# RF Exposure Evaluation Report

| | | |
|---|---|---|
| **APPLICANT** | : | **Quectel Wireless Solutions Co., Ltd.** |
| **EQUIPMENT** | : | **Wi-Fi & Bluetooth Module** |
| **BRAND NAME** | : | **Quectel** |
| **MODEL NAME** | : | **FCS866R** |
| **FCC ID** | : | **XMR2023FCS866R** |
| **STANDARD** | : | **47 CFR Part 2.1091** |

**The product evaluation date was started from Feb. 04, 2024 and completed on Mar. 11, 2024. We, Sporton International Inc. (Kunshan), would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and FCC KDB 447498 D01 v06, and pass the limit. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.**

Si Zhang

**Approved by: Si Zhang**

ACCREDITED Cert #5145.02

***Sporton International Inc. (Kunshan)***
***No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300***
***People's Republic of China***

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## Revision History

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FA3D2611 | Rev. 01 | Initial issue of report. | Mar. 12, 2024 |
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# 1. Administration Data

## 1.1. Testing Laboratory

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

| Testing Laboratory | | | |
|---|---|---|---|
| Test Firm | Sporton International Inc. (Kunshan) | | |
| Test Site Location | No. 1098, Pengxi North Road, Kunshan Economic Development Zone<br>Jiangsu Province 215300 People's Republic of China<br>TEL : +86-512-57900158 | | |
| Test Site No. | Sporton Site No. | FCC Designation No. | FCC Test Firm Registration No. |
| | SAR01-KS | CN1257 | 314309 |

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

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

## 2. Description of Equipment Under Test (EUT)

| Product Feature & Specification | |
|---|---|
| EUT Type | Wi-Fi & Bluetooth Module |
| Brand Name | Quectel |
| Model Name | FCS866R |
| FCC ID | XMR2023FCS866R |
| Wireless Technology and Frequency Range | WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz<br>WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz<br>WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz<br>WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz<br>WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz<br>Bluetooth: 2402 MHz ~ 2480 MHz |
| Mode | WLAN 2.4GHz 802.11b/g<br>WLAN 2.4GHz 802.11n HT20/HT40<br>WLAN 2.4GHz 802.11ax HE20/HE40<br>WLAN 5GHz 802.11a<br>WLAN 5GHz 802.11n HT20/HT40<br>WLAN 5GHz 802.11ac VHT20/VHT40/VHT80<br>WLAN 5GHz 802.11ax HE20/HE40/HE80<br>Bluetooth BR/EDR/LE |
| Antenna Type | Dipole antenna |
| HW Version | R1.0 |
| SW Version | NA |
| EUT Stage | Identical Prototype |

**Remark:**

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. WLAN2.4GHz /WLAN5GHz all support SISO and MIMO mode, we chose MIMO tune up power to perform MPE calculation conservatively.

| Comments and Explanations: |
|---|
| 1. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification. |
| 2. The maximum RF output tune up power, antenna gain also the safe distance used for evaluate RF exposure were declared by manufacturer. |

**Antenna Gain:**

| WLAN | Ant.0 | Ant.1 | Ant.2 |
|---|---|---|---|
| WLAN2.4GHz | -0.1 | -0.1 | / |
| WLAN5.2GHz | -0.9 | -0.9 | / |
| WLAN5.3GHz | -1.4 | -1.4 | / |
| WLAN5.5GHz | -0.3 | -0.3 | / |
| WLAN5.8GHz | 0.4 | 0.4 | / |
| Bluetooth | -0.1 | / | -0.1 |

# 3. Maximum RF average output tune up power among production units

**<Bluetooth>**

| Mode | Maximum Average Power (dBm) | |
|---|---|---|
| | Ant.0 | Ant.2 |
| Bluetooth BR/EDR | 9.00 | 9.00 |
| Bluetooth LE | 8.00 | 8.50 |

**<2.4GHz WLAN >**

| Mode | | Maximum Average Power (dBm) |
|---|---|---|
| | | Ant.0+1 |
| 2.4GHz | 802.11b | 24.00 |
| | 802.11g | 24.00 |
| | 802.11n-HT20 | 27.00 |
| | 802.11n-HT40 | 19.00 |
| | 802.11ax-HE20 | 24.00 |
| | 802.11ax-HE40 | 17.00 |

**<5GHz WLAN >**

| Mode | | Maximum Average Power (dBm) |
|---|---|---|
| | | Ant.0+1 |
| 5.2GHz | 802.11a | 21.00 |
| | 802.11n-HT20 | 21.00 |
| | 802.11n-HT40 | 22.00 |
| | 802.11ac-VHT20 | 21.00 |
| | 802.11ac-VHT40 | 22.00 |
| | 802.11ac-VHT80 | 20.00 |
| | 802.11ax-HE20 | 21.00 |
| | 802.11ax-HE40 | 22.00 |
| | 802.11ax-HE80 | 19.00 |
| 5.3GHz | 802.11a | 23.00 |
| | 802.11n-HT20 | 22.00 |
| | 802.11n-HT40 | 23.00 |
| | 802.11ac-VHT20 | 22.00 |
| | 802.11ac-VHT40 | 23.00 |
| | 802.11ac-VHT80 | 19.00 |
| | 802.11ax-HE20 | 23.00 |
| | 802.11ax-HE40 | 23.00 |
| | 802.11ax-HE80 | 19.00 |
| 5.5GHz | 802.11a | 23.50 |
| | 802.11n-HT20 | 23.50 |
| | 802.11n-HT40 | 23.98 |
| | 802.11ac-VHT20 | 23.50 |
| | 802.11ac-VHT40 | 23.98 |
| | 802.11ac-VHT80 | 23.98 |
| | 802.11ax-HE20 | 23.98 |
| | 802.11ax-HE40 | 23.98 |
| | 802.11ax-HE80 | 23.98 |
| 5.8GHz | 802.11a | 23.00 |
| | 802.11n-HT20 | 24.00 |
| | 802.11n-HT40 | 24.00 |
| | 802.11ac-VHT20 | 24.00 |
| | 802.11ac-VHT40 | 24.00 |
| | 802.11ac-VHT80 | 24.00 |
| | 802.11ax-HE20 | 24.00 |
| | 802.11ax-HE40 | 24.00 |
| | 802.11ax-HE80 | 24.00 |

Note: WLAN2.4GHz /WLAN5GHz all support SISO/MIMO mode, we only chose MIMO tune up power to perform MPE calculation conservatively for MIMO power is higher.

# 4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

| Frequency range (MHz) | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density ($mW/cm^2$) | Averaging time (minutes) |
|---|---|---|---|---|
| (A) Limits for Occupational/Controlled Exposures | | | | |
| 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 | | | f/300 | 6 |
| 1500-100,000 | | | 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 | | | f/1500 | 30 |
| 1500-100,000 | | | 1.0 | 30 |

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

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

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

# 5. Radio Frequency Radiation Exposure Evaluation

## 5.1. Standalone Power Density Calculation

| Band | Frequency (MHz) | Antenna Gain (dBi) | Maximum Power (dBm) | Maximum EIRP (dBm) | Average EIRP (mW) | Power Density at 20cm (mW/cm^2) | Limit (mW/cm^2) | Power Density / Limit |
|---|---|---|---|---|---|---|---|---|
| 2.4GHz WLAN | 2412.0 | -0.10 | 27.00 | 26.900 | 489.779 | 0.097 | 1.000 | **0.097** |
| 5.2GHz WLAN | 5180.0 | -0.90 | 22.00 | 21.100 | 128.825 | 0.026 | 1.000 | 0.026 |
| 5.3GHz WLAN | 5260.0 | -1.40 | 23.00 | 21.600 | 144.544 | 0.029 | 1.000 | 0.029 |
| 5.5GHz WLAN | 5500.0 | -0.30 | 23.98 | 23.680 | 233.346 | 0.046 | 1.000 | 0.046 |
| 5.8GHz WLAN | 5745.0 | 0.40 | 24.00 | 24.400 | 275.423 | 0.055 | 1.000 | **0.055** |
| Bluetooth | 2402.0 | -0.10 | 9.00 | 8.900 | 7.762 | 0.002 | 1.000 | **0.002** |

**Note:**
1. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
2. WLAN2.4GHz and WLAN5GHz chose the higher SISO gain as MIMO gain to perform MPE calculation.
3. Chose the maximum power to do MPE analysis.
4. Chose the maximum RF output tune up power of all antennas among same frequency BT band and the maximum antenna gain to perform MPE calculation conservatively.

## 5.2. Collocated Power Density Calculation

| Bluetooth Power Density / Limit | WLAN 5GHz Power Density / Limit | Σ(Power Density / Limit) of Bluetooth + WLAN 5GHz |
|---|---|---|
| 0.002 | 0.055 | 0.057 |

| Bluetooth Power Density / Limit | WLAN 2.4GHz Power Density / Limit | Σ(Power Density / Limit) of Bluetooth + WLAN 2.4GHz |
|---|---|---|
| 0.002 | 0.097 | 0.099 |

**Note:**
1. According to the EUT characteristic, Bluetooth antennas cannot transmit simultaneously.
2. According to the EUT characteristic, WLAN 2.4GHz and WLAN5GHz cannot transmit simultaneously.
3. Σ(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for Bluetooth +WLAN5GHz, Bluetooth + WLAN2.4GHz.
4. Considering all transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1.

## Conclusion:

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.

------THE END------