

TEST REPORT

Applicant: Queclink Wireless Solutions Co., Ltd.
Address: No.30, Hongqiao Wanchuang Center Phase I, Lane
500, Xinlong Road, Minhang District, Shanghai,
China 201101
Equipment Type: GL31MG
Model Name: GL31MG
Brand Name: Queclink
FCC ID: YQD-GL31MG
Test Standard: 47 CFR Part 2.1091
KDB 447498 D04 v01
Sample Arrival Date: Jul. 01, 2024
Test Date: Jul. 03, 2024
Date of Issue: Aug. 01, 2024

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Xu Rui**Checked by:** Zong Liyao**Approved by:** Tolan Tu
(Testing Director)

Revision History

<u>Version</u>	<u>Issue Date</u>	<u>Revisions Content</u>
<u>Rev. 01</u>	<u>Aug. 01, 2024</u>	<u>Initial Issue</u>

TABLE OF CONTENTS

1	GENERAL INFORMATION.....	3
1.1	Test Laboratory	3
1.2	Test Location	3
2	PRODUCT INFORMATION	4
2.1	Applicant Information	4
2.2	Manufacturer Information.....	4
2.3	General Description for Equipment under Test (EUT).....	4
2.4	Technical Information	5
3	SUMMARY OF TEST RESULT	6
3.1	Test Standards	6
4	DEVICE CATEGORY AND LEVELS LIMITS	7
5	ASSESSMENT RESULT	9
5.1	Output Power	9
5.2	Tune-up power	11
5.3	RF Exposure Evaluation Result	12
5.4	Collocated Power Calculation	13
5.5	Conclusion.....	13

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	Queclink Wireless Solutions Co., Ltd.
Address	No.30, Hongqiao Wanchuang Center Phase I, Lane 500, Xinlong Road, Minhang District, Shanghai, China 201101

2.2 Manufacturer Information

Manufacturer	Queclink Wireless Solutions Co., Ltd.
Address	No.30, Hongqiao Wanchuang Center Phase I, Lane 500, Xinlong Road, Minhang District, Shanghai, China 201101

2.3 General Description for Equipment under Test (EUT)

EUT Name	GL31MG
Model Name Under Test	GL31MG
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	V1.03
Software Version	R00A01V08
Dimensions (Approx.)	106 × 32 × 20mm
Weight (Approx.)	N/A

2.4 Technical Information

Network and Wireless connectivity	2G Network GSM/GPRS/EDGE 850/900/1800/1900 MHz 4G Network LTE FDD Cat M1: B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B27/B28/B66/B85 LTE FDD Cat NB2: B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B28/B66/B71/B85 Bluetooth BLE, GPS
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The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	WWAN, Bluetooth		
Frequency Range	GSM 850	TX: 824 ~ 849 MHz	RX: 869 ~ 894 MHz
	GSM 1900	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 25	TX: 1850 ~ 1915 MHz	RX: 1930 ~ 1995 MHz
	LTE-M1 Band 66	TX: 1710 ~ 1780 MHz	RX: 2110 ~ 2180 MHz
	LTE-M1 Band 85	TX: 698 ~ 716 MHz	RX:728 ~ 746 MHz
	LTE-NB-IoT Band 2	TX: 1850 ~ 1910 MHz	RX: 1930 ~ 1990 MHz
	LTE-NB-IoT Band 4	TX: 1710 ~ 1755 MHz	RX: 2110 ~ 2155 MHz
	LTE-NB-IoT Band 5	TX: 824 ~ 849 MHz	RX: 869 ~ 894 MHz
	LTE-NB-IoT Band 12	TX: 699 ~ 716 MHz	RX: 729 ~ 746 MHz
	LTE-NB-IoT Band 13	TX: 777~ 787 MHz	RX: 746 ~ 756 MHz
	LTE-NB-IoT Band 25	TX: 1850 ~ 1915 MHz	RX: 1930 ~ 1995 MHz
	LTE-NB-IoT Band 66	TX: 1710 ~ 1780 MHz	RX: 2110 ~ 2180 MHz
	LTE-NB-IoT Band 71	TX: 663 ~ 698 MHz	RX: 617 ~ 652 MHz
	LTE-NB-IoT Band 85	TX: 698 ~ 716 MHz	RX:728 ~ 746 MHz
	Bluetooth	2400 ~ 2483.5 MHz	
Antenna Type	WWAN: Ceramics Antenna Bluetooth: Ceramics 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							
GSM850 Band	Burst Average Power(dBm)			Division Factors	Frame-Averaged power (dBm)		
Channel	Low Channel	Middle Channel	High Channel		Low Channel	Middle Channel	High Channel
GSM (GMSK, 1-Slot)	32.95	33.30	33.14	9.19	23.76	24.11	23.95
GPRS (GMSK, 1-Slot)	32.95	33.30	33.14	9.19	23.76	24.11	23.95
GPRS (GMSK, 2-Slots)	31.41	31.76	31.74	6.13	25.28	25.63	25.61
GPRS (GMSK, 3-Slots)	29.87	29.57	29.53	4.42	25.45	25.15	25.11
GPRS (GMSK, 4-Slots)	28.29	28.12	28.41	3.18	25.11	24.94	25.23
EGPRS (8PSK, 1-Slot)	27.53	27.57	27.37	9.19	18.34	18.38	18.18
EGPRS (8PSK, 2-Slots)	26.34	26.48	26.09	6.13	20.21	20.35	19.96
EGPRS (8PSK, 3-Slots)	25.24	25.18	24.99	4.42	20.82	20.76	20.57
EGPRS (8PSK, 4-Slots)	23.98	24.16	23.89	3.18	20.80	20.98	20.71
GSM1900 Band	Burst Average Power(dBm)			Division Factors	Frame-Averaged power(dBm)		
Channel	Low Channel	Middle Channel	High Channel		Low Channel	Middle Channel	High Channel
GSM (GMSK, 1-Slot)	30.89	30.76	30.35	9.19	21.70	21.57	21.16
GPRS (GMSK, 1-Slot)	30.89	30.76	30.35	9.19	21.70	21.57	21.16
GPRS (GMSK, 2-Slots)	29.35	29.22	29.42	6.13	23.22	23.09	23.29
GPRS (GMSK, 3-Slots)	28.38	27.89	28.01	4.42	23.96	23.47	23.59
GPRS (GMSK, 4-Slots)	26.96	26.79	26.91	3.18	23.78	23.61	23.73
EGPRS (8PSK, 1-Slot)	25.82	25.54	25.29	9.19	16.63	16.35	16.10
EGPRS (8PSK, 2-Slots)	24.95	24.83	24.47	6.13	18.82	18.70	18.34
EGPRS (8PSK, 3-Slots)	23.19	23.04	22.76	4.42	18.77	18.62	18.34
EGPRS (8PSK, 4-Slots)	22.19	21.94	21.98	3.18	19.01	18.76	18.80
Note: This table listed the worst case power value, please refer to BL-EC2140498-501 report for more details.							

Mode	GSM	
	GSM850	GSM1900
Conducted Power (dBm)	25.63	23.96
Antenna Gain (dBm)	-0.76	-1.20
ERP/EIRP (dBm)	22.72	22.76
Note: This table listed the worst case power value, please refer to BL-EC2140498-501 report for more details.		

LTE-M1

Mode	Band2	Band4	Band5	Band12	Band13	Band25	Band66
Conducted Power (dBm)	22.98	22.79	22.80	22.80	22.66	22.5	22.48
Antenna Gain (dBi)	-1.20	-0.90	-0.76	-3.00	-0.81	-1.20	-0.90
ERP/EIRP (dBm)	21.78	21.89	19.89	17.65	19.70	21.30	21.58

Note: This table listed the worst case power value, please refer to BL-EC2140498-501 report for more details.

LTE-NB-IoT

Mode	Band2	Band4	Band5	Band12	Band13	Band25	Band66	Band71	Band85
Conducted Power (dBm)	22.40	22.39	22.40	22.34	22.37	22.30	22.31	21.88	22.29
Antenna Gain (dBi)	-1.20	-0.90	-0.76	-3.00	-0.81	-1.20	-0.90	-4.10	-2.40
ERP/EIRP (dBm)	21.20	21.49	19.49	17.19	19.41	21.10	21.41	15.63	17.74

Note: This table listed the worst case power value, please refer to BL-EC2140498-501 report for more details.

Bluetooth

Mode	BLE
Conducted Power (dBm)	4.95
Antenna Gain (dBi)	3.95
EIRP (dBm)	8.90

Note: This report listed the maximal case power value, please refer to BL-SH2470362-601 report for more details.

5.2 Tune-up power

Mode	Conducted Power Range (dBm)	EIRP Range (dBm)	ERP Range (dBm)
GSM850	[25.00,27.00]	/	[21.85,23.85]
GSM1900	[23.00,25.00]	[22.00,24.00]	[19.85,21.85]
LTE-M1 Band2	[22.00,24.00]	[21.00,23.00]	[18.85,20.85]
LTE-M1 Band4	[22.00,24.00]	[21.00,23.00]	[18.85,20.85]
LTE-M1 Band5	[22.00,24.00]	/	[18.85,20.85]
LTE-M1 Band12	[22.00,24.00]	/	[16.85, 18.85]
LTE-M1 Band13	[22.00,24.00]	/	[18.85,20.85]
LTE-M1 Band25	[21.00,23.00]	[20.00,22.00]	[17.85,19.85]
LTE-M1 Band66	[21.00,23.00]	[20.00,22.00]	[17.85,19.85]
LTE-M1 Band85	[21.00,23.00]	/	[16.85,18.85]
LTE-NB-IoT Band Band2	[21.00,23.00]	[20.00,22.00]	[17.85,19.85]
LTE-NB-IoT Band Band4	[21.00,23.00]	[20.00,22.00]	[17.85,19.85]
LTE-NB-IoT Band Band5	[21.00,23.00]	/	[18.85,20.85]
LTE-NB-IoT Band Band12	[21.00,23.00]	/	[15.85,17.85]
LTE-NB-IoT Band Band13	[21.00,23.00]	/	[18.85,20.85]
LTE-NB-IoT Band Band25	[21.00,23.00]	[20.00,22.00]	[17.85,19.85]
LTE-NB-IoT Band Band66	[21.00,23.00]	[20.00,22.00]	[17.85,19.85]
LTE-NB-IoT Band Band71	[21.00,23.00]	/	[14.85,16.85]
LTE-NB-IoT Band Band85	[21.00,23.00]	/	[16.85,18.85]
Bluetooth BLE	[4.00,6.00]	[8.00,10.00]	[5.85,7.85]
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
GSM850	27.00	501.19	200	1731.96	0.289	Pass
GSM1900	25.00	316.23	200	3060.00	0.103	Pass
LTE-M1 Band2	24.00	251.19	200	3060.00	0.082	Pass
LTE-M1 Band4	24.00	251.19	200	3060.00	0.082	Pass
LTE-M1 Band5	24.00	251.19	200	1731.96	0.145	Pass
LTE-M1 Band12	24.00	251.19	200	1460.64	0.172	Pass
LTE-M1 Band13	24.00	251.19	200	1605.48	0.156	Pass
LTE-M1 Band25	23.00	199.53	200	3060.00	0.065	Pass
LTE-M1 Band66	23.00	199.53	200	3060.00	0.065	Pass
LTE-M1 Band85	23.00	199.53	200	1460.64	0.137	Pass
LTE-NB-IoT Band Band2	23.00	199.53	200	3060.00	0.065	Pass
LTE-NB-IoT Band Band4	23.00	199.53	200	3060.00	0.065	Pass
LTE-NB-IoT Band Band5	23.00	199.53	200	1731.96	0.115	Pass
LTE-NB-IoT Band Band12	23.00	199.53	200	1460.64	0.137	Pass
LTE-NB-IoT Band Band13	23.00	199.53	200	1605.48	0.124	Pass
LTE-NB-IoT Band Band25	23.00	199.53	200	3060.00	0.065	Pass
LTE-NB-IoT Band Band66	23.00	199.53	200	3060.00	0.065	Pass
LTE-NB-IoT Band Band71	23.00	199.53	200	1423.92	0.140	Pass
LTE-NB-IoT Band Band85	23.00	199.53	200	1460.64	0.137	Pass
Bluetooth BLE	7.85	6.10	200	3060.00	0.002	Pass

5.4 Collocated Power Calculation

Evolution mode	Frequency(MHz)	Power /Limit	$\Sigma(\text{Power} / \text{Limit})$ of WWAN + BT	Verdict
GSM850	824 ~ 849 MHz	0.289	0.291	Pass
Bluetooth BLE	2400 ~ 2483.5 MHz	0.002		

Note:

1. $\Sigma(\text{Power} / \text{Limit})$: This is a summation of [(power for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding Power limit)], for BT+WWAN.
2. Both of the BT/WWAN 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
3. The worst-case situation is 0.291, 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, 663 MHz ~ 698 MHz 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

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--