

MEASUREMENT REPORT

FCC PART 27 Subpart L

FCC ID: VBNAHIB-01

Application: Nokia Solutions and Networks

Application Type: Certification

Product: AirScale Base Station RRH 2100MHz

Model No.: AHIB

Brand Name: Nokia

FCC Rule Part(s): Part 27 Subpart L

Test Procedure(s): ANSI C63.26: 2015

Test Date: June 21 ~ 28, 2021

Reviewed By:

Paddy Chen

Paddy Chen

Approved By:

Chenz Ker

Chenz Ker



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 (Taiwan) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
2107TW0001-U1	Rev. 01	Initial Report	07-18-2021	Valid

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

CONTENTS

Description	Page
General Information.....	5
1. INTRODUCTION	6
1.1. Scope	6
1.2. MRT Test Location	6
2. PRODUCT INFORMATION	7
2.1. Equipment Description	7
2.2. Emission Designator.....	7
2.3. Description of Available Antennas	7
2.4. Test Mode and Channel Detail	8
2.5. EMI Suppression Device(s)/Modifications.....	8
2.6. Test Environment Condition.....	8
3. TEST EQUIPMENT CALIBRATION DATE	9
4. MEASUREMENT UNCERTAINTY	10
5. TEST RESULT.....	11
5.1. Summary.....	11
5.2. Equivalent Isotropically Radiated Power Measurement	12
5.2.1. Test Limit.....	12
5.2.2. Test Procedure Used	12
5.2.3. Test Setting	12
5.2.4. Test Setup	13
5.2.5. Test Result	14
5.3. Frequency Stability Measurement	20
5.3.1. Test Limit.....	20
5.3.2. Test Procedure Used	20
5.3.3. Test Setting	20
5.3.4. Test Setup	21
5.3.5. Test Result	22
5.4. Emission Bandwidth	23
5.4.1. Test Limit.....	23
5.4.2. Test Procedure Used	23
5.4.3. Test Setting	23
5.4.4. Test Setup	23
5.4.5. Test Result	24
5.5. Band Edge Measurement.....	32

5.5.1.	Test Limit	32
5.5.2.	Test Procedure Used	32
5.5.3.	Test Setting	32
5.5.4.	Test Setup	33
5.5.5.	Test Result	34
5.6.	Peak to Average Ratio Measurement	41
5.6.1.	Test Limit	41
5.6.2.	Test Procedure Used	41
5.6.3.	Test Setting	41
5.6.4.	Test Setup	41
5.6.5.	Test Result	42
5.7.	Conducted Spurious Emission Measurement	45
5.7.1.	Test Limit	45
5.7.2.	Test Procedure Used	45
5.7.3.	Test Setting	45
5.7.4.	Test Setup	46
5.7.5.	Test Result	47
5.8.	Radiated Spurious Emission Measurement	51
5.8.1.	Test Limit	51
5.8.2.	Test Procedure Used	51
5.8.3.	Test Setting	51
5.8.4.	Test Setup	52
5.8.5.	Test Result	53
6.	CONCLUSION.....	54

General Information

Applicant:	Nokia Solutions and Networks
Applicant Address:	3201 Olympus Blvd, Dallas, Texas, 75039
Manufacturer:	Nokia Solutions and Networks
Manufacturer Address:	3201 Olympus Blvd, Dallas, Texas, 75039
Test Site:	MRT Technology (Taiwan) Co., Ltd
Test Site Address:	No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C)

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Fuxing Rd., Taoyuan, Taiwan (R.O.C)

- MRT facility is a FCC registered (Reg. No. TW3261) test facility with the site description report on file and is designated by the FCC as an Accredited Test Film.
- MRT facility is an IC registered (MRT Reg. No. 21723-1) test laboratory with the site description on file at Industry Canada.
- MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (TAF) under the American Association for Laboratory Accreditation Program (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC, Industry Taiwan, EU and TELEC Rules.

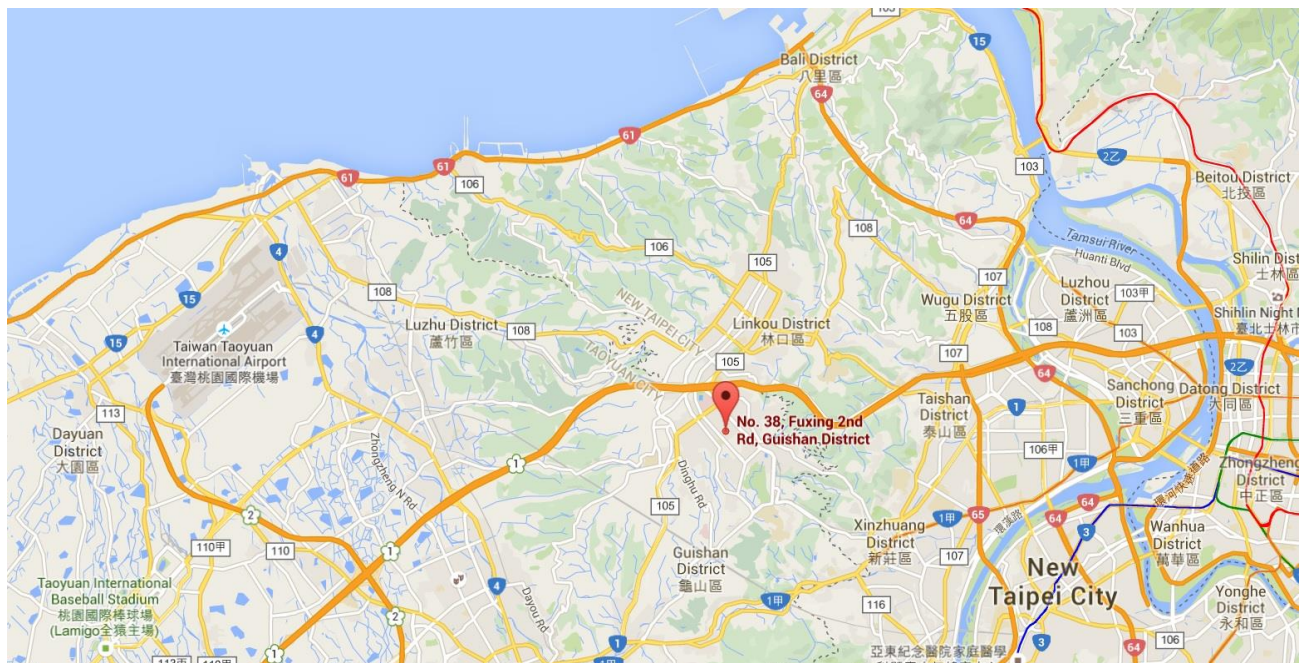
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taoyuan City. These measurement tests were conducted at the MRT Technology (Taiwan) Co., Ltd. Facility located at No.38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan (R.O.C).



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	AirScale Base Station RRH 2100MHz
Model No.	AHIB
Brand Name	Nokia
Test Device Serial No.	AH193900754
Operating Band (s)	5G NR n66
Modulation Type	QPSK, 16QAM, 64QAM, 256QAM
Frequency Range	T _x : 2110 ~ 2180 MHz; R _x : 1710 ~ 1780 MHz
Max EIRP	5MHz: 55.61dBm; 10MHz: 55.54dBm; 15MHz: 55.65dBm
Emission Designator:	Refer to Section 2.2
Antenna Specification:	Refer to Section 2.3

2.2. Emission Designator

Bandwidth (MHz)	Modulation	Emission Designator	Bandwidth (MHz)	Modulation	Emission Designator
5	QPSK	4M49G7D	10	QPSK	9M17G7D
	16QAM	4M49W7D		16QAM	9M23W7D
	64QAM	4M48W7D		64QAM	9M29W7D
	256QAM	4M47W7D		256QAM	9M28W7D
15	QPSK	14M2G7D	--		
	16QAM	14M1W7D			
	64QAM	14M1W7D			
	256QAM	14M1W7D			

2.3. 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.			

2.4. Test Mode and Channel Detail

Test Item	Channel Bandwidth	Modulation
Equivalent Isotropically Radiated Power	5 MHz, 10 MHz, 15 MHz	QPSK, 16QAM, 64QAM, 256QAM
Emission Bandwidth		
Conducted Spurious Emissions	5 MHz, 10 MHz, 15 MHz	QPSK
Band Edge Measurements		
Peak to Average Ratio	15MHz	
Frequency Stability		
Radiated Spurious Emissions	5 MHz	

2.5. EMI Suppression Device(s)/Modifications

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

2.6. Test Environment Condition

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

3. TEST EQUIPMENT CALIBRATION DATE

Radiated Emissions Test Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2021/10/05
Active Loop Antenna	SCHWARZBECK	FMZB 1519B	MRTTWA00002	1 year	2022/05/06
Broadband Hornantenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2022/04/21
Breitband Hornantenna	SCHWARZBECK	BBHA 9170	MRTTWA00004	1 year	2022/04/28
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2022/04/21
Broadband Amplifier	SCHWARZBECK	BBV 9721	MRTTWA00006	1 year	2022/04/26
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2022/03/23
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2022/03/24
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2021/10/14
EXA Signal Analyzer	KEYSIGHT	N9010B	MRTTWA00074	1 year	2021/07/14
Antenna Cable	HUBERSUHNER	SF106	MRTTWE00010	1 year	2022/06/15
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00032	1 year	2022/05/26
Cable	Rosnol	K1K50-UP026 4-K1K50-4M	MRTTWE00012	1 year	2022/06/20

Conducted Test Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00014	1 year	2022/04/23
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00015	1 year	2022/03/25
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2022/10/01
EXA Signal Analyzer	KEYSIGHT	N9010B	MRTTWA00074	1 year	2021/07/11
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2022/03/23
DC Power Supply	GWINSTEK	SPS-606	MRTTWA00034	Check by TRUE RMS MULTIMETER	
TRUE RMS MULTIMETER	FLUKE	117	MRTTWA00022	1 year	2022/05/05
Temperature & Humidity Chamber	TEN BILLION	TTH-B3UP	MRTTWA00036	1 year	2021/11/06
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2022/03/08

Software	Version	Function
EMI Software	V3	EMI Test Software

4. 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 Measurement
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 2.65dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 9kHz ~ 30MHz: 3.92dB 30MHz ~ 1GHz: 4.25dB 1GHz ~ 18GHz: 4.40dB

5. TEST RESULT

5.1. Summary

FCC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1046; 27.50(d)(2)	Equivalent Isotropically Radiated Power	EIRP < 1640 watts/MHz	Conducted	Pass	Section 5.2
2.1055; 27.54	Frequency Stability	Refer to Section 5.3	Conducted	Pass	Section 5.3
2.1049	Emission Bandwidth	Refer to Section 5.4		Pass	Section 5.4
27.53(h)	Band Edge Measurements	< -13dBm/1% BW		Pass	Section 5.5
2.1046; 27.50(d)(5)	Peak to Average Ratio	< 13dB		Pass	Section 5.6
2.1051; 27.53(h)	Conducted Spurious Emissions	< -13dBm/MHz		Pass	Section 5.7
2.1053; 27.53(h)	Radiated Spurious Emissions	< -13dBm/MHz	Radiated	Pass	Section 5.8

Notes:

- 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.
- The Channel Band-edge, Radiated Spurious Emission were presented the worst test data of modulation & antenna port in the test report.

5.2. Equivalent Isotropically Radiated Power Measurement

5.2.1. Test Limit

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

5.2.2. Test Procedure Used

ANSI C63.26-2015 - Section 5.2.4.2 & 5.2.7

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:

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

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)

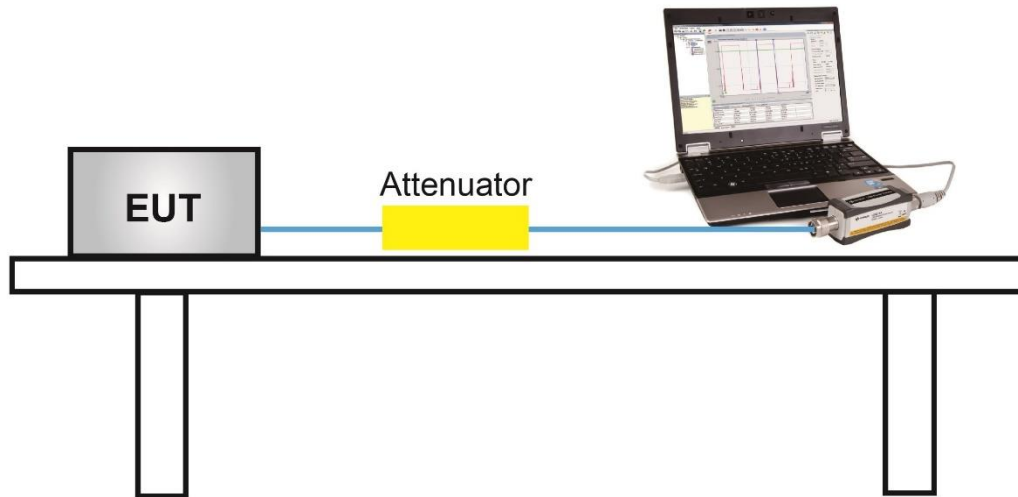
P_{Meas} measured transmitter output power or PSD, in dBm or dBW

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

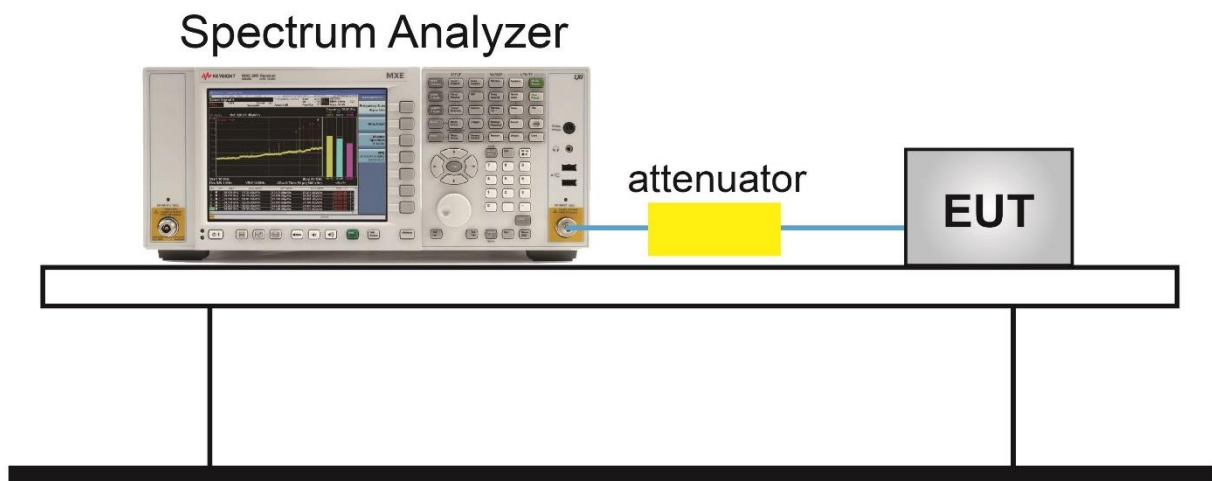
For devices utilizing multiple antennas, see 6.4 for guidance with respect to determining the effective array transmit antenna gain term to be used in the above equation.

5.2.4.Test Setup

Conducted Output Power



Conducted Power Density



5.2.5. Test Result

Test Engineer	Peter Xu	Test Site	SR2
Test Date	2021/06/22	Test Configuration	BW=5MHz
Test Item	EIRP Density		

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								
2112.5	31.26	31.32	30.98	31.27	37.23	49.73	< 62.15	Pass
2145.0	31.24	31.20	30.97	31.21	37.18	49.68	< 62.15	Pass
2177.5	31.51	31.46	31.16	31.46	37.42	49.92	< 62.15	Pass
16QAM								
2112.5	31.08	31.10	30.89	31.06	37.05	49.55	< 62.15	Pass
2145.0	31.10	31.06	30.96	31.02	37.06	49.56	< 62.15	Pass
2177.5	31.42	31.32	31.09	31.33	37.31	49.81	< 62.15	Pass
64QAM								
2112.5	30.64	30.64	30.45	30.74	36.64	49.14	< 62.15	Pass
2145.0	30.64	30.59	30.44	30.58	36.58	49.08	< 62.15	Pass
2177.5	30.86	30.92	30.61	30.80	36.82	49.32	< 62.15	Pass
256QAM								
2112.5	30.60	30.60	30.37	30.66	36.58	49.08	< 62.15	Pass
2145.0	30.50	30.44	30.41	30.55	36.50	49.00	< 62.15	Pass
2177.5	30.76	30.79	30.53	30.82	36.75	49.25	< 62.15	Pass

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

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

Test Engineer	Peter Xu	Test Site	SR2
Test Date	2021/06/22	Test Configuration	BW=10MHz
Test Item	EIRP Density		

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								
2115.0	29.56	29.61	29.39	29.68	35.58	48.08	< 62.15	Pass
2145.0	29.60	29.64	29.56	29.73	35.65	48.15	< 62.15	Pass
2175.0	29.79	29.84	29.56	29.67	35.74	48.24	< 62.15	Pass
16QAM								
2115.0	28.47	28.50	28.27	28.52	34.46	46.96	< 62.15	Pass
2145.0	28.45	28.54	28.49	28.56	34.53	47.03	< 62.15	Pass
2175.0	28.73	28.75	28.61	28.75	34.73	47.23	< 62.15	Pass
64QAM								
2115.0	27.37	27.45	27.37	27.41	33.42	45.92	< 62.15	Pass
2145.0	27.27	27.66	27.49	27.44	33.49	45.99	< 62.15	Pass
2175.0	27.53	27.77	27.66	27.59	33.66	46.16	< 62.15	Pass
256QAM								
2115.0	27.20	27.45	27.33	27.50	33.39	45.89	< 62.15	Pass
2145.0	27.13	27.56	27.46	27.50	33.44	45.94	< 62.15	Pass
2175.0	27.49	27.72	27.59	27.56	33.61	46.11	< 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).

Test Engineer	Peter Xu	Test Site	SR2
Test Date	2021/06/22	Test Configuration	BW=15MHz
Test Item	EIRP Density		

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								
2117.5	27.57	27.41	27.23	27.45	33.44	45.94	< 62.15	Pass
2145.0	27.55	27.36	27.26	27.44	33.42	45.92	< 62.15	Pass
2172.5	27.69	27.41	27.63	27.63	33.61	46.11	< 62.15	Pass
16QAM								
2117.5	27.44	27.40	27.15	27.31	33.35	45.85	< 62.15	Pass
2145.0	27.54	27.30	27.29	27.34	33.39	45.89	< 62.15	Pass
2172.5	27.64	27.38	27.27	27.58	33.49	45.99	< 62.15	Pass
64QAM								
2117.5	25.79	25.64	25.43	25.74	31.67	44.17	< 62.15	Pass
2145.0	25.71	25.43	25.41	25.51	31.54	44.04	< 62.15	Pass
2172.5	25.78	25.71	25.38	25.87	31.71	44.21	< 62.15	Pass
256QAM								
2117.5	25.85	25.55	25.29	25.83	31.66	44.16	< 62.15	Pass
2145.0	25.90	25.57	25.36	25.55	31.62	44.12	< 62.15	Pass
2172.5	25.91	25.45	25.45	25.81	31.68	44.18	< 62.15	Pass

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

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

Test Engineer	Peter Xu	Test Site	SR2
Test Date	2021/06/23	Test Configuration	BW=5MHz
Test Item	EIRP		

Frequency (MHz)	Output Power (dBm)				Total Power (dBm)	EIRP (dBm)	Limit (dBm)	Result
	Ant 0	Ant 1	Ant 2	Ant 3				
QPSK								
2112.5	37.05	36.87	36.82	36.95	42.94	55.44	< 62.15	Pass
2145.0	36.96	36.82	36.85	36.83	42.89	55.39	< 62.15	Pass
2177.5	37.02	36.92	36.91	36.97	42.98	55.48	< 62.15	Pass
16QAM								
2112.5	37.02	36.89	36.85	36.97	42.95	55.45	< 62.15	Pass
2145.0	36.95	36.85	36.83	36.96	42.92	55.42	< 62.15	Pass
2177.5	37.10	36.98	36.92	36.98	43.02	55.52	< 62.15	Pass
64QAM								
2112.5	37.09	36.92	36.89	37.02	43.00	55.50	< 62.15	Pass
2145.0	37.12	36.94	36.95	37.06	43.04	55.54	< 62.15	Pass
2177.5	37.06	37.12	37.01	37.15	43.11	55.61	< 62.15	Pass
256QAM								
2112.5	37.10	36.82	36.81	36.99	42.95	55.45	< 62.15	Pass
2145.0	37.09	36.87	36.91	37.03	43.00	55.50	< 62.15	Pass
2177.5	37.13	37.03	36.95	37.01	43.05	55.55	< 62.15	Pass

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

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

Test Engineer	Peter Xu	Test Site	SR2
Test Date	2021/06/23	Test Configuration	BW=10MHz
Test Item	EIRP		

Frequency (MHz)	Output Power (dBm)				Total Power (dBm)	EIRP (dBm)	Limit (dBm)	Result
	Ant 0	Ant 1	Ant 2	Ant 3				
QPSK								
2115.0	37.01	36.96	36.83	36.89	42.94	55.44	< 62.15	Pass
2145.0	37.03	36.93	36.95	36.95	42.99	55.49	< 62.15	Pass
2175.0	37.06	36.95	36.94	36.97	43.00	55.50	< 62.15	Pass
16QAM								
2115.0	36.85	36.82	36.87	36.91	42.88	55.38	< 62.15	Pass
2145.0	36.97	36.91	36.97	36.95	42.97	55.47	< 62.15	Pass
2175.0	37.08	36.97	36.91	36.94	43.00	55.50	< 62.15	Pass
64QAM								
2115.0	36.97	37.02	36.89	37.02	43.00	55.50	< 62.15	Pass
2145.0	36.99	36.89	36.90	37.03	42.97	55.47	< 62.15	Pass
2175.0	37.02	36.93	36.91	36.99	42.98	55.48	< 62.15	Pass
256QAM								
2115.0	36.92	36.95	36.85	36.93	42.93	55.43	< 62.15	Pass
2145.0	37.02	36.93	36.95	36.97	42.99	55.49	< 62.15	Pass
2175.0	37.05	37.02	36.98	37.01	43.04	55.54	< 62.15	Pass

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).

Test Engineer	Peter Xu	Test Site	SR2
Test Date	2021/06/23	Test Configuration	BW=15MHz
Test Item	EIRP		

Frequency (MHz)	Output Power (dBm)				Total Power (dBm)	EIRP (dBm)	Limit (dBm)	Result
	Ant 0	Ant 1	Ant 2	Ant 3				
QPSK								
2117.5	37.06	37.03	36.99	37.05	43.05	55.55	< 62.15	Pass
2145.0	37.14	37.06	37.09	37.09	43.12	55.62	< 62.15	Pass
2172.5	37.23	37.12	37.07	37.10	43.15	55.65	< 62.15	Pass
16QAM								
2117.5	37.03	37.06	37.01	37.03	43.05	55.55	< 62.15	Pass
2145.0	37.05	37.02	37.04	37.04	43.06	55.56	< 62.15	Pass
2172.5	37.06	37.07	37.03	37.02	43.07	55.57	< 62.15	Pass
64QAM								
2117.5	37.07	37.03	37.05	37.06	43.07	55.57	< 62.15	Pass
2145.0	37.15	37.11	37.08	36.99	43.10	55.60	< 62.15	Pass
2172.5	37.09	37.03	37.02	37.01	43.06	55.56	< 62.15	Pass
256QAM								
2117.5	37.10	37.09	37.01	36.95	43.06	55.56	< 62.15	Pass
2145.0	37.20	37.08	36.99	36.99	43.09	55.59	< 62.15	Pass
2172.5	37.12	37.02	36.98	36.96	43.04	55.54	< 62.15	Pass

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).

5.3. Frequency Stability Measurement

5.3.1. Test Limit

N/A

5.3.2. Test Procedure Used

ANSI C63.26-2015 - Section 5.6

5.3.3. Test Setting

Frequency Stability Under Temperature Variations:

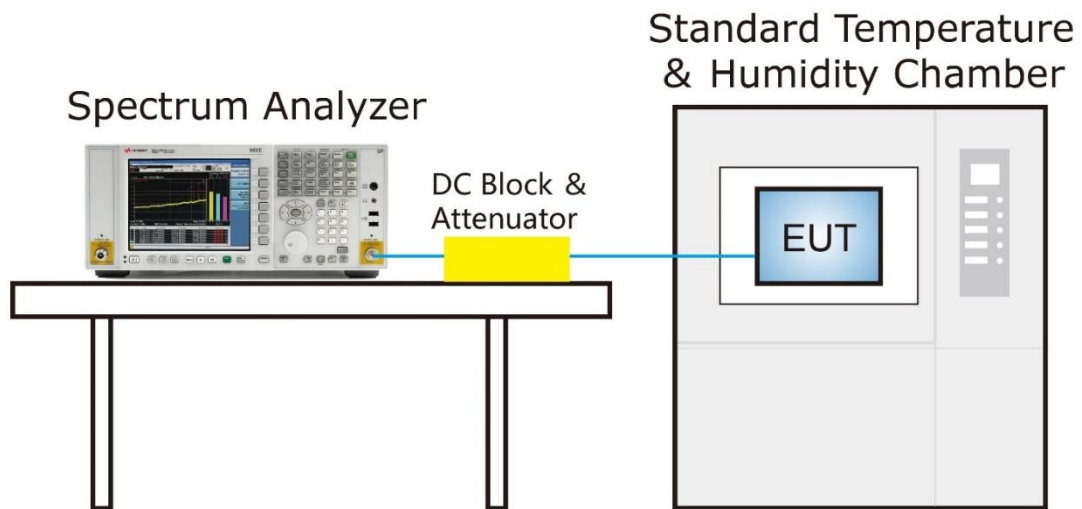
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain 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 (If a product is specified to operate over a range of input voltage then the -15% variation is applied to the lowermost voltage and the $+15\%$ is applied to the uppermost voltage), record the maximum frequency change.

5.3.4. Test Setup



5.3.5. Test Result

Test Engineer	Peter Xu	Test Site	SR3
Test Date	2021/06/22	Test Configuration	BW=15MHz, Middle Channel

Voltage (DC)	Temp (°C)	Frequency Tolerance (ppm)
48V	- 30	-0.036
	- 20	-0.032
	- 10	-0.030
	0	-0.035
	+ 10	-0.032
	+ 20	-0.035
	+ 30	-0.029
	+ 40	-0.030
	+ 50	-0.024
40.5V	+ 20	-0.034
57.0V	+ 20	-0.027

5.4. Emission Bandwidth

5.4.1. Test Limit

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

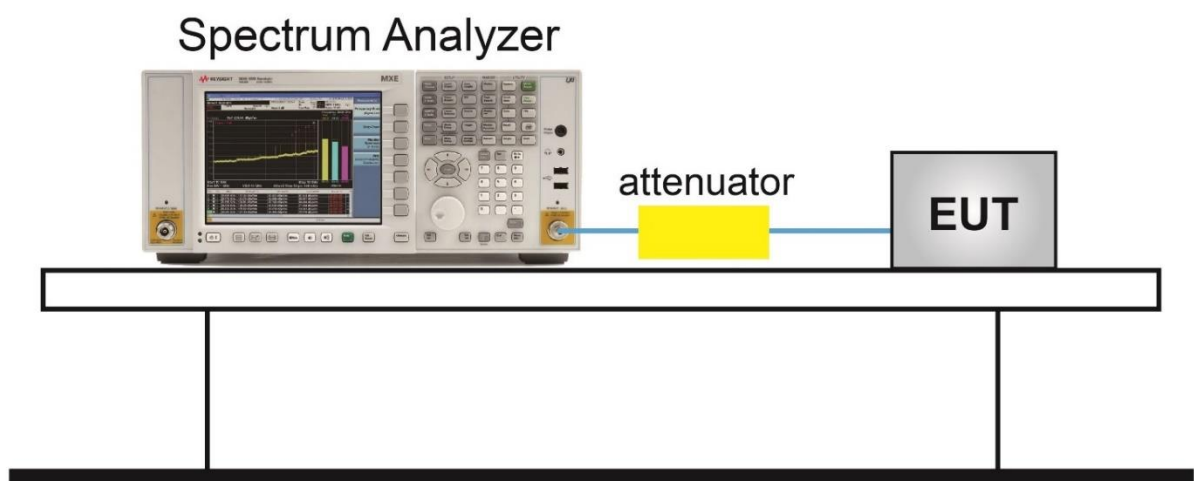
5.4.2. Test Procedure Used

ANSI C63.26-2015 - Section 5.4.4

5.4.3. 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% OBW function to record the OBW measurement result.

5.4.4. Test Setup



5.4.5. Test Result

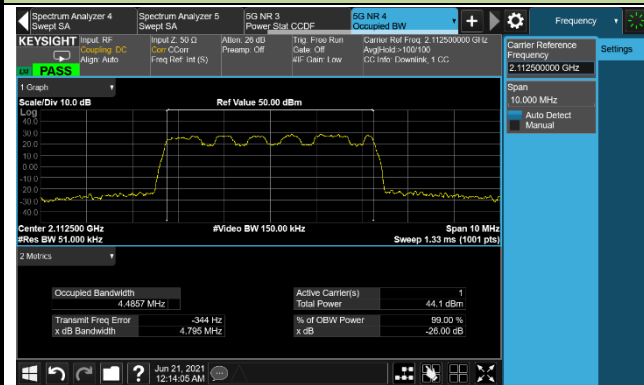
Test Engineer	Peter Xu	Test Site	SR2
Test Date	2021/06/21 ~ 2021/06/22		

Frequency (MHz)	Bandwidth (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
QPSK			
2112.5	5	4.80	4.49
2145.0	5	4.80	4.49
2177.5	5	4.79	4.49
2115.0	10	9.73	9.17
2145.0	10	9.69	9.15
2175.0	10	9.70	9.13
2117.5	15	14.72	14.14
2145.0	15	14.71	14.14
2172.5	15	14.71	14.15
16QAM			
2112.5	5	4.78	4.49
2145.0	5	4.78	4.49
2177.5	5	4.79	4.49
2115.0	10	9.71	9.23
2145.0	10	9.69	9.22
2175.0	10	9.68	9.21
2117.5	15	14.71	14.14
2145.0	15	14.71	14.14
2172.5	15	14.70	14.14

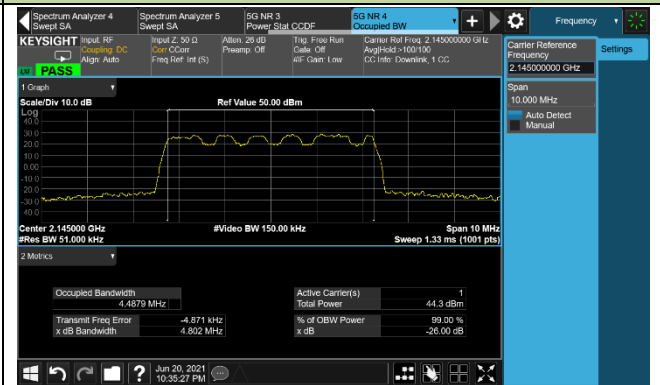
Frequency (MHz)	Bandwidth (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
64QAM			
2112.5	5	4.77	4.47
2145.0	5	4.78	4.48
2177.5	5	4.78	4.48
2115.0	10	9.72	9.28
2145.0	10	9.73	9.29
2175.0	10	9.72	9.28
2117.5	15	14.69	14.12
2145.0	15	14.72	14.12
2172.5	15	14.71	14.12
256QAM			
2112.5	5	4.77	4.46
2145.0	5	4.78	4.46
2177.5	5	4.77	4.47
2115.0	10	9.76	9.28
2145.0	10	9.75	9.27
2175.0	10	9.72	9.27
2117.5	15	14.10	14.10
2145.0	15	14.69	14.06
2172.5	15	14.71	14.10

5MHz Channel Bandwidth - QPSK

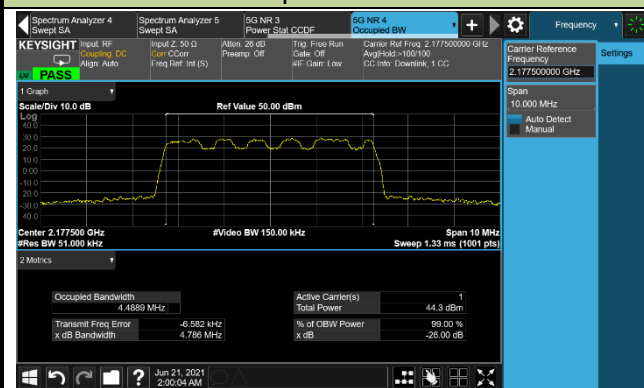
Bottom Channel



Middle Channel

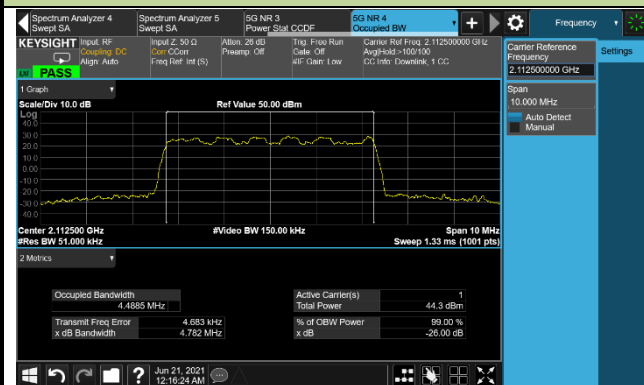


Top Channel

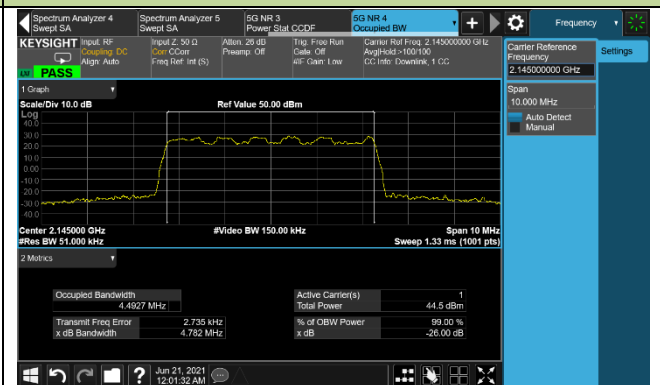


5MHz Channel Bandwidth - 16QAM

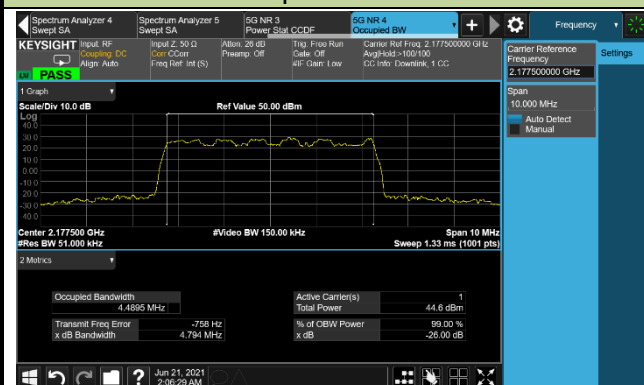
Bottom Channel



Middle Channel

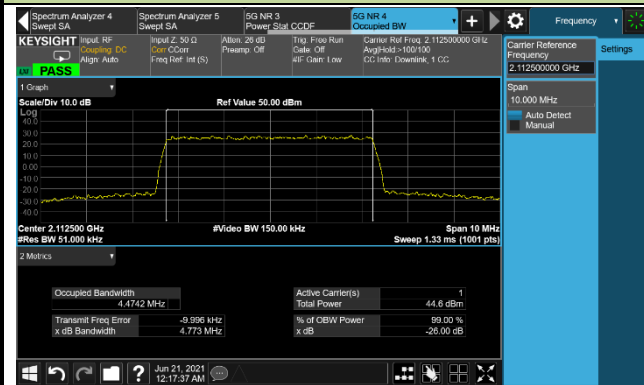


Top Channel

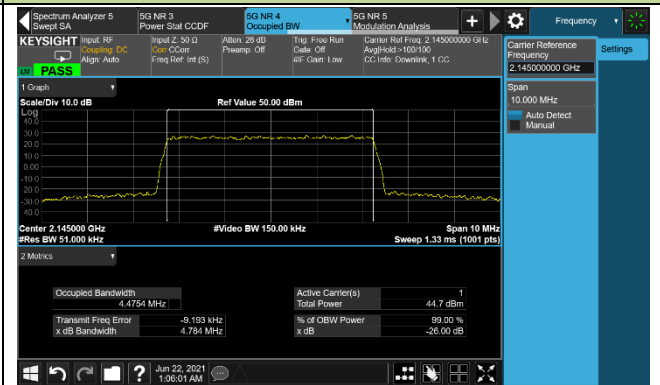


5MHz Channel Bandwidth - 64QAM

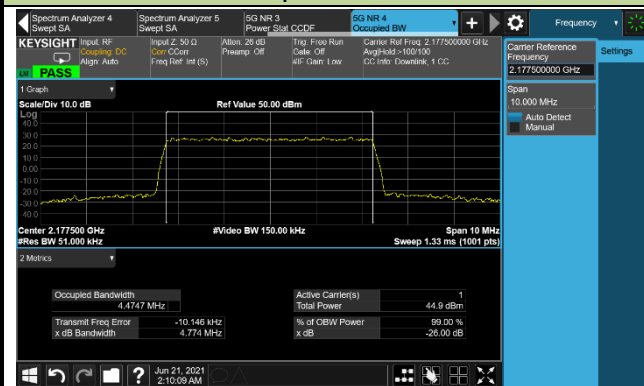
Bottom Channel



Middle Channel

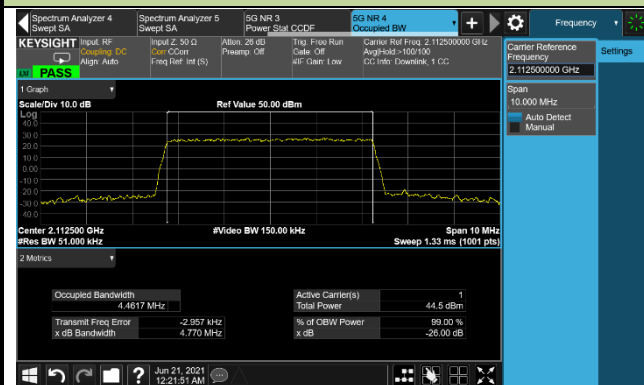


Top Channel

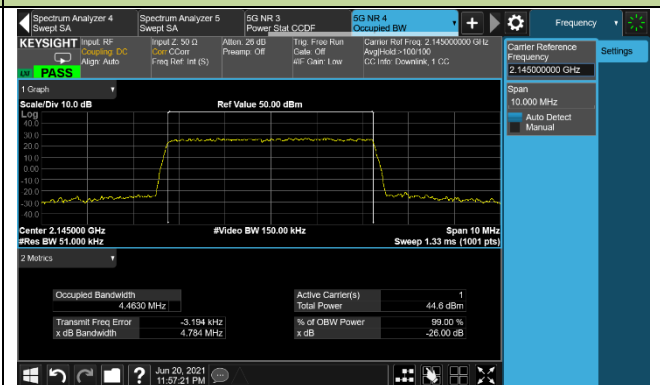


5MHz Channel Bandwidth - 256QAM

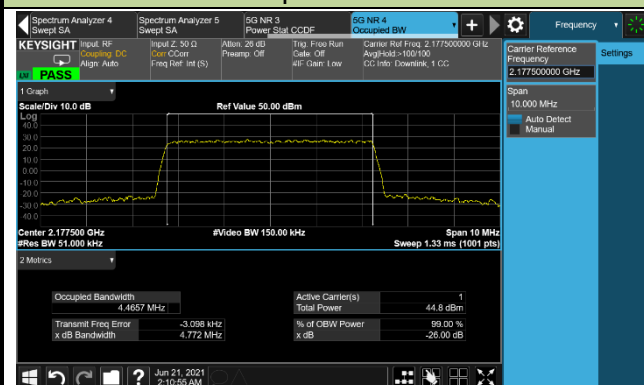
Bottom Channel



Middle Channel

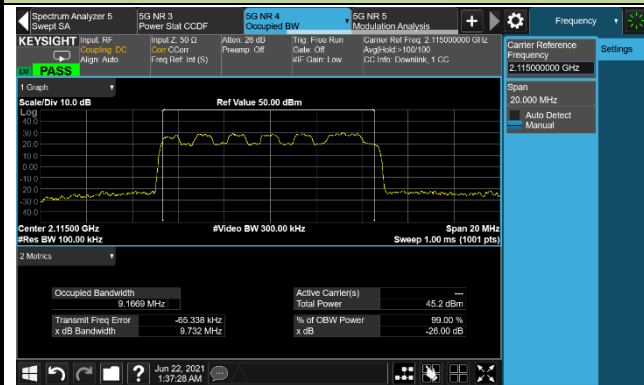


Top Channel

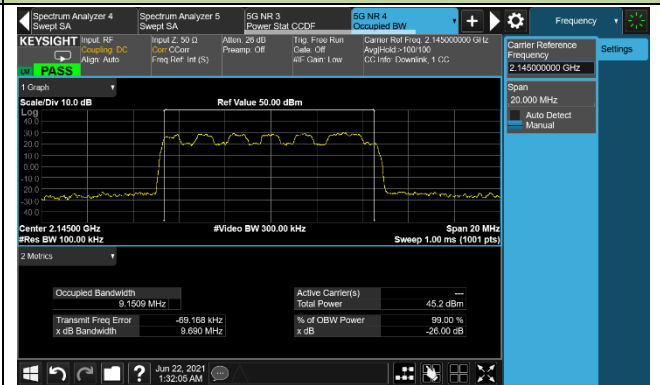


10MHz Channel Bandwidth - QPSK

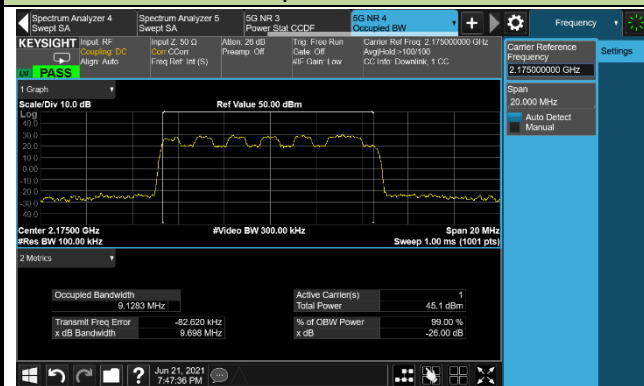
Bottom Channel



Middle Channel

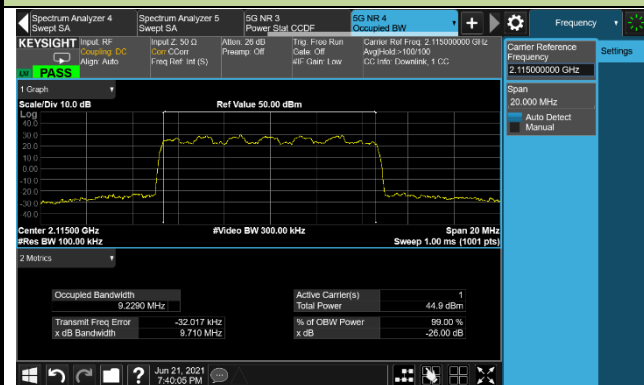


Top Channel

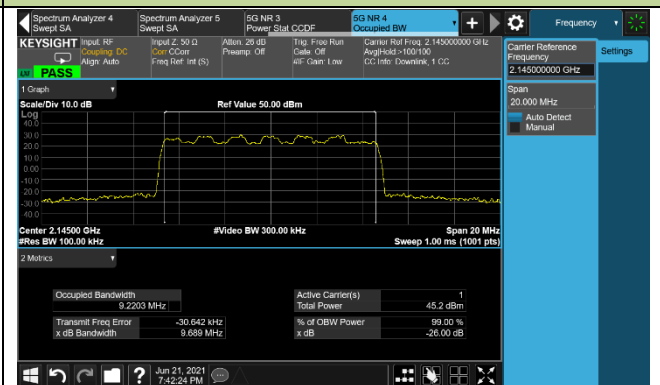


10MHz Channel Bandwidth - 16QAM

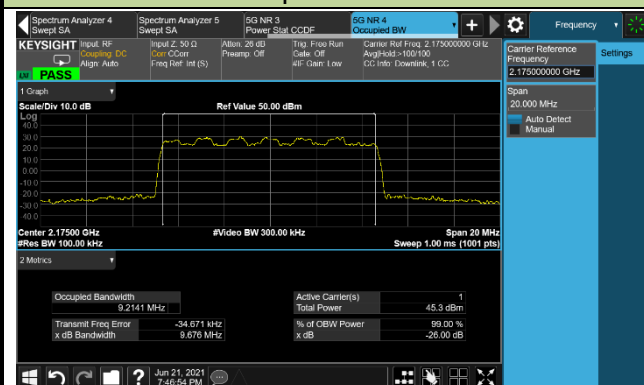
Bottom Channel



Middle Channel

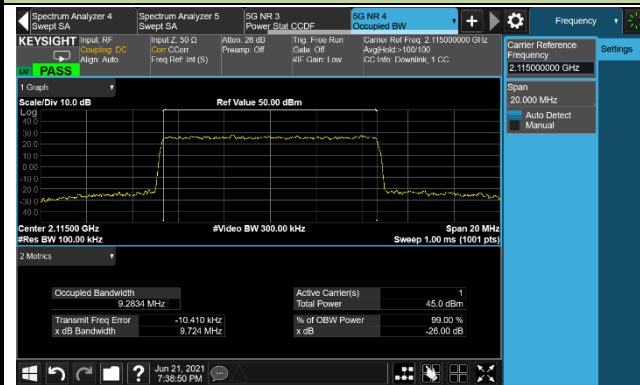


Top Channel

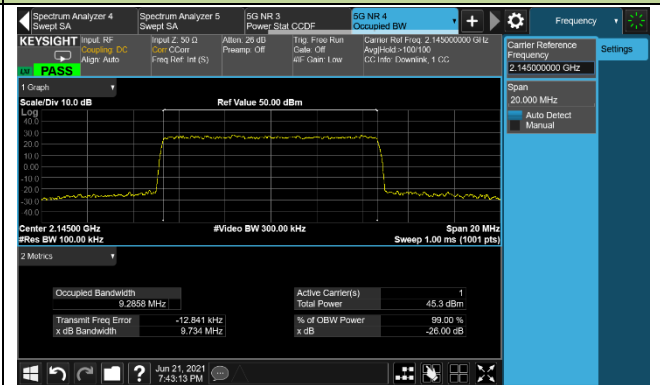


10MHz Channel Bandwidth - 64QAM

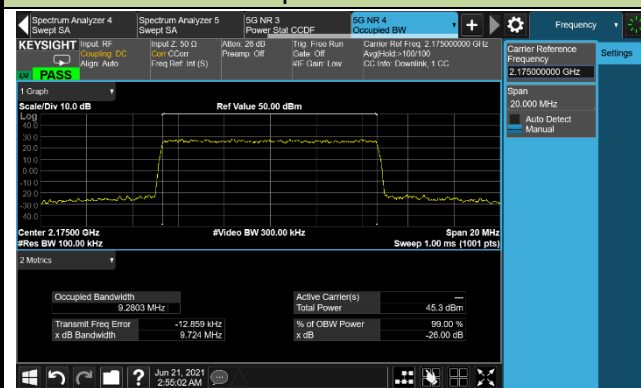
Bottom Channel



Middle Channel

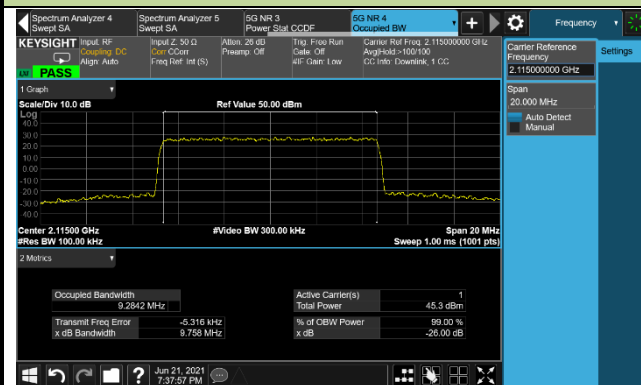


Top Channel

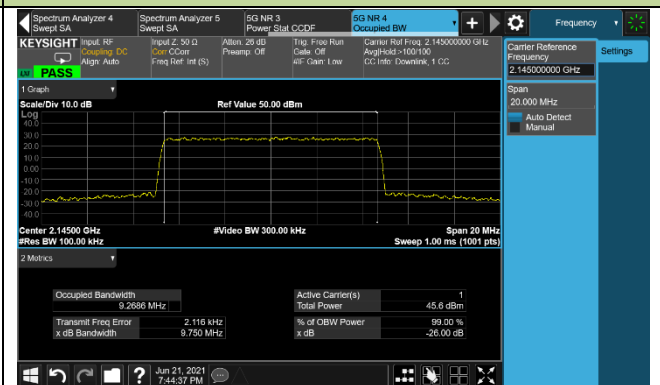


10MHz Channel Bandwidth - 256QAM

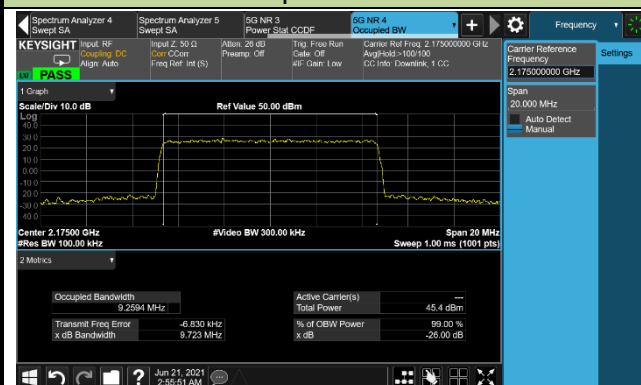
Bottom Channel



Middle Channel

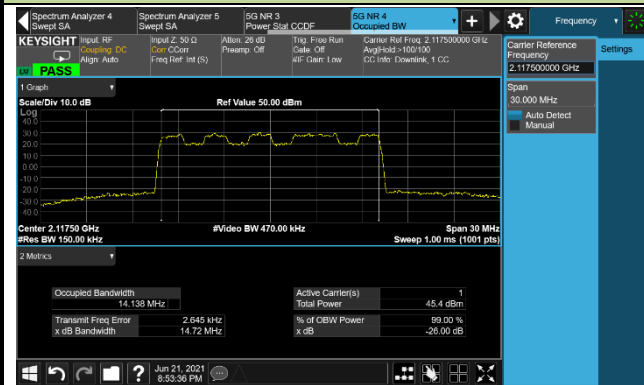


Top Channel

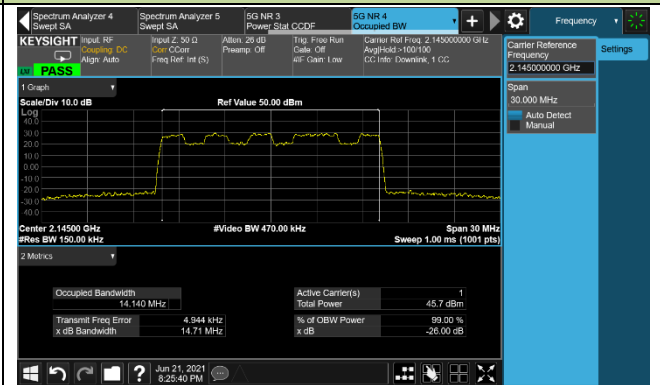


15MHz Channel Bandwidth - QPSK

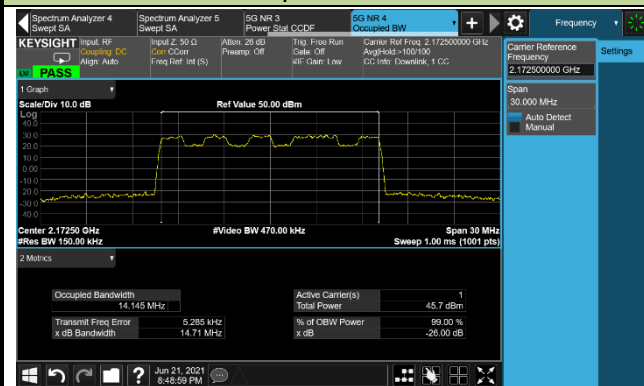
Bottom Channel



Middle Channel

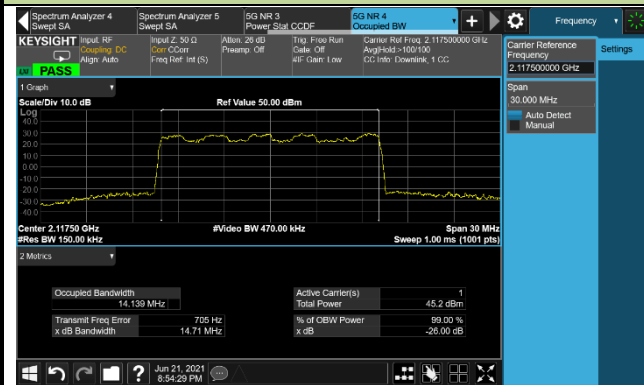


Top Channel

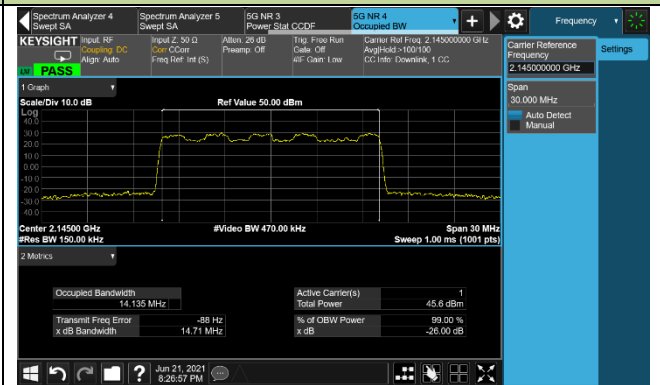


15MHz Channel Bandwidth - 16QAM

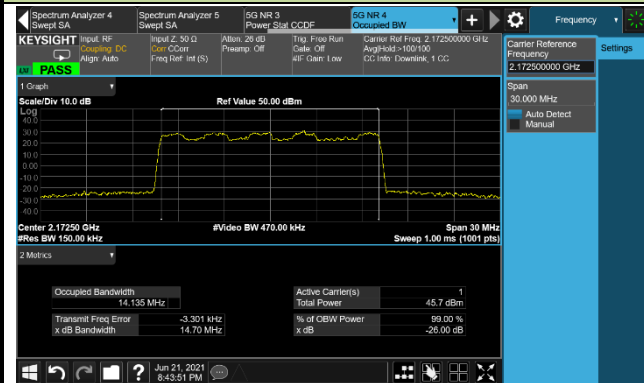
Bottom Channel



Middle Channel

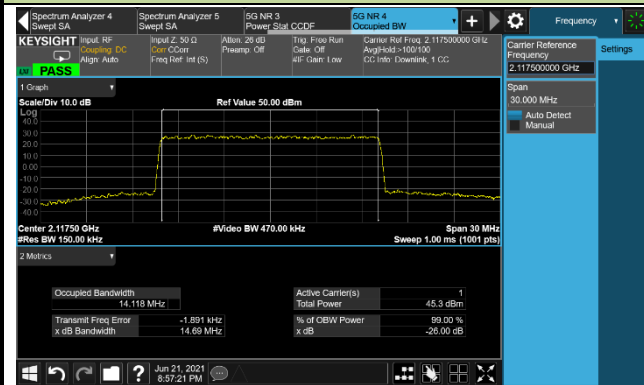


Top Channel

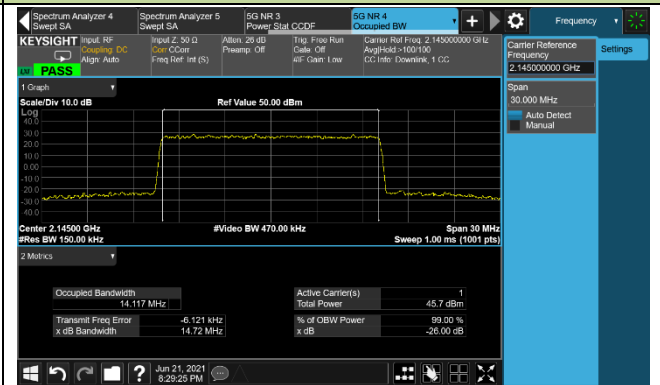


15MHz Channel Bandwidth - 64QAM

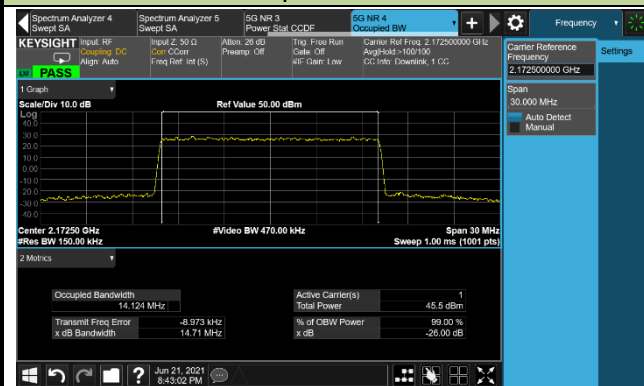
Bottom Channel



Middle Channel

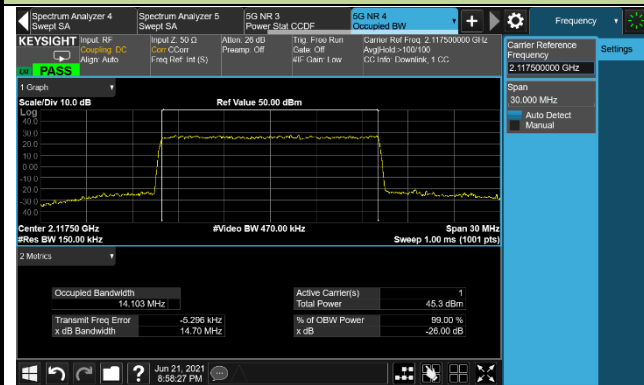


Top Channel

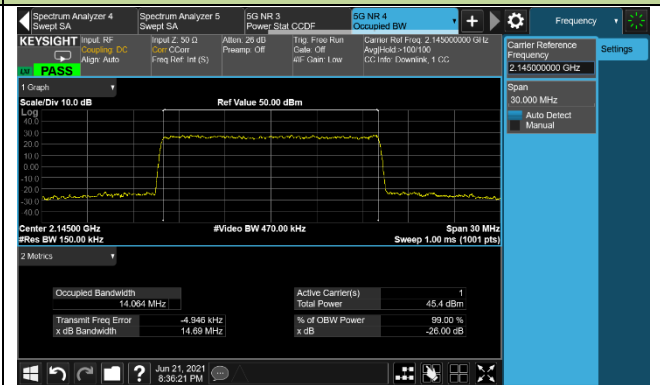


15MHz Channel Bandwidth - 256QAM

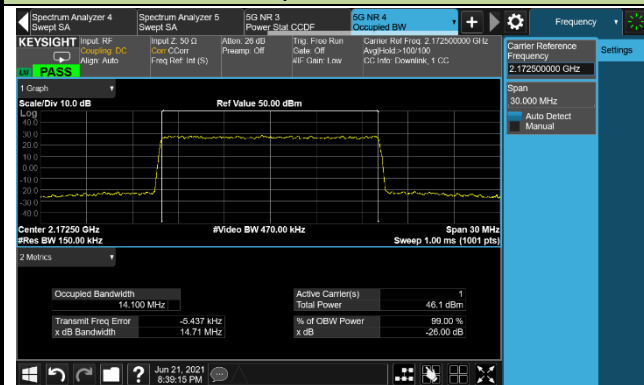
Bottom Channel



Middle Channel



Top Channel



5.5. Band Edge Measurement

5.5.1. Test Limit

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.

This device can be implement MIMO function, so the limit of spurious emissions needs to be reduced by $10 \cdot \log(\text{Numbers}_{\text{Ant}})$ 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 Used

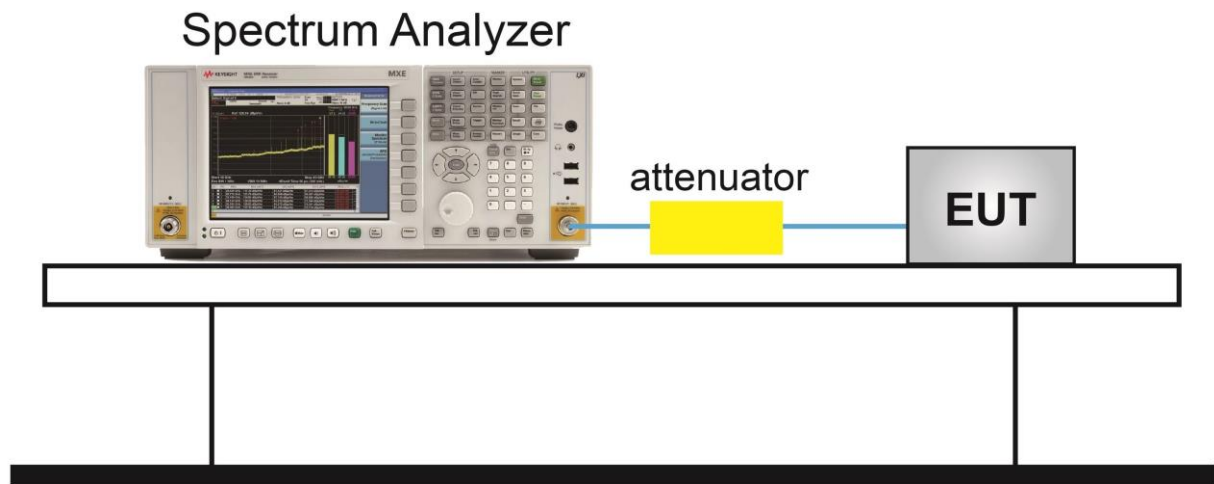
ANSI C63.26-2015 - Section 5.7.1

5.5.3. Test Setting

1. Set the analyzer frequency to Bottom or Top channel.
1. RBW = The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW
2. VBW $\geq 3 \cdot \text{RBW}$
3. Sweep time = auto
4. Detector = power averaging (rms)
5. Set sweep trigger to "free run"
6. 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



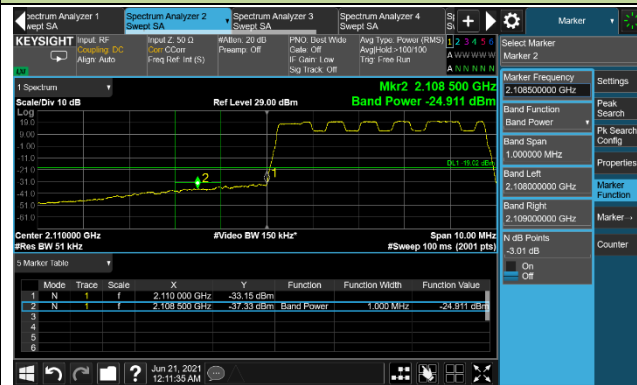
5.5.5. Test Result

Test Engineer	Peter Xu	Test Site	SR2
Test Date	2021/06/23 ~ 2021/06/24		

Frequency (MHz)	Channel BW (MHz)	Max Band Edge (dBm/MHz)				Limit (dBm/MHz)	Result
		Ant 0	Ant 1	Ant 2	Ant 3		
2112.5	5	-24.91	-24.48	-25.17	-25.29	≤ -19.02	Pass
2177.5	5	-23.95	-22.18	-24.34	-23.65	≤ -19.02	Pass
2115.0	10	-25.39	-25.22	-25.85	-25.76	≤ -19.02	Pass
2175.0	10	-24.23	-24.26	-24.08	-24.84	≤ -19.02	Pass
2117.5	15	-26.50	-26.58	-27.32	-26.81	≤ -19.02	Pass
2172.5	15	-25.04	-25.33	-25.60	-25.21	≤ -19.02	Pass

5MHz Channel Bandwidth - Ant 0

Bottom Channel

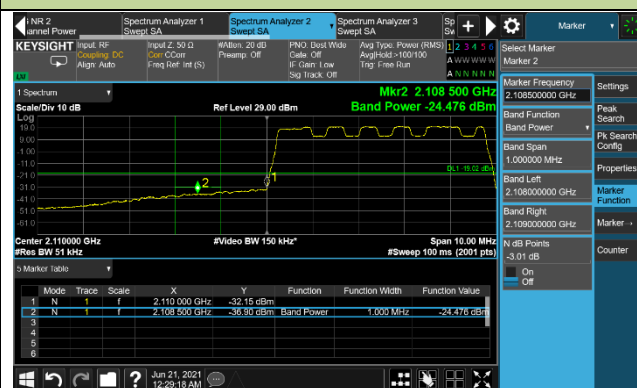


Top Channel

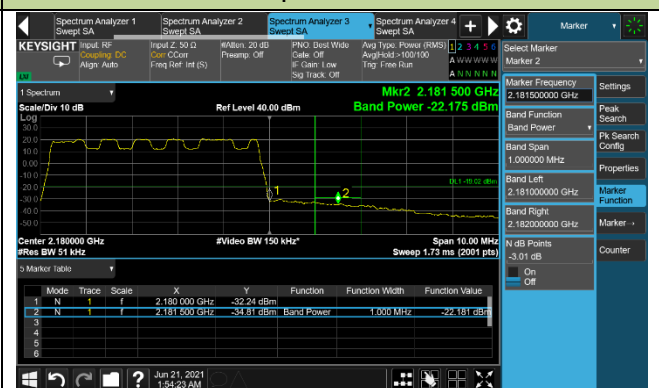


5MHz Channel Bandwidth - Ant 1

Bottom Channel

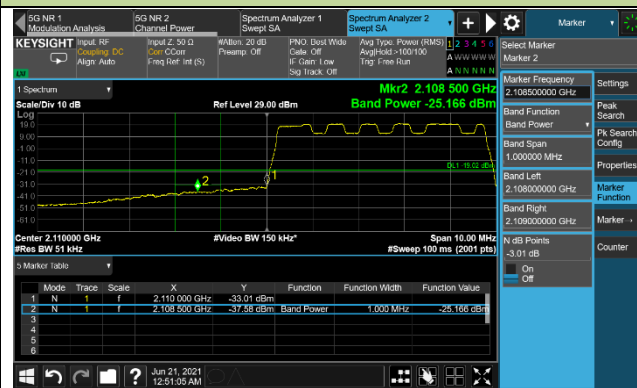


Top Channel



5MHz Channel Bandwidth - Ant 2

Bottom Channel

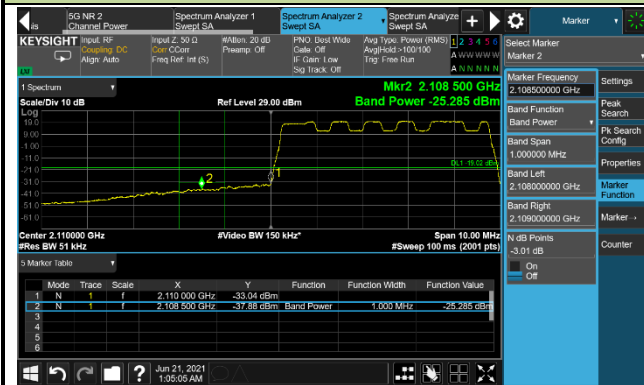


Top Channel



5MHz Channel Bandwidth - Ant 3

Bottom Channel



Top Channel

