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NVLAP®

**TESTING**
**NVLAP LAB CODE: 100275-0**

# Title 47 Code of Federal Regulations Test Report

**Regulation:**
FCC Part 2 and 27

**Client:**
Nokia Mobile Networks

**Product Evaluated:**
AAHJ 5G NR 40 MHz
FCC ID: VBNAAHJ-01

**Report Number:**
TR-2019-0047-FCC2-27

**Date Issued:**
May 22, 2019

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## Revisions

| Date | Revision | Section | Change |
|---|---|---|---|
| 5/22/19 | 0 | | Initial Release |
| | | | |
| | | | |
| | | | |

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Signed:  5/22/2019

Walter Steve Majkowski
Compliance Engineer

# 1. System Information and 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 Murray-Hill, NJ.

| | |
|---|---|
| **Equipment Under Test (EUT):** | AAHJ 5G NR 40MHz |
| **FCC ID:** | VBNAAHJ-01 |
| **Part Number:** | 474795A.M01 |
| **Serial Number:** | 6Q184613831 |
| **Frequency Range:** | 2590-2690 MHz |
| **GPCL Project Number:** | 2019-0047 |
| **Manufacturer:** | NOKIA SOLUTIONS AND NETWORKS OY<br>KARAPORTTI 3, FI-02610 ESPOO<br>FINLAND |
| **Test Requirement(s):** | Title 47 CFR Parts 2 and 27 |
| **Test Standards:** | • Title 47 CFR Parts 2 and 27<br>• KDB 971168 D01 Power Measurement License Digital Systems v03r01 April 9, 2018.<br>• KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013<br>• ANSI C63.26 (2015)<br>• ANSI C63.4 (2014) |
| **Measurement Procedure(s):** | • FCC-IC-OB - GPCL Occupied Bandwidth and Power Measurement Test Procedure 12-4-2017<br>• FCC-IC-SE - GPCL Spurious Emissions Test Procedure 12-4-2017 |
| **Test Date(s):** | April-May 2019 |
| **Test Performed By:** | Nokia<br>Global Product Compliance Laboratory<br>600-700 Mountain Ave.<br>P.O. Box 636<br>Murray Hill, NJ 07974-0636 |
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| **Product Engineer(s):** | Ron Remy |
| **Lead Engineer:** | W. Steve Majkowski |
| **Test Engineer (s):** | W. Steve Majkowski, Jaideep Yadav, Mike Soli |
| **Test Results**: The AAHJ 5G-NR 40MHz, 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 test report applies to the AAHJ 5G NR 40MHz, 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 add the 5G-NR Emissions Designator for 40 MHz bandwidth carriers.

## 1.3 EUT Description

The Nokia AirScale AAHJ mMIMO Radio Head is a 64 port radio head that over the Band 41 spectrum of 2590 - 2690 MHz. Each transmit port generates 28dBm/0.63095W for each 20 MHz of signal bandwidth. The overall 64 port product generates:

- 40W for 20 MHz of signal bandwidth.
- 80W for 40 MHz of signal bandwidth.
- 120W for 60 MHz of signal bandwidth

The product configured with a 40 MHz 5G-NR carrier PROVIDES a total of 31 dBm / 1.25W per Transmit port, 49.04 dBm / 80 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 40 MHz bandwidth 5G-NR carriers are addressed herein utilizing QPSK, 16QAM, 64QAM and 256QAM modulation formats. With the 40 MHz bandwidth 5G-NR carrier the total RF output power will be 80W.

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-TM1.1** | **QPSK** |
| **NR-FR1-TM3.1** | **64QAM** |
| **NR-FR1-TM 3.1a** | **256QAM** |
| **NR-FR1-TM 3.2** | **QPSK+16QAM** |

The product was configured for single carrier configuration.

## 1.4 Test Requirements

Each required measurement is listed below:

| 47 CFR FCC Sections | Description of Tests | Test Required |
|---|---|---|
| 2.1046, 27.53 | RF Power Output | Yes |
| 2.1047, 27.53 | Modulation Characteristics | Yes |
| 2.1049, 27.53 | (a) Occupied Bandwidth<br>(b) Out-of-Band Emissions | Yes |
| 2.1051, 27.53 | Spurious Emissions at Antenna Terminals | Yes |
| 2.1053, 27.53 | Field Strength of Spurious Radiation | Yes |
| 2.1055, 27.53 | Frequency Stability | Yes |

## 1.5 Standards & Procedures

### 1.5.1 Standards

- Title 47 Code of Federal Regulations, Federal Communications Commission Part 2.
- Title 47 Code of Federal Regulations, Federal Communications Commission Part 27.
- ANSI C63.26, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

### 1.5.2 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. FCC KDB 971168 D01 Power Measurement License Digital Systems v03r01 April 9, 2018.
   FCC KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013

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

## 1.5.3 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<br>30 MHz – 200 MHz V<br>200 MHz – 1000 MHz H<br>200 MHz – 1000 MHz V<br>1 GHz - 18 GHz | ±5.1 dB<br>±5.1 dB<br>±4.7 dB<br>±4.7 dB<br>±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<br>100 Hz<br>10 kHz to 1 MHz<br>1MHz | 9 kHz to 20 MHz<br>20 MHz to 1 GHz<br>1 GHz to 10 GHz<br>10 GHz to 40 GHz: | 1.78 dB |
| RF Power | 10 Hz to 20 MHz | 50 MHz to 18 GHz | 0.5 dB |

## 1.6 Executive Summary

| Requirement | Description | Result |
|---|---|---|
| **47 CFR FCC Parts 2 and 27** | | |
| 2.1046, 27.53 | RF Power Output<br>Peak to Average Power Ratio | COMPLIES |
| 2.1047, 27.53 | Modulation Characteristics | COMPLIES |
| 2.1049, 27.53 | (a) Occupied Bandwidth<br>(b) Edge of Band Emissions | COMPLIES |
| 2.1051, 27.53 | Spurious Emissions at Antenna Terminals | COMPLIES |
| 2.1053, 27.53 | Field Strength of Spurious Radiation | COMPLIES |
| 2.1055, 27.53 | Frequency Stability | Complies, Not retested |

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, as shown in the accompanying test set-up diagram.

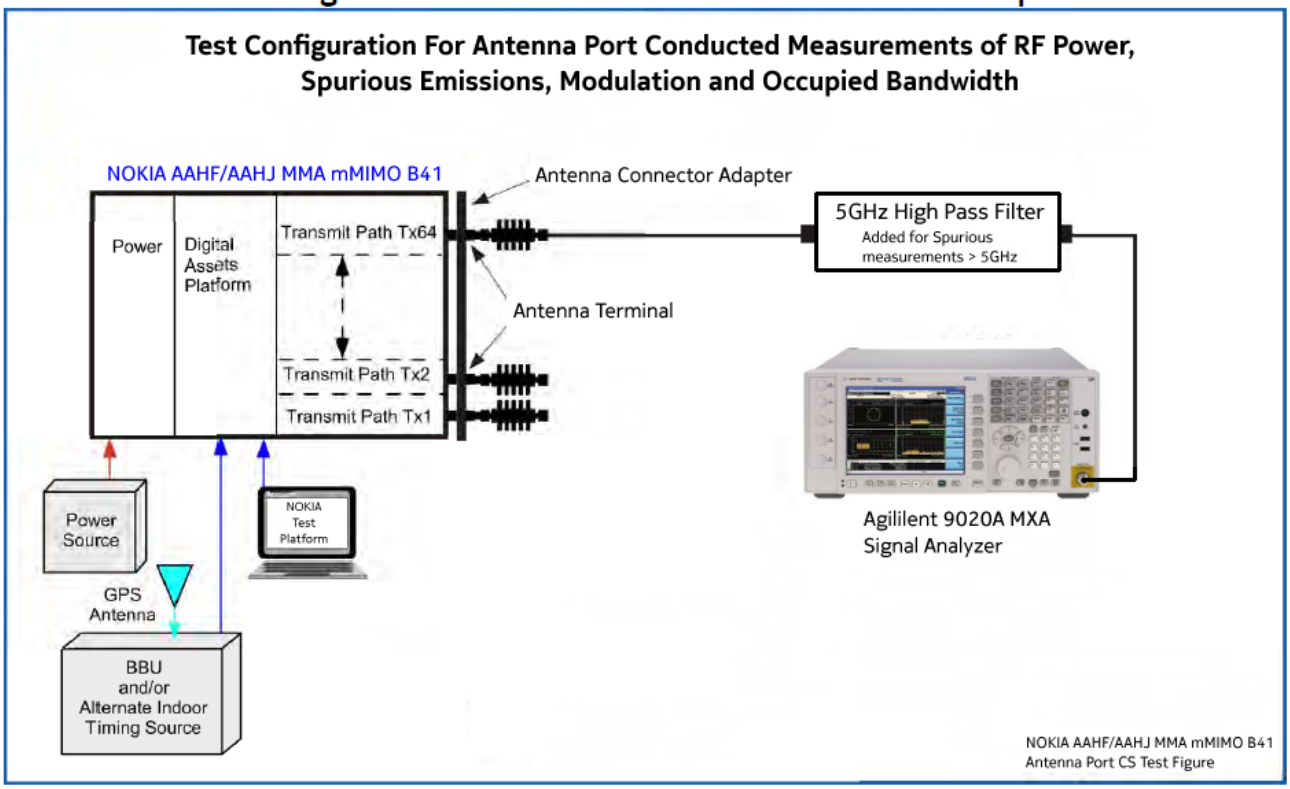
Power measurements were made using the MXA Channel Power Functionality. The transmit port was connected to the MXA with calibrated attenuators and cable whose path loss was verified before test. The Base Station was given sufficient "warm-up" period prior to testing as required by ANSI C63.26-2015.

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**



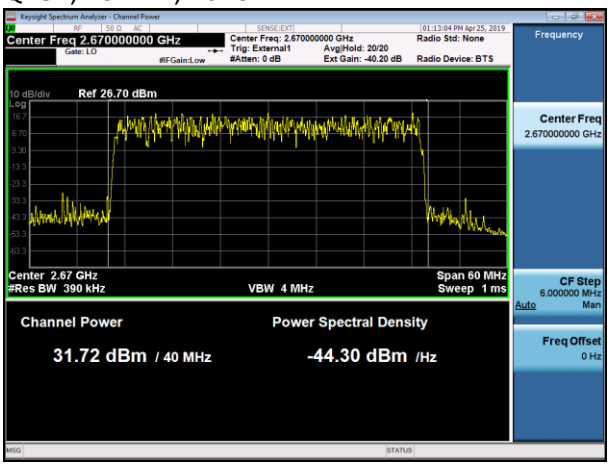
## 2.3 RF Power Output Results

The data below documents that the total sum power that the products 64 ports can provide is 80 Watts. That power is up to 1.25 Watts/port for a Total Rated power of 80W/40MHz carrier.

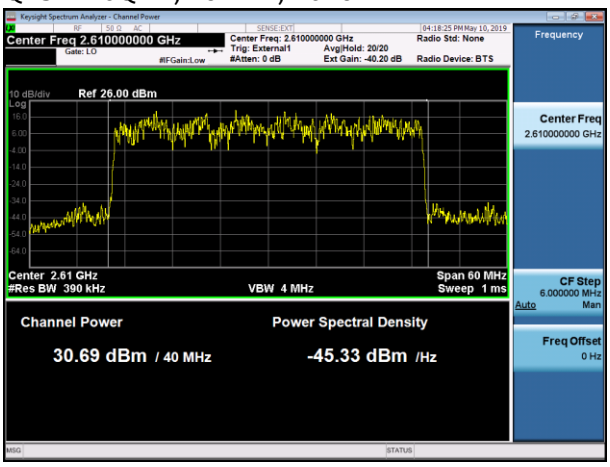
### 2.3.1 Single Carrier Channel Power – 40MHz BW

| Channel Frequency, MHz | Modulation Type | Individual Port Channel Power, dBm | Individual Port Channel Power, Watts |
|---|---|---|---|
| 2670 | QPSK | 31.72 | 1.485 |
| 2610 | QPSK+16QAM | 30.69 | 1.172 |
| 2640 | 64QAM | 31.05 | 1.012 |
| 2670 | 64QAM | 30.78 | 1.197 |
| 2610 | 256QAM | 31.05 | 1.274 |
| 2640 | 256QAM | 31.26 | 1.337 |
| 2670 | 256QAM | 31.00 | 1.259 |

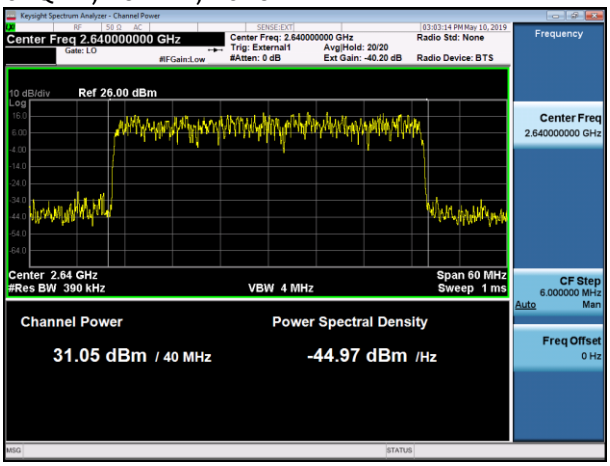
QPSK, 40MBW, 2670



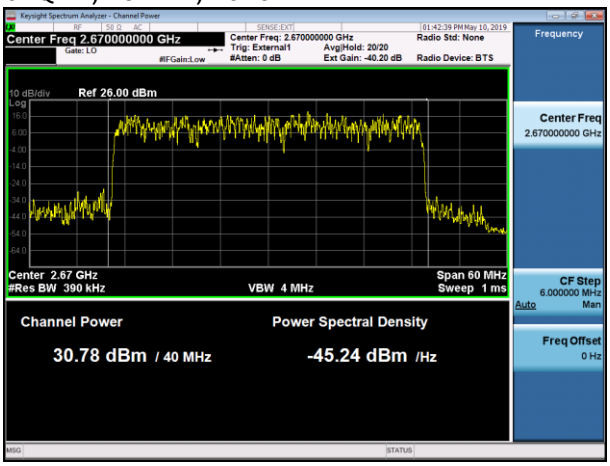

QPSK+16QAM, 40MBW, 2610



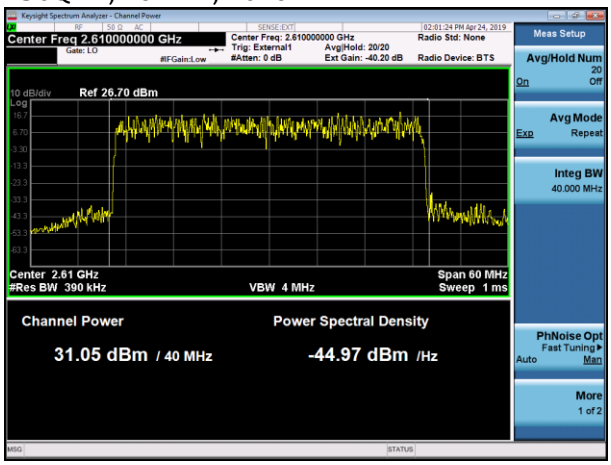

64QAM, 40MBW, 2640



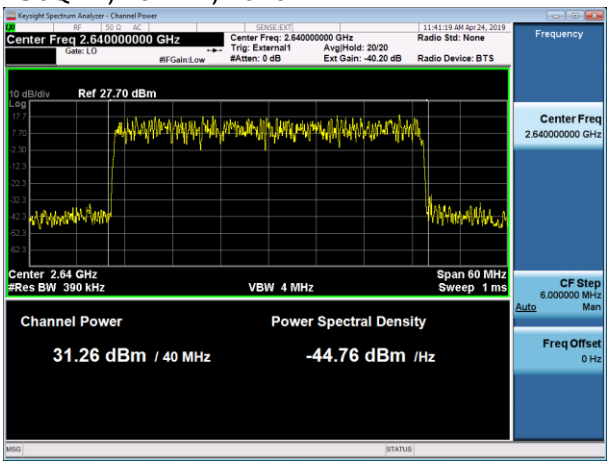

64QAM, 40MBW, 2670



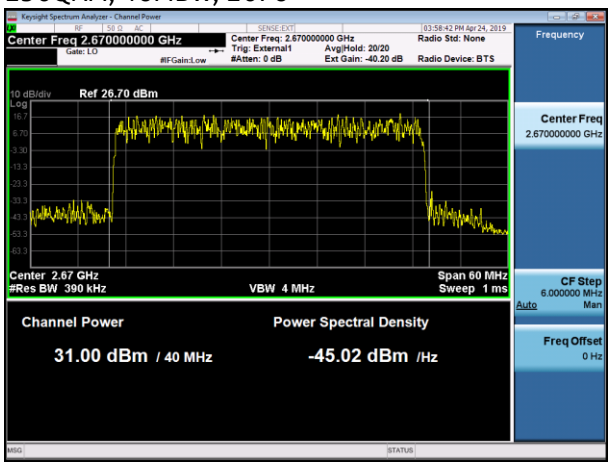
256QAM, 40MBW, 2610




256QAM, 40MBW, 2640




256QAM, 40MBW, 2670



## 2.4 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 the plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

### 2.4.1 Single Carrier Peak to Average Ratio – 40MHz BW

The Peak to Average Power Ratio is required to be below 13dB. All the measured values were below the required 13dB limit at the required 0.1 percent of the time. The measured results are tabulated below.

| Channel Frequency MHz | Modulation Type | PAR dB |
|---|---|---|
| 2670 | QPSK | 10.6 |
| 2610 | QPSK+16QAM | 10.5 |
| 2670 | QPSK+16QAM | 10.6 |
| 2670 | 64QAM | 10.5 |
| 2610 | 256QAM | 10.7 |
| 2640 | 256QAM | 10.3 |
| 2670 | 256QAM | 10.4 |

# 3. FCC Section 2.1047 - Modulation Characteristics

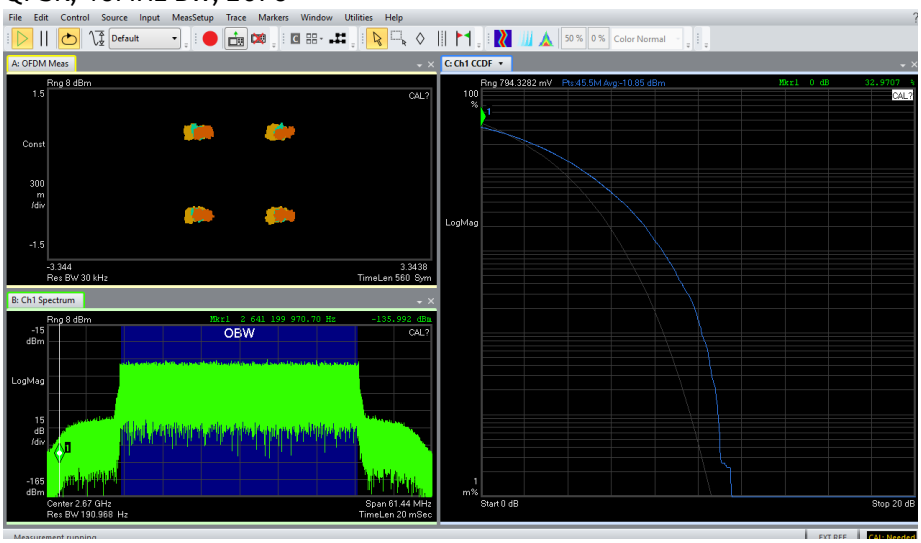
## 3.1 Modulation Characteristics

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 40 MHz 5G-NR carrier was verified as QPSK and 256QAM modulation. Samples of the Modulation configurations are shown below.

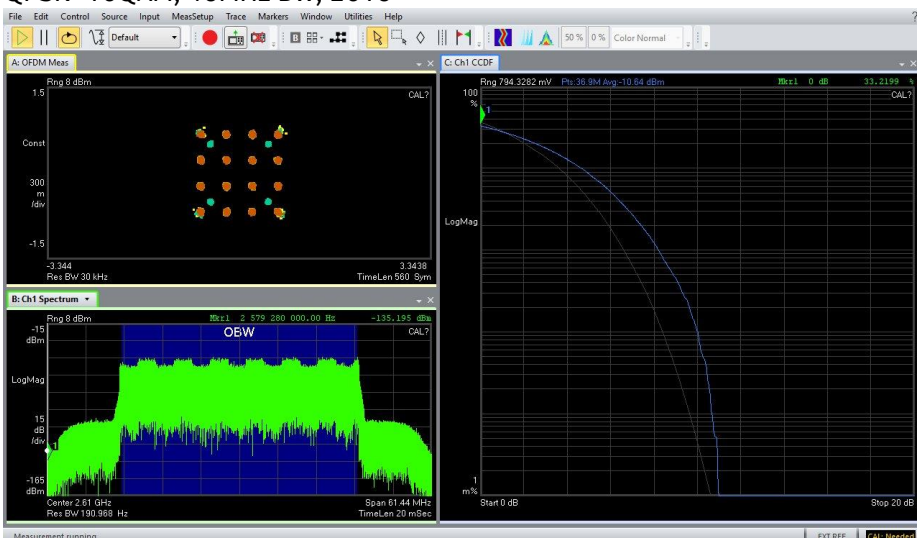
NOTE: Only a sample of the plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

### 3.1.1 Single Carrier Modulation – 40MHz BW

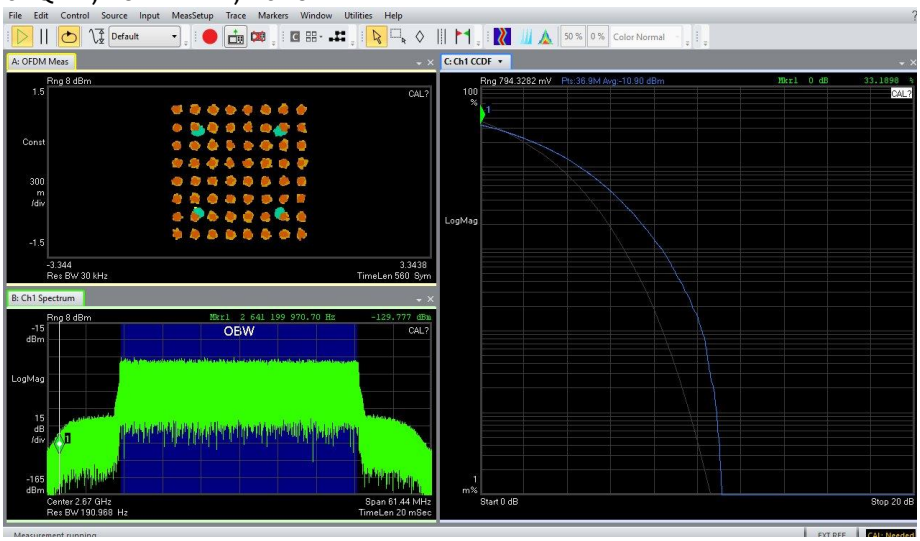
QPSK, 40MHz BW, 2670



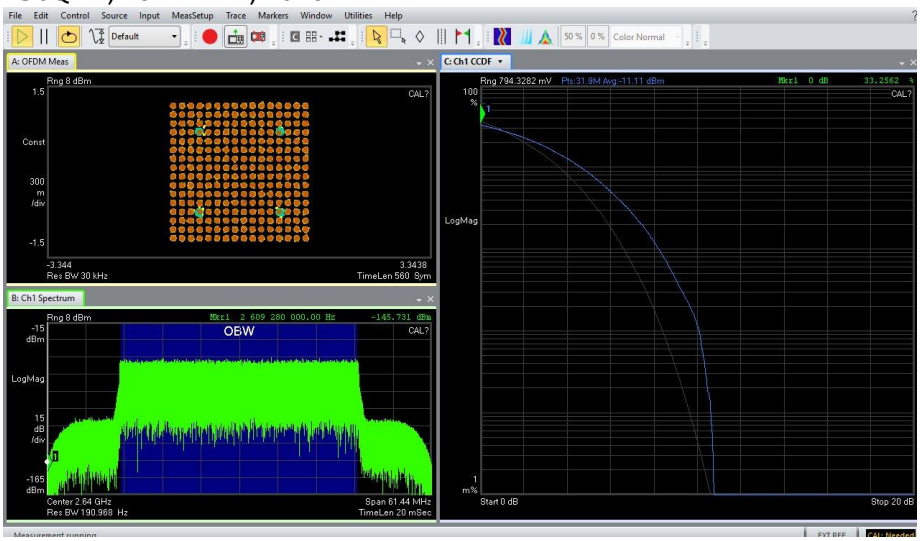

QPSK+16QAM, 40MHz BW, 2610



64QAM, 40MHz BW, 2670




256QAM, 40MHz BW, 2640



# 4. FCC Section 2.1049 – Occupied Bandwidth/Edge of Band Emissions

## 4.1 Occupied 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 40 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.

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% (340 kHz) of the nominal 40 MHz bandwidth.

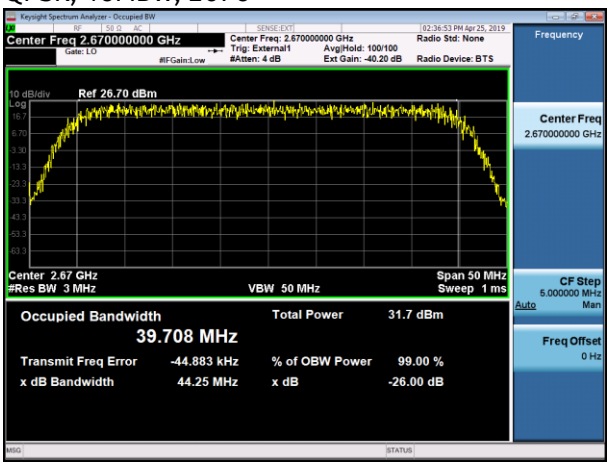
NOTE: Only a sample of all the data taken has been used in this report. The full suite of raw data resides at the MH, New Jersey location.

### 4.1.1 Single Carrier Occupied Bandwidth Measured at 3 MHz RBW

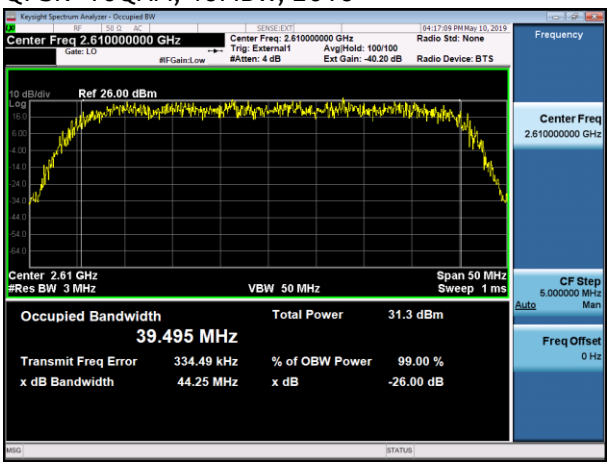
The single carrier bandwidth measurements are presented below for left, center and right side of band. They represent various 5G-NR modulation types.

| Channel Frequency MHz | Modulation Type | Occupied BW MHz |
|---|---|---|
| 2670 | QPSK | 39.708 |
| 2610 | QPSK+16QAM | 39.495 |
| 2640 | 64QAM | 39.794 |
| 2670 | 64QAM | 39.783 |
| 2610 | 256QAM | 39.884 |
| 2640 | 256QAM | 39.910 |
| 2670 | 256QAM | 39.909 |

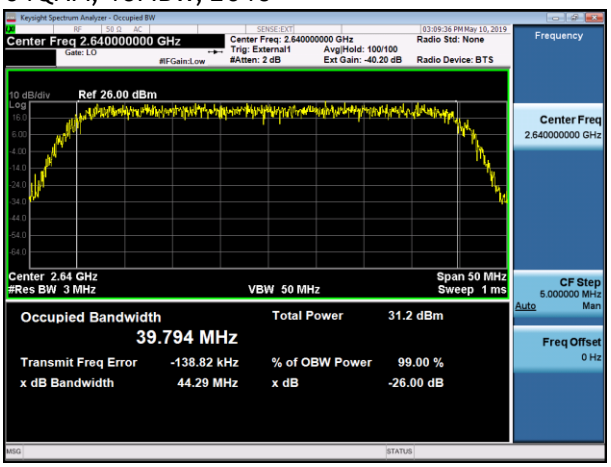
QPSK, 40MBW, 2670



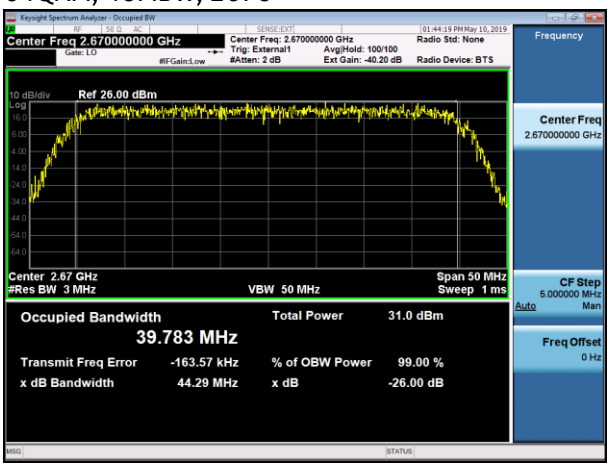

QPSK+16QAM, 40MBW, 2610



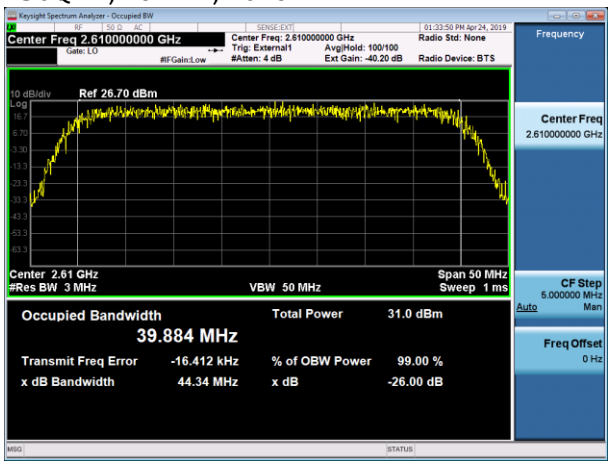

64QAM, 40MBW, 2640



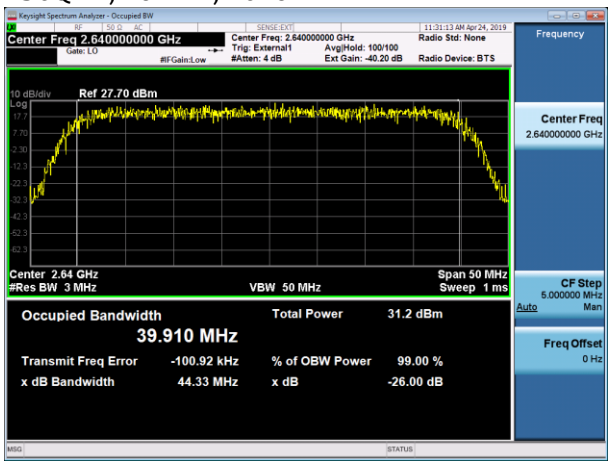

64QAM, 40MBW, 2670



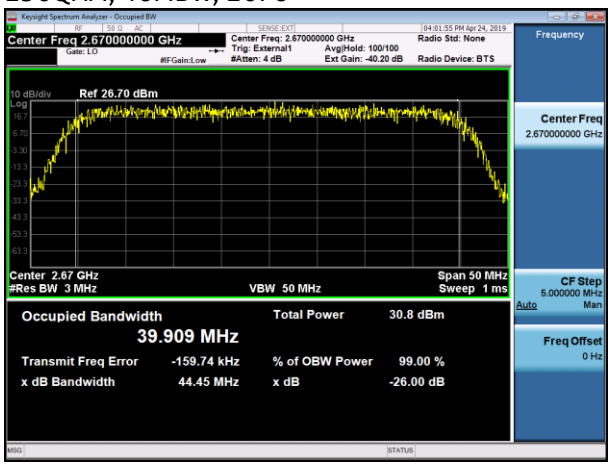
256QAM, 40MBW, 2610




256QAM, 40MBW, 2640




256QAM, 40MBW, 2670



## 4.2 Edge of band Emissions

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 (390 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:

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

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

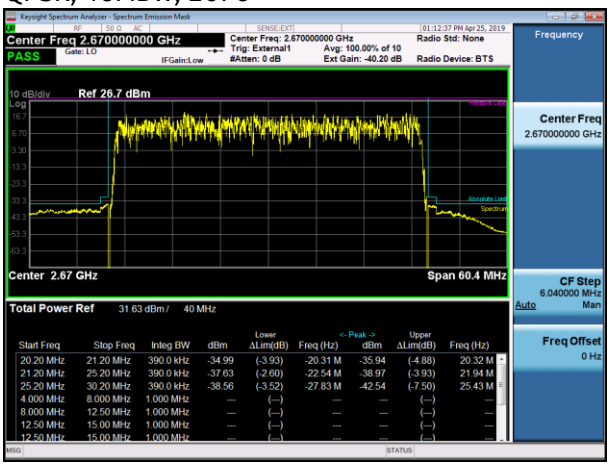
| Carrier Power | | Signal Bandwidth | Measurement RBW | Signal Offset Reference level | | "n" x MIMO | MIMO Factor | 1st MHz limit | | Beyond the 1st MHz Limit | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| W | dBm | MHz | MHz | dBc | dBm | integer | dB | dBm | dBc | dBm | dBc |
| 1.25 | 30.97 | 40 | 0.39 | -20.11 | 10.86 | 64 | 18.06 | -31.17 | -62.14 | -35.15 | -66.12 |
| 1.25 | 30.97 | 40 | 1 | -16.02 | 14.95 | 64 | 18.06 | -27.08 | -58.05 | -31.06 | -62.03 |
| 80 | 49.03 | 40 | 0.39 | -20.11 | 28.92 | 64 | 18.06 | -31.17 | -80.20 | -35.15 | -84.18 |
| 80 | 49.03 | 40 | 1 | -16.02 | 33.01 | 64 | 18.06 | -27.08 | -76.11 | -31.06 | -80.09 |

## 4.2.1 Single Carrier OOBE - 40 MHz BW

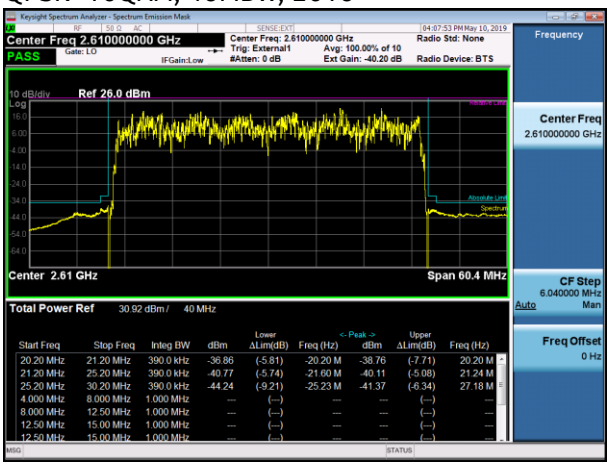
All of the measurements met the requirements of Part 27.53 when measured per Part 2.1049.

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

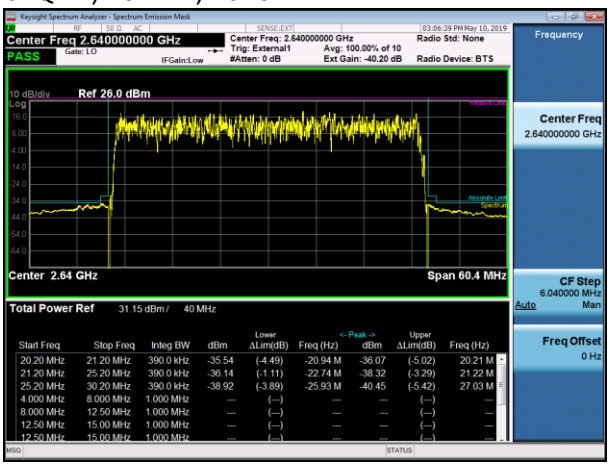
QPSK, 40MBW, 2670



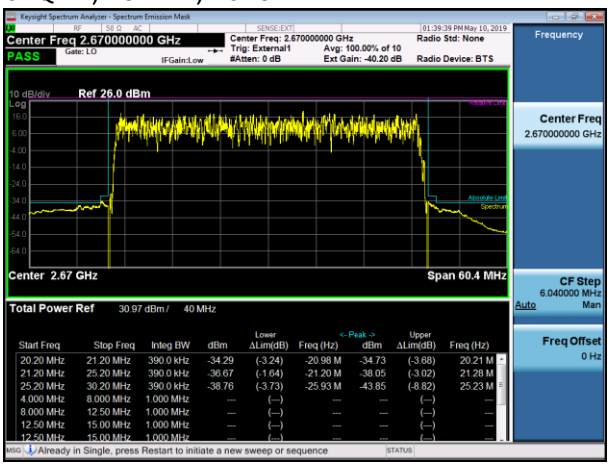

QPSK+16QAM, 40MBW, 2610



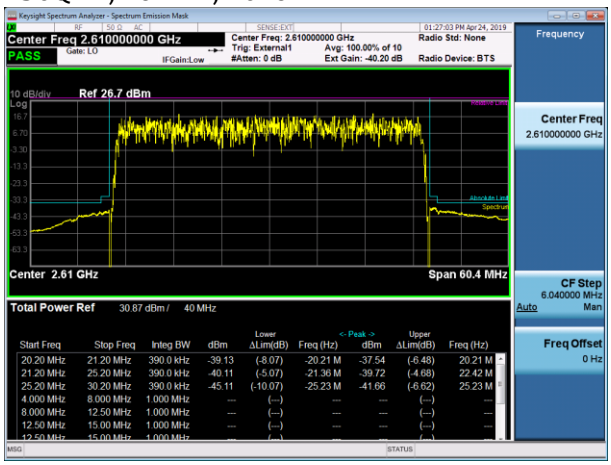

64QAM, 40MBW, 2640



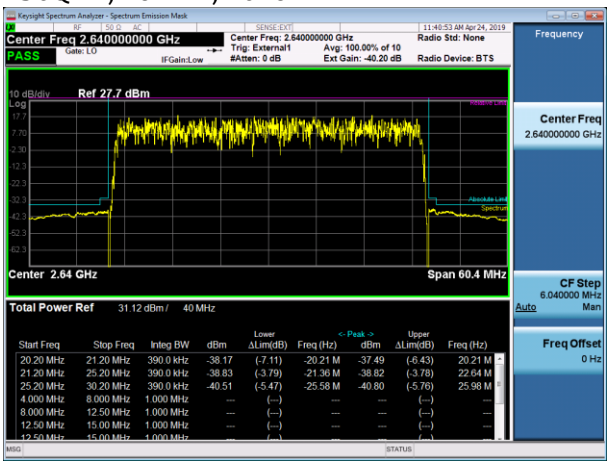

64QAM, 40MBW, 2670



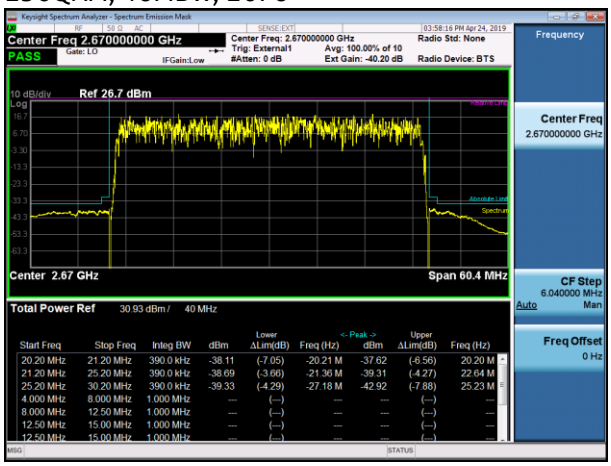
256QAM, 40MBW, 2610




256QAM, 40MBW, 2640




256QAM, 40MBW, 2670



# 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 beyond the 10th harmonic of the specific transmit band. For this band of operation, the measurements were performed up to 27GHz. Measurements were made using a Keysight MXA Signal Analyzer. The RF output from the transmitter was reduced (to an amplitude usable by the receivers) using calibrated attenuators. The RF power level was continuously monitored via a coupled RF Power Meter.

The required emission limitation is specified as appropriate in 27.53. The measured spurious emission levels were plotted for the frequency range as specified in 2.1057. There were no reportable emissions. Data below documents performance up to 27 GHz.

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

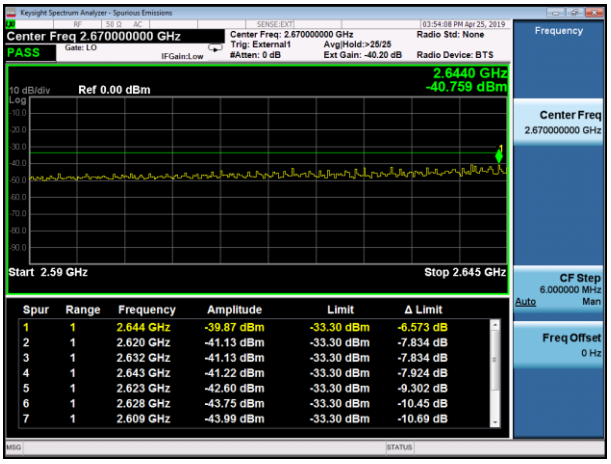
## 5.2 Results - Measurement of Spurious Emissions at Transmit Antenna Port

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, QPSK+16QAM, 64QAM and 256QAM modulation configurations are presented below.

## 5.2.1 Spurious Emissions Data

### 5.2.1.1 Spurious Emissions QPSK, 2670MHz

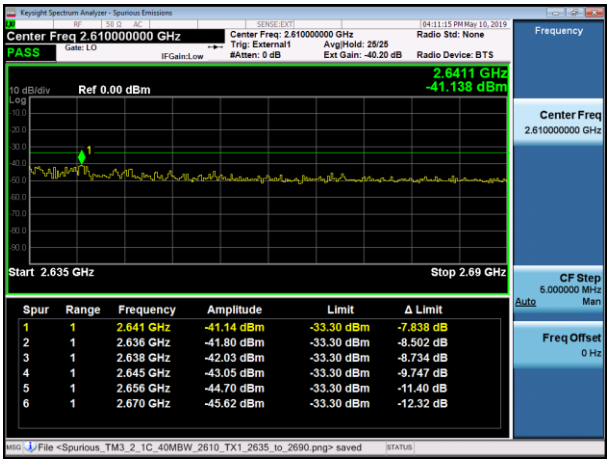






### 5.2.1.1 Spurious Emissions, QPSK+16QAM, 2610MHz

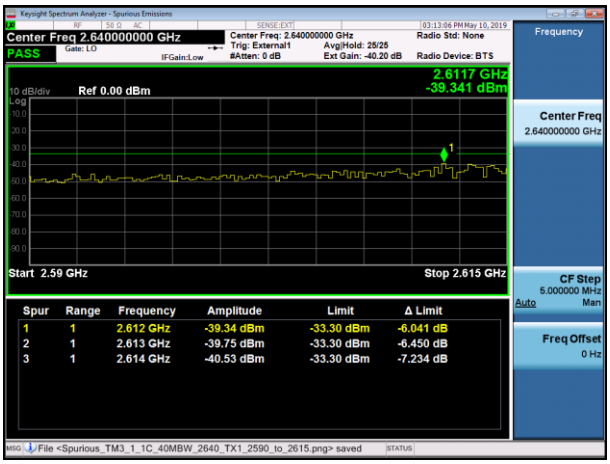


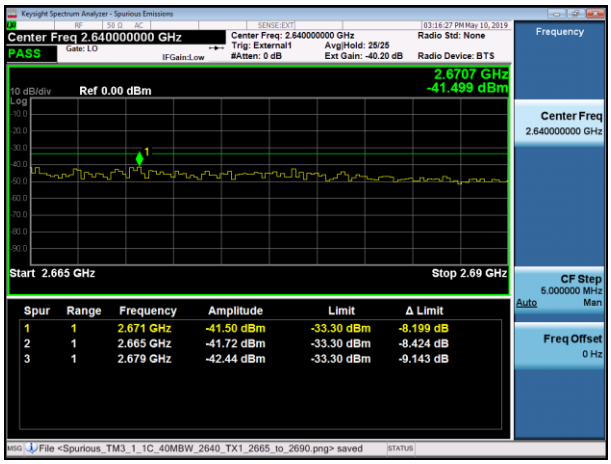


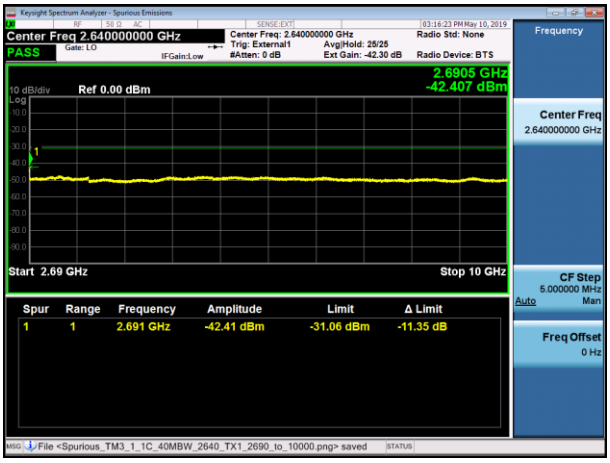


### 5.2.1.2 Spurious Emissions, 64QAM, 2640MHz



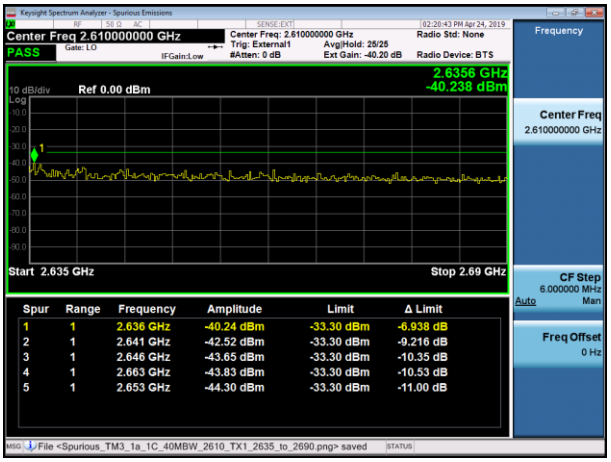



### 5.2.1.3 Spurious Emissions, 256QAM, 2610MHz








## 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

| 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 | | N9020B | MY57430927 | 2018-09-13 | 2018-12-13 | Requires Calibration | Active |
| E1208 | RLC Electronics Inc | High Pass Filter | 2.5Ghz 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 | Cable | UFB142A-0-0720-2G0200/A. MFR65639 227883-001 | 142A Series 503609-G | | 2019-02-25 | 2020-02-25 | Path loss with attenuators or filters were verified as a combined unit. | |

# 6. FCC Section 2.1053 and Part 15.109 - Field strength of spurious radiation

## 6.1 Section 2.1053 Field Strength of Spurious Emissions

Field strength measurements of radiated spurious emissions were made in an FCC registered 3m Semi-Anechoic Chamber which is maintained by Nokia Bell Labs in Murray Hill, New Jersey. A complete description and full measurement data for the site is on file with the Commission (Site Registration Number: 515091).

The spectrum from 30 MHz to beyond the tenth harmonic of the carrier, 27 GHz, 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)

## 6.2 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.

## 6.3 Radiated Spurious Emissions Test Setup Photographs

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

## 6.4 Radiated Spurious Emissions Test Equipment

| Asset ID | Manufacturer | Type | Description | Model | Serial | Calibration Date | Calibration Due | Calibration Type | Status |
|---|---|---|---|---|---|---|---|---|---|
| E602 | A.H. Systems Inc. | Bilogical Antenna | 25 - 2000 MHz | SAS-521-2 | 410 | 2019-02-11 | 2021-02-11 | Requires Calibration | Active |
| E555 | EMC Test Systems | Multi-Device Controller | | 2090 | 1577 | | | Calibration Not Required | Active |
| E1119 | Extech | Data Logger | Pressure Humidity Temp data logger | SD700 | Q668960 | 2018-12-10 | 2020-12-10 | Requires Calibration | Active |
| E908 | Rohde & Schwarz | Test Receiver | EMI (20Hz to 40 GHz)-150 +30dBM | ESIB40 | 100100 | 2018-03-12 | 2020-03-12 | Requires Calibration | Active |
| E507 | Sonoma Instrument Co. | Amplifier | 9KHz-1GHz | 310 | 185794 | 2018-08-14 | 2020-08-14 | Requires Calibration | Active |
| 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 | Active |
| E1166 | Agilent Technologies | Pre-Amplifier | Pre-Amplifier 1-26.5GHz | 8449B | 3008A01740 | 2018-10-24 | 2020-10-24 | Requires Calibration | Active |
| E520 | EMC Test Systems | Horn Antenna | Double Ridged Horn 18-40 GHz | 3116 | 2537 | 2018-08-09 | 2020-08-09 | Requires Calibration | Active |
| E376 | Hewlett Packard | Pre-Amplifier | Preamplifier 1-26.5 GHz | 8449B | 3008A01270 | 2019-05-01 | 2020-05-01 | Limited Use | Active |
| E1210 | RLC Electronics Inc | High Pass Filter | 2.5GHz-26GHz High Pass filter | F-19391 | 1440-003 | | | Calibration Not Required, Must Be Verified | Active |
| E889 | Weinschel | Attenuator | 6 dB DC-18GHz 5 Watt | 2-6 | BX3438 | 2018-05-23 | 2020-05-23 | Requires Calibration | Active |

# 7. FCC Section 2.1055 - Measurement of Frequency Stability

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

# 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*