

4 FCC §15.247 (i), §2.1091 & IC RSS-102 – RF Exposure

4.1 Applicable Standard

According to FCC §15.247(i) and §1.1307(b)(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

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF fields.

According to IC RSS-102 Issue 4 section 4.2, RF limits used for general public will be applied to the EUT.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Time Averaging (min)
0.003 - 1	280	2.19	-	6
1 - 10	280 / f	2.19 / f	-	6
10 - 30	28	2.19 / f	-	6
30 – 300	28	0.073	2*	6
300 – 1 500	1.585 f ^{0.5}	0.0042 f ^{0.5}	f / 150	6
1 500 – 15 000	61.4	0.163	10	6
15 000 – 150 000	61.4	0.163	10	616000 / f ^{1.2}
150 000- 300 000	0.158 f ^{0.5}	4.21 x 10 ⁻⁴ f ^{0.5}	6.67 x 10 ⁻⁵ f	616000 / f ^{1.2}

Note: f is frequency in MHz

* = Power density limit is applicable at frequencies greater than 100 MHz

4.2 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

4.3 MPE Results

Note: The EUT contains the following modules which can transmit simultaneously.

902-928 MHz:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>29.96</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>990.83</u>
<u>Prediction distance (cm):</u>	<u>50</u>
<u>Prediction frequency (MHz):</u>	<u>927.6</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.99</u>
<u>Power density of prediction frequency at 50.0 cm (mW/cm²):</u>	<u>0.0629</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>0.6184</u>

MPE Percentage: $0.0629/0.6184 \times 100\% = 10.17\%$

2.4 GHz Wi-Fi:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>14.85</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>30.549</u>
<u>Prediction distance (cm):</u>	<u>50</u>
<u>Prediction frequency (MHz):</u>	<u>2412</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>4</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>2.511</u>
<u>Power density of prediction frequency at 50.0 cm (mW/cm²):</u>	<u>0.02443</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

MPE Percentage: $0.02443/1.0 \times 100\% = 0.24\%$

2.4 GHz BT:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>2.16</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>1.644</u>
<u>Prediction distance (cm):</u>	<u>50</u>
<u>Prediction frequency (MHz):</u>	<u>2402</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>4</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>2.511</u>
<u>Power density of prediction frequency at 50.0 cm (mW/cm²):</u>	<u>0.000131</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

MPE Percentage: $0.000131/1.0 \times 100\% = 0.01\%$

Cellular Band:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>30.49</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>1119.438</u>
<u>Prediction distance (cm):</u>	<u>50</u>
<u>Prediction frequency (MHz):</u>	<u>824.2</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3.92</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>2.466</u>
<u>Power density of prediction frequency at 50.0 cm (mW/cm²):</u>	<u>0.0878</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>0.549</u>

MPE Percentage: $0.0878/0.549 \times 100\% = 15.99\%$

Co-Location MPE: $10.17\% + 0.24\% + 0.013\% + 15.99\% = 26.413\%$.

The device meets FCC/IC MPE at 20 distance.