

RF Exposure Evaluation For FCC ID: 2AOXH-GJAN182018002

Refer user manual this device is a Gee Chain X, and this device was designed used in Mobile devices that the minimum distance between human's body is **20cm**. 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 the 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)

Antenna Configuration

Mode	Antenna					
	Antenna 0	Antenna 1	Antenna 2	Antenna 3	Antenna 0+1	Antenna 0+1+2+3
802.11a	√	√	-	-	-	-
802.11b	√	√	√	√	-	-
802.11g	√	√	√	√	-	-
802.11n20	√	√	√	√	√	√
802.11n40	√	√	√	√	√	√
802.11ac	√	√	-	-	√	-

Note 1: The 802.11a, 802.11b and 802.11g only support single antenna launch.

Note 2: The 802.11ac support double antennas launch.

Note 3: 2.4G WIFI of 802.11n20, 802.11n40 support four antennas launch, and 5G WIFI of 802.11n20, 802.11n40 support double antennas launch.

Test data

2.4G WIFI				
Mode	802.11b	802.11g	802.11n (HT20)	802.11n (HT40)
(ANT0) Peak Power (dBm)	21.07	22.00	20.85	21.40
(ANT1) Peak Power (dBm)	21.28	21.35	21.25	21.47
(ANT2) Peak Power (dBm)	21.35	22.19	22.20	21.46
(ANT3) Peak Power (dBm)	21.41	21.19	21.32	21.62
Note: This report listed the worst case Peak power value, please refer to RF test report for more details.				

2.4G WIFI		
Mode	802.11n (HT20)	802.11n (HT40)
ANT0+ANT1+ANT2+ ANT3 Peak Power (dBm)	27.34	27.51
Note: This report listed the worst case Peak power value, please refer to RF test report for more details.		

5.2G WIFI (5150 MHz ~ 5250 MHz)						
Mode	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (VHT20)	802.11ac (VHT40)	802.11ac (VHT80)
(ANT0) Conducted Power (dBm)	18.81	19.00	18.79	19.95	18.77	18.65
(ANT1) Conducted Power (dBm)	20.03	19.36	18.98	19.33	18.98	18..77
Note: This report listed the worst case Conducted power value, please refer to RF test report for more details.						

5.8G WIFI (5725 MHz ~ 5850 MHz)						
Mode	802.11a	802.11n-20	802.11n-40	802.11ac (VHT20)	802.11ac (VHT40)	802.11ac (VHT80)
(ANT0) Conducted Power (dBm)	26.05	26.20	25.96	26.22	25.94	25.92
(ANT1) Conducted Power (dBm)	25.98	26.19	25.92	26.18	25.89	25.81
Note: This report listed the worst case Conducted power value, please refer to RF test report for more details.						

5.2G WIFI (5150 MHz ~ 5250 MHz)					
Mode	802.11n-20	802.11n-40	802.11ac (VHT20)	802.11ac (VHT40)	802.11ac (VHT80)
(ANT0+ ANT1) Conducted Power (dBm)	22.12	21.90	22.15	21.89	21.72
Note: This report listed the worst case Conducted power value, please refer to RF test report for more details.					

5.8G WIFI (5725 MHz ~ 5850 MHz)					
Mode	802.11n-20	802.11n-40	802.11ac (VHT20)	802.11ac (VHT40)	802.11ac (VHT80)
(ANT0+ ANT1) Conducted Power (dBm)	29.19	28.95	29.19	28.93	28.88

Note: This report listed the worst case Conducted power value, please refer to RF test report for more details.

Turn-up power

Band	Antenna	Mode	Range (dBm)
2.4G WIFI (2412MHz~2462 MHz)	ANT0	802.11b	19.50-21.50
		802.11g	20.00-22.50
		802.11n (HT20)	19.50-21.50
		802.11n (HT40)	20.00-22.00
	ANT1	802.11b	19.50-21.50
		802.11g	20.00-22.00
		802.11n (HT20)	19.50-21.50
		802.11n (HT40)	20.00-22.00
	ANT2	802.11b	19.50-21.50
		802.11g	20.00-22.50
		802.11n (HT20)	20.00-22.50
		802.11n (HT40)	20.00-22.00
	ANT3	802.11b	19.50-22.00
		802.11g	19.50-21.50
		802.11n (HT20)	19.50-21.50
		802.11n (HT40)	20.00-22.00
	ANT0+ANT1+ANT2+ ANT3	802.11n (HT20)	25.50-27.50
		802.11n (HT40)	26.00-28.00
5.2G WIFI (5150 MHz~ 5250 MHz)	ANT0	802.11a	17.00-19.00
		802.11n (HT20)	17.50-19.50
		802.11n (HT40)	17.00-19.00
		802.11ac (VHT20)	17.50-19.50
		802.11ac (VHT40)	17.00-19.00
		802.11ac (VHT80)	17.00-19.00
	ANT1	802.11a	18.50-20.50
		802.11n (HT20)	17.50-19.50
		802.11n (HT40)	17.50-19.50
		802.11ac (VHT20)	17.50-19.50
		802.11ac (VHT40)	17.50-19.50
		802.11ac (VHT80)	17.00-19.00
	ANT0 + ANT1	802.11n (HT20)	20.50-22.50
		802.11n (HT40)	20.50-22.50
		802.11ac (VHT20)	20.50-22.50
		802.11ac (VHT40)	20.50-22.50
		802.11ac (VHT80)	20.50-22.50
5.8G WIFI (5725 MHz~ 5850 MHz)	ANT0	802.11a	24.50-26.50
		802.11n (HT20)	24.50-26.50
		802.11n (HT40)	24.50-26.50
		802.11ac (VHT20)	24.50-26.50
		802.11ac (VHT40)	24.50-26.50

	ANT1	802.11ac (VHT80)	24.50-26.50
		802.11a	24.50-26.50
		802.11n (HT20)	24.50-26.50
		802.11n (HT40)	24.50-26.50
		802.11ac (VHT20)	24.50-26.50
		802.11ac (VHT40)	24.50-26.50
		802.11ac (VHT80)	24.50-26.50
	ANT0 + ANT1	802.11n (HT20)	27.50-29.50
		802.11n (HT40)	27.50-29.50
		802.11ac (VHT20)	27.50-29.50
		802.11ac (VHT40)	27.50-29.50
		802.11ac (VHT80)	27.50-29.50

Test result

Mode	Maximum peak output power (dBm)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Power Density/ Limit	Verdict
2.4G WIFI	28.00	5	20	0.397	10	0.040	Pass
5150 MHz ~ 5250 MHz	22.50	5	20	0.112	10	0.011	Pass
5725 MHz ~ 5850 MHz	29.50	5	20	0.561	10	0.056	Pass

Collocated Power Density Calculation

Evolution mode	Frequency(MHz)	Power Density/Limit	Σ (Power Density / Limit) of WIFI 2.4GHz+ WIFI 5GHz	Verdict
2.4G WIFI	2412MHz ~ 2462MHz	0.040	0.050	Pass
5.2G WIFI	5150 MHz ~ 5250 MHz	0.010		Pass
2.4G WIFI	2412MHz ~ 2462MHz	0.040	0.096	Pass
5.8G WIFI	5725 MHz ~ 5850 MHz	0.056		Pass

Note:

1. Σ (Power Density / Limit): This is a summation of [(power density for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding Power Density limit)], for WLAN 2.4GHz+ WLAN 5GHz.
2. Both of the 2.4GHz and 5GHz can transmit simultaneously, the formula of calculated the Power Density is

$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$
CPD = Calculation power density
LPD = Limit of power density
3. The worst-case situation is 0.096, which is less than "1". This confirmed that the device comply with Council Recommendation 199-519-EC Power Density limit.
4. The Gee Chain X work frequency range used is 2412 MHz ~ 2462 MHz, 5150 MHz ~ 5250 MHz and 5725 MHz ~ 5850 MHz, the result close to the limit by the above formula

5. More power list please refer to RF test report.

Conclusion:

RF exposure Evaluation Results: **Compliance**