

RF Exposure Report

FCC ID: EF400191

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 Friss 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 Friss 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 ²)
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

Friss Formula

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

Where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 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.

1.BLE

Mode	2402-2480MHz
Detector	PEAK
GFSK	9±1dBm

ANT Gain (G)

Antenna gain : 3dBi (gain of antenna in linear scale=1.995)

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 ²)	Limit (mW/cm ²)
GFSK	1.995	2440	10	10	0.003969	1

2. 2.4G WIFI

Mode	802.11b/g/n:2412-2462MHz
Detector	PEAK
802.11b	16±1dBm
802.11g	14±1dBm
802.11n20	16±1dBm
802.11n40	13±1dBm

Antenna number: 2

Antenna A gain : 3dBi

Antenna B gain : 3dBi

MIMO technology Directional gain=6.01dBi

Antenna gain : 3dBi (gain of antenna in linear scale=1.995)

Antenna gain: 6.01dBi (gain of antenna in linear scale=3.99)

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 ²)	Limit (mW/cm ²)
802.11 b	1.995	2412	17	50.11872	0.019892	1
802.11 g	1.995	2412	15	31.62278	0.012550	1
802.11 n20	3.99	2412	17	50.11872	0.039783	1
802.11 n40	3.99	2422	14	25.11886	0.019939	1

3. 5G WIFI: 5180-5240MHz

Mode	802.11a/n/ac:5180-5240MHz
Detector	PEAK
802.11a	12±1dBm
802.11n20	14±1dBm
802.11n40	11±1dBm
802.11ac20	14±1dBm
802.11ac40	11±1dBm
802.11ac80	13±1dBm

Antenna number: 2

Antenna A gain : 3dBi

Antenna B gain : 3dBi

MIMO technology Directional gain=6.01dBi

Antenna gain : 3dBi (gain of antenna in linear scale=1.995)

Antenna gain: 6.01dBi (gain of antenna in linear scale=3.99)

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 ²)	Limit (mW/cm ²)
802.11a	1.995	5240	13	19.95262	0.007919	1
802.11n20	3.99	5230	15	31.62278	0.025102	1
802.11n40	3.99	5190	12	15.84893	0.012581	1
802.11ac20	3.99	5240	15	31.62278	0.025102	1
802.11ac40	3.99	5230	12	15.84893	0.012581	1
802.11ac80	3.99	5210	14	25.11886	0.019939	1

4. 5G WIFI: 5260-5320MHz

Mode	802.11a/n/ac:5260-5320MHz
Detector	PEAK
802.11a	12±1dBm
802.11n20	14±1dBm
802.11n40	12±1dBm
802.11ac20	14±1dBm
802.11ac40	12±1dBm
802.11ac80	12±1dBm

Antenna number: 2

Antenna A gain : 3dBi

Antenna B gain : 3dBi

MIMO technology Directional gain=6.01dBi

Antenna gain : 3dBi (gain of antenna in linear scale=1.995)

Antenna gain: 6.01dBi (gain of antenna in linear scale=3.99)

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 ²)	Limit (mW/cm ²)
802.11a	1.995	5240	13	19.95262	0.007919	1
802.11n20	3.99	5230	15	31.62278	0.025102	1
802.11n40	3.99	5190	13	19.95262	0.015838	1
802.11ac20	3.99	5240	15	31.62278	0.025102	1
802.11ac40	3.99	5230	13	19.95262	0.015838	1
802.11ac80	3.99	5210	13	19.95262	0.015838	1

5. 5G WIFI: 5500-5700MHz

Mode	802.11a/n/ac:5500-5700MHz
Detector	PEAK
802.11a	12±1dBm
802.11n20	14±1dBm
802.11n40	12±1dBm
802.11ac20	15±1dBm
802.11ac40	13±1dBm
802.11ac80	13±1dBm

Antenna number: 2

Antenna A gain : 3dBi

Antenna B gain : 3dBi

MIMO technology Directional gain=6.01dBi

Antenna gain : 3dBi (gain of antenna in linear scale=1.995)

Antenna gain: 6.01dBi (gain of antenna in linear scale=3.99)

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 ²)	Limit (mW/cm ²)
802.11a	1.995	5240	13	19.95262	0.007919	1
802.11n20	3.99	5230	15	31.62278	0.025102	1
802.11n40	3.99	5190	13	19.95262	0.015838	1
802.11ac20	3.99	5240	16	39.81072	0.031601	1
802.11ac40	3.99	5230	14	25.11886	0.019939	1
802.11ac80	3.99	5210	14	25.11886	0.019939	1

6. 5G WIFI: 5745-5825MHz

Mode	802.11a/n/ac:5745-5825MHz
Detector	PEAK
802.11a	12±1dBm
802.11n20	15±1dBm
802.11n40	12±1dBm
802.11ac20	15±1dBm
802.11ac40	13±1dBm
802.11ac80	13±1dBm

Antenna number: 2

Antenna A gain : 3dBi

Antenna B gain : 3dBi

MIMO technology Directional gain=6.01dBi

Antenna gain : 3dBi (gain of antenna in linear scale=1.995)

Antenna gain: 6.01dBi (gain of antenna in linear scale=3.99)

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 ²)	Limit (mW/cm ²)
802.11a	1.995	5240	13	19.95262	0.007919	1
802.11n20	3.99	5230	16	39.81072	0.031601	1
802.11n40	3.99	5190	13	19.95262	0.015838	1
802.11ac20	3.99	5240	16	39.81072	0.031601	1
802.11ac40	3.99	5230	14	25.11886	0.019939	1
802.11ac80	3.99	5210	14	25.11886	0.019939	1

Remark: Bluetooth, 2.4G WIFI and 5G WIFI cannot transmit at the same time.

According to the maximum gain of the antenna and the total output power to the antenna, through calculation, we will know MPE value **0.039783** at distance 20cm. This is less than the limit 1, so the SAR test is not required.