

# 1. RF Exposure Requirements

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## 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
<b>Wi-Fi 2.4G</b>	
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
<b>Wi-Fi 5G</b>	
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  $\lambda$  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	$0.0128 R^2 f$
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
			(dBm)	(mW)			
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:**

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

Result: Pass