

TEST REPORT

Applicant: Quectel Wireless Solutions Co., Ltd
Address: Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
Equipment Type: Wi-Fi & BT Module
Model Name: FC80A
Brand Name: Quectel
FCC ID: XMR202203FC80A
ISED Number: 10224A-202203FC80A
Test Standard: 47 CFR Part 2.1091
KDB 447498 D01 v06
Test Date: Mar. 02, 2022 - Jun. 08, 2022
Date of Issue: Jun. 14, 2022

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

**Tested by:** Julie Zhu**Checked by:** Liyao Zong**Approved by:** Wei Yanquan
(Chief Engineer)

Revision History

<u>Version</u>	<u>Issue Date</u>	<u>Revisions Content</u>
<u>Rev. 01</u>	<u>Jun. 14, 2022</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	Quectel Wireless Solutions Co., Ltd
Address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233

2.2 Manufacturer Information

Manufacturer	Quectel Wireless Solutions Co., Ltd
Address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233

2.3 Factory Information

Factory	N/A
Address	N/A

2.4 General Description for Equipment under Test (EUT)

EUT Name	Wi-Fi & BT Module
Model Name Under Test	FC80A
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	R1.0
Software Version	N/A
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.5 Ancillary Equipment

N/A.

2.6 Technical Information

Network and Wireless connectivity	Bluetooth (BR+EDR+BLE) 2.4G WIFI 802.11b, 802.11g, 802.11n(HT20) 5G WIFI 802.11a, 802.11n(20/40), 802.11ac(VHT20/40/80) U-NII-1/2A/2C/3
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The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	2.4G WLAN; 5G WLAN; Bluetooth	
Frequency Range	Bluetooth	2400 ~ 2483.5 MHz
	802.11b/g	2400 ~ 2483.5 MHz
	802.11n(HT20/HT40)	2400 ~ 2483.5 MHz
	802.11a	5150 ~ 5350 MHz
		5470 ~ 5725 MHz
		5725 ~ 5850 MHz
	802.11n(HT20/HT40)	5150 ~ 5350 MHz
		5470 ~ 5725 MHz
		5725 ~ 5850 MHz
	802.11ac(VHT20/VHT40/VHT80)	5150 ~ 5350 MHz
		5470 ~ 5725 MHz
Antenna Type	WLAN	Dipole Antenna
	Bluetooth	Dipole 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

Bluetooth				
Mode	BR+EDR			BLE
	GFSK	$\pi/4$ -DQPSK	8-DPSK	GFSK
Peak Power (dBm)	7.18	5.39	5.73	7.60

Note: This report listed the worst case peak power value, please refer to RF test report for more details.

2.4G WIFI			
Mode	Main Antenna		
	802.11b	802.11g	802.11n20
Average Power (dBm)	17.81	17.99	17.99
Mode	Aux. Antenna		
	802.11b	802.11g	802.11n20
Average Power (dBm)	17.82	17.81	17.93
Mode	MIMO-Main Antenna		
	802.11n20		
Average Power (dBm)	15.14		
Mode	MIMO-Aux. Antenna		
	802.11n20		
Average Power (dBm)	14.78		
Mode	MIMO		
	802.11n20		
Average Power (dBm)	17.97		

Note: This report listed the worst case average power value, please refer to RF test report for more details.

5.2G WIFI						
Mode	Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	14.52	14.57	14.68	14.60	15.35	11.35
Mode	Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	14.97	14.86	15.10	15.12	15.02	10.93
Mode	MIMO-Main Antenna					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	11.78	11.68	11.55	11.85	12.54	
Mode	MIMO-Aux. Antenna					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	12.21	11.56	11.87	11.83	11.96	
Mode	MIMO					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	15.01	14.63	14.60	14.85	15.27	
Note: This report listed the worst case conducted power value, please refer to RF test report for more details.						

5.3G WIFI						
Mode	Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	15.03	14.89	14.75	14.92	15.00	15.23
Mode	Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	15.12	15.16	15.34	14.95	15.34	14.23
Mode	MIMO-Main Antenna					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	11.70	11.99	11.96	11.91	12.16	
Mode	MIMO-Aux. Antenna					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	11.88	11.95	11.80	11.90	12.01	
Mode	MIMO					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	14.74	14.92	14.89	14.92	15.10	
Note: This report listed the worst case conducted power value, please refer to RF test report for more details.						

5.6G WIFI						
Mode	Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	14.93	14.71	14.81	14.70	15.03	14.86
Mode	Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	14.76	14.64	15.17	14.05	14.47	14.78
Mode	MIMO-Main Antenna					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	11.37	11.85	11.28	11.77	11.99	
Mode	MIMO-Aux. Antenna					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	11.56	11.38	11.65	11.47	11.91	
Mode	MIMO					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	14.48	14.55	14.48	14.63	14.96	
Note: This report listed the worst case conducted power value, please refer to RF test report for more details.						

5.8G WIFI						
Mode	Main Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	14.74	14.54	14.77	14.60	14.85	14.96
Mode	Aux. Antenna					
	802.11a	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80
Conducted Power (dBm)	15.21	14.95	14.94	14.96	15.07	14.99
Mode	MIMO-Main Antenna					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	11.52	11.85	11.27	11.55	12.01	
Mode	MIMO-Aux. Antenna					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	12.29	12.22	11.96	12.18	12.46	
Mode	MIMO					
	802.11n20	802.11n40	802.11ac20	802.11ac40	802.11ac80	
Conducted Power (dBm)	14.69	15.02	14.63	14.89	15.25	
Note: This report listed the worst case conducted power value, please refer to RF test report for more details.						

5.2 Tune-up power

Mode		Range (dBm)
Bluetooth		5.00-8.00
2.4G WIFI	Main Antenna	11.00-19.00
	Aux. Antenna	14.00-19.00
	MIMO-Main Antenna	12.00-16.00
	MIMO-Aux. Antenna	12.00-15.00
	MIMO	15.00-19.00
5.2G WIFI	Main Antenna	11.00-16.00
	Aux. Antenna	10.00-16.00
	MIMO-Main Antenna	9.00-14.00
	MIMO-Aux. Antenna	9.00-13.00
	MIMO	12.00-16.00
5.3G WIFI	Main Antenna	12.00-16.00
	Aux. Antenna	14.00-16.00
	MIMO-Main Antenna	11.00-13.00
	MIMO-Aux. Antenna	11.00-13.00
	MIMO	14.00-16.00
5.6G WIFI	Main Antenna	12.00-16.00
	Aux. Antenna	11.00-16.00
	MIMO-Main Antenna	8.00-13.00
	MIMO-Aux. Antenna	9.00-13.00
	MIMO	11.00-16.00
5.8G WIFI	Main Antenna	14.00-16.00
	Aux. Antenna	14.00-16.00
	MIMO-Main Antenna	10.00-13.00
	MIMO-Aux. Antenna	11.00-13.00
	MIMO	14.00-16.00

5.3 RF Exposure Evaluation Result

Evolution mode	Maximum Conducted power (dBm)	Antenna Gain (typical) (dBi):	Total Power (mw)	Distance (cm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Power Density / Limit	Verdict
Bluetooth	8.00	1.00	7.943	20	1.00	0.002	0.002	Pass
2.4G WIFI	19.00	1.00	100.000	20	1.00	0.020	0.020	Pass
5.2G WIFI	16.00	1.00	50.119	20	1.00	0.010	0.010	Pass
5.3G WIFI	16.00	1.00	50.119	20	1.00	0.010	0.010	Pass
5.6G WIFI	16.00	1.00	50.119	20	1.00	0.010	0.010	Pass
5.8G WIFI	16.00	1.00	50.119	20	1.00	0.010	0.010	Pass

5.4 Collocated Power Density Calculation

Evolution mode	Frequency(MHz)	Power Density/Limit	Σ (Power Density / Limit) of Bluetooth + 2.4G WIFI + 5G WIFI	Verdict
Bluetooth	2400 MHz ~ 2483.5 MHz	0.002	0.032	Pass
2.4G WIFI	2400 MHz ~ 2483.5 MHz	0.020		
5.8G WIFI	5725 MHz ~ 5850 MHz	0.010		

Note:

1. Σ (Power Density / Limit): This is a summation of [(power density for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WLAN + Bluetooth.
2. The worst-case situation is 0.032, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.
3. The DUT work frequency range used is 2400 MHz ~ 2483.5 MHz and 5725 MHz ~ 5850 MHz the result close to the limit by the above formula, so we select worst case power to calculate the exclusion power threshold.
4. More power list please refer to RF 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.
4. This report is invalid if it is altered, without the signature of the testing and approval personnel, or without the "inspection and testing dedicated stamp" or test report stamp.
5. The test data and results are only valid for the tested samples provided by the customer.
6. This report shall not be partially reproduced without the written permission of the laboratory.
7. Any objection shall be raised to the laboratory within 30 days after receiving the report.

--END OF REPORT--