REPORT No. : SZ18030098S01

TEST REPORT

APPLICANT	:	UNIVERSAL ELECTRONICS INC
PRODUCT NAME	:	Wi-Fi Dongle
MODEL NAME	:	MG3-2236B
BRAND NAME	:	UNIVERSAL ELECTRONICS INC
FCC ID	:	MG3-2236B
STANDARD(S)	:	47CFR 2.1093 IEEE 1528-2013
TEST DATE	:	2018-05-13 to 2018-05-15
ISSUE DATE	:	2018-05-16

Tested by: Gan Yueming
Gan Yueming(Test engineer)

Approved by: Peng Huarui
Peng Huarui (Supervisor)

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DIRECTORY

Change History		
Issue	**Date**	**Reason for change**
1.0	2018-05-16	First edition

1. Technical Information

Note: Provide by manufacturer.

1.1. Applicant and Manufacturer Information

Applicant:	UNIVERSAL ELECTRONICS INC
Applicant Address:	201 East Sandpointe Ave, 8th Floor, Santa Ana, CA, United States
Manufacturer:	ITON Technology Corp.
Manufacturer Address:	Room 1302, Block A, Building 4, Tianan Cyber Park, Huangge Road, Longgang District, Shenzhen, China

1.2. Equipment Under Test (EUT) Description

EUT Type:	WiFi Dongle		
Hardware Version:	V1.1		
Software Version:	V1.0		
Frequency Bands:	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz		
Modulation Mode:	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 5GHz 802.11a/n HT20/HT40		
Hotspot function:	Support		
Antenna type:	WLAN : PCB Internal Antenna		
SIM cards description:	No SIM Card		
Max Scaled SAR-1g(W/Kg)	Body	0.762W/kg	Limit(W/kg): 1.6W/kg

Note: For a more detailed description, please refer to specification or user's manual supplied by the applicant and/or manufacturer.

1.3. Summary of Maximum SAR Value

Frequency Band	Highest SAR Summary
	Body (Separation 5mm)
	1g SAR (W/kg)
WLAN 2.4GHz	0.762
WLAN 5GHz	0.494
Highest Simultaneous Transmission	1.076

1.4. Photographs of the EUT

Please refer to the External Photos for the Photos of the EUT

1.5. Applied Reference Documents

Leading reference documents for testing:

No.	Identity	Document Title
1	**47 CFR§2.1093**	Radiofrequency Radiation Exposure Evaluation: Portable Devices
2	**IEEE 1528-2013**	IEEE Recommended Practice forDetermining the Peak Spatial-AverageSpecific Absorption Rate (SAR) in theHuman Head from WirelessCommunications Devices: Measurement Techniques
3	**KDB 447498 D01v06**	General RF Exposure Guidance
4	**KDB 248227 D01v02r02**	SAR Measurement Procedures for 802.11 Transmitters
5	**KDB 865664 D01v01r04**	SAR Measurement 100 MHz to 6 GHz
6	**KDB 865664 D02v01r02**	RF Exposure Reporting
7	**KDB 648474 D04v01r03**	Handset SAR
8	**KDB 941225 D06v02r01**	SAR Evaluation Procedures For Portable Devices With Wireless Router Capabilities

2. RF Exposure Limits

Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Uncontrolled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

3. Specific Absorption Rate (SAR)

3.1. Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are Middle than the limits for general population/uncontrolled.

3.2. SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density. (ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be either related to the temperature elevation in tissue by,

$$\mathbf{SAR} = C\left(\frac{\delta T}{\delta t}\right)$$

Where C is the specific head capacity, δT is the temperature rise and δt the exposure duration, or related to the electrical field in the tissue by

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

Where σ is the conductivity of the tissue, ρ is the mass density of the tissue and $|E|$ is the rms electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

4. SAR Measurement System

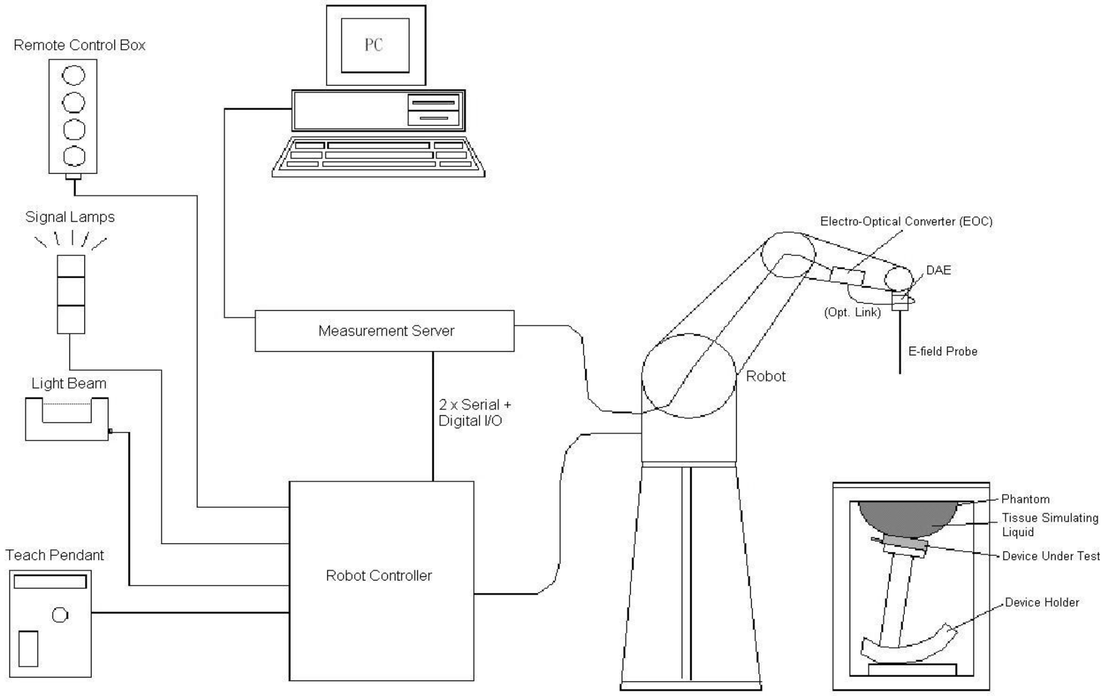


Fig 4.1 SPEAG DASY System Configurations

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

A standard high precision 6-axis robot with controller, a teach pendant and software

A data acquisition electronic (DAE) attached to the robot arm extension

A dosimetric probe equipped with an optical surface detector system

The electro-optical converter (ECO) performs the conversion between optical and electrical signals

A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.

A probe alignment unit which improves the accuracy of the probe positioning

A computer operating Windows XP

DASY software

Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.

The SAM twin phantom

A device holder

Tissue simulating liquid

Dipole for evaluating the proper functioning of the system

Some of the components are described in details in the following sub-sections.

4.1. E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

E-Field Probe Specification

<ET3DV6 Probe >

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz to 3 GHz; Linearity: ± 0.2 dB
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic Range	5 µW/g to 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm

Fig 3.2 Photo of ES3DV3

<EX3DV4 Probe>

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 µW/g to 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

Fig 3.3 Photo of EX3DV4

E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy shall be evaluated and within ± 0.25 dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix C of this report.

4.2. Data Acquisition Electronics (DAE)

The data acquisition electronics(DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 3.4Photo of DAE

4.3. Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:
High precision (repeatability ±0.035 mm)
High reliability (industrial design)
Jerk-free straight movements
Low ELF interference (the closed metallic construction shields against motor control fields)

Fig 3.5 Photo of DASY5

4.4. Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium;

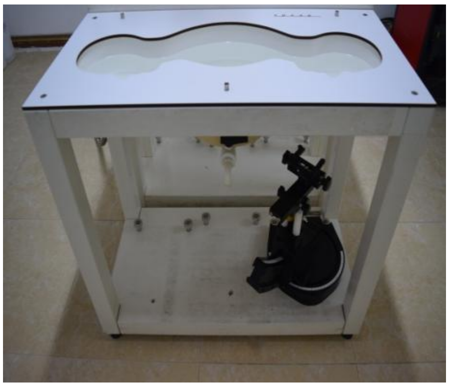
DASY5: 400 MHz, Intel Celeron), chip disk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

Fig 3.6 Photo of Server for DASY5

4.5. Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%) Center ear point: 6 ± 0.2 mm	
Filling Volume	Approx. 25 liters	
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet	
Measurement Areas	Left Hand, Right Hand, Flat Phantom	**Fig 3.7Photo of SAM Phantom**

The bottom plate contains three pair 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 tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

5. Device Holder

<Device Holder for SAM Twin Phantom>

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ± 0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

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

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

Fig 4.1 Device Holder

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

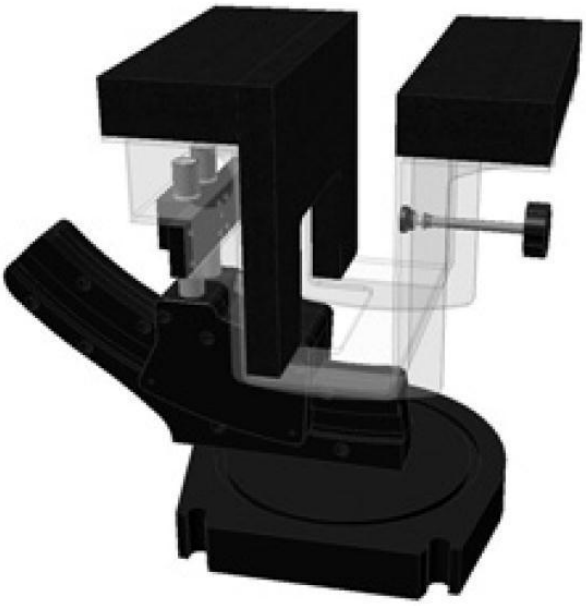


Fig 4.2 Laptop Extension Kit

5.1. Data Storage and Evaluation

Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing 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 erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

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

Data Evaluation

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

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- 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 DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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

The formula for each channel can be given as:

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

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 primary field data for each channel can be evaluated:

$$\text{E-field Probes:} E_i = \sqrt{\frac{V_i}{Norm_i \times ConvF}}$$

$$\text{H-field Probes:} H_i = \sqrt{V_i} \times \frac{a_{i0} + a_{i1} + a_{i2} f^2}{f}$$

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

$Norm_i$ = sensor sensitivity of channel i, (i = x, y, z), $\mu V/(V/m)^2$ for E-field

Probes ConvF = sensitivity enhancement in solution

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

f = carrier frequency [GHz]

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

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

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

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

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

$$SAR = E_{tot}^2 \times \frac{\sigma}{\rho \times 1000}$$

with SAR = local specific absorption rate in mW/g

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

σ = conductivity in [mho/m] or [Siemens/m]

ρ = equivalent tissue density in g/cm^3

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

6. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.

(b) Read the WWAN RF power level from the base station simulator.

(c) 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

Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel

(b) Place the EUT in the positions as Appendix D demonstrates.

(c) Set scan area, grid size and other setting on the DASY software.

(d) Measure SAR results for the highest power channel on each testing position.

(e) Find out the largest SAR result on these testing positions of each band

(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

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 scan

(c) Zoom scan

(d) Power drift measurement

6.1. Spatial Peak SAR Evaluation

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

6.2. 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.

6.3. 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 D01v01r04 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	½·δ·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.	

6.4. 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 D01v01r04 SAR measurement 100 MHz to 6 GHz

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 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.

6.5. 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.

6.6. 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.

7. Tissue Simulating Liquids

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 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 5.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 5.2.The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in below table.

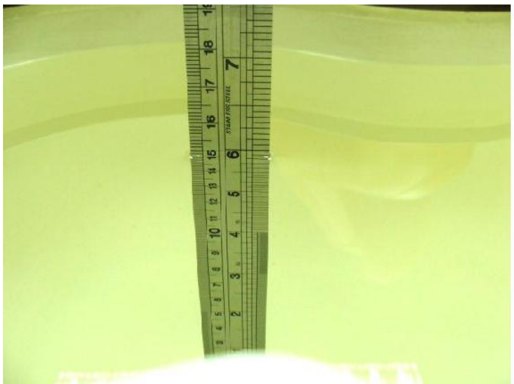


Fig 5.1 Photo of Liquid Height for Head SAR

Fig 5.2 Photo of Liquid Height for Body SAR

The following table gives the recipes for tissue simulating liquids

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0
Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

Note: Please refer to the validation results for dielectric parameters of each frequency band.

The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using an Agilent 85033E Dielectric Probe Kit and an Agilent Network Analyzer.

Table 1: Dielectric Performance of Tissue Simulating Liquid

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road,
Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China
Tel: 86-755-36698555 Fax: 86-755-36698525
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8. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[(a)]	1/k[(b)]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 8.1. Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.0	N	1	1	1	6.0	6.0
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	1.0	R	1.732	1	1	0.6	0.6
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	2.9	R	1.732	1	1	1.7	1.7
Max. SAR Eval.	2.0	R	1.732	1	1	1.2	1.2
Test Sample Related							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.1	R	1.732	1	1	3.5	3.5
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						11.4%	11.4%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						22.9%	22.7%

9. SAR Measurement Evaluation

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

9.1. Purpose of System Performance check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

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9.2. System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.

The output power on dipole port must be calibrated to 24 dBm (250 mW) before dipole is connected.

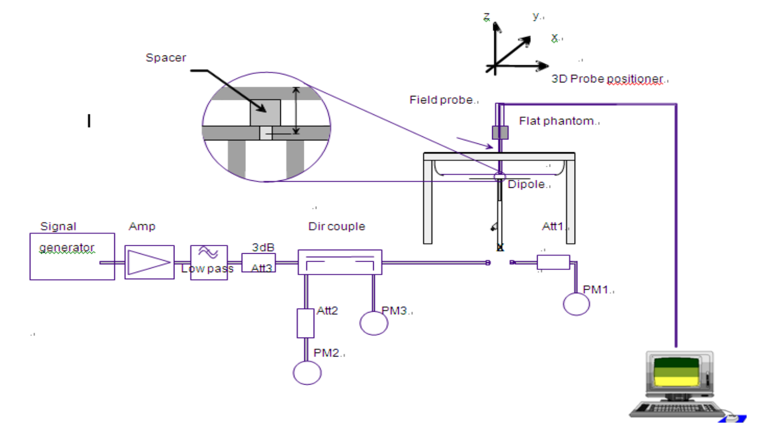


Fig 7.1 System Setup for System Evaluation


Fig 7.2 Photo of Dipole Setup

9.3. Validation Results

After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

<1g SAR>

<10g SAR>

Note: System checks the specific test data please see Annex C

10. RF Exposure Positions

10.1. Information on the testing

The mobile phone antenna and battery are those specified by the manufacturer. The battery is fully charged before each measurement. The output power and frequency are controlled using a base station simulator. The mobile phone is set to transmit at its highest output peak power level.
The mobile phone is test in the "cheek" and "tilted" positions on the left and right sides of the phantom. The mobile phone is placed with the vertical centre line of the body of the mobile phone and the horizontal line crossing the centre of the earpiece in a plane parallel to the sagittal plane of the phantom.

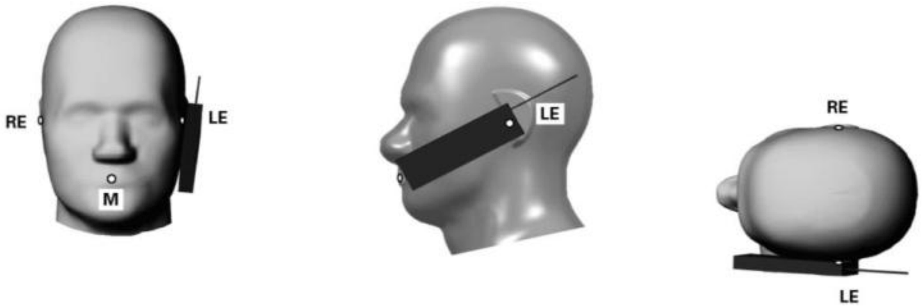


Fig 10.1 Illustration for Cheek Position

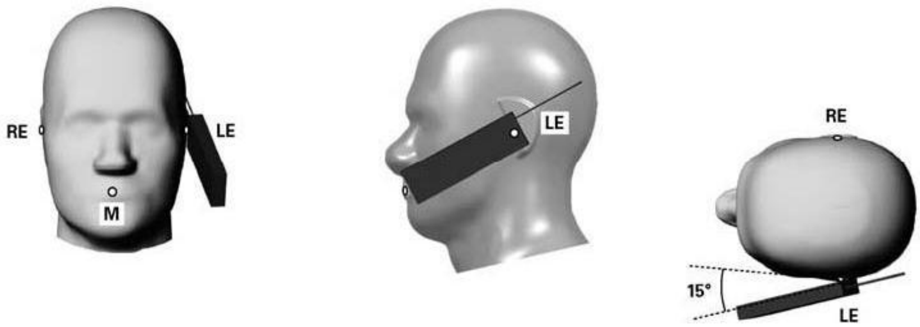


Fig 10.2 Illustration for Tilted Position

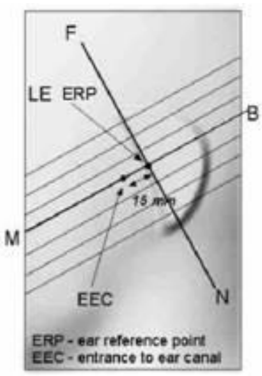


Fig 10.3 Close-up side view of phantom showing the ear region.

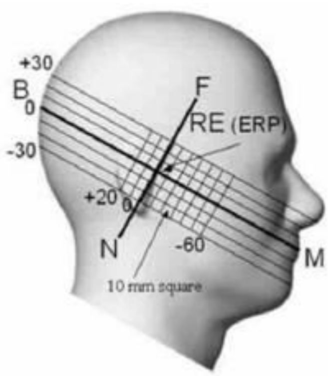


Fig 10.4 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

Description of the "cheek" position:
The mobile phone is well placed in the reference plane and the earpiece is in contact with the ear. Then the mobile phone is moved until any point on the front side get in contact with the cheek of the phantom or until contact with the ear is lost.

Description of the "tilted" position:
The mobile phone is well placed in the "cheek" position as described above. Then the mobile phone is moved outward away from the month by an angle of 15 degrees or until contact with the ear lost.

Remark: Please refer to Appendix B for the test setup photos.

10.2. Body-worn Configurations

The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration.

For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

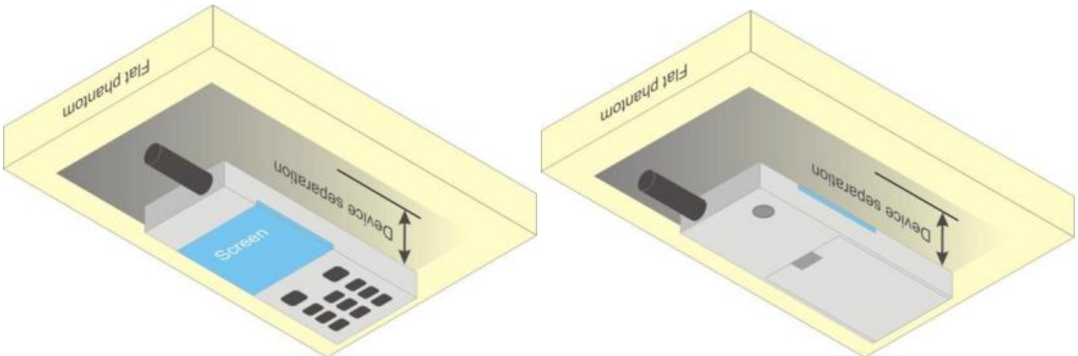
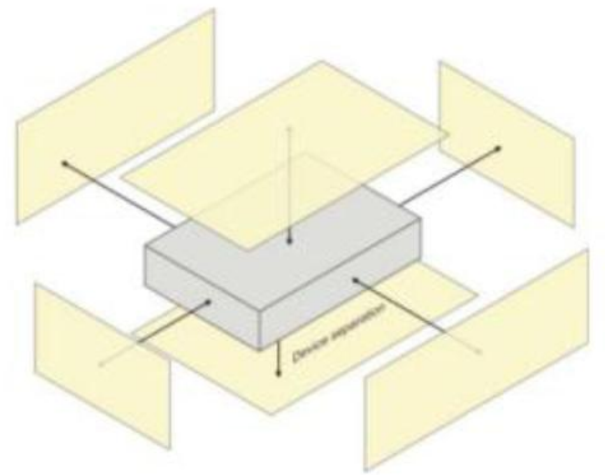


Fig 10.3 Illustration for Body Worn Position

10.3. Hotspot Mode Exposure Position Conditions

For handsets that support hotspot mode operations, with wireless router capabilities and various web browsing functions, the relevant hand and body exposure conditions are tested according to the hotspot SAR procedures in KDB 941225. A test separation distance of 10 mm is required between the phantom and all surfaces and edges with a transmitting antenna located within 25 mm from that surface or edge. When the form factor of a handset is smaller than 9 cm x 5 cm, a test separation distance of 5 mm (instead of 10 mm) is required for testing hotspot mode. When the separation distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, in the same wireless mode and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface).



10.4. USB Connector Orientations Implemented on Laptop Computers

(A) Horizontal-Up | (B) Horizontal-Down | (C) Vertical-Front | (D) Vertical-Back

Note: These are USB connector orientations on laptop computers; USB dongles have the reverse configuration for plugging into the corresponding laptop computers.

10.5. Simple Dongle Test Procedures

Test all USB orientations [see figure below: (A) Horizontal-Up, (B) Horizontal-Down, (C) Vertical-Front, and (D) Vertical-Back] with a device-to-phantom separation distance of 5mm according to KDB447498. These test orientations are intended for the exposure conditions found in typical laptop/notebook/netbook or tablet computers with either horizontal or vertical USB connector configurations at various locations in the keyboard section of the computer. Current generation portable host computers should be used to establish the required SAR measurement separation distance. The same test separation distance must be used to test all frequency bands and modes in each USB orientation. The typical Horizontal-Up USB connection (A), found in the majority of host computers, must be tested using an appropriate host computer. A host computer with either Vertical-Front (C) or Vertical-Back (D) USB connection should be used to test one of the vertical USB orientations. If a suitable host computer is not available for testing the Horizontal-Down (B) or the remaining Vertical USB orientation, a high quality USB cable, 12 inches or less, may be used for testing these other orientations. It must be documented that the USB cable does not influence the radiating characteristics and output power of the transmitter.

10.6. Dongles with Swivel or Rotating Connectors

A swivel or rotating USB connector may enable the dongle to connect in different orientations to host computers. When the antenna is built-in within the housing of a dongle, a swivel or rotating connector may allow the antenna to assume different positions. The combination of these possible configurations must be considered to determine the SAR test requirements. When the antenna is located near the tip of a dongle, it may operate at closer proximity to users in certain connector orientations where dongle tip testing may be required.

The 5 mm test separation distance used for testing simple dongles has been established based on the overall host platform (laptop/notebook/netbook) and device variations, and varying user operating configurations and exposure conditions expected for a peripheral device. The same test distance should generally apply to dongles with swivel or rotating connectors. The procedures described for simple dongles should be used to position the four surfaces of the dongle at 5 mm from the phantom to evaluate SAR. At least one of the horizontal and one of the vertical positions should be tested using an applicable host computer. If the antenna is within 1 cm from the tip of the dongle (the end without the USB connector), the tip of the dongle should also be tested at 5 mm perpendicular to the phantom. For antennas located within 2.5 cm from the USB connector and if the dongle can be positioned at 45º to 90º from the horizontal position [(A) or (B)], testing in one or more of these configurations may need to be considered. A KDB inquiry should be submitted to determine the applicable test configurations.

11. SAR Measurement Procedure

11.1. General scan Requirements

Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Boththe probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances ofthe post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2013.

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>> 3 GHz</th></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>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 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 <u>reported</u> 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>

11.2. Measurement procedure

The Following steps are used for each test position

1. Establish a call with the maximum output power with a base station simulator. The connection between the mobile and the base station simulator is established via air interface.
2. Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.
3. Measurement of the SAR distribution with a grid of 8 to 16mm * 8 to16 mm and a constant distance to the inner surface of the phantom. Since the sensors cannot directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With these values the area of the maximum SAR is calculated by an interpolation scheme.
4. Around this point, a cube of 30 * 30 * 30 mm or 32 * 32 * 32 mm is assessed by measuring 5 or 8 * 5 or 8*4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

11.3. Description of interpolation/extrapolation scheme

The local SAR inside the phantom is measured using small dipole sensing elements inside a probe body. The probe tip must not be in contact with the phantom surface in order to minimize measurements errors, but the highest local SAR will occur at the surface of the phantom.

An extrapolation is using to determinate this highest local SAR values. The extrapolation is based on a fourth-order least-square polynomial fit of measured data. The local SAR value is then extrapolated from the liquid surface with a 1mm step.

The measurements have to be performed over a limited time (due to the duration of the battery) so the step of measurement is high. It could vary between 5 and 8 mm. To obtain an accurate assessment of the maximum SAR averaged over 10 grams and 1 gram requires a very fine resolution in the three dimensional scanned data array.

11.4. Wireless Router

Some battery-operated handsets have the capability to transmit and receive user through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges, determined form general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

12. Measurement Of Conducted output power

WLAN 2.4GHz Average output power

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN2.4GHz ANT 0	802.11b 1Mbps	CH 1	2412	15.60	16.00	94.86
		CH 6	2437	**15.28**	**16.00**	
		CH 11	2462	14.77	15.50	
	802.11g 6Mbps	CH 1	2412	12.34	13.00	94.90
		CH 6	2437	12.12	13.00	
		CH 11	2462	11.47	12.00	
	802.11n-HT20 MCS0	CH 1	2412	10.88	11.50	90.75
		CH 6	2437	10.32	11.00	
		CH 11	2462	8.61	9.00	
	802.11n-HT40 MCS0	CH 3	2422	7.69	8.00	82.34
		CH 6	2437	7.39	8.00	
		CH 9	2452	6.96	7.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN2.4GHz ANT 1	802.11b 1Mbps	CH 1	2412	**15.72**	**16.00**	95.02
		CH 6	2437	15.09	16.00	
		CH 11	2462	15.26	16.00	
	802.11g 6Mbps	CH 1	2412	11.82	12.00	94.95
		CH 6	2437	11.67	12.00	
		CH 11	2462	11.39	12.00	
	802.11n-HT20 MCS0	CH 1	2412	11.02	12.00	90.70
		CH 6	2437	9.87	10.50	
		CH 11	2462	10.17	11.00	
	802.11n-HT40 MCS0	CH 3	2422	8.78	9.50	82.91
		CH 6	2437	8.90	9.50	
		CH 9	2452	8.04	9.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN ANT 0+1	802.11g 6Mbps	CH 1	2412	24.16	25.00	94.95
		CH 6	2437	23.79	24.00	
		CH 11	2462	22.86	23.50	
	802.11n-HT20 MCS0	CH 1	2412	21.90	22.50	90.70
		CH 6	2437	20.19	21.00	
		CH 11	2462	18.78	19.00	
	802.11n-HT40 MCS0	CH 3	2422	16.47	17.00	82.91
		CH 6	2437	16.29	17.00	
		CH 9	2452	15.00	15.00	

Notes:

1. SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:
   1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
   2) When the reported SAR is > 0.8 W/kg, SAR is required for that position 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.
2. 2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.
3. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
4. Justification for test configurations for WLAN per KDB Publication 248227 D02DR02-41929 for 2.4 GHz WI-FI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.

WLAN 5GHz Average output power

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.2GHz ANT 0	802.11a 6Mbps	CH 36	5180	5.70	6.00	94.93
		CH 44	5220	4.89	5.50	
		CH 48	5240	4.23	5.00	
	802.11n-HT20 MCS0	CH 36	5180	5.48	6.00	90.65
		CH 44	5220	4.80	5.50	
		CH 48	5240	4.51	5.00	
	802.11n-HT40 MCS0	CH 38	5190	3.08	4.00	82.61
		CH 46	5230	2.94	3.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.2GHz ANT 1	802.11a 6Mbps	CH 36	5180	6.48	7.00	94.93
		CH 44	5220	6.72	7.00	
		CH 48	5240	6.73	7.00	
	802.11n-HT20 MCS0	CH 36	5180	6.61	7.00	90.70
		CH 44	5220	6.22	7.00	
		CH 48	5240	6.76	7.00	
	802.11n-HT40 MCS0	CH 38	5190	4.85	5.50	82.61
		CH 46	5230	5.39	6.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.2GHz ANT 0+1	802.11n-HT20 MCS0	CH 36	5180	12.09	12.50	90.70
		CH 44	5220	11.02	12.00	
		CH 48	5240	11.27	12.00	
	802.11n-HT40 MCS0	CH 38	5190	7.93	8.50	82.61
		CH 46	5230	8.33	8.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.3GHz ANT 0	802.11a 6Mbps	CH 52	5260	**8.22**	**9.00**	94.93
		CH 60	5300	7.90	8.50	
		CH 64	5320	7.53	8.00	
	802.11n-HT20 MCS0	CH 52	5260	6.56	7.00	90.65
		CH 60	5300	7.05	7.50	
		CH 64	5320	6.76	7.00	
	802.11n-HT40 MCS0	CH 54	5270	5.77	6.00	82.61
		CH 62	5310	5.45	6.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.3GHz ANT 1	802.11a 6Mbps	CH 52	5260	**8.03**	**9.00**	94.93
		CH 60	5300	7.85	8.50	
		CH 64	5320	7.71	8.50	
	802.11n-HT20 MCS0	CH 52	5260	7.97	8.50	90.70
		CH 60	5300	7.16	8.00	
		CH 64	5320	6.87	7.50	
	802.11n-HT40 MCS0	CH 54	5270	6.45	7.00	82.61
		CH 62	5310	6.37	7.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.3GHz ANT 0+1	802.11n-HT20 MCS0	CH 52	5260	14.53	15.00	90.70
		CH 60	5300	14.21	15.00	
		CH 64	5320	13.63	14.00	
	802.11n-HT40 MCS0	CH 54	5270	12.22	13.00	82.61
		CH 62	5310	11.82	12.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.5GHz ANT 0	802.11a 6Mbps	CH 100	5500	**8.66**	**9.00**	94.93
		CH 120	5600	7.80	8.50	
		CH 140	5700	8.44	9.00	
	802.11n-HT20 MCS0	CH 100	5500	8.32	9.00	90.65
		CH 120	5600	7.62	8.00	
		CH 140	5700	8.66	9.00	
	802.11n-HT40 MCS0	CH 102	5510	7.01	8.00	**82.61**
		CH 126	5630	6.22	7.00	
		CH 134	5670	6.67	7.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.5GHz ANT 1	802.11a 6Mbps	CH 100	5500	**10.84**	**11.50**	94.93
		CH 120	5600	9.73	10.50	
		CH 140	5700	9.99	10.50	
	802.11n-HT20 MCS0	CH 100	5500	9.79	10.50	90.70
		CH 120	5600	8.88	9.50	
		CH 140	5700	9.11	10.00	
	802.11n-HT40 MCS0	CH 102	5510	8.79	9.50	82.61
		CH 126	5630	8.05	9.00	
		CH 134	5670	8.10	9.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.5GHz ANT 0+1	802.11n-HT20 MCS0	CH 100	5500	18.11	19.00	90.70
		CH 116	5580	16.50	17.00	
		CH 140	5700	17.77	18.00	
	802.11n-HT40 MCS0	CH 102	5510	15.80	16.00	82.61
		CH 126	5630	14.27	15.00	
		CH 134	5670	14.77	15.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.8GHz ANT 0	802.11a MCS0	CH 149	5745	8.65	9.00	94.93
		CH 157	5785	8.59	9.00	
		CH 165	5825	8.05	9.00	
	802.11n-HT20 MCS0	CH 149	5745	**8.73**	**9.00**	90.65
		CH 157	5785	7.79	8.50	
		CH 165	5825	7.81	8.50	
	802.11n-HT40 MCS0	CH 151	5755	7.30	8.00	82.61
		CH 159	5795	7.25	8.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.8GHz ANT 1	802.11a MCS0	CH 149	5745	10.39	11.00	94.93
		CH 157	5785	**10.52**	**11.00**	
		CH 165	5825	10.02	11.00	
	802.11n-HT20 MCS0	CH 149	5745	9.22	10.00	90.70
		CH 157	5785	9.62	10.00	
		CH 165	5825	8.66	9.00	
	802.11n-HT40 MCS0	CH 151	5755	8.78	9.00	82.61
		CH 159	5795	8.43	9.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WLAN5.8GHz ANT 0+1	802.11n-HT20 MCS0	CH 149	5745	17.95	18.50	90.70
		CH 157	5785	17.41	18.00	
		CH 165	5825	16.47	17.00	
	802.11n-HT40 MCS0	CH 151	5755	16.08	17.00	82.61
		CH 159	5795	15.68	16.00	

Note:

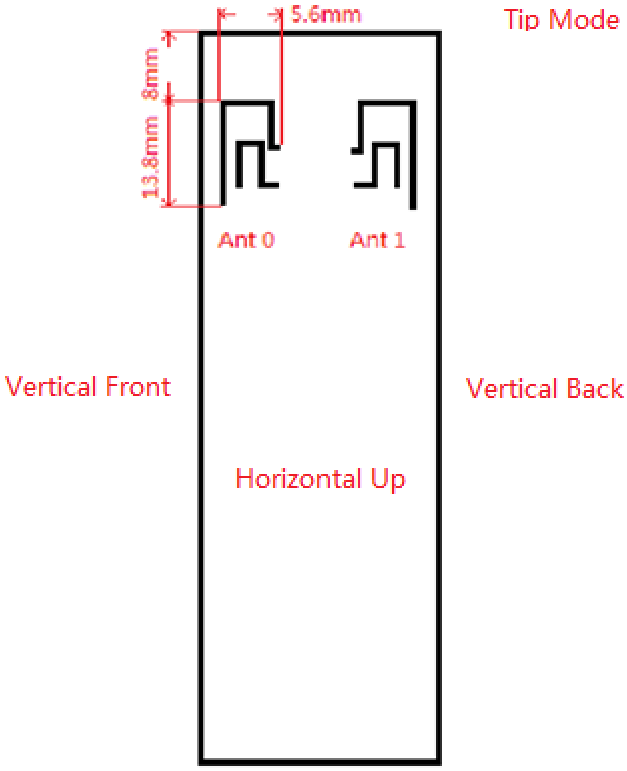
1. Per KDB 248227 D01v02r02, U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1

band.

2. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
3. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
4. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

13. Hotspot Evaluation

13.1 EUT Antenna Location



13.2 SAR Test Exclusion Consider Table

According with FCC KDB 447498 D01, Appendix A, <SAR Test Exclusion Thresholds for 100 MHz –6 GHz and ≤50 mm> Table, this Device SAR test configurations consider as following:

Band	Horizontal-Up	Horizontal-Down	Vertical-Front	Vertical-Back	Tip
Distance	<5mm	<5mm	<5mm	<5mm	<5mm
WLAN 2.4GHz	Yes	Yes	Yes	Yes	Yes
WLAN 5GHz	Yes	Yes	Yes	Yes	Yes

Note :

1. Maximum power is the source-based time-average power and represents the maximum RF output power among production units.
2. Per KDB 447498 D01, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.

3. Per KDB 447498 D01, standalone SAR test exclusion threshold is applied; If the distance of the antenna to the user is < 5mm, 5mm is used to determine SAR exclusion threshold
4. Per KDB 447498 D01, 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
   a. f(GHz) is the RF channel transmit frequency in GHz
   b. Power and distance are rounded to the nearest mW and mm before calculation
   c. The result is rounded to one decimal place for comparison
   d. For < 50 mm distance, we just calculate mW of the exclusion threshold value (3.0) to do compare.
   e. This formula is [3.0] / [√f(GHz)] ·[(min. test separation distance, mm)] = exclusion threshold of mW.
5. Per KDB 447498 D01, at 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following:
   a. [Threshold at 50 mm in step 1) + (test separation distance -50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz
   b. [Threshold at 50 mm in step 1) + (test separation distance -50 mm)·10] mW at > 1500 MHz and ≤ 6 GHz
6. Per KDB 248227 D01 SAR is not required for the following 2.4 GHz OFDM conditions.
   (a) When the reported SAR of the highest measured maximum output power channel 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
7. Per KDB 248227 D01SAR is not required for the following 2.4 GHz OFDM conditions.
   a. When KDB Publication 447498 D01 SAR test exclusion applies to the OFDM configuration.
   b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output

14. Test Results List

Test Guidance:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
   d. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
   e. For TDD LTE SAR measurement, the duty cycle 1:1.59 (62.9 %) was used perform testing and considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix 63.3%/62.9% = 1.006 is applied to scale-up the measured SAR result. The Reported TDD LTE SAR = measured SAR (W/kg)* Tune-up Scaling Factor* scaling factor for extended cyclic prefix.
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is: ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
4. Per KDB 648474 D04v01r03, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is ≤ 1.2 W/kg, SAR testing with a headset connected to the handset is not required.

Test Results:

<WLAN 2.4GHz & WLAN 5GHz>

Plot No.	Band	Mode	Test Position	Antenna	Ch.	Average Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Mea. 1g SAR (W/kg)	Rep. 1g SAR (W/kg)
	WLAN2.4GHz	802.11b	Horizontal Up	Ant 1	1	15.6	16	1.096	94.86	1.054	0.101	0.117
	WLAN2.4GHz	802.11b	Horizontal Down	Ant 1	1	15.6	16	1.096	94.86	1.054	0.136	0.157
	WLAN2.4GHz	802.11b	Vertical Front	Ant 1	1	15.6	16	1.096	94.86	1.054	0.102	0.118
	WLAN2.4GHz	802.11b	Vertical Back	Ant 1	1	15.6	16	1.096	94.86	1.054	0.036	0.041
	WLAN2.4GHz	802.11b	Tip	Ant 1	1	15.6	16	1.096	94.86	1.054	0.018	0.021
	WLAN2.4GHz	802.11b	Horizontal Up	Ant 2	1	15.72	16	1.067	95.02	1.052	0.431	0.484
1#	WLAN2.4GHz	802.11b	Horizontal Down	Ant 2	1	15.72	16	1.067	95.02	1.052	0.679	**0.762**
	WLAN2.4GHz	802.11b	Vertical Front	Ant 2	1	15.72	16	1.067	95.02	1.052	0.474	0.532
	WLAN2.4GHz	802.11b	Vertical Back	Ant 2	1	15.72	16	1.067	95.02	1.052	0.146	0.164
	WLAN2.4GHz	802.11b	Tip	Ant 2	1	15.72	16	1.067	95.02	1.052	0.066	0.074
	WLAN2.4GHz	802.11n-H T20	Horizontal Up	Ant 1+2	1	21.9	22.5	1.148	95.02	1.052	0.042	0.050
	WLAN2.4GHz	802.11n-H T20	Horizontal Down	Ant 1+2	1	21.9	22.5	1.148	95.02	1.052	0.066	0.079
	WLAN2.4GHz	802.11n-H T20	Vertical Front	Ant 1+2	1	21.9	22.5	1.148	95.02	1.052	0.046	0.056
	WLAN2.4GHz	802.11n-H T20	Vertical Back	Ant 1+2	1	21.9	22.5	1.148	95.02	1.052	0.014	0.017
	WLAN2.4GHz	802.11n-H T20	Tip	Ant 1+2	1	21.9	22.5	1.148	95.02	1.052	0.006	0.008
	WLAN5GHz	802.11a	Horizontal Up	Ant 1	52	8.22	9	1.197	94.93	1.053	0.082	0.103
	WLAN5GHz	802.11a	Horizontal Down	Ant 1	52	8.22	9	1.197	94.93	1.053	0.249	0.314
	WLAN5GHz	802.11a	Vertical Front	Ant 1	52	8.22	9	1.197	94.93	1.053	0.152	0.192
	WLAN5GHz	802.11a	Vertical Back	Ant 1	52	8.22	9	1.197	94.93	1.053	0.138	0.174
	WLAN5GHz	802.11a	Tip	Ant 1	52	8.22	9	1.197	94.93	1.053	0.088	0.111

Plot No.	Band	Mode	Test Position	Ant.	Ch.	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Mea. 1g SAR (W/kg)	Rep. 1g SAR (W/kg)
	WLAN5GHz	802.11a	Horizontal Up	Ant 2	52	8.03	9	1.250	94.93	1.053	0.191	0.251
2#	WLAN5GHz	802.11a	Horizontal Down	Ant 2	52	8.03	9	1.250	94.93	1.053	0.329	**0.433**
	WLAN5GHz	802.11a	Vertical Front	Ant 2	52	8.03	9	1.250	94.93	1.053	0.159	0.209
	WLAN5GHz	802.11a	Vertical Back	Ant 2	52	8.03	9	1.250	94.93	1.053	0.174	0.229
	WLAN5GHz	802.11a	Tip	Ant 2	52	8.03	9	1.250	94.93	1.053	0.112	0.147
	WLAN5GHz	802.11n-HT20	Horizontal Up	Ant 1+2	52	14.53	15	1.114	94.93	1.053	0.214	0.251
	WLAN5GHz	802.11n-HT20	Horizontal Down	Ant 1+2	52	14.53	15	1.114	94.93	1.053	0.369	0.433
	WLAN5GHz	802.11n-HT20	Vertical Front	Ant 1+2	52	14.53	15	1.114	94.93	1.053	0.178	0.209
	WLAN5GHz	802.11n-HT20	Vertical Back	Ant 1+2	52	14.53	15	1.114	94.93	1.053	0.195	0.229
	WLAN5GHz	802.11n-HT20	Tip	Ant 1+2	52	14.53	15	1.114	94.93	1.053	0.126	0.148
	WLAN5GHz	802.11a	Horizontal Up	Ant 1	100	8.66	9	1.081	94.93	1.053	0.192	0.219
	WLAN5GHz	802.11a	Horizontal Down	Ant 1	100	8.66	9	1.081	94.93	1.053	0.245	0.279
	WLAN5GHz	802.11a	Vertical Front	Ant 1	100	8.66	9	1.081	94.93	1.053	0.192	0.219
	WLAN5GHz	802.11a	Vertical Back	Ant 1	100	8.66	9	1.081	94.93	1.053	0.072	0.082
	WLAN5GHz	802.11a	Tip	Ant 1	100	8.66	9	1.081	94.93	1.053	0.080	0.091
	WLAN5GHz	802.11a	Horizontal Up	Ant 2	100	10.84	11.5	1.164	94.93	1.053	0.285	0.349
	WLAN5GHz	802.11a	Horizontal Down	Ant 2	100	10.84	11.5	1.164	94.93	1.053	0.403	0.494
	WLAN5GHz	802.11a	Vertical Front	Ant 2	100	10.84	11.5	1.164	94.93	1.053	0.156	0.191
	WLAN5GHz	802.11a	Vertical Back	Ant 2	100	10.84	11.5	1.164	94.93	1.053	0.230	0.282
	WLAN5GHz	802.11a	Tip	Ant 2	100	10.84	11.5	1.164	94.93	1.053	0.142	0.174

Plot No.	Band	Mode	Test Position	Ant.	Ch.	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Mea. 1g SAR (W/kg)	Rep. 1g SAR (W/kg)
	WLAN5GHz	802.11n-HT20	Horizontal Up	Ant 1+2	100	18.11	19	1.227	94.93	1.053	0.335	0.433
3#	WLAN5GHz	802.11n-HT20	Horizontal Down	Ant 1+2	100	18.11	19	1.227	94.93	1.053	0.474	**0.613**
	WLAN5GHz	802.11n-HT20	Vertical Front	Ant 1+2	100	18.11	19	1.227	94.93	1.053	0.183	0.237
	WLAN5GHz	802.11n-HT20	Vertical Back	Ant 1+2	100	18.11	19	1.227	94.93	1.053	0.271	0.350
	WLAN5GHz	802.11n-HT20	Tip	Ant 1+2	100	18.11	19	1.227	94.93	1.053	0.167	0.216
	WLAN5GHz	802.11n-HT20	Horizontal Up	Ant 1	149	8.73	9	1.064	90.7	1.103	0.219	0.257
	WLAN5GHz	802.11n-HT20	Horizontal Down	Ant 1	149	8.73	9	1.064	90.7	1.103	0.188	0.221
	WLAN5GHz	802.11n-HT20	Vertical Front	Ant 1	149	8.73	9	1.064	90.7	1.103	0.252	0.296
	WLAN5GHz	802.11n-HT20	Vertical Back	Ant 1	149	8.73	9	1.064	90.7	1.103	0.157	0.184
	WLAN5GHz	802.11n-HT20	Tip	Ant 1	149	8.73	9	1.064	90.7	1.103	0.093	0.110
	WLAN5GHz	802.11a	Horizontal Up	Ant 2	157	10.52	11	1.117	94.93	1.053	0.263	0.309
4#	WLAN5GHz	802.11a	Horizontal Down	Ant 2	157	10.52	11	1.117	94.93	1.053	0.390	**0.459**
	WLAN5GHz	802.11a	Vertical Front	Ant 2	157	10.52	11	1.117	94.93	1.053	0.247	0.290
	WLAN5GHz	802.11a	Vertical Back	Ant 2	157	10.52	11	1.117	94.93	1.053	0.214	0.252
	WLAN5GHz	802.11a	Tip	Ant 2	157	10.52	11	1.117	94.93	1.053	0.181	0.213

Plot No.	Band	Mode	Test Position	Ant.	Ch.	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Mea. 1g SAR (W/kg)	Rep. 1g SAR (W/kg)
	WLAN5GHz	802.11n-HT20	Horizontal Up	Ant 1+2	149	17.95	18.5	1.135	94.93	1.053	0.234	0.280
	WLAN5GHz	802.11n-HT20	Horizontal Down	Ant 1+2	149	17.95	18.5	1.135	94.93	1.053	0.347	0.415
	WLAN5GHz	802.11n-HT20	Vertical Front	Ant 1+2	149	17.95	18.5	1.135	94.93	1.053	0.220	0.263
	WLAN5GHz	802.11n-HT20	Vertical Back	Ant 1+2	149	17.95	18.5	1.135	94.93	1.053	0.190	0.227
	WLAN5GHz	802.11n-HT20	Tip	Ant 1+2	149	17.95	18.5	1.135	94.93	1.053	0.161	0.192

15. Repeated SAR Measurement

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

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16. Simultaneous SAR Evaluation

Simultaneous Evaluation:

No.	Simultaneous transmission Condition	Body
1	WLAN2.4GHz Ant.0 + WLAN2.4GHz Ant.1	Yes
2	WLAN2.4GHz Ant.0 + WLAN5GHz Ant.1	Yes
3	WLAN2.4GHz Ant.1 + WLAN 5GHz Ant .0	Yes
4	WLAN5GHz Ant.0 + WLAN 5GHz Ant .1	Yes

Note:

1、 For 2.4GHz and 5GHz WLAN, SAR testing was performed on SISO and MIMO mode.

2、 The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WiFi Direct and Hotspot capability. Therefore, the following summations represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

3、 The maximum SAR summation is calculated based on the same configuration and exposure position.

4、 Per KDB 447498 D01v06, simultaneous transmission SAR is compliant when,

(a) Scalar SAR summation < 1.6W/kg.

(b) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined

(c) From the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of

(d) The extrapolated peak SAR locations in the zoom scan.

(e) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.

(f) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

Annex A General Information

1. Identification of the Responsible Testing Laboratory

Company Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Department:	Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Responsible Test Lab Manager:	Mr. Su Feng
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

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3. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	805	2017.10.12	2018.10.11
SPEAG	5000MHz System Validation Kit	D5GHzV2	1176	2017.09.25	2018.09.24
SPEAG	Dosimetric E-Field Probe	EX3DV4	3823	2017.09.30	2018.09.29
SPEAG	Data Acquisition Electronics	DAE4	480	2017.9.27	2018.9.26
SPEAG	SAM Twin Phantom 1	QD 000 P40 CB	TP-1471	NCR	NCR
SPEAG	SAM Twin Phantom 2	QD 000 P40 CB	TP-1464	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
R&S	Network Emulator	CMW500	124534	2017.5.25	2018.5.24
Agilent	Network Analyzer	E5071B	MY42404762	2017.5.25	2018.5.24
mini-circuits	Amplifier	ZVE-8G+	754401735	NCR	NCR
Agilent	Signal Generator	SMP_02	N/A	2017.7.8	2018.7.7
Agilent	Signal Generator	N5182B	MY53050509	2017.5.24	2018.5.23
Agilent	Power Senor	N8482A	MY41091706	2017.7.8	2018.7.7
Anritsu	Power Sensor	MA2411B	N/A	2017.7.8	2018.7.7
R&S	Power Meter	NRVD	101066	2017.7.8	2018.7.7
MCL	Attenuation1	351-218-010	N/A	NA	NA
N/A	Liquid	2450/5GHz	N/A	24H	

Annex B Test Setup Photos

Body

Horizontal Up_5mm

Horizontal Down_5mm

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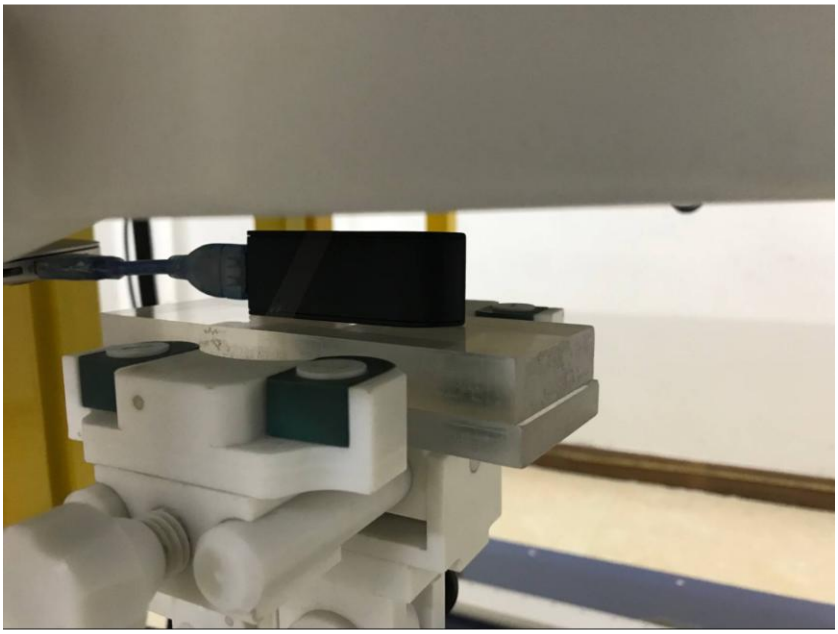
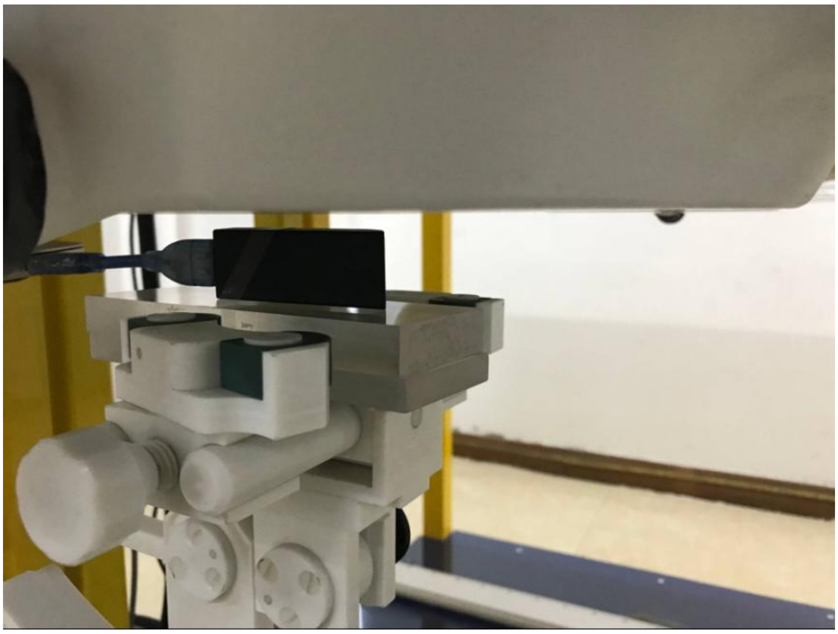
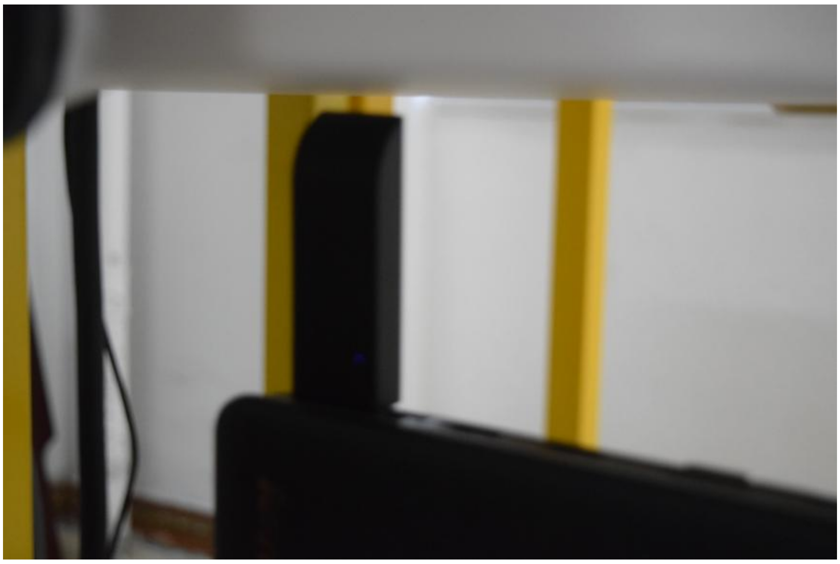


Vertical Front_5mm



Vertical Back_5mm



Tip Mode_5mm

Annex C Plots of System Performance Check

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Test Laboratory: SAR Lab. of Shenzhen Morlab Communications Technology Co., Ltd. Date: 2018.05.13

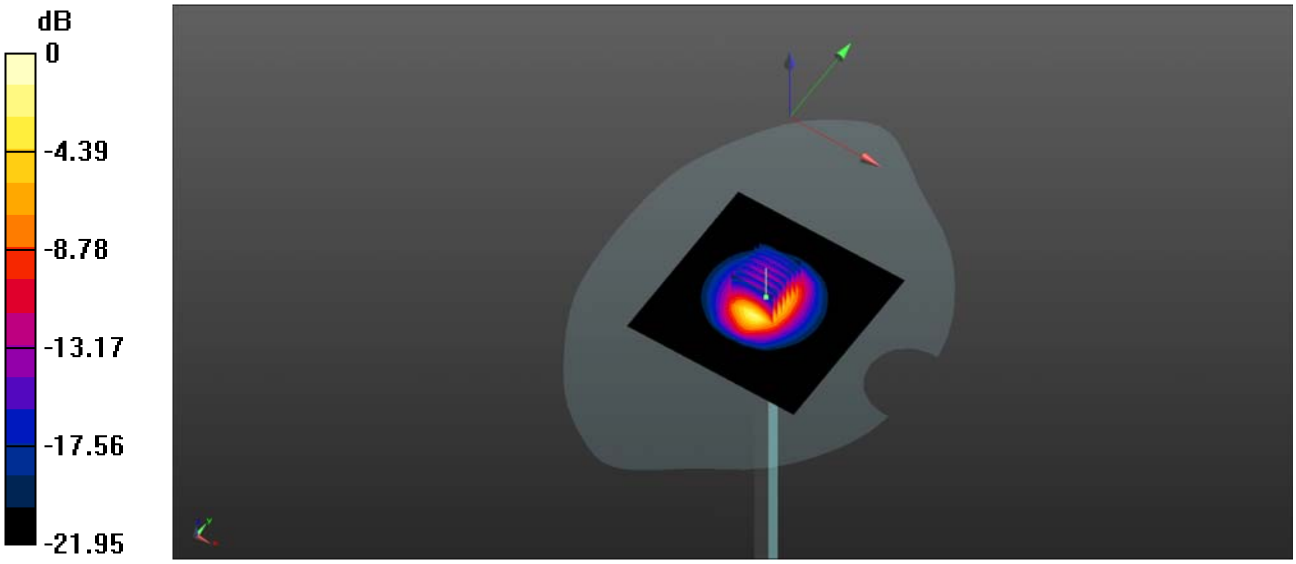
System Check_2450MHz_Body_180513

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450_180513 Medium parameters used: f = 2450 MHz; σ = 2.039 S/m; ε_r = 50.603; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3823; ConvF(7.17, 7.17, 7.17); Calibrated: 2017.09.30;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn480; Calibrated: 2017.09.27
- Phantom: SAM 1; Type: QD000P40CC; Serial: TP:1471
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW 2450/Area Scan (101x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 15.6 W/kg

CW 2450/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.40 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 28.3 W/kg
SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.15 W/kg
Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg

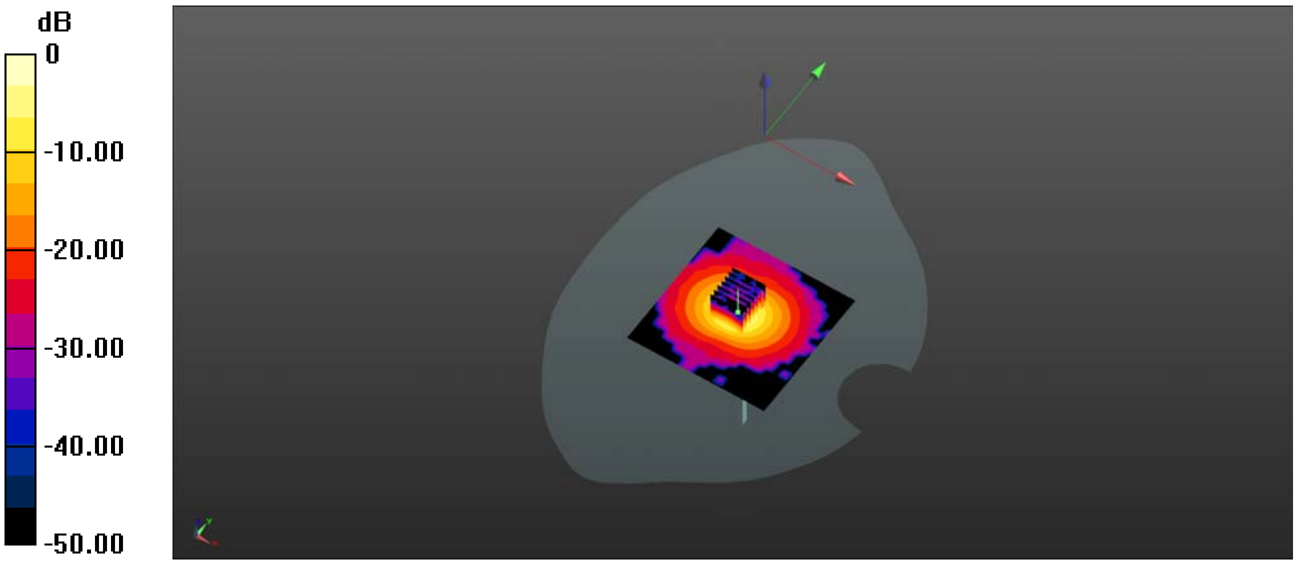
System Check_5200MHz_Body_180514

Communication System: UID 0, CW (0); Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL_5200_180514 Medium parameters used: f = 5200 MHz; σ = 5.364 S/m; ε_r = 48.458; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3823; ConvF(4.81, 4.81, 4.81); Calibrated: 2017.09.30;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn480; Calibrated: 2017.09.27
- Phantom: SAM 2; Type: QD000P40CC; Serial: TP:1464
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW5200/Area Scan (201x201x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 9.05 W/kg

CW5200/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=4mm
Reference Value = 36.95 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 43.9 W/kg
SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.20 W/kg
Maximum value of SAR (measured) = 14.91 W/kg



0 dB = 14.91W/kg

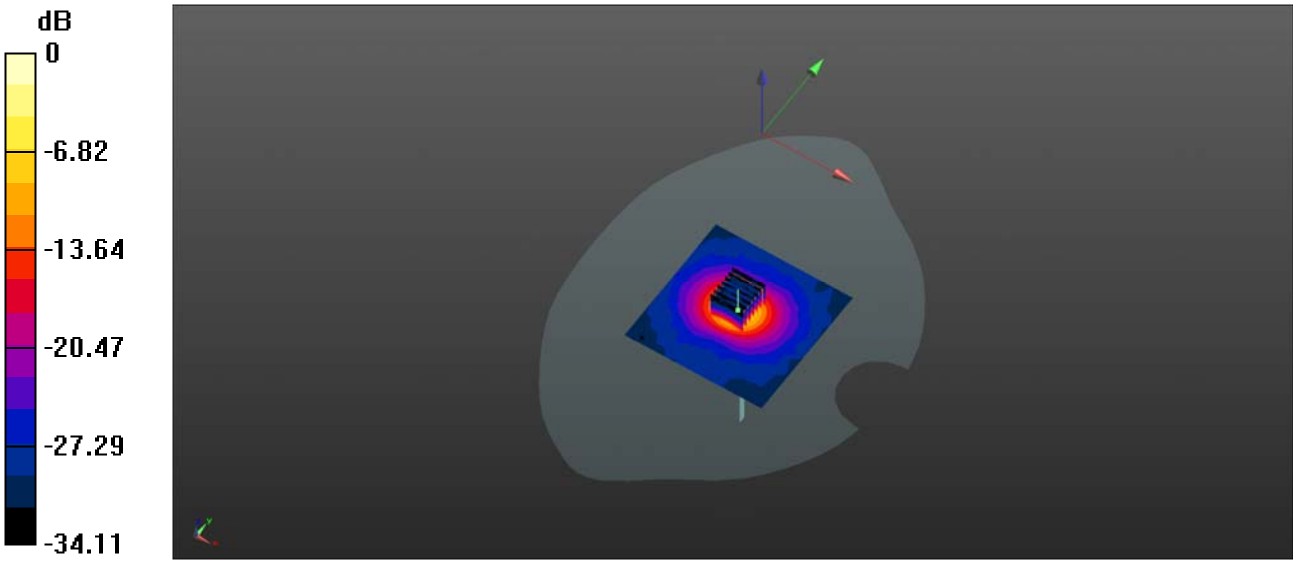
System Check_5300MHz_Body_180514

Communication System: UID 0, CW (0); Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: MSL_5300_180514 Medium parameters used: f = 5300 MHz; σ = 5.503 S/m; ε_r = 48.195; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3823; ConvF(4.46, 4.46, 4.46); Calibrated: 2017.09.30;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn480; Calibrated: 2017.09.27
- Phantom: SAM 2; Type: QD000P40CC; Serial: TP:1464
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW5300/Area Scan (201x201x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 8.5 W/kg

CW5300/Zoom Scan (7x7x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 38.52 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 42.2 W/kg
SAR(1 g) = 7.44 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 18.5 W/kg



0 dB = 18.5 W/kg

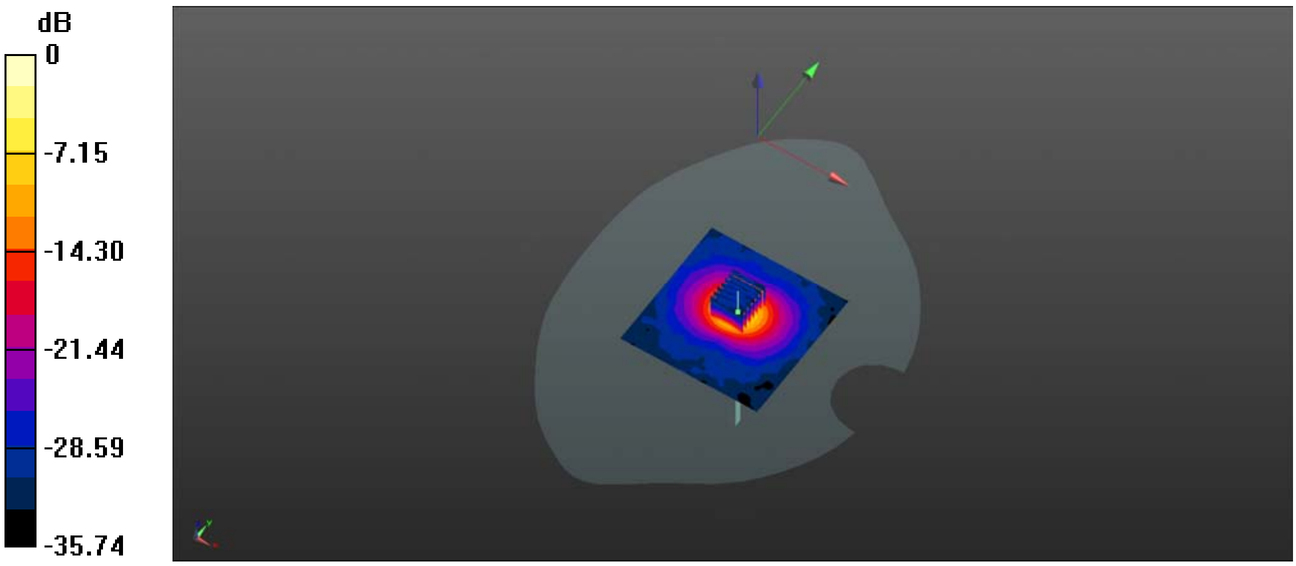
System Check_5500MHz_Body_180515

Communication System: UID 0, CW (0); Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: MSL_5500_180515 Medium parameters used: f = 5500 MHz; σ = 5.679 S/m; ε_r = 47.843; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3823; ConvF(4.15, 4.15, 4.15); Calibrated: 2017.09.30;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn480; Calibrated: 2017.09.27
- Phantom: SAM 2; Type: QD000P40CC; Serial: TP:1464
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW5500/Area Scan (201x201x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 9.6 W/kg

CW5500/Zoom Scan (7x7x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 34.94 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 44.0 W/kg
SAR(1 g) = 8.54 W/kg; SAR(10 g) = 2.35 W/kg
Maximum value of SAR (measured) = 19.6 W/kg



0 dB = 19.6 W/kg

Test Laboratory: SAR Lab. of Shenzhen Morlab Communications Technology Co., Ltd. Date: 2018.05.15

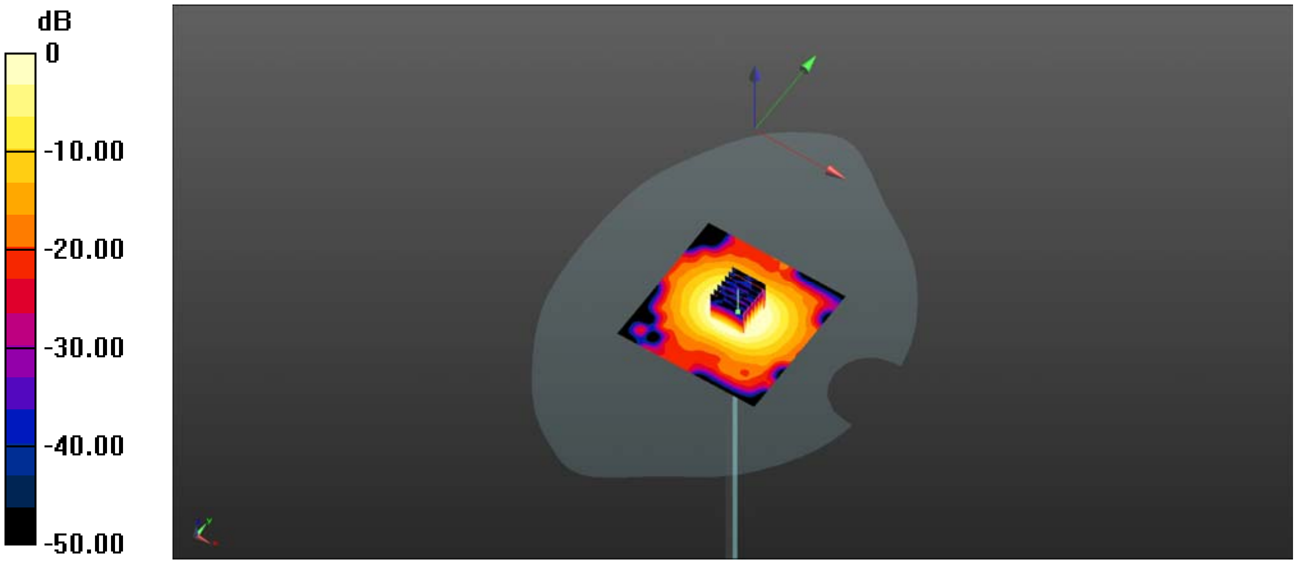
System Check_5800MHz_Body_180515

Communication System: UID 0, CW (0); Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: MSL_5800_180515 Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3 , Medium parameters used: f = 5800 MHz; $\sigma = 6.182$ S/m; $\varepsilon_r = 47.417$; $\rho = 1000$ kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3823; ConvF(3.99, 3.99, 3.99); Calibrated: 2017.09.30;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn480; Calibrated: 2017.09.27
- Phantom: SAM 2; Type: QD000P40CC; Serial: TP:1464
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW5800/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of Total (interpolated) = 8.60 W/kg

CW5800/Zoom Scan (7x7x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 37.03 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 48.6 W/kg
SAR(1 g) = 7.81 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 18.30 V/m

Annex D Plots of Maximum SAR Test Results

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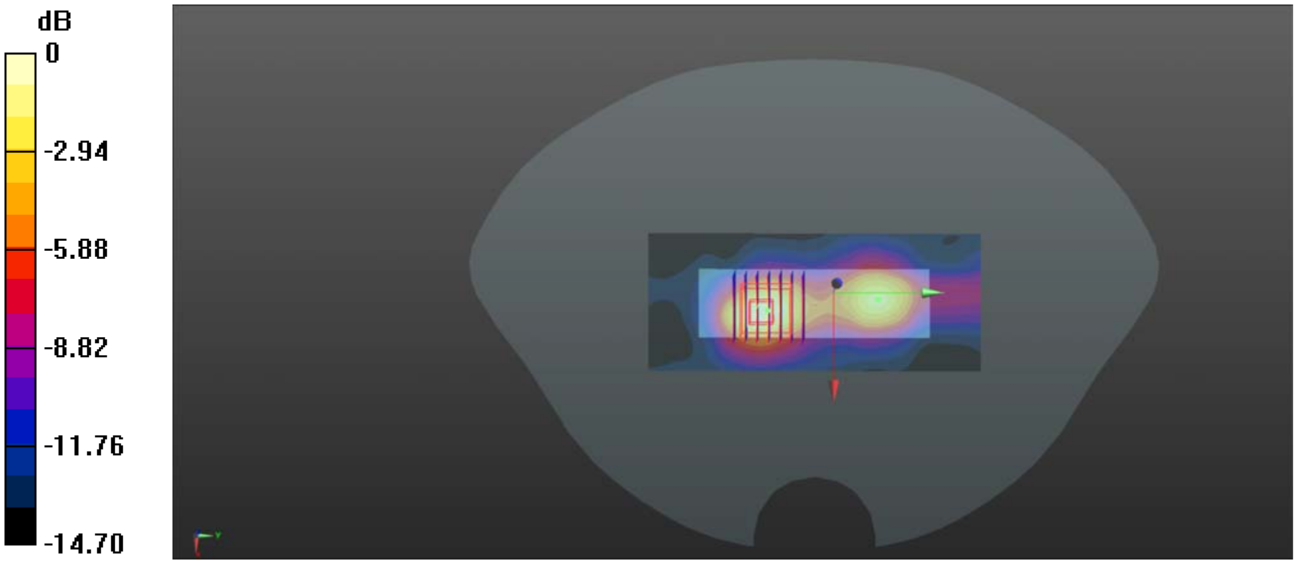
WLAN2.4GHz_802.11b 1Mbps_Horizontal Down_5mm_Ch1_Ant 1

Communication System: UID 0, WLAN 2.4GHz (0); Frequency: 2412 MHz;Duty Cycle: 1:1.052
Medium: MSL_2450_180513 Medium parameters used: f = 2412 MHz; σ = 1.988 S/m; ε_r = 50.888; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3823; ConvF(7.17, 7.17, 7.17); Calibrated: 2017.09.30;
- Sensor-Surface: 4mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn480; Calibrated: 2017.09.27
- Phantom: SAM 1; Type: QD000P40CC; Serial: TP:1471
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1/Area Scan (51x121x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.842 W/kg

Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.48 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 1.38 W/kg
SAR(1 g) = 0.679 W/kg; SAR(10 g) = 0.324 W/kg
Maximum value of SAR (measured) = 1.09 W/kg



0 dB = 0.842 W/kg

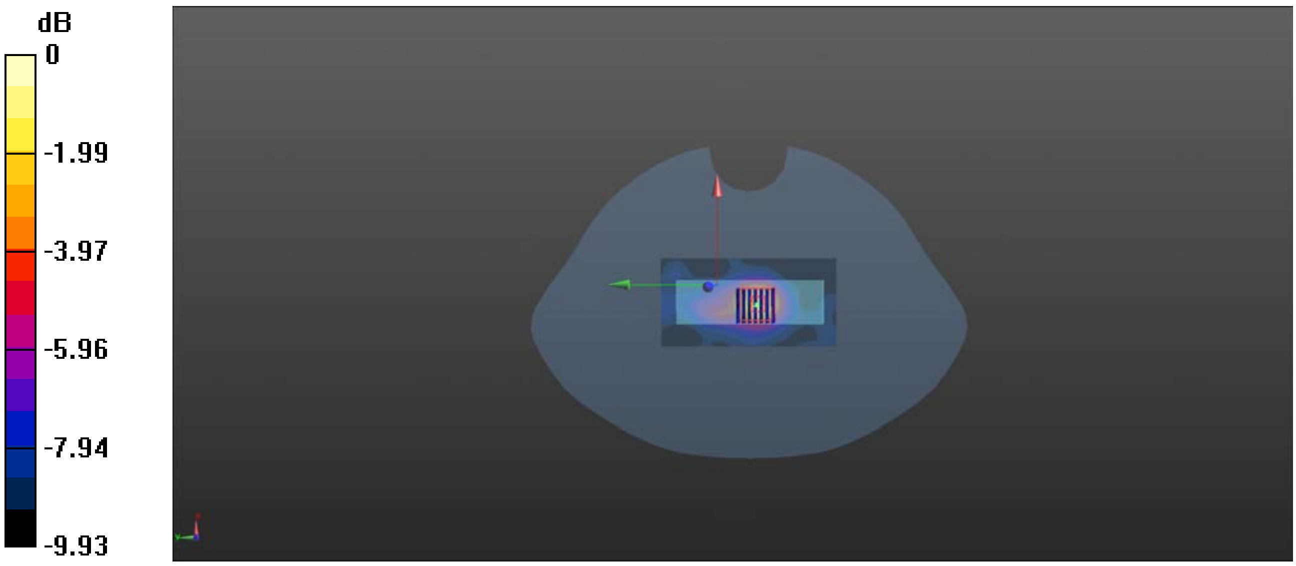
WLAN5GHz_802.11n-HT20_Horizontal Down_5mm_Ch52_Ant 0+1

Communication System: UID 0, WLAN 5GHz (0); Frequency: 5260 MHz;Duty Cycle: 1:1.053
Medium: MSL_5300_180514 Medium parameters used: f = 5260 MHz; σ = 5.431 S/m; ε_r = 48.172; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3823; ConvF(4.46, 4.46, 4.46); Calibrated: 2017.09.30;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn480; Calibrated: 2017.09.27
- Phantom: SAM 2; Type: QD000P40CC; Serial: TP:1464
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch52/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.703 W/kg

Ch52/Zoom Scan (7x7x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 8.049 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 1.20 W/kg
SAR(1 g) = 0.369 W/kg; SAR(10 g) = 0.193 W/kg
Maximum value of SAR (measured) = 0.726 W/kg



0 dB = 0.726 W/kg

Test Laboratory: SAR Lab. of Shenzhen Morlab Communications Technology Co., Ltd. Date: 2018.05.15

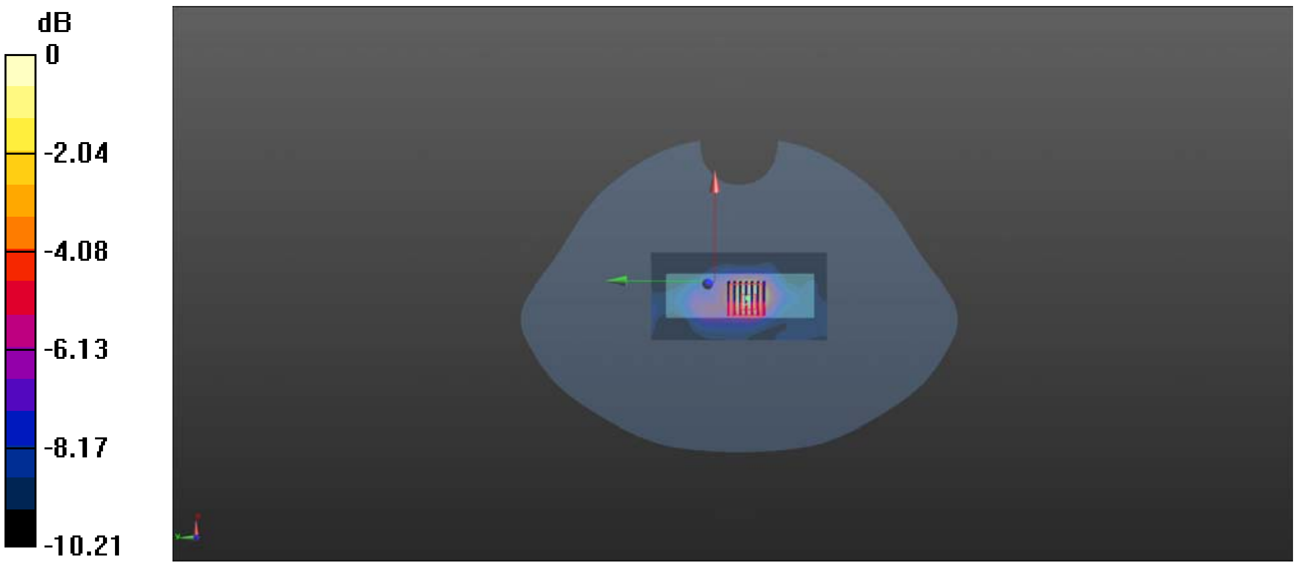
WLAN5GHz_802.11n-HT20_Horizontal Down_5mm_Ch100_Ant 0+1

Communication System: UID 0, WLAN 5GHz (0); Frequency: 5500 MHz;Duty Cycle: 1:1.053
Medium: MSL_5500_180515 Medium parameters used: f = 5500 MHz; σ = 5.679 S/m; ε_r = 47.843; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3823; ConvF(4.15, 4.15, 4.15); Calibrated: 2017.09.30;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn480; Calibrated: 2017.09.27
- Phantom: SAM 2; Type: QD000P40CC; Serial: TP:1464
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch100/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.842 W/kg

Ch100/Zoom Scan (7x7x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 8.119 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.47 W/kg
SAR(1 g) = 0.474 W/kg; SAR(10 g) = 0.280 W/kg
Maximum value of SAR (measured) = 0.883 W/kg



0 dB = 0.883 W/kg

Test Laboratory: SAR Lab. of Shenzhen Morlab Communications Technology Co., Ltd. Date: 2018.05.15

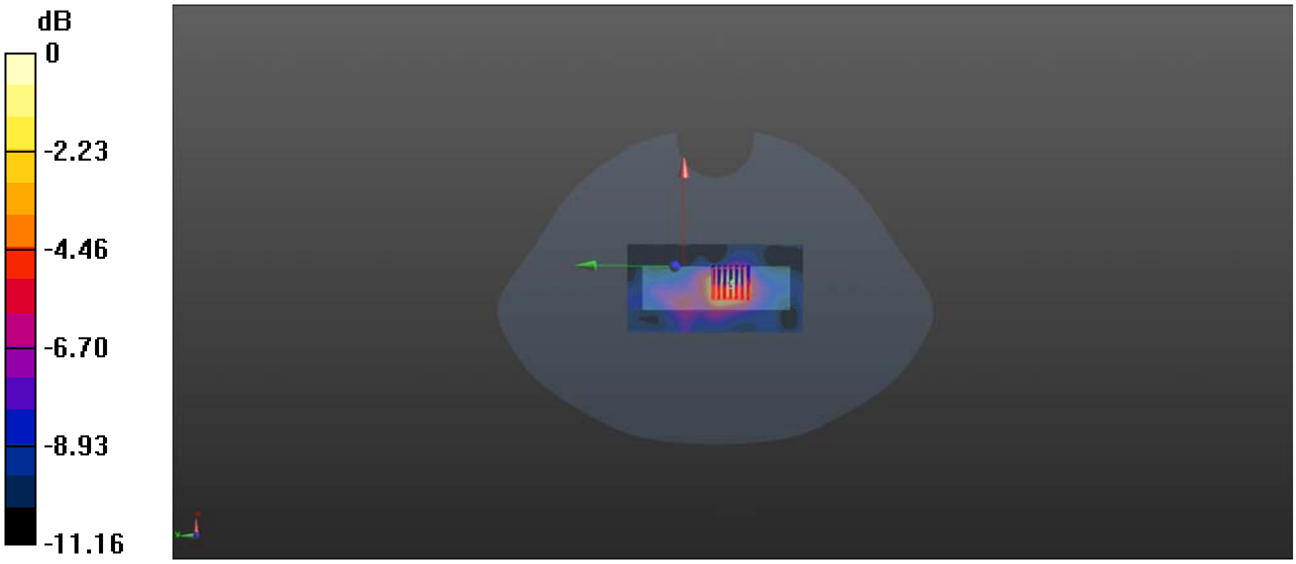
WLAN5GHz_802.11a 6Mbps_Horizontal Down_5mm_Ch157_Ant 1

Communication System: UID 0, WLAN 5GHz (0); Frequency: 5785 MHz;Duty Cycle: 1:1.053
Medium: MSL_5800_180515 Medium parameters used: f = 5785 MHz; σ = 6.15 S/m; ε_r = 47.364; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3823; ConvF(3.99, 3.99, 3.99); Calibrated: 2017.09.30;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn480; Calibrated: 2017.09.27
- Phantom: SAM 2; Type: QD000P40CC; Serial: TP:1464
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch157/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.556 W/kg

Ch157/Zoom Scan (7x7x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 6.615 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.20 W/kg
SAR(1 g) = 0.390 W/kg; SAR(10 g) = 0.216 W/kg
Maximum value of SAR (measured) = 0.736 W/kg



0 dB = 0.736 W/kg