FCC SAR Test Report

APPLICANT	:	Zebra Technologies Corporation
EQUIPMENT	:	Personal Shopper
BRAND NAME	:	ZEBRA
MODEL NAME	:	PS30JP
FCC ID	:	UZ7PS30JP
STANDARD	:	FCC 47 CFR PART 2 (2.1093)

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Approved by: Si Zhang

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA3D0816	Rev. 01	Initial issue of report.	Feb. 19, 2024

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Zebra Technologies Corporation, Personal Shopper, PS30JP,** are as follows.

Highest 1g SAR Summary					
Equipment Class	Frequency Band		Hotspot (Separation 10mm)	Body (Separation 0mm)	Highest Simultaneous Transmission 1g SAR (W/kg)
			1g SAR (W/kg)		
DTS	WLAN	2.4GHz WLAN	**0.63**	**0.48**	0.73
NII		5GHz WLAN		0.24	0.73
DSS	Bluetooth	2.4GHz Bluetooth	<0.10	<0.10	0.73

Highest 10g SAR Summary				
Equipment Class	Frequency Band		Product Specific 10g SAR (W/kg) (Separation 0mm)	Highest Simultaneous Transmission 10g SAR (W/kg)
NII	WLAN	5GHz WLAN	**2.94**	2.94
Date of Testing:			2024/1/6 ~ 2024/1/15	

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Product Specific 10g SAR) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR03-KS	CN1257	314309

Applicant	
Company Name	Zebra Technologies Corporation
Address	1 Zebra Plaza, Holtsville, NY 11742

Manufacturer	
Company Name	Zebra Technologies Corporation
Address	1 Zebra Plaza, Holtsville, NY 11742

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Personal Shopper
Brand Name	ZEBRA
Model Name	PS30JP
FCC ID	UZ7PS30JP
S/N	233405247E0141
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz WLAN 6GHz U-NII-5: 5925 MHz ~ 6425 MHz WLAN 6GHz U-NII-6: 6425 MHz ~ 6525 MHz WLAN 6GHz U-NII-7: 6525 MHz ~ 6875 MHz WLAN 6GHz U-NII-8: 6875 MHz ~ 7125 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC: 13.56 MHz
Mode	WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac/ax VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160 WLAN 6GHz 802.11a / ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE NFC: ASK
HW Version	EV2
SW Version	13-13-11.00-TG-U00-PRD-NEM-04
MFD	13Dec23
EUT Stage	Identical Prototype

Remark:

1. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO and MIMO mode.
2. The device supports 1S2T (CDD & Tx Beamforming) mode.
3. The device support DBS (Dual Band Simultaneous) function, when the device WLAN 2.4GHz and WLAN 5GHz or WLAN 6GHz transmit at the same time the module will limit different output power for simultaneous transmission compliance.
4. This device has two batteries. For battery 1/2 only suppliers are different, so only battery 1 was chosen to perform full SAR testing.
5. This device has one soft holster, and soft holster spot check worst case to ensure the RF exposure is compliance at different exposure conditions.
6. SAR Power density test report for WLAN6GHz U-NII-5/6/7/8 will be separately submitted. About co-located SAR with WLAN/Bluetooth, always chose higher SAR of WLAN5G U-NII-1/2A/2C/3 and WLAN6G U-NII-5/6/7/8.
7. This device has NFC function and the NFC SAR report will be separately submitted.
8. This device 5GHz/6GHz WLAN not support hotspot operation.

Specification of Accessory				
Battery 1	**Brand Name**	Zebra	**Part Number**	BT-000355-0020
Battery 2	**Brand Name**	Zebra	**Part Number**	BT-000355-5020

Supported Unit used in test configuration and system				
1-slot cradle	**Brand Name**	Zebra	**Part Number**	CRD-MC18-1SLOT-01
Adapter	**Brand Name**	Zebra	**Part Number**	PWR-BGA12V108W0WW
Programming USB cable	**Brand Name**	Zebra	**Part Number**	CBL-PS30-USBCHG-01
Soft Holster	**Brand Name**	Zebra	**Part Number**	SG-PS20-SFTHLT-01

5. RF Exposure Limits

5.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

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

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram 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.

6. Specific Absorption Rate (SAR)

6.1 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. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

6.2 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:

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

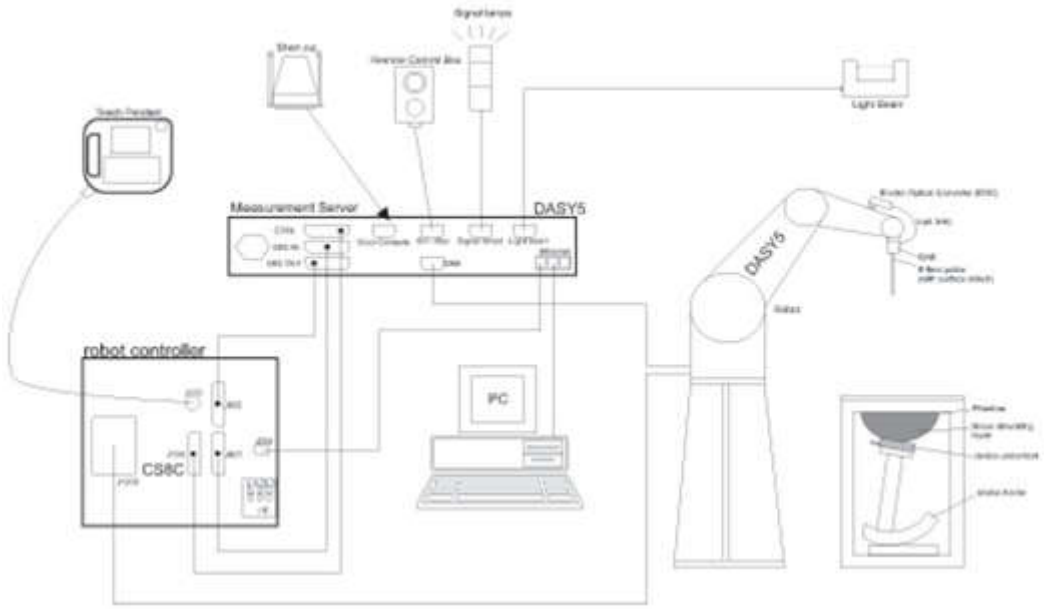
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

7. System Description and Setup

The DASY system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

7.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).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. This probe has a built in optical surface detection system to prevent from collision with phantom.

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)
Directivity	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 µW/g – >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

7.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Photo of DAE

7.3 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm

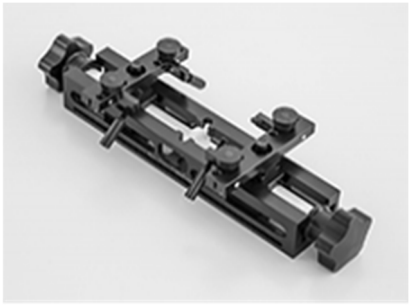
The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices or for evaluating transmitters operating at low frequencies. ELI is fully compatible with standard and all known tissue simulating liquids.

7.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

8. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

8.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

8.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

8.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><td></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td>Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">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.</td></tr>
</table>

8.4 Zoom Scan

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

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

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

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

8.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	1040	2023/4/25	2024/4/24
SPEAG	5000MHz System Validation Kit	D5GHzV2	1113	2022/9/23	2025/9/22
SPEAG	Data Acquisition Electronics	DAE4	1279	2023/6/7	2024/6/6
SPEAG	Dosimetric E-Field Probe	EX3DV4	7764	2023/10/5	2024/10/4
SPEAG	SAM Twin Phantom	SAM Twin	TP-1697	NCR	NCR
Testo	Thermo-Hygrometer	608-H1	1241332126	2023/7/10	2024/7/9
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	2023/7/5	2024/7/4
SPEAG	Dielectric Probe Kit	DAK-3.5	1144	2023/8/17	2024/8/16
Anritsu	Vector Signal Generator	MG3710A	6201682672	2024/1/2	2025/1/1
Rohde & Schwarz	Power Meter	NRVD	102081	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2023/7/5	2024/7/4
R&S	BLUETOOTH TESTER	CBT	101246	2023/5/15	2024/5/14
Rohde & Schwarz	Spectrum Analyzer	FSV7	101631	2023/10/11	2024/10/10
TES	DIGITAC THERMOMETER	1310	220305411	2023/7/8	2024/7/7
ARRA	Power Divider	A3200-2	N/A	Note 1	
MCL	Attenuation1	BW-S10W5+	N/A	Note 1	
MCL	Attenuation2	BW-S10W5+	N/A	Note 1	
MCL	Attenuation3	BW-S10W5+	N/A	Note 1	
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	Note 1	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	Note 1	
Agilent	Dual Directional Coupler	778D	20500	Note 1	
Agilent	Dual Directional Coupler	11691D	MY48151020	Note 1	

Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check
2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.

10. System Verification

10.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 12.2.

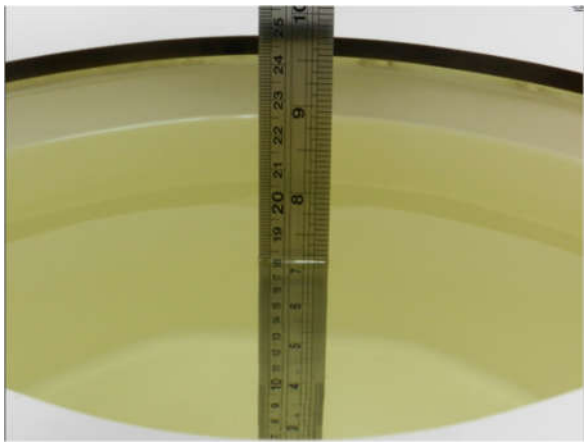


Fig 12.2 Photo of Liquid Height for Body SAR

10.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For Head								
2450	55.0	0	0	0	0	45.0	1.80	39.2

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	Head	22.6	1.873	40.835	1.80	39.20	4.06	4.17	±5	2024/1/6
5250	Head	22.9	4.575	36.286	4.71	35.90	-2.87	1.08	±5	2024/1/9
5600	Head	22.9	4.952	35.732	5.07	35.50	-2.33	0.65	±5	2024/1/12
5750	Head	22.7	5.134	35.562	5.22	35.40	-1.65	0.46	±5	2024/1/15

10.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

<1g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2024/1/6	2450	Head	50	1040	7764	1279	2.490	52.70	49.8	-5.50
2024/1/9	5250	Head	50	1113	7764	1279	4.120	81.50	82.4	1.10
2024/1/12	5600	Head	50	1113	7764	1279	4.310	82.60	86.2	4.36
2024/1/15	5750	Head	50	1113	7764	1279	3.990	80.80	79.8	-1.24

<10g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2024/1/6	2450	Head	50	1040	7764	1279	1.180	24.60	23.6	-4.07
2024/1/9	5250	Head	50	1113	7764	1279	1.190	23.30	23.8	2.15
2024/1/12	5600	Head	50	1113	7764	1279	1.230	23.70	24.6	3.80
2024/1/15	5750	Head	50	1113	7764	1279	1.140	23.00	22.8	-0.87

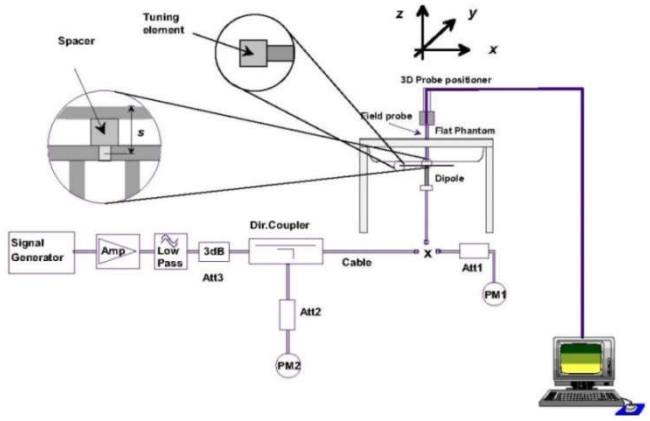


Fig 12.3.1 System Performance Check Setup

Fig 12.3.2 Setup Photo

11. RF Exposure Positions

11.1 Body Device

(a) To position the device parallel to the phantom surface with all surfaces of the device.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 5mm.

11.2 Product Specific 10g SAR Exposure

(a) The device shall be placed directly against the flat phantom, for those sides of the device that are in contact with the hand during intended use.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 0 cm.

11.3 Wireless Router

Some battery-operated handsets have the capability to transmit and receive user through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10mm from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges, determined form general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

12. Conducted RF Output Power (Unit: dBm)

<WLAN Conducted Power>

General Note:

1. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures. For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration. Additional output power measurements were not necessary.
2. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
3. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
4. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, 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 for each frequency band.
5. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
   a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
   b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
6. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
7. 802.11 ax supports both full tone size mode and partial tone size mode, after verification on partial tone size mode that partial size tone mode power will not be higher than full tone size mode, therefore, full tone mode power was chosen to be measured in this report.
8. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO and MIMO mode.
9. For WLAN SISO & MIMO(CDD) &TX Beamforming mode of 802.11ax, and WLAN SISO & TX Beamforming mode is not greater than WLAN MIMO(CDD) mode, so conducted power of WLAN SISO &Tx Beamforming mode is not required.

<2.4GHz WLAN>

2.4GHz WLAN				Ant 0		Ant 1		Ant 0+1		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	21.40	21.50	21.00	21.50	24.21	24.50	98.22
		6	2437	21.30	21.50	20.80	21.50	24.07	24.50	
		11	2462	21.40	21.50	21.20	21.50	24.31	24.50	
	802.11g 6Mbps	1	2412	22.40	22.50	22.10	22.50	25.26	25.50	99.24
		6	2437	22.20	22.50	21.80	22.50	25.01	25.50	
		11	2462	21.70	22.00	21.40	22.00	24.56	25.00	
	802.11n-HT20 MCS0	1	2412	22.10	22.50	21.70	22.50	24.91	25.50	99.70
		6	2437	22.20	22.50	22.00	22.50	25.11	25.50	
		11	2462	21.30	21.50	21.10	21.50	24.21	24.50	
	802.11n-HT40 MCS0	3	2422	20.60	21.00	20.70	21.00	23.66	24.00	99.69
		6	2437	14.70	15.50	15.20	15.50	17.97	18.50	
		9	2452	15.90	16.50	16.10	16.50	19.01	19.50	
	802.11ax-HE20 MCS0	1	2412	22.30	22.50	21.90	22.50	25.11	25.50	99.71
		6	2437	22.40	22.50	22.20	22.50	25.31	25.50	
		11	2462	21.50	22.00	21.30	22.00	24.41	25.00	
	802.11ax-HE40 MCS0	3	2422	20.80	21.00	20.90	21.00	23.86	24.00	99.61
		6	2437	14.90	15.50	15.40	15.50	18.17	18.50	
		9	2452	16.10	16.50	16.30	16.50	19.21	19.50	

<5.2GHz WLAN>

				Ant 0		Ant 1		Ant 0+1		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	18.80	19.50	19.10	19.50	21.96	22.50	99.25
		40	5200	19.20	19.50	19.40	19.50	22.31	22.50	
		44	5220	19.00	19.50	19.40	19.50	22.21	22.50	
		48	5240	18.60	19.50	19.40	19.50	22.03	22.50	
	802.11n-HT20 MCS0	36	5180	18.90	19.50	19.20	19.50	22.06	22.50	99.70
		40	5200	19.20	20.00	19.50	20.00	22.36	23.00	
		44	5220	18.90	20.00	19.50	20.00	22.22	23.00	
		48	5240	18.30	19.50	19.30	19.50	21.84	22.50	
	802.11n-HT40 MCS0	38	5190	19.80	21.00	20.80	21.00	23.34	24.00	99.70
		46	5230	19.90	21.00	20.90	21.00	23.44	24.00	
	802.11ac-VHT20 MCS0	36	5180	19.00	19.50	19.30	19.50	22.16	22.50	99.70
		40	5200	19.30	20.00	19.60	20.00	22.46	23.00	
		44	5220	19.00	21.00	19.60	21.00	22.32	23.00	
		48	5240	18.40	19.50	19.40	19.50	21.94	22.50	
	802.11ac-VHT40 MCS0	38	5190	19.90	21.00	20.90	21.00	23.44	24.00	99.63
		46	5230	20.00	21.50	21.00	21.50	23.54	24.50	
	802.11ac-VHT80 MCS0	42	5210	18.90	20.50	20.10	20.50	22.55	23.50	99.49
	802.11ax-HE20 MCS0	36	5180	19.10	19.50	19.40	19.50	22.26	22.50	99.70
		40	5200	19.40	20.00	19.70	20.00	22.56	23.00	
		44	5220	19.10	20.00	19.70	20.00	22.42	23.00	
		48	5240	18.50	20.00	19.50	20.00	22.04	23.00	
	802.11ax-HE40 MCS0	38	5190	20.00	21.50	21.00	21.50	23.54	24.50	99.67
		46	5230	20.10	21.50	21.10	21.50	23.64	24.50	
	802.11ax-HE80 MCS0	42	5210	19.00	20.50	20.20	20.50	22.65	23.50	99.38

<5.3GHz WLAN>

				Ant 0		Ant 1		Ant 0+1		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	18.30	19.00	18.80	19.00	21.57	22.00	99.25
		56	5280	18.20	19.00	18.60	19.00	21.41	22.00	
		60	5300	18.70	19.00	18.80	19.00	21.76	22.00	
		64	5320	18.60	19.00	18.20	19.00	21.41	22.00	
	802.11n-HT20 MCS0	52	5260	18.60	19.00	18.90	19.00	21.76	22.00	99.70
		56	5280	18.50	19.00	18.70	19.00	21.61	22.00	
		60	5300	18.90	19.50	19.00	19.50	21.96	22.50	
		64	5320	18.60	19.00	18.40	19.00	21.51	22.00	
	802.11n-HT40 MCS0	54	5270	20.00	21.50	21.00	21.50	23.54	24.50	99.70
		62	5310	19.50	20.00	19.20	20.00	22.36	23.00	
	802.11ac-VHT20 MCS0	52	5260	18.70	19.50	19.00	19.50	21.86	22.50	99.70
		56	5280	18.60	19.50	18.80	19.50	21.71	22.50	
		60	5300	19.00	19.50	19.10	19.50	22.06	22.50	
		64	5320	18.70	19.00	18.50	19.00	21.61	22.00	
	802.11ac-VHT40 MCS0	54	5270	20.10	21.50	21.10	21.50	23.64	24.50	99.63
		62	5310	19.60	20.00	19.30	20.00	22.46	23.00	
	802.11ac-VHT80 MCS0	58	5290	19.60	21.00	20.70	21.00	23.20	24.00	99.49
	802.11ac-VHT160 MCS0	50	5250	17.20	17.50	17.30	17.50	20.26	20.50	99.28
	802.11ax-HE20 MCS0	52	5260	18.80	19.50	19.10	19.50	21.96	22.50	99.70
		56	5280	18.70	19.50	18.90	19.50	21.81	22.50	
		60	5300	19.10	19.50	19.20	19.50	22.16	22.50	
		64	5320	18.80	19.50	18.60	19.50	21.71	22.50	
	802.11ax-HE40 MCS0	54	5270	20.20	21.50	21.20	21.50	23.74	24.50	99.67
		62	5310	19.70	20.00	19.40	20.00	22.56	23.00	
	802.11ax-HE80 MCS0	58	5290	19.70	21.00	20.80	21.00	23.30	24.00	99.38
	802.11ax-HE160 MCS0	50	5250	17.30	17.50	17.40	17.50	20.36	20.50	99.28

<5.5GHz WLAN>

				Ant 0		Ant 1		Ant 0+1		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	18.00	19.00	17.90	19.00	20.96	22.00	99.25
		116	5580	18.00	19.00	18.30	19.00	21.16	22.00	
		124	5620	18.10	19.00	18.30	19.00	21.21	22.00	
		132	5660	18.40	19.00	18.40	19.00	21.41	22.00	
		140	5700	18.40	19.00	18.00	19.00	21.21	22.00	
		144	5720	18.70	19.00	18.30	19.00	21.51	22.00	
	802.11n-HT20 MCS0	100	5500	18.70	19.00	18.70	19.00	21.71	22.00	99.70
		116	5580	17.90	19.00	18.30	19.00	21.11	22.00	
		124	5620	18.80	19.00	18.80	19.00	21.81	22.00	
		132	5660	19.10	19.50	18.80	19.50	21.96	22.50	
		140	5700	19.00	19.50	18.50	19.50	21.77	22.50	
		144	5720	19.00	19.50	18.40	19.50	21.72	22.50	
	802.11n-HT40 MCS0	102	5510	20.50	21.50	20.40	21.50	23.46	24.50	99.70
		110	5550	20.50	21.50	20.20	21.50	23.36	24.50	
		126	5630	20.50	21.50	20.50	21.50	23.51	24.50	
		134	5670	20.70	21.50	20.60	21.50	23.66	24.50	
		142	5710	20.70	21.50	20.20	21.50	23.47	24.50	
	802.11ac-VHT20 MCS0	100	5500	18.80	19.50	18.80	19.50	21.81	22.50	99.70
		116	5580	18.00	19.50	18.40	19.50	21.21	22.50	
		124	5620	18.90	19.50	18.90	19.50	21.91	22.50	
		132	5660	19.20	19.50	18.90	19.50	22.06	22.50	
		140	5700	19.10	19.50	18.60	19.50	21.87	22.50	
		144	5720	19.10	19.50	18.50	19.50	21.82	22.50	
	802.11ac-VHT40 MCS0	102	5510	20.60	21.50	20.50	21.50	23.56	24.50	99.63
		110	5550	20.60	21.50	20.30	21.50	23.46	24.50	
		126	5630	20.60	21.50	20.60	21.50	23.61	24.50	
		134	5670	20.80	21.50	20.70	21.50	23.76	24.50	
		142	5710	20.80	21.50	20.30	21.50	23.57	24.50	
	802.11ac-VHT80 MCS0	106	5530	20.50	21.50	21.10	21.50	23.82	24.50	99.49
		122	5610	20.70	21.50	20.90	21.50	23.81	24.50	
		138	5690	20.50	21.50	21.10	21.50	23.82	24.50	
	802.11ac-VHT160 MCS0	114	5570	19.10	19.50	19.40	19.50	22.26	22.50	99.28
	802.11ax-HE20 MCS0	100	5500	18.90	19.50	18.90	19.50	21.91	22.50	99.70
		116	5580	18.80	19.50	19.20	19.50	22.01	22.50	
		124	5620	19.00	19.50	19.00	19.50	22.01	22.50	
		132	5660	19.30	19.50	19.00	19.50	22.16	22.50	
		140	5700	19.20	19.50	18.70	19.50	21.97	22.50	
		144	5720	19.20	19.50	18.60	19.50	21.92	22.50	
	802.11ax-HE40 MCS0	102	5510	21.00	21.50	20.90	21.50	23.96	24.50	99.67
		110	5550	21.00	21.50	20.80	21.50	23.91	24.50	
		126	5630	20.70	21.50	20.70	21.50	23.71	24.50	
		134	5670	20.90	21.50	20.80	21.50	23.86	24.50	
		142	5710	20.90	21.50	20.40	21.50	23.67	24.50	
	802.11ax-HE80 MCS0	106	5530	20.60	21.50	21.20	21.50	23.92	24.50	99.38
		122	5610	20.80	21.50	21.00	21.50	23.91	24.50	
		138	5690	20.60	21.50	21.20	21.50	23.92	24.50	
	802.11ax-HE160 MCS0	114	5570	19.60	20.50	19.90	20.50	22.76	23.50	99.28

<5.8GHz WLAN>

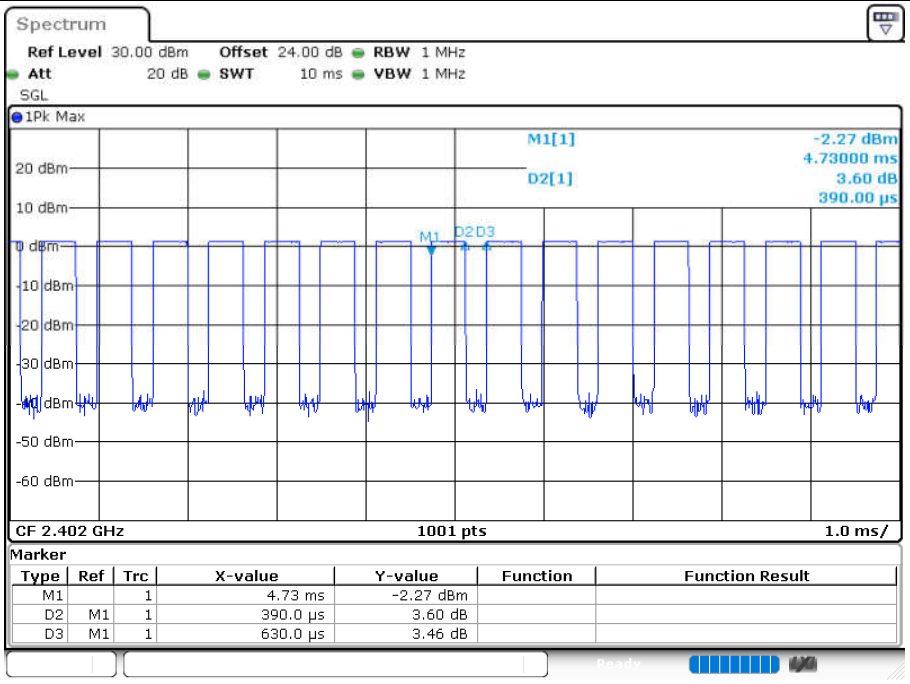
				Ant 0		Ant 1		Ant 0+1		
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	21.40	21.50	21.40	21.50	24.41	24.50	99.25
		157	5785	21.00	21.50	21.20	21.50	24.11	24.50	
		165	5825	21.30	21.50	21.20	21.50	24.26	24.50	
	802.11n-HT20 MCS0	149	5745	21.00	21.50	21.00	21.50	24.01	24.50	99.70
		157	5785	21.00	21.50	21.10	21.50	24.06	24.50	
		165	5825	21.20	21.50	21.10	21.50	24.16	24.50	
	802.11n-HT40 MCS0	151	5755	21.20	21.50	21.10	21.50	24.16	24.50	99.70
		159	5795	21.20	21.50	21.00	21.50	24.11	24.50	
	802.11ac-VHT20 MCS0	149	5745	21.10	21.50	21.10	21.50	24.11	24.50	99.70
		157	5785	21.10	21.50	21.20	21.50	24.16	24.50	
		165	5825	21.30	21.50	21.20	21.50	24.26	24.50	
	802.11ac-VHT40 MCS0	151	5755	21.30	21.50	21.20	21.50	24.26	24.50	99.63
		159	5795	21.30	21.50	21.10	21.50	24.21	24.50	
	802.11ac-VHT80 MCS0	155	5775	21.20	21.50	21.30	21.50	24.26	24.50	99.49
	802.11ax-HE20 MCS0	149	5745	21.20	21.50	21.20	21.50	24.21	24.50	99.70
		157	5785	21.20	21.50	21.30	21.50	24.26	24.50	
		165	5825	21.40	21.50	21.30	21.50	24.36	24.50	
	802.11ax-HE40 MCS0	151	5755	21.40	21.50	21.30	21.50	24.36	24.50	99.67
		159	5795	21.40	21.50	21.20	21.50	24.31	24.50	
	802.11ax-HE80 MCS0	155	5775	21.30	21.50	21.40	21.50	24.36	24.50	99.38

<2.4GHz Bluetooth>

General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps, due to its highest average power.
2. The Bluetooth duty cycle is 61.9%, Bluetooth SAR scaling need further consideration and the duty cycle is 83.3%, therefore the actual duty cycle will be scaled up to the value of Bluetooth reported SAR calculation.

Bluetooth time-domain plot



Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	3.85	3.61	3.58
	CH 39	2441	3.88	3.74	3.73
	CH 78	2480	3.99	3.85	3.81
Tune-up Limit			4.50	4.50	4.50

Mode	Channel	Frequency (MHz)	Average power (dBm)
LE_1M	CH 00	2402	4.40
	CH 19	2440	4.90
	CH 39	2480	4.90
Tune-up Limit			5.50

Mode	Channel	Frequency (MHz)	Average power (dBm)
LE_2M	CH 00	2402	4.40
	CH 19	2440	4.90
	CH 38	2480	4.90
Tune-up Limit			5.50

13. Antenna Location

The detailed antenna location information can refer to SAR Test Setup Photos in Appendix D.

14. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For SAR testing of BT signal with 83.3% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)*83.3%"
   d. For BT/WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥ 0.8W/kg. Per KDB 865664 D01v01r04, if the extremity repeated SAR is necessary, the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.
4. WLAN 5GHz tested the product specific 10g SAR since it has no hotspot mode.
5. For WLAN SISO & MIMO(CDD) &TX Beamforming mode of 802.11ax, and WLAN SISO & TX Beamforming mode is not greater than WLAN MIMO(CDD) mode, so WLAN MIMO(CDD) mode SAR covers WLAN SISO &Tx Beamforming mode SAR.

WLAN Note:

1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
2. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
3. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
4. During SAR testing the WLAN transmission was verified using a spectrum analyzer.
5. For full RU and partial tone size output power measurement, after verification for the partial tone size mode power level will not higher than full tone size power level, so chose full tone power to be measured in this report.
6. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO and MIMO mode.
7. SISO and MIMO all supported by WLAN2.4GHz/WLAN5GHz, for SISO mode power is less than per chain power of MIMO mode. For WLAN SISO & MIMO mode, the whole testing has assessed only MIMO mode by referring to their higher conducted power, so only chose MIMO power to perform SAR testing.
8. For the conducted power measurement is MIMO chains transmitting simultaneously and measured the separately conducted power for both chains and then based on the conducted power of SISO antennas respectively to calculate sum of the power for MIMO mode.

14.1 Hotspot SAR

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	Ant 0+1(1)	11	2462	21.20	21.50	1.072	98.22	1.018	-0.05	0.406	0.443
01	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 0+1(1)	11	2462	21.20	21.50	1.072	98.22	1.018	0.04	0.578	**0.630**
	WLAN2.4GHz	802.11b 1Mbps	Left Side	10mm	Ant 0+1(1)	11	2462	21.20	21.50	1.072	98.22	1.018	0.01	0.418	0.456
	WLAN2.4GHz	802.11b 1Mbps	Right Side	10mm	Ant 0+1(1)	11	2462	21.20	21.50	1.072	98.22	1.018	0.1	0.416	0.454
	BLE	1Mbps	Front	10mm	Ant 0	19	2440	4.90	5.50	1.148	61.9	1.346	0.14	0.000	0.000
02	BLE	1Mbps	Back	10mm	Ant 0	19	2440	4.90	5.50	1.148	61.9	1.346	0.05	0.003	**0.005**
	BLE	1Mbps	Left Side	10mm	Ant 0	19	2440	4.90	5.50	1.148	61.9	1.346	-0.17	0.000	0.000
	BLE	1Mbps	Right Side	10mm	Ant 0	19	2440	4.90	5.50	1.148	61.9	1.346	0.17	0.000	0.000

14.2 Body Worn Accessory SAR

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Accessories	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
03	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 0+1(1)	Soft Holster	11	2462	21.20	21.50	1.072	98.22	1.018	-0.02	0.444	**0.484**
04	BLE	1Mbps	Front	0mm	Ant 0	Soft Holster	19	2440	4.90	5.50	1.148	61.9	1.346	0.09	0.003	**0.005**
05	WLAN5.3GHz	802.11n-HT40 MCS0	Front	0mm	Ant 0+1(0)	Soft Holster	54	5270	20.00	21.50	1.413	99.7	1.003	-0.01	0.149	**0.211**
06	WLAN5.5GHz	802.11ac-VHT80 MCS0	Front	0mm	Ant 0+1(0)	Soft Holster	106	5530	20.50	21.50	1.259	99.49	1.005	0.01	0.188	**0.238**
07	WLAN5.8GHz	802.11ac-VHT80 MCS0	Front	0mm	Ant 0+1(0)	Soft Holster	155	5775	21.20	21.50	1.072	99.49	1.005	-0.02	0.188	**0.202**

14.3 Product Specific 10g SAR

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	WLAN5.3GHz	802.11n-HT40 MCS0	Front	0mm	Ant 0+1(0)	54	5270	20.00	21.50	1.413	99.7	1.003	-0.17	0.231	0.327
	WLAN5.3GHz	802.11n-HT40 MCS0	Back	0mm	Ant 0+1(0)	54	5270	20.00	21.50	1.413	99.7	1.003	-0.03	1.52	2.153
	WLAN5.3GHz	802.11n-HT40 MCS0	Back	0mm	Ant 0+1(1)	62	5310	19.20	20.00	1.202	99.7	1.003	0.01	1.39	1.676
08	WLAN5.3GHz	802.11n-HT40 MCS0	Left Side	0mm	Ant 0+1(0)	54	5270	20.00	21.50	1.413	99.7	1.003	0.03	2.05	**2.904**
	WLAN5.3GHz	802.11n-HT40 MCS0	Left Side	0mm	Ant 0+1(1)	62	5310	19.20	20.00	1.202	99.7	1.003	0.09	1.94	2.339
	WLAN5.3GHz	802.11n-HT40 MCS0	Right Side	0mm	Ant 0+1(0)	54	5270	20.00	21.50	1.413	99.7	1.003	0.14	1.83	2.593
	WLAN5.3GHz	802.11n-HT40 MCS0	Right Side	0mm	Ant 0+1(1)	62	5310	19.20	20.00	1.202	99.7	1.003	-0.03	1.76	2.122
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Front	0mm	Ant 0+1(0)	106	5530	20.50	21.50	1.259	99.49	1.005	-0.08	0.276	0.349
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Back	0mm	Ant 0+1(0)	106	5530	20.50	21.50	1.259	99.49	1.005	-0.08	0.591	0.748
09	WLAN5.5GHz	802.11ac-VHT80 MCS0	Left Side	0mm	Ant 0+1(0)	106	5530	20.50	21.50	1.259	99.49	1.005	0.08	2.32	**2.935**
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Left Side	0mm	Ant 0+1(0)	122	5610	20.70	21.50	1.202	99.49	1.005	0.1	1.59	1.921
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Left Side	0mm	Ant 0+1(0)	138	5690	20.50	21.50	1.259	99.49	1.005	-0.18	2.19	2.771
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Right Side	0mm	Ant 0+1(0)	106	5530	20.50	21.50	1.259	99.49	1.005	0.1	2.12	2.682
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Right Side	0mm	Ant 0+1(0)	122	5610	20.70	21.50	1.202	99.49	1.005	0.12	1.64	1.982
	WLAN5.5GHz	802.11ac-VHT80 MCS0	Right Side	0mm	Ant 0+1(0)	138	5690	20.50	21.50	1.259	99.49	1.005	0.08	1.96	2.480
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Front	0mm	Ant 0+1(0)	155	5775	21.20	21.50	1.072	99.49	1.005	0.08	0.365	0.393
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Back	0mm	Ant 0+1(0)	155	5775	21.20	21.50	1.072	99.49	1.005	0.01	2.11	2.272
10	WLAN5.8GHz	802.11ac-VHT80 MCS0	Left Side	0mm	Ant 0+1(0)	155	5775	21.20	21.50	1.072	99.49	1.005	-0.06	2.70	**2.908**
	WLAN5.8GHz	802.11ac-VHT80 MCS0	Right Side	0mm	Ant 0+1(0)	155	5775	21.20	21.50	1.072	99.49	1.005	0.03	2.21	2.380

14.4 Repeated SAR Measurement

<10g>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Ratio	Reported 10g SAR (W/kg)
1st	WLAN5.3GHz	802.11n-HT40 MCS0	Left Side	0mm	Ant 0+1(0)	54	5270	20.00	21.50	1.413	99.7	1.003	0.03	2.05	1	2.904
2nd	WLAN5.3GHz	802.11n-HT40 MCS0	Left Side	0mm	Ant 0+1(0)	54	5270	20.00	21.50	1.413	99.7	1.003	0.01	1.99	1.030	2.819
1st	WLAN5.5GHz	802.11ac-VHT80 MCS0	Left Side	0mm	Ant 0+1(0)	106	5530	20.50	21.50	1.259	99.49	1.005	0.08	2.32	1	2.935
2nd	WLAN5.5GHz	802.11ac-VHT80 MCS0	Left Side	0mm	Ant 0+1(0)	106	5530	20.50	21.50	1.259	99.49	1.005	-0.03	2.21	1.050	2.796
1st	WLAN5.8GHz	802.11ac-VHT80 MCS0	Left Side	0mm	Ant 0+1(0)	155	5775	21.20	21.50	1.072	99.49	1.005	-0.06	2.70	1	2.908
2nd	WLAN5.8GHz	802.11ac-VHT80 MCS0	Left Side	0mm	Ant 0+1(0)	155	5775	21.20	21.50	1.072	99.49	1.005	0.01	2.64	1.023	2.843

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. Per KDB 865664 D01v01r04, if the extremity repeated SAR is necessary, the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.
4. The ratio is the difference in percentage between original and repeated *measured SAR*.
5. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

15. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Personal Shopper		
		Body-worn	Hotspot	Product specific 10g SAR
1.	WLAN2.4GHz + WLAN5GHz	Yes		Yes
2.	WLAN2.4GHz + WLAN6GHz	Yes		Yes
3.	WLAN5GHz+ Bluetooth	Yes		Yes
4.	WLAN6GHz+ Bluetooth	Yes		Yes
5.	WLAN2.4GHz + Bluetooth	Yes	Yes	Yes
6.	WLAN2.4GHz + WLAN5GHz + Bluetooth	Yes		Yes
7.	WLAN2.4GHz + WLAN6GHz + Bluetooth	Yes		Yes
8.	WLAN2.4GHz + WLAN5GHz+NFC			Yes
9.	WLAN2.4GHz + WLAN6GHz+NFC			Yes
10.	WLAN5GHz+ Bluetooth + NFC			Yes
11.	WLAN6GHz+ Bluetooth + NFC			Yes
12.	WLAN2.4GHz + Bluetooth + NFC			Yes
13.	WLAN2.4GHz + WLAN5GHz + Bluetooth + NFC			Yes
14.	WLAN2.4GHz + WLAN6GHz + Bluetooth + NFC			Yes

General Note:

1. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO and MIMO mode, and MIMO SAR can represent SISO SAR.
2. According to the EUT characteristic, WLAN 5GHz/6GHz and Bluetooth can transmit simultaneously.
3. According to the EUT characteristic, WLAN 5GHz/6GHz and WLAN 2.4GHz can transmit simultaneously.
4. According to the EUT characteristic, WLAN 5GHz and WLAN 6GHz cannot transmit simultaneously.
5. According to the EUT characteristic, WLAN 2.4GHz Ant1 and Bluetooth Ant0 can transmit simultaneously.
6. WLAN 2.4GHz and Bluetooth share the same antenna, and they cannot transmit simultaneously each other.
7. The worst case 5 GHz WLAN SAR for each configuration was used for SAR summation.
8. The reported SAR summation is calculated based on the same configuration and test position.
9. SAR Power density test report for WLAN6GHz U-NII-5/6/7/8 will be separately submitted with report no. FA3D0816B. About co-located SAR with WLAN/Bluetooth always chose higher SAR of WLAN5G U-NII-1/2A/2C/3 and WLAN6G U-NII-5/6/7/8.
10. For simultaneously analysis, since the SAR summation of 3 transmitters can cover others combination of 2 transmitters, therefore in this section did not additional to evaluate 2TX combination of simultaneously transmission.
11. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
    i) 1g Scalar SAR summation < 1.6W/kg and 10g Scalar SAR summation < 4.0W/kg.
    ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
    iii) If SPLSR ≤ 0.04 for 1g SAR and SPLSR≤ 0.10 for 10g SAR , simultaneously transmission SAR measurement is not necessary.
    iv) Simultaneously transmission SAR measurement, and the reported multi-band 1g SAR < 1.6W/kg and 10g SAR < 4.0W/kg.
12. The WLAN6GHz Sim-Tx analysis guidance with other transmitters was based on SAR test results. The simultaneous transmission and test exemption analysis were compliant with KDB 447498 D01. For the device does not support FR2 or other MPE field measurement, therefore section 15 in the SAR report has no TER analysis according to KDB 987594 requirement.

15.1 Hotspot Exposure Conditions

Exposure Position	1	2	1+2
	WLAN2.4GHz Ant 0+1	Bluetooth Ant 0	Summed
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
Front	0.443		0.44
Back	0.630	0.005	0.64
Left side	0.456		0.46
Right side	0.454		0.45

15.2 Body Accessory Exposure Conditions

Exposure Position	1	2	3	4	1+2+4	1+3+4
	WLAN2.4GHz Ant 0+1	WLAN5GHz Ant 0+1	WLAN6GHz Ant 0+1	Bluetooth Ant 0	Summed	Summed
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
Front	0.484	0.238	0.040	0.005	**0.73**	0.53

Note: the SAR value of WLAN 6GHz is chose from test report FA3D0816B.

15.3 Product Specific 10g SAR Exposure Conditions

Exposure Position	1	2	3	1+3	2+3
	WLAN5GHz Ant 0+1	WLAN6GHz Ant 0+1	NFC	Summed	Summed
	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)
Front	0.393	0.032	0.036	0.43	0.07
Back	2.272	0.792	0.010	2.28	0.80
Left side	2.935	0.612	0.002	**2.94**	0.61
Right side	2.682	0.235	0.003	2.69	0.24
Top side			0.023	0.02	0.02

Note:
1. The SAR value of WLAN 6GHz is chose from test report FA3D0816B.
2. For WLAN2.4GHz/Bluetooth Product specific 10g stand-alone SAR is not required for a transmitter or antenna, due to 1g hotspot SAR is <1.2W/kg.

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16. Uncertainty Assessment

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

17. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[6] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

[7] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[8] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[9] FCC KDB 941225 D06 v02r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", Oct 2015.

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