



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	2440	4.459	2.79	1.9	0.00056	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	2441	5.433	3.49	1.9	0.00070	1.0	PASS
$\pi/4$ -DQPSK	2441	6.188	4.16	1.9	0.00083	1.0	PASS
8-DPSK	2441	6.324	4.29	1.9	0.00085	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	14.878	30.75	1.2	0.00612	1.0	PASS
802.11g	2437	17.315	53.89	1.2	0.01072	1.0	PASS
802.11n20	2412	17.327	54.04	1.2	0.01075	1.0	PASS
802.11n40	2422	17.827	60.63	1.2	0.01206	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	5180	9.846	9.65	2.3	0.00192	1.0	PASS
802.11n20	5180	9.866	9.70	2.3	0.00193	1.0	PASS
802.11n40	5230	11.724	14.87	2.3	0.00296	1.0	PASS
802.11ac20	5180	9.809	9.57	2.3	0.00190	1.0	PASS
802.11ac40	5230	11.511	14.16	2.3	0.00282	1.0	PASS
802.11ac80	5210	10.145	10.34	2.3	0.00206	1.0	PASS



Remark: The same antenna cannot transmit at the same time, ANT1 & ANT2 & ANT3 can transmit at the same time, So the worst simultaneous transmitting consideration:

The ratio = $\text{ANT1 MPE}_{(\text{MAX})} / \text{limit} + \text{ANT2 MPE}_{(\text{MAX})} / \text{limit} + \text{ANT3 MPE}_{(\text{MAX})} / \text{limit} = 0.00085 / 1.0 + 0.01206 / 1.0 + 0.00296 / 1.0 = 0.01587 < 1.0$.