SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 USB Dongle

FCC ID: RYK-WUBT239ACND
Model Name: WUBT-239ACN(BT) Dongle

Report Number: 4790038917B-US-S0-V0
Issue Date: 1/12/2022

Prepared for
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REVISION HISTORY

Rev.	Date	Revisions	Revised By
V0	1/12/2022	Initial Issue	Sally Lu

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1. Attestation of Test Results

Applicant Name	SparkLAN Communications, Inc.		
FCC ID	RYK-WUBT239ACND		
Model Name	WUBT-239ACN(BT) Dongle		
Exposure Category	General Population/Uncontrolled Exposure		
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013		
Exposure Category	SAR Limits (W/Kg)		
	Peak spatial-average(1g of tissue)		
General population/Uncontrolled exposure	1.6		
RF Exposure Conditions	Equipment Class - Highest Reported SAR (W/kg)		
	DTS	NII	DSS
Body	0.624	1.097	0.069
Highest Simultaneous TX	1.469		
Date Tested	10/16/2021 ~ 10/24/2021		
Test Results	Pass		

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of any government. This report is written to support regulatory compliance of the applicable standards stated above.

Approved and Authorized By:	Prepared By:
	
Jeff Shih Senior Project Engineer Underwriters Laboratories Taiwan Co., Ltd.	Sally Lu Project Handler Underwriters Laboratories Taiwan Co., Ltd.

2. Test Specification, Methods and Procedures

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

(Updated: 05/08/2020)

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D02 SAR Procedures for Dongle Xmtr v02r01
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02

3. Facilities and Accreditation

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

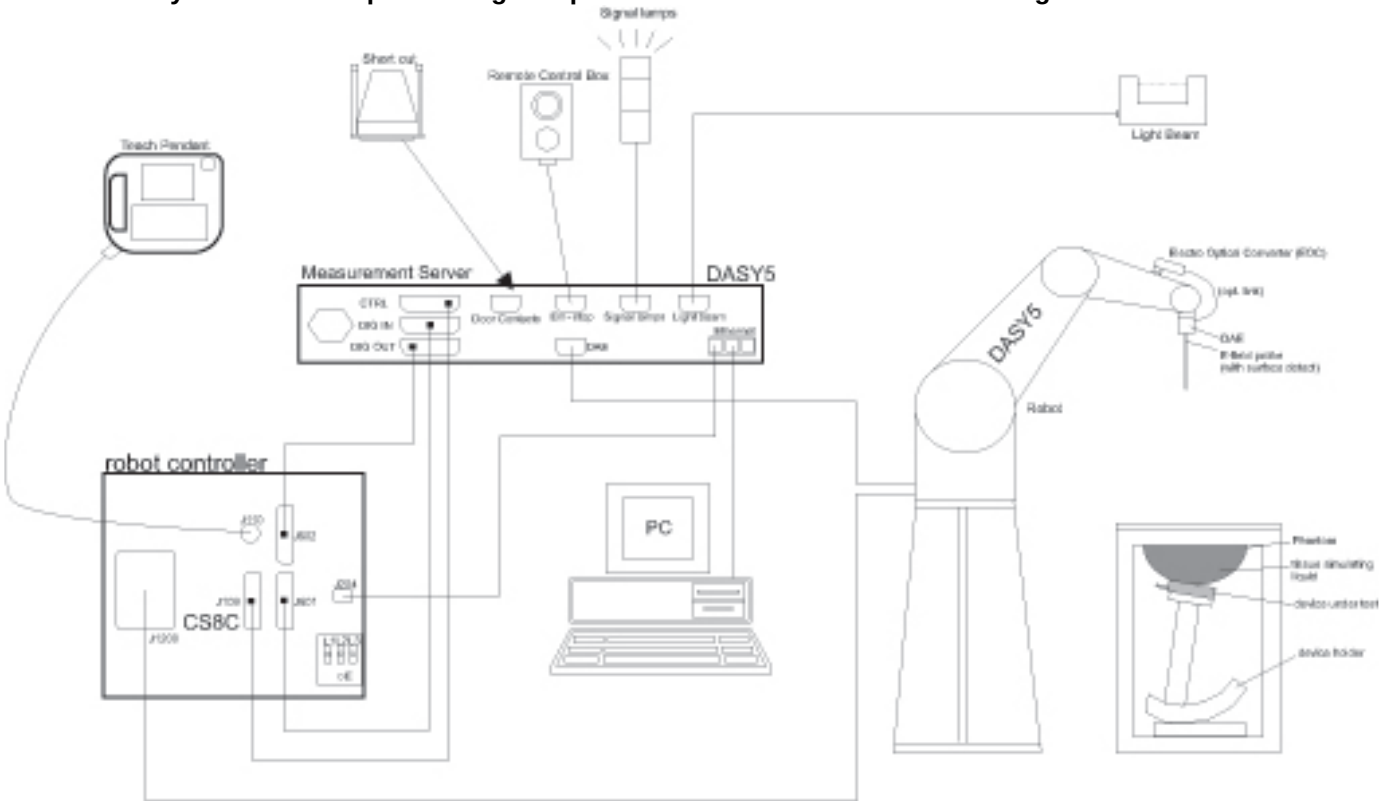
Underwriters Laboratories Taiwan Co., Ltd.,
SAR Room

Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

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 or Win10 and the DASY5 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 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 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.

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.

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Anritsu	MS46322B	1740002	2022/1/7
Dielectric Assessment Kit	SPEAG	DAK-3.5	1250	2022/9/23
Thermometer	DER EE	DE-3003	P0006880	2021/12/21

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
EXG-B RF Vector Signal Generator	Keysight Technologies	N5172B	MY56200315	2022/5/26
Power Meter	Keysight Technologies	N1914A	MY56360007	2021/12/20
Power Sensor	Keysight Technologies	N8481H	MY56350009	2021/12/20
Power Meter	Anritsu	ML2495A	1645002	2021/12/20
Power Sensor	Anritsu	MA2411B	1531202	2021/12/20
Dosimetric E-Field Probe	SPEAG	EX3DV4	3826	2022/7/28
Data Acquisition Electronice	SPEAG	DAE3	528	2022/7/26
System Validation Dipole	SPEAG	D2450V2	988	2021/11/9
System Validation Dipole	SPEAG	D5GHzV2	1244	2021/11/9
Humidity/Temp meter	TECPEL	DTM-20	17020735	2022/4/11
Thermometer	DER EE	DE-3003	P0006880	2021/12/21

UL Software

Software Version
DASY NEO52 D10.4 S14.6.14
SEMCAD-X-PostPro

5. Measurement Uncertainty

Measurement uncertainty for 300 MHz to 3 GHz

Source of Uncertainty	Tolerance (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (± %, 1g)	Standard Uncertainty (± %, 10g)
Measurement System							
Probe Calibration	6.00	Normal	1	1	1	6.00	6.00
Axial Isotropy	4.70	Rectangular	1.732	0.7	0.7	1.90	1.90
Hemispherical Isotropy	9.60	Rectangular	1.732	0.7	0.7	3.88	3.88
Boundary Effect	1.00	Rectangular	1.732	1	1	0.58	0.58
Probe Linearity	4.70	Rectangular	1.732	1	1	2.71	2.71
System Detection Limits	0.25	Rectangular	1.732	1	1	0.14	0.14
Readout Electronics	0.30	Normal	1	1	1	0.30	0.30
Probe Modulation Response	2.40	Rectangular	1.732	1	1	1.39	1.39
Response Time	0.00	Rectangular	1.732	1	1	0.00	0.00
Integration Time	2.60	Rectangular	1.732	1	1	1.50	1.50
RF Ambient Conditions – Noise	3.00	Rectangular	1.732	1	1	1.73	1.73
RF Ambient Conditions – Reflections	3.00	Rectangular	1.732	1	1	1.73	1.73
Probe Positioner Mechanical Restrictions	0.40	Rectangular	1.732	1	1	0.23	0.23
Probe Positioning with Respect to Phantom Shell	2.90	Rectangular	1.732	1	1	1.67	1.67
Interpolation, Extrapolation and Averaged SAR calculation algorithms of the Postprocessor	2.00	Rectangular	1.732	1	1	1.15	1.15
Test Sample Related							
Device Positioning	2.90	Normal	1	1	1	2.90	2.90
Device Holder Disturbance	3.60	Normal	1	1	1	3.60	3.60
DUT Power Drift of Measured SAR	5.00	Rectangular	1.732	1	1	2.89	2.89
SAR Scaling	0.00	Rectangular	1.732	1	1	0.00	0.00
Phantom and Setup							
Phantom Uncertainty - Shape,Thickness and Permittivity	7.20	Rectangular	1.732	1	1	4.16	4.16
SAR Correction for Deviations in Permittivity and Conductivity	1.90	Normal	1	1	0.84	1.90	1.60
Liquid Conductivity - measurement(DAK)	2.50	Normal	1	0.78	0.71	1.95	1.78
Liquid Permittivity - measurement(DAK)	2.50	Normal	1	0.23	0.26	0.58	0.65
Liquid Conductivity – Temperature Uncertainty	3.40	Rectangular	1.732	0.78	0.71	1.53	1.39
Liquid Permittivity – Temperature Uncertainty	0.40	Rectangular	1.732	0.23	0.26	0.05	0.06
Combined Standard Uncertainty (K=1)						11.57	11.48
Expanded Uncertainty U (K=2)						**23.14**	**22.97**

Measurement uncertainty for 3 GHz to 6 GHz

Source of Uncertainty	Tolerance (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (± %, 1g)	Standard Uncertainty (± %, 10g)
Measurement System							
Probe Calibration	6.55	Normal	1	1	1	6.55	6.55
Axial Isotropy	4.70	Rectangular	1.732	0.7	0.7	1.90	1.90
Hemispherical Isotropy	9.60	Rectangular	1.732	0.7	0.7	3.88	3.88
Boundary Effect	2.00	Rectangular	1.732	1	1	1.15	1.15
Probe Linearity	4.70	Rectangular	1.732	1	1	2.71	2.71
System Detection Limits	0.25	Rectangular	1.732	1	1	0.14	0.14
Readout Electronics	0.30	Normal	1	1	1	0.30	0.30
Probe Modulation Response	2.40	Rectangular	1.732	1	1	1.39	1.39
Response Time	0.00	Rectangular	1.732	1	1	0.00	0.00
Integration Time	2.60	Rectangular	1.732	1	1	1.50	1.50
RF Ambient Conditions – Noise	3.00	Rectangular	1.732	1	1	1.73	1.73
RF Ambient Conditions – Reflections	3.00	Rectangular	1.732	1	1	1.73	1.73
Probe Positioner Mechanical Restrictions	0.40	Rectangular	1.732	1	1	0.23	0.23
Probe Positioning with Respect to Phantom Shell	6.70	Rectangular	1.732	1	1	3.87	3.87
Interpolation, Extrapolation and Averaged SAR calculation algorithms of the Postprocessor	4.00	Rectangular	1.732	1	1	2.31	2.31
Test Sample Related							
Device Positioning	2.90	Normal	1	1	1	2.90	2.90
Device Holder Disturbance	3.60	Normal	1	1	1	3.60	3.60
DUT Power Drift of Measured SAR	5.00	Rectangular	1.732	1	1	2.89	2.89
SAR Scaling	0.00	Rectangular	1.732	1	1	0.00	0.00
Phantom and Setup							
Phantom Uncertainty - Shape,Thickness and Permittivity	7.60	Rectangular	1.732	1	1	4.39	4.39
SAR Correction for Deviations in Permittivity and Conductivity	1.90	Normal	1	1	0.84	1.90	1.60
Liquid Conductivity - measurement(DAK)	2.50	Normal	1	0.78	0.71	1.95	1.78
Liquid Permittivity - measurement(DAK)	2.50	Normal	1	0.23	0.26	0.58	0.65
Liquid Conductivity – Temperature Uncertainty	3.40	Rectangular	1.732	0.78	0.71	1.53	1.39
Liquid Permittivity – Temperature Uncertainty	0.40	Rectangular	1.732	0.23	0.26	0.05	0.06
Combined Standard Uncertainty (K=1)						12.65	12.57
Expanded Uncertainty U (K=2)						**25.29**	**25.13**

6. Device Under Test (DUT) Information

6.1. DUT Description

Product	802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 USB Dongle	
Brand Name	SparkLAN	
Model Name	WUBT-239ACN(BT) Dongle	
Device Dimension	Overall (Length * Width * Height): 67mm * 11mm * 25mm	
Operating Frequency	Wi-Fi 2.4GHz:	2412 ~ 2462 MHz
	Wi-Fi 5GHz:	5180 ~ 5320 MHz, 5500 ~ 5720 MHz, 5745 ~ 5825 MHz
	Bluetooth:	2402 ~ 2480 MHz
Sample ID	4197853	
Received Date	2021/10/8	

Antenna information

Ant. No.	Transmitter Circuit	Brand Name	Model Name	Ant. Type	Maximum Gain (dBi)	Remark
1	Chain (0)	SparkLAN	N/A	PCB	2.4GHz: 0.7 5GHz: 4.24	Ant L
	Chain (1)	SparkLAN	N/A	PCB	2.4GHz: 0.25 5GHz: 3.83	Ant R

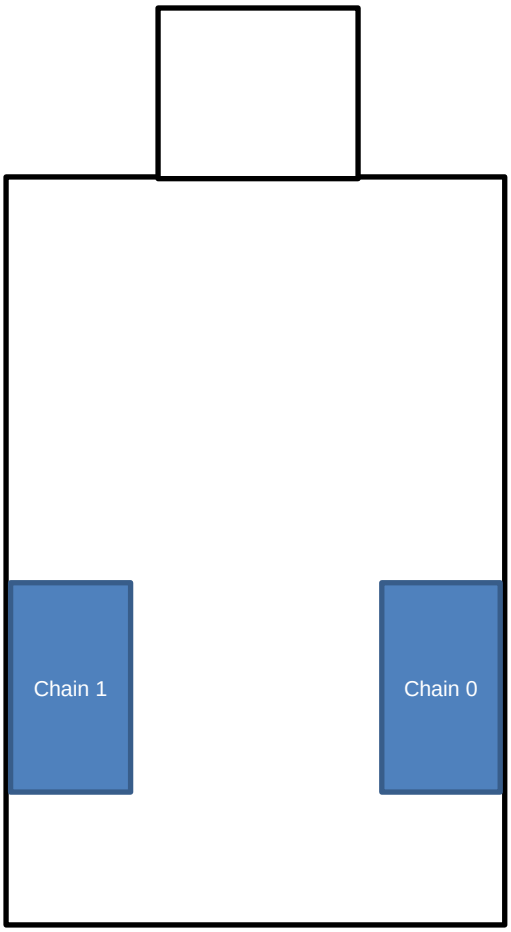
Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20) 802.11n (HT40)	100%
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)	100%
	Does this device support bands 5.60 ~ 5.65 GHz? ☒ Yes ☐ No		
	Does this device support straddle channel? ☒ Yes ☐ No		
Bluetooth	2.4 GHz	BR	77.43%
Bluetooth	2.4 GHz	EDR	77.52%
Bluetooth	2.4 GHz	BLE	85.26%

7. Antenna Location

Horizontal-Down View



Antenna	To Horizontal-Up	To Horizontal-Down	To Vertical-Front	To Vertical-Back	To Tip
Chain 0	4.5	4.5	16.2	3.5	15.21
Chain 1	4.5	4.5	3.5	16.2	15.21

Unit : mm

8. RF Exposure Conditions (Test Configurations)

According to KDB 447498D02 If the antenna is within 1 cm from the tip of the dongle (the end without the USB connector), the tip of the dongle If the antenna is within 1 cm from the tip of the dongle (the end without the USB connector), the tip of the dongle.

Wireless technologies	RF Exposure Conditions	DUT to User Separation	Test Position	Antenna to edge/surface	SAR Required	Note
Chain 0	Body	4.5	Horizontal-Up	<5mm	Yes	
		4.5	Horizontal-Down	<5mm	Yes	
		16.2	Vertical-Front	>5mm	Yes	
		3.5	Vertical-Back	<5mm	Yes	
		15.21	Tip	>10mm	No	
Chain 1	Body	4.5	Horizontal-Up	<5mm	Yes	
		4.5	Horizontal-Down	<5mm	Yes	
		3.5	Vertical-Front	<5mm	Yes	
		16.2	Vertical-Back	>5mm	Yes	
		15.21	Tip	>10mm	No	

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.
The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

Target Frequency	Head	
(MHz)	ε_r	σ (S/m)
150	52.3	0.76
300	45.3	0.87
450	43.5	0.87
835	41.5	0.90
900	41.5	0.97
915	41.5	0.98
1450	40.5	1.20
1610	40.3	1.29
1800 – 2000	40.0	1.40
2450	39.2	1.80
3000	38.5	2.40
5800	35.3	5.27

IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

Dielectric Property Measurements Results:

Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
			Measured	Target	Delta (%)	Measured	Target	Delta (%)
2021/10/22	Head	2412	37.853	39.256	-3.57	1.813	1.764	2.74
		2422	37.824	39.241	-3.61	1.827	1.774	3.02
		2437	37.804	39.219	-3.61	1.845	1.788	3.21
		2450	37.765	39.2	-3.66	1.857	1.8	3.16
		2452	37.750	39.197	-3.69	1.859	1.802	3.17
		2462	37.734	39.183	-3.70	1.867	1.812	3.06
2021/10/24	Head	2412	37.764	39.256	-3.80	1.770	1.764	0.30
		2422	37.705	39.241	-3.91	1.783	1.774	0.50
		2437	37.657	39.219	-3.98	1.803	1.788	0.85
		2450	37.624	39.2	-4.02	1.819	1.8	1.04
		2452	37.619	39.197	-4.03	1.821	1.802	1.05
		2462	37.626	39.183	-3.98	1.833	1.812	1.21
2021/10/24	Head	2402	37.855	39.272	-3.61	1.761	1.756	0.30
		2440	37.654	39.214	-3.98	1.806	1.791	0.87
		2441	37.644	39.213	-4.00	1.808	1.792	0.90
		2450	37.624	39.2	-4.02	1.819	1.8	1.04
		2480	37.636	39.158	-3.89	1.852	1.830	1.22
2021/10/16	Head	5180	34.934	36.020	-3.01	4.552	4.639	-1.87
		5190	34.911	36.010	-3.05	4.558	4.650	-1.97
		5200	34.862	36.000	-3.16	4.570	4.660	-1.94
		5210	34.841	35.990	-3.19	4.578	4.670	-1.99
		5220	34.797	35.980	-3.29	4.590	4.681	-1.93
		5230	34.780	35.970	-3.31	4.604	4.691	-1.84
		5240	34.788	35.960	-3.26	4.622	4.701	-1.67
		5250	34.788	35.950	-3.23	4.623	4.711	-1.87
		5260	34.752	35.940	-3.31	4.631	4.721	-1.90
		5270	34.732	35.930	-3.33	4.629	4.731	-2.15
		5280	34.754	35.920	-3.25	4.637	4.740	-2.18
		5290	34.712	35.910	-3.34	4.651	4.750	-2.09
		5300	34.678	35.900	-3.40	4.660	4.760	-2.11
		5310	34.666	35.890	-3.41	4.671	4.770	-2.08
		5320	34.648	35.880	-3.43	4.689	4.780	-1.90

Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
			Measured	Target	Delta (%)	Measured	Target	Delta (%)
2021/10/16	Head	5500	34.274	35.65	-3.86%	4.868	4.96	-1.95%
		5510	34.275	35.63	-3.81%	4.883	4.98	-1.86%
		5530	34.284	35.60	-3.69%	4.898	5.00	-1.98%
		5550	34.229	35.57	-3.76%	4.901	5.02	-2.33%
		5580	34.129	35.52	-3.92%	4.941	5.05	-2.15%
		5600	34.107	35.500	-3.92%	4.968	5.070	-2.01%
		5610	34.110	35.490	-3.89%	4.986	5.080	-1.85%
		5620	34.136	35.480	-3.79%	4.995	5.090	-1.87%
		5630	34.124	35.470	-3.79%	4.997	5.100	-2.02%
		5660	34.041	35.440	-3.95%	5.023	5.130	-2.09%
		5670	34.013	35.430	-4.00%	5.032	5.140	-2.10%
		5690	34.005	35.410	-3.97%	5.054	5.160	-2.05%
		5700	33.982	35.400	-4.01%	5.070	5.170	-1.93%
		5710	33.951	35.390	-4.07%	5.086	5.180	-1.81%
		5720	33.956	35.380	-4.02%	5.094	5.190	-1.85%
2021/10/16	Head	5745	33.862	35.355	-4.22%	5.108	5.215	-2.05%
		5755	33.830	35.345	-4.29%	5.119	5.225	-2.03%
		5775	33.805	35.325	-4.30%	5.137	5.245	-2.06%
		5785	33.792	35.315	-4.31%	5.145	5.255	-2.09%
		5795	33.789	35.305	-4.29%	5.154	5.265	-2.11%
		5800	33.776	35.300	-4.32%	5.162	5.270	-2.05%
		5825	33.721	35.275	-4.41%	5.174	5.296	-2.30%
2021/10/18	Head	5180	36.058	36.020	0.11%	4.761	4.639	2.63%
		5190	36.012	36.010	0.01%	4.768	4.650	2.54%
		5200	35.946	36.000	-0.15%	4.778	4.660	2.53%
		5210	35.892	35.990	-0.27%	4.788	4.670	2.53%
		5220	35.834	35.980	-0.41%	4.805	4.681	2.65%
		5230	35.826	35.970	-0.40%	4.828	4.691	2.92%
		5240	35.839	35.960	-0.34%	4.854	4.701	3.25%
		5250	35.857	35.950	-0.26%	4.855	4.711	3.06%
		5260	35.869	35.940	-0.20%	4.859	4.721	2.92%
		5270	35.828	35.930	-0.28%	4.859	4.731	2.71%
		5280	35.838	35.920	-0.23%	4.870	4.740	2.74%
		5290	35.779	35.910	-0.36%	4.878	4.750	2.69%
		5300	35.728	35.900	-0.48%	4.889	4.760	2.71%
		5310	35.703	35.890	-0.52%	4.903	4.770	2.79%
		5320	35.661	35.880	-0.61%	4.923	4.780	2.99%

Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
			Measured	Target	Delta (%)	Measured	Target	Delta (%)
2021/10/18	Head	5500	35.307	35.65	-0.96%	5.112	4.96	2.96%
		5510	35.299	35.63	-0.94%	5.128	4.98	3.06%
		5530	35.330	35.60	-0.75%	5.161	5.00	3.29%
		5550	35.261	35.57	-0.86%	5.164	5.02	2.91%
		5580	35.132	35.52	-1.10%	5.195	5.05	2.88%
		5600	35.098	35.500	-1.13%	5.220	5.070	2.96%
		5610	35.091	35.490	-1.12%	5.242	5.080	3.19%
		5620	35.116	35.480	-1.03%	5.254	5.090	3.22%
		5630	35.101	35.470	-1.04%	5.260	5.100	3.14%
		5660	35.030	35.440	-1.16%	5.280	5.130	2.92%
		5670	35.031	35.430	-1.13%	5.295	5.140	3.02%
		5690	35.005	35.410	-1.14%	5.315	5.160	3.00%
		5700	34.985	35.400	-1.17%	5.329	5.170	3.08%
		5710	34.951	35.390	-1.24%	5.349	5.180	3.26%
		5720	34.951	35.380	-1.21%	5.359	5.190	3.26%
2021/10/18	Head	5745	34.867	35.355	-1.38%	5.391	5.215	3.37%
		5755	34.855	35.345	-1.39%	5.409	5.225	3.52%
		5775	34.869	35.325	-1.29%	5.432	5.245	3.57%
		5785	34.839	35.315	-1.35%	5.448	5.255	3.67%
		5795	34.819	35.305	-1.38%	5.455	5.265	3.61%
		5825	34.707	35.275	-1.61%	5.468	5.296	3.25%
2021/10/19	Head	5180	34.982	36.020	-2.88%	4.807	4.639	3.62%
		5190	34.951	36.010	-2.94%	4.816	4.650	3.57%
		5200	34.897	36.000	-3.06%	4.826	4.660	3.56%
		5210	34.843	35.990	-3.19%	4.838	4.670	3.60%
		5220	34.798	35.980	-3.29%	4.851	4.681	3.63%
		5230	34.786	35.970	-3.29%	4.871	4.691	3.84%
		5240	34.806	35.960	-3.21%	4.892	4.701	4.06%
		5250	34.814	35.950	-3.16%	4.892	4.711	3.84%
		5260	34.813	35.940	-3.14%	4.894	4.721	3.66%
		5270	34.775	35.930	-3.21%	4.895	4.731	3.47%
		5280	34.784	35.920	-3.16%	4.907	4.740	3.52%
		5290	34.725	35.910	-3.30%	4.920	4.750	3.58%
		5300	34.684	35.900	-3.39%	4.933	4.760	3.63%
		5310	34.639	35.890	-3.49%	4.949	4.770	3.75%
		5320	34.608	35.880	-3.55%	4.968	4.780	3.93%

Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
			Measured	Target	Delta (%)	Measured	Target	Delta (%)
2021/10/19	Head	5500	34.250	35.65	-3.93%	5.153	4.96	3.79%
		5510	34.230	35.63	-3.94%	5.170	4.98	3.91%
		5530	34.222	35.60	-3.87%	5.208	5.00	4.23%
		5550	34.198	35.57	-3.85%	5.220	5.02	4.03%
		5580	34.085	35.52	-4.04%	5.245	5.05	3.87%
		5600	34.033	35.500	-4.13%	5.260	5.070	3.75%
		5610	34.028	35.490	-4.12%	5.282	5.080	3.98%
		5620	34.028	35.480	-4.09%	5.294	5.090	4.01%
		5630	34.000	35.470	-4.14%	5.205	5.100	2.06%
		5660	33.957	35.440	-4.18%	5.216	5.130	1.68%
		5670	33.957	35.430	-4.16%	5.231	5.140	1.77%
		5690	33.963	35.410	-4.09%	5.147	5.160	-0.25%
		5700	33.954	35.400	-4.08%	5.261	5.170	1.76%
		5710	33.917	35.390	-4.16%	5.282	5.180	1.97%
		5720	33.904	35.380	-4.17%	5.292	5.190	1.97%
2021/10/19	Head	5745	33.794	35.355	-4.42%	5.422	5.215	3.97%
		5755	33.777	35.345	-4.44%	5.443	5.225	4.17%
		5775	33.769	35.325	-4.40%	5.472	5.245	4.33%
		5785	33.743	35.315	-4.45%	5.494	5.255	4.55%
		5795	33.729	35.305	-4.46%	5.498	5.265	4.43%
		5825	33.667	35.275	-4.56%	5.514	5.296	4.12%
2021/10/21	Head	5180	35.334	36.020	-1.90%	4.465	4.639	-3.75%
		5190	35.336	36.010	-1.87%	4.464	4.650	-4.00%
		5200	35.304	36.000	-1.93%	4.469	4.660	-4.10%
		5210	35.280	35.990	-1.97%	4.468	4.670	-4.33%
		5220	35.255	35.980	-2.02%	4.470	4.681	-4.51%
		5230	35.233	35.970	-2.05%	4.482	4.691	-4.46%
		5240	35.254	35.960	-1.96%	4.492	4.701	-4.45%
		5250	35.269	35.950	-1.89%	4.496	4.711	-4.56%
		5260	35.248	35.940	-1.93%	4.499	4.721	-4.70%
		5270	35.219	35.930	-1.98%	4.499	4.731	-4.90%
		5280	35.210	35.920	-1.98%	4.505	4.740	-4.96%
		5290	35.218	35.910	-1.93%	4.5124	4.750	-5.00%
		5300	35.144	35.900	-2.11%	4.5224	4.760	-4.99%
		5310	35.119	35.890	-2.15%	4.539	4.770	-4.84%
		5320	35.075	35.880	-2.24%	4.564	4.780	-4.52%

Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
			Measured	Target	Delta (%)	Measured	Target	Delta (%)
2021/10/21	Head	5500	34.580	35.65	-3.00%	4.783	4.96	-3.66%
		5510	34.492	35.63	-3.20%	4.804	4.98	-3.45%
		5530	34.439	35.60	-3.26%	4.870	5.00	-2.54%
		5550	34.437	35.57	-3.17%	4.911	5.02	-2.13%
		5580	34.479	35.52	-2.94%	4.909	5.05	-2.78%
		5600	34.384	35.500	-3.14%	4.898	5.070	-3.39%
		5610	34.335	35.490	-3.25%	4.918	5.080	-3.19%
		5620	34.309	35.480	-3.30%	4.932	5.090	-3.10%
		5630	34.270	35.470	-3.38%	4.948	5.100	-2.98%
		5660	34.265	35.440	-3.32%	4.962	5.130	-3.27%
		5670	34.330	35.430	-3.10%	4.967	5.140	-3.37%
		5690	34.390	35.410	-2.88%	4.964	5.160	-3.80%
		5700	34.389	35.400	-2.86%	4.979	5.170	-3.69%
		5710	34.355	35.390	-2.92%	5.001	5.180	-3.46%
		5720	34.312	35.380	-3.02%	5.016	5.190	-3.35%
2021/10/21	Head	5745	34.216	35.355	-3.22%	5.046	5.215	-3.24%
		5755	34.202	35.345	-3.23%	5.068	5.225	-3.00%
		5775	34.162	35.325	-3.29%	5.092	5.245	-2.92%
		5785	34.082	35.315	-3.49%	5.120	5.255	-2.57%
		5795	34.097	35.305	-3.42%	5.137	5.265	-2.43%
		5800	34.095	35.300	-3.41%	5.148	5.270	-2.31%
		5825	34.040	35.275	-3.50%	5.157	5.296	-2.62%

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 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.

Date	Tissue Type	Dipole S/N	Input Power (mW)	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Delta 1g ±10 (%)	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Delta 10g ±10 (%)	Plot No.
2021/10/22	Head	D2450V2-988	250	13.4	52.20	53.6	2.68	6.08	23.90	24.32	1.76	1
2021/10/24	Head	D2450V2-988	250	14.1	52.20	56.4	8.05	6.51	23.90	26.04	8.95	2
2021/10/16	Head	D5GHzV2-1244-5250	100	7.76	77.00	77.6	0.78	2.15	22.00	21.5	-2.27	3
2021/10/18	Head	D5GHzV2-1244-5250	100	7.54	77.00	75.4	-2.08	2.09	22.00	20.9	-5.00	4
2021/10/19	Head	D5GHzV2-1244-5600	100	8.65	80.60	86.5	7.32	2.36	23.00	23.6	2.61	5
2021/10/21	Head	D5GHzV2-1244-5600	100	7.81	80.60	78.1	-3.10	2.19	23.00	21.9	-4.78	6
2021/10/16	Head	D5GHzV2-1244-5800	100	7.75	77.70	77.5	-0.26	2.15	22.00	21.5	-2.27	7
2021/10/21	Head	D5GHzV2-1244-5800	100	8.18	77.70	81.8	5.28	2.29	22.00	22.9	4.09	8

10. Conducted Output Power Measurements

10.1. Wi-Fi 2.4GHz (DTS Band)

Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)		Duty Cycle %		Tune-up Limit (dBm)		SAR Test (Yes/No)	
					Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1
2.4GHz (DTS)	802.11b	1 Mbps	1	2412	13.32	12.44	100	100	14.0	13.0	Yes	Yes
			6	2437	18.92	17.67			19.0	18.0		
			11	2462	13.42	12.28			14.0	13.0		
	802.11g	6 Mbps	1	2412	11.58	11.88	100	100	12.0	12.0	No	No
			6	2437	18.41	17.59			19.0	18.0		
			11	2462	10.37	10.05			11.0	11.0		
	802.11n (HT20)	MCS0	1	2412	10.15	10.27	100	100	11.0	11.0	No	No
			6	2437	18.38	17.31			19.0	18.0		
			11	2462	9.38	9.50			10.0	10.0		
	802.11n (HT40)	MCS0	3	2422	9.09	9.39	100	100	10.0	10.0	No	No
			6	2437	11.19	11.59			12.0	12.0		
			9	2452	8.17	8.67			9.0	9.0		

Note(s):

1. SAR is not required for 802.11g/n modes when the adjusted SAR for 802.11b is < 1.2 W/kg.
2. For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.

10.2. Wi-Fi 5GHz (U-NII Bands)

Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)		Duty Cycle %		Tune-up Limit (dBm)		SAR Test (Yes/No)	
					Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1
5.2GHz (U-NII 1)	802.11a	6 Mbps	36	5180	13.31	12.43	100	100	14.0	13.0	No	No
			40	5200	13.33	12.60			14.0	13.0		
			44	5220	13.03	12.91			14.0	13.0		
			48	5240	13.48	12.76			14.0	13.0		
	802.11n (HT20)	MCS0	36	5180	13.42	12.04	100	100	14.0	13.0	No	No
			40	5200	13.26	12.58			14.0	13.0		
			44	5220	12.91	12.81			14.0	13.0		
			48	5240	13.14	12.77			14.0	13.0		
	802.11n (HT40)	MCS0	38	5190	9.90	11.41	100	100	10.0	12.0	No	No
			46	5230	12.92	12.68			13.0	14.0		
	802.11ac (VHT20)	MCS0	36	5180	13.68	12.68	100	100	14.0	13.0	No	No
			40	5200	13.40	12.87			14.0	13.0		
			44	5220	13.97	13.00			14.0	13.0		
			48	5240	14.78	12.54			15.0	13.0		
	802.11ac (VHT40)	MCS0	38	5190	9.92	11.49	100	100	10.0	12.0	No	No
			46	5230	13.83	13.82			14.0	14.0		
	802.11ac (VHT80)	MCS0	42	5210	7.18	9.13	100	100	8.0	10.0	No	No
5.3GHz (U-NII 2A)	802.11a	6 Mbps	52	5260	13.20	14.33	100	100	14.0	15.0	No	No
			56	5280	13.72	14.50			14.0	15.0		
			60	5300	13.82	14.63			14.0	15.0		
			64	5320	13.11	14.92			14.0	15.0		
	802.11n (HT20)	MCS0	52	5260	14.82	14.42	100	100	15.0	15.0	Yes	No
			56	5280	14.83	14.62			15.0	15.0		
			60	5300	14.92	14.42			15.0	15.0		
			64	5320	11.26	14.88			13.0	15.0		
	802.11n (HT40)	MCS0	54	5270	13.80	14.12	100	100	14.0	15.0	No	No
			62	5310	9.58	10.44			10.0	11.0		
	802.11ac (VHT20)	MCS0	52	5260	14.63	14.62	100	100	15.0	15.0	No	No
			56	5280	14.40	14.87			15.0	15.0		
			60	5300	14.80	14.99			15.0	15.0		
			64	5320	12.81	14.35			13.0	15.0		
	802.11ac (VHT40)	MCS0	54	5270	13.91	15.76	100	100	14.0	16.0	No	Yes
			62	5310	9.96	10.33			10.0	12.0		
	802.11ac (VHT80)	MCS0	58	5290	7.27	9.04	100	100	8.0	10.0	No	No

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)		Duty Cycle %		Tune-up Limit (dBm)		SAR Test (Yes/No)	
					Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1
5.5GHz (U-NII 2C)	802.11a	6 Mbps	100	5500	11.67	15.56	100	100	12.0	16.0	No	No
			116	5580	11.80	15.82			12.0	16.0		
			124	5620	11.56	15.93			12.0	16.0		
			132	5660	11.97	15.88			12.0	16.0		
			140	5700	11.75	15.76			12.0	16.0		
			144	5720	11.58	15.83			12.0	16.0		
	802.11n (HT20)	MCS0	100	5500	12.00	15.82	100	100	12.0	16.0	No	No
			116	5580	11.72	15.67			12.0	16.0		
			124	5620	11.34	15.99			12.0	16.0		
			132	5660	11.73	15.98			12.0	16.0		
			140	5700	11.91	15.28			12.0	16.0		
			144	5720	11.93	15.83			12.0	16.0		
	802.11n (HT40)	MCS0	102	5510	9.58	11.33	100	100	10.0	12.0	No	No
			110	5550	11.32	15.13			12.0	16.0		
			126	5630	11.57	15.78			12.0	16.0		
			134	5670	11.74	15.63			12.0	16.0		
			142	5710	11.93	15.60			12.0	16.0		
	802.11ac (VHT20)	MCS0	100	5500	11.64	15.09	100	100	12.0	16.0	No	No
			116	5580	11.55	15.24			12.0	16.0		
			124	5620	11.68	15.17			12.0	16.0		
			132	5660	11.47	15.65			12.0	16.0		
			140	5700	11.31	15.47			12.0	16.0		
			144	5720	11.70	15.63			12.0	16.0		
	802.11ac (VHT40)	MCS0	102	5510	9.68	11.12	100	100	10.0	12.0	No	No
			110	5550	11.79	15.33			12.0	16.0		
			126	5630	11.35	15.15			12.0	16.0		
			134	5670	11.76	15.48			12.0	16.0		
			142	5710	11.92	15.77			12.0	16.0		
	802.11ac (VHT80)	MCS0	106	5530	11.00	11.64	100	100	11.0	12.0	Yes	Yes
			122	5610	12.44	15.59			13.0	16.0		
			138	5690	12.85	16.00			13.0	16.0		

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)		Duty Cycle %		Tune-up Limit (dBm)		SAR Test (Yes/No)	
					Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1
5.8GHz (U-NII 3)	802.11a	6 Mbps	149	5745	12.33	14.58	100	100	13.0	15.0	No	No
			157	5785	12.09	14.92			13.0	15.0		
			165	5825	12.27	14.99			13.0	15.0		
	802.11n (HT20)	MCS0	149	5745	12.67	14.42	100	100	13.0	15.0	No	No
			157	5785	12.63	14.60			13.0	15.0		
			165	5825	12.55	14.88			13.0	15.0		
	802.11n (HT40)	MCS0	151	5755	12.62	14.71	100	100	13.0	15.0	No	No
			159	5795	12.71	14.83			13.0	15.0		
	802.11ac (VHT20)	MCS0	149	5745	12.57	14.11	100	100	13.0	15.0	No	No
			157	5785	12.62	14.88			13.0	15.0		
			165	5825	12.56	14.82			13.0	15.0		
	802.11ac (VHT40)	MCS0	151	5755	12.40	14.69	100	100	13.0	15.0	No	No
			159	5795	12.45	14.87			13.0	15.0		
	802.11ac (VHT80)	MCS0	155	5775	12.80	14.90	100	100	13.0	15.0	Yes	Yes

Note(s):

1. For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.
2. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.
3. When the specified maximum output power is the same for both UNII band I and UNII band 2A, begin SAR measurement in UNII band 2A; and if the highest *reported* SAR for UNII band 2A is
   - ≤ 1.2 W/kg, SAR is not required for UNII band I
   - > 1.2 W/kg, both bands should be tested independently for SAR.

10.3. Bluetooth

Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)		Duty Cycle %		Tune-up Limit (dBm)		SAR Test (Yes/No)	
					Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1
Bluetooth	BR	1 Mbps	0	2402	-	10.36	-	77.43	-	11.0	-	Yes
			39	2441	-	10.27			-	11.0		
			78	2480	-	10.12			-	11.0		
	EDR	2 Mbps	0	2402	-	8.72	-	75.31	-	9.0	-	No
			39	2441	-	8.56			-	9.0		
			78	2480	-	8.64			-	9.0		
	EDR	3 Mbps	0	2402	-	8.61	-	77.52	-	9.0	-	No
			39	2441	-	8.58			-	9.0		
			78	2480	-	8.54			-	9.0		
Bluetooth	BLE	1 Mbps	0	2402	-	5.37	-	85.26	-	6.0	-	No
			19	2440	-	5.52			-	6.0		
			39	2480	-	5.32			-	6.0		
Bluetooth	BLE	2 Mbps	0	2402	-	5.65	-	57.45	-	6.0	-	No
			19	2440	-	5.67			-	6.0		
			39	2480	-	5.47			-	6.0		

11. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

KDB 447498 D01 General RF Exposure Guidance:

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

KDB 248227 D01 SAR meas for 802.11:

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the *initial test position(s)* by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The *initial test position(s)* is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the *reported* SAR for the *initial test position* is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the *initial test position* to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the *reported* SAR is ≤ 0.8 W/kg or all required test positions are tested.
    - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
    - When it is unclear, all equivalent conditions must be tested.
- For all positions/configurations tested using the *initial test position* and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required test channels are considered.
    - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.
- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the *initial test position*, Area Scans were performed to determine the position with the *Maximum Value of SAR (measured)*. The position that produced the highest *Maximum Value of SAR* is considered the worst case position; thus used as the *initial test position*.

11.1. Test Condition

Test Item	Test Site No.	Environmental Condition	Test Date	Tested by
SAR	SAR1	21.8~22.3°C	Oct. 16, 2021 ~ Oct. 24, 2021	Edison Hu

11.2. Wi-Fi (DTS Band)

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)	
								Tune-up Limit	Meas.	Meas.	Scaled
Body	802.11b (1Mbps)	Chain 0	5	Horizontal-Up	6	2437	100.0%	19.0	18.92	0.581	0.592
Body	802.11b (1Mbps)	Chain 0	5	Horizontal-Down	6	2437	100.0%	19.0	18.92	0.613	0.624
Body	802.11b (1Mbps)	Chain 0	5	Horizontal-Down	1	2412	100.0%	14.0	13.32	0.201	0.235
Body	802.11b (1Mbps)	Chain 0	5	Horizontal-Down	11	2462	100.0%	14.0	13.42	0.209	0.239
Body	802.11b (1Mbps)	Chain 0	5	Vertical-Front	6	2437	100.0%	19.0	18.92	0.379	0.386
Body	802.11b (1Mbps)	Chain 0	5	Vertical-Back	6	2437	100.0%	19.0	18.92	0.070	0.071
Body	802.11b (1Mbps)	Chain 1	5	Horizontal-Up	6	2437	100.0%	18.0	17.67	0.404	0.436
Body	802.11b (1Mbps)	Chain 1	5	Horizontal-Down	6	2437	100.0%	18.0	17.67	0.436	0.470
Body	802.11b (1Mbps)	Chain 1	5	Horizontal-Down	1	2412	100.0%	13.0	12.44	0.131	0.149
Body	802.11b (1Mbps)	Chain 1	5	Horizontal-Down	11	2462	100.0%	13.0	12.28	0.128	0.151
Body	802.11b (1Mbps)	Chain 1	5	Vertical-Front	6	2437	100.0%	18.0	17.67	0.140	0.151
Body	802.11b (1Mbps)	Chain 1	5	Vertical-Back	6	2437	100.0%	18.0	17.67	0.340	0.367

11.3. Wi-Fi (U-NII Band)

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)	
								Tune-up Limit	Meas.	Meas.	Scaled
Body	802.11n (HT20)	Chain 0	5	Horizontal-Up	60	5300	100.0%	15.0	14.92	0.546	0.556
Body	802.11n (HT20)	Chain 0	5	Horizontal-Down	60	5300	100.0%	15.0	14.92	0.486	0.495
Body	802.11n (HT20)	Chain 0	5	Vertical-Front	60	5300	100.0%	15.0	14.92	0.819	0.834
Body	802.11n (HT20)	Chain 0	5	Vertical-Front	52	5260	100.0%	15.0	14.82	0.840	0.876
Body	802.11n (HT20)	Chain 0	5	Vertical-Front	56	5280	100.0%	15.0	14.83	0.876	0.911
Body	802.11n (HT20)	Chain 0	5	Vertical-Front	64	5320	100.0%	13.0	11.26	0.321	0.479
Body	802.11n (HT20)	Chain 0	5	Vertical-Back	60	5300	100.0%	15.0	14.92	0.139	0.142
Body	802.11ac (VHT40)	Chain 1	5	Horizontal-Up	54	5270	100.0%	16.0	15.76	0.296	0.313
Body	802.11ac (VHT40)	Chain 1	5	Horizontal-Down	54	5270	100.0%	16.0	15.76	0.373	0.394
Body	802.11ac (VHT40)	Chain 1	5	Vertical-Front	54	5270	100.0%	16.0	15.76	0.031	0.033
Body	802.11ac (VHT40)	Chain 1	5	Vertical-Back	54	5270	100.0%	16.0	15.76	0.413	0.436
Body	802.11ac (VHT40)	Chain 1	5	Vertical-Back	62	5310	100.0%	12.0	10.33	0.088	0.130
Body	802.11ac (VHT80)	Chain 0	5	Horizontal-Up	138	5690	100.0%	13.0	12.85	0.566	0.586
Body	802.11ac (VHT80)	Chain 0	5	Horizontal-Down	138	5690	100.0%	13.0	12.85	0.635	0.657
Body	802.11ac (VHT80)	Chain 0	5	Vertical-Front	138	5690	100.0%	13.0	12.85	1.060	1.097
Body	802.11ac (VHT80)	Chain 0	5	Vertical-Front	106	5530	100.0%	11.0	11.00	0.604	0.604
Body	802.11ac (VHT80)	Chain 0	5	Vertical-Front	122	5610	100.0%	13.0	12.44	0.912	1.038
Body	802.11ac (VHT80)	Chain 0	5	Vertical-Back	138	5690	100.0%	13.0	12.85	0.111	0.115
Body	802.11ac (VHT80)	Chain 1	5	Horizontal-Up	138	5690	100.0%	16.0	16.00	0.566	0.566
Body	802.11ac (VHT80)	Chain 1	5	Horizontal-Down	138	5690	100.0%	16.0	16.00	0.520	0.520
Body	802.11ac (VHT80)	Chain 1	5	Vertical-Front	138	5690	100.0%	16.0	16.00	0.081	0.081
Body	802.11ac (VHT80)	Chain 1	5	Vertical-Back	138	5690	100.0%	16.0	16.00	0.938	0.938
Body	802.11ac (VHT80)	Chain 1	5	Vertical-Back	106	5530	100.0%	12.0	11.64	0.293	0.318
Body	802.11ac (VHT80)	Chain 1	5	Vertical-Back	122	5610	100.0%	16.0	15.59	0.929	1.021
Body	802.11ac (VHT80)	Chain 0	5	Horizontal-Up	155	5775	100.0%	13.0	12.80	0.862	0.903
Body	802.11n (HT40)	Chain 0	5	Horizontal-Up	159	5795	100.0%	13.0	12.71	0.788	0.842
Body	802.11ac (VHT80)	Chain 0	5	Horizontal-Down	155	5775	100.0%	13.0	12.80	0.462	0.484
Body	802.11ac (VHT80)	Chain 0	5	Vertical-Front	155	5775	100.0%	13.0	12.80	0.787	0.824
Body	802.11ac (VHT80)	Chain 0	5	Vertical-Back	155	5775	100.0%	13.0	12.80	0.094	0.099
Body	802.11ac (VHT80)	Chain 1	5	Horizontal-Up	155	5775	100.0%	15.0	14.90	0.191	0.195
Body	802.11ac (VHT80)	Chain 1	5	Horizontal-Down	155	5775	100.0%	15.0	14.90	0.643	0.658
Body	802.11n (HT40)	Chain 1	5	Horizontal-Down	159	5795	100.0%	15.0	14.83	0.479	0.498
Body	802.11ac (VHT80)	Chain 1	5	Vertical-Front	155	5775	100.0%	15.0	14.90	0.034	0.035
Body	802.11ac (VHT80)	Chain 1	5	Vertical-Back	155	5775	100.0%	15.0	14.90	0.510	0.522

11.4. Bluetooth

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)	
								Tune-up Limit	Meas.	Meas.	Scaled
Body	Bluetooth	Chain 1	5	Horizontal-Up	0	2402	77.43%	11.0	10.36	0.002	0.003
Body	Bluetooth	Chain 1	5	Horizontal-Down	0	2402	77.43%	11.0	10.36	0.046	0.069
Body	Bluetooth	Chain 1	5	Horizontal-Down	39	2441	77.43%	11.0	10.27	0.043	0.065
Body	Bluetooth	Chain 1	5	Horizontal-Down	78	2480	77.43%	11.0	10.12	0.044	0.069
Body	Bluetooth	Chain 1	5	Vertical-Front	0	2402	77.43%	11.0	10.36	0.002	0.003
Body	Bluetooth	Chain 1	5	Vertical-Back	0	2402	77.43%	11.0	10.36	0.001	0.002

12. SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is <0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio
								Original	Repeated	
Body	802.11n (HT20)	Chain 0	5	Vertical-Front	56	5280	100	0.876	0.848	0.97
Body	802.11ac (VHT80)	Chain 0	5	Vertical-Front	138	5690	100	1.06	1.01	0.95
Body	802.11ac (VHT80)	Chain 0	5	Horizontal-Up	155	5775	100	0.862	0.781	0.91

Note(s):

Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is < 1.20.

13. Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance explains how to calculate the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$$

Where:

SAR_1 is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR_2 is the highest measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of $\mathbf{[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]}$

In order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)^{1.5} / Ri \leq 0.04$$

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations		
Standalone	1	DTS Chain 0	+	BT
	2	U-NII Chain 0	+	BT
	3	DTS Chain 0	+	DTS Chain 1
	4	U-NII Chain 0	+	U-NII Chain 1

Notes:

1. The device support simultaneous operation for BT & WLAN 2.4 GHz chain 0 and BT & WLAN 5 GHz chain 0 only.

13.1. Sum of the SAR

Test Position	Standalone 1g SAR (W/kg)					∑ 1-g SAR (W/kg)			
	DTS Chain 0	DTS Chain 1	U-NII Chain 0	U-NII Chain 1	BT Chain 1	① + ②	① + ⑤	③ + ④	③ + ⑤
	①	②	③	④	⑤				
Horizontal-Up	0.592	0.436	0.903	0.566	0.003	1.028	0.595	1.469	0.906
Horizontal-Down	0.624	0.470	0.657	0.658	0.069	1.094	0.693	1.315	0.726
Vertical-Front	0.386	0.151	1.097	0.081	0.003	0.537	0.389	1.178	1.1
Vertical-Back	0.071	0.367	0.142	1.021	0.002	0.438	0.073	1.163	0.144

Appendixes

Refer to separated files for the following appendixes.

4790038917B-US-S0-V0_Appendix A: SAR Setup Photos

4790038917B-US-S0-V0_Appendix B: SAR System Check Plots

4790038917B-US-S0-V0_Appendix C: Highest SAR Test Plots

4790038917B-US-S0-V0_Appendix D: SAR Probe and Dipole Calibration Certificates

END OF REPORT