

RF Exposure evaluation

FCC ID: 2A5HX-MARS5ULTRA

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

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. MPE Calculation Method

Predication of MPE limit at a given distance

Equation from page 18 of 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

4. Antenna Information

EUT can only use antennas certificated as follows provided by manufacturer;

Antenna No.	Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
WIFI	/	External antenna	1.49dBi for 2400-2480MHz 2.3dBi for 5150-5250MHz 3.22dBi for 5745-5825MHz	

5. Manufacturing Tolerance

WIFI (Conducted)

Frequency (MHz)	11b(Peak)		
	2412	2437	2462
Target (dBm)	14.0	14.0	14.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	11g(Peak)		
	2412	2437	2462
Target (dBm)	14.0	14.0	14.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	11n(HT20) (Peak)		
	2412	2437	2462
Target (dBm)	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	11n(HT40) (Peak)		
	2422	2437	2452
Target (dBm)	12.0	12.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0

5.2G WIFI (Conducted)

Frequency (MHz)	IEEE 802.11a(AV)		
	5180	5200	5240
Target (dBm)	14.0	14.0	14.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	IEEE 802.11n20(AV)		
	5180	5200	5240
Target (dBm)	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	IEEE 802.11n40(AV)		
	5190	5230	
Target (dBm)	12.0	12.0	
Tolerance ± (dB)	1.0	1.0	
Frequency (MHz)	IEEE 802.11ac20(AV)		
	5180	5200	5240
Target (dBm)	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	IEEE 802.11ac40(AV)		
	5190	5230	
Target (dBm)	12.0	12.0	
Tolerance ± (dB)	1.0	1.0	
Frequency (MHz)	IEEE 802.11ac80(AV)		
	5210		
Target (dBm)	12.0		
Tolerance ± (dB)	1.0		

5.8G WIFI (Conducted)

Frequency (MHz)	IEEE 802.11a(AV)		
	5745	5785	5825
Target (dBm)	11.0	11.0	11.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	IEEE 802.11n20(AV)		
	5745	5785	5825
Target (dBm)	11.0	11.0	11.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	IEEE 802.11n40(AV)		
	5755	5795	
Target (dBm)	11.0	11.0	
Tolerance ± (dB)	1.0	1.0	
Frequency (MHz)	IEEE 802.11ac20(AV)		
	5745	5785	5825
Target (dBm)	11.0	11.0	11.0

Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	IEEE 802.11ac40(AV)		
	5755	5795	
Target (dBm)	11.0	11.0	
Tolerance $\pm$ (dB)	1.0	1.0	
Frequency (MHz)	IEEE 802.11ac80(AV)		
	5775		
Target (dBm)	11.0		
Tolerance $\pm$ (dB)	1.0		

6. Standalone MPE 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 refer to section 4, the RF power density can be obtained.

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
2.4G WIFI	15.0	31.623	1.49	1.409	0.00887	1.0000
5.2G WIFI	15.0	31.623	2.3	1.698	0.01068	1.0000
5.8G WIFI	12.0	15.849	3.22	2.099	0.00662	1.0000

Remark:

1. Output power (Peak) including turn-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer.

7. Conclusion

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

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