6 FCC §2.1091, §15.247(i) & ISEDC RSS-102 - RF Exposure

6.1 Applicable Standards

According to FCC §15.247(i), §15.407(f) 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 ISED RSS-102 must be followed concerning the exposure of humans to RF field

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 MHz[6] 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.

6.2 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

6.3 MPE Results for FCC

BLE:

Maximum average output power at antenna input terminal (dBm):	5.52
Maximum average output power at antenna input terminal (mW):	3.56
Prediction distance (cm):	20
Prediction frequency (MHz):	2440
Maximum Antenna Gain, typical (dBi):	2.5
Maximum Antenna Gain (numeric):	1.78
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0013
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

5.2 GHz band:

Maximum average output power at antenna input terminal (dBm):	16.15
Maximum average output power at antenna input terminal (mW):	41.21
Prediction distance (cm):	20
Prediction frequency (MHz):	5240
Maximum Antenna Gain, typical (dBi):	2.5
Maximum Antenna Gain (numeric):	1.78
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0146
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

5.8 GHz band:

Maximum average output power at antenna input terminal (dBm):	15.47
Maximum average output power at antenna input terminal (mW):	35.24
Prediction distance (cm):	20
Prediction frequency (MHz):	5745
Maximum Antenna Gain, typical (dBi):	2.5
Maximum Antenna Gain (numeric):	1.78
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0125
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Radio Co-location

BLE + 5 GHz Wi-Fi:

0.0013/1 + 0.0146/1 = 0.0159 < 1

Conclusion

The device is compliant with the requirement MPE limit for uncontrolled exposure. All transceiver modules must be installed with a separation distance of no less than **20** cm from all persons.

6.4 RF exposure evaluation exemption for IC

Frequency Band	Channel Frequency (MHz)	Maximum e.i.r.p. (dBm)	Maximum e.i.r.p. (W)	ISED RF Exposure Exemption Threshold (W)	Result
BLE	2440	8.02	0.006	2.705	Exempt
U-NII-1	5240	18.65	0.073	4.561	Exempt
U-NII-3	5745	17.97	0.063	4.857	Exempt

Conclusion

The RF exposure evaluation is not required.