

RF Exposure Evaluation Report

APPLICANT : Quectel Wireless Solutions Co., Ltd.
EQUIPMENT : Smart LTE Module with Wi-Fi & Bluetooth
BRAND NAME : Quectel
MODEL NAME : SC20-AX
FCC ID : XMR202201SC20AX
STANDARD : 47 CFR Part 2.1091

We, Sporton International Inc. (Kunshan), would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091, and pass the limit. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

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Reviewed by: Tony Zhang / Supervisor

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Sporton International Inc. (Kunshan)

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA1D2404	Rev. 01	Initial issue of report	Feb. 21, 2022



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 Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
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	Smart LTE Module with Wi-Fi & Bluetooth
Brand Name	Quectel
Model Name	SC20-AX
FCC ID	XMR202201SC20AX
Wireless Technology and Frequency Range	GSM850: 824 MHz ~ 849 MHz GSM1900: 1850MHz ~ 1910MHz WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV : 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2 : 1850 MHz ~ 1910 MHz LTE Band 4 : 1710 MHz ~ 1755 MHz LTE Band 5 : 824 MHz ~ 849 MHz LTE Band 7 : 2500 MHz ~ 2570 MHz LTE Band 12 : 699 MHz ~ 716 MHz LTE Band 13 : 777 MHz ~ 787 MHz LTE Band 25 : 1850 MHz ~ 1915 MHz LTE Band 26 : 814 MHz ~ 849 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+ (16QAM uplink is not supported) LTE: QPSK, 16QAM 802.11b/g/n HT20/HT40 802.11a/n HT20/HT40 Bluetooth BR/EDR/LE V4.2
Antenna Type	WWAN : External Antenna WLAN : External Antenna Bluetooth : External Antenna
HW Version	R1.0
SW Version	SC20AXPAR09A05
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. The device supports GPRS/EGPRS Class 33.	

Comments and Explanations:

- 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.
- The maximum RF output tune up power, antenna gain also the safe distance used for evaluate RF exposure were declared by manufacturer.



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

<GSM>

Mode	Burst Average Power (dBm)	
	GSM 850	GSM 1900
GSM 1 Tx slot	35.00	32.00
GPRS 1 Tx slot	35.00	32.00
GPRS 2 Tx slots	35.00	32.00
GPRS 3 Tx slots	33.00	32.00
GPRS 4 Tx slots	32.00	32.00
EDGE 1 Tx slot	30.00	29.00
EDGE 2 Tx slots	30.00	29.00
EDGE 3 Tx slots	30.00	29.00
EDGE 4 Tx slots	30.00	29.00

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.

To frame-averaged power, the Division Factors are shown as below:

Tx slot	1 Tx Slot	2 Tx Slot	3 Tx Slot	4 Tx Slot
Division Factors(dB)	-9	-6	-4.26	-3

The calculated method are shown as below:

Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB

Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB

Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB

Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

<WCDMA>

Mode		Maximum Average power(dBm)
WCDMA	Band II	25.00
	Band IV	25.00
	Band V	25.00

<LTE>

Mode		Maximum Average power(dBm)
LTE	Band 2	25.00
	Band 4	25.00
	Band 5	25.00
	Band 7	25.00
	Band 12	25.00
	Band 13	25.00
	Band 25	25.00
	Band 26	25.00

**<2.4GHz WLAN>**

Frequency	Mode	Maximum Average Power (dBm)
WLAN 2.4GHz	802.11b	18.50
	802.11g	18.50
	802.11n-HT20	17.50
	802.11n-HT40	16.50

<5GHz WLAN>

Frequency	Mode	Maximum Average Power (dBm)
WLAN 5.2GHz	802.11a	13.00
	802.11n-HT20	14.00
	802.11n-HT40	13.50
WLAN 5.3GHz	802.11a	13.50
	802.11n-HT20	14.00
	802.11n-HT40	13.50
WLAN 5.5GHz	802.11a	13.00
	802.11n-HT20	13.50
	802.11n-HT40	12.50
WLAN 5.8GHz	802.11a	12.50
	802.11n-HT20	12.00
	802.11n-HT40	11.00

<Bluetooth>

Frequency	Mode	Maximum Average Power (dBm)
Bluetooth	BR/EDR	12.50
	LE	3.00



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/f ²)	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/f ²)	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
GSM 850 (1 Tx slot)	824.2	3.00	35.00	38.00	794.328	0.158	0.549	0.288
GPRS 850 (1 Tx slot)	824.2	3.00	35.00	38.00	794.328	0.158	0.549	0.288
GPRS 850 (2 Tx slots)	824.2	3.00	35.00	38.00	1584.893	0.315	0.549	0.574
GPRS 850 (3 Tx slots)	824.2	3.00	33.00	36.00	1492.794	0.297	0.549	0.541
GPRS 850 (4 Tx slots)	824.2	3.00	32.00	35.00	1584.893	0.315	0.549	0.574
EGPRS 850 (1 Tx slot)	824.2	3.00	30.00	33.00	251.189	0.050	0.549	0.091
EGPRS 850 (2 Tx slots)	824.2	3.00	30.00	33.00	501.187	0.100	0.549	0.182
EGPRS 850 (3 Tx slots)	824.2	3.00	30.00	33.00	748.170	0.149	0.549	0.271
EGPRS 850 (4 Tx slots)	824.2	3.00	30.00	33.00	1000.000	0.199	0.549	0.362
GSM 1900 (1 Tx slot)	1850.2	1.00	32.00	33.00	251.189	0.050	1.000	0.050
GPRS 1900 (1 Tx slot)	1850.2	1.00	32.00	33.00	251.189	0.050	1.000	0.050
GPRS 1900 (2 Tx slots)	1850.2	1.00	32.00	33.00	501.187	0.100	1.000	0.100
GPRS 1900 (3 Tx slots)	1850.2	1.00	32.00	33.00	748.170	0.149	1.000	0.149
GPRS 1900 (4 Tx slots)	1850.2	1.00	32.00	33.00	1000.000	0.199	1.000	0.199
EGPRS 1900 (1 Tx slot)	1850.2	1.00	29.00	30.00	125.893	0.025	1.000	0.025
EGPRS 1900 (2 Tx slots)	1850.2	1.00	29.00	30.00	251.189	0.050	1.000	0.050
EGPRS 1900 (3 Tx slots)	1850.2	1.00	29.00	30.00	374.973	0.075	1.000	0.075
EGPRS 1900 (4 Tx slots)	1850.2	1.00	29.00	30.00	501.187	0.100	1.000	0.100
WCDMA Band II	1852.4	8.00	25.00	33.00	1995.262	0.397	1.000	0.397
WCDMA Band IV	1712.4	5.00	25.00	30.00	1000.000	0.199	1.000	0.199
WCDMA Band V	826.4	9.00	25.00	34.00	2511.886	0.500	0.551	0.908
LTE Band 2	1850.7	8.00	25.00	33.00	1995.262	0.397	1.000	0.397
LTE Band 4	1710.7	5.00	25.00	30.00	1000.000	0.199	1.000	0.199
LTE Band 5	824.7	9.00	25.00	34.00	2511.886	0.500	0.550	0.909
LTE Band 7	2502.5	8.00	25.00	33.00	1995.262	0.397	1.000	0.397
LTE Band 12	699.7	8.50	25.00	33.50	2238.721	0.446	0.466	0.955
LTE Band 13	779.5	8.50	25.00	33.50	2238.721	0.446	0.520	0.857
LTE Band 25	1850.7	8.00	25.00	33.00	1995.262	0.397	1.000	0.397
LTE Band 26	814.7	9.00	25.00	34.00	2511.886	0.500	0.543	0.921
WLAN2.4GHz	2412	0.47	18.50	18.97	78.886	0.016	1.000	0.016
WLAN5.2GHz	5180	-0.67	14.00	13.33	21.528	0.004	1.000	0.004
WLAN5.3GHz	5260	-0.19	14.00	13.81	24.044	0.005	1.000	0.005
WLAN5.5GHz	5500	1.28	13.50	14.78	30.061	0.006	1.000	0.006
WLAN5.8GHz	5745	1.10	12.50	13.60	22.909	0.005	1.000	0.005
Bluetooth	2402	0.47	12.50	12.97	19.815	0.004	1.000	0.004

Note: For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.



5.2. Collocated Power Density Calculation

General Note:

1. This MPE analysis is applicable to any collocated transmitters with EIRP for WLAN / Bluetooth is less than the below table , a maximum antenna gain of WLAN / Bluetooth has been assumed for the below table.

Band	Antenna Gain (dBi)	Maximum Power(dBm)	Maximum EIRP (dBm)
WLAN2.4GHz	0.47	18.50	18.97
WLAN5.2GHz	-0.67	14.00	13.33
WLAN5.3GHz	-0.19	14.00	13.81
WLAN5.5GHz	1.28	13.50	14.78
WLAN5.8GHz	1.10	12.50	13.60
Bluetooth	0.47	12.50	12.97

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
GSM 850 (1 Tx slot)	824.2	3.00	35.00	38.00	794.328	0.158	0.549	0.288
GPRS 850 (1 Tx slot)	824.2	3.00	35.00	38.00	794.328	0.158	0.549	0.288
GPRS 850 (2 Tx slots)	824.2	3.00	35.00	38.00	1584.893	0.315	0.549	0.574
GPRS 850 (3 Tx slots)	824.2	3.00	33.00	36.00	1492.794	0.297	0.549	0.541
GPRS 850 (4 Tx slots)	824.2	3.00	32.00	35.00	1584.893	0.315	0.549	0.574
EGPRS 850 (1 Tx slot)	824.2	3.00	30.00	33.00	251.189	0.050	0.549	0.091
EGPRS 850 (2 Tx slots)	824.2	3.00	30.00	33.00	501.187	0.100	0.549	0.182
EGPRS 850 (3 Tx slots)	824.2	3.00	30.00	33.00	748.170	0.149	0.549	0.271
EGPRS 850 (4 Tx slots)	824.2	3.00	30.00	33.00	1000.000	0.199	0.549	0.362
GSM 1900 (1 Tx slot)	1850.2	1.00	32.00	33.00	251.189	0.050	1.000	0.050
GPRS 1900 (1 Tx slot)	1850.2	1.00	32.00	33.00	251.189	0.050	1.000	0.050
GPRS 1900 (2 Tx slots)	1850.2	1.00	32.00	33.00	501.187	0.100	1.000	0.100
GPRS 1900 (3 Tx slots)	1850.2	1.00	32.00	33.00	748.170	0.149	1.000	0.149
GPRS 1900 (4 Tx slots)	1850.2	1.00	32.00	33.00	1000.000	0.199	1.000	0.199
EGPRS 1900 (1 Tx slot)	1850.2	1.00	29.00	30.00	125.893	0.025	1.000	0.025
EGPRS 1900 (2 Tx slots)	1850.2	1.00	29.00	30.00	251.189	0.050	1.000	0.050
EGPRS 1900 (3 Tx slots)	1850.2	1.00	29.00	30.00	374.973	0.075	1.000	0.075
EGPRS 1900 (4 Tx slots)	1850.2	1.00	29.00	30.00	501.187	0.100	1.000	0.100
WCDMA Band II	1852.4	8.00	25.00	33.00	1995.262	0.397	1.000	0.397
WCDMA Band IV	1712.4	5.00	25.00	30.00	1000.000	0.199	1.000	0.199
WCDMA Band V	826.4	9.00	25.00	34.00	2511.886	0.500	0.551	0.908
LTE Band 2	1850.7	8.00	25.00	33.00	1995.262	0.397	1.000	0.397
LTE Band 4	1710.7	5.00	25.00	30.00	1000.000	0.199	1.000	0.199
LTE Band 5	824.7	9.00	25.00	34.00	2511.886	0.500	0.550	0.909
LTE Band 7	2502.5	8.00	25.00	33.00	1995.262	0.397	1.000	0.397
LTE Band 12	699.7	8.00	25.00	33.00	1995.262	0.397	0.466	0.851
LTE Band 13	779.5	8.00	25.00	33.00	1995.262	0.397	0.520	0.764
LTE Band 25	1850.7	8.00	25.00	33.00	1995.262	0.397	1.000	0.397
LTE Band 26	814.7	9.00	25.00	34.00	2511.886	0.500	0.543	0.921
WLAN2.4GHz	2412	0.47	18.50	18.97	78.886	0.016	1.000	0.016
WLAN5.2GHz	5180	-0.67	14.00	13.33	21.528	0.004	1.000	0.004
WLAN5.3GHz	5260	-0.19	14.00	13.81	24.044	0.005	1.000	0.005
WLAN5.5GHz	5500	1.28	13.50	14.78	30.061	0.006	1.000	0.006
WLAN5.8GHz	5745	1.10	12.50	13.60	22.909	0.005	1.000	0.005
Bluetooth	2402	0.47	12.50	12.97	19.815	0.004	1.000	0.004



Power Density / Limit				Σ (Power Density / Limit) of WWAN+2.4GHz WLAN/ WWAN+5GHz WLAN/ WWAN+ Bluetooth
1	2	3	4	1 + max(2, 3, 4)
WWAN	2.4GHz WLAN	5GHz WLAN	Bluetooth	
0.921	0.016	0.006	0.004	0.937

Note:

1. For colocation analysis, LTE Band 12 is chosen for summation due to the highest (power density/limit) among all WWAN wireless modes.
2. Σ (Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)].

Conclusion:

Based on 47 CFR §2.1091, the analysis concludes that this product when transmitting in standalone within a host device, is compliant with the FCC RF exposure requirements in mobile exposure condition, provided the conducted power and antenna gain do not exceed the limits for each given frequency band per wireless technology as follow table:

Technology	Band	Maximum Conducted Power (dBm)	Standalone Maximum Antenna Gain (dBi)	Collocated Maximum Antenna Gain (dBi)
GSM	GSM850	35.0	3.00	3.00
	GSM1900	32.0	1.00	1.00
WCDMA	Band II	25.0	8.00	8.00
	Band IV	25.0	5.00	5.00
	Band V	25.0	9.00	9.00
LTE	Band 2	25.0	8.00	8.00
	Band 4	25.0	5.00	5.00
	Band 5	25.0	9.00	9.00
	Band 7	25.0	8.00	8.00
	Band 12	25.0	8.50	8.00
	Band 13	25.0	8.50	8.00
	Band 25	25.0	8.00	8.00
	Band 26	25.0	9.00	9.00
WLAN	2.4GHz WLAN	18.5	0.47	0.47
	5GHz WLAN	14.0	1.28	1.28
Bluetooth	2.4GHz Bluetooth	12.5	0.47	0.47