

4 FCC§15.407(f), §1.1307, § 2.1091 – 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/cm²)	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	2.80	1.9054	24.00	251.1886	20	0.0953	1.00
Wi-Fi 5G UNII-1	5150-5250	3.10	2.0417	17.00	50.1187	20	0.0204	1.00
Wi-Fi 5G UNII-3	5745-5850	3.10	2.0417	21.00	125.8925	20	0.0512	1.00
WCDMA II	1852.4-1907.6	3.00	1.9953	25.00	316.2278	20	0.1256	1.00
WCDMA IV	1712.4-1752.6	3.00	1.9953	25.00	316.2278	20	0.1256	1.00
WCDMA V	826.4-846.6	2.00	1.5849	25.00	316.2278	20	0.0998	0.55
LTE Band 2	1850.7-1909.3	3.00	1.9953	25.00	316.2278	20	0.1256	1.00
LTE Band 4	1710.7-1754.3	3.00	1.9953	25.00	316.2278	20	0.1256	1.00
LTE Band 5	824.7-848.3	2.00	1.5849	25.00	316.2278	20	0.0998	0.55
LTE Band 12	699.7-715.3	2.00	1.5849	25.00	316.2278	20	0.0998	0.47
LTE Band 13	779.5-784.5	2.00	1.5849	25.00	316.2278	20	0.0998	0.52
LTE Band 14	790.5-795.5	2.00	1.5849	25.00	316.2278	20	0.0998	0.53
LTE Band 66	1710.7-1779.3	3.00	1.9953	25.00	316.2278	20	0.1256	1.00
LTE Band 71	665.5-695.5	2.00	1.5849	25.00	316.2278	20	0.0998	0.45

Note: Wi-Fi 2.4G and Wi-Fi 5G can't simultaneously.

Wi-Fi and WWAN 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 + Max MPE of LTE
 $= 0.0953/1.0+0.0998/0.45 = 0.3171 < 1.0$

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