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

WIFI

Mode	Channel	Frequency (MHz)	Conducted Output Power (dBm)
802.11b	1	2412	15.60
	6	2437	15.85
	11	2462	16.38
802.11g	1	2412	14.70
	6	2437	15.18
	11	2462	15.26
802.11n(HT20)	1	2412	13.85
	6	2437	14.32
	11	2462	14.29
802.11n(HT40)	3	2422	14.05
	6	2437	14.41
	9	2452	14.40

BLE

Mode	Rate	Channel	Frequency (MHz)	Conducted Peak Output Power (dBm)
GFSK	1M	0	2402	3.58
		19	2440	3.22
		39	2480	3.25
	2M	0	2402	3.68
		19	2440	3.27
		39	2480	3.3

Manufacturing tolerance

WIFI

802.11b			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	16	16	16
Tolerance ±(dB)	1	1	1
802.11g			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	15	15	15
Tolerance ±(dB)	1	1	1
802.11n20			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	14	14	14
Tolerance ±(dB)	1	1	1
802.11n40			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	14	14	14
Tolerance ±(dB)	1	1	1

BLE

GFSK (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	3.5	3.5	3.5
Tolerance ±(dB)	1	1	1

Evaluation Results

WIFI

Band/Mode	Antenna Distance (cm)	EIRP		Gain of antenna in linear scale	Power Density (mW/cm^2)	Limit (mW/cm^2)	Result
		dBm	mW				
802.11b	20	19	79.43	1.58	0.016	1.0	Pass
802.11g	20	18	63.10	1.58	0.013	1.0	Pass
802.11n20	20	17	50.12	1.58	0.010	1.0	Pass
802.11n40	20	17	50.12	1.58	0.010	1.0	Pass

BLE

Band/Mode	Antenna Distance (cm)	Rate	EIRP		Gain of antenna in linear scale	Power Density (mW/cm^2)	Limit (mW/cm^2)	Result
			dBm	mW				
GFSK	20	1M	6.5	4.47	1.58	0.001	1.0	Pass
		2M	6.5	4.47	1.58	0.001	1.0	Pass

According to KDB Publication 447498 D01, Section 7.2
Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to the MPE limit at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios.

Simulation Transmission

WIFI+BLE

Antenna Distance (cm)	Maximum MPE Value (mw/cm2)		Transmit simultaneously	Limit (mW/cm^2)	Result
	BT	WIFI			
20	0.001	0.016	0.017	1.0	Pass

Remark:

1. Output power including tune up tolerance;

2. The maximum antenna gain is 2dBi

3. The exposure safety distance is 20cm.

4. EIRP = Conducted Peak Output Power + Antenna Gain + Tolerance

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.