

## APPENDIX C - RF EXPOSURE EVALUATION

### Maximum Permissible Exposure (MPE)

#### Applicable Standard

According to subpart §1.1310, 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 Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
<b>Frequency Range (MHz)</b>	<b>Electric Field Strength (V/m)</b>	<b>Magnetic Field Strength (A/m)</b>	<b>Power Density (mW/cm<sup>2</sup>)</b>	<b>Averaging Time (minutes)</b>
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f <sup>2</sup> )	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;

According to §1.1310 and §2.1091 RF exposure is calculated.

#### Calculation formula:

Prediction of power density at the distance of the applicable MPE limit

$S = PG/4\pi R^2$  = power density (in appropriate units, e.g. mW/cm<sup>2</sup>);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

**Calculated Data:**

Operation Modes	Frequency (MHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
		(dBi)	(numeric)	(dBm)	(mW)			
WiFi 2.4G	2412-2462	5.73	3.74	24	251.18864	20.00	0.1870	1.0
WiFi 5.2G	5150-5250	4.21	2.64	13	19.95	20.00	0.0105	1.0
WiFi 5.3G	5250-5350	4.21	2.64	12	15.85	20.00	0.0083	1.0
WiFi 5.6G	5470-5725	6.45	4.42	12	15.85	20.00	0.0139	1.0
WiFi 5.8G	5725-5850	5.65	3.67	13	19.95	20.00	0.0146	1.0
Bluetooth	2402-2480	5.73	3.74	9	7.94	20.00	0.0059	1.0
BLE	2402-2480	5.73	3.74	9	7.94	20.00	0.0059	1.0
NFC	13.56	/	/	-44.28	0.00004	20.00	<<0.0001	0.98

NFC field strength is 50.92BμV/m @ 3m = -44.28 dBm(0.00004mW) EIRP. That equal to antenna gain is 0dBi and used the EIRP value as conducted power.

Note: The Conducted output power including Tune-up Tolerance provided by manufacturer

**Simultaneous transmission:**

BT, BLE, WiFi can't transmit simultaneously. WiFi/BLE/Bluetooth and NFC can transmit simultaneously:

$$S_{BLE}/S_{limit-BLE} + S_{NFC}/S_{limit-NFC}$$

$$= 0.187/1 + 0.0001/0.98$$

$$= 0.187$$

$$< 1.0$$

**Result:** The device meet FCC MPE at 20 cm distance