

FCC ID: HBOWA2436

Maximum Permissible Exposure (MPE)

According to FCC 1.1310: 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 Exposure				
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
300-1,500			f/300	6
1,500-100,000			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
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 * P * G}}{d} \qquad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 * P * G}{377 * D^2}$$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

BT:

Measurement Result

Operation Frequency: 2402MHz~2480MHz

Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: PCB antenna

Antenna gain: 1.0dBi;

R=20cm

$\text{mW}=10^{(\text{dBm}/10)}$

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(1/10)}=1.26$

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2402	DH5	3.86	3±1	4	2.512	1.00	1.26	0.0006	1
2441		3.53	3±1	4	2.512	1.00	1.26	0.0006	1
2480		3.37	3±1	4	2.512	1.00	1.26	0.0006	1
2402	2DH5	3.89	3±1	4	2.512	1.00	1.26	0.0006	1
2441		3.54	3±1	4	2.512	1.00	1.26	0.0006	1
2480		3.44	3±1	4	2.512	1.00	1.26	0.0006	1
2402	3DH5	3.9	3±1	4	2.512	1.00	1.26	0.0006	1
2441		3.56	3±1	4	2.512	1.00	1.26	0.0006	1
2480		3.43	3±1	4	2.512	1.00	1.26	0.0006	1

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density (mW/cm ²)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2402	GFSK(1M)	4.61	4±1	5	3.162	1.00	1.26	0.0008	1
2440		4.4	4±1	5	3.162	1.00	1.26	0.0008	1
2480		4.46	4±1	5	3.162	1.00	1.26	0.0008	1
2402	GFSK(2M)	4.73	4±1	5	3.162	1.00	1.26	0.0008	1
2440		4.53	4±1	5	3.162	1.00	1.26	0.0008	1
2480		4.58	4±1	5	3.162	1.00	1.26	0.0008	1

2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,
WIFI 802.11n HT40:2422-2452MHz
Power density limited: 1mW/ cm²

Antenna Type: FPC antenna

Antenna gain: 2.87dBi;

R=20cm

$mW=10^{(dBm/10)}$

antenna gain Numeric= $10^{(dBi/10)}=10^{(2.87/10)}=1.94$

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2412	802.11b	15.97	16±1	17	50.119	2.87	1.94	0.0193	1
2437		16.19	16±1	17	50.119	2.87	1.94	0.0193	1
2462		15.12	16±1	17	50.119	2.87	1.94	0.0193	1
2412	802.11g	15.35	16±1	17	50.119	2.87	1.94	0.0193	1
2437		15.94	16±1	17	50.119	2.87	1.94	0.0193	1
2462		15.04	16±1	17	50.119	2.87	1.94	0.0193	1
2412	802.11n H20	14.43	15±1	16	39.811	2.87	1.94	0.0153	1
2437		14.49	15±1	16	39.811	2.87	1.94	0.0153	1
2462		14.86	15±1	16	39.811	2.87	1.94	0.0153	1
2422	802.11n(HT 40)	14.85	15±1	16	39.811	2.87	1.94	0.0153	1
2437		15.3	15±1	16	39.811	2.87	1.94	0.0153	1
2452		15.57	15±1	16	39.811	2.87	1.94	0.0153	1

5G WIFI:

Operation Frequency:

WIFI 802.11a/ac/n(HT20): 5180-5240MHz;5260-5320MHz,5500-5700MHz,5745-5825MHz;

WIFI 802.11ac/n(HT40): 5190-5230MHz;5270-5310MHz,5510-5670MHz;5755-5795MHz;

WIFI 802.11ac80:5210-5210MHz;5290-5290MHz;5530-5610MHz;5775-5775MHz

Power density limited: 1mW/cm

Antenna Type: FPC antenna

Antenna gain:6.06dBi;

R=20cm

$mW=10^{(dBm/10)}$

antenna gain Numeric= $10^{(dBi/10)}=10^{(6.06/10)}=4.04$

5.2G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density (mW/cm ²)
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
5180	802.11a	11.91	11±1	12	15.849	6.06	4.04	0.0127	1
5200		10.76	11±1	12	15.849	6.06	4.04	0.0127	1
5240		12.1	12±1	13	19.953	6.06	4.04	0.0160	1
5180	802.11n H20	11.89	11±1	12	15.849	6.06	4.04	0.0127	1
5200		10.62	11±1	12	15.849	6.06	4.04	0.0127	1
5240		10.12	11±1	12	15.849	6.06	4.04	0.0127	1
5190	802.11n H40	9.15	10±1	11	12.589	6.06	4.04	0.0101	1
5230		10.21	10±1	11	12.589	6.06	4.04	0.0101	1

5.3G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density (mW/cm ²)
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
5260	802.11a	12.23	12±1	13	19.953	6.06	4.04	0.0160	1
5280		11.64	12±1	13	19.953	6.06	4.04	0.0160	1
5320		11.73	12±1	13	19.953	6.06	4.04	0.0160	1
5260	802.11n H20	11.36	11±1	12	15.849	6.06	4.04	0.0127	1
5280		10.52	11±1	12	15.849	6.06	4.04	0.0127	1
5320		10.07	11±1	12	15.849	6.06	4.04	0.0127	1
5270	802.11n H40	10.95	10±1	11	12.589	6.06	4.04	0.0101	1
5310		8.44	8±1	9	7.943	6.06	4.04	0.0064	1

5.6G

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density (mW/cm2)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
5500	802.11a	11.52	11±1	12	15.849	6.06	4.04	0.0127	1
5600		11.44	11±1	12	15.849	6.06	4.04	0.0127	1
5700		12.3	12±1	13	19.953	6.06	4.04	0.0160	1
5500	802.11n(HT20)	10.67	11±1	12	15.849	6.06	4.04	0.0127	1
5600		12.52	12±1	13	19.953	6.06	4.04	0.0160	1
5700		11.34	12±1	13	19.953	6.06	4.04	0.0160	1
5510	802.11n(HT40)	8.44	8±1	9	7.943	6.06	4.04	0.0064	1
5590		9.51	9±1	10	10.000	6.06	4.04	0.0080	1
5670		10.21	10±1	11	12.589	6.06	4.04	0.0101	1

5.8G

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density (mW/cm2)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
5745	802.11a	11.66	9±1	10	10.000	6.06	4.04	0.0080	1
5785		11.67	9±1	10	10.000	6.06	4.04	0.0080	1
5825		12	9±1	10	10.000	6.06	4.04	0.0080	1
5745	802.11n H20	12.3	8±1	9	7.943	6.06	4.04	0.0064	1
5785		10.92	8±1	9	7.943	6.06	4.04	0.0064	1
5825		11.37	8±1	9	7.943	6.06	4.04	0.0064	1
5755	802.11n H40	11	7±1	8	6.310	6.06	4.04	0.0051	1
5795		11.79	7±1	8	6.310	6.06	4.04	0.0051	1

SIMULTANEOUS TRANSMISSIONS

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE. To comply with the MPE, the fraction of the MPE in terms of E^2 , H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^n \frac{S_i}{MPE_i} \leq 1$$

Max. SIMULTANEOUS TRANSMISSIONS MODE

Band	Max conducted Power	Antenna	Separation distance (cm)	Evaluation result	Power density Limits	Evaluation result	Power density Limits	Verdict
	(dBm)	Gain (dBi)		(mW/cm ²)	(mW/cm ²)			
	Wi-Fi 2.4G + BT	16.19	2.87	20	0.0193	1	0.020100	
	4.73	1	20	0.0008	1			

Signature:

Date: 2024-03-01



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