

SAR EVALUATION REPORT

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

For
USB dongle

**FCC ID: 2AYYS-UD2403
Model Name: UD2403**

**Report Number: 4790729268-US-S0-V0
Issue Date: 2023/3/27**

Prepared for
**Luxshare Precision Industry Co., Ltd.
2nd floor,A building,Sanyo New Industrial Area,West of Maoyi,Shajing Street,Ban'an
District,Shenzhen City,Guangdong Province,China**

Prepared by
**Underwriters Laboratories Taiwan Co., Ltd.,
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd.,
Zhudong Township, Hsinchu County, Taiwan
TEL: +886-2-7737-3000
FAX: +886-3-583-7948
Website: www.ul.com**



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REVISION HISTORY

Rev.	Date	Revisions	Revised By
V0	2023/3/27	Initial Issue	Cindy Hsin

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1. Attestation of Test Results

Applicant Name	Luxshare Precision Industry Co., Ltd.	
FCC ID	2AYYS-UD2403	
Model Name	UD2403	
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	
Body-worn*	0.269	
Date Tested	2023/3/13	
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: 
Eric Lee 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:

- 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

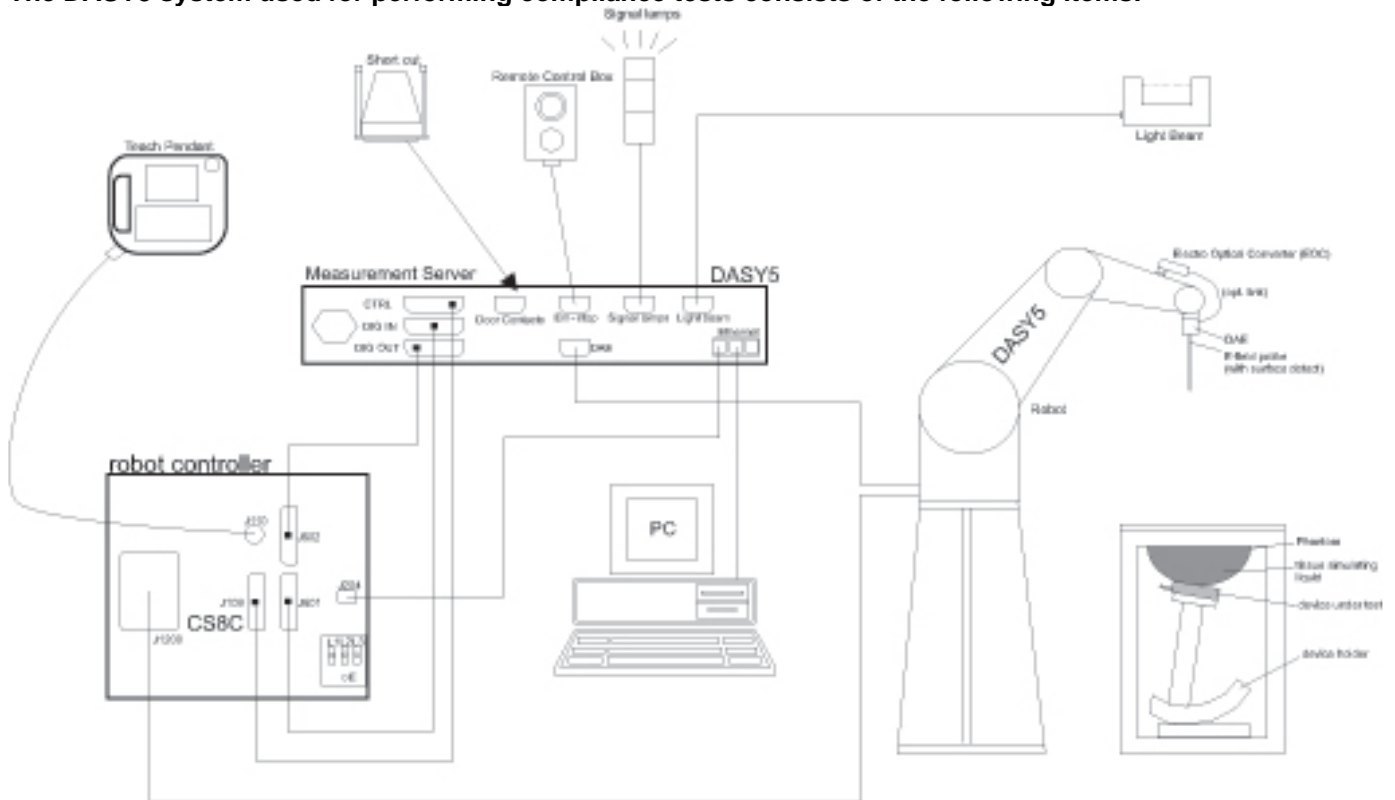
Underwriters Laboratories Taiwan Co., Ltd.,
SAR Room

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	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}	≤ 2 GHz: ≤ 15 mm $2 - 3$ GHz: ≤ 12 mm	$3 - 4$ GHz: ≤ 12 mm $4 - 6$ GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be \leq the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

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

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$			≤ 2 GHz: ≤ 8 mm $2 - 3$ GHz: ≤ 5 mm*	$3 - 4$ GHz: ≤ 5 mm* $4 - 6$ GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	$3 - 4$ GHz: ≤ 4 mm $4 - 5$ GHz: ≤ 3 mm $5 - 6$ GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	$3 - 4$ GHz: ≤ 3 mm $4 - 5$ GHz: ≤ 2.5 mm $5 - 6$ GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	$3 - 4$ GHz: ≥ 28 mm $4 - 5$ GHz: ≥ 25 mm $5 - 6$ GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Step 4: Power drift measurement

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

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	2024/2/6
Dielectric Assessment Kit	SPEAG	DAK-3.5	1250	2023/9/27
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	2023/12/19
Power Sensor	Keysight Technologies	N8481H	MY56350009	2023/12/19
Power Meter	Anritsu	ML2495A	1645002	2023/12/6
Power Sensor	Anritsu	MA2411B	1531202	2023/12/6
Dosimetric E-Field Probe	SPEAG	EX3DV4	3901	2023/10/17
Data Acquisition Electronice	SPEAG	DAE4	1360	2023/9/28
System Validation Dipole	SPEAG	D2450V2	988	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

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

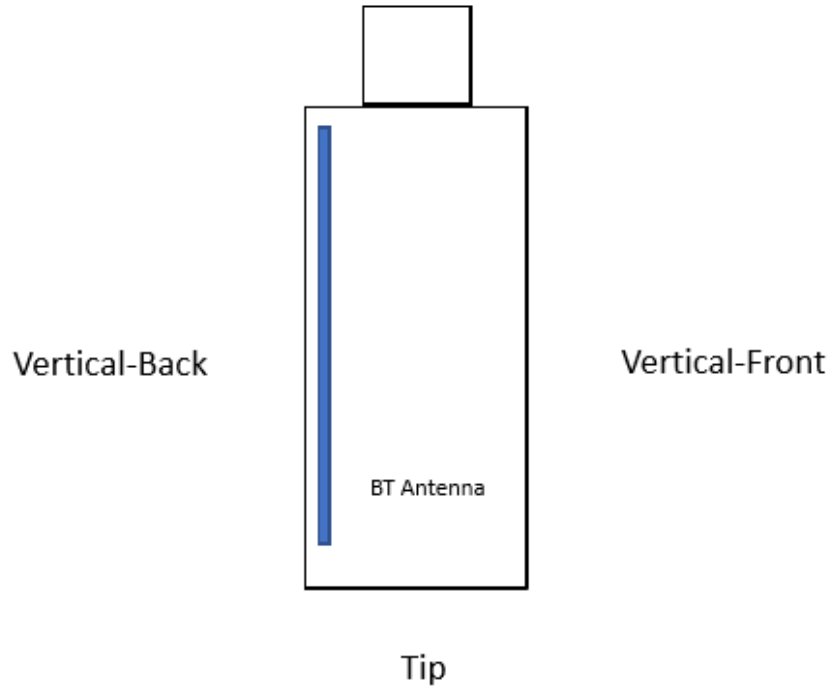
Product	USB dongle
Brand Name	Dell
Model Name	UD2403
Operating Frequency	2402MHz ~ 2480MHz
Modulation	GFSK
Hardware Version	NA
Software Version	NA
Received Date	2023/3/10

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Bluetooth	2.4 GHz	BT-LE	30.45%

7. Antenna Location

Horizontal-Up View



Antenna	To Horizontal-Up	To Horizontal-Down	To Vertical-Front	To Vertical-Back	To Tip
Bluetooth	1.18	1.18	16.7	3.15	1.20

Unit : mm

8. RF Exposure Conditions (Test Configurations)

Wireless technologies	RF Exposure Conditions	DUT to User Separation	Test Position	Antenna to edge/surface	SAR Required	Note
Bluetooth	Body	1.18	Horizontal-Up	<5mm	Yes	
		1.18	Horizontal-Down	<5mm	Yes	
		16.7	Vertical-Front	<5mm	Yes	
		3.15	Vertical-Back	<5mm	Yes	
		1.2	Tip	<5mm	Yes	

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 $\pm 2^\circ\text{C}$ 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 (ϵ_r) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within $\pm 5\%$ 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 ϵ_r and σ may be relaxed to $\pm 10\%$. 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 (ϵ_r)			Conductivity (σ)		
			Measured	Target	Delta (%)	Measured	Target	Delta (%)
2023/3/13	Head	2404	38.88	39.27	-0.99	1.78	1.76	1.50
		2440	38.75	39.21	-1.19	1.83	1.79	1.99
		2441	38.74	39.21	-1.19	1.83	1.79	1.94
		2450	38.72	39.20	-1.22	1.83	1.80	1.72
		2478	38.58	39.16	-1.47	1.86	1.83	2.05

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.
2023/3/13	Head	D2450V2-988	250	12.5	52.20	50	-4.21	5.77	23.90	23.08	-3.43	1

10. Conducted Output Power Measurements

10.1. 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	BLE	1 Mbps	0	2402	8.47	9.0	Yes
			19	2440	8.53	9.0	
			39	2480	8.48	9.0	
		2 Mbps	1	2404	8.48	9.0	Yes
			19	2440	8.54	9.0	
			38	2478	8.52	9.0	

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

11.1. Test Condition

Test Item	Test Site No.	Test Date	Tested by
SAR	SAR1	2023/3/13	Edison Hu

11.2. Bluetooth

Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Power Drift	Plot No.
						Tune-up Limit	Meas.	Meas.	Scaled	Meas.	Scaled		
802.11b (1Mbps)	5	Horizontal-Up	19	2440	30.45%	9.0	8.54	0.074	0.269	0.033	0.119	0.17	1
802.11b (1Mbps)	5	Horizontal-Up	1	2404	30.45%	9.0	8.48	0.060	0.222	0.027	0.100	0.19	
802.11b (1Mbps)	5	Horizontal-Up	38	2478	30.45%	9.0	8.52	0.062	0.227	0.026	0.095	0.15	
802.11b (1Mbps)	5	Horizontal-Down	19	2440	30.45%	9.0	8.54	0.016	0.059	0.005	0.020	-0.11	
802.11b (1Mbps)	5	Vertical-Front	19	2440	30.45%	9.0	8.54	0.018	0.065	0.005	0.019	0.14	
802.11b (1Mbps)	5	Vertical-Back	19	2440	30.45%	9.0	8.54	0.041	0.151	0.017	0.061	0.18	
802.11b (1Mbps)	5	Tip	19	2440	30.45%	9.0	8.54	<0.1	<0.1	<0.1	<0.1	0.00	

Appendixes

Refer to separated files for the following appendixes.

4790729268-US-S0-V0_Appendix A: SAR Setup Photos

4790729268-US-S0-V0_Appendix B: SAR System Check Plots

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END OF REPORT

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