FCC SAR Test Report

APPLICANT	:	Realtek Semiconductor Corp.
EQUIPMENT	:	802.11a/b/g/n/ac RTL8822CE Combo module
BRAND NAME	:	Realtek
Model Name	:	RTL8822CE
FCC ID	:	TX2-RTL8822CE
STANDARD	:	FCC 47 CFR Part 2 (2.1093) ANSI/IEEE C95.1-1992 IEEE 1528-2013

The product was installed into Notebook Computer (Brand Name: Lenovo, Model Name: Lenovo ideapad S530-13IML******, 81WU******** (* = 0~9, A~Z, a~z, "-" or blank, for marketing use only, with no impact on RF compliance of the product)) during test**

The product was received on Jun. 20, 2019 and testing was started from Jul. 11, 2019 and completed on Jul. 13, 2019. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

Rose Wang

Reviewed by: Rose Wang / Supervisor

Kat Yin

Approved by: Kat Yin / Manager

ilac-MRA ACCREDITED Cert #5145.02

Sporton International (Kunshan) Inc.
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China

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History of this test report

Report No.	Version	Description	Issued Date
FA962005	Rev. 01	Initial issue of report	Aug. 15, 2019

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Realtek Semiconductor Corp., 802.11a/b/g/n/ac RTL8822CE Combo module, RTL8822CE,** are as follows.

Highest Standalone 1g SAR Summary				Highest Simultaneous Transmission 1g SAR (W/kg)
Equipment Class	Highest Simultaneous Transmission 1g SAR (W/kg)		Body 1g SAR (W/kg) Gap(0mm)	
DTS	WLAN	2.4GHz WLAN	0.47	0.92
NII		5GHz WLAN	**1.17**	1.17
DSS	Bluetooth	Bluetooth	<0.10	0.51
Date of Testing:		2019/7/11~2019/7/13		

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications

2. Administration Data

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory		
Test Firm	Sporton International (Kunshan) Inc.	
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958	
Test Site No.	FCC Designation No.	FCC Test Firm Registration No.
	CN1257	314309

Applicant	
Company Name	Realtek Semiconductor Corp.
Address	No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan.

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	802.11a/b/g/n/ac RTL8822CE Combo module
Brand Name	Realtek
Model Name	RTL8822CE
Wireless Technology and Frequency Range	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 ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
EUT Stage	Identical Prototype

Host Feature & Specification	
Equipment Name	Notebook Computer
Brand Name	Lenovo
Model Name	Lenovo ideapad S530-13IML********, 81WU******** (* = 0~9, A~Z, a~z, "-" or blank, for marketing use only, with no impact on RF compliance of the product)
Applicant	**Lenovo (Shanghai) Electronics Technology Co., Ltd.** Section 304-305, Building No. 4, # 222, Meiyue Road, China (Shanghai) Pilot Free Trade Zone
Note 1: There are two samples of EUT, The difference between them is only with the different WLAN/Bluetooth antenna: sample 1 means EUT with High-Tek Antenna while sample 2 means EUT with Yageo Antenna. According to the difference, we choose sample 1 to perform SAR full testing, and sample 2 to verify the worst case of sample 1.	

5. RF Exposure Limits

5.1 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.

5.2 Controlled 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.

6. Specific Absorption Rate (SAR)

6.1 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 higher than the limits for general population/uncontrolled.

6.2 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:

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

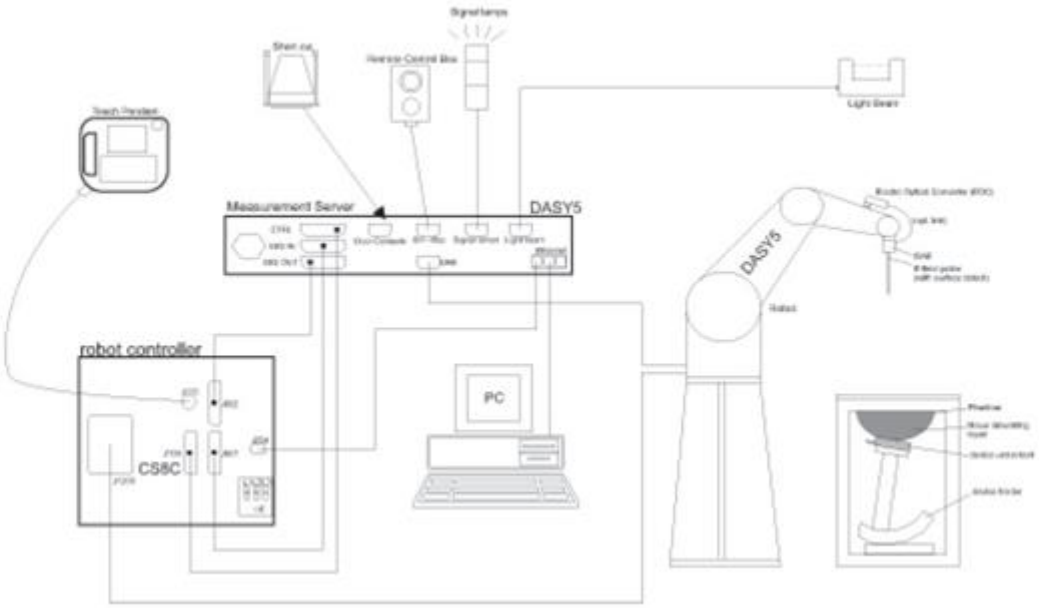
SAR is expressed in units of Watts per kilogram (W/kg)

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

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

7. System Description and Setup

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



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (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.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

7.1 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.

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)	
Directivity	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 µW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 µW/g)	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

7.2 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. 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.

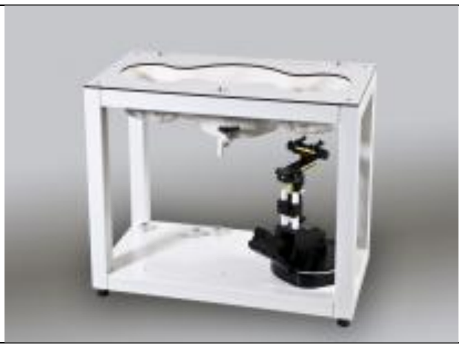
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Photo of DAE

7.3 Phantom

<SAM Twin Phantom>

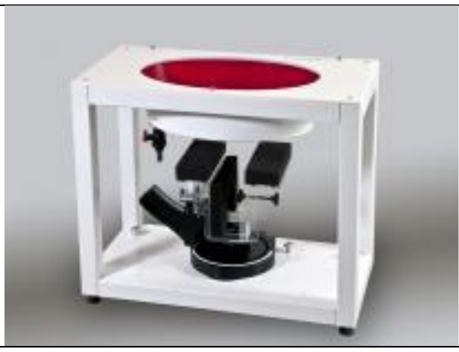
Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom



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.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm



The ELI phantom is intended 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 standard and all known tissue simulating liquids.

7.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters

Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

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.

Mounting Device for Laptops

8. 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
(d) 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

8.1 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

8.2 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.

8.3 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.	

8.4 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.

<table>
<tr><th colspan="3"></th><th>$\leq$ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 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 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

8.5 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.

8.6 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.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	908	2019/3/25	2020/3/24
SPEAG	5000MHz System Validation Kit	D5GHzV2	1006	2018/9/27	2019/9/26
SPEAG	Data Acquisition Electronics	DAE4	1338	2018/12/3	2019/12/2
SPEAG	Dosimetric E-Field Probe	EX3DV4	3954	2019/4/25	2020/4/24
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
SPEAG	ELI5 Phantom	QD 0VA 002 AA	TP-1201	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	2019/4/17	2020/4/16
SPEAG	Dielectric Probe Kit	DAK-3.5	1138	2018/11/20	2019/11/19
Anritsu	Vector Signal Generator	MG3710A	6201682672	2019/1/14	2020/1/13
Rohde & Schwarz	Power Meter	NRVD	102081	2018/8/20	2019/8/19
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2018/8/20	2019/8/19
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2018/8/20	2019/8/19
R&S	CBT BLUETOOTH TESTER	CBT	101641	2019/1/14	2020/1/13
EXA	Spectrum Analyzer	FSV7	101631	2019/1/14	2020/1/13
Testo	Hygrometer	608-H1	1241332126	2018/8/21	2019/8/20
FLUKE	DIGITAC THERMOMETER	51II	97240029	2018/8/8	2019/8/7
ARRA	Power Divider	A3200-2	N/A	Note	
MCL	Attenuation1	BW-S10W5+	N/A	Note	
MCL	Attenuation2	BW-S10W5+	N/A	Note	
MCL	Attenuation3	BW-S10W5+	N/A	Note	
Agilent	Dual Directional Coupler	778D	20500	Note	
Agilent	Dual Directional Coupler	11691D	MY48151020	Note	
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	Note	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	Note	

Note: Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.

10. System Verification

10.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. 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. 10.1.

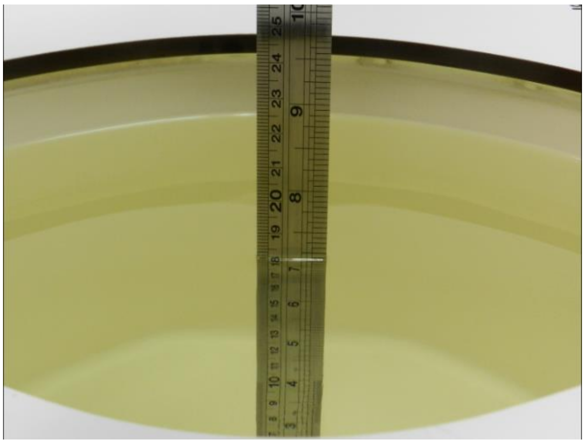


Fig 10.1.1 Photo of Liquid Height for Body SAR

10.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For Head								
2450	55.0	0	0	0	0	45.0	1.80	39.2

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%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	Head	22.8	1.841	38.237	1.80	39.20	2.28	-2.46	±5	2019/7/11
5250	Head	22.7	4.530	36.364	4.71	35.90	-3.82	1.29	±5	2019/7/12
5600	Head	22.7	4.860	35.894	5.07	35.50	-4.14	1.11	±5	2019/7/13
5750	Head	22.7	5.006	35.700	5.22	35.40	-4.10	0.85	±5	2019/7/13

10.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2019/7/11	2450	Head	250	908	3954	1338	13.20	52.80	52.8	0.00
2019/7/12	5250	Head	100	1006	3954	1338	7.75	80.70	77.5	-3.97
2019/7/13	5600	Head	100	1006	3954	1338	8.09	83.30	80.9	-2.88
2019/7/13	5750	Head	100	1006	3954	1338	7.84	80.40	78.4	-2.49

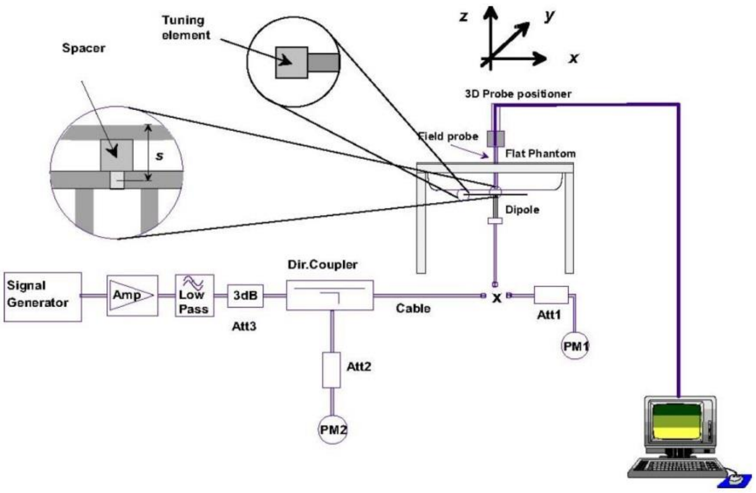


Fig 10.3.1 System Performance Check Setup

Fig 10.3.2 Setup Photo

11. RF Exposure Positions

11.1 SAR Testing for Tablet

This DUT was tested in two positions. There are Bottom of Laptop with phantom 0 cm gap and Back of Display Screen with phantom 25 cm gap.

<EUT Setup Photos>

Please refer to Appendix D for the test setup photos.

12. Conducted RF Output Power (Unit: dBm)

<WLAN Conducted Power>

General Note:

1. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
2. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
3. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
4. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
5. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
   a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
   b. 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.
   c. 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.

<2.4GHz WLAN Ant.1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	15.39	15.50	100.00
		6	2437	15.05	15.50	
		11	2462	15.33	15.50	
	802.11g 6Mbps	1	2412	14.96	15.00	100.00
		6	2437	15.41	15.50	
		11	2462	14.95	15.00	
	802.11n-HT20 MCS0	1	2412	14.94	15.00	100.00
		6	2437	15.36	15.50	
		11	2462	14.88	15.00	
	802.11n-HT40 MCS0	3	2422	14.91	15.00	100.00
		6	2437	15.46	15.50	
		9	2452	14.98	15.00	

<2.4GHz WLAN Ant.2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	15.38	15.50	100.00
		6	2437	15.47	15.50	
		11	2462	15.36	15.50	
	802.11g 6Mbps	1	2412	14.96	15.00	100.00
		6	2437	15.38	15.50	
		11	2462	14.71	15.00	
	802.11n-HT20 MCS0	1	2412	14.72	15.00	100.00
		6	2437	15.41	15.50	
		11	2462	14.96	15.00	
	802.11n-HT40 MCS0	3	2422	14.88	15.00	100.00
		6	2437	15.37	15.50	
		9	2452	14.93	15.00	

<2.4GHz WLAN Ant.1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	17.28	18.50	100.00
		6	2437	17.19	18.50	
		11	2462	17.44	18.50	
	802.11g 6Mbps	1	2412	17.21	18.00	100.00
		6	2437	17.31	18.50	
		11	2462	17.02	18.00	
	802.11n-HT20 MCS0	1	2412	16.71	18.00	100.00
		6	2437	17.38	18.50	
		11	2462	16.95	18.00	
	802.11n-HT40 MCS0	3	2422	16.65	18.00	100.00
		6	2437	17.48	18.50	
		9	2452	17.11	18.00	

<5GHz WLAN Ant.1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	13.49	13.50	100.00
		40	5200	13.47	13.50	
		44	5220	13.45	13.50	
		48	5240	13.43	13.50	
	802.11n-HT20 MCS0	36	5180	13.36	13.50	100.00
		40	5200	13.35	13.50	
		44	5220	13.34	13.50	
		48	5240	13.32	13.50	
	802.11n-HT40 MCS0	38	5190	13.37	13.50	100.00
		46	5230	13.34	13.50	
	802.11ac-VHT20 MCS0	36	5180	13.49	13.50	100.00
		40	5200	13.47	13.50	
		44	5220	13.46	13.50	
		48	5240	13.45	13.50	
	802.11ac-VHT40 MCS0	38	5190	13.48	13.50	100.00
		46	5230	13.46	13.50	
	802.11ac-VHT80 MCS0	42	5210	13.45	13.50	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	13.44	13.50	100.00
		56	5280	13.46	13.50	
		60	5300	13.47	13.50	
		64	5320	13.49	13.50	
	802.11n-HT20 MCS0	52	5260	13.33	13.50	100.00
		56	5280	13.35	13.50	
		60	5300	13.36	13.50	
		64	5320	13.38	13.50	
	802.11n-HT40 MCS0	54	5270	13.35	13.50	100.00
		62	5310	13.36	13.50	
	802.11ac-VHT20 MCS0	52	5260	13.43	13.50	100.00
		56	5280	13.42	13.50	
		60	5300	13.45	13.50	
		64	5320	13.47	13.50	
	802.11ac-VHT40 MCS0	54	5270	13.45	13.50	100.00
		62	5310	13.47	13.50	
	802.11ac-VHT80 MCS0	58	5290	13.47	13.50	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	13.48	13.50	100.00
		116	5580	13.43	13.50	
		124	5620	13.47	13.50	
		132	5660	13.41	13.50	
		140	5700	13.49	13.50	
		144	5720	13.44	13.50	
	802.11n-HT20 MCS0	100	5500	13.39	13.50	100.00
		116	5580	13.33	13.50	
		124	5620	13.31	13.50	
		132	5660	13.34	13.50	
		140	5700	13.38	13.50	
		144	5720	13.36	13.50	
	802.11n-HT40 MCS0	102	5510	13.38	13.50	100.00
		110	5550	13.34	13.50	
		126	5630	13.32	13.50	
		134	5670	13.37	13.50	
		142	5710	13.36	13.50	
	802.11ac-VHT20 MCS0	100	5500	13.48	13.50	100.00
		116	5580	13.41	13.50	
		124	5620	13.45	13.50	
		132	5660	13.46	13.50	
		140	5700	13.49	13.50	
		144	5720	13.45	13.50	
	802.11ac-VHT40 MCS0	102	5510	13.48	13.50	100.00
		110	5550	13.44	13.50	
		126	5630	13.45	13.50	
		134	5670	13.47	13.50	
		142	5710	13.45	13.50	
	802.11ac-VHT80 MCS0	106	5530	13.44	13.50	100.00
		122	5610	13.46	13.50	
		138	5690	13.41	13.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	12.98	13.50	100.00
		157	5785	12.97	13.50	
		165	5825	12.99	13.50	
	802.11n-HT20 MCS0	149	5745	12.36	13.00	100.00
		157	5785	12.37	13.00	
		165	5825	12.38	13.00	
	802.11n-HT40 MCS0	151	5755	12.35	13.00	100.00
		159	5795	12.37	13.00	
	802.11ac-VHT20 MCS0	149	5745	12.48	13.00	100.00
		157	5785	12.45	13.00	
		165	5825	12.47	13.00	
	802.11ac-VHT40 MCS0	151	5755	12.48	13.00	100.00
		159	5795	12.46	13.00	
	802.11ac-VHT80 MCS0	155	5775	12.44	13.00	100.00

<5GHz WLAN Ant.2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	13.48	13.50	100.00
		40	5200	13.44	13.50	
		44	5220	13.46	13.50	
		48	5240	13.45	13.50	
	802.11n-HT20 MCS0	36	5180	13.37	13.50	100.00
		40	5200	13.35	13.50	
		44	5220	13.36	13.50	
		48	5240	13.34	13.50	
	802.11n-HT40 MCS0	38	5190	13.38	13.50	100.00
		46	5230	13.36	13.50	
	802.11ac-VHT20 MCS0	36	5180	13.46	13.50	100.00
		40	5200	13.44	13.50	
		44	5220	13.42	13.50	
		48	5240	13.43	13.50	
	802.11ac-VHT40 MCS0	38	5190	13.47	13.50	100.00
		46	5230	13.44	13.50	
	802.11ac-VHT80 MCS0	42	5210	13.47	13.50	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	13.42	13.50	100.00
		56	5280	13.43	13.50	
		60	5300	13.45	13.50	
		64	5320	13.47	13.50	
	802.11n-HT20 MCS0	52	5260	13.35	13.50	100.00
		56	5280	13.33	13.50	
		60	5300	13.32	13.50	
		64	5320	13.37	13.50	
	802.11n-HT40 MCS0	54	5270	13.35	13.50	100.00
		62	5310	13.37	13.50	
	802.11ac-VHT20 MCS0	52	5260	13.45	13.50	100.00
		56	5280	13.44	13.50	
		60	5300	13.46	13.50	
		64	5320	13.47	13.50	
	802.11ac-VHT40 MCS0	54	5270	13.45	13.50	100.00
		62	5310	13.46	13.50	
	802.11ac-VHT80 MCS0	58	5290	13.46	13.50	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	13.48	13.50	100.00
		116	5580	13.45	13.50	
		124	5620	13.46	13.50	
		132	5660	13.43	13.50	
		140	5700	13.49	13.50	
		144	5720	13.47	13.50	
	802.11n-HT20 MCS0	100	5500	13.38	13.50	100.00
		116	5580	13.32	13.50	
		124	5620	13.36	13.50	
		132	5660	13.34	13.50	
		140	5700	13.39	13.50	
		144	5720	13.37	13.50	
	802.11n-HT40 MCS0	102	5510	13.38	13.50	100.00
		110	5550	13.34	13.50	
		126	5630	13.35	13.50	
		134	5670	13.37	13.50	
		142	5710	13.34	13.50	
	802.11ac-VHT20 MCS0	100	5500	13.48	13.50	100.00
		116	5580	13.47	13.50	
		124	5620	13.42	13.50	
		132	5660	13.47	13.50	
		140	5700	13.49	13.50	
		144	5720	13.43	13.50	
	802.11ac-VHT40 MCS0	102	5510	13.48	13.50	100.00
		110	5550	13.45	13.50	
		126	5630	13.43	13.50	
		134	5670	13.47	13.50	
		142	5710	13.42	13.50	
	802.11ac-VHT80 MCS0	106	5530	13.44	13.50	100.00
		122	5610	13.45	13.50	
		138	5690	13.42	13.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	12.97	13.50	100.00
		157	5785	12.95	13.50	
		165	5825	12.98	13.50	
	802.11n-HT20 MCS0	149	5745	12.37	13.00	100.00
		157	5785	12.36	13.00	
		165	5825	12.38	13.00	
	802.11n-HT40 MCS0	151	5755	12.35	13.00	100.00
		159	5795	12.36	13.00	
	802.11ac-VHT20 MCS0	149	5745	12.48	13.00	100.00
		157	5785	12.46	13.00	
		165	5825	12.47	13.00	
	802.11ac-VHT40 MCS0	151	5755	12.48	13.00	100.00
		159	5795	12.46	13.00	
	802.11ac-VHT80 MCS0	155	5775	12.44	13.00	100.00

<5GHz WLAN Ant.1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	15.95	16.50	100.00
		40	5200	15.93	16.50	
		44	5220	15.93	16.50	
		48	5240	15.94	16.50	
	802.11n-HT20 MCS0	36	5180	15.87	16.50	100.00
		40	5200	15.86	16.50	
		44	5220	15.87	16.50	
		48	5240	15.87	16.50	
	802.11n-HT40 MCS0	38	5190	15.82	16.50	100.00
		46	5230	15.80	16.50	
	802.11ac-VHT20 MCS0	36	5180	15.98	16.50	100.00
		40	5200	15.96	16.50	
		44	5220	15.95	16.50	
		48	5240	15.96	16.50	
	802.11ac-VHT40 MCS0	38	5190	15.90	16.50	100.00
		46	5230	15.89	16.50	
	802.11ac-VHT80 MCS0	42	5210	15.82	16.50	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	15.96	16.50	100.00
		56	5280	15.94	16.50	
		60	5300	15.94	16.50	
		64	5320	15.98	16.50	
	802.11n-HT20 MCS0	52	5260	15.85	16.50	100.00
		56	5280	15.83	16.50	
		60	5300	15.87	16.50	
		64	5320	15.89	16.50	
	802.11n-HT40 MCS0	54	5270	15.83	16.50	100.00
		62	5310	15.81	16.50	
	802.11ac-VHT20 MCS0	52	5260	15.93	16.50	100.00
		56	5280	15.94	16.50	
		60	5300	15.91	16.50	
		64	5320	15.94	16.50	
	802.11ac-VHT40 MCS0	54	5270	15.87	16.50	100.00
		62	5310	15.85	16.50	
	802.11ac-VHT80 MCS0	58	5290	15.84	16.50	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	15.95	16.50	100.00
		116	5580	15.97	16.50	
		124	5620	15.89	16.50	
		132	5660	15.93	16.50	
		140	5700	15.97	16.50	
		144	5720	15.96	16.50	
	802.11n-HT20 MCS0	100	5500	15.90	16.50	100.00
		116	5580	15.84	16.50	
		124	5620	15.86	16.50	
		132	5660	15.86	16.50	
		140	5700	15.89	16.50	
		144	5720	15.89	16.50	
	802.11n-HT40 MCS0	102	5510	15.83	16.50	100.00
		110	5550	15.82	16.50	
		126	5630	15.78	16.50	
		134	5670	15.81	16.50	
		142	5710	15.84	16.50	
	802.11ac-VHT20 MCS0	100	5500	15.97	16.50	100.00
		116	5580	15.92	16.50	
		124	5620	15.91	16.50	
		132	5660	15.94	16.50	
		140	5700	15.96	16.50	
		144	5720	15.92	16.50	
	802.11ac-VHT40 MCS0	102	5510	15.89	16.50	100.00
		110	5550	15.86	16.50	
		126	5630	15.84	16.50	
		134	5670	15.87	16.50	
		142	5710	15.86	16.50	
	802.11ac-VHT80 MCS0	106	5530	15.83	16.50	100.00
		122	5610	16.17	16.50	
		138	5690	15.83	16.50	

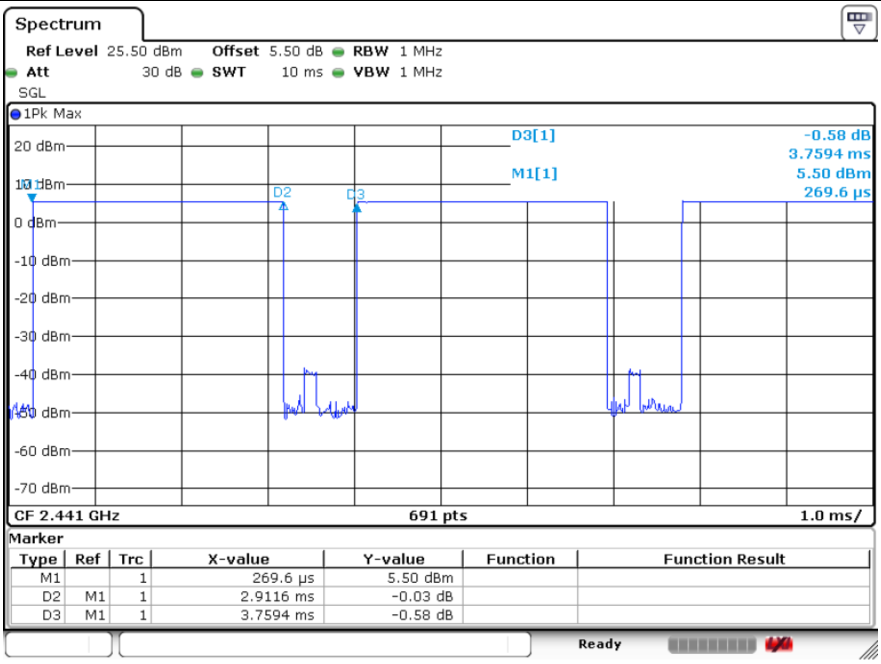
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	15.48	16.50	100.00
		157	5785	15.46	16.50	
		165	5825	15.46	16.50	
	802.11n-HT20 MCS0	149	5745	14.85	16.00	100.00
		157	5785	14.88	16.00	
		165	5825	14.88	16.00	
	802.11n-HT40 MCS0	151	5755	14.81	16.00	100.00
		159	5795	14.81	16.00	
	802.11ac-VHT20 MCS0	149	5745	14.94	16.00	100.00
		157	5785	14.96	16.00	
		165	5825	14.93	16.00	
	802.11ac-VHT40 MCS0	151	5755	14.88	16.00	100.00
		159	5795	14.87	16.00	
	802.11ac-VHT80 MCS0	155	5775	14.84	16.00	100.00

<2.4GHz Bluetooth>

General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps, due to its highest average power.
2. The Bluetooth duty cycle is 77.45 % as following figure, according to 2016 Oct. TCB workshop for Bluetooth SAR scaling need further consideration and the theoretical duty cycle is 83.3%, therefore the actual duty cycle will be scaled up to the theoretical value of Bluetooth reported SAR calculation

Bluetooth time-domain plot

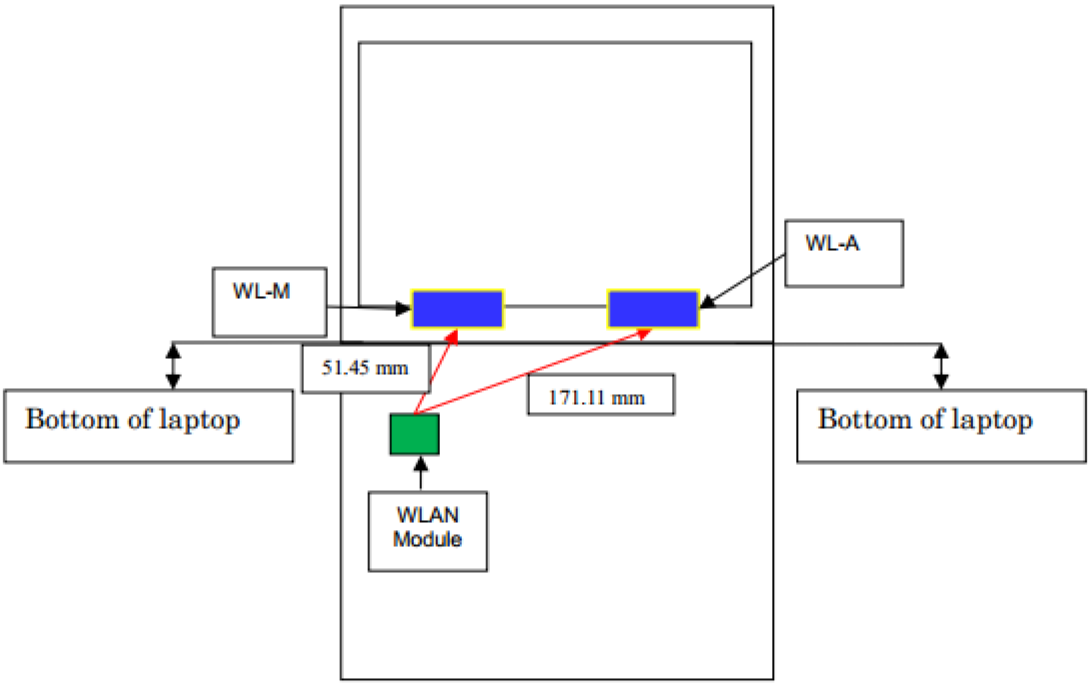


Mode	Channel	Frequency (MHz)	Average power (dBm)
			1Mbps
BR/EDR	CH 00	2402	5.11
	CH 39	2441	**5.59**
	CH 78	2480	5.50
Tune-up limit (dBm)			6.00

Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
v4.0 LE	CH 00	2402	4.93
	CH 19	2440	**5.47**
	CH 39	2480	5.42
Tune-up Limit			6.00

Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
v5.0 LE	CH 00	2402	4.94
	CH 19	2440	4.91
	CH 39	2480	**4.99**
Tune-up Limit			6.00

13. Antenna Location



14. SAR Test Results

General Note:

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 WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
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.

WLAN Note:

1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
2. 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.
3. 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.
4. 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.
5. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
6. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

14.1 Body SAR

<WLAN2.4G SAR>

Plot No.	Sample	Ant. Port	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	1	1	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	1	2412	15.39	15.50	1.026	100	1.000	0.02	0.342	0.351
	1	1	WLAN2.4GHz	802.11b 1Mbps	Back of Display Screen	25	1	2412	15.39	15.50	1.026	100	1.000	0.06	0.011	0.011
	1	1	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	6	2437	15.05	15.50	1.109	100	1.000	0.01	0.324	0.359
	1	1	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	11	2462	15.33	15.50	1.040	100	1.000	0.02	0.339	0.353
01	2	1	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	6	2437	15.05	15.50	1.109	100	1.000	0.01	0.419	**0.465**
	1	2	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	6	2437	15.47	15.50	1.007	100	1.000	-0.02	0.353	0.355
	1	2	WLAN2.4GHz	802.11b 1Mbps	Back of Display Screen	25	6	2437	15.47	15.50	1.007	100	1.000	0.06	0.005	0.005
	1	2	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	1	2412	15.38	15.50	1.028	100	1.000	0.04	0.333	0.342
	1	2	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	11	2462	15.36	15.50	1.033	100	1.000	0.07	0.369	0.381
02	2	2	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	11	2462	15.36	15.50	1.033	100	1.000	0.03	0.438	**0.452**

<Bluetooth SAR>

Plot No.	Sample	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	1	Bluetooth	1Mbps	Bottom	0	39	2441	5.59	6.00	1.099	77.45	1.076	0.06	0.028	0.033
	1	Bluetooth	1Mbps	Back of Display Screen	25	39	2441	5.59	6.00	1.099	77.45	1.076	0.05	<0.001	<0.001
	1	Bluetooth	1Mbps	Bottom	0	00	2402	5.11	6.00	1.227	77.45	1.076	0.01	0.026	0.035
	1	Bluetooth	1Mbps	Bottom	0	78	2480	5.50	6.00	1.122	77.45	1.076	0.02	0.030	0.036
03	2	Bluetooth	1Mbps	Bottom	0	78	2480	5.50	6.00	1.122	77.45	1.076	0.07	0.037	**0.044**

<WLAN5G SAR>

Plot No.	Sample	Ant. Port	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
04	1	1	WLAN5.3GHz	802.11ac-VHT80 MCS0	Bottom	0	58	5290	13.47	13.50	1.007	100	1.000	0.09	0.689	**0.694**
	1	1	WLAN5.3GHz	802.11ac-VHT80 MCS0	Back of Display Screen	25	58	5290	13.47	13.50	1.007	100	1.000	0.03	0.049	0.049
	2	1	WLAN5.3GHz	802.11ac-VHT80 MCS0	Bottom	0	58	5290	13.47	13.50	1.000	100	1.000	0.09	0.514	0.514
	1	2	WLAN5.3GHz	802.11ac-VHT80 MCS0	Bottom	0	58	5290	13.46	13.50	1.009	100	1.000	0.09	0.775	0.782
	1	2	WLAN5.3GHz	802.11ac-VHT80 MCS0	Back of Display Screen	25	58	5290	13.46	13.50	1.009	100	1.000	0.03	0.059	0.060
05	2	2	WLAN5.3GHz	802.11ac-VHT80 MCS0	Bottom	0	58	5290	13.46	13.50	1.009	100	1.000	0.09	1.050	**1.060**
	1	1	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	122	5610	13.46	13.50	1.009	100	1.000	0.09	0.924	0.933
	1	1	WLAN5.5GHz	802.11ac-VHT80 MCS0	Back of Display Screen	25	122	5610	13.46	13.50	1.009	100	1.000	-0.05	0.027	0.027
	1	1	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	106	5530	13.44	13.50	1.014	100	1.000	0.07	0.768	0.779
06	1	1	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	138	5690	13.41	13.50	1.021	100	1.000	0.09	0.993	**1.014**
	2	1	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	138	5690	13.41	13.50	1.021	100	1.000	0.04	0.733	0.748
	1	2	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	122	5610	13.45	13.50	1.012	100	1.000	0.08	0.660	0.668
	1	2	WLAN5.5GHz	802.11ac-VHT80 MCS0	Back of Display Screen	25	122	5610	13.45	13.50	1.012	100	1.000	0.03	0.063	0.064
	1	2	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	106	5530	13.44	13.50	1.014	100	1.000	0.09	0.829	0.841
	1	2	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	138	5690	13.42	13.50	1.019	100	1.000	0.09	0.234	0.238
07	2	2	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	106	5530	13.44	13.50	1.014	100	1.000	0.06	1.150	**1.166**
	1	1	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	165	5825	12.99	13.50	1.125	100	1.000	0.07	0.814	0.915
	1	1	WLAN5.8GHz	802.11a 6Mbps	Back of Display Screen	25	165	5825	12.99	13.50	1.125	100	1.000	0.04	0.008	0.009
	1	1	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	149	5745	12.98	13.50	1.127	100	1.000	0.04	0.862	0.972
	1	1	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	157	5785	12.97	13.50	1.130	100	1.000	-0.05	0.659	0.745
08	2	1	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	149	5745	12.98	13.50	1.127	100	1.000	0.08	0.968	**1.091**
	2	1	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	157	5785	12.97	13.50	1.130	100	1.000	0.03	0.867	0.980
	2	1	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	165	5825	12.99	13.50	1.125	100	1.000	0.02	0.665	0.748
	1	2	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	165	5825	12.98	13.50	1.127	100	1.000	0.04	0.504	0.568
	1	2	WLAN5.8GHz	802.11a 6Mbps	Back of Display Screen	25	165	5825	12.98	13.50	1.127	100	1.000	0.01	0.008	0.009
	1	2	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	149	5745	12.97	13.50	1.130	100	1.000	-0.03	0.296	0.334
	1	2	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	157	5785	12.95	13.50	1.135	100	1.000	-0.05	0.379	0.430
09	2	2	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	149	5745	12.97	13.50	1.130	100	1.000	0.01	0.795	**0.898**
	2	2	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	157	5785	12.95	13.50	1.135	100	1.000	0.01	0.698	0.792
	2	2	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	165	5825	12.98	13.50	1.127	100	1.000	0.04	0.498	0.561

14.2 Repeated SAR Measurement

Plot No.	Sample	Ant. Port	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	2	2	WLAN5.3GHz	802.11ac-VHT80 MCS0	Bottom	0	58	5290	13.46	13.50	1.009	100	1.000	0.09	1.050	1	1.060
2nd	2	2	WLAN5.3GHz	802.11ac-VHT80 MCS0	Bottom	0	58	5290	13.46	13.50	1.009	100	1.000	0.09	1.010	1.040	1.019
1st	2	2	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	106	5530	13.44	13.50	1.014	100	1.000	0.06	1.150	1	1.166
2nd	2	2	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom	0	106	5530	13.44	13.50	1.014	100	1.000	0.06	1.110	1.036	1.125
1st	2	1	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	149	5745	12.98	13.50	1.127	100	1.000	0.08	0.968	1	1.091
2nd	2	1	WLAN5.8GHz	802.11a 6Mbps	Bottom	0	149	5745	12.98	13.50	1.127	100	1.000	0.08	0.955	1.014	1.076

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

15. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Supported
1.	WLAN 2.4GHz Antenna 1 + Bluetooth	Yes
2.	WLAN 2.4GHz Antenna 1 + WLAN 2.4GHz Antenna 2	Yes
3.	WLAN 5GHz Antenna 1 + Bluetooth	Yes
4.	WLAN 5GHz Antenna 2 + Bluetooth	Yes
5.	WLAN 5GHz Antenna 1 + WLAN 5GHz Antenna 2	Yes
6.	WLAN 5GHz Antenna 1 + WLAN 5GHz Antenna 2 + Bluetooth	Yes

General Note:

1. Bluetooth and WLAN2.4GHz share the same antenna 2, and cannot transmit simultaneously.
2. According to the EUT character, WLAN 2.4GHz antenna 1 and Bluetooth can transmit simultaneously.
3. According to the EUT character, WLAN 5GHz and Bluetooth can transmit simultaneously
4. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
5. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment.
6. The worst case WLAN5GHz SAR was used for SAR summation. Therefore, the following summations represent the absolute worst cases for simultaneous transmission with WLAN.
7. The reported SAR summation is calculated based on the same configuration and test position.
8. For simultaneously analysis, since the SAR summation of 3 transmitters can cover others combination of 2 transmitters, therefore in this section did not additional to evaluate 2TX combination of simultaneously transmission.
9. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) SPLSR = (SAR1 + SAR2)^1.5 / (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.
   iii) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

15.1 Body Exposure Conditions

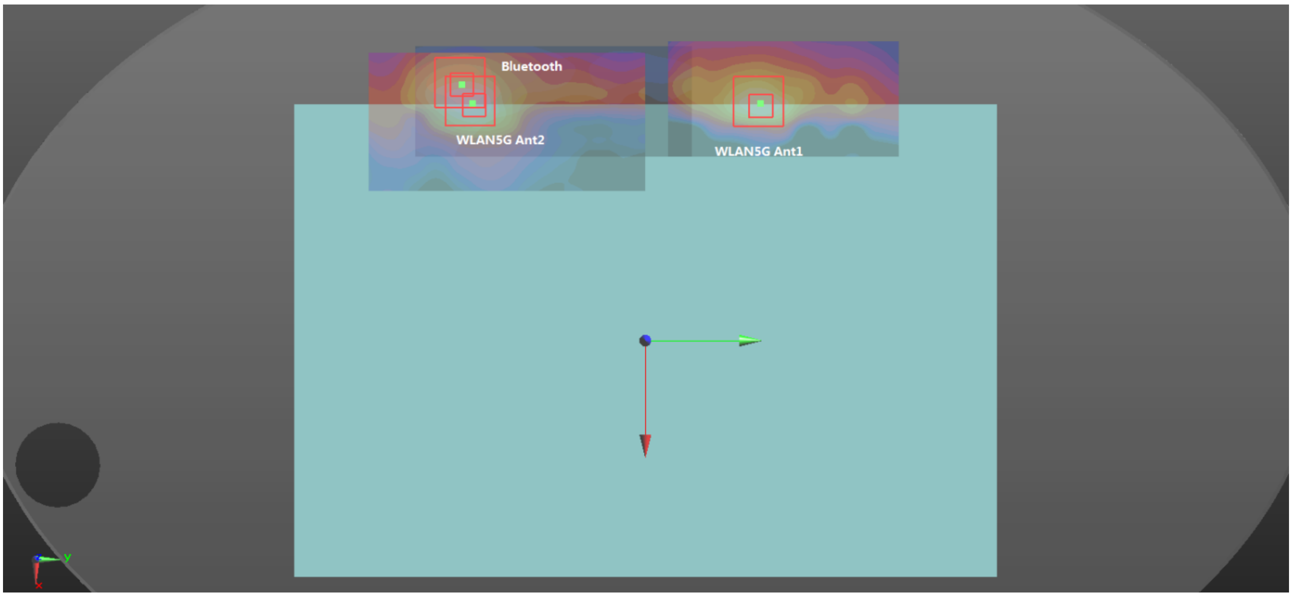
Exposure Position	1	2	3	4	5	1+2 Summed 1g SAR (W/kg)	1+5 Summed 1g SAR (W/kg)	3+4+5		
	2.4GHz WLAN Ant.1	2.4GHz WLAN Ant.2	5GHz WLAN Ant.1	5GHz WLAN Ant.2	Bluetooth Ant.2			Summed 1g SAR (W/kg)	SPLSR	Case No
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)					
Bottom at 0mm	0.465	0.452	1.091	1.166	0.044	**0.92**	**0.51**	**2.30**	**0.03**	**#01**
Back of Display Screen at 25mm	0.011	0.005	0.049	0.064	<0.001	0.02	0.01	0.11		

15.2 SPLSR Evaluation and Analysis

General Note:

1. When standalone SAR is measured for both antennas in the pair, the peak location separation distance is computed by the square root of [(x1−x2)2 + (y1−y2)2 + (z1−z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates in the area scans or extrapolated peak SAR locations in the zoom scans, as appropriate.
2. SPLSR = (SAR1 + SAR2)1.5 / (min. separation distance, mm). If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.

	Band	Position	1g SAR (W/kg)	Gap (mm)	SAR peak location (mm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
					X	Y	Z				
Case #01	WLAN5GHz Ant1	Bottom	1.091	0	-100.6	50.8	-1.28	128.7	2.301	0.03	Not required
	WLAN5GHz Ant2		1.166	0	-101.4	-74.2	-1.97				
	Bluetooth		0.044	0	-109.2	-77.6	-1.66				
	WLAN5GHz Ant1	Bottom	1.091	0	-100.6	50.8	-1.28	125.0	2.301	0.03	Not required
	Bluetooth		0.044	0	-109.2	-77.6	-1.66				
	WLAN5GHz Ant2		1.166	0	-101.4	-74.2	-1.97				



Test Engineer: Nick Hu, Yuan Zhao, Jiaxing Chang, Yuankai Kong

16. Uncertainty Assessment

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg. Therefore, the measurement uncertainty table is not required in this report.

17. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[6] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

[7] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[8] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[9] FCC KDB 616217 D04 v01r02, “SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers”, Oct 2015

Appendix A. Plots of System Performance Check

The plots are submitted separately.

Appendix B. Plots of SAR Measurement

The plots are submitted separately.

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are submitted separately.