SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
Portable Computing Device

FCC ID: C3K1724B
Model Name: 1724

Report Number: 15U21305-S1V3
Issue Date: 10/23/2015

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Revision History

Rev.	Date	Revisions	Revised By
V1	10/2/2015	Initial Issue	--
V2	10/5/2015	Updated FCC ID	Coltyce Sanders
V3	10/23/2015	Updated Section 6.4.1 based on FCC guidance	Coltyce Sanders

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1. Attestation of Test Results

Applicant Name	Microsoft Corporation			
FCC ID	C3K1724B			
Model Name	1724			
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013			
SAR Limits (W/Kg)				
Exposure Category	Peak spatial-average(1g of tissue)			
General population / Uncontrolled exposure	1.6			
The Highest Reported SAR (W/kg)				
RF Exposure Conditions	**Equipment Class**			
	Licensed	**DTS**	**U-NII**	**DSS (BT)**
Standalone	N/A	1.058	1.187	N/A
Simultaneous Tx	N/A	N/A	1.313	
Date Tested	8/17/2015 to 8/25/2015			
Test Results	Pass			

UL Verification Services Inc. 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 Verification Services Inc. 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.

Note: 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released By:	Prepared By:
	
David Weaver Program Manager UL Verification Services Inc.	Nathan Sousa Laboratory Engineer UL Verification Services Inc.

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 v02
- 447498 D01 General RF Exposure Guidance v05r02
- 616217 D04 SAR for laptop and tablets v01r01
- 690783 D01 SAR Listings on Grants v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03
- 865664 D02 RF Exposure Reporting v01r01

3. Facilities and Accreditation

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

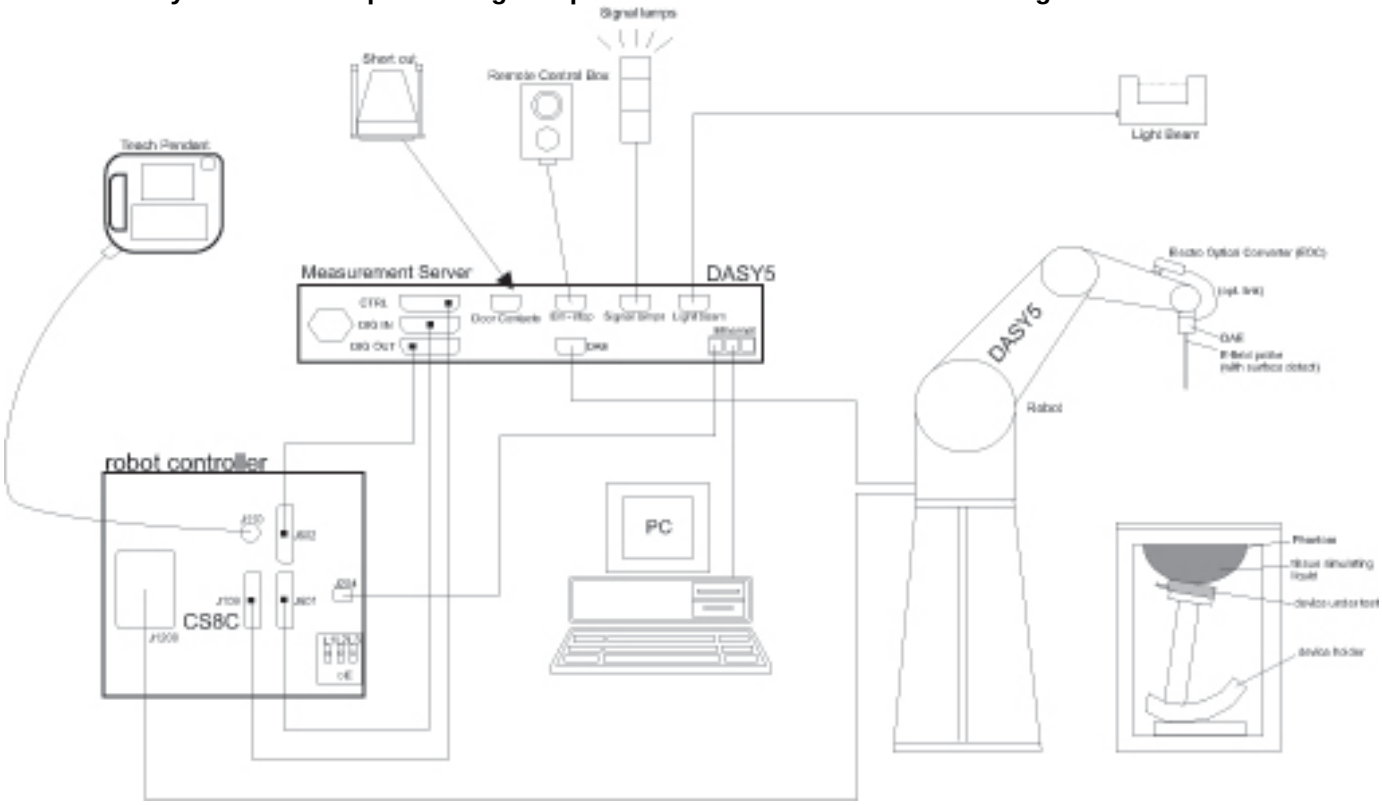
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	SAR Lab 5
SAR Lab F	
SAR Lab G	
SAR Lab H	

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

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

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

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

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

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

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

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	8753ES	MY40001647	7/28/2016
Dielectric Probe kit	SPEAG	DAK-3.5	1082	9/16/2015
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	Control Company	Traceable	140493798	8/4/2016

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	Agilent	8665B	3438A00633	8/29/2015
Power Meter	HP	437B	3125U09516	8/27/2015
Power Meter	HP	437B	3125U11347	10/6/2015
Power Sensor	HP	8481A	3318A95392	10/6/2015
Power Sensor	HP	8481A	1926A16917	10/10/2015
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1808938	N/A
Bi-directional coupler	Werlatone, Inc.	C8060-102	2710	N/A
DC Power Supply	HP	6296A	2841A-05955	N/A
E-Field Probe (SAR Lab 1)	SPEAG	EX3DV4	7356	4/22/2016
E-Field Probe (SAR Lab 4)	SPEAG	EX3DV4	3989	3/17/2016
Data Acquisition Electronics (SAR Lab 1)	SPEAG	DAE4	1352	11/7/2015
Data Acquisition Electronics (SAR Lab 4)	SPEAG	DAE4	1377	8/27/2015
System Validation Dipole	SPEAG	D2450V2	706	5/11/2016
System Validation Dipole	SPEAG	D5GHzV2	1138	9/18/2015
Thermometer (SAR Lab 1)	EXTECH	445703	CCS-205	3/20/2016
Thermometer (SAR Lab 4)	EXTECH	445703	CCS-238	6/5/2016

Other

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Meter	Agilent	N1912A	MY55196007	7/2/2017
Power Sensor	Agilent	N1921A	MY53020038	3/6/2016
Power Sensor	Agilent	N1921A	MY53260010	7/8/2016

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): 201 mm x 292 mm Overall Diagonal: 350 mm Display Diagonal: 310 mm		
Back Cover	☒ The rechargeable battery is not user accessible.		
Battery Options	☒ 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 (Wi-Fi 2.4 GHz) ☐ Mobile Hotspot (Wi-Fi 5 GHz)		
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other ☒ Wi-Fi Direct (Wi-Fi 2.4 GHz) ☐ Wi-Fi Direct (Wi-Fi 5 GHz)		
Test sample information	**S/N**	**IMEI**	**Notes**
	012181153053	N/A	SAR WLAN RADIATED #1
	012184553053	N/A	SAR WLAN RADIATED #2
Hardware Version	EV2.5		
Software Version	Mte OS 1.416.0		

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? ☒ Yes ☐ No		
	Does this device support Band gap channel? ☒ Yes ☐ No		
Bluetooth	2.4 GHz	Version 4.0 LE	77.5% (DH5)

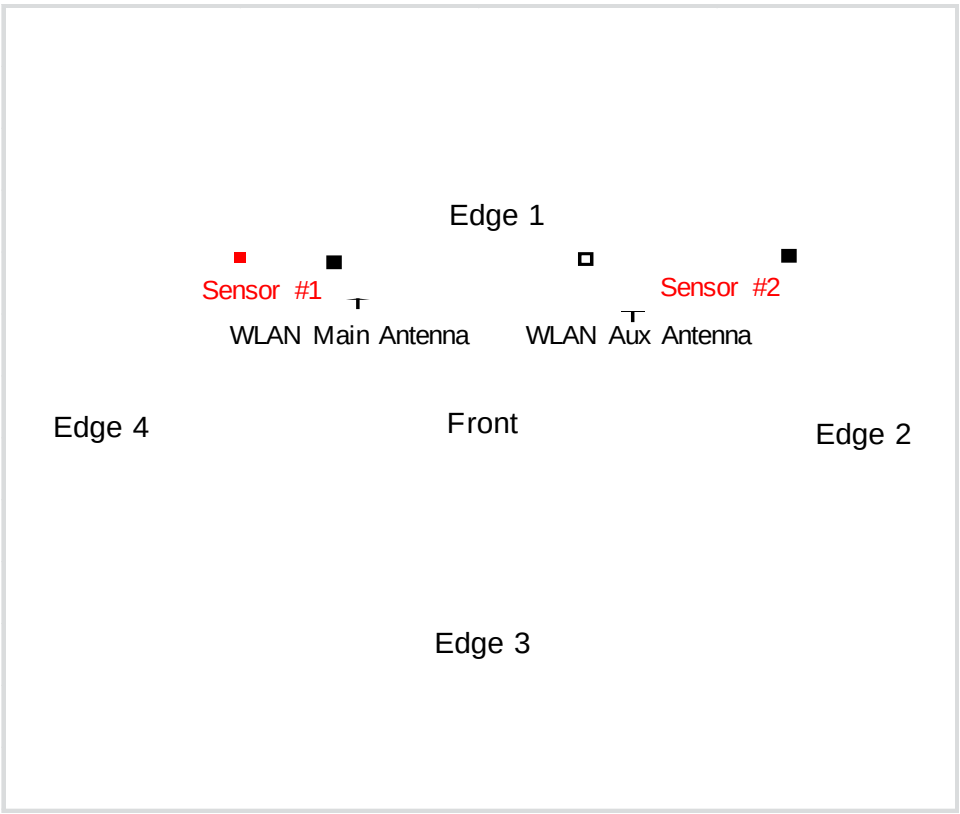
6.3. Nominal and Maximum Output Power

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): -1.5 ~ 0.5		Channels	Maximum Power		Reduced Power	
RF Air interface	Mode		Target	Max. tune-up tolerance limit	Target	Max. tune-up tolerance limit
Wi-Fi 2.4 GHz	802.11b	1,11	11.0	**11.5**	11.0	**11.5**
		2-10	13.0	**13.5**	13.0	**13.5**
		12-13	9.0	**9.5**	9.0	**9.5**
	802.11g	1,11	15.0	**15.5**	12.2	**12.7**
		2-10	17.0	**17.5**	14.0	**14.5**
		12-13	13.0	**13.5**	10.0	**10.5**
	802.11n HT20	1,11	15.0	**15.5**	12.2	**12.7**
		2-10	17.0	**17.5**	14.0	**14.5**
		12-13	13.0	**13.5**	10.0	**10.5**
Wi-Fi 5.2 GHz	802.11a	5150-5250 MHz	15.0	**15.5**	8.5	**9.0**
	802.11n HT20	5150-5250 MHz	15.0	**15.5**	8.5	**9.0**
	802.11n HT40	5150-5250 MHz	12.0	**12.5**	8.5	**9.0**
	802.11ac VHT20	5150-5250 MHz	15.0	**15.5**	8.5	**9.0**
	802.11ac VHT40	5150-5250 MHz	12.0	**12.5**	8.5	**9.0**
	802.11ac VHT80	5150-5250 MHz	8.0	**8.5**	5.5	**6.0**
Wi-Fi 5.3 GHz	802.11a	5250-5350 MHz	15.0	**15.5**	8.5	**9.0**
	802.11n HT20	5250-5350 MHz	15.0	**15.5**	8.5	**9.0**
	802.11n HT40	5250-5350 MHz	12.0	**12.5**	8.5	**9.0**
	802.11ac VHT20	5250-5350 MHz	15.0	**15.5**	8.5	**9.0**
	802.11ac VHT40	5250-5350 MHz	12.0	**12.5**	8.5	**9.0**
	802.11ac VHT80	5250-5350 MHz	8.0	**8.5**	5.5	**6.0**
Wi-Fi 5.5 GHz	802.11a	5470-5725 MHz	15.0	**15.5**	9.2	**9.7**
	802.11n HT20	5470-5725 MHz	15.0	**15.5**	9.2	**9.7**
	802.11n HT40	5470-5725 MHz	12.0	**12.5**	9.2	**9.7**
	802.11ac VHT20	5470-5725 MHz	15.0	**15.5**	9.2	**9.7**
	802.11ac VHT40	5470-5725 MHz	12.0	**12.5**	9.2	**9.7**
	802.11ac VHT80	5470-5725 MHz	8.0	**8.5**	7.5	**8.0**
Wi-Fi 5.8 GHz	802.11a	5725-5850 MHz	15.0	**15.5**	10.0	**10.5**
	802.11n HT20	5725-5850 MHz	15.0	**15.5**	10.0	**10.5**
	802.11n HT40	5725-5850 MHz	12.0	**12.5**	10.0	**10.5**
	802.11ac VHT20	5725-5850 MHz	15.0	**15.5**	10.0	**10.5**
	802.11ac VHT40	5725-5850 MHz	12.0	**12.5**	10.0	**10.5**
	802.11ac VHT80	5725-5850 MHz	8.0	**8.5**	7.0	**7.5**
Bluetooth		All	3.5	**4.0**	3.5	**4.0**
Bluetooth LE		All	3.5	**4.0**	3.5	**4.0**

6.4. Power Reduction by Proximity Sensing

The Proximity Envelope Sensor (PES) consists of two metallic capacitive proximity sense elements parallel to the beveled top surface and immediately adjacent to the WiFi antenna pair on either side. Each of these sense elements sets up an electric field between itself and the various components of the tablet. For a given excitation voltage, assuming the remainder of the tablet remains static, the number of point charges remains relatively constant. As an object (or operator) approaches these sense elements, the field starts to change to include the object (or operator). The number of point charges on the sense plate increases. By definition, this process increases the capacitance. A trigger event is determined when capacitance increases above a threshold determined by noise and range considerations. Transmit power is reduced at both antenna ports when the sensor system is triggered. The position of the sensors and antenna are as shown in the graphic below.



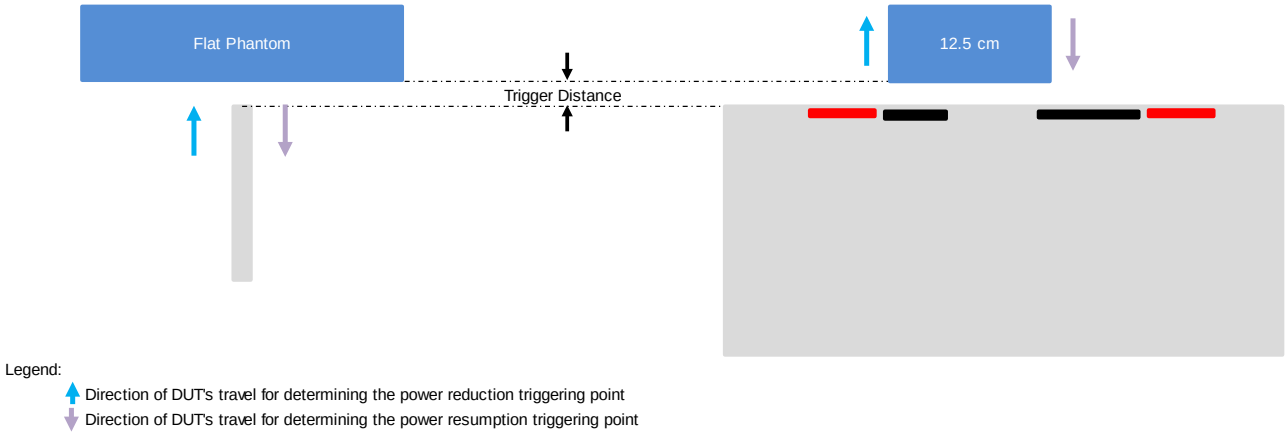
6.4.1. Proximity Sensor Triggering Distance (KDB 616217 §6.2)

A non-standard setup was used for proximity sensor triggering distance determination based on guidance from the FCC. The operational description contains additional information.

Edge 1 (Top) of the DUT was placed directly below the flat phantom and a 12.5 cm 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, per antenna and its respective Proximity Sensor. 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.



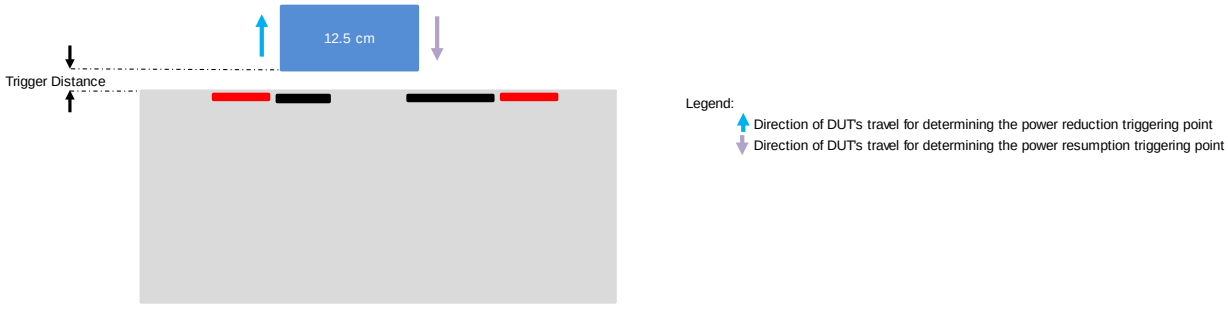
Summary of Trigger Distances

Tissue simulating liquid	Trigger distance – Edge 1 (Main)		Trigger distance – Edge 1 (Aux)		Trigger distance – Edge 1 (Main)		Trigger distance – Edge 1 (Aux)	
	Moving toward phantom	Moving from phantom	Moving toward phantom	Moving from phantom	Moving toward the Left	Moving toward the Right	Moving toward the Left	Moving toward the Right
2450 muscle	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm
5 GHz muscle	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm

6.4.2. Proximity Sensor Coverage (KDB 616217 §6.3)

The rear surface or edge of the tablet is positioned at a test separation distance less than or equal to the distance required for rear surface or edge triggering, with both the antenna and sensor pad located at least 20 mm laterally outside the edge (boundary) of the phantom, along the direction of maximum antenna and sensor offset.

Each applicable tablet edge should be positioned perpendicularly to the phantom to determine sensor coverage. For antennas and/or sensors located near the corner of a tablet, both adjacent edges must be considered.



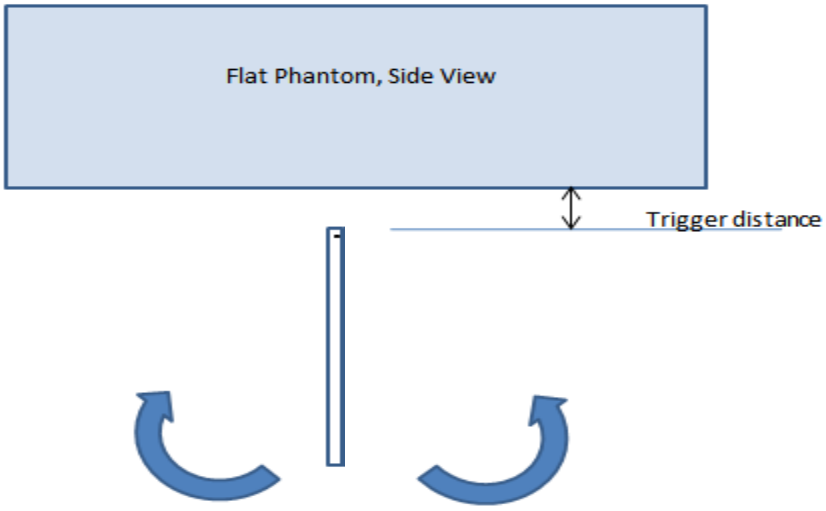
Summary of Tablet Sensor coverage to Proximity Sensor Triggering

Band		Edge 1 (mm)		Minimum Distance (mm)	
		Left	Right	#1	#2
Wi-Fi	2.4 GHz	49.09	36.29	10	10
	5 GHz	49.09	36.29		

6.4.3. Proximity Sensor Tilt Angle Assessment (KDB 616217 §6.4)

The DUT was positioned directly below the flat phantom at the minimum measured trigger distance with Edge 1 parallel to the base of the flat phantom for each band.

The EUT was rotated about Edge 1 for angles up to +/- 45°. If the output power increased during the rotation the DUT was moved 1mm toward the phantom and the rotation repeated. This procedure was repeated until the power remained reduced for all angles up to +/- 45°.



Proximity sensor tilt angle assessment (Edge 1) KDB 616217 §6.4

Summary of Tablet Tilt Angle Influence to Proximity Sensor Triggering

Band (MHz)	Minimum trigger distance measured according to KDB 616217 §6.2	Minimum distance at which power reduction was maintained over +/-45°	Power reduction status										
			-45°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	45°
2.4 GHz	10 mm	10 mm	On	On	On	On	On	On	On	On	On	On	On
5 GHz	10 mm	10 mm	On	On	On	On	On	On	On	On	On	On	On

6.4.4. Resulting test positions for SAR measurements

Wireless technologies	Position	§6.2 Triggering Distance	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for SAR
Wi-Fi	Edge 1	10 mm	10 mm	10 mm	9 mm

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 at Maximum Power

Antennas < 50mm to adjacent edges

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
Wi-Fi Main Antenna															
Wi-Fi 2.4 GHz	2457	17.50	56	5	5	172.01	191.06	77.19		17.6 -MEASURE-	17.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	
Wi-Fi 5.2 GHz	5240	15.50	35	5	5	172.01	191.06	77.19		16 -MEASURE-	16 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	
Wi-Fi 5.3 GHz	5320	15.50	35	5	5	172.01	191.06	77.19		16.1 -MEASURE-	16.1 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	
Wi-Fi 5.5 GHz	5700	15.50	35	5	5	172.01	191.06	77.19		16.7 -MEASURE-	16.7 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	
Wi-Fi 5.8 GHz	5825	15.50	35	5	5	172.01	191.06	77.19		16.9 -MEASURE-	16.9 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	
Bluetooth	2480	4.00	3	5	5	172.01	191.06	77.19		0.9 -EXEMPT-	0.9 -EXEMPT-	> 50 mm	> 50 mm	> 50 mm	
Wi-Fi Sub Antenna															
Wi-Fi 2.4 GHz	2457	17.50	56	5	5	65.19	191.06	167.01		17.6 -MEASURE-	17.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	
Wi-Fi 5.2 GHz	5240	15.50	35	5	5	65.19	191.06	167.01		16 -MEASURE-	16 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	
Wi-Fi 5.3 GHz	5320	15.50	35	5	5	65.19	191.06	167.01		16.1 -MEASURE-	16.1 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	
Wi-Fi 5.5 GHz	5700	15.50	35	5	5	65.19	191.06	167.01		16.7 -MEASURE-	16.7 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	
Wi-Fi 5.8 GHz	5825	15.50	35	5	5	65.19	191.06	167.01		16.9 -MEASURE-	16.9 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	

Note(s):

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

Antennas > 50mm to adjacent edges

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
Wi-Fi Main Antenna															
Wi-Fi 2.4 GHz	2457	17.50	56	5	5	172.01	191.06	77.19		< 50 mm	< 50 mm	1315.8 mW -EXEMPT-	1506.3 mW -EXEMPT-	367.6 mW -EXEMPT-	
Wi-Fi 5.2 GHz	5240	15.50	35	5	5	172.01	191.06	77.19		< 50 mm	< 50 mm	1285.6 mW -EXEMPT-	1476.1 mW -EXEMPT-	337.4 mW -EXEMPT-	
Wi-Fi 5.3 GHz	5320	15.50	35	5	5	172.01	191.06	77.19		< 50 mm	< 50 mm	1285.1 mW -EXEMPT-	1475.6 mW -EXEMPT-	336.9 mW -EXEMPT-	
Wi-Fi 5.5 GHz	5700	15.50	35	5	5	172.01	191.06	77.19		< 50 mm	< 50 mm	1282.9 mW -EXEMPT-	1473.4 mW -EXEMPT-	334.7 mW -EXEMPT-	
Wi-Fi 5.8 GHz	5825	15.50	35	5	5	172.01	191.06	77.19		< 50 mm	< 50 mm	1282.3 mW -EXEMPT-	1472.8 mW -EXEMPT-	334.1 mW -EXEMPT-	
Bluetooth	2480	4.00	3	5	5	172.01	191.06	77.19		< 50 mm	< 50 mm	1315.4 mW -EXEMPT-	1505.9 mW -EXEMPT-	367.2 mW -EXEMPT-	
Wi-Fi Sub Antenna															
Wi-Fi 2.4 GHz	2457	17.50	56	5	5	65.19	191.06	167.01		< 50 mm	< 50 mm	247.6 mW -EXEMPT-	1506.3 mW -EXEMPT-	1265.8 mW -EXEMPT-	
Wi-Fi 5.2 GHz	5240	15.50	35	5	5	65.19	191.06	167.01		< 50 mm	< 50 mm	217.4 mW -EXEMPT-	1476.1 mW -EXEMPT-	1235.6 mW -EXEMPT-	
Wi-Fi 5.3 GHz	5320	15.50	35	5	5	65.19	191.06	167.01		< 50 mm	< 50 mm	216.9 mW -EXEMPT-	1475.6 mW -EXEMPT-	1235.1 mW -EXEMPT-	
Wi-Fi 5.5 GHz	5700	15.50	35	5	5	65.19	191.06	167.01		< 50 mm	< 50 mm	214.7 mW -EXEMPT-	1473.4 mW -EXEMPT-	1232.9 mW -EXEMPT-	
Wi-Fi 5.8 GHz	5825	15.50	35	5	5	65.19	191.06	167.01		< 50 mm	< 50 mm	214.1 mW -EXEMPT-	1472.8 mW -EXEMPT-	1232.3 mW -EXEMPT-	

Note(s):

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	Rear	Edge 1	Edge 2	Edge 3	Edge 4
		(Top Edge)	(Right Edge)	(Bottom Edge)	(Left Edge)
Wi-Fi 2.4 GHz SISO (Main Antenna)	Yes	Yes	No	No	No
Wi-Fi 2.4 GHz SISO (Sub Antenna)	Yes	Yes	No	No	No
Wi-Fi 2.4 GHz MIMO	Yes	Yes	No	No	No
Wi-Fi 5 GHz SISO (Main Antenna)	Yes	Yes	No	No	No
Wi-Fi 5 GHz SISO (Sub Antenna)	Yes	Yes	No	No	No
Wi-Fi 5 GHz MIMO	Yes	Yes	No	No	No
Bluetooth	No	No	No	No	No

Note(s):

Yes = Testing is required.

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 ± 2°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	
	ε_r	σ (S/m)	ε_r	σ (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 Lab 1

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/17/2015	Body 2450	e'	51.2900	Relative Permittivity (ϵ_r):	51.29	52.70	-2.68	5
		e''	14.9100	Conductivity (σ):	2.03	1.95	4.16	5
	Body 2410	e'	51.4700	Relative Permittivity (ϵ_r):	51.47	52.76	-2.44	5
		e''	14.8300	Conductivity (σ):	1.99	1.91	**4.18**	5
	Body 2475	e'	51.3300	Relative Permittivity (ϵ_r):	51.33	52.67	-2.54	5
		e''	14.9300	Conductivity (σ):	2.05	1.99	3.50	5
8/21/2015	Body 2450	e'	51.6900	Relative Permittivity (ϵ_r):	51.69	52.70	-1.92	5
		e''	14.8500	Conductivity (σ):	2.02	1.95	3.74	5
	Body 2410	e'	51.8200	Relative Permittivity (ϵ_r):	51.82	52.76	-1.78	5
		e''	14.7500	Conductivity (σ):	1.98	1.91	3.62	5
	Body 2475	e'	51.6300	Relative Permittivity (ϵ_r):	51.63	52.67	-1.97	5
		e''	14.8700	Conductivity (σ):	2.05	1.99	3.08	5

SAR Lab 4

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/17/2015	Body 5180	e'	47.7100	Relative Permittivity (ϵ_r):	47.71	49.05	-2.73	5
		e''	18.6100	Conductivity (σ):	5.36	5.27	1.68	5
	Body 5200	e'	47.7100	Relative Permittivity (ϵ_r):	47.71	49.02	-2.67	5
		e''	18.5700	Conductivity (σ):	5.37	5.29	1.41	5
	Body 5600	e'	47.0000	Relative Permittivity (ϵ_r):	47.00	48.48	-3.05	5
		e''	18.8900	Conductivity (σ):	5.88	5.76	2.10	5
	Body 5800	e'	46.6700	Relative Permittivity (ϵ_r):	46.67	48.20	-3.17	5
		e''	19.2200	Conductivity (σ):	6.20	6.00	3.31	5
	Body 5825	e'	46.5600	Relative Permittivity (ϵ_r):	46.56	48.20	**-3.40**	5
		e''	19.2000	Conductivity (σ):	6.22	6.00	3.64	5
8/21/2015	Body 5180	e'	48.1900	Relative Permittivity (ϵ_r):	48.19	49.05	-1.75	5
		e''	18.5600	Conductivity (σ):	5.35	5.27	1.41	5
	Body 5200	e'	48.0700	Relative Permittivity (ϵ_r):	48.07	49.02	-1.94	5
		e''	18.5700	Conductivity (σ):	5.37	5.29	1.41	5
	Body 5600	e'	47.7900	Relative Permittivity (ϵ_r):	47.79	48.48	-1.42	5
		e''	18.9800	Conductivity (σ):	5.91	5.76	2.59	5
	Body 5800	e'	47.0600	Relative Permittivity (ϵ_r):	47.06	48.20	-2.37	5
		e''	19.0800	Conductivity (σ):	6.15	6.00	2.55	5
	Body 5825	e'	47.1600	Relative Permittivity (ϵ_r):	47.16	48.20	-2.16	5
		e''	19.1600	Conductivity (σ):	6.21	6.00	3.43	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	706	5/11/2015	2450	1g	52.6	51.3
				10g	24.6	24.0
D5GHzV2	1138	9/18/2014	5200	1g	81.4	75.4
				10g	23.3	21.0
			5600	1g	85.1	81.9
				10g	24.2	22.6
			5800	1g	80.6	75.2
				10g	23.0	20.8

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 Lab 1

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
8/17/2015	D2450V2	706	Body	1g	5.27	52.7	51.30	2.73	
				10g	2.43	24.3	24.00	1.25	
8/21/2015	D2450V2	706	Body	1g	5.41	54.1	51.30	**5.46**	1, 2
				10g	2.49	24.9	24.00	3.75	

SAR Lab 4

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
8/17/2015	D5GHzV2 (5200)	1138	Body	1g	7.99	79.9	75.4	5.97	
				10g	2.24	22.4	21.0	6.67	
8/17/2015	D5GHzV2 (5600)	1138	Body	1g	8.73	87.3	81.9	**6.59**	3,4
				10g	2.42	24.2	22.6	7.08	
8/17/2015	D5GHzV2 (5800)	1138	Body	1g	7.82	78.2	75.2	3.99	
				10g	2.20	22.0	20.8	5.77	
8/21/2015	D5GHzV2 (5.2)	1138	Body	1g	7.39	73.9	75.4	-1.99	
				10g	2.08	20.8	21.0	-0.95	
8/21/2015	D5GHzV2 (5.6)	1138	Body	1g	8.43	84.3	81.9	2.93	
				10g	2.36	23.6	22.6	4.42	
8/21/2015	D5GHzV2 (5.8)	1138	Body	1g	7.29	72.9	75.2	-3.06	
				10g	2.04	20.4	20.8	-1.92	

9. Conducted Output Power Measurements

9.1. Wi-Fi 2.4GHz (DTS Band)

MIMO Measured Results for Max Power

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Power (dBm)		Max Output Power (dBm)		SAR Test (Yes/No)	Note(s)
					Main Ant	Aux Ant	Main Ant	Aux Ant		
2.4	802.11b	1 Mbps	2	2417	12.4	12.4	13.5	13.5	Yes	
			6	2437	12.4	12.4				
			10	2457	12.5	12.5				
	802.11g	6 Mbps	2	2417	16.0	15.8	17.5	17.5	Yes	
			6	2437	15.7	15.7				
			10	2457	15.7	15.6				
	802.11n (HT20)	6.5 Mbps	2	2417	15.8	15.8	17.5	17.5	Yes	
			6	2437	15.9	15.8				
			10	2457	15.9	15.6				

MIMO Measured Results for Reduced Power

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Power (dBm)		Max Output Power (dBm)		SAR Test (Yes/No)	Note(s)
					Main Ant	Aux Ant	Main Ant	Aux Ant		
2.4	802.11b	1 Mbps	2	2417	12.4	12.4	13.5	13.5	Yes	
			6	2437	12.4	12.4				
			10	2457	12.5	12.5				
	802.11g	6 Mbps	2	2417	13.0	13.0	14.5	14.5	Yes	
			6	2437	13.0	13.0				
			10	2457	12.9	12.7				
	802.11n (HT20)	6.5 Mbps	2	2417	13.0	12.8	14.5	14.5	Yes	
			6	2437	13.0	12.8				
			10	2457	12.9	12.9				

Note(s):

1. Additionally, SAR is not required for Channels 12 and 13 because the tune-up limit and the measured output power for these two channels are no greater than those for the default test channels.

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

MIMO Measured Results for Max Power

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Power (dBm)		Max Output Power (dBm)		SAR Test (Yes/No)	Note(s)
					Main Ant	Aux Ant	Main Ant	Aux Ant		
5.3 (U-NII 2A)	802.11a	6 Mbps	52	5260	13.7	13.9	15.5	15.5	Yes	1, 2
			56	5280	13.5	14.1				
			60	5300	13.8	14.0				
			64	5320	13.7	14.2				
	802.11n (HT20)	6.5 Mbps	52	5260	13.5	14.1	15.5	15.5	No	
			56	5280	13.5	14.3				
			60	5300	13.7	14.2				
			64	5320	13.8	14.2				
	802.11n (HT40)	13.5 Mbps	54	5270	11.3	11.4	12.5	12.5	No	
			62	5310	11.2	11.2				
	802.11ac (VHT20)	6.5 Mbps	52	5260	13.5	14.1	15.5	15.5	No	
			56	5280	13.7	14.3				
			60	5300	13.7	14.1				
			64	5320	13.9	14.2				
	802.11ac (VHT40)	13.5 Mbps	54	5270	11.3	11.3	12.5	12.5	No	
			62	5310	11.4	11.4				
	802.11ac (VHT80)	29.3 Mbps	58	5290	7.0	7.2	8.5	8.5	No	
5.5 (UNII-2C)	802.11a	6 Mbps	100	5500	13.5	13.8	15.5	15.5	Yes	1
			112	5560	13.4	13.8				
			116	5580	13.8	13.7				
			128	5640	13.5	13.8				
	802.11n (HT20)	6.5 Mbps	100	5500	13.5	13.9	15.5	15.5	No	
			112	5560	13.8	13.9				
			116	5580	13.7	13.8				
			128	5640	13.7	13.9				
	802.11n (HT40)	13.5 Mbps	102	5510	11.0	11.1	12.5	12.5	No	
			110	5550	11.1	11.3				
			118	5590	11.0	11.1				
			126	5630	11.2	11				
	802.11ac (VHT20)	6.5 Mbps	100	5500	13.6	13.9	15.5	15.5	No	
			112	5560	13.7	13.8				
			116	5580	13.4	13.8				
			128	5640	13.5	13.7				
	802.11ac (VHT40)	13.5 Mbps	102	5510	11.1	11.0	12.5	12.5	Mo	
			110	5550	11.1	11.3				
			118	5590	11.2	11.2				
			126	5630	11.2	11.0				
	802.11ac (VHT80)	29.3 Mbps	106	5530	6.9	6.7	8.5	8.5	No	
			122	5610	6.8	6.5				
Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Power (dBm)		Max Output Power (dBm)		SAR Test (Yes/No)	Note(s)
					Main Ant	Aux Ant	Main Ant	Aux Ant		
5.8 (UNII-3)	802.11a	6 Mbps	132	5660	13.7	14.0	15.5	15.5	Yes	1
			149	5745	13.8	13.7				
			165	5825	14.0	13.9				
	802.11n (HT20)	6.5 Mbps	132	5660	13.7	13.7	15.5	15.5	No	
			149	5745	13.8	13.8				
			165	5825	13.8	14.0				
	802.11n (HT40)	13.5 Mbps	134	5670	11.0	11.0	12.5	12.5	No	
			142	5710	11.0	11.0				
			151	5755	11.1	10.8				
			159	5795	11.3	10.9				
	802.11ac (VHT20)	6.5 Mbps	132	5660	13.4	14.0	15.5	15.5	No	
			149	5745	13.8	13.9				
			165	5825	13.8	14.0				
	802.11ac (VHT40)	13.5 Mbps	134	5670	11.0	11.0	12.5	12.5	No	
			142	5710	11.0	11.0				
			151	5755	11.3	11.1				
			159	5795	11.3	11.0				
	802.11ac (VHT80)	29.3 Mbps	138	5690	6.0	5.7	8.5	8.5	No	
			155	5775	7.2	6.3				

MIMO Measured Results for Reduced Power

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Power (dBm)		Max Output Power (dBm)		SAR Test (Yes/No)	Note(s)
					Main Ant	Aux Ant	Main Ant	Aux Ant		
5.3 (U-NII 2A)	802.11a	6 Mbps	52	5260	7.8	7.8	9.0	9.0	No	
			56	5280	7.9	8.1				
			60	5300	8.2	8.3				
			64	5320	8.2	8.1				
	802.11n (HT20)	6.5 Mbps	52	5260	7.9	7.9	9.0	9.0	No	
			56	5280	8.2	8.2				
			60	5300	8.3	8.3				
			64	5320	8.1	8.3				
	802.11n (HT40)	13.5 Mbps	54	5270	7.9	7.9	9.0	9.0	Yes	1,2
			62	5310	8.1	8.0				
	802.11ac (VHT20)	6.5 Mbps	52	5260	8.0	8.3	9.0	9.0	No	
			56	5280	8.0	8.3				
			60	5300	8.2	8.0				
			64	5320	8.2	8.0				
	802.11ac (VHT40)	13.5 Mbps	54	5270	8.1	8.1	9.0	9.0	No	
			62	5310	7.9	8.1				
	802.11ac (VHT80)	29.3 Mbps	58	5290	5.0	5.2	6.0	6.0	No	
5.5 (UNII-2C)	802.11a	6 Mbps	100	5500	9.5	9.5	9.7	9.7	No	
			112	5560	9.6	9.5				
			116	5580	9.6	9.7				
			128	5640	9.7	9.7				
	802.11n (HT20)	6.5 Mbps	100	5500	9.3	9.7	9.7	9.7	No	
			112	5560	9.6	9.6				
			116	5580	9.6	9.7				
			128	5640	9.6	9.7				
	802.11n (HT40)	13.5 Mbps	102	5510	9.6	9.6	9.7	9.7	Yes	1
			110	5550	9.6	9.6				
			118	5590	9.5	9.7				
			126	5630	9.6	9.7				
	802.11ac (VHT20)	6.5 Mbps	100	5500	9.5	9.6	9.7	9.7	No	
			112	5560	9.6	9.7				
			116	5580	9.7	9.7				
			128	5640	9.7	9.7				
	802.11ac (VHT40)	13.5 Mbps	102	5510	9.5	9.5	9.7	9.7	No	
			110	5550	9.7	9.7				
			118	5590	9.7	9.7				
			126	5630	9.7	9.7				
	802.11ac (VHT80)	29.3 Mbps	106	5530	6.8	6.7	8.0	8.0	No	
			122	5610	6.8	6.5				

MIMO Measured Results for Reduced Power (continued)

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Power (dBm)		Max Output Power (dBm)		SAR Test (Yes/No)	Note(s)
					Main Ant	Aux Ant	Main Ant	Aux Ant		
5.8 (UNII-3)	802.11a	6 Mbps	132	5660	10.0	9.7	9.7	9.7	No	
			149	5745	10.0	9.4	10.5	10.5		
			165	5825	10.0	9.8				
	802.11n (HT20)	6.5 Mbps	132	5660	9.7	9.8	9.7	9.7	No	
			149	5745	10.0	9.5	10.5	10.5		
			165	5825	10.0	9.9				
	802.11n (HT40)	13.5 Mbps	134	5670	9.8	9.4	9.7	9.7	Yes	1
			142	5710	9.8	9.6				
			151	5755	9.7	9.3	10.5	10.5		
			159	5795	9.7	9.6				
	802.11ac (VHT20)	6.5 Mbps	132	5660	9.8	9.7	9.7	9.7	No	
			149	5745	10.0	9.6	10.5	10.5		
			165	5825	10.0	9.9				
	802.11ac (VHT40)	13.5 Mbps	134	5670	9.6	9.5	9.7	9.7	No	
			142	5710	10.0	9.5				
			151	5755	9.9	9.7	10.5	10.5		
			159	5795	9.6	9.4				
	802.11ac (VHT80)	29.3 Mbps	138	5690	7.0	6.6	8.0	8.0	No	
			155	5775	7.3	6.3	7.5	7.5		

Note(s):

1. 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.
2. 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
   - o ≤ 1.2 W/kg, SAR is not required for UNII band I
   - o > 1.2 W/kg, both bands should be tested independently for SAR.

9.3. Bluetooth

Maximum tune-up tolerance limit is 4.00 dBm from the rated nominal maximum output power. This power level qualifies for exclusion of SAR testing.

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

KDB 447498 D01 General RF Exposure Guidance:

Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

KDB 248227 D01 SAR meas for 802.11 v02:

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:

- ≤ 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 ≤ 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 ≤ 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 ≤ 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 ≤ 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*.

10.1. Wi-Fi (DTS Band)

Frequency Band	Mode	Pwr Back-off	ANT	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Notes	Plot No.
									Tune-up limit	Meas.	Meas.	Scaled		
2.4GHz	MIMO 802.11b 1 Mbps	N/A	Main	0	Rear	10	2457	0.243	13.5	12.5				
					Edge 1	10	2457	0.722	13.5	12.5	0.495	0.623		
					Edge 1 Slant	10	2457	0.522	13.5	12.5	0.552	0.695	2	
		N/A	Aux	0	Rear	10	2457	0.243	13.5	12.5				
					Edge 1	10	2457	0.722	13.5	12.5	0.513	0.646	2	
					Edge 1 Slant	10	2457	0.522	13.5	12.5	0.441	0.555		
Frequency Band	Mode	Pwr Back-off	ANT	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Notes	Plot No.
									Tune-up limit	Meas.	Meas.	Scaled		
2.4GHz	MIMO 802.11g 6 Mbps	OFF	Main	0	Rear	2	2417	0.598	17.5	16.0	0.407	0.575	2	
				9	Edge 1	2	2417	0.185	17.5	16.0	0.139	0.196		
					Edge 1 Slant	2	2417	0.137	17.5	16.0				
		OFF	Aux	0	Rear	2	2417	0.598	17.5	15.8	0.219	0.324	2	
				9	Edge 1	2	2417	0.185	17.5	15.8	0.143	0.212		
					Edge 1 Slant	2	2417	0.137	17.5	15.8				
2.4GHz	MIMO 802.11g 6 Mbps	ON	Main	0	Rear	6	2437	0.316	14.5	13.0				
					Edge 1	2	2417		14.5	13.0	0.498	0.703	3	
						6	2437	0.593	14.5	13.0	0.470	0.664		
						10	2457		14.5	12.9	0.488	0.705	3	
					Edge 1 Slant	2	2417		14.5	13.0	0.613	0.866	3	
						6	2437	0.940	14.5	13.0	0.621	0.877	2	
						10	2457		14.5	12.9	0.711	1.028	3	
		ON	Aux	0	Rear	6	2437	0.316	14.5	13.0				
					Edge 1	2	2417		14.5	13.0	0.660	0.932	3	
						6	2437	0.593	14.5	13.0	0.751	1.061		
						10	2457		14.5	12.7	0.716	1.084	3	
					Edge 1 Slant	2	2417		14.5	13.0	0.539	0.761	3	
						6	2437	0.940	14.5	13.0	0.637	0.900	2	
						10	2457		14.5	12.7	0.699	**1.058**	3	1
Frequency Band	Mode	Pwr Back-off	ANT	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Notes	Plot No.
									Tune-up limit	Meas.	Meas.	Scaled		
2.4GHz	MIMO 802.11n HT40 6.5 Mbps	OFF	Main	0	Rear	6	2437	0.489	17.5	15.9	0.332	0.480	2	
				9	Edge 1	6	2437	0.168	17.5	15.9				
					Edge 1 Slant	6	2437	0.179	17.5	15.9	0.169	0.244		
		OFF	Aux	0	Rear	6	2437	0.489	17.5	15.8	0.198	0.293	2	
				9	Edge 1	6	2437	0.168	17.5	15.8				
					Edge 1 Slant	6	2437	0.179	17.5	15.8	0.176	0.260		
2.4GHz	MIMO 802.11n HT40 6.5 Mbps	ON	Main	0	Rear	6	2437	0.179	14.5	13.0				
					Edge 1	2	2417		14.5	13.0	0.512	0.723	3	
						6	2437	0.617	14.5	13.0	0.504	0.712		
						10	2457		14.5	12.9	0.727	1.051	3	
					Edge 1 Slant	2	2417		14.5	13.0	0.583	0.824	3	
						6	2437	0.627	14.5	13.0	0.645	0.911	2	
						10	2457		14.5	12.9	0.693	1.002	3	
		ON	Aux	0	Rear	6	2437	0.179	14.5	12.8				
					Edge 1	2	2417		14.5	12.8	0.677	1.001	3	
						6	2437	0.617	14.5	12.8	0.736	1.089		
						10	2457		14.5	12.9	0.491	0.710	3	
					Edge 1 Slant	2	2417		14.5	12.8	0.549	0.812	3	
						6	2437	0.627	14.5	12.8	0.614	0.908	2	
						10	2457		14.5	12.9	0.587	0.848	3	

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 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.

10.2. Wi-Fi (U-NII Band)

Frequency Band	Mode	Pwr Back-off	ANT	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Notes	Plot No.
									Tune-up limit	Meas.	Meas.	Scaled		
5.3 GHz U-NII 2A	MIMO 802.11a 6 Mbps	OFF	Main	0	Rear	52	5260	0.382	15.5	13.7				
				9	Edge 1	52	5260	0.765	15.5	13.7	0.455	0.689	2	
					Edge 1 Slant	52	5260	0.451	15.5	13.7	0.347	0.525	3	
		OFF	Aux	0	Rear	52	5260	0.382	15.5	13.9				
				9	Edge 1	52	5260	0.765	15.5	13.9	0.517	0.747	2	
					Edge 1 Slant	52	5260	0.451	15.5	13.9	0.350	0.506	3	
5.3 GHz U-NII 2A	MIMO 802.11n HT40 13.5 Mbps	ON	Main	0	Rear	54	5270		9.0	7.9				
						62	5320	0.167	9.0	8.1	0.125	0.154		
					Edge 1	54	5270		9.0	7.9	0.812	1.046	3	
						62	5320	1.730	9.0	8.1	0.932	1.147	2	2
					Edge 1 Slant	54	5270		9.0	7.9	0.257	0.331	3	
						62	5320	1.490	9.0	8.1	0.740	0.910		
		ON	Aux	0	Rear	54	5270		9.0	7.9				
						62	5320	0.167	9.0	8.0	0.181	0.228		
					Edge 1	54	5270		9.0	7.9	0.768	0.989	3	
						62	5320	1.730	9.0	8.0	0.730	0.919	2	
					Edge 1 Slant	54	5270		9.0	7.9	0.348	0.448	3	
						62	5320	1.490	9.0	8.0	0.750	0.944		

Frequency Band	Mode	Pwr Back-off	ANT	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Notes	Plot No.
									Tune-up limit	Meas.	Meas.	Scaled		
5.5 GHz U-NII 2C	MIMO 802.11a 6 Mbps	OFF	Main	0	Rear	100	5500	0.359	15.5	13.5				
				9	Edge 1	100	5500	0.954	15.5	13.5	0.518	0.821	3	
						116	5580		15.5	13.8	0.504	0.745	2	
					Edge 1 Slant	100	5500	0.647	15.5	13.5	0.324	0.514	2	
		OFF	Aux	0	Rear	100	5500	0.359	15.5	13.8				
				9	Edge 1	100	5500	0.954	15.5	13.8	0.336	0.497	3	
						116	5580		15.5	13.7	0.357	0.540	2	
					Edge 1 Slant	100	5500	0.647	15.5	13.8	0.260	0.385	2	
5.5 GHz U-NII 2C	MIMO 802.11n HT40 13.5 Mbps	ON	Main	0	Rear	118	5590	0.209	9.7	9.5				
					Edge 1	102	5510		9.7	9.6	1.160	**1.187**	3	3
						110	5550		9.7	9.6	1.060	1.085	3	
						118	5590	1.490	9.7	9.5	0.923	0.966	2	
					Edge 1 Slant	118	5590		9.7	9.5	0.334	0.350		
		ON	Aux	0	Rear	118	5590	0.209	9.7	9.7				
					Edge 1	102	5510		9.7	9.6	0.705	0.721	3	
						110	5550		9.7	9.6	0.689	0.705	3	
						118	5590	1.490	9.7	9.7	0.630	0.630	2	
					Edge 1 Slant	118	5590		9.7	9.7	0.318	0.318		

Frequency Band	Mode	Pwr Back-off	ANT	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Notes	Plot No.
									Tune-up limit	Meas.	Meas.	Scaled		
5.8 GHz U-NII 3	MIMO 802.11a 6 Mbps	OFF	Main	0	Rear	165	5825	0.301	15.5	14.0				
				9	Edge 1	165	5825	0.655	15.5	14.0	0.311	0.439	2	
					Edge 1 Slant	165	5825	0.389	15.5	14.0	0.192	0.271	2	
		OFF	Aux	0	Rear	165	5825	0.301	15.5	13.9				
				9	Edge 1	165	5825	0.655	15.5	13.9	0.295	0.426	3	
					Edge 1 Slant	165	5825	0.389	15.5	13.9	0.209	0.302	2	
5.8 GHz U-NII 3	MIMO 802.11n HT40 13.5 Mbps	ON	Main	0	Rear	159	5795	0.108	10.5	9.7				
					Edge 1	151	5755		10.5	9.7	0.667	0.802	3	
						159	5795	0.466	10.5	9.7	0.574	0.690	2	
					Edge 1 Slant	159	5795		10.5	9.7	0.421	0.506		
		ON	Aux	0	Rear	159	5795	0.108	10.5	9.6				
					Edge 1	151	5755		10.5	9.3	0.699	**0.921**	3	4
						159	5795	0.466	10.5	9.6	0.638	0.785	2	
					Edge 1 Slant	159	5795		10.5	9.6	0.592	0.728		

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 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.

10.3. Bluetooth

Standalone SAR Test Exclusion Considerations & Estimated SAR

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)] ≤ 3.0, for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- $f_{(GHz)}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

When the standalone SAR test exclusion is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- *(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√$f_{(GHz)}$/x]* W/kg for test separation distances ≤ 50 mm;
  where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

Body-worn Accessory Exposure Conditions

Max. tune-up tolerance limit		Min. test separation distance (mm)	Frequency (GHz)	SAR test exclusion Result*	Test Configuration	Estimated 1-g SAR (W/kg)
(dBm)	(mW)					
4.0	3	5	2.480	0.9	Rear/Front	0.126

Conclusion:

*: The computed value is ≤ 3; therefore, Bluetooth qualifies for Standalone SAR test exclusion.

11. 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 <1.6 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), 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 3 (1-g or 10-g respectively) or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 or 3 (1-g or 10-g respectively).

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	First Repeated		Second Repeated		Third Repeated
						Measured SAR (W/kg)	Largest to Smallest SAR Ratio	Measured SAR (W/kg)	Largest to Smallest SAR Ratio	Measured SAR (W/kg)
2400	Wi-Fi 802.11b/g/n	Standalone	Edge 1	No	0.751	N/A	N/A	N/A	N/A	N/A
5300	Wi-Fi 802.11a/n/ac	Standalone	Edge 1	Yes	0.932	0.92	1.01	N/A	N/A	N/A
5500	Wi-Fi 802.11a/n/ac	Standalone	Edge 1	Yes	1.16	1.13	1.03	N/A	N/A	N/A
5800	Wi-Fi 802.11a/n/ac	Standalone	Edge 1	No	0.699	N/A	N/A	N/A	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 or 3 (1-g or 10-g respectively).

12. Simultaneous Transmission SAR Analysis

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations
Standalone	1	U-NII + BT

Notes:

1. Only DTS supports Hotspot.
2. DTS Radio cannot transmit simultaneously with Bluetooth Radio.
3. U-NII Radio can transmit simultaneously with Bluetooth Radio.

Estimated SAR for Simultaneous Transmission SAR Analysis

Considerations for SAR estimation

1. When standalone SAR test exclusion applies, standalone SAR must also be estimated to determine simultaneous transmission SAR test exclusion.
2. Dedicated Host Approach criteria for SAR test exclusion is likewise applied to SAR estimation, with certain distinctions between test exclusion and SAR estimation:
   - When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied for SAR estimation; this is the same between test exclusion and SAR estimation calculations.
   - When the separation distance from the antenna to an adjacent edge is > 5 mm but ≤ 50 mm, the actual antenna-to-edge separation distance is applied for SAR estimation.
   - When the minimum test separation distance is > 50 mm, the estimated SAR value is 0.4 W/kg
3. Please refer to Estimated SAR Tables to see which test positions are inherently compliant as they consist of only estimated SAR values for all applicable transmitters and consequently will always have sum of SAR values < 1.2 W/kg. Simultaneous transmission SAR analysis was therefore not performed for these test positions.

Estimated SAR for WLAN

Tx Interface	Frequency (MHz)	Output Power dBm	Output Power mW	Separation Distances (mm) Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Estimated 1-g SAR Value (W/kg) Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front
Wi-Fi Main Antenna															
Wi-Fi 2.4 GHz	2457	17.50	56	5	5	65.1		274		-MEASURE-	-MEASURE-	0.400		0.400	
Wi-Fi 5.2 GHz	5240	15.50	35	5	5	65.1		274		-MEASURE-	-MEASURE-	0.400		0.400	
Wi-Fi 5.3 GHz	5320	15.50	35	5	5	65.1		274		-MEASURE-	-MEASURE-	0.400		0.400	
Wi-Fi 5.5 GHz	5700	15.50	35	5	5	65.1		274		-MEASURE-	-MEASURE-	0.400		0.400	
Wi-Fi 5.8 GHz	5825	15.50	35	5	5	65.1		274		-MEASURE-	-MEASURE-	0.400		0.400	
Wi-Fi Sub Antenna															
Wi-Fi 2.4 GHz	2457	17.50	56	5	5	173.7		76.3		-MEASURE-	-MEASURE-	0.400		0.400	
Wi-Fi 5.2 GHz	5240	15.50	35	5	5	173.7		76.3		-MEASURE-	-MEASURE-	0.400		0.400	
Wi-Fi 5.3 GHz	5320	15.50	35	5	5	173.7		76.3		-MEASURE-	-MEASURE-	0.400		0.400	
Wi-Fi 5.5 GHz	5700	15.50	35	5	5	173.7		76.3		-MEASURE-	-MEASURE-	0.400		0.400	
Wi-Fi 5.8 GHz	5825	15.50	35	5	5	173.7		76.3		-MEASURE-	-MEASURE-	0.400		0.400	
Bluetooth	2480	4.00	3	5	5	65.1		274		0.126	0.126	0.400		0.400	

12.1. Sum of the SAR for WLAN + Bluetooth

RF Exposure conditions	③ U-NII (Main)	⑤ BT (Aux)	③ + ⑤ U-NII + BT ∑ 1-g SAR	③ + ⑤ U-NII + BT SPLSR (Yes/ No)
Rear	0.137	0.126	0.263	No
Edge 1	1.187	0.126	**1.313**	No
Edge 1 Slant	0.811	0.126	0.937	No

Conclusion:

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

Appendixes

Refer to separated files for the following appendixes.

15U21305-S1V1 SAR_App A Photos & Ant. Locations

15U21305-S1V1 SAR_App B System Check Plots

15U21305-S1V1 SAR_App C Highest Test Plots

15U21305-S1V1 SAR_App D Tissue Ingredients

15U21305-S1V1 SAR_App E Probe Cal. Certificates

15U21305-S1V1 SAR_App F Dipole Cal. Certificates

END OF REPORT