

Per FCC §1.1310

MPE Evaluation Formula: $P_d = (P_r) / (4\pi r^2)$

Where,

P_d = Power Density (mW/cm^2)

P_r = Output Power in EIRP (mW) = $1 * 10^{((P_{\text{out}} + G)/10)}$

P_{out} = Conducted output power (dBm)

G = gain of antenna (dBi)

$\pi = 3.1416$

r = distance between observation point and center of the radiator (cm)

FCC 47 CFR 1.1310 MPE Exclusion Calculation									
Antenna	Tx	Frequency Range (MHz)	Maximum Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Separation Distance (cm)	Worst Case (mW/cm^2)	Threshold (mW/cm^2)	Result
1	2.4GHz	2412 - 2462	26.78	3.00	950.60	20	0.19	1.0	Pass by Exclusion; Threshold Value is less than 1.0
2	2.4GHz	2412 - 2462							
1	U-NII 1	5190 – 5230	21.94	4.00	392.64	20	0.08	1.0	Pass by Exclusion; Threshold Value is less than 1.0
2	U-NII 1	5190 – 5230							
1	U-NII 3	5755 - 5795	20.84	4.00	304.79	20	0.06	1.0	Pass by Exclusion; Threshold Value is less than 1.0
2	U-NII 3	5755 - 5795							

RSS-102 MPE exemption calculation

Summary:

Minimum typical separation distance between the antenna and the user = 20cm

Exemption limit from RSS-102 for routine evaluation based on frequency and separation distance for

2450 MHz @ >50mm = **1 mW/cm^2** (see Appendix A: Table 1)

5800 MHz @ >50mm = **1 mW/cm^2** (see Appendix A: Table 1)

EUT's Worst Case @ 2.4GHz= 0.19 mW/cm^2 (see Worst Case calculation below)

EUT's Worst Case @ 5.23GHz= 0.08 mW/cm^2 (see Worst Case calculation below)

EUT's Worst Case@ 5.755GHz= 0.06 mW/cm^2 (see Worst Case calculation below)

0.39 < 1, 0.08 < 1, and 0.06 < 1, therefore the EUT is exempt from routine MPE evaluation.

Worst Case calculation:**@2.4GHz**

29.88dBm maximum conducted RF output power as measured using a method compliant with RSS-210

3 dBi peak antenna gain

EIRP = peak conducted RF power + peak antenna gain = 26.78dBm + 3 dBi = 29.78dBm = 950.60mW

Power Density = EIRP / $(4 \times 3.1416 \times \text{distance}^2)$ = 950.60 / $(4 \times 3.1416 \times 20^2)$ = 0.19 mW/cm²

@5.23GHz

20dBm Maximum conducted RF output power as measured using a method compliant with RSS-210

4 dBi peak antenna gain

EIRP = peak conducted RF power + peak antenna gain = 21.94dBm + 4 dBi = 25.94 dBm = 392.64mW

Power Density = EIRP / $(4 \times 3.1416 \times \text{distance}^2)$ = 392.64 / $(4 \times 3.1416 \times 20^2)$ = 0.08 mW/cm²

@5.755GHz

20dBm Maximum conducted RF output power as measured using a method compliant with RSS-210

4 dBi peak antenna gain

EIRP = peak conducted RF power + peak antenna gain = 20.84dBm + 4 dBi = 24.84 dBm = 304.79mW

Power Density = EIRP / $(4 \times 3.1416 \times \text{distance}^2)$ = 304.79 / $(4 \times 3.1416 \times 20^2)$ = 0.06 mW/cm²

Conclusion:

For our EUT transmitting at 2462 MHz, if we evaluate the EUT against the exemption limits at a distance of 20cm (typical use case), the power at this distance must be below 1 mW/cm². 1 mW/cm² – 0.39 mW/cm² = 0.61mW of margin (pass).

For our EUT transmitting at 5230 MHz, if we evaluate the EUT against the exemption limits at a distance of 20cm (typical use case), the power at this distance must be below 1 mW/cm². 1 mW/cm² – 0.08 mW/cm² = 0.92 mW/cm² of margin (pass).

For our EUT transmitting at 5755 MHz, if we evaluate the EUT against the exemption limits at a distance of 20cm (typical use case), the power at this distance must be below 1 mW/cm². 1 mW/cm² – 0.06 mW/cm² = 0.94 mW/cm² of margin (pass).

Appendix A:

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1.

According to FCC §1.1310 and RSS-102: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	...	...	f/300	6
1500-100,000	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	...	...	f/1500	30
1500-100,000	...	...	1.0	30

Table 1-1. Limits for Maximum Permissible Exposure (MPE)