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 (dBm)	Output power (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
2441MHz	8.25	6.68	0.0047	1.0	PASS

Remark: antenna gain=5.5dBi

BLE

Channel	Max output power (dBm)	Output power (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
2480MHz	5.74	3.7	0.0026	1.0	PASS

Remark: antenna gain=5.5dBi

WIFI 2.4G

Channel	Max output power (dBm)	Output power (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
2437MHz 802.11n(HT20) MIMO	12.97	19.82	0.0243	1.0	PASS
2437MHz 802.11 g ANT 1	15.18	19.63	0.0142	1.0	PASS

Remark: ANT 1: 3.37dBi
ANT 2: 6.18dBi
MIMO: 7.90dBi

WIFI 5.2G

Channel	Max output power (dBm)	Output power (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
5240 MHz 802.11n (HT20) MIMO	9.26	8.433	0.0129	1.0	PASS
5230MHz 802.11n (HT40) ANT 1	13.28	21.281	0.0120	1.0	PASS

Remark: ANT 1: 4.51dBi
ANT 2: 7.0dBi
MIMO: 8.85dBi

WIFI 5.3G

Channel	Max output power (dBm)	Output power (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
5280MHz 802.11ax (HE20) MIMO	9.29	8.49	0.0138	1.0	PASS
5320MHz 802.11ax (HE20) ANT 1	13.50	22.39	0.0129	1.0	PASS

Remark: ANT 1: 4.73dBi
ANT 2: 7.31dBi
MIMO: 9.13dBi

WIFI 5.6G

Channel	Max output power (dBm)	Output power (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
5510MHz (802.11n HT40) MIMO	9.36	8.63	0.0147	1.0	PASS
5510MHz 802.11n (HT40) ANT 1	13.42	21.98	0.0156	1.0	PASS

Remark: ANT 1: 5.52dBi
ANT 2: 7.07dBi
MIMO: 9.34dBi

WIFI 5.8G

Channel	Max output power (dBm)	Output power (mW)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
5785MHz (802.11ac VHT80) MIMO	9.85	9.66	0.0139	1.0	PASS
5745MHz (802.11ax HE20) ANT 1	12.94	19.68	0.0122	1.0	PASS

Remark: ANT 1: 4.94dBi
ANT 2: 6.20dBi
MIMO: 8.60dBi

BT and WIFI Simultaneous Transmission:

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

BT EDR + 2.4G WIFI MIMO+5.6G WIFI =(0.0047/1)+(0.0243/1) +(0.0156/1)= 0.0047+0.0243+0.0156=0.0446<1

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