

5. FCC §15.247(i), §1.1307(b)(3), §2.1091 - RF Exposure

5.1. Applicable Standard

According to subpart 15.247(i) and subpart §2.1091, 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 λ/2π, 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 λ/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 | 19.2R ² . |

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

5.2. RF Exposure Evaluation Result

Project info

| Band | Freq (MHz) | Tune-up Power (dBm) | Ant Gain (dBi) | Distances (mm) | Tune-up Power (mW) | ERP (dBm) | ERP (mW) |
|-------------|------------|---------------------|----------------|----------------|--------------------|-----------|----------|
| BT | 2402-2480 | 11 | 4.94 | 200 | 12.59 | 13.79 | 23.93 |
| WIFI 2.4GHz | 2412-2462 | 19 | 4.94 | 200 | 79.43 | 21.79 | 151.01 |
| WIFI 5GHz | 5180-5825 | 16.5 | 3.43 | 200 | 44.67 | 17.78 | 59.98 |

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

§ 1.1307(b)(3)(i)(C)

| Band | Freq (MHz) | λ/2π (mm) | Distances applies | ERP Limit (mW) | Result Option C |
|-------------|------------|-----------|-------------------|----------------|-----------------|
| BT | 2402 | 19.88 | apply | 768.00 | exempt |
| WIFI 2.4GHz | 2412 | 19.8 | apply | 768.00 | exempt |
| WIFI 5GHz | 5180 | 9.22 | apply | 768.00 | exempt |

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

ERP (watts) is no more than the calculated value prescribed for that frequency

R must be at least λ /2π

λ is the free-space operating wavelength in meters

The BT and Wi-Fi can transmit simultaneously.

Simultaneous transmitting consideration (worst case):

The ratio=ERP_{BT}/limit + ERP_{Wi-Fi}/limit=23.93/768+151.01/768=0.23 < 1.0

So simultaneous exposure is compliant.

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