

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 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 SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)
	1	2	3
Right Cheek	0.168	0.069	0.341*
Right Tilt	0.168*	0.067	0.341
Left Cheek	0.168*	0.034	0.341*
Left Tilt	0.168*	0.041	0.178

Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth + 5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	2+3	
Right Cheek	0.168	0.069	0.341	0.410	0.410
Right Tilt	0.168	0.067	0.341	0.408	0.408
Left Cheek	0.168	0.034	0.341	0.375	0.375
Left Tilt	0.168	0.041	0.178	0.219	0.219

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

Configuration	Ant A SAR (W/kg)	Ant B SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Ant A + WLAN/BT SAR (W/kg)	Ant B + WLAN/BT SAR (W/kg)
Right Cheek	0.300	0.274	0.410	0.710	0.684
Right Tilt	0.144	0.272	0.408	0.552	0.680
Left Cheek	0.246	0.369	0.375	0.621	0.744
Left Tilt	0.133	0.213	0.219	0.352	0.432



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Table D-3
Stand-alone data for EN-DC SAR (Held to Ear)

Configuration	A	B
	LTE Band 5 (Cell) SAR (W/kg)	NR Band n66 (AWS) SAR (W/kg)
	8	13
Right Cheek	0.248	0.206
Right Tilt	0.138	0.177
Left Cheek	0.235	0.223
Left Tilt	0.128	0.205

Table D-4
Simultaneous Transmission Scenario with EN-DC (Held to Ear)

LTE Band 5 (Cell) Ant A + NR Band n66 (AWS) Ant B SAR (W/kg)	ENDC Worst-case Combination SAR (W/kg)
8+13	
0.454	0.454
0.315	0.315
0.458	0.458
0.333	0.333

Configuration	ENDC Worst-case Combination SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	ENDC + WLAN/BT Worst-Case Combinations SAR (W/kg)
Right Cheek	0.454	0.410	0.864
Right Tilt	0.315	0.408	0.723
Left Cheek	0.458	0.375	0.833
Left Tilt	0.333	0.219	0.552

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D.4 Body-worn Simultaneous Transmission Analysis

Table D-5
Simultaneous Transmission Scenarios of WLAN/BT (Body-worn at 1.5 cm)

Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	
Back	0.087	0.016	0.163	

Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth + 5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	2+3	
Back	0.087	0.016	0.163	0.179	0.179

Table D-6
Simultaneous Transmission Scenario with WLAN/BT (Body-worn at 1.5 cm)



Configuration	Ant A SAR (W/kg)	Ant B SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Ant A + WLAN/BT SAR (W/kg)	Ant B + WLAN/BT SAR (W/kg)
Back	0.412	0.397	0.179	0.591	0.576

Table D-7
Stand-alone data for EN-DC SAR (Body-worn at 1.5 cm)

Mode		4G/5G SAR (W/kg)	
8	LTE Band 5 (Cell)	0.374	A
13	NR Band n66 (AWS)	0.354	B

Table D-8
Simultaneous Transmission Scenario with EN-DC (Body-worn at 1.5 cm)

Configuration	LTE Band 5 (Cell) Ant A + NR Band n66 (AWS) Ant B SAR (W/kg)	ENDC Worst-case Combination SAR (W/kg)
	8+13	
Back	0.728	0.728

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Configuration	ENDC Worst-case Combination SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	ENDC + WLAN/BT Worst-Case Combinations SAR (W/kg)
Back	0.728	0.179	0.907

D.5 Hotspot Simultaneous Transmission Analysis

Table D-9
Simultaneous Transmission Scenarios of WLAN/BT (Hotspot at 1.0 cm)

Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	
Back	0.198	0.038	0.124*	0.198
Front	0.198*	0.014	0.124*	
Top	0.198*	0.020	0.124	
Left	0.198*	0.005	0.124*	

Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth + 5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	2+3	
back	0.198	0.038	0.124	0.162	0.198
front	0.198	0.014	0.124	0.138	0.198
top	0.198	0.020	0.124	0.144	0.198
left	0.198	0.005	0.124	0.129	0.198

Table D-10
Simultaneous Transmission Scenarios with WLAN/BT (Hotspot at 1.0 cm)

Configuration	Ant A SAR (W/kg)	Ant B SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Ant A + WLAN/BT SAR (W/kg)	Ant B + WLAN/BT SAR (W/kg)
Back	0.999	0.401	0.198	1.197	0.599
Front	0.243	0.354	0.198	0.441	0.552
Top	-	-	0.198	0.198	0.198
Bottom	0.382	0.441	-	0.382	0.441
Right	0.444	-	-	0.444	-
Left	0.227	0.270	0.198	0.425	0.468



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Table D-11
Stand-alone data for EN-DC SAR (Hotspot at 1.0 cm)

Configuration	A	B
	LTE Band 5 (Cell) SAR (W/kg)	NR Band n66 (AWS) SAR (W/kg)
	8	13
Back	0.861	0.268
Front	0.229	0.260
Top	-	-
Bottom	0.355	0.337
Right	0.312	-
Left	0.165	0.150

Table D-12
Simultaneous Transmission Scenario with EN-DC (Hotspot at 1.0 cm)

Configuration	LTE Band 5 (Cell) Ant A + NR Band n66 (AWS) Ant B SAR (W/kg)	ENDC Worst-case Combination SAR (W/kg)
	8+13	
back	1.129	1.129
front	0.489	0.489
bottom	0.692	0.692
right	0.312	0.312
left	0.315	0.315

Configuration	ENDC Worst-case Combination SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	ENDC + WLAN/BT Worst-Case Combinations SAR (W/kg)
Back	1.129	0.198	1.327
Front	0.489	0.198	0.687
Top	-	0.198	0.198
Bottom	0.692	-	0.692
Right	0.312	-	0.312
Left	0.315	0.198	0.513

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D.6 Phablet Simultaneous Transmission Analysis

For SAR summation, the highest reported SAR across all test distances was used as the most conservative evaluation for simultaneous transmission analysis for each device edge.

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-13
Simultaneous Transmission Scenarios of WLAN/BT

Configuration	5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	
Back	0.603*	0.603
Front	0.603*	
Top	0.603	
Left	0.603*	



Configuration	5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	
back	0.603	0.603
front	0.603	0.603
top	0.603	0.603
left	0.603	0.603

Table D-14
Simultaneous Transmission Scenarios with WLAN/BT

Configuration	Ant B SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Ant B + WLAN/BT SAR (W/kg)
Back	2.735	0.603	3.338
Front	2.888	0.603	3.491
Top	-	0.603	0.603
Bottom	1.233	-	1.233
Left	0.951	0.603	1.554

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.

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