FCC §15.247 (i), §2.1091 – RF Exposure

FCC ID: 2ALT6-ERM200

Applied procedures / limit

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm^2)	Averaging Time $\|E\|^2$,$\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

Note: f is frequency in MHz

* = Power density limit is applicable at frequencies greater than 100 MHz

Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm^2)	Averaging Time $\|E\|^2$,$\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz

* = Plane-wave equivalent power density

2.4G

IEEE 802.11b

max possible output power (PK,conducted)：15±1dbm

IEEE 802.11g

max possible output power (PK,conducted)：14±1dbm

IEEE 802.11N(HT20)

max possible output power (PK,conducted)：15±1dbm

IEEE 802.11N(HT40)

max possible output power (PK,conducted)：13±1dbm

The max possible output power (PK,conducted) of All (IEEE 802.11b , IEEE 802.11g, IEEE 802.11n(20), IEEE 802.11n(40)) is IEEE 802.11b.

	Frequency	Antenna port	Maximum Conducted Output Power(PK)	Maximum Conducted Output Power(PK)	Total Conducted Output Power(PK)	Total Conducted Output Power(PK)	LIMIT
	(MHz)		(dBm)	(mW)	(mW)	(dBm)	dBm
802.11b	2412	Ant.1	15.85	38.46	N/A	N/A	30
		Ant.2	15.55	35.89			
	2437	Ant.1	15.63	36.56	N/A	N/A	30
		Ant.2	15.45	35.08			
	2462	Ant.1	15.57	36.06	N/A	N/A	30
		Ant.2	15.51	35.56			
802.11g	2412	Ant.1	14.86	38.46	N/A	N/A	30
		Ant.2	14.48	28.05			
	2437	Ant.1	14.69	29.44	N/A	N/A	30
		Ant.2	14.37	35.08			
	2462	Ant.1	14.35	36.06	N/A	N/A	30
		Ant.2	14.05	35.56			
802.11n20	2412	Ant.1	12.35	2.72	34.88	15.43	30
		Ant.2	12.48	2.81			
	2437	Ant.1	12.39	2.75	34.80	15.42	30
		Ant.2	12.42	2.77			

	2462	Ant.1	12.65	2.92	35.20	15.46	30
		Ant.2	12.25	2.66			
802.11n40	2422	Ant.1	10.87	2.44	23.34	13.68	30
		Ant.2	10.46	2.22			
	2437	Ant.1	10.57	2.28	22.96	13.61	30
		Ant.2	10.63	2.31			
	2452	Ant.1	10.76	2.38	23.53	13.72	30
		Ant.2	10.65	2.32			

5G

IEEE 802.11a

max possible output power (PK conducted)：15±1dbm

IEEE 802.11N(20)

max possible output power (PK,conducted)：17±1dbm

IEEE 802.11N(40)

max possible output power (PK conducted)：16±1dbm

IEEE 802.11ac(20)

max possible output power (PK conducted)：17±1dbm

IEEE 802.11ac(40)

max possible output power (PK conducted)：16±1dbm

IEEE 802.11ac(80)

max possible output power (PK conducted)：15±1dbm

The max possible output power (PK,conducted) of All (IEEE 802.11a , IEEE 802.11n(20), IEEE 802.11n(40), IEEE 802.11ac(20), EEE 802.11ac(40), EEE 802.11ac(80)) is IEEE 802.11ac(20).

Test Channel	Frequency	Maximum output (PK) (dBm)		Total Power (PK)	LIMIT	Result
	(MHz)	ANT 1	ANT 2	dBm	dBm	
TX 802.11a Mode						
CH36	5180	15.72	15.27	-	23.98	Pass
CH40	5200	15.69	15.12	-	23.98	Pass
CH48	5240	15.35	15.18	-	23.98	Pass
TX 802.11 n20M Mode						
CH36	5180	14.570	14.280	17.438	23.98	Pass
CH40	5200	14.760	14.170	17.485	23.98	Pass
CH48	5240	14.080	14.070	17.085	23.98	Pass
TX 802.11 n40M Mode						
CH38	5190	13.870	13.150	16.535	23.98	Pass
CH46	5230	13.570	13.070	16.337	23.98	Pass
TX 802.11 AC20M Mode						
CH36	5180	14.840	14.270	17.575	23.98	Pass
CH40	5200	14.540	14.060	17.317	23.98	Pass
CH48	5240	14.250	14.110	17.191	23.98	Pass
TX 802.11 AC40M Mode						
CH38	5190	13.140	13.010	16.086	23.98	Pass
CH46	5230	13.110	13.100	16.115	23.98	Pass
TX 802.11 AC80M Mode						
CH42	5210	12.530	12.420	15.486	23.98	Pass

Test Channel	Frequency	Maximum output (PK) (dBm)		Total Power (PK)	LIMIT	Result
	(MHz)	ANT 1	ANT 2	dBm	dBm	
TX 802.11a Mode						
CH 149	5745	15.15	15.36	-	30	Pass
CH 157	5785	15.29	15.11	-	30	Pass
CH 165	5825	15.38	15.37	-	30	Pass
TX 802.11 n20M Mode						
CH 149	5745	14.31	14.13	17.231	30	Pass
CH 157	5785	14.37	14.29	17.340	30	Pass
CH 165	5825	14.22	14.44	17.342	30	Pass
TX 802.11 n40M Mode						
CH 151	5755	12.28	12.14	15.221	30	Pass
CH 159	5795	12.16	12.03	15.106	30	Pass
TX 802.11 AC20M Mode						
CH 149	5745	14.14	14.05	17.106	30	Pass
CH 157	5785	14.21	14.09	17.161	30	Pass
CH 165	5825	14.22	14.15	17.195	30	Pass
TX 802.11 AC40M Mode						
CH 151	5755	12.58	12.25	15.428	30	Pass
CH 159	5795	12.34	12.28	15.320	30	Pass
TX 802.11 AC80M Mode						
CH 155	5775	12.02	12.1	15.070	30	Pass

MPE PREDICTION

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
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,R=20cm

Test Result of RF Exposure Evaluation

2.4G

	Target power W/ tolerance (dBm)	Max tune up power tolerance (dBm)	Output power to antenna (mW)	Antenna Gain(dBi)	Power Density at R=20cm (mW/cm^2)	Total Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
802.11b ANT1	15±1.0	16.0	39.81	1.26 (1.0dBi)	0.00997	/	1.0	Pass
802.11b ANT2	15±1.0	16.0	39.81	1.26 (1.0dBi)	0.00997	/	1.0	Pass
802.11g ANT1	14±1.0	15.0	31.62	1.26 (1.0dBi)	0.00792	/	1.0	Pass
802.11g ANT2	14±1.0	15.0	31.62	1.26 (1.0dBi)	0.00792	/	1.0	Pass
802.11n20MHz ANT1	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.00999	0.01994	1.0	Pass
802.11n20MHz ANT2	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.00999		1.0	Pass
802.11n40MHz ANT1	10±1.0	11.0	12.59	2.52 (4.01dBi)	0.00631	0.01262	1.0	Pass
802.11n40MHz ANT2	10±1.0	11.0	12.59	2.52 (4.01dBi)	0.00631		1.0	Pass

5G

	Target power W/ tolerance (dBm)	Max tune up power tolerance (dBm)	Output power to antenna (mW)	Antenna Gain(dBi)	Power Density at R=20cm (mW/cm^2)	Total Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
802.11a ANT1	15±1.0	16.0	39.81	1.26 (1.0dBi)	0.00997	/	1.0	Pass
802.11a ANT2	15±1.0	16.0	39.81	1.26 (1.0dBi)	0.00997	/	1.0	Pass
802.11n 20MHz ANT1	14±1.0	15.0	31.62	2.52 (4.01dBi)	0.01584	0.03168	1.0	Pass
802.11n 20MHz ANT2	14±1.0	15.0	31.62	2.52 (4.01dBi)	0.01584		1.0	Pass
802.11n 40MHz ANT1	13±1.0	14.0	25.12	2.52 (4.01dBi)	0.01258	0.02516	1.0	Pass
802.11n 40MHz ANT2	13±1.0	14.0	25.12	2.52 (4.01dBi)	0.01258		1.0	Pass
802.11ac 20MHz ANT1	14±1.0	15.0	31.62	2.52 (4.01dBi)	0.01584	0.03168	1.0	Pass
802.11ac 20MHz ANT2	14±1.0	15.0	31.62	2.52 (4.01dBi)	0.01584		1.0	Pass
802.11ac 40MHz ANT1	13±1.0	14.0	25.12	2.52 (4.01dBi)	0.01258	0.02516	1.0	Pass
802.11ac 40MHz ANT2	13±1.0	14.0	25.12	2.52 (4.01dBi)	0.01258		1.0	Pass
802.11ac 80MHz ANT1	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.00999	0.01998	1.0	Pass
802.11ac 80MHz ANT2	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.00999		1.0	Pass

5.8G

	Target power W/ tolerance (dBm)	Max tune up power tolerance (dBm)	Output power to antenna (mW)	Antenna Gain(dBi)	Power Density at R=20cm (mW/cm^2)	Total Power Density at R=20cm (mW/cm^2)	Limit (mW/cm^2)	Result
802.11a ANT1	15±1.0	16.0	39.81	1.26 (1.0dBi)	0.00997	/	1.0	Pass
802.11a ANT2	15±1.0	16.0	39.81	1.26 (1.0dBi)	0.00997	/	1.0	Pass
802.11n 20MHz ANT1	14±1.0	15.0	31.62	2.52 (4.01dBi)	0.01584	0.03168	1.0	Pass
802.11n 20MHz ANT2	14±1.0	15.0	31.62	2.52 (4.01dBi)	0.01584		1.0	Pass
802.11n 40MHz ANT1	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.01258	0.01998	1.0	Pass
802.11n 40MHz ANT2	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.01258		1.0	Pass
802.11ac 20MHz ANT1	14±1.0	15.0	31.62	2.52 (4.01dBi)	0.01584	0.03168	1.0	Pass
802.11ac 20MHz ANT2	14±1.0	15.0	31.62	2.52 (4.01dBi)	0.01584		1.0	Pass
802.11ac 40MHz ANT1	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.01258	0.01998	1.0	Pass
802.11ac 40MHz ANT2	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.01258		1.0	Pass
802.11ac 80MHz ANT1	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.00999	0.01998	1.0	Pass
802.11ac 80MHz ANT2	12±1.0	13.0	19.95	2.52 (4.01dBi)	0.00999		1.0	Pass

For 2.4G and 5G

Note: Directional Gain=1.0dBi+10log(2)=4.01dBi