

FCC SAR TEST REPORT

Product Name: Hyebrid Full-Touch Handheld Computer

Trade Mark:



Model No.: HF550X

Add. Model No.: N/A

Report Number: 2304244979SAR-1

Test Standards: FCC 47 CFR Part 2 §2.1093
ANSI/IEEE C95.1-1992
IEEE Std 1528-2013

FCC ID: SS4HF550XR

Test Result: PASS

Date of Issue: October 7, 2023

Prepared for:

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UTTR-SAR-IEEE Std 1528-2013-V1.1

Version

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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 Head SAR _{1g} (W/kg)	Highest Reported Body-worn SAR _{1g} (1.0 cm Gap) (W/kg)	Highest Reported Hotspot SAR _{1g} (1.0 cm Gap) (W/kg)
DTS	2.4G WLAN	0.356	0.924	0.924
NII	5.2G WLAN	1.061	0.639	0.639
	5.3G WLAN	1.302	1.165	1.165
	5.6G WLAN	0.828	0.571	0.571
	5.8G WLAN	0.564	0.403	0.403
DSS	Bluetooth	0.030	0.114	0.114
DSS	RFID	1.369	0.969	0.969
DXX	NFC	N/A	N/A	N/A
Highest Simultaneous Transmission SAR		Head (W/kg)	Body-worn (W/kg)	Hotspot (W/kg)
NII / DTS + DSS		1.379	1.165	1.165

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1.2. CLIENT INFORMATION

Applicant:	Bluebird Inc.
Address of Applicant:	3F, 115, Irwon-ro, Gangnam-gu, Seoul, Republic of Korea
Manufacturer:	Bluebird Inc.
Address of Manufacturer:	3F, 115, Irwon-ro, Gangnam-gu, Seoul, Republic of Korea

1.3. EUT INFORMATION

1.3.1. General Description of EUT

Product Name:	Hybrid Full-Touch Handheld Computer
Trade Mark:	 BLUEBIRD
Model No.:	HF550X
Add. Model No.:	N/A
FCC ID:	SS4HF550XR
DUT Stage:	Identical Prototype
Software Version:	R1.0 (Provided by the customer)
Hardware Version:	REV0.8 (Provided by the customer)
Sample Received Date:	April 13, 2023
Sample Tested Date:	May 10, 2023 to May 31, 2023

1.3.2. Description of Accessories

Adapter	
Model No.:	KSA29B0500200D5
Input:	100-240 V~50/60 Hz 0.5A
Output:	5.0 V $\equiv$ 2.0A
AC Cable:	N/A
DC Cable:	N/A

Battery	
Model No.:	BAT-400001
Battery Type:	Lithium-ion Rechargeable Battery
Rated Voltage:	3.85 Vdc
Limited Charge Voltage:	4.4 Vdc
Rated Capacity:	4000 mAh

Cable	
Description:	USB Type-C Plug Cable
Connector:	USB Type-C / USB 3.0 Type A
Cable Type:	Shielded without ferrite
Length:	1 Meter

1.3.3. EUT Tx Frequency Bands

RF Type	Band(s)	Tx Frequency Range (Unit: MHz)
WLAN	2.4 GHz:	2412 - 2472
	U-NII-1:	5180 - 5240
	U-NII-2A:	5260 - 5320
	U-NII-2C:	5500 - 5700
	U-NII-3:	5745 - 5825
Bluetooth	2.4 GHz:	2402 - 2480
RFID	902 - 928 MHz	902.75 - 927.25
NFC	13.553 - 13.567 MHz	13.56

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)
Bluetooth	BR+EDR LE 2LE
Others	NFC, RFID
Antenna Type	PIFA Antenna
Power Reduction	Not Support
Dynamic Antenna	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)		
	Ant. 0	Ant. 1	Ant. 0 + 1
802.11b	18.5	17.0	--
802.11g	17.0	16.0	--
802.11n-HT20	16.0	14.5	18.0
802.11n-HT40	16.5	14.5	18.5

➤ 5GHz WLAN

Mode	Band(s)	Maximum Conducted Power (dBm)		
		Ant. 0	Ant. 1	Ant. 0 + 1
802.11a	U-NII-1	17.5	16.5	--
	U-NII-2A	17.0	16.0	--
	U-NII-2C	16.5	16.0	--
	U-NII-3	15.5	16.5	--
802.11n-HT20	U-NII-1	13.5	12.0	16.0
	U-NII-2A	13.0	12.0	15.5
	U-NII-2C	12.5	12.0	15.0
	U-NII-3	11.5	12.0	15.0
802.11n-HT40	U-NII-1	12.5	11.0	15.0
	U-NII-2A	12.0	11.5	14.5
	U-NII-2C	11.5	12.0	14.5
	U-NII-3	11.0	11.5	14.0
802.11ac-VHT20	U-NII-1	13.5	12.0	15.5
	U-NII-2A	13.0	12.5	15.5
	U-NII-2C	12.5	12.0	15.0
	U-NII-3	12.0	12.0	15.0
802.11ac-VHT40	U-NII-1	12.5	11.5	15.0
	U-NII-2A	12.0	11.5	15.0
	U-NII-2C	11.5	12.0	14.5
	U-NII-3	11.0	11.5	14.0
802.11ac-VHT80	U-NII-1	11.5	10.5	14.0
	U-NII-2A	11.5	10.5	14.0
	U-NII-2C	11.0	10.5	13.5
	U-NII-3	12.0	11.0	14.5

➤ Bluetooth

Mode	Modulation	Maximum Conducted Power (dBm)
BR + EDR	GFSK	9.5
	$\pi/4$ -DQPSK	7.0
	8-DPSK	7.0
LE	GFSK	8.5
2LE	GFSK	6.0

➤ RFID

Mode	Modulation	Maximum Conducted Power (dBm)
RFID	ASK	27.5

1.5. OTHER INFORMATION

None.

1.6. TEST LOCATION

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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 D04 v01

KDB 648474 D04 v01r03

KDB 941225 D06 v02r01

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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:

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

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be related to the electrical field in the tissue by

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

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

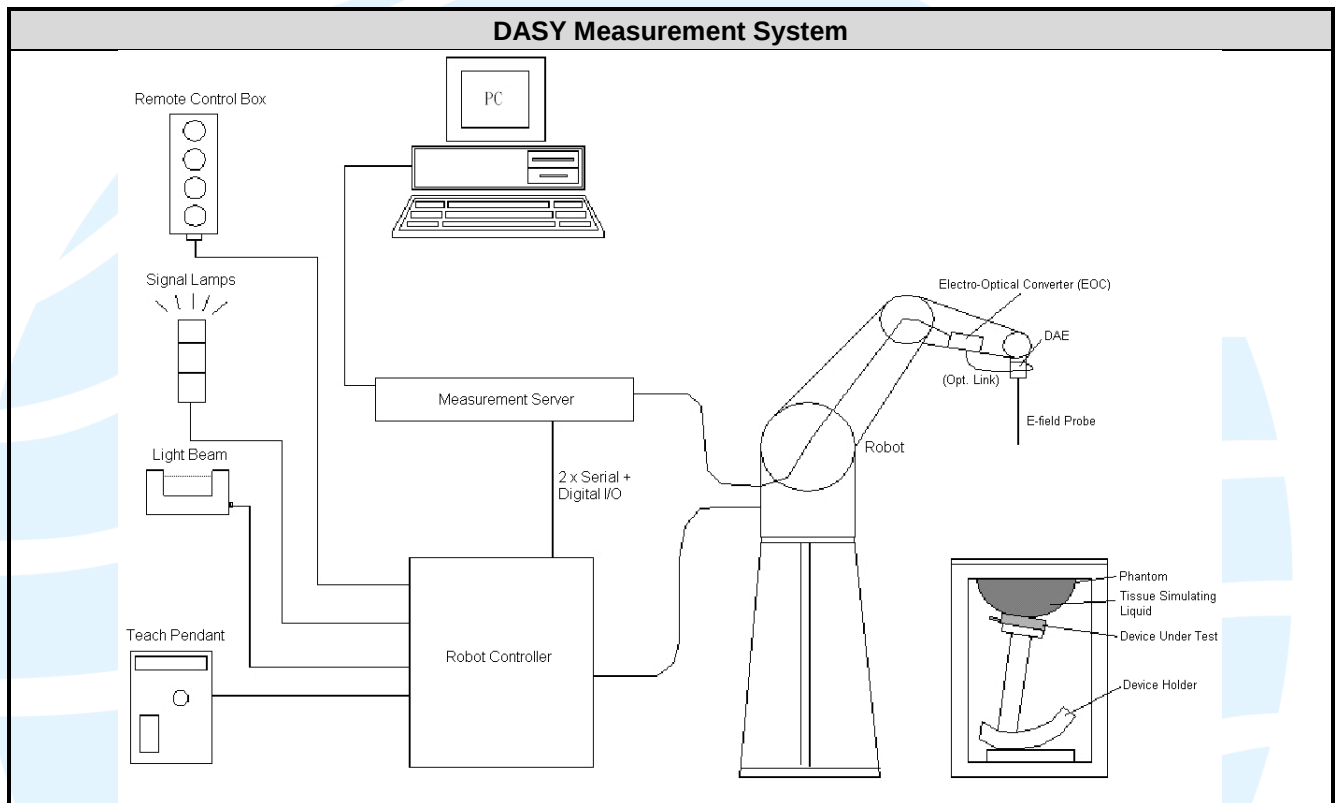
Note:

- 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 from the optical into digital electric signal of the DAE and transfers data to the PC.



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 μ W/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/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 μ W/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 Voltage Offset	$< 5\mu$ V (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 1/4 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 $\frac{1}{2}$ 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 $\pm$ 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm $\pm$ 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 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 $\leq$ 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: $\Delta x_{Zoom}, \Delta y_{Zoom}$			≤ 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	$\leq 1.5 \cdot \Delta Z_{Zoom}(n-1)$ 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 $\pm 5\%$.

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	D900V2	136	Apr. 13, 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	3818	Aug. 06, 2022	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	Shanghai Gao Zhi Precision Instrument Co., Ltd.	HB6801	18022507	Nov. 02, 2022	1 Year
Dual Directional 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

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UTTR-SAR-IEEE Std 1528-2013-V1.1

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)	7.4	N (k=2)	2	1	1	3.70	3.70	∞
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)						9.62	9.60	
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)	7.4	N (k=2)	2	1	1	3.70	3.70	∞
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)						9.62	9.60	
Max. Expanded Uncertainty (k = 2)						19.24	19.19	

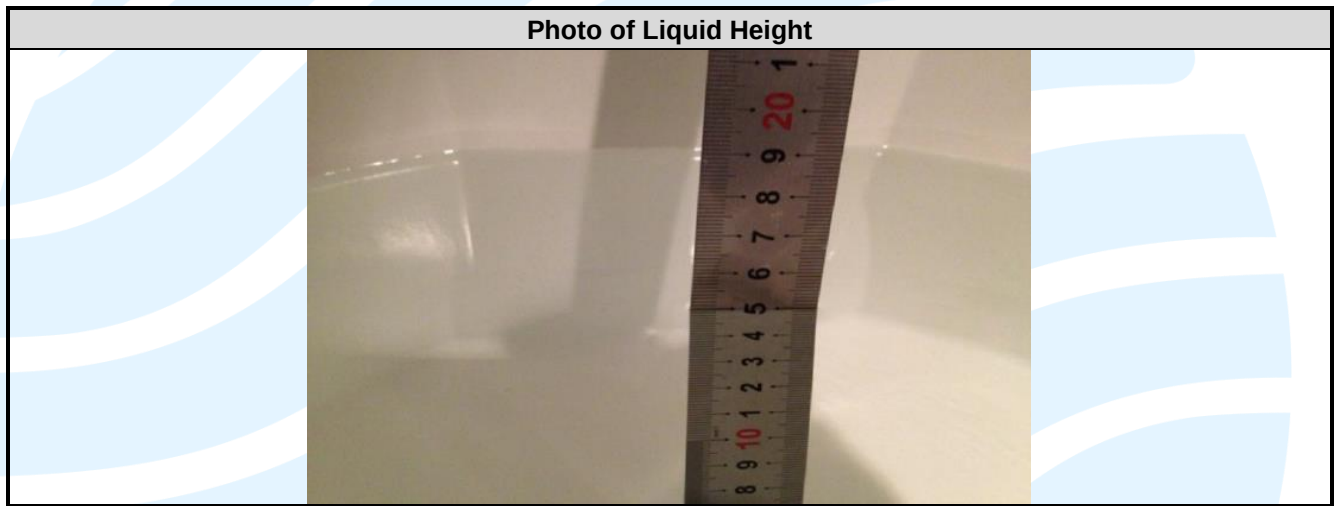
3.5. TISSUE DIELECTRIC PARAMETER MEASUREMENT & SYSTEM VERIFICATION

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 $\leq \pm 0.5$ cm variation for SAR measurements ≤ 3 GHz and ≥ 10.0 cm with $\leq \pm 0.5$ 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.



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

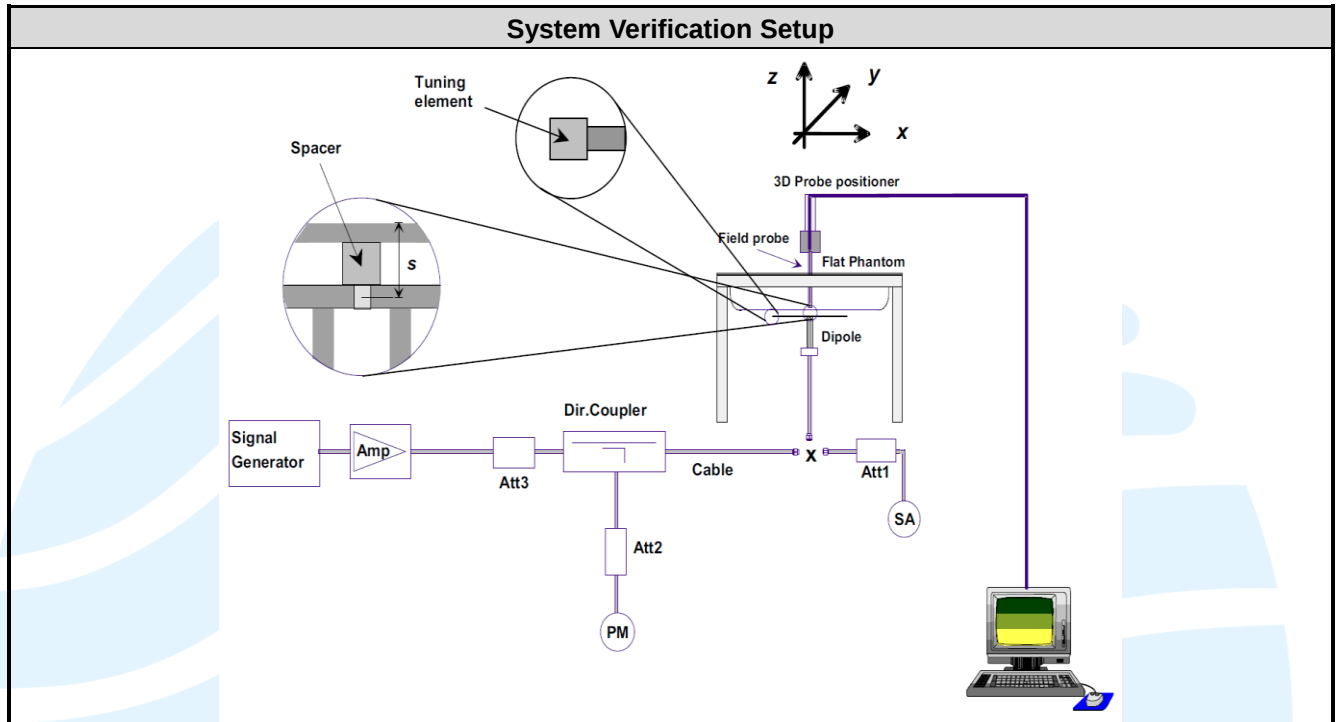
(ϵ_r = relative permittivity, σ = conductivity and $\rho = 1000$ kg/m³)

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	-	-	-	-	-	17.2	65.52	17.3
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.



3.5.3. Tissue Verification

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

Test Date	Tissue Type	Frequency (MHz)	Liquid Temp. (°C)	Measured Conductivity (σ)	Measured Permittivity (ϵ_r)	Target Conductivity (σ)	Target Permittivity (ϵ_r)	Conductivity Deviation (%)	Permittivity Deviation (%)
May. 18, 2023	Head	900	21.2	0.976	39.860	0.97	41.50	0.60	-3.95
May. 26, 2023	Head	900	21.6	0.976	39.890	0.97	41.50	0.66	-3.88
May. 30, 2023	Head	900	22.0	0.976	39.920	0.97	41.50	0.64	-3.81
May. 11, 2023	Head	2450	21.3	1.757	38.650	1.80	39.20	-2.39	-1.40
May. 31, 2023	Head	2450	21.9	1.732	38.410	1.80	39.20	-3.78	-2.02
May. 10, 2023	Head	2450	21.5	1.762	38.680	1.80	39.20	-2.11	-1.33
May. 12, 2023	Head	2450	21.5	1.758	38.710	1.80	39.20	-2.33	-1.25
May. 30, 2023	Head	2450	21.9	1.764	38.730	1.80	39.20	-2.00	-1.20
May. 26, 2023	Head	5250	21.6	4.847	36.890	4.71	35.93	2.91	2.67
May. 23, 2023	Head	5250	21.4	4.845	36.850	4.71	35.93	2.87	2.56
May. 24, 2023	Head	5250	21.5	4.852	36.870	4.71	35.93	3.01	2.62
May. 25, 2023	Head	5250	21.2	4.848	36.910	4.71	35.93	2.93	2.73
May. 27, 2023	Head	5250	21.4	4.854	36.920	4.71	35.93	3.06	2.76
May. 29, 2023	Head	5250	21.5	4.849	36.880	4.71	35.93	2.95	2.64
May. 24, 2023	Head	5600	21.6	5.202	35.900	5.07	35.53	2.60	1.04
May. 23, 2023	Head	5600	21.4	5.204	35.860	5.07	35.53	2.64	0.93
May. 25, 2023	Head	5600	21.2	5.196	35.940	5.07	35.53	2.49	1.15
May. 26, 2023	Head	5600	21.6	5.199	35.890	5.07	35.53	2.54	1.01
May. 27, 2023	Head	5600	21.5	5.201	35.880	5.07	35.53	2.58	0.99
May. 29, 2023	Head	5600	21.5	5.199	35.930	5.07	35.53	2.54	1.13
May. 28, 2023	Head	5800	21.7	5.405	35.490	5.27	35.30	2.56	0.54
May. 23, 2023	Head	5800	21.4	5.400	35.510	5.27	35.30	2.47	0.59
May. 24, 2023	Head	5800	21.5	5.398	35.460	5.27	35.30	2.43	0.45
May. 25, 2023	Head	5800	21.3	5.397	35.500	5.27	35.30	2.41	0.57
May. 26, 2023	Head	5800	21.6	5.402	35.480	5.27	35.30	2.50	0.51
May. 27, 2023	Head	5800	21.4	5.404	35.530	5.27	35.30	2.54	0.65
May. 29, 2023	Head	5800	21.5	5.397	35.510	5.27	35.30	2.41	0.59

Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within $\pm 5\%$ of the target values. The variation of the liquid temperature must be within $\pm 2^\circ\text{C}$ 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	900	0.977	39.861	Pass	Pass	Pass	GMSK	N/A	Pass
Mar. 23, 2023	3090	Head	2450	1.811	38.510	Pass	Pass	Pass	OFDM	N/A	Pass
Aug. 23, 2022	3818	Head	5250	4.934	37.410	Pass	Pass	Pass	OFDM	N/A	Pass
Aug. 23, 2022	3818	Head	5600	5.201	35.899	Pass	Pass	Pass	OFDM	N/A	Pass
Aug. 23, 2022	3818	Head	5800	5.461	36.150	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
May. 18, 2023	Head	900	10.90	0.112	11.20	2.75	136	3090	662
May. 26, 2023	Head	900	10.90	0.113	11.30	3.67	136	3090	662
May. 30, 2023	Head	900	10.90	0.107	10.70	-1.83	136	3090	662
May. 11, 2023	Head	2450	51.80	0.509	50.90	-1.74	1014	3090	662
May. 31, 2023	Head	2450	51.80	0.488	48.80	-5.79	1014	3090	662
May. 10, 2023	Head	2450	51.80	0.503	50.30	-2.90	1014	3090	662
May. 12, 2023	Head	2450	51.80	0.513	51.30	-0.97	1014	3090	662
May. 30, 2023	Head	2450	51.80	0.497	49.70	-4.05	1014	3090	662
May. 26, 2023	Head	5250	79.20	0.774	77.40	-2.27	1280	3818	662
May. 23, 2023	Head	5250	79.20	0.723	72.30	-8.71	1280	3818	662
May. 24, 2023	Head	5250	79.20	0.745	74.50	-5.93	1280	3818	662
May. 25, 2023	Head	5250	79.20	0.722	72.20	-8.84	1280	3818	662
May. 27, 2023	Head	5250	79.20	0.735	73.50	-7.20	1280	3818	662
May. 29, 2023	Head	5250	79.20	0.760	76.00	-4.04	1280	3818	662
May. 24, 2023	Head	5600	83.60	0.795	79.50	-4.90	1280	3818	662
May. 23, 2023	Head	5600	83.60	0.875	87.50	4.67	1280	3818	662
May. 25, 2023	Head	5600	83.60	0.849	84.90	1.56	1280	3818	662
May. 26, 2023	Head	5600	83.60	0.822	82.20	-1.67	1280	3818	662
May. 27, 2023	Head	5600	83.60	0.787	78.70	-5.86	1280	3818	662
May. 29, 2023	Head	5600	83.60	0.807	80.70	-3.47	1280	3818	662
May. 28, 2023	Head	5800	80.60	0.792	79.20	-1.74	1280	3818	662
May. 23, 2023	Head	5800	80.60	0.776	77.60	-3.72	1280	3818	662
May. 24, 2023	Head	5800	80.60	0.754	75.40	-6.45	1280	3818	662
May. 25, 2023	Head	5800	80.60	0.788	78.80	-2.23	1280	3818	662
May. 26, 2023	Head	5800	80.60	0.816	81.60	1.24	1280	3818	662
May. 27, 2023	Head	5800	80.60	0.777	77.70	-3.60	1280	3818	662
May. 29, 2023	Head	5800	80.60	0.806	80.60	0.00	1280	3818	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.

Test Reduction for U-NII-1 (5.2 GHz) and U-NII-2A (5.3 GHz) Bands

For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following.

- 1) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition).
- 2) When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration.



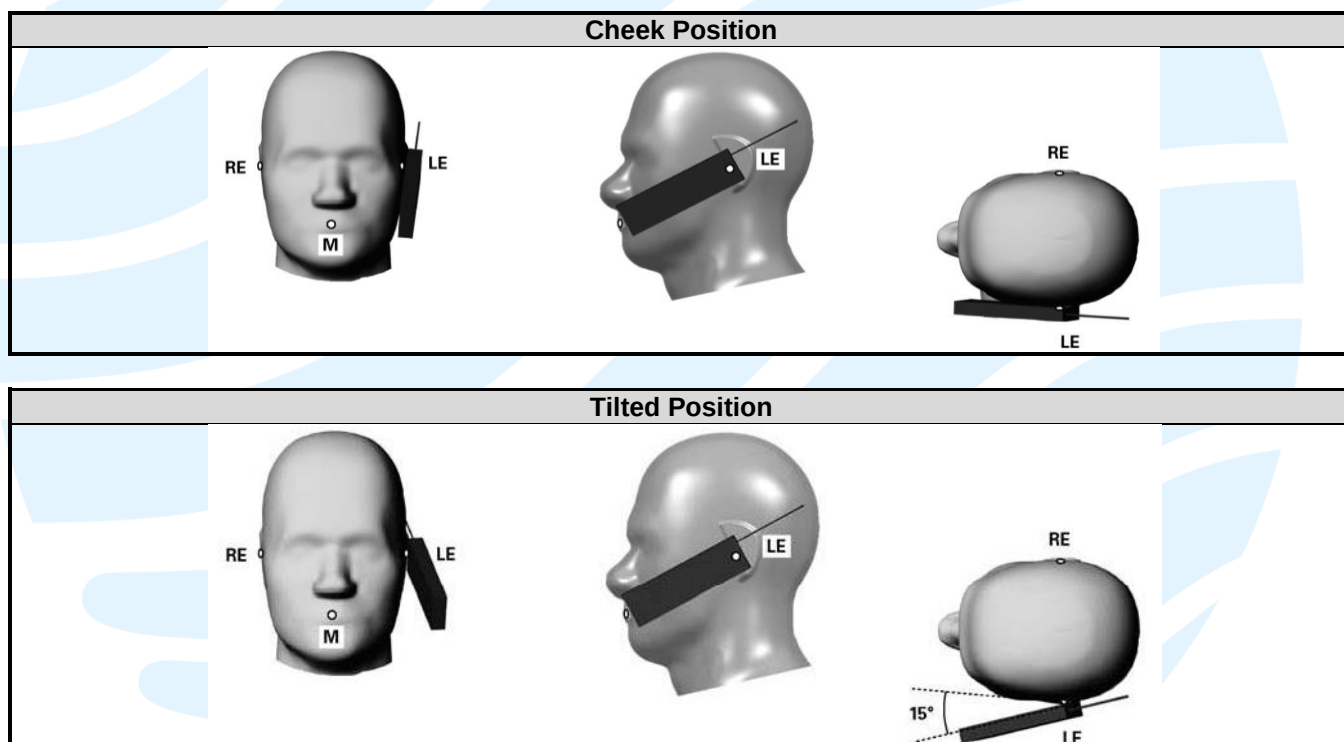
4.2. EUT TESTING POSITION

4.2.1. Head Exposure Conditions

RF Exposure Conditions	Test Position	Separation Distance	SAR test exclusion
Head	Right Cheek	0 cm	N/A
	Right Tilted		
	Left Cheek		
	Left Tilted		

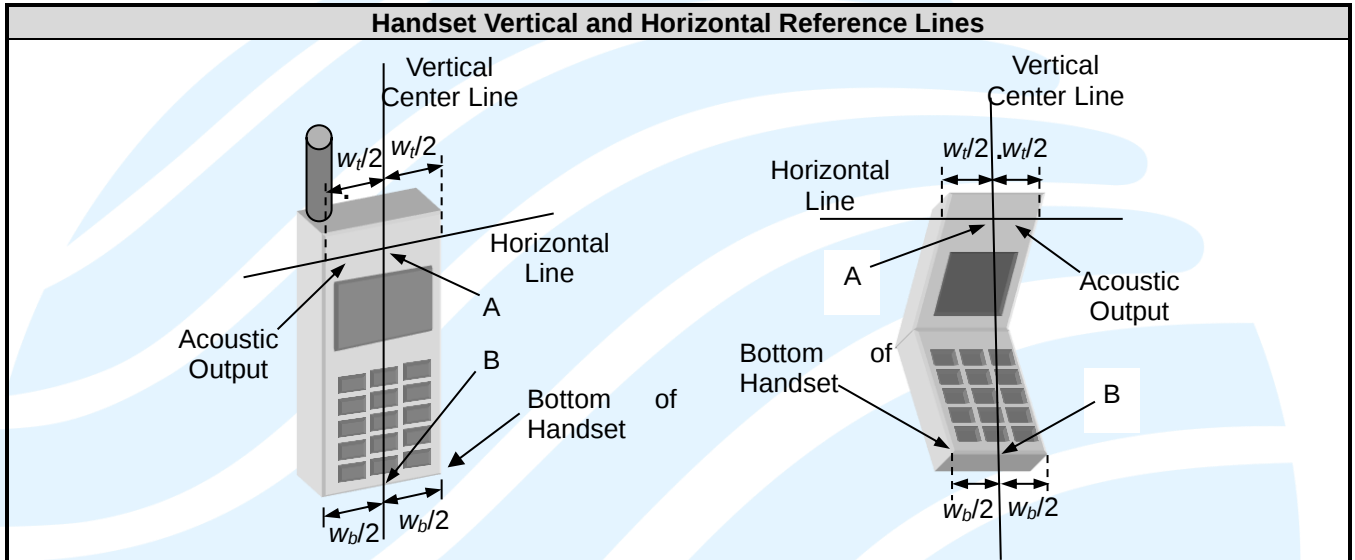
Note:

- 1) Head exposure for voice mode of handset is limited to next to the ear exposure conditions.
- 2) Devices that are designed to transmit next to the ear must be tested using the SAM phantom.
- 3) Other head exposure conditions, for example, in-front-of the face, should be tested using a flat phantom according to the required published RF exposure KDB procedures.
- 4) When data mode operates in next to the ear configurations, either data alone or in conjunction with voice transmissions, SAR evaluation is required for such use conditions.
- 5) When device supports VoIP, SAR evaluation for head Exposure Conditions using the most appropriate wireless data mode configurations is required.



Define two imaginary lines on the handset

- 1) The vertical centerline passes through two points on the front side of the handset - the midpoint of the width w_t of the handset at the level of the acoustic output, and the midpoint of the width w_b of the bottom of the handset.
- 2) The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.
- 3) The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.

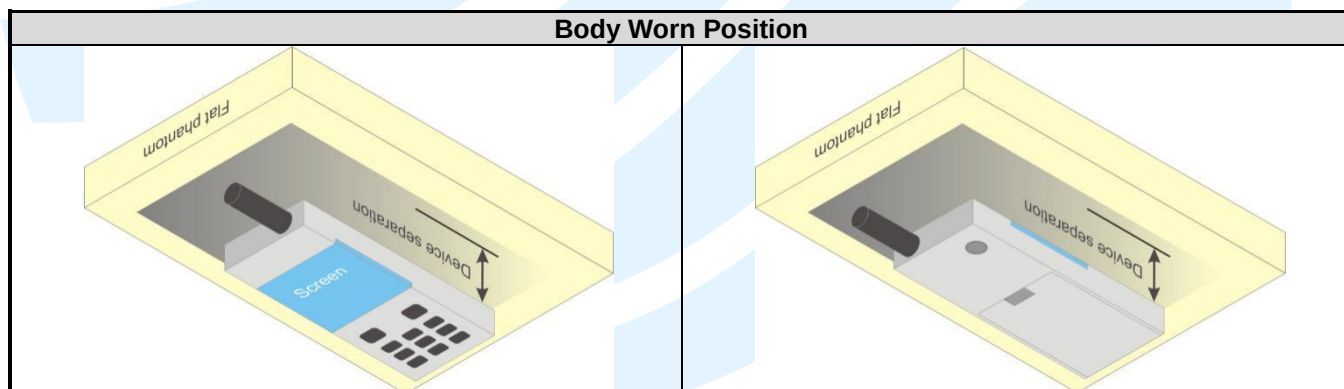


4.2.2. Body-worn Accessory Exposure Conditions

RF Exposure Conditions	Test Position	Separation Distance	SAR test exclusion
Body-worn	Front Face	0 ~ 2.5 cm	N/A
	Rear Face		

Note:

- 1) Body-worn accessories that do not contain metallic or conductive components may be tested according to worst-case exposure configurations, typically according to the smallest test separation distance required for the group of body-worn accessories with similar operating and exposure characteristics. All body-worn accessories containing metallic components are tested in conjunction with the host device.
- 2) Body-worn accessory SAR compliance is based on a single minimum test separation distance for all wireless and operating modes applicable to each body-worn accessory used by the host, and according to the relevant voice and/or data mode transmissions and operations. If a body-worn accessory supports voice only operations in its normal and expected use conditions, testing of data mode for body-worn compliance is not required.
- 3) A conservative minimum test separation distance for supporting off-the-shelf body-worn accessories that may be acquired by users of consumer handsets should be used to test for body-worn accessory SAR compliance. This distance is determined by the handset manufacturer according to the typical body-worn accessories users may acquire at the time of equipment certification, but not more than 2.5 cm, to enable users to purchase aftermarket body-worn accessories with the required minimum separation.
- 4) Devices that are designed to operate on the body of users using lanyards and straps or without requiring additional body-worn accessories must be tested for SAR compliance using a conservative minimum test separation distance ≤ 5 mm to support compliance.
- 5) When device supports VoIP, SAR evaluation for body-worn accessory Exposure Conditions using the most appropriate wireless data mode configurations is required.
- 6) Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories.
- 7) When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for the body-worn accessory with a headset attached to the handset.

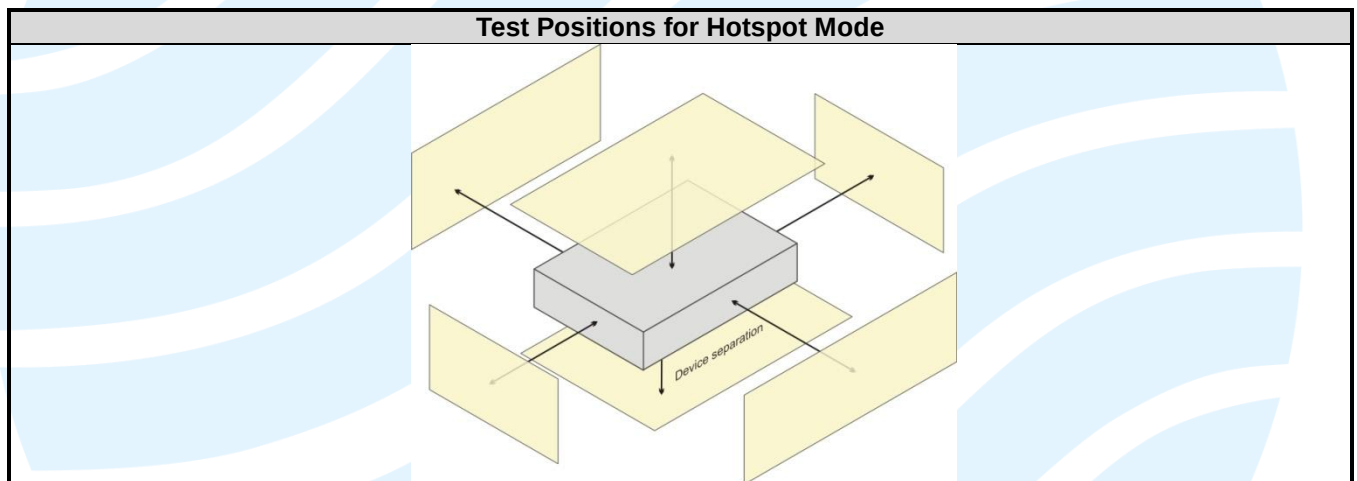


4.2.3. Hotspot Accessory Exposure Conditions

RF Exposure Conditions	Test Position	Separation Distance	SAR test exclusion
Hotspot	Front Face	1 cm	Note 2/3
	Rear Face		
	Left Side		
	Right Side		
	Top Side		
	Bottom Side		

Note:

- 1) The SAR test separation distance for hotspot mode is determined according to device form factor. When the overall length and width of a device is > 9 cm x 5 cm (~3.5" x 2"), a test separation distance of 10 mm is required for hotspot mode SAR measurements. A test separation distance of 5 mm or less is required for smaller devices. The SAR test separation distance for hotspot mode is determined according to device form factor.
- 2) 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.
- 3) Based on the antenna location shown on appendix D of this report, the SAR testing required for hotspot mode is listed on section 4.5.1.



4.3. MEASURED CONDUCTED POWER RESULT

4.3.1. Conducted Power of WLAN

The measuring conducted average power is shown as below.

Mode		Channel	Frequency (MHz)	Average Power (dBm)		
				Ant. 0	Ant. 1	Ant. 0 + 1
2.4GHz	802.11b	1	2412	17.68	16.68	
		6	2437	17.91	16.58	
		11	2462	17.59	16.49	
	802.11g	1	2412	16.25	15.38	
		6	2437	16.72	15.19	
		11	2462	16.27	15.32	
	802.11n (HT20)	1	2412	14.89	13.66	17.32
		6	2437	15.29	13.79	17.61
		11	2462	14.88	13.55	17.27
	802.11n (HT40)	3	2422	15.58	14.19	17.95
		6	2437	15.80	14.25	18.10
		9	2452	15.55	14.05	17.88

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)		
				Ant. 0	Ant. 1	Ant. 0 + 1
802.11a	U-NII-1	36	5180	16.28	15.53	--
		44	5220	16.77	15.56	--
		48	5240	16.61	15.82	--
	U-NII-2A	52	5260	16.27	15.72	--
		60	5300	16.37	15.55	--
		64	5320	15.98	15.67	--
	U-NII-2C	100	5500	15.21	15.68	--
		120	5600	15.88	15.44	--
		140	5700	15.38	15.75	--
	U-NII-3	149	5745	15.22	15.96	--
		157	5785	14.92	15.62	--
		165	5825	14.98	15.28	--

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)		
				Ant. 0	Ant. 1	Ant. 0 + 1
802.11n-HT20	U-NII-1	36	5180	12.21	11.36	14.82
		44	5220	12.81	11.64	15.27
		48	5240	12.68	11.59	15.18
	U-NII-2A	52	5260	12.26	11.71	15.00
		60	5300	12.43	11.61	15.05
		64	5320	11.89	11.54	14.73
	U-NII-2C	100	5500	11.15	11.42	14.30
		120	5600	11.84	11.16	14.52
		140	5700	11.43	11.51	14.48
	U-NII-3	149	5745	11.14	11.62	14.40
		157	5785	11.08	11.39	14.25
		165	5825	11.13	11.32	14.24

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)		
				Ant. 0	Ant. 1	Ant. 0 + 1
802.11n-HT40	U-NII-1	38	5190	11.54	10.65	14.13
		46	5230	12.02	10.68	14.41
	U-NII-2A	54	5270	11.48	10.84	14.18
		62	5310	11.51	10.94	14.24
	U-NII-2C	102	5510	10.54	10.79	13.68
		118	5590	11.03	10.73	13.89
		134	5670	10.84	11.26	14.07
	U-NII-3	151	5755	10.38	10.96	13.69
		159	5795	10.38	10.88	13.65

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)		
				Ant. 0	Ant. 1	Ant. 0 + 1
802.11ac-VHT20	U-NII-1	36	5180	12.22	11.32	14.80
		44	5220	12.85	11.47	15.22
		48	5240	12.71	11.57	15.19
	U-NII-2A	52	5260	12.26	11.85	15.07
		60	5300	12.43	11.55	15.02
		64	5320	11.87	11.54	14.72
	U-NII-2C	100	5500	11.27	11.51	14.40
		120	5600	11.82	11.15	14.51
		140	5700	11.47	11.47	14.48
	U-NII-3	149	5745	11.27	11.48	14.39
		157	5785	10.96	11.65	14.33
		165	5825	11.15	11.26	14.22

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)		
				Ant. 0	Ant. 1	Ant. 0 + 1
802.11ac-VHT40	U-NII-1	38	5190	11.56	10.67	14.15
		46	5230	12.13	10.86	14.55
	U-NII-2A	54	5270	11.58	11.03	14.32
		62	5310	11.45	10.89	14.19
	U-NII-2C	102	5510	10.55	10.84	13.71
		118	5590	10.99	10.71	13.86
		134	5670	10.85	11.29	14.09
	U-NII-3	151	5755	10.39	10.92	13.67
		159	5795	10.41	10.75	13.59

Mode	Band	Channel	Frequency (MHz)	Average Power (dBm)		
				Ant. 0	Ant. 1	Ant. 0 + 1
802.11ac-VHT80	U-NII-1	42	5210	11.18	10.16	13.71
	U-NII-2A	58	5290	10.78	9.83	13.34
	U-NII-2C	106	5530	10.41	10.04	13.24
		122	5610	9.41	9.57	12.50
	U-NII-3	155	5775	11.56	10.67	14.15

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4.3.2. Conducted Power of BT

Mode	Modulation	Channel	Frequency (MHz)	Average Power (dBm)
BR + EDR	GFSK	0	2402	8.76
		39	2441	8.72
		78	2480	8.96
	$\pi/4$ -DQPSK	0	2402	5.92
		39	2441	5.67
		78	2480	6.32
	8-DPSK	0	2402	5.93
		39	2441	5.66
		78	2480	6.31

Mode	Modulation	Channel	Frequency (MHz)	Average Power (dBm)
LE	GFSK	0	2402	7.85
		19	2440	7.79
		39	2480	8.05
2LE	GFSK	0	2402	5.06
		19	2440	5.01
		39	2480	5.29

4.3.3. Conducted Power of RFID

Mode	Modulation	Channel	Frequency (MHz)	Average Power (dBm)
RFID	ASK	1	902.75	26.72
		25	914.75	26.81
		50	927.25	26.77

4.4. SAR TEST EXCLUSION EVALUATIONS

4.4.1. Standalone SAR Test Exclusion Considerations

According to KDB 447498 D04, SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by Formula (B.2).

$$P_{th} \text{ (mW)} = ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases} \quad (\text{B.1})$$

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases} \quad (\text{B.2})$$

where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right)$$

f is in GHz, d is the separation distance (cm), and $ERP_{20 \text{ cm}}$ is per Formula (B.1).

Table B.2—Example Power Thresholds (mW)

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

Mode	Max. Tune-up Power (dBm)	Max. Tune-up Power (mW)	Front Face			Rear Face			Left Side		
			Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?
BT	9.5	8.91	5	2.72	Yes	5	2.72	Yes	5	2.72	Yes
2.4 GHz Wi-Fi (Ant. 0)	18.5	70.79	5	2.73	Yes	5	2.73	Yes	5	2.73	Yes
2.4 GHz Wi-Fi (Ant. 1)	17.0	50.12	5	2.73	Yes	5	2.73	Yes	36	117.04	No
2.4 GHz Wi-Fi (Ant. 0+1)	18.5	70.79	5	2.73	Yes	5	2.73	Yes	5	2.73	Yes
5 GHz Wi-Fi (Ant. 0)	17.5	56.23	5	1.37	Yes	5	1.37	Yes	5	1.37	Yes
5 GHz Wi-Fi (Ant. 1)	16.5	44.67	5	1.37	Yes	5	1.37	Yes	36	84.93	No
5 GHz Wi-Fi (Ant. 0+1)	16.0	39.81	5	1.37	Yes	5	1.37	Yes	5	1.37	Yes
RFID	27.5	562.34	5	12.89	Yes	5	12.89	Yes	5	12.89	Yes

Mode	Max. Tune-up Power (dBm)	Max. Tune-up Power (mW)	Right Side			Top Side			Bottom Side		
			Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?
BT	9.5	8.91	5	2.72	Yes	5	2.72	Yes	12.7	1288.38	No
2.4 GHz Wi-Fi (Ant. 0)	18.5	70.79	63	339.55	No	5	2.73	Yes	12.7	1289.31	No
2.4 GHz Wi-Fi (Ant. 1)	17.0	50.12	5	2.73	Yes	5	2.73	Yes	12.9	1328.23	No
2.4 GHz Wi-Fi (Ant. 0+1)	18.5	70.79	5	2.73	Yes	5	2.73	Yes	12.7	1289.31	No
5 GHz Wi-Fi (Ant. 0)	17.5	56.23	63	273.58	No	5	1.37	Yes	12.7	1184.34	No
5 GHz Wi-Fi (Ant. 1)	16.5	44.67	5	1.37	Yes	5	1.37	Yes	12.9	1223.66	No
5 GHz Wi-Fi (Ant. 0+1)	16.0	39.81	5	1.37	Yes	5	1.37	Yes	12.7	1184.34	No
RFID	27.5	562.34	5	12.89	Yes	5	0.02	Yes	12.9	1597.12	No

Note:

- 1) Based on the antenna location shown on appendix D of this report for SAR test exclusion.
- 2) The 1 mW Blanket Exemption applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.

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

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- 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 Head Exposure Condition

Plot No.	Band	Mode	Test Position	Ch.	Antenna	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)
1	2.4GHz	IEEE 802.11b	Right Cheek	6	Ant. 0	98.88%	1.0113	18.5	17.91	0.05	0.161	1.15	0.187
	2.4GHz	IEEE 802.11b	Right Tilted	6	Ant. 0	98.88%	1.0113	18.5	17.91	0.11	0.0936	1.15	0.108
	2.4GHz	IEEE 802.11b	Left Cheek	6	Ant. 0	98.88%	1.0113	18.5	17.91	0.09	0.0492	1.15	0.057
	2.4GHz	IEEE 802.11b	Left Tilted	6	Ant. 0	98.88%	1.0113	18.5	17.91	0.08	0.0294	1.15	0.034
2	2.4GHz	IEEE 802.11b	Right Cheek	1	Ant. 1	98.88%	1.0113	17.0	16.68	0.17	0.0959	1.08	0.104
	2.4GHz	IEEE 802.11b	Right Tilted	1	Ant. 1	98.88%	1.0113	17.0	16.68	0.03	0.0624	1.08	0.068
	2.4GHz	IEEE 802.11b	Left Cheek	1	Ant. 1	98.88%	1.0113	17.0	16.68	0.02	0.327	1.08	0.356
	2.4GHz	IEEE 802.11b	Left Tilted	1	Ant. 1	98.88%	1.0113	17.0	16.68	0.05	0.162	1.08	0.176
3	2.4GHz	IEEE 802.11n40	Right Cheek	6	Ant. 0+1	94.83%	1.0545	18.5	17.87	0.04	0.109	1.16	0.133
	2.4GHz	IEEE 802.11n40	Right Tilted	6	Ant. 0+1	94.83%	1.0545	18.5	17.87	0.04	0.0644	1.16	0.079
	2.4GHz	IEEE 802.11n40	Left Cheek	6	Ant. 0+1	94.83%	1.0545	18.5	17.87	0.03	0.129	1.16	0.157
	2.4GHz	IEEE 802.11n40	Left Tilted	6	Ant. 0+1	94.83%	1.0545	18.5	17.87	0.06	0.0902	1.16	0.110
4	2.4GHz	BT_BR_DH5	Right Cheek	78	Ant. 0	76.80%	1.3021	9.5	8.96	0.06	0.0203	1.13	0.030
	2.4GHz	BT_BR_DH5	Right Tilted	78	Ant. 0	76.80%	1.3021	9.5	8.96	0.16	0.0118	1.13	0.017
	2.4GHz	BT_BR_DH5	Left Cheek	78	Ant. 0	76.80%	1.3021	9.5	8.96	-0.17	0.00678	1.13	0.010
	2.4GHz	BT_BR_DH5	Left Tilted	78	Ant. 0	76.80%	1.3021	9.5	8.96	-0.03	0.0069	1.13	0.010
5	5.2GHz	IEEE 802.11a	Right Cheek	44	Ant. 0	98.10%	1.0194	17.5	16.77	0.13	0.737	1.18	0.889
	5.2GHz	IEEE 802.11a	Right Tilted	44	Ant. 0	98.10%	1.0194	17.5	16.77	-0.04	0.374	1.18	0.451
	5.2GHz	IEEE 802.11a	Left Cheek	44	Ant. 0	98.10%	1.0194	17.5	16.77	-0.16	0.462	1.18	0.557
	5.2GHz	IEEE 802.11a	Left Tilted	44	Ant. 0	98.10%	1.0194	17.5	16.77	0.06	0.425	1.18	0.513
6	5.2GHz	IEEE 802.11a	Right Cheek	36	Ant. 0	98.10%	1.0194	17.5	16.28	-0.04	0.786	1.32	1.061
	5.2GHz	IEEE 802.11a	Right Cheek	48	Ant. 0	98.10%	1.0194	17.5	16.61	-0.05	0.635	1.23	0.795
	5.2GHz	IEEE 802.11a	Right Cheek	48	Ant. 1	98.10%	1.0194	16.5	15.82	0.02	0.247	1.17	0.294
	5.2GHz	IEEE 802.11a	Right Tilted	48	Ant. 1	98.10%	1.0194	16.5	15.82	0.10	0.335	1.17	0.399
7	5.2GHz	IEEE 802.11a	Left Cheek	48	Ant. 1	98.10%	1.0194	16.5	15.82	0.07	0.191	1.17	0.228
	5.2GHz	IEEE 802.11a	Left Tilted	48	Ant. 1	98.10%	1.0194	16.5	15.82	0.03	0.187	1.17	0.223
	5.2GHz	IEEE 802.11n20	Right Cheek	44	Ant. 0+1	97.81%	1.0224	16.0	15.27	-0.05	0.328	1.18	0.397
	5.2GHz	IEEE 802.11n20	Right Tilted	44	Ant. 0+1	97.81%	1.0224	16.0	15.27	0.03	0.314	1.18	0.380
8	5.3GHz	IEEE 802.11a	Left Cheek	44	Ant. 0+1	97.81%	1.0224	16.0	15.27	0.09	0.234	1.18	0.283
	5.3GHz	IEEE 802.11a	Left Tilted	44	Ant. 0+1	97.81%	1.0224	16.0	15.27	0.02	0.224	1.18	0.271
	5.3GHz	IEEE 802.11a	Right Cheek	60	Ant. 0	98.10%	1.0194	17.0	16.37	-0.17	0.894	1.16	1.054
	5.3GHz	IEEE 802.11a	Right Tilted	60	Ant. 0	98.10%	1.0194	17.0	16.37	0.04	0.538	1.16	0.634
9	5.3GHz	IEEE 802.11a	Left Cheek	60	Ant. 0	98.10%	1.0194	17.0	16.37	0.03	0.724	1.16	0.853
	5.3GHz	IEEE 802.11a	Left Tilted	60	Ant. 0	98.10%	1.0194	17.0	16.37	0.10	0.671	1.16	0.791
	5.3GHz	IEEE 802.11a	Right Cheek	52	Ant. 0	98.10%	1.0194	17.0	16.27	-0.03	0.685	1.18	0.826
	5.3GHz	IEEE 802.11a	Right Cheek	64	Ant. 0	98.10%	1.0194	17.0	15.98	-0.03	1.01	1.26	1.302
10	5.3GHz	IEEE 802.11a	Right Cheek	52	Ant. 1	98.10%	1.0194	16.0	15.72	0.05	0.265	1.07	0.288
	5.3GHz	IEEE 802.11a	Right Tilted	52	Ant. 1	98.10%	1.0194	16.0	15.72	0.07	0.344	1.07	0.374
	5.3GHz	IEEE 802.11a	Left Cheek	52	Ant. 1	98.10%	1.0194	16.0	15.72	0.06	0.213	1.07	0.232
	5.3GHz	IEEE 802.11a	Left Tilted	52	Ant. 1	98.10%	1.0194	16.0	15.72	0.05	0.195	1.07	0.212
11	5.6GHz	IEEE 802.11ac20	Right Cheek	52	Ant. 0+1	97.82%	1.0223	15.5	15.07	0.06	0.447	1.10	0.505
	5.6GHz	IEEE 802.11ac20	Right Tilted	52	Ant. 0+1	97.82%	1.0223	15.5	15.07	-0.04	0.206	1.10	0.233
	5.6GHz	IEEE 802.11ac20	Left Cheek	52	Ant. 0+1	97.82%	1.0223	15.5	15.07	-0.02	0.216	1.10	0.244
	5.6GHz	IEEE 802.11ac20	Left Tilted	52	Ant. 0+1	97.82%	1.0223	15.5	15.07	0.05	0.245	1.10	0.277
12	5.6GHz	IEEE 802.11a	Right Cheek	120	Ant. 0	98.10%	1.0194	16.5	15.88	-0.02	0.704	1.15	0.828
	5.6GHz	IEEE 802.11a	Right Tilted	120	Ant. 0	98.10%	1.0194	16.5	15.88	0.09	0.527	1.15	0.620
	5.6GHz	IEEE 802.11a	Left Cheek	120	Ant. 0	98.10%	1.0194	16.5	15.88	-0.18	0.518	1.15	0.609
	5.6GHz	IEEE 802.11a	Left Tilted	120	Ant. 0	98.10%	1.0194	16.5	15.88	0.11	0.538	1.15	0.633
13	5.6GHz	IEEE 802.11a	Right Cheek	100	Ant. 0	98.10%	1.0194	16.5	15.21	0.10	0.593	1.35	0.814
	5.6GHz	IEEE 802.11a	Right Cheek	140	Ant. 0	98.10%	1.0194	16.5	15.38	0.18	0.573	1.29	0.756
	5.6GHz	IEEE 802.11a	Right Cheek	140	Ant. 1	98.10%	1.0194	16.0	15.75	-0.03	0.197	1.06	0.213
	5.6GHz	IEEE 802.11a	Right Tilted	140	Ant. 1	98.10%	1.0194	16.0	15.75	0.07	0.29	1.06	0.313
14	5.6GHz	IEEE 802.11a	Left Cheek	140	Ant. 1	98.10%	1.0194	16.0	15.75	-0.02	0.139	1.06	0.150
	5.6GHz	IEEE 802.11a	Left Tilted	140	Ant. 1	98.10%	1.0194	16.0	15.75	0.02	0.168	1.06	0.181
	5.6GHz	IEEE 802.11n20	Right Cheek	120	Ant. 0+1	97.81%	1.0224	15.0	14.52	-0.13	0.174	1.12	0.199
	5.6GHz	IEEE 802.11n20	Right Tilted	120	Ant. 0+1	97.81%	1.0224	15.0	14.52	0.04	0.162	1.12	0.185

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Plot No.	Band	Mode	Test Position	Ch.	Antenna	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)
13	5.6GHz	IEEE 802.11n20	Left Cheek	120	Ant. 0+1	97.81%	1.0224	15.0	14.52	0.14	0.197	1.12	0.225
	5.6GHz	IEEE 802.11n20	Left Tilted	120	Ant. 0+1	97.81%	1.0224	15.0	14.52	0.03	0.166	1.12	0.190
14	5.8GHz	IEEE 802.11a	Right Cheek	149	Ant. 0	98.10%	1.0194	16.0	15.22	0.02	0.462	1.20	0.564
	5.8GHz	IEEE 802.11a	Right Tilted	149	Ant. 0	98.10%	1.0194	16.0	15.22	-0.04	0.343	1.20	0.418
	5.8GHz	IEEE 802.11a	Left Cheek	149	Ant. 0	98.10%	1.0194	16.0	15.22	0.11	0.34	1.20	0.415
	5.8GHz	IEEE 802.11a	Left Tilted	149	Ant. 0	98.10%	1.0194	16.0	15.22	-0.20	0.345	1.20	0.421
	5.8GHz	IEEE 802.11a	Right Cheek	149	Ant. 1	98.10%	1.0194	16.5	15.96	0.08	0.187	1.13	0.216
15	5.8GHz	IEEE 802.11a	Right Tilted	149	Ant. 1	98.10%	1.0194	16.5	15.96	0.13	0.285	1.13	0.329
	5.8GHz	IEEE 802.11a	Left Cheek	149	Ant. 1	98.10%	1.0194	16.5	15.96	-0.05	0.154	1.13	0.178
	5.8GHz	IEEE 802.11a	Left Tilted	149	Ant. 1	98.10%	1.0194	16.5	15.96	0.03	0.176	1.13	0.203
	5.8GHz	IEEE 802.11n20	Right Cheek	149	Ant. 0+1	97.81%	1.0224	15.0	14.40	0.05	0.119	1.15	0.140
	5.8GHz	IEEE 802.11n20	Right Tilted	149	Ant. 0+1	97.81%	1.0224	15.0	14.40	-0.04	0.117	1.15	0.137
16	5.8GHz	IEEE 802.11n20	Left Cheek	149	Ant. 0+1	97.81%	1.0224	15.0	14.40	0.19	0.123	1.15	0.144
	5.8GHz	IEEE 802.11n20	Left Tilted	149	Ant. 0+1	97.81%	1.0224	15.0	14.40	0.04	0.117	1.15	0.137
	900MHz	RFID	Right Cheek	25	Ant. 1	64.67%	1.5463	27.5	26.81	0.12	0.55	1.17	0.997
	900MHz	RFID	Right Tilted	25	Ant. 1	64.67%	1.5463	27.5	26.81	0.11	0.371	1.17	0.672
	900MHz	RFID	Left Cheek	25	Ant. 1	64.67%	1.5463	27.5	26.81	0.05	0.702	1.17	1.272
	900MHz	RFID	Left Tilted	25	Ant. 1	64.67%	1.5463	27.5	26.81	0.06	0.46	1.17	0.834
17	900MHz	RFID	Left Cheek	1	Ant. 1	64.67%	1.5463	27.5	26.72	-0.13	0.74	1.20	1.369
	900MHz	RFID	Left Cheek	50	Ant. 1	64.67%	1.5463	27.5	26.77	-0.01	0.741	1.18	1.356

4.5.3. SAR Results for Body-worn & Hotspot Exposure Condition (Separation Distance is 1.0 cm)

Plot No.	Band	Mode	Test Position	Ch.	Antenna	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)
18	2.4GHz	IEEE 802.11b	Front Face	6	Ant. 0	98.88%	1.0113	18.5	17.91	0.06	0.0532	1.15	0.062
	2.4GHz	IEEE 802.11b	Rear Face	6	Ant. 0	98.88%	1.0113	18.5	17.91	0.13	0.798	1.15	0.924
	2.4GHz	IEEE 802.11b	Left Side	6	Ant. 0	98.88%	1.0113	18.5	17.91	0.06	0.309	1.15	0.358
	2.4GHz	IEEE 802.11b	Top Side	6	Ant. 0	98.88%	1.0113	18.5	17.91	-0.04	0.057	1.15	0.066
	2.4GHz	IEEE 802.11b	Rear Face	1	Ant. 0	98.88%	1.0113	18.5	17.68	0.14	0.559	1.21	0.683
	2.4GHz	IEEE 802.11b	Rear Face	11	Ant. 0	98.88%	1.0113	18.5	17.59	0.03	0.675	1.23	0.842
19	2.4GHz	IEEE 802.11b	Front Face	1	Ant. 1	98.88%	1.0113	17.0	16.68	0.08	0.0761	1.08	0.083
	2.4GHz	IEEE 802.11b	Rear Face	1	Ant. 1	98.88%	1.0113	17.0	16.68	0.05	0.67	1.08	0.729
	2.4GHz	IEEE 802.11b	Right Side	1	Ant. 1	98.88%	1.0113	17.0	16.68	0.14	0.386	1.08	0.420
	2.4GHz	IEEE 802.11b	Top Side	1	Ant. 1	98.88%	1.0113	17.0	16.68	-0.07	0.0739	1.08	0.080
20	2.4GHz	IEEE 802.11n40	Front Face	6	Ant. 0+1	94.83%	1.0545	18.5	18.10	0.06	0.0348	1.10	0.040
	2.4GHz	IEEE 802.11n40	Rear Face	6	Ant. 0+1	94.83%	1.0545	18.5	18.10	0.08	0.372	1.10	0.430
	2.4GHz	IEEE 802.11n40	Left Side	6	Ant. 0+1	94.83%	1.0545	18.5	18.10	0.04	0.188	1.10	0.217
	2.4GHz	IEEE 802.11n40	Right Side	6	Ant. 0+1	94.83%	1.0545	18.5	18.10	-0.03	0.225	1.10	0.260
	2.4GHz	IEEE 802.11n40	Top Side	6	Ant. 0+1	94.83%	1.0545	18.5	18.10	0.17	0.0543	1.10	0.063
21	2.4GHz	BT_BR_DH5	Front Face	78	Ant. 0	76.80%	1.3021	9.5	8.96	0.10	0.0063	1.13	0.009
	2.4GHz	BT_BR_DH5	Rear Face	78	Ant. 0	76.80%	1.3021	9.5	8.96	0.02	0.077	1.13	0.114
	2.4GHz	BT_BR_DH5	Left Side	78	Ant. 0	76.80%	1.3021	9.5	8.96	0.18	0.0417	1.13	0.061
	2.4GHz	BT_BR_DH5	Top Side	78	Ant. 0	76.80%	1.3021	9.5	8.96	-0.20	0.00558	1.13	0.008
22	5.2GHz	IEEE 802.11a	Front Face	44	Ant. 0	98.10%	1.0194	17.5	16.77	0.05	0.167	1.18	0.201
	5.2GHz	IEEE 802.11a	Rear Face	44	Ant. 0	98.10%	1.0194	17.5	16.77	-0.11	0.53	1.18	0.639
	5.2GHz	IEEE 802.11a	Left Side	44	Ant. 0	98.10%	1.0194	17.5	16.77	0.05	0.379	1.18	0.457
	5.2GHz	IEEE 802.11a	Top Side	44	Ant. 0	98.10%	1.0194	17.5	16.77	0.14	0.164	1.18	0.198
23	5.2GHz	IEEE 802.11a	Front Face	48	Ant. 1	98.10%	1.0194	16.5	15.82	-0.10	0.0537	1.17	0.064
	5.2GHz	IEEE 802.11a	Rear Face	48	Ant. 1	98.10%	1.0194	16.5	15.82	0.00	0.425	1.17	0.507
	5.2GHz	IEEE 802.11a	Right Side	48	Ant. 1	98.10%	1.0194	16.5	15.82	0.00	0.142	1.17	0.169
	5.2GHz	IEEE 802.11a	Top Side	48	Ant. 1	98.10%	1.0194	16.5	15.82	-0.06	0.277	1.17	0.330
24	5.2GHz	IEEE 802.11n20	Front Face	44	Ant. 0+1	97.81%	1.0224	16.0	15.27	-0.05	0.137	1.18	0.166
	5.2GHz	IEEE 802.11n20	Rear Face	44	Ant. 0+1	97.81%	1.0224	16.0	15.27	-0.17	0.342	1.18	0.414
	5.2GHz	IEEE 802.11n20	Left Side	44	Ant. 0+1	97.81%	1.0224	16.0	15.27	-0.14	0.292	1.18	0.353
	5.2GHz	IEEE 802.11n20	Right Side	44	Ant. 0+1	97.81%	1.0224	16.0	15.27	-0.10	0.0477	1.18	0.058
	5.2GHz	IEEE 802.11n20	Top Side	44	Ant. 0+1	97.81%	1.0224	16.0	15.27	-0.10	0.131	1.18	0.158
25	5.3GHz	IEEE 802.11a	Front Face	60	Ant. 0	98.10%	1.0194	17.0	16.37	0.04	0.258	1.16	0.304
	5.3GHz	IEEE 802.11a	Rear Face	60	Ant. 0	98.10%	1.0194	17.0	16.37	-0.03	0.773	1.16	0.911
	5.3GHz	IEEE 802.11a	Left Side	60	Ant. 0	98.10%	1.0194	17.0	16.37	0.02	0.72	1.16	0.849
	5.3GHz	IEEE 802.11a	Top Side	60	Ant. 0	98.10%	1.0194	17.0	16.37	0.03	0.255	1.16	0.301
	5.3GHz	IEEE 802.11a	Rear Face	52	Ant. 0	98.10%	1.0194	17.0	16.27	-0.09	0.675	1.18	0.814
26	5.3GHz	IEEE 802.11a	Rear Face	64	Ant. 0	98.10%	1.0194	17.0	15.98	-0.09	0.904	1.26	1.165
	5.3GHz	IEEE 802.11a	Front Face	52	Ant. 1	98.10%	1.0194	16.0	15.72	0.00	0.051	1.07	0.055
	5.3GHz	IEEE 802.11a	Rear Face	52	Ant. 1	98.10%	1.0194	16.0	15.72	0.00	0.4	1.07	0.435
	5.3GHz	IEEE 802.11a	Right Side	52	Ant. 1	98.10%	1.0194	16.0	15.72	0.00	0.152	1.07	0.165
27	5.3GHz	IEEE 802.11a	Top Side	52	Ant. 1	98.10%	1.0194	16.0	15.72	-0.18	0.306	1.07	0.333
	5.3GHz	IEEE 802.11ac20	Front Face	52	Ant. 0+1	97.82%	1.0223	15.5	15.07	-0.10	0.151	1.10	0.170
	5.3GHz	IEEE 802.11ac20	Rear Face	52	Ant. 0+1	97.82%	1.0223	15.5	15.07	-0.04	0.349	1.10	0.394
	5.3GHz	IEEE 802.11ac20	Left Side	52	Ant. 0+1	97.82%	1.0223	15.5	15.07	-0.04	0.287	1.10	0.324
	5.3GHz	IEEE 802.11ac20	Right Side	52	Ant. 0+1	97.82%	1.0223	15.5	15.07	0.00	0.0526	1.10	0.059
28	5.3GHz	IEEE 802.11ac20	Top Side	52	Ant. 0+1	97.82%	1.0223	15.5	15.07	-0.12	0.168	1.10	0.190
	5.6GHz	IEEE 802.11a	Front Face	120	Ant. 0	98.10%	1.0194	16.5	15.88	0.04	0.229	1.15	0.269
	5.6GHz	IEEE 802.11a	Rear Face	120	Ant. 0	98.10%	1.0194	16.5	15.88	-0.10	0.197	1.15	0.232
	5.6GHz	IEEE 802.11a	Left Side	120	Ant. 0	98.10%	1.0194	16.5	15.88	-0.12	0.486	1.15	0.571
29	5.6GHz	IEEE 802.11a	Top Side	120	Ant. 0	98.10%	1.0194	16.5	15.88	-0.04	0.196	1.15	0.230
	5.6GHz	IEEE 802.11a	Front Face	140	Ant. 1	98.10%	1.0194	16.0	15.75	0.00	0.0608	1.06	0.066
	5.6GHz	IEEE 802.11a	Rear Face	140	Ant. 1	98.10%	1.0194	16.0	15.75	-0.10	0.0686	1.06	0.074
30	5.6GHz	IEEE 802.11a	Right Side	140	Ant. 1	98.10%	1.0194	16.0	15.75	-0.10	0.0519	1.06	0.056
	5.6GHz	IEEE 802.11a	Top Side	140	Ant. 1	98.10%	1.0194	16.0	15.75	-0.04	0.275	1.06	0.297
31	5.6GHz	IEEE 802.11a	Top Side	140	Ant. 1	98.10%	1.0194	16.0	15.75	-0.04	0.275	1.06	0.297

Plot No.	Band	Mode	Test Position	Ch.	Antenna	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)
32	5.6GHz	IEEE 802.11n20	Front Face	120	Ant. 0+1	97.81%	1.0224	15.0	14.52	0.00	0.0977	1.12	0.112
	5.6GHz	IEEE 802.11n20	Rear Face	120	Ant. 0+1	97.81%	1.0224	15.0	14.52	0.00	0.0671	1.12	0.077
33	5.6GHz	IEEE 802.11n20	Left Side	120	Ant. 0+1	97.81%	1.0224	15.0	14.52	-0.10	0.156	1.12	0.178
	5.6GHz	IEEE 802.11n20	Right Side	120	Ant. 0+1	97.81%	1.0224	15.0	14.52	0.06	0.0365	1.12	0.042
	5.6GHz	IEEE 802.11n20	Top Side	120	Ant. 0+1	97.81%	1.0224	15.0	14.52	0.06	0.111	1.12	0.127
34	5.8GHz	IEEE 802.11a	Front Face	149	Ant. 0	98.10%	1.0194	16.0	15.22	0.03	0.168	1.20	0.205
	5.8GHz	IEEE 802.11a	Rear Face	149	Ant. 0	98.10%	1.0194	16.0	15.22	-0.10	0.0981	1.20	0.120
35	5.8GHz	IEEE 802.11a	Left Side	149	Ant. 0	98.10%	1.0194	16.0	15.22	-0.04	0.296	1.20	0.361
	5.8GHz	IEEE 802.11a	Top Side	149	Ant. 0	98.10%	1.0194	16.0	15.22	-0.18	0.126	1.20	0.154
	5.8GHz	IEEE 802.11a	Front Face	149	Ant. 1	98.10%	1.0194	16.5	15.96	0.00	0.056	1.13	0.065
36	5.8GHz	IEEE 802.11a	Rear Face	149	Ant. 1	98.10%	1.0194	16.5	15.96	0.00	0.11	1.13	0.127
	5.8GHz	IEEE 802.11a	Right Side	149	Ant. 1	98.10%	1.0194	16.5	15.96	-0.10	0.06	1.13	0.069
37	5.8GHz	IEEE 802.11a	Top Side	149	Ant. 1	98.10%	1.0194	16.5	15.96	-0.16	0.349	1.13	0.403
38	5.8GHz	IEEE 802.11n20	Front Face	149	Ant. 0+1	97.81%	1.0224	15.0	14.40	-0.10	0.0654	1.15	0.077
	5.8GHz	IEEE 802.11n20	Rear Face	149	Ant. 0+1	97.81%	1.0224	15.0	14.40	0.00	0.0413	1.15	0.048
	5.8GHz	IEEE 802.11n20	Left Side	149	Ant. 0+1	97.81%	1.0224	15.0	14.40	0.03	0.106	1.15	0.124
	5.8GHz	IEEE 802.11n20	Right Side	149	Ant. 0+1	97.81%	1.0224	15.0	14.40	0.00	<0.0001	1.15	<0.001
39	5.8GHz	IEEE 802.11n20	Top Side	149	Ant. 0+1	97.81%	1.0224	15.0	14.40	0.04	0.15	1.15	0.176
	900MHz	RFID	Front Face	25	Ant. 1	64.67%	1.5463	27.5	26.81	0.12	0.258	1.17	0.302
	900MHz	RFID	Rear Face	25	Ant. 1	64.67%	1.5463	27.5	26.81	-0.09	0.732	1.17	0.858
	900MHz	RFID	Left Side	25	Ant. 1	64.67%	1.5463	27.5	26.81	0.09	0.112	1.17	0.131
	900MHz	RFID	Right Side	25	Ant. 1	64.67%	1.5463	27.5	26.81	0.15	0.141	1.17	0.165
	900MHz	RFID	Top Side	25	Ant. 1	64.67%	1.5463	27.5	26.81	-0.04	0.268	1.17	0.314
40	900MHz	RFID	Rear Face	1	Ant. 1	64.67%	1.5463	27.5	26.72	-0.05	0.81	1.20	0.969
	900MHz	RFID	Rear Face	50	Ant. 1	64.67%	1.5463	27.5	26.77	-0.03	0.783	1.18	0.926

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.

Band	Mode	Test Position	Channel	Antenna	Original Measured SAR-1g (W/kg)	1st Repeated SAR-1g (W/kg)	L/S Ratio	2nd Repeated SAR-1g (W/kg)	L/S Ratio	3rd Repeated SAR-1g (W/kg)	L/S Ratio
Head Exposure Condition											
5.3GHz	IEEE 802.11a	Right Cheek	64	Ant. 0	1.01	0.997	1.013	N/A	N/A	N/A	N/A
Body Exposure Condition											
5.3GHz	IEEE 802.11a	Rear Face	64	Ant. 0	0.904	0.859	1.052	N/A	N/A	N/A	N/A
900MHz	RFID	Rear Face	1	Ant. 1	0.807	0.783	1.020	N/A	N/A	N/A	N/A

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 SAR_{1g} of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR_{1g} 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR_{1g} is greater than the SAR limit (SAR_{1g} 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

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

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					
Mode	BT ANT 0	WLAN_SISO ANT 0	WLAN_SISO ANT 1	WLAN_MIMO ANT 0+1	RFID ANT 1
BT_ANT 0	Not support	×	√	×	√
WLAN_SISO_ANT 0	Not support	Not support	×	×	×
WLAN_SISO_ANT 1	Support	Not support	Not support	×	×
WLAN_MIMO_ANT 0+1	Not support	Not support	Not support	Not support	×
RFID_ANT 1	Support	Not support	Not support	Not support	Not support

Note:

- 1) The 2.4G WLAN and 5G WLAN cannot transmit simultaneously.
- 2) The WLAN ANT 0 and Bluetooth cannot transmit simultaneously, so there is no co-location test requirement for WLAN and Bluetooth.
- 3) The WLAN ANT 1 and RFID cannot transmit simultaneously, so there is no co-location test requirement for WLAN and Bluetooth.

4.7.3. Max. Standalone SAR

Position		2.4GHz WLAN			5GHz WLAN			BT	RFID
		Ant. 0	Ant. 1	Ant. 0 + 1	Ant. 0	Ant. 1	Ant. 0 + 1	Ant. 0	Ant. 1
Head	Right Cheek	0.187	0.104	0.133	1.302	0.294	0.505	0.030	0.997
	Right Tilted	0.108	0.068	0.079	0.634	0.399	0.38	0.017	0.672
	Left Cheek	0.057	0.356	0.157	0.853	0.232	0.283	0.010	1.369
	Left Tilted	0.034	0.176	0.110	0.791	0.223	0.277	0.010	0.834
Body-worn	Front Face	0.062	0.083	0.040	0.304	0.066	0.17	0.009	0.302
	Rear Face	0.924	0.729	0.430	1.165	0.507	0.414	0.114	0.969
Hotspot	Front Face	0.062	0.083	0.040	0.304	0.066	0.17	0.009	0.302
	Rear Face	0.924	0.729	0.430	1.165	0.507	0.414	0.114	0.969
	Left Side	0.358	--	0.217	0.849	--	0.353	0.061	0.131
	Right Side	--	0.420	0.260	--	0.169	0.059	--	0.165
	Top Side	0.066	0.080	0.063	0.301	0.403	0.19	0.008	0.314
	Bottom Side	--	--	--	--	--	--	--	--

4.7.4. Sum of SAR

WLAN (ANT 1) or RFID (ANT 1) + BT (ANT 0)

Position		Highest Simultaneous Transmission SAR	2.4GHz WLAN			5GHz WLAN			RFID
			Ant. 0	Ant. 1	Ant. 0 + 1	Ant. 0	Ant. 1	Ant. 0 + 1	Ant. 1
Head	Right Cheek	1.379	0.187	0.134	0.133	1.302	0.324	0.505	1.027
	Right Tilted		0.108	0.085	0.079	0.634	0.416	0.380	0.689
	Left Cheek		0.057	0.366	0.157	0.853	0.242	0.283	1.379
	Left Tilted		0.034	0.186	0.110	0.791	0.233	0.277	0.844
Body-worn	Front Face	1.165	0.062	0.092	0.040	0.304	0.075	0.170	0.311
	Rear Face		0.924	0.843	0.430	1.165	0.621	0.414	1.083
Hotspot	Front Face	1.165	0.062	0.092	0.040	0.304	0.075	0.170	0.311
	Rear Face		0.924	0.843	0.430	1.165	0.621	0.414	1.083
	Left Side		0.358	0.061	0.217	0.849	0.061	0.353	0.192
	Right Side		--	0.420	0.260	--	0.169	0.059	0.165
	Top Side		0.066	0.088	0.063	0.301	0.411	0.190	0.322
	Bottom Side		--	--	--	--	--	--	--

*** End of Report ***

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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.

