FCC SAR TEST REPORT

Applicant	**:**	**Lenovo(Shanghai) Electronics Technology Co., Ltd.**
Equipment	**:**	**Portable Tablet Computer**
Brand Name	**:**	**Lenovo**
Model Name	**:**	**TB570FU**
FCC ID	**:**	**O57TB570FU**
Standard	**:**	**FCC 47 CFR Part 2 (2.1093)**

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been in compliance with the applicable technical standards.

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

Approved by: Si Zhang

ACCREDITED Cert #5145.02

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

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History of this test report

Report No.	Version	Description	Issued Date
FA2O1214	01	Initial issue of report	Dec. 09, 2022

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Lenovo(Shanghai) Electronics Technology Co., Ltd., Portable Tablet Computer, TB570FU**, are as follows.

Equipment Class	Frequency Band	Reported SAR Body (Separation 0mm) (1g SAR W/kg)	Highest Simultaneous Transmission 1g SAR (W/kg)	APD Body (W/m^2)	Scaled PD psPD (W/m^2)
DTS	2.4GHz WLAN	0.70	1.51		
NII	5GHz WLAN	0.79	1.51		
6XD	WIFI6E	**1.18**	1.53	4.69	5.37
DSS	Bluetooth	0.32	1.53		
Date of Testing:		2022/11/8 ~ 2022/11/22			

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.

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) and Power density exposure limits (1 mW/cm^2 = 10 W/m^2) specified in FCC 47 CFR part 2 (2.1093), ANSI/IEEE C95.1-1992 and FCC 47 CFR Part1.1310, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

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

Testing Laboratory			
Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR07-KS	CN1257	314309

Applicant	
Company Name	Lenovo(Shanghai) Electronics Technology Co., Ltd.
Address	Section 304-305, Building No. 4, # 222, Meiyue Road, China (Shanghai) Pilot Free Trade Zone

Manufacturer	
Company Name	Lenovo PC HK Limited
Address	23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong, China

3. Guidance Applied

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

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- IEC/IEEE 62209-1528:2020
- SPEAG DASY6 System Handbook
- SPEAG DASY6 Application Note (Interim Procedure for Device Operation at 6GHz-10GHz)
- IEC TR 63170:2018
- IEC 62479:2010
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02

4. Equipment Under Test (EUT) Information

4.1 General Information

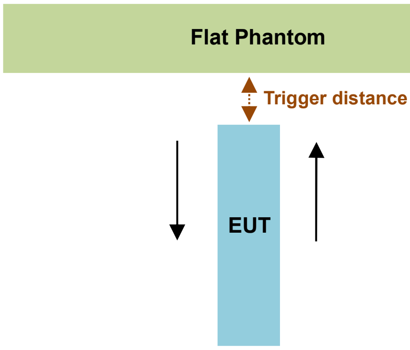
Product Feature & Specification	
Equipment Name	Portable Tablet Computer
Brand Name	Lenovo
Model Name	TB570FU
FCC ID	O57TB570FU
S/N	Sample 1: 8SSP68D60921HA192AC0091 Sample 2: HA1RL6S8
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz WLAN 6E U-NII-5: 5925 MHz ~ 6425 MHz WLAN 6E U-NII-6: 6425 MHz ~ 6525 MHz WLAN 6E U-NII-7: 6525 MHz ~ 6875 MHz WLAN 6E U-NII-8: 6875 MHz ~ 7125 MHz Bluetooth: 2402 MHz ~ 2480 MHz WPT: 13.56MHz
Mode	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac/ax VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160 WLAN 6GHz 802.11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE WPT: ASK
HW Version	TB570FU
SW Version	TB570FU_RF01_20221124
EUT Stage	Identical Prototype

Remark:
1. The EUT has no voice function.
2. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO/MIMO antenna mode.
3. The device supports 13.56MHz wireless charging (WLC) function and the function of charging the stylus only.
4. RF Exposure report for WPT will be separately submitted. About co-located SAR with WLAN/Bluetooth always chose higher SAR of WPT SAR.
5. The device employs proximity sensors that detect the presence of the user's body also a finger or hand near the bottom face of the device, reduced power will be active for all WLAN bands. (P-sensor can't work at detecting presence of the user's body at other edges of the device.)
6. There are three samples, the different between them refer to the TB570FU_Operational Description of Product Equality Declaration which is exhibit separately. According to the difference, we choose sample 1 to perform full test and sample 2 to verify the worst case of sample 1. For Sample 3, the differences do not affect the test, so sample 3 are not tested.

5. Proximity Sensor Triggering Test

<Proximity Sensor Triggering Distance (KDB 616217 D04 section 6.2)>:

1. Proximity sensor triggering distance testing was performed according to the procedures outlined in KDB 616217 D04 section 6.2, and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed and the tissue-equivalent medium for highest frequency 7125MHz and lowest 2450MHz frequency was used for proximity sensor triggering testing.
2. Capacitive proximity sensor placed coincident with antenna elements at the Bottom Face of the device are utilized to determine when the device comes in proximity of the user's body at the Bottom Face side of the device. There is no need to do sensor coverage testing for the proximity sensor is designed to support sufficient detection range and sensitivity to cover regions of the sensors in all applicable directions since the proximity sensor entirely covers the antenna.
3. When the sensor is active, WLAN 2.4GHz / WLAN 5.2GHz / WLAN 5.3GHz / WLAN 5.5GHz / WLAN 5.8GHz / WLAN 6GHz reduced power will be active.
4. The sensors used to detect the proximity of the user's body at the Bottom Face side of the device use a detection threshold distance. The data shown in the sections below shows the distance(s).



Proximity Sensor Triggering Distance (mm)		
Position	Bottom Face	
	Moving away	Moving towards
Minimum	13	11

<Proximity Sensor Triggering Coverage (KDB 616217 D04 section 6.3)>:

If a sensor is spatially offset from the antenna(s), it is necessary to verify sensor triggering for conditions where the antenna is next to the user but the sensor is laterally further away to ensure sensor coverage is sufficient for reducing the power to maintain compliance. For p-sensor coverage testing, the device is moved and "along the direction of maximum antenna and sensor offset".
Illustrated in the internal photo exhibit, although the senor is spatially offset, there is no trigger condition where the antenna is next to the user but the sensor is laterally further away, therefore proximity sensor coverage testing is not required.
This procedure is not required because antenna and sensor are collocated and the peak SAR location is overlapping with the sensor.

Proximity sensor power reduction

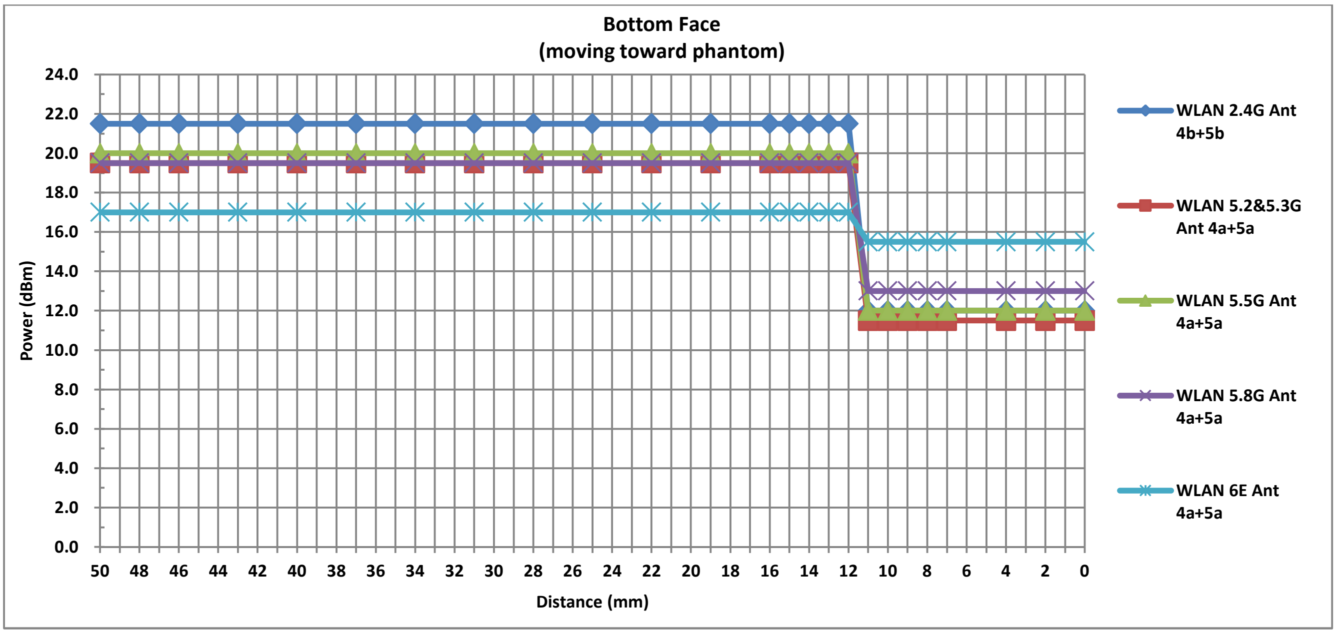
Exposure Position / wireless mode	Bottom Face[1]	Edge 1	Edge 2	Edge 3	Edge 4
WLAN 2.4GHz	10.00 dB	0dB	0dB	0dB	0dB
WLAN 5.2GHz	9.00 dB	0dB	0dB	0dB	0dB
WLAN 5.3GHz	9.00 dB	0dB	0dB	0dB	0dB
WLAN 5.5GHz	8.00 dB	0dB	0dB	0dB	0dB
WLAN 5.8GHz	7.00 dB	0dB	0dB	0dB	0dB
WLAN 6GHz	2.00 dB	0dB	0dB	0dB	0dB

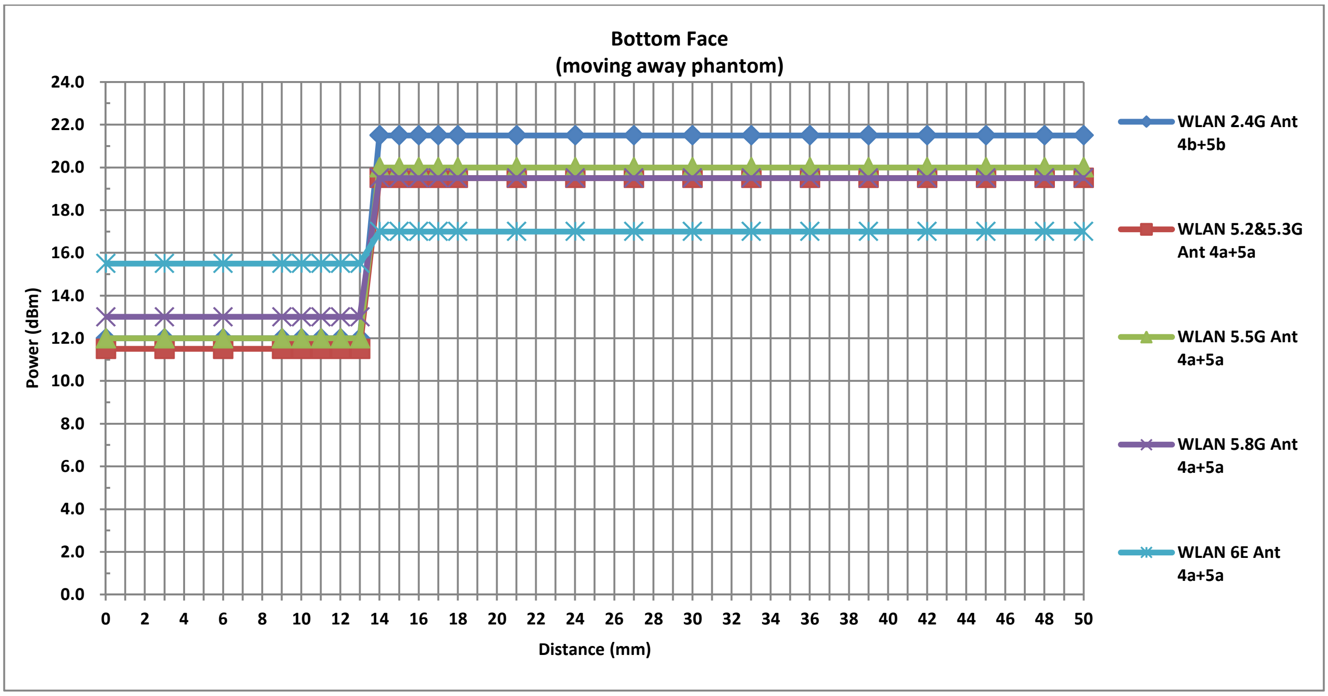
Remark:
1. [1]: Reduced maximum limit applied by activation of proximity sensor.
2. Tests were performed in accordance with KDB 616217 D04 section 6.1, 6.2, 6.3 and 6.5 and compliant results are shown and described in exhibit “P-Sensor operational description
3. For verification of compliance of power reduction scheme, additional SAR testing with EUT transmitting at full RF power at a conservative trigger distance was performed:

· Bottom Face: 10 mm

Power Measurement during Sensor Trigger distance testing

Band/Mode	Measured power reduction (dBm)		Reduction Levels
	w/o power back-off	w/ power back-off	(dB)
WLAN 2.4GHz	24.50	14.50	10.0
WLAN 5.2GHz	22.50	13.50	9.0
WLAN 5.3GHz	22.50	13.50	9.0
WLAN 5.5GHz	22.00	14.00	8.0
WLAN 5.8GHz	22.00	15.00	7.0
WLAN 6GHz	20.50	18.50	2.0





6. RF Exposure Limits

6.1 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.

6.2 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.

6.3 RF Exposure limit for below 6GHz

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.

6.4 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. The unit of power density evaluation is W/m^2 or mW/cm^2.

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/cm2)	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

Note: 1.0 mW/cm^2 is 10 W/m^2

7. Specific Absorption Rate (SAR)

7.1 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.

7.2 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:

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

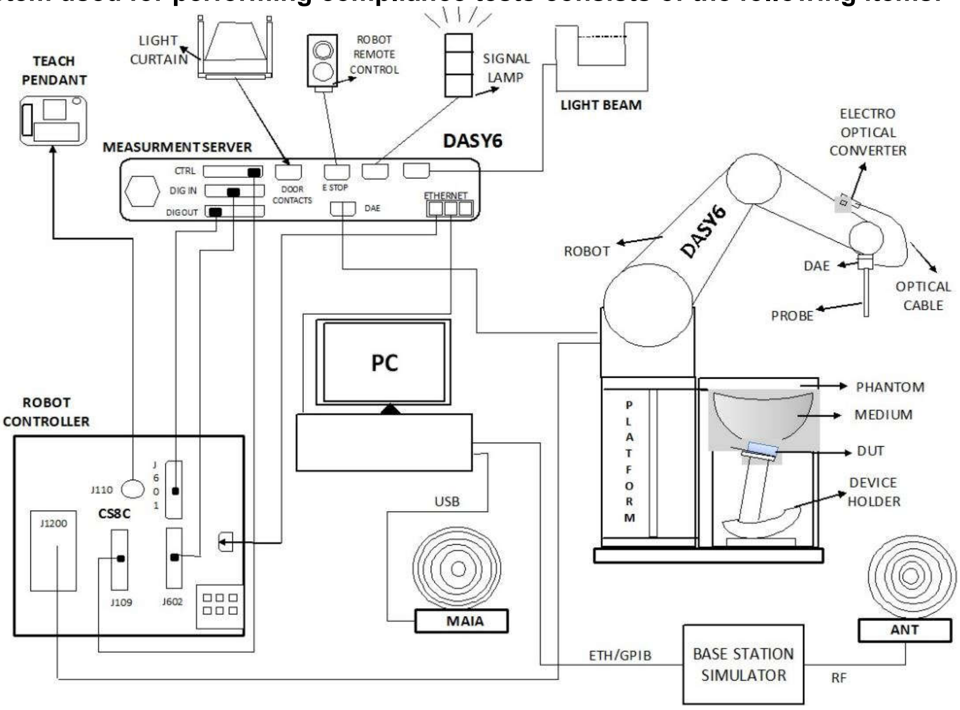
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

8. 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 Win7 or Win10 and the DASY5 or DASY6 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.

8.1 E-Field Probe

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

<EX3DV4 Probe>

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

8.2 Data Acquisition Electronics (DAE)

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

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

Photo of DAE

8.3 Phantom

<SAM Twin Phantom>

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

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

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

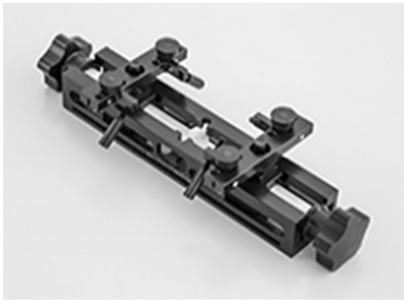
The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices or for evaluating transmitters operating at low frequencies. ELI is fully compatible with standard and all known tissue simulating liquids.

8.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

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

Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

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

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

Mounting Device for Laptops

9. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

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

<SAR measurement>

(a) Use 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

9.1 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

9.2 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.

9.3 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.	

9.4 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.

			$\leq$ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			$\leq$ 2 GHz: $\leq$ 8 mm 2 – 3 GHz: $\leq$ 5 mm*	3 – 4 GHz: $\leq$ 5 mm* 4 – 6 GHz: $\leq$ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		$\leq$ 5 mm	3 – 4 GHz: $\leq$ 4 mm 4 – 5 GHz: $\leq$ 3 mm 5 – 6 GHz: $\leq$ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	$\leq$ 4 mm	3 – 4 GHz: $\leq$ 3 mm 4 – 5 GHz: $\leq$ 2.5 mm 5 – 6 GHz: $\leq$ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		$\geq$ 30 mm	3 – 4 GHz: $\geq$ 28 mm 4 – 5 GHz: $\geq$ 25 mm 5 – 6 GHz: $\geq$ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is $\leq$ 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.				

9.5 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.

9.6 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.

10. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	1040	2020/5/6	2023/5/4
SPEAG	5000MHz System Validation Kit	D5GHzV2	1341	2021/12/13	2022/12/12
SPEAG	6500MHz System Validation Kit	D6.5GHzV2	1031	2021/3/1	2024/2/29
SPEAG	5G Verification Source	10GHz	2005	2021/11/26	2022/11/25
SPEAG	Data Acquisition Electronics	DAE4	1305	2022/4/27	2023/4/26
SPEAG	Data Acquisition Electronics	DAE4	690	2022/6/15	2023/6/14
SPEAG	Dosimetric E-Field Probe	EX3DV4	7630	2022/3/4	2023/3/3
SPEAG	EUmmWV Probe Tip Protection	EUmmWV4	9553	2022/9/9	2023/9/8
SPEAG	mmWave Phantom	mmWave	1065	NCR	NCR
SPEAG	ELI Phantom	ELI V8.0	TP-2135	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Rohde & Schwarz	Signal Generator	SMB100A	100455	2022/1/5	2023/1/4
Anritsu	Vector Signal Generator	MG3710A	6201682672	2022/1/6	2023/1/5
Keysight	Preamplifier	83017A	MY57280111	2022/7/11	2023/7/10
Agilent	ENA Series Network Analyzer	E5071C	MY46104587	2022/5/24	2023/5/23
Speag	Dielectric Assessment KIT	DAK-3.5	1071	2022/1/24	2023/1/23
Rohde & Schwarz	Power Meter	NRVD	102081	2022/7/14	2023/7/13
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2022/7/14	2023/7/13
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2022/7/14	2023/7/13
Rohde & Schwarz	Power Sensor	NRP50S	101254	2022/4/7	2023/4/6
R&S	Spectrum Analyzer	FSV7	101631	2022/1/5	2023/1/4
TES	DIGITAC THERMOMETER	1310	200505600	2022/7/12	2023/7/11
Testo	Thermo-Hygrometer	608-H1	1241332102	2022/1/6	2023/1/5
R&S	CBT BLUETOOTH TESTER	CBT	100641	2022/1/5	2023/1/4
mini-circuits	amplifier	ZVE-3W-83+	162601250	Note 1	
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	Note 1	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	Note 1	
Agilent	Dual Directional Coupler	778D	20500	Note 1	
Agilent	Dual Directional Coupler	11691D	MY48151020	Note 1	
ET Industries	Dual Directional Coupler	C-058-10	N/A	Note 1	
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
ARRA	Power Divider	A3200-2	N/A	Note 1	
MCL	Attenuation1	BW-S10W5+	N/A	Note 1	
MCL	Attenuation2	BW-S10W5+	N/A	Note 1	
MCL	Attenuation3	BW-S10W5+	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.

11. SAR System Verification

11.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 11.1.

Fig 11.1 Photo of Liquid Height for Body SAR

11.2 SAR 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

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

Simulating Liquid for 5GHz, Manufactured by SPEAG

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

<Tissue Dielectric Parameter Check Results>

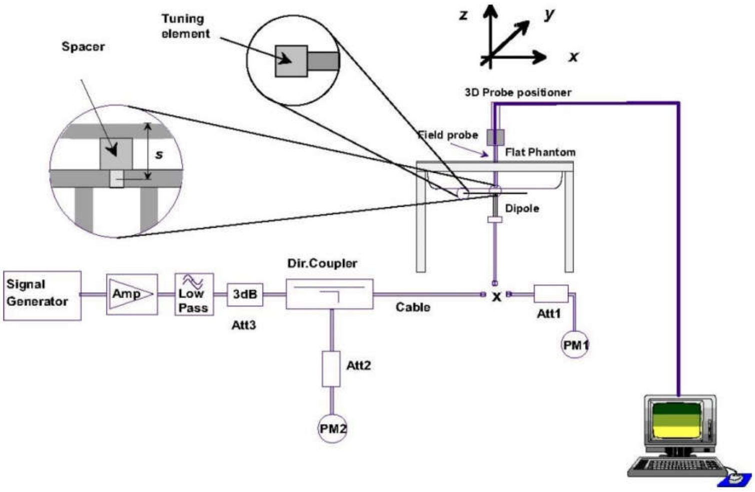
Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	Head	22.6	1.851	39.052	1.80	39.20	2.83	-0.38	±5	2022/11/8
5250	Head	22.7	4.574	35.973	4.71	35.90	-2.89	0.20	±5	2022/11/10
5600	Head	22.7	4.973	35.436	5.07	35.50	-1.91	-0.18	±5	2022/11/12
5750	Head	22.7	5.138	35.247	5.22	35.40	-1.57	-0.43	±5	2022/11/14
6500	Head	22.6	6.100	35.600	6.07	34.50	0.49	3.19	±5	2022/11/22

11.3 SAR 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.

<1g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2022/11/8	2450	Head	50	1040	7630	1305	2.660	51.80	53.2	2.70
2022/11/10	5250	Head	50	1341	7630	1305	4.130	80.70	82.6	2.35
2022/11/12	5600	Head	50	1341	7630	1305	4.510	84.50	90.2	6.75
2022/11/14	5750	Head	50	1341	7630	1305	4.120	80.60	82.4	2.23
2022/11/22	6500	Head	50	1031	7630	1305	14.900	289.00	298.0	3.11



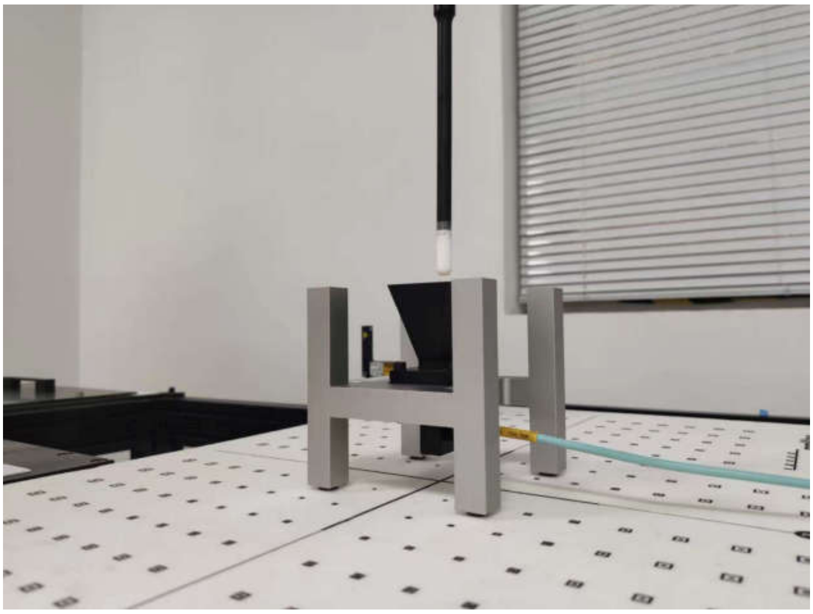
System Performance Check Setup

Setup Photo

11.4 PD System Verification 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.

Frequency (GHz)	5G Verification Source	Probe S/N	DAE S/N	Distance (mm)	Prad (mW)	Measured 4 cm^2 (W/m^2)	Targeted 4 cm^2 (W/m^2)	Deviation (dB)	Date
10	10GHz_2005	9553	690	10	125	137	151	-0.42	2022/11/17



System Verification Setup Photo

12. RF Exposure Positions

12.1 SAR Testing for Tablet

This device can be used also in full sized tablet exposure conditions, due to its size. Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR exclusion threshold in KDB 447498 D01v06 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

<EUT Setup Photos>

Please refer to Appendix D for the test setup photos.

12.2 Miscellaneous Testing Considerations

- Evaluate SAR using 6-7 GHz parameters per IEC/IEEE 62209-1528:2020.
- Per procedures of KDB Pubs. 447498 and 248227, and applicable product-specific procedures among KDB Pubs. 648474 (handsets/phablets).
- Where supported by the test system, also report estimated absorbed (epithelial) power density (for reference purposes only, not specifically for compliance) and estimated incident PD, derived from measured SAR.
- In addition, for the 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)
  - Adjust measured results per amount that measurement uncertainty exceeds 30 % (see e.g. IEC 62479:2010)

13. Conducted RF Output Power (Unit: dBm)

The detailed conducted power table can refer to Appendix E.

<WLAN Conducted Power>

General Note:

1. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
2. Per KDB 248227 D01v02r02, 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, for each frequency band or when MIMO mode was not performed, due to 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. 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.

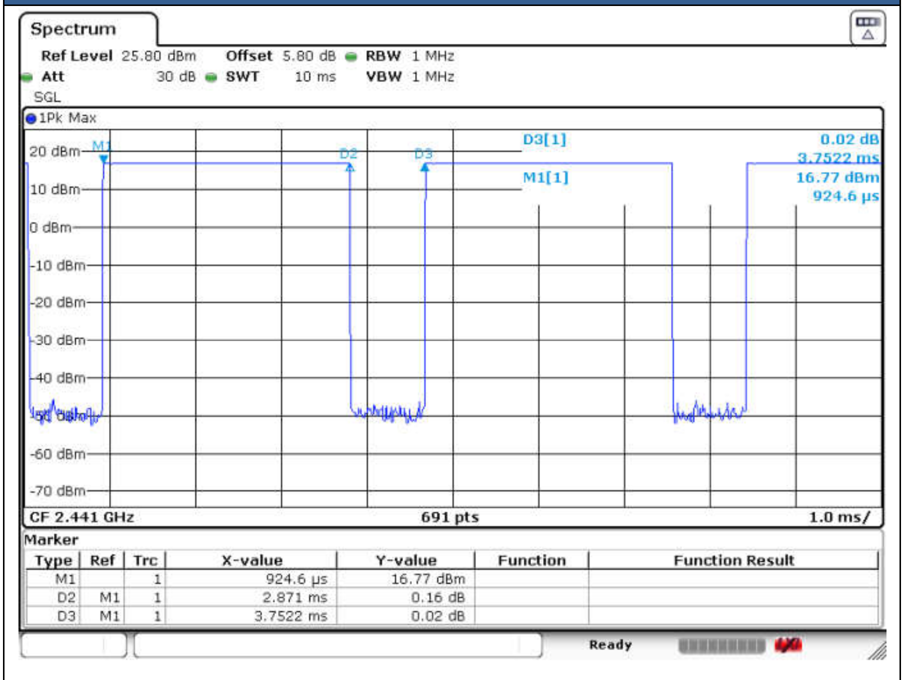
8. 802.11ax full tone and partial tone supported for WLAN2.4GHz/WLAN5GHz, after verification for the partial tone power level is far less than full tone power level, so we chose full tone power to be measured in this report.
9. In applying the test guidance, the IEEE 802.11 mode with the maximum output 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 Bluetooth>

General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps, due to its highest average power.
2. The Bluetooth duty cycle is 76.52 % as following figure, according to 2016 Oct. TCB workshop for Bluetooth SAR scaling need further consideration and the maximum duty cycle is 100%, therefore the actual duty cycle will be scaled up to100% for Bluetooth reported SAR calculation.

Bluetooth time-domain plot



14. Antenna Location

The detailed antenna location information can refer to SAR Test Setup Photos.

<SAR test exclusion table>
General Note:

1. The below table, when the distance is < 50 mm exclusion threshold is "Ratio", when the distance is > 50 mm exclusion threshold is "mW"
2. Maximum power is the source-based time-average power and represents the maximum RF output power among production units
3. Per KDB 447498 D01v06, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
4. Per KDB 447498 D01v06, standalone SAR test exclusion threshold is applied; If the test separation distance is < 5mm, 5mm is used to determine SAR exclusion threshold.
5. Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
   - f(GHz) is the RF channel transmit frequency in GHz
   - Power and distance are rounded to the nearest mW and mm before calculation
   - The result is rounded to one decimal place for comparison
6. Per KDB 447498 D01v06, at 100 MHz to 6 GHz and for *test separation distances* > 50 mm, the SAR test exclusion threshold is determined according to the following
   a) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz
   b) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·10] mW at > 1500 MHz and ≤ 6 GHz

Exposure Position	Wireless Interface	BT ANT 4b	2.4GHz WLAN ANT 4b	2.4GHz WLAN ANT 5b	2.4GHz WLAN ANT 4b+5b	5GHz WLAN ANT 4a	5GHz WLAN ANT 5a	5GHz WLAN ANT 4a+5a	6GHz WLAN ANT 4a	6GHz WLAN ANT 5a	6GHz WLAN ANT 4a+5a
	Calculated Frequency (MHz)	2480	2462	2462	2462	5825	5825	5825	7025	7025	7025
	Maximum power (dBm)	9.5	21.5	21.0	24.5	19.5	19.5	22.5	17.5	17.0	20.5
	Maximum rated power(mW)	8.91	141.25	125.89	281.84	89.13	89.13	177.83	56.23	50.12	112.20
Bottom Face	Separation distance(mm)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	exclusion threshold	2.8	44.3	39.5	88.5	43.0	43.0	85.8	29.8	26.6	59.5
	Testing required?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Edge 1	Separation distance(mm)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	exclusion threshold	2.8	44.3	39.5	88.5	43.0	43.0	85.8	29.8	26.6	26.6
	Testing required?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Edge 2	Separation distance(mm)	86.0	86.0	188.0	86.0	234.0	74.0	74.0	234.0	74.0	74.0
	exclusion threshold	455.0	456.0	1476.0	456.0	1902.0	302.0	302.0	1897.0	297.0	297.0
	Testing required?	No	No	No	No	No	No	No	No	No	No
Edge 3	Separation distance(mm)	202.0	202.0	202.0	202.0	202.0	202.0	202.0	202.0	202.0	202.0
	exclusion threshold	1615.0	1616.0	1616.0	1616.0	1582.0	1582.0	1582.0	1577.0	1577.0	1577.0
	Testing required?	No	No	No	No	No	No	No	No	No	No
Edge 4	Separation distance(mm)	188.0	188.0	86.0	86.0	74.0	234.0	74.0	74.0	234.0	74.0
	exclusion threshold	1475.0	1476.0	456.0	456.0	302.0	1902.0	302.0	297.0	1897.0	297.0
	Testing required?	No	No	No	No	No	No	No	No	No	No

15. 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/BT 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/BT: 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.
4. For WIFI6E doesn't support wireless router capability.
5. Per FCC guidance, SAR was performed using 6.5 GHz SAR probe calibration factors.
6. Per October 2020 TCB Workshop Interim procedures, start instead with a minimum of 5 test channels across the full band, then adapt and apply conducted power and SAR test reduction procedures of KDB Pub. 248227 v02r02
7. Absorbed power density (APD) using a 4cm2 averaging area is reported based on SAR measurements.

WLAN SAR 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. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO/MIMO antenna mode.
6. SISO and MIMO all supported by WLAN2.4GHz/WLAN5GHz, for SISO mode power is less than per chain power of MIMO mode. For WLAN SISO & MIMO mode, the whole testing has assessed only MIMO mode by referring to their higher conducted power, so chose MIMO power to perform SAR testing.
7. 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 SISO antenna respectively to calculate sum of the power for MIMO mode.
8. For WLAN SAR testing was performed on dual antenna, due to the single antenna RF power in MIMO mode is larger than the single antenna RF power in SISO mode. Therefore, the following summations in MIMO mode can represent the absolute worst cases in SISO mode for simultaneous transmission.
9. During SAR testing the WIFI6E transmission was verified using a spectrum analyzer.
10. When SAR testing for 802.11ax is required
    d. 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
    e. Otherwise, consider the fully allocated channel for SAR testing
    f. 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.

15.1 Body SAR Test Result

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	Ch.	Freq. (MHz)	Sample	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)
01	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	0mm	Ant 4b+5b	Reduced	1	2412	1	13.07	14.50	1.390	100	1.000	0.04	0.500	**0.695**
	WLAN2.4GHz tablet with stylus	802.11b 1Mbps	Bottom Face	0mm	Ant 4b+5b	Reduced	1	2412	1	13.07	14.50	1.390	100	1.000	0.03	0.099	0.138
	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	0mm	Ant 4b+5b	Reduced	1	2412	2	13.07	14.50	1.390	100	1.000	0.01	0.360	0.500
	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	0mm	Ant 4b+5b	Reduced	6	2437	1	12.84	14.50	1.466	100	1.000	0.05	0.402	0.589
	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	0mm	Ant 4b+5b	Reduced	11	2462	1	12.80	14.50	1.479	100	1.000	0.01	0.374	0.553
	WLAN2.4GHz	802.11b 1Mbps	Edge 1	0mm	Ant 4b+5b	Full	1	2412	1	22.81	24.50	1.476	100	1.000	0.05	0.465	0.686
	WLAN2.4GHz tablet with stylus	802.11b 1Mbps	Edge 1	0mm	Ant 4b+5b	Full	1	2412	1	22.81	24.50	1.476	100	1.000	0.01	0.432	0.638
	WLAN2.4GHz	802.11b 1Mbps	Edge 2	0mm	Ant 4b+5b	Full	1	2412	1	22.81	24.50	1.476	100	1.000	0.03	0.015	0.022
	WLAN2.4GHz	802.11b 1Mbps	Edge 3	0mm	Ant 4b+5b	Full	1	2412	1	22.81	24.50	1.476	100	1.000	0.01	0.020	0.030
	WLAN2.4GHz	802.11b 1Mbps	Edge 4	0mm	Ant 4b+5b	Full	1	2412	1	22.81	24.50	1.476	100	1.000	0.02	0.013	0.019
	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	10mm	Ant 4b+5b	Full	1	2412	1	22.81	24.50	1.476	100	1.000	0.01	0.380	0.561
02	Bluetooth	1Mbps	Bottom Face	0mm	Ant 4b	Full	39	2441	1	9.06	9.50	1.107	76.52	1.307	0.01	0.224	**0.324**
	Bluetooth	1Mbps	Bottom Face	0mm	Ant 4b	Full	0	2402	1	8.42	9.50	1.282	76.52	1.307	0.03	0.189	0.317
	Bluetooth	1Mbps	Bottom Face	0mm	Ant 4b	Full	78	2480	1	7.92	9.50	1.439	76.52	1.307	0.01	0.155	0.291
	Bluetooth	1Mbps	Edge 1	0mm	Ant 4b	Full	39	2441	1	9.06	9.50	1.107	76.52	1.307	0.13	0.033	0.048
03	WLAN5.3GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	58	5290	1	12.69	13.50	1.206	88.49	1.130	-0.01	0.545	**0.743**
	WLAN5GHz tablet with stylus	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	58	5290	1	12.69	13.50	1.206	88.49	1.130	0.02	0.014	0.019
	WLAN5.3GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	58	5290	2	12.69	13.50	1.206	88.49	1.130	0.08	0.311	0.424
	WLAN5.3GHz	802.11n-HT40 MCS0	Edge 1	0mm	Ant 4a+5a	Full	54	5270	1	20.53	22.50	1.574	93.86	1.065	0.06	0.399	0.669
	WLAN5.3GHz tablet with stylus	802.11n-HT40 MCS0	Edge 1	0mm	Ant 4a+5a	Full	54	5270	1	20.53	22.50	1.574	93.86	1.065	0.03	0.385	0.645
	WLAN5.3GHz	802.11n-HT40 MCS0	Edge 2	0mm	Ant 4a+5a	Full	54	5270	1	20.53	22.50	1.574	93.86	1.065	0.02	0.016	0.027
	WLAN5.3GHz	802.11n-HT40 MCS0	Edge 3	0mm	Ant 4a+5a	Full	54	5270	1	20.53	22.50	1.574	93.86	1.065	-0.01	0.050	0.084
	WLAN5.3GHz	802.11n-HT40 MCS0	Edge 4	0mm	Ant 4a+5a	Full	54	5270	1	20.53	22.50	1.574	93.86	1.065	0.03	0.020	0.034
	WLAN5.3GHz	802.11ac-VHT80 MCS0	Bottom Face	10mm	Ant 4a+5a	Full	54	5270	1	20.53	22.50	1.574	93.86	1.065	-0.03	0.186	0.312
04	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	138	5690	1	13.17	14.00	1.211	88.49	1.130	0.06	0.534	**0.731**
	WLAN5.5GHz tablet with stylus	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	138	5690	1	13.17	14.00	1.211	88.49	1.130	0.01	0.026	0.036
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	138	5690	2	13.17	14.00	1.211	88.49	1.130	0.03	0.425	0.582
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	106	5530	1	13.11	14.00	1.226	88.49	1.130	0.04	0.435	0.603
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	122	5610	1	13.13	14.00	1.220	88.49	1.130	0.02	0.528	0.728
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Edge 1	0mm	Ant 4a+5a	Full	138	5690	1	20.41	22.00	1.442	88.49	1.130	0.05	0.443	0.722
	WLAN5.5GHz tablet with stylus	802.11ac-VHT80 MCS0	Edge 1	0mm	Ant 4a+5a	Full	138	5690	1	20.41	22.00	1.442	88.49	1.130	0.06	0.412	0.671
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Edge 2	0mm	Ant 4a+5a	Full	138	5690	1	20.41	22.00	1.442	88.49	1.130	0.03	0.020	0.033
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Edge 3	0mm	Ant 4a+5a	Full	138	5690	1	20.41	22.00	1.442	88.49	1.130	-0.02	0.059	0.096
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Edge 4	0mm	Ant 4a+5a	Full	138	5690	1	20.41	22.00	1.442	88.49	1.130	0.01	0.025	0.041
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	10mm	Ant 4a+5a	Full power	138	5690	1	20.41	22.00	1.442	88.49	1.130	0.07	0.203	0.331
05	WLAN5.8GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	155	5775	1	14.11	15.00	1.227	88.49	1.130	0.01	0.568	**0.788**
	WLAN5.8GHz tablet with stylus	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	155	5775	1	14.11	15.00	1.227	88.49	1.130	0.09	0.042	0.058
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	155	5775	2	14.11	15.00	1.227	88.49	1.130	0.06	0.410	0.569
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Edge 1	0mm	Ant 4a+5a	Full	155	5775	1	20.41	22.00	1.442	88.49	1.130	0.05	0.436	0.711
	WLAN5.8GHz tablet with stylus	802.11ac-VHT80 MCS0	Edge 1	0mm	Ant 4a+5a	Full	155	5775	1	20.41	22.00	1.442	88.49	1.130	0.01	0.416	0.678
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Edge 2	0mm	Ant 4a+5a	Full	155	5775	1	20.41	22.00	1.442	88.49	1.130	0.03	0.023	0.037
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Edge 3	0mm	Ant 4a+5a	Full	155	5775	1	20.41	22.00	1.442	88.49	1.130	0.01	0.048	0.078
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Edge 4	0mm	Ant 4a+5a	Full	155	5775	1	20.41	22.00	1.442	88.49	1.130	0.02	0.017	0.028
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Bottom Face	10mm	Ant 4a+5a	Full	155	5775	1	20.41	22.00	1.442	88.49	1.130	0.01	0.245	0.399

<WLAN6G SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	Ch.	Freq. (MHz)	Sample	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)
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	167	6785	1	15.23	16.50	1.340	86.9	1.151	0.06	0.668	1.030	4.02
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	7	5985	1	13.83	15.50	1.469	86.9	1.151	0.03	0.523	0.884	3.18
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	71	6305	1	16.57	18.50	1.560	86.9	1.151	0.09	0.589	1.057	3.43
06	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	119	6545	1	17.25	18.50	1.334	86.9	1.151	0.02	0.769	1.180	4.69
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	119	6545	2	17.25	18.50	1.334	86.9	1.151	-0.13	0.719	1.104	4.27
	WLAN6GHz tablet with stylus	802.11ax-HE80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	119	6545	1	17.25	18.50	1.334	86.9	1.151	-0.01	0.173	0.266	1.23
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	0mm	Ant 4a+5a	Reduced	215	7025	1	15.06	16.00	1.242	86.9	1.151	0.03	0.614	0.877	3.89
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	10mm	Ant 4a+5a	Full	167	6785	1	18.75	20.50	1.496	86.9	1.151	0.02	0.153	0.263	1.11
	WLAN6GHz	802.11ax-HE80 MCS0	Edge 1	0mm	Ant 4a+5a	Full	167	6785	1	18.75	20.50	1.496	86.9	1.151	0.06	0.487	0.839	3.15
	WLAN6GHz tablet with stylus	802.11ax-HE80 MCS0	Edge 1	0mm	Ant 4a+5a	Full	167	6785	1	18.75	20.50	1.496	86.9	1.151	0.11	0.455	0.784	3.01
	WLAN6GHz	802.11ax-HE80 MCS0	Edge 1	0mm	Ant 4a+5a	Full	7	5985	1	16.60	18.50	1.549	86.9	1.151	0.03	0.311	0.554	2.33
	WLAN6GHz	802.11ax-HE80 MCS0	Edge 2	0mm	Ant 4a+5a	Full	167	6785	1	18.75	20.50	1.496	86.9	1.151	0	0.000	0.000	0
	WLAN6GHz	802.11ax-HE80 MCS0	Edge 2	0mm	Ant 4a+5a	Full	7	5985	1	16.60	18.50	1.549	86.9	1.151	0	0.000	0.000	0
	WLAN6GHz	802.11ax-HE80 MCS0	Edge 3	0mm	Ant 4a+5a	Full	167	6785	1	18.75	20.50	1.496	86.9	1.151	0	0.000	0.000	0
	WLAN6GHz	802.11ax-HE80 MCS0	Edge 3	0mm	Ant 4a+5a	Full	7	5985	1	16.60	18.50	1.549	86.9	1.151	0	0.000	0.000	0
	WLAN6GHz	802.11ax-HE80 MCS0	Edge 4	0mm	Ant 4a+5a	Full	167	6785	1	18.75	20.50	1.496	86.9	1.151	0	0.000	0.000	0
	WLAN6GHz	802.11ax-HE80 MCS0	Edge 4	0mm	Ant 4a+5a	Full	7	5985	1	16.60	18.50	1.549	86.9	1.151	0	0.000	0.000	0

15.2 PD Test Result

Power Density General Notes:

1. 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.
2. Batteries are fully charged at the beginning of the measurements.
3. Absorbed power density (APD) using a 4cm^2 averaging area is reported based on SAR measurements.
4. Power density was calculated by repeated E-field measurements on two measurement planes separated by λ/4.
5. 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.
6. Per FCC guidance and equipment manufacturer guidance, 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.
7. Per April 2021 TCB Workshop, For the highest SAR test configurations also measure incident PD (total) using power-density reconstruction method in 2 mm closest measurement plane.
8. 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.

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

<WLAN PD>

Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Grip Step (λ)	iPDn	iPD ratio (≥ -1)	Normal psPD (W/m^2)	Total psPD (W/m^2)
WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	2mm	Ant 4a+5a	7	5985	13.83	0.0625	0.364	-0.96	0.746	1.19
WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	10mm	Ant 4a+5a	7	5985	13.83	0.15	0.454		0.833	1.15
WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	2mm	Ant 4a+5a	215	7025	15.06	0.0625	0.624	-0.97	0.533	0.896
WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	8.59mm	Ant 4a+5a	215	7025	15.06	0.15	0.781		0.746	0.838

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Grip 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)
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	2mm	Ant 4a+5a	7	5985	13.83	15.50	1.469	86.9	1.151	0.0625	1.5535	-0.02	0.746	1.96	1.190	3.13
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	2mm	Ant 4a+5a	71	6305	16.57	18.50	1.560	86.9	1.151	0.0625	1.5535	-0.02	1.010	2.82	1.400	3.90
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	2mm	Ant 4a+5a	119	6545	17.25	18.50	1.334	86.9	1.151	0.0625	1.5535	-0.06	1.520	3.62	2.110	5.03
01	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	2mm	Ant 4a+5a	167	6785	15.23	16.50	1.340	86.9	1.151	0.0625	1.5535	-0.14	1.590	3.81	2.240	**5.37**
	WLAN6GHz	802.11ax-HE80 MCS0	Bottom Face	2mm	Ant 4a+5a	215	7025	15.06	16.00	1.242	86.9	1.151	0.0625	1.5535	0.03	0.533	1.18	0.896	1.99
	WLAN6GHz	802.11ax-HE80 MCS0	Edge 1	2mm	Ant 4a+5a	119	6545	18.75	20.50	1.496	86.9	1.151	0.0625	1.5535	-0.03	0.978	2.62	1.150	3.08

16. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Portable Tablet Computer
		Body
1.	WLAN5GHz + Bluetooth + WPT	Yes
2.	WLAN6GHz + Bluetooth + WPT	Yes
3.	WLAN2.4GHz + WLAN5GHz + WPT	Yes
4.	WLAN 2.4GHz + WPT	Yes

Note:

1. The EUT has no voice function means data only.
2. The 2.4GHz/5GHz/6GHz WLAN can transmit in MIMO and SISO antenna mode.
3. RF Exposure report for WPT will be separately submitted. About co-located SAR with WLAN/Bluetooth always chose higher SAR of WPT SAR.
4. According to the EUT characteristic, WLAN 5GHz/6GHz and Bluetooth can transmit simultaneously.
5. According to the EUT characteristic, WLAN 2.4GHz and Bluetooth can't transmit simultaneously.
6. According to the EUT characteristic, WLAN 2.4GHz/5GHz and WLAN 6GHz can't transmit simultaneously.
7. According to the EUT characteristic, WLAN 2.4GHz Ant 4b and WLAN 5GHz Ant 5a can transmit simultaneously.
8. According to the EUT characteristic, WLAN 2.4GHz/5GHz/6GHz and WPT can transmit simultaneously.
9. The worst case 5 GHz WLAN SAR for each configuration was used for SAR summation.
10. The maximum SAR summation is calculated based on the same configuration and test position.
11. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
    i) 1g 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 for 1g SAR, simultaneously transmission SAR measurement is not necessary.
    iv) Simultaneously transmission SAR measurement, and the reported multi-band 1g SAR < 1.6W/kg.
12. For simultaneous transmission compliance can be assessed on BT+WLAN 6GHz+WPT (SAR,PD), total exposure ration is calculated:

$$SAR\ ratio(\mathrm{ER}) = \frac{SAR}{SAR_{limit}} \quad [1] \qquad PD\ ratio(\mathrm{ER}) = \frac{PD}{PD_{limit}} \quad [2]$$

$$\text{Total exposure ratio (TER)} = \frac{SAR}{SAR_{limit}} + \frac{PD}{PD_{limit}} \quad [3]$$

13. Compliance with the SAR-PD based RF exposure limits is achieved if Total exposure ratio (TER) ≤ 1.

16.1 Body Exposure Conditions

Exposure Position	1	2	3	4	5	2+3+5	3+4+5	1+2+5
	WLAN2.4GHz Ant 4b+5b	WLAN5GHz Ant 4a+5a	Bluetooth Ant 4b	WLAN6GHz Ant 4a+5a	WPT-13.56MHz	**Summed**	**Summed**	**Summed**
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	**1g SAR (W/kg)**	**1g SAR (W/kg)**	**1g SAR (W/kg)**
Bottom Face	0.695	0.788	0.324	1.180	0.023	1.14	**1.53**	**1.51**
Edge 1	0.686	0.722	0.048	0.839	0.011	0.78	0.90	1.42
Edge 2	0.022	0.033				0.03	0.00	0.06
Edge 3	0.030	0.096				0.10	0.00	0.13
Edge 4	0.019	0.041				0.04	0.00	0.06

3	4	5	3+4+5
Bluetooth Ant 4b	PD	WPT-13.56MHz	**Summed**
1g SAR (W/kg)	**(W/m^2)**	1g SAR (W/kg)	Reported SAR/1.6 + PD/10 Summation
0.324	5.37	0.023	**0.754**

Test Engineer : Martin Li, Varus Wang, Light Wang, Ricky Gu

17. 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. 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.

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.

Uncertainty Budget According to IEC/IEEE 62209-1528 (Frequency band: 4 MHz - 10 GHz range)							
Error Description	**Uncert. Value (±%)**	**Prob. Dist.**	**Div.**	**(Ci) 1g**	**(Ci) 10g**	**Standard Uncertainty (1g) (±%)**	**Standard Uncertainty (10g) (±%)**
Measurement System errors							
Probe calibration	18.6	N	2	1	1	9.3	9.3
Probe calibration drift	1.7	R	1.732	1	1	1.0	1.0
Probe linearity and detection Limit	4.7	R	1.732	1	1	2.7	2.7
Broadband signal	2.8	R	1.732	1	1	1.6	1.6
Probe isotropy	7.6	R	1.732	1	1	4.4	4.4
Other probe and data acquisition errors	2.4	N	1	1	1	2.4	2.4
RF ambient and noise	1.8	N	1	1	1	1.8	1.8
Probe positioning errors	0.006	N	1	0.5	0.5	0.0	0.0
Data processing errors	4.0	N	1	1	1	4.0	4.0
Phantom and Device Errors							
Measurement of phantom conductivity (σ)	2.5	N	1	0.78	0.71	2.0	1.8
Temperature effects (medium)	5.4	R	1.732	0.78	0.71	2.4	2.2
Shell permittivity	14.0	R	1.732	0.5	0.5	4.0	4.0
Distance between the radiating element of the DUT and the phantom medium	2.0	N	1	2	2	4.0	4.0
Repeatability of positioning the DUT or source against the phantom	1.0	N	1	1	1	1.0	1.0
Device holder effects	3.6	N	1	1	1	3.6	3.6
Effect of operating mode on probe sensitivity	2.4	R	1.732	1	1	1.4	1.4
Time-average SAR	1.7	R	1.732	1	1	1.0	1.0
Variation in SAR due to drift in output of DUT	2.5	N	1	1	1	2.5	2.5
Validation antenna uncertainty (validation measurement only)	0.0	N	1	1	1	0.0	0.0
Uncertainty in accepted power (validation measurement only)	0.0	N	1	1	1	0.0	0.0
Correction to the SAR results							
Phantom deviation from target (ε',σ)	1.9	N	1	1	0.84	1.9	1.6
SAR scaling	0.0	R	1.732	1	1	0.0	0.0
Combined Std. Uncertainty						**14.5%**	**14.4%**
Coverage Factor for 95 %						**K=2**	**K=2**
Expanded STD Uncertainty						**29.0%**	**28.8%**

SAR Uncertainty Budget for frequency range 4MHz to 10GHz

cDASY6 Module mmWave Uncertainty Budget Evaluation Distances to the Antennas > λ/2π In Compliance with IEC TR 63170					
Error Description	**Uncertainty Value (±dB)**	**Probability**	**Divisor**	**(Ci)**	**Standard Uncertainty (±dB)**
Uncertainty terms dep endent on the measurement system					
Probe Calibration	0.49	N	1	1	0.49
Probe correction	0.00	R	1.732	1	0.00
Frequency response	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 dependence	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**

PD Uncertainty Budget

18. References

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

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

[9] 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

[10] IEC 62479:2010 Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)

[11] IEC TR 63170: 2018 Measurement procedure for the evaluation of power density related to human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 100 GHz

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

[13] SPEAG DASY6 System Handbook

[14] SPEAG DASY6 Application Note (Interim Procedures for Devices Operating at 6-10 GHz)

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