

5 FCC §2.1091, FCC §15.407(f) & ISEDC RSS-102 – RF Exposure

5.1 Applicable Standards

As per FCC §15.407(f) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a “general population/uncontrolled” environment. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

As per FCC §1.1310(d) (3), At operating frequencies above 6 GHz, the MPE limits listed in Table 1 in paragraph (e)(1) of this section shall be used in all cases to evaluate the environmental impact of human exposure to RF radiation as specified in §1.1307(b) of this part.

TABLE 1 TO §1.1310(E)(1)—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| Frequency range (MHz) | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density (mW/cm ²) | Averaging time (minutes) |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| (i) Limits for Occupational/Controlled Exposure | | | | |
| 0.3-3.0 | 614 | 1.63 | *(100) | ≤ 6 |
| 3.0-30 | 1842/f | 4.89/f | *(900/f ²) | < 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | < 6 |
| 300-1,500 | | | f/300 | < 6 |
| 1,500-100,000 | | | 5 | < 6 |
| (ii) Limits for General Population/Uncontrolled Exposure | | | | |
| 0.3-1.34 | 614 | 1.63 | *(100) | < 30 |
| 1.34-30 | 824/f | 2.19/f | *(180/f ²) | < 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | < 30 |
| 300-1,500 | | | f/1500 | < 30 |
| 1,500-100,000 | | | 1.0 | < 30 |

f = frequency in MHz. * = Plane-wave equivalent power density.

According to ISED RSS-102 Issue 6 Section 6.6: Field reference level exposure exemption limits

Field reference level (FRL) 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 (i.e. mobile devices), except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum EIRP 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 EIRP of the device is equal to or less than $4.49/f^{0.5} \text{ W}$ (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 EIRP 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 EIRP of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834} \text{ W}$ (adjusted for tune-up tolerance), where f is in MHz
- at or above 6 GHz and the source-based, time-averaged maximum EIRP 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 EIRP was derived.

5.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

5.3 MPE Result for FCC

| Radio | Frequency (MHz) | Antenna Gain (dBi) | Maximum Power (dBm) | Maximum EIRP (dBm) | Maximum EIRP (mW) | Power Density at 20cm (mW/cm ²) | Limit (mW/cm ²) |
|--------------|-----------------|--------------------|---------------------|--------------------|-------------------|---|-----------------------------|
| 2.4GHz Wi-Fi | 2437 | 3.6 | 24.32 | 27.92 | 619.44 | 0.123 | 1.0 |
| 6 GHz Wi-Fi | 6105 | 18.49 | - | 27.97 | 626.61 | 0.125 | 1.0 |

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.116 mW/cm² for 2.4 GHz Wi-Fi and 0.125 for 6 GHz Wi-Fi. Limit is 1 mW/cm².

Worst Case Sum of Ratios:

$$2.4 \text{ GHz Wi-Fi} + 6 \text{ GHz Wi-Fi} = (0.123/1.0) + (0.125/1.0) = 0.248 < 1.0$$

For the different combination of transmitters, a separation distance of 20 cm complies with the SAR simultaneous transmission limit of ≤ 1.0 .

5.4 IC Exemption

2.4 GHz Wi-Fi

The EIRP of this device is 27.92 dBm (619.44 mW) which is less than the exemption threshold, i.e., $1.31 \times 10^{(-2)} \times f^{(0.6834)} = 2.70 \text{ W}$. Therefore, the RF exposure evaluation is exempt.

6 GHz Wi-Fi

The EIRP of this device is 27.97 dBm (626.61 mW) which is less than the exemption threshold, i.e., 5 W. Therefore, the RF exposure evaluation is exempt.

Worst Case Sum of Ratios:

$$2.4 \text{ GHz Wi-Fi} + 6 \text{ GHz Wi-Fi} = (0.61944/2.7) + (0.62661/5) = 0.355 < 1.0$$

Therefore, RF exposure is not required.