

TEST REPORT

Applicant: Calamp Wireless Networks
Address: 2200 Faraday Ave, Suite 220 Carlsbad, CA 92008
USA
Equipment Type: LTE CAT-M1 Telematics Gateway
Model Name: LMU3642MB
Brand Name: Calamp
FCC ID: APV-3642MB
Test Standard: 47 CFR Part 2.1091
KDB 447498 D01 v06
Test Date: Jun. 13, 2023 – Jun. 25, 2023
Date of Issue: Jun. 26, 2023

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>Jun. 26, 2023</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

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Calamp Wireless Networks
Address	2200 Faraday Ave, Suite 220 Carlsbad, CA 92008 USA

2.2 Manufacturer Information

Manufacturer	Calamp Wireless Networks
Address	2200 Faraday Ave, Suite 220 Carlsbad, CA 92008 USA

2.3 Factory Information

Factory	N/A
Address	N/A

2.4 General Description for Equipment under Test (EUT)

EUT Name	LTE CAT-M1 Telematics Gateway
Model Name Under Test	LMU3642MB
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	N/A
Software Version	N/A
Dimensions (Approx.)	145mm(L) ×53mm(W) ×33mm(H)
Weight (Approx.)	142.0 g

2.5 Ancillary Equipment

Not Applicable

2.6 Technical Information

All Network and Wireless connectivity for EUT	2G Network GSM/GPRS/EDGE 850/900/1800/1900 MHz 4G Network FDD LTE-M1 Band 1/2/3/4/5/8/12/13/18/19/20/25/26/28 FDD NB-IoT Band 1/2/3/4/5/8/12/13/18/19/20/25/26/28 Bluetooth (BLE) GPS, GLONASS, Galileo
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The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	GSM, LTE, Bluetooth		
Operating Frequency	GSM 850	TX: 824 ~ 849 MHz	RX: 869 ~ 894 MHz
	GSM 1900	TX: 1850 ~ 1910 MHz	RX: 1930 ~ 1990 MHz
	LTE Band 2	TX: 1850 ~ 1910 MHz	RX: 1930 ~ 1990 MHz
	LTE Band 4	TX: 1710 ~ 1755 MHz	RX: 2110 ~ 2155 MHz
	LTE Band 5	TX: 824 ~ 849 MHz	RX: 869 ~ 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 25	TX: 1850 ~ 1915 MHz	RX: 1930 ~ 1995 MHz
	LTE Band 26	TX: 814 ~ 849 MHz	RX: 859 ~ 894 MHz
	Bluetooth	2400 ~ 2483.5 MHz	
Antenna Type	WWAN	PIFA Antenna	
	Bluetooth	Ceramic Antenna	
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 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

GSM		
Mode	GSM 850	GSM 1900
Conducted Power (dBm)	32.46	31.86
Note: This report listed the worst case conducted power value, please refer to RF test report No. BL-EC2341272-501 for more details.		

LTE-NB-IoT							
Mode	Band 2	Band 4	Band 5	Band 12	Band 13	Band 25	Band 26
Conducted Power (dBm)	23.96	24.23	25	24.65	24.86	24.83	24.18
Note: This report listed the worst case conducted power value, please refer to RF test report No. BL-EC2341272-501 for more details.							

LTE-M1							
Mode	Band 2	Band 4	Band 5	Band 12	Band 13	Band 25	Band 26
Conducted Power (dBm)	23.28	23.45	23.11	23.39	23.28	22.45	22.49
Note: This report listed the worst case conducted power value, please refer to RF test report No. BL-EC2341272-501 for more details.							

Bluetooth	
Mode	BLE
Conducted Power (dBm)	4.05
Note: This report listed the worst case conducted power value, please refer to RF test report No. BL-EC2341272-601 and BL-EC2350663-602 for more details.	

5.2 Turn-up power

Mode		Conducted Power Range (dBm)
GSM	GSM850	29.50-32.50
	GSM1900	29.00-32.00
LTE	Band 2-NB-IoT	22.50-25.50
	Band 4-NB-IoT	23.00-26.00
	Band 5-NB-IoT	23.50-26.50
	Band 12-NB-IoT	23.00-26.00
	Band 13-NB-IoT	23.50-26.50
	Band 25-NB-IoT	23.50-26.50
	Band 26-NB-IoT	23.00-26.00
	Band 2- M1	22.00-25.00
	Band 4- M1	22.00-25.00
	Band 5- M1	22.00-25.00
	Band 12- M1	22.00-25.00
	Band 13- M1	22.00-25.00
	Band 25- M1	21.00-24.00
	Band 26- M1	21.00-24.00
Bluetooth	BLE	2.50-5.50

5.3 RF Exposure Evaluation Result

Evolution mode		Maximum Conducted power Tune up (dBm)	Directional Gain (dBi)	Distance (cm)	Maximum EIRP/ERP power (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	P/Plimit	Verdict
GSM	GSM850	32.50	0.70	20	1273.50	0.254	0.549	0.4627	Pass
	GSM1900	32.00	1.00	20	1995.26	0.397	1.000	0.3970	Pass
LTE	Band 2-NB-IoT	25.50	1.00	20	446.68	0.089	1.000	0.0890	Pass
	Band 4-NB-IoT	26.00	1.00	20	501.19	0.100	1.000	0.1000	Pass
	Band 5-NB-IoT	26.50	0.70	20	393.55	0.078	0.549	0.1421	Pass
	Band 12-NB-IoT	26.00	0.70	20	350.75	0.070	0.466	0.1502	Pass
	Band 13-NB-IoT	26.50	0.70	20	393.55	0.078	0.518	0.1506	Pass
	Band 25-NB-IoT	26.50	1.00	20	562.34	0.112	1.000	0.1120	Pass
	Band 26-NB-IoT	26.00	0.70	20	350.75	0.070	0.543	0.1289	Pass
	Band 2- M1	25.00	1.00	20	398.11	0.079	1.000	0.0790	Pass
	Band 4- M1	25.00	1.00	20	398.11	0.079	1.000	0.0790	Pass
	Band 5- M1	25.00	0.70	20	278.61	0.056	0.549	0.1020	Pass
	Band 12- M1	25.00	0.70	20	278.61	0.056	0.466	0.1202	Pass
	Band 13- M1	25.00	0.70	20	278.61	0.056	0.518	0.1081	Pass
	Band 25- M1	24.00	1.00	20	316.23	0.063	1.000	0.0630	Pass
	Band 26- M1	24.00	0.70	20	221.31	0.044	0.543	0.0810	Pass
Bluetooth	BLE	5.50	1.88	20	5.47	0.001	1.000	0.0010	Pass

5.4 Collocated Power Density Calculation

Evolution mode	Frequency(MHz)	Power /Limit	$\Sigma(\text{Power / Limit})$ of WWAN + Bluetooth	Verdict
GSM850	824MHz ~ 849MHz	0.4627	0.4637	Pass
Bluetooth	2400MMHz ~ 2483.5MHz	0.0010		

Note:

1. $\Sigma(\text{Power Density / Limit})$: This is a summation of [(power density for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WWAN+Bluetooth
2. Both of the WWAN/Bluetooth can transmit simultaneously, the formula of calculated the MPE is $\text{CPD1} / \text{LPD1} + \text{CPD2} / \text{LPD2} + \dots \text{etc.} < 1$
 CPD = Calculation power density
 LPD = Limit of power density
3. The worst-case situation is 0.4637, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.
4. The DUT work frequency range used is 699 MHz ~ 716 MHz, 777 MHz ~ 787 MHz, 814 MHz ~ 849 MHz, 824 MHz ~ 849 MHz, 1850 MHz ~ 1910 MHz, 1710 MHz ~ 1755MHz, 2400MHz ~ 2483.5MHz, 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 RF (BL-EC2341272-501/601) 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

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.
2. The report without China inspection body and laboratory Mandatory Approval (CMA) mark has no effect of proving to the society.
3. For the report with CNAS mark or A2LA mark, the items marked with "☆" are not within the accredited scope.
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5. The test data and results are only valid for the tested samples provided by the customer.
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7. Any objection shall be raised to the laboratory within 30 days after receiving the report.

--END OF REPORT--