

**RF Exposure Evaluation****FCC § 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.**

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 BR/EDR worst case

Antenna Gain: 2.09dBi

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	8.19	8±1	7.94	1.62	1	0.0026	Pass
2441	20.00	7.35	7±1	6.31	1.62	1	0.0020	Pass
2480	20.00	7.17	7±1	6.31	1.62	1	0.0020	Pass

For BLE worst case

Antenna Gain: 2.09dBi

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	6.35	6±1	5.01	1.62	1	0.0016	Pass
2440	20.00	5.88	6±1	5.01	1.62	1	0.0016	Pass
2480	20.00	5.67	6±1	5.01	1.62	1	0.0016	Pass

For 2.4G Wi-Fi Ant 1 worst case

Antenna Gain: 2.78dBi

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	15.8	15±1	39.81	1.90	1	0.015	Pass
2422	20.00	13.66	13±1	25.12	1.90	1	0.0095	Pass
2437	20.00	15.51	15±1	39.81	1.90	1	0.015	Pass
2452	20.00	13.38	13±1	25.12	1.90	1	0.0095	Pass
2462	20.00	15.34	15±1	39.81	1.90	1	0.015	Pass

For 2.4G Wi-Fi Ant 2 worst case

Antenna Gain: -4.56dBi

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
2412	20.00	15.4	15±1	39.81	0.35	1	0.0028	Pass
2422	20.00	13.55	13±1	25.12	0.35	1	0.0017	Pass
2437	20.00	15.67	15±1	39.81	0.35	1	0.0028	Pass
2452	20.00	13.65	13±1	25.12	0.35	1	0.0017	Pass
2462	20.00	15.86	15±1	39.81	0.35	1	0.0028	Pass



For 5G Wi-Fi Ant 1 worst case

Antenna Gain: U-NII-1/ U-NII-2A: -1.58dBi

U-NII-2C/ U-NII-3: 3.35dBi

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	12.57	12±1	19.953	0.70	1	0.0086	Pass
5190	20	12.38	12±1	19.953	0.70	1	0.0086	Pass
5200	20	13.04	13±1	25.119	0.70	1	0.0108	Pass
5210	20	9.74	9±1	10	0.70	1	0.0034	Pass
5230	20	11.39	12±1	19.953	0.70	1	0.0086	Pass
5240	20	12.66	12±1	19.953	0.70	1	0.0086	Pass
5260	20	14.22	14±1	31.623	0.70	1	0.0136	Pass
5290	20	9.87	9±1	10	0.70	1	0.0043	Pass
5300	20	12.93	13±1	25.119	0.70	1	0.0108	Pass
5310	20	11.94	12±1	19.953	0.70	1	0.0086	Pass
5320	20	13.67	13±1	25.119	0.70	1	0.0108	Pass
5500	20	12.59	13±1	25.119	2.16	1	0.0108	Pass
5510	20	10.92	11±1	15.849	2.16	1	0.0068	Pass
5530	20	7.67	8±1	7.943	2.16	1	0.0034	Pass
5550	20	9.26	9±1	10	2.16	1	0.0043	Pass
5580	20	12.14	12±1	19.953	2.16	1	0.0086	Pass
5610	20	8.79	9±1	10	2.16	1	0.0043	Pass
5670	20	12.49	12±1	19.953	2.16	1	0.0086	Pass
5690	20	10.06	10±1	12.589	2.16	1	0.0054	Pass
5700	20	12.89	13±1	25.119	2.16	1	0.0108	Pass
5710	20	11.61	12±1	19.953	2.16	1	0.0086	Pass
5720	20	12.96	13±1	25.119	2.16	1	0.0108	Pass
5745	20	14.98	15±1	39.811	2.16	1	0.0171	Pass
5755	20	11.74	12±1	19.953	2.16	1	0.0086	Pass
5775	20	9.65	10±1	12.589	2.16	1	0.0054	Pass
5785	20	14.89	15±1	39.811	2.16	1	0.0171	Pass
5795	20	11.47	12±1	19.953	2.16	1	0.0086	Pass
5825	20	14.23	15±1	39.811	2.16	1	0.0171	Pass



For 5G Wi-Fi Ant 2 worst case

Antenna Gain: U-NII-1/ U-NII-2A: -2.38dBi

U-NII-2C/ U-NII-3: 5.85dBi

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	12.99	13±1	25.119	0.58	1	0.0181	Pass
5190	20	11.81	12±1	19.099	0.58	1	0.0137	Pass
5200	20	13.27	13±1	26.424	0.58	1	0.0190	Pass
5210	20	8.91	9±1	10	0.58	1	0.0057	Pass
5230	20	12.17	12±1	20.749	0.58	1	0.0149	Pass
5240	20	13.48	13±1	27.861	0.58	1	0.0200	Pass
5260	20	14.06	14±1	31.989	0.58	1	0.0230	Pass
5290	20	8.62	9±1	9.162	0.58	1	0.0066	Pass
5300	20	14.65	15±1	36.813	0.58	1	0.0265	Pass
5310	20	12.71	13±1	23.496	0.58	1	0.0169	Pass
5320	20	14.31	14±1	34.041	0.58	1	0.0245	Pass
5500	20	11.52	12±1	18.072	3.61	1	0.0130	Pass
5510	20	9.55	10±1	11.35	3.61	1	0.0082	Pass
5530	20	7.35	7±1	6.839	3.61	1	0.0049	Pass
5550	20	10.46	10±1	13.996	3.61	1	0.0101	Pass
5580	20	11.89	12±1	19.498	3.61	1	0.0140	Pass
5610	20	9.12	9±1	10	3.61	1	0.0072	Pass
5670	20	10.44	10±1	13.932	3.61	1	0.0100	Pass
5690	20	7.69	8±1	7.396	3.61	1	0.0053	Pass
5700	20	12.52	12±1	22.336	3.61	1	0.0161	Pass
5710	20	10.64	11±1	14.588	3.61	1	0.0105	Pass
5720	20	12.65	13±1	23.878	3.61	1	0.0172	Pass
5745	20	13.68	14±1	29.785	3.61	1	0.0214	Pass
5755	20	10.01	10±1	12.618	3.61	1	0.0091	Pass
5775	20	8.12	8±1	8.166	3.61	1	0.0059	Pass
5785	20	14.61	15±1	37.068	3.61	1	0.0267	Pass
5795	20	10.51	11±1	14.158	3.61	1	0.0102	Pass
5825	20	14.12	14±1	32.734	3.61	1	0.0235	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	0.0642	1.000	Pass
0.0026	0.015	0.0171	0.0028	0.0267			

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:

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

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