

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	Body	Extremity
1	RFID 920 MHz + 2.4 GHz Bluetooth LE	Yes	Yes

E.2. Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D04v01, IEEE 1528-2013 Section 6.3.4.1.2 and IEC/IEEE 62209-1528 Section 7.4.4, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g/10g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg for 1g SAR or ≤ 4.0 W/kg for 10g SAR. 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.

E.3. Bluetooth LE 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:

$$\frac{MaxPower}{Distance} \cdot \frac{\sqrt{f_{GHz}}}{7.5} \quad (\text{for 1-g SAR})$$
$$\frac{MaxPower}{Distance} \cdot \frac{\sqrt{f_{GHz}}}{18.75} \quad (\text{for 10-g SAR})$$

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 Bluetooth LE, 4.5 dBm = 3 mW

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

$$\frac{\text{MaxPower}}{\text{Distance}} \cdot \frac{\sqrt{f_{\text{GHz}}}}{7.5} = \frac{3}{5} \cdot \frac{\sqrt{2.48}}{7.5} = 0.13 \text{ W/kg} \quad (\text{for 1-g SAR})$$

$$\frac{\text{MaxPower}}{\text{Distance}} \cdot \frac{\sqrt{f_{\text{GHz}}}}{18.75} = \frac{3}{5} \cdot \frac{\sqrt{2.48}}{18.75} = 0.05 \text{ W/kg} \quad (\text{for 10-g SAR})$$

Bluetooth LE Estimated SAR is 0.13 W/kg for 1-g SAR and 0.05 W/kg for 10-g SAR.

E.3.2 ISSED 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 Bluetooth LE, 4.5 dBm = 3 mW

Per RSS-102 Section 6.3, the maximum power level of exemption at frequency 2450 MHz and distance $\leq 5\text{mm}$ is 3.0 mW for 1-g SAR and 7.5 mW for 10-g SAR.

$$\frac{P_{\text{max}}}{P_{\text{max,exemption}}} \cdot 0.25 \cdot \text{SAR}_{\text{limit}} = \frac{3}{3} \times 0.25 \times 1.6 = 0.40 \text{ W/kg} \quad (\text{for 1-g SAR})$$

$$\frac{P_{\text{max}}}{P_{\text{max,exemption}}} \cdot 0.25 \cdot \text{SAR}_{\text{limit}} = \frac{3}{7.5} \times 0.25 \times 4.0 = 0.40 \text{ W/kg} \quad (\text{for 10-g SAR})$$

Bluetooth LE Estimated SAR is 0.40 W/kg for 1-g SAR and 10-g SAR.

E.4. Simultaneous Transmission Analysis

Table E-2 – FCC Simultaneous Transmission Analysis

Exposure Condition	Max 920 MHz SAR (W/kg)	Max Bluetooth LE SAR (W/kg)	ΣSAR_{1g} (W/kg)	ΣSAR_{10g} (W/kg)
Body	0.737	0.130	0.867	-
Extremity	0.282	0.050	-	0.332

Table E-3 – ISED Simultaneous Transmission Analysis

Exposure Condition	Max 920 MHz SAR (W/kg)	Max Bluetooth LE SAR (W/kg)	ΣSAR_{1g} (W/kg)	ΣSAR_{10g} (W/kg)
Body	0.737	0.400	1.137	-
Extremity	0.282	0.400	-	0.682

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, IEEE 1528- 2013 Section 6.3.4.1, and IEC/IEEE 62209-1528 Section 7.4.4.