RF Exposure Evaluation

Standard(s): FCC Guidelines for Human Exposure IEEE C95.1 & FCC Title 47 Part 2.1091, KDB 447498 D01 General RF Exposure Guidance v06

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.

Table for Filed Antenna

For 2.4GWiFi

Antenna gain		Antenna Type
Ant1: 9dBi	Ant2: 9dBi	Internal antenna

For 5GWiFi

Antenna gain		Antenna Type
Ant1: 9dBi	Ant2: 9dBi	Internal antenna

For BLE

Antenna gain	Antenna Type
4.5dBi	Internal antenna

Test Result of RF Exposure Evaluation

Worst case as below

Operating Mode	Freq.	Maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP		MPE Limit	MPE Value
	(MHz)	(dBm)		(dBi)	(dBm)	(mW)	(mW/cm^2)	
2.4G Wifi ant1	2412-2462	9.98	1	9	19.98	99.54	1	0.0198
2.4G Wifi ant2	2412-2462	12.06	1	9	22.06	160.69	1	0.0320
BLE	2402-2480	1.95	1	4.5	7.45	5.56	1	0.0011
5G Wifi ant1	5180-5825	11.36	1	9	21.36	136.77	1	0.0272
5G Wifi ant2	5180-5825	10.97	1	9	20.97	523.60	1	0.0248

Note: 1. The calculated distance is 20 cm.

2. The 2.4G Wifi function and BLE function can transmit at the same time with the 5G Wifi function

Simultaneous transmitting consideration

The ratio= $MPE_{2.4G\ Wifi\ ant1}$/limit+ $MPE_{2.4G\ Wifi\ ant2}$/limit+$MPE_{5G\ Wifi\ ant1}$/limit+$MPE_{5G\ Wifi\ ant2}$/limit+ MPE_{BLE}/limit
=0.0198/1+0.0320/1+0.0272/1+0.0248/1+0.0011/1=0.1049<1.0

Result: Complies

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