Testing Laboratory 1190

FCC SAR TEST REPORT

FCC ID : **PPD-QCNFA344AH**
Equipment : **802.11 a/b/g/n/ac + BT 4.1 M.2 2230 Type Card**
Brand Name : **Qualcomm Atheros**
Model Name : **QCNFA344A**
Applicant : **Qualcomm Atheros, Inc**
1700 Technology Drive, San Jose, CA 95110
Manufacturer : **Qualcomm Atheros, Inc**
1700 Technology Drive, San Jose, CA 95110
Standard : **FCC 47 CFR Part 2 (2.1093)**

The product was installed into Portable Computer (Brand Name DELL, Model Name: P143G) during test.

The product was received on Dec. 11, 2020 and testing was started from Jan. 06, 2021 and completed on Jan. 06, 2021. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been pass the FCC requirement.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Cona Huang

Approved by: Cona Huang / Deputy Manager

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

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History of this test report

Report No.	Version	Description	Issued Date
FA0D1624	01	Initial issue of report	Feb. 23, 2021
FA0D1624	02	Update Antenna Information	Mar. 03, 2021
FA0D1624	03	Update BLE power	Mar. 16, 2021

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Qualcomm Atheros, Inc, 802.11 a/b/g/n/ac + BT 4.1 M.2 2230 Type Card, QCNFA344A, are as follows.

Equipment Class	Frequency Band		Highest SAR Summary Body (Separation 0mm) 1g SAR (W/kg)	Highest Simultaneous Transmission 1g SAR (W/kg)
DTS	WLAN	2.4GHz WLAN	0.82	0.87
NII		5GHz WLAN	1.11	1.17
DSS	2.4GHz Band	Bluetooth	0.14	1.17
Date of Testing:			2021/1/6	

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No.TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test. 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

Reviewed by: Jason Wang
Report Producer: Paula Chen

2. 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

3. Equipment Under Test (EUT) Information

3.1 General Information

Product Feature & Specification	
Equipment Name	802.11 a/b/g/n/ac + BT 4.1 M.2 2230 Type Card
Brand Name	Qualcomm Atheros
Model Name	QCNFA344A
FCC ID	PPD-QCNFA344AH
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2472 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: 802.11a/b/g/n/ac HT20 / HT40 / VHT20 / VHT40 / VHT80 Bluetooth BR/EDR/LE

Remark:
1. This product has two antenna vendors and will match two product appearances; RF exposure evaluation is used highest output to test below samples and find the worst case sample to further tested.
2. The difference between GEO and Craft is Speaker & Screw location Antenna CU foil location.
3. Output power documented in the SAR report has been set based on the maximum rated power including production tolerances which may be higher than the powers reported in the original filing, which have not accounted for production tolerances except when performing MPE / SAR assessments.

Host Information	
Equipment Name	Portable Computer
Brand Name	DELL
Model Name	P143G
EUT Stage	Identical Prototype

Sample	Product appearance	Antenna Vendor
Sample 1	GEO	WNC
Sample 2	Craft	WNC
Sample 3	GEO	SPEED
Sample 4	Craft	SPEED

Antenna Information								
Product appearance	manufacturer	Antenna type	Antenna	2.4G	5G B1	5G B2	5G B3	5G B4
Craft	SPEED	PIFA	1(main)	0.54	2.83	2.94	4.02	3.75
			2(aux)	-0.59	2.79	2.85	3.05	2.81
	WNC	PIFA	1(main)	0.57	2.92	2.83	4.42	3.91
			2(aux)	-0.59	2.84	2.78	3.05	2.95
Product appearance	manufacturer	Antenna type	Antenna	2.4G	5G B1	5G B2	5G B3	5G B4
GEO	SPEED	PIFA	1(main)	-0.75	2.88	2.88	4.62	4.13
			2(aux)	-1.83	2.71	2.74	4.19	4.63
	WNC	PIFA	1(main)	-0.73	2.84	2.78	4.65	4.2
			2(aux)	-1.86	2.81	2.81	4.18	3.86

4. RF Exposure Limits

4.1 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.

4.2 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

1. 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.

5. Specific Absorption Rate (SAR)

5.1 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.

5.2 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:

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

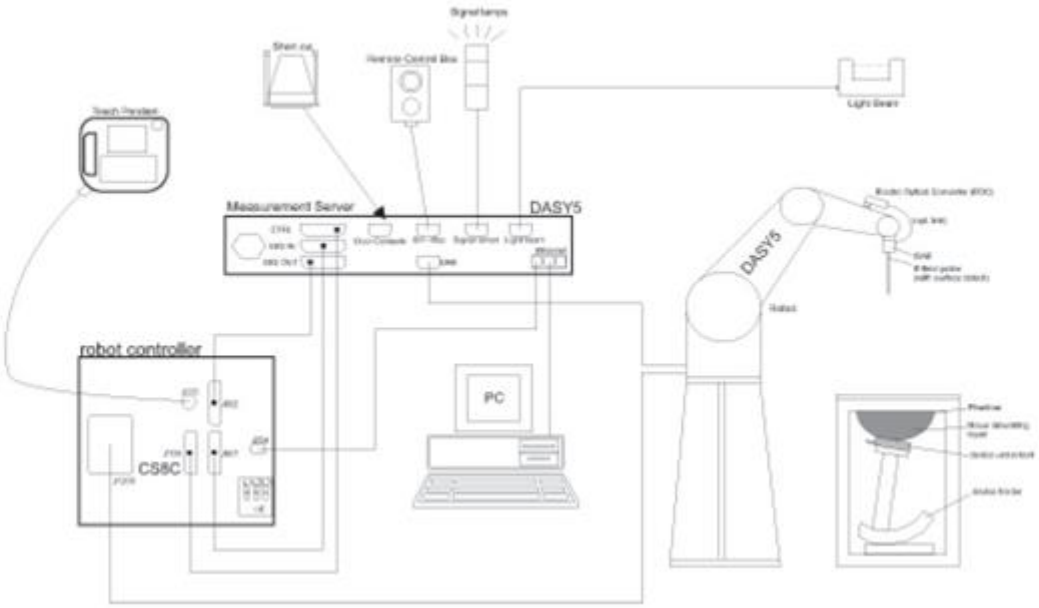
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

6. 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.

6.1 Test Site Location

The SAR measurement facilities used to collect data are within both Sporton Lab list below test site location are accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190 and 0007) and the FCC designation No.TW1190 and TW0007 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

Test Site	SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory			
Test Site Location	TW1190 No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, CHINESE TAIPEI		TW0007 No. 58, Aly. 75, Ln. 564, Wehnua 3rd, Rd., Guishan Dist., Taoyuan City, CHINESE TAIPEI	
Test Site No.	SAR01-HY	SAR03-HY	SAR08-HY	SAR09-HY
	SAR04-HY	SAR05-HY	SAR11-HY	SAR12-HY
	SAR06-HY	SAR10-HY		

6.2 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.

<ES3DV3 Probe>

Construction	Symmetric design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – 4 GHz; Linearity: ±0.2 dB (30 MHz – 4 GHz)	
Directivity	±0.2 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)	
Dynamic Range	5 µW/g – >100 mW/g; Linearity: ±0.2 dB	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 3.0 mm	

<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	

6.3 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.

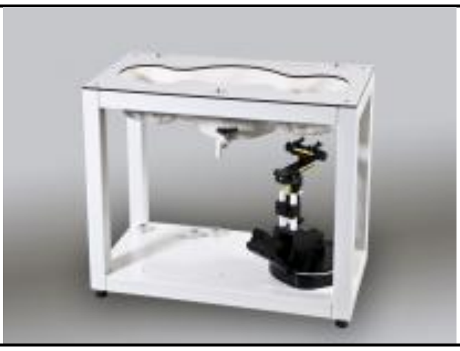
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.1 Photo of DAE

6.4 Phantom

<SAM Twin Phantom>

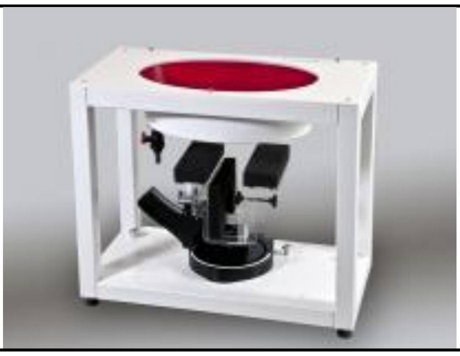
Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom



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.

6.5 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

7. 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

7.1 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

7.2 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.

7.3 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.

<table>
<tr><th></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td>Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
</table>

7.4 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><td colspan="3"></td><td>$\leq$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</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>

7.5 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.

7.6 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.

8. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit(2)	D2450V2	736	Aug. 31, 2018	Aug. 28, 2021
SPEAG	5GHz System Validation Kit(2)	D5GHzV2	1006	Sep. 27, 2018	Sep. 24, 2021
SPEAG	Data Acquisition Electronics	DAE3	577	Sep. 16, 2020	Sep. 15, 2021
SPEAG	Dosimetric E-Field Probe	EX3DV4	7306	Jul. 24, 2020	Jul. 23, 2021
RCPTWN	Thermometer	HTC-1	TM560-2	Nov. 10, 2020	Nov. 09, 2021
R&S	BT Base Station	CBT	100815	Feb. 15, 2020	Feb. 14, 2021
SPEAG	Device Holder	N/A	N/A	N/A	N/A
R&S	Signal Generator	SMA100A	101091	Jul. 20, 2020	Jul. 19, 2021
Keysight	ENA Network Analyzer	E5071C	MY46101588	Jun. 10, 2020	Jun. 09, 2021
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 16, 2020	Sep. 15, 2021
LINE SEIKI	Digital Thermometer	DTM3000-spezial	2942	Nov. 06, 2020	Nov. 05, 2021
Anritsu	Power Meter	ML2495A	1419002	Aug. 19, 2020	Aug. 18, 2021
Anritsu	Power Sensor	MA2411B	1911176	Aug. 18, 2020	Aug. 17, 2021
Anritsu	Power Meter	ML2495A	1804003	Oct. 21, 2020	Oct. 20, 2021
Anritsu	Power Sensor	MA2411B	1726150	Oct. 21, 2020	Oct. 20, 2021
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jun. 30, 2020	Jun. 29, 2021
Anritsu	Spectrum Analyzer	N9010A	MY53470118	Mar. 12, 2020	Mar. 11, 2021
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 21, 2020	Oct. 20, 2021
Mini-Circuits	Power Amplifier	ZVE-8G+	479102029	Aug. 26, 2020	Aug. 25, 2021
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General Note:

1. 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.
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

9. System Verification

9.1 Tissue Verification

The tissue dielectric parameters of tissue-equivalent media used for SAR measurements must be characterized within a temperature range of 18℃ to 25℃, measured with calibrated instruments and apparatuses, such as network analyzers and temperature probes. The temperature of the tissue-equivalent medium during SAR measurement must also be within 18℃ to 25℃ and within ± 2℃ of the temperature when the tissue parameters are characterized. The tissue dielectric measurement system must be calibrated before use. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements.
The liquid tissue depth was at least 15cm in the phantom for all SAR testing

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	22.6	1.834	38.598	1.80	39.20	1.89	-1.54	±5	2021/1/6
5250	22.6	4.634	35.967	4.71	35.95	-1.61	0.05	±5	2021/1/6
5600	22.6	4.974	35.437	5.07	35.50	-1.89	-0.18	±5	2021/1/6
5750	22.6	5.147	35.246	5.22	35.35	-1.40	-0.29	±5	2021/1/6

9.2 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)	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 (%)
2021/1/6	2450	250	D2450V2-736	EX3DV4 - SN7306	DAE3 Sn577	13.10	52.70	52.4	-0.57
2021/1/6	5250	100	D5GHzV2-1006-5250	EX3DV4 - SN7306	DAE3 Sn577	7.35	80.70	73.5	-8.92
2021/1/6	5600	100	D5GHzV2-1006-5600	EX3DV4 - SN7306	DAE3 Sn577	8.50	83.30	85	2.04
2021/1/6	5750	100	D5GHzV2-1006-5750	EX3DV4 - SN7306	DAE3 Sn577	7.52	80.40	75.2	-6.47

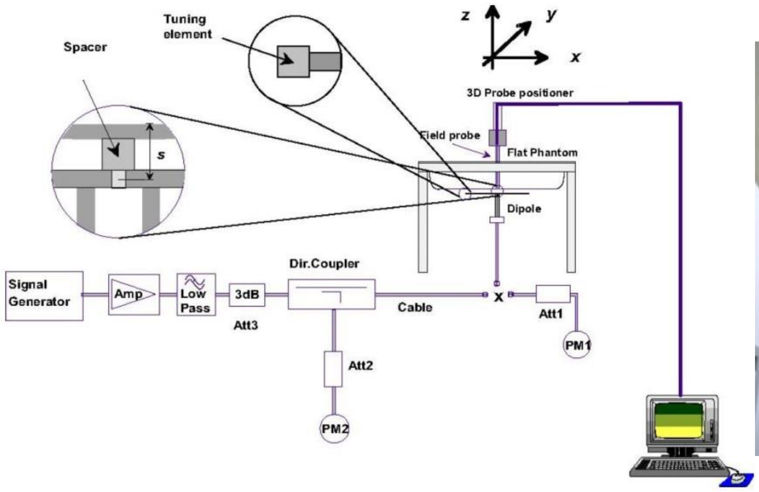


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

10. Conducted RF Output Power (Unit: dBm)

<WLAN Conducted Power>

General Note:

1. The reported TX power in EMC report is per actual shipping power setting and measured in this unit, the power set for SAR test is included the tune-up tolerance which is considered as worst case.
2. For the conducted power measurement is MIMO chains transmitting simultaneously and measured the separately conducted power for both chains and then based on the conducted power of antenna 1 and antenna 2 respectively to calculate sum of the power for MIMO mode
3. All of the wireless technology of this device only supports MIMO mode operation.
4. 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.
5. 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).
6. 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.
7. 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				MIMO Ant 1		MIMO Ant 2		MIMO Ant 1+2		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	15.90	16.00	15.60	16.00	18.76	19.00	100.00
		6	2437	15.70	16.00	15.90	16.00	18.81	19.00	
		11	2462	15.40	16.00	15.80	16.00	18.61	19.00	
		12	2467	12.00	12.50	12.40	12.50	15.21	15.50	
		13	2472	11.00	11.50	11.40	11.50	14.21	14.50	
	802.11g 6Mbps	1	2412	15.40	16.00	15.90	16.00	18.67	19.00	95.18
		6	2437	15.30	16.00	15.90	16.00	18.62	19.00	
		11	2462	15.20	16.00	15.90	16.00	18.57	19.00	
		12	2467	13.10	14.00	13.90	14.00	16.53	17.00	
		13	2472	1.80	3.00	2.60	3.00	5.23	6.00	
	802.11n-HT20 MCS0	1	2412	15.30	16.00	15.90	16.00	18.62	19.00	94.61
		6	2437	15.20	16.00	15.80	16.00	18.52	19.00	
		11	2462	15.00	16.00	15.90	16.00	18.48	19.00	
		12	2467	13.00	14.00	13.90	14.00	16.48	17.00	
		13	2472	0.50	1.50	1.40	1.50	3.98	4.50	
	802.11n-HT40 MCS0	3	2422	12.10	13.00	12.70	13.00	15.42	16.00	93.31
		6	2437	15.00	16.00	15.70	16.00	18.37	19.00	
		9	2452	9.90	11.00	10.80	11.00	13.38	14.00	
		10	2457	9.90	11.00	10.80	11.00	13.38	14.00	
		11	2462	1.40	2.50	2.40	2.50	4.94	5.50	
	802.11ac-VHT20 MCS0	1	2412	15.20	16.00	15.80	16.00	18.52	19.00	94.39
		6	2437	15.10	16.00	15.70	16.00	18.42	19.00	
		11	2462	14.90	16.00	15.80	16.00	18.38	19.00	
		12	2467	12.90	14.00	13.80	14.00	16.38	17.00	
		13	2472	0.40	1.50	1.30	1.50	3.88	4.50	
	802.11ac-VHT40 MCS0	3	2422	12.00	13.00	12.60	13.00	15.32	16.00	93.62
		6	2437	14.90	16.00	15.60	16.00	18.27	19.00	
		9	2452	9.80	11.00	10.70	11.00	13.28	14.00	
		10	2457	9.80	11.00	10.70	11.00	13.28	14.00	
		11	2462	1.30	2.50	2.30	2.50	4.84	5.50	

5.2GHz WLAN				MIMO Ant 1		MIMO Ant 2		MIMO Ant 1+2		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	10.70	11.00	10.90	11.00	13.81	14.00	94.74
		40	5200	10.30	11.00	10.40	11.00	13.36	14.00	
		44	5220	10.50	11.00	10.80	11.00	13.66	14.00	
		48	5240	9.50	11.00	10.80	11.00	13.21	14.00	
	802.11n-HT20 MCS0	36	5180	10.50	11.00	10.70	11.00	13.61	14.00	94.36
		40	5200	10.30	11.00	10.30	11.00	13.31	14.00	
		44	5220	10.20	11.00	10.70	11.00	13.47	14.00	
		48	5240	9.80	11.00	10.60	11.00	13.23	14.00	
	802.11n-HT40 MCS0	38	5190	10.50	11.00	10.80	11.00	13.66	14.00	89.62
		46	5230	10.50	11.00	10.80	11.00	13.66	14.00	
	802.11ac-VHT20 MCS0	36	5180	10.60	11.00	10.80	11.00	13.71	14.00	94.85
		40	5200	10.40	11.00	10.40	11.00	13.41	14.00	
		44	5220	10.50	11.00	10.80	11.00	13.66	14.00	
		48	5240	9.90	11.00	10.90	11.00	13.44	14.00	
	802.11ac-VHT40 MCS0	38	5190	10.60	11.00	10.90	11.00	13.76	14.00	93.37
		46	5230	10.60	11.00	10.90	11.00	13.76	14.00	
	802.11ac-VHT80 MCS0	42	5210	9.10	10.50	9.40	10.50	12.26	13.50	86.39

5.3GHz WLAN				MIMO Ant 1		MIMO Ant 2		MIMO Ant 1+2		
5.3GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	52	5260	9.50	11.00	10.90	11.00	13.27	14.00	94.74
		56	5280	9.80	11.00	10.90	11.00	13.40	14.00	
		60	5300	9.90	11.00	10.90	11.00	13.44	14.00	
		64	5320	9.90	11.00	10.80	11.00	13.38	14.00	
	802.11n-HT20 MCS0	52	5260	9.30	11.00	10.50	11.00	12.95	14.00	94.36
		56	5280	10.00	11.00	10.70	11.00	13.37	14.00	
		60	5300	9.90	11.00	10.80	11.00	13.38	14.00	
		64	5320	10.00	11.00	10.80	11.00	13.43	14.00	
	802.11n-HT40 MCS0	54	5270	10.50	11.00	10.80	11.00	13.66	14.00	89.62
		62	5310	10.00	11.00	10.80	11.00	13.43	14.00	
	802.11ac-VHT20 MCS0	52	5260	9.40	11.00	10.80	11.00	13.17	14.00	94.85
		56	5280	10.10	11.00	10.80	11.00	13.47	14.00	
		60	5300	10.00	11.00	10.90	11.00	13.48	14.00	
		64	5320	10.10	11.00	10.90	11.00	13.53	14.00	
	802.11ac-VHT40 MCS0	54	5270	10.60	11.00	10.90	11.00	13.76	14.00	93.37
		62	5310	10.60	11.00	10.90	11.00	13.76	14.00	
	802.11ac-VHT80 MCS0	58	5290	9.60	11.00	10.90	11.00	13.31	14.00	86.39

5.5GHz WLAN				MIMO Ant 1		MIMO Ant 2		MIMO Ant 1+2		
5.5GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	100	5500	10.70	11.00	10.90	11.00	13.81	14.00	94.74
		116	5580	10.80	11.00	10.60	11.00	13.71	14.00	
		124	5620	10.30	11.00	10.50	11.00	13.41	14.00	
		132	5660	10.60	11.00	10.90	11.00	13.76	14.00	
		144	5720	10.30	11.00	10.90	11.00	13.62	14.00	
	802.11n-HT20 MCS0	100	5500	10.80	11.00	10.80	11.00	13.81	14.00	94.36
		116	5580	10.30	11.00	10.70	11.00	13.51	14.00	
		124	5620	10.60	11.00	10.70	11.00	13.66	14.00	
		132	5660	10.30	11.00	10.70	11.00	13.51	14.00	
		144	5720	10.40	11.00	10.70	11.00	13.56	14.00	
	802.11n-HT40 MCS0	102	5510	10.50	11.00	10.70	11.00	13.61	14.00	89.62
		110	5550	10.20	11.00	10.60	11.00	13.41	14.00	
		126	5630	10.00	11.00	10.70	11.00	13.37	14.00	
		134	5670	10.60	11.00	10.80	11.00	13.71	14.00	
		142	5710	10.50	11.00	10.70	11.00	13.61	14.00	
	802.11ac-VHT20 MCS0	100	5500	10.90	11.00	10.90	11.00	13.91	14.00	94.85
		116	5580	10.80	11.00	10.90	11.00	13.86	14.00	
		124	5620	10.70	11.00	10.80	11.00	13.76	14.00	
		132	5660	10.40	11.00	10.80	11.00	13.61	14.00	
		144	5720	10.50	11.00	10.80	11.00	13.66	14.00	
	802.11ac-VHT40 MCS0	102	5510	10.90	11.00	10.90	11.00	13.91	14.00	93.37
		110	5550	10.30	11.00	10.60	11.00	13.46	14.00	
		126	5630	10.10	11.00	10.80	11.00	13.47	14.00	
		134	5670	10.70	11.00	10.90	11.00	13.81	14.00	
		142	5710	10.70	11.00	10.80	11.00	13.76	14.00	
	802.11ac-VHT80 MCS0	106	5530	10.50	11.00	10.90	11.00	13.71	14.00	86.39
		122	5610	10.50	11.00	10.70	11.00	13.61	14.00	
		138	5690	10.50	11.00	10.70	11.00	13.61	14.00	

5.8GHz WLAN				MIMO Ant 1		MIMO Ant 2		MIMO Ant 1+2		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	10.10	11.00	11.00	11.00	13.58	14.00	94.74
		157	5785	10.40	11.00	10.90	11.00	13.67	14.00	
		165	5825	10.70	11.00	10.30	11.00	13.51	14.00	
	802.11n-HT20 MCS0	149	5745	10.30	11.00	10.90	11.00	13.62	14.00	94.36
		157	5785	10.70	11.00	10.90	11.00	13.81	14.00	
		165	5825	10.60	11.00	10.50	11.00	13.56	14.00	
	802.11n-HT40 MCS0	151	5755	10.00	11.00	10.90	11.00	13.48	14.00	89.62
		159	5795	10.80	11.00	10.90	11.00	13.86	14.00	
	802.11ac-VHT20 MCS0	149	5745	10.40	11.00	11.00	11.00	13.72	14.00	94.85
		157	5785	10.80	11.00	11.00	11.00	13.91	14.00	
		165	5825	10.70	11.00	10.60	11.00	13.66	14.00	
	802.11ac-VHT40 MCS0	151	5755	10.10	11.00	11.00	11.00	13.58	14.00	93.37
		159	5795	10.90	11.00	11.00	11.00	13.96	14.00	
	802.11ac-VHT80 MCS0	155	5775	9.20	10.00	10.00	10.00	12.63	13.00	86.39

<2.4GHz Bluetooth>

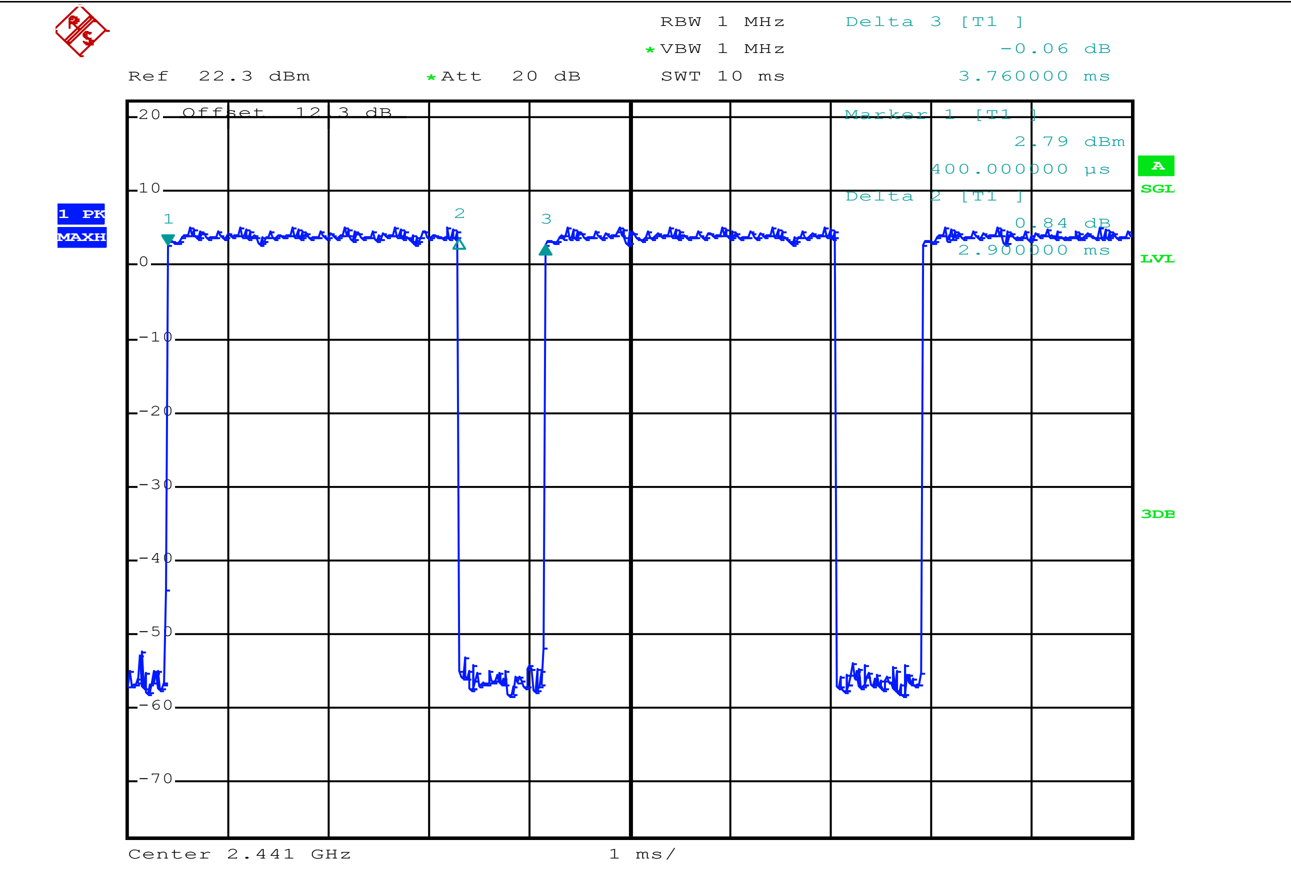
Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	5.05	3.95	2.60
	CH 39	2441	5.46	4.17	3.25
	CH 78	2480	6.01	4.71	3.78
Tune-up Limit			7	7	7

Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
LE	CH 00	2402	1.75
	CH 19	2440	2.35
	CH 39	2480	2.45
Tune-up Limit			4.5

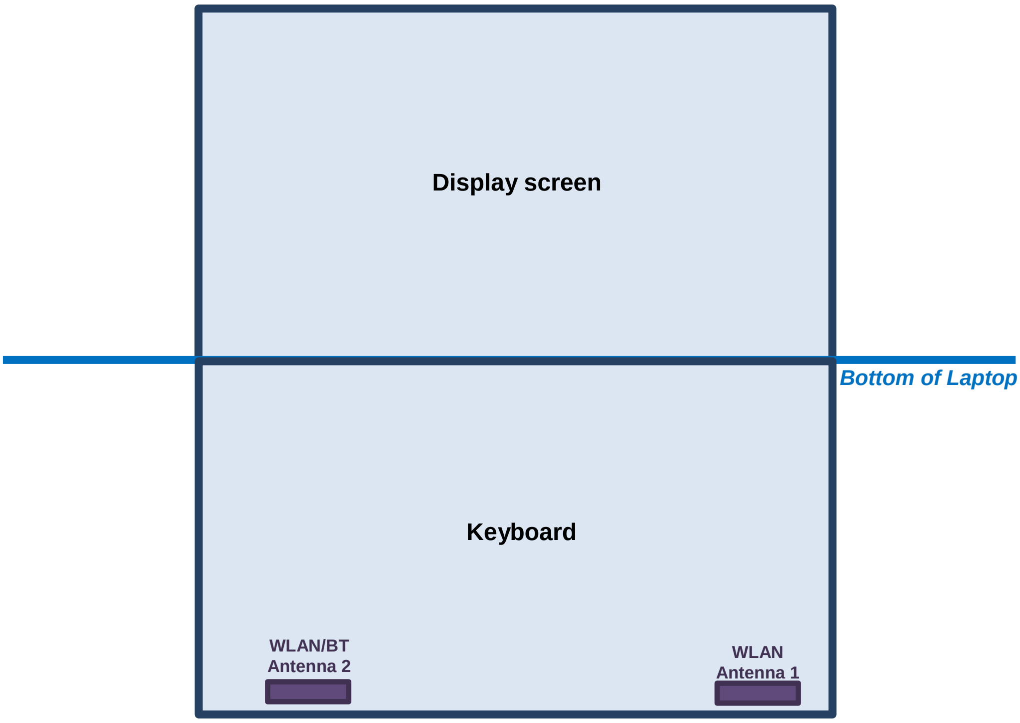
General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps due to its highest average power and duty cycle is 77.13% considered in SAR testing, and the duty cycle would be scaled to theoretical 83.3% in reported SAR calculation.

BT Duty cycle



11. Antenna Location



The separation distance for antenna to edge:

Antenna	To Bottom of Laptop (mm)
WLAN Antenna 1	<5
WLAN/BT Antenna 2	<5

12. 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. When in MIMO SAR testing, if the hot spots are separated the scaling factor would scale each hot spot based on the difference between the power for that transmit antenna and the maximum rated power, if the hot spot were not separable or too much overlap which the scaling factor is the worst case rated power/measured power across the two chains in SAR calculation.
6. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

12.1 Body SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Antenna	Ant	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)
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 1+2	Ant 1	6	2437	15.90	16.00	1.023	100	1.000	0.1	0.256	0.262
							Ant 2	6	2437	15.60	16.00	1.096	100	1.000	0.1	0.433	0.475
01	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 2	Ant 1+2	Ant 1	6	2437	15.90	16.00	1.023	100	1.000	0	0.392	0.401
							Ant 2	6	2437	15.60	16.00	1.096	100	1.000	0	0.746	0.818
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 3	Ant 1+2	Ant 1	6	2437	15.90	16.00	1.023	100	1.000	-0.12	0.200	0.205
							Ant 2	6	2437	15.60	16.00	1.096	100	1.000	-0.12	0.402	0.441
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 4	Ant 1+2	Ant 1	6	2437	15.90	16.00	1.023	100	1.000	0	0.611	0.625
							Ant 2	6	2437	15.60	16.00	1.096	100	1.000	0	0.444	0.487
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 2	Ant 1+2	Ant 1	1	2412	15.90	16.00	1.023	100	1.000	0.11	0.413	0.423
							Ant 2	1	2412	15.60	16.00	1.096	100	1.000	0.11	0.654	0.717
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 2	Ant 1+2	Ant 1	11	2462	15.40	16.00	1.148	100	1.000	0.02	0.552	0.634
							Ant 2	11	2462	15.80	16.00	1.047	100	1.000	0.02	0.353	0.370
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1+2	Ant 1	58	5290	9.60	11.00	1.380	86.39	1.158	-0.14	0.546	0.873
							Ant 2	58	5290	10.90	11.00	1.023	86.39	1.158	-0.14	0.656	0.777
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1+2	Ant 1	58	5290	9.60	11.00	1.380	86.39	1.158	0.1	0.492	0.786
							Ant 2	58	5290	10.90	11.00	1.023	86.39	1.158	0.1	0.313	0.371
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1+2	Ant 1	58	5290	9.60	11.00	1.380	86.39	1.158	-0.02	0.505	0.807
							Ant 2	58	5290	10.90	11.00	1.023	86.39	1.158	-0.02	0.334	0.396
02	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1+2	Ant 1	58	5290	9.60	11.00	1.380	86.39	1.158	-0.05	0.695	1.111
							Ant 2	58	5290	10.90	11.00	1.023	86.39	1.158	-0.05	0.332	0.393
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1+2	Ant 1	54	5270	10.50	11.00	1.122	86.39	1.158	0.14	0.741	0.963
							Ant 2	54	5270	10.80	11.00	1.047	86.39	1.158	0.14	0.384	0.466
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1+2	Ant 1	106	5530	10.50	11.00	1.122	86.39	1.158	0.07	0.455	0.591
							Ant 2	106	5530	10.90	11.00	1.023	86.39	1.158	0.07	0.377	0.447
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1+2	Ant 1	106	5530	10.50	11.00	1.122	86.39	1.158	-0.02	0.562	0.730
							Ant 2	106	5530	10.90	11.00	1.023	86.39	1.158	-0.02	0.505	0.598
03	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1+2	Ant 1	106	5530	10.50	11.00	1.122	86.39	1.158	-0.04	0.671	0.872
							Ant 2	106	5530	10.90	11.00	1.023	86.39	1.158	-0.04	0.109	0.129
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1+2	Ant 1	106	5530	10.50	11.00	1.122	86.39	1.158	-0.17	0.277	0.360
							Ant 2	106	5530	10.90	11.00	1.023	86.39	1.158	-0.17	0.500	0.592
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1+2	Ant 1	122	5610	10.50	11.00	1.122	86.39	1.158	0	0.414	0.538
							Ant 2	122	5610	10.70	11.00	1.072	86.39	1.158	0	0.247	0.306
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1+2	Ant 1	138	5690	10.50	11.00	1.122	86.39	1.158	0.06	0.315	0.409
							Ant 2	138	5690	10.70	11.00	1.072	86.39	1.158	0.06	0.206	0.256
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1+2	Ant 1	159	5795	10.80	11.00	1.047	89.62	1.116	0.12	0.411	0.480
							Ant 2	159	5795	10.90	11.00	1.023	89.62	1.116	0.12	0.168	0.192
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1+2	Ant 1	159	5795	10.80	11.00	1.047	89.62	1.116	0.04	0.038	0.044
							Ant 2	159	5795	10.90	11.00	1.023	89.62	1.116	0.04	0.027	0.031
04	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1+2	Ant 1	159	5795	10.80	11.00	1.047	89.62	1.116	0.05	0.494	0.577
							Ant 2	159	5795	10.90	11.00	1.023	89.62	1.116	0.05	0.058	0.066
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1+2	Ant 1	159	5795	10.80	11.00	1.047	89.62	1.116	0.1	0.457	0.534
							Ant 2	159	5795	10.90	11.00	1.023	89.62	1.116	0.1	0.254	0.290
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1+2	Ant 1	151	5755	10.00	11.00	1.259	89.62	1.116	0.11	0.400	0.562
							Ant 2	151	5755	10.90	11.00	1.023	89.62	1.116	0.11	0.301	0.344

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Antenna	Ant	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)
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 2	Ant 2	78	2441	6.01	7.00	1.256	77.13	1.080	0.1	0.018	0.024
05	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 2	Ant 2	Ant 2	78	2480	6.01	7.00	1.256	77.13	1.080	-0.03	0.040	0.054
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 3	Ant 2	Ant 2	78	2441	6.01	7.00	1.256	77.13	1.080	0.12	0.021	0.028
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 4	Ant 2	Ant 2	78	2441	6.01	7.00	1.256	77.13	1.080	-0.01	0.019	0.026
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 2	Ant 2	Ant 2	0	2402	5.05	7.00	1.566	77.13	1.080	0	0.023	0.039
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 2	Ant 2	Ant 2	39	2480	5.46	7.00	1.425	77.13	1.080	0.05	0.015	0.023

13. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body
1.	WLAN2.4GHz Ant 1+2+ Bluetooth Ant 2	Yes
2.	WLAN5GHz Ant 1+2 + Bluetooth Ant 2	Yes

General Note:

1. 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.
2. The Scaled SAR summation is calculated based on the same configuration and test position.
3. 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.

13.1 Body Exposure Conditions

Exposure Position	1	2	3	1+3 Summed 1g SAR (W/kg)	2+3 Summed 1g SAR (W/kg)
	2.4GHz WLAN Ant 1+2	5GHz WLAN Ant 1+2	Bluetooth Ant 2		
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)		
Bottom of Laptop at 0mm	0.818	1.111	0.054	**0.872**	**1.165**

Test Engineer： Willie Huang and Bob Cheng

14. 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.

Declaration of Conformity:
The test results with all measurement uncertainty excluded is presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

15. 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 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

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

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

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

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