

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	17.47	16.5	1
	802.11g	16.19	15.5	1
	802.11n(HT20)	15.99	15	1
	802.11n(HT40)	16.06	15.5	1
BLE	GFSK	8.37	7.5	1
BT+EDR	GFSK	5.35	4.5	1
	$\pi/4$ DQPSK	7.16	6.5	1
	8DPSK	7.56	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	17.5	56.23	1.41	0.016	1	PASS
	802.11g	20	16.5	44.67	1.41	0.013	1	PASS
	802.11n(HT20)	20	16	39.81	1.41	0.011	1	PASS
	802.11n(HT40)	20	16.5	44.67	1.41	0.013	1	PASS
BLE	GFSK	20	8.5	7.08	1.41	0.002	1	PASS
BT+EDR	GFSK	20	5.5	3.55	1.41	0.001	1	PASS
	π/4DQPSK	20	7.5	5.62	1.41	0.002	1	PASS
	8DPSK	20	8	6.31	1.41	0.002	1	PASS

Remark:

1. Output power including tune up tolerance;
2. The maximum 2.4G antenna gain is 1.5dBi
3. The exposure safety distance is 20cm.

Simulation Transmission

EUT can only work in 2.4GWIFI+BLE 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	0.018	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.