

Test Report

Verified code: 639843

Report No.: E20221227602901-5

Customer: Lumi United Technology Co., Ltd

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

Sample Name: Camera Hub G3

Sample Model: CH-H03

Receive Sample Date: Jan.05,2023

Test Date: Jan.10,2023 ~ Feb.06,2023

Reference Document: CFR 47, FCC Part 2.1091 Radiofrequency radiation exposure evaluation:
mobile devices.

Test Result: Pass

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GRG METROLOGY & TEST GROUP CO., LTD

Issued Date: 2023-04-14

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E20221227602901-5	Original Issue	2023-03-13

The applicant declared that the model CH-H03 comparison before and after the change as below: The 802.11n HT40 mode of the 2.4G Wi-Fi module has been deleted for this model, as well as other modification information in the following table. There are corresponding changes to the circuit schematic and PCB layout, but this will not affect the RF performance test results. For details, see the following table:

The Original model		The New model	
Change 1. Parameter before change	Bit number C160 is vacant	Parameter after Change	Add C160 capacitor, capacity : 12pF
Change 2. Add components	1.R97 location as shown below 2.R17, C158, and C159 are empty as shown below 3.R34 is another name on the motherboard, under the camera	Parameter after Change	1.Move bit number R97 position 2.Move bit number R34 position 3.Add resistor R17=120R, capacitor C158=27pF, C159=27pF
Change 3. Change component parameters (Change pcba: usb small version)	bit number: L1 (resistor) Parameter: 0R (usb small version)	Parameter after Change	bit number: L1 (magnetic bead) Parameter: magnetic bead value: 100MHz@120ohm magnetic beads (usb small version)
Change 4. Parameter before change (U1 added one replacement suppliers)	bit number: U1 parameter: 2.8V~30V\1MHz\2A\0.6mA\SOT23-6 SILERGY SY7200AABC	Parameter after Change	bit number: U1 A:parameter: 2.8V~30V\1MHz\2A\0.6mA\SOT23-6 SILERGY SY7200AABC B: parameter: 2.7~6V\60mA\0.8MHz\1A\SOT23-6 ETA ETA1617S2G

Change 5. Parameter before change	Bit number U6 is FORESEE/FS35ND02G-S3Y2QWFI000	Parameter after Change	Bit number U6 is 1.ESMT/F50L2G41XA -104YG2B or 2.Winbond/W25N02KVZEIR
Change 6. Add components	Bit number U19 is HDSC/HC32F005C6UA	Parameter after Change	Bit number U19 is Cmsemicon/CMS32L031QN20
Change 7. Change component parameters (Change pcba: usb small version)	1.Bit number U18 is SmartSens/SC3335 2.Bit number U12 is 1.2V LDO	Parameter after Change	1.Bit number U18 is SmartSens/SC3338 2.Bit number U12 is vacant
Change 8. Software Version	3.2.8_0003.0004	Parameter after Change	V3.5.2_0010.0004

Note: According to the difference declared letter by applicant, maximum output power test data please refer to the report E20210426746801-13 which issue on 2021-09-04.

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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: Camera Hub G3
Model No.: CH-H03
Adding Model: /
Trade Name: Aqara
FCC ID: 2AKIT-CHH03
Power Supply: DC5V power supplied by adapter
Adapter Specification: Model: A8A-050200U-US1
Input: 100-240V~ 50/60Hz 0.35A
Output: 5.0V 2.0A
Frequency Range: Zigbee: 2405~2475MHz
2.4G Wi-Fi: 2412~2462MHz
5G Wi-Fi: 5180 MHz~5825 MHz
Transmit Power: Zigbee: 7.58dBm
2.4G Wi-Fi:
19.32dBm for 802.11b mode
21.93dBm for 802.11g mode
22.13dBm for 802.11n HT20 mode
5G Wi-Fi:
U-NII-1:
10.12dBm for IEEE 802.11a
9.96dBm for IEEE 802.11n HT20
8.31dBm for IEEE 802.11ac VHT20
10.03dBm for IEEE 802.11n HT40
7.85dBm for IEEE 802.11ac VHT40
8.49dBm for IEEE 802.11ac VHT80
U-NII-2A:
10.39dBm for IEEE 802.11a
10.16dBm for IEEE 802.11n HT20
8.51dBm for IEEE 802.11ac VHT20
10.53dBm for IEEE 802.11n HT40
8.46dBm for IEEE 802.11ac VHT40
9.05dBm for IEEE 802.11ac VHT80
U-NII-2C:
8.91dBm for IEEE 802.11a
8.27dBm for IEEE 802.11n HT20

	6.82dBm for IEEE 802.11ac VHT20
	8.77dBm for IEEE 802.11n HT40
	6.67dBm for IEEE 802.11ac VHT40
	7.00dBm for IEEE 802.11ac VHT80
	U-NII-3:
	8.34dBm for IEEE 802.11a
	7.90dBm for IEEE 802.11n HT20
	6.64dBm for IEEE 802.11acVHT20
	8.07dBm for IEEE 802.11n HT40
	6.01dBm for IEEE 802.11ac VHT40
	6.65dBm for IEEE 802.11ac VHT80
Modulation type:	Zigbee: OQPSK
	2.4G Wi-Fi: DSSS, OFDM
	5G Wi-Fi: OFDM
Antenna	Zigbee: Internal antenna 2dBi gain (Max.)
Specification:	2.4G Wi-Fi: Internal antenna 3dBi gain (Max.)
	5G Wi-Fi:Internal antenna 2dBi gain (Max.)
Temperature Range:	-10℃~40℃
Hardware	
Version:	A20-GHC01-MIAN-X4
Software	
Version:	V3.5.2_0010.0004
Sample No:	E20210426746801-0005
I/O Port:	/
Note:	/

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2. 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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3. ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

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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4. LIMITS FOR GENERAL POPULATION/UNCONTROLLED EXPOSURE

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	19.2R 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).

$$P_{\text{th}} \text{ (mW)} = ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases} \quad (4.1)$$

In accordance with KDB447498D04 Either SAR-based or MPE-based exemption may be considered for test exemption for fixed, mobile, or portable device exposure conditions; therefore, the contributions from each exemption in conjunction with the measured SAR (Evaluated_k term) shall be used to determine exemption for simultaneous transmission according to Formula

$$\text{MPE Ratio} = \sum_{j=1}^b \frac{ERP_j}{ERP_{\text{th},j}} < 1$$

ERP_j: the available maximum time-averaged power or the ERP, whichever is greater, of fixed, mobile, or portable RF source j.

ERP_{th,j}: exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least $\lambda/2\pi$, according to the applicable § 1.1307(b)(3)(i)(C) Table 1 formula at the location in question.

the sum of the ratios of the applicable terms for SAR-based, MPE-based and measured SAR or MPE shall be less than 1, to determine simultaneous transmission exposure compliance

5. CALCULATION METHOD

Predication of MPE limit at a given distance

$$S = PG / 4\pi R^2$$

Where: S=power density

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to anisotropic radiator

R=distance to the center of radiation of the antenna

From the EUT RF output power, the minimum mobile separation distance, $d=0.2\text{m}$, as well as the maximum gain of the used as following information, the RF power density can be obtained.

Table 1 Antenna Specification

Frequency Band	Antenna type	Maximum antenna gain
5G Wi-Fi	Internal antenna	2dBi
2.4G Wi-Fi	Internal antenna	3dBi
Zigbee	Internal antenna	2dBi

Table 2 Transmit Power

Mode	Channel	Frequency(MHz)	Peak Conducted Output Power (dBm)
Zigbee	Lowest	2405	7.58
	Middle	2440	7.56
	Highest	2475	7.45

2.4G Wi-Fi	Mode	Frequency(MHz)	Peak Conducted Output Power (dBm)
	IEEE 802.11b	2412	19.32
		2437	19.21
		2462	18.97
	IEEE 802.11g	2412	21.53
		2437	21.93
		2462	21.72
	IEEE 802.11n HT20	2412	22.13
		2437	21.53
		2462	21.60

5G Wi-Fi

Test Mode	Band	Frequency (MHz)	AVG Conducted Output Power (dBm)
802.11a	U-NII-1	5180	9.11
		5200	9.53
		5240	10.12
	U-NII-2A	5260	10.38
		5300	10.39
		5320	10.07
	U-NII-2C	5500	7.92
		5580	8.72
		5700	8.91
	U-NII-3	5745	7.94
		5785	8.27
		5825	8.34
802.11n HT20	U-NII-1	5180	8.91
		5200	9.54
		5240	9.96
	U-NII-2A	5260	9.84
		5300	10.16
		5320	9.87
	U-NII-2C	5500	7.67
		5580	8.27
		5700	8.06
	U-NII-3	5745	7.37
		5785	7.90
		5825	7.87
IEEE 802.11ac VHT20	U-NII-1	5180	7.22
		5200	7.67
		5240	8.31
	U-NII-2A	5260	8.51
		5300	8.19
		5320	8.23
	U-NII-2C	5500	5.91
		5580	6.82
		5700	6.49
	U-NII-3	5745	5.82
		5785	5.98
		5825	6.64
802.11n HT40	U-NII-1	5190	9.15
		5230	10.03
	U-NII-2A	5270	10.52

	U-NII-2C	5310	10.53
		5510	8.43
		5550	8.13
		5670	8.77
	U-NII-3	5755	7.83
		5795	8.07

802.11ac VHT40	U-NII-1	5190	7.47
		5230	7.85
	U-NII-2A	5270	8.36
		5310	8.46
	U-NII-2C	5510	5.84
		5550	6.32
		5670	6.67
	U-NII-3	5755	5.95
		5795	6.01
802.11ac VHT80	U-NII-1	5210	8.49
	U-NII-2A	5290	9.05
	U-NII-2C	5530	7.00
		5610	6.68
	U-NII-3	5775	6.65

Note:

1. The maximum output Power of ZigBee is refer to the report. (Report No.: E20210426746801-10 which issue on 2021-09-04).
2. The maximum output Power of 2.4G wifi is refer to the report. (Report No.: E20210426746801-9 which issue on 2021-09-04).
3. The maximum output Power of 5G wifi are refer to the report. (Report No.: E20210426746801-11 which issue on 2021-09-04).

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6. MANUFACTURING TOLERANCE

Frequency (MHz)	Zigbee
	2405
Target (dBm)	7.0
Tolerance $\pm$ (dB)	1.0

Frequency (MHz)	2.4G Wi-Fi			
	IEEE 802.11b	IEEE 802.11g	IEEE 802.11n HT20	IEEE 802.11n HT40
	2412	2437	2412	/
Target (dBm)	19.0	21.0	22.00	/
Tolerance $\pm$ (dB)	1.0	1.0	1.0	/

Frequency (MHz)	5G Wi-Fi			
	802.11a	802.11n HT20	802.11ac VHT20	802.11n HT40
	5300	5300	5260	5310
Target (dBm)	10.0	10.0	8.0	10.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0

Frequency (MHz)	5G Wi-Fi	
	802.11ac VHT40	802.11ac VHT80
	5310	5290
Target (dBm)	8.0	9.0
Tolerance $\pm$ (dB)	1.0	1.0

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7. ESTIMATION RESULT

7.1 MEASUREMENT RESULTS

STANDALONE MPE

ZigBee:

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)				
ZigBee	8.00	6.3096	2	1.5849	0.0020	1.0000

2.4G Wi-Fi

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)				
IEEE 802.11 b	20.00	100.0000	3	1.9953	0.0397	1.0000
IEEE 802.11 g	22.00	158.4893	3	1.9953	0.0629	1.0000
IEEE 802.11 n HT20	23.00	199.5262	3	1.9953	0.0792	1.0000

5G Wi-Fi

Mode	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	(dBm)	(mW)				
IEEE 802.11 a	11.0	12.5893	2	1.5849	0.0040	1.0000
IEEE 802.11 n HT20	11.0	12.5893	2	1.5849	0.0040	1.0000
IEEE 802.11 n HT40	11.0	12.5893	2	1.5849	0.0040	1.0000
IEEE 802.11acVHT20	9.0	7.9433	2	1.5849	0.0025	1.0000
IEEE 802.11acVHT40	9.0	7.9433	2	1.5849	0.0025	1.0000
IEEE 802.11 acVHT80	10.0	10.0000	2	1.5849	0.0032	1.0000

Remark:

1. Maximum average power including tune-up tolerance;
2. MPE use distance is 20cm from manufacturer declaration of user manual.

Maximum Simultaneous transmission MPE Ratio for WLAN and Zigbee

Maximum MPE ratio 2.4G wifi	Maximum MPE ratio Zigbee	Σ MPEratios	Limit	Results
0.0792	0.0020	0.0812	1.000	Pass

Maximum MPE ratio 5G wifi	Maximum MPE ratio Zigbee	Σ MPEratios	Limit	Results
0.0040	0.0020	0.0060	1.000	Pass

Remark:

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations; $\sum$ of MPE ratios ≤ 1.0

8. 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** -----