



**FCC OET BULLETIN 65 SUPPLEMENT C 01-01
IEEE Std 1528-2003 and IEEE Std 1528a-2005**

(Class II Permissive Change)

SAR EVALUATION REPORT

For
**Intel Centrino Advanced-N 6235
(Tested inside of Panasonic Tablet PC CF-19)**

**Model: WL12A
FCC ID: ACJ9TGWL12A**

**Report Number: 13J15516-1B
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Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	7/25/2013	Initial Issue	--
A	7/29/2013	Section 2 – corrected KDB 616217 revision number Section 8.3 – replaced device photos with drawings. Section 12.1.1 – amended tables to show 1 decimal place. Section 3 – corrected website address Section 13.4 – added additional simultaneous transmission analysis.	Dave Weaver
B	7/31/2013	Section 12.1 – clarified the SAR test exclusion separation distance selection rationale Section 12.2 – clarified the estimated SAR separation distance selection rationale	Dave Weaver

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1. Attestation of Test Results

Applicant	Panasonic Corporation of North America	
DUT description	Intel Centrino Advanced-N 6235 (Tested inside of Panasonic Tablet PC CF-19)	
Model	WL12A	
Test device is	An identical prototype	
Device category	Portable	
Exposure category	General Population/Uncontrolled Exposure	
Date tested	6/9/2013 – 7/19/2013	
Applicable Standards		Test Results
Published RF exposure KDB procedures, TCB workshop updates and OET Bulletin 65 Supplement C, IEEE Std 1528-2003 and IEEE Std 1528a-2005		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 For UL VERIFICATION SERVICES, INC. By:		Tested By:
		
Dave Weaver Program Manager UL VERIFICATION SERVICES, INC.		Jose Abadilla SAR Engineer UL VERIFICATION SERVICES, INC.

1.1. Summary of Highest 1-g SAR Results

Worst Case SAR data for each Frequency Band

RF Exposure Rule	Freq. Range	Highest Reported SAR	Limit
15.247 (Wi-Fi)	2412-2462 MHz	Body: 0.109W/kg (Edge 4 Tilt)	1.6 W/kg
15.407	5150-5250 MHz	Body: 0.463W/kg (Edge 2)	
	5250-5350 MHz	Body: 0.519 W/kg (Edge 2)	
	5500-5700 MHz	Body: 0.659W/kg (Edge 2)	
15.247	5725-5850 MHz	Body: 0.392W/kg (Edge 2)	
Simultaneous Transmission Condition		0.047 W/kg (refer to Section 13.) (The highest across exposure conditions)	

LEGEND:

- Rear = Back
- Edge 1 = Top Edge
- Edge 2 = Right Edge
- Edge 3 = Bottom Edge
- Edge 4 = Left Edge

2. Test Methodology

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C Edition 01-01, IEEE STD 1528-2003, IEEE Std 1528a-2005 and the following published RF exposure KDB procedures:

- o 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r01
- o 865664 D02 SAR Reporting v01r01
- o 447498 D01 General RF Exposure Guidance v05r01
- o 248227 D01 SAR Meas for 802 11abg v01r02
- o 616217 D04 SAR for laptop and tablets v01r1

3. Facilities and Accreditation

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

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.

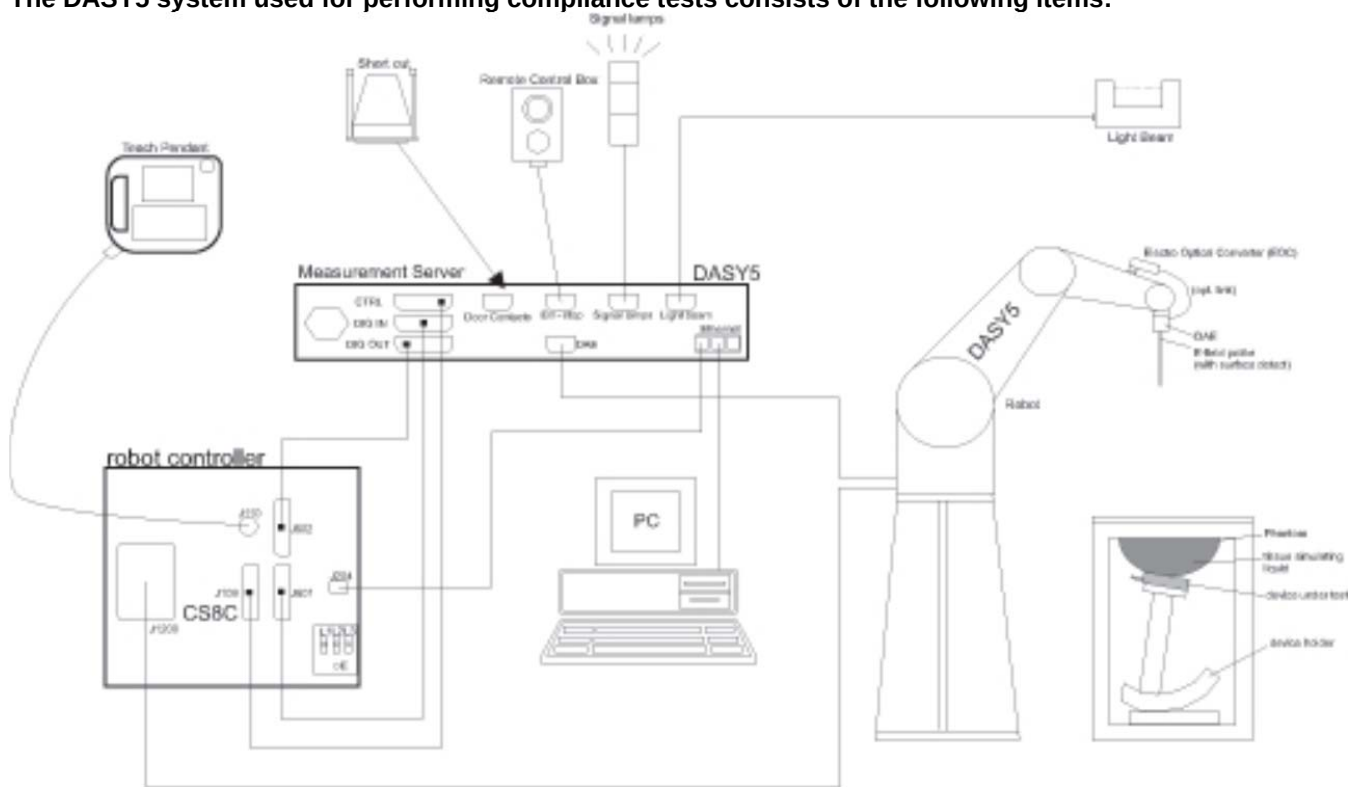
Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due date		
				MM	DD	Year
S-Parameter Network Analyzer	Agilent	8753ES	MY40000980	2	20	2014
Dielectronic Probe kit	SPEAG	SM DAK 040 CA	1082	9	18	2013
ENA Series Network Analyzer	Agilent	E5071B	MY42100131	2	21	2014
Dielectronic Probe kit	HP	85070E	594	N/A		
Synthesized Signal Generator	HP	8665B	3744A01084	5	7	2014
Power Meter	HP	438A	3513U04320	9	17	2013
Power Sensor A	HP	8481A	2237A31744	8	17	2013
Power Sensor B	HP	8481A	3318A95392	8	17	2013
Amplifier	MITEQ	4D00400600-50-30P	1622052	N/A		
Directional coupler	Werlatone	C8060-102	2149	N/A		
Synthesized Signal Generator	HP	8665B	3744A01084	3	26	2014
Power Meter	HP	438A	2822A05684	10	7	2013
Power Sensor A	HP	8481A	2702A66876	8	1	2013
Power Sensor B	HP	8482A	2349A08568	9	26	2013
Amplifier	MITEQ	4D00400600-50-30P	1620606	N/A		
Directional coupler	Werlatone	C8060-102	2141	N/A		
Thermometer	TRACEABLE	4242	122529162	9	19	2013
E-Field Probe	SPEAG	EX3DV4	3772	2	20	2014
E-Field Probe	SPEAG	EX3DV4	3773	4	26	2014
Data Acquisition Electronics	SPEAG	DAE4	1359	2	14	2014
System Validation Dipole	SPEAG	D2450V2	899	10	9	2013
System Validation Dipole	SPEAG	D5GHzV2	1138	10	5	2013
Power Meter	Agilent	N1912A	MY52310061	7	5	2013
Power Sensor	Agilent	N1921A	MY52260009	7	5	2013
Power Sensor Ch B	Agilent	N1921A	MY52270022	7	21	2013

4.2. Measurement Uncertainty

Per KDB 865664, when no measured SAR values exceed 1.5 W/kg, measurement uncertainty analysis does not need to be provided in the test report.

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 v01

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$	≤ 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 $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01 (Draft)

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

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

Device Under Test Intel Centrino Advanced-N 6235 (Tested inside of Panasonic Tablet PC CF-19) Model: WL12A	
Operating Configuration(s)	Tablet Mode
Exposure Condition(s)	The device is used in close proximity to the body. Specific details of the required test positions are provided in Section 8 "Exposure Conditions"
Accessory	None

7.1. Band and Air Interfaces

Tx Frequency Bands	802.11a/b/g/n: 2412 - 2462 MHz, b / g / HT20 / HT40 5150 - 5250 MHz, a / HT20 / HT40 5250 - 5350 MHz, a / HT20 / HT40 5500 - 5700 MHz, a / HT20 / HT40 5725 - 5850 MHz, a / HT20 / HT40 - Bluetooth: 2402 - 2480 MHz
Modulation	802.11a/b/g/n : BPSK, QPSK, CCK, 16-QAM and 64-QAM - Bluetooth 4.0+LE: GFSK, DQPSK, 8-DPSK
Duty Cycle	100%

7.2. Simultaneous Transmission

Usage Scenario	Modes	Mode of Operation	BAND	802.11b/g/n WLAN Main	802.11b/g/n WLAN Aux	802.11a/n WLAN Main	802.11a/n WLAN Aux	BT 2.4 GHz
Body SAR	2.4GHz WLAN SISO + BT (WLAN 1 Tx)	802.11b/g/n WLAN Main	2.4 GHz	YES	No	No	No	YES
		802.11b/g/n WLAN Aux	2.4 GHz	No	YES	No	No	No
	5 GHz Bands WLAN SISO + BT (WLAN 1 Tx)	802.11a/n WLAN Main	5 GHz Bands	No	No	YES	No	YES
		802.11a/n WLAN Aux	5 GHz Bands	No	No	No	YES	No
	2.4GHz WLAN MIMO (WLAN 2 Tx)	802.11n WLAN Main	2.4 GHz	YES	YES	No	No	No
		802.11n WLAN Aux	2.4 GHz	YES	YES	No	No	No
	5 GHz Bands WLAN MIMO (WLAN 2 Tx)	802.11n WLAN Main	5 GHz Bands	No	No	YES	YES	No
		802.11n WLAN Aux	5 GHz Bands	No	No	YES	YES	No

Notes:

1. Bluetooth transmits using the WLAN Aux Antenna
2. Bluetooth can transmit simultaneously with the WLAN Main Antenna, in any of the WLAN bands.
3. Bluetooth cannot transmit simultaneously with the WLAN Aux Antenna, in any of the WLAN bands; this also precludes the transmission of Bluetooth when WLAN is in MIMO mode.
4. With a maximum output power of **5.6 mW** (7.5 dBm), Bluetooth qualifies for Standalone SAR test exclusion based on the formula for Standalone SAR test exclusion considerations outlined in KDB 447498 D01 . For the exact value that this formula yields, please refer to **Section 12** of this report.

8. Exposure Conditions

Refer to Section 16 “Antenna Locations and Separation Distances” for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

8.1. Test Configurations for the Main Antenna, SISO and MIMO Modes

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	38.2mm	Yes	
Front	-	No	SAR is not required as this is not a typical use scenario
Edge 1	102.9mm	No	Refer to section 12 for SAR exclusion justification
Edge 2	16.7mm	Yes	
Edge 3	86.9mm	No	Refer to section 12 for SAR exclusion justification
Edge 4	283.0mm	No	Refer to section 12 for SAR exclusion justification

8.2. Test Configurations for the Auxiliary Antenna, SISO and MIMO Modes

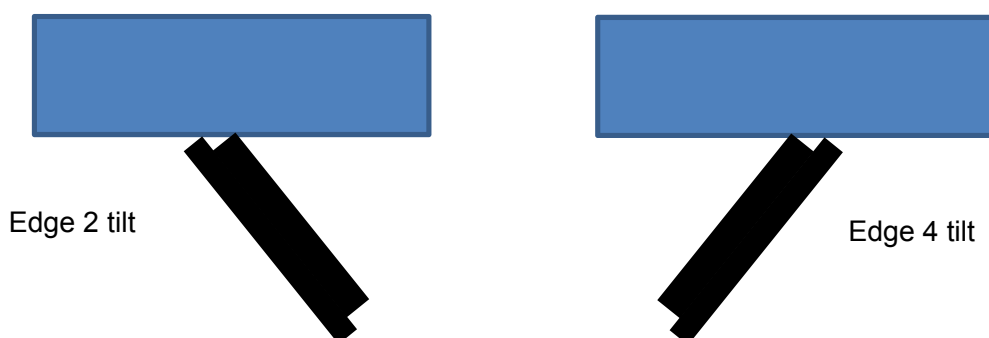
Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	38.2mm	Yes	
Front	-	No	SAR is not required as this is not a typical use scenario
Edge 1	102.9mm	No	Refer to section 12 for SAR exclusion justification
Edge 2	283.0mm	No	Refer to section 12 for SAR exclusion justification
Edge 3	88.2mm	No	Refer to section 12 for SAR exclusion justification
Edge 4	16.7mm	Yes	

LEGEND:

- Rear = Back
- Edge 1 = Top Edge
- Edge 2 = Right Edge
- Edge 3 = Bottom Edge
- Edge 4 = Left Edge

8.3. Additional Test Scenarios

Due to the extensions protruding from the screen section a KDB enquiry was made to discuss additional test scenarios. Additional testing was performed with the DUT tilted against the flat phantom. Testing at the indented corners was excluded under the test exclusion guidelines from KDB 447498. See section 12.



Summary of Required Test Modes

8.4. Wi-Fi 2.4 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/ Edges requiring SAR evaluation
				Main	Aux		
802.11b	1 Tx	1	2412	12.0		Yes	Rear, Edge 2, Edge 2 tilt
		6	2437	14.5			
		11	2462	12.0			
		1	2412		12.0	Yes	Rear, Edge 4, Edge 4 tilt
		6	2437		15.0		
		11	2462		11.5		
802.11g	1 Tx	1	2412	12.0		No	
		6	2437	14.5			
		11	2462	11.5			
		1	2412		12.0	Yes	Rear, Edge 4, Edge 4 tilt
		6	2437		15.5		
		11	2462		11.5		
802.11n HT20	1 Tx	1	2412	12.0		No	
		6	2437	14.5			
		11	2462	11.5			
		1	2412		11.5	No	
		6	2437		15.0		
		11	2462		11.5		
802.11n HT20	2 Tx	1	2412	11.5	11.5	No	
		6	2437	12.5	12.5		
		11	2462	10.5	10.4		
802.11n HT40	1 Tx	3	2422	10.6		No	
		6	2437	13.6			
		9	2450	10.1			
		3	2422		9.2	No	
		6	2437		12.7		
		9	2450		10.1		
802.11n HT40	2 Tx	3	2422	7.3	7.0	No	
		6	2437	12.3	12.3		
		9	2450	6.5	6.7		

Note(s):

- Per KDB 248227, SAR is not required for 802.HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a/b channels.

8.5. Wi-Fi 5.2 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/ Edges requiring SAR evaluation
				Main	Aux		
802.11a	1 Tx	36	5180	13.0		Yes	Rear, Edge 2, Edge 2 tilt
		40	5200	15.0			
		44	5220	15.0			
		48	5240	15.0			
		36	5180		13.0	Yes	Rear, Edge 4, Edge 4 tilt
		40	5200		15.0		
		44	5220		15.0		
		48	5240		15.0		
802.11n HT20	1 Tx	36	5180	13.0		No	
		40	5200	15.0			
		44	5220	15.0			
		48	5240	15.0			
		36	5180		14.0	No	
		40	5200		15.0		
		44	5220		15.0		
		48	5240		15.0		
802.11n HT20	2 Tx	36	5180	12.0	12.0	No	
		40	5200	12.0	12.0		
		48	5240	12.0	12.0		
802.11n HT40	1 Tx	38	5190	12.8		No	
		46	5230	14.5			
		38	5190		12.7		
		46	5230		14.5		
802.11n HT40	2 Tx	38	5190	10.0	10.8	No	
		46	5230	12.0	12.0		

Note(s):

- Per KDB 248227, SAR is not required for 802.HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a/b channels.

8.6. Wi-Fi 5.3 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/ Edges requiring SAR evaluation
				Main	Aux		
802.11a	1 Tx	52	5260	15.0		Yes	Rear, Edge 2, Edge 2 tilt
		56	5280	15.0			
		60	5300	15.0			
		64	5320	14.5			
		52	5260		15.0	Yes	Rear, Edge 4, Edge 4 tilt
		56	5280		15.0		
		60	5300		15.0		
		64	5320		15.0		
802.11n HT20	1 Tx	52	5260	15.0		No	
		60	5300	15.0			
		64	5320	14.5			
		52	5260		15.0	No	
		60	5300		15.0		
		64	5320		14.5		
802.11n HT20	2 Tx	52	5260	12.0	12.0	No	
		60	5300	12.0	12.0		
		64	5320	12.0	12.0		
802.11n HT40	1 Tx	54	5270	15.0		No	
		62	5310	11.5			
		54	5270		15.0	No	
		62	5310		12.4		
802.11n HT40	2 Tx	54	5270	12.0	12.0	No	
		62	5310	12.4	12.3		

Note(s):

- Per KDB 248227, SAR is not required for 802.HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a/b channels.

8.7. Wi-Fi 5.5 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/ Edges requiring SAR evaluation
				Main	Aux		
802.11a	1 Tx	100	5500	15.0		Yes	Rear, Edge 2, Edge 2 tilt
		104	5520	15.0			
		108	5540	15.0			
		112	5560	15.0			
		116	5580	15.0			
		120	5600	15.0			
		124	5620	15.0			
		128	5640	15.0			
		132	5660	15.0			
		136	5680	15.0			
		140	5700	15.0			
		100	5500		15.0	Yes	Rear, Edge 4, Edge 4 tilt
		104	5520		15.0		
		108	5540		15.0		
		112	5560		15.0		
		116	5580		15.0		
		120	5600		15.0		
		124	5620		15.0		
		128	5640		15.0		
		132	5660		15.0		
		136	5680		15.0		
		140	5700		15.0		
802.11n HT20	1 Tx	100	5500	15.0		No	
		116	5580	15.0			
		140	5700	15.0			
		100	5500		15.0	No	
		116	5580		15.0		
		140	5700		15.0		
802.11n HT20	2 Tx	100	5500	15.0	15.0	No	
		120	5600	15.0	15.0		
		140	5700	15.0	15.0		
802.11n HT40	1 Tx	102	5510	13.5		No	
		110	5550	15.0			
		134	5670	15.0			
		102	5510		13.5	No	
		110	5550		15.0		
		134	5670		15.0		
802.11n HT40	2 Tx	102	5510	11.5	11.5	No	
		110	5550	12.5	12.5		
		134	5670	12.5	12.5		

Note(s):

- Per KDB 248227, SAR is not required for 802.HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a/b channels.

8.8. Wi-Fi 5.8 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/ Edges requiring SAR evaluation
				Main	Aux		
802.11a	1 Tx	149	5745	15.0		Yes	Rear, Edge 2, Edge 2 tilt
		153	5765	15.0			
		157	5785	15.0			
		161	5805	15.0			
		165	5825	15.0			
		149	5745		15.0	Yes	Rear, Edge 4, Edge 4 tilt
		153	5765		15.0		
		157	5785		15.0		
		161	5805		15.0		
		165	5825		15.0		
802.11n HT20	1 Tx	149	5745	15.0		No	
		157	5785	15.0			
		165	5825	15.0			
		149	5745		15.0	No	
		157	5785		15.0		
		165	5825		15.0		
802.11n HT20	2 Tx	149	5745	12.0	12.0	No	
		157	5785	12.0	12.0		
		165	5825	12.0	12.0		
802.11n HT40	1 Tx	151	5755	15.0		No	
		159	5795	15.0			
		151	5755		15.0	No	
		159	5795		15.0		
802.11n HT40	2 Tx	151	5755	12.0	12.0	No	
		159	5795	12.0	12.0		

Note(s):

- Per KDB 248227, SAR is not required for 802.HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a/b channels.

9. RF Output Power Measurement

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 [#]	√	▽
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"

▽ = possible 802.11g channels with maximum average output $\frac{1}{4}$ dB $\geq$ 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.

9.1. Output Power

The target power is the absolute maximum.

Mode	Antenna	BAND	Channel	Frequency (MHz)	Target Power (dBm)	Measured Power (dBm)
802.11b	Main	2400MHz	1	2412	12.0	11.8
			2	2417	14.5	14.5
			3	2422	14.5	14.5
			4	2427	14.5	14.5
			5	2432	14.5	14.5
			6	2437	14.5	14.5
			7	2442	14.5	14.5
			8	2447	14.5	14.5
			9	2452	14.5	14.5
			10	2457	14.5	14.5
			11	2462	11.5	11.5
802.11g		2400MHz	1	2412	12.0	11.8
			2	2417	14.5	14.5
			3	2422	14.5	14.5
			4	2427	14.5	14.5
			5	2432	14.5	14.5
			6	2437	14.5	14.5
			7	2442	14.5	14.5
			8	2447	14.5	14.5
			9	2452	14.5	14.5
			10	2457	14.5	14.5
			11	2462	11.5	11.5
802.11a		5200MHz	36	5180	13.0	13.0
			40	5200	15.0	14.9
			44	5220	15.0	14.9
			48	5240	15.0	14.9
		5300MHz	52	5260	15.0	14.9
			56	5280	15.0	14.8
			60	5300	15.0	14.9
			64	5320	14.5	14.5
		5500MHz	100	5500	15.0	15.0
			104	5520	15.0	15.0
			108	5540	15.0	14.8
	112		5560	15.0	14.8	
	116		5580	15.0	14.9	
	120		5600	15.0	14.9	
	124		5620	15.0	14.9	
	128		5640	15.0	14.9	
	132		5660	15.0	14.9	
	136		5680	15.0	14.9	
	140	5700	15.0	14.9		
	5800MHz	149	5745	15.0	15.0	
		153	5765	15.0	14.8	
157		5785	15.0	14.8		
161		5805	15.0	14.8		
165		5825	15.0	15.0		

Output Power (continued)

Mode	Antenna	Band	Channel	Frequency (MHz)	Target Power (dBm)	Measured Power (dBm)
802.11b	Aux	2400MHz	1	2412	12.0	11.9
			2	2417	15.0	15.0
			3	2422	15.0	15.0
			4	2427	15.0	15.0
			5	2432	15.0	15.0
			6	2437	15.0	15.0
			7	2442	15.0	15.0
			8	2447	15.0	15.0
			9	2452	15.0	15.0
			10	2457	15.0	15.0
			11	2462	11.5	11.5
802.11g		2400MHz	1	2412	12.0	12.0
			2	2417	15.5	15.4
			3	2422	15.5	15.4
			4	2427	15.5	15.4
			5	2432	15.5	15.4
			6	2437	15.5	15.4
			7	2442	15.5	15.4
			8	2447	15.5	15.5
			9	2452	15.5	15.5
			10	2457	15.5	15.5
			11	2462	11.5	11.4
802.11a		5200MHz	36	5180	13.0	13.0
			40	5200	15.0	15.0
			44	5220	15.0	14.8
			48	5240	15.0	15.0
		5300MHz	52	5260	15.0	15.0
			56	5280	15.0	15.0
			60	5300	15.0	15.0
			64	5320	14.5	14.5
		5500MHz	100	5500	15.0	15.0
			104	5520	15.0	15.0
			108	5540	15.0	15.0
			112	5560	15.0	14.9
			116	5580	15.0	15.0
			120	5600	15.0	15.0
			124	5620	15.0	15.0
			128	5640	15.0	14.9
			132	5660	15.0	14.9
			136	5680	15.0	14.9
			140	5700	15.0	14.9
		5800MHz	149	5745	15.0	15.0
			153	5765	15.0	15.0
			157	5785	15.0	15.0
			161	5805	15.0	15.0
			165	5825	14.5	14.5

Output Power (continued)

Mode	Antenna	Band	Channel	Frequency (MHz)	Target Power (dBm)	Measured Power (dBm)
802.11n 20MHz 1Tx	Main	2400MHz	1	2412	12.0	11.8
			6	2437	14.5	14.2
			11	1462	11.5	11.3
	Aux		1	2412	11.5	11.2
			6	2437	15.0	14.8
			11	1462	11.5	11.4
802.11n 20MHz 2Tx	Main	2400MHz	1	2412	11.5	11.2
			6	2437	12.5	12.4
			11	1462	10.5	10.2
	Aux		1	2412	11.5	11.4
			6	2437	12.5	12.3
			11	1462	10.4	10.2
802.11n 40MHz 1Tx	Main	2400MHz	3	2422	10.6	10.2
			6	2437	13.6	13.5
			9	2450	10.1	9.9
	Aux		3	2422	9.2	9.0
			6	2437	12.7	12.4
			9	2450	10.1	10.0
802.11n 40MHz 2Tx	Main	2400MHz	3	2422	7.3	7.1
			6	2437	12.3	12.2
			9	2450	6.5	6.3
	Aux		3	2422	7.0	6.8
			6	2437	12.3	12.1
			9	2450	6.7	6.4
802.11a 20MHz 1Tx	Main	5200MHz	36	5180	13.0	12.7
			40	5200	15.0	14.7
			48	5240	15.0	14.8
		5300MHz	52	5260	15.0	14.9
			60	5300	15.0	15.0
			64	5320	14.5	14.4
		5500MHz	100	5500	15.0	14.8
			116	5580	15.0	14.9
			140	5700	15.0	14.8
		5800MHz	149	5745	15.0	14.8
			157	5785	15.0	14.9
			165	5825	15.0	14.8
	Aux	5200MHz	36	5180	14.0	14.0
			40	5200	15.0	14.9
			48	5240	15.0	14.7
		5300MHz	52	5260	15.0	14.9
			60	5300	15.0	14.9
			64	5320	14.5	14.2
		5500MHz	100	5500	15.0	14.9
			116	5580	15.0	14.8
			140	5700	15.0	14.9
		5800MHz	149	5745	15.0	15.0
			157	5785	15.0	14.9
			165	5825	15.0	14.9

Output Power (continued)

Mode	Antenna	Band	Channel	Frequency (MHz)	Target Power (dBm)	Measured Power (dBm)
802.11a 40MHz 1Tx	Main	5200MHz	38	5180	12.8	12.7
			46	5230	14.5	14.5
		5300MHz	54	5270	15.0	14.9
			62	5310	11.5	11.2
		5500MHz	102	5510	13.5	13.4
			110	5550	15.0	14.8
		5800MHz	134	5670	15.0	14.8
			151	5755	15.0	14.8
	Aux	5200MHz	159	5795	15.0	14.8
			38	5180	12.7	12.5
		5300MHz	46	5230	14.5	14.3
			54	5270	15.0	14.8
		5500MHz	62	5310	12.4	12.3
			102	5510	13.5	13.2
		5800MHz	110	5550	15.0	14.8
			134	5670	15.0	14.8
802.11a 40MHz 2Tx	Main	5200MHz	151	5755	15.0	14.8
			159	5795	15.0	14.9
		5300MHz	38	5180	10.0	9.8
			46	5230	12.0	11.7
		5500MHz	54	5270	12.0	11.9
			62	5310	12.4	12.2
		5800MHz	102	5510	11.5	11.2
			110	5550	12.5	12.3
	Aux	5200MHz	134	5670	12.5	12.3
			151	5755	12.0	11.7
		5300MHz	159	5795	12.0	11.6
			38	5180	10.8	10.7
		5500MHz	46	5230	12.0	11.8
			54	5270	12.0	11.8
		5800MHz	62	5310	12.3	12.1
			102	5510	11.5	11.3
			110	5550	12.5	12.1
			134	5670	12.5	12.2
			151	5755	12.0	11.8
			159	5795	12.0	11.7

10. Tissue Dielectric Properties

IEEE Std 1528-2003 Table 2

Target Frequency (MHz)	Head	
	ϵ_r	σ (S/m)
300	45.3	0.87
450	43.5	0.87
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1800 – 2000	40.0	1.40
2450	39.2	1.80
2600	39.0	1.96
3000	38.5	2.40

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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

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 $\pm 2^\circ\text{C}$ of the temperature when the tissue parameters are characterized.

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

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

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/10/2013	Body 5180	e'	48.1400	Relative Permittivity (ϵ_r):	48.14	49.05	-1.85	10
		e"	18.2700	Conductivity (σ):	5.26	5.27	-0.17	5
	Body 5200	e'	48.1500	Relative Permittivity (ϵ_r):	48.15	49.02	-1.77	10
		e"	18.2300	Conductivity (σ):	5.27	5.29	-0.45	5
	Body 5600	e'	47.4800	Relative Permittivity (ϵ_r):	47.48	48.48	-2.06	10
		e"	18.6300	Conductivity (σ):	5.80	5.76	0.69	5
	Body 5800	e'	47.1400	Relative Permittivity (ϵ_r):	47.14	48.20	-2.20	10
		e"	18.8800	Conductivity (σ):	6.09	6.00	1.48	5
	Body 5825	e'	47.1600	Relative Permittivity (ϵ_r):	47.16	48.20	-2.16	10
		e"	18.8900	Conductivity (σ):	6.12	6.00	1.97	5
6/13/2013	Body 5180	e'	47.4200	Relative Permittivity (ϵ_r):	47.42	49.05	-3.32	10
		e"	17.6400	Conductivity (σ):	5.08	5.27	-3.62	5
	Body 5200	e'	47.3800	Relative Permittivity (ϵ_r):	47.38	49.02	-3.34	10
		e"	17.7300	Conductivity (σ):	5.13	5.29	-3.18	5
	Body 5600	e'	46.9400	Relative Permittivity (ϵ_r):	46.94	48.48	-3.17	10
		e"	18.1100	Conductivity (σ):	5.64	5.76	-2.12	5
	Body 5800	e'	46.6000	Relative Permittivity (ϵ_r):	46.60	48.20	-3.32	10
		e"	18.3400	Conductivity (σ):	5.91	6.00	-1.42	5
	Body 5825	e'	46.6500	Relative Permittivity (ϵ_r):	46.65	48.20	-3.22	10
		e"	18.3000	Conductivity (σ):	5.93	6.00	-1.21	5
6/19/2013	Body 2450	e'	50.6400	Relative Permittivity (ϵ_r):	50.64	52.70	-3.91	5
		e"	14.5900	Conductivity (σ):	1.99	1.95	1.93	5
	Body 2410	e'	50.8100	Relative Permittivity (ϵ_r):	50.81	52.76	-3.69	5
		e"	14.4500	Conductivity (σ):	1.94	1.91	1.51	5
	Body 2475	e'	50.5500	Relative Permittivity (ϵ_r):	50.55	52.67	-4.02	5
		e"	14.7100	Conductivity (σ):	2.02	1.99	1.98	5
7/18/2013	Body 2450	e'	51.7100	Relative Permittivity (ϵ_r):	51.71	52.70	-1.88	5
		e"	14.6200	Conductivity (σ):	1.99	1.95	2.14	5
	Body 2410	e'	51.8600	Relative Permittivity (ϵ_r):	51.86	52.76	-1.70	5
		e"	14.4700	Conductivity (σ):	1.94	1.91	1.65	5
	Body 2475	e'	51.6200	Relative Permittivity (ϵ_r):	51.62	52.67	-1.99	5
		e"	14.7200	Conductivity (σ):	2.03	1.99	2.05	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
D5GHzV2	1138	10/09/2012	5.2GHz	1g	79.5	73.2
				10g	22.8	20.4
			5.5GHz	1g	83.6	77.9
				10g	23.8	21.7
			5.8GHz	1g	78.7	72.8
				10g	22.4	20.1
D2450V2	899	10/05/2012	2.45GHz	1g	53.6	51.7
				10g	25	24.3

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.

Date Tested	System Dipole		T.S. Liquid	Measured Results			Target (Ref. Value)	Delta ±10 %	Est./Zoo m Ratio ±2 %	Plot No.	
	Type	Serial #		Area Scan	Zoom Scan	Normalize to 1 W					
6/11/2013	D5GHzV 2(5.2)	1138	Body	1g	7.08	7.51	75.1	73.2	2.60	-6.07	1,2
				10g	1.97	2.10	21.0	20.4	2.94		
6/11/2013	D5GHzV 2(5.5)	1138	Body	1g	7.45	7.84	78.4	77.9	0.64	-5.23	3,4
				10g	2.03	2.22	22.2	21.7	2.30		
6/11/2013	D5GHzV 2(5.8)	1138	Body	1g	6.44	6.87	68.7	72.80	-5.63	-6.68	5,6
				10g	6.87	1.93	19.3	20.10	-3.98		
6/13/2013	D5GHzV 2(5.2)	1138	Body	1g	6.92	7.08	70.8	73.2	-3.28	-2.31	7,8
				10g	1.89	2.00	20.0	20.4	-1.96		
6/13/2013	D5GHzV 2(5.5)	1138	Body	1g	6.96	7.28	72.8	77.9	-6.55	-4.60	8,9
				10g	1.92	2.00	20.0	21.7	-7.83		
6/20/2013	D2450V2	899	Body	1g	5.04	5.19	51.9	51.7	0.39	-2.98	10,11
				10g	2.22	2.44	24.4	24.3	0.41		
7/18/2013	D2450V2	899	Body	1g	5.37	5.43	54.3	51.7	5.03	-1.12	12,13
				10g	2.33	2.52	25.2	24.3	3.70		

12. SAR Test Results

12.1. Standalone SAR Test Exclusion Considerations

Standalone SAR test exclusion was based upon the following criteria:

1. According to KDB 447498 § 4.1.5 if the antenna is at close proximity to user then the outer surface of the DUT should be treated as the radiating surface. The test separation distance is then determined by the smallest distance between the outer surface of the device and the user. For the purposes of this report close proximity has been defined as closer than 50 mm. For antennas <50 mm from the rear or edge the separation distance used for the SAR exclusion calculations is 0mm.
2. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.
3. If the antenna to DUT adjacent edge or bottom separation distance is >50mm the actual antenna to user separation distance is used to determine SAR exclusion and estimated SAR value
4. As the SISO (1 Tx) mode powers are higher than the MIMO (2Tx) powers separate testing of the MIMO (2 Tx) SAR was considered unnecessary. The reported stand-alone values for 1Tx mode are used to cover simultaneous conditions.

12.1.1. SAR exclusion calculations for Wi-Fi SISO (1 Tx) and Bluetooth for antenna <50mm from the user

Edges and rear

Antenna	Tx	Frequency (MHz)	Output power		Separation distances (mm)						Calculated Threshold Value					
			dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front
WLAN Main	WiFi	2412	14.50	28	0	102.9	0	86.9	282		8.7	> 50 mm	8.7	> 50 mm	> 50 mm	N/A
WLAN Main	WiFi	5180	15.00	32	0	102.9	0	86.9	282		14.6	> 50 mm	14.6	> 50 mm	> 50 mm	N/A
WLAN Main	WiFi	5260	15.00	32	0	102.9	0	86.9	282		14.7	> 50 mm	14.7	> 50 mm	> 50 mm	N/A
WLAN Main	WiFi	5500	15.00	32	0	102.9	0	86.9	282		15.0	> 50 mm	15.0	> 50 mm	> 50 mm	N/A
WLAN Main	WiFi	5745	15.00	32	0	102.9	0	86.9	282		15.3	> 50 mm	15.3	> 50 mm	> 50 mm	N/A
Bluetooth / WiFi - Aux Antenna																
WLAN Aux	WiFi	2412	15.50	35	0	102.9	282	88.2	0		10.9	> 50 mm	> 50 mm	> 50 mm	10.9	N/A
WLAN Aux	WiFi	5180	15.00	32	0	102.9	282	88.2	0		14.6	> 50 mm	> 50 mm	> 50 mm	14.6	N/A
WLAN Aux	WiFi	5260	15.00	32	0	102.9	282	88.2	0		14.7	> 50 mm	> 50 mm	> 50 mm	14.7	N/A
WLAN Aux	WiFi	5500	15.00	32	0	102.9	282	88.2	0		15.0	> 50 mm	> 50 mm	> 50 mm	15.0	N/A
WLAN Aux	WiFi	5745	15.00	32	0	102.9	282	88.2	0		15.3	> 50 mm	> 50 mm	> 50 mm	15.3	N/A
WLAN Aux	Bluetooth	2402	7.50	6	0	102.9	282	88.2	0		1.9	> 50 mm	> 50 mm	> 50 mm	1.9	N/A

Corners and edge tilted

Antenna	Tx	Frequency (MHz)	Output power		Separation distances (mm)						Calculated Threshold Value					
			dBm	mW	Edge 2 tilt	Corner 1	Corner 2	Corner 3	Corner 4	Front	Edge 2 tilt	Corner 1	Corner 2	Corner 3	Corner 4	Front
WLAN Main	WiFi	2412	14.50	28	0	281	84	50	272		8.7	> 50 mm	> 50 mm	0.9	> 50 mm	N/A
WLAN Main	WiFi	5180	15.00	32	0	281	84	50	272		14.6	> 50 mm	> 50 mm	1.5	> 50 mm	N/A
WLAN Main	WiFi	5260	15.00	32	0	281	84	50	272		14.7	> 50 mm	> 50 mm	1.5	> 50 mm	N/A
WLAN Main	WiFi	5500	15.00	32	0	281	84	50	272		15.0	> 50 mm	> 50 mm	1.5	> 50 mm	N/A
WLAN Main	WiFi	5745	15.00	32	0	281	84	50	272		15.3	> 50 mm	> 50 mm	1.5	> 50 mm	N/A
Bluetooth / WiFi - Aux Antenna																
WLAN Aux	WiFi	2412	15.50	35	0	84	281	272	51		10.9	> 50 mm	> 50 mm	> 50 mm	> 50 mm	N/A
WLAN Aux	WiFi	5180	15.00	32	0	84	281	272	51		14.6	> 50 mm	> 50 mm	> 50 mm	> 50 mm	N/A
WLAN Aux	WiFi	5260	15.00	32	0	84	281	272	51		14.7	> 50 mm	> 50 mm	> 50 mm	> 50 mm	N/A
WLAN Aux	WiFi	5500	15.00	32	0	84	281	272	51		15.0	> 50 mm	> 50 mm	> 50 mm	> 50 mm	N/A
WLAN Aux	WiFi	5745	15.00	32	0	84	281	272	51		15.3	> 50 mm	> 50 mm	> 50 mm	> 50 mm	N/A
WLAN Aux	Bluetooth	2402	7.50	6	0	84	281	272	51		1.9	> 50 mm	> 50 mm	> 50 mm	> 50 mm	N/A

Note(s):

1. According to KDB 447498, if the calculated threshold value is >3 then SAR testing is required.
2. SAR exclusion was not assessed for 2 Tx (MIMO) as the higher 1 Tx (SISO) SAR values were used for simultaneous transmission analysis.

12.1.2. SAR exclusion calculations for Wi-Fi SISO (1 Tx) and Bluetooth for antenna >50mm from the user

Edges and rear

Antenna	Tx	Frequency (MHz)	Output power		Separation distances (mm)						Calculated Threshold Value (mW)					
			dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front
WiFi - Main Antenna																
WLAN Main	WiFi	2412	14.50	28	0	102.9	0	86.9	282		< 50 mm	625.6	< 50 mm	465.6	2416.6	N/A
WLAN Main	WiFi	5180	15.00	32	0	102.9	0	86.9	282		< 50 mm	594.9	< 50 mm	434.9	2385.9	N/A
WLAN Main	WiFi	5260	15.00	32	0	102.9	0	86.9	282		< 50 mm	594.4	< 50 mm	434.4	2385.4	N/A
WLAN Main	WiFi	5500	15.00	32	0	102.9	0	86.9	282		< 50 mm	593.0	< 50 mm	433.0	2384.0	N/A
WLAN Main	WiFi	5745	15.00	32	0	102.9	0	86.9	282		< 50 mm	591.6	< 50 mm	431.6	2382.6	N/A
Bluetooth / WiFi - Aux Antenna																
WLAN Aux	WiFi	2412	15.00	32	0	102.9	282	88.2	0		< 50 mm	625.6	2416.6	478.6	< 50 mm	N/A
WLAN Aux	WiFi	5180	15.00	32	0	102.9	282	88.2	0		< 50 mm	594.9	2385.9	447.9	< 50 mm	N/A
WLAN Aux	WiFi	5260	15.00	32	0	102.9	282	88.2	0		< 50 mm	594.4	2385.4	447.4	< 50 mm	N/A
WLAN Aux	WiFi	5500	15.00	32	0	102.9	282	88.2	0		< 50 mm	593.0	2384.0	446.0	< 50 mm	N/A
WLAN Aux	WiFi	5745	15.00	32	0	102.9	282	88.2	0		< 50 mm	591.6	2382.6	444.6	< 50 mm	N/A
WLAN Aux	Bluetooth	2402	7.50	6	0	102.9	282	88.2	0		< 50 mm	625.8	2416.8	478.8	< 50 mm	N/A

Corners and edge tilted

Antenna	Tx	Frequency (MHz)	Output power		Separation distances (mm)						Calculated Threshold Value (mW)					
			dBm	mW	Edge 2 tilt	Corner 1	Corner 2	Corner 3	Corner 4	Front	Edge 2 tilt	Corner 1	Corner 2	Corner 3	Corner 4	Front
WLAN Main	WiFi	2412	14.50	28	0	281	88	50	272		< 50 mm	2406.6	476.6	< 50 mm	2316.6	N/A
WLAN Main	WiFi	5180	15.00	32	0	281	88	50	272		< 50 mm	2375.9	445.9	< 50 mm	2285.9	N/A
WLAN Main	WiFi	5260	15.00	32	0	281	88	50	272		< 50 mm	2375.4	445.4	< 50 mm	2285.4	N/A
WLAN Main	WiFi	5500	15.00	32	0	281	88	50	272		< 50 mm	2374.0	444.0	< 50 mm	2284.0	N/A
WLAN Main	WiFi	5745	15.00	32	0	281	88	50	272		< 50 mm	2372.6	442.6	< 50 mm	2282.6	N/A
Bluetooth / WiFi - Aux Antenna																
WLAN Aux	WiFi	2412	15.50	35	0	88	281	272	51		< 50 mm	476.6	2406.6	2316.6	106.6	N/A
WLAN Aux	WiFi	5180	15.00	32	0	88	281	272	51		< 50 mm	445.9	2375.9	2285.9	75.9	N/A
WLAN Aux	WiFi	5260	15.00	32	0	88	281	272	51		< 50 mm	445.4	2375.4	2285.4	75.4	N/A
WLAN Aux	WiFi	5500	15.00	32	0	88	281	272	51		< 50 mm	444.0	2374.0	2284.0	74.0	N/A
WLAN Aux	WiFi	5745	15.00	32	0	88	281	272	51		< 50 mm	442.6	2372.6	2282.6	72.6	N/A
WLAN Aux	Bluetooth	2402	7.50	6	0	88	281	272	51		< 50 mm	476.8	2406.8	2316.8	106.8	N/A

Note(s):

1. According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required.
2. SAR exclusion was not assessed for 2 Tx (MIMO) as the higher 1 Tx (SISO) SAR values were used for simultaneous transmission analysis

Conclusion:

- As the calculated Power Threshold is greater than the DUT output power for Edge1, 3 and 4 for the main antenna and for Edge 1, 3 and 4 for the aux antenna SAR testing is not required for these configurations
- As the calculated Power Threshold is greater than the DUT output power for Corner 1, 2, 3 and 4 for the main antenna and for Corner 1, 2, 3 and 4 for the aux antenna SAR testing is not required for these configurations

12.2. Estimated SAR for Simultaneous Transmission SAR Analysis

Considerations for using estimated SAR values:

1. According to KDB 447498 § 4.1.5 if the antenna is at close proximity to user then the outer surface of the DUT should be treated as the radiating surface. The test separation distance is then determined by the smallest distance between the outer surface of the device and the user. For the purposes of this report close proximity has been defined as closer than 50 mm. For antennas <50 mm from the rear or edge the separation distance used for the estimated SAR calculations is 0mm.
2. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.
3. Output power is the maximum rated power (including tune-up or manufacturing tolerances) and includes source-based averaging.
4. If the antenna separation distance is > 50mm then the estimated SAR value is 0.4 W/Kg.
5. Formulas round separation distance to nearest mm and power to nearest mW before calculating estimated SAR

12.2.1. Estimated SAR for Wi-Fi 1 Tx (SISO)

Edges and rear

Antenna	Tx	Frequency (MHz)	Output power		Separation distances (mm)							Calculated Threshold Value					
			dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	
WiFi - Main Antenna																	
WLAN Main	WiFi	2412	14.50	28	0	102.9	0	86.9	282		Measure	0.400	Measure	0.400	>200 mm	N/A	
WLAN Main	WiFi	5180	15.00	32	0	102.9	0	86.9	282		Measure	0.400	Measure	0.400	>200 mm	N/A	
WLAN Main	WiFi	5260	15.00	32	0	102.9	0	86.9	282		Measure	0.400	Measure	0.400	>200 mm	N/A	
WLAN Main	WiFi	5500	15.00	32	0	102.9	0	86.9	282		Measure	0.400	Measure	0.400	>200 mm	N/A	
WLAN Main	WiFi	5745	15.00	32	0	102.9	0	86.9	282		Measure	0.400	Measure	0.400	>200 mm	N/A	
Bluetooth / WiFi - Aux Antenna																	
WLAN Aux	WiFi	2412	15.50	35	0	102.9	282	88.2	0		Measure	0.400	>200 mm	0.400	Measure	N/A	
WLAN Aux	WiFi	5180	15.00	32	0	102.9	282	88.2	0		Measure	0.400	>200 mm	0.400	Measure	N/A	
WLAN Aux	WiFi	5260	15.00	32	0	102.9	282	88.2	0		Measure	0.400	>200 mm	0.400	Measure	N/A	
WLAN Aux	WiFi	5500	15.00	32	0	102.9	282	88.2	0		Measure	0.400	>200 mm	0.400	Measure	N/A	
WLAN Aux	WiFi	5745	15.00	32	0	102.9	282	88.2	0		Measure	0.400	>200 mm	0.400	Measure	N/A	
WLAN Aux	Bluetooth	2402	7.50	6	0	102.9	282	88.2	0		0.248	0.400	>200 mm	0.400	0.248	N/A	

Corners and the edge 2 or 4 tilted

Antenna	Tx	Frequency (MHz)	Output power		Separation distances (mm)						Calculated Threshold Value					
			dBm	mW	Edge 2 tilt	Corner 1	Corner 2	Corner 3	Corner 4	Front	Edge 2 tilt	Corner 1	Corner 2	Corner 3	Corner 4	Front
WiFi - Main Antenna																
WLAN Main	WiFi	2412	14.50	28	0	281	88	50	272		Measure	>200 mm	0.400	0.116	>200 mm	N/A
WLAN Main	WiFi	5180	15.00	32	0	281	88	50	272		Measure	>200 mm	0.400	0.194	>200 mm	N/A
WLAN Main	WiFi	5260	15.00	32	0	281	88	50	272		Measure	>200 mm	0.400	0.196	>200 mm	N/A
WLAN Main	WiFi	5500	15.00	32	0	281	88	50	272		Measure	>200 mm	0.400	0.200	>200 mm	N/A
WLAN Main	WiFi	5745	15.00	32	0	281	88	50	272		Measure	>200 mm	0.400	0.205	>200 mm	N/A
Bluetooth / WiFi - Aux Antenna					Edge 4 tilt	Corner 1	Corner 2	Corner 3	Corner 4	Front	Edge 4 tilt	Corner 1	Corner 2	Corner 3	Corner 4	Front
WLAN Aux	WiFi	2412	15.50	35	0	88	281	272	51		Measure	0.400	>200 mm	>200 mm	0.400	N/A
WLAN Aux	WiFi	5180	15.00	32	0	88	281	272	51		Measure	0.400	>200 mm	>200 mm	0.400	N/A
WLAN Aux	WiFi	5260	15.00	32	0	88	281	272	51		Measure	0.400	>200 mm	>200 mm	0.400	N/A
WLAN Aux	WiFi	5500	15.00	32	0	88	281	272	51		Measure	0.400	>200 mm	>200 mm	0.400	N/A
WLAN Aux	WiFi	5745	15.00	32	0	88	281	272	51		Measure	0.400	>200 mm	>200 mm	0.400	N/A
WLAN Aux	Bluetooth	2402	7.50	6	0	88	281	272	51		0.248	0.400	>200 mm	>200 mm	0.400	N/A

Notes:

1. Estimated SAR for 2 Tx (MIMO) was not assessed as the higher 1 Tx (SISO) SAR values were used for simultaneous transmission analysis.
2. As Simultaneous Transmission SAR of the DUT was compliant under the higher power conditions of Wi-Fi 1 Tx, it was judged that such analyses would be unnecessary for Wi-Fi 2 Tx (MIMO), given the substantially lower MIMO power levels and considerable separation distance between WLAN Main and the WLAN Auxiliary antennas.
3. Wherever appropriate, Wi-Fi 1 Tx (SISO) SAR values were used to represent those of Wi-Fi 2 Tx (MIMO); if compliance can be shown with the more conservative Wi-Fi 1 Tx values, then there is no need to perform separate assessment for Wi-Fi 2 Tx.

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4. For separation distances >200 mm the estimated SAR value of 0.4 is much too conservative. Simultaneous transmission analysis for these conditions was done in accordance with KDB 447498 §7.2: *Transmitters used in mobile exposure conditions for simultaneous transmission operations.*

12.3. Wi-Fi 2.4 GHz Band

Main Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11b	0	2	2417	14.50	14.5				1
			6	2437	14.50	14.5	0.006	0.006		
			10	2457	14.50	14.5				1
Edge 2	802.11b	0	2	2417	14.50	14.5				1
			6	2437	14.50	14.5	0.083	0.083		
			10	2457	14.50	14.5				1
Edge 2 Tilt	802.11b	0	2	2417	14.50	14.5				
			6	2437	14.50	14.5	0.096	0.096	1	
			10	2457	14.50	14.5				

Note(s):

- According to KDB 447498, 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.

Auxiliary Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11b	0	2	2417	15.0	15.0				
			6	2437	15.0	15.0	0.017	0.017		
			10	2457	15.0	15.0				
Edge 4	802.11b	0	2	2417	15.0	15.0				
			6	2437	15.0	15.0	0.097	0.097		
			10	2457	15.0	15.0				
Edge 4 Tilt	802.11b	0	2	2417	15.0	15.0				
			6	2437	15.0	15.0	0.104	0.104		
			10	2457	15.0	15.0				

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11g	0	2	2417	15.5	15.4				
			6	2437	15.5	15.4	0.025	0.025		
			10	2457	15.5	15.5				
Edge 4	802.11g	0	2	2417	15.5	15.4				
			6	2437	15.5	15.4	0.094	0.096		
			10	2457	15.5	15.5				
Edge 4 Tilt	802.11g	0	2	2417	15.5	15.4				
			6	2437	15.5	15.4	0.107	0.109	2	
			10	2457	15.5	15.5				

Note(s):

- According to KDB 447498, 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.

12.4. Wi-Fi 5.2 GHz Band

Main Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11a	0	40	5200	15.0	14.9	0.034	0.035		
			48	5240	15.0	14.9				
Edge 2	802.11a	0	40	5200	15.0	14.9	0.431	0.441		
			48	5240	15.0	14.9	0.452	0.463	3	
Edge 2 Tilt	802.11a	0	40	5200	15.0	14.9				
			48	5240	15.0	14.9	0.336	0.344		

Auxiliary Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11a	0	40	5200	15.0	15.0	0.012	0.012		
			48	5240	15.0	15.0				
Edge 4	802.11a	0	40	5200	15.0	15.0	0.266	0.269	4	
			48	5240	15.0	15.0				
Edge 4 Tilt	802.11a	0	40	5200	15.0	15.0				
			48	5240	15.0	15.0	0.092	0.092		

Note(s):

According to KDB 447498 D01 General RF Exposure Guidance v05, 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.

1. ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
2. ≤ 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
3. ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

12.5. Wi-Fi 5.3 GHz Band

Main Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11a	0	52	5260	15.0	14.9				
			60	5300	15.0	14.9	0.034	0.035		
Edge 2	802.11a	0	52	5260	15.0	14.9	0.475	0.492		
			60	5300	15.0	14.9	0.503	0.519	5	
Edge 2 Tilt	802.11a	0	52	5260	15.0	14.9	0.380	0.389		
			60	5300	15.0	14.9				

Auxiliary Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11a	0	56	5280	15.0	15.0				
			60	5300	15.0	15.0	0.0003	0.0003		
Edge 4	802.11a	0	56	5280	15.0	15.0				
			60	5300	15.0	15.0	0.151	0.151	6	
Edge 4 Tilt	802.11a	0	56	5280	15.0	15.0				
			60	5300	15.0	15.0	0.101	0.101		

Note(s):

According to KDB 447498 D01 General RF Exposure Guidance v05, 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.

1. ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
2. ≤ 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
3. ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

12.6. Wi-Fi 5.5 GHz Band

Main Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11a	0	104	5520	15.0	15.0	0.039	0.039		
			116	5580	15.0	14.9				
			124	5620	15.0	14.9				
			136	5680	15.0	14.9				
Edge 2	802.11a	0	104	5520	15.0	15.0	0.659	0.659	7	
			116	5580	15.0	14.9	0.540	0.553		
			124	5620	15.0	14.9	0.545	0.558		
			136	5680	15.0	14.9	0.588	0.602		
Edge 2 Tilt	802.11a	0	104	5520	15.0	15.0	0.586	0.586		
			116	5580	15.0	14.9	0.409	0.419		
			124	5620	15.0	14.9	0.405	0.414		
			136	5680	15.0	14.9	0.448	0.458		

Auxiliary Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11a	0	104	5520	15.0	15.0				
			116	5580	15.0	15.0	0.0002	0.0002		
			124	5620	15.0	15.0				
			136	5680	15.0	14.9				
Edge 4	802.11a	0	104	5520	15.0	15.0				
			116	5580	15.0	15.0	0.242	0.242	8	
			124	5620	15.0	15.0				
			136	5680	15.0	14.9				
Edge 4 Tilt	802.11a	0	104	5520	15.0	15.0				
			116	5580	15.0	15.0				
			124	5620	15.0	15.0	0.172	0.172		
			136	5680	15.0	14.9				

Note(s):

According to KDB 447498 D01 General RF Exposure Guidance v05, 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.

1. ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
2. ≤ 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
3. ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

12.7. Wi-Fi 5.8 GHz Band

Main Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11a	0	149	5745	15.0	15.0	0.030	0.030		
			157	5785	15.0	14.8				
			165	5825	15.0	15.0				
Edge 2	802.11a	0	149	5745	15.0	15.0				
			157	5785	15.0	14.8	0.374	0.392	9	
			165	5825	15.0	15.0				
Edge 2 Tilt	802.11a	0	149	5745	15.0	15.0				
			157	5785	15.0	14.8				
			165	5825	15.0	15.0	0.256	0.256		

Auxiliary Antenna

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11a	0	149	5745	15.0	15.0	0.0003	0.0003		
			157	5785	15.0	15.0				
			165	5825	15.0	15.0				
Edge 4	802.11a	0	149	5745	15.0	15.0				
			157	5785	15.0	15.0	0.136	0.136	10	
			165	5825	15.0	15.0				
Edge 4 Tilt	802.11a	0	149	5745	15.0	15.0				
			157	5785	15.0	15.0	0.099	0.099		
			161	5825	15.0	15.0				

Note(s):

According to KDB 447498 D01 General RF Exposure Guidance v05, 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.

1. ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
2. ≤ 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
3. ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

12.8. Summary of Highest SAR Values

Results for the highest measured SAR values in each frequency band and mode

Technology/ Band	Test configuration			Mode	Dist. (mm)	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)
	Transmit Antenna	Exposure	Position					
Wi-Fi 2.4 GHz	Auxiliary	Body	Edge 2 Tilt	802.11g	0	2437	15.4	0.107
Wi-Fi 5.2 GHz	Main	Body	Edge 2	802.11a	0	5240	14.9	0.452
Wi-Fi 5.3 GHz	Main	Body	Edge 2	802.11a	0	5300	14.9	0.503
Wi-Fi 5.5 GHz	Main	Body	Edge 2	802.11a	0	5520	15.0	0.659
Wi-Fi 5.8 GHz	Main	Body	Edge 2	802.11a	0	5785	14.8	0.374

12.9. SAR Measurement Variability and Uncertainty

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz v01. 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 ($\sim 10\%$ 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 .

No measured values exceeded 0.8 W/kg. Additional measurements are not required.

13. Simultaneous Transmission SAR Analysis

13.1. Rear

Test Position	WiFi 5 GHz Main	WiFi 5 GHz Aux	Bluetooth	Σ 1-g SAR (mW/g)
Rear, 2.4 GHz	0.006	0.025		0.031
	0.006		0.248	0.254
Rear, 5.2 GHz	0.035	0.012		0.047
	0.035		0.248	0.283
Rear, 5.3 GHz	0.035	0.0003		0.035
	0.035		0.248	0.283
Rear, 5.5 GHz	0.039	0.0002		0.039
	0.039		0.248	0.287
Rear, 5.8 GHz	0.030	0.0003		0.030
	0.030		0.248	0.278

13.2. Edge 1 and Edge 3

As there are only estimated SAR values for Edge 1 or Edge 3 the sum of the estimated SAR cannot exceed 0.8W/kg.

13.3. Edge 2 and Edge 4

The WLAN aux antenna is 281 mm from edge 2 and can be treated as mobile for simultaneous transmission analysis.

The WLAN main antenna is 281 mm from edge 4 and can be treated as mobile for simultaneous transmission analysis.

According to KDB 447498 §7.2 simultaneous transmission evaluations can be excluded when:

The $[\Sigma \text{ of (the highest measured or estimated SAR for each standalone antenna configuration, adjusted for maximum tune-up tolerance)} / 1.6 \text{ W/kg}] + [\Sigma \text{ of MPE ratios}] \leq 1.0$.

13.3.1. MPE calculations for the WLAN main and aux antennas

Main Antenna at edge 4

Mode	Frequency (MHz)	Output power (dBm)	Gain (dBi)	Duty Cycle	EIRP (mW)	Distance (cm)	Power density (mW/cm ²)	FCC Limit (mW/cm ²)	% of limit
WLAN	2400	14.5	0.86	100%	34.4	28.1	0.0035	1.00	0.35%
	5250	15.0	0.17	100%	32.9	28.1	0.0033	1.00	0.33%
	5600	15.0	-0.25	100%	29.9	28.1	0.0030	1.00	0.30%
	5800	15.0	-0.25	100%	29.9	28.1	0.0030	1.00	0.30%

MPE ratio compared to the MPE limit is 0.004

Aux Antenna at edge 2

Mode	Frequency (MHz)	Output power (dBm)	Gain (dBi)	Duty Cycle	EIRP (mW)	Distance (cm)	Power density (mW/cm ²)	FCC Limit (mW/cm ²)	% of limit
WLAN	2400	15.5	2.93	100%	69.7	28.1	0.0070	1.00	0.70%
	5250	15.0	3.57	100%	71.9	28.1	0.0073	1.00	0.73%
	5600	15.0	3.55	100%	71.6	28.1	0.0072	1.00	0.72%
	5800	15.0	3.33	100%	68.1	28.1	0.0069	1.00	0.69%

MPE ratio compared to the MPE limit is 0.007

13.3.2. Edge 2 Simultaneous Transmission analysis

The maximum reported SAR for edge 2 is 0.659W/kg (WLAN main antenna)

The maximum MPE of the WLAN aux antenna at edge 2 is 0.007

$0.659/1.6 + 0.007 = 0.419$ which is ≤ 1.0

13.3.1. Edge 4 Simultaneous Transmission analysis

The maximum reported SAR for edge 4 is 0.269W/kg (WLAN aux antenna)

The maximum MPE of the WLAN main antenna at edge 4 is 0.003

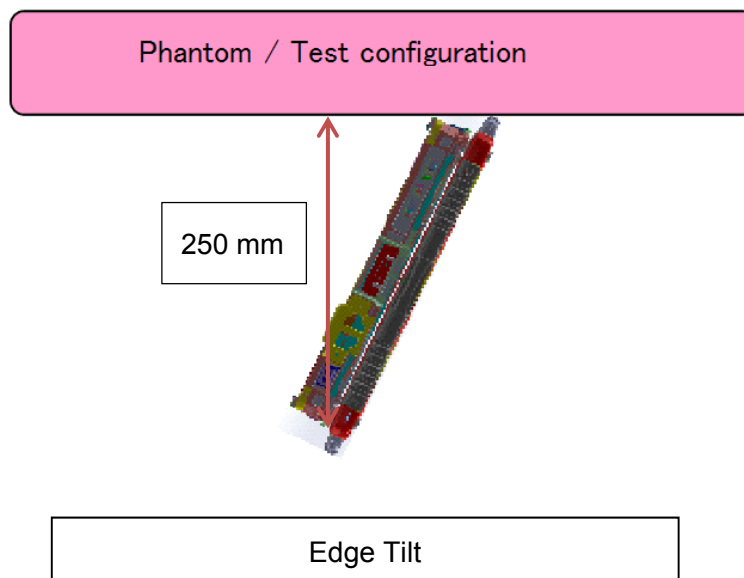
$0.269/1.6 + 0.004 = 0.172$ which is ≤ 1.0

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because either the sum of the 1-g SAR is < 1.6 W/kg or the sum of the ratios of the SAR and MPE ≤ 1.0 .

13.4. Edge 2 tilt and Edge 4 tilt

When tested in the tilt position the antennas on the opposite edge are closer to the phantom than when the DUT is vertical.



250 mm was used as the separation distance when calculating the MPE when the DUT was tilted.

13.4.1. MPE calculations for the WLAN main and aux antennas

Main Antenna at edge 4 tilt

Mode	Frequency (MHz)	Output power (dBm)	Gain (dBi)	Duty Cycle	EIRP (mW)	Distance (cm)	Power density (mW/cm ²)	FCC Limit (mW/cm ²)	% of limit
WLAN	2400	14.5	0.86	100%	34.4	25	0.0044	1.00	0.44%
	5250	15.0	0.17	100%	32.9	25	0.0042	1.00	0.42%
	5600	15.0	-0.25	100%	29.9	25	0.0038	1.00	0.38%
	5800	15.0	-0.25	100%	29.9	25	0.0038	1.00	0.38%

MPE ratio compared to the MPE limit is 0.004

Aux Antenna at edge 2 tilt

Mode	Frequency (MHz)	Output power (dBm)	Gain (dBi)	Duty Cycle	EIRP (mW)	Distance (cm)	Power density (mW/cm ²)	FCC Limit (mW/cm ²)	% of limit
WLAN	2400	15.5	2.93	100%	69.7	25	0.0089	1.00	0.89%
	5250	15.0	3.57	100%	71.9	25	0.0092	1.00	0.92%
	5600	15.0	3.55	100%	71.6	25	0.0091	1.00	0.91%
	5800	15.0	3.33	100%	68.1	25	0.0087	1.00	0.87%

MPE ratio compared to the MPE limit is 0.009

13.4.2. Edge 2 Tilt Simultaneous Transmission analysis

The maximum reported SAR for edge 2 tilt is 0.586 W/kg (WLAN main antenna)

The maximum MPE of the WLAN aux antenna at edge 2 is 0.007

$0.586/1.6 + 0.009 = 0.375$ which is ≤ 1.0

13.4.3. Edge 4 Tilt Simultaneous Transmission analysis

The maximum reported SAR for edge 4 tilt is 0.172 W/kg (WLAN aux antenna)

The maximum MPE of the WLAN main antenna at edge 4 is 0.003

$0.172/1.6 + 0.004 = 0.112$ which is ≤ 1.0

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because either the sum of the 1-g SAR is < 1.6 W/kg or the sum of the ratios of the SAR and MPE ≤ 1.0 .

14. Appendixes

Refer to separated files for the following appendixes.

- 14.1. System Performance Check Plots
- 14.2. SAR Test Plots
- 14.3. Calibration Certificate for E-Field Probe EX3DV4 - SN 3773
- 14.4. Calibration Certificate for E-Field Probe EX3DV4 - SN 3772
- 14.5. Calibration Certificate for D2450V2 - SN 899
- 14.6. Calibration Certificate for D5GHzV2 - SN 1138