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RF Exposure Evaluation Report

Application No.: KSCR2409001776AT
FCC ID: 2AQQMLBAIRBOX
IC: 27586-LBAIRBOX
Applicant: Zhejiang Libiao Robotics Co., Ltd.
Address of Applicant: No.96,Changda Road,Linping Street,Linping District,Hangzhou City,Zhejiang Province,China
Manufacturer: Zhejiang Libiao Robotics Co., Ltd.
Address of Manufacturer: No.96,Changda Road,Linping Street,Linping District,Hangzhou City,Zhejiang Province,China
Factory: Zhejiang Libiao Robotics Co., Ltd.
Address of Factory: No.96,Changda Road,Linping Street,Linping District,Hangzhou City,Zhejiang Province,China
Equipment Under Test (EUT):
EUT Name: AirBox
Model No.: LBAirBox
Trade Mark: LiBiao
Standard(s) : FCC Rules 47 CFR §2.1091
KDB 447498 D04 interim General RF Exposure Guidance v01
RSS-102 Issue 6 (December 15, 2023)
Date of Receipt: 2024-09-09
Date of Test: 2025-04-10 to 2025-04-24
Date of Issue: 2025-04-24

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.



Revision Record			
Version	Description	Date	Remark
00	Original	2025-04-24	/

Authorized for issue by:				
Tested By		Damon Zhou		
		Damon_Zhou/Project Engineer		
Approved By		Terry Hou		
		Terry Hou /Reviewer		



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3 General Information

3.1 General Description of E.U.T.

Power supply:	DC 25-29V
SN:	18-06-1B-30-C7-70-00
Firmware Version:	F002

3.2 Technical Specifications

2.4GHz WiFi

Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2462MHz
Modulation Type:	802.11b: DSSS (CCK, DQPSK, DBPSK) 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Number of Channels:	802.11b/g/n(HT20):11
Channel Spacing:	5MHz
Antenna Type:	Dipole Antenna
Antenna Gain:	1.95dBi (Provided by the manufacturer)

5GHz WiFi

Operation Frequency	U-NII-1: 5180-5240MHz (4 Channels); U-NII-3: 5745-5825MHz (5 Channels)
Modulation Type:	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM)
Channel Spacing:	802.11a/n 20: 20MHz
Antenna Type:	Dipole Antenna
Antenna Gain:	1.11dBi (Provided by the manufacturer)

902-928MHz

Operation Frequency:	902-928MHz
Modulation Type:	FSK
Channel Spacing:	200KHz
Channel number:	111
Antenna Type:	Dipole Antenna
Antenna Gain:	2.54dBi (Provided by the manufacturer)



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3.3 Separation Distance

Separation distance between the antenna to person (R):	>20cm
Remark: This minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander. R has been stated in user manual.	

3.4 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc.

No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86 512 5735 5888 Fax: +86 512 5737 0818

No tests were sub-contracted.

Note:

1.SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc) is provided by the applicant. (if applicable).

2.SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).

3. Sample source: sent by customer.

3.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA**

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

- **FCC**

Compliance Certification Services (Kunshan) Inc. has been recognized as an accredited testing laboratory. Designation Number: CN1172.

- **ISED**

Compliance Certification Services (Kunshan) Inc. has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 2324E

- **VCCI**

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-20134, R-11600, C-11707, T-11499, G-10216 respectively.

4 RF Exposure Test Exemptions

Test exemptions apply for devices used in general population/uncontrolled exposure environments, according to the SAR-based, or MPE-based exemption thresholds.

4.1 FCC RF Exposure Test Exemptions for single RF sources

4.1.1 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of §1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.

The 1-mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph §1.1307(b)(3)(ii)(A).

The 1-mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

4.1.2 MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of §1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz. The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, **R must be at least $\lambda/2\pi$** , where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP 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 (1.64 linear value).



Table B.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. R: Separation distance between the antenna to person						

The table applies to any RF source (i.e. single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least $\lambda/2\pi$. The thresholds are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.

Limit calculation				
Frequency range	Frequency(MHz)	$\lambda/2\pi$ (m)	R(m)	Threshold ERP(W)
300~1500MHz	926.25	0.0516	0.6000	4.268
1500~100000MHz	2462	0.0194	0.2000	0.768
1500~100000MHz	5825	0.0082	0.2000	0.768

4.1.3 SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of $\lambda/4$.

As for devices with antennas of length greater than $\lambda/4$ where the gain is not well defined, but always less than that of a half-wave dipole (length $\lambda/2$), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known. The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

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 **0.5cm to 40cm** 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).

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	d(cm)	Pth (mW)
0.3~1.5	0.92625	1.482	20	1889.550
1.5~6	2.462	1.903	20	3060.000

4.2 RF Exposure Test Exemptions for Simultaneous Transmission

The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

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. In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure \ Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for P_{th} , including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source *i* at a distance between 0.5 cm and 40 cm (inclusive).

P_{th,i} = the exemption threshold power (P_{th}) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source *i*.

ERP_j = the ERP 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 formula of paragraph (b)(3)(i)(C) of this section.

Evaluated_k = the maximum reported SAR or MPE of fixed, mobile, or portable RF source *k* either in the device or at the transmitter site from an existing evaluation at the location of exposure.

Exposure Limit_k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source *k*, as applicable from § 1.1310 of this chapter.

4.3 IC Field reference level exposure exemption limits:

According to RSS-102 issue 6 section 6.6, RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);

- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).



5 Measurement and Calculation

5.1 Maximum transmit power

The Power Data is based on the RF Test Report KSCR240900177601, KSCR240900177602, KSCR240900177603.

2.4GHz WiFi

Test Mode	Test Channel	Ant	Power [dBm]	Power [mW]
11B	2412	Ant1	15.81	38.11
11B	2437	Ant1	16.48	44.46
11B	2462	Ant1	15.82	38.19
11G	2412	Ant1	15.61	36.39
11G	2437	Ant1	14.71	29.58
11G	2462	Ant1	15.49	35.40
11N20SISO	2412	Ant1	15.68	36.98
11N20SISO	2437	Ant1	14.78	30.06
11N20SISO	2462	Ant1	15.38	34.51

5GHz WiFi

Test Mode	Test Channel	Ant	Power [dBm]	Power [mW]
802.11a	5180	Ant1	8.44	6.98
	5200	Ant1	8.20	6.61
	5240	Ant1	8.38	6.89
	5745	Ant1	8.79	7.57
	5785	Ant1	9.06	8.05
	5825	Ant1	7.58	5.73
802.11n (HT20)	5180	Ant1	8.49	7.06
	5200	Ant1	8.32	6.79
	5240	Ant1	8.69	7.40
	5745	Ant1	9.08	8.09
	5785	Ant1	8.92	7.80
	5825	Ant1	7.43	5.53

926.25MHz @3m=101.45 dBuV/m

5.2 RF Exposure Calculation

For FCC:

Band	Frequency	Max power (dBm)	Ant Gain (dBi)	EIRP (dBm)	Max power (mW)	Limit (mW)	Distance R (cm)
WLAN 2.4GHz	2400	16.48	1.95	18.43	69.66	3060	20
WLAN 5GHz B1	5150	8.69	1.11	9.8	9.55	3060	20
WLAN 5GHz B4	5725	9.08	1.11	10.19	10.45	3060	20

Test Frequency (MHz)	Field Strength@3m (dBuV/m)	EIRP (dBm)	EIRP (mW)	E.I.R.P Limit (mW)
926.25MHz	101.45	6.15	4.12	1889.55

Note: At a specified measurement distance of 3 m: $EIRP(dBm) = E(dBuV/m) - 95.3$

For single RF source :

	Evaluation method	Separation distance between the antenna to person (R)
<input type="checkbox"/>	Blanket 1 mW Blanket Exemption	Regardless of separation distance
<input type="checkbox"/>	MPE-based Exemption(ERP)	$R \geq (\lambda / 2 \pi)$
<input checked="" type="checkbox"/>	SAR-based Exemption(P_{th})	$0.5cm < R < 40cm$

For multiple RF sources:

The 2.4GHz/5GHz WLAN & 902MHz can transmit simultaneously, but $69.66/3060 + 10.45/3060 + 4.12/1889.55 = 0.028 \leq 1$. So the MPE of collocated transmitter is compliant.

For IC:

Band	Frequency (MHz)	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Distance R (cm)	E.I.R.P (W)	E.I.R.P Limit (W)
WLAN 2.4GHz	2400	16.48	1.95	18.43	20	0.070	2.67
WLAN 5GHz B1	5150	8.69	1.11	9.8	20	0.010	4.51
WLAN 5GHz B4	5725	9.08	1.11	10.19	20	0.010	4.85

Test Frequency (MHz)	Field Strength@3m (dBuV/m)	EIRP (dBm)	EIRP (mW)	E.I.R.P Limit (W)
926.25MHz	101.45	6.15	4.12	1.4

Note: At a specified measurement distance of 3 m: $EIRP(dBm) = E(dBuV/m) - 95.3$

For multiple RF sources:

The 2.4GHz/5GHz WLAN & 902MHz can transmit simultaneously but the maximum rate of MPE is $0.07/2.67 + 0.01/4.51 + 0.004/1.4 = 0.31 \leq 1$.

So the MPE of collocated transmitter is compliant.

--End of the Report--