

TEST REPORT

Applicant: Libre Wireless Technologies, Inc.
Address: 17835 Newhope Street, Ste A, Fountain Valley, CA
92708, US
Equipment Type: High Performance Wireless Media Module
Model Name: LS11 (refer to section 2.3)
Brand Name: LIBRE
FCC ID: 2ADBM-LS11
Test Standard: 47 CFR Part 2.1091
KDB 447498 D04 v01
Sample Arrival Date: Aug. 22, 2023
Test Date: Sep. 08, 2023 - Sep. 20, 2023
Date of Issue: Oct. 09, 2023

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

**Tested by:** Xiong Lining**Checked by:** Xu Rui**Approved by:** Tolan Tu
(Testing Director)

Revision History

<u>Version</u>	<u>Issue Date</u>	<u>Revisions Content</u>
<u>Rev. 01</u>	<u>Oct. 09, 2023</u>	<u>Initial Issue</u>

TABLE OF CONTENTS

1	GENERAL INFORMATION	3
1.1	Test Laboratory	3
1.2	Test Location.....	3
2	PRODUCT INFORMATION.....	4
2.1	Applicant Information.....	4
2.2	Manufacturer Information	4
2.3	General Description for Equipment under Test (EUT)	4
2.4	Ancillary Equipment.....	4
2.5	Technical Information	5
3	SUMMARY OF TEST RESULT	6
3.1	Test Standards	6
4	DEVICE CATEGORY AND LEVELS LIMITS	7
5	ASSESSMENT RESULT	9
5.1	Output Power	9
5.2	Tune-up power	10
5.3	RF Exposure Evaluation Result	11
5.4	Collocated Power Calculation	12
5.5	Conclusion.....	12

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	Libre Wireless Technologies, Inc.
Address	17835 Newhope Street, Ste A, Fountain Valley, CA 92708, US

2.2 Manufacturer Information

Manufacturer	Libre Wireless Technologies, Inc.
Address	17835 Newhope Street, Ste A, Fountain Valley, CA 92708, US

2.3 General Description for Equipment under Test (EUT)

EUT Name	High Performance Wireless Media Module
Model Name Under Test	LS11
Series Model Name	LS11-EA-44G-R, LS11-NA-44G-R, LS11-EA-88G-R, LS11-NA-88G-R, LS11-EA-22G-R, LS11-NA-22G-R, LS11-EN-22G-R, LS11-EN-88G-R, LS11-EN-44G-R
Description of Model name differentiation	All models are same with electrical parameters and internal circuit structure, but only differ in model name and mainly memory difference and with ethernet or without ethernet, with PN or not. (this information provided by the applicant)
Hardware Version	VC3.0
Software Version	18.35.387.23.104 (gf431dd32) FWID 01-c7e36b48
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.4 Ancillary Equipment

Note: Not applicable.

2.5 Technical Information

Network and Wireless connectivity	Bluetooth (BR+EDR+BLE) 2.4G WIFI 802.11b, 802.11g, 802.11n(HT20) and 802.11ax(HE20) 5G WIFI 802.11a, 802.11n(HT20/40), 802.11ac(VHT20/40/80) and 802.11ax(HE20/40/80) U-NII-1/2A/2C/3
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The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	2.4G WLAN, 5G WLAN, Bluetooth	
Frequency Range	802.11b/g/n(HT20)	2412 MHz ~ 2462 MHz
	802.11ax(HE20)	2412 MHz ~ 2462 MHz
	802.11a	5150 MHz ~ 5250 MHz
		5250 MHz ~ 5350 MHz
		5470 MHz ~ 5725 MHz
		5725 MHz ~ 5850 MHz
	802.11n(HT20/HT40)	5150 MHz ~ 5250 MHz
		5250 MHz ~ 5350 MHz
		5470 MHz ~ 5725 MHz
		5725 MHz ~ 5850 MHz
	802.11ac (VHT20/VHT40/VHT80)	5150 MHz ~ 5250 MHz
		5250 MHz ~ 5350 MHz
		5470 MHz ~ 5725 MHz
		5725 MHz ~ 5850 MHz
	802.11ax (HE20/HE40/HE80)	5150 MHz ~ 5250 MHz
		5250 MHz ~ 5350 MHz
		5470 MHz ~ 5725 MHz
		5725 MHz ~ 5850 MHz
	Bluetooth	2400 MHz ~ 2483.5 MHz
Antenna Type	WLAN	PCB Antenna
	Bluetooth	PCB Antenna
Exposure Category	General Population/Uncontrolled Exposure	
Product Type	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).

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

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	GFSK
Conducted Power (dBm)	2.49
Antenna Gain (dBi)	3.50
EIRP (dBm)	5.99
Note: This report listed the worst case conducted power value, please refer to BL-SZ2381398-601~602 test report for more details.	

2.4G WIFI			
Mode	SISO-Main Antenna	SISO-Aux. Antenna	MIMO
Conducted Power (dBm)	17.22	16.84	19.67
Antenna Gain (dBi)	3.50	3.50	3.50
EIRP (dBm)	20.72	20.34	23.17
5.2G WIFI			
Mode	SISO-Main Antenna	SISO-Aux. Antenna	MIMO
Conducted Power (dBm)	13.39	14.09	17.96
Antenna Gain (dBi)	5.90	5.90	5.90
EIRP (dBm)	19.29	19.99	23.86
5.3G WIFI			
Mode	SISO-Main Antenna	SISO-Aux. Antenna	MIMO
Conducted Power (dBm)	13.73	14.48	17.60
Antenna Gain (dBi)	5.90	5.90	5.90
EIRP (dBm)	19.63	20.38	23.50
5.6G WIFI			
Mode	SISO-Main Antenna	SISO-Aux. Antenna	MIMO
Conducted Power (dBm)	14.45	14.27	17.75
Antenna Gain (dBi)	5.90	5.90	5.90
EIRP (dBm)	20.35	20.17	23.65
5.8G WIFI			
Mode	SISO-Main Antenna	SISO-Aux. Antenna	MIMO
Conducted Power (dBm)	14.23	14.51	17.92
Antenna Gain (dBi)	5.90	5.90	5.90
EIRP (dBm)	20.13	20.41	23.82
Note: This report listed the worst case conducted power value, please refer to BL-SZ2381398-603~604 test report for more details.			

5.2 Tune-up power

Mode		Conducted Power Range (dBm)	EIRP Range (dBm)	ERP Range (dBm)
Bluetooth		[1.00, 3.00]	[4.50, 6.50]	[2.35, 4.35]
2.4G WIFI	SISO-Main Antenna	[16.00,18.00]	[19.50, 21.50]	[17.35, 19.35]
	SISO-Aux. Antenna	[16.00,18.00]	[19.50, 21.50]	[17.35, 19.35]
	MIMO	[18.00, 20.00]	[21.50, 23.50]	[19.35, 21.35]
5.2G WIFI	SISO-Main Antenna	[13.00, 15.00]	[18.90, 20.90]	[16.75, 18.75]
	SISO-Aux. Antenna	[13.00, 15.00]	[18.90, 20.90]	[16.75, 18.75]
	MIMO	[16.00,18.00]	[21.90, 23.90]	[19.75, 21.75]
5.3G WIFI	SISO-Main Antenna	[13.00, 15.00]	[18.90, 20.90]	[16.75, 18.75]
	SISO-Aux. Antenna	[13.00, 15.00]	[18.90, 20.90]	[16.75, 18.75]
	MIMO	[16.00,18.00]	[21.90, 23.90]	[19.75, 21.75]
5.6G WIFI	SISO-Main Antenna	[13.00, 15.00]	[18.90, 20.90]	[16.75, 18.75]
	SISO-Aux. Antenna	[13.00, 15.00]	[18.90, 20.90]	[16.75, 18.75]
	MIMO	[16.00,18.00]	[21.90, 23.90]	[19.75, 21.75]
5.8G WIFI	SISO-Main Antenna	[13.00, 15.00]	[18.90, 20.90]	[16.75, 18.75]
	SISO-Aux. Antenna	[13.00, 15.00]	[18.90, 20.90]	[16.75, 18.75]
	MIMO	[16.00,18.00]	[21.90, 23.90]	[19.75, 21.75]
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 (mm)	Threshold Power (mW)	Power / Limit	Verdict
Bluetooth		4.35	2.72	200	3060.00	0.001	Pass
2.4G WIFI	SISO-Main Antenna	19.35	86.10	200	3060.00	0.028	Pass
	SISO-Aux. Antenna	19.35	86.10	200	3060.00	0.028	Pass
	MIMO	21.35	136.46	200	3060.00	0.045	Pass
5.2G WIFI	SISO-Main Antenna	18.75	74.99	200	3060.00	0.025	Pass
	SISO-Aux. Antenna	18.75	74.99	200	3060.00	0.025	Pass
	MIMO	21.75	149.62	200	3060.00	0.049	Pass
5.3G WIFI	SISO-Main Antenna	18.75	74.99	200	3060.00	0.025	Pass
	SISO-Aux. Antenna	18.75	74.99	200	3060.00	0.025	Pass
	MIMO	21.75	149.62	200	3060.00	0.049	Pass
5.6G WIFI	SISO-Main Antenna	18.75	74.99	200	3060.00	0.025	Pass
	SISO-Aux. Antenna	18.75	74.99	200	3060.00	0.025	Pass
	MIMO	21.75	149.62	200	3060.00	0.049	Pass
5.8G WIFI	SISO-Main Antenna	18.75	74.99	200	3060.00	0.025	Pass
	SISO-Aux. Antenna	18.75	74.99	200	3060.00	0.025	Pass
	MIMO	21.75	149.62	200	3060.00	0.049	Pass



5.4 Collocated Power Calculation

Evolution mode	Frequency (GHz)	Power /Limit	$\Sigma(\text{Power / Limit})$ of Bluetooth + 2.4G WIFI + 5G WIFI	Verdict
Bluetooth	2.48	0.001	0.095	Pass
Max 2.4G WIFI	2.462	0.045		
Max 5G WIFI	5.25	0.049		

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 + 2.4G WIFI + 5G WIFI.
2. Both of the 2.4GHz/5GHz 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 0.095, 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 and 5150 MHz~ 5250 MHz the result close to the limit by the above formula, so we select worst case power to calculate the exclusion power threshold.
5. More power list please refer to BL-SZ2381398-601~604 test report.

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--

