WiFi 2.4GHz (DSSS, 1Mbps) (0); Frequency: 2437 MHz  
Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 2.013$  S/m;  $\epsilon_r = 50.739$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3932; ConvF(7.6, 7.6, 7.6); Calibrated: 01/30/2015;
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 31.0$
- Electronics: DAE4 Sn1390; Calibrated: 09/15/2014
- Phantom: SAM 1; Type: SAM; Serial: 1784
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

**Right Side 0mm/T1-701w/Area Scan (5x22x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$   
Maximum value of SAR (measured) = 0.153 W/kg

**Right Side 0mm/T1-701w/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
Reference Value = 2.331 V/m; Power Drift = 0.05 dB  
Peak SAR (extrapolated) = 0.303 W/kg  
**SAR(1 g) = 0.116 W/kg; SAR(10 g) = 0.047 W/kg**  
Maximum value of SAR (measured) = 0.234 W/kg



Test Laboratory: BTL Inc.

Smart phone Huawei T1-701w 802.11b 2437MHz CH 6 Body Top.

DUT: Smart phone ; Type: T1-701w; Serial: NA

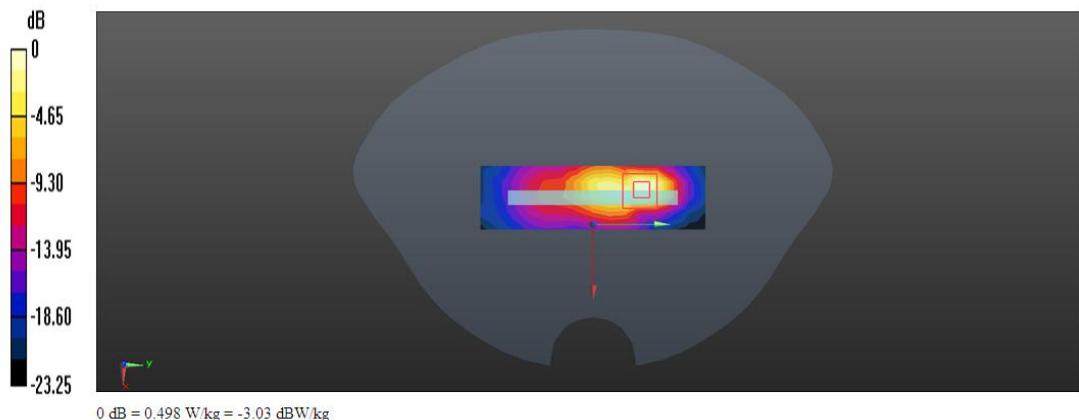
Communication System: UID 0, IEEE 802.11b WiFi 2.4GHz (DSSS, 1Mbps) (0); Frequency: 2437 MHz  
Medium parameters used (interpolated):  $f = 2437$  MHz;  $\sigma = 2.013$  S/m;  $\epsilon_r = 50.739$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3932; ConvF(7.6, 7.6, 7.6); Calibrated: 01/30/2015;
- Sensor-Surface: 2mm (Mechanical Surface Detection),  $z = 1.0, 31.0$
- Electronics: DAE4 Sn1390; Calibrated: 09/15/2014
- Phantom: SAM 1; Type: SAM; Serial: 1784
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

**Top Side 0mm/T1-701w/Area Scan (5x15x1):** Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$   
Maximum value of SAR (measured) = 0.498 W/kg

**Top Side 0mm/T1-701w/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
Reference Value = 9.242 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 1.65 W/kg  
**SAR(1 g) = 0.475 W/kg; SAR(10 g) = 0.154 W/kg**  
Maximum value of SAR (measured) = 1.18 W/kg



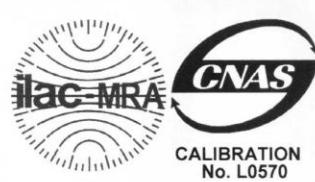
## 4. Calibration Certificate

EX3DV4 - 3932



In Collaboration with  
**S p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [ctl@chinattl.com](mailto:ctl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)



CALIBRATION  
No. L0570

Client

NIM

**Certificate No: Z15-97006**

### CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3932

Calibration Procedure(s) FD-Z11-2-004-01  
Calibration Procedures for Dosimetric E-field Probes

Calibration date: January 30, 2015

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

All calibrations have been conducted in the closed laboratory facility: environment temperature( $22\pm3$ )°C and humidity<70%.

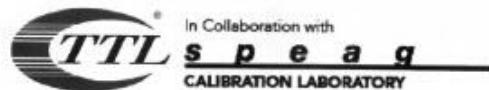
#### Calibration Equipment used (M&TE critical for calibration)

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 777	17-Sep-14 (SPEAG, DAE4-777_Sep14)	Sep-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: January 31, 2015

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



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) Http://www.chinattl.cn

#### 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 $\theta=0$ 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:

- $NORM_{x,y,z}$ : 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.
- $Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z; A,B,C$  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 values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to  $NORM_{x,y,z} * ConvF$  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  $\pm 50$ 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  $NORM_x$  (no uncertainty required).



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [ttl@chinattl.com](mailto:ttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

# Probe EX3DV4

SN: 3932

Calibrated: January 30, 2015

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3932

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm( $\mu$ V/(V/m) <sup>2</sup> ) <sup>A</sup>	0.52	0.55	0.46	$\pm$ 10.8%
DCP(mV) <sup>B</sup>	105.1	102.5	106.9	

### Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB/ $\mu$ V	C	D dB	VR mV	Unc <sup>E</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	201.4	$\pm$ 2.3%
		Y	0.0	0.0	1.0		208.3	
		Z	0.0	0.0	1.0		188.1	

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.



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) Http://www.chinattl.cn

## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3932

### 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)	Uncrt. (k=2)
750	41.9	0.89	10.38	10.38	10.38	0.13	1.31	±12%
835	41.5	0.90	9.75	9.75	9.75	0.14	1.36	±12%
900	41.5	0.97	9.61	9.61	9.61	0.15	1.27	±12%
1750	40.1	1.37	8.42	8.42	8.42	0.23	1.04	±12%
1900	40.0	1.40	8.23	8.23	8.23	0.24	1.05	±12%
2100	39.8	1.49	7.81	7.81	7.81	0.18	1.28	±12%
2300	39.5	1.67	7.84	7.84	7.84	0.31	0.92	±12%
2450	39.2	1.80	7.38	7.38	7.38	0.51	0.77	±12%
2600	39.0	1.96	7.20	7.20	7.20	0.59	0.70	±12%
5200	36.0	4.66	5.62	5.62	5.62	0.40	1.06	±13%
5300	35.9	4.76	5.37	5.37	5.37	0.38	1.05	±13%
5500	35.6	4.96	5.10	5.10	5.10	0.49	1.03	±13%
5600	35.5	5.07	5.03	5.03	5.03	0.46	1.05	±13%
5800	35.3	5.27	4.89	4.89	4.89	0.43	1.31	±13%

<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.



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [ttl@chinattl.com](mailto:ttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3932

### 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)
750	55.5	0.96	10.25	10.25	10.25	0.14	1.55	±12%
835	55.2	0.97	10.19	10.19	10.19	0.16	1.52	±12%
900	55.0	1.05	9.82	9.82	9.82	0.26	1.11	±12%
1750	53.4	1.49	8.08	8.08	8.08	0.15	1.65	±12%
1900	53.3	1.52	7.86	7.86	7.86	0.19	1.33	±12%
2100	53.2	1.62	8.05	8.05	8.05	0.20	1.80	±12%
2300	52.9	1.81	7.92	7.92	7.92	0.34	1.15	±12%
2450	52.7	1.95	7.60	7.60	7.60	0.33	1.16	±12%
2600	52.5	2.16	7.48	7.48	7.48	0.45	0.89	±12%
5200	49.0	5.30	5.17	5.17	5.17	0.45	1.15	±13%
5300	48.9	5.42	4.97	4.97	4.97	0.48	1.20	±13%
5500	48.6	5.65	4.54	4.54	4.54	0.51	1.37	±13%
5600	48.5	5.77	4.47	4.47	4.47	0.51	1.50	±13%
5800	48.2	6.00	4.50	4.50	4.50	0.55	0.90	±13%

<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.

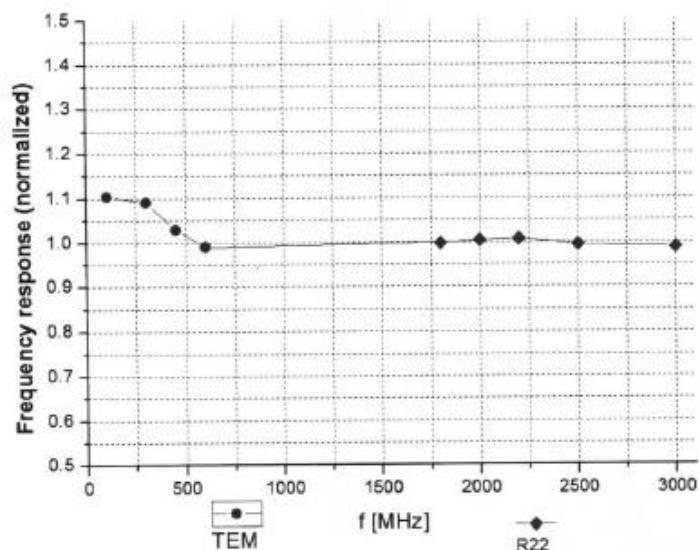
<sup>F</sup> At frequency below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to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



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

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



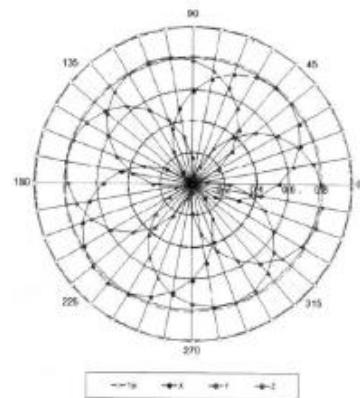
Uncertainty of Frequency Response of E-field:  $\pm 7.5\%$  (k=2)



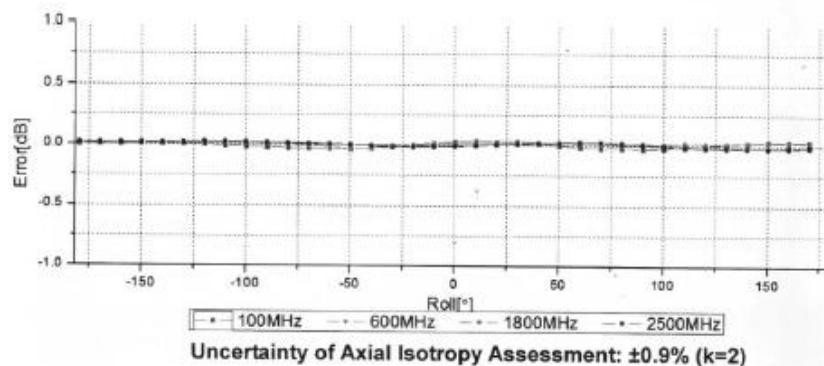
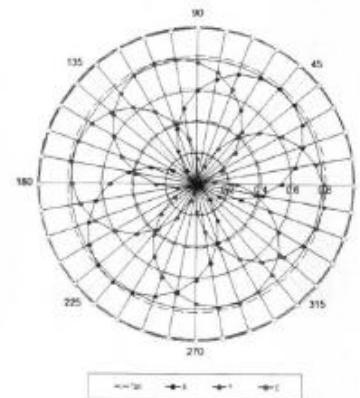
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) Http://www.chinattl.cn

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

**f=600 MHz, TEM**



**f=1800 MHz, R22**

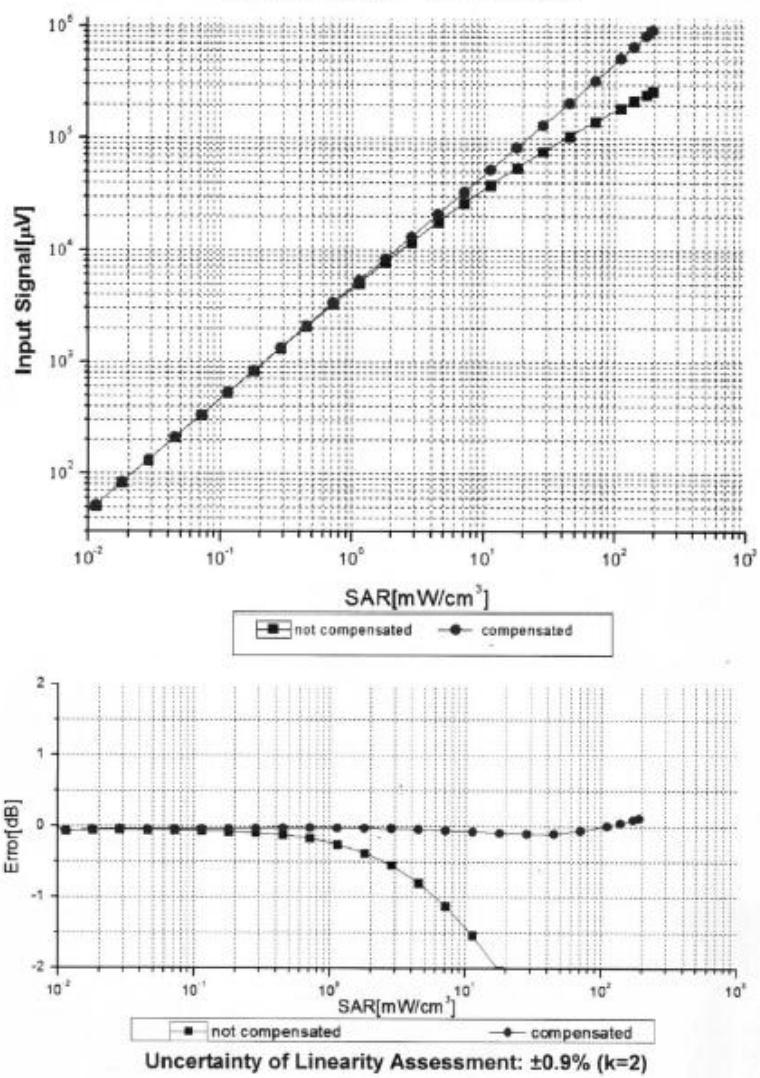


Certificate No: Z15-97006

Page 8 of 11

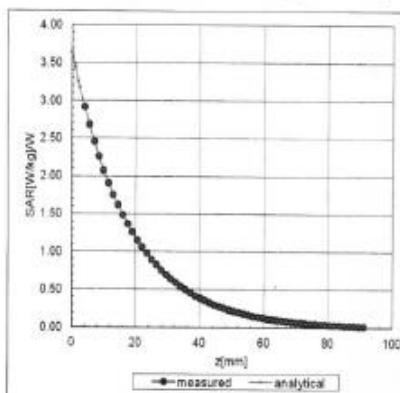
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: [chinattl.com](mailto:chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

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

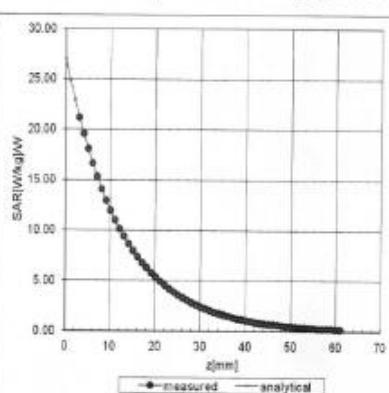


## Conversion Factor Assessment

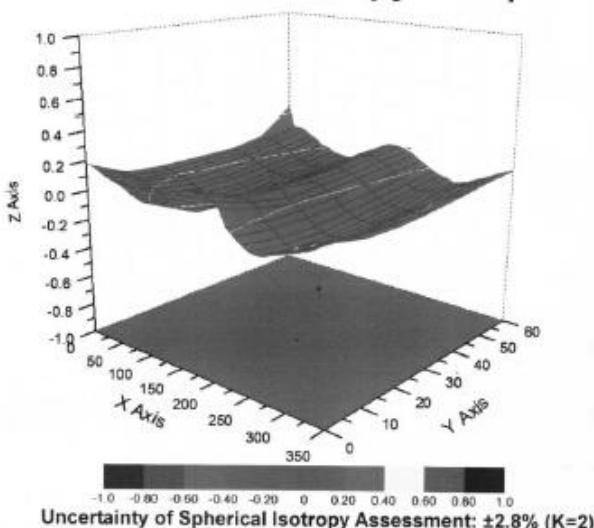
**f=900 MHz, WGLS R9(H\_convF)**



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



## Deviation from Isotropy in Liquid





Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3932

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	69.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

## 5. Libration Certificate

### D2450V2 – SN919



In Collaboration with  
**s p e a g**  
 CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: ctll@chinattl.com Http://www.chinattl.cn



CALIBRATION  
No. L0570

Client

NIM

Certificate No: Z14-97101

#### CALIBRATION CERTIFICATE

Object

D2450V2 - SN: 919

Calibration Procedure(s)

TMC-OS-E-02-194

Calibration procedure for dipole validation kits

Calibration date:

September 17, 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 NRVD	102196	14-Mar-14 (CTTL, No.JZ14-896)	Mar-15
Power sensor NRV-Z5	100596	14-Mar-14 (CTTL, No. JZ14-896)	Mar -15
Reference Probe ES3DV3	SN 3142	1- Sep-14 (CTTL-SPEAG, No.JZ14-97079)	Aug-15
DAE3	SN 536	23-Jan-14 (SPEAG, DAE3-536_Jan14)	Jan -15
Signal Generator E4438C	MY49070393	13-Nov-13 (TMC, No.JZ13-394)	Nov-14
Network Analyzer E8362B	MY43021135	19-Oct-13 (TMC, No.JZ13-278)	Oct-14

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

Issued: September 30, 2014

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

Certificate No: Z14-97101

Page 1 of 8



In Collaboration with  
**s p e a g**  
 CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)



CALIBRATION  
 No. L0576

**Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

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

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- c) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

**Additional Documentation:**

- d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

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



In Collaboration with  
**s p e a g**  
 CALIBRATION LABORATORY



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: ctll@chinattl.com Http://www.chinattl.cn

### Measurement Conditions

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

DASY Version	DASY52	52.8.8.1222
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.8 ± 6 %	1.85 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

### SAR result with Head TSL

SAR averaged over 1 $\text{cm}^3$ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	51.5 mW / g ± 20.8 % (k=2)
SAR averaged over 10 $\text{cm}^3$ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.03 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.0 mW / g ± 20.4 % (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	51.2 ± 6 %	1.97 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	---	---

### SAR result with Body TSL

SAR averaged over 1 $\text{cm}^3$ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	50.7 mW / g ± 20.8 % (k=2)
SAR averaged over 10 $\text{cm}^3$ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.02 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.9 mW / g ± 20.4 % (k=2)



In Collaboration with  
**S p e a g**  
 CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)



CALIBRATION  
No. L0570

## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	56.6Ω- 0.44jΩ
Return Loss	- 24.1dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	56.2Ω+ 2.77jΩ
Return Loss	- 23.9dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.117 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
-----------------	-------



In Collaboration with  
**s p e a g**  
 CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: ctll@chinattl.com Http://www.chinattl.cn



Date: 17.09.2014

### DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 919

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.852$  S/m;  $\epsilon_r = 39.76$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3142; ConvF(4.58, 4.58, 4.58); Calibrated: 2014-09-01;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 2014-01-23
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/2
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

#### System Performance Check /d=10mm, Pin=250 mW, dist=3.0mm

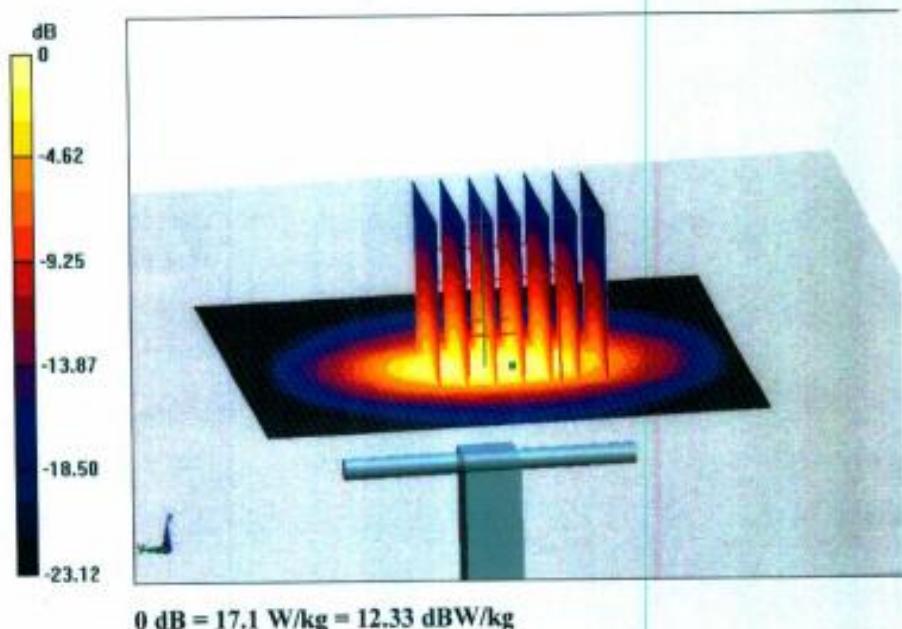
(ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.50 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 27.8 W/kg

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

Maximum value of SAR (measured) = 17.1 W/kg



Certificate No: Z14-97101

Page 5 of 8



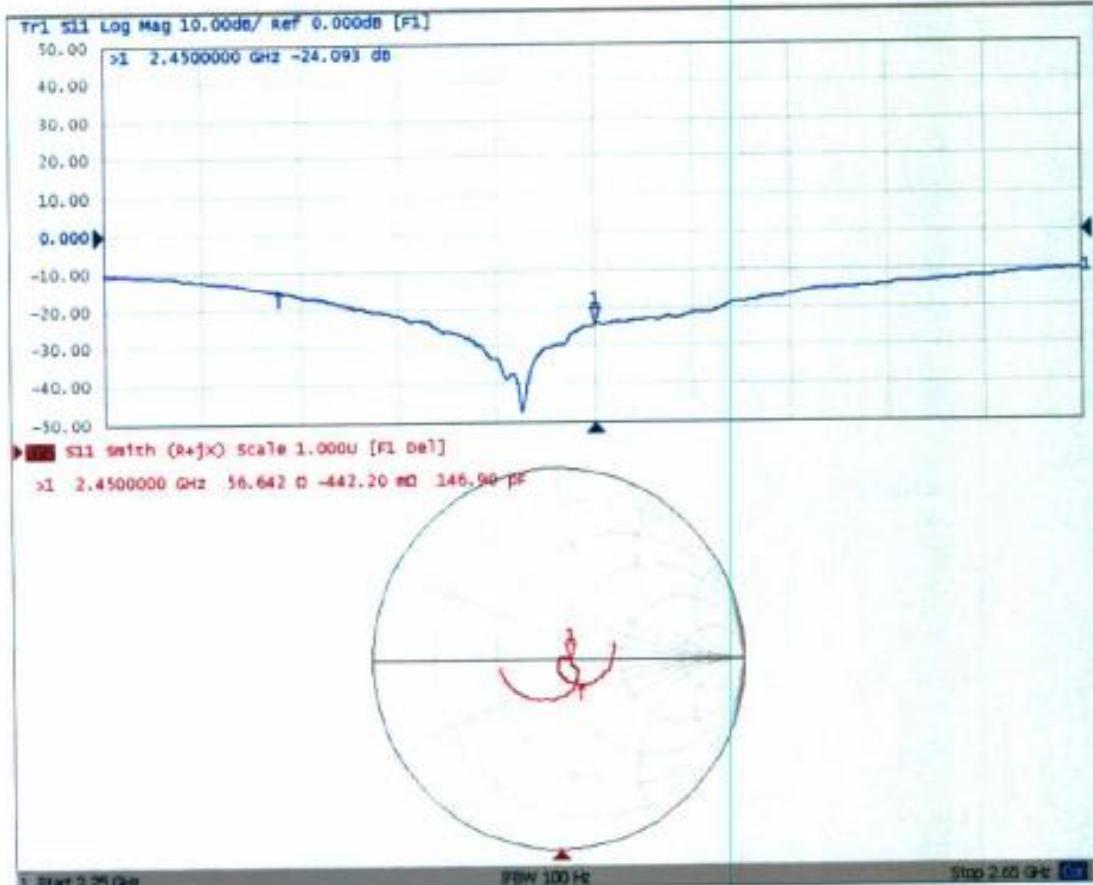
In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: ctll@chinattl.com Http://www.chinattl.cn



CALIBRATION  
No. L0570

### Impedance Measurement Plot for Head TSL



Certificate No: Z14-97101

Page 6 of 8



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)



Date: 17.09.2014

### DASY5 Validation Report for Body TSL

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 919

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.966$  S/m;  $\epsilon_r = 51.18$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3142; ConvF(4.29, 4.29, 4.29); Calibrated: 2014-09-01;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 2014-01-23
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/3
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

#### System Performance Check /d=10mm, Pin=250 mW, dist=3.0mm

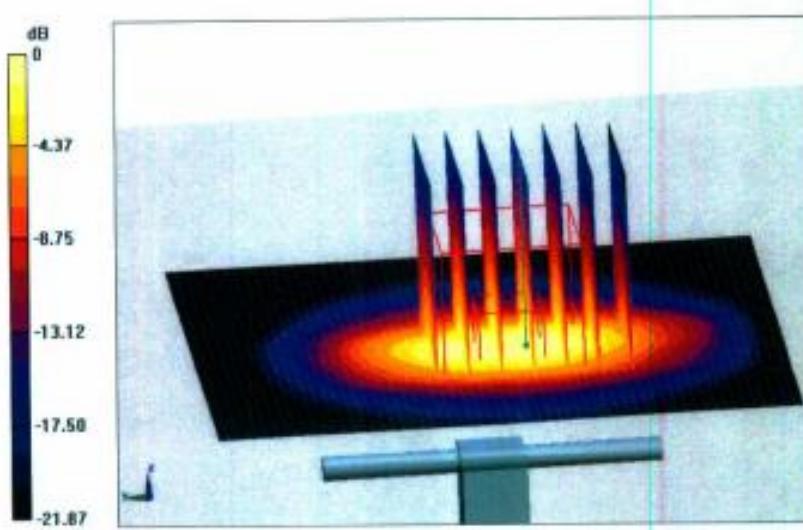
(ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.44 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 25.7 W/kg

SAR(1 g) = 12.8 W/kg; SAR(10 g) = 6.02 W/kg

Maximum value of SAR (measured) = 16.7 W/kg



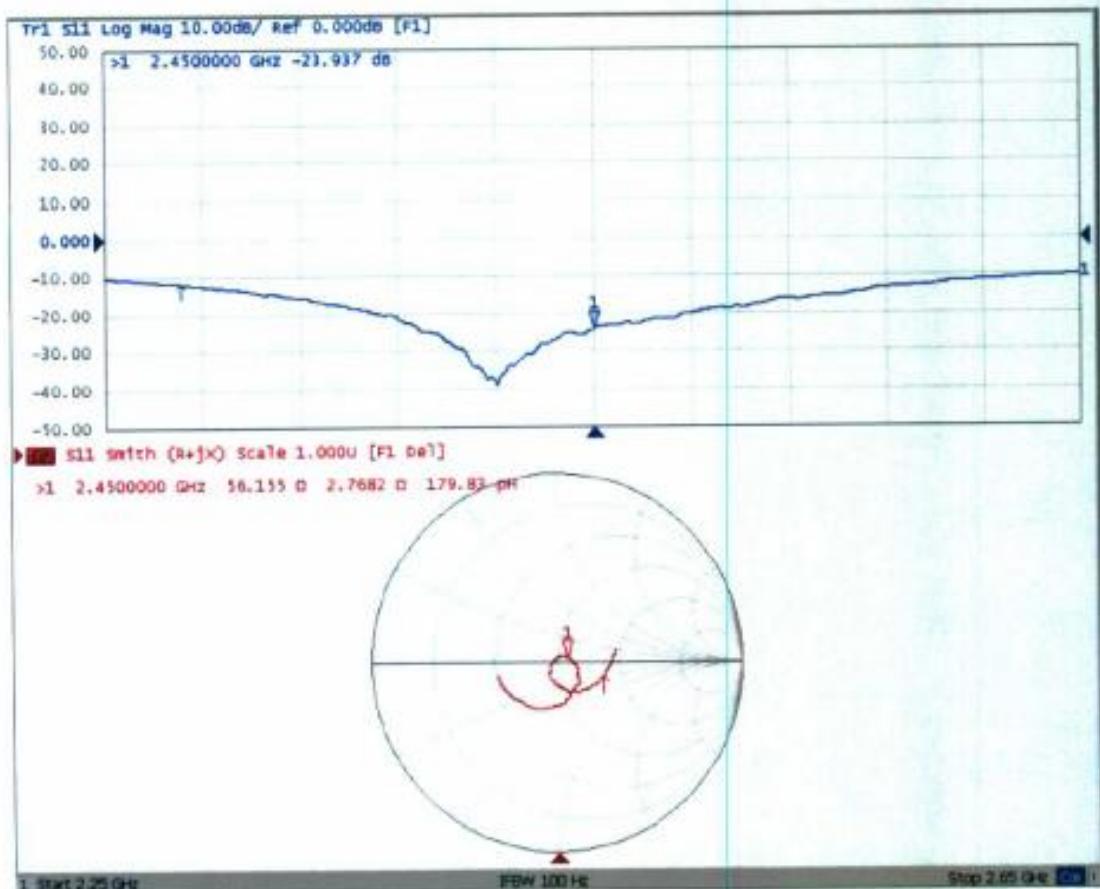


In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [ctl@chinatll.com](mailto:ctl@chinatll.com) [Http://www.chinatll.cn](http://www.chinatll.cn)



### Impedance Measurement Plot for Body TSL



Certificate No: Z14-97101

Page 8 of 8

## 6. DAE4 Calibration Certificate



In Collaboration with  
**s p e a g**  
 CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: ctll@chinatll.com [Http://www.chinatll.cn](http://www.chinatll.cn)



CALIBRATION  
No. L0570

Client : **NIM**

**Certificate No: Z14-97093**

### CALIBRATION CERTIFICATE

Object **DAE4 - SN: 1390**

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

Calibration date: **September 15, 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( $22\pm3$ )°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	01-July-14 (CTTL, No:J14X02147)	July-15

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

Issued: September 17, 2014

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



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

**Glossary:**

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

**Methods Applied and Interpretation of Parameters:**

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



In Collaboration with  
**s p e a g**  
 CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
 E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 $\mu$ V, full range = -100...+300 mV

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

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

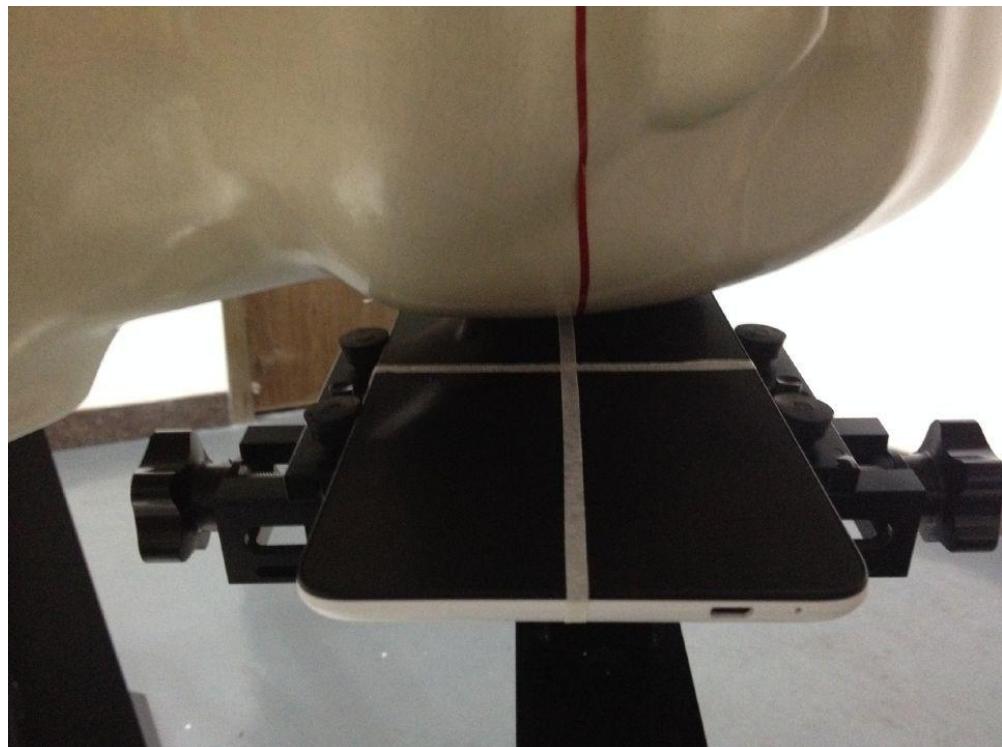
Calibration Factors	X	Y	Z
High Range	$403.699 \pm 0.15\% \text{ (k=2)}$	$403.423 \pm 0.15\% \text{ (k=2)}$	$404.3 \pm 0.15\% \text{ (k=2)}$
Low Range	$3.96442 \pm 0.7\% \text{ (k=2)}$	$3.98241 \pm 0.7\% \text{ (k=2)}$	$3.98276 \pm 0.7\% \text{ (k=2)}$

### Connector Angle

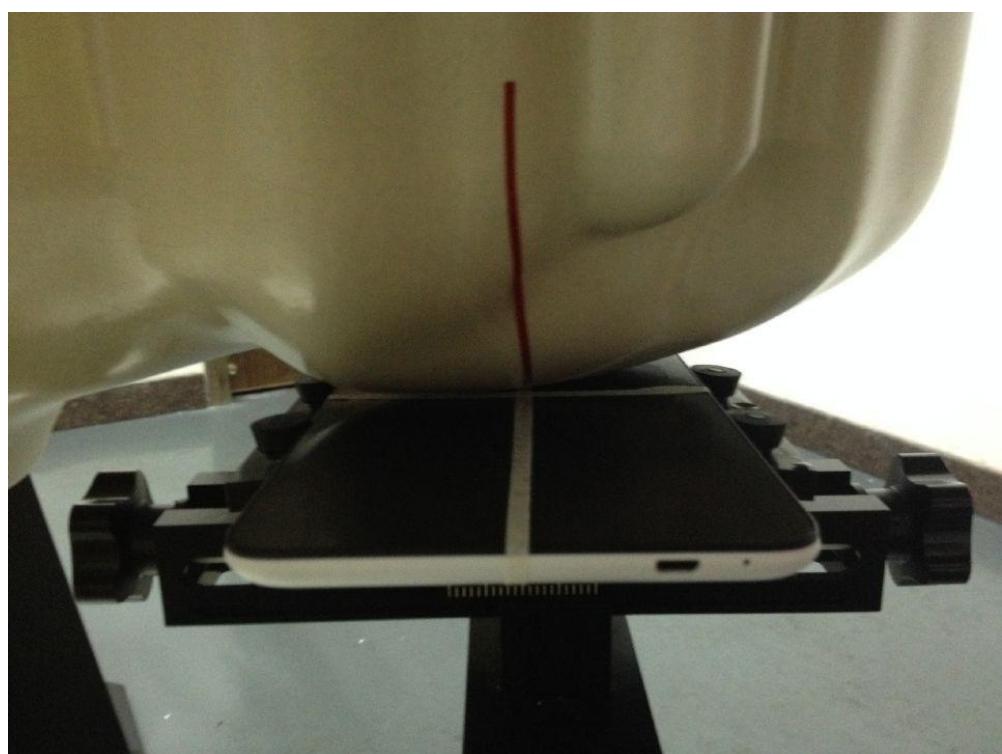
Connector Angle to be used in DASY system	$72^\circ \pm 1^\circ$
---	------------------------

## 5. EUT Testing Position and Antenna Location

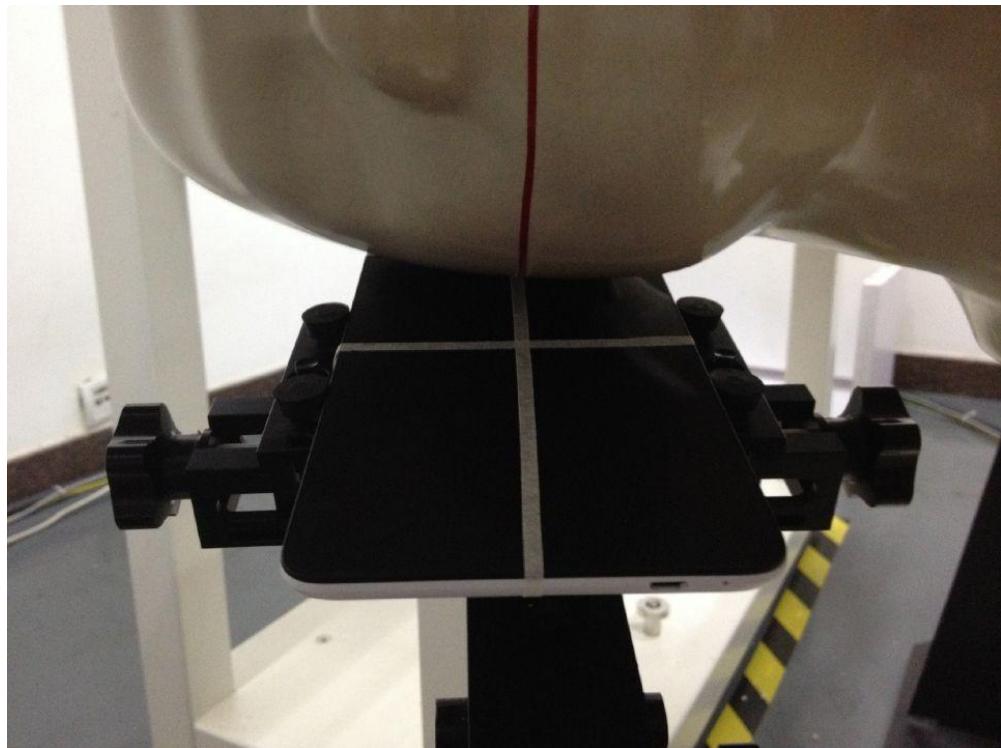
Test Position Left hand tilted



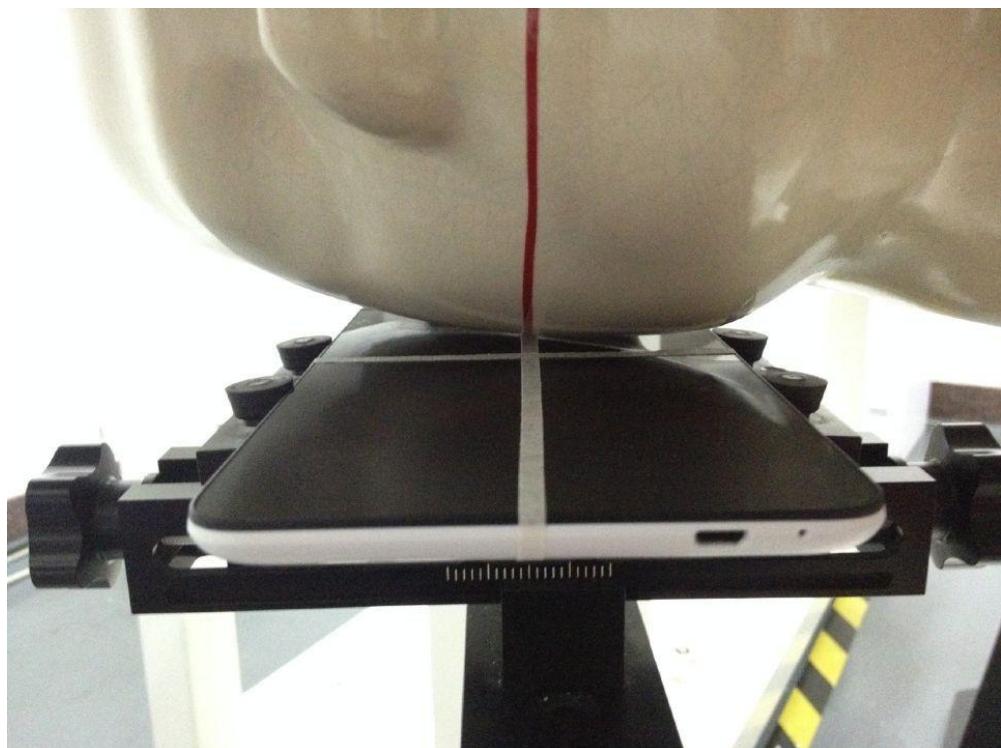
Test Position Left hand touch cheek



Test Position Right hand tilted



Test Position Right hand touch cheek



Test Position Back



Test Position Left



Test Position Right



Test Position Top



Test Position Bottom

