

5. RF EXPOSURE EVALUATION

5.1 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

5.1.1 Applicable Standard

FCC §15.247 (i) & §1.1310 & §2.1091

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 levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

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)	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.

5.1.2 Procedure

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/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:

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

Calculated Data:

Radio	Frequency (MHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
Lora-DSS	902.3-914.9	2	1.58	18	125.89	20.00	0.02	0.60
Lora-DTS	923.3-927.5	2	1.58	27	501.19	20.00	0.16	0.60
BLE	2402-2480	2	1.58	6	3.98	20.00	0.001	1.0
WLAN	2412-2462	4	2.51	23	199.53	20.00	0.1	1.0
WCDMA B2	1850-1910	3	2.00	25	316.23	20.00	0.13	1.0
WCDMA B4	1710-1755	3	2.00	25	316.23	20.00	0.13	1.0
WCDMA B5	824-849	3	2.00	25	316.23	20.00	0.13	0.55
LTE B2	1850-1910	3	2.00	25	316.23	20.00	0.13	1.0
LTE B4	1710-1755	3	2.00	25	316.23	20.00	0.13	1.0
LTE B5	824-849	3	2.00	25	316.23	20.00	0.13	0.55
LTE B12	699-716	3	2.00	25	316.23	20.00	0.13	0.47
LTE B13	777-787	3	2.00	25	316.23	20.00	0.13	0.52
LTE B14	788-798	3	2.00	25	316.23	20.00	0.13	0.53
LTE B66	1710-1780	3	2.00	25	316.23	20.00	0.13	1.0
LTE B71	663-698	3	2.00	25	316.23	20.00	0.13	0.44

The devices may contain certified WWAN Module, FCC ID: XMR202008EC25AFXD.

The WLAN 2.4G/BLE/Lora/WWAN can transmit simultaneously:

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

$$= S_{WLAN}/S_{limit-WLAN} + S_{Lora}/S_{limit-Lora} + S_{BLE}/S_{limit-BLE} + S_{WWAN}/S_{limit-WWAN}$$

$$= 0.10/1 + 0.16/0.60 + 0.001/1 + 0.13/0.44$$

$$= 0.66$$

$$< 1.0$$

Result: The device meet FCC MPE at 20 cm distance

******* END OF REPORT *******