Global Product Compliance Laboratory
600-700 Mountain Avenue
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TESTING
NVLAP LAB CODE: 100275-0

Test Report

Regulation:
FCC Part 2 and 27

Client:
Nokia Mobility

Product Evaluated:
(AAHF Full Band - 5G NR)
AirScale MAA 64T64R 128AE B41 120W AAHF Radio Unit
FCC ID: VBNAAHF-01

Report Number:
TR-2019-0046-FCC2-27

Date Issued:
March 22, 2019

Table of Contents

Revisions

Date	Revision	Section	Change
3/21/2019	0		Initial Release
3/22/2019	1		Test photos removed.

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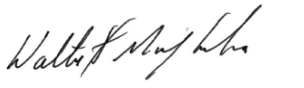
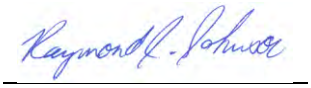
Prepared by:

Signed:  3/22/2019

Walter Steve Majkowski
Compliance Engineer

Approved by:

Signed:  3/22/2019

Technical Manager

1. System Information and Requirements

Equipment Under Test (EUT):	AAHF mMIMO - Full Band, formally identified as: **AirScale MAA 64T64R 128AE B41 120W AAHF Radio Unit**
FCC ID:	**VBNAAHF-01**
Serial Number:	(1P) – 474715A.M01 (S/N) – 6Q184012463 and 6Q183702544
Cell Name / Number	GPCL Project Number:2018-0258
Company:	Nokia Solutions and Networks US LLC 6000 Connection Drive Irving, TX, 75039
Manufacturer:	Nokia Solutions and Networks US LLC
Test Standards and Requirement(s):	• 47 CFR FCC Part 2 and Part 27 • KDB 971168 D01 Licensed DTS Guidance v03r01 April 9, 2018 • KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013
Measurement Procedure(s):	• ANSI C63.4 (2014), • ANSI C63.26 (2015) • FCC-IC-0B; Power Measurement, Occupied Bandwidth & Modulation Test Procedure (12-4-17) • FCC-IC-SE; Spurious Emissions Test Procedure (12-4-17)
Test Date(s):	February 25, 2019 – March 12, 2019
Test Performed by:	Nokia Global Product Compliance Laboratory 600-700 Mountain Ave. P.O. Box 636 Murray Hill, NJ 07974-0636
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Product Engineer(s):	Ron Remy
Lead Engineer	W. Steve Majkowski
Test Engineer (s):	Jaideep Yadav, Mike Soli
Test Results: The AAHF mMIMO - Full Band, *as tested* met the above listed requirements. Report copies and other information not contained in this report are held by either the product engineer or in an identified file at the Global Product Compliance Laboratory in New Providence, NJ.	

1.1 Introduction

This Conformity Assessment Report applies to the AAHF Full Band - 5G NR, hereinafter referred to as the Equipment Under Test (EUT).

1.2 Purpose and Scope

The purpose of this document is to provide the Class II testing data required for qualifying the EUT in compliance with FCC Parts 2 and 27, measured in accordance with the procedures set out in Section 2.1033 (c) (14) of the Rules. This Class II Change is to adds the 5G-NR Emissions Designator for 60 MHz bandwidth carriers.

1.3 EUT Description

The Nokia's AirScale AAHF mMIMO Radio Head is a 64 port radio head that transmits 1.9W per port over the Band 41 spectrum of 2496 – 2690 MHz. The product provides 28 dBm per carrier for 1 to 3 carriers for a total of 33 dBm / 1.9W per Transmit port / 120 Watts total for all 64 ports. The product initially supported 10 and 20 MHz LTE carriers utilizing QPSK, 16 QAM, 64QAM and 256QAM modulation formats. The 64 individual transmit ports are identical in design, rated power and performance. The 60 MHz bandwidth 5G-NR carriers addressed herein utilizing QPSK, 16QAM, 64QAM and 256QAM modulation formats.

Nokia's AirScale massive MIMO Adaptive Antenna deploys 64 transmit and 64 receive streams,16-layer Massive MIMO, and Carrier Aggregation with broad range of customized variants to deliver up to five times more network capacity, high peak downlink throughput, significantly improved uplink, and greater coverage.

1.3.1 EUT Test Configurations

The EUT was configured with 5G-NR digital modulation in accordance to the latest guidelines of the following standards:

3GPP TS 36.211: 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical channels and modulation (Release 15)

3GPP TS 38.141-1 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Base Station (BS) conformance testing Part 1: Conducted conformance testing (Release 15)

3GPP TS 38.104: 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Base Station (BS) radio transmission and reception (Release 15)

The following Base Station Test Models were used:

NR-FR1-TM 1.1	**QPSK**
NR-FR1-TM 1.2	**16QAM**
NR-FR1-TM 3.1	**64QAM**
NR-FR1-TM 3.1a	**256QAM**

The product was configured for both single and multiple carrier configurations for up to three carriers. Testing was performed for Contiguous and Non-Contiguous carrier configurations

1.3.2 Test Requirements

Each required measurement is listed below:

47 CFR FCC Sections	Description of Tests	Test Required
2.1046	RF Power Output	Yes
2.1047	Modulation Characteristics	Yes
2.1049	(a) Occupied Bandwidth (b) Out-of-Band Emissions	Yes
2.1051	Spurious Emissions at Antenna Terminals	Yes
2.1053	Field Strength of Spurious Radiation	Yes
2.1055	Measurement of Frequency Stability	Yes

1.4 Reference Documents, Test Specifications & Procedures

A list of the applicable documents is provided herein.

1.4.1 Test Specifications

- Title 47 Code of Federal Regulations, Federal Communications Commission Part 2.
- Title 47 Code of Federal Regulations 47, Federal Communications Commission Part 27.

1.4.2 Procedures

1. FCC-IC-0B and FCC-IC-SE

2. ANSI C63.4 (2014) entitled: "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz", American National Standards Institute, Institute of Electrical and Electronic Engineers, Inc., New York, NY 10017-2394, USA.

3. ANSI C63.26 (2015) entitled: "American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services", American National Standards Institute, Institute of Electrical and Electronic Engineers, Inc., New York, NY 10017-2394, USA.

4. FCC KDB 971168 D01 v03r01 Measurement Guidance for Certification of Licensed Digital Transmitters

1.4.3 MEASUREMENT UNCERTAINTY

The results of the calculations to estimate uncertainties for the several test methods and standards are shown in the Table below. These are the worst-case values.

Worst-Case Estimated Measurement Uncertainties

Standard, Method or Procedure	Condition	Frequency MHz	Expanded Uncertainty (k=2)
a. Classical Emissions, (*e.g.*, ANSI C63.4, CISPR 11, 14, 22, *etc.*, using ESHS 30,	Conducted Emissions	0.009 - 30	±3.5 dB
	Radiated Emissions (AR-6 Semi-Anechoic Chamber)	30 MHz – 200MHz H 30 MHz – 200 MHz V 200 MHz – 1000 MHz H 200 MHz – 1000 MHz V 1 GHz - 18 GHz	±5.1 dB ±5.1 dB ±4.7 dB ±4.7 dB ±3.3 dB

Antenna Port Test	Signal Bandwidth	Frequency Range	Expanded Uncertainty (k=2), Amplitude
Occupied Bandwidth, Edge of Band, Conducted Spurious Emissions	10 Hz 100 Hz 10 kHz to 1 MHz 1MHz	9 kHz to 20 MHz 20 MHz to 1 GHz 1 GHz to 10 GHz 10 GHz to 40 GHz:	1.78 dB
RF Power	10 Hz to 20 MHz	50 MHz to 18 GHz	0.5 dB

1.5 Executive Summary

Requirement	Description	Result
47 CFR FCC Parts 2 and 27		
2.1046	RF Power Output Peak to Average Power Ratio	COMPLIES
2.1047	Modulation Characteristics	COMPLIES
2.1049	Occupied Bandwidth (a) Emissions Signal Bandwidth (b) Occupied Bandwidth/ Edge of Band Emissions	COMPLIES
2.1051	Spurious Emissions at Antenna Terminals	COMPLIES
2.1053	Field Strength of Spurious Radiation	COMPLIES
2.1055	Measurement of Frequency Stability	COMPLIES

1. **COMPLIES -** Passed all applicable tests.
2. **N/A –** Not Applicable.
3. **NT –** Not Tested.

2. FCC Section 2.1046 - RF Power Output

2.1 RF Power Output

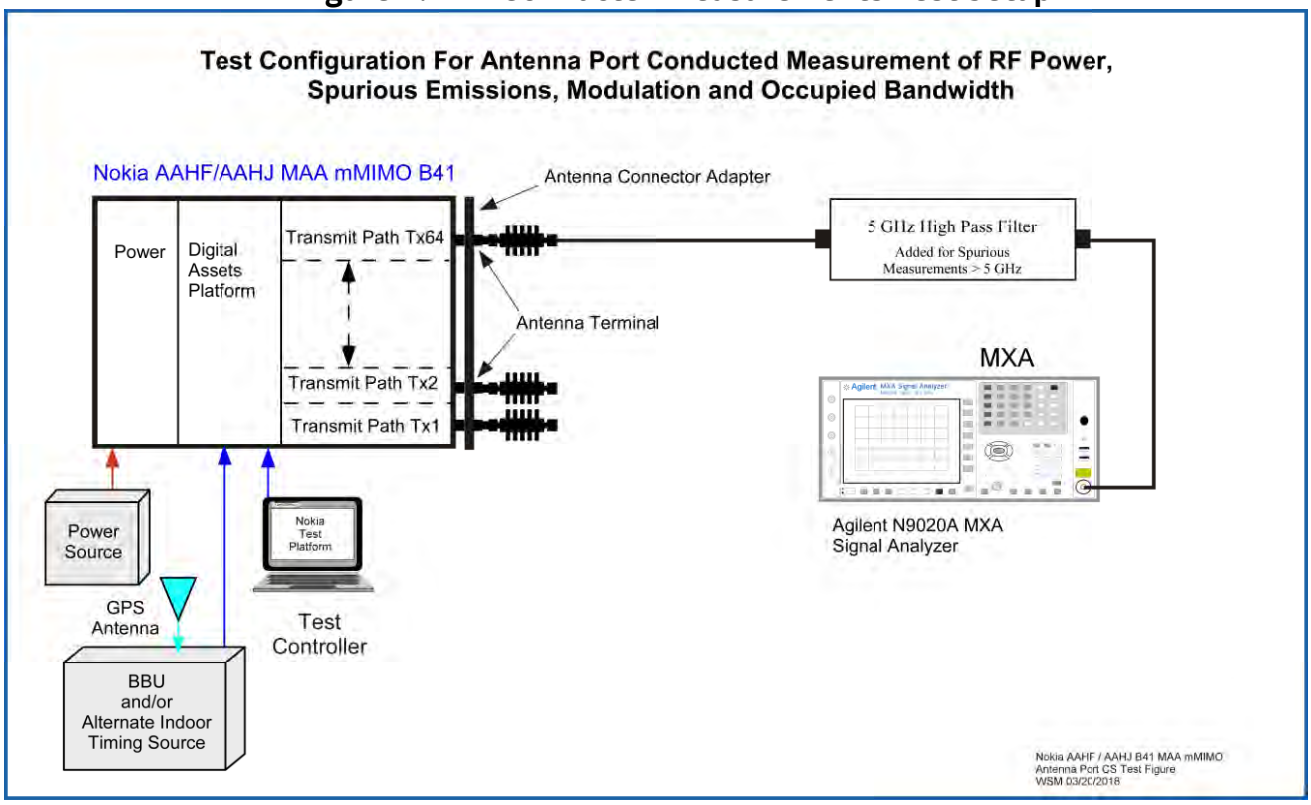
This test is a measurement of the total RF power level transmitted at the antenna-transmitting terminal (J4), as shown in the accompanying test set-up diagram.
Power measurements were made using the MXA Channel Power Functionality. The transmit port was connected to the MXA with calibrated attenuators and cable whose path loss was verified before test. The Base Station was given a sufficient "warm-up" period prior to testing as required by ANSI C63.26-2015.

NOTE: Only a sample of all the data taken has been used in this report. The full suite of raw data resides at the MH, New Jersey location.

2.2 RF Conducted Measurements Test Setup.

The Test configuration in Figure 2.2 was used for antenna port measurement of RF Power, Modulation, Occupied Bandwidth, Out of Band Emissions and Conducted Spurious Emissions.

Figure 2.2 RF Conducted Measurements Test Setup



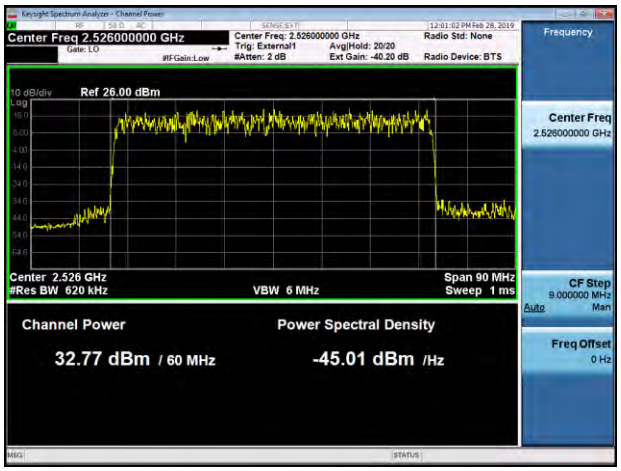
2.3 RF Power Output Results

The data below documents that the total sum power that the products 64 ports can provide is 120 Watts. That power is up to 1.88 Watts/port for a Total Rated power of 120W/ 60MHz carrier.

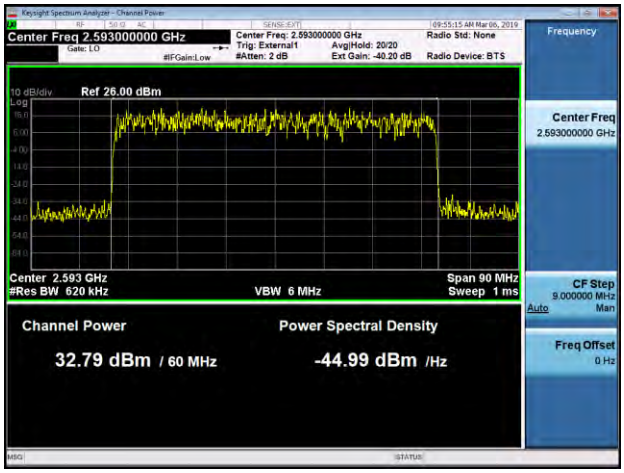
2.4 Sample Data Single Carrier (1C)

2.4.1 Channel Power Data - QPSK Single Carrier 60 MHz

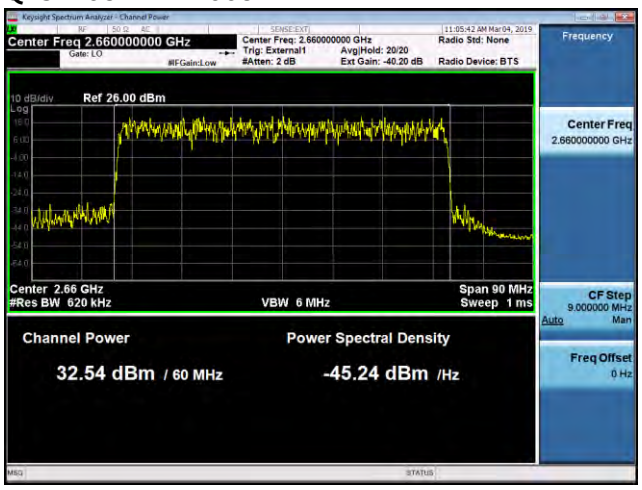
QPSK 60MBW 2526



QPSK 60MBW 2593



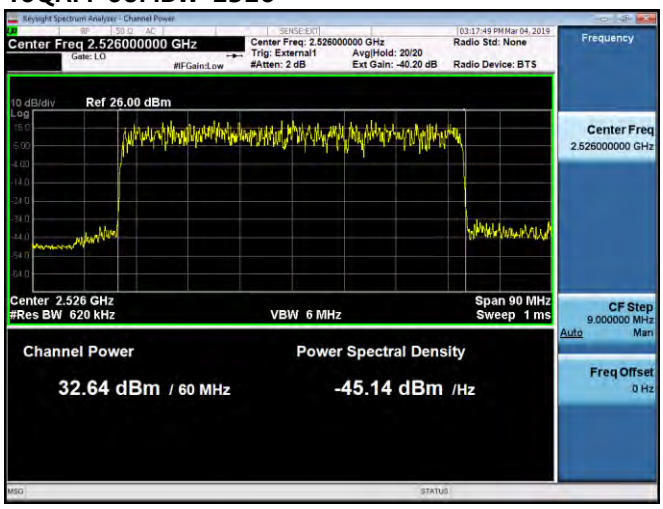
QPSK 60MBW 2660



Frequency	Modulation	Power	Power
MHz	Type	dBm	Watts
2526	QPSK	32.77	1.89
2593	QPSK	32.79	1.90
2660	QPSK	32.54	1.79

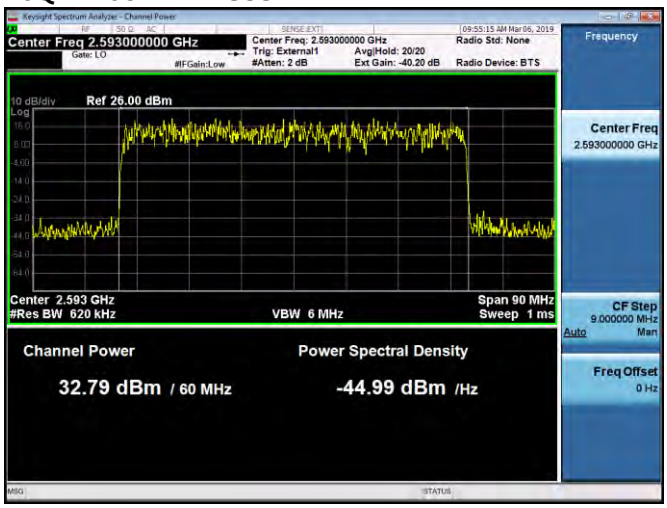
2.4.2 Channel Power Data - 16QAM Single Carrier 60 MHz

16QAM 60MBW 2526

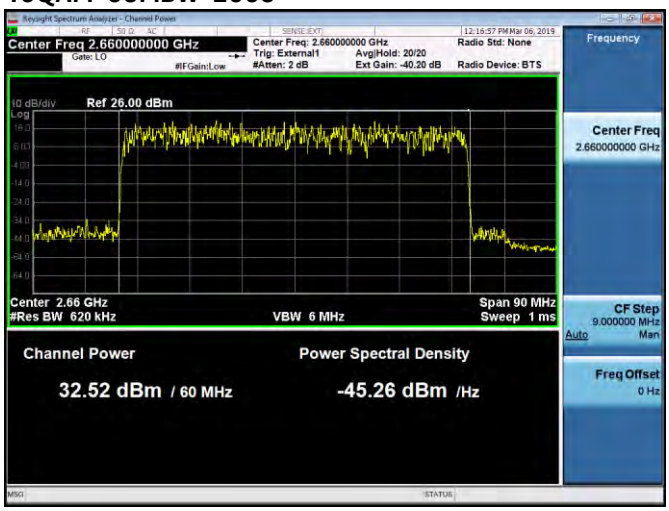


Frequency	Modulation	Port Power	Port Power
MHz	Type	dBm	Watts
2526	16QAM	32.64	1.84
2593	16QAM	32.79	1.90
2660	16QAM	32.52	1.79

16QAM 60MBW 2593

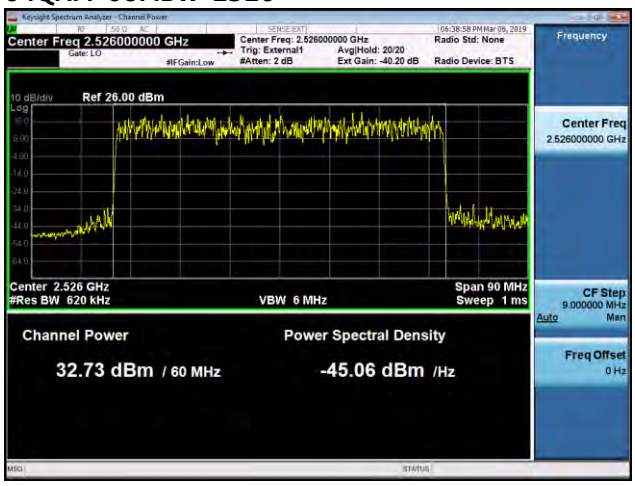


16QAM 60MBW 2660



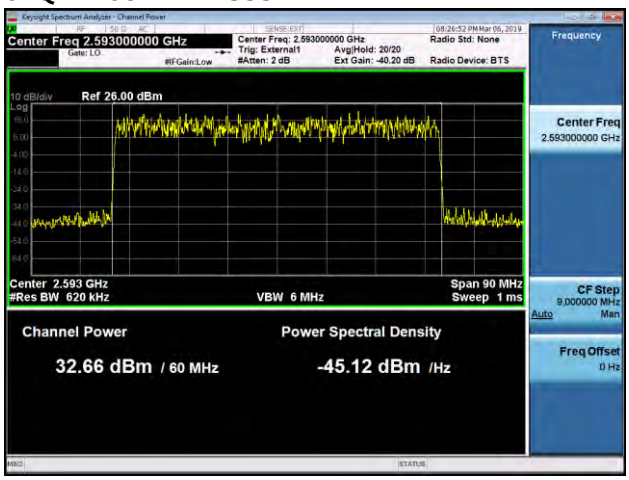
2.4.3 Channel Power Data - 64QAM Single Carrier 60 MHz

64QAM 60MBW 2526

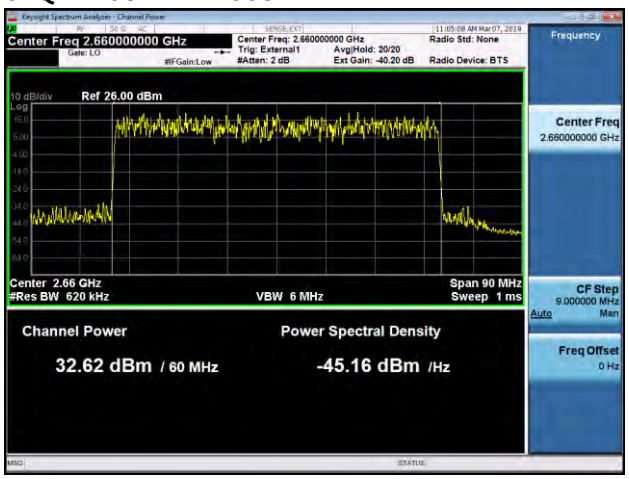


Frequency	Modulation	Port Power	Port Power
MHz	Type	dBm	Watts
2526	64QAM	32.73	1.87
2593	64QAM	32.66	1.85
2660	64QAM	32.62	1.83

64QAM 60MBW 2593

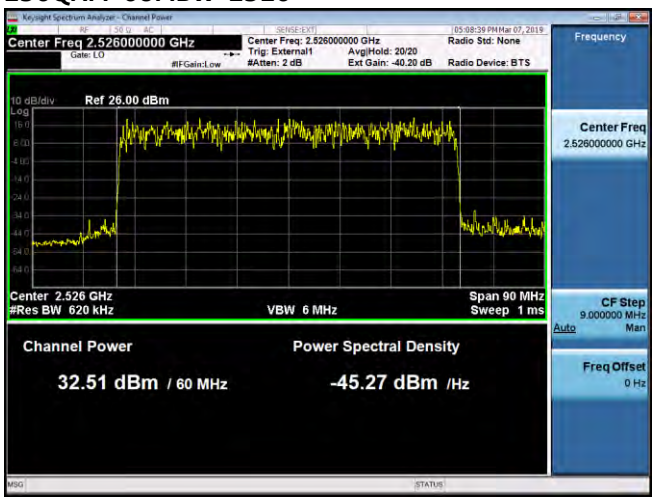


64QAM 60MBW 2660



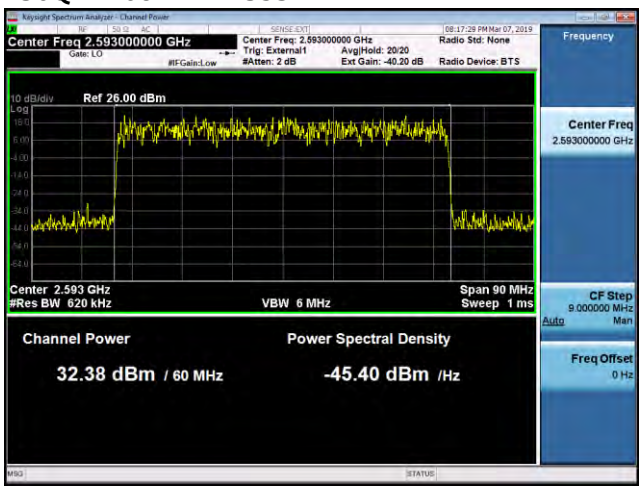
2.4.4 Channel Power Data - 256QAM Single Carrier 60 MHz

256QAM 60MBW 2526

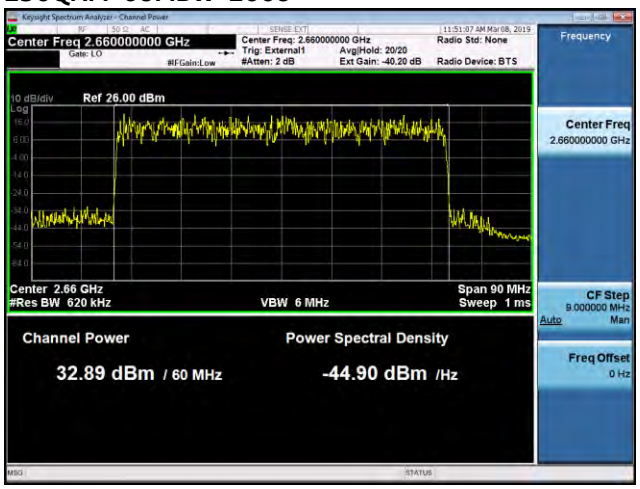


Frequency	Modulation	Port Power	Port Power
MHz	Type	dBm	Watts
2526	256QAM	32.51	1.78
2593	256QAM	32.38	1.73
2660	256QAM	32.89	1.95

256QAM 60MBW 2593



256QAM 60MBW 2660



2.5 Peak-to-Average Power Ratio (PAPR) 47CFR 27.50

The measurement of the Peak-to-Average Power Ratio (PAPR) was performed using the Complementary Cumulative Distribution Function (CCDF) feature of a Keysight MXA Signal Analyzer and the test setup of Figure 2.2.

NOTE: Only a sample of all the data taken has been used in this report. The full suite of raw data resides at the MH, New Jersey location.

2.5.1 Results Peak to Average Ratio - 60 MHz Carrier

. All the measured values were below the required 13dB limit at the required 0.1 percent of the time.

Frequency	Modulation	PAR
MHz	Type	dB
2526	QPSK	11
2593	QPSK	10.5
2660	QPSK	11
2526	16QAM	11.9
2593	16QAM	11.8
2660	16QAM	11
2526	64QAM	11
2593	64QAM	11.8
2660	64QAM	12
2526	256QAM	11.5
2593	256QAM	12
2660	256QAM	12

3. FCC Section 2.1047 - Modulation Characteristics

3.1 Modulation Characteristics

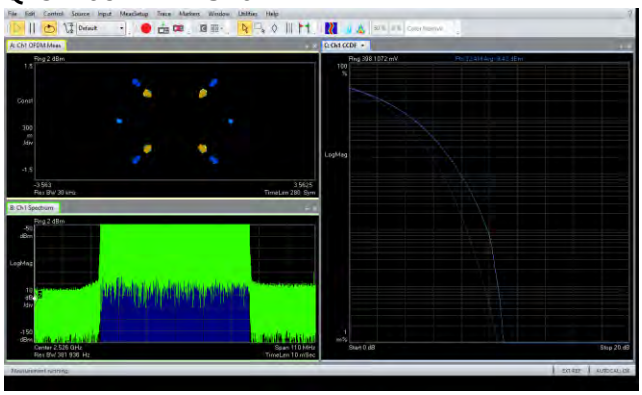
The RF signal at the antenna port was evaluated with a Keysight MXA Signal Analyzer and the test setup of Figure 2.2. The Modulation was verified for correctness of the modulation signal used before each test was performed. For these products the operation of the 60 MHz 5G-NR carrier was verified as QPSK, 16QAM, 64QAM or 256QAM modulation. Samples of the Modulation configurations are shown below.

NOTE: Only a sample of all the data taken has been used in this report. The full suite of raw data resides at the MH, New Jersey location.

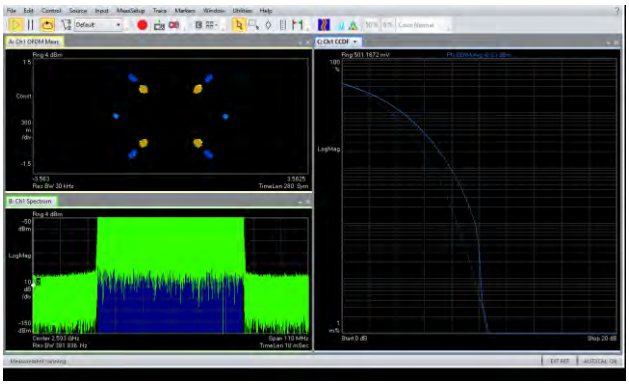
3.2 Sample Modulation 5G-NR 60 MHz Bandwidth Carrier

3.2.1 QPSK Modulation 5G-NR 60 MHz Bandwidth Carrier

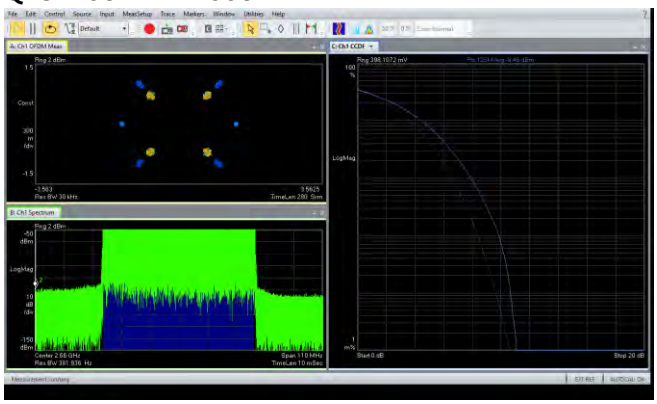
QPSK 60MBW 2526



QPSK 60MBW 2593

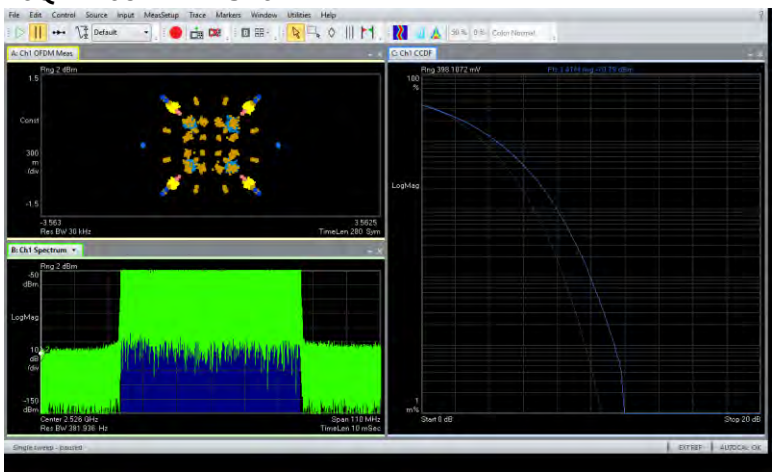


QPSK 60MBW 2660

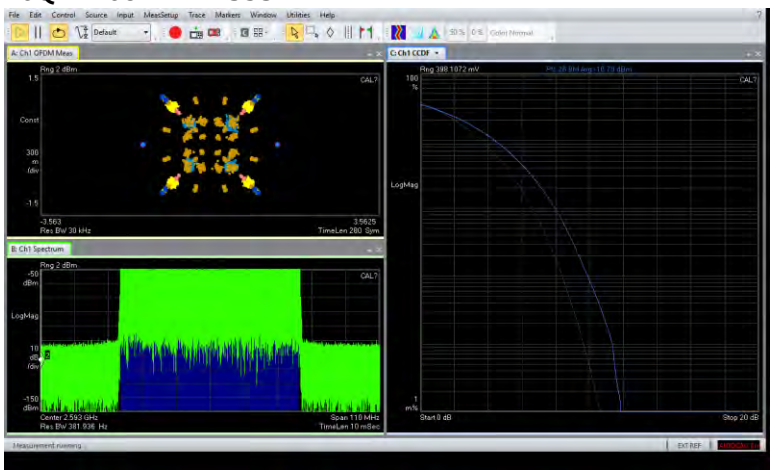


3.2.2 16QAM Modulation 5G-NR 60 MHz Bandwidth Carrier

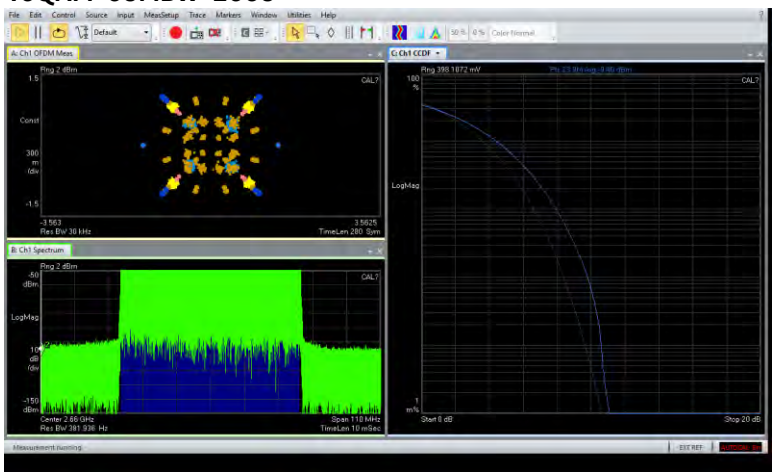
16QAM 60MBW 2526



16QAM 60MBW 2593

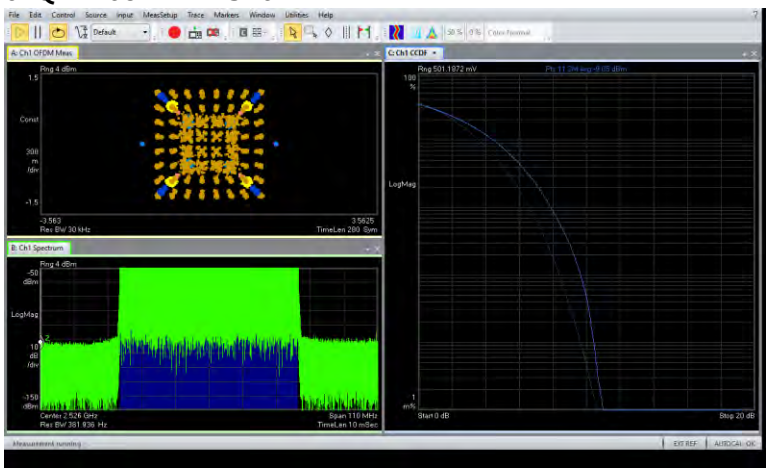


16QAM 60MBW 2660

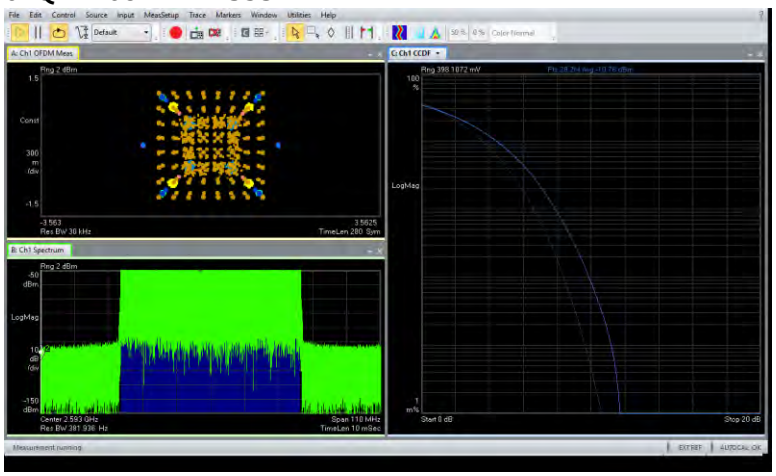


3.2.3 64QAM Modulation 5G-NR 60 MHz Bandwidth Carrier

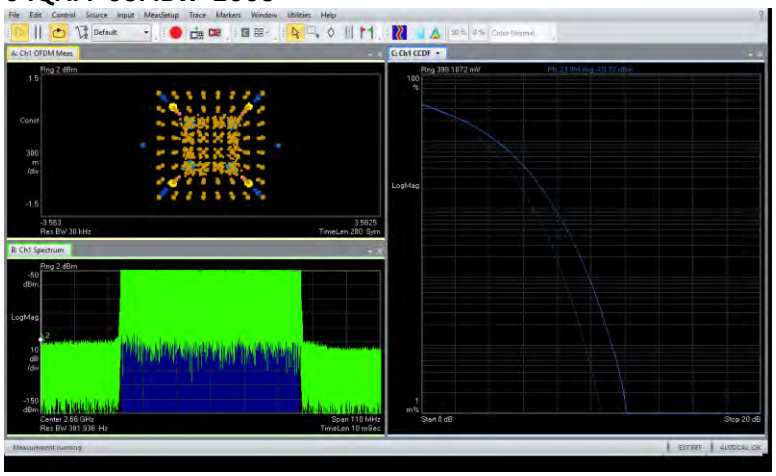
64QAM 60MBW 2526



64QAM 60MBW 2593

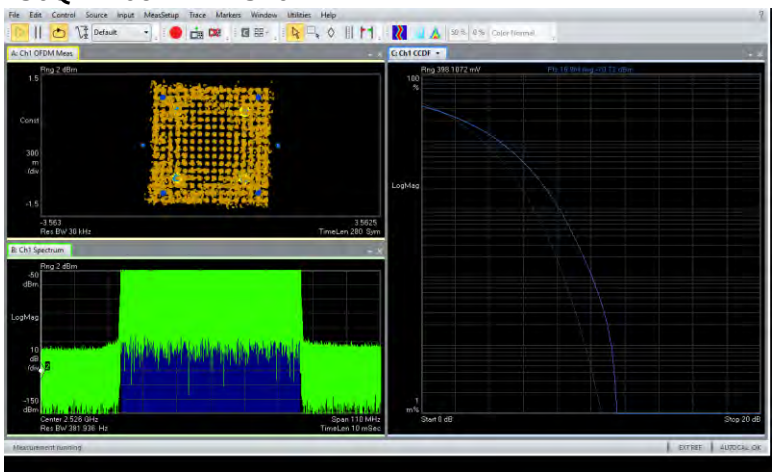


64QAM 60MBW 2660

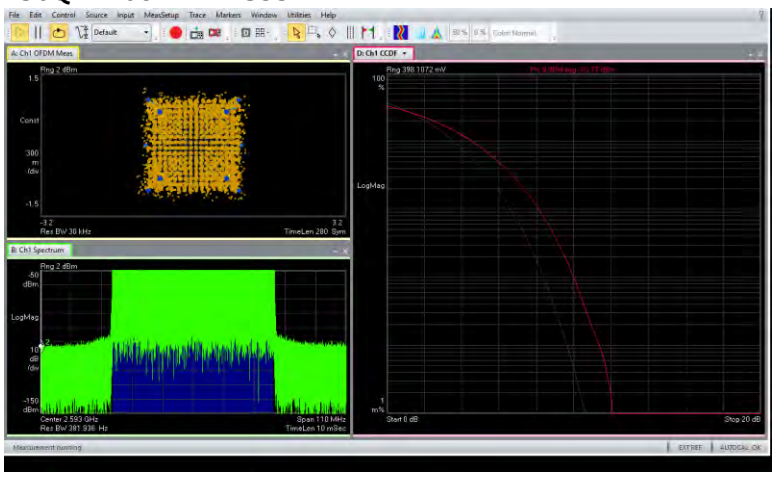


3.2.4 256QAM Modulation 5G-NR 60 MHz Bandwidth Carrier

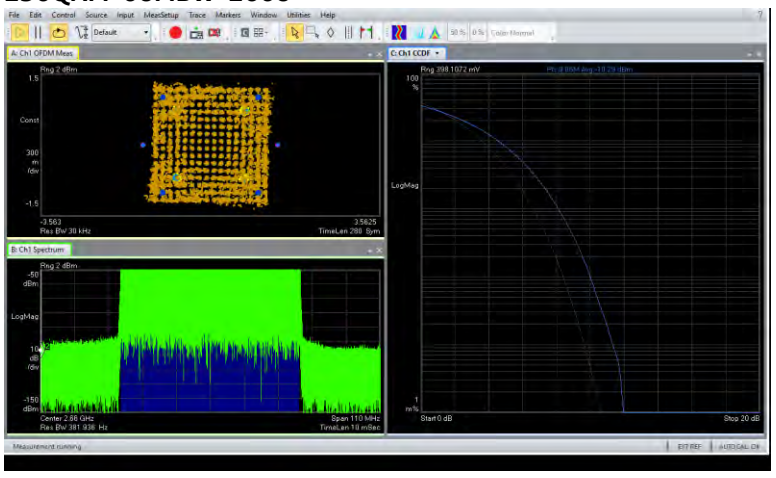
256QAM 60MBW 2526



256QAM 60MBW 2593



256QAM 60MBW 2660



4. FCC Section 2.1049 – Occupied Bandwidth

4.1 Occupied Bandwidth (Signal Bandwidth)

In 47CFR 2.1049 the FCC requires:

> "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 under the following conditions as applicable."
>
> Per C63.26 section 5.4.3 b) The measurement shall be made with the resolution bandwidth set between 1% and 5 % of the expected bandwidth. For a 60 MHz nominal bandwidth a 3MHz RBW is the 5% setpoint.

This required measurement is the 99% Occupied Bandwidth, also called the designated signal bandwidth and needs to be within the parameters of the products specified emissions designator. The -26 dB bandwidth values were also recorded.

4.2 Occupied Bandwidth (Signal Bandwidth) Results

The transmitted signal occupied bandwidth was measured using a Keysight MXA Signal Analyzer and the test setup of Figure 2.2.

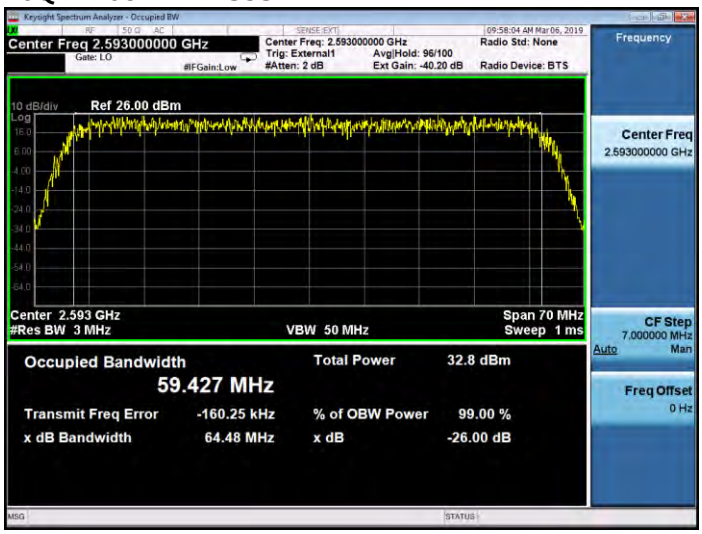
The measured Signal Bandwidth was within 0.85% (522 kHz) of the nominal 60 MHz bandwidth.
NOTE: Only a sample of all the data taken has been used in this report. The full suite of raw data resides at the MH, New Jersey location.

4.2.1 60 MHz Signal Bandwidth Measured at 3 MHz RBW

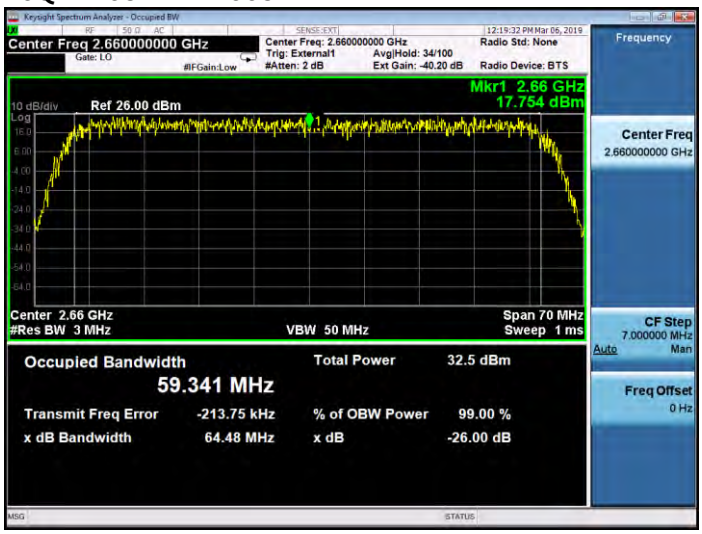
The single carrier bandwidth measurements are presented below for left center and right side of band. They represent various 5G-NR modulation types.

QPSK 60MBW 2593

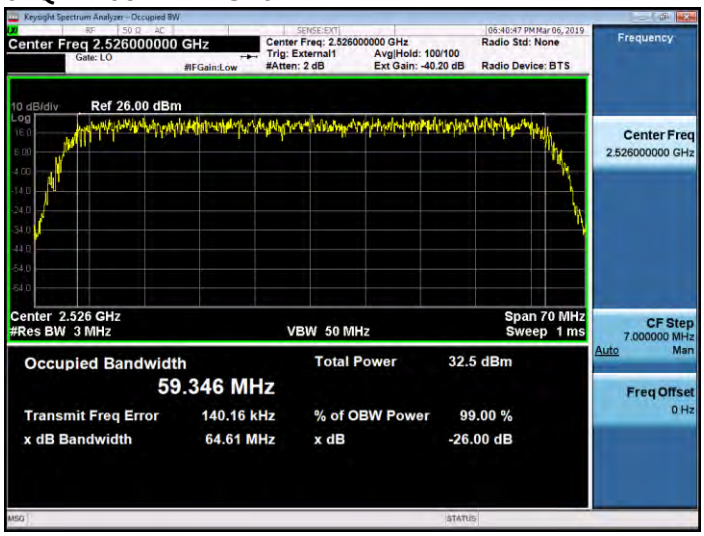
16QAM 60MBW 2593



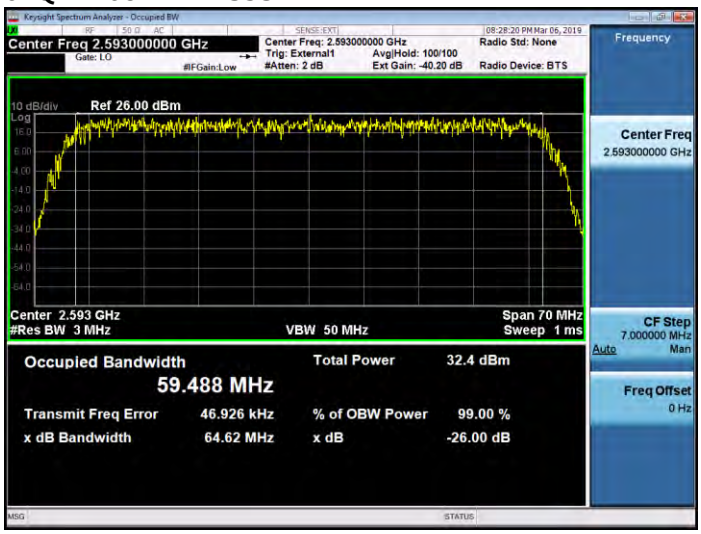
16QAM 60MBW 2660



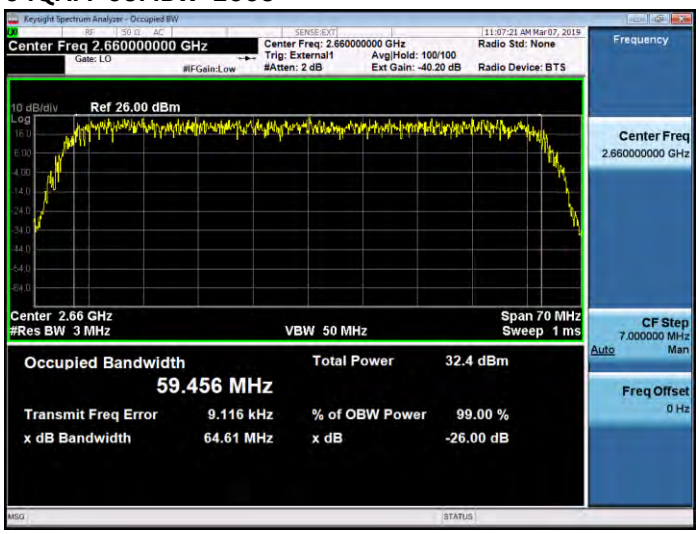
64QAM 60MBW 2526



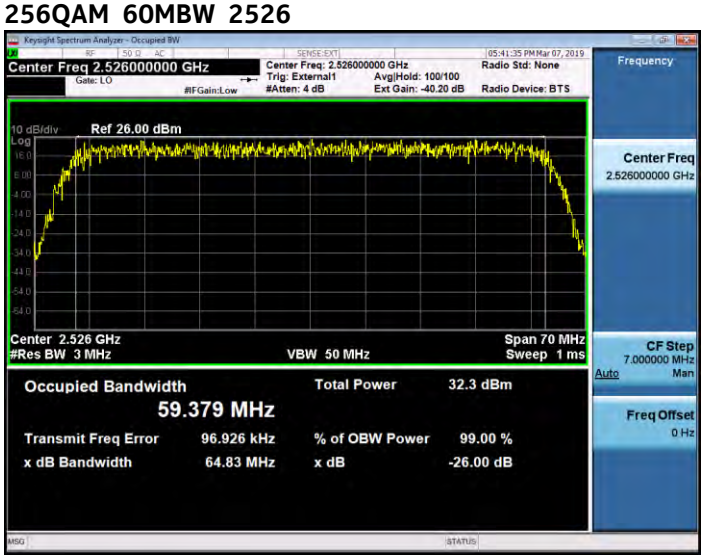
64QAM 60MBW 2593



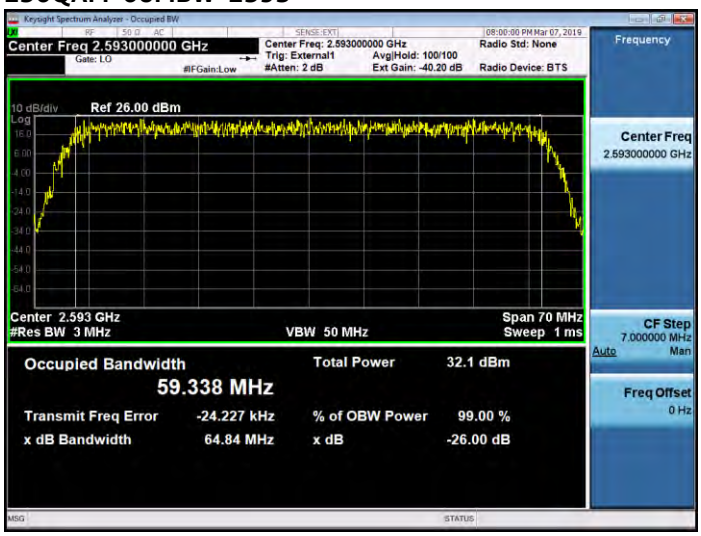
64QAM 60MBW 2660



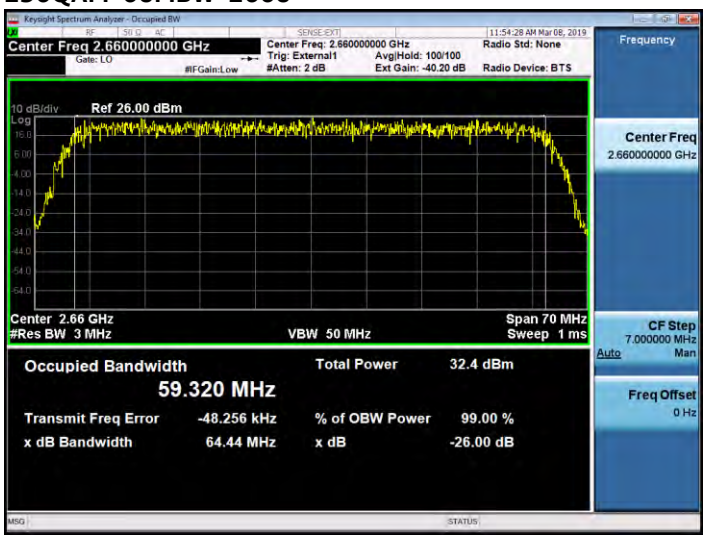
256QAM 60MBW 2526



256QAM 60MBW 2593



256QAM 60MBW 2660



4.3 Occupied Bandwidth/ Out Of Band Emissions (OOBE)

The Occupied Bandwidth / Out Of Band Emissions (OOBE) of the EUT at the external antenna connector (EAC) were measured using a Keysight MXA Signal Analyzer and the test setup of Figure 2.2.

The RF power level and modulation was verified before measurement. The RF output from the EAC port to spectrum analyzer was reduced (to an amplitude usable by the spectrum analyzer) by using a calibrated attenuator and test cable. The maximum path attenuation was offset on the display and the signal was set to the maximum RF power level. The resolution bandwidth was set to 1% of the nominal bandwidth of the transmit signal (620 kHz) for the 1st MHz outside the band. Beyond the 1st MHz outside the transmit band the resolution bandwidth was set to 1 MHz. All mask values were adjusted based upon the designated signal bandwidth and measurement bandwidths as listed in Table 4.2 below.

The Block edge requirements as specified in 47CFR 27.53 were followed. The mask for emissions outside the band were set to be:

$$-43 + 10LOG_{10}(P) = -13 \text{ dBm}$$

The resolution bandwidth of 1% of the signal bandwidth was used for the 1st MHz outside the band.

The resolution bandwidth for greater than 1MHz outside the band was 1 MHz.

The procedural direction of KDB 662911 D01 were followed and the mask limits were adjusted for a MIMO value corresponding to $10LOG_{10}(N)$ where N=64

For this product The MIMO adjustment is equal to:

$$10LOG(N) = 10(LOG_{10}(64) = 18.06 \text{ dB}$$

The mask values are as listed in the table below:

Table 4.2 - Mask values for OBW and Conducted Spurious measurements at various bandwidths

Carrier Power		Signal Bandwidth	Measurement RBW	Signal Offset Reference level		"n" x MIMO	MIMO Factor	1st MHz limit		Beyond the 1st MHz Limit	
W	dBm	MHz	MHz	dBc	dBm	integer	dB	dBm	dBc	dBm	dBc
1.88	32.74	60	0.620	-19.86	12.88	64	18.06	-30.92	-63.66	-33.14	-65.88
1.88	32.74	60	1	-17.78	14.96	64	18.06	-28.84	-61.58	-31.06	-63.80
120	50.79	60	0.620	-19.86	30.93	64	18.06	-30.92	-81.71	-33.14	-83.93
120	50.79	60	1	-17.78	33.01	64	18.06	-28.84	-79.64	-31.06	-81.85

NOTE: Only a sample of all the data taken has been used in this report. The full suite of raw data resides at the GPCL MH, New Jersey location.

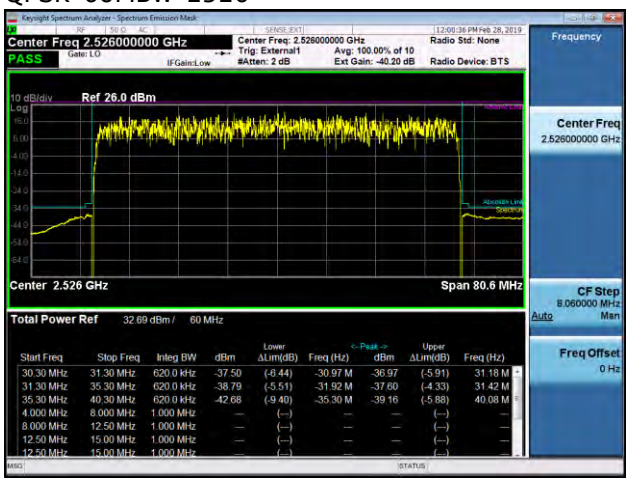
4.3.1 OOBE Results - 60 MHz 5G-NR Carrier

The Out Of Band Emissions were measured and found to be compliant with FCC requirements. Individual results for Left, Center and Right side of the Band are plotted below for QPSK, 16QAM, 64QAM and 256QAM modulation.

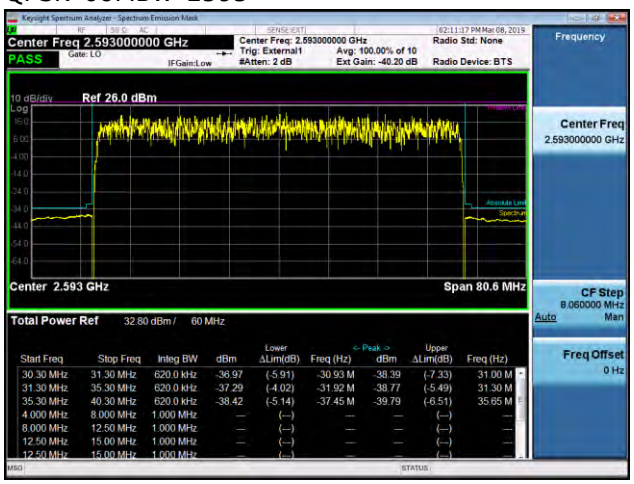
4.3.2 60 MHz Out Of Band Emissions for QPSK

4.3.2.1 QPSK - Out Of Band Emissions

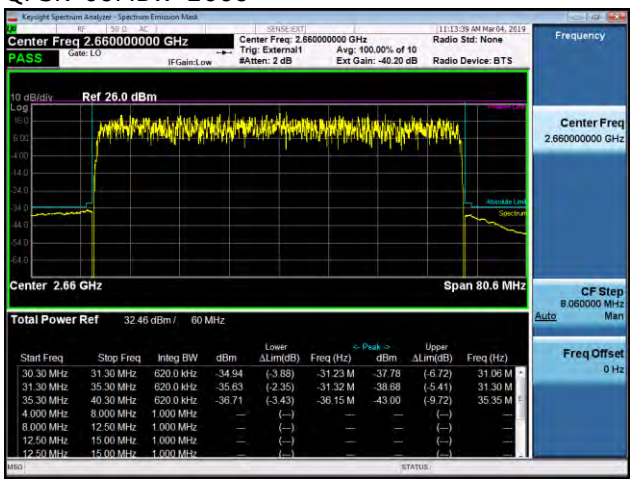
QPSK 60MBW 2526



QPSK 60MBW 2593

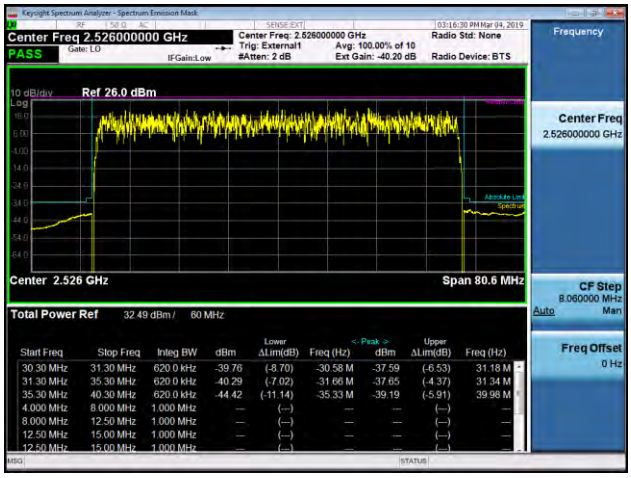


QPSK 60MBW 2660

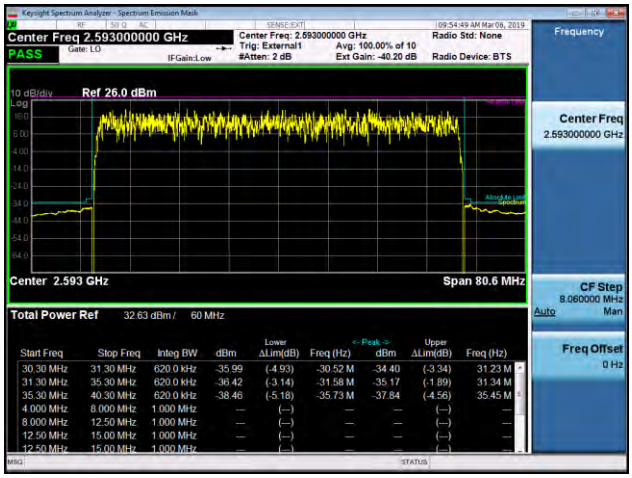


4.3.2.2 16QAM - Out Of Band Emissions

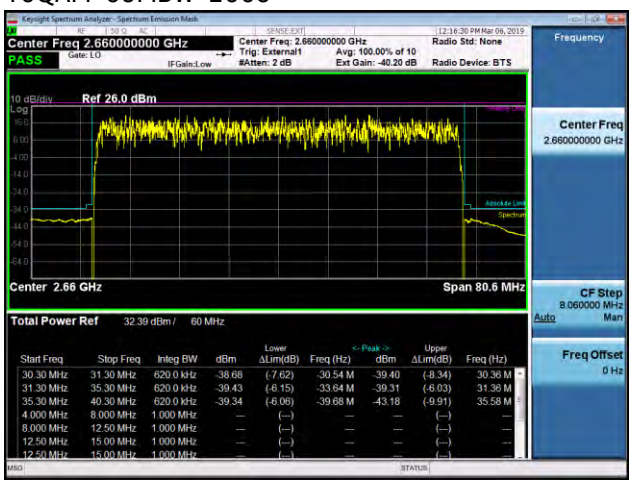
16QAM 60MBW 2526



16QAM 60MBW 2593

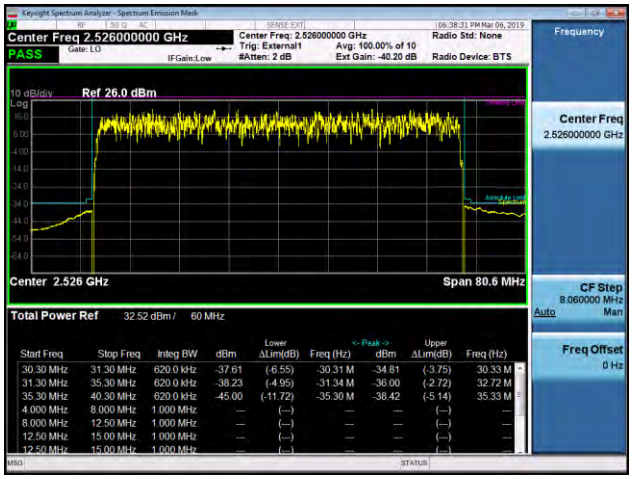


16QAM 60MBW 2660

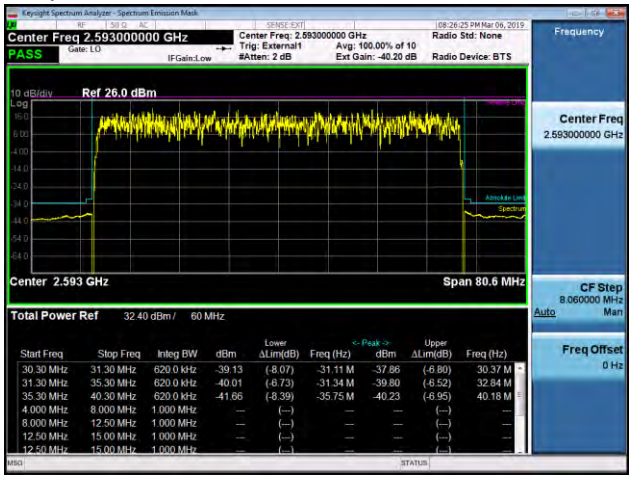


4.3.2.3 64QAM - Out Of Band Emissions

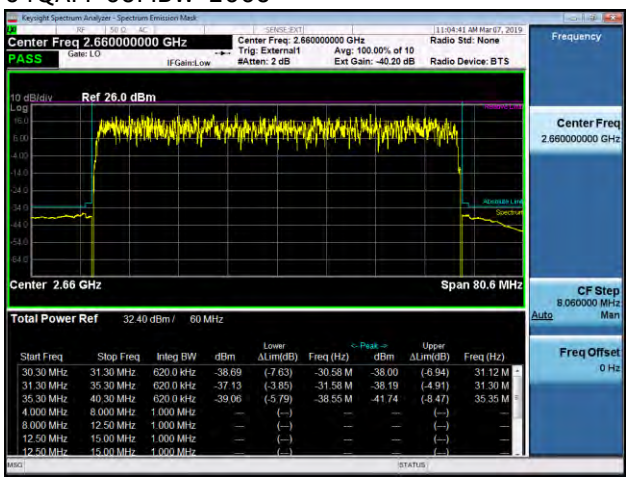
64QAM 60MBW 2526



64QAM 60MBW 2593

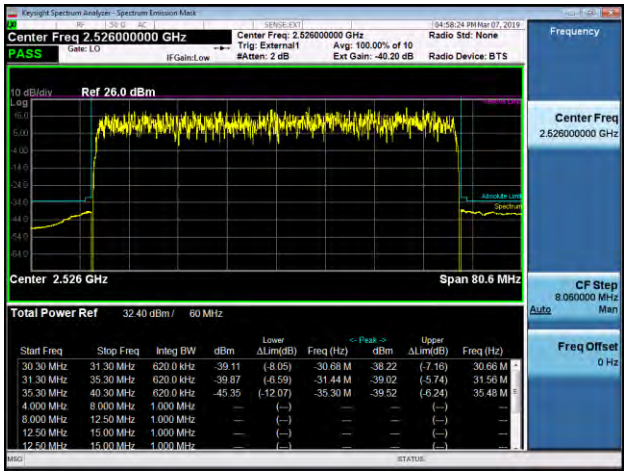


64QAM 60MBW 2660

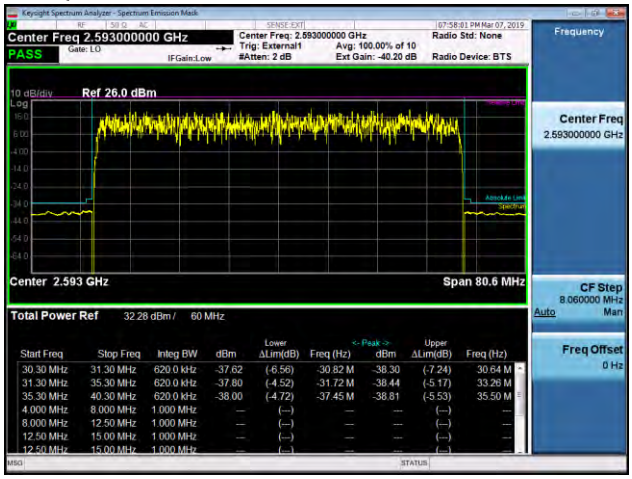


4.3.2.4 256QAM - Out Of Band Emissions

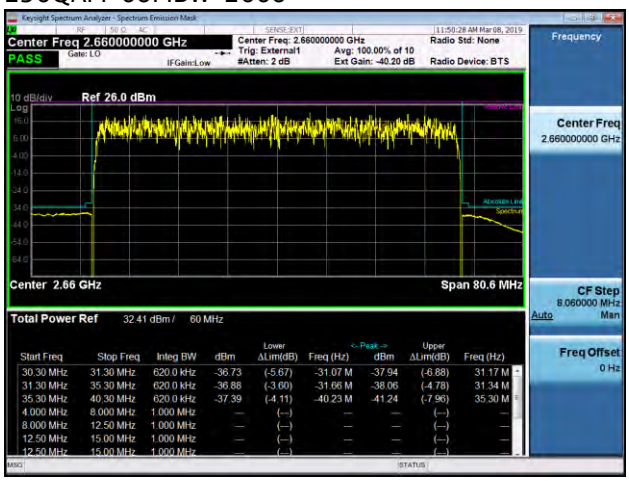
256QAM 60MBW 2526



256QAM 60MBW 2593



256QAM 60MBW 2660



5. FCC Section 2.1051 - Spurious Emissions at Transmit Antenna Port

5.1 Measurement of Spurious Emissions at Transmit Antenna Port

Spurious Emissions at the transmit-antenna terminals were investigated over the frequency range of 10 MHz to the 10th harmonic of the specific transmit band. Depending on the specific band of operation, the measurements were performed up to 27GHz. Measurements were made by using a Keysight MXA Signal Analyzer and the test setup of Figure 2.2.

The RF output from the transmitter was reduced (to an amplitude usable by the receivers) using calibrated attenuators and cables that were verified as a group. Above 10 GHz a high pass filter was used with reduced attenuation to maintain dynamic range.

The required emission limitation is specified as appropriate in 27.53 and as tabulated in Table 4.2. The measured spurious emission levels were plotted for the frequency range as specified in 2.1057. Data below documents performance up to 27 GHz.

NOTE: Only a sample of all the data taken has been used in this report. The full suite of raw data resides at the MH, New Jersey location.

5.2 Results - Measurement of Spurious Emissions at Transmit Antenna Port

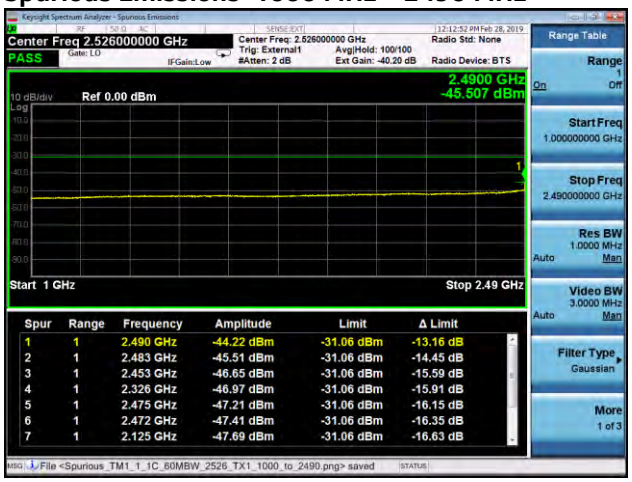
The Spurious Emissions at the transmit-antenna terminals were measured at left center and right side of the band for every modulation configuration. All emissions were found to be compliant. A representative set of plots for the QPSK, 16QAM and 256QAM modulation configurations are presented below.

5.2.1 60 MHz Spurious Emissions Data.

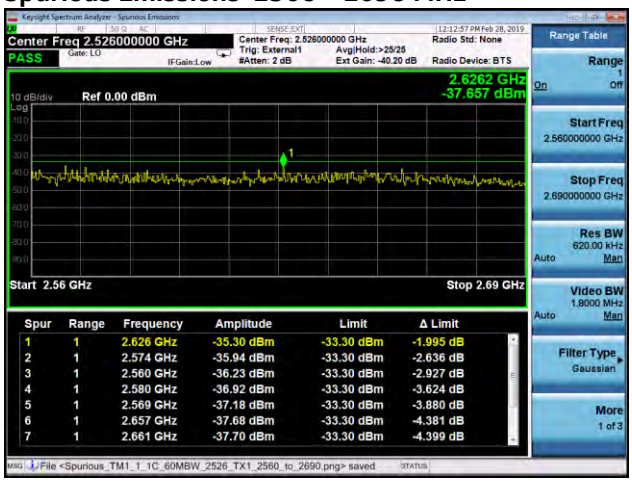
5.2.1.1 Spurious Emissions, 60MBW, QPSK, 2526 MHz, Port 29.

Spurious Emissions 10 MHz – 1000 MHz

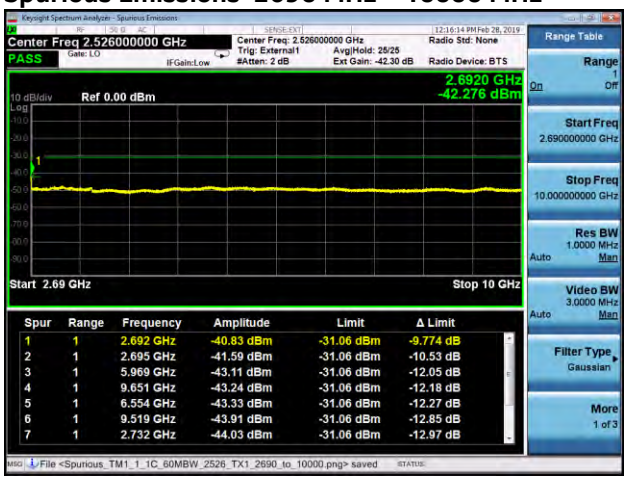
Spurious Emissions 1000 MHz – 2490 MHz



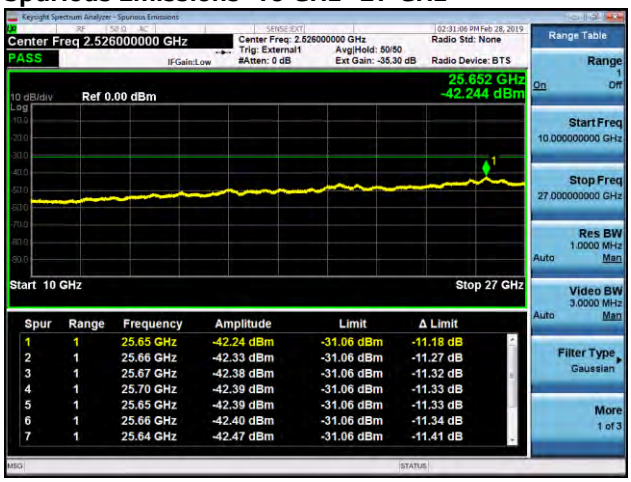
Spurious Emissions 2560 – 2690 MHz



Spurious Emissions 2690 MHz – 10000 MHz

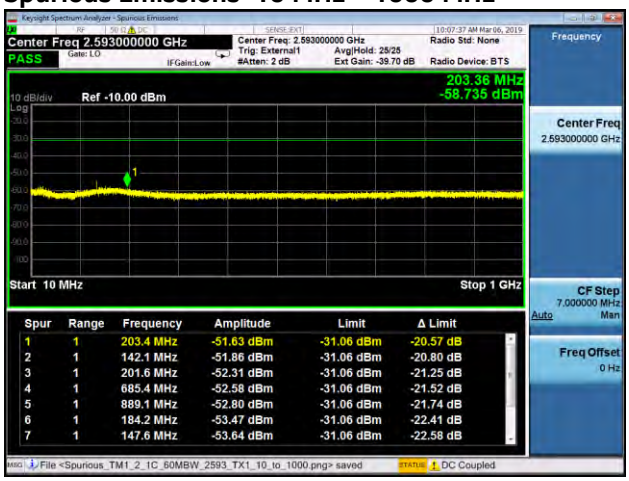


Spurious Emissions 10 GHz- 27 GHz

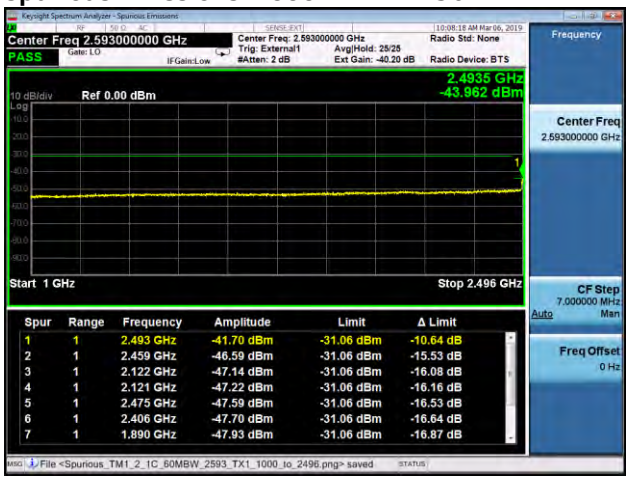


5.2.1.2 Spurious Emissions, 60MBW, 16QAM, 2593 MHz, Port 29

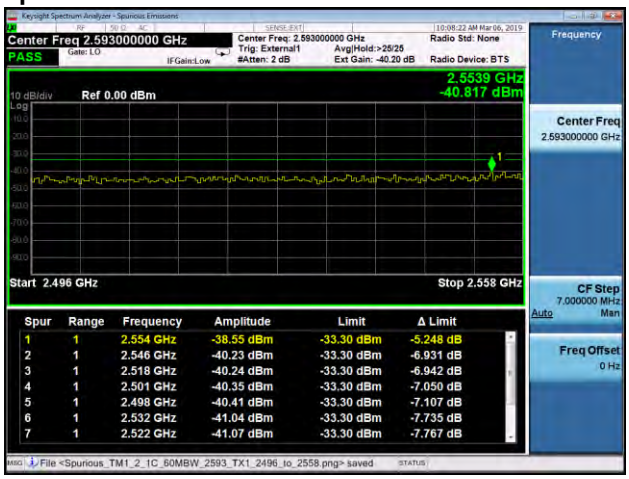
Spurious Emissions 10 MHz – 1000 MHz



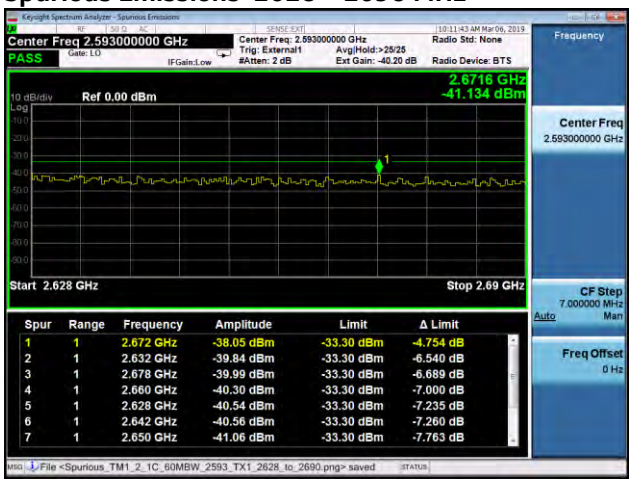
Spurious Emissions 1000 MHz – 2496 MHz



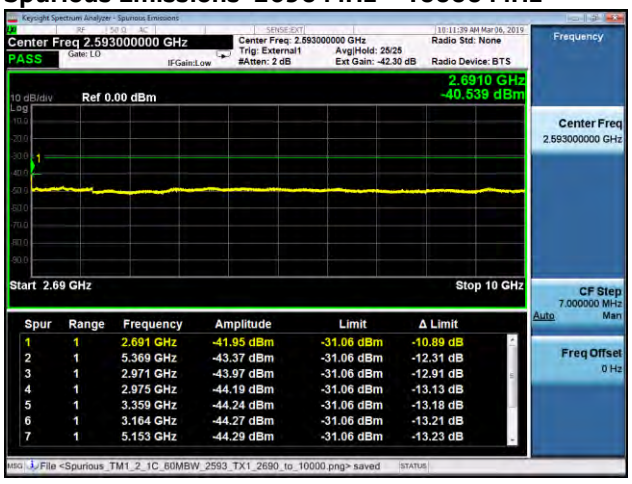
Spurious Emissions 2496 – 2558 MHz



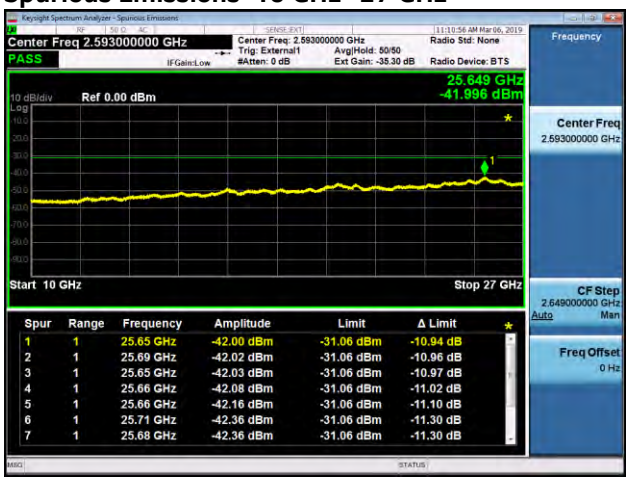
Spurious Emissions 2628 – 2690 MHz



Spurious Emissions 2690 MHz – 10000 MHz



Spurious Emissions 10 GHz- 27 GHz

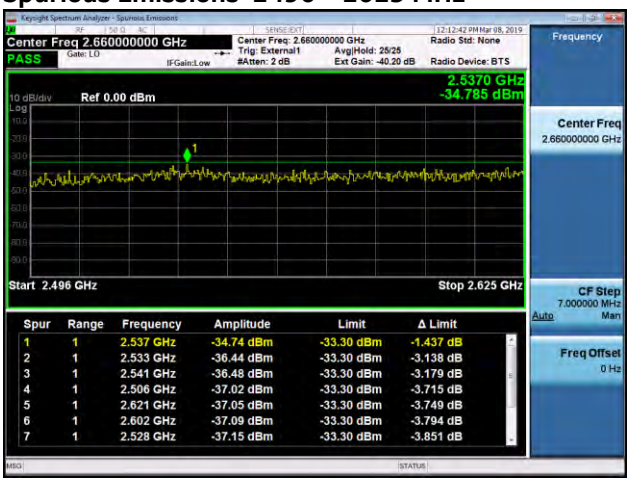


5.2.1.3 Spurious Emissions, 60MBW, 256QAM, 2660 MHz, Port 29

Spurious Emissions 10 MHz – 1000 MHz

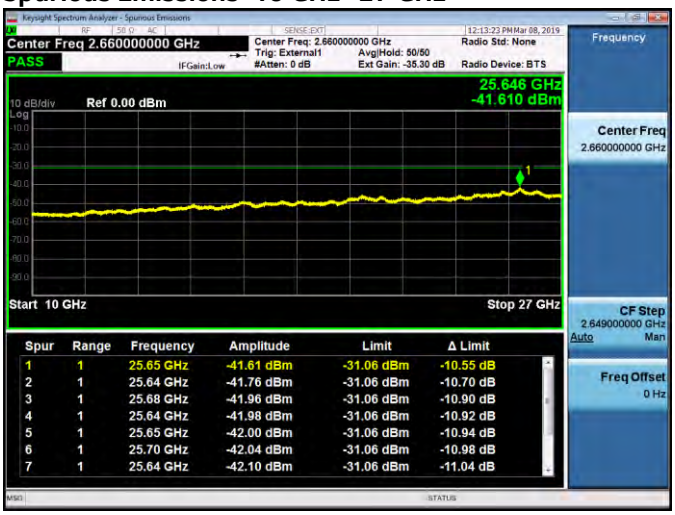
Spurious Emissions 1000 MHz – 2496 MHz

Spurious Emissions 2496 – 2625 MHz



Spurious Emissions 2695 MHz – 10000 MHz

Spurious Emissions 10 GHz- 27 GHz



5.3 Antenna Port Measurements Test Setup Photographs

The Antenna Port Measurements Test Setup Photographs are detailed in the filing exhibits.

5.4 Antenna Port Measurements Test Equipment

The Antenna Port Measurements Test Equipment is detailed below.

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due	Calibration Type	Status
E831	Agilent Technologies	MXA Signal Analyzer	20Hz-26.5GHz	N9020A	MY48011791	2018-02-15	2020-02-15	Requires Calibration	Active
E1338	Keysight Technologies	MXA Signal Analyzer	20 Hz – 44GHz	N9020B	MY57430927	2018-09-13	2020-09-13	Requires Calibration	Active
E1208	RLC Electronics Inc.	High Pass Filter	5GHz to 26GHz High Pass Filter	F-19391	1440-001	2019-02-25	2020-02-25	Calibration Not Required, Must Be Verified	Active
E1156	Weinschel	Attenuator	10dB 0.05GHz-26GHz 25W	74-10-12	1069	2019-02-25	2020-02-25	Calibration Not Required, Must Be Verified	Active
E1155	Weinschel	Attenuator	10dB 25Watt 0.05GHz - 26GHz	74-10-12	1068	2019-02-25	2020-02-25	Calibration Not Required, Must Be Verified	Active
E1154	Weinschel	Attenuator	30dB 25W 0.05GHz-26GHz	74-30-12	1065	2019-02-25	2020-02-25	Calibration Not Required, Must Be Verified	Active
	UTIFLEX Micro Coax	RF Cable	UFB142A-0-0720-2G0200/A. MFR65639 227883-001	142A Series 503609-G		2019-02-25	2020-02-25	Pathloss verified with attenuators	

6. Section 2.1055: FREQUENCY STABILITY

There were no changes to the frequency generating and stabilizing circuitry of the AAHF, the subject of this test report and Class II Change. There have been no hardware changes. The Frequency Stability performance has not changes from the results initially reported to the FCC

7. FCC Section 2.1053 and Part 15.109

7.1 Section 2.1053 Field Strength of Spurious Emissions

Field strength measurements of radiated spurious emissions were made in 3m Semi-Anechoic Chambers the of Global Product Compliance Laboratories of Nokia Bell Labs in Murray Hill NJ. A complete description and full measurement data for the site is on file with the Commission (FCC File 515091).

The spectrum from 30 MHz to the tenth harmonic of the carrier, as high as 27 GHz depending upon the product, was searched for spurious radiation. Measurements were made using both horizontally and vertically polarized broadband antennas. Per FCC regulations, the comparison of out of band spurious emissions directly to the limit is appropriately made using the substitution method. However, when the emissions are more than 20 dB below the specification limit, the use of field strength measurements for compliance determination is acceptable and those emissions are considered not reportable (Section 2.1053 and the FCC Interpretive database for 2.1053). For this case the evaluation of acceptable radiated field strength is as follows.

Sections 2.1053 and 27.53 contain the requirements for the levels of spurious radiation as a function of the level of the unmodulated carrier. The reference level for the unmodulated carrier is calculated as the field produced by an ideal dipole excited by the transmitter output power according to the following relation taken from Reference Data for Radio Engineers, page 676, 4th edition, IT&T Corp.

$$E= [(30*P)^{1/2}]/R$$

$$20 \log (E*10^{6}) – (43 + 10 \log P) = 82.23 \text{ dB}\mu\text{V/meter}$$

Where:
E = Field Intensity in Volts/meter P = Transmitted Power in Watts
R = Measurement distance in meters = 3 m

The compliance limit is 82.23 dBμV/m. The non-report level is 62.23 dBμV/m which is higher than the FCC Part 15 Class B limit of 54 dBμV/m.

The calculated emission levels were found by:

Measured level (dBμV) + Cable Loss(dB)+Antenna Factor(dB) = Field Strength (dBμV/m)

7.2 Results - Field Strength of Spurious Emissions:

For compliance with 47CFR Parts 2 and 27, the field strength of any spurious radiation, measured at 3m, is required to be less than 82.23 dBμV/meter (82.23 @ 3m). Emissions equal to or less than 62.23 dBμV/meter at 3m are not reportable and may be verified using field strength measurements and broadband antennas. Over the out of band spectrum investigated from 30 MHz to beyond the tenth harmonic of the carrier (up to 27GHz), no reportable spurious emissions were detected.

The product was also compliant with Part 15 Class B.

7.3 Radiated Spurious Emissions Test Setup Photographs

The Radiated Emissions Test Setup Photographs are detailed in the filing exhibits.

7.4 Radiated Spurious Emissions Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due	Calibration Type
E393	EMCO	Horn Antenna	Double Ridged Horn 1-18 GHz	3115	9903-5769	2017-06-05	2019-06-05	Requires Calibration
E1356	Hewlett Packard	Pre-Amplifier	Pre-Amplifier 1-26.5GHz	8449B	3008A01353	2018-09-10	2020-09-10	Requires Calibration
EIH69	Rohde & Schwarz	Test Receiver	EMI 20Hz - 40GHz -155 dBm +30 dBm	ESU40	100247	2018-05-22	2020-05-22	Requires Calibration
E588	Sunol Sciences Corp	System Controller		SC99V	32802-1			Calibration Not Required
E601	A.H. Systems Inc.	Bilogical Antenna	25 - 2000 MHz	SAS-521-2	408	2017-07-11	2019-07-11	Requires Calibration
E526	A.H. Systems Inc.	Horn Antenna	Ridged Horn 26.5 GHz - 40 GHz	SAS-200/573	137	2017-10-04	2019-10-04	Requires Calibration
E513	EMC Test Systems	Horn Antenna	Double Ridged Horn 18-40 GHz	3116	2539	2017-06-16	2019-06-16	Requires Calibration
E1235	RLC Electronics Inc.	High Pass Filter	High Pass filter 5GHz to 26GHz	F-19413	1446-006	2019-02-25	2020-02-25	Calibration Not Required, Must Be Verified
E907	Rohde & Schwarz	Test Receiver	EMI (20Hz to 40 GHz)-150 +30dBM	ESIB40	100101	2018-04-17	2020-04-17	Requires Calibration
E813	Sonoma Instrument Co.	Amplifier	9kHz-1GHz	310N	186750	2018-09-14	2020-09-14	Requires Calibration
E1130	Weinschel	Attenuator	6dB	2/6	CD2545	2017-03-03	2019-03-03	Requires Calibration

Test Cables

Applicable Test	Cable	S/N	Part #	MMFG	Cal Date
RE 30M-1GHz	#1	D230-N1N1 36	1GVT414198302-001		5/2/2018
	#2	D230-N1N1 72	1GVT414198501-001		5/2/2018
	#3	D230-N1N1 278	1GVT414198301-001		5/2/2018
RE 1-18 GHz	#1	13171302-002	EMC1-K1K1-48	Cage 1GVT4	12/4/2018
	#2	13171301-001	EMC1-K1K1-108	Cage 1GVT4	12/4/2018
RE 18-26.5	#1	13171302-002	EMC1-K1K1-48	Cage 1GVT4	12/4/2018
	#2	13171301-001	EMC1-K1K1-108	Cage 1GVT4	12/4/2018
RE 26.5-40G; This cable is part of E526	#1	504586-D0000090	UBF-142A-0-2000-2002G0	64839-232491-001	11/16/2018

8. NVLAP Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 100275-0

Nokia, Global Product Compliance Lab
Murray Hill, NJ

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2018-09-05 through 2019-09-30
Effective Dates

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

For the National Voluntary Laboratory Accreditation Program