

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

Band	Frequency	Max output power (dBm)	Output power (mW)	Antenna gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Verdict
BT EDR	2402MHz	7.10	5.13	2.92	0.003	1.0	PASS
BLE	2440MHz	5.14	3.27	2.92	0.002	1.0	PASS

Module 1: ANT 1&2

Band	Frequency	Max output power (dBm)	Output power (mW)	Antenna gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Verdict
5.2G	5200MHz ANT 1	16.54	45.08	2.32	0.015	1.0	PASS
WIFI	5180MHz MIMO	14.15	26.00	5.40	0.018	1.0	
5.8G	5755MHz ANT 2	18.18	65.77	2.46	0.023	1.0	
WIFI	5785MHz MIMO	16.08	40.55	5.44	0.028	1.0	

Module 2: ANT 3&4

Band	Frequency	Max output power (dBm)	Output power (mW)	Antenna gain (dBi)	Power Density at R=20cm (mW/cm ²)	Limit (mW/cm ²)	Verdict
5.2G	5190MHz ANT 3	16.60	44.71	2.34	0.016	1.0	PASS
WIFI	5190MHz MIMO	15.08	32.21	4.61	0.019	1.0	
5.8G	5755MHz ANT 3	16.91	49.09	3.45	0.022	1.0	
WIFI	5755MHz MIMO	15.43	34.91	6.32	0.030	1.0	

BT and WIFI Module 1 Simultaneous Transmission:

$$\sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k}$$

$$BT\ EDR + 5.8G\ WIFI = (0.003/1) + (0.023/1) = 0.003 + 0.023 = 0.026 < 1$$

Note:

1. The product contains two WIFI modules, each WIFI module has two antennas, and the two WIFI modules cannot transmit signals at the same time.
2. The max power density is less than MPE exempt limit, so it is compliance.