

5 FCC §2.1091, §15.247(i) & ISED RSS-102 - RF Exposure

5.1 Applicable Standards

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 field

According to ISED RSS-102 Issue 5:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ f ^{0.5}	-	-	6**
10-20	27.46	0.0728	-2	6
20-48	58.07/ f ^{0.25}	0.1540/ f ^{0.25}	8.944/ f ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 f ^{0.3417}	0.008335 f ^{0.3417}	0.02619 f ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ f ^{1.2}
150000-300000	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. * Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

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 Results

Host SPS986

Single Transmitter MPE Evaluation

900 MHz Radio:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>29.95</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>988.55</u>
<u>Prediction distance (cm):</u>	<u>25</u>
<u>Prediction frequency (MHz):</u>	<u>902.6</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2.5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.778</u>
<u>Power density of prediction frequency at 25 cm (mW/cm²):</u>	<u>0.2239</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>0.602</u>

2.4 GHz Bluetooth:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>11.64</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>14.588</u>
<u>Prediction distance (cm):</u>	<u>25</u>
<u>Prediction frequency (MHz):</u>	<u>2402</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.585</u>
<u>Power density of prediction frequency at 25 cm (mW/cm²):</u>	<u>0.0029</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

2.4GHz Wi-Fi:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>23.86</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>243.2204</u>
<u>Prediction distance (cm):</u>	<u>25</u>
<u>Prediction frequency (MHz):</u>	<u>2437</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.585</u>
<u>Power density of prediction frequency at 25 cm (mW/cm²):</u>	<u>0.0491</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>

Note: Bluetooth Module: JUP-WL18DBMOD, IC: 1756A-WL18DBMOD.
2.4 GHz Wi-Fi Module: JUP-WL18DBMOD, IC: 1756A-WL18DBMOD.

Multi Transmitter MPE Evaluation

Wi-Fi+Bluetooth+900 MHz Radio = $0.0491/1+0.0029/1+0.2239/0.602 = 0.4239 < 1.0$

Conclusion

In order to meet the multi-transmitter RF Exposure requirement, all transceiver modules must be installed with a separation distance of no less than 25 cm from all persons.

5.4 RF exposure evaluation for IC

Host SPS986

Single Transmitter MPE Evaluation

900 MHz Radio:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>29.95</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>988.55</u>
<u>Prediction distance (cm):</u>	<u>25</u>
<u>Prediction frequency (MHz):</u>	<u>902.6</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2.5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.778</u>
<u>Power density of prediction frequency at 25 cm (W/m²):</u>	<u>2.2394</u>
<u>ISED MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u>	<u>2.741</u>

2.4 GHz Bluetooth:

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>11.64</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>14.588</u>
<u>Prediction distance (cm):</u>	<u>25</u>
<u>Prediction frequency (MHz):</u>	<u>2402</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.585</u>
<u>Power density of prediction frequency at 25 cm (W/m²):</u>	<u>0.02945</u>
<u>ISED MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u>	<u>5.35</u>