

APPENDIX D: SIMULTANEOUS NUMERICAL CALCULATIONS

D.1 Introduction




The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

D.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤ 1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1g or 10g SAR.

Per FCC KDB Publication 941225 D06v02r01, the devices edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR (“-”).

(*) For test positions that were not required to be evaluated for WLAN SAR per FCC KDB publication 248227, the worst case WLAN SAR result for the applicable exposure conditions was used for simultaneous transmission analysis.

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D.3 Head Simultaneous Transmission Analysis




Table D-1
Simultaneous Transmission Scenarios of WLAN/BT (Held to Ear)

Configuration	2.4 GHz WLAN Ant 1	2.4 GHz WLAN Ant 2	2.4 GHz Bluetooth Ant 1	2.4 GHz Bluetooth Ant 2	5 GHz WLAN MIMO	6 GHz WLAN MIMO
Right Cheek	0.130	0.329	0.078	0.188	0.326	0.209
Right Tilt	0.130*	0.329*	0.035	0.040	0.326*	0.020
Left Cheek	0.130*	0.329*	0.042	0.133	0.326*	0.070
Left Tilt	0.130*	0.329*	0.025	0.026	0.326*	0.017

Configuration	2.4 GHz WLAN Ant 1	2.4 GHz WLAN Ant 2	2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2	5 GHz WLAN MIMO	6 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1	2.4 GHz Bluetooth Ant 2	2.4 GHz Bluetooth Ant 1 + 2.4 GHz Bluetooth Ant 2	2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	2.4 GHz WLAN Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 6 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO	WLAN/BT Worst-case Combination
	1	2	1+2	5	6	3	4	3+4	1+2+5	1+2+6	3+4+5	3+4+6	3+5	4+5	3+6	4+6	
Right Cheek	0.130	0.329	0.459	0.326	0.209	0.078	0.188	0.266	0.785	0.668	0.592	0.475	0.404	0.514	0.287	0.397	0.785
Right Tilt	0.130	0.329	0.459	0.326	0.020	0.035	0.040	0.075	0.785	0.479	0.401	0.095	0.361	0.366	0.055	0.060	0.785
Left Cheek	0.130	0.329	0.459	0.326	0.070	0.042	0.133	0.175	0.785	0.529	0.501	0.245	0.368	0.459	0.112	0.203	0.785
Left Tilt	0.130	0.329	0.459	0.326	0.017	0.025	0.026	0.051	0.785	0.476	0.377	0.068	0.351	0.352	0.042	0.043	0.785

Table D-2
Simultaneous Transmission Scenario with WLAN/BT (Held to Ear)

	Configuration	Licensed	WLAN/BT Worst-case Combination	Licensed + WLAN/BT Worst-case
Head SAR	Right Cheek	0.176	0.785	0.961
	Right Tilt	0.098	0.785	0.883
	Left Cheek	0.220	0.785	1.005
	Left Tilt	0.095	0.785	0.880

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D.4 Body-worn Simultaneous Transmission Analysis

Table D-3
Simultaneous Transmission Scenarios of WLAN/BT (Body-worn at 1.5 cm)

Configuration	2.4 GHz WLAN Ant 1	2.4 GHz WLAN Ant 2	2.4 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1	2.4 GHz Bluetooth Ant 2	5 GHz WLAN MIMO	6 GHz WLAN MIMO
Back	0.026	0.188	0.120	0.007	0.064	0.322	0.056

Configuration	2.4 GHz WLAN Ant 1	2.4 GHz WLAN Ant 2	2.4 GHz WLAN MIMO	5 GHz WLAN MIMO	6 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1	2.4 GHz Bluetooth Ant 2	2.4 GHz Bluetooth Ant 1 + 2.4 GHz Bluetooth Ant 2	2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 2.4 GHz Bluetooth Ant 2	2.4 GHz Bluetooth Ant 1 + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 6 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO	WLAN/BT Worst-case Combination
Back	1	2	3	6	7	4	5	4+5	3+6	3+7	4+5+6	4+5+7	4+6	5+6	4+7	5+7	0.442	

Table D-4
Simultaneous Transmission Scenario with WLAN/BT (Body-worn at 1.5 cm)

Configuration	Licensed	WLAN/BT Worst-case Combination	Licensed + WLAN/BT Worst-case
Bodyworn SAR Back	0.672	0.442	1.114

D.5 Hotspot Simultaneous Transmission Analysis

Table D-5
Simultaneous Transmission Scenarios of WLAN/BT (Hotspot at 1.0 cm)

Configuration	2.4 GHz WLAN Ant 1	2.4 GHz WLAN Ant 2	2.4 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1	2.4 GHz Bluetooth Ant 2	5 GHz WLAN MIMO
Back	0.079	0.361	0.336*	0.022	0.144	0.338
Front	0.079*	0.524*	0.336*	0.015	0.056	0.338*
Top	0.079*	-	0.336*	0.009	-	0.338*
Bottom	-	-	-	-	-	-
Right	-	-	-	-	-	-
Left	0.079*	0.524	0.336	0.009	0.180	0.338*

Configuration	2.4 GHz WLAN Ant 1	2.4 GHz WLAN Ant 2	2.4 GHz WLAN MIMO	5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1	2.4 GHz Bluetooth Ant 2	2.4 GHz Bluetooth Ant 1 + 2.4 GHz Bluetooth Ant 2	2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	2.4 GHz Bluetooth Ant 1 + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	WLAN/BT Worst-case Combination
Back	1	2	3	6	4	5	4+5	3+6	4+6	5+6	4+5+6	0.674
Front	0.079	0.361	0.336	0.338	0.022	0.144	0.166	0.674	0.360	0.482	0.504	0.674
Top	0.079	0.000	0.336	0.338	0.009	0.000	0.009	0.674	0.347	0.338	0.347	0.674
Bottom	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-
Right	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-
Left	0.079	0.524	0.336	0.338	0.009	0.180	0.189	0.674	0.347	0.518	0.527	0.674






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Table D-6
Simultaneous Transmission Scenarios with WLAN/BT (Hotspot at 1.0 cm)

	Configuration	Licensed	WLAN/BT Worst-case Combination	Licensed + WLAN/BT Worst-case
Hotspot SAR	Back	0.558	0.674	1.232
	Front	0.428	0.674	1.102
	Top	0.000	0.674	0.674
	Bottom	1.042	-	1.042
	Right	0.169	-	0.169
	Left	0.266	0.674	0.940

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D.6 Phablet Simultaneous Transmission Analysis

Per FCC KDB Publication 648474 D04 Handset SAR, Phablet SAR tests were not required if wireless router 1g SAR (scaled to the maximum output power, including tolerance) < 1.2 W/kg. Therefore, no further analysis beyond the tables included in this section was required to determine that possible simultaneous transmission scenarios would not exceed the SAR limit.



Table D-7
Simultaneous Transmission Scenarios of WLAN/BT

Configuration	5 GHz WLAN MIMO	6 GHz WLAN MIMO
Back	1.707	0.237
Front	1.707*	0.159
Top	1.707*	0.018
Bottom	-	-
Right	-	-
Left	1.061	0.485

Configuration	5 GHz WLAN MIMO	6 GHz WLAN MIMO	WLAN/BT Worst-case Combination
	1	2	
Back	1.707	0.237	1.707
Front	1.707	0.159	1.707
Top	1.707	0.018	1.707
Bottom	0.000	0.000	-
Right	0.000	0.000	-
Left	1.061	0.485	1.061

Table D-8
Simultaneous Transmission Scenarios with WLAN/BT (Phablet Max DSI= 0)

	Configuration	Licensed	WLAN/BT Worst-case Combination	Licensed + WLAN/BT Worst-case
Phablet SAR	Back	0.913	1.707	2.620
	Front	1.185	1.707	2.892
	Top	0.000	1.707	1.707
	Bottom	1.184	-	1.184
	Right	1.355	-	1.355
	Left	0.358	1.061	1.419



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**Table D-9
Simultaneous Transmission Scenarios with WLAN/BT (Phablet Reduced DSI= 1)**

	Configuration	Licensed	WLAN/BT Worst-case Combination	Licensed + WLAN/BT Worst-case
Phablet SAR	Back	1.222	1.707	2.929
	Front	0.948	1.707	2.655
	Top	0.000	1.707	1.707
	Bottom	1.245	-	1.245
	Right	1.355	-	1.355
	Left	0.358	1.061	1.419

D.7 Simultaneous Transmission Conclusion

The above numerical summed SAR results are sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 and IEEE 1528- 2013 Section 6.3.4.1.

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