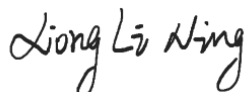


TEST REPORT

Applicant: Zome Energy Networks, Inc.
Address: 268 Bush St., Suite 3633, San Francisco, CA, 94104, USA
Equipment Type: Zome IoT Gateway
Model Name: ZK-200
Brand Name: Zome Energy Networks
FCC ID: 2BE3K-ZK200
Test Standard: 47 CFR Part 2.1091
KDB 447498 D04 v01
Sample Arrival Date: Feb. 01, 2024
Test Date: Feb. 01, 2024 - Apr. 12, 2024
Date of Issue: Apr. 12, 2024

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>Mar. 28, 2024</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Apr. 12, 2024</u>	<u>Add 2G Network information and data</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	Zome Energy Networks, Inc.
Address	268 Bush St., Suite 3633, San Francisco, CA, 94104, USA

2.2 Manufacturer Information

Manufacturer	Aimtron Electronic Limited (India HQ)
Address	1A, Wagodia Gidc Rd, GIDC Industrial Estate, Vadodara, Gujarat 391760

2.3 General Description for Equipment under Test (EUT)

EUT Name	Zome IoT Gateway
Model Name Under Test	ZK-200
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	IoT Gateway PCBA_v3.1 & Mikrobus ZW700 PCBA_v3.0
Software Version	FCC_1_0_8
Dimensions (Approx.)	180(L)x100(W)x32(H)mm
Weight (Approx.)	245g

2.4 Technical Information

Network and Wireless connectivity	2G Network GSM/GPRS/EDGE 850/1900 MHz 4G Network FDD LTE-M1 Band 2/4/5/12/13/26 FDD NB-IoT Band 2/4/5/12/13 Z-wave 908.4MHz to 916MHz
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The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	GSM, LTE-M1, NB-IoT, Z-wave		
Frequency Range	GSM 850 MHz	TX: 824 ~ 849 MHz	RX: 869 ~ 894 MHz
	GSM 1900 MHz	TX: 1850 ~ 1910 MHz	RX: 1930 ~ 1990 MHz
	LTE-M1 Band 2	TX: 1850 ~ 1910 MHz	RX: 1930 ~ 1990 MHz
	LTE-M1 Band 4	TX: 1710 ~ 1755 MHz	RX: 2110 ~ 2155 MHz
	LTE-M1 Band 5	TX: 824 ~ 849 MHz	RX: 869 ~ 894 MHz
	LTE-M1 Band 12	TX: 699 ~ 716 MHz	RX: 729 ~ 746 MHz
	LTE-M1 Band 13	TX: 777 ~ 787 MHz	RX: 746 ~ 756 MHz
	LTE-M1 Band 26	TX: 814 ~ 824 MHz	RX: 859 ~ 869 MHz
		TX: 824 ~ 849 MHz	RX: 869 ~ 894 MHz
	NB-IoT Band 2	TX: 1850 ~ 1910 MHz	RX: 1930 ~ 1990 MHz
	NB-IoT Band 4	TX: 1710 ~ 1755 MHz	RX: 2110 ~ 2155 MHz
	NB-IoT Band 5	TX: 824 ~ 849 MHz	RX: 869 ~ 894 MHz
	NB-IoT Band 12	TX: 699 ~ 716 MHz	RX: 729 ~ 746 MHz
	NB-IoT Band 13	TX: 777 ~ 787 MHz	RX: 746 ~ 756 MHz
Z-wave	908.40 ~ 916.00 MHz		
Antenna Type	WWAN	Rod Antenna	
	Z-wave	External Whip Z-wave 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 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

GSM					
Channel	Burst Average Power (dBm)	Division Factors	Frame-Averaged power (dBm)	Antenna Gain (dBi)	EIRP/ERP (dBm)
GSM 850 (GMSK, 1-Slot)	32.31	9.19	23.12	0.38	23.50
GSM 850 (GMSK, 2-Slot)	32.11	6.13	25.98	0.38	26.36
GSM 850 (GMSK, 3-Slot)	31.31	4.42	26.89	0.38	27.27
GSM 850 (GMSK, 4-Slot)	30.28	3.18	27.10	0.38	27.48
GSM 1900 (GMSK, 1-Slot)	29.76	9.19	20.57	4.16	24.73
GSM 1900 (GMSK, 2-Slot)	29.65	6.13	23.52	4.16	27.68
GSM 1900 (GMSK, 3-Slot)	29.51	4.42	25.09	4.16	29.25
GSM 1900 (GMSK, 4-Slot)	29.42	3.18	26.24	4.16	30.40

Note 1: This report listed the worst case conducted power value, please refer to No. R2003A0151-R4 & No. R2003A0151-R5 report for more details.

Note 2: The frame-averaged power is linearly proportion to the slot number configured and it is linearly scaled the maximum burst-averaged power based on time slots. The calculated method is shown as below:

Frame-averaged power = Burst averaged power (1 Tx Slot) – 9.19 dB

Frame-averaged power = Burst averaged power (2 Tx Slots) – 6.13 dB

Frame-averaged power = Burst averaged power (3 Tx Slots) - 4.42dB

Frame-averaged power = Burst averaged power (4 Tx Slots) – 3.18 dB

LTE-M1					
Mode	Band 2	Band 4	Band 5	Band 12	Band 13
Conducted Power (dBm)	23.87	22.40	23.81	23.23	23.81
Antenna Gain (dBi)	4.16	3.35	0.38	0.3	1.1
EIRP/ERP (dBm)	28.03	25.75	24.19	23.53	24.91
Mode	Band 26(part22)	Band 26(part90)	/	/	/
Conducted Power (dBm)	23.58	23.19	/	/	/
Antenna Gain (dBi)	0.5	0.5	/	/	/
EIRP/ERP (dBm)	24.08	23.69	/	/	/

Note: This report listed the worst case conducted power value, please refer to No. R2003A0151-R4 & No. R2003A0151-R5 & No. R2003A0151-R6 & No. R2003A0151-R7 report for more details.

NB-IoT					
Mode	Band 2	Band 4	Band 5	Band 12	Band 13
Conducted Power (dBm)	22.98	23.46	22.73	23.56	23.13
Antenna Gain (dBi)	4.16	3.35	0.38	0.3	1.1
EIRP/ERP (dBm)	27.14	26.81	23.11	23.86	24.23
Note: This report listed the worst case conducted power value, please refer to No. R2003A0151-R1 & No. R2003A0151-R2 & No. R2003A0151-R3 report for more details.					

Z-wave						
Mode	PoE Splitter Power Supply			Adapter Power Supply		
	Low	Middle	High	Low	Middle	High
Field Strength (dBuV/m)	72.11	69.07	78.47	76.65	73.50	82.02
Conducted Power (dBm)	-25.15	-28.19	-18.79	-20.61	-23.76	-15.24
Antenna Gain (dBi)	2.0					
ERP (dBm)	-23.15	-26.19	-16.79	-18.61	-21.76	-13.24
Note1: This table listed the worst case power value, please refer to No. BL-SZ2420071-601 report for more details. Note2: Add the appropriate maximum ground reflection factor to the EIRP level (6dB for frequencies≤30MHz, 4.7dB for frequencies between 30MHz and 1000MHz, inclusive and 0dB for frequencies > 1000 MHz). Note3: Convert the resultant EIRP level to an equivalent electric field strength using the following relationship: $E = \sqrt{EIRP \cdot 20 \log D + 104.8}$ + maximum ground reflection factor where: E=electric field strength in dBuV/m EIRP =equivalent isotropic radiated powerin dBm D=specified measurement distance in meters						

5.2 Tune-up power

Mode	Conducted Power Range (dBm)	EIRP Range (dBm)	ERP Range (dBm)
GSM 850	[25.50, 27.50]	/	[25.88, 27.88]
GSM 1900	[24.50, 26.50]	[28.66, 26.66]	[26.51, 28.51]
LTE-M1 Band 2	[22.00, 24.00]	[26.16, 28.16]	[22.01, 24.01]
LTE-M1 Band 4	[20.50, 22.50]	[23.85, 25.85]	[21.70, 23.70]
LTE-M1 Band 5	[22.00, 24.00]	/	[22.38, 24.38]
LTE-M1 Band 12	[21.50, 23.50]	/	[21.80, 23.80]
LTE-M1 Band 13	[22.00, 24.00]	/	[23.10, 25.10]
LTE-M1 Band 26(part22)	[22.00, 24.00]	/	[22.50, 24.50]
LTE-M1 Band 26(part90)	[21.50, 23.50]	/	[22.00, 24.00]
NB-IoT Band 2	[21.00, 23.00]	[25.16, 27.16]	[23.01, 25.01]
NB-IoT Band 4	[21.50, 23.50]	[24.85, 26.85]	[22.70, 24.70]
NB-IoT Band 5	[21.00, 23.00]	/	[21.38, 23.38]
NB-IoT Band 12	[22.00, 24.00]	/	[22.30, 24.30]
NB-IoT Band 13	[21.50, 23.50]	/	[22.60, 24.60]
Z-wave	[-17.00, -15.00]	/	[-15.00, -13.00]

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
GSM 850	27.88	613.76	200	1680.96	0.365	Pass
GSM 1900	28.51	709.58	200	3060.00	0.232	Pass
LTE-M1 Band 2	24.01	251.77	200	3060.00	0.082	Pass
LTE-M1 Band 4	23.70	234.42	200	3060.00	0.077	Pass
LTE-M1 Band 5	24.38	274.16	200	1680.96	0.163	Pass
LTE-M1 Band 12	23.80	239.88	200	1425.96	0.168	Pass
LTE-M1 Band 13	25.10	323.59	200	1521.84	0.213	Pass
LTE-M1 Band 26(part22)	24.50	281.84	200	1680.96	0.168	Pass
LTE-M1 Band 26(part90)	24.00	251.19	200	1660.56	0.151	Pass
NB-IoT Band 2	25.01	316.96	200	3060.00	0.104	Pass
NB-IoT Band 4	24.70	295.12	200	3060.00	0.096	Pass
NB-IoT Band 5	23.38	217.77	200	1680.96	0.130	Pass
NB-IoT Band 12	24.30	269.15	200	1425.96	0.189	Pass
NB-IoT Band 13	24.60	288.40	200	1521.84	0.190	Pass
Z-wave	-13.00	0.05	200	1853.14	0.001	Pass

5.4 Collocated Power Calculation

Evolution mode	Frequency	Power /Limit	$\Sigma(\text{Power} / \text{Limit})$ of GSM 850 + Z-wave	Verdict
GSM 850	824 MHz ~ 849 MHz	0.365	0.366	Pass
Z-wave	908.40 MHz ~ 916.00 MHz	0.001		
Evolution mode	Frequency	Power /Limit	$\Sigma(\text{Power} / \text{Limit})$ of LTE-M1 Band 13 + Z-wave	Verdict
LTE-M1 Band 13	746 MHz ~ 756 MHz	0.213	0.214	Pass
Z-wave	908.40 MHz ~ 916.00 MHz	0.001		

Note:

- $\Sigma(\text{Power} / \text{Limit})$: This is a summation of [(power for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding Power limit)], for GSM 850 + Z-wave.
- Both of the 0.824GHz/0.9084GHz can transmit simultaneously, the formula of calculated the Power is

$$\text{CP1} / \text{LP1} + \text{CP2} / \text{LP2} + \dots \text{etc.} < 1$$

CP = Calculation power
LP = Limit of power
- The worst-case situation is 0.366, which is less than "1". This confirmed that the device comply with FCC KDB 447498 D04 Power limit.
- The DUT work frequency range used is 824 MHz ~ 849 MHz and 908.40 MHz ~ 916.00 MHz the result close to the limit by the above formula, so we select worst case power to calculate the exclusion power threshold.
- More power list please refer to No. R2003A0151-R1 & No. R2003A0151-R2 & No. R2003A0151-R3 & No. R2003A0151-R4 & No. R2003A0151-R5 & No. R2003A0151-R6 & No. R2003A0151-R7 & No. BL-SZ2420071-601 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

1. The laboratory guarantees the scientificity, accuracy and impartiality of the test, and is responsible for all the information in the report, except the information provided by the customer. The customer is responsible for the impact of the information provided on the validity of the results.
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--END OF REPORT--