TEST REPORT

Report Reference No. .... :	**TRE18010155**	R/C……….:	39717
FCC ID .... :	**2AEY7-S8A004**		
Applicant's name .... :	**Bak USA Technologies Corp.**		
Address..:	425 Michigan Avenue, Buffalo, NY, 14203,USA		
Manufacturer....................................:	Bak USA Technologies Corp.		
Address..:	425 Michigan Avenue, Buffalo, NY, 14203,USA		
Test item description .... :	**Tablet PC**		
Trade Mark ....:	-		
Model/Type reference.......................:	Wifi only		
Listed Model(s) ....:	-		
Standard .... :	**FCC 47 CFR Part2.1093** **IEEE 1528: 2013 ANSI/IEEE C95.1: 1999**		
Date of receipt of test sample……….:	Jan.19, 2018		
Date of testing…………………………...:	Jan.22, 2018- Jan.30, 2018		
Date of issue…………………………..:	Jan.31, 2018		
Result................. ……………………...:	**PASS**		

Compiled by (position+printedname+signature)...:	File administrators:Xiaodong Zhao	Xiaodong Zhao
Supervised by (position+printedname+signature)...:	Test Engineer: Xiaodong Zhao	Xiaodong Zhao
Approved by (position+printedname+signature)...:	Manager: Hans Hu	Hans Hu

Testing Laboratory Name .... :	**Shenzhen Huatongwei International Inspection Co., Ltd**
Address..:	1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

The test report merely correspond to the test sample.

Contents

1 . Test Standards and Report version

1.1. Test Standards

The tests were performed according to following standards:

FCC 47 Part 2.1093 Radiofrequency Radiation Exposure Evaluation:Portable Devices
IEEE Std C95.1, 1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz.
IEEE Std 1528™-2013: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.
KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04: SAR Measurement Requirements for 100 MHz to 6 GHz
KDB 865664 D02 RF Exposure Reporting v01r02: RF Exposure Compliance Reporting and Documentation Considerations
KDB 447498 D01 General RF Exposure Guidance v06: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB 248227 D01 802 11 Wi-Fi SAR v02r02: SAR Measurement Proceduresfor802.11 a/b/g Transmitters
616217 D04 SAR for laptop and tablets v01r02: SAR Evaluation Requirements for Laptop, Notebook, Netbook and Tablet Computers

1.2. Report version

Version No.	Date of issue	Description
00	Jan.31,2018	Original

2. Summary

2.1. Client Information

Applicant:	Bak USA Technologies Corp.
Address:	425 Michigan Avenue, Buffalo, NY, 14203,USA
Manufacturer:	Bak USA Technologies Corp.
Address:	425 Michigan Avenue, Buffalo, NY, 14203,USA

2.2. Product Description

Name of EUT:	Tablet PC
Trade Mark:	-
Model No.:	Wifi only
Listed Model(s):	-
Power supply:	DC 3.7V From exchange battery
Device Category:	Tablet PC
Product stage:	Production unit
RF Exposure Environment:	General Population / Uncontrolled
Device Class:	B
Hardware version:	1.1
Software version:	1703
Maximum SAR Value	
Separation Distance:	Body: 0mm
Max Report SAR Value (1g):	**Body:** 0.051 W/Kg
WIFI 2.4G	
Supported type:	802.11b/802.11g/802.11n(HT20)/802.11n(HT40)
Modulation:	DSSS for 802.11b OFDM for 802.11g/802.11n(HT20)/802.11n(HT40)
Operation frequency:	2412MHz~2462MHz
Channel number:	11
Channel separation:	5MHz
Antenna type:	Integral antenna

WIFI 5G	
Supported type:	802.11a/802.11n(HT20)/802.11n(HT40)/802.11ac(HT20)/802.11ac(HT40)/ 802.11ac(HT80)
Modulation:	BPSK, QPSK, 16QAM, 64QAM
Operation frequency:	Band U-NII-1:5150MHz~5250MHz Band U-NII-2A: 5250MHz~5350MHz Band U-NII-2C: 5470MHz~5725MHz Band U-NII-3: 5725MHz~5850MHz
Supported Bandwidth:	20MHz: 802.11n, 802.11a, 802.11ac 40MHz: 802.11n, 802.11ac 80MHz: 802.11ac
Antenna type:	Integral antenna
Bluetooth	
Version:	Supported BT4.0+EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	Integral antenna
Bluetooth-BLE	
Version:	Supported BT4.0+BLE
Modulation:	GFSK
Operation frequency:	2402MHz~2480MHz
Channel number:	40
Channel separation:	2MHz
Antenna type:	Integral antenna
Remark: *The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power*	

3. Test Environment

3.1. Test laboratory

Laboratory:Shenzhen Huatongwei International Inspection Co., Ltd.
Address: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

3.2. Test Facility

CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025:2005 General Requirements) for the Competence of Testing and Calibration Laboratories

A2LA-Lab Cert. No. 3902.01

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC-Registration No.: 762235

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files.

IC-Registration No.:5377B

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No.: 5377B

ACA

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our A2LA accreditation.

4. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Calibration	Calibration Interval
Data Acquisition Electronics DAEx	SPEAG	DAE4	1315	2017/08/15	1
E-field Probe	SPEAG	EX3DV4	3650	2017/07/21	1
System Validation Dipole	SPEAG	D2450V2	884	2017/10/26	3
System Validation Dipole	SPEAG	D5GHzV2	1019	2017/08/20	3
Dielectric Assessment Kit	SPEAG	DAK-3.5	1038	2016/08/25	3
Network analyzer	Agilent	N9923A	MY51491493	2017/09/05	1
Power meter	Agilent	N1914A	MY52090010	2017/03/23	1
Power sensor	Agilent	E9304A	MY52140008	2017/03/23	1
Power sensor	Agilent	E9301H	MY54470001	2017/06/02	1
Signal Generator	ROHDE & SCHWARZ	SMB100A	175248	2017/09/02	1
Dual Directional Coupler	Agilent	772D	MY46151257	2017/03/23	1
Power Amplifier	Mini-Circuits	ZVE-8G+	421401127	2017/03/23	1
Power Amplifier	Mini-Circuits	ZHL-42W	QA1202003	2017/11/27	1

Note:

1. *The Probe,Dipole and DAE calibration reference to the Appendix A.*
2. *Referring to KDB865664 D01, the dipole calibration interval can be extended to 3 years with justifcatio. The dipole are also not physically damaged or repaired during the interval.*

5. Measurement Uncertainty

Measurement Uncertainty										
No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement System										
1	Probe calibration	B	6.0%	N	1	1	1	6.0%	6.0%	∞
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90%	1.90%	∞
3	Hemispherical isotropy	B	9.60%	R	$\sqrt{3}$	0.7	0.7	3.90%	3.90%	∞
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70%	2.70%	∞
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50%	0.50%	∞
10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
11	RF ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
12	Probe positioned mech. restrictions	B	0.40%	R	$\sqrt{3}$	1	1	0.20%	0.20%	∞
13	Probe positioning with respect to phantom shell	B	2.90%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
14	Max.SAR evalation	B	3.90%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
Test Sample Related										
15	Test sample positioning	A	1.86%	N	1	1	1	1.86%	1.86%	∞
16	Device holder uncertainty	A	1.70%	N	1	1	1	1.70%	1.70%	∞
17	Drift of output power	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
Phantom and Set-up										
18	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
19	Liquid conductivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	∞
20	Liquid conductivity (meas.)	A	0.50%	N	1	0.64	0.43	0.32%	0.26%	∞
21	Liquid permittivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	∞
22	Liquid cpermittivity (meas.)	A	0.16%	N	1	0.64	0.43	0.10%	0.07%	∞
Combined standard uncertainty		$u_c=\sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	9.79%	9.67%	∞
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$		R	K=2	/	/	19.57%	19.34%	∞

System Check Uncertainty										
No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement System										
1	Probe calibration	B	6.0%	N	1	1	1	6.0%	6.0%	∞
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90%	1.90%	∞
3	Hemispherical isotropy	B	9.60%	R	$\sqrt{3}$	0.7	0.7	3.90%	3.90%	∞
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70%	2.70%	∞
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50%	0.50%	∞
10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
11	RF ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
12	Probe positioned mech. restrictions	B	0.40%	R	$\sqrt{3}$	1	1	0.20%	0.20%	∞
13	Probe positioning with respect to phantom shell	B	2.90%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
14	Max.SAR evalation	B	3.90%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
System validation source-dipole										
15	Deviation of experimental dipole from numerical dipole	A	1.58%	N	1	1	1	1.58%	1.58%	∞
16	Dipole axis to liquid distance	A	1.35%	N	1	1	1	1.35%	1.35%	∞
17	Input power and SAR drift	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
Phantom and Set-up										
18	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
20	Liquid conductivity (meas.)	A	0.50%	N	1	0.64	0.43	0.32%	0.26%	∞
22	Liquid cpermittivity (meas.)	A	0.16%	N	1	0.64	0.43	0.10%	0.07%	∞
Combined standard uncertainty		$u_c=\sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	8.80%	8.79%	∞
Expanded uncertainty (confidence interval of 95 %)		$u_e=2u_c$		R	K=2	/	/	17.59%	17.58%	∞

6. SAR Measurements System Configuration

6.1. SAR Measurement Set-up

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

A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).

A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.

A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

A unit to operate the optical surface detector which is connected to the EOC.

The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.

The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.

DASY5 software and SEMCAD data evaluation software.

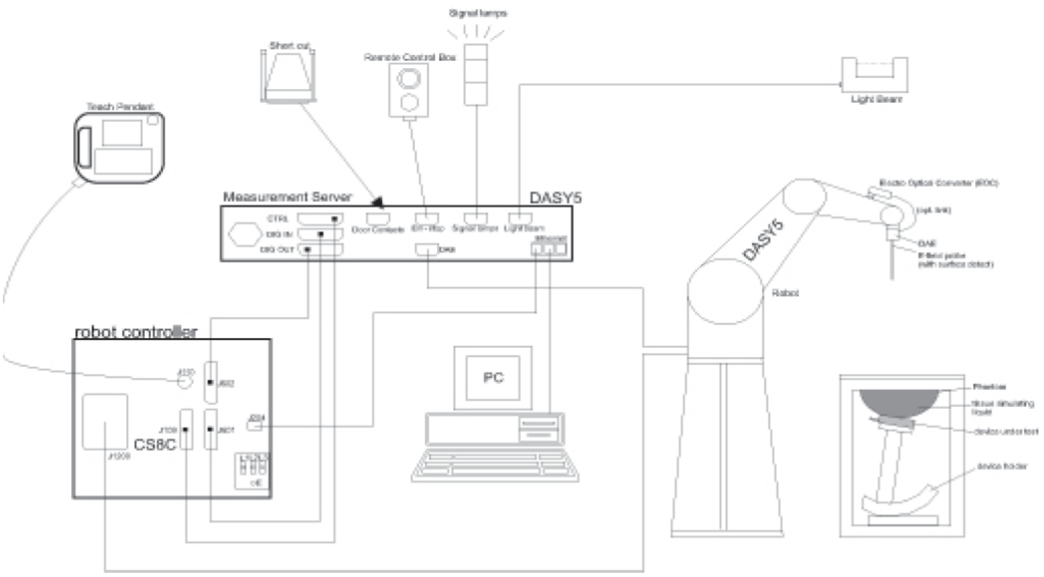
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

The generic twin phantom enabling the testing of left-hand and right-hand usage.

The device holder for handheld Mobile Phones.

Tissue simulating liquid mixed according to the given recipes.

System validation dipoles allowing to validate the proper functioning of the system.



6.2. DASY5 E-field Probe System

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

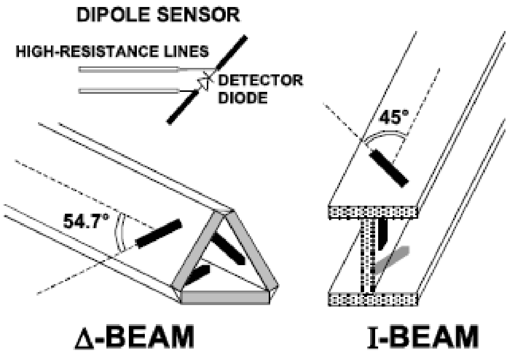
- **Probe Specification**

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: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 μW/g to > 100 W/kg; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.0 mm
Application	General dosimetry up to 6 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

- **Isotropic E-Field Probe**

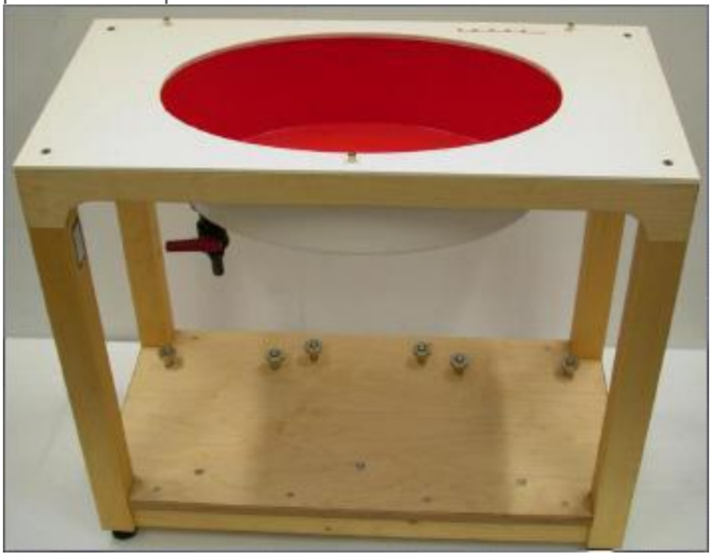
The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

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



6.3. Phantoms

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI isfully compatible with standard and all known tissuesimulating liquids. ELI has been optimized regarding its performance and can beintegrated into our standard phantom tables. A cover prevents evaporation ofthe liquid. Reference markings on the phantom allow installation of thecomplete setup, including all predefined phantom positions and measurementgrids, by teaching three points. The phantom is compatible with all SPEAGdosimetric probes and dipoles.



ELI4 Phantom

6.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

Device holder supplied by SPEAG

7. SAR Test Procedure

7.1. Scanning Procedure

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

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

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

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

Zoom Scan
After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm.

Spatial Peak Detection
The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses.The DASY5 system allows evaluations that combine measured data and robot positions, such as:
• maximum search
• extrapolation
• boundary correction
• peak search for averaged SAR
During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard’s method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.
Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space.
They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard’s method for extrapolation.

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 5mm steps.

Table 1: Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v04

<table>
<tr><td colspan="3"></td><td>$\leq$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>$\frac{1}{2}\cdot\delta\cdot\ln(2)$ mm ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>$\leq$ 2 GHz: $\leq$ 15 mm
2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm
4 – 6 GHz: $\leq$ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5\cdot\Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.
* When zoom scan is required and the <u>*reported*</u> SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

7.2. Data Storage and Evaluation

Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors),s together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [W/kg], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation

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

Probe parameters:	Sensitivity:	Normi, ai0, ai1, ai2
	Conversion factor:	ConvFi
	Diode compression point:	Dcpi
Device parameters:	Frequency:	f
	Crest factor:	cf
Media parameters:	Conductivity:	σ
	Density:	ρ

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

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

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

Vi: compensated signal of channel (i = x, y, z)
Ui: input signal of channel (i = x, y, z)
cf: crest factor of exciting field (DASY parameter)
dcpi: diode compression point (DASY parameter)

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

$$\mathrm{E-fieldprobes:} \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

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

Vi: compensated signal of channel (i = x, y, z)
Normi: sensor sensitivity of channel (i = x, y, z), [mV/(V/m)2] for E-field Probes
ConvF: sensitivity enhancement in solution
aij: sensor sensitivity factors for H-field probes
f: carrier frequency [GHz]
Ei: electric field strength of channel i in V/m
Hi: magnetic field strength of channel i in A/m

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

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

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

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

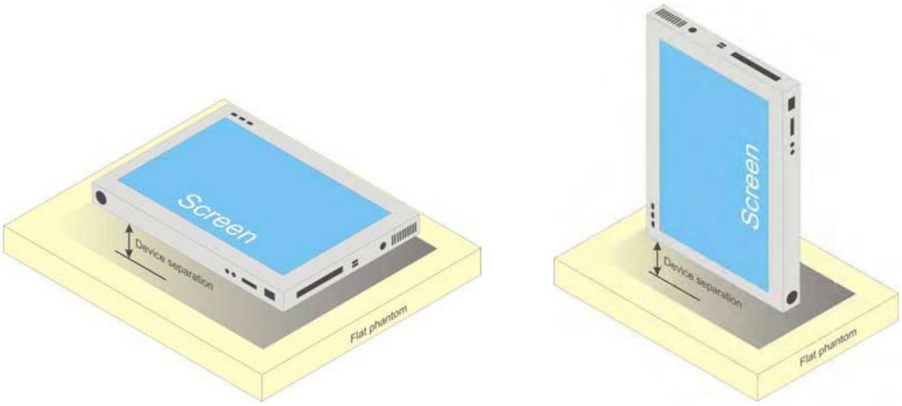
SAR:	local specific absorption rate in W/kg
Etot:	total field strength in V/m
σ:	conductivity in [mho/m] or [Siemens/m]
ρ:	equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

8. Position of the wireless device in relation to the phantom

8.1. Body-supported device

Other devices that fall into this category include tablet type portable computers and credit card transaction authorisation terminals, point-of-sale and/or inventory terminals. Where these devices may be torso or limb-supported, the same principles for body-supported devices are applied.



b) Tablet form factor portable computer

9. System Check

9.1. Tissue Dielectric Parameters

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.The table 3 and table 4 show the detail solition.It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

Tissue dielectric parameters for head and body phantoms		
Target Frequency	Body	
(MHz)	εr	σ(s/m)
2450	52.7	1.95
5200	49.0	5.30
5300	48.9	5.42
5600	48.5	5.77
5800	48.2	6.00

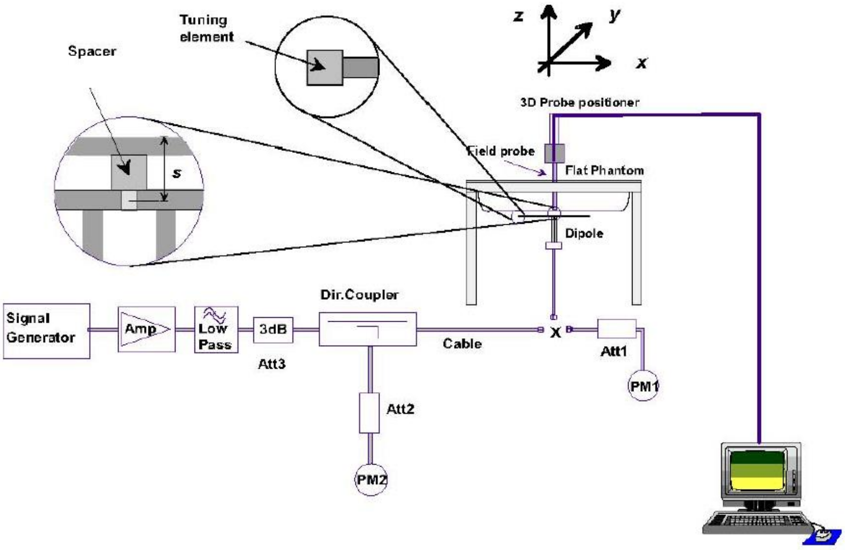
Check Result:

Dielectric performance of Body tissue simulating liquid									
Frequency (MHz)	εr		σ(s/m)		Delta (εr)	Delta (σ)	Limit	Temp (℃)	Date
	Target	Measured	Target	Measured					
2450	52.70	52.52	1.95	1.94	-0.34%	-0.51%	±5%	22	2017-12-22
5300	48.90	49.25	5.42	5.52	0.72%	1.85%	±5%	22	2017-12-24
5600	48.50	48.98	5.77	5.87	0.99%	1.73%	±5%	22	2017-12-25
5800	48.20	48.57	6.00	6.02	0.77%	0.33%	±5%	22	2017-12-26

9.2. SAR System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice test frequency.The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10%).
System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



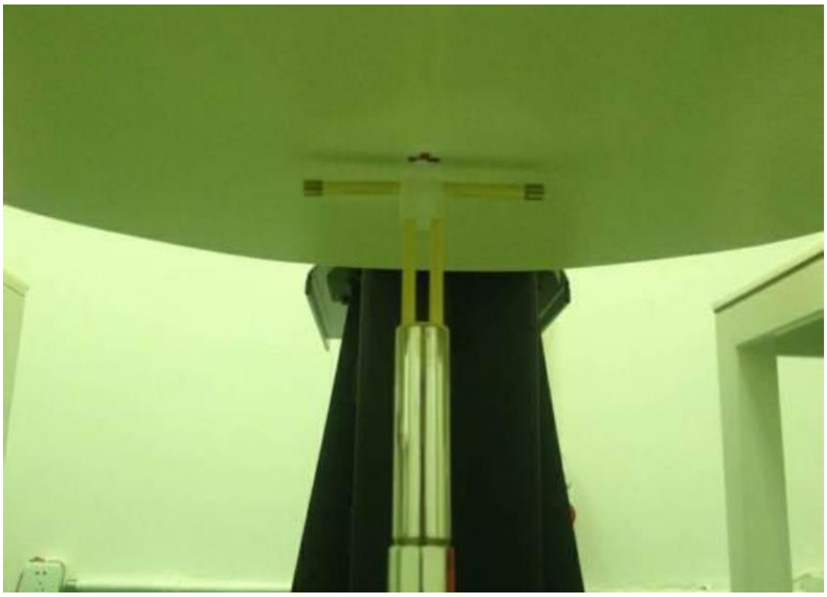


Photo of Dipole Setup

Check Result:

Body									
Frequency (MHz)	1g SAR		10g SAR		Delta (1g)	Delta (10g)	Limit	Temp (℃)	Date
	Target	Measured	Target	Measured					
2450	12.60	12.50	5.88	5.76	-0.79%	-2.04%	±10%	22	2017-12-22
5300	7.78	7.97	2.16	2.20	2.44%	1.85%	±10%	22	2017-12-24
5600	8.15	8.39	2.26	2.30	2.94%	1.77%	±10%	22	2017-12-25
5800	7.45	7.57	2.08	2.09	1.61%	0.48%	±10%	22	2017-12-26

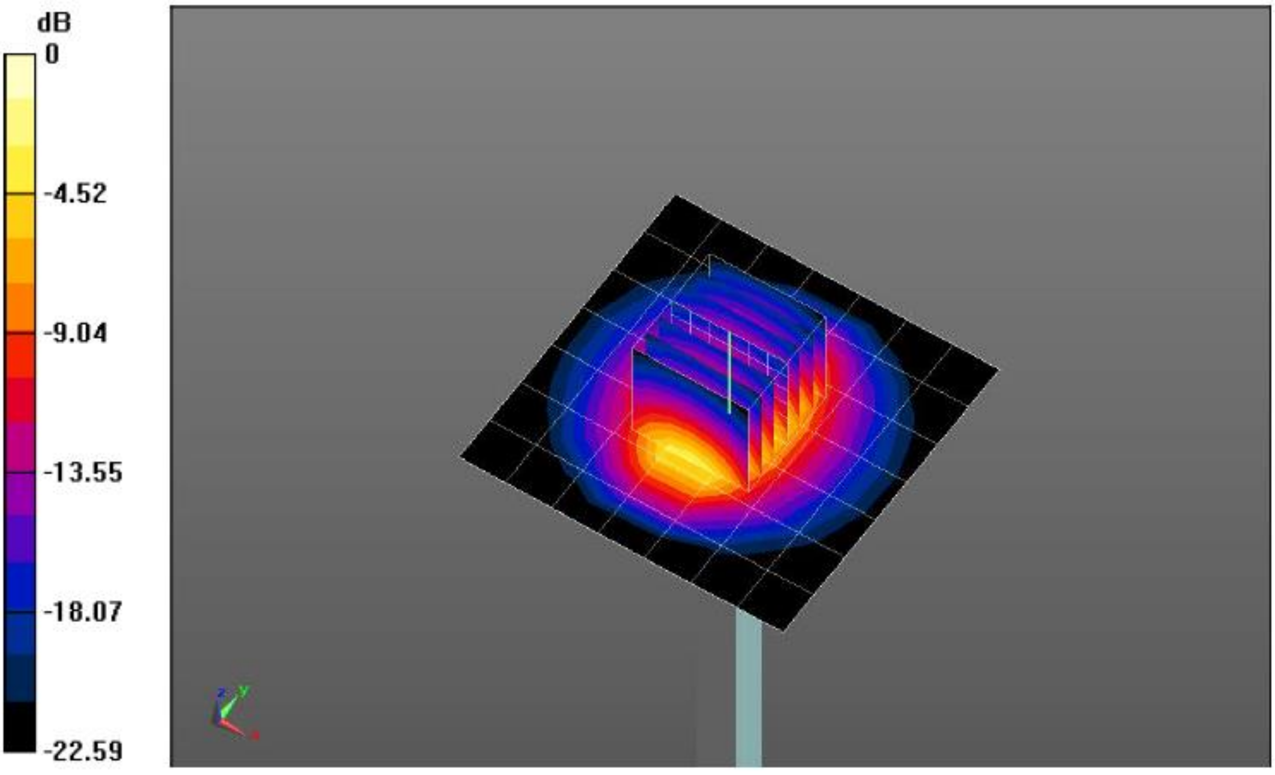
Plots of System Performance Check

System Performance Check at 2450 MHz Body

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 884
Date:2017-12-22
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.94S/m; εr = 52.52; ρ = 1000 kg/m3
Phantom section: Flat Section

DASY5 Configuration:
Probe: EX3DV4 - SN3650; ConvF(7.01, 7.01, 7.01); Calibrated: 2017/7/21
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 2017/08/15
Phantom: ELI v4.0; Type: QDOVA001BB
Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (8x8x1): Measurement grid: dx=12.00 mm, dy=12.00 mm
Maximum value of SAR (interpolated) = 19.266 W/kg
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 84.170 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 26.174 W/kg
SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.76 W/kg
Maximum value of SAR (measured) = 19.27W/kg



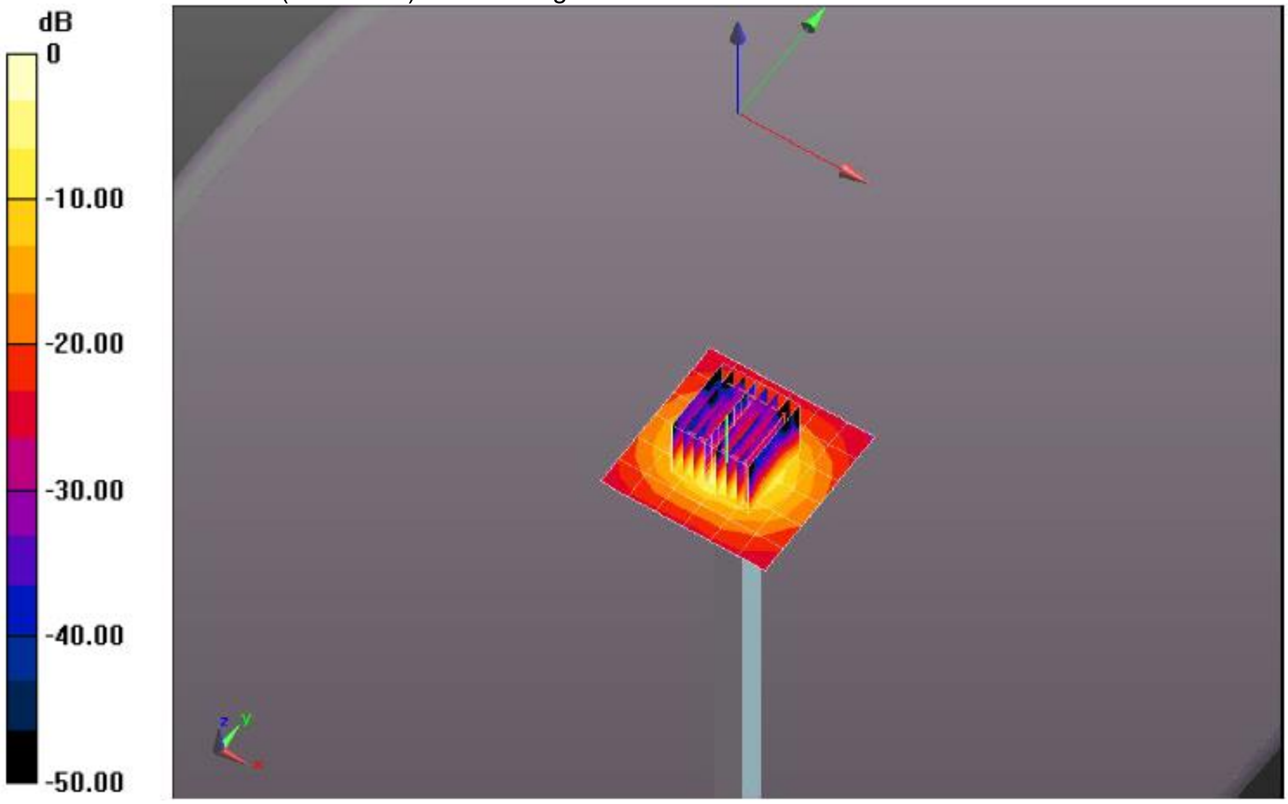
System Performance Check 2450MHz 250mW

System Performance Check at 5300 MHz Body

DUT: Dipole 5GHz; Type: 5GHzV2; Serial: 1019
Date:2017-12-24
Communication System: CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5300 MHz; σ = 5.52S/m; εr = 49.25; ρ = 1000 kg/m3
Phantom section: Flat Section

DASY5 Configuration:
Probe: EX3DV4 - SN3650; ConvF(4.56, 4.56, 4.56); Calibrated: 2017/07/21
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 2017/08/15
Phantom: ELI v4.0; Type: QDOVA001BB
Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (7x7x1): Measurement grid: dx=10.00 mm, dy=10.00 mm
Maximum value of SAR (interpolated) = 18.0 W/kg
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 52.559 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 31.9 W/kg
SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.20 W/kg
Maximum value of SAR (measured) = 18.4 W/kg



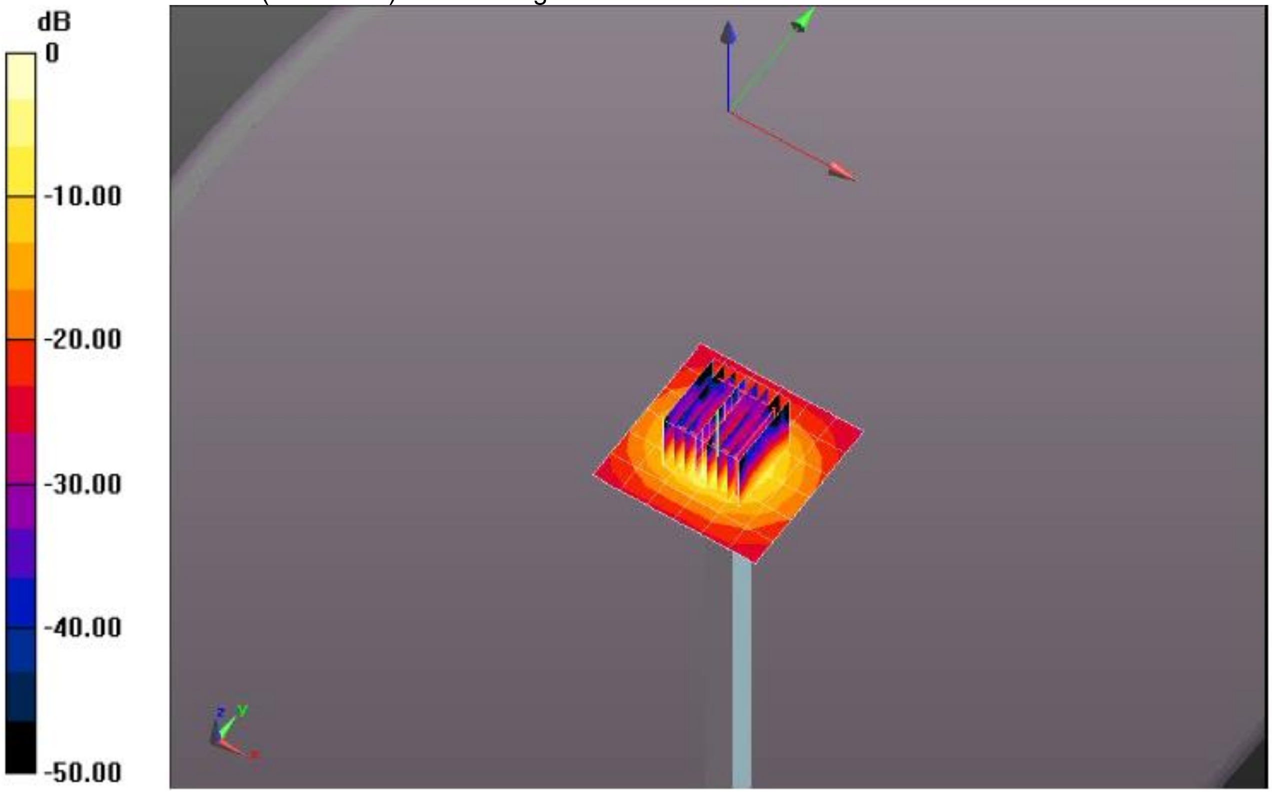
System Performance Check 5300MHz 100mW

System Performance Check at 5600 MHz Body

DUT: Dipole 5GHz; Type: 5GHzV2; Serial: 1019
Date:2017-12-25
Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5600 MHz; σ = 5.87S/m; εr = 48.98; ρ = 1000 kg/m3
Phantom section: Flat Section

DASY5 Configuration:
Probe: EX3DV4 - SN3650; ConvF(3.99, 3.99, 3.99); Calibrated: 2017/07/21;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 2017/08/15
Phantom: ELI v4.0; Type: QDOVA001BB
Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (7x7x1): Measurement grid: dx=10.00 mm, dy=10.00 mm
Maximum value of SAR (interpolated) = 21.3 W/kg
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.98 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 36.6 W/kg
SAR(1 g) = 8.39 W/kg; SAR(10 g) = 2.30 W/kg
Maximum value of SAR (measured) = 20.5 W/kg



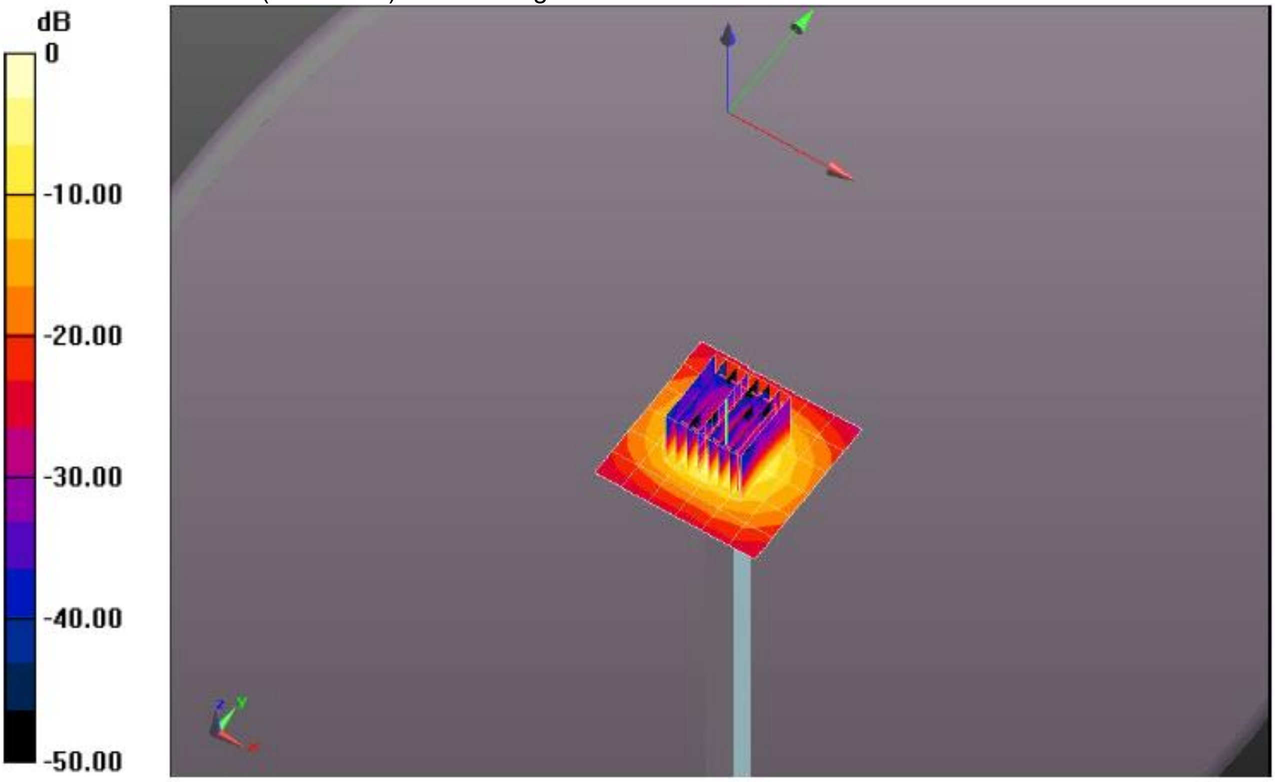
System Performance Check 5600MHz 100mW

System Performance Check at 5800 MHz Body

DUT: Dipole 5GHz; Type: 5GHzV2; Serial: 1019
Date:2017-12-26
Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5800 MHz; σ = 6.02S/m; εr = 48.57; ρ = 1000 kg/m3
Phantom section: Flat Section

DASY5 Configuration:
Probe: EX3DV4 - SN3650; ConvF(4.40, 4.40, 4.40); Calibrated: 2017/07/21;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 2017/08/15
Phantom: ELI v4.0; Type: QDOVA001BB
Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (7x7x1): Measurement grid: dx=10.00 mm, dy=10.00 mm
Maximum value of SAR (interpolated) = 19.7 W/kg
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 50.298 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 33.4 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 18.0 W/kg



System Performance Check 5800MHz 100mW

10. SAR Exposure Limits

SAR assessments have been made in line with the requirements of ANSI/IEEE C95.1-1992

Type Exposure	Limit (W/kg)	
	General Population / Uncontrolled Exposure Environment	Occupational / Controlled Exposure Environment
Spatial Average SAR (whole body)	0.08	0.4
Spatial Peak SAR (1g cube tissue for head and trunk)	1.6	8.0
Spatial Peak SAR (10g for limb)	4.0	20.0

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

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

11. Conducted Power Measurement Results

WLAN Conducted Power

For 2.4GHz WLAN SAR testing, highest average RF output power channel for the lowest data rate for 802.11b were for SAR evaluation. 802.11g/n were not investigated since the average putput powers over all channels and data rates were not more than 0.25dB higher than the tested channel in the lowest data rate of 802.11b mode.

The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures

WIFI 2.4G			
Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
802.11b	01	2412	14.94
	06	2437	15.42
	11	2462	14.82
802.11g	01	2412	11.92
	06	2437	11.98
	11	2462	12.25
802.11n(HT20)	01	2412	10.95
	06	2437	10.91
	11	2462	11.30
802.11n(HT40)	03	2422	10.15
	06	2437	10.15
	09	2452	10.25

WIFI 5G U-NII-1				
Bandwidth	Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
20	802.11ac	36	5180	11.30
		40	5200	11.40
		48	5240	11.39
	802.11n	36	5180	12.20
		40	5200	12.35
		48	5240	12.30
	802.11a	36	5180	12.54
		40	5200	12.57
		48	5240	12.22
40	802.11ac	38	5190	10.90
		46	5230	11.00
	802.11n	38	5190	11.71
		46	5230	11.90
80	802.11ac	42	5210	9.21

WIFI 5G U-NII-2A				
Bandwidth	Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
20	802.11ac	52	5260	10.30
		56	5280	10.59
		64	5320	10.48
	802.11n	52	5260	11.98
		56	5280	12.05
		64	5320	11.68
	802.11a	52	5260	12.68
		56	5280	12.65
		64	5320	12.29
40	802.11ac	54	5270	10.20
		62	5310	10.13
	802.11n	54	5270	11.63
		62	5310	11.48
80	802.11ac	58	5290	8.64

WIFI 5G U-NII-2C				
Bandwidth	Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
20	802.11ac	100	5500	10.65
		120	5600	10.47
		140	5700	10.39
	802.11n	100	5500	12.50
		120	5600	12.53
		140	5700	12.10
	802.11a	102	5500	12.35
		118	5600	12.20
		134	5700	12.51
40	802.11ac	102	5510	9.66
		118	5590	10.22
		134	5670	10.44
	802.11n	102	5510	10.60
		118	5590	10.76
		134	5670	10.66
80	802.11ac	106	5530	8.66
		122	5610	9.09

WIFI 5G U-NII-3				
Bandwidth	Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
20	802.11ac	149	5745	10.47
		157	5785	10.78
		165	5825	10.78
	802.11n	149	5745	11.96
		157	5785	12.11
		165	5825	12.39
	802.11a	149	5745	12.14
		157	5785	12.49
		165	5825	12.00
40	802.11ac	151	5755	9.75
		159	5795	9.70
	802.11n	151	5755	10.79
		159	5795	10.48
80	802.11ac	155	5775	9.26

Bluetooth Conducted Power

Bluetooth			
Mode	Channel	Frequency (MHz)	Conducted power (dBm)
GFSK	0	2402	5.92
	39	2441	6.23
	78	2480	5.20
π/4QPSK	0	2402	3.34
	39	2441	5.15
	78	2480	3.39
8DPSK	0	2402	4.01
	39	2441	5.75
	78	2480	4.25
BLE	0	2402	-3.87
	19	2440	-3.30
	39	2480	-2.57

12. Maximum Tune-up Limit

WLAN 2.4G	
Mode	Maximum Tune-up (dBm) Burst Average Power
802.11b	15.50
802.11g	12.50
802.11n(HT20)	11.50
802.11n(HT40)	10.50

WLAN 5G U-NII-1	
Mode	Maximum Tune-up (dBm) Burst Average Power
802.11ac(HT20)	11.50
802.11n(HT20)	12.50
802.11a	13.00
802.11ac(HT40)	11.00
802.11n(HT40)	12.00
802.11ac(HT80)	9.50

WLAN 5G U-NII-2A	
Mode	Maximum Tune-up (dBm) Burst Average Power
802.11ac(HT20)	11.00
802.11n(HT20)	12.50
802.11a	13.00
802.11ac(HT40)	10.50
802.11n(HT40)	12.00
802.11ac(HT80)	9.00

WLAN 5G U-NII-2C	
Mode	Maximum Tune-up (dBm) Burst Average Power
802.11ac(HT20)	11.00
802.11n(HT20)	12.60
802.11a	12.60
802.11ac(HT40)	10.50
802.11n(HT40)	11.00
802.11ac(HT80)	9.50

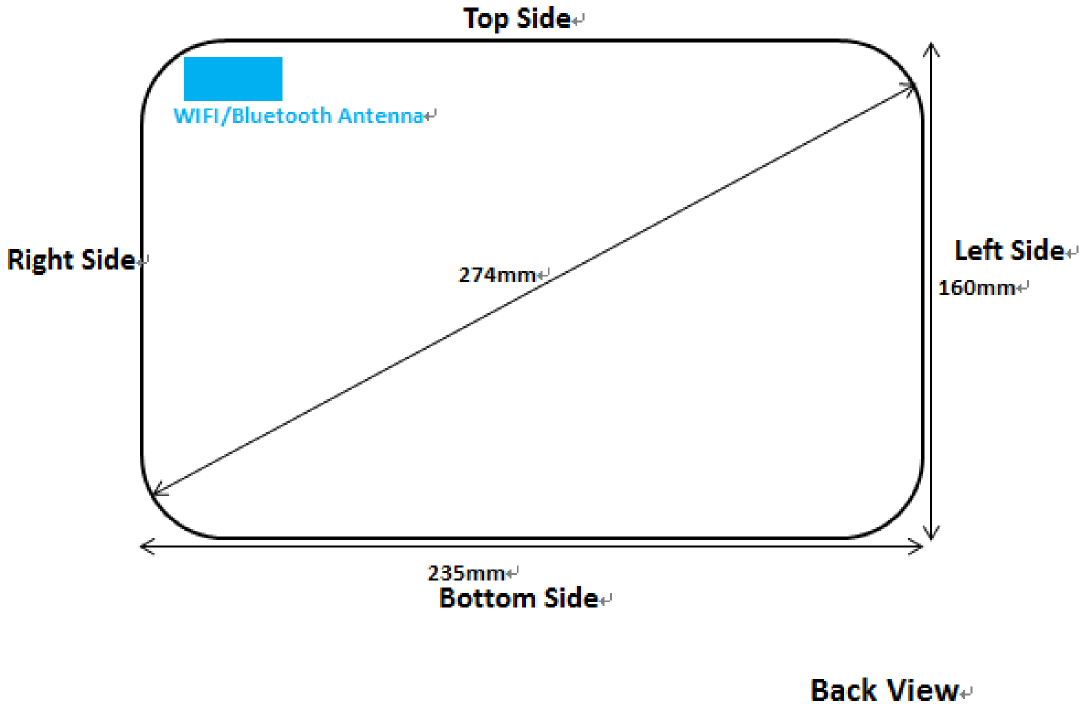
WLAN 5G U-NII-3	
Mode	Maximum Tune-up (dBm) Burst Average Power
802.11ac(HT20)	11.00
802.11n(HT20)	12.50
802.11a	12.50
802.11ac(HT40)	10.00
802.11n(HT40)	11.00
802.11ac(HT80)	9.50

Note:
When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band.

Bluetooth	
Mode	Maximum Tune-up (dBm)
GFSK	6.50
π/4QPSK	5.20
8DPSK	5.80
BLE	-2.50

13. RF Exposure Conditions (Test Configurations)

13.1. Antenna Location



13.2. Standalone SAR test exclusion considerations

KDB 447498 with KDB 616217:
a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g *SAR test exclusion thresholds* are determined by the following:
[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [√f(GHz)] ≤ 3.0 for 1-g SAR
When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according is applied to determine SAR test exclusion.
b) For 100 MHz to 6 GHz and *test separation distances* > 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following :
1) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance - 50 mm)·(f(MHz)/150)]} mW, for 100 MHz to 1500 MHz
2) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance - 50 mm)·10]} mW, for > 1500 MHz and ≤6 GHz

Tx Interface	Frequency (MHz)	Output Power		Rear Face		Left Side		Right Side		Top Side		Bottom Side	
		dBm	mW	separation distances (mm)	Calculated Result (mW)	separation distances (mm)	Calculated Result (mW)	separation distances (mm)	Calculated Result (mW)	separation distances (mm)	Calculated Result (mW)	separation distances (mm)	Calculated Result (mW)
WIFI 2.4G	2437	15.5	35	5	11	203	1626	5	11	5	11	137	966
WIFI 5G U-NII-1	5200	13.0	20	5	9	203	1596	5	9	5	9	137	936
WIFI 5G U-NII-2A	5280	13.0	20	5	9	203	1595	5	9	5	9	137	935
WIFI 5G U-NII-2C	5700	12.6	18	5	9	203	1594	5	9	5	9	137	934
WIFI 5G U-NII-3	5785	12.5	18	5	9	203	1592	5	9	5	9	137	932
Bluetooth	2480	6.5	4	5	1	203	1625	5	1	5	1	137	965

Positions for SAR tests					
Test Configurations	Rear Face	Left Side	Right Side	Top Side	Bottom Side
WIFI 2.4G	Yes	No	Yes	Yes	No
WIFI 5.2G	Yes	No	Yes	Yes	No
WIFI 5.3G	Yes	No	Yes	Yes	No
WIFI 5.6G	Yes	No	Yes	Yes	No
WIFI 5.8G	Yes	No	Yes	Yes	No
Bluetooth	No	No	No	No	No

13.3. Estimated SAR

Bluetooth SAR is estimated per KDB 447498 D01 based on the formula below:

a) [(max. Power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)/x]W/kg for test separation distances ≦50mm; whetn x=7.5 for 1-g SAR, and x=18.75 for 10-g SAR.

b) When the minimum separation distance is <5mm, the distance is used 5mm to determine SAR test exclusion

c) 0.4 W/kg for 1-g SAR and 1.0W/kg for 10-g SAR, when the test separation distances is >50mm.

Estimated SAR(W/kg)					
Test Configurations	Rear Face	Left Side	Right Side	Top Side	Bottom Side
WIFI 2.4G	-	0.400	-	-	0.400
WIFI 5G U-NII-1	-	0.400	-	-	0.400
WIFI 5G U-NII-2A	-	0.400	-	-	0.400
WIFI 5G U-NII-2C	-	0.400	-	-	0.400
WIFI 5G U-NII-3	-	0.400	-	-	0.400
Bluetooth	0.188	0.400	0.188	0.188	0.400

14. SAR Measurement Results

WLAN 2.4G										
Mode	Test Position	Frequency		Conducted Power (dBm)	Tune up limit (dBm)	Tune up scaling factor	Power Drift(dB)	Measured SAR(1g) (W/kg)	Report SAR(1g) (W/kg)	Test Plot
		CH	MHz							
802.11b 1Mbps	Back	1	2412	14.94	15.50	1.14	-	-	-	-
		6	2437	15.42	15.50	1.02	0.06	0.049	0.050	B1
		11	2462	14.82	15.50	1.17	-	-	-	-
	Left	6	2437	15.42	15.50	1.02	-	-	-	-
	Right	6	2437	15.42	15.50	1.02	0.04	0.041	0.042	-
	Top	6	2437	15.42	15.50	1.02	-0.02	0.032	0.033	-
	Bottom	6	2437	15.42	15.50	1.02	-	-	-	-

Note:

1. According to the above table, the initial test position for body is “Back”, and its reported SAR is≤ 0.4W/kg. Thus further SAR measurement is not required for the other (remaining) test positions. Because the reported SAR of the highest measured maximum output power channel for the exposureconfiguration is ≤ 0.8W/kg, no further SAR testing is required for 802.11b DSSS in that exposureconfiguration.
2. When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied. SAR is not required for the following 2.4 GHz OFDM conditions.
   a) When KDB Publication 447498 D01 SAR test exclusion applies to the OFDM configuration.
   b) When the highest *reported* SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg. the 802.11g/n is not required

WLAN 2.4G- Scaled Reported SAR							
Mode	Test Position	Frequency		Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
		CH	MHz				
802.11b 1Mbps	Back	6	2437	98.43%	100%	0.050	0.051
	Right	6	2437	98.43%	100%	0.042	0.042
	Top	6	2437	98.43%	100%	0.033	0.033

Note:

1. According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. A maximum transmission duty factor of 98.43% is achievable for WLAN in this project.

WLAN 5G										
Mode	Test Position	Frequency		Conducted Power (dBm)	Tune up limit (dBm)	Tune up scaling factor	Power Drift(dB)	Measured SAR(1g) (W/kg)	Report SAR(1g) (W/kg)	Test Plot
		CH	MHz							
U-NII-2A 802.11a	Back	56	5280	12.65	13.00	1.08	0.08	0.045	0.049	B2
	Left	56	5280	12.65	13.00	1.08	0.06	0.038	0.041	-
	Right	56	5280	12.65	13.00	1.08	-	-	-	-
	Top	56	5280	12.65	13.00	1.08	-0.03	0.030	0.032	-
	Bottom	56	5280	12.65	13.00	1.08	-	-	-	-
U-NII-2C 802.11a	Back	140	5700	12.51	12.60	1.02	0.17	0.042	0.043	-
	Left	140	5700	12.51	12.60	1.02	0.13	0.035	0.036	-
	Right	140	5700	12.51	12.60	1.02	-	-	-	-
	Top	140	5700	12.51	12.60	1.02	-0.05	0.028	0.028	-
	Bottom	140	5700	12.51	12.60	1.02	-	-	-	-
U-NII-3 8.2.11a	Back	157	5785	12.49	12.50	1.00	0.10	0.041	0.041	-
	Left	157	5785	12.49	12.50	1.00	0.07	0.034	0.034	-
	Right	157	5785	12.49	12.50	1.00	-	-	-	-
	Top	157	5785	12.49	12.50	1.00	-0.03	0.027	0.027	-
	Bottom	157	5785	12.49	12.50	1.00	-	-	-	-

Note:
When SAR measurement is required for 802.11 a/g/n/ac OFDM configurations, each standalone and aggregated frequency band is considered separately for SAR test reduction. When the same transmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction applies.

a) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements.If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
b) b) When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.
c)

WLAN 5G- Scaled Reported SAR							
Mode	Test Position	Frequency		Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
		CH	MHz				
U-NII-2A 802.11a	Back	56	5280	98.45%	100%	0.049	0.050
	Right	56	5280	98.45%	100%	0.041	0.041
	Top	56	5280	98.45%	100%	0.032	0.033

Note:
1. According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. A maximum transmission duty factor of 98.45% is achievable for WLAN in this project.

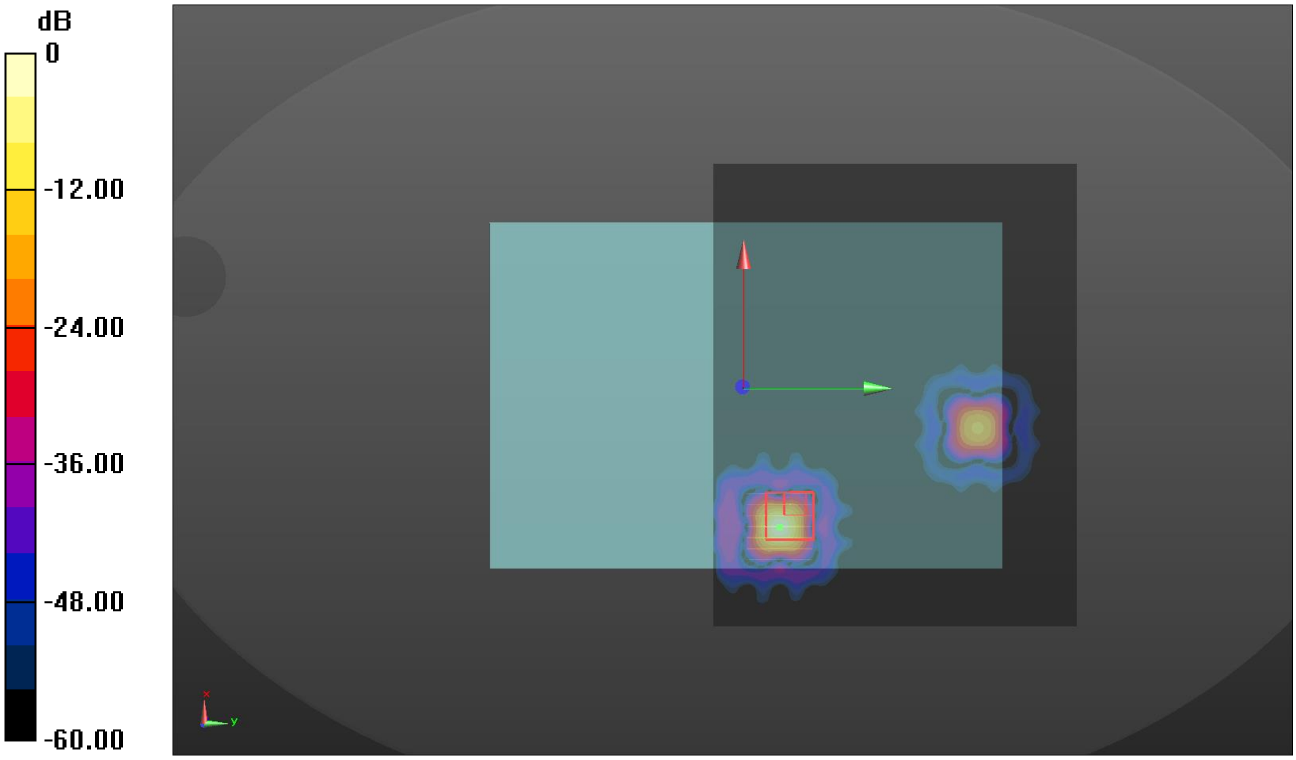
SAR Test Data Plots

Test mode:	WLAN 802.11b	Test Position:	Rear Side	Test Plot:	B1

Date:2017-12-22
Communication System: wifi; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 2.02 mho/m; ε_r = 50.719; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:
•Probe: EX3DV4 – SN3650; ConvF(7.01, 7.01, 7.01); Calibrated: 2017/7/21;
•Sensor-Surface: 1.4mm (Mechanical Surface Detection)
•Electronics: DAE4 Sn1315; Calibrated: 2017/8/15
•Phantom: ELI v4.0; Type: QDOVA001BB
•Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (141x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.179 W/kg
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.698 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.182 W/kg
SAR(1 g) = 0.049 W/kg; SAR(10 g) = 0.031 W/kg
Maximum value of SAR (measured) = 0.174 W/kg

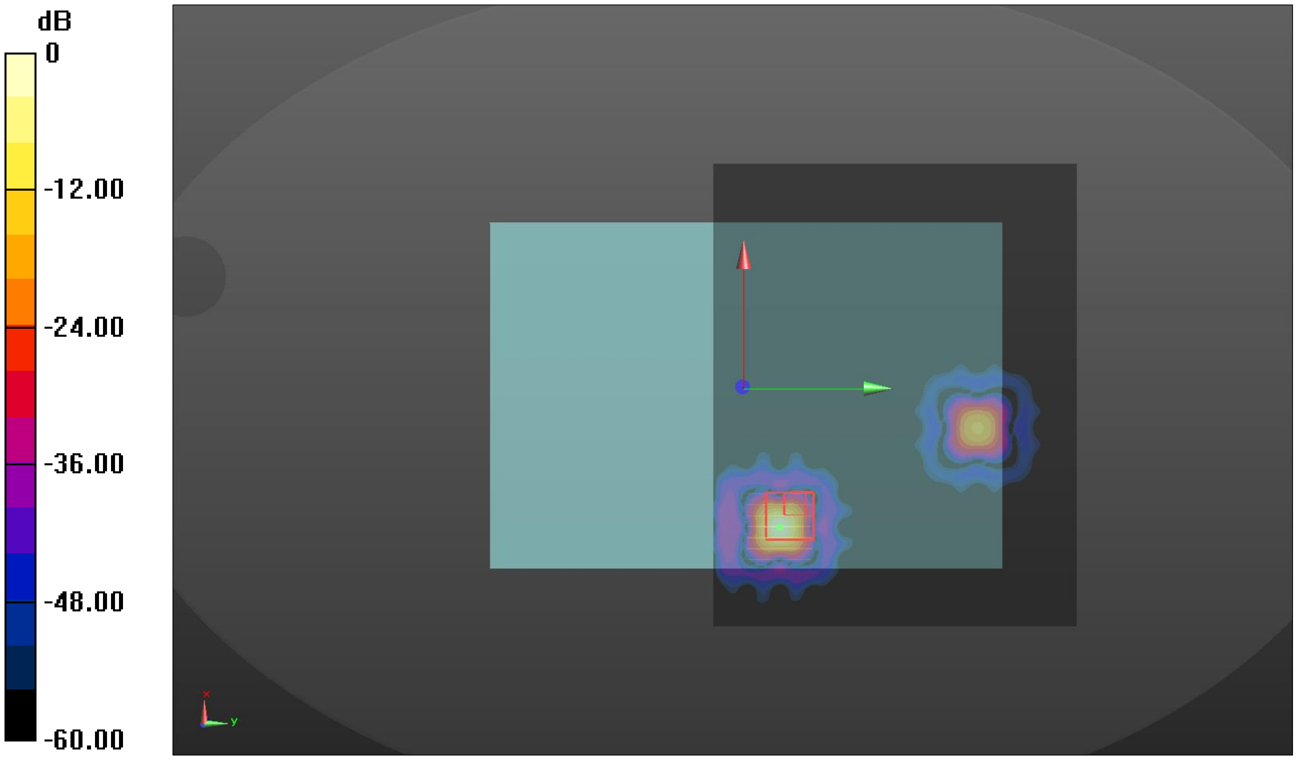


Test mode:	WLAN 802.11a	Test Position:	Rear Side	Test Plot:	B2

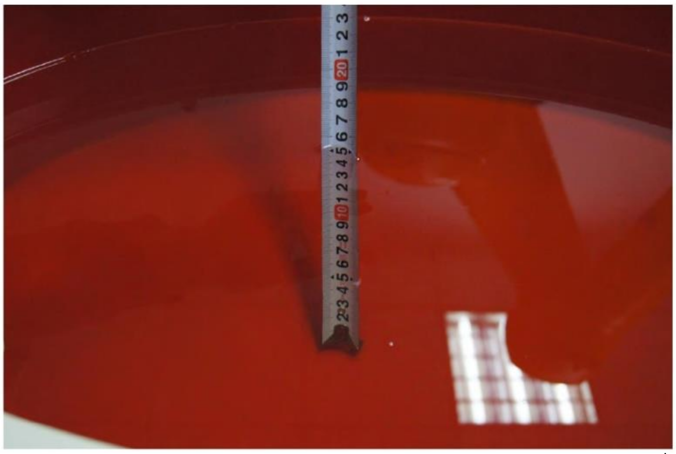
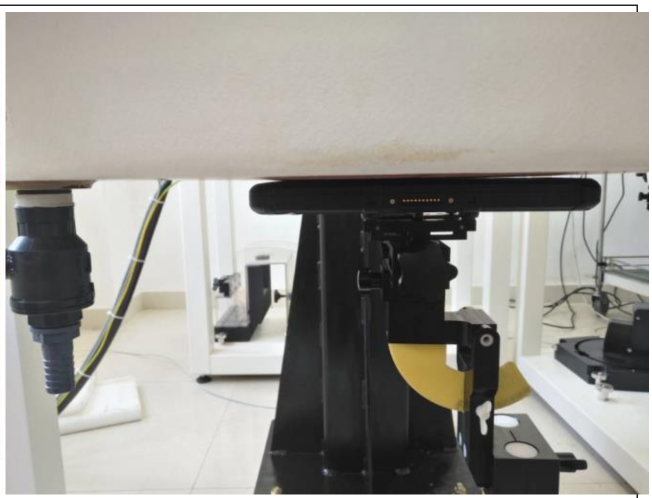
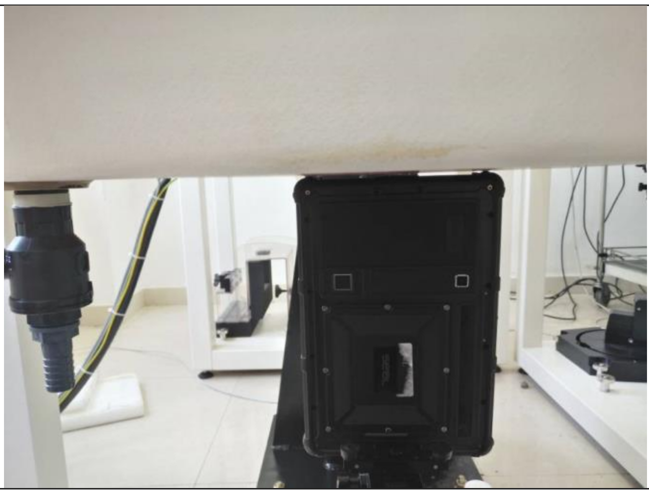
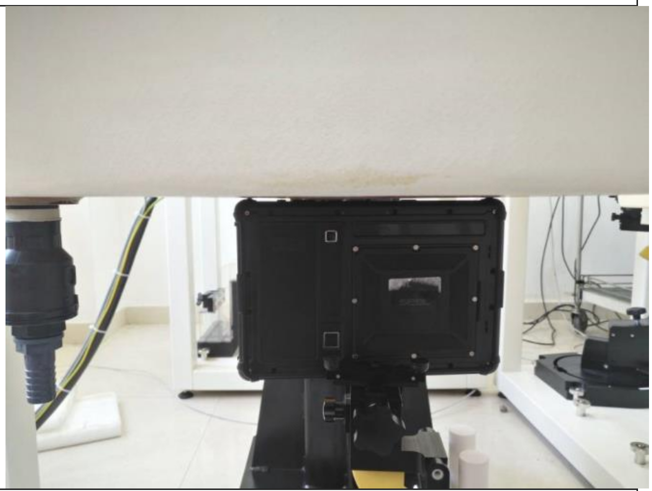
Date:2017-12-23
Communication System: wifi; Frequency: 5280 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 5280 MHz; σ = 5.51 mho/m; ε_r = 49.47; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:
•Probe: EX3DV4 – SN3650; ConvF(7.01, 7.01, 7.01); Calibrated: 2017/7/21;
•Sensor-Surface: 1.4mm (Mechanical Surface Detection)
•Electronics: DAE4 Sn1315; Calibrated: 2017/8/15
•Phantom: ELI v4.0; Type: QDOVA001BB
•Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (121x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.112 W/kg
Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 4.547 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.157 W/kg
SAR(1 g) = 0.045 W/kg; SAR(10 g) = 0.023 W/kg
Maximum value of SAR (measured) = 0.114 W/kg



15. TestSetup Photos

	
Liquid depth in the Body phantom	Rear Side (0mm)
	
Right Side (0mm)	Top Side (0mm)

16. External and Internal Photos of the EUT

Please reference to the report No.: TRE1801015401

---------End of Report----------

1.1. DAE4 Calibration Certificate

In Collaboration with s p e a g CALIBRATION LABORATORY

中国认可 国际互认 校准 CALIBRATION CNAS L0570

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

Client : CIQ(Shenzhen) Certificate No: Z17-97109

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 1315
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	August 15, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	27-Jun-17 (CTTL, No.J17X05859)	June-18

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: August 16, 2017

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

Certificate No: Z17-97109 Page 1 of 3

In Collaboration with
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CALIBRATION LABORATORY

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

Glossary:

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

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.

- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.

- The report provide only calibration results for DAE, it does not contain other performance test results.

In Collaboration with
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CALIBRATION LABORATORY

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

DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	405.175 ± 0.15% (k=2)	405.013 ± 0.15% (k=2)	404.971 ± 0.15% (k=2)
Low Range	3.99087 ± 0.7% (k=2)	3.98644 ± 0.7% (k=2)	3.98913 ± 0.7% (k=2)

Connector Angle

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

1.2. Probe Calibration Certificate

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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 **CIQ-SZ (Auden)**

Certificate No: **EX3-3650_Jul17**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3650

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: July 21, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-17 (No. 217-01911)	Apr-18
Power sensor E4412A	MY41498087	03-Apr-17 (No. 217-01911)	Apr-18
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-17 (No. 217-01915)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-17 (No. 217-01919)	Apr-18
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-17 (No. 217-01920)	Apr-18
Reference Probe ES3DV2	SN: 3013	30-Dec-16 (No. ES3-3013_Dec16)	Dec-17
DAE4	SN: 660	13-Dec-16 (No. DAE4-660_Dec16)	Dec-17
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-15)	In house check: Apr-18
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-18

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

Issued: July 21, 2017

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

Certificate No: EX3-3650_Jul17 Page 1 of 11

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3650

Manufactured: March 18, 2008
Calibrated: July 21, 2017

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3650

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.40	0.43	0.42	± 10.1 %
DCP (mV)[B]	96.9	98.8	98.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	131.1	±3.3 %
		Y	0.0	0.0	1.0		148.7	
		Z	0.0	0.0	1.0		136.9	

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3650

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	41.9	0.89	9.93	9.93	9.93	0.51	0.78	± 12.0 %
835	41.5	0.90	9.52	9.52	9.52	0.25	1.15	± 12.0 %
900	41.5	0.97	9.33	9.33	9.33	0.28	1.10	± 12.0 %
1450	40.5	1.20	8.76	8.76	8.76	0.45	0.83	± 12.0 %
1640	40.3	1.29	8.59	8.59	8.59	0.80	0.50	± 12.0 %
1750	40.1	1.37	8.10	8.10	8.10	0.75	0.57	± 12.0 %
1900	40.0	1.40	7.92	7.92	7.92	0.40	0.80	± 12.0 %
2000	40.0	1.40	7.93	7.93	7.93	0.67	0.62	± 12.0 %
2300	39.5	1.67	7.57	7.57	7.57	0.34	0.85	± 12.0 %
2450	39.2	1.80	7.18	7.18	7.18	0.49	0.74	± 12.0 %
2600	39.0	1.96	7.01	7.01	7.01	0.49	0.75	± 12.0 %
3500	37.9	2.91	7.19	7.19	7.19	0.38	1.09	± 13.1 %
5200	36.0	4.66	5.31	5.31	5.31	0.35	1.80	± 13.1 %
5300	35.9	4.76	5.10	5.10	5.10	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.85	4.85	4.85	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.77	4.77	4.77	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.86	4.86	4.86	0.40	1.80	± 13.1 %

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

EX3DV4– SN:3650 July 21, 2017

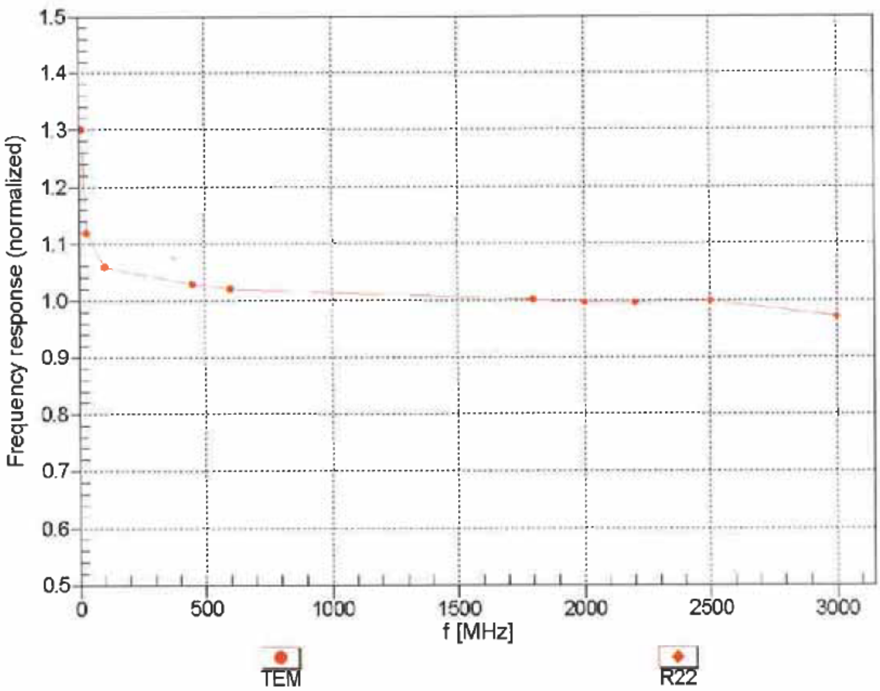
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3650

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
750	55.5	0.96	9.62	9.62	9.62	0.18	1.50	± 12.0 %
835	55.2	0.97	9.70	9.70	9.70	0.79	0.65	± 12.0 %
900	55.0	1.05	9.32	9.32	9.32	0.28	1.22	± 12.0 %
1450	54.0	1.30	8.21	8.21	8.21	0.37	0.91	± 12.0 %
1640	53.8	1.40	8.19	8.19	8.19	0.59	0.75	± 12.0 %
1750	53.4	1.49	7.78	7.78	7.78	0.40	0.96	± 12.0 %
1900	53.3	1.52	7.41	7.41	7.41	0.35	1.00	± 12.0 %
2000	53.3	1.52	7.50	7.50	7.50	0.32	0.99	± 12.0 %
2300	52.9	1.81	7.21	7.21	7.21	0.61	0.71	± 12.0 %
2450	52.7	1.95	6.81	6.81	6.81	0.68	0.50	± 12.0 %
2600	52.5	2.16	6.69	6.69	6.69	0.80	0.57	± 12.0 %
3500	51.3	3.31	6.77	6.77	6.77	0.32	1.27	± 13.1 %
5200	49.0	5.30	4.87	4.87	4.87	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.56	4.56	4.56	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.27	4.27	4.27	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.99	3.99	3.99	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.40	4.40	4.40	0.50	1.90	± 13.1 %

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

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



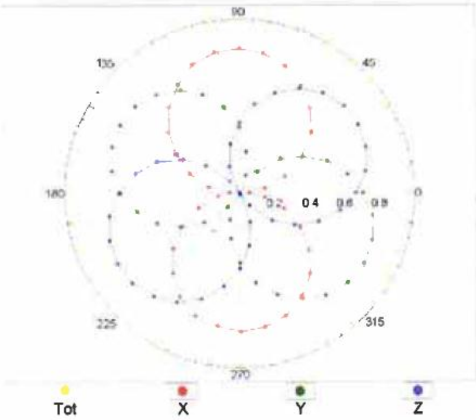
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

EX3DV4– SN:3650

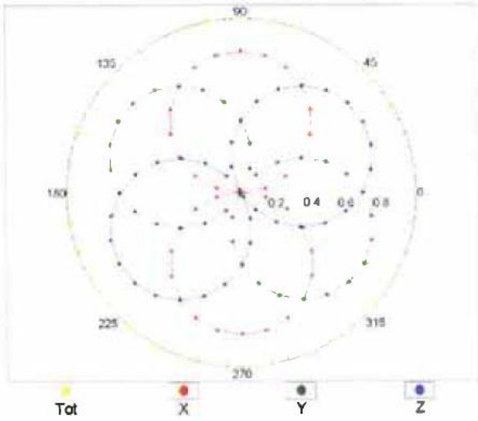
July 21, 2017

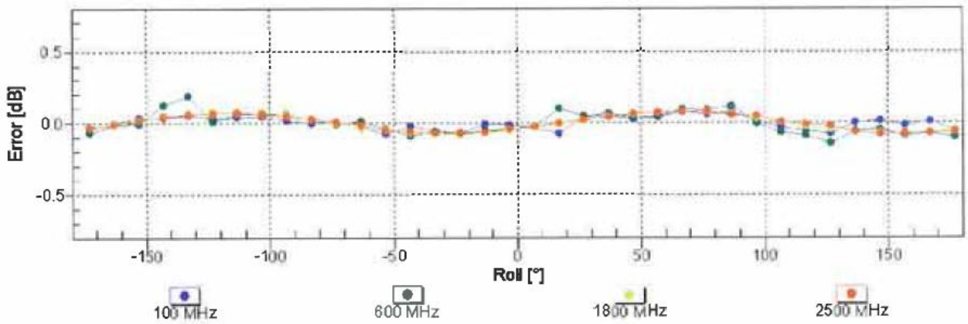
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22





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

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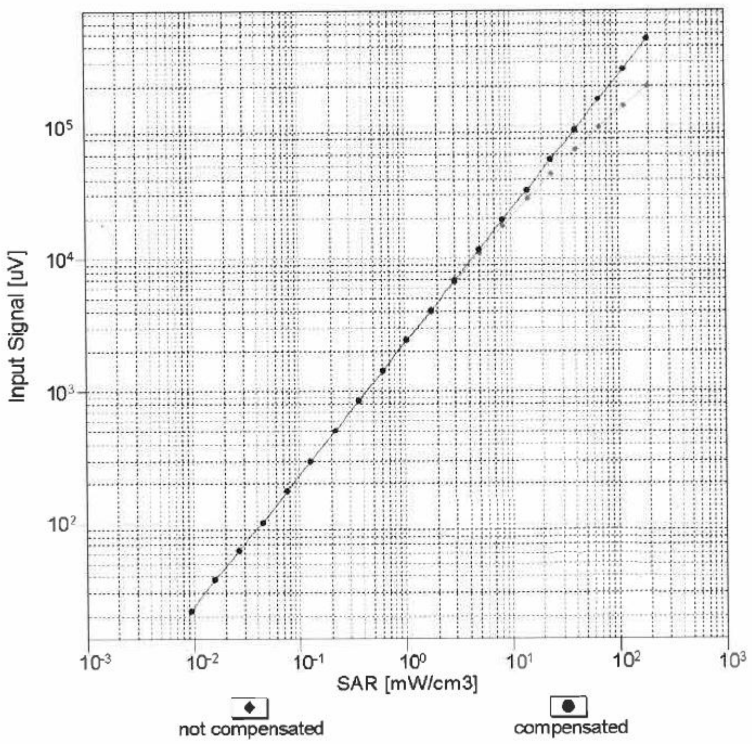
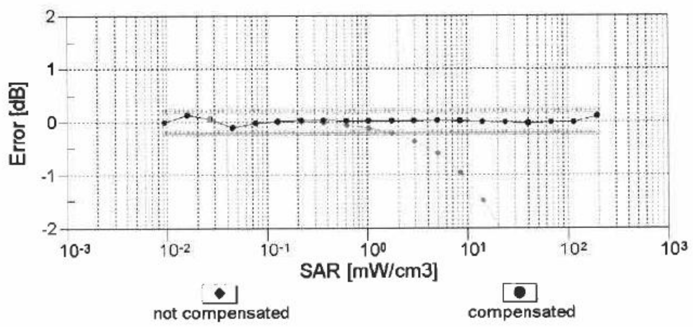
Dynamic Range f(SAR_{head})

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

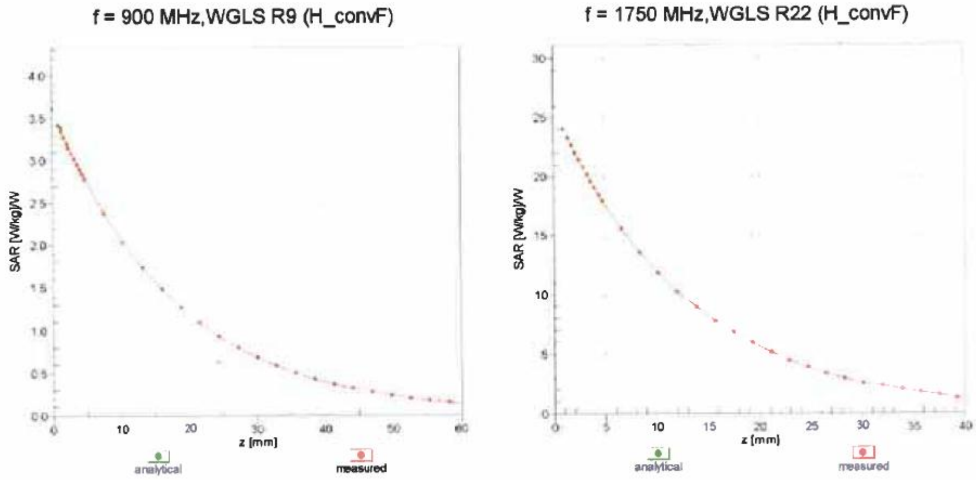




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

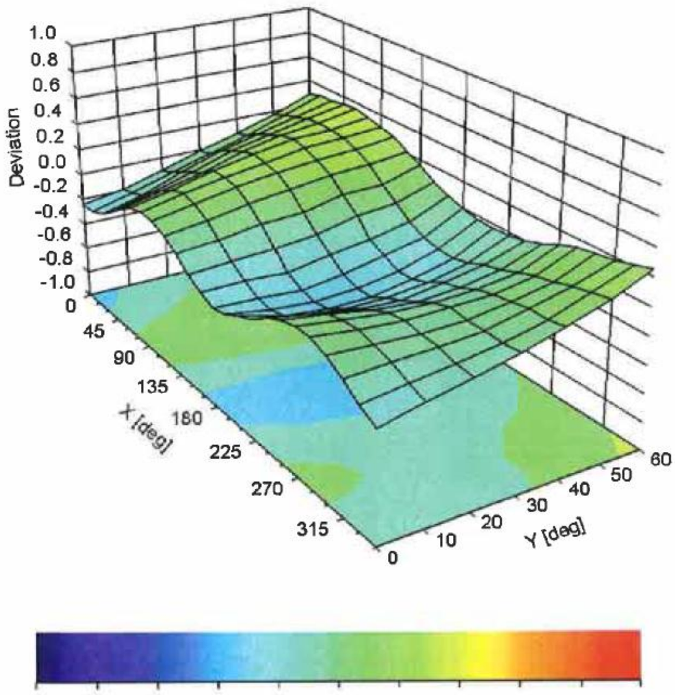
EX3DV4– SN:3650 July 21, 2017

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3650

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-23.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

1.2. D2450V2 Dipole Calibration Certificate

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中国认可
国际互认
校准
CALIBRATION
CNAS L0570

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 http://www.chinattl.cn

Client CIQ(Shenzhen) Certificate No: Z17-97210

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 884
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	October 26, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 7307	17-Mar-17(CTTL-SPEAG,No.Z17-97028)	Mar-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: October 29, 2017

Certificate No: Z17-97210 Page 1 of 8

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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, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.0.1446
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	38.9 ± 6 %	1.78 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**51.8 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.07 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.3 mW /g ± 18.7 % (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	52.3 ± 6 %	1.92 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.6 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**50.7 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.88 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**23.6 mW /g ± 18.7 % (k=2)**