SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std. 1528-2013

For
CHAMPe Bingo Handset

FCC ID: 2AUX7-VK10
Model: VK10

Report Number: 4789182259-11-SAR-2

Issue Date: December 24, 2019

Prepared for
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Prepared by
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Revision History

Rev.	Date	Revisions	Revised By
V1.0	November 22, 2019	Initial Issue	\
V2.0	December 24, 2019	1. Page 17 Updated antenna location 2. Page 10 section 4.3, updated table. 3. Page 27, section 10.2, updated SAR test results table 4. Updated Appendix A	Jacky Jiang

Table of Contents

1. Attestation of Test Results

Applicant Name	Estone Technology LTD.,		
Address	2F,Building No.1, Jia'an Industrial Park, No.2 Long Chang Road, Bao'an, Shenzhen 518101, China.		
Manufacturer	Estone Technology LTD.,		
Address	2F,Building No.1, Jia'an Industrial Park, No.2 Long Chang Road, Bao'an, Shenzhen 518101, China.		
EUT Name	CHAMPe Bingo Handset		
Model	VK10		
Sample Status	Normal		
Sample Received Date	October 10, 2019		
Date of Tested	October 15~November 21, 2019		
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**		
	DSS	**DTS**	**U-NII**
Body (1-g)	/	1.338	1.429
Simultaneous Transmission (1-g)	1.471		
Test Results	Pass		

Prepared By:	Reviewed By:	Approved By:
Jacky Jiang	Shawn Wen	Stephen Guo
Engineer Project Associate	Laboratory Leader	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
- 616217 D04 SAR for laptop and tablets

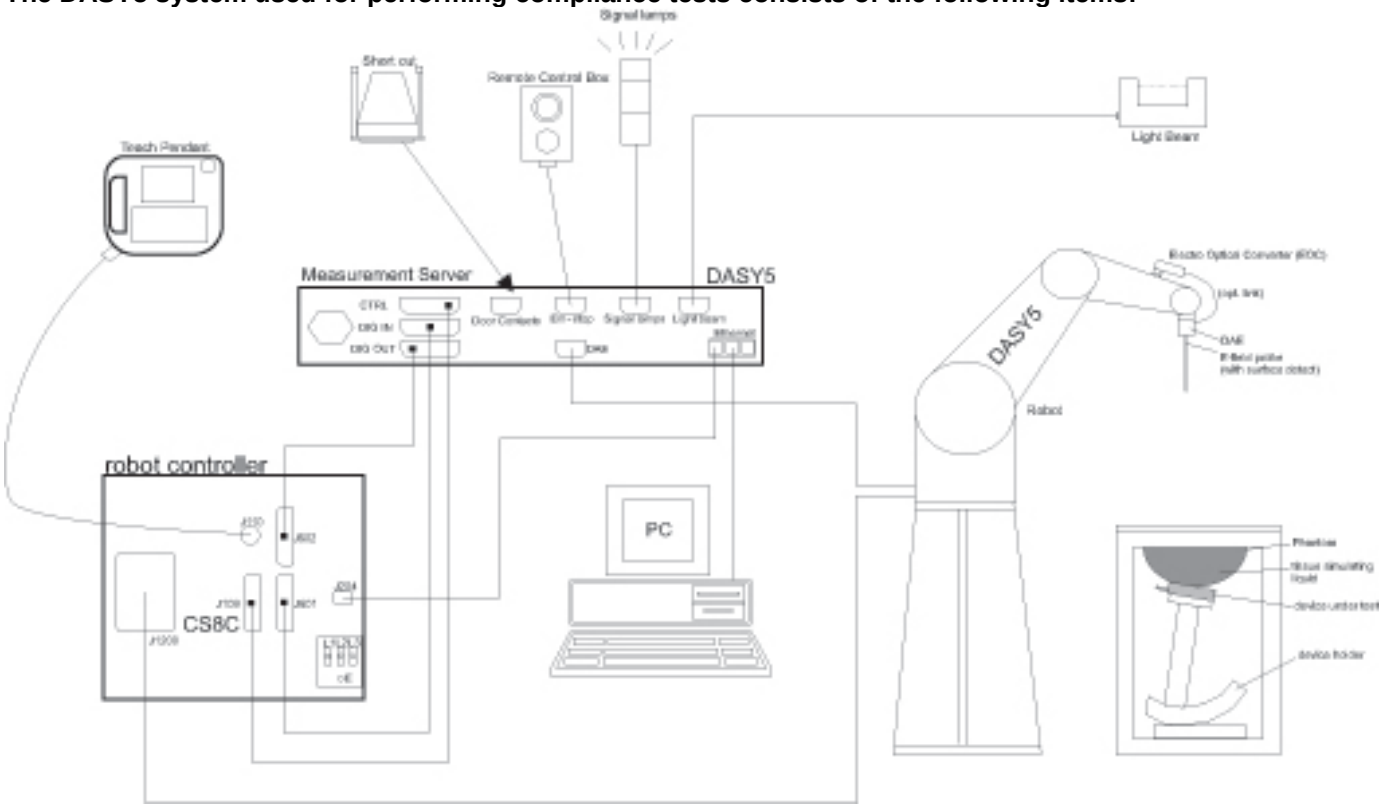
3. Facilities and Accreditation

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	**A2LA (Certificate No.: 4102.01)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been assessed and proved to be in compliance with A2LA. **FCC (FCC Recognized No.: CN1187)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules **IC(Company No.: 21320)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been registered and fully described in a report filed with Industry Canada. The Company Number is 21320. **VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011)** UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793. Facility Name: Chamber D, the VCCI registration No. is G-20019 and R-20004 Shielding Room B , the VCCI registration No. is C-20012 and T-20011
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	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

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: Δx_{Zoom}, Δy_{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 1st 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 *reported* SAR from the area scan based *1-g SAR estimation* 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 10, 2019
Dielectric Probe kit	SPEAG	SM DAK 040 SA	1155	NCR
DC power supply	Keysight	E36103A	MY55350020	December 10, 2019
Signal Generator	Rohde & Schwarz	SME06	837633\001	December 10, 2019
BI-Directional Coupler	WERLATONE	C8060-102	3423	December 10, 2019
Peak and Average Power Sensor	Keysight	E9323A	MY55440013	December 10, 2019
Peak and Average Power Sensor	Keysight	E9323A	MY55420006	December 10, 2019
Dual Channel PK Power Meter	Keysight	N1912A	MY55416024	December 10, 2019
Amplifier	CORAD TECHNOLOGY LTD	AMF-4D-00400600-50-30P	1983561	NCR
Dosimetric E-Field Probe	SPEAG	EX3DV4	7383	December 19, 2019
Data Acquisition Electronic	SPEAG	DAE3	427	December 11, 2019
Dipole Kit 2450 MHz	SPEAG	D2450V2	977	December 4, 2021
Dipole Kit 5 GHz	SPEAG	D5GHzV2	1231	December 14, 2021
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 6, 2019
Thermometer	VICTOR	VC230	/	December 10, 2019

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 DUT is a CHAMPe Bingo Handset with IEEE 802.11a/b/g/n/ac radio.	
Dimension	Overall (Length x Width x Height): 293 mm x 187 mm x 27.5 mm

6.2. Wireless Technology

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

7. Conducted Output Power Measurement and tune-up tolerance

7.1. Power measurement result of 2.4GHz Wi-Fi.

Mode	Channel	Frequency (MHz)	Data Rate	Average Power (dBm)	Tune-up Limit (dBm)	SAR Test	Duty Cycle %
802.11b	1	2412	1Mbps	15.76	15.5	Required	100
	6	2437		15.60	15.5		
	11	2462		15.06	15.5		
802.11g	1	2412	6Mbps	Not Required	15.0	Excluded	\
	6	2437			15.0		
	11	2462			15.0		
802.11n-HT20	1	2412	MCS0	Not Required	14.0	Excluded	\
	6	2437			14.0		
	11	2462			14.0		
802.11n-HT40	3	2422	MCS0	Not Required	13.0	Excluded	\
	6	2437			13.0		
	9	2452			13.0		

7.2. Power measurement result of 5GHz Wi-Fi (U-NII-1).

Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-up Limit	SAR Test	Duty Cycle %
802.11a	36	5180	6Mbps	15.39	15.5	Required	97.6
	40	5200		15.38	15.5		
	48	5240		15.29	15.5		
802.11n-HT20	36	5180	MCS0	Not Required	14.5	Excluded	\
	40	5200			14.5		
	48	5240			14.5		
802.11n-HT40	38	5190	MCS0	Not Required	14.5	Excluded	\
	46	5230			14.5		
802.11ac-VHT20	36	5180	MCS0	Not Required	13.5	Excluded	\
	40	5200			13.5		
	48	5240			13.5		
802.11ac-VHT40	38	5190	MCS0	Not Required	13.5	Excluded	\
	46	5230			13.5		
802.11ac-VHT80	42	5210	MCS0	Not Required	13.5	Excluded	\

7.3. Power measurement result of 5GHz Wi-Fi (U-NII-2A).

Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-up Limit	SAR Test	Duty Cycle %
802.11a	52	5260	6Mbps	Not Required	15.5	Required	97.6
	60	5300			15.5		
	64	5320			15.5		
802.11n-HT20	52	5260	MCS0	Not Required	14.5	Excluded	\
	60	5300			14.5		
	64	5320			14.5		
802.11n-HT40	54	5270	MCS0	Not Required	14.5	Excluded	\

	62	5310			14.5		
802.11ac-VHT20	52	5260	MCS0	Not Required	13.5	Excluded	\
	60	5300			13.5		
	64	5320			13.5		
802.11ac-VHT40	54	5270	MCS0	Not Required	13.5	Excluded	\
	62	5310			13.5		
802.11ac-VHT80	58	5290	MCS0	Not Required	13.5	Excluded	\

7.4. Power measurement result of 5GHz Wi-Fi (U-NII-2C).

Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-up Limit	SAR Test	Duty Cycle %
802.11a	100	5500	6Mbps	14.83	15.5	Required	97.6
	104	5520		14.75	15.5		
	108	5540		14.62	15.5		
	112	5560		14.39	15.5		
	116	5580		14.77	15.5		
	120	5600		15.08	15.5		
	124	5620		14.59	15.5		
	128	5640		14.81	15.5		
	132	5660		14.63	15.5		
	136	5680		14.76	15.5		
	140	5700		14.94	15.5		
	144	5720		14.36	15.5		
802.11n-HT20	100	5500	MCS0	Not Required	14.5	Excluded	\
	104	5520			14.5		
	108	5540			14.5		
	112	5560			14.5		
	116	5580			14.5		
	120	5600			14.5		
	124	5620			14.5		
	128	5640			14.5		
	132	5660			14.5		
	136	5680			14.5		
	140	5700			14.5		
	144	5720			14.5		
802.11n-HT40	102	5510	MCS0	Not Required	14.5	Excluded	\
	110	5550			14.5		
	118	5590			14.5		
	126	5630			14.5		
	134	5670			14.5		
	142	5710			14.5		
802.11ac-VHT20	100	5500	MCS0	Not Required	13.5	Excluded	\
	104	5520			13.5		
	108	5540			13.5		
	112	5560			13.5		
	116	5580			13.5		
	120	5600			13.5		
	124	5620			13.5		

	128	5640			13.5		
	132	5660			13.5		
	136	5680			13.5		
	140	5700			13.5		
	144	5720			13.5		
802.11ac-VHT40	102	5510	MCS0	Not Required	13.5	Excluded	\
	110	5550			13.5		
	118	5590			13.5		
	126	5630			13.5		
	134	5670			13.5		
	142	5710			13.5		
802.11ac-VHT80	106	5530	MCS0	Not Required	13.5	Excluded	\
	122	5610			13.5		
	138	5690			13.5		

7.5. Power measurement result of 5GHz Wi-Fi (U-NII-3).

Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-up Limit	SAR Test	Duty Cycle %
802.11a	149	5745	6Mbps	13.04	14.0	Required	97.6
	153	5765		12.98	14.0		
	157	5785		13.16	14.0		
	161	5805		13.02	14.0		
	165	5825		13.31	14.0		
802.11n-HT20	149	5745	MCS0	Not Required	13.0	Excluded	\
	153	5765			13.0		
	157	5785			13.0		
	161	5805			13.0		
	165	5825			13.0		
802.11n-HT40	151	5755	MCS0	Not Required	13.0	Excluded	\
	159	5795			13.0		
802.11ac-VHT20	149	5745	MCS0	Not Required	13.0	Excluded	\
	153	5765			13.0		
	157	5785			13.0		
	161	5805			13.0		
	165	5825			13.0		
802.11ac-VHT40	151	5755	MCS0	Not Required	13.0	Excluded	\
	159	5795			13.0		
802.11ac-VHT80	155	5775	MCS0	Not Required	13.0	Excluded	\

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.

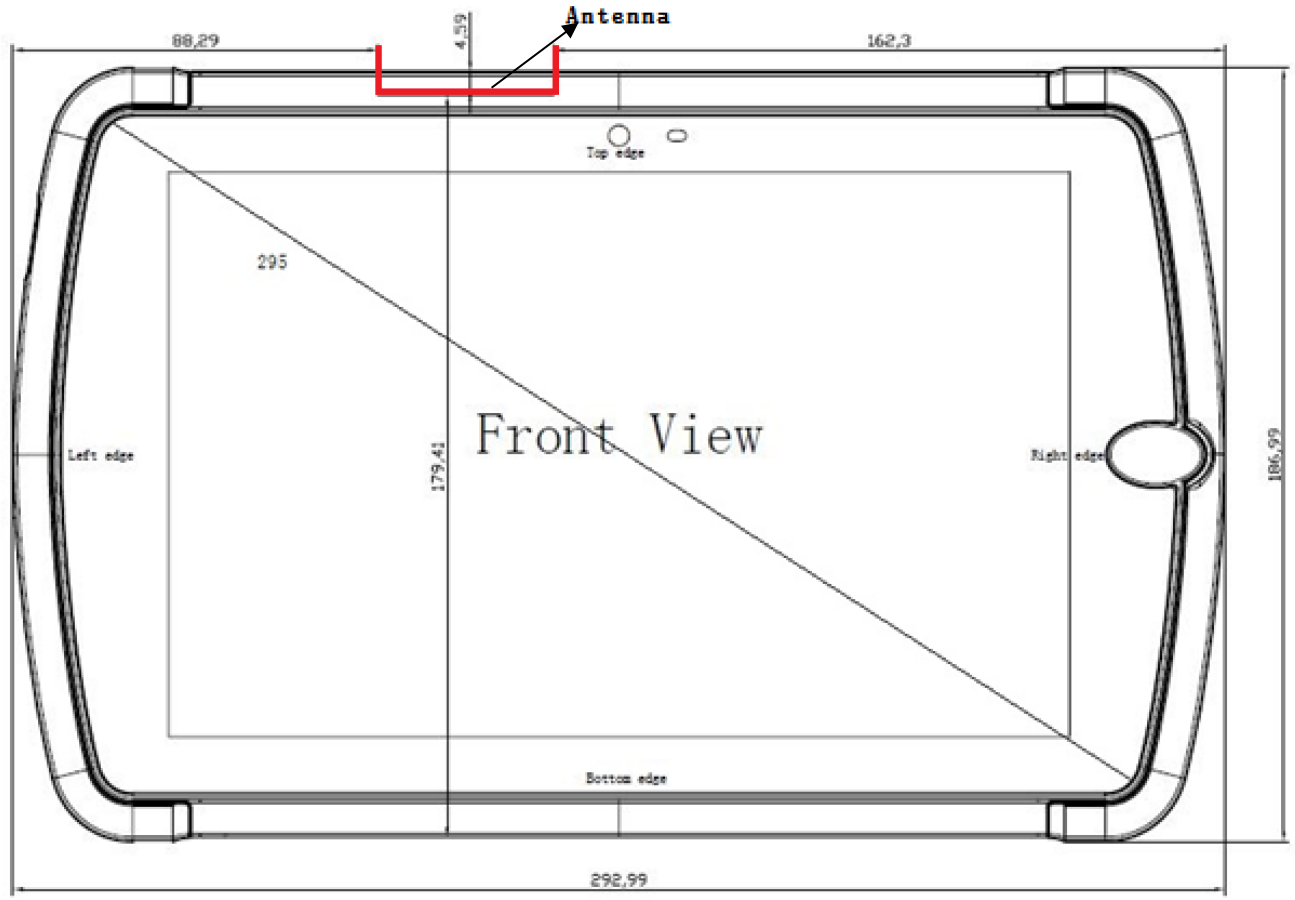
7.6. Power measurement result BT

Band	Mode	Average Conducted Power (dBm)			Tune-up
		0CH	39CH	78CH	
2.4G	DH5	4.60	4.66	4.78	5.0
	3DH5	-1.30	-1.28	-1.32	-1.0

Band	Mode	Average Conducted Power (dBm)			Tune-up
		0CH	19CH	39CH	
2.4G	BLE	3.09	3.84	3.24	4.0

8. RF Exposure Conditions

Refer to the diagram of the device below for the specific details of the antenna to edges distances.



Per FCC KDB 616217 D04

The overall diagonal dimension of the display section of a tablet is > 20cm, the bottom surface and edges of the tablet should be selected for SAR evaluation at a 0mm separation distance, Exposures from antennas through the front surface of the display section of a full-size tablet, away from the edges, are generally limited to the user's hands. Exposures to hands for typical consumer transmitters used in tablets are not expected to exceed the extremity SAR limit; therefore, SAR evaluation for the front surface of tablet display screens are generally not necessary, except for tablets that are designed to require continuous operations with the hand(s) next to the antenna(s)

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:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for product specific 10-g SAR, where:

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

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 >50mm is defined by the following equation, as illustrated in KDB 447498 D01 Appendix B:

a) at 100 MHz to 1500 MHz

[Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW

b) at > 1500 MHz and ≤ 6 GHz

[Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·10] mW

3. The test separation distances required for a device to demonstrate SAR or MPE compliance must be sufficiently conservative to support the operational separation distances required by the device and its antennas and radiating structures. For devices such as tablets and transmitters embedded in keyboard sections of laptop computers that are typically used in close proximity to users, the test separation distance is determined by the smallest distance between the outer surface of the device and the user. For larger devices, as the antenna operational separation distance increases to where the SAR characteristics of the device and its antennas are not directly influenced by the user, such as antennas along the top and upper side edges of laptop computer displays or opposite and adjacent edges of tablets, the test separation distance is normally determined by the closest separation between the antenna and the user.

For Bluetooth 1-g SAR (antenna to edges separation distance less than 50mm)

Position	Frequency	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculated Result	Threshold	SAR Test
Top edge	2462	5	3.16	5.00	1.0	3.0	Excluded
Bottom edge	2462	5	3.16	\	\	\	\
Left edge	2462	5	3.16	\	\	\	\
Right edge	2462	5	3.16	\	\	\	\
Rear surface	2462	5	3.16	5.00	1.0	3.0	Excluded

Note:

Because the calculated result is greater than the threshold, so SAR evaluation for corresponding position is required.

For Bluetooth 1-g SAR (antenna to edges separation distance greater than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Power allowed at 50mm	Separation Distance (mm)	Calculation Result (mW)	SAR Test
Top edge	2480	5	39.81	\	\	\	\
Bottom edge	2480	5	39.81	95.25	179.41	2234.83	Excluded
Left edge	2480	5	39.81	95.25	88.29	728.31	Excluded
Right edge	2480	5	39.81	95.25	162.3	1951.94	Excluded
Rear surface	2480	5	39.81	\	\	\	\

Note:
Because the power in mW is less than the calculation result, so SAR evaluation for corresponding position is not required.

For 2.4GHz Wi-Fi 1-g SAR (antenna to edges separation distance less than 50mm)

Position	Frequency	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculated Result	Threshold	SAR Test
Top edge	2462	16.0	39.81	5.00	12.5	3.0	Required
Bottom edge	2462	16.0	39.81	\	\	\	\
Left edge	2462	16.0	39.81	\	\	\	\
Right edge	2462	16.0	39.81	\	\	\	\
Rear surface	2462	16.0	39.81	5.00	12.5	3.0	Required

Note:
Because the calculated result is greater than the threshold, so SAR evaluation for corresponding position is required.

For 2.4GHz Wi-Fi 1-g SAR (antenna to edges separation distance greater than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Power allowed at 50mm	Separation Distance (mm)	Calculation Result (mW)	SAR Test
Top edge	2462	16.0	39.81	\	\	\	\
Bottom edge	2462	16.0	39.81	95.60	55	179.41	Excluded
Left edge	2462	16.0	39.81	95.60	195	88.29	Excluded
Right edge	2462	16.0	39.81	95.60	195	162.3	Excluded
Rear surface	2462	16.0	39.81	\	\	\	\

Note:
Because the power in mW is less than the calculation result, so SAR evaluation for corresponding position is not required.

For 5GHz Wi-Fi 1-g SAR (antenna to edges separation distance less than 50mm)

Position	Frequency	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculated Result	Threshold	SAR Test
Top edge	5825	15.5	35.48	5.00	17.1	3.0	Required
Bottom edge	5825	15.5	35.48	\	\	\	\
Left edge	5825	15.5	35.48	\	\	\	\
Right edge	5825	15.5	35.48	\	\	\	\
Rear surface	5825	15.5	35.48	5.00	17.1	3.0	Required

Note:
Because the calculated result is greater than the threshold, so SAR evaluation for corresponding position is required.

For 5GHz Wi-Fi 1-g SAR (antenna to edges separation distance greater than 50mm)

Position	Frequency (MHz)	Power (dBm)	Power (mW)	Power allowed at 50mm	Separation Distance (mm)	Calculation Result (mW)	SAR Test
Top edge	5825	15.5	35.48	\	\	\	\
Bottom edge	5825	15.5	35.48	62.15	55	5087.57	Excluded
Left edge	5825	15.5	35.48	62.15	195	1549.08	Excluded
Right edge	5825	15.5	35.48	62.15	158	4423.13	Excluded
Rear surface	5825	15.5	35.48	\	\	\	\

Note:
Because the power in mW is less than the calculation result, so SAR evaluation for corresponding position is not required.

9. Dielectric Property Measurements & System Check

9.1. 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. (℃)	Test Date
		Measured		Target						
		ϵ_r	σ	ϵ_r	σ	ϵ_r	σ			
Body 2450	2360	51.71	1.87	52.82	1.86	-2.10	0.65	±5	23.5	November 12, 2019
	2450	51.46	1.96	52.70	1.95	-2.35	0.72	±5		
	2540	51.15	2.07	52.59	2.08	-2.74	-0.48	±5		
Body 5250	5160	50.25	5.43	49.07	5.25	2.40	3.50	±5	23.1	November 18, 2019
	5250	49.95	5.48	48.95	5.36	2.04	2.29	±5		
	5340	49.90	5.57	48.96	5.46	1.92	1.96	±5		
Body 5600	5500	48.73	5.57	48.59	5.66	0.29	-1.59	±5	22.9	November 18, 2019
	5600	48.54	5.74	48.47	5.77	0.14	-0.45	±5		
	5700	48.39	5.90	48.35	5.87	0.08	0.44	±5		
Body 5750	5660	48.98	5.87	48.39	5.84	1.22	0.48	±5	23.0	November 18, 2019
	5750	48.90	5.99	48.27	5.94	1.31	0.88	±5		
	5840	48.65	6.11	48.16	6.03	1.02	1.31	±5		

9.2. 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(≤2GHz), 12 mm in x- and y-dimension(2-4 GHz) and 10mm in x- and y- dimension(4-6GHz).
- For zoom scan, Δx_{zoom}, Δy_{zoom}≤ 2GHz - ≤8mm, 2-4GHz - ≤5 mm and 4-6 GHz-≤4mm; Δz_{zoom} ≤3GHz - ≤5 mm, 3-4 GHz- ≤4mm and 4-6GHz-≤2mm.
- 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.

T.S. Liquid		Measured Results		Target (Ref. value)	Delta (%)	Limit (%)	Temp. (℃)	Test Date
		Zoom Scan (W/Kg)	Normalize to 1W (W/Kg)					
Body 2450	1g	12.500	50.00	51.70	-3.29	±10	23.5	November 12, 2019
	10g	5.850	23.40	24.30	-3.70			
Body 5250	1g	7.290	72.90	76.10	-4.20	±10	23.1	November 18, 2019
	10g	2.070	20.70	21.40	-3.27			
Body 5600	1g	7.750	77.50	80.40	-3.61	±10	22.9	November 18, 2019
	10g	2.190	21.90	22.50	-2.67			
Body 5750	1g	7.520	75.20	77.00	-2.34	±10	23.0	November 19, 2019
	10g	2.120	21.20	21.50	-1.40			

10. 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.

Scaled SAR calculation formula:

Scaled SAR = Tune-up in mW / Conducted power in mW * Duty cycle (if available) * SAR value

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 ≥0.8W/Kg; if the deviation among the repeated measurement is ≤ 20%, and the measured SAR <1.45W/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 ≤ 0.4W/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 ≤ 0.8W/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.

Note:

The same procedure is applied to extremity SAR evaluation, and the corresponding limitation is 2.5 times of 1-g SAR.

10.1. SAR Test Results of 2.4GHz Wi-Fi.

Test Position (Body 0mm)	Test Mode	Channel/ Frequency	Power (dBm)		SAR Value	Power Drift	Duty Factor (%)	Scaled (W/Kg)
			Tune-up	Meas.	1-g (Zoom Scan)			
Rear surface	802.11b	1/2412	16.00	15.76	0.167	0.16	100.00	0.176
Top Edge	802.11b	1/2412	16.00	15.76	1.060	0.07	100.00	1.120
Top Edge	802.11b	6/2437	16.00	15.60	1.220	0.15	100.00	1.338
Top Edge	802.11b	11/2462	16.00	15.46	1.180	0.03	100.00	1.336
Repeated test at worst measured SAR configuration above								
Top Edge	802.11b	6/2437	16.00	15.60	1.193	0.05	100.00	1.308

OFDM mode SAR evaluation exclusion analysis

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR (W/Kg)	Adjusted SAR (W/Kg)	SAR Test
802.11b	16.0	39.81	1.338	\	\
802.11g	15.0	31.62	\	1.063	Excluded
802.11n (20M)	14.0	25.12	\	0.844	Excluded
802.11n (40M)	13.0	19.95	\	0.671	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.

10.2. SAR Test Results of 5GHz Wi-Fi.

Test Position (Body 0mm)	Test Mode	Channel/ Frequency	Power (dBm)		SAR Value	Power Drift	Duty Factor (%)	Scaled (W/Kg)
			Tune-up	Meas.	1-g (Zoom Scan)			
UNII-2A								
Rear surface	802.11a	60/5300	15.5	15.30	0.185	0.13	97.60	0.198
Top	802.11a	60/5300	15.5	15.30	0.987	-0.06	97.60	1.059
Top	802.11a	52/5260	15.5	15.23	0.982	0.00	97.60	1.071
Top	802.11a	64/5320	15.5	15.13	0.978	-0.11	97.60	1.092
Repeated test at worst measured SAR configuration above								
Top	802.11a	60/5300	15.5	15.30	0.980	-0.04	97.60	1.051
UNII-2C								
Rear surface	802.11a	120/5600	15.5	15.08	0.268	-0.09	97.60	0.303
Top	802.11a	120/5600	15.5	15.08	1.150	0.19	97.60	1.298
Top	802.11a	100/5500	15.5	14.83	1.002	0.02	97.60	1.198
Top	802.11a	140/5700	15.5	14.94	1.108	-0.13	97.60	1.292
Repeated test at worst measured SAR configuration above								
Top	802.11a	140/5700	15.5	15.08	1.122	-0.08	97.60	1.266
UNII-3								
Rear surface	802.11a	165/5825	14.0	13.31	0.375	0.17	97.60	0.419
Top	802.11a	165/5825	14.0	13.31	1.190	-0.14	97.60	1.429
Top	802.11a	149/5745	14.0	13.04	0.935	-0.13	97.60	1.195
Top	802.11a	157/5785	14.0	13.16	1.101	-0.13	97.60	1.369
Repeated test at worst measured SAR configuration above								
Top	802.11a	149/5745	14.0	13.31	1.050	0.18	97.60	1.261

Subsequent test configuration SAR evaluation exclusion analysis for U-NII-2A band

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR (W/Kg)	Adjusted SAR (W/Kg)	SAR Test
802.11a	15.5	35.48	1.092	\	\
802.11n 20M	15	31.62	\	0.973	Excluded
802.11n 40M	15	31.62	\	0.973	Excluded
802.11ac 20M	14	25.12	\	0.773	Excluded
802.11ac 40M	14	25.12	\	0.773	Excluded
802.11ac 80M	14	25.12	\	0.773	Excluded

Note:

1) 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 U-NII-2C band

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR (W/Kg)	Adjusted SAR (W/Kg)	SAR Test
802.11a	15.5	35.48	1.298	\	\
802.11n 20M	15	31.62	\	1.157	Excluded
802.11n 40M	15	31.62	\	1.157	Excluded
802.11ac 20M	14	25.12	\	0.919	Excluded
802.11ac 40M	14	25.12	\	0.919	Excluded
802.11ac 80M	13	19.95	\	0.730	Excluded

Note:

1) 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 U-NII-3 band

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR (W/Kg)	Adjusted SAR (W/Kg)	SAR Test
802.11a	14	25.12	1.429	\	\
802.11n 20M	13	19.95	\	1.135	Excluded
802.11n 40M	13	19.95	\	1.135	Excluded
802.11ac 20M	13	19.95	\	1.135	Excluded
802.11ac 40M	13	19.95	\	1.135	Excluded
802.11ac 80M	13	19.95	\	1.135	Excluded

Note:

1) 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.

11. 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 supports 2.4GHz Wi-Fi, 5GHz Wi-Fi and BT.

Combination	Mode
1	2.4GHz Wi-Fi+ BT
2	5GHz Wi-Fi + BT

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) (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·
[√f(GHz)/x] W/kg for test separation distances ≤ 50 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 mm.
When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied.

Wireless technologies	Scenario	Frequency (GHz)	Power (dBm)	Power (mW)	Separation Distance (mm)	Estimated SAR (W/Kg)
BT	Top edge	2.48	5.00	3.16	5	0.042
BT	Rear surface	2.48	5.00	3.16	5	0.042

For Combination NO.1

Test Position	2.4GHz Wi-Fi Max 1-g SAR (W/Kg)	BT 1-g SAR (W/Kg)	SUM 1-g SAR (W/Kg)	SPLSR
Top edge	1.338	0.042	1.380	Excluded

For Combination NO.2

Test Position	5GHz Wi-Fi Max 1-g SAR (W/Kg)	BT (aux ANT) 1-g SAR (W/Kg)	SUM 1-g SAR (W/Kg)	SPLSR
Top edge	1.429	0.42	1.471	Excluded

Appendixes

Refer to separated files for the following appendixes.

4789182259-SAR-2_App A Photo

4789182259-SAR-2_App B System Check Plots

4789182259-SAR-2_App C Highest Test Plots

4789182259-SAR-2_App D Cal. Certificates

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