FCC SAR Test Report

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

The product was tested inside of Lenovo Notebook Computer.

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.

Si Zhang

Approved by: Si Zhang

ilac-MRA 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
FA3N0713	01	Initial issue of report	Dec. 27, 2023

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Realtek Semiconductor Corp., 11ax RTL8852CE Combo module, RTL8852CE**, are as follows.

Equipment Class	Band	Reported SAR	Highest Simultaneous Transmission	Measured APD	Scaled PD
		Body (Separation 0mm) (1g SAR W/kg)	1g SAR (W/kg)	Body (W/m^2)	psPD (W/m^2)
DTS	2.4GHz WLAN	0.75	1.51		
NII	5GHz WLAN	**0.77**	1.51		
6CD	6GHz WLAN	0.67	1.50	4.58	6.76
DSS	Bluetooth	<0.10	1.50		
Date of Testing:		2023/11/14 ~ 2023/12/20			

Declaration of Conformity:
The test results with all measurement uncertainty excluded are 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		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR04-KS, SAR06-KS	CN1257	314309

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	11ax RTL8852CE Combo module
Brand Name	REALTEK
Model Name	RTL8852CE
FCC ID	TX2-RTL8852CE
S/N	Sample 1(INPAQ Ant): YX07TYK3 Sample 2(AWAN Ant): YX07TYMK
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3GHz Band: 5250 MHz ~ 5350 MHz WLAN 5.5GHz Band: 5470 MHz ~ 5725 MHz WLAN 5.8GHz Band: 5725 MHz ~ 5850 MHz WLAN 6GHz U-NII-5: 5925 MHz ~ 6425 MHz WLAN 6GHz U-NII-6: 6425 MHz ~ 6525 MHz WLAN 6GHz U-NII-7: 6525 MHz ~ 6875 MHz WLAN 6GHz U-NII-8: 6875 MHz ~ 7125 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz
Mode	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ac VHT20/VHT40 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80/VHT160 WLAN 5GHz 802.11ax HE20/HE40/HE80/HE160 WLAN 6GHz 802.11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE
Remark: 1. The EUT has no voice function. 2. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO and MIMO mode. 3. There are two samples under test, sample 1 with INPAQ antenna and sample 2 with AWAN antenna. According to the difference, sample 1/2 was all chosen to perform full SAR testing.	

Host Information	
Equipment Name	Notebook Computer
Brand Name	Lenovo
Model Name	Yoga Pro 7 14AHP9，Yoga Pro 7 14AHP9********(The"*"in model name can be 0 to 9,A to Z,a to z,"-", blank,or any symbol)
EUT Stage	Identical Prototype

5. RF Exposure Limits

5.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

5.3 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.

5.4 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/m2 or mW/cm2.

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

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

6. Specific Absorption Rate (SAR)

6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

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

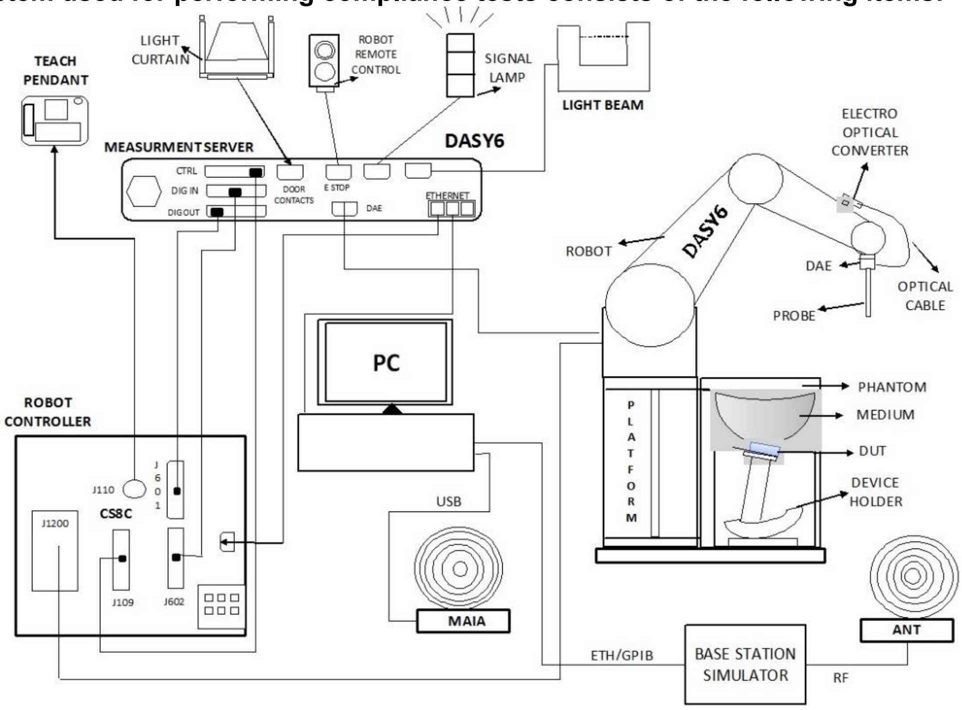
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

7. System Description and Setup

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



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win7 or Win10 and the DASY5 or DASY6[1] 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.
  Note: 1. DASY6 software used: DASY6 mmWave V3.0.0.841 and older generations and used the developed Plane-to-Plane Phase Reconstruction (PTP-PR) Algorithm which was used in PD measurement.

7.1 E-Field Probe

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

<EX3DV4 Probe>

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

7.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

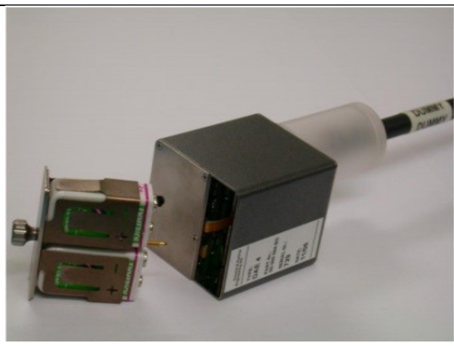


Photo of DAE

7.3 Phantom

<SAM Twin Phantom>

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

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

<ELI Phantom>

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

The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

7.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

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

Mounting Device for Hand-Held Transmitters

Mounting Device Adaptor for Wide-Phones

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

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

Mounting Device for Laptops

8. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

8.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

8.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

8.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

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

8.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

			$\leq$ 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.				

8.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	1040	2023/4/25	2024/4/24
SPEAG	5000MHz System Validation Kit	D5GHzV2	1113	2022/9/23	2025/9/22
SPEAG	6500MHz System Validation Kit	D6.5GHzV2	1031	2023/2/22	2024/2/21
SPEAG	5G Verification Source	10GHz	2005	2022/12/7	2023/12/6
SPEAG	Data Acquisition Electronics	DAE4	1358	2023/2/21	2024/2/20
SPEAG	Data Acquisition Electronics	DAE4	1338	2022/12/15	2023/12/14
SPEAG	Dosimetric E-Field Probe	EX3DV4	7764	2023/10/5	2024/10/4
SPEAG	EUmmWV Probe Tip Protection	EUmmWV4	9553	2023/10/18	2024/10/17
SPEAG	mmWave Phantom	mmWave	1065	NCR	NCR
SPEAG	ELI Phantom	ELI V8.0	TP-2134	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	2023/7/5	2024/7/4
Rohde & Schwarz	Signal Generator	SMB100A	100455	2023/1/5	2024/1/4
Keysight	Preamplifier	83017A	MY57280111	2023/7/5	2024/7/4
Rohde & Schwarz	Power Meter	NRVD	102081	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRP50S	101254	2023/4/6	2024/4/5
CHIGO	Thermo-Hygrometer	HTC-1	55011	2023/1/8	2024/1/7
TES	DIGITAC THERMOMETER	1310	220305411	2023/1/8	2024/1/7
R&S	BLUETOOTH TESTER	CBT	101246	2023/5/15	2024/5/14
Rohde & Schwarz	Spectrum Analyzer	FSV7	101631	2023/10/11	2024/10/10
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	
MCL	Attenuation1	BW-S10W5+	N/A	Note 1	
MCL	Attenuation2	BW-S10W5+	N/A	Note 1	
MCL	Attenuation3	BW-S10W5+	N/A	Note 1	
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	Note 1	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	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.

10. SAR System Verification

10.1 Tissue Simulating Liquids

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

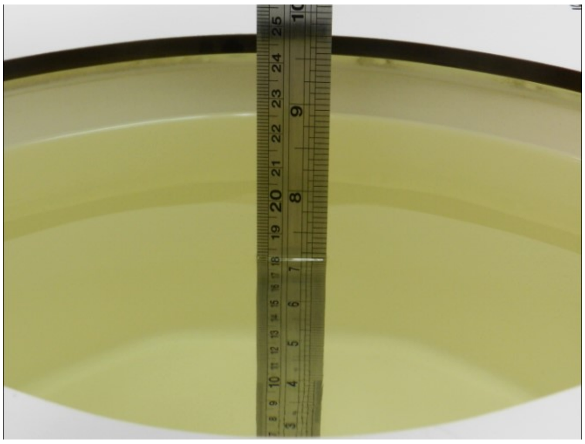


Fig 11.1 Photo of Liquid Height for Body SAR

10.2 Tissue Verification

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

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

Simulating Liquid for 5GHz, Manufactured by SPEAG

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

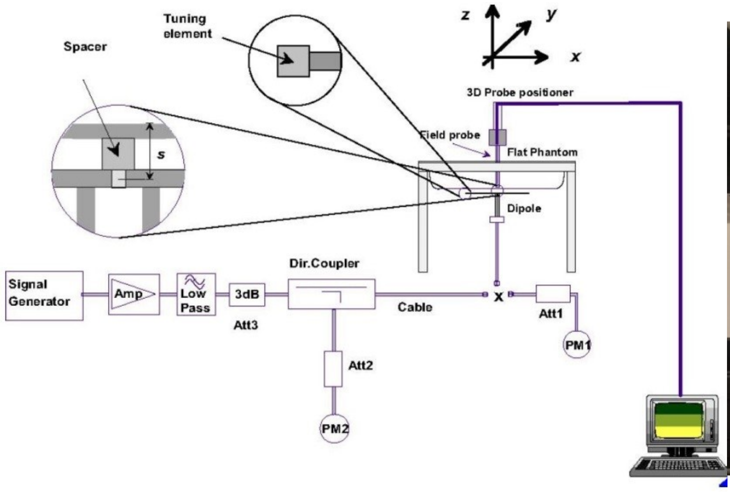
<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	Head	22.9	1.830	37.500	1.80	39.20	1.67	-4.34	±5	2023/11/14
6500	Head	22.6	6.140	35.100	6.07	34.50	1.15	1.74	±5	2023/11/18
5250	Head	22.8	4.570	36.000	4.71	35.90	-2.97	0.28	±5	2023/12/19
5600	Head	22.8	4.970	35.400	5.07	35.50	-1.97	-0.28	±5	2023/12/19
5750	Head	22.7	5.140	35.200	5.22	35.40	-1.53	-0.56	±5	2023/12/20

10.3 System Performance Check Results

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

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2023/11/14	2450	Head	50	1040	7764	1358	2.740	52.70	54.8	3.98
2023/11/18	6500	Head	50	1031	7764	1358	14.500	297.00	290	-2.36
2023/12/19	5250	Head	50	1113	7764	1358	4.140	81.50	82.8	1.60
2023/12/19	5600	Head	50	1113	7764	1358	4.420	82.60	88.4	7.02
2023/12/20	5750	Head	50	1113	7764	1358	4.210	80.80	84.2	4.21



System Performance Check Setup

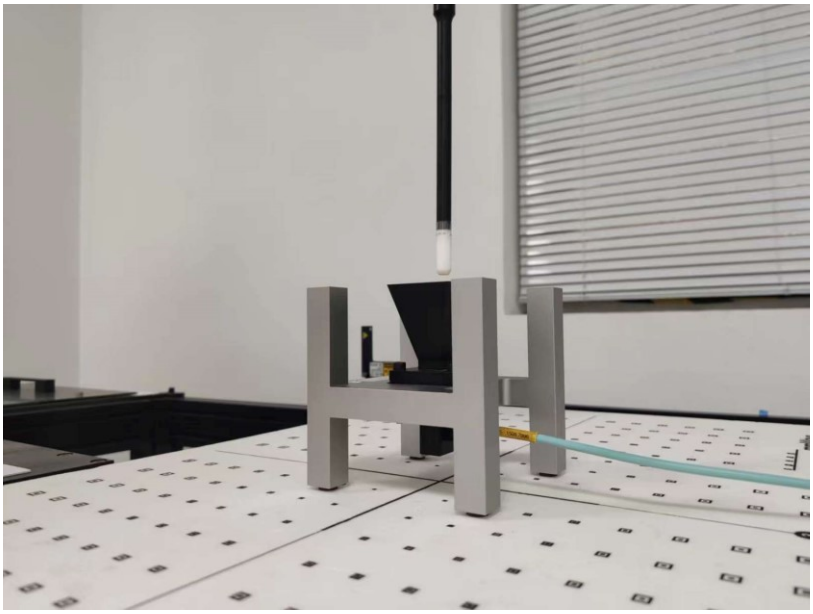
Setup Photo

10.4 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)	Input Power (mW)	Measured 4 cm^2 (W/m^2)	Normalized(1) 4 cm^2 (W/m^2)	Targeted 4 cm^2 (W/m^2)	Deviation (dB)	Date
10	10GHz_2005	9553	1338	10	62	57.1	142.1	150	-0.23	2023/11/21

Note: 1. Measured PD after normalized to Pard power with DASY Calibration Certificate in appendix C.



System Verification Setup Photo

11. RF Exposure Positions

11.1 SAR testing for Notebook Computer

For laptop PC, according to KDB 616217 D04, SAR evaluation is required for the bottom surface of the keyboard. This EUT was tested in the base of EUT directly against the flat phantom. The required minimum test separation distance for incorporating transmitters and antennas into laptop computer display is determined with the display screen opened at an angle of 90° to the keyboard compartment.

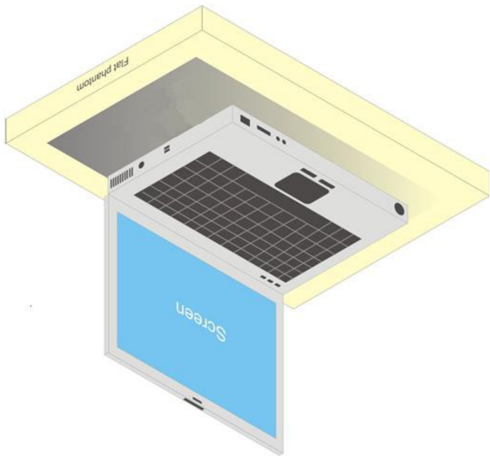


Illustration for Laptop Setup

<EUT Setup Photos>

Please refer to Appendix D for the test setup photos.

11.2 Miscellaneous Testing Considerations

- Evaluate SAR using 6-7 GHz parameters per IEC/IEEE 62209-1528:2020.
- Per procedures of KDB Pubs. 447498 and 248227
- 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)

12. Conducted RF Output Power (Unit: dBm)

<WLAN Conducted Power>

General Note:

1. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
2. Per KDB 248227 D01v02r02, 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. In applying the test guidance, the IEEE 802.11 mode with the maximum output power (out of all modes) should be considered for testing
9. 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

10. 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>

				Main Ant			Aux Ant			MIMO		
	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	20.30	20.50	100.00	20.35	20.50	100.00	Not Required	23.50	Not Required
		6	2437	20.44	20.50		20.82	21.00			23.50	
		11	2462	19.13	19.50		19.01	19.50			22.50	
		12	2467	12.07	12.50		12.57	13.00			15.50	
		13	2472	5.97	6.00		6.09	6.50			9.00	
	802.11g 6Mbps	1	2412	Not Required	18.00	Not Required	Not Required	18.00	Not Required		21.00	
		6	2437		20.50			21.00			23.50	
		11	2462		17.00			17.00			20.00	
		12	2467		17.00			17.00			20.00	
		13	2472		11.00			11.00			14.00	
	802.11n-HT20 MCS0	1	2412		18.00			18.00			21.00	
		6	2437		20.50			21.00			23.50	
		11	2462		17.00			17.00			20.00	
		12	2467		17.00			17.00			20.00	
		13	2472		6.00			6.00			9.00	
	802.11n-HT40 MCS0	3	2422		17.00			17.00			20.00	
		6	2437		17.00			17.00			20.00	
		9	2452		16.00			16.00			19.00	
		10	2457		16.00			16.00			19.00	
		11	2462		13.00			13.00			16.00	
	802.11ac-VHT20 MCS0	1	2412		18.00			18.00			21.00	
		6	2437		20.50			21.00			23.50	
		11	2462		17.00			17.00			20.00	
		12	2467		17.00			17.00			20.00	
		13	2472		6.00			6.00			9.00	
	802.11ac-VHT40 MCS0	3	2422		17.00			17.00			20.00	
		6	2437		17.00			17.00			20.00	
		9	2452		16.00			16.00			19.00	
		10	2457		16.00			16.00			19.00	
		11	2462		13.00			13.00			16.00	
	802.11ax-HE20 MCS0	1	2412		18.00			18.00			21.00	
		6	2437		20.50			21.00			23.50	
		11	2462		17.00			17.00			20.00	
		12	2467		17.00			17.00			20.00	
		13	2472		6.00			6.00			9.00	
	802.11ax-HE40 MCS0	3	2422		17.00			17.00			20.00	
		6	2437		17.00			17.00			20.00	
		9	2452		16.00			16.00			19.00	
		10	2457		16.00			16.00			19.00	
		11	2462		13.00			13.00			16.00	

<5.2GHz WLAN>

				Main Ant			Aux Ant			MIMO		
	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	17.50	Not Required	Not Required	17.50	Not Required	Not Required	20.50	Not Required
		40	5200		17.50			17.50			20.50	
		44	5220		17.50			17.50			20.50	
		48	5240		17.50			17.50			20.50	
	802.11n-HT20 MCS0	36	5180		17.50			17.50			20.50	
		40	5200		17.50			17.50			20.50	
		44	5220		17.50			17.50			20.50	
		48	5240		17.50			17.50			20.50	
	802.11n-HT40 MCS0	38	5190		16.00			16.00			19.00	
		46	5230		17.50			17.50			20.50	
	802.11ac-VHT20 MCS0	36	5180		17.50			17.50			20.50	
		40	5200		17.50			17.50			20.50	
		44	5220		17.50			17.50			20.50	
		48	5240		17.50			17.50			20.50	
	802.11ac-VHT40 MCS0	38	5190		16.00			16.00			19.00	
		46	5230		17.50			17.50			20.50	
	802.11ac-VHT80 MCS0	42	5210		15.00			15.00			18.00	
	802.11ax-HE20 MCS0	36	5180		17.50			17.50			20.50	
		40	5200		17.50			17.50			20.50	
		44	5220		17.50			17.50			20.50	
		48	5240		17.50			17.50			20.50	
	802.11ax-HE40 MCS0	38	5190		16.00			16.00			19.00	
		46	5230		17.50			17.50			20.50	
	802.11ax-HE80 MCS0	42	5210		15.00			15.00			18.00	

<5.3GHz WLAN>

				Main Ant			Aux Ant			MIMO		
	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	17.50	Not Required	Not Required	17.50	Not Required	Not Required	20.50	Not Required
		56	5280		17.50			17.50			20.50	
		60	5300		17.50			17.50			20.50	
		64	5320		17.50			17.50			20.50	
	802.11n-HT20 MCS0	52	5260		17.50			17.50			20.50	
		56	5280		17.50			17.50			20.50	
		60	5300		17.50			17.50			20.50	
		64	5320		17.50			17.50			20.50	
	802.11n-HT40 MCS0	54	5270	16.96	17.50	98.77	17.37	17.50	98.77		20.50	
		62	5310	14.96	16.00		15.54	16.00			19.00	
	802.11ac-VHT20 MCS0	52	5260	Not Required	17.50	Not Required	Not Required	17.50	Not Required		20.50	
		56	5280		17.50			17.50			20.50	
		60	5300		17.50			17.50			20.50	
		64	5320		17.50			17.50			20.50	
	802.11ac-VHT40 MCS0	54	5270		17.50			17.50			20.50	
		62	5310		16.00			16.00			19.00	
	802.11ac-VHT80 MCS0	58	5290		12.50			12.50			15.50	
	802.11ac-VHT160 MCS0	50	5250		8.00			8.00			11.00	
	802.11ax-HE20 MCS0	52	5260		17.50			17.50			20.50	
		56	5280		17.50			17.50			20.50	
		60	5300		17.50			17.50			20.50	
		64	5320		17.50			17.50			20.50	
	802.11ax-HE40 MCS0	54	5270		17.50			17.50			20.50	
		62	5310		16.00			16.00			19.00	
	802.11ax-HE80 MCS0	58	5290		12.50			12.50			15.50	
	802.11ax-HE160 MCS0	50	5250		8.00			8.00			11.00	

<5.5GHz WLAN>												
				Main Ant			Aux Ant			MIMO		
	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 %
5.5GHz WLAN	802.11a 6Mbps	100	5500	Not Required	17.00	Not Required	Not Required	16.00	Not Required	Not Required	19.50	Not Required
		116	5580		17.00			16.00			19.50	
		124	5620		17.00			16.00			19.50	
		132	5660		17.00			16.00			19.50	
		140	5700		16.00			16.00			19.00	
		144	5720		17.00			16.00			19.50	
	802.11n-HT20 MCS0	100	5500		17.00			16.00			19.50	
		116	5580		17.00			16.00			19.50	
		124	5620		17.00			16.00			19.50	
		132	5660		17.00			16.00			19.50	
		140	5700		15.00			15.00			18.00	
		144	5720		17.00			16.00			19.50	
	802.11n-HT40 MCS0	102	5510		16.00			16.00			19.00	
		110	5550		17.00			16.00			19.50	
		126	5630		17.00			16.00			19.50	
		134	5670		16.00			16.00			19.00	
		142	5710		17.00			16.00			19.50	
	802.11ac-VHT20 MCS0	100	5500		17.00			16.00			19.50	
		116	5580		17.00			16.00			19.50	
		124	5620		17.00			16.00			19.50	
		132	5660		17.00			16.00			19.50	
		140	5700		15.00			15.00			18.00	
		144	5720		17.00			16.00			19.50	
	802.11ac-VHT40 MCS0	102	5510		16.00			16.00			19.00	
		110	5550		17.00			16.00			19.50	
		126	5630		17.00			16.00			19.50	
		134	5670		16.00			16.00			19.00	
		142	5710		17.00			16.00			19.50	
	802.11ac-VHT80 MCS0	106	5530	14.07	16.00	97.58	14.02	16.00	97.58		19.00	
		122	5610	14.57	16.00		14.57	16.00			19.00	
		138	5690	16.49	17.00		15.71	16.00			19.50	
	802.11ac-VHT160 MCS0	114	5570	Not Required	11.00	Not Required	Not Required	12.00	Not Required		14.50	
	802.11ax-HE20 MCS0	100	5500		17.00			16.00			19.50	
		116	5580		17.00			16.00			19.50	
		124	5620		17.00			16.00			19.50	
		132	5660		17.00			16.00			19.50	
		140	5700		15.00			15.00			18.00	
		144	5720		17.00			16.00			19.50	
	802.11ax-HE40 MCS0	102	5510		17.00			16.00			19.50	
		110	5550		17.00			16.00			19.50	
		126	5630		17.00			16.00			19.50	
		134	5670		17.00			16.00			19.50	
		142	5710		17.00			16.00			19.50	
	802.11ax-HE80 MCS0	106	5530		16.00			16.00			19.00	
		122	5610		16.00			16.00			19.00	
		138	5690		17.00			16.00			19.50	
	802.11ax-HE160 MCS0	114	5570		11.00			12.00			14.50	

<5.8GHz WLAN>

				Main Ant			Aux Ant			MIMO		
	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	17.50	Not Required	Not Required	17.00	Not Required	Not Required	20.00	Not Required
		157	5785		17.50			17.00			20.00	
		165	5825		17.50			17.00			20.00	
	802.11n-HT20 MCS0	149	5745		17.50			17.00			20.00	
		157	5785		17.50			17.00			20.00	
		165	5825		17.50			17.00			20.00	
	802.11n-HT40 MCS0	151	5755		17.50			17.00			20.00	
		159	5795		17.50			17.00			20.00	
	802.11ac-VHT20 MCS0	149	5745		17.50			17.00			20.00	
		157	5785		17.50			17.00			20.00	
		165	5825		17.50			17.00			20.00	
	802.11ac-VHT40 MCS0	151	5755		17.50			17.00			20.00	
		159	5795		17.50			17.00			20.00	
	802.11ac-VHT80 MCS0	155	5775	16.51	17.50	97.58	16.63	17.00	97.58		20.00	
	802.11ax-HE20 MCS0	149	5745	Not Required	17.50	Not Required	Not Required	17.00	Not Required		20.00	
		157	5785		17.50			17.00			20.00	
		165	5825		17.50			17.00			20.00	
	802.11ax-HE40 MCS0	151	5755		17.50			17.00			20.00	
		159	5795		17.50			17.00			20.00	
	802.11ax-HE80 MCS0	155	5775		17.50			17.00			20.00	

<WiFi 6E>

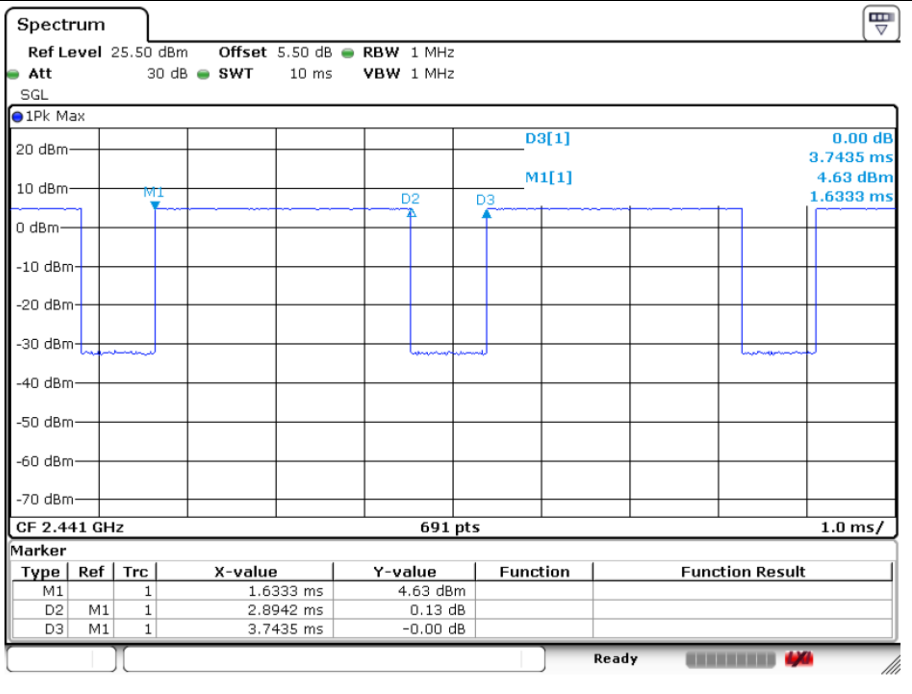
				Main Ant			Aux Ant			MIMO		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %
WiFi 6E	802.11ax-HE20 MCS0	1	5955	Not Required	13.50	Not Required	Not Required	13.00	Not Required	Not Required	16.00	Not Required
		57	6235		16.00			15.50			18.50	
		113	6515		9.50			9.00			12.00	
		173	6815		17.00			17.00			20.00	
		233	7115		9.50			9.50			12.50	
	802.11ax-HE40 MCS0	3	5965		13.50			13.00			16.00	
		59	6245		16.00			15.50			18.50	
		107	6485		9.50			9.00			12.00	
		171	6805		17.00			17.00			20.00	
		227	7085		9.50			9.50			12.50	
	802.11ax-HE80 MCS0	7	5985		13.50			13.00			16.00	
		71	6305		16.00			15.50			18.50	
		119	6545		9.50			9.00			12.00	
		167	6785		17.00			17.00			20.00	
		215	7025		9.50			9.50			12.50	
	802.11ax-HE160 MCS0	15	6025	13.33	13.50	95.00	12.96	13.00	95.00		16.00	
		47	6185	15.91	16.00		15.11	15.50			18.50	
		111	6505	9.05	9.50		8.79	9.00			12.00	
		143	6665	16.69	17.00		16.80	17.00			20.00	
		207	6985	9.24	9.50		9.32	9.50			12.50	

<2.4GHz Bluetooth>

General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps, due to its highest average power.
2. The Bluetooth duty cycle is 77.31 % 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



Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	11.91	Not Required	Not Required
	CH 39	2441	11.99		
	CH 78	2480	11.86		
Tune-up Limit			12.50	10.00	10.00

Mode	Channel	Frequency (MHz)	Average power (dBm)	
			1Mbps	2Mbps
LE	CH 01	2404	Not Required	Not Required
	CH 19	2440		
	CH 38	2478		
Tune-up Limit			12.50	12.50

13. Antenna Location

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

14. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN/Bluetooth 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.
4. For WLAN6GHz 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 4cm^2 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. 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. So WLAN SAR testing was performed on SISO antenna, MIMO SAR base on standalone SAR summed together as MIMO SAR.
6. During SAR testing the WLAN transmission was verified using a spectrum analyzer.
7. 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.

14.1 Body SAR Test Result

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Antenna Type	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 Face	0mm	Main Ant	6	2437	INPAQ Ant	20.44	20.50	1.014	100	1.000	0.07	0.713	0.723
	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	0mm	Main Ant	6	2437	AWAN Ant	20.44	20.50	1.014	100	1.000	0.06	0.493	0.500
	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	0mm	Aux Ant	6	2437	INPAQ Ant	20.82	21.00	1.042	100	1.000	-0.09	0.685	0.714
01	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	0mm	Aux Ant	6	2437	AWAN Ant	20.82	21.00	1.042	100	1.000	0.01	0.717	0.747
	Bluetooth	1Mbps	Bottom Face	0mm	Main Ant	39	2441	INPAQ Ant	11.99	12.50	1.125	77.31	1.293	0.05	0.059	0.086
02	Bluetooth	1Mbps	Bottom Face	0mm	Main Ant	39	2441	AWAN Ant	11.99	12.50	1.125	77.31	1.293	0.05	0.062	0.090
03	WLAN5.3GHz	802.11n-HT40 MCS0	Bottom Face	0mm	Main Ant	54	5270	INPAQ Ant	16.96	17.50	1.132	98.77	1.012	0.09	0.668	0.766
	WLAN5.3GHz	802.11n-HT40 MCS0	Bottom Face	0mm	Main Ant	62	5310	INPAQ Ant	14.96	16.00	1.271	98.77	1.012	0.04	0.327	0.420
	WLAN5.3GHz	802.11n-HT40 MCS0	Bottom Face	0mm	Main Ant	54	5270	AWAN Ant	16.96	17.50	1.132	98.77	1.012	0.08	0.457	0.524
	WLAN5.3GHz	802.11n-HT40 MCS0	Bottom Face	0mm	Aux Ant	54	5270	INPAQ Ant	17.37	17.50	1.030	98.77	1.012	0.03	0.605	0.631
	WLAN5.3GHz	802.11n-HT40 MCS0	Bottom Face	0mm	Aux Ant	54	5270	AWAN Ant	17.37	17.50	1.030	98.77	1.012	-0.08	0.523	0.545
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Main Ant	138	5690	INPAQ Ant	16.49	17.00	1.125	97.58	1.025	0.1	0.614	0.708
04	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Main Ant	138	5690	AWAN Ant	16.49	17.00	1.125	97.58	1.025	0.01	0.623	0.718
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Aux Ant	138	5690	INPAQ Ant	15.71	16.00	1.069	97.58	1.025	-0.04	0.587	0.643
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Aux Ant	138	5690	AWAN Ant	15.71	16.00	1.069	97.58	1.025	-0.18	0.432	0.473
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Main Ant	155	5775	INPAQ Ant	16.51	17.50	1.256	97.58	1.025	0.1	0.452	0.582
05	WLAN5.8GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Main Ant	155	5775	AWAN Ant	16.51	17.50	1.256	97.58	1.025	0.04	0.574	0.739
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Aux Ant	155	5775	INPAQ Ant	16.63	17.00	1.089	97.58	1.025	-0.09	0.505	0.564
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Bottom Face	0mm	Aux Ant	155	5775	AWAN Ant	16.63	17.00	1.089	97.58	1.025	-0.08	0.503	0.561

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Antenna Type	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-HE160 MCS0	Bottom Face	0mm	Main Ant	15	6025	INPAQ Ant	13.33	13.50	1.040	95	1.053	-0.05	0.395	0.433	2.98
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Main Ant	47	6185	INPAQ Ant	15.91	16.00	1.021	95	1.053	0.06	0.600	0.645	4.23
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Main Ant	111	6505	INPAQ Ant	9.05	9.50	1.109	95	1.053	-0.09	0.096	0.112	0.653
06	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Main Ant	143	6665	INPAQ Ant	16.69	17.00	1.074	95	1.053	-0.04	0.588	0.665	4.58
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Main Ant	207	6985	INPAQ Ant	9.24	9.50	1.062	95	1.053	-0.09	0.085	0.095	0.649
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Main Ant	15	6025	AWAN Ant	13.33	13.50	1.040	95	1.053	0.02	0.315	0.345	2.44
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Main Ant	47	6185	AWAN Ant	15.91	16.00	1.021	95	1.053	0.02	0.571	0.614	4.51
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Main Ant	111	6505	AWAN Ant	9.05	9.50	1.109	95	1.053	0.08	0.100	0.117	0.715
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Main Ant	143	6665	AWAN Ant	16.69	17.00	1.074	95	1.053	0.06	0.379	0.429	2.94
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Main Ant	207	6985	AWAN Ant	9.24	9.50	1.062	95	1.053	0.05	0.033	0.037	0.224
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	15	6025	INPAQ Ant	12.96	13.00	1.009	95	1.053	0.06	0.164	0.174	1.25
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	47	6185	INPAQ Ant	15.11	15.50	1.094	95	1.053	0.05	0.558	0.643	4.52
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	111	6505	INPAQ Ant	8.79	9.00	1.050	95	1.053	0.07	0.096	0.106	0.737
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	143	6665	INPAQ Ant	16.80	17.00	1.047	95	1.053	0.02	0.414	0.456	3.19
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	207	6985	INPAQ Ant	9.32	9.50	1.042	95	1.053	-0.05	0.113	0.124	0.728
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	15	6025	AWAN Ant	12.96	13.00	1.009	95	1.053	0.02	0.211	0.224	1.57
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	47	6185	AWAN Ant	15.11	15.50	1.094	95	1.053	0.03	0.467	0.538	3.63
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	111	6505	AWAN Ant	8.79	9.00	1.050	95	1.053	0.04	0.089	0.098	0.581
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	143	6665	AWAN Ant	16.80	17.00	1.047	95	1.053	0.02	0.572	0.631	4.55
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	0mm	Aux Ant	207	6985	AWAN Ant	9.32	9.50	1.042	95	1.053	0.05	0.064	0.070	0.539

14.2 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. The WiFi 6GHz PD was performed according 2020 TCB workshop RF Exposure 5G RFX Policies Interim Procedures.
8. First, evaluate SAR using 6-7 GHz parameters per IEC/EEE 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)
9. Per October 2020 TCB Workshop, for distances smaller than λ/5, used the developed Plane-to-Plane Phase Reconstruction (PTP-PR) Algorithm which was used in PD measurement.
10. 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.
11. 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>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Antenna Type	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-HE160 MCS0	Bottom Face	2mm	Aux Ant	AWAN Ant	15	6025	12.96	0.0625	0.883	0.71	1.370	1.440
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	10mm	Aux Ant	AWAN Ant	15	6025	12.96	0.15	0.749		0.895	0.967
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	AWAN Ant	207	6985	9.32	0.0625	0.614	0.73	0.356	0.382
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	8.59mm	Aux Ant	AWAN Ant	207	6985	9.32	0.15	0.519		0.199	0.277

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Antenna Type	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-HE160 MCS0	Bottom Face	2mm	Main Ant	INPAQ Ant	15	6025	13.33	13.50	1.040	95	1.053	0.0625	1.5535	-0.12	2.890	4.92	2.770	4.71
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Main Ant	INPAQ Ant	47	6185	15.91	16.00	1.021	95	1.053	0.0625	1.5535	-0.01	2.460	4.11	2.990	4.99
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Main Ant	INPAQ Ant	111	6505	9.05	9.50	1.109	95	1.053	0.0625	1.5535	0.01	0.150	0.27	0.161	0.29
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Main Ant	INPAQ Ant	143	6665	16.69	17.00	1.074	95	1.053	0.0625	1.5535	0.13	2.820	4.95	3.030	5.32
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Main Ant	INPAQ Ant	207	6985	9.24	9.50	1.062	95	1.053	0.0625	1.5535	-0.07	0.558	0.97	0.596	1.04
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	INPAQ Ant	15	6025	12.96	13.00	1.009	95	1.053	0.0625	1.5535	-0.01	1.090	1.80	1.290	2.13
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	INPAQ Ant	47	6185	15.11	15.50	1.094	95	1.053	0.0625	1.5535	-0.01	3.180	5.69	3.730	6.67
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	INPAQ Ant	111	6505	8.79	9.00	1.050	95	1.053	0.0625	1.5535	0.05	0.730	1.25	0.815	1.40
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	INPAQ Ant	143	6665	16.80	17.00	1.047	95	1.053	0.0625	1.5535	0.08	3.060	5.24	3.470	5.94
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	INPAQ Ant	207	6985	9.32	9.50	1.042	95	1.053	0.0625	1.5535	0.07	0.473	0.81	0.560	0.95
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Main Ant	AWAN Ant	15	6025	13.33	13.50	1.040	95	1.053	0.0625	1.5535	-0.01	1.610	2.74	1.810	3.08
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Main Ant	AWAN Ant	47	6185	15.91	16.00	1.021	95	1.053	0.0625	1.5535	0.04	2.850	4.76	3.290	5.49
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Main Ant	AWAN Ant	111	6505	9.05	9.50	1.109	95	1.053	0.0625	1.5535	-0.03	0.104	0.19	0.107	0.19
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Main Ant	AWAN Ant	143	6665	16.69	17.00	1.074	95	1.053	0.0625	1.5535	-0.09	1.940	3.41	2.260	3.97
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Main Ant	AWAN Ant	207	6985	9.24	9.50	1.062	95	1.053	0.0625	1.5535	0.05	0.344	0.60	0.362	0.63
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	AWAN Ant	15	6025	12.96	13.00	1.009	95	1.053	0.0625	1.5535	0.04	1.370	2.26	1.440	2.38
01	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	AWAN Ant	47	6185	15.11	15.50	1.094	95	1.053	0.0625	1.5535	-0.19	3.440	6.16	3.780	6.76
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	AWAN Ant	111	6505	8.79	9.00	1.050	95	1.053	0.0625	1.5535	0.06	0.386	0.66	0.411	0.71
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	AWAN Ant	143	6665	16.80	17.00	1.047	95	1.053	0.0625	1.5535	-0.14	3.210	5.50	3.820	6.54
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom Face	2mm	Aux Ant	AWAN Ant	207	6985	9.32	9.50	1.042	95	1.053	0.0625	1.5535	0.08	0.356	0.61	0.382	0.65

15. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Notebook Computer
		Body
1.	WLAN 2.4GHz Main Ant + WLAN 2.4GHz Aux Ant	Yes
2.	WLAN 2.4GHz Main Ant + WLAN 5GHz Aux Ant	Yes
3.	WLAN 2.4GHz Aux Ant + WLAN 5GHz Main Ant	Yes
4.	WLAN 2.4GHz Main Ant + WLAN 6GHz Aux Ant	Yes
5.	WLAN 2.4GHz Aux Ant + WLAN 6GHz Main Ant	Yes
6.	WLAN 5GHz Main Ant + WLAN 5GHz Aux Ant + Bluetooth Main Ant	Yes
7.	WLAN 6GHz Main Ant + WLAN 6GHz Aux Ant + Bluetooth Main Ant	Yes
8.	WLAN 5GHz Main Ant + WLAN 6GHz Aux Ant + Bluetooth Main Ant	Yes
9.	WLAN 5GHz Aux Ant + WLAN 6GHz Main Ant + Bluetooth Main Ant	Yes

Note:

1. The EUT has no voice function means data only.
2. According to the EUT characteristic, WLAN 5GHz/6GHz and Bluetooth can transmit simultaneously.
3. According to the EUT characteristic, WLAN 2.4GHz and Bluetooth cannot transmit simultaneously.
4. According to the EUT characteristic, WLAN 2.4GHz and WLAN 5GHz/6GHz can transmit simultaneously.
5. According to the EUT characteristic, WLAN 5GHz and WLAN 6GHz can transmit simultaneously.
6. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO/MIMO antenna mode and MIMO SAR base on standalone SAR summed together as MIMO SAR
7. The worst case 5 GHz WLAN SAR for each configuration was used for SAR summation.
8. The maximum SAR summation is calculated based on the same configuration and test position.
9. 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.
10. The WLAN6GHz Sim-Tx analysis guidance with other transmitters was based on SAR test results. The simultaneous transmission and test exemption analysis were compliant with KDB 447498 D01. For the device does not support FR2 or other MPE field measurement, therefore section 15 in the SAR report has no TER analysis according to KDB 987594 requirement.

15.1 Body Exposure Conditions

Exposure Position	1	2	3	4	5	6	7	1+2	1+4	2+3	1+7	2+6	3+4+5	5+6+7	3+5+7	4+5+6
	WLAN2.4GHz Main Ant	WLAN2.4GHz Aux Ant	WLAN5GHz Main Ant	WLAN5GHz Aux Ant	Bluetooth Main Ant	WLAN6GHz Main Ant	WLAN6GHz Aux Ant	Summed	Summed	Summed	Summed	Summed	Summed	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)	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	0.723	0.747	0.766	0.643	0.090	0.665	0.643	1.47	1.37	**1.51**	1.37	1.41	**1.50**	1.40	**1.50**	1.40

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

16. Uncertainty Assessment

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/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 (Frequency band: 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
Probe Calibration Drift	1.00	N	1	1	1	1.0	1.0
Probe Linearity	4.70	R	1.732	1	1	2.7	2.7
Broadband Signal	3.00	N	1	1	1	3.0	3.0
Probe Isotropy	7.60	R	2	1	1	3.8	3.8
Data Acquisition	0.30	N	1.732	1	1	0.2	0.2
RF Ambient	1.80	N	1	1	1	1.8	1.8
Probe Positioning	0.20	N	1	0.33	0.33	0.1	0.1
Data Processing	3.50	N	1	1	1	3.5	3.5
Phantom and Device Errors							
Conductivity (meas.) DAK	2.50	N	1	0.78	0.71	2.0	1.8
Conductivity (temp.) BB	5.40	R	1.732	0.78	0.71	2.4	2.2
Phantom Permittivity	14.00	R	1.732	0.5	0.5	4.0	4.0
Distance DUT - TSL	2.00	N	1	2	2	4.0	4.0
Device Holder	3.60	N	1	1	1	3.6	3.6
DUT Modulationm	2.40	R	1.732	1	1	1.4	1.4
Time-average SAR	2.60	R	1.732	1	1	1.5	1.5
DUT drift	5.00	N	1	1	1	5.0	5.0
Correction to the SAR results							
Deviation to Target	1.90	N	1	1	0.84	1.9	1.6
SAR scalingp	0.00	R	1.732	1	1	0.0	0.0
Combined Std. Uncertainty						14.9%	14.8%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						29.8%	29.6%

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 (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

PD Uncertainty Budget

17. References

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

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

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

[4] SPEAG DASY System Handbook

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

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

[9] FCC KDB 616217 D04 v01r02, "SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers", 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] 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)

[12] 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

[13] SPEAG DASY6 System Handbook

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

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