

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 27 Subpart D
Test Procedure(s): ANSI C63.26: 2015
Result: Complies
Received Date: 2023-05-11
Test Date: 2023-05-12 ~ 2023-06-26

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.

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Revision History

Report No.	Version	Description	Issue Date	Note
2305RSU024-U10	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>	

CONTENTS

Description	Page
1. General Information.....	5
1.1. Applicant.....	5
1.2. Manufacturer.....	5
1.3. Testing Facility.....	5
1.4. Product Information.....	6
1.5. Radio Specification under Test.....	6
1.6. Description of Available Antennas.....	7
1.7. Test Methodology.....	7
2. Test Configuration.....	8
2.1. Test System Connection Diagram.....	8
2.2. Test Environment Condition.....	8
3. Measuring Instrument.....	9
4. Decision Rules and Measurement Uncertainty.....	11
4.1. Decision Rules.....	11
4.2. Measurement Uncertainty.....	11
5. Test Result.....	12
5.1. Summary.....	12
5.2. Equivalent Isotropically Radiated Power Measurement.....	13
5.2.1. Test Limit.....	13
5.2.2. Test Procedure.....	13
5.2.3. Test Setting.....	13
5.2.4. Test Setup.....	14
5.2.5. Test Result.....	14
5.3. Band Edge Measurement.....	15
5.3.1. Test Limit.....	15
5.3.2. Test Procedure.....	15
5.3.3. Test Setting.....	15
5.3.4. Test Setup.....	16
5.3.5. Test Result.....	16
5.4. Radiated Spurious Emissions Measurement.....	17
5.4.1. Test Limit.....	17
5.4.2. Test Procedure.....	17
5.4.3. Test Setting.....	17
5.4.4. Test Setup.....	17

5.4.5.	Test Result	18
Appendix A - Test Result.....		19
A.1	Equivalent Isotropically Radiated Power Test Result	19
A.2	Band Edge Test Result.....	20
A.3	Radiated Spurious Emissions Test Result.....	23
Appendix B - Test Setup Photograph		24
Appendix C - EUT Photograph.....		25

1.1. Applicant

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

Quectel Wireless Solutions Co., Ltd

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai,
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 FCC: CN1166 VCCI: R-20025, G-20034, C-20020, T-20020
	CNAS: L10551 ISED: CN0001
<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 FCC: CN1284
	CNAS: L10551 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
	CNAS: L3261 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

FDD T _x Frequency Range	Band 30: 2305 ~ 2315 MHz
FDD R _x Frequency Range	Band 30: 2350 ~ 2360 MHz
Modulation	UL up to 256QAM, DL up to 256QAM
Remark: For other features of this EUT, test report will be issued separately.	

1.6. Description of Available Antennas

Technology	Frequency Range (MHz)	Antenna Type	MaxPeak Gain (dBi)
LTE Band 2	1850 ~ 1910	Dipole	1.37
LTE Band 4	1710 ~ 1755		1.37
LTE Band 5	824 ~ 849		1.18
LTE Band 7	2500 ~ 2570		2.07
LTE Band 12	699 ~ 716		1.18
LTE Band 13	777 ~ 787		1.18
LTE Band 14	788 ~ 798		1.18
LTE Band 17	704~ 716		1.18
LTE Band 25	1850 ~ 1915		1.37
LTE Band 26	814~849		1.18
LTE Band 30	2305 ~ 2315		1.11
LTE Band 38	2570 ~ 2620		2.07
LTE Band 41	2496 ~ 2690		2.07
LTE Band 42	3450 ~ 3550		0.58
LTE Band 43	3700 ~ 3800		0.58
LTE Band 48	3550 ~ 3700		0.58
LTE Band 66	1710 ~ 1780		1.37
LTE Band 71	663 ~ 698		1.18

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

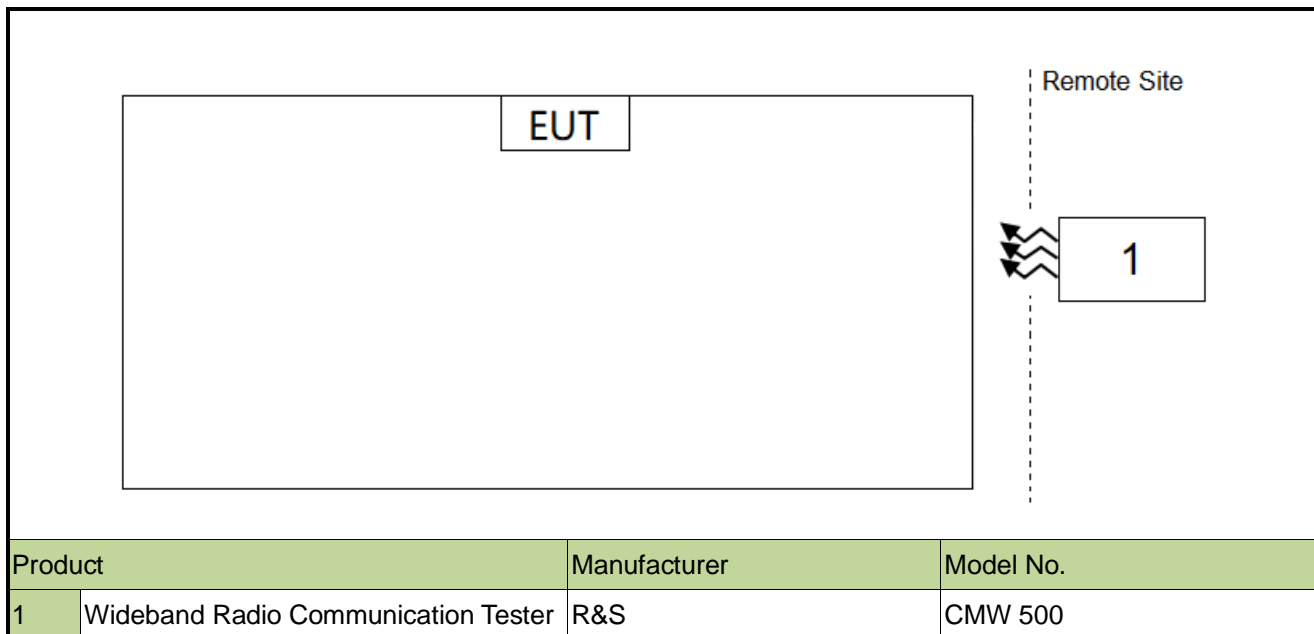
1.7. Test Methodology

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 27
- 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

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
USB Power Sensor	Keysight	U8488A	MRTSUE06958	1 year	2026-07-08	SIP-SR1
Directional Coupler	ar	DC7200A	MRTSUE06147	N/A	N/A	SIP
Directional Coupler	ar	DC6080A	MRTSUE06148	N/A	N/A	SIP-SR1
Directional Coupler	narda	4226-10	MRTSUE06564	1 year	2023-10-10	SIP-SR1
Directional Coupler	PULSAR	CS10-23-436/20	MRTSUE06846	1 year	2024-06-01	SIP-SR1
Directional Coupler	PULSAR	CS10-23-436/20	MRTSUE06848	1 year	2024-06-01	SIP-SR1
Attenuator	MVE	MVE2213	MRTSUE11055	1 year	2024-06-08	SIP-SR1
Attenuator	MVE	MVE2213	MRTSUE11056	1 year	2024-06-08	SIP-SR1
Attenuator	MVE	MVE2213	MRTSUE11057	1 year	2024-06-08	SIP-SR1
Attenuator	MVE	MVE2213	MRTSUE11058	1 year	2024-06-08	SIP-SR1
Attenuator	MVE	MVE2213	MRTSUE11059	1 year	2024-06-08	SIP-SR1

Attenuator	MVE	MVE2213	MRTSUE11060	1 year	2024-06-08	SIP-SR1
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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% ($U=2Uc(y)$):	
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% ($U=2Uc(y)$):	
0.78dB	
Output Power	
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$):	
1.13dB	

5. Test Result

5.1. Summary

FCC Part Section(s)	Test Description	Test Condition	Test Result	Reference
27.50(a)(3)	Equivalent Isotropic Radiated Power Density	Conducted	Pass	Section 5.2
2.1051, 27.53(a)(4)	Band Edge			Section 5.3
2.1053, 27.53(a)(4)	Spurious Emissions	Radiated	Pass	Section 5.4

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. Equivalent Isotropically Radiated Power Measurement

5.2.1. Test Limit

For mobile and portable stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band, the average EIRP must not exceed 50 milliwatts within any 1 megahertz of authorized bandwidth, except that for mobile and portable stations compliant with 3GPP LTE standards or another advanced mobile broadband protocol that avoids concentrating energy at the edge of the operating band the average EIRP must not exceed 250 milliwatts within any 5 megahertz of authorized bandwidth but may exceed 50 milliwatts within any 1 megahertz of authorized bandwidth

5.2.2. Test Procedure

ANSI C63.26-2015 - Section 5.2.4.4.2 & 5.2.5.5

5.2.3. Test Setting

When the fundamental condition for average power measurements cannot be realized (i.e., the EUT can not be configured to transmit at full-power on a continuous basis (i.e., duty cycle < 98%) and the instrumentation cannot be configured to measure only during active full-power transmissions), then the following procedure can be used if the EUT duty cycle is constant (i.e., duty cycle variations are less than or equal to $\pm 2\%$).

- a) Set span to $2 \times$ to $3 \times$ the OBW.
- b) Set RBW = 1% to 5% of the OBW.
- c) Set VBW $\geq 3 \times$ RBW.
- d) Set number of measurement points in sweep $\geq 2 \times$ span / RBW.
- e) Sweep time:
 - 1) Set = auto-couple, or
 - 2) Set $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$ for single sweep (automation-compatible) measurement.
- f) Detector = power averaging (rms).
- g) Set sweep trigger to "free run."
- h) 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.
- i) Using the marker function to identify the maximum PSD.

j) Add $10 \log (1/\text{duty cycle})$ to the measured power level to compute the average power during continuous transmission. For example, add $[10 \log (1/0.25)] = 6 \text{ dB}$ if the duty cycle is a constant 25%.

The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is given in Equation (1) as follows:

$$\text{ERP or EIRP} = P_{\text{Meas}} + G_T \quad (1)$$

where

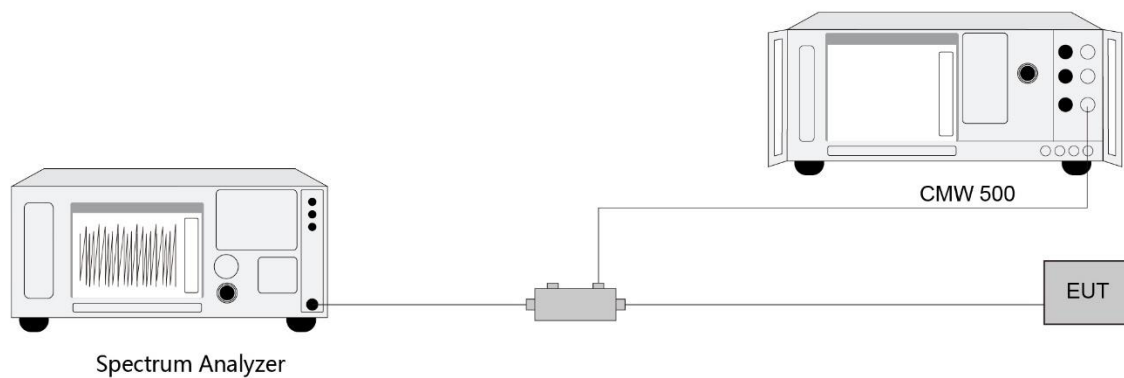
ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas} , e.g., dBm or dBW)

P_{Meas} measured transmitter output power or PSD, in dBm or dBW

G_T gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

For devices utilizing multiple antennas, see 6.4 for guidance with respect to determining the effective array transmit antenna gain term to be used in the above equation.

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

For mobile and portable stations operating in the 2305-2315 MHz and 2350-2360MHz bands:

- (1) By a factor of not less than: $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, not less than $55 + 10 \log (P)$ dB on all frequencies between 2320 and 2324 MHz and on all frequencies between 2341 and 2345 MHz, not less than $61 + 10 \log (P)$ dB on all frequencies between 2324 and 2328 MHz and on all frequencies between 2337 and 2341 MHz, and not less than $67 + 10 \log (P)$ dB on all frequencies between 2328 and 2337 MHz;
- (2) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2300 and 2305 MHz, $55 + 10 \log (P)$ dB on all frequencies between 2296 and 2300 MHz, $61 + 10 \log (P)$ dB on all frequencies between 2292 and 2296 MHz, $67 + 10 \log (P)$ dB on all frequencies between 2288 and 2292 MHz, and $70 + 10 \log (P)$ dB below 2288 MHz;
- (3) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2360 and 2365 MHz, and not less than $70 + 10 \log (P)$ dB above 2365 MHz.

5.3.2. Test Procedure

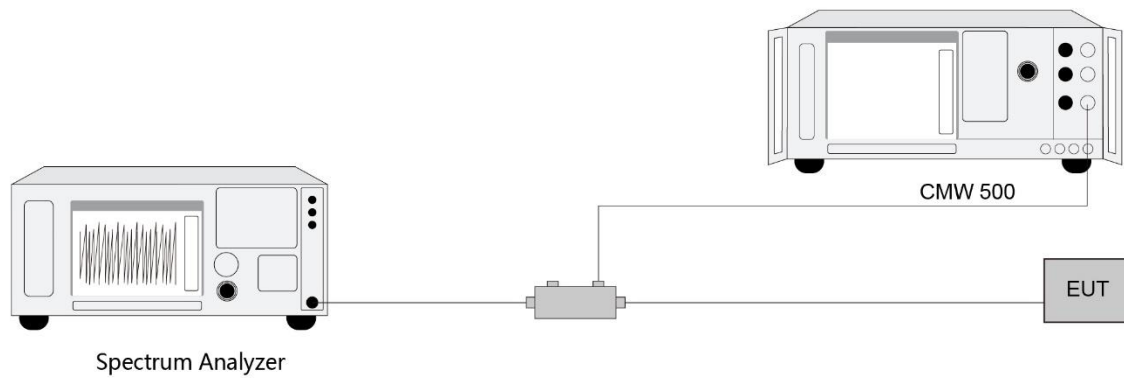
ANSI C63.26-2015 - Section 5.7

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 lower than the transmitter power (P) by a factor of at least $70 + 10 \log (P)$ dB.

$E \text{ (dB}\mu\text{V/m)} = \text{EIRP (dBm)} - 20 \log D + 104.8$; where D is the measurement distance in meters. The emission limit equal to 55.3dB μ V/m.

5.4.2. Test Procedure

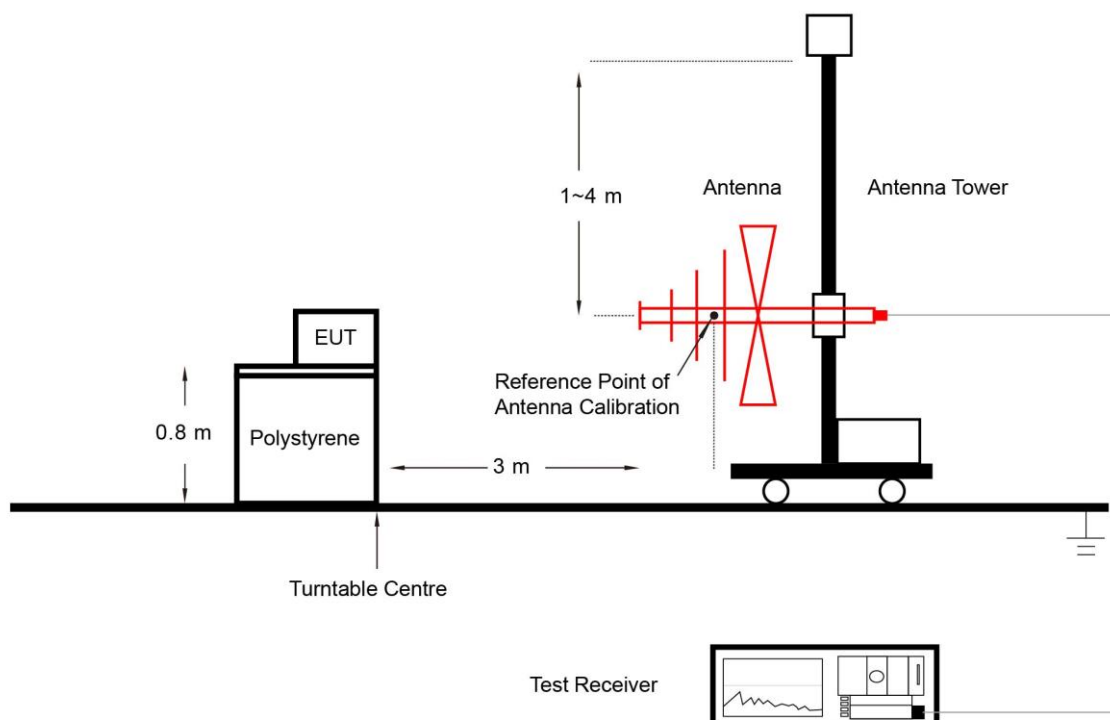
ANSI C63.26-2015 - Section 5.2.7 & 5.5

5.4.3. Test Setting

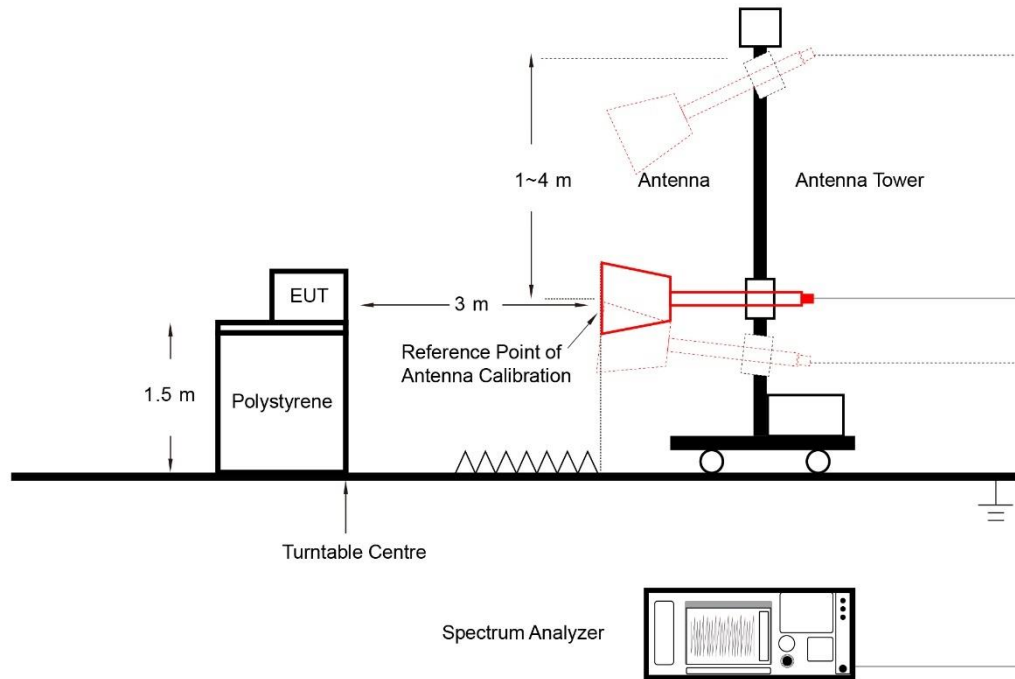
1. RBW = 1MHz
2. VBW $\geq 3 \times$ RBW
3. Sweep time $\geq 10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})$
4. Detector = Peak
5. Trace mode = max hold
6. The trace was allowed to stabilize

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

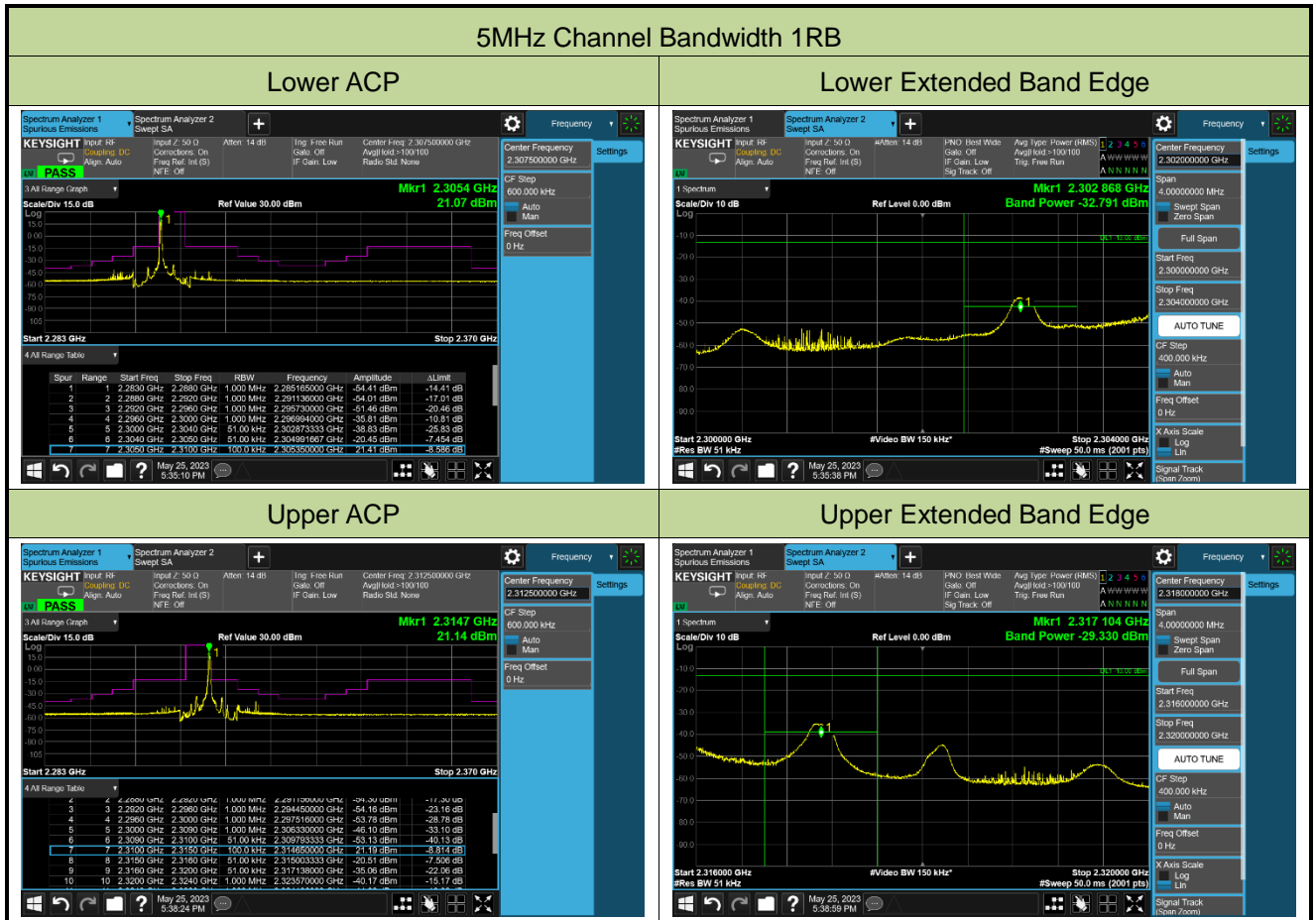
A.1 Equivalent Isotropically Radiated Power Test Result

Test Site	SIP-SR1	Test Engineer	Sunshine Wan
Test Date	2023/06/26	Test Band	Band 30

Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Power Density (dBm/5MHz)	EIRP Density (dBm/5MHz)	Limit (dBm /5MHz)
QPSK						
2307.5	5	25	0	21.32	22.43	< 23.98
2310.0				21.29	22.40	< 23.98
2312.5				21.34	22.45	< 23.98
2310.0	10	50	0	18.74	19.85	< 23.98
Note: The EIRP Density (dBm/5MHz) = Power Density (dBm/5MHz) + Antenna Gain (dBi)						

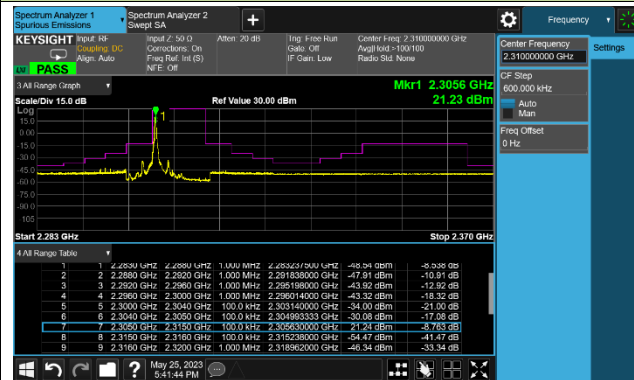
A.2 Band Edge Test Result

Test Site	SIP-SR1	Test Engineer	Sunshine Wan
Test Date	2023/05/25 ~ 2023/06/05	Test Band	Band 30

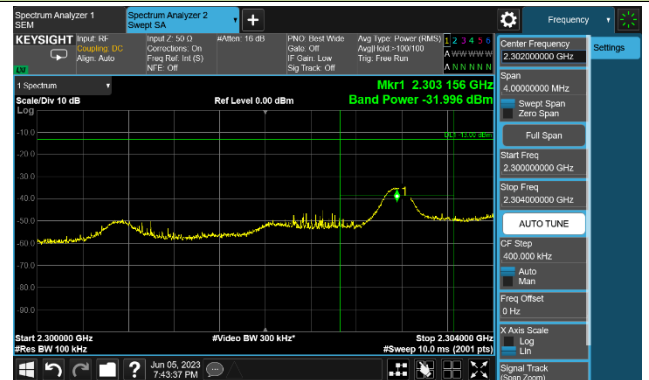


10MHz Channel Bandwidth 1RB

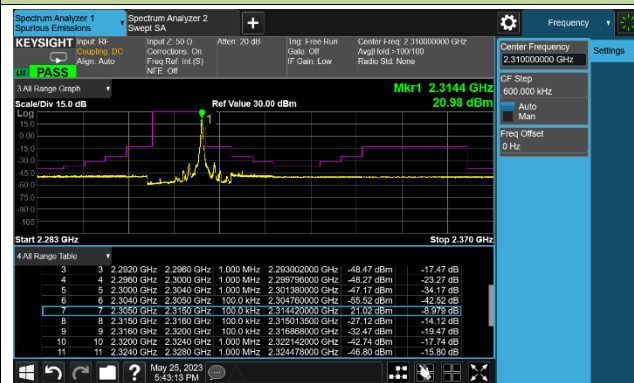
Lower ACP



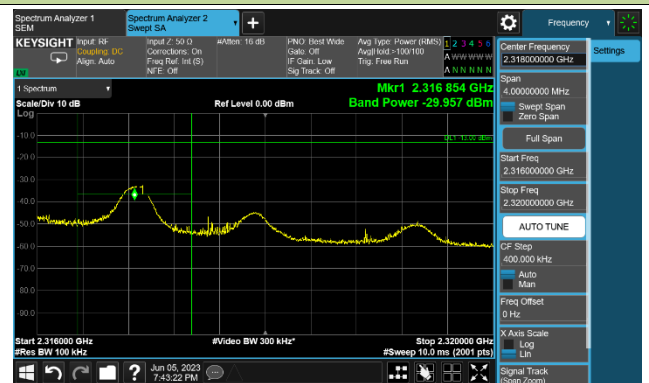
Lower Extended Band Edge



Upper ACP

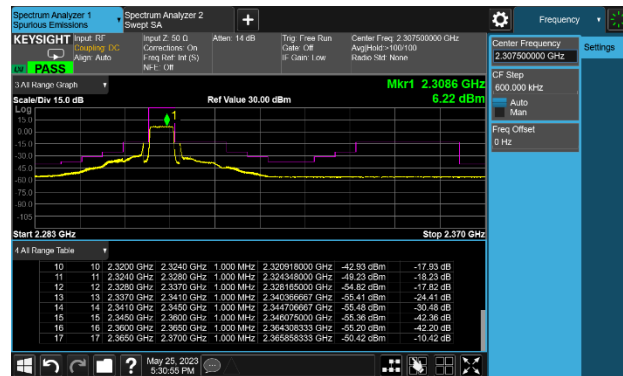


Upper Extended Band Edge

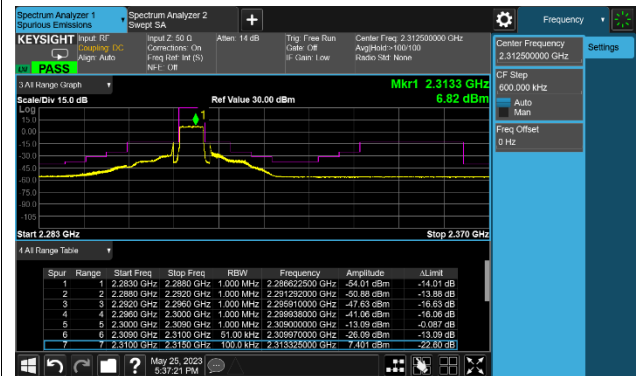


5MHz Channel Bandwidth Full RB

Lower ACP

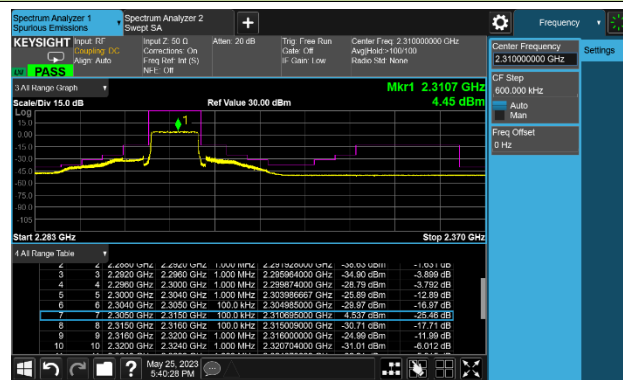


Upper ACP



10MHz Channel Bandwidth Full RB

Middle ACP



A.3 Radiated Spurious Emissions Test Result

Test Site	SIP-AC2	Test Engineer	Barry Wu
Test Date	2023/05/12 ~ 2023/05/18	Test Band	LTE Band 30, 5MHz, 1RB

Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
Middle Channel							
53.8	5.8	18.4	24.2	55.3	-31.1	Peak	Horizontal
910.3	5.3	30.2	35.5	55.3	-19.8	Peak	Horizontal
53.8	15.0	18.4	33.4	55.3	-21.9	Peak	Vertical
64.9	17.0	17.6	34.6	55.3	-20.7	Peak	Vertical
4672.0	52.3	-10.5	41.8	55.3	-13.5	Peak	Horizontal
10103.5	49.9	-4.6	45.3	55.3	-10.0	Peak	Horizontal
10180.0	49.8	-4.7	45.1	55.3	-10.2	Peak	Vertical
13605.5	47.5	-1.1	46.4	55.3	-8.9	Peak	Vertical

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

Appendix B - Test Setup Photograph

Refer to "2305RSU024-UT" file.

Appendix C - EUT Photograph

Refer to "2305RSU024-UE" file.