

RF Exposure evaluation

FCC ID: 2AMA8-UPRO

1. Reference

According to §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.

According to §1.1310 and §2.1091 RF exposure is calculated.

KDB447498 D01: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

2. Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
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 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 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

*=Plane-wave equivalent power density

3. Manufacturing tolerance

802.11b(PK)			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	15.0	15.0	15.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11g(PK)			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	17.0	17.0	17.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n(HT20)(PK)			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	16.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n(HT40)(PK)			
Channel	Channel 03	Channel 6	Channel 9
Target (dBm)	16.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

[5GWLAN Band 1]

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	---	Channel 46
Target (dBm)	12.0	---	12.0
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	---	Channel 46
Target (dBm)	12.0	---	12.0
Tolerance $\pm$ (dB)	1.0	---	1.0
IEEE 802.11ac VHT80 (Average)			
Channel	---	Channel 42	---
Target (dBm)	---	12.0	---
Tolerance $\pm$ (dB)	---	1.0	---

[5GWLAN Band 3]

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	12.0	12.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	12.0	12.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	12.0	12.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	---	Channel 159
Target (dBm)	12.0	---	12.0
Tolerance ±(dB)	1.0	---	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	---	Channel 159
Target (dBm)	12.0	---	12.0
Tolerance ±(dB)	1.0	---	1.0
IEEE 802.11ac VHT80 (Average)			
Channel	---	Channel 155	---
Target (dBm)	---	12.0	---
Tolerance ±(dB)	---	1.0	---

4. MPE Calculation Method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

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

5. Result

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, $r = 20\text{cm}$, as well as the gain of the used antenna is 0.00 dBi, the RF power density can be obtained.

2.4G WIFI

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11b	16.0	39.81072	0.00	1.00	0.007924	1.0000
IEEE 802.11g	18.0	63.09573	0.00	1.00	0.012559	1.0000
IEEE 802.11n HT20	17.0	50.11872	0.00	1.00	0.009976	1.0000
IEEE 802.11n HT40	17.0	50.11872	0.00	1.00	0.009976	1.0000

[5GWLAN Band 1]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11n HT20	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11ac VHT20	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11n HT40	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11ac VHT40	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11ac VHT80	13.0	19.95262	0.00	1.00	0.003971	1.0000

[5GWLAN Band 3]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11n HT20	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11ac VHT20	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11n HT40	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11ac VHT40	13.0	19.95262	0.00	1.00	0.003971	1.0000
IEEE 802.11ac VHT80	13.0	19.95262	0.00	1.00	0.003971	1.0000

6. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.