RF MEASUREMENT REPORT

FCC ID:	VBNAHFB-01
Application:	Nokia Solutions and Networks
Product:	AirScale Base Station RRH 1.9GHz
Model No.:	AHFB
Brand Name:	Nokia
FCC Rule Part(s):	Part 2, 24 (E)
Result:	Complies
Test Date:	2022-08-21 ~ 2022-08-23

Reviewed By: Sunny Sun

Approved By: Robin Wu

Revision History

Report No.	Version	Description	Issue Date	Note
2208RSU052-U1	Rev. 01	Initial Report	2022-08-26	Valid

Note: This report is prepared for FCC Class II permissive supplement to FCC ID: VBNAHFB-01, added 5G NR bandwidth and related data.

CONTENTS

1. General Information

1.1. Applicant

Nokia Solutions and Networks

6000 Connection Drive, Irving, TX 75039

1.2. Manufacturer

Nokia Solutions and Networks

6000 Connection Drive, Irving, TX 75039

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 Base Station RRH 1.9GHz
Model No.	AHFB
Brand Name	Nokia
Test Device Serial No.	AH220101105
Software Version	SBTS22R4_ENB_9999_220608_000015
Operating Band (s)	LTE Band 25, 5G NR n25
Voltage Range	DC: 40.5V to 57VDC AC:100-240VAC
Remark: 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

5G NR n25	
Frequency Range	DL: 1930 ~ 1995 MHz UL: 1850 ~ 1915MHz
Bandwidth	NR 20 + 20MHz
Modulation Type	QPSK, 16QAM, 64QAM, 256QAM
Max EIRP	55.58dBm
Emission Designator:	Refer to Section 1.6
Antenna Specification:	Refer to Section 1.7
Remark: For other features of this EUT, test report will be issued separately.	

1.6. Emission Designator

Bandwidth (MHz)	Modulation	Emission Designator
20 + GAP25 + 20	QPSK	37M8G7D
	16QAM	37M9W7D
	64QAM	37M8W7D
	256QAM	37M8W7D

1.7. Description of Available Antennas

Band Support	Antenna Type	Model	Antenna Gain
n25	Directional Antenna	AAFA	12.5dBi

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.

1.8. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

1.9. Test Methodology

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

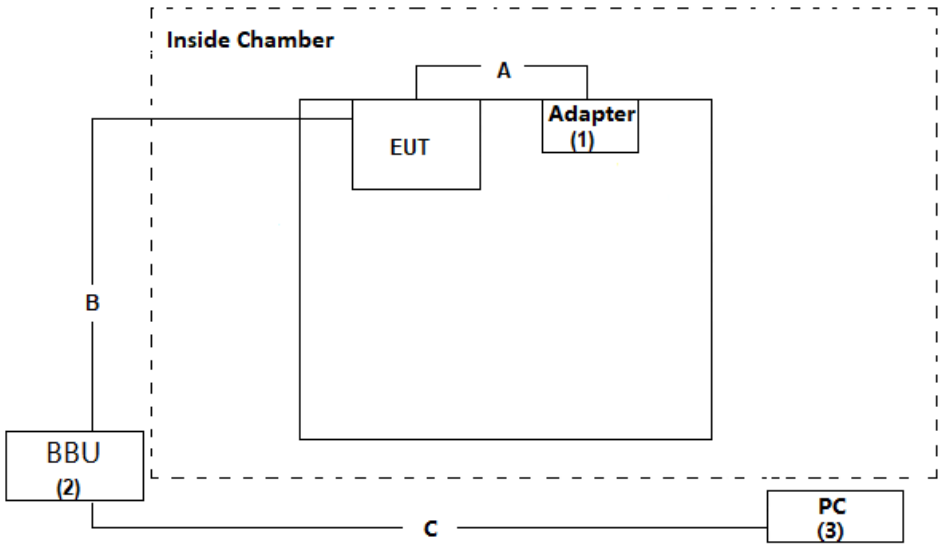
- ANSI C63.26:2015
- FCC CFR 47 Part 2, Part 24
- FCC KDB 971168 D01 v03r01: Power Meas License Digital Systems
- FCC KDB 971168 D02 v02r01: Misc Rev Approv License Devices
- FCC KDB 412172 D01 v01r01: Determining ERP and EIRP
- FCC KDB 662911 D01 v02r01: Multiple Transmitter Output

2. Test Configuration

2.1. Test Mode

Test Item	Channel Bandwidth	Modulation
Transmitter output power	20 + GAP25 + 20MHz	QPSK, 16QAM, 64QAM, 256QAM
Occupied bandwidth		QPSK, 16QAM, 64QAM, 256QAM
Unwanted emissions		QPSK
Out-of-frequency band unwanted emissions		QPSK
Remark: This report has assessed the typical multi-carrier mode.		

2.2. Test System Connection Diagram



No.	Cable Type	Cable Spec.	Length
A	Power cable	Non-Shielding, 1.0m	Power cable
B	Optical fiber cable	Non-Shielding, >10.0m	Optical fiber cable
C	LAN cable	Non-Shielding, 2.0m	LAN cable
No.	Product	Manufacturer	Model No.
1	AC/DC Power supply	SUPLET	S818A210-220S54W
2	BBU	Nokia	AMIA
3	Personal Computer	HP	TPN-C141

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
Signal Analyzer	Keysight	N9010B	MRTSUE07027	1 year	2022-12-05	WZ-TR3
Signal Analyzer	Keysight	N9020B	MRTSUE07037	1 year	2023-03-29	WZ-TR3
Temperature Chamber	BAOYT	BYH-150CL	MRTSUE06051	1 year	2022-10-10	WZ-TR3
Vibration Test System	DongLing	ES-1-150	MRTSUE06206	1 year	2023-07-07	WZ-TR3
Thermohygrometer	testo	608-H1	MRTSUE06401	1 year	2023-06-06	WZ-TR3
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	2022-10-10	WZ-SR6
Signal Generator	Keysight	N5173B	MRTSUE06606	1 year	2022-11-29	WZ-SR6
Attenuator	SHX	SMA10-20dB-18G	MRTSUE06697	1 year	2023-03-02	WZ-SR6

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)): 0.78dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.13dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 0.28%

5. Test Result

5.1. Summary

FCC Section(s)	Test Description	Test Condition	Verdict
2.1049	Occupied Bandwidth	Conducted	Pass
2.1046; 27.50(d)(2)	Equivalent Isotropically Radiated Power		Pass
27.53(h)	Band Edge		Pass
27.53(h)	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 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.

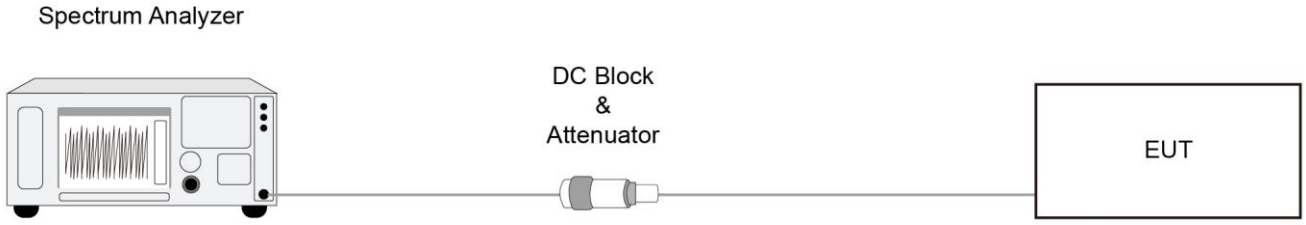
5.2.2. Test Procedure

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. Equivalent Isotropically Radiated Power Measurement

5.3.1. Test Limit

The equivalent isotropically radiated power (e.i.r.p.) of base stations shall not exceed 1640 W when transmitting with an emission bandwidth of 1 MHz or less, and 1640 W/MHz when transmitting with an emission bandwidth greater than 1MHz.

5.3.2. Test Procedure

ANSI C63.26-2015 - Section 5.2.4.2 & 5.2.5.5

5.3.3. Test Setting

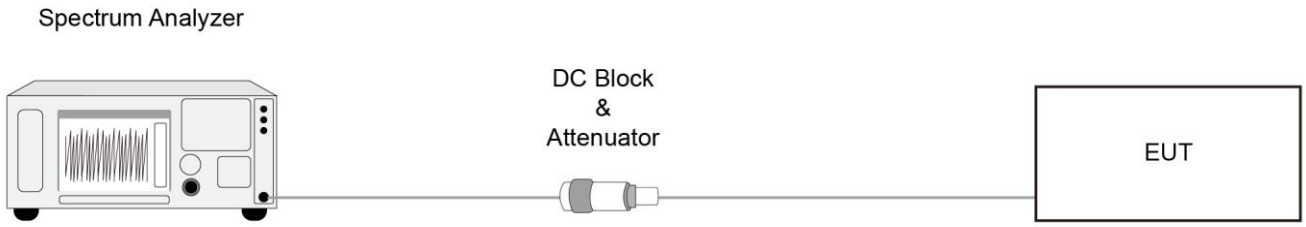
Average Power Measurement

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.

5.3.4. Test Setup



5.3.5. Test Result

Refer to Appendix A.3.

5.4. Band Edge Measurement

5.4.1. 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

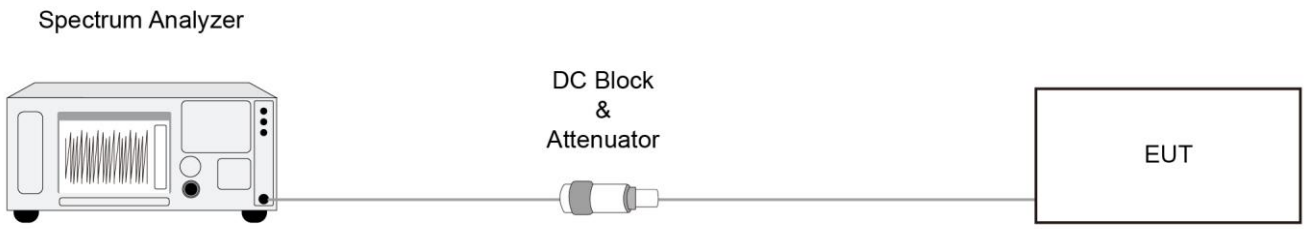
5.4.2. Test Procedure

ANSI C63.26-2015 - Section 5.7.1

5.4.3. 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.

5.4.4. Test Setup



5.4.5. Test Result

Refer to Appendix A.4.

5.5. Out-of-frequency Band unwanted Emissions 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

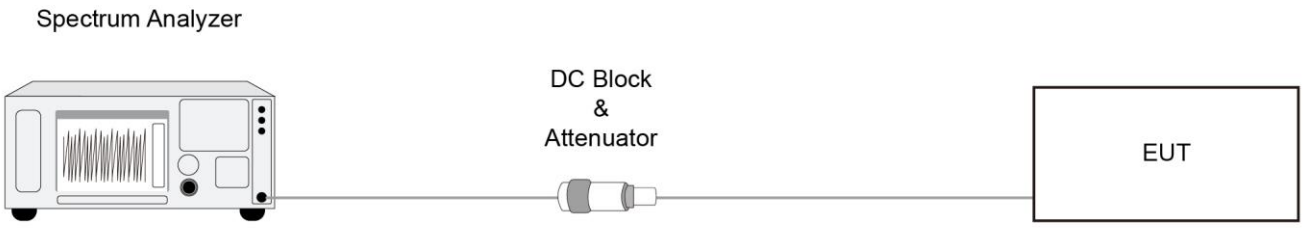
5.5.2. Test Procedure

ANSI C63.26-2015 - Section 5.7.1

5.5.3. Test Setting

1. Set the analyzer frequency to 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.

5.5.4. Test Setup



5.5.5. Test Result

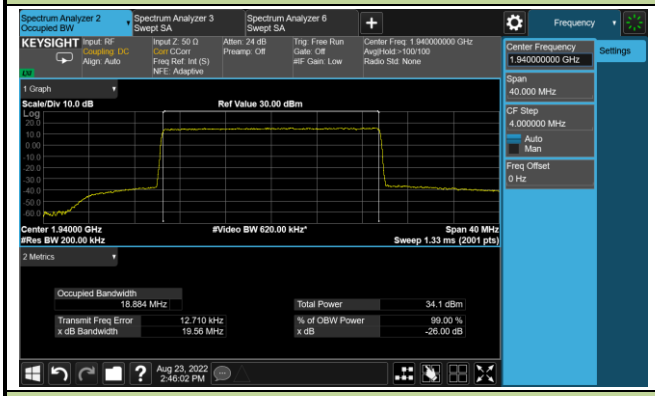
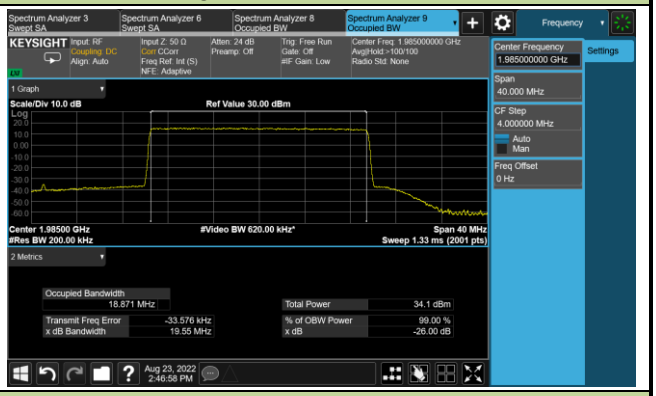
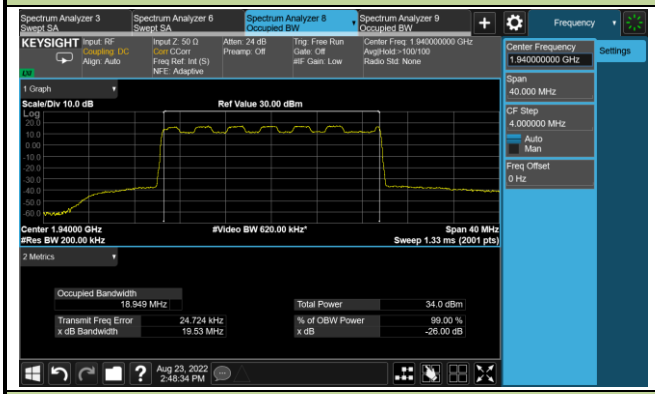
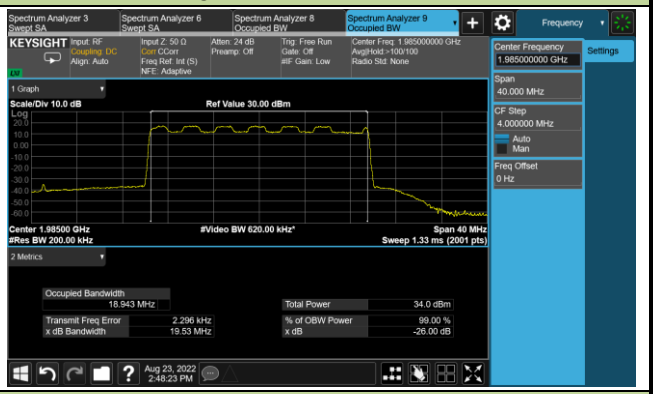
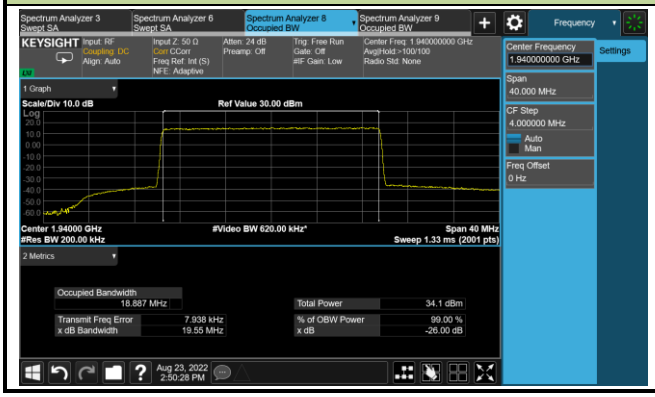
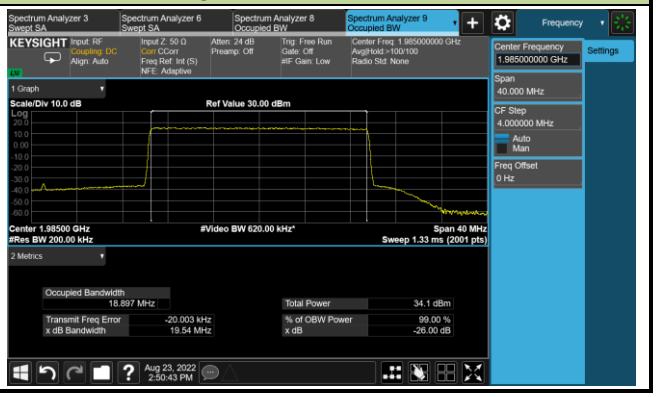
Refer to Appendix A.5.

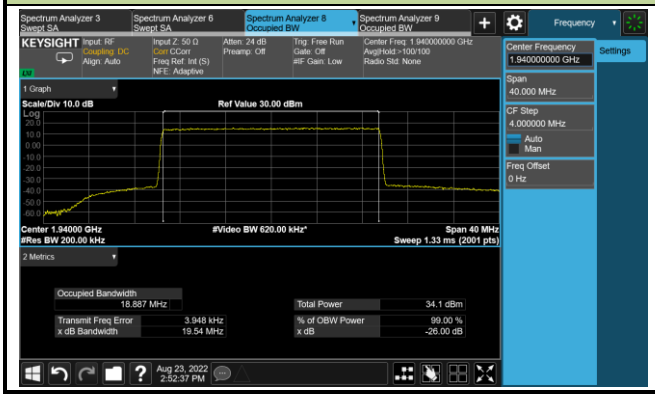
Appendix A - Test Result

A.1 Occupied Bandwidth Test Result

Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/21 ~ 2022/08/23	Test Configuration	n25

Frequency (MHz)	Bandwidth (MHz)	99% Bandwidth (MHz)
QPSK		
1940 + 1985	20 + GAP25 + 20	37.755
16QAM		
1940 + 1985	20 + GAP25 + 20	37.892
64QAM		
1940 + 1985	20 + GAP25 + 20	37.784
256QAM		
1940 + 1985	20 + GAP25 + 20	37.772

20 + GAP25 + 20MHz Channel Bandwidth - QPSK	
Low Channel – 1940MHz	High Channel - 1985MHz
	
20 + GAP25 + 20MHz Channel Bandwidth - 16QAM	
Low Channel – 1940MHz	High Channel - 1985MHz
	
20 + GAP25 + 20MHz Channel Bandwidth - 64QAM	
Low Channel – 1940MHz	High Channel - 1985MHz
	

20 + GAP25 + 20MHz Channel Bandwidth - 256QAM	
Low Channel – 1940MHz	High Channel - 1985MHz
	

A.2 Equivalent Isotropically Radiated Power Test Result

Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/21 ~ 2022/08/23	Test Configuration	n25, 20 + GAP25 + 20

Frequency (MHz)	Output Power Density (dBm/MHz)				Total Power Density (dBm/MHz)	EIRP Density (dBm/MHz)	Limit (dBm /MHz)	Result
	Ant 0	Ant 1	Ant 2	Ant 3				
QPSK								
1940 + 1985	21.515	21.705	22.052	21.780	27.788	40.288	< 62.15	Pass
16QAM								
1940 + 1985	23.135	23.498	23.654	23.329	29.429	41.929	< 62.15	Pass
64QAM								
1940 + 1985	21.455	21.857	21.961	21.548	27.731	40.231	< 62.15	Pass
256QAM								
1940 + 1985	21.517	21.764	22.070	21.604	27.765	40.265	< 62.15	Pass

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

Note 2: EIRP (dBm) = Total Power (dBm) + Directional Gain (dBi).

Worst case output power

20 + GAP25 + 20MHz Channel Bandwidth – 1940 + 1985MHz - 16QAM	
Ant 1	Ant 2
	
Ant 3	Ant 4
	

Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/21 ~ 2022/08/23	Test Configuration	n25 Band, 20 + GAP25 + 20 Report only

Frequency (MHz)	Output Power (dBm)				Total Power (dBm)	EIRP (dBm)	Limit (dBm)
	Ant 0	Ant 1	Ant 2	Ant 3			
QPSK							
1940 + 1985	36.80	37.08	37.25	36.97	43.05	55.55	NA
16QAM							
1940 + 1985	36.71	36.95	37.11	36.91	42.94	55.44	NA
64QAM							
1940 + 1985	36.76	37.10	37.27	36.93	43.04	55.54	NA
256QAM							
1940 + 1985	36.94	37.07	37.25	36.98	43.08	55.58	NA

Note 1: 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).

Note 2: EIRP (dBm) = Total Power (dBm) + Directional Gain (dBi)

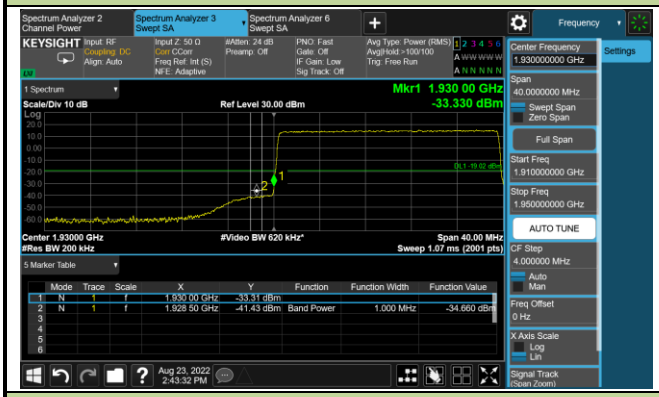
A.3 Band Edge Test Result

Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/21 ~ 2022/08/23	Test Configuration	n25, 20 + GAP25 + 20

Frequency (MHz)	Max Band Edge (dBm)				Limit (dBm)	Result
	Ant 1	Ant 2	Ant 3	Ant 4		
1940 + 1985	-30.500	-32.416	-32.409	-30.785	≤ -19.02	Pass

20 + GAP25 + 20MHz Channel Bandwidth - Ant 1

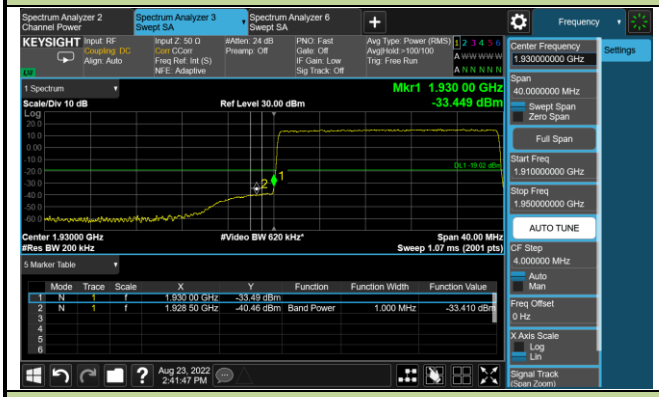
Low Channel – 1940MHz



High Channel - 1985MHz

20 + GAP25 + 20MHz Channel Bandwidth - Ant 2

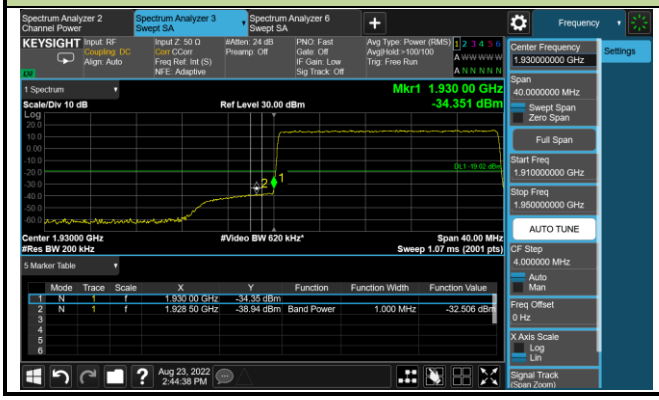
Low Channel – 1940MHz



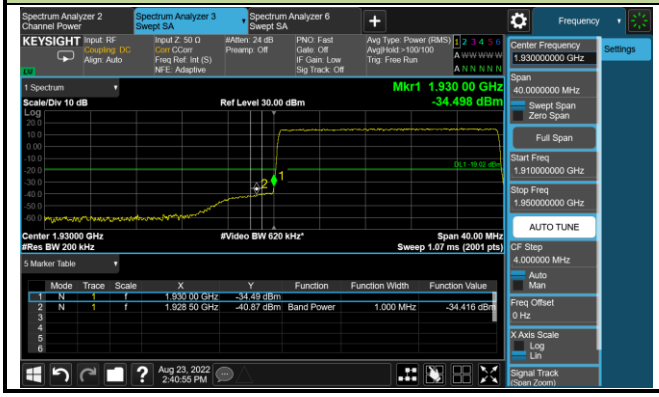
High Channel - 1985MHz

20 + GAP25 + 20MHz Channel Bandwidth - Ant 3

Low Channel – 1940MHz



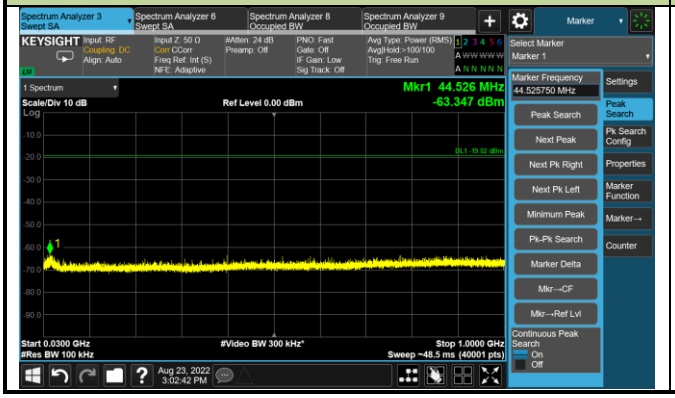
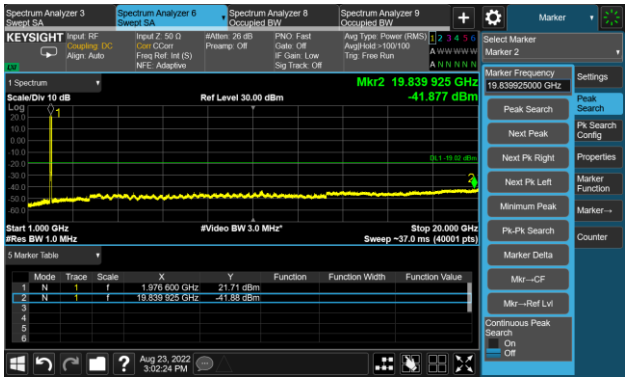
High Channel - 1985MHz

20 + GAP25 + 20MHz Channel Bandwidth - Ant 4	
Low Channel – 1940MHz	High Channel - 1985MHz
	

A.4 Conducted Spurious Emissions Test Result

Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/21 ~ 2022/08/23	Test Configuration	n25, 20 + GAP25 + 20

Frequency (MHz)	Frequency Range (MHz)	Max Spurious Emissions (dBm)	Limit (dBm)	Result
1940 + 1985	30 ~ 1000	-63.347	≤ -19.02	Pass
	1000 ~ 22000	-41.877	≤ -19.02	Pass

20+GAP25+20 MHz Channel Bandwidth	
30MHz ~ 1GHz	1GHz ~ 20GHz
	

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 “2208RSU052-UT” file.

Appendix C - EUT Photograph

Refer to “2208RSU052-UE” file.

The End