

Prüfbericht-Nr.: Test report no.:	CN229XMY(FCC SAR)001	Auftrags-Nr.: Order no.:	238549005	Seite 1 von 37 Page 1 of 37
Kunden-Referenz-Nr.: Client reference no.:	N/A	Auftragsdatum: Order date:	2022-10-21	
Auftraggeber: Client:	TP-Link Corporation Limited Room 901, 9/F., New East Ocean Centre, 9 Science Museum Road, Tsim Sha Tsui, Kowloon, Hong Kong			
Prüfgegenstand: Test item:	AX1800 High Gain Wireless USB Adapter			
Bezeichnung / Typ-Nr.: Identification / Type no.:	Archer TX20UH			
Auftrags-Inhalt: Order content:	Test Report for FCC SAR			
Prüfgrundlage: Test specification:	FCC 47 CFR §2.1093 ANSI Std C95.1 IEEE Std 1528:2013 IEC/IEEE 62209-1528:2020 Published RF Exposure KDB Procedures			
Wareneingangsdatum: Date of sample receipt:	2022-10-13			
Prüfmuster-Nr.: Test sample no.:	A003354860-001			
Prüfzeitraum: Testing period:	2022-10-15 - 2022-10-16			
Ort der Prüfung: Place of testing:	EMC/RF Taipei Testing Site			
Prüflaboratorium: Testing laboratory:	Taipei Testing Laboratories			
Prüfergebnis*: Test result*:	Pass			
überprüft von: compiled by:			genehmigt von: authorized by:	
Datum: Date:	2022-10-20	Morrison Huang Project Engineer	Ausstellungsdatum: Issue date:	2022-10-20
Stellung / Position:			Stellung / Position:	Ryan Chen Senior Project Manager
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:		Prüfmuster vollständig und unbeschädigt Test item complete and undamaged		
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend N/A = nicht anwendbar	4 = ausreichend N/T = nicht getestet
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory N/A = not applicable	4 = sufficient N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

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HISTORY OF THIS TEST REPORT

Report No.	Description	Date Issued
CN229XMY(FCC SAR)001	Original Release	2022-10-20

1. General Information

1.1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for the EUT are as follows:

Operating Mode	Highest Body SAR _{1g} (W/kg)
2.4G WLAN	1.188
5.25G WLAN	1.078
5.6G WLAN	1.140
5.8G WLAN	1.113

Note:

The maximum results of Specific Absorption Rate (SAR) found during testing for the EUT are as follows:
This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6W/kg as averaged over any 1 gram of tissue; 10-gram SAR for Product Specific 10g SAR, limit: 4.0W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

1.2 Equipment Under Test (EUT) Information

1.2.1 General Information

EUT Type	AX1800 High Gain Wireless USB Adapter				
Brand Name	tp-link				
Model Name	Archer TX20UH				
FCC ID	2AXJ4TX20UH				
Test Channels	1-6-11 (2.4G WiFi 802.11b/g/n HT20/ax HE20)				
	3-6-9 (2.4G WiFi 802.11n HT40/ax HE40)				
	Band	5.2G WiFi	5.3G WiFi	5.6G WiFi	5.8G WiFi
	802.11a/nHT20/ac/VHT20/ax HE20	36-40-44-48	52-56-60-64	100-104-108-112-116-132-136-140	149-153-157-161-165
	802.11n HT40/ac VHT40/ax HE40	38-46	54-62	102-110-118-126-134	151-159
Antenna Gain:	802.11ac VHT80/ax HE80	42	58	106-122	155
	WLAN2.4G	Ant0: 0.61dBi		Ant1: 0.74dBi	
	WLAN5G	Ant0: 2dBi		Ant1: 2dBi	

1.2.2 Wireless Technologies

Tx Frequency Bands (Unit: MHz)	WLAN 2.4GHz Band: 2400 MHz ~ 2483.5 MHz WLAN U-NII 1: 5150 MHz ~ 5250 MHz WLAN U-NII 2: 5250 MHz ~ 5350 MHz WLAN U-NII 3: 5470 MHz ~ 5725 MHz WLAN U-NII 4: 5725 MHz ~ 5850 MHz
Uplink Modulations	802.11b:DSSS 802.11a/g/n/ac:OFDM 802.11ax:OFDMA

Note:

- The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

1.3 Maximum Conducted Power

The maximum conducted average power (Unit: dBm) including tune-up tolerance is shown as below.

Mode	2.4G WLAN	5.2G WLAN	5.3G WLAN	5.6G WLAN	5.8G WLAN
802.11b	18	N/A	N/A	N/A	N/A
802.11g	18	N/A	N/A	N/A	N/A
802.11a	N/A	15	15	15	16
802.11n HT20	18	15	15	15	16
802.11n HT40	18	15	15	15	16
802.11ac VHT20	N/A	15	15	15	16
802.11ac VHT40	N/A	15	15	15	16
802.11ac VHT80	N/A	15	15	15	16
802.11aX HE20	18	15	15	15	16
802.11ax HE40	18	15	15	15	16
802.11ax HE80	N/A	15	15	15	16

2. Test Sites

2.1 Test Laboratory

Taipei Testing Laboratories

11F., No. 758, Sec. 4, Bade Rd., Songshan Dist., Taipei City 105 Taiwan (R.O.C.)

2.2 Test Facilities

Taipei Testing Laboratories

No. 458-18, Sec. 2, Fenliao Rd., Linkou Dist., New Taipei City 244 Taiwan (R.O.C.)

The tests at the test sites have been conducted under the supervision of a TÜV engineer.

2.3 List of Test and Measurement Instruments

<i>Equipment</i>	<i>Manufacturer</i>	<i>Model</i>	<i>SN</i>	<i>Cal. Date</i>	<i>Cal. Interval</i>
Data Acquisition Electronics	SPEAG	DAE4	855	Apr. 21, 2022	1 year
E-Field Probe	SPEAG	EX3DV4	7400	Apr. 29, 2022	1 year
System Validation Dipole	SPEAG	D2450V2	804	Mar. 24, 2022	1 year
System Validation Dipole	SPEAG	D5GV2	1235	Mar. 28, 2022	1 year
Signal Analyzer	R&S	FSV40	101502	Feb. 24, 2022	1 year
Signal Generator	R&S	SMB100A03	181334	Feb. 25, 2022	1 year
Power Meter	Anritsu	ML2495A	1901008	Mar. 15, 2022	1 year
Power Sensor	Anritsu	MA2411B	1725269	Mar. 15, 2022	1 year
Power Sensor	R&S	SMB100A03	181334	Feb. 25, 2022	1 year
Directional coupler	Fairview microwave	FMCP1025-20	A000553136-001	N/A	N/A
Power Amplifier Mini circuit	mini-circuits	ZHL-42W	SN002101809	N/A	N/A
Power Amplifier Mini circuit	Emci	EMC2830P	980352	N/A	N/A
Digital Thermometer	Testo	608-H1	45197159	Nov. 26, 2021	1 year
Dielectric assessment Kit	SPEAG	DAK-3.5	1292	N/A	N/A
Phantom	SPEAG	SAM-Twin V5.0	1467	N/A	N/A

3. Measurement Uncertainty

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A 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) k 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.

Per KDB865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. The equivalent ratio (1.5/1.6) is applied to extremity and occupational exposure conditions.

4. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR §2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures & manufacturer KDB inquiries:

- KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- KDB 447498 D04 Interim General RF Exposure Guidance v01
- KDB 447498 D02 SAR Procedures for Dongle Xmtr v02r01
- KDB 690783 D01 SAR Listings on Grants v01r03

5. RF Exposure Limits

5.1 Uncontrolled Environment

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

5.2 Controlled Environment

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

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is average over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

6. SAR Measurement System

6.1 Definition of Specific Absorption Rate (SAR)

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.

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:

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

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

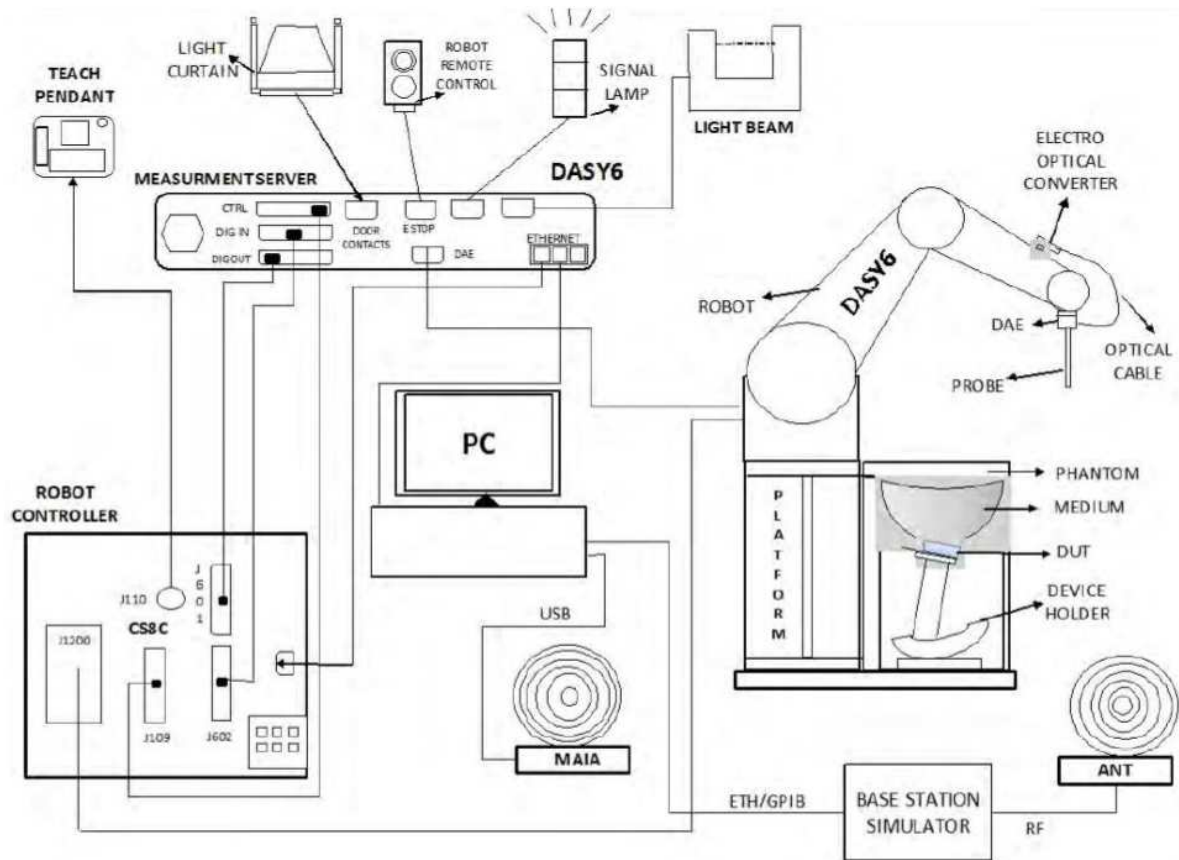
SAR measurement can be related to the electrical field in the tissue by

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

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

6.2 SPEAG DASY System

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY6 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC.



DASY System Setup

6.2.1 Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY6: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ± 0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)



DASY6

6.2.2 Probes

The SAR measurement is conducted with the dosimetric probe. 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.

Model	EX3DV4	
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	4 MHz to 10 GHz Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 μ W/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/g)	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

6.2.3 Data Acquisition Electronics (DAE)

Model	DAE4	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)	
Input Offset Voltage	$< 5\mu$ V (with auto zero)	
Input Bias Current	< 50 fA	
Dimensions	60 x 60 x 68 mm	

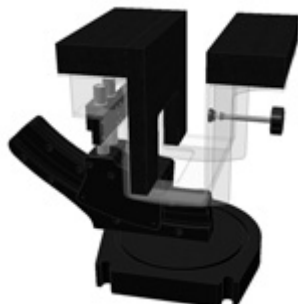
6.2.4 Phantoms

Model	Twin SAM	
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEC/IEEE 62209-1528. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)	
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	

Model	ELI	
Construction	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 4 MHz to 10 GHz. ELI is fully compatible with the IEC/IEEE 62209-1528 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2.0 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	approx. 30 liters	

6.2.5 Device Holder

Model	Mounting Device	
Construction	In combination with the Twin SAM Phantom or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).	
Material	POM	

Model	Laptop Extensions Kit	
Construction	Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC/IEEE 62209-1528 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner.	
Material	POM, Acrylic glass, Foam	

6.2.6 System Validation Dipoles

Model	D-Serial	
Construction	Symmetrical dipole with 1/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.	
Frequency	300 MHz to 10 GHz	
Return Loss	> 20 dB	
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)	

6.2.7 Tissue Simulating Liquids

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed.

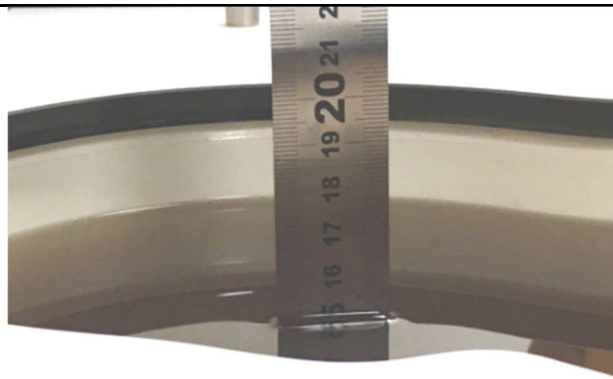


Photo of Liquid Height for Head Position

The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528, and KDB 865664 D01 Appendix A. For the body tissue simulating liquids, the dielectric properties are defined in KDB 865664 D01 Appendix A. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using a dielectric assessment kit and a network analyzer.

Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of $\pm 5\%$	Target Conductivity	Range of $\pm 5\%$
For Head				
750	41.9	39.8 ~ 44.0	0.89	0.85 ~ 0.93
835	41.5	39.4 ~ 43.6	0.90	0.86 ~ 0.95
900	41.5	39.4 ~ 43.6	0.97	0.92 ~ 1.02
1450	40.5	38.5 ~ 42.5	1.20	1.14 ~ 1.26
1640	40.3	38.3 ~ 42.3	1.29	1.23 ~ 1.35
1750	40.1	38.1 ~ 42.1	1.37	1.30 ~ 1.44
1800	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
1900	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
2000	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
2300	39.5	37.5 ~ 41.5	1.67	1.59 ~ 1.75
2450	39.2	37.2 ~ 41.2	1.80	1.71 ~ 1.89
2600	39.0	37.1 ~ 41.0	1.96	1.86 ~ 2.06
3500	37.9	36.0 ~ 39.8	2.91	2.76 ~ 3.06
5200	36.0	34.2 ~ 37.8	4.66	4.43 ~ 4.89
5300	35.9	34.1 ~ 37.7	4.76	4.52 ~ 5.00
5500	35.6	33.8 ~ 37.4	4.96	4.71 ~ 5.21
5600	35.5	33.7 ~ 37.3	5.07	4.82 ~ 5.32
5800	35.3	33.5 ~ 37.1	5.27	5.01 ~ 5.53
6500	34.5	32.8 ~ 36.2	6.07	6.04 ~ 6.11

7. SAR Measurement Procedure

According to the SAR 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

The SAR measurement procedures for each of test conditions are as follows:

- (a) Make EUT to transmit maximum output power
- (b) Measure conducted output power through RF cable
- (c) Place the EUT in the specific position of phantom
- (d) Perform SAR testing steps on the DASY system
- (e) Record the SAR value

7.1 Area & Zoom Scan Procedure

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. According to KDB 865664 D01, the resolution for Area and Zoom scan is specified in the table below.

Items	≤ 2GHz	2-3 GHz	3-4 GHz	4-5 GHz	5-6 GHz
Area Scan ($\Delta x, \Delta y$)	≤ 15mm	≤ 12 mm	≤ 12 mm	≤ 10 mm	≤ 10 mm
Zoom Scan ($\Delta x, \Delta y$)	≤ 8 mm	≤ 5 mm	≤ 5 mm	≤ 4 mm	≤ 4 mm
Zoom Scan (Δz)	≤ 5 mm	≤ 5 mm	≤ 4 mm	≤ 3 mm	≤ 2 mm
Zoom Scan Volume	≥ 30 mm	≥ 30 mm	≥ 28 mm	≥ 25 mm	≥ 22 mm

Note:

When zoom scan is required and report SAR is ≤ 1.4 W/kg, the zoom scan resolution of $\Delta x / \Delta y$ (2-3 GHz): ≤ 8 mm, 3-4 GHz: ≤ 7 mm, 4-6 GHz: ≤ 5 mm) may be applied.

7.2 Volume Scan Procedure

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

7.3 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 drift more than 5%, the SAR will be retested.

7.4 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 from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g

7.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

8. SAR Measurement Evaluation

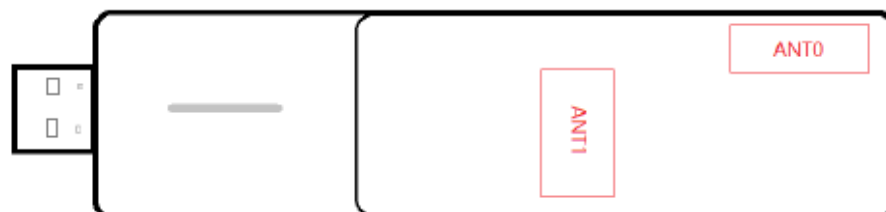
8.1 EUT Configuration and Setting

Test all USB orientations [see figure below: (A) Horizontal-Up, (B) Horizontal-Down, (C) Vertical-Front, and (D) Vertical-Back and Tip] with a device-to-phantom separation distance of 5 mm.

			
USB Orientation 1 (Horizontal-Up)	USB Orientation 2 (Horizontal-Down)	USB Orientation 3 (Vertical-Front)	USB Orientation 4 (Vertical-Back)

Illustration for USB Connector Orientations

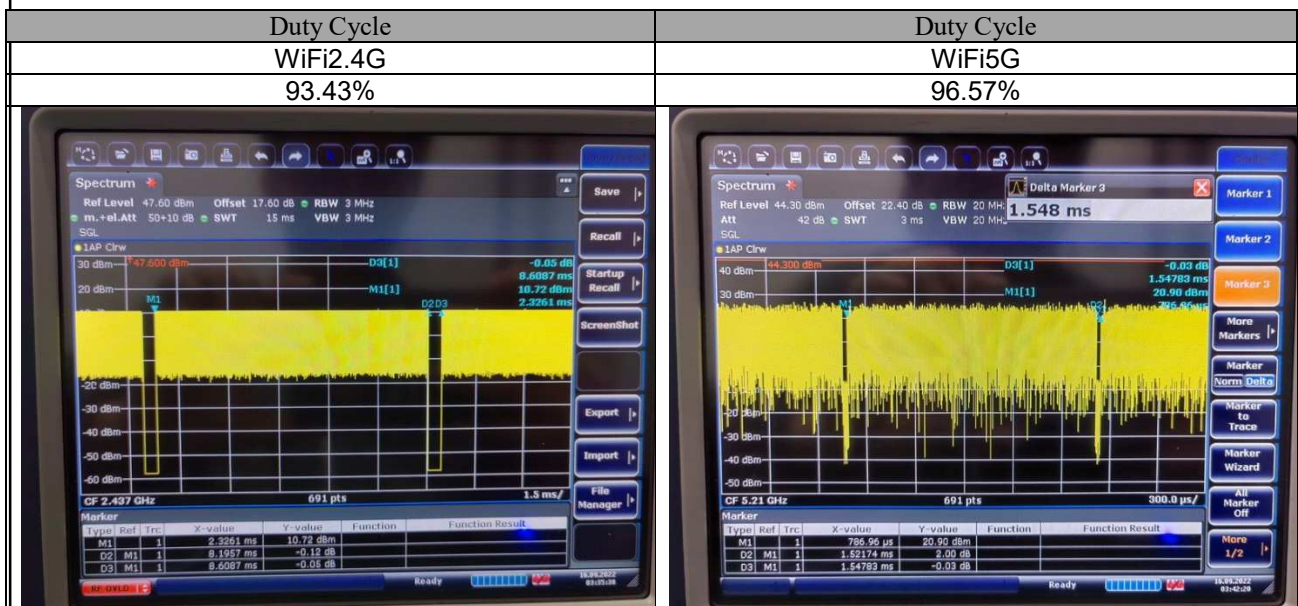
8.1.1 Antenna Location



8.1.2 WIFI TEST CONFIGURATION

For WLAN SAR testing, WLAN engineering testing software installed on the DUT can provide continuous transmitting RF signal.

For WiFi SAR testing, a communication link is set up with the test mode software for WiFi mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. The test procedures in KDB 248227 D01 are applied.



8.1.3 WLAN 2.4G SAR Test Requirements

802.11b DSSS SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

- 1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- 2) When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied. SAR is not required for the following 2.4 GHz OFDM conditions.

- 1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
- 2) 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.

SAR Test Requirements for OFDM configurations

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, each stand alone. And frequency aggregated band is considered separately for SAR test reduction. In applying the initial test configuration and subsequent test configuration procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the procedures.

8.1.4 WLAN 5G SAR Test Requirements

U-NII-1 and U-NII-2A Band

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, both bands are tested independently for SAR. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, both bands are tested independently for SAR.

U-NII-2C, U-NII-3 Bands

The frequency range covered by these bands is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, they must be considered for SAR testing.

To maintain SAR measurement accuracy and to facilitate test reduction, the channels in U-NII-2C band above 5.65 GHz may be grouped with the 5.8 GHz channels in U-NII-3 or §15.247 band to enable two SAR probe calibration frequency points to cover the bands, including the band gap channels. When band gap channels are supported and the bands are not aggregated for SAR testing, band gap channels must be considered independently in each band according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

8.1.5 OFDM transmission mode and SAR test channel selection

For the 2.4GHz and 5GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations (for example 802.11a, 802.11n and 802.11ac, or 802.11g and 802.11n, with the same channel bandwidth, modulation, and data rate, etc.), the lower order 802.11 mode (i.e. 802.11a then 802.11n and 802.11ac, or 802.11g then 802.11n) is used for SAR measurement. When the maximum output power is the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

8.1.6 Initial test configuration procedure

For OFDM, in both 2.4G and 5GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output powers is the initial test channel.

Otherwise, the channel of the transmission mode with the highest average RF output power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurement.

8.2 Tissue Verification

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine if the dielectric parameters are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within $\pm 5\%$ of the target values.

The following materials are used for producing the tissue-equivalent materials.

Recipes of Tissue Simulating Liquid

Tissue Type	Oxidized mineral oil	Tween20	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
H750	44	-	0.2	-	56.0	-	42.1	-
H835	44	48.4	0.2	1.3	57.0	-	41.1	-
H900	44	48.4	0.2	1.4	58.0	-	40.2	-
H1450	44	-	-	0.6	-	-	56.1	-
H1640	44	-	-	0.5	-	-	53.7	-
H1750	44	45.3	-	0.4	-	-	52.6	-
H1800	44	45.3	-	0.5	-	-	55.2	-
H1900	44	45.3	-	0.2	-	-	55.3	-
H2000	44	45.3	-	0.1	-	-	55.4	-
H2300	44	-	-	0.1	-	-	55.0	-
H2450	44	-	-	0.1	-	-	54.9	-
H2600	44	-	-	0.1	-	-	54.8	-
H3500	44	-	-	0.2	-	20.0	71.8	-
H4000	44	-	-	-	-	-	56.0	-
H5G	44	-	-	-	-	17.2	65.5	17.2
H6G	44	-	-	-	-	-	56.0	-

Salt: 99+% Pure Sodium Chloride; Sugar: 98+% Pure Sucrose; Water: De-ionized, 16M +resistivity
 HEC: Hydroxyethyl Cellulose; Sorbitan monolaurate(Tween 20) ;Di(ethylene glycol) butyl ether,
 [2-(2-butoxyethoxy)ethanol] ;Triton X-100(ultra pure): Polyethylene glycol mono
 [4-(1,1,3,3-tetramethylbutyl)phenyl]ether.

The measuring results for tissue simulating liquid are shown as below.

Test Date	Tissue Type	Frequency (MHz)	Measured Conductivity (σ)	Measured Permittivity (ϵ_r)	Target Conductivity (σ)	Target Permittivity (ϵ_r)	Conductivity Deviation (%)	Permittivity Deviation (%)
Oct. 15, 2022	Head	2450	1.806	40.660	1.80	39.2	0.33	3.72
Oct. 16, 2022	Head	5250	4.694	36.841	4.71	35.9	-0.34	2.62
Oct. 16, 2022	Head	5600	5.090	36.289	5.07	35.5	0.39	2.22
Oct. 16, 2022	Head	5750	5.261	36.160	5.22	35.4	0.79	2.15

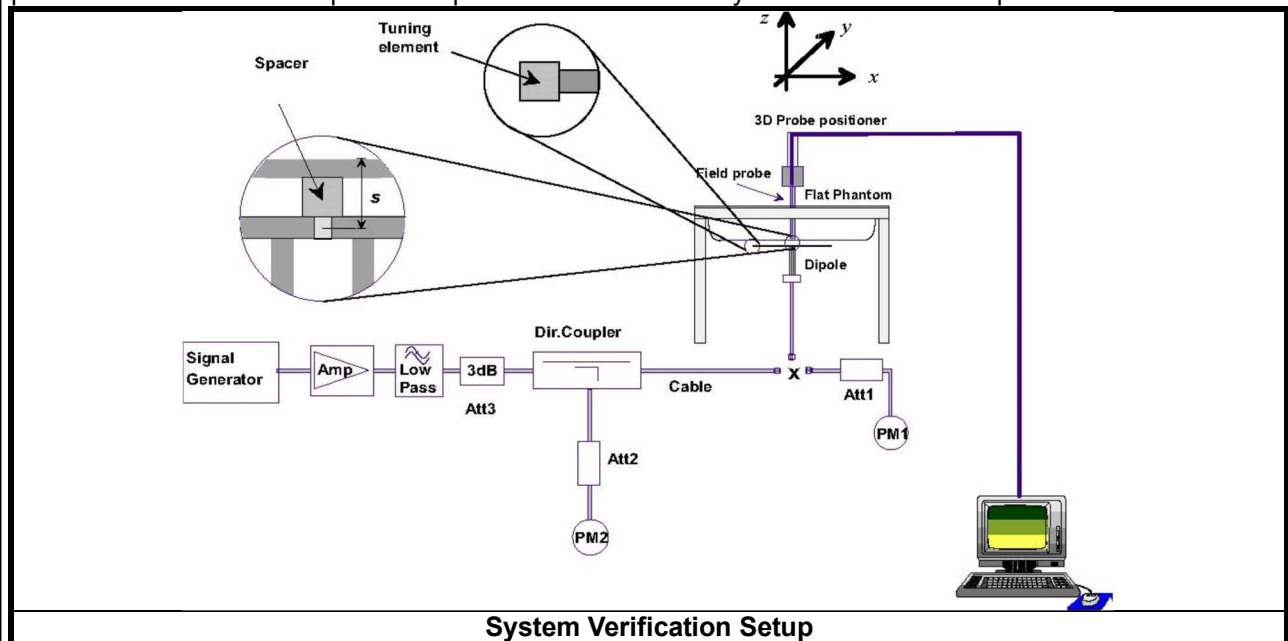
Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within $\pm 5\%$ of the target values. Liquid temperature during the SAR testing must be within $\pm 2^\circ\text{C}$.

8.3 System Validation

System check Procedure

The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.



The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The spectrum analyzer measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power (250 mW is used for 700 MHz to 3 GHz, 100 mW is used for 3.5 GHz to 6 GHz) at the dipole connector and the power meter is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter.

After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

8.4 System Verification

The measuring results for system check are shown as below.

Test Date	Frequency (MHz)	1W Target SAR-1g (W/kg)	Measured SAR-1g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
Oct. 15 2022	2450	51.90	12.35	49.40	-4.82	804	7400	855
Oct. 16 2022	5250	51.90	12.35	49.40	-4.82	1235	7400	855
Oct. 16 2022	5600	81.10	8.19	81.90	0.99	1235	7400	855
Oct. 16 2022	5750	83.50	8.56	85.60	2.51	1235	7400	855

Note:

Comparing to the reference SAR value provided by SPEAG, the validation data should be within its specification of 10 %. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

8.5 Maximum Output Power

8.5.1 Measured Conducted Power Result

All Rate have been tested, the Worst average power (Unit: dBm) is shown as below.

<WLAN2.4G>

Mode	Channel	Frequency(MHz)	Data Rate(Mbps)	ANT 0 Average Power (dBm)	ANT 1 Average Power (dBm)	Max. Tune up	Total Average Power (dBm)
802.11b	1	2412	1	14.78	14.91	18	17.86
	6	2437		14.79	14.72	18	17.77
	11	2462		14.58	14.82	18	17.71
802.11g	1	2412	6	14.37	14.66	18	17.53
	6	2437		14.31	14.45	18	17.39
	11	2462		14.23	14.64	18	17.45
802.11n HT20	1	2412	MCS0	14.29	14.42	18	17.37
	6	2437		14.19	14.34	18	17.28
	11	2462		14.15	14.54	18	17.36
802.11n HT40	3	2422	MCS0	14.25	14.34	18	17.31
	6	2437		14.11	14.25	18	17.19
	9	2452		14.12	14.46	18	17.30
802.11ax HE20	1	2412	MCS0	14.58	14.75	18	17.68
	6	2437		14.48	14.61	18	17.56
	11	2462		14.45	14.78	18	17.63
802.11ax HE40	3	2422	MCS0	14.51	14.56	18	17.55
	6	2437		14.38	14.54	18	17.47
	9	2452		14.09	13.76	18	16.94

Note:

- 1) The Average conducted power of 2.4G WiFi is measured with RMS detector.
- 2) Per KDB248227 D01, for 2.4G WiFi, the highest measured maximum output power Channel for DSSS modes (802.11b) was selected for SAR measurement. SAR for OFDM modes (2.4GHz 802.11g/n) was not required When the highest reported SAR for DSSS is adjusted by the ratio of OFDM modes (802.11g/n) to DSSS modes (802.11b) specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
- 3) The tested channel results are marks in bold.

<WLAN5.2G>

Band	Mode	Channel	Frequency (MHz)	Data Rate(Mbps)	ANT 0 Average Power (dBm)	ANT 1 Average Power (dBm)	Max. Tune up	Total Average Power (dBm)
5.2G	802.11a	36	5180	6	11.48	11.58	15	14.54
		40	5200		11.35	11.56	15	14.47
		44	5220		11.46	11.39	15	14.44
		48	5240		11.49	11.38	15	14.45
	802.11n HT20	36	5180	MCS8	11.42	11.35	15	14.40
		40	5200		11.66	11.45	15	14.57
		44	5220		11.73	11.24	15	14.50
		48	5240		11.67	11.28	15	14.49
	802.11n HT40	38	5190	MCS8	11.72	11.64	15	14.69
		46	5230		11.68	11.42	15	14.56
	802.11ac VHT20	36	5180	MCS8	11.39	11.51	15	14.46
		40	5200		11.28	11.48	15	14.39
		44	5220		11.28	11.34	15	14.32
		48	5240		11.28	11.34	15	14.32
	802.11ac VHT40	38	5190	MCS8	11.46	11.52	15	14.50
		46	5230		11.38	11.36	15	14.38
	802.11ac VHT80	42	5210	MCS8	11.75	11.76	15	14.77
	802.11ax HE20	36	5180	MCS8	11.46	11.43	15	14.46
		40	5200		11.51	11.41	15	14.47
		44	5220		11.44	11.28	15	14.37
		48	5240		11.59	11.28	15	14.45
	802.11ax HE40	38	5190	MCS8	11.17	11.61	15	14.41
		46	5230		11.19	11.44	15	14.33
	802.11ax HE80	42	5210	MCS8	11.07	11.48	15	14.29

<WLAN5.3G>

Band	Mode	Channel	Frequency (MHz)	Data Rate(Mbps)	ANT 0 Average Power (dBm)	ANT 1 Average Power (dBm)	Max. Tune up	Total Average Power (dBm)
5.3G	802.11a	36	5180	6	11.34	11.48	15	14.42
		40	5200		11.35	11.56	15	14.47
		44	5220		11.33	11.42	15	14.39
		48	5240		11.25	11.45	15	14.36
	802.11n HT20	36	5180	MCS8	11.27	11.29	15	14.29
		40	5200		11.28	11.35	15	14.33
		44	5220		11.15	11.28	15	14.23
		48	5240		11.17	11.26	15	14.23
	802.11n HT40	38	5190	MCS8	11.18	11.55	15	14.38
		46	5230		11.58	11.45	15	14.53
	802.11ac VHT20	36	5180	MCS8	11.81	11.52	15	14.68
		40	5200		11.76	11.48	15	14.63
		44	5220		11.65	11.37	15	14.52
		48	5240		11.64	11.34	15	14.50
	802.11ac VHT40	38	5190	MCS8	11.31	11.50	15	14.42
		46	5230		11.12	11.31	15	14.23
	802.11ac VHT80	42	5210	MCS8	11.69	11.85	15	14.78
	802.11ax HE20	36	5180	MCS8	11.86	11.53	15	14.71
		40	5200		11.84	11.45	15	14.66
		44	5220		11.77	11.32	15	14.56
		48	5240		11.78	11.33	15	14.57
	802.11ax HE40	38	5190	MCS8	11.73	11.36	15	14.56
		46	5230		11.57	11.25	15	14.42
	802.11ax HE80	42	5210	MCS8	11.61	11.41	15	14.52

<WLAN5.6G>

Band	Mode	Channel	Frequency(MHz)	Data Rate(Mbps)	ANT 0 Average Power(dBm)	ANT 1 Average Power(dBm)	Max. Tune up	Total Average Power(dBm)
5.6G	802.11a	100	5500	6	11.33	11.43	15	14.39
		104	5520		11.31	11.46	15	14.40
		108	5540		11.15	11.28	15	14.23
		112	5560		11.11	11.36	15	14.25
		116	5580		11.17	11.37	15	14.28
		132	5660		11.33	11.21	15	14.28
		136	5680		11.36	11.25	15	14.32
		140	5700		11.24	11.45	15	14.36
	802.11n HT20	100	5500	MCS8	11.34	11.35	15	14.36
		104	5520		11.23	11.34	15	14.30
		108	5540		11.37	11.18	15	14.29
		112	5560		11.43	11.17	15	14.31
		116	5580		11.52	11.22	15	14.38
		132	5660		11.61	11.45	15	14.54
		136	5680		11.47	11.48	15	14.49
		140	5700		11.58	11.28	15	14.44
	802.11n HT40	102	5510	MCS8	11.54	11.51	15	14.54
		110	5550		11.48	11.39	15	14.45
		118	5590		11.38	11.38	15	14.39
		126	5630		11.28	11.25	15	14.28
		134	5670		11.38	11.24	15	14.32
	802.11ac VHT20	100	5500	MCS8	11.17	11.32	15	14.26
		104	5520		11.19	11.38	15	14.30
		108	5540		11.47	11.18	15	14.34
		112	5560		11.45	11.19	15	14.33
		116	5580		11.58	11.25	15	14.43
		132	5660		11.49	11.13	15	14.32
		136	5680		11.46	11.11	15	14.30
		140	5700		11.59	11.29	15	14.45

5.6G	802.11ac VHT40	102	5510	MCS8	11.56	11.39	15	14.49
		110	5550		11.38	11.27	15	14.34
		118	5590		11.38	11.27	15	14.34
		126	5630		11.26	11.15	15	14.22
		134	5670		11.43	11.12	15	14.29
	802.11ac VHT80	106	5530	MCS8	11.56	11.84	15	14.71
		122	5610		11.89	11.84	15	14.88
	802.11ax HE20	100	5500	MCS8	11.79	11.32	15	14.57
		104	5520		11.68	11.31	15	14.51
		108	5540		11.65	11.18	15	14.43
		112	5560		11.65	11.18	15	14.43
		116	5580		11.58	11.14	15	14.38
		132	5660		11.62	11.53	15	14.59
		136	5680		11.64	11.58	15	14.62
		140	5700		11.66	11.31	15	14.50
	802.11ax HE40	102	5510	MCS8	11.60	11.36	15	14.49
		110	5550		11.45	11.25	15	14.36
		118	5590		11.51	11.19	15	14.36
		126	5630		11.31	11.32	15	14.33
		134	5670		11.48	11.28	15	14.39
	802.11ax HE80	106	5530	MCS8	11.33	11.28	15	14.32
		122	5610		11.26	11.19	15	14.24
		138	5690		11.39	11.17	15	14.29

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	ANT 0 Average Power(dBm)	ANT 1 Average Power(dBm)	Max. Tune up	Total Average Power(dBm)
5.8G	802.11a	149	5745	6	12.26	12.31	16	15.30
		153	5765		12.23	12.26	16	15.26
		157	5785		12.23	12.19	16	15.22
		161	5805		12.32	12.17	16	15.26
		165	5825		11.92	12.58	16	15.27
	802.11n HT20	149	5745	MCS8	12.64	12.33	16	15.50
		153	5765		12.62	12.36	16	15.50
		157	5785		12.25	12.21	16	15.24
		161	5805		12.15	12.26	16	15.22
		165	5825		12.27	12.29	16	15.29
	802.11n HT40	151	5755	MCS8	12.49	12.36	16	15.44
		159	5795		12.12	12.42	16	15.28
	802.11ac VHT20	149	5745	MCS8	12.52	12.26	16	15.40
		153	5765		12.58	12.22	16	15.41
		157	5785		12.17	12.31	16	15.25
		161	5805		12.23	12.58	16	15.42
		165	5825		12.23	12.45	16	15.35
	802.11ac VHT40	151	5755	MCS8	12.35	12.28	16	15.33
		159	5795		12.34	12.54	16	15.45
	802.11ac VHT80	155	5775	MCS8	12.65	12.71	16	15.69
	802.11ax HE20	149	5745	MCS8	12.59	12.23	16	15.42
		153	5765		12.71	12.25	16	15.50
		157	5785		12.31	12.15	16	15.24
		161	5805		12.38	12.15	16	15.28
		165	5825		11.98	12.48	16	15.25
	802.11ax HE40	151	5755	MCS8	12.59	12.48	16	15.55
		159	5795		12.12	12.35	16	15.25
	802.11ax HE80	155	5775	MCS8	12.26	12.22	16	15.25

9. SAR TEST RESULTS

9.1.1 SAR Test Reduction Considerations

<KDB 447498 D01, General RF Exposure Guidance>

- 1) Per KDB447498 D04, all measurement SAR results are scaled to the maximum tune-up tolerance limit to demonstrate compliant.
- 2) Per KDB447498 D04, 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. When the maximum output power variation across the required test channels is $> \frac{1}{2}$ dB, instead of the middle channel, the highest output power channel must be used.
- 3) Per KDB865664 D01, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/kg; if the deviation among the repeated measurement is $\leq 20\%$, and the measured SAR < 1.45 W/kg, only one repeated measurement is required.
- 4) Per KDB941225 D06, the DUT Dimension is bigger than 9 cm x 5 cm, so 10mm is chosen as the test separation distance for Hotspot mode. When the antenna-to-edge distance is greater than 2.5cm, such position does not need to be tested.
- 5) Per KDB648474 D04, SAR is evaluated without a headset connected to the device. When the standalone reported body-worn SAR is ≤ 1.2 W/kg, no additional SAR evaluations using a headset are required.
- 6) Per KDB865664 D02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is > 1.5 W/kg, or > 7.0 W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing.

WLAN Notes:

1. For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all positions in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other (remaining) test positions. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 for 2.4GHz WIFI single transmission chain operations, the highest measured maximum output power Channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 7.1.4 for more information.
3. Justification for test configurations for WLAN per KDB Publication 248227 for 5GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed power. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2W/kg. See Section 6.1.4 for more information.

9.1.2 SAR Results for Body Exposure Condition (Separation Distance is 5mm Gap)

1. SAR test results of 2.4G WiFi

Plot No.	Band	Mode	Test Position	Antenna	Ant Status	Ant Angle	Ch.	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Tune-up Scaling Factor	Duty Cycle Scaling Factor	Power Drift (dB)	Measured SAR-1g (W/kg)	Measured SAR-10g (W/kg)	Reported SAR-1g (W/kg)
1	WLAN2.4GHz	802.11b 1Mbps	Horizontal Up	0+1	Close	0	6	2437	17.77	18.00	1.054	1.006	-0.11	1.120	0.521	1.188
2	WLAN2.4GHz	802.11b 1Mbps	Horizontal Down	0+1	Close	0	6	2437	17.77	18.00	1.054	1.006	-0.17	0.100	0.060	0.106
3	WLAN2.4GHz	802.11b 1Mbps	Vertical Front	0+1	Close	0	6	2437	17.77	18.00	1.054	1.006	-0.15	0.189	0.092	0.200
4	WLAN2.4GHz	802.11b 1Mbps	Vertical Back	0+1	Close	0	6	2437	17.77	18.00	1.054	1.006	-0.07	0.733	0.342	0.778
5	WLAN2.4GHz	802.11b 1Mbps	Tip Side	0+1	Close	0	6	2437	17.77	18.00	1.054	1.006	-0.14	0.045	0.027	0.048
6	WLAN2.4GHz	802.11b 1Mbps	Horizontal Down	0+1	Open	90	6	2437	17.77	18.00	1.054	1.006	0.08	0.038	0.020	0.040
7	WLAN2.4GHz	802.11b 1Mbps	Horizontal Up	0+1	Close	0	1	2412	17.86	18.00	1.033	1.006	-0.18	1.140	0.494	1.184
8	WLAN2.4GHz	802.11b 1Mbps	Horizontal Up	0+1	Close	0	11	2462	17.71	18.00	1.069	1.006	0.15	1.080	0.454	1.162

Note: The value with boldface is the maximum SAR Value of each test band.

2. SAR test results of 5G WiFi

Plot No.	Band	Mode	Test Position	Antenna	Ant Status	Ant Angle	Ch.	Frequency (MHz)	Measured Conducted Power (dBm)	Max. Tune-up Power (dBm)	Tune-up Scaling Factor	Duty Cycle Scaling Factor	Power Drift (dB)	Measured SAR-1g (W/kg)	Measured SAR-10g (W/kg)	Reported SAR-1g (W/kg)
18	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Up	0+1	Close	0	42	5210	14.77	15.00	1.054	1.036	0.02	0.987	0.347	1.078
23	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Down	0+1	Close	0	42	5210	14.77	15.00	1.054	1.036	0.03	0.088	0.035	0.096
12	WLAN5GHz	802.11ac-VHT80 MCS0	Vertical Front	0+1	Close	0	42	5210	14.77	15.00	1.054	1.036	-0.13	0.309	0.103	0.338
15	WLAN5GHz	802.11ac-VHT80 MCS0	Vertical Back	0+1	Close	0	42	5210	14.77	15.00	1.054	1.036	-0.11	0.376	0.134	0.411
9	WLAN5GHz	802.11ac-VHT80 MCS0	Tip Side	0+1	Close	0	42	5210	14.77	15.00	1.054	1.036	0.1	0.172	0.070	0.188
24	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Down	0+1	Open	90	42	5210	14.77	15.00	1.054	1.036	0.05	0.123	0.061	0.134
19	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Up	Ant 0+1	Close	0	122	5610	14.88	15.00	1.028	1.036	-0.1	1.070	0.372	1.140
22	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Down	Ant 0+1	Close	0	122	5610	14.88	15.00	1.028	1.036	0.07	0.138	0.510	0.147
13	WLAN5GHz	802.11ac-VHT80 MCS0	Vertical Front	Ant 0+1	Close	0	122	5610	14.88	15.00	1.028	1.036	-0.14	0.288	0.091	0.307
16	WLAN5GHz	802.11ac-VHT80 MCS0	Vertical Back	Ant 0+1	Close	0	122	5610	14.88	15.00	1.028	1.036	-0.14	0.468	0.161	0.498
10	WLAN5GHz	802.11ac-VHT80 MCS0	Tip Side	Ant 0+1	Close	0	122	5610	14.88	15.00	1.028	1.036	0.14	0.180	0.074	0.192
25	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Down	Ant 0+1	Open	90	122	5610	14.88	15.00	1.028	1.036	-0.09	0.147	0.069	0.157
27	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Up	Ant 0+1	Close	0	106	5530	14.71	15.00	1.069	1.036	0.14	1.020	0.357	1.130
20	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Up	Ant 0+1	Close	0	155	5775	15.69	16.00	1.074	1.036	-0.09	1.000	0.347	1.113
21	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Down	Ant 0+1	Close	0	155	5775	15.69	16.00	1.074	1.036	0.05	0.178	0.069	0.198
14	WLAN5GHz	802.11ac-VHT80 MCS0	Vertical Front	Ant 0+1	Close	0	155	5775	15.69	16.00	1.074	1.036	0	0.182	0.056	0.203
17	WLAN5GHz	802.11ac-VHT80 MCS0	Vertical Back	Ant 0+1	Close	0	155	5775	15.69	16.00	1.074	1.036	0.02	0.526	0.268	0.585
11	WLAN5GHz	802.11ac-VHT80 MCS0	Tip Side	Ant 0+1	Close	0	155	5775	15.69	16.00	1.074	1.036	-0.17	0.217	0.093	0.241
26	WLAN5GHz	802.11ac-VHT80 MCS0	Horizontal Down	Ant 0+1	Open	90	155	5775	15.69	16.00	1.074	1.036	-0.04	0.164	0.083	0.182

Note: The value with boldface is the maximum SAR Value of each test band.

10. Multiple Transmitter Evaluation

The following tables list information which is relevant for the decision if a simultaneous transmit evaluation is necessary according to FCC KDB 447498D01 General RF Exposure Guidance v06.

The location of the antennas inside the EUT is shown as below picture



Note: The results of transmit simultaneous please refer to section 9.1.2.

11. Appendixes

Appendix A – SAR Plots of System Verification

Appendix B – SAR Plots of SAR Measurement

Appendix C – Calibration Certificate for Probe and Dipole

Appendix D – Photographs of the Test Set-Up

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