SAR EVALUATION REPORT

CLASS II PERMISSIVE CHANGE

FCC 47 CFR § 2.1093
IEEE Std. 1528-2013

For
Chromebook

FCC ID: 2AOUD-9560NGW
Model Name: Foob 360, CTL Chromebook VX11T

Report Number: 4789451308.1-SAR-1

Issue Date: May 17, 2020

Prepared for

SHENZHEN BITLAND INFORMATION TECHNOLOGY CO LTD

1-6F #7 BLDG TONGFUYU INDUSTRIAL TOWN XILI TANGLANG TAOYUAN ST NANSHAN DISTRICT SHENZHEN GUANGDONG 518055 CHINA

Prepared by

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Revision History

Rev.	Date	Revisions	Revised By
V1.0	May 17, 2020	Initial Issue	\

Note:

1. The Measurement result for the sample received is<Pass> according to < IEEE Std. 1528-2013> when <Accuracy Method> decision rule is applied.

2. This test report is only published to and used by the applicant, and it is not for evidence purpose in China.

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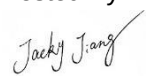
2. Attestation of Test Results

Applicant Name	SHENZHEN BITLAND INFORMATION TECHNOLOGY CO LTD		
Address	1-6F #7 BLDG TONGFUYU INDUSTRIAL TOWN XILI TANGLANG TAOYUAN ST NANSHAN DISTRICT SHENZHEN GUANGDONG 518055 CHINA		
Manufacturer	SHENZHEN BITLAND INFORMATION TECHNOLOGY CO LTD		
Address	1-6F #7 BLDG TONGFUYU INDUSTRIAL TOWN XILI TANGLANG TAOYUAN ST NANSHAN DISTRICT SHENZHEN GUANGDONG 518055 CHINA		
EUT Name	Chromebook		
Model Name	Foob 360		
Serial Model	CTL Chromebook VX11T		
Model difference:	CTL Chromebook VX11T have the same technical construction including circuit diagram, PCB Layout, components and component layout, all electrical construction and mechanical construction with Foob. The difference lies only on the model name and sales region.		
Sample Status	Normal		
Brand	/		
Sample Received Date	April 28, 2020		
Date of Tested	May 06, 2020 ~ May 12, 2020		
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**	**DSS**
Body (1-g)	1.10	1.195	0.03
Simultaneous Transmission (1-g)	1.198		
Test Results	Pass		
Tested By:  Jacky Jiang Engineer Project Associate	Reviewed By:  Shawn Wen Laboratory Leader	Approved By:  Stephen Guo Laboratory Manager	

3. 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

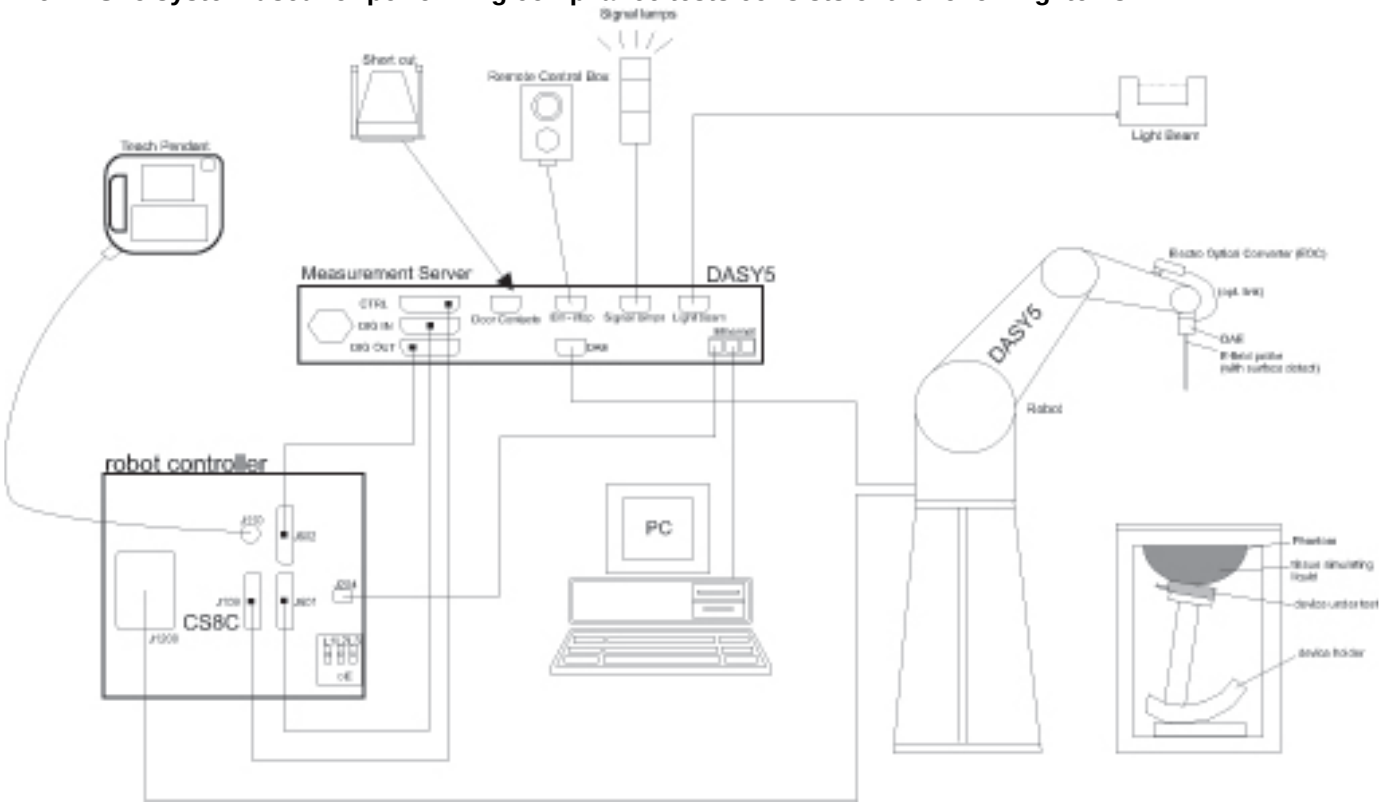
4. Facilities and Accreditation

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

5. SAR Measurement System & Test Equipment

5.1. 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.

5.2. 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	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
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.

5.3. 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	2020.12.05
Dielectric Assessment Kit	SPEAG	SM DAK 040 SA	1155	NCR
DC power supply	Keysight	E36103A	MY55350020	2020.12.04
Signal Generator	Rohde & Schwarz	SME06	837633\001	2020.12.04
BI-Directional Coupler	WERLATONE	C8060-102	3423	2020.12.04
Peak and Average Power Sensor	Keysight	E9323A	MY55440013	2020.12.05
Peak and Average Power Sensor	Keysight	E9323A	MY55420006	2020.12.05
Dual Channel PK Power Meter	Keysight	N1912A	MY55416024	2020.12.05
Amplifier	CORAD TECHNOLOGY LTD	AMF-4D-00400600-50-30P	1983561	NCR
Dosimetric E-Field Probe	SPEAG	EX3DV4	7383	2021.01.02
Data Acquisition Electronic	SPEAG	DAE3	427	2021.03.30
Dipole Kit 2450 MHz	SPEAG	D2450V2	977	2021.12.04
Dipole Kit 5 GHz	SPEAG	D5GHzV2	1231	2021.12.07
Software	SPEAG	DASY52	N/A	NCR
Twin Phantom	SPEAG	SAM V5.0	1805	NCR
ELI Phantom	SPEAG	ELI V5.0	1235	NCR
Thermometer	/	GX-138	150709653	2020.12.09
Hygrometer	VICTOR	ITHX-SD-5	18470005	2020.12.10

Note:

1) As per KDB865664D01 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) Dielectric assessment kit is calibrated against air, distilled water and a shorting block performed before measuring liquid parameters.
3) NCR is short for "No Calibration Requirement".

6. 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.

7. Device Under Test (DUT) Information

7.1. DUT Description

The DUT is a laptop computer with IEEE 802.11a/b/g/n/ac, and BT radio.	
DUT Dimension	Overall (Length x Width x Height): 290.0 mm x 205.0 mm x 22.0mm

The host antenna is designed for a lower peak gain in the intentional transmit frequency bands and therefore radiated performance in the intentional frequency bands and the spurious emissions out of bands are expected to be lower than that measured in the original modular approval.

7.2. Wireless Technology and Antenna information

The DUT have two types of Antenna SKU-1 and SKU-3, SAR was tested with higher gain Antenna as the Initial Test Configuration, the lower antenna gain was tested based the worst case of antenna with higher gain.

Wireless technology	Frequency band	Antenna Gain(dBi)	
		SKU-1	SKU-3
Wi-Fi	2.4 GHz	-0.69	**0.92**
	5.2 GHz	-0.44	**0.14**
	5.5 GHz	0.31	**0.91**
	5.8 GHz	**1.45**	1.31
BT	2.4 GHz	-0.64	**0.92**

7.3. Test signal, Output power and Test Frequencies

For WiFi and BT transmission modes the device was put into operation by using an own control software to program the test mode required to select the continuous transmission with 100% duty cycle.

The output power of the device was set to transmit at maximum pwer for all tests.

8. SAR Test Configuration

The antennas of the laptop are located the top edge of display screen, so SAR tests for bystander are necessary for the normal use condition. The display can rotate 360 degree based the axis, then it can be used as a tablet. The other side and surface are evaluated as a tablet according KDB 616217 D04.

9. Conducted Output Power Measurement and tune-up tolerance

General note:

1) 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.

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

Mode	Channel	Frequency (MHz)	Data Rate	Main Ant		Aux Ant		SAR Test	Duty Cycle (%)
				Average Power (dBm)	Tune-up Limit (dBm)	Average Power (dBm)	Tune-up Limit (dBm)		
802.11b	1	2412	1Mbps	17.93	18.0	17.92	18.0	Required	100
	6	2437		18.0	18.0	18.0	18.0		
	11	2462		17.95	18.0	17.96	18.0		
802.11g	1	2412	6Mbps	NMR	17.0	NMR	17.0	Excluded	\
	6	2437			18.0		18.0		
	11	2462			17.0		17.0		
802.11n20	1	2412	HT0		16.5		16.5	Excluded	
	6	2437			18.0		18.0		
	11	2462			16.5		16.5		
802.11n40	3	2422	HT0		15.0		15.0	Excluded	
	6	2437			16.0		16.0		
	9	2452			14.5		14.5		

Note:
1) NMR is short for “No measurement requirement”.

9.2. Power measurement result of 5GHz Wi-Fi.

Band	Mode	Channel	Frequency (MHz)	Data Rate	Main Ant		Aux Ant		SAR Test
					Average power (dBm)	Tune-up Limit (dBm)	Average power (dBm)	Tune-up Limit (dBm)	
U-NII-1	802.11a	36	5180	6Mbps	NMR	13.5	NMR	13.5	Excluded
		40	5200			13.5		13.5	
		44	5220			13.5		13.5	
		48	5240			13.5		13.5	
	802.11n20	36	5180	HT0		13.5		13.5	
		40	5200			13.5		13.5	
		44	5220			13.5		13.5	
		48	5240			13.5		13.5	
	802.11n40	38	5190			13.5		13.5	
		46	5230			13.5		13.5	
	802.11ac20	36	5180	VHT0		13.5		13.5	
		40	5200			13.5		13.5	
		44	5220			13.5		13.5	
		48	5240			13.5		13.5	
	802.11ac40	38	5190			13.5		13.5	
		46	5230			13.5		13.5	
	802.11ac80	42	5210			13.5		13.5	
	802.11ac160	50	5250			13.5		13.5	
U-NII-2A	802.11a	52	5260	6Mbps		13.5		13.5	
		56	5280			13.5		13.5	
		60	5300			13.5		13.5	
		64	5320			13.5		13.5	
	802.11n20	52	5260	HT0		13.5		13.5	
		56	5280			13.5		13.5	
		60	5300			13.5		13.5	
		64	5320			13.5		13.5	
	802.11n40	54	5270			13.5		13.5	
		62	5310			13.5		13.5	
	802.11ac20	52	5260	VHT0		13.5		13.5	
		56	5280			13.5		13.5	
		60	5300			13.5		13.5	
		64	5320			13.5		13.5	
	802.11ac40	54	5270			13.5		13.5	
		62	5310			13.5		13.5	
	802.11ac80	58	5290		13.45	13.5	13.5	13.5	Required

Band	Mode	Channel	Frequency (MHz)	Data Rate	Main Ant		Aux Ant		SAR Test
					Average power (dBm)	Tune-up Limit (dBm)	Average power (dBm)	Tune-up Limit (dBm)	
U-NII-2C	802.11a	100	5500	6Mbps	NMR	13.5	NMR	13.5	Excluded
		104	5520			13.5		13.5	
		108	5540			13.5		13.5	

		112	5560			13.5		13.5	
		116	5580			13.5		13.5	
		120	5600			13.5		13.5	
		124	5620			13.5		13.5	
		128	5640			13.5		13.5	
	802.11n20	100	5500	HT0		13.5		13.5	
		104	5520			13.5		13.5	
		108	5540			13.5		13.5	
		112	5560			13.5		13.5	
		116	5580			13.5		13.5	
		120	5600			13.5		13.5	
		124	5620			13.5		13.5	
		128	5640			13.5		13.5	
	802.11n40	102	5510			13.5		13.5	
		110	5550			13.5		13.5	
		118	5590			13.5		13.5	
		126	5630			13.5		13.5	
	802.11ac20	100	5500	VHT0		13.5		13.5	
		104	5520			13.5		13.5	
		108	5540			13.5		13.5	
		112	5560			13.5		13.5	
		116	5580			13.5		13.5	
		120	5600			13.5		13.5	
		124	5620			13.5		13.5	
		128	5640			13.5		13.5	
	802.11ac40	102	5510			13.5		13.5	
		110	5550			13.5		13.5	
		118	5590			13.5		13.5	
		126	5630			13.5		13.5	
	802.11ac80	106	5530			13.5		13.5	
		122	5610			13.5		13.5	
	802.11ac160	114	5570		13.47	13.5	13.49	13.5	

Band	Mode	Channel	Frequency (MHz)	Data Rate	Main Ant		Aux Ant		SAR Test
					Average power (dBm)	Tune-up Limit (dBm)	Average power (dBm)	Tune-up Limit (dBm)	
U-NII-3	802.11a	132	5660	6Mbps	NMR	13.5	NMR	13.5	Excluded
		136	5680			13.5		13.5	
		140	5700			13.5		13.5	
		149	5745			13.5		13.5	
		153	5765			13.5		13.5	
		157	5785			13.5		13.5	
		161	5805			13.5		13.5	
		165	5825			13.5		13.5	
	802.11n20	132	5660	HT0		13.5		13.5	
		136	5680			13.5		13.5	
		140	5700			13.5		13.5	
		149	5745			13.5		13.5	

		153	5765			13.5		13.5	
		157	5785			13.5		13.5	
		161	5805			13.5		13.5	
		165	5825			13.5		13.5	
	802.11n40	134	5670			13.5		13.5	
		142	5710			13.5		13.5	
		151	5755			13.5		13.5	
		159	5795			13.5		13.5	
	802.11ac20	132	5660	VHT0		13.5		13.5	
		136	5680			13.5		13.5	
		140	5700			13.5		13.5	
		149	5745			13.5		13.5	
		153	5765			13.5		13.5	
		157	5785			13.5		13.5	
		161	5805			13.5		13.5	
		165	5825			13.5		13.5	
	802.11ac40	134	5670			13.5		13.5	
		142	5710			13.5		13.5	
		151	5755			13.5		13.5	
		159	5795			13.5		13.5	
	802.11ac80	138	5690		13.5	13.5	13.45	13.5	
		155	5775		13.46	13.5	13.48	13.5	

Note:
1) NMR is short for “No measurement requirement”.
2) When band gap channels between U-NII-2C and U-NII-3 band are supported channels in U-NII-2C band below 5.65 GHz are considered as one band and channels above 5.65 GHz, together with channels in 5.8 GHz U-NII-3 or § 15.247 band, are considered as a separate band.

9.3. Power measurement result BT

Band	Mode	Antenna	Average Conducted Power (dBm)			Tune-up
			0CH	39CH	78CH	
2.4G	DH5	Aux Ant	10.5	11.0	11.5	11.5
	2DH5	Aux Ant	NMR	NMR	NMR	11.0
	3DH5	Aux Ant	NMR	NMR	NMR	11.0

Band	Mode	Antenna	Average Conducted Power (dBm)			Tune-up
			0CH	19CH	39CH	
2.4G	BLE	Aux Ant	NMR	NMR	NMR	9.0

Note:
1) NMR is short for “No measurement requirement”.

10. RF Exposure Conditions

The antenna location diagram inside the device can be found in App A.

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 bottom edge of Laptop usage and tablet usage .

Position	Mode	Frequency (MHz)	Power (dBm)	Power (mW)	The Max Power allowed at 50mm	Separation Distance (mm)	Calculation Result (mW)	SAR Test
Bottom surface	BT	2480	11.50	14.13	95.25	202	1615.25	Excluded
	WiFi 2.4G	2462	18.00	63.10	95.60	202	1605.60	Excluded
	WiFi 5G	5825	13.50	22.39	62.15	202	1582.15	Excluded

For tablet usage, antenna to edges separation distance less than 50mm

Position	Mode	Frequency (MHz)	Power (dBm)	Power (mW)	Separation Distance (mm)	Calculation Result	Threshold	SAR Test
Left Edge	BT	2480	11.50	14.13	35.60	0.6	3.0	Excluded
	WiFi 2.4G	2462	18.00	63.10	35.60	2.8	3.0	Excluded
	WiFi 5G	5825	13.50	22.39	35.60	1.5	3.0	Excluded
Right Edge	BT	2480	11.50	14.13	38.30	0.6	3.0	Excluded
	WiFi 2.4G	2462	18.00	63.10	38.30	2.6	3.00	Excluded
	WiFi 5G	5825	13.50	22.39	38.30	1.4	3.00	Excluded
Front keyboard surface	BT	2480	11.50	14.13	16.50	1.3	3.0	Excluded
	WiFi 2.4G	2462	18.00	63.10	16.50	6.0	3.00	Required
	WiFi 5G	5825	13.50	22.39	16.50	3.3	3.00	Required
Top Edge	BT	2480	11.50	14.13	5.00	4.4	3.0	Required
	WiFi 2.4G	2462	18.00	63.10	5.00	19.8	3.00	Required
	WiFi 5G	5825	13.50	22.39	5.00	10.8	3.00	Required
Rear screen surface (bystander mode)	BT	2480	11.50	14.13	25	0.9	3.0	Excluded
	WiFi 2.4G	2462	18.00	63.10	25	4.0	3.00	Required
	WiFi 5G	5825	13.50	22.39	25	2.2	3.00	Excluded

11. Dielectric Property Measurements & System Check

11.1. 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				Deviation(%)		Limit (%)	Temp. (℃)	Test Date
		Measured		Target						
		ϵ_r	σ	ϵ_r	σ	ϵ_r	σ			
Head 2450	2360	40.00	1.69	39.36	1.72	1.63	-1.86	±5	22.3	May 11, 2020
	2450	39.90	1.80	39.20	1.80	1.79	-0.06			
	2540	39.44	1.90	39.09	1.90	0.90	0.21			
Head 5250	5160	36.23	4.60	36.03	4.61	0.56	-0.28	±5	22.5	May 08, 2020
	5250	36.09	4.73	35.93	4.71	0.45	0.42			
	5340	35.90	4.78	35.83	4.80	0.20	0.37			
Head 5600	5500	35.95	4.99	35.64	4.96	0.87	1.45	±5	21.8	May 08, 2020
	5600	35.63	5.03	35.53	5.07	0.28	0.41			
	5700	35.65	5.09	35.41	5.17	0.68	-0.83			
Head 5700	5660	36.70	5.26	35.46	5.13	3.50	2.53	±5	22.7	May 08, 2020
	5750	36.33	5.44	35.36	5.22	2.74	4.18			
	5840	35.87	5.43	35.27	5.30	1.70	2.49			

11.2. 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)					
Head 2450	1-g	12.7	50.80	53.70	-5.40	±10	22.3	May 11, 2020
	10-g	5.79	23.16	25.00	-7.36			
Head 5250	1-g	8.57	85.7	78.60	9.03	±10	22.5	May 08, 2020
	10-g	2.44	24.4	22.50	8.44			
Head 5600	1-g	8.41	84.1	81.20	3.57	±10	21.8	May 08, 2020
	10-g	2.38	23.8	23.40	1.71			
Head 5750	1-g	8.300	83.00	80.00	3.75	±10	21.8	May 08, 2020
	10-g	2.410	24.10	22.80	5.70			

12. 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:
1) The same procedure is applied to extremity SAR evaluation, and the corresponding limitation is 2.5 times of 1-g SAR.

12.1. SAR Test Results of 2.4G Wi-Fi

Test Positon	Test Mode	Channel/ Frequency	Power (dBm)		Measured SAR Value	Power Drift	Duty Factor (%)	Scaled (W/Kg)
			Tune-up	Meas.	1g(W/Kg)			
SISO Main antenna(SKU-3)								
Top edge	802.11b	6/2437	18.0	18.00	0.625	0.15	100.00	0.625
Front keyboard surface	802.11b	6/2437	18.0	18.00	0.136	0.13	100.00	0.151
Rear screen surface	802.11b	6/2437	18.0	18.00	0.092	-0.16	100.00	0.102
SISO Aux antenna(SKU-3)								
Top edge	802.11b	6/2437	18.0	18.00	0.909	0.17	100.00	0.909
Front keyboard surface	802.11b	6/2437	18.0	18.00	0.157	0.12	100.00	0.157
Rear screen surface	802.11b	6/2437	18.0	18.00	0.076	-0.01	100.00	0.076
Top edge	802.11b	1/2412	18.0	17.92	1.090	0.05	100.00	1.110
Top edge	802.11b	13/2472	18.0	17.96	0.746	0.17	100.00	0.753
The worst case with SKU-1 antenna								
Top edge	802.11b	1/2412	18.0	17.92	0.908	0.05	100.00	0.925
Repeat test								
Top edge	802.11b	1/2412	18.0	17.92	1.050	0.05	100.00	1.070

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

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR (W/Kg)	Adjusted SAR (W/Kg)	SAR Test
802.11b	18.0	63.10	1.110	\	\
802.11g	18.0	63.10	\	1.110	Excluded
802.11n20	18.0	63.10	\	1.110	Excluded
802.11n 40	18.0	63.10	\	1.110	Excluded
802.11ax20	18.0	63.10	\	1.110	Excluded
802.11ax40	18.0	63.10	\	1.110	Excluded

Note:

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

12.2. SAR Test Results of 5G Wi-Fi

Test Positon	Test Mode	Channel/ Frequency	Power (dBm)		Measured SAR Value	Power Drift	Duty Factor (%)	Scaled (W/Kg)
			Tune-up	Meas.	1g (W/Kg)			
SISO 5.3GHz-Main antenna-SKU-3								
Top edge	802.11AC80	58/5290	13.50	13.45	1.180	0.11	100.00	1.194
Front keyboard surface	802.11AC80	58/5290	13.50	13.45	0.152	0.15	100.00	0.153
Rear screen surface	802.11AC80	58/5290	13.50	13.45	0.072	-0.12	100.00	0.073
The worst case with SKU-1 antenna for 5.3GHz and 5.6GHz Band								
Top edge	802.11AC80	58/5290	13.50	13.45	1.022	0.06	100.00	1.034
SISO 5.6GHz-Main antenna-SKU-3								
Top edge	802.11AC160	114/5570	13.50	13.47	1.100	0.11	100.00	1.108
Front keyboard surface	802.11AC160	114/5570	13.50	13.47	0.185	0.17	100.00	0.186
Rear screen surface	802.11AC160	114/5570	13.50	13.47	0.087	-0.13	100.00	0.087
SISO 5.8GHz-Main antenna-SKU-1								
Top edge	802.11AC80	138/5690	13.50	13.50	1.130	0.13	100.00	1.130
Top edge	802.11AC80	155/5775	13.50	13.46	1.070	-0.15	100.00	1.080
Front keyboard surface	802.11AC80	138/5690	13.50	13.50	0.179	0.20	100.00	0.179
Rear screen surface	802.11AC80	138/5690	13.50	13.46	0.091	0.02	100.00	0.092
SISO 5.3GHz-Aux antenna -SKU-3								
Top edge	802.11AC80	58/5290	13.50	13.50	1.090	0.13	100.00	1.090
Front keyboard surface	802.11AC80	58/5290	13.50	13.50	0.183	0.13	100.00	0.183
Rear screen surface	802.11AC80	58/5290	13.50	13.50	0.054	0.12	100.00	0.054
SISO 5.6GHz-Aux antenna-SKU-3								
Top edge	802.11AC160	114/5570	13.50	13.49	1.180	0.09	100.00	1.183
Front keyboard surface	802.11AC160	114/5570	13.50	13.49	0.203	0.15	100.00	0.204
Rear screen surface	802.11AC160	114/5570	13.50	13.49	0.088	0.08	100.00	0.089
SISO 5.8GHz-Aux antenna-SKU-1								
Top edge	802.11AC80	138/5690	13.50	13.45	1.181	0.10	100.00	1.195
Top edge	802.11AC80	155/5775	13.50	13.48	1.150	0.16	100.00	1.155
Front keyboard surface	802.11AC80	138/5690	13.50	13.45	0.258	-0.11	100.00	0.261
Rear screen surface	802.11AC80	138/5690	13.50	13.48	0.082	-0.08	100.00	0.082
The worst case with SKU-3 antenna for 5.8GHz band								

Top edge	802.11AC80	138/5690	13.50	13.45	1.1441	0.10	100.00	1.147

Subsequent test configuration SAR evaluation exclusion analysis for 1-g SAR at worst case condition.

Mode	Tune-up (dBm)	Tune-up (mW)	Highest Reported SAR (W/Kg)	Adjusted SAR (W/Kg)	SAR Test
802.11ac 80	13.5	22.39	1.195	\	\
802.11a	13.5	22.39	\	1.195	Excluded
802.11n/ac20	13.5	22.39	\	1.195	Excluded
802.11n/ac40	13.5	22.39	\	1.195	Excluded
802.11n 80	13.5	22.39	\	1.195	Excluded
802.11ac160	13.5	22.39	\	1.195	Excluded

Note:

1) The 802.11ac80 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.

12.3. SAR Test Results of 2.4GHz-DSS

Test Position	Test Mode	Channel/ Frequency	Power (dBm)		Measured SAR Value	Power Drift	Duty Cycle (%)	Scaled (W/Kg)
			Tune-up	Meas.	1-g (W/Kg)			
Aux Antenna(SKU-3)								
Top edge	Bluetooth/DH5	78/2480	11.50	11.50	0.03	-0.02	100.0	0.03

13. Simultaneous Transmission SAR Analysis

According to FCC OET KDB447498 D01, when the sum of 1g SAR for all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

Depend on the description of coexistence mode on the module certification report, the Wi-Fi and BT can transmit simultaneously, but 2.4G and 5G can't transmit an the same time.

13.1. 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) (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.

Position	Mode	Frequency (GHz)	Power (dBm)	Power (mW)	Separation Distance (mm)	Estimated 1-g SAR (W/Kg)
Front keyboard surface	BT	2.48	11.5	14.13	16.5	0.180
Rear screen surface	BT	2.48	11.5	14.13	25.0	0.119

13.2. Simultaneous Transmission calculation WLAN and BT antenna.

All the value stated in the table below are the worst case found for standalone measurement with disregard of the transmission mode or channel where the worst case was found.

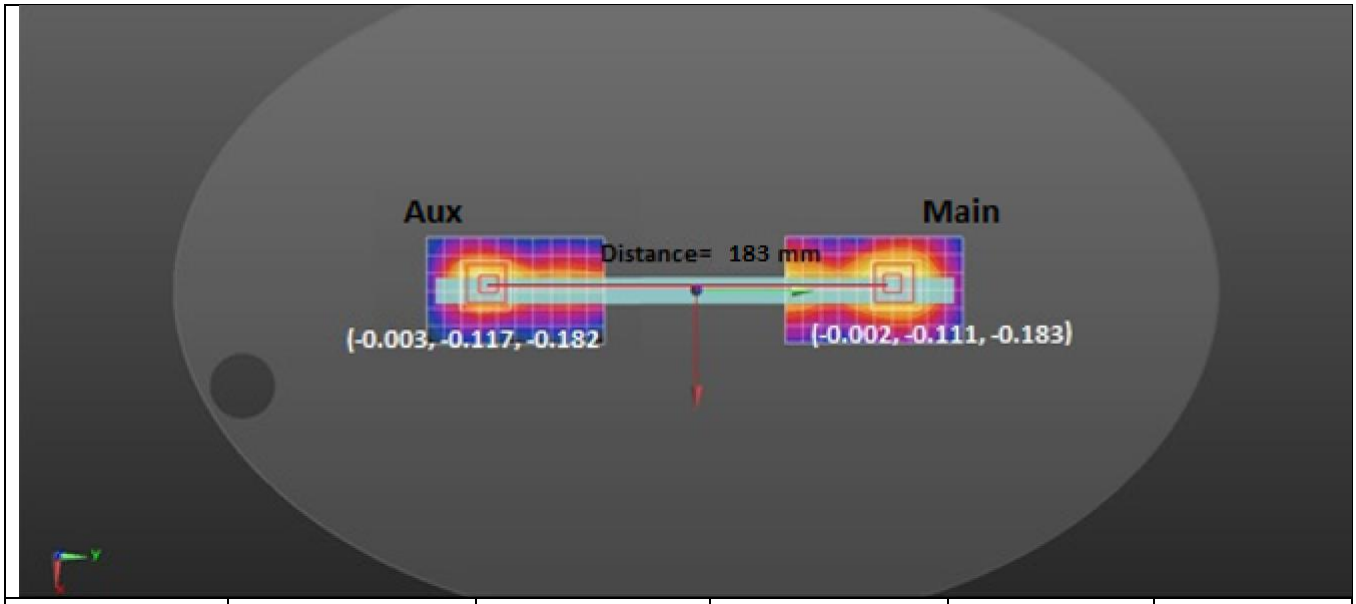
Position	Antenna	Highest Reported SAR(1g)(W/kg)		
		WLAN 2.4GHz	WLAN 5GHz	Bluetooth
Top edge	Main	0.625	1.194	/
	Aux	1.110	1.195	0.03
Front keyboard surface	Main	0.136	0.179	/
	Aux	0.157	0.261	0.180
Rear screen surface	Main	0.107	0.092	/
	Aux	0.076	0.089	0.119

Position	Simultaneous Tx Antenna Combination		∑SAR 1g (W/kg)	SPLSR
	Aux	Main		
Top edge	WLAN 5GHz	WLAN 5GHz	2.389	Required
	WLAN 5GHz+BT	WLAN 5GHz	2.392	Required
	BT	WLAN 5G Hz	1.197	Excluded
	WLAN 2.4GHz	WLAN 2.4GHz	1.735	Required
	BT	WLAN 2.4GHz	0.628	Excluded
Front keyboard surface	WLAN 5GHz	WLAN 5GHz	0.440	Excluded
	WLAN 5GHz+BT	WLAN 5GHz	0.620	Excluded
	BT	WLAN 5G Hz	0.359	Excluded
	WLAN 2.4GHz	WLAN 2.4GHz	0.293	Excluded
	BT	WLAN 2.4GHz	0.316	Excluded
Rear screen surface	WLAN 5GHz	WLAN 5GHz	0.181	Excluded
	WLAN 5GHz+BT	WLAN 5GHz	0.300	Excluded
	BT	WLAN 5G Hz	0.211	Excluded
	WLAN 2.4GHz	WLAN 2.4GHz	0.168	Excluded
	BT	WLAN 2.4GHz	0.226	Excluded

Note:
1) For 2.4G and 5G SAR was evaluated for SISO mode. The SAR distributions in MIMO mode were verified and the hot spots were sufficiently separated such that the two chains can be treated independently. So the highest SAR value across both chains in SISO mode represents the SAR value for MIMO mode.
2) For the maximum SUM 1-g SAR ≤ 1.6 W/Kg, the SPLSR analysis is not required.

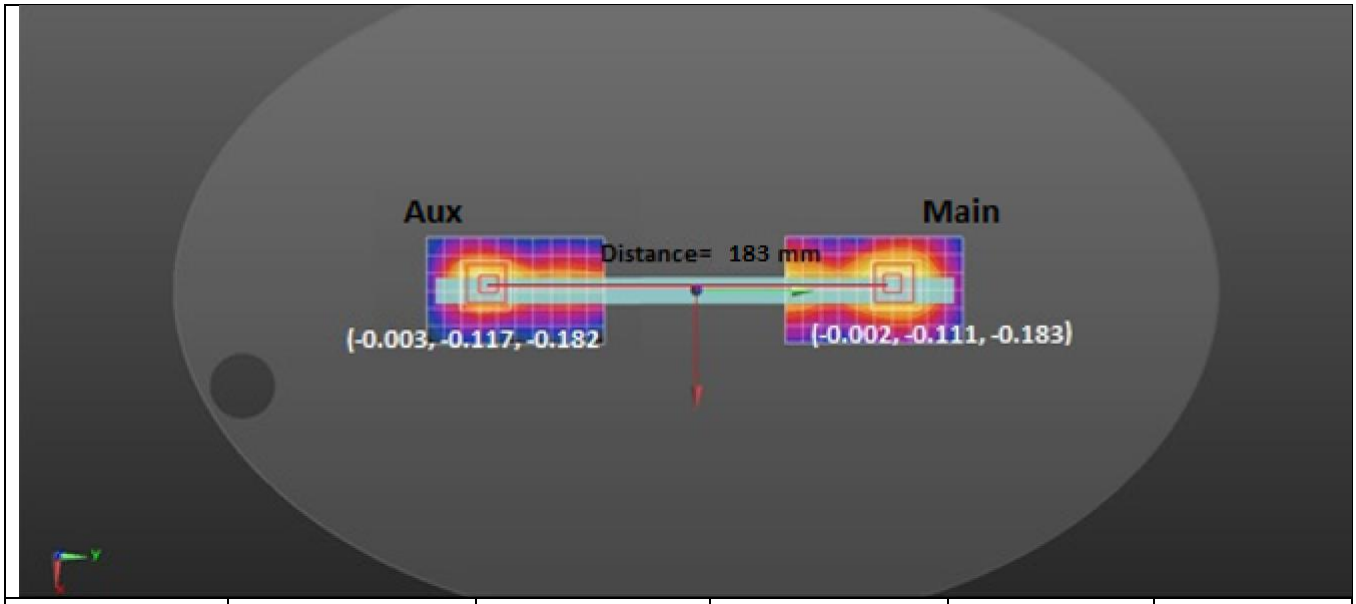
13.4. SPLSR Analysis

FOR Main(5G)+Aux(5G)



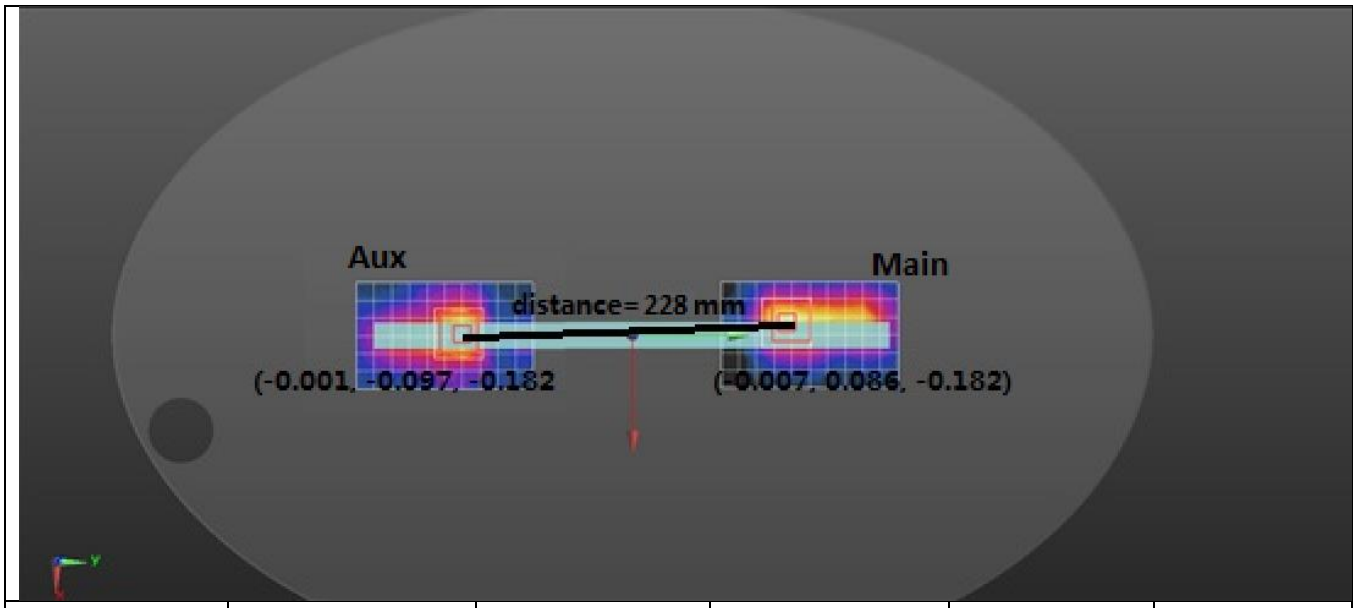
SAR(Main) (W/Kg)	SAR(Aux) (W/Kg)	Separation Distance (mm)	Calculation Result	Threshold	SAR Test
1.194	1.195	183.0	0.02	0.04	Excluded

FOR Main(5G&BT)+Aux(5G)



SAR(Main) (W/Kg)	SAR(Aux) (W/Kg)	Separation Distance (mm)	Calculation Result	Threshold	SAR Test
1.194	1.198	183.0	0.02	0.04	Excluded

FOR Main(2.4G)+Aux(2.4G)



SAR(Main) (W/Kg)	SAR(Aux) (W/Kg)	Separation Distance (mm)	Calculation Result	Threshold	SAR Test
0.625	1.110	228.0	0.01	0.04	Excluded

Appendixes

Refer to separated files for the following appendixes.

4789451308.1-SAR-1_App A Photo

4789451308.1-SAR-1_App B System Check Plots

4789451308.1-SAR-1_App C Highest Test Plots

4789451308.1-SAR-1_App D Cal. Certificates

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