

TEST REPORT

Applicant: GL Technologies (Hong Kong) Limited
Address: FLAT/RM 203 2/F BUILDING 19W 19 SCIENCE PARK WEST AVENUE SHATIN NT Hong Kong
Equipment Type: Thread Border Router
Model Name: GL-S200
Brand Name: GL.iNET
FCC ID: 2AFIW-S200
Test Standard: 47 CFR Part 2.1091
KDB 447498 D04 v01
Test Date: Sep. 22, 2022 - Oct. 14, 2022
Date of Issue: Nov. 30, 2022

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Yu Yingyuan

Checked by: Xu Rui

Approved by: Wei Yanquan
(Chief Engineer)



| Revision History | | |
|-------------------------|----------------------|----------------------|
| Version | Issue Date | Revisions Content |
| <u>Rev. 01</u> | <u>Nov. 30, 2022</u> | <u>Initial Issue</u> |

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1 GENERAL INFORMATION

1.1 Test Laboratory

| | |
|--------------|--|
| Name | Shenzhen BALUN Technology Co., Ltd. |
| Address | Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| Phone Number | +86 755 6685 0100 |

1.2 Test Location

| | |
|---------------------------|---|
| Name | Shenzhen BALUN Technology Co., Ltd. |
| Location | <input checked="" type="checkbox"/> Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| | <input type="checkbox"/> 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| Accreditation Certificate | The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. |

2 PRODUCT INFORMATION

2.1 Applicant Information

| | |
|-----------|--|
| Applicant | GL Technologies (Hong Kong) Limited |
| Address | FLAT/RM 203 2/F BUILDING 19W 19 SCIENCE PARK WEST AVENUE SHATIN NT Hong Kong |

2.2 Manufacturer Information

| | |
|--------------|--|
| Manufacturer | Shenzhen Guanglian Zhitong Technology Co., LTD |
| Address | Room 305, 306, Chuangwei Digital Building, Songbai Road, Shiyan Street, Baoan District, Shenzhen |

2.3 Factory Information

| | |
|---------|--|
| Factory | Shenzhen Guanglian Zhitong Technology Co., LTD |
| Address | Room 305, 306, Chuangwei Digital Building, Songbai Road, Shiyan Street, Baoan District, Shenzhen |

2.4 General Description for Equipment under Test (EUT)

| | |
|---|----------------------|
| EUT Name | Thread Border Router |
| Model Name Under Test | GL-S200 |
| Series Model Name | N/A |
| Description of Model name differentiation | N/A |
| Hardware Version | V1.3 |
| Software Version | N/A |
| Dimensions (Approx.) | N/A |
| Weight (Approx.) | N/A |

2.5 Ancillary Equipment

Note: Not applicable.

2.6 Technical Information

| | |
|-----------------------------------|---|
| Network and Wireless connectivity | Bluetooth (BLE) Thread 2.4G WIFI 802.11b, 802.11g, 802.11n(HT20/40) |
|-----------------------------------|---|

The requirement for the following technical information of the EUT was tested in this report:

| | | |
|-------------------|--|-------------------|
| Operating Mode | Bluetooth; Thread; WLAN | |
| Frequency Range | Bluetooth | 2400 ~ 2483.5 MHz |
| | Thread | 2400 ~ 2483.5 MHz |
| | 802.11b/g/n(HT20/40) | 2412 ~ 2462 MHz |
| Antenna Type | Bluetooth | PCB Antenna |
| | Thread | PCB Antenna |
| | WLAN | PCB Antenna |
| Exposure Category | General Population/Uncontrolled Exposure | |
| EUT Stage | Mobile Device | |

3 SUMMARY OF TEST RESULT

3.1 Test Standards

| No. | Identity | Document Title |
|-----|--------------------|--|
| 1 | 47 CFR Part 2.1091 | Radiofrequency radiation exposure evaluation: mobile devices |
| 2 | KDB 447498 D04 v01 | 447498 D04 Interim General RF Exposure Guidance v01 |

4 DEVICE CATEGORY AND LEVELS LIMITS

Mobile Device:

CFR Title 47 §2.1091(b)

(b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

FCC KDB 447498 D04 General RF Exposure Guidance v01 Limit

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 (B.1) [repeated from § 2.1091(c)(1) and § 1.1307(b)(1)(i)(B)].

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

If the ERP is not easily obtained, then the available maximum time-averaged power may be used (i. e., without consideration of ERP only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole.

SAR-based exemptions are constant at separation distances between 20 cm and 40 cm to avoid discontinuities in the threshold when transitioning between SAR-based and MPE-based exemption criteria at 40 cm, considering the importance of reflections.

The SAR-based exemption formula of § 1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (mW).

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by Formula (B.2).

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases} \quad \text{(B.2)}$$

where

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

and f is in GHz, d is the separation distance (cm), and $ERP_{20\text{cm}}$ is per Formula (B.1). The example values shown in Table B.2 are for illustration only.

Table B.2—Example Power Thresholds (mW)

| Frequency (MHz) | Distance (mm) | | | | | | | | | |
|-----------------|---------------|----|----|-----|-----|-----|-----|-----|-----|-----|
| | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| 300 | 39 | 65 | 88 | 110 | 129 | 148 | 166 | 184 | 201 | 217 |
| 450 | 22 | 44 | 67 | 89 | 112 | 135 | 158 | 180 | 203 | 226 |
| 835 | 9 | 25 | 44 | 66 | 90 | 116 | 145 | 175 | 207 | 240 |
| 1900 | 3 | 12 | 26 | 44 | 66 | 92 | 122 | 157 | 195 | 236 |
| 2450 | 3 | 10 | 22 | 38 | 59 | 83 | 111 | 143 | 179 | 219 |
| 3600 | 2 | 8 | 18 | 32 | 49 | 71 | 96 | 125 | 158 | 195 |
| 5800 | 1 | 6 | 14 | 25 | 40 | 58 | 80 | 106 | 136 | 169 |

5 ASSESSMENT RESULT

5.1 Output Power

| Bluetooth | | | |
|-----------------------|-------------|----------------|--------------|
| Mode | Low Channel | Middle Channel | High Channel |
| Conducted Power (dBm) | 4.48 | 4.35 | 3.96 |
| Antenna Gain (dBi) | 3.65 | | |
| EIRP (dBm) | 8.13 | 8.00 | 7.61 |

Note: This report listed the maximal case power value, please refer to Report No. BL-SZ2290727-601 for more details.

| Thread | | | |
|-----------------------|-------------|----------------|--------------|
| Mode | Low Channel | Middle Channel | High Channel |
| Conducted Power (dBm) | 5.64 | 5.52 | 3.93 |
| Antenna Gain (dBi) | 3.79 | | |
| EIRP (dBm) | 9.43 | 9.31 | 7.72 |

Note: This report listed the maximal case power value, please refer to Report No. BL-SZ2290727-602 for more details.

| WLAN 2.4G | | | |
|-----------------------|--------------|----------------|--------------|
| Mode | Low Channel | Middle Channel | High Channel |
| Conducted Power (dBm) | 23.10 | 21.85 | 22.95 |
| Antenna Gain (dBi) | 3.79 | | |
| EIRP (dBm) | 26.89 | 25.64 | 26.74 |

Note: This report listed the maximal case power value, please refer to Report No. BL-SZ2290727-603 for more details.

5.2 Tune-up power

| Mode | Conducted Power Range (dBm) | EIRP Range (dBm) | ERP Range (dBm) |
|-----------|-----------------------------|------------------|-----------------|
| Bluetooth | [3.00, 5.00] | [6.65, 8.65] | [4.50, 6.50] |
| Thread | [4.00, 6.00] | [7.79, 9.79] | [5.64, 7.64] |
| WLAN 2.4G | [22.00, 24.00] | [25.79, 27.79] | [23.64, 25.64] |

Note1: ERP= EIRP -2.15dB.
Note2: According KDB 447498 D04, used the greater of maximum conducted power and ERP to compare with the threshold value Pth.

5.3 RF Exposure Evaluation Result

| Evolution mode | Maximum power (dBm) | Maximum power (mw) | Distance (cm) | Threshold Power (mW) | Power / Limit | Verdict |
|----------------|---------------------|--------------------|---------------|----------------------|---------------|---------|
| Bluetooth | 6.50 | 4.47 | 20 | 3060.00 | 0.001 | Pass |
| Thread | 7.64 | 5.81 | 20 | 3060.00 | 0.002 | Pass |
| WLAN 2.4G | 25.64 | 366.44 | 20 | 3060.00 | 0.120 | Pass |

5.4 Collocated Power Calculation

| Evolution mode | Frequency(MHz) | Power /Limit | $\Sigma(\text{Power} / \text{Limit})$ of Bluetooth + Thread + WLAN 2.4G | Verdict |
|----------------|----------------|--------------|---|---------|
| Bluetooth | 2480 | 0.001 | 0.123 | Pass |
| Thread | 2480 | 0.002 | | |
| WLAN 2.4G | 2462 | 0.120 | | |

Note:

- $\Sigma(\text{Power} / \text{Limit})$: This is a summation of [(power for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding Power limit)], for Bluetooth + Thread + WLAN 2.4G.
- Both of the Bluetooth/Thread/WLAN 2.4G can transmit simultaneously, the formula of calculated the Power is

$$CP1 / LP1 + CP2 / LP2 + \dots \text{etc.} < 1$$

CP = Calculation power
LP = Limit of power
- The worst-case situation is 0.123, which is less than "1". This confirmed that the device comply with FCC KDB 447498 D04 Power limit.
- The DUT work frequency range used is 2400 MHz ~ 2483.5 MHz, 2412 MHz ~ 2462 MHz the result close to the limit by the above formula, so we select worst case power to calculate the exclusion power threshold.

5.5 Conclusion

This EUT is deemed to comply with the reference level limits, therefore the basic restrictions are compliant with human exposure limits.

Statement

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--END OF REPORT--