

# 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 <sup>2</sup> ) | 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 <sup>2</sup> )*              | 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 <sup>2</sup> ) | 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 <sup>2</sup> )*              | 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 <sup>2</sup> ) | MPE Limits (mW/cm <sup>2</sup> ) |
|----------|--------------|------|--------------------|----------------------|---------------------------|----------------------------------|
|          | 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  $\leq 1.0$

| 2.4GWIFI MAX<br>MPE ratios | 433M MPE<br>ratios | $\Sigma$ 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-----