

# RF Exposure Report

**FCC ID: 2AFENXL03A**

## RF Exposure Measurement

The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The gain of the antennas used in the product is extracted from the Antenna data sheets provided and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis Transmission formula is far field assumption, the calculated result of that is an over-prediction for near field power density. It is taken as worst case to specify the safety range.

## RF Exposure Limit

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of the human exposure to radio-frequency (RF) radiation as specified in 1.1307 (b)

Limits for Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )
Limits for Occupational / controlled Exposures			
300 - 1500	--	--	F/300
1500 – 100000	--	--	5.0
Limits for General population / Uncontrolled Exposure			
300 - 1500	--	--	F/1500
1500 – 100000	--	--	1.0

F= Frequency in MHz

## Friss Formula

Friss Transmission Formula:  $P_d = (P_{out} * G) / (4 * \pi * r^2)$

Where

$P_d$  = power density in mW/cm<sup>2</sup>

$P_{out}$  = output power to antenna in mW

$G$  = gain of antenna in linear scale

$\pi$  = 3.1416

$R$  = Distance between observation point and the center of radiator in cm

If we know the maximum gain of the antenna and the total output power to the antenna, through calculation, we will know MPE value at distance 20cm.

## EUT Operation condition

EUT was enabled to transmit and receive at lowest, middle and highest channels.

## Classification

The antenna of this product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance from the antenna should be included in the User manual. So, this device is classified as Mobile device.

BT and Wi-Fi support simultaneous transmission

## BT5.0 BR+EDR+BLE

Mode	2402-2480MHz
Detector	AV
BT-GFSK	5±1dBm
BT- $\pi/4$ -DQPSK	5±1dBm
BT-8DPSK	5±1dBm
BLE-GFSK 1M PHY	5±1dBm
BLE-GFSK 2M PHY	5±1dBm

## ANT Gain (G)

Antenna gain : 3.49dBi (gain of antenna in linear scale=2.234)

Protocol	ANT Gain (gain of antenna in linear scale)	Channel Frequency (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
GFSK	2.234	2402	6	3.9811	0.00177	1
$\pi/4$ -DQPSK	2.234	2402	6	3.9811	0.00177	1
8DPSK	2.234	2402	6	3.9811	0.00177	1
BLE 1M PHY	2.234	2402	6	3.9811	0.00177	1
BLE 2M PHY	2.234	2402	6	3.9811	0.00177	1

## 2.4G WIFI

Mode	802.11b/g/n20:2412-2462MHz 802.11n40:2422-2452MHz
Detector	AV
802.11b	15±1dBm
802.11g	13±1dBm
802.11n20(mimo)	14±1dBm
802.11n40(mimo)	14±1dBm

### ANT Gain (G)

Antenna number: 2

Antenna A gain : 3.57dBi

Antenna B gain : 3.57dBi

(gain of antenna in linear scale=2.275)

MIMO technology Directional gain= 6.58dBi

(gain of antenna in linear scale=4.55)

Protocol	ANT Gain(gain of antenna in linear scale)	Channel Frequency (MHz)	Output Power to Antenna	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
802.11 b	2.275	2412	16	39.8107	0.01803	1
802.11 g	2.275	2412	14	25.1189	0.01137	1
802.11 n20(mimo)	4.55	2412	15	31.6228	0.02864	1
802.11 n40(mimo)	4.55	2422	15	31.6228	0.02864	1

## 5.2G WIFI

Mode	802.11a/n20/n40/ac20/ac40/ac80: 5.15-5.25GHz
Detector	AV
802.11a	9±1dBm
802.11n20 (mimo)	11±1dBm
802.11 n40 (mimo)	5±1dBm
802.11ac20 (mimo)	11±1dBm
802.11ac40 (mimo)	4±1dBm
802.11ac80 (mimo)	4±1dBm

### ANT Gain (G)

Antenna number: 2

Antenna A gain : 6.99dBi

Antenna B gain : 6.99dBi

(gain of antenna in linear scale=5.0)

MIMO technology Directional gain= 10dBi

(gain of antenna in linear scale=10)

Protocol	ANT Gain(gain of antenna in linear scale)	Channel Frequency (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
802.11 a	5	5240	10	10.0000	0.00995	1
802.11 n20(mimo)	10	5240	12	15.8489	0.03155	1
802.11 n40(mimo)	10	5230	6	3.9811	0.00792	1
802.11 ac20(mimo)	10	5240	12	15.8489	0.03155	1
802.11 ac40(mimo)	10	5230	5	3.1623	0.00629	1
802.11 ac80(mimo)	10	5210	5	3.1623	0.00629	1

### 5.3G WIFI

Mode	802.11a/n20/n40/ac20/ac40/ac80: 5.25-5.35GHz
Detector	AV
802.11a	9±1dBm
802.11n20 (mimo)	11±1dBm
802.11 n40 (mimo)	6±1dBm
802.11ac20 (mimo)	11±1dBm
802.11ac40 (mimo)	5±1dBm
802.11ac80 (mimo)	4±1dBm

#### ANT Gain (G)

Antenna number: 2

Antenna A gain : 6.99dBi

Antenna B gain : 6.99dBi

(gain of antenna in linear scale=5.0)

MIMO technology Directional gain= 10dBi

(gain of antenna in linear scale=10)

Protocol	ANT Gain(gain of antenna in linear scale)	Channel Frequency (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
802.11 a	5	5300	10	10.0000	0.00995	1
802.11 n20(mimo)	10	5320	12	15.8489	0.03155	1
802.11 n40(mimo)	10	5310	7	5.0119	0.00998	1
802.11 ac20(mimo)	10	5320	12	15.8489	0.03155	1
802.11 ac40(mimo)	10	5310	6	3.9811	0.00792	1
802.11 ac80(mimo)	10	5290	5	3.1623	0.00629	1

### 5.6G WIFI

Mode	802.11a/n20/n40/ac20/ac40/ac80: 5.47-5.725GHz
Detector	AV
802.11a	8±1dBm;
802.11n20 (mimo)	9±1dBm
802.11 n40 (mimo)	5±1dBm
802.11ac20 (mimo)	9±1dBm
802.11ac40 (mimo)	4±1dBm
802.11ac80 (mimo)	3±1dBm

#### ANT Gain (G)

Antenna number: 2

Antenna number: 2

**Antenna A gain : 6.99dBi**

**Antenna B gain : 6.99dBi**

**(gain of antenna in linear scale=5.0)**

**MIMO technology Directional gain= 10dBi**

**(gain of antenna in linear scale=10)**

Protocol	ANT Gain(gain of antenna in linear scale)	Channel Frequency (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
802.11 a	5	5500	9	7.9433	0.00791	1
802.11 n20(mimo)	10	5500	10	10.0000	0.01990	1
802.11 n40(mimo)	10	5510	6	3.9811	0.00792	1
802.11 ac20(mimo)	10	5500	10	10.0000	0.01990	1
802.11 ac40(mimo)	10	5510	5	3.1623	0.00629	1
802.11 ac80(mimo)	10	5530	4	2.5119	0.00500	1

### **5.8G WIFI**

Mode	802.11a/n20/n40/ac20/ac40/ac80: 5.525-5.85GHz
Detector	AV
802.11a	6±1dBm
802.11n20 (mimo)	8±1dBm
802.11 n40 (mimo)	8±1dBm
802.11ac20 (mimo)	8±1dBm
802.11ac40 (mimo)	7±1dBm
802.11ac80 (mimo)	10±1dBm

#### **ANT Gain (G)**

**Antenna number: 2**

**Antenna A gain : 6.99dBi**

**Antenna B gain : 6.99dBi**

**(gain of antenna in linear scale=5.0)**

**MIMO technology Directional gain= 10dBi**

**(gain of antenna in linear scale=10)**

Protocol	ANT Gain(gain of antenna in linear scale)	Channel Frequency (MHz)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
802.11 a	9	5745	7	5.0119	0.00898	1
802.11 n20(mimo)	10	5745	9	7.9433	0.01581	1
802.11 n40(mimo)	10	5755	9	7.9433	0.01581	1
802.11 ac20(mimo)	10	5745	9	7.9433	0.01581	1
802.11 ac40(mimo)	10	5755	8	6.3096	0.01256	1
802.11 ac80(mimo)	10	5775	11	12.5893	0.02506	1

**The max MPE of BT & WIFI simultaneous transmission:**

$$0.00177(\text{BT}) + 0.02864(2.4\text{GHz Wi-Fi}) + 0.03155(5\text{G Wi-Fi}) = 0.06196 < 1$$

**According to the maximum gain of the antenna and the total output power to the antenna, through calculation, we will know max MPE value 0.11698 at distance 20cm.**

**This is less than the limit 1. So SAR testing is not required.**