

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: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

P_d = power density in mW/cm², P_{out} = output power to antenna in mW, G = gain of antenna in linear scale;

π = 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	15.99	15.5	1
	802.11g	13.84	13	1
	802.11n(HT20)	13.81	13	1
	802.11n(HT40)	13.80	13	1
BLE	GFSK	8.71	8	1
BT+EDR	GFSK	8.3	7.5	1
	$\pi/4$ DQPSK	7.58	7	1
	8DPSK	7.94	7	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	16.5	44.67	2.88	0.0256	1	PASS
	802.11g	20	14	25.12	2.88	0.0144	1	PASS
	802.11n(HT20)	20	14	25.12	2.88	0.0144	1	PASS
	802.11n(HT40)	20	14	25.12	2.88	0.0144	1	PASS
BLE	GFSK	20	9	7.94	2.88	0.0045	1	PASS
BT+EDR	GFSK	20	8.5	7.08	2.88	0.0041	1	PASS
	$\pi/4$ DQPSK	20	8	6.31	2.88	0.0036	1	PASS
	8DPSK	20	8	6.31	2.88	0.0036	1	PASS

Remark:

1. Output power including tune up tolerance;
2. The maximum 2.4G antenna gain is 4.59dBi
3. The exposure safety distance is 20cm.

Simulation Transmission

EUT can only work in 2.4GWIFI+BT mode

The formula of calculated the Simulation Transmission MPE is:

$$CPD1/LPD1+CPD2/LPD2+.....etc. < 1$$

CPD=Calculation Maximum Power Denisty

Mode	Calculate	Limit	Result
2.4GWIFI+BT mode	0.0297	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 compliceance per KDB 447498 v06.