

RF Exposure evaluation

FCC ID	2BKK2-X6-A
Product Name	SMART DOORBELL
Model/Type reference	X6-A
Listed Model(s)	X6-FA, X6-FD, X2, X2-A, X2-F, X3, X3-A, X3-F, X5, X5-A, X5-F
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Device

1. Reference

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

FCC CFR 47 part1 1.1310: Radio frequency radiation exposure limits.

FCC CFR 47 part2 2.1091: Radio frequency radiation exposure evaluation: mobile devices

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

Antenna No.	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
2.4GWIFI	Metal Antenna	1.65dBi	2400-2500MHz
433M	Metal(Carbon steel) Antenna	1.2dBi	433MHz

5. Conducted Peak Output Power

TX frequency range: 433.92MHz

Device category: Mobile Device (Distance: 20cm) Max. Field Strength: 72.93dBuV/m @3m

EIRP=E-104.8+20logD=72.93-104.8+20log3=-19.12dBm

Maximum Conducted Output Power:-19.12dBm

Tune-up: -19±1

Mode	Channel	Peak Output Power (dBm)	Peak Output Power (mW)
IEEE 802.11b	1	8.87	7.71
	6	8.60	7.24
	11	8.81	7.60
IEEE 802.11g	1	7.66	5.83
	6	7.27	5.33
	11	8.17	6.56
IEEE 802.11n_20	1	7.55	5.69
	6	7.84	6.08
	11	8.48	7.05

6. Manufacturing Tolerance

IEEE 802.11b			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	9	9	8
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11g			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	8	8	9
Tolerance \pm (dB)	1.0	1.0	1.0
IEEE 802.11n_20			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	8	9	9
Tolerance \pm (dB)	1.0	1.0	1.0

7. Evaluation 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 2.4GWIFI antenna is 1.65dBi and 433M antenna is 1.2dBi, the RF power density can be obtained.

Mode	Output power		Antenna Gain (dBi)	Antenna Gain(linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
2.4GWIFI	10	10	1.65	1.46	0.00291	1.0000
ASK	-19	0.01	1.20	1.32	0.000004	0.2893

Remark:

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

8. Simultaneous Transmission MPE Evaluation

The EUT equipped with four 2.4GWIFI antennas. So, need consider simultaneous transmission;

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

$\Sigma\Sigma$ of MPE ratios ≤ 1.0

2.4GWIFI MAX MPE ratios	433M MPE ratios	Σ MPE ratios	Limit	Results
0.00291	0.0000139	0.0029239	1.0	Pass

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1093 for the uncontrolled RF Exposure and SAR Exclusion Threshold per KDB 447498 v06.

-----End of the report-----