



RF Exposure evaluation

Report Reference No.....: GTSR19010009-04

FCC ID.: 2ASJA-B8821CU1

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Date of issue.....: Feb.25, 2019

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Applicant's name.....: REV Robotics LLC

Address: 1621 W Crosby Road Suite 104 Carrollton TX,75006

Test specification

47CFR §1.1310

Standard: **47CFR §2.1091**

KDB447498 v06

TRF Originator.....: Shenzhen Global Test Service Co.,Ltd.

Master TRF.....: Dated 2014-12

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Test item description: IEEE 802.11a/b/g/n/ac(1T1R) USB WLAN And BT Module

Trade Mark: /

Manufacturer: Shenzhen Bilian Electronic Co.,Ltd

Model/Type reference.....: BL-M8821CU1

Listed Models: /

Modulation Type: IEEE 802.11a /802.11ac /802.11b/802.11g/802.11n

Operation Frequency.....: From 2412 - 2462MHz &5180 - 5240MHz

Hardware Version: V1.1

Software Version: V30_20121220

Rating: DC 3.3V

Result: **PASS**

TEST REPORT

Test Report No. : GTSR19010009-04	Feb. 25, 2019
	Date of issue

Equipment under Test : IEEE 802.11a/b/g/n/ac(1T1R) USB WLAN And BT Module

Model /Type : BL-M8821CU1

Listed Models : /

Applicant : REV Robotics LLC

Address : 1621 W Crosby Road Suite 104 Carrollton TX, 75006

Manufacturer : Shenzhen Bilian Electronic Co.,Ltd

Address : No.3 Building 401, 107 FuQian Rd, JuTang Community
Fucheng Street, Longhua District, shenzhen, P.R.China

Test Result:	PASS
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The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1. SUMMARY

1.1. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - supplied by the lab

○		Length (m) :	/
		Shield :	/
		Detachable :	/

1.2. Product Description

Product Name:	IEEE 802.11a/b/g/n/ac(1T1R) USB WLAN And BT Module
Trade Mark:	/
Model/Type reference:	BL-M8821CU1
Antenna Type	Connect to external antenna
Power supply:	DC 3.3V
Notebook:	Manufacturer: TOSHIBA Model: Satellite S40Dt-A
WIFI	
WLAN	Supported 802.11 a/b/g/n/ac
Modulation Type	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11ac: OFDM(64QAM, 16QAM, QPSK, BPSK)
Operation frequency	IEEE 802.11a:5180-5240MHz IEEE 802.11b:2412-2472MHz IEEE 802.11g:2412-2472MHz IEEE 802.11n HT20:2412-2472MHz, 5180-5240MHz IEEE 802.11n HT40:2422-2462MHz, 5180-5240MHz IEEE 802.11ac:5180-5240MHz
Antenna gain	1.62 dBi Max
BT	
Modulation Type	GFSK
Operation frequency	2402-2480MHz
Antenna gain	1.62 dBi Max

2. TEST ENVIRONMENT

2.1. Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.

1F, Building No. 13A, Zhonghaixin Science and Technology City, No.12,6 Road, Ganli Industrial Park, Buji Street, Longgang District, Shenzhen, Guangdong

2.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 165275

Shenzhen Global Test Service Co.,Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

CNAS-Lab Code: L8169

Shenzhen Global Test Service Co.,Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No.: 4758.01

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

2.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

2.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the Shenzhen Global Test Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

Test Items	Measurement Uncertainty	Notes
Transmitter power conducted	0.57 dB	(1)

- (1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3. Method of measurement

3.1. Applicable Standard

According to §1.1307(b)(1), 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.

According to §1.1310 and §2.1091 RF exposure is calculated.

KDB447498 v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

3.2. Requirement

Systems operating under the provisions of FCC 47 CFR 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.

In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 . The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

3.3. Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	6
3.0 – 30	1842/f	4.89/f	(900/f ²)*	6
30 – 300	61.4	0.163	1.0	6
300 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 30	824/f	2.19/f	(180/f ²)*	30
30 – 300	27.5	0.073	0.2	30
300 – 1500	/	/	f/1500	30
1500 – 100,000	/	/	1.0	30

F=frequency in MHz

*=Plane-wave equivalent power density

3.4. MPE Calculation Method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

Where: S=power density

P=power input to antenna

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

R=distance to the center of radiation of the antenna

As declared by the Applicant, the EUT transmits with the maximum source-based Duty Cycle of 100%-see the User manual, and the EUT is a wireless device used in a mobile application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum mobile separation distance, $r = 20\text{cm}$, as well as the gain of the used antenna is 1.06dBi for WLAN, and the power drift from Turn-up Procedure provide by manufacturer as following states, the RF power density can be obtained..

3.5. Antenna Information

BL-R8812AF1 can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna	2.4G Wifi /BT 5G wifi	External Antenna	2.4GHz – 2.4835 GHz 5.150-5.250 GHz	1.62dBi(Max.)

4. Evaluation Result

4.1. Standalone MPE

	Target power W/ tolerance (dBm)	Max tune up power tolerance(dB m)	Max Output power to antenna (mW)	Antenna Gain (Numeric)	Power Density at R=20cm (mW/cm2)	Limit (mW/cm2)	Result
BT	1 ± 1.5	2.5	1.7783	1.452	0.0005	1.0	Pass
2.4G wifi	15 ± 1.5	16.5	44.6684	1.452	0.0129	1.0	Pass
5G wifi	15 ± 1.5	16.5	44.6684	1.452	0.0129	1.0	Pass

4.2. Simultaneous transmission MPE Considerations

According to KDB447498 :For mobile exposure host platform to qualify for simultaneous transmission MPE test exclusion, all transmitters and antennas in the host must be either evaluated for MPE compliance, by measurement or computational modeling, or qualify for the standalone MPE test exclusion in section 7.1. Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 .

This means that:

$\sum$ of MPE ratios ≤ 1.0

The EUT is Not Applicable.

5. Conclusion

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

.....End of Report.....