

## **RF Exposure Evaluation for FCC ID: 2AFIW-AX1800**

Refer user manual this device is a AX1800 Wireless Router, 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  $\geq 20$  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 <sup>2</sup> )
0.3-1.34	614	1.63	(100)*
1.34-30	824/f	2.19/f	(180/f <sup>2</sup> )*
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**

Bluetooth						
Mode	GFSK(BLE 1Mbps)			GFSK(BLE 2Mbps)		
	Low Channel	Middle Channel	High Channel	Low Channel	Middle Channel	High Channel
Peak Power (dBm)	7.52	6.84	5.87	<b>7.55</b>	6.86	6.22

Note: This report listed the worst case peak power value, please refer to Report No. BL-SZ2190509-601 for more details.

2.4G WIFI								
Mode	Main Antenna							
	802.11b	802.11g	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ax20(SU)	802.11ax40(SU)
Average Power (dBm)	24.44	<b>24.94</b>	23.12	16.50	23.10	20.16	22.87	19.60
Mode	Aux. Antenna							
	802.11b	802.11g	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ax20(SU)	802.11ax40(SU)
Average Power (dBm)	24.28	<b>24.73</b>	23.06	18.16	23.31	17.62	23.01	17.32
Mode	MIMO-Main Antenna							
	802.11b	802.11g	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ax20(SU)	802.11ax40(SU)
Average Power (dBm)	22.25	22.02	21.94	12.51	21.55	13.84	<b>23.00</b>	14.78
Mode	MIMO-Aux. Antenna							
	802.11b	802.11g	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ax20(SU)	802.11ax40(SU)
Average Power (dBm)	22.09	22.12	<b>23.20</b>	12.45	21.78	13.88	22.90	14.76
Mode	MIMO							
	802.11b	802.11g	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ax20(SU)	802.11ax40(SU)
Average Power (dBm)	24.98	24.93	25.55	15.48	24.68	16.87	<b>25.96</b>	17.78

Note: This report listed the worst case average power value, please refer to Report No. BL-SZ2190509-602 for more details.



### Turn-up power

Mode		Range (dBm)
Bluetooth	BLE	5.50-8.00
2.4G WIFI	Main Antenna	11.00-25.00
	Aux. Antenna	12.00-25.00
	MIMO-Main Antenna	8.50-23.50
	MIMO-Aux. Antenna	8.00-23.50
	MIMO	11.00-26.00
5.2G WIFI	Main Antenna	16.00-23.50
	Aux. Antenna	13.50-24.00
	MIMO-Main Antenna	11.00-20.00
	MIMO-Aux. Antenna	12.50-21.50
	MIMO	15.00-23.50
5.8G WIFI	Main Antenna	22.00-24.00
	Aux. Antenna	22.00-24.00
	MIMO-Main Antenna	22.00-24.00
	MIMO-Aux. Antenna	22.00-24.00
	MIMO	24.50-26.50

### Test result

Evolution mode	Max. output power (dBm)	Antenna Gain (dBi)	Total Power (mw)	Distance (cm)	Limit of Power Density (mW/cm <sup>2</sup> )	Power Density (mW/cm <sup>2</sup> )	Power Density/Limit	Verdict
Bluetooth	8.00	-0.36	5.81	20	1.00	0.001	0.001	Pass
2.4G WIFI	26.00	2.79	756.83	20	1.00	0.151	0.151	Pass
5.2G WIFI	24.00	2.86	485.29	20	1.00	0.097	0.097	Pass
5.8G WIFI	26.50	3.15	922.57	20	1.00	0.184	0.184	Pass

### Collocated Power Density Calculation

Evolution mode	Frequency(MHz)	Power Density/Limit	Σ (Power Density / Limit) of 2.4G WIFI + 5G WIFI	Verdict
2.4G WIFI	2400 MHz ~ 2483.5 MHz	0.151	<b>0.335</b>	Pass
5.8G WIFI	5725 MHz ~ 5850 MHz	0.184		

Note:

1.  $\Sigma$  (Power Density / Limit): This is a summation of [(power density for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding Power Density limit)], for 2.4G WIFI + 5G WIFI.
2. Bluetooth and WLAN antenna can't simultaneous transmission at the same time.
3. Both of the 2.4GHz WIFI/5GHz WIFI 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

4. The worst-case situation is 0.335, which is less than "1". This confirmed that the device comply with Council Recommendation 199-519-EC Power Density limit.
5. More power list please refer to RF test report.

**Conclusion:**

RF exposure Evaluation Results: **Compliance**