4 FCC §2.1091 & §15.407(f) - RF Exposure

4.1 Applicable Standard

According to FCC §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

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

5.3 GHz band:

Antenna gain = 4 dBi

Maximum peak output power at antenna input terminal (dBm):	21.35
Maximum peak output power at antenna input terminal (mW):	136.458
Prediction distance (cm):	20
Prediction frequency (MHz):	5270
Maximum Antenna Gain, typical (dBi):	4
Maximum Antenna Gain (numeric):	2.512
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.068
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Antenna gain = 7 dBi

Maximum peak output power at antenna input terminal (dBm):	19.00
Maximum peak output power at antenna input terminal (mW):	79.433
Prediction distance (cm):	20
Prediction frequency (MHz):	5310
Maximum Antenna Gain, typical (dBi):	7
Maximum Antenna Gain (numeric):	5.012
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.079
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Antenna gain = 14 dBi

Maximum peak output power at antenna input terminal (dBm):	12.51
Maximum peak output power at antenna input terminal (mW):	17.824
Prediction distance (cm):	20
Prediction frequency (MHz):	5260
Maximum Antenna Gain, typical (dBi):	14
Maximum Antenna Gain (numeric):	25.119
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.089
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure.

5.6 GHz band:

Antenna gain = 4 dBi

Maximum peak output power at antenna input terminal (dBm):	22.08
Maximum peak output power at antenna input terminal (mW):	161.436
Prediction distance (cm):	20
Prediction frequency (MHz):	5510
Maximum Antenna Gain, typical (dBi):	4
Maximum Antenna Gain (numeric):	2.512
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.081
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Antenna gain = 7 dBi

Maximum peak output power at antenna input terminal (dBm):	19.31
Maximum peak output power at antenna input terminal (mW):	85.310
Prediction distance (cm):	20
Prediction frequency (MHz):	5550
Maximum Antenna Gain, typical (dBi):	7
Maximum Antenna Gain (numeric):	5.012
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.085
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

Antenna gain = 14 dBi

Maximum peak output power at antenna input terminal (dBm):	11.13
Maximum peak output power at antenna input terminal (mW):	12.972
Prediction distance (cm):	20
Prediction frequency (MHz):	5550
Maximum Antenna Gain, typical (dBi):	14
Maximum Antenna Gain (numeric):	25.119
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.065
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure.

Co-location:

2.4 GHz and 5 GHz bands can transmit simultaneously. A certified 2G/3G/4G module (FCC ID: N7NMC7355, IC: 2417C-MC7355) was built in the host. Per FCC KDB 447498, when RF sources have difference frequencies, the fraction of the FCC power density limit shall be determined and the sum of all fractional components shall be less than 1.

WLAN Co-location

Frequency Band	Evaluated Distance (cm)	Worst-Case MPE (mW/cm^2)	MPE Limit (mW/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
2.4 GHz	20	0.246	1.0	24.6 %	57.2 %	100 %
5 GHz	20	0.572	1.0	32.6 %		

2.4 GHz WLAN + 5 GHz WLAN + 850 MHz Co-Location

Frequency Band	Evaluated Distance (cm)	Worst-Case MPE (mW/cm^2)	MPE Limit (mW/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
2.4 GHz	20	0.246	1.0	24.6 %	93.3 %	100 %
5 GHz	20	0.572	1.0	32.6 %		
850 MHz	20	0.198	0.549	36.1 %		

2.4 GHz WLAN + 5 GHz WLAN + 1900 MHz Co-Location

Frequency Band	Evaluated Distance (cm)	Worst-Case MPE (mW/cm^2)	MPE Limit (mW/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
2.4 GHz	20	0.246	1.0	24.6 %	69.8 %	100 %
5 GHz	20	0.572	1.0	32.6 %		
1900 MHz	20	0.126	1.0	12.6 %		

2.4 GHz WLAN + 5 GHz WLAN + 700 MHz Co-Location

Frequency Band	Evaluated Distance (cm)	Worst-Case MPE (mW/cm^2)	MPE Limit (mW/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
2.4 GHz	20	0.246	1.0	24.6 %	99.6 %	100 %
5 GHz	20	0.572	1.0	32.6 %		
700 MHz	20	0.199	0.469	42.4 %		

2.4 GHz WLAN + 5 GHz WLAN + 1700 MHz Co-Location

Frequency Band	Evaluated Distance (cm)	Worst-Case MPE (mW/cm^2)	MPE Limit (mW/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
2.4 GHz	20	0.246	1.0	24.6 %	77.1 %	100 %
5 GHz	20	0.572	1.0	32.6 %		
1700 MHz	20	0.199	1.0	19.9 %		

Conclusion: Simultaneous transmission MPE test exclusion applied to this device due to the sum of MPE ratios for all simultaneous transmitting antennas incorporated in the host is less than 1.0.