

RF Exposure evaluation

FCC ID: 2A54Y-X5BAI

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

X5 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:
Bluetooth	/	FPC Antenna	2.5dBi for 2402-2480MHz;	
2.4G&5GWIFI	/	FPC Antenna	2.5dBi for 2412-2462MHz for ant 1 and ant 2	
			2.5dBi for 5150-5250MHz for ant 1 and ant 2	
			2.5dBi for 5725-5875MHz for ant 1 and ant 2	

5. Manufacturing Tolerance

<BT LE>

GFSK (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	6.0	6.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0

<BT Classics>

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	7.0	7.0	7.0
Tolerance ±(dB)	1.0	1.0	1.0
π/4DQPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	7.0	7.0	7.0
Tolerance ±(dB)	1.0	1.0	1.0
8DPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	7.0	7.0	7.0
Tolerance ±(dB)	1.0	1.0	1.0

[2.4GHz WLAN]

IEEE 802.11b (Peak)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	13.0	13.0	13.0	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11g(Peak)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462

Target (dBm)	13.0	13.0	13.0	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<i>IEEE 802.11n HT20 (Peak)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2437	2462	2412	2437	2462
Target (dBm)	13.0	13.0	13.0	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<i>IEEE 802.11n HT40 (Peak)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	2422	2437	2452	2422	2437	2452
Target (dBm)	13.0	13.0	13.0	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0

5GHz WLAN Band 1

<i>IEEE 802.11a (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5180	5200	5240	5180	5200	5240
Target (dBm)	12.0	12.0	12.0	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<i>IEEE 802.11n HT20 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5180	5200	5240	5180	5200	5240
Target (dBm)	12.0	12.0	12.0	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<i>IEEE 802.11ac VHT20 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5180	5200	5240	5180	5200	5240
Target (dBm)	12.0	12.0	12.0	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<i>IEEE 802.11n HT40 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5190	5230		5190	5230	
Target (dBm)	12.0	12.0		12.0	12.0	
Tolerance $\pm$ (dB)	1.0	1.0		1.0	1.0	
<i>IEEE 802.11ac VHT40 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5190	5230		5190	5230	
Target (dBm)	12.0	12.0		12.0	12.0	
Tolerance $\pm$ (dB)	1.0	1.0		1.0	1.0	
<i>IEEE 802.11ac VHT80 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5210			5210		
Target (dBm)	12.0			12.0		
Tolerance $\pm$ (dB)	1.0			1.0		

5GHz WLAN Band 3

IEEE 802.11a (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	5745	5785	5825	5745	5785	5825
Target (dBm)	12.0	12.0	12.0	12.0	12.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	5745	5785	5825	5745	5785	5825
Target (dBm)	12.0	12.0	12.0	12.0	12.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	5745	5785	5825	5745	5785	5825
Target (dBm)	12.0	12.0	12.0	12.0	12.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)						
Frequency (MHz)	Antenna 1		Antenna 2			
	5755	5795	5755	5795		
Target (dBm)	12.0	12.0	12.0	12.0		
Tolerance ± (dB)	1.0	1.0	1.0	1.0		
IEEE 802.11ac VHT40 (Average)						
Frequency (MHz)	Antenna 1		Antenna 2			
	5755	5795	5755	5795		
Target (dBm)	12.0	12.0	12.0	12.0		
Tolerance ± (dB)	1.0	1.0	1.0	1.0		
IEEE 802.11ac VHT80 (Average)						
Frequency (MHz)	Antenna 1		Antenna 2			
	5775		5775			
Target (dBm)	12.0		12.0			
Tolerance ± (dB)	1.0		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 WIFI antenna is 2.5dBi, the gain of BT antenna is 2.5dBi. the RF power density can be obtained.

[Antenna 1]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
BT	8.0	6.3096	2.50	1.7783	0.0022	1.0000
2.4G WIFI	14.0	25.1189	2.50	1.7783	0.0089	1.0000
5.2GWIFI	13.0	19.9526	2.50	1.7783	0.0071	1.0000
5.8GWIFI	13.0	19.9526	2.50	1.7783	0.0071	1.0000

[Antenna 2]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
2.4G WIFI	14.0	25.1189	2.50	1.7783	0.0089	1.0000
5.2GWIFI	13.0	19.9526	2.50	1.7783	0.0071	1.0000
5.8GWIFI	13.0	19.9526	2.50	1.7783	0.0071	1.0000

Remark:

1. Output power (Peak) including turn-up tolerance;
2. Output power was adjust to duty cycle at 100% if measured duty cycle less than 98%;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer.

7. Summary simultaneous transmission results

The sample supports 2 antennas for 2.4G WLAN and 5G WLAN. The antenna 1 and antenna 2 can transmit simultaneous.

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

Σ of MPE ratios ≤ 1.0

Antenna 1 and Antenna 2 for 2.4G WLAN and 5G WALN

Modulation Type	MPE _{ant0} (mW/cm ²)	MPE _{ant1} (mW/cm ²)	ΣMPE ratios	Limit	Results
WIFI	0.0089	0.0089	0.0178	1.0	PASS

8. Conclusion

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

-----THE END OF REPORT-----