# Maximum Permissible Exposure Report

## 1. Product Information

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|---|---|
| FCC ID: | 2AEUPBHADB001 |
| Product name | Steplight |
| Model number | 5LD1S8 |
| Power supply | DC 4.5 by Battery(3*C) |
| Modulation Type | GFSK for Bluetooth V5.0 (BLE) |
| Channel Number | 40 channels for Bluetooth V5.0 (BLE) |
| Channel Spacing | 2MHz for Bluetooth V5.0 (BLE) |
| Antenna Type | PCB Antenna for Bluetooth<br>Internal Antenna for LoRa |
| Antenna Gain | 1.1 dBi (Max) for Bluetooth<br>1.1 dBi (Max) for LoRa |
| Hardware version | C40-V2.2 20181011 |
| Software version | 0.7.5 |
| Bluetooth Operation frequency | 2402 MHz- 2480 MHz |
| LoRa Operation frequency | 903 MHz - 927.5 MHz |
| LoRa Channel number | 26 |
| LoRa Modulation Type | CSS |
| Exposure category | General population/uncontrolled environment |
| EUT Type | Production Unit |
| Device Type | Mobile Device |

## 2. Evaluation Method

Systems operating under the provisions of FCC 47 CFR 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.
In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modelled or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

## 3. Limit

### 3. 1 Refer Evaluation Method

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: Radiofrequency radiation exposure limits.
FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: mobile devices

**3. 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

## 4. 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

## 5. Antenna Information

5LD1S8 can only use antennas certificated as follows provided by manufacturer;

| Internal Identification | Antenna type and antenna number | Operate frequency band | Maximum antenna gain | Note |
|---|---|---|---|---|
| Antenna 0 | PCB Antenna | 2000 MHz – 2500 MHz | 1.1 dBi | BT Antenna |
| Antenna 1 | Internal Antenna | 900 MHz – 1000 MHz | 1.1 dBi | ROLA Antenna |

## 6. Conducted Power

| Mode | Channel | Frequency (MHz) | Maximum Peak Power (dBm) |
|---|---|---|---|
| GFSK (BT LE) | 0 | 2402 | 0.530 |
| | 19 | 2440 | 0.316 |
| | 39 | 2480 | -0.703 |
| LORA | 1 | 903.0 | 15.356 |
| | 13 | 915.0 | 15.796 |
| | 25 | 927.5 | 15.499 |

## 7. Manufacturing Tolerance

| GFSK (BT LE) (Peak) | | | |
|---|---|---|---|
| Channel | Channel 0 | Channel 19 | Channel 35 |
| Target (dBm) | 1.0 | 1.0 | 0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |
| LoRa (Peak) | | | |
| Channel | Channel 1 | Channel 13 | Channel 25 |
| Target (dBm) | 16.0 | 16.0 | 16.0 |
| Tolerance ±(dB) | 1.0 | 1.0 | 1.0 |

## 8. Measurement Results

### 8.1 Standalone MPE Evaluation

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 =20cm, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

[Antenna 0]

| Modulation Type | Output power | | Antenna Gain (dBi) | Antenna Gain (linear) | Duty Cycle | MPE ($mW/cm^2$) | MPE Limits ($mW/cm^2$) |
|---|---|---|---|---|---|---|---|
| | dBm | mW | | | | | |
| GFSK (BT LE) | 2.00 | 1.5849 | 1.10 | 1.2882 | 100% | 0.0004 | 1.0000 |

[Antenna 1]

| Modulation Type | Output power | | Antenna Gain (dBi) | Antenna Gain (linear) | Duty Cycle | MPE ($mW/cm^2$) | MPE Limits ($mW/cm^2$) |
|---|---|---|---|---|---|---|---|
| | dBm | mW | | | | | |
| LORA | 17.00 | 50.1187 | 1.10 | 1.2882 | 100% | 0.0129 | 0.6013 |

*Remark:*
*1. Output power including tune-up tolerance;*
*2. MPE evaluate distance is 20cm from user manual provide by manufacturer;*

### 8.2 Simultaneous Transmission MPE

The sample support one BT and one LoRa modular also share difference antennas, they can transmit at same time, need consider simultaneous transmission;

**[**Antenna 0 + Antenna 1**]**

| $MPE_{Antenna\ 0}$ Ratios | $MPE_{Antenna\ 1}$ Ratios | ∑MPE ratios | Limit | Results |
|---|---|---|---|---|
| 0.0003 | 0.0214 | 0.1 | 1.0 | PASS |

## 9. 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----------