

RF MEASUREMENT REPORT

FCC ID: XMR2023RG520FNA
Applicant: Quectel Wireless Solutions Co., Ltd
Product: 5G Sub-6 GHz LGA Module
Model No.: RG520F-NA
Brand Name: Quectel
FCC Rule Part(s): Part 90 Subpart S
Test Procedure(s): ANSI C63.26: 2015
Result: Complies
Received Date: 2023-05-11
Test Date: 2023-05-13 ~ 2023-06-06

Reviewed By:

Sunny Sun

Approved By:

Robin Wu



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.26-2015. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
2305RSU024-U4	Rev. 01	Initial Report	2023-07-01	Valid

Note: RG520F-NA and RG520N-NA share the same chipset baseline, same software and hardware design, support same bands, the difference is on software enable or disable modem features like some ENDC/CA combs. This application for certification is leveraging the data reuse procedures from KDB 484596 based on reference FCC ID “XMR2023RG520NNA” to cover this variant and assessing the output power, band edge, radiated spurious emissions.

Test Item	Reuse Data Description
Occupied Bandwidth	Refer to FCC ID: XMR2023RG520NNA
Frequency Stability	Refer to FCC ID: XMR2023RG520NNA
Equivalent (Isotropic) Radiated Power	Make Spot Check
Peak to Average Ratio	Refer to FCC ID: XMR2023RG520NNA
Band Edge	Make Spot Check
Spurious Emission	Make Spot Check
<p>Remark: This application reused the following bands test data of the original FCC ID: XMR2023RG520NNA</p> <p>LTE Band: Band 2, 4, 5, 7, 12, 13, 14, 17, 25, 26, 30, 38, 41, 48, 66, 71</p> <p>NR Bands: n2, n5, n7, n12, n13, n14, n25, n26, n30, n38, n41, n48, n66, n71, n77, n78</p>	

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1.1. Applicant

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai,
China 200233

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China 200233

<input checked="" type="checkbox"/>	Test Site - MRT Suzhou Laboratory		
	Laboratory Location (Suzhou - Wuzhong)		
	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China		
	Laboratory Location (Suzhou - SIP)		
	4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China		
	Laboratory Accreditations		
A2LA: 3628.01		CNAS: L10551	
FCC: CN1166		ISED: CN0001	
VCCI: R-20025, G-20034, C-20020, T-20020			
<input type="checkbox"/>	Test Site - MRT Shenzhen Laboratory		
	Laboratory Location (Shenzhen)		
	1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China		
	Laboratory Accreditations		
	A2LA: 3628.02		CNAS: L10551
	FCC: CN1284		ISED: CN0105
<input type="checkbox"/>	Test Site - MRT Taiwan Laboratory		
	Laboratory Location (Taiwan)		
	No. 38, Fuxing 2 nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)		
	Laboratory Accreditations		
	TAF: L3261-190725		
FCC: 291082, TW3261		ISED: TW3261	

1.4. Product Information

Product Name	5G Sub-6 GHz LGA Module
Model No.	RG520F-NA
Brand Name	Quectel
IMEI	Conducted Measurement 1: 864766050012138 Conducted Measurement 2: 864766050012534 Radiated Measurement 1: 864766050012070 Radiated Measurement 2: 864766050012716
E-UTRA Band	Band 2, 4, 5, 7, 12, 13, 14, 17, 25, 26, 30, 38, 41, 42, 43, 48, 66, 71
5G NR Band	n2, n5, n7, n12, n13, n14, n25, n26, n30, n38, n41, n48, n66, n71, n77, n78
5G NR NSA Band	n2, n5, n7, n12, n13, n14, n25, n26, n30, n38, n41, n48, n66, n71, n77, n78
Operating Temperature	-30 ~ 75 °C
Power Type	3.3 ~ 4.4Vdc, typical 3.8Vdc
Remark: 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.	

1.5. Radio Specification under Test

Single Band	n26
FDD T _x Frequency Range	814 ~ 824 MHz
FDD R _x Frequency Range	859 ~ 869 MHz
Support Bandwidth	5, 10, 15, 20MHz
SCS for NR cell	FDD Band: 15kHz
Modulation	UL up to 256QAM, DL up to 256QAM
Remark: 1. For other features of this EUT, test report will be issued separately. 2. 5G NR n26 transmit frequency for part 90 rule is 814 ~ 824MHz and part 22 rule is 824 ~ 849MHz. ERP over 15MHz bandwidth complies the ERP limit line of part 22 rule, therefore ERP of the partial frequency spectrum which falls within part 22 also complies.	

1.6. Description of Available Antennas

Technology	Frequency Range (MHz)	Antenna Type	Max Peak Gain (dBi)
n2	1850 ~ 1910	Dipole	1.37
n5	824 ~ 849		1.18
n7	2500 ~ 2570		2.07
n12	699 ~ 716		1.18
n13	777 ~ 787		1.18
n14	788 ~ 798		1.18
n25	1850 ~ 1915		1.37
n26	814-849		1.18
n30	2305 ~ 2315		1.11
n38	2570 ~ 2620		2.07
n41	2496 ~ 2690		2.07
n66	1710 ~ 1780		1.37
n71	663 ~ 698		1.18
n77	3450 ~ 3550		0.58
	3700 ~ 3980		
n78	3450 ~ 3550		0.58
	3700 ~ 3980		

Note: All antenna information (Antenna type and Peak Gain) is provided by the manufacturer.

1.7. Test Methodology

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ANSI C63.26:2015
- FCC CFR 47 Part 90
- FCC KDB 971168 D01 v03r01: Power Meas License Digital Systems
- FCC KDB 971168 D02 v02r01: Misc Rev Approv License Devices
- FCC KDB 412172 D01 v01r01: Determining ERP and EIRP

1.8. Device Capabilities

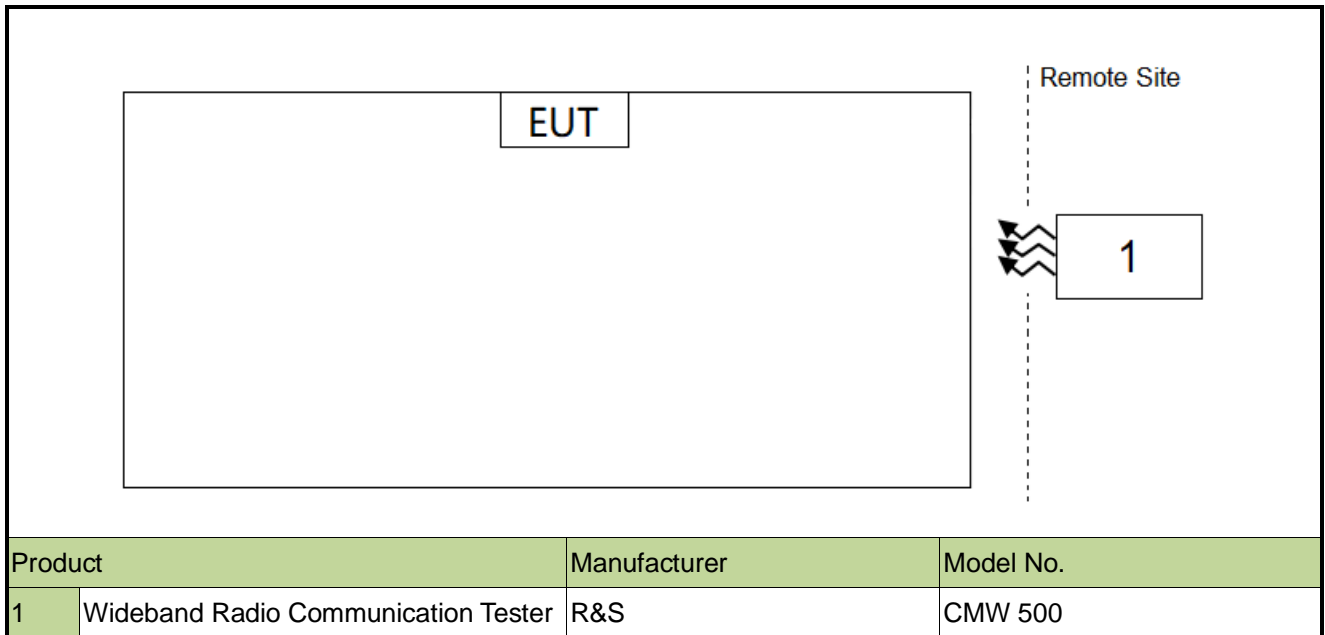
PI/2 BPSK modulation applied for 5G NR band frequencies and has the same tune up power as QPSK modulations.

The DFT-s-OFDM and CP-OFDM waveforms were investigated, and DFT-s-OFDM was found to be the worst case.

The worst-case scenario for all measurements is based on an engineering evaluation and QPSK was observed as the worst one and set for all conducted and radiated. Output power measurements were measured on PI/2 BPSK modulations.

2. Test Configuration

2.1. Test System Connection Diagram



2.2. Test Environment Condition

Ambient Temperature	15 ~ 35°C
Relative Humidity	20% ~ 75%RH

3. Measuring Instrument

Instrument	Manufacturer	Model No.	Asset No.	Cali. Interval	Cali. Due Date	Test Site
Signal Analyzer	Keysight	N9010B	MRTSUE07028	1 year	2023-11-25	SIP-SR1
Signal Analyzer	Keysight	N9010B	MRTSUE06559	1 year	2024-05-23	SIP-SR1
Signal Analyzer	Keysight	N9010B	MRTSUE06603	1 year	2023-10-25	SIP-SR1
Signal Analyzer	Keysight	N9020B	MRTSUE06604	1 year	2023-11-07	SIP-SR1
Communication Tester	R&S	CMU 200	MRTSUE06009	1 year	2023-08-23	SIP-SR1
Communication Tester	R&S	CMW500	MRTSUE06243	1 year	2023-10-08	SIP-SR1
Signal Generator	Keysight	E8257D	MRTSUE06453	1 year	2024-05-23	SIP-SR1
Thermohygrometer	testo	622	MRTSUE06629	1 year	2024-01-03	SIP-SR1
5G Wireless Test Platform	Keysight	E7515B	MRTSUE06903	1 year	2023-10-25	SIP-SR1
Signal Generator	Keysight	E8257D	MRTSUE06904	1 year	2023-10-25	SIP-SR1
DC POWER MODULE	Keysight	N6743B	MRTSUE06905	N/A	N/A	SIP-SR1
DC POWER MODULE	Keysight	N6743B	MRTSUE06906	N/A	N/A	SIP-SR1
Low-Profile Modular Power System Mainframe	Keysight	N6700C	MRTSUE06907	N/A	N/A	SIP-SR1
FR1 Switching Unit	Keysight	C8880A	MRTSUE06908	N/A	N/A	SIP-SR1
Signal Analyzer	Keysight	N9021B	MRTSUE06915	1 year	2023-12-28	SIP-SR1
Temperature Chamber	BAOYT	BYG-80CL	MRTSUE06932	1 year	2024-02-12	SIP-SR1
Shielding Room	MIX-BEP	SIP-SR1	MRTSUE06948	N/A	N/A	SIP-SR1
Millimeter-Wave Transceiver for 5G	Keysight	M1740A	MRTSUE06954	3 years	2024-06-02	SIP-SR1
Millimeter-Wave Transceiver for 5G	Keysight	M1740A	MRTSUE06955	3 years	2024-06-02	SIP-SR1
5G Wireless Test Platform	Keysight	E7515B	MRTSUE06956	1 year	2024-05-23	SIP-SR1
Common Interface Unit	Keysight	E7770A	MRTSUE06957	N/A	N/A	SIP-SR1
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2024-06-07	SIP-AC3
EMI Test Receiver	R&S	ESR3	MRTSUE06185	1 year	2023-12-28	SIP-AC3
Signal Analyzer	Keysight	N9010B	MRTSUE06559	1 year	2024-05-23	SIP-AC3
Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06598	1 year	2023-11-05	SIP-AC3
Signal Analyzer	Keysight	N9010B	MRTSUE06603	1 year	2023-10-25	SIP-AC3
Signal Analyzer	Keysight	N9020B	MRTSUE06604	1 year	2023-11-07	SIP-AC3
Horn Antenna	R&S	HF907	MRTSUE06611	1 year	2023-07-30	SIP-AC3
EMI Test Receiver	R&S	ESR3	MRTSUE06613	1 year	2024-05-23	SIP-AC3
Thermohygrometer	testo	608-H1	MRTSUE06619	1 year	2023-11-01	SIP-AC3
Thermohygrometer	testo	608-H1	MRTSUE06622	1 year	2023-11-27	SIP-AC3
Preamplifier	EMCI	EMC012645SE	MRTSUE06642	1 year	2024-01-12	SIP-AC3

Preamplifier	EMCI	EMC001330	MRTSUE06643	1 year	2024-01-12	SIP-AC3
TRILOG Antenna	Schwarzbeck	VULB 9168	MRTSUE06646	1 year	2023-08-16	SIP-AC3
Anechoic Chamber	RIKEN	SIP-AC3	MRTSUE06782	1 year	2023-12-22	SIP-AC3
Loop Antenna	Schwarzbeck	FMZB 1519 B	MRTSUE06937	1 year	2024-02-26	SIP-AC3
Signal Analyzer	Keysight	N9010B	MRTSUE07028	1 year	2023-11-25	SIP-AC3
Directional Coupler	ar	DC7200A	MRTSUE06147	N/A	N/A	SIP
Directional Coupler	ar	DC6080A	MRTSUE06148	N/A	N/A	SIP
Directional Coupler	narda	4226-10	MRTSUE06564	1 year	2023-10-10	SIP
Directional Coupler	PULSAR	CS10-23-436/20	MRTSUE06846	1 year	2024-06-01	SIP
Directional Coupler	PULSAR	CS10-23-436/20	MRTSUE06848	1 year	2024-06-01	SIP
Attenuator	MVE	MVE2213	MRTSUE11055	1 year	2024-06-08	SIP
Attenuator	MVE	MVE2213	MRTSUE11056	1 year	2024-06-08	SIP
Attenuator	MVE	MVE2213	MRTSUE11057	1 year	2024-06-08	SIP
Attenuator	MVE	MVE2213	MRTSUE11058	1 year	2024-06-08	SIP
Attenuator	MVE	MVE2213	MRTSUE11059	1 year	2024-06-08	SIP
Attenuator	MVE	MVE2213	MRTSUE11060	1 year	2024-06-08	SIP

Software	Version	Function
EMI Software	V3.0.0	EMI Test Software

4. Decision Rules and Measurement Uncertainty

4.1. Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2.
(Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

4.2. Measurement Uncertainty

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Radiated Spurious Emissions	
Measurement Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$):	
Horizontal: 9kHz ~ 300MHz: 5.04dB	
300MHz ~ 1GHz: 4.95dB	
1GHz ~ 40GHz: 6.40dB	
Vertical: 9kHz ~ 300MHz: 5.24dB	
300MHz ~ 1GHz: 6.03dB	
1GHz ~ 40GHz: 6.40dB	
Conducted Spurious Emissions	
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$):	
0.78dB	
Output Power	
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$):	
1.13dB	

5. Test Result

5.1. Summary

FCC Part Section(s)	Test Description	Test Condition	Verdict
90.635	Conducted Output Power	Conducted	Pass
2.1051, 90.691(a)	Band Edge		
2.1053, 90.691(a)	Spurious Emissions	Radiated	Pass

Notes:

- 1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 2) The worst-case emission of modulation was selected. Therefore, the Channel Band Edge, Radiated Spurious Emission were presented worst-case in the test report.
- 3) For radiated emission tests, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.

5.2. Conducted Output Power Measurement

5.2.1. Test Limit

The maximum output power of the transmitter for mobile stations is 100 watts (20dBw).

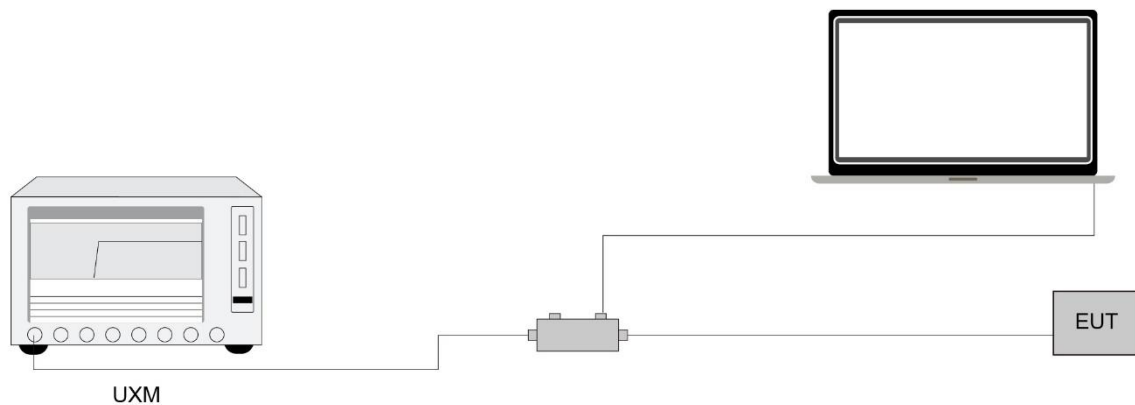
5.2.2. Test Procedure

ANSI C63.26-2015 - Section 5.2

5.2.3. Test Setting

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.

5.2.4. Test Setup



5.2.5. Test Result

Refer to Appendix A.1.

5.3. Band Edge Measurement

5.3.1. Test Limit

Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

- (1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log(f/6.1)$ decibels or $50 + 10 \log(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.
- (2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

5.3.2. Test Procedure

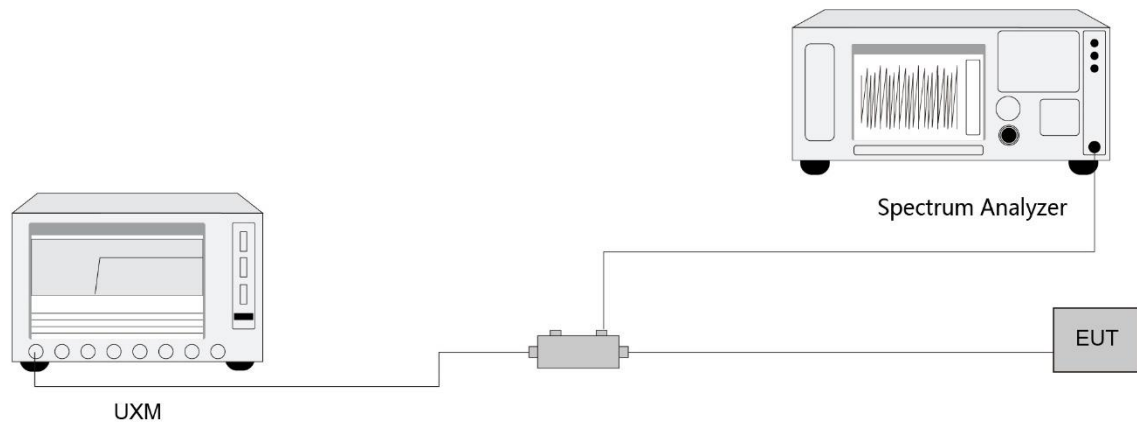
ANSI C63.26-2015 - Section 5.7

5.3.3. Test Setting

1. Set the analyzer frequency to low or high channel
2. $RBW \geq$ The nominal RBW shall be in the range of 1% of the anticipated OBW (in the 1MHz band immediately outside and adjacent to the band edge). For improvement of the accuracy in the measurement of the average power of a noise-like emission, a RBW narrower than the specified reference bandwidth can be used (generally limited to no less than 1% of the OBW), provided that a subsequent integration is performed over the full required measurement bandwidth. This integration should be performed using the spectrum analyzer's band power functions.
3. $VBW \geq 3 \cdot RBW$
4. Sweep time = auto
5. Detector = power averaging (rms)
6. Set sweep trigger to “free run.”
7. User gate triggered such that the analyzer only sweeps when the device is transmitting at full power
8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to

increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.

5.3.4. Test Setup



5.3.5. Test Result

Refer to Appendix A.2.

5.4. Radiated Spurious Emissions Measurement

5.4.1. Test Limit

Out of band emissions: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB. The emission limit equal to -13dBm.

E (dBμV/m) = EIRP (dBm) - $20 \log D$ + 104.8; where D is the measurement distance in meters. The emission limit equal to 82.3dBμV/m.

5.4.2. Test Procedure

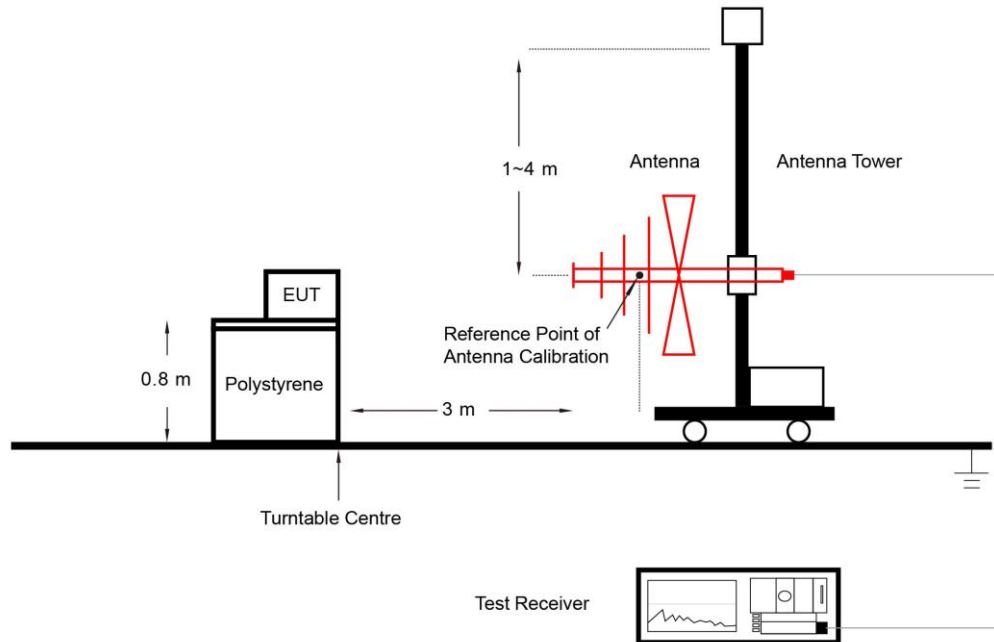
ANSI C63.26-2015 - Section 5.2.7 & 5.5

5.4.3. Test Setting

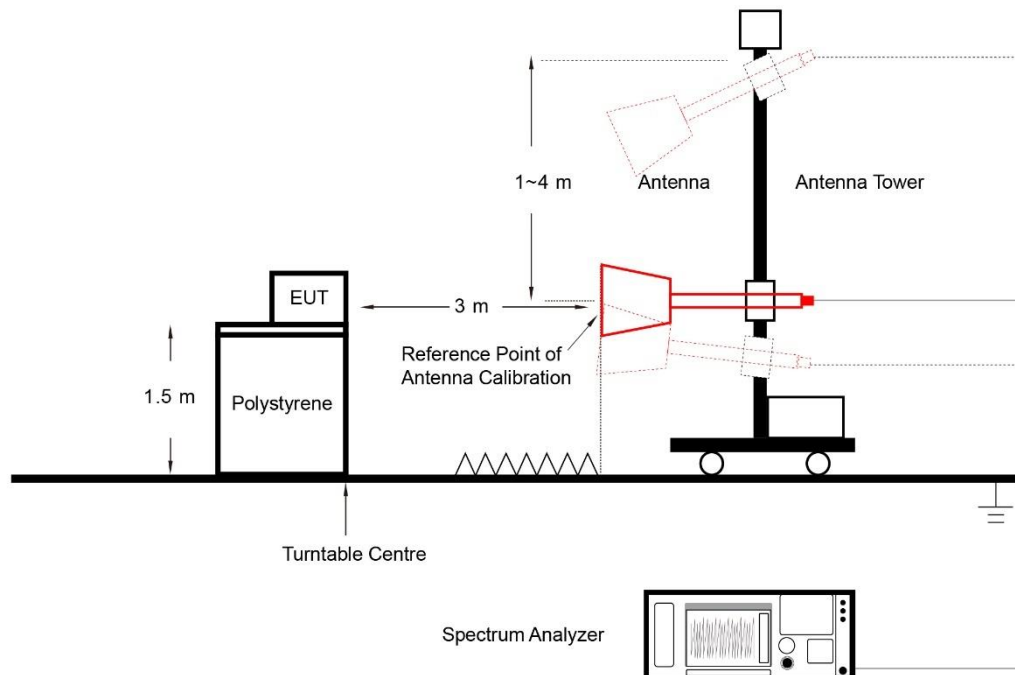
1. RBW = 1MHz
2. VBW $\geq 3 \times$ RBW
3. Sweep time $\geq 10 \times$ (number of points in sweep) \times (transmission symbol period)
4. Detector = Peak
5. Trace mode = max hold
6. The trace was allowed to stabilize

5.4.4. Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



5.4.5. Test Result

Refer to Appendix A.3.

Appendix A - Test Result

A.1 Conducted Output Power Test Result

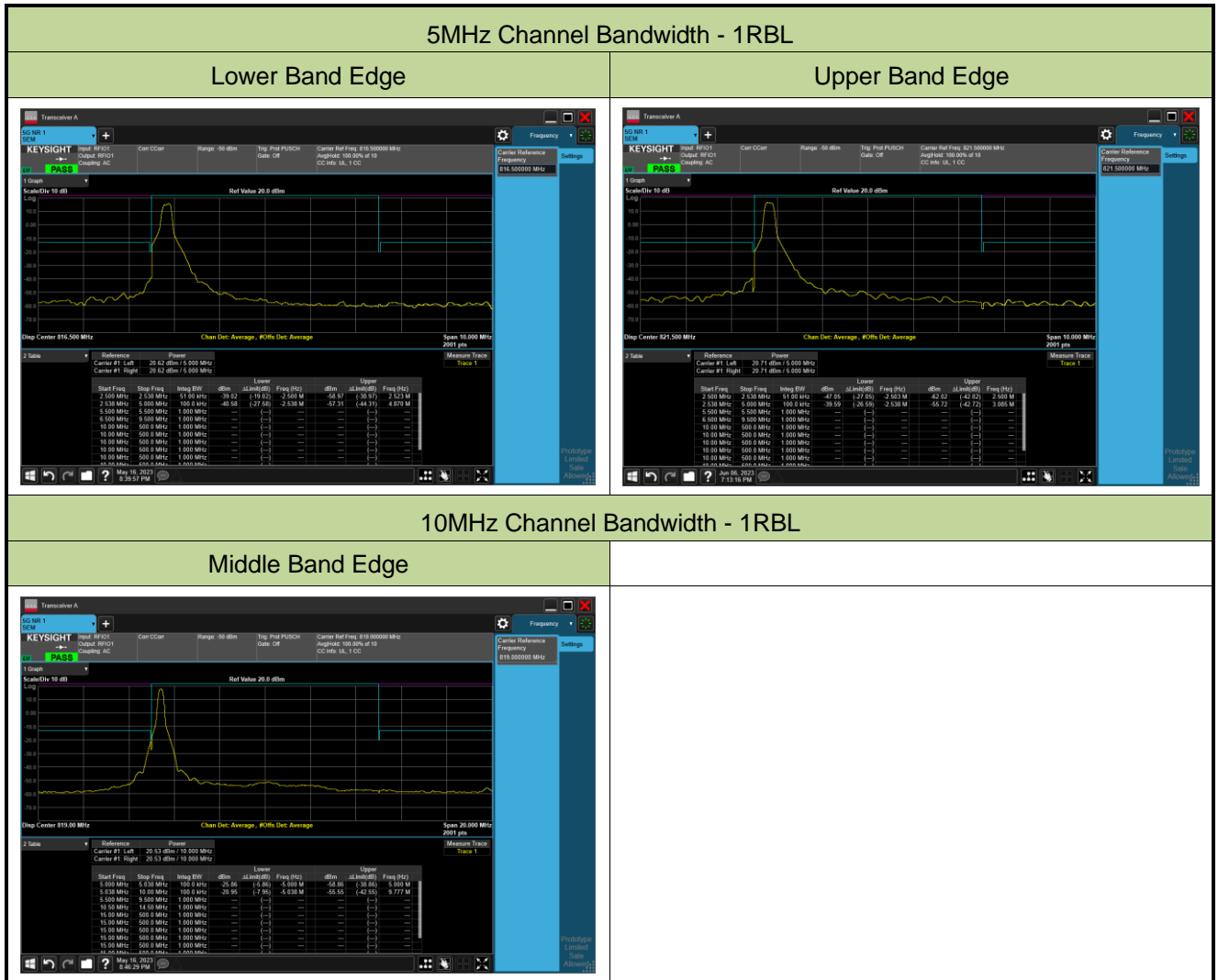
Test Site	SIP-SR1	Test Engineer	Candy Luo
Test Date	2023/05/13	Test Band	NR n26

Channel Bandwidth (MHz)	Frequency (MHz)	RB Size	RB Offset	Output Power (dBm)	Output Power (W)	Limit (W)
DFT-s-OFDM PI/2 BPSK						
5	816.5	12	6	22.94	0.1968	<100
		1	1	22.95	0.1972	<100
		1	23	22.87	0.1936	<100
		25	0	22.99	0.1991	<100
		1	24	22.88	0.1941	<100
		1	0	22.84	0.1923	<100
	819.0	12	6	22.96	0.1977	<100
		1	1	22.87	0.1936	<100
		1	23	22.85	0.1928	<100
		25	0	22.94	0.1968	<100
		1	24	22.98	0.1986	<100
		1	0	22.88	0.1941	<100
	821.5	12	6	23.07	0.2028	<100
		1	1	22.86	0.1932	<100
		1	23	22.96	0.1977	<100
		25	0	23.01	0.2000	<100
		1	24	22.93	0.1963	<100
		1	0	22.95	0.1972	<100
10	819.0	25	12	22.99	0.1991	<100
		1	1	22.94	0.1968	<100
		1	50	23.02	0.2004	<100
		50	0	22.99	0.1991	<100
		1	51	22.97	0.1982	<100
		1	0	22.91	0.1954	<100

15	821.5	36	18	23.14	0.2061	<100
		1	1	23.03	0.2009	<100
		1	77	23.11	0.2046	<100
		75	0	23.18	0.2080	<100
		1	78	23.06	0.2023	<100
		1	0	23.05	0.2018	<100
20	824.0	50	25	23.26	0.2118	<100
		1	1	23.00	0.1995	<100
		1	104	23.07	0.2028	<100
		100	0	23.23	0.2104	<100
		1	105	23.05	0.2018	<100
		1	0	23.20	0.2089	<100

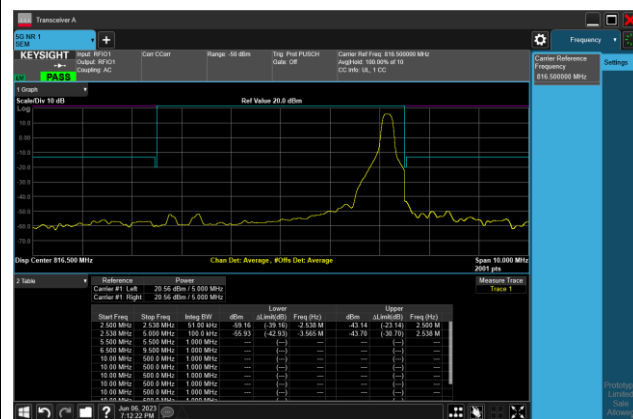
A.2 Band Edge Test Result

Test Site	SIP-SR1	Test Engineer	Candy Luo
Test Date	2023/05/16 ~ 2023/06/06	Test Band	NR n26

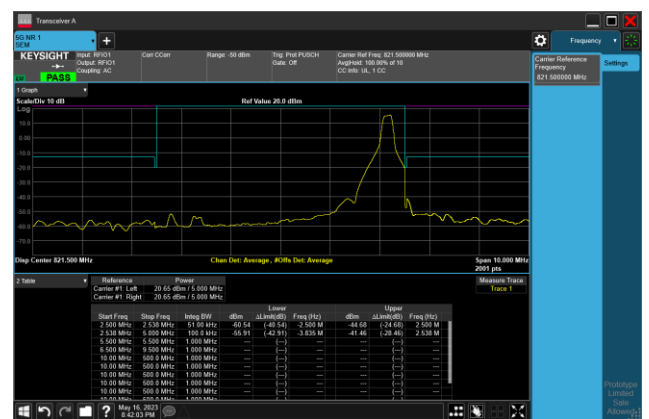


5MHz Channel Bandwidth - 1RBH

Lower Band Edge

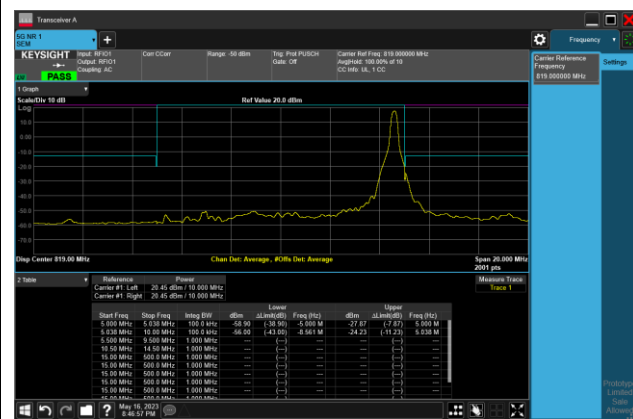


Upper Band Edge



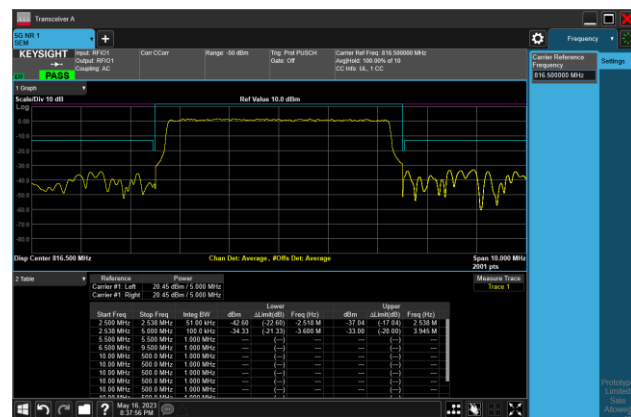
10MHz Channel Bandwidth - 1RBH

Middle Band Edge

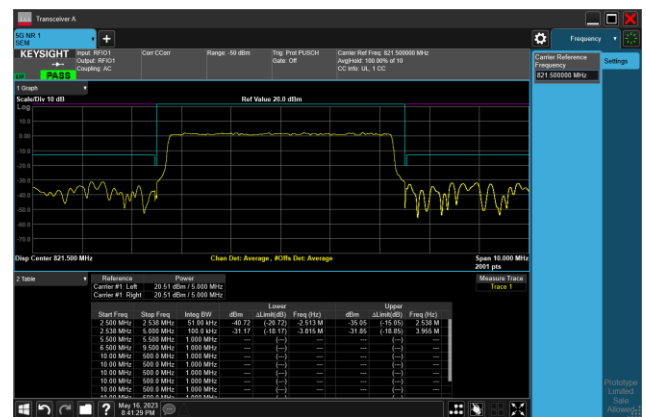


5MHz Channel Bandwidth - Full RB

Lower Band Edge

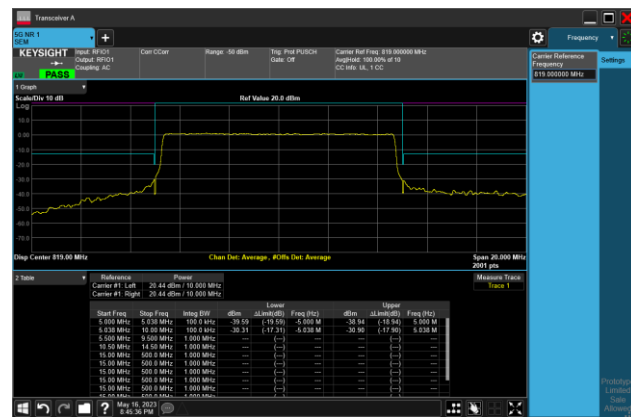


Upper Band Edge



10MHz Channel Bandwidth - Full RB

Middle Band Edge



A.3 Radiated Suprious Emissions Test Result

Test Site	WZ-AC2	Test Engineer	Dick Shen
Test Date	2023/05/13 ~ 2023/05/18	Test Band	NR n26, 5MHz, 1RB

Frequency (MHz)	Reading Level (dBμV)	Factor (dB/m)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
Low Channel							
427.215	10.2	22.1	32.3	82.3	-50.0	Peak	Horizontal
685.720	11.8	26.6	38.4	82.3	-43.9	Peak	Horizontal
559.620	11.5	24.5	36.0	82.3	-46.3	Peak	Vertical
694.450	11.7	26.9	38.5	82.3	-43.8	Peak	Vertical
1654.500	38.7	-5.8	32.9	82.3	-49.4	Peak	Horizontal
14812.500	30.7	19.8	50.4	82.3	-31.9	Peak	Horizontal
2827.500	36.5	-2.9	33.6	82.3	-48.7	Peak	Vertical
10443.500	31.2	15.6	46.8	82.3	-35.5	Peak	Vertical

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB/m).

Appendix B - Test Setup Photograph

Refer to "2305RSU024-UT" file.

Appendix C - EUT Photograph

Refer to "2305RSU024-UE" file.