

## 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 id 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	9.47	8.85	0.0042	1.0	PASS

Remark: antenna gain=3.80dBi

### 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
2480MHz	2.64	1.84	0.0009	1.0	PASS

Remark: antenna gain=3.80dBi

### 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
2452MHz MIMO 802.11n(HT40)	14.15	26.00	0.0263	1.0	PASS
2437MHz ANT 1 802.11 n(HT20)	14.16	26.06	0.0122	1.0	PASS

Remark: ANT 0: 4.40dBi

ANT 1: 3.70dBi

MIMO: 7.07dBi

### Wifi 5.2G

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
5190 MHz MIMO 802.11ac (HT40)	10.5	11.22	0.0127	1.0	PASS
5180MHz ANT 1 802.11a	13.96	24.89	0.0119	1.0	PASS

Remark: ANT 0: 5.2dBi

ANT 1: 3.8dBi

MIMO: 7.54dBi

## Wifi 5.3G

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
5290MHz MIMO 802.11ac (HT80)	10.96	12.47	0.0126	1.0	PASS
5280MHz ANT 1 802.11a	14.52	28.31	0.0112	1.0	PASS

Remark: ANT 0: 5.0dBi  
 ANT 1: 3.0dBi  
 MIMO: 7.07dBi

## Wifi 5.6G

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
5670MHz MIMO (802.11n HT40)	10.99	12.56	0.0128	1.0	PASS
5580MHz ANT 1 802.11ac (HT20)	14.91	30.97	0.0126	1.0	PASS

Remark: ANT 0: 5.0dBi  
 ANT 1: 3.10dBi  
 MIMO: 7.11dBi

## Wifi 5.8G

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
5745MHz MIMO 802.11n(HT20)	10.53	11.30	0.0120	1.0	PASS
5775MHz ANT 1 802.11ac( HT40)	14.7	29.51	0.0126	1.0	PASS

Remark: ANT 0: 5.10dBi  
 ANT 1: 3.30dBi  
 MIMO: 7.26dBi

BT and WIFI Simultaneous Transmission:

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

BT EDR + 2.4G WIFI MIMO+5.6G WIFI MIMO =(0.0042/1)+( 0.0263/1) +(0.0128/1)=  
 0.0042+0.0263+0.0128=0.0433<1

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