

## FCC RF Exposure Evaluation

### 1. Product Information

FCC ID:	2AATL-6221C-PUC
Product name	2.4G+5G WIFI+BT Module
Model number	6221C-PUC
Power supply	DC 3.3V AC 120V 60Hz(Adapter for DSP)
Modulation Type	GFSK,8-DPSK, $\pi$ /4-DQPSK(BT V4.2); IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20:OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40:OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT20:OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11ac VHT40:OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11ac VHT80:OFDM (64QAM, 16QAM, QPSK,BPSK)
Antenna Type	PCB Antenna
Antenna Gain	2 dBi (maximum)
Hardware version	V1.0
Software version	V1.0
Bluetooth Operation frequency	2402MHz-2480MHz
WLAN FCC Operation frequency	IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz,5180-5240MHz,5745-5825MHz IEEE 802.11n HT40:2422-2452MHz,5190-5230MHz,5755-5795MHz IEEE 802.11a:5180-5240MHz, 5745-5825MHz IEEE 802.11ac VHT20:5180-5240MHz, 5745-5825MHz IEEE 802.11ac VHT40:5190-5230MHz, 5755-5795MHz IEEE 802.11ac VHT80:5210MHz, 5775MHz
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Portable Device

## 2. Evaluation method and Limit

According to ANSI/IEEE C95.1-1992, the Criteria Listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposure</b>				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f <sup>2</sup>	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f <sup>2</sup>	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz \* = Plane-wave equivalent power density

The MPE was calculated at **20 cm** to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

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

Where:

S = Power Density

P = Output Power at Antenna Terminals

G = Gain of Transmit Antenna ( linear gain )

R = Distance from Transmitting Antenna

**3. Antenna Information**

Product can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna 0	2.4G/5G Wifi Chain 0	PIFA Antenna	2400MHz-2483.5MHz, 5150MHz-5250MHz, 5745MHz-5850MHz	2.00 dBi
Antenna 1	2.4G/5G Wifi Chain 1 Bluetooth	PIFA Antenna		2.00 dBi

Note: The product has two antenna ports, but only support SISO only, the antennas used for antenna ports are the same(Model number: XK-W5515A-PCB-2.4-5.8-150).

**4. Conducted Power****4.1 Test Setup Block Diagram****4.2 Test Procedure**

- 1) The EUT was directly connected to the power meter and antenna output port as show in the Block diagram;
- 2) Reading average power in RMS detector.

**4.3 Measurement Equipment**

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1	Power Meter	R&S	NRVS	100444	2017-06-17	2018-06-16
2	Power Sensor	R&S	NRV-232	10057	2017-06-17	2018-06-16

**Bluetooth**

Mode	Channel	Frequency(MHz)	Average Conducted Output Power (dBm)
8DPSK	0	2402	9.759
	39	2441	8.257
	78	2480	6.415

Note:

- 1) Test GFSK,  $\pi/4$ DQPSK and 8-DPSK for BT classic and GFSK for BT LE, only report 8-DPSK results to represents BT mode, as this is worst case .
- 2) Test performed on antenna 1 and antenna 2 separately, worst case result reported.

**2.4GHz WLAN**

Mode	Channel	Frequency(MHz)	Average Conducted Output Power (dBm)
802.11n HT20/OFDM	1	2412	14.38
	6	2437	13.56
	11	2462	13.44

Note:

- 1) Test IEEE 802.11b, IEEE 802.11g, IEEE 802.11n20 and IEEE 802.11n40 for 2.4GHz WLAN, only report IEEE 802.11n20 results to represents 2.4GHz WLAN mode, as this is worst case .
- 2) Test performed on antenna 1 and antenna 2 separately, worst case result reported.

**5GHz WLAN Band 1**

Mode	Channel	Frequency(MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a /OFDM	36	5180	13.69
	40	5200	13.25
	48	5240	13.17

Note:

- 1) Test IEEE 802.11a, IEEE 802.11n, and IEEE 802.11ac for 5GHz WLAN Band1, only report IEEE 802.11a results to represents 5GHz WLAN Band1 mode, as this is worst case .
- 2) Test performed on antenna 1 and antenna 2 separately, worst case result reported.

**5GHz WLAN Band 3**

Mode	Channel	Frequency(MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a /OFDM	149	5745	14.60
	157	5785	14.56
	165	5825	13.92

- 1) Test IEEE 802.11a, IEEE 802.11n, and IEEE 802.11ac for 5GHz WLAN Band3, only report IEEE 802.11a results to represents 5GHz WLAN Band3 mode, as this is worst case .
- 2) Test performed on antenna 1 and antenna 2 separately, worst case result reported.

**5. Manufacturing tolerance**

<b>8DPSK (Average)</b>			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	8	8	8
Tolerance $\pm$ (dB)	2.0	2.0	2.0

<b>802.11nHT20 (Average)</b>			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	14	14	14
Tolerance $\pm$ (dB)	1.5	1.5	1.5

<b>IEEE 802.11a (Average)</b>			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	13	13	13
Tolerance $\pm$ (dB)	1.5	1.5	1.5

<b>IEEE 802.11a (Average)</b>			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	13	13	13
Tolerance $\pm$ (dB)	1.5	1.5	1.5

**6. Evaluation Results**

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Maximum Output Power Limit (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
2.4GHz WLAN	2412	2.0	15.5	17.500	0.056	1.000	56.234	0.011	1.000
2.4GHz BT	2402	2.0	10.0	12.000	0.016	1.000	15.849	0.003	1.000
5.8GHz WLAN	5745	2.0	14.5	16.500	0.045	1.000	44.668	0.009	1.000
5.2GHz WLAN	5180	2.0	14.5	16.500	0.045	0.050	44.668	0.009	1.000

**Remark:**

1. Output power including tune up tolerance;
2. Product has two antennas, but only supports SISO, no need consider simultaneous transmit.

**7. Conclusion**

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure.

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