

APPENDIX E: MULTI-TX AND ANTENNA SAR CONSIDERATIONS

E.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D04v01 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter

E.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D04v01 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 (“-“).

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E.3 Head Simultaneous Transmission Analysis

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

Configuration	2.4 GHz WLAN MIMO SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WiFi Main SAR (W/kg)	2.4 GHz Bluetooth WiFi Sub SAR (W/kg)	2.4 GHz Bluetooth WiFi Main + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WiFi Sub + 5 GHz WLAN MIMO SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	3	1+3	4	5	4+3	5+3	
Right Cheek	0.581	0.187	0.768	0.229	0.000	0.416	0.187	0.768
Right Tilt	0.154	0.070	0.224	0.034	0.003	0.104	0.073	0.224
Left Cheek	0.133	0.100	0.233	0.048	0.000	0.148	0.100	0.233
Left Tilt	0.047	0.033	0.080	0.011	0.000	0.044	0.033	0.080

Table E-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	0.134	0.768	0.902
Right Tilt	0.052	0.224	0.276
Left Cheek	0.128	0.233	0.361
Left Tilt	0.050	0.080	0.130

Notes:

1. For all combinations where the sum of Licensed+WLAN/BT is less than 1.6 W/kg, there's no further analysis required for compliance demonstration.

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E.4 Body-worn Simultaneous Transmission Analysis

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

Configuration	2.4 GHz WLAN MIMO SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WiFi Main SAR (W/kg)	2.4 GHz Bluetooth WiFi Sub SAR (W/kg)	2.4 GHz Bluetooth WiFi Main + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WiFi Sub + 5 GHz WLAN MIMO SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	3	1+3	4	5	4+3	5+3	
Back	0.125	0.070	0.195	0.048	0.061	0.118	0.131	0.195

Table E-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	0.435	0.195	0.630

Notes:

1. For all combinations where the sum of Licensed+WLAN/BT is less than 1.6 W/kg, there's no further analysis required for compliance demonstration.

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E.5 Hotspot Simultaneous Transmission Analysis

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

Configuration	2.4 GHz WLAN MIMO SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WiFi Main SAR (W/kg)	2.4 GHz Bluetooth WiFi Sub SAR (W/kg)
	1	3	4	5
Back	0.125	0.084	0.048	0.061
Front	0.066	0.036	0.036	0.005
Top	0.014	0.032	0.006	-
Bottom	0.019	0.025	-	0.007
Right	-	-	-	-
Left	0.161	0.087	0.099	0.005

Configuration	2.4 GHz WLAN MIMO SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WiFi Main SAR (W/kg)	2.4 GHz Bluetooth WiFi Sub SAR (W/kg)	2.4 GHz Bluetooth WiFi Main + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WiFi Sub + 5 GHz WLAN MIMO SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	3	1+3	4	5	4+3	5+3	
Back	0.125	0.084	0.209	0.048	0.061	0.132	0.145	0.209
Front	0.066	0.036	0.102	0.036	0.005	0.072	0.041	0.102
Top	0.014	0.032	0.046	0.006	-	0.038	0.032	0.046
Bottom	0.019	0.025	0.044	-	0.007	0.025	0.032	0.044
Right	-	-	-	-	-	-	-	-
Left	0.161	0.087	0.248	0.099	0.005	0.186	0.092	0.248

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

Hotspot SAR	Configuration	Licensed SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Licensed + WLAN/BT SAR (W/kg)
	Back		0.435	0.209
Front		0.338	0.102	0.440
Top		-	0.046	0.046
Bottom		0.379	0.044	0.423
Right		0.104	-	0.104
Left		0.113	0.248	0.361

Notes:

- For all combinations where the sum of Licensed+WLAN/BT is less than 1.6, there's no further analysis required for compliance demonstration.

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E.6 Max 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 E-7
Simultaneous Transmission Scenarios of WLAN (Phablet)

Configuration	5 GHz WLAN MIMO SAR (W/kg)
	1
Back	0.321
Front	0.142
Top	0.032
Bottom	0.027
Right	-
Left	0.515

Table E-8
Simultaneous Transmission Scenarios of NFC with WLAN (Phablet)

Configuration	NFC SAR (W/kg)	WLAN Worst-case Combination SAR (W/kg)	NFC + WLAN SAR (W/kg)
Back	0.036	0.321	0.357
Front	0.000	0.142	0.142
Top	-	0.032	0.032
Bottom	-	0.027	0.027
Right	-	-	-
Left	0.000	0.515	0.515

Notes:

1. For all combinations where the sum of NFC+WLAN is less than 4W/kg, there's no further analysis required for compliance demonstration.

E.7 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 D04v01 and IEEE 1528- 2013 Section 6.3.4.1.

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