



FCC ID:XHWAGT418

RF EXPOSURE EVALUATION

1. Introduction

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), a device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 cm is normally maintained between the transmitting antenna and the body of the user or nearby persons. In this context, the term “fixed location” means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 cm separation requirement. The limits to be used for MPE evaluation are specified in §1.1310. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

2.RF Radiation Exposure Limits

According to 47 CFR §1.1310, the criteria listed in below table shall be used to evaluate the environmental impact of human exposure to RF radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093.

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (min)
(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 – 100000	-	-	5	6
(B) Limits for General Population / Uncontrolled Exposures				
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 – 100000	-	-	1.0	30

Limits for maximum permissible exposure (MPE)

Notes: 1. f = frequency in MHz 2. Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided they are made aware of the potential for exposure. 3. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.



3.MPE Assessment Method

Calculations can be made to predict RF field strength and power density levels around typical RF sources. For example, in the case of a single radiating antenna, a prediction for power density in the far-field of the antenna can be made by use of the general Equations below. This equation is generally accurate in the far-field of an antenna but will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction.

$$\text{Power Density (S)} = \frac{PG}{4\pi R^2} = \frac{\text{EIRP}}{4\pi R^2}$$

Where

S = Power Density, unit in mW/cm²

P = Power input to the antenna, unit in mW

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna, unit in cm

EIRP = Effective isotropically radiated power

4. MPE Calculation for Standalone Operations

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,

Power density limited: 1mW/ cm²

Antenna Type: PCB Antenna

Antenna gain: 1.0dBi,

R=20cm

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

802.11b/g/n:

Channel Freq. (MHz)	modulation	conducted power (dBm)	conducted power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
2412	802.11b	13.53	22.54	14±1	15	31.62	1.26	0.007920	1
2437	802.11b	13.79	23.93	14±1	15	31.62	1.26	0.007920	1
2462	802.11b	14.04	25.35	14±1	15	31.62	1.26	0.007920	1
2412	802.11g	12.99	19.91	12±1	13	19.95	1.26	0.004997	1
2437	802.11g	12.33	17.10	12±1	13	19.95	1.26	0.004997	1
2462	802.11g	12.32	17.06	12±1	13	19.95	1.26	0.004997	1
2412	802.11n H20	12.37	17.26	12±1	13	19.95	1.26	0.004997	1
2437	802.11n H20	12.75	18.84	12±1	13	19.95	1.26	0.004997	1
2462	802.11n H20	12.12	16.29	12±1	13	19.95	1.26	0.004997	1

Operation Frequency: 2402-2480MHz,

Power density limited: 1mW/ cm²

Antenna Type: PCB Antenna

Antenna gain: 1.0dBi,

R=20cm

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

BT:



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Channel Freq. (MHz)	modulation	conducted power (dBm)	conducted power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
2402	GFSK	0.841	1.21	1±1	2	1.58	1.26	0.000397	1
2441	GFSK	1.207	1.32	1±1	2	1.58	1.26	0.000397	1
2480	GFSK	0.899	1.23	1±1	2	1.58	1.26	0.000397	1
2402	PI/4 DQPSK	-3.447	0.45	-3±1	-2	0.63	1.26	0.000158	1
2441	PI/4 DQPSK	-3.019	0.50	-3±1	-2	0.63	1.26	0.000158	1
2480	PI/4 DQPSK	-2.871	0.52	-3±1	-2	0.63	1.26	0.000158	1
2402	8DPSK	-2.887	0.51	-2±1	-1	0.79	1.26	0.000199	1
2441	8DPSK	-2.413	0.57	-2±1	-1	0.79	1.26	0.000199	1
2480	8DPSK	-2.912	0.51	-2±1	-1	0.79	1.26	0.000199	1

Operation Frequency: 2402-2480MHz,
Power density limited: 1mW/ cm²
Antenna Type: PCB Antenna
Antenna gain: 1.0dBi,
R=20cm
mW=10^{^(dBm/10)}
BLE:

Channel Freq. (MHz)	modulation	conducted power (dBm)	conducted power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
2402	GFSK	4.889	3.08	5±1	6	3.98	1.26	0.000997	1
2440	GFSK	5.342	3.42	5±1	6	3.98	1.26	0.000997	1
2480	GFSK	4.757	2.99	5±1	6	3.98	1.26	0.000997	1

Operation Frequency: 5180-5240MHz,
Power density limited: 1mW/ cm²
Antenna Type: PCB Antenna
Antenna gain: 2.0dBi,
R=20cm
mW=10^{^(dBm/10)}



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Channel Freq. (MHz)	modulation	conducted power (dBm)	conducted power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
5180	802.11a	9.53	8.97	9±1	10	10.00	1.585	0.003153	1
5200	802.11a	9.00	7.94	9±1	10	10.00	1.585	0.003153	1
5240	802.11a	8.68	7.38	9±1	10	10.00	1.585	0.003153	1
5180	802.11n H20	9.22	8.36	9±1	10	10.00	1.585	0.003153	1
5200	802.11n H20	9.71	9.35	9±1	10	10.00	1.585	0.003153	1
5240	802.11n H20	8.91	7.78	9±1	10	10.00	1.585	0.003153	1
5190	802.11n H40	9.55	9.02	9±1	10	10.00	1.585	0.003153	1
5230	802.11n H40	8.68	7.38	9±1	10	10.00	1.585	0.003153	1
5210	802.11n ac80	8.26	6.70	9±1	10	10.00	1.585	0.003153	1

Operation Frequency: 5250-5350MHz,
Power density limited: 1mW/ cm²
Antenna Type: PCB Antenna
Antenna gain: 2.0dBi,
R=20cm
mW=10^(dBm/10)

Channel Freq. (MHz)	modulation	conducted power (dBm)	conducted power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
5260	802.11a	9.05	8.04	8±1	9	7.94	1.585	0.002504	1
5280	802.11a	8.62	7.28	8±1	9	7.94	1.585	0.002504	1
5320	802.11a	8.67	7.36	8±1	9	7.94	1.585	0.002504	1
5260	802.11n H20	9.13	8.18	8±1	9	7.94	1.585	0.002504	1
5280	802.11n H20	8.89	7.74	8±1	9	7.94	1.585	0.002504	1
5320	802.11n H20	8.97	7.89	8±1	9	7.94	1.585	0.002504	1
5270	802.11n H40	8.90	7.76	7±1	8	6.31	1.585	0.001989	1
5310	802.11n H40	8.12	6.49	7±1	8	6.31	1.585	0.001989	1
5290	802.11n ac80	8.31	6.78	7±1	8	6.31	1.585	0.001989	1

Operation Frequency: 5470-5725MHz,
Power density limited: 1mW/ cm²
Antenna Type: PCB Antenna
Antenna gain: 2.0dBi,
R=20cm
mW=10^(dBm/10)



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Channel Freq. (MHz)	modulation	conducted power (dBm)	conducted power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
5500	802.11a	7.57	5.71	6±1	7	5.01	1.585	0.001580	1
5600	802.11a	9.21	8.34	8±1	9	7.94	1.585	0.002504	1
5700	802.11a	8.77	7.53	8±1	9	7.94	1.585	0.002504	1
5500	802.11n H20	7.71	5.90	6±1	7	5.01	1.585	0.001580	1
5600	802.11n H20	8.10	6.46	7±1	8	6.31	1.585	0.001989	1
5700	802.11n H20	8.88	7.73	7±1	8	6.31	1.585	0.001989	1
5510	802.11n H40	7.61	5.77	6±1	7	5.01	1.585	0.001580	1
5590	802.11n H40	8.02	6.34	7±1	8	6.31	1.585	0.001989	1
5670	802.11n H40	8.64	7.31	7±1	8	6.31	1.585	0.001989	1
5530	802.11n ac80	7.35	5.43	5±1	6	3.98	1.585	0.001255	1
5610	802.11n ac80	7.69	5.87	5±1	6	3.98	1.585	0.001255	1

Operation Frequency: 5720-5850MHz,

Power density limited: 1mW/ cm²

Antenna Type: PCB Antenna

Antenna gain: 2.0dBi,

R=20cm

mW=10^(dBm/10)

Channel Freq. (MHz)	modulation	conducted power (dBm)	conducted power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain Numeric	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
5745	802.11a	9.93	9.84	10±1	11	12.59	1.585	0.003969	1
5785	802.11a	9.80	9.55	10±1	11	12.59	1.585	0.003969	1
5825	802.11a	10.06	10.14	10±1	11	12.59	1.585	0.003969	1
5745	802.11n H20	9.09	8.11	9±1	10	10.00	1.585	0.003153	1
5785	802.11n H20	9.25	8.41	9±1	10	10.00	1.585	0.003153	1
5825	802.11n H20	9.82	9.59	9±1	10	10.00	1.585	0.003153	1
5755	802.11n H40	9.75	9.44	9±1	10	10.00	1.585	0.003153	1
5795	802.11n H40	9.29	8.49	9±1	10	10.00	1.585	0.003153	1
5775	802.11n H40	8.41	6.93	9±1	10	10.00	1.585	0.003153	1

simultaneous emission

Power density Limits (mW/cm ²) BT	Power density Limits (mW/cm ²) 2.4G WIFI	Power density Limits (mW/cm ²) BLE	Power density Limits (mW/cm ²) 5G WIFI	Calculate Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
0.000397	0.007920	0.000997	0.003969	0.013	1



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Conclusion:

For the max result : $0.013 \leq 1.0$, compliance with FCC's RF Exposure.