FCC §15.407 (f) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE

Applicable Standard

According to §15.407(f) and §1.1310 & §2.1091, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) 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)**
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;

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

Per 447498 D01 General RF Exposure Guidance v06**,** simultaneous transmission MPE test exclusion applies when the sum of the MPE for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0.

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where:
S = power density (in appropriate units, e.g. mW/cm^2);
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:

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

Calculated Data:

(WiFi or BLE) + Z-wave + G-power (FCC ID: WP3PGMODEMLP) + WCDMA/LTE module (FCC ID: XMR201807EG91NA)

MPE evaluation for single transmission:

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
WiFi	2412-2462	2.67	1.85	23.0	199.53	20	0.073	1.0
	5180-5240	1.02	1.26	13.0	19.95	20	0.005	1.0
	5745-5825	1.02	1.26	6.0	3.98	20	0.001	1.0
BLE	2402-2480	2.67	1.85	5.0	3.16	20	0.001	1.0
Power-G	912.75-919.106	0.43	1.10	13.5	22.39	20	0.005	0.61
Z-wave	908.4-916	0.50	1.12	-20.0	0.01	20	0.000	0.61
WCDMA Band 5	824-849	1.6	1.45	24.0	251.19	20	0.072	0.55
WCDMA Band 4	1710-1755	2.4	1.74	24.0	251.19	20	0.087	1.0
WCDMA Band 2	1850-1910	2.4	1.74	24.0	251.19	20	0.087	1.0
LTE Band 2	1850-1910	2.4	1.74	24.5	281.84	20	0.098	1.0
LTE Band 4	1710-1755	2.4	1.74	24.5	281.84	20	0.098	1.0
LTE Band 5	824-849	1.6	1.45	24.5	281.84	20	0.081	0.55
LTE Band 12	699-716	1.6	1.45	24.5	281.84	20	0.081	0.47
LTE Band 13	777-787	1.6	1.45	24.5	281.84	20	0.081	0.52

MPE evaluation for simultaneous transmission:

Note: 1. Wi-Fi & BLE can't transmit simultaneously.
2. Wi-Fi(2.4G) & Wi-Fi(5G) can't transmit simultaneously.
3. Wi-Fi &Z-wave&Power-G&WCDMA/LTE or BLE&Z-wave&Power-G&WCDMA/LTE can transmit simultaneously, MPE evaluation is as below formula:

PD1/Limit1+PD2/Limit2+……＜1, PD (Power Density)

The worst case is as below:

Max MPE of Wi-Fi(2.4G) + Max MPE of Power-G + Max MPE of LTE

= 0.073/1.0+0.005/0.61+0.081/0.47=0.254＜1.0

Result: MPE evaluation of single and simultaneous transmission meet the requirement of standard.