RF Exposure Evaluation

FCC KDB publication 447498 D01 General RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

Limits

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 1.1307(b)

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

f = frequency in MHz

Friis transmission formula: **$Pd = (Pout*G)/(4*pi*r^2)$**

Where

Pd = power density in mW/cm^2, **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

Pd id the limit of MPE, 1 mW/cm^2. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, and highest channel individually.

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Test Result of RF Exposure Evaluation

For BT Antenna gain=2.44dBi

Test Frequency（MHz）	Minimum Separation Distance (cm)	Output Power (dBm)	Target power (dBm)	Target power (mW)	Antenna Gain (Numeric)	Power Density Limit (mW/cm^2)	Power Density At 20 cm (mW/cm^2)	Test Results
2402	20	1.46	1±1	1.58	1.75	1	0.0006	Pass
2441	20	1.01	1±1	1.58	1.75	1	0.0006	Pass
2480	20	0.86	1±1	1.58	1.75	1	0.0006	Pass

For BLE Antenna gain=2.44dBi

Test Frequency（MHz）	Minimum Separation Distance (cm)	Output Power (dBm)	Target power (dBm)	Target power (mW)	Antenna Gain (Numeric)	Power Density Limit (mW/cm^2)	Power Density At 20 cm (mW/cm^2)	Test Results
2402	20.00	-0.5	-1±1	1	1.75	1	0.0003	Pass
2440	20.00	-0.75	-1±1	1	1.75	1	0.0003	Pass
2480	20.00	-0.98	-1±1	1	1.75	1	0.0003	Pass

For 2.4G Wi-Fi Antenna gain=3.91dBi

Test Frequency（MHz）	Minimum Separation Distance (cm)	Output Power (dBm)	Target power (dBm)	Target power (mW)	Antenna Gain (Numeric)	Power Density Limit (mW/cm^2)	Power Density At 20 cm (mW/cm^2)	Test Results
2412	20.00	14.88	15±1	39.81	2.46	1	0.0195	Pass
2422	20.00	14.52	15±1	39.81	2.46	1	0.0195	Pass
2437	20.00	14.06	15±1	39.81	2.46	1	0.0195	Pass
2452	20.00	14.1	15±1	39.81	2.46	1	0.0195	Pass
2462	20.00	14.39	15±1	39.81	2.46	1	0.0195	Pass

Simultaneous Transmission for SAR Exclusion

The 2.4G Wi-Fi and BT or 2.4G Wi-Fi and BLE can transmit at the same, need consider simultaneous transmission. Maximum Simultaneous transmission SAR Ratio worst case for BT and 2.4G Wi-Fi

Maximum SAR Ratio $_{BT}$	Maximum SAR Ratio $_{2.4G\ Wi\text{-}Fi}$	$\sum SAR_{ratio\ BT} + SAR_{ratio\ BLE} + SAR_{ratio\ WPT}$	Limit	Results
0.0006	0.0195	0.0201	1	PASS

Remark: 1. Output power including tune-up tolerance;

2.Max. SAR Ratio=Max. Evaluation Values/Sar Limit, So:

Maximum SAR Ratio BT =0.0006/1=0.0004

Maximum SAR Ratio 2.4G Wi-Fi =0.0195/1=0.0004

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure.

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