SAR EVALUATION REPORT

IEEE Std 1528-2013
IEC/IEEE 62209-1528:2020

For
Sensor Device and Charger

FCC ID:	**2AJ2X-WS50** **2AJ2X-WB50** **2AJ2X-WD50**
Model Name:	**WS50** **WB50** **WD50**

Report Number: R14956064-S1
Issue Date: 2025-03-05

Prepared for
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CERT #0751.06

Revision History

Rev.	Date	Revisions	Revised By
V1	2024-09-11	Initial Issue	--
V2	2024-11-08	Added reference to IEC/IEEE 62209-1528:2020 to Cover Page, §1, and §2 to address 13.56 MHz testing	Sarah Kuhaneck
V3	2024-11-27	Added Accessory WD50 (FCC ID: 2AJ2X-WD50) to report. §1 – Simultaneous Tx updated to include WD50. Results summary table reformatted for clarity. Changed NFC to DXX. Added notes that WD50 is accessory only and clarifying simultaneous transmissions. §4.1 – Updated DASY version footnote to version 16.4.0.5005. §4.3 – Added equipment used for WD50 measurements. Added secondary calibration dates for equipment that was recalibrated during test window. §6.1 – Added WD50 as an accessory. Added WD50 sample serial number and software version. §6.2 – Added WD50 wireless technologies. §7 – Removed reference to Appendix A for antenna diagram as diagram was not provided. Added Device Configuration column. Added configurations “WS50 Tx with WD50 Mounted” and “WD50 Tx Mounted on WS50”. Reformatted for clarity. §8 – Added Dielectric Property Measurements and System Checks for measurements with WD50. Unified formatting with updated template. §10 – Added WS50 BLE measurements with WD50 mounted and WD50 WPT measurements mounted on WS50. Added Device Configuration column for clarity. §12 – Added WS50 with WD50 simultaneous transmission condition and Sum of SAR. Added notes explaining simultaneous transmission scenarios. Appendix A – Added setup photos with WD50. Appendix B – Updated System Check Plots to reflect inclusion of WD50. Appendix C – Added Highest Test Plots for “WS50 Tx with WD50 Mounted” and “WD50 Tx Mounted on WS50” device configurations. Appendix E – Added Calibration Certificate for EX3DV4 SN 7711. Appendix F – Added Calibration Certificate for D2450V2 SN 963.	Sarah Kuhaneck
V4	2025-01-08	Corrected model name in §1.	Lindsay Ryan
V5	2025-02-03	Updated wording of note in §6.2.	Lindsay Ryan
V6	2025-02-19	Added FCC IDs 2AJ2X-WB50 and 2AJ2X-WD50 and Model Names WB50 and WD50 to cover page and §1	Sarah Kuhaneck
V7	2025-03-05	Corrected BLE equipment class to DTS. Corrected BLE tune-up to match Operational Description. Updated BLE tune-up and scaled values in §9, 10, and 11.	Lindsay Ryan

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1. Attestation of Test Results

Applicant Name		WHOOP Inc.		
FCC ID		2AJ2X-WS50, 2AJ2X-WB50, and 2AJ2X-WD50		
Model Name		WS50, WB50, and WD50		
Applicable Standards		Published RF exposure KDB procedures IEEE Std 1528-2013 IEC/IEEE 62209-1528:2020		
Exposure Category		SAR Limits (W/Kg)		
		Extremities (hands, wrists, ankles, etc.) (10g of tissue)		
General population / Uncontrolled expusure		4.0		
RF Exposure Conditions		Equipment Class - Highest Reported SAR (W/kg)		
		DTS	DXX (WPT)	DXX (NFC)
Extremity		0.029	0.000	0.000
Extremity	WS50	0.013	N/A	0.000
	WB50	0.029	0.000	N/A
Simultaneous Tx		0.015	0.015	0.012
Simultaneous Tx	WS50 Standalone	0.012	N/A	0.012
	WS50 + WB50[1]	0.015	0.015	N/A
	WS50 + WD50[2]	0.013	0.013	N/A
Date Tested		2024-06-17 to 2024-11-15		
Test Results		Pass		

Note: This report includes Simultaneous Transmission analysis with the WPT charger accessory model WD50 (FCC ID: 2AJ2X-WD50). Model WD50 requires no standalone SAR assessment.

1. For a more accurate simultaneous transmission scenario of the WS50 + WB50 system, only the Device Configurations “WS50 Tx with WB50 Mounted” and “WB50 Tx Mounted on WS50” are considered.
2. For a more accurate simultaneous transmission scenario of the WS50 + WD50 system, only the Device Configurations “WS50 Tx with WD50 Mounted” and “WD50 Tx Mounted on WS50” are considered.

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

This report contains data provided by the customer which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

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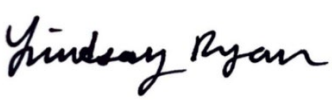
Approved & Released By:	Prepared By:
	
Richard Jankovics Staff Engineer UL LLC	Lindsay Ryan Engineer UL LLC

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, IEC/IEEE 62209-1528:2020, and the following FCC Published RF exposure KDB procedures:

- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 680106 D01 RF Exposure Wireless Charging Apps v04
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02

In addition to the above, the following information was used:

- TCB Workshop October 2016; RF Exposure Procedures (Bluetooth Duty Factor)
- TCB Workshop October 2016; RF Exposure Procedures (DUT Holder Perturbations)
- TCB Workshop April 2019; RF Exposure Procedures (Tissue Simulating Liquids (TSL))

3. Facilities and Accreditation

UL LLC is accredited by A2LA, cert. # 0751.06 for all testing performed within the scope of this report. Testing was performed at the locations noted below.

The test sites and measurement facilities used to collect data are located at 2800 Perimeter Park Dr, Morrisville, NC, USA.

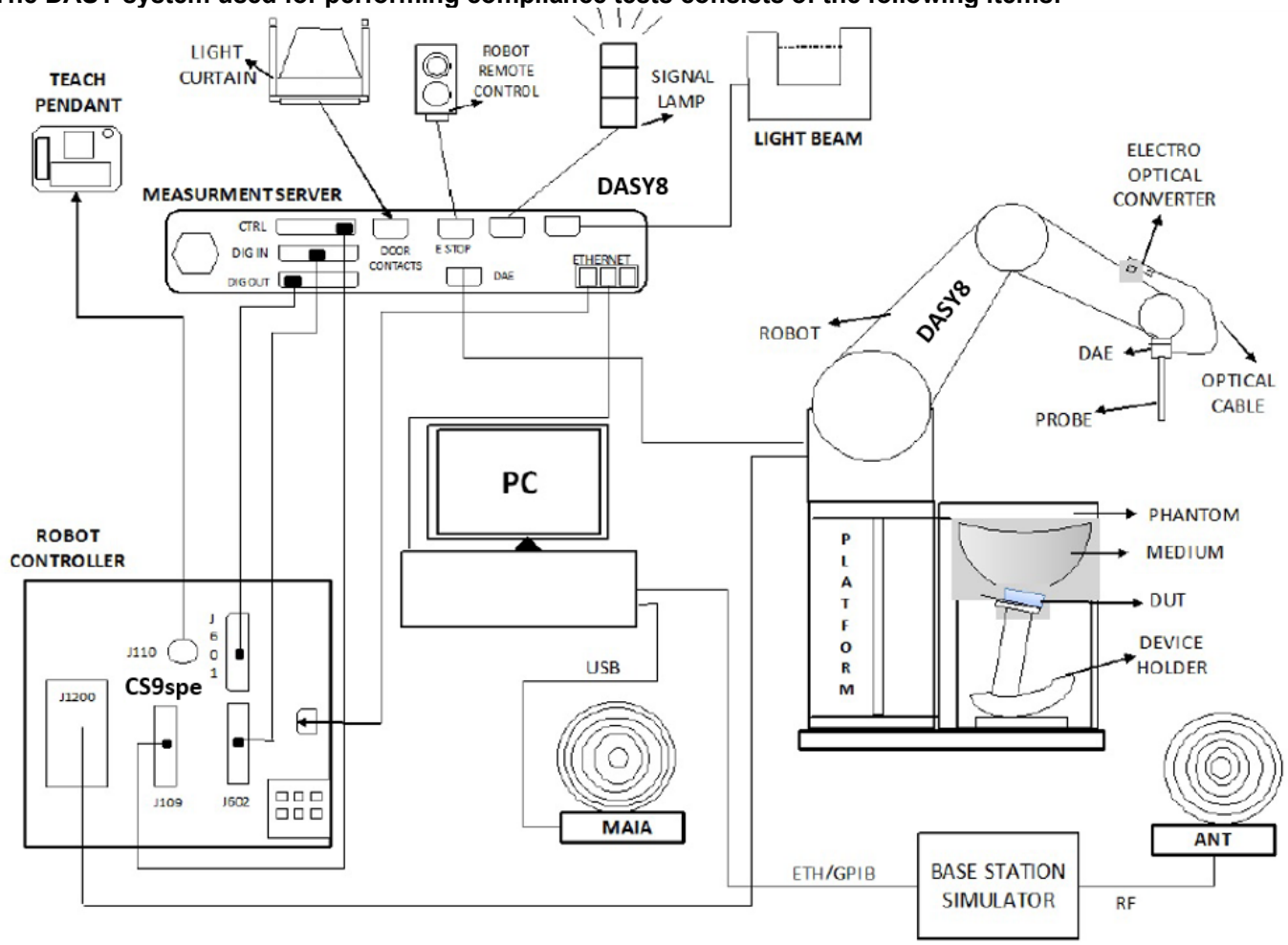
- SAR Lab 1A
- SAR Lab 2A

	Address	ISED CABID	ISED Company Number	FCC Registration
☐	Building: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	825374
☒	Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A	US0067	27265	825374

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

The DASY 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 Win10 and the DASY8[1] 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.

[1] DASY8 software used: DASY16.4.0.5005 and older generations.

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 IEC/IEEE 62209-1528, 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	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Step 4: Power drift measurement

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

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. Date	Cal. Due Date
Network Analyzer[2]	Keysight	E5063A	MY54100681	2023-08-04	2024-08-04
				2024-07-31	2025-07-31
Dielectric Probe[1]	SPEAG	DAKS-3.5	1051	2023-10-25	2024-10-25
Shorting Block[1]	SPEAG	DAK-3.5 Short	SM DAK 200 DA	2023-10-25	2024-10-25
Dielectric Probe	SPEAG	DAKS-3.5	1147	2024-03-11	2025-03-11
Shorting Block	SPEAG	DAK-3.5 Short	SM DAK 200 DB	2024-03-11	2025-03-11
Dielectric Probe	SPEAG	DAKS-12	1037	2024-03-11	2025-03-11
Shorting Block	SPEAG	DAK-12 Short	2044	2024-03-11	2025-03-11
Thermometer	Fisher Scientific	15-078-181	1817705017	2024-03-30	2025-03-30

Notes:

1. Equipment not used for calibrated measurements past calibration due date.
2. Equipment was recalibrated during the test period. Both calibrations are listed.

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Date	Cal. Due Date
Signal Generator[2]	Keysight	N5181A	MY50140788	2023-08-03	2024-08-03
				2024-08-01	2025-08-01
3-Path Diode Power Sensor[1,2]	Rohde & Schwarz	NRP8S	112236	2023-06-03	2024-06-30
				2024-07-12	2025-07-12
3-Path Diode Power Sensor[1,2]	Rohde & Schwarz	NRP8S	112237	2023-06-03	2024-06-30
				2024-07-12	2025-07-12
RF Power Meter[2]	Keysight	N1912A	MY55136012	2023-08-04	2024-08-04
				2024-08-02	2025-08-02
RF Power Sensor[2]	Keysight	N1921A	MY55090025	2023-08-21	2024-08-21
				2024-08-16	2025-08-16
RF Power Sensor[1,2]	Keysight	N1921A	MY55090030	2023-06-26	2024-06-26
				2024-07-09	2025-07-09
Amplifier	Mini-Circuits	ZVA-183WA-S+	SC484802241	N/A	N/A
Directional Coupler	Mini-Circuits	ZUDC10-183+	2214	NA	NA
Dual Directional Coupler	Werlatone	C5100-10	92249	N/A	N/A
DC Power Supply	Miteq	PS 15V1	1990186	N/A	N/A

Notes:

1. Equipment not used for calibrated measurements between calibration expiration and next calibration.
2. Equipment was recalibrated during the test period. Both calibrations are listed.

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Date	Cal. Due Date
E-Field Probe	SPEAG	EX3DV4	7709	2023-11-30	2024-11-30
E-Field Probe	SPEAG	EX3DV4	7710	2024-01-16	2025-01-16
E-Field Probe	SPEAG	EX3DV4	7711	2024-03-15	2025-03-15
Data Acquisition Electronics	SPEAG	DAE4	1714	2023-11-22	2024-11-22
Data Acquisition Electronics	SPEAG	DAE4	1715	2024-02-12	2025-02-12
Data Acquisition Electronics	SPEAG	DAE4	1716	2024-03-13	2025-03-13
System Validation Dipole	SPEAG	CLA13	1017	2024-03-07	2025-03-07
System Validation Dipole	SPEAG	D2450V2	963	2023-10-20	2024-10-20
				2024-10-11	2025-10-11
Environmental Indicator	Fisher Scientific	Traceable	240072452	2024-01-24	2026-01-24
Environmental Indicator	Fisher Scientific	Traceable	240072459	2024-01-24	2026-01-24

Other

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Date	Cal. Due Date
RF Power Sensor[1]	Boonton Electronics	RTP5000	211057	2023-08-01	2024-08-01

Notes:

1. Equipment not used for calibrated measurements past calibration due date.

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

Device Dimension WS50	Overall (Length x Width x Depth): 40 mm x 25 mm x 14 mm This is a Small wearable device (When the factor is smaller than 9 cm × 5 cm)
Device Dimension WB50	Overall (Length x Width x Depth): 43 mm x 34 mm x 14 mm This is a Small wearable device (When the factor is smaller than 9 cm × 5 cm)
Back Cover	The Back Cover is not removable
Battery Options	The rechargeable battery is not user accessible.
Accessory	Charger WD50
Test sample information	**S/N** — **Notes** 5AMD001305 — WS50 Radiated 5AMD002598 — WS50 Conducted B5APD001559 — WB50 Radiated B5APD002872 — WB50 Conducted D5ZPE200050 — WD50 WPT
Hardware Version	A
Software Version	WS50 BLE: 50.13.1.110000943 WS50 NFC: 50.19.0.130000256 WB50: 3.13.1.0 WD50: 23.19.1.0

6.2. Wireless Technologies

WS50 - EUT

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Bluetooth	2.4 GHz	LE	100.0% (GFSK) [1]
NFC	13.56 MHz	Type A	N/A

Notes:

1. Duty cycle for Bluetooth is referenced from §9.

WB50 - EUT

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Bluetooth	2.4 GHz	LE	100.0% (GFSK) [1]
WPT	13.56 MHz	N/A	100%

Notes:

1. Duty cycle for Bluetooth is referenced from §9.

WD50

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
WPT	13.56 MHz	N/A	100%

7. RF Exposure Conditions (Test Configurations)

Wireless technologies	RF Exposure Conditions	DUT-to-User Separation	Device Configuration	Test Position	Antenna To Surface Separation	SAR Required
BLE	Extremity (Wrist)	0	WS50 Standalone	Back	N/A	Yes
			WB50 Standalone	Back	N/A	Yes
			WS50 Tx with WB50 Mounted	Back	N/A	Yes
			WB50 Tx Mounted on WS50	Back	N/A	Yes
			WS50 Tx with WD50 Mounted	Back	N/A	Yes
WPT	Extremity (Wrist)	0	WB50 Tx Mounted on WS50	Back	N/A	Yes
			WD50 Tx Mounted on WS50	Back	N/A	Yes
NFC (Tag On and Tag Off)	Extremity (Wrist)	0	WS50 Standalone	Back	N/A	Yes

8. Dielectric Property Measurements & System Check

8.1. Dielectric Property Measurements

IEC/IEEE 62209-1528

Table 2 – Dielectric properties of the tissue-equivalent medium

Frequency MHz	Real part of the complex relative permittivity, ε_r'	Conductivity, σ S/m	Penetration depth (E-field), δ mm
4	*55,0*	*0,75*	293,0
13	*55,0*	*0,75*	165,5
30	55,0	0,75	112,8
150	52,3	0,76	62,0
300	45,3	0,87	46,1
450	43,5	0,87	43,0
750	*41,9*	*0,89*	39,8
835	41,5	0,90	39,0
900	41,5	0,97	36,2
1 450	40,5	1,20	28,6
1 800	40,0	1,40	24,3
1 900	40,0	1,40	24,3
1 950	40,0	1,40	24,3
2 000	40,0	1,40	24,3
2 100	*39,8*	*1,49*	22,8
2 450	39,2	1,80	18,7
2 600	*39,0*	*1,96*	17,2
3 000	38,5	2,40	14,0
3 500	*37,9*	*2,91*	11,4
4 000	*37,4*	*3,43*	10,0
4 500	*36,8*	*3,94*	9,7

Frequency MHz	Real part of the complex relative permittivity, ε_r'	Conductivity, σ S/m	Penetration depth (E-field), δ mm
5 000	*36,2*	*4,45*	1,5
5 200	*36,0*	*4,66*	8,4
5 400	*35,8*	*4,86*	8,1
5 600	*35,5*	*5,07*	7,5
5 800	35,3	5,27	7,3
6 000	*35,1*	*5,48*	7,0
6 500	*34,5*	*6,07*	6,7
7 000	*33,9*	*6,65*	6,4
7 500	*33,3*	*7,24*	6,1
8 000	*32,7*	*7,84*	5,9
8 500	*32,1*	*8,46*	5,3
9 000	*31,6*	*9,08*	4,8
9 500	*31,0*	*9,71*	4,4
10 000	*30,4*	*10,40*	4,0

NOTE For convenience, permittivity and conductivity values are linearly interpolated for frequencies that are not a part of the original data from Drossos et al. [2]. They are shown in italics in Table 2. The italicized values are linearly interpolated (below 5800 MHz) or extrapolated (above 5800 MHz) from the non-italicized values that are immediately above and below these values.

Dielectric Property Measurements Results:

SAR Lab	Date	Tissue Type	Band (MHz)	Freq. (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta	Measured	Target	Delta
SAR 1A	2024-06-17	Head	13	13	53.7	55.0	-2.33%	0.73	0.75	-2.29%
				12	53.7	55.0	-2.29%	0.73	0.75	-2.29%
				14	53.7	55.0	-2.40%	0.73	0.75	-2.28%
SAR 1A	2024-11-12	Head	13	13	53.4	55.0	-2.85%	0.73	0.75	-2.85%
				12	53.4	55.0	-2.93%	0.73	0.75	-2.87%
				14	53.4	55.0	-2.87%	0.73	0.75	-2.84%
SAR 2A	2024-06-17	Head	2450	2450	37.4	39.2	-4.64%	1.78	1.80	-1.06%
				2400	37.5	39.3	-4.55%	1.74	1.75	-0.55%
				2480	37.3	39.2	-4.68%	1.80	1.83	-1.66%
SAR 2A	2024-06-28	Head	2450	2450	37.4	39.2	-4.25%	1.78	1.80	-0.94%
				2400	37.5	39.3	-4.55%	1.74	1.75	-0.49%
				2480	37.4	39.2	-4.50%	1.78	1.83	-2.70%
SAR 2A	2024-11-15	Head	2450	2450	40.2	39.2	0.02%	1.76	1.80	-0.02%
				2400	40.3	39.3	0.02%	1.72	1.75	-0.02%
				2500	40.1	39.1	0.02%	1.80	1.85	-0.03%

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 Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was recorded and the results are normalized to 1 W input power.

System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within ±10% of the manufacturer calibrated dipole SAR target. Refer to Appendix B for the SAR System Check Plots.

SAR Lab	Date	Dipole Type & Serial Number	Dipole Cal. Due Date	Input Power (dBm)	Measured results for 1-g SAR				Measured results for 10-g SAR				Plot No.
					Meas. Zoom Scan	Normalize to 1 W	Target (Ref. Value)	Delta ±10%	Meas. Zoom Scan	Normalize to 1 W	Target (Ref. Value)	Delta ±10%	
SAR 1A	2024-06-17	CLA13 SN: 1017	2024-05-01	16.0	0.021	0.527	0.548	-3.74%	0.013	0.327	0.342	-4.52%	-
SAR 1A	2024-11-12	CLA13 SN: 1017	2025-03-07	16.0	0.021	0.527	0.551	-4.27%	0.013	0.327	0.344	-5.07%	1
SAR 2A	2024-06-17	D2450V2 SN: 963	2024-10-20	17.0	2.650	52.874	53.300	-0.80%	1.230	24.542	25.100	-2.22%	-
SAR 2A	2024-06-28	D2450V2 SN: 963	2024-10-20	17.0	2.580	51.478	53.300	-3.42%	1.200	23.943	25.100	-4.61%	-
SAR 2A	2024-11-15	D2450V2 SN: 963	2025-10-11	17.0	2.470	49.283	52.600	-6.31%	1.160	23.145	24.400	-5.14%	2

9. Conducted Output Power Measurements

Tune-Up Power Limits provided by the manufacturer are used to scale measured SAR values.

9.1. Bluetooth

Band	Mode	Dat Rate	Channel	Frequency (MHz)	Tune-up PowerLimit (dBm)
					BLE Main Antenna
Bluetooth 2.4 GHz WS50	LE	1 Mbps / 2Mbps	37	2402	4.11
			17	2440	4.11
			39	2480	4.11
Bluetooth 2.4 GHz WB50	LE	1 Mbps / 2Mbps	37	2402	8.04
			17	2440	8.04
			39	2480	8.04

WS50 Bluetooth Measured Results

Band	Mode	Ch #	Freq. (MHz)	BLE Antenna Average Power (dBm)		
				Meas Pwr	Tune-up	SAR Test (Yes/No)
Bluetooth 2.4 GHz	LE, GFSK	37	2402	3.9	4.11	Yes
		17	2440	3.7	4.11	
		39	2480	3.5	4.11	

WB50 Bluetooth Measured Results

Band	Mode	Ch #	Freq. (MHz)	BLE Antenna Average Power (dBm)		
				Meas Pwr	Tune-up	SAR Test (Yes/No)
Bluetooth 2.4 GHz	LE, GFSK	37	2402	7.8	8.04	Yes
		17	2440	7.8	8.04	
		39	2480	7.8	8.04	

Duty Factor Measured Results

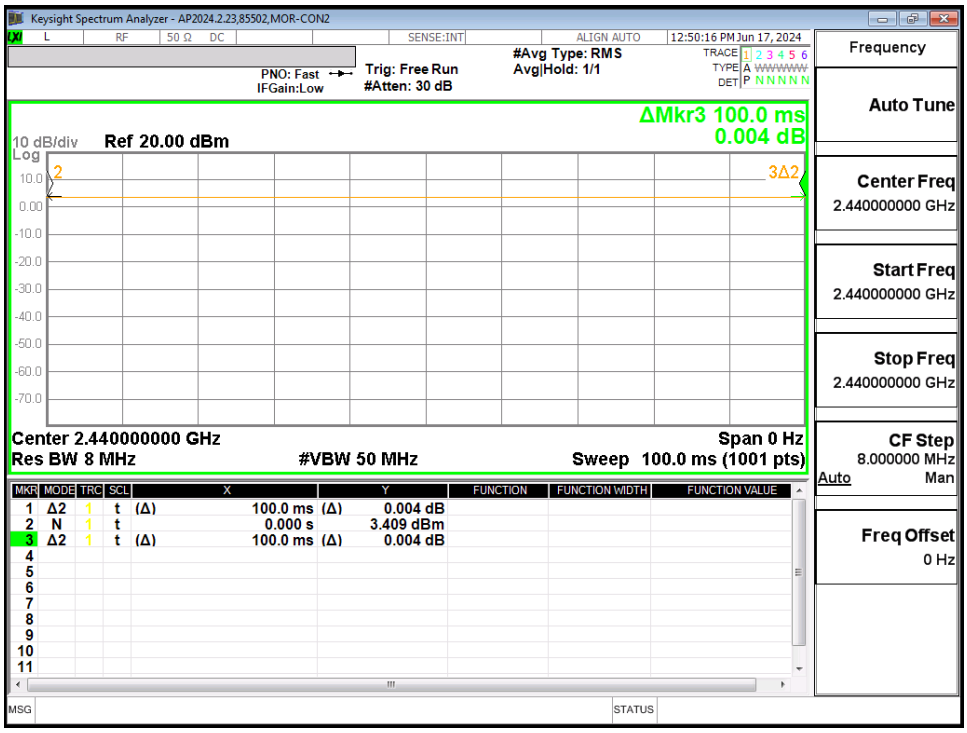
Mode	Type	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
GFSK	DH5	100	100	100.00%	1.00

Note(s):

Duty Cycle = (T on / period) * 100%

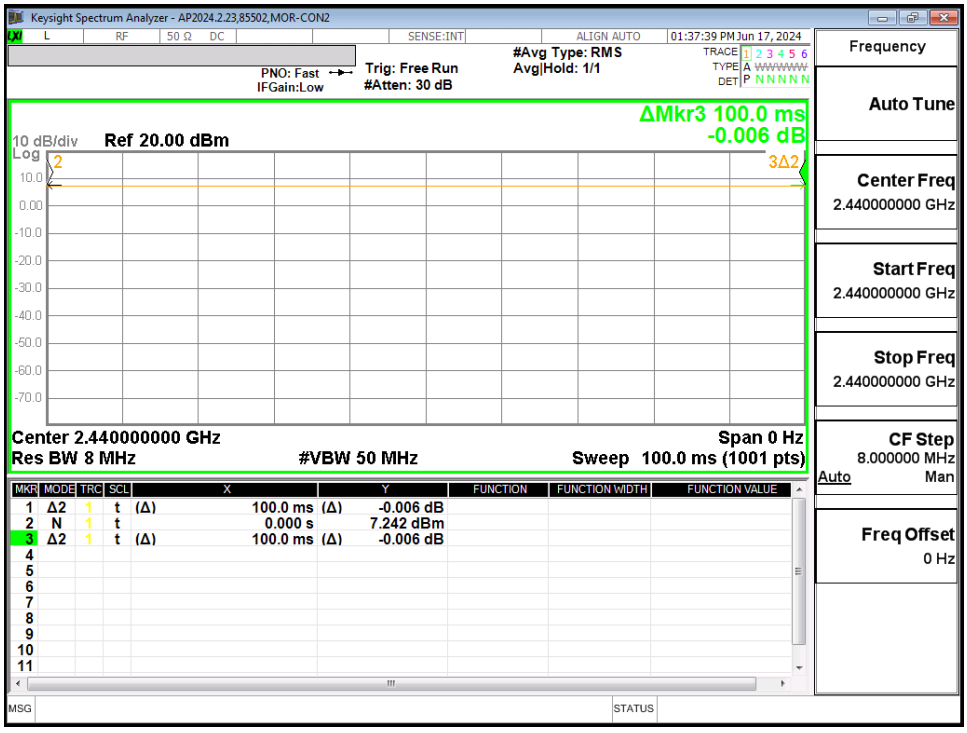
Duty Cycle plots

LE, GFSK, 1 Mbps (WS50)



Duty Cycle plots

LE, GFSK, 1 Mbps (WB50)



9.2. WPT

Conducted output power cannot be measured for WPT, therefore a 2 dB scaling factor shall be used to account for potential variations between samples.

9.3. NFC

Conducted output power cannot be measured for NFC, therefore a 2 dB scaling factor shall be used to account for potential variations between samples.

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

- Reported SAR(W/kg) for Bluetooth = Measured SAR * Tune-up scaling factor

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

10.1. Bluetooth

WS50 Standalone

RF Exposure Conditions	Mode	Device Configuration	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		10-g SAR (W/kg)		Plot No.
								Tune-up Limit	Meas.	Meas.	Scaled	
Extremity	LE GFSK 1 Mbps	WS50 Standalone	0	Back	17	2440	100%	4.11	3.7	0.011	0.012	1

WB50 Standalone

RF Exposure Conditions	Mode	Device Configuration	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		10-g SAR (W/kg)		Plot No.
								Tune-up Limit	Meas.	Meas.	Scaled	
Extremity	LE GFSK 1 Mbps	WB50 Standalone	0	Back	17	2440	100%	8.04	7.8	0.027	**0.029**	2

WS50 with WB50

RF Exposure Conditions	Mode	Device Configuration	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		10-g SAR (W/kg)		Plot No.
								Tune-up Limit	Meas.	Meas.	Scaled	
Extremity	LE GFSK 1 Mbps	WS50 Tx with WB50 Mounted	0	Back	17	2440	100%	4.11	3.7	0.010	0.011	3
Extremity	LE GFSK 1 Mbps	WB50 Tx Mounted on WS50	0	Back	17	2440	100%	8.04	7.8	0.004	0.004	4

WS50 with WD50

RF Exposure Conditions	Mode	Device Configuration	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		10-g SAR (W/kg)		Plot No.
								Tune-up Limit	Meas.	Meas.	Scaled	
Extremity	LE GFSK 1 Mbps	WS50 Tx with WD50 Mounted	0	Back	17	2440	100%	4.11	3.7	0.012	**0.013**	5

10.2. WPT

WS50 with WB50

RF Exposure Conditions	Mode	Device Configuration	Dist. (mm)	Test Position	Freq. (MHz)	Duty Cycle	Tolerance Scaling Factor (dBm)	10-g SAR (W/kg)		Plot No.
								Meas.	Scaled	
Extremity	WPT	WB50 Tx Mounted on WS50	0	Back	13.56	100%	2.0	0.000	**0.000**	6

Note:

Conducted output power cannot be measured for WPT, therefore a 2 dB scaling factor shall be used to account for potential variations between samples.

WS50 with WD50

RF Exposure Conditions	Mode	Device Configuration	Dist. (mm)	Test Position	Freq. (MHz)	Duty Cycle	Tolerance Scaling Factor (dBm)	10-g SAR (W/kg)		Plot No.
								Meas.	Scaled	
Extremity	WPT	WD50 Tx Mounted on WS50	0	Back	13.56	100%	2.0	0.000	0.000	7

Note:

Conducted output power cannot be measured for WPT, therefore a 2 dB scaling factor shall be used to account for potential variations between samples. WPT is only supported on model WD50 (FCC ID: 2AJ2X-WD50). It is included here for Simultaneous Transmission analysis only.

10.3. NFC

WS50 Standalone

RF Exposure Conditions	Mode	Device Configuration	Dist. (mm)	Test Position	Freq. (MHz)	Duty Cycle	Tolerance Scaling Factor (dBm)	10-g SAR (W/kg)		Plot No.
								Meas.	Scaled	
Extremity	NFC	WS50 Standalone	0	Back (Tag)	13.56	100%	2.0	0.000	**0.000**	8
				Back (No Tag)	13.56	100%	2.0	0.000	0.000	

Note:

Conducted output power cannot be measured for NFC, therefore a 2 dB scaling factor shall be used to account for potential variations between samples.

11. 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.

Note(s):

Repeated measurement is not required since the original highest measured SAR is <0.8 W/kg (1-g) or 2 W/kg (10-g) .

12. Simultaneous Transmission Conditions

RF Exposure Condition	Item	Capable Transmit Configurations				
Extremity	1	DTS (WS50)	+	DXX (WS50)		
	2	DTS (WS50)	+	DTS(WB50)	+	DXX (WB50)
	3	DTS (WS50)	+	DXX (WD50)		

Notes:
* For a more accurate simultaneous transmission scenario of the WS50 Standalone use-case, only the Device Configuration "WS50 Standalone" is considered.
** For a more accurate simultaneous transmission scenario of the WS50 + WB50 system, only the Device Configurations "WS50 Tx with WB50 Mounted" and "WB50 Tx Mounted on WS50" are considered.
*** For a more accurate simultaneous transmission scenario of the WS50 + WD50 system, only the Device Configurations "WS50 Tx with WD50 Mounted" and "WD50 Tx Mounted on WS50" are considered.

12.1. Sum of the SAR for BLE & NFC (WS50 Standalone)

RF Exposure conditions	Test Position	Standalone SAR (W/kg)		∑ 10-g SAR (W/kg)
		1	2	1+2
		BLE WS50	NFC WS50	
Extremity	Back	0.012	0.000	**0.012**

12.2. Sum of the SAR for BLE & WPT (WS50 with WB50)

RF Exposure conditions	Test Position	Standalone SAR (W/kg)			∑ 10-g SAR (W/kg)
		1	2	3	1+2+3
		BLE WS50	BLE WB50	WPT WB50	
Extremity	Back	0.011	0.004	0.000	**0.015**

12.3. Sum of the SAR for BLE & WPT (WS50 with WD50)

RF Exposure conditions	Test Position	Standalone SAR (W/kg)		∑ 10-g SAR (W/kg)
		1	2	1+2
		BLE WS50	WPT WD50	
Extremity	Back	0.013	0.000	**0.013**

Appendixes

Refer to separated files for the following appendixes.

Appendix A: SAR Setup Photos

Appendix B: SAR System Check Plots

Appendix C: SAR Highest Test Plots

Appendix D: SAR Tissue Ingredients

Appendix E: SAR Probe Certificates

Appendix F: SAR Dipole Certificates

END OF REPORT