

# APPENDIX F: SIMULTANEOUS NUMERICAL CALCULATIONS

## F.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.

## F.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  $\leq 1.6$  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.

This device is enabled with Qualcomm® Smart Transmit Gen2 with pre-defined sub6 antenna groups (AG0 and AG1). Simultaneous transmission analysis is performed per antenna groups. Appendix E contains analysis to demonstrate the AG0 and AG1 are operate mutually exclusive. Additional analysis is provided below to show compliance between AG0 and BT/WLAN and AG1 BT/WLAN.

When operating in the same antenna group, Qualcomm Smart Transmit algorithm in WWAN directly adds the time-averaged RF exposure from 4G and time-averaged RF exposure from 5G NR. Smart Transmit algorithm controls the total RF exposure from both 4G and 5G NR to not exceed FCC limit. Therefore, simultaneous transmission compliance between 4G+5G operations within an antenna group is demonstrated in the Part 2 Report during algorithm validation.

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### F.3 Head Simultaneous Transmission Analysis

**Table F-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 0 at 11 dBm SAR (W/kg)	2.4 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz WLAN Chain 1 at 11 dBm SAR (W/kg)	5 GHz WLAN Chain 0 SAR (W/kg)	5 GHz WLAN Chain 0 at 9.5 dBm SAR (W/kg)	5 GHz WLAN Chain 1 SAR (W/kg)	5 GHz WLAN Chain 1 at 9.5 dBm SAR (W/kg)	6 GHz WLAN MIMO 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	7	8	9	10	11	
Right Cheek	0.816	0.390	0.010*	0.010*	0.353	0.171	0.010*	0.010	0.137	0.361	0.014	
Right Tilt	0.122	0.069	0.010*	0.010*	0.353*	0.171*	0.010*	0.010*	0.016	0.071	0.014	
Left Cheek	0.206	0.078	0.010*	0.010	0.353*	0.171*	0.010	0.010*	0.027	0.091	0.014	
Left Tilt	0.068	0.020	0.010	0.010*	0.353*	0.171*	0.010	0.010*	0.018	0.018	0.014	
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 at 11 dBm + 2.4 GHz WLAN Chain 1 at 11 dBm + 5 GHz WLAN Chain 0 at 9.5 dBm + 5 GHz WLAN Chain 1 at 9.5 dBm SAR (W/kg)	2.4 GHz WLAN Chain 0 at 11 dBm + 2.4 GHz WLAN Chain 1 at 11 dBm + 6 GHz WLAN MIMO 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)	2.4 GHz Bluetooth Chain 0 + 6 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth Chain 1 + 6 GHz WLAN MIMO SAR (W/kg)	6 GHz WLAN MIMO SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1+3	5+7	2+4+6+8	2+4+9	10	11	10+5+7	11+5+7	10+9	11+9	9	
Right Cheek	0.826	0.363	0.581	0.537	0.361	0.014	0.724	0.377	0.498	0.151	0.137	0.826
Right Tilt	0.132	0.363	0.260	0.095	0.071	0.014	0.434	0.377	0.087	0.030	0.016	0.434
Left Cheek	0.216	0.363	0.269	0.115	0.091	0.014	0.454	0.377	0.118	0.041	0.027	0.454
Left Tilt	0.078	0.363	0.211	0.048	0.018	0.014	0.381	0.377	0.036	0.032	0.018	0.381

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

Head SAR	Configuration	AG0 SAR (W/kg)	AG1 SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	AG0 + WLAN/BT SAR (W/kg)	AG1 + WLAN/BT SAR (W/kg)
		Right Cheek	0.212	0.274	0.826	1.038
Right Tilt	0.209	0.150	0.434	0.643	0.584	
Left Cheek	0.165	0.975	0.454	0.619	1.429	
Left Tilt	0.165	0.559	0.381	0.546	0.940	

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## F.4 Body-worn Simultaneous Transmission Analysis

**Table F-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 0 at 11 dBm SAR (W/kg)	2.4 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz WLAN Chain 1 at 11 dBm SAR (W/kg)	5 GHz WLAN Chain 0 SAR (W/kg)	5 GHz WLAN Chain 0 at 9.5 dBm SAR (W/kg)	5 GHz WLAN Chain 1 SAR (W/kg)	5 GHz WLAN Chain 1 at 9.5 dBm SAR (W/kg)	6 GHz WLAN MIMO 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	7	8	9	10	11
Back	0.139*	0.052	0.082	0.048	0.026	0.019	0.155	0.108	0.061	0.066	0.016
Front	0.139	0.052*	0.082*	0.048*	0.017	0.009	0.155*	0.108*	0.008	0.051	0.014

  

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 at 11 dBm + 2.4 GHz WLAN Chain 1 at 11 dBm + 5 GHz WLAN Chain 0 at 9.5 dBm + 5 GHz WLAN Chain 1 at 9.5 dBm SAR (W/kg)	2.4 GHz WLAN Chain 0 at 11 dBm + 2.4 GHz WLAN Chain 1 at 11 dBm + 6 GHz WLAN MIMO 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)	2.4 GHz Bluetooth Chain 0 + 6 GHz WLAN MIMO SAR (W/kg)	2.4 GHz Bluetooth Chain 1 + 6 GHz WLAN MIMO SAR (W/kg)	6 GHz WLAN MIMO SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1+3	5+7	2+4+6+8	2+4+9	10	11	10+5+7	11+5+7	10+9	11+9	9	
Back	0.221	0.181	0.227	0.161	0.066	0.016	0.247	0.197	0.127	0.077	0.061	0.247
Front	0.221	0.172	0.217	0.108	0.051	0.014	0.223	0.186	0.059	0.022	0.008	0.223

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

Body-worn SAR	Configuration	AG0 SAR (W/kg)	AG1 SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	AG0 + WLAN/BT SAR (W/kg)	AG1 + WLAN/BT SAR (W/kg)
		Back	0.832	0.156	0.247	1.079
Front	0.734	0.163	0.223	0.957	0.386	

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## F.5 Hotspot Simultaneous Transmission Analysis

**Table F-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 0 at 11 dBm SAR (W/kg)	2.4 GHz WLAN Chain 1 SAR (W/kg)	2.4 GHz WLAN Chain 1 at 11 dBm SAR (W/kg)	5 GHz WLAN Chain 0 SAR (W/kg)	5 GHz WLAN Chain 0 at 9.5 dBm SAR (W/kg)	5 GHz WLAN Chain 1 SAR (W/kg)	5 GHz WLAN Chain 1 at 9.5 dBm 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	7	8	9	10
Back	0.232*	0.052	0.082	0.048	0.106*	0.065*	0.087	0.039	0.066	0.016
Front	0.139	0.103*	0.082*	0.048*	0.014	0.009	0.087*	0.039*	0.051	0.014
Top	0.232*	0.103*	-	-	0.106*	0.065*	-	-	0.001	-
Bottom	-	-	0.004	0.010	-	-	0.087*	0.039*	-	0.014
Right	-	-	-	-	-	-	-	-	-	-
Left	0.232	0.103	0.082*	0.048*	0.106	0.065	0.087*	0.039*	0.117	0.014

  

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 at 11 dBm + 2.4 GHz WLAN Chain 1 at 11 dBm + 5 GHz WLAN Chain 0 at 9.5 dBm + 5 GHz WLAN Chain 1 at 9.5 dBm 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+3	5+7	2+4+6+8	9	10	9+5+7	10+5+7	
Back	0.314	0.193	0.204	0.066	0.016	0.259	0.209	0.314
Front	0.221	0.101	0.199	0.051	0.014	0.152	0.115	0.221
Top	0.232	0.106	0.168	0.001	-	0.107	0.106	0.232
Bottom	0.004	0.087	0.049	-	0.014	0.087	0.101	0.101
Right	-	-	-	-	-	-	-	-
Left	0.314	0.193	0.255	0.117	0.014	0.310	0.207	0.314

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

Hotspot SAR	Configuration	AG0 SAR (W/kg)	AG1 SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	AG0 + WLAN/BT SAR (W/kg)	AG1 + WLAN/BT SAR (W/kg)
		Back	0.721	0.156	0.314	1.035
Front	0.676	0.160	0.221	0.897	0.381	
Top	-	0.115	0.232	0.232	0.347	
Bottom	0.347	-	0.101	0.448	0.101	
Right	0.143	0.236	-	0.143	0.236	
Left	0.323	0.191	0.314	0.637	0.505	

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## F.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 F-7  
Simultaneous Transmission Scenarios of WLAN**

Configuration	5 GHz WLAN Chain 0 SAR (W/kg)	5 GHz WLAN Chain 1 SAR (W/kg)	6 GHz WLAN MIMO SAR (W/kg)	NFC (W/kg)
	1	2	3	4
Back	0.322*	0.288	0.304	0.010
Front	0.322*	0.288*	0.040	0.000
Top	0.322*	-	0.018	0.000
Bottom	-	0.288*	0.002	-
Right	-	0.288*	-	0.000
Left	0.322	-	0.199	-

**Table F-8  
Simultaneous Transmission Scenarios with WLAN**

Configuration	5 GHz WLAN Chain 0 + 5 GHz WLAN Chain 1 SAR (W/kg)	6 GHz WLAN MIMO SAR (W/kg)	NFC (W/kg)	WLAN Worst-case Combination SAR (W/kg)
	1+2	3	4	
Back	0.610	0.304	0.010	0.610
Front	0.610	0.040	0.000	0.610
Top	0.322	0.018	0.000	0.322
Bottom	0.288	0.002	-	0.288
Right	0.288	-	0.000	0.288
Left	0.322	0.199	-	0.322

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**Table F-9  
Simultaneous Transmission Scenarios with WLAN**

Phablet SAR	Configuration	AGO SAR (W/kg)	WLAN Worst-case Combination SAR (W/kg)	AGO + WLAN SAR (W/kg)
	Back	1.727	0.610	2.337
	Front	-	0.610	0.610
	Top	-	0.322	0.322
	Bottom	1.082	0.288	1.370
	Right	-	0.288	0.288
	Left	-	0.322	0.322

Notes:

1. 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.

**F.7 Simultaneous Transmission Conclusion**

The above numerical summed SAR results and SPLSR 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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