FCC SAR TEST REPORT

Product Name:	Embodied Moxie V2
Trade Mark:	Embodied
Model No.:	101600
Add. Model No.:	N/A
Report Number:	2309206883SAR-1
Test Standards:	FCC 47 CFR Part 2 §2.1093 ANSI/IEEE C95.1-1992 IEEE Std 1528-2013
FCC ID:	2AV9NEMBMOXIEVTWO
Test Result:	PASS
Date of Issue:	November 14, 2023

Prepared for:

Embodied Inc.
385 E. Colorado Blvd. Suite 110, Pasadena, CA. 91101, USA

Prepared by:

Shenzhen UnionTrust Quality and Technology Co., Ltd.
Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China
TEL: +86-755-2823 0888
FAX: +86-755-2823 0886

Prepared by:	Curry Xue Test Engineer	Reviewed by:	Henry Lu Team Leader
Approved by:	Kevin Liang Assistant Manager	Date:	November 14, 2023

UnionTrust Test Laboratories UnionTrust *Certified*

Version

Version No.	Date	Description
V1.0	November 14, 2023	Original Report

CONTENTS

1. GENERAL INFORMATION 5
   1.1. STATEMENT OF COMPLIANCE 5
   1.2. CLIENT INFORMATION 6
   1.3. EUT INFORMATION 6
      1.3.1. GENERAL DESCRIPTION OF EUT 6
      1.3.2. DESCRIPTION OF ACCESSORIES 6
      1.3.3. EUT TX FREQUENCY BANDS 6
      1.3.4. WIRELESS TECHNOLOGIES 6
   1.4. MAXIMUM CONDUCTED POWER 7
   1.5. OTHER INFORMATION 7
   1.6. TEST LOCATION 7
   1.7. TEST FACILITY 7
   1.8. GUIDANCE STANDARD 8
2. SPECIFIC ABSORPTION RATE (SAR) 9
   2.1. INTRODUCTION 9
   2.2. SAR DEFINITION 9
   2.3. SAR LIMITS 9
3. SAR MEASUREMENT SYSTEM 10
   3.1. SPEAG DASY SYSTEM 10
      3.1.1. ROBOT 10
      3.1.2. PROBE 11
      3.1.3. DATA ACQUISITION ELECTRONICS (DAE) 11
      3.1.4. PHANTOM 12
      3.1.5. DEVICE HOLDER 13
      3.1.6. SYSTEM VALIDATION DIPOLES 13
   3.2. SAR SCAN PROCEDURE 14
      3.2.1. SAR REFERENCE MEASUREMENT (DRIFT) 14
      3.2.2. AREA SCAN 14
      3.2.3. ZOOM SCAN 15
      3.2.4. SAR DRIFT MEASUREMENT 15
   3.3. EQUIPMENT LIST 16
   3.4. MEASUREMENT UNCERTAINTY 17
   3.5. TISSUE DIELECTRIC PARAMETER MEASUREMENT & SYSTEM VERIFICATION 19
      3.5.1. TISSUE SIMULATING LIQUIDS 19
      3.5.2. SYSTEM CHECK DESCRIPTION 21
      3.5.3. TISSUE VERIFICATION 21
      3.5.4. SYSTEM VALIDATION 22
      3.5.5. SYSTEM VERIFICATION 22
4. SAR MEASUREMENT EVALUATION 23
   4.1. EUT CONFIGURATION AND SETTING 23
      4.1.1. WLAN CONFIGURATION AND TESTING 23
   4.2. EUT TESTING POSITION 24
      4.2.1. BODY EXPOSURE CONDITIONS 24
   4.3. MEASURED CONDUCTED POWER RESULT 25
      4.3.1. CONDUCTED POWER OF WLAN 25
   4.4. SAR TEST EXCLUSION EVALUATIONS 27
      4.4.1. STANDALONE SAR TEST EXCLUSION CONSIDERATIONS 27
   4.5. SAR TESTING RESULTS 28
      4.5.1. SAR TEST REDUCTION CONSIDERATIONS 28
      4.5.2. SAR RESULTS FOR BODY EXPOSURE CONDITION 29
   4.6. SAR MEASUREMENT VARIABILITY 30
      4.6.1. REPEATED MEASUREMENT 30

4.7. SIMULTANEOUS MULTI-BAND TRANSMISSION EVALUATION 31
4.7.1. SIMULTANEOUS TRANSMISSION SAR TEST EXCLUSION CONSIDERATIONS 31
4.7.2. SIMULTANEOUS TRANSMISSION POSSIBILITIES 31

Appendix A. SAR Plots of System Verification
Appendix B. SAR Plots of SAR Measurement
Appendix C. Calibration Certificate for Probe and Dipole
Appendix D. Photographs of EUT and Setup

1. GENERAL INFORMATION

1.1. STATEMENT OF COMPLIANCE

The maximum results of Specific Absorption Rate (SAR) found during testing for the EUT are as follows:

Equipment Class	Mode	Highest Reported Body SAR_{1g} (0 cm Gap) (W/kg)
DTS	**2.4G WLAN**	0.537
NII	**5.2G WLAN**	0.067
	5.8G WLAN	0.126

1.2. CLIENT INFORMATION

Applicant:	Embodied Inc.
Address of Applicant:	385 E. Colorado Blvd. Suite 110, Pasadena, CA. 91101, USA

1.3. EUT INFORMATION

1.3.1. General Description of EUT

Product Name:	Embodied Moxie V2
Trade Mark:	Embodied
Model No.:	101600
Add. Model No.:	N/A
FCC ID:	2AV9NEMBMOXIEVTWO
DUT Stage:	Identical Prototype
Software Version:	not provided
Hardware Version:	101600 (SKU) Moxie Robot V2
Sample Received Date:	September 20, 2023
Sample Tested Date:	October 8, 2023 to November 13, 2023

1.3.2. Description of Accessories

Adaptor	**Model Name:**	AD0651-1404000D
	Input:	100-240V~50/60Hz 1.5 A Max
	Output:	14.0V ⎓ 4.0 A 56.0W
Battery	**Brand Name:**	GLW
	Model Name:	101561 - GLW Battery 3S1P MJ1
	Rated Voltage:	10.9Vdc
	Rated Capacity:	3500mAh
	Type:	Li-ion

1.3.3. EUT Tx Frequency Bands

RF Type	Band(s)	Tx Frequency Range (Unit: MHz)
WLAN	**2.4 GHz:**	2412 - 2462
	U-NII-1:	5180 - 5240
	U-NII-3:	5745 - 5825

1.3.4. Wireless Technologies

2.4G WLAN	802.11b 802.11g 802.11n (HT20/HT40)
5G WLAN	802.11a 802.11n (HT20/HT40) 802.11ac (VHT20/VHT40/VHT80)
Antenna Type	Fixed Internal Antenna Dual Band
Power Reduction	Not Support
Dynamic Antenna	Not Support
Wireless Router (Hotspot)	2.4G WLAN: Not Support 5.2G WLAN: Not Support 5.8G WLAN: Not Support

1.4. MAXIMUM CONDUCTED POWER

The maximum conducted average power including tune-up tolerance is shown as below.

➢ **2.4GHz WLAN**

Mode	Maximum Conducted Power (dBm)					
	Richtek module Camera			Sincere module Camera		
	Lowest Ch.	Middle Ch.	Highest Ch.	Lowest Ch.	Middle Ch.	Highest Ch.
802.11b	14.5			14.5		
802.11g	11.0	14.0	11.0	11.5	14.0	10.5
802.11n-HT20	10.5	14.0	14.5	11.0	12.5	13.0
802.11n-HT40	9.0	9.0	9.5	9.0	9.0	9.0

➢ **5GHz WLAN**

Mode	Band	Maximum Conducted Power (dBm)					
		Richtek module Camera			Sincere module Camera		
		Lowest Ch.	Middle Ch.	Highest Ch.	Lowest Ch.	Middle Ch.	Highest Ch.
802.11a	U-NII-1	5.5	5.5	5.5	4.0	0.0	3.5
	U-NII-3	6.0	3.5	4.5	6.0	6.0	6.0
802.11n-HT20	U-NII-1	4.5	4.5	4.5	3.5	2.0	3.0
	U-NII-3	6.0	3.5	4.0	3.5	6.0	5.5
802.11n-HT40	U-NII-1	2.5	--	4.5	2.5	--	1.5
	U-NII-3	4.5	--	3.0	4.5	--	5.0
802.11ac-VHT20	U-NII-1	4.5	4.5	5.0	3.5	-0.5	3.0
	U-NII-3	6.0	3.0	4.0	6.0	5.0	5.5
802.11ac-VHT40	U-NII-1	2.5	--	4.0	2.5	--	1.5
	U-NII-3	4.0	--	3.0	4.0	--	4.5
802.11ac-VHT80	U-NII-1	--	3.5	--	--	1.0	--
	U-NII-3	--	3.0	--	--	4.5	--

1.5. OTHER INFORMATION

None.

1.6. TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

1.7. TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

Shenzhen UnionTrust Quality and Technology Co., Ltd.

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01
Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories
CAB identifier: CN0032

FCC Accredited Lab.
Designation Number: CN1194
Test Firm Registration Number: 259480

1.8. GUIDANCE STANDARD

The tests documented in this report were performed in accordance with FCC 47 CFR Part 2 §2.1093, IEEE Std 1528-2013, ANSI/IEEE C95.1-1992, the following FCC Published RF exposure KDB procedures:

KDB 865664 D01 v01r04
KDB 865664 D02 v01r02
KDB 248227 D01 v02r02
KDB 447498 D01 v06
KDB 941225 D06 v02r01

2. SPECIFIC ABSORPTION RATE (SAR)

2.1. INTRODUCTION

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling, by appropriate techniques, to produce specific absorption rates (SARs) as averaged over the whole-body, any 1 g or any 10 g of tissue (defined as a tissue volume in the shape of a cube). All SAR values are to be averaged over any six-minute period. When portable device was used within 20 cm of the user's body, SAR evaluation of the device will be required. The SAR limit in chapter 2.3.

2.2. SAR DEFINITION

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\mathbf{dm}}\right) = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\boldsymbol{\rho}\mathbf{dv}}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be related to the electrical field in the tissue by

$$\mathbf{SAR} = \frac{\boldsymbol{\sigma}|\mathbf{E}|^2}{\boldsymbol{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

2.3. SAR LIMITS

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Note:

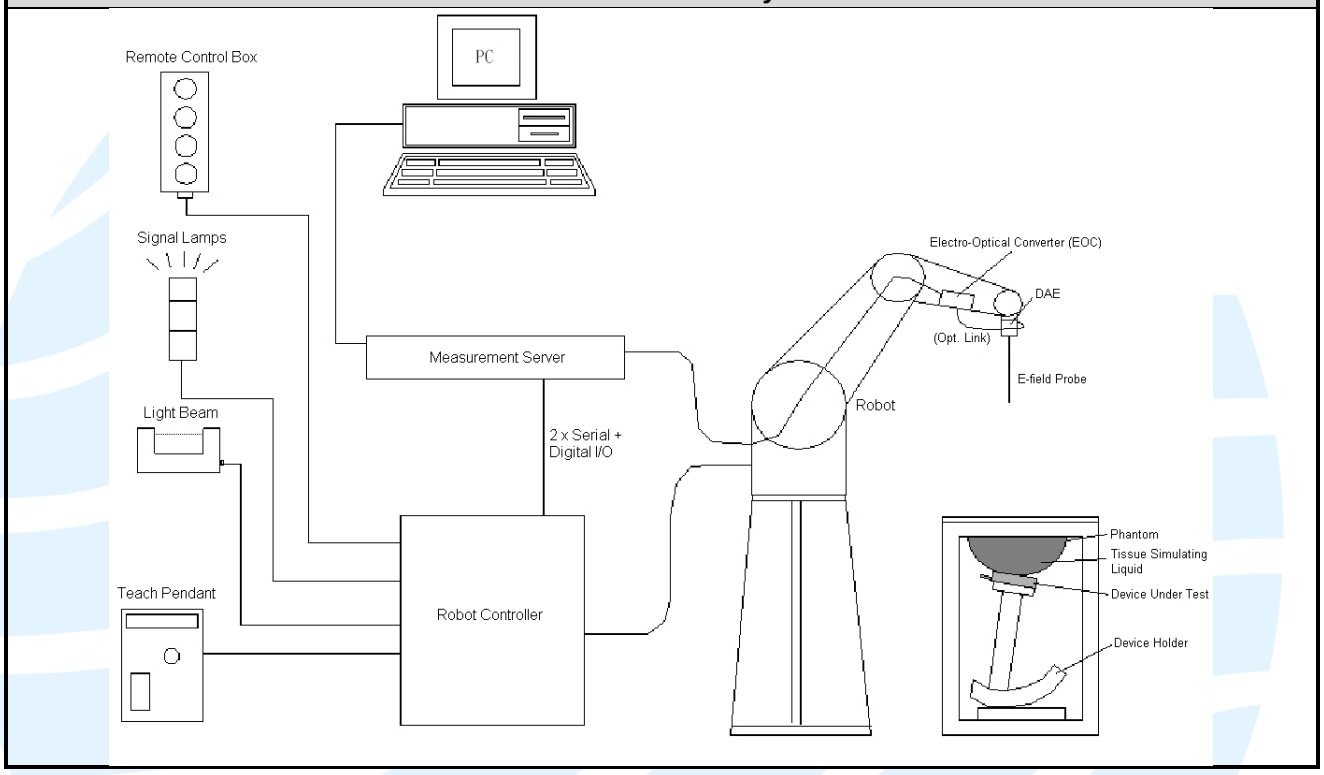
1) Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.
2) At frequencies above 6.0 GHz, SAR limits are not applicable and MPE limits for power density should be applied at 5 cm or more from the transmitting device.
3) The SAR limit is specified in FCC 47 CFR Part 2 §2.1093, ANSI/IEEE C95.1-1992.

3. SAR MEASUREMENT SYSTEM

3.1. SPEAG DASY SYSTEM

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY5 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

DASY Measurement System



3.1.1. Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ±0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

3.1.2. Probe

The SAR measurement is conducted with the dosimetric probe. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

Model	EX3DV4	
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

Model	ES3DV3	
Construction	Symmetrical design with triangular core. Interleaved sensors. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	10 MHz to 4 GHz Linearity: ± 0.2 dB	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	5 µW/g to 100 mW/g Linearity: ± 0.2 dB	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm	

3.1.3. Data Acquisition Electronics (DAE)

Model	DAE3, DAE4	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detectors for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mV (16-bit resolution and two range settings: 4mV, 400mV)	
Input Offset Voltage	< 5µV (with auto zero)	
Input Bias Current	< 50 fA	
Dimensions	60 x 60 x 68 mm	

3.1.4. Phantom

Model	Twin SAM	
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)	
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	

Model	ELI	
Construction	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.	
Material	Vinylester, glass fiber reinforced (VE-GF)	
Shell Thickness	2.0 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	approx. 30 liters	

3.1.5. Device Holder

Model	Mounting Device	
Construction	In combination with the Twin SAM Phantom or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).	
Material	POM	

Model	Laptop Extensions Kit	
Construction	Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner.	
Material	POM, Acrylic glass, Foam	

3.1.6. System Validation Dipoles

Model	D-Serial	
Construction	Symmetrical dipole with l/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.	
Frequency	750 MHz to 5800 MHz	
Return Loss	> 20 dB	
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)	

3.2. SAR SCAN PROCEDURE

3.2.1. SAR Reference Measurement (drift)

Prior to the SAR test, local SAR shall be measured at a stationary reference point where the SAR exceeds the lower detection limit of the measurement system.

3.2.2. Area Scan

Measurement procedures for evaluating the SAR of wireless device start with a coarse measurement grid to determine the approximate location of the local peak SAR values. This is known as the area-scan procedure. All antennas and radiating structures that may contribute to the measured SAR or influence the SAR distribution must be included in the area scan. The area scan measurement resolution must enable the extrapolation algorithms of the SAR system to correctly identify the peak SAR location(s) for subsequent zoom scan measurements to correctly determine the 1-g SAR. Area scans are performed at a constant distance from the phantom surface, determined by the measurement frequencies. When a measured peak is closer than ½ the zoom scan volume dimension (x, y) from the edge of the area scan region, unless the entire peak and gram-averaging volume are both captured within the zoom scan volume, the area scan must be repeated by shifting and expanding the area scan region to ensure all peaks are away from the area scan boundary. The area scan resolutions specified in the table below must be applied to the SAR measurements.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm ± 1 mm	½·δ·ln(2) mm ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scans 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.	

3.2.3. Zoom Scan

To evaluate the peak spatial-average SAR values with respect to 1 g or 10 g cubes, fine resolution volume scans, called zoom scans, are performed at the peak SAR locations identified during the area scan. If the cube volume within the zoom scan chosen to calculate the peak spatial-average SAR touches any boundary of the zoom-scan volume, the zoom scan shall be repeated with the center of the zoom-scan volume shifted to the new maximum SAR location. For any secondary peaks found in the area scan that are within 2 dB of the maximum peak and are not within this zoom scan, the zoom scan shall be performed for such peaks, unless the peak spatial-average SAR at the location of the maximum peak is more than 2 dB below the applicable SAR limit (i.e., 1 W/kg for a 1.6 W/kg 1 g limit, or 1.26 W/kg for a 2 W/kg 10 g limit). The zoom scan resolutions specified in the table below must be applied to the SAR measurements.

			≤ 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·$\Delta Z_{Zoom}(n-1)$ mm	
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 IEEE Std 1528-2013 for details.

* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 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.

3.2.4. SAR Drift Measurement

The local SAR (or conducted power) shall be measured at exactly the same location as in 3.2.1 section. The absolute value of the measurement drift (the difference between the SAR measured in 3.2.1 and 3.2.4 section) shall be recorded. The SAR drift shall be kept within ± 5%.

3.3. EQUIPMENT LIST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval
System Validation Dipole	SPEAG	D2450V2	1014	May 19, 2021	3 Year
System Validation Dipole	SPEAG	D5GHzV2	1280	May. 17, 2021	3 Year
Dosimetric E-Field Probe	SPEAG	ES3DV3	3090	Mar. 15,2023	1 Year
Dosimetric E-Field Probe	SPEAG	EX3DV4	7506	Jun. 29, 2023	1 Year
Data Acquisition Electronics	SPEAG	DAE4	662	Mar. 08,2023	1 Year
ENA Series Network Analyzer	Agilent	8753ES	US39170317	Nov. 11, 2022	1 Year
Dielectric Assessment Kit	SPEAG	DAK-3.5	1056	N/A	N/A
USB/GPIB Interface	Agilent	82357B	N10149	N/A	N/A
Signal Generator	R&S	SMB100A	103718	Apr. 14, 2023	1 Year
POWER METER	R&S	NRP	101293	Nov. 03, 2022	1 Year
Thermometer	120100323	Shanghai Gao Zhi Precision Instrument Co., Ltd.	HB6801	Nov. 02, 2022	1 Year
Coupler	Agilent	778D	MY52180234	Nov. 03, 2022	1 Year
Amplifier	Mini-Circuit	ZHL42	QA1252001	Apr. 15, 2023	1 Year
DC Source	Agilent	66319B	MY43000795	Nov. 01, 2022	1 Year

3.4. MEASUREMENT UNCERTAINTY

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

TABLE 1 EXPOSURE ASSESSMENT UNCERTAINTY FOR HANDSET SAR

Source of Uncertainty	Tolerance (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g) (± %)	Standard Uncertainty (10g) (± %)	Vi Veff
Measurement System								
Probe Calibration (< 3 GHz)	7.4	N (k=2)	2	1	1	3.70	3.70	∞
Probe Calibration (> 3 GHz)	6.3	N (k=2)	2	1	1	3.15	3.15	∞
Axial Isotropy	1.2	N (k=2)	2	0.7	0.7	0.42	0.42	∞
Hemispherical Isotropy	3.2	N (k=2)	2	0.7	0.7	1.12	1.12	∞
Boundary Effects	2	Rectangular	√3	1	1	1.15	1.15	∞
Linearity	0.9	N (k=2)	2	1	1	0.45	0.45	∞
Detection Limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Modulation Response	2.4	Rectangular	√3	1	1	1.39	1.39	∞
Readout Electronics	0.3	Normal	1	1	1	0.30	0.30	∞
Response Time	0	Rectangular	√3	1	1	0.00	0.00	∞
Integration Time	1.7	Rectangular	√3	1	1	0.98	0.98	∞
RF Ambient – Noise	3	Rectangular	√3	1	1	1.73	1.73	∞
RF Ambient – Reflections	3	Rectangular	√3	1	1	1.73	1.73	∞
Probe Positioner	0.4	Rectangular	√3	1	1	0.23	0.23	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.87	3.87	∞
Max. SAR Evaluation	4	Rectangular	√3	1	1	2.31	2.31	∞
Test Sample Related								
Device Positioning	2.3 / 2.4	Normal	1	1	1	2.30	2.40	30
Device Holder	2.8 / 2.8	Normal	1	1	1	2.80	2.80	30
Power Drift	5	Rectangular	√3	1	1	2.89	2.89	∞
Power Scaling	0	Rectangular	√3	1	1	0.00	0.00	∞
Phantom and Setup								
Phantom Uncertainty	7.9	Rectangular	√3	1	1	4.56	4.56	∞
SAR correction	1.2 / 0.97	Rectangular	√3	1	0.84	0.69	0.47	∞
Liquid Conductivity (Meas.)	2.5	Rectangular	√3	0.78	0.71	1.13	1.02	∞
Liquid Permittivity (Meas.)	2.5	Rectangular	√3	0.26	0.26	0.38	0.38	∞
Temp. unc. - Conductivity	3.4	Rectangular	√3	0.78	0.71	1.53	1.39	∞
Temp. unc. - Permittivity	0.4	Rectangular	√3	0.23	0.26	0.05	0.06	∞
Combined Standard Uncertainty (k = 1) (≤ 3 GHz)						9.62	9.60	
Combined Standard Uncertainty (k = 1) (> 3 GHz)						9.42	9.40	
Max. Expanded Uncertainty (k = 2)						**19.24**	**19.19**	

TABLE 2SYSTEM VALIDATION Measurement uncertainty

Source of Uncertainty	Tolerance (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g) (± %)	Standard Uncertainty (10g) (± %)	Vi Veff
Measurement System								
Probe Calibration (< 3 GHz)	7.4	N (k=2)	2	1	1	3.70	3.70	∞
Probe Calibration (> 3 GHz)	6.3	N (k=2)	2	1	1	3.15	3.15	∞
Axial Isotropy	1.2	N (k=2)	2	0.7	0.7	0.42	0.42	∞
Hemispherical Isotropy	3.2	N (k=2)	2	0.7	0.7	1.12	1.12	∞
Boundary Effects	2	Rectangular	√3	1	1	1.15	1.15	∞
Linearity	0.9	N (k=2)	2	1	1	0.45	0.45	∞
Detection Limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Modulation Response	2.4	Rectangular	√3	1	1	1.39	1.39	∞
Readout Electronics	0.3	Normal	1	1	1	0.30	0.30	∞
Response Time	0	Rectangular	√3	1	1	0.00	0.00	∞
Integration Time	1.7	Rectangular	√3	1	1	0.98	0.98	∞
RF Ambient – Noise	3	Rectangular	√3	1	1	1.73	1.73	∞
RF Ambient – Reflections	3	Rectangular	√3	1	1	1.73	1.73	∞
Probe Positioner	0.4	Rectangular	√3	1	1	0.23	0.23	∞
Probe Positioning	6.7	Rectangular	√3	1	1	3.87	3.87	∞
Max. SAR Evaluation	4	Rectangular	√3	1	1	2.31	2.31	∞
Test Sample Related								
Device Positioning	2.3 / 2.4	Normal	1	1	1	2.30	2.40	30
Device Holder	2.8 / 2.8	Normal	1	1	1	2.80	2.80	30
Power Drift	5	Rectangular	√3	1	1	2.89	2.89	∞
Power Scaling	0	Rectangular	√3	1	1	0.00	0.00	∞
Phantom and Setup								
Phantom Uncertainty	7.9	Rectangular	√3	1	1	4.56	4.56	∞
SAR correction	1.2 / 0.97	Rectangular	√3	1	0.84	0.69	0.47	∞
Liquid Conductivity (Meas.)	2.5	Rectangular	√3	0.78	0.71	1.13	1.02	∞
Liquid Permittivity (Meas.)	2.5	Rectangular	√3	0.26	0.26	0.38	0.38	∞
Temp. unc. - Conductivity	3.4	Rectangular	√3	0.78	0.71	1.53	1.39	∞
Temp. unc. - Permittivity	0.4	Rectangular	√3	0.23	0.26	0.05	0.06	∞
Combined Standard Uncertainty (k = 1) (≤ 3 GHz)						9.62	9.60	
Combined Standard Uncertainty (k = 1) (> 3 GHz)						9.42	9.40	
Max. Expanded Uncertainty (k = 2)						**19.24**	**19.19**	

3.5. TISSUE DIELECTRIC PARAMETER MEASUREMENT & SYSTEM VERIFICATION

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

3.5.1. Tissue Simulating Liquids

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.

The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm with ≤ ± 0.5 cm variation for SAR measurements ≤ 3 GHz and ≥ 10.0 cm with ≤ ± 0.5 cm variation for measurements > 3 GHz. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in Table-3.1.

Photo of Liquid Height

Tissue Dielectric Parameters for Head and Body				
Target Frequency	Head		Body	
(MHz)	ε_r	σ(S/m)	ε_r	σ(S/m)
750	*41.9*	*0.89*	*55.5*	*0.96*
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
1450	*40.5*	*1.20*	*54.0*	*1.30*
1640	*40.3*	*1.29*	*53.8*	*1.40*
1750	*40.1*	*1.37*	*53.4*	*1.49*
1800	40.0	1.40	53.3	1.52
1900	40.0	1.40	53.3	1.52
2000	40.0	1.40	53.3	1.52
2300	*39.5*	*1.67*	*52.9*	*1.81*
2450	39.2	1.80	52.7	1.95
2600	*39.0*	*1.96*	*52.5*	*2.16*
3500	*37.9*	*2.91*	*51.3*	*3.31*
5200	*36.0*	*4.66*	*49.0*	*5.30*
5300	*35.9*	*4.76*	*48.9*	*5.42*
5500	*35.6*	*4.96*	*48.6*	*5.65*
5600	*35.5*	*5.07*	*48.5*	*5.77*
5800	35.3	5.27	48.2	6.00
(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m³)				

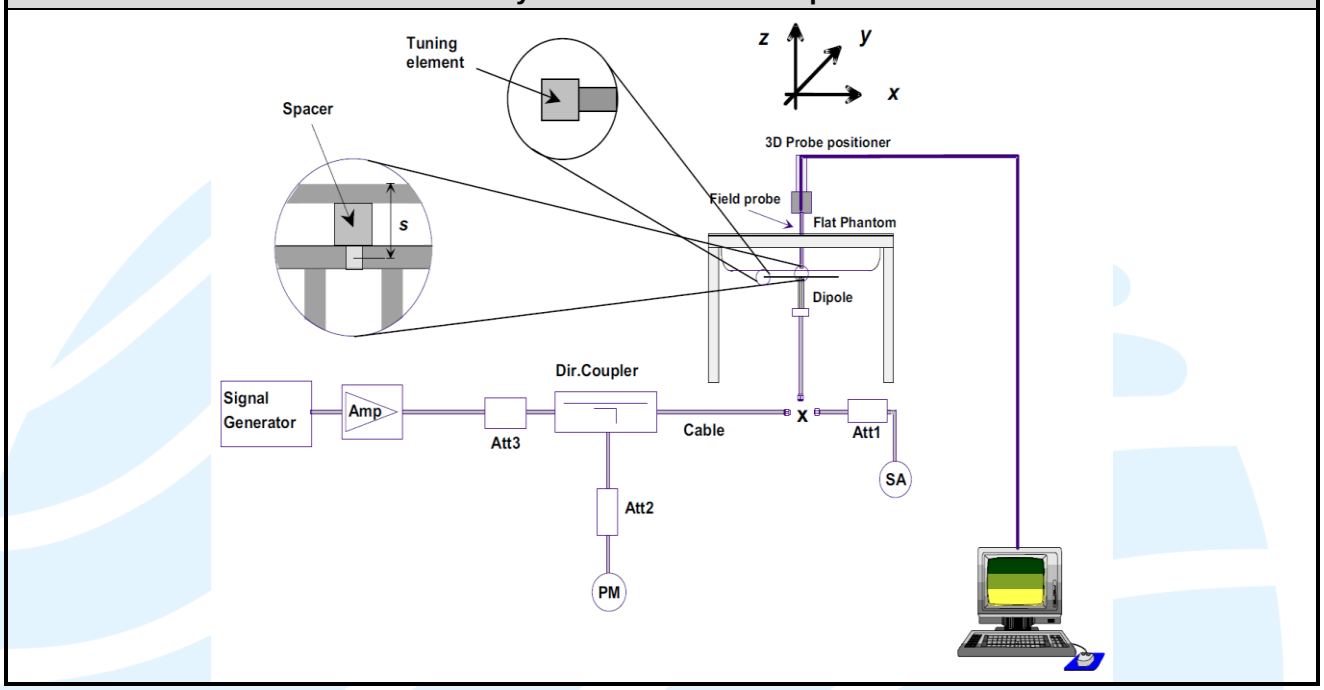
The following table gives the recipes for tissue simulating liquids.

Recipes of Tissue Simulating Liquid								
Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
H750	0.2	-	0.2	1.4	57.0	-	41.1	-
H835	0.1	-	1.0	1.4	57.0	-	40.5	-
H900	0.1	-	1.0	1.5	56.5	-	40.9	-
H1450	-	45.5	-	0.7	-	-	53.8	-
H1640	-	45.8	-	0.5	-	-	53.7	-
H1750	-	44.5	-	0.3	-	-	55.2	-
H1800	-	44.9	-	0.2	-	-	54.9	-
H1900	-	44.9	-	0.2	-	-	54.9	-
H2000	-	50	-	-	-	-	50	-
H2300	-	44.9	-	0.1	-	-	55.0	-
H2450	-	45.0	-	0.1	-	-	54.9	-
H2600	-	45.1	-	0.1	-	-	54.8	-
H3500	-	8.0	-	0.2	-	20.0	71.8	-
H5G	-	-	-	-	-	17.24	65.52	17.24
B750	0.2	-	0.2	0.8	48.8	-	50.0	-
B835	0.2	-	0.2	0.9	48.5	-	50.2	-
B900	0.2	-	0.2	0.9	48.2	-	50.5	-
B1450	-	34.0	-	0.3	-	-	65.7	-
B1640	-	32.5	-	0.3	-	-	67.2	-
B1750	-	29.4	-	0.4	-	-	70.2	-
B1800	-	29.5	-	0.4	-	-	70.1	-
B1900	-	29.5	-	0.3	-	-	70.2	-
B2000	-	30.0	-	0.2	-	-	69.8	-
B2300	-	31.0	-	0.1	-	-	68.9	-
B2450	-	31.4	-	0.1	-	-	68.5	-
B2600	-	31.8	-	0.1	-	-	68.1	-
B3500	-	28.8	-	0.1	-	-	71.1	-
B5G	-	-	-	-	-	10.7	78.6	10.7

3.5.2. System Check Description

The system check procedure provides a simple, fast, and reliable test method that can be performed daily or before every SAR measurement. The objective here is to ascertain that the measurement system has acceptable accuracy and repeatability. This test requires a flat phantom and a radiating source. The system verification setup is shown as below.

System Verification Setup



3.5.3. Tissue Verification

The measuring results for tissue simulating liquid are shown as below.

Test Date	Tissue Type	Frequency (MHz)	Liquid Temp. (℃)	Measured Conductivity (σ)	Measured Permittivity (ε_r)	Target Conductivity (σ)	Target Permittivity (ε_r)	Conductivity Deviation (%)	Permittivity Deviation (%)
Nov. 09, 2023	Head	2450	22.2	1.812	37.770	1.80	39.20	0.67	-3.65
Nov. 10, 2023	Head	5250	21.5	4.827	36.070	4.71	35.93	2.48	0.39
Nov. 13, 2023	Head	5800	21.7	5.379	34.770	5.27	35.30	2.07	-1.50

Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within ± 5% of the target values. The variation of the liquid temperature must be within ± 2 °C during the test.

3.5.4. System Validation

The SAR measurement system was validated according to procedures in KDB 865664 D01. The validation status in tabulated summary is as below.

Test Date	Probe S/N	Calibration Point		Measured Conductivity (σ)	Measured Permittivity (ε_r)	Validation for CW			Validation for Modulation		
						Sensitivity Range	Probe Linearity	Probe Isotropy	Modulation Type	Duty Factor	PAR
Mar. 23, 2023	3090	Head	2450	1.81	38.51	Pass	Pass	Pass	DSSS	N/A	PASS
Aug. 28, 2022	7506	Head	5250	4.93	37.41	Pass	Pass	Pass	OFDM	N/A	PASS
Aug. 28, 2023	7506	Head	5600	5.20	35.90	Pass	Pass	Pass	OFDM	N/A	PASS
Aug. 28, 2023	7506	Head	5800	5.46	36.15	Pass	Pass	Pass	OFDM	N/A	PASS

3.5.5. System Verification

The measuring result for system verification is tabulated as below.

Test Date	Tissue Type	Frequency (MHz)	1W Target SAR-1g (W/kg)	Measured SAR-1g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
Nov. 09, 2023	Head	2450	51.80	13.500	54.00	4.25	1014	3090	662
Nov. 10, 2023	Head	5250	79.20	8.240	82.40	4.04	1280	7506	662
Nov. 13, 2023	Head	5800	80.60	8.330	83.30	3.35	1280	7506	662

Note:

Comparing to the reference SAR value, the validation data should be within its specification of 10%. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

4. SAR MEASUREMENT EVALUATION

4.1. EUT CONFIGURATION AND SETTING

4.1.1. WLAN Configuration and Testing

In general, various vendor specific external test software and chipset based internal test modes are typically used for SAR measurement. These chipset-based test mode utilities are generally hardware and manufacturer dependent, and often include substantial flexibility to reconfigure or reprogram a device. A Wi-Fi device must be configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools for SAR measurement. The test frequencies established using test mode must correspond to the actual channel frequencies. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. In addition, a periodic transmission duty factor is required for current generation SAR systems to measure SAR correctly. The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

According to KDB 248227 D01, this device has installed WLAN engineering testing software which can provide continuous transmitting RF signal. During WLAN SAR testing, this device was operated to transmit continuously at the maximum transmission duty with specified transmission mode, operating frequency, lowest data rate, and maximum output power.

Initial Test Configuration

An initial test configuration is determined for OFDM transmission modes in 2.4 GHz and 5 GHz bands according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. 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.

Subsequent Test Configuration

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units. Additional power measurements may be required to determine if SAR measurements are required for subsequent highest output power channels in a subsequent test configuration. When the highest reported SAR for the initial test configuration according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.

SAR Test Configuration and Channel Selection

When multiple channel bandwidth configurations in a frequency band have the same specified maximum output power, the initial test configuration is using largest channel bandwidth, lowest order modulation, lowest data rate, and lowest order 802.11 mode (i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n). After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following.
1) The channel closest to mid-band frequency is selected for SAR measurement.
2) For channels with equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

4.2. EUT TESTING POSITION

4.2.1. Body Exposure Conditions

Test Configurations	Operation Mode	SAR Required	Note
Front 0mm Separation	Data	No	--
Back 0mm Separation	Data	No	--
Left 0mm Separation	Data	No	--
Right 0mm Separation	Data	No	--
Top 0mm Separation	Data	Yes	--
Bottom 0mm Separation	Data	No	--

Note:
1. Per KDB 447498 D01, SAR test exclusion can be applied to determine the test configuration for adjacent edge.

4.3. MEASURED CONDUCTED POWER RESULT

4.3.1. Conducted Power of WLAN

The measuring conducted average power is shown as below.

Band	Mode	Channel	Frequency (MHz)	Average Power (dBm)	
				Richtek module Camera	Sincere module Camera
2.4GHz	802.11b	1	2412	14.103	14.14
		6	2437	13.421	13.377
		11	2462	13.929	13.856
	802.11g	1	2412	10.592	10.776
		6	2437	13.492	13.401
		11	2462	10.554	10.24
	802.11n-HT20	1	2412	10.244	10.428
		6	2437	13.456	12.194
		11	2462	13.886	12.477
	802.11n-HT40	3	2422	8.392	8.62
		6	2437	8.38	8.281
		9	2452	8.729	8.385

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)	
				Richtek module Camera	Sincere module Camera
802.11a	U-NII-1	36	5180	4.269	3.367
		40	5200	4.493	-0.539
		48	5240	4.874	2.915
	U-NII-3	149	5745	5.627	5.67
		157	5785	3.033	5.253
		165	5825	4.244	5.394

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)	
				Richtek module Camera	Sincere module Camera
802.11n-HT20	U-NII-1	36	5180	3.763	3.097
		40	5200	4.187	1.691
		48	5240	4.108	2.641
	U-NII-3	149	5745	5.367	3.188
		157	5785	2.809	5.695
		165	5825	3.495	5.159

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)	
				Richtek module Camera	Sincere module Camera
802.11n-HT40	U-NII-1	38	5190	1.874	1.953
		46	5230	3.972	0.964
	U-NII-3	151	5755	3.804	3.763
		159	5795	2.521	4.292

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)	
				Richtek module Camera	Sincere module Camera
802.11ac-VHT20	U-NII-1	36	5180	3.807	3.137
		40	5200	4.134	-1.063
		48	5240	4.271	2.648
	U-NII-3	149	5745	5.366	5.278
		157	5785	2.677	4.675
		165	5825	3.304	5.118

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)	
				Richtek module Camera	Sincere module Camera
802.11ac-VHT40	U-NII-1	38	5190	2.083	1.756
		46	5230	3.609	1.06
	U-NII-3	151	5755	3.648	3.704
		159	5795	2.559	4.11

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)	
				Richtek module Camera	Sincere module Camera
802.11ac-VHT80	U-NII-1	42	5210	3.12	0.456
	U-NII-3	155	5775	2.686	4.198

4.4. SAR TEST EXCLUSION EVALUATIONS

4.4.1. Standalone SAR Test Exclusion Considerations

According to KDB 447498 D01, the SAR test exclusion condition is based on source-based time-averaged maximum conducted output power, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The 1-g and 10-g SAR test exclusion thresholds are determined by the following:

1) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm:

$$\frac{Max.Tune\ up\ Power_{(mW)}}{Min.Test\ Separation\ Distance_{(mm)}} \times \sqrt{f_{(GHz)}} \leq 3.0 \text{ for SAR-1g, } \leq 7.5 \text{ for SAR-10g}$$

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

2) For 100 MHz to 1500 MHz and test separation distances > 50 mm:

{[Threshold for 50 mm in step a)] + [(test separation distance – 50 mm) · ($f_{(MHz)}$/150)]} mW

3) For > 1500 MHz and ≤ 6 GHz and test separation distances > 50 mm:

{[Threshold for 50 mm in step a)] + [(test separation distance – 50 mm) ·10]} mW

When the calculated result in step a) is <= 3.0 for SAR-1g exposure condition, or <= 7.5 for SAR-10g exposure condition, the SAR testing exclusion is applied.

When the device output power is less than the calculated result (power threshold, mW) shown in in step b) and c), the SAR testing exclusion is applied.

For 2.4GHz Wi-Fi

Exposure Position	Antenna to Outer Housing Separation Distance	Calculated SAR Exclusion Threshold	Maximum Time-Averaged Conducted Power	SAR Exclusion Result
Upper Front	<5 mm	10 mW	28.18 mW	Test required
Top	<5 mm	10 mW		Test required
Upper Left	<5 mm	10 mW		Test required
Upper Right	<5 mm	10 mW		Test required
Upper Rear	>10 mm	19 mW		Test required
Bottom	>190 mm	>1496 mW		Excluded

For 5GHz Wi-Fi

Exposure Position	Antenna to Outer Housing Separation Distance	Calculated SAR Exclusion Threshold	Maximum Time-Averaged Conducted Power	SAR Exclusion Result
Upper Front	<5 mm	6 mW	3.98 mW	Excluded
Top	<5 mm	6 mW		Excluded
Upper Left	<5 mm	6 mW		Excluded
Upper Right	<5 mm	6 mW		Excluded
Upper Rear	>10 mm	12 mW		Excluded
Bottom	>190 mm	>1462 mW		Excluded

Note:
Client optional decided to keep Front position for data evaluation.

4.5. SAR TESTING RESULTS

4.5.1. SAR Test Reduction Considerations

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 SAR for the mid-band or highest output power channel is:

a) ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
b) ≤ 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
c) ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

KDB 941225 D06 Hot Spot SAR

Hotspot mode SAR is measured for all edges and surfaces of the device with a transmitting antenna located within 25 mm from that surface or edge.

Antenna	Front Face	Rear Face	Left Side	Right Side	Top Side	Bottom Side
WWAN Ant. 1	Yes	Yes	Yes	Yes	No	No

KDB 248227 D01 Wi-Fi SAR

a) For handsets operating next to ear, hotspot mode or mini-tablet configurations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When the reported SAR of initial test position is <= 0.4 W/kg, SAR testing for remaining test positions is not required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is <= 0.8 W/kg or all test positions are measured.
b) For WLAN 2.4 GHz, the highest measured maximum output power channel for DSSS was selected for SAR measurement. When the reported SAR is <= 0.8 W/kg, no further SAR testing is required. Otherwise, SAR is evaluated at the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel. For OFDM modes (802.11g/n), SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and it is <= 1.2 W/kg.
c) For WLAN 5 GHz, the initial test configuration was selected according to the transmission mode with the highest maximum output power. When the reported SAR of initial test configuration is > 0.8 W/kg, SAR is required for the subsequent highest measured output power channel until the reported SAR result is <= 1.2 W/kg or all required channels are measured. For other transmission modes, SAR is not required when the highest reported SAR for initial test configuration is adjusted by the ratio of subsequent test configuration to initial test configuration specified maximum output power and it is <= 1.2 W/kg.
d) For WLAN MIMO mode, the power-based standalone SAR test exclusion or the sum of SAR provision in KDB 447498 to determine simultaneous transmission SAR test exclusion should be applied. Otherwise, SAR for MIMO mode will be measured with all applicable antennas transmitting simultaneously at the specified maximum output power of MIMO operation.

4.5.2. SAR Results for Body Exposure Condition

Richtek module Camera

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	Duty Cycle	Duty Cycle Scaling Factor	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaling Factor	Scaled SAR-1g (W/kg)
	2.4 GHz	IEEE 802.11b	Upper Front	0	1	100.00%	1.00	14.5	14.10	0.03	0.302	1.10	0.331
1	2.4 GHz	IEEE 802.11b	Upper Rear	0	1	100.00%	1.00	14.5	14.10	-0.05	0.45	1.10	**0.493**
	2.4 GHz	IEEE 802.11b	Upper Left	0	1	100.00%	1.00	14.5	14.10	-0.04	0.276	1.10	0.303
	2.4 GHz	IEEE 802.11b	Upper Right	0	1	100.00%	1.00	14.5	14.10	0.03	0.269	1.10	0.295
	5.2 GHz	IEEE 802.11a	Upper Front	0	48	96.59%	1.04	5.5	4.87	-0.10	0.044	1.16	0.053
2	5.2 GHz	IEEE 802.11a	Upper Rear	0	48	96.59%	1.04	5.5	4.87	-0.04	0.0559	1.16	**0.067**
	5.2 GHz	IEEE 802.11a	Upper Left	0	48	96.59%	1.04	5.5	4.87	-0.03	0.0174	1.16	0.021
	5.2 GHz	IEEE 802.11a	Upper Right	0	48	96.59%	1.04	5.5	4.87	-0.15	0.0405	1.16	0.048
	5.8 GHz	IEEE 802.11a	Upper Front	0	149	96.59%	1.04	6.0	5.63	-0.05	0.0582	1.09	0.066
3	5.8 GHz	IEEE 802.11a	Upper Rear	0	149	96.59%	1.04	6.0	5.63	0.03	0.0587	1.09	**0.066**
	5.8 GHz	IEEE 802.11a	Upper Left	0	149	96.59%	1.04	6.0	5.63	0.03	0.0451	1.09	0.051
	5.8 GHz	IEEE 802.11a	Upper Right	0	149	96.59%	1.04	6.0	5.63	-0.10	0.0391	1.09	0.044

Sincere module Camera

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	Duty Cycle	Duty Cycle Scaling Factor	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaling Factor	Scaled SAR-1g (W/kg)
	2.4 GHz	IEEE 802.11b	Upper Front	0	1	100.00%	1.00	14.5	14.14	-0.05	0.314	1.09	0.341
4	2.4 GHz	IEEE 802.11b	Upper Rear	0	1	100.00%	1.00	14.5	14.14	-0.13	0.494	1.09	**0.537**
	2.4 GHz	IEEE 802.11b	Upper Left	0	1	100.00%	1.00	14.5	14.14	-0.06	0.263	1.09	0.286
	2.4 GHz	IEEE 802.11b	Upper Right	0	1	100.00%	1.00	14.5	14.14	0.16	0.277	1.09	0.301
	5.2 GHz	IEEE 802.11a	Upper Front	0	36	96.59%	1.04	4.0	3.37	0.03	0.03	1.16	0.036
5	5.2 GHz	IEEE 802.11a	Upper Rear	0	36	96.59%	1.04	4.0	3.37	-0.04	0.0416	1.16	0.050
	5.2 GHz	IEEE 802.11a	Upper Left	0	36	96.59%	1.04	4.0	3.37	-0.05	0.0359	1.16	0.043
	5.2 GHz	IEEE 802.11a	Upper Right	0	36	96.59%	1.04	4.0	3.37	-0.04	0.0462	1.16	**0.055**
	5.8 GHz	IEEE 802.11a	Upper Front	0	149	96.59%	1.04	6.0	5.67	-0.09	0.0624	1.08	0.070
6	5.8 GHz	IEEE 802.11a	Upper Rear	0	149	96.59%	1.04	6.0	5.67	-0.15	0.053	1.08	0.059
	5.8 GHz	IEEE 802.11a	Upper Left	0	149	96.59%	1.04	6.0	5.67	-0.04	0.0477	1.08	0.053
	5.8 GHz	IEEE 802.11a	Upper Right	0	149	96.59%	1.04	6.0	5.67	-0.04	0.113	1.08	**0.126**

4.6. SAR MEASUREMENT VARIABILITY

4.6.1. Repeated Measurement

According to KDB 865664 D01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10, the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. 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.

SAR repeated measurement procedure:

1) When the highest measured SAR is < 0.80 W/kg, repeated measurement is not required.
2) When the highest measured SAR is >= 0.80 W/kg, repeat that measurement once.
3) 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 W/kg, perform a second repeated measurement.
4) If the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20, and the original, first or second repeated measurement is >= 1.5 W/kg, perform a third repeated measurement.

All the measured SAR are less than 0.8 W/kg, so the repeated measurement is not required.

4.7. SIMULTANEOUS MULTI-BAND TRANSMISSION EVALUATION

4.7.1. Simultaneous Transmission SAR Test Exclusion Considerations

a) Sum of SAR

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of SAR1g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR1g 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR1g is greater than the SAR limit (SAR1g 1.6 W/kg), SAR test exclusion is determined by the SPLSR.

b) SAR to Peak Location Separation Ratio

The simultaneous transmitting antennas in each operating mode and exposure condition combination are considered one pair at a time to determine the SPLSR.

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

The ratio is rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. When 10-g SAR applies, the ratio must be ≤ 0.10.
SAR_1 and SAR_2 are the highest reported or estimated SAR values for each antenna in the pair, and R_i is the separation distance in mm between the peak SAR locations for the antenna pair

$$peak\ location\ separation\ distance = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

Where $(x_1,\ y_1,\ z_1)$ and $(x_2,\ y_2,\ z_2)$ are the coordinates of the extrapolated peak SAR locations in the area or zoom scans.
When standalone test exclusion applies, SAR is estimated; the peak location is assumed to be at the feed-point or geometric center of the antenna. Due to curvatures on the SAM phantom, when SAR is estimated for one of the antennas in an antenna pair, the measured peak SAR location will be translated onto the test device to determine the peak location separation for the antenna pair.
When SAR is estimated for both antennas, the peak location separation should be determined by the closest physical separation of the antennas, according to the feed-point or geometric center of the antennas.

c) Volume Scan

When the SPLSR is <= 0.04 for 1-g SAR and <= 0.10 for 10-g SAR, the simultaneous transmission SAR is not required. Otherwise, the enlarged zoom scan and volume scan post-processing procedures will be performed.

4.7.2. Simultaneous Transmission Possibilities

The simultaneous transmission possibilities for this device are listed as below.

Simultaneous Transmission Configurations	Body Exposure Condition
2.4 GHz WLAN (Data) + 5GHz WLAN (Data)	No

Note:
The 2.4G WLAN and 5G WLAN cannot transmit simultaneously.

*** End of Report ***

The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.

APPENDIX A. SAR PLOTS OF SYSTEM VERIFICATION

The plots for system verification with largest deviation for each SAR system combination are shown as follows.

APPENDIX B. SAR PLOTS OF SAR MEASUREMENT

The SAR plots for highest measured SAR in each exposure configuration, wireless mode and frequency band combination, and measured SAR > 1.5 W/kg are shown as follows.

APPENDIX C. CALIBRATION CERTIFICATE FOR PROBE AND DIPOLE

The calibration certificates are shown as follows.

APPENDIX D. PHOTOGRAPHS OF EUT AND SETUP

The photographs of EUT and setup are shown as follows.