



## SAR EVALUATION REPORT

**FCC 47 CFR § 2.1093  
IEEE Std 1528-2013**

*For*  
**Bluetooth & DTS/UNII a/b/g/n/ac Tablet**

**FCC ID: A3LSMW700  
Model Name: SM-W700 and SM-W703**

**Report Number: 15K21999-S1V1  
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**TL-637**

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# 1. Attestation of Test Results

Applicant Name		SAMSUNG ELECTRONICS CO.,LTD.			
FCC ID		A3LSMW700			
Model Name		SM-W700 and SM-W703			
Applicable Standards		FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013			
<b>SAR Limits (W/Kg)</b>					
Exposure Category		Peak spatial-average(1g of tissue)			
General population / Uncontrolled exposure		1.6			
<b>The Highest Reported SAR (W/kg)</b>					
<b>RF Exposure Conditions</b>		<b>Equipment Class</b>			
		<b>Licensed</b>	<b>DTS</b>	<b>U-NII</b>	<b>DSS(BT)</b>
Standalone		N/A	1.032	0.423	0.213
Simultaneous TX	Body	N/A	0.775	0.734	N/A
Date Tested		1/13/2016 to 1/18/2016			
Test Results		Pass			
<p>UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.</p> <p><b>Note:</b> The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.</p>					
Approved & Released By:			Prepared By:		
					
JiHo Choi Operations Manager UL Korea, Ltd Suwon Laboratory			Sunghoon Kim Laboratory Engineer UL Korea, Ltd Suwon Laboratory		

## 2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure [KDB](#) procedures:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 616217 D04 SAR for laptop and tablets v01r02
- 690783 D01 SAR Listings on Grants v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02

## 3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

Suwon
SAR 1 Room
SAR 2 Room
SAR 3 Room

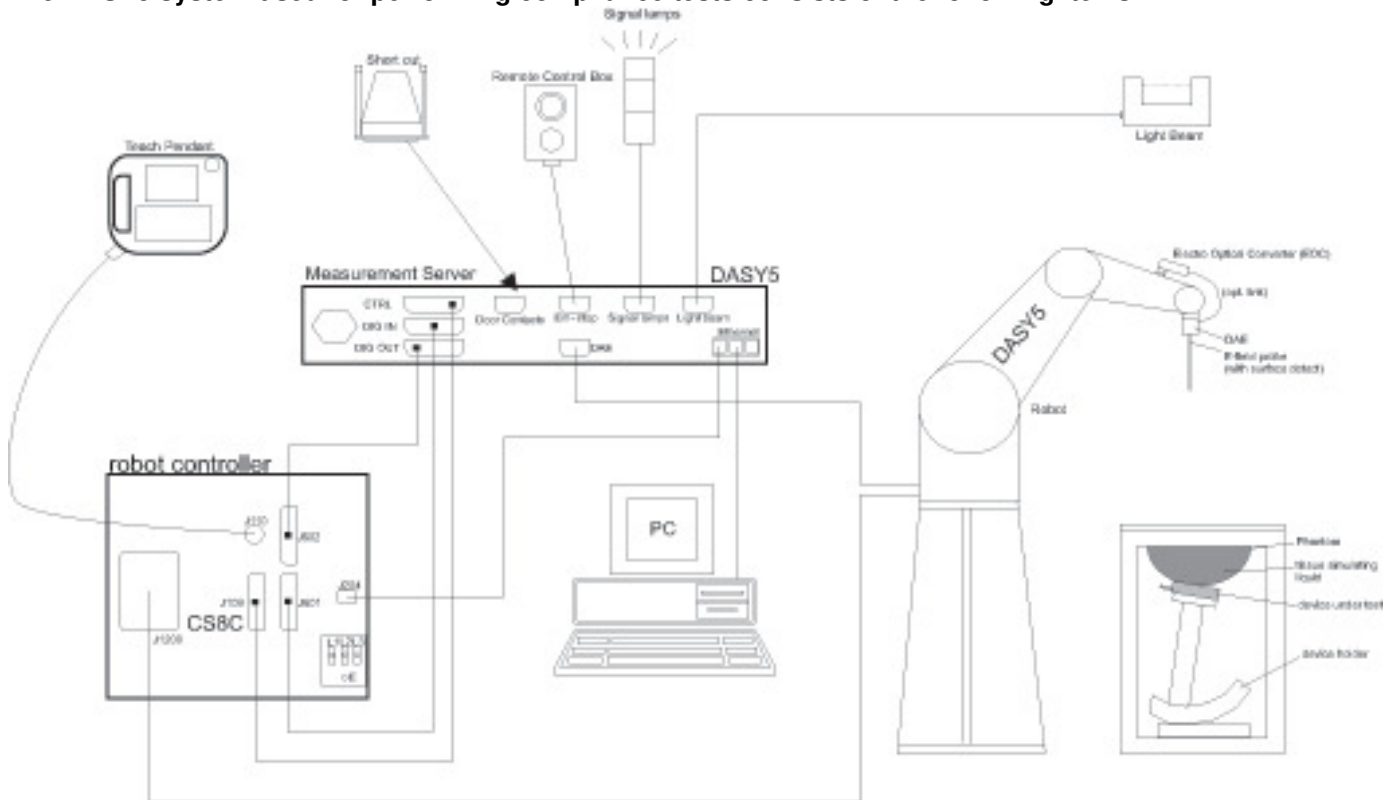
UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637.

The full scope of accreditation can be viewed at <http://www.iasonline.org/PDF/TL/TL-637.pdf>.

## 4. SAR Measurement System & Test Equipment

### 4.1. SAR Measurement System

The DASY5 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.

## 4.2. SAR Scan Procedures

### Step 1: 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. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

### Step 2: 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 locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) 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 KDB 865664 D01 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	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{Area}$ , $\Delta y_{Area}$	$\leq 2$ GHz: $\leq 15$ mm $2 - 3$ GHz: $\leq 12$ mm	$3 - 4$ GHz: $\leq 12$ mm $4 - 6$ GHz: $\leq 10$ 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 $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

**Step 3: Zoom Scan**

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g 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 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

		$\leq 3$ GHz	$> 3$ GHz	
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$		$\leq 2$ 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: $\Delta z_{\text{Zoom}}(n)$	$\leq 5$ mm	3 – 4 GHz: $\leq 4$ mm 4 – 5 GHz: $\leq 3$ mm 5 – 6 GHz: $\leq 2$ mm	
	graded grid	$\Delta z_{\text{Zoom}}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface	$\leq 4$ mm	3 – 4 GHz: $\leq 3$ mm 4 – 5 GHz: $\leq 2.5$ mm 5 – 6 GHz: $\leq 2$ mm
		$\Delta z_{\text{Zoom}}(n>1)$ : between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$	
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 <i>reported</i> 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.				

**Step 4: Power drift measurement**

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

**Step 5: Z-Scan (FCC only)**

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be larger than the step size in Z-direction.

### 4.3. Test Equipment

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

#### Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	E5071C	MY46522054	8-18-2016
Dielectric Assessment Kit	SPEAG	DAK-3.5	1196	8-4-2016
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	LKM	DTM3000	3424	8-19-2016
Thermometer	Lutron	MHB-382SD	AH.91478	8-12-2016

#### System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	Agilent	N5181A	MY50145882	8-18-2016
Power Sensor	Agilent	U2000A	MY54260010	8-18-2016
Power Sensor	Agilent	U2000A	MY54260007	8-18-2016
Power Amplifier	EXODUS	1410025-AMP2027-10003	10003	8-18-2016
Directional Coupler	Agilent	772D	MY52180193	8-18-2016
Directional Coupler	Agilent	778D	MY52180432	8-18-2016
Low Pass Filter	MICROLAB	LA-15N	03943	8-18-2016
Low Pass Filter	FILTRON	L14012FL	1410003S	8-18-2016
Low Pass Filter	MICROLAB	LA-60N	03942	8-18-2016
Attenuator	Agilent	8491B/003	MY39269292	8-18-2016
Attenuator	Agilent	8491B/010	MY39269315	8-18-2016
Attenuator	Agilent	8491B/020	MY39269298	8-18-2016
E-Field Probe (SAR1)	SPEAG	EX3DV4	7314	9-25-2016
E-Field Probe (SAR2)	SPEAG	EX3DV4	7376	9-2-2016
Data Acquisition Electronics (SAR1)	SPEAG	DAE4	1447	9-23-2016
Data Acquisition Electronics (SAR2)	SPEAG	DAE4	1468	9-15-2016
System Validation Dipole	SPEAG	D2450V2	960	2-5-2016
System Validation Dipole	SPEAG	D5GHzV2	1184	8-26-2016
Thermometer (SAR1)	Lutron	MHB-382SD	AH.91463	8-12-2016
Thermometer (SAR2)	Lutron	MHB-382SD	AH.50215	8-19-2016

#### Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Bluetooth Tester	TESCOM	TC-3000C	3000C000546	8-18-2016

### 5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

## 6. Device Under Test (DUT) Information

### 6.1. DUT Description

Device Dimension	Overall (Length x Width): 287.5 mm x 196 mm Overall Diagonal: 348 mm Display Diagonal: 315 mm
Back Cover	<input checked="" type="checkbox"/> The rechargeable battery is not user accessible.
Battery Options	<input checked="" type="checkbox"/> The rechargeable battery is not user accessible.
Wireless Router (Hotspot)	Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi-enabled devices. Mobile Hotspot is not supported
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other <input checked="" type="checkbox"/> Wi-Fi Direct (Wi-Fi 2.4 GHz) <input checked="" type="checkbox"/> Wi-Fi Direct (Wi-Fi 5.8 GHz)

### 6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)	100%
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)	100%
	Does this device support bands 5.60 ~ 5.65 GHz? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
	Does this device support Band gap channel? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Bluetooth	2.4 GHz	Version 4.1 LE	76.85% (DH5)

### 6.3. Nominal and Maximum Output Power

KDB 447498 sec.4.1.(3) at the maximum rated output power and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance limit

Upper limit (dB): ~ 0.5		Max. RF Output Power (dBm)		Reduce RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. Power limit	Target	Max. Power limit
WiFi 2.4 GHz (Ch.1 ~ Ch.11)	802.11b	16.0	<b>16.5</b>	11.0	<b>11.5</b>
	802.11g	14.0	<b>14.5</b>	11.0	<b>11.5</b>
	802.11n HT20	14.0	<b>14.5</b>	11.0	<b>11.5</b>
WiFi 2.4 GHz (Ch.12)	802.11b	13.0	<b>13.5</b>	11.0	<b>11.5</b>
	802.11g	11.0	<b>11.5</b>	11.0	<b>11.5</b>
	802.11n HT20	11.0	<b>11.5</b>	11.0	<b>11.5</b>
WiFi 2.4 GHz (Ch.13)	802.11b	13.0	<b>13.5</b>	11.0	<b>11.5</b>
	802.11g	4.0	<b>4.5</b>	4.0	<b>4.5</b>
	802.11n HT20	3.0	<b>3.5</b>	3.0	<b>3.5</b>
WiFi 5 GHz	802.11a	13.0	<b>13.5</b>	9.0	<b>9.5</b>
	802.11n HT20	13.0	<b>13.5</b>	9.0	<b>9.5</b>
	802.11n HT40	11.0	<b>11.5</b>	9.0	<b>9.5</b>
	802.11ac VHT20	11.0	<b>11.5</b>	9.0	<b>9.5</b>
	802.11ac VHT40	11.0	<b>11.5</b>	9.0	<b>9.5</b>
	802.11ac VHT80	10.0	<b>10.5</b>	9.0	<b>9.5</b>
Bluetooth		9.5	<b>10.0</b>	N/A	
Bluetooth LE		4.0	<b>4.5</b>	N/A	

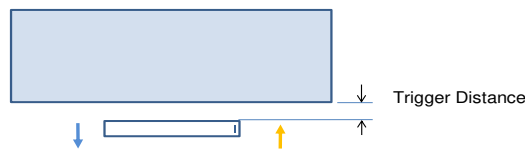
## 6.4. Power Reduction by Proximity Sensing

### 6.4.1. Proximity Sensor Triggering Distance (KDB 616217 §6.2)

Rear of the DUT was placed directly below the flat phantom. The DUT was moved toward the phantom in accordance with the steps outlined in KDB 616217 §6.2 to determine the trigger distance for enabling power reduction. The DUT was moved away from the phantom to determine the trigger distance for resuming full power.

The DUT featured a visual indicator on its display that showed the status of the proximity sensor (Triggered or not triggered). This was used to determine the status of the sensor during the proximity sensor assessment as monitoring the output power directly was not practical without affecting the measurement.

It was confirmed separately that the output power was altered according to the proximity sensor status indication. This was achieved by observing the proximity sensor status at the same time as monitoring the conducted power. Section 9 contains both the full and reduced conducted power measurements.



Proximity Sensor Trigger Distance Assessment  
KDB 616217 §6.2, **Rear**

#### LEGEND

- ➔ Direction of DUT travel for determination of power reduction triggering point
- ➔ Direction of DUT travel for determination of full power resumption triggering point

### Summary of Trigger Distances

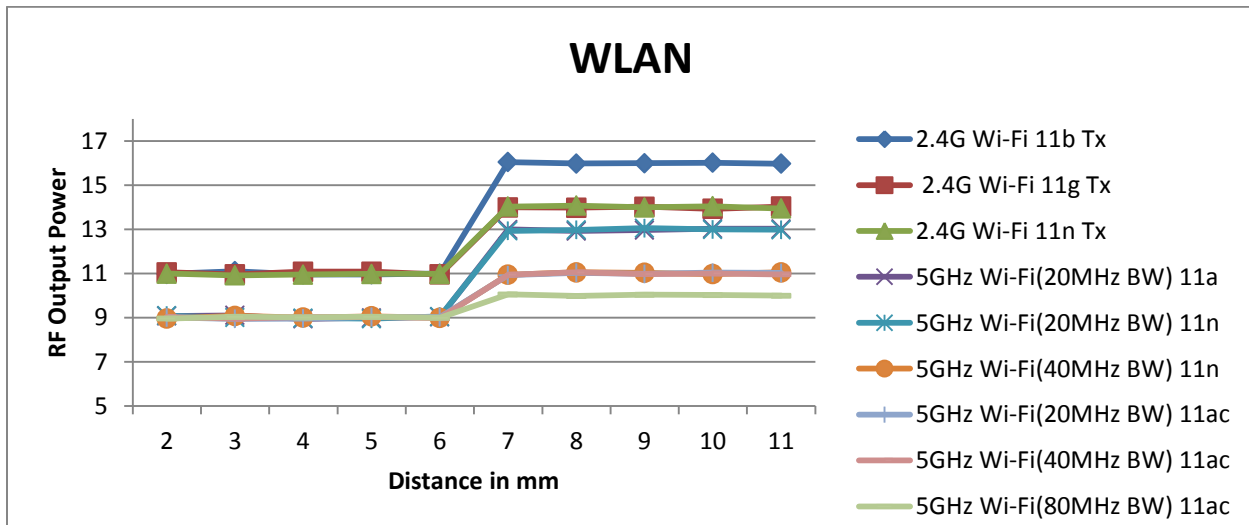
Tissue simulating liquid	Trigger distance - Rear	
	Moving toward phantom	Moving from phantom
2450 muscle	6 mm	6 mm
5000 muscle	6 mm	6 mm

**Proximity Sensor Triggering Distance Measurement Results**

**Wi-Fi 2.4GHz and 5GHz**

Rear, DUT Moving Toward (Trigger) and Away (Release) from the Phantom

Distance to DUT vs. Output Power in dBm										
Distance	2	3	4	5	6	7	8	9	10	11
2.4G Wi-Fi 11b Tx	10.98	11.10	10.96	10.96	10.99	16.04	15.98	15.99	16.01	15.97
2.4G Wi-Fi 11g Tx	11.05	10.96	11.08	11.08	10.96	13.99	13.98	14.02	13.93	14.03
2.4G Wi-Fi 11n Tx	10.99	10.91	10.95	10.98	10.98	14.03	14.07	13.99	14.04	13.94
5GHz Wi-Fi(20MHz BW) 11a	9.07	9.10	8.94	8.99	9.03	12.99	12.92	12.96	13.03	13.02
5GHz Wi-Fi(20MHz BW) 11n	9.09	9.00	8.98	8.95	9.05	12.93	12.97	13.05	12.99	12.98
5GHz Wi-Fi(40MHz BW) 11n	8.96	9.08	9.00	9.06	8.99	10.94	11.05	11.03	10.97	11.05
5GHz Wi-Fi(20MHz BW) 11ac	9.01	8.94	8.96	9.03	9.02	10.92	11.03	10.98	11.04	11.02
5GHz Wi-Fi(40MHz BW) 11ac	9.03	8.95	9.02	9.02	8.98	10.94	11.05	10.97	11.00	10.96
5GHz Wi-Fi(80MHz BW) 11ac	8.96	9.04	9.01	9.04	8.99	10.05	9.98	10.04	10.02	9.99



## 7. RF Exposure Conditions (Test Configurations)

Refer to “SAR Photos and Ant locations” Appendix for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

### 7.1. Standalone SAR Test Exclusion Considerations

Since the *Dedicated Host Approach* is applied, the standalone SAR test exclusion procedure in KDB 447498 § 4.3.1 is applied in conjunction with KDB 616217 § 4.3 to determine the minimum test separation distance:

- When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.
- When the separation distance from the antenna to an adjacent edge is > 5 mm, the actual antenna-to-edge separation distance is applied to determine SAR test exclusion.

### SAR Test Exclusion Calculations for WLAN

Antennas < 50mm to adjacent edges

Antenna	Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value						
			dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	
<b>Full Power, Proximity Sensor Off</b>																	
Main	Wi-Fi 2.4 GHz	2462	16.50	45	1	95	281	90	4		14.1	> 50 mm	> 50 mm	> 50 mm	14.1		
	Wi-Fi 5.2 GHz	5240	13.50	22	1	95	281	90	4		-MEASURE-	> 50 mm	> 50 mm	> 50 mm	-MEASURE-		
	Wi-Fi 5.3 GHz	5320	13.50	22	1	95	281	90	4		-MEASURE-	> 50 mm	> 50 mm	> 50 mm	-MEASURE-		
	Wi-Fi 5.5 GHz	5700	13.50	22	1	95	281	90	4		-MEASURE-	> 50 mm	> 50 mm	> 50 mm	-MEASURE-		
	Wi-Fi 5.8 GHz	5825	13.50	22	1	95	281	90	4		-MEASURE-	> 50 mm	> 50 mm	> 50 mm	-MEASURE-		
	Bluetooth	2480	10.00	10	1	95	281	90	4		-MEASURE-	> 50 mm	> 50 mm	> 50 mm	-MEASURE-		
	<b>Power Back-off, Proximity Sensor On</b>																
	Wi-Fi 2.4 GHz	2462	11.50	14	1							4.4					
	Wi-Fi 5.2 GHz	5240	9.50	9	1							-MEASURE-					
	Wi-Fi 5.3 GHz	5320	9.50	9	1							-MEASURE-					
	Wi-Fi 5.5 GHz	5700	9.50	9	1							-MEASURE-					
Wi-Fi 5.8 GHz	5825	9.50	9	1							-MEASURE-						
<b>Full Power, Proximity Sensor Off</b>																	
Sub	Wi-Fi 2.4 GHz	2462	16.50	45	1	5	232	184	24		14.1	14.1	> 50 mm	> 50 mm	2.9		
	Wi-Fi 5.2 GHz	5240	13.50	22	1	5	232	184	24		-MEASURE-	-MEASURE-	> 50 mm	> 50 mm	-EXEMPT-		
	Wi-Fi 5.3 GHz	5320	13.50	22	1	5	232	184	24		-MEASURE-	-MEASURE-	> 50 mm	> 50 mm	-EXEMPT-		
	Wi-Fi 5.5 GHz	5700	13.50	22	1	5	232	184	24		-MEASURE-	-MEASURE-	> 50 mm	> 50 mm	-EXEMPT-		
	Wi-Fi 5.8 GHz	5825	13.50	22	1	5	232	184	24		-MEASURE-	-MEASURE-	> 50 mm	> 50 mm	-EXEMPT-		
	<b>Power Back-off, Proximity Sensor On</b>																
	Wi-Fi 2.4 GHz	2462	11.50	14	1							4.4					
	Wi-Fi 5.2 GHz	5240	9.50	9	1							-MEASURE-					
	Wi-Fi 5.3 GHz	5320	9.50	9	1							-MEASURE-					
	Wi-Fi 5.5 GHz	5700	9.50	9	1							-MEASURE-					
	Wi-Fi 5.8 GHz	5825	9.50	9	1							-MEASURE-					

**Note(s):**

1. According to KDB 447498, if the calculated threshold value is >3 then SAR testing is required.

Antennas > 50mm to adjacent edges

Antenna	Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value						
			dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	
<b>Full Power, Proximity Sensor Off</b>																	
Main	Wi-Fi 2.4 GHz	2462	16.50	45	1	95	281	90	4		< 50 mm	545.6 mW -EXEMPT-	2405.6 mW -EXEMPT-	495.6 mW -EXEMPT-	< 50 mm		
	Wi-Fi 5.2 GHz	5240	13.50	22	1	95	281	90	4		< 50 mm	515.5 mW -EXEMPT-	2375.5 mW -EXEMPT-	465.5 mW -EXEMPT-	< 50 mm		
	Wi-Fi 5.3 GHz	5320	13.50	22	1	95	281	90	4		< 50 mm	515 mW -EXEMPT-	2375 mW -EXEMPT-	465 mW -EXEMPT-	< 50 mm		
	Wi-Fi 5.5 GHz	5700	13.50	22	1	95	281	90	4		< 50 mm	512.8 mW -EXEMPT-	2372.8 mW -EXEMPT-	462.8 mW -EXEMPT-	< 50 mm		
	Wi-Fi 5.8 GHz	5825	13.50	22	1	95	281	90	4		< 50 mm	512.2 mW -EXEMPT-	2372.2 mW -EXEMPT-	462.2 mW -EXEMPT-	< 50 mm		
	Bluetooth	2480	10.00	10	1	95	281	90	4		< 50 mm	545.3 mW -EXEMPT-	2405.3 mW -EXEMPT-	495.3 mW -EXEMPT-	< 50 mm		
	<b>Power Back-off, Proximity Sensor On</b>																
Wi-Fi 2.4 GHz	2462	11.50	14	1							< 50 mm						
Wi-Fi 5.2 GHz	5240	9.50	9	1							< 50 mm						
Wi-Fi 5.3 GHz	5320	9.50	9	1							< 50 mm						
Wi-Fi 5.5 GHz	5700	9.50	9	1							< 50 mm						
Wi-Fi 5.8 GHz	5825	9.50	9	1							< 50 mm						
<b>Full Power, Proximity Sensor Off</b>																	
Sub	Wi-Fi 2.4 GHz	2462	16.50	45	1	5	232	184	24		< 50 mm	< 50 mm	1915.6 mW -EXEMPT-	1435.6 mW -EXEMPT-	< 50 mm		
	Wi-Fi 5.2 GHz	5240	13.50	22	1	5	232	184	24		< 50 mm	< 50 mm	1885.5 mW -EXEMPT-	1405.5 mW -EXEMPT-	< 50 mm		
	Wi-Fi 5.3 GHz	5320	13.50	22	1	5	232	184	24		< 50 mm	< 50 mm	1885 mW -EXEMPT-	1405 mW -EXEMPT-	< 50 mm		
	Wi-Fi 5.5 GHz	5700	13.50	22	1	5	232	184	24		< 50 mm	< 50 mm	1882.8 mW -EXEMPT-	1402.8 mW -EXEMPT-	< 50 mm		
	Wi-Fi 5.8 GHz	5825	13.50	22	1	5	232	184	24		< 50 mm	< 50 mm	1882.2 mW -EXEMPT-	1402.2 mW -EXEMPT-	< 50 mm		
	<b>Power Back-off, Proximity Sensor On</b>																
	Wi-Fi 2.4 GHz	2462	11.50	14	1							< 50 mm					
Wi-Fi 5.2 GHz	5240	9.50	9	1							< 50 mm						
Wi-Fi 5.3 GHz	5320	9.50	9	1							< 50 mm						
Wi-Fi 5.5 GHz	5700	9.50	9	1							< 50 mm						
Wi-Fi 5.8 GHz	5825	9.50	9	1							< 50 mm						

**Note(s):**

1. According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required.

## 7.2. Required Test Configurations

The table below identifies the standalone test configurations required for this device according to the findings in Section 7.1:

Test Configurations	Power Back-Off	Rear	Edge 1	Edge 2	Edge 3	Edge 4
			(Top Edge)	(Right Edge )	(Bottom Edge)	(Left Edge)
Wi-Fi 2.4 GHz (Main Antenna)	OFF	Yes	No	No	No	Yes
	ON	Yes	No	No	No	No
Wi-Fi 2.4 GHz (Sub Antenna)	OFF	Yes	Yes	No	No	No
	ON	Yes	No	No	No	No
Wi-Fi 5 GHz (Main Antenna)	OFF	Yes	No	No	No	Yes
	ON	Yes	No	No	No	No
Wi-Fi 5 GHz (Sub Antenna)	OFF	Yes	Yes	No	No	No
	ON	Yes	No	No	No	No
Bluetooth	N/A	Yes	No	No	No	Yes

### Note(s):

1. Yes = Testing is required.
2. No = Testing is not required.

## 8. Dielectric Property Measurements & System Check

### 8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within  $\pm 2^\circ\text{C}$  of the temperature when the tissue parameters are characterized.

The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.

Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.

#### Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

Target Frequency (MHz)	Head		Body	
	$\epsilon_r$	$\sigma$ (S/m)	$\epsilon_r$	$\sigma$ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

#### IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

**Dielectric Property Measurements Results:**

**SAR 1 Room**

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)		
1-13-2016	Body 5180	e'	48.8700	Relative Permittivity ( $\epsilon_r$ ):	48.87	49.05	-0.36	5	
		e''	18.4600	Conductivity ( $\sigma$ ):	5.32	5.27	0.86	5	
	Body 5200	e'	48.8400	Relative Permittivity ( $\epsilon_r$ ):	48.84	49.02	-0.37	5	
		e''	18.4900	Conductivity ( $\sigma$ ):	5.35	5.29	0.97	5	
	Body 5600	e'	48.1500	Relative Permittivity ( $\epsilon_r$ ):	48.15	48.48	-0.68	5	
		e''	18.8200	Conductivity ( $\sigma$ ):	5.86	5.76	1.72	5	
	Body 5800	e'	47.8400	Relative Permittivity ( $\epsilon_r$ ):	47.84	48.20	-0.75	5	
		e''	18.9900	Conductivity ( $\sigma$ ):	6.12	6.00	2.07	5	
	Body 5825	e'	47.8000	Relative Permittivity ( $\epsilon_r$ ):	47.80	48.20	-0.83	5	
		e''	19.0300	Conductivity ( $\sigma$ ):	6.16	6.00	2.73	5	
	1-17-2016	Body 5180	e'	49.0500	Relative Permittivity ( $\epsilon_r$ ):	49.05	49.05	0.01	5
			e''	17.8300	Conductivity ( $\sigma$ ):	5.14	5.27	-2.58	5
Body 5200		e'	49.0200	Relative Permittivity ( $\epsilon_r$ ):	49.02	49.02	0.00	5	
		e''	17.8500	Conductivity ( $\sigma$ ):	5.16	5.29	-2.52	5	
Body 5600		e'	48.3300	Relative Permittivity ( $\epsilon_r$ ):	48.33	48.48	-0.30	5	
		e''	18.3000	Conductivity ( $\sigma$ ):	5.70	5.76	-1.09	5	
Body 5800		e'	48.0400	Relative Permittivity ( $\epsilon_r$ ):	48.04	48.20	-0.33	5	
		e''	18.5200	Conductivity ( $\sigma$ ):	5.97	6.00	-0.46	5	
Body 5825		e'	47.9900	Relative Permittivity ( $\epsilon_r$ ):	47.99	48.20	-0.44	5	
		e''	18.5600	Conductivity ( $\sigma$ ):	6.01	6.00	0.19	5	

**SAR 2 Room**

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)	
1-13-2016	Body 2450	e'	50.7500	Relative Permittivity ( $\epsilon_r$ ):	50.75	52.70	-3.70	5
		e''	14.8400	Conductivity ( $\sigma$ ):	2.02	1.95	3.67	5
	Body 2410	e'	50.9200	Relative Permittivity ( $\epsilon_r$ ):	50.92	52.76	-3.49	5
		e''	14.7600	Conductivity ( $\sigma$ ):	1.98	1.91	3.69	5
	Body 2475	e'	50.6600	Relative Permittivity ( $\epsilon_r$ ):	50.66	52.67	-3.81	5
		e''	14.9500	Conductivity ( $\sigma$ ):	2.06	1.99	3.64	5

## 8.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

### System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.  
For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 3 mm.  
For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

### Reference Target SAR Values

The reference SAR values can be obtained from the calibration certificate of system validation dipoles

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (W/kg)		
				1g/10g	Head	Body
D2450V2	960	2-5-2015	2450	1g	53.3	50.8
				10g	24.8	23.6
D5GHzV2	1184	8-26-2015	5200	1g	79.6	76.1
				10g	22.7	21.2
			5600	1g	82.8	80.5
				10g	23.6	22.3
			5800	1g	80.3	78.7
				10g	22.8	21.7

**System Check Results**

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target.

**SAR 1 Room**

Date Tested	System Dipole		T.S. Liquid	Measured Results		Target (Ref. Value)	Delta $\pm 10\%$	Plot No.	
	Type	Serial #		Zoom Scan to 100 mW	Normalize to 1 W				
1-13-2016	D5GhzV2 (5200)	1184	Body	1g	7.69	76.90	76.10	1.05	
				10g	2.17	21.70	21.20	2.36	
1-13-2016	D5GhzV2 (5600)	1184	Body	1g	8.28	82.80	80.50	2.86	
				10g	2.30	23.00	22.30	3.14	
1-13-2016	D5GhzV2 (5800)	1184	Body	1g	7.58	75.80	78.70	-3.68	
				10g	2.12	21.20	21.70	-2.30	
1-17-2016	D5GhzV2 (5200)	1184	Body	1g	7.74	77.40	76.10	1.71	
				10g	2.18	21.80	21.20	2.83	
1-17-2016	D5GhzV2 (5600)	1184	Body	1g	8.31	83.10	80.50	3.23	
				10g	2.32	23.20	22.30	4.04	
1-17-2016	D5GhzV2 (5800)	1184	Body	1g	7.33	73.30	78.70	-6.86	1,2
				10g	2.05	20.50	21.70	-5.53	

**SAR 3 Room**

Date Tested	System Dipole		T.S. Liquid	Measured Results		Target (Ref. Value)	Delta $\pm 10\%$	Plot No.	
	Type	Serial #		Zoom Scan to 100 mW	Normalize to 1 W				
1-13-2016	D2450V2	960	Body	1g	5.33	53.30	50.80	4.92	3,4
				10g	2.44	24.40	23.60	3.39	

## 9. Conducted Output Power Measurements

### 9.1. Wi-Fi 2.4GHz (DTS Band)

#### Measured Results

#### SISO

Antenna	Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Max Pwr.			Reduced Pwr.		
						Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
Main	2.4	802.11b	1 Mbps	1	2412	16.3	16.5	Yes	11.3	11.5	Yes
				6	2437	15.7			11.0		
				11	2462	15.7			10.8		
				12	2467	12.8			10.6		
				13	2472	12.9			10.9		
		802.11g	6 Mbps	1	2412	Not Required	14.5	No	10.9	11.5	No
				6	2437				10.6		
				11	2462				10.5		
				12	2467				10.5		
				13	2472				4.6		
		802.11n (HT20)	6.5 Mbps	1	2412	Not Required	14.5	No	10.7	11.5	No
				6	2437				10.5		
				11	2462				10.4		
				12	2467				10.4		
				13	2472				3.5		
Sub	2.4	802.11b	1 Mbps	1	2412	16.4	16.5	Yes	11.3	11.5	Yes
				6	2437	16.1			11.3		
				11	2462	16.3			11.4		
				12	2467	13.3			11.1		
				13	2472	13.2			11.1		
		802.11g	6 Mbps	1	2412	Not Required	14.5	No	10.5	11.5	No
				6	2437				10.8		
				11	2462				10.9		
				12	2467				10.9		
				13	2472				4.5		
		802.11n (HT20)	6.5 Mbps	1	2412	Not Required	14.5	No	10.3	11.5	No
				6	2437				10.8		
				11	2462				10.9		
				12	2467				10.7		
				13	2472				3.5		

#### MIMO

Antenna	Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Max Pwr.			Reduced Pwr.		
						Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
MINO Main	2.4	802.11n (HT20)	6.5 Mbps	1	2412	13.9	14.5	No	10.4	11.5	No
				6	2437	13.4			10.6		
				11	2462	13.3			10.4		
				12	2467	10.4			10.3		
				13	2472	3.0			3.4		
MINO Sub	2.4	802.11n (HT20)	6.5 Mbps	1	2412	14.0	14.5	No	10.6	11.5	No
				6	2437	13.8			10.9		
				11	2462	14.0			11.1		
				12	2467	11.0			10.8		
				13	2472	3.4			3.3		

#### Note(s):

- Output Power and SAR is not required for 802.11g/n HT20 channels 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  $\leq 1.2$  W/kg.

## 9.2. Wi-Fi 5GHz (U-NII Bands)

### Measured Results

#### SISO

Antenna	Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Max Pwr.			Reduce Pwr		
						Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
SISO Main	5.3 (U-NII 2A)	802.11a	6 Mbps	52	5260	12.7	13.5	Yes	9.4	9.5	No
				56	5280	12.8			9.4		
				60	5300	13.0			9.4		
				64	5320	13.2			9.4		
		802.11n (HT20)	6.5 Mbps	52	5260	13.3	13.5	No	9.0	9.5	No
				56	5280	13.4			9.0		
				60	5300	12.5			9.1		
		802.11n (HT40)	13.5 Mbps	54	5270	Not Required	11.5	No	9.0	9.5	No
				62	5310				9.4		
				52	5260				9.0		
		802.11ac (VHT20)	6.5 Mbps	56	5280	Not Required	11.5	No	9.0	9.5	No
				60	5300				9.1		
				64	5320				9.0		
		802.11ac (VHT40)	13.5 Mbps	54	5270	Not Required	11.5	No	8.8	9.5	No
	62			5310	9.4						
	802.11ac (VHT80)	29.3 Mbps	58	5290	Not Required	10.5	No	9.5	9.5	Yes	
	5.5 (U-NII 2C) <5.65GHz	802.11a	6 Mbps	100		5500	12.6	13.5	Yes	9.5	9.5
				112	5560	13.5	8.8				
				116	5580	12.8	8.7				
				128	5640	12.7	8.9				
		802.11n (HT20)	6.5 Mbps	100	5500	13.3	13.5	No	9.2	9.5	No
				112	5560	13.2			9.4		
				116	5580	12.5			9.4		
		802.11n (HT40)	13.5 Mbps	102	5510	Not Required	11.5	No	8.8	9.5	No
				110	5550				8.9		
				118	5590				9.0		
		802.11ac (VHT20)	6.5 Mbps	100	5500	Not Required	11.5	No	9.2	9.5	No
				112	5560				9.4		
				116	5580				9.4		
		802.11ac (VHT40)	13.5 Mbps	102	5510	Not Required	11.5	No	8.7	9.5	No
				110	5550				8.8		
				118	5590				8.9		
		802.11ac (VHT80)	29.3 Mbps	106	5530	Not Required	10.5	No	9.4	9.5	Yes
				122	5610				9.5		
	5.5 (U-NII 2C) >5.65GHz + 5.8 (U-NII 3)	802.11a	6 Mbps	132	5660	12.8	13.5	Yes	8.9	9.5	No
				149	5745	12.9			8.9		
				165	5825	12.6			8.8		
		802.11n (HT20)	6.5 Mbps	132	5660	13.4	13.5	No	8.9	9.5	No
				149	5745	12.5			8.9		
				165	5825	13.2			8.9		
		802.11n (HT40)	13.5 Mbps	134	5670	Not Required	11.5	No	8.8	9.5	No
				142	5710				8.7		
151				5755	8.8						
802.11ac (VHT20)		6.5 Mbps	132	5660	Not Required	11.5	No	8.8	9.5	No	
			149	5745				8.9			
			165	5825				8.8			
802.11ac (VHT40)		13.5 Mbps	134	5670	Not Required	11.5	No	8.7	9.5	No	
			142	5710				8.8			
			151	5755				8.7			
802.11ac (VHT80)		29.3 Mbps	138	5790	Not Required	10.5	No	8.8	9.5	No	
			155	5775				8.9			

Antenna	Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Max Pwr.			Reduce Pwr			
						Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	
SISO Aux	5.3 (U-NII 2A)	802.11a	6 Mbps	52	5260	12.9	13.5	Yes	9.1	9.5	No	
				56	5280	12.8			9.1			
				60	5300	12.7			9.0			
				64	5320	12.7			9.1			
		802.11n (HT20)	6.5 Mbps	52	5260	12.6	13.5	No	9.0	9.5	No	
				56	5280	12.5			9.0			
				60	5300	13.4			9.0			
		802.11n (HT40)	13.5 Mbps	54	5270	Not Required	11.5	No	9.0	9.5	No	
				62	5310				8.9			
		802.11ac (VHT20)	6.5 Mbps	52	5260	Not Required	11.5	No	9.0	9.5	No	
				56	5280				9.0			
				60	5300				9.0			
		802.11ac (VHT40)	13.5 Mbps	54	5270	Not Required	11.5	No	9.0	9.5	No	
				62	5310				9.1			
		802.11ac (VHT80)	29.3 Mbps	58	5290	Not Required	10.5	No	9.1	9.5	Yes	
		5.5 (U-NII 2C) <5.65GHz	802.11a	6 Mbps	100	5500	12.9	13.5	Yes	9.4	9.5	No
					112	5560	13.5			9.3		
					116	5580	12.9			9.3		
	128				5640	12.9	8.6					
	802.11n (HT20)		6.5 Mbps	100	5500	12.6	13.5	No	9.0	9.5	No	
				112	5560	13.3			9.0			
				116	5580	12.6			9.1			
				128	5640	13.5			9.2			
	802.11n (HT40)		13.5 Mbps	102	5510	Not Required	11.5	No	9.3	9.5	No	
				110	5550				9.3			
				118	5590				9.3			
				126	5630				9.3			
	802.11ac (VHT20)		6.5 Mbps	100	5500	Not Required	11.5	No	9.0	9.5	No	
				112	5560				9.0			
				116	5580				9.1			
				128	5640				9.2			
	802.11ac (VHT40)		13.5 Mbps	102	5510	Not Required	11.5	No	9.3	9.5	No	
				110	5550				9.4			
		118		5590	9.3							
		126		5630	9.3							
	802.11ac (VHT80)	29.3 Mbps	106	5530	Not Required	10.5	No	9.1	9.5	Yes		
	5.5 (U-NII 2C) >5.65GHz + 5.8 (U-NII 3)	802.11a	6 Mbps	132	5660	12.8	13.5	Yes	9.4	9.5	No	
				149	5745	13.0			9.4			
				165	5825	12.7			9.2			
		802.11n (HT20)	6.5 Mbps	132	5660	13.4	13.5	No	9.0	9.5	No	
				149	5745	12.6			9.1			
				165	5825	13.3			8.8			
		802.11n (HT40)	13.5 Mbps	134	5670	Not Required	11.5	No	9.4	9.5	No	
				142	5710				9.4			
				151	5755				9.4			
				159	5795				9.4			
		802.11ac (VHT20)	6.5 Mbps	132	5660	Not Required	11.5	No	9.0	9.5	No	
				149	5745				9.1			
165				5825	8.8							
802.11ac (VHT40)		13.5 Mbps	134	5670	Not Required	11.5	No	9.4	9.5	No		
			142	5710				9.4				
			151	5755				9.4				
			159	5795				9.3				
802.11ac (VHT80)		29.3 Mbps	138	5790	Not Required	10.5	No	9.2	9.5	Yes		
								9.4				

**MIMO**

Antenna	Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Max Pwr.			Reduce Pwr			
						Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	
MIMO Main	5.3 (U-NII2A)	802.11n (HT20)	6.5 Mbps	52	5260	12.2	13.5	No	9.0	9.5	No	
				56	5280	12.2			9.0			
				60	5300	12.2			9.1			
				64	5320	12.2			9.1			
		802.11n (HT40)	13.5 Mbps	54	5270	Not Required	11.5	No	9.4	9.5	No	
				62	5310				9.4			
		802.11ac (VHT20)	6.5 Mbps	52	5260	Not Required	11.5	No	9.1	9.5	No	
				56	5280				9.1			
				60	5300				9.2			
		802.11ac (VHT40)	13.5 Mbps	64	5320	Not Required	11.5	No	9.1	9.5	No	
				54	5270				9.4			
		802.11ac (VHT80)	29.3 Mbps	62	5310	Not Required	10.5	No	9.4	9.5	No	
	58			5290	9.4							
	5.5 (U-NII2C) <5.65GHz	802.11n (HT20)	6.5 Mbps	100	5500	12.3	13.5	No	9.0	9.5	No	
				112	5560	12.6			9.2			
				116	5580	12.5			9.2			
				128	5640	12.8			8.6			
		802.11n (HT40)	13.5 Mbps	102	5510	Not Required	11.5	No	9.1	9.5	No	
				110	5550				9.2			
				118	5590				8.7			
				126	5630				8.9			
		802.11ac (VHT20)	6.5 Mbps	100	5500	Not Required	11.5	No	9.2	9.5	No	
				112	5560				9.2			
				116	5580				9.2			
		802.11ac (VHT40)	13.5 Mbps	128	5640	Not Required	11.5	No	8.6	9.5	No	
				102	5510				9.2			
				110	5550				9.1			
		802.11ac (VHT80)	29.3 Mbps	118	5590	Not Required	10.5	No	8.7	9.5	No	
				126	5630				8.9			
				106	5530				9.2			
		5.5 (U-NII2C) >5.65GHz + 5.8 (U-NII 3)	802.11n (HT20)	6.5 Mbps	122	5610	12.8	13.5	No	8.5	9.5	No
					149	5745	12.6			8.5		
					165	5825	12.3			9.0		
					134	5670	12.3			8.8		
			802.11n (HT40)	13.5 Mbps	142	5710	Not Required	11.5	No	8.9	9.5	No
					151	5755				8.8		
					159	5795				8.8		
	132				5660	8.6						
	802.11ac (VHT20)		6.5 Mbps	149	5745	Not Required	11.5	No	8.5	9.5	No	
				165	5825				9.0			
134				5670	8.8							
802.11ac (VHT40)	13.5 Mbps		142	5710	Not Required	11.5	No	8.9	9.5	No		
			151	5755				8.8				
			159	5795				8.8				
			138	5790				9.0				
802.11ac (VHT80)	29.3 Mbps		138	5790	Not Required	10.5	No	9.0	9.5	No		
			155	5775				9.0				

Antenna	Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Max Pwr.			Reduce Pwr			
						Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	
MIMO Aux	5.3 (U-NII2A)	802.11n (HT20)	6.5 Mbps	52	5260	12.7	13.5	No	9.2	9.5	No	
				56	5280	12.5			9.1			
				60	5300	12.5			9.1			
				64	5320	12.5			9.1			
		802.11n (HT40)	13.5 Mbps	54	5270	Not Required	11.5	No	9.1	9.5	No	
				62	5310				9.2			
		802.11ac (VHT20)	6.5 Mbps	52	5260		11.5	No	9.5	9.2	9.5	No
				56	5280					9.1		
				60	5300					9.1		
				64	5320					9.2		
		802.11ac (VHT40)	13.5 Mbps	54	5270		11.5	No	9.5	9.2	9.5	No
				62	5310					9.1		
	802.11ac (VHT80)	29.3 Mbps	58	5290	10.5		No	9.2	9.5	No		
	5.5 (U-NII2C) <5.65GHz	802.11n (HT20)	6.5 Mbps	100	5500		12.7	13.5	No	9.1	9.5	No
				112	5560		12.4			9.1		
				116	5580		12.7			9.2		
				128	5640	12.6	9.3					
		802.11n (HT40)	13.5 Mbps	102	5510	Not Required	11.5	No	9.3	9.5	No	
				110	5550				9.3			
				118	5590				9.2			
				126	5630				9.0			
		802.11ac (VHT20)	6.5 Mbps	100	5500		11.5	No	9.5	9.1	9.5	No
				112	5560					9.1		
				116	5580					9.2		
				128	5640					9.3		
		802.11ac (VHT40)	13.5 Mbps	102	5510		11.5	No	9.5	9.3	9.5	No
				110	5550					9.3		
				118	5590					9.2		
				126	5630					9.1		
		802.11ac (VHT80)	29.3 Mbps	106	5530	10.5	No	9.5	9.3	9.5	No	
122				5610	8.7							
132	5660			9.1								
149	5745			12.8								
5.5 (U-NII2C) >5.65GHz + 5.8 (U-NII 3)	802.11n (HT20)	6.5 Mbps	165	5825	12.4	13.5	No	9.2	9.5	No		
			134	5670	12.4			8.8				
			142	5710	11.5			9.4				
	802.11n (HT40)	13.5 Mbps	151	5755	Not Required	11.5	No	9.3	9.5	No		
			159	5795				9.4				
			132	5660				9.1				
	802.11ac (VHT20)	6.5 Mbps	149	5745		11.5	No	9.5	9.2	9.5	No	
			165	5825					8.9			
			134	5670					9.4			
	802.11ac (VHT40)	13.5 Mbps	142	5710		11.5	No	9.5	9.3	9.5	No	
			151	5755					9.4			
			159	5795					8.6			
802.11ac (VHT80)	29.3 Mbps	138	5790	10.5		No	9.5	8.5	9.5	No		
		155	5775					8.6				

**Note(s):**

- Output Power and SAR measurement is not required for 802.11n/ac (V)HT20/(V)HT40/VHT80 channels when the specified tune-up tolerances for 802.11n/ac (V)HT20/(V)HT40/VHT80 are lower than 802.11a by more than 1/2 dB and the measured SAR is ≤ 1.2 W/Kg.
- When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.
- When the specified maximum output power is the same for both UNII band I and UNII band 2A, begin SAR measurement in UNII band 2A; and if the highest reported SAR for UNII band 2A is
  - ≤ 1.2 W/kg, SAR is not required for UNII band I
  - > 1.2 W/kg, both bands should be tested independently for SAR.

### 9.3. Bluetooth

Band (GHz)	Mode	Ch #	Freq. (MHz)	Avg Pwr (dBm)
2.4	V3.0 + EDR, GFSK	0	2402	9.1
		39	2441	9.0
		78	2480	7.5
	V3.0 + EDR, $\pi/4$ DQPSK	0	2402	6.0
		39	2441	5.8
		78	2480	4.1
	V3.0 + EDR, 8-DPSK	0	2402	6.0
		39	2441	5.8
		78	2480	4.2
	V4.0 LE, GFSK	0	2402	1.9
		19	2440	2.2
		39	2480	1.3

## 9.4. Measured and Reported (Scaled) SAR Results

### KDB 248227 D01 SAR meas for 802.11 v02r02:

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the *initial test position(s)* by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The *initial test position(s)* is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the *reported* SAR for the *initial test position* is:

- $\leq 0.4$  W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- $> 0.4$  W/kg, SAR is repeated using the same wireless mode test 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 *reported* SAR is  $\leq 0.8$  W/kg or all required test positions are tested.
  - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
  - When it is unclear, all equivalent conditions must be tested.
- For all positions/configurations tested using the *initial test position* and subsequent test positions, when the *reported* SAR is  $> 0.8$  W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is  $\leq 1.2$  W/kg or all required test channels are considered.
  - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.
- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is  $\leq 1.2$  W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is  $\leq 1.2$  W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the *initial test position*, Area Scans were performed to determine the position with the *Maximum Value of SAR (measured)*. The position that produced the highest *Maximum Value of SAR* is considered the worst case position; thus used as the *initial test position*.

### 9.5. Wi-Fi (DTS Band)

Frequency Band	Mode	Antenna	RF Exposure Conditions	Pwr Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Plot No.
										Tune-up limit	Meas.	Meas.	Scaled	
2.4GHz	802.11b 1 Mbps	SISO Main	Body	On	0	Rear	1	2412.0	1.002	11.5	11.3	0.656	0.693	
		SISO Sub	Body		0	Rear	11	2462.0	0.434	11.5	11.4	0.442	0.451	
	802.11b 1 Mbps	SISO Main	Body	Off	5	Rear	1	2412.0	1.268	16.5	16.3	0.870	0.909	
					6	Rear	6	2437.0	1.205	16.5	15.7	0.857	1.023	
		0	Edge 4		1	2412.0	0.447	16.5	16.3	0.383	0.400			
		5	Rear		1	2412.0	1.028	16.5	16.4	0.948	0.979			
		11	Rear		11	2462.0	1.433	16.5	16.3	0.988	1.032	1		
		0	Edge 1		1	2412.0	0.486	16.5	16.4	0.363	0.375			

**Note(s):**

1. Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
2. Highest reported SAR is > 0.4 W/kg. Due to the highest reported SAR for this test position, other test positions in this exposure condition were evaluated until a SAR ≤ 0.8 W/kg was reported.
3. Testing for a second channel was required because the reported SAR for this test position was >0.8 W/kg.

### 9.6. Wi-Fi (U-NII Band)

Frequency Band	Mode	Antenna	RF Exposure Conditions	Pwr Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Plot No.	
										Tune-up limit	Meas.	Meas.	Scaled		
5.3 GHz U-NII 2A	802.11ac 29.3 Mbps (VHT80)	SISO Main	Body	On	0	Rear	58	5290.0	0.415	9.5	9.5	0.283	0.285	2	
		SISO Sub	Body		0	Rear	58	5290.0	0.507	9.5	9.1	0.208	0.228		
	802.11a 6 Mbps	SISO Main	Body	Off	5	Rear	64	5320.0	0.410	13.5	13.2				
					0	Edge 4	64	5320.0	0.480	13.5	13.2	0.267	0.283		
		5	Rear		52	5260.0	0.305	13.5	12.9	0.127	0.146				
		0	Edge 1		52	5260.0	0.059	13.5	12.9						
5.5 GHz U-NII 2C	802.11ac 29.3 Mbps (VHT80)	SISO Main	Body		On	0	Rear	122	5610.0	0.928	9.5	9.5	0.423	0.423	3
		SISO Sub	Body			0	Rear	122	5610.0	0.651	9.5	9.4	0.225	0.232	
802.11a 6 Mbps	SISO Main	Body	Off	5	Rear	112	5560.0	0.511	13.5	13.5					
				0	Edge 4	112	5560.0	0.777	13.5	13.5	0.256	0.256			
	5	Rear		112	5560.0	0.722	13.5	13.5	0.311	0.311					
	0	Edge 1		112	5560.0	0.164	13.5	13.5							
5.8 GHz U-NII 3	802.11ac 29.3 Mbps (VHT80)	SISO Main		Body	On	0	Rear	155	5775.0	0.478	9.5	8.9	0.231	0.265	
		SISO Sub		Body		0	Rear	155	5775.0	0.461	9.5	9.4	0.198	0.205	
	802.11a 6 Mbps	SISO Main	Body	Off	5	Rear	149	5745.0	0.380	13.5	12.9				
					0	Edge 4	149	5745.0	0.503	13.5	12.9	0.242	0.280	4	
		5	Rear		149	5745.0	0.395	13.5	13.0	0.189	0.212				
		0	Edge 1		149	5745.0	0.093	13.5	13.0						

**Note(s):**

1. Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
2. Highest reported SAR is > 0.4 W/kg. Due to the highest reported SAR for this test position, other test positions in this exposure condition were evaluated until a SAR ≤ 0.8 W/kg was reported.
3. Testing for a second channel was required because the reported SAR for this test position was >0.8 W/kg.

## 9.7. Bluetooth

Frequency Band	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
2.4 GHz	GFSK	0	Rear	0	2402.0	10.0	9.1	0.174	0.213	5
			Edge 4	0	2402.0	10.0	9.1	0.026	0.032	

## 10. SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

- 1) Repeated measurement is not required when the original highest measured SAR is  $< 0.80$  W/kg; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is  $\geq 0.80$  W/kg, repeat that measurement once.
- 3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$  or when the original or repeated measurement is  $\geq 1.45$  W/kg (~ 10% from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Repeated Measured SAR (W/kg)	Largest to Smallest SAR Ratio
2400	Wi-Fi 802.11b/g/n	Standalone	Rear	No	0.988	1.01	1.02
	Bluetooth	Standalone	Rear	No	0.174	N/A	N/A
5300	Wi-Fi 802.11a/n/ac	Standalone	Rear	No	0.283	N/A	N/A
5500	Wi-Fi 802.11a/n/ac	Standalone	Rear	No	0.423	N/A	N/A
5800	Wi-Fi 802.11a/n/ac	Standalone	Edge 4	No	0.242	N/A	N/A

### Note(s):

Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not  $> 1.20$ .

## 11. Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance introduces a new formula for calculating the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$$

Where:

**SAR<sub>1</sub>** is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

**SAR<sub>2</sub>** is the highest measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

**Ri** is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of  $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$

In order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)^{1.5} / Ri < 0.04$$

### Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations		
Standalone	1	DTS	+	DTS
	2	U-NII	+	U-NII
Notes:				
1. DTS, U-NII supports Wi-Fi Direct.				
2. DTS Radio cannot transmit simultaneously with Bluetooth Radio.				
3. DTS Radio cannot transmit simultaneously with U-NII Radio.				
4. U-NII Radio cannot transmit simultaneously with Bluetooth Radio.				

### 11.1. Sum of the SAR for Wi-Fi & BT

RF Exposure conditions	Test position	DTS		U-NII		⑤ BT	DTS		U-NII	
		① Main	② Aux	③ Main	④ Aux		① Main + ② Aux		③ Main + ④ Aux	
							∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)	∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)
Standalone	Rear	1.023	1.032	0.423	0.311	0.213	2.055	Yes	0.734	No
	Edge 1	0.400	0.375	0.283	0.311	0.032	0.775	No	0.594	No
	Edge 4	0.400	0.375	0.283	0.311	0.032	0.775	No	0.594	No

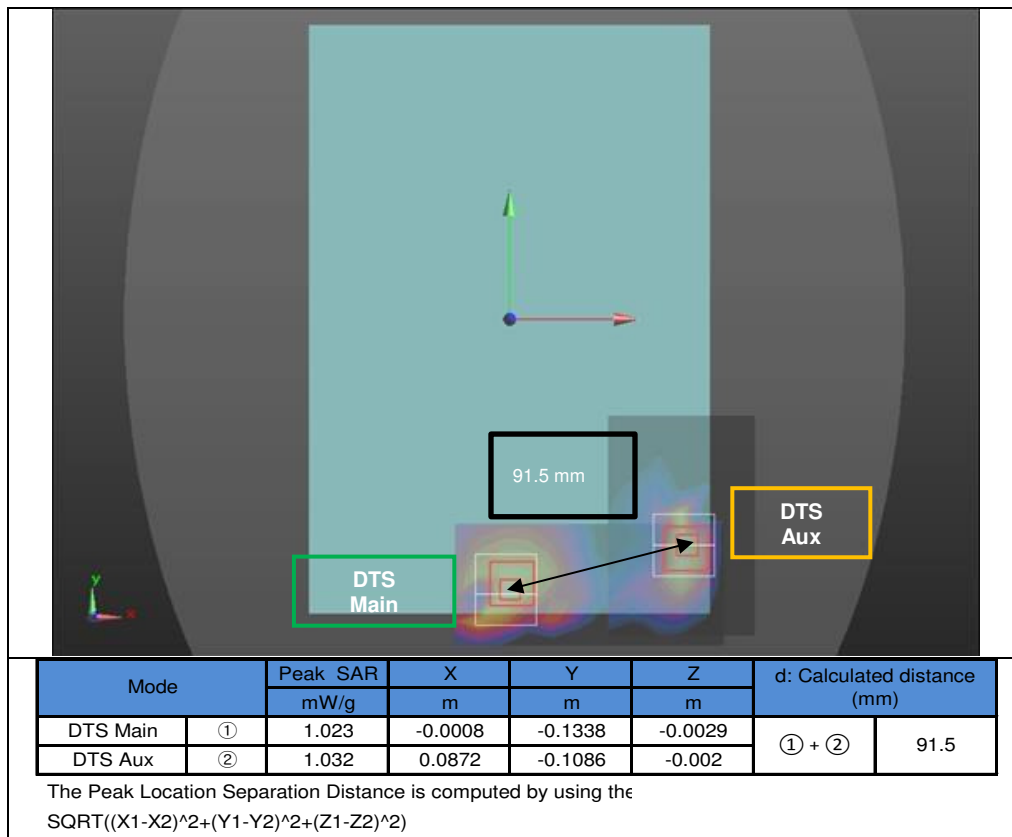
#### SAR to Peak Location Separation Ratio (SPLSR)

Test Position	Worst-case combination		∑ 1-g SAR (mW/g)	Calculated distance (mm)	SPLSR (≤ 0.04)	Volume Scan (Yes/ No)	Figure
	① DTS Main	② DTS Aux					
Rear	1.023	1.032	① + ② 2.055	91.5	0.032	No	1

#### Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because the either sum of the 1-g SAR is < 1.6 W/kg or the SPLSR is < 0.04 for all circumstances that require SPLSR calculation.

Figure (1)



## **Appendixes**

**Refer to separated files for the following appendixes.**

**15K21999-S1V1 FCC Report SAR\_App A\_Photos & Ant. Locations**

**15K21999-S1V1 FCC Report SAR\_App B\_Highest SAR Test Plots**

**15K21999-S1V1 FCC Report SAR\_App C\_System Check Plots**

**15K21999-S1V1 FCC Report SAR\_App D\_SAR Tissue Ingredients**

**15K21999-S1V1 FCC Report SAR\_App E\_Probe Cal. Certificates**

**15K21999-S1V1 FCC Report SAR\_App F\_Dipole Cal. Certificates**

**END OF REPORT**