

Appendix E: Simultaneous Transmission Analysis

E.1. Introduction

According to FCC KDB Publication 447498 D04v01, transmitters are considered to be operating simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

Table E-1 - Supported Simultaneous Transmission Scenarios

#	Scenario	Head	Body-worn	Hotspot	Phablet
1	GSM + 2.4 GHz WIFI_MIMO	Yes	Yes	Yes	Yes
2	GSM + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1	Yes	Yes	Yes	Yes
3	GSM + 2.4 GHz Bluetooth_Chain0	Yes	Yes	Yes	Yes
4	GSM + 2.4 GHz Bluetooth_Chain1	Yes	Yes	Yes	Yes
5	GSM + 2.4 GHz WIFI_MIMO + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1	Yes	Yes	Yes	Yes
6	GSM + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1 + 2.4 GHz Bluetooth_Chain0	Yes	Yes	Yes	Yes
7	GSM + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1 + 2.4 GHz Bluetooth_Chain1	Yes	Yes	Yes	Yes
8	UMTS + 2.4 GHz WIFI_MIMO	Yes	Yes	Yes	Yes
9	UMTS + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1	Yes	Yes	Yes	Yes
10	UMTS + 2.4 GHz Bluetooth_Chain0	Yes	Yes	Yes	Yes
11	UMTS + 2.4 GHz Bluetooth_Chain1	Yes	Yes	Yes	Yes
12	UMTS + 2.4 GHz WIFI_MIMO + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1	Yes	Yes	Yes	Yes
13	UMTS + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1 + 2.4 GHz Bluetooth_Chain0	Yes	Yes	Yes	Yes
14	UMTS + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1 + 2.4 GHz Bluetooth_Chain1	Yes	Yes	Yes	Yes
15	LTE + 2.4 GHz WIFI_MIMO	Yes	Yes	Yes	Yes
16	LTE + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1	Yes	Yes	Yes	Yes
17	LTE + 2.4 GHz Bluetooth_Chain0	Yes	Yes	Yes	Yes
18	LTE + 2.4 GHz Bluetooth_Chain1	Yes	Yes	Yes	Yes
19	LTE + 2.4 GHz WIFI_MIMO + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1	Yes	Yes	Yes	Yes
20	LTE + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1 + 2.4 GHz Bluetooth_Chain0	Yes	Yes	Yes	Yes
21	LTE + 5 GHz WIFI_Chain0 + 5 GHz WIFI_Chain1 + 2.4 GHz Bluetooth_Chain1	Yes	Yes	Yes	Yes

Note: NFC can simultaneously transmit with all the above combinations and was evaluated for phablet based on usage conditions.

E.2. 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 (“-”).

E.3. Simultaneous Transmission Analysis

Table E-2 - WWAN Maximum Reported SAR Values

Exposure Condition	Position	WWAN (W/kg)		
		Main1	Main2	Maximum SAR
Head	Right Cheek	0.126	0.124	0.126
Head	Right Tilt	0.057	0.065	0.065
Head	Left Cheek	0.121	0.055	0.121
Head	Left Tilt	0.061	0.042	0.061
Body-worn	Back	0.268	0.415	0.415
Hotspot	Back	0.257	0.415	0.415
Hotspot	Front	0.166	0.307	0.307
Hotspot	Top	-	-	-
Hotspot	Bottom	0.163	0.463	0.463
Hotspot	Right	-	0.263	0.263
Hotspot	Left	0.200	-	0.200

Table E-3 – Maximum Bluetooth/WLAN Simultaneous Transmission Scenarios

Exposure Condition	Band/Mode	2.4 GHz WiFi	2.4 GHz WiFi	5 GHz WiFi	5 GHz WiFi	2.4 GHz Bluetooth	2.4 GHz Bluetooth	2.4 GHz WiFi_MIMO (W/kg)	5 GHz WiFi_Chain0 + 5 GHz WiFi_Chain1 (W/kg)	2.4 GHz Bluetooth_Chain0 (W/kg)	2.4 GHz Bluetooth_Chain1 (W/kg)	2.4 GHz WiFi_MIMO + 5 GHz WiFi_Chain0 + 5 GHz WiFi_Chain1 (W/kg)	2.4 GHz Bluetooth_Chain0 + 5 GHz WiFi_Chain0 + 5 GHz WiFi_Chain1 (W/kg)	2.4 GHz Bluetooth_Chain1 + 5 GHz WiFi_Chain0 + 5 GHz WiFi_Chain1 (W/kg)	Max BT/WiFi Simultaneous SAR (W/kg)
		Power Level	Power Level	Power Level	Power Level	Power Level	Power Level								
Antenna	Antenna	MIMO	MIMO	Chain0	Chain1	Chain0	Chain1	1	2+3	4	5	1+2+3	2+3+4	2+3+5	
Head (1g)	Right Cheek	0.522	0.375	0.283	0.000	0.043	0.000	0.522	0.283	0.043	0.000	0.658	0.326	0.283	0.658
Head (1g)	Right Tilt	0.100	0.068	0.135	0.002	0.009	0.000	0.100	0.137	0.009	0.000	0.205	0.146	0.137	0.205
Head (1g)	Left Cheek	0.144	0.095	0.081	0.000	0.010	0.000	0.144	0.081	0.010	0.000	0.176	0.091	0.081	0.176
Head (1g)	Left Tilt	0.029	0.013	0.054	0.000	0.005	0.003	0.029	0.054	0.005	0.003	0.067	0.059	0.057	0.067
Body-worn (1g)	Back	0.210	0.105	0.047	0.127	0.072	0.002	0.210	0.174	0.072	0.002	0.279	0.246	0.176	0.279
Hotspot (1g)	Back	0.210	0.105	0.030	0.127	0.072	0.002	0.210	0.157	0.072	0.002	0.262	0.229	0.159	0.262
Hotspot (1g)	Front	0.072	0.060	0.027	0.000	0.055	0.000	0.072	0.027	0.055	0.000	0.087	0.082	0.027	0.087
Hotspot (1g)	Top	0.010	0.007	0.019	-	0.013	-	0.010	0.019	0.013	-	0.026	0.032	0.019	0.032
Hotspot (1g)	Bottom	0.039	0.015	-	0.000	-	0.002	0.039	0.000	-	0.002	0.015	0.000	0.002	0.039
Hotspot (1g)	Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hotspot (1g)	Left	0.168	0.103	0.046	0.023	0.137	0.007	0.168	0.069	0.137	0.007	0.172	0.206	0.076	0.206
Phablet 10g	Back	-	-	0.119	0.263	-	-	-	0.382	-	-	0.382	0.382	0.382	0.382
Phablet 10g	Front	-	-	0.227	0.004	-	-	-	0.231	-	-	0.231	0.231	0.231	0.231
Phablet 10g	Top	-	-	0.031	-	-	-	-	0.031	-	-	0.031	0.031	0.031	0.031
Phablet 10g	Bottom	-	-	-	0.006	-	-	-	0.006	-	-	0.006	0.006	0.006	0.006
Phablet 10g	Right	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phablet 10g	Left	-	-	0.35	0.012	-	-	-	0.362	-	-	0.362	0.362	0.362	0.362

Table E-4 – WWAN+NFC+BT/WLAN Simultaneous

Exposure Condition	Position	Max WWAN SAR (W/kg)	Max NFC SAR (W/kg)	Max BT/WIFI SAR (W/kg)	Σ SAR _{1g} (W/kg)	Σ SAR _{10g} (W/kg)
Head	Right Cheek	0.126	-	0.658	0.784	-
Head	Right Tilt	0.065	-	0.205	0.270	-
Head	Left Cheek	0.121	-	0.176	0.297	-
Head	Left Tilt	0.061	-	0.067	0.128	-
Body-worn	Back	0.415	-	0.279	0.694	-
Hotspot	Back	0.415	-	0.262	0.677	-
Hotspot	Front	0.307	-	0.087	0.394	-
Hotspot	Top	-	-	0.032	0.032	-
Hotspot	Bottom	0.463	-	0.039	0.502	-
Hotspot	Right	0.263	-	-	0.263	-
Hotspot	Left	0.200	-	0.206	0.406	-
Phablet	Back	-	0.011	0.382	-	0.393
Phablet	Front	-	0.000	0.231	-	0.231
Phablet	Top	-	0.000	0.031	-	0.031
Phablet	Bottom	-	-	0.006	-	0.006
Phablet	Right	-	-	-	-	-
Phablet	Left	-	0.000	0.362	-	0.362

The above analysis of the simultaneous transmission scenarios is sufficient to show that simultaneous transmission cases will not exceed the SAR limit. Therefore, no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D04v01 and IEEE 1528- 2013 Section 6.3.4.1.