

Report SUHR/2021/B001006

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TEST REPORT

Application No.: HR/2021/B0010

Applicant: Quectel Wireless Solutions Co., Ltd.

Address of Applicant: Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin

Road, Minhang District, Shanghai, China 200233

Manufacturer: Quectel Wireless Solutions Co., Ltd.

Address of Manufacturer: Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin

Road, Minhang District, Shanghai, China 200233

EUT Description: Wi-Fi & Bluetooth Module

Model No.: AF51Y

Trade Mark: QUECTEL

FCC ID: XMR202201AF51Y **Standards:** 47 CFR Part 2.1091

FCC KDB 447498 D01 v06

Date of Receipt: 2022/2/12 **Date of Issue:** 2022/4/2

Test Result: PASS*

Authorized Signature:

Panta Sun Wireless Laboratory Manager



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 t (86—512) 62992980
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 邮编: 215000
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 sgs.china@sgs.com

^{*} In the configuration tested, the EUT complied with the standards specified above.

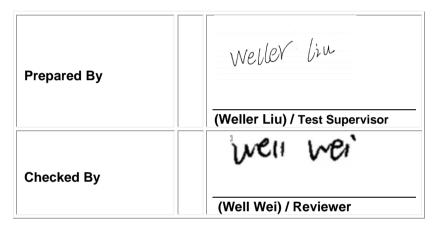


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1 Version

Revision Record							
Version	Chapter	Date	Modifier	Remark			
01		2022/3/31		Original			
02		2022/4/2		Add A2LA+ILAC logo			



Remark: This report supersedes our previous report SUHR/2021/B001006 issued on 2021-03-31, which is hereby deemed null and void.



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2 General Information

2.1 Client Information

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

2.2 Test Facility

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

• A2LA (Certificate No. 6336.01)

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 6336.01.

• Innovation, Science and Economic Development Canada

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0120.

IC#: 27594.

• FCC –Designation Number: CN1312

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized as an

accredited testing laboratory. Designation Number: CN1312.

Test Firm Registration Number: 717327





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2.3 General Description of EUT

EUT Description:	Wi-Fi & Bluetooth Module
Model No.:	AF51Y
Trade Mark:	QUECTEL
Hardware Version:	R1.0
Software Version:	AG525RGLAAR01A16M4G_OCPU _01.011 (Remark: the SW of branch is Post-CS[13]0.0.125.1)
Sample Type:	☐ Portable Device, ☑Module
Antenna Type:	⊠ External, ☐ Integrated
	⊠Provided by client
	Bluetooth -1.38dBi (Ant2);
	WiFi 2.4G -1.97dBi (Ant1); -1.38dBi (Ant2);
Antenna Gain*:	WiFi 5G (Band I) -2.96dBi (Ant1); -2.04dBi (Ant2);
	WiFi 5G (Band II-A) -1.24dBi (Ant1); -0.32dBi (Ant2);
	WiFi 5G (Band II-C) -1.46dBi (Ant1); -0.54dBi (Ant2);
	WiFi 5G (Band III) -1.71dBi (Ant1); -0.79dBi (Ant2);

Note: *Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information, SGS is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.

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3 RF Exposure Evaluation

3.1 RF Exposure Compliance Requirement

3.1.1 Limits

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm2)	Averaging time (minutes)						
	(A) Limits for Occup	ational/Controlled Expo	sures							
0.3-3.0	614	1.63	*(100)	6						
3.0-30	1842/f	4.89/f	*(900/f2)	6						
30-300	61.4	0.163	1.0	6						
300-1500	/	1	f/300	6						
1500-100,000	/	1	5	6						
	(B) Limits for General Population/Uncontrolled Exposure									
0.3-1.34	614	1.63	*(100)	30						
1.34-30	824/f	2.19/f	*(180/f2)	30						
30-300	27.5	0.073	0.2	30						
300-1500	1	1	f/1500	30						
1500-100,000	1	1	1.0	30						

F=frequency in MHz

RF exposure compliance will need to be determined with respect to 1.1307(c) and (d) of the FCC rules. The emissions should be within the limits at 300kHz in Table 1 of 1.1310(use the 300kHz limits for 150kHz:614V/m,1.63A/m).

Friis Formula

Friis transmission formula: Pd = (Pout*G)/(4* Pi * R 2)

Where

Pd = power density in mW/cm2

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

Pd id the limit of MPE, 1 mW/cm2. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.



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^{*=}Plane-wave equivalent power density



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Frequency	Gain1	Gain2	Directional Gain
2412-2472	-1.97	-1.38	-1.66
5150-5250	-2.96	-2.04	-2.48
5250-5350	-1.24	-0.32	-0.76
5470-5725	-1.46	-0.54	-0.98
5725-5850	-1.71	-0.79	-1.23

Remark: Refer to KDB662911 D01 Multiple Transmitter Output v02r01.

- d) Unequal antenna gains, with equal transmit powers. For antenna gains given by G1, G2, ..., GN dBi
 - (i) If transmit signals are correlated, then Directional gain = 10 log[(10^{G_I/20} + 10^{G₂/20} + ... + 10^{G_N/20})²/N_{ANT}] dBi [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]



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3.1.2 Test Procedure

Software provided by client enabled the EUT to transmit data at lowest, middle and highest channel individually

3.1.3 EUT RF Exposure Evaluation

Antenna Gain: The maximum Gain measured in fully anechoic chamber is $2.0 \, / \, 2.0$ in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

This confirmed that the device comply with MPE limit.

Operating Band	Frequenc y (MHz)	Antenna Gain (dBi)	Max Conducted Average Output Power (dBm)	Output Power to Antenna (dBm)	EIRP(ERP) Limit (dBm)	Output Power to Antenna (mw)	Power Density at R = 20 cm (mW/cm2)	Limit (mW/cm2)	Gain according to EIRP (dBi)	Gain according to Pd (dBi)	Max Gain Allowed (dBi)	conclusion
Bluetooth	2402	-1.38	12.00	10.62	30.00	15.8489	0.0023	1.0000	18.00	25.01	18.00	Pass
2.4G WiFi	2412	-1.38	19.50	18.12	30.00	89.1251	0.0129	1.0000	10.50	17.51	10.50	Pass
2.4G WiFi(MIMO)	2412	-1.66	19.00	17.34	30.00	79.4328	0.0108	1.0000	11.00	18.01	11.00	Pass
5G WiFi	5320	-0.32	17.50	17.18	30.00	56.2341	0.0104	1.0000	12.50	19.51	12.50	Pass
5G WiFi(MIMO)	5320	-0.76	17.50	16.74	30.00	56.2341	0.0094	1.0000	12.50	19.51	12.50	Pass



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3.1.4 Exposure calculations for multiple sources

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE in accordance with the provisions of Table(A) and Table(B). To comply with the MPE, the fraction of the MPE in terms of E2, H2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity.

In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \le 1$$

The product also has multiple transmitters The Simultaneous Transmission Possibilities are as below:

Simultaneous Tx Combination	Configuration
4	Bluetooth + WiFi 2.4G
1	Bluetooth + WiFi 2.4G(MIMO)
2	Bluetooth + WiFi 5G
2	Bluetooth + WiFi 5G(MIMO)

No.	Mode	Power Density (mW/cm2)	MPE Limit (mW/cm2)	Result Ratio	Total Ratio	Limit	Result
	Bluetooth	0.0023	1.0000	0.0023	0.0152	1.00	Pass
	WiFi 2.4G	0.0129	1.0000	0.0129	0.0152		
'	Bluetooth	0.0023	1.0000	0.0023	0.0131	1.00	Pass
	WiFi 2.4G(MIMO)	0.0108	1.0000	0.0108	0.0131		
	Bluetooth	0.0023	1.0000	0.0023	0.0127	1.00	Pass Pass
2	WiFi 5G	0.0104	1.0000	0.0104	0.0127		
	Bluetooth	0.0023	1.0000	0.0023	0.0117	1.00	
	WiFi 5G(MIMO)	0.0094	1.0000	0.0094	0.0117	1.00	

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