APPENDIX E: MULTI-TX AND ANTENNA SAR CONSIDERATIONS

E.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.

E.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D01v06 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.

E.3 Tablet SAR Analysis

Table E-1
Simultaneous Transmission Scenarios of WLAN/BT

Configuration	2.4 GHz WLAN WIFI 0 SAR (W/kg)	2.4 GHz WLAN WIFI 0 at 11 dBm SAR (W/kg)	2.4 GHz WLAN WIFI 1 SAR (W/kg)	2.4 GHz WLAN WIFI 1 at 11 dBm SAR (W/kg)	2.4 GHz WLAN WIFI 1 at 9 dBm SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	2.4 GHz WLAN MIMO at 14 dBm SAR (W/kg)	2.4 GHz WLAN MIMO at 12 dBm SAR (W/kg)	5 GHz WLAN WIFI 0 SAR (W/kg)	5 GHz WLAN WIFI 0 at 7 dBm SAR (W/kg)	5 GHz WLAN WIFI 1 SAR (W/kg)	5 GHz WLAN WIFI 1 at 7 dBm SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	5 GHz WLAN MIMO at 10 dBm SAR (W/kg)	5 GHz WLAN MIMO at 8.5 dBm SAR (W/kg)	6 GHz WLAN WIFI 0 SAR (W/kg)	6 GHz WLAN WIFI 0 at 5.5 dBm SAR (W/kg)	6 GHz WLAN WIFI 1 SAR (W/kg)	6 GHz WLAN WIFI 1 at 5.5 dBm SAR (W/kg)	6 GHz WLAN MIMO SAR (W/kg)	6 GHz WLAN MIMO at 8.5 dBm SAR (W/kg)	6 GHz WLAN MIMO at 4.5 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 at 6.5 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 1 SAR (W/kg)	2.4 GHz Bluetooth WIFI 1 at 6.5 dBm SAR (W/kg)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Back	0.029	0.421	0.040	0.396	0.259	0.041	0.427	0.297	0.088	0.646	0.100	0.322	0.106	0.651	0.382	0.015	0.709	0.005	0.130	0.013	0.816	0.468	0.020	0.153	0.029	0.135
Top	0.010	0.209	0.047	0.213	0.175	0.045	0.235	0.203	0.075	0.096	0.098	0.129	0.093	0.114	0.107	0.009	0.025	0.007	0.024	0.006	0.048	0.027	0.012	0.059	0.021	0.067
Bottom	0.014	0.044*	0.045	0.107*	0.107*	0.051	0.051*	0.051*	0.019	0.019*	0.083	0.083*	0.087	0.087*	0.087*	0.005	0.005*	0.000	0.000	0.000	0.000*	0.000*	0.017	0.017	0.035	0.035
Right	0.000	0.009*	0.095	0.500	0.274	0.105	0.575	0.360	0.014	0.014*	0.295	0.542	0.247	0.523	0.334	0.001	0.001*	0.013	0.247	0.010	0.377	0.110	0.000	0.000	0.079	0.182
Left	0.051	0.248	0.004	0.005*	0.005*	0.056	0.241	0.192	0.274	0.634	0.005	0.005*	0.222	0.728	0.493	0.034	0.167	0.002	0.002*	0.028	0.458	0.157	0.025	0.081	0.001	0.001

Configuration	2.4 GHz Bluetooth WIFI 1 at 6.5 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 1 at 6.5 dBm + 5 GHz WLAN MIMO at 10 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 1 at 6.5 dBm + 6 GHz WLAN MIMO at 8.5 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 at 6.5 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 at 6.5 dBm + 5 GHz WLAN MIMO at 10 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 at 6.5 dBm + 6 GHz WLAN MIMO at 8.5 dBm SAR (W/kg)	2.4 GHz WLAN MIMO at 12 dBm + 6 GHz WLAN MIMO at 4.5 dBm SAR (W/kg)	2.4 GHz WLAN MIMO at 12 dBm + 5 GHz WLAN MIMO at 8.5 dBm SAR (W/kg)	2.4 GHz WLAN WIFI 1 at 11 dBm SAR (W/kg)	5 GHz WLAN MIMO at 10 dBm SAR (W/kg)	6 GHz WLAN MIMO at 8.5 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 at 6.5 dBm + 2.4 GHz WLAN WIFI 1 at 9 dBm + 5 GHz WLAN MIMO at 8.5 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 at 6.5 dBm + 2.4 GHz WLAN WIFI 1 at 9 dBm + 6 GHz WLAN MIMO at 4.5 dBm SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 at 6.5 dBm + 2.4 GHz WLAN WIFI 1 at 11 dBm SAR (W/kg)	2.4 GHz WLAN WIFI 0 at 11 dBm SAR (W/kg)	2.4 GHz WLAN WIFI 1 at 11 dBm SAR (W/kg)	5 GHz WLAN WIFI 0 at 7 dBm SAR (W/kg)	5 GHz WLAN WIFI 1 at 7 dBm SAR (W/kg)	6 GHz WLAN WIFI 0 at 5.5 dBm SAR (W/kg)	6 GHz WLAN WIFI 1 at 5.5 dBm SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	26	26+14	26+21	24	24+14	24+21	8+22	8+15	4	14	21	24+5+15	24+5+22	24+4	2	4	10	12	17	19	
Back	0.135	0.786	0.951	0.153	0.804	0.969	0.765	0.679	0.396	0.651	0.816	0.794	0.880	0.549	0.421	0.396	0.646	0.322	0.709	0.130	0.969
Top	0.067	0.181	0.115	0.059	0.173	0.107	0.230	0.310	0.213	0.114	0.048	0.341	0.261	0.272	0.209	0.213	0.096	0.129	0.025	0.024	0.341
Bottom	0.035	0.122	0.035	0.017	0.104	0.017	0.051	0.138	0.107	0.087	0.000	0.211	0.124	0.124	0.044	0.107	0.019	0.083	0.005	0.000	0.211
Right	0.182	0.705	0.559	0.000	0.523	0.377	0.470	0.694	0.500	0.523	0.377	0.608	0.384	0.500	0.009	0.500	0.014	0.542	0.001	0.247	0.705
Left	0.001	0.729	0.459	0.081	0.809	0.539	0.349	0.685	0.005	0.728	0.458	0.579	0.243	0.086	0.248	0.005	0.634	0.005	0.167	0.002	0.809

Notes:

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

2. Values with * were tested at a higher, more conservative power level.

E.4 Laptop SAR Analysis

Table E-2
Simultaneous Transmission Scenarios of WLAN/BT

Configuration	2.4 GHz WLAN WIFI 0 SAR (W/kg)	2.4 GHz WLAN WIFI 1 SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	5 GHz WLAN WIFI 0 SAR (W/kg)	5 GHz WLAN WIFI 1 SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	6 GHz WLAN WIFI 0 SAR (W/kg)	6 GHz WLAN WIFI 1 SAR (W/kg)	6 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 SAR (W/kg)	2.4 GHz Bluetooth WIFI 1 SAR (W/kg)
	1	2	3	4	5	6	7	8	9	10	11
Bottom	0.157	0.005	0.191	0.373	0.054	0.371	0.157	0.015	0.415	0.075	0.000

Configuration	2.4 GHz Bluetooth WIFI 1 SAR (W/kg)	2.4 GHz Bluetooth WIFI 1 + 6 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WIFI 1 + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 + 6 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO SAR (W/kg)	2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz WLAN MIMO SAR (W/kg)	6 GHz WLAN MIMO SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 + 2.4 GHz WLAN WIFI 1 + 5 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 + 2.4 GHz WLAN WIFI 1 + 6 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth WIFI 0 + 2.4 GHz WLAN WIFI 1 SAR (W/kg)	2.4 GHz WLAN WIFI 0 SAR (W/kg)	2.4 GHz WLAN WIFI 1 SAR (W/kg)	5 GHz WLAN WIFI 0 SAR (W/kg)	5 GHz WLAN WIFI 1 SAR (W/kg)	6 GHz WLAN WIFI 0 SAR (W/kg)	6 GHz WLAN WIFI 1 SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	11	11+9	11+6	10	10+9	10+6	3+9	3+6	3	9	6	10+2+6	10+2+9	10+2	1	2	4	5	7	8	
Bottom	0.000	0.415	0.371	0.075	0.490	0.446	0.606	0.562	0.191	0.415	0.371	0.451	0.495	0.080	0.157	0.005	0.373	0.054	0.157	0.015	0.606

Notes:

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

E.5 Conclusion

The above numerical summed SAR results are sufficient to show 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