Certificate # 2861.01

# 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 2.1091Radiofrequency radiation exposure evaluation: mobile devices. |
| Test Result: | Pass |

Prepared by: Reviewed by: Approved by: Zhao Zehan

GRG METROLOGY & TEST GROUP CO., LTD

Issued Date: 2023-04-14

GRG METROLOGY & TEST GROUP CO., LTD.
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5. Without the agreement of the laboratory, the client is not authorized to use the test results for unapproved propaganda.

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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.<br>Parameter before change | Bit number C160 is vacant | Parameter after Change | Add C160 capacitor,<br>capacity : 12pF |
| Change 2.<br>Add components | 1.R97 location as shown below<br>2.R17, C158, and C159 are empty as shown below<br>3.R34 is another name on the motherboard, under the camera | Parameter after Change | 1.Move bit number R97 position<br>2.Move bit number R34 position<br>3.Add resistor R17=120R, capacitor C158=27pF, C159=27pF |
| Change 3.<br>Change component parameters<br>（Change pcba: usb small version） | bit number: L1 （ resistor）<br>Parameter: 0R（usb small version ） | Parameter after Change | bit number: L1 （magnetic bead）<br>Parameter:<br>magnetic bead value: 100MHz@120ohm<br>magnetic beads（usb small version ） |
| Change 4.<br>Parameter before change<br>（U1 added one replacement suppliers） | bit number: U1<br>parameter:<br>2.8V~30V\1MHz\2A\0.6mA\SOT23-6<br>SILERGY SY7200AABC | Parameter after Change | bit number: U1<br>A:parameter:<br>2.8V~30V\1MHz\2A\0.6mA\SOT23-6<br>SILERGY SY7200AABC<br>B: parameter:<br>2.7~6V\60mA\0.8MHz\1A\SOT23-6<br>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 DESCRIPTIONOF EQUIPMENTUNDER 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<br>Model:A8A-050200U-US1 |
| Adapter Specification: | Input:100-240V~ 50/60Hz 0.35A<br>Output:5.0V ⎓ 2.0A |
| Frequency Range: | Zigbee: 2405~2475MHz<br>2.4G Wi-Fi: 2412~2462MHz<br>5G Wi-Fi:5180 MHz~5825 MHz |
| Transmit Power: | Zigbee: 7.58dBm<br>2.4G Wi-Fi:<br>19.32dBm for 802.11b mode<br>21.93dBm for 802.11g mode<br>22.13dBm for 802.11n HT20 mode<br>5G Wi-Fi:<br>U-NII-1:<br>10.12dBm for IEEE 802.11a<br>9.96dBm for IEEE 802.11n HT20<br>8.31dBm for IEEE 802.11acVHT20<br>10.03dBm for IEEE 802.11n HT40<br>7.85dBm for IEEE 802.11acVHT40<br>8.49dBm for IEEE 802.11ac VHT80<br>U-NII-2A:<br>10.39dBm for IEEE 802.11a<br>10.16dBm for IEEE 802.11n HT20<br>8.51dBm for IEEE 802.11ac VHT20<br>10.53dBm for IEEE 802.11n HT40<br>8.46dBm for IEEE 802.11acVHT40<br>9.05dBm for IEEE 802.11ac VHT80<br>U-NII-2C:<br>8.91dBm for IEEE 802.11a<br>8.27dBm for IEEE 802.11n HT20 |

| | |
|---|---|
| | 6.82dBm for IEEE 802.11ac VHT20<br>8.77dBm for IEEE 802.11n HT40<br>6.67dBm for IEEE 802.11ac VHT40<br>7.00dBm for IEEE 802.11ac VHT80<br>U-NII-3:<br>8.34dBm for IEEE 802.11a<br>7.90dBm for IEEE 802.11n HT20<br>6.64dBm for IEEE 802.11acVHT20<br>8.07dBm for IEEE 802.11n HT40<br>6.01dBm for IEEE 802.11ac VHT40<br>6.65dBm for IEEE 802.11ac VHT80 |
| Modulation type: | Zigbee: OQPSK<br>2.4G Wi-Fi: DSSS, OFDM<br>5G Wi-Fi: OFDM |
| Antenna Specification: | Zigbee: Internal antenna 2dBi gain (Max.)<br>2.4G Wi-Fi: Internal antenna 3dBi gain (Max.)<br>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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| P.C.: | 518110 |
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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) |

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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 $R^2f$ |
| 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 $ERP_{20cm}$ in Formula (4.1).

$$P_{th}\ (\text{mW}) = ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases} \quad (4,1)$$

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

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

$ERP_j$: 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 λ/2π, 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=0.2m, 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 |

| | **Mode** | **Frequency(MHz)** | **Peak Conducted Output Power (dBm)** |
|---|---|---|---|
| 2.4G Wi-Fi | 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 |

| | | | |
|---|---|---|---|
| | | 5310 | 10.53 |
| | U-NII-2C | 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 ±(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 ±(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 ±(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 ±(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 | ∑ MPEratios | Limit | Results |
|---|---|---|---|---|
| 0.0792 | 0.0020 | 0.0812 | 1.000 | Pass |

| Maximum MPE ratio 5G wifi | Maximum MPE ratio Zigbee | ∑ 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; ∑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 ----------**