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

Band	Frequency	Max output power (dBm)	Output power (mW)	Antenna gain (dBi)	Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Verdict
BT EDR	2441MHz	3.89	2.45	5.2	0.00161	1.0	PASS
BLE	2440MHz	-4.25	0.38	5.2	0.00025	1.0	
2.4G WIFI	2437MHz ANT 1	12.93	19.63	5.5	0.01387	1.0	
	2437MHz MIMO	9.85	9.66	8.56	0.01380	1.0	
5.2G WIFI	5240MHz ANT 1	15.46	35.16	2.5	0.01245	1.0	
	5180MHz MIMO	10.31	10.74	7.56	0.01218	1.0	
5.3G WIFI	5310MHz ANT 1	15.40	34.67	2.6	0.01256	1.0	
	5320MHz MIMO	10.45	11.09	7.42	0.01218	1.0	
5.6G WIFI	5510MHz ANT 1	14.89	30.83	2.7	0.01141	1.0	
	5510MHz MIMO	10.70	11.75	7.11	0.01201	1.0	
5.8G WIFI	5775MHz ANT 1	14.94	31.19	2.9	0.01210	1.0	
	5785MHz MIMO	10.53	11.30	6.91	0.01104	1.0	

Remark: Directional gain=10log $[(10^{ANT1/20}+10^{ANT2/20})^2/2]$dBi

BT and WIFI Simultaneous Transmission:

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

BT EDR + 2.4G WIFI +5.6G WIFI =(0.00161/1)+(0.01387/1) +(0.01256/1)=0.02804<1

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