

APPENDIX E: MULTI-TX AND ANTENNA SAR CONSIDERATIONS

FCC ID: BCGA3416	RF EXPOSURE REPORT	Approved by: Technical Manager
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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 together.

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 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.

Note:

SAR Summations for some scenarios when the output power levels are reduced, SAR values at the maximum output power level were used as the most conservative evaluation for simultaneous transmission analysis.

*Per FCC approved test plan when two antennas operate in simultaneous mode, simultaneous transmission were treated independently for this configuration since their SAR peaks do not occur on the same plane and only one side of the device will become the main contributor to the overall

E.3 Head SAR Simultaneous Transmission Analysis

Table E-1
NB UNII Simultaneous Transmission Scenario with 2.4 GHz Bluetooth

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	Bluetooth Ant 1 SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	4	1+2+3	1+2+4
Head SAR	Head	0.086	0.056	0.021	0.003	0.086*	0.086*

Table E-2
NB UNII Simultaneous Transmission Scenario with 2.4 GHz WLAN

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	4	1+2+3	1+2+4
Head SAR	Head	0.086	0.056	0.036	0.059	0.086*	0.086*

Table E-3
NB UNII Simultaneous Transmission Scenario with 5 GHz WLAN

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	4	1+2+3	1+2+4
Head SAR	Head	0.086	0.056	0.029	0.024	0.086*	0.086*

Table E-4
NB UNII Simultaneous Transmission Scenario with 2.4 GHz Bluetooth and 5 GHz WLAN

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	Bluetooth Ant 1 SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)			
		1	2	3	4	5	6	1+2+3+5	1+2+3+6	1+2+4+5	1+2+4+6
Head SAR	Head	0.086	0.056	0.021	0.003	0.029	0.024	0.086*	0.086*	0.086*	0.086*

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Table E-5

NB UNII Simultaneous Transmission Scenario with 2.4 GHz WLAN and 2.4 GHz Bluetooth

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	4	1+2+3+4
Head SAR	Head	0.086	0.056	0.003	0.036	0.086*

Table E-6

2.4 GHz WLAN Simultaneous Transmission Scenario with 2.4 GHz Bluetooth

Exposure Condition	Configuration	Bluetooth Ant 2 SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	1+3	2+3
Head SAR	Head	0.072	0.003	0.036	0.072*	0.036*

Table E-7

5 GHz WLAN Simultaneous Transmission Scenario with 2.4 GHz Bluetooth

Exposure Condition	Configuration	Bluetooth Ant 1 SAR (W/kg)	Bluetooth Ant 2 SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)					
		1	2	3	4	5	1+4	1+5	2+4	2+5	3+4	3+5
Head SAR	Head	0.021	0.072	0.003	0.029	0.024	0.050	0.024*	0.072*	0.096	0.029*	0.024*

Table E-8

2.4 GHz Bluetooth(TXBF) Simultaneous Transmission Scenario

Exposure Condition	Configuration	Bluetooth Ant 1 SAR (W/kg)	Bluetooth Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Head	0.021	0.072	0.072*

Table E-9

5 GHz WLAN Simultaneous Transmission Scenario with 2.4 GHz Bluetooth(TXBF)

Exposure Condition	Configuration	Bluetooth Ant 1 SAR (W/kg)	Bluetooth Ant 2 SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	4	1+2+3	1+2+4
Head SAR	Head	0.021	0.072	0.029	0.024	0.05*	0.096

E.4 Extremity SAR Simultaneous Transmission Analysis

For SAR summation, the highest reported SAR across all housing and wristband types was used as a conservative evaluation for simultaneous transmission analysis.

Table E-10

NB UNII Simultaneous Transmission Scenario with 2.4 GHz Bluetooth

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	Bluetooth Ant 1 SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	4	1+2+3	1+2+4
Extremity SAR	Extremity	0.085	0.086	1.634	0.141	1.634*	0.227*

Table E-11

NB UNII Simultaneous Transmission Scenario with 2.4 GHz WLAN

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	4	1+2+3	1+2+4
Extremity SAR	Extremity	0.085	0.086	2.702	2.332	2.702*	2.332*

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Table E-12
NB UNII TxBF Simultaneous Transmission Scenario with 5 GHz WLAN

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	4	1+2+3	1+2+4
Extremity SAR	Extremity	0.085	0.086	2.943	2.946	2.943*	2.946*

Table E-13
NB UNII Simultaneous Transmission Scenario with 2.4 GHz Bluetooth, and 5 GHz WLAN

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	Bluetooth Ant 1 at 16.5 dBm SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)			
		1	2	3	4	5	6	1+2+3+5	1+2+3+6	1+2+4+5	1+2+4+6
Extremity SAR	Extremity	0.085	0.086	0.689	0.141	2.943	2.946	3.632*	2.946*	2.943*	2.946*

Table E-14
NB UNII Simultaneous Transmission Scenario with 2.4 GHz WLAN and 2.4 GHz Bluetooth

Exposure Condition	Configuration	NB UNII Ant NB UNII_R (5/6 GHz) SAR (W/kg)	NB UNII Ant NB UNII_L (5/6 GHz) SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	4	1+2+3+4
Extremity SAR	Extremity	0.085	0.086	0.141	2.702	2.702*

Table E-15
2.4 GHz WLAN Simultaneous Transmission Scenario with 2.4 GHz Bluetooth

Exposure Condition	Configuration	Bluetooth Ant 2 SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	1+3	2+3
Extremity SAR	Extremity	1.500	0.141	2.702	2.702*	2.702*

Table E-16
5 GHz WLAN Simultaneous Transmission Scenario with 2.4 GHz Bluetooth

Exposure Condition	Configuration	Bluetooth Ant 1 at 16.5 dBm SAR (W/kg)	Bluetooth Ant 2 at 18 dBm SAR (W/kg)	Bluetooth Ant NB UNII_L (2.4GHz) SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)					
		1	2	3	4	5	1+4	1+5	2+4	2+5	3+4	3+5
Extremity SAR	Extremity	0.689	0.779	0.141	2.943	2.946	3.632	2.946*	2.943*	3.725	2.943*	2.946*

Table E-17
2.4 GHz Bluetooth(TXBF) Simultaneous Transmission Scenario

Exposure Condition	Configuration	Bluetooth Ant 1 SAR (W/kg)	Bluetooth Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Extremity SAR	Extremity	1.634	1.500	1.634*

Table E-18
5 GHz WLAN Simultaneous Transmission Scenario with 2.4 GHz Bluetooth(TXBF)

Exposure Condition	Configuration	Bluetooth Ant 1 at 16.5 dBm SAR (W/kg)	Bluetooth Ant 2 at 18 dBm SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	4	1+2+3	1+2+4
Extremity SAR	Extremity	0.689	0.779	2.943	2.946	3.632*	3.725*

Table E-19
2.4 GHz WLAN MIMO Simultaneous Transmission Scenario

Exposure Condition	Configuration	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Extremity SAR	Extremity	2.702	2.332	2.702*

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Table E-20
5 GHz WLAN MIMO Simultaneous Transmission Scenario

Exposure Condition	Configuration	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Extremity SAR	Extremity	2.943	2.946	2.946*

E.5 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is 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.

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