

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	Extremity
1	WWAN + 2.4 GHz WIFI	N/A	Yes
2	WWAN + 2.4 GHz Bluetooth	Yes	Yes
3	WWAN + 2.4 GHz ANT/ANT+	N/A	Yes

Note:

- NTN, WIFI, ANT/ANT+ are permanently disabled during all voice scenarios where the device may operating in front of the face. Therefore, no held to face scenario was required for standalone or simultaneous transmission analysis for these modes.
- NFC can simultaneously transmit with all the above combinations and was evaluated for extremity 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 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. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the 1g thresholds for the equivalent test cases.

E.3. ANT/ANT+ Estimated SAR

E.3.1 FCC Estimated SAR

Per FCC KDB 447498 D01 v06 Section 4.3.2, when an antenna qualifies for the standalone SAR test exemption and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:

$$\frac{MaxPower}{Distance} \cdot \frac{\sqrt{f_{GHz}}}{18.75} \quad (\text{for 10-g SAR})$$

Where: f_{GHz} = RF Channel frequency in GHz
 $MaxPower$ = Power of channel, including tune-up tolerance, rounded to the nearest mW before calculation
 $Distance$ = Min. Test Separation Distance in mm, rounded to the nearest mm before calculation

Per FCC KDB 447498 D01 v06 Section 4.3.1, "Power and distance are rounded to the nearest mW and mm before calculation." The result is rounded to one decimal place for comparison.

For ANT/ANT+, 4.5 dBm + 2 dB = 6.5 dBm = 4 mW

For distances ≤ 5 mm, per FCC policy the value of 5 shall be used for the distance component of the equation.

$$\frac{\text{MaxPower}}{\text{Distance}} \cdot \frac{\sqrt{f_{\text{GHz}}}}{18.75} = \frac{4}{5} \cdot \frac{\sqrt{2.48}}{18.75} = 0.1 \text{ W/kg} \quad (\text{for 10-g SAR})$$

ANT/ANT+ Estimated SAR is 0.1 W/kg for 10-g SAR.

E.3.2 ISED Estimated SAR

Per RSS-102 Section 7.1.8, an estimated SAR value based on the ratio of the power level and the power exemption limit may be used to determine the standalone SAR value for test configurations that do not require a SAR evaluation based on test reductions. The estimated SAR value is calculated using equation below:

$$\frac{P_{\text{max}}}{P_{\text{max,exemption}}} \cdot 0.25 \cdot \text{SAR}_{\text{limit}}$$

Where:

P_{max}	= maximum power level, including tune-up tolerance, in mW
$P_{\text{max,exemption}}$	= maximum power level of exemption, in mW
$\text{SAR}_{\text{limit}}$	= applicable SAR limit for 1-g and 10-g SAR, in W/kg

For ANT/ANT+, 4.5 dBm + 2 dB = 6.5 dBm = 4 mW

Per RSS-102 Section 6.3, the maximum power level of exemption at frequency 2450 MHz and distance ≤ 5 mm is 7.5 mW for 10-g SAR.

$$\frac{P_{\text{max}}}{P_{\text{max,exemption}}} \cdot 0.25 \cdot \text{SAR}_{\text{limit}} = \frac{4}{7.5} \times 0.25 \times 4.0 = 0.5 \text{ W/kg} \quad (\text{for 10-g SAR})$$

ANT/ANT+ Estimated SAR is 0.5 W/kg for 10-g SAR.

E.4. Simultaneous Transmission Analysis

NFC, NTN, WIFI, ANT/ANT+ are permanently disabled during all voice scenarios where the device may operating in front of the face. Therefore, no held to face scenario was required for standalone or simultaneous transmission analysis for these modes. 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 E-2 – WWAN Maximum Reported SAR Values

Exposure Condition	Position	WWAN SAR (W/kg)
		Main
Head	Front	0.042
Extremity	Back	0.634

Table E-3 – FCC Simultaneous Transmission Analysis

Exposure Condition	Position	Max WWAN SAR (W/kg)	Max NFC SAR (W/kg)	Max BT/WIFI/AN T+ SAR (W/kg)	ΣSAR_{1g} (W/kg)	ΣSAR_{10g} (W/kg)
Head	Front	0.042	-	0.051	0.093	-
Extremity	Back	0.634	0.000	0.127	-	0.761

Table E-4 – ISED Simultaneous Transmission Analysis

Exposure Condition	Position	Max WWAN SAR (W/kg)	Max NFC SAR (W/kg)	Max BT/WIFI/AN T+ SAR (W/kg)	ΣSAR_{1g} (W/kg)	ΣSAR_{10g} (W/kg)
Head	Front	0.042	-	0.051	0.093	-
Extremity	Back	0.634	0.000	0.500	-	1.134

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.