FCC 47 CFR Parts 1 & 2
Published RF Exposure KDB Procedures
IEEE Std 1528-2013

SAR EVALUATION REPORT

For
Portable Computing Device with Wi-Fi 802.11 a/b/g/n/ac MIMO + Bluetooth

Model: 1631
FCC ID: C3K1631

Report Number: 14U17394-S1
Issue Date: 04/30/2014

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	04/13/2014	Initial Issue	--

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1. Attestation of Test Results

Applicant	Microsoft Corporation			
DUT description	Portable Computing Device with Wi-Fi 802.11 a/b/g/n/ac MIMO + Bluetooth			
Model	1631			
Test device is	An identical prototype			
Device category	Portable			
Exposure category	General Population/Uncontrolled Exposure			
Date tested	03/27/2014 – 04/26/2014			
The highest reported SAR values	RF exposure condition	Licensed	DTS	UNII
	Stand-alone	N/A W/kg	1.260 W/kg	1.288 W/kg
	Simultaneous Transmission	N/A W/kg	N/A W/kg	N/A W/kg
Applicable Standards	FCC 47 CFR Parts 1 & 2 Published RF Exposure KDB Procedures, and TCB workshop updates IEEE Std 1528-2013			
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:

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2. Test Methodology

The tests documented in this report were performed in accordance with FCC 47 CFR Parts 1 & 2, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures, and TCB workshop updates:

- 447498 D01 General RF Exposure Guidance v05r02
- 616217 D04 SAR for Laptop and Tablets v01r01
- 248227 D01 SAR Meas for 802 11abg v01r02
- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- 865664 D02 SAR Reporting v01r01
- 690783 D01 SAR Listings on Grants v01r02
- April 2013 TCB Workshop Updates

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

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 F	

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4. Calibration and Uncertainty

4.1. Measuring Instrument Calibration

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.

Tissue Dielectric Properties

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	E8363C	MY49030443	12/3/2014
Dielectronic Probe kit	SPEAG	DAK-3.5	1082	9/14/2014
Dielectronic Probe kit	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	Control Company	4242	122529163	9/9/2014

System Performance Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	HP	8665B	3744A01084	5/7/2014
Power Meter	HP	8481A	3125U11364	8/26/2014
Power Meter	HP	8481A	3125U12345	7/29/2014
Power Sensor	HP	8481A	270A76223	9/17/2014
Power Sensor	HP	8481A	1926127048	7/29/2014
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1622052	N/A
Directional coupler	Werlatone	C8060-102	2149	N/A
DC Power Supply	EKNWOOD	PA36-3A	7060074	N/A
E-Field Probe	SPEAG	EX3DV4	3901	2/25/2015
Data Acquisition Electronics	SPEAG	DAE4	1357	2/17/2015
System Validation Dipole	SPEAG	D2450V2	899	9/10/2014
System Validation Dipole	SPEAG	D5GHzV2	1003	2/26/2015

Others

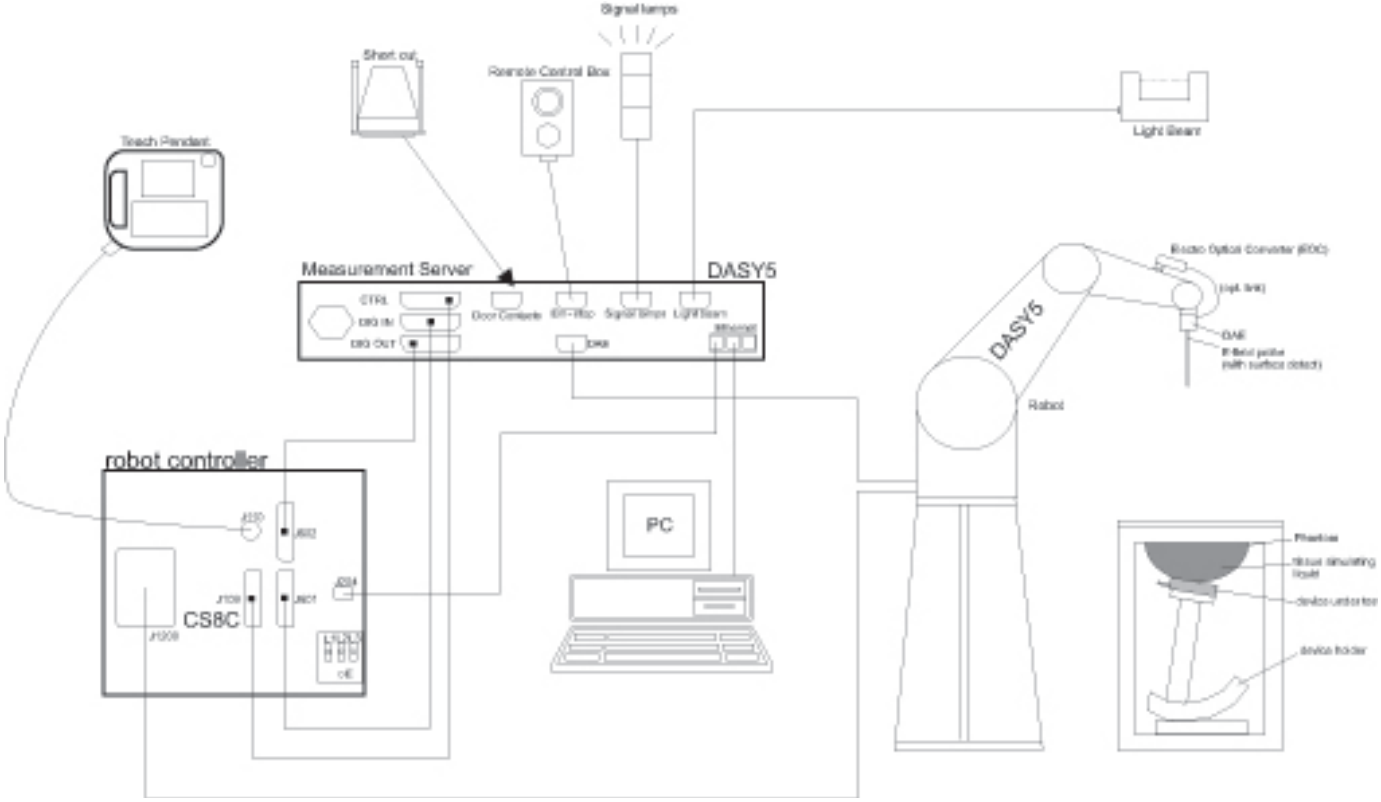
Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Meter	Agilent	N1912A	MY52310061	10/12/2014
Power Sensor	Agilent	N1921A	MY50001018	5/13/2014
Power Sensor	Agilent	N1921A	MY52200012	9/25/2014

4.2. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz Section 2.8.1., 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 1528-2003 is not required in SAR reports submitted for equipment approval.

5. Measurement System Description and Setup

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.

6. SAR Measurement Procedure

6.1. Normal SAR Measurement Procedure

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

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

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.

6.2. Volume Scan Procedures

Step 1: Repeat Step 1-4 in Section 6.1

Step 2: Volume Scan
Volume Scans are used to assess peak SAR and averaged SAR measurements in largely extended 3-dimensional volumes within any phantom. This measurement does not need any previous area scan. The grid can be anchored to a user specific point or to the current probe location.

Step 3: 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.

7. Device Under Test

7.1. General Information

RF Exposure Condition(s)	Body Exposure with all surfaces and edges. Refer to Section 9 for details.
Device dimension	Overall (Length x Width): 200mm x 290mm Overall Diagonal: 350.mm Display Diagonal: 311mm

7.2. Wireless Technologies

Wireless Technology and Frequency Bands	WiFi: 2.4 / 5 GHz Bluetooth: 2.4 GHz.
Mode	WiFi 2.4GHz (802.11b/g/n) - ☒ 802.11b - ☒ 802.11g - ☒ 802.11n (20MHz) - ☒ 802.11n (40MHz) Wi-Fi 5GHz - ☒ 802.11a - ☒ 802.11n (HT20) - ☒ 802.11n (HT40) - ☒ 802.11ac (20MHz) - ☒ 802.11ac (40MHz) - ☒ 802.11ac (80MHz) Bluetooth Ver. 4.0 (LE)
Duty Cycle	WiFi 802.11a/b/g/n/ac: 100%

7.3. Simultaneous Transmission Condition

RF Exposure Condition	Capable Transmit Configurations
Body	**SISO (1Tx)** 1. 2.4GHz (Main) + BT (Aux) 2. 5GHz (Main) + BT (Aux) **MIMO (2Tx)** 3. 5GHz (Main+Aux) + BT (Aux)
Refer to Appendix for Main and Aux antenna locations. Wi-Fi 2.4GHz MIMO mode cannot transmit simultaneously with Bluetooth Radio.	

7.4. RF Output Power Tolerance

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Max.Target Power (dBm)	
						Main	Aux
2.4 GHz	802.11b	1 Mbps	1 Tx	1	2412	11.0	11.0
				6	2437	11.0	11.0
				11	2462	11.0	11.0
			2 Tx	1	2412	11.0	11.0
				6	2437	11.0	11.0
				11	2462	11.0	11.0
	802.11g	6 Mbps	1 Tx	1	2412	11.0	11.0
				6	2437	11.0	11.0
				11	2462	11.0	11.0
			2 Tx	1	2412	11.0	11.0
				6	2437	11.0	11.0
				11	2462	11.0	11.0
	802.11n (HT20)	MCS0	1 Tx	1	2412	11.0	11.0
				6	2437	11.0	11.0
				11	2462	11.0	11.0
			2 Tx	1	2412	11.0	11.0
				6	2437	11.0	11.0
				11	2462	11.0	11.0
	802.11n (HT40)	MCS0	1 Tx	1	2412	11.0	11.0
				6	2437	11.0	11.0
				11	2462	11.0	11.0
			2 Tx	1	2412	11.0	11.0
				6	2437	11.0	11.0
				11	2462	11.0	11.0

RF Output power tolerance continued

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)	
						Main	Aux
5.2 (UNII)	802.11a	6 Mbps	1 Tx	36	5180	10.0	10.0
				40	5200	10.0	10.0
				44	5220	10.0	10.0
				48	5240	10.0	10.0
			2 Tx	36	5180	10.0	10.0
				40	5200	10.0	10.0
				44	5220	10.0	10.0
				48	5240	10.0	10.0
	802.11n (HT20)	MCS0	1 Tx	36	5180	10.0	10.0
				40	5200	10.0	10.0
				44	5220	10.0	10.0
				48	5240	10.0	10.0
			2 Tx	36	5180	10.0	10.0
				40	5200	10.0	10.0
				44	5220	10.0	10.0
				48	5240	10.0	10.0
	802.11n (HT40)	MCS0	1 Tx	38	5190	10.0	10.0
				46	5230	10.0	10.0
			2 Tx	38	5190	10.0	10.0
				46	5230	10.0	10.0
	802.11ac (20MHz)	MCS0	1 Tx	36	5180	10.0	10.0
				40	5200	10.0	10.0
				48	5240	10.0	10.0
			2 Tx	36	5180	10.0	10.0
				40	5200	10.0	10.0
				48	5240	10.0	10.0
	802.11ac (40MHz)	MCS0	1 Tx	38	5190	10.0	10.0
				46	5230	10.0	10.0
			2 Tx	38	5190	10.0	10.0
				46	5230	10.0	10.0
	802.11ac (80MHz)	MCS0	1 Tx	42	5210	9.0	9.0
			2 Tx	42	5210	9.0	9.0

RF Output power tolerance continued

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)	
						Main	Aux
5.3 (UNII)	802.11a	6 Mbps	1 Tx	52	5260	10.0	10.0
				56	5280	10.0	10.0
				60	5300	10.0	10.0
				64	5320	10.0	10.0
			2 Tx	52	5260	10.0	10.0
				56	5280	10.0	10.0
				60	5300	10.0	10.0
				64	5320	10.0	10.0
	802.11n (HT20)	MCS0	1 Tx	52	5260	10.0	10.0
				60	5300	10.0	10.0
				64	5320	10.0	10.0
			2 Tx	52	5260	10.0	10.0
				60	5300	10.0	10.0
				64	5320	10.0	10.0
	802.11n (HT40)	MCS0	1 Tx	54	5270	10.0	10.0
				62	5310	10.0	10.0
			2 Tx	54	5270	10.0	10.0
				62	5310	10.0	10.0
	802.11ac (20MHz)	MCS0	1 Tx	52	5260	10.0	10.0
				60	5300	10.0	10.0
				64	5320	10.0	10.0
			2 Tx	52	5260	10.0	10.0
				60	5300	10.0	10.0
				64	5320	10.0	10.0
	802.11ac (40MHz)	MCS0	1 Tx	54	5270	10.0	10.0
				62	5310	10.0	10.0
			2 Tx	54	5270	10.0	10.0
				62	5310	10.0	10.0
	802.11ac (80MHz)	MCS0	1 Tx	58	5290	9.0	9.0
			2 Tx	58	5290	9.0	9.0

RF Output power tolerance continued

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)	
						Main	Aux
5.5 (UNII)	802.11a	6 Mbps	1 Tx	100	5500	10.0	10.0
				104	5520	10.0	10.0
				108	5540	10.0	10.0
				112	5560	10.0	10.0
				116	5580	10.0	10.0
				120	5600	10.0	10.0
				124	5620	10.0	10.0
				128	5640	10.0	10.0
				132	5660	10.0	10.0
				136	5680	10.0	10.0
				140	5700	10.0	10.0
			2 Tx	100	5500	10.0	10.0
				104	5520	10.0	10.0
				108	5540	10.0	10.0
				112	5560	10.0	10.0
				116	5580	10.0	10.0
				120	5600	10.0	10.0
				124	5620	10.0	10.0
				128	5640	10.0	10.0
				132	5660	10.0	10.0
				136	5680	10.0	10.0
				140	5700	10.0	10.0
	802.11n (HT20)	MCS0	1 Tx	100	5500	10.0	10.0
				120	5600	10.0	10.0
				140	5700	10.0	10.0
			2 Tx	100	5500	10.0	10.0
				120	5600	10.0	10.0
				140	5700	10.0	10.0
	802.11n (HT40)	MCS0	1 Tx	102	5510	10.0	10.0
				118	5590	10.0	10.0
				134	5670	10.0	10.0
			2 Tx	102	5510	10.0	10.0
				118	5590	10.0	10.0
				134	5670	10.0	10.0
	802.11ac (20MHz)	MCS0	1 Tx	100	5500	10.0	10.0
				116	5580	10.0	10.0
				140	5700	10.0	10.0
			2 Tx	100	5500	10.0	10.0
				116	5580	10.0	10.0
				140	5700	10.0	10.0

RF Output power tolerance continued

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)	
						Main	Aux
5.5 (UNII)	802.11ac (40MHz)	MCS0	1 Tx	102	5510	10.0	10.0
				118	5590	10.0	10.0
				134	5670	10.0	10.0
			2 Tx	102	5510	10.0	10.0
				118	5590	10.0	10.0
				134	5670	10.0	10.0
	802.11ac (80MHz)	MCS0	1 Tx	106	5530	9.0	9.0
			2 Tx	106	5530	9.0	9.0

RF Output power tolerance continued

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)	
						Main	Aux
5.8 (DTS)	802.11a	6 Mbps	1 Tx	149	5745	11.0	11.0
				153	5765	11.0	11.0
				157	5785	11.0	11.0
				161	5805	11.0	11.0
				165	5825	11.0	11.0
			2 Tx	149	5745	11.0	11.0
				153	5765	11.0	11.0
				157	5785	11.0	11.0
				161	5805	11.0	11.0
				165	5825	11.0	11.0
	802.11n (HT20)	MCS0	1 Tx	149	5745	11.0	11.0
				157	5785	11.0	11.0
				161	5805	11.0	11.0
			2 Tx	149	5745	11.0	11.0
				157	5785	11.0	11.0
				161	5805	11.0	11.0
	802.11n (HT40)	MCS0	1 Tx	151	5755	11.0	11.0
				159	5795	11.0	11.0
		MCS0	2 Tx	151	5755	11.0	11.0
				159	5795	11.0	11.0
	802.11ac (20MHz)	MCS0	1 Tx	149	5745	11.0	11.0
				157	5785	11.0	11.0
				165	5825	11.0	11.0
			2 Tx	149	5745	11.0	11.0
				157	5785	11.0	11.0
				165	5825	11.0	11.0
	802.11ac (40MHz)	MCS0	1 Tx	151	5755	11.0	11.0
				159	5795	11.0	11.0
			2 Tx	151	5755	11.0	11.0
				159	5795	11.0	11.0
	802.11ac (80MHz)	MCS0	1 Tx	155	5775	10.0	10.0
			2 Tx	155	5775	10.0	10.0

8. RF Exposure Conditions

8.1. 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.

8.1.1. SAR Test Exclusion Calculations for Wi-Fi SISO (1 Tx) Transmit Conditions

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	Bevel	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Bevel
Main															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	19	227	288	63	169	2.5 -EXEMPT-	4.1 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.1 -MEASURE-
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	19	227	288	63	169	2.9 -EXEMPT-	4.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.6 -MEASURE-
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	19	227	288	63	169	2.9 -EXEMPT-	4.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.6 -MEASURE-
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	19	227	288	63	169	3 -EXEMPT-	4.8 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.8 -MEASURE-
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	19	227	288	63	169	3.9 -MEASURE-	6.3 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	6.3 -MEASURE-
Aux/Bluetooth															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	19	64	288	226	169	2.5 -EXEMPT-	4.1 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.1 -MEASURE-
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	19	64	288	226	169	2.9 -EXEMPT-	4.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.6 -MEASURE-
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	19	64	288	226	169	2.9 -EXEMPT-	4.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.6 -MEASURE-
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	19	64	288	226	169	3 -EXEMPT-	4.8 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.8 -MEASURE-
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	19	64	288	226	169	3.9 -MEASURE-	6.3 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	6.3 -MEASURE-
Bluetooth	2480	8.00	6	8.2	19	64	288	226	169	12 -EXEMPT-	19 -EXEMPT-	> 50 mm	> 50 mm	> 50 mm	19 -EXEMPT-

Note(s):

1. 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	Bevel	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Bevel
Main															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1865.6 mW -EXEMPT-	2475.6 mW -EXEMPT-	225.6 mW -EXEMPT-	< 50 mm
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1835.5 mW -EXEMPT-	2445.5 mW -EXEMPT-	195.5 mW -EXEMPT-	< 50 mm
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1835 mW -EXEMPT-	2445 mW -EXEMPT-	195 mW -EXEMPT-	< 50 mm
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1832.8 mW -EXEMPT-	2442.8 mW -EXEMPT-	192.8 mW -EXEMPT-	< 50 mm
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1832.2 mW -EXEMPT-	2442.2 mW -EXEMPT-	192.2 mW -EXEMPT-	< 50 mm
Aux/Bluetooth															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	19	64	288	226	169	< 50 mm	< 50 mm	235.6 mW -EXEMPT-	2475.6 mW -EXEMPT-	1855.6 mW -EXEMPT-	< 50 mm
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	19	64	288	226	169	< 50 mm	< 50 mm	205.5 mW -EXEMPT-	2445.5 mW -EXEMPT-	1825.5 mW -EXEMPT-	< 50 mm
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	19	64	288	226	169	< 50 mm	< 50 mm	205 mW -EXEMPT-	2445 mW -EXEMPT-	1825 mW -EXEMPT-	< 50 mm
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	19	64	288	226	169	< 50 mm	< 50 mm	202.8 mW -EXEMPT-	2442.8 mW -EXEMPT-	1822.8 mW -EXEMPT-	< 50 mm
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	19	64	288	226	169	< 50 mm	< 50 mm	202.2 mW -EXEMPT-	2442.2 mW -EXEMPT-	1822.2 mW -EXEMPT-	< 50 mm
Bluetooth	2480	8.00	6	8.2	19	64	288	226	169	< 50 mm	< 50 mm	235.3 mW -EXEMPT-	2475.3 mW -EXEMPT-	1855.3 mW -EXEMPT-	< 50 mm

Note(s):

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

8.1.2. SAR Test Exclusion Calculations for Wi-Fi MIMO (2 Tx) Transmit Conditions

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	Bevel	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Bevel
Main															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	19	227	288	63	169	2.5 -EXEMPT-	4.1 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.1 -MEASURE-
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	19	227	288	63	169	2.9 -EXEMPT-	4.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.6 -MEASURE-
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	19	227	288	63	169	2.9 -EXEMPT-	4.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.6 -MEASURE-
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	19	227	288	63	169	3 -EXEMPT-	4.8 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.8 -MEASURE-
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	19	227	288	63	169	3.9 -MEASURE-	6.3 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	6.3 -MEASURE-
Aux															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	19	64	288	226	169	2.5 -EXEMPT-	4.1 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.1 -MEASURE-
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	19	64	288	226	169	2.9 -EXEMPT-	4.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.6 -MEASURE-
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	19	64	288	226	169	2.9 -EXEMPT-	4.6 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.6 -MEASURE-
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	19	64	288	226	169	3 -EXEMPT-	4.8 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	4.8 -MEASURE-
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	19	64	288	226	169	3.9 -MEASURE-	6.3 -MEASURE-	> 50 mm	> 50 mm	> 50 mm	6.3 -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

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
		dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Bevel	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Bevel
Main															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1865.6 mW -EXEMPT-	2475.6 mW -EXEMPT-	225.6 mW -EXEMPT-	< 50 mm
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1835.5 mW -EXEMPT-	2445.5 mW -EXEMPT-	195.5 mW -EXEMPT-	< 50 mm
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1835 mW -EXEMPT-	2445 mW -EXEMPT-	195 mW -EXEMPT-	< 50 mm
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1832.8 mW -EXEMPT-	2442.8 mW -EXEMPT-	192.8 mW -EXEMPT-	< 50 mm
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	19	227	288	63	169	< 50 mm	< 50 mm	1832.2 mW -EXEMPT-	2442.2 mW -EXEMPT-	192.2 mW -EXEMPT-	< 50 mm
Aux															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	19	64	288	226	169	< 50 mm	< 50 mm	235.6 mW -EXEMPT-	2475.6 mW -EXEMPT-	1855.6 mW -EXEMPT-	< 50 mm
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	19	64	288	226	169	< 50 mm	< 50 mm	205.5 mW -EXEMPT-	2445.5 mW -EXEMPT-	1825.5 mW -EXEMPT-	< 50 mm
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	19	64	288	226	169	< 50 mm	< 50 mm	205 mW -EXEMPT-	2445 mW -EXEMPT-	1825 mW -EXEMPT-	< 50 mm
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	19	64	288	226	169	< 50 mm	< 50 mm	202.8 mW -EXEMPT-	2442.8 mW -EXEMPT-	1822.8 mW -EXEMPT-	< 50 mm
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	19	64	288	226	169	< 50 mm	< 50 mm	202.2 mW -EXEMPT-	2442.2 mW -EXEMPT-	1822.2 mW -EXEMPT-	< 50 mm

Note(s):

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

8.2. Required Test Configurations

Based on Sec. 8.1, the test configurations required for this device were determined to be as follows:

Test Modes	Rear	Edge 1 (Top Edge)	Edge 2 (Right Edge)	Edge 3 (Bottom Edge)	Edge 4 (Left Edge)	Bevel (Edge 1 Slant)
Wi-Fi Main (5.8 GHz) (SISO & MIMO)	Yes	Yes	No	No	No	Yes
Wi-Fi Main (2.4GHz,5.2-5.5 GHz) (SISO & MIMO)	No	Yes	No	No	No	Yes
Wi-Fi Aux (5.8 GHz) (SISO & MIMO)	Yes	Yes	No	No	No	Yes
Wi-Fi Aux (2.4GHz 5.2-5.5 GHz) (SISO & MIMO)	No	Yes	No	No	No	Yes
Bluetooth	No	No	No	No	No	No

8.3. Additional Test Scenarios

The DUT features beveled edges. Additional testing of Bevel (Edge 1 Slant) was performed with the DUT angled so that the edges were placed flush to the surface of the flat phantom. These test positions are identified as Bevel (Edge 1 Slant).

9. RF Output Power Measurement

9.1. WiFi (2.4 GHz Band)

Required Test Channels per KDB 248227 D01

Mode	Band	GHz	Channel	"Default Test Channels"	
				802.11b	802.11g
802.11b/g	2.4 GHz	**2.412**	1#	√	∇
		2.437	6	√	∇
		2.462	11#	√	∇

Notes:
√ = "default test channels"
∇ = possible 802.11g channels with maximum average output ¼ dB ≥ the "default test channels"
= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

Measured Results

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)		SAR Test (Yes/No)
						Main	Aux	
2.4 GHz	**802.11b**	**1 Mbps**	**1 Tx**	**1**	**2412**	**10.8**	**11.0**	**Yes**
				6	**2437**	**10.8**	**11.0**	
				11	**2462**	**11.0**	**11.0**	
			2 Tx	**1**	**2412**	**11.0**	**11.0**	**Yes**
				6	**2437**	**11.0**	**11.0**	
				11	**2462**	**11.0**	**11.0**	
	802.11g	6 Mbps	1 Tx	1	2412	11.0	10.8	No
				6	2437	11.0	10.8	
				11	2462	10.8	11.0	
			2 Tx	1	2412	10.6	11.0	No
				6	2437	10.6	10.8	
				11	2462	10.4	10.8	
	802.11n (HT20)	MCS0	1 Tx	1	2412	11.0	10.6	No
				6	2437	11.0	10.6	
				11	2462	10.6	11.0	
			2 Tx	1	2412	10.6	11.0	No
				6	2437	10.8	11.0	
				11	2462	10.4	10.8	
	802.11n (HT40)	MCS0	1 Tx	1	2412	10.8	10.7	No
				6	2437	10.8	10.6	
				11	2462	10.4	10.8	
			2 Tx	1	2412	10.6	11.0	No
				6	2437	10.6	10.8	
				11	2462	10.5	10.8	

Note(s):
Per KDB 248227 D01, SAR is not required for 802.11g/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

Power measurements to determine worst-case data rates

Mode	Ch #	Freq. (MHz)	No. of Transmitters	Data Rate	Avg Pwr (dBm)	SAR test (Yes/No)
802.11b	11	2462	1 Tx	1 Mbps	11.0	Yes
				2 Mbps	10.9	No
				5.5 Mbps	10.8	No
				11 Mbps	10.8	No

9.2. WiFi (5 GHz Bands)

Required Test Channels per KDB 248227 D01

Mode		Band	GHz	Channel	"Default Test Channels"	
					802.11a	
802.11a	UNII (15.407)	5.2 GHz	5.180	36	√	
			5.200	40		*
			2.220	44		*
			5.240	48	√	
		5.3 GHz	5.260	52	√	
			5.280	56		*
			5.300	60		*
			5.320	64	√	
		5.5 GHz	5.500	100		
			5.520	104	√	
			5.540	108		*
			5.560	112		*
			5.580	116	√	
			5.600	120		*
			5.620	124	√	
			5.640	128		*
			5.660	132		*
			5.680	136	√	
			5.700	140		*
	DTS (15.247)	5.8 GHz	5.745	149	√	
			5.765	153		*
			5.785	157	√	
			5.805	161		*
			5.825	165	√	

√ = "default test channels"

* = possible 802.11a channels with maximum average output > the "default test channels"

= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

WiFi 5 GHz Bands Measured Results

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)		SAR Test (Yes/No)
						Main	Aux	
5.2 (UNII)	**802.11a**	**6 Mbps**	**1 Tx**	**36**	**5180**	**9.8**	**10.0**	**Yes**
				40	**5200**	**9.8**	**10.0**	
				44	**5220**	**10.0**	**10.0**	
				48	**5240**	**10.0**	**10.0**	
			2 Tx	**36**	**5180**	**10.0**	**10.0**	**Yes**
				40	**5200**	**9.8**	**10.0**	
				44	**5220**	**9.8**	**9.7**	
				48	**5240**	**9.8**	**9.7**	
	802.11n (HT20)	MCS0	1 Tx	36	5180	10.0	10.0	No
				40	5200	9.7	9.7	
				44	5220	10.0	10.0	
				48	5240	10.0	10.0	
			2 Tx	36	5180	10.0	9.8	No
				40	5200	10.0	9.8	
				44	5220	10.0	10.0	
				48	5240	10.0	10.0	
	802.11n (HT40)	MCS0	1 Tx	38	5190	9.8	9.8	No
				46	5230	9.8	10.0	
			2 Tx	38	5190	9.8	9.8	No
				46	5230	10.0	9.8	
	802.11ac (20MHz)	MCS0	1 Tx	36	5180	10.0	10.0	No
				40	5200	9.7	10.0	
				48	5240	10.0	9.5	
			2 Tx	36	5180	9.6	9.4	No
				40	5200	9.4	9.3	
				48	5240	9.6	9.5	
	802.11ac (40MHz)	MCS0	1 Tx	38	5190	9.5	10.0	No
				46	5230	9.7	9.6	
			2 Tx	38	5190	9.8	10.0	No
				46	5230	9.2	9.6	
	802.11ac (80MHz)	MCS0	1 Tx	42	5210	9.0	9.0	No
			2 Tx	42	5210	8.8	8.8	No
5.3 (UNII)	**802.11a**	**6 Mbps**	**1 Tx**	**52**	**5260**	**10.0**	**10.0**	**Yes**
				56	**5280**	**9.7**	**9.6**	
				60	**5300**	**9.8**	**9.8**	
				64	**5320**	**10.0**	**10.0**	
			2 Tx	**52**	**5260**	**9.8**	**9.8**	**Yes**
				56	**5280**	**9.2**	**9.6**	
				60	**5300**	**9.6**	**9.3**	
				64	**5320**	**10.0**	**10.0**	
	802.11n (HT20)	MCS0	1 Tx	52	5260	9.6	10.0	No
				60	5300	9.6	9.8	
				64	5320	9.6	9.6	
			2 Tx	52	5260	10.0	10.0	No
				60	5300	10.0	9.8	
				64	5320	9.8	9.5	

Wi-Fi 5 GHz Bands Measured Results continued

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)		SAR Test (Yes/No)
						Main	Aux	
5.3 GHz (UNII)	802.11n (HT40)	MCS0	1 Tx	54	5270	10.0	10.0	No
				62	5310	10.0	9.8	
			2 Tx	54	5270	9.8	9.8	No
				62	5310	9.6	9.4	
	802.11ac (20MHz)	MCS0	1 Tx	52	5260	10.0	10.0	No
				60	5300	10.0	10.0	
				64	5320	9.8	9.6	
			2 Tx	52	5260	10.0	10.0	No
				60	5300	9.6	9.3	
				64	5320	9.6	9.2	
	802.11ac (40MHz)	MCS0	1 Tx	54	5270	9.5	9.5	No
				62	5310	9.7	10.0	
			2 Tx	54	5270	9.5	10.0	No
				62	5310	9.7	10.0	
	802.11ac (80MHz)	MCS0	1 Tx	58	5290	9.0	9.0	No
			2 Tx	58	5290	9.0	9.0	No
5.5 (UNII)	**802.11a**	**6 Mbps**	**1 Tx**	**100**	**5500**	**9.8**	**9.4**	**Yes**
				104	**5520**	**10.0**	**9.8**	
				108	**5540**	**10.0**	**9.4**	
				112	**5560**	**10.0**	**9.8**	
				116	**5580**	**10.0**	**9.8**	
				120	**5600**	**9.6**	**9.6**	
				124	**5620**	**10.0**	**9.8**	
				128	**5640**	**9.7**	**9.5**	
				132	**5660**	**9.8**	**9.5**	
				136	**5680**	**9.8**	**10.0**	
				140	**5700**	**9.7**	**10.0**	
			2 Tx	**100**	**5500**	**10.0**	**9.2**	**Yes**
				104	**5520**	**10.0**	**9.8**	
				108	**5540**	**10.0**	**9.2**	
				112	**5560**	**10.0**	**9.8**	
				116	**5580**	**10.0**	**10.0**	
				120	**5600**	**9.7**	**9.5**	
				124	**5620**	**10.0**	**9.6**	
				128	**5640**	**9.8**	**9.5**	
				132	**5660**	**9.8**	**9.2**	
				136	**5680**	**9.8**	**9.8**	
				140	**5700**	**9.8**	**9.1**	
	802.11n (HT20)	MCS0	1 Tx	100	5500	10.0	9.7	No
				120	5600	9.7	10.0	
				140	5700	9.8	9.7	
			2 Tx	100	5500	9.8	8.9	No
				120	5600	9.8	9.2	
				140	5700	9.8	9.0	

Wi-Fi 5 GHz Bands Measured Results continued

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)	
						Main	Aux
5.5 (UNII)	802.11n (HT40)	MCS0	1 Tx	102	5510	9.6	9.6
				118	5590	9.8	9.6
				134	5670	9.6	9.4
			2 Tx	102	5510	9.8	9.4
				118	5590	9.8	9.6
				134	5670	9.8	9.4
	802.11ac (20MHz)	MCS0	1 Tx	100	5500	10.0	10.0
				116	5580	10.0	10.0
				140	5700	9.8	9.7
			2 Tx	100	5500	9.8	9.4
				116	5580	10.0	9.8
				140	5700	9.6	9.4
	802.11ac (40MHz)	MCS0	1 Tx	102	5510	9.5	9.6
				118	5590	9.5	9.6
				134	5670	9.4	9.6
			2 Tx	102	5510	9.8	9.4
				118	5590	9.8	9.6
				134	5670	9.6	9.4
	802.11ac (80MHz)	MCS0	1 Tx	106	5530	9.0	8.2
			2 Tx	106	5530	9.0	8.0

Wi-Fi 5 GHz Bands Measured Results continued

Band (GHz)	Mode	Data Rate	No. of Transmitters	Ch #	Freq. (MHz)	Avg. Power (dBm)		SAR Test (Yes/No)
						Main	Aux	
5.8 (DTS)	**802.11a**	**6 Mbps**	**1 Tx**	**149**	**5745**	**11.0**	**10.6**	**Yes**
				153	**5765**	**10.7**	**10.7**	
				157	**5785**	**10.8**	**10.8**	
				161	**5805**	**10.8**	**10.8**	
				165	**5825**	**10.7**	**10.8**	
			2 Tx	**149**	**5745**	**10.6**	**10.5**	**Yes**
				153	**5765**	**10.7**	**10.8**	
				157	**5785**	**10.8**	**10.5**	
				161	**5805**	**10.8**	**10.6**	
				165	**5825**	**11.0**	**10.6**	
	802.11n (HT20)	MCS0	1 Tx	149	5745	10.6	10.6	No
				157	5785	11.0	11.0	
				161	5805	11.0	11.0	
			2 Tx	149	5745	10.4	10.2	No
				157	5785	11.0	10.6	
				161	5805	11.0	10.5	
	802.11n (HT40)	MCS0	1 Tx	151	5755	10.8	10.6	No
				159	5795	11.0	10.8	
			2 Tx	151	5755	10.8	10.8	No
				159	5795	11.0	10.6	
	802.11ac (20MHz)	MCS0	1 Tx	149	5745	10.8	11.0	No
				157	5785	10.5	10.4	
				165	5825	10.5	10.5	
			2 Tx	149	5745	11.0	11.0	No
				157	5785	11.0	11.0	
				165	5825	11.0	11.0	
	802.11ac (40MHz)	MCS0	1 Tx	151	5755	10.6	10.8	No
				159	5795	10.4	11.0	
			2 Tx	151	5755	10.6	10.8	
				159	5795	10.5	10.4	
	802.11ac (80MHz)	MCS0	1 Tx	155	5775	10.0	9.8	No
			2 Tx	155	5775	10.0	9.8	

Note(s):

Per KDB 248227, SAR is not required for 802.11n HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a channels.

Power measurements to determine worst-case data rates

Band	Mode	No. of Transmitters	Ch #	Freq. (MHz)	Data Rate	Avg Pwr (dBm)	SAR test (Yes/No)
5.2 GHz (UNII)	802.11a	1 Tx	48	5220	6 Mbps	10.0	Yes
					9 Mbps	9.8	No
					12 Mbps	9.8	No
					18 Mbps	9.8	No
					24 Mbps	9.7	No
					36 Mbps	9.6	No
					48 Mbps	9.6	No
					54 Mbps	9.6	No
5.3 GHz (UNII)	802.11a	1Tx	64	5320	6 Mbps	10.0	Yes
					9 Mbps	9.9	No
					12 Mbps	9.8	No
					18 Mbps	9.8	No
					24 Mbps	9.6	No
					36 Mbps	9.6	No
					48 Mbps	9.8	No
					54 Mbps	9.7	No
5.5 GHz (UNII)	802.11a	1 Tx	136	5700	6 Mbps	10.0	Yes
					9 Mbps	9.7	No
					12 Mbps	9.7	No
					18 Mbps	9.6	No
					24 Mbps	9.5	No
					36 Mbps	9.4	No
					48 Mbps	9.5	No
					54 Mbps	9.6	No
5.8 GHz (DTS)	802.11a	1Tx	149	5745	6 Mbps	11.0	Yes
					9 Mbps	10.8	No
					12 Mbps	10.8	No
					18 Mbps	10.9	No
					24 Mbps	10.8	No
					36 Mbps	10.8	No
					48 Mbps	10.7	No
					54 Mbps	10.7	No

9.3. Bluetooth

Maximum tune-up tolerance limit is 8 dBm from the rated nominal maximum output power. This power level qualifies for exclusion of SAR testing.

Refer to Standalone SAR Test Exclusion Considerations Section.

10. Tissue Dielectric Properties

IEEE Std 1528-2013

Target Frequency (MHz)	Head	
	ε_r	σ (S/m)
300	45.3	0.87
450	43.5	0.87
750	41.9	0.89
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1500	40.4	1.23
1640	40.2	1.31
1750	40.1	1.37
1800	40.0	1.40
1900	40.0	1.40
2000	40.0	1.40
2100	39.8	1.49
2300	39.5	1.67
2450	39.2	1.80
2600	39.0	1.96
3000	38.5	2.40
3500	37.9	2.91
4000	37.4	3.43
4500	36.8	3.94
5000	36.2	4.45
5200	36.0	4.66
5400	35.8	4.86
5600	35.5	5.07
5800	35.3	5.27
600	35.1	5.48

NOTE—For convenience, permittivity and conductivity values at some frequencies that are not part of the original data from Drossos et al. [B60] or the extension to 5800 MHz are provided (i.e., the values shown in italics). These values were linearly interpolated between the values in this table that are immediately above and below these values, except the values at 6000 MHz that were linearly extrapolated from the values at 3000 MHz and 5800 MHz.

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

10.1. Composition of Ingredients for the Tissue Material Used in the SAR Tests

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride Sugar: 98+% Pure Sucrose
Water: De-ionized, 16 MΩ+ resistivity HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

MSL/HSL750 (Body and Head liquids for 700 – 800 MHz)

Item	Head Tissue Simulation Liquids HSL750 Muscle (body) Tissue Simulation Liquids MSL750
Type No	SL AAH 075
Manufacturer	SPEAG
The item is composed of the following ingredients:	
H^2O	Water, 35 – 58%
Sucrese	Sugar, white, refined, 40-60%
NaCl	Sodium Chloride, 0-6%
Hydroxyethel-cellulsoe	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone, 0.1-0.7%

MSL/HSL1750 (Body and Head liquids for 1700 – 1800 MHz)

Item	Head Tissue Simulation Liquids HSL1750 Muscle (body) Tissue Simulation Liquids MSL1750
Type No	SL AAM 175
Manufacturer	SPEAG
-The item is composed of the following ingredients:	
H^2O	Water, 52 – 75%
C8H18O3	Diethylene glycol monobutyl ether (DGBE), 25-48%
NaCl	Sodium Chloride, <1.0%

Simulating Liquids for 5 GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2

10.2. Tissue Dielectric Parameter Check Results

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.

SAR Lab E

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
3/27/2014	Body 2450	e'	50.8700	Relative Permittivity (ϵ_r):	50.87	52.70	-3.47	5
		e''	14.4600	Conductivity (σ):	1.97	1.95	1.02	5
	Body 2410	e'	51.0200	Relative Permittivity (ϵ_r):	51.02	52.76	-3.30	5
		e''	14.3200	Conductivity (σ):	1.92	1.91	0.60	5
	Body 2475	e'	50.7900	Relative Permittivity (ϵ_r):	50.79	52.67	-3.57	5
		e''	14.5800	Conductivity (σ):	2.01	1.99	1.07	5
3/28/2014	Body 5180	e'	49.4300	Relative Permittivity (ϵ_r):	49.43	49.05	0.78	5
		e''	18.5600	Conductivity (σ):	5.35	5.27	1.41	5
	Body 5200	e'	49.4400	Relative Permittivity (ϵ_r):	49.44	49.02	0.86	5
		e''	18.6200	Conductivity (σ):	5.38	5.29	1.68	5
	Body 5600	e'	48.8000	Relative Permittivity (ϵ_r):	48.80	48.48	0.66	5
		e''	18.9500	Conductivity (σ):	5.90	5.76	2.42	5
	Body 5800	e'	48.4900	Relative Permittivity (ϵ_r):	48.49	48.20	0.60	5
		e''	19.1100	Conductivity (σ):	6.16	6.00	2.72	5
	Body 5825	e'	48.5000	Relative Permittivity (ϵ_r):	48.50	48.20	0.62	5
		e''	19.2400	Conductivity (σ):	6.23	6.00	3.86	5
4/1/2014	Body 5180	e'	48.2500	Relative Permittivity (ϵ_r):	48.25	49.05	-1.62	5
		e''	18.5600	Conductivity (σ):	5.35	5.27	1.41	5
	Body 5200	e'	48.2200	Relative Permittivity (ϵ_r):	48.22	49.02	-1.63	5
		e''	18.5900	Conductivity (σ):	5.38	5.29	1.52	5
	Body 5600	e'	47.6100	Relative Permittivity (ϵ_r):	47.61	48.48	-1.79	5
		e''	18.8500	Conductivity (σ):	5.87	5.76	1.88	5
	Body 5800	e'	47.2700	Relative Permittivity (ϵ_r):	47.27	48.20	-1.93	5
		e''	19.0500	Conductivity (σ):	6.14	6.00	2.39	5
	Body 5825	e'	47.2100	Relative Permittivity (ϵ_r):	47.21	48.20	-2.05	5
		e''	19.1400	Conductivity (σ):	6.20	6.00	3.32	5
4/2/2014	Body 2450	e'	50.6700	Relative Permittivity (ϵ_r):	50.67	52.70	-3.85	5
		e''	14.5300	Conductivity (σ):	1.98	1.95	1.51	5
	Body 2410	e'	50.8500	Relative Permittivity (ϵ_r):	50.85	52.76	-3.62	5
		e''	14.3800	Conductivity (σ):	1.93	1.91	1.02	5
	Body 2475	e'	50.6000	Relative Permittivity (ϵ_r):	50.60	52.67	-3.93	5
		e''	14.6300	Conductivity (σ):	2.01	1.99	1.42	5
4/3/2014	Body 5180	e'	48.7500	Relative Permittivity (ϵ_r):	48.75	49.05	-0.60	5
		e''	18.7400	Conductivity (σ):	5.40	5.27	2.39	5
	Body 5200	e'	48.7100	Relative Permittivity (ϵ_r):	48.71	49.02	-0.63	5
		e''	18.7500	Conductivity (σ):	5.42	5.29	2.39	5
	Body 5600	e'	48.0300	Relative Permittivity (ϵ_r):	48.03	48.48	-0.92	5
		e''	19.1000	Conductivity (σ):	5.95	5.76	3.23	5
	Body 5800	e'	47.7300	Relative Permittivity (ϵ_r):	47.73	48.20	-0.98	5
		e''	19.3000	Conductivity (σ):	6.22	6.00	3.74	5
	Body 5825	e'	47.7200	Relative Permittivity (ϵ_r):	47.72	48.20	-1.00	5
		e''	19.3300	Conductivity (σ):	6.26	6.00	4.35	5

Tissue Dielectric Parameter Check Results (continued)

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
4/7/2014	Body 5180	e'	47.2500	Relative Permittivity (ϵ_r):	47.25	49.05	-3.66	5
		e''	18.5300	Conductivity (σ):	5.34	5.27	1.25	5
	Body 5200	e'	47.2000	Relative Permittivity (ϵ_r):	47.20	49.02	-3.71	5
		e''	18.5900	Conductivity (σ):	5.38	5.29	1.52	5
	Body 5600	e'	46.6300	Relative Permittivity (ϵ_r):	46.63	48.48	-3.81	5
		e''	18.9400	Conductivity (σ):	5.90	5.76	2.37	5
	Body 5800	e'	46.2800	Relative Permittivity (ϵ_r):	46.28	48.20	-3.98	5
		e''	19.1500	Conductivity (σ):	6.18	6.00	2.93	5
	Body 5825	e'	46.2400	Relative Permittivity (ϵ_r):	46.24	48.20	-4.07	5
		e''	19.1500	Conductivity (σ):	6.20	6.00	3.37	5
4/9/2014	Body 2450	e'	52.0700	Relative Permittivity (ϵ_r):	52.07	52.70	-1.20	5
		e''	14.6900	Conductivity (σ):	2.00	1.95	2.62	5
	Body 2410	e'	52.1900	Relative Permittivity (ϵ_r):	52.19	52.76	-1.08	5
		e''	14.5900	Conductivity (σ):	1.96	1.91	2.50	5
	Body 2475	e'	52.0100	Relative Permittivity (ϵ_r):	52.01	52.67	-1.25	5
		e''	14.7200	Conductivity (σ):	2.03	1.99	2.05	5
4/19/2014	Body 5180	e'	48.6900	Relative Permittivity (ϵ_r):	48.69	49.05	-0.73	5
		e''	18.1800	Conductivity (σ):	5.24	5.27	-0.67	5
	Body 5200	e'	48.6400	Relative Permittivity (ϵ_r):	48.64	49.02	-0.77	5
		e''	18.2100	Conductivity (σ):	5.27	5.29	-0.56	5
	Body 5600	e'	48.0300	Relative Permittivity (ϵ_r):	48.03	48.48	-0.92	5
		e''	18.4500	Conductivity (σ):	5.74	5.76	-0.28	5
	Body 5800	e'	47.7800	Relative Permittivity (ϵ_r):	47.78	48.20	-0.87	5
		e''	18.7100	Conductivity (σ):	6.03	6.00	0.57	5
	Body 5825	e'	47.7900	Relative Permittivity (ϵ_r):	47.79	48.20	-0.85	5
		e''	18.7400	Conductivity (σ):	6.07	6.00	1.16	5
4/26/2014	Body 5180	e'	47.8000	Relative Permittivity (ϵ_r):	47.80	49.05	-2.54	5
		e''	18.4000	Conductivity (σ):	5.30	5.27	0.54	5
	Body 5200	e'	47.7600	Relative Permittivity (ϵ_r):	47.76	49.02	-2.57	5
		e''	18.4000	Conductivity (σ):	5.32	5.29	0.48	5
	Body 5600	e'	47.1400	Relative Permittivity (ϵ_r):	47.14	48.48	-2.76	5
		e''	18.7500	Conductivity (σ):	5.84	5.76	1.34	5
	Body 5800	e'	46.8500	Relative Permittivity (ϵ_r):	46.85	48.20	-2.80	5
		e''	18.9500	Conductivity (σ):	6.11	6.00	1.86	5
	Body 5825	e'	46.8000	Relative Permittivity (ϵ_r):	46.80	48.20	-2.90	5
		e''	18.9400	Conductivity (σ):	6.13	6.00	2.24	5

11. System Performance 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 remeasured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

11.1. 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 ± 0.5 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm ± 0.5 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.

11.2. Reference SAR Values for System Performance Check

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 (mW/g)		
				1g/10g	Head	Body
D2450V2	899	09/10/2013	2450	1g	51.3	49.7
				10g	23.9	23.3
D5GHzV2	1003	12/26/2014	5200	1g	77.7	73.5
				10g	22.2	20.5
			5600	1g	81.8	79.6
				10g	23.2	22.1
			5800	1g	78.3	73.8
				10g	22.1	20.4

11.3. System Performance 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 E

Date Tested	System Dipole		T.S. Liquid		Measured Results			Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Area Scan	Zoom Scan	Normalize to 1 W			
3/27/2014	D2450V2	899	Body	1g	5.04	5.03	50.3	49.7	1.21	
				10g	2.19	2.34	23.4	23.3	0.43	
3/28/2014	D5GHzV2 (5800)	1003	Body	1g	6.72	7.33	73.3	73.8	-0.68	
				10g	1.89	2.06	20.6	20.4	0.98	
4/1/2014	D5GHzV2 (5600)	1003	Body	1g	7.71	8.11	81.1	79.6	1.88	
				10g	2.12	2.26	22.6	22.1	2.26	
4/2/2014	D2450V2	899	Body	1g	4.96	4.97	49.7	49.7	0.00	
				10g	2.15	2.29	22.9	23.3	-1.72	
4/3/2014	D5GHzV2 (5200)	1003	Body	1g	7.09	7.75	77.5	73.5	5.44	1,2
				10g	2.01	2.19	21.9	20.5	6.83	
4/7/2014	D5GHzV2 (5200)	1003	Body	1g	7.14	7.59	75.9	73.5	3.27	
				10g	2.00	2.15	21.5	20.5	4.88	
4/7/2014	D5GHzV2 (5600)	1003	Body	1g	7.48	8.09	80.9	79.6	1.63	
				10g	2.07	2.26	22.6	22.1	2.26	
4/7/2014	D5GHzV2 (5800)	1003	Body	1g	6.56	7.17	71.7	73.8	-2.85	
				10g	1.83	2.01	20.1	20.4	-1.47	
4/9/2014	D2450V2	899	Body	1g	5.28	5.16	51.6	49.7	3.82	3,4
				10g	2.27	2.32	23.2	23.3	-0.43	
4/19/2014	D5GHzV2 (5800)	1003	Body	1g	6.72	7.17	71.7	73.8	-2.85	
				10g	1.86	2.02	20.2	20.4	-0.98	
4/26/2014	D5GHzV2 (5600)	1003	Body	1g	7.09	7.68	76.8	79.6	-3.52	
				10g	1.99	2.15	21.5	22.1	-2.71	

12. SAR Test 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

April 2013 TCB Workshop Updates:

Apply usual 802.11 test exclusion considerations, but include 802.11ac SAR for highest 802.11a configuration in each frequency band and each exposure condition.

12.1. Wi-Fi DTS Band

12.1.1. 2.4 GHz Band

Band	Position	Mode	No. of Transmitters	Ch #.	Freq. (MHz)	Power (dBm)			1-g SAR (W/kg)				Plot No.
						Tune-up limit	Meas.		Meas.	Scaled	Meas.	Scaled	
							Main	Aux	Main		Aux		
2.4 GHz	Edge1	802.11b 1 Mbps	1 Tx	1	2412	11.0	10.8		1.020	1.068			
				6	2437	11.0	10.8		1.010	1.058			
				11	2462	11.0	11.0		1.030	1.030			
				1	2412	11.0		11.0			1.070	1.070	
				6	2437	11.0		11.0			1.080	1.080	
				11	2462	11.0		11.0			1.010	1.010	
			2 Tx	1	2412	11.0	11.0	11.0	0.961	0.961	1.090	1.090	
				6	2437	11.0	11.0	11.0	0.969	0.969	1.110	1.110	
				11	2462	11.0	11.0	11.0	1.040	1.040	1.060	1.060	
	Bevel (Edge 1 Slant)	802.11b 1 Mbps	1 Tx	1	2412	11.0	10.8		0.997	1.044			
				6	2437	11.0	10.8		1.040	1.089			
				11	2462	11.0	11.0		1.140	1.140			
				1	2412	11.0		11.0			0.948	0.948	
				6	2437	11.0		11.0			0.978	0.978	
				11	2462	11.0		11.0			0.977	0.977	
			2 Tx	1	2412	11.0	11.0	11.0	1.020	1.020	1.000	1.000	
				6	2437	11.0	11.0	11.0	1.130	1.130	1.090	1.090	
				11	2462	11.0	11.0	11.0	1.260	1.260	1.080	1.080	1

12.1.2. 5.8 GHz Band

Band	Position	Mode	No. of Transmitters	Ch #.	Freq. (MHz)	Power (dBm)			1-g SAR (W/kg)				Plot No.
						Tune-up limit	Meas.		Meas.	Scaled	Meas.	Scaled	
							Main	Aux	Main		Aux		
5.8 GHz	Rear	802.11a 6 Mbps	1 Tx	157	5765	11.0	10.8		0.169	0.177			
				157	5765	11.0		10.8			0.147	0.154	
			2Tx	157	5765	11.0	10.8	10.5	0.185	0.194	0.158	0.177	
	Edge 1	802.11a 6 Mbps	1Tx	149	5745	11.0	11.0		0.538	0.538			
				165	5825	11.0		10.8			0.450	0.471	
			2Tx	165	5825	11.0	11.0	10.6	0.532	0.532	0.537	0.589	
	Bevel (Edge 1 Slant)	802.11a 6 Mbps	1 Tx	149	5745	11.0	11.0		0.822	0.822			
				157	5765	11.0	10.8		0.736	0.771			
				165	5825	11.0	10.7		0.891	0.955			
				149	5745	11.0		10.6			1.110	1.217	2
				157	5765	11.0		10.8			1.090	1.141	
				165	5825	11.0		10.8			0.992	1.039	
			2 Tx	153	5765	11.0	10.8	10.8	0.870	0.911	1.050	1.099	
				157	5765	11.0	10.8	10.5	0.817	0.856	0.942	1.057	
				165	5825	11.0	11.0	10.6	0.648	0.648	0.850	0.932	
		802.11ac	1Tx	149	5745	11.0		11.0			1.190	1.190	

12.2. Wi-Fi UNII Band

12.2.1. 5.2 GHz Band

Band	Position	Mode	No. of Transmitters	Ch #.	Freq. (MHz)	Power (dBm)			1-g SAR (W/kg)				Plot No.
						Tune-up limit	Meas.		Meas.	Scaled	Meas.	Scaled	
							Main	Aux	Main		Aux		
5.2GHz	Edge 1	802.11a 6Mbps	1 Tx	36	5180	10.0	9.8		0.822	0.861			
				48	5240	10.0	10.0		1.000	1.000			3
				36	5180	10.0		10.0			0.793	0.793	
				48	5240	10.0		10.0			0.978	0.978	
			2Tx	36	5180	10.0	10.0	10.0	0.853	0.853	0.717	0.717	
				48	5240	10.0	9.8	9.7	0.871	0.912	0.745	0.798	
		802.11ac	1Tx	48	5240	10.0	10.0		0.919	0.919			
	Bevel (edge 1 Slant)	802.11a 6Mbps	1 Tx	36	5180	10.0	9.8		0.828	0.867			
				48	5240	10.0	10.0		0.812	0.812			
				36	5180	10.0		10.0			0.859	0.859	
				48	5240	10.0		10.0			0.926	0.926	
			2 Tx	36	5180	10.0	10.0	10.0	0.877	0.877	0.924	0.924	
				48	5240	10.0	9.8	9.7	0.821	0.860	0.895	0.959	

12.2.2. 5.3 GHz Band

Band	Position	Mode	No. of Transmitters	Ch #.	Freq. (MHz)	Power (dBm)			1-g SAR (W/kg)				Plot No.
						Tune-up limit	Meas.		Meas.	Scaled	Meas.	Scaled	
							Main	Aux	Main		Aux		
5.3GHz	Edge 1	802.11a 6Mbps	1 Tx	52	5260	10.0	10.0		1.200	1.200			
				64	5320	10.0	10.0		1.000	1.000			
				52	5260	10.0		10.0			1.080	1.080	
				64	5320	10.0		10.0			1.090	1.090	
			2Tx	52	5260	10.0	9.8	9.8	0.984	1.030	0.907	0.950	
				64	5320	10.0	10.0	10.0	0.965	0.965	1.260	1.260	4
		802.11ac		52	5260	10.0	10.0	10.0	0.802	0.802	0.871	0.871	
	Bevel (Edge 1 Slant)	802.11a 6Mbps	1 Tx	52	5260	10.0	10.0		1.100	1.100			
				64	5320	10.0	10.0		0.865	0.865			
				52	5260	10.0		10.0			1.000	1.000	
				64	5320	10.0		10.0			0.974	0.974	
			2 Tx	52	5260	10.0	9.8	9.8	0.783	0.820	0.889	0.931	
				64	5320	10.0	10.0	10.0	1.040	1.040	1.160	1.160	

12.2.3. 5.5 GHz Band

Band	Position	Mode	No. of Transmitters	Ch #.	Freq. (MHz)	Power (dBm)			1-g SAR (W/kg)				Plot No.
						Tune-up limit	Meas.		Meas.	Scaled	Meas.	Scaled	
							Main	Aux	Main		Aux		
5.5GHz	Edge 1	802.11a 6Mbps	1 Tx	104	5520	10.0	10.0		0.624	0.624			
				116	5580	10.0	10.0		0.739	0.739			
				124	5620	10.0	10.0		0.797	0.797			
				136	5680	10.0	9.8		0.768	0.804			
				104	5520	10.0		9.8			1.060	1.110	
				116	5580	10.0		9.8			1.160	1.215	
				124	5620	10.0		9.8			1.070	1.120	
				136	5680	10.0		10.0			1.090	1.090	
			2Tx	104	5520	10.0	10.0	9.8	0.773	0.773	1.200	1.257	
				116	5580	10.0	10.0	10.0	0.725	0.725	1.260	1.260	
				124	5620	10.0	10.0	9.6	0.805	0.805	1.140	1.250	
				136	5680	10.0	9.8	9.8	0.795	0.832	1.130	1.183	
		802.11ac	2Tx	116	5580	10.0	10.0	9.8	0.644	0.644	0.975	1.021	
	Bevel (Edge 1 Slant)	802.11a 6Mbps	1 Tx	104	5520	10.0	10.0		0.543	0.543			
				116	5580	10.0	9.8		0.518	0.542			
				124	5620	10.0	10.0		0.884	0.884			
				136	5680	10.0	10.0		0.840	0.840			
				104	5520	10.0		9.8			1.070	1.120	
				116	5580	10.0		9.8			1.230	1.288	5
				124	5620	10.0		9.8			1.040	1.089	
				136	5680	10.0		10.0			1.080	1.080	
			2 Tx	104	5520	10.0	10.0	9.8	0.534	0.534	1.030	1.079	
				116	5580	10.0	10.0	10.0	0.730	0.730	1.100	1.100	
				124	5620	10.0	10.0	9.6	0.808	0.808	1.000	1.096	
				136	5680	10.0	9.8	9.8	0.750	0.785	0.945	0.990	

12.3. Bluetooth

12.3.1. Standalone SAR Test Exclusion Considerations

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.

Body Exposure Conditions

Max. tune-up tolerance limit		Min. test separation distance (mm)	Frequency (GHz)	Result
(dBm)	(mW)			
8.0	6	5	2.480	2.0

Conclusion:

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

13. SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 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 ≥ 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 ≥ 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 ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

13.1. The Highest Measured SAR Configuration in Each Frequency Band

Frequency Band (MHz)	Air Interface	Stand-alone (W/kg)	Repeated SAR (Yes/No)
2400	WiFi 802.11b/g/n	1.26	Yes
5200	WiFi 802.11a/n	1.00	Yes
5300	WiFi 802.11a/n	1.26	Yes
5500	WiFi 802.11a/n	1.26	Yes
5800	WiFi 802.11a/n	1.19	Yes

13.2. Repeated Measurement Results

Frequency band	Test Position	Mode	Ch #.	Freq. (MHz)	Meas. SAR (W/kg)		Meas. SAR (W/kg)		Largest to Smallest SAR Ratio		Note
					Original	Repeated	Original	Repeated			
					Main		Aux		Main	Aux	
2.4	Bevel (Edge 1 Slant)	802.11b	11	2462.0	1.260	1.080	1.080	1.010	1.17	1.07	1
5.2	Edge 1	802.11a	48	5240.0	1.000	0.985			1.02		1
5.3	Edge 1	802.11a	64	5320.0	0.965	0.977	1.260	1.170	1.01	1.08	1
5.5	Edge 1	802.11a	116	5580.0	0.725	0.736	1.260	1.160	1.02	1.09	1
5.8	Bevel (Edge 1 Slant)	802.11a	149	5745.0			1.190	1.090		1.09	1

Note(s):

1. 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.

14. 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_1 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_2 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 $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$

A new threshold of 0.04 is also introduced in the draft KDB. Thus, 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:

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

14.1. 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. Test positions Edge 2, Edge 3 and Edge 4 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.

14.1.1. Estimated SAR

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Estimated 1-g SAR Value (W/kg)					
		dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Bevel	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Bevel
Main															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	1.9	227	288	63	1.69	0.340	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	1.9	227	288	63	1.69	0.382	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	1.9	227	288	63	1.69	0.384	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	1.9	227	288	63	1.69	0.398	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	1.9	227	288	63	1.69	-MEASURE-	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Aux/Bluetooth															
Wi-Fi 2.4 GHz	2462	11.00	13	8.2	1.9	64	288	226	1.69	0.340	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Wi-Fi 5.2 GHz	5240	10.00	10	8.2	1.9	64	288	226	1.69	0.382	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Wi-Fi 5.3 GHz	5320	10.00	10	8.2	1.9	64	288	226	1.69	0.384	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Wi-Fi 5.5 GHz	5700	10.00	10	8.2	1.9	64	288	226	1.69	0.398	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Wi-Fi 5.8 GHz	5825	11.00	13	8.2	1.9	64	288	226	1.69	-MEASURE-	-MEASURE-	0.400	0.400	0.400	-MEASURE-
Bluetooth	2480	8.00	6	8.2	1.9	64	288	226	1.69	0.157	0.252	0.400	0.400	0.400	0.252

14.2. Sum of the SAR for Wi-Fi DTS Band & Bluetooth

RF Exposure condition	Test Position	Simultaneous Transmission Scenario				∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)
		DTS Band			Bluetooth		
		Main	Aux	Main + Aux			
Body	Rear	0.340			0.157	0.497	No
			0.340		0.157	0.497	No
				0.340	0.157	0.497	No
	Edge 1	1.068			0.252	1.320	No
			1.080		0.252	1.332	No
				1.090	0.252	1.342	No
	Bevel (Edge 1 Slant)	1.140			0.252	1.392	No
			1.217		0.252	1.469	No
				1.260	0.252	1.512	No

SAR to Peak Location Separation Ratio (SPLSR)
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

14.3. Sum of the SAR for Wi-Fi UNII Band & Bluetooth

RF Exposure condition	Test Position	Simultaneous Transmission Scenario				∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)
		UNII Band			Bluetooth		
		Main	Aux	Main + Aux			
Body	Rear	0.398			0.157	0.555	No
			0.398		0.157	0.555	No
				0.398	0.157	0.555	No
	Edge 1	1.200			0.252	1.452	No
			1.215		0.252	1.467	No
				1.260	0.252	1.512	No
	Bevel (Edge 1 Slant)	1.100			0.252	1.352	No
			1.288		0.252	1.540	No
				1.160	0.252	1.412	No

SAR to Peak Location Separation Ratio (SPLSR)
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

15. Appendixes

Refer to separated files for the following appendixes.

15.1. Photos and Antenna Locations

15.2. Highest System Performance Check Plots

15.3. Highest SAR Test Plots

15.4. Calibration Certificate for E-Field Probe EX3DV4 - SN 3901

15.5. Calibration Certificate for D2450V2 - SN 899

15.6. Calibration Certificate for D5GHzV2 - SN 1003

END OF REPORT