

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.



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Revision History

<u>Version</u>	<u>Issue Date</u>	<u>Revisions Content</u>
<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	☒ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	☐ 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)
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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 maximun 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	$\Sigma(\text{Power / Limit})$ 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:

1. $\Sigma(\text{Power / Limit})$: This is a summation of [(power for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding Power limit)], for Bluetooth + Thread + WLAN 2.4G.
2. 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
3. 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.
4. 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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