

# RF Exposure Report

FCC-ID: 2BA9P-003

## 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)

F= Frequency in MHz

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

## Friis Formula

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

Where

Pd = power density in mW/cm<sup>2</sup>

Pout = 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.

## Bluetooth+BLE

Mode	Bluetooth+BLE(1M PHY and 2M PHY)
Detector	PEAK
Ant Gain(dBi)	2.59
GFSK	6±1dBm
$\pi/4$ -DQPSK	6±1dBm
8DPSK	6±1dBm
BLE1M	8±1dBm
BLE2M	8.5±1dBm

### ANT Gain (G)

Antenna A gain: 2.59dB<sub>i</sub>

(gain of antenna in linear scale=1.816)

Protocol	ANT Gain(gain of antenna in linear scale)	Output Power to Antenna (dBm)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )
GFSK	1.816	7	5.0119	0.00181	1
$\pi/4$ -DQPSK	1.816	7	5.0119	0.00181	1
8DPSK	1.816	7	5.0119	0.00181	1
BLE1M	1.816	9	7.9433	0.00287	1
BLE2M	1.816	9.5	8.9125	0.00322	1

## 2.4G WIFI WORST CASE

Mode	802.11b/g/n:2412-2462MHz 802.11n:2422-2452MHz	
Detector	PEAK	
802.11b	ANT1=12±1dBm	ANT2=10±1dBm
802.11g	ANT1=11.5±1dBm	ANT2=13.5±1dBm
802.11n20	MIMO=16.0±1dBm	

### ANT Gain (G)

Antenna number: 2

Antenna A gain: 2.59dBi

Antenna B gain: 2.59dBi

(gain of antenna in linear scale=1.816)

MIMO technology Directional gain= 5.6dBi

(gain of antenna in linear scale=3.631)

Protocol	ANT Gain(gain of antenna in linear scale)	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 b	1.816	13	19.9526	0.00721	1
802.11 g	1.816	14.5	28.1838	0.01019	1
802.11 n20	3.631	17	50.1187	0.03622	1

## 5G WIFI WORST CASE

### ANT Gain (G)

Mode	IEEE 802.11a/n(HT20)/ac(VHT20): 5.180GHz-5.240GHz
	IEEE 802.11n(HT40)/ac(VHT40): 5.190GHz-5.230GHz
	IEEE 802.11ac(VHT80): 5.210GHz
	IEEE 802.11a/n(HT20)/ac(VHT20): 5.260GHz-5.320GHz
	IEEE 802.11 n(HT40)/ac(VHT40): 5.270GHz-5.310GHz
	IEEE 802.11ac(VHT80): 5.290GHz
	IEEE 802.11a/n(HT20)/ac(VHT20): 5.500GHz-5.700GHz
	IEEE 802.11 n(HT40)/ac(VHT40): 5.510GHz-5.670GHz
	IEEE 802.11ac(VHT80): 5.530GHz-5.610GHz
	IEEE 802.11a/n(HT20)/ac(VHT20): 5.745GHz-5.825GHz
	IEEE 802.11a/n(HT40)/ac(VHT40): 5.755GHz-5.795GHz
	IEEE 802.11ac(VHT80): 5.775GHz
Detector	AVG
802.11 a	16±1dBm
802.11 n/ac20	15.5±1dBm
802.11 n/ac40	15.5±1dBm
802.11 ac80	16±1dBm

**Antenna number: 2**

**Antenna A gain: 2.84dBi**

**Antenna B gain: 2.84dBi**

**(gain of antenna in linear scale=1.923)**

**MIMO technology Directional gain= 5.85dBi**

**(gain of antenna in linear scale=3.846)**

Protocol	ANT Gain(gain of antenna in linear scale)	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	1.923	17	50.1187	0.01918	1
802.11 n/ac20	3.846	16.5	44.6684	0.01710	1
802.11 n/ac40	3.846	16.5	44.6684	0.03419	1
802.11 ac80	3.846	17	50.1187	0.03837	1

**2.4 G WiFi and 5 GHz WiFi & BT can simultaneously transmission, maximum Power Density (S) is 0.07781 (mW/cm<sup>2</sup>) does not exceed Limit of Power Density (S) 1 (mW/cm<sup>2</sup>).**