RF Exposure Evaluation

Limit

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 1.1310 & 2.1091

Table 1-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

Note: f = frequency in MHz

Evaluation Method

Transmission formula: $P_d = (Pout*G)/(4*pi*R^2)$

Where

Pd = power density in mW/cm2, 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

Conducted Power Results & Manufacturing tolerance

Specification	Operating Mode	Conducted Peak Output Power (dBm)	Target (dBm)	Tolerance ±(dB)
2.4GWIFI	802.11b	14.14	13.5	1
	802.11g	13.69	13.0	1
	802.11n(HT20)	13.33	12.5	1
BLE	GFKS	5.15	4.5	1
BT+EDR	GFKS	6.09	5.5	1
	π/4DQPSK	7.69	7.0	1
	8DPSK	7.95	7.0	1
5GWIFI	802.11a	13.96	13.0	1
	802.11n HT20	13.70	13.0	1
	802.11n HT40	13.24	13.0	1
	802.11ac VHT20	13.69	13.0	1
	802.11ac VHT40	13.16	12.5	1
	802.11ac VHT80	13.88	13.0	1

Evaluation Results

Spec.	Operating Mode	Antenna Distance (cm)	Conducted Output Power		Gain of antenna in linear scale	Power Density (mW/cm^2)	Limit (mW/cm^2)	Result
			dBm	mW				
2.4GWIFI	802.11b	20	14.50	28.18	1.58	0.009	1	PASS
	802.11g	20	14.00	25.12	1.58	0.008	1	PASS
	802.11n (HT20)	20	13.50	22.39	1.58	0.007	1	PASS
BLE	GFKS	20	5.50	3.55	1.58	0.001	1	PASS
BT+EDR	GFKS	20	6.50	4.47	1.58	0.001	1	PASS
	π/4DQPSK	20	8.00	6.31	1.58	0.002	1	PASS
	8DPSK	20	8.00	6.31	1.58	0.002	1	PASS
5GWIFI	802.11a	20	14.00	25.12	1.58	0.008	1	PASS
	802.11n (HT20)	20	14.00	25.12	1.58	0.008	1	PASS
	802.11n (HT40)	20	14.00	25.12	1.58	0.008	1	PASS
	802.11ac (VHT20)	20	14.00	25.12	1.58	0.008	1	PASS
	802.11ac (VHT40)	20	13.50	22.39	1.58	0.007	1	PASS
	802.11ac (VHT80)	20	14.00	25.12	1.58	0.008	1	PASS

Remark:

1. Output power including tune up tolerance;

2. The maximum 2.4G antenna gain is 2dBi

3. The maximum 5G antenna gain is 2dBi

4. The exposure safety distance is 20cm.

Simulation Transmission

EUT can only work in *2.4GWIFI+ Bluetooth mode* or *5GWIFI+ Bluetooth mode*

The formula of calculated the Simulation Transmission MPE is:

CPD1 /LPD1 + CPD2 /LPD2 + …… etc. < 1

CPD = Calculation Maximum Power Density

LPD = Limit of Power Density

Mode	Calculate	Limit	Result
2.4GWIFI+ Bluetooth mode	0.0110	1	PASS
5GWIFI+ Bluetooth mode	0.0100	1	PASS

Conclusion

The measurement results comply with the FCC Limit per 47 CFR 1.1310 & 2.1091 for the uncontrolled RF Exposure and MPE complicance per KDB 447498 v06.