



RF Exposure Evaluation

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, middle and highest channel individually.



Test Result of RF Exposure Evaluation

BLE Mode						
Mode	Output power to antenna (dBm)	Output power to antenna (mW)	Antenna Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
GFSK	-0.357	0.92	2.0	0.000306	1.0	PASS

BT Mode						
Mode	Output power to antenna (dBm)	Output power to antenna (mW)	Antenna Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
GFSK	-1.658	0.68	2.0	0.000215	1.0	PASS
π/4-DQPSK	-1.331	0.74	2.0	0.000232	1.0	PASS
8-DPSK	-1.045	0.79	2.0	0.000248	1.0	PASS

2.4G WI-FI Mode							
Mode	Frequency (MHz)	Output power to antenna (dBm)	Output power to antenna (mW)	Antenna Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
802.11b	2437	14.89	30.83	2.0	0.009721	1.0	PASS
802.11g	2437	13.72	23.55	2.0	0.007425	1.0	PASS
802.11n20 (MIMO)	2462	16.66	46.34	2.0	0.014612	1.0	PASS
802.11n40 (MIMO)	2452	16.39	43.55	2.0	0.013732	1.0	PASS
802.11ax20 (MIMO)	2462	14.46	27.93	2.0	0.008805	1.0	PASS

All model has been tested, only the worst-case data has been evaluated.



5.2G WI-FI Mode							
Mode	Frequency (MHz)	Output power to antenna (dBm)	Output power to antenna (mW)	Antenna Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
802.11a	5240	14.886	30.80	2.0	0.009712	1.0	PASS
802.11n20	5180	17.578	57.25	2.0	0.018052	1.0	PASS
802.11n40	5190	17.549	56.87	2.0	0.017932	1.0	PASS
802.11ac20	5180	17.549	56.87	2.0	0.017932	1.0	PASS
802.11ac40	5190	16.693	46.70	2.0	0.014724	1.0	PASS
802.11ac80	5210	15.410	34.75	2.0	0.013795	1.0	PASS
802.11ax80	5210	13.640	23.12	2.0	0.011554	1.0	PASS

All model has been tested, only the worst-case data has been evaluated.

5.3G WI-FI Mode							
Mode	Frequency (MHz)	Output power to antenna (dBm)	Output power to antenna (mW)	Antenna Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
802.11a	5260	14.728	29.70	2.0	0.009365	1.0	PASS
802.11n20	5280	17.838	60.79	2.0	0.019165	1.0	PASS
802.11n40	5270	17.586	57.36	2.0	0.018085	1.0	PASS
802.11ac20	5260	17.586	57.36	2.0	0.018085	1.0	PASS
802.11ac40	5310	16.544	45.12	2.0	0.014227	1.0	PASS
802.11ac80	5290	15.301	33.89	2.0	0.013453	1.0	PASS
802.11ax80	5290	15.617	36.45	2.0	0.011493	1.0	PASS

All model has been tested, only the worst-case data has been evaluated.



5.6G WI-FI Mode						
Mode	Output Power dBm Total to antenna (dBm)	Output power to antenna (mW)	Antenna Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
802.11a	14.465	27.96	2.0	0.008815	1.0	PASS
802.11n20	17.439	55.45	2.0	0.017483	1.0	PASS
802.11n40	17.316	53.90	2.0	0.016995	1.0	PASS
802.11ac20	17.316	53.90	2.0	0.016995	1.0	PASS
802.11ac40	16.682	46.58	2.0	0.014687	1.0	PASS
802.11ac80	14.918	31.03	2.0	0.012317	1.0	PASS
802.11ax80	15.016	31.74	2.0	0.015861	1.0	PASS

All model has been tested, only the worst-case data has been evaluated.

5.8G WI-FI Mode						
Mode	Output Power dBm Total to antenna (dBm)	Output power to antenna (mW)	Antenna Gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
802.11a	14.782	30.07	2.0	0.009482	1.0	PASS
802.11n20	17.787	60.08	2.0	0.018942	1.0	PASS
802.11n40	17.540	56.75	2.0	0.017895	1.0	PASS
802.11ac20	17.585	57.35	2.0	0.018081	1.0	PASS
802.11ac40	16.571	45.40	2.0	0.014316	1.0	PASS
802.11ac80	15.536	35.78	2.0	0.014201	1.0	PASS
802.11ax80	14.939	31.18	2.0	0.015582	1.0	PASS

All model has been tested, only the worst-case data has been evaluated.

Note: The device BT and 2.4G Wi-Fi & 5.8G WI-FI can transmit at the same time;

So the worst simultaneous transmitting consideration:

$$\text{The ratio} = \text{MPE}_{(\text{BT})} / \text{limit} + \text{MPE}_{(2.4\text{G WI-FI})} / \text{limit} + \text{MPE}_{(5.8\text{G WI-FI})} / \text{limit} = 0.000356 / 1.0 + 0.012976 / 1.0 + 0.010811 / 1.0 = 0.024143 < 1.0.$$