425948 RF Exposure Technical Brief

FCC 47 CFR 2.1093 SAR Exclusion Calculation

As per FCC KDB 447498 D01 General RF Exposure Guidance DR03-41372

FCC 47 CFR 2.1093 SAR Exclusion Calculation as per KDB 447498 D01 General RF Exposure Guidance DR03-41372								
			Maximum Avg Output Power					
Antenna	Tx	Frequency (MHz)	dBm	mW	Separation Distance (mm)	Worst Case	Threshold	**Result**
1	BLE	2402	1.38	1.37	200	1.00	3.0	**Pass by Exclusion; Threshold Value is less than 3.0.**
1	Zigbee	2480	-4.01	0.40	200	1.00	3.0	**Pass by Exclusion; Threshold Value is less than 3.0.**
1+1	Co-location	2405	2.24	1.68	200	1.00	3.0	**Pass by Exclusion; Threshold Value is less than 3.0.**

KDB 447498 D01 Example Calculation:

$$\left(\frac{\mathrm{mW}}{\mathrm{mM}}\right) * \sqrt{f_{GHz}} \leq 3.0$$

mW = Maximum Output Power in milliWatt

mM = Minimum separation distance in milliMeters.

f_{GHz}= Center frequency of channel.

Results below 1.0 are rounded to nearest 1.

Co-location evaluation explanation:

The co-location evaluation was confirmed to be below the limits by taking the BLE and Zigbee Radiated peak RF output power when measured at the highest found output power frequency, which was found at 2.405GHz. The results were individually tested and then found in compliance by having the ration of the two outputs divided by the respective limits combined and proven to be less than 100% or 1.

BLE Results: 1.38 dBm TX Results (+antenna gain) @ 2.405GHz = 1.374 mW = 0.011 Worst Case = 0.004 or 0.4% of the limit.

Zigbee Results: -5.19 dBm TX Results (+antenna gain) @ 2.405GHz = 0.303 mW = 0.002 Worst Case = 0.001 or 0.1% of the limit.

Combined Results: 0.004+0.001 Worst Case = 0.005 Combined Worst Case or 0.5% of the limit.

RSS-102 SAR exemption calculation

Summary:

Minimum typical separation distance between the antenna and the user = 200mm

Exemption limit from RSS-102 for routine evaluation based on frequency and separation distance for 2450 MHz @ >50mm = **309mW** (see Appendix A: Table 1)

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EUT's EIRP With BLE@ 2.402GHz= 1.37 mW (see EIRP calculation below)

EUT's EIRP With Zigbee @ 2.480GHz= 0.40 mW (see EIRP calculation below)

EUT's EIRP With Co-location @ 2.405GHz= 1.68 mW (see EIRP calculation below)

1.37 mW < 309 mW, 0.4 mW < 309 mW, and 1.68 mW < 309 mW therefore the EUT is exempt from routine SAR evaluation.

EIRP calculation:

BLE @2.402GHz

-0.62 dBm Radiated peak RF output power as measured using a method compliant with RSS-210

2 dBi peak antenna gain

EIRP = peak radiated RF power + peak antenna gain = -0.62dBm + 3 dBi = 1.38dBm = 1.37mW

Zigbee @2.480GHz

-7.21dBm Radiated peak RF output power as measured using a method compliant with RSS-210

3.2 dBi peak antenna gain

EIRP = peak conducted RF power + peak antenna gain = -7.21dBm + 3.2 dBi = -4.01dBm = 0.40mW

EUT's EIRP With Co-location @ 2.405GHz

-0.96 Radiated peak RF output power as measured with BLE and Zigbee @ 2.405GHz and using a method compliant with RSS-210

3.2 dBi peak antenna gain

EIRP = peak conducted RF power + peak antenna gain = -0.96 dBm + 3.2 dBi = 2.24dBm =1.68 mW

Conclusion:

For our EUT transmitting with BLE at 2402 MHz, if we evaluate the EUT against the exemption limits at a distance of 200mm (typical use case), the power at this distance must be below 309mW. 309 mW – 1.37 mW = 307.63mW of margin (pass).

For our EUT transmitting with Zigbee at 2480 MHz, if we evaluate the EUT against the exemption limits at a distance of 200mm (typical use case), the power at this distance must be below 309mW. 309 mW – 0.4 mW = 308.6mW of margin (pass).

For our EUT transmitting with BLE and Zigbee at 2405 MHz, if we evaluate the EUT against the exemption limits at a distance of 200mm (typical use case), the power at this distance must be below 309mW. 309 mW – 1.68mW = 307.32mW of margin (pass).

Appendix A:

From RSS-102

2.5.1 Exemption Limits for Routine Evaluation — SAR Evaluation

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation — Exemption limits for routine evaluation based on frequency and separation distance [4, 5]

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW