

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

	Modulation	Frequency MHz	Output power to antenna (dBm)	Target power W/tolerance (dBm)	Max Output power to antenna (dBm)	Max Output power to antenna (mW)	Power Density at R=20cm (mW/cm2)	Limit (mW/cm ²)	Result
Wifi 2.4g	802.11b	2412	27.55	27±1	28	630.9573	0.198030	1.0	PASS
		2437	27.21	27±1	28	630.9573	0.198030	1.0	PASS
		2462	26.75	27±1	28	630.9573	0.198030	1.0	PASS
	802.11g	2412	22.56	23±1	24	251.1886	0.078837	1.0	PASS
		2437	23.34	23±1	24	251.1886	0.078837	1.0	PASS
		2462	22.93	23±1	24	251.1886	0.078837	1.0	PASS
	802.11n(20)	2412	26.59	27±1	28	630.9573	0.198030	1.0	PASS
		2437	27.30	27±1	28	630.9573	0.198030	1.0	PASS
		2462	26.93	27±1	28	630.9573	0.198030	1.0	PASS
	802.11ax(20)	2412	27.66	28±1	29	794.3282	0.249305	1.0	PASS
		2437	28.57	28±1	29	794.3282	0.249305	1.0	PASS
		2462	28.31	28±1	29	794.3282	0.249305	1.0	PASS
	802.11n(40)	2422	22.19	22±1	23	199.5262	0.062622	1.0	PASS
		2437	22.94	22±1	23	199.5262	0.062622	1.0	PASS
		2452	22.73	22±1	23	199.5262	0.062622	1.0	PASS
	802.11ax(40)	2422	20.54	21±1	22	158.4893	0.049743	1.0	PASS
		2437	21.53	21±1	22	158.4893	0.049743	1.0	PASS
		2452	21.40	21±1	22	158.4893	0.049743	1.0	PASS

	Modulation	Frequency MHz	Output power to antenna (dBm)	Target power W/tolerance (dBm)	Max Output power to antenna (dBm)	Max Output power to antenna (mW)	Power Density at R=20cm (mW/cm2)	Limit (mW/cm ²)	Result
Wifi 5.2g	802.11a	5180	15.25	15±1	16	39.8107	0.014953	1.0	PASS
		5200	15.02	15±1	16	39.8107	0.014953	1.0	PASS
		5240	14.67	15±1	16	39.8107	0.014953	1.0	PASS
	802.11n(20)	5180	13.44	13±1	14	25.1189	0.009435	1.0	PASS
		5200	13.36	13±1	14	25.1189	0.009435	1.0	PASS
		5240	13.22	13±1	14	25.1189	0.009435	1.0	PASS
	802.11n(40)	5190	12.68	13±1	14	25.1189	0.009435	1.0	PASS
		5230	13.33	13±1	14	25.1189	0.009435	1.0	PASS
	802.11ac(20)	5180	14.49	14±1	15	31.6228	0.011878	1.0	PASS

		5200	14.29	14±1	15	31.6228	0.011878	1.0	PASS
		5240	14.72	14±1	15	31.6228	0.011878	1.0	PASS
	802.11ac(40)	5190	13.43	13±1	14	25.1189	0.009435	1.0	PASS
		5230	13.91	13±1	14	25.1189	0.009435	1.0	PASS
	802.11ax(20)	5180	13.52	13±1	14	25.1189	0.009435	1.0	PASS
		5200	13.44	13±1	14	25.1189	0.009435	1.0	PASS
		5240	13.38	13±1	14	25.1189	0.009435	1.0	PASS
	802.11ax(40)	5190	12.92	13±1	14	25.1189	0.009435	1.0	PASS
		5230	13.73	13±1	14	25.1189	0.009435	1.0	PASS

	Modulation	Frequency MHz	Output power to antenna (dBm)	Target power W/tolerance (dBm)	Max Output power to antenna (dBm)	Max Output power to antenna (mW)	Power Density at R=20cm (mW/cm2)	Limit (mW/ cm2)	Result
Wifi 5.8g	802.11a	5745	16.98	17±1	18	63.0957	0.027023	1.0	PASS
		5785	17.44	17±1	18	63.0957	0.027023	1.0	PASS
		5825	17.37	17±1	18	63.0957	0.027023	1.0	PASS
	802.11n(20)	5745	17.13	17±1	18	63.0957	0.027023	1.0	PASS
		5785	16.56	17±1	18	63.0957	0.027023	1.0	PASS
		5825	16.09	17±1	18	63.0957	0.027023	1.0	PASS
	802.11n(40)	5755	17.62	17±1	18	63.0957	0.027023	1.0	PASS
		5795	15.17	15±1	16	39.8107	0.017050	1.0	PASS
	802.11ac(20)	5745	17.33	17±1	18	63.0957	0.027023	1.0	PASS
		5785	16.56	17±1	18	63.0957	0.027023	1.0	PASS
		5825	16.34	17±1	18	63.0957	0.027023	1.0	PASS
	802.11ac(40)	5755	15.34	16±1	17	50.1187	0.021465	1.0	PASS
		5795	17.14	17±1	18	63.0957	0.027023	1.0	PASS
	802.11ax(20)	5745	17.35	17±1	18	63.0957	0.027023	1.0	PASS
		5785	16.59	17±1	18	63.0957	0.027023	1.0	PASS
		5825	16.37	17±1	18	63.0957	0.027023	1.0	PASS
	802.11ax(40)	5755	17.26	17±1	18	63.0957	0.027023	1.0	PASS
		5795	17.85	17±1	18	63.0957	0.027023	1.0	PASS

	Modulation	Rate	Frequency MHz	Output power to antenna (dBm)	Target power W/tolerance (dBm)	Max Output power to antenna (dBm)	Max Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
BLE	GFSK	1Mbps	2402	-0.54	0 ± 1	1	1.2589	0.000395	1.0	PASS
			2440	0.34	0 ± 1	1	1.2589	0.000395	1.0	PASS
			2480	0.22	0 ± 1	1	1.2589	0.000395	1.0	PASS
		2Mbps	2402	-0.64	0 ± 1	1	1.2589	0.000395	1.0	PASS
			2440	0.24	0 ± 1	1	1.2589	0.000395	1.0	PASS
			2480	0.09	0 ± 1	1	1.2589	0.000395	1.0	PASS

Remark: 1. BT Antenna gain is 1.98dBi, wifi 2.4g Antenna gain is 1.98dBi

wifi 5.2g Antenna gain is 2.76dBi, wifi 5.8g Antenna gain is 3.33dBi

2. Wifi2.4g, wifi5.2g and wifi5.8g do not transmit at the same time

BT and wifi can transmit at the same time

3. In the case of simultaneous launches for wifi and BT:

The Max Calc. Thresholds : BT: 0.000395, Wifi 2.4G: 0.249305 Wifi 5G:0.027023

BT and Wifi: $0.000395 + 0.249305 = 0.249700 \leq 1$

So a SAR test is not required