

## 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, middle and highest channel individually.

## Test Result of RF Exposure Evaluation

### BT EDR

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
2441MHz	5.41	3.48	0.0011	1.0	PASS

Remark: antenna gain=2.04dBi

### BLE

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
2440MHz	3.19	2.08	0.0007	1.0	PASS

Remark: antenna gain=2.04dBi

### WIFI 2.4G

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
802.11n(HT20) 2412MHz SISO(ANT 1)	17.37	54.58	0.0174	1.0	PASS
802.11n(HT40) 2437MHz MIMO	19.44	87.90	0.0280	1.0	PASS

Antenna gain:

ANT 1: 2.04dBi

ANT 2: 2.04dBi

MIMO: 2.04dBi

### UNII-Band I

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
802.11ac(HT20) 5180 SISO(ANT 1)	14.51	28.25	0.0101	1.0	PASS
802.11ac(HT20) 5240MHz MIMO	16.76	47.42	0.0169	1.0	PASS

Antenna gain:

ANT 1: 2.53dBi

ANT 2: 2.53dBi

MIMO: 2.53dBi

## UNII-Band III

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Result
802.11a 5785MHz SISO(ANT 1)	16.45	44.16	0.0144	1.0	PASS
802.11ac(HT80) 5775MHz MIMO	18.74	74.82	0.0245	1.0	PASS

Antenna gain:

ANT 1: 2.16dBi

ANT 2: 2.16dBi

MIMO: 2.16dBi

BT and WIFI Simultaneous Transmission:

$$\sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k}$$

BT + 2.4G WIFI MIMO+5G WIFI MIMO=(0.0011/1)+(0.0174/1) +(0.0245/1)= 0.0011+0.0174+0.0245=0.043<1

The max power density is less than MPE exempt limit, so it is compliance.