



# FCC SAR TEST REPORT

**FCC ID** : U4G-Q10W  
**Equipment** : PDA  
**Brand Name** : DATALOGIC  
**Model Name** : MEMOR 20  
**Applicant** : Datalogic S.r.l.  
Via S. Vitalino, 13 40012, Lippo di Calderara  
di Reno (BO) ITALY  
**Manufacturer** : Datalogic S.r.l.  
Via S. Vitalino, 13 40012, Lippo di Calderara  
di Reno (BO) ITALY  
**Standard** : FCC 47 CFR Part 2 (2.1093)  
ANSI/IEEE C95.1-1992  
IEEE 1528-2013

The product was received on Apr. 10, 2019 and testing was started from May 03, 2019 and completed on May 07, 2019. 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 report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Cona Huang / Deputy Manager

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## History of this test report



## 1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Datalogic S.r.l., PDA, MEMOR 20**, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary			Highest Simultaneous Transmission 1g SAR (W/kg)	Highest Simultaneous Transmission 10g SAR (W/kg)
		Head (Separation 0mm)	Body-worn (Separation 10mm)	Extremity (Product Specific) (Separation 0mm)		
		1g SAR (W/kg)	10g SAR (W/kg)			
DTS	2.4GHz WLAN	0.42	0.39	0.99	0.61	0.99
NII	5GHz WLAN	0.56	1.09	2.06	1.09	3.41
DSS	Bluetooth	0.03	0.02	0.05	0.85	3.41
Date of Testing:		2019/5/3 ~ 2019/5/7				

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 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

Reviewed by: Jason Wang

Report Producer: Daisy Peng

## 2. Guidance Applied

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

- 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	PDA
Brand Name	DATALOGIC
Model Name	MEMOR 20
FCC ID	U4G-Q10W
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
Mode	WLAN: 802.11a/b/g/n/ac HT20 / HT40 / VHT20 / VHT40 / VHT80 Bluetooth BR/EDR/LE
HW Version	DVT



## 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:

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

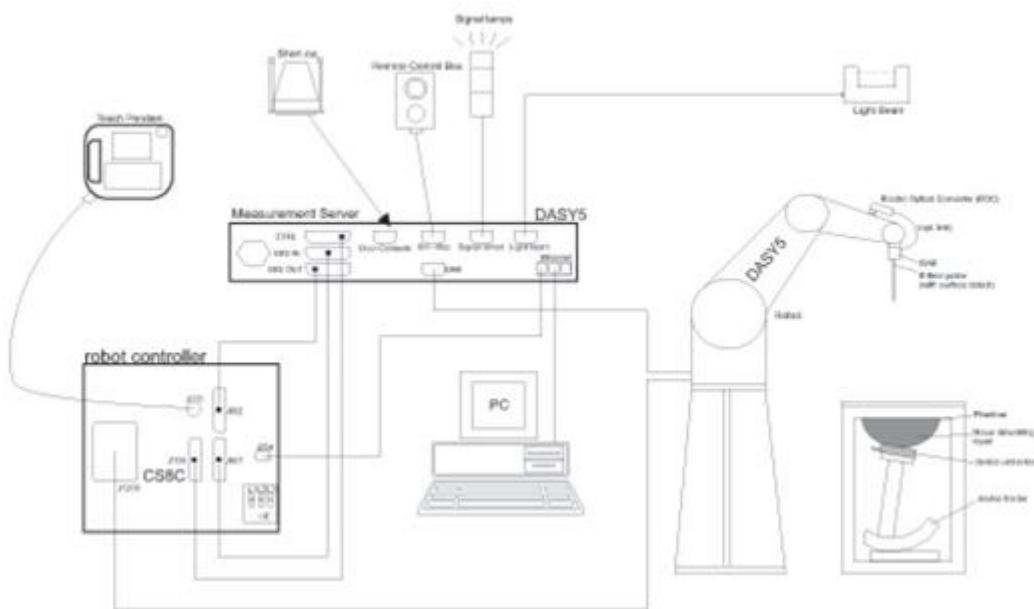
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

## **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>

<b>Construction</b>	Symmetric design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
<b>Frequency</b>	10 MHz – 4 GHz; Linearity: $\pm 0.2$ dB (30 MHz – 4 GHz)	
<b>Directivity</b>	$\pm 0.2$ dB in TSL (rotation around probe axis) $\pm 0.3$ dB in TSL (rotation normal to probe axis)	
<b>Dynamic Range</b>	5 $\mu$ W/g – >100 mW/g; Linearity: $\pm 0.2$ dB	
<b>Dimensions</b>	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>

<b>Construction</b>	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
<b>Frequency</b>	10 MHz – >6 GHz Linearity: $\pm 0.2$ dB (30 MHz – 6 GHz)	
<b>Directivity</b>	$\pm 0.3$ dB in TSL (rotation around probe axis) $\pm 0.5$ dB in TSL (rotation normal to probe axis)	
<b>Dynamic Range</b>	10 $\mu$ W/g – >100 mW/g Linearity: $\pm 0.2$ dB (noise: typically <1 $\mu$ W/g)	
<b>Dimensions</b>	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 M $\Omega$ ; 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>

<b>Shell Thickness</b>	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm	 A photograph of the SAM Twin Phantom. It is a white, rectangular phantom housed in a clear acrylic frame. A black device holder is mounted inside, holding a black device. Three small red markers are visible on the top surface of the phantom.
<b>Filling Volume</b>	Approx. 25 liters	
<b>Dimensions</b>	Length: 1000 mm; Width: 500 mm; Height: adjustable feet	
<b>Measurement Areas</b>	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>

<b>Shell Thickness</b>	2 ± 0.2 mm (sagging: <1%)	 A photograph of the ELI Phantom. It is a white, rectangular phantom with a red circular top. A black device holder is mounted inside, holding a black device.
<b>Filling Volume</b>	Approx. 30 liters	

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 from 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.

	$\leq 3$ GHz	$> 3$ GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	$5 \pm 1$ mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
	$\leq 2$ GHz: $\leq 15$ mm $2 - 3$ GHz: $\leq 12$ mm	$3 - 4$ GHz: $\leq 12$ mm $4 - 6$ GHz: $\leq 10$ mm
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}$ , $\Delta y_{\text{Area}}$	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	



## 7.4 Zoom Scan

Zoom scans are used to 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 whose 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.

		$\leq 3$ GHz	$> 3$ GHz
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$ , $\Delta y_{Zoom}$		$\leq 2$ GHz: $\leq 8$ mm $2 - 3$ GHz: $\leq 5$ mm*	$3 - 4$ GHz: $\leq 5$ mm* $4 - 6$ GHz: $\leq 4$ mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		$3 - 4$ GHz: $\leq 4$ mm $4 - 5$ GHz: $\leq 3$ mm $5 - 6$ GHz: $\leq 2$ mm
	graded grid	$\Delta z_{Zoom}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface	$3 - 4$ GHz: $\leq 3$ mm $4 - 5$ GHz: $\leq 2.5$ mm $5 - 6$ GHz: $\leq 2$ mm
		$\Delta z_{Zoom}(n>1)$ : between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$
Minimum zoom scan volume	x, y, z	$\geq 30$ mm	$3 - 4$ GHz: $\geq 28$ mm $4 - 5$ GHz: $\geq 25$ mm $5 - 6$ GHz: $\geq 22$ mm

Note:  $\delta$  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  $\leq 1.4$  W/kg,  $\leq 8$  mm,  $\leq 7$  mm and  $\leq 5$  mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

## 7.5 Volume Scan Procedures

The volume scan is used to 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 remains 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 installed 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	736	Aug. 31, 2018	Aug. 30, 2019
SPEAG	5GHz System Validation Kit	D5GHzV2	1006	Sep. 27, 2018	Sep. 26, 2019
SPEAG	Data Acquisition Electronics	DAE3	577	Sep. 19, 2018	Sep. 18, 2019
SPEAG	Data Acquisition Electronics	DAE4	918	Jun. 20, 2018	Jun. 19, 2019
SPEAG	Data Acquisition Electronics	DAE4	1399	Nov. 16, 2018	Nov. 15, 2019
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Sep. 24, 2018	Sep. 23, 2019
SPEAG	Dosimetric E-Field Probe	EX3DV4	3925	May. 31, 2018	May. 30, 2019
SPEAG	Dosimetric E-Field Probe	EX3DV4	3931	Sep. 27, 2018	Sep. 26, 2019
SPEAG	Dosimetric E-Field Probe	EX3DV4	7515	Oct. 03, 2018	Oct. 02, 2019
R&S	BT Base Station	CBT32	100519	May. 30, 2018	May. 29, 2019
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Dec. 11, 2018	Dec. 10, 2019
Agilent	ENA Network Analyzer	E5071C	MY46104758	Sep. 19, 2018	Sep. 18, 2019
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 19, 2018	Sep. 18, 2019
LINE SEIKI	Digital Thermometer	DTM3000-spezial	3169	Sep. 11, 2018	Sep. 10, 2019
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	1240001	Sep. 13, 2018	Sep. 12, 2019
Anritsu	Power Sensor	MA2411B	1207349	Sep. 13, 2018	Sep. 12, 2019
Agilent	Spectrum Analyzer	E4408B	MY44211028	Aug. 28, 2018	Aug. 27, 2019
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jun. 23, 2018	Jun. 22, 2019
Mini-Circuits	Power Amplifier	ZVE-8G+	070501814	Oct. 08, 2018	Oct. 07, 2019
Mini-Circuits	Power Amplifier	ZVE-8G+	6382	Aug. 09, 2018	Aug. 08, 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 10.1 Photo of Liquid Height for Head SAR

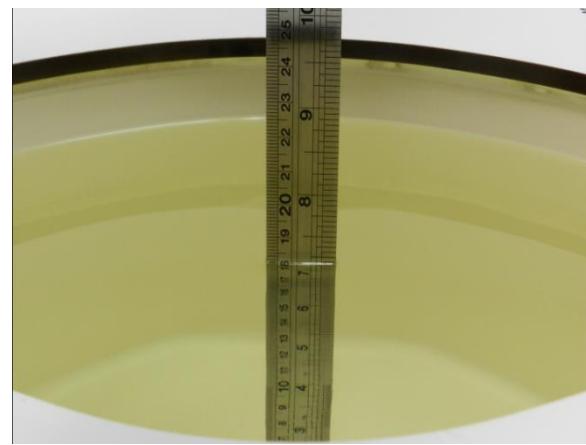


Fig 10.2 Photo of Liquid Height for Body SAR



## 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 ( $\sigma$ )	Permittivity ( $\epsilon_r$ )
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 >

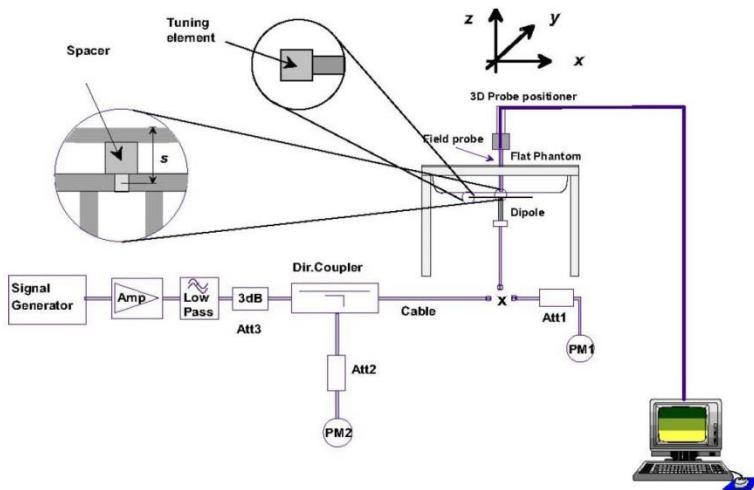
Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )	Conductivity Target ( $\sigma$ )	Permittivity Target ( $\epsilon_r$ )	Delta ( $\sigma$ ) (%)	Delta ( $\epsilon_r$ ) (%)	Limit (%)	Date
2450	HSL	22.5	1.815	38.886	1.80	39.20	0.83	-0.80	±5	2019/5/3
5250	HSL	22.4	4.750	36.074	4.71	35.95	0.85	0.34	±5	2019/5/4
5600	HSL	22.7	5.081	35.520	5.07	35.50	0.22	0.06	±5	2019/5/5
5600	HSL	22.2	5.087	35.530	5.07	35.50	0.34	0.08	±5	2019/5/6
5600	HSL	22.2	5.087	35.530	5.07	35.50	0.34	0.08	±5	2019/5/6
5600	HSL	22.1	5.013	36.071	5.07	35.50	-1.12	1.61	±5	2019/5/7
5750	HSL	22.2	5.229	35.420	5.22	35.35	0.17	0.20	±5	2019/5/6
5750	HSL	22.1	5.183	35.864	5.22	35.35	-0.71	1.45	±5	2019/5/7

### 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 (%)
2019/5/3	2450	HSL	250	D2450V2-736	ES3DV3 - SN3270	DAE3 Sn577	13.70	52.70	54.8	3.98
2019/5/4	5250	HSL	100	D5GHzV2-1006-5250	EX3DV4 - SN3931	DAE4 Sn1399	8.17	80.70	81.7	1.24
2019/5/5	5600	HSL	100	D5GHzV2-1006-5600	EX3DV4 - SN3925	DAE4 Sn1399	8.55	83.30	85.5	2.64
2019/5/6	5600	HSL	100	D5GHzV2-1006-5600	EX3DV4 - SN7515	DAE4 Sn918	8.77	83.30	87.7	5.28
2019/5/6	5600	HSL	100	D5GHzV2-1006-5600	EX3DV4 - SN3931	DAE4 Sn918	8.77	83.30	87.7	5.28
2019/5/7	5600	HSL	100	D5GHzV2-1006-5600	EX3DV4 - SN3931	DAE4 Sn918	8.42	83.30	84.2	1.08
2019/5/6	5750	HSL	100	D5GHzV2-1006-5750	EX3DV4 - SN3931	DAE4 Sn918	8.54	80.40	85.4	6.22
2019/5/7	5750	HSL	100	D5GHzV2-1006-5750	EX3DV4 - SN3931	DAE4 Sn918	8.46	80.40	84.6	5.22

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 (%)
2019/5/3	2450	HSL	250	D2450V2-736	ES3DV3 - SN3270	DAE3 Sn577	6.32	24.60	25.28	2.76
2019/5/4	5250	HSL	100	D5GHzV2-1006-5250	EX3DV4 - SN3931	DAE4 Sn1399	2.36	23.20	23.6	1.72
2019/5/5	5600	HSL	100	D5GHzV2-1006-5600	EX3DV4 - SN3925	DAE4 Sn1399	2.39	23.80	23.9	0.42
2019/5/6	5600	HSL	100	D5GHzV2-1006-5600	EX3DV4 - SN7515	DAE4 Sn918	2.43	23.80	24.3	2.10
2019/5/6	5600	HSL	100	D5GHzV2-1006-5600	EX3DV4 - SN3931	DAE4 Sn918	2.48	23.80	24.8	4.20
2019/5/7	5600	HSL	100	D5GHzV2-1006-5600	EX3DV4 - SN3931	DAE4 Sn918	2.36	23.80	23.6	-0.84
2019/5/6	5750	HSL	100	D5GHzV2-1006-5750	EX3DV4 - SN3931	DAE4 Sn918	2.38	22.90	23.8	3.93
2019/5/7	5750	HSL	100	D5GHzV2-1006-5750	EX3DV4 - SN3931	DAE4 Sn918	2.36	22.90	23.6	3.06



**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.

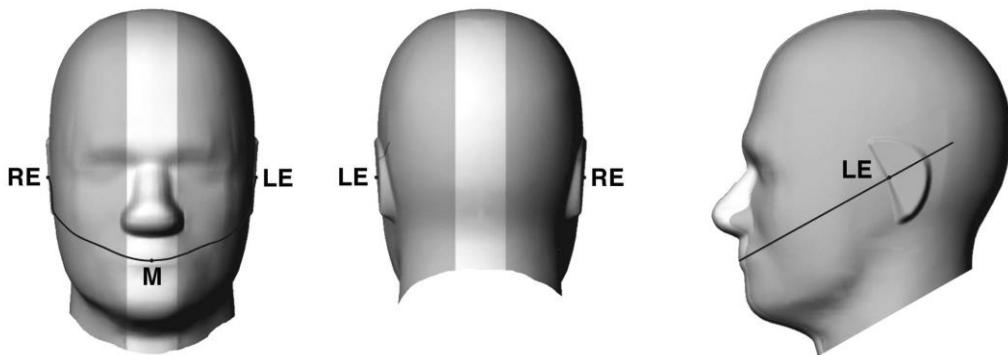


Fig 9.1.1 Front, back, and side views of SAM twin phantom

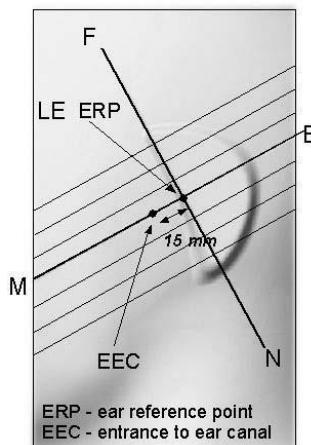


Fig 9.1.2 Close-up side view of phantom showing the ear region.

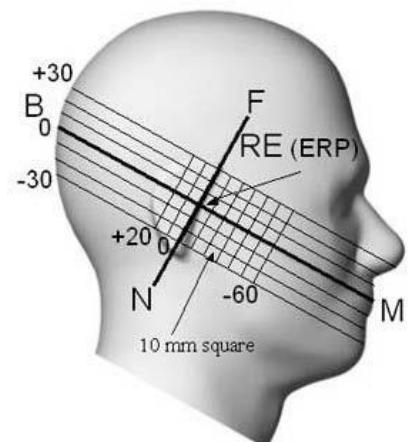


Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

## 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  $w_t$  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  $w_b$  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.

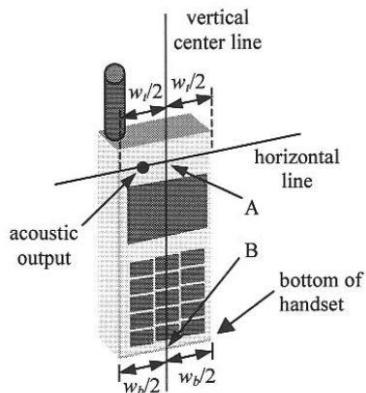


Fig 9.2.1 Handset vertical and horizontal reference lines—"fixed case"

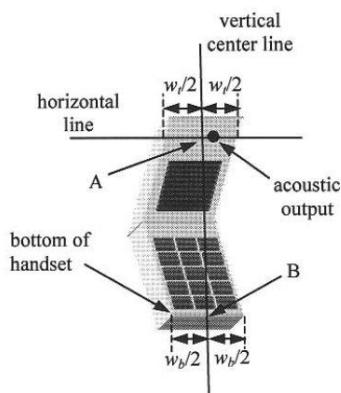


Fig 9.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

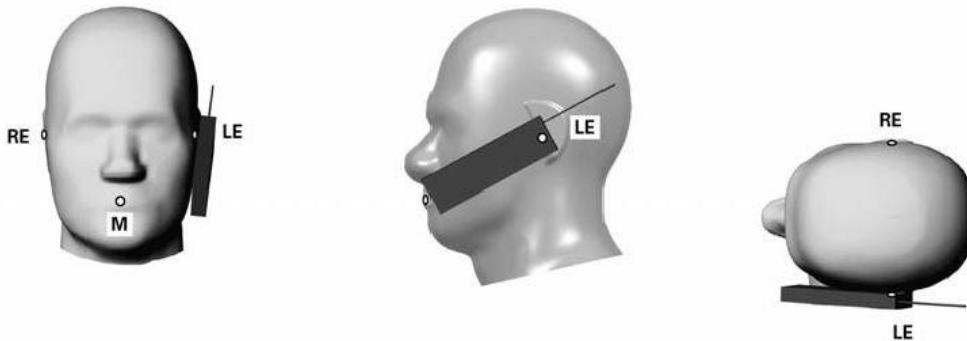
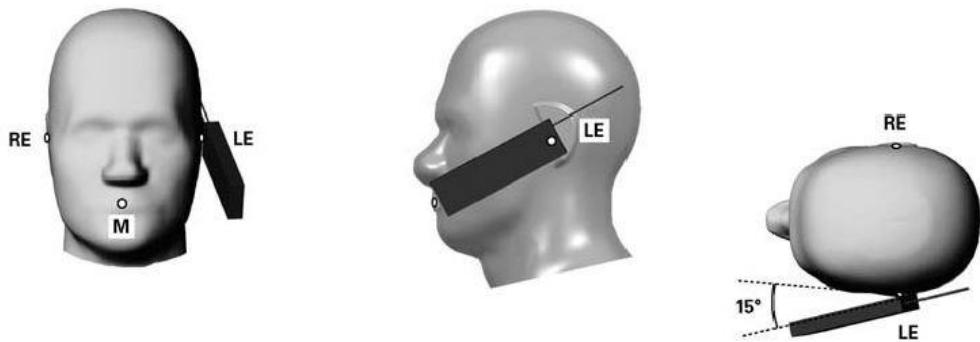


Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

### 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  $> 1.2 \text{ W/kg}$ , 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.

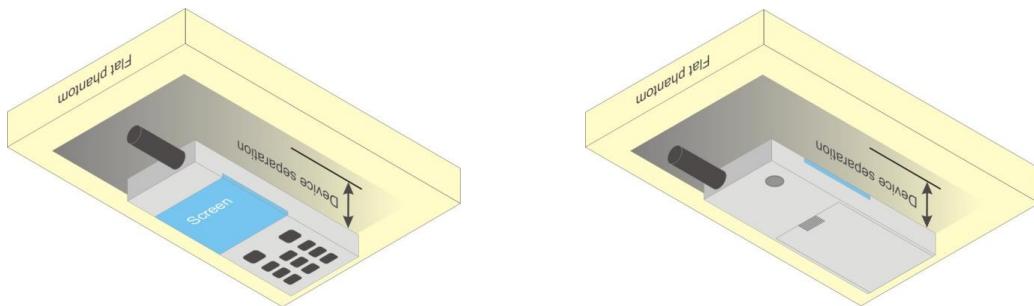


Fig 9.4 Body Worn Position

## 10.5 Extremity Exposure

For smart phones with a display diagonal dimension  $> 15.0 \text{ cm}$  or an overall diagonal dimension  $> 16.0 \text{ cm}$  that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that 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  $\leq 25 \text{ mm}$  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.<sup>6</sup> 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  $> 1.2 \text{ W/kg}$ .



## 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  $< 1.6\text{W/kg}$  and SAR peak to location ratio  $\leq 0.04$ , 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.<sup>18</sup> The initial test position procedure is described in the following:
  - a. When the reported SAR of the initial test position is  $\leq 0.4\text{ W/kg}$ , 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  $> 0.4\text{ W/kg}$ , SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closest/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is  $\leq 0.8\text{ W/kg}$  or all required test position are tested.
  - c. For all positions/configurations, when the reported SAR is  $> 0.8\text{ W/kg}$ , SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is  $\leq 1.2\text{ W/kg}$  or all required channels are tested.

**<2.4GHz WLAN ANT 1>**

2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11b 1Mbps	1	2412	18.49	19.00	99.20
		6	2437	18.24	19.00	
		11	2462	18.23	19.00	
	802.11g 6Mbps	1	2412	15.18	16.00	95.40
		6	2437	15.11	16.00	
		11	2462	15.02	16.00	
	802.11n-HT20 MCS0	1	2412	15.43	16.00	95.20
		6	2437	15.49	16.00	
		11	2462	15.46	16.00	

**<2.4GHz WLAN ANT 2>**

2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11b 1Mbps	1	2412	18.44	19.00	99.20
		6	2437	18.29	19.00	
		11	2462	18.25	19.00	
	802.11g 6Mbps	1	2412	15.15	16.00	95.40
		6	2437	15.14	16.00	
		11	2462	15.09	16.00	
	802.11n-HT20 MCS0	1	2412	15.33	16.00	95.20
		6	2437	15.21	16.00	
		11	2462	15.12	16.00	

**<2.4GHz WLAN ANT 1+2>**

2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11b 1Mbps	1	2412	21.46	21.50	99.20
		6	2437	21.26	21.50	
		11	2462	21.19	21.50	
	802.11g 6Mbps	1	2412	18.05	18.50	95.40
		6	2437	18.46	18.50	
		11	2462	17.95	18.50	
	802.11n-HT20 MCS0	1	2412	18.39	18.50	95.20
		6	2437	18.36	18.50	
		11	2462	18.30	18.50	

<5GHz WLAN ANT1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	16.13	16.50	94.30
		40	5200	16.31	16.50	
		44	5220	16.30	16.50	
		48	5240	16.29	16.50	
	802.11n-HT20 MCS0	36	5180	15.06	15.50	97.50
		40	5200	15.07	15.50	
		44	5220	15.08	15.50	
		48	5240	15.06	15.50	
	802.11n-HT40 MCS0	38	5190	14.97	15.50	94.00
		46	5230	14.84	15.50	
	802.11ac-VHT20 MCS0	36	5180	15.07	15.50	95.10
		40	5200	15.13	15.50	
		44	5220	15.11	15.50	
		48	5240	15.09	15.50	
	802.11ac-VHT40 MCS0	38	5190	14.98	15.50	91.10
		46	5230	14.87	15.50	
	802.11ac-VHT80 MCS0	42	5210	14.99	15.00	81.90

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	16.27	16.50	94.30
		56	5280	16.14	16.50	
		60	5300	16.08	16.50	
		64	5320	16.12	16.50	
	802.11n-HT20 MCS0	52	5260	15.25	15.50	97.50
		56	5280	15.11	15.50	
		60	5300	15.01	15.50	
		64	5320	14.87	15.50	
	802.11n-HT40 MCS0	54	5270	15.01	15.50	94.00
		62	5310	14.82	15.50	
	802.11ac-VHT20 MCS0	52	5260	15.27	15.50	95.10
		56	5280	15.15	15.50	
		60	5300	15.07	15.50	
		64	5320	14.88	15.50	
	802.11ac-VHT40 MCS0	54	5270	15.03	15.50	91.10
		62	5310	14.85	15.50	
	802.11ac-VHT80 MCS0	58	5290	13.29	14.00	81.90



	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	16.07	16.50	94.30
		116	5580	15.82	16.50	
		124	5620	15.91	16.50	
		132	5660	16.34	16.50	
		144	5720	16.21	16.50	
	802.11n-HT20 MCS0	100	5500	15.00	15.50	97.50
		116	5580	15.22	15.50	
		124	5620	15.23	15.50	
		132	5660	15.25	15.50	
		144	5720	15.15	15.50	
	802.11n-HT40 MCS0	102	5510	14.91	15.50	94.00
		110	5550	15.36	15.50	
		126	5630	15.18	15.50	
		134	5670	15.14	15.50	
		142	5710	15.29	15.50	
	802.11ac-VHT20 MCS0	100	5500	15.04	15.50	95.10
		116	5580	15.24	15.50	
		124	5620	15.27	15.50	
		132	5660	15.28	15.50	
		144	5720	15.20	15.50	
	802.11ac-VHT40 MCS0	102	5510	14.95	15.50	91.10
		110	5550	15.43	15.50	
		126	5630	15.21	15.50	
		134	5670	15.18	15.50	
		142	5710	15.34	15.50	
	802.11ac-VHT80 MCS0	106	5530	14.99	15.00	81.90
		122	5610	14.93	15.00	
		138	5690	14.99	15.00	

**FCC SAR TEST REPORT****Report No. : FA872411-01**

5.8GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	149	5745	16.15	16.50	94.30
		157	5785	16.29	16.50	
		165	5825	16.36	16.50	
	802.11n-HT20 MCS0	149	5745	14.93	15.50	97.50
		157	5785	15.06	15.50	
		165	5825	15.01	15.50	
	802.11n-HT40 MCS0	151	5755	15.13	15.50	94.00
		159	5795	15.00	15.50	
	802.11ac-VHT20 MCS0	149	5745	14.95	15.50	95.10
		157	5785	15.10	15.50	
		165	5825	15.08	15.50	
	802.11ac-VHT40 MCS0	151	5755	15.18	15.50	91.10
		159	5795	15.04	15.50	
	802.11ac-VHT80 MCS0	155	5775	14.91	15.00	81.90

<5GHz WLAN ANT2>

5.2GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	36	5180	16.31	16.50	94.30
		40	5200	16.39	16.50	
		44	5220	16.34	16.50	
		48	5240	16.28	16.50	
	802.11n-HT20 MCS0	36	5180	15.36	15.50	97.50
		40	5200	15.34	15.50	
		44	5220	15.33	15.50	
		48	5240	15.36	15.50	
	802.11n-HT40 MCS0	38	5190	15.22	15.50	94.00
		46	5230	15.43	15.50	
	802.11ac-VHT20 MCS0	36	5180	15.39	15.50	95.10
		40	5200	15.37	15.50	
		44	5220	15.36	15.50	
		48	5240	15.41	15.50	
	802.11ac-VHT40 MCS0	38	5190	15.26	15.50	91.10
		46	5230	15.45	15.50	
	802.11ac-VHT80 MCS0	42	5210	14.99	15.00	81.90

5.3GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	52	5260	16.30	16.50	94.30
		56	5280	16.13	16.50	
		60	5300	16.05	16.50	
		64	5320	16.11	16.50	
	802.11n-HT20 MCS0	52	5260	15.29	15.50	97.50
		56	5280	15.26	15.50	
		60	5300	15.23	15.50	
		64	5320	15.01	15.50	
	802.11n-HT40 MCS0	54	5270	14.90	15.50	94.00
		62	5310	14.99	15.50	
	802.11ac-VHT20 MCS0	52	5260	15.30	15.50	95.10
		56	5280	15.31	15.50	
		60	5300	15.25	15.50	
		64	5320	15.06	15.50	
	802.11ac-VHT40 MCS0	54	5270	14.95	15.50	91.10
		62	5310	15.02	15.50	
	802.11ac-VHT80 MCS0	58	5290	13.72	14.00	81.90



5.5GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	100	5500	16.13	16.50	94.30
		116	5580	15.88	16.50	
		124	5620	15.92	16.50	
		132	5660	16.30	16.50	
		144	5720	16.17	16.50	
	802.11n-HT20 MCS0	100	5500	15.22	15.50	97.50
		116	5580	15.15	15.50	
		124	5620	15.16	15.50	
		132	5660	15.19	15.50	
		144	5720	15.07	15.50	
	802.11n-HT40 MCS0	102	5510	15.00	15.50	94.00
		110	5550	15.19	15.50	
		126	5630	15.07	15.50	
		134	5670	15.05	15.50	
		142	5710	15.31	15.50	
	802.11ac-VHT20 MCS0	100	5500	15.29	15.50	95.10
		116	5580	15.19	15.50	
		124	5620	15.18	15.50	
		132	5660	15.20	15.50	
		144	5720	15.11	15.50	
	802.11ac-VHT40 MCS0	102	5510	15.03	15.50	91.10
		110	5550	15.22	15.50	
		126	5630	15.14	15.50	
		134	5670	15.06	15.50	
		142	5710	15.38	15.50	
	802.11ac-VHT80 MCS0	106	5530	14.99	15.00	81.90
		122	5610	14.88	15.00	
		138	5690	14.95	15.00	

**FCC SAR TEST REPORT****Report No. : FA872411-01**

5.8GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	149	5745	16.21	16.50	94.30
		157	5785	16.25	16.50	
		165	5825	16.39	16.50	
	802.11n-HT20 MCS0	149	5745	14.70	15.50	97.50
		157	5785	15.07	15.50	
		165	5825	15.17	15.50	
	802.11n-HT40 MCS0	151	5755	15.10	15.50	94.00
		159	5795	14.94	15.50	
	802.11ac-VHT20 MCS0	149	5745	14.75	15.50	95.10
		157	5785	15.10	15.50	
		165	5825	15.20	15.50	
	802.11ac-VHT40 MCS0	151	5755	15.13	15.50	91.10
		159	5795	14.96	15.50	
	802.11ac-VHT80 MCS0	155	5775	14.84	15.00	81.90

<5GHz WLAN ANT1+2>

5.2GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	36	5180	16.16	16.50	94.30
		40	5200	16.15	16.50	
		44	5220	16.18	16.50	
		48	5240	16.22	16.50	
	802.11n-HT20 MCS0	36	5180	15.16	15.50	97.50
		40	5200	15.19	15.50	
		44	5220	15.22	15.50	
		48	5240	15.28	15.50	
	802.11n-HT40 MCS0	38	5190	18.11	18.50	94.00
		46	5230	18.16	18.50	
	802.11ac-VHT20 MCS0	36	5180	15.20	15.50	95.10
		40	5200	15.22	15.50	
		44	5220	15.25	15.50	
		48	5240	15.30	15.50	
	802.11ac-VHT40 MCS0	38	5190	18.13	18.50	91.10
		46	5230	18.18	18.50	
	802.11ac-VHT80 MCS0	42	5210	17.99	18.00	81.90

5.3GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	52	5260	18.75	19.50	94.30
		56	5280	18.69	19.50	
		60	5300	18.62	19.50	
		64	5320	18.50	19.50	
	802.11n-HT20 MCS0	52	5260	18.28	18.50	97.50
		56	5280	18.20	18.50	
		60	5300	18.13	18.50	
		64	5320	17.95	18.50	
	802.11n-HT40 MCS0	54	5270	17.97	18.50	94.00
		62	5310	17.92	18.50	
	802.11ac-VHT20 MCS0	52	5260	18.30	18.50	95.10
		56	5280	18.24	18.50	
		60	5300	18.17	18.50	
		64	5320	17.98	18.50	
	802.11ac-VHT40 MCS0	54	5270	18.00	18.50	91.10
		62	5310	17.95	18.50	
	802.11ac-VHT80 MCS0	58	5290	16.52	17.00	81.90



	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	19.04	19.50	94.30
		116	5580	18.97	19.50	
		124	5620	19.07	19.50	
		132	5660	19.33	19.50	
		144	5720	19.34	19.50	
	802.11n-HT20 MCS0	100	5500	18.12	18.50	97.50
		116	5580	18.20	18.50	
		124	5620	18.21	18.50	
		132	5660	18.23	18.50	
		144	5720	18.12	18.50	
	802.11n-HT40 MCS0	102	5510	17.97	18.50	94.00
		110	5550	18.29	18.50	
		126	5630	18.14	18.50	
		134	5670	18.11	18.50	
		142	5710	18.31	18.50	
	802.11ac-VHT20 MCS0	100	5500	18.18	18.50	95.10
		116	5580	18.23	18.50	
		124	5620	18.24	18.50	
		132	5660	18.25	18.50	
		144	5720	18.17	18.50	
	802.11ac-VHT40 MCS0	102	5510	18.00	18.50	91.10
		110	5550	18.34	18.50	
		126	5630	18.19	18.50	
		134	5670	18.13	18.50	
		142	5710	18.37	18.50	
	802.11ac-VHT80 MCS0	106	5530	17.99	18.00	81.90
		122	5610	17.92	18.00	
		138	5690	17.99	18.00	

**FCC SAR TEST REPORT****Report No. : FA872411-01**

5.8GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	149	5745	19.39	19.50	94.30
		157	5785	19.13	19.50	
		165	5825	19.14	19.50	
	802.11n-HT20 MCS0	149	5745	17.83	18.50	97.50
		157	5785	18.08	18.50	
		165	5825	18.10	18.50	
	802.11n-HT40 MCS0	151	5755	18.13	18.50	94.00
		159	5795	17.98	18.50	
	802.11ac-VHT20 MCS0	149	5745	17.86	18.50	95.10
		157	5785	18.11	18.50	
		165	5825	18.15	18.50	
	802.11ac-VHT40 MCS0	151	5755	18.17	18.50	91.10
		159	5795	18.01	18.50	
	802.11ac-VHT80 MCS0	155	5775	17.89	18.00	81.90

**<2.4GHz Bluetooth>**

Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	6.07	2.59	2.58
	CH 39	2441	5.27	1.54	1.52
	CH 78	2480	6.87	3.46	3.43
Tune-up Limit			7.00	4.00	4.00

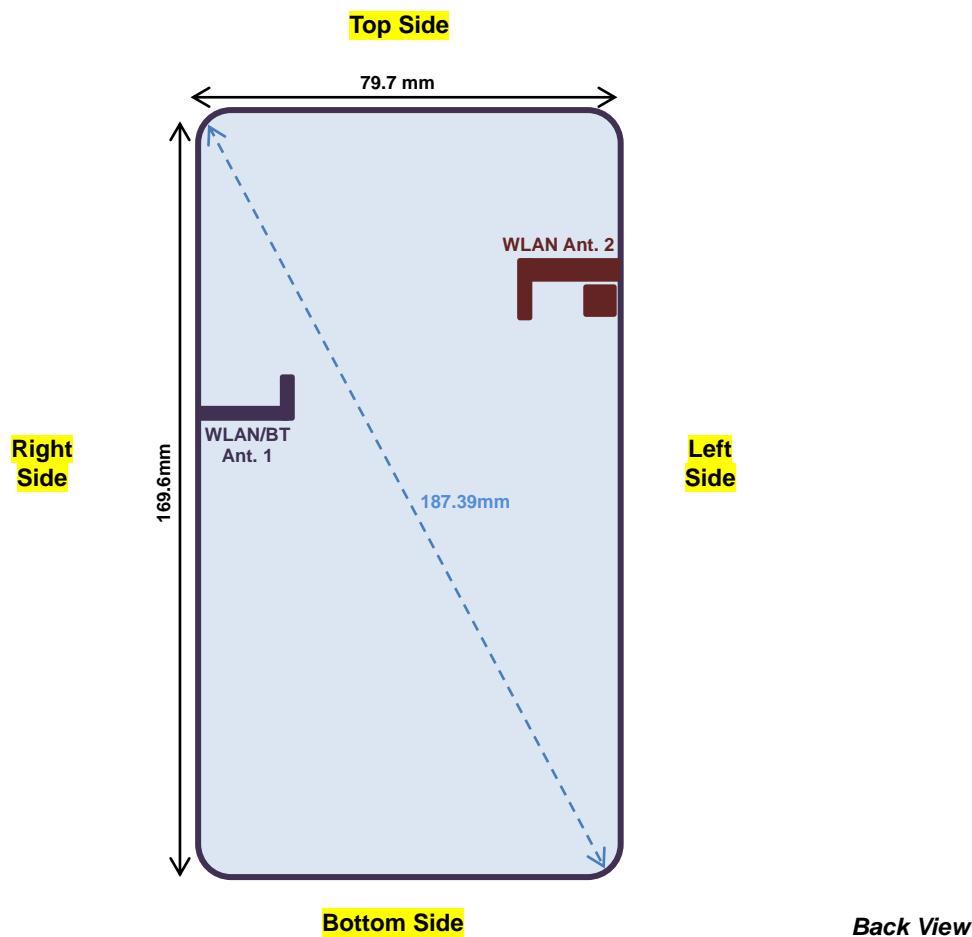
Mode	Channel	Frequency (MHz)	Average power (dBm)	
			1Mbps	2Mbps
LE	CH 00	2402	1.79	1.27
	CH 19	2440	0.90	0.29
	CH 39	2480	1.81	1.31
Tune-up Limit			2.00	2.00

**General Note:**

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps due to its highest average power and duty cycle is 76.3% considered in SAR testing, and the duty cycle would be scaled to theoretical 83.3% in reported SAR calculation.



## 12. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
BT&WLAN Antenna 1	≤ 25mm	≤ 25mm	>25mm	>25mm	≤ 25mm	>25mm
WLAN Antenna 2	≤ 25mm	≤ 25mm	≤ 25mm	>25mm	>25mm	≤ 25mm



## 13. 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:
  - $\leq 0.8 \text{ W/kg}$  or  $2.0 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is  $\leq 100 \text{ MHz}$
  - $\leq 0.6 \text{ W/kg}$  or  $1.5 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is between  $100 \text{ MHz}$  and  $200 \text{ MHz}$
  - $\leq 0.4 \text{ W/kg}$  or  $1.0 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is  $\geq 200 \text{ MHz}$
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8 \text{ W/kg}$ .
4. Per KDB 648474 D04v01r03, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is  $\leq 1.2 \text{ W/kg}$ , SAR testing with a headset connected to the handset is not required.
5. Per KDB 648474 D04v01r03, for the device an overall diagonal dimension  $> 16.0 \text{ cm}$ , product specific SAR consideration is necessary, and must also be applied to test the SAR of all surfaces and edges with an antenna located at  $\leq 25 \text{ mm}$  from that surface or edge

### 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  $\leq 1.2 \text{ W/kg}$ .
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  $\leq 1.2 \text{ W/kg}$ , SAR is not required for U-NII-1 band.
3. When the reported SAR of the test position is  $> 0.4 \text{ W/kg}$ , SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closest/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is  $\leq 0.8 \text{ W/kg}$  or all required test position are tested.
4. For all positions / configurations, when the reported SAR is  $> 0.8 \text{ W/kg}$ , SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is  $\leq 1.2 \text{ W/kg}$  or all required channels are tested.
5. 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.
6. 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  $< 1.6 \text{ W/kg}$  and SAR peak to location ratio  $\leq 0.04$ , no additional SAR measurements for MIMO.
7. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

**13.1 Head SAR****<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
01	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	0mm	Ant 1	1	2412	18.49	19.00	1.125	99.20	1.008	0.05	0.144	0.163
	WLAN2.4GHz	802.11b 1Mbps	Right Tilted	0mm	Ant 1	1	2412	18.49	19.00	1.125	99.20	1.008	0.11	0.072	0.082
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	1	2412	18.49	19.00	1.125	99.20	1.008	0.04	0.302	0.342
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	6	2437	18.24	19.00	1.191	99.20	1.008	0.1	0.352	0.423
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	11	2462	18.23	19.00	1.194	99.20	1.008	0.02	0.349	0.420
	WLAN2.4GHz	802.11b 1Mbps	Left Tilted	0mm	Ant 1	1	2412	18.49	19.00	1.125	99.20	1.008	0.07	0.107	0.121
	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	0mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	-0.04	0.249	0.286
	WLAN2.4GHz	802.11b 1Mbps	Right Tilted	0mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	0.14	0.135	0.155
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	0.07	0.086	0.099
	WLAN2.4GHz	802.11b 1Mbps	Left Tilted	0mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	0	0.068	0.078
02	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 1	52	5260	16.27	16.50	1.054	94.30	1.060	0.06	0.247	0.276
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 1	52	5260	16.27	16.50	1.054	94.30	1.060	-0.04	0.260	0.291
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 1	52	5260	16.27	16.50	1.054	94.30	1.060	0.12	0.275	0.307
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 1	52	5260	16.27	16.50	1.054	94.30	1.060	0.03	0.273	0.305
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	0.05	0.490	0.544
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	56	5280	16.13	16.50	1.089	94.30	1.060	0.19	0.475	0.548
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	60	5300	16.05	16.50	1.109	94.30	1.060	0.09	0.476	0.560
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	64	5320	16.11	16.50	1.094	94.30	1.060	0.11	0.457	0.530
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	0.11	0.282	0.313
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	0.05	0.299	0.332
03	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	0.08	0.241	0.267
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 1	132	5660	16.34	16.50	1.038	94.30	1.060	-0.16	0.205	0.225
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 1	132	5660	16.34	16.50	1.038	94.30	1.060	-0.1	0.196	0.216
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 1	132	5660	16.34	16.50	1.038	94.30	1.060	0.12	0.236	0.260
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 1	132	5660	16.34	16.50	1.038	94.30	1.060	0.04	0.239	0.263
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	0.14	0.327	0.363
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	100	5500	16.13	16.50	1.089	94.30	1.060	0.16	0.338	0.390
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	116	5580	15.88	16.50	1.153	94.30	1.060	0.13	0.232	0.284
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	124	5620	15.92	16.50	1.143	94.30	1.060	0.13	0.252	0.305
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	144	5720	16.17	16.50	1.079	94.30	1.060	0.02	0.286	0.327
04	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	-0.09	0.147	0.163
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	-0.02	0.187	0.208
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	-0.12	0.172	0.191
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 1	165	5825	16.36	16.50	1.033	94.30	1.060	-0.1	0.136	0.149
	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 1	165	5825	16.36	16.50	1.033	94.30	1.060	0.03	0.055	0.060
04	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 1	165	5825	16.36	16.50	1.033	94.30	1.060	-0.02	0.128	0.140
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 1	165	5825	16.36	16.50	1.033	94.30	1.060	-0.04	0.156	0.171
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	0.16	0.338	0.367
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	149	5745	16.21	16.50	1.069	94.30	1.060	-0.05	0.249	0.282
	WLAN5GHz	802.11a 6Mbps	Right Cheek	0mm	Ant 2	157	5785	16.25	16.50	1.059	94.30	1.060	-0.02	0.350	0.393
04	WLAN5GHz	802.11a 6Mbps	Right Tilted	0mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	0.02	0.168	0.183
	WLAN5GHz	802.11a 6Mbps	Left Cheek	0mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	-0.09	0.258	0.280
	WLAN5GHz	802.11a 6Mbps	Left Tilted	0mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	-0.02	0.257	0.279

**<Bluetooth SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Bluetooth	1Mbps	Right Cheek	0mm	Ant 1	78	2480	6.87	7.00	1.030	76.30	1.092	0.14	0.010	0.011
	Bluetooth	1Mbps	Right Tilted	0mm	Ant 1	78	2480	6.87	7.00	1.030	76.30	1.092	0.09	0.002	0.002
	Bluetooth	1Mbps	Left Cheek	0mm	Ant 1	78	2480	6.87	7.00	1.030	76.30	1.092	0.11	0.021	0.024
	Bluetooth	1Mbps	Left Cheek	0mm	Ant 1	0	2402	6.07	7.00	1.239	76.30	1.092	-0.08	0.019	0.026
05	Bluetooth	1Mbps	Left Cheek	0mm	Ant 1	39	2441	5.27	7.00	1.489	76.30	1.092	0.12	0.018	0.029
	Bluetooth	1Mbps	Left Tilted	0mm	Ant 1	78	2480	6.87	7.00	1.030	76.30	1.092	0.11	0.005	0.006

**13.2 Body Worn Accessory SAR****<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	Ant 1	1	2412	18.49	19.00	1.125	99.20	1.008	0.03	0.104	0.118
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 1	1	2412	18.49	19.00	1.125	99.20	1.008	0.18	0.197	0.223
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	0.02	0.094	0.108
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	-0.12	0.323	0.370
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 2	6	2437	18.29	19.00	1.178	99.20	1.008	-0.13	0.309	0.367
06	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 2	11	2462	18.25	19.00	1.189	99.20	1.008	-0.07	0.321	0.385
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 1	52	5260	16.27	16.50	1.054	94.30	1.060	-0.18	0.134	0.150
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 1	52	5260	16.27	16.50	1.054	94.30	1.060	-0.01	0.709	0.792
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	-0.01	0.136	0.151
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	-0.01	0.844	0.937
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	56	5280	16.13	16.50	1.089	94.30	1.060	-0.03	0.855	0.987
07	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	60	5300	16.05	16.50	1.109	94.30	1.060	-0.04	0.923	1.085
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	64	5320	16.11	16.50	1.094	94.30	1.060	-0.08	0.913	1.059
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 1	132	5660	16.34	16.50	1.038	94.30	1.060	0.05	0.056	0.062
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 1	132	5660	16.34	16.50	1.038	94.30	1.060	-0.13	0.663	0.729
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	0.02	0.141	0.157
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	-0.07	0.876	0.972
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	100	5500	16.13	16.50	1.089	94.30	1.060	-0.15	0.841	0.971
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	116	5580	15.88	16.50	1.153	94.30	1.060	-0.09	0.756	0.924
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	124	5620	15.92	16.50	1.143	94.30	1.060	-0.13	0.796	0.964
08	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	144	5720	16.17	16.50	1.079	94.30	1.060	-0.13	0.898	1.027
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 1	165	5825	16.36	16.50	1.033	94.30	1.060	-0.11	0.052	0.057
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 1	165	5825	16.36	16.50	1.033	94.30	1.060	-0.19	0.604	0.661
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	0.08	0.124	0.135
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	-0.08	0.812	0.883
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	149	5745	16.21	16.50	1.069	94.30	1.060	-0.14	0.802	0.909
09	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	157	5785	16.25	16.50	1.059	94.30	1.060	-0.14	0.857	0.962

**<Bluetooth SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Bluetooth	1Mbps	Front	10mm	Ant 1	78	2480	6.87	7.00	1.030	76.30	1.092	0.01	0.006	0.007
	Bluetooth	1Mbps	Back	10mm	Ant 1	78	2480	6.87	7.00	1.030	76.30	1.092	-0.04	0.014	0.016
	Bluetooth	1Mbps	Back	10mm	Ant 1	0	2402	6.07	7.00	1.239	76.30	1.092	0.05	0.012	0.016
10	Bluetooth	1Mbps	Back	10mm	Ant 1	39	2441	5.27	7.00	1.489	76.30	1.092	-0.01	0.013	0.021

**13.3 Extremity (Product Specific) SAR****<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 1	1	2412	18.49	19.00	1.125	99.20	1.008	0.11	0.233	0.264
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 1	1	2412	18.49	19.00	1.125	99.20	1.008	-0.07	0.176	0.200
	WLAN2.4GHz	802.11b 1Mbps	Right Side	0mm	Ant 1	1	2412	18.49	19.00	1.125	99.20	1.008	0.13	0.468	0.531
	WLAN2.4GHz	802.11b 1Mbps	Front	0mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	0.01	0.177	0.203
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	-0.1	0.532	0.610
	WLAN2.4GHz	802.11b 1Mbps	Left Side	0mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	0	0.800	0.917
	WLAN2.4GHz	802.11b 1Mbps	Left Side	0mm	Ant 2	6	2437	18.29	19.00	1.178	99.20	1.008	0.17	0.802	0.952
11	WLAN2.4GHz	802.11b 1Mbps	Left Side	0mm	Ant 2	11	2462	18.25	19.00	1.189	99.20	1.008	0.05	0.826	0.990
	WLAN2.4GHz	802.11b 1Mbps	Top Side	0mm	Ant 2	1	2412	18.44	19.00	1.138	99.20	1.008	-0.16	0.148	0.170
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	52	5260	16.27	16.50	1.054	94.30	1.060	-0.04	0.208	0.232
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	52	5260	16.27	16.50	1.054	94.30	1.060	-0.09	1.180	1.319
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Ant 1	52	5260	16.27	16.50	1.054	94.30	1.060	0.16	0.462	0.516
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	0.1	0.228	0.253
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	-0.04	1.790	1.987
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	56	5280	16.13	16.50	1.089	94.30	1.060	-0.03	1.750	2.020
12	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	60	5300	16.05	16.50	1.109	94.30	1.060	-0.06	1.750	2.058
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	64	5320	16.11	16.50	1.094	94.30	1.060	0	1.710	1.983
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	0.02	0.624	0.693
	WLAN5GHz	802.11a 6Mbps	Top Side	0mm	Ant 2	52	5260	16.30	16.50	1.047	94.30	1.060	0	0.148	0.164
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	132	5660	16.34	16.50	1.038	94.30	1.060	-0.09	0.126	0.139
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	132	5660	16.34	16.50	1.038	94.30	1.060	-0.17	1.180	1.298
13	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	100	5500	16.07	16.50	1.104	94.30	1.060	-0.18	1.140	1.334
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	116	5580	15.82	16.50	1.169	94.30	1.060	-0.17	1.010	1.252
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	124	5620	15.91	16.50	1.146	94.30	1.060	-0.17	1.040	1.263
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	144	5720	16.21	16.50	1.069	94.30	1.060	-0.17	1.060	1.201
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Ant 1	132	5660	16.34	16.50	1.038	94.30	1.060	0.01	0.396	0.436
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	-0.11	0.183	0.203
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	-0.09	1.130	1.254
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	0.07	0.529	0.587
	WLAN5GHz	802.11a 6Mbps	Top Side	0mm	Ant 2	132	5660	16.30	16.50	1.047	94.30	1.060	0.08	0.119	0.132
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	165	5825	16.36	16.50	1.033	94.30	1.060	-0.12	0.094	0.103
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 1	165	5825	16.36	16.50	1.033	94.30	1.060	-0.14	0.901	0.986
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Ant 1	165	5825	16.36	16.50	1.033	94.30	1.060	-0.18	0.360	0.394
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	0.01	0.155	0.169
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	-0.04	0.959	1.043
14	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	149	5745	16.21	16.50	1.069	94.30	1.060	-0.04	0.948	1.074
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Ant 2	157	5785	16.25	16.50	1.059	94.30	1.060	-0.02	0.956	1.073
	WLAN5GHz	802.11a 6Mbps	Left Side	0mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	-0.09	0.421	0.458
	WLAN5GHz	802.11a 6Mbps	Top Side	0mm	Ant 2	165	5825	16.39	16.50	1.026	94.30	1.060	-0.18	0.094	0.102

**<Bluetooth SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	Bluetooth	1Mbps	Front	0mm	Ant 1	78	2480	6.87	7.00	1.030	76.30	1.092	0.14	0.016	0.018
	Bluetooth	1Mbps	Back	0mm	Ant 1	78	2480	6.87	7.00	1.030	76.30	1.092	-0.12	0.015	0.017
	Bluetooth	1Mbps	Right Side	0mm	Ant 1	78	2480	6.87	7.00	1.030	76.30	1.092	0.16	0.036	0.041
	Bluetooth	1Mbps	Right Side	0mm	Ant 1	0	2402	6.07	7.00	1.239	76.30	1.092	0.12	0.028	0.038
15	Bluetooth	1Mbps	Right Side	0mm	Ant 1	39	2441	5.27	7.00	1.489	76.30	1.092	0.12	0.029	0.047

**13.4 Repeated SAR Measurement**

No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	60	5300	16.05	16.50	1.109	94.30	1.060	-0.04	0.923		1.085
2nd	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	60	5300	16.05	16.50	1.109	94.30	1.060	0	0.889	1.04	1.045
1st	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	144	5720	16.17	16.50	1.079	94.30	1.060	-0.13	0.898		1.027
2nd	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	144	5720	16.17	16.50	1.079	94.30	1.060	-0.11	0.895	1.00	1.024
1st	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	157	5785	16.25	16.50	1.059	94.30	1.060	-0.14	0.857		0.962
2nd	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	157	5785	16.25	16.50	1.059	94.30	1.060	-0.09	0.854	1.00	0.959

**General Note:**

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8\text{W/kg}$ .
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is  $\leq 1.2$  and the measured SAR  $< 1.45\text{W/kg}$ , 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.



## 14. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Head	Body-worn	Product Specific
1.	WLAN 2.4GHz Ant.2 + Bluetooth Ant.1	Yes	Yes	Yes
2.	WLAN 2.4GHz Ant.1 + WLAN 2.4GHz Ant.2	Yes	Yes	Yes
3.	WLAN 2.4GHz Ant.1 + Bluetooth Ant.1	Yes	Yes	Yes
4.	WLAN 5GHz Ant.2 + Bluetooth Ant.1	Yes	Yes	Yes
5.	WLAN 5GHz Ant.1 + WLAN 5GHz Ant.2	Yes	Yes	Yes
6.	WLAN 5GHz Ant.1 + WLAN 5GHz Ant.2 + Bluetooth Ant.1	Yes	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. 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.
4. The Scaled SAR summation is calculated based on the same configuration and test position.
5. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
  - i) Scalar SAR summation < 1.6W/kg.
  - ii)  $SPLSR = (SAR1 + SAR2)^{1.5} / (\text{min. separation distance, mm})$ , 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  $SPLSR \leq 0.04$ , 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 14.4.

**14.1 Head Exposure Conditions**

Exposure Position	1	2	3	4	5	1+2 Summed 1g SAR (W/kg)	1+5 Summed 1g SAR (W/kg)	2+5 Summed 1g SAR (W/kg)	3+4+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 1				
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)				
Right Cheek	0.163	0.286	0.276	0.560	0.011	<b>0.449</b>	<b>0.174</b>	<b>0.297</b>	<b>0.847</b>
Right Tilted	0.082	0.155	0.291	0.313	0.002	<b>0.237</b>	<b>0.084</b>	<b>0.157</b>	<b>0.606</b>
Left Cheek	0.423	0.099	0.307	0.332	0.029	<b>0.522</b>	<b>0.452</b>	<b>0.128</b>	<b>0.668</b>
Left Tilted	0.121	0.078	0.305	0.279	0.006	<b>0.199</b>	<b>0.127</b>	<b>0.084</b>	<b>0.590</b>

**14.2 Body-Worn Accessory Exposure Conditions**

Exposure Position	1	2	3	4	5	1+2 Summed 1g SAR (W/kg)	1+5 Summed 1g SAR (W/kg)	2+5 Summed 1g SAR (W/kg)	3+4+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 1						
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)						
Front	0.118	0.108	0.150	0.157	0.007	<b>0.226</b>	<b>0.125</b>	<b>0.115</b>	<b>0.314</b>		
Back	0.223	0.385	0.792	<b>1.085</b>	0.021	<b>0.608</b>	<b>0.244</b>	<b>0.406</b>	<b>1.898</b>	0.04	Case 1

**14.3 Product Specific SAR**

Exposure Position	1	2	3	4	5	1+2 Summed 10g SAR (W/kg)	1+5 Summed 10g SAR (W/kg)	2+5 Summed 10g SAR (W/kg)	3+4+5 Summed 10g 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 1						
	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)						
Front	0.264	0.203	0.232	0.253	0.018	<b>0.467</b>	<b>0.282</b>	<b>0.221</b>	<b>0.503</b>		
Back	0.200	0.610	1.334	2.058	0.017	<b>0.810</b>	<b>0.217</b>	<b>0.627</b>	<b>3.409</b>		
Left side		0.990		0.693		<b>0.990</b>	<b>0.000</b>	<b>0.990</b>	<b>0.693</b>		
Right side	0.531		0.516		0.047	<b>0.531</b>	<b>0.578</b>	<b>0.047</b>	<b>0.563</b>		
Top side		0.170		0.164		<b>0.170</b>	<b>0.000</b>	<b>0.170</b>	<b>0.164</b>		

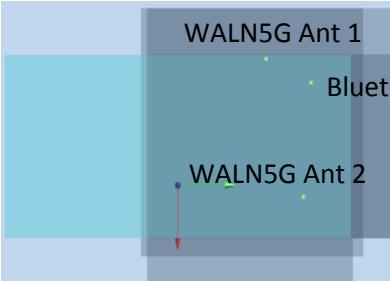


#### 14.4 SPLSR Evaluation and Analysis

**General Note:**

1. SPLSR =  $(\text{SAR}_1 + \text{SAR}_2)^{1.5} / (\text{min. separation distance, mm})$ . If SPLSR  $\leq 0.04$ , 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				
WLAN5G Ant 1	Back	0.792	10mm	-31.6	39	-0.12		57.4	1.88	0.04	Not required
WLAN5G Ant 2		1.085	10mm	22	59.4	0.06					
WLAN5G Ant 2	Back	1.085	10mm	22	59.4	0.06		50.8	1.11	0.02	Not required
Bluetooth Ant 1		0.021	10mm	-28.6	63.8	-1.12					
WLAN5G Ant 1	Back	0.792	10mm	-31.6	39	-0.12		25.0	0.81	0.03	Not required
Bluetooth Ant 1		0.021	10mm	-28.6	63.8	-1.12					



WLAN5G Ant 1

Bluetooth Ant 1

WLAN5G Ant 2

**Test Engineer :** Iran Wang, Willy Yu, Ray Sun and Charles Shen



## 15. 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  $\leq 30\%$ , 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.

## 16. 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.