

Test Report

Verified code: 624372

Report No.: E20230331478001-9

Customer: Lumi United Technology Co., Ltd

Address: B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District,
Nanshan District, Shenzhen, China

Sample Name: Hub M3

Sample Model: HM-G01E

Receive Sample Date: Aug.02,2023

Test Date: Aug.08,2023 ~ Dec.18,2023

Reference Document: 47 CFR, FCC Part 2.1091 Radio frequency radiation exposure evaluation: mobile devices

Test Result: Pass

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GRG METROLOGY & TEST GROUP CO., LTD.

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E20230331478001-9	Original Issue	2024-01-05

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1. GENERAL DESCRIPTION OF EUT

1.1 APPLICANT

Name: Lumi United Technology Co., Ltd

Address: B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China

1.2 MANUFACTURER

Name: Lumi United Technology Co., Ltd

Address: B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China

1.3 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: Hub M3

Model No.: HM-G01E

Adding Model: HM-G01D

Models Difference: The model NO. HM-G01E & HM-G01D have the same technical construction including circuit diagram, PCB LAYOUT, hardware version and software version identical, except sales area and packaging are different.

Trade Name: Aqara

FCC ID: 2AKIT-HMG01

Power supply: DC 3V power supplied by battery

Frequency Band: 2412MHz - 2472MHz for IEEE 802.11b/g/n HT20
2422MHz - 2462MHz for IEEE 802.11n HT40
5180MHz-5240MHz & 5745MHz~5825MHz for IEEE 802.11a/n HT20/ac VHT20;
5190MHz-5230MHz & 5755MHz~5795MHz for IEEE 802.11n HT40/ac VHT40;
5210MHz & 5775MHz for IEEE 802.11ac VHT80
2402MHz - 2480MHz for Bluetooth LE with 1M&2M
2405MHz - 2475MHz for Zigbee & Thread
BLE for 1Mbps:5.0dBm,
BLE for 2Mbps:5.0dBm,
Zigbee: 6.77dBm
Thread: 7.22dBm

Transmit Power: 2.4GHz WIFI:
16.98dBm for IEEE 802.11b
17.65dBm for IEEE 802.11g
18.48dBm for IEEE 802.11n HT20
18.79dBm for IEEE 802.11n HT40
U-NII-1:

	13.08dBm for IEEE 802.11a 12.73dBm for IEEE 802.11n HT20 12.91dBm for IEEE 802.11acVHT20 13.14dBm for IEEE 802.11n HT40 12.83dBm for IEEE 802.11acVHT40 12.55dBm for IEEE 802.11ac VHT80 U-NII-3: 13.87dBm for IEEE 802.11a 14.03dBm for IEEE 802.11n HT20 14.31dBm for IEEE 802.11acVHT20 14.35dBm for IEEE 802.11n HT40 14.44dBm for IEEE 802.11acVHT40 12.10dBm for IEEE 802.11ac VHT80
Modulation type:	GFSK for BLE, O-QPSK for Thread & Zigbee, DSSS for IEEE 802.11b mode, OFDM for IEEE 802.11g/n mode, OFDM for IEEE 802.11a/n/ac mode BLE: Antenna 1: -0.5dBi gain (Max) Zigbee: Antenna 2: 0dBi gain (Max) Thread: Antenna 3: 0.5dBi gain (Max) 2.4G WIFI: Antenna 4: 0dBi gain (Max) 5G WIFI: 5150MHz – 5250MHz Antenna 4: 0.5dBi gain (Max) 5G WIFI: 5725MHz – 5850MHz Antenna 4: 0.2dBi gain (Max)
Antenna Specification:	
Temperature Range:	-10 °C ~ 55 °C
Hardware Version:	V2.0.5_1060
Software Version:	T0
Sample No:	E20230331478001-0002
Note 1:	The EUT antenna gain is provided by the applicant. This report is made solely on the basis of such data and/or information. We accept no responsibility for the authenticity and completeness of the above data and information and the validity of the results and/or conclusions.
Note 2:	All the tests were performed on the model HM-G01E.

2. LABORATORY

2.1 LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of GRG METROLOGY & TEST GROUP CO., LTD.

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2.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to GB/T 27025(ISO/IEC 17025:2017)

USA A2LA(Certificate #2861.01)

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada ISED (Company Number: 24897, CAB identifier:CN0069)

USA FCC (Registration Number: 759402, Designation Number:CN1198)

Copies of granted accreditation certificates are available for downloading from our web site,
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3. LIMITS FOR GENERAL POPULATION/UNCONTROLLED EXPOSURE

General

According to the KDB 447498 D04 Interim General RF Exposure Guidance v01, General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table 4.1 to support an exemption from further evaluation from 300 kHz through 100 GHz.

TABLE 4.1—THRESHOLDS FOR SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	$1,920 R^2$
1.34	–	30	35.6 m	–	1.6 m	$3,450 R^2/f^2$
30	–	300	1.6 m	–	159 mm	$3.83 R^2$
300	–	1,500	159 mm	–	31.8 mm	$0.0128 R^2 f$
1,500	–	100,000	31.8 mm	–	0.5 mm	$19.2 R^2$
Subscripts L and H are low and high; λ is wavelength. From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.						

For mobile devices that are not exempt per Table 4.1 at distances from 20 cm to 40 cm and in 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in §1.1310 is necessary if the ERP of the device is greater than $ERP_{20\text{cm}}$ in Formula (4.1).

Formula (4.1):

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

4. CALCULATION METHOD

Predication of MPE limit at a given distance

$EIRP(dBm) = \text{Maximum Tune-up Output power (dBm)} + \text{Maximum antenna gain(dBi)}$

$ERP(dBm) = EIRP(dBm) - 2.15$

R=minimum distance to the center of radiation of the antenna

From the EUT RF output power, the minimum mobile separation distance, $d=20\text{cm}$, as well as the maximum gain of the used as following information, the RF power ERP can be obtained.

Table 1 Antenna Specification

Mode	Antenna type	Internal Identification	Maximum antenna gain
BLE 1M	PIFA antenna	Antenna 1	-0.5dBi
BLE 2M	PIFA antenna	Antenna 1	-0.5dBi
Zigbee	PIFA antenna	Antenna 2	0.0dBi
Thread	PIFA antenna	Antenna 3	0.5dBi
2.4GHz WiFi	PIFA antenna	Antenna 4	0.0dBi
5GHz WiFi U-NII-1	PIFA antenna	Antenna 4	0.5dBi
5GHz WiFi U-NII-3	PIFA antenna	Antenna 4	0.2dBi

Table 2 Transmit Power

Mode		Maximum Output Power (dBm)	Maximum Tune-up Output power (dBm)
BLE 1M		5.50	5.00 ± 1.00
BLE 2M		5.50	5.00 ± 1.00
Zigbee		6.77	6.00 ± 1.00
Thread		6.72	6.00 ± 1.00
2.4GHz WiFi	802.11b	16.98	16.00 ± 1.00
	802.11g	17.65	17.00 ± 1.00
	802.11n HT20	18.48	18.00 ± 1.00
	802.11n HT40	18.79	18.00 ± 1.00
5GHz WiFi U-NII-1	802.11a	12.58	12.00 ± 1.00
	802.11n HT20	12.23	12.00 ± 1.00
	802.11ac VHT20	12.41	12.00 ± 1.00
	802.11n HT40	12.64	12.00 ± 1.00
	802.11ac VHT40	12.33	12.00 ± 1.00
	802.11ac VHT80	12.05	12.00 ± 1.00
5GHz WiFi U-NII-3	802.11a	13.87	13.00 ± 1.00
	802.11n HT20	14.03	14.00 ± 1.00
	802.11ac VHT20	14.31	14.00 ± 1.00
	802.11n HT40	14.35	14.00 ± 1.00
	802.11ac VHT40	14.44	14.00 ± 1.00
	802.11ac VHT80	12.10	12.00 ± 1.00

5. ESTIMATION RESULT

5.1 MEASUREMENT RESULTS

STANDALONE MPE

Mode	Frequency (MHz)	Maximum Tune-up Output power (dBm)	Antenna Gain (dBi)	Maximum Tune-up EIRP (dBm)	ERP (dBm)	Maximum Tune-up ERP (W)	Threshold ERP(W)
BLE 1M	2402- 2480	6.00	-0.5dBi	5.50	3.35	0.00216	0.768
BLE 2M	2402- 2480	6.00	-0.5dBi	5.50	3.35	0.00216	0.768
Zigbee	2405-0475	7.00	0.0dBi	7.00	4.85	0.00305	0.768
Thread	2405-0475	7.00	0.5dBi	7.50	5.35	0.00343	0.768
2.4GHz WiFi	2412-2462	19.00	0.0dBi	19.00	16.85	0.04842	0.768
5GHz WiFi U-NII-1	5150-5250	13.00	0.5dBi	13.50	11.35	0.01365	0.768
5GHz WiFi U-NII-3	5725-5850	15.00	0.2dBi	15.20	13.05	0.02018	0.768

Remark:

1. RF Exposure use distance is 20cm from manufacturer declaration of user manual.
2. Threshold $ERP(W) = 19.2R^2(W) = 19.2 \times 0.2 \times 0.2(W) = 0.768(W)$.
3. The BLE and Thread do not support simultaneous transmission
4. $ERP(dBm) = EIRP(dBm) - 2.15$

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FOR SIMULTANEOUS TRANSMISSION:

Maximum MPE ratio BLE	Maximum MPE ratio Zigbee	Maximum MPE ratio Thread	Maximum MPE ratio 2.4GHz- WiFi	Σ MPE ratios ^{a)}	Limit	Results
0.00281	0.00397	0.00447	0.06305	0.07430	1.00000	Pass

Maximum MPE ratio BLE	Maximum MPE ratio Zigbee	Maximum MPE ratio Thread	Maximum MPE ratio 5GHz-WiFi	Σ MPE ratios ^{b)}	Limit	Results
0.00281	0.00397	0.00447	0.02628	0.03753	1.00000	Pass

Remark:

- The 2.4GHz-WiFi and 5GHz-WiFi can't simultaneously transmit.
- According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations: Σ of MPE ratios ≤ 1.0
- Maximum MPE Ratio (BLE) = Max tune-up ERP / Limit(EIRP Exemption) = $0.00216\text{W}/0.768\text{W} = 0.00281$
Maximum MPE Ratio (Zigbee) = Max tune-up ERP / Limit(EIRP Exemption) = $0.00305\text{W}/0.768\text{W} = 0.00397$
Maximum MPE Ratio (Thread) = Max tune-up ERP / Limit(EIRP Exemption) = $0.00343\text{W}/0.768\text{W} = 0.00447$
Maximum MPE Ratio (2.4GHz-WiFi) = Max tune-up ERP / Limit(EIRP Exemption) = $0.04842\text{W}/0.768\text{W} = 0.06305$
Maximum MPE Ratio (5GHz-WiFi) = Max tune-up ERP / Limit(EIRP Exemption) = $0.02018\text{W}/0.768\text{W} = 0.02628$
a) Σ MPE ratios = Maximum MPE Ratio (BLE) + Maximum MPE Ratio (Zigbee) + Maximum MPE Ratio (Thread) + Maximum MPE Ratio (2.4GHz-WiFi) = $0.00281 + 0.00397 + 0.00447 + 0.06305 = 0.07430$
b) Σ MPE ratios = Maximum MPE Ratio (BLE) + Maximum MPE Ratio (Zigbee) + Maximum MPE Ratio (Thread) + Maximum MPE Ratio (5GHz-WiFi) = $0.00281 + 0.00397 + 0.00447 + 0.02628 = 0.03753$

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6. CONCLUSION

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

----- End of Report -----