



**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 FZ-G1)**

Model: WL12A

FCC ID: ACJ9TGWL12A

Report Number: 12J14673-1F

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Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	1/29/2013	Initial Issue	--
A	1/31/2013	Section 1.1 – corrected 2.4GHz result from 1.17 to 1.19	
B	2/14/2013	<ul style="list-style-type: none"> - Section 8 – Revised table for determination of required test configurations. - Section 11 and 12 – Added liquid and system check information required to support additional testing. - Section 13 – Additional testing results for Bluetooth and Wi-Fi 5 GHz bands at Edge 4 - Section 15 – Amended simultaneous transmission tables to account for the Edge 4 test position. - Section 19 – Added Edge 4 test setup photo. - Updated contents in the appendixes. 	Ray Su
C	2/18/2013	Added and replaced edge test results with values measured during retest, and updated all related plots and supporting information accordingly.	Ray Su
D	2/21/2013	Purged previous rear side test results obtained from testing under the SAM phantom and replaced with values measured under the ELI phantom. All associated plots, supporting documents and other analyses have been updated accordingly.	Ray Su
E	2/26/2013	<ul style="list-style-type: none"> - Section 7.2 – Modified table for consistent usage of terms. - Section 8 – Split tables to distinguish between test exclusion considerations for above and below 50 mm. - Section 9 – Added column to tables in order to identify the surfaces and edges requiring SAR evaluation. - Section 13 – Inserted new content to Section 13.2, which is now used for documenting the estimated SAR values wherever standalone SAR test exclusion applies. 	Ray Su
F	3/1/2013	<ul style="list-style-type: none"> - Removed information and language inconsistent or no longer required by current KDBs in various sections. This includes statement on Z-Scans and the uncertainty budget. - Section 7 – Revised duty factor with newly measured values. - Section 8 – Replaced original tables with simplified versions. - Section 11 and 12 – New liquid and system check information in support for additional testing performed. - Section 13 – Added new test results, and inserted/relocated tables originally from Section 8 and 14 for SAR test exclusion and estimated SAR values, respectively. - Section 14 – Revised tables to allow for more comprehensive simultaneous transmission analysis, and updated values in accordance with changes that have taken place in other sections. 	Ray Su

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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 FZ-G1)
Model	WL12A
Test device is	An identical prototype
Device category	Portable
Exposure category	General Population/Uncontrolled Exposure
Date tested	1/4/2013 – 2/28/2013

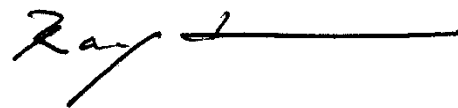
Applicable Standards	Test Results
Published RF exposure KDB procedures, TCB workshop updates and OET Bulletin 65 Supplement C, IEEE Std 1528-2003 and IEEE Std 1528a-2005	Pass

UL CCS 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 CCS 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS 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 CCS By:

Tested By:

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 Program Manager
 UL CCS

Ray Su
 SAR Engineer
 UL CCS

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: 1.19 W/kg (Edge 4)	1.6 W/kg
15.407	5150-5250 MHz	Body: 0.797 W/kg (Edge 3)	
	5250-5350 MHz	Body: 1.14 W/kg (Edge 3)	
	5500-5700 MHz	Body: 1.1 W/kg (Edge 3)	
15.247	5725-5850 MHz	Body: 0.754 W/kg (Edge 3)	
Simultaneous Transmission Condition		1.26 W/kg (refer to Section 14.3.) (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:

- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01
- 865664 D02 SAR Reporting v01
- 447498 D01 General RF Exposure Guidance v05
- 248227 D01 SAR Meas for 802 11abg v01r02

3. Facilities and Accreditation

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

UL CCS 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.

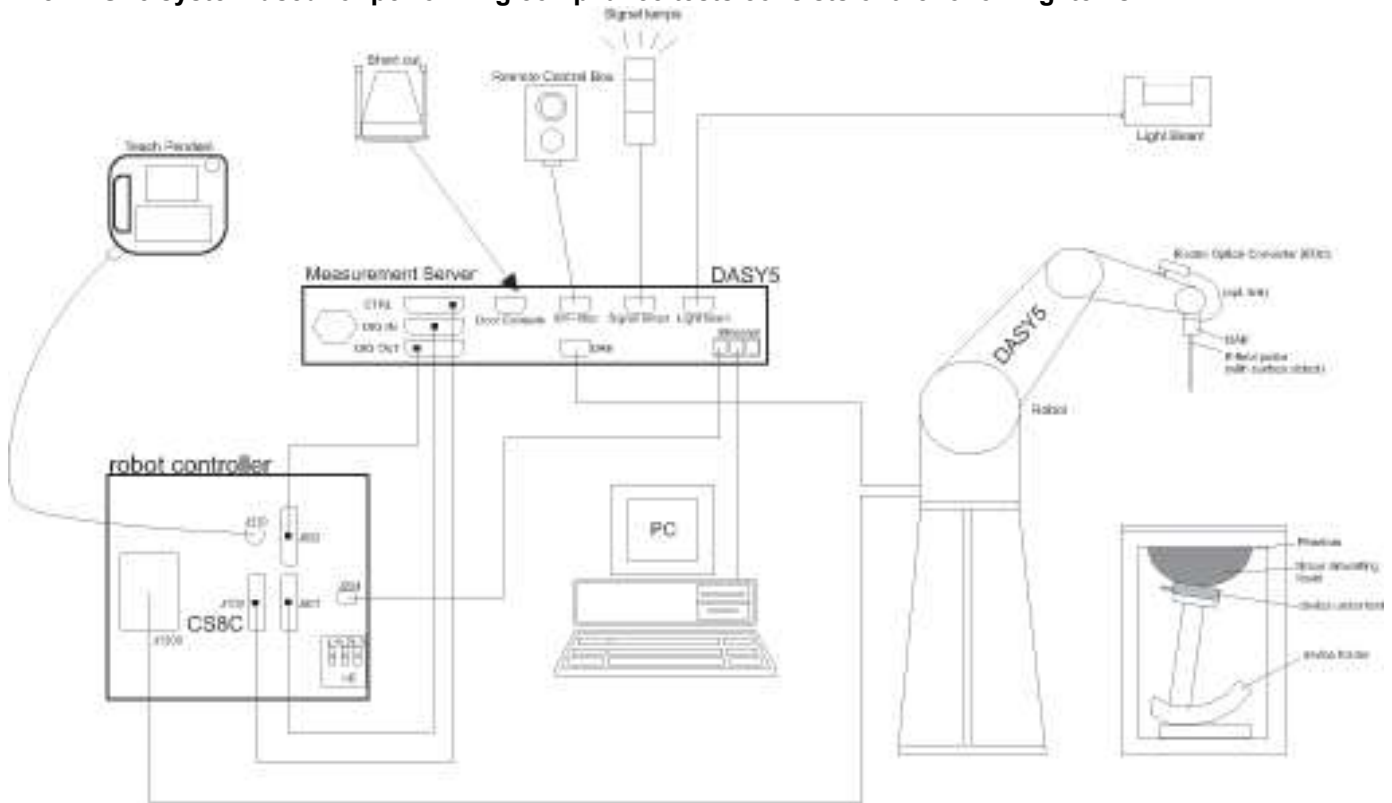
Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due date		
				MM	DD	Year
S-Parameter Network Analyzer	Agilent	8753ES	MY40001647	6	27	2013
Dielectronic Probe kit	SPEAG	SM DAK 040 CA	1082	9	18	2013
Dielectronic Probe kit	HP	85070E	594	N/A		
Synthesized Signal Generator	HP	8665B	3438A00633	2	22	2013
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	5	3	2013
Power Meter	HP	438A	2822A05684	10	7	2013
Power Sensor A	HP	8481A	2702A66876	8	1	2013
Power Sensor B	HP	8482A	2349A08568	4	14	2013
Amplifier	MITEQ	4D00400600-50-30P	1620606	N/A		
Directional coupler	Werlatone	C8060-102	2141	N/A		
Thermometer	ERTCO	639-1S	8350	7	30	2013
E-Field Probe	SPEAG	EX3DV4	3686	2	16	2013
E-Field Probe	SPEAG	EX3DV4	3885	10	9	2013
E-Field Probe	SPEAG	EX3DV4	3773	3	14	2013
E-Field Probe	SPEAG	EX3DV4	3751	11	15	2013
Data Acquisition Electronics	SPEAG	DAE4	1239	6	6	2013
Data Acquisition Electronics	SPEAG	DAE4	1352	10	8	2013
Data Acquisition Electronics	SPEAG	DAE4	1259	2	13	2013
System Validation Dipole	SPEAG	D2450V2	706	4	11	2013
System Validation Dipole	SPEAG	D2450V2	899	10	5	2013
System Validation Dipole	SPEAG	D5GHzV2	1003	9	18	2013
System Validation Dipole	SPEAG	D5GHzV2	1138	10	9	2013
Power Meter	R & S	NRP	100673	5	5	2013
Power Sensor	R & S	NRP - Z23	100168	5	5	2013
Power Meter	Agilent	N1912A	MY52310061	7	5	2013
Power Sensor Ch A	Agilent	N1921A	MY52260009	7	5	2013
Power Sensor Ch B	Agilent	N1921A	MY52270022	7	21	2013
Power Meter	Agilent	N1912A	MY50001018	8	10	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	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5 \text{ mm}$
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

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

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

		≤ 3 GHz	> 3 GHz	
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$		≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*	
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm	
	graded grid	$\Delta z_{Zoom}(1)$: between 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
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z	≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm	
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the <i>reported</i> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Step 4: Power drift measurement

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

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

Intel Centrino Advanced-N 6235 (Tested inside of Panasonic Tablet PC FZ-G1) Model: WL12A	
Operating Configuration(s)	<ul style="list-style-type: none"> Tablet Mode
Exposure Condition(s)	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> None

7.1. Band and Air Interfaces

Tx Frequency Bands	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 802.11a/b/g/n : BPSK, QPSK, CCK, 16-QAM and 64-QAM Bluetooth 4.0+LE: GFSK, DQPSK, 8-DPSK
Duty Cycle	<ul style="list-style-type: none"> 802.11b: 98.9% 802.11g: 97.7% 802.11a: 98.3% 802.11n: Not assessed <p>Note: Given the close proximity of the measured duty factors to 100%, scaling to compensate for duty factor was found to have no impact on the measured SAR results and therefore not performed.</p>

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 either of the WLAN bands.
3. Bluetooth cannot transmit simultaneously with the WLAN Aux Antenna, in either of the WLAN bands; this also precludes the transmission of Bluetooth when WLAN is in MIMO mode.
4. With a maximum output power of **4.47 mW** (6.5 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 15 “Simultaneous Transmission SAR Analysis”** of this report.

8. Exposure Conditions

Refer to Section 18 “Antenna Dimensions 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	13mm	Yes	
Front	-	No	SAR is not required as this is not a typical use scenario
Edge 1	32mm	Yes	
Edge 2	265.5mm	No	Refer to section 13 for SAR exclusion justification
Edge 3	139mm	No	Refer to section 13 for SAR exclusion justification
Edge 4	5mm	Yes	

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

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	13mm	Yes	
Front	-	No	SAR is not required as this is not a typical use scenario
Edge 1	184.5mm	Yes	Refer to section 13 for SAR exclusion justification
Edge 2	228.3mm	Yes	Refer to section 13 for SAR exclusion justification
Edge 3	5mm	No	
Edge 4	23.7mm	No	

LEGEND:

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

9. Summary of Required Test Modes

9.1. Wi-Fi 2.4 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power from Original Approval (dBm)		Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/Edges requiring SAR evaluation		
				Main	Aux	Main	Aux				
802.11b	1 Tx	1	2412	16.8		12.0		Yes	Bottom, Edge 1, Edge 4		
		6	2437	16.8		14.5					
		11	2462	16.8		11.5					
		802.11g	1 Tx	1	2412		16.6		12.0	Yes	Bottom, Edge 3, Edge 4
				6	2437		15.0		15.0		
				11	2462		16.0		11.5		
802.11n HT20	1 Tx	1	2412	14.1		12.0		Yes	Bottom, Edge 1, Edge 4		
		6	2437	16.6		14.5					
		11	2462	14.0		11.5					
		802.11n HT20	1 Tx	1	2412		13.9		12.0	Yes	Bottom, Edge 3, Edge 4
				6	2437		16.7		15.5		
				11	2462		13.5		11.5		
802.11n HT20	2 Tx	1	2412	11.6	11.6	11.5	11.5	Yes	Covered by testing in 802.11b/g		
		6	2437	13.3	13.0	12.5	12.5				
		11	2462	11.1	10.4	10.5	10.4				
		802.11n HT40	1 Tx	3	2422	10.6		10.6		No	N/A
				6	2437	13.6		13.6			
				9	2450	10.1		10.1			
802.11n HT40	2 Tx	3	2422		9.2		9.2	No	N/A		
		6	2437		12.7		12.7				
		9	2450		10.1		10.1				
802.11n HT40	2 Tx	3	2422	7.3	7.0	7.3	7.0	No	N/A		
		6	2437	12.3	12.3	12.3	12.3				
		9	2450	6.5	6.7	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.

9.2. Wi-Fi 5.2 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power from Original Approval (dBm)		Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/ Edges requiring SAR evaluation		
				Main	Aux	Main	Aux				
802.11a	1 Tx	36	5180	16.2		13.0		Yes	Bottom, Edge 1, Edge 4		
		40	5200	16.2		15.0					
		44	5220								
		48	5240	15.9		15.0					
				36	5180		15.9		13.0	Yes	Bottom, Edge 3, Edge 4
				40	5200		15.8		15.0		
				44	5220						
				48	5240		15.7		15.0		
802.11n HT20	1 Tx	36	5180	15.9		13.0		No	N/A		
		40	5200	16.5		15.0					
		44	5220								
		48	5240	16.4		15.0					
				36	5180		16.0		14.0	No	N/A
				40	5200		16.0		15.0		
				44	5220						
				48	5240		15.9		15.0		
802.11n HT20	2 Tx	36	5180	13.3	13.3	12.0	12.0	Yes	Coverd by testing in 802.11a		
		40	5200	12.2	13.2	12.0	12.0				
		48	5240	13.0	12.9	12.0	12.0				
802.11n HT40	1 Tx	38	5190	12.8		12.8		No	N/A		
		46	5230	16.4		14.5					
				38	5190		12.7		12.7	No	N/A
				46	5230		15.8		14.5		
802.11n HT40	2 Tx	38	5190	10.0	10.8	10.0	10.8	No	N/A		
		46	5230	13.4	13.3	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.

9.3. Wi-Fi 5.3 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power from Original Approval (dBm)		Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/ Edges requiring SAR evaluation		
				Main	Aux	Main	Aux				
802.11a	1 Tx	52	5260	15.9		15.0		Yes	Bottom, Edge 1, Edge 4		
		56	5280								
		60	5300	16.3		15.0					
				64	5320	16.4		14.5		Yes	Bottom, Edge 3, Edge 4
		52	5260		15.3		15.0				
		56	5280								
		60	5300		15.4		15.0				
		64	5320		15.9		14.5				
802.11n HT20	1 Tx	52	5260	16.1		15.0		No	N/A		
		60	5300	16.6		15.0					
		64	5320	16.6		14.5					
				52	5260		15.4		15.0	No	N/A
				60	5300		15.3		15.0		
				64	5320		15.7		14.5		
802.11n HT20	2 Tx	52	5260	12.7	12.5	12.0	12.0	Yes	Covered by testing in 802.11a		
		60	5300	13.2	12.6	12.0	12.0				
		64	5320	12.9	13.1	12.0	12.0				
802.11n HT40	1 Tx	54	5270	16.0		15.0		No	N/A		
		62	5310	11.5		11.5					
				54	5270		15.2		15.0	No	N/A
				62	5310		12.4		12.4		
802.11n HT40	2 Tx	54	5270	12.6	12.5	12.0	12.0	No	N/A		
		62	5310	12.4	12.3	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.

9.4. Wi-Fi 5.5 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power from Original Approval (dBm)		Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/ Edges requiring SAR evaluation
				Main	Aux	Main	Aux		
802.11a	1 Tx	100	5500	16.4		15.0		Yes	Bottom, Edge 1, Edge 4
		104	5520						
		108	5540						
		112	5560						
		116	5580	16.5		15.0			
		120	5600						
		124	5620						
		128	5640						
		132	5660						
		136	5680						
		140	5700	16.5		15.0			
		100	5500			15.6	15.0		
		104	5520						
		108	5540						
112	5560								
802.11a	1 Tx	116	5580		15.7	15.0		Yes	Bottom, Edge 3, Edge 4
		120	5600						
		124	5620						
		128	5640						
		132	5660						
		136	5680						
		140	5700		15.5		15.0		
802.11n HT20	1 Tx	100	5500	16.4		15.0		No	N/A
		116	5580	16.4		15.0			
		140	5700	16.3		15.0			
		100	5500		15.6		15.0	No	N/A
		116	5580		15.7		15.0		
		140	5700		15.5		15.0		
802.11n HT20	2 Tx	100	5500	12.7	13.2	12.5	12.5	Yes	Covered by testing in 802.11a
		120	5600	12.7	13.2	12.5	12.5		
		140	5700	12.4	12.4	12.4	12.4		
802.11n HT40	1 Tx	102	5510	15.5		13.5		No	N/A
		110	5550	16.5		15.0			
		134	5670	16.4		15.0			
		102	5510		14.8		13.5	No	N/A
		110	5550		15.8		15.0		
		134	5670		15.6		15.0		
802.11n HT40	2 Tx	102	5510	13.1	13.0	11.5	11.5	No	N/A
		110	5550	13.1	13.2	12.5	12.5		
		134	5670	12.6	12.8	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.

9.5. Wi-Fi 5.8 GHz Band

Mode	Number of Transmitters	Ch. #	Freq. (MHz)	Maximum Target Power from Original Approval (dBm)		Maximum Target Power for Host Approval (dBm)		SAR Test (Yes/No)	Surfaces/ Edges requiring SAR evaluation
				Main	Aux	Main	Aux		
802.11a	1 Tx	149	5745	16.5		15.0		Yes	Bottom, Edge 1, Edge 4
		153	5765						
		157	5785	16.5		15.0			
		161	5805						
		165	5825	16.5		15.0			
	1 Tx	149	5745		16.7		15.0	Yes	Bottom, Edge 3, Edge 4
		153	5765						
		157	5785		16.7		15.0		
		161	5805						
		165	5825		16.6		14.5		
802.11n HT20	1 Tx	149	5745	16.6		15.0		No	N/A
		157	5785	16.6		15.0			
		165	5825	16.5		15.0			
	1 Tx	149	5745		16.7		15.0	No	N/A
		157	5785		16.6		15.0		
		165	5825		16.6		15.0		
802.11n HT20	2 Tx	149	5745	13.6	13.5	12.0	12.0	Yes	Covered by testing in 802.11a
		157	5785	13.5	13.4	12.0	12.0		
		165	5825	13.3	13.7	12.0	12.0		
802.11n HT40	1 Tx	151	5755	16.5		15.0		No	N/A
		159	5795	16.5		15.0			
		151	5755		16.6		15.0	No	N/A
		159	5795		16.6		15.0		
802.11n HT40	2 Tx	151	5755	13.5	13.5	12.0	12.0	No	N/A
		159	5795	13.5	13.5	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.

10. 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		*	
	5.8 GHz	5.660	132		*	
		5.680	136	√		
		5.700	140		*	
		DTS (15.247)	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 ¼ dB ≥ the "default test channels"

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

10.1. Wi-Fi 2.4 GHz Band

Tune-up Tolerance: -1.0 dB / +0 dB

Mode	Number of Transmitters	Ch #	Freq. (MHz)	Target Avg Pwr (dBm)		Measured Avg Pwr (dBm)	
				Main	Aux	Main	Aux
802.11b	1 Tx	1	2412	12.0		11.7	
		6	2437	14.5		14.5	
		11	2462	11.5		11.3	
		1	2412		12.0		11.7
		6	2437		15.0		15.0
		11	2462		11.5		11.5
802.11g	1 Tx	1	2412	12.0		11.8	
		6	2437	14.5		14.2	
		11	2462	11.5		11.5	
		1	2412		12.0		11.7
		6	2437		15.5		15.1
		11	2462		11.5		11.3
802.11n HT20	2 Tx	1	2412	11.5	11.5	11.3	11.5
		6	2437	12.5	12.5	12.2	12.4
		11	2462	10.5	10.4	10.4	10.3

Note(s):

- Per KDB 248227 D01, SAR is not required for 802.11g/HT20 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.
- Cells highlighted in blue under the “Measured Avg Pwr” columns denote:
 - In cases where there are variations between the power of channels within a band, the highest output power channels within the band for the transmit antenna and diversity mode, and are consequently the channels initially selected for SAR evaluation.
 - In cases where there are no variations between the power of channels within a band, the default Required Test Channels as listed in KDB 248227 D01.

10.2. Wi-Fi 5.2 GHz Band

Tune-up Tolerance: -1.0 dB / +0 dB

Mode	Number of Transmitters	Ch #	Freq. (MHz)	Target Avg Pwr (dBm)		Measured Avg Pwr (dBm)	
				Main	Aux	Main	Aux
802.11a	1 Tx	36	5180	13.0		12.9	
		40	5200	15.0		15.0	
		44	5220			15.0	
		48	5240	15.0		14.9	
		36	5180		13.0		12.7
		40	5200		15.0		14.8
		44	5220				14.7
		48	5240		15.0		14.8
802.11n HT20	2 Tx	36	5180	12.0	12.0	11.6	11.7
		40	5200	12.0	12.0	11.8	11.7
		48	5240	12.0	12.0	11.8	11.7

10.3. Wi-Fi 5.3 GHz Band

Tune-up Tolerance: -1.0 dB / +0 dB

Mode	Number of Transmitters	Ch #	Freq. (MHz)	Target Avg Pwr (dBm)		Measured Avg Pwr (dBm)	
				Main	Aux	Main	Aux
802.11a	1 Tx	52	5260	15.0		15.0	
		56	5280			15.0	
		60	5300	15.0		15.0	
		64	5320	14.5		14.5	
		52	5260		15.0		14.8
		56	5280				14.9
		60	5300		15.0		14.8
		64	5320		14.5		14.3
802.11n HT20	2 Tx	52	5260	12.0	12.0	11.7	11.5
		60	5300	12.0	12.0	11.6	11.7
		64	5320	12.0	12.0	11.7	11.8

Note(s):

- Per KDB 248227 D01, SAR is not required for 802.11n/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a channels.
- Cells highlighted in blue under the “Measured Avg Pwr” columns denote:
 - In cases where there are variations between the power of channels within a band, the highest output power channels within the band for the transmit antenna and diversity mode, and are consequently the channels initially selected for SAR evaluation.
 - In cases where there are no variations between the power of channels within a band, the default Required Test Channels as listed in KDB 248227 D01.

10.4. Wi-Fi 5.5 GHz Band

Tune-up Tolerance: -1.0 dB / +0 dB

Mode	Number of Transmitters	Ch #	Freq. (MHz)	Target Avg Pwr (dBm)		Measured Avg Pwr (dBm)	
				Main	Aux	Main	Aux
802.11a	1 Tx	100	5500	15.0		14.9	
		104	5520			14.9	
		108	5540			14.8	
		112	5560			14.6	
		116	5580	15.0		14.8	
		120	5600			14.6	
		124	5620			14.8	
		128	5640			15.0	
		132	5660			15.0	
		136	5680			14.9	
		140	5700	15.0		14.8	
		100	5500		15.0		14.9
		104	5520				14.6
		108	5540				14.6
		112	5560				15.0
		116	5580		15.0		14.7
		120	5600				14.9
		124	5620				14.8
		128	5640				15.0
		132	5660				14.7
136	5680				14.9		
140	5700		15.0		15.0		
802.11n HT20	2 Tx	100	5500	12.5	12.5	12.4	11.7
		120	5600	12.5	12.5	11.9	11.8
		140	5700	12.4	12.4	12.0	12.3

Note(s):

- Per KDB 248227 D01, SAR is not required for 802.11n/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a channels.
- Cells highlighted in blue under the “Measured Avg Pwr” columns denote:
 - In cases where there are variations between the power of channels within a band, the highest output power channels within the band for the transmit antenna and diversity mode, and are consequently the channels initially selected for SAR evaluation.
 - In cases where there are no variations between the power of channels within a band, the default Required Test Channels as listed in KDB 248227 D01.

10.5. Wi-Fi 5.8 GHz Band

Tune-up Tolerance: -1.0 dB / +0 dB

Mode	Number of Transmitters	Ch #	Freq. (MHz)	Target Avg Pwr (dBm)		Measured Avg Pwr (dBm)	
				Main	Aux	Main	Aux
802.11a	1 Tx	149	5745	15.0		14.9	
		153	5765			14.8	
		157	5785	15.0		14.9	
		161	5805			14.9	
		165	5825	15.0		15.0	
		149	5745		15.0		15.0
		153	5765				14.9
		157	5785		15.0		14.9
		161	5805				14.4
		165	5825		14.5		14.5
802.11n HT20	2 Tx	149	5745	12.0	12.0	12.0	11.6
		157	5785	12.0	12.0	11.9	11.7
		165	5825	12.0	12.0	11.9	11.3

Note(s):

- Per KDB 248227 D01, SAR is not required for 802.11n/HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a channels.
- Cells highlighted in blue under the “Measured Avg Pwr” columns denote:
 - In cases where there are variations between the power of channels within a band, the highest output power channels within the band for the transmit antenna and diversity mode, and are consequently the channels initially selected for SAR evaluation.
 - In cases where there are no variations between the power of channels within a band, the default Required Test Channels as listed in KDB 248227 D01.

11. 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

FCC OET Bulletin 65 Supplement C 01-01

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

11.2. Tissue Dielectric Parameter Check Results

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.

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

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

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)		
1/3/2012	Body 5180	e'	47.0900	Relative Permittivity (ϵ_r):	47.09	49.05	-3.99	10	
		e"	18.4800	Conductivity (σ):	5.32	5.27	0.97	5	
	Body 5200	e'	47.1300	Relative Permittivity (ϵ_r):	47.13	49.02	-3.85	10	
		e"	18.5400	Conductivity (σ):	5.36	5.29	1.24	5	
	Body 5600	e'	46.5400	Relative Permittivity (ϵ_r):	46.54	48.48	-4.00	10	
		e"	18.8400	Conductivity (σ):	5.87	5.76	1.83	5	
	Body 5800	e'	46.3500	Relative Permittivity (ϵ_r):	46.35	48.20	-3.84	10	
		e"	19.1100	Conductivity (σ):	6.16	6.00	2.72	5	
	Body 5825	e'	46.2600	Relative Permittivity (ϵ_r):	46.26	48.20	-4.02	10	
		e"	19.0900	Conductivity (σ):	6.18	6.00	3.05	5	
	1/7/2013	Body 5180	e'	47.3200	Relative Permittivity (ϵ_r):	47.32	49.05	-3.52	10
			e"	18.6000	Conductivity (σ):	5.36	5.27	1.63	5
Body 5200		e'	47.2600	Relative Permittivity (ϵ_r):	47.26	49.02	-3.59	10	
		e"	18.6300	Conductivity (σ):	5.39	5.29	1.74	5	
Body 5600		e'	46.6200	Relative Permittivity (ϵ_r):	46.62	48.48	-3.83	10	
		e"	18.9700	Conductivity (σ):	5.91	5.76	2.53	5	
Body 5800		e'	46.3100	Relative Permittivity (ϵ_r):	46.31	48.20	-3.92	10	
		e"	19.1400	Conductivity (σ):	6.17	6.00	2.88	5	
Body 5825		e'	46.2500	Relative Permittivity (ϵ_r):	46.25	48.20	-4.05	10	
		e"	19.1900	Conductivity (σ):	6.22	6.00	3.59	5	
1/11/2013	Body 2450	e'	51.4200	Relative Permittivity (ϵ_r):	51.42	52.70	-2.43	5	
		e"	14.1100	Conductivity (σ):	1.92	1.95	-1.43	5	
	Body 2410	e'	51.5200	Relative Permittivity (ϵ_r):	51.52	52.76	-2.35	5	
		e"	13.9400	Conductivity (σ):	1.87	1.91	-2.07	5	
	Body 2475	e'	51.3900	Relative Permittivity (ϵ_r):	51.39	52.67	-2.43	5	
		e"	14.3300	Conductivity (σ):	1.97	1.99	-0.66	5	
1/14/2013	Body 2450	e'	52.2300	Relative Permittivity (ϵ_r):	52.23	52.70	-0.89	5	
		e"	14.5500	Conductivity (σ):	1.98	1.95	1.65	5	
	Body 2410	e'	52.4000	Relative Permittivity (ϵ_r):	52.40	52.76	-0.68	5	
		e"	14.4600	Conductivity (σ):	1.94	1.91	1.58	5	
	Body 2475	e'	52.1600	Relative Permittivity (ϵ_r):	52.16	52.67	-0.97	5	
		e"	14.7300	Conductivity (σ):	2.03	1.99	2.11	5	

Tissue Dielectric Parameter Check Results (continued)

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)		
1/15/2013	Body 5180	e'	47.7300	Relative Permittivity (ϵ_r):	47.73	49.05	-2.68	10	
		e''	18.1200	Conductivity (σ):	5.22	5.27	-0.99	5	
	Body 5200	e'	47.6900	Relative Permittivity (ϵ_r):	47.69	49.02	-2.71	10	
		e''	18.1400	Conductivity (σ):	5.24	5.29	-0.94	5	
	Body 5600	e'	47.0600	Relative Permittivity (ϵ_r):	47.06	48.48	-2.92	10	
		e''	18.5400	Conductivity (σ):	5.77	5.76	0.21	5	
	Body 5800	e'	46.7400	Relative Permittivity (ϵ_r):	46.74	48.20	-3.03	10	
		e''	18.7800	Conductivity (σ):	6.06	6.00	0.94	5	
	Body 5825	e'	46.7100	Relative Permittivity (ϵ_r):	46.71	48.20	-3.09	10	
		e''	18.8000	Conductivity (σ):	6.09	6.00	1.48	5	
	1/16/2013	Body 2450	e'	50.7000	Relative Permittivity (ϵ_r):	50.70	52.70	-3.80	5
			e''	14.4700	Conductivity (σ):	1.97	1.95	1.09	5
Body 2410		e'	50.8000	Relative Permittivity (ϵ_r):	50.80	52.76	-3.71	5	
		e''	14.3100	Conductivity (σ):	1.92	1.91	0.53	5	
Body 2475		e'	50.6000	Relative Permittivity (ϵ_r):	50.60	52.67	-3.93	5	
		e''	14.4800	Conductivity (σ):	1.99	1.99	0.38	5	
1/23/2013	Body 2450	e'	53.0900	Relative Permittivity (ϵ_r):	53.09	52.70	0.74	5	
		e''	14.3800	Conductivity (σ):	1.96	1.95	0.46	5	
	Body 2410	e'	53.2200	Relative Permittivity (ϵ_r):	53.22	52.76	0.87	5	
		e''	14.2900	Conductivity (σ):	1.91	1.91	0.39	5	
	Body 2475	e'	52.9900	Relative Permittivity (ϵ_r):	52.99	52.67	0.61	5	
		e''	14.3900	Conductivity (σ):	1.98	1.99	-0.24	5	
2/13/2013	Body 5180	e'	49.4600	Relative Permittivity (ϵ_r):	49.46	49.05	0.84	10	
		e''	17.5100	Conductivity (σ):	5.04	5.27	-4.33	5	
	Body 5200	e'	49.4100	Relative Permittivity (ϵ_r):	49.41	49.02	0.80	10	
		e''	17.5100	Conductivity (σ):	5.06	5.29	-4.38	5	
	Body 5600	e'	48.8800	Relative Permittivity (ϵ_r):	48.88	48.48	0.83	10	
		e''	17.8500	Conductivity (σ):	5.56	5.76	-3.52	5	
	Body 5800	e'	48.6500	Relative Permittivity (ϵ_r):	48.65	48.20	0.93	10	
		e''	18.0400	Conductivity (σ):	5.82	6.00	-3.04	5	
	Body 5825	e'	48.6200	Relative Permittivity (ϵ_r):	48.62	48.20	0.87	10	
		e''	18.0400	Conductivity (σ):	5.84	6.00	-2.62	5	
	2/14/2013	Body 2450	e'	50.5000	Relative Permittivity (ϵ_r):	50.50	52.70	-4.17	5
			e''	14.4600	Conductivity (σ):	1.97	1.95	1.02	5
Body 2410		e'	50.6500	Relative Permittivity (ϵ_r):	50.65	52.76	-4.00	5	
		e''	14.3200	Conductivity (σ):	1.92	1.91	0.60	5	
Body 2475		e'	50.4400	Relative Permittivity (ϵ_r):	50.44	52.67	-4.23	5	
		e''	14.5400	Conductivity (σ):	2.00	1.99	0.80	5	
2/19/2013	Body 5180	e'	48.2600	Relative Permittivity (ϵ_r):	48.26	49.05	-1.60	10	
		e''	18.5300	Conductivity (σ):	5.34	5.27	1.25	5	
	Body 5200	e'	48.2200	Relative Permittivity (ϵ_r):	48.22	49.02	-1.63	10	
		e''	18.5500	Conductivity (σ):	5.36	5.29	1.30	5	
	Body 5600	e'	47.6000	Relative Permittivity (ϵ_r):	47.60	48.48	-1.81	10	
		e''	19.0000	Conductivity (σ):	5.92	5.76	2.69	5	
	Body 5800	e'	47.2000	Relative Permittivity (ϵ_r):	47.20	48.20	-2.07	10	
		e''	19.2000	Conductivity (σ):	6.19	6.00	3.20	5	
	Body 5825	e'	47.1800	Relative Permittivity (ϵ_r):	47.18	48.20	-2.12	10	
		e''	19.2200	Conductivity (σ):	6.23	6.00	3.75	5	

Tissue Dielectric Parameter Check Results (continued)

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)	
2/28/2013	Body 2450	e'	51.1300	Relative Permittivity (ϵ_r):	51.13	52.70	-2.98	5
		e"	14.0200	Conductivity (σ):	1.91	1.95	-2.06	5
	Body 2410	e'	51.2500	Relative Permittivity (ϵ_r):	51.25	52.76	-2.86	5
		e"	13.8600	Conductivity (σ):	1.86	1.91	-2.63	5
	Body 2475	e'	51.0300	Relative Permittivity (ϵ_r):	51.03	52.67	-3.11	5
		e"	14.1100	Conductivity (σ):	1.94	1.99	-2.18	5

12. 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.

12.1. 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.

12.2. Reference SAR Values for System Performance Check

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

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (mW/g)		
				1g/10g	Head	Body
D2450V2	706	4/11/2012	2450	1g	51.2	49.6
				10g	23.9	23.4
D2450V2	899	10/5/12	2450	1g	53.6	51.7
				10g	25.0	24.3
D5GHV2	1003	9/18/2012	5.2GHz	1g	76.5	74.8
				10g	21.9	20.9
			5.6GHz	1g	82.8	79.0
				10g	23.6	22.0
			5.8GHz	1g	76.9	77.0
				10g	22.0	21.4
D5GHV2	1138	10/9/2012	5.2GHz	1g	79.5	73.2
				10g	22.8	20.4
			5.5 GHz	1g	83.6	77.9
				10g	23.8	21.7
			5.8GHz	1g	78.7	72.8
				10g	22.4	20.1

12.3. 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./Zoom Ratio ±3 %	
	Type	Serial #		Area Scan	Zoom Scan	Normalize to 1 W				
1/3/2013	D5GHzV2 5.2 GHz	1138	Body	1g	7.02	7.70	77.0	73.2	5.19	-9.69
				10g	2.01	2.18	21.8	20.4	6.86	
1/3/2013	D5GHzV2 5.6 GHz	1138	Body	1g	7.73	8.34	83.4	77.9	7.06	-7.89
				10g	2.10	2.31	23.1	21.7	6.45	
1/3/2013	D5GHzV2 5.8 GHz	1138	Body	1g	7.07	7.89	78.9	72.8	8.38	-11.60
				10g	1.97	2.20	22.0	20.1	9.45	
1/7/2013	D5GHzV2 5.2 GHz	1138	Body	1g	6.87	7.44	74.4	73.2	1.64	-8.30
				10g	1.93	2.11	21.1	20.4	3.43	
1/7/2013	D5GHzV2 5.6 GHz	1138	Body	1g	7.19	7.87	78.7	77.9	1.03	-9.46
				10g	2.00	2.18	21.8	21.7	0.46	
1/7/2013	D5GHzV2 5.8 GHz	1138	Body	1g	6.31	7.09	70.9	72.8	-2.61	-12.36
				10g	1.76	1.96	19.6	20.1	-2.49	
1/11/2013	D2450V2	706	Body	1g	5.11	5.05	50.5	49.6	1.81	1.17
				10g	2.21	2.28	22.8	23.4	-2.56	
1/14/2013	D2450V2	706	Body	1g	5.17	5.18	51.8	49.6	4.44	-0.19
				10g	2.22	2.39	23.9	23.4	2.14	
1/15/2013	D5GHzV2 5.2 GHz	1003	Body	1g	7.30	7.81	78.1	74.8	4.41	-6.99
				10g	1.99	2.19	21.9	20.9	4.78	
1/15/2013	D5GHzV2 5.6 GHz	1003	Body	1g	6.54	7.54	75.4	79.0	-4.56	-15.29
				10g	1.80	2.07	20.7	22.0	-5.91	
1/15/2013	D5GHzV2 5.8 GHz	1003	Body	1g	6.04	7.04	70.4	77.0	-8.57	-16.56
				10g	1.66	1.98	19.8	21.4	-7.48	
1/15/2013	D5GHzV2 5.2 GHz	1003	Body	1g	7.22	7.56	75.6	74.8	1.07	-4.71
				10g	1.98	2.14	21.4	20.9	2.39	
1/15/2013	D5GHzV2 5.6 GHz	1003	Body	1g	8.58	8.06	80.6	79.0	2.03	6.06
				10g	2.30	2.24	22.4	22.0	1.82	
1/15/2013	D5GHzV2 5.8 GHz	1003	Body	1g	8.44	7.52	75.2	77.0	-2.34	10.90
				10g	2.27	2.09	20.9	21.4	-2.34	
1/16/2013	D2450V2	706	Body	1g	5.09	5.08	50.8	49.6	2.42	0.20
				10g	2.20	2.36	23.6	23.4	0.85	
1/24/2013	D2450V2	706	Body	1g	4.99	5.07	50.7	49.6	2.22	-1.60
				10g	2.13	2.34	23.4	23.4	0.00	
2/13/2013	D5GHzV2 5.2 GHz	1138	Body	1g	7.23	7.61	76.1	73.2	3.96	-5.26
				10g	1.98	2.15	21.5	20.4	5.39	
2/13/2013	D5GHzV2 5.6 GHz	1138	Body	1g	7.74	7.97	79.7	77.9	2.31	-2.97
				10g	2.07	2.21	22.1	21.7	1.84	
2/13/2013	D5GHzV2 5.8 GHz	1138	Body	1g	6.77	7.09	70.9	72.8	-2.61	-4.73
				10g	1.82	1.97	19.7	20.1	-1.99	
2/14/2013	D2450V2	899	Body	1g	5.35	5.38	53.8	51.7	4.06	-0.56
				10g	2.31	2.48	24.8	24.3	2.06	
2/20/2013	D2450V2	899	Body	1g	5.19	5.24	52.4	51.7	1.35	-0.96
				10g	2.26	2.43	24.3	24.3	0.00	

System Performance Check Results continued

Date Tested	System Dipole		T.S. Liquid	Measured Results			Target (Ref. Value)	Delta ±10 %	Est./Zoom Ratio ±3 %	
	Type	Serial #		Area Scan	Zoom Scan	Normalize to 1 W				
2/19/2013	D5GHzV2 5.2 GHz	1003	Body	1g	6.69	7.02	70.2	74.8	-6.15	-4.93
				10g	1.82	1.98	19.8	20.9	-5.26	
2/19/2013	D5GHzV2 5.6 GHz	1003	Body	1g	7.33	7.80	78.0	79.0	-1.27	-6.41
				10g	1.95	2.15	21.5	22.0	-2.27	
2/19/2013	D5GHzV2 5.8 GHz	1003	Body	1g	6.72	7.31	73.1	77.0	-5.06	-8.78
				10g	1.81	2.03	20.3	21.4	-5.14	
2/28/2013	D2450V2	706	Body	1g	5.27	5.33	53.3	49.6	7.46	-1.14
				10g	2.29	2.46	24.6	23.4	5.13	

13. SAR Test Results

13.1. Standalone SAR Test Exclusion Considerations

Standalone SAR test exclusion was based upon the following criteria:

1. If the antenna to DUT edge or bottom separation distance is < 50mm a distance of 5mm is used to determine SAR exclusion and estimated SAR value
2. If the antenna to DUT edge or bottom separation distance is >50 the actual antenna to user separation distance is used to determine SAR exclusion and estimated SAR value
3. 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.
4. Despite its qualifications for test exclusion on all surfaces and edges, SAR measurement was performed for Bluetooth at Edge 4 because the estimated value at this edge was deemed overly conservative

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

Antenna	Tx	Frequency (MHz)	Output power ^{Note 2, 4}		Separation distances (mm) ^{Note 1 and 4}						Calculated Threshold Value					
			dBm	mW	Bottom	Edge 1	Edge 2	Edge 3	Edge 4	Front	Bottom	Edge 1	Edge 2	Edge 3	Edge 4	Front
WiFi - Main Antenna																
WLAN Main	WiFi	2412	14.50	28	5	5	265.5	139	5		8.7	8.7	> 50 mm	> 50 mm	8.7	N/A
WLAN Main	WiFi	5180	15.00	32	5	5	265.5	139	5		14.6	14.6	> 50 mm	> 50 mm	14.6	N/A
WLAN Main	WiFi	5260	15.00	32	5	5	265.5	139	5		14.7	14.7	> 50 mm	> 50 mm	14.7	N/A
WLAN Main	WiFi	5500	15.00	32	5	5	265.5	139	5		15.0	15.0	> 50 mm	> 50 mm	15.0	N/A
WLAN Main	WiFi	5745	15.00	32	5	5	265.5	139	5		15.3	15.3	> 50 mm	> 50 mm	15.3	N/A
Bluetooth / WiFi - Aux Antenna																
WLAN Aux	WiFi	2412	15.50	35	5	184.5	228.3	5	5		10.9	> 50 mm	> 50 mm	10.9	10.9	N/A
WLAN Aux	WiFi	5180	15.00	32	5	184.5	228.3	5	5		14.6	> 50 mm	> 50 mm	14.6	14.6	N/A
WLAN Aux	WiFi	5260	15.00	32	5	184.5	228.3	5	5		14.7	> 50 mm	> 50 mm	14.7	14.7	N/A
WLAN Aux	WiFi	5500	15.00	32	5	184.5	228.3	5	5		15.0	> 50 mm	> 50 mm	15.0	15.0	N/A
WLAN Aux	WiFi	5745	15.00	32	5	184.5	228.3	5	5		15.3	> 50 mm	> 50 mm	15.3	15.3	N/A
WLAN Aux	Bluetooth	2402	6.50	4	5	184.5	228.3	5	5		0.2	> 50 mm	> 50 mm	0.2	0.2	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.

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

Antenna	Tx	Frequency (MHz)	Output power		Separation distances (mm)						Power Threshold					
			dBm	mW	Bottom	Edge 1	Edge 2	Edge 3	Edge 4	Front	Bottom	Edge 1	Edge 2	Edge 3	Edge 4	Front
WiFi - Main Antenna																
WLAN Main	WiFi	2412	14.50	28	5	5	265.5	139	5		< 50 mm	< 50 mm	2252	987	< 50 mm	N/A
WLAN Main	WiFi	5180	15.00	32	5	5	265.5	139	5		< 50 mm	< 50 mm	2221	956	< 50 mm	N/A
WLAN Main	WiFi	5260	15.00	32	5	5	265.5	139	5		< 50 mm	< 50 mm	2220	955	< 50 mm	N/A
WLAN Main	WiFi	5500	15.00	32	5	5	265.5	139	5		< 50 mm	< 50 mm	2219	954	< 50 mm	N/A
WLAN Main	WiFi	5745	15.00	32	5	5	265.5	139	5		< 50 mm	< 50 mm	2218	953	< 50 mm	N/A
Bluetooth / WiFi - Aux Antenna																
WLAN Aux	WiFi	2412	15.00	32	5	184.5	228.3	5	5		< 50 mm	1442	1880	< 50 mm	< 50 mm	N/A
WLAN Aux	WiFi	5180	15.00	32	5	184.5	228.3	5	5		< 50 mm	1411	1849	< 50 mm	< 50 mm	N/A
WLAN Aux	WiFi	5260	15.00	32	5	184.5	228.3	5	5		< 50 mm	1410	1848	< 50 mm	< 50 mm	N/A
WLAN Aux	WiFi	5500	15.00	32	5	184.5	228.3	5	5		< 50 mm	1409	1847	< 50 mm	< 50 mm	N/A
WLAN Aux	WiFi	5745	15.00	32	5	184.5	228.3	5	5		< 50 mm	1408	1846	< 50 mm	< 50 mm	N/A
WLAN Aux	Bluetooth	2402	6.50	4	5	184.5	228.3	5	5		< 50 mm	1442	1880	< 50 mm	< 50 mm	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

13.2. Estimated SAR for Simultaneous Transmission SAR Analysis

Considerations for using estimated SAR values:

1. If the antenna to DUT surface separation distance is < 50mm a distance of 5mm is used to determine SAR estimated SAR value.
2. If the antenna to DUT surface separation distance is >50 the actual antenna to user separation distance is used to determine SAR estimated SAR value.
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 the lesser of the estimated value at 50mm or 0.4 W/Kg.
5. Formulas round separation distance to nearest mm and power to nearest mW before calculating estimated SAR

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

Antenna	Tx	Frequency (MHz)	Output power ^{Note 2, 4}		Separation distances (mm) ^{Note 1 and 4}						Estimated SAR Value ^{Note 3 and 4}					
			dBm	mW	Bottom	Edge 1	Edge 2	Edge 3	Edge 4	Front	Bottom	Edge 1	Edge 2	Edge 3	Edge 4	Front
WLAN Main	WiFi	2412	14.50	28	5	5	265.5	139	5		Measure	Measure	0.116	0.116	Measure	N/A
WLAN Main	WiFi	5180	15.00	32	5	5	265.5	139	5		Measure	Measure	0.194	0.194	Measure	N/A
WLAN Main	WiFi	5260	15.00	32	5	5	265.5	139	5		Measure	Measure	0.196	0.196	Measure	N/A
WLAN Main	WiFi	5500	15.00	32	5	5	265.5	139	5		Measure	Measure	0.200	0.200	Measure	N/A
WLAN Main	WiFi	5745	15.00	32	5	5	265.5	139	5		Measure	Measure	0.205	0.205	Measure	N/A
Bluetooth / WiFi - Aux Antenna																
WLAN Aux	WiFi	2412	15.50	35	5	184.5	228.3	5	5		Measure	0.145	0.145	Measure	Measure	N/A
WLAN Aux	WiFi	5180	15.00	32	5	184.5	228.3	5	5		Measure	0.194	0.194	Measure	Measure	N/A
WLAN Aux	WiFi	5260	15.00	32	5	184.5	228.3	5	5		Measure	0.196	0.196	Measure	Measure	N/A
WLAN Aux	WiFi	5500	15.00	32	5	184.5	228.3	5	5		Measure	0.200	0.200	Measure	Measure	N/A
WLAN Aux	WiFi	5745	15.00	32	5	184.5	228.3	5	5		Measure	0.205	0.205	Measure	Measure	N/A
WLAN Aux	Bluetooth	2402	6.50	4	5	184.5	228.3	5	5		0.165	0.017	0.017	0.165	0.165	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. Situations that comprised only estimated values (i.e. edge 2) are not reported as they are inherently compliant. The maximum SAR value based on two estimated values would be 0.8 W/Kg, well below the highest stand-alone SAR value for Edges 3 and 4 and therefore not the most conservative exposure condition for simultaneous transmission analysis
3. 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.
4. 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.

13.3. Bluetooth

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Edge 4	802.15	0	39	2441	6.5	6.5	0.0089	0.0089	1	1

Note(s):

1. 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.
2. Although testing was not required due to the estimated SAR being less than 0.4 it was performed to support simultaneous transmission analysis of co-located antennas in associated products.

13.4. 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	1	2412	12.00	11.7				1
			6	2437	14.50	14.5	0.186	0.186	1	
			11	2462	11.50	11.3				1
	802.11g	0	1	2412	12.00	11.8				1
			6	2437	14.50	14.2	0.183	0.196	2	
			11	2462	11.50	11.5				1
Edge 1	802.11b	0	1	2412	12.00	11.7				1
			6	2437	14.50	14.5	0.081	0.081	3	
			11	2462	11.50	11.3				1
	802.11g	0	1	2412	12.00	11.8				1
			6	2437	14.50	14.2	0.078	0.084	4	
			11	2462	11.50	11.5				1
Edge 4	802.11b	0	1	2412	12.00	11.7	0.598	0.641	5	
			6	2437	14.50	14.5	1.080	1.080	6	
			11	2462	11.50	11.3	0.461	0.483	7	
	802.11g	0	1	2412	12.00	11.8	0.585	0.613	8	
			6	2437	14.50	14.2	1.020	1.093	9	
			11	2462	11.50	11.5	0.479	0.479	10	

Note(s):

1. 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.

Wi-Fi 2.4 GHz Band continued

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	1	2412	12.00	11.7				1
			6	2437	15.00	15.0	0.040	0.040	11	
			11	2462	11.50	11.5				1
	802.11g	0	1	2412	12.00	11.7				1
			6	2437	15.50	15.1	0.057	0.062	12	
			11	2462	11.50	11.3				1
Edge 3	802.11b	0	1	2412	12.00	11.7				1
			6	2437	15.00	15.0	0.280	0.280	13	
			11	2462	11.50	11.5				1
	802.11g	0	1	2412	12.00	11.7				1
			6	2437	15.50	15.1	0.381	0.418	14	
			11	2462	11.50	11.3				1
Edge 4	802.11b	0	1	2412	12.00	11.7				1
			6	2437	15.00	15.0	0.086	0.086	15	
			11	2462	11.50	11.5				1
	802.11g	0	1	2412	12.00	11.7				1
			6	2437	15.50	15.1	0.115	0.126	16	
			11	2462	11.50	11.3				1

Note(s):

1. 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.

13.5. 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	15.00	15.0	0.136	0.136	1	
			44	5220	15.00	15.0	0.123	0.123	2	
Edge 1	802.11a	0	40	5200	15.00	15.0	0.058	0.058	3	
			44	5220	15.00	15.0	0.061	0.061	4	
Edge 4	802.11a	0	40	5200	15.00	15.0	0.674	0.674	5	
			44	5220	15.00	15.0	0.797	0.797	6	

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	15.00	14.8	0.108	0.113	7	
			48	5240	15.00	14.8	0.142	0.149	8	
Edge 3	802.11a	0	40	5200	15.00	14.8	0.360	0.377	9	
			48	5240	15.00	14.8	0.520	0.545	10	
Edge 4	802.11a	0	40	5200	15.00	14.8	0.039	0.041	11	
			48	5240	15.00	14.8	0.054	0.057	12	

Note(s):

13.6. 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	15.00	15.0	0.206	0.206	13	
			60	5300	15.00	15.0	0.201	0.201	14	
Edge 1	802.11a	0	52	5260	15.00	15.0	0.107	0.107	15	
			60	5300	15.00	15.0	0.138	0.138	16	
Edge 4	802.11a	0	52	5260	15.00	15.0	1.010	1.010	17	
			60	5300	15.00	15.0	1.140	1.140	18	

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	15.00	14.9	0.220	0.225	19	
			60	5300	15.00	14.8	0.243	0.254	20	
Edge 3	802.11a	0	56	5280	15.00	14.9	0.821	0.840	21	
			60	5300	15.00	14.8	0.896	0.938	22	
Edge 4	802.11a	0	56	5280	15.00	14.9	0.099	0.101	23	
			60	5300	15.00	14.8	0.118	0.124	24	

Note(s):

13.7. 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	15.00	14.9	0.134	0.137	25	
			116	5580	15.00	14.8	0.210	0.220	26	
			124	5620	15.00	14.8	0.159	0.166	27	
			132	5660	15.00	15.0	0.118	0.118	28	
Edge 1	802.11a	0	104	5520	15.00	14.9	0.080	0.082	29	
			116	5580	15.00	14.8	0.059	0.062	30	
			124	5620	15.00	14.8	0.038	0.040	31	
			132	5660	15.00	15.0	0.007	0.007	32	
Edge 4	802.11a	0	104	5520	15.00	14.9	0.648	0.663	33	
			116	5580	15.00	14.8	1.050	1.099	34	
			124	5620	15.00	14.8	0.805	0.843	35	
			132	5660	15.00	15.0	0.543	0.543	36	

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	100	5500	15.00	14.9	0.137	0.140	37	
			112	5560	15.00	15.0	0.229	0.229	38	
			128	5640	15.00	15.0	0.116	0.116	39	
			140	5700	15.00	15.0	0.087	0.087	40	
Edge 3	802.11a	0	100	5500	15.00	14.9	0.565	0.578	41	
			112	5560	15.00	15.0	1.030	1.030	42	
			128	5640	15.00	15.0	0.533	0.533	43	
			140	5700	15.00	15.0	0.376	0.376	44	
Edge 4	802.11a	0	100	5500	15.00	14.9	0.052	0.053	45	
			112	5560	15.00	15.0	0.094	0.094	46	
			128	5640	15.00	15.0	0.034	0.034	47	
			140	5700	15.00	15.0	0.027	0.027	48	

Note(s):

13.8. 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	15.00	14.9	0.081	0.083	49	
			157	5785	15.00	14.9	0.084	0.086	50	
			165	5825	15.00	15.0	0.090	0.090	51	
Edge 1	802.11a	0	149	5745	15.00	14.9	0.025	0.026	52	
			157	5785	15.00	14.9	0.037	0.038	53	
			165	5825	15.00	15.0	0.021	0.021	54	
Edge 4	802.11a	0	149	5745	15.00	14.9	0.324	0.332	55	
			157	5785	15.00	14.9	0.354	0.362	56	
			165	5825	15.00	15.0	0.414	0.414	57	

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	15.00	15.0	0.123	0.123	58	
			157	5785	15.00	14.9	0.145	0.148	59	
			165	5825	14.50	14.5	0.116	0.116	60	
Edge 3	802.11a	0	149	5745	15.00	15.0	0.578	0.578	61	
			157	5785	15.00	14.9	0.737	0.754	62	
			165	5825	14.50	14.5	0.551	0.551	63	
Edge 4	802.11a	0	149	5745	15.00	15.0	0.040	0.040	64	
			157	5785	15.00	14.9	0.042	0.043	65	
			165	5825	14.50	14.5	0.043	0.043	66	

Note(s):

13.9. 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	Main	Body	Edge 4	802.11b 1Mbps	0	2437	14.5	1.08
Wi-Fi 5.2 GHz	Main	Body	Edge 4	802.11a 6Mbps	0	5220	15.0	0.795
Wi-Fi 5.3 GHz	Auxiliary	Body	Edge 3	802.11a 6Mbps	0	5300	14.8	1.14
Wi-Fi 5.5 GHz	Auxiliary	Body	Edge 3	802.11a 6Mbps	0	5560	15.0	1.05
Wi-Fi 5.8 GHz	Auxiliary	Body	Edge 3	802.11a 6Mbps	0	5785	14.9	0.737

13.10. 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 (~ 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.

Wireless Technologies	Test Configuration			Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio	Plot No.
	Transmit Antenna	Exposure	Position					Original	Repeated		
Wi-Fi 2.4 GHz	Main	Body	Edge 3	802.11b 1 Mbps	0	6	2437	1.08	1.06	1.02	1
Wi-Fi 5.2 GHz	Main	Body	Edge 4	802.11a 6 Mbps	0	44	5220	0.797	0.795	1.00	2
Wi-Fi 5.3 GHz	Main	Body	Edge 4	802.11a 6 Mbps	0	60	5300	1.19	1.14	1.04	3
Wi-Fi 5.5 GHz	Main	Body	Edge 4	802.11a 6 Mbps	0	112	5560	1.05	1.00	1.05	4
Wi-Fi 5.8 GHz	Auxiliary	Body	Edge 4	802.11a 6 Mbps	0	157	5785	0.737	0.723	1.02	5

Note(s):

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

13.11. SAR Plots (from Summary of Highest Measured SAR Values)

Test Laboratory: UL CCS SAR Lab F Date: 2/16/2013

Wi-Fi 2.4 GHz

Frequency: 2437 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.956$ mho/m; $\epsilon_r = 50.566$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1352; Calibrated: 10/8/2012
- Probe: EX3DV4 - SN3885; ConvF(6.8, 6.8, 6.8); Calibrated: 10/9/2012;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (B); Type: QDOVA001BB; Serial: 1118

Main Ant., Edge 4/802.11b Ch 6/Area Scan (8x9x1): Measurement grid: dx=12mm, dy=12mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.58 W/kg

Main Ant., Edge 4/802.11b Ch 6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

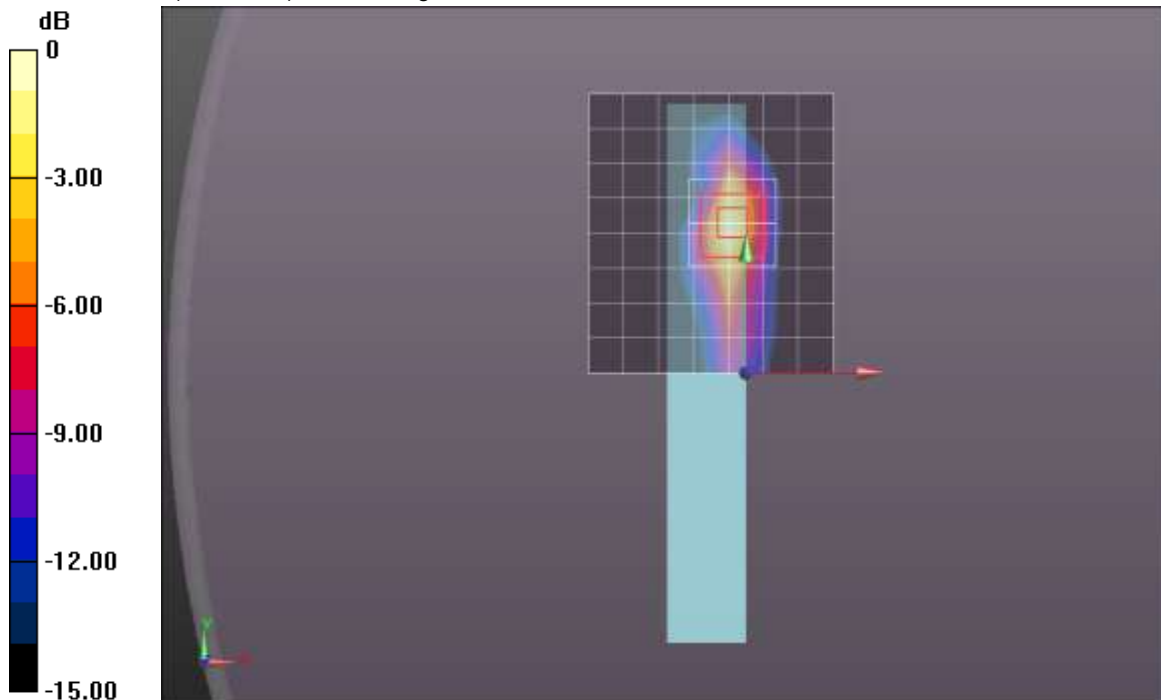
Reference Value = 28.412 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 2.67 W/kg

SAR(1 g) = 1.08 W/kg; SAR(10 g) = 0.420 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 1.72 W/kg



Test Laboratory: UL CCS SAR Lab C

Date: 2/17/2013

Wi-Fi 5 GHz

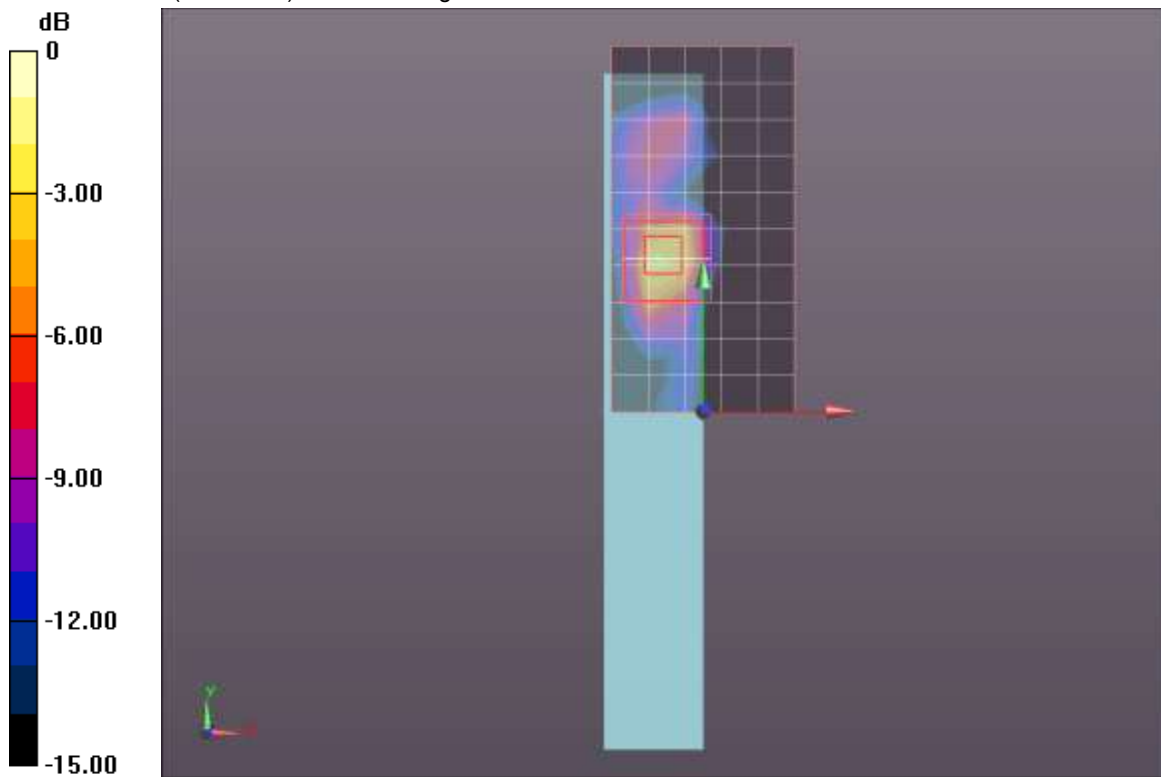
Frequency: 5220 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: $f = 5220$ MHz; $\sigma = 5.448$ mho/m; $\epsilon_r = 47.026$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1239; Calibrated: 6/6/2012
- Probe: EX3DV4 - SN3773; ConvF(4.15, 4.15, 4.15); Calibrated: 3/14/2012
- Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1117

Main Ant., Edge 4 Under ELI/802.11a Ch 44/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.995 mW/g

Main Ant., Edge 4 Under ELI/802.11a Ch 44/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 14.145 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 3.524 W/kg
SAR(1 g) = 0.797 mW/g; SAR(10 g) = 0.204 mW/g
Maximum value of SAR (measured) = 1.744 mW/g



0 dB = 1.740mW/g

Test Laboratory: UL CCS SAR Lab C

Date: 2/16/2013

Wi-Fi 5 GHz

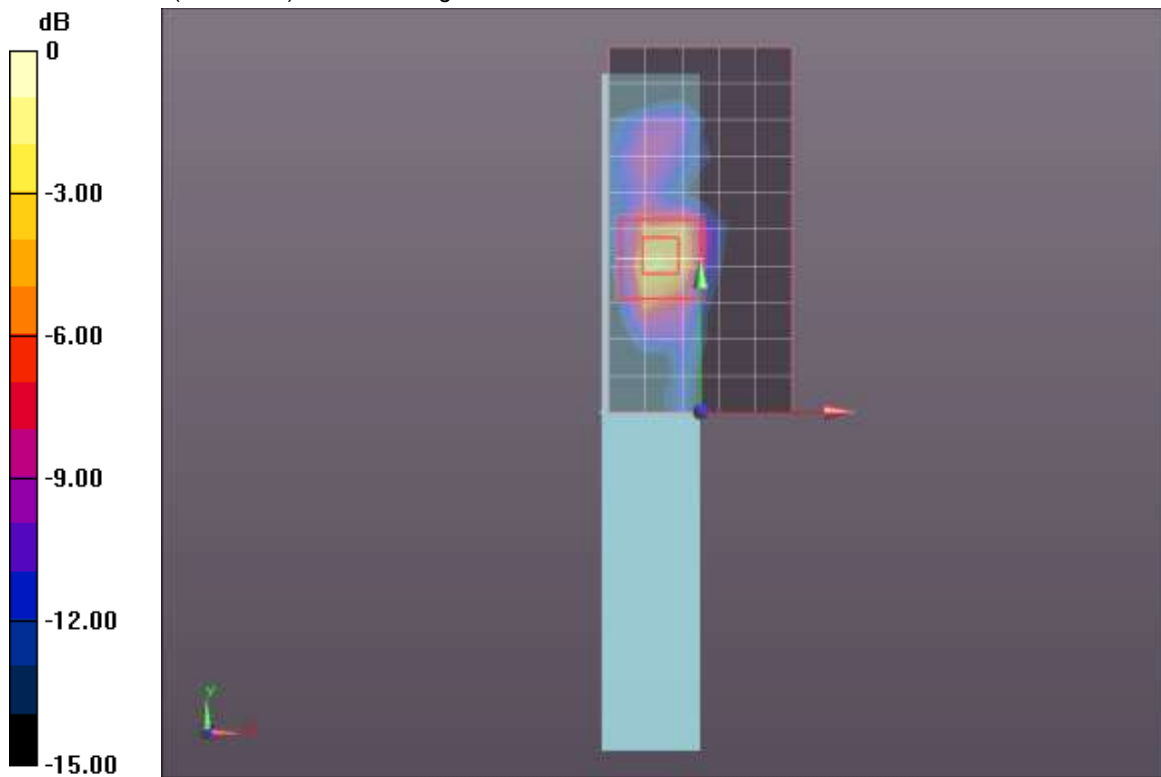
Frequency: 5300 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: $f = 5300$ MHz; $\sigma = 5.537$ mho/m; $\epsilon_r = 46.928$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1239; Calibrated: 6/6/2012
- Probe: EX3DV4 - SN3773; ConvF(3.83, 3.83, 3.83); Calibrated: 3/14/2012
- Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1117

Main Ant., Edge 4 Under ELI/802.11a Ch 60/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.546 mW/g

Main Ant., Edge 4 Under ELI/802.11a Ch 60/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 17.663 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 5.209 W/kg
SAR(1 g) = 1.19 mW/g; SAR(10 g) = 0.310 mW/g
Maximum value of SAR (measured) = 2.608 mW/g



0 dB = 2.610mW/g

Test Laboratory: UL CCS SAR Lab C

Date: 2/16/2013

Wi-Fi 5 GHz

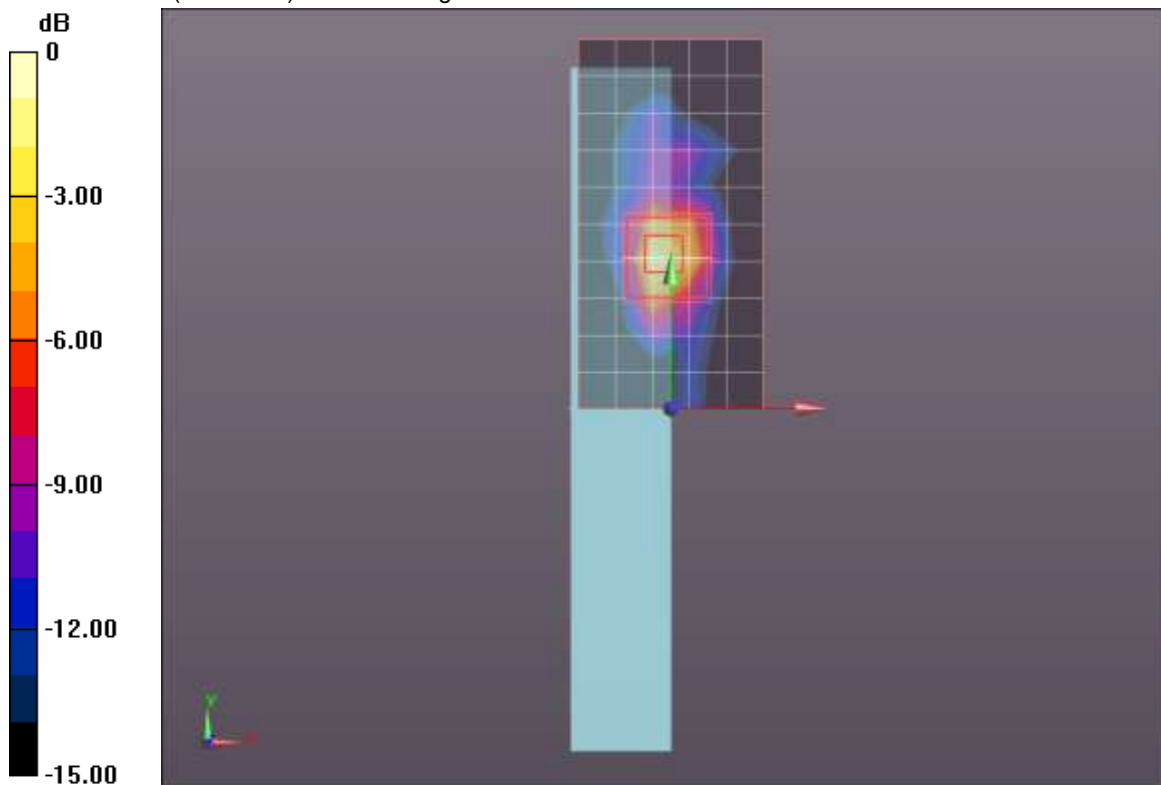
Frequency: 5580 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: $f = 5580$ MHz; $\sigma = 5.913$ mho/m; $\epsilon_r = 46.405$; $\rho = 1000$ kg/m³

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1239; Calibrated: 6/6/2012
- Probe: EX3DV4 - SN3773; ConvF(3.46, 3.46, 3.46); Calibrated: 3/14/2012
- Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1117

Main Ant., Edge 4 Under ELI/802.11a Ch 116/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.831 mW/g

Main Ant., Edge 4 Under ELI/802.11a Ch 116/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 17.201 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 4.683 W/kg
SAR(1 g) = 1.05 mW/g; SAR(10 g) = 0.276 mW/g
Maximum value of SAR (measured) = 2.305 mW/g



0 dB = 2.300mW/g

Test Laboratory: UL CCS SAR Lab C

Date: 2/17/2013

Wi-Fi 5 GHz

Frequency: 5785 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 25.0°C; Liquid Temperature: 24.0°C
Medium parameters used: $f = 5785 \text{ MHz}$; $\sigma = 6.174 \text{ mho/m}$; $\epsilon_r = 46.102$; $\rho = 1000 \text{ kg/m}^3$

DASY5 Configuration:

- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Averaged Fast SAR: Polynomial fit
- Electronics: DAE4 Sn1239; Calibrated: 6/6/2012
- Probe: EX3DV4 - SN3773; ConvF(3.57, 3.57, 3.57); Calibrated: 3/14/2012
- Sensor-Surface: 2mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1117

Aux Ant., Edge 3 Under ELI/802.11a Ch 157/Area Scan (7x13x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.160 mW/g

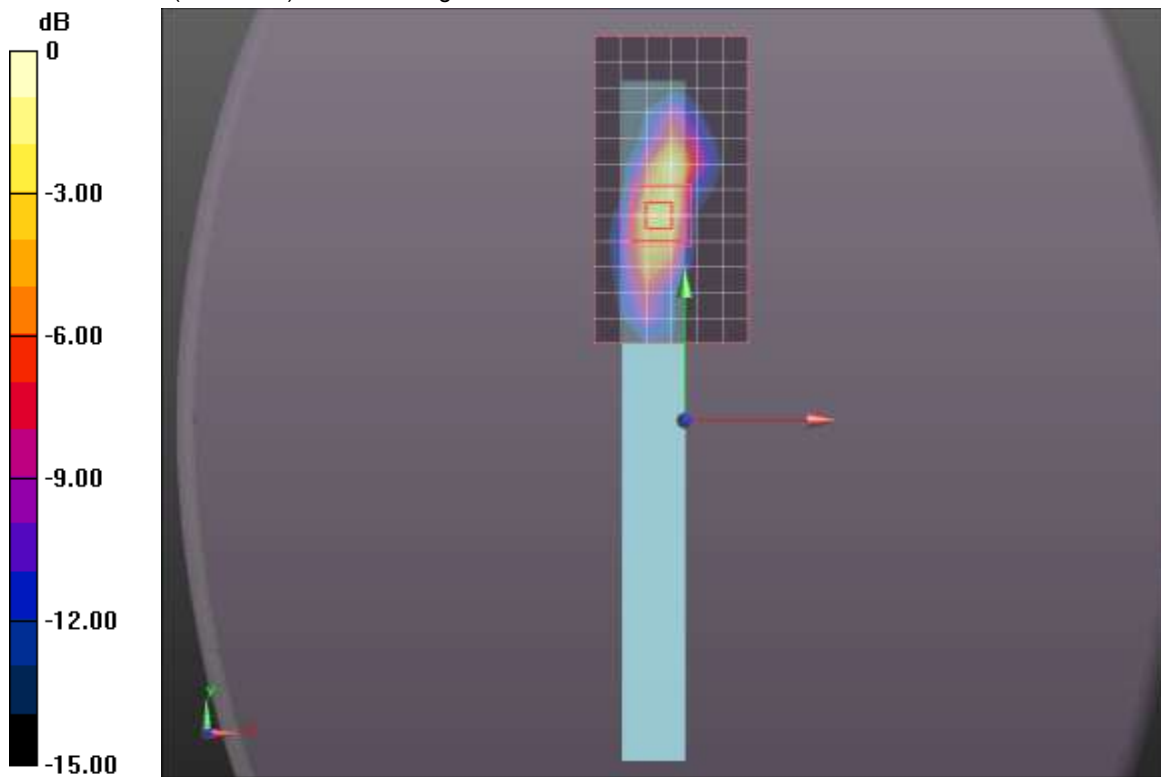
Aux Ant., Edge 3 Under ELI/802.11a Ch 157/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 14.028 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.344 W/kg

SAR(1 g) = 0.737 mW/g; SAR(10 g) = 0.215 mW/g

Maximum value of SAR (measured) = 1.603 mW/g



0 dB = 1.600mW/g

14. Simultaneous Transmission SAR Analysis

14.1. Sum of the SAR for Wi-Fi 2.4 GHz Band & Bluetooth

Test Position	Data	Data	Data	Σ 1-g SAR (mW/g)
	Wi-Fi 2.4 GHz Main	Wi-Fi 2.4 GHz Aux	Bluetooth	
Rear, Wi-Fi 1 Tx	0.196		0.165	0.361
Rear, Wi-Fi 2 Tx	0.196	0.062		0.258
Edge 1, Wi-Fi 1 Tx	0.084		0.017	0.101
Edge 1, Wi-Fi 2 Tx	0.084	0.133		0.217
Edge 3, Wi-Fi 1 Tx	0.116		0.165	0.281
Edge 3, Wi-Fi 2 Tx	0.116	0.418		0.534
Edge 4, Wi-Fi 1 Tx	1.093		0.0089	1.102
Edge 4, Wi-Fi 2 Tx	1.093	0.126		1.219

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:

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

14.2. Sum of the SAR for Wi-Fi 5.2 GHz Band & Bluetooth

Test Position	Data	Data	Data	Σ 1-g SAR (mW/g)
	Wi-Fi 5.2 GHz Main	Wi-Fi 5.2 GHz Aux	Bluetooth	
Rear, Wi-Fi 1 Tx	0.136		0.165	0.301
Rear, Wi-Fi 2 Tx	0.136	0.149		0.285
Edge 1, Wi-Fi 2 Tx	0.061		0.017	0.078
Edge 1, Wi-Fi 2 Tx	0.061	0.194		0.255
Edge 3, Wi-Fi 2 Tx	0.194		0.165	0.359
Edge 3, Wi-Fi 2 Tx	0.194	0.545		0.739
Edge 4, Wi-Fi 1 Tx	0.797		0.0089	0.806
Edge 4, Wi-Fi 2 Tx	0.797	0.057		0.854

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:

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

14.3. Sum of the SAR for Wi-Fi 5.3 GHz Band & Bluetooth

Test Position	Data	Data	Data	Σ 1-g SAR (mW/g)
	Wi-Fi 5.3 GHz Main	Wi-Fi 5.3 GHz Aux	Bluetooth	
Rear, Wi-Fi 1 Tx	0.206		0.165	0.371
Rear, Wi-Fi 2 Tx	0.206	0.254		0.460
Edge 1, Wi-Fi 1 Tx	0.138		0.017	0.155
Edge 1, Wi-Fi 2 Tx	0.138	0.196		0.334
Edge 3, Wi-Fi 1 Tx	0.196		0.165	0.361
Edge 3, Wi-Fi 2 Tx	0.196	0.938		1.134
Edge 4, Wi-Fi 1 Tx	1.14		0.0089	1.149
Edge 4, Wi-Fi 2 Tx	1.14	0.124		1.264

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:

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

14.4. Sum of the SAR for Wi-Fi 5.5 GHz Bands & Bluetooth

Test Position	Data	Data	Data	Σ 1-g SAR (mW/g)
	Wi-Fi 5.5 GHz Main	Wi-Fi 5.5 GHz Aux	Bluetooth	
Rear, Wi-Fi 1 Tx	0.220		0.165	0.385
Rear, Wi-Fi 2 Tx	0.220	0.229		0.449
Edge 1, Wi-Fi 1 Tx	0.082		0.017	0.099
Edge 1, Wi-Fi 2 Tx	0.082	0.200		0.282
Edge 3, Wi-Fi 1 Tx	0.200		0.165	0.365
Edge 3, Wi-Fi 2 Tx	0.200	1.030		1.230
Edge 4, Wi-Fi 1 Tx	1.099		0.0089	1.108
Edge 4, Wi-Fi 2 Tx	1.099	0.094		1.193

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:

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

14.5. Sum of the SAR for Wi-Fi 5.8 GHz Band & Bluetooth

Test Position	Data	Data	Data	Σ 1-g SAR (mW/g)
	Wi-Fi 5.8 GHz Main	Wi-Fi 5.8 GHz Aux	Bluetooth	
Rear, Wi-Fi 1 Tx	0.090		0.165	0.255
Rear, Wi-Fi 2 Tx	0.090	0.148		0.238
Edge 1, Wi-Fi 1 Tx	0.038		0.017	0.055
Edge 1, Wi-Fi 2 Tx	0.038	0.205		0.243
Edge 3, Wi-Fi 1 Tx	0.205		0.165	0.370
Edge 3, Wi-Fi 2 Tx	0.205	0.754		0.959
Edge 4, Wi-Fi 1 Tx	0.414		0.0089	0.423
Edge 4, Wi-Fi 2 Tx	0.414	0.043		0.457

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:

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

15. Appendixes

Refer to separated files for the following appendixes.

- 15.1. System Performance Check Plots**
- 15.2. SAR Test Plots for Bluetooth**
- 15.3. SAR Test Plots for Wi-Fi 2.4 GHz Band**
- 15.4. SAR Test Plots for Wi-Fi 5 GHz Bands**
- 15.5. SAR Test Plots for Repeated Test**
- 15.6. Calibration Certificate for E-Field Probe EX3DV4 - SN 3686**
- 15.7. Calibration Certificate for E-Field Probe EX3DV4 - SN 3751**
- 15.8. Calibration Certificate for E-Field Probe EX3DV4 - SN 3773**
- 15.9. Calibration Certificate for E-Field Probe EX3DV4 - SN 3885**
- 15.10. Calibration Certificate for D2450V2 - SN 706**
- 15.11. Calibration Certificate for D2450V2 - SN 899**
- 15.12. Calibration Certificate for D5GHzV2 - SN 1003**
- 15.13. Calibration Certificate for D5GHzV2 - SN 1138**

16. External Photos

Front View of the DUT



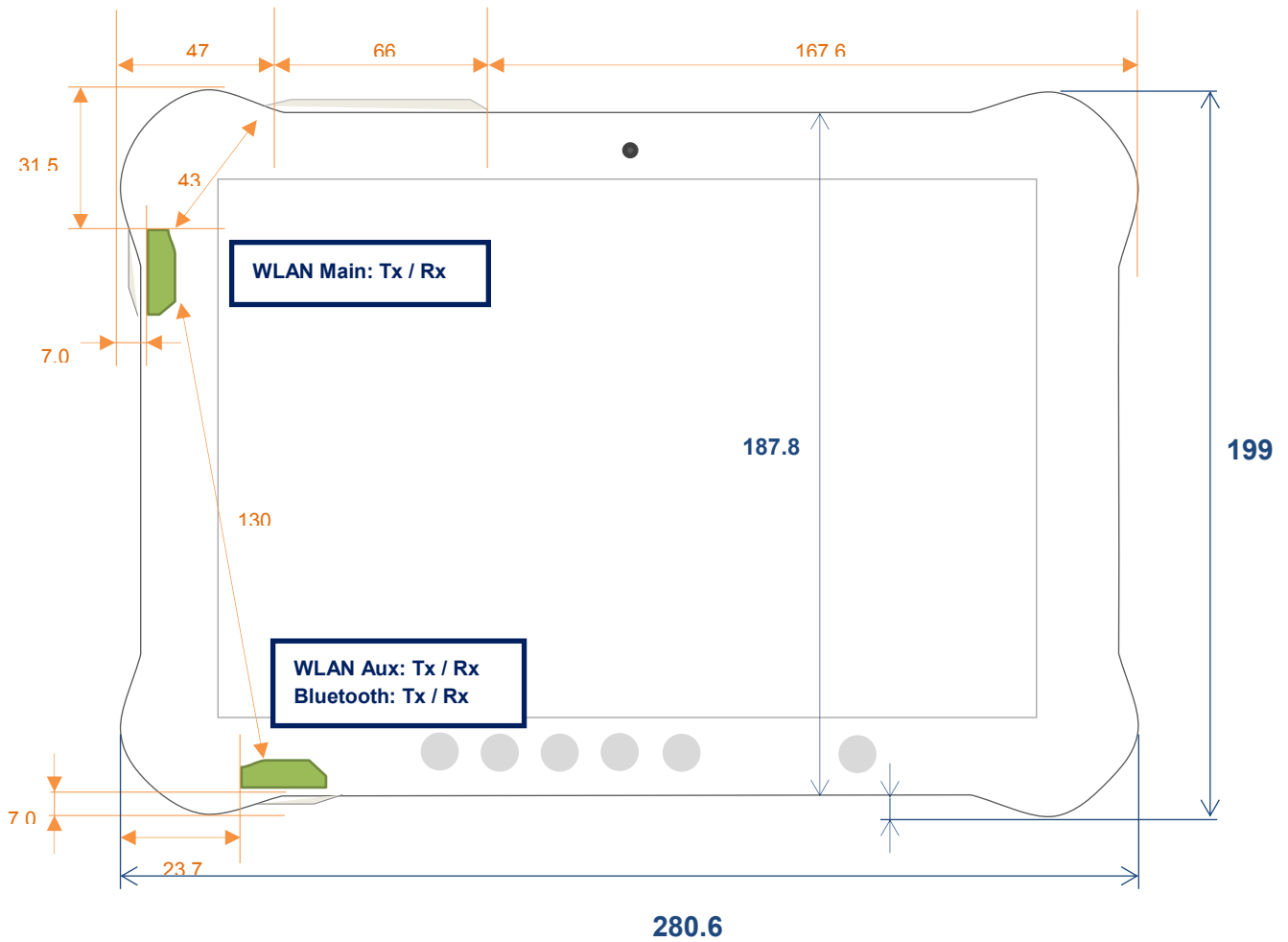
Rear View of the DUT



17. Antenna Dimensions & Separation Distances

Unit: mm

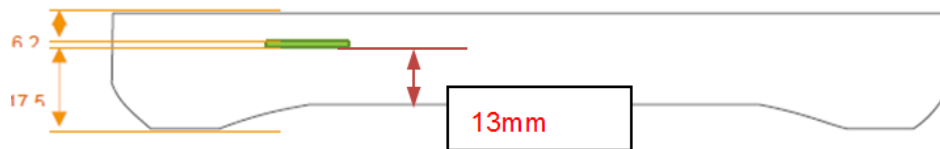
Front View



Bottom (Edge 3) View



Bottom (Edge 4) View



18. Setup Photos

Rear, Main and Auxiliary Antenna, 0 mm Separation Distance



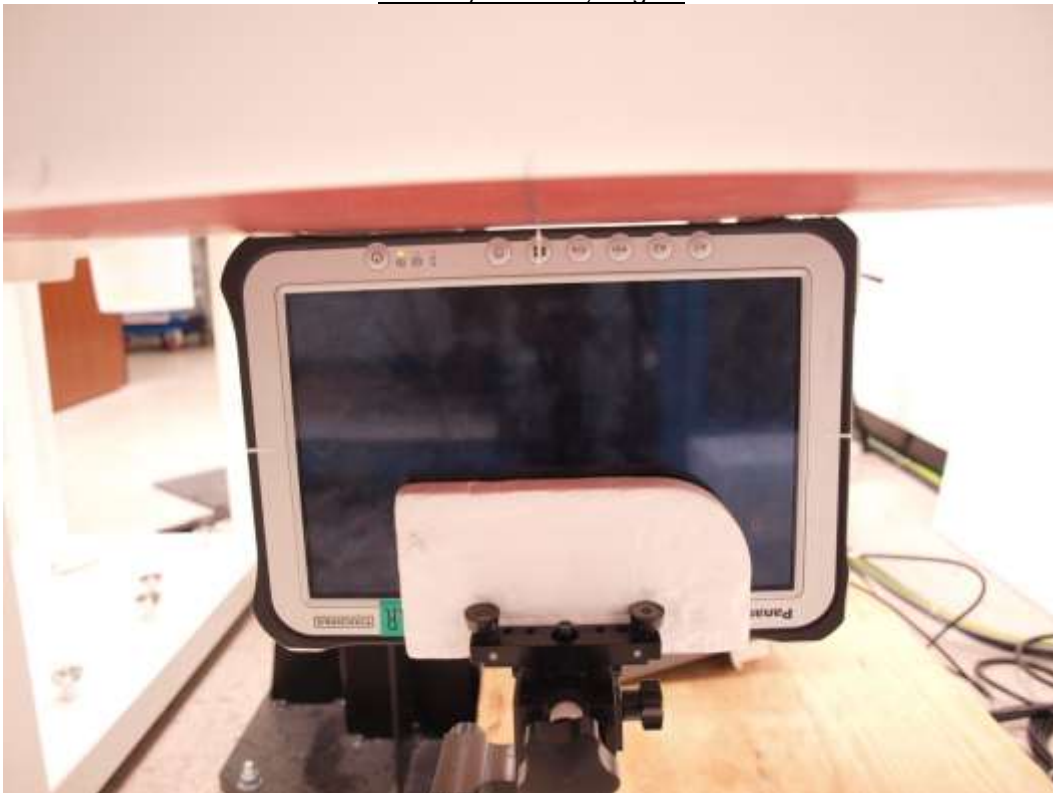
Edge 4, Main and Auxiliary Antenna, 0 mm Separation Distance



Main Antenna, Edge 1



Auxiliary Antenna, Edge 3



END OF REPORT