

1. RF Exposure Requirements

1.1 General Information

Client Information

| | |
|--------------------------|---|
| Applicant: | Lumi United Technology Co., Ltd. |
| Address of applicant: | B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China |
| Manufacturer: | Lumi United Technology Co., Ltd. |
| Address of manufacturer: | B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China |

General Description of EUT:

| | |
|-------------------|--------------|
| Product Name: | Hub M200 |
| Trade Name: | Aqara |
| Model No.: | HM-G03D |
| Adding Model(s): | HM-G03E |
| Rated Voltage: | DC5V |
| | POE:DC48V |
| Battery Capacity: | / |
| Power Adapter: | / |
| FCC ID: | 2AKIT-HMG03 |
| Equipment Type: | Fixed device |

Technical Characteristics of EUT:

Thread

| | |
|-----------------------|---------------------|
| Frequency Range: | 2405-2480MHz |
| RF Output Power: | 9.10dBm (Conducted) |
| Type of Modulation: | QPSK |
| Quantity of Channels: | 16 |
| Channel Separation: | 5MHz |
| Type of Antenna: | Internal Antenna |
| Antenna Gain: | 0dBi |

ZigBee

| | |
|-----------------------|---------------------|
| Support Standards: | IEEE802.15.4 |
| Frequency Range: | 2405-2480MHz |
| RF Output Power: | 9.29dBm (Conducted) |
| Type of Modulation: | QPSK |
| Quantity of Channels: | 16 |
| Channel Separation: | 5MHz |
| Type of Antenna: | Internal Antenna |
| Antenna Gain: | 0dBi |

Bluetooth

Bluetooth Version: V5.1 (LE mode)
Frequency Range: 2402-2480MHz
RF Output Power: 1Mbps: 4.30dBm (Conducted)
2Mbps: 4.34dBm (Conducted)
Data Rate: 1Mbps, 2Mbps
Modulation: GFSK
Quantity of Channels: 40
Channel Separation: 2MHz
Type of Antenna: Internal Antenna
Antenna Gain: 1dBi

Wi-Fi 2.4G

Support Standards: 802.11b, 802.11g, 802.11n, 802.11ax
Frequency Range: 2412-2462MHz for 802.11b/g/n/ax(HT/HE20)
2422-2452MHz for 802.11n/ax(HT/HE40)
RF Output Power: 15.85dBm (Conducted)
Type of Modulation: CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM
Quantity of Channels: 11 for 802.11b/g/n/ax(HT/HE20); 7 for 802.11n/ax(HT/HE40)
Channel Separation: 5MHz
Type of Antenna: Integral Antenna
Antenna Gain: 0dBi

Wi-Fi 5G

Support Standards: 802.11a, 802.11n(HT20), 802.11n-HT40, 802.11ac-VHT20/40,
802.11ax-HE40
Frequency Range: 5180-5240MHz, 5745-5825MHz
Max. RF Output Power: 14.79dBm (Conducted)
Type of Modulation: QPSK, 16QAM, 64QAM
Type of Antenna: Integral Antenna
Antenna Gain: 0.5dBi

1.2 RF Exposure Exemption

According to §1.1307(b)(3) and KDB 447498 D04 Interim General RF Exposure Guidance v01, 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.

Option A: FCC Rule Part 1.1307 (b)(3)(i)(A): The available maximum time-averaged power is no more than 1mW, regardless of separation distance.

Option B: FCC Rule Part 1.1307 (b)(3)(i)(B): The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

Option C: FCC Rule Part 1.1307 (b)(3)(i)(C): The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters.

| Single RF Sources Subject to Routine Environmental Evaluation | |
|---|-----------------------|
| RF Source frequency (MHz) | Threshold ERP (watts) |
| 0.3-1.34 | $1,920 R^2$ |
| 1.34-30 | $3,450 R^2/f^2$ |
| 30-300 | $3.83 R^2$ |
| 300-1,500 | $0.0128 R^{2f}$ |
| 1,500-100,000 | $19.2R^2$ |

For Multiple RF sources: FCC Rule Part 1.1307(b)(3)(ii):

- (A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required).
- (B) In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

1.3 Calculated Result

| Radio Access Technology | Prediction Frequency (MHz) | Output Power (dBm) | Antenna Gain (dBi) | Duty Cycle (%) | Tune-Up Time-Averaged Power (dBm) | ERP (dBm) |
|-------------------------|----------------------------|--------------------|--------------------|----------------|-----------------------------------|-----------|
| Thread | 2405 | 9.10 | 0 | 100 | 10.00 | 7.85 |
| ZigBee | 2405 | 9.29 | 0 | 100 | 10.00 | 7.85 |
| Bluetooth | 2402 | 4.34 | 1 | 100 | 5.00 | 3.85 |
| Wi-Fi 2.4G | 2412 | 15.85 | 0 | 100 | 16.00 | 13.85 |
| Wi-Fi 5G | 5180 | 14.79 | 0.5 | 100 | 15.00 | 13.35 |
| Wi-Fi 5G | 5745 | 14.17 | 0.5 | 100 | 15.00 | 13.35 |

| Frequency (MHz) | Option | Min. Distance (cm) | Max. Power (dBm) (mW) | | Exposure Limit (mW) | Ratio | Result Pass/Fail |
|-----------------|--------|--------------------|-----------------------|-------|---------------------|-------|------------------|
| 2405 | C | 20.00 | 7.85 | 6.10 | 768.00 | 0.01 | Pass |
| 2405 | C | 20.00 | 7.85 | 6.10 | 768.00 | 0.01 | Pass |
| 2402 | C | 20.00 | 3.85 | 2.43 | 768.00 | 0.01 | Pass |
| 2412 | C | 20.00 | 13.85 | 24.27 | 768.00 | 0.03 | Pass |
| 5180 | C | 20.00 | 13.35 | 21.63 | 768.00 | 0.03 | Pass |
| 5745 | C | 20.00 | 13.35 | 21.63 | 768.00 | 0.03 | Pass |

Note: 1. Time-Averaged Power=Output Power * Duty Cycle; ERP= Time-Averaged Power+ Antenna gain-2.15dB

2. Option A, B and C refers as clause 1.2.

3. For option B, Max (time-averaged power, effective radiated power (ERP)) converts to Max. Power. For option C, ERP converts to Max. Power;

4. For option B, P_{th} (mW) converts to Exposure Limit (mW); For option C, ERP (W) converts to Exposure Limit (mW).

5. Ratio= Tune-Up ERP (mW)/ Exposure Limit (mW)

Mode for Simultaneous Multi-band Transmission:

| Radio Access Technology | Ratio 1 | Ratio 2 | Ratio 3 | Simultaneous Ratio | Limit | Result |
|---|---------|---------|---------|--------------------|-------|-----------|
| | | | | | | Pass/Fail |
| ZigBee/Thread Ant + LE Ant + Wi-Fi Ant | 0.01 | 0.01 | 0.03 | 0.05 | 1 | Pass |

Result: Pass