

RF Exposure Evaluation Report

Application No.: KSCR2509001991AT
FCC ID: XMR202401AF68E
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
Equipment Under Test (EUT):
EUT Name: Wi-Fi & Bluetooth Module
Model No.: AF68E
Trade Mark: QUECTEL
Standard(s) : FCC Rules 47 CFR §2.1091
KDB 447498 D04 interim General RF Exposure Guidance v01
Date of Receipt: 2025-08-31
Date of Test: 2025-09-01 to 2025-09-04
Date of Issue: 2025-09-12

Test Result:	Pass*
---------------------	--------------

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

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/en/Terms-and-Conditions/Terms-e-Documents>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.



Revision Record			
Version	Description	Date	Remark
00	Add a new antenna	2025-09-12	Based on KSCR240200030907

Authorized for issue by:				
Tested By		Maker Qi		
		Maker Qi /Project Engineer		
Approved By		Terry Hou		
		Terry Hou /Reviewer		



1 Contents

	Page
1 Contents	3
2 General Information.....	4
2.1 General Description of E.U.T.	4
2.2 Technical Specifications.....	4
2.3 Separation Distance	7
2.4 Test Location.....	8
2.5 Test Facility	8
3 RF Exposure Test Exemptions.....	9
3.1 RF Exposure Test Exemptions for single RF sources	9
3.2 RF Exposure Test Exemptions for Simultaneous Transmission.....	11
4 Measurement and Calculation.....	13
4.1 Maximum transmit power	13
4.2 RF Exposure Calculation	13

2 General Information

2.1 General Description of E.U.T.

Power supply:	DC 3.3-4.8V,Typ: 3.85V
---------------	------------------------

2.2 Technical Specifications

BLE

Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	V5.3 Dual mode
Modulation Type:	GFSK
Number of Channels:	40
Channel Spacing:	2MHz
Antenna Type:	External antenna
Antenna Gain:	2.5dBi(Provided by the manufacturer)

BT

Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	V5.3 Dual mode
Modulation Type:	GFSK, pi/4DQPSK, 8DPSK
Number of Channels:	79
Channel Spacing:	1MHz
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Antenna Type:	External antenna
Antenna Gain:	2.5dBi(Provided by the manufacturer)

2.4GHz WiFi

Operation Frequency:	802.11b/g/n(HT20)/ax(HEW20): 2412MHz to 2462MHz; 802.11n(HT40)/ax(HEW40): 2422MHz to 2452MHz
Modulation Type:	802.11b: DSSS (CCK, DQPSK, DBPSK); 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK), 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024-QAM)
Number of Channels:	802.11b/g/n(HT20)/ax(HE2W0):11;802.11n(HT40)/ax(HEW40):7
Channel Spacing:	5MHz
Antenna Type:	External antenna
Antenna Gain:	ANT5 (WIFI0): 2.5dBi (Provided by the manufacturer) ANT6 (WIFI1):2.7dBi (Provided by the manufacturer)



5GHz WiFi

Operation Frequency/Number of channels (20MHz):	U-NII-1: 5180-5240MHz (4 Channels); U-NII-2A: 5260-5320MHz (4 Channels); U-NII-2C: 5500-5700MHz (11 Channels); U-NII-3: 5745-5825MHz (5 Channels)
Operation Frequency/Number of channels/(40MHz):	U-NII-1: 5190-5230MHz (2 Channels); U-NII-2A: 5270-5310MHz (2 Channels); U-NII-2C: 5510-5670MHz (5 Channels); U-NII-3: 5755-5795MHz (2 Channels)
Operation Frequency/Number of channels (80MHz):	U-NII-1: 5210MHz (1 Channel); U-NII-2A: 5290MHz (1 Channel); U-NII-2C: 5530-5610MHz (2 Channels); U-NII-3: 5775MHz (1 Channel)
Operation Frequency/Number of channels (160MHz):	U-NII-2A: 5250MHz(1 Channel); U-NII-2C: 5570MHz (1 Channel)
Modulation Type:	802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK); 802.11n: OFDM (BPSK, QPSK, 16QAM, 64QAM); 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM); 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024-QAM)
Channel Spacing:	802.11a/n/ac/ax 20: 20MHz; 802.11n/ac/ax 40: 40MHz; 802.11ac/ax 80: 80MHz; 802.11ac/ax 160: 160MHz
DFS Function:	Slave without Radar detection
TPC Function:	Support TPC function
Antenna Type:	External antenna
Antenna Gain:	5150MHz~5250MHz: ANT5(WIFI0): 3.3dBi (Provided by the manufacturer) ANT6(WIFI1): 3.0dBi (Provided by the manufacturer) 5250MHz~5350MHz: ANT5(WIFI0): 2.6dBi (Provided by the manufacturer) ANT6(WIFI1): 3.1dBi (Provided by the manufacturer) 5470MHz~5725MHz: ANT5(WIFI0): 3.2dBi (Provided by the manufacturer) ANT6(WIFI1): 3.0dBi (Provided by the manufacturer) 5725MHz~5850MHz: ANT5(WIFI0): 2.9dBi (Provided by the manufacturer) ANT6(WIFI1): 2.4dBi (Provided by the manufacturer)

6E WIFI Indoor Client

IEEE 802.11 WLAN Mode Supported:	☒ 802.11a (20 MHz channel bandwidth), ☒ 802.11ax (20 MHz channel bandwidth) ☒ 802.11ax (40 MHz channel bandwidth) ☒ 802.11ax (80 MHz channel bandwidth) ☒ 802.11ax (160 MHz channel bandwidth)	
Operation Frequency:	IEEE 802.11 a/ax(HE20/40/80/160): 5925 MHz ~ 6425 MHz IEEE 802.11 a/ax(HE20/40/80/160): 6425 MHz ~ 6525 MHz IEEE 802.11 a/ax(HE20/40/80/160): 6525 MHz ~ 6875 MHz IEEE 802.11 a/ax(HE20/40/80/160): 6875 MHz ~ 7125 MHz	
Type of Modulation:	OFDM/OFDMA	
Antenna Type:	☒ External, ☐ Integrated	
Antenna Ports:	☒ Ant 1, ☒ Ant 2	
Smart System:	☒ SISO	802.11a/ax
	☒ MIMO	802.11ax: 2Tx & 2Rx
Antenna Gain:	UNII-5: ANT5(WIFI0): 2.0dBi, ANT6(WIFI1): 2.1dBi(Provided by the manufacturer) UNII-6: ANT5(WIFI0): 1.5dBi, ANT6(WIFI1): 1.9dBi(Provided by the manufacturer) UNII-7: ANT5(WIFI0): 1.7dBi, ANT6(WIFI1): 1.8dBi(Provided by the manufacturer) UNII-8: ANT5(WIFI0): 1.8dBi, ANT6(WIFI1): 1.8dBi(Provided by the manufacturer)	

6E WIFI Standard Client

IEEE 802.11 WLAN Mode Supported:	☒ 802.11a (20 MHz channel bandwidth), ☒ 802.11ax (20 MHz channel bandwidth) ☒ 802.11ax (40 MHz channel bandwidth) ☒ 802.11ax (80 MHz channel bandwidth) ☒ 802.11ax (160 MHz channel bandwidth)	
Operation Frequency:	IEEE 802.11 a/ax(HE20/40/80/160): 5925 MHz ~ 6425 MHz IEEE 802.11 a/ax(HE20/40/80/160): 6525 MHz ~ 6875 MHz	
Type of Modulation:	OFDM/OFDMA	
Antenna Type:	☒ External, ☐ Integrated	
Antenna Ports:	☒ Ant 1, ☒ Ant 2	
Smart System:	☒ SISO	802.11a/ax
	☒ MIMO	802.11ax: 2Tx & 2Rx
Antenna Gain:	UNII-5: ANT5(WIFI0): 2.0Bi, ANT6(WIFI1): 2.1dBi(Provided by the manufacturer) UNII-7: ANT5(WIFI0): 1.7dBi, ANT6(WIFI1): 1.8dBi(Provided by the manufacturer)	



Report No.: KSCR250900199107

Page: 7 of 13

2.3 Separation Distance

Separation distance between the antenna to person (R):	> 20cm
Remark: This minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander. R has been stated in user manual.	

2.4 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc.

No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86 512 5735 5888 Fax: +86 512 5737 0818

No tests were sub-contracted.

Note:

1.SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc) is provided by the applicant. (if applicable).

2.SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).

3. Sample source: sent by customer.

2.5 Test Facility

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

• A2LA

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

• FCC

Compliance Certification Services (Kunshan) Inc. has been recognized as an accredited testing laboratory. Designation Number: CN1172.

• ISED

Compliance Certification Services (Kunshan) Inc. has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 2324E

• VCCI

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-20134, R-11600, C-11707, T-11499, G-10216 respectively.

3 RF Exposure Test Exemptions

Test exemptions apply for devices used in general population/uncontrolled exposure environments, according to the SAR-based, or MPE-based exemption thresholds.

3.1 RF Exposure Test Exemptions for single RF sources

3.1.1 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of §1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.

The 1-mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph §1.1307(b)(3)(ii)(A).

The 1-mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

3.1.2 MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of §1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz. The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, **R must be at least $\lambda/2\pi$** , where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP 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 (1.64 linear value).

Table B.1—Thresholds For Single RF Sources Subject to Routine Environmental Evaluation

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	1,920 R ²
1.34	–	30	35.6 m	–	1.6 m	3,450 R ² /f ²
30	–	300	1.6 m	–	159 mm	3.83 R ²
300	–	1,500	159 mm	–	31.8 mm	0.0128 R ² f
1,500	–	100,000	31.8 mm	–	0.5 mm	19.2R ²
Subscripts L and H are low and high; λ is wavelength. R: Separation distance between the antenna to person						

The table applies to any RF source (i.e. single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least $\lambda/2\pi$. The thresholds are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.

Limit calculation				
Frequency range	Frequency(MHz)	$\lambda/2\pi$ (m)	R(m)	Threshold ERP(W)
1.34~30MHz	13.56	3.5229	3.6000	243.167
300~1500MHz	433	0.1103	0.6000	1.995
1500~100000MHz	2462	0.0194	0.2000	0.768
1500~100000MHz	5825	0.0082	0.2000	0.768

3.1.3 SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of $\lambda/4$.

As for devices with antennas of length greater than $\lambda/4$ where the gain is not well defined, but always less than that of a half-wave dipole (length $\lambda/2$), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known. The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

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 **0.5cm to 40cm** 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).

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	d(cm)	Pth (mW)
0.3~1.5	0.45	1.011	1	44.373
1.5~6	2.462	1.903	20	3060.000

3.2 RF Exposure Test Exemptions for Simultaneous Transmission

The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

Either SAR-based or MPE-based exemption may be considered for test exemption for fixed, mobile, or portable device exposure conditions; therefore, the contributions from each exemption in conjunction with the measured SAR (Evaluated k term) shall be used to determine exemption for simultaneous transmission. In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for P_{th} , including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.



P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

$P_{th,i}$ = the exemption threshold power (P_{th}) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i .

ERP_j = the ERP of fixed, mobile, or portable RF source j .

$ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j , at a distance of at least $\lambda / 2 \pi$ according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

$Evaluated_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

$Exposure\ Limit_k$ = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k , as applicable from § 1.1310 of this chapter.

4 Measurement and Calculation

4.1 Maximum transmit power

The Power Data is based on the RF Test Report KSCR250900199101, KSCR250900199102, KSCR250900199103, KSCR250900199104, KSCR250900199105, KSCR250900199106

4.2 RF Exposure Calculation

For single RF source :

	Evaluation method	Separation distance between the antenna to person (R)
☐	Blanket 1 mW Blanket Exemption	Regardless of separation distance
☐	MPE-based Exemption(ERP)	$R \geq (\lambda / 2\pi)$
☒	SAR-based Exemption(P_{th})	$0.5\text{cm} < R < 40\text{cm}$

Band	Frequency (MHz)	Max power (dBm)	Ant Gain (dBi)	EIRP (dBm)	Max EIRP (mW)	Limit (mW)	Distance R (cm)	Result	Ratio
Bluetooth	2402	10.36	2.5	12.86	19.32	3060	20	Pass	0.01
WLAN 2.4GHz	2412	20.22	2.7	22.92	195.88	3060	20	Pass	0.06
WLAN 5GHz B1	5150	19.48	3.3	22.78	189.67	3060	20	Pass	0.06
WLAN 5GHz B2	5250	21.13	3.1	24.23	264.85	3060	20	Pass	0.09
WLAN 5GHz B3	5470	20.81	3.2	24.01	251.77	3060	20	Pass	0.08
WLAN 5GHz B4	5725	20.87	2.9	23.77	238.23	3060	20	Pass	0.08
WLAN 6E B5	5925	19.94	2.1	22.04	159.96	3060	20	Pass	0.05
WLAN 6E B6	6425	13.7	1.9	15.6	36.31	3060	20	Pass	0.01
WLAN 6E B7	6525	19.69	1.8	21.49	140.93	3060	20	Pass	0.05
WLAN 6E B8	6875	13.68	1.8	15.48	35.32	3060	20	Pass	0.01

Note:

1.The BT/WiFi can transmit simultaneously, but the maximum rate of MPE is $0.06+0.09=0.15 \leq 1$. So, the device is to qualify for SAR test exemption, the exemption report is in lieu of the SAR report.

2. AF68E is a module that only supports Wi-Fi and Bluetooth functions, and needs to be tested with a PCBA board. This PCBA board has integrated the WWAN module AG555Q-GL. In this Co-location test, both AF68E and AG555Q-GL have been included in the scope of evaluation and testing. Given that the maximum MPE Ratio value of AG555Q-GL is 0.427, the concurrent transmission Ratio value of AF68E and AG555Q-GL is therefore: $0.15 + 0.427 = 0.577$.

--End of the Report--