RF MEASUREMENT REPORT

FCC ID:	2AD8UAWHQN01
Application:	Nokia Solutions and Networks, OY
Product:	AirScale Micro RRH
Model No.:	AWHQN
Brand Name:	Nokia
FCC Rule Part(s):	Part 2, 27 Subpart O
Result:	Complies
Received Date:	2022-02-06
Test Date:	2023-02-06 ~ 2023-02-09

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.

Revision History

Report No.	Version	Description	Issue Date	Note
2302RSU017-U1	Rev. 01	Initial Report	2023-02-13	Valid

Note: This report is prepared for FCC Class II permissive supplement to FCC ID: 2AD8UAWHQN01, added 80MHz bandwidth test data.

CONTENTS

1. General Information

1.1. Applicant

Nokia Solutions and Networks, OY

2000 W. Lucent Lane, Naperville, Illinois, United States, 60563

1.2. Manufacturer

Nokia Solutions and Networks, OY

2000 W. Lucent Lane, Naperville, Illinois, United States, 60563

1.3. Testing Facility

☒	**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
		☐R-20141	☐G-20134	☐C-20103	☐T-20104
☐	**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		
☐	**Test Site - MRT Taiwan Laboratory**				
	Laboratory Location (Taiwan)				
	No. 38, Fuxing 2nd 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	AirScale Micro RRH
Model No.	AWHQN
Brand Name	Nokia
Operating Band (s)	5G NR: n77
Power Supply Rating	PoE (40.5 ~ 57Vdc)
Antenna Specification	Refer to Section 1.6
Accessories	
AC to DC Adapter	Model: BLP0554FPXXXZ01A Input: 100-240V ~ 50/60Hz, 7.0A Output: 54V⎓9.3A
The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.	

1.5. Radio Specification under Test

NR Band Specification	
Single Band	5G NR n77
T_X Frequency Range	3700 ~ 3980 MHz
R_X Frequency Range	3700 ~ 3980 MHz
Modulation	QPSK, 16QAM, 64QAM, 256QAM
Max EIRP Power	80 MHz: 47.25 dBm/MHz.

1.6. Description of Available Antennas

Band Support	Antenna Type	Nokia Code	Antenna Gain
n77	Directional Antenna (Internal)	P567454	14.5dBi

Remark:

1. The transmit signals are completely uncorrelated with each other, directional gain = G_{ANT} dBi, G_{ANT} is the antenna gain in dBi;
2. The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.

1.7. Test Methodology

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

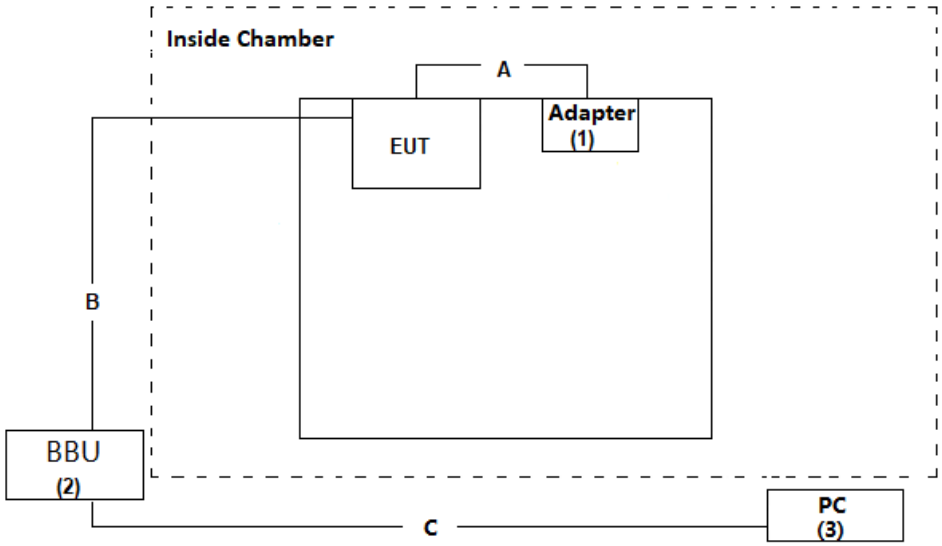
- ANSI C63.26:2015
- FCC CFR 47 Part 2, Part 27
- FCC KDB 971168 D01 v03r01: Power Meas License Digital Systems
- FCC KDB 971168 D02 v02r01: Misc Rev Approv License Devices
- FCC KDB 412172 D01 v01r01: Determining ERP and EIRP
- FCC KDB 662911 D01 v02r01: Multiple Transmitter Output

2. Test Configuration

2.1. Test Mode

Test Item	Channel Bandwidth	Modulation
Equivalent Isotropically Radiated Power	80MHz	QPSK, 16QAM, 64QAM, 256QAM
Emission Bandwidth		
Conducted Spurious Emissions		16QAM
Band Edge Measurements		16QAM
Peak to Average Ratio		16QAM

2.2. Test System Connection Diagram



No.	Cable Type	Cable Spec.	Length
A	Power cable	Non-Shielding	Non-Shielding, 1.0m
B	Optical fiber cable	Non-Shielding	Non-Shielding, >10.0m
C	LAN cable	Non-Shielding	Non-Shielding, 2.0m
No.	Product	Manufacturer	Model No.
1	AC/DC Power supply	GE power Electronics	BLP0554FPXXXZ01A
2	BBU	Nokia	ASIB+ABIO
3	Personal Computer	HP	TPN-C143

2.3. Test Environment Condition

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

3. Measuring Instrument

Instrument Name	Manufacturer	Model No.	Asset No.	Cali. Interval	Cal. Due Date	Test Site
Thermohygrometer	testo	608-H1	MRTSUE06362	1 year	2023-02-15	WZ-SR6
Shielding Room	HUAMING	WZ-SR6	MRTSUE06443	N/A	N/A	WZ-SR6
Signal Analyzer	Keysight	N9020B	MRTSUE06583	1 year	2023-10-08	WZ-SR6
Attenuator	SHX	WDTS100-40dB-6G-B	MRTSUE06685	1 year	2023-03-02	WZ
Attenuator	SHX	WDTS100-40dB-6G-B	MRTSUE06688	1 year	2023-03-02	WZ
Attenuator	SHX	WDTS100-40dB-6G-B	MRTSUE06690	1 year	2023-03-02	WZ
Attenuator	SHX	WDTS100-40dB-6G-B	MRTSUE06693	1 year	2023-03-02	WZ
Attenuator	SHX	DTS 100G-6dB-19G-A	MRTSUE06964	1 year	2023-03-02	WZ
Attenuator	SHX	SMA10-40dB-18G	MRTSUE06701	1 year	2023-03-03	WZ

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.

Conducted Spurious Emissions
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.468dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 0.66dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 69.28KHz

5. Test Result

5.1. Summary

FCC Section(s)	Test Description	Test Condition	Verdict
2.1049	Emission Bandwidth	Conducted	Pass
2.1046; 27.50(j)(4)	Peak to Average Ratio		Pass
2.1046; 27.50(j)(2)	Equivalent Isotropically Radiated Power		Pass
27.53(l)(1)	Transmitter unwanted emissions (Band Edge)		Pass
2.1051; 27.53(l)(1)	Out-of-frequency Band unwanted Emissions		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 Occupied Bandwidth, Peak to Average Ratio and Conducted Spurious Emission were presented the worst test data of modultation & antenna port in the test report.

5.2. Occupied Bandwidth Measurement

5.2.1. Test Limit

The occupied bandwidth shall not exceed the equipment's channel bandwidth, which is declared by the manufacturer.

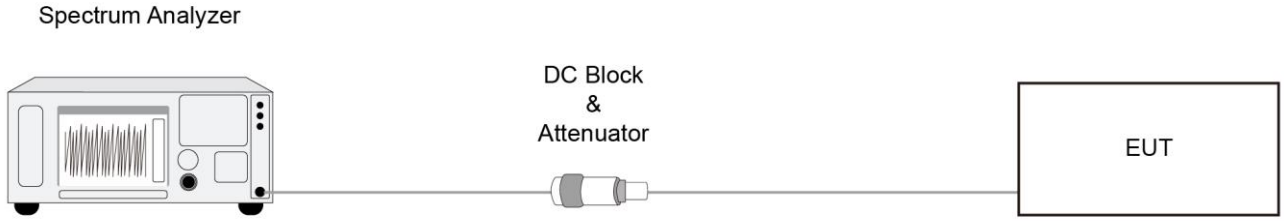
5.2.2. Test Procedure

ANSI C63.26-2015 - Section 5.4.4

5.2.3. Test Setting

1. Set center frequency to the nominal EUT channel center frequency
2. RBW = The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize
8. Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

5.2.4. Test Setup



5.2.5. Test Result

Refer to Appendix A.1.

5.3. Peak to Average Ratio Measurement

5.3.1. Test Limit

A peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

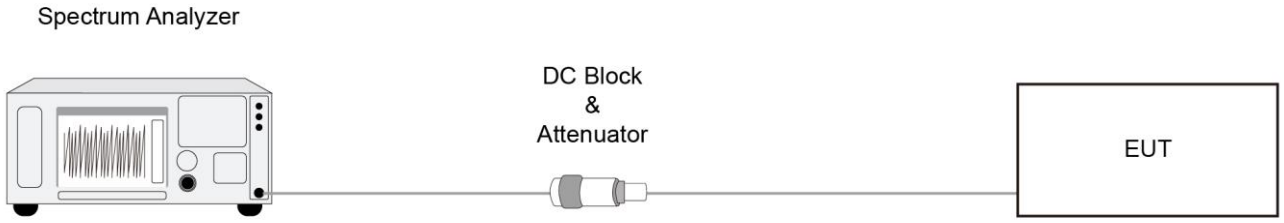
5.3.2. Test Procedure Used

ANSI C63.26-2015 - Section 5.2.3.4 (CCDF).

5.3.3. Test Setting

1. Set the resolution / measurement bandwidth ≥ signal's occupied bandwidth
2. Set the number of counts to a value that stabilizes the measured CCDF curve
3. Record the maximum PARR level associated with a probability of 0.1%

5.3.4. Test Setup



5.3.5.Test Result

Refer to Appendix A.3.

5.4. Equivalent Isotropically Radiated Power Measurement

5.4.1. Test Limit

The Radiated Equivalent Isotropically Power shall be according to the specific rule Part 27.50(j)(2) that are limited to EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

5.4.2. Test Procedure

ANSI C63.26-2015 - Section 5.2.4.2 & 5.2.5.5

5.4.3. Test Setting

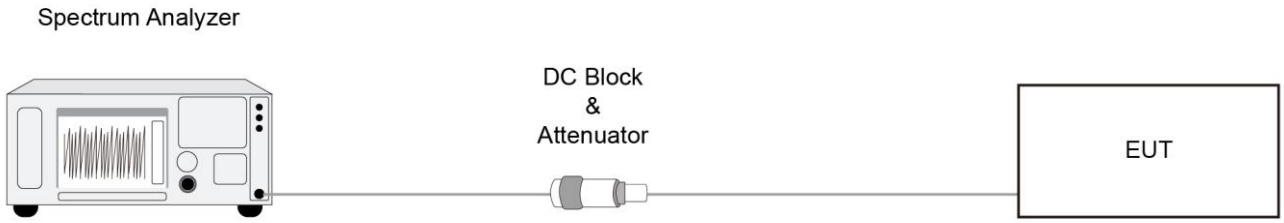
Average Power Measurement

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.

Average Power Spectral Density Measurement

1. Span to 2 × to 3 × the OBW
2. RBW ≥ 1% to 5% of the OBW
3. VBW ≥ 3*RBW
4. Sweep time ≥ 10 × (number of points in sweep) × (transmission symbol period)
5. Detector = power averaging (rms)
6. Set sweep trigger to “free run”
7. If the EUT can be configured to transmit continuously, then set the trigger to free run
8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple.
9. The trace was allowed to stabilize
10. Compute the power by integrating the spectrum across the OBW of the signal using the Instrument’s band power measurement function, with the band/channel limits set equal to the OBW band edges.
11. EIRP = Output Power Level of S.G - T_X Cable Loss + Antenna Gain of Substitution Antenna.

5.4.4. Test Setup



5.4.5. Test Result

Refer to Appendix A.4.

5.5. Band Edge Measurement

5.5.1. Test Limit

The first 1.0 MHz band immediately outside and adjacent to each of the sub-bands, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p (watts)

Note: This device can be impelement MIMO function, so the limit os spurious emissions needs to be reduced 10*log($Numbers_{Ant}$) according to FCC KDB 662911 D01 guidance.

The limit is adjusted to -13dBm - 10*log(4) = -19.02dBm

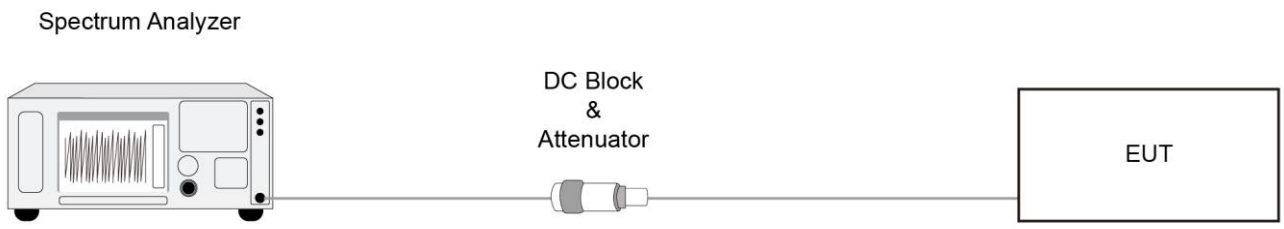
5.5.2. Test Procedure

ANSI C63.26-2015 - Section 5.7.1

5.5.3. Test Setting

1. Set the analyzer frequency to Bottom or Top channel.
2. RBW = The nominal RBW shall be in the range of 1% of the anticipated OBW;
3. VBW ≥ 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.
9. Used power integration when using a measurement bandwidth smaller than the specified bandwidth.

5.5.4. Test Setup



5.5.5. Test Result

Refer to Appendix A.5.

5.6. Out-of-frequency Band unwanted Emissions Measurement

5.6.1. Test Limit

The first 1.0 MHz band immediately outside and adjacent to each of the sub-bands, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p (watts)

Note: This device can be impelement MIMO function, so the limit os spurious emissions needs to be reduced 10*log($Numbers_{Ant}$) according to FCC KDB 662911 D01 guidance.

The limit is adjusted to -13dBm - 10*log(4) = -19.02dBm

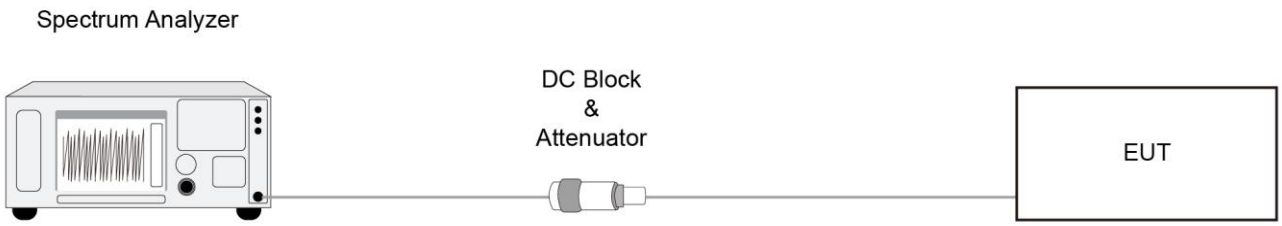
5.6.2. Test Procedure

ANSI C63.26-2015 - Section 5.7

5.6.3. Test Setting

1. Set the analyzer frequency to low or high channel.
2. RBW = 1MHz
3. VBW ≥ 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.

5.6.4. Test Setup



5.6.5. Test Result

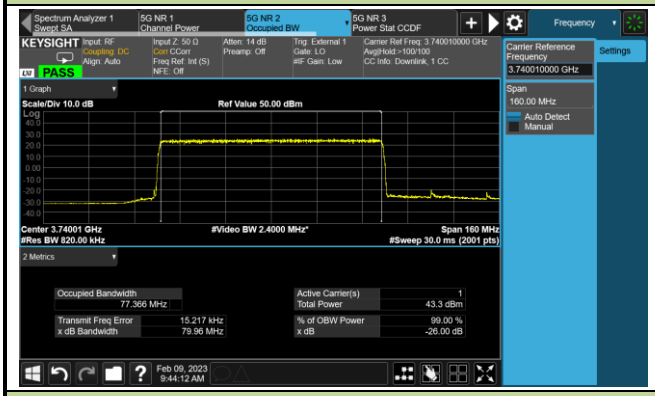
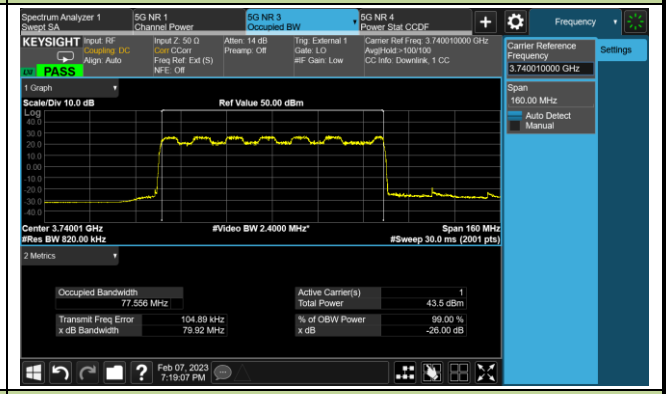
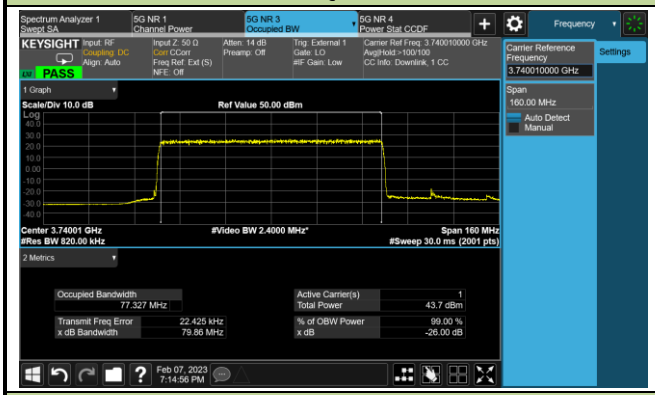
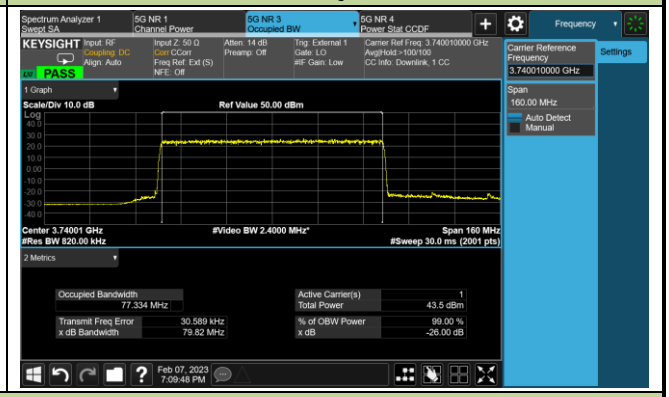
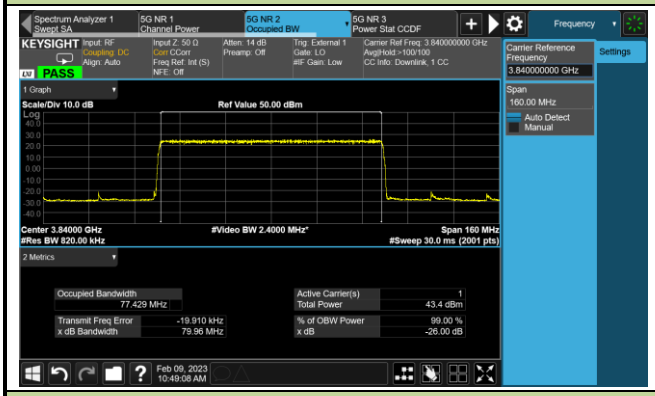
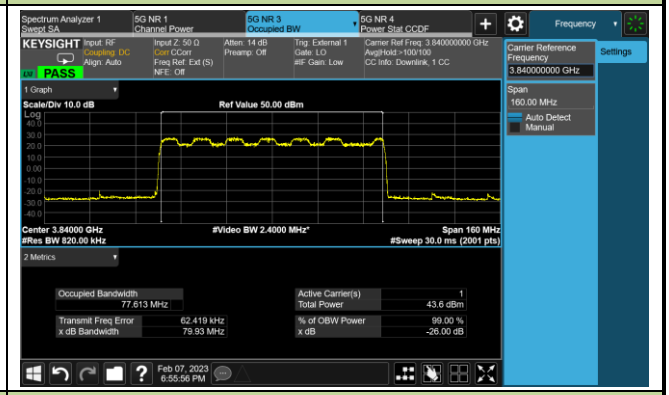
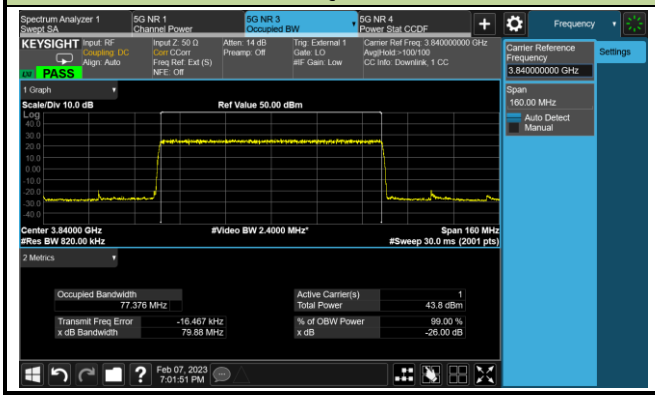
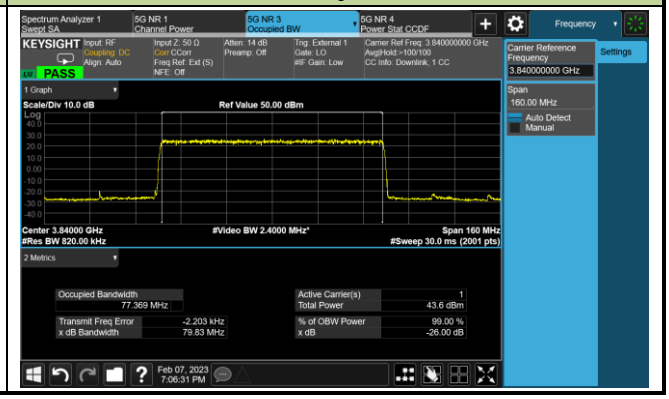
Refer to Appendix A.6.

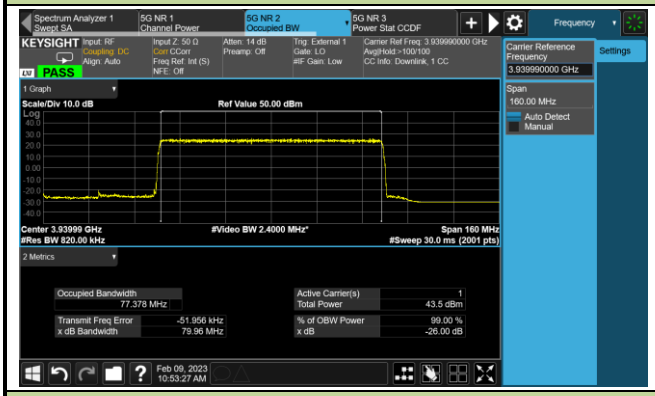
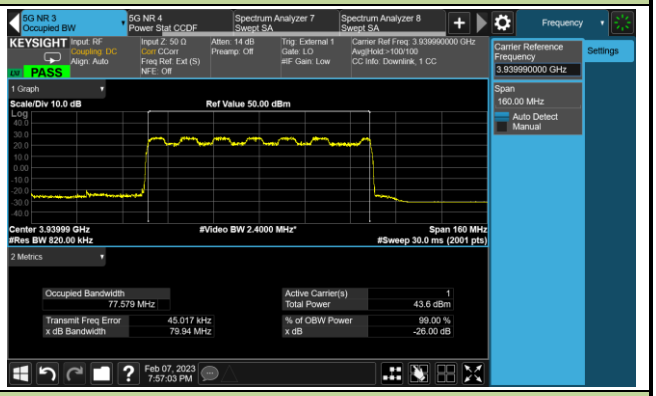
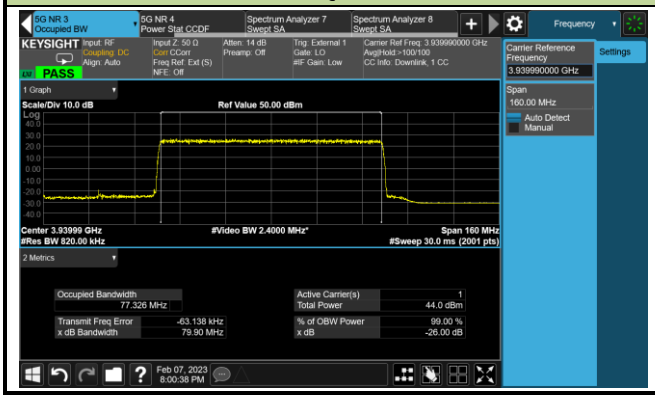
Appendix A - Test Result

A.1 Occupied Bandwidth Test Result

Test Site	WZ-SR6	Test Engineer	Larry Yan
Test Date	2023-02-07	Test Configuration	n77

Frequency (MHz)	Bandwidth (MHz)	99% Bandwidth (MHz)
QPSK		
3740.01	80	77.37
3840.00	80	77.43
3939.99	80	77.38
16QAM		
3740.01	80	77.56
3840.00	80	77.61
3939.99	80	77.58
64QAM		
3740.01	80	77.33
3840.00	80	77.38
3939.99	80	77.33
256QAM		
3740.01	80	77.33
3840.00	80	77.37
3939.99	80	77.35

80MHz Channel Bandwidth – 3740.01MHz	
QPSK	16QAM
	
64QAM	256QAM
	
80MHz Channel Bandwidth – 3840.00MHz	
QPSK	16QAM
	
64QAM	256QAM
	

80MHz Channel Bandwidth – 3939.99MHz	
QPSK	16QAM
	
64QAM	256QAM
	

A.2 Peak to Average Ratio Measurement Test Result

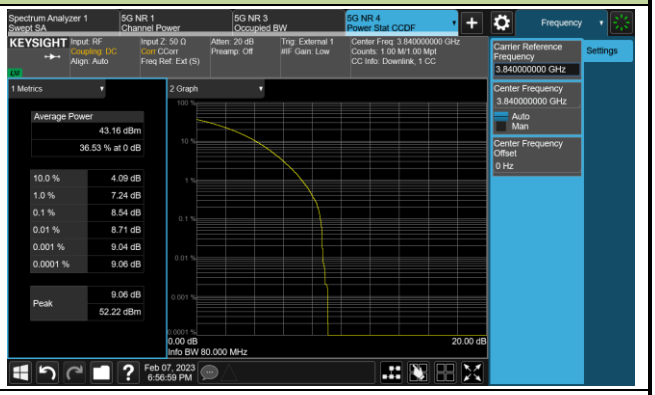
Test Engineer	Larry Yan	Test Site	WZ-SR6
Test Date	2023-02-07	Test Configuration	n77

Frequency (MHz)	Channel Bandwidth (MHz)	Peak to Average Ratio (dB)	Limit (dB)	Result
3740.01	80	8.60	≤ 13.00	Pass
3840.00	80	8.54	≤ 13.00	Pass
3939.99	80	8.62	≤ 13.00	Pass

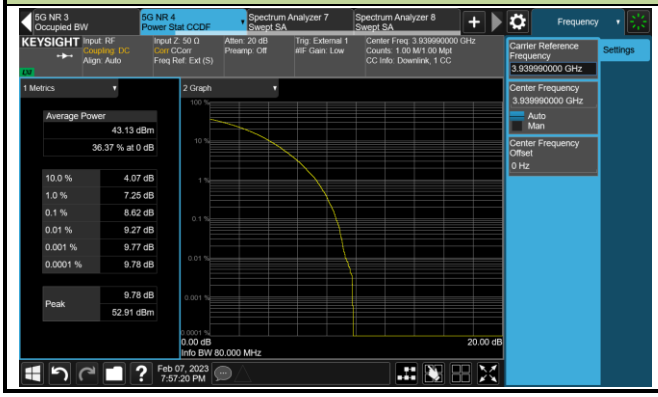
80MHz Channel Bandwidth

3740.01 MHz

3840.00 MHz



3939.99 MHz



A.3 Equivalent Isotropically Radiated Power Test Result

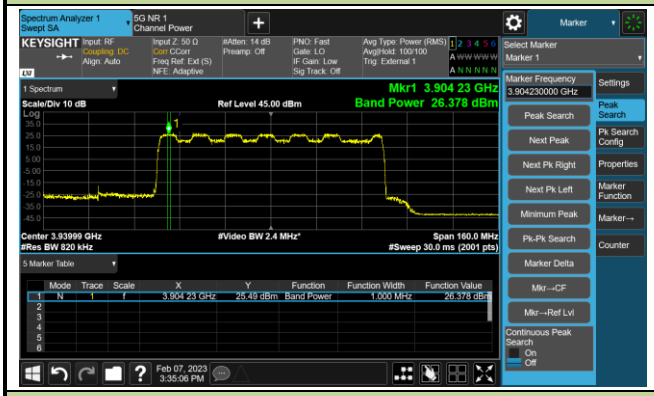
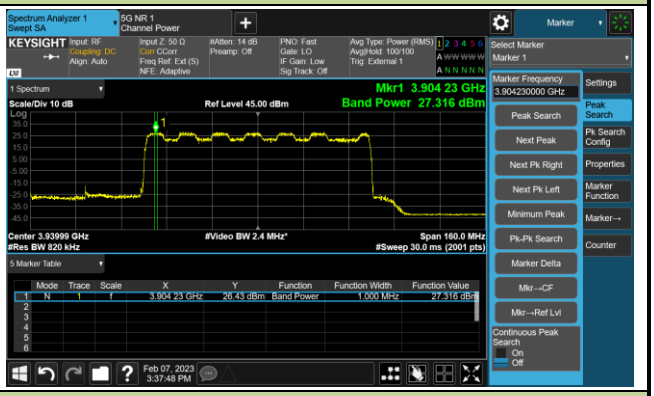
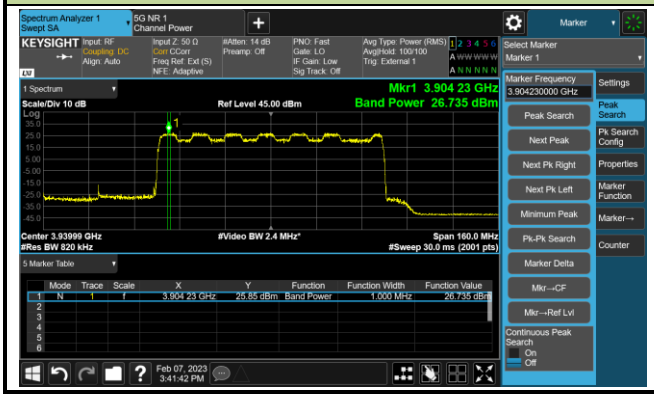
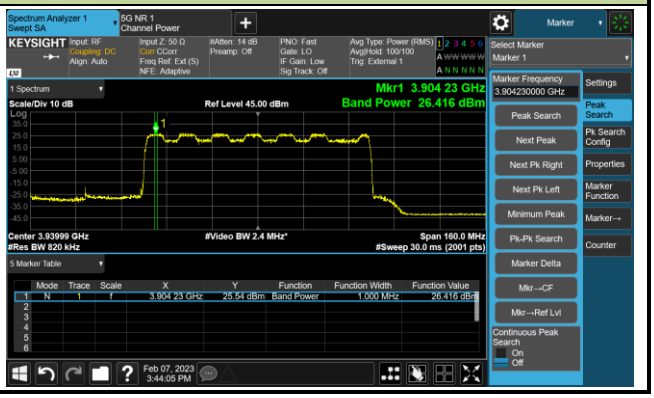
Test Engineer	Larry Yan	Test Site	WZ-SR6
Test Date	2023-02-07 ~ 2023-02-08	Test Configuration	n77

Frequency (MHz)	Channel BW (MHz)	Output Power Density (dBm/MHz)				Total Power Density (dBm/MHz)	EIRP Density (dBm/MHz)	Limit (dBm /MHz)
		Ant 1	Ant 2	Ant 3	Ant 4			
QPSK								
3740.01	80	24.17	25.23	24.86	24.52	30.73	45.23	< 62.15
3840.00	80	24.04	24.75	24.59	24.46	30.49	44.99	< 62.15
3939.99	80	24.45	24.97	24.93	24.68	30.79	45.29	< 62.15
16QAM								
3740.01	80	25.63	26.36	26.22	26.30	32.16	46.66	< 62.15
3840.00	80	25.99	26.58	26.30	26.11	32.27	46.77	< 62.15
3939.99	80	26.38	27.32	26.74	26.42	32.75	47.25	< 62.15
64QAM								
3740.01	80	24.50	25.08	25.01	24.82	30.88	45.38	< 62.15
3840.00	80	24.18	25.16	24.68	24.54	30.67	45.17	< 62.15
3939.99	80	24.58	25.52	25.13	24.90	31.07	45.57	< 62.15
256QAM								
3740.01	80	24.50	25.09	25.16	24.74	30.90	45.40	< 62.15
3840.00	80	24.34	25.21	25.00	24.71	30.85	45.35	< 62.15
3939.99	80	24.66	25.50	25.03	24.78	31.02	45.52	< 62.15

Note 1: Total Power Density(dBm/MHz) = 10*log*{$10^{[\text{ANT 1 Power (dBm/MHz) / 10}]}$ + $10^{[\text{ANT 2 Power (dBm/MHz) / 10}]}$ + $10^{[\text{ANT 3 Power (dBm/MHz) / 10}]}$ + $10^{[\text{ANT 4 Power (dBm/MHz) / 10}]}$} (dBm/MHz).

Note 2: EIRP Density (dBm/MHz) = Total Power Density (dBm/MHz) + Antenna Gain (dBi).

Worst case test plots

80MHz Channel Bandwidth – 3740.01MHz - 16QAM	
Ant 1	Ant 2
	
Ant 3	Ant 4
	

Test Engineer	Larry Yan	Test Site	WZ-SR6
Test Date	2023-02-08	Test Configuration	n77 (Report Only)

Frequency (MHz)	Channel BW (MHz)	Output Power (dBm)				Total Power (dBm)
		Ant 1	Ant 2	Ant 3	Ant 4	
QPSK						
3740.01	80	42.73	43.64	43.25	43.01	49.19
3840.00	80	42.65	43.43	43.20	43.05	49.11
3939.99	80	42.94	43.47	43.43	43.22	49.29
16QAM						
3740.01	80	42.37	43.07	42.89	42.60	48.76
3840.00	80	42.73	43.40	43.16	42.97	49.09
3939.99	80	42.94	44.00	43.43	43.19	49.43
64QAM						
3740.01	80	42.79	43.37	43.38	42.67	49.09
3840.00	80	42.74	43.63	43.21	42.95	49.17
3939.99	80	42.97	43.99	43.50	43.22	49.46
256QAM						
3740.01	80	42.74	43.34	43.29	42.99	49.12
3840.00	80	42.74	43.53	43.25	43.14	49.19
3939.99	80	42.93	43.93	43.36	43.18	49.39
Note: Total Power (dBm) = 10*log*{$10^{\wedge[\text{ANT 1 Power (dBm) / 10}]}$ + $10^{\wedge[\text{ANT 2 Power (dBm) / 10}]}$ + $10^{\wedge[\text{ANT 3 Power (dBm) / 10}]}$ + $10^{\wedge[\text{ANT 4 Power (dBm) / 10}]}$} (dBm).						

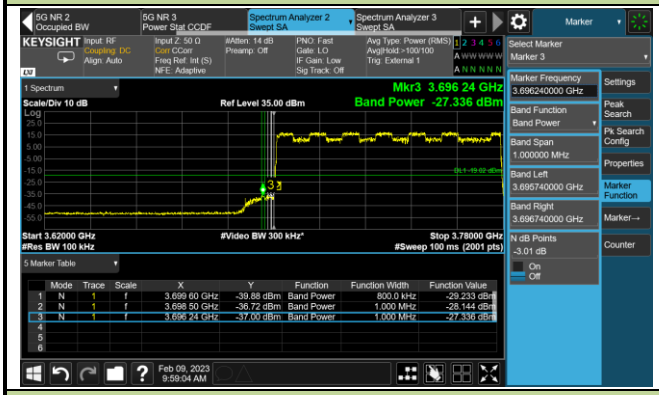
A.4 Band Edge Test Result

Test Site	WZ-SR6	Test Engineer	Larry Yan
Test Date	2023-02-09	Test Configuration	n77

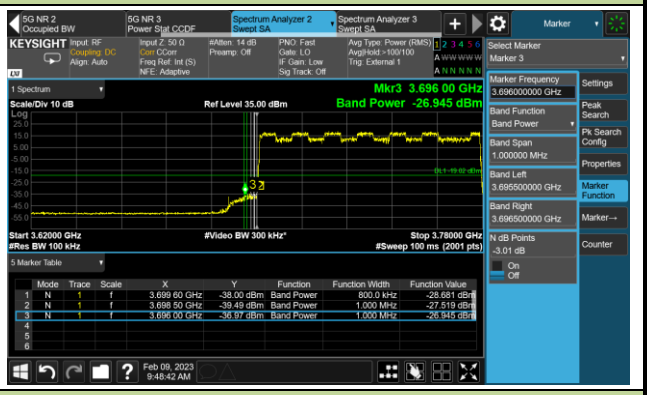
Frequency (MHz)	Max Band Edge (dBm)				Limit (dBm)	Result
	Ant 1	Ant 2	Ant 3	Ant 4		
3740.01	-27.34	-26.94	-28.31	-27.76	≤ -19.02	Pass
3939.99	-25.74	-26.14	-26.60	-25.64	≤ -19.02	Pass

80MHz Channel Bandwidth - 3740.01MHz

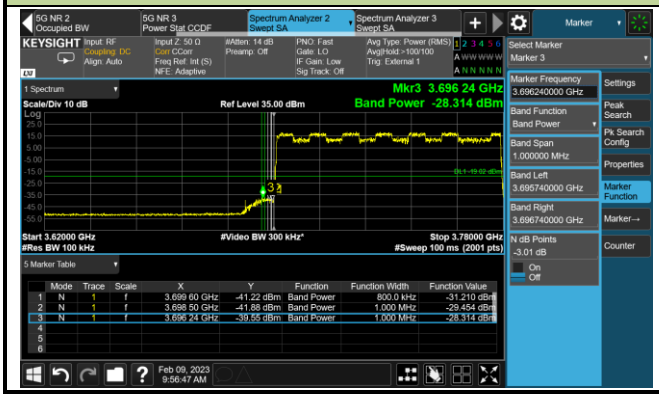
Ant 1



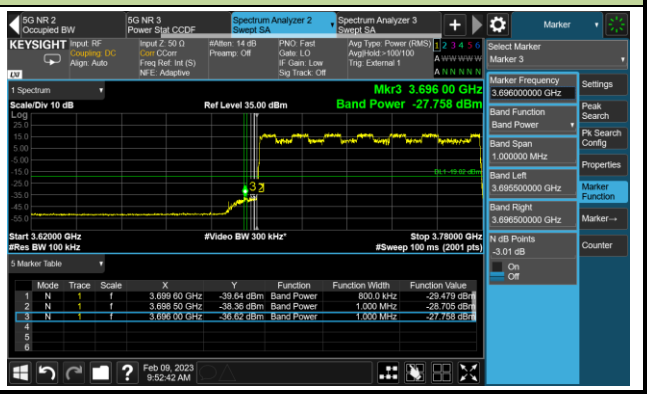
Ant 2

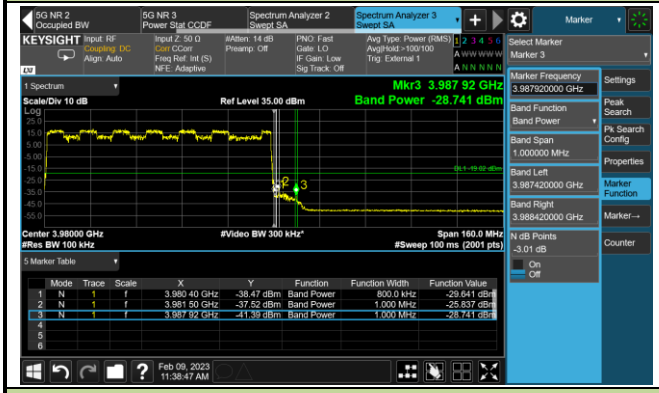
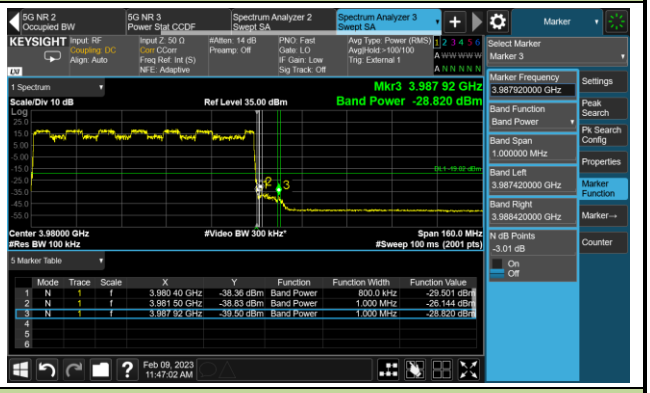
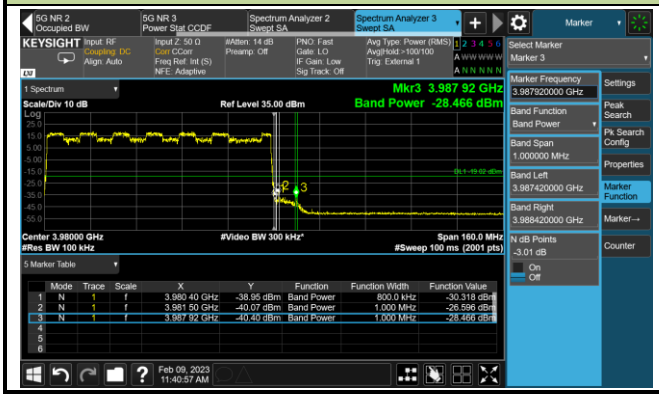
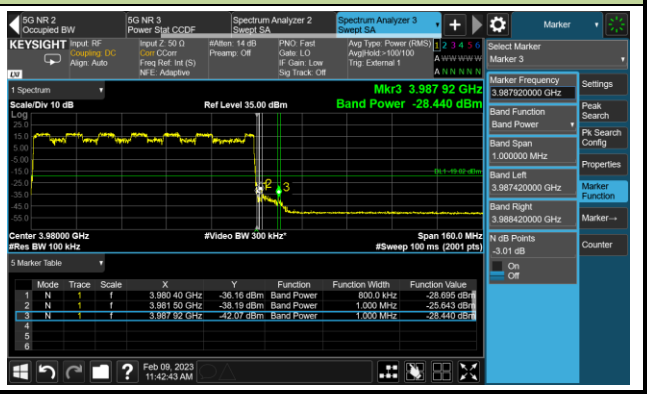


Ant 3



Ant 4



80MHz Channel Bandwidth - 3939.99MHz	
Ant 1	Ant 2
	
Ant 3	Ant 4
	

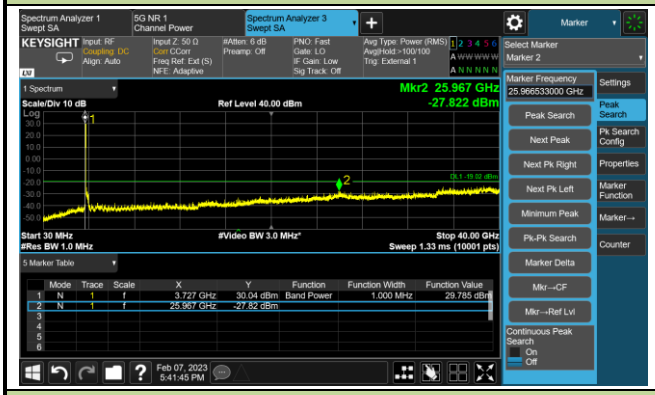
A.5 Out-of-frequency Band unwanted Emissions Test Result

Test Site	WZ-SR6	Test Engineer	Larry Yan
Test Date	2023-02-08	Test Configuration	n77

Frequency (MHz)	Channel BW(MHz)	Frequency Range (MHz)	Max Spurious Emissions (dBm)	Limit (dBm)	Result
3740.01	80	30 ~ 40000	-27.82	≤ -19.02	Pass
3840.00	80	30 ~ 40000	-28.43	≤ -19.02	Pass
3939.99	80	30 ~ 40000	-28.59	≤ -19.02	Pass

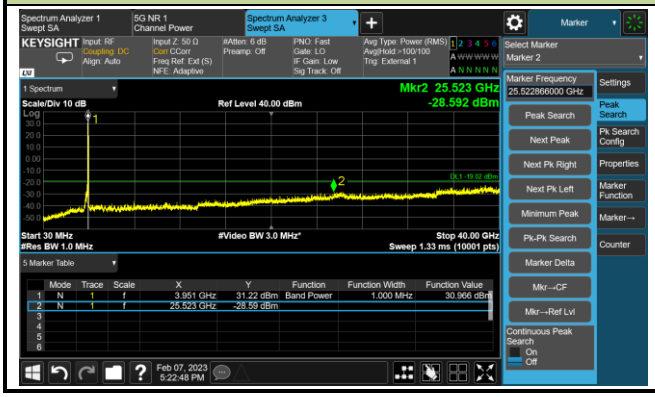
80MHz Channel Bandwidth

3740.01 MHz



3840.00 MHz

3939.99 MHz



Note: The amplitude of Conducted Spurious emissions (frequency range from 9kHz to 30MHz) is that proximity to ambient noise, which also are attenuated more than 20 dB below the permissible value. Therefore, the data is not presented in the report.

Appendix B - Test Setup Photograph

Refer to “2302RSU017-UT” file.

Appendix C - EUT Photograph

Refer to “2302RSU017-UE” file.

The End