FCC SAR TEST REPORT

FCC ID	:	**UZ7TC520K**
Equipment	:	**Touch Computer**
Brand Name	:	**Zebra**
Model Name	:	**TC520K**
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) ANSI/IEEE C95.1-1992 IEEE 1528-2013**

The product was received on Jul. 20, 2018 and testing was started from Aug. 06, 2018 and completed on Aug. 16, 2018. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

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

Cona Huang

Approved by: Cona Huang / Deputy Manager

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History of this test report

Report No.	Version	Description	Issued Date
FA853105	01	Initial issue of report	Aug. 29, 2018

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Zebra Technologies Corporation, Touch Computer, TC520K**, are as follows.

Equipment Class	Frequency Band		Highest SAR Summary		Highest Simultaneous Transmission 1g SAR (W/kg)
			Head	Body-worn	
			1g SAR (W/kg)		
DTS	WLAN	2.4GHz WLAN	1.01	0.23	1.40
NII		5GHz WLAN	1.19	1.06	1.48
Date of Testing:			2018/8/6 ~ 2018/8/16		

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) 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) 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: Eric Huang
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:

- 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

3. Equipment Under Test (EUT) Information

3.1 General Information

Product Feature & Specification	
Equipment Name	Touch Computer
Brand Name	Zebra
Model Name	TC520K
FCC ID	UZ7TC520K
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 Bluetooth: 2402 MHz ~ 2480 MHz NFC : 13.56 MHz
Mode	WLAN 2.4GHz : 802.11b/g/n/ac HT20/HT40/VHT20/VHT40 WLAN 5GHz : 802.11a/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE NFC:ASK
HW Version	DV
SW Version	91-09-14.00-ON-U00-STD
FW Version	FUSION_QA_2_1.0.0.027_O
MFD	20-Jul-18
EUT Stage	Engineering sample
Remark: 1. There are two kinds battery options, the battery1 as the main testing, battery2 is selected worst case from battery1 perform. 2. Choose the worst case to be verification the earphone / Exoskeleton / trigger handle / soft holster for SAR compliance.	

Specification of Accessories				
Adapter	Brand Name	Zebra	Part Number	PWR-WUA5V12W0US
Battery 1	Brand Name	Zebra	Part Number	BT-000314-50
Battery 2	Brand Name	Zebra	Part Number	BT-000314-01
USB cable	Brand Name	Zebra	Part Number	CBL-TC51-USB1-01
Headset Jumper 1	Brand Name	Zebra	Part Number	CBL-TC51-HDST25-01
Headset Jumper 2	Brand Name	Zebra	Part Number	CBL-TC51-HDST35-01
2.5mm Earphone	Brand Name	Zebra	Part Number	HDST-25MM-PTVP-01
3.5mm Earphone	Brand Name	Zebra	Part Number	HDST-35MM-PTVP-01
Exoskeleton	Brand Name	Zebra	Part Number	SG-TC51-EX01-01
Trigger Handle 1	Brand Name	Zebra	Part Number	TRG-TC51-SNP1-01
Soft Holster	Brand Name	Zebra	Part Number	SG-TC51-HLSTR1-01
Hand strap	Brand Name	Zebra	Part Number	SG-TC51-BHDSTP1-03
USB-C Adaptor	Brand Name	Zebra	Part Number	ADPTR-TC56-USBC-01
USB Type C cable	**Brand Name**	Zebra	**Part Number**	N/A

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:

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

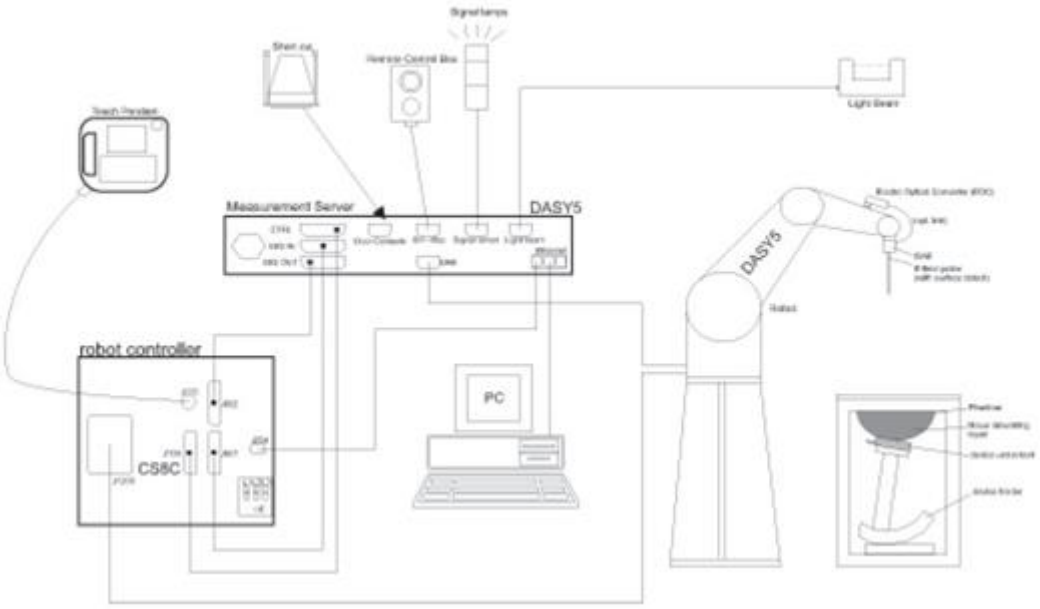
SAR is expressed in units of Watts per kilogram (W/kg)

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

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:



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

6.1 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.

<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	

6.2 Data Acquisition Electronics (DAE)

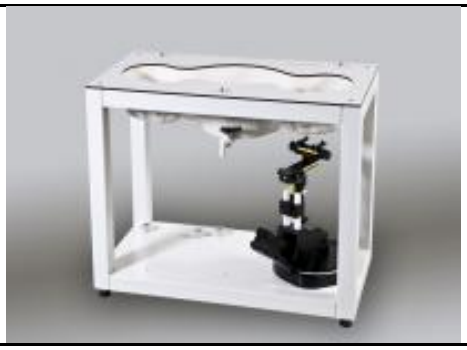
The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an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

Fig 5.1 Photo of DAE

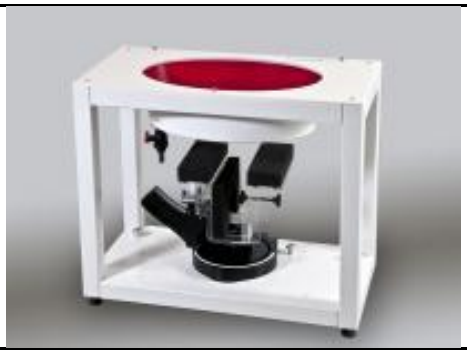
6.3 Phantom

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

6.4 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

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.

	≤ 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.	

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.

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

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

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

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	D2450V2	929	Mar. 01, 2018	Feb. 28, 2019
SPEAG	5GHz System Validation Kit	D5GHzV2	1006	Sep. 26, 2017	Sep. 25, 2018
SPEAG	Data Acquisition Electronics	DAE3	495	May. 24, 2018	May. 23, 2019
SPEAG	Data Acquisition Electronics	DAE4	1399	Nov. 16, 2017	Nov. 15, 2018
SPEAG	Dosimetric E-Field Probe	EX3DV4	3925	May. 31, 2018	May. 30, 2019
SPEAG	Dosimetric E-Field Probe	EX3DV4	3931	Sep. 29, 2017	Sep. 28, 2018
RCPTWN	Thermometer	HTC-1	TM685-1	Mar. 16, 2018	Mar. 15, 2019
RCPTWN	Thermometer	HTC-1	TM281-1	Mar. 16, 2018	Mar. 15, 2019
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Dec. 07, 2017	Dec. 06, 2018
Agilent	ENA Network Analyzer	E5071C	MY46316648	Jan. 17, 2018	Jan. 16, 2019
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 26, 2017	Sep. 25, 2018
LINE SEIKI	Digital Thermometer	DTM3000-spezial	3169	Sep. 06, 2017	Sep. 05, 2018
Anritsu	Power Meter	ML2495A	1419002	May. 18, 2018	May. 17, 2019
Anritsu	Power Sensor	MA2411B	1339124	May. 18, 2018	May. 17, 2019
Anritsu	Power Meter	ML2495A	1218006	Oct. 06, 2017	Oct. 05, 2018
Anritsu	Power Sensor	MA2411B	1207363	Oct. 06, 2017	Oct. 05, 2018
Agilent	Spectrum Analyzer	E4408B	MY44211028	Aug. 23, 2017	Aug. 22, 2018
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jun. 23, 2018	Jun. 22, 2019
Mini-Circuits	Power Amplifier	ZVE-8G+	D120604	Mar. 12, 2018	Mar. 11, 2019
Mini-Circuits	Power Amplifier	ZHL-42W+	QA1344002	Mar. 12, 2018	Mar. 11, 2019
ATM	Dual Directional Coupler	C122H-10	P610410z-02	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.

9. System Verification

9.1 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. 10.1. 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. 10.2.

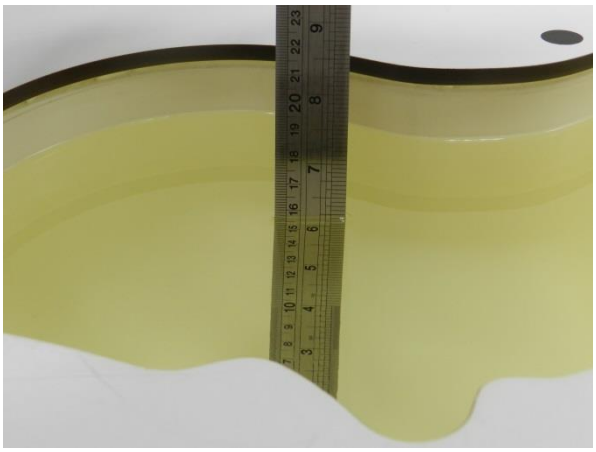


Fig 10.1Photo of Liquid Height for Head SAR

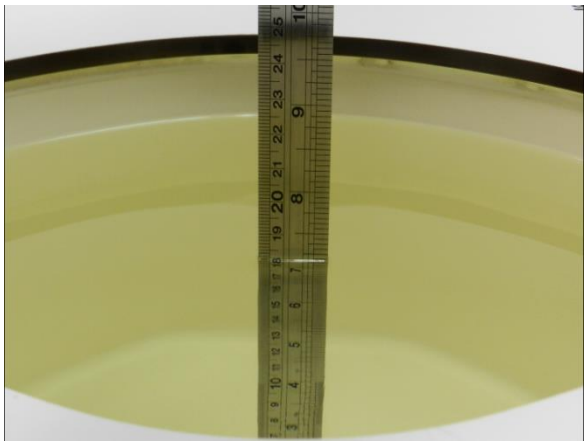


Fig 10.2 Photo of Liquid Height for Body SAR

9.2 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								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0
For Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

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	HSL	22.3	1.860	40.500	1.80	39.20	3.33	3.32	±5	2018/8/6
2450	MSL	22.5	1.971	53.602	1.95	52.70	1.08	1.71	±5	2018/8/16
5250	HSL	22.3	4.648	36.700	4.71	35.95	-1.32	2.09	±5	2018/8/15
5250	MSL	22.4	5.354	47.569	5.36	48.95	-0.11	-2.82	±5	2018/8/14
5600	HSL	22.3	4.994	36.235	5.07	35.50	-1.50	2.07	±5	2018/8/15
5600	MSL	22.4	5.820	47.184	5.77	48.50	0.87	-2.71	±5	2018/8/14
5750	HSL	22.5	5.031	34.916	5.22	35.35	-3.62	-1.23	±5	2018/8/12
5750	HSL	22.3	5.154	36.042	5.22	35.35	-1.26	1.96	±5	2018/8/15
5750	MSL	22.4	6.044	47.170	5.94	48.28	1.75	-2.30	±5	2018/8/14

9.3 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.

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 (%)
2018/8/6	2450	HSL	250	D2450V2-929	EX3DV4 - SN3931	DAE4 Sn1399	13.40	52.20	53.60	2.68
2018/8/16	2450	MSL	250	D2450V2-929	EX3DV4 - SN3931	DAE4 Sn1399	12.50	52.30	50.00	-4.40
2018/8/15	5250	HSL	100	D5GHzV2-1006-5250	EX3DV4 - SN3931	DAE4 Sn1399	8.36	78.30	83.60	6.77
2018/8/14	5250	MSL	100	D5GHzV2-1006-5250	EX3DV4 - SN3931	DAE4 Sn1399	7.44	77.00	74.40	-3.38
2018/8/15	5600	HSL	100	D5GHzV2-1006-5600	EX3DV4 - SN3931	DAE4 Sn1399	9.07	85.00	90.70	6.71
2018/8/14	5650	MSL	100	D5GHzV2-1006-5600	EX3DV4 - SN3931	DAE4 Sn1399	8.15	80.10	81.50	1.75
2018/8/12	5750	HSL	100	D5GHzV2-1006-5750	EX3DV4 - SN3925	DAE3 Sn495	7.16	78.50	71.60	-8.79
2018/8/15	5750	HSL	100	D5GHzV2-1006-5750	EX3DV4 - SN3931	DAE4 Sn1399	7.81	78.50	78.10	-0.51
2018/8/14	5750	MSL	100	D5GHzV2-1006-5750	EX3DV4 - SN3931	DAE4 Sn1399	7.35	75.10	73.50	-2.13

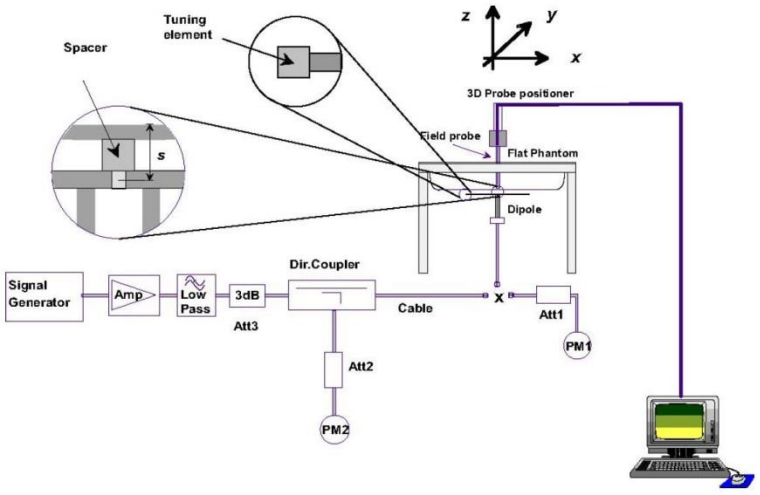


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

10. RF Exposure Positions

10.1 Ear and handset reference point

Figure 9.1.1 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 9.1.2 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 9.1.3). 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 9.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

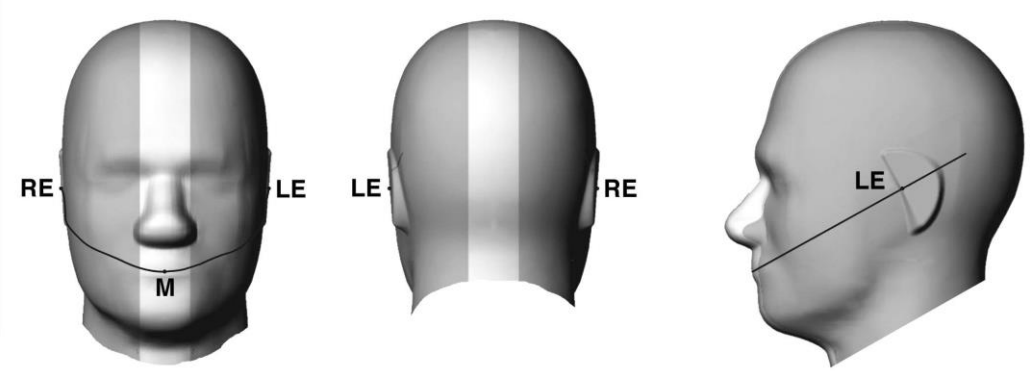


Fig 9.1.1 Front, back, and side views of SAM twin phantom

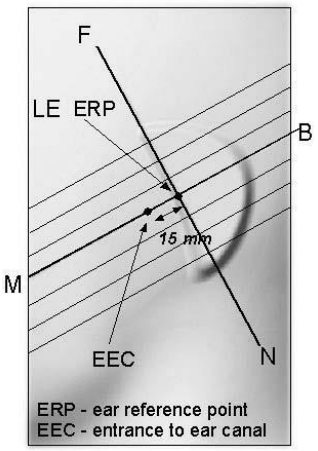


Fig 9.1.2 Close-up side view of phantom showing the ear region.

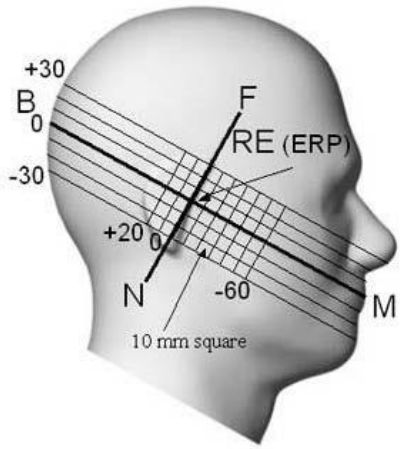


Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

10.2 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 9.2.1 and Figure 9.2.2), 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 9.2.1). 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 9.2.2), 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 9.2.3), 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 9.2.3. The actual rotation angles should be documented in the test report.

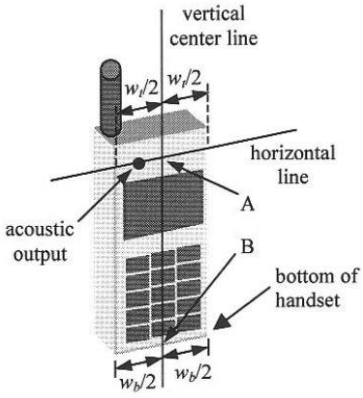


Fig 9.2.1 Handset vertical and horizontal reference lines—"fixed case

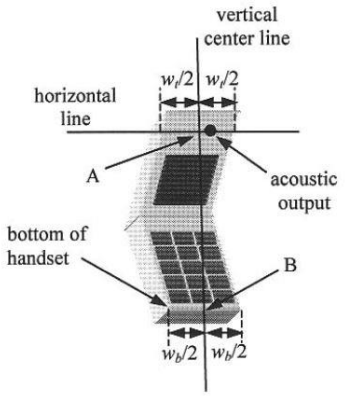


Fig 9.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

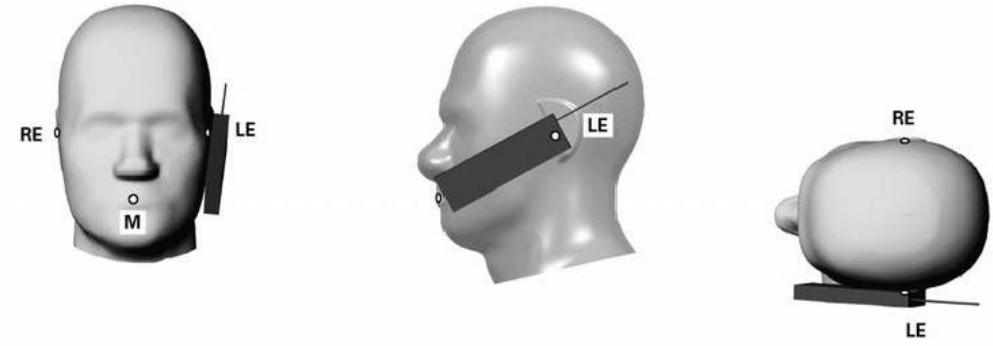


Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

10.3 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 9.3.1. 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

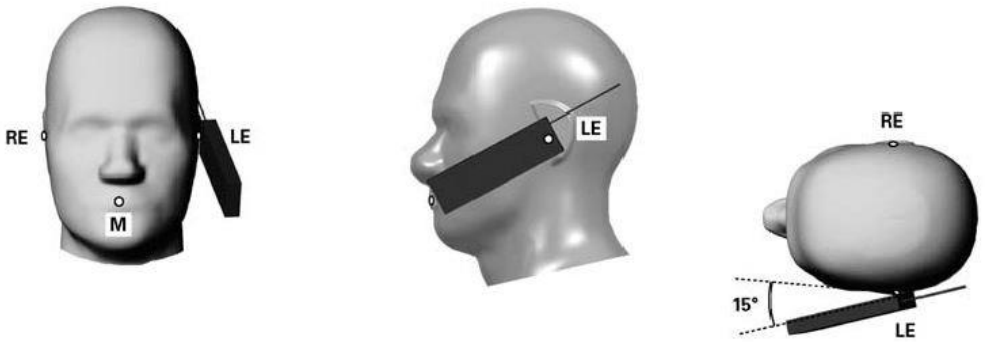


Fig 9.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

10.4 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 9.4). 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 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.

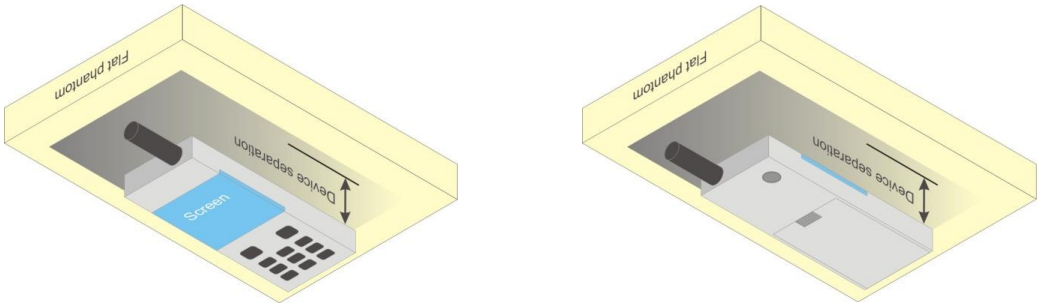


Fig 9.4 Body Worn Position

11. Conducted RF Output Power (Unit: dBm)

<WLAN Conducted Power>

General Note:

1. 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. 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.
4. 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).
5. 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.
6. 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.

<Non-beamforming Mode>

<2.4GHz WLAN ANT 1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	18.30	18.50	100.00
		2	2417	18.42	18.50	
		6	2437	18.08	18.50	
		10	2457	18.44	18.50	
		11	2462	18.45	18.50	
	802.11g 6Mbps	1	2412	16.50	17.00	95.28
		2	2417	16.96	17.00	
		6	2437	16.64	17.00	
		10	2457	16.79	17.00	
		11	2462	16.54	17.00	
	802.11n-HT20 MCS0	1	2412	15.72	16.00	94.95
		2	2417	16.80	17.00	
		6	2437	16.53	17.00	
		10	2457	16.92	17.00	
		11	2462	16.68	17.00	
	802.11n-HT40 MCS0	3	2422	15.44	15.50	90.20
		4	2427	15.94	16.00	
		6	2437	16.13	16.50	
		8	2447	15.94	16.00	
		9	2452	15.30	15.50	
	802.11ac-VHT20 MCS0	1	2412	15.60	16.00	95.28
		2	2417	16.60	17.00	
		6	2437	16.47	16.50	
		10	2457	16.85	17.00	
		11	2462	16.50	17.00	
	802.11ac-VHT40 MCS0	3	2422	15.18	15.50	91.35
		4	2427	15.71	16.00	
		6	2437	15.68	16.00	
		8	2447	15.67	16.00	
		9	2452	15.14	15.50	

<2.4GHz WLAN ANT 2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	18.22	18.50	100.00
		2	2417	18.32	18.50	
		6	2437	18.19	18.50	
		10	2457	18.33	18.50	
		11	2462	18.34	18.50	
	802.11g 6Mbps	1	2412	16.41	16.50	94.39
		2	2417	16.94	17.00	
		6	2437	16.75	17.00	
		10	2457	16.94	17.00	
		11	2462	16.81	17.00	
	802.11n-HT20 MCS0	1	2412	15.22	15.50	94.95
		2	2417	16.82	17.00	
		6	2437	16.99	17.00	
		10	2457	16.91	17.00	
		11	2462	16.44	16.50	
	802.11n-HT40 MCS0	3	2422	14.34	14.50	90.20
		4	2427	15.26	15.50	
		6	2437	16.17	16.50	
		8	2447	15.33	15.50	
		9	2452	14.84	15.00	
	802.11ac-VHT20 MCS0	1	2412	15.20	15.50	94.49
		2	2417	16.80	17.00	
		6	2437	16.96	17.00	
		10	2457	16.90	17.00	
		11	2462	16.43	16.50	
	802.11ac-VHT40 MCS0	3	2422	14.33	14.50	91.35
		4	2427	15.14	15.50	
		6	2437	15.88	16.00	
		8	2447	15.18	15.50	
		9	2452	14.83	15.00	

<2.4GHz WLAN ANT 1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	21.25	21.50	100.00
		2	2417	21.23	21.50	
		6	2437	21.40	21.50	
		10	2457	21.43	21.50	
		11	2462	21.49	21.50	
	802.11g 6Mbps	1	2412	19.16	19.50	95.33
		2	2417	19.55	20.00	
		6	2437	19.71	20.00	
		10	2457	19.95	20.00	
		11	2462	19.15	19.50	
	802.11n-HT20 MCS0	1	2412	17.31	17.50	94.95
		2	2417	19.54	20.00	
		6	2437	19.59	20.00	
		10	2457	19.95	20.00	
		11	2462	18.96	19.00	
	802.11n-HT40 MCS0	3	2422	16.36	16.50	90.20
		4	2427	17.77	18.00	
		6	2437	18.12	18.50	
		8	2447	17.48	17.50	
		9	2452	17.96	18.00	
	802.11ac-VHT20 MCS0	1	2412	17.27	17.50	94.49
		2	2417	19.33	19.50	
		6	2437	19.58	20.00	
		10	2457	19.85	20.00	
		11	2462	18.83	19.00	
	802.11ac-VHT40 MCS0	3	2422	16.35	16.50	90.48
		4	2427	17.56	18.00	
		6	2437	17.98	18.00	
		8	2447	17.31	17.50	
		9	2452	17.87	18.00	

<Beamforming Mode>

<2.4GHz WLAN Antenna 1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11ac-VHT20 MCS0	1	2412	19.63	20.00	100.00
		6	2437	19.95	20.00	
		11	2462	19.83	20.00	
	802.11ac-VHT40 MCS0	3	2422	19.01	19.50	100.00
		6	2437	19.41	19.50	
		9	2452	17.96	18.00	

<Non-beamforming Mode>

<5GHz WLAN ANT1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	18.38	18.50	95.31
		40	5200	18.33	18.50	
		44	5220	18.40	18.50	
		48	5240	18.40	18.50	
	802.11n-HT20 MCS0	36	5180	17.73	18.00	94.96
		40	5200	17.70	18.00	
		44	5220	17.60	18.00	
		48	5240	17.55	18.00	
	802.11n-HT40 MCS0	38	5190	15.85	16.00	91.18
		46	5230	16.60	17.00	
	802.11ac-VHT20 MCS0	36	5180	17.29	17.50	95.50
		40	5200	17.69	18.00	
		44	5220	17.26	17.50	
		48	5240	17.19	17.50	
	802.11ac-VHT40 MCS0	38	5190	15.67	16.00	92.16
		46	5230	16.07	16.50	
	802.11ac-VHT80 MCS0	42	5210	14.96	15.00	88.24

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	18.19	18.50	95.31
		56	5280	18.15	18.50	
		60	5300	18.33	18.50	
		64	5320	17.96	18.00	
	802.11n-HT20 MCS0	52	5260	17.62	18.00	94.96
		56	5280	17.60	18.00	
		60	5300	17.92	18.00	
		64	5320	17.96	18.00	
	802.11n-HT40 MCS0	54	5270	16.66	17.00	91.18
		62	5310	12.75	13.00	
	802.11ac-VHT20 MCS0	52	5260	17.19	17.50	95.50
		56	5280	17.59	18.00	
		60	5300	17.45	17.50	
		64	5320	17.51	18.00	
	802.11ac-VHT40 MCS0	54	5270	16.14	16.50	92.16
		62	5310	12.57	13.00	
	802.11ac-VHT80 MCS0	58	5290	11.89	12.00	88.24

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	17.81	18.00	95.31
		116	5580	17.83	18.00	
		124	5620	17.80	18.00	
		132	5660	17.80	18.00	
		144	5720	17.80	18.00	
	802.11n-HT20 MCS0	100	5500	17.98	18.00	94.96
		116	5580	17.70	18.00	
		124	5620	17.80	18.00	
		132	5660	17.59	18.00	
		144	5720	17.57	18.00	
	802.11n-HT40 MCS0	102	5510	15.01	15.50	91.18
		110	5550	16.94	17.00	
		126	5630	16.86	17.00	
		134	5670	16.58	17.00	
		142	5710	16.78	17.00	
	802.11ac-VHT20 MCS0	100	5500	17.42	17.50	95.50
		116	5580	17.29	17.50	
		124	5620	17.79	18.00	
		132	5660	17.58	18.00	
		144	5720	17.25	17.50	
	802.11ac-VHT40 MCS0	102	5510	14.80	15.00	92.16
		110	5550	16.44	16.50	
		126	5630	16.85	17.00	
		134	5670	16.07	16.50	
		142	5710	16.30	16.50	
	802.11ac-VHT80 MCS0	106	5530	14.24	14.50	88.24
		122	5610	16.60	17.00	
		138	5690	16.85	17.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	18.24	18.50	95.31
		157	5785	18.26	18.50	
		165	5825	18.25	18.50	
	802.11n-HT20 MCS0	149	5745	17.63	18.00	94.96
		157	5785	17.94	18.00	
		165	5825	17.69	18.00	
	802.11n-HT40 MCS0	151	5755	16.67	17.00	91.18
		159	5795	16.60	17.00	
	802.11ac-VHT20 MCS0	149	5745	17.05	17.50	95.50
		157	5785	17.45	17.50	
		165	5825	17.15	17.50	
	802.11ac-VHT40 MCS0	151	5755	16.00	16.50	92.16
		159	5795	15.98	16.00	
	802.11ac-VHT80 MCS0	155	5775	16.91	17.00	88.24

<5GHz WLAN ANT2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	18.16	18.50	95.31
		40	5200	18.20	18.50	
		44	5220	18.23	18.50	
		48	5240	18.18	18.50	
	802.11n-HT20 MCS0	36	5180	17.72	18.00	94.97
		40	5200	17.61	18.00	
		44	5220	17.63	18.00	
		48	5240	17.59	18.00	
	802.11n-HT40 MCS0	38	5190	14.86	15.00	91.18
		46	5230	16.66	17.00	
	802.11ac-VHT20 MCS0	36	5180	17.16	17.50	95.50
		40	5200	17.60	18.00	
		44	5220	17.15	17.50	
		48	5240	17.12	17.50	
	802.11ac-VHT40 MCS0	38	5190	14.50	15.00	92.16
		46	5230	16.20	16.50	
	802.11ac-VHT80 MCS0	42	5210	13.89	14.00	88.24

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	17.08	17.50	95.31
		56	5280	17.10	17.50	
		60	5300	17.09	17.50	
		64	5320	17.01	17.50	
	802.11n-HT20 MCS0	52	5260	17.01	17.50	94.97
		56	5280	17.00	17.50	
		60	5300	17.16	17.50	
		64	5320	17.11	17.50	
	802.11n-HT40 MCS0	54	5270	16.61	17.00	91.18
		62	5310	13.02	13.50	
	802.11ac-VHT20 MCS0	52	5260	16.62	17.00	95.50
		56	5280	16.99	17.00	
		60	5300	16.95	17.00	
		64	5320	16.99	17.00	
	802.11ac-VHT40 MCS0	54	5270	16.14	16.50	92.16
		62	5310	12.83	13.00	
	802.11ac-VHT80 MCS0	58	5290	11.44	11.50	88.24

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	16.49	16.70	95.31
		116	5580	16.61	16.70	
		124	5620	16.41	16.70	
		132	5660	16.40	16.70	
		144	5720	16.23	16.70	
	802.11n-HT20 MCS0	100	5500	16.31	16.70	94.97
		116	5580	16.47	16.70	
		124	5620	16.45	16.70	
		132	5660	16.02	16.70	
		144	5720	16.31	16.70	
	802.11n-HT40 MCS0	102	5510	14.59	15.00	91.18
		110	5550	16.41	16.50	
		126	5630	16.21	16.50	
		134	5670	16.22	16.50	
		142	5710	16.05	16.50	
	802.11ac-VHT20 MCS0	100	5500	15.75	16.70	95.50
		116	5580	16.39	16.70	
		124	5620	16.44	16.70	
		132	5660	16.01	16.70	
		144	5720	15.96	16.70	
	802.11ac-VHT40 MCS0	102	5510	14.30	15.00	92.16
		110	5550	15.94	16.50	
		126	5630	16.20	16.50	
		134	5670	15.83	16.50	
		142	5710	15.64	16.50	
	802.11ac-VHT80 MCS0	106	5530	14.25	14.50	88.24
		122	5610	16.01	16.50	
		138	5690	16.15	16.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	17.12	17.20	95.31
		157	5785	17.13	17.30	
		165	5825	16.98	17.00	
	802.11n-HT20 MCS0	149	5745	17.18	17.30	94.97
		157	5785	16.87	17.30	
		165	5825	16.92	17.30	
	802.11n-HT40 MCS0	151	5755	16.60	17.00	91.18
		159	5795	16.55	17.00	
	802.11ac-VHT20 MCS0	149	5745	17.17	17.30	95.50
		157	5785	16.85	17.00	
		165	5825	16.75	17.00	
	802.11ac-VHT40 MCS0	151	5755	16.57	17.00	92.16
		159	5795	16.53	17.00	
	802.11ac-VHT80 MCS0	155	5775	16.74	17.00	88.24

<5GHz WLAN ANT1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	21.23	21.50	95.77
		40	5200	21.28	21.50	
		44	5220	21.32	21.50	
		48	5240	21.25	21.50	
	802.11n-HT20 MCS0	36	5180	20.59	21.00	95.48
		40	5200	20.58	21.00	
		44	5220	20.54	21.00	
		48	5240	20.63	21.00	
	802.11n-HT40 MCS0	38	5190	17.01	17.50	91.18
		46	5230	19.63	20.00	
	802.11ac-VHT20 MCS0	36	5180	20.54	21.00	95.48
		40	5200	20.57	21.00	
		44	5220	20.51	21.00	
		48	5240	20.61	21.00	
	802.11ac-VHT40 MCS0	38	5190	16.97	17.00	91.26
		46	5230	19.59	20.00	
	802.11ac-VHT80 MCS0	42	5210	14.83	15.00	88.24

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	20.35	20.50	95.77
		56	5280	20.40	20.50	
		60	5300	20.49	20.50	
		64	5320	19.15	19.50	
	802.11n-HT20 MCS0	52	5260	20.06	20.50	95.48
		56	5280	20.13	20.50	
		60	5300	20.20	20.50	
		64	5320	19.43	19.50	
	802.11n-HT40 MCS0	54	5270	19.63	20.00	91.18
		62	5310	14.76	15.00	
	802.11ac-VHT20 MCS0	52	5260	20.01	20.50	95.48
		56	5280	20.12	20.50	
		60	5300	20.14	20.50	
		64	5320	19.38	19.50	
	802.11ac-VHT40 MCS0	54	5270	19.57	20.00	91.26
		62	5310	14.70	15.00	
	802.11ac-VHT80 MCS0	58	5290	12.18	12.50	88.24

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	19.26	19.70	95.77
		116	5580	19.14	19.70	
		124	5620	19.13	19.70	
		132	5660	19.11	19.70	
		144	5720	19.27	19.70	
	802.11n-HT20 MCS0	100	5500	19.49	19.70	95.48
		116	5580	19.22	19.70	
		124	5620	19.41	19.70	
		132	5660	19.40	19.70	
		144	5720	19.40	19.70	
	802.11n-HT40 MCS0	102	5510	17.34	17.50	91.18
		110	5550	19.11	19.70	
		126	5630	19.10	19.70	
		134	5670	19.20	19.70	
		142	5710	19.09	19.70	
	802.11ac-VHT20 MCS0	100	5500	19.42	19.70	95.48
		116	5580	19.20	19.70	
		124	5620	19.40	19.70	
		132	5660	19.39	19.70	
		144	5720	19.36	19.70	
	802.11ac-VHT40 MCS0	102	5510	17.29	17.50	91.26
		110	5550	19.03	19.70	
		126	5630	19.09	19.70	
		134	5670	19.18	19.70	
		142	5710	19.06	19.70	
	802.11ac-VHT80 MCS0	106	5530	16.57	17.00	88.24
		122	5610	19.16	19.70	
		138	5690	19.00	19.70	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	19.35	19.50	95.77
		157	5785	20.06	20.30	
		165	5825	20.02	20.30	
	802.11n-HT20 MCS0	149	5745	20.17	20.30	95.48
		157	5785	19.93	20.30	
		165	5825	19.99	20.30	
	802.11n-HT40 MCS0	151	5755	19.88	20.00	91.18
		159	5795	19.63	20.00	
	802.11ac-VHT20 MCS0	149	5745	20.11	20.30	95.48
		157	5785	19.90	20.30	
		165	5825	19.94	20.30	
	802.11ac-VHT40 MCS0	151	5755	19.83	20.00	91.26
		159	5795	19.53	20.00	
	802.11ac-VHT80 MCS0	155	5775	19.51	20.00	88.24

<Beamforming Mode>

<5GHz WLAN ANT1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11ac-VHT20 MCS0	36	5180	20.54	21.00	100.00
		40	5200	20.50	21.00	
		44	5220	20.65	21.00	
		48	5240	20.64	21.00	
	802.11ac-VHT40 MCS0	38	5190	17.92	18.00	100.00
		46	5230	19.68	20.00	
	802.11ac-VHT80 MCS0	42	5210	16.46	16.50	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11ac-VHT20 MCS0	52	5260	20.15	20.50	100.00
		56	5280	20.05	20.50	
		60	5300	20.11	20.50	
		64	5320	19.34	19.50	
	802.11ac-VHT40 MCS0	54	5270	19.68	20.00	100.00
		62	5310	14.97	15.00	
	802.11ac-VHT80 MCS0	58	5290	14.18	14.50	100.00

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11ac-VHT20 MCS0	100	5500	19.67	20.00	100.00
		116	5580	19.53	20.00	
		124	5620	19.52	20.00	
		132	5660	19.50	20.00	
		144	5720	19.48	19.50	
	802.11ac-VHT40 MCS0	102	5510	17.61	18.00	100.00
		110	5550	19.67	20.00	
		126	5630	19.45	19.50	
		134	5670	19.46	19.50	
		142	5710	19.26	19.50	
	802.11ac-VHT80 MCS0	106	5530	17.83	18.00	100.00
		122	5610	19.38	19.50	
		138	5690	19.42	19.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11ac-VHT20 MCS0	149	5745	19.88	20.00	100.00
		157	5785	19.82	20.00	
		165	5825	19.92	20.00	
	802.11ac-VHT40 MCS0	151	5755	19.66	20.00	100.00
		159	5795	19.51	20.00	
	802.11ac-VHT80 MCS0	155	5775	19.61	20.00	100.00

12. Bluetooth Exclusions Applied

Mode Band	Max Average power(dBm)	
	BR/EDR	LE
2.4GHz Bluetooth	3.0	2.5

Note:

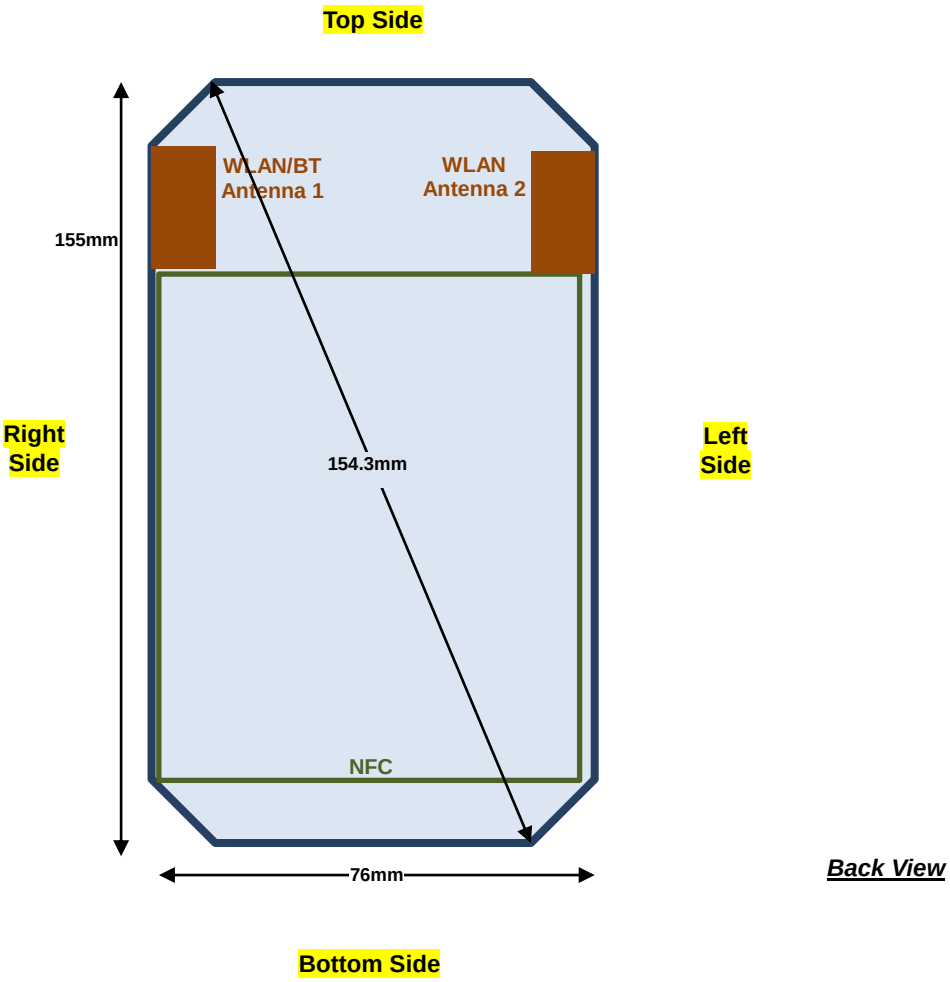
1. Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g 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

Bluetooth Max Power (dBm)	Separation Distance (mm)	Frequency (GHz)	exclusion thresholds
3.0	< 5	2.48	0.56

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 is 0.63 which is <= 3, SAR testing is not required.

13. Antenna Location



14. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For 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, for U-NII-1 Ant 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. Per KDB 248227 D01v02r02, for U-NII-2A Ant 2 SAR testing is not required when the U-NII-I band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-2A band.
4. 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.
5. 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.
6. 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.
7. 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.
8. During SAR testing the WLAN transmission was verified using a spectrum analyzer.
9. When EUT is placed into the holster, only front face of EUT will toward to the human body.

14.1 Head SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Battery	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	0mm	Ant 1	Battery 1	11	2462	18.45	18.50	1.012	100	1.000	0.02	0.461	0.466
	WLAN2.4GHz	802.11b 1Mbps	Right Tilted	0mm	Ant 1	Battery 1	11	2462	18.45	18.50	1.012	100	1.000	-0.01	0.482	0.488
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	Battery 1	11	2462	18.45	18.50	1.012	100	1.000	0.03	0.939	0.950
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	Battery 1	1	2412	18.30	18.50	1.047	100	1.000	0.03	0.896	0.938
01	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	Battery 1	6	2437	18.08	18.50	1.102	100	1.000	0.11	0.918	1.011
	WLAN2.4GHz	802.11b 1Mbps	Left Tilted	0mm	Ant 1	Battery 1	11	2462	18.45	18.50	1.012	100	1.000	0.09	0.422	0.427
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	Battery 2	6	2437	18.08	18.50	1.102	100	1.000	-0.05	0.906	0.998
	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	0mm	Ant 2	Battery 1	11	2462	18.34	18.50	1.038	100	1.000	-0.02	0.756	0.784
	WLAN2.4GHz	802.11b 1Mbps	Right Tilted	0mm	Ant 2	Battery 1	11	2462	18.34	18.50	1.038	100	1.000	0.19	0.631	0.655
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 2	Battery 1	11	2462	18.34	18.50	1.038	100	1.000	-0.04	0.372	0.386
	WLAN2.4GHz	802.11b 1Mbps	Left Tilted	0mm	Ant 2	Battery 1	11	2462	18.34	18.50	1.038	100	1.000	0.15	0.375	0.389
	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	0mm	Ant 2	Battery 2	11	2462	18.34	18.50	1.038	100	1.000	0.17	0.732	0.759
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 1	Battery 1	60	5300	18.33	18.50	1.040	95.31	1.049	0.05	0.195	0.213
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 1	Battery 1	60	5300	18.33	18.50	1.040	95.31	1.049	0.04	0.105	0.115
02	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 1	Battery 1	60	5300	18.33	18.50	1.040	95.31	1.049	-0.04	0.726	0.792
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 1	Battery 1	60	5300	18.33	18.50	1.040	95.31	1.049	-0.18	0.298	0.325
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 1	Battery 2	60	5300	18.33	18.50	1.040	95.31	1.049	-0.18	0.711	0.776
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	44	5220	18.23	18.50	1.064	95.31	1.049	-0.13	1.030	1.150
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	36	5180	18.16	18.50	1.082	95.31	1.049	-0.06	1.030	1.169
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	40	5200	18.20	18.50	1.072	95.31	1.049	-0.04	1.010	1.135
03	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	48	5240	18.18	18.50	1.077	95.31	1.049	-0.11	1.040	1.175
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 2	Battery 1	44	5220	18.23	18.50	1.064	95.31	1.049	0.1	0.380	0.424
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 2	Battery 1	44	5220	18.23	18.50	1.064	95.31	1.049	-0.03	0.543	0.606
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 2	Battery 1	44	5220	18.23	18.50	1.064	95.31	1.049	0	0.321	0.358
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 2	48	5240	18.18	18.50	1.077	95.31	1.049	0.06	1.020	1.152
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 1	Battery 1	116	5580	17.83	18.00	1.040	95.31	1.049	0.02	0.267	0.291
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 1	Battery 1	116	5580	17.83	18.00	1.040	95.31	1.049	0	0.251	0.274
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 1	Battery 1	116	5580	17.83	18.00	1.040	95.31	1.049	-0.16	0.598	0.653
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 1	Battery 1	116	5580	17.83	18.00	1.040	95.31	1.049	-0.08	0.287	0.313
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 1	Battery 2	116	5580	17.83	18.00	1.040	95.31	1.049	0.09	0.581	0.634
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	116	5580	16.61	16.70	1.021	95.31	1.049	-0.09	1.050	1.125
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	100	5500	16.49	16.70	1.050	95.31	1.049	-0.16	1.030	1.134
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	124	5620	16.41	16.70	1.069	95.31	1.049	-0.14	0.960	1.077
04	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	132	5660	16.40	16.70	1.072	95.31	1.049	-0.19	1.060	1.191
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	144	5720	16.23	16.70	1.115	95.31	1.049	-0.19	0.861	1.007
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 2	Battery 1	116	5580	16.61	16.70	1.021	95.31	1.049	0.08	0.454	0.486
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 2	Battery 1	116	5580	16.61	16.70	1.021	95.31	1.049	-0.03	0.579	0.620
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 2	Battery 1	116	5580	16.61	16.70	1.021	95.31	1.049	0	0.409	0.438
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 2	132	5660	16.40	16.70	1.072	95.31	1.049	0.01	1.030	1.158

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Battery	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)
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 1	Battery 1	157	5785	18.26	18.50	1.057	95.31	1.049	-0.13	0.191	0.212
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 1	Battery 1	157	5785	18.26	18.50	1.057	95.31	1.049	-0.05	0.192	0.213
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 1	Battery 1	157	5785	18.26	18.50	1.057	95.31	1.049	-0.02	0.698	0.774
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 1	Battery 1	157	5785	18.26	18.50	1.057	95.31	1.049	-0.07	0.277	0.307
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 1	Battery 2	157	5785	18.26	18.50	1.057	95.31	1.049	-0.15	0.645	0.715
05	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	157	5785	17.13	17.30	1.040	95.31	1.049	-0.06	1.090	1.189
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	149	5745	17.12	17.20	1.019	95.31	1.049	-0.15	1.110	1.186
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	165	5825	16.98	17.00	1.005	95.31	1.049	-0.09	1.120	1.181
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 2	Battery 1	157	5785	17.13	17.30	1.040	95.31	1.049	-0.03	0.415	0.453
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 2	Battery 1	157	5785	17.13	17.30	1.040	95.31	1.049	0.05	0.552	0.602
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 2	Battery 1	157	5785	17.13	17.30	1.040	95.31	1.049	0.03	0.518	0.565
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 2	157	5785	17.13	17.30	1.040	95.31	1.049	-0.04	1.070	1.168

14.2 Body Worn Accessory SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Battery	Accessories	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front	15mm	Ant 1	Battery 1		11	2462	18.45	18.50	1.012	100	1.000	-0.19	0.125	0.126
	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Ant 1	Battery 1		11	2462	18.45	18.50	1.012	100	1.000	-0.15	0.092	0.093
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 1	Battery 1	Soft Holster	11	2462	18.45	18.50	1.012	100	1.000	-0.06	0.114	0.115
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 1	Battery 1	Soft Holster+Exoskeleton +Trigger Handle	11	2462	18.45	18.50	1.012	100	1.000	-0.12	0.099	0.100
	WLAN2.4GHz	802.11b 1Mbps	Front	15mm	Ant 1	Battery 2		11	2462	18.45	18.50	1.012	100	1.000	-0.14	0.115	0.116
	WLAN2.4GHz	802.11b 1Mbps	Front	15mm	Ant 2	Battery 1		11	2462	18.34	18.50	1.038	100	1.000	-0.01	0.119	0.123
	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Ant 2	Battery 1		11	2462	18.34	18.50	1.038	100	1.000	0.04	0.210	0.218
	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Ant 2	Battery 1		1	2412	18.22	18.50	1.067	100	1.000	-0.12	0.184	0.196
06	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Ant 2	Battery 1		6	2437	18.19	18.50	1.074	100	1.000	-0.17	0.215	0.231
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 2	Battery 1	Soft Holster	6	2437	18.19	18.50	1.074	100	1.000	0.05	0.113	0.121
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 2	Battery 1	Soft Holster+Exoskeleton +Trigger Handle	6	2437	18.19	18.50	1.074	100	1.000	-0.13	0.075	0.081
	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Ant 2	Battery 2		6	2437	18.19	18.50	1.074	100	1.000	0.07	0.205	0.220
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Ant 1	Battery 1		60	5300	18.33	18.50	1.040	95.31	1.049	-0.02	0.144	0.157
07	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		60	5300	18.33	18.50	1.040	95.31	1.049	-0.12	0.849	0.926
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		52	5260	18.19	18.50	1.074	95.31	1.049	-0.13	0.718	0.809
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		56	5280	18.15	18.50	1.084	95.31	1.049	-0.17	0.734	0.835
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		64	5320	17.96	18.00	1.009	95.31	1.049	-0.19	0.834	0.883
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	Battery 1	Soft Holster	60	5300	18.33	18.50	1.040	95.31	1.049	0.02	0.134	0.146
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	Battery 1	Soft Holster+Exoskeleton +Trigger Handle	60	5300	18.33	18.50	1.040	95.31	1.049	0.01	0.139	0.152
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 2		60	5300	18.33	18.50	1.040	95.31	1.049	0.03	0.840	0.917
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Ant 2	Battery 1		44	5220	18.23	18.50	1.064	95.31	1.049	-0.01	0.131	0.146
08	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 2	Battery 1		44	5220	18.23	18.50	1.064	95.31	1.049	-0.08	0.337	0.376
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	Battery 1	Soft Holster	44	5220	18.23	18.50	1.064	95.31	1.049	-0.01	0.158	0.176
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	Battery 1	Soft Holster+Exoskeleton +Trigger Handle	44	5220	18.23	18.50	1.064	95.31	1.049	-0.04	0.124	0.138
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 2	Battery 2		44	5220	18.23	18.50	1.064	95.31	1.049	-0.11	0.284	0.317
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Ant 1	Battery 1		116	5580	17.83	18.00	1.040	95.31	1.049	0.01	0.144	0.157
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		116	5580	17.83	18.00	1.040	95.31	1.049	-0.05	0.823	0.898
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		100	5500	17.81	18.00	1.045	95.31	1.049	-0.02	0.763	0.836
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		124	5620	17.80	18.00	1.047	95.31	1.049	-0.08	0.691	0.759
09	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		132	5660	17.80	18.00	1.047	95.31	1.049	-0.14	0.916	1.006
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		144	5720	17.80	18.00	1.047	95.31	1.049	-0.14	0.884	0.971
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	Battery 1	Soft Holster	132	5660	17.80	18.00	1.047	95.31	1.049	-0.01	0.131	0.144
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	Battery 1	Soft Holster+Exoskeleton +Trigger Handle	132	5660	17.80	18.00	1.047	95.31	1.049	-0.08	0.163	0.179
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 2		132	5660	17.80	18.00	1.047	95.31	1.049	-0.14	0.850	0.934
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Ant 2	Battery 1		116	5580	16.61	16.70	1.021	95.31	1.049	0.1	0.143	0.153
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 2	Battery 1		116	5580	16.61	16.70	1.021	95.31	1.049	-0.05	0.357	0.382
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	Battery 1	Soft Holster	116	5580	16.61	16.70	1.021	95.31	1.049	-0.04	0.156	0.167
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	Battery 1	Soft Holster+Exoskeleton +Trigger Handle	116	5580	16.61	16.70	1.021	95.31	1.049	-0.15	0.158	0.169
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 2	Battery 2		116	5580	16.61	16.70	1.021	95.31	1.049	-0.13	0.313	0.335

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Battery	Accessories	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Ant 1	Battery 1		157	5785	18.26	18.50	1.057	95.31	1.049	-0.09	0.155	0.172
10	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		157	5785	18.26	18.50	1.057	95.31	1.049	-0.16	0.951	1.055
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		149	5745	18.24	18.50	1.062	95.31	1.049	-0.06	0.925	1.031
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1		165	5825	18.25	18.50	1.060	95.31	1.049	-0.1	0.936	1.040
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	Battery 1	Soft Holster	157	5785	18.26	18.50	1.057	95.31	1.049	-0.16	0.149	0.165
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	Battery 1	Soft Holster+Exoskeleton +Trigger Handle	157	5785	18.26	18.50	1.057	95.31	1.049	-0.08	0.169	0.187
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 2		157	5785	18.26	18.50	1.057	95.31	1.049	-0.01	0.891	0.988
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Ant 2	Battery 1		157	5785	17.30	17.30	1.000	95.31	1.049	-0.07	0.157	0.165
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 2	Battery 1		157	5785	17.30	17.30	1.000	95.31	1.049	-0.01	0.310	0.325
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Ant 2	Battery 1	Soft Holster	157	5785	17.30	17.30	1.000	95.31	1.049	-0.09	0.108	0.113
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	Battery 1	Soft Holster+Exoskeleton +Trigger Handle	157	5785	17.30	17.30	1.000	95.31	1.049	-0.09	0.155	0.163
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 2	Battery 2		157	5785	17.30	17.30	1.000	95.31	1.049	-0.16	0.354	0.371

14.3 Repeated SAR Measurement

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Battery	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	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	Battery 1	11	2462	18.45	18.50	1.012	100	1.000	0.03	0.939		0.950
2nd	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	Battery 1	11	2462	18.45	18.50	1.012	100	1.000	0.08	0.932	1.00	0.943
1st	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	48	5240	18.18	18.50	1.077	95.31	1.049	-0.11	1.040		1.175
2nd	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	48	5240	18.18	18.50	1.077	95.31	1.049	-0.03	0.996	1.04	1.125
1st	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	132	5660	16.40	16.70	1.072	95.31	1.049	-0.19	1.060		1.191
2nd	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	132	5660	16.40	16.70	1.072	95.31	1.049	-0.01	1.050	1.00	1.180
1st	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	165	5825	16.98	17.00	1.005	95.31	1.049	-0.09	1.120		1.181
2nd	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	Battery 1	165	5825	16.98	17.00	1.005	95.31	1.049	-0.12	1.090	1.02	1.149
1st	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1	60	5300	18.33	18.50	1.040	95.31	1.049	-0.12	0.849		0.926
2nd	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1	60	5300	18.33	18.50	1.040	95.31	1.049	-0.05	0.803	1.06	0.876
1st	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1	132	5660	17.80	18.00	1.047	95.31	1.049	-0.14	0.916		1.006
2nd	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1	132	5660	17.80	18.00	1.047	95.31	1.049	-0.11	0.904	1.01	0.993
1st	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1	157	5785	18.26	18.50	1.057	95.31	1.049	-0.16	0.951		1.055
2nd	WLAN5GHz	802.11a 6Mbps	Back	15mm	Ant 1	Battery 1	157	5785	18.26	18.50	1.057	95.31	1.049	0.12	0.947	1.00	1.050

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	Head	Body-worn
1.	WLAN Ant 1 + WLAN Ant 2	Yes	Yes
2.	Bluetooth Ant 1 + WLAN Ant 2	Yes	Yes

General Note:

1. WLAN RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode. Therefore SPLSR calculation was choose worst case with SAR test results of each antenna in SISO mode perform evaluation.
2. For 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.
3. WLAN and Bluetooth share the same antenna 1, and cannot transmit simultaneously.
4. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment.
5. The Scaled SAR summation is calculated based on the same configuration and test position.
6. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/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, simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
   v) The SPLSR calculated results please refer to section 16.2.
7. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v06 based on the formula below.
   i) (*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[√f(GHz)/*x*] W/kg for *test separation distances* ≤ 50 mm; where *x* = 7.5 for 1-g SAR, and *x* = 18.75 for 10-g SAR.
   ii) When the minimum separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
   iii) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the *test separation distances* is > 50 mm.

Bluetooth Max Power	Exposure Position	Head	Body worn
	Test separation	0 mm	15 mm
2.5 dBm	Estimated SAR (W/kg)	0.084 W/kg	0.028 W/kg

15.1 Head Exposure Conditions

Exposure Position	1	2	3	4	5	1+2 Summed 1g SAR (W/kg)	3+4 Summed 1g SAR (W/kg)	1+4 Summed 1g SAR (W/kg)	1+5 Summed 1g SAR (W/kg)	3+5 Summed 1g SAR (W/kg)	SPLSR	Case No
	2.4GHz WLAN Ant 1	2.4GHz WLAN Ant 2	5GHz WLAN Ant 1	5GHz WLAN Ant 2	Bluetooth Ant 2							
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)							
Right Cheek	0.466	0.784	0.291	1.191	0.084	**1.250**	**1.482**	**1.657**	**0.550**	**0.375**	0.040	Case 1
Right Tilted	0.488	0.655	0.274	0.486	0.084	**1.143**	**0.760**	**0.974**	**0.572**	**0.358**		
Left Cheek	1.011	0.386	0.792	0.620	0.084	**1.397**	**1.412**	**1.631**	**1.095**	**0.876**	0.030	Case 2
Left Tilted	0.427	0.389	0.325	0.565	0.084	**0.816**	**0.890**	**0.992**	**0.511**	**0.409**		

15.2 Body-Worn Accessory Exposure Conditions

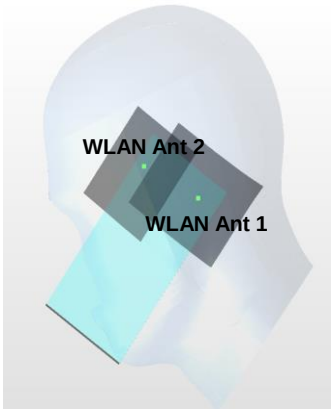
Exposure Position	1	2	3	4	5	1+2 Summed 1g SAR (W/kg)	3+4 Summed 1g SAR (W/kg)	1+4 Summed 1g SAR (W/kg)	1+5 Summed 1g SAR (W/kg)	3+5 Summed 1g SAR (W/kg)
	2.4GHz WLAN Ant 1	2.4GHz WLAN Ant 2	5GHz WLAN Ant 1	5GHz WLAN Ant 2	Bluetooth Ant 2					
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)					
Front at 15mm	0.126	0.123	0.172	0.165	0.028	**0.249**	**0.337**	**0.291**	**0.154**	**0.200**
Back at 15mm	0.093	0.231	1.055	0.382	0.028	**0.324**	**1.437**	**0.475**	**0.121**	**1.083**
Front with Soft Holster at 0mm	0.115	0.121	0.165	0.176	0.084	**0.236**	**0.341**	**0.291**	**0.199**	**0.249**
Front with Soft Holster+Exoskeleton+Trigger Handle at 0mm	0.100	0.081	0.187	0.169	0.084	**0.181**	**0.356**	**0.269**	**0.184**	**0.271**

15.3 SPLSR Evaluation and Analysis

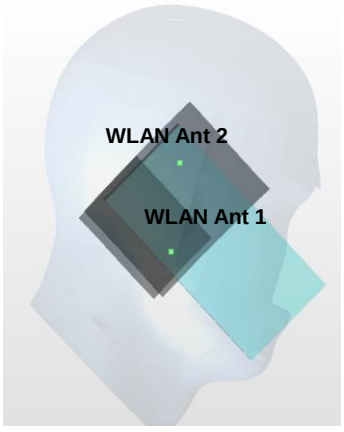
General Note:

1. SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (*min. separation distance, mm*). If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary

Case 1	Band	Position	SAR (W/kg)	Gap (mm)	SAR peak location (mm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
					X	Y	Z				
	WLAN2.4G Ant 1	Right Cheek	0.466	0	-0.42	22.54	1.92	51.1	1.66	0.04	Not required
	WLAN5G Ant 2		1.191	0	30.26	-18.09	-2.12				



Case 2	Band	Position	SAR (W/kg)	Gap (mm)	SAR peak location (mm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
					X	Y	Z				
	WLAN2.4G Ant 1	Left Cheek	1.011	0	15.93	12.95	-2.59	64.1	1.63	0.03	Not required
	WLAN5G Ant 2		0.62	0	26.07	-50.28	-0.92				



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16. Uncertainty Assessment

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg. 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 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 648474 D04 v01r03, “SAR Evaluation Considerations for Wireless Handsets”, Oct 2015.

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

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