TEST REPORT

Application No.:	SEWA2309000114RG
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:	5G Sub-6 GHz M.2 Module
Model No.:	RM520N-GL
Trade Mark:	Quectel
FCC ID:	XMR2023RM520NGLM
Standards:	47 CFR Part 2.1091 FCC KDB 447498 D01 v06
Date of Receipt:	2023/09/26 (for report SEWA2309000114RG04) 2023/11/10 (for report SEWA2309000114RG12)
Date of Issue:	2023/11/10
Test Result:	**PASS***

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

Authorized Signature:

Well Wei
Wireless Laboratory Manager

1 Version

Revision Record				
Version	***Chapter***	***Date***	***Modifier***	***Remark***
01		2023/11/10		Original

Prepared By		**(Nick Hu) / Test Engineer**
Checked By		**(Stone Gu) / Reviewer**

Remark for report SEWA2309000114RG12 issue on 2023/11/10:

This test report (Report No.: SEWA2309000114RG12 issue on 2023/11/10) is based on the original test report (Report No.: SEWA2309000114RG04 issue on 2023/10/31).

Review this report and original report, this report just changing FCC ID.

Therefore in this report all items do not need to recalculated and all test data in this report are based on the previous report with report number SEWA2309000114RG04 issue on 2023/10/31.

Contents

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

2.3 General Description of EUT

EUT Description:	5G Sub-6 GHz M.2 Module			
Model No.:	RM520N-GL			
Trade Mark:	Quectel			
Hardware Version:	R1.0			
Software Version:	RM520NGLAAR03A01M4G			
Power Supply:	DC 3.7V			
Antenna Type:	External Antenna PIFA Antenna			
Antenna Gain:	WCDMA Band II:	0.25dBi	WCDMA Band IV:	1.47dBi
	WCDMA Band V:	2.68dBi		
	LTE Band 2:	0.25dBi(Ant0)	LTE Band 4:	1.47dBi(Ant0)
	LTE Band 5:	2.68dBi(Ant0)	LTE Band 7:	0.55dBi(Ant0)
	LTE Band 12:	-0.2dBi(Ant0)	LTE Band 13:	1.54dBi(Ant0)
	LTE Band 14:	2.42dBi(Ant0)	LTE Band 17:	-0.2dBi(Ant0)
	LTE Band 25:	0.25dBi(Ant0)	LTE Band 26:	2.87dBi(Ant0)
	LTE Band 30:	-3dBi(Ant0)	LTE Band 38:	2.4dBi(Ant0)
	LTE Band 41:	2.4dBi(Ant0)	LTE Band 42:	1dBi(Ant2)
	LTE Band 43:	1dBi(Ant2)	LTE Band 66:	1.47dBi(Ant0)
	LTE Band 71:	1.22dBi(Ant0)	LTE CA_2C:	0.25dBi(Ant0)
	LTE CA_5B:	2.68dBi(Ant0)	LTE CA_7C:	0.55dBi(Ant0)
	LTE CA_38C:	2.4dBi(Ant0)	LTE CA_41C:	2.4dBi(Ant0)
	LTE CA_42C:	1dBi(Ant2)	LTE CA_43C:	1dBi(Ant2)
	LTE CA_66B:	1.47dBi(Ant0)	LTE CA_66C:	1.47dBi(Ant0)
	LTE Band 48:	1dBi(Ant2)	LTE CA_48C:	1dBi(Ant2)
	NR Band n2:	0.25dBi (Ant0)	NR Band n5:	2.68dBi (Ant0)
	NR Band n7:	0.55dBi (Ant0)	NR Band n12:	-0.2dBi (Ant0)
	NR Band n13:	1.54dBi (Ant0)	NR Band n14:	2.42dBi (Ant0)
	NR Band n25:	0.25dBi (Ant0)	NR Band n26:	2.87dBi (Ant0)
	NR Band n30:	-3dBi (Ant0)	NR Band n38 MIMO:	2.4dBi (Ant0); 2.4dBi (Ant2)
	NR Band n41 MIMO:	2.4dBi (Ant0); 2.4dBi (Ant2)	NR Band n66:	1.47dBi (Ant0)
	NR Band n48 MIMO:	1dBi (Ant0); 1dBi (Ant2)	NR Band n70:	1.3dBi (Ant2)

NR Band n71:	1.22dBi (Ant0)		NR Band n77 MIMO:	1dBi (Ant0); 1dBi (Ant2)
NR Band n78 MIMO:	1dBi (Ant0); 1dBi (Ant2)			

CA:

UL CA_2C; UL CA_5B; UL CA_7C; UL CA_38C; UL CA_41C; UL CA_43C;

UL CA_66C; UL CA_66B; UL CA_48C; UL CA_42C;

UL CA_2A-4A; UL CA_2A-5A; UL CA_2A-7A; UL CA_2A-12A; UL CA_2A-13A;

UL CA_2A-30A; UL CA_2A-66A;

UL CA_4A-5A; UL CA_4A-7A; UL CA_4A-12A; UL CA_4A-13A;

UL CA_4A-30A;

UL CA_5A-7A; UL CA_5A-30A; UL CA_5A-66A;

UL CA_12A-30A; UL CA_12A-66A; UL CA_13A-66A; UL CA_14A-30A;

ENDC:

DC_13A_n66A;DC_5A_n2A;DC_14A_n2A;DC_30A_n2A;DC_2A_n5A;

DC_30A_n5A;DC_66A_n5A;DC_2A_n12A;DC_66A_n12A;DC_2A_n66A;

DC_5A_n66A;DC_12A_n66A;DC_14A_n66A;DC_30A_n66A;DC_12A_n2A;

DC_66A_n2A;DC_71A_n2A;DC_12A_n41A;DC_71A_n66A;DC_2A_n71A

DC_66A_n71A;DC_66A_n25A;DC_25A_n41A;DC_12A_n78A;DC_13A_n78A

DC_25A_n78A;DC_12A_n77A;DC_13A_n77A;DC_14A_n77A;DC_26A_n78A

DC_2A_n78A;DC_26A_n41A;DC_2A_n41A;DC_7A_n5A;DC_38A_n78A

DC_7A_n71A;DC_41A_n78A;DC_5A_n7A;DC_12A_n7A;DC_66A_n7A

DC_13A_n2A;DC_48A_n5A;DC_48A_n66A;DC_7A_n66A;DC_2A_n48A

DC_5A_n48A;DC_13A_n48A;DC_66A_n48A;DC_4A_n78A;DC_20A_n77A

DC_5A_n78A;DC_4A_n41A;DC_66A_n38A;DC_2A_n38A;DC_12A_n38A

DC_4A_n38A;DC_5A_n38A;DC_66A_n78A;DC_12A_n25A;DC_25A_n77A

DC_2A_n77A;DC_71A_n78A;DC_71A_n38A;DC_13A_n7A;DC_5A_n41A

DC_66A_n41A;DC_2A_n7A;DC_7A_n2A;DC_5A_n40A;DC_30A_n77A

DC_41A_n77A;DC_7A_n78A;DC_48A_n25A;DC_66A_n28A;DC_71A_n41A

DC_28A_n66A;DC_30A_n12A;DC_2A_n14A;DC_30A_n14A;DC_66A_n14A

DC_2A_n30A;DC_5A_n30A;DC_12A_n30A;DC_14A_n30A;DC_66A_n30A

DC_71A_n7A;DC_7A_n12A;DC_5A_n77A;DC_66A_n77A;DC_71A_n77A

DC_4A_n2A;DC_7A_n25A;DC_71A_n25A;DC_5A_n25A;DC_26A_n25A

	DC_4A_n7A;DC_13A_n25A;DC_7A_n77A;DC_48A_n71A;DC_48A_n12A NR UL CA: n25A-n41A;n41A-n66A;n41A-n71A;n7A-n78A;n5A-n78A n66A-n78A;n7A-n77A;n2A-n77A;n5A-n77A;n66A-n77A n30A-n77A;n48A-n66A;n2A-n48A;n5A-n48A;n48A-n70A n48A-n71A;n71A-n77A;n71A-n78A;n25A-n78A;n38A-n66A n25A-n48A;n25A-n77A;n25A-n38A;n13A-n77A; n2A-n41A
	Note: The antenna gain are derived from the gain information report provided by the manufacturer.
Remark: As above information is provided and confirmed by the applicant. SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.	

Directional Gain Calculations
a) Basic methodology with NANT transmit antennas, each with the same directional gain GANT dBi, being driven by NANT transmitter outputs of equal power. Directional gain is to be computed as follows
(ii) all transmit signals are completely uncorrelated with each other, Directional gain = GANT

Band	ANT Gain0 (dBi)	ANT Gain2 (dBi)	Directional gain (dBi)
NR Band n38:	2.4	2.4	2.4
NR Band n41:	2.4	2.4	2.4
NR Band n48:	1	1	1
NR Band n77:	1	1	1
NR Band n78:	1	1	1

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 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

F=frequency in MHz
*=Plane-wave equivalent power density
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.

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

Output Power Into Antenna & RF Exposure Evaluation Distance:
This confirmed that the device comply with MPE limit.

Operating Band	Frequency (MHz)	Antenna Gain (dBi)	Max Conducted Power (dBm)	EIRP(ERP) (dBm)	EIRP(ERP) Limit (dBm)	Power Density at R = 20 cm (mW/cm2)	Limit (mW/cm2)	Gain according to EIRP(ERP) (dBi)	Gain according to Pd (dBi)	Max Gain Allowed (dBi)	conclusion
WCDMA Band II	1852.4	0.25	25.00	25.25	33.00	0.0666	1.0000	8.00	12.01	8.00	Pass
WCDMA Band IV	1712.4	1.47	25.00	26.47	30.00	0.0883	1.0000	5.00	12.01	5.00	Pass
WCDMA Band V	826.4	2.68	25.00	25.53	38.45	0.1166	0.5509	15.60	9.42	9.42	Pass
LTE Band 2/LTE CA_2C	1850.7	0.25	25.00	25.25	33.00	0.0666	1.0000	8.00	12.01	8.00	Pass
LTE Band 4	1710.7	1.47	25.00	26.47	30.00	0.0883	1.0000	5.00	12.01	5.00	Pass
LTE Band 5/LTE CA_5B	824.7	2.68	25.00	25.53	38.45	0.1166	0.5498	15.60	9.41	9.41	Pass
LTE Band 7/LTE CA_7C	2502.5	0.55	25.00	25.55	33.00	0.0714	1.0000	8.00	12.01	8.00	Pass
LTE Band 12	699.7	-0.20	25.00	22.65	34.77	0.0601	0.4665	11.92	8.70	8.70	Pass
LTE Band 13	779.5	1.54	25.00	24.39	34.77	0.0897	0.5197	11.92	9.16	9.16	Pass
LTE Band 14	790.5	2.42	25.00	25.27	34.77	0.1098	0.5270	11.92	9.23	9.23	Pass
LTE Band 17	706.5	-0.20	25.00	22.65	34.77	0.0601	0.4710	11.92	8.74	8.74	Pass
LTE Band 25	1850.7	0.25	25.00	25.25	33.00	0.0666	1.0000	8.00	12.01	8.00	Pass
LTE Band 26(814-824)	814.7	2.87	25.00	NA	NA	0.1218	0.5431	NA	9.36	9.36	Pass
LTE Band 26(824-849)	824.7	2.87	25.00	25.72	38.45	0.1218	0.5498	15.60	9.41	9.41	Pass
LTE Band 30	2307.5	-3.00	23.00	20.00	23.98	0.0199	1.0000	0.98	14.01	0.98	Pass
LTE Band 38/LTE CA_38C	2572.5	2.40	25.00	27.40	33.00	0.1093	1.0000	8.00	12.01	8.00	Pass
LTE Band 41/LTE CA_41C	2498.5	2.40	27.00	29.40	33.00	0.1733	1.0000	6.00	10.01	6.00	Pass
LTE Band 42(3450-3550) /LTE CA_42C	3452.5	1.00	22.00	23.00	30.00	0.0397	1.0000	8.00	15.01	8.00	Pass
LTE Band 43(3700-3800)/LTE CA_43C	3702.5	1.00	22.00	23.00	30.00	0.0397	1.0000	8.00	15.01	8.00	Pass
LTE Band 48/LTE CA_48C	3552.5	1.00	22.00	23.00	23.00	0.0397	1.0000	1.00	15.01	1.00	Pass
LTE Band 66/LTE CA_66B/LTE CA_66C	1710.7	1.47	25.00	26.47	30.00	0.0883	1.0000	5.00	12.01	5.00	Pass
LTE Band 71	665.5	1.22	25.00	24.07	34.77	0.0833	0.4437	11.92	8.48	8.48	Pass

Operating Band	Frequency (MHz)	Antenna Gain (dBi)	MIMO Directional gain	Max Conducted Power (dBm)	EIRP(ERP) (dBm)	EIRP(ERP) Limit (dBm)	Power Density at R = 20 cm (mW/cm2)	Limit (mW/cm2)	Gain according to EIRP(ERP) (dBi)	Gain according to Pd (dBi)	Max Gain Allowed (dBi)	conclusion
NR Band n2	1852.5	0.25	NA	25.00	25.25	33.00	0.0666	1.0000	8.00	12.01	8.00	Pass
NR Band n5	826.5	2.68	NA	25.00	25.53	38.45	0.1166	0.5510	15.60	9.42	9.42	Pass
NR Band n7	2502.5	0.55	NA	25.00	25.55	33.00	0.0714	1.0000	8.00	12.01	8.00	Pass
NR Band n12	701.5	-0.20	NA	25.00	22.65	34.77	0.0601	0.4677	11.92	8.71	8.71	Pass
NR Band n13	779.5	1.54	NA	25.00	24.39	34.77	0.0897	0.5197	11.92	9.16	9.16	Pass
NR Band n14	790.5	2.42	NA	25.00	25.27	34.77	0.1098	0.5270	11.92	9.23	9.23	Pass
NR Band n25	1852.5	0.25	NA	25.00	25.25	33.00	0.0666	1.0000	8.00	12.01	8.00	Pass
NR Band n26(814-824)	816.5	2.87	NA	25.00	NA	NA	0.1218	0.5443	NA	9.37	9.37	Pass
NR Band n26(824-849)	826.5	2.87	NA	25.00	25.72	38.45	0.1218	0.5510	15.60	9.42	9.42	Pass
NR Band n30	2307.5	-3.00	NA	23.00	20.00	23.98	0.0199	1.0000	0.98	14.01	0.98	Pass
NR Band n38	2575.0	2.40	NA	25.00	27.40	33.00	0.1093	1.0000	8.00	12.01	8.00	Pass
NR Band n38(MIMO)	2575.0	2.40	2.40	25.00	27.40	33.00	0.1093	1.0000	8.00	12.01	8.00	Pass
NR Band n41	2506.0	2.40	NA	27.50	29.90	33.00	0.1944	1.0000	5.50	9.51	5.50	Pass
NR Band n41(MIMO)	2506.0	2.40	2.40	27.50	29.90	33.00	0.1944	1.0000	5.50	9.51	5.50	Pass
NR Band n48	3555.0	1.00	NA	22.00	23.00	23.00	0.0397	1.0000	1.00	15.01	1.00	Pass
NR Band n48(MIMO)	3555.0	1.00	1.00	22.00	23.00	23.00	0.0397	1.0000	1.00	15.01	1.00	Pass
NR Band n66	1712.5	1.47	NA	25.00	26.47	30.00	0.0883	1.0000	5.00	12.01	5.00	Pass
NR Band n70	1697.5	1.30	NA	24.00	25.30	30.00	0.0674	1.0000	6.00	13.01	6.00	Pass
NR Band n71	665.5	1.22	NA	25.00	24.07	34.77	0.0833	0.4437	11.92	8.48	8.48	Pass
NR Band n77 (3450-3550)	3455.0	1.00	NA	27.50	28.50	30.00	0.1408	1.0000	2.50	9.51	2.50	Pass
NR Band n77 (3450-3550)(MIMO)	3455.0	1.00	1.00	27.50	28.50	30.00	0.1408	1.0000	2.50	9.51	2.50	Pass
NR Band n77 (3700-3980)	3707.5	1.00	NA	27.50	28.50	30.00	0.1408	1.0000	2.50	9.51	2.50	Pass
NR Band n77 (3700-3980)(MIMO)	3707.5	1.00	1.00	27.50	28.50	30.00	0.1408	1.0000	2.50	9.51	2.50	Pass
NR Band n78 (3450-3550)	3455.0	1.00	NA	27.50	28.50	30.00	0.1408	1.0000	2.50	9.51	2.50	Pass
NR Band n78 (3450-3550)(MIMO)	3455.0	1.00	1.00	27.50	28.50	30.00	0.1408	1.0000	2.50	9.51	2.50	Pass
NR Band n78 (3700-3800)	3705.0	1.00	NA	27.50	28.50	30.00	0.1408	1.0000	2.50	9.51	2.50	Pass
NR Band n78 (3700-3800)(MIMO)	3705.0	1.00	1.00	27.50	28.50	30.00	0.1408	1.0000	2.50	9.51	2.50	Pass
Bluetooth	2402.0	5.00	NA	23.00	28.00	NA	0.1255	1.0000	NA	NA	NA	NA
WLAN2.4GHz	2412.0	5.00	NA	23.00	28.00	NA	0.1255	1.0000	NA	NA	NA	NA
WLAN5GHz	5180.0	5.00	NA	23.00	28.00	NA	0.1255	1.0000	NA	NA	NA	NA

Note:

1. This MPE analysis is applicable to any collocated transmitters with transmit power for WLAN is less than or equal to 28dBm and for Bluetooth is less than or equal to 28dBm.
2. A maximum antenna gain of 5dBi for WLAN/BT has been assumed for all collocated antennas.

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Due to the EUT support NR ENDC and CA
Both LTE and NR/LTE band can transmit simultaneously, the formula of the calculated the MPE is:

$$\sum_{i=1}^{n} \frac{S_{E_i}(duty\,factor)}{MPE_{E_i}} < 1$$

NOTE The corresponding MEs must be expressed in terms of power density in the above summation
Therefore, the worst-case(DC_26A_n41A) situation is 0.2243+0.1944=0.4187, which is less than “1”, this confirmed that the device comply with MPE limit.

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

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

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

Simultaneous Tx Combination	Configuration
1	WWAN + WiFi 2.4G + WiFi 5G + Bluetooth

No.	Mode	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)	Result Ratio	Total Ratio	Limit	Result
1	NR Band n71	0.0833	0.4437	0.1877	0.5642	1.00	Pass
	Bluetooth	0.1255	1.0000	0.1255			
	WiFi 2.4G	0.1255	1.0000	0.1255			
	WiFi 5G	0.1255	1.0000	0.1255			

Note: Considering the WWAN module collocation with the WLAN and Bluetooth transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 3 collocated transmitters is compliant.

---End of Report---