

FCC

SAR

TEST REPORT

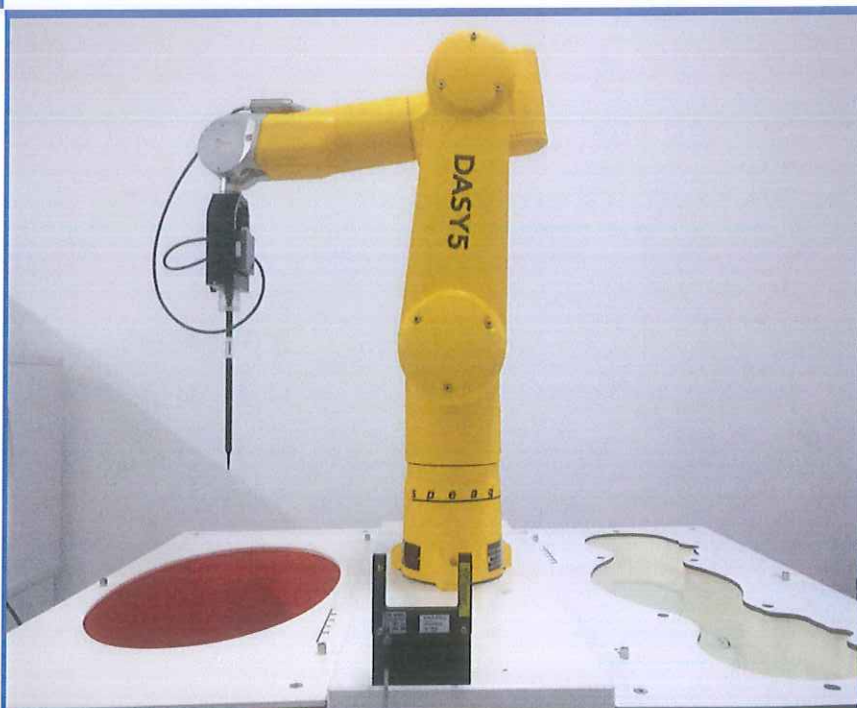
ISSUED BY  
Shenzhen BALUN Technology Co., Ltd.



FOR  
**Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2**  
**Type Card**

ISSUED TO  
Qualcomm Atheros, Inc.

1700 Technology Drive, San Jose, CA 95110



Tested by: Zong Liyao  
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Date: Aug. 16, 2017

Approved by: Wei Yanquan  
Wei Yanquan  
(Chief Engineer)

Date: Aug. 16, 2017

Report No.: BL-SZ1760285-701

EUT Name: Single Stream 802.11a/b/g/n/ac +  
BT 4.1 M.2 Type Card

Model Name QCNFA435

Brand Name: Qualcomm Atheros

FCC ID: PPD-QCNFA435

Test Standard: FCC 47 CFR Part 2.1093  
ANSI C95.1: 1999, IEEE 1528: 2013

Maximum SAR: Body 2.4GHz (1 g): 1.138 W/kg  
Body 5GHz (1 g): 1.182 W/kg

Test Conclusion: Pass

Test Date: Jun. 27, 2017 ~ Jun. 28, 2017

Date of Issue: Aug. 16, 2017

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### Revision History

Version	Issue Date	Revisions Content
<u>Rev. 01</u>	<u>Jul. 10, 2017</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Jul. 25, 2017</u>	<u>Added 2.4GHz Maximum SAR Value in Cover page.</u>
<u>Rev. 03</u>	<u>Jul. 27, 2017</u>	<u>Updated Product Description in page 6.</u> <u>Updated tune up power and recalculated the Scaled SAR Values.</u>
<u>Rev. 04</u>	<u>Aug. 16, 2017</u>	<u>Updated 802.11n (HT20) channel 11 tune up limit in section 8.</u> <u>Updated 802.11ac (VHT40) channel 54 and 62 tune up limit in section 8.</u> <u>Updated 802.11 n (HT40) and ac (VHT40) channel 102 tune up limit in section 8.</u>

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## 1 GENERAL INFORMATION

### 1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co.,Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province,P. R. China
Phone Number	+86 755 6685 0100
Fax Number	+86 755 6182 4271

### 1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co.,Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province,P. R. China
Accreditation Certificate	<p>The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1.</p> <p>The laboratory has been listed by US Federal Communications Commission to perform electromagnetic emission measurements. The recognition numbers of test site are 832625.</p> <p>The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.</p>
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

### 1.3 Test Environment Condition

Ambient Temperature	21 to 23°C
Ambient Relative Humidity	37 to 48%
Ambient Pressure	100 to 102KPa

## 1.4 Announce

- (1) The test report reference to the report template version v2.2.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.
- (5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.
- (6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

## 2 PRODUCT INFORMATION

### 2.1 Applicant

Applicant	Qualcomm Atheros, Inc.
Address	1700 Technology Drive, San Jose, CA 95110

### 2.2 Manufacturer

Manufacturer	Qualcomm Atheros, Inc.
Address	1700 Technology Drive, San Jose, CA 95110

### 2.3 Factory Information

Factory	N/A
Address	N/A

### 2.4 General Description for Equipment under Test (EUT)

EUT Name	Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 Type Card
Model Name Under Test	QCNFA435
Series Model Name	N/A
Description of Model Name Differentiation	N/A
Hardware Version	N/A
Software Version	N/A
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A
Network and Wireless connectivity	WIFI 802.11a, 802.11b, 802.11g, 802.11n(HT20/40), 802.11ac(HT20/40/80); Bluetooth

#### 2.4.1 Host Information:

Product Description	Notebook / Tablet Computer
Model Name	Lenovo YOGA 720-12IKB, 81B5
brand	Lenovo



## 2.4.2 Antenna Information:

Antenna Port	Antenna Manufacturer	Antenna Type	Antenna Gain (dBi)			
			2.4~2.4835 GHz	5.15~5.35 GHz	5.47~5.725 GHz	5.725~5.850 GHz
Main Antenna	South Star	PIFA	1.22	1.31	1.25	1.29
Auxiliary Antenna		PIFA	0.94	0.74	1.12	0.65
Note: The Main Antenna supports TX/RX function, and the Auxiliary Antenna only support RX function.						

## 2.5 Ancillary Equipment

Ancillary Equipment 1	Battery1	
	Battery Name	LG CHEM, LTD.
	Brand Name	Lenovo
	Model No.	L17L3P61
	Serial No.	N/A
	Capacitance	36Wh
	Rated Voltage	11.58 V
	Limit Charge Voltage	N/A
Ancillary Equipment 2	Battery2	
	Battery Name	CELXPERT
	Brand Name	Lenovo
	Model No.	L17C3P61
	Serial No.	N/A
	Capacitance	36Wh
	Rated Voltage	11.52 V
	Limit Charge Voltage	N/A
Ancillary Equipment 3	Battery3	
	Battery Name	Simplo
	Brand Name	Lenovo
	Model No.	L17M3P61
	Serial No.	N/A
	Capacitance	36Wh
	Rated Voltage	11.52 V
	Limit Charge Voltage	N/A
Note: This device has three kinds of batteries, RF exposure chose battery1 to evaluate full SAR test, battery2 and battery3 verified the worse cases of battery 1.		



## 2.6 Technical Information

The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	2.4G WLAN, 5G WLAN, Bluetooth	
Frequency Range	802.11b/g/n(HT20/HT40)	2400 MHz ~ 2483.5 MHz
	802.11a/n(HT20/HT40)	5150 MHz ~ 5250 MHz
	/ac(HT20/HT40)	5250 MHz ~ 5350 MHz
	/HT80)	5470 MHz ~ 5725 MHz
	Bluetooth	5725 MHz ~ 5850 MHz
Antenna Type	WLAN: PIFA Antenna Bluetooth: PIFA Antenna	
Hotspot Function	N/A	
Power Reduction	Not Support	
Exposure Category	General Population/Uncontrolled exposure	
EUT Stage	Portable Device	
Product	Type	
	<input checked="" type="checkbox"/> Production unit	<input type="checkbox"/> Identical prototype

### 3 SUMMARY OF TEST RESULT

#### 3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
2	ANSI/IEEE Std. C95.1-1999	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
3	IEEE Std. 1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
4	FCC KDB 447498 D01 v06	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
5	FCC KDB 865664 D01 v01r04	SAR Measurement 100 MHz to 6 GHz
6	FCC KDB 865664 D02 v01r02	RF Exposure Reporting
7	KDB 248227 D01 v02r02	SAR Guidance for IEEE 802.11 (Wi-Fi) Transmitters
8	KDB 616217 D04v01r02	SAR for laptop and tablets

### 3.2 Device Category and SAR Limit

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user.

Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

Table of Exposure Limits:

Body Position	SAR Value (W/Kg)	
	General Population/ Uncontrolled Exposure	Occupational/ Controlled Exposure
Whole-Body SAR (averaged over the entire body)	0.08	0.4
Partial-Body SAR (averaged over any 1 gram of tissue)	1.60	8.0
SAR for hands, wrists, feet and ankles (averaged over any 10 grams of tissue)	4.0	20.0

**NOTE:**

**General Population/Uncontrolled Exposure:** Locations where there is the exposure of individuals who have no knowledge or control of their exposure. 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.

**Occupational/Controlled Exposure:** Locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, 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. This 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.

### 3.3 Test Result Summary

#### 3.3.1 Highest SAR (1 g Value)

Band	Antenna	Maximum Scaled SAR (W/kg)	Maximum Report SAR (W/kg)
		Body (0mm)	Body (0mm)
2.4G WLAN	Main Antenna	1.138	1.182
5.3G WLAN	Main Antenna	<b>1.182</b>	
5.6G WLAN	Main Antenna	1.094	
5.8G WLAN	Main Antenna	1.091	
Limit (W/kg)		1.60	
Verdict		Pass	

#### 3.3.2 Highest Simultaneous SAR

Position	Simultaneous Configuration	Simultaneous SAR (W/kg)	Limit (W/kg)	Verdict
Body	5 WLAN (Main Antenna) + Bluetooth (Main Antenna)	1.349	1.6	Pass

### 3.4 Test Uncertainty

According to KDB 865664 D01, when the highest measured 1 g SAR within a frequency band is  $< 1.5 \text{ W/kg}$ , the extensive SAR measurement uncertainty analysis is not required in SAR reports submitted for equipment approval.

The maximum 1 g SAR for the EUT in this report is  $1.182 \text{ W/kg}$ , which is lower than  $1.5 \text{ W/kg}$ , so the extensive SAR measurement uncertainty analysis is not required in this report.

## 4 MEASUREMENT SYSTEM

### 4.1 Specific Absorption Rate (SAR) Definition

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 higher than the limits for general population/uncontrolled.

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 ( $\rho$ ). The equation description is as below:

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

SAR is expressed in units of Watts per kilogram (W/kg) SAR measurement can be related to the electrical field in the tissue by

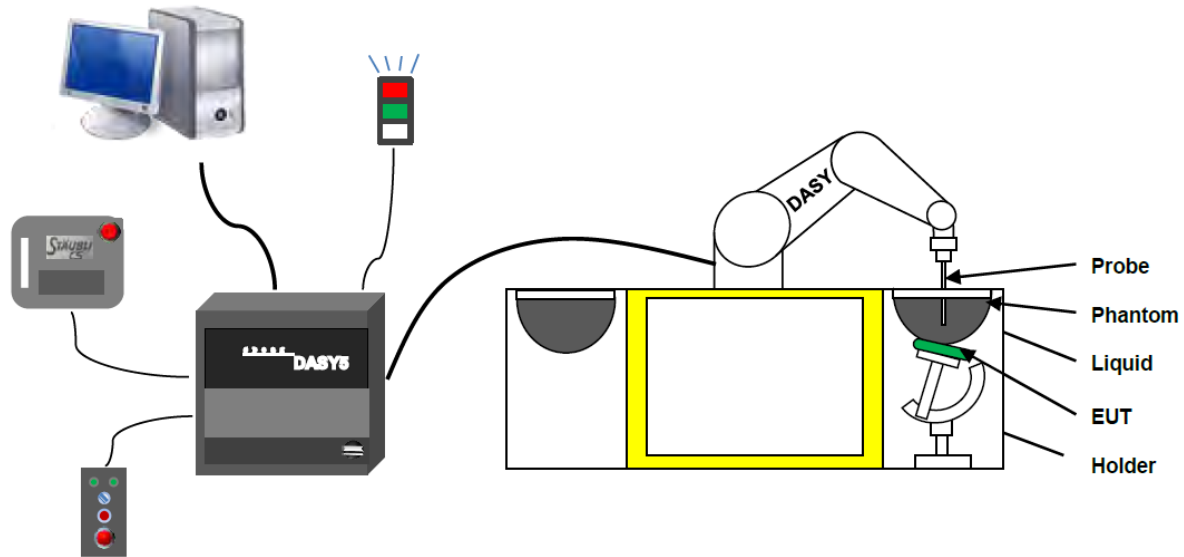
$$\text{SAR} = \frac{\sigma E^2}{\rho}$$

Where:  $\sigma$  is the conductivity of the tissue,

$\rho$  is the mass density of the tissue and E is the RMS electrical field strength.

## 4.2 DASY SAR System

### 4.2.1 DASY SAR System Diagram



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

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



#### 4.2.2 Robot

The Dasy SAR system uses the high precision robots. Symmetrical design with triangular core Built-in optical fiber for surface detection system For the 6-axis controller system, Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents). The robot series have many features that are important for our application:



- High precision  
(repeatability  $\pm 0.02$  mm)
- High reliability  
(industrial design)
- Low maintenance costs  
(virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements  
(brush less synchron motors; no stepper motors)
- Low ELF interference  
(motor control \_elds shielded via the closed metallic construction shields)

### 4.2.3 E-Field Probe

The probe is specially designed and calibrated for use in liquids with high permittivities for the measurements the Specific Dosimetric E-Field Probe EX3DV4-SN:7340 with following specifications is used.

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., glycolether)
Calibration	ISO/IEC 17025 calibration service available
Frequency	10 MHz to 6 GHz; Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)
Directivity	$\pm 0.2$ dB in HSL (rotation around probe axis) ; $\pm 0.4$ dB in HSL (rotation normal to probe axis)
Dynamic range	5 $\mu$ W/g to > 100 mW/g; Linearity: $\pm 0.2$ dB
Dimensions	Overall length: 337 mm (Tip: 9 mm) Tip diameter: 2.5 mm (Body: 10 mm) Distance from probe tip to dipole centers: 1.0 mm
Application	General dosimetry up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms (EX3DV4)



#### E-Field Probe Calibration Process

Probe calibration is realized, in compliance with CENELEC EN 62209-1/-2 and IEEE 1528 std, with CALISAR, Antennessa proprietary calibration system. The calibration is performed with the EN 62209-1/2 annexe technique using reference guide at the five frequencies.

#### 4.2.4 Data Acquisition Electronics

The data acquisition electronics (DAE) consist 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 with a 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.



- Input Impedance: 200M $\Omega$ m
- The Inputs: Symmetrical and Floating
- Common Mode Rejection: Above 80dB

#### 4.2.5 Phantoms

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2mm +/- 0.2mm. It enables the dosimetric evaluation of left and right phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.



- Left hand
- Right hand
- Flat phantom

Photo of Phantom SN1857



Serial Number	Material	Length	Height
SN 1857 SAM	Vinylester, glass fiber reinforced	1000	500

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



• Flat phantom

Photo of Phantom SN1012



Serial Number	Shell Thickness (mm)	Major ellipse axis (mm)	Minor axis ( mm )
SN 1012 ELI4	2.0 ± 0.2	600	500

#### 4.2.6 Device Holder

The DASY5 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of  $65^\circ$ . 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. This device holder is used for standard mobile phones or PDA"s only. If necessary an additional support of polystyrene material is used. Larger DUT"s (e.g. notebooks) cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values. Therefore those devices are normally only tested at the flat part of the SAM.



The positioning system allows obtaining cheek and tilting position with a very good accuracy. Incompliance with CENELEC, the tilt angle uncertainty is lower than  $1^\circ$ .

#### 4.2.7 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 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. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5%.



The following table gives the recipes for tissue simulating liquid and the theoretical Conductivity/Permittivity.

Head (Reference IEEE1528)								
Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity $\sigma$ (S/m)	Permittivity $\epsilon$
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
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.4	40.0
2450	55.0	0	0	0.1	0	44.9	1.80	39.2
2600	54.9	0	0	0.1	0	45.0	1.96	39.0
Frequency (MHz)	Water (%)	Hexyl Carbitol (%)			Triton X-100 (%)		Conductivity $\sigma$ (S/m)	Permittivity $\epsilon$
5200	62.52	17.24			17.24		4.66	36.0
5800	62.52	17.24			17.24		5.27	35.3
Body (From instrument manufacturer)								
Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity $\sigma$ (S/m)	Permittivity $\epsilon$
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
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0.1	0	31.3	1.95	52.7
2600	68.2	0	0	0.1	0	31.7	2.16	52.5
Frequency(MHz)	Water	DGBE (%)			Salt (%)		Conductivity $\sigma$ (S/m)	Permittivity $\epsilon$
5200	78.60	21.40			/		5.54	47.86
5800	78.50	21.40			0.1		6.0	48.20



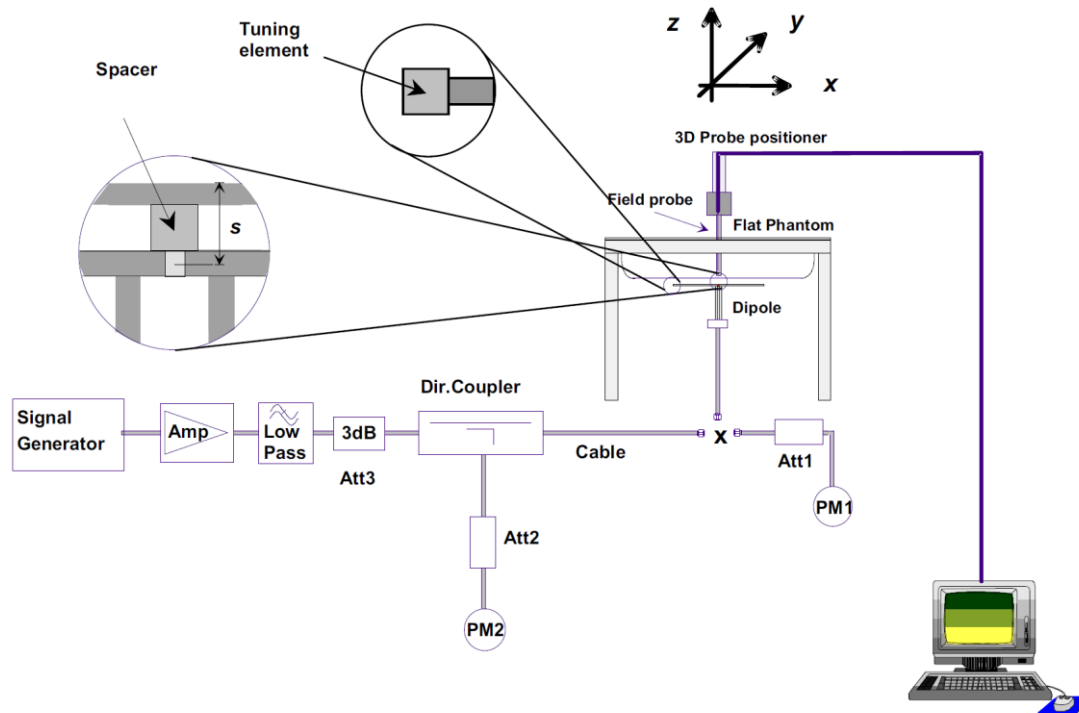
## 5 SYSTEM VERIFICATION

### 5.1 Purpose of System 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.

### 5.2 System Check Setup

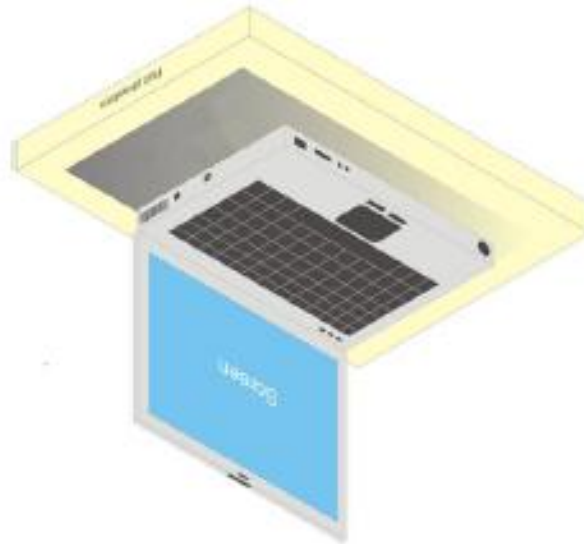
In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. 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 equipment setup is shown below:



## 6 TEST POSITION CONFIGURATIONS

This DUT was tested in one position which is bottom of laptop touching with phantom 0 mm air gap.

### 6.1 Body Supported Exposure Condition



### 6.2 Tablet Exposure Condition

This DUT was tested in three different positions. They are back side, left edge and top edge in these positions, the surface of DUT is touching with phantom 0mm.

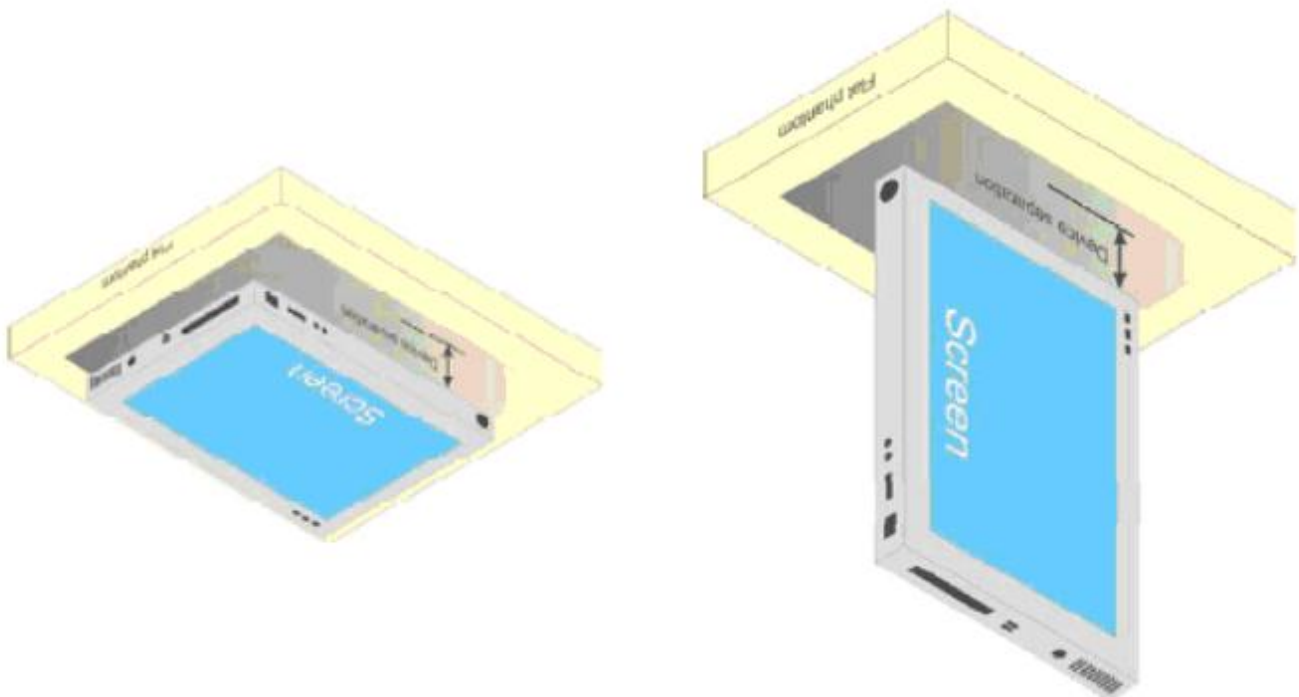
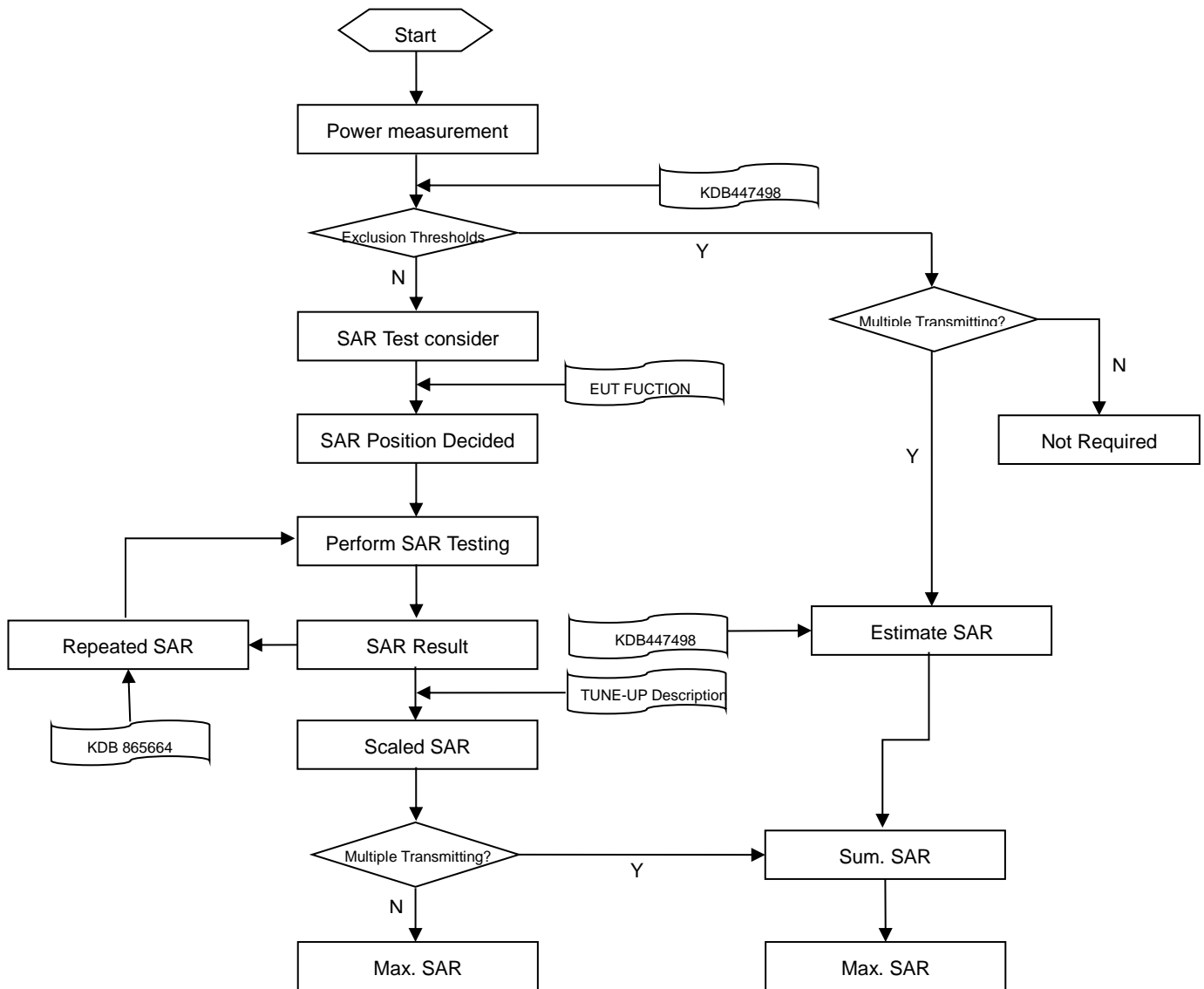


Fig Illustration for Lap-touching Position

## 7 MEASUREMENT PROCEDURE

### 7.1 Measurement Process Diagram



## 7.2 SAR Scan General Requirement

Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the 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 of the 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.

			≤3GHz	>3GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5±1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ 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.	
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: Δz Zoom (n)		≤ 5 mm	3–4 GHz: ≤ 4 mm
				4–5 GHz: ≤ 3 mm
				5–6 GHz: ≤ 2 mm
	graded grid	Δz 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
			Δz Zoom (n>1): between subsequent points	≤ 1.5·Δz 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:				
1. δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.				
2. * 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 3GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

### 7.3 Measurement Procedure

The following steps are used for each test position

- a. 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
- b. Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.
- c. Measurement of the SAR distribution with a grid of 8 to 16mm \* 8 to 16 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.
- d. 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.

### 7.4 Area & Zoom Scan Procedure

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01r04 quoted below.

When the 1 g SAR of the highest peak is within 2 dB of the SAR limit, additional zoom scans are required for other peaks within 2 dB of the highest peak that have not been included in any zoom scan to ensure there is no increase in SAR.

## 8 CONDUCTED RF OUPUT POWER

The Main Antenna supports TX/RX function, and the Auxiliary Antenna only supports RX function. So all frequency bands and modulations test chain main in this report.

### 8.1 WIFI

#### 8.1.1 2.4G WIFI

Band (GHz)	Mode	Channel	Freq. (MHz)	Avg. Power (dBm)	Tune-up Power Limit (dBm)	SAR Test Require.
2.4 (2.4~2.4835)	802.11b	1	2412	19.70	<b>20.00</b>	Yes
		6	2437	<b>19.85</b>		Yes
		11	2462	19.22		Yes
	802.11g	1	2412	16.49	17.50	No
		6	2437	19.33	19.50	No
		11	2462	15.62	18.00	No
	802.11n(HT20)	1	2412	16.11	17.50	No
		6	2437	19.31	19.50	No
		11	2462	15.40	16.00	No
	802.11n(HT40)	3	2422	15.25	16.50	No
		6	2437	18.28	18.50	No
		9	2452	13.14	15.00	No

## 8.1.2 5G WIFI

Band (GHz)	Mode	Channel	Freq. (MHz)	Avg. Power (dBm)	Tune-up Power Limit (dBm)	SAR Test Require.
5.2 (5.15~5.25)	802.11a	36	5180	12.73	13.00	No
		40	5200	12.86		No
		48	5240	13.05	13.50	No
	802.11n(HT20)	36	5180	13.01	13.50	No
		40	5200	13.05		No
		48	5240	12.83		No
	802.11n(HT40)	38	5190	12.63	13.00	No
		46	5230	12.52		No
	802.11ac(VHT20)	36	5180	12.38	13.00	No
		40	5200	12.97		No
		48	5240	13.03	13.50	No
	802.11ac(VHT40)	38	5190	12.73	13.00	No
		46	5230	12.68		No
	802.11ac(VHT80)	42	5210	13.16	13.50	No
5.3 (5.25~5.35)	802.11a	52	5260	13.16	<b>13.50</b>	Yes
		60	5300	<b>13.18</b>		Yes
		64	5320	12.70	13.00	Yes
	802.11n(HT20)	52	5260	13.01	13.50	No
		60	5300	13.03		No
		64	5320	12.93		No
	802.11n(HT40)	54	5270	12.47	13.00	No
		62	5310	12.79		No
	802.11ac(VHT20)	52	5260	12.62	13.00	No
		60	5300	13.13	13.50	No
		64	5320	13.09		No
	802.11ac(VHT40)	54	5270	12.34	13.00	No
		62	5310	12.50		No
	802.11ac(VHT80)	58	5290	11.01	12.00	No
5.6 (5.47~5.725)	802.11a	100	5500	10.61	12.00	Yes
		116	5580	<b>12.56</b>	<b>13.00</b>	Yes
		140	5700	12.46		Yes
	802.11n(HT20)	100	5500	11.25	12.00	No
		116	5580	11.16		No
		140	5700	11.74		No
	802.11n(HT40)	102	5510	10.48	11.00	No
		134	5670	12.37	12.50	No
	802.11ac(VHT20)	100	5500	10.14	12.00	No
		116	5580	10.97		No
		140	5700	11.75		No
	802.11ac(VHT40)	102	5510	10.41	11.00	No
		134	5670	12.27	12.50	No
	802.11ac(VHT80)	106	5530	10.17	11.50	No



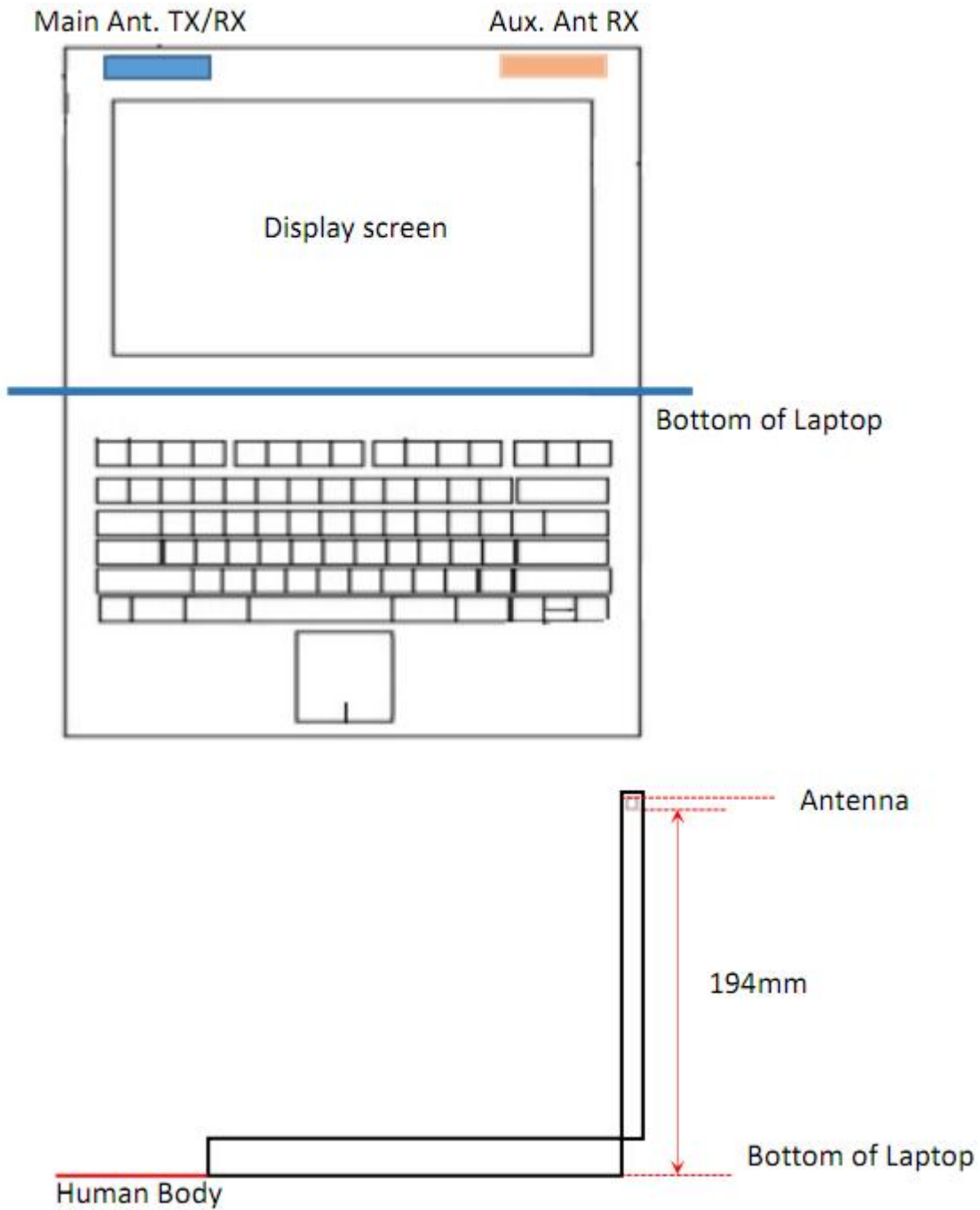
5.8 (5.725~5.850)	802.11a	149	5745	12.60	13.00	No
		157	5785	12.06	12.50	No
		165	5825	11.40		No
	802.11n(HT20)	149	5745	12.19	13.00	No
		157	5785	12.78		No
		165	5825	11.72		No
	802.11n(HT40)	151	5755	12.23	13.00	No
		159	5795	12.54		No
	802.11ac(VHT20)	149	5745	12.34	13.00	No
		157	5785	12.84		No
		165	5825	11.56	12.00	No
	802.11ac(VHT40)	151	5755	12.23	12.50	No
		159	5795	12.38		No
	802.11ac(VHT80)	155	5775	<b>12.96</b>	<b>13.00</b>	Yes

## 8.2 Bluetooth

Mode	GFSK			$\pi/4$ -DQPSK		
Channel	0	39	78	0	39	78
Frequency (MHz)	2402	2441	2480	2402	2441	2480
Avg. Power (dBm)	2.54	<b>3.28</b>	2.75	1.67	2.34	2.28
Tune-up Power Limit (dBm)	6.0			6.0		
Mode	8-DPSK			BLE		
Channel	0	39	78	0	19	39
Frequency (MHz)	2402	2441	2480	2402	2440	2480
Avg. Power (dBm)	0.67	1.21	1.41	-1.93	-1.41	-1.13
Tune-up Power Limit (dBm)	6.0			6.0		

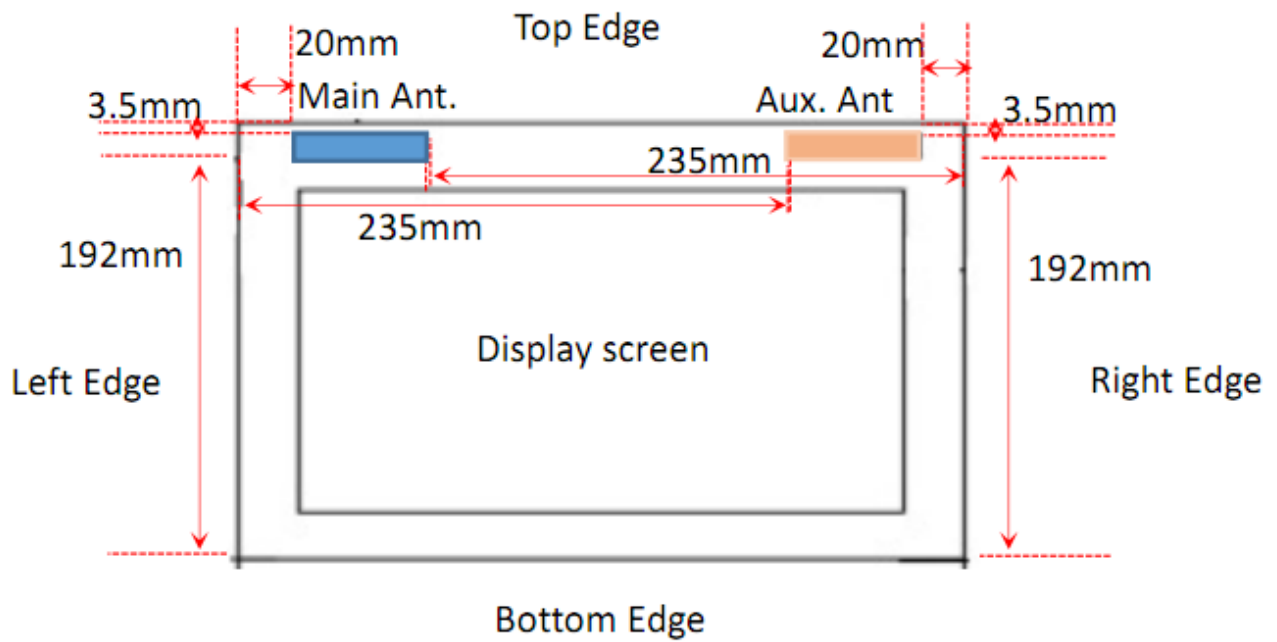
## 9 TEST EXCLUSION CONSIDERATION

### 9.1 NB Mode antenna location sketch:

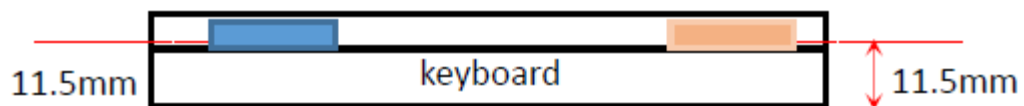


## 9.2 Tablet Mode antenna location sketch:

EUT Front View:



EUT Side View:



Aux. Antenna RX



Main Antenna TX/RX

### 9.3 SAR Test Exclusion Consideration 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 :

#### 9.3.1 NB mode SAR Test Exclusion Consideration

Test Position Configurations	Mode	Bluetooth	WLAN 2.4GHz	WLAN 5.2&5.3GHz	WLAN 5.6GHz	WLAN 5.8GHz
<b>Main Antenna</b>						
Bottom of Laptop	Distance to User (mm)	194				
	Max. Peak Power (dBm)	6.00	20.00	13.50	13.00	13.00
	Max. Peak Power (mW)	3.98	100.00	22.39	19.95	19.95
	Exclusion Threshold (mW)	1535.0	1536.0	1502.0	1502.0	1502.0
	SAR Test Required	No	No	No	No	No

#### 9.3.2 Tablet mode SAR Test Exclusion Consideration

Band	Mode	Max. Peak Power		Test Position Configurations				
				Back Side (with keyboard)	Left Edge	Right Edge	Top Edge	Bottom Edge
		dBm	mW					
Distance to User (mm)				11.5	20.0	235.0	<5.0	192.0
Main Antenna								
WLAN 2.4 G	SAR Test Required							
	Exclusion Threshold			13.6	7.9	1946.0	31.4	1516.0
	802.11b	20.00	100.00	Yes	Yes	No	Yes	No
	802.11g	19.50	89.13	No	No	No	No	No
	802.11n(HT20)	19.50	89.13	No	No	No	No	No
	802.11n(HT40)	18.50	70.79	No	No	No	No	No
WLAN 5.2 G&5.3G	Exclusion Threshold			4.6	2.7	1912	10.6	1482.0
	802.11a	13.50	22.39	Yes	Yes	No	Yes	No
	802.11n(HT20)	13.50	22.39	No	No	No	No	No
	802.11n(HT40)	13.00	19.95	No	No	No	No	No
	802.11ac(VHT20)	13.50	22.39	No	No	No	No	No
	802.11ac(VHT40)	13.00	19.95	No	No	No	No	No
	802.11ac(VHT80)	12.00	15.85	No	No	No	No	No
WLAN 5.6 G	Exclusion Threshold			4.2	2.4	1912.0	9.7	1482.0
	802.11a	13.00	19.95	Yes	Yes	No	Yes	No
	802.11n(HT20)	12.00	15.85	No	No	No	No	No
	802.11n(HT40)	12.50	17.78	No	No	No	No	No
	802.11ac(VHT20)	12.00	15.85	No	No	No	No	No
	802.11ac(VHT40)	12.50	17.78	No	No	No	No	No
	802.11ac(VHT80)	10.50	11.22	No	No	No	No	No
WLAN 5.8 G	Exclusion Threshold			4.2	2.4	1912	9.7	1482.0
	802.11a	13.00	19.95	No	No	No	No	No
	802.11n(HT20)	13.00	19.95	No	No	No	No	No

	802.11n(HT40)	13.00	19.95	No	No	No	No	No
	802.11ac(VHT20)	13.00	19.95	No	No	No	No	No
	802.11ac(VHT40)	12.50	17.78	No	No	No	No	No
	802.11ac(VHT80)	13.00	19.95	Yes	Yes	No	Yes	No
Bluetooth	Exclusion Threshold			0.6	0.3	1945.0	1.3	1515.0
	BR/EDR	6.00	3.98	No	No	No	No	No
	BLE	6.00	3.98	No	No	No	No	No

Note:

- Maximum power is the source-based time-average power and represents the maximum RF output power including tune-up tolerance among production units
- 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.
- 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
- 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:  

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR}$$
  - 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
  - For < 50 mm distance, we just calculate mW of the exclusion threshold value (3.0) to do compare.

This formula is  $[3.0] / [\sqrt{f(\text{GHz})}] \cdot [(\text{min. test separation distance, mm})] = \text{exclusion threshold of mW}$ .
- 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
  - [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · (f(MHz)/150)] mW, at 100 MHz to 1500 MHz
  - [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · 10] mW at > 1500 MHz and ≤ 6 GHz
- Per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA /HSUPA /DC-HSDPA output power is < 0.25dB higher than RMC12.2Kbps, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA/DC-HSDPA SAR evaluation can be excluded.
- Per KDB 248227 D01, choose the highest output power channel to test SAR and determine further SAR exclusion.8. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate
- Per KDB 248227 D01 SAR is not required for the following 2.4 GHz OFDM conditions.
  - When KDB Publication 447498 D01 SAR test exclusion applies to the OFDM configuration.
  - 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.
- Per KDB 248227 D01 SAR is not required for the following U-NII-1 and U-NII-2A bands conditions.
  - When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
  - 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.

## 10 TEST RESULT

### 10.1 WIFI 2.4GHz

Mode	Antenna	Test Mode	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (dB)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune- up Power (dBm)	Scaling Factor	Duty Cycle (%)	Duty Cycle Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
<b>Body (Battery 1)</b>															
802.11 b	Main	Tablet	Back Side	0	6	2437	0.01	0.052	19.85	20.00	1.04	100	1.000	0.054	/
			Left Edge	0	6	2437	0.00	0.411	19.85	20.00	1.04	100	1.000	0.425	/
			Top Edge	0	6	2437	-0.06	1.000	19.85	20.00	1.04	100	1.000	1.035	/
				0	1	2412	-0.02	0.965	19.70	20.00	1.07	100	1.000	1.034	/
				0	11	2462	0.07	0.951	19.22	20.00	1.20	100	1.000	<b>1.138</b>	<b>1#</b>

### 10.2 WIFI 2.4GHz (worst case with Battery)

Mode	Antenna	Test Mode	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (dB)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune- up Power (dBm)	Scaling Factor	Duty Cycle (%)	Duty Cycle Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
<b>Body (Battery 2)</b>															
802.11 b	Main	Tablet	Top Edge	0	11	2462	0.15	0.939	19.22	20.00	1.20	100	1.000	1.124	/
<b>Body (Battery 3)</b>															
802.11 b	Main	Tablet	Top Edge	0	11	2462	-0.09	0.928	19.22	20.00	1.20	100	1.000	1.111	/



## 10.3WIFI 5GHz

Fre. Band	Mode	Antenna	Test Mode	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-Up Power (dBm)	Scaling Factor	Duty Cycle (%)	Duty Cycle Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
<b>Body (Battery 1)</b>																
5.3G	802.11a	Main	Tablet	Back Side	0	60	5300	0.07	0.064	13.18	13.50	1.08	99.5	1.005	0.069	/
				Left Edge	0	60	5300	0.08	0.071	13.18	13.50	1.08	99.5	1.005	0.077	/
				Top Edge	0	60	5300	0.01	0.928	13.18	13.50	1.08	99.5	1.005	1.004	/
					0	52	5260	0.03	1.090	13.16	13.50	1.08	99.5	1.005	<b>1.182</b>	2#
					0	64	5320	-0.04	0.789	12.70	13.00	1.07	99.5	1.005	0.850	/
5.6G	802.11 a	Main	Tablet	Back Side	0	116	5580	0.05	0.083	12.56	13.00	1.11	99.5	1.005	0.092	/
				Left Edge	0	116	5580	0.03	0.094	12.56	13.00	1.11	99.5	1.005	0.105	/
				Top Edge	0	116	5580	0.01	0.984	12.56	13.00	1.11	99.5	1.005	<b>1.094</b>	3#
					0	100	5500	0.10	0.598	10.61	12.00	1.38	99.5	1.005	0.828	/
					0	140	5700	0.01	0.802	12.46	13.00	1.13	99.5	1.005	0.913	/
5.8G	802.11 ac (HT80)	Main	Tablet	Back Side	0	155	5775	-0.05	0.061	12.96	13.00	1.01	98.0	1.020	0.063	/
				Left Edge	0	155	5775	-0.02	0.070	12.96	13.00	1.01	98.0	1.020	0.072	/
				Top Edge	0	155	5775	0.06	1.060	12.96	13.00	1.01	98.0	1.020	<b>1.091</b>	4#

## 10.4WIFI 5GHz (worst case with other Battery)

Fre. Band	Mode	Antenna	Test Mode	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (%)	1 g Meas. SAR (W/Kg)	Meas. Power (dBm)	Max. tune-Up Power (dBm)	Scaling Factor	Duty Cycle (%)	Duty Cycle Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
<b>Body (Battery 2)</b>																
5.3G	802.11a	Main	Tablet	Top Edge	0	52	5260	0.08	1.035	13.16	13.50	1.08	99.5	1.005	1.125	/
<b>Body (Battery 3)</b>																
5.3G	802.11a	Main	Tablet	Top Edge	0	52	5260	0.02	1.033	13.16	13.50	1.08	99.5	1.005	1.122	/

## 11 SAR Measurement Variability

According to KDB 865664 D01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are  $\leq 1.45$  W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is  $\leq 1.10$ , the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. 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.

SAR repeated measurement procedure:

1. When the highest measured SAR is  $< 0.80$  W/kg, repeated measurement is not required.
2. When the highest measured SAR is  $\geq 0.80$  W/kg, repeat that measurement once.
3. If the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$ , or when the original or repeated measurement is  $\geq 1.45$  W/kg, perform a second repeated measurement.
4. If the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ , and the original, first or second repeated measurement is  $\geq 1.5$  W/kg, perform a third repeated measurement.

Frequency Band (MHz)	Wireless Band	Antenna	RF Exposure Conditions	Test Position	Highest Measured SAR (W/kg)	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Largest to Smallest SAR Ratio
2400	WIFI 802.11 b	Main Antenna	Body	Top Edge	1.000	Yes	0.977	1.02
5300	WIFI 802.11 a	Main Antenna	Body	Top Edge	1.090	Yes	1.035	1.05
5600	WIFI 802.11 a	Main Antenna	Body	Top Edge	0.984	Yes	0.956	1.03
5800	WIFI 802.11 ac (HT80)	Main Antenna	Body	Top Edge	1.060	Yes	0.998	1.06

Note: The ratio of largest to smallest SAR for the original and first repeated measurements is  $< 1.20$ , the second repeated measurement is not required.

## 12 SIMULTANEOUS TRANSMISSION

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of SAR 1g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR 1g 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR 1g is greater than the SAR limit (SAR 1g 1.6 W/kg), SAR test exclusion is determined by the SAR to Peak Location Ratio (SPLSR).

According KDB 447498 D01v06, simultaneous transmission:

- $SPLSR = (SAR1 + SAR2)^{1.5} / R_i$  (min. separation distance, mm), and the peak separation distance is determined 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 the extrapolated peak SAR locations in the zoom scan.  
SAR1 is the highest reported or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition.  
SAR2 is the highest reported or estimated SAR for the second of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition as the first.
- If  $SPLSR \leq 0.04$ , simultaneously transmission SAR measurement is not necessary.
- Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

### 12.1 Simultaneous Transmission Mode Consider

NO.	Mode	2.4G WLAN & 5G WLAN & 2.4G Bluetooth
		Body
1	5 G WLAN (Main Antenna)	+Bluetooth (Main Antenna)
Note:		
1. The Main Antenna supports TX/RX function, and the Auxiliary Antenna only supports RX function.		
2. 2.4G WLAN and 5G WLAN does not support transmission together, only WLAN 5GHz and Bluetooth will be transmitting from the main antenna at same time.		

### 12.2 Estimated SAR Calculation

According to KDB 447498 D01, when standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR was estimated according to following formula to result in substantially conservative SAR values of  $\leq 0.4$  W/kg to determine simultaneous transmission SAR test exclusion.

$$\text{Estimated SAR} = \frac{\text{Max. Tune Up Power (mw)}}{\text{Min Test Separation Distance}} * \frac{\sqrt{f_{GHz}}}{x} \quad (\text{where } x = 7.5 \text{ for 1-g SAR})$$

If the minimum test separation distance is < 5 mm, a distance of 5 mm is used for estimated SAR calculation. When the test separation distance is > 50 mm, the 0.4 W/kg is used for SAR-1g.

Band	Mode	Position	Antenna To user (mm)	SAR Testing	Max. Tune-up Power (dBm)	Max. Tune-up Power (mW)	Frequency (GHz)	Calculation Distance/Gap (mm)	Estimated SAR (W/kg)
Bluetooth	GFSK	Back Side	11.5	NO	6.00	4.00	2.441	5	0.167
		Left Edge	20.0	NO	6.00	4.00	2.441	5	0.167

		Top Edge	3.5	NO	6.00	4.00	2.441	5	0.167
Note: For conservativeness, 5mm is used to calculate the estimated SAR.									

## 12.3 Sum SAR of Simultaneous Transmission

### 12.3.1 Highest Sum Body SAR of Simultaneous Transmission

Test Mode	Position	Mode	Max. 1g SAR (W/kg)	1g Sum SAR (W/kg)	SPLSR (Yes/No)
Body (Separation 0 mm)					
Tablet	Back Side	Bluetooth (Main Antenna)	0.167	0.259	No
		5G WLAN (Main Antenna)	0.092		
	Left Edge	Bluetooth (Main Antenna)	0.167	0.272	No
		5G WLAN (Main Antenna)	0.105		
	Top Edge	Bluetooth (Main Antenna)	0.167	1.349	No
		5G WLAN (Main Antenna)	1.182		

## 13 TEST EQUIPMENTS LIST

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
PC	Dell	N/A	N/A	N/A	N/A
E-Field Probe	Speag	EX3DV4	SN: 7340	2016/12/27	2017/12/26
2450MHz Validation Dipole	Speag	D2450V2	SN: 952	2014/11/27	2017/11/26
5GHz Validation Dipole	Speag	D5GHzV2	SN: 1200	2014/12/04	2017/12/03
Data Acquisition Electronics	Speag	DAE4	SN: 1454	2016/12/19	2017/12/18
Signal Generator	R&S	SMBV100A	260592	2017/06/12	2018/06/11
Power Meter	Agilent	E4419B	GB40201833	2016/11/25	2017/11/24
Power Sensor	Agilent	E9300A	MY41498012	2016/11/25	2017/11/24
Power Sensor	Agilent	E9300A	MY41499891	2016/11/25	2017/11/24
Power Amplifier	SATIMO	6552B	22374	2017/06/12	2018/06/11
Network Analyzer	Agilent	5071B	MY42404001	2017/06/12	2018/06/11
Thermometer	Elitech	RC-4HC	N/A	2017/02/18	2018/02/17
Dielectric Probe Kit	SATIMO	SCLMP	SN 25/13 OCPG56	N/A	N/A
Phantom1	Speag	SAM	SN: 1859	N/A	N/A
Phantom2	Speag	ELI4	SN: 1012	N/A	N/A
Attenuator	COM-MW	ZA-S1-31	1305003187	N/A	N/A
Directional coupler	AA-MCS	AAMCS-UDC	000272	N/A	N/A

**Note:**

Per KDB 865664 D01, Dipole SAR Validation Verification, BALUN LAB has adopted 3 years calibration intervals. On annual basis, every measurement dipole has been evaluated and is in compliance with the following criteria:

1. There is no physical damage on the dipole;
2. System validation with specific dipole is within 10% of calibrated value;
1. 3. Return-loss in within 20% of calibrated measurement.

## ANNEX A SIMULATING LIQUID VERIFICATION RESULT

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an SCLMP Dielectric Probe Kit.

Date	Liquid Type	Fre. (MHz)	Temp. (°C)	Meas. Conductivity ( $\sigma$ ) (S/m)	Meas. Permittivity ( $\epsilon$ )	Target Conductivity ( $\sigma$ ) (S/m)	Target Permittivity ( $\epsilon$ )	Conductivity Tolerance (%)	Permittivity Tolerance (%)
2017.06.28	Body	2450	21.2	2.02	50.75	1.95	52.70	3.59	-3.70
2017.06.28	Body	5200	21.2	5.32	48.40	5.30	49.01	0.38	-1.22
2017.06.27	Body	5600	21.4	5.83	46.73	5.77	48.47	1.11	-3.59
2017.06.27	Body	5800	21.4	6.01	46.24	6.00	48.20	0.17	-4.07
Note: The tolerance limit of Conductivity and Permittivity is $\pm 5\%$ .									

## ANNEX B SYSTEM CHECK RESULT

Comparing to the original SAR value provided by SPEAG, the validation data should be within its specification of 10 % (for 1 g).

Date	Liquid Type	Freq. (MHz)	Power (mW)	Measured SAR (W/kg)	Normalized SAR (W/kg)	Dipole SAR (W/kg)	Tolerance (%)	Targeted SAR (W/kg)	Tolerance (%)
2017.06.28	Body	2450	100	5.08	50.8	50.60	0.40	52.40	-3.05
2017.06.28	Body	5200	100	7.10	70.1	75.30	-6.91	76.50	-8.37
2017.06.27	Body	5600	100	8.26	82.6	80.50	2.61	83.30	-0.84
2017.06.27	Body	5800	100	7.61	76.1	74.70	1.87	78.00	-2.44

Note: The tolerance limit of System validation  $\pm 10\%$ .

# System Performance Check Data (2450MHz Body)

Date: 2017.06.28

Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.02$  S/m;  $\epsilon_r = 50.75$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.0 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(7.71, 7.71, 7.71); Calibrated: 2016.12.27;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2016.12.19
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**CW2450 100mw/Area Scan (101x101x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 5.85 W/kg

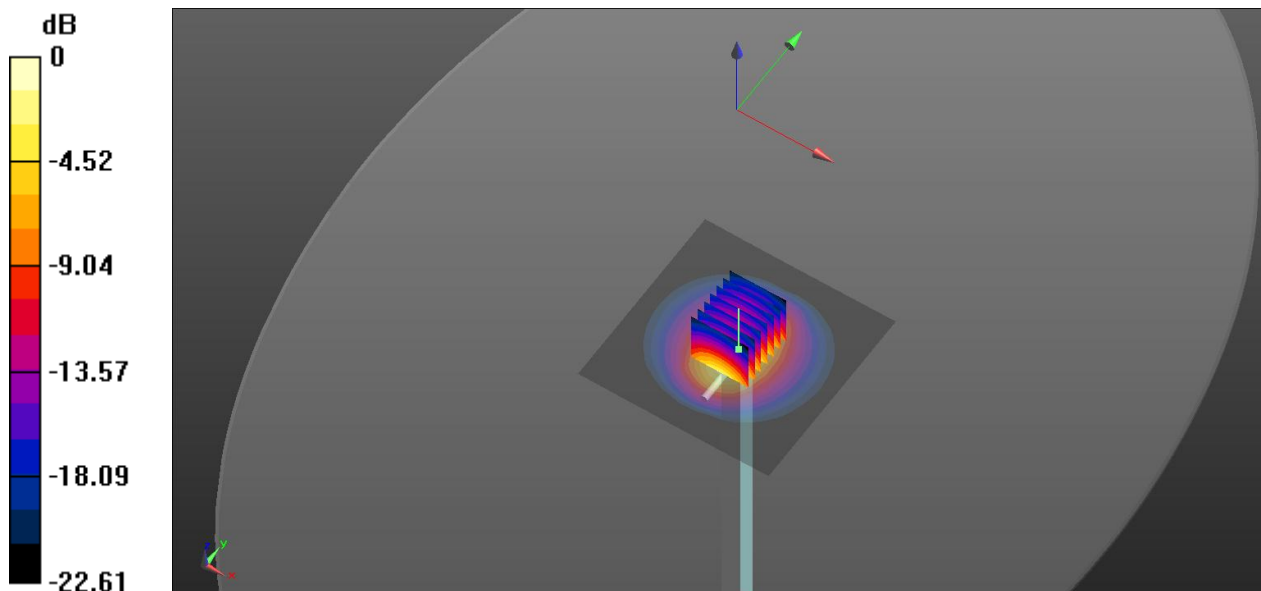
**CW2450 100mw/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 53.73 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 10.6 W/kg

**SAR(1 g) = 5.08 W/kg; SAR(10 g) = 2.31 W/kg**

Maximum value of SAR (measured) = 5.85 W/kg



0 dB = 5.85 W/kg



# System Performance Check Data (5200MHz Body)

Date: 2017.06.28

Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5200 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.32$  S/m;  $\epsilon_r = 48.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.0 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.82, 4.82, 4.82); Calibrated: 2016.12.27;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2016.12.19
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**CW 5200 100mw/Area Scan (101x101x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 8.06 W/kg

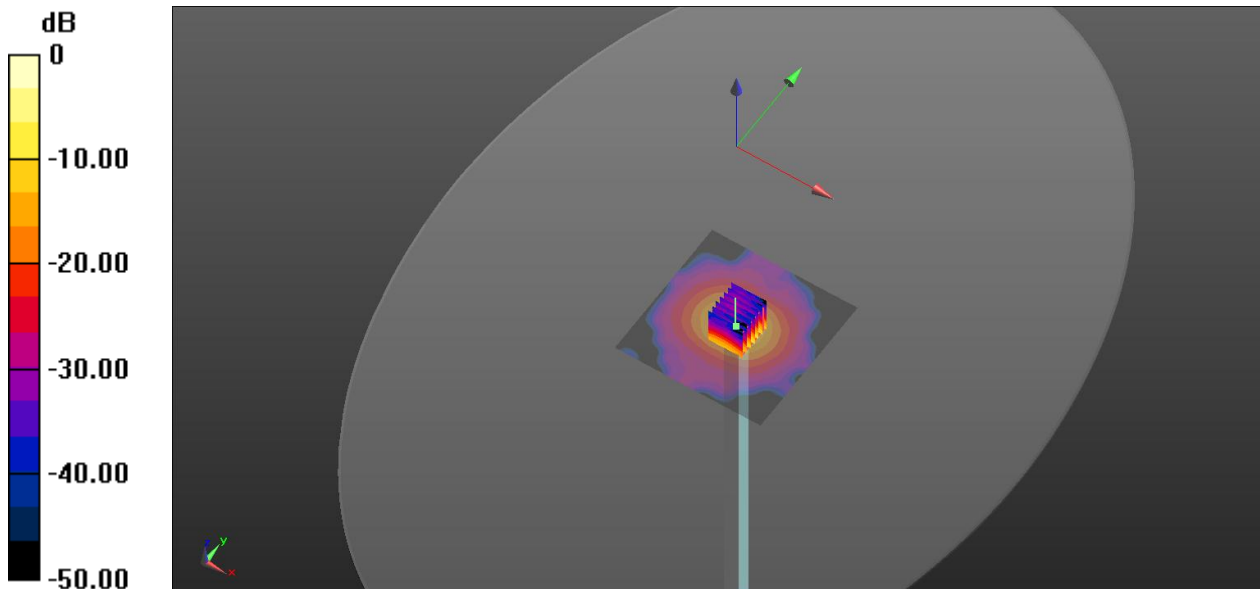
**CW 5200 100mw/Zoom Scan (7x7x21)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 40.31 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 28.8 W/kg

**SAR(1 g) = 7.10 W/kg; SAR(10 g) = 1.96 W/kg**

Maximum value of SAR (measured) = 17.3 W/kg



0 dB = 17.3 W/kg

# System Performance Check Data (5600MHz Body)

Date: 2017.06.27

Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5600 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.83$  S/m;  $\epsilon_r = 46.73$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.2 Liquid Temperature: 21.4

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.12, 4.12, 4.12); Calibrated: 2016.12.27;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2016.12.19
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**CW 5600 100mw/Area Scan (101x101x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 9.38 W/kg

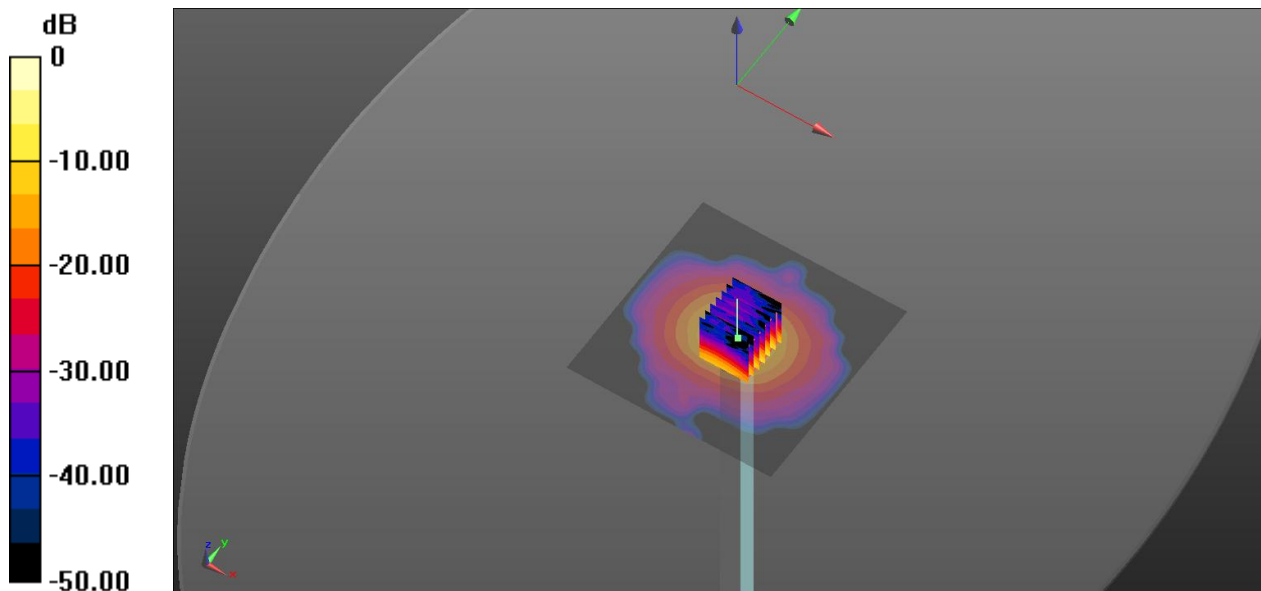
**CW 5600 100mw/Zoom Scan (7x7x21)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 41.39 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 36.1 W/kg

**SAR(1 g) = 8.26 W/kg; SAR(10 g) = 2.21 W/kg**

Maximum value of SAR (measured) = 20.7 W/kg



0 dB = 20.7 W/kg

# System Performance Check Data (5800MHz Body)

Date: 2017.06.27

Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5800 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.01$  S/m;  $\epsilon_r = 46.24$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.2 Liquid Temperature: 21.4

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.56, 4.56, 4.56); Calibrated: 2016.12.27;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2016.12.19
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**CW 5800/Area Scan (101x101x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 7.88 W/kg

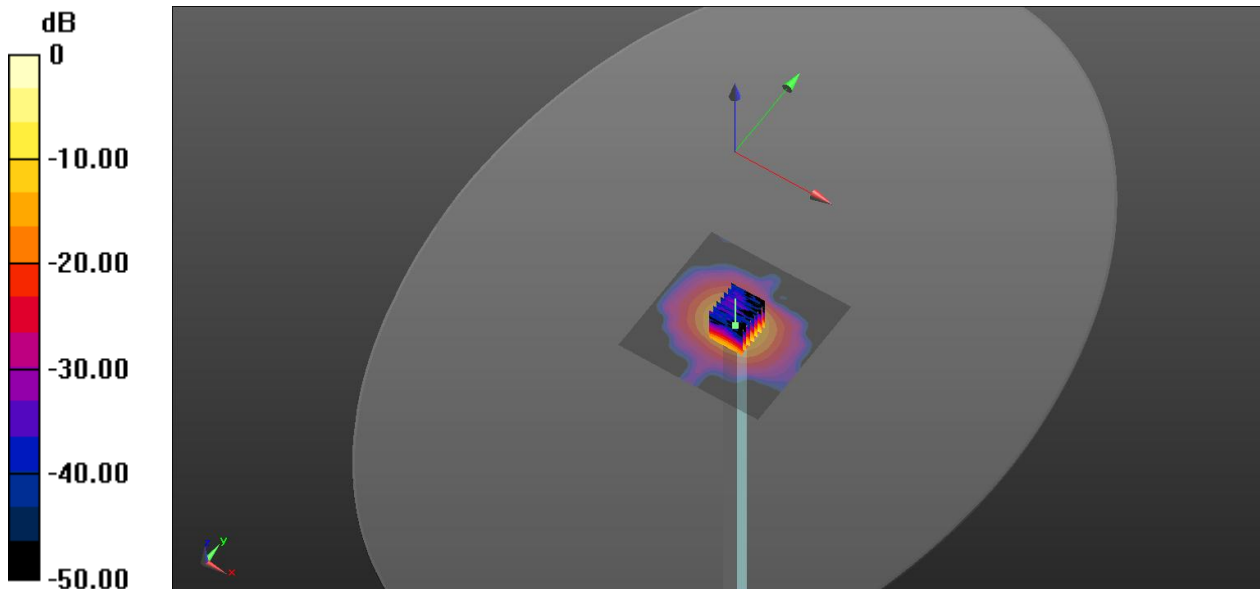
**CW 5800/Zoom Scan (7x7x21)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=1.4$ mm

Reference Value = 46.77 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 35.9 W/kg

**SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.09 W/kg**

Maximum value of SAR (measured) = 17.8 W/kg



0 dB = 17.8 W/kg

## ANNEX C TEST DATA

### MEAS. 1 Body Plane with Top Edge 0 mm on Channel 11 in IEEE 802.b mode with Main Ant.

Date: 2017.06.28

Communication System Band: WLAN(b); Frequency: 2462 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2462$  MHz;  $\sigma = 2.048$  S/m;  $\epsilon_r = 50.622$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.0 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(7.71, 7.71, 7.71); Calibrated: 2016.12.27;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2016.12.19
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch11/Area Scan (51x121x1):** Interpolated grid:  $dx=1.200$  mm,  $dy=1.200$  mm

Maximum value of SAR (interpolated) = 0.983 W/kg

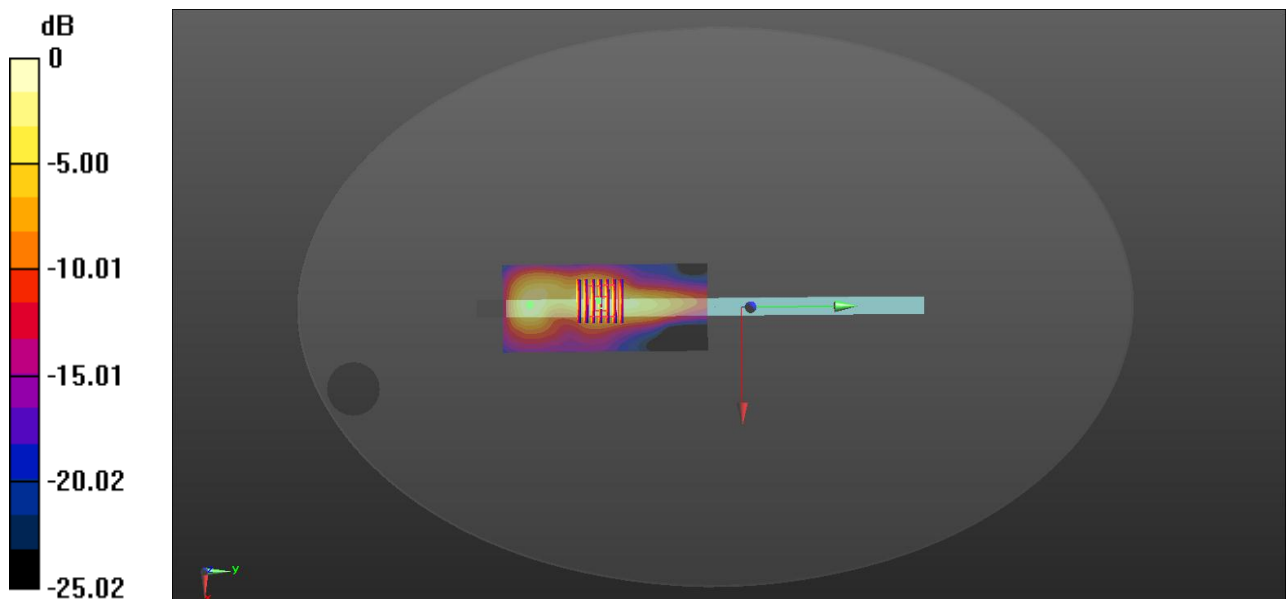
**Ch11/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 5.082 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 2.22 W/kg

**SAR(1 g) = 0.951 W/kg; SAR(10 g) = 0.449 W/kg**

Maximum value of SAR (measured) = 1.43 W/kg



0 dB = 1.43 W/kg

## MEAS. 2 Body Plane with Top Edge 0 mm on Channel 52 in IEEE 802.a mode with Main Ant.

Date: 2017.06.28

Communication System Band: WLAN(a); Frequency: 5260 MHz; Duty Cycle: 1:1.005

Medium parameters used (interpolated):  $f = 5260$  MHz;  $\sigma = 5.368$  S/m;  $\epsilon_r = 47.76$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.0 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.82, 4.82, 4.82); Calibrated: 2016.12.27;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2016.12.19
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch52/Area Scan (71x141x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 1.58 W/kg

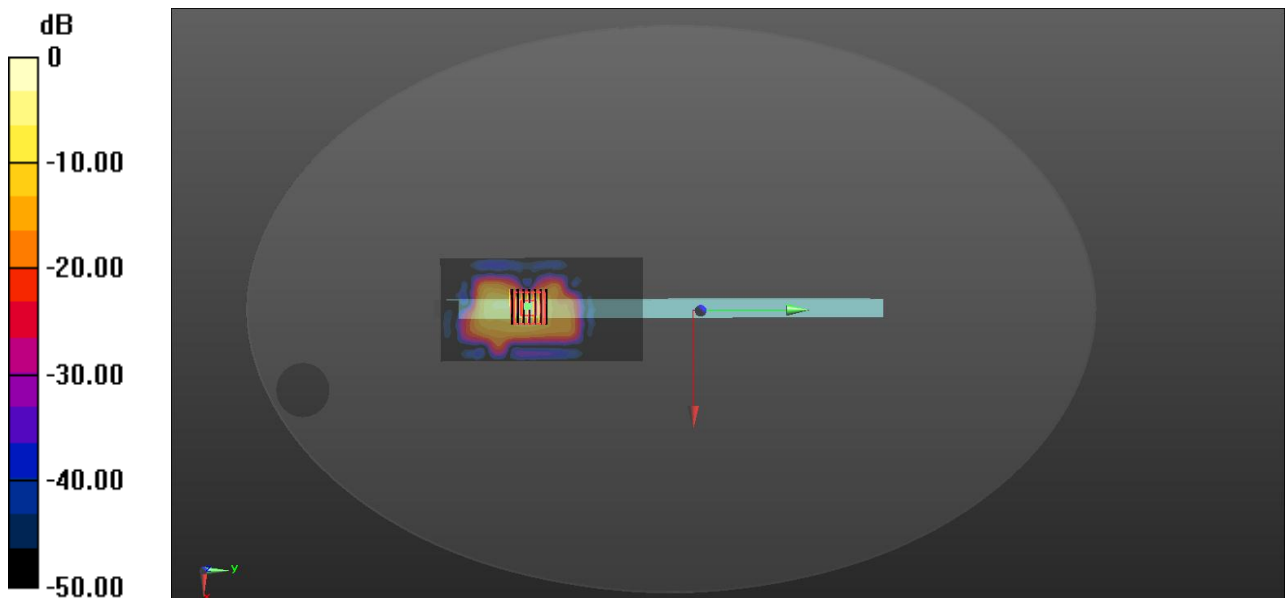
**Ch52/Zoom Scan (7x7x15)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=2$ mm

Reference Value = 1.658 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 5.73 W/kg

**SAR(1 g) = 1.09 W/kg; SAR(10 g) = 0.258 W/kg**

Maximum value of SAR (measured) = 2.77 W/kg



0 dB = 1.58 W/kg

### MEAS. 3 Body Plane with Top Edge 0 mm on Channel 116 in IEEE 802.a mode with Main Ant.

Date: 2017.06.27

Communication System Band: WLAN(a); Frequency: 5580 MHz; Duty Cycle: 1:1.005

Medium parameters used:  $f = 5580$  MHz;  $\sigma = 5.82$  S/m;  $\epsilon_r = 46.75$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.2 Liquid Temperature: 21.4

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.12, 4.12, 4.12); Calibrated: 2016.12.27;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2016.12.19
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch116/Area Scan (71x141x1):** Interpolated grid:  $dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 1.08 W/kg

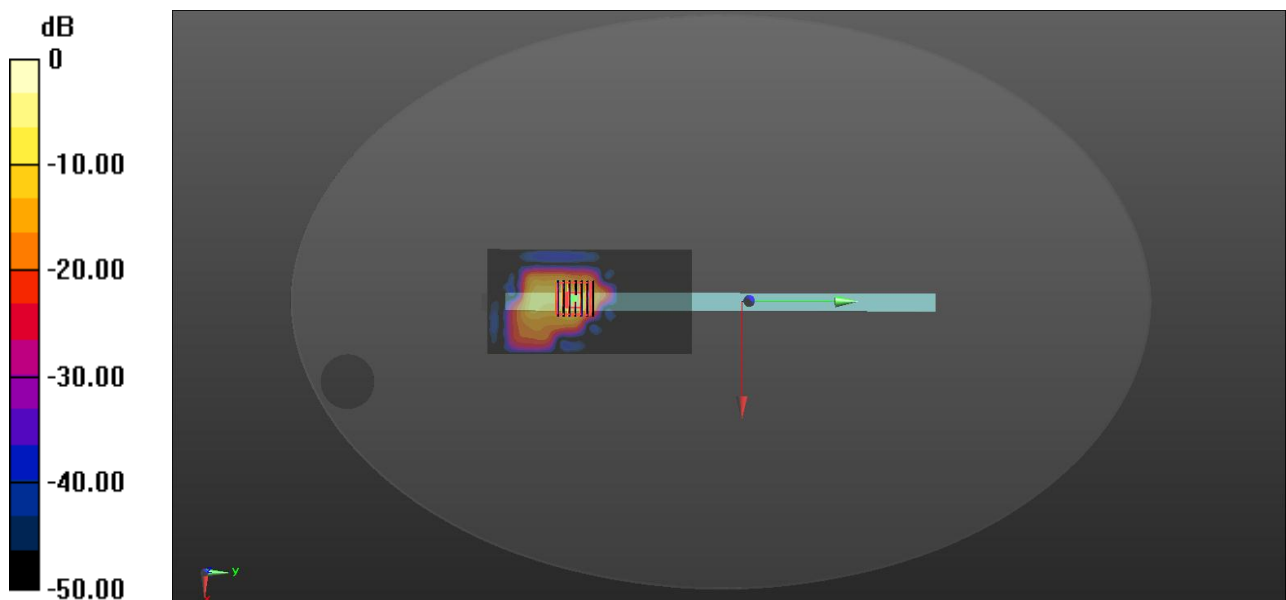
**Ch116/Zoom Scan (7x7x15)/Cube 0:** Measurement grid:  $dx=4$ mm,  $dy=4$ mm,  $dz=2$ mm

Reference Value = 1.215 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 5.15 W/kg

**SAR(1 g) = 0.984 W/kg; SAR(10 g) = 0.222 W/kg**

Maximum value of SAR (measured) = 2.40 W/kg



0 dB = 2.40 W/kg

## MEAS. 4 Body Plane with Top Edge 0 mm on Channel 155 in IEEE 802.ac(HT80) mode with

### Main Ant.

Date: 2017.06.27

Communication System Band: WLAN(ac) 80Mhz; Frequency: 5775 MHz;Duty Cycle: 1:1.020

Medium parameters used:  $f = 5775$  MHz;  $\sigma = 5.98$  S/m;  $\epsilon_r = 46.46$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature:22.2 Liquid Temperature:21.4

### DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.56, 4.56, 4.56); Calibrated: 2016.12.27;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2016.12.19
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Ch155/Area Scan (71x141x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.24 W/kg

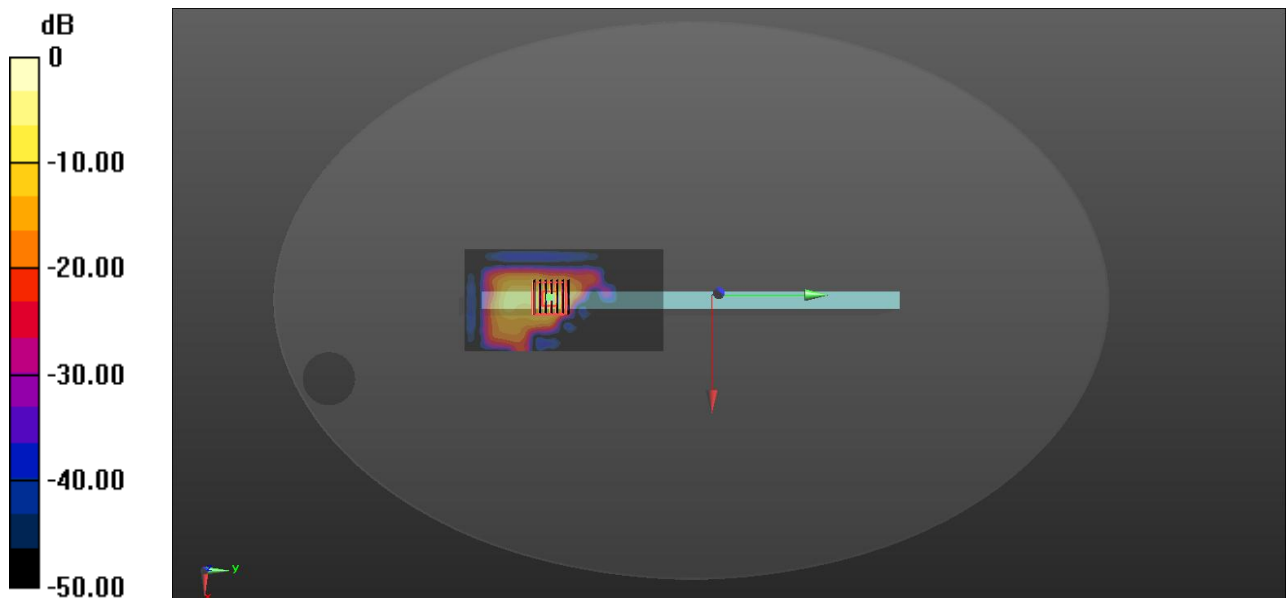
**Ch155/Zoom Scan (7x7x15)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.598 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 5.90 W/kg

**SAR(1 g) = 1.06 W/kg; SAR(10 g) = 0.255 W/kg**

Maximum value of SAR (measured) = 2.71 W/kg



0 dB = 2.71 W/kg

## **ANNEX D EUT EXTERNAL PHOTOS**

Please refer the document "BL-SZ1760285-AW.pdf".

## **ANNEX E SAR TEST SETUP PHOTOS**

Please refer the document "BL-SZ1760285-AS.pdf".

## **ANNEX F CALIBRATION REPORT**

Please refer the document "CALIBRATION REPORT.pdf".

--END OF REPORT--