

TEST REPORT

Applicant: Waveinnova Inc
Address: 319 Thompson Ave, Mountain View, CA 94043, USA
Equipment Type: WaveTrac X1
Model Name: 0124-010
Brand Name: WaveTrac
FCC ID: 2BFGFWTX1
Test Standard: 47 CFR Part 2.1091
KDB 447498 D04 v01
Sample Arrival Date: Apr. 05, 2024
Test Date: Apr. 15, 2024 - Apr. 30, 2024
Date of Issue: May. 07, 2024

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>May. 07, 2024</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	Waveinnova Inc
Address	319 Thompson Ave, Mountain View, CA 94043,USA

2.2 Manufacturer Information

Manufacturer	Waveinnova Inc
Address	319 Thompson Ave, Mountain View, CA 94043,USA

2.3 General Description for Equipment under Test (EUT)

EUT Name	WaveTrac X1
Model Name Under Test	0124-010
Hardware Version	WAVETRAC_X1
Software Version	BC660KGLAAR01A05
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.4 Technical Information

Network and Wireless connectivity	4G Network FDD NB-IoT Band 2,4,5,12,13,17,25,66,85 GPS, GLONASS, Beidou, Galileo BLE,WIFI(Only Receiver)
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The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	LTE, Bluetooth		
Frequency Range	LTE Band 2	TX:1850 MHz ~ 1910 MHz	RX:1930MHz ~ 1990 MHz
	LTE Band 4	TX:1710 MHz ~ 1755 MHz	RX:2110 MHz ~ 2155 MHz
	LTE Band 5	TX:824 MHz ~ 849 MHz	RX:869 MHz ~ 894 MHz
	LTE Band 12	TX:699 ~ 716 MHz	RX:729 ~ 746 MHz
	LTE Band 13	TX:777 ~ 787 MHz	RX:746 ~ 756 MHz
	LTE Band 17	TX:704 ~ 716 MHz	RX:734 ~ 746 MHz
	LTE Band 25	TX:1850 ~ 1915 MHz;	RX:1930 ~ 1995 MHz
	LTE Band 66	TX:1710 ~ 1780 MHz	RX:2110 ~ 2180 MHz
	LTE Band 85	TX:698 ~ 716 MHz	RX:728 ~ 746 MHz
	Bluetooth	2400 ~ 2483.5 MHz	
Antenna Type	WWAN	SMD	
	Bluetooth	Ceramics	
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 Devices:

CFR Title 47 §2.1091(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

Mode	LTE NB-IOT								
	LTE B2	LTE B4	LTE B5	LTE B12	LTE B13	LTE B17	LTE B25	LTE B66	LTE B85
Conducted Power (dBm)	22.43	22.67	22.45	22.71	22.55	22.81	22.32	22.46	22.79
Antenna Gain (dBi)	2.7	2.7	0	-0.2	-0.2	-0.2	2.7	2.7	-0.2
ERP/EIRP(dBm)	25.13	25.37	20.3	20.36	20.2	20.46	25.02	25.16	20.44
Note: This table listed the worst case power value, please refer to BL-SH244049-501 report for more details.									

Mode	BLE1M	BLE2M
Conducted Power (dBm)	-0.83	-0.77
Antenna Gain (dBm)	0.10	0.10
EIRP (dBm)	-0.73	-0.67
Note: This table listed the worst case power value, please refer to BL-SH244049-601 report for more details.		

5.2 Tune-up power

Mode	Conducted Power Range (dBm)	EIRP Range (dBm)	ERP Range (dBm)
LTENB-IOT B2	[21.00, 23.00]	[24.00, 26.00]	[21.85,23.85]
LTENB-IOT B4	[21.00, 23.00]	[24.00, 26.00]	[21.85,23.85]
LTENB-IOT B5	[21.00, 23.00]	/	[18.85, 20.85]
LTE NB-IOT B12	[21.00, 23.00]	/	[18.85, 20.85]
LTE NB-IOT B13	[21.00, 23.00]	/	[18.85, 20.85]
LTE NB-IOT B17	[21.00, 23.00]	/	[18.85, 20.85]
LTE NB-IOT B25	[21.00, 23.00]	[24.00, 26.00]	[21.85,23.85]
LTE NB-IOT B66	[21.00, 23.00]	[24.00, 26.00]	[21.85,23.85]
LTE NB-IOT B85	[21.00, 23.00]	/	[18.85, 20.85]
BLE 1M	[-1, 1]	[-1, 1]	[-3.15, -1.15]
BLE 2M	[-1, 1]	[-1, 1]	[-3.15, -1.15]
Note1: ERP= EIRP -2.15dB			
Note2: According KDB 447498 D04, used the greater of maximum conducted power or 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
LTENB-IOT B2	23.85	242.66	200	3060.00	0.079	Pass
LTENB-IOT B4	23.85	242.66	200	3060.00	0.079	Pass
LTENB-IOT B5	23.00	199.53	200	1680.96	0.119	Pass
LTENB-IOT B12	23.00	199.53	200	1425.96	0.140	Pass
LTE NB-IOT B13	23.00	199.53	200	1585.08	0.126	Pass
LTE NB-IOT B17	23.00	199.53	200	1436.16	0.139	Pass
LTE NB-IOT B25	23.85	242.66	200	3060.00	0.079	Pass
LTE NB-IOT B66	23.85	242.66	200	3060.00	0.079	Pass
LTE NB-IOT B85	23.00	199.53	200	1423.92	0.140	Pass
BLE 1M	1.00	1.26	200	3060.00	0.001	Pass
BLE 2M	1.00	1.26	200	3060.00	0.001	Pass

5.4 Collocated Power Calculation

Evolution mode	Frequency(MHz)	Power /Limit	Σ (Power / Limit) of WWAN + BT	Verdict
LTE NB-IOT B85	698 ~ 716 MHz	0.140	0.141	Pass
Bluetooth	2400 ~ 2483.5 MHz	0.001		

Note:

1. Σ (Power / Limit): This is a summation of [(power for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding Power limit)], for WWAN/BT.
2. Both of the WWAN/BT 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 0.141, 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, 698 ~ 716 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-SH244049-501-501&601 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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