

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

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-U8	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
Remark: This application reused the following bands test data of the original FCC ID: XMR2023RG520NNA LTE Band: Band 2, 4, 5, 7, 12, 13, 14, 17, 25, 26, 30, 38, 41, 48, 66, 71 NR Bands: n2, n5, n7, n12, n13, n14, n25, n26, n30, n38, n41, n48, n66, n71, n77, n78	

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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 Tx Frequency Range	Band 14: 788 ~ 798 MHz
FDD Rx Frequency Range	Band 14: 758 ~ 768 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.

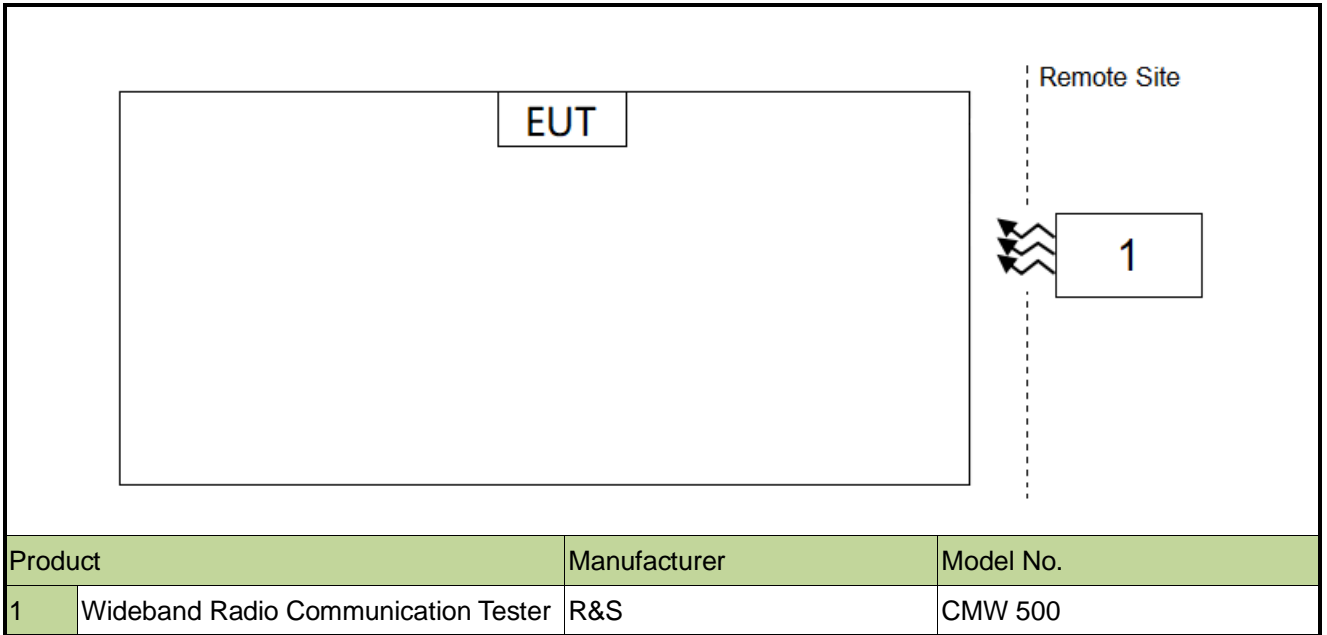
1.7. Test Methodology

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 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

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
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

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
90.542(a)(7)	Equivalent Radiated Power	Conducted	Pass	Section 5.2
2.1051, 90.543(e)(2)(3)	Band Edge			Section 5.3
2.1051, 90.210(n)	Emission Mask			Section 5.4
2.1053, 90.543(e)(3) 90.543(f)	Spurious Emissions	Radiated	Pass	Section 5.5

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

Control stations and mobile stations transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 30 watts ERP.

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.

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

$$\text{ERP or EIRP} = P_{\text{Meas}} + G_T$$

where

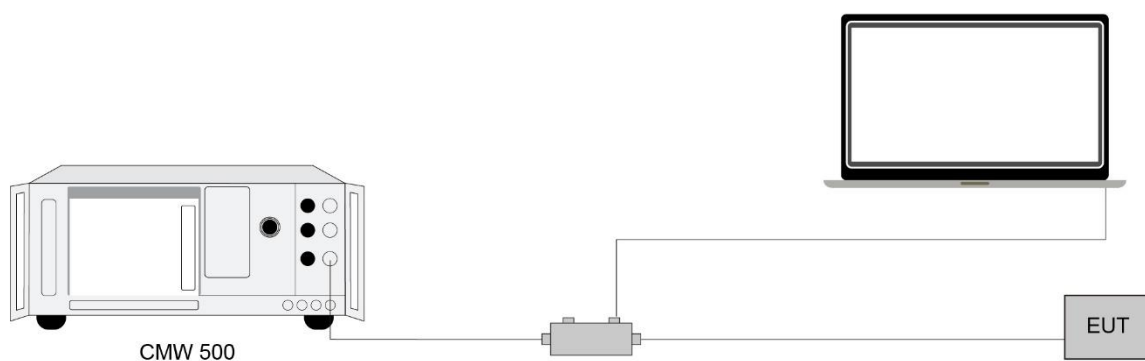
ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas} , e.g., dBm or dBW)

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)

$$\text{ERP} = \text{EIRP} - 2.15$$

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 operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than $65 + 10 \log (P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;
- (2) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least $43 + 10 \log (P)$ dB.

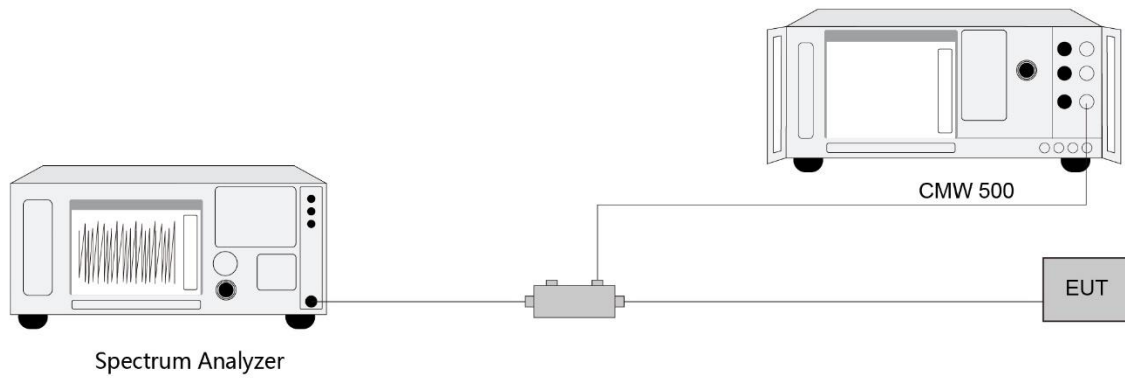
5.3.2. Test Procedure

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. $VBW \geq 3 * RBW$
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. Emission Mask Measurement

5.4.1. Test Limit

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

- (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
- (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

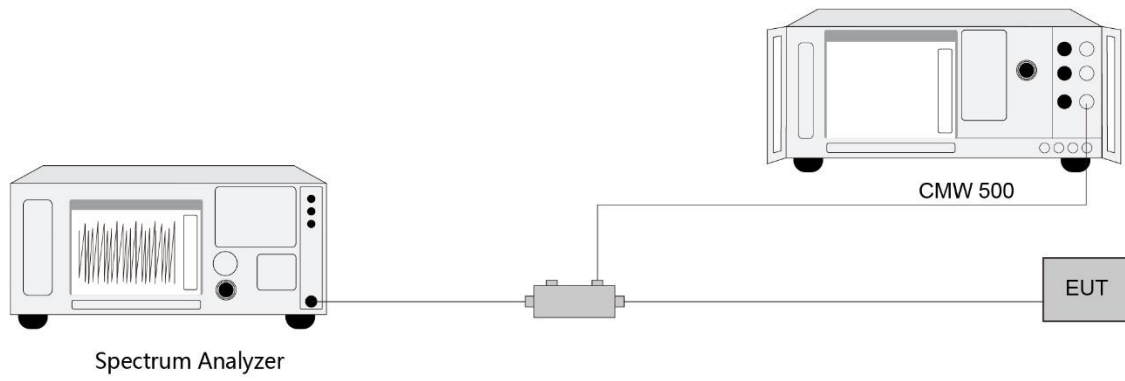
5.4.2. Test Procedure

ANSI C63.26-2015 - Section 5.7

5.4.3. 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. $VBW \geq 3 * RBW$
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.

5.4.4. Test Setup



5.4.5. Test Result

Refer to Appendix A.3.

5.5. Radiated Spurious Emissions Measurement

5.5.1. 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.

For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to -70 dBW/MHz (-40 dBm/MHz) equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW (-50 dBm) EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

E (dB μ V/m) = EIRP (dBm) - $20 \log D$ + 104.8; where D is the measurement distance in meters. The emission limit equal to 82.3dB μ V/m or 55.3dB μ V/m.

5.5.2. Test Procedure

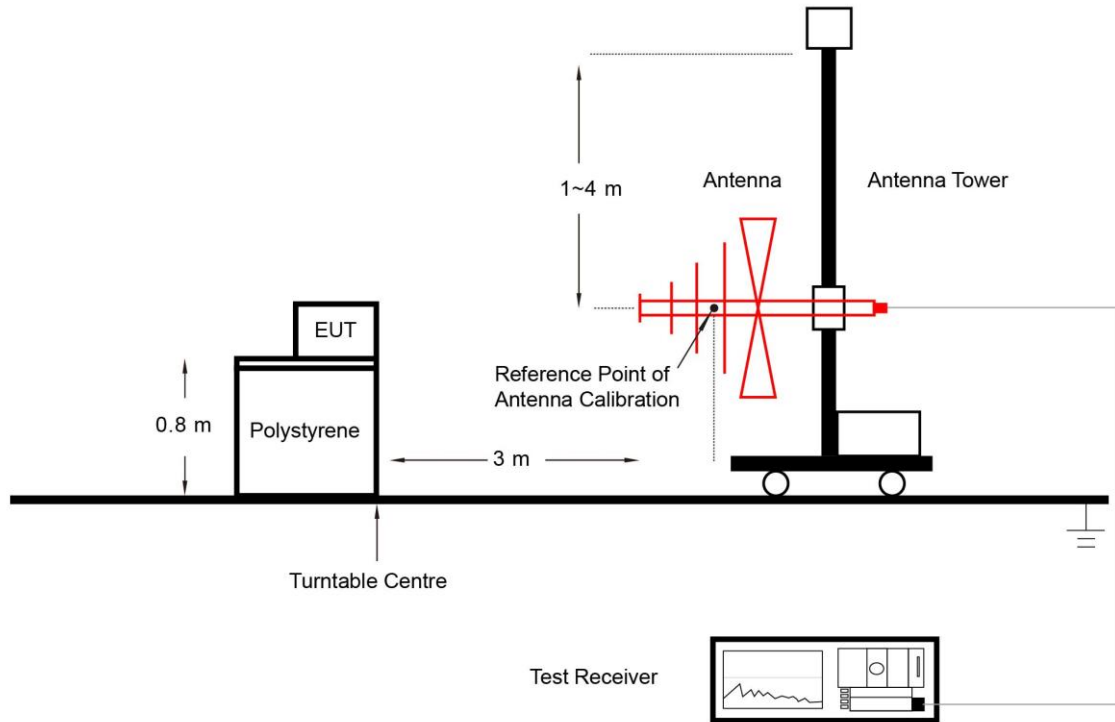
ANSI C63.26-2015 - Section 5.2.7 & 5.5

5.5.3. Test Setting

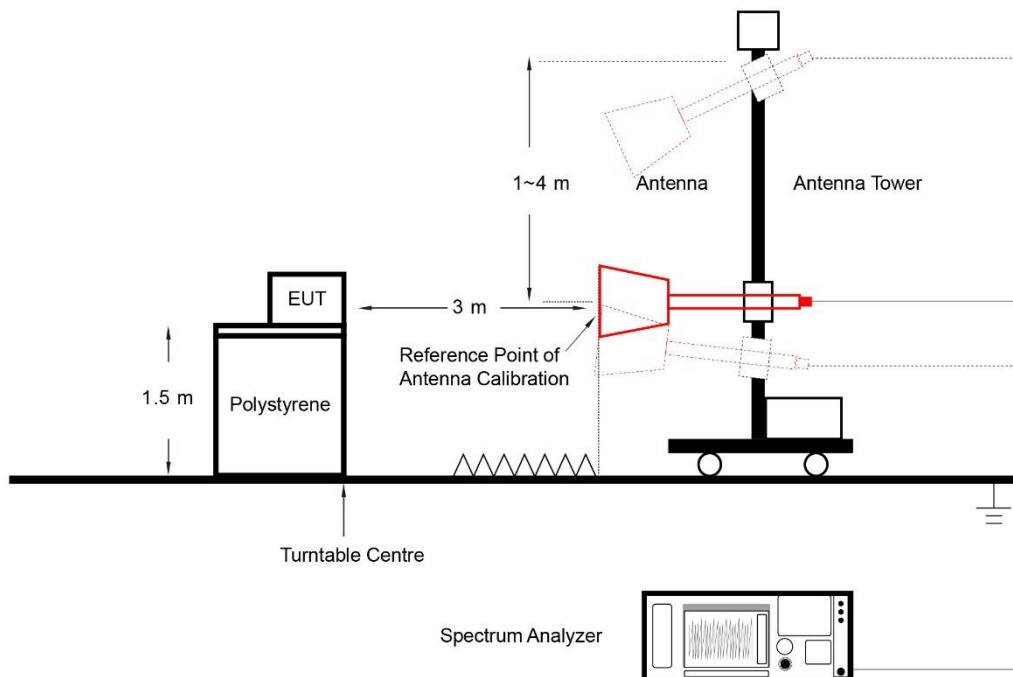
1. RBW = 1MHz
2. VBW ≥ 3 *RBW
3. Sweep time $\geq 10 \times$ (number of points in sweep) \times (transmission symbol period)
4. Detector = Peak
5. Trace mode = max hold
6. The trace was allowed to stabilize

5.5.4. Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



5.5.5. Test Result

Refer to Appendix A.4.

Appendix A - Test Result

A.1 Equivalent Isotropically Radiated Power Test Result

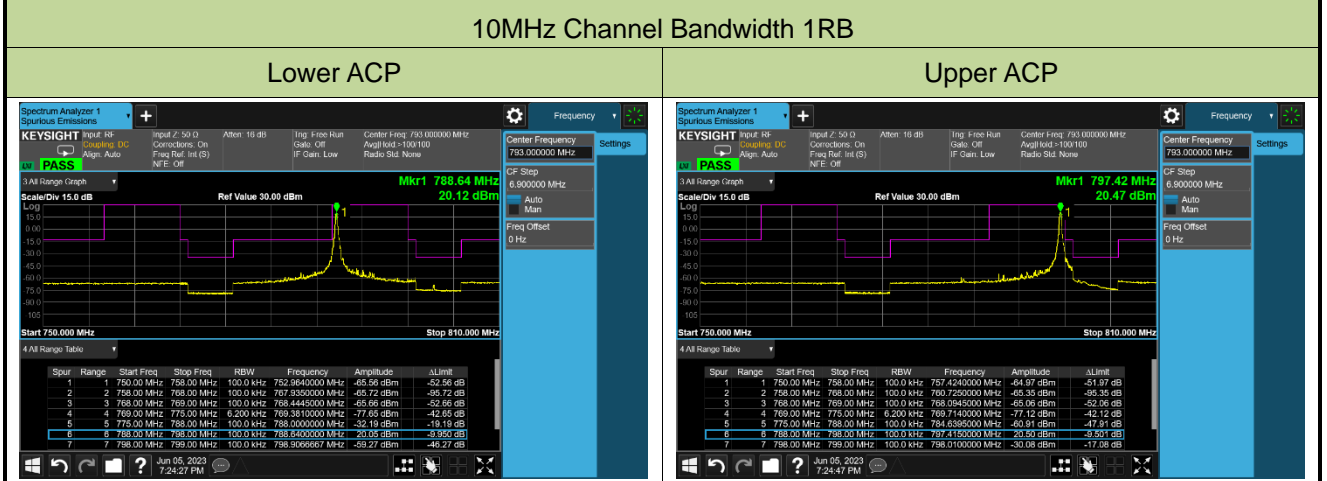
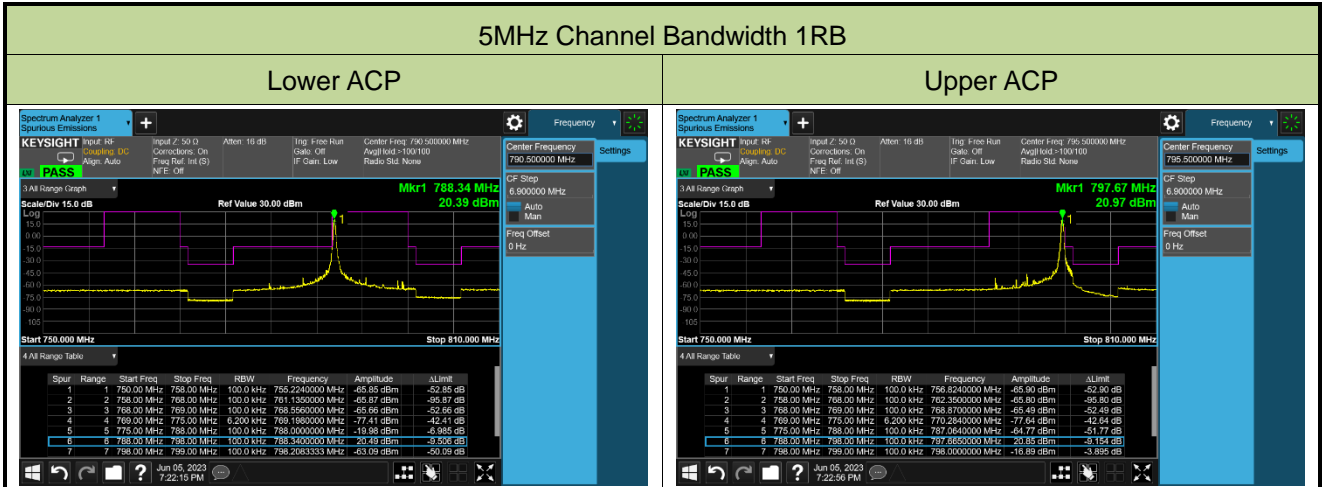
Test Site	SIP-SR1	Test Engineer	Sunshine Wan
Test Date	2023/05/12 ~ 2023/06/04	Test Band	Band 14

Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm)	ERP (dBm)	Limit (dBm)
QPSK						
790.5	5	1	0	23.55	22.58	<44.77
793.0				23.59	22.62	<44.77
795.5				23.58	22.61	<44.77
790.5	5	1	12	23.59	22.62	<44.77
793.0				23.69	22.72	<44.77
795.5				23.69	22.72	<44.77
790.5	5	1	24	23.54	22.57	<44.77
793.0				23.57	22.60	<44.77
795.5				23.55	22.58	<44.77
790.5	5	25	0	22.59	21.62	<44.77
793.0				22.54	21.57	<44.77
795.5				22.52	21.55	<44.77
793.0	10	1	0	23.58	22.61	<44.77
793.0			24	23.59	22.62	<44.77
793.0			49	23.51	22.54	<44.77
793.0	10	50	0	22.58	21.61	<44.77

Note: The ERP (dBm) = Output Power (dBm) + Antenna Gain (dBi) - 2.15

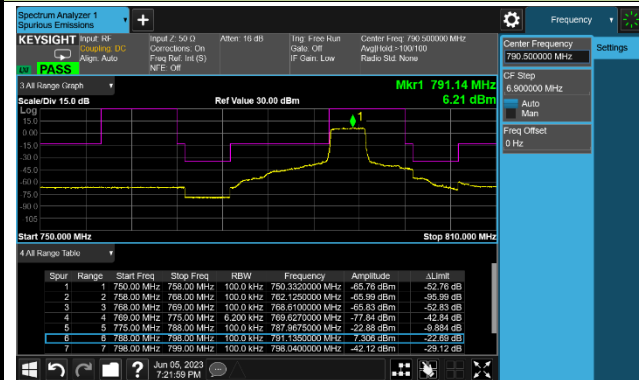
A.2 Band Edge Test Result

Test Site	SIP-SR1	Test Engineer	Sunshine Wan
Test Date	2023/05/25 ~ 2023/06/05	Test Band	Band 14

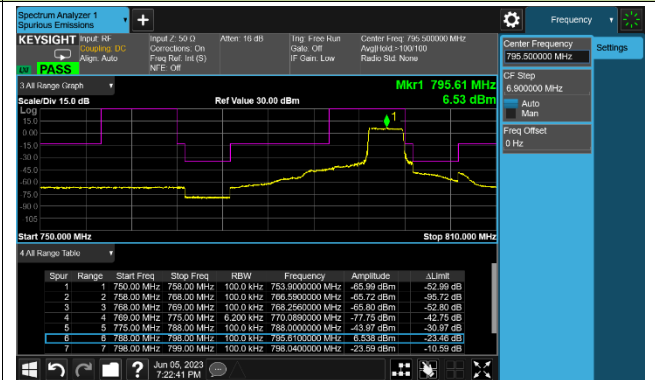


5MHz Channel Bandwidth Full RB

Lower ACP

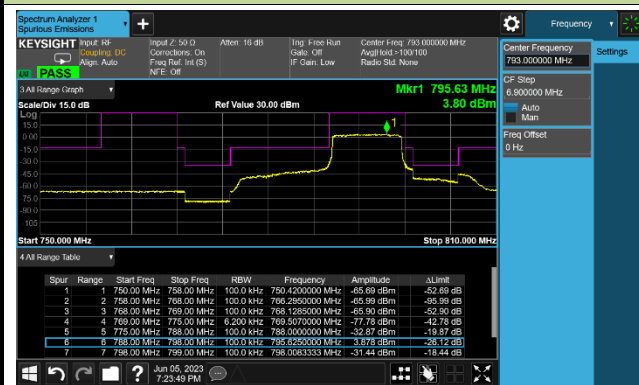


Upper ACP



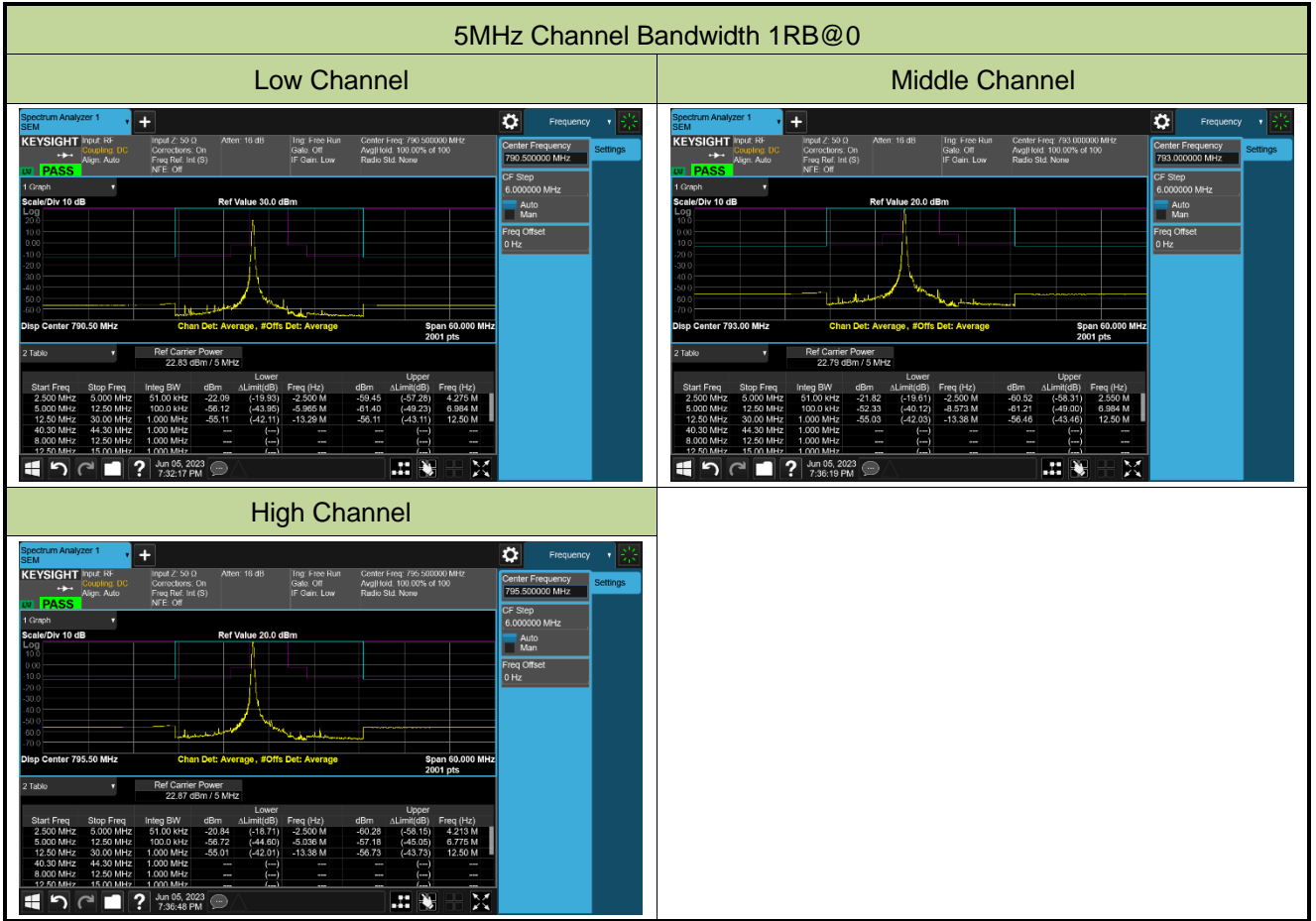
10MHz Channel Bandwidth Full RB

Middle ACP



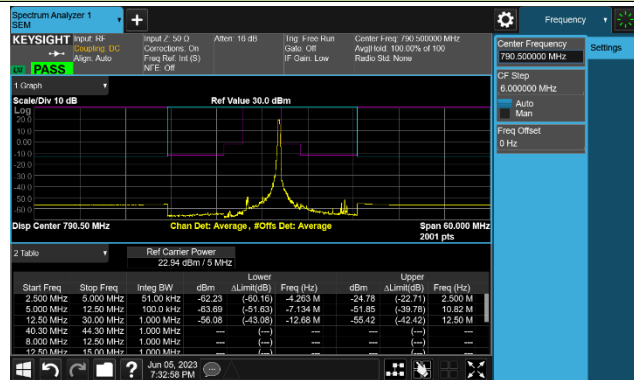
A.3 Emission Mask Test Result

Test Site	SIP-SR1	Test Engineer	Sunshine Wan
Test Date	2023/05/25 ~ 2023/06/05	Test Band	Band 14

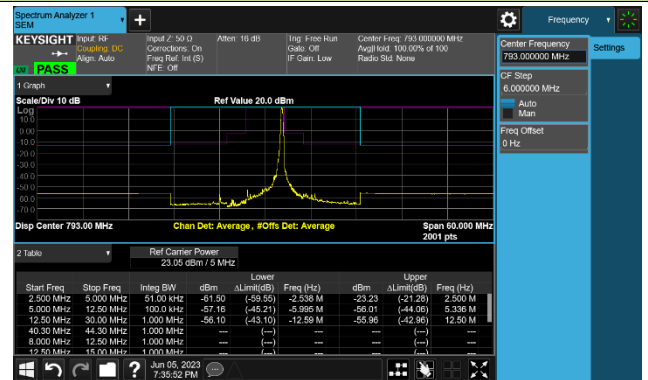


5MHz Channel Bandwidth 1RB@24

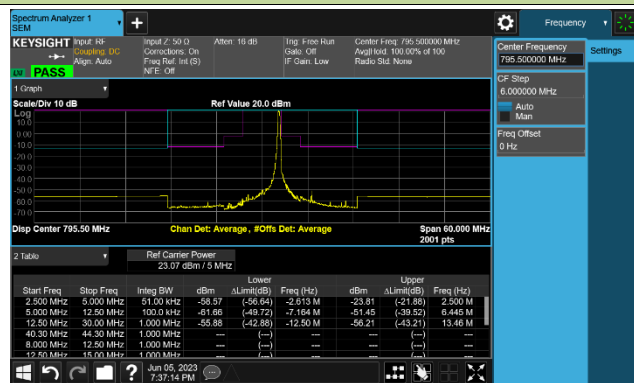
Low Channel



Middle Channel

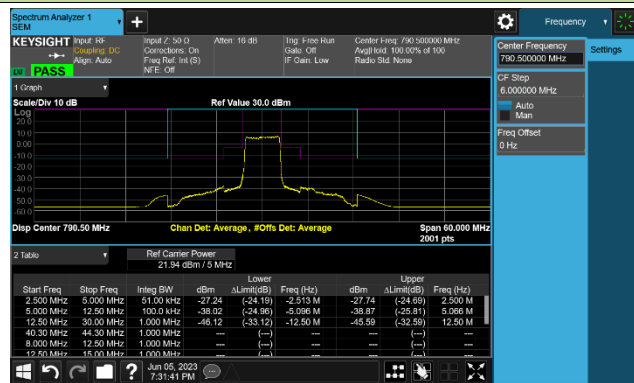


High Channel

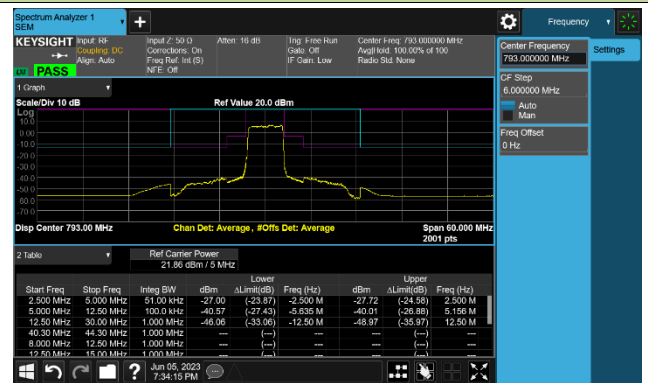


5MHz Channel Bandwidth Full RB

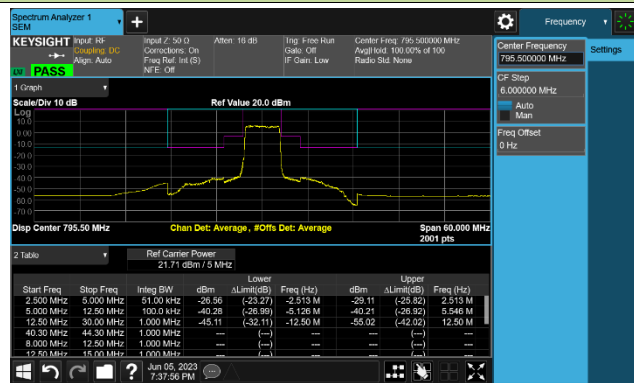
Low Channel



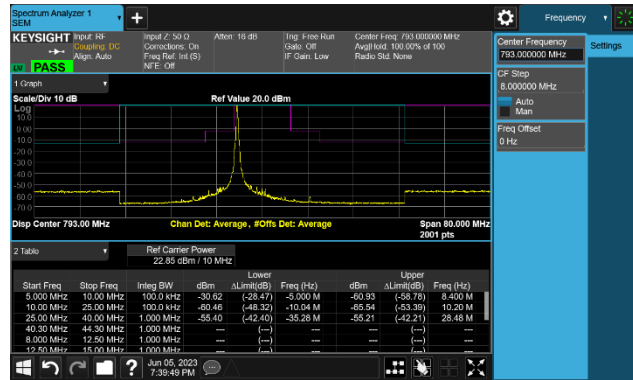
Middle Channel



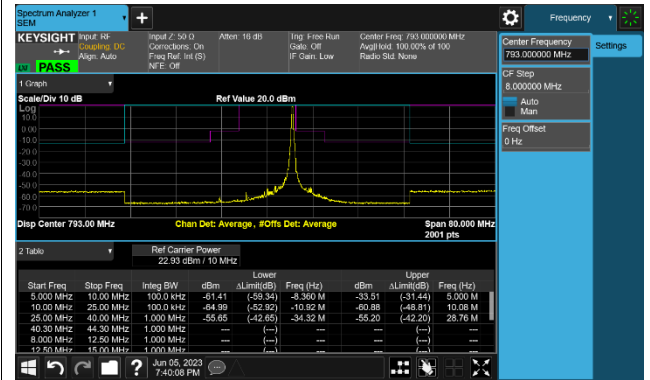
High Channel



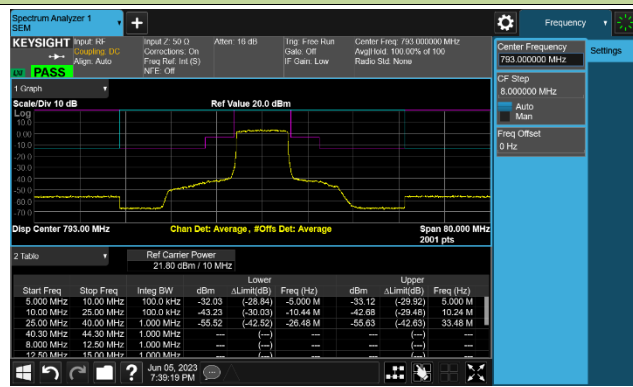
10MHz Channel Bandwidth 1RB@0



10MHz Channel Bandwidth 1RB@49



10MHz Channel Bandwidth Full RB



A.4 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 14, 5MHz, 1RB

Frequency (MHz)	Reading Level (dB μ V)	Factor (dB)	Measure Level(dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Polarization
Middle Channel							
610.1	21.4	26.3	47.7	82.3	-34.6	Peak	Horizontal
945.7	22.0	30.6	52.6	82.3	-29.7	Peak	Horizontal
602.8	21.3	26.1	51.9	82.3	-30.4	Peak	Vertical
947.1	22.1	30.6	2.0	82.3	-80.3	Peak	Vertical
1581.0	57.8	-20.1	37.7	55.3	-17.6	Peak	Horizontal
2533.0	57.9	-16.2	41.7	82.3	-40.6	Peak	Horizontal
1581.0	57.2	-20.1	50.2	55.3	-5.1	Peak	Vertical
7069.0	50.8	-7.0	43.8	82.3	-38.5	Peak	Vertical

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

Appendix B - Test Setup Photograph

Refer to "2305RSU024-UT" file.

Appendix C - EUT Photograph

Refer to "2305RSU024-UE" file.