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^2)	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	*($900/f^2$)	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	*($180/f^2$)	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^2, **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^2. 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^2)	Limit (mW/cm^2)	Result
2480MHz	9.15	8.22	0.0042	1.0	PASS

Remark: antenna gain=4.1dBi

BLE

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
2480MHz	7.3	5.37	0.0027	1.0	PASS

Remark: antenna gain=4.1dBi

Wifi 2.4G

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
2452MHz MIMO 802.11n(HT40)	21.45	139.64	0.0691	1.0	PASS
2437MHz ANT 1 802.11g	21.17	130.92	0.0685	1.0	PASS

Remark: ANT 1: 4.2dBi
ANT 2: 3.7dBi
MIMO: 6.96dBi

Wifi 5.2G

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
5190 MHz MIMO 802.11AC(HT40)	14.03	25.29	0.0171	1.0	PASS
5190MHz ANT 1 802.11AC(HT40)	13.27	21.23	0.0134	1.0	PASS

Remark: ANT 1: 5.0dBi
ANT 2: 5.6dBi
MIMO: 8.31dBi

Wifi 5.3G

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
5310MHz MIMO 802.11n (HT40)	14.52	28.31	0.0191	1.0	PASS
5310MHz ANT 1 802.11AC (HT40)	13.45	22.13	0.0136	1.0	PASS

Remark: ANT 1: 4.9dBi
ANT 2: 5.7dBi
MIMO: 8.31dBi

Wifi 5.6G

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
5510MHz MIMO (802.11n HT40)	14.37	27.35	0.0171	1.0	PASS
5500MHz ANT 1 (802.11a)	13.79	23.93	0.0185	1.0	PASS

Remark: ANT 1: 5.9dBi
ANT 2: 3.8dBi
MIMO: 7.92dBi

Wifi 5.8G

Channel	Max output power to antenna (dBm)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
5755MHz MIMO 802.11ac(HT40)	14.38	27.42	0.0171	1.0	PASS
5795MHz ANT 2 802.11n(HT40)	13.58	22.80	0.0104	1.0	PASS

Remark: ANT 1: 6.0dBi
ANT 2: 3.6dBi
MIMO: 7.89dBi

BT and WIFI Simultaneous Transmission:

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

BLE + 2.4G WIFI MIMO+5.3G WIFI MIMO =(0.0042/1)+(0.069/1) +(0.0191/1)=0.004+0.0691+0.0191=0.0924<1

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