

5 FCC §2.1091, §1.1307 (b) & ISEDC RSS-102 - RF Exposure

5.1 Applicable Standards

According to FCC §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.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
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
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

According to FCC §1.1307(b)(1),

(i) With respect to the limits on human exposure to RF provided in [§ 1.1310 of this chapter](#), applicants to the Commission for the grant or modification of construction permits, licenses or renewals thereof, temporary authorities, equipment authorizations, or any other authorizations for radiofrequency sources must either:

(A) Determine that they qualify for an exemption pursuant to [§ 1.1307\(b\)\(3\)](#);

(B) Prepare an evaluation of the human exposure to RF radiation pursuant to [§ 1.1310](#) and include in the application a statement confirming compliance with the limits in [§ 1.1310](#); or

(C) Prepare an Environmental Assessment if those RF sources would cause human exposure to levels of RF radiation in excess of the limits in [§ 1.1310](#).

(ii) Compliance with these limits for fixed RF source(s) may be accomplished by use of mitigation actions, as provided in [§ 1.1307\(b\)\(4\)](#). Upon request by the Commission, the party seeking or holding such authorization must electronically submit technical information showing the basis for such compliance, either by exemption or evaluation. Notwithstanding the preceding requirements, in the event that RF sources cause human exposure to levels of RF radiation in excess of the limits in [§ 1.1310 of this chapter](#), such RF exposure exemptions and evaluations are not deemed sufficient to show that there is no significant effect on the quality of the human environment or that the RF sources are categorically excluded from environmental processing.

According to ISED RSS-102 Issue 6:

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

$$S = \text{EIRP}/4\pi R^2$$

Where: S = power density

EIRP= Equivalent (or effective) Isotopically Radiated Power

R = distance to the center of radiation of the antenna

5.3 FCC MPE Result

RFID Standalone

E.I.R.P. (dBm): -38.06

Maximum E.I.R.P. (mW): 0.000156

Prediction distance (cm): 20

Prediction frequency (MHz): 13.56

Power density of prediction frequency at 20 cm (mW/cm²): 0.00000003104

FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²): 0.979

Note: Per ANSI C63.10 Sections 10.3.9 and G.4, Max EIRP was determined by the following calculation:
57.24dBuV/m @ 3m – 95.3 dB = -38.06 dBm [EIRP]

The device is compliant with the FCC requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.00000003104 mW/cm². Limit is 0.979 mW/cm².

Worst Case Co-location MPE Calculation:

Radio	Power (dBm)	Max EIRP (dBm)	Worst-Case Exposure Level (mW/cm ²)	Limit (mW/cm ²)	Worst-Case Ratios	Sum of Ratios	Limit
Worst Case							
2.4GHz Wi-Fi	22.18	23.43	0.043825	1.0	0.043825	28%	100%
5GHz Wi-Fi	23.64	25.81	0.075811	1.0	0.075811		
BLE	3.66	4.91	0.000616	1.0	0.000616		
LTE	25	25.5	0.070587	0.4420	0.1596991		
RFID	-	-38.06	0.00000003104	0.979	0.0000000317		

Note: 2.4GHz Wi-Fi Antenna gain is 1.25 dBi

Note: 5GHz Wi-Fi Antenna gain is 2.17 dBi

Note: Band 71 was chosen to represent the worst case as its EIRP correlated with the worst-case MPE. This means, the resulting ratio is the highest of all possible band selections.

Note: LTE Antenna gain is 0.5 dBi, as per Quectel's YC0003BA Datasheet per evaluated band covering the range of 700-810MHz. Per the antenna datasheet band 71 is not covered, therefore the highest antenna gain from the adjacent band was selected as a worst case.

Note: Evaluated Distance is 20 cm

Note: RFID Limit (mW/cm²) = $180/f^2$ where f = fundamental frequency in MHz.

Note: BLE, 2.4 GHz and 5 GHz Wi-Fi Power (dBm) are referenced from previous report FA132339

Note: LTE Power (dBm) is referenced from previous report PD20240057RF02

5.4 IC Field Reference Level Exposure Exemption

Maximum NFC e.i.r.p. = -38.06 dBm (0.000156 mW), which is less than the exemption threshold, i.e., 1 W.

Therefore, the RF exposure evaluation is exempt for NFC.