

Global Product Compliance Laboratory
600-700 Mountain Avenue
Room 5B-108
Murray Hill, New Jersey 07974-0636 USA



Title 47 Code of Federal Regulations Test Report

Regulation:

FCC Part 2 and 27

Client:

NOKIA SOLUTIONS AND NETWORKS

Product Evaluated:

AirScale MAA 64T64R B41 320W AEHC (AEHC)

Report Number:

TR-2021-0087-FCC2-27

Date Issued:

August 23, 2021

This report shall not be reproduced, in whole or in part without the approval of Nokia Global Product Compliance Laboratory. This report must not be used by the recipient to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Table of Contents

1. SYSTEM INFORMATION AND REQUIREMENTS	5
1.1 INTRODUCTION	6
1.2 PURPOSE AND SCOPE	6
1.3 EUT DETAILS.....	7
1.3.1 Specifications.....	7
1.3.2 Photographs.....	8
1.4 TEST REQUIREMENTS	10
1.5 TEST STANDARDS & MEASUREMENT PROCEDURES	10
1.5.1 Test Standards.....	10
1.5.2 Measurement Procedures	10
1.6 MEASUREMENT UNCERTAINTY.....	11
1.7 EXECUTIVE SUMMARY	12
1.8 TEST CONFIGURATIONS	13
2. FCC SECTION 2.1046 - RF POWER OUTPUT	14
2.1 RF POWER OUTPUT	14
2.1.1 5G-NR Only.....	14
2.1.2 5G-NR + LTE Data	17
2.1.3 5G-NR + 2xLTE Data	17
2.1.4 5G-NR + 3xLTE Data	18
2.1.5 2x5G-NR + 2xLTE Data	18
2.1.6 2x5G-NR + 3xLTE Data	19
2.1.7 LTE + 5G-NR Data	20
2.1.8 2xLTE + 5G-NR Data	20
2.1.9 3xLTE + 5G-NR Data	20
2.2 CHANNEL RF POWER – PLOTS	21
2.2.1 5G-NR Only Plots.....	21
2.2.2 5G-NR + LTE Plots.....	22
2.2.3 5G-NR + 2xLTE Plots.....	22
2.2.4 5G-NR + 3xLTE Plots.....	23
2.2.5 2x5G-NR + 2xLTE Plots.....	23
2.2.6 2x5G-NR + 3xLTE Plots.....	24
2.2.7 LTE + 5G-NR Plots.....	24
2.2.8 2xLTE + 5G-NR Plots.....	25
2.2.9 3xLTE + 5G-NR Plots.....	25
2.3 PEAK-TO-AVERAGE POWER RATIO (PAPR)	26
2.3.1 Peak-to-Average Power Ratio – 5G Only Plots	26
2.3.2 Peak-to-Average Power Ratio – 5G-NR + LTE Plots.....	27
2.3.3 Peak-to-Average Power Ratio – 5G-NR + 2xLTE Plots.....	27
2.3.4 Peak-to-Average Power Ratio – 2x5G-NR + 2xLTE Plots.....	28
2.3.5 Peak-to-Average Power Ratio – 2x5G-NR + 3xLTE Plots.....	28
2.3.6 Peak-to-Average Power Ratio – 2xLTE + 5G-NR Plots.....	29

- 3. FCC SECTION 2.1047 - MODULATION CHARACTERISTICS 30**
 - 3.1 MODULATION CHARACTERISTICS30
 - 3.1.1 Modulation Characteristics – 5G-NR Plots.....30*
 - 3.1.2 Modulation Characteristics – LTE Plots.....31*
- 4. FCC SECTION 2.1049 – OCCUPIED BANDWIDTH/EDGE OF BAND EMISSIONS..... 32**
 - 4.1 OCCUPIED BANDWIDTH32
 - 4.1.1 Occupied Bandwidth - Plots.....34*
 - 4.2 EDGE OF BAND EMISSIONS39
 - 4.2.1 Edge of Band Emissions – Plots.....40*
- 5. FCC SECTION 2.1051 - SPURIOUS EMISSIONS AT TRANSMIT ANTENNA PORT..... 45**
 - 5.1 MEASUREMENT OF SPURIOUS EMISSIONS AT TRANSMIT ANTENNA PORT45
- 6. FCC SECTION 2.1053 - FIELD STRENGTH OF SPURIOUS RADIATION 54**
 - 6.1 SECTION 2.1053 FIELD STRENGTH OF SPURIOUS EMISSIONS54
 - 6.2 FIELD STRENGTH OF SPURIOUS EMISSIONS - LIMITS.....54
- 7. NVLAP CERTIFICATE OF ACCREDITATION 55**


Revisions

Date	Revision	Section	Change
08/23/2021	0		Initial Release


Nokia Global Product Compliance Laboratories is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP®) for specific services, listed on the Scope of Accreditation, for: Electromagnetic Compatibility and Telecommunications. This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated January 2009). NVLAP LAB CODE: 100275-0.

Nokia Global Product Compliance Laboratory represents to the client that the laboratory's accreditation or any of its calibration or test reports in no way constitutes or implies product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Prepared By:

Signed:  08/23/2021
 Mark Nguyen
 Compliance Engineer
 NVLAP Signatory
 mark.nguyen@nokia-bell-labs.com

Approved By:

Signed:  08/23/2021
 Raymond Johnson
 Technical Manager
 NVLAP Signatory
 ray.johnson@nokia-bell-labs.com

Reviewed By:

Signed:  08/23/2021
 Nilesch Patel
 EMC Engineer
 NVLAP Signatory
 nilesch.patel@nokia-bell-labs.com

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):	AirScale MAA 64T64R B41 320W AEHC (AEHC)
Serial Number:	L1203206454
FCC ID:	VBNAEHC-01
Hardware Version:	475124B.101
Software Version:	LTE: SBTS21B 5G: 5G20B
Frequency Range:	2496-2690 MHz
GPCL Project Number:	2021-0087
Applicant	Nokia Solutions and Networks Steve Mitchell 3201 Olympus Blvd Dallas, TX 75019
Test Requirement(s):	Title 47 CFR Parts 2 and 27
Test Standards:	<ul style="list-style-type: none"> • Title 47 CFR Parts 2 and 27 • KDB 971168 D01 Power Measurement License Digital Systems v03r01 April 9, 2018. • KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013 • ANSI C63.26 (2015) • ANSI C63.4 (2014)
Measurement Procedure(s):	<ul style="list-style-type: none"> • FCC-IC-OB - GPCL Power Measurement, Occupied Bandwidth & Modulation Test Procedure 6-20-2019 • FCC-IC-SE - GPCL Spurious Emissions Test Procedure 6-20-2019
Test Date(s):	7/14/2021 - 8/12/2021
Test Performed By:	Nokia Global Product Compliance Laboratory 600-700 Mountain Ave. P.O. Box 636 Murray Hill, NJ 07974-0636
Product Engineer(s):	Ron Remy
Lead Engineer:	Steve Gordon
Test Engineer (s):	Nilesh Patel
Test Results: The EUT, <i>as tested</i> met the above listed Test Requirements. The decision rule employed is binary (Pass/Fail) based on the measured values without accounting for Measurement Uncertainty or any Guard Band. The measured values obtained during testing were compared to a value given in the referenced regulation or normative standard. 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 AirScale MAA 64T64R B41 320W AEHC (AEHC), hereinafter referred to as the Equipment Under Test (EUT).

1.2 Purpose and Scope

The purpose of this document is to provide the 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 report covers the Class II Permissive change to add new 5G/LTE and only 5G multicarrier configurations to the existing grant. No new bandwidths are being added. The AEHC product is certified under FCC ID: VBNAEHC-01.

The following new multicarrier configurations were tested:

5G NR/LTE (37dBm(5W) per port Total)

- LTE 20+5G NR 90
- 5G NR 50+LTE 20
- 5G NR 50+LTE 2x20
- 5G NR 50+LTE 3x20
- LTE 2x20 + 5G NR 90
- 5G NR 2x40+LTE 2x20
- 5G NR 2x50+LTE 2x20
- 5G NR 2x40+LTE 3x20
- 5G NR 2x50+LTE 3x20
- LTE 3x20 + 5G NR 90

5G NR/5G NR only (37dBm(5W) per port Total)

- 5G NR 100+5G NR 20
- 5G NR 100+5G NR 40
- 5G NR 60+5G NR 100
- 5G NR 80+5G NR 100
- 5G NR 60+5G NR 40

No Frequency Stability testing was considered necessary for this test program since there were no changes to the basic frequency determining and stabilizing circuitry (including clock and data rates).

1.3 EUT Details

1.3.1 Specifications

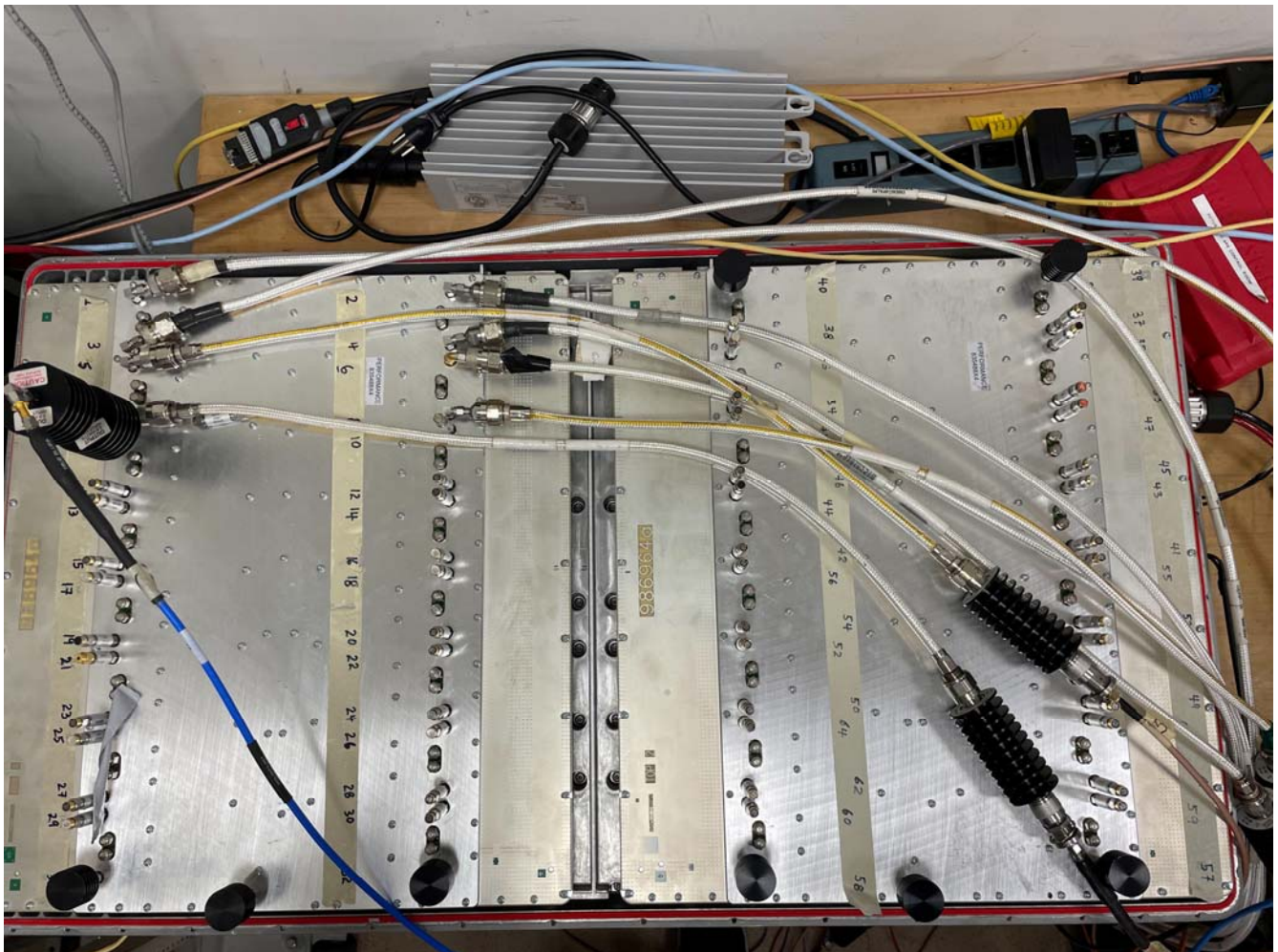
Radio Characteristics	
Max RF Output Power	320 W (5 W per TRX)
TX / RX	64T64R
Band / Frequency Range	n41: 2496 - 2690 MHz
Instantaneous bandwidth (IBW)	194 MHz
Occupied bandwidth (OBW)	190 MHz
Carrier bandwidth	20, 40, 50, 60, 70, 80, 100 MHz
Operating mode	64TRX Digital Beamforming

Other Characteristics	
External Interfaces	4 * SFP28 for eCPRI 10/25, DC -48 V, AISG-ES-RAE 2.0, ext. alarms MDR-26
Installation Options	Pole / Wall with mechanical adjustment

Antenna Characteristics	
Antenna configurations	physical: 12, 8, 2 (192 AE) logical: 4, 8, 2
Minimum beamwidth	horizontal: 15° (boresight) vertical: 6° (boresight)
Beamsteering angle	horizontal: ±45° vertical: ±6°
Maximum antenna gain	>=25.5 dBi

1.3.2 Photographs

Serial Number



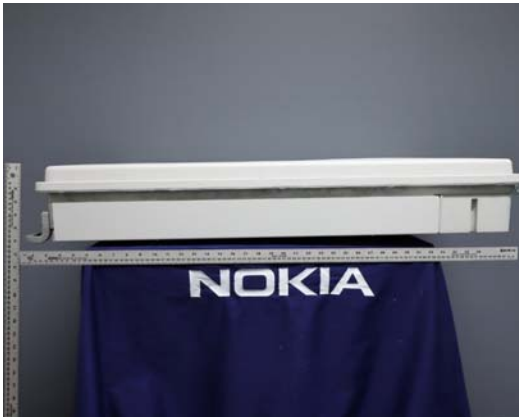
Front



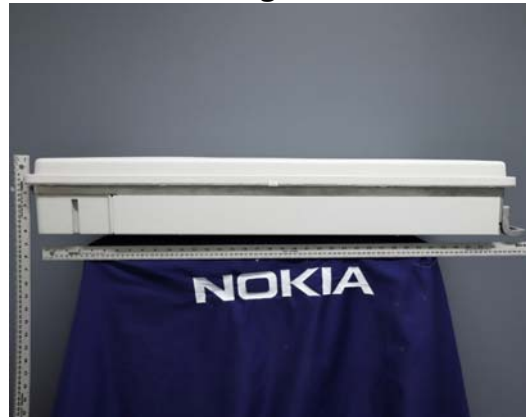
Rear



Left



Right



Top



Bottom



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 (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	No*

* No Frequency Stability testing was considered necessary for this test program since there were no changes to the basic frequency determining and stabilizing circuitry (including clock and data rates.)

1.5 Test Standards & Measurement Procedures

1.5.1 Test Standards

- Title 47 Code of Federal Regulations, Federal Communications Commission Part 2.
- Title 47 Code of Federal Regulations, Federal Communications Commission Part 27.
- KDB 971168 D01 Power Measurement License Digital Systems v03r01 April 9, 2018.
- KDB 662911 D01 Multiple Transmitter Output v02r01 Oct 2013
- ANSI C63.26-2015, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
- ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

1.5.2 Measurement Procedures

- FCC-IC-OB - GPCL Power Measurement, Occupied Bandwidth & Modulation Test Procedure 6-20-2019
- FCC-IC-SE - GPCL Spurious Emissions Test Procedure 6-20-2019

1.6 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, 32, 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

1.7 Executive Summary

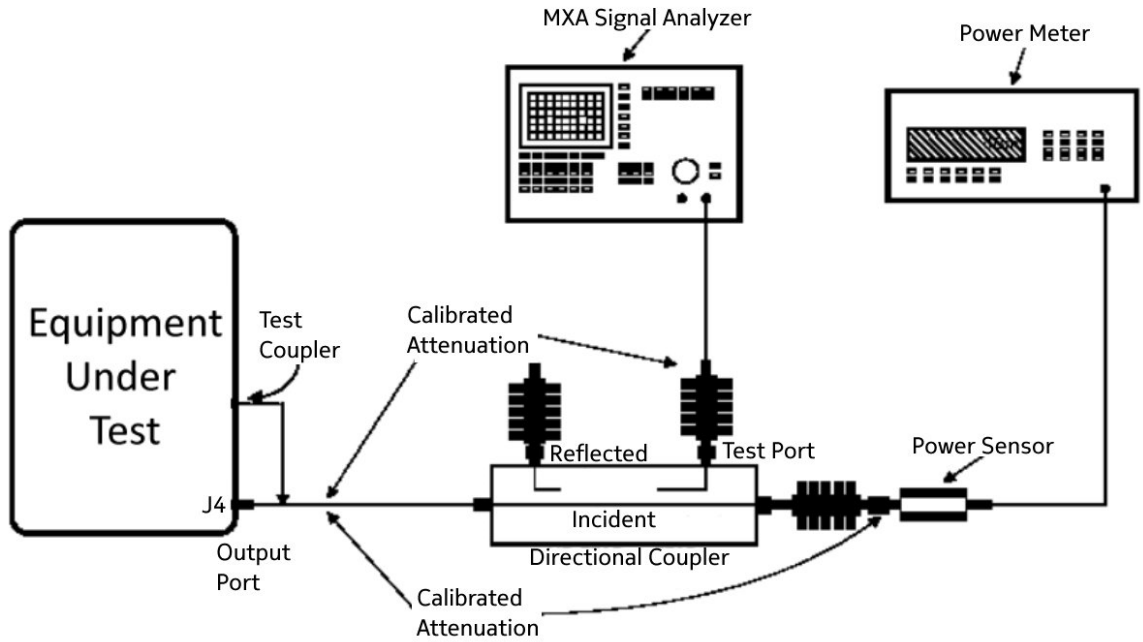
Requirement	Description	Result
47 CFR FCC Parts 2 and 27		
2.1046, 27.50	RF Power Output Peak to Average Power Ratio	COMPLIES
2.1047	Modulation Characteristics	COMPLIES
2.1049, 27.53	(a) Occupied Bandwidth (b) Edge of Band Emissions	COMPLIES
2.1051, 27.53	Spurious Emissions at Antenna Terminals	COMPLIES
2.1053, 27.53	Field Strength of Spurious Radiation	COMPLIES
2.1055, 27.54	Frequency Stability	NT*

* No Frequency Stability testing was considered necessary for this test program since there were no changes to the basic frequency determining and stabilizing circuitry (including clock and data rates.)

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

1.8 Test Configurations

Test Setup for all Antenna Port Measurements



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. The product was configured for test as shown in section above and allowed to warm up and stabilize per KDB 971168 D01 and ANSI C63.26. The product has 64 ports divided into 8 segments. One segment of 8 ports was measured and is representative of the remaining segments. Power measurements were made with an MXA Signal Analyzer

2.1.1 5G-NR Only

Tabular Data – Channel RF Power (2-Carrier TM1.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2559 + 2640	60 + 100	QPSK	35.75
2	2559 + 2640	60 + 100	QPSK	37.02
3	2559 + 2640	60 + 100	QPSK	37.58
4	2559 + 2640	60 + 100	QPSK	35.98
5	2559 + 2640	60 + 100	QPSK	36.81
6	2559 + 2640	60 + 100	QPSK	36.77
7	2559 + 2640	60 + 100	QPSK	36.07
8	2559 + 2640	60 + 100	QPSK	35.75
1	2546 + 2616	100 + 40	QPSK	35.90
2	2546 + 2616	100 + 40	QPSK	37.16
3	2546 + 2616	100 + 40	QPSK	37.63
4	2546 + 2616	100 + 40	QPSK	36.14
5	2546 + 2616	100 + 40	QPSK	36.96
6	2546 + 2616	100 + 40	QPSK	36.91
7	2546 + 2616	100 + 40	QPSK	36.20
8	2546 + 2616	100 + 40	QPSK	35.95

Tabular Data – Channel RF Power (2-Carrier TM3.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2526 + 2606	60 + 100	64QAM	35.70
2	2526 + 2606	60 + 100	64QAM	36.92
3	2526 + 2606	60 + 100	64QAM	37.47
4	2526 + 2606	60 + 100	64QAM	35.91
5	2526 + 2606	60 + 100	64QAM	36.73
6	2526 + 2606	60 + 100	64QAM	36.71
7	2526 + 2606	60 + 100	64QAM	36.02
8	2526 + 2606	60 + 100	64QAM	35.68

1	2546 + 2606	100 + 20	64QAM	36.88
2	2546 + 2606	100 + 20	64QAM	38.19
3	2546 + 2606	100 + 20	64QAM	38.51
4	2546 + 2606	100 + 20	64QAM	37.11
5	2546 + 2606	100 + 20	64QAM	37.92
6	2546 + 2606	100 + 20	64QAM	37.87
7	2546 + 2606	100 + 20	64QAM	37.14
8	2546 + 2606	100 + 20	64QAM	36.89

Tabular Data – Channel RF Power (2-Carrier TM3.1a)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2526 + 2670	60 + 40	256QAM	35.58
2	2526 + 2670	60 + 40	256QAM	36.83
3	2526 + 2670	60 + 40	256QAM	37.41
4	2526 + 2670	60 + 40	256QAM	35.82
5	2526 + 2670	60 + 40	256QAM	36.63
6	2526 + 2670	60 + 40	256QAM	36.61
7	2526 + 2670	60 + 40	256QAM	35.91
8	2526 + 2670	60 + 40	256QAM	35.70
1	2620 + 2670	60 + 40	256QAM	35.36
2	2620 + 2670	60 + 40	256QAM	36.73
3	2620 + 2670	60 + 40	256QAM	36.57
4	2620 + 2670	60 + 40	256QAM	35.62
5	2620 + 2670	60 + 40	256QAM	36.50
6	2620 + 2670	60 + 40	256QAM	36.43
7	2620 + 2670	60 + 40	256QAM	35.71
8	2620 + 2670	60 + 40	256QAM	35.44
1	2550 + 2640	80 + 100	256QAM	35.63
2	2550 + 2640	80 + 100	256QAM	36.79
3	2550 + 2640	80 + 100	256QAM	36.81
4	2550 + 2640	80 + 100	256QAM	35.87
5	2550 + 2640	80 + 100	256QAM	36.72
6	2550 + 2640	80 + 100	256QAM	36.47
7	2550 + 2640	80 + 100	256QAM	35.96
8	2550 + 2640	80 + 100	256QAM	35.68
1	2619 + 2679	100 + 20	256QAM	36.91
2	2619 + 2679	100 + 20	256QAM	38.35
3	2619 + 2679	100 + 20	256QAM	38.07
4	2619 + 2679	100 + 20	256QAM	37.20
5	2619 + 2679	100 + 20	256QAM	38.05
6	2619 + 2679	100 + 20	256QAM	37.97
7	2619 + 2679	100 + 20	256QAM	37.29
8	2619 + 2679	100 + 20	256QAM	36.99

1	2599 + 2670	100 + 40	256QAM	35.51
2	2599 + 2670	100 + 40	256QAM	36.96
3	2599 + 2670	100 + 40	256QAM	37.38
4	2599 + 2670	100 + 40	256QAM	35.79
5	2599 + 2670	100 + 40	256QAM	36.63
6	2599 + 2670	100 + 40	256QAM	36.56
7	2599 + 2670	100 + 40	256QAM	35.84
8	2599 + 2670	100 + 40	256QAM	35.63

Tabular Data – Channel RF Power (2-Carrier TM3.2)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2526 + 2576	60 + 40	QPSK/16QAM	35.60
2	2526 + 2576	60 + 40	QPSK/16QAM	36.62
3	2526 + 2576	60 + 40	QPSK/16QAM	36.79
4	2526 + 2576	60 + 40	QPSK/16QAM	35.84
5	2526 + 2576	60 + 40	QPSK/16QAM	36.65
6	2526 + 2576	60 + 40	QPSK/16QAM	36.45
7	2526 + 2576	60 + 40	QPSK/16QAM	35.92
8	2526 + 2576	60 + 40	QPSK/16QAM	35.66
1	2593 + 2643	60 + 40	QPSK/16QAM	35.56
2	2593 + 2643	60 + 40	QPSK/16QAM	36.77
3	2593 + 2643	60 + 40	QPSK/16QAM	36.71
4	2593 + 2643	60 + 40	QPSK/16QAM	35.79
5	2593 + 2643	60 + 40	QPSK/16QAM	36.65
6	2593 + 2643	60 + 40	QPSK/16QAM	36.59
7	2593 + 2643	60 + 40	QPSK/16QAM	35.89
8	2593 + 2643	60 + 40	QPSK/16QAM	35.62
1	2536 + 2626	80 + 100	QPSK/16QAM	35.74
2	2536 + 2626	80 + 100	QPSK/16QAM	36.90
3	2536 + 2626	80 + 100	QPSK/16QAM	37.52
4	2536 + 2626	80 + 100	QPSK/16QAM	35.98
5	2536 + 2626	80 + 100	QPSK/16QAM	36.81
6	2536 + 2626	80 + 100	QPSK/16QAM	36.77
7	2536 + 2626	80 + 100	QPSK/16QAM	36.06
8	2536 + 2626	80 + 100	QPSK/16QAM	35.75
1	2546 + 2679	100 + 20	QPSK/16QAM	36.44
2	2546 + 2679	100 + 20	QPSK/16QAM	37.70
3	2546 + 2679	100 + 20	QPSK/16QAM	37.57
4	2546 + 2679	100 + 20	QPSK/16QAM	36.71
5	2546 + 2679	100 + 20	QPSK/16QAM	37.53
6	2546 + 2679	100 + 20	QPSK/16QAM	37.48
7	2546 + 2679	100 + 20	QPSK/16QAM	36.78
8	2546 + 2679	100 + 20	QPSK/16QAM	36.49

1	2592 + 2652	100 + 20	QPSK/16QAM	36.84
2	2592 + 2652	100 + 20	QPSK/16QAM	38.11
3	2592 + 2652	100 + 20	QPSK/16QAM	38.70
4	2592 + 2652	100 + 20	QPSK/16QAM	37.09
5	2592 + 2652	100 + 20	QPSK/16QAM	37.93
6	2592 + 2652	100 + 20	QPSK/16QAM	37.86
7	2592 + 2652	100 + 20	QPSK/16QAM	37.17
8	2592 + 2652	100 + 20	QPSK/16QAM	36.87
1	2592 + 2663	100 + 40	QPSK/16QAM	35.61
2	2592 + 2663	100 + 40	QPSK/16QAM	36.93
3	2592 + 2663	100 + 40	QPSK/16QAM	37.45
4	2592 + 2663	100 + 40	QPSK/16QAM	35.87
5	2592 + 2663	100 + 40	QPSK/16QAM	36.71
6	2592 + 2663	100 + 40	QPSK/16QAM	36.63
7	2592 + 2663	100 + 40	QPSK/16QAM	35.93
8	2592 + 2663	100 + 40	QPSK/16QAM	35.69

2.1.2 5G-NR + LTE Data

Tabular Data – Channel RF Power (2-Carrier TM1.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2521 + 2680	50 + 20	QPSK	36.47
2	2521 + 2680	50 + 20	QPSK	37.49
3	2521 + 2680	50 + 20	QPSK	37.40
4	2521 + 2680	50 + 20	QPSK	36.81
5	2521 + 2680	50 + 20	QPSK	37.73
6	2521 + 2680	50 + 20	QPSK	37.90
7	2521 + 2680	50 + 20	QPSK	36.89
8	2521 + 2680	50 + 20	QPSK	36.81

2.1.3 5G-NR + 2xLTE Data

Tabular Data – Channel RF Power (3-Carrier TM1.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2521 + 2660 + 2680	50 + 20 + 20	QPSK	36.67
2	2521 + 2660 + 2680	50 + 20 + 20	QPSK	37.77
3	2521 + 2660 + 2680	50 + 20 + 20	QPSK	37.54
4	2521 + 2660 + 2680	50 + 20 + 20	QPSK	37.05
5	2521 + 2660 + 2680	50 + 20 + 20	QPSK	38.13

6	2521 + 2660 + 2680	50 + 20 + 20	QPSK	38.38
7	2521 + 2660 + 2680	50 + 20 + 20	QPSK	37.28
8	2521 + 2660 + 2680	50 + 20 + 20	QPSK	37.33

2.1.4 5G-NR + 3xLTE Data

Tabular Data – Channel RF Power (4-Carrier TM1.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2521 + 2640 + 2660 + 2680	50 + 20 + 20 + 20	QPSK	36.86
2	2521 + 2640 + 2660 + 2680	50 + 20 + 20 + 20	QPSK	38.03
3	2521 + 2640 + 2660 + 2680	50 + 20 + 20 + 20	QPSK	37.90
4	2521 + 2640 + 2660 + 2680	50 + 20 + 20 + 20	QPSK	37.36
5	2521 + 2640 + 2660 + 2680	50 + 20 + 20 + 20	QPSK	38.53
6	2521 + 2640 + 2660 + 2680	50 + 20 + 20 + 20	QPSK	38.92
7	2521 + 2640 + 2660 + 2680	50 + 20 + 20 + 20	QPSK	37.66
8	2521 + 2640 + 2660 + 2680	50 + 20 + 20 + 20	QPSK	37.75

2.1.5 2x5G-NR + 2xLTE Data

Tabular Data – Channel RF Power (4-Carrier TM3.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2516 + 2556 + 2660 + 2680	40 + 40 + 20 + 20	64QAM	35.26
2	2516 + 2556 + 2660 + 2680	40 + 40 + 20 + 20	64QAM	36.62
3	2516 + 2556 + 2660 + 2680	40 + 40 + 20 + 20	64QAM	36.98
4	2516 + 2556 + 2660 + 2680	40 + 40 + 20 + 20	64QAM	35.75
5	2516 + 2556 + 2660 + 2680	40 + 40 + 20 + 20	64QAM	36.90
6	2516 + 2556 + 2660 + 2680	40 + 40 + 20 + 20	64QAM	37.21
7	2516 + 2556 + 2660 + 2680	40 + 40 + 20 + 20	64QAM	36.12
8	2516 + 2556 + 2660 + 2680	40 + 40 + 20 + 20	64QAM	36.26

Tabular Data – Channel RF Power (4-Carrier TM3.1a)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2521 + 2571 + 2640 + 2680	50 + 50 + 20 + 20	256QAM	35.13
2	2521 + 2571 + 2640 + 2680	50 + 50 + 20 + 20	256QAM	36.42
3	2521 + 2571 + 2640 + 2680	50 + 50 + 20 + 20	256QAM	36.85
4	2521 + 2571 + 2640 + 2680	50 + 50 + 20 + 20	256QAM	35.59
5	2521 + 2571 + 2640 + 2680	50 + 50 + 20 + 20	256QAM	36.71
6	2521 + 2571 + 2640 + 2680	50 + 50 + 20 + 20	256QAM	36.93
7	2521 + 2571 + 2640 + 2680	50 + 50 + 20 + 20	256QAM	35.96
8	2521 + 2571 + 2640 + 2680	50 + 50 + 20 + 20	256QAM	35.91

2.1.6 2x5G-NR + 3xLTE Data

Tabular Data – Channel RF Power (5-Carrier TM1.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2521 + 2592+2640 + 2660 + 2680	50 + 50 + 60	QPSK	34.84
2	2521 + 2592+2640 + 2660 + 2680	50 + 50 + 60	QPSK	36.28
3	2521 + 2592+2640 + 2660 + 2680	50 + 50 + 60	QPSK	36.56
4	2521 + 2592+2640 + 2660 + 2680	50 + 50 + 60	QPSK	35.44
5	2521 + 2592+2640 + 2660 + 2680	50 + 50 + 60	QPSK	36.85
6	2521 + 2592+2640 + 2660 + 2680	50 + 50 + 60	QPSK	37.38
7	2521 + 2592+2640 + 2660 + 2680	50 + 50 + 60	QPSK	36.07
8	2521 + 2592+2640 + 2660 + 2680	50 + 50 + 60	QPSK	36.36

Tabular Data – Channel RF Power (5-Carrier TM3.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2516 + 2556+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	35.15
2	2516 + 2556+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	36.66
3	2516 + 2556+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	36.90
4	2516 + 2556+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	35.76
5	2516 + 2556+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	37.12
6	2516 + 2556+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	37.60
7	2516 + 2556+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	36.32
8	2516 + 2556+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	36.64
1	2516 + 2592+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	35.60
2	2516 + 2592+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	37.05
3	2516 + 2592+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	37.38
4	2516 + 2592+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	36.14
5	2516 + 2592+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	37.49
6	2516 + 2592+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	37.92
7	2516 + 2592+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	36.69
8	2516 + 2592+2640 + 2660 + 2680	40 + 40 + 20 + 20 + 20	64QAM	36.97
1	2521 + 2571+2640 + 2660 + 2680	50 + 50 + 20 + 20 + 20	64QAM	34.65
2	2521 + 2571+2640 + 2660 + 2680	50 + 50 + 20 + 20 + 20	64QAM	36.17
3	2521 + 2571+2640 + 2660 + 2680	50 + 50 + 20 + 20 + 20	64QAM	36.41
4	2521 + 2571+2640 + 2660 + 2680	50 + 50 + 20 + 20 + 20	64QAM	35.29
5	2521 + 2571+2640 + 2660 + 2680	50 + 50 + 20 + 20 + 20	64QAM	36.67
6	2521 + 2571+2640 + 2660 + 2680	50 + 50 + 20 + 20 + 20	64QAM	37.22
7	2521 + 2571+2640 + 2660 + 2680	50 + 50 + 20 + 20 + 20	64QAM	35.90
8	2521 + 2571+2640 + 2660 + 2680	50 + 50 + 20 + 20 + 20	64QAM	36.20

2.1.7 LTE + 5G-NR Data

Tabular Data – Channel RF Power (2-Carrier TM3.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2506 + 2644	20 + 90	64QAM	35.74
2	2506 + 2644	20 + 90	64QAM	36.70
3	2506 + 2644	20 + 90	64QAM	36.89
4	2506 + 2644	20 + 90	64QAM	36.20
5	2506 + 2644	20 + 90	64QAM	37.13
6	2506 + 2644	20 + 90	64QAM	37.30
7	2506 + 2644	20 + 90	64QAM	36.44
8	2506 + 2644	20 + 90	64QAM	36.40

2.1.8 2xLTE + 5G-NR Data

Tabular Data – Channel RF Power (3-Carrier TM3.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2506 + 2526 + 2644	20 + 20 + 90	64QAM	35.95
2	2506 + 2526 + 2644	20 + 20 + 90	64QAM	37.01
3	2506 + 2526 + 2644	20 + 20 + 90	64QAM	37.02
4	2506 + 2526 + 2644	20 + 20 + 90	64QAM	36.49
5	2506 + 2526 + 2644	20 + 20 + 90	64QAM	37.53
6	2506 + 2526 + 2644	20 + 20 + 90	64QAM	37.90
7	2506 + 2526 + 2644	20 + 20 + 90	64QAM	36.85
8	2506 + 2526 + 2644	20 + 20 + 90	64QAM	36.97

2.1.9 3xLTE + 5G-NR Data

Tabular Data – Channel RF Power (4-Carrier TM3.1)

TX Port	Channel Frequency MHz	Signal BW MHz	Modulation	Channel Power dBm
1	2506 + 2526 + 2546 + 2644	20 + 20 + 20 + 90	64QAM	36.36
2	2506 + 2526 + 2546 + 2644	20 + 20 + 20 + 90	64QAM	37.42
3	2506 + 2526 + 2546 + 2644	20 + 20 + 20 + 90	64QAM	37.25
4	2506 + 2526 + 2546 + 2644	20 + 20 + 20 + 90	64QAM	36.91
5	2506 + 2526 + 2546 + 2644	20 + 20 + 20 + 90	64QAM	38.05
6	2506 + 2526 + 2546 + 2644	20 + 20 + 20 + 90	64QAM	38.57
7	2506 + 2526 + 2546 + 2644	20 + 20 + 20 + 90	64QAM	37.34
8	2506 + 2526 + 2546 + 2644	20 + 20 + 20 + 90	64QAM	37.58

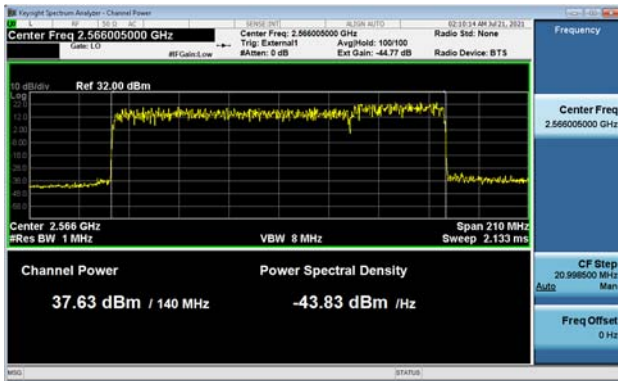
2.2 Channel RF Power – Plots

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.

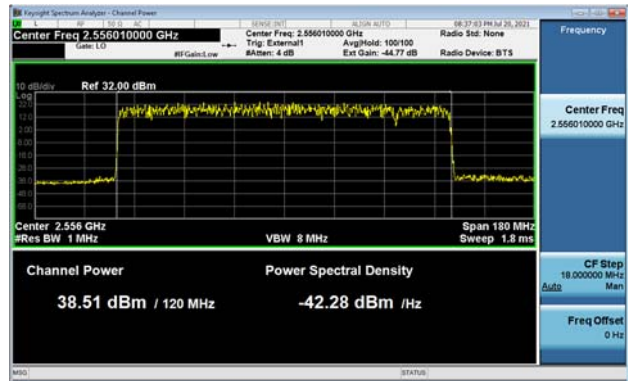
2.2.1 5G-NR Only Plots

Channel RF Power 2-Carrier

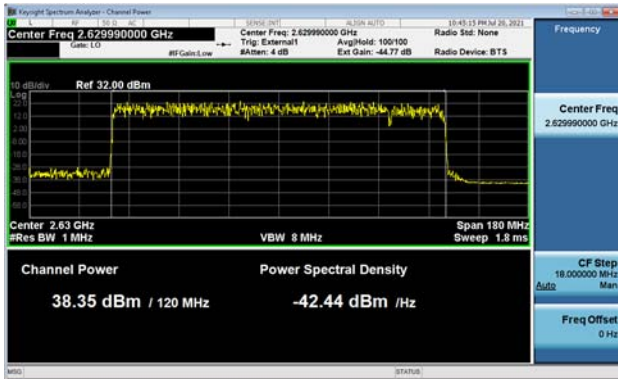
Test Model 1.1
Modulation QPSK
Channel Frequency 2546 + 2616MHz
TX3



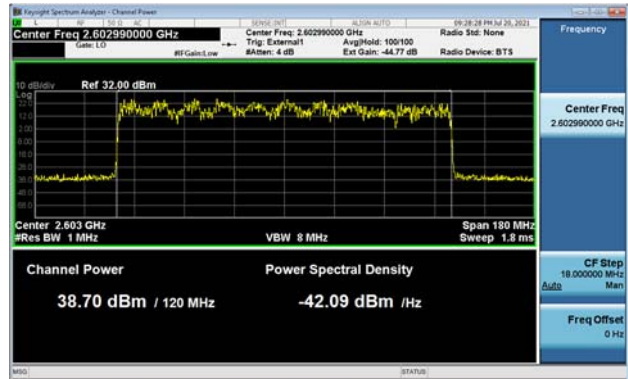
Test Model 3.1
Modulation 64QAM
Channel Frequency 2546 + 2606MHz
TX3



Test Model 3.1a
Modulation 256QAM
Channel Frequency 2619 + 2679MHz
TX2



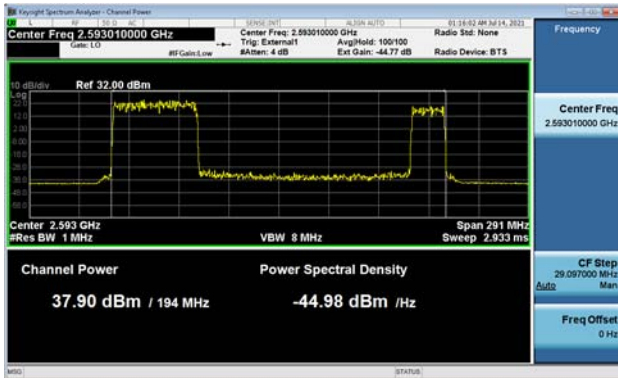
Test Model 3.2
Modulation QPSK/16QAM
Channel Frequency 2592 + 2652MHz
TX3



2.2.2 5G-NR + LTE Plots

Channel RF Power 2-Carrier

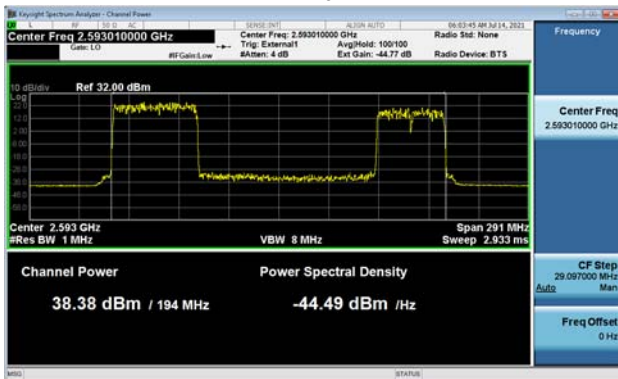
Test Model 1.1
Modulation QPSK
Channel Frequency 2521 + 2680MHz
TX6



2.2.3 5G-NR + 2xLTE Plots

Channel RF Power 3-Carrier

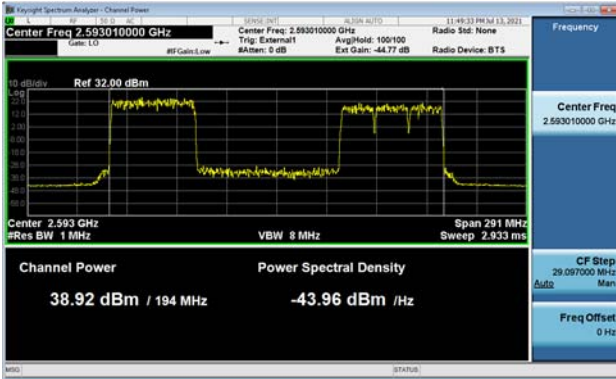
Test Model 1.1
Modulation QPSK
Channel Frequency 2521 + 2660 + 2680MHz
TX6



2.2.4 5G-NR + 3xLTE Plots

Channel RF Power 4-Carrier

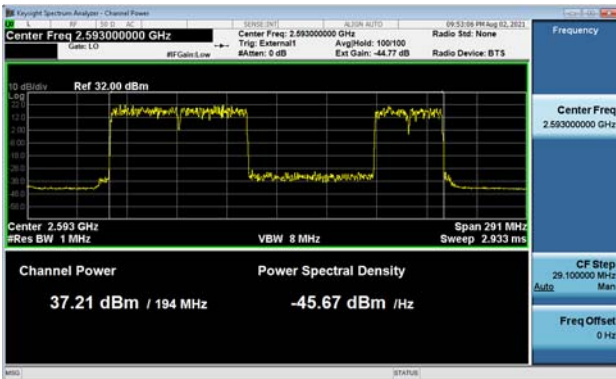
Test Model 1.1
Modulation QPSK
Channel Frequency 2521 + 2640 + 2660 + 2680MHz
TX6



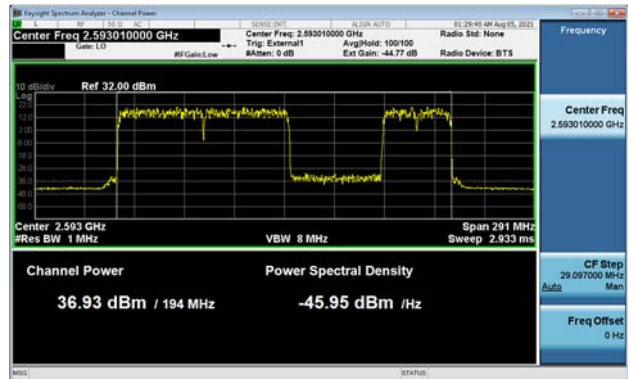
2.2.5 2x5G-NR + 2xLTE Plots

Channel RF Power 4-Carrier

Test Model 3.1
Modulation 64QAM
Channel Frequency 2516 + 2556 + 2660 + 2680MHz
TX6



Test Model 3.1a
Modulation 256QAM
Channel Frequency 2521 + 2571 + 2640 + 2680MHz
TX6

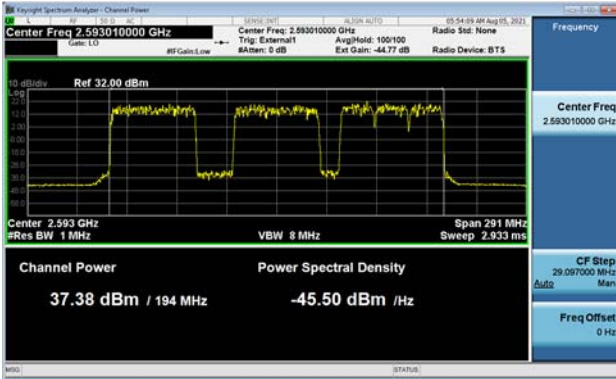


2.2.6 2x5G-NR + 3xLTE Plots

Channel RF Power 5-Carrier

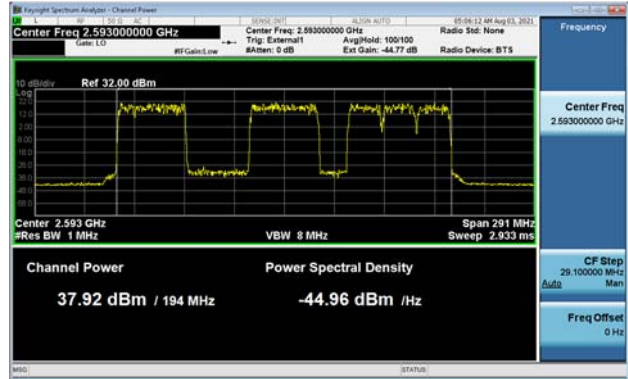
Test Model 1.1
Modulation QPSK

Channel Frequency 2521 + 2592 + 2640 + 2660 + 2680MHz
TX6



Test Model 3.1
Modulation 64QAM

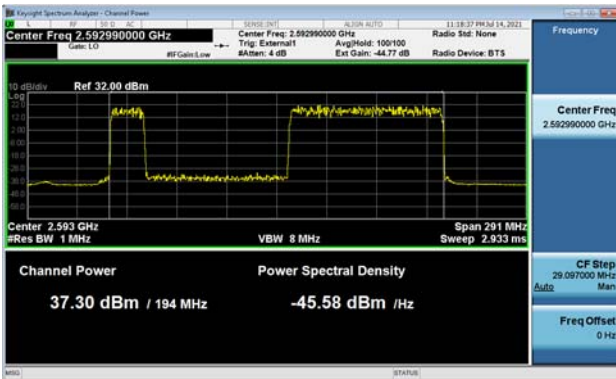
Channel Frequency 2516 + 2592 + 2640 + 2660 + 2680MHz
TX6



2.2.7 LTE + 5G-NR Plots

Channel RF Power 2-Carrier

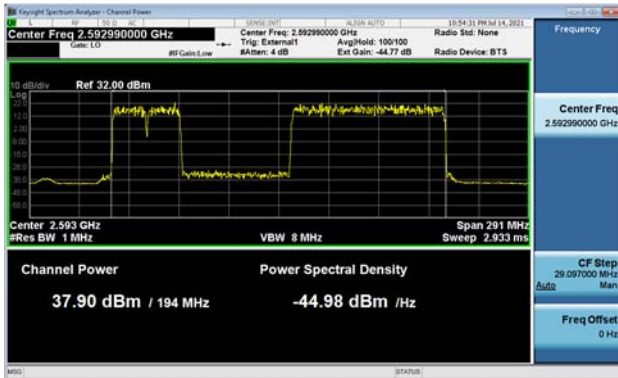
Test Model 3.1
Modulation 64QAM
Channel Frequency 2506 + 2644MHz
TX6



2.2.8 2xLTE + 5G-NR Plots

Channel RF Power 3-Carrier

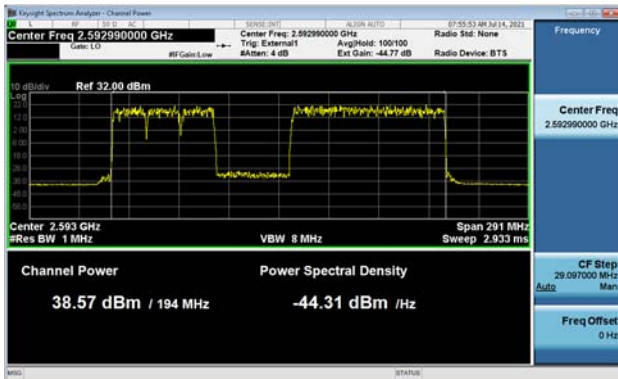
Test Model 3.1
Modulation 64QAM
Channel Frequency 2506 + 2526 + 2644MHz
TX6



2.2.9 3xLTE + 5G-NR Plots

Channel RF Power 4-Carrier

Test Model 3.1
Modulation 64QAM
Channel Frequency 2506 + 2526 + 2546 + 2644MHz
TX6



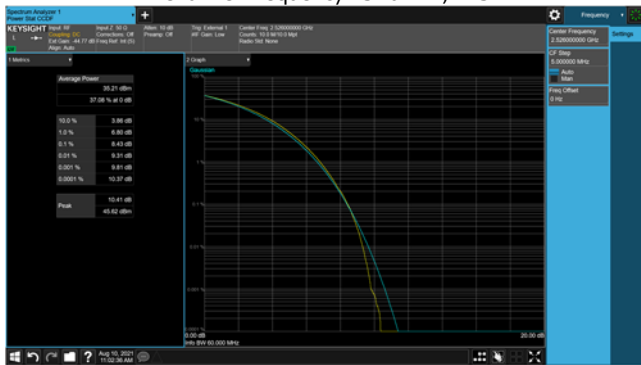
2.3 Peak-to-Average Power Ratio (PAPR)

The Peak-to-Average Power Ratio (PAPR) was evaluated per KDB 971168. The PAPR values of all carriers measured are below 13dB.

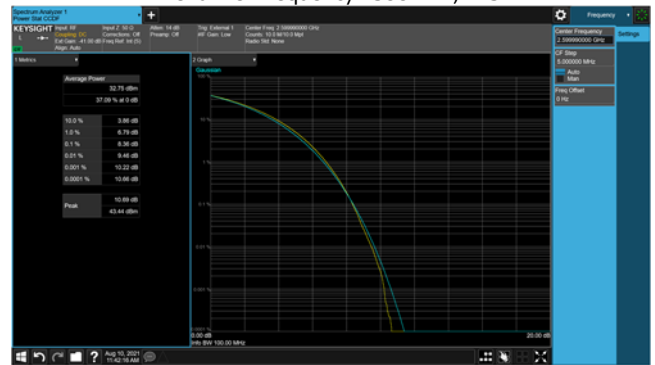
NOTE: Only a sample of the plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

2.3.1 Peak-to-Average Power Ratio – 5G Only Plots

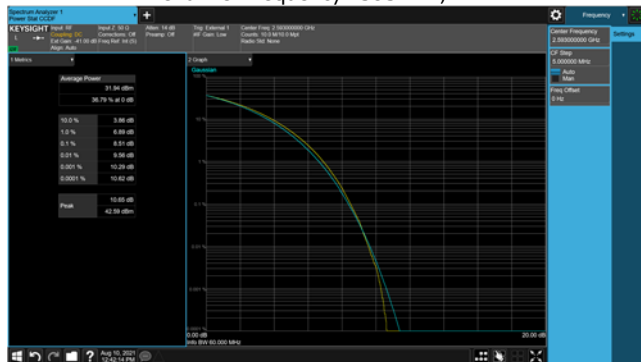
Test Model 3.1
 Modulation 64QAM
 Channel Frequency 2526MHz, TX3



Test Model 3.1a
 Modulation 256QAM
 Channel Frequency 2599MHz, TX3

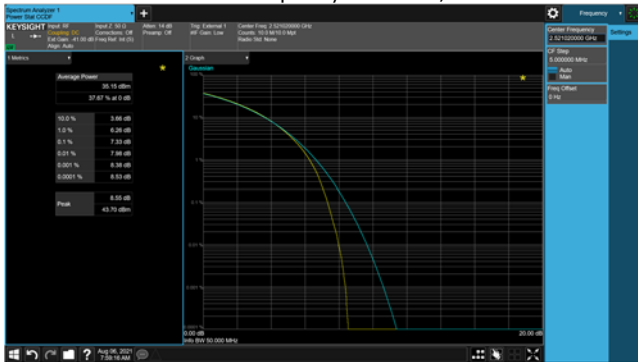


Test Model 3.2
 Modulation QPSK/16QAM
 Channel Frequency 2593MHz, TX2



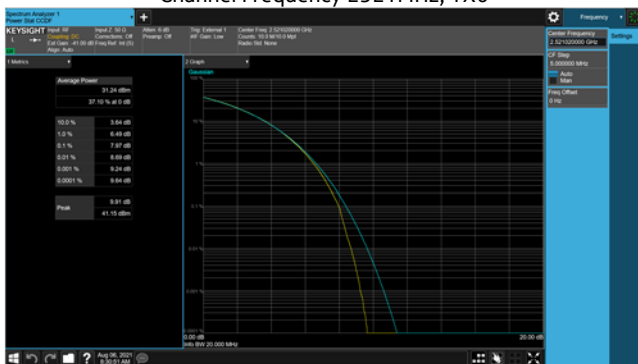
2.3.2 Peak-to-Average Power Ratio – 5G-NR + LTE Plots

Test Model 1.1
Modulation QPSK
Channel Frequency 2521MHz, TX6



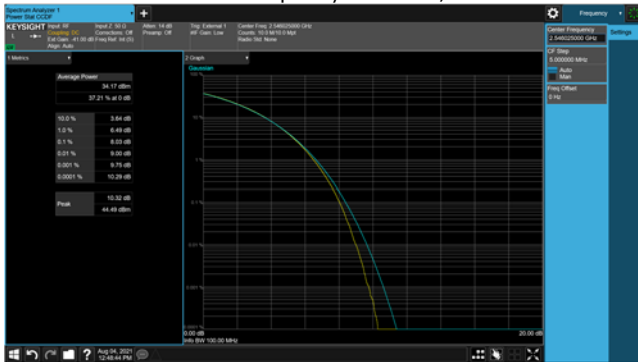
2.3.3 Peak-to-Average Power Ratio – 5G-NR + 2xLTE Plots

Test Model 1.1
Modulation QPSK
Channel Frequency 2521MHz, TX6



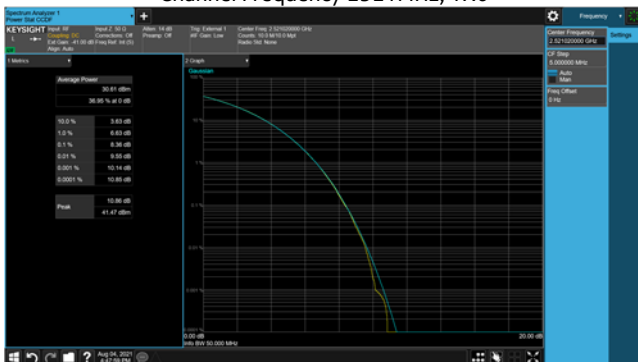
2.3.4 Peak-to-Average Power Ratio – 2x5G-NR + 2xLTE Plots

Test Model 3.1a
 Modulation 256QAM
 Channel Frequency 2546MHz, TX6

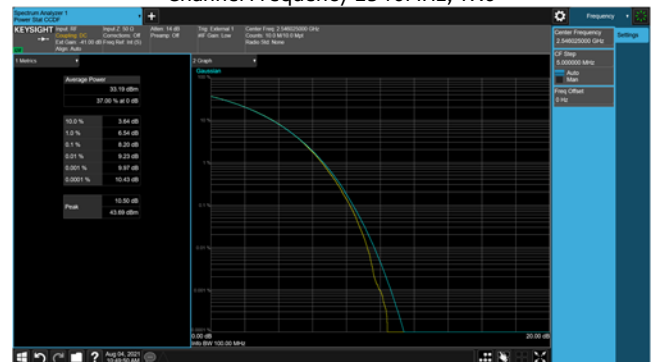


2.3.5 Peak-to-Average Power Ratio – 2x5G-NR + 3xLTE Plots

Test Model 1.1
 Modulation QPSK
 Channel Frequency 2521MHz, TX6

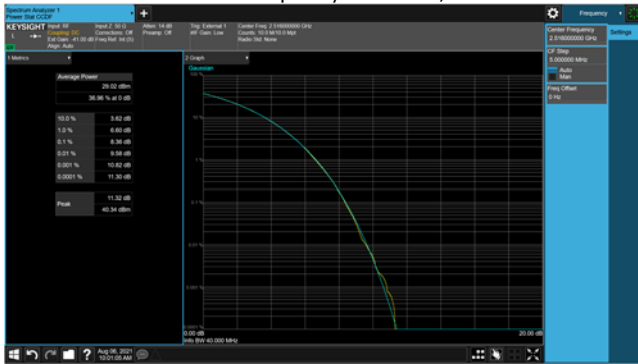


Test Model 3.1
 Modulation 64QAM
 Channel Frequency 2546MHz, TX6



2.3.6 Peak-to-Average Power Ratio – 2xLTE + 5G-NR Plots

Test Model 1.1
Modulation QPSK
Channel Frequency 2516MHz, TX6



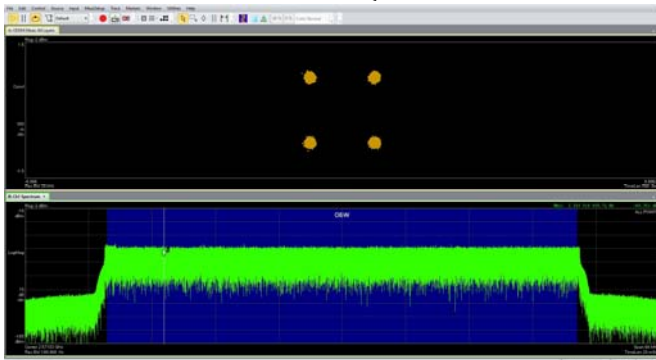
3. FCC Section 2.1047 - Modulation Characteristics

3.1 Modulation Characteristics

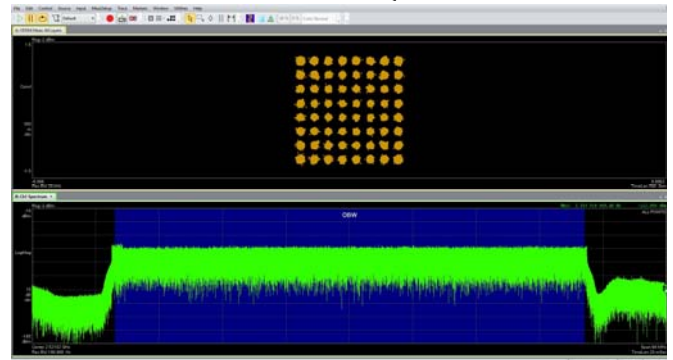
The RF signal at the antenna port was demodulated and verified for correctness of the modulation signal used before each test was performed.

3.1.1 Modulation Characteristics – 5G-NR Plots

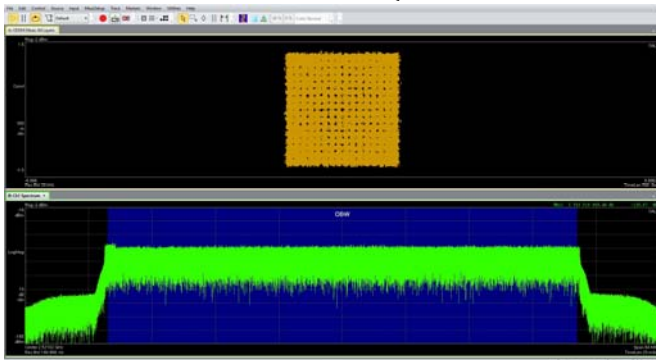
Modulation QPSK



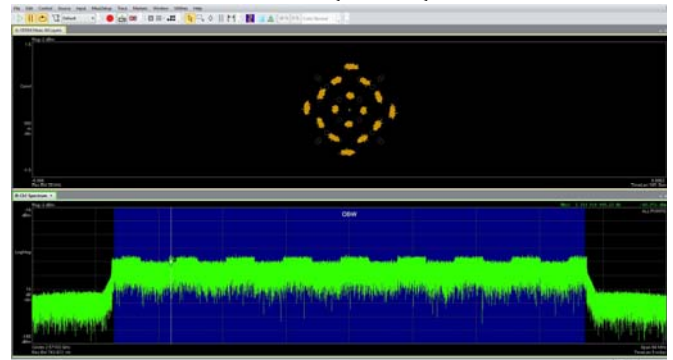
Modulation 64QAM



Modulation 256QAM

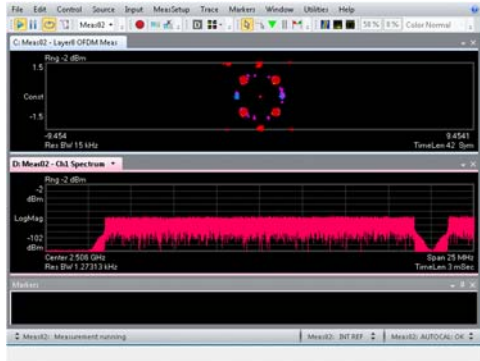


Modulation QPSK/16QAM

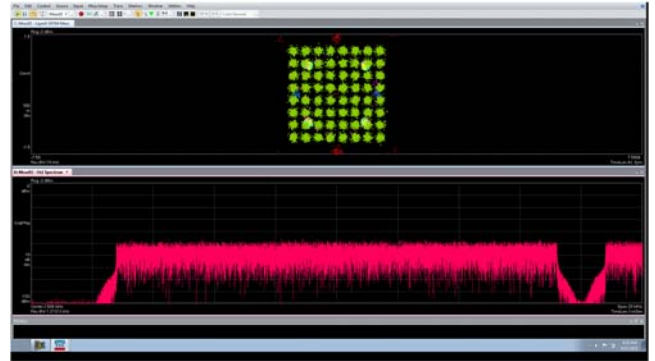


3.1.2 Modulation Characteristics – LTE Plots

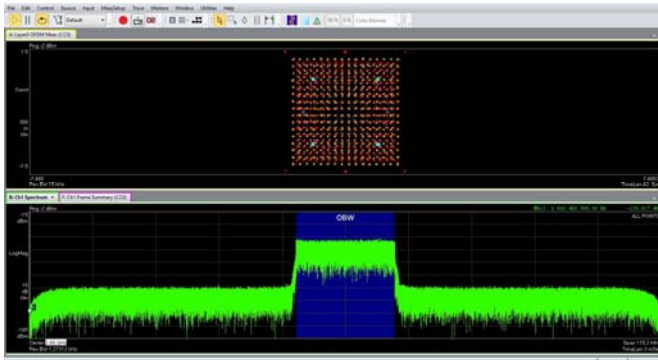
Modulation QPSK



Modulation 64QAM



Modulation 256QAM



Modulation QPSK/16QAM



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.”

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. During these measurements it is customary to evaluate the Edge of Band emissions at block/band edges.

The transmitted signal occupied bandwidth was measured using a Keysight MXA Signal Analyzer. All emissions were within the parameters as required.

Tabular Data – Occupied Bandwidth

# of Carriers	Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Radio Access Technology	Occupied BW MHz
2	1.1	QPSK	2	2546_2616	140	5G-NR	136.48
2	1.1	QPSK	3	2559_2640	160	5G-NR	156.41
2	3.1	64QAM	3	2546+2606	100+20	5G-NR	116.66
2	3.1	64QAM	3	2526_2606	160	5G-NR	156.42
2	3.1a	256QAM	3	2526+2670	60+40	5G-NR	57.699+38.140
2	3.1a	256QAM	3	2620+2670	60+40	5G-NR	97.343
2	3.1a	256QAM	3	2550+2640	80+100	5G-NR	175.69
2	3.1a	256QAM	2	2619+2679	100+20	5G-NR	116.95
2	3.1a	256QAM	3	2599_2670	140	5G-NR	137.24
2	3.2	QPSK/16QAM	3	2536_2626	180	5G-NR	176.47
2	3.2	QPSK/16QAM	2	2593+2643	60+40	5G-NR	97.604
2	3.2	QPSK/16QAM	2	2546+2679	100+20	5G-NR	97.018+18.847
2	3.2	QPSK/16QAM	3	2592+2652	100+20	5G-NR	117.68
2	3.2	QPSK/16QAM	3	2526_2576	100	5G-NR	97.501
2	3.2	QPSK/16QAM	3	2592_2663	140	5G-NR	136.94
2	1.1	QPSK	6	2521+2680	50+20	5G-NR+LTE	47.506+18.369
3	1.1	QPSK	6	2521+2660+2680	50+20+20	5G-NR+LTE+LTE	47.501+37.891
4	1.1	QPSK	6	2521+2640+2660+2680	50+20+20+20	5G-NR+LTE+LTE+LTE	47.502+57.437
4	3.1	64QAM	5	2516+2556+2660+2680	40+40+20+20	5G-NR+5G-NR+LTE+LTE	77.624+37.861
4	3.1a	256QAM	6	2521+2571+2640+2680	50+50+20+20	5G-NR+5G-NR+LTE+LTE	97.334+37.729
5	1.1	QPSK	6	2521+2592+2640+2660+2680	50+50+60	5G-NR+5G-NR+LTE+LTE+LTE	47.668+47.691+57.411
5	3.1	64QAM	6	2516+2556+2640+2660+2680	40+40+20+20+20	5G-NR+5G-NR+LTE+LTE+LTE	77.611+57.544
5	3.1	64QAM	6	2516+2592+2640+2660+2680	40+40+20+20+20	5G-NR+5G-NR+LTE+LTE+LTE	38.128+38.306+57.159
5	3.1	64QAM	6	2521+2571+2640+2660+2680	50+50+20+20+20	5G-NR+5G-NR+LTE+LTE+LTE	97.011+57.464

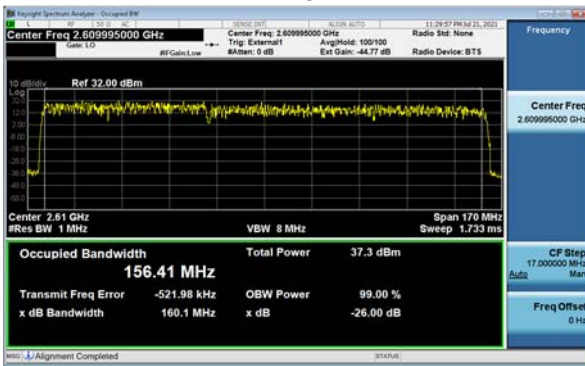
2	3.1	64QAM	6	2506+2644	20+90	LTE+5G-NR	18.314+87.230
3	3.1	64QAM	6	2506 + 2526 + 2644	20+20+90	LTE+LTE+5G-NR	37.972+87.254
4	3.1	64QAM	6	2506+2526+2546+2644	20+20+20+90	LTE+LTE+LTE+5G-NR	57.804+86.974

4.1.1 Occupied Bandwidth - Plots

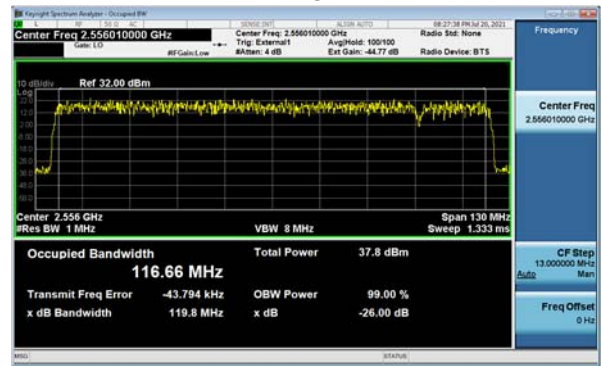
NOTE: Only a sample of the plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

4.1.1.1 5G-NR Only Plots

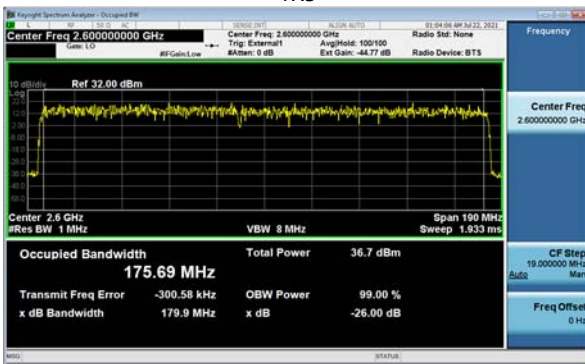
Test Model 1.1
 Modulation QPSK
 Channel Frequency 2559_2640MHz
 TX3



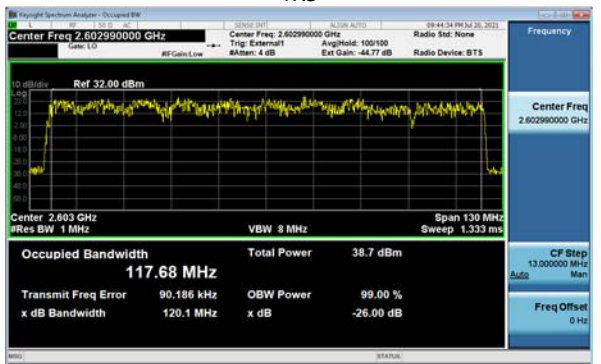
Test Model 3.1
 Modulation 64QAM
 Channel Frequency 2546+2606MHz
 TX3



Test Model 3.1a
 Modulation 256QAM
 Channel Frequency 2550+2640MHz
 TX3

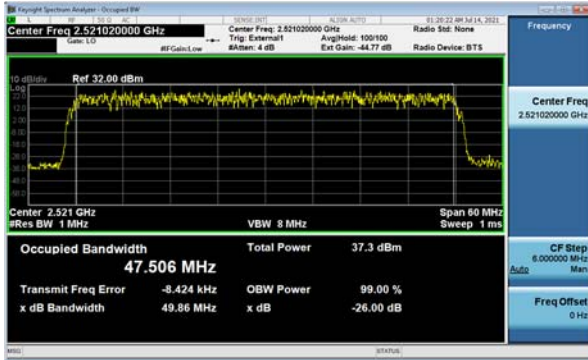


Test Model 3.2
 Modulation QPSK/16QAM
 Channel Frequency 2592+2652MHz
 TX3



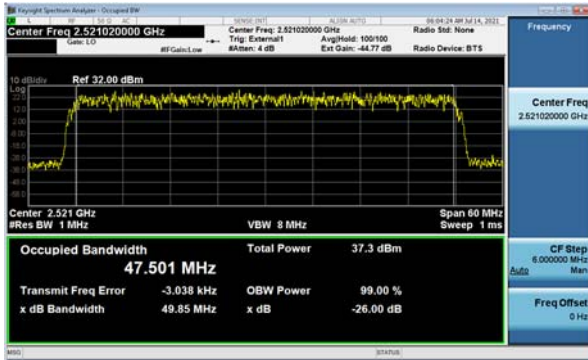
4.1.1.2 5G-NR + LTE Plots

Test Model 1.1
Modulation QPSK
Channel Frequency 2521MHz
TX6



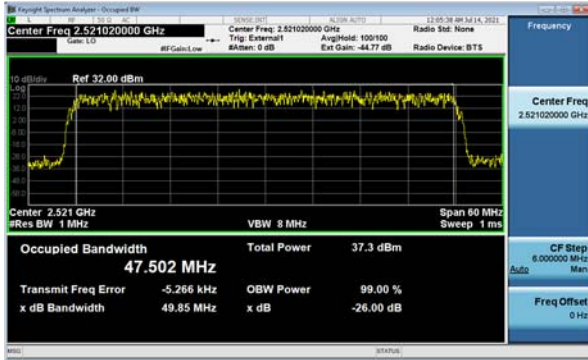
4.1.1.3 5G-NR + 2xLTE Plots

Test Model 1.1
Modulation QPSK
Channel Frequency 2521MHz
TX6



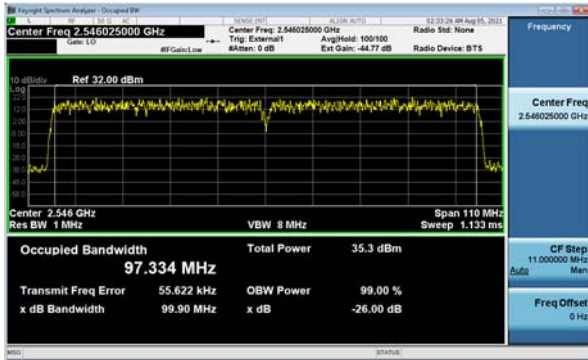
4.1.1.4 5G-NR + 3xLTE Plots

Test Model 1.1
Modulation QPSK
Channel Frequency 2521MHz
TX6



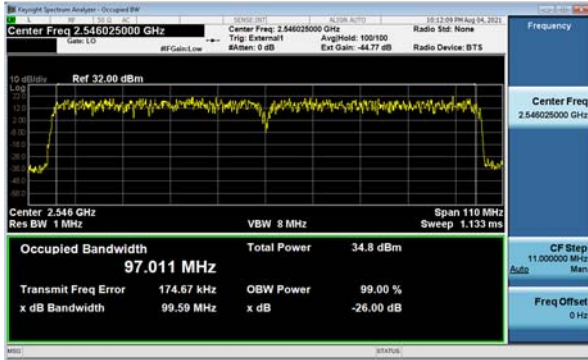
4.1.1.5 2x5G-NR + 2xLTE Plots

Test Model 3.1a
Modulation 256QAM
Channel Frequency 2546MHz
TX6



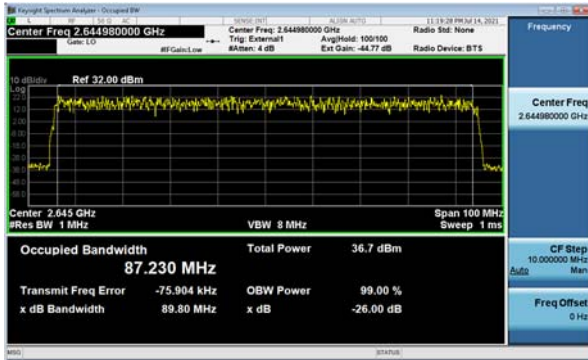
4.1.1.6 2x5G-NR + 3xLTE Plots

Test Model 3.1
Modulation 64QAM
Channel Frequency 2546MHz
TX6



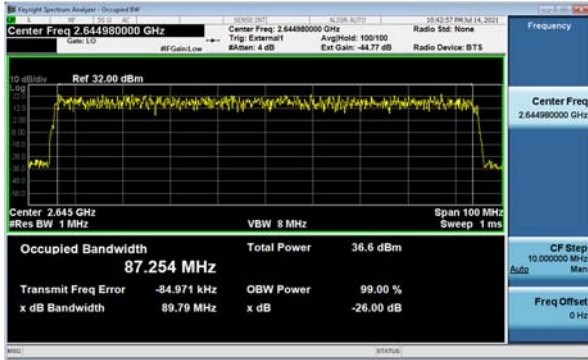
4.1.1.7 LTE + 5G-NR Plots

Test Model 3.1
Modulation 64QAM
Channel Frequency 2644MHz
TX6



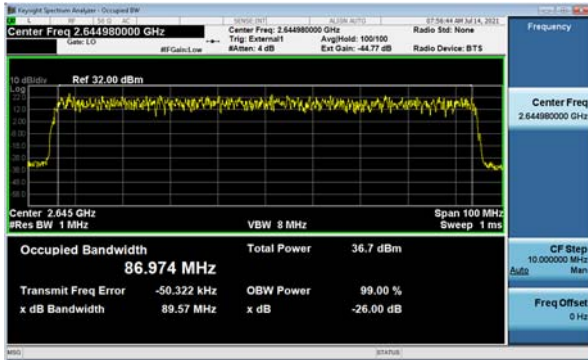
4.1.1.8 2xLTE + 5G-NR Plots

Test Model 3.1
 Modulation 64QAM
 Channel Frequency 2644MHz
 TX6



4.1.1.9 3xLTE + 5G-NR Plots

Test Model 3.1
 Modulation 64QAM
 Channel Frequency 2644MHz
 TX6



4.2 Edge of band Emissions

The Edge of Band emissions of the EUT at the external antenna connector (EAC) were measured using a Keysight MXA Signal Analyzer. The RF power level was continuously measured using a RF broadband power meter. The RF output from the EAC port to signal analyzer was reduced (to an amplitude usable by the signal analyzer) by using a calibrated attenuator and test coupler. The path attenuation was offset on the display and the signal for the carrier was adjusted to the corrected RF power level for the resolution bandwidth used for the transmit signal. All mask values were adjusted based upon the designated signal bandwidth and measurement bandwidths. The Top of Mask corresponds to the set rated power level as confirmed by the RF power meter.

Per FCC Part 27.53 (L)(1), for base station operations in the 3700-3980 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed -13 dBm/MHz. Compliance with this paragraph (L)(1) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 MHz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the 26dB emission bandwidth of the fundamental emission of the transmitter may be employed. Therefore, with 64 TX ports, the conducted limit per port is -31 dBm/1% BW in the 1MHz immediately outside and adjacent to the licensee's frequency block and -31 dBm/MHz outside the 1MHz.

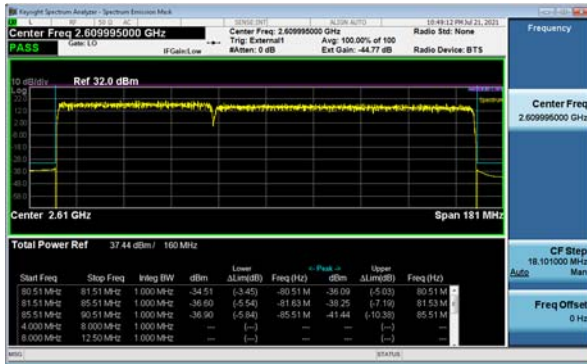
4.2.1 Edge of Band Emissions – Plots

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

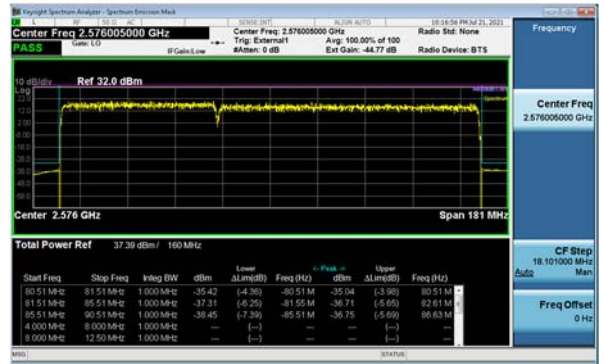
NOTE: Only a sample of the plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

4.2.1.1 Edge of Band Emissions – 5G-NR Only Plots

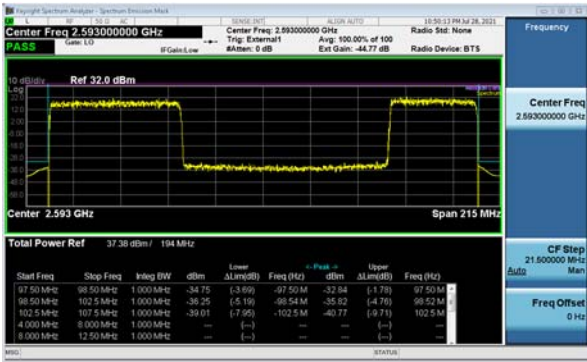
Test Model 1.1
 Modulation QPSK
 Channel Frequency 2559+2640MHz
 TX3



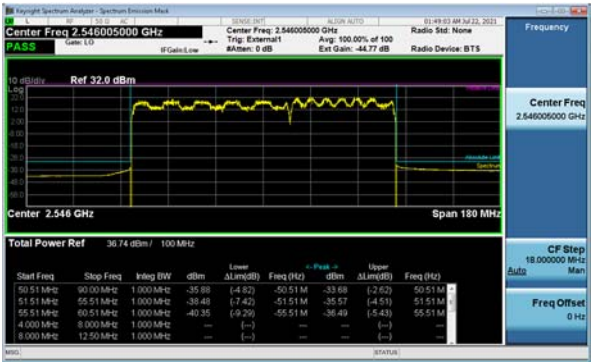
Test Model 3.1
 Modulation 64QAM
 Channel Frequency 2526+2606MHz
 TX3



Test Model 3.1a
 Modulation 256QAM
 Channel Frequency 2526+2670MHz
 TX3



Test Model 3.2
 Modulation QPSK/16QAM
 Channel Frequency 2526+2576MHz
 TX3



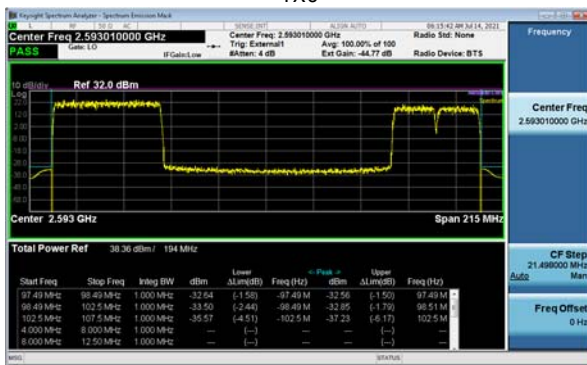
4.2.1.2 Edge of Band Emissions – 5G-NR + LTE Plots

Test Model 1.1
 Modulation QPSK
 Channel Frequency 2521+2680MHz
 TX6



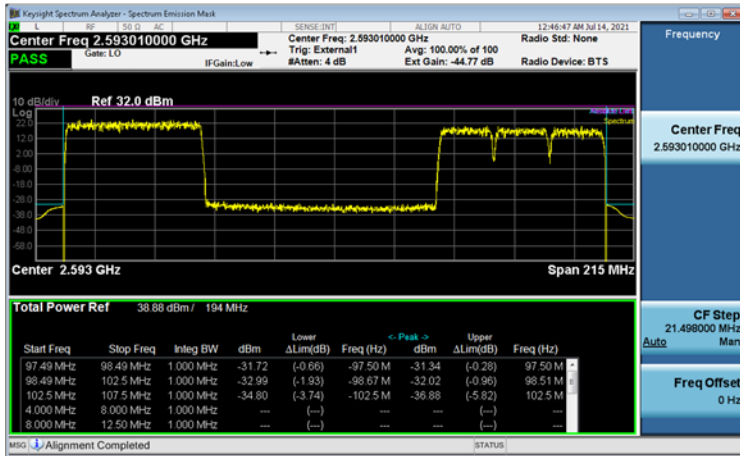
4.2.1.3 Edge of Band Emissions – 5G-NR + 2xLTE Plots

Test Model 1.1
 Modulation QPSK
 Channel Frequency 2521+2660+2680MHz
 TX6



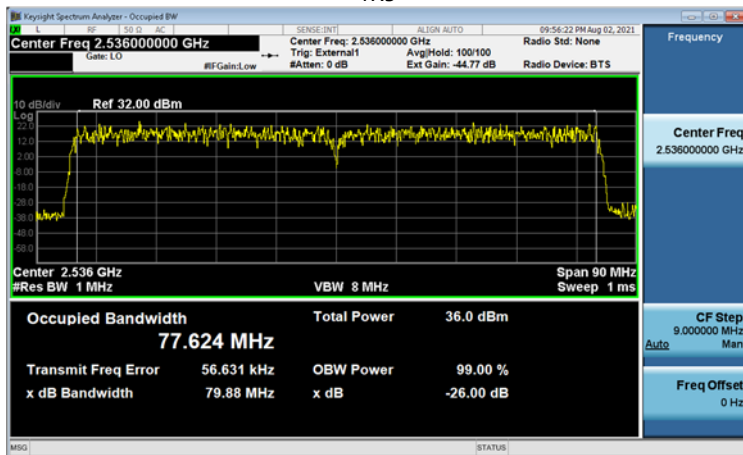
4.2.1.4 Edge of Band Emissions – 5G-NR + 3xLTE Plots

Test Model 1.1
 Modulation QPSK
 Channel Frequency 2521+2640+2660+2680MHz
 TX6

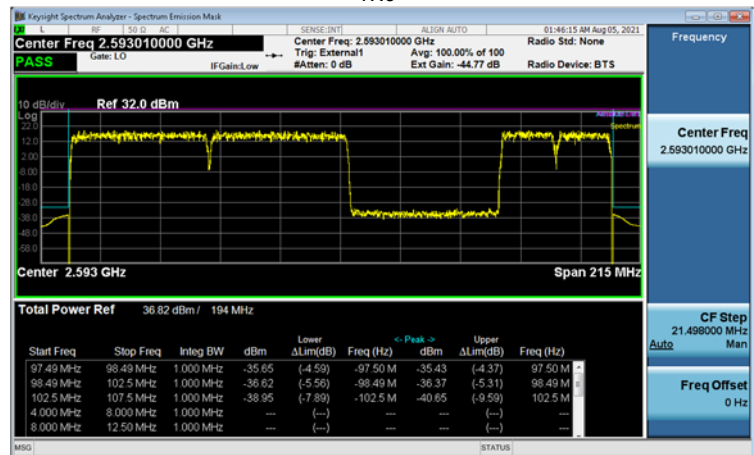


4.2.1.5 Edge of Band Emissions – 2x5G-NR + 2xLTE Plots

Test Model 3.1
 Modulation 256QAM
 Channel Frequency 2516+2556+2660+2680MHz
 TX5



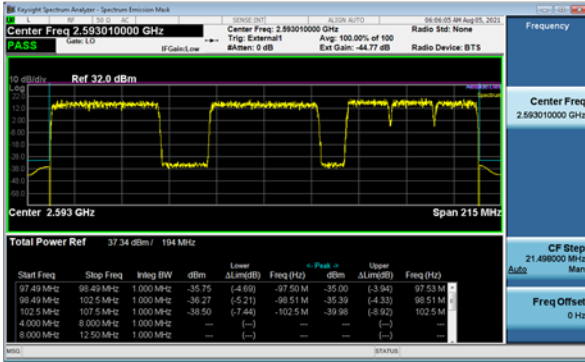
Test Model 3.1a
 Modulation 256QAM
 Channel Frequency 2521+2571+2640+2680MHz
 TX6



4.2.1.6 Edge of Band Emissions – 2x5G-NR + 3xLTE Plots

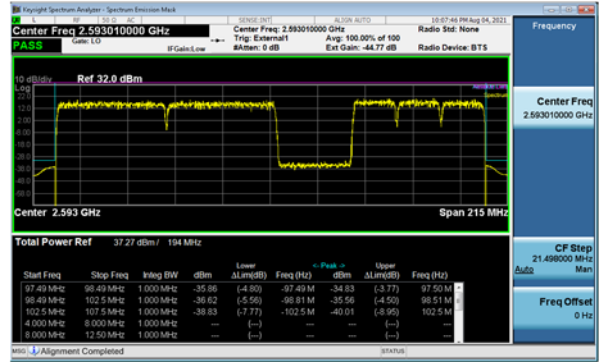
Test Model 1.1
 Modulation QPSK

Channel Frequency 2521+2592+2640+2660+2680MHz
 TX6



Test Model 3.1
 Modulation 64QAM

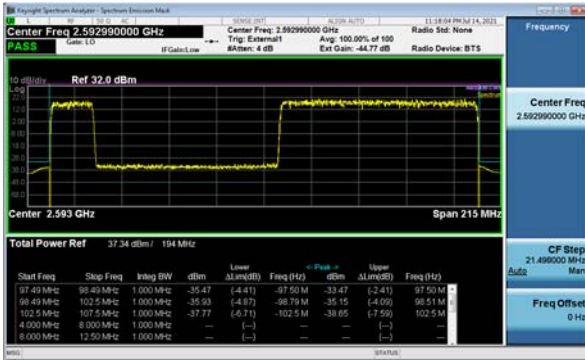
Channel Frequency 2521+2571+2640+2660+2680MHz
 TX6



4.2.1.7 Edge of Band Emissions – LTE + 5G-NR Plots

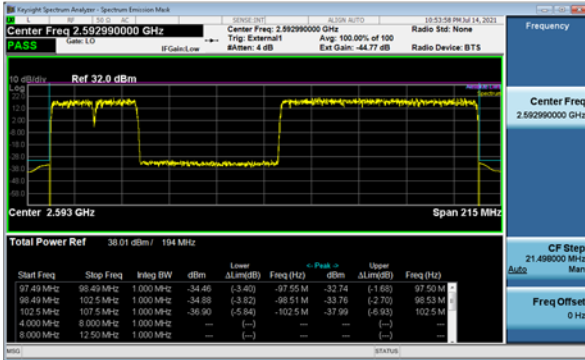
Test Model 3.1
 Modulation 64QAM

Channel Frequency 2506+2644MHz
 TX6



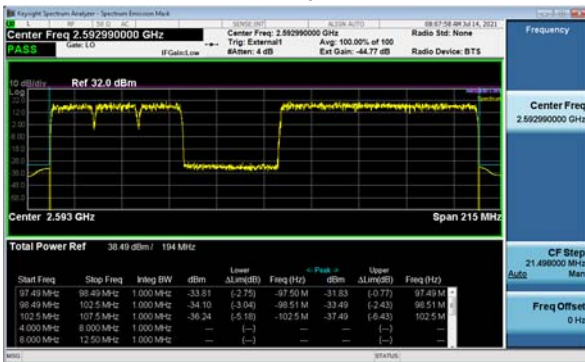
4.2.1.8 Edge of Band Emissions – 2xLTE + 5G-NR Plots

Test Model 3.1
 Modulation 64QAM
 Channel Frequency 2506+2526+2644MHz
 TX6



4.2.1.9 Edge of Band Emissions – 3xLTE + 5G-NR Plots

Test Model 3.1
 Modulation 64QAM
 Channel Frequency 2506+2526+2546+2644MHz
 TX6



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. Carrier Bandwidth is exempt. For this band of operation, the measurements were performed up to 37 GHz. 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. For 64 ports where $10\log(64) = 18\text{dBm}$, the limit is 31dBm/MHz.. Data below documents performance up to 37 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.

5G-NR Only Data

60+100MHz BW

Test Model 3.1

Modulation 64QAM

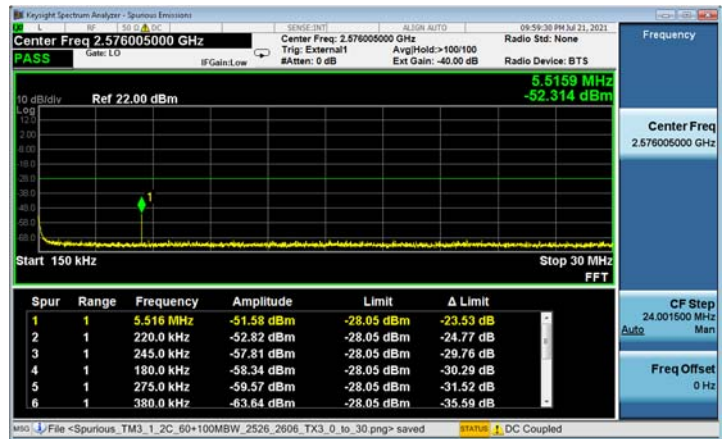
Channel Frequency 2526 + 2606MHz

TX3

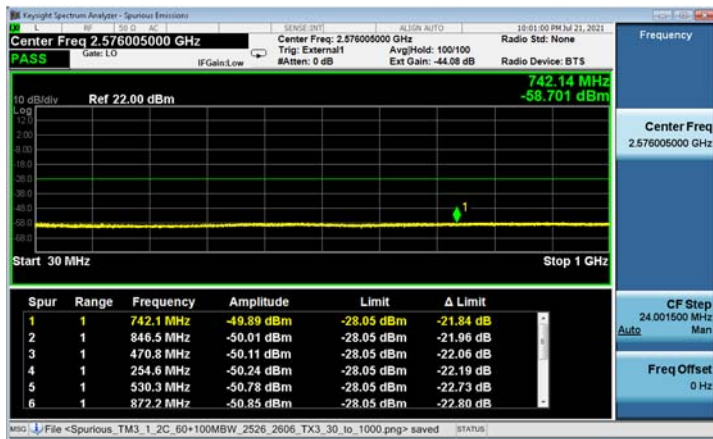
9KHz – 150KHz



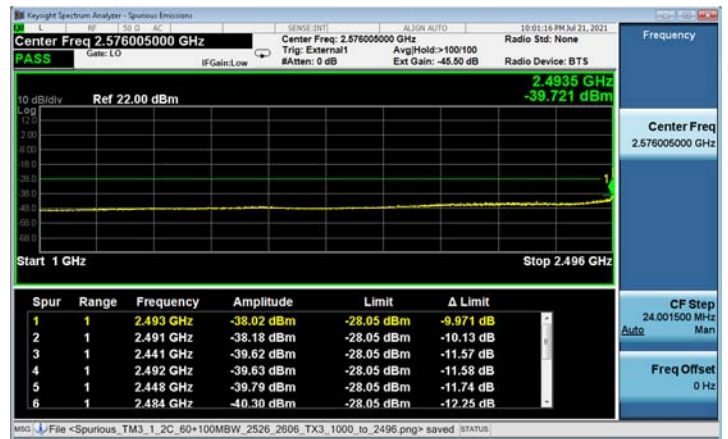
150KHz – 30MHz



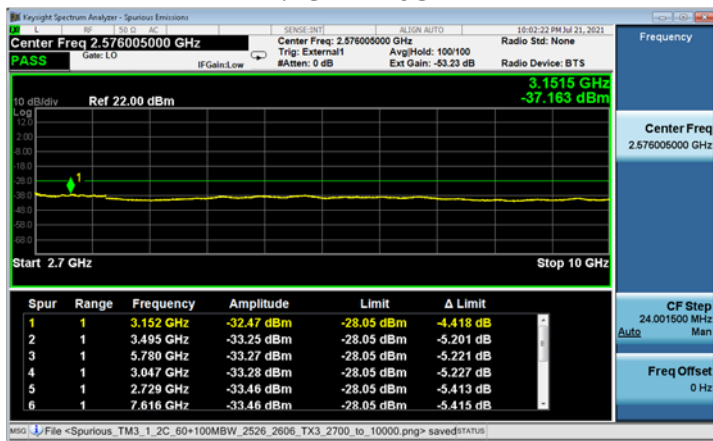
30MHz – 1GHz



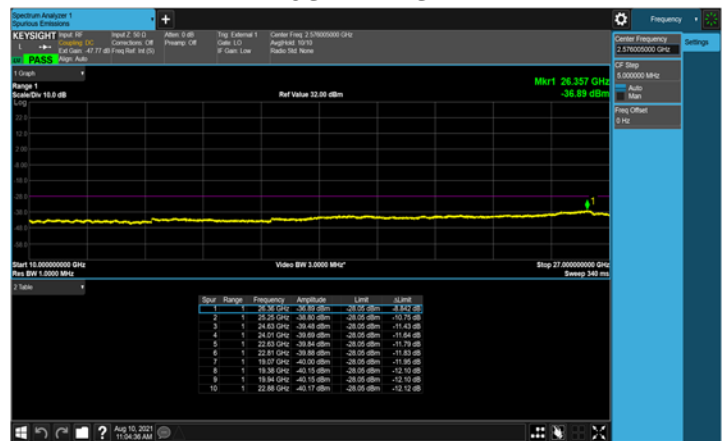
1GHz – 2.496GHz



2.7GHz – 10GHz



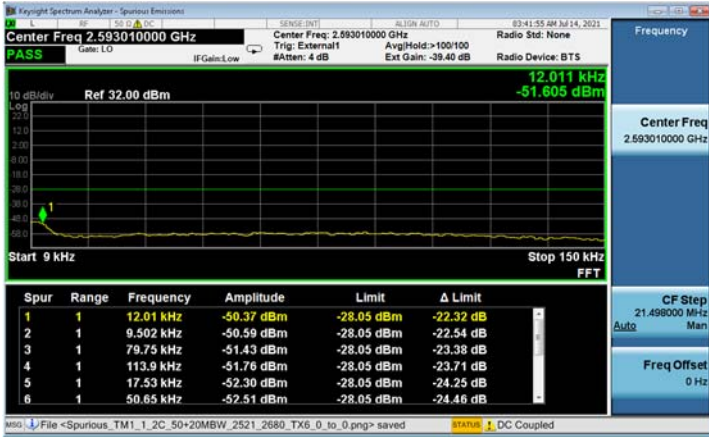
10GHz – 27GHz



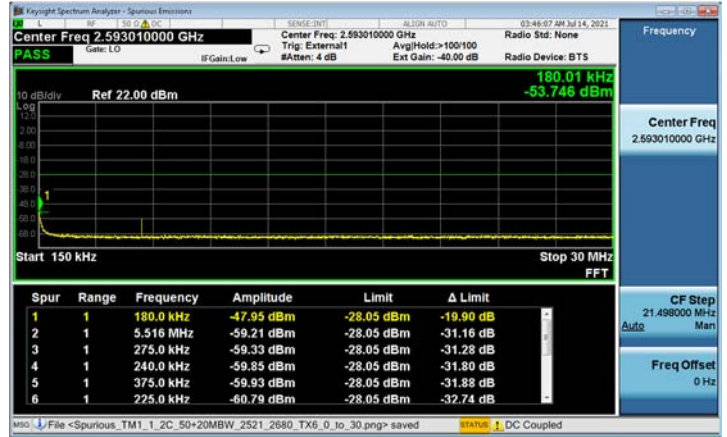
5G-NR + LTE Data
50+20MHz BW

Test Model 1.1
 Modulation QPSK
 Channel Frequency 2521 + 2680MHz
 TX6

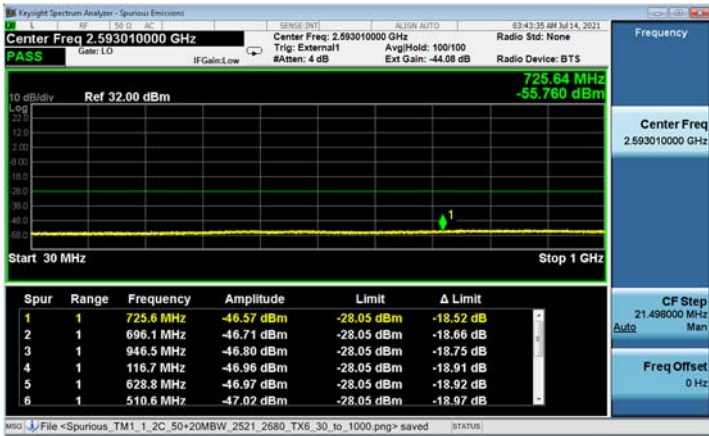
9KHz – 150kHz



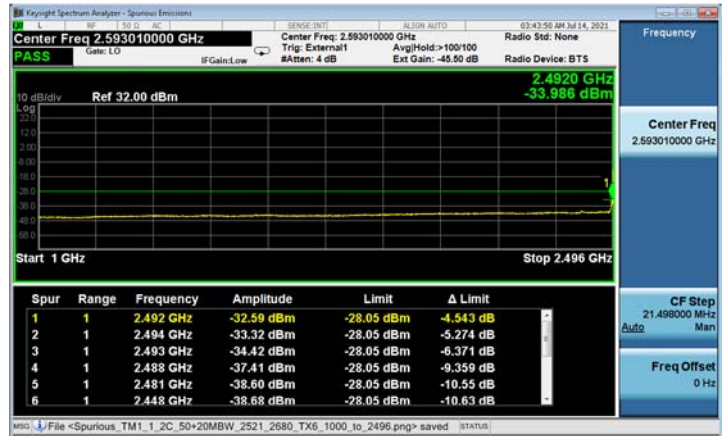
150KHz – 30MHz



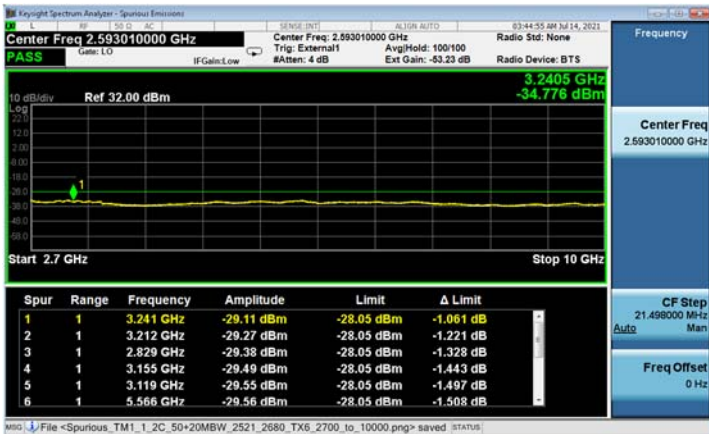
30MHz – 1GHz



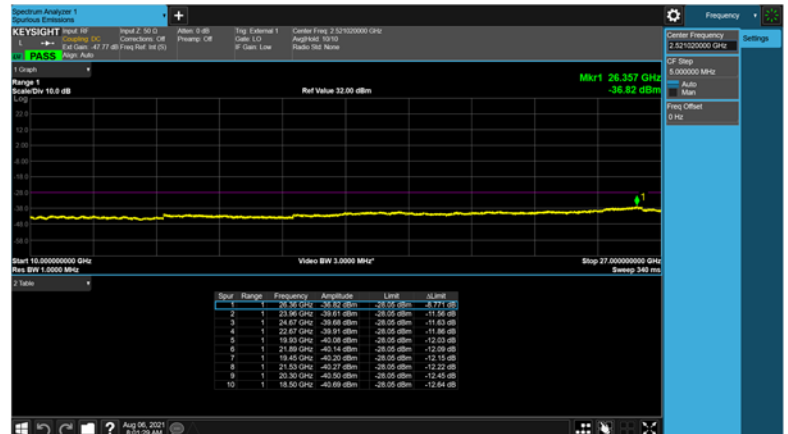
1GHz – 2.496GHz



2.7GHz – 10GHz



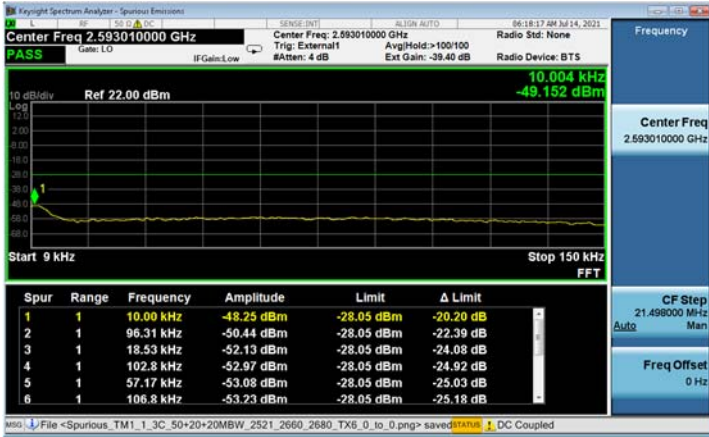
10GHz – 27GHz



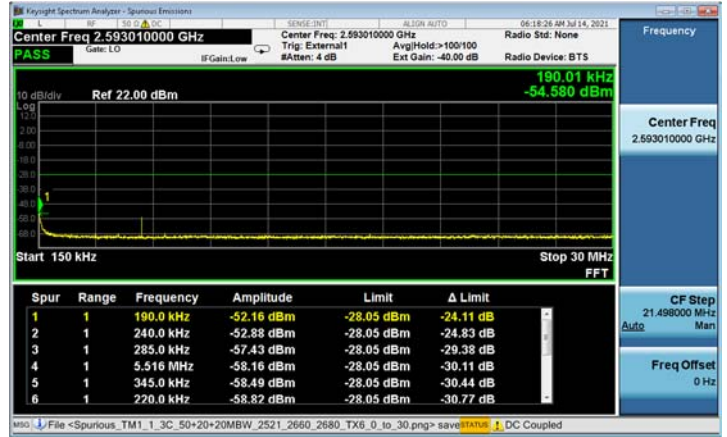
**5G-NR + 2xLTE Data
 50+20+20MHz BW**

Test Model 1.1
 Modulation QPSK
 Channel Frequency 2521 + 2660 + 2680MHz
 TX6

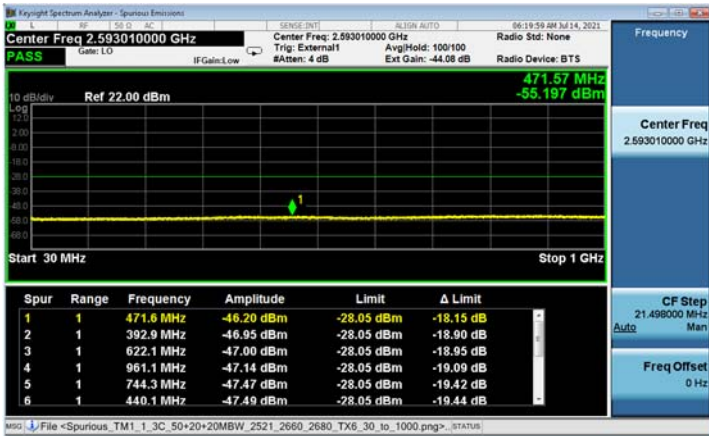
9KHz – 150kHz



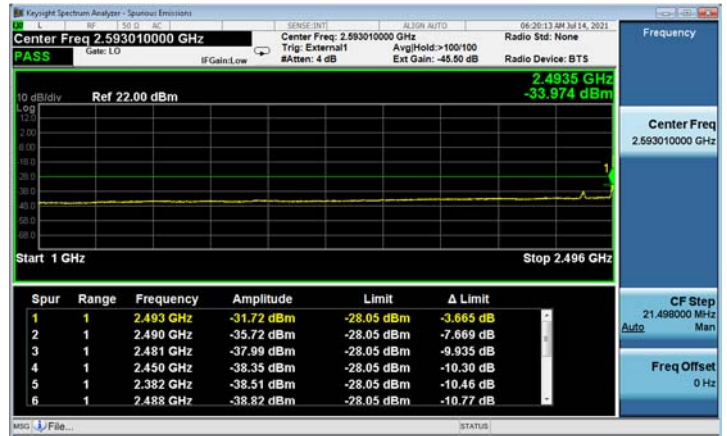
150KHz – 30MHz



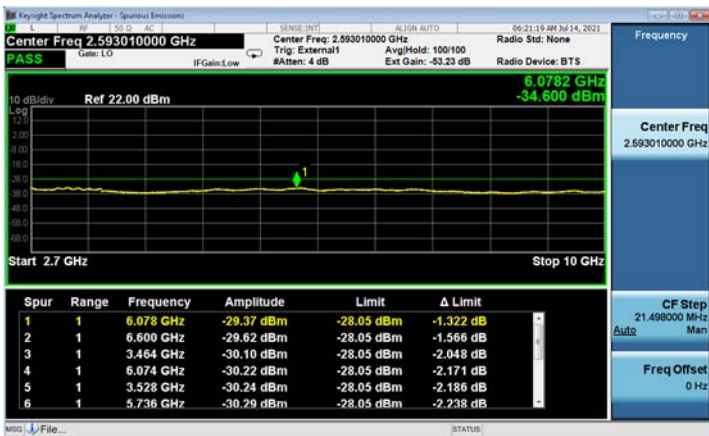
30MHz – 1GHz



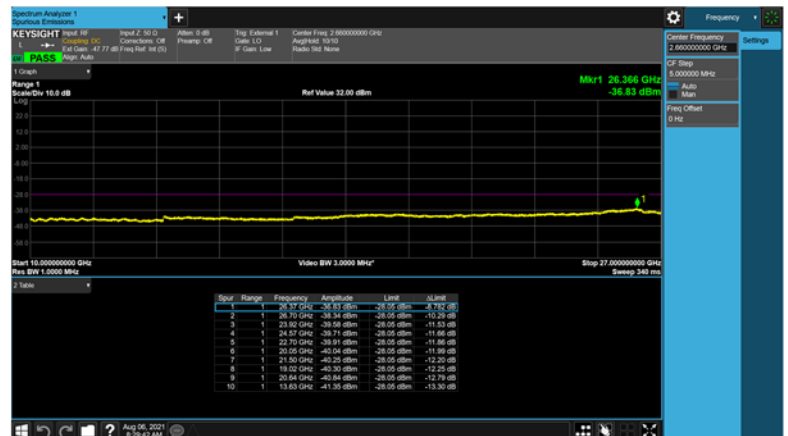
1GHz – 2.496GHz



2.7GHz – 10GHz



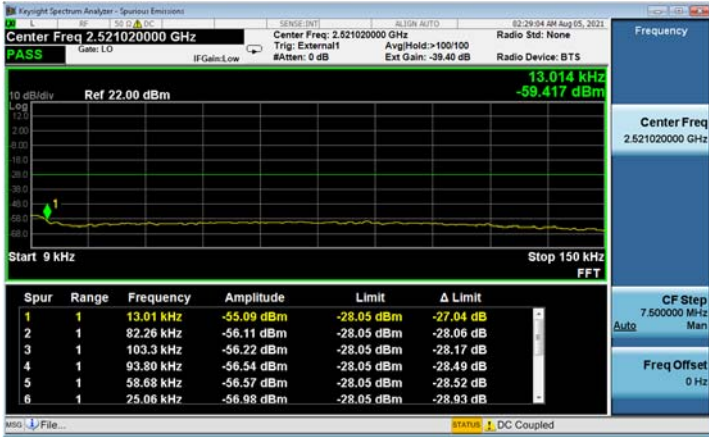
10GHz – 27GHz



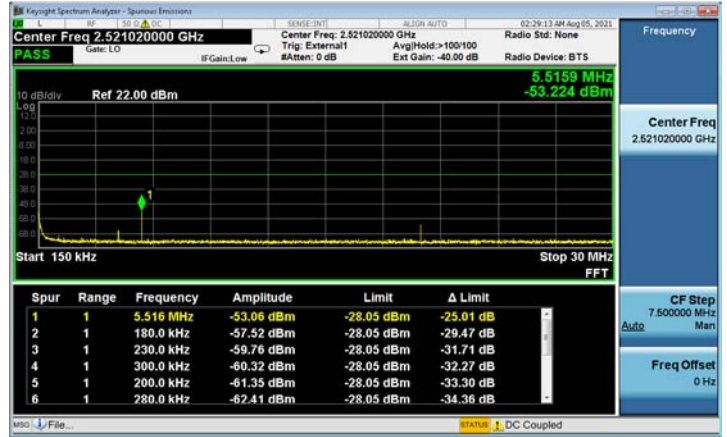
**2x5G-NR + 2xLTE Data
 50+50+20+20MHz BW**

Test Model 3.1a
 Modulation 256QAM
 Channel Frequency 2521 + 2571 + 2640 + 2680MHz
 TX6

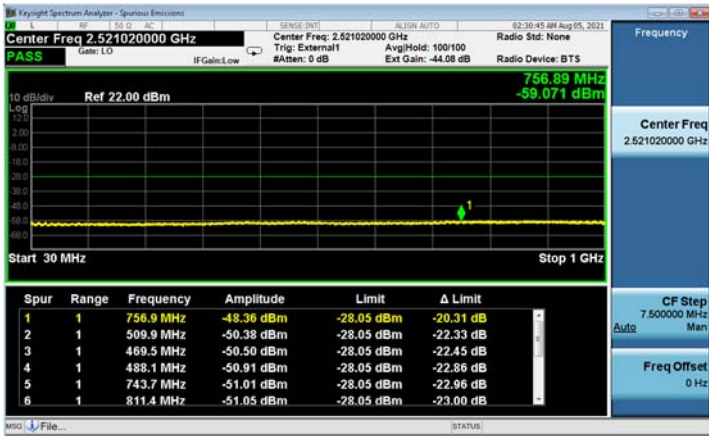
9KHz – 150kHz



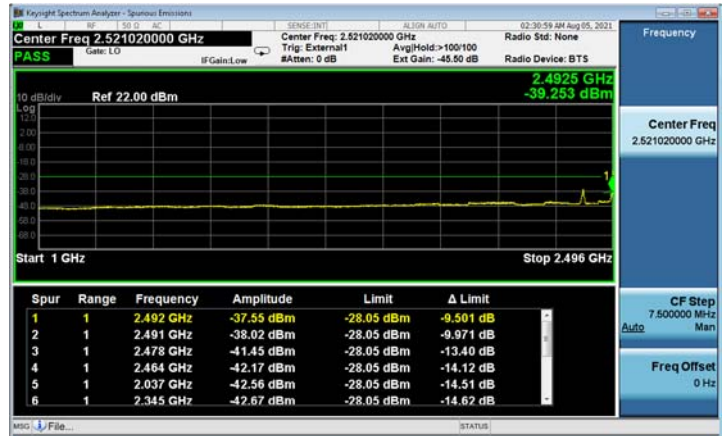
150KHz – 30MHz



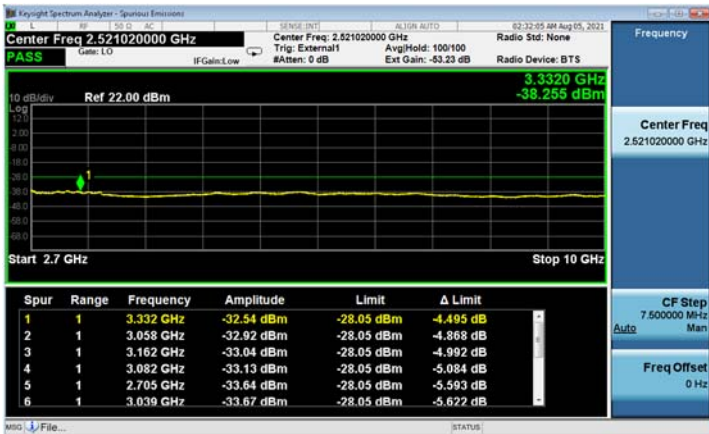
30MHz – 1GHz



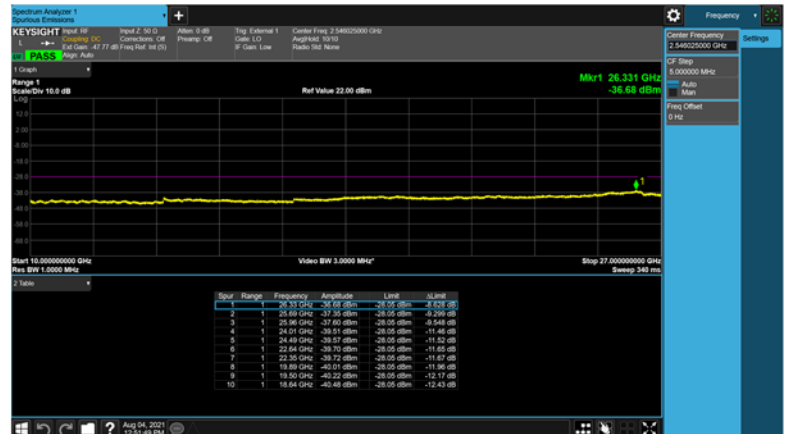
1GHz – 2.496GHz



2.7GHz – 10GHz



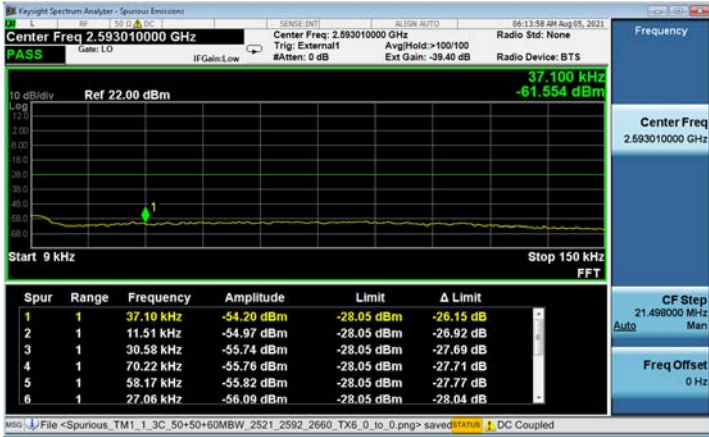
10GHz – 27GHz



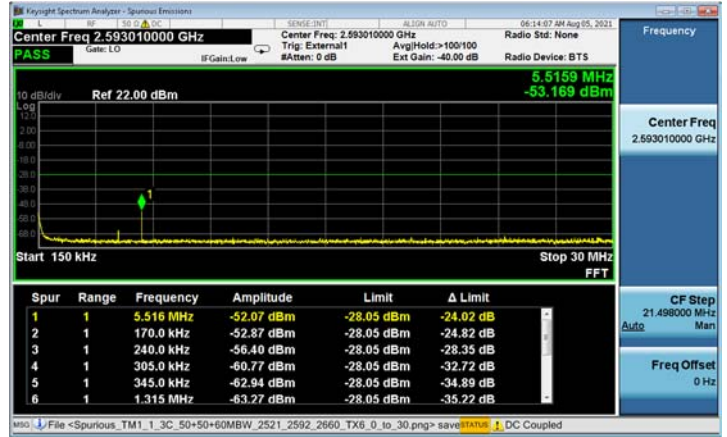
**2x5G-NR + 3xLTE Data
 50+50+60MHz BW**

Test Model 1.1
 Modulation QPSK
 Channel Frequency 2521 + 2592 + 2640 + 2660 + 2680MHz
 TX6

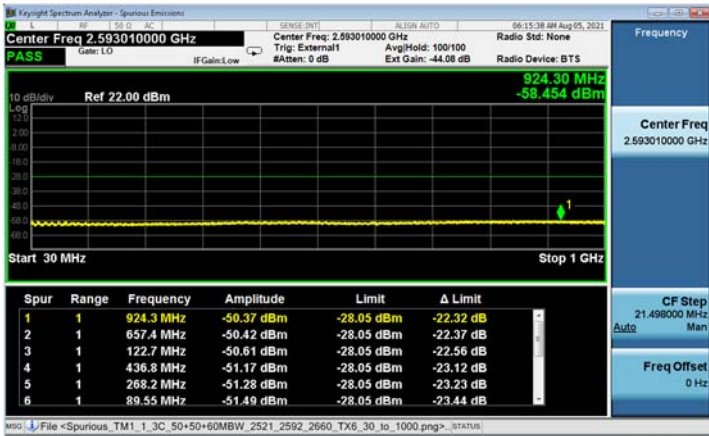
9KHz – 150kHz



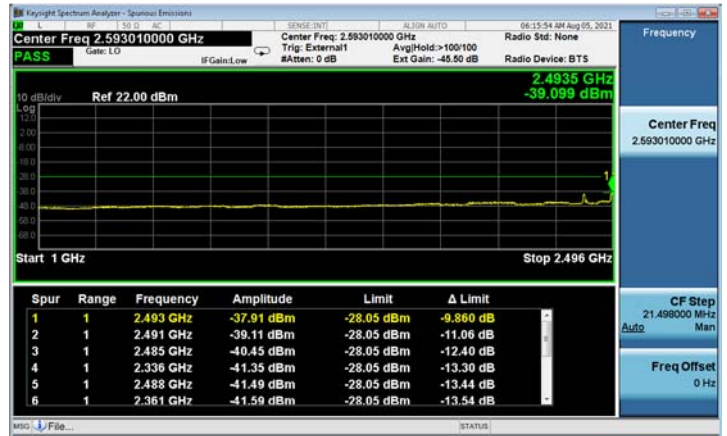
150KHz – 30MHz



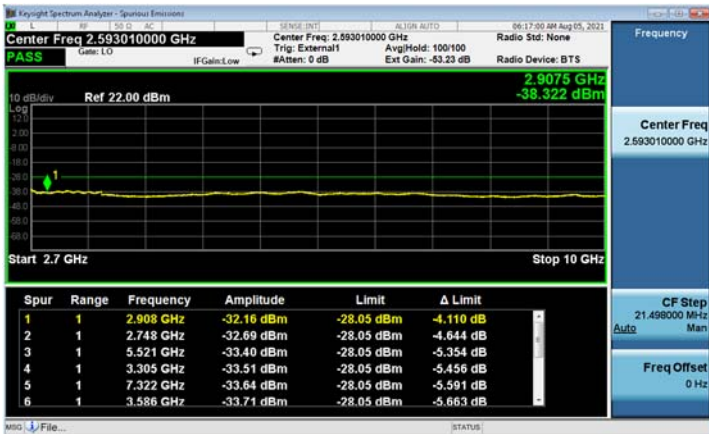
30MHz – 1GHz



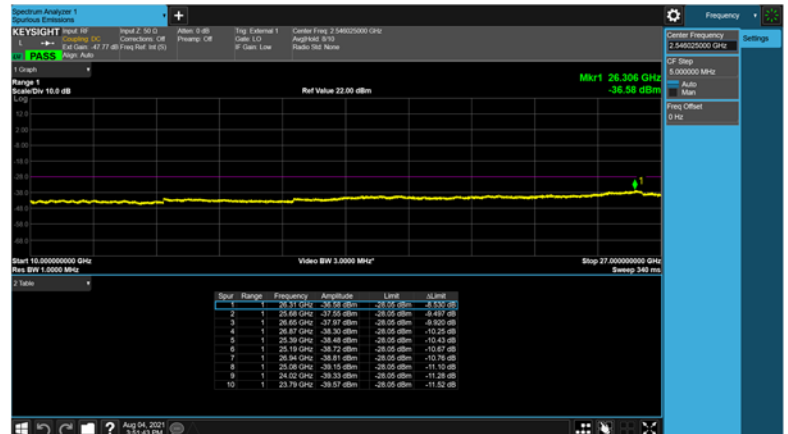
1GHz – 2.496GHz



2.7GHz – 10GHz



10GHz – 27GHz



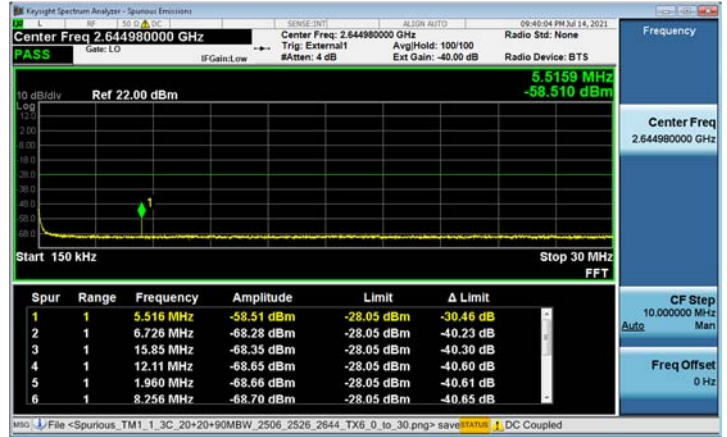
**2xLTE + 5G-NR Data
 20+20+90MHz BW**

Test Model 3.1
 Modulation 64QAM
 Channel Frequency 2506 + 2526 + 2644MHz
 TX6

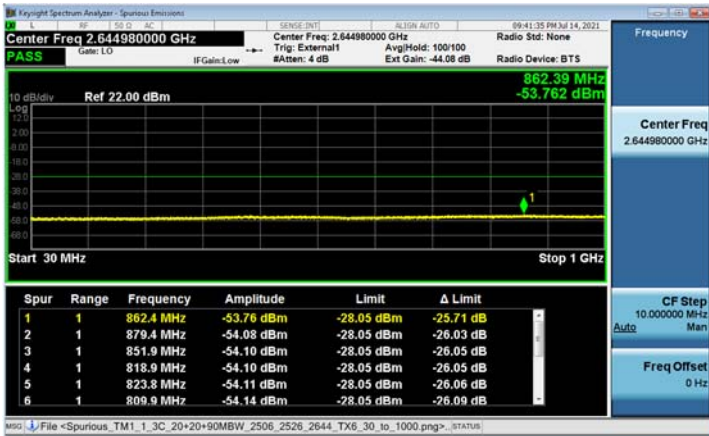
9KHz – 150kHz



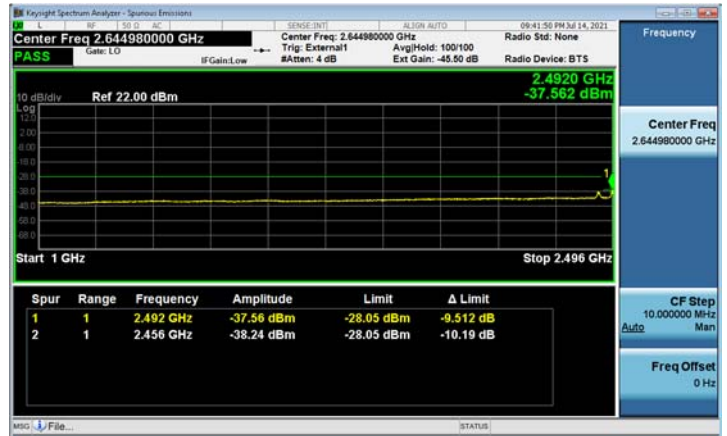
150KHz – 30MHz



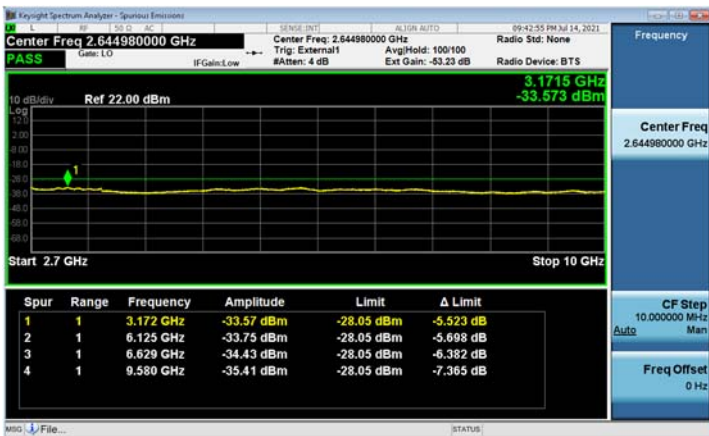
30MHz – 1GHz



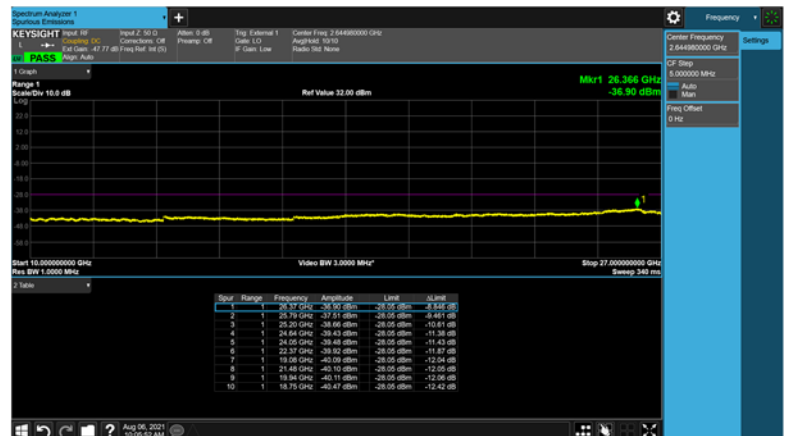
1GHz – 2.496GHz



2.7GHz – 10GHz

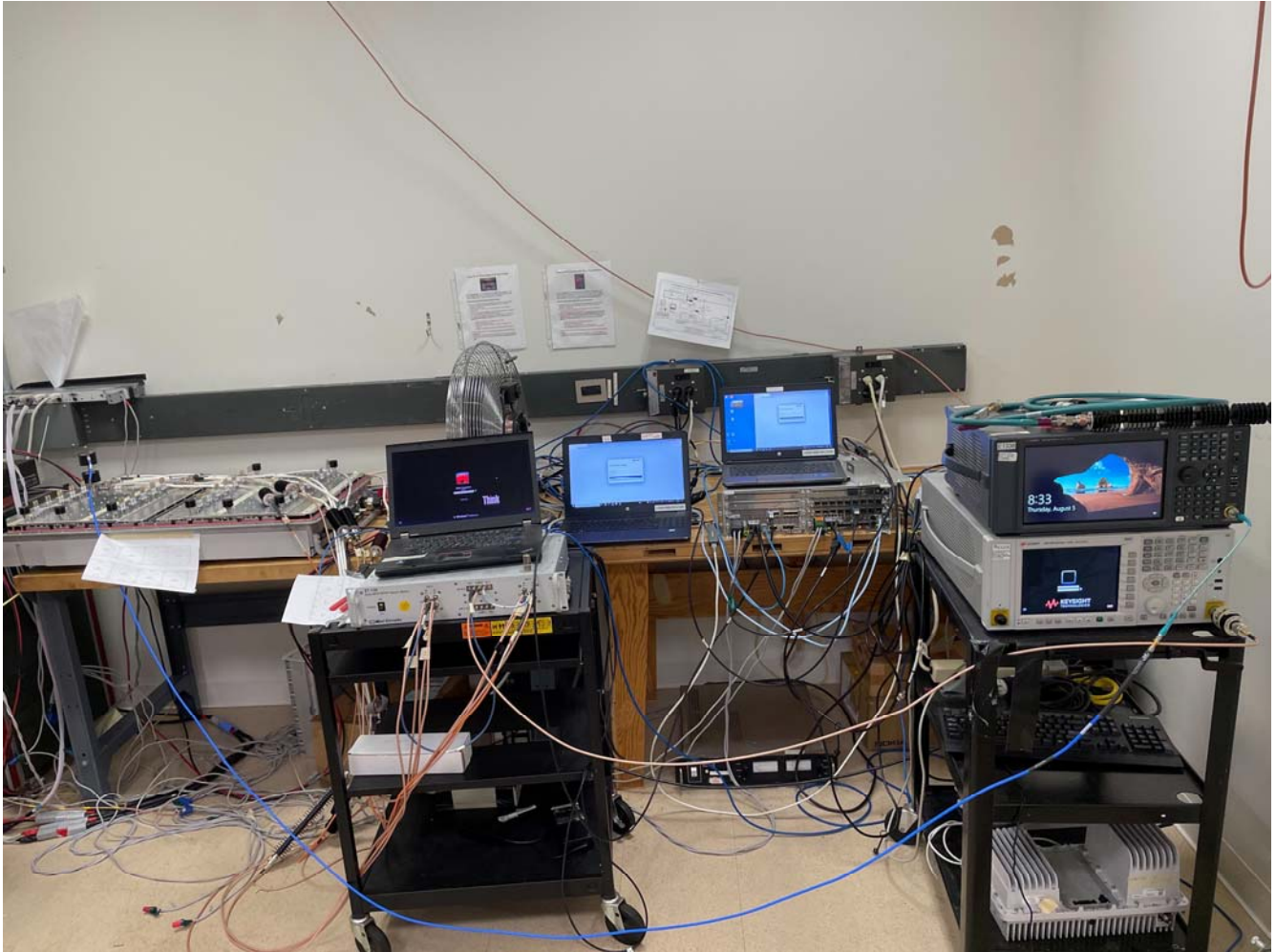


10GHz – 27GHz



Photographs

Equipment Setup



Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E1218	KeySight Technologies	EMI Receiver	MXE EMI Receiver 26.5GHz	N9038A	MY54130037	2020-08-28	2022-08-28
E1338	KeySight Technologies	MXA Signal Analyzer		N9020B	MY57430927	2019-11-14	2021-11-14
E896	Agilent Technologies	Network Analyzer	10 MHz - 40 GHz	N5230C	MY49000897	2021-03-03	2023-03-03
E1534	Traceable	Data Logger	Barometric Humidity Temp Data Logger	6529	200648430	2020-10-21	2022-10-21
E1022	Weinschel	Attenuator	10dB DC-18GHz 25W	46-10-34-LIM	BN3118	CNR-V	CNR-V
E1023	Weinschel	Attenuator	20 dB DC-18 GHz 25W	46-20-34	BJ4772	CNR-V	CNR-V
E1344	Macom	Attenuator	3 dB, DC - 4 GHz, 2W	2082-6171-03	N/A	CNR-V	CNR-V
E1155	Weinschel	Attenuator	10dB 25W 0.05- 26GHz	74-10-12	1068	CNR-V	CNR-V
E1154	Weinschel	Attenuator	30dB 25W 0.05GHz-26GHz	74-30-12	1065	CNR-V	CNR-V
E1250	Weinschel	Attenuator	3dB Attenuator 100W	24-3-43	BB9072	CNR-V	CNR-V
E1251	Aeroflex	Attenuator	30dB 150W DC-18GHz Attenuator	66-30-33	BV1667	CNR-V	CNR-V

CNR-V: Calibration Not Required, Must Be Verified

Tests were performed between 7/14/2021 to 8/12/2021.

6. FCC Section 2.1053 - 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, 26.5 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.

6.2 Field Strength of Spurious Emissions - Limits

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.

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

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

Where:

E = Field Intensity in Volts/meter

P = Transmitted Power in Watts

R = Measurement distance in meters = 3 m

The Part 27 Limit is 82.23 dB μ V/m at 3m and 91.77 dB μ V/m at 1m

The Part 27 non-report level is 62.23 dB μ V/m at 3m.

The calculated emission levels were found by:

$$\text{Measured level (dB}\mu\text{V)} + \text{Cable Loss(dB)} + \text{Antenna Factor(dB)} = \text{Field Strength (dB}\mu\text{V}/\text{m)}$$

RESULTS:

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 dB μ V/meter (82.23 @ 3m). Emissions equal to or less than 62.23 dB μ V/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 26.5 GHz), no reportable spurious emissions were detected.

7. NVLAP Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 100275-0

Nokia, Global Product Compliance Lab
Murray Hill, NJ

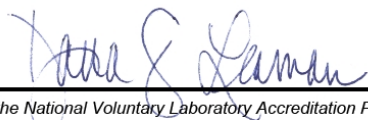
*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

Electromagnetic Compatibility & Telecommunications

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
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).*

2020-09-25 through 2021-09-30
Effective Dates




For the National Voluntary Laboratory Accreditation Program