FCC SAR TEST REPORT

FCC ID	**:**	**UZ7WS5001**
Equipment	**:**	**WS50 Wearable Computer**
Brand Name	**:**	**Zebra**
Model Name	**:**	**WS5001**
Applicant	**:**	**Zebra Technologies Corporation 1 Zebra Plaza, Holtsville, NY 11742**
Manufacturer	**:**	**Zebra Technologies Corporation 1 Zebra Plaza, Holtsville, NY 11742**
Standard	**:**	**FCC 47 CFR Part 2 (2.1093)**

The product was received on Feb. 22, 2022 and testing was started from Mar. 09, 2022 and completed on Mar. 14, 2022. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been pass the FCC requirement.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. Laboratory, the test report shall not be reproduced except in full.

Cona Huang

Approved by: Cona Huang / Deputy Manager

ilac-MRA TAF Testing Laboratory 1190

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History of this test report

Report No.	Version	Description	Issued Date
FA1O0707-02	01	Initial issue of report	Mar. 16, 2022

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Zebra Technologies Corporation, WS50 Wearable Computer, WS5001**, are as follows.

Equipment Class	Frequency Band		Highest SAR Summary	
			Head (Separation 10mm)	Hand (Separation 0mm)
			1g SAR (W/kg)	10g SAR (W/kg)
DTS	WLAN	2.4GHz WLAN	1.09	0.80
NII		5GHz WLAN	1.19	0.44
DSS	2.4GHz Band	Bluetooth	0.03	0.03
Date of Testing:			2022/3/9 ~ 2022/3/14	

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test. This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Head 1g SAR, 4.0 W/kg for Hand 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.

Reviewed by: Jason Wang
Report Producer: Daisy Peng

2. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards, the below KDB standard may not including in the TAF code without accreditation.

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEC/IEEE 62209-1528:2020
- 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

3. Equipment Under Test (EUT) Information

3.1 General Information

Product Feature & Specification	
Equipment Name	WS50 Wearable Computer
Brand Name	Zebra
Model Name	WS5001
FCC ID	UZ7WS5001
Wireless Technology and Frequency Range	WLAN 2.4 GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2 GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3 GHz Band: 5250 MHz ~ 5350 MHz WLAN 5.6 GHz Band: 5470 MHz ~ 5725 MHz WLAN 5.8 GHz Band: 5725 MHz ~ 5850 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz NFC : 13.56 MHz
Mode	WLAN: 802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE NFC: ASK
HW Version	EV2.2
SW Version	Terminal Version:11-12-01.00-RN-U00-PRD-WTX-04
FW Version	Terminal Version:FUSION_QA_3_1.0.0.007_R
MFD	SKU1:23NOV21
	SKU3-1:14DEC21
	SKU3-2:15DEC21
	SKU5:23NOV21
EUT Stage	Identical Prototype

Remark:
1. The device has four kinds of SKU as below table. SKU1/SKU5 only difference is cover and does not affect RF characteristics, RF Exposure was perform with SKU 1.
2. SKU 1 as the main tested, and SKU 3-1/3-2 will spot check worst case found in SKU 1.
3. WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
4. This device has NFC operations, the NFC antenna is integrated into the device for this model, therefore, all SAR test were performed with the device which already incorporates the NFC antenna. A diagram showing the location of the antenna can be found in the operational description.
5. According to FCC KDB publication 447498 D01v06, transmitters are consider to be operating simultaneously when there is overlapping transmission, with the exception of transmission during network hand-offs with maximum hand-off duration less than 30 seconds.

Helix SKU	Scanner	Battery	Camera	Mounting
SKU 1	SE4770	1.6x Battery	N/A	Finger Trigger
SKU 3-1	N/A	1x Battery	Yes	Wrist Strap
SKU 3-2	N/A	1x Battery	N/A	Wrist Strap
SKU 5	SE4770	1.6x Battery	N/A	BOH

Accessories Information				
Adaptor	Brand Name	Zebra	Model Number	PWR-WUA5V12W0US
Battery 1x	Brand Name	Zebra	Model Number	BT-000446
Battery 1.6x	Brand Name	Zebra	Model Number	BT-000446B
USB charging cable with cup	Brand Name	Zebra	Model Number	CBL-WS5X-USB1-01
USB C CABLE	Brand Name	Zebra	Model Number	CBL-TC2X-USBC-01

Support unit				
Converged Scanner Shell	Brand Name	Zebra	Part Number	SG-WS5X-SHLCS-01
Replacement Finger Trigger for Converged	Brand Name	Zebra	Part Number	SG-WS5X-TRGA-01
Wrist Shell	Brand Name	Zebra	Part Number	SG-WS5X-SHLWR-01
Wrist Strap	Brand Name	Zebra	Part Number	SG-WS5X-WSTRP-01
Wrist Mount (without strap)	Brand Name	Zebra	Part Number	SG-WS5X-WSTMT-01
Wrist Mount with strap	Brand Name	Zebra	Part Number	SG-WS5X-WPLTS-01
Back of Hand Mount for Converged	Brand Name	Zebra	Part Number	SG-WS5X-BHMT-01

4. RF Exposure Limits

4.1 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.

4.2 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

1. 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.

5. Specific Absorption Rate (SAR)

5.1 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.

5.2 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:

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

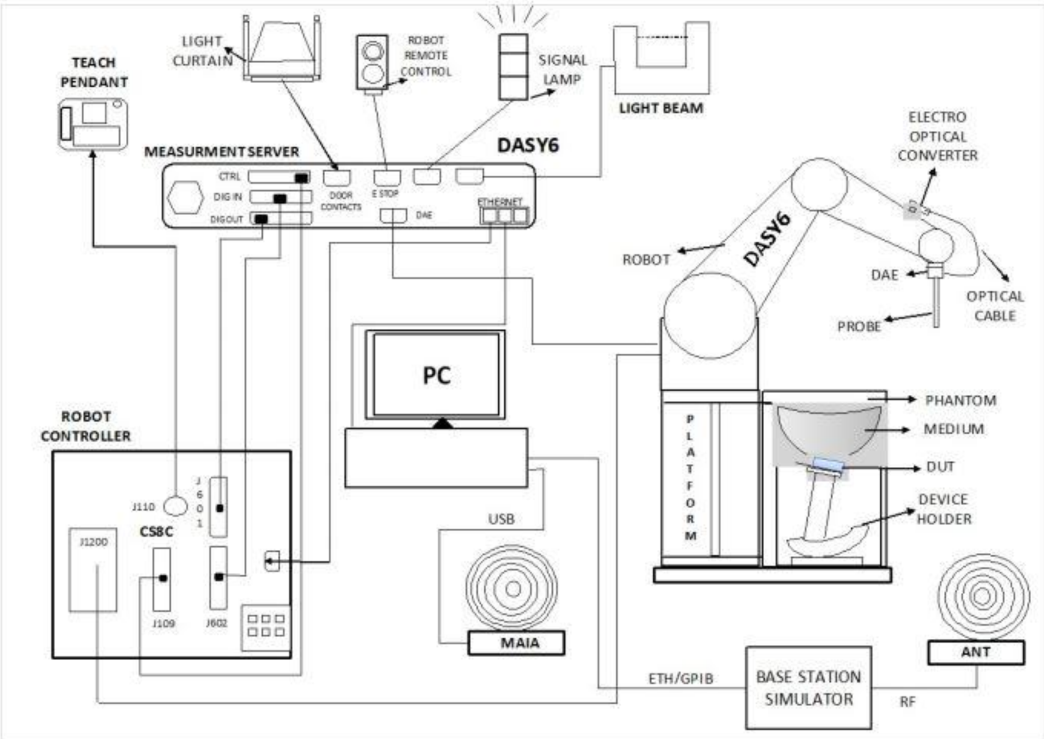
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

6. System Description and Setup

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



- The DASY system in DASY6/DASY5 V5.2 SAR Configuration is shown above
- 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 windows software and the DASY5/DASY6 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.

6.1 Test Site Location

The SAR measurement facilities used to collect data are within both Sporton Lab list below test site location are accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190 and 3786) and the FCC designation No. TW1190 and TW3786 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

Test Site	EMC & Wireless Communications Laboratory		Wensan Laboratory		
Test Site Location	TW1190 No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan		TW3786 No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan		
Test Site No.	SAR01-HY	SAR03-HY	SAR08-HY	SAR09-HY	SAR15-HY
	SAR04-HY	SAR05-HY	SAR11-HY	SAR12-HY	
	SAR06-HY	SAR10-HY	SAR13-HY	SAR14-HY	

6.2 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.

<ES3DV3 Probe>

Construction	Symmetric 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 – 4 GHz; Linearity: ±0.2 dB (30 MHz – 4 GHz)	
Directivity	±0.2 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)	
Dynamic Range	5 µW/g – >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: 3.0 mm	

<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	

6.3 Data Acquisition Electronics (DAE)

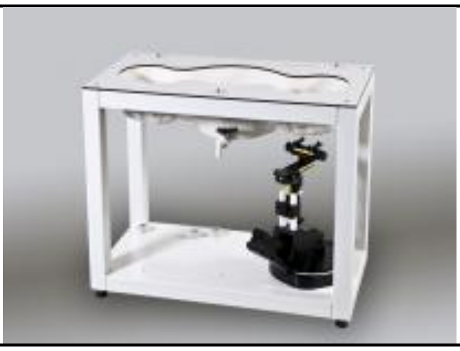
The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an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

Fig 5.1 Photo of DAE

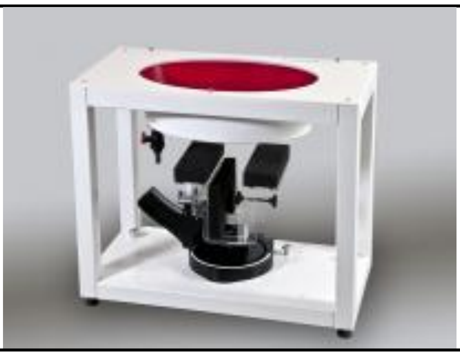
6.4 Phantom

<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 in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

6.5 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

7. 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

7.1 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

7.2 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.

7.3 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><th></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>$\frac{1}{2}\cdot\delta\cdot\ln(2) \pm 0.5$ 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>

7.4 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.

<table>
<tr><th colspan="3"></th><th>$\leq$ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">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 <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 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.</td></tr>
</table>

7.5 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.

7.6 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.

8. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit(2)	D2450V2	929	Nov. 21, 2019	Nov. 18, 2022
SPEAG	5GHz System Validation Kit	D5GHzV2	1171	Apr. 20, 2021	Apr. 19, 2022
SPEAG	Data Acquisition Electronics	DAE4	853	Jul. 14, 2021	Jul. 13, 2022
SPEAG	Data Acquisition Electronics	DAE4	1694	Nov. 03, 2021	Nov. 02, 2022
SPEAG	Dosimetric E-Field Probe	ES3DV3	3124	Nov. 23, 2021	Nov. 22, 2022
SPEAG	Dosimetric E-Field Probe	EX3DV4	7692	Nov. 03, 2021	Nov. 02, 2022
Testo	Hygro meter	608-H1	45196600	Oct. 22, 2021	Oct. 21, 2022
Testo	Hygro meter	608-H1	45207528	Oct. 22, 2021	Oct. 21, 2022
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Oct. 24, 2021	Oct. 23, 2022
Keysight	ENA Network Analyzer	E5071C	MY46104758	Sep. 19, 2021	Sep. 18, 2022
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 24, 2021	Sep. 23, 2022
LINE SEIKI	Digital Thermometer	DTM3000-spezial	2942	Oct. 26, 2021	Oct. 25, 2022
Anritsu	Power Meter	ML2495A	1419002	Aug. 18, 2021	Aug. 17, 2022
Anritsu	Power Sensor	MA2411B	1911176	Aug. 18, 2021	Aug. 17, 2022
Anritsu	Power Meter	ML2495A	1804003	Oct. 09, 2021	Oct. 08, 2022
Anritsu	Power Sensor	MA2411B	1726150	Oct. 09, 2021	Oct. 08, 2022
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jul. 16, 2021	Jul. 15, 2022
Anritsu	Spectrum Analyzer	N9010A	MY53470118	Jan. 12, 2022	Jan. 11, 2023
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 12, 2021	Oct. 11, 2022
Mini-Circuits	Power Amplifier	ZVE-8G+	479102029	Sep. 06, 2021	Sep. 05, 2022
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Warison	Directional Coupler	WCOU-10-50S-10	WR889BMC4B1	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General 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 source.
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

9. System Verification

9.1 Tissue Verification

The tissue dielectric parameters of tissue-equivalent media used for SAR measurements must be characterized within a temperature range of 18℃ to 25℃, measured with calibrated instruments and apparatuses, such as network analyzers and temperature probes. The temperature of the tissue-equivalent medium during SAR measurement must also be within 18℃ to 25℃ and within ± 2℃ of the temperature when the tissue parameters are characterized. The tissue dielectric measurement system must be calibrated before use. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements.
The liquid tissue depth was at least 15cm in the phantom for all SAR testing

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	22.5	1.810	38.900	1.80	39.20	0.56	-0.77	±5	2022/3/9
2450	22.6	1.824	39.562	1.80	39.20	1.33	0.92	±5	2022/3/14
5250	22.5	4.630	36.200	4.71	35.95	-1.70	0.70	±5	2022/3/9
5600	22.5	4.990	35.700	5.07	35.50	-1.58	0.56	±5	2022/3/9
5750	22.5	5.140	35.500	5.22	35.35	-1.53	0.42	±5	2022/3/9

9.2 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.

Test Site	Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Power Drift (dB)	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
SAR10-HY	2022/3/9	2450	50	D2450V2-929	EX3DV4 - SN7692	DAE4 Sn1694	0.01	2.460	53.10	49.2	-7.34
SAR3-HY	2022/3/14	2450	50	D2450V2-929	ES3DV3 - SN3124	DAE4 Sn853	0.10	2.730	53.10	54.6	2.82
SAR10-HY	2022/3/9	5250	50	D5GHzV2-1171-5250	EX3DV4 - SN7692	DAE4 Sn1694	0.01	3.620	80.30	72.4	-9.84
SAR10-HY	2022/3/9	5600	50	D5GHzV2-1171-5600	EX3DV4 - SN7692	DAE4 Sn1694	0	3.980	83.40	79.6	-4.56
SAR10-HY	2022/3/9	5750	50	D5GHzV2-1171-5750	EX3DV4 - SN7692	DAE4 Sn1694	0.01	3.650	80.40	73	-9.20

Test Site	Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Power Drift (dB)	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
SAR10-HY	2022/3/9	2450	50	D2450V2-929	EX3DV4 - SN7692	DAE4 Sn1694	0.01	1.130	24.70	22.6	-8.50
SAR3-HY	2022/3/14	2450	50	D2450V2-929	ES3DV3 - SN3124	DAE4 Sn853	0.10	1.290	24.70	25.8	4.45
SAR10-HY	2022/3/9	5250	50	D5GHzV2-1171-5250	EX3DV4 - SN7692	DAE4 Sn1694	0.01	1.050	23.00	21	-8.70
SAR10-HY	2022/3/9	5600	50	D5GHzV2-1171-5600	EX3DV4 - SN7692	DAE4 Sn1694	0	1.130	23.70	22.6	-4.64
SAR10-HY	2022/3/9	5750	50	D5GHzV2-1171-5750	EX3DV4 - SN7692	DAE4 Sn1694	0.01	1.040	22.80	20.8	-8.77

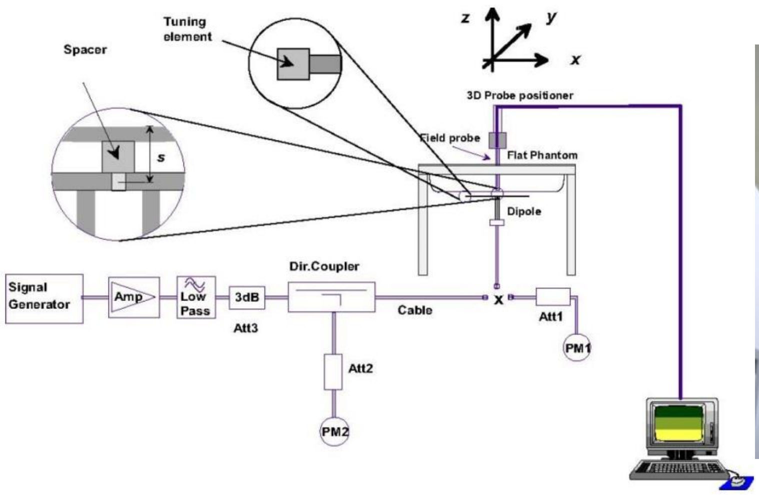


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

10. WiFi/Bluetooth Output Power (Unit: dBm)

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.
    c. 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.

<2.4GHz WLAN>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	21.70	22.00	98.40
		6	2437	21.00	22.00	
		11	2462	20.60	22.00	
	802.11g 6Mbps	1	2412	20.10	21.50	91.10
		6	2437	22.00	22.00	
		11	2462	19.60	21.50	
	802.11n-HT20 MCS0	1	2412	20.00	20.00	90.50
		6	2437	19.90	20.00	
		11	2462	19.20	20.00	
	802.11n-HT40 MCS0	3	2422	18.70	20.50	99.20
		6	2437	20.30	20.50	
		9	2452	17.60	18.00	
	802.11ac-VHT20 MCS0	1	2412	19.90	20.00	99.20
		6	2437	19.80	20.00	
		11	2462	19.10	19.50	
	802.11ac-VHT40 MCS0	3	2422	18.60	19.50	98.40
		6	2437	20.20	20.50	
		9	2452	17.50	19.50	

<5GHz WLAN>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	21.50	21.50	91.10
		40	5200	21.20	21.50	
		44	5220	20.80	21.50	
		48	5240	20.30	21.50	
	802.11n-HT20 MCS0	36	5180	19.90	21.50	90.50
		40	5200	20.00	21.50	
		44	5220	20.90	21.50	
		48	5240	20.30	21.50	
	802.11n-HT40 MCS0	38	5190	18.80	19.50	99.40
		46	5230	21.00	21.50	
	802.11ac-VHT20 MCS0	36	5180	19.80	20.50	99.40
		40	5200	19.90	20.50	
		44	5220	20.80	21.50	
		48	5240	20.20	20.50	
	802.11ac-VHT40 MCS0	38	5190	18.70	20.50	98.80
		46	5230	20.90	21.00	
	802.11ac-VHT80 MCS0	42	5210	16.10	16.50	97.50

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	20.50	21.50	91.10
		56	5280	20.30	21.50	
		60	5300	20.10	21.50	
		64	5320	20.60	21.50	
	802.11n-HT20 MCS0	52	5260	20.20	21.50	90.50
		56	5280	20.00	21.50	
		60	5300	20.10	21.50	
		64	5320	20.10	21.50	
	802.11n-HT40 MCS0	54	5270	21.10	21.50	99.40
		62	5310	19.10	19.50	
	802.11ac-VHT20 MCS0	52	5260	20.10	20.50	99.40
		56	5280	19.90	20.50	
		60	5300	20.00	20.50	
		64	5320	20.00	20.50	
	802.11ac-VHT40 MCS0	54	5270	21.00	21.50	98.80
		62	5310	19.00	20.50	
	802.11ac-VHT80 MCS0	58	5290	19.10	20.50	97.50

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	21.30	21.50	91.10
		116	5580	21.20	21.50	
		124	5620	21.00	21.50	
		132	5660	20.60	21.50	
		144	5720	21.30	21.50	
	802.11n-HT20 MCS0	100	5500	21.40	21.50	90.50
		116	5580	21.30	21.50	
		124	5620	21.00	21.50	
		132	5660	20.10	21.50	
		144	5720	21.40	21.50	
	802.11n-HT40 MCS0	102	5510	18.20	18.50	99.40
		110	5550	21.10	21.50	
		126	5630	21.00	21.50	
		134	5670	21.10	21.50	
		142	5710	21.10	21.20	
	802.11ac-VHT20 MCS0	100	5500	21.30	21.50	99.40
		116	5580	21.20	21.50	
		124	5620	20.90	21.00	
		132	5660	20.00	20.50	
		144	5720	21.30	21.50	
	802.11ac-VHT40 MCS0	102	5510	18.10	18.50	98.80
		110	5550	21.00	21.50	
		126	5630	20.90	21.50	
		134	5670	21.00	21.50	
		142	5710	21.00	21.20	
	802.11ac-VHT80 MCS0	106	5530	19.50	20.50	97.50
		122	5610	20.10	20.50	
		138	5690	20.30	20.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	19.80	20.00	91.10
		157	5785	19.70	20.00	
		165	5825	19.60	20.00	
	802.11n-HT20 MCS0	149	5745	19.60	20.00	90.50
		157	5785	19.70	20.00	
		165	5825	19.70	20.00	
	802.11n-HT40 MCS0	151	5755	19.60	20.00	99.40
		159	5795	19.60	20.00	
	802.11ac-VHT20 MCS0	149	5745	19.50	20.00	99.40
		157	5785	19.60	20.00	
		165	5825	19.60	20.00	
	802.11ac-VHT40 MCS0	151	5755	19.80	20.00	98.80
		159	5795	19.80	20.00	
	802.11ac-VHT80 MCS0	155	5775	19.80	20.00	97.50

<2.4GHz Bluetooth>

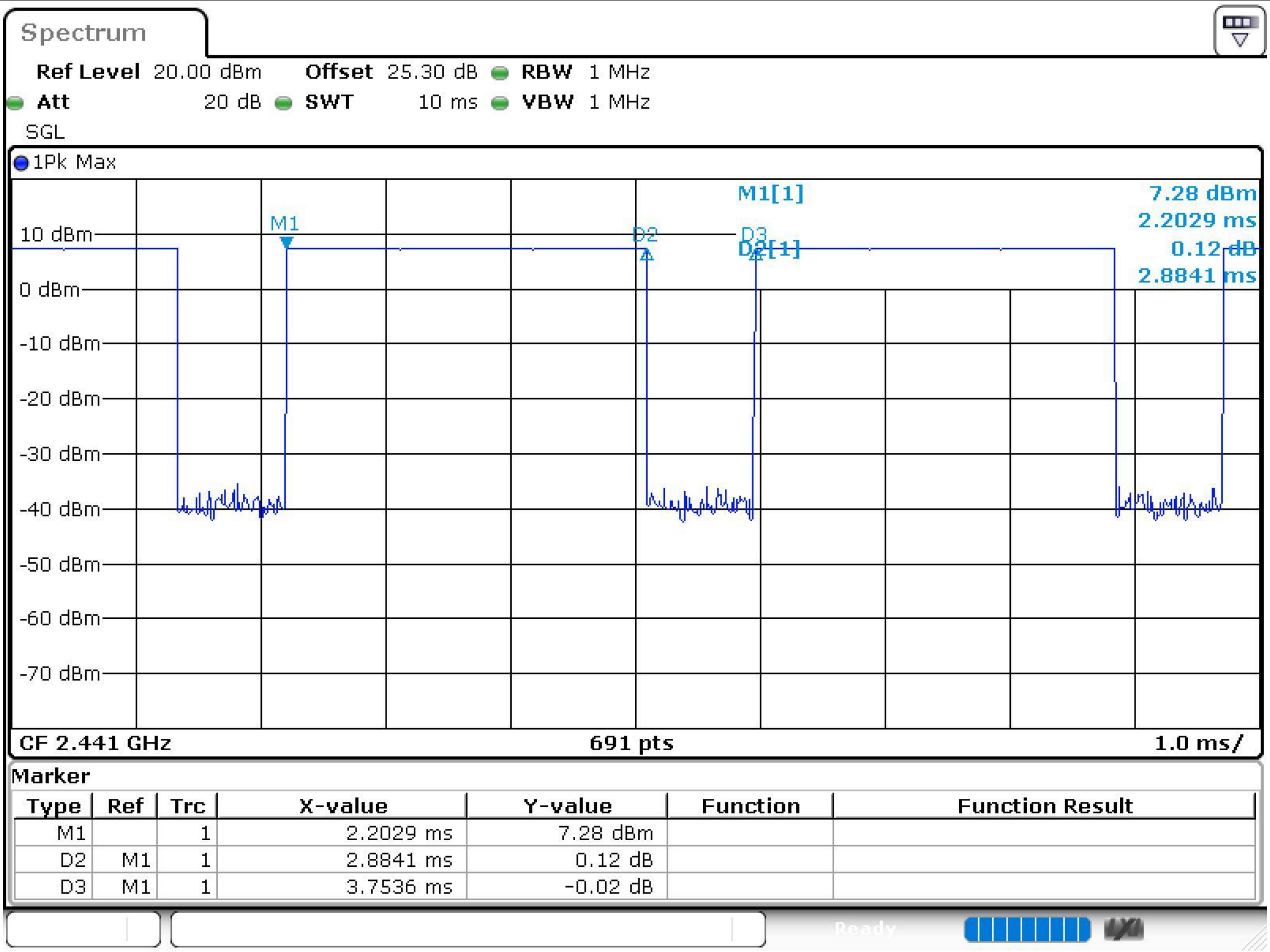
General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps due to its highest average power and duty cycle is 77.22% considered in SAR testing, and the duty cycle would be scaled to theoretical 83.3% in reported SAR calculation.

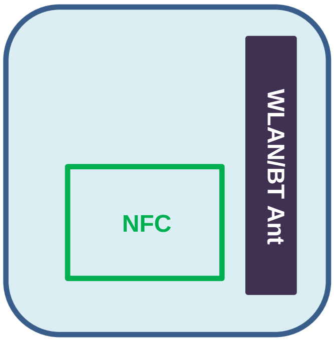
Mode	Channel	Frequency (MHz)	Average power (dBm)			Tune up limit (dBm)		
			1Mbps	2Mbps	3Mbps	1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	5.38	3.13	3.36	6	4	4
	CH 39	2441	6.01	3.57	3.65	6.5	4	4
	CH 78	2480	4.38	2.81	2.98	5	4	4

Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune up limit (dBm)
			GFSK	GFSK
LE	CH 00	2402	5.10	6.00
	CH 19	2440	5.90	6.00
	CH 39	2480	4.80	6.00

BT Duty cycle



11. Antenna Location



Back View

12. 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 WLAN/Bluetooth: 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 only when the measured SAR is ≥0.8W/kg.

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. Per KDB 248227 D01v02r02, WLAN5.2GHz SAR testing is not required when the WLAN5.3GHz band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for WLAN5.2GHz band.
3. 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.
4. 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.
5. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

12.1 Head SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	SKU	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	1	2412	SKU 1	21.70	22.00	1.072	98.4	1.016	-0.06	0.734	0.799
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	6	2437	SKU 1	21.00	22.00	1.259	98.4	1.016	-0.07	0.735	0.940
01	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	11	2462	SKU 1	20.60	22.00	1.380	98.4	1.016	0.07	0.776	1.088
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	11	2462	SKU 3-2	20.60	22.00	1.380	98.4	1.016	0.05	0.560	0.785
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	11	2462	SKU 3-1	20.60	22.00	1.380	98.4	1.016	-0.05	0.486	0.682
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	54	5270	SKU 1	21.10	21.50	1.096	99.4	1.006	-0.08	0.487	0.537
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	62	5310	SKU 1	19.10	19.50	1.096	99.4	1.006	-0.09	0.322	0.355
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	54	5270	SKU 3-2	21.10	21.50	1.096	99.4	1.006	-0.03	0.528	0.582
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	62	5310	SKU 3-2	19.10	19.50	1.096	99.4	1.006	-0.05	0.301	0.332
02	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	54	5270	SKU 3-1	21.10	21.50	1.096	99.4	1.006	-0.13	0.595	0.656
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	62	5310	SKU 3-1	19.10	19.50	1.096	99.4	1.006	0.14	0.348	0.384
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	110	5550	SKU 1	21.10	21.50	1.096	99.4	1.006	0	0.866	0.955
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	102	5510	SKU 1	18.20	18.50	1.072	99.4	1.006	-0.07	0.748	0.806
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	126	5630	SKU 1	21.00	21.50	1.122	99.4	1.006	-0.06	1.040	1.174
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	134	5670	SKU 1	21.10	21.50	1.096	99.4	1.006	-0.09	1.030	1.136
03	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	142	5710	SKU 1	21.10	21.20	1.023	99.4	1.006	-0.12	1.150	1.184
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	142	5710	SKU 3-2	21.10	21.20	1.023	99.4	1.006	-0.08	0.543	0.559
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	142	5710	SKU 3-1	21.10	21.20	1.023	99.4	1.006	0	0.661	0.680
	WLAN5GHz	802.11ac-VHT80 MCS0	Front	10mm	155	5775	SKU 1	19.80	20.00	1.047	97.5	1.026	-0.09	1.020	1.096
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	151	5755	SKU 1	19.60	20.00	1.096	99.4	1.006	0.15	0.994	1.096
	WLAN5GHz	802.11ac-VHT80 MCS0	Front	10mm	155	5775	SKU 3-2	19.80	20.00	1.047	97.5	1.026	-0.1	1.030	1.107
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	151	5755	SKU 3-2	19.60	20.00	1.096	99.4	1.006	0.08	0.987	1.089
04	WLAN5GHz	802.11ac-VHT80 MCS0	Front	10mm	155	5775	SKU 3-1	19.80	20.00	1.047	97.5	1.026	0.01	1.110	1.193
	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	151	5755	SKU 3-1	19.60	20.00	1.096	99.4	1.006	-0.12	0.958	1.057

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	SKU	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)
05	Bluetooth	1Mbps	Front	10mm	39	2441	SKU 1	6.01	6.50	1.119	77.22	1.079	-0.01	0.023	0.028
	Bluetooth	1Mbps	Front	10mm	0	2402	SKU 1	5.38	6.00	1.153	77.22	1.079	-0.04	0.020	0.025
	Bluetooth	1Mbps	Front	10mm	78	2480	SKU 1	4.38	5.00	1.153	77.22	1.079	0.08	0.021	0.026
	Bluetooth	1Mbps	Front	10mm	39	2441	SKU 3-2	6.01	6.50	1.119	77.22	1.079	0.05	0.019	0.023
	Bluetooth	1Mbps	Front	10mm	39	2441	SKU 3-1	6.01	6.50	1.119	77.22	1.079	-0.02	0.020	0.024

12.2 Hand SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	SKU	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)
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	1	2412	SKU 1	21.70	22.00	1.072	98.4	1.016	-0.08	0.490	0.533
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	6	2437	SKU 1	21.00	22.00	1.259	98.4	1.016	0	0.458	0.586
06	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	11	2462	SKU 1	20.60	22.00	1.380	98.4	1.016	0.02	0.571	0.801
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	11	2462	SKU 3-2	20.60	22.00	1.380	98.4	1.016	-0.05	0.502	0.704
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	11	2462	SKU 3-1	20.60	22.00	1.380	98.4	1.016	-0.09	0.510	0.715
07	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	54	5270	SKU 1	21.10	21.50	1.096	99.4	1.006	-0.03	0.338	0.373
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	62	5310	SKU 1	19.10	19.50	1.096	99.4	1.006	-0.02	0.222	0.245
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	54	5270	SKU 3-2	21.10	21.50	1.096	99.4	1.006	-0.03	0.200	0.221
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	54	5270	SKU 3-1	21.10	21.50	1.096	99.4	1.006	0	0.149	0.164
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	110	5550	SKU 1	21.10	21.50	1.096	99.4	1.006	-0.02	0.192	0.212
08	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	102	5510	SKU 1	18.20	18.50	1.072	99.4	1.006	-0.1	0.213	0.230
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	126	5630	SKU 1	21.00	21.50	1.122	99.4	1.006	-0.02	0.191	0.216
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	134	5670	SKU 1	21.10	21.50	1.096	99.4	1.006	-0.09	0.206	0.227
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	142	5710	SKU 1	21.10	21.20	1.023	99.4	1.006	-0.07	0.174	0.179
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	102	5510	SKU 3-2	18.20	18.50	1.072	99.4	1.006	-0.03	0.039	0.042
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	102	5510	SKU 3-1	18.20	18.50	1.072	99.4	1.006	-0.1	0.030	0.032
09	WLAN5GHz	802.11ac-VHT80 MCS0	Back	0mm	155	5775	SKU 1	19.80	20.00	1.047	97.5	1.026	-0.02	0.408	0.438
	WLAN5GHz	802.11ac-VHT80 MCS0	Back	0mm	155	5775	SKU 3-2	19.80	20.00	1.047	97.5	1.026	-0.08	0.236	0.254
	WLAN5GHz	802.11ac-VHT80 MCS0	Back	0mm	155	5775	SKU 3-1	19.80	20.00	1.047	97.5	1.026	-0.08	0.194	0.208

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	SKU	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)
10	Bluetooth	1Mbps	Back	0mm	39	2441	SKU 1	6.01	6.50	1.119	77.22	1.079	0.01	0.021	0.025
	Bluetooth	1Mbps	Back	0mm	0	2402	SKU 1	5.38	6.00	1.153	77.22	1.079	-0.03	0.018	0.022
	Bluetooth	1Mbps	Back	0mm	78	2480	SKU 1	4.38	5.00	1.153	77.22	1.079	0.09	0.016	0.020
	Bluetooth	1Mbps	Back	0mm	39	2441	SKU 3-2	6.01	6.50	1.119	77.22	1.079	0.02	0.019	0.023
	Bluetooth	1Mbps	Back	0mm	39	2441	SKU 3-1	6.01	6.50	1.119	77.22	1.079	-0.11	0.016	0.019

12.3 Repeated SAR Measurement

No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	SKU	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)	Ratio	Reported 1g SAR (W/kg)
1st	WLAN5GHz	802.11ac-VHT80 MCS0	Front	10mm	58	5290	SKU 3-1	19.00	19.50	1.122	96	1.042	-0.12	1.010	-	1.181
2nd	WLAN5GHz	802.11ac-VHT80 MCS0	Front	10mm	58	5290	SKU 3-1	19.00	19.50	1.122	96	1.042	0.05	0.994	1.02	1.162
1st	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	142	5710	SKU 1	21.10	21.20	1.023	99.4	1.006	-0.12	1.150	-	1.184
2nd	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	142	5710	SKU 1	21.10	21.20	1.023	99.4	1.006	0.13	1.040	1.11	1.071
1st	WLAN5GHz	802.11ac-VHT80 MCS0	Front	10mm	155	5775	SKU 3-1	19.80	20.00	1.047	97.5	1.026	0.01	1.110	-	1.193
2nd	WLAN5GHz	802.11ac-VHT80 MCS0	Front	10mm	155	5775	SKU 3-1	19.80	20.00	1.047	97.5	1.026	0.17	1.010	1.10	1.085

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. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

Test Engineer： Bob Cheng

13. 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.
Declaration of Conformity:
The test results with all measurement uncertainty excluded is 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.

14. 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 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

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

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

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