# 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: Chime Repeater

Trade Name: Aqara

Model No.: CH-C11E

Adding Model(s): CH-C11D

Rated Voltage: DC 5V

FCC ID: 2AKIT-CHC11
Equipment Type: Fixed device

**Technical Characteristics of EUT:** 

**Thread** 

Frequency Range: 2405-2480MHz

RF Output Power: 7.98dBm (Conducted)

Type of Modulation: QPSK
Quantity of Channels: 16
Channel Separation: 5MHz

Type of Antenna: FPC Antenna

Antenna Gain: 1dBi

ZigBee

Support Standards: IEEE802.15.4 Frequency Range: 2405-2480MHz

RF Output Power: 7.91dBm (Conducted)

Type of Modulation: QPSK
Quantity of Channels: 16
Channel Separation: 5MHz

Type of Antenna: FPC Antenna

Antenna Gain: 1dBi

**Bluetooth** 

Bluetooth Version: V5.0 (BLE mode)
Frequency Range: 2402-2480MHz

RF Output Power: 9.87dBm (Conducted)

Data Rate: 1Mbps Modulation: **GFSK** Quantity of Channels: 40 **Channel Separation:** 2MHz

Type of Antenna: FPC Antenna

Antenna Gain: 0dBi

**Wi-Fi 2.4G ANT 1** 

Support Standards: 802.11b, 802.11g, 802.11n

2412-2462MHz for 802.11b/g/n(HT20) Frequency Range:

RF Output Power: 15.67dBm (Conducted)

CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM Type of Modulation:

Quantity of Channels: 11 for 802.11b/g/n(HT20)

Channel Separation: 5MHz

Type of Antenna: FPC Antenna

0dBi Antenna Gain:

**Wi-Fi 2.4G ANT 2** 

Support Standards: 802.11b, 802.11g, 802.11n

Frequency Range: 2412-2462MHz for 802.11b/g/n(HT20)

RF Output Power: 20.51dBm (Conducted)

CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM Type of Modulation:

Quantity of Channels: 11 for 802.11b/g/n(HT20)

Channel Separation: 5MHz

Type of Antenna: FPC Antenna

Antenna Gain: 0dBi

Wi-Fi 5G

Support Standards:

802.11a, 802.11n(HT20), 802.11n-HT40, 802.11ac-VHT20,

802.11ac-VHT40,802.11ac-VHT80

Frequency Range: 5180-5240MHz, 5745-5825MHz

Max. RF Output Power: 16.60dBm (Conducted) Type of Modulation: QPSK, 16QAM, 64QAM

Type of Antenna: FPC 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  $\lambda/2\pi$ , 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 <sup>2</sup>				
1.34-30	3,450 R <sup>2</sup> /f <sup>2</sup>				
30-300	3.83 R <sup>2</sup>				
300-1,500	0.0128 R <sup>2</sup> f				
1,500-100,000	19.2R <sup>2</sup>				

#### 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.

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

#### 1.3 Calculated Result

Radio	Prediction	Output	Antenna	Duty	Tune-Up	ERP
Access	Frequency	Power	Gain	Cycle	Time-Averaged Power	ERP
Technology	(MHz)	(dBm)	(dBi)	(%)	(dBm)	(dBm)
Thread	2405	7.98	1.0	100	8.00	6.85
ZigBee	2405	7.91	1.0	100	8.00	6.85
Bluetooth	2402	9.87	0	100	10.00	7.85
Wi-Fi 2.4G	2412	15.67	0	100	16.00	13.85
ANT 1	2412	13.07	U		10.00	
Wi-Fi 2.4G	2412	20.51	0 100	21.00	18.85	
ANT 2	2412	20.31	U	21.00		10.05
Wi-Fi 5G	5180	16.60	0.5	100	17.00	15.35
Wi-Fi 5G	5745	15.89	0.5	100	16.00	14.35

Frequency	Option	Min. Distance	Max. Power		Exposure Limit	Detie	Result
(MHz)		(cm)	(dBm)	(mW)	(mW)	Ratio	Pass/Fail
2405	С	20.00	6.85	4.84	768.00	0.01	Pass
2405	С	20.00	6.85	4.84	768.00	0.01	Pass
2402	С	20.00	7.85	6.10	768.00	0.01	Pass
2412	С	20.00	13.85	24.27	768.00	0.03	Pass
2412	С	20.00	18.85	76.74	768.00	0.10	Pass
5180	С	20.00	15.35	34.28	768.00	0.04	Pass
5745	С	20.00	14.35	27.23	768.00	0.04	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	Ratio 1	Ratio 2	Ratio 3	Simultaneous Ratio	Limit	Result
Technology						Pass/Fail
ZigBee/Thread Ant	0.01	0.04	0.10	0.15	1	Pass
+ BLE/2.4G Wi-Fi						
1/5GWi-Fi Ant +						
Wi-Fi 2 Ant						

Result: Pass