FCC §15.247 (I), §2.1091 & §1.1307(B)(1) - MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i)and 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) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	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.

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/cm²);
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:

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

WiFi+Zigbee+LTE (FCC ID: RI7LE910SVV2)

Mode	Frequency Range	Antenna Gain		Tune-up Conducted Power		Evaluation Distance	Power Density	Limit
	MHz	dBi	numeric	dBm	mW	cm	mW/cm^2	mW/cm^2
WiFi	2412-2462	2.00	1.58	17.26	53.21	20	0.017	1.00
	2422-2452	2.00	1.58	14.03	25.29	20	0.008	1.00
Zigbee	2405-2480	2.00	1.58	10.08	10.19	20	0.003	1.00
LTE band 2	1850.7-1909.3	5.00	3.16	24.00	251.19	20	0.158	1.00
LTE band 4	1710.7-1754.3	5.00	3.16	24.00	251.19	20	0.158	1.00
LTE band 13	777-787	3.00	2.00	24.00	251.19	20	0.100	0.52

MPE evaluation for simultaneous transmission:

Wi-Fi&Zigbee&LTE can transmit at the same time, 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+ Max MPE of Zigbee + Max MPE of LTE = 0.017/1+0.003/1+0.100/0.52
=0.212＜1.0

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

WIFI+Zigbee+WCDMA/LTE (FCC ID: RI7LE910NAV2)

Mode	Frequency Range	Antenna Gain		Tune-up Conducted Power		Evaluation Distance	Power Density	Limit
	MHz	dBi	numeric	dBm	mW	cm	mW/cm^2	mW/cm^2
WiFi	2412-2462	2.00	1.58	17.26	53.21	20	0.017	1.00
	2422-2452	2.00	1.58	14.03	25.29	20	0.008	1.00
Zigbee	2405-2480	2.00	1.58	10.08	10.19	20	0.003	1.00
WCDMA Band 2	1852.4-1907.6	5.00	3.16	24.50	281.84	20	0.177	1.00
WCDMA Band 5	826.4-846.6	3.00	2.00	24.50	281.84	20	0.112	0.55
LTE band 2	1850.7-1909.3	5.00	3.16	24.00	251.19	20	0.158	1.00
LTE band 4	1710.7-1754.3	5.00	3.16	24.00	251.19	20	0.158	1.00
LTE band 5	824.7-848.3	3.00	2.00	24.00	251.19	20	0.100	1.00
LTE band 13	777-787	3.00	2.00	24.00	251.19	20	0.100	0.52
LTE band 17	704-715.9	3.00	2.00	24.00	251.19	20	0.100	0.47
LTE band 12	699-716	3.00	2.00	24.00	251.19	20	0.100	0.47

MPE evaluation for simultaneous transmission:

Wi-Fi&Zigbee&WCDMA/LTE can transmit at the same time, 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+ Max MPE of Zigbee + Max MPE of LTE = 0.017/1+0.003/1+0.100/0.47
=0.233＜1.0

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