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:	Edge Hub M300
Trade Name:	Aqara
Model No.:	HM-G04D
Adding Model(s):	HM-G04E
Rated Voltage:	DC5V POE:DC48V
Battery Capacity:	/
Power Adapter:	/
FCC ID:	2AKIT-HMG04
Equipment Type:	Fixed device

Technical Characteristics of EUT:

Thread

Frequency Range:	2405-2480MHz
RF Output Power:	8.62dBm (Conducted)
Type of Modulation:	QPSK
Quantity of Channels:	16
Channel Separation:	5MHz
Type of Antenna:	PIFA Antenna
Antenna Gain:	0.5dBi

ZigBee

Support Standards:	IEEE802.15.4
Frequency Range:	2405-2480MHz
RF Output Power:	5.72dBm (Conducted)
Type of Modulation:	QPSK
Quantity of Channels:	16
Channel Separation:	5MHz
Type of Antenna:	PIFA Antenna
Antenna Gain:	0dBi

Bluetooth

Bluetooth:	LE mode
Frequency Range:	2402-2480MHz
RF Output Power:	1Mbps: 4.00dBm (Conducted) 2Mbps: 4.07dBm (Conducted)
Data Rate:	1Mbps, 2Mbps
Modulation:	GFSK
Quantity of Channels:	40
Channel Separation:	2MHz
Type of Antenna:	PIFA Antenna
Antenna Gain:	-0.5dBi
Wi-Fi 2.4G	
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:	15.75dBm (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:	PIFA Antenna
Antenna Gain:	0dBi
Wi-Fi 5G	
Support Standards:	802.11a, 802.11n(HT20), 802.11n-HT40, 802.11ac-VHT20/40/80
Frequency Range:	5180-5240MHz, 5745-5825MHz
Max. RF Output Power:	15.69dBm (Conducted)
Type of Modulation:	QPSK, 16QAM, 64QAM, 256QAM
Type of Antenna:	PIFA 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:

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

Where

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

and

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

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 λ/2π, 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	8.62	0.5	100	9.00	7.35
ZigBee	2405	5.72	0	100	6.00	3.85
Bluetooth	2402	4.07	-0.5	100	5.00	2.35
Wi-Fi 2.4G	2412	15.75	0	100	16.00	13.85
Wi-Fi 5G	5180	15.69	0.5	100	16.00	14.35
Wi-Fi 5G	5745	13.88	0.5	100	14.00	12.35

Frequency (MHz)	Option	Min. Distance (cm)	Max. Power (dBm)	Max. Power (mW)	Exposure Limit (mW)	Ratio	Result Pass/Fail
2405	C	20.00	7.35	5.43	768.00	0.01	Pass
2405	C	20.00	3.85	2.43	768.00	0.01	Pass
2402	C	20.00	2.35	1.72	768.00	0.01	Pass
2412	C	20.00	13.85	24.27	768.00	0.03	Pass
5180	C	20.00	14.35	27.23	768.00	0.04	Pass
5745	C	20.00	12.35	17.18	768.00	0.02	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	Ratio 4	Simultaneous Ratio	Limit	Result Pass/Fail
ZigBee Ant + Thread Ant + LE Ant + Wi-Fi Ant	0.01	0.01	0.01	0.04	0.07	1	Pass

Result: Pass