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

FCC ID: 2AKVD-F4PLUS

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)：21±1dbm

IEEE 802.11g

max possible output power (PK,conducted)：18±1dbm

IEEE 802.11N(HT20)

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

IEEE 802.11N(HT40)

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

TX 802.11b Mode			
Frequency	Antenna port	Maximum Conducted Output Power(PK)	LIMIT
(MHz)		(dBm)	dBm
2412	Ant 1	21.53	30
	Ant 2	20.68	30
2437	Ant 1	21.49	30
	Ant 2	20.86	30
2462	Ant 1	21.37	30
	Ant 2	20.66	30
TX 802.11g Mode			
2412	Ant 1	18.84	30
	Ant 2	18.36	30
2437	Ant 1	18.72	30
	Ant 2	18.31	30
2462	Ant 1	18.76	30
	Ant 2	18.25	30

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
TX 802.11n-HT20 Mode						

2412	Ant 1	16.63	46.03	93.34	19.70	29.49
	Ant 2	16.75	47.32			
2437	Ant 1	16.83	48.19	94.65	19.76	29.49
	Ant 2	16.67	46.45			
2462	Ant 1	16.52	44.87	89.34	19.51	29.49
	Ant 2	16.48	44.46			
TX 802.11n-HT40 Mode						
2422	Ant 1	14.63	29.04	55.89	17.47	29.49
	Ant 2	14.29	26.85			
2437	Ant 1	14.72	29.65	57.57	17.6	29.49
	Ant 2	14.46	27.93			
2452	Ant 1	14.85	30.55	59.66	17.77	29.49
	Ant 2	14.64	29.11			

5G

IEEE 802.11a

max possible output power (PK conducted)：6±1dbm

IEEE 802.11N(20)

max possible output power (PK,conducted)：5±1dbm

IEEE 802.11N(40)

max possible output power (PK conducted)：4±1dbm

IEEE 802.11ac(20)

max possible output power (PK conducted)：5±1dbm

IEEE 802.11ac(40)

max possible output power (PK conducted)：4±1dbm

IEEE 802.11ac(80)

max possible output power (PK conducted)：4±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).

Band IV (5.725-5.85GHz)								
Test Channel	Frequency (MHz)	PK Power A(dBm)	PK Power B(dBm)	PK Power Total(dBm)	AV Power (dBm)	AV Power B(dBm)	AV Power Total(dBm)	LIMIT (dBm)
802.11a								
149	5745	6.13	3.41	--	4.37	1.28	--	30
157	5785	5.68	3.57	--	3.22	1.52	--	30
165	5825	5.94	3.65	--	3.47	1.38	--	30
802.11n(HT20)								
149	5745	5.83	3.34	7.771	4.16	1.05	5.888	29.49
157	5785	5.27	3.46	7.469	2.84	1.83	5.375	29.49
165	5825	5.76	3.57	7.812	4.01	1.47	5.933	29.49
802.11n(HT40)								
151	5755	4.85	2.94	7.009	2.48	1.16	4.880	29.49
159	5795	4.73	3.07	6.989	2.52	0.67	4.703	29.49
802.11ac(HT20)								
149	5745	5.14	3.28	7.319	3.61	0.82	5.446	29.49
157	5785	5.06	3.34	7.295	2.62	0.99	4.891	29.49
165	5825	5.33	3.46	7.505	3.36	1.75	5.639	29.49
802.11ac(HT40)								
151	5755	4.62	2.87	6.843	2.90	0.83	4.997	29.49
159	5795	4.57	2.94	6.841	2.91	1.01	5.073	29.49
802.11ac(HT80)								
155	5775	4.35	2.74	6.629	2.17	0.89	4.587	29.49

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	21±1.0	22.0	158.49	2.24 (3.5dBi)	0.07066	/	1.0	Pass
802.11b ANT2	18±1.0	19.0	79.43	2.24 (3.5dBi)	0.03541	/	1.0	Pass
802.11g ANT1	16±1.0	17.0	50.12	2.24 (3.5dBi)	0.02235	/	1.0	Pass
802.11g ANT2	14±1.0	15.0	31.62	2.24 (3.5dBi)	0.01410	/	1.0	Pass

802.11n20MHz ANT1	12±1.0	13.0	19.95	4.48 (6.51dBi)	0.01779	0.03558	1.0	Pass
802.11n20MHz ANT2	12±1.0	13.0	19.95	4.48 (6.51dBi)	0.01779		1.0	Pass
802.11n40MHz ANT1	10±1.0	11.0	12.59	4.48 (6.51dBi)	0.01123	0.02246	1.0	Pass
802.11n40MHz ANT2	10±1.0	11.0	12.59	4.48 (6.51dBi)	0.01123		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	6±1.0	7	5.01	2.24 (3.5dBi)	0.00223	/	1.0	Pass
802.11a ANT2	6±1.0	7	5.01	2.24 (3.5dBi)	0.00223	/	1.0	Pass
802.11n 20MHz ANT1	5±1.0	6	3.98	4.48 (6.51dBi)	0.00355	0.0071	1.0	Pass
802.11n 20MHz ANT2	5±1.0	6	3.98	4.48 (6.51dBi)	0.00355		1.0	Pass
802.11n 40MHz ANT1	4±1.0	5	3.16	4.48 (6.51dBi)	0.00282	0.00564	1.0	Pass
802.11n 40MHz ANT2	4±1.0	5	3.16	4.48 (6.51dBi)	0.00282		1.0	Pass
802.11ac 20MHz ANT1	5±1.0	6	3.98	4.48 (6.51dBi)	0.00355	0.0071	1.0	Pass
802.11ac 20MHz ANT2	5±1.0	6	3.98	4.48 (6.51dBi)	0.00355		1.0	Pass
802.11ac 40MHz ANT1	4±1.0	5	3.16	4.48 (6.51dBi)	0.00282	0.00564	1.0	Pass
802.11ac 40MHz ANT2	4±1.0	5	3.16	4.48 (6.51dBi)	0.00282		1.0	Pass
802.11ac 80MHz ANT1	4±1.0	5	3.16	4.48 (6.51dBi)	0.00282	0.00564	1.0	Pass
802.11ac 80MHz ANT2	4±1.0	5	3.16	4.48 (6.51dBi)	0.00282		1.0	Pass

For 2.4G and 5G

Note: Directional Gain=3.5dBi+10log(2)=6.51dBi