SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
WLAN TRANSCEIVER

FCC ID: AFJ399510
Model Name: IP110H

Report Number: 4790590080-US-S0-V3
Issue Date: 2023/3/6

Prepared for
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REVISION HISTORY

Rev.	Date	Revisions	Revised By
V0	2022/12/23	Initial Issue	Cindy Hsin
V1	2023/2/14	1. Revised P. 13 BT Version. 2. Revised P. 15 tune up. 3. Revised P. 23 tune up and add notes.	Cindy Hsin
V2	2023/3/12023/3/6	1. Revised P. 4 Highest Reported SAR 2. Revised P. 15, P. 19~ P. 21 tune up. 3. Revised P. 25 data 4. Revised P. 28 data	Cindy Hsin
V3	2023/3/6	1. Revised P. 4 Highest Reported SAR 2. Revised P. 27 Simultaneous Transmission Condition	Cindy Hsin

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1. Attestation of Test Results

Applicant Name	Icom Incorporated		
FCC ID	AFJ399510		
Model Name	IP110H		
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)	Extremities (hands, wrists, ankles, etc.) (10g of tissue)	
General population/Uncontrolled exposure	1.6	4	
RF Exposure Conditions	Equipment Class - Highest Reported SAR (W/kg)		
	DTS	NII	DSS
Head	0.016	0.02	< 0.1
Body-worn*	0.136	0.171	< 0.1
Simultaneous TX	0.136	0.171	0.171
Date Tested	2022/10/25 ~ 2022/11/23		
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:
	
Kent Liu Senior Laboratory Engineer Underwriters Laboratories Taiwan Co., Ltd.	Cindy Hsin 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:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D04 Interim General RF Exposure Guidance v01
- 643646 D01 SAR Test for PTT Radios v01r03
- 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

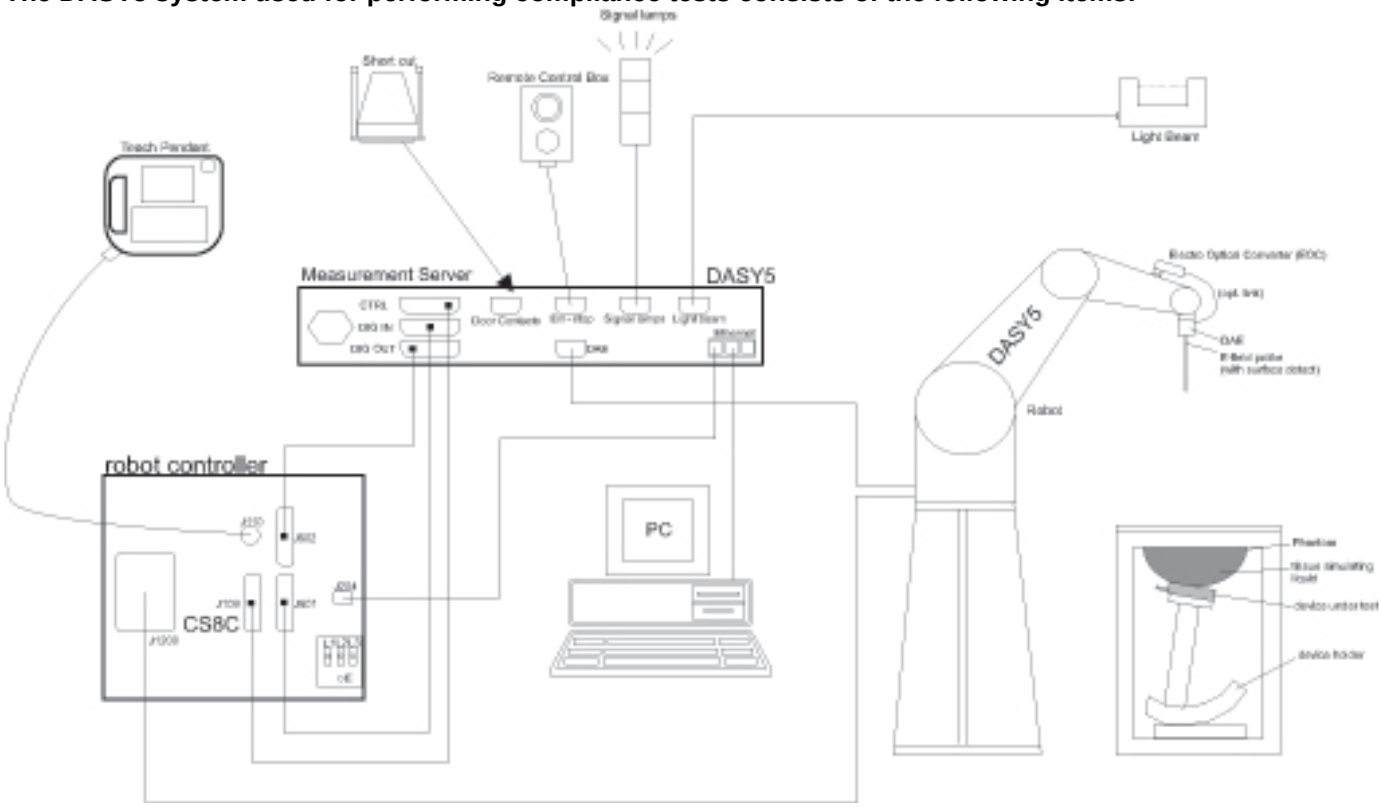
Underwriters Laboratories Taiwan Co., Ltd.,
SAR Room

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	2023/2/10
Dielectric Assessment Kit	SPEAG	DAK-3.5	1058	2023/6/14
Humidity/Temp meter	TECPEL	DTM-20	17020736	2023/5/31

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
EXG-B RF Vector Signal Generator	Keysight Technologies	N5172B	MY56200315	2023/5/26
Power Meter	Keysight Technologies	N1914A	MY56360007	2022/12/20
Power Sensor	Keysight Technologies	N8481H	MY56350009	2022/12/20
Power Meter	Anritsu	ML2495A	1645002	2022/12/21
Power Sensor	Anritsu	MA2411B	1531202	2022/12/21
Dosimetric E-Field Probe	SPEAG	EX3DV4	3820	2023/7/26
Dosimetric E-Field Probe	SPEAG	EX3DV4	3901	2023/10/17
Data Acquisition Electronice	SPEAG	DAE3	528	2023/5/18
Data Acquisition Electronice	SPEAG	DAE4	1360	2023/9/28
System Validation Dipole	SPEAG	D2450V2	988	2023/11/9
System Validation Dipole	SPEAG	D5GHzV2	1244	2023/11/9
Humidity/Temp meter	TECPEL	DTM-20	17020735	2023/4/11

UL Software

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

5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

Therefore, the measurement uncertainty is not required.

6. Device Under Test (DUT) Information

6.1. DUT Description

Product	WLAN TRANSCEIVER
Brand Name	ICOM
Model Name	IP110H
Operating Frequency	Wi-Fi 2.4GHz : 2412MHz ~ 2462MHz Wi-Fi 5GHz : 5180 ~ 5320MHz, 5500 ~ 5700MHz, 5745 ~ 5825MHz Bluetooth : 2402 ~ 2480MHz
Modulation	CCK, DQPSK, DBPSK for DSSS 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM 256QAM, 64QAM, 16QAM for OFDMA GFSK, π/4-DQPSK, 8DPSK
Sample ID	399533000311
Hardware Version	N/A
Software Version	N/A
Received Date	2022/10/12

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)	99.13% (802.11b)
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)	94.57% (802.11a)
	Does this device support bands 5.60 ~ 5.65 GHz? ☒ Yes ☐ No		
	Does this device support straddle channel? ☐ Yes ☒ No		
Bluetooth	2.4 GHz	Version 4.2	92.6%

7. RF Exposure Conditions (Test Configurations)

Refer to Appendix B for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

7.1. Standalone SAR Test Exclusion Considerations

The SAR-based exemption formula of § 1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold Pth (mW)

Table B.2—Example Power Thresholds (mW)

Frequency (MHz)	Distance (mm)										
	5	10	15	20	25	30	35	40	45	50
300	39	65	88	110	129	148	166	184	201	217
450	22	44	67	89	112	135	158	180	203	226
835	9	25	44	66	90	116	145	175	207	240
1900	3	12	26	44	66	92	122	157	195	236
2450	3	10	22	38	59	83	111	143	179	219
3600	2	8	18	32	49	71	96	125	158	195
5800	1	6	14	25	40	58	80	106	136	169

SAR Test Exclusion Calculations for WLAN

Band	Test Position	separation distance(mm)	Max. EIRP power(dBm)	Max. EIRP power(mW)	Exemption Limits	Test Require
Wi-Fi 2.4GHz	In-front-of the face	8.75	15.15	32.7	10.0	Yes
	Back	14.00			22.0	Yes
Wi-Fi 5GHz U-NII I	In-front-of the face	8.75	8.65	7.3	6.0	Yes
	Back	14.00			14.0	No
Wi-Fi 5GHz U-NII 2A	In-front-of the face	8.75	9.65	9.2	6.0	Yes
	Back	14.00			14.0	No
Wi-Fi 5GHz U-NII 2C	In-front-of the face	8.75	8.62	7.3	6.0	Yes
	Back	14.00			14.0	No
Wi-Fi 5GHz U-NII 3	In-front-of the face	8.75	10.12	10.3	6.0	Yes
	Back	14.00			14.0	No
Bluetooth	In-front-of the face	8.87	6.22	4.2	10.0	No
	Back	14.95			22.0	No

Note(s):

8. Dielectric Property Measurements & System Check

8.1. 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 (MHz)	Head	
	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
5000	36.2	4.45
5100	36.1	4.55
5200	36.0	4.66
5300	35.9	4.76
5400	35.8	4.86
5500	35.6	4.96
5600	35.5	5.07
5700	35.4	5.17
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 (%)
2022/10/25	Head	5180	36.82	36.02	2.22	4.77	4.64	2.76
		5190	36.71	36.01	1.94	4.79	4.65	2.92
		5200	36.70	36.00	1.95	4.82	4.66	3.48
		5210	36.77	35.99	2.18	4.82	4.67	3.25
		5220	36.70	35.98	2.01	4.82	4.68	2.89
		5230	36.63	35.97	1.83	4.83	4.69	2.87
		5240	36.60	35.96	1.78	4.86	4.70	3.29
		5250	36.66	35.95	1.97	4.86	4.71	3.26
		5260	36.67	35.94	2.02	4.86	4.72	2.95
		5270	36.57	35.93	1.79	4.87	4.73	2.87
		5280	36.51	35.92	1.65	4.89	4.74	3.26
		5290	36.57	35.91	1.84	4.91	4.75	3.37
		5300	36.59	35.90	1.93	4.91	4.76	3.11
		5310	36.48	35.89	1.65	4.91	4.77	2.92
		5320	36.44	35.88	1.56	4.94	4.78	3.32
2022/10/26	Head	5500	34.43	35.65	-3.43	4.90	4.97	-1.27
		5510	34.37	35.63	-3.53	4.89	4.98	-1.67
		5530	34.31	35.60	-3.62	4.93	5.00	-1.28
		5550	34.28	35.57	-3.61	4.93	5.02	-1.67
		5580	34.28	35.52	-3.49	4.99	5.05	-1.18
		5600	34.18	35.50	-3.71	4.99	5.07	-1.59
		5610	34.15	35.49	-3.77	5.01	5.08	-1.30
		5620	34.17	35.48	-3.70	5.04	5.09	-1.01
		5630	34.16	35.47	-3.70	5.03	5.10	-1.40
		5660	34.06	35.44	-3.91	5.08	5.13	-0.97
		5670	34.07	35.43	-3.84	5.08	5.14	-1.15
		5690	34.00	35.41	-3.98	5.10	5.16	-1.14
		5700	34.02	35.40	-3.90	5.13	5.17	-0.81
		5710	34.01	35.39	-3.89	5.12	5.18	-1.09
		5720	33.96	35.38	-4.01	5.12	5.19	-1.26
2022/10/27	Head	5745	34.45	35.36	-2.57	5.23	5.21	0.32
		5755	34.35	35.35	-2.81	5.23	5.22	0.19
		5775	34.25	35.33	-3.05	5.28	5.24	0.72
		5785	34.23	35.32	-3.08	5.31	5.25	1.08
		5795	34.31	35.31	-2.81	5.32	5.26	0.97
		5800	34.27	35.30	-2.92	5.30	5.27	0.53
		5825	34.22	35.28	-2.98	5.38	5.30	1.51
2022/10/28	Head	2412	38.89	39.26	-0.92	1.76	1.76	-0.33
		2422	38.81	39.24	-1.10	1.77	1.77	-0.17
		2437	38.79	39.22	-1.10	1.79	1.79	0.36
		2450	38.78	39.20	-1.06	1.80	1.80	0.15
		2452	38.78	39.20	-1.06	1.80	1.80	0.07
		2462	38.70	39.18	-1.22	1.81	1.81	0.14
2022/11/23	Head	2402	38.19	39.27	-2.76	1.81	1.76	3.19
		2440	37.98	39.21	-3.14	1.84	1.79	2.92
		2441	37.99	39.21	-3.13	1.85	1.79	3.00
		2450	38.08	39.20	-2.86	1.86	1.80	3.48
		2480	37.84	39.16	-3.37	1.88	1.83	2.62

8.2. 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.
2022/10/28	Head	D2450V2-988	250	13.1	52.20	52.4	0.38	6.08	23.90	24.32	1.76	1
2022/11/23	Head	D2450V2-988	250	12.4	52.20	49.6	-4.98	5.75	23.90	23	-3.77	2
2022/10/25	Head	D5GHzV2-1244-5250	100	7.93	77.00	79.3	2.99	2.21	22.00	22.1	0.45	3
2022/10/26	Head	D5GHzV2-1244-5600	100	7.83	80.60	78.3	-2.85	2.14	23.00	21.4	-6.96	4
2022/10/27	Head	D5GHzV2-1244-5800	100	8.26	77.70	82.6	6.31	2.27	22.00	22.7	3.18	5

9. Conducted Output Power Measurements

9.1. Wi-Fi 2.4GHz (DTS Band)

Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Tune-up Limit (dBm)	SAR Test (Yes/No)
2.4GHz (DTS)	802.11b	1 Mbps	1	2412	12.68	14	Yes
			6	2437	12.41	14	
			11	2462	12.35	14	
	802.11g	6 Mbps	1	2412	9.17	11	No
			6	2437	9.51	11	
			11	2462	9.47	11	
	802.11n (HT20)	MCS0	1	2412	12.11	13.5	No
			6	2437	11.91	13.5	
			11	2462	11.85	13.5	
	802.11n (HT40)	MCS0	3	2422	11.31	13	No
			6	2437	11.17	13	
			9	2452	11.02	13	

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.

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

Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Tune-up Limit (dBm)	SAR Test (Yes/No)
5.2GHz (U-NII 1)	802.11a	6 Mbps	36	5180	7.03	8.5	No
			40	5200	6.82	8.5	
			44	5220	6.96	8.5	
			48	5240	6.90	8.5	
	802.11n (HT20)	MCS0	36	5180	5.97	7.5	No
			40	5200	6.15	7.5	
			44	5220	6.19	7.5	
			48	5240	6.75	7.5	
	802.11n (HT40)	MCS0	38	5190	3.13	5.0	No
			46	5230	3.03	5.0	
	802.11ac (VHT20)	MCS0	36	5180	5.83	7.5	No
			40	5200	6.09	7.5	
			44	5220	6.12	7.5	
			48	5240	6.65	7.5	
	802.11ac (VHT40)	MCS0	38	5190	3.04	5.0	No
			46	5230	3.02	5.0	
	802.11ac (VHT80)	MCS0	42	5210	5.08	7.0	No
5.3GHz (U-NII 2A)	802.11a	6 Mbps	52	5260	7.63	9.5	Yes
			56	5280	8.00	9.5	
			60	5300	7.78	9.5	
			64	5320	7.66	9.5	
	802.11n (HT20)	MCS0	52	5260	6.42	7.5	No
			56	5280	6.24	7.5	
			60	5300	6.10	7.5	
			64	5320	5.99	7.5	
	802.11n (HT40)	MCS0	54	5270	2.94	4.5	No
			62	5310	3.32	4.5	
	802.11ac (VHT20)	MCS0	52	5260	6.41	7.5	No
			56	5280	6.24	7.5	
			60	5300	6.09	7.5	
			64	5320	5.80	7.5	
	802.11ac (VHT40)	MCS0	54	5270	2.88	4.5	No
			62	5310	3.22	4.5	
	802.11ac (VHT80)	MCS0	58	5290	4.90	6.5	No

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Tune-up Limit (dBm)	SAR Test (Yes/No)
5.5GHz (U-NII 2C)	802.11a	6 Mbps	100	5500	7.03	8.0	Yes
			116	5580	7.62	8.0	
			124	5620	6.47	8.0	
			132	5660	7.92	8.0	
			140	5700	7.99	8.0	
	802.11n (HT20)	MCS0	100	5500	7.48	8.0	No
			116	5580	7.45	8.0	
			124	5620	6.40	8.0	
			132	5660	7.45	8.0	
			140	5700	7.45	8.0	
	802.11n (HT40)	MCS0	102	5510	4.76	6.0	No
			110	5550	4.95	6.0	
			126	5630	4.84	6.0	
			134	5670	4.23	6.0	
	802.11ac (VHT20)	MCS0	100	5500	6.74	8.0	No
			116	5580	7.45	8.0	
			124	5620	6.30	8.0	
			132	5660	7.64	8.0	
			140	5700	7.94	8.0	
	802.11ac (VHT40)	MCS0	102	5510	4.79	6.0	No
			110	5550	4.88	6.0	
			126	5630	4.79	6.0	
			134	5670	4.21	6.0	
	802.11ac (VHT80)	MCS0	106	5530	4.09	4.5	No
			122	5610	3.84	4.5	
			138	5690	2.80	4.5	
5.8GHz (U-NII 3)	802.11a	6 Mbps	149	5745	7.74	9.5	Yes
			157	5785	7.99	9.5	
			165	5825	7.81	9.5	
	802.11n (HT20)	MCS0	149	5745	7.49	9.0	No
			157	5785	7.22	9.0	
			165	5825	7.47	9.0	
	802.11n (HT40)	MCS0	151	5755	4.23	6.0	No
			159	5795	4.33	6.0	
	802.11ac (VHT20)	MCS0	149	5745	7.43	9.0	No
			157	5785	7.16	9.0	
			165	5825	7.28	9.0	
	802.11ac (VHT40)	MCS0	151	5755	4.17	6.0	No
			159	5795	4.30	6.0	
	802.11ac (VHT80)	MCS0	155	5775	3.21	5.0	No

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.

9.3. Bluetooth

Average Power Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Tune-up Limit (dBm)	SAR Test (Yes/No)
Bluetooth	BR	1 Mbps	0	2402	4.11	6.22	Yes
			39	2441	5.68	6.22	
			78	2480	5.74	6.22	

Note(s):

Peak output power was used as the tune-up limit in the original BT module certification. for this RF exposure, AVG power measured based on the BT module certification that is the worst-case evaluation.

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

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*.

10.1. Test Condition

Test Item	Test Site No.	Test Date	Tested by
SAR	SAR1	2022/10/25 ~ 2022/11/23	Edison Hu

10.2. Wi-Fi (U-NII Band)

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Power Drift	Accessory	Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled			
Body	802.11b (1Mbps)	25	In-front-of the face	1	2412	99.13%	14.0	12.68	0.012	0.016	0.005	0.007	0.08		
Body	802.11b (1Mbps)	0	Back	1	2412	99.13%	14.0	12.68	0.118	0.161	0.055	0.075	-0.03		
Body	802.11b (1Mbps)	0	Back	1	2412	99.13%	14.0	12.68	0.125	**0.171**	0.059	**0.081**	0	Headset Microphone	1
Body	802.11b (1Mbps)	0	Back	6	2437	99.13%	14.0	12.41	0.095	0.139	0.043	0.063	0.12	Headset Microphone	
Body	802.11b (1Mbps)	0	Back	11	2462	99.13%	14.0	12.35	0.083	0.122	0.037	0.054	-0.06	Headset Microphone	
Body	802.11b (1Mbps)	0	Back	1	2412	99.13%	14.0	12.68	0.122	0.167	0.056	0.077	0.03	Speaker Microphone	

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Power Drift	Accessory	Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled			
Body	802.11a (6Mbps)	25	In-front-of the face	56	5280	94.57%	9.5	8.0	0.014	0.020	0.006	0.008	-0.19		
Body	802.11a (6Mbps)	0	Back	56	5280	94.57%	9.5	8.0	0.087	0.130	0.024	0.035	0.04		
Body	802.11a (6Mbps)	0	Back	56	5280	94.57%	9.5	8.0	0.092	0.138	0.024	0.036	-0.09	Headset Microphone	
Body	802.11a (6Mbps)	0	Back	56	5280	94.57%	9.5	8.0	0.104	0.155	0.026	0.039	-0.09	Speaker Microphone	
Body	802.11a (6Mbps)	0	Back	52	5260	94.57%	9.5	7.63	0.082	0.133	0.021	0.034	-0.11	Speaker Microphone	
Body	802.11a (6Mbps)	0	Back	60	5300	94.57%	9.5	7.78	0.109	**0.171**	0.027	**0.043**	0.03	Speaker Microphone	2
Body	802.11a (6Mbps)	0	Back	64	5320	94.57%	9.5	7.66	0.103	0.166	0.026	0.041	-0.14	Speaker Microphone	

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Power Drift	Accessory	Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled			
Body	802.11a (6Mbps)	25	In-front-of the face	140	5700	94.57%	8.0	7.99	0.002	0.002	0.000	0.000	-0.18		
Body	802.11a (6Mbps)	0	Back	140	5700	94.57%	8.0	7.99	0.056	0.059	0.013	0.014	0.07		
Body	802.11a (6Mbps)	0	Back	100	5500	94.57%	8.0	7.03	0.056	**0.074**	0.013	0.017	-0.10		3
Body	802.11a (6Mbps)	0	Back	116	5580	94.57%	8.0	7.62	0.054	0.062	0.012	0.014	-0.18		
Body	802.11a (6Mbps)	0	Back	124	5620	94.57%	8.0	6.47	0.038	0.057	0.009	0.013	-0.19		
Body	802.11a (6Mbps)	0	Back	132	5660	94.57%	8.0	7.92	0.055	0.059	0.013	0.014	0.08		
Body	802.11a (6Mbps)	0	Back	140	5700	94.57%	8.0	7.99	0.045	0.048	0.010	0.011	0.01	Headset Microphone	
Body	802.11a (6Mbps)	0	Back	140	5700	94.57%	8.0	7.99	0.047	0.050	0.014	0.014	0.03	Speaker Microphone	

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Power Drift	Accessory	Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled			
Body	802.11a (6Mbps)	25	In-front-of the face	157	5785	94.57%	9.5	7.99	0.008	0.012	0.002	0.004	-0.16		
Body	802.11a (6Mbps)	0	Back	157	5785	94.57%	9.5	7.99	0.053	0.079	0.013	0.020	0.09		
Body	802.11a (6Mbps)	0	Back	157	5785	94.57%	9.5	7.99	0.050	0.075	0.014	0.021	-0.18	Headset Microphone	
Body	802.11a (6Mbps)	0	Back	157	5785	94.57%	9.5	7.99	0.057	0.085	0.016	**0.024**	-0.12	Speaker Microphone	
Body	802.11a (6Mbps)	0	Back	149	5745	94.57%	9.5	7.74	0.059	**0.093**	0.014	0.022	-0.06	Speaker Microphone	4
Body	802.11a (6Mbps)	0	Back	165	5825	94.57%	9.5	7.81	0.050	0.078	0.013	0.020	0.09	Speaker Microphone	

10.3. Bluetooth

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Power Drift	Accessory	Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled			
Body	Bluetooth	25	In-front-of the face	78	2480	92.6%	6.22	5.74	0.000	**0.000**	0.000	**0.000**	-		
Body	Bluetooth	0	Back	78	2480	92.6%	6.22	5.74	0.000	**0.000**	0.000	**0.000**	-		
Body	Bluetooth	0	Back	78	2480	92.6%	6.22	5.74	0.000	**0.000**	0.000	**0.000**	-	Headset Microphone	
Body	Bluetooth	0	Back	78	2480	92.6%	6.22	5.74	0.000	**0.000**	0.000	**0.000**	-	Speaker Microphone	

Note(s):

11. 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 $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$

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	U-NII	+	BT		
	2	DTS	+	BT		

11.1. Sum of the SAR for Wi-Fi & BT

Test Position	Standalone SAR (W/kg)			∑ 1-g SAR (W/kg)	
	① WLAN 2.4 GHz	② WLAN 5 GHz	③ Bluetooth	①+③	②+③
In-front-of the face	0.016	0.02	0	0.016	0.02
Back	0.136	0.171	0	0.136	0.171

Appendixes

Refer to separated files for the following appendixes.

4790590080-US-S0-V1_Appendix A: SAR Setup Photos

4790590080-US-S0-V1_Appendix B: Antenna Dimensions and Separation Distances

4790590080-US-S0-V1_Appendix C: SAR System Check Plots

4790590080-US-S0-V1_Appendix D: Highest SAR Test Plots

4790590080-US-S0-V1_Appendix E: SAR Probe and Dipole Calibration Certificates

END OF REPORT