



SAR EVALUATION REPORT

**FCC 47 CFR § 2.1093
IEEE Std. 1528-2013**

For

**FCC ID: APIHKALLUREPORT
Model Name: ALLURE PORTABLE**

Report Number: 4788325650-2

Issue Date: January 23, 2018

Prepared for
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Revision History

Rev.	Date	Revisions	Revised By
V1.0	January 23, 2018	Initial Issue	\

Table of Contents

1. Attestation of Test Results 5

2. Test Specification, Methods and Procedures..... 6

3. Facilities and Accreditation 7

4. SAR Measurement System & Test Equipment 8

 4.1. SAR Measurement System..... 8

 4.2. SAR Scan Procedures..... 9

 4.3. Test Equipment..... 11

5. Measurement Uncertainty..... 12

6. Device Under Test (DUT) Information 13

 6.1. DUT Description 13

 6.2. Wireless Technology..... 13

7. SAR Test Configuration 14

8. Conducted Output Power Measurement and tune-up tolerance..... 15

 8.1. 2.4GHz Wi-Fi..... 15

 8.2. 5GHz Wi-Fi (U-NII-1) 16

 8.3. 5GHz Wi-Fi (U-NII-2A)..... 17

 8.4. 5GHz Wi-Fi (U-NII-2C)..... 18

 8.5. 5GHz Wi-Fi (U-NII-3) 21

 8.6. BT..... 22

9. RF Exposure Conditions..... 23

10. Dielectric Property Measurements & System Check 29

 10.1. Dielectric Property Measurements..... 29

 10.2. System Check..... 31

11. Measured and Reported (Scaled) SAR Results..... 33

 11.1. SAR Test Results of 2.4G Wi-Fi 35

 11.2. SAR Test Results of 5G Wi-Fi..... 37

12. Simultaneous Transmission SAR Analysis 42




 12.1. Estimated SAR..... 42

 12.2. Simultaneous Transmission calculation for 1-g SAR 43

 12.3. Simultaneous Transmission calculation for 10-g SAR 45

Appendixes	47
<i>4788325650-2_App A Photo.....</i>	<i>47</i>
<i>4788325650-2_App B System Check Plots.....</i>	<i>47</i>
<i>4788325650-2_App C Highest Test Plots</i>	<i>47</i>
<i>4788325650-2_App D Cal. Certificates.....</i>	<i>47</i>

1. Attestation of Test Results

Applicant Name	Harman International Industries, Incorporated	
Address	8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES	
Manufacturer	Harman International Industries, Incorporated	
Address	8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES	
EUT Name	Wireless Speaker	
Model Name	ALLURE PORTABLE	
Sample Status	Normal	
Sample ID	1365696	
Brand	Harman Kardon	
Sample Received Date	January 15, 2018	
Date of Tested	January 20, 2018 to January 25, 2018	
Applicable Standards	FCC 47 CFR § 2.1093 IEEE Std. 1528-2013 KDB publication	
SAR Limits (W/Kg)		
Exposure Category	Peak spatial-average(1g of tissue)	Extremities (hands, wrists, ankles, etc.) (10g of tissue)
General population / Uncontrolled exposure	1.6	4
The Highest Reported SAR (W/kg)		
RF Exposure Conditions	Equipment Class	
	DTS	U-NII
Body (1-g)	0.705	1.127
Extremities (10-g)	0.287	\
Simultaneous Transmission	Body	Extremities
	1.527	2.0
Test Results	Pass	
Tested By:  James Qin Engineer Project Associate	Reviewed By:  Shawn Wen Laboratory Leader	Approved By:  Stephen Guo Laboratory Manager

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with IEEE Std. 1528-2013, the following FCC Published RF exposure KDB procedures:

- 248227 D01 802.11 Wi-Fi SAR
- 447498 D01 General RF Exposure Guidance
- 690783 D01 SAR Listings on Grants
- 865664 D01 SAR measurement 100 MHz to 6 GHz
- 865664 D02 RF Exposure Reporting
- 941225 D07 UMPC Mini Tablet

3. Facilities and Accreditation

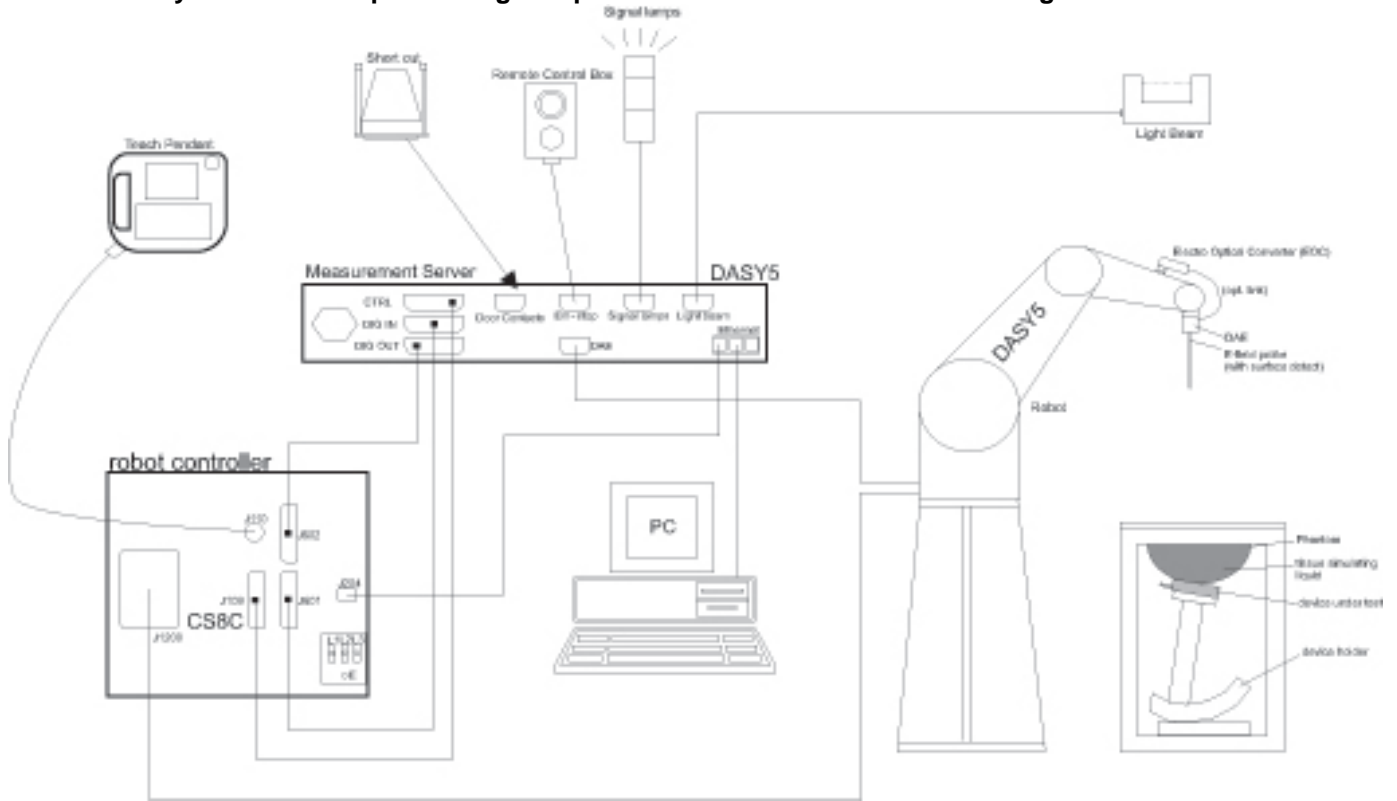
The test site and measurement facilities used to collect data are located at

Test Location	UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch.
Address	Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China
Accreditation Certificate	The Laboratory has been assessed and proved to be in compliance with IAS & A2LA. Laboratory code is TL-702 & 4102.01 respectively.
Description	All measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

The DASY5 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 and the DASY52 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.

4.2. SAR Scan Procedures

Step 1: 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. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: 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 locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) 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 KDB 865664 D01 v01r04 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	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
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 \leq the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose 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 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 v01r04 SAR Measurement 100 MHz to 6 GHz

		≤ 3 GHz	> 3 GHz	
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$		≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm *	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*	
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm	
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 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	≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 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 <i>reported</i> SAR from the area scan based <i>1-g SAR estimation</i> procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 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.				

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

Step 5: Z-Scan (FCC only)

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be greater than the step size in Z-direction.

4.3. Test Equipment

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Name of equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
ENA Network Analyzer	Keysight	E5080A	MY55100583	December 11, 2018
Dielectric Probe kit	SPEAG	SM DAK 040 SA	1155	NCR
DC power supply	Keysight	E36103A	MY55350020	December 11, 2018
Signal Generator	Rohde & Schwarz	SME06	837633\001	May 16, 2018
BI-Directional Coupler	WERLATONE	C8060-102	3423	December 11, 2018
Peak and Average Power Sensor	Keysight	E9323A	MY55440013	December 11, 2018
Peak and Average Power Sensor	Keysight	E9323A	MY55420006	December 11, 2018
Dual Channel PK Power Meter	Keysight	N1912A	MY55416024	December 11, 2018
Amplifier	CORAD TECHNOLOGY LTD	AMF-4D-00400600-50-30P	1983561	NCR
Dosimetric E-Field Probe	SPEAG	EX3DV4	7383	December 13, 2018
Data Acquisition Electronic	SPEAG	DAE3	427	December 3, 2018
Dipole Kit 2450 MHz	SPEAG	D2450V2	977	January 13, 2019
Dipole Kit 5 GHz	SPEAG	D5GHzV2	1231	January 12, 2019
Software	SPEAG	DASY52	N/A	NCR
Twin Phantom	SPEAG	SAM V5.0	1805	NCR
ELI Phantom	SPEAG	ELI V5.0	1235	NCR
Thermometer	Control Company	4242	150709653	December 11, 2018
Thermometer	VICTOR	VC230	/	December 11, 2018

Note:

- 1) Per KDB865664D01 v01r04 requirements for dipole calibration, the test laboratory has adopted three-year extended calibration interval. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.
 - a) There is no physical damage on the dipole;
 - b) System check with specific dipole is within 10% of calibrated value;
 - c) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement.
 - d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.
- 2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

5. Measurement Uncertainty

Per KDB 865664 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.

6. Device Under Test (DUT) Information

6.1. DUT Description

The EUT is a wireless speaker with IEEE 802.11a/b/g/n/ac, and BT radio.	
Device Dimension	Overall (Length x Width x Height): 114 mm x 114 mm x 160 mm
Battery Options	Type: Lithium-ion Polymer Capacity: DC 3.7V, 6000mAh Power supply: 5V/2.3A
Accessory	Charging stand, USB Cable, Adapter

6.2. Wireless Technology

Wireless technology	Frequency band
Wi-Fi	2.4 GHz
Wi-Fi	5 GHz
BT	2.4 GHz

7. SAR Test Configuration

The EUT supports handheld using scenario, and it may very close to the human body when used, so the 10-g Extremity SAR and 1-g Body SAR (10mm) evaluation are both considered.

8. Conducted Output Power Measurement and tune-up tolerance

8.1. 2.4GHz Wi-Fi

Band	Antenna	Mode	Ch.#	Rate(Mbps)	Freq.(MHz)	Meas. Avg. Pwr.(dBm)	Tune-up(dBm)
2.4G	1	b	1	1	2412	20.24	22.0
			6		2437	20.56	22.0
			11		2462	20.31	22.0
		g	1	6	2412	20.67	22.0
			6		2437	20.99	22.0
			11		2462	20.67	22.0
		n20	1	6.5	2412	20.87	22.0
			6		2437	21.31	22.0
			11		2462	21.05	22.0
	2	b	1	1	2412	20.22	22.0
			6		2437	20.67	22.0
			11		2462	20.29	22.0
		g	1	6	2412	20.54	22.0
			6		2437	21.04	22.0
			11		2462	20.77	22.0
n20		1	6.5	2412	20.84	22.0	
		6		2437	21.26	22.0	
		11		2462	20.91	22.0	

8.2. 5GHz Wi-Fi (U-NII-1)

Band	Antenna	Mode	Ch.#	Rate(Mbps)	Freq.(MHz)	Meas. Avg. Pwr.(dBm)	Tune-up(dBm)
5G	1	a	36	6	5180	15.49	16.0
			40		5200	14.76	16.0
			44		5220	15.54	16.0
			48		5240	15.25	16.0
		n20	36	MCS0	5180	15.65	16.0
			40		5200	14.79	16.0
			44		5220	14.33	16.0
			48		5240	15.27	16.0
		n40	38	MCS0	5190	15.52	16.0
			46		5230	15.11	16.0
		ac	36	6	5180	14.79	15.0
			40		5200	14.37	15.0
			44		5220	14.34	15.0
			48		5240	14.71	15.0
		ac40	38	MCS0	5190	13.39	14.0
			46		5230	12.55	14.0
	ac80	42	MCS0	5210	13.32	14.0	
	2	a	36	6	5180	15.04	16.0
			40		5200	15.57	16.0
			44		5220	15.31	16.0
			48		5240	14.71	16.0
		n20	36	MCS0	5180	14.58	16.0
			40		5200	14.96	16.0
			44		5220	14.25	16.0
			48		5240	14.13	16.0
		n40	38	MCS0	5190	15.44	16.0
			46		5230	15.35	16.0
		ac	36	6	5180	14.06	15.0
			40		5200	14.59	15.0
			44		5220	14.19	15.0
			48		5240	14.13	15.0
		ac40	38	MCS0	5190	13.02	14.0
46			5230		13.09	14.0	
ac80	42	MCS0	5210	13.26	14.0		

8.3. 5GHz Wi-Fi (U-NII-2A)

Band	Antenna	Mode	Ch.#	Rate(Mbps)	Freq.(MHz)	Meas. Avg. Pwr.(dBm)	Tune-up(dBm)
5G	1	a	52	6	5260	14.93	16.0
			56		5280	15.00	16.0
			60		5300	15.83	16.0
			64		5320	15.75	16.0
		n20	52	MCS0	5260	10.59	12.0
			56		5280	10.50	12.0
			60		5300	11.37	12.0
			64		5320	11.69	12.0
		n40	54	MCS0	5270	13.60	15.0
			62		5310	14.50	15.0
		ac	52	6	5260	10.47	12.0
			56		5280	10.65	12.0
			60		5300	11.35	12.0
			64		5320	11.73	12.0
		ac40	54	MCS0	5270	11.80	13.0
			62		5310	12.66	13.0
	ac80	58	MCS0	5290	12.93	14.0	
	2	a	6	52	5260	15.35	16.0
				56	5280	15.64	16.0
				60	5300	15.99	16.0
				64	5320	15.98	16.0
		n20	MCS0	52	5260	10.92	12.0
				56	5280	11.39	12.0
				60	5300	11.24	12.0
				64	5320	11.99	12.0
		n40	MCS0	54	5270	13.91	15.0
				62	5310	14.62	15.0
		ac	6	52	5260	10.6	12.0
56				5280	11.05	12.0	
60				5300	11.31	12.0	
64				5320	11.97	12.0	
ac40		MCS0	54	5270	11.99	13.0	
			62	5310	12.87	13.0	
ac80		58	MCS0	5290	13.12	14.0	

8.4. 5GHz Wi-Fi (U-NII-2C)

Band	Antenna	Mode	Ch.#	Rate(Mbps)	Freq.(MHz)	Meas. Avg. Pwr.(dBm)	Tune-up(dBm)
5G	1	a	100	6	5500	15.76	16.0
			104		5520	15.64	16.0
			108		5540	14.12	16.0
			112		5560	14.66	16.0
			116		5580	14.59	16.0
			120		5600	14.60	16.0
			124		5620	14.67	16.0
			128		5640	14.42	16.0
			132		5660	14.74	16.0
			136		5680	14.70	16.0
			140		5700	15.70	16.0
			n20		100	MCS0	5500
		104		5520	14.58		15.0
		108		5540	13.09		15.0
		112		5560	13.61		15.0
		116		5580	13.67		15.0
		120		5600	13.59		15.0
		124		5620	13.87		15.0
		128		5640	13.24		15.0
		132		5660	13.50		15.0
		136		5680	13.50		15.0
		140		5700	13.53		15.0
		n40		102	MCS0		5510
			110	5550		14.06	16.0
			118	5590		14.12	16.0
			126	5630		14.74	16.0
			134	5670		14.03	16.0
			140	5700		14.88	16.0
		ac	100	6	5500	14.77	15.0
			104		5520	14.58	15.0
			108		5540	13.36	15.0
			112		5560	13.81	15.0
			116		5580	13.53	15.0
			120		5600	13.79	15.0
			124		5620	13.78	15.0
			128		5640	13.45	15.0
			132		5660	13.64	15.0
			136		5680	13.53	15.0
			140		5700	14.07	15.0
			ac40		102	MCS0	5510
		110		5550	11.65		13.0
		118		5590	12.10		13.0
		126		5630	11.92		13.0
		134		5670	11.82		13.0
		140		5700	12.47		13.0
		ac80	106	MCS0	5530	12.95	14.0

5G	2		122		5610	12.50	14.0		
			138		5690	12.65	14.0		
		a	6	100	5500	15.39	16.0		
				104	5520	15.42	16.0		
				108	5540	14.26	16.0		
				112	5560	14.37	16.0		
				116	5580	14.36	16.0		
				120	5600	14.53	16.0		
				124	5620	14.61	16.0		
				128	5640	14.47	16.0		
				132	5660	14.54	16.0		
				136	5680	14.39	16.0		
				140	5700	15.26	16.0		
				n20	MCS0	100	5500	14.14	15.0
						104	5520	14.24	15.0
						108	5540	13.41	15.0
		112	5560			13.24	15.0		
		116	5580			13.10	15.0		
		120	5600			13.23	15.0		
		124	5620			13.14	15.0		
		128	5640			13.51	15.0		
		132	5660			13.28	15.0		
		136	5680			13.34	15.0		
		n40	MCS0	102	5510	14.78	16.0		
				110	5550	14.07	16.0		
				118	5590	14.35	16.0		
				126	5630	14.63	16.0		
				134	5670	14.24	16.0		
				140	5700	14.75	16.0		
		ac	6	100	5500	13.67	15.0		
				104	5520	13.54	15.0		
				108	5540	13.52	15.0		
				112	5560	13.49	15.0		
				116	5580	13.18	15.0		
				120	5600	13.61	15.0		
				124	5620	13.57	15.0		
				128	5640	13.60	15.0		
				132	5660	13.47	15.0		
				136	5680	13.46	15.0		
		ac40	MCS0	102	5510	12.40	13.0		
				110	5550	11.75	13.0		
				118	5590	12.16	13.0		
126	5630			11.92	13.0				
134	5670			12.14	13.0				
140	5700			11.89	13.0				
ac80	MCS0	106	5530	12.75	14.0				
		122	5610	12.53	14.0				

			138		5690	12.51	14.0
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8.5. 5GHz Wi-Fi (U-NII-3)

Band	Antenna	Mode	Ch.#	Rate(Mbps)	Freq.(MHz)	Meas. Avg. Pwr.(dBm)	Tune-up(dBm)
5G	1	a	149	6	5745	14.71	16.5
			153		5765	15.54	16.5
			157		5785	15.94	16.5
			161		5805	16.31	16.5
			165		5825	15.83	16.5
		n20	149	MCS0	5745	13.78	15.5
			153		5765	14.43	15.5
			157		5785	14.83	15.5
			161		5805	15.22	15.5
			165		5825	14.29	15.5
		n40	151	MCS0	5755	14.93	16.0
			159		5795	15.67	16.0
		ac20	149	6	5745	13.55	15.5
			153		5765	14.46	15.5
			157		5785	14.69	15.5
			161		5805	15.24	15.5
			165		5825	14.28	15.5
		ac40	151	MCS0	5755	13.07	14.0
			159		5795	13.51	14.0
		ac80	155	MCS0	5775	13.73	14.0
	2	a	149	6	5745	15.27	16.5
			153		5765	15.52	16.5
			157		5785	16.01	16.5
			161		5805	16.34	16.5
			165		5825	15.65	16.5
		n20	149	MCS0	5745	14.09	15.5
			153		5765	14.47	15.5
			157		5785	14.73	15.5
			161		5805	15.17	15.5
			165		5825	14.24	15.5
		n40	151	MCS0	5755	15.16	16.0
			159		5795	15.65	16.0
		ac20	149	6	5745	14.12	15.5
			153		5765	14.36	15.5
			157		5785	14.83	15.5
			161		5805	15.43	15.5
			165		5825	14.37	15.5
		ac40	151	MCS0	5755	13.24	14.0
			159		5795	13.42	14.0
		ac80	155	MCS0	5775	13.83	14.0

8.6. BT

ANT.2

BT 2450	Average Conducted Power (dBm)			Tune-up
	0CH	39CH	78CH	
DH5	5.4	5.3	4.49	6.0
2DH5	-0.27	0	-0.98	0.5
3DH5	-0.19	0.1	-0.95	0.5

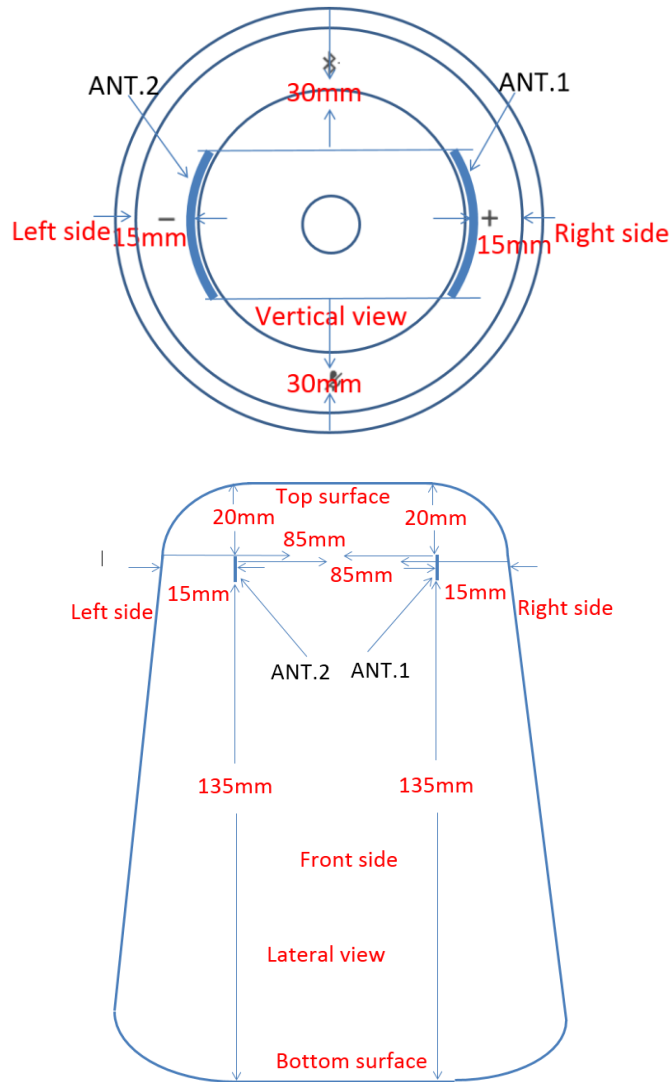
BT 2450	Average Conducted Power (dBm)			Tune-up
	0CH	39CH	78CH	
BLE	4.8	4.98	3.79	5.5

Note:

As per KDB 447498 sec.4.1.d) at the maximum rated output power and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance limit.

9. RF Exposure Conditions

Refer to the diagram inside the device which attached below for the specific details of the antennas to outer surface distances.



Per FCC KDB 447498D01:

1. The 1-g SAR and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for product specific 10-g SAR, where:

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

2. The SAR exclusion threshold for distances > 50 mm is defined by the following equation, as illustrated in KDB 447498 D01 Appendix B:

a) at 100 MHz to 1500 MHz

$[\text{Power allowed at numeric threshold for 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) \cdot (f(\text{MHz}) / 150)] \text{ mW}$

b) at > 1500 MHz and ≤ 6 GHz

$[\text{Power allowed at numeric Threshold at 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) \cdot 10] \text{ mW}$

For BT 1-g SAR

Mode	Frequency	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculated Result	Threshold	SAR Test
2.4G	2480	6	3.98	15.00	0.4	3.0	Excluded

Note:

Because the calculated result is less than the threshold, so SAR evaluation for BT 1-g SAR is not required.

For BT 10-g SAR

Mode	Frequency	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculated Result	Threshold	SAR Test
2.4G	2480	6	3.98	15.00	0.4	7.5	Excluded

Note:

Because the calculated result is less than the threshold, so SAR evaluation for BT 10-g SAR is not required.

For 2.4G Wi-Fi 1-g SAR (antenna to outer surface separation distance less than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculated Result	Threshold	SAR Test
Top surface	2462	22.00	158.49	20.00	12.4	3.0	Required
Bottom surface	2462	22.00	158.49	\	\	\	\
Left side for antenna 1	2462	22.00	158.49	\	\	\	\
Left side for antenna 2	2462	22.00	158.49	15.00	16.6	3.0	Required
Right side for antenna 1	2462	22.00	158.49	15.00	16.6	3.0	Required
Right side for antenna 2	2462	22.00	158.49	\	\	\	\
Front side	2462	22.00	158.49	30.00	8.3	3.0	Required
Back side	2462	22.00	158.49	30.00	8.3	3.0	Required

Note:

If the calculated result is greater than the threshold, SAR evaluation for the corresponding position is required. If not, SAR evaluation for the corresponding position is not required.

For 2.4G Wi-Fi 1-g SAR (antenna to outer surface separation distance greater than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Power allowed at 50mm	Separation Distance (mm)	Calculated Result (mW)	SAR Test
Top surface	2462	22.00	223.87	\	\	\	\
Bottom surface	2462	22.00	223.87	95.60	135	945.60	Excluded
Left side for antenna 1	2462	22.00	223.87	95.60	85	445.60	Excluded
Left side for antenna 2	2462	22.00	223.87	\	\	\	\
Right side for antenna 1	2462	22.00	223.87	\	\	\	\
Right side for antenna 2	2462	22.00	223.87	95.60	85	445.60	Excluded
Front side	2462	22.00	223.87	\	\	\	\
Back side	2462	22.00	223.87	\	\	\	\

Note:

If the power in mW is greater than the calculated result, SAR evaluation for the corresponding position is required. If not, SAR evaluation for the corresponding position is not required.

For 2.4G Wi-Fi 10-g SAR (antenna to outer surface separation distance less than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculated Result	Threshold	SAR Test
Top surface	2462	22.00	158.49	20.00	12.4	7.5	Required
Bottom surface	2462	22.00	158.49	\	\	\	\
Left side for antenna 1	2462	22.00	158.49	\	\	\	\
Left side for antenna 2	2462	22.00	158.49	15.00	16.6	7.5	Required
Right side for antenna 1	2462	22.00	158.49	15.00	16.6	7.5	Required
Right side for antenna 2	2462	22.00	158.49	\	\	\	\
Front side	2462	22.00	158.49	30.00	8.3	7.5	Required
Back side	2462	22.00	158.49	30.00	8.3	7.5	Required

Note:

If the calculated result is greater than the threshold, SAR evaluation for the corresponding position is required. If not, SAR evaluation for the corresponding position is not required.

For 2.4G Wi-Fi 10-g SAR (antenna to outer surface separation distance greater than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Power allowed at 50mm	Separation Distance (mm)	Calculated Result (mW)	SAR Test
Top surface	2462	22.00	223.87	\	\	\	\
Bottom surface	2462	22.00	223.87	238.99	135	1088.99	Excluded
Left side for antenna 1	2462	22.00	223.87	238.99	85	588.99	Excluded
Left side for antenna 2	2462	22.00	223.87	\	\	\	\
Right side for antenna 1	2462	22.00	223.87	\	\	\	\
Right side for antenna 2	2462	22.00	223.87	238.99	85	588.99	Excluded
Front side	2462	22.00	223.87	\	\	\	\
Back side	2462	22.00	223.87	\	\	\	\

Note:

If the power in mW is greater than the calculated result, SAR evaluation for the corresponding position is required. If not, SAR evaluation for the corresponding position is not required.

For 5G Wi-Fi 1-g SAR (antenna to outer surface separation distance less than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculated Result	Threshold	SAR Test
Top surface	5825	16.50	44.67	20.00	5.4	3.0	Required
Bottom surface	5825	16.50	44.67	\	\	\	\
Left side for antenna 1	5825	16.50	44.67	\	\	\	\
Left side for antenna 2	5825	16.50	44.67	15.00	7.2	3.0	Required
Right side for antenna 1	5825	16.50	44.67	15.00	7.2	3.0	Required
Right side for antenna 2	5825	16.50	44.67	\	\	\	\
Front side	5825	16.50	44.67	30.00	3.6	3.0	Required
Back side	5825	16.50	44.67	30.00	3.6	3.0	Required

Note:

If the calculated result is greater than the threshold, SAR evaluation for the corresponding position is required. If not, SAR evaluation for the corresponding position is not required.

For 5G Wi-Fi 1-g SAR (antenna to outer surface separation distance greater than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Power allowed at 50mm	Separation Distance (mm)	Calculated Result (mW)	SAR Test
Top surface	5825	16.50	44.67	\	\	\	\
Bottom surface	5825	16.50	44.67	62.15	135	912.15	Excluded
Left side for antenna 1	5825	16.50	44.67	62.15	85	412.15	Excluded
Left side for antenna 2	5825	16.50	44.67	\	\	\	\
Right side for antenna 1	5825	16.50	44.67	\	\	\	\
Right side for antenna 2	5825	16.50	44.67	62.15	85	412.15	Excluded
Front side	5825	16.50	44.67	\	\	\	\
Back side	5825	16.50	44.67	\	\	\	\

Note:

If the power in mW is greater than the calculated result, SAR evaluation for the corresponding position is required. If not, SAR evaluation for the corresponding position is not required.

For 5G Wi-Fi 10-g SAR (antenna to outer surface separation distance less than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculated Result	Threshold	SAR Test
Top surface	5825	16.50	44.67	20.00	5.4	7.5	Excluded
Bottom surface	5825	16.50	44.67	\	\	\	\
Left side for antenna 1	5825	16.50	44.67	\	\	\	\
Left side for antenna 2	5825	16.50	44.67	15.00	7.2	7.5	Excluded
Right side for antenna 1	5825	16.50	44.67	15.00	7.2	7.5	Excluded
Right side for antenna 2	5825	16.50	44.67	\	\	\	\
Front side	5825	16.50	44.67	30.00	3.6	7.5	Excluded
Back side	5825	16.50	44.67	30.00	3.6	7.5	Excluded

Note:

If the calculated result is greater than the threshold, SAR evaluation for the corresponding position is required. If not, SAR evaluation for the corresponding position is not required.

For 5G Wi-Fi 10-g SAR (antenna to outer surface separation distance greater than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Power allowed at 50mm	Separation Distance (mm)	Calculated Result (mW)	SAR Test
Top surface	5825	16.50	44.67	\	\	\	\
Bottom surface	5825	16.50	44.67	155.38	135	1005.38	Excluded
Left side for antenna 1	5825	16.50	44.67	155.38	85	505.38	Excluded
Left side for antenna 2	5825	16.50	44.67	\	\	\	\
Right side for antenna 1	5825	16.50	44.67	\	\	\	\
Right side for antenna 2	5825	16.50	44.67	155.38	85	505.38	Excluded
Front side	5825	16.50	44.67	\	\	\	\
Back side	5825	16.50	44.67	\	\	\	\

Note:

If the power in mW is greater than the calculated result, SAR evaluation for the corresponding position is required. If not, SAR evaluation for the corresponding position is not required.

10. Dielectric Property Measurements & System Check

10.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.

The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.

Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.

Tissue Dielectric Parameters

FCC KDB 865664 D01 v01r04 SAR Measurement 100 MHz to 6 GHz

Target Frequency (MHz)	Head		Body	
	ϵ_r	σ (S/m)	ϵ_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

Dielectric Property Measurements Results:

Liquid	Freq.	Liquid Parameters				Delta(%)		Limit (%)	Temp. (°C)	Test Date
		Measured		Target		ϵ_r	σ			
		ϵ_r	σ	ϵ_r	σ					
Body 2450	2360	52.81	1.92	52.82	1.86	-0.02	2.96	±5	22.4	January 23, 2018
	2450	52.53	2.01	52.70	1.95	-0.32	3.18	±5		
	2540	52.28	2.11	52.59	2.08	-0.59	1.54	±5		
Body 5250	5160	49.90	5.40	49.07	5.25	1.69	2.88	±5	21.9	January 20, 2018
	5250	49.61	5.45	48.95	5.36	1.35	1.66	±5		
	5340	49.55	5.62	48.96	5.46	1.21	2.99	±5		
Body 5600	5510	48.76	5.62	48.59	5.66	0.35	-0.64	±5	21.9	January 20, 2018
	5600	48.77	5.78	48.47	5.77	0.62	0.16	±5		
	5690	48.56	5.92	48.35	5.87	0.43	0.92	±5		
Body 5750	5660	48.47	5.82	48.39	5.84	0.17	-0.29	±5	21.9	January 20, 2018
	5750	48.38	5.95	48.27	5.94	0.23	0.12	±5		
	5840	48.14	6.06	48.16	6.03	-0.04	0.55	±5		
Body 5750	5660	48.99	5.77	48.39	5.84	1.24	-1.20	±5	21.6	January 25, 2018
	5750	48.91	5.89	48.27	5.94	1.33	-0.79	±5		
	5840	48.66	6.01	48.16	6.03	1.04	-0.35	±5		
Body 5750	48.67	5.81	48.39	5.84	0.58	-0.53	48.67	5.81	21.2	February 9, 2018
	48.59	5.93	48.27	5.94	0.66	-0.13	48.59	5.93		
	48.34	6.05	48.16	6.03	0.37	0.32	48.34	6.05		

10.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ± 0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm (above 1GHz) and 15mm (below 1GHz) from dipole center to the simulating liquid surface.
- For area scan, standard grid spacing for head measurements is 15 mm in x- and y- dimension (≤ 2 GHz), 12 mm in x- and y-dimension (2-4 GHz) and 10mm in x- and y- dimension (4-6GHz).
- For zoom scan, Δx_{zoom} , $\Delta y_{zoom} \leq 2$ GHz - ≤ 8 mm, 2-4GHz - ≤ 5 mm and 4-6 GHz - ≤ 4 mm; $\Delta z_{zoom} \leq 3$ GHz - ≤ 5 mm, 3-4 GHz - ≤ 4 mm and 4-6GHz - ≤ 2 mm.
- Distance between probe sensors and phantom surface was set to 3 mm except for 5 GHz band. For 5GHz band, Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was set to 100 mW or 250 mW depend on the certificate of the dipoles.
- The results are normalized to 1 W input power.

System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target.

System Dipole	T.S. Liquid		Measured Results		Target (Ref. value)	Delta (%)	Limit (%)	Temp. (°C)	Test Date
			Zoom Scan (W/Kg)	Normalize to 1W (W/Kg)					
Serial #									
977	Body 2450	1g	13.200	52.80	51.70	2.13	±10	22.4	January 23, 2018
		10g	6.230	24.92	24.30	2.55			
1231	Body 5250	1g	7.760	77.60	76.10	1.97	±10	21.9	January 20, 2018
		10g	2.200	22.00	21.40	2.80			
	Body 5600	1g	8.080	80.80	80.40	0.50	±10	21.9	January 20, 2018
		10g	2.240	22.40	22.50	-0.44			
	Body 5750	1g	7.710	77.10	77.00	0.13	±10	21.9	January 20, 2018
		10g	2.150	21.50	21.50	0.00			
	Body 5750	1g	7.640	76.40	77.00	-0.78	±10	21.6	January 25, 2018
		10g	2.130	21.30	21.50	-0.93			
	Body 5750	1g	7.700	77.00	77.00	0.00	±10	21.2	February 9, 2018
		10g	2.140	21.40	21.50	-0.47			

11. Measured and Reported (Scaled) SAR Results

As per KDB 447498 sec.4.1.e), When SAR or MPE is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported.

SAR Test Reduction criteria are as follows:

KDB 447498 D01 General RF Exposure Guidance:

- A) Per KDB447498 D01 v06, all SAR measurement results are scaled to the maximum tune-up tolerance limit to demonstrate SAR compliance.
- B) 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.

Per KDB865664 D01 v01r04:

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.

Per KDB 248227 D01 v02r02:

For Wi-Fi SAR testing, a communication link is set up with the testing software for Wi-Fi mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. The RF signal utilized in SAR measurement has 100% duty cycle and its crest factor is 1. The test procedures in KDB 248227 D01 v02r02 are applied. (Refer to KDB 248227D01 v02r02 for more details)

Initial Test Position Procedure

For exposure condition with multiple test position, such as handsets operating next to the ear, devices with hotspot mode or UMPC mini-tablet, 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 position in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test position is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8 W/kg or all test position are measured. For all positions/configurations tested using the initial test position and subsequent test positions, 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.

Initial Test Configuration Procedure

An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. SAR is measured using the highest measured maximum output power channel. For configurations with the same specified or measured maximum output power, additional transmission mode and test channel selection procedures are required (see section 5.3.2 of KDB 248227D01 v02r02). SAR test reduction of subsequent highest output test channels is based on the reported SAR of the initial test configuration.

For next to the ear, hotspot mode and UMC mini-tablet exposure configurations where multiple test positions are required, the initial test position procedure is applied to minimize the number of test positions required for SAR

measurement using the initial test configuration transmission mode. For fixed exposure conditions that do not have multiple SAR test positions, SAR is measured in the transmission mode determined by the initial test configuration. When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

Sub Test Configuration Procedure

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units. When the highest reported SAR for the initial test configuration, according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.

11.1. SAR Test Results of 2.4G Wi-Fi

Test Position (Body 0mm)	Test Mode	Channel/Frequency	Power (dBm)		SAR Value		Power Drift	Duty Factor (%)	Scaled 1-g (W/Kg)	Scaled 10-g (W/Kg)
			Tune-up	Meas.	1-g (W/Kg)	10-g (W/Kg)				
ANT.1										
Top Surface	802.11 b	6/2437	22.00	20.56	0.143	0.067	0.16	99.0	0.201	0.095
Right Side	802.11 b	6/2437	22.00	20.56	0.501	0.204	0.00	99.0	0.705	0.287
Front Side	802.11 b	6/2437	22.00	20.56	0.123	0.061	-0.11	99.0	0.173	0.086
Back Side	802.11 b	6/2437	22.00	20.56	0.079	0.036	-0.04	99.0	0.111	0.051
ANT.2										
Top Surface	802.11 b	6/2437	22.00	20.67	0.145	0.067	-0.03	99.0	0.199	0.092
Left Side	802.11 b	6/2437	22.00	20.67	0.443	0.186	0.09	99.0	0.608	0.255
Front Side	802.11 b	6/2437	22.00	20.67	0.123	0.062	-0.05	99.0	0.169	0.084
Back Side	802.11 b	6/2437	22.00	20.67	0.102	0.049	0.11	99.0	0.140	0.067

Note:

Because the SAR value evaluated at 0mm meet the limit of 1-g SAR and 10-g SAR at the same time, so SAR evaluation for 1-g Body SAR is abandoned.

OFDM mode SAR evaluation exclusion analysis for 1-g SAR for ANT.1

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11b	22	158.49	0.705	\	\
802.11g	22	158.49	\	0.705	Excluded
802.11n (20M)	22	158.49	\	0.705	Excluded

Note:

1) The highest reported SAR for DSSS adjusted by the ratio of OFDM 802.11g/n to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, so SAR evaluation for 802.11g/n is not required.

OFDM mode SAR evaluation exclusion analysis for 10-g SAR for ANT.1

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 10-g (W/Kg)	Adjusted SAR 10-g (W/Kg)	SAR test
802.11b	22	158.49	0.287	\	\
802.11g	22	158.49	\	0.287	Excluded
802.11n (20M)	22	158.49	\	0.287	Excluded

Note:

1) The highest reported SAR for DSSS adjusted by the ratio of OFDM 802.11g/n to DSSS specified maximum output power and the adjusted SAR is ≤ 2.4 W/kg, so SAR evaluation for 802.11g/n is not required.

OFDM mode SAR evaluation exclusion analysis for 1-g SAR for ANT.2

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11b	22	158.49	0.608	\	\
802.11g	22	158.49	\	0.608	Excluded
802.11n (20M)	22	158.49	\	0.608	Excluded

Note:

1) The highest reported SAR for DSSS adjusted by the ratio of OFDM 802.11g/n to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, so SAR evaluation for 802.11g/n is not required.

OFDM mode SAR evaluation exclusion analysis for 10-g SAR for ANT.2

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 10-g (W/Kg)	Adjusted SAR 10-g (W/Kg)	SAR test
802.11b	22	158.49	0.255	\	\
802.11g	22	158.49	\	0.255	Excluded
802.11n (20M)	22	158.49	\	0.255	Excluded

Note:

1) The highest reported SAR for DSSS adjusted by the ratio of OFDM 802.11g/n to DSSS specified maximum output power and the adjusted SAR is ≤ 2.4 W/kg, so SAR evaluation for 802.11g/n is not required.

11.2. SAR Test Results of 5G Wi-Fi

Test Position (Body 10mm)	Test Mode	Channel/ Frequency	Power (dBm)		SAR Value 1-g (W/Kg)	Power Drift	Duty Factor (%)	Scaled 1-g (W/Kg)
			Tune-up	Meas.				
ANT.1								
U-NII-1								
Top Surface	802.11n 40M	38/5190	16.00	15.52	0.242	-0.04	86.0	0.314
Right Side	802.11n 40M	38/5191	16.00	15.52	0.356	-0.07	86.0	0.462
Front Side	802.11n 40M	38/5190	16.00	15.52	0.054	0.16	86.0	0.070
Back Side	802.11n 40M	38/5190	16.00	15.52	0.114	-0.11	86.0	0.148
U-NII-2A								
Top Surface	802.11a	60/5300	16.00	15.83	0.366	-0.08	93.0	0.409
Right Side	802.11a	60/5300	16.00	15.83	0.544	-0.05	93.0	0.608
Front Side	802.11a	60/5300	16.00	15.83	0.092	0.01	93.0	0.103
Back Side	802.11a	60/5300	16.00	15.83	0.200	0.16	93.0	0.224
U-NII-2C								
Top Surface	802.11n 40M	102/5510	16.00	15.23	0.290	-0.14	86.0	0.403
Right Side	802.11n 40M	102/5510	16.00	15.23	0.443	-0.01	86.0	0.615
Front Side	802.11n 40M	102/5510	16.00	15.23	0.036	0.00	86.0	0.051
Back Side	802.11n 40M	102/5510	16.00	15.23	0.082	-0.17	86.0	0.114
U-NII-3								
Top Surface	802.11a	161/5805	16.50	16.31	0.441	-0.13	93.0	0.495
Right Side	802.11a	161/5805	16.50	16.31	0.952	-0.01	93.0	1.069
Front Side	802.11a	161/5805	16.50	16.31	0.085	-0.18	93.0	0.096
Back Side	802.11a	161/5805	16.50	16.31	0.144	0.04	93.0	0.162
Right Side	802.11a	157/5785	16.50	15.94	0.864	-0.01	93.0	1.057
Right Side-Repeated	802.11a	161/5805	16.50	16.31	0.863	0.00	93.0	0.969
ANT.2								
U-NII-1								
Top Surface	802.11n 40M	38/5190	16.00	15.44	0.274	0.18	86.0	0.362
Left Side	802.11n 40M	38/5190	16.00	15.44	0.379	0.15	86.0	0.501
Front Side	802.11n 40M	38/5191	16.00	15.44	0.096	0.14	86.0	0.127
Back Side	802.11n 40M	38/5192	16.00	15.44	0.153	0.18	86.0	0.202
U-NII-2A								
Top Surface	802.11a	60/5300	16.00	15.99	0.317	-0.18	93.0	0.342
Left Side	802.11a	60/5300	16.00	15.99	0.470	0.04	93.0	0.507
Front Side	802.11a	60/5300	16.00	15.99	0.121	0.05	93.0	0.130
Back Side	802.11a	60/5300	16.00	15.99	0.142	0.13	93.0	0.153
U-NII-2C								
Top Surface	802.11n 40M	102/5510	16.00	14.78	0.229	-0.19	86.0	0.353
Left Side	802.11n 40M	102/5510	16.00	14.78	0.636	0.01	86.0	0.979
Front Side	802.11n 40M	102/5510	16.00	14.78	0.054	0.05	86.0	0.083
Back Side	802.11n 40M	102/5510	16.00	14.78	0.115	0.02	86.0	0.177
Left Side	802.11n 40M	140/5700	16.00	14.75	0.526	0.12	86.0	0.816
U-NII-3								
Top Surface	802.11a	161/5805	16.50	16.34	0.338	0.14	93.0	0.377
Left Side	802.11a	161/5805	16.50	16.34	0.943	0.15	93.0	1.052
Front Side	802.11a	161/5805	16.50	16.34	0.081	-0.17	93.0	0.090

Back Side	802.11a	161/5805	16.50	16.34	0.199	0.09	93.0	0.222
Left Side	802.11a	157/5785	16.50	16.01	0.704	0.16	93.0	0.847
Right Side-Repeated	802.11a	161/5805	16.50	16.34	1.010	0.20	93.0	1.127

Subsequent test configuration SAR evaluation exclusion analysis for 1-g SAR for ANT.1 (U-NII-1)

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11n 40M	16	39.81	0.462	\	\
802.11a	16	39.81	\	0.462	Excluded
802.11n 20M	16	39.81	\	0.462	Excluded
802.11ac 20M	15	31.62	\	0.367	Excluded
802.11ac 40M	14	25.12	\	0.292	Excluded
802.11ac 80M	14	25.12	\	0.292	Excluded

Note:

The 802.11n 40M mode is selected as Initial Test Configuration for SAR test according to the specified maximum output power. As the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR test for the other 802.11 modes are not required.

Subsequent test configuration SAR evaluation exclusion analysis for 1-g SAR for ANT.1 (U-NII-2A)

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11a	16	39.81	0.608	\	\
802.11n 20M	12	15.85	\	0.242	Excluded
802.11n 40M	15	31.62	\	0.483	Excluded
802.11ac 20M	12	15.85	\	0.242	Excluded
802.11ac 40M	13	19.95	\	0.305	Excluded
802.11ac 80M	14	25.12	\	0.384	Excluded

Note:

The 802.11a mode is selected as Initial Test Configuration for SAR test according to the specified maximum output power. As the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR test for the other 802.11 modes are not required.

Subsequent test configuration SAR evaluation exclusion analysis for 1-g SAR for ANT.1 (U-NII-2C)

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11n 40M	16	39.81	0.615	\	\
802.11a	16	39.81	\	0.615	Excluded
802.11n 20M	15	31.62	\	0.489	Excluded
802.11ac 20M	15	31.62	\	0.489	Excluded
802.11ac 40M	13	19.95	\	0.308	Excluded
802.11ac 80M	14	25.12	\	0.388	Excluded

Note:

The 802.11n 40M mode is selected as Initial Test Configuration for SAR test according to the specified maximum output power. As the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR test for the other 802.11 modes are not required.

Subsequent test configuration SAR evaluation exclusion analysis for 1-g SAR for ANT.1 (U-NII-3)

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11a	16.5	44.67	1.069	\	\
802.11n 20M	15.5	35.48	\	0.849	Excluded
802.11n 40M	16	39.81	\	0.953	Excluded
802.11ac 20M	15.5	35.48	\	0.849	Excluded
802.11ac 40M	14	25.12	\	0.601	Excluded
802.11ac 80M	14	25.12	\	0.601	Excluded

Note:

The 802.11a mode is selected as Initial Test Configuration for SAR test according to the specified maximum output power. As the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR test for the other 802.11 modes are not required.

Subsequent test configuration SAR evaluation exclusion analysis for 1-g SAR for ANT.2 (U-NII-1)

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11n 40M	16	39.81	0.501	\	\
802.11a	16	39.81	\	0.501	Excluded
802.11n 20M	16	39.81	\	0.501	Excluded
802.11ac 20M	15	31.62	\	0.398	Excluded
802.11ac 40M	14	25.12	\	0.316	Excluded
802.11ac 80M	14	25.12	\	0.316	Excluded

Note:

The 802.11n 40M mode is selected as Initial Test Configuration for SAR test according to the specified maximum output power. As the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR test for the other 802.11 modes are not required.

Subsequent test configuration SAR evaluation exclusion analysis for 1-g SAR for ANT.2 (U-NII-2A)

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11a	16	39.81	0.507	\	\
802.11n 20M	12	15.85	\	0.202	Excluded
802.11n 40M	15	31.62	\	0.403	Excluded
802.11ac 20M	12	15.85	\	0.202	Excluded
802.11ac 40M	13	19.95	\	0.254	Excluded
802.11ac 80M	14	25.12	\	0.320	Excluded

Note:

The 802.11a mode is selected as Initial Test Configuration for SAR test according to the specified maximum output power. As the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR test for the other 802.11 modes are not required.

Subsequent test configuration SAR evaluation exclusion analysis for 1-g SAR for ANT.2 (U-NII-2C)

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11n 40M	16	39.81	0.979	\	\
802.11a	16	39.81	\	0.979	Excluded
802.11n 20M	15	31.62	\	0.778	Excluded
802.11ac 20M	15	31.62	\	0.778	Excluded
802.11ac 40M	13	19.95	\	0.491	Excluded
802.11ac 80M	14	25.12	\	0.618	Excluded

Note:

The 802.11n 40M mode is selected as Initial Test Configuration for SAR test according to the specified maximum output power. As the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR test for the other 802.11 modes are not required.

Subsequent test configuration SAR evaluation exclusion analysis for 1-g SAR for ANT.2 (U-NII-3)

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR 1-g (W/Kg)	Adjusted SAR 1-g (W/Kg)	SAR test
802.11a	16.5	44.67	1.127	\	\
802.11n 20M	15.5	35.48	\	0.895	Excluded
802.11n 40M	16	39.81	\	1.004	Excluded
802.11ac 20M	15.5	35.48	\	0.895	Excluded
802.11ac 40M	14	25.12	\	0.634	Excluded
802.11ac 80M	14	25.12	\	0.634	Excluded

Note:

The 802.11a mode is selected as Initial Test Configuration for SAR test according to the specified maximum output power. As the highest reported SAR for the initial test configuration is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR test for the other 802.11 modes are not required.

12. Simultaneous Transmission SAR Analysis

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna.

The antenna 1 supports 2.4 Wi-Fi and 5G Wi-Fi, the antenna 2 supports 2.4 Wi-Fi, 5G Wi-Fi and BT. The two antennas can always transmit simultaneously. The work mode combination is showed as below table.

Combination NO.	Mode
1	2.4G Wi-Fi(antenna 1)+ 2.4G Wi-Fi(antenna 2)
2	2.4G Wi-Fi(antenna 1)+ 5G Wi-Fi(antenna 2)
3	2.4G Wi-Fi(antenna 1)+ BT(antenna 2)
4	5G Wi-Fi(antenna 1)+ 2.4G Wi-Fi(antenna 2)
5	5G Wi-Fi(antenna 1)+ 5G Wi-Fi(antenna 2)
6	5G Wi-Fi(antenna 1)+ BT(antenna 2)

12.1. Estimated SAR

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- 1) $(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})$.
 $[\sqrt{f(\text{GHz})}/x] \text{ W/kg}$ for test separation distances $\leq 50 \text{ mm}$, where $x = 7.5$ for 1-g SAR and $x = 18.75$ for 10-g SAR.
- 2) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distance is $> 50 \text{ mm}$.

When the minimum test separation distance is $< 5 \text{ mm}$, a distance of 5 mm is applied.

Estimated 10-g SAR calculated result of 5G Wi-Fi

Position	Frequency (GHz)	Power (dBm)	Power (mW)	Separation Distance (mm)	Estimate 10g SAR (W/Kg)
Top surface	0.5825	16.50	44.67	20	0.091
Bottom surface	0.5825	16.50	44.67	135	1.000
Left side for antenna 1	0.5825	16.50	44.67	85	1.000
Left side for antenna 2	0.5825	16.50	44.67	15	0.121
Right side for antenna 1	0.5825	16.50	44.67	15	0.121
Right side for antenna 2	0.5825	16.50	44.67	85	1.000
Front side	0.5825	16.50	44.67	30	0.061
Back side	0.5825	16.50	44.67	30	0.061

12.2. Simultaneous Transmission calculation for 1-g SAR

For Combination NO.1 1-g SAR

Test Position	2.4G Wi-Fi (antenna 1) 1-g SAR (W/Kg)	2.4G Wi-Fi (antenna 2) 1-g SAR (W/Kg)	SUM 1-g SAR (W/Kg)	SPLSR
Top Surface	0.201	0.199	0.400	Excluded
Bottom Surface	0.400	0.400	0.800	Excluded
Left Side	0.400	0.608	1.008	Excluded
Right Side	0.705	0.400	1.105	Excluded
Front Side	0.173	0.169	0.342	Excluded
Back Side	0.111	0.140	0.251	Excluded

Note:

Because the maximum SUM 1-g SAR ≤ 1.6 W/Kg, so the SPLSR analysis is not required.

For Combination NO.2 1-g SAR

Test Position	2.4G Wi-Fi (antenna 1) 1-g SAR (W/Kg)	5G Wi-Fi (antenna 2) 1-g SAR (W/Kg)	SUM 1-g SAR (W/Kg)	SPLSR
Top Surface	0.201	0.377	0.578	Excluded
Bottom Surface	0.400	0.400	0.800	Excluded
Left Side	0.400	1.127	1.527	Excluded
Right Side	0.705	0.400	1.105	Excluded
Front Side	0.173	0.130	0.303	Excluded
Back Side	0.111	0.222	0.333	Excluded

Note:

Because the maximum SUM 1-g SAR ≤ 1.6 W/Kg, so the SPLSR analysis is not required.

For Combination NO.3 1-g SAR

Test Position	2.4G Wi-Fi (antenna 1) 1-g SAR (W/Kg)	BT (antenna 2) 1-g SAR (W/Kg)	SUM 1-g SAR (W/Kg)	SPLSR
Top Surface	0.201	0.013	0.214	Excluded
Bottom Surface	0.400	0.400	0.800	Excluded
Left Side	0.400	0.018	0.418	Excluded
Right Side	0.705	0.400	1.105	Excluded
Front Side	0.173	0.009	0.182	Excluded
Back Side	0.111	0.009	0.120	Excluded

Note:

Because the maximum SUM 1-g SAR ≤ 1.6 W/Kg, so the SPLSR analysis is not required.

For Combination NO.4 1-g SAR

Test Position	5G Wi-Fi (antenna 1) 1-g SAR (W/Kg)	2.4G Wi-Fi (antenna 2) 1-g SAR (W/Kg)	SUM 1-g SAR (W/Kg)	SPLSR
Top Surface	0.495	0.199	0.694	Excluded
Bottom Surface	0.400	0.400	0.800	Excluded
Left Side	0.400	0.608	1.008	Excluded
Right Side	1.069	0.400	1.469	Excluded
Front Side	0.103	0.169	0.272	Excluded
Back Side	0.224	0.140	0.364	Excluded

Note:

Because the maximum SUM 1-g SAR \leq 1.6 W/Kg, so the SPLSR analysis is not required.

For Combination NO.5 1-g SAR

Test Position	5G Wi-Fi (antenna 1) 1-g SAR (W/Kg)	5G Wi-Fi (antenna 2) 1-g SAR (W/Kg)	SUM 1-g SAR (W/Kg)	SPLSR
Top Surface	0.495	0.377	0.872	Excluded
Bottom Surface	0.400	0.400	0.800	Excluded
Left Side	0.400	1.127	1.527	Excluded
Right Side	1.069	0.400	1.469	Excluded
Front Side	0.103	0.130	0.233	Excluded
Back Side	0.224	0.222	0.446	Excluded

Note:

Because the maximum SUM 1-g SAR \leq 1.6 W/Kg, so the SPLSR analysis is not required.

For Combination NO.6 1-g SAR

Test Position	5G Wi-Fi (antenna 1) 1-g SAR (W/Kg)	BT (antenna 2) 1-g SAR (W/Kg)	SUM 1-g SAR (W/Kg)	SPLSR
Top Surface	0.495	0.013	0.495	Excluded
Bottom Surface	0.400	0.400	0.400	Excluded
Left Side	0.400	0.018	0.400	Excluded
Right Side	1.069	0.400	1.069	Excluded
Front Side	0.103	0.009	0.103	Excluded
Back Side	0.224	0.009	0.224	Excluded

Note:

Because the maximum SUM 1-g SAR \leq 1.6 W/Kg, so the SPLSR analysis is not required.

12.3. Simultaneous Transmission calculation for 10-g SAR

For Combination NO.1 10-g SAR

Test Position	2.4G Wi-Fi (antenna 1) 10-g SAR (W/Kg)	2.4G Wi-Fi (antenna 2) 10-g SAR (W/Kg)	SUM 10-g SAR (W/Kg)	SPLSR
Top Surface	0.095	0.092	0.187	Excluded
Bottom Surface	1.000	1.000	2.000	Excluded
Left Side	1.000	0.255	1.255	Excluded
Right Side	0.287	1.000	1.287	Excluded
Front Side	0.086	0.084	0.170	Excluded
Back Side	0.051	0.067	0.118	Excluded

Note:

Because the maximum SUM 10-g SAR \leq 4.0 W/kg, so the SPLSR analysis is not required.

For Combination NO.2 10-g SAR

Test Position	2.4G Wi-Fi (antenna 1) 10-g SAR (W/Kg)	5G Wi-Fi (antenna 2) 10-g SAR (W/Kg)	SUM 10-g SAR (W/Kg)	SPLSR
Top Surface	0.095	0.091	0.186	Excluded
Bottom Surface	1.000	1.000	2.000	Excluded
Left Side	1.000	0.121	1.121	Excluded
Right Side	0.287	1.000	1.287	Excluded
Front Side	0.086	0.061	0.147	Excluded
Back Side	0.051	0.061	0.112	Excluded

Note:

Because the maximum SUM 10-g SAR \leq 4.0 W/kg, so the SPLSR analysis is not required.

For Combination NO.3 10-g SAR

Test Position	2.4G Wi-Fi (antenna 1) 10-g SAR (W/Kg)	BT (antenna 2) 10-g SAR (W/Kg)	SUM 10-g SAR (W/Kg)	SPLSR
Top Surface	0.095	0.005	0.100	Excluded
Bottom Surface	1.000	1.000	2.000	Excluded
Left Side	1.000	0.007	1.007	Excluded
Right Side	0.287	1.000	1.287	Excluded
Front Side	0.086	0.004	0.090	Excluded
Back Side	0.051	0.004	0.055	Excluded

Note:

Because the maximum SUM 10-g SAR \leq 4.0 W/kg, so the SPLSR analysis is not required.

For Combination NO.4 10-g SAR

Test Position	5G Wi-Fi (antenna 1) 10-g SAR (W/Kg)	2.4G Wi-Fi (antenna 2) 10-g SAR (W/Kg)	SUM 10-g SAR (W/Kg)	SPLSR
Top Surface	0.091	0.092	0.183	Excluded
Bottom Surface	1.000	1.000	2.000	Excluded
Left Side	1.000	0.255	1.255	Excluded
Right Side	0.121	1.000	1.121	Excluded
Front Side	0.061	0.084	0.145	Excluded
Back Side	0.061	0.067	0.128	Excluded

Note:

Because the maximum SUM 10-g SAR ≤ 4.0 W/kg, so the SPLSR analysis is not required.

For Combination NO.5 10-g SAR

Test Position	5G Wi-Fi (antenna 1) 10-g SAR (W/Kg)	5G Wi-Fi (antenna 2) 10-g SAR (W/Kg)	SUM 10-g SAR (W/Kg)	SPLSR
Top Surface	0.091	0.092	0.183	Excluded
Bottom Surface	1.000	1.000	2.000	Excluded
Left Side	1.000	0.255	1.255	Excluded
Right Side	0.121	1.000	1.121	Excluded
Front Side	0.061	0.084	0.145	Excluded
Back Side	0.061	0.067	0.128	Excluded

Note:

Because the maximum SUM 10-g SAR ≤ 4.0 W/kg, so the SPLSR analysis is not required.

For Combination NO.6 10-g SAR

Test Position	5G Wi-Fi (antenna 1) 10-g SAR (W/Kg)	BT (antenna 2) 10-g SAR (W/Kg)	SUM 10-g SAR (W/Kg)	SPLSR
Top Surface	0.091	0.092	0.183	Excluded
Bottom Surface	1.000	1.000	2.000	Excluded
Left Side	1.000	0.255	1.255	Excluded
Right Side	0.121	1.000	1.121	Excluded
Front Side	0.061	0.084	0.145	Excluded
Back Side	0.061	0.067	0.128	Excluded

Note:

Because the maximum SUM 10-g SAR ≤ 4.0 W/kg, so the SPLSR analysis is not required.

Appendixes

Refer to separated files for the following appendixes.

4788325650-2_App A Photo

4788325650-2_App B System Check Plots

4788325650-2_App C Highest Test Plots

4788325650-2_App D Cal. Certificates

-----End of Report-----