



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: $Pd = (Pout \cdot G) / (4 \cdot \pi \cdot r^2)$

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

Pd is the limit of MPE, 1 mW/cm². 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.



Test Result of RF Exposure Evaluation

For BT Antenna gain=1.56dBi

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	5.63	6±1	5.01	1.432	1	0.0014	Pass
2441	20	5.41	6±1	5.01	1.432	1	0.0014	Pass
2480	20	5.51	6±1	5.01	1.432	1	0.0014	Pass

For BLE Antenna gain=1.56dBi

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	4.23	4±1	3.16	1.432	1	0.0009	Pass
2440	20.00	4.02	4±1	3.16	1.432	1	0.0009	Pass
2480	20.00	4.16	4±1	3.16	1.432	1	0.0009	Pass

WIFI 2.4GHz (Antenna1 Worst case)

Antenna gain=1.56dBi, Directional gain=4.57dBi

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	16.57	17±1	63.10	1.432	1	0.0180	Pass
2422	20.00	16.53	17±1	63.10	1.432	1	0.0180	Pass
2437	20.00	16.73	17±1	63.10	1.432	1	0.0180	Pass
2452	20.00	16.45	17±1	63.10	1.432	1	0.0180	Pass
2462	20.00	16.68	17±1	63.10	1.432	1	0.0180	Pass

WIFI 2.4GHz (Antenna2 Worst case)

Antenna gain=1.56dBi, Directional gain=4.57dBi

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	16.30	16±1	50.12	1.432	1	0.0143	Pass
2422	20.00	15.59	16±1	50.12	1.432	1	0.0143	Pass
2437	20.00	16.31	16±1	50.12	1.432	1	0.0143	Pass
2452	20.00	15.63	16±1	50.12	1.432	1	0.0143	Pass
2462	20.00	16.18	16±1	50.12	1.432	1	0.0143	Pass



WIFI 5GHz (Antenna1 Worst case)

Antenna gain=0.67dBi, Directional gain=3.68dBi

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
5180	20	16.59	17±1	63.10	1.1668	1	0.0146	Pass
5190	20	16.72	17±1	63.10	1.1668	1	0.0146	Pass
5210	20	15.88	16±1	50.12	1.1668	1	0.0116	Pass
5230	20	16.28	16±1	50.12	1.1668	1	0.0116	Pass
5240	20	15.93	16±1	50.12	1.1668	1	0.0116	Pass
5250	20	15.80	16±1	50.12	1.1668	1	0.0116	Pass
5260	20	16.64	17±1	63.10	1.1668	1	0.0146	Pass
5270	20	15.81	16±1	50.12	1.1668	1	0.0116	Pass
5300	20	16.66	17±1	63.10	1.1668	1	0.0146	Pass
5310	20	15.36	15±1	39.81	1.1668	1	0.0092	Pass
5320	20	15.79	16±1	50.12	1.1668	1	0.0116	Pass
5500	20	15.73	16±1	50.12	1.1668	1	0.0116	Pass
5510	20	15.38	15±1	39.81	1.1668	1	0.0092	Pass
5570	20	15.82	16±1	50.12	1.1668	1	0.0116	Pass
5580	20	15.60	16±1	50.12	1.1668	1	0.0116	Pass
5610	20	15.58	16±1	50.12	1.1668	1	0.0116	Pass
5670	20	15.48	16±1	50.12	1.1668	1	0.0116	Pass
5690	20	15.63	16±1	50.12	1.1668	1	0.0116	Pass
5700	20	15.97	16±1	50.12	1.1668	1	0.0116	Pass
5720	20	15.96	16±1	50.12	1.1668	1	0.0116	Pass
5745	20	16.60	17±1	63.10	1.1668	1	0.0146	Pass
5755	20	16.28	16±1	50.12	1.1668	1	0.0116	Pass
5775	20	15.97	16±1	50.12	1.1668	1	0.0116	Pass
5785	20	16.56	17±1	63.10	1.1668	1	0.0146	Pass
5795	20	16	16±1	50.12	1.1668	1	0.0116	Pass
5825	20	16.84	17±1	63.10	1.1668	1	0.0146	Pass

WIFI 5GHz (Antenna2 Worst case)

Antenna gain=0.67dBi, Directional gain=3.68dBi

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
5180	20	15.55	16±1	50.12	1.1668	1	0.0116	Pass
5190	20	15.81	16±1	50.12	1.1668	1	0.0116	Pass
5210	20	15.72	16±1	50.12	1.1668	1	0.0116	Pass
5230	20	15.97	16±1	50.12	1.1668	1	0.0116	Pass
5240	20	15.60	16±1	50.12	1.1668	1	0.0116	Pass



5250	20	15.22	15±1	39.81	1.1668	1	0.0092	Pass
5260	20	16.11	16±1	50.12	1.1668	1	0.0116	Pass
5270	20	15.74	16±1	50.12	1.1668	1	0.0116	Pass
5290	20	15.55	16±1	50.12	1.1668	1	0.0116	Pass
5300	20	15.45	16±1	50.12	1.1668	1	0.0116	Pass
5310	20	15.66	16±1	50.12	1.1668	1	0.0116	Pass
5320	20	14.49	15±1	39.81	1.1668	1	0.0092	Pass
5500	20	15.93	16±1	50.12	1.1668	1	0.0116	Pass
5510	20	15.93	16±1	50.12	1.1668	1	0.0116	Pass
5530	20	15.93	16±1	50.12	1.1668	1	0.0116	Pass
5550	20	14.59	15±1	39.81	1.1668	1	0.0092	Pass
5570	20	14.36	14±1	25.12	1.1668	1	0.0058	Pass
5580	20	14.25	14±1	25.12	1.1668	1	0.0058	Pass
5610	20	13.81	14±1	25.12	1.1668	1	0.0058	Pass
5670	20	14.04	14±1	25.12	1.1668	1	0.0058	Pass
5690	20	14.00	14±1	25.12	1.1668	1	0.0058	Pass
5700	20	13.98	14±1	25.12	1.1668	1	0.0058	Pass
5720	20	13.87	14±1	25.12	1.1668	1	0.0058	Pass
5745	20	16.16	16±1	50.12	1.1668	1	0.0116	Pass
5755	20	15.56	15±1	39.81	1.1668	1	0.0092	Pass
5775	20	15.37	15±1	39.81	1.1668	1	0.0092	Pass
5785	20	16.64	17±1	63.10	1.1668	1	0.0146	Pass
5795	20	15.74	16±1	50.12	1.1668	1	0.0116	Pass
5825	20	16.71	17±1	63.10	1.1668	1	0.0146	Pass

For the max simultaneous transmission MPE (Worst case):

Power Density (mW/cm ²)	Power Density (mW/cm ²) ANT 1	Power Density (mW/cm ²) ANT 1	Power Density (mW/cm ²) ANT 2	Power Density (mW/cm ²) ANT 2	Total	Power Density Limit (mW/cm ²)	Test Results
BT	2.4GHz	5GHz	2.4GHz	5GHz	0.063	1.000	Pass
0.0014	0.0180	0.0146	0.0143	0.0146			

Note: 1. The Bluetooth function can transmit at the same time with the Wi-Fi function.

2. When the ANT 1 and ANT 2 transmit simultaneously (MIMO Mode), the formula of calculated the exposure is:

$$(MPE1 / Limit) + (MPE2 / Limit) + \dots \leq 1$$

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