



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

BLE 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
GFSK	2402	2.835	1.92	3.30	0.00082	1.0	PASS

BT 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
GFSK	2402	2.876	1.94	3.30	0.00082	1.0	PASS
$\pi/4$ -DQPSK	2402	4.697	2.95	3.30	0.00125	1.0	PASS
8-DPSK	2402	5.124	3.25	3.30	0.00138	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	2412	14.064	25.49	2.74	0.00953	1.0	PASS
802.11g	2412	12.596	18.18	2.74	0.00680	1.0	PASS
802.11n20	2412	11.846	15.30	2.74	0.00572	1.0	PASS
802.11n40	2422	10.886	12.26	2.74	0.00458	1.0	PASS

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	12.156	16.43	4.35	0.00890	1.0	PASS
802.11n20	5240	11.662	14.66	4.35	0.00794	1.0	PASS
802.11n40	5230	10.199	10.47	4.35	0.00567	1.0	PASS
802.11ac20	5240	10.708	11.77	4.35	0.00638	1.0	PASS
802.11ac40	5190	11.500	14.13	4.35	0.00765	1.0	PASS
802.11ac80	5210	11.527	14.21	4.35	0.00770	1.0	PASS



5.8G 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	5785	13.438	22.07	4.43	0.01218	1.0	PASS
802.11n20	5785	12.431	17.50	4.43	0.00966	1.0	PASS
802.11n40	5795	12.958	19.76	4.43	0.01090	1.0	PASS
802.11ac20	5785	11.688	14.75	4.43	0.00814	1.0	PASS
802.11ac40	5755	12.455	17.60	4.43	0.00971	1.0	PASS
802.11ac80	5775	13.243	21.10	4.43	0.01164	1.0	PASS

Remark: The same antenna cannot transmit at the same time, ANT1 & ANT2 can transmit at the same time, So the worst simultaneous transmitting consideration:

The ratio = ANT1 MPE_(MAX) / limit + ANT2 MPE_(MAX) / limit = 0.00138 / 1.0 + 0.01218 / 1.0 = 0.01356 < 1.0.