



RF MEASUREMENT REPORT

FCC ID: VBNAHIB-01
Application: Nokia Solutions and Networks
Product: AirScale Base Station RRH 2100MHz
Model No.: AHIB
Brand Name: Nokia
FCC Rule Part(s): Part 2, 27 (L)
Result: Complies
Test Date: 2022-08-01 ~ 2022-08-04

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
2207RSU071-U1	Rev. 01	Initial Report	2022-08-15	Valid

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

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1.4. Product Information

Product Name	AirScale Base Station RRH 2100MHz
Model No.	AHIB
Brand Name	Nokia
Test Device Serial No.	AH193900754
Software Version	SBTS22R4_ENB_9999_220608_000015
Operating Band (s)	LTE Band 66, 5G NR n66
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 n66	
Frequency Range	DL: 2110 ~ 2200 MHz UL: 1710 ~ 1780MHz
Bandwidth	NR 30MHz
Modulation Type	QPSK, 16QAM, 64QAM, 256QAM
Max EIRP	30MHz: 55.90dBm
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
30	QPSK	28M5G7D
	16QAM	28M4W7D
	64QAM	28M5W7D
	256QAM	28M5W7D

1.7. Description of Available Antennas

Band Support	Antenna Type	Model	Antenna Gain
n66	Directional Antenna	AAFA	12.5dBi
Remark: - The transmit signals are completely uncorrelated with each other, directional gain = G_{ANT} dBi, G_{ANT} is the antenna gain in dBi; - The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.			

1.8. Test Methodology

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

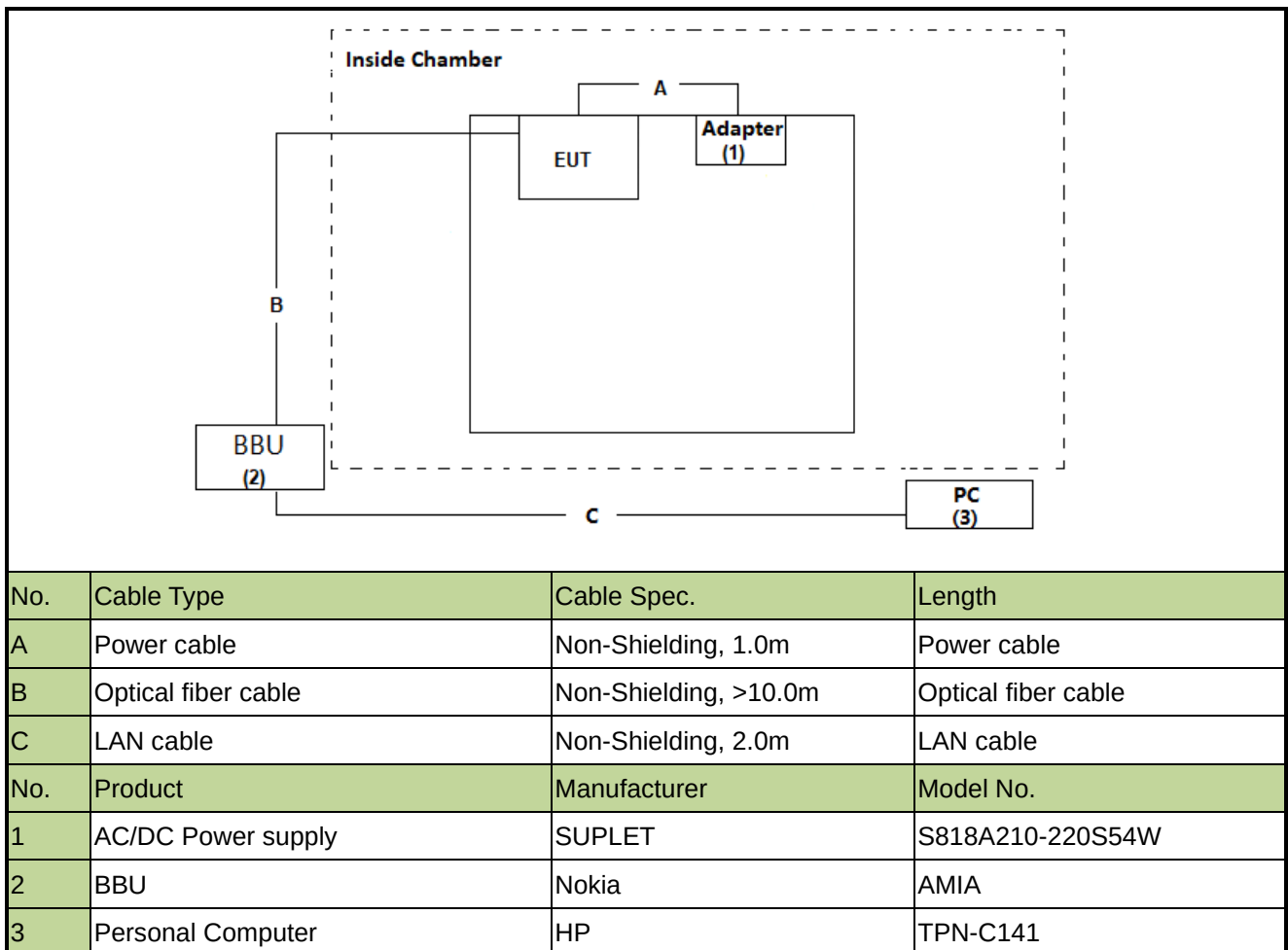
- ANSI C63.26:2015
- FCC CFR 47 Part 2, Part 27
- FCC KDB 971168 D01 v03r01: Power Meas License Digital Systems
- FCC KDB 971168 D02 v02r01: Misc Rev Approv License Devices
- FCC KDB 412172 D01 v01r01: Determining ERP and EIRP
- FCC KDB 662911 D01 v02r01: Multiple Transmitter Output

2. Test Configuration

2.1. Test Mode

Test Item	Channel Bandwidth	Modulation
Transmitter output power	30MHz	QPSK, 16QAM, 64QAM, 256QAM
Occupied bandwidth		QPSK, 16QAM, 64QAM, 256QAM
Band Edge		QPSK
Out-of-frequency band unwanted emissions		QPSK
Frequency stability		QPSK

2.2. Test System Connection Diagram



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%
Frequency Stability
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 76.2Hz

5. Test Result

5.1. Summary

FCC Section(s)	Test Description	Test Condition	Verdict
2.1049	Occupied Bandwidth	Conducted	Pass
2.1055; 27.54	Frequency Stability		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, Frequency Stability and Conducted Spurious Emission were presented the worst test data of modulation & antenna port in the test report.

5.2. Occupied Bandwidth Measurement

5.2.1. Test Limit

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

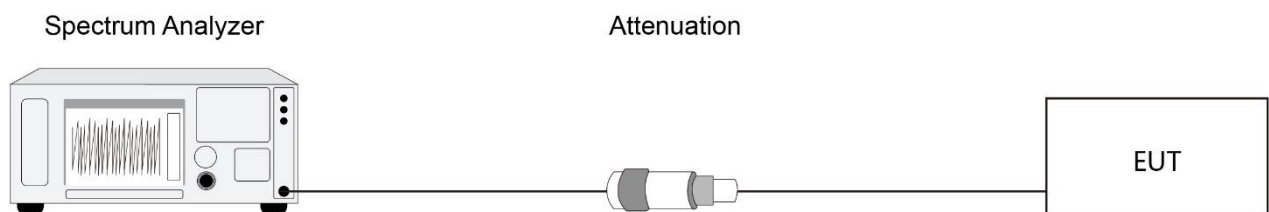
5.2.2. Test Procedure

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. $VBW \geq 3 \times RBW$
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. Frequency Stability Measurement

5.3.1. Test Limit

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

5.3.2. Test Procedure

ANSI C63.26-2015 - Section 5.6

5.3.3. Test Setting

Frequency Stability Under Temperature Variations:

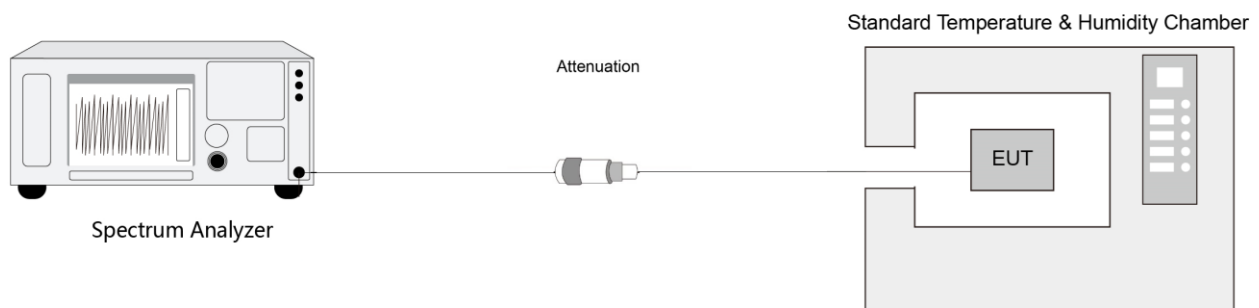
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to highest. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C decreased per stage until the lowest temperature reached.

Frequency Stability Under Voltage Variations:

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ($\pm 15\%$) and endpoint, record the maximum frequency change.

5.3.4. Test Setup



5.3.5. Test Result

Refer to Appendix A.2.

5.4. Equivalent Isotropically Radiated Power Measurement

5.4.1. 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.

5.4.2. Test Procedure

ANSI C63.26-2015 - Section 5.2.4.2, 5.2.5.5

5.4.3. Test Setting

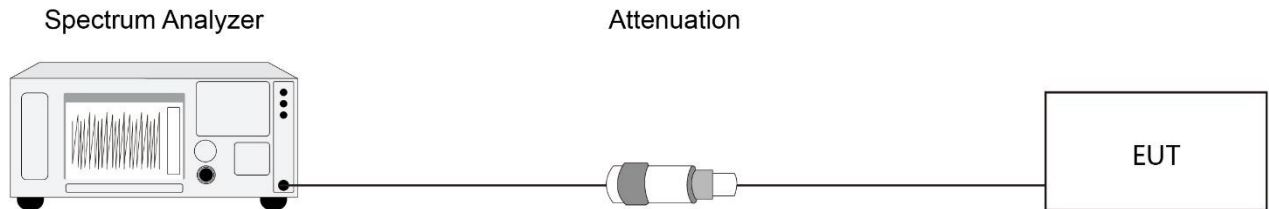
Average Power Measurement

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 $2 \times$ to $3 \times$ the OBW
2. RBW $\geq 1\%$ to 5% of the OBW
3. VBW $\geq 3 \times$ RBW
4. Sweep time $\geq 10 \times$ (number of points in sweep) $\times$ (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 - Tx Cable Loss + Antenna Gain of Substitution Antenna.

5.4.4. Test Setup



5.4.5. Test Result

Refer to Appendix A.3.

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 $43 + 10 \log_{10} P$ (watts)

This device can be implement MIMO function, so the limit os spurious emissions needs to be reduced $10 \cdot \log(\text{Numbers}_{\text{Ant}})$ according to FCC KDB 662911 D01 guidance.

The limit is adjusted to $-13\text{dBm} - 10 \cdot \log(4) = -19.02\text{dBm}$

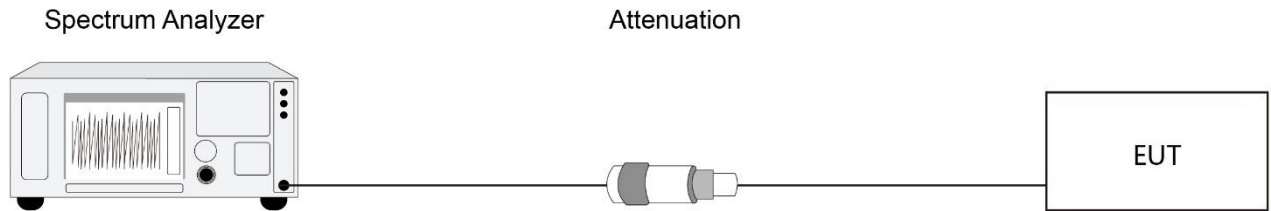
5.5.2. Test Procedure

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 $\geq 3 \cdot \text{RBW}$
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.4.

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 $43 + 10 \log_{10} P$ (watts)

Note: This device can be implement MIMO function, so the limit os spurious emissions needs to be reduced $10 \cdot \log(\text{Numbers}_{\text{Ant}})$ according to FCC KDB 662911 D01 guidance.

The limit is adjusted to $-13\text{dBm} - 10 \cdot \log(4) = -19.02\text{dBm}$

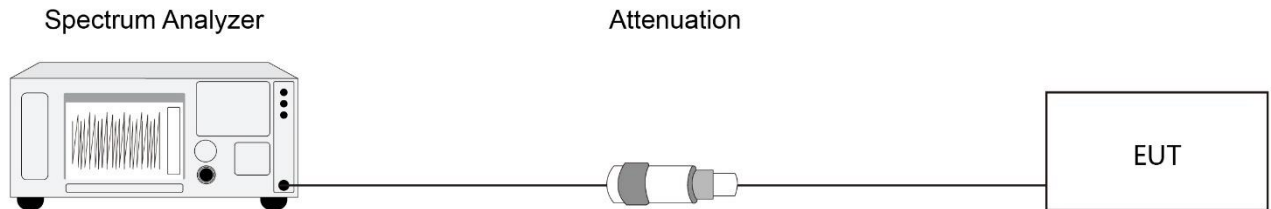
5.6.2. Test Procedure

ANSI C63.26-2015 - Section 5.7.1

5.6.3. Test Setting

1. Set the analyzer frequency to low or high channel.
2. RBW = 1MHz
3. VBW $\geq 3 \cdot \text{RBW}$
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.5.

Appendix A - Test Result

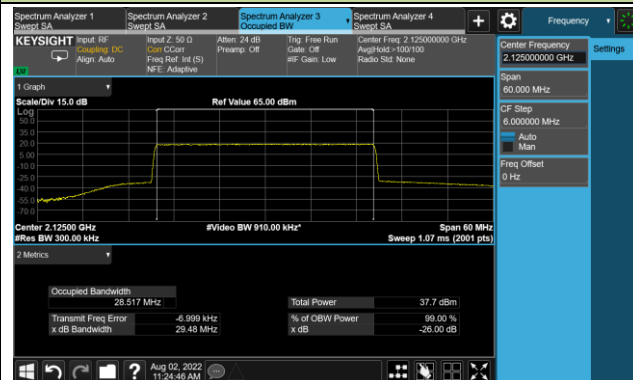
A.1 Occupied Bandwidth Test Result

Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/01 ~ 2022/08/03	Test Configuration	n66, BW = 30MHz

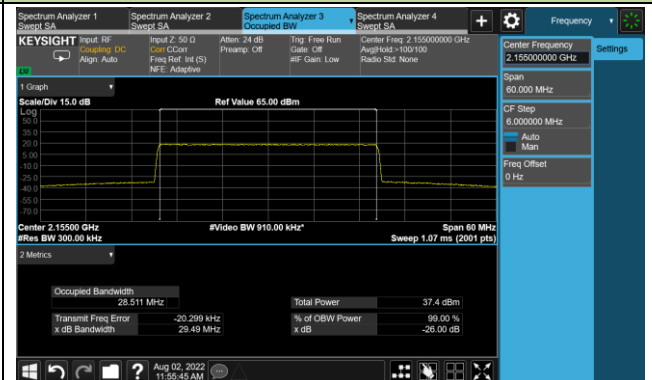
Frequency (MHz)	Bandwidth (MHz)	99% Bandwidth (MHz)
QPSK		
2125	30	28.517
2155	30	28.511
2185	30	28.489
16QAM		
2125	30	28.368
2155	30	28.398
2185	30	28.324
64QAM		
2125	30	28.521
2155	30	28.532
2185	30	28.497
256QAM		
2125	30	28.505
2155	30	28.510
2185	30	28.511

30MHz Channel Bandwidth - QPSK

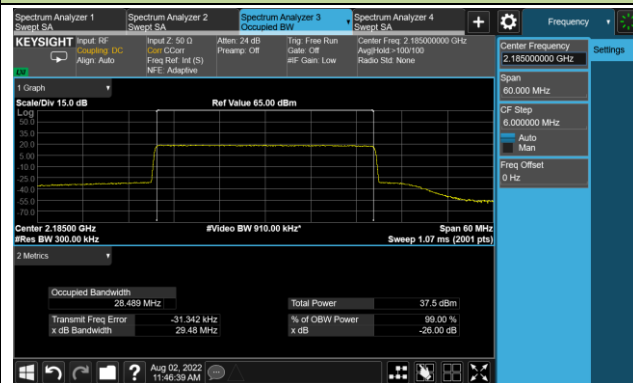
Bottom Channel



Middle Channel

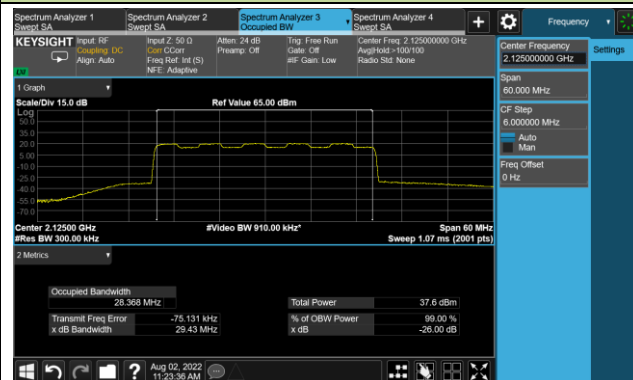


Top Channel

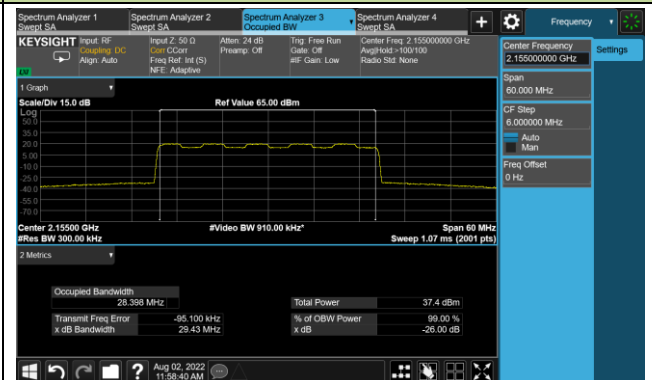


30MHz Channel Bandwidth - 16QAM

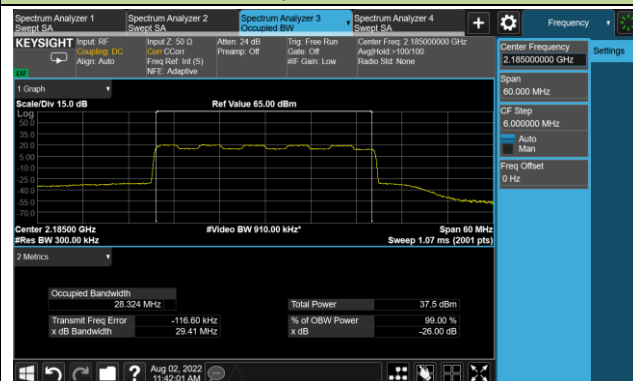
Bottom Channel



Middle Channel

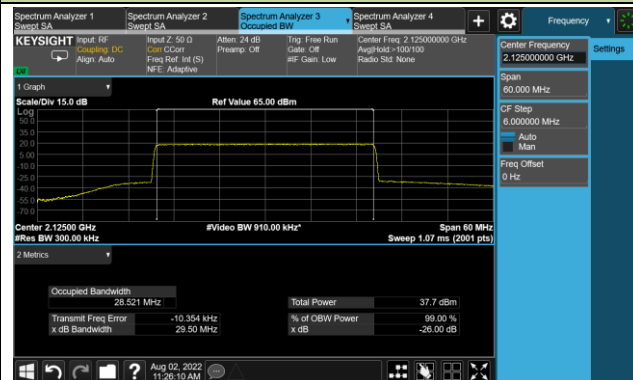


Top Channel

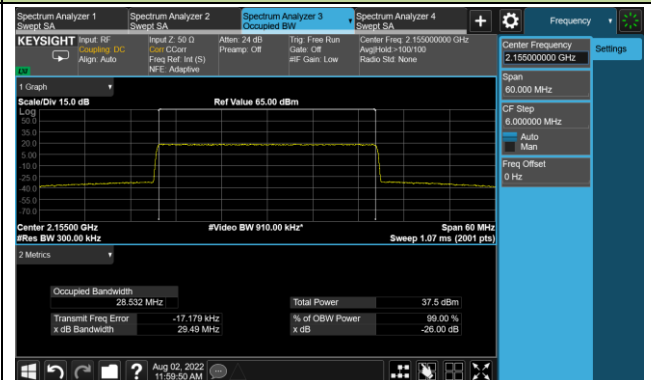


30MHz Channel Bandwidth - 64QAM

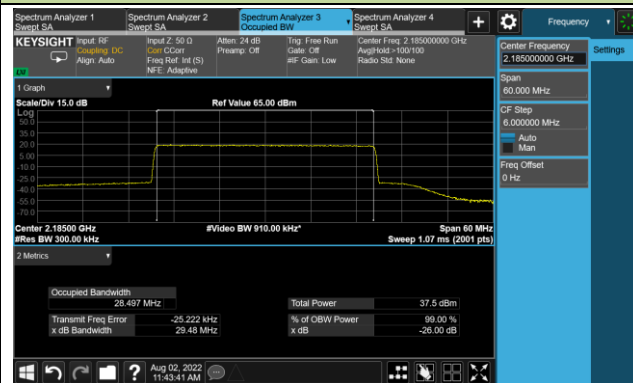
Bottom Channel



Middle Channel

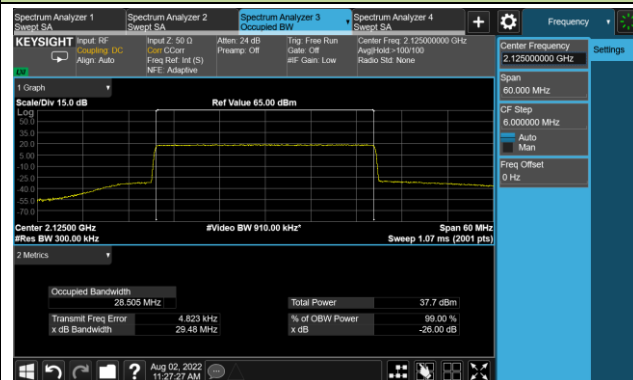


Top Channel

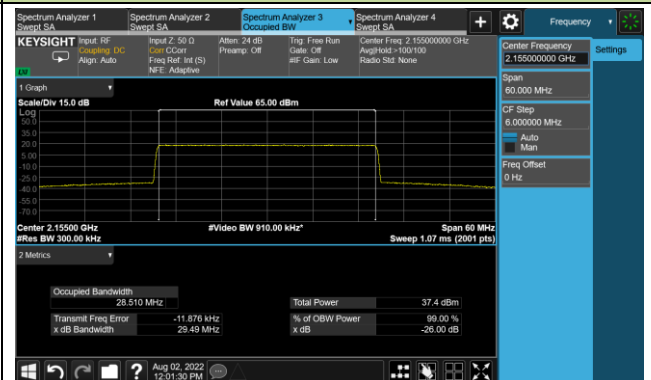


30MHz Channel Bandwidth - 256QAM

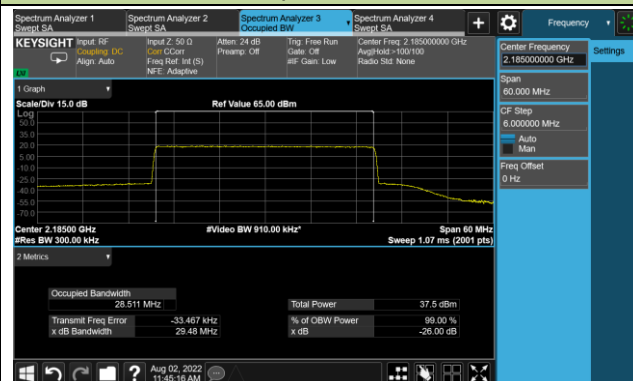
Bottom Channel



Middle Channel



Top Channel



A.2 Frequency Stability Test Result

Test Site	WZ-TR3	Test Engineer	Lucas Wang
Test Date	2022/08/03	Test Configuration	n66, BW = 30MHz

Voltage	Temp (°C)	Frequency Range (MHz)		Limit (MHz)
		f _L	f _H	
48V	- 30	2110.16	2199.82	2110 ~ 2200
	- 20	2110.16	2199.83	2110 ~ 2200
	- 10	2110.16	2199.83	2110 ~ 2200
	0	2110.16	2199.83	2110 ~ 2200
	+ 10	2110.16	2199.83	2110 ~ 2200
	+ 20	2110.15	2199.83	2110 ~ 2200
	+ 30	2110.16	2199.83	2110 ~ 2200
	+ 40	2110.15	2199.83	2110 ~ 2200
	+ 50	2110.16	2199.83	2110 ~ 2200
40.5V	+ 20	2110.16	2199.83	2110 ~ 2200
57.0V	+ 20	2110.16	2199.83	2110 ~ 2200

Voltage	Temp (°C)	Frequency Tolerance (ppm)
48V	- 30	0.0230
	- 20	0.0240
	- 10	0.0250
	0	0.0240
	+ 10	0.0220
	+ 20	0.0230
	+ 30	0.0230
	+ 40	0.0230
	+ 50	0.0230
40.5V	+ 20	0.0230
57.0V	+ 20	0.0220

A.3 Equivalent Isotropically Radiated Power Test Result

Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/01 ~ 2022/08/03	Test Configuration	n66, BW = 30MHz

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								
2125.0	23.13	23.17	22.93	23.23	29.14	41.64	< 62.15	Pass
2155.0	23.00	23.16	22.63	23.10	29.00	41.50	< 62.15	Pass
2185.0	22.83	22.94	22.79	23.12	28.94	41.44	< 62.15	Pass
16QAM								
2125.0	24.75	24.92	24.53	24.85	30.78	43.28	< 62.15	Pass
2155.0	24.57	24.65	24.19	24.74	30.56	43.06	< 62.15	Pass
2185.0	24.76	24.53	24.16	24.93	30.62	43.12	< 62.15	Pass
64QAM								
2125.0	23.05	23.42	22.92	23.16	29.16	41.66	< 62.15	Pass
2155.0	22.90	22.67	22.55	22.96	28.79	41.29	< 62.15	Pass
2185.0	22.94	22.52	22.79	23.37	28.94	41.44	< 62.15	Pass
256QAM								
2125.0	23.27	23.23	22.88	23.20	29.17	41.67	< 62.15	Pass
2155.0	22.58	22.87	22.51	22.97	28.76	41.26	< 62.15	Pass
2185.0	23.23	23.04	22.58	23.03	29.00	41.50	< 62.15	Pass

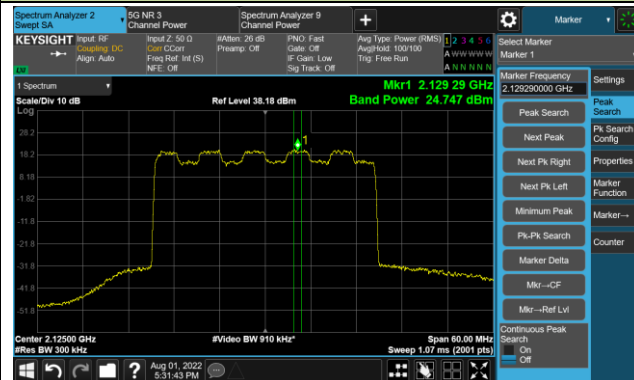
Note 1: Note: Total Power Density (dBm/MHz) = $10 \cdot \log \{ 10^{[ANT\ 1\ Power\ (dBm/MHz) / 10]} + 10^{[ANT\ 2\ Power\ (dBm/MHz) / 10]} + 10^{[ANT\ 3\ Power\ (dBm/MHz) / 10]} + 10^{[ANT\ 4\ Power\ (dBm/MHz) / 10]} \}$ (dBm/MHz).

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

Worst case output power

30MHz Channel Bandwidth - 2125 MHz - 16QAM

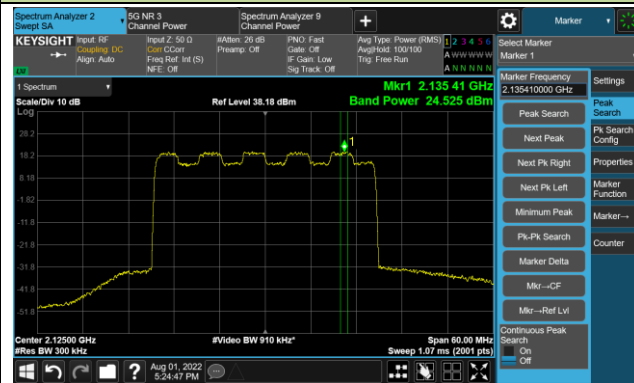
Ant 1



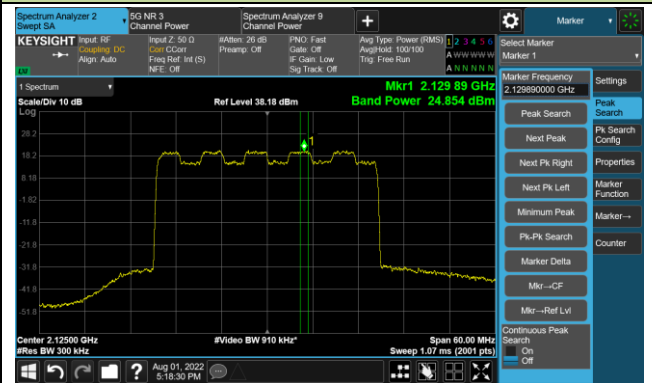
Ant 2



Ant 3



Ant 4



Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/01 ~ 2022/08/03	Test Configuration	n66, BW = 30MHz (Reported Only)

Frequency (MHz)	Output Power (dBm)				Total Power (dBm)	EIRP (dBm)	Limit (dBm)
	Ant 0	Ant 1	Ant 2	Ant 3			
QPSK							
2125.0	37.37	37.47	37.12	37.49	43.39	55.89	NA
2155.0	37.19	37.25	36.92	37.38	43.21	55.71	NA
2185.0	37.28	37.38	37.00	37.49	43.31	55.81	NA
16QAM							
2125.0	37.34	37.43	37.09	37.51	43.37	55.87	NA
2155.0	37.09	37.20	36.87	37.35	43.15	55.65	NA
2185.0	37.23	37.31	36.94	37.48	43.26	55.76	NA
64QAM							
2125.0	37.38	37.46	37.14	37.51	43.40	55.90	NA
2155.0	37.23	37.30	36.95	37.42	43.25	55.75	NA
2185.0	37.27	37.38	37.01	37.44	43.30	55.80	NA
256QAM							
2125.0	37.41	37.44	37.15	37.49	43.40	55.90	NA
2155.0	37.15	37.16	36.89	37.35	43.16	55.66	NA
2185.0	37.23	37.33	37.02	37.47	43.29	55.79	NA

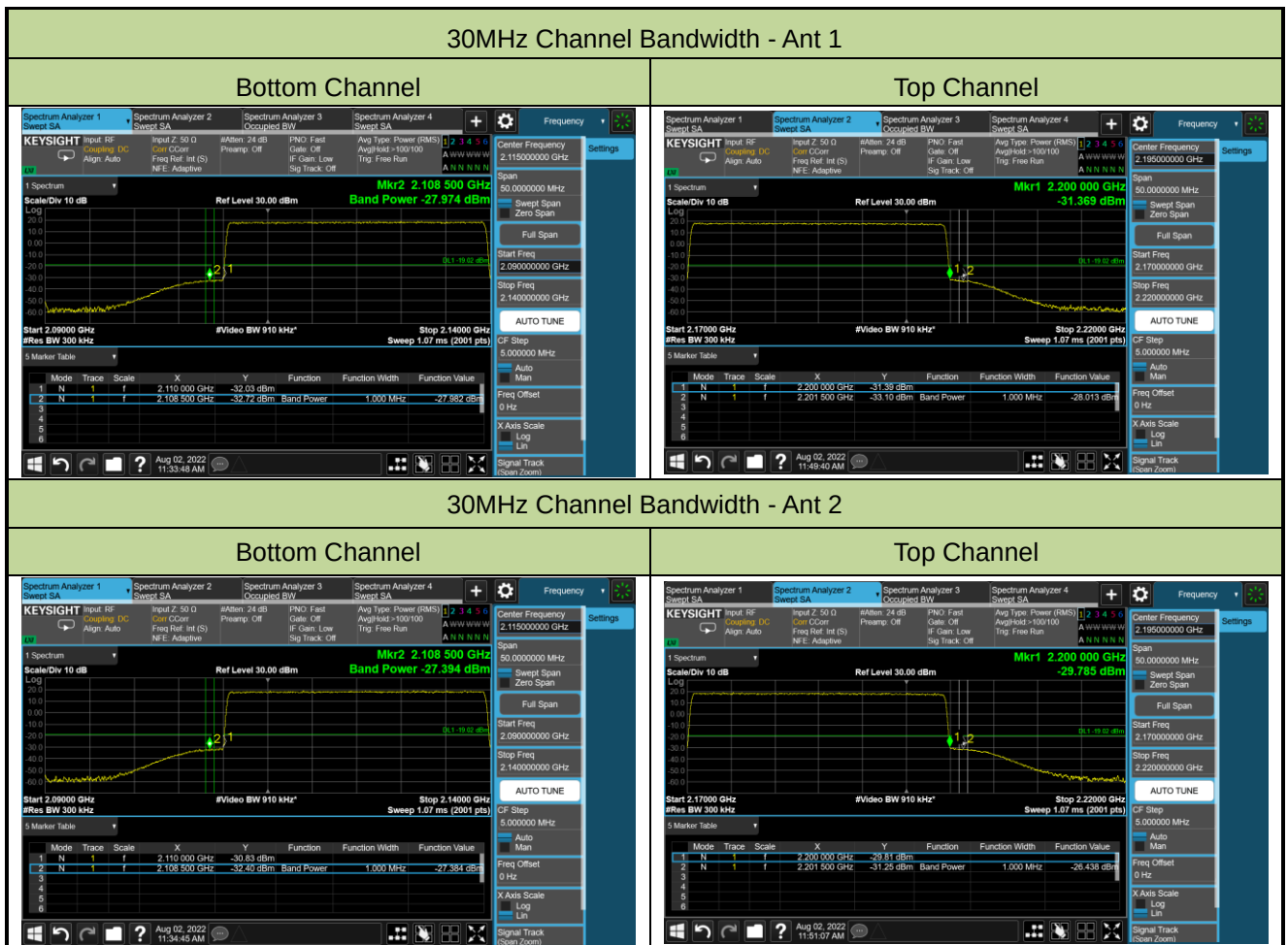
Note 1: Note: Total Power (dBm) = $10 \cdot \log \{ 10^{[\text{ANT 1 Power (dBm)} / 10]} + 10^{[\text{ANT 2 Power (dBm)} / 10]} + 10^{[\text{ANT 3 Power (dBm)} / 10]} + 10^{[\text{ANT 4 Power (dBm)} / 10]} \}$ (dBm).

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

A.4 Band Edge Test Result

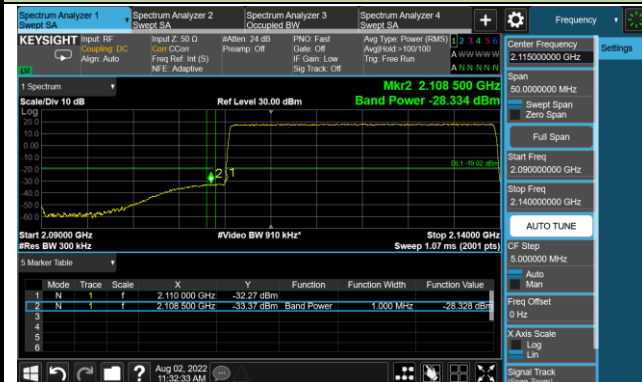
Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/01 ~ 2022/08/03	Test Configuration	n66, BW = 30MHz

Frequency (MHz)	Max Band Edge (dBm)				Limit (dBm)	Result
	Ant 1	Ant 2	Ant 3	Ant 4		
2125	-27.982	-27.384	-28.328	-28.553	≤ -19.02	Pass
2185	-28.013	-26.438	-27.476	-27.440	≤ -19.02	Pass

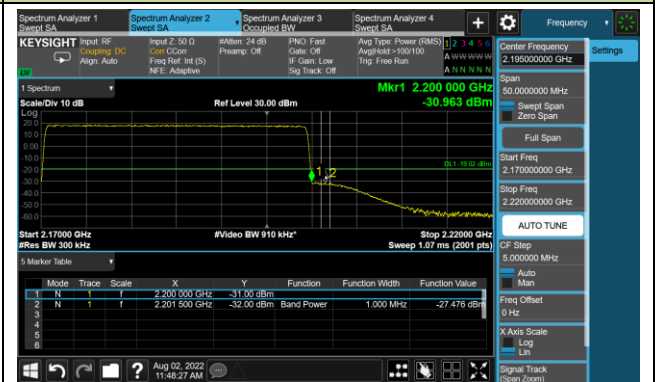


30MHz Channel Bandwidth - Ant 3

Bottom Channel

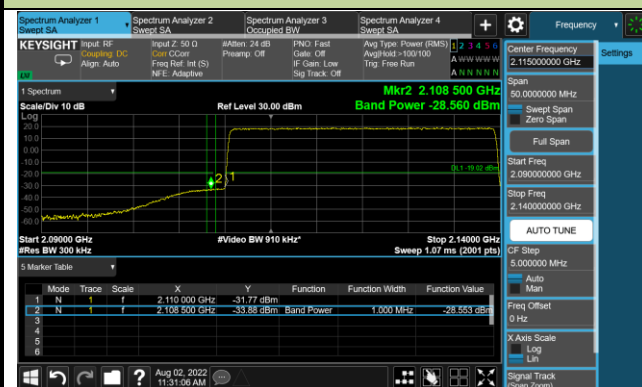


Top Channel

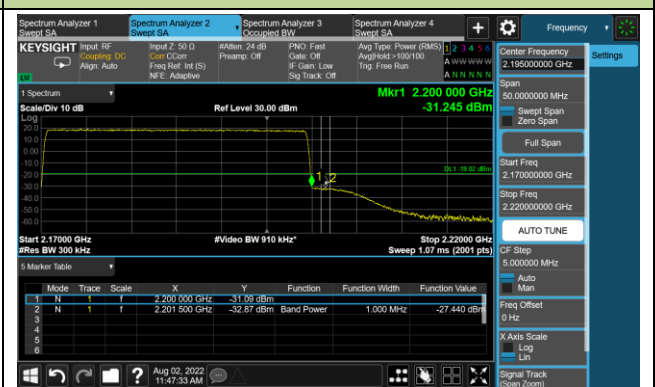


30MHz Channel Bandwidth - Ant 4

Bottom Channel



Top Channel



A.5 Conducted Spurious Emissions Test Result

Test Site	WZ-SR6	Test Engineer	Lucas Wang
Test Date	2022/08/01 ~ 2022/08/03	Test Configuration	n66, BW = 30MHz, Ant 4

Frequency (MHz)	Channel Bandwidth (MHz)	Frequency Range (MHz)	Max Spurious Emissions (dBm)	Limit (dBm)	Result
2125	30	30 ~ 1000	-64.491	≤ -19.02	Pass
		1000 ~ 22000	-39.939	≤ -19.02	Pass
2155	30	30 ~ 1000	-64.057	≤ -19.02	Pass
		1000 ~ 22000	-40.965	≤ -19.02	Pass
2185	30	30 ~ 1000	-63.170	≤ -19.02	Pass
		1000 ~ 22000	-40.789	≤ -19.02	Pass



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.