

## **RF Exposure Evaluation For FCC ID: 2A4FL-AE810**

Refer user manual this device is a AE Touch Technologies IFPD, and this device was designed used in Mobile devices that the minimum distance between human's body is **20 cm**. 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 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 <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

### 7668 module

Bluetooth				
Mode	BR+EDR			BLE
	GFSK	$\pi/4$ -DQPSK	8-DPSK	GFSK
Peak Power (dBm)	8.93	11.20	<b>11.66</b>	9.12
Note: This report listed the worst case peak power value, please refer to RF test report for more details.				

2.4G WIFI				
Mode	Main Antenna			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	20.96	24.54	22.57	22.34
Mode	Aux. Antenna			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	21.89	24.70	22.94	22.74
Mode	MIMO-Main Antenna			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	21.69	24.86	22.65	22.98
Mode	MIMO-Aux. Antenna			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	21.75	24.99	23.51	23.52
Mode	MIMO			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	24.73	27.85	25.90	26.27
Note: This report listed the worst case average power value, please refer to RF test report for more details.				

5.2G WIFI						
Mode	Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.93	14.95	14.92	13.84	14.03	10.57
Mode	Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.90	14.88	14.98	13.78	13.92	12.10
Mode	MIMO-Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.65	14.95	14.91	13.98	13.96	10.78
Mode	MIMO-Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.65	14.95	14.77	13.84	13.92	10.86
Mode	MIMO					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	19.66	17.92	17.85	16.88	16.95	13.83
Note: This report listed the worst case conducted power value, please refer to RF test report for more details.						

5.8G WIFI						
Mode	Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.58	14.85	14.94	13.95	13.98	13.91
Mode	Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.83	14.92	14.95	13.94	13.96	13.97
Mode	MIMO-Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.64	14.91	14.92	13.90	13.99	13.91
Mode	MIMO-Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.76	14.96	14.95	13.77	13.93	13.96
Mode	MIMO					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	19.71	17.93	17.95	16.76	16.97	16.95
Note: This report listed the worst case conducted power value, please refer to RF test report for more details.						

**8812 module**

2.4G WIFI				
Mode	Main Antenna			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	18.73	24.60	22.26	22.75
Mode	Aux. Antenna			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	19.88	24.86	22.97	22.45
Mode	MIMO-Main Antenna			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	15.85	24.40	22.32	22.29
Mode	MIMO-Aux. Antenna			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	17.35	24.34	23.12	21.96
Mode	MIMO			
	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	19.50	27.38	25.59	25.14
Note: This report listed the worst case average power value, please refer to RF test report for more details.				

5.2G WIFI						
Mode	Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.60	14.73	14.47	13.86	13.70	10.63
Mode	Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.60	14.73	14.47	13.86	13.70	10.63
Mode	MIMO-Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.71	14.58	14.82	13.70	13.54	10.31
Mode	MIMO-Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	16.72	14.84	13.39	13.89	13.82	12.08
Mode	MIMO					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	19.72	17.66	17.62	16.78	16.69	14.29
Note: This report listed the worst case conducted power value, please refer to RF test report for more details.						

Turn-up power

7668 module

Mode		Range (dBm)
Bluetooth		8.00-12.00
2.4G WIFI	Main Antenna	20.00-25.00
	Aux. Antenna	21.00-25.00
	MIMO-Main Antenna	21.00-25.00
	MIMO-Aux. Antenna	21.00-25.00
	MIMO	24.00-28.00
5.2G WIFI	Main Antenna	10.00-17.00
	Aux. Antenna	10.00-17.00
	MIMO-Main Antenna	10.00-17.00
	MIMO-Aux. Antenna	10.00-17.00
	MIMO	13.00-20.00
5.8G WIFI	Main Antenna	13.00-17.00
	Aux. Antenna	13.00-17.00
	MIMO-Main Antenna	13.00-17.00
	MIMO-Aux. Antenna	13.00-17.00
	MIMO	16.00-20.50

**8812 module**

Mode		Range (dBm)
2.4G WIFI	Main Antenna	19.00-23.00
	Aux. Antenna	15.00-22.50
	MIMO-Main Antenna	17.00-22.00
	MIMO-Aux. Antenna	17.00-22.00
	MIMO	19.00-26.00
5.2G WIFI	Main Antenna	11.00-17.00
	Aux. Antenna	11.00-17.00
	MIMO-Main Antenna	11.00-17.00
	MIMO-Aux. Antenna	13.00-17.00
	MIMO	15.00-19.00

**Test result****7668 module**

Evolution mode	Maximum peak 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	12.00	4.00	39.811	20	1.00	0.008	0.008	Pass
2.4G WIFI	28.00	3.50	1412.538	20	1.00	0.281	0.281	Pass
5.2G WIFI	20.00	5.00	316.228	20	1.00	0.063	0.063	Pass
5.8G WIFI	20.50	5.00	354.813	20	1.00	0.071	0.071	Pass

**8812 module**

Evolution mode	Maximum peak 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
2.4G WIFI	26.00	3.00	794.328	20	1.00	0.158	0.158	Pass
5.2G WIFI	19.00	3.00	158.489	20	1.00	0.032	0.032	Pass

## Collocated Power Density Calculation

### 7668 module + 8812 module

Evolution mode	Frequency(MHz)	Power Density/Limit	$\Sigma$ (Power Density / Limit) of Bluetooth + 2.4G WIFI + 5G WIFI	Verdict
Bluetooth (7668 module)	2400 MHz ~ 2483.5 MHz	0.008	0.550	Pass
2.4G WIFI (7668 module)	2400 MHz ~ 2483.5 MHz	0.281		
2.4G WIFI (8812 module)	2400 MHz ~ 2483.5 MHz	0.158		
5G WIFI (7668 module)	5725 MHz ~ 5850 MHz	0.071		
5G WIFI (8812 module)	5725 MHz ~ 5850 MHz	0.032		

#### Note:

1.  $\Sigma$  (Power Density / Limit): This is a summation of [(power density for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WLAN 2.4GHz+WLAN 5GHz.
2. Both of the Bluetooth/ 2.4GHz/5GHz can transmit simultaneously, the formula of calculated the MPE is  
$$\text{CPD1} / \text{LPD1} + \text{CPD2} / \text{LPD2} + \dots \text{etc.} < 1$$
  
CPD = Calculation power density  
LPD = Limit of power density
3. The worst-case situation is 0.550, which is less than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.
4. The AE Touch Technologies IFPD work frequency range used is 2400 MHz ~ 2483.5 MHz, 5150 MHz~ 5250 MHz and 5725 MHz ~ 5850 MHz the result close to the limit by the above formula so, we select worst case power to calculate the exclusion power threshold.
5. More power list please refer to RF test report.

#### Conclusion:

RF exposure Evaluation Results: **Compliance**