

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	14.48	13.5	1
	802.11g	14.32	13.5	1
	802.11n(HT20)	14.16	13.5	1
	802.11n(HT40)	14.03	13.5	1
BLE	GFSK	2.32	1.5	1
BT+EDR	GFSK	3.62	3	1
	$\pi/4$ DQPSK	2.91	2	1
	8DPSK	2.12	1.5	1
5GWIFI	802.11ac VHT80	11.82	11	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	2.00	0.011	1	PASS
	802.11g	20	14.50	28.18	2.00	0.011	1	PASS
	802.11n (HT20)	20	14.50	28.18	2.00	0.011	1	PASS
	802.11n (HT40)	20	14.50	28.18	2.00	0.011	1	PASS
BLE	GFKS	20	2.50	1.78	2.00	0.001	1	PASS
BT+EDR	GFKS	20	4.00	2.51	2.00	0.001	1	PASS
	π/4DQPSK	20	3.00	2.00	2.00	0.001	1	PASS
	8DPSK	20	2.50	1.78	2.00	0.001	1	PASS
5GWIFI	802.11ac (VHT80)	20	12.00	15.85	3.16	0.010	1	PASS

Remark:

1. Output power including tune up tolerance;
2. The maximum 2.4G antenna gain is 3dBi
3. The maximum 5G antenna gain is 5dBi
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	0.0122	1	PASS
5GWIFI+ Bluetooth mode	0.0110	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 compliance per KDB 447498 v06.