FCC SAR Test Report

APPLICANT	:	Honeywell International Inc
EQUIPMENT	:	Mobile computer
BRAND NAME	:	Honeywell
MODEL NAME	:	CT47X0N
FCC ID	:	HD5-CT47X0N
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.

Si Zhang

Approved by: Si Zhang

ilac-MRA

ACCREDITED
Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA272913-01	Rev. 01	Initial issue of report.	Dec. 13, 2022

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Honeywell International Inc, Mobile computer, CT47X0N,** are as follows.

Highest 1g SAR Summary					
Equipment Class	Frequency Band		Head (Separation 0mm)	Body-worn (Separation 15mm)	Highest Simultaneous Transmission 1g SAR (W/kg)
			1g SAR (W/kg)		
DTS	WLAN	2.4GHz WLAN	0.94	0.31	-
NII		5GHz WLAN	**1.19**	**0.71**	1.47
DSS	Bluetooth	2.4GHz Bluetooth	0.28	<0.10	1.47

Highest 10g SAR Summary				
Equipment Class	Frequency Band		Product Specific 10g SAR (W/kg) (Separation 0mm)	Highest Simultaneous Transmission 10g SAR (W/kg)
DTS	WLAN	2.4GHz WLAN	1.24	-
NII		5GHz WLAN	**1.54**	1.78
DSS	Bluetooth	2.4GHz Bluetooth	0.25	1.78
Date of Testing:			2022/11/18 ~ 2022/11/21	

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 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR05-KS	CN1257	314309

Applicant	
Company Name	Honeywell International Inc
Address	9680 Old Bailes Rd, Fort Mill, SC 29707 United States

Manufacturer	
Company Name	Honeywell International Inc
Address	9680 Old Bailes Rd, Fort Mill, SC 29707 United States

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 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r03
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 941225 D07 UMPC Mini Tablet v01r02

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Mobile computer
Brand Name	Honeywell
Model Name	CT47X0N
FCC ID	HD5-CT47X0N
SN	22211E3670
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 VHT20/VHT40/VHT80/VHT160 WLAN 5GHz 802.11ax HE20/HE40/HE80/HE160 WLAN 6GHz 802.11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE NFC: ASK
HW Version	V1.0
SW Version	CT47-S-412.01.00.1628-G-DEBUG-TEST-H2G-QFIL
EUT Stage	Identical Prototype

Remark:

1. This device 2.4GHz WLAN/5GHz WLAN /6GHz WLAN has no hotspot function.
2. The device implements the power management and receiver detection for SAR compliance at different exposure conditions (head, body-worn, extremity). And the device will invoke corresponding work scenarios power level base on frequency bands/antennas, which can refer to power table at appendix E.
3. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO and MIMO mode.
4. Bluetooth LE has two States for normal state and switch OFF state. Bluetooth LE is to ensure it sends beacons and beep when the device is switch OFF and cannot be transmitted simultaneously with other wireless modes.
5. This device will be equipped with Sling, the Sling has no metallic wristband and do not contain any electronic circuitry. It has no effect on RF exposure, so no need to test with it.
6. SAR Power density test report for WLAN6GHz U-NII-5/6/7/8 will be separately submitted. About co-located SAR with WWAN/Bluetooth, always chose higher SAR of WLAN5G U-NII-1/2A/2C/3 and U-NII-5/6/7/8.
7. There are four samples, the differences could be referred to the CT47X0N_Operational Description of Product Equality Declaration which is exhibit separately. According to the difference, we choose sample 1 to full test. For sample 2/3/4, the differences do not affect the test, so sample 2/3/4 are not tested.
8. This device has NFC function and the NFC SAR report will be separately submitted.

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:

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

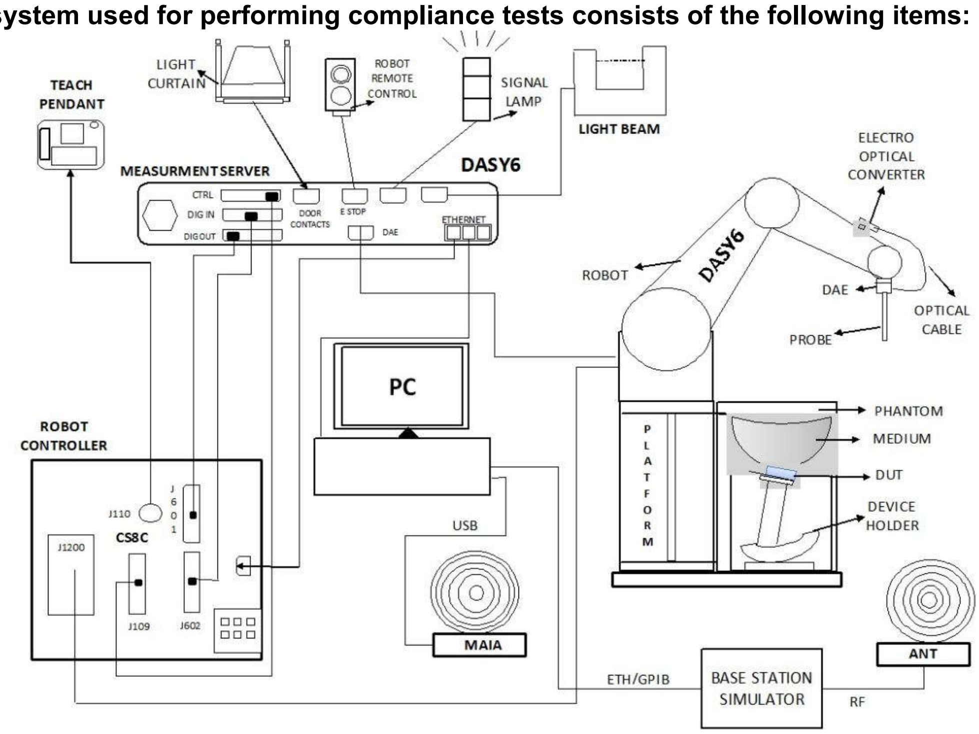
SAR is expressed in units of Watts per kilogram (W/kg)

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

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 Win10 and the DASY 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	

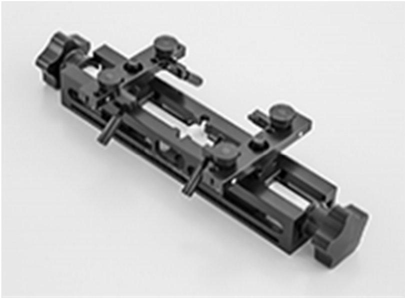
The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices or for evaluating transmitters operating at low frequencies. ELI is fully compatible with standard and all known tissue simulating liquids.

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.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

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.

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 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>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 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>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 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>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 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 ≤ 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.</td></tr>
</table>

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	2020/5/6	2023/5/4
SPEAG	5000MHz System Validation Kit	D5GHzV2	1341	2021/12/13	2022/12/12
SPEAG	Data Acquisition Electronics	DAE4	1279	2022/10/26	2023/10/25
SPEAG	Dosimetric E-Field Probe	EX3DV4	7764	2022/9/30	2023/9/29
SPEAG	SAM Twin Phantom	SAM Twin	TP-2074	NCR	NCR
Testo	Thermo-Hygrometer	608-H1	1241332126	2022/1/6	2023/1/5
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46104587	2022/5/24	2023/5/23
SPEAG	Dielectric Probe Kit	DAK-3.5	1071	2022/1/24	2023/1/23
Anritsu	Vector Signal Generator	MG3710A	6201682672	2022/1/6	2023/1/5
Rohde & Schwarz	Power Meter	NRVD	102081	2022/7/14	2023/7/13
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2022/7/14	2023/7/13
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2022/7/14	2023/7/13
R&S	CBT BLUETOOTH TESTER	CBT	100641	2022/1/5	2023/1/4
Rohde & Schwarz	Spectrum Analyzer	FSV7	101631	2022/10/12	2023/10/11
TES	DIGITAC THERMOMETER	1310	200505600	2022/7/12	2023/7/11
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 head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 12.1. 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.

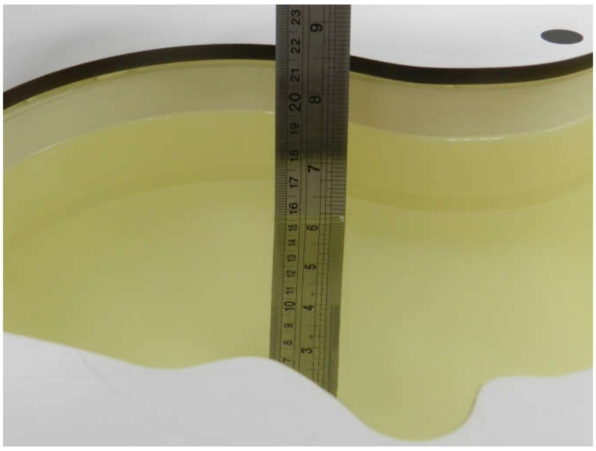


Fig 12.1 Photo of Liquid Height for Head SAR

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	22.7	1.740	39.200	1.80	39.20	-3.33	0.00	±5	2022/11/18
5250	Head	22.9	4.580	35.700	4.71	35.90	-2.76	-0.56	±5	2022/11/19
5600	Head	22.8	4.960	35.000	5.07	35.50	-2.17	-1.41	±5	2022/11/19
5750	Head	22.9	5.120	34.800	5.22	35.40	-1.92	-1.69	±5	2022/11/19
2450	Head	22.6	1.740	39.200	1.80	39.20	-3.33	0.00	±5	2022/11/20
5250	Head	22.9	4.580	35.700	4.71	35.90	-2.76	-0.56	±5	2022/11/21
5600	Head	22.8	4.950	35.100	5.07	35.50	-2.37	-1.13	±5	2022/11/21
5750	Head	22.8	5.110	34.900	5.22	35.40	-2.11	-1.41	±5	2022/11/21

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 (%)
2022/11/18	2450	Head	50	1040	7764	1279	2.470	51.80	49.4	-4.63
2022/11/19	5250	Head	50	1341	7764	1279	4.030	80.70	80.6	-0.12
2022/11/19	5600	Head	50	1341	7764	1279	3.950	84.50	79	-6.51
2022/11/19	5750	Head	50	1341	7764	1279	3.950	80.60	79	-1.99
2022/11/20	2450	Head	50	1040	7764	1279	2.520	51.80	50.4	-2.70
2022/11/21	5250	Head	50	1341	7764	1279	3.980	80.70	79.6	-1.36
2022/11/21	5600	Head	50	1341	7764	1279	4.020	84.50	80.4	-4.85
2022/11/21	5750	Head	50	1341	7764	1279	3.920	80.60	78.4	-2.73

<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 (%)
2022/11/18	2450	Head	50	1040	7764	1279	1.130	24.00	22.6	-5.83
2022/11/19	5250	Head	50	1341	7764	1279	1.160	23.10	23.2	0.43
2022/11/19	5600	Head	50	1341	7764	1279	1.120	24.00	22.4	-6.67
2022/11/19	5750	Head	50	1341	7764	1279	1.130	22.70	22.6	-0.44
2022/11/20	2450	Head	50	1040	7764	1279	1.180	24.00	23.6	-1.67
2022/11/21	5250	Head	50	1341	7764	1279	1.120	23.10	22.4	-3.03
2022/11/21	5600	Head	50	1341	7764	1279	1.160	24.00	23.2	-3.33
2022/11/21	5750	Head	50	1341	7764	1279	1.100	22.70	22	-3.08

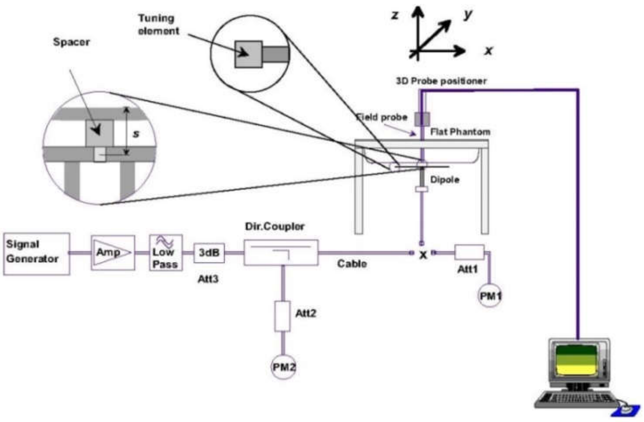


Fig 12.3.1 System Performance Check Setup

Fig 12.3.2 Setup Photo

11. RF Exposure Positions

11.1 Ear and handset reference point

Figure 12.1.1 shows the front, back, and side views of the SAM phantom. The center-of-mouth reference point is labeled “M,” the left ear reference point (ERP) is marked “LE,” and the right ERP is marked “RE.” Each ERP is 15 mm along the B-M (back-mouth) line behind the entrance-to-ear-canal (EEC) point, as shown in Figure 12.1.2 The Reference Plane is defined as passing through the two ear reference points and point M. The line N-F (neck-front), also called the reference pivoting line, is normal to the Reference Plane and perpendicular to both a line passing through RE and LE and the B-M line (see Figure 12.1.3). Both N-F and B-M lines should be marked on the exterior of the phantom shell to facilitate handset positioning. Posterior to the N-F line the ear shape is a flat surface with 6 mm thickness at each ERP, and forward of the N-F line the ear is truncated, as illustrated in Figure 12.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

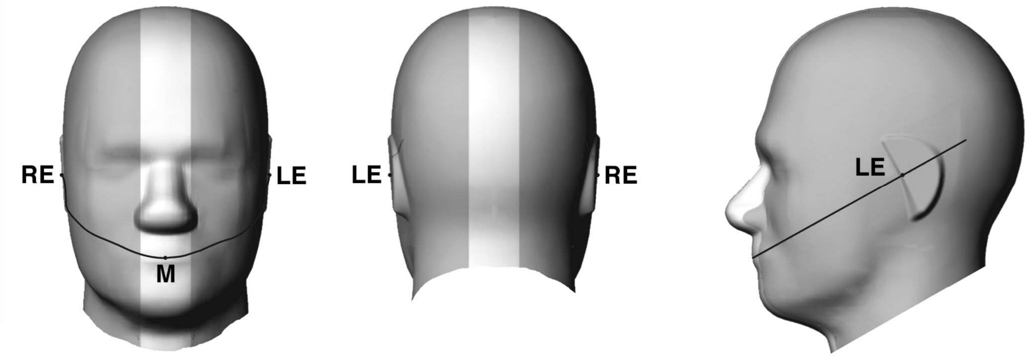


Fig 12.1.1 Front, back, and side views of SAM twin phantom

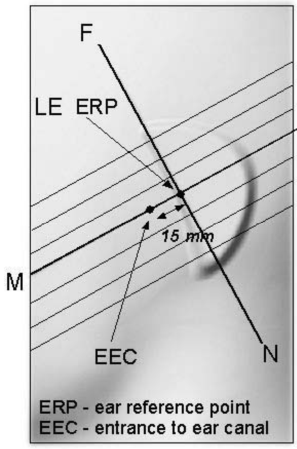


Fig 12.1.2 Close-up side view of phantom showing the ear region.

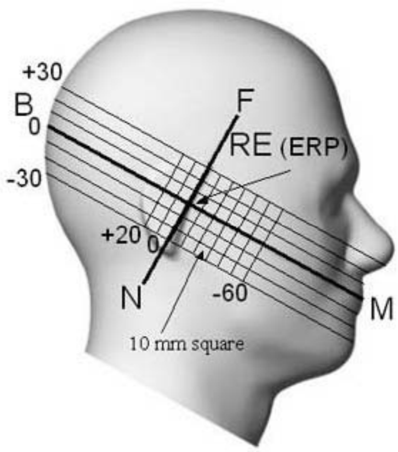


Fig 12.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

11.2 Definition of the cheek position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. Define two imaginary lines on the handset—the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset—the midpoint of the width wt of the handset at the level of the acoustic output (point A in Figure 12.2.1 and Figure 12.2.2), and the midpoint of the width wb of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 12.2.1). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 12.2.2), especially for clamshell handsets, handsets with flip covers, and other irregularly-shaped handsets.
3. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 12.2.3), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
4. Translate the handset towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP.
5. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane.
6. Rotate the handset around the vertical centerline until the handset (horizontal line) is parallel to the N-F line.
7. While maintaining the vertical centerline in the Reference Plane, keeping point A on the line passing through RE and LE, and maintaining the handset contact with the pinna, rotate the handset about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek. See Figure 12.2.3. The actual rotation angles should be documented in the test report.

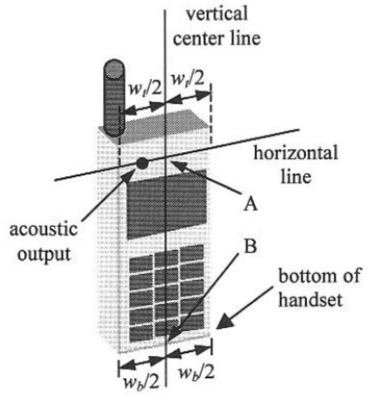


Fig 12.2.1 Handset vertical and horizontal reference lines—"fixed case

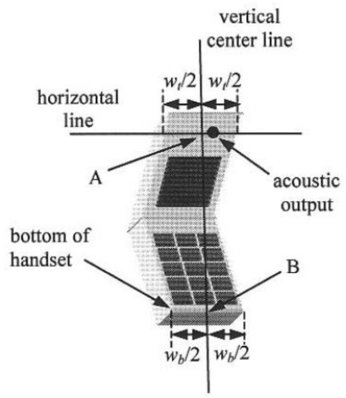


Fig 12.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

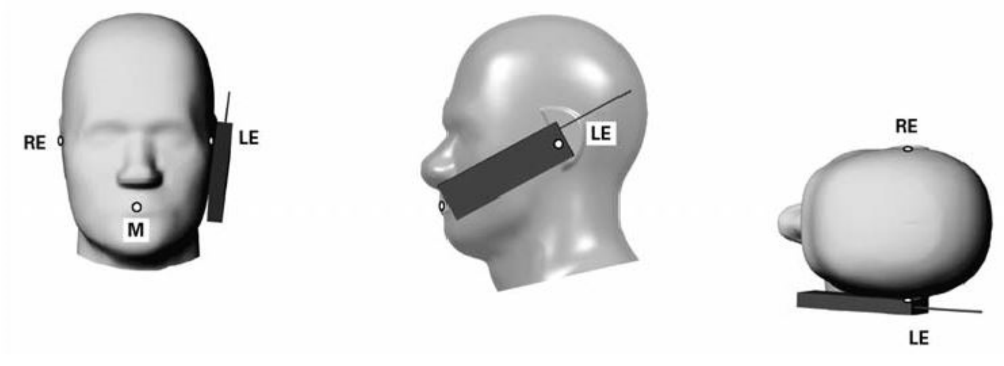


Fig 12.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

11.3 Definition of the tilt position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. While maintaining the orientation of the handset, move the handset away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°.
3. Rotate the handset around the horizontal line by 15°.
4. While maintaining the orientation of the handset, move the handset towards the phantom on the line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact point is on the pinna. See Figure 12.3.1. If contact occurs at any location other than the pinna, e.g., the antenna at the back of the phantom head, the angle of the handset should be reduced. In this case, the tilt position is obtained if any point on the handset is in contact with the pinna and a second point

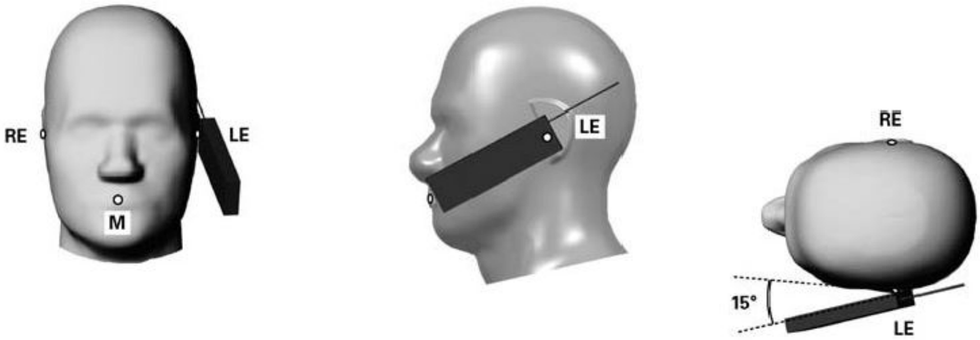


Fig 12.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

11.4 Body Worn Accessory

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 12.4). Per KDB648474 D04v01r03, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a handset attached to the handset.

Accessories for body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

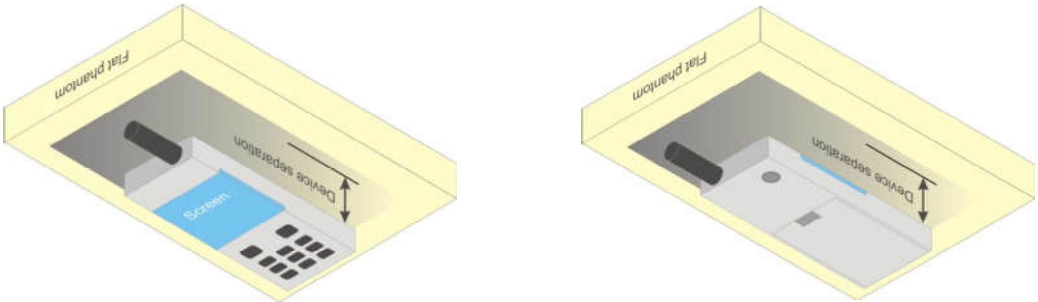


Fig 12.4 Body Worn Position

11.5 Product Specific 10g SAR Exposure

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm, that can provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets and support voice calls next to the ear, According to KDB648474 D04v01r03, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance

1. The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.

2. The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions.6 The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.

12. Conducted RF Output Power (Unit: dBm)

The detailed conducted power table can refer to Appendix E.

<WLAN Conducted Power>

General Note:

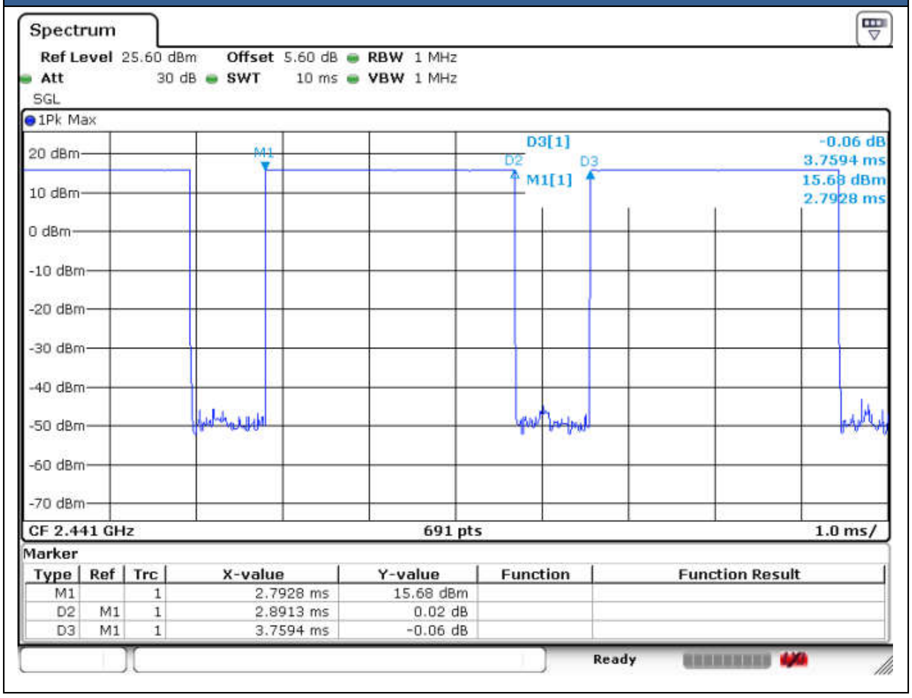
1. For each frequency band or when MIMO mode was not performed, due to for each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
2. Per KDB 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6W/kg and SAR peak to location ratio ≤ 0.04, no additional SAR measurements for MIMO.
3. 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.
4. 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.
5. 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).
6. 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.
7. 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.
8. 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.
9. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO and MIMO mode.

<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 76.91 % for ANT9 as following figure, according to 2016 Oct. TCB workshop for Bluetooth SAR scaling need further consideration and the maximum duty cycle is 100%, therefore the actual duty cycle will be scaled up to100% for Bluetooth reported SAR calculation.

Bluetooth time-domain plot for ANT9



3. Bluetooth LE Max output power is 6 dBm at switch OFF state on this device, and Per KDB 447498 D01v06, the detailed BLE Exclusions analysis are as follows:

Mode Band	Max Average power(dBm)
2.4GHz BLE	6.0

Note:

1. Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
   - f(GHz) is the RF channel transmit frequency in GHz
   - Power and distance are rounded to the nearest mW and mm before calculation
   - The result is rounded to one decimal place for comparison

BLE Max Power (dBm)	exposure conditions	Separation Distance (mm)	Frequency (GHz)	1g SAR exclusion thresholds	10g SAR exclusion thresholds
6.0	Head	< 5	2.48	1.3	-
6.0	body-worn	15	2.48	0.4	-
6.0	Extremity	0	2.48	-	0.4

Note:

Per KDB 447498 D01v06, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion. The test exclusion threshold all are <= 3 for 1g SAR or 7.5 for 10g SAR, SAR testing is not required.

13. Antenna Location

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

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 BT/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 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. The device implements receiver detection for SAR compliance at different exposure conditions (head, body-worn, extremity). And the device will invoke corresponding work scenarios power level base on frequency bands/antennas, which can refer to power table at appendix E.
5. Per KDB648474 D04v01r03, for smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm, the more conservative normal tablet SAR results can be used to support phablet mode 10-g extremity SAR.
   a. WLAN 2.4/5.2/5.3/5.5/5.8GHz/BT tested the product specific 10g SAR since it has no hotspot mode.

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, U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 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.
6. 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.
7. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO and MIMO mode.
8. For WLAN SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
9. The WLAN can transmit in SISO/MIMO antenna mode, 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.

14.1 Head SAR

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	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)
WIFI/Bluetooth																
	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	0mm	Ant 9+10	Receiver on	1	2412	19.22	20.50	1.343	100	1.000	-0.16	0.545	0.732
	WLAN2.4GHz	802.11b 1Mbps	Right Tilted	0mm	Ant 9+10	Receiver on	1	2412	19.22	20.50	1.343	100	1.000	0.07	0.410	0.550
01	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	1	2412	19.22	20.50	1.343	100	1.000	-0.09	0.703	**0.944**
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	6	2437	19.14	20.50	1.366	100	1.000	-0.04	0.512	0.699
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	11	2462	19.20	20.50	1.349	100	1.000	-0.12	0.636	0.858
	WLAN2.4GHz	802.11b 1Mbps	Left Tilted	0mm	Ant 9+10	Receiver on	1	2412	19.22	20.50	1.343	100	1.000	0.02	0.488	0.655
	Bluetooth	1Mbps	Right Cheek	0mm	Ant 9	Full Power	0	2402	17.40	18.00	1.148	76.91	1.300	0.11	0.040	0.060
	Bluetooth	1Mbps	Right Tilted	0mm	Ant 9	Full Power	0	2402	17.40	18.00	1.148	76.91	1.300	-0.03	0.001	0.001
	Bluetooth	1Mbps	Left Cheek	0mm	Ant 9	Full Power	0	2402	17.40	18.00	1.148	76.91	1.300	0.05	0.151	0.225
	Bluetooth	1Mbps	Left Tilted	0mm	Ant 9	Full Power	0	2402	17.40	18.00	1.148	76.91	1.300	0.06	0.001	0.001
02	Bluetooth	1Mbps	Left Cheek	0mm	Ant 9	Full Power	39	2441	17.23	18.00	1.194	76.91	1.300	-0.01	0.181	**0.281**
	Bluetooth	1Mbps	Left Cheek	0mm	Ant 9	Full Power	78	2480	16.82	18.00	1.312	76.91	1.300	0.08	0.093	0.159
	WLAN5.3GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 9+10	Receiver on	64	5320	21.16	22.50	1.363	99.27	1.007	0.03	0.454	0.623
	WLAN5.3GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 9+10	Receiver on	64	5320	21.16	22.50	1.363	99.27	1.007	0.12	0.371	0.509
03	WLAN5.3GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	64	5320	21.16	22.50	1.363	99.27	1.007	-0.11	0.864	**1.186**
	WLAN5.3GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 9+10	Receiver on	64	5320	21.16	22.50	1.363	99.27	1.007	-0.14	0.575	0.789
	WLAN5.3GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	52	5260	21.14	22.50	1.368	99.27	1.007	0.02	0.763	1.051
	WLAN5.3GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	56	5280	21.15	22.50	1.365	99.27	1.007	0.05	0.777	1.068
	WLAN5.5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 9+10	Receiver on	124	5620	21.24	22.00	1.191	99.27	1.007	-0.18	0.642	0.770
	WLAN5.5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 9+10	Receiver on	124	5620	21.24	22.00	1.191	99.27	1.007	0.05	0.595	0.714
04	WLAN5.5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	124	5620	21.24	22.00	1.191	99.27	1.007	0.06	0.910	**1.091**
	WLAN5.5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 9+10	Receiver on	124	5620	21.24	22.00	1.191	99.27	1.007	0.03	0.658	0.789
	WLAN5.5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	100	5500	21.20	22.00	1.202	99.27	1.007	0.15	0.801	0.970
	WLAN5.5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	144	5720	20.46	22.00	1.426	99.27	1.007	0.11	0.671	0.963
05	WLAN5.8GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 9+10	Receiver on	149	5745	20.69	21.50	1.206	99.27	1.007	-0.06	0.778	**0.945**
	WLAN5.8GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 9+10	Receiver on	149	5745	20.69	21.50	1.206	99.27	1.007	0.15	0.585	0.710
	WLAN5.8GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	149	5745	20.69	21.50	1.206	99.27	1.007	-0.15	0.592	0.719
	WLAN5.8GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 9+10	Receiver on	149	5745	20.69	21.50	1.206	99.27	1.007	0.01	0.550	0.668
	WLAN5.8GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 9+10	Receiver on	157	5785	20.62	21.50	1.224	99.27	1.007	-0.08	0.718	0.885
	WLAN5.8GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 9+10	Receiver on	165	5825	20.48	21.50	1.266	99.27	1.007	-0.08	0.646	0.823

14.2 Body Worn Accessory SAR

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	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)
WIFI/Bluetooth																
	WLAN2.4GHz	802.11b 1Mbps	Front	15mm	Ant 9+10	Full Power	1	2412	22.07	23.00	1.239	100	1.000	-0.19	0.151	0.187
06	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Ant 9+10	Full Power	1	2412	22.07	23.00	1.239	100	1.000	-0.07	0.249	**0.308**
	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Ant 9+10	Full Power	6	2437	21.86	23.00	1.302	100	1.000	0.04	0.214	0.279
	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Ant 9+10	Full Power	11	2462	21.74	23.00	1.338	100	1.000	-0.1	0.227	0.304
	Bluetooth	1Mbps	Front	15mm	Ant 9	Full Power	0	2402	17.40	18.00	1.148	76.91	1.300	0.04	0.032	0.048
	Bluetooth	1Mbps	Back	15mm	Ant 9	Full Power	0	2402	17.40	18.00	1.148	76.91	1.300	-0.06	0.038	0.057
07	Bluetooth	1Mbps	Back	15mm	Ant 9	Full Power	39	2441	17.23	18.00	1.194	76.91	1.300	-0.08	0.040	**0.062**
	Bluetooth	1Mbps	Back	15mm	Ant 9	Full Power	78	2480	16.82	18.00	1.312	76.91	1.300	0.02	0.026	0.044
	WLAN5.3GHz	802.11a 6Mbps	Front	15mm	Ant 9+10	Full Power	64	5320	22.43	23.50	1.281	99.27	1.007	0.08	0.187	0.241
08	WLAN5.3GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	64	5320	22.43	23.50	1.281	99.27	1.007	0.06	0.273	**0.352**
	WLAN5.3GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	56	5280	22.32	23.50	1.312	99.27	1.007	0.1	0.243	0.321
	WLAN5.3GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	52	5260	22.39	23.50	1.292	99.27	1.007	0.07	0.237	0.308
	WLAN5.5GHz	802.11a 6Mbps	Front	15mm	Ant 9+10	Full Power	124	5620	22.07	23.00	1.240	99.27	1.007	-0.15	0.212	0.265
09	WLAN5.5GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	124	5620	22.07	23.00	1.240	99.27	1.007	0.08	0.566	**0.707**
	WLAN5.5GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	132	5660	21.97	23.00	1.268	99.27	1.007	-0.17	0.531	0.678
	WLAN5.5GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	100	5500	21.79	23.00	1.323	99.27	1.007	-0.18	0.466	0.621
	WLAN5.5GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	144	5720	21.83	23.00	1.309	99.27	1.007	0.01	0.500	0.659
	WLAN5.8GHz	802.11a 6Mbps	Front	15mm	Ant 9+10	Full Power	149	5745	22.01	23.00	1.256	99.27	1.007	0.08	0.201	0.254
10	WLAN5.8GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	149	5745	22.01	23.00	1.256	99.27	1.007	0.05	0.535	**0.677**
	WLAN5.8GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	157	5785	21.97	23.00	1.269	99.27	1.007	-0.13	0.520	0.665
	WLAN5.8GHz	802.11a 6Mbps	Back	15mm	Ant 9+10	Full Power	165	5825	21.95	23.00	1.272	99.27	1.007	0.03	0.485	0.621

14.3 Product Specific SAR

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	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)
WIFI/Bluetooth																
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 9+10	Full Power	1	2412	22.07	23.00	1.239	100	1.000	0.18	0.723	0.896
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 9+10	Full Power	1	2412	22.07	23.00	1.239	100	1.000	0.1	0.383	0.474
	WLAN2.4GHz	802.11b 1Mbps	Left Side	0mm	Ant 9+10	Full Power	1	2412	22.07	23.00	1.239	100	1.000	-0.05	0.397	0.492
	WLAN2.4GHz	802.11b 1Mbps	Right Side	0mm	Ant 9+10	Full Power	1	2412	22.07	23.00	1.239	100	1.000	0.05	0.295	0.365
	WLAN2.4GHz	802.11b 1Mbps	Top Side	0mm	Ant 9+10	Full Power	1	2412	22.07	23.00	1.239	100	1.000	-0.18	0.427	0.529
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 9+10	Full Power	6	2437	21.86	23.00	1.302	100	1.000	0.15	0.682	0.888
11	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 9+10	Full Power	11	2462	21.74	23.00	1.338	100	1.000	-0.04	0.930	**1.244**
12	Bluetooth	1Mbps	Front	0mm	Ant 9	Full Power	39	2441	17.23	18.00	1.194	76.91	1.300	-0.12	0.158	**0.245**
	Bluetooth	1Mbps	Front	0mm	Ant 9	Full Power	0	2402	17.40	18.00	1.148	76.91	1.300	0.09	0.144	0.215
	Bluetooth	1Mbps	Front	0mm	Ant 9	Full Power	78	2480	16.82	18.00	1.312	76.91	1.300	0.12	0.130	0.222
	WLAN5.3GHz	802.11a 6Mbps	Front	0mm	Ant 9+10	Full Power	64	5320	22.43	23.50	1.281	99.27	1.007	0.09	0.569	0.734
	WLAN5.3GHz	802.11a 6Mbps	Back	0mm	Ant 9+10	Full Power	64	5320	22.43	23.50	1.281	99.27	1.007	0.03	0.910	1.174
	WLAN5.3GHz	802.11a 6Mbps	Left Side	0mm	Ant 9+10	Full Power	64	5320	22.43	23.50	1.281	99.27	1.007	0.18	0.315	0.406
13	WLAN5.3GHz	802.11a 6Mbps	Right Side	0mm	Ant 9+10	Full Power	64	5320	22.43	23.50	1.281	99.27	1.007	-0.01	1.100	**1.419**
	WLAN5.3GHz	802.11a 6Mbps	Top Side	0mm	Ant 9+10	Full Power	64	5320	22.43	23.50	1.281	99.27	1.007	-0.04	0.802	1.034
	WLAN5.3GHz	802.11a 6Mbps	Right Side	0mm	Ant 9+10	Full Power	56	5280	22.32	23.50	1.312	99.27	1.007	-0.1	1.050	1.387
	WLAN5.3GHz	802.11a 6Mbps	Right Side	0mm	Ant 9+10	Full Power	52	5260	22.39	23.50	1.292	99.27	1.007	0.07	1.040	1.353
	WLAN5.5GHz	802.11a 6Mbps	Front	0mm	Ant 9+10	Full Power	124	5620	22.07	23.00	1.240	99.27	1.007	0.06	0.522	0.652
14	WLAN5.5GHz	802.11a 6Mbps	Back	0mm	Ant 9+10	Full Power	124	5620	22.07	23.00	1.240	99.27	1.007	0.03	1.230	**1.535**
	WLAN5.5GHz	802.11a 6Mbps	Left Side	0mm	Ant 9+10	Full Power	124	5620	22.07	23.00	1.240	99.27	1.007	-0.1	0.831	1.037
	WLAN5.5GHz	802.11a 6Mbps	Right Side	0mm	Ant 9+10	Full Power	124	5620	22.07	23.00	1.240	99.27	1.007	0.05	1.160	1.448
	WLAN5.5GHz	802.11a 6Mbps	Top Side	0mm	Ant 9+10	Full Power	124	5620	22.07	23.00	1.240	99.27	1.007	0.05	0.819	1.022
	WLAN5.5GHz	802.11a 6Mbps	Back	0mm	Ant 9+10	Full Power	100	5500	21.79	23.00	1.323	99.27	1.007	0.07	0.930	1.239
	WLAN5.5GHz	802.11a 6Mbps	Back	0mm	Ant 9+10	Full Power	144	5720	21.83	23.00	1.309	99.27	1.007	0.1	1.120	1.477
	WLAN5.8GHz	802.11a 6Mbps	Front	0mm	Ant 9+10	Full Power	149	5745	22.01	23.00	1.256	99.27	1.007	0.17	0.415	0.525
	WLAN5.8GHz	802.11a 6Mbps	Back	0mm	Ant 9+10	Full Power	149	5745	22.01	23.00	1.256	99.27	1.007	-0.12	1.010	1.278
	WLAN5.8GHz	802.11a 6Mbps	Left Side	0mm	Ant 9+10	Full Power	149	5745	22.01	23.00	1.256	99.27	1.007	0.09	0.666	0.842
	WLAN5.8GHz	802.11a 6Mbps	Right Side	0mm	Ant 9+10	Full Power	149	5745	22.01	23.00	1.256	99.27	1.007	0.04	0.871	1.102
	WLAN5.8GHz	802.11a 6Mbps	Top Side	0mm	Ant 9+10	Full Power	149	5745	22.01	23.00	1.256	99.27	1.007	-0.17	0.799	1.011
	WLAN5.8GHz	802.11a 6Mbps	Back	0mm	Ant 9+10	Full Power	157	5785	21.97	23.00	1.269	99.27	1.007	0.03	0.967	1.236
15	WLAN5.8GHz	802.11a 6Mbps	Back	0mm	Ant 9+10	Full Power	165	5825	21.95	23.00	1.272	99.27	1.007	-0.01	1.090	**1.396**

14.4 Repeated SAR Measurement

<1g>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power State	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)	Ratio	Reported 1g SAR (W/kg)
1st	WLAN5.3GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	64	5320	21.16	22.50	1.363	99.27	1.007	-0.11	0.864	1	1.186
2nd	WLAN5.3GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	64	5320	21.16	22.50	1.363	99.27	1.007	0.04	0.822	1.051	1.128
1st	WLAN5.5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	124	5620	21.24	22.00	1.191	99.27	1.007	0.06	0.910	1	1.091
2nd	WLAN5.5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 9+10	Receiver on	124	5620	21.24	22.00	1.191	99.27	1.007	0.01	0.871	1.045	1.045

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.

15. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Mobile computer		
		Head	Body-worn	Product Specific
1.	WLAN5GHz+ Bluetooth	Yes	Yes	Yes
2.	WLAN6GHz+ Bluetooth	Yes	Yes	Yes

General Note:

1. The 2.4GHz/5GHz/6GHz WLAN can transmit in SISO and MIMO mode.
2. This device 2.4GHz WLAN/5GHz WLAN /6GHz WLAN has no hotspot function.
3. According to the EUT characteristic, WLAN 5GHz/6GHz and Bluetooth can transmit simultaneously.
4. According to the EUT characteristic, WLAN 5GHz/6GHz and WLAN 2.4GHz cannot transmit simultaneously.
5. According to the EUT characteristic, WLAN 5GHz and WLAN 6GHz cannot 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. Chose the worst zoom scan SAR of WLAN correspondingly for co-located with WWAN analysis.
9. The reported SAR summation is calculated based on the same configuration and test position.
10. SAR Power density test report for WLAN6GHz U-NII-5/6/7/8 will be separately submitted. About co-located SAR with WWAN/Bluetooth always chose higher SAR of WLAN5G U-NII-1/2A/2C/3 and U-NII-5/6/7/8.
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.

15.1 Head Exposure Conditions

Exposure Position	2	3	4	2+3	3+4
	WLAN5GHz Ant 9+10	Bluetooth Ant 9	WLAN6E Ant 9+10	Summed	Summed
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
Right Cheek	0.945	0.281	0.662	1.23	0.94
Right Tilted	0.714	0.281	0.529	1.00	0.81
Left Cheek	1.186	0.281	0.581	1.47	0.86
Left Tilted	0.789	0.281	0.405	1.07	0.69

15.2 Body-Worn Accessory Exposure Conditions

Exposure Position	2	3	4	2+3	3+4
	WLAN5GHz Ant 9+10	Bluetooth Ant 9	WLAN 6E Ant 9+10	Summed	Summed
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
Front	0.265	0.062	0.129	0.33	0.19
Back	0.707	0.062	0.044	0.77	0.11

15.3 Product Specific 10g SAR Exposure Conditions

Exposure Position	2	3	4	2+3	3+4
	WLAN5GHz Ant 9+10	Bluetooth Ant 9	WLAN 6E Ant 9+10	Summed	Summed
	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)
Front	0.734	0.245	0.236	0.98	0.48
Back	1.535	0.245	0.198	1.78	0.44
Left side	1.037	0.245	0.494	1.28	0.74
Right side	1.448	0.245	0.190	1.69	0.44
Top side	1.034	0.245	0.379	1.28	0.62

Test Engineer : Martin Li, Varus Wang, Light Wang, Ricky Gu

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 648474 D04 v01r03, "SAR Evaluation Considerations for Wireless Handsets", Oct 2015.
[9] FCC KDB 248227 D01 v02r02, "SAR Guidance for IEEE 802.11 (WiFi) Transmitters", Oct 2015.
[10] KDB 941225 D07 v01r02, SAR Evaluation Procedures For UMPC Mini-Tablet Devices

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