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

4.1 Applicable Standards

According to §2.1091 (Mobile Devices) RF exposure is calculated.

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 (minute)
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

Note: 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 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.

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

2.4 GHz Wi-Fi

Maximum peak output power at antenna input terminal (dBm):	17.9
Maximum peak output power at antenna input terminal (mW):	61.66
Prediction distance (cm):	20
Predication frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	2.5
Maximum Antenna Gain (numeric):	1.78
Power density of prediction frequency at prediction distance (mW/cm^2):	0.0218
FCC limit (mW/cm^2):	1.00

LE910-NAV2 Cellular Radio

Band	Frequency (MHz)	Max Conducted Power (dBm)	Evaluated Distance (cm)	Antenna Gain (dBi)	MPE (mW/cm^2)	MPE Limit (mW/cm^2)	MPE Ratio
FDD 12	699.0	24.00	20	3.0	0.0997	0.466	0.2139
FDD 17	704.0	24.00	20	3.0	0.0997	0.469	0.2126
FDD 13	777.0	24.00	20	3.0	0.0997	0.518	0.0192
FDD 5	824.7	24.00	20	3.0	0.0997	0.5498	0.1813
FDD V	826.4	24.50	20	3.0	0.112	0.551	0.2033
FDD 4	1710.7	24.00	20	3.0	0.0997	1.0	0.0997
FDD 2	1850.7	24.00	20	3.0	0.0997	1.0	0.0997
FDD II	1852.4	24.50	20	3.0	0.112	1.0	0.112

Note: antenna gain information provided by the applicant.

Radio Co-location

Worst Case Co-location 2.4 GHz WiFi and LTE Band FDD 12:

Frequency Band	Max EIRP Power(dBm)	Evaluated Distance (cm)	Worst-Case MPE (mW/cm^2)	MPE Limit (mW/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
Worst Case							
2.4 GHz Wi-Fi	20.4	20	0.0218	1.0	2.18%	23.57%	100%
LTE Band FDD 12	24.00	20	0.0997	0.466	21.39%		

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum MPE ratio at the distance of 20 cm is 23.57%. Limit is 100%.

IC RF Exposure Evaluation:

2.4 GHz Wi-Fi:

17.9 dBm + 2.5 dBi = 20.4 dBm < $1.31\times10^{-2}f^{0.6834}$ = 2.703 W = 34.318 dBm

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 **20** cm from all persons.