

APPENDIX D: MULTI-TX AND ANTENNA SAR CONSIDERATION

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.

D.3 Head Simultaneous Transmission Analysis

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

Configuration	2.4 GHz WLAN Chain 0 SAR (W/kg)	2.4 GHz WLAN Chain 1 SAR (W/kg)	5 GHz WLAN Chain 0 SAR (W/kg)	5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 0 SAR (W/kg)	2.4 GHz Bluetooth Chain 1 SAR (W/kg)	
	1	2	3	4	5	6	
Right Cheek	0.647	0.000*	0.401	0.000	0.165	0.000	
Right Tilt	0.112	0.000*	0.401*	0.000	0.035	0.000	
Left Cheek	0.647*	0.000	0.177	0.001	0.026	0.000	
Left Tilt	0.647*	0.000*	0.039	0.000	0.007	0.000	

Configuration	2.4 GHz WLAN Chain 0 + 2.4 GHz WLAN Chain 1 SAR (W/kg)	5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz WLAN Chain 0 + 2.4 GHz WLAN Chain 1 + 5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 0 SAR (W/kg)	2.4 GHz Bluetooth Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 0 + 5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 1 + 5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1+2	3+4	1+2+3+4	5	6	5+3+4	6+3+4	
Right Cheek	0.647	0.401	1.048	0.165	0.000	0.566	0.401	1.048
Right Tilt	0.112	0.401	0.513	0.035	0.000	0.436	0.401	0.513
Left Cheek	0.647	0.178	0.825	0.026	0.000	0.204	0.178	0.825
Left Tilt	0.647	0.039	0.686	0.007	0.000	0.046	0.039	0.686

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

Configuration	Licensed SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Licensed + WLAN/BT SAR (W/kg)
Right Cheek	0.206	1.048	1.254
Right Tilt	0.059	0.513	0.572
Left Cheek	0.195	0.825	1.020
Left Tilt	0.060	0.686	0.746

D.4 Body-worn Simultaneous Transmission Analysis

Table D-3
Simultaneous Transmission Scenarios of WLAN/BT (Body-worn at 1.0 cm)

Configuration	2.4 GHz WLAN Chain 0 SAR (W/kg)	2.4 GHz WLAN Chain 1 SAR (W/kg)	5 GHz WLAN Chain 0 SAR (W/kg)	5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 0 SAR (W/kg)	2.4 GHz Bluetooth Chain 1 SAR (W/kg)
	1	2	3	4	5	6
Back	0.121	0.084	0.065	0.084	0.036	0.022

Configuration	2.4 GHz WLAN Chain 0 + 2.4 GHz WLAN Chain 1 SAR (W/kg)	5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz WLAN Chain 0 + 2.4 GHz WLAN Chain 1 + 5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 0 SAR (W/kg)	2.4 GHz Bluetooth Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 0 + 5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 1 + 5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1+2	3+4	1+2+3+4	5	6	5+3+4	6+3+4	
Back	0.205	0.149	0.354	0.036	0.022	0.185	0.171	0.354

Table D-4
Simultaneous Transmission Scenario with WLAN/BT (Body-worn at 1.0 cm)

Configuration	Licensed SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Licensed + WLAN/BT SAR (W/kg)
Back	0.319	0.354	0.673

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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 Chain 0 SAR (W/kg)	2.4 GHz WLAN Chain 1 SAR (W/kg)	5 GHz WLAN Chain 0 SAR (W/kg)	5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 0 SAR (W/kg)	2.4 GHz Bluetooth Chain 1 SAR (W/kg)
	1	2	3	4	5	6
Back	0.176*	0.084	0.110*	0.084	0.036	0.022
Front	0.176*	0.084*	0.110*	0.084*	0.025	0.000
Top	0.176*	-	0.110*	-	0.002	-
Bottom	-	0.084*	-	0.084*	-	0.001
Left	0.176	0.084*	0.110	0.084*	0.067	0.000

Configuration	2.4 GHz WLAN Chain 0 + 2.4 GHz WLAN Chain 1 SAR (W/kg)	5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz WLAN Chain 0 + 2.4 GHz WLAN Chain 1 + 5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 0 SAR (W/kg)	2.4 GHz Bluetooth Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 0 + 5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz Bluetooth Chain 1 + 5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1+2	3+4	1+2+3+4	5	6	5+3+4	6+3+4	
Back	0.260	0.194	0.454	0.036	0.022	0.230	0.216	0.454
Front	0.260	0.194	0.454	0.025	0.000	0.219	0.194	0.454
Top	0.176	0.110	0.286	0.002	-	0.112	0.110	0.286
Bottom	0.084	0.084	0.168	-	0.001	0.084	0.085	0.168
Left	0.260	0.194	0.454	0.067	0.000	0.261	0.194	0.454

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

Configuration	Licensed SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Licensed + WLAN/BT SAR (W/kg)
Back	0.319	0.454	0.773
Front	0.266	0.454	0.720
Top	-	0.286	0.286
Bottom	0.472	0.168	0.640
Right	0.161	-	0.161
Left	0.216	0.454	0.670

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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

Configuration	5 GHz WLAN Chain 0 SAR (W/kg)	5 GHz WLAN Chain 1 SAR (W/kg)
	1	2
Back	0.522*	0.378
Front	0.522*	0.378*
Top	0.522*	-
Bottom	-	0.378*
Right	-	-
Left	0.522	0.378*

Configuration	5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	WLAN Worst-case Combination SAR (W/kg)
	1+2	
Back	0.900	0.900
Front	0.900	0.900
Top	0.522	0.522
Bottom	0.378	0.378
Right	-	0.000
Left	0.900	0.900

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Table D-8
Simultaneous Transmission Scenarios with WLAN

Configuration	NFC SAR (W/kg)	WLAN Worst- case Combination SAR (W/kg)	NFC + WLAN/BT SAR (W/kg)
Back	0.017	0.900	0.917
Front	0.000	0.900	0.900
Top	0.000	0.522	0.522
Bottom	-	0.378	0.378
Right	0.000	-	0.000
Left	0.000	0.900	0.900

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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