

FCC ID: 2APQQ-01WIMRA

## RF Exposure Evaluation

### Limits

The criteria listed in the following table shall be used to evaluate the environment impact of 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> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
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
300–1500			f/300	6
1500–100,000			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 <sup>2</sup> )	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

Friis transmission formula:  $Pd = (Pout * G) / (4 * pi * r^2)$

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 center of the radiator in cm

Pd is the limit of MPE, 1 mW/cm<sup>2</sup>. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

### Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, and highest channel individually.

## Test Result of RF Exposure Evaluation

BT (Worst case)

Antenna gain=2dBi

Test Frequency (MHz)	Minimum Separation Distance (cm)	Output Power (dBm)	Target power (dBm)	Target power (mW)	Antenna Gain (Numeric)	Power Density Limit (mW/cm <sup>2</sup> )	Power Density At 20 cm (mW/cm <sup>2</sup> )	Test Results
2402	20	-1.795	1±1	1.58	1.5849	1	0.0005	Pass
2441	20	0.421	1±1	1.58	1.5849	1	0.0005	Pass
2402	20	-1.795	1±1	1.58	1.5849	1	0.0005	Pass

BLE (Worst case)

Antenna gain=2dBi

Test Frequency (MHz)	Minimum Separation Distance (cm)	Output Power (dBm)	Target power (dBm)	Target power (mW)	Antenna Gain (Numeric)	Power Density Limit (mW/cm <sup>2</sup> )	Power Density At 20 cm (mW/cm <sup>2</sup> )	Test Results
2402	20	3.186	3±1	2.51	1.5849	1	0.0008	Pass
2440	20	2.465	3±1	2.51	1.5849	1	0.0008	Pass
2480	20	3.105	3±1	2.51	1.5849	1	0.0008	Pass

WIFI 2.4GHz (Antenna-A Worst case)

Antenna gain=2dBi, Directional gain=5.01dBi

Test Frequency (MHz)	Minimum Separation Distance (cm)	Output Power (dBm)	Target power (dBm)	Target power (mW)	Antenna Gain (Numeric)	Power Density Limit (mW/cm <sup>2</sup> )	Power Density At 20 cm (mW/cm <sup>2</sup> )	Test Results
2412	20.00	15.059	15±1	39.81	1.5849	1	0.0126	Pass
2422	20.00	13.434	14±1	31.62	1.5849	1	0.01	Pass
2437	20.00	15.239	15±1	39.81	1.5849	1	0.0126	Pass
2452	20.00	13.556	14±1	31.62	1.5849	1	0.01	Pass
2462	20.00	15.222	15±1	39.81	1.5849	1	0.0126	Pass

WIFI 2.4GHz (Antenna-B Worst case)

Antenna gain=2dBi, Directional gain=5.01dBi

Test Frequency (MHz)	Minimum Separation Distance (cm)	Output Power (dBm)	Target power (dBm)	Target power (mW)	Antenna Gain (Numeric)	Power Density Limit (mW/cm <sup>2</sup> )	Power Density At 20 cm (mW/cm <sup>2</sup> )	Test Results
2412	20.00	16.524	16±1	50.12	1.5849	1	0.0158	Pass
2422	20.00	14.849	15±1	39.81	1.5849	1	0.0126	Pass
2437	20.00	16.361	16±1	50.12	1.5849	1	0.0158	Pass
2452	20.00	14.477	15±1	39.81	1.5849	1	0.0126	Pass
2462	20.00	16.254	16±1	50.12	1.5849	1	0.0158	Pass

WIFI 5GHz (Antenna-A Worst case)

Antenna gain=2dBi, Directional gain=5.01dBi

Test Frequency (MHz)	Minimum Separation Distance (cm)	Output Power (dBm)	Target power (dBm)	Target power (mW)	Antenna Gain (Numeric)	Power Density Limit (mW/cm <sup>2</sup> )	Power Density At 20 cm (mW/cm <sup>2</sup> )	Test Results
5180	20	17.308	17±1	63.1	1.5849	1	0.0199	Pass
5190	20	14.745	15±1	39.81	1.5849	1	0.0126	Pass
5210	20	14.289	15±1	39.81	1.5849	1	0.0126	Pass
5230	20	14.481	15±1	39.81	1.5849	1	0.0126	Pass
5240	20	16.51	17±1	63.1	1.5849	1	0.0199	Pass
5745	20	16.848	17±1	63.1	1.5849	1	0.0199	Pass
5755	20	14.81	15±1	39.81	1.5849	1	0.0126	Pass
5775	20	14.458	15±1	39.81	1.5849	1	0.0126	Pass
5785	20	16.724	17±1	63.1	1.5849	1	0.0199	Pass
5795	20	14.353	15±1	39.81	1.5849	1	0.0126	Pass
5825	20	16.585	17±1	63.1	1.5849	1	0.0199	Pass

WIFI 5GHz (Antenna-B Worst case)

Antenna gain=2dBi, Directional gain=5.01dBi

Test Frequency (MHz)	Minimum Separation Distance (cm)	Output Power (dBm)	Target power (dBm)	Target power (mW)	Antenna Gain (Numeric)	Power Density Limit (mW/cm <sup>2</sup> )	Power Density At 20 cm (mW/cm <sup>2</sup> )	Test Results
5180	20	17.049	17±1	63.1	1.5849	1	0.0199	Pass
5190	20	14.662	15±1	39.81	1.5849	1	0.0126	Pass
5210	20	14.166	15±1	39.81	1.5849	1	0.0126	Pass
5230	20	14.627	15±1	39.81	1.5849	1	0.0126	Pass
5240	20	16.871	17±1	63.1	1.5849	1	0.0199	Pass
5745	20	16.198	17±1	63.1	1.5849	1	0.0199	Pass
5755	20	14.29	15±1	39.81	1.5849	1	0.0126	Pass
5775	20	13.902	14±1	31.62	1.5849	1	0.01	Pass
5785	20	16.854	17±1	63.1	1.5849	1	0.0199	Pass
5795	20	14.013	15±1	39.81	1.5849	1	0.0126	Pass
5825	20	16.22	17±1	63.1	1.5849	1	0.0199	Pass

For the max simultaneous transmission MPE (Worst case):

Power Density (mW/cm <sup>2</sup> )	Power Density (mW/cm <sup>2</sup> ) ANT A	Power Density (mW/cm <sup>2</sup> ) ANT A	Power Density (mW/cm <sup>2</sup> ) ANT B	Power Density (mW/cm <sup>2</sup> ) ANT B	Total	Power Density Limit (mW/cm <sup>2</sup> )	Test Results
BLE	2.4GHz	5GHz	2.4GHz	5GHz	0.069	1.000	Pass
0.0008	0.0126	0.0199	0.0158	0.0199			

Note: 1. The Bluetooth function can transmit at the same time with the Wi-Fi function.

2. When the ANT 1 and ANT 2 transmit simultaneously (MIMO Mode), the formula of calculated the exposure is:

$$(MPE1 / Limit) + (MPE2 / Limit) + \dots\text{etc.} \leq 1$$

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