

## APPENDIX D: SIMULTANEOUS NUMERICAL CALCULATIONS

### D.1 Simultaneous Transmission Procedures

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 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.

When standalone SAR is not required to be measured, per FCC KDB 447498 D01v06 4.3.2 b), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

$$\text{Estimated SAR} = \frac{\sqrt{f(\text{GHz})}}{7.5} * \frac{(\text{Max Power of channel, mW})}{\text{Min. Separation Distance, mm}}$$




**Table D-1  
Estimated SAR**

Mode	Frequency	Maximum Allowed Power	Separation Distance (Head)	Estimated SAR (Head)	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]	[mm]	[W/kg]
Bluetooth	2480	9.00	5	0.336	15	0.112

Note: Per KDB Publication 447498 D01v06, the maximum power of the channel was rounded to the nearest mW before calculation.

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.

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### D.3 Head Simultaneous Transmission Analysis

**Table D-2**  
**Simultaneous Transmission Scenarios of WLAN/BT (Held to Ear)**




Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	
Right Cheek	0.209	0.336	0.356*	0.692
Right Tilt	0.209*	0.336	0.356*	
Left Cheek	0.209*	0.336	0.356*	
Left Tilt	0.209*	0.336	0.356	

Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth + 5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	2+3	
Right Cheek	0.209	0.336	0.356	0.692	0.692
Right Tilt	0.209	0.336	0.356	0.692	0.692
Left Cheek	0.209	0.336	0.356	0.692	0.692
Left Tilt	0.209	0.336	0.356	0.692	0.692

**Table D-3**  
**Simultaneous Transmission Scenario with WLAN/BT (Held to Ear)**

Configuration	Ant A SAR (W/kg)	Ant B SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Ant A + WLAN/BT SAR (W/kg)	Ant B + WLAN/BT SAR (W/kg)
	Right Cheek	0.378	0.236	0.692	1.070
Right Tilt	0.196	0.217	0.692	0.888	0.909
Left Cheek	0.325	0.316	0.692	1.017	1.008
Left Tilt	0.181	0.189	0.692	0.873	0.881

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## D.4 Body-worn Simultaneous Transmission Analysis

**Table D-4**  
**Simultaneous Transmission Scenarios of WLAN/BT (Body-worn at 1.5 cm)**




Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	
Back	0.176	0.112	0.543	

Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth + 5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	2+3	
Back	0.176	0.112	0.543	0.655	0.655

**Table D-5**  
**Simultaneous Transmission Scenario with WLAN/BT (Body-worn at 1.5 cm)**

	Configuration	Ant A SAR (W/kg)	Ant B SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Ant A + WLAN/BT SAR (W/kg)	Ant B + WLAN/BT SAR (W/kg)
Bodyworn SAR	Back	0.497	0.397	0.655	1.152	1.052

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## D.5 Hotspot Simultaneous Transmission Analysis

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




Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	
Back	0.444	0.025	0.639	0.664
Front	0.444*	0.006	0.639*	0.645
Top	0.444*	0.006	0.536	0.542
Left	0.192	0.018	0.639*	0.657

Configuration	2.4 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN SAR (W/kg)	2.4 GHz Bluetooth + 5 GHz WLAN SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)
	1	2	3	2+3	
Back	0.444	0.025	0.639	0.664	0.664
Front	0.444	0.006	0.639	0.645	0.645
Top	0.444	0.006	0.536	0.542	0.542
Left	0.192	0.018	0.639	0.657	0.657

**Table D-7**  
Simultaneous Transmission Scenarios with WLAN/BT (Hotspot at 1.0 cm)

Configuration	Ant A SAR (W/kg)	Ant B SAR (W/kg)	WLAN/BT Worst-case Combination SAR (W/kg)	Ant A + WLAN/BT SAR (W/kg)	Ant B + WLAN/BT SAR (W/kg)
	Back	0.755	0.588	0.664	<b>1.419</b>
Front	0.369	0.294	0.645	1.014	0.939
Top	-	-	0.542	0.542	0.542
Bottom	0.486	0.288	-	0.486	0.288
Right	0.517	-	-	0.517	-
Left	0.296	0.302	0.657	0.953	0.959

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## D.6 Phablet Simultaneous Transmission Analysis

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.

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-8**  
**Simultaneous Transmission Scenarios of WLAN**



Configuration	5 GHz WLAN SAR (W/kg)
	1
Back	2.627
Front	0.235
Top	1.011
Left	2.627*

Configuration	5 GHz WLAN SAR (W/kg)	WLAN Worst-case Combination SAR (W/kg)
	1	
Back	2.627	2.627
Front	0.235	0.235
Top	1.011	1.011
Left	2.627	2.627

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




	Configuration	Licensed SAR (W/kg)	WLAN Worst-case Combination SAR (W/kg)	Licensed + WLAN SAR (W/kg)
Phablet SAR	Back	2.656	2.627	See Table Below
	Front	3.043	0.235	3.278
	Top	-	1.011	1.011
	Bottom	1.232	-	1.232
	Left	0.904	2.627	<b>3.531</b>

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Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	$\Sigma$ SAR (W/kg)	SPLSR
		1	2	1+2	1+2
Phablet SAR	Back	1.940	2.627	See Note 1	0.07
Simult Tx	Configuration	UMTS 1750 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	$\Sigma$ SAR (W/kg)	SPLSR
		1	2	1+2	1+2
Phablet SAR	Back	2.182	2.627	See Note 1	0.07
Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	$\Sigma$ SAR (W/kg)	SPLSR
		1	2	1+2	1+2
Phablet SAR	Back	2.421	2.627	See Note 1	0.08
Simult Tx	Configuration	LTE Band 66 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	$\Sigma$ SAR (W/kg)	SPLSR
		1	2	1+2	1+2
Phablet SAR	Back	1.995	2.627	See Note 1	0.07
Simult Tx	Configuration	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	$\Sigma$ SAR (W/kg)	SPLSR
		1	2	1+2	1+2
Phablet SAR	Back	2.400	2.627	See Note 1	0.08
Simult Tx	Configuration	LTE Band 30 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	$\Sigma$ SAR (W/kg)	SPLSR
		1	2	1+2	1+2
Phablet SAR	Back	1.977	2.627	See Note 1	0.07
Simult Tx	Configuration	LTE Band 7 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	$\Sigma$ SAR (W/kg)	SPLSR
		1	2	1+2	1+2
Phablet SAR	Back	2.656	2.627	See Note 1	0.08

Notes:

1. No evaluation was performed to determine the aggregate 10g SAR for these configurations as the SPLS ratio between the antenna pairs was not greater than 0.10 per FCC KDB 447498 D01v06. See Section D.7 for detailed SPLS ratio analysis.

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## D.7 SPLSR Evaluation and Analysis

Per FCC KDB Publication 447498 D01v06, when the sum of the standalone transmitters is more than 1.6 W/kg for 1g and 4 W/kg for 10g, the SAR sum to peak locations can be analyzed to determine SAR distribution overlaps. When the SAR peak to location ratio (shown below) for each pair of antennas is  $\leq 0.04$  for 1g and  $\leq 0.10$  for 10g, simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formula.

$$\text{Distance}_{\text{Tx1} - \text{Tx2}} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \text{ (Phablet)}$$

$$\text{SPLS Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{R_i}$$



## D.8 Phablet Back Side SPLSR Evaluation and Analysis

**Table D-10**  
Peak SAR Locations for Phablet Back Side

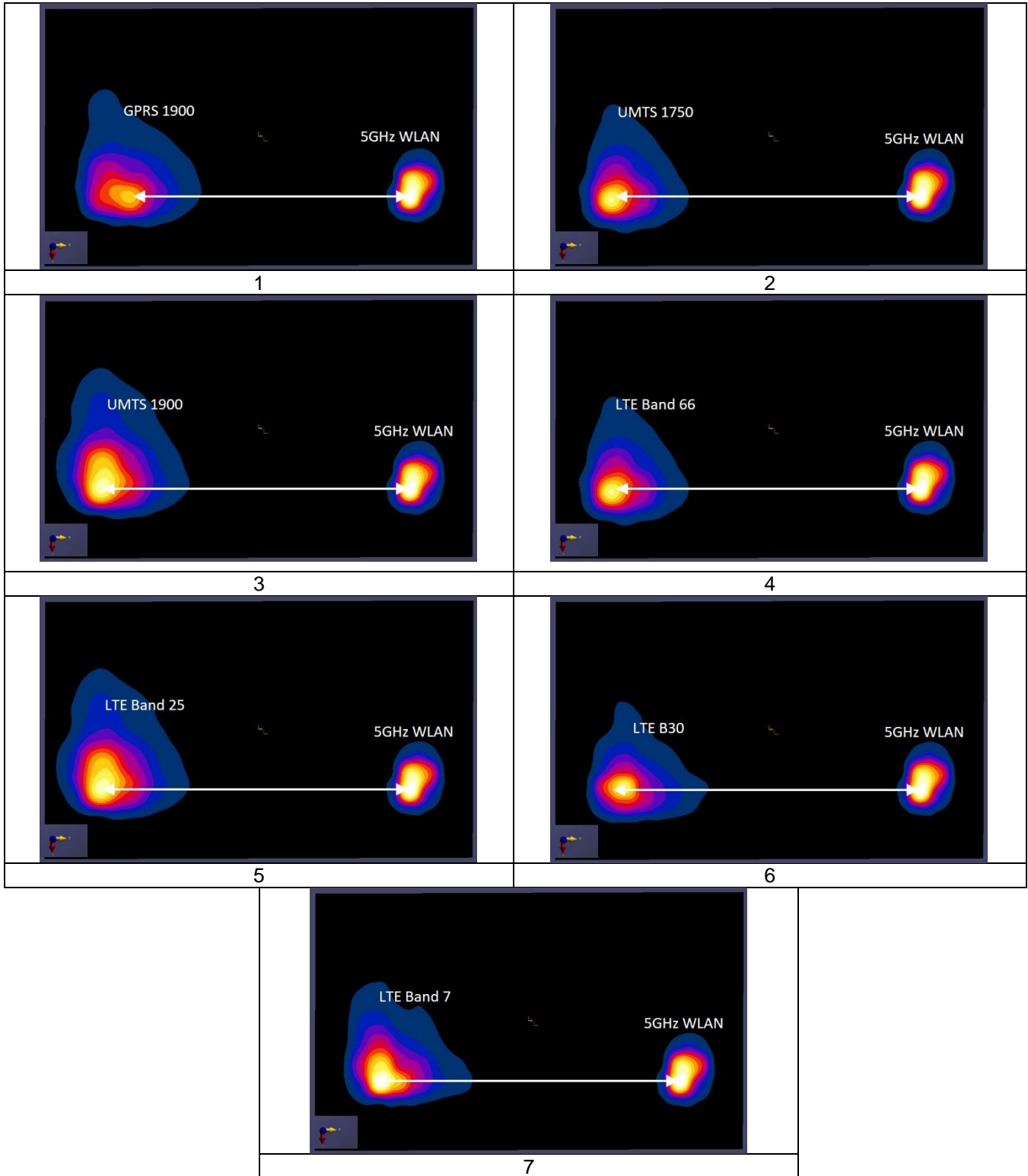
Mode/Band	x (mm)	y (mm)	Reported SAR (W/kg)
5 GHz WLAN	-5.80	74.20	2.627
GPRS 1900	1.00	-69.70	1.940
UMTS 1750	4.90	-74.40	2.182
UMTS 1900	0.00	-76.20	2.421
LTE Band 66 (AWS)	5.70	-74.50	1.995
LTE Band 25 (PCS)	3.40	-69.00	2.400
LTE Band 30	-0.30	-70.90	1.977
LTE Band 7	1.00	-71.90	2.656




**Table D-11**  
Phablet Back Side SAR to Peak Location Separation Ratio Calculations

Antenna Pair		Standalone SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio	Plot Number
Ant "a"	Ant "b"	a	b	a+b	D <sub>a-b</sub>	(a+b) <sup>1.5</sup> /D <sub>a-b</sub>	
5 GHz WLAN	GPRS 1900	2.627	1.940	4.567	144.06	0.07	1
5 GHz WLAN	UMTS 1750	2.627	2.182	4.809	148.98	0.07	2
5 GHz WLAN	UMTS 1900	2.627	2.421	5.048	150.51	0.08	3
5 GHz WLAN	LTE Band 66 (AWS)	2.627	1.995	4.622	149.14	0.07	4
5 GHz WLAN	LTE Band 25 (PCS)	2.627	2.400	5.027	143.50	0.08	5
5 GHz WLAN	LTE Band 30	2.627	1.977	4.604	145.20	0.07	6
5 GHz WLAN	LTE Band 7	2.627	2.656	5.283	146.26	0.08	7

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**Table D-12**  
**Phablet Back Side SAR to Peak Location Separation Plot**






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## D.9 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 6.3.4.1.

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