

Per FCC §1.1310

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

Where,

P_d = Power Density (mW/cm²)

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

P_{out} = Conducted output power (dBm)

G = gain of antenna (dBi)

π = 3.141592654

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

FCC 47 CFR 1.1310 MPE Exclusion Calculation									
				Maximum Peak Output Power				Threshold (mW/cm ²)	Result
Antenna	Antenna Type	Tx	Frequency (MHz)	dBm	mW	Separation Distance (cm)	Worst Case (mW/cm ²)		
1	Dipole	U-NII 1	5220	23.89	244.71	300	0.01	1.0	Pass by Exclusion; Threshold Value is less than 1.0.
2	Dipole	U-NII 1	5220						
1	Horn	U-NII 1	5220	7.05	5.07	300	0.01	1.0	Pass by Exclusion; Threshold Value is less than 1.0.
2	Horn	U-NII 1	5220						
1	Dipole	U-NII 3	5745	25.38	345.16	300	0.01	1.0	Pass by Exclusion; Threshold Value is less than 1.0.
2	Dipole	U-NII 3	5745						
1	Horn	U-NII 3	5745	7.29	5.36	300	0.01	1.0	Pass by Exclusion; Threshold Value is less than 1.0.
2	Horn	U-NII 3	5745						

*Results are rounded to nearest 0.01

RSS-102 SAR exemption calculation

Summary:

Minimum typical separation distance between the antenna and the user = 3 Meters = 300 centimeters

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

300MHz $\leq$ 6GHz = **4.5491W @ 5.22GHz & 4.857W @ 5.745GHz** (see Appendix A)

EUT's EIRP with Dipole Antenna @ 5.22GHz= 0.8091 W (see EIRP calculation below)

EUT's EIRP with Horn Antenna @ 5.22Gz= 0.1366 W (see EIRP calculation below)

EUT's EIRP with Dipole Antenna @ 5.745GHz= 0.9863 W (see EIRP calculation below)

EUT's EIRP with Horn Antenna @ 5.745GHz= 0.1443 W (see EIRP calculation below)

0.8091W < 4.5491W, 0.1366W < 4.5491W, 0.9863W < 4.857W, and 0.1443W < 4.857W, therefore the

EUT is exempt from routine SAR evaluation.

EIRP Limit calculation:

$$\text{@5.22GHz} = 1.31 * 10^{-2} (5220^{0.6834}) = 4.5491 \text{ W}$$

$$\text{@5.745GHz} = 1.31 * 10^{-2} (5745^{0.6834}) = 4.857 \text{ W}$$

EIRP calculation:

Dipole Antenna @5.22GHz

23.89dBm peak conducted RF output power as measured using a method compliant with RSS-210

5.19 dBi peak antenna gain

$$\text{EIRP} = \text{peak conducted RF power} + \text{peak antenna gain} = 23.89\text{dBm} + 5.19 \text{ dBi} = 29.08\text{dBm} = 0.8091\text{W}$$

Horn Antenna @5.22GHz

7.05 dBm peak conducted RF output power as measured using a method compliant with RSS-210

14.3 dBi peak antenna gain

$$\text{EIRP} = \text{peak conducted RF power} + \text{peak antenna gain} = 7.05\text{dBm} + 14.3\text{dBi} = 21.35\text{dBm} = 0.1366\text{W}$$

Dipole Antenna @5.745GHz

25.38dBm peak conducted RF output power as measured using a method compliant with RSS-210

4.56dBi peak antenna gain

$$\text{EIRP} = \text{peak conducted RF power} + \text{peak antenna gain} = 25.38\text{dBm} + 4.56 \text{ dBi} = 29.94\text{dBm} = 0.9863\text{W}$$

Horn Antenna @5.745GHz

7.29 dBm peak conducted RF output power as measured using a method compliant with RSS-210

14.3 dBi dBi peak antenna gain

$$\text{EIRP} = \text{peak conducted RF power} + \text{peak antenna gain} = 7.29\text{dBm} + 14.3\text{dBi} = 21.59\text{dBm} = 0.1443 \text{ W}$$

Conclusion:

For our EUT transmitting at 5220 MHz with the dipole antenna, if we evaluate the EUT against the exemption limits at a distance of 3m (typical use case), the power at this distance must be below 4.5491W. $4.5491\text{W} - 0.8091\text{W} = 3.7400\text{W}$ of margin (pass).

For our EUT transmitting at 5220 MHz with the horn antenna, if we evaluate the EUT against the exemption limits at a distance of 3m (typical use case), the power at this distance must be below 4.5491W. $4.5491\text{W} - 0.1366\text{W} = 4.4125\text{W}$ of margin (pass).

For our EUT transmitting at 5745 MHz with the dipole antenna, if we evaluate the EUT against the exemption limits at a distance of 3m (typical use case), the power at this distance must be below 4.857W. $4.857\text{W} - 0.9863\text{W} = 3.5628\text{W}$ of margin (pass).

For our EUT transmitting at 5745 MHz with the Horn antenna, if we evaluate the EUT against the exemption limits at a distance of 3m (typical use case), the power at this distance must be below 4.857W. $4.857\text{W} - 0.1443\text{W} = 4.7127\text{W}$ 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)

From RSS-102

2.5.2 Exemption Limits for Routine Evaluation — RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz⁶ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $22.48/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.