TEST REPORT

Report Reference No. ....: **CTL1610310501-SAR**

Compiled by: (position+printed name+signature)	Allen Wang (File administrators)	Allen Wang
Tested by: (position+printed name+signature)	Nice Nong (Test Engineer)	Nice Nong
Approved by: (position+printed name+signature)	Tracy Qi (Manager)	Tracy Qi

Product Name...............................:	RELESS RePad R606
Model/Type reference ....:	R606
List Model(s).................................:	N/A
Trade Mark ....:	RePad
FCC ID ....:	**2AFL3-R606**
Applicant's name ....:	**Hummingbird System Inc**
Address of applicant ....:	2140 Peralta Blvd Suite 212D, Fremont, CA 94536
Authorized Lab.............................:	**Shenzhen CTL Testing Technology Co., Ltd.**
Address..:	Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055
Test specification ....:	
Standard..:	**ANSI C95.1–1999** **47CFR §2.1093** **KDB 447498**
TRF Originator ....:	Shenzhen CTL Testing Technology Co., Ltd.
Master TRF ....:	Dated 2011-01
Date of Receipt............................:	Nov. 03, 2016
Date of Test Date ....:	Nov. 05, 2016 – Nov. 06, 2016
Data of Issue................................:	Nov. 18, 2016
Result ....:	Pass

TEST REPORT

Test Report No. :	**CTL1610310501-SAR**	Nov. 18, 2016 Date of issue

Equipment under Test : RELESS RePad R606

Model /Type : R606

Listed Models : N/A

Applicant : **Hummingbird System Inc**

Address : 2140 Peralta Blvd Suite 212D, Fremont, CA 94536

Manufacturer : **Five Science and Technology Co.,LTD.**

Address : 12-13F, Block C2, Nanshan Zhiyuan, No. 1001 Xueyuan Road, Nanshan District, Shenzhen, China

Test result	**Pass ***

* In the configuration tested, the EUT complied with the standards specified page 5.

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

** Modified History **

Version	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	2016-11-18	CTL1610310501-SAR	Tracy Qi

Contents

1 SUMMARY

1.1 TEST STANDARDS

IEEE Std. C95-3 (2002): IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave
IEEE 1528-2013 (2014-06): Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

FCC Part 2.1093 Radiofrequency Radiation Exposure Evaluation: Portable Devices

KDB 447498 D01 General RF Exposure Guidance v06 (October 23, 2015): Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies
KDB447498 D03 Supplement C Cross-Reference v01 (January 17, 2014): Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB 865664D01v01r04 (August 7, 2015): SAR Measurement Requirements for 100 MHz to 6 GHz
KDB 865664D02v01r02 (October 23, 2015): RF Exposure Compliance Reporting and Documentation Considerations
KDB248227 D01 802.11 Wi-Fi SAR v02r02: SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS
KDB616217 D04 SAR for laptop and tablets v01r02 (October 23, 2015): SAR EVALUATION CONSIDERATIONS FOR LAPTOP, NOTEBOOK, NETBOOK AND TABLET COMPUTERS.

KDB648474 D04, Handset SAR v01r03: SAR Evaluation Considerations for Wireless Handsets

1.2 Summary SAR Results

The maximum of results of SAR found during testing for Tab R606 are follows:
<Highest Reported standalone SAR Summary>

Body Configuration

Frequency Band	Mode	Test Position	Channel /Frequency(MHz)	Reported SAR_{1g} (W/kg)
2.4GHz	IEEE 802.11b	Test Position 1	6/2437	**1.111**
5.2GHz	IEEE 802.11ac HT20	Test Position 1	48/5240	0.779
5.8GHz	IEEE 802.11ac HT20	Test Position 1	157/5785	0.797

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

<Highest Reported simultaneous SAR Summary>
No need consider Simultaneous Transmission as the sample only shares one antenna;

1.3 Test Facility

1.3.1 Address of the test laboratory

SHENZHEN YIDAJIETONG INFORMATION TECHNOLOGY CO., LTD
No.12 Building Shangsha, Innovation & Technology Park, Futian District, Shenzhen, P.R.China

1.3.2 Test Lab Facility

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

CNAS-Lab Code: 7547

SHENZHEN YIDA JIETONG INFORMATION TECHNOLOGY CO., LTD has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: Mar 17, 2015. Valid time is until Mar 17, 2018.

1.4 Measurement Uncertainty (300 – 6000 MHz)

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

2 GENERAL INFORMATION

2.1 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	22°C±2°C
Relative Humidity	25% - 55 %
Air Pressure	101 KPa

2.2 General Description of EUT

Product Name:	RELESS RePad R606
Model/Type reference:	R606
Power supply:	DC 3.8V from battery
Exposure category	General population / Uncontrolled environment
Device category	Portable Device
EUT Type	Production Unit
WIFI:	
Supported type:	IEEE 802.11b/IEEE 802.11g/IEEE 802.11n/IEEE 802.11ac
Modulation:	IEEE 802.11b: DSSS IEEE 802.11g/ IEEE 802.11n HT20/ IEEE 802.11ac VHT20/ IEEE 802.11ac VHT40: OFDM
Operation frequency:	IEEE 802.11b/ IEEE 802.11g/ IEEE 802.11n H20: 2412MHz~2462MHz IEEE 802.11ac VHT20:5180MHz~5240MHz/5745MHz~5825MHz IEEE 802.11ac VHT40:5190MHz~5230MHz/5755MHz~5795MHz
Channel number:	IEEE 802.11b/ IEEE 802.11g/ IEEE 802.11n H20: 11 IEEE 802.11ac VHT20: 9 IEEE 802.11ac VHT40: 4
Channel separation:	5MHz
Channel Bandwidth	20 MHz/40 MHz
Antenna type:	FPC antenna
Antenna gain:	0dBi
Bluetooth:	
Version:	Supported BT3.0
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	FPC antenna
Antenna gain:	0dBi
Bluetooth BLE	
Supported type:	Version 4.0 for low Energy
Modulation:	GFSK
Operation frequency:	2402MHz to 2480MHz
Channel number:	40
Channel separation:	2 MHz
Antenna type:	FPC antenna
Antenna gain:	0dBi

Note: For more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

2.3 Description of Test Modes

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power the EUT has been tested under typical operating condition and The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.
The Applicant provides communication tools software (AMFAN RF Test Tool) to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing.

2.4 Equipment Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Calibration	Calibration Interval
Data Acquisition Electronics DAEx	SPEAG	DAE4	1315	2016/07/26	1
E-field Probe	SPEAG	EX3DV4	3836	2016/07/07	1
System Validation Dipole D2450V2	SPEAG	D2450V2	818	2015/09/14	3
System Validation Dipole D5GHzV2	SPEAG	D5GV2	1185	2014/08/22	3
Network analyzer	Agilent	8753E	US37390562	2016/03/05	1
Dielectric Probe Kit	Agilent	85070E	US44020288	/	/
Power meter	Agilent	E4417A	GB41292254	2015/12/15	1
Power sensor	Agilent	8481H	MY41095360	2015/12/15	1
Power sensor	Agilent	8481H	MY41095361	2015/12/15	1
Signal generator	IFR	2032	203002/100	2016/10/08	1
Amplifier	AR	75A250	302205	2016/10/08	1

Note:
(1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evaluate with following criteria at least on annual interval.
a. There is no physical damage on the dipole;
b. System check with specific dipole is within 10% of calibrated values;
c. The most recent return-loss results, measured at least annually, deviates by no more than 20% from the previous measurement;
d. The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 50 Ω from the previous measurement.
(2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

2.5 SAR Measurements System

2.5.1 SAR Measurement Set-up

The DASY4 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 DASY4 measurement server.

The DASY4 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.

DASY4 software and SEMCAD data evaluation software.

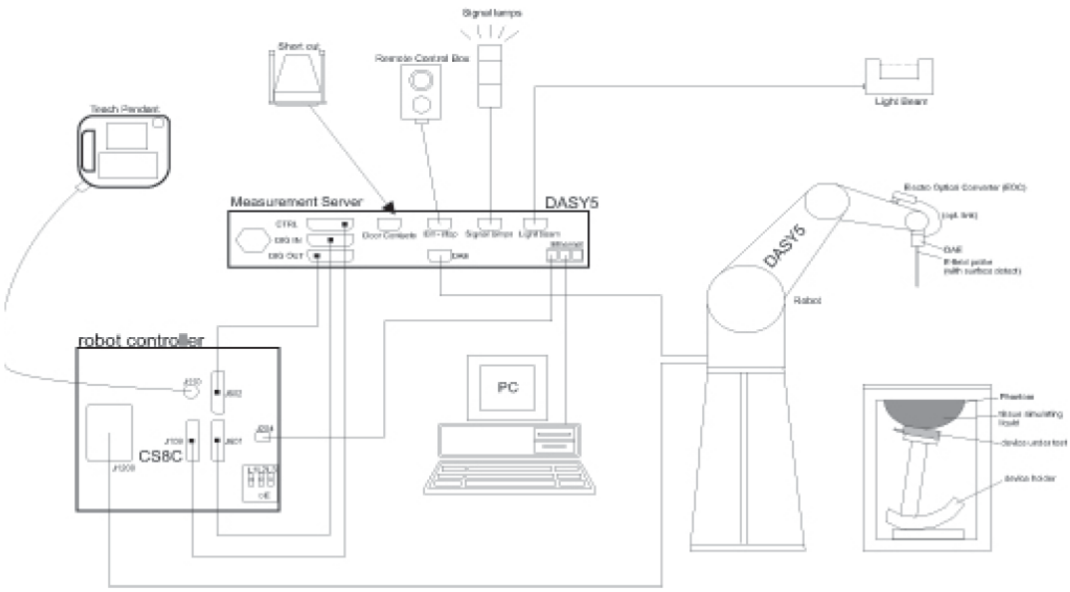
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

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.



2.5.2 DASY4 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.

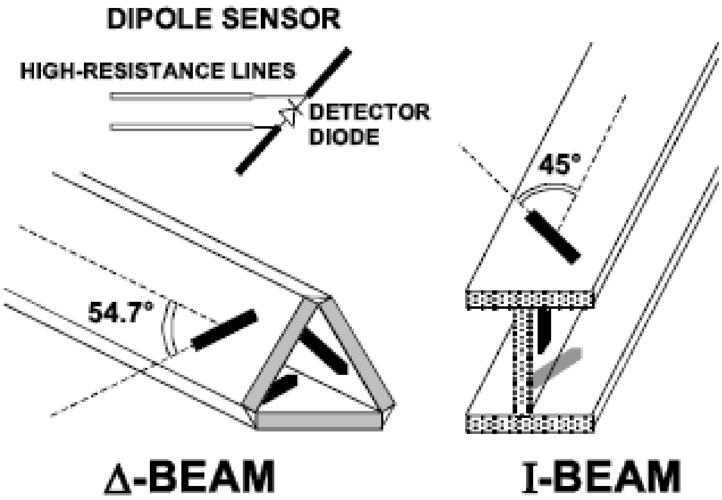
Probe Specification

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 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 μW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

Isotropic E-Field Probe

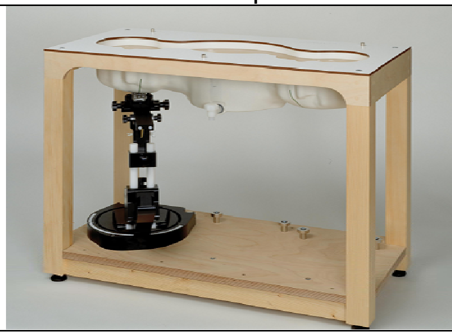
The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

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



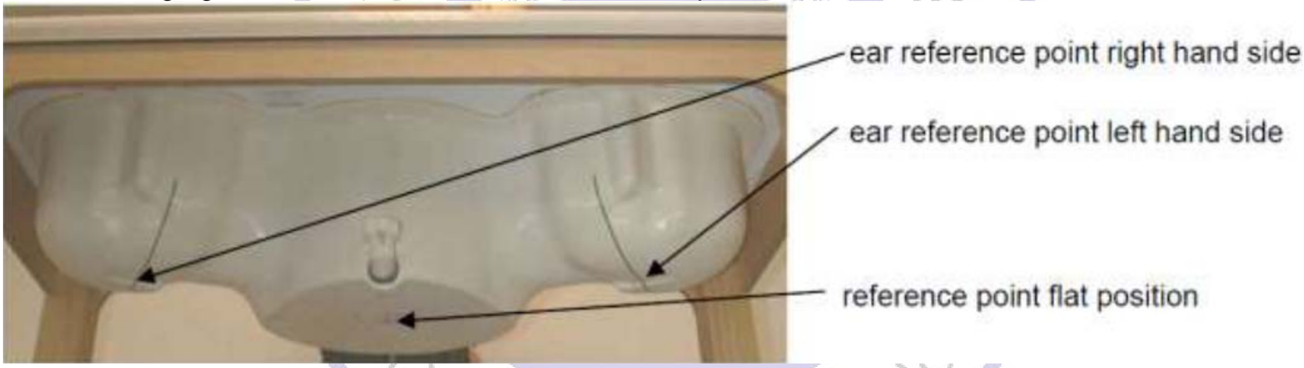
2.5.3 Phantoms

SAM Twin Phantom
The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

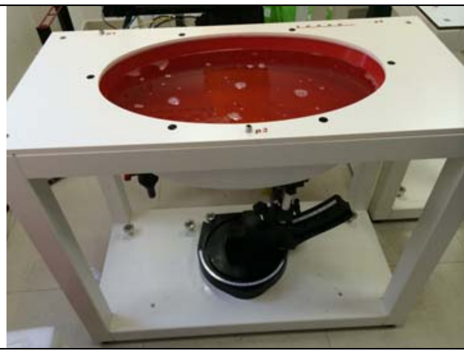
Shell Thickness	2mm +/- 0.2 mm; The ear region: 6mm	
Filling Volume	Approximately 25 liters	
Dimensions	Major axis:600mm; Minor axis:400mm;	
Measurement Areas	Left hand Right hand Flat phantom	

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 off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on top of this phantom cover are possible. Three reference marks are provided on the phantom counter. These reference marks are used to teach the absolute phantom position relative to the robot.

The following figure shows the definition of reference point:



ELI4 Phantom
Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.

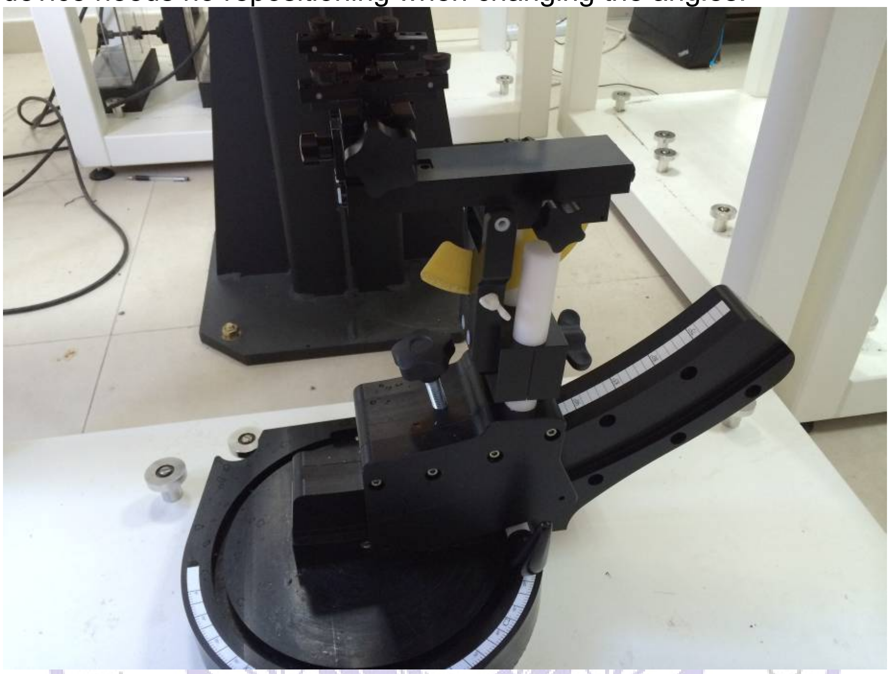
Shell Thickness	2mm +/- 0.2 mm	
Filling Volume	Approximately 30 liters	
Dimensions	Major axis:600mm; Minor axis:400mm;	
Measurement Areas	Flat phantom	

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209-2 and all known tissue simulating liquids.

The phantom shell material is resistant to all ingredients used in the tissue-equivalent liquid recipes. The shell of the phantom including ear spacers is constructed from low permittivity and low loss material, with a relative permittivity ≤5 and a loss tangent ≤0.05.

2.5.4 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 are the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder supplied by SPEAG

2.5.5 Scanning Procedure

The DASY4 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°.)
According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:
(a) Power reference measurement
(b) Area scans
(c) Zoom scan
(d) Power drift measurement

Power Reference Measurement
The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.
Area Scan
The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.
Area scan parameters extracted from FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz.

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

Zoom Scan
Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within

a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><td></td><td></td><td></td><td>≤ 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>½· δ ·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>30º± 1º</td><td>20º± 1º</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 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 ≤ 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>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 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>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 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>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5· $\Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 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 reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 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>

Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.
The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:
(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

2.5.6 Data Storage and Evaluation

Data Storage
The DASY4 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

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

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

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

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY4 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:

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

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

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

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

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

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (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 priMayy field data are used to calculate the derived field units.

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

with SAR = local specific absorption rate in mW/g
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.

3 Position of the wireless device in relation to the phantom

3.1 Body Configuration

The overall diagonal dimension of the display section of a tablet is 23.2 cm > 20 cm, Per FCC KDB 616217 Tablet host platform test requirements, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. Exposures from antennas through the front (top) surface of the display section of a full-size tablet, away from the edges, are generally limited to the user’s hands. Exposures to hands for typical consumer transmitters used in tablets are not expected to exceed the extremity SAR limit; therefore, SAR evaluation for the front surface of tablet display screens are generally not necessary, except for tablets that are designed to require continuous operations with the hand(s) next to the antenna(s).
Per KDB 648474 SAR Evaluation Considerations for Wireless Handsets, when the over diagonal dimension of the device is > 20.0 cm. Hotspot mode SAR is not required when normal tablet procedures are applied. Extremity 10-g SAR is also not required for the front (top) surface of large form factor full size tablets. The more conservative tablet SAR results can be used to support the 10-g extremity SAR for phablet mode.

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

4 Measurement Procedures

The measurement procedures are as follows:

4.1 Conducted power measurement

a. For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously Transmission, at maximum RF power in each supported wireless interface and frequency band.
b. Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power.

4.2 SAR measurement

4.2.1 WIFI Test Configuration

The SAR measurement and test reduction procedures are structured according to either the DSSS or OFDM transmission mode configurations used in each standalone frequency band and aggregated band. For devices that operate in exposure configurations that require multiple test positions, additional SAR test reduction may be applied. The maximum output power specified for production units, including tune-up tolerance, are used to determine initial SAR test requirements for the 802.11 transmission modes in a frequency band. SAR is measured using the highest measured maximum output power channel for the initial test configuration. SAR measurement and test reduction for the remaining 802.11 modes and test channels are determined according to measured or specified maximum output power and reported SAR of the initial measurements. The general test reduction and SAR measurement approaches are summarized in the following:
1. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures. Channels with measured maximum output power within ¼ dB are considered to have the same maximum output.
2. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, an “initial test configuration” is first determined for each standalone and aggregated frequency band according to the maximum output power and tune-up tolerance specified for production units.
a. When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band.
b. SAR is measured for OFDM configurations using the initial test configuration procedures. Additional frequency band specific SAR test reduction may be considered for individual frequency bands
c. Depending on the reported SAR of the highest maximum output power channel tested in the initial test configuration, SAR test reduction may apply to subsequent highest output channels in the initial test configuration to reduce the number of SAR measurements.
3. The Initial test configuration does not apply to DSSS. The 2.4 GHz band SAR test requirements and 802.11b DSSS procedures are used to establish the transmission configurations required for SAR measurement.
4. An “initial test position “is applied to further reduce the number of SAR tests for devices operating in next to the ear, UMPC mini-tablet or hotspot mode exposure configurations that require multiple test positions.
a. SAR is measured for 802.11b according to the 2.4 GHz DSSS procedure using the exposure condition established by the initial test position.
b. SAR is measured for 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration. 802.11b/g/n operating modes are tested independently according to the service requirements in each frequency band. 802.11b/g/n modes are tested on the maximum average output channel.
5. The Initial test position does not apply to devices that require a fixed exposure test position. SAR is measured in a fixed exposure test position for these devices in 802.11b according to the 2.4 GHz DSSS procedure or in 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration procedures.
6. The “subsequent test configuration “procedures are applied to determine if additional SAR measurements are required for the remaining OFDM transmission modes that have not been tested in the initial test configuration. SAR test exclusion is determined according to reported SAR in the initial

test configuration and maximum output power specified or measured for these other OFDM configurations.

2.4 GHz SAR Procedures

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

1. 802.11b DSSS SAR Test Requirements

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

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

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

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

a. When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration
b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

2. SAR Test Requirements for OFDM Configurations

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

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

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

a. The largest channel bandwidth configuration is selected among the multiple configurations with the same specified maximum output power.
b. If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
c. If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.
d. When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n.

After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following. These channel selection procedures apply to both the initial test configuration and subsequent test configuration(s), with respect to the default power measurement procedures or additional power measurements required for further SAR test reduction. The same procedures also apply to subsequent highest output power channel(s) selection.

a. Channels with measured maximum output power within ¼ dB of each other are considered to have the same maximum output.
b. When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement.
c. When there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

4. Initial Test Configuration Procedures

An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. SAR is measured using the highest measured maximum output power channel. For configurations with the same specified or measured maximum output power, additional transmission mode and test channel selection procedures are required (see section 5.3.2). SAR test reduction of subsequent highest output test channels is based on the reported SAR of the initial test configuration.
For next to the ear, hotspot mode and UMC mini-tablet exposure configurations where multiple test positions are required, the initial test position procedure is applied to minimize the number of test positions required for SAR measurement using the initial test configuration transmission mode.[23] For fixed exposure conditions that do not have multiple SAR test positions, SAR is measured in the transmission mode determined by the initial test configuration. When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

5. Subsequent Test Configuration Procedures

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

a. When SAR test exclusion provisions of KDB Publication 447498 are applicable and SAR measurement is not required for the initial test configuration, SAR is also not required for the next highest maximum output power transmission mode subsequent test configuration(s) in that frequency band or aggregated band and exposure configuration.
b. When the highest reported SAR for the initial test configuration (when applicable, include subsequent highest output channels), according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.
c. The number of channels in the initial test configuration and subsequent test configuration can be different due to differences in channel bandwidth. When SAR measurement is required for a subsequent test configuration and the channel bandwidth is smaller than that in the initial test configuration, all channels in the subsequent test configuration that overlap with the larger bandwidth channel tested in the initial test configuration should be used to determine the highest maximum output power channel. This step requires additional power measurement to identify the highest maximum output power channel in the subsequent test configuration to determine SAR test reduction.
   1). SAR should first be measured for the channel with highest measured output power in the subsequent test configuration.
   2). SAR for subsequent highest measured maximum output power channels in the subsequent test configuration is required only when the reported SAR of the preceding higher maximum output power channel(s) in the subsequent test configuration is > 1.2 W/kg or until all required channels

are tested.

a) For channels with the same measured maximum output power, SAR should be measured using the channel closest to the center frequency of the larger channel bandwidth channel in the initial test configuration.

d. SAR measurements for the remaining highest specified maximum output power OFDM transmission mode configurations that have not been tested in the initial test configuration (highest maximum output) or subsequent test configuration(s) (subsequent next highest maximum output power) is determined by applying the subsequent test configuration procedures in this section to the remaining configurations according to the following:

1) replace “subsequent test configuration” with “next subsequent test configuration” (i.e., subsequent next highest specified maximum output power configuration)
2) replace “initial test configuration” with “all tested higher output power configurations”

4.3 Power Drift

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

4.4 Power Reduction

The product without any power reduction.

5 TISSUE SIMULATING LIQUID

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15cm. For head SAR testing the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15cm For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15cm.The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in 5.2

5.1 The composition of the tissue simulating liquid

Ingredient	2450MHz		5200MHz		5800MHz	
(% Weight)	Head	Body	Head	Body	Head	Body
Water	62.7	73.2	65.53	72.60	65.53	72.60
Salt	0.50	0.10	0.00	0.00	0.00	0.00
Sugar	0.00	0.00	0.00	0.00	0.00	0.00
Triton X-100	0.00	0.00	17.23	0.10	17.23	0.10
Preventol	0.00	0.00	0.00	0.00	0.00	0.00
HEC	0.00	0.00	0.00	0.00	0.00	0.00
Diethylenglycol monohexylether	0.00	0.00	17.24	27.30	17.24	27.30
Glycol	36.8	26.7	0.00	0.00	0.00	0.00

5.2 Tissue Calibration Result

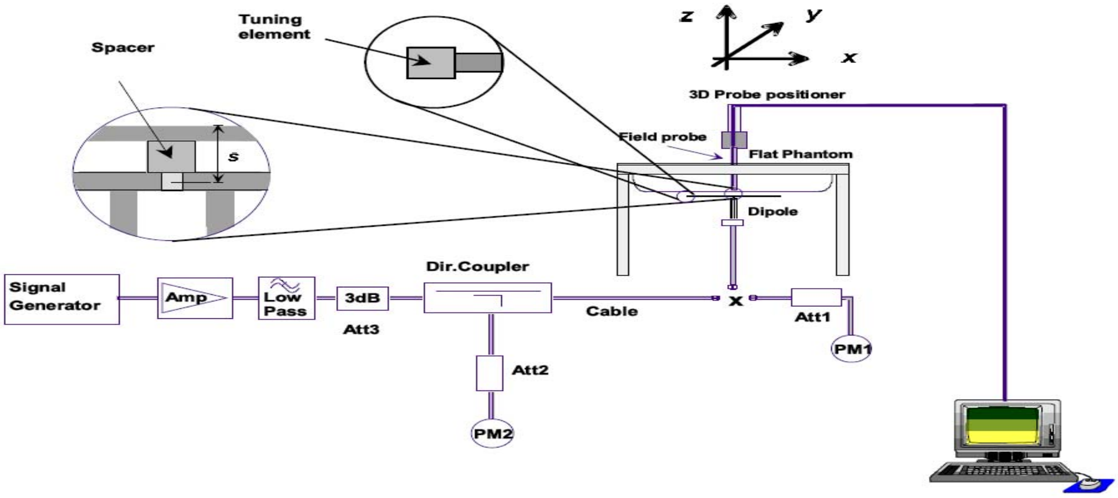
The dielectric parameters of the liquids were verified prior to the SAR evaluation using Agilent Dielectric Probe Kit and Agilent Network Analyzer 8753E.

Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp. (degree)	Test Data
		ε_r	σ	ε_r	Dev. %	σ	Dev. %		
2450B	2450	52.7	1.95	53.50	1.52%	1.96	0.51%	22.2	2016-11-05
5200B	5200	49.0	5.30	50.10	2.24%	5.33	0.57%	22.2	2016-11-06
5800B	5800	48.2	6.00	49.80	3.32%	6.07	1.17%	22.2	2016-11-06

6 System Check

The purpose of the system check is to verify that the system operates within its specifications at the device test frequency. The system check is 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.



The output power on dipole port must be calibrated to 20 dBm (100mW) before dipole is connected.

Justification for Extended SAR Dipole Calibrations
Referring to KDB 865664D01V01r04, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended. While calibration intervals not exceed 3 years.

D2450V2, Serial No.: 818 Extend Dipole Calibrations

5.2GHz Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-09-14	-26.40		52.00		4.41	
2016-08-22	-26.80	-1.515%	52.564	0.564	4.678	0.268
5.2GHz Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-09-14	-26.40		49.40		4.75	
2016-08-22	-27.10	-2.652%	50.316	0.916	4.866	0.116

D5GHzV2, Serial No.: 1185 Extend Dipole Calibrations

5.2GHz Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2014-08-22	-22.300		48.800		-7.500	
2015-08-24	-21.870	1.928%	50.200	1.400	-6.1187	1.3813
2016-08-22	-23.168	3.892%	51.424	2.624	-6.889	0.611
5.2GHz Body						
Date of	Return-Loss	Delta	Real	Delta	Imaginary	Delta

Measurement	(dB)	(%)	Impedance (ohm)	(ohm)	Impedance (ohm)	(ohm)
2014-08-22	-23.700		49.000		-6.400	
2015-08-24	-23.022	2.861%	49.794	0.794	-9.9234	-3.5234
2016-08-22	-24.588	3.747%	50.615	1.615	-8.666	-2.266
5.8GHz Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2014-08-22	-29.300		55.900		0.6	
2015-08-24	-29.646	-1.181%	52.365	-3.535	-0.33877	-0.93877
2016-08-22	-29.974	-2.300%	54.004	-1.891	-0.5113	-0.0887
5.8GHz Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2014-08-22	-23.400		56.900		2.2000	
2015-08-24	-28.000	-19.66%	52.532	-4.368	2.9515	0.7515
2016-08-22	-26.611	-13.722%	54.878	-2.022	2.7170	0.5170

System Check in Body Tissue Simulating Liquid

Freq	**Test Date**	**Dielectric Parameters**		**Temp**	**100mW Measured**	**1W Normalized**	**1W Target**	**Limit (±10% Deviation)**
		ε_r	σ(s/m)		SAR_{1g}	SAR_{1g}	SAR_{1g}	SAR_{1g}
2450 MHz	2016-11-05	53.5	1.96	22.2	5.06	50.60	51.1	-0.98%
5200 MHz	2016-11-05	50.1	5.33	22.2	7.22	72.20	75.7	-4.62%
5800 MHz	2016-11-05	49.8	6.07	22.2	7.48	74.80	76.8	-2.60%

7 TEST CONDITIONS AND RESULTS

7.1 Conducted Power Results

According KDB 447498 D01 General RF Exposure Guidance v06 Section 4.1 2) states that “Unless it is specified differently in the published RF exposure KDB procedures, these requirements also apply to test reduction and test exclusion considerations. Time-averaged maximum conducted output power applies to SAR and, as required by § 2.1091(c), time-averaged ERP applies to MPE. When an antenna port is not available on the device to support conducted power measurement, such as FRS and certain Part 15 transmitters with built-in integral antennas, the maximum output power allowed for production units should be used to determine RF exposure test exclusion and compliance.”

<WLAN 2.4GHz Conducted Power>

Mode	Channel	Frequency (MHz)	Data rate (Mbps)	Average Output Power (dBm)
IEEE 802.11b	1	2412	1	16.23
			2	16.11
			5.5	16.06
			11	16.01
	6	2437	1	16.38
			2	16.25
			5.5	16.17
			11	16.08
	11	2462	1	16.30
			2	16.22
			5.5	16.15
			11	16.09
IEEE 802.11g	1	2412	6	15.03
			9	14.98
			12	14.94
			18	14.92
			24	14.89
			36	14.83
			48	14.81
			54	14.76
	6	2437	6	15.16
			9	15.12
			12	15.10
			18	15.08
			24	15.06
			36	15.02
			48	14.97
			54	14.95
	11	2462	6	15.04
			9	15.00
			12	14.98
			18	14.95
			24	14.91
			36	14.88
			48	14.85
			54	14.80
IEEE 802.11n HT20	1	2412	MCS0	13.87
			MCS1	13.86
			MCS2	13.86
			MCS3	13.82
			MCS4	13.80
			MCS5	13.75
			MCS6	13.75

			MCS7	13.72
	6	2437	MCS0	14.03
			MCS1	14.01
			MCS2	14.00
			MCS3	13.97
			MCS4	13.93
			MCS5	13.93
			MCS6	13.91
			MCS7	13.90
	11	2462	MCS0	13.87
			MCS1	13.84
			MCS2	13.81
			MCS3	13.79
			MCS4	13.75
			MCS5	13.75
			MCS6	13.72
			MCS7	13.71

<WLAN 5GHz Conducted Power>

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)							
			Data rate (Mbps)							
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
IEEE 802.11ac VHT20	36	5180	13.58	13.56	13.56	13.53	13.51	13.48	13.46	13.46
	40	5200	13.26	13.25	13.25	13.22	13.21	13.19	13.17	13.17
	44	5220	14.02	14.00	13.97	13.95	13.94	13.91	13.89	13.86
	48	5240	14.98	14.97	14.97	14.95	14.94	14.91	14.90	14.88
	149	5745	12.54	12.54	12.53	12.50	12.48	12.48	12.44	12.41
	153	5765	12.62	12.61	12.60	12.58	12.57	12.55	12.53	12.53
	157	5785	12.89	12.84	12.84	12.82	12.81	12.81	12.81	12.77
	161	5805	12.72	12.71	12.69	12.67	12.67	12.63	12.63	12.62
	165	5825	12.63	12.63	12.63	12.60	12.57	12.58	12.54	12.54
IEEE 802.11ac VHT40	38	5190	12.15	12.13	12.13	12.11	12.10	12.10	12.08	12.06
	46	5230	12.41	12.41	12.38	12.38	12.35	12.33	12.32	12.19
	151	5755	12.32	12.30	12.30	12.27	12.27	12.26	12.23	12.23
	159	5795	12.29	12.27	12.26	12.24	12.24	12.21	12.20	12.20

<Bluetooth Conducted Power>

Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
BLE-GFSK	0	2402	0.55
	19	2440	1.26
	39	2480	1.22
GFSK	0	2402	5.22
	39	2441	6.85
	78	2480	6.18
π/4DQPSK	0	2402	4.78
	39	2441	5.44
	78	2480	5.06
8DPSK	0	2402	4.71
	39	2441	5.96
	78	2480	4.82

7.2 Manufacturing tolerance

2.4GHzWLAN

IEEE 802.11b (Average)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	16.0	16.0	16.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11g (Average)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	15.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	13.0	14.0	13.0
Tolerance ±(dB)	1.0	1.0	1.0

<5GHzWLAN Band 1>

IEEE 802.11ac VHT20 (Average)				
Frequency (MHz)	5180	5200	5220	5240
Target (dBm)	13.0	13.0	14.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0

IEEE 802.11ac VHT40 (Average)		
Frequency (MHz)	5190	5230
Target (dBm)	12.0	12.0
Tolerance ±(dB)	1.0	1.0

<5GHzWLAN Band 3>

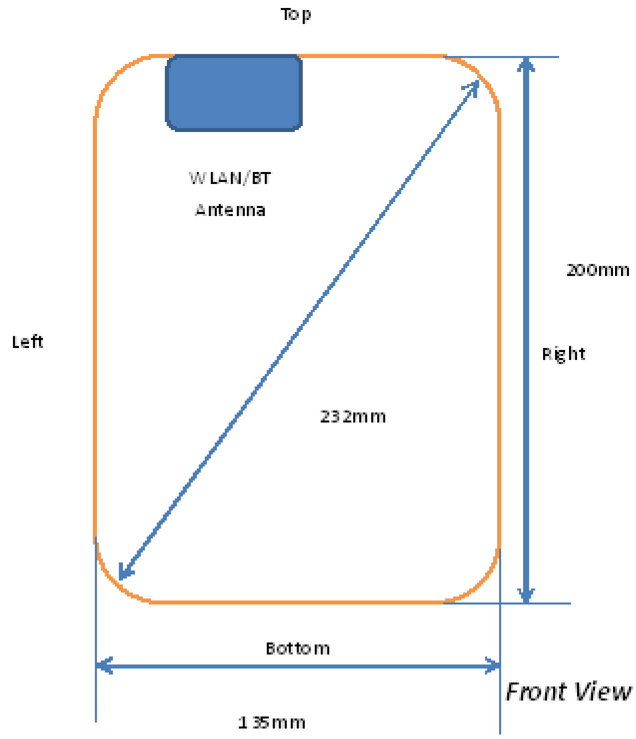
IEEE 802.11ac VHT20 (Average)					
Frequency (MHz)	5745	5765	5785	5805	5825
Target (dBm)	12.0	12.0	12.0	12.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0

IEEE 802.11ac VHT40 (Average)		
Frequency (MHz)	5755	5795
Target (dBm)	12.0	12.0
Tolerance ±(dB)	1.0	1.0

Bluetooth

BLE-GFSK (Average)			
Frequency (MHz)	2402	2440	2480
Target (dBm)	1.0	1.0	1.0
Tolerance ±(dB)	1.0	1.0	1.0
GFSK (Average)			
Frequency (MHz)	2402	2441	2480
Target (dBm)	6.0	6.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0
8DPSK (Average)			
Frequency (MHz)	2402	2441	2480
Target (dBm)	5.0	5.0	5.0
Tolerance ±(dB)	1.0	1.0	1.0
π/4DQPSK (Average)			
Frequency (MHz)	2402	2441	2480
Target (dBm)	5.0	5.0	5.0
Tolerance ±(dB)	1.0	1.0	1.0

7.3 Transmit Antennas Position



Antenna information:

WLAN/GPS/BT	WLAN/BT TX/RX Antenna

Distance of The Antenna to the EUT surface and edge						
Antennas	**Front**	**Back**	**Top Side**	**Bottom Side**	**Left Side**	**Right Side**
BT/WLAN	<5mm	<5mm	<5mm	177mm	18mm	85mm

7.4 Standalone SAR Test Exclusion Considerations

Per KDB447498 for standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.
The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

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 (also illustrated in Appendix B):[32]

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

Standalone SAR test exclusion considerations							
Modulation	Frequency (MHz)	Configuration	Maximum Average Power (dBm)	Separation Distance (mm)	Calculation Result	SAR Exclusion Thresholds	Standalone SAR Exclusion
IEEE 802.11b	2450	Test Position 1	17.00	5	15.6	3.0	no
		Test Position 2	17.00	18	4.3	3.0	no
		Test Position 3	17.00	85	17.00dBm	26.49dBm	yes
		Test Position 4	17.00	5	15.6	3.0	no
		Test Position 5	17.00	177	17.00dBm	31.35dBm	yes
IEEE 802.11g	2450	Test Position 1	16.00	5	12.4	3.0	no
		Test Position 2	16.00	18	3.5	3.0	no
		Test Position 3	16.00	85	16.00dBm	26.49dBm	yes
		Test Position 4	16.00	5	12.4	3.0	no
		Test Position 5	16.00	177	16.00dBm	31.35dBm	yes
IEEE 802.11n HT20	2450	Test Position 1	15.00	5	9.8	3.0	no
		Test Position 2	15.00	18	2.7	3.0	yes
		Test Position 3	15.00	85	15.00dBm	26.49dBm	yes
		Test Position 4	15.00	5	9.8	3.0	no
		Test Position 5	15.00	177	15.00dBm	31.35dBm	yes
IEEE 802.11ac VHT20	5250	Test Position 1	15.00	5	14.4	3.0	no
		Test Position 2	15.00	18	4.0	3.0	no
		Test Position 3	15.00	85	15.00dBm	26.19dBm	yes
		Test Position 4	15.00	5	14.4	3.0	no
		Test Position 5	15.00	177	15.00dBm	31.26dBm	yes
	5850	Test Position 1	13.00	5	12.2	3.0	no
		Test Position 2	13.00	18	3.4	3.0	no
		Test Position 3	13.00	85	15.00dBm	26.15dBm	yes
		Test Position 4	13.00	5	12.2	3.0	no
		Test Position 5	13.00	177	15.00dBm	31.24dBm	yes
IEEE 802.11ac VHT40	5250	Test Position 1	13.00	5	9.1	3.0	no
		Test Position 2	13.00	18	2.5	3.0	yes
		Test Position 3	13.00	85	13.00dBm	26.19dBm	yes
		Test Position 4	13.00	5	9.1	3.0	no
		Test Position 5	13.00	177	13.00dBm	31.26dBm	yes
	5850	Test Position 1	13.00	5	9.6	3.0	no
		Test Position 2	13.00	18	2.7	3.0	yes
		Test Position 3	13.00	85	13.00dBm	26.15dBm	yes
		Test Position 4	13.00	5	9.6	3.0	no
		Test Position 5	13.00	177	13.00dBm	31.24dBm	yes
Bluetooth*	2450	Test Position 1	7.00	5	1.6	3.0	yes
		Test Position 2	7.00	18	0.4	3.0	yes
		Test Position 3	7.00	85	7.00dBm	26.49dBm	yes
		Test Position 4	7.00	5	1.6	3.0	yes
		Test Position 5	7.00	177	7.00dBm	31.35dBm	yes

Remark:
1. *Maximum average power including tune-up tolerance;*
2. *Bluetooth including BLE-Lower Energy Bluetooth and Classical Bluetooth;*
3. *When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion*
4. *Per KDB 648474, if overall diagonal dimension of the display section of a tablet lager than 20 cm, no need consider Hotspot mode.*

7.5 Standalone Estimated SAR

Per KDB447498 requires when the standalone SAR test exclusion of section 4.3.1 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion;
● (max. power of channel, including tune-up tolerance, mW)/ (min. test separation distance, mm)]·[$\sqrt{f(GHz)}$/x] W/kg for test separation distances ≤ 50 mm;
Where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
● 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm

Per FCC KD B447498 D01, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for the entire transmitting antenna in a specific a physical test configuration is ≤1.6 W/Kg. When the sum is greater than the SAR limit, AR test exclusion is determined by the SAR to peak location separation ratio.

$$\text{Ratio}=\frac{(SAR_1+SAR_2)^{1.5}}{(\text{peak location separation,mm})}<0.04$$

Estimated Standalone SAR					
Communication system	Frequency (MHz)	Configuration	Maximum Power (dBm)	Separation Distance (mm)	Estimated SAR_{1-g} (W/kg)
Bluetooth*	2450	Test Position 1	7.00	5.00	0.208
	2450	Test Position 2	7.00	18.00	0.058
	2450	Test Position 4	7.00	5.00	0.208

Remark:
1. Maximum average power including tune-up tolerance;
2. Bluetooth including BLE-Lower Energy Bluetooth and Classical Bluetooth;
3. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

7.6 Standalone SAR Measurement Results

The calculated SAR is obtained by the following formula:

Reported SAR=Measured SAR*$10^{(Ptarget-Pmeasured))/10}$
Scaling factor=$10^{(Ptarget-Pmeasured))/10}$
Reported SAR= Measured SAR* Scaling factor

Where P_{target} is the power of manufacturing upper limit;
$P_{measured}$ is the measured power;
Measured SAR is measured SAR at measured power which including power drift)
Reported SAR which including Power Drift and Scaling factor

Duty Cycle

Test Mode	Duty Cycle
2.4GWLAN	1:1
5GWLAN	1:1

Table 5: SAR Values [2.4GWLAN IEEE 802.11b/g/n]

Ch.	Freq. (MHz)	Service	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Power drift	Scaling Factor	SAR_{1-g} results(W/Kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers – Body (distance 0mm)										
6	2437	DSSS	Test Position 1	17.00	16.38	-0.11	1.153	**0.964**	**1.111**	1
1	2412	DSSS		17.00	16.23	-0.10	1.194	0.912	1.089	
11	2462	DSSS		17.00	16.30	-0.01	1.175	0.884	1.039	
6	2437	DSSS	Test Position 4	17.00	16.38	-0.04	1.153	0.892	1.028	
1	2412	DSSS		17.00	16.23	0.12	1.194	0.844	1.008	
11	2462	DSSS		17.00	16.30	-0.06	1.175	0.835	0.981	
6	2437	DSSS	Test Position 2	17.00	16.38	-0.08	1.153	0.231	0.266	

Remark:
1. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
2. SAR is not required for the following 2.4 GHz OFDM conditions as the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is 0.885 [1.111(39.81/50.12)] ≤ 1.2 W/kg.*

Table 6: SAR Values [5GWLAN Band 1 IEEE 802.11ac VHT20]

Ch.	Freq. (MHz)	Service	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Power drift	Scaling Factor	SAR_{1-g} results(W/Kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers – Body										
48	5240	OFDM	Test Position 1	15.00	14.98	-0.01	1.005	**0.775**	**0.779**	2
48	5240	OFDM	Test Position 4	15.00	14.98	0.05	1.005	0.749	0.753	
48	5240	OFDM	Test Position 2	15.00	14.98	0.09	1.005	0.206	0.207	

Remark:
1. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
2. 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.

Table 6: SAR Values [5GWLAN Band 3 IEEE 802.11ac VHT20]

Ch.	Freq. (MHz)	Service	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Power drift	Scaling Factor	SAR_{1-g} results(W/Kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers – Body										
157	5785	OFDM	Test Position 1	13.00	12.89	0.11	1.026	**0.777**	**0.797**	3
157	5785	OFDM	Test Position 4	13.00	12.89	0.06	1.026	0.732	0.751	
157	5785	OFDM	Test Position 2	13.00	12.89	-0.05	1.026	0.165	0.169	

Remark:
1. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
2. The initial test configuration for 2.4 GHz and 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures (see Clause 4).

7.7 Simultaneous TX SAR Considerations

7.7.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For the DUT, the BT, 2.4GWLAN and 5GWLAN share same module and same antenna, No need consider simultaneous.

7.7.2 Evaluation of Simultaneous SAR

N/A

7.8 SAR Measurement Variability

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

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

Frequency Band	Air Interface	RF Exposure Configuration	Test Position	Repeated SAR (yes/no)	Highest Measured SAR_{1-g} (W/Kg)	First Repeated	
						Measured SAR_{1-g} (W/Kg)	Largest to Smallest SAR Ratio
2450	2.4GWLAN	Standalone	Test Position 1	yes	0.964	0.971	1.01
5250	5GWLAN	Standalone	Test Position 1	no	0.775		
5850	5GWLAN	Standalone	Test Position 1	no	0.777		

Remark:

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

7.9 System Check Results

System Performance Check at 2450 MHz Body TSL

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 816

Date/Time: 11/05/2016 8:55:19 AM

Communication System: DuiJiangJi; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2450 MHz; σ = 1.96 S/m; ε_r = 53.50; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY5 Configuration:
Probe: EX3DV4 - SN3836; ConvF (7.20, 7.20, 7.20); Calibrated: 07/07/2016;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 07/26/2016
Phantom: ELI 4.0; Type: QDOVA001BA;
Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

System Performance Check at 2450MHz/Area Scan (81x111x1): Interpolated grid: dx=1.200 mm, dy=1.20 mm

Maximum value of SAR (interpolated) = 6.26 mW/g

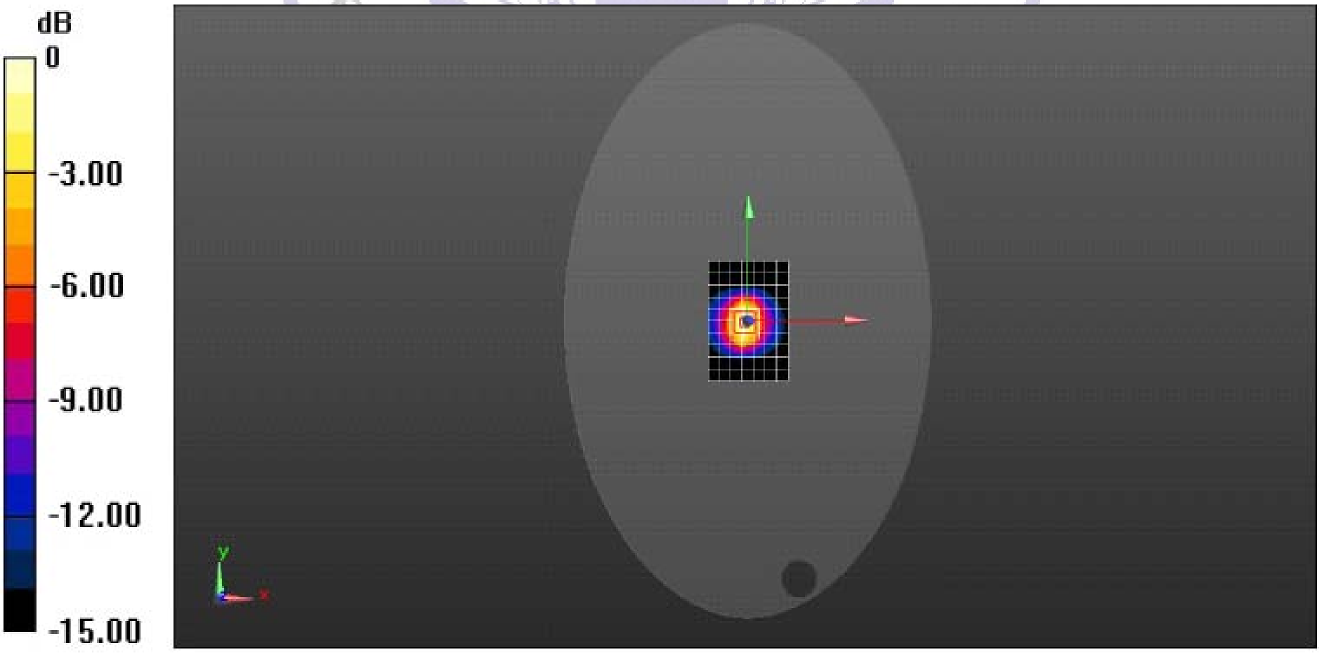
System Performance Check at 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 71.79 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 8.52 mW/g

SAR (1 g) = 5.06 mW/g; SAR (10 g) = 2.85 mW/g

Maximum value of SAR (measured) = 5.75 mW/g



0 dB = 5.75 mW/g = 7.60 dB mW/g

System Performance Check 2450MHz Body 100mW

System Performance Check at 5200 MHz Body TSL

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1185

Date/Time: 11/06/2016 09:35:27 AM

Medium parameters used (interpolated): f = 5200 MHz; σ = 5.33 S/m; ε_r = 50.10; ρ = 1000 kg/m^3
Communication System: DuiJiangJi; Frequency: 5200 MHz; Duty Cycle: 1:1
Phantom section: Flat Section
DASY5 Configuration:
Probe: EX3DV4 - SN3836; ConvF (4.83, 4.83, 4.83); Calibrated: 07/07/2016;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 07/26/2016
Phantom: ELI 4.0; Type: QDOVA001BA;
Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

System Performance Check at 5200MHz/Area Scan (81x91x1): Interpolated grid: dx=1.00 mm, dy=1.00 mm

Maximum value of SAR (interpolated) = 8.16 mW/g

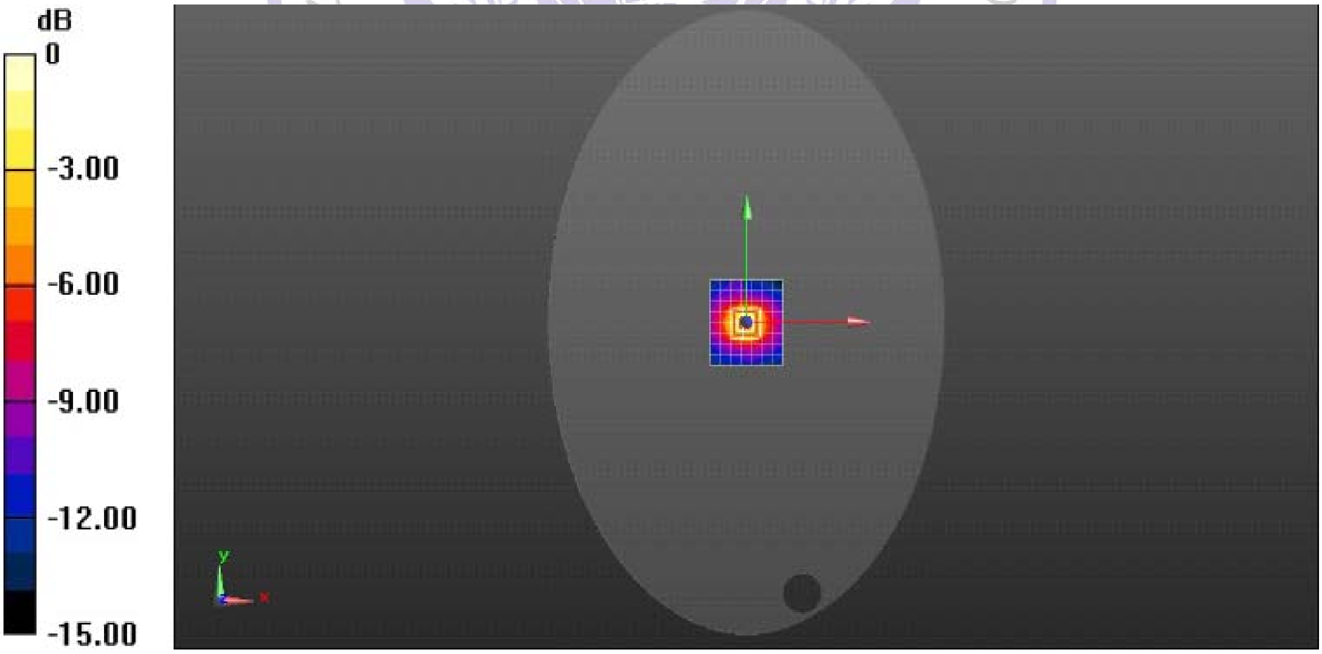
System Performance Check at 5200MHz/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 38.28 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 22.4 mW/g

SAR (1 g) = 7.22 mW/g; SAR (10 g) = 2.19 mW/g

Maximum value of SAR (measured) = 8.58 mW/g



0 dB = 8.58 mW/g = 9.33 dB mW/g

System Performance Check 5200MHz Body 100mW

System Performance Check at 5800 MHz Body TSL

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: 1185

Date/Time: 11/06/2016 14:36:54 PM

Medium parameters used (interpolated): f = 5800 MHz; σ = 6.07 S/m; ε_r = 49.80; ρ = 1000 kg/m^3
Communication System: DuiJiangJi; Frequency: 5800 MHz; Duty Cycle: 1:1
Phantom section: Flat Section
DASY5 Configuration:
Probe: EX3DV4 - SN3836; ConvF (4.30, 4.30, 4.30); Calibrated: 07/07/2016;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 07/26/2016
Phantom: ELI 4.0; Type: QDOVA001BA;
Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

System Performance Check at 5800MHz/Area Scan (81x91x1): Interpolated grid: dx=1.00 mm, dy=1.00 mm

Maximum value of SAR (interpolated) = 8.12 mW/g

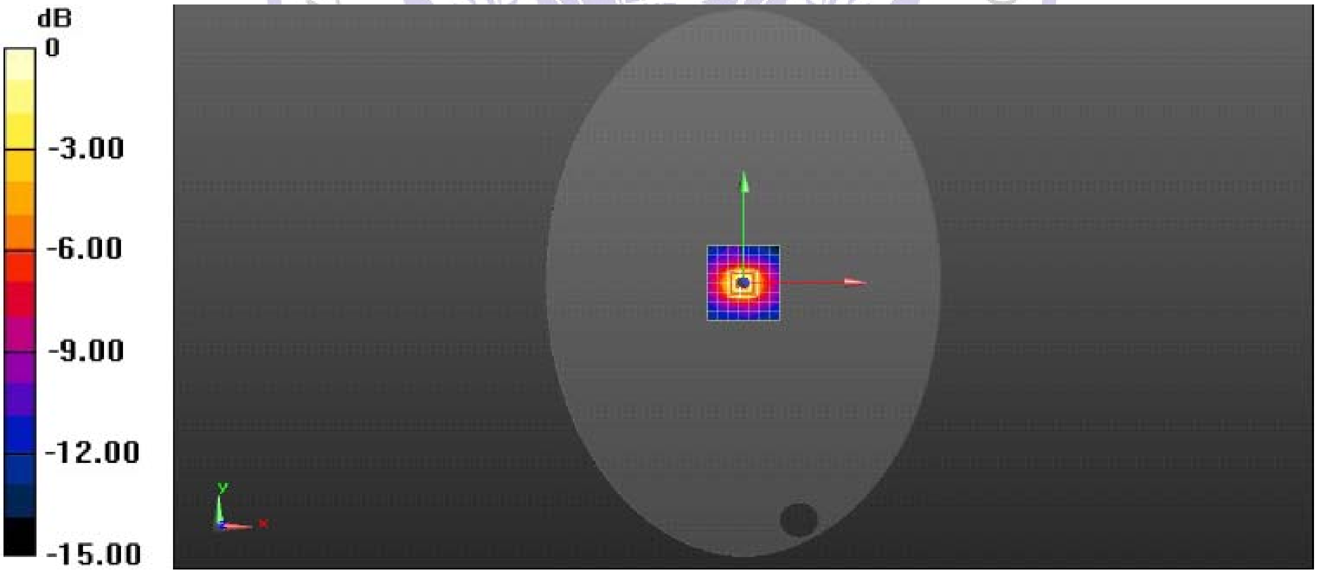
System Performance Check at 5800MHz/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 39.71 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 24.02 mW/g

SAR (1 g) = 7.48 mW/g; SAR (10 g) = 2.26 mW/g

Maximum value of SAR (measured) = 8.84 mW/g



0 dB = 8.84 mW/g = 9.46 dB mW/g

System Performance Check 5800MHz Body 100mW

7.10 SAR Test Graph Results

SAR plots for **the highest measured SAR** in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02

Body- Worn 2.4GWLAN, Test Position 1, IEEE 802.11b, 2437 MHz

Communication System: 2.4GWLAN; Frequency: 2437.0 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437.0 MHz; σ = 1.96 S/m; ε_r = 53.80; ρ = 1000 kg/m^3
Phantom section: Flat Section
Probe: EX3DV4 - SN3836; ConvF (7.20, 7.20, 7.20); Calibrated: 07/07/2016;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 07/26/2016
Phantom: ELI 4.0; Type: QDOVA001BA;
Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Test Position 1 2437 MHz / Area Scan (135x135x1): Interpolated grid: dx=1.50 mm, dy=1.50 mm

Maximum value of SAR (interpolated) = 1.14 mW/g

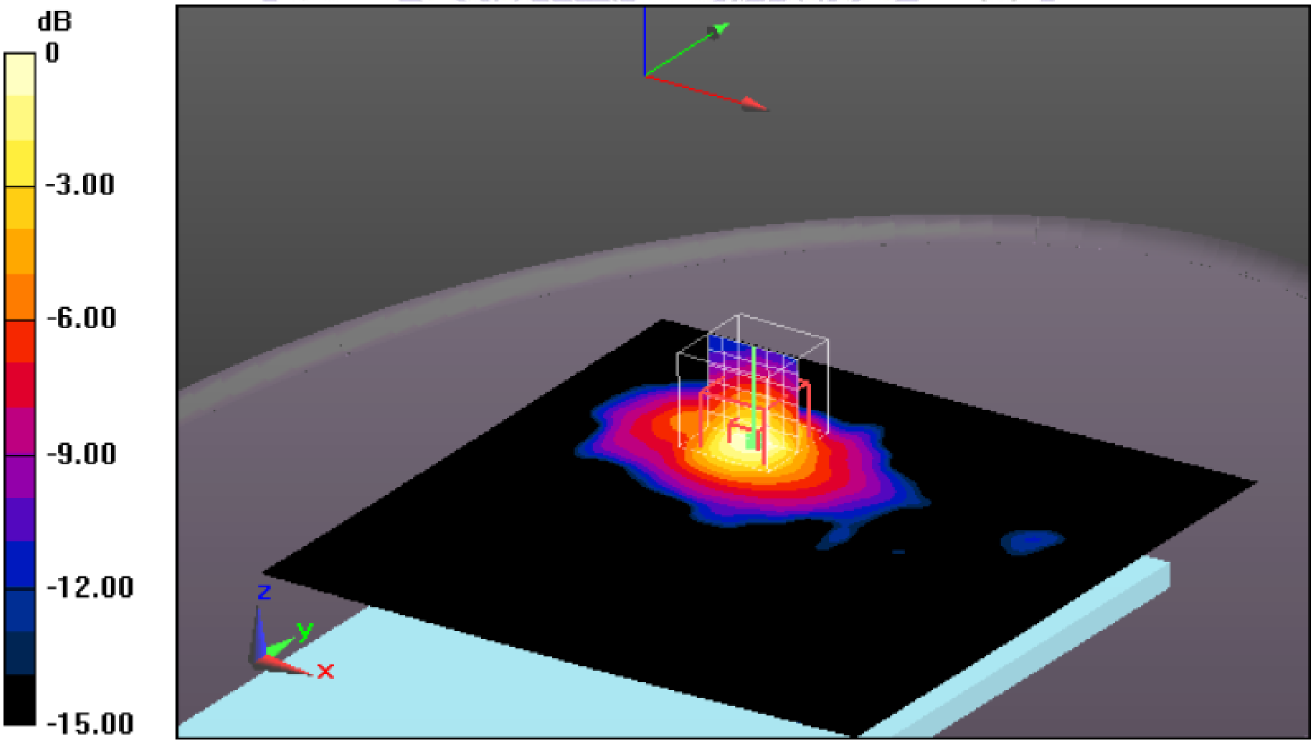
Test Position 1 2437 MHz / Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 21.094 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 2.88 mW/g

SAR (1 g) = 0.964 mW/g; SAR (10 g) = 0.362 mW/g

Maximum value of SAR (measured) = 1.12 mW/g



0 dB = 1.12 mW/g = 0.492 dB mW/g

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Figure 1: Body- Worn 2.4GWLAN, Test Position 1, IEEE 802.11b, 2437 MHz

Body- Worn 5GWLAN Band 1, Test Position 1, IEEE 802.11ac VHT20, 5240 MHz

Communication System: 5GWLAN; Frequency: 5240.0 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): f = 5240.0 MHz; σ = 5.32 S/m; ε_r = 50.60; ρ = 1000 kg/m^3
Phantom section: Flat Section
Probe: EX3DV4 - SN3836; ConvF (4.83, 4.83, 4.83); Calibrated: 07/07/2016;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 07/26/2016
Phantom: ELI 4.0; Type: QDOVA001BA;
Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Test Position 1 5240 MHz / Area Scan (171x201x1): Interpolated grid: dx=1.00 mm, dy=1.00 mm

Maximum value of SAR (interpolated) = 1.38 mW/g

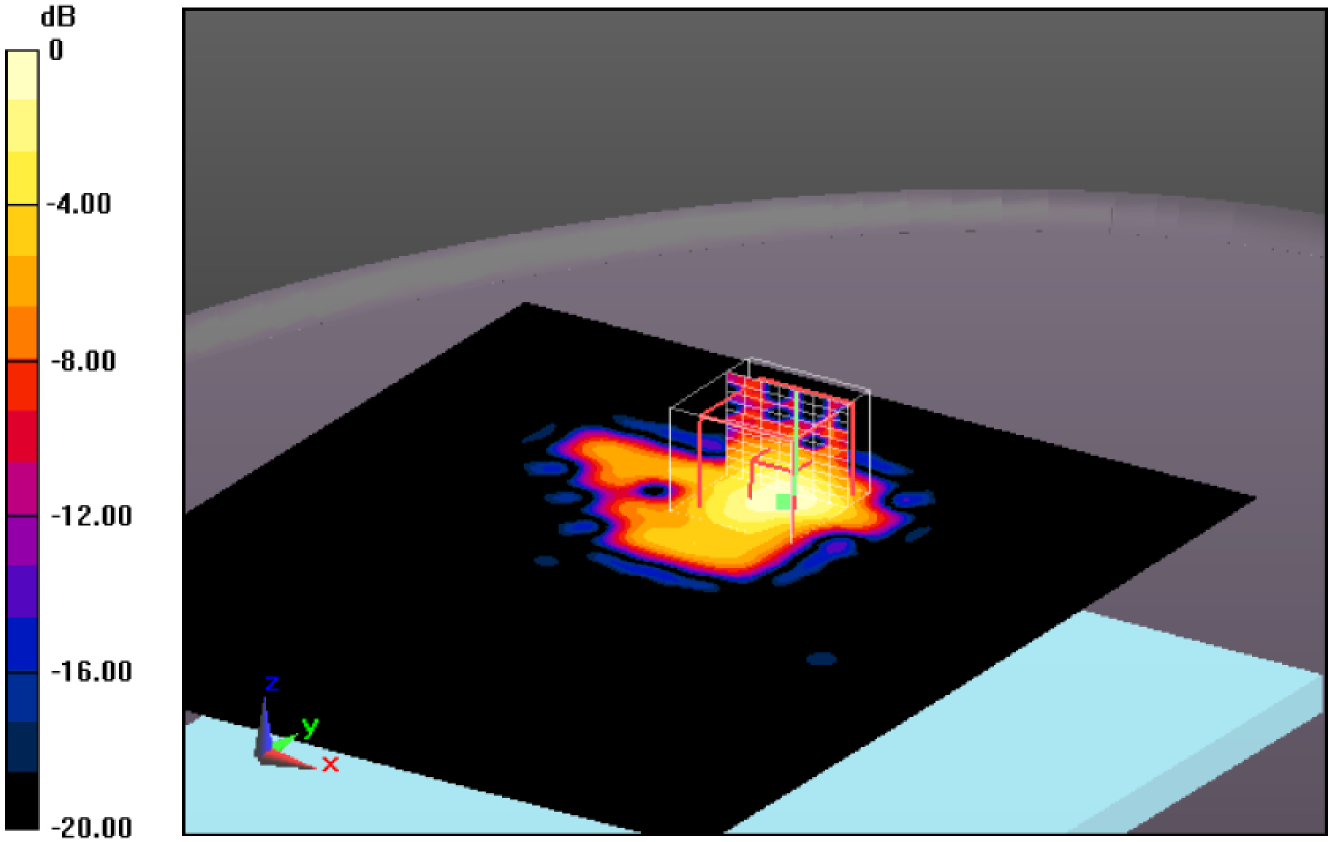
Test Position 1 5240 MHz / Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=3mm

Reference Value = 25.147 V/m; Power Drift = - 0.01 dB

Peak SAR (extrapolated) = 3.82 mW/g

SAR (1 g) = 0.775 mW/g; SAR (10 g) = 0.177 mW/g

Maximum value of SAR (measured) = 1.66 mW/g



0 dB = 1.66 mW/g = 2.2 dB mW/g

Date/Time: 11/06/2016 11:12:08 AM

Figure 2: Body- Worn 5GWLAN Band 1, Test Position 1, IEEE 802.11ac VHT20, 5240 MHz

Body- Worn 5GWLAN Band 3, Test Position 1, IEEE 802.11ac VHT20, 5785 MHz

Communication System: 5GWLAN; Frequency: 5785.0 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): f = 5785 MHz; σ = 6.07 S/m; ε_r = 49.90; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY5 Configuration:
Probe: EX3DV4 - SN3836; ConvF (4.30, 4.30, 4.30); Calibrated: 07/07/2016;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1315; Calibrated: 07/26/2016
Phantom: ELI 4.0; Type: QDOVA001BA;
Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Test Position 1 5785 MHz / Area Scan (171x201x1): Interpolated grid: dx=1.00 mm, dy=1.00 mm

Maximum value of SAR (interpolated) = 1.42 mW/g

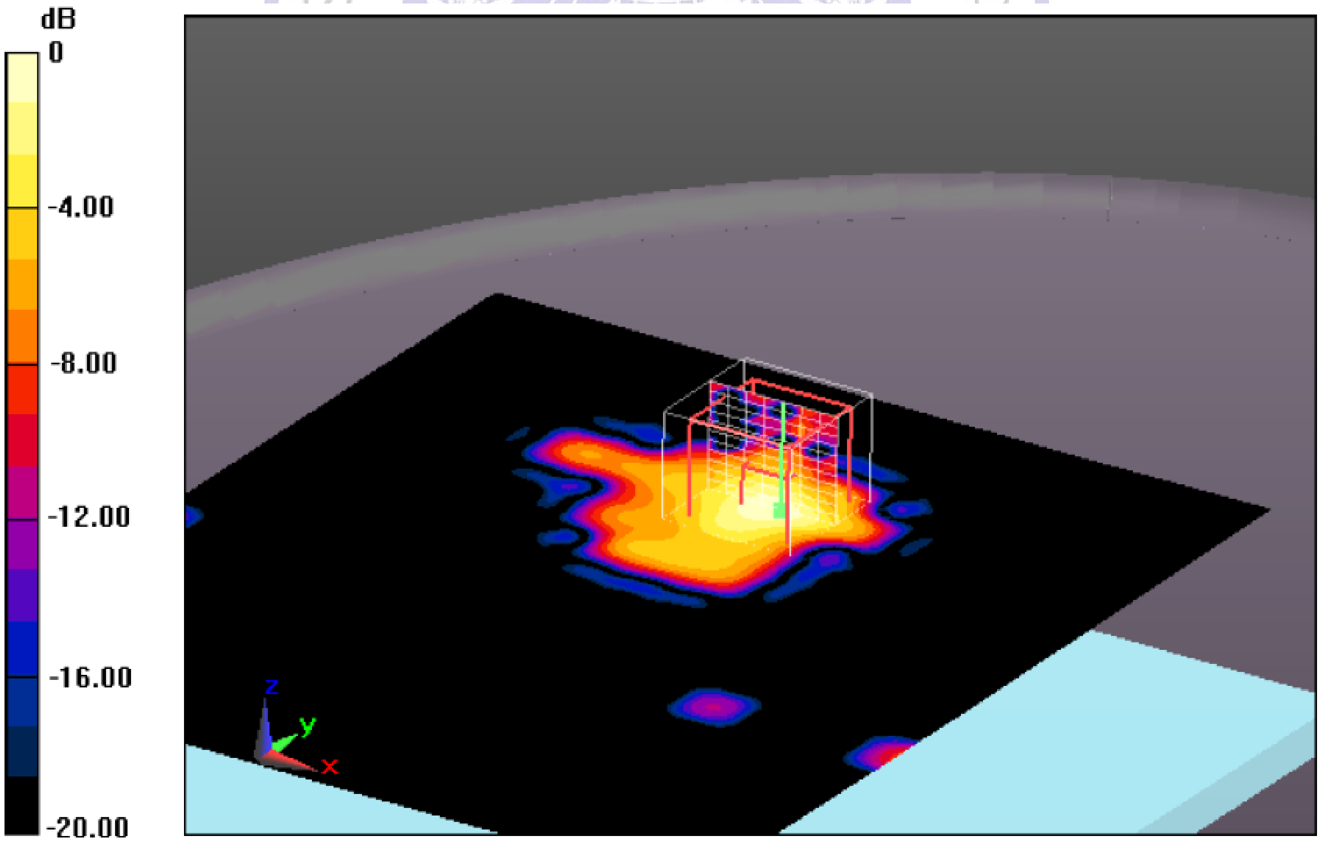
Test Position 1 5785 MHz / Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=3mm

Reference Value = 1.311 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 3.16 mW/g

SAR (1 g) = 0.777 mW/g; SAR (10 g) = 0.178 mW/g

Maximum value of SAR (measured) = 1.67 mW/g



0 dB = 1.67 mW/g = 2.23 dB mW/g

Date/Time: 11/06/2016 15:39:17 PM

Figure 3: Body- Worn 5GWLAN Band 3, Test Position 1, IEEE 802.11ac VHT20, 5785 MHz

8 Calibration Certificate

8.1 Probe Calibration Certificate

In Collaboration with
speag
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 Sunway Certificate No: Z16-97101

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3836
Calibration Procedure(s)	FD-Z11-2-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	July 07, 2016

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 NRP2	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101548	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference10dBAttenuator	18N50W-10dB	13-Mar-16(CTTL,No.J16X01547)	Mar-18
Reference20dBAttenuator	18N50W-20dB	13-Mar-16(CTTL, No.J16X01548)	Mar-18
Reference Probe EX3DV4	SN 3617	26-Aug-15(SPEAG,No.EX3-3617_Aug15)	Aug-16
DAE4	SN 1331	21-Jan-16(SPEAG, No.DAE4-1331_Jan16)	Jan -17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	27-Jun-16 (CTTL, No.J16X04776)	Jun-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan -17

	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: July 08, 2016

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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 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 300MHz to 3GHz)", February 2005

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

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect 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 (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≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to 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±50MHz to±100MHz.
- *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).

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Probe EX3DV4

SN: 3836

Calibrated: July 07, 2016

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3836

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(µV/(V/m)^2)^A	0.40	0.46	0.43	±10.8%
DCP(mV)^B	93.2	100.2	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	167.8	±2.0%
		Y	0.0	0.0	1.0		182.5	
		Z	0.0	0.0	1.0		176.7	

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

^{A} The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 5 and Page 6).
^{B} Numerical linearization parameter: uncertainty not required.
^{E} Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3836

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	9.43	9.43	9.43	0.30	0.80	±12%
835	41.5	0.90	9.42	9.42	9.42	0.15	1.58	±12%
900	41.5	0.97	9.03	9.03	9.03	0.15	1.46	±12%
1750	40.1	1.37	8.04	8.04	8.04	0.14	1.63	±12%
1900	40.0	1.40	7.60	7.60	7.60	0.16	1.59	±12%
2300	39.5	1.67	7.45	7.45	7.45	0.53	0.68	±12%
2450	39.2	1.80	7.07	7.07	7.07	0.54	0.71	±12%
2600	39.0	1.96	6.96	6.96	6.96	0.61	0.66	±12%
5200	36.0	4.66	5.32	5.32	5.32	0.40	1.42	±13%
5300	35.9	4.76	5.13	5.13	5.13	0.40	1.40	±13%
5500	35.6	4.96	4.85	4.85	4.85	0.40	1.35	±13%
5600	35.5	5.07	4.59	4.59	4.59	0.40	1.45	±13%
5800	35.3	5.27	4.71	4.71	4.71	0.40	1.45	±13%

[C] Frequency validity above 300 MHz 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. 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 frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3836

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	9.38	9.38	9.38	0.30	0.85	±12%
835	55.2	0.97	9.25	9.25	9.25	0.17	1.44	±12%
900	55.0	1.05	8.95	8.95	8.95	0.14	1.60	±12%
1750	53.4	1.49	7.64	7.64	7.64	0.17	1.71	±12%
1900	53.3	1.52	7.33	7.33	7.33	0.18	1.80	±12%
2300	52.9	1.81	7.45	7.45	7.45	0.51	0.80	±12%
2450	52.7	1.95	7.20	7.20	7.20	0.62	0.70	±12%
2600	52.5	2.16	6.99	6.99	6.99	0.52	0.79	±12%
5200	49.0	5.30	4.83	4.83	4.83	0.50	1.25	±13%
5300	48.9	5.42	4.60	4.60	4.60	0.50	1.35	±13%
5500	48.6	5.65	4.32	4.32	4.32	0.50	1.35	±13%
5600	48.5	5.77	4.20	4.20	4.20	0.50	1.40	±13%
5800	48.2	6.00	4.30	4.30	4.30	0.50	1.30	±13%

[C] Frequency validity above 300 MHz 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. 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 frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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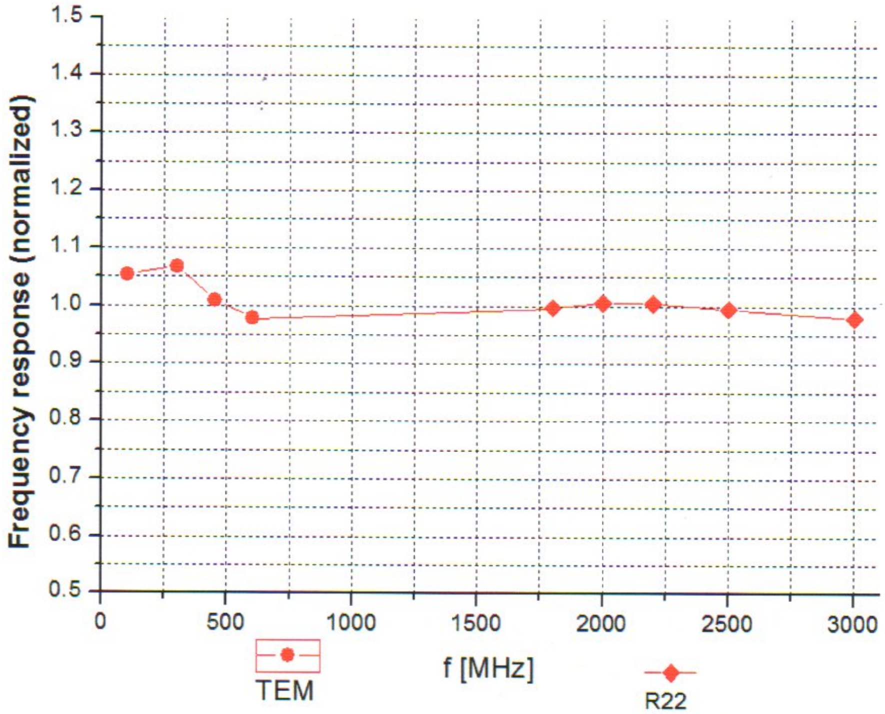
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

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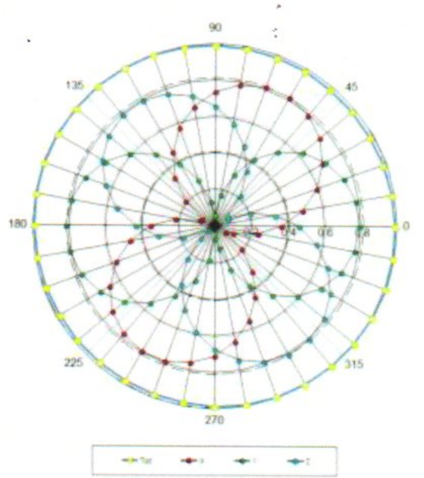
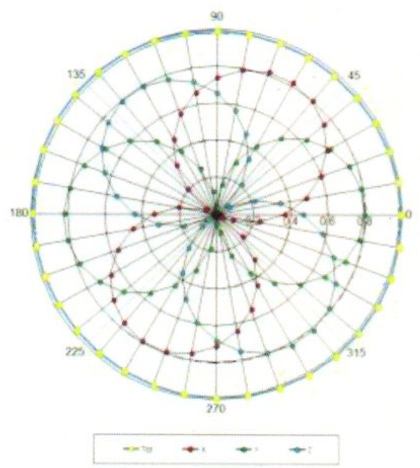
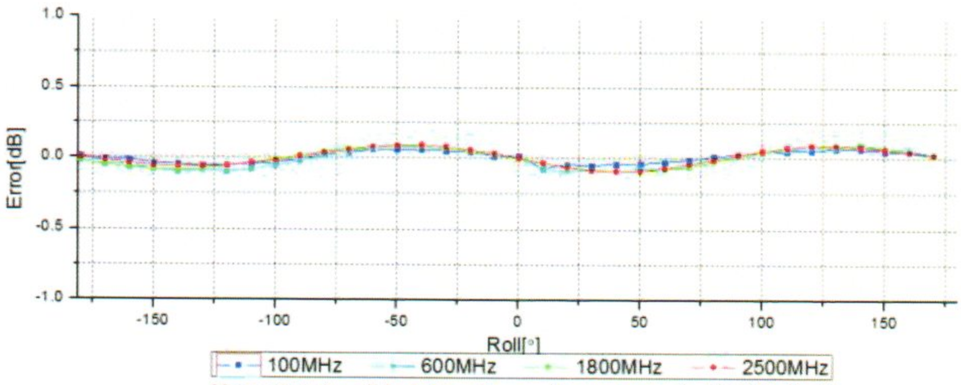
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM **f=1800 MHz, R22**







Uncertainty of Axial Isotropy Assessment: ±0.9% (k=2)

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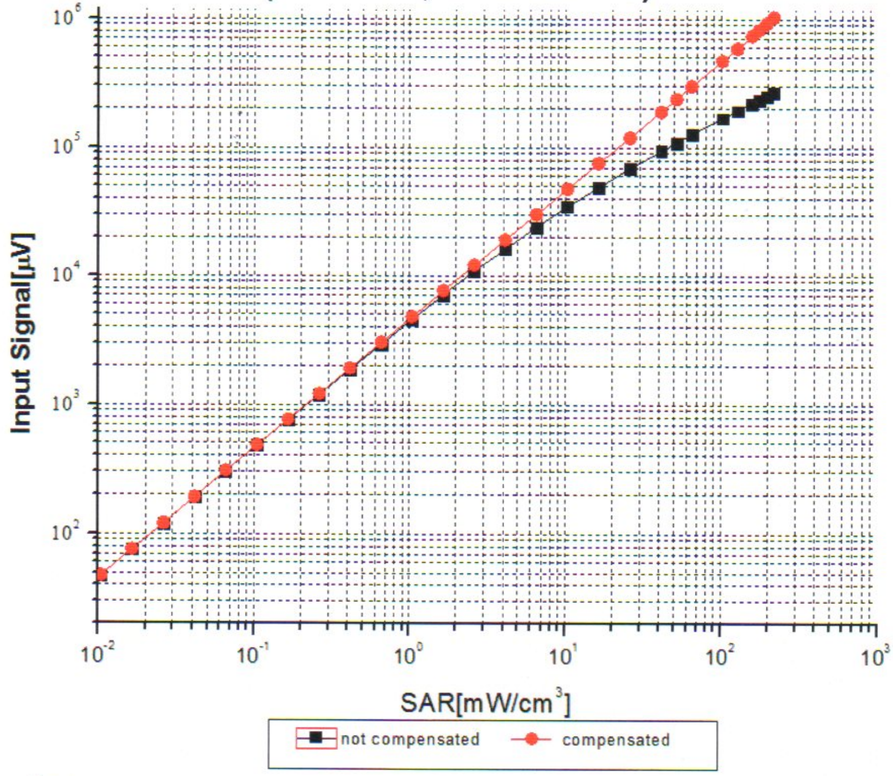
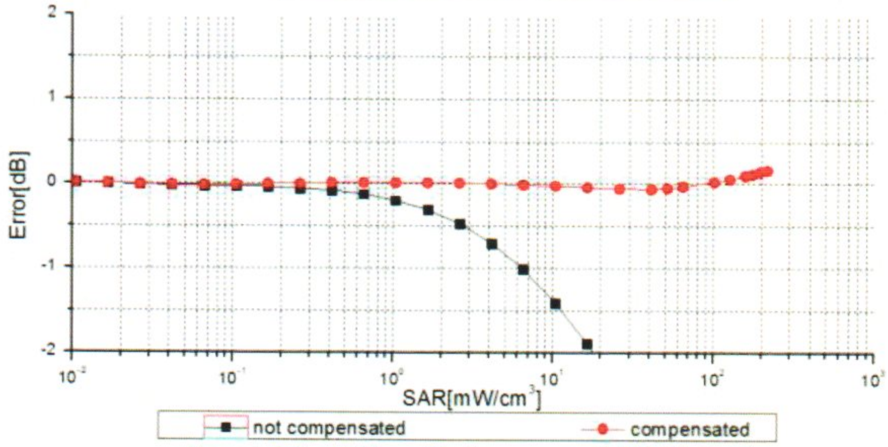
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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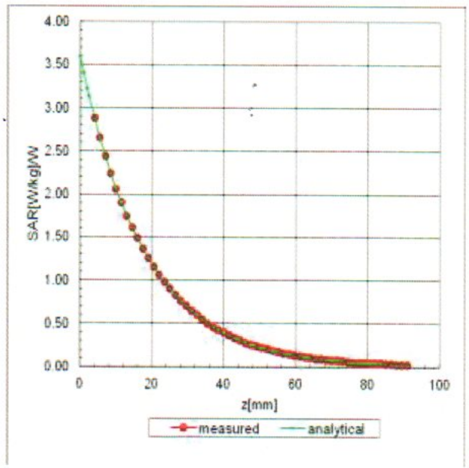
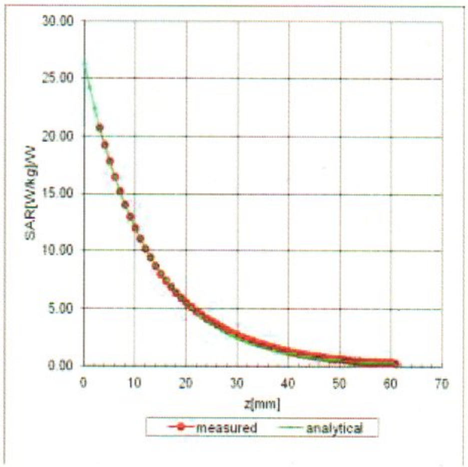
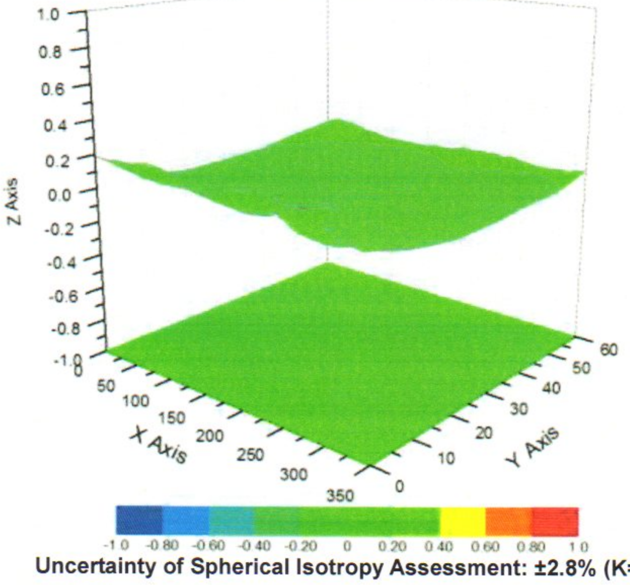
Conversion Factor Assessment

f=900 MHz, WGLS R9(H_convF) **f=1900 MHz, WGLS R22(H_convF)**





Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3836

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	47.9
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

8.2 D2450V2 Dipole Calibration Certificate

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ilac-MRA CNAS CALIBRATION No. L0570

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Client SMQ Certificate No: Z15-97122

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 818

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

Calibration date: September 14, 2015

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

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ 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-15 (CTTL, No.J15X04256)	Jun-16
Power sensor NRP-Z91	101547	01-Jul-15 (CTTL, No.J15X04256)	Jun-16
Reference Probe EX3DV4	SN 3846	24-Sep-14(SPEAG,No.EX3-3846_Sep14)	Sep-15
DAE4	SN 910	16-Jun-15(SPEAG,No.DAE4-910_Jun15)	Jun-16
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	02-Feb-15 (CTTL, No.J15X00729)	Feb-16
Network Analyzer E5071C	MY46110673	03-Feb-15 (CTTL, No.J15X00728)	Feb-16

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

Issued: September 23, 2015

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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, "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%.