

# 1. MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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## 1.1 General Information

### Client Information

Applicant: Shenzhen HiLetgo E-Commerce Co., Ltd  
Address of applicant: Room 1716, HuaNan FaZhan Building, HuaNanCheng, PingHu, LongGang, ShenZhen, GuangDong, China

Manufacturer: Shenzhen HiLetgo E-Commerce Co., Ltd  
Address of manufacturer: Room 1716, HuaNan FaZhan Building, HuaNanCheng, PingHu, LongGang, ShenZhen, GuangDong, China

### General Description of EUT:

Product Name: ESP32 Development Board  
Trade Name: /  
Model No.: ESP32  
Adding Model(s): /  
Rated Voltage: DC 5V  
FCC ID: 2A54N-ESP32  
Equipment Type: Mobile device

### Technical Characteristics of EUT:

#### Wi-Fi

Support Standards: 802.11b, 802.11g, 802.11n  
Frequency Range: 2412-2462MHz for 802.11b/g/n(HT20)  
2422-2452MHz for 802.11n(HT40)  
RF Output Power: 15.96dBm (Conducted)  
Type of Modulation: CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM  
Quantity of Channels: 11 for 802.11b/g/n(HT20); 7 for 802.11n(HT40)  
Channel Separation: 5MHz  
Type of Antenna: PCB Printed Antenna  
Antenna Gain: 2dBi

#### Bluetooth

Bluetooth Version: V4.2 (BLE mode)  
Frequency Range: 2402-2480MHz  
RF Output Power: 0.23dBm (Conducted)  
Data Rate: 1Mbps  
Modulation: GFSK  
Quantity of Channels: 40  
Channel Separation: 2MHz  
Type of Antenna: PCB Printed Antenna  
Antenna Gain: 2dBi

## 1.2 Standard Applicable

According to § 1.1307(b)(1) and KDB 447498 D01 General RF Exposure Guidance v06, system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

### (a) Limits for Occupational / Controlled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Times   E   <sup>2</sup> ,   H   <sup>2</sup> or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	F/300	6
1500-100000	/	/	5	6

### (b) Limits for General Population / Uncontrolled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Times   E   <sup>2</sup> ,   H   <sup>2</sup> or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-100000	/	/	1	30

Note: f = frequency in MHz: \* = Plane-wave equivalents power density

## 1.3 MPE Calculation Method

$$S = (30*P*G) / (377*R^2)$$

S = power density (in appropriate units, e.g., mw/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mw)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator,

the power gain factor is normally numeric gain.

R = distance to the center of radiation of the antenna (in appropriate units, e.g., cm)

## 1.4 MPE Calculation Result

For Wi-Fi:

Maximum Tune-Up output power: 16.0 (dBm)

Maximum peak output power at antenna input terminal: 39.81 (mW)

Prediction distance: >20(cm)

Prediction frequency: 2412 (MHz)

Antenna gain: 2.0 (dBi)

Directional gain (numeric gain): 1.58

The worst case is power density at prediction frequency at 20cm: 0.0126 (mw/cm<sup>2</sup>)

MPE limit for general population exposure at prediction frequency: 1 (mw/cm<sup>2</sup>)

For Bluetooth:

Maximum Tune-Up output power: 1.0 (dBm)

Maximum peak output power at antenna input terminal: 1.26 (mW)

Prediction distance: >20(cm)

Prediction frequency: 2440 (MHz)

Antenna gain: 2.0 (dBi)

Directional gain (numeric gain): 1.58

The worst case is power density at prediction frequency at 20cm: 0.0004 (mw/cm<sup>2</sup>)

MPE limit for general population exposure at prediction frequency: 1 (mw/cm<sup>2</sup>)

Result: Pass