FCC SAR TEST REPORT

FCC ID	:	**TX2-RTL8852CE**
Equipment	:	**11ax RTL8852CE Combo Module**
Brand Name	:	**REALTEK**
Model Name	:	**RTL8852CE**
Applicant	:	**Realtek Semiconductor Corp. No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan**
Standard	:	**FCC 47 CFR Part 2 (2.1093)**

The product was tested inside of Lenovo Notebook Computer.

The product was received on Jan. 12, 2023 and testing was started from Jan. 14, 2023 and completed on Jan. 17, 2023. 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.

Cona Huang

Approved by: Cona Huang / Deputy Manager

Testing Laboratory
3786

Sporton International Inc. Wensan Laboratory

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History of this test report

Report No.	Version	Description	Issued Date
FA2N1109-02	01	Initial issue of report	Feb. 23, 2023

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) for Realtek Semiconductor Corp., 11ax RTL8852CE Combo Module, RTL8852CE, 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	0.79	1.56
NII		5GHz WLAN	0.73	1.56
6CD		6GHz WLAN	0.27	1.32
DSS	2.4GHz Band	Bluetooth	0.03	1.32
Equipment Class	Frequency Band		Reported APD Body (mW/cm^2)	Reported PD Body (mW/cm^2)
6CD	WLAN	6GHz WLAN	0.20	0.33
Date of Testing:			2023/01/14 ~ 2023/01/17	

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation and the FCC designation No. TW3786 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), Human Exposure to RF Radiation Limits (1.0 mW/cm^2=10 W/m^2) specified in FCC 47 CFR part 1.1310 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, the below KDB standard may not including in the TAF code without accreditation.

- 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
- IEC/IEEE 62209-1528:2020
- SPEAG DASY6 System Handbook
- SPEAG DASY6 Application Note (Interim Procedure for Device Operation at 6GHz-10GHz)

3. Equipment Under Test (EUT) Information

3.1 General Information

Product Feature & Specification	
Equipment Name	11ax RTL8852CE Combo Module
Brand Name	REALTEK
Model Name	RTL8852CE
FCC ID	TX2-RTL8852CE
Wireless Technology and Frequency Range	WLAN 2.4 GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2 GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3 GHz Band: 5250 MHz ~ 5350 MHz WLAN 5.6 GHz Band: 5470 MHz ~ 5725 MHz WLAN 5.8 GHz Band: 5725 MHz ~ 5850 MHz WLAN 6E: 5925 MHz ~ 6425 MHz, 6425 MHz ~ 6525 MHz, 6525 MHz ~ 6875 MHz, 6875 MHz ~ 7125 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz
Mode	WLAN: 802.11a/b/g/n/ac/ax HT20/HT40/VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE
Remark: There are four kinds of samples as below. First RF exposure selects sample 1 as main test and sample 2, 3 and 4 spot check worst case found sample 1.	

Host Information	
Equipment Name	Notebook Computer
Brand Name	Lenovo
Model Name	IdeaPad Slim 5 16ABR8***************(*=0~9，A~Z, a~z, “- “ or blank, for marketing use only, with no impact on RF compliance of the product)
EUT Stage	Identical Prototype

	Antenna Vendor	Material
Sample 1	South Star	Plastic
Sample 2	High-Tek	Plastic
Sample 3	South Star	Metal
Sample 4	High-Tek	Metal

Antenna Information									
Sample with Cover : Metal									
1 High-Tek	Ant. Type	PIFA	connector	SpeedTeh C87P115-00002-H	2 SOUTHSTAR TECHNOLOGY CO.,LTD	Ant. Type	PIFA	connector	Consus electronic MHF-B13-N-01
	Model No.	Main: DC33002ST10 (0ACCN022017N)	Aux: DC33002ST10 (0ACCN022017N)			Model No.	Main: DC33002SV10 (3.N201.0221)	Aux: DC33002SV10 (3.N201.0221)	
	Peak Gain (dBi)					Peak Gain (dBi)			
	2400~2483.5MHz	Main: 2.81 Aux: 2.63	5470~5725MHz	Main: 2.76 Aux: 2.81		2400~2483.5MHz	Main: 0.84 Aux: 2.05	5470~5725MHz	Main: 2.56 Aux: 2.1
	5150~5250MHz	Main: 2.61 Aux: 2.88	5725~5850MHz	Main: 2.56 Aux: 1.53		5150~5250MHz	Main: 0.89 Aux: -0.81	5725~5850MHz	Main: 2.84 Aux: 1.18
	5250~5350MHz	Main: 2.48 Aux: 2.88	5925~7125MHz	Main: 3.93 Aux: 3.8		5250~5350MHz	Main: 2.35 Aux: -0.15	5925~7125MHz	Main: 2.99 Aux: 2.76
Sample with Cover : Plastic									
1 High-Tek	Ant. Type	PIFA	connector	SpeedTeh C87P115-00002-H	2 SOUTHSTAR TECHNOLOGY CO.,LTD	Ant. Type	PIFA	connector	Consus electronic MHF-B13-N-01
	Model No.	Main: DC33002ST00 (0ACCN022018N)	Aux: DC33002ST00 (0ACCN022018N)			Model No.	Main: DC33002SV00 (3.N201.0222)	Aux: DC33002SV00 (3.N201.0222)	
	Peak Gain (dBi)					Peak Gain (dBi)			
	2400~2483.5MHz	Main: 2.03 Aux: 2.14	5470~5725MHz	Main: 2.8 Aux: 2.84		2400~2483.5MHz	Main: 0.24 Aux: -0.9	5470~5725MHz	Main: 2.95 Aux: 2.45
	5150~5250MHz	Main: 2.82 Aux: 2.85	5725~5850MHz	Main: 2.83 Aux: 2.84		5150~5250MHz	Main: 2.87 Aux: -1.91	5725~5850MHz	Main: 2.87 Aux: 2.5
	5250~5350MHz	Main: 2.8 Aux: 2.85	5925~7125MHz	Main: 3.92 Aux: 3.85		5250~5350MHz	Main: 2.9 Aux: 2.21	5925~7125MHz	Main: 2.65 Aux: 2.81

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.

4.3 RF Exposure limit for above 6GHz

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Peak Spatially Averaged Power Density was evaluated over a circular area of 4cm^2 per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f2)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

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:

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

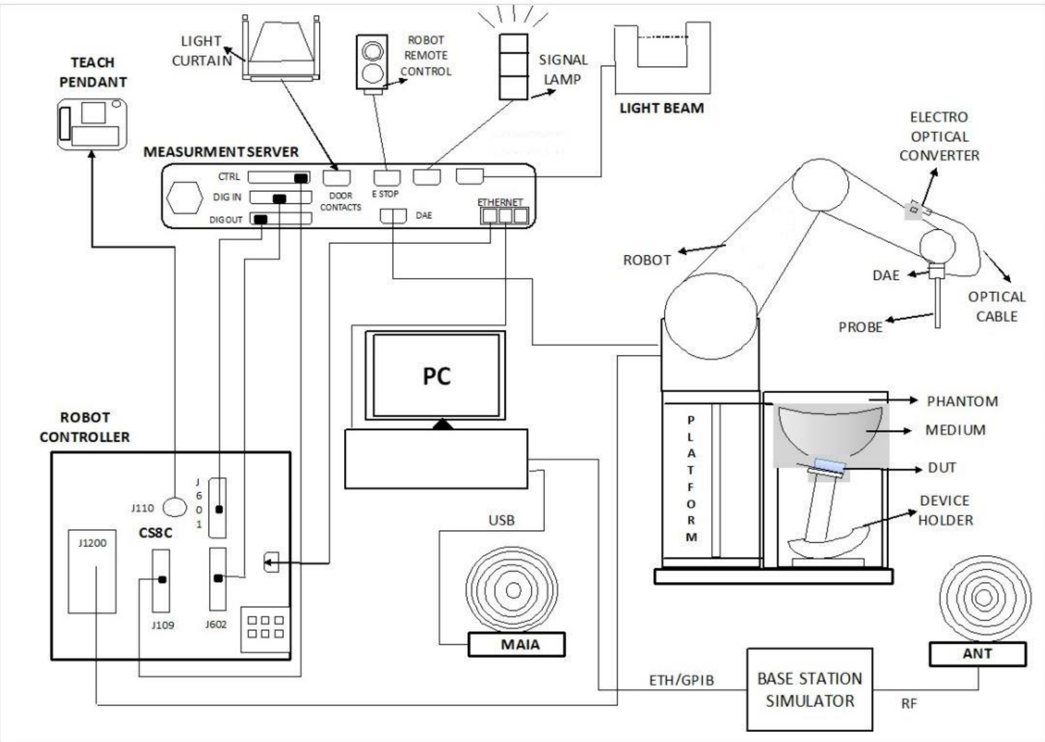
SAR is expressed in units of Watts per kilogram (W/kg)

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

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:



- The DASY system in SAR Configuration is shown above
- 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 windows software and the DASY 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 3786) and the FCC designation No. TW1190 and TW3786 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

Test Site	EMC & Wireless Communications Laboratory		Wensan Laboratory		
Test Site Location	TW1190 No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333		TW3786 No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010		
Test Site No.	SAR01-HY	SAR03-HY	SAR08-HY	SAR09-HY	SAR15-HY
	SAR04-HY	SAR05-HY	SAR11-HY	SAR12-HY	SAR16-HY
	SAR06-HY	SAR10-HY	SAR13-HY	SAR14-HY	SAR17-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)

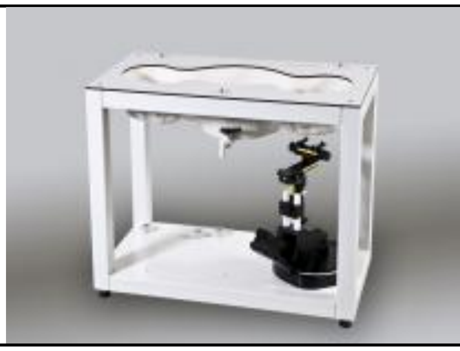
The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an 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

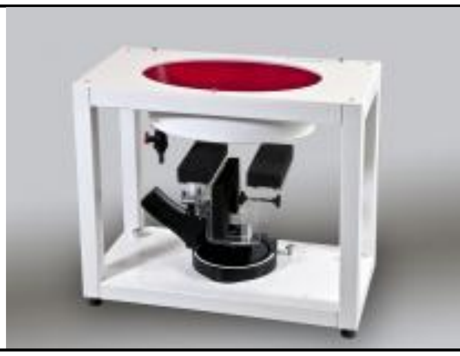
6.4 Phantom

<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:

(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.

	≤ 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.	

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	D2450V2	929	Nov. 21, 2022	Nov. 20, 2023
SPEAG	5GHz System Validation Kit	D5GHzV2	1128	Nov. 23, 2022	Nov. 22, 2023
SPEAG	6500MHz System Validation Kit	D6.5GHzV2	1083	Sep. 06, 2022	Sep. 05, 2023
SPEAG	5G Verification Source	10GHz	1020	Jan. 18, 2022	Jan. 17, 2023
SPEAG	EUmmWV Probe Tip Protection	EUmmWV4	9672	Oct. 03, 2022	Oct. 02, 2023
SPEAG	Data Acquisition Electronics	DAE4	376	Oct. 19, 2022	Oct. 18, 2023
SPEAG	Data Acquisition Electronics	DAE4	1399	Feb. 28, 2022	Feb. 27, 2023
SPEAG	Data Acquisition Electronics	DAE4	1647	Nov. 18, 2022	Nov. 17, 2023
SPEAG	Dosimetric E-Field Probe	ES3DV3	3115	Oct. 25, 2022	Oct. 24, 2023
SPEAG	Dosimetric E-Field Probe	EX3DV4	3931	Oct. 31, 2022	Oct. 30, 2023
SPEAG	Dosimetric E-Field Probe	EX3DV4	7590	Mar. 28, 2022	Mar. 27, 2023
RCPTWN	Thermometer	HTC-1	TM685-1	Jun. 27, 2022	Jun. 26, 2023
RCPTWN	Thermometer	HTC-1	TM560-2	Mar. 15, 2022	Mar. 14, 2023
R&S	BT Base Station	CBT	100815	Feb. 24, 2022	Feb. 23, 2023
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Oct. 12, 2022	Oct. 11, 2023
Keysight	ENA Network Analyzer	E5071C	MY46104758	Sep. 22, 2022	Sep. 21, 2023
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 28, 2022	Sep. 27, 2023
LINE SEIKI	Digital Thermometer	DTM3000-spezial	2942	Oct. 31, 2022	Oct. 30, 2023
Anritsu	Power Meter	ML2495A	1419002	Aug. 16, 2022	Aug. 15, 2023
Anritsu	Power Meter	ML2495A	1804003	Oct. 17, 2022	Oct. 16, 2023
Anritsu	Power Sensor	MA2411B	1726150	Oct. 17, 2022	Oct. 16, 2023
Anritsu	Power Sensor	MA2411B	1911334	Jun. 22, 2022	Jun. 21, 2023
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jul. 21, 2022	Jul. 20, 2023
Agilent	Spectrum Analyzer	E4408B	MY44211028	Aug. 19, 2021	Aug. 17, 2023
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 14, 2022	Oct. 13, 2023
Mini-Circuits	Power Amplifier	ZVE-8G+	479102029	Sep. 15, 2022	Sep. 14, 2023
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	22.2	1.823	38.896	1.80	39.20	1.28	-0.78	±5	2023/1/14
2450	22.5	1.833	39.254	1.80	39.20	1.83	0.14	±5	2023/1/17
5250	22.4	4.652	36.084	4.71	35.95	-1.23	0.37	±5	2023/1/14
5600	22.4	5.044	35.536	5.07	35.50	-0.51	0.10	±5	2023/1/14
5750	22.4	5.196	35.344	5.22	35.35	-0.46	-0.02	±5	2023/1/14
6500	22.5	6.110	33.760	6.07	34.50	0.66	-2.14	±5	2023/1/15

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.

Test Site	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 (%)
SAR08	2023/1/14	2450	250	D2450V2-929	ES3DV3 - SN3115	DAE4 Sn1647	12.5	52.4	50	-4.58
SAR09	2023/1/17	2450	250	D2450V2-929	EX3DV4 - SN7590	DAE4 Sn376	13.2	52.4	52.8	0.76
SAR09	2023/1/14	5250	50	D5GHzV2-1128-5250	EX3DV4 - SN7590	DAE4 Sn376	3.59	77.9	71.8	-7.83
SAR09	2023/1/14	5600	50	D5GHzV2-1128-5600	EX3DV4 - SN7590	DAE4 Sn376	3.68	80.1	73.6	-8.11
SAR09	2023/1/14	5750	50	D5GHzV2-1128-5750	EX3DV4 - SN7590	DAE4 Sn376	3.73	79.3	74.6	-5.93
SAR13	2023/1/15	6500	100	D6.5GHzV2-1083	EX3DV4 - SN3931	DAE4 Sn1399	29.1	291	291	0.00

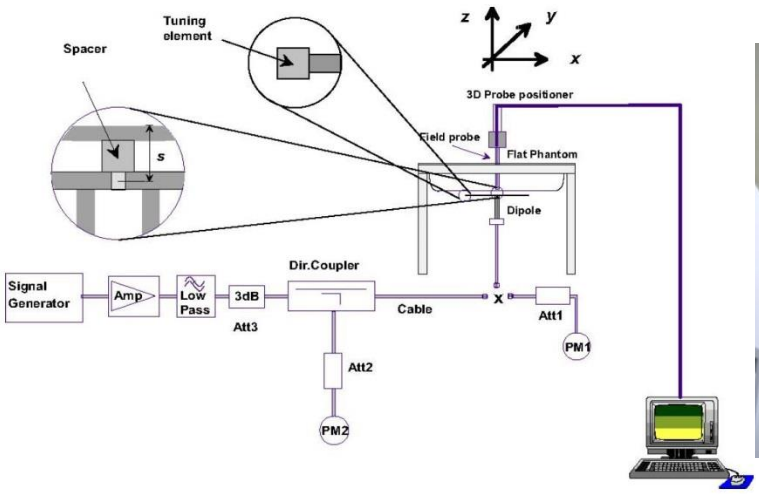


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

9.3 PD System Performance Check Results

The system was verified to be within ±0.66 dB of the power density targets on the calibration certificate according to the test system specification in the user's manual and calibration facility recommendation. The 0.66 dB deviation threshold represents the expanded uncertainty for system performance checks using SPEAG's mmWave verification sources. The same spatial resolution and measurement region used in the source calibration was applied during the system check. The measured power density distribution of verification source was also confirmed through visual inspection to have no noticeable differences, both spatially (shape) and numerically (level) from the distribution provided by the manufacturer, per November 2017 TCBC Workshop Notes.

Test Location	Frequency (GHz)	5G Verification Source	Probe S/N	DAE S/N	Distance (mm)	Measured 4 cm^2 (W/m^2)	Targeted 4 cm^2 (W/m^2)	Deviation (dB)	Date
SAR013	10G	10GHz_1020	SN 9672	1399	10	54.8	51.7	0.25	2023/1/14

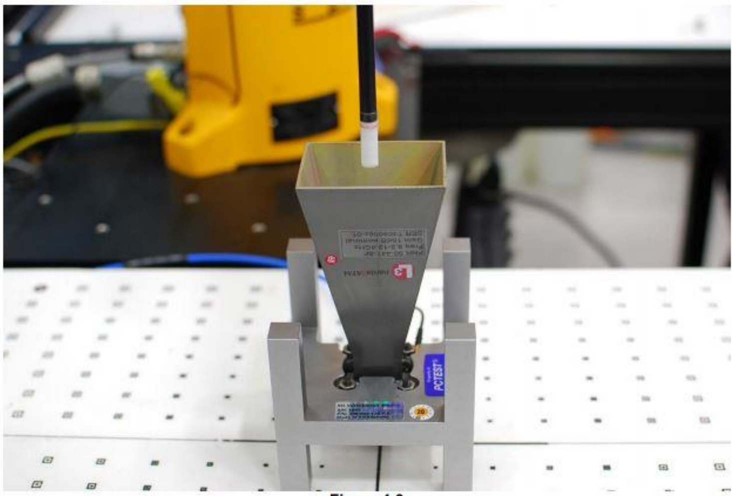


Figure 4-3
System Verification Setup Photo

System Performance Check Setup

10. WiFi/Bluetooth Output Power (Unit: dBm)

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, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6W/kg and SAR peak to location ratio ≤ 0.04, no additional SAR measurements for MIMO.
3. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures. For "Not required", SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, additional output power measurements were not necessary.
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.
8. Per 201904 TCBC workshops, General principles of FCC KDB Publication 248227 D01 can be applied to determine the SAR Initial Test Configurations and test reduction for 802.11ax SAR testing. For the table below the 802.11ax maximum power is SU (non-OFDMA), and the SU maximum power also higher than RU (OFDMA)
9. In applying the test guidance, the IEEE 802.11 mode with the maximum output power (out of all modes) should be considered for testing
10. For modes with the same maximum output power, the guidance from section 5.3.2 a) of FCC KDB Publication 248227 D01 should be applied, with 802.11ax being considered as the highest 802.11 mode for the appropriate frequency bands
11. When SAR testing for 802.11ax is required
    a. If the maximum output power is highest for OFDMA scenarios, choose the tone size with the maximum number of tones and the highest maximum output power
    b. Otherwise, consider the fully allocated channel for SAR testing
    c. When SAR testing is required on RU sizes less than the fully allocated channel, use the RU number closest to the middle of the channel, choosing the higher RU number when two RUs are equidistant to the middle of the channel

2.4GHz WLAN				Ant 1			Ant 2			Ant 1+2		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	17.90	18.00	98.30	18.00	18.00	98.30	Not Required	19.00	Not Required
		6	2437	17.90	18.00		17.80	18.00			19.00	
		11	2462	17.90	18.00		17.70	18.00			18.00	
		12	2467	14.00	14.50		14.10	14.50			11.00	
		13	2472	11.30	11.50		11.10	11.50			4.50	
	802.11g 6Mbps	1	2412	Not Required	16.50	Not Required	Not Required	16.50	Not Required		16.50	
		6	2437		19.50			19.50			19.50	
		11	2462		16.50			16.50			15.50	
		12	2467		15.50			15.50			15.00	
		13	2472		15.00			15.00			9.00	
	802.11n-HT20 MCS0	1	2412		16.50			16.50			16.00	
		6	2437		19.50			19.50			19.50	
		11	2462		15.50			15.50			14.50	
		12	2467		15.00			15.00			14.50	
		13	2472		9.50			9.50			4.00	
	802.11n-HT40 MCS0	3	2422		16.00			16.00			15.00	
		6	2437		17.00			17.00			15.00	
		9	2452		15.50			15.50			13.50	
		10	2457		15.00			15.00			13.50	
		11	2462		14.00			14.00			11.50	
	802.11ax-HE20 MCS0	1	2412		16.50			16.50			16.00	
		6	2437		19.50			19.50			19.50	
		11	2462		15.50			15.50			14.50	
		12	2467		15.00			15.00			14.50	
		13	2472		9.50			9.50			4.00	
	802.11ax-HE40 MCS0	3	2422		16.00			16.00			15.00	
		6	2437		17.00			17.00			15.00	
		9	2452		15.50			15.50			13.50	
		10	2457		15.00			15.00			13.50	
		11	2462		14.00			14.00			11.50	

5.2GHz WLAN				Ant 1			Ant 2			Ant 1+2		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	Not Required	16.00	Not Required	Not Required	16.00	Not Required	Not Required	18.00	Not Required
		40	5200		16.00			16.00			18.00	
		44	5220		16.00			16.00			18.00	
		48	5240		16.00			16.00			18.00	
	802.11n-HT20 MCS0	36	5180		16.00			16.00			18.50	
		40	5200		16.00			16.00			18.50	
		44	5220		16.00			16.00			18.50	
		48	5240		16.00			16.00			18.50	
	802.11n-HT40 MCS0	38	5190		16.00			16.00			18.50	
		46	5230		16.00			16.00			18.50	
	802.11ac-VHT20 MCS0	36	5180		16.00			16.00			18.50	
		40	5200		16.00			16.00			18.50	
		44	5220		16.00			16.00			18.50	
		48	5240		16.00			16.00			18.50	
	802.11ac-VHT40 MCS0	38	5190		16.00			16.00			18.50	
		46	5230		16.00			16.00			18.50	
	802.11ac-VHT80 MCS0	42	5210		13.00			13.00			18.50	
	802.11ax-HE20 MCS0	36	5180		16.00			15.50			18.50	
		40	5200		16.00			16.00			18.50	
		44	5220		16.00			16.00			18.50	
		48	5240		16.00			16.00			18.50	
	802.11ax-HE40 MCS0	38	5190		16.00			16.00			18.50	
		46	5230		16.00			16.00			18.50	
	802.11ax-HE80 MCS0	42	5210		13.00			13.00			18.50	

5.3GHz WLAN				Ant 1			Ant 2			Ant 1+2		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	Not Required	16.00	Not Required	Not Required	16.00	Not Required	Not Required	18.50	Not Required
		56	5280		16.00			16.00			18.50	
		60	5300		16.00			16.00			18.50	
		64	5320		16.00			16.00			18.50	
	802.11n-HT20 MCS0	52	5260		16.00			16.00			18.50	
		56	5280		16.00			16.00			18.50	
		60	5300		16.00			16.00			18.50	
		64	5320		16.00			16.00			18.50	
	802.11n-HT40 MCS0	54	5270	14.50	16.00	95.30	14.50	16.00	95.30	17.66	18.50	95.30
		62	5310	14.30	16.00		14.20	16.00		17.61	18.50	
	802.11ac-VHT20 MCS0	52	5260	Not Required	16.00	Not Required	Not Required	16.00	Not Required	Not Required	18.50	Not Required
		56	5280		16.00			16.00			18.50	
		60	5300		16.00			16.00			18.50	
		64	5320		16.00			16.00			18.50	
	802.11ac-VHT40 MCS0	54	5270		16.00			16.00			18.50	
		62	5310		14.00			14.00			17.00	
	802.11ac-VHT80 MCS0	58	5290		11.50			11.50			14.50	
	802.11ac-VHT160 MCS0	50	5250		9.00			9.00			12.00	
	802.11ax-HE20 MCS0	52	5260		16.00			16.00			18.50	
		56	5280		16.00			16.00			18.50	
		60	5300		16.00			16.00			18.50	
		64	5320		16.00			16.00			18.50	
	802.11ax-HE40 MCS0	54	5270		16.00			16.00			18.50	
		62	5310		14.00			14.00			17.00	
	802.11ax-HE80 MCS0	58	5290		11.50			11.50			14.50	
	802.11ax-HE160 MCS0	50	5250		9.00			9.00			12.00	

5.5GHz WLAN				Ant 1			Ant 2			Ant 1+2		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %
		100	5500		15.50			15.50			18.00	
		116	5580		15.50			15.50			18.00	
	802.11a 6Mbps	124	5620		15.50			15.50			18.00	
		132	5660		15.50			15.50			18.00	
		144	5720		15.50			15.50			18.50	
		100	5500		15.50			15.50			18.00	
		116	5580		15.50			15.50			18.50	
	802.11n-HT20 MCS0	124	5620		15.50			15.50			18.50	
		132	5660		15.50			15.50			18.50	
		144	5720		15.50			15.50			18.50	
		102	5510		15.50			15.50			17.00	
		110	5550		15.50			15.50			18.50	
	802.11n-HT40 MCS0	126	5630	Not Required	15.50	Not Required	Not Required	15.50	Not Required	Not Required	18.50	Not Required
		134	5670		15.50			15.50			17.00	
		142	5710		15.50			15.50			18.50	
		100	5500		15.50			15.50			15.00	
		116	5580		15.50			15.50			15.50	
	802.11ac-VHT20 MCS0	124	5620		15.50			15.50			15.50	
		132	5660		15.50			15.50			15.50	
5.5GHz WLAN		144	5720		15.50			15.50			15.50	
		102	5510		15.50			15.50			17.00	
		110	5550		15.50			15.50			18.50	
	802.11ac-VHT40 MCS0	126	5630		15.50			15.50			18.50	
		134	5670		15.50			15.50			17.00	
		142	5710		15.50			15.50			18.50	
		106	5530	14.70	15.00		15.00	15.00		15.21	15.50	
	802.11ac-VHT80 MCS0	122	5610	15.20	15.50	91.10	15.20	15.50	91.10	15.71	16.00	91.10
		138	5690	15.40	15.50		15.10	15.50		18.06	18.50	
	802.11ac-VHT160 MCS0	114	5570		10.50			10.50			12.00	
		100	5500		15.50			15.50			18.00	
		116	5580		15.50			15.50			18.50	
	802.11ax-HE20 MCS0	124	5620		15.50			15.50			18.50	
		132	5660		15.50			15.50			18.50	
		144	5720		15.50			15.50			18.50	
		102	5510		15.50			15.50			17.00	
		110	5550	Not Required	15.50	Not Required	Not Required	15.50	Not Required	Not Required	18.50	Not Required
	802.11ax-HE40 MCS0	126	5630		15.50			15.50			18.50	
		134	5670		15.50			15.50			17.00	
		142	5710		15.50			15.50			18.50	
		106	5530		15.00			15.00			15.50	
	802.11ax-HE80 MCS0	122	5610		15.50			15.50			16.00	
		138	5690		15.50			15.50			18.50	
	802.11ax-HE160 MCS0	114	5570		10.50			10.50			9.00	

5.8GHz WLAN				Ant 1			Ant 2			Ant 1+2		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	Not Required	15.00	Not Required	Not Required	15.00	Not Required	Not Required	18.00	Not Required
		157	5785		15.00			15.00			18.00	
		165	5825		15.00			15.00			18.00	
	802.11n-HT20 MCS0	149	5745		15.00			15.00			18.00	
		157	5785		15.00			15.00			18.00	
		165	5825		15.00			15.00			18.00	
	802.11n-HT40 MCS0	151	5755		15.00			15.00			18.00	
		159	5795		15.00			15.00			18.00	
	802.11ac-VHT20 MCS0	149	5745		15.00			15.00			18.00	
		157	5785		15.00			15.00			18.00	
		165	5825		15.00			15.00			18.00	
	802.11ac-VHT40 MCS0	151	5755		15.00			15.00			18.00	
		159	5795		15.00			15.00			18.00	
	802.11ac-VHT80 MCS0	155	5775	14.70	15.00	91.10	14.90	15.00	91.10	17.86	18.00	91.10
	802.11ax-HE20 MCS0	149	5745	Not Required	15.00	Not Required	Not Required	15.00	Not Required	Not Required	18.00	Not Required
		157	5785		15.00			15.00			18.00	
		165	5825		15.00			15.00			18.00	
	802.11ax-HE40 MCS0	151	5755		15.00			15.00			18.00	
		159	5795		15.00			15.00			18.00	
	802.11ax-HE80 MCS0	155	5775		15.00			15.00			18.00	

WiFi 6E				Ant 1			Ant 2			Ant 1+2		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WiFi 6E	802.11ac-VHT160 MCS0	15	6025	Not Required	10.00	Not Required	Not Required	10.00	Not Required	Not Required	11.00	Not Required
		47	6185		10.00			10.00			10.50	
		111	6505		10.00			10.00			10.50	
		143	6665		10.00			10.00			11.00	
		207	6985		10.00			10.00			7.50	
	802.11ax-HE20 MCS0	1	5955		6.00			6.00			2.50	
		57	6235		5.50			5.50			2.00	
		113	6515		5.50			5.50			2.50	
		173	6815		5.50			5.50			2.50	
		233	7115		6.00			6.00			3.00	
	802.11ax-HE40 MCS0	3	5965		8.50			8.50			5.50	
		59	6245		8.50			8.50			5.50	
		107	6485		8.50			8.50			6.00	
		171	6805		8.50			8.50			5.50	
		227	7085		9.00			9.00			6.00	
	802.11ax-HE80 MCS0	7	5985	11.33	11.50	91.30	11.02	11.50	91.30		8.50	
		71	6305	10.60	11.50		10.86	11.50			8.00	
		119	6545	11.14	11.50		11.09	11.50			8.00	
		167	6785	10.77	11.50		10.83	11.50			8.00	
		215	7025	10.80	11.50		10.52	11.50			8.50	
	802.11ax-HE160 MCS0	15	6025	Not Required	10.00	Not Required	Not Required	10.00	Not Required		11.00	
		47	6185		10.00			10.00			10.50	
		111	6505		10.00			10.00			10.50	
		143	6665		10.00			10.00			11.00	
		207	6985		10.00			10.00			7.50	

<u><2.4GHz Bluetooth></u>

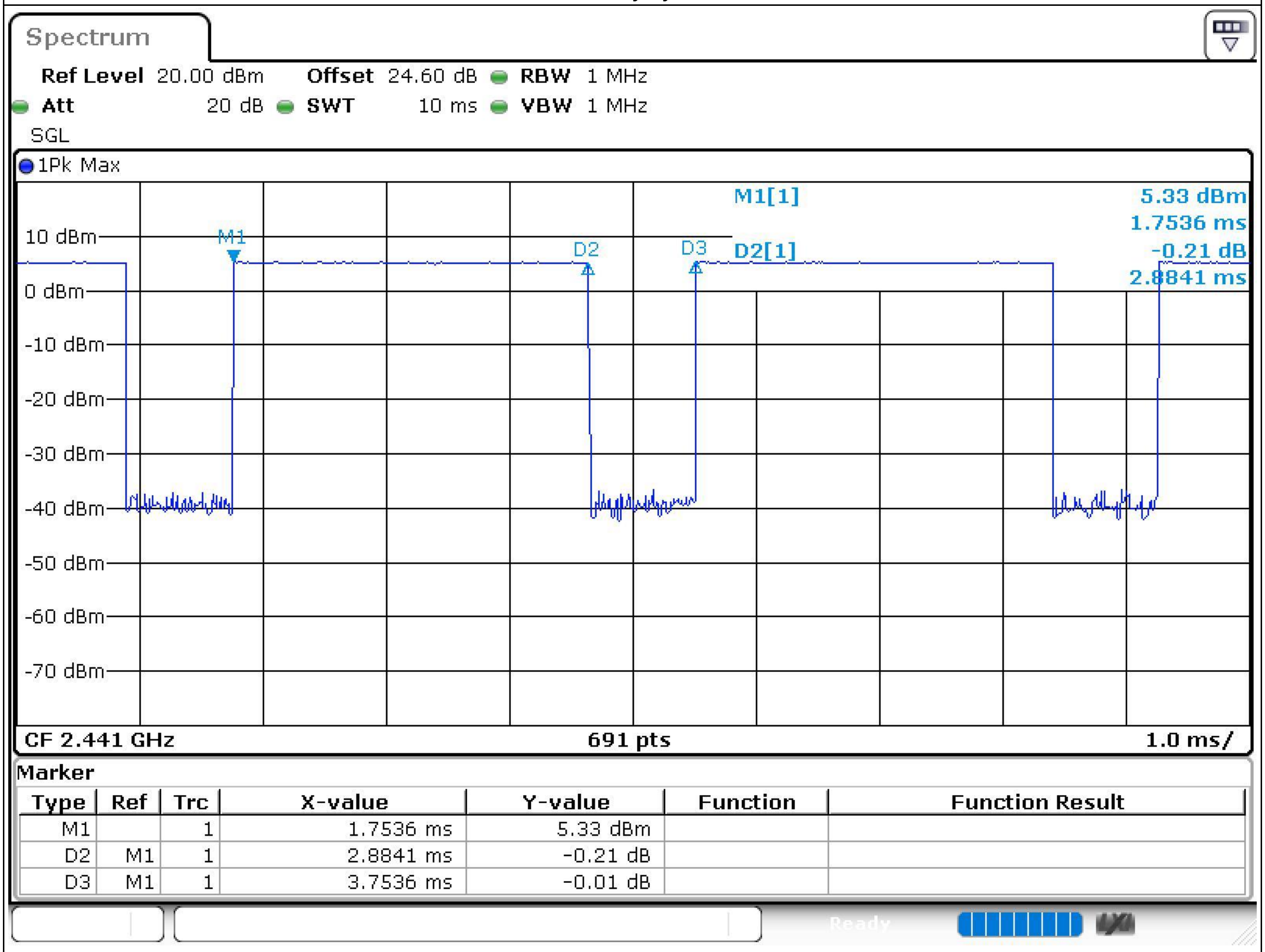
Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	5.90	Not Required	Not Required
	CH 39	2441	5.80		
	CH 78	2480	5.70		
Tune-up Limit			6.00	6.00	6.00

Ant 2				
Mode	Channel	Frequency (MHz)	Average power (dBm)	
			1Mbps	2Mbps
LE	CH 00	2402	Not Required	Not Required
	CH 19	2440		
	CH 39	2480		
Tune-up Limit			6.00	6.00

General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps due to its highest average power and duty cycle is 76.83% considered in SAR testing, and the duty cycle would be scaled to theoretical 83.3% in reported SAR calculation.

BT Duty cycle



11. 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, WLAN5.2GHz SAR testing is not required when the WLAN5.3GHz band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for WLAN5.2GHz 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 WLAN SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
6. Per KDB 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6W/kg and SAR peak to location ratio ≤ 0.04, no additional SAR measurements for MIMO.
7. Additional MIMO operation for 5GHz WLAN is performed Sim-Tx analysis.
8. During SAR testing the WLAN transmission was verified using a spectrum analyzer.
9. Refer to tune-up procedure the channel 12 and 13 powers are low than others channel, therefore, the measure power and SAR consideration is not necessary.

WLAN PD Note:

1. The WiFi 6E PD was performed according 2020 TCB workshop RF Exposure 5G RFX Policies Interim Procedures.
2. First, evaluate SAR using 6-7 GHz parameters per IEC/IEEE 62209-1528:2020 and using highest SAR test configurations evaluate incident PD using the mmw near-field probe and total-field/power-density reconstruction method (2 mm closest meas. plane).
3. Per Interim Procedures. The power density results were scaled according to IEC 62479:2010 for the portion of the measurement uncertainty > 30%. Total expanded uncertainty of 2.68 dB (85.4%) was used to determine the psPD measurement scaling factor
4. The manufacturer has confirmed that the devices tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. The WiFi 6E RF Exposure results are used for simultaneous transmission analysis with the other transmitters and total exposure ratio, the analysis can be found in this report section 12
6. Absorbed power density (APD) using a 4cm2 averaging area is reported based on SAR measurements.
7. Power density was calculated by repeated E-field measurements on two measurement planes separated by λ/4.
8. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools.
9. The measurement procedure consists of measuring the PDinc at two different distances: 2 mm (compliance distance) and λ/5. The grid extents should be large enough to fully capture the transmitted energy. The grid step should be fine enough to demonstrate that the integrated Power Density iPDn fulfill the criterion described below. Since iPD ratio between the two distances is ≥ -1dB, the grid step (0.0625) was sufficient for determining compliance at d=2mm.

$$10 \cdot log_{10} \frac{iPD_n(2mm)}{iPD_n(\lambda/5)} \geq -1$$

11.1 Body SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Antenna	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	1	2412	17.90	18.00	1.023	98.30	1.017	0.09	0.582	0.606
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 1	6	2437	17.90	18.00	1.023	98.30	1.017	-0.1	0.561	0.584
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 1	11	2462	17.90	18.00	1.023	98.30	1.017	0.15	0.546	0.568
01	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 2	Ant 1	1	2412	17.90	18.00	1.023	98.30	1.017	-0.03	0.763	0.794
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 3	Ant 1	1	2412	17.90	18.00	1.023	98.30	1.017	0.03	0.448	0.466
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 4	Ant 1	1	2412	17.90	18.00	1.023	98.30	1.017	0.18	0.469	0.488
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 2	1	2412	18.00	18.00	1.000	98.30	1.017	0.12	0.506	0.515
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 2	6	2437	17.80	18.00	1.047	98.30	1.017	0.03	0.621	0.661
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 2	11	2462	17.70	18.00	1.072	98.30	1.017	-0.02	0.701	0.764
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 2	Ant 2	11	2462	17.70	18.00	1.072	98.30	1.017	-0.19	0.606	0.660
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 3	Ant 2	11	2462	17.70	18.00	1.072	98.30	1.017	0.07	0.404	0.440
	WLAN2.4GHz	802.11b 1Mbps	Bottom of Laptop	0mm	Sample 4	Ant 2	11	2462	17.70	18.00	1.072	98.30	1.017	0.02	0.342	0.373

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Antenna	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)
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	54	5270	14.50	16.00	1.413	95.30	1.049	0.12	0.200	0.296
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	62	5310	14.30	16.00	1.479	95.30	1.049	0.09	0.514	0.798
02	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1	62	5310	14.30	16.00	1.479	95.30	1.049	-0.03	0.655	1.016
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1	54	5270	14.50	16.00	1.413	95.30	1.049	-0.02	0.251	0.372
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1	62	5310	14.30	16.00	1.479	95.30	1.049	0.11	0.261	0.405
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1	62	5310	14.30	16.00	1.479	95.30	1.049	-0.12	0.463	0.718
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	54	5270	14.50	16.00	1.413	95.30	1.049	-0.03	0.220	0.326
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	62	5310	14.20	16.00	1.514	95.30	1.049	-0.1	0.462	0.734
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 2	62	5310	14.20	16.00	1.514	95.30	1.049	0.03	0.439	0.697
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 2	62	5310	14.20	16.00	1.514	95.30	1.049	0.02	0.284	0.451
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 2	62	5310	14.20	16.00	1.514	95.30	1.049	-0.11	0.479	0.761
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1+2	54	5270	17.66	18.50	1.213	95.30	1.049	0.01	0.166	0.211
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1+2	62	5310	17.61	18.50	1.227	95.30	1.049	0.05	0.342	0.440
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1+2	62	5310	17.61	18.50	1.227	95.30	1.049	-0.05	0.488	0.628
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1+2	62	5310	17.61	18.50	1.227	95.30	1.049	0.09	0.315	0.406
	WLAN5GHz	802.11n-HT40 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1+2	62	5310	17.61	18.50	1.227	95.30	1.049	0.11	0.349	0.449
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	138	5690	15.40	15.50	1.023	91.10	1.098	-0.15	0.438	0.492
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	106	5530	14.70	15.00	1.072	91.10	1.098	-0.06	0.416	0.489
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	122	5610	15.20	15.50	1.072	91.10	1.098	-0.18	0.417	0.491
03	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1	138	5690	15.40	15.50	1.023	91.10	1.098	-0.13	0.646	0.726
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1	138	5690	15.40	15.50	1.023	91.10	1.098	0.05	0.201	0.226
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1	138	5690	15.40	15.50	1.023	91.10	1.098	-0.13	0.386	0.434
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	122	5610	15.20	15.50	1.072	91.10	1.098	0.08	0.310	0.365
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	106	5530	15.00	15.00	1.000	91.10	1.098	-0.13	0.317	0.348
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	138	5690	15.10	15.50	1.096	91.10	1.098	-0.07	0.355	0.427
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 2	138	5690	15.10	15.50	1.096	91.10	1.098	0.01	0.338	0.407
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 2	138	5690	15.10	15.50	1.096	91.10	1.098	-0.12	0.279	0.336
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 2	138	5690	15.10	15.50	1.096	91.10	1.098	0.05	0.353	0.425
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1+2	138	5690	18.06	18.50	1.107	91.10	1.098	-0.05	0.302	0.367
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1+2	122	5610	15.71	16.00	1.069	91.10	1.098	0.07	0.266	0.312
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1+2	106	5530	15.21	15.50	1.069	91.10	1.098	0.01	0.242	0.284
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1+2	138	5690	18.06	18.50	1.107	91.10	1.098	0.12	0.266	0.323
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1+2	138	5690	18.06	18.50	1.107	91.10	1.098	0.05	0.211	0.256
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1+2	138	5690	18.06	18.50	1.107	91.10	1.098	0.09	0.303	0.368
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	155	5775	14.70	15.00	1.072	91.10	1.098	0.04	0.373	0.439
04	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1	155	5775	14.70	15.00	1.072	91.10	1.098	-0.16	0.538	0.633
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1	155	5775	14.70	15.00	1.072	91.10	1.098	-0.15	0.251	0.295
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1	155	5775	14.70	15.00	1.072	91.10	1.098	0.09	0.402	0.473
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	155	5775	14.90	15.00	1.023	91.10	1.098	0.06	0.344	0.387
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 2	155	5775	14.90	15.00	1.023	91.10	1.098	0.01	0.315	0.354
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 2	155	5775	14.90	15.00	1.023	91.10	1.098	-0.15	0.234	0.263
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 2	155	5775	14.90	15.00	1.023	91.10	1.098	-0.16	0.306	0.344
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1+2	155	5775	17.86	18.00	1.033	91.10	1.098	0.07	0.262	0.297
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1+2	155	5775	17.86	18.00	1.033	91.10	1.098	-0.13	0.229	0.260
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1+2	155	5775	17.86	18.00	1.033	91.10	1.098	0.09	0.315	0.357
	WLAN5GHz	802.11ac-VHT80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1+2	155	5775	17.86	18.00	1.033	91.10	1.098	-0.01	0.303	0.344

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Antenna	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)	Measured APD (W/m^2)	Reported APD (W/m^2)
05	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	7	5985	11.33	11.50	1.040	91.30	1.095	0.1	0.240	0.273	1.730	1.970
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	71	6305	10.60	11.50	1.230	91.30	1.095	-0.05	0.162	0.218	1.170	1.576
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	119	6545	11.14	11.50	1.086	91.30	1.095	0.01	0.123	0.146	0.889	1.058
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	167	6785	10.77	11.50	1.183	91.30	1.095	-0.13	0.083	0.108	0.632	0.819
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 1	215	7025	10.80	11.50	1.175	91.30	1.095	0.08	0.061	0.078	0.328	0.422
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 1	7	5985	11.33	11.50	1.040	91.30	1.095	-0.15	0.221	0.252	1.500	1.708
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 1	7	5985	11.33	11.50	1.040	91.30	1.095	-0.11	0.114	0.130	0.842	0.959
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 1	7	5985	11.33	11.50	1.040	91.30	1.095	0.09	0.132	0.150	0.959	1.092
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	119	6545	11.09	11.50	1.099	91.30	1.095	0.05	0.193	0.232	1.450	1.745
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	7	5985	11.02	11.50	1.117	91.30	1.095	0.1	0.220	0.269	1.600	1.957
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	71	6305	10.86	11.50	1.159	91.30	1.095	0.06	0.193	0.245	1.450	1.840
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	167	6785	10.83	11.50	1.167	91.30	1.095	-0.11	0.177	0.226	1.360	1.738
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 1	Ant 2	215	7025	10.52	11.50	1.253	91.30	1.095	0.03	0.139	0.191	1.060	1.455
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 2	Ant 2	7	5985	11.02	11.50	1.117	91.30	1.095	-0.12	0.151	0.185	1.200	1.468
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 3	Ant 2	7	5985	11.02	11.50	1.117	91.30	1.095	0.06	0.132	0.161	1.020	1.247
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	0mm	Sample 4	Ant 2	7	5985	11.02	11.50	1.117	91.30	1.095	-0.09	0.144	0.176	1.130	1.382

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Antenna	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)
06	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 2	0	2402	5.90	6.00	1.023	76.83	1.084	-0.04	0.027	0.030
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 2	39	2441	5.80	6.00	1.047	76.83	1.084	0.05	0.023	0.026
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 1	Ant 2	78	2480	5.70	6.00	1.072	76.83	1.084	0.12	0.022	0.026
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 2	Ant 2	0	2402	5.90	6.00	1.023	76.83	1.084	0.03	0.026	0.029
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 3	Ant 2	0	2402	5.90	6.00	1.023	76.83	1.084	-0.11	0.019	0.021
	Bluetooth	1Mbps	Bottom of Laptop	0mm	Sample 4	Ant 2	0	2402	5.90	6.00	1.023	76.83	1.084	0.17	0.014	0.016

11.2 6GHz PD SAR Result

Band	Mode	Test Position	Gap (mm)	Antenna	Sample	Ch.	Freq. (MHz)	Average Power (dBm)	Grid Step (λ)	iPDn	iPD ratio (≥ -1)	Normal psPD (W/m^2)	Total psPD (W/m^2)
WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 1	7	5985	11.33	0.0625	1.14	-0.95383493	1.750	1.890
WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	10mm	Ant 1	Sample 1	7	5985	11.33	0.25	1.42		0.961	1.020
WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 1	215	7025	10.80	0.0625	0.601	-0.79060793	0.685	0.724
WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	8.59mm	Ant 1	Sample 1	215	7025	10.80	0.25	0.721		0.404	0.410

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Sample	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Grid Step (λ)	Scaling Factor for Measurement Uncertainty	Power Drift (dB)	Normal psPD (W/m^2)	Scaled Normal psPD (W/m^2)	Total psPD (W/m^2)	Scaled Total psPD (W/m^2)
01	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 1	7	5985	11.33	11.50	1.040	91.30	1.095	0.0625	1.5535	-0.06	1.750	3.096	1.890	3.343
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 1	71	6305	10.60	11.50	1.230	91.30	1.095	0.0625	1.5535	-0.01	1.140	2.386	1.230	2.574
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 1	119	6545	11.14	11.50	1.086	91.30	1.095	0.0625	1.5535	-0.02	0.841	1.554	0.908	1.678
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 1	167	6785	10.77	11.50	1.183	91.30	1.095	0.0625	1.5535	0.01	0.611	1.230	0.660	1.328
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 1	215	7025	10.80	11.50	1.175	91.30	1.095	0.0625	1.5535	0.06	0.685	1.369	0.724	1.447
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 2	7	5985	11.33	11.50	1.040	91.30	1.095	0.0625	1.5535	-0.15	1.300	2.300	1.400	2.477
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 3	7	5985	11.33	11.50	1.040	91.30	1.095	0.0625	1.5535	0.08	0.674	1.192	0.728	1.288
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 1	Sample 4	7	5985	11.33	11.50	1.040	91.30	1.095	0.0625	1.5535	-0.12	0.684	1.210	0.739	1.307
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 2	Sample 1	119	6545	11.09	11.50	1.099	91.30	1.095	0.0625	1.5535	-0.1	1.030	1.926	1.150	2.150
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 2	Sample 1	7	5985	11.02	11.50	1.117	91.30	1.095	0.0625	1.5535	0.18	1.490	2.831	1.660	3.154
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 2	Sample 1	71	6305	10.86	11.50	1.159	91.30	1.095	0.0625	1.5535	0.05	1.040	2.050	1.160	2.287
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 2	Sample 1	167	6785	10.83	11.50	1.167	91.30	1.095	0.0625	1.5535	-0.15	1.010	2.005	1.120	2.223
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 2	Sample 1	215	7025	10.52	11.50	1.253	91.30	1.095	0.0625	1.5535	-0.06	0.796	1.697	0.887	1.891
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 2	Sample 2	7	5985	11.02	11.50	1.117	91.30	1.095	0.0625	1.5535	-0.01	0.929	1.765	1.040	1.976
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 2	Sample 3	7	5985	11.02	11.50	1.117	91.30	1.095	0.0625	1.5535	0.1	0.758	1.440	0.845	1.605
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom of Laptop	2mm	Ant 2	Sample 4	7	5985	11.02	11.50	1.117	91.30	1.095	0.0625	1.5535	0.06	0.815	1.548	0.908	1.725

12. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body
1.	WLAN2.4GHz Ant 1 + WLAN2.4GHz Ant 2	Yes
2.	WLAN2.4GHz Ant 1 + WLAN5GHz Ant 2	Yes
3.	WLAN2.4GHz Ant 1 + WLAN6GHz Ant 2	Yes
4.	WLAN2.4GHz Ant 2 + WLAN5GHz Ant 1	Yes
5.	WLAN2.4GHz Ant 2 + WLAN6GHz Ant 1	Yes
6.	WLAN5GHz Ant 1 + WLAN5GHz Ant 2 + Bluetooth Ant 2	Yes
7.	WLAN6GHz Ant 1 + WLAN6GHz Ant 2 + Bluetooth Ant 2	Yes
8.	WLAN5GHz Ant 1 + WLAN6GHz Ant 2 + Bluetooth Ant 2	Yes
9.	WLAN5GHz Ant 2 + WLAN6GHz Ant 1 + Bluetooth Ant 2	Yes

General Note:

1. The worst case WLAN reported SAR for each configuration was used for SAR summation. Therefore, the following summations represent the absolute worst cases for simultaneous transmission with WLAN.
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.

12.1 Body Exposure Conditions

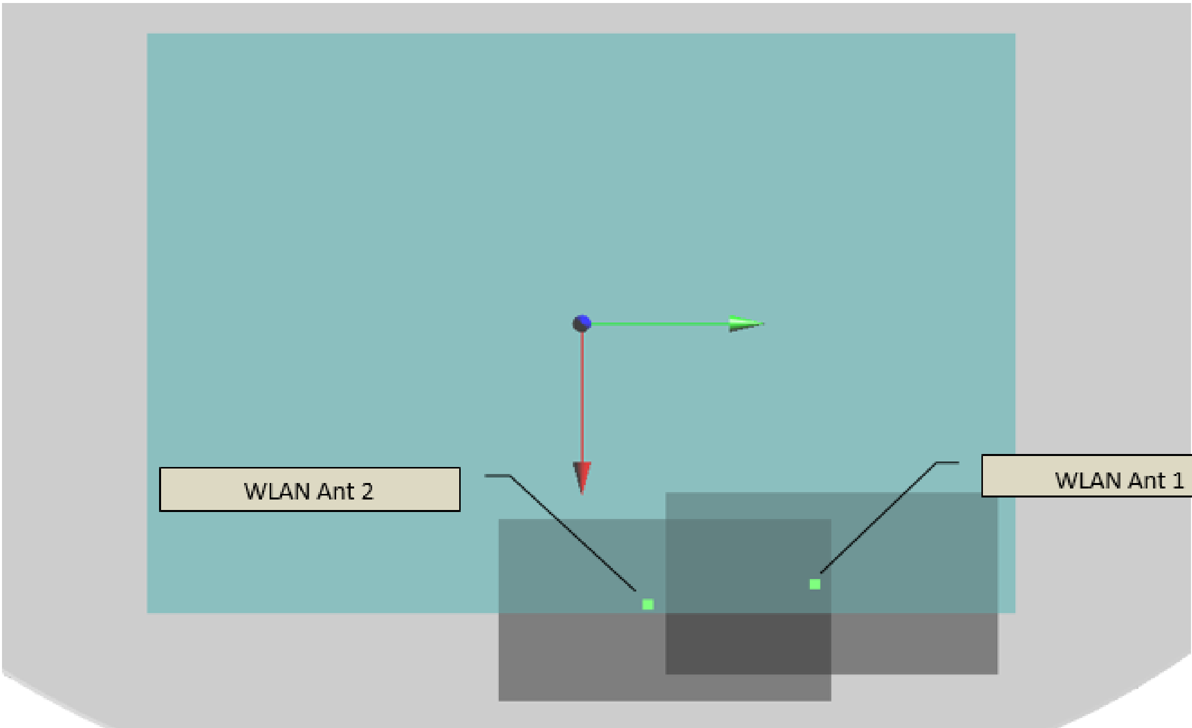
Exposure Position	1 WLAN 2.4GHz Ant 1 1g SAR (W/kg)	2 WLAN 2.4GHz Ant 2 1g SAR (W/kg)	3 WLAN 5GHz Ant 1 1g SAR (W/kg)	4 WLAN 5GHz Ant 2 1g SAR (W/kg)	5 WLAN 5GHz Ant 1+2 1g SAR (W/kg)	6 WLAN 6GHz Ant 1 1g SAR (W/kg)	7 WLAN 6GHz Ant 2 1g SAR (W/kg)	8 Bluetooth Ant 2 1g SAR (W/kg)	1+2 Summed 1g SAR (W/kg)	5+8 Summed 1g SAR (W/kg)	6+7+8 Summed 1g SAR (W/kg)	1+4 Summed 1g SAR (W/kg)	1+7 Summed 1g SAR (W/kg)	2+3 Summed 1g SAR (W/kg)	2+6 Summed 1g SAR (W/kg)	3+7+8 Summed 1g SAR (W/kg)	4+6+8 Summed 1g SAR (W/kg)	SPLSR	Case No
Bottom of Laptop at 0mm	0.794	0.764	1.016	0.761	0.628	0.273	0.269	0.030	**1.558**	**0.658**	**0.572**	**1.555**	**1.063**	**1.780**	**1.037**	**1.315**	**1.064**	**0.02**	**Case 1**

12.2 SPLSR Evaluation and Analysis

General Note:

1. Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneously transmitting antenna. When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration. Therefore, the adjacent transmit antennas will be summed first, and then the SPLSR calculation will be evaluated with the farther transmitted antennas.
2. SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (*min. separation distance, mm*). If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary
3. The detail hotspot point for each transmitter in each exposure condition are showing as below figure and the minimum 3D distance for each sum combination is used for SPLSR analysis.

Bottom of laptop hotspot point



Case 1	Band	Position	SAR (W/kg)	Gap (mm)	SAR peak location (mm) X	Y	Z	3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
Case 1	WLAN2.4G Ant 2	Bottom of Laptop	0.764	0	121	-14.2	2.14	110.4	1.78	0.02	Not required
	WLAN5G Ant 1		1.016	0	115	96	5.02				

Test Engineer : White Huang, Willie Huang and Shane Song

13. Uncertainty Assessment

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.

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

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

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

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

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

(b) κ is the coverage factor

Standard Uncertainty for Assumed Distribution

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

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

The judgment of conformity in the report is based on the measurement results excluding the measurement uncertainty.

Applicable for SAR Measurements:

Uncertainty Budget (4 MHz - 10 GHz range)							
Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	18.60	N	2	1	1	9.3	9.3
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9
Linearity	4.70	R	1.732	1	1	2.7	2.7
Modulation Response	4.68	R	1.732	1	1	2.7	2.7
System Detection Limits	1.00	R	1.732	1	1	0.6	0.6
Boundary Effects	2.00	R	1.732	1	1	1.2	1.2
Readout Electronics	0.30	N	1	1	1	0.3	0.3
Response Time	0.00	R	1.732	1	1	0.0	0.0
Integration Time	2.60	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7
Probe Positioner	0.40	R	1.732	1	1	0.2	0.2
Probe Positioning	6.70	R	1.732	1	1	3.9	3.9
Post-processing	4.00	R	1.732	1	1	2.3	2.3
Test Sample Related							
Device Holder	3.60	N	1	1	1	3.6	3.6
Test sample Positioning	3.03	N	1	1	1	3.0	3.0
Power Scaling	0.00	R	1.732	1	1	0.0	0.0
Power Drift	5.00	R	1.732	1	1	2.9	2.9
Phantom and Setup							
Phantom Uncertainty	7.60	R	1.732	1	1	4.4	4.4
SAR correction	0.00	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.03	N	1	0.78	0.77	0.0	0.0
Liquid Conductivity (target)	5.00	R	1.732	0.78	0.77	2.3	2.2
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.77	1.1	1.1
Temp. unc. - Conductivity	3.68	R	1.732	0.78	0.77	1.7	1.6
Liquid Permittivity Repeatability	0.02	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.00	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.84	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						14.5%	14.2%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						29.0%	28.4%

Applicable for Power Density Measurements:

Error Description	Uncertainty Value (±dB)	Probability	Divisor	(Ci)	Standard Uncertainty (±dB)
Probe Calibration	0.49	N	1	1	0.49
Probe correction	0.00	R	1.732	1	0.00
Frequency response (BW ≤ 1 GHz)	0.20	R	1.732	1	0.12
Sensor cross coupling	0.00	R	1.732	1	0.00
Isotropy	0.50	R	1.732	1	0.29
Linearity	0.20	R	1.732	1	0.12
Probe scattering	0.00	R	1.732	1	0.00
Probe positioning offset	0.30	R	1.732	1	0.17
Probe positioning repeatability	0.04	R	1.732	1	0.02
Sensor mechanical offset	0.00	R	1.732	1	0.00
Probe spatial resolution	0.00	R	1.732	1	0.00
Field impedance dependance	0.00	R	1.732	1	0.00
Amplitude and phase drift	0.00	R	1.732	1	0.00
Amplitude and phase noise	0.04	R	1.732	1	0.02
Measurement area truncation	0.00	R	1.732	1	0.00
Data acquisition	0.03	N	1	1	0.03
Sampling	0.00	R	1.732	1	0.00
Field reconstruction	2.00	R	1.732	1	1.15
Forward transformation	0.00	R	1.732	1	0.00
Power density scaling	0.00	R	1.732	1	0.00
Spatial averaging	0.10	R	1.732	1	0.06
System detection limit	0.04	R	1.732	1	0.02
Uncertainty terms dep endent on the DUT and environmental factors					
Probe coupling with DUT	0.00	R	1.732	1	0.0
Modulation response	0.40	R	1.732	1	0.2
Integration time	0.00	R	1.732	1	0.0
Response time	0.00	R	1.732	1	0.0
Device holder influence	0.10	R	1.732	1	0.1
DUT alignment	0.00	R	1.732	1	0.0
RF ambient conditions	0.04	R	1.732	1	0.0
Ambient reflections	0.04	R	1.732	1	0.0
Immunity / secondary reception	0.00	R	1.732	1	0.0
Drift of the DUT		R	1.732	1	
Combined Std. Uncertainty					1.34
Expanded STD Uncertainty (95%)					**2.68**

14. 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.

[10] IEC/IEEE 62209-1528:2020, “Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)”, Oct. 2020

[11] SPEAG DASY6 System Handbook

[12] SPEAG DASY6 Application Note (Interim Procedure for Device Operation at 6GHz-10GHz)