

5 FCC §15.247(i), §1.1307(b)(3) - RF Exposure

5.1 Applicable Standard

According to subpart 15.247(i) and subpart §1.1307(b)(3), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.

5.2 RF Exposure Evaluation Result

Project info

Beam-forming:

For the 2.4G Wi-Fi, as it can support the beam-forming function,

So Directional gain = GANT + 10*log(2) , 2.4+3.01 = 5.41 dBi

Band	Freq (MHz)	Tune-up Average Power (dBm)	Ant Gain (dBi)	Distances (mm)	Tune-up Average Power (mW)	ERP (dBm)	ERP (mW)
WIFI 2.4GHz	2412	22.9	5.41	200	194.98	26.16	413.05
WIFI 5GHz Band 1	5180	26.5	9.05	200	446.68	33.4	2187.76
WIFI 5GHz Band 4	5745	26	9.49	200	398.11	33.34	2157.74

§ 1.1307(b)(3)(i)(A) and (C) method is not applicable.

§ 1.1307(b)(3)(i)(B)

Band	Freq (MHz)	Pth (mW)	X	ERP 20cm (mW)	Ratio	Result Option B
WIFI 2.4GHz	2412	3060.00	1.899	3060	0.13	exempt
WIFI 5GHz Band 1	5180	3060.00	2.065	3060	0.71	exempt
WIFI 5GHz Band 4	5745	3060.00	2.087	3060	0.71	exempt

The available maximum time-averaged power or effective radiated power (ERP), whichever is greater
This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive).

Non Beam-forming:

Band	Freq (MHz)	Tune-up Average Power (dBm)	Ant Gain (dBi)	Distances (mm)	Tune-up Average Power (mW)	ERP (dBm)	ERP (mW)
WIFI 2.4GHz	2412	26.1	2.4	200	407.38	26.35	431.52
WIFI 5GHz Band 1	5180	25.9	4.8	200	389.05	28.55	716.14
WIFI 5GHz Band 4	5745	29.6	5.8	200	912.01	33.25	2113.49

§ 1.1307(b)(3)(i)(A) and (C) method is not applicable.

§ 1.1307(b)(3)(i)(B)

Band	Freq (MHz)	Pth (mW)	X	ERP 20cm (mW)	Ratio	Result Option B
WIFI 2.4GHz	2412	3060.00	1.899	3060	0.14	exempt
WIFI 5GHz Band 1	5180	3060.00	2.065	3060	0.23	exempt
WIFI 5GHz Band 4	5745	3060.00	2.087	3060	0.69	exempt

The available maximum time-averaged power or effective radiated power (ERP), whichever is greater
This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive).

The WIFI 2.4GHz and WIFI 5GHz cannot transmit simultaneously

Result: The device compliant the SAR-Based Exemption at 20cm distances.