# 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<br>AC 120V 60Hz(Adapter for DSP) |
| Modulation Type | GFSK,8-DPSK,π/4-DQPSK(BT V4.2);<br>IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK)<br>IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)<br>IEEE 802.11n HT20:OFDM (64QAM, 16QAM, QPSK,BPSK)<br>IEEE 802.11n HT40:OFDM (64QAM, 16QAM, QPSK,BPSK)<br>IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK)<br>IEEE 802.11ac VHT20:OFDM (64QAM, 16QAM, QPSK,BPSK)<br>IEEE 802.11ac VHT40:OFDM (64QAM, 16QAM, QPSK,BPSK)<br>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<br>IEEE 802.11g:2412-2462MHz<br>IEEE 802.11n HT20:2412-2462MHz,5180-5240MHz,5745-5825MHz<br>IEEE 802.11n HT40:2422-2452MHz,5190-5230MHz,5755-5795MHz<br>IEEE 802.11a:5180-5240MHz, 5745-5825MHz<br>IEEE 802.11ac VHT20:5180-5240MHz, 5745-5825MHz<br>IEEE 802.11ac VHT40:5190-5230MHz, 5755-5795MHz<br>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$^2$) | Averaging time (minutes) |
|---|---|---|---|---|
| **(A) Limits for Occupational/Controlled Exposure** | | | | |
| 0.3-3.0 | 614 | 1.63 | *100 | 6 |
| 3.0-30 | 1842/f | 4.89/f | *900/f$^2$ | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1,500 | | | f/300 | 6 |
| 1,500-100,000 | | | 5 | 6 |
| **(B) Limits for General Population/Uncontrolled Exposure** | | | | |
| 0.3-1.34 | 614 | 1.63 | *100 | 30 |
| 1.34-30 | 824/f | 2.19/f | *180/f$^2$ | 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 certified 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-Z32 | 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, π/4DQPSK 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

| 8DPSK (Average) | | | |
|---|---|---|---|
| Channel | Channel 0 | Channel 39 | Channel 78 |
| Target (dBm) | 8 | 8 | 8 |
| Tolerance ±(dB) | 2.0 | 2.0 | 2.0 |

| 802.11nHT20 (Average) | | | |
|---|---|---|---|
| Channel | Channel 1 | Channel 6 | Channel 11 |
| Target (dBm) | 14 | 14 | 14 |
| Tolerance ±(dB) | 1.5 | 1.5 | 1.5 |

| IEEE 802.11a (Average) | | | |
|---|---|---|---|
| Channel | Channel 36 | Channel 40 | Channel 48 |
| Target (dBm) | 13 | 13 | 13 |
| Tolerance ±(dB) | 1.5 | 1.5 | 1.5 |

| IEEE 802.11a (Average) | | | |
|---|---|---|---|
| Channel | Channel 0 | Channel 39 | Channel 78 |
| Target (dBm) | 13 | 13 | 13 |
| Tolerance ±(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^2) | Limit (mW/cm^2) |
|---|---|---|---|---|---|---|---|---|---|
| 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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