

RF Exposure Evaluation For FCC ID: 2AMPF-MX1902

Refer user manual this device is a MX1902, and this device was designed used in Mobile devices that the minimum distance between human's body is **25cm**. Based on the 47CFR 2.1091, this device belongs to Mobile device. The definition of the category as following:

Mobile Derives:

CFR Title 47 §2.1091(b)

(b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

FCC KDB 447498 D01 General RF Exposure Guidance v06 Limit

Devices operating in standalone mobile exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When the categorical exclusion provision of § 2.1091(c) applies, the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to FCC Part 1.1307, 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 General Population/ Uncontrolled Exposure			
Frequency Range (MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength (H)(A/m)	Power Density (S)(mW/cm ²)
0.3-1.34	614	1.63	(100)*
1.34-30	824/f	2.19/f	(180/f ²)*
30-300	27.5	0.073	0.2
300-1500			f/1500
1500-100,000			1.0

MPE calculation formula

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = power density

P = output power (mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Separation distance between radiator and human body (cm)

Test data

2.4G WIFI									
Mode	802.11b			802.11g			802.11n20		
	Low	Middle	High	Low	Middle	High	Low	Middle	High
Peak power (dBm)	18.10	18.48	17.58	21.08	23.28	23.48	22.74	23.12	20.56
Note: This report listed the worst case EIRP/ERP value, please refer to RF test report for more details.									

LoRa			
125KHz (Main Antenna)			
Mode	Low Channel	Middle Channel	High Channel
Peak Power (dBm)	26.11	24.54	23.72
125KHz (Aux. Antenna)			
Mode	Low Channel	Middle Channel	High Channel
Peak Power (dBm)	26.11	24.70	24.04
500KHz (Main Antenna)			
Mode	Low Channel	Middle Channel	High Channel
Peak Power (dBm)	26.19	24.44	23.50
500KHz (Aux. Antenna)			
Mode	Low Channel	Middle Channel	High Channel
Peak Power (dBm)	26.07	24.93	24.47
Note: This report listed the worst case peak power value, please refer to RF test report for more details.			

Turn-up power

Mode		Range (dBm)
2.4G WIFI	802.11b	17.50-18.50
	802.11g	21.00-23.50
	802.11n20	20.50-23.50
LoRa (125KHz) (Main Antenna)		23.50-26.50
LoRa (125KHz) (Aux. Antenna)		23.50-26.50
LoRa (500KHz) (Main Antenna)		23.50-26.50
LoRa (500KHz) (Aux. Antenna)		23.50-26.50

Test result

Evolution mode	Maximum peak output power (dBm)	Antenna Gain (typical) (dBi)	Total Power (mw)	Distance (cm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Power Density / Limit	Verdict
2.4G WIFI	23.50	2.0	223.87	25	0.045	1.00	0.045	Pass
LoRa (Main)	26.50	2.1	724.44	25	0.092	0.6013	0.153	Pass
LoRa (Aux.)	26.50	2.1	724.44	25	0.092	0.6013	0.153	Pass

Collocated Power Density Calculation

Evolution mode	Frequency(MHz)	Power Density/Limit	Σ (Power Density / Limit) of WLAN + Lora	Verdict
2.4G WIFI	2400 MHz ~ 2483.5 MHz	0.045	0.198	Pass
Lora (Main)	902 MHz ~ 928 MHz	0.153		Pass
Evolution mode	Frequency(MHz)	Power Density/Limit	Σ (Power Density / Limit) of WLAN + Lora	Verdict
2.4G WIFI	2400 MHz ~ 2483.5 MHz	0.045	0.198	Pass
Lora (Aux.)	902 MHz ~ 928 MHz	0.153		Pass

Note:

1. Σ (Power Density / Limit): This is a summation of [(power density for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding MPE limit)].
2. The formula of calculated the MPE is
$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$

CPD = Calculation power density
LPD = Limit of power density
3. The worst-case situation is 0.198, which is less than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.
4. The MX1902 work frequency range used is 902 MHz ~ 928 MHz and 2400 MHz ~ 2483.5 MHz, the result close to the limit by the above formula, so we select 2400 MHz and 902MHz to calculate the exclusion power threshold.
5. More power list please refer to RF test report.

Conclusion:

RF exposure Evaluation Results: **Compliance**