SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
Radio Frequency Device with 802.11a/b/g/n/ac, BT, and BLE

FCC ID: 2AM5NM1000
Model Name: M1001

Report Number: 11694639-S1V2
Issue Date: 7/10/2018

Prepared for
Magic Leap, Inc
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Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Date	Revisions	Revised By
V1	6/8/2018	Initial Issue	--
V2	7/10/2018	Changed Chain 0/1/2 to ANT 0/1/2 Section 1: Updated Highest Reported SAR Section 6.2: Updated Table Section 6.2 & Section 10: Updated Duty Cycles Appendix C: Updated Test plots	Coltyce Sanders

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1. Attestation of Test Results

Applicant Name	Magic Leap, Inc			
FCC ID	2AM5NM1000			
Model Name	M1001			
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013			
Exposure Category	SAR Limits (W/Kg)			
	Peak spatial-average(1g of tissue)		Extremities (hands, wrists, ankles, etc.) (10g of tissue)	
General population / Uncontrolled exposure	1.6		4	
RF Exposure Conditions	Equipment Class - Highest Reported SAR (W/kg)			
	PCT	DTS	NII	DSS
Body-worn	N/A	0.949	0.738	0.187
Simultaneous TX	N/A	1.555	1.555	1.435
Date Tested	11/6/2017 to 12/6/2017 and 2/12/2018 to 4/4/2018			
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:
	
Dave Weaver Operations Leader UL Verification Services Inc.	Coltyce Sanders Test Engineer UL Verification Services Inc.

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2. Test Specification, Methods and Procedures

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

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02

In addition to the above, the following information was used:

- TCB workshop October, 2016; Page 7, RF Exposure Procedures (Bluetooth Duty Factor)

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 F	
SAR Lab G	
SAR Lab H	

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

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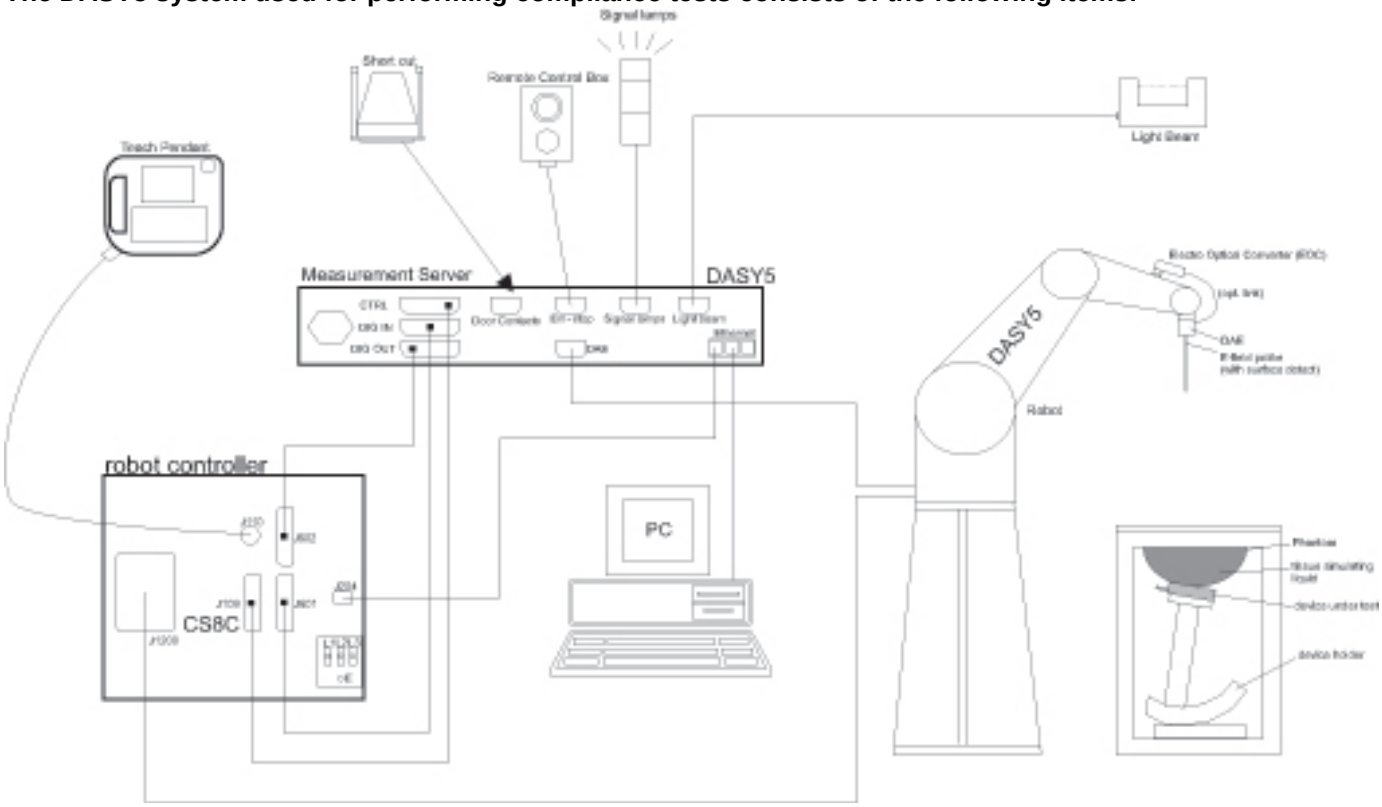
4. SAR Measurement System & Test Equipment

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.

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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

	≤ 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.	

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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

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

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.

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4.3. Volume Scan Procedures

Step 1: Repeat Step 1-4 in Section 4.2

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.

4.4. 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.

Test Equipment used for Test dates 11/6/2017 to 12/6/2017:

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	8753ES	MY40000980	5/10/2018
Dielectric Probe kit	SPEAG	DAK-3.5	1082	10/17/2018
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	10/17/2018
Thermometer*	Traceable Calibration Control Co.	15-078-179	140493798	11/30/2017
Thermometer	Traceable Calibration Control Co.	15-078-179	170064398	1/30/2018

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	Agilent	N5181A	MY50140610	5/31/2018
Power Meter	Keysight	N1912A	MY55196008	5/12/2018
Power Sensor	Agilent	N1921A	MY52260009	1/5/2018
Power Sensor	Agilent	N1921A	MY52270022	12/17/2017
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795093	N/A
Directional coupler	Werlatone	C8060-102	2149	N/A
DC Power Supply	BK PRECISION	E3610A	KR24104150	N/A

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab 2)	SPEAG	EX3DV4	3885	10/24/2018
E-Field Probe (SAR Lab 3)	SPEAG	EX3DV4	3902	5/30/2018
Data Acquisition Electronics (SAR Lab 2)	SPEAG	DAE4	1433	3/8/2018
Data Acquisition Electronics (SAR Lab 3)	SPEAG	DAE4	1239	7/27/2018
System Validation Dipole	SPEAG	D2450V2	706	5/9/2018
System Validation Dipole	SPEAG	D5GHzV2	1138	10/262018
System Validation Dipole	SPEAG	D5GHzV2	1003	2/13/2018

Other

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Sensor	Agilent	N1921A	MY53260010	10/17/2018
Power Meter	Agilent	N1912A	MY55196007	7/17/2018
Base Station Simulator	R & S	CBT	1153.9000K35-100987-WW	6/1/2018
Thermometer (SAR 2)	Extech	Big Digit Hygro-Thermometer	445703	7/13/2018
Thermometer (SAR 3)	Extech	Big Digit Hygro-Thermometer	445703	6/14/2018
PXA Signal Analzer	Agilent	N9030A	MY52350671	2/23/2018

Note(s):
*Equipment not used past calibration due date.

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Test Equipment used for Test dates 2/12/2018 to 4/4/2018:

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	8753ES	MY40000980	5/10/2018
Dielectric Probe kit	SPEAG	DAK-3.5	1082	10/17/2018
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	10/17/2018
Thermometer	Traceable Calibration Control Co.	15-078-179	170064398	5/26/2018

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	Agilent	N5181A	MY50140610	5/31/2018
Power Meter	Keysight	N1912A	MY55196008	5/12/2018
Power Sensor	Agilent	N1921A	MY53260001	10/27/2018
Power Sensor	Agilent	N1921A	MY53020038	4/13/2018
DC Power Supply	HP	6296A	2841A-05955	N/A
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795093	N/A
Directional coupler	Werlatone	C8060-102	2149	N/A
Synthesized Signal Generator	Agilent	N5181A	MY50140630	5/16/2018
Power Meter	HP	437B	3125U12345	8/10/2018
Power Meter	HP	437B	3125U11347	8/15/2018
Power Sensor	HP	8481A	3318A92374	8/15/2018
Power Sensor	HP	8481A	1926A27048	8/10/2018
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795092	N/A
Directional coupler	Werlatone	C8060-102	2141	N/A
DC Power Supply	BK Precision	1611	215-02292	N/A

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab 2)	SPEAG	EX3DV4	3885	10/24/2018
E-Field Probe (SAR Lab 2)	SPEAG	EX3DV4	3990	2/14/2019
E-Field Probe (SAR Lab 3)	SPEAG	EX3DV4	3902	5/30/2018
Data Acquisition Electronics (SAR Lab 2)*	SPEAG	DAE4	1433	3/8/2018
Data Acquisition Electronics (SAR Lab 2)	SPEAG	DAE4	1357	2/8/2019
Data Acquisition Electronics (SAR Lab 3)	SPEAG	DAE4	1239	7/27/2018
System Validation Dipole	SPEAG	D2450V2	706	5/9/2018
System Validation Dipole	SPEAG	D2450V2	748	2/14/2019
System Validation Dipole	SPEAG	D5GHzV2	1168	11/23/2018
System Validation Dipole	SPEAG	D5GHzV2	1138	10/26/2018

Other

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Sensor	Agilent	N1921A	MY53260010	10/17/2018
Power Meter	Agilent	N1912A	MY55196007	7/17/2018
Base Station Simulator	R & S	CBT	1153.9000K35-100987-WW	6/1/2018
Thermometer (SAR 2)	Extech	Big Digit Hygro-Thermometer	445703	7/13/2018
Thermometer (SAR 3)	Extech	Big Digit Hygro-Thermometer	445703	6/14/2018

Note(s):

*Equipment not used past calibration due date.

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 and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

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6. Device Under Test (DUT) Information

6.1. DUT Description

Device Dimension	Overall (Length x Width x Height): 110 mm x 110 mm x 44.9 mm Overall Diagonal: 110 mm		
Back Cover	The Back Cover is not removable.		
Battery Options	The rechargeable battery is not user accessible.		
Test sample information	**S/N**	**Model**	**Notes**
	K01023	M1001	SAR Radiated & Conducted
	K01376	M1001	SAR Radiated & Conducted
	C01021	M1001	SAR Radiated & Conducted
Hardware Version	PEQ4 & PEQ5		
Software Version	PEQ5		

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)	99.68% (802.11b)[1] 99.46% (802.11g)[1]
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)	97.63% (802.11a)[1]
	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 4.2 LE	60.64% (GFSK) N/A (LE)[2]

Notes:

1. Duty cycle for Wi-Fi is referenced from the DTS and U-NII report.
2. Measured Duty Cycle is not required due to SAR test exemption. Refer to §7.1.

6.3. Test Rationale

The DUT is a body worn device that may be worn on a belt clip or a hanging from a lanyard. The front and rear of the DUT were subjected to SAR testing

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6.4. Maximum Output Power from Tune-up Procedure

RF Air interface	Mode	Channels	Max. RF Output Power (dBm)				
			SISO MODE			MIMO MODE	
			ANT 0	ANT 1	ANT 2	ANT 0	ANT1
WiFi 2.4 GHz (DTS)	802.11b	All	15.7	16.0	N/A	N/A	N/A
	802.11g	1-2	12.4	13.5	N/A	13.7	14.0
		3	16.3	16.5		13.7	14.0
		4-9	16.3	16.5		16.3	16.5
		10-11	12.4	13.5		13.7	14.0
	802.11n HT20	1	12.1	12.8	N/A	12.1	12.8
		2	12.1	12.8		15.0	15.6
		3-9	15.0	15.6		15.0	15.6
		10	12.1	12.8		15.0	15.6
		11	12.1	12.8		12.1	12.8
WiFi 5.2 GHz (U-NII 1)	802.11a	All	13.2	14.3	N/A	13.2	14.3
	802.11n HT20	All	13.1	14.2		13.1	14.2
	802.11n HT40	All	13.1	14.2		11.0	12.0
	802.11ac VHT20	All	13.1	14.2		13.1	14.2
	802.11ac VHT40	All	13.1	14.2		11.0	12.0
	802.11ac VHT80	All	12.6	13.4		10.0	11.0
WiFi 5.3 GHz (U-NII 2A)	802.11a	All	13.2	14.3	N/A	13.2	14.3
	802.11n HT20	All	13.1	14.2		13.1	14.2
	802.11n HT40	All	13.1	14.2		11.0	12.0
	802.11ac VHT20	All	13.1	14.2		13.1	14.2
	802.11ac VHT40	All	13.1	14.2		11.0	12.0
	802.11ac VHT80	All	12.6	13.4		10.0	11.0
WiFi 5.6 GHz (U-NII 2C)	802.11a	All	13.2	14.3	N/A	13.2	14.3
	802.11n HT20	All	13.1	14.2		13.1	14.2
	802.11n HT40	102	12.1	13.1		11.0	12.0
		118-134	13.1	14.0		11.0	12.0
	802.11ac VHT20	All	13.1	14.2		13.1	14.2
	802.11ac VHT40	102	12.1	13.1		11.0	12.0
		118-134	13.1	14.0		11.0	12.0
	802.11ac VHT80	All	12.6	13.4		10.0	11.0
WiFi 5.8 GHz (U-NII 3)	802.11a	All	13.2	14.3	N/A	13.2	14.3
	802.11n HT20	All	13.1	14.2		13.1	14.2
	802.11n HT40	All	13.0	13.8		11.0	12.2
	802.11ac VHT20	All	13.1	14.2		13.1	14.2
	802.11ac VHT40	All	13.0	13.8		11.0	12.2
	802.11ac VHT80	All	12.6	13.4		10.0	11.0
Bluetooth	GFSK	All	N/A	11.0	N/A	N/A	N/A
	EDR	All		8.0			
Bluetooth LE	GFSK	All	N/A	8.0	5.0	N/A	N/A

Note(s):

1. When the specified maximum output power is the same for both U-NII band 1 and U-NII band 2A, begin SAR measurement in U-NII band 2A; and if the highest *reported* SAR for U-NII band 2A is
   a. ≤ 1.2 W/kg, SAR is not required for U-NII band 1
   b. > 1.2 W/kg, both bands should be tested independently for SAR.

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7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A 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 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 threshold determines SAR exclusion
    a. SAR Test exclusion threshold is calculated using the procedure in KDB 447498 § 4.3.1.

SAR Test Exclusion Calculations for WLAN & Bluetooth

Antennas < 50mm to adjacent edges

Antenna	Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)		Calculated Threshold Value	
			dBm	mW	Rear	Front	Rear	Front
ANT 0	Wi-Fi 2.4 GHz	2462	16.30	43	5.00	5.00	13.5 -MEASURE-	13.5 -MEASURE-
ANT 0	Wi-Fi 5.2 GHz	5240	13.20	21	5.00	5.00	9.6 -MEASURE-	9.6 -MEASURE-
ANT 0	Wi-Fi 5.3 GHz	5320	13.20	21	5.00	5.00	9.7 -MEASURE-	9.7 -MEASURE-
ANT 0	Wi-Fi 5.6 GHz	5700	13.20	21	5.00	5.00	10 -MEASURE-	10 -MEASURE-
ANT 0	Wi-Fi 5.8 GHz	5825	13.20	21	5.00	5.00	10.1 -MEASURE-	10.1 -MEASURE-
ANT 1	Wi-Fi 2.4 GHz	2462	16.50	45	5.00	5.00	14.1 -MEASURE-	14.1 -MEASURE-
ANT 1	Wi-Fi 5.2 GHz	5240	14.30	27	5.00	5.00	12.4 -MEASURE-	12.4 -MEASURE-
ANT 1	Wi-Fi 5.3 GHz	5320	14.30	27	5.00	5.00	12.5 -MEASURE-	12.5 -MEASURE-
ANT 1	Wi-Fi 5.6 GHz	5700	14.30	27	5.00	5.00	12.9 -MEASURE-	12.9 -MEASURE-
ANT 1	Wi-Fi 5.8 GHz	5825	14.30	27	5.00	5.00	13 -MEASURE-	13 -MEASURE-
ANT 1	Bluetooth	2480	11.00	13	5.00	5.00	4.1 -MEASURE-	4.1 -MEASURE-
ANT 1	Bluetooth LE	2480	8.00	6	5.00	5.00	1.9 -EXEMPT-	1.9 -EXEMPT-
ANT 2	Bluetooth LE	2480	5.00	3	5.00	5.00	0.9 -EXEMPT-	0.9 -EXEMPT-

Note(s):

1. According to KDB 447498, if the calculated threshold value is >3, then SAR testing is required.
2. Bluetooth LE for ANT 1 and ANT 2 qualifies for SAR Test Exclusion.

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:

Antenna	Test Configurations	Rear	Front
ANT 0	Wi-Fi 2.4 GHz	Yes	Yes
	Wi-Fi 5.2 GHz	Yes	Yes
	Wi-Fi 5.3 GHz	Yes	Yes
	Wi-Fi 5.6 GHz	Yes	Yes
	Wi-Fi 5.8 GHz	Yes	Yes
ANT 1	Wi-Fi 2.4 GHz	Yes	Yes
	Wi-Fi 5.2 GHz	Yes	Yes
	Wi-Fi 5.3 GHz	Yes	Yes
	Wi-Fi 5.6 GHz	Yes	Yes
	Wi-Fi 5.8 GHz	Yes	Yes
	Bluetooth	Yes	Yes
	Bluetooth LE	No	No
ANT 2	Bluetooth LE	No	No

Note(s):

Yes = SAR Testing is required.

No = SAR Testing is not required.

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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 (rounded to the nearest 10MHz).
The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

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

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Dielectric Property Measurements Results for Test dates 11/6/2017 to 12/6/2017:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
2	11/10/2017	5600	Body	5600	48.28	48.48	-0.41	5.63	5.76	-2.36
				5500	48.50	48.61	-0.23	5.46	5.64	-3.34
				5725	48.04	48.31	-0.56	5.78	5.91	-2.09
2	11/10/2017	5800	Body	5800	47.95	48.20	-0.52	5.86	6.00	-2.40
				5700	47.99	48.34	-0.73	5.74	5.88	-2.27
				5850	47.89	48.20	-0.64	5.97	6.00	-0.48
2	11/13/2017	5200	Body	5200	48.29	49.02	-1.49	5.28	5.29	-0.20
				5150	48.35	49.09	-1.50	5.21	5.24	-0.43
				5350	47.91	48.82	-1.86	5.47	5.47	0.06
2	11/14/2017	2450	Body	2450	50.70	52.70	-3.80	2.00	1.95	2.67
				2400	51.02	52.77	-3.32	1.98	1.90	4.42
				2480	50.40	52.66	-4.30	2.03	1.99	1.80
2	11/27/2017	2450	Body	2450	52.15	52.70	-1.04	2.04	1.95	4.56
				2400	52.38	52.77	-0.74	1.95	1.90	2.69
				2480	52.27	52.66	-0.74	2.08	1.99	4.31
2	11/28/2017	5600	Body	5600	49.94	48.48	3.02	5.79	5.76	0.49
				5500	49.92	48.61	2.69	5.60	5.64	-0.81
				5725	49.87	48.31	3.23	5.96	5.91	0.97
3	11/6/2017	2450	Body	2450	50.61	52.70	-3.97	1.91	1.95	-1.95
				2400	50.85	52.77	-3.64	1.86	1.90	-1.79
				2480	50.57	52.66	-3.97	1.96	1.99	-1.66
3	11/12/2017	5200	Body	5200	47.82	49.02	-2.45	5.29	5.29	-0.05
				5150	48.08	49.09	-2.05	5.24	5.24	0.11
				5350	47.65	48.82	-2.39	5.47	5.47	0.04
3	11/12/2017	5800	Body	5800	46.96	48.20	-2.57	6.04	6.00	0.67
				5700	47.16	48.34	-2.45	5.91	5.88	0.59
				5850	46.85	48.20	-2.80	6.16	6.00	2.72

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Dielectric Property Measurements Results for Test dates 2/12/2018 to 4/4/2018:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
2	2/12/2018	2450	Body	2450	51.55	52.70	-2.18	2.00	1.95	2.46
				2400	51.71	52.77	-2.01	1.94	1.90	2.11
				2480	51.48	52.66	-2.24	2.03	1.99	2.00
2	3/21/2018	5200	Body	5200	48.00	49.02	-2.08	5.06	5.29	-4.38
				5150	48.24	49.09	-1.73	4.99	5.24	-4.71
				5350	47.85	48.82	-1.98	5.28	5.47	-3.48
2	3/21/2018	5600	Body	5600	47.50	48.48	-2.02	5.56	5.76	-3.42
				5500	47.73	48.61	-1.82	5.46	5.64	-3.25
				5725	47.26	48.31	-2.17	5.73	5.91	-3.04
2	3/21/2018	5800	Body	5800	47.17	48.20	-2.14	5.79	6.00	-3.47
				5700	47.26	48.34	-2.24	5.67	5.88	-3.57
				5850	47.02	48.20	-2.45	5.91	6.00	-1.47
2	3/27/2018	5200	Body	5200	47.22	49.02	-3.67	5.22	5.29	-1.49
				5150	47.28	49.09	-3.68	5.10	5.24	-2.66
				5350	47.10	48.82	-3.52	5.42	5.47	-0.98
2	3/27/2018	5600	Body	5600	46.59	48.48	-3.89	5.73	5.76	-0.63
				5500	46.90	48.61	-3.52	5.58	5.64	-1.12
				5725	46.45	48.31	-3.85	5.87	5.91	-0.61
2	3/27/2018	5800	Body	5800	46.20	48.20	-4.15	5.87	6.00	-2.15
				5700	46.20	48.34	-4.43	5.78	5.88	-1.64
				5850	45.99	48.20	-4.59	6.01	6.00	0.20
2	3/29/2018	5200	Body	5200	47.31	49.02	-3.49	5.29	5.29	-0.05
				5150	47.49	49.09	-3.25	5.24	5.24	0.14
				5350	47.02	48.82	-3.68	5.48	5.47	0.21
2	3/29/2018	5800	Body	5800	46.13	48.20	-4.29	6.02	6.00	0.27
				5700	46.43	48.34	-3.96	5.88	5.88	-0.01
				5850	46.06	48.20	-4.44	6.09	6.00	1.50
2	4/2/2018	5200	Body	5200	48.48	49.02	-1.10	5.04	5.29	-4.79
				5150	48.55	49.09	-1.09	4.98	5.24	-4.93
				5350	48.21	48.82	-1.24	5.25	5.47	-4.05
2	4/2/2018	5600	Body	5600	47.89	48.48	-1.21	5.56	5.76	-3.58
				5500	47.98	48.61	-1.30	5.45	5.64	-3.52
				5725	47.75	48.31	-1.16	5.74	5.91	-2.77

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Dielectric Property Measurements Results for Test dates 2/12/2018 to 4/4/2018 (continued):

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
3	2/12/2018	5200	Body	5200	49.39	49.02	0.76	5.24	5.29	-1.07
				5150	49.49	49.09	0.82	5.18	5.24	-1.00
				5350	48.96	48.82	0.29	5.43	5.47	-0.74
3	2/12/2018	5600	Body	5600	48.67	48.48	0.40	5.84	5.76	1.41
				5500	48.75	48.61	0.28	5.72	5.64	1.39
				5725	48.30	48.31	-0.02	6.09	5.91	3.03
3	2/12/2018	5800	Body	5800	48.28	48.20	0.17	6.21	6.00	3.57
				5700	48.48	48.34	0.28	6.03	5.88	2.66
				5850	48.00	48.20	-0.41	6.29	6.00	4.77
3	3/21/2018	2450	Body	2450	51.83	52.70	-1.65	1.93	1.95	-0.92
				2400	51.88	52.77	-1.69	1.88	1.90	-0.84
				2480	51.74	52.66	-1.75	1.97	1.99	-0.91
3	3/22/2018	5200	Body	5200	47.78	49.02	-2.53	5.16	5.29	-2.60
				5150	47.86	49.09	-2.50	5.08	5.24	-2.95
				5350	47.58	48.82	-2.53	5.35	5.47	-2.28
3	3/22/2018	5600	Body	5600	47.26	48.48	-2.51	5.65	5.76	-1.87
				5500	47.40	48.61	-2.50	5.52	5.64	-2.13
				5725	47.13	48.31	-2.44	5.82	5.91	-1.43
3	3/22/2018	5800	Body	5800	46.97	48.20	-2.55	5.90	6.00	-1.70
				5700	47.07	48.34	-2.63	5.78	5.88	-1.63
				5850	46.93	48.20	-2.63	6.00	6.00	-0.03
3	3/26/2018	2450	Body	2450	54.83	52.70	4.04	2.07	1.95	6.31
				2400	54.96	52.77	4.15	2.02	1.90	6.53
				2480	54.77	52.66	4.00	2.12	1.99	6.22
3	3/27/2018	2450	Body	2450	53.39	52.70	1.31	1.92	1.95	-1.64
				2400	53.54	52.77	1.45	1.88	1.90	-0.79
				2480	53.28	52.66	1.17	1.95	1.99	-2.17
3	3/28/2018	5200	Body	5200	47.26	49.02	-3.59	5.26	5.29	-0.73
				5150	47.29	49.09	-3.66	5.16	5.24	-1.48
				5350	47.12	48.82	-3.48	5.39	5.47	-1.42
3	3/29/2018	2450	Body	2450	50.48	52.70	-4.21	2.04	1.95	4.82
				2400	50.65	52.77	-4.02	1.98	1.90	4.42
				2480	50.46	52.66	-4.18	2.08	1.99	4.36
3	4/2/2018	2450	Body	2450	53.06	52.70	0.68	2.02	1.95	3.64
				2400	53.18	52.77	0.77	1.97	1.90	3.90
				2480	52.94	52.66	0.53	2.05	1.99	3.05

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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.

System Check Results for Test dates 11/6/2017 to 12/6/2017:

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	Date	Tissue Type	Dipole Type _Serial #	Dipole Cal. Due Data	Measured Results for 1g SAR				Measured Results for 10g SAR				Plot No.
					Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	
2	11/10/2017	Body	D5GHzV2 SN:1138 (5.6 GHz)	10/26/2018	7.660	76.60	79.50	-3.65	2.100	21.00	22.30	-5.83	
2	11/10/2017	Body	D5GHzV2 SN:1138 (5.8 GHz)	10/26/2018	7.290	72.90	76.80	-5.08	2.010	20.10	21.30	-5.63	
2	11/14/2017	Body	D5GHzV2 SN:1138 (5.2 GHz)	10/26/2018	7.570	75.70	73.40	3.13	2.190	21.90	20.60	6.31	
2	11/14/2017	Body	D2450V2 SN:706	5/9/2018	5.350	53.50	50.60	**5.73**	2.450	24.50	23.80	2.94	1,2
2	11/27/2017	Body	D2450V2 SN:706	5/9/2018	5.340	53.40	50.60	5.53	2.440	24.40	23.80	2.52	
2	11/28/2017	Body	D5GHzV2 SN:1138 (5.6 GHz)	10/26/2018	8.510	85.10	79.50	**7.04**	2.350	23.50	22.30	5.38	3,4
3	11/6/2017	Body	D2450V2 SN:706	5/9/2018	5.180	51.80	50.60	**2.37**	2.380	23.80	23.80	0.00	5,6
3	11/12/2017	Body	D5GHzV2 SN:1003 (5.2 GHz)	2/13/2018	7.670	76.70	70.50	**8.79**	2.160	21.60	19.80	9.09	7,8
3	11/12/2017	Body	D5GHzV2 SN:1003 (5.8 GHz)	2/13/2018	7.730	77.30	73.50	5.17	2.180	21.80	20.50	6.34	

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System Check Results for Test dates 2/12/2018 to 4/4/2018:

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	Date	Tissue Type	Dipole Type _Serial #	Dipole Cal. Due Data	Measured Results for 1g SAR				Measured Results for 10g SAR				Plot No.
					Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	
2	2/12/2018	Body	D2450V2 SN:706	5/9/2018	5.260	52.60	50.60	**3.95**	2.400	24.00	23.80	0.84	9,10
2	3/21/2018	Body	D5GHzV2 SN:1168 (5.2 GHz)	11/23/2018	7.400	74.00	70.70	4.67	2.130	21.30	19.70	8.12	
2	3/21/2018	Body	D5GHzV2 SN:1168 (5.6 GHz)	11/23/2018	7.950	79.50	75.60	5.16	2.210	22.10	20.80	6.25	
2	3/21/2018	Body	D5GHzV2 SN:1168 (5.8 GHz)	11/23/2018	6.080	60.80	65.30	**-6.89**	1.700	17.00	18.20	-6.59	11,12
2	3/26/2018	Body	D5GHzV2 SN:1138 (5.2 GHz)	10/26/2018	8.010	80.10	73.40	**9.13**	2.250	22.50	20.60	9.22	13,14
2	3/26/2018	Body	D5GHzV2 SN:1138 (5.6 GHz)	10/26/2018	7.910	79.10	79.50	-0.50	2.050	20.50	22.30	-8.07	
2	3/27/2018	Body	D5GHzV2 SN:1138 (5.8 GHz)	10/26/2018	7.640	76.40	76.80	-0.52	2.130	21.30	21.30	0.00	
2	3/29/2018	Body	D5GHzV2 SN:1138 (5.2 GHz)	10/26/2018	7.400	74.00	73.40	0.82	2.090	20.90	20.60	1.46	
2	3/29/2018	Body	D5GHzV2 SN:1138 (5.8 GHz)	10/26/2018	7.230	72.30	76.80	-5.86	2.000	20.00	21.30	-6.10	
2	4/2/2018	Body	D5GHzV2 SN:1138 (5.2 GHz)	10/26/2018	7.370	73.70	73.40	0.41	2.090	20.90	20.60	1.46	
2	4/2/2018	Body	D5GHzV2 SN:1138 (5.6 GHz)	10/26/2018	8.140	81.40	79.50	2.39	2.240	22.40	22.30	0.45	
3	2/12/2018	Body	D5GHzV2 SN:1138 (5.2 GHz)	10/26/2018	7.240	72.40	73.40	-1.36	2.050	20.50	20.60	-0.49	
3	2/12/2018	Body	D5GHzV2 SN:1138 (5.6 GHz)	10/26/2018	8.130	81.30	79.50	2.26	2.290	22.90	22.30	2.69	
3	2/12/2018	Body	D5GHzV2 SN:1138 (5.8 GHz)	10/26/2018	7.420	74.20	76.80	**-3.39**	2.090	20.90	21.30	-1.88	15,16
3	3/21/2018	Body	D2450V2 SN:748	2/14/2019	5.130	51.30	50.95	**0.69**	2.370	23.70	23.80	-0.42	17,18
3	3/22/2018	Body	D5GHzV2 SN:1168 (5.2 GHz)	11/23/2018	7.300	73.00	70.70	3.25	2.080	20.80	19.70	5.58	
3	3/22/2018	Body	D5GHzV2 SN:1168 (5.6 GHz)	11/23/2018	7.980	79.80	75.60	5.56	2.240	22.40	20.80	7.69	
3	3/22/2018	Body	D5GHzV2 SN:1168 (5.8 GHz)	11/23/2018	6.970	69.70	65.30	**6.74**	1.960	19.60	18.20	7.69	19,20
3	3/26/2018	Body	D2450V2 SN:748	2/14/2019	5.090	50.90	50.95	-0.10	2.330	23.30	23.80	-2.10	
3	3/26/2018	Body	D5GHzV2 SN:1138 (5.2 GHz)	10/26/2018	7.280	72.80	73.40	-0.82	2.070	20.70	20.60	0.49	
3	3/29/2018	Body	D2450V2 SN:748	2/14/2019	5.100	51.00	50.95	0.10	2.350	23.50	23.80	-1.26	
3	4/2/2018	Body	D2450V2 SN:706	5/9/2018	5.260	52.60	50.60	**3.95**	2.400	24.00	23.80	0.84	21,22

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9. Conducted Output Power Measurements

9.1. Wi-Fi 2.4GHz (DTS Band)

9.1.1. Wi-Fi 2.4GHz Measured Output Power

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)		Max Output Power (dBm)		SAR Test (Yes/No)	
					ANT 0	ANT 1	ANT 0	ANT 1	ANT 0	ANT 1
2.4 (DTS)	802.11b	1 Mbps	1	2412	15.0	15.8	15.7	16.0	Yes	Yes
			6	2437	15.2	15.6				
			11	2462	15.0	15.7				
	802.11g	6 Mbps	1	2412	Not Required	Not Required	12.4	13.5	No	No
			2	2417						
			4	2427	14.7	15.1	16.3	16.5	Yes	Yes
			6	2437	14.6	15.2				
			9	2452	14.8	15.3				
			10	2457	Not Required	Not Required	12.4	13.5	No	No
			11	2462						
	802.11n (HT20)	6.5 Mbps	1	2412	Not Required	Not Required	12.1	12.8	No	No
			2	2417						
			3-9	2422-2452			15.0	15.6		
			10	2457			12.1	12.8		
			11	2462						

Note(s):

1. For “Not required”, SAR Test reduction was applied in accordance with KDB 248227.
2. SAR Not Required for 802.11n HT20 mode when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg per KDB 248227.
3. SAR is Required for 802.11g mode for Simultaneous Transmission Analysis.
   - During MIMO transmission, the Maximum output power channels for 802.11g mode are channels 4, 6 & 9. Therefore, these channels were selected for SAR evaluation.

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

9.2.1. Wi-Fi 5GHz Measured Output Power

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)		Max Output Power (dBm)		SAR Test (Yes/No)	
					ANT 0	ANT 1	ANT 0	ANT 1	ANT 0	ANT 1
5.3 (U-NII 2A)	802.11a	6 Mbps	52	5260	12.8	13.3	13.2	14.3	Yes	Yes
			56	5280	12.9	13.4				
			60	5300	12.9	13.5				
			64	5320	12.9	13.3				
	802.11n (HT20)	6.5 Mbps	52	5260	Not Required	Not Required	13.1	14.2	No	No
			56	5280						
			60	5300						
			64	5320						
	802.11n (HT40)	13.5 Mbps	54	5270	Not Required	Not Required	13.1	14.2	No	No
			62	5310						
	802.11ac VHT20	6.5 Mbps	52	5260	Not Required	Not Required	13.1	14.2	No	No
			56	5280						
			60	5300						
			64	5320						
	802.11ac VHT40	13.5 Mbps	54	5270	Not Required	Not Required	13.1	14.2	No	No
			62	5310						
	802.11ac VHT80	29.3 Mbps	58	5290	Not Required	Not Required	12.6	13.4	No	No
5.5 (U-NII 2C)	802.11a	6 Mbps	100	5500	12.5	13.3	13.2	14.3	Yes	Yes
			116	5580	12.4	13.3				
			124	5620	12.3	13.2				
			140	5700	12.5	13.3				
			144	5720	Not Tested	Not Tested				
	802.11n (HT20)	6.5 Mbps	100	5500	Not Required	Not Required	13.1	14.2	No	No
			116	5580						
			124	5620						
			140	5700						
			144	5720						
	802.11n (HT40)	13.5 Mbps	102	5510	Not Required	Not Required	12.1	13.1	No	No
			118	5590			13.1	14.0		
			134	5670						
			142	5710						
	802.11ac VHT20	6.5 Mbps	100	5500	Not Required	Not Required	13.1	14.2	No	No
			116	5580						
			124	5620						
			140	5700						
			144	5720						
	802.11ac VHT40	13.5 Mbps	102	5510	Not Required	Not Required	12.1	13.1	No	No
			118	5590			13.1	14.0		
			134	5670						
			142	5710						
	802.11ac VHT80	29.3 Mbps	106	5530	Not Required	Not Required	12.6	13.4	No	No
			122	5610						
			138	5690						

Note(s):

1. For “Not required”, SAR Test reduction was applied in accordance with KDB 248227.
2. The Transmission mode configuration with the Highest Maximum output power for each transmission ANT is selected for SAR testing per KDB 248227.
3. When the specified maximum output power is the same for both U-NII band I and U-NII band 2A, begin SAR measurement in U-NII band 2A; and if the highest *reported* SAR for U-NII band 2A is
   a. ≤ 1.2 W/kg, SAR is not required for U-NII band I
   b. > 1.2 W/kg, both bands should be tested independently for SAR.

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Wi-Fi 5GHz Measured Output Power (continued):

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)		Max Output Power (dBm)		SAR Test (Yes/No)	
					ANT 0	ANT 1	ANT 0	ANT 1	ANT 0	ANT 1
5.8 (U-NII 3)	802.11a	6 Mbps	149	5745	12.7	13.3	13.2	14.3	Yes	Yes
			157	5785	12.6	13.3				
			165	5825	12.5	13.4				
	802.11n (HT20)	6.5 Mbps	149	5745	Not Required	Not Required	13.1	14.2	No	No
			157	5785						
			165	5825						
	802.11n (HT40)	13.5 Mbps	151	5755	Not Required	Not Required	13.0	13.8	No	No
			159	5795						
	802.11ac VHT20	6.5 Mbps	149	5745	Not Required	Not Required	13.1	14.2	No	No
			157	5785						
			165	5825						
	802.11ac VHT40	13.5 Mbps	151	5755	Not Required	Not Required	13.0	13.8	No	No
			159	5795						
	802.11ac VHT80	29.3 Mbps	155	5775	Not Required	Not Required	12.6	13.4	No	No

Note(s):

1. For “Not required”, SAR Test reduction was applied in accordance with KDB 248227.
2. The Transmission mode configuration with the Highest Maximum output power for each transmission ANT is selected for SAR testing per KDB 248227.

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9.3. Bluetooth

9.3.1. Bluetooth Measured Output Power

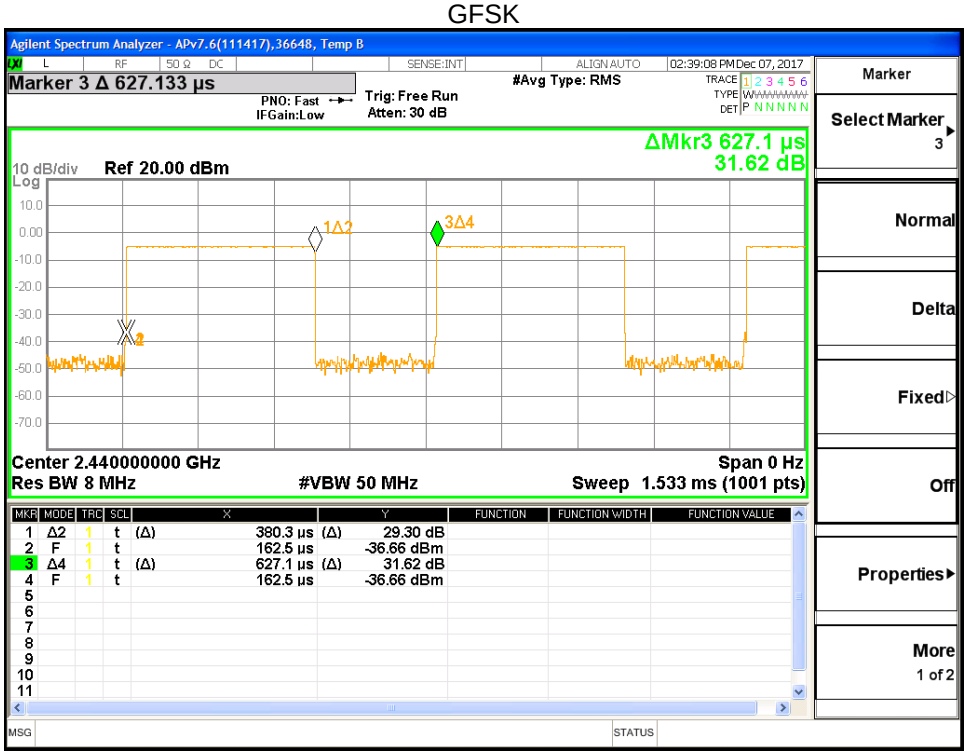
Band (GHz)	Mode	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
				ANT 1	ANT 1	
2.4	GFSK	0	2402	9.1	11.0	Yes
		39	2441	9.2		
		78	2480	9.1		
	EDR, π/4 DQPSK	0	2402	Not Required	8.0	No
		39	2441			
		78	2480			
	EDR, 8-DPSK	0	2402	Not Required	8.0	No
		39	2441			
		78	2480			

Duty Factor Measured Results:

Mode	Type	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
GFSK	DH5	0.3803	0.6271	60.64%	1.65

Duty Cycle plots

GFSK



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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:
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*.

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10.1. Wi-Fi (DTS Band)

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
Body-worn	802.11b 1 Mbps	ANT 0	0	Rear	6	2437.0	99.68%	15.7	15.2	0.021	0.024	
				Front	6	2437.0	99.68%	15.7	15.2	0.273	**0.307**	1
		ANT 1	0	Rear	6	2437.0	99.68%	16.0	15.6	0.029	0.032	
				Front	1	2412.0	99.68%	16.0	15.8	0.793	0.833	
					6	2437.0	99.68%	16.0	15.6	0.746	0.821	
					11	2462.0	99.68%	16.0	15.7	0.824	**0.886**	2
Body-worn	802.11g 6 Mbps	ANT 0	0	Rear	6	2437.0	99.46%	16.3	14.6	0.034	0.051	
				Front	6	2437.0	99.46%	16.3	14.6	0.365	**0.543**	3
		ANT 1	0	Rear	6	2437.0	99.46%	16.5	15.2	0.042	0.057	
				Front	4	2427.0	99.46%	16.5	15.1	0.684	**0.949**	4
					6	2437.0	99.46%	16.5	15.2	0.648	0.879	
					9	2452.0	99.46%	16.5	15.3	0.578	0.766	

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10.2. Wi-Fi (U-NII Band)

U-NII 2A

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
Body-worn	802.11a 6 Mbps	ANT 0	0	Rear	60	5300.0	97.63%	13.2	12.9	0.000	0.000	
				Front	60	5300.0	97.63%	13.2	12.9	0.307	**0.337**	5
Body-worn	802.11a 6 Mbps	ANT 1	0	Rear	60	5300.0	97.63%	14.3	13.5	0.000	0.000	
				Front	56	5280.0	97.63%	14.3	13.4	0.554	0.698	
					60	5300.0	97.63%	14.3	13.5	0.567	0.698	
					64	5320.0	97.63%	14.3	13.3	0.572	**0.738**	6

Note(s):

The highest *reported* SAR for U-NII band 2A is ≤ 1.2 W/kg, therefore SAR is not required for U-NII band I.

U-NII 2C

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
Body-worn	802.11a 6 Mbps	ANT 0	0	Rear	140	5700.0	97.63%	13.2	12.5	0.000	0.000	
				Front	140	5700.0	97.63%	13.2	12.5	0.424	**0.510**	7
Body-worn	802.11a 6 Mbps	ANT 1	0	Rear	116	5580.0	97.63%	14.3	13.3	0.014	0.018	
				Front	100	5500.0	97.63%	14.3	13.3	0.556	0.717	
					116	5580.0	97.63%	14.3	13.3	0.560	**0.722**	8
					140	5700.0	97.63%	14.3	13.3	0.376	0.485	

U-NII 3

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
Body-worn	802.11a 6 Mbps	ANT 0	0	Rear	149	5745.0	97.63%	13.2	12.7	0.000	0.000	
				Front	149	5745.0	97.63%	13.2	12.7	0.352	**0.405**	9
Body-worn	802.11a 6 Mbps	ANT 1	0	Rear	157	5785.0	97.63%	14.3	13.3	0.014	0.018	
				Front	149	5745.0	97.63%	14.3	13.3	0.346	0.446	
					157	5785.0	97.63%	14.3	13.3	0.411	**0.530**	10
					165	5825.0	97.63%	14.3	13.4	0.338	0.426	

10.3. Bluetooth

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
Body-worn	GFSK	ANT 1	0	Rear	39	2441.0	60.64%	11.0	9.2	0.000	0.000	
				Front	39	2441.0	60.64%	11.0	9.2	0.075	**0.187**	11

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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 <0.8 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 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.

Frequency Band (MHz)	Air Interface	Antenna	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	First Repeated	
							Measured SAR (W/kg)	Largest to Smallest SAR Ratio
2400	Wi-Fi 802.11b/g/n/ac	ANT 1	Body-worn	Front	Yes	0.824	0.819	1.01
	BT	ANT 1	Body-worn	Front	No	0.075	N/A	N/A
5300	Wi-Fi 802.11a/n/ac	ANT 1	Body-worn	Front	No	0.572	N/A	N/A
5500	Wi-Fi 802.11a/n/ac	ANT 1	Body-worn	Front	No	0.560	N/A	N/A
5800	Wi-Fi 802.11a/n/ac	ANT 1	Body-worn	Front	No	0.411	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 < 1.20.

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12. Simultaneous Transmission Conditions

RF Exposure Condition	Item	Simultaneous Transmission Configurations											
		DTS				U-NII				Bluetooth			
		ANT 0		ANT 1		ANT 0		ANT 1		ANT 1		ANT 2	
Body-worn	1	802.11g	+	802.11g	+	802.11a	+	802.11a			+	BLE	
	2	802.11g	+	802.11g	+	802.11n	+	802.11n			+	BLE	
	3	802.11g	+	802.11g	+	802.11ac	+	802.11ac			+	BLE	
	4	802.11n	+	802.11n	+	802.11a	+	802.11a			+	BLE	
	5	802.11n	+	802.11n	+	802.11n	+	802.11n			+	BLE	
	6	802.11n	+	802.11n	+	802.11ac	+	802.11ac			+	BLE	
	7	802.11b	+			802.11a	+	802.11a			+	BLE	
	8	802.11b	+			802.11n	+	802.11n			+	BLE	
	9	802.11b	+			802.11ac	+	802.11ac			+	BLE	
	10			802.11b	+	802.11a	+	802.11a			+	BLE	
	11			802.11b	+	802.11n	+	802.11n			+	BLE	
	12			802.11b	+	802.11ac	+	802.11ac			+	BLE	
	13					802.11a	+	802.11a	+	BT/BLE	+	BLE	
	14					802.11n	+	802.11n	+	BT/BLE	+	BLE	
	15					802.11ac	+	802.11ac	+	BT/BLE	+	BLE	
	16									BT/BLE	+	BLE	

Notes:

1. ANT 2 supports BLE only. The SAR distribution for ANT 2 does not overlap with the other two chains, therefore it is considered spatially separated per KDB 248227.

12.1. Simultaneous transmission SAR test exclusion considerations

KDB 447498 D01 General RF Exposure Guidance provides two procedures for determining simultaneous transmission SAR test exclusion: Sum of SAR and SAR to Peak Location Ratio (SPLSR)

12.1.1. Sum of SAR

To qualify for simultaneous transmission SAR test exclusion based upon Sum of SAR the sum of the reported standalone SARs for all simultaneously transmitting antennas shall be below the applicable standalone SAR limit. If the sum of the SARs is above the applicable limit then simultaneous transmission SAR test exclusion may still apply if the requirements of the SAR to Peak Location Ratio (SPLSR) evaluation are met.

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12.1.2. SAR to Peak Location Ratio (SPLSR)

KDB 447498 D01 General RF Exposure Guidance explains how to calculate 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 reported 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 reported or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of

$$[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$$

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

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

When an individual antenna transmits at on two bands simultaneously, the sum of the highest *reported* SAR for the frequency bands should be used to determine SAR_1.or SAR_2. When SPLSR is necessary, the smallest distance between the peak SAR locations for the antenna pair with respect to the peaks from each antenna should be used.

The antennas in all antenna pairs that do not qualify for simultaneous transmission SAR test exclusion must be tested for SAR compliance, according to the enlarged zoom scan and volume scan post-processing procedures in KDB Publication 865664 D01

12.1.3. Simultaneous transmission SAR measurement

When simultaneous transmission SAR measurements are required in different frequency bands not covered by a single probe calibration point then separate tests for each frequency band are performed. The tests are performed using enlarged zoom scans which are processed, by means of superposition, using the DASY5 volume scan post-processing procedures to determine the 1-g SAR for the aggregate SAR distribution.

The spatial resolution used for all enlarged zoom scans is the same as used for the most stringent zoom scans. I.E. the scan parameters required for the highest frequency assessed are used for all enlarged zoom scans. The scans cover the complete area of the device to ensure all transmitting antennas and radiating structures are assessed.

DASY5 provides the ability to perform Multiband Evaluations according to the latest standards using the Volume Scan job as well as appropriate routines for the Post-processing.

In order to extract and process measurements within different frequency bands, the SEMCAD X Post-processor performs the combination and subsequent superposition of these measurement data via DASY5= Combined Multi-Band Averaged SAR.

Combined Multi Band Averaged SAR allows - in addition to the data extraction - an evaluation of the 1 g, 10 g and/or arbitrary averaged mass SAR.
Power Scaling Factor is used to allow the volume scans to be scaled by a value other than "1", this is important when the results need to be scaled to different maximum power levels. The Power Scaling Factor is applied to each individual point of the scan. When power scaling is used in multi-band combinations the scaling factor is applied to each individual point of the first scan, the second factor is then applied to each individual point of the second scan and so on. The scans are then combined.

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12.2. Estimated SAR for Simultaneous Transmission SAR Analysis

Considerations for SAR estimation per KDB 447498:

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

Estimated SAR for WLAN & Bluetooth:

Antenna	Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)		Estimated 1-g SAR Value (W/kg)	
			dBm	mW	Rear	Front	Rear	Front
ANT 0	Wi-Fi 2.4 GHz	2462	16.30	43	5	5	-MEASURE-	-MEASURE-
ANT 0	Wi-Fi 5.2 GHz	5240	13.20	21	5	5	-MEASURE-	-MEASURE-
ANT 0	Wi-Fi 5.3 GHz	5320	13.20	21	5	5	-MEASURE-	-MEASURE-
ANT 0	Wi-Fi 5.6 GHz	5700	13.20	21	5	5	-MEASURE-	-MEASURE-
ANT 0	Wi-Fi 5.8 GHz	5825	13.20	21	5	5	-MEASURE-	-MEASURE-
ANT 1	Wi-Fi 2.4 GHz	2462	16.50	45	5	5	-MEASURE-	-MEASURE-
ANT 1	Wi-Fi 5.2 GHz	5240	14.30	27	5	5	-MEASURE-	-MEASURE-
ANT 1	Wi-Fi 5.3 GHz	5320	14.30	27	5	5	-MEASURE-	-MEASURE-
ANT 1	Wi-Fi 5.6 GHz	5700	14.30	27	5	5	-MEASURE-	-MEASURE-
ANT 1	Wi-Fi 5.8 GHz	5825	14.30	27	5	5	-MEASURE-	-MEASURE-
ANT 1	Bluetooth	2480	11.00	13	5	5	-MEASURE-	-MEASURE-
ANT 1	Bluetooth LE	2480	8.00	6	5	5	0.252	0.252
ANT 2	Bluetooth LE	2480	5.00	3	5	5	0.126	0.126

Note(s):

Bluetooth LE for ANT 1 and ANT 2 qualifies for SAR Test Exclusion.

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12.3. Sum of the Wi-Fi SAR

Test Position	Standalone SAR (W/kg)				∑ 1-g SAR (W/kg)				
	DTS 802.11g		U-NII 802.11a		DTS + DTS + U-NII	DTS + DTS + U-NII	DTS+ U-NII + U-NII	DTS+ U-NII + U-NII	DTS + DTS + U-NII + U-NII
	ANT 0 ①	ANT 1 ②	ANT 0 ③	ANT 1 ④	① + ② + ③	① + ② + ④	① + ③ + ④	② + ③ + ④	① + ② + ③ + ④
Rear	0.051	0.057	0.000	0.018	0.108	0.126	0.069	0.075	0.126
Front	0.543	0.949	0.510	0.738	2.002	2.230	1.791	2.197	2.740

Conclusion:

SPLSR analysis is required because the Sum of the SAR is > 1.6 W/kg.

Test Position	Standalone SAR (W/kg)				∑ 1-g SAR (W/kg)	
	DTS 802.11b		U-NII 802.11a		DTS+ U-NII + U-NII	DTS+ U-NII + U-NII
	ANT 0 ①	ANT 1 ②	ANT 0 ③	ANT 1 ④	① + ③ + ④	② + ③ + ④
Rear	0.024	0.032	0.000	0.018	0.042	0.050
Front	0.307	0.886	0.510	0.738	**1.555**	2.134

Conclusion:

SPLSR analysis is required because the Sum of the SAR is > 1.6 W/kg.

SAR to Peak Location Separation Ratio (SPLSR):

Test Position	Standalone SAR (W/kg)				∑ 1-g SAR (W/kg)		Calculated distance (mm)	SPLSR (≤ 0.04)	Volume Scan (Yes/ No)
	DTS g-mode		U-NII a-mode						
	ANT 0 ①	ANT 1 ②	ANT 0 ③	ANT 1 ④					
Front	0.543	0.949	0.510	0.738	① + ② + ③ + ④	2.740	53.6	0.085	Yes
	0.543	0.949			① + ②	1.492	71.5	0.025	No
	0.543			0.738	① + ④	1.281	55.1	0.026	No
		0.949	0.510		② + ③	1.459	71.0	0.025	No
			0.510	0.738	③ + ④	1.248	53.6	0.026	No

Mode	①	Peak SAR	X	Y	Z	d: Calculated distance (mm)	
		W/kg	m	m	m		
ANT 0 (2.4G)	②	0.632	0.0192	-0.0408	-0.184	① + ②	71.5
ANT 1 (2.4G)		1.26	0.0288	0.03	-0.182		
Mode	①	Peak SAR	X	Y	Z	d: Calculated distance (mm)	
		W/kg	m	m	m		
ANT 0 (2.4G)		0.632	0.0192	-0.0408	-0.184	① + ④	55.1
ANT 1 (5G)	④	1.31	0.035	0.012	-0.183		
Mode		Peak SAR	X	Y	Z	d: Calculated distance (mm)	
		W/kg	m	m	m		
ANT 1 (2.4G)	②	1.26	0.0288	0.03	-0.182	② + ③	71.0
ANT 0 (5G)	③	1.1	0.027	-0.041	-0.183		
Mode		Peak SAR	X	Y	Z	d: Calculated distance (mm)	
		W/kg	m	m	m		
ANT 0 (5G)	③	1.1	0.027	-0.041	-0.183	③ + ④	53.6
ANT 1 (5G)	④	1.31	0.035	0.012	-0.183		

The Peak Location Separation Distance is computed by using the formula below from KDB 447498:

SQRT((X1-X2)^2+(Y1-Y2)^2+(Z1-Z2)^2)

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is required because the SPLSR is > 0.04.

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Volume Scan:

Test Position	Mode	Antenna	Dist. (mm)	Ch #.	Freq. (MHz)	Volume Scan 1-g SAR (W/kg)		Plot No.
						Measured	Combined Multi-Band	
Front	802.11g	0	0	6	2437.0	0.340	1.55	12-16
	802.11g	1	0	4	2427.0	0.688		
	802.11a	0	0	140	5700.0	0.310		
	802.11a	1	0	64	5320.0	0.688		

Conclusion:
The combined 1g SAR is < 1.6 W/kg and is therefore compliant.

SAR to Peak Location Separation Ratio (SPLSR) (continued):

Test Position	Standalone SAR (W/kg)				∑ 1-g SAR (W/kg)		Calculated distance (mm)	SPLSR (≤ 0.04)	Volume Scan (Yes/ No)
	DTS b-mode		U-NII a-mode						
	ANT 0 ①	ANT 1 ②	ANT 0 ③	ANT 1 ④					
Front		0.886	0.510	0.738	② + ③ + ④	2.134	53.6	0.058	Yes
		0.886	0.510		② + ③	1.396	71.0	0.023	No
			0.510	0.738	③ + ④	1.248	53.6	0.026	No

Mode		Peak SAR	X	Y	Z	d: Calculated distance (mm)	
		W/kg	m	m	m		
ANT 1 (2.4G)	②	1.52	0.0288	0.03	-0.182	② + ③	71.0
ANT 0 (5G)	③	1.1	0.027	-0.041	-0.183		
Mode		Peak SAR	X	Y	Z	d: Calculated distance (mm)	
		W/kg	m	m	m		
ANT 0 (5G)	③	1.1	0.027	-0.041	-0.183	③ + ④	53.6
ANT 1 (5G)	④	1.31	0.035	0.012	-0.183		

The Peak Location Separation Distance is computed by using the formula below from KDB 447498:

SQRT((X1-X2)^2+(Y1-Y2)^2+(Z1-Z2)^2)

Conclusion:
Simultaneous transmission SAR measurement (Volume Scan) is required because the SPLSR is > 0.04.

Volume Scan:

Test Position	Mode	Antenna	Dist. (mm)	Ch #.	Freq. (MHz)	Volume Scan 1-g SAR (W/kg)		Plot No.
						Measured	Combined Multi-Band	
Front	802.11b	1	0	11	2462.0	0.656	1.26	17-20
	802.11a	0	0	140	5700.0	0.310		
	802.11a	1	0	64	5320.0	0.688		

Conclusion:
The combined 1g SAR is < 1.6 W/kg and is therefore compliant.

12.4. Sum of the Wi-Fi & Bluetooth SAR

Test Position	**Standalone SAR (W/kg)**			**∑ 1-g SAR (W/kg)**
	U-NII 802.11a		BT	U-NII + U-NII + BT
	ANT 0 ①	ANT 1 ②	ANT 1 ③	① + ② + ③
Rear	0.000	0.018	0.000	0.018
Front	0.510	0.738	0.187	**1.435**

Conclusion:
Simultaneous transmission SAR measurement (Volume Scan) is not required because the Sum of the SAR is < 1.6 W/kg.

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Appendixes

Refer to separated files for the following appendixes.

11694639-S1V1 Appendix A: SAR Setup Photos

11694639-S1V1 Appendix B: SAR System Check Plots

11694639-S1V2 Appendix C: Highest SAR Test Plots

11694639-S1V1 Appendix D: SAR Liquid Tissue Ingredients

11694639-S1V1 Appendix E: SAR Probe Calibration Certificates

11694639-S1V1 Appendix F: SAR Dipole Calibration Certificates

END OF REPORT

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