

TEST REPORT

Applicant: Sonoc Corp.
Address: 8F.-3, No.1071, Zhongzheng Rd., Taoyuan Dist., Taiwan
Equipment Type: LoRaWAN Gateway
Model Name: SL100 (refer section 2.4)
Brand Name: SONoC
FCC ID: 2A7JX-SL100
Test Standard: 47 CFR Part 2.1091
KDB 447498 D01 v06
Test Date: Jul. 05, 2022 - Jul. 14, 2022
Date of Issue: Jul. 26, 2022

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

**Tested by:** Julie Zhu**Checked by:** Xu Rui**Approved by:** Wei Yanquan
(Chief Engineer)

Revision History

<u>Version</u>	<u>Issue Date</u>	<u>Revisions Content</u>
<u>Rev. 01</u>	<u>Jul. 26, 2022</u>	<u>Initial Issue</u>

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1 GENERAL INFORMATION

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China
Phone Number	+86 755 6685 0100

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.
Description	All measurement facilities used to collect the measurement data are located at Block B, 1/F, Baisha Science and Technology Park, Shahe West Road, Nanshan District, ShenZhen, GuangDong Province, China

1.3 Test Environment Condition

Ambient Temperature	+20.0°C to +23.5°C
Ambient Relative Humidity	40% to 70%

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Sonoc Corp.
Address	8F.-3, No.1071, Zhongzheng Rd., Taoyuan Dist., Taiwan

2.2 Manufacturer Information

Manufacturer	Sonoc Corp.
Address	8F.-3, No.1071, Zhongzheng Rd., Taoyuan Dist., Taiwan

2.3 Factory Information

Factory	N/A
Address	N/A

2.4 General Description for Equipment under Test (EUT)

EUT Name	LoRaWAN Gateway
Model Name Under Test	SL100
Series Model Name	SL100-US915, SL100-AS923, SL100-AU915
Description of Model name differentiation	Software configuration is different (nothing to do with wireless)
Hardware Version	v2.0
Software Version	1.0.0
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) WIFI 802.11b, 802.11g, 802.11n(HT20/40) LoraWAN
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The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	Bluetooth	
Frequency Range	Bluetooth	2400 ~ 2483.5 MHz
	WIFI	2400 ~ 2483.5 MHz
	LoRa(DTS)	923.3 ~ 927.5MHz
	LoRa(Hopping)	902.3 ~ 914.9MHz
Antenna Type	Bluetooth	PCB Antenna
	WIFI	PCB Antenna
	LoRa(DTS)	External Rubber Duck Antenna
	LoRa(Hopping)	External Rubber Duck Antenna
Exposure Category	General Population/Uncontrolled Exposure	
EUT Stage	Fixed Location 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 D01 v06	447498 D01 General RF Exposure Guidance D01 v06

4 DEVICE CATEGORY AND LEVELS LIMITS

Mobile Derives:

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 D01 General RF Exposure Guidance v06 Limit

Devices operating in standalone mobile exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When the categorical exclusion provision of § 2.1091(c) applies, the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to FCC Part 1.1307, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the commission's guidelines.

Limits for General Population/ Uncontrolled Exposure			
Frequency Range (MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength (H)(A/m)	Power Density (S)(mW/cm ²)
0.3-1.34	614	1.63	(100)*
1.34-30	824/f	2.19/f	(180/f ²)*
30-300	27.5	0.073	0.2
300-1500			f/1500
1500-100,000			1.0

MPE calculation formula

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = power density

P = output power (mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Separation distance between radiator and human body (cm)

5 ASSESSMENT RESULT

5.1 Output Power

Bluetooth	
Mode	GFSK
Conductor Power (dBm)	-1.02
Note: This report listed the worst case conductor power value, please refer to Report No. BL-SZ2260818-601 for more details.	

WIFI				
Mode	802.11b	802.11g	802.11n20	802.11n40
Conductor Power (dBm)	12.04	12.32	12.34	12.51
Note: This report listed the worst case conductor power value, please refer to Report No. BL-SZ2260818-602 for more details.				

LoRa(DTS)	
Mode	LoRa(DTS)
Conductor Power (dBm)	26.98
Note: This report listed the worst case conductor power value, please refer to Report No. BL-SZ2260818-603 for more details.	

LoRa(Hopping)	
Mode	LoRa(Hopping)
Conductor Power (dBm)	19.97
Note: This report listed the worst case conductor power value, please refer to Report No. BL-SZ2260818-604 for more details.	

5.2 Tune-up power

Mode	Range
Bluetooth	(-1.00)-(-1.50)
WIFI	12.00-13.00
LoRa(DTS)	26.00-27.00
LoRa(Hopping)	19.00-20.00

5.3 RF Exposure Evaluation Result

Evolution mode	Maximum Conducted power (dBm)	Antenna Gain (typical) (dBi):	Total Power (mw)	Distance (cm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Power Density / Limit	Verdict
Bluetooth	-1.50	2.0	1.122	20	0.0002	1	0.0002	Pass
WIFI	13.00	2.0	31.623	20	0.0063	1	0.0063	Pass
LoRa(DTS)	27.00	1.2	660.693	20	0.1314	1	0.1314	Pass
LoRa(Hopping)	20.00	1.2	131.826	20	0.0262	1	0.0262	Pass

5.4 Collocated Power Density Calculation

Evolution mode	Frequency(MHz)	Power Density/Limit	Σ (Power Density / Limit) of Simultaneous Transmission	Verdict
Bluetooth + LoRa(DTS)	2400MHz ~ 2483.5MHz	0.0002	0.1316	Pass
	923.3MHz ~ 927.5MHz	0.1314		
WIFI + LoRa(DTS)	2400MHz ~ 2483.5MHz	0.0063	0.1377	Pass
	923.3MHz ~ 927.5MHz	0.1314		

Note:

- Σ (Power Density / Limit): This is a summation of [(power density for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for Bluetooth + LoRa(DTS), WIFI + LoRa(DTS).
- Both of the Bluetooth/WIFI/LoRa(DTS) can transmit simultaneously, the formula of calculated the MPE is

$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$
CPD = Calculation power density
LPD = Limit of power density
- The worst-case situation is 0.1377, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.
- The DUT work frequency range used is 2400 MHz ~ 2483.5 MHz and 923.3MHz ~ 927.5MHz 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--