

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

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

Bluetooth mode:

GFSK

Channel(MHz)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
2480.00	0.622	0.00019	1.0	PASS

Remark:

Field strength =95.17dBuV/m @3m

Ant gain =2.0dBi, so Ant numeric gain=1.58

So $P_t = \{ [10(95.17/20)/10^6 \times 3]^2 / 30 \times 1.58 \} \times 1000 \text{ mW} = 0.622 \text{ mW}$

BLE mode:

Channel(MHz)	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
2480.00	0.224	0.0000696	1.0	PASS

Remark:

Field strength =90.74dBuV/m @3m

Ant gain =2.0dBi, so Ant numeric gain=1.58

So $P_t = \{ [10(90.74/20)/10^6 \times 3]^2 / 30 \times 1.58 \} \times 1000 \text{ mW} = 0.224 \text{ mW}$

WIFI 2.4G mode:

802.11b

Channel	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
Lowest (2412MHz)	36.98	0.01162	1.0	PASS
Middle (2437MHz)	37.58	0.01181	1.0	PASS
Highest (2462MHz)	37.41	0.01176	1.0	PASS

WIFI 5G mode:

802.11a

Channel	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
36(5180.00MHz)	18.24	0.00573	1.0	PASS
40(5200.00MHz)	18.58	0.00584	1.0	PASS
48(5240.00MHz)	18.84	0.00592	1.0	PASS

802.11n(HT40)

Channel	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
38(5190.00MHz)	9.23	0.00290	1.0	PASS
46(5230.00MHz)	9.35	0.00294	1.0	PASS

802.11ac(HT80)

Channel	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
42(5210.00MHz)	5.51	0.00173	1.0	PASS

WIFI 5.8G mode:

802.11 n(HT20)

Channel	Output power to antenna (mW)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Result
Lowest	19.36	0.00609	1.0	PASS
Middle	19.23	0.00604	1.0	PASS
Highest	19.32	0.00607	1.0	PASS

Remark: antenna gain=2.0 dBi