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

2.4GWIFI

Mode	Conducted Peak Output Power (dBm)
802.11b	16.21
802.11b	13.89
802.11n(HT20)	13.46
802.11n(HT40)	12.66

BLE

Mode	Conducted Peak Output Power (dBm)
GFKS	3.51

BT+EDR

Mode	Conducted Peak Output Power (dBm)
GFKS	1.25
π/4DQPSK	1.21
8DPSK	1.57

5GWIFI

Mode	Conducted Peak Output Power (dBm)
802.11a	14.80
802.11n HT20	13.71
802.11n HT40	13.85
802.11ac VHT20	12.53
802.11ac VHT40	12.88
802.11ac VHT80	12.16

Manufacturing tolerance

2.4GWIFI

802.11b (Peak)	
Target (dBm)	15.5
Tolerance ±(dB)	1
802.11g (Peak)	
Target (dBm)	13
Tolerance ±(dB)	1
802.11n20 (Peak)	
Target (dBm)	12.5
Tolerance ±(dB)	1
802.11n40 (Peak)	
Target (dBm)	12
Tolerance ±(dB)	1

BLE

802.11b (Peak)	
Target (dBm)	3
Tolerance ±(dB)	1

BT+EDR

GFSK	
Target (dBm)	1
Tolerance ±(dB)	1
π/4DQPSK	
Target (dBm)	1
Tolerance ±(dB)	1
8DPSK	
Target (dBm)	1
Tolerance ±(dB)	1

5GWIFI

802.11a (Peak)	
Target (dBm)	14
Tolerance ±(dB)	1
802.11n HT20 (Peak)	
Target (dBm)	13
Tolerance ±(dB)	1

802.11n HT40 (Peak)	
Target (dBm)	13
Tolerance ±(dB)	1
802.11ac VHT20 (Peak)	
Target (dBm)	12
Tolerance ±(dB)	1
802.11ac VHT40 (Peak)	
Target (dBm)	12
Tolerance ±(dB)	1
802.11ac VHT80 (Peak)	
Target (dBm)	11.5
Tolerance ±(dB)	1

Evaluation Results

2.4G WIFI

Band/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				
802.11b	20	16.5	44.67	0.81	0.007	1.0	Pass
802.11g	20	14	25.12	0.81	0.004	1.0	Pass
802.11n20	20	13.5	22.39	0.81	0.004	1.0	Pass
802.11n40	20	13	19.95	0.81	0.003	1.0	Pass

BLE

Band/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				
GFSK	20	4	2.51	0.81	0.0004	1.0	Pass

BT+EDR

Band/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				
GFSK	20	2	1.58	0.81	0.0003	1.0	Pass
π/4DQPSK	20	2	1.58	0.81	0.0003	1.0	Pass
8DPSK	20	2	1.58	0.81	0.0003	1.0	Pass

5G WIFI

Band/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				
802.11a	20	15	31.62	2.86	0.018	1.0	Pass
802.11n(HT20)	20	14	25.12	2.86	0.014	1.0	Pass
802.11n(HT40)	20	14	25.12	2.86	0.014	1.0	Pass
11ac(VHT20)	20	13	19.95	2.86	0.011	1.0	Pass
11ac(VHT40)	20	13	19.95	2.86	0.011	1.0	Pass
11ac(VHT80)	20	12.5	17.78	2.86	0.010	1.0	Pass

FCC ID: 2ACML-201850

Remark:

1. Output power including tune up tolerance;

2. The maximum 2.4G antenna gain is -0.94dBi

3. The maximum 2.4G antenna gain is 4.56dBi

3. The exposure safety distance is 20cm.

Simulation Transmission

EUT can only work in 2.4G WiFi+ Bluetooth mode or 5G WiFi+ 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	Result
2.4G WiFi+ Bluetooth	0.0074
5G WiFi+ Bluetooth mode	0.0184

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.