

4 FCC §1.1310, §2.1091, §15.407(f) - Maximum Permissible Exposure (MPE)

4.1 Applicable Standard

According to §15.407(f), U-NII devices are subject to the radio frequency radiation exposure requirements specified in § 1.1307(b), and 2.1091 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request

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.

Calculated Formulary: Predication of MPE limit at a given distance

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

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

4.2 RF Exposure Evaluation Result

MPE Evaluation:

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi 2.4G	2412-2462	3.00	1.995	25.00	316.2278	20	0.1256	1.0
BLE	2402-2480	3.00	1.995	4.00	2.5119	20	0.0010	1.0
BR+EDR	2402-2480	3.00	1.995	9.00	7.9433	20	0.0032	1.0
Wi-Fi 5G UNII-1	5150-5250	3.00	1.995	20.00	100.0000	20	0.0397	1.0
Wi-Fi 5G UNII-3	5745-5850	3.00	1.995	21.00	125.8925	20	0.0500	1.0

LTE module FCC ID: 2AJYU-SIM7000A

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
LTE B2	1850-1910	0.48	1.117	25.70	371.54	20	0.0826	1.0
LTE B4	1710-1755	-0.73	0.845	25.70	371.54	20	0.0625	1.0
LTE B12	699-716	2.11	1.626	25.70	371.54	20	0.1202	0.466
LTE B13	777-787	2.11	1.626	25.70	371.54	20	0.1202	0.518

LTE module FCC ID: RI7LE910NAV2

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
LTE B2	1850-1910	0.48	1.117	24.00	251.189	20	0.0558	1.0
LTE B4	1710-1755	-0.73	0.845	24.00	251.189	20	0.0422	1.0
LTE B5	824-849	2.65	1.841	24.00	251.189	20	0.0920	0.550
LTE B12	699-716	2.11	0.845	24.00	251.189	20	0.0812	0.466
LTE B13	777-787	2.11	1.626	24.00	251.189	20	0.0812	0.518
LTE B17	704-716	2.11	0.845	24.00	251.189	20	0.0812	0.469

MPE evaluation for simultaneous transmission:

Note:

1. Wi-Fi (2.4G) or Wi-Fi 5G and BT can't transmit simultaneously.
2. Wi-Fi (2.4G) and Wi-Fi 5G can't transmit simultaneously

Wi-Fi or BT & WWAN can transmit simultaneously , MPE evaluation is as below formula:

$$PD1/Limit1 + PD2/Limit2 + \dots < 1, \text{ PD (Power Density)}$$

The worst case is as below:

Max MPE of Wi-Fi + Max MPE of LTE
= $0.1256/1.0 + 0.1202/0.466 = 0.3835 < 1.0$

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