

5 FCC §2.1091 & ISEDC RSS-102 - RF Exposure

5.1 Applicable Standards

According to FCC §2.1091 and §1.1310(e)(1), 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 ISED RSS-102 Issue 5:

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 $4.49/f^{0.5}$ 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.

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 FCC MPE Results

HF RFID Standalone

Maximum ERP (dBm): -21.8

Maximum ERP (mW): 0.0066

Prediction distance (cm): 20

Prediction frequency (MHz): 13.56

Power density of prediction frequency at 20 cm (mW/cm²): 0.0000013

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

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0000013 mW/cm². Limit is 0.979 mW/cm².

BLE Standalone

Maximum EIRP (dBm): 4.579

Maximum EIRP (mW): 2.87

Prediction distance (cm): 20

Prediction frequency (MHz): 2402

Power density of prediction frequency at 20 cm (mW/cm²): 0.00057

FCC MPE limit for uncontrolled exposure at prediction frequency 1
(mW/cm²):

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.00057 mW/cm². Limit is 1 mW/cm².

LF RFID

Maximum ERP (dBm): -2.05
Maximum ERP (mW): 0.62
Prediction distance (cm): 20
Prediction frequency (MHz): 0.125
Power density of prediction frequency at 20 cm (mW/cm²): 0.00012
FCC MPE limit for uncontrolled exposure at prediction frequency 100
(mW/cm²):

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.00012 mW/cm². Limit is 100 mW/cm².

Worst Case Co-location MPE Calculation:

Radio	Max EIRP (dBm)	Evaluated Distance (cm)	Worst-Case Exposure Level	Limit	Worst-Case Ratios	Sum of Ratios	Limit
Worst Case							
HF RFID ¹	-21.8	20	0.000013 mW/cm ²	0.979 mW/cm ²	0.00013%	0.057%	100%
BLE ²	4.579	20	0.00057 mW/cm ²	1.0 mW/cm ²	0.057%		
LF RFID ¹	-2.05	20	0.00012 mW/cm ²	100 mW/cm ²	0.00012%		

¹ NFC is e.r.p

² BLE Max EIRP is based on test report "BMD-340 FCC OQPSK" by AGC issued on 2018-05-30.

5.4 IC Exemption**HF RFID**

Maximum e.r.p = -21.8 dBm (0.0066 mW) which is less than the exemption threshold, i.e., 1W

Therefore, the SAR evaluation is exempt

BLE

Maximum e.i.r.p = 4.579 dBm (2.87 mW) which is less than the exemption threshold, i.e., $1.31 \times 10^{-2} \times f^{0.6834} \text{ W} = 2.68 \text{ W}$.

Therefore, the SAR evaluation is exempt

LF RFID

Maximum LF RFID e.r.p = -2.14 dBm (0.61 mW) which is less than the exemption threshold, i.e., 1W.

Therefore, the SAR evaluation is exempt

Note: Per ANSI C63.10 Sections 10.3.9 and G.4, Max ERP for HF RFID was determined by the following calculation: $75.65 \text{ dBuV/m @ } 3\text{m} - 95.3 - 2.15 \text{ dB} = -21.8 \text{ dBm [e.r.p]}$

Note: Per ANSI C63.10 Sections 10.3.9 and G.4, Max ERP was determined by the following calculation: $95.31 \text{ dBuV/m @ } 3\text{m} - 95.39 - 2.15 \text{ dB} = -2.05 \text{ dBm [e.r.p]}$