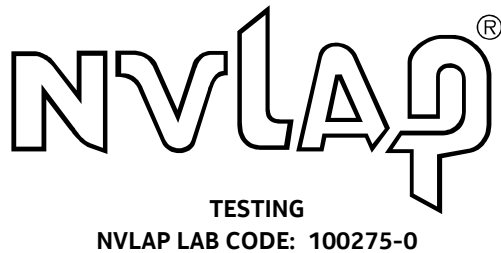


Global Product Compliance Laboratory
600-700 Mountain Avenue
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Murray Hill, New Jersey 07974-0636 USA



Title 47 Code of Federal Regulations Test Report

Regulation:
FCC Part 2 and 27

Client:
NOKIA SOLUTIONS AND NETWORKS, OY

Product Evaluated:
AirScale MAA 64T64R B41 320W AEHC (AEHC)

Report Number:
TR-2024-0012-FCC2-27

Date Issued:
April 5, 2024

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Revisions

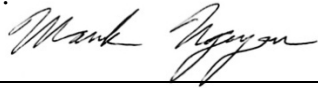
Date	Revision	Section	Change
4/5/2024	0		Initial Release

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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:	Refer to Section 1.3.2
FCC ID:	VBNAEHC-01
Hardware Version:	Refer to Section 1.3.2
Software Version:	STBS24R3
Frequency Range:	2495 - 2690 MHz
GPCL Project Number:	2024-0012
Applicant:	NOKIA SOLUTIONS AND NETWORKS Steve Mitchell Nokia Solutions and Networks 3201 Olympus Blvd Dallas, Texas, 75019. USA
Test Requirement(s):	Title 47 CFR Parts 2 and 27
Test Standards:	See Section 1.5.1
Measurement Procedure(s):	See Section 1.5.2
Test Date(s):	2/22/2024 - 3/4/2024
Test Performed By:	Nokia Global Product Compliance Laboratory 600-700 Mountain Ave. P.O. Box 636 Murray Hill, NJ 07974-0636 Test Site Number: US5302
Product Engineer(s):	Ron Remy
Lead Engineer:	Steve Gordon
Test Engineer (s):	Jaideep Yadav
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).

The Slim Carrier is a 40 MHz, 50 MHz, or 60 MHz carrier with disabled resource blocks on the upper and lower portions of the carrier intended to act as a smaller carrier for reduced bandwidth carrier applications.

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 Class II change was performed on the AEHC to add additional bandwidths to the grant that are a result of a Slim Carrier (Disabled Resource Blocks) to confirm that it would meet the out of band emissions when used in a smaller BW segment. The additional BW segments are 33 and 38.5 MHz (40 MHz Slim Carrier, 160 W), 44, 49, 49.5 MHz (50 MHz Slim Carrier, 200 W), and 55 MHz (60 MHz Slim Carrier, 240 W).

1.3 EUT Details

1.3.1 Specifications

Specification Items	Description
Radio Access Technology	5G-NR & LTE
Modulation Type(s)	QPSK, 16QAM, 64QAM, 256QAM
Frequency Range	2495 - 2690 MHz
Standard Channel Bandwidths	20, 40, 50, 60, 70, 80, 100 MHz
Slim Carrier Channel Bandwidths	33, 38.5, 44, 49, 49.5, 55 MHz
Number of Tx Ports per Unit	64
MIMO	Yes
Max Conducted Power	5W (37dBm) per port. Total 320W
Deployment Environment	Outdoor
Environment Temperature Range	-40°C to 55°C
Power Source	DC

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. 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



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

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.
- FCC-IC-FS – GPCL Frequency Stability Measurement Process 6-20-2019.

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 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

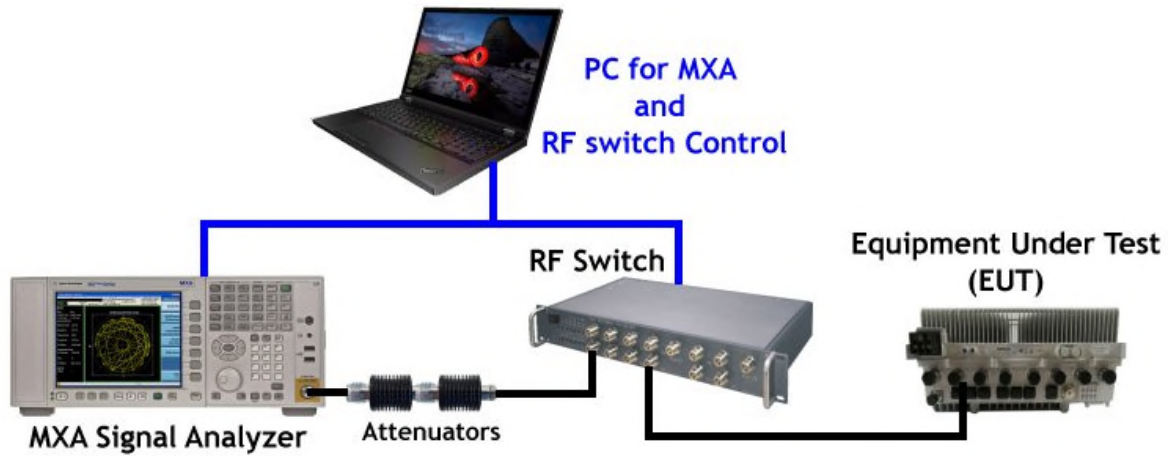
1.6 Executive Summary

Requirement	Description	Result
47 CFR FCC Parts 2 and 27		
2.1046, 27.53	RF Power Output Peak to Average Power Ratio	COMPLIES
2.1047, 27.53	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, 27.53	Frequency Stability	NT

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

1.7 Test Configuration

Test Setup for all Antenna Port Measurements



2. FCC Section 2.1046 - RF Power Output

2.1 RF Power Output

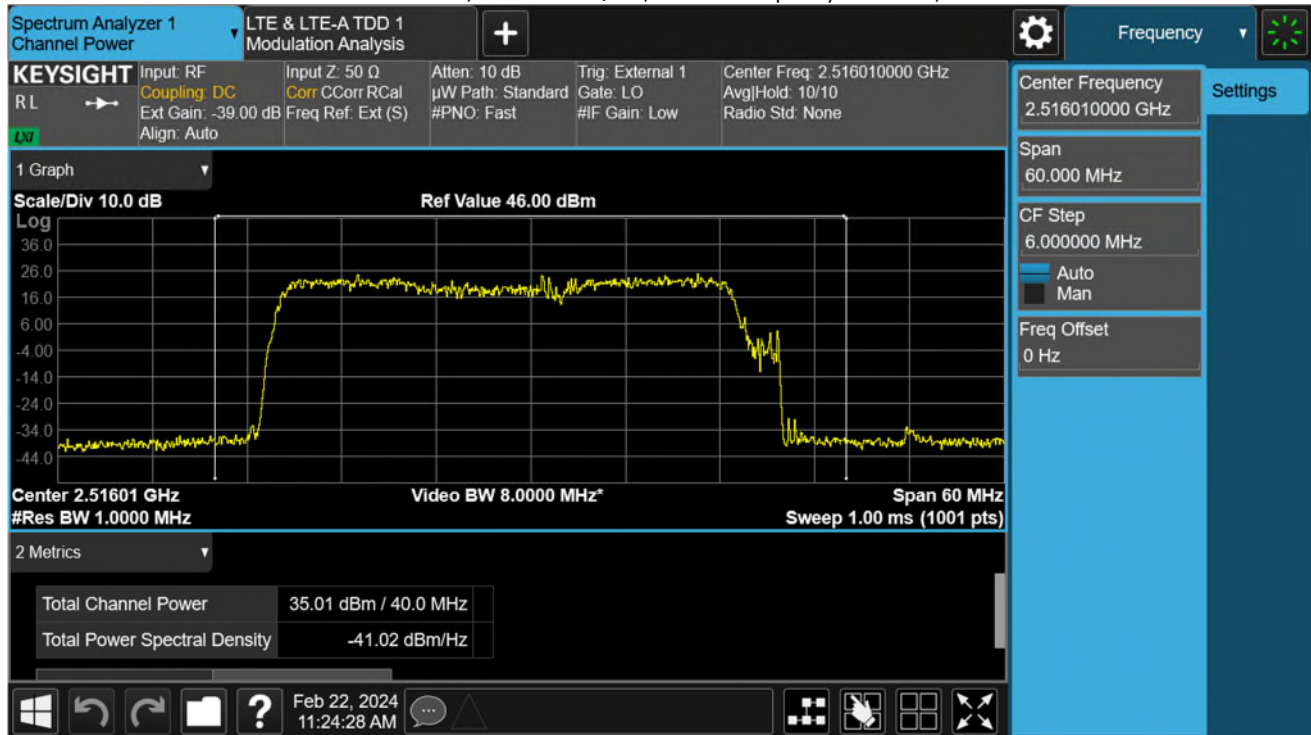
This test is a measurement of the total RF power level transmitted at the antenna-transmitting terminal. The product was configured for test as shown in section above and allowed to warm up and stabilize per KDB 971168 D01 and ANSI C63.26. All 64 ports were measured, converted to W, and summed to determine total conducted power. Power measurements were made with an MXA Signal Analyzer.

Tabular Data – Channel RF Power

Channel Power - Signal BW 33MHz											
Test Model 1.1 Modulation QPSK Channel Frequency 2516MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2593MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2670MHz			
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
0	34.18	32	34.10	0	33.58	32	33.41	0	33.73	32	33.64
1	34.16	33	33.78	1	34.19	33	33.47	1	34.27	33	33.60
2	33.87	34	34.08	2	33.17	34	33.62	2	33.39	34	33.95
3	34.05	35	33.70	3	33.92	35	33.53	3	33.83	35	33.56
4	34.03	36	34.07	4	33.71	36	33.51	4	33.65	36	33.82
5	33.81	37	31.82	5	33.87	37	31.47	5	33.80	37	31.75
6	33.90	38	33.85	6	33.64	38	33.50	6	33.36	38	33.51
7	33.88	39	34.07	7	33.54	39	33.68	7	33.55	39	33.75
8	34.15	40	34.42	8	33.93	40	33.91	8	33.87	40	34.03
9	34.61	41	34.10	9	34.24	41	33.58	9	34.14	41	33.81
10	34.15	42	34.31	10	33.88	42	34.10	10	33.66	42	34.11
11	34.12	43	34.34	11	33.77	43	33.91	11	33.83	43	33.80
12	34.30	44	28.95	12	34.14	44	28.65	12	34.07	44	28.84
13	34.28	45	34.48	13	33.93	45	33.88	13	33.95	45	33.95
14	34.09	46	34.39	14	33.74	46	34.17	14	33.65	46	34.15
15	33.96	47	34.12	15	33.87	47	33.99	15	33.99	47	33.87
16	34.24	48	34.44	16	33.97	48	34.32	16	34.17	48	34.33
17	34.25	49	34.65	17	34.02	49	34.12	17	33.97	49	34.24
18	34.34	50	35.01	18	34.06	50	34.75	18	34.34	50	34.81
19	34.02	51	34.64	19	33.64	51	34.47	19	33.75	51	34.48
20	34.17	52	34.60	20	33.92	52	34.23	20	33.89	52	34.26
21	34.07	53	34.27	21	33.85	53	34.01	21	33.72	53	34.13
22	34.33	54	34.52	22	34.22	54	34.51	22	34.05	54	34.38
23	34.04	55	34.19	23	33.94	55	33.99	23	33.85	55	33.93
24	33.96	56	33.99	24	33.81	56	33.72	24	33.89	56	33.65
25	33.73	57	33.98	25	33.60	57	33.37	25	33.84	57	33.90
26	33.71	58	34.00	26	33.74	58	33.63	26	33.55	58	33.52
27	33.40	59	34.03	27	33.31	59	33.88	27	33.23	59	33.79
28	33.83	60	33.39	28	33.37	60	33.44	28	33.58	60	33.49
29	33.60	61	33.96	29	33.65	61	33.54	29	33.52	61	33.67
30	33.77	62	33.75	30	33.54	62	33.60	30	33.56	62	33.69
31	33.83	63	33.93	31	33.66	63	33.69	31	33.66	63	33.69
Total Power (dBm)		52.09		Total Power (dBm)		51.82		Total Power (dBm)		51.85	
Total Power (W)		161.93		Total Power (W)		151.99		Total Power (W)		153.13	

1 Carrier, 33MHz BW, Max Value Plot

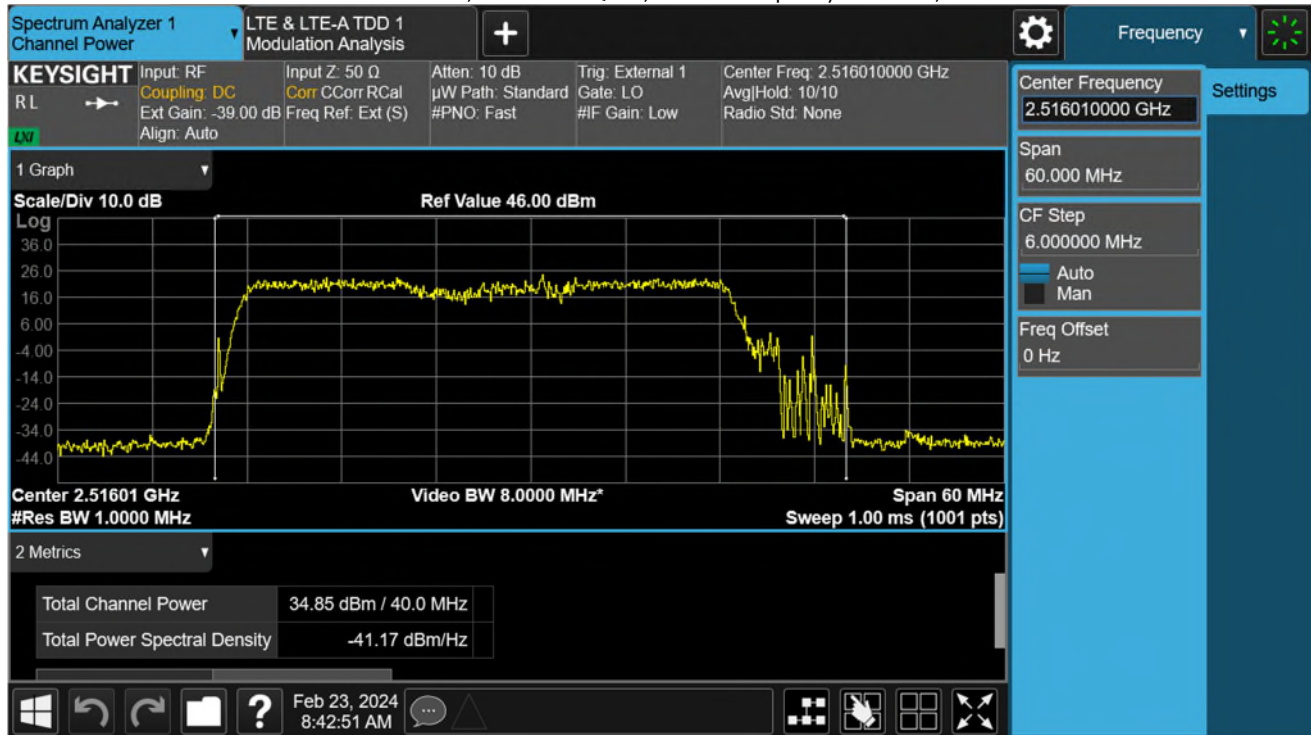
Test Model 1.1, Modulation QPSK, Channel Frequency 2516MHz, TX50



Channel Power - Signal BW 38.5MHz											
Test Model 1.1 Modulation QPSK Channel Frequency 2516MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2670MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2693MHz			
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
0	34.08	32	33.41	0	33.78	32	33.72	0	34.21	32	33.16
1	33.99	33	33.93	1	33.76	33	33.46	1	34.03	33	33.69
2	33.32	34	33.93	2	33.27	34	33.72	2	33.29	34	33.78
3	33.62	35	33.94	3	33.55	35	33.60	3	33.73	35	33.49
4	34.08	36	33.81	4	33.99	36	33.63	4	33.97	36	33.42
5	33.89	37	31.53	5	33.93	37	31.94	5	33.86	37	32.10
6	33.97	38	33.66	6	33.60	38	33.76	6	33.76	38	33.55
7	33.46	39	33.87	7	33.41	39	33.48	7	33.03	39	33.40
8	34.20	40	34.11	8	33.66	40	34.08	8	33.96	40	33.87
9	34.55	41	34.00	9	34.23	41	33.69	9	34.14	41	33.54
10	33.96	42	33.93	10	33.66	42	34.04	10	33.85	42	34.01
11	34.13	43	34.17	11	33.74	43	33.53	11	33.77	43	33.71
12	34.43	44	28.72	12	34.06	44	28.81	12	33.85	44	28.63
13	34.27	45	34.40	13	34.03	45	33.93	13	34.23	45	33.74
14	33.79	46	34.43	14	33.43	46	33.91	14	33.59	46	34.12
15	33.95	47	34.20	15	33.80	47	33.68	15	33.94	47	33.98
16	34.09	48	34.54	16	33.96	48	34.38	16	33.94	48	34.10
17	34.03	49	34.51	17	34.03	49	34.19	17	33.90	49	34.15
18	33.88	50	34.85	18	33.70	50	34.56	18	34.05	50	34.77
19	33.73	51	34.60	19	33.73	51	34.20	19	33.40	51	34.45
20	33.80	52	34.34	20	33.65	52	34.09	20	33.66	52	34.20
21	34.15	53	34.09	21	33.66	53	33.99	21	33.74	53	33.89
22	34.17	54	34.49	22	33.88	54	34.35	22	34.07	54	34.49
23	34.05	55	34.04	23	33.51	55	34.13	23	33.68	55	33.92
24	33.99	56	33.96	24	33.87	56	33.44	24	33.94	56	33.74
25	33.93	57	33.84	25	33.84	57	33.79	25	33.90	57	33.51
26	33.82	58	33.60	26	33.39	58	33.55	26	33.81	58	33.66
27	33.37	59	33.87	27	33.07	59	33.53	27	33.09	59	33.81
28	33.98	60	33.25	28	33.70	60	33.42	28	33.65	60	33.12
29	33.41	61	33.62	29	33.39	61	32.98	29	33.23	61	33.43
30	33.50	62	34.06	30	33.50	62	33.54	30	33.45	62	33.51
31	33.83	63	34.04	31	33.20	63	33.12	31	33.57	63	33.44
Total Power (dBm)			51.98	Total Power (dBm)			51.74	Total Power (dBm)			51.78
Total Power (W)			157.72	Total Power (W)			149.18	Total Power (W)			150.62

1 Carrier, 38.5MHz BW, Max Value Plot

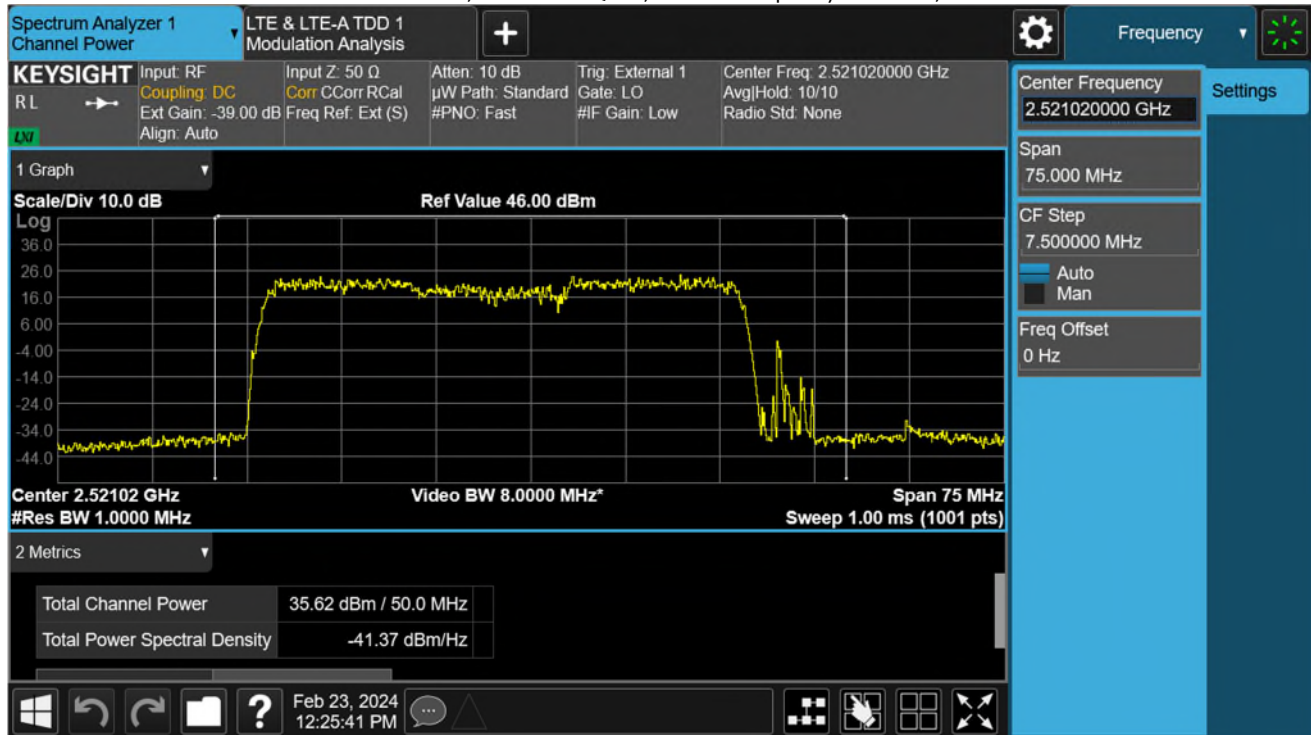
Test Model 1.1, Modulation QPSK, Channel Frequency 2516MHz, TX50



Channel Power - Signal BW 44MHz											
Test Model 1.1 Modulation QPSK Channel Frequency 2521MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2593MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2665MHz			
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
0	34.59	32	34.53	0	34.19	32	33.86	0	34.51	32	34.00
1	34.57	33	34.28	1	34.51	33	33.96	1	34.97	33	34.11
2	33.89	34	34.40	2	33.96	34	34.12	2	34.22	34	34.15
3	34.23	35	34.41	3	34.29	35	34.06	3	34.22	35	33.77
4	34.77	36	34.42	4	34.38	36	34.22	4	34.45	36	34.09
5	34.28	37	32.26	5	34.41	37	31.82	5	34.32	37	32.05
6	34.66	38	34.61	6	34.18	38	34.30	6	34.11	38	34.16
7	34.39	39	34.63	7	34.15	39	33.99	7	33.98	39	33.86
8	34.68	40	34.81	8	34.54	40	34.72	8	34.39	40	34.40
9	35.06	41	34.68	9	34.84	41	34.28	9	34.84	41	34.29
10	34.73	42	34.87	10	34.49	42	34.35	10	34.37	42	34.44
11	34.58	43	34.45	11	34.39	43	34.40	11	34.41	43	34.27
12	34.79	44	29.12	12	34.51	44	28.81	12	34.60	44	29.10
13	35.03	45	34.87	13	34.62	45	34.23	13	34.69	45	34.41
14	34.34	46	34.79	14	34.39	46	34.52	14	34.21	46	34.47
15	34.68	47	34.83	15	34.39	47	34.38	15	34.52	47	34.05
16	35.13	48	35.23	16	34.57	48	34.55	16	34.53	48	34.87
17	34.92	49	35.15	17	34.39	49	34.73	17	34.43	49	34.56
18	34.84	50	35.62	18	34.49	50	35.05	18	34.72	50	35.42
19	34.45	51	35.28	19	34.34	51	34.87	19	34.18	51	35.08
20	34.42	52	34.97	20	34.28	52	34.85	20	34.33	52	34.67
21	34.44	53	34.96	21	34.38	53	34.53	21	34.41	53	34.66
22	34.55	54	35.12	22	34.49	54	34.72	22	34.39	54	34.95
23	34.72	55	34.82	23	34.41	55	34.49	23	34.10	55	34.41
24	34.48	56	34.51	24	34.25	56	34.10	24	34.42	56	34.11
25	34.70	57	34.63	25	34.31	57	33.79	25	34.41	57	34.20
26	34.71	58	34.23	26	34.15	58	34.31	26	34.04	58	34.15
27	33.86	59	34.29	27	33.99	59	34.37	27	34.05	59	34.28
28	34.08	60	33.81	28	33.91	60	33.70	28	33.88	60	34.09
29	34.30	61	34.48	29	34.05	61	34.07	29	34.10	61	34.22
30	34.27	62	34.21	30	34.12	62	34.13	30	34.18	62	34.27
31	34.37	63	34.43	31	33.92	63	34.20	31	33.92	63	33.98
Total Power (dBm)			52.61	Total Power (dBm)			52.32	Total Power (dBm)			52.34
Total Power (W)			182.30	Total Power (W)			170.45	Total Power (W)			171.41

1 Carrier, 44MHz BW, Max Value Plot

Test Model 1.1, Modulation QPSK, Channel Frequency 2521MHz, TX50



Channel Power - Signal BW 49MHz											
Test Model 1.1 Modulation QPSK Channel Frequency 2521MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2593MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2665MHz			
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
0	35.12	32	35.04	0	34.83	32	34.81	0	35.11	32	34.65
1	35.05	33	35.29	1	35.09	33	34.44	1	35.47	33	34.58
2	34.86	34	35.03	2	34.61	34	34.69	2	34.36	34	34.78
3	35.08	35	34.70	3	34.95	35	34.79	3	35.05	35	34.56
4	35.05	36	35.24	4	34.81	36	34.75	4	35.12	36	34.68
5	34.95	37	32.55	5	34.83	37	32.26	5	34.96	37	32.08
6	35.02	38	35.05	6	34.83	38	34.73	6	35.03	38	34.82
7	34.85	39	35.18	7	34.58	39	34.56	7	34.73	39	34.94
8	35.42	40	35.52	8	35.10	40	35.10	8	35.18	40	35.26
9	35.61	41	35.37	9	35.16	41	34.60	9	35.49	41	34.92
10	35.27	42	35.48	10	34.96	42	35.10	10	35.08	42	35.22
11	35.37	43	35.38	11	34.95	43	34.93	11	34.90	43	34.99
12	35.49	44	29.70	12	35.19	44	29.38	12	35.33	44	29.28
13	35.33	45	35.57	13	34.92	45	35.16	13	35.29	45	34.97
14	35.13	46	35.55	14	34.80	46	35.29	14	34.77	46	35.27
15	35.25	47	35.24	15	34.92	47	35.24	15	34.99	47	34.95
16	35.29	48	35.52	16	35.11	48	35.50	16	35.29	48	35.23
17	35.21	49	35.94	17	35.03	49	35.25	17	35.07	49	35.50
18	35.55	50	35.96	18	34.70	50	35.88	18	35.26	50	35.93
19	35.27	51	35.91	19	34.82	51	35.19	19	34.91	51	35.66
20	35.20	52	35.55	20	34.93	52	35.38	20	34.76	52	35.37
21	34.97	53	35.43	21	34.88	53	35.53	21	35.02	53	34.98
22	35.42	54	35.94	22	35.09	54	35.59	22	35.26	54	35.64
23	34.96	55	35.39	23	34.99	55	35.03	23	34.84	55	35.15
24	34.98	56	35.09	24	34.91	56	34.75	24	34.72	56	34.79
25	35.10	57	34.90	25	34.96	57	34.43	25	34.66	57	34.57
26	35.08	58	35.01	26	34.72	58	34.49	26	34.55	58	34.54
27	34.75	59	35.09	27	34.33	59	34.74	27	34.52	59	34.88
28	34.71	60	34.58	28	34.91	60	34.56	28	34.97	60	34.69
29	34.95	61	35.12	29	34.72	61	34.99	29	34.81	61	34.92
30	35.02	62	35.24	30	34.68	62	34.68	30	34.58	62	34.79
31	35.25	63	34.99	31	34.36	63	34.57	31	34.69	63	34.87
Total Power (dBm)			53.21	Total Power (dBm)			52.90	Total Power (dBm)			52.97
Total Power (W)			209.65	Total Power (W)			195.06	Total Power (W)			198.22

1 Carrier, 49MHz BW, Max Value Plot

Test Model 1.1, Modulation QPSK, Channel Frequency 2521MHz, TX50



Channel Power - Signal BW 49.5MHz											
Test Model 1.1 Modulation QPSK Channel Frequency 2521MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2593MHz				Test Model 1.1 Modulation QPSK Channel Frequency 2665MHz			
TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)	TX Port	(dBm)
0	34.65	32	34.73	0	35.23	32	34.86	0	34.79	32	34.50
1	34.90	33	34.53	1	35.53	33	34.86	1	34.80	33	34.32
2	34.24	34	34.46	2	34.68	34	34.78	2	34.40	34	34.31
3	34.57	35	34.56	3	34.52	35	34.68	3	34.63	35	34.30
4	34.77	36	34.56	4	34.98	36	34.84	4	34.36	36	34.15
5	34.81	37	32.25	5	35.21	37	31.97	5	34.31	37	31.99
6	34.65	38	34.37	6	35.05	38	34.55	6	34.37	38	34.55
7	34.51	39	34.45	7	34.56	39	34.48	7	34.15	39	34.30
8	34.79	40	34.97	8	35.16	40	35.14	8	34.64	40	34.62
9	35.23	41	34.77	9	35.48	41	34.79	9	35.09	41	34.48
10	34.81	42	34.84	10	35.13	42	34.99	10	34.46	42	34.59
11	34.86	43	34.88	11	34.94	43	34.88	11	34.51	43	34.41
12	34.89	44	29.30	12	35.11	44	29.48	12	34.71	44	29.24
13	35.14	45	35.05	13	34.98	45	35.33	13	34.84	45	34.66
14	34.76	46	35.16	14	35.12	46	35.20	14	34.53	46	34.64
15	34.76	47	34.92	15	34.98	47	35.00	15	34.41	47	34.47
16	34.93	48	35.27	16	35.27	48	35.31	16	34.78	48	34.89
17	34.80	49	35.16	17	35.05	49	35.39	17	34.81	49	34.87
18	34.97	50	35.70	18	35.21	50	35.90	18	34.58	50	35.41
19	34.69	51	35.39	19	35.03	51	35.32	19	34.62	51	35.08
20	34.66	52	35.07	20	35.03	52	35.61	20	34.51	52	34.92
21	34.68	53	35.15	21	34.86	53	35.38	21	34.72	53	34.75
22	34.77	54	35.23	22	35.27	54	35.72	22	34.67	54	35.02
23	34.83	55	34.88	23	35.12	55	35.02	23	34.47	55	34.61
24	34.78	56	34.64	24	34.92	56	34.79	24	34.58	56	34.31
25	34.66	57	34.64	25	35.05	57	34.79	25	34.53	57	34.43
26	34.55	58	34.57	26	35.07	58	34.84	26	34.23	58	34.31
27	34.30	59	34.80	27	34.70	59	34.90	27	34.16	59	34.72
28	34.10	60	34.01	28	34.80	60	34.63	28	34.22	60	34.53
29	34.42	61	34.58	29	34.80	61	34.75	29	33.85	61	34.27
30	34.47	62	34.52	30	34.61	62	34.66	30	34.42	62	34.41
31	34.39	63	34.62	31	34.56	63	34.92	31	34.13	63	34.34
Total Power (dBm)			52.75	Total Power (dBm)			52.99	Total Power (dBm)			52.53
Total Power (W)			188.30	Total Power (W)			199.23	Total Power (W)			179.10

1 Carrier, 49.5MHz BW, Max Value Plot

Test Model 1.1, Modulation QPSK, Channel Frequency 2593MHz, TX50



2.2 Peak-to-Average Power Ratio (PAPR)

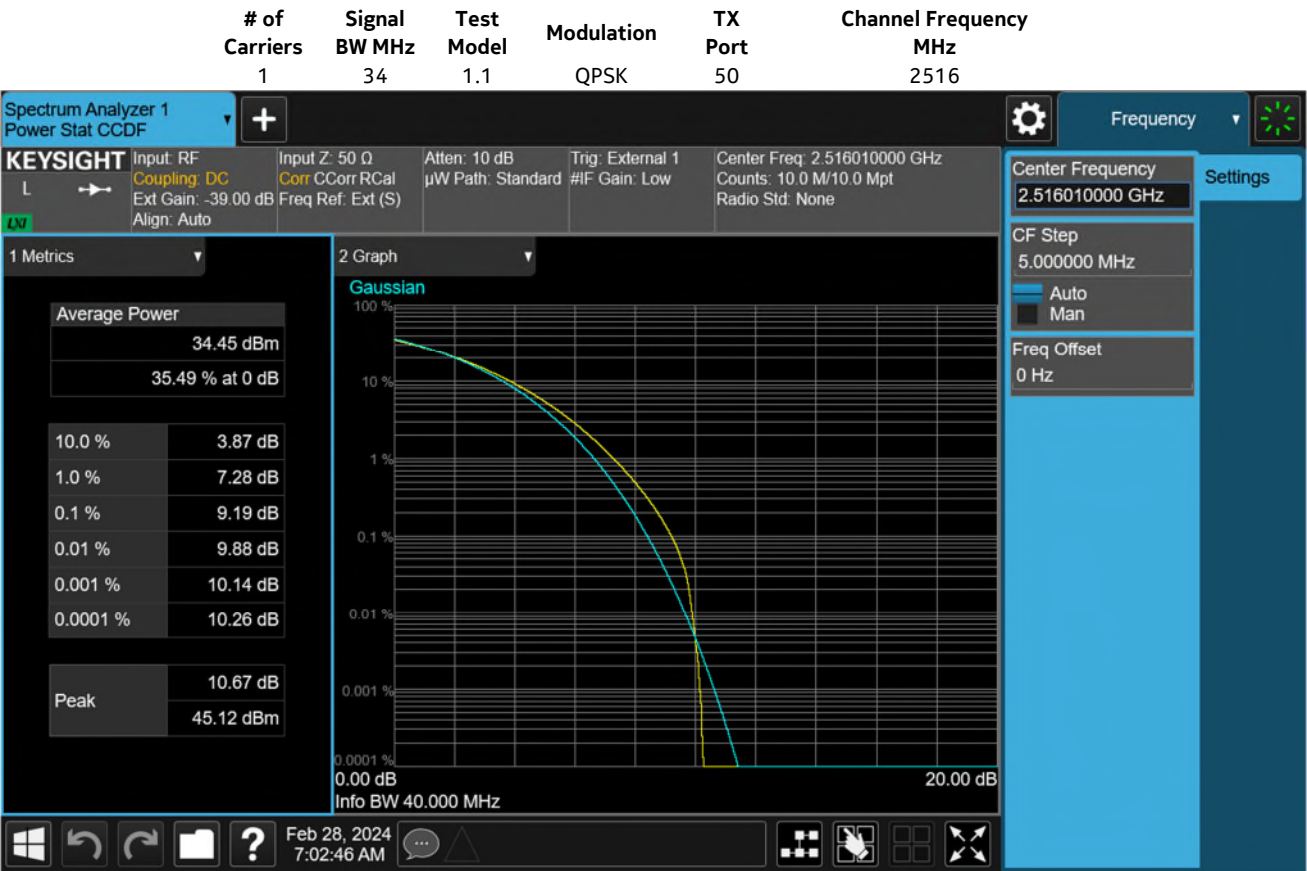
The Peak-to-Average Power Ratio (PAPR) was evaluated per KDB 971168 for Single and Multiple Carriers. The PAPR values of all carriers measured are below 13dB.

Tabular Data – PAPR

# of Carrier	Signal BW MHz	Modulation	TX Port	Channel Frequency MHz	PAR at 0.1% Limit - 13 dB
1	33	QPSK	50	2516	9.15
1	33	QPSK	50	2593	9.18
1	33	QPSK	50	2670	9.16
1	34	QPSK	50	2516	9.19
1	34	QPSK	50	2593	9.19
1	34	QPSK	50	2670	9.19
1	38	QPSK	50	2516	9.12
1	38	QPSK	50	2670	9.14
1	38	QPSK	50	2693	9.14
1	38.5	QPSK	50	2516	9.05
1	38.5	QPSK	50	2670	9.06
1	38.5	QPSK	50	2693	8.98
1	44	QPSK	50	2521	9.12
1	44	QPSK	50	2593	9.05
1	44	QPSK	50	2665	9.07
1	49	QPSK	50	2521	8.77
1	49	QPSK	50	2593	8.98
1	49	QPSK	50	2665	8.79
1	49.5	QPSK	50	2521	8.91
1	49.5	QPSK	50	2593	8.70
1	49.5	QPSK	50	2665	8.97

2.2.1 Peak-to-Average Power Ratio Plots

NOTE: Only the plot with the minimum margin measured is given in this report. The full suite of raw data resides at the MH, New Jersey location.



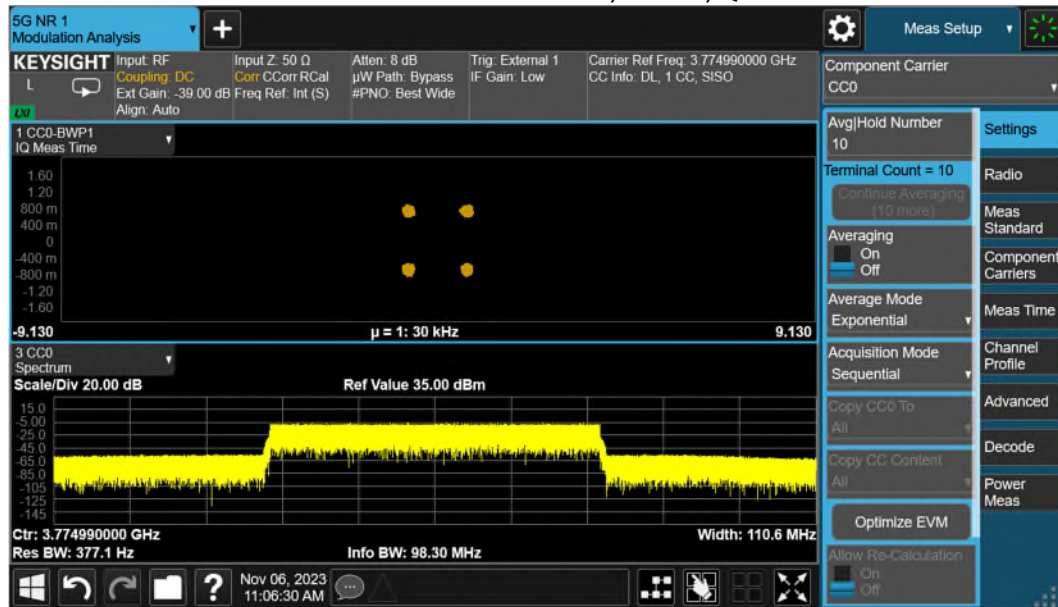
3. FCC Section 2.1047 - Modulation Characteristics

3.1 Modulation Characteristics

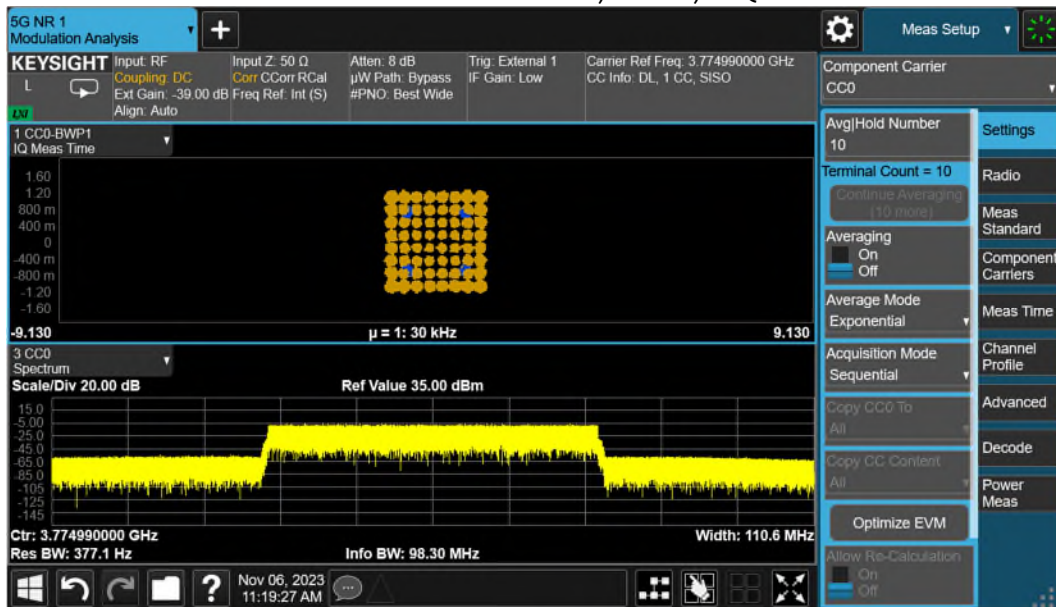
The RF signal at the antenna port was demodulated and verified for correctness of the modulation signal used before each test was performed.

3.1.1 Modulation Characteristics – Plots

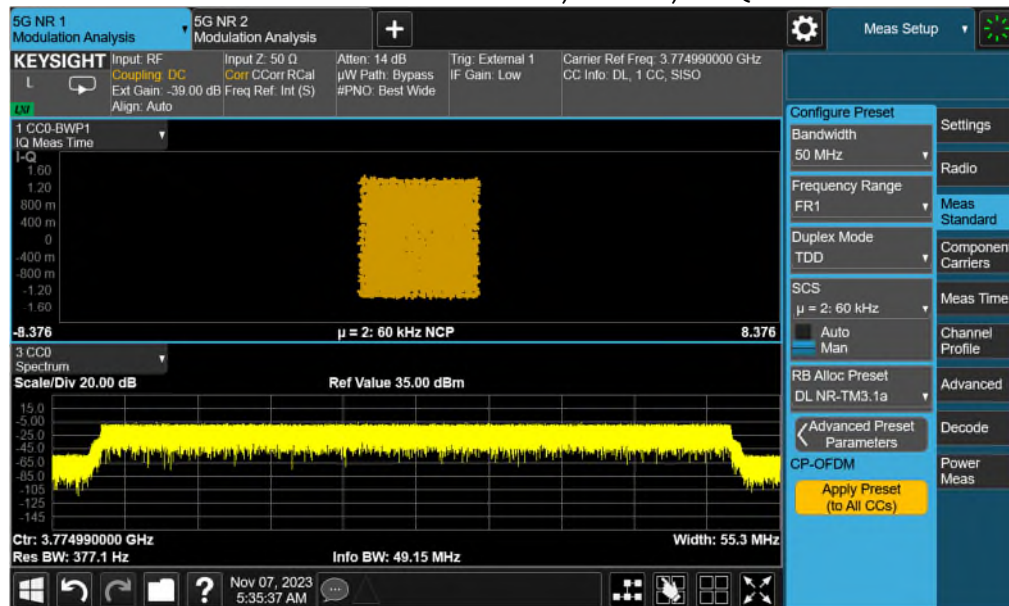
Modulation Characteristics, TM 1.1, QPSK



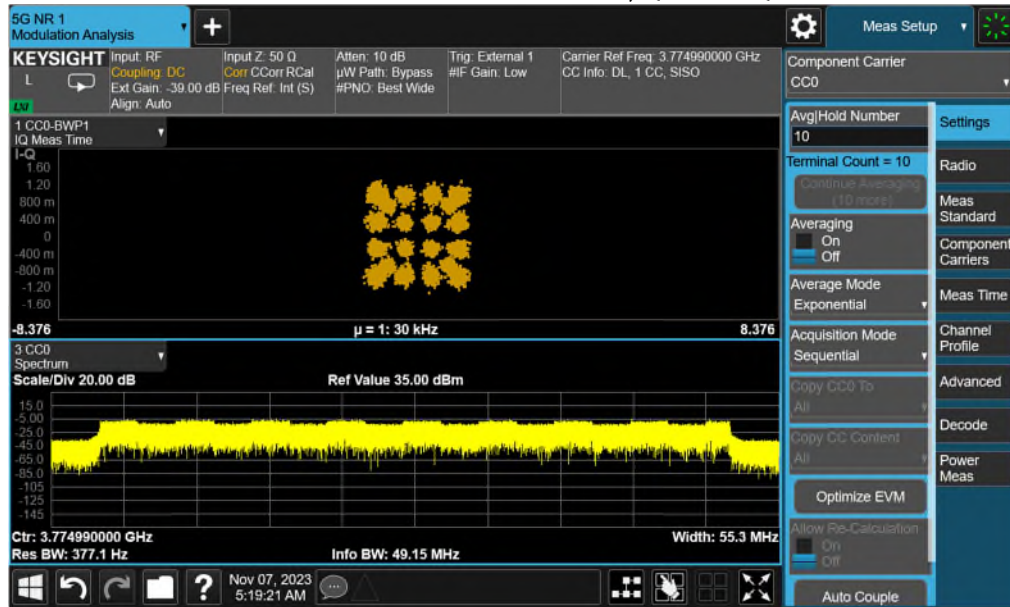
Modulation Characteristics, TM 3.1, 64QAM



Modulation Characteristics, TM 3.1a, 256QAM



Modulation Characteristics TM 3.2, 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.

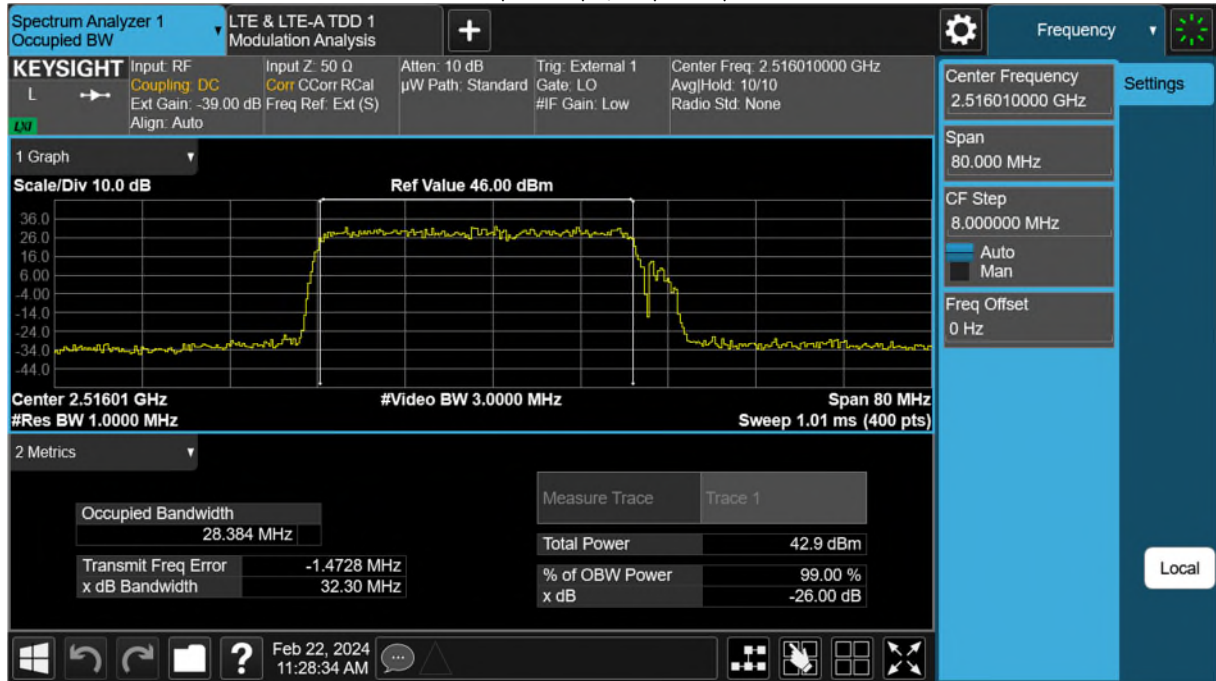
The transmitted signal occupied bandwidth was measured using a Keysight MXA Signal Analyzer. All emissions were within the parameters as required.

# of Carrier	Signal BW MHz	Modulation	TX Port	Channel Frequency MHz	99% Occupied BW MHz
1	33	QPSK	50	2516	28.384
1	33	QPSK	50	2593	28.264
1	33	QPSK	50	2670	28.219
1	34	QPSK	50	2516	28.524
1	34	QPSK	50	2593	28.660
1	34	QPSK	50	2670	28.536
1	38	QPSK	50	2516	30.888
1	38	QPSK	50	2670	30.744
1	38	QPSK	50	2693	30.840
1	38.5	QPSK	50	2516	30.667
1	38.5	QPSK	50	2670	30.677
1	38.5	QPSK	50	2693	30.741
1	44	QPSK	50	2521	37.013
1	44	QPSK	50	2593	37.017
1	44	QPSK	50	2665	36.899
1	49	QPSK	50	2521	42.368
1	49	QPSK	50	2593	42.180
1	49	QPSK	50	2665	42.128
1	49.5	QPSK	50	2521	42.610
1	49.5	QPSK	50	2593	42.553
1	49.5	QPSK	50	2665	42.583
1	55	QPSK	50	2593	43.368

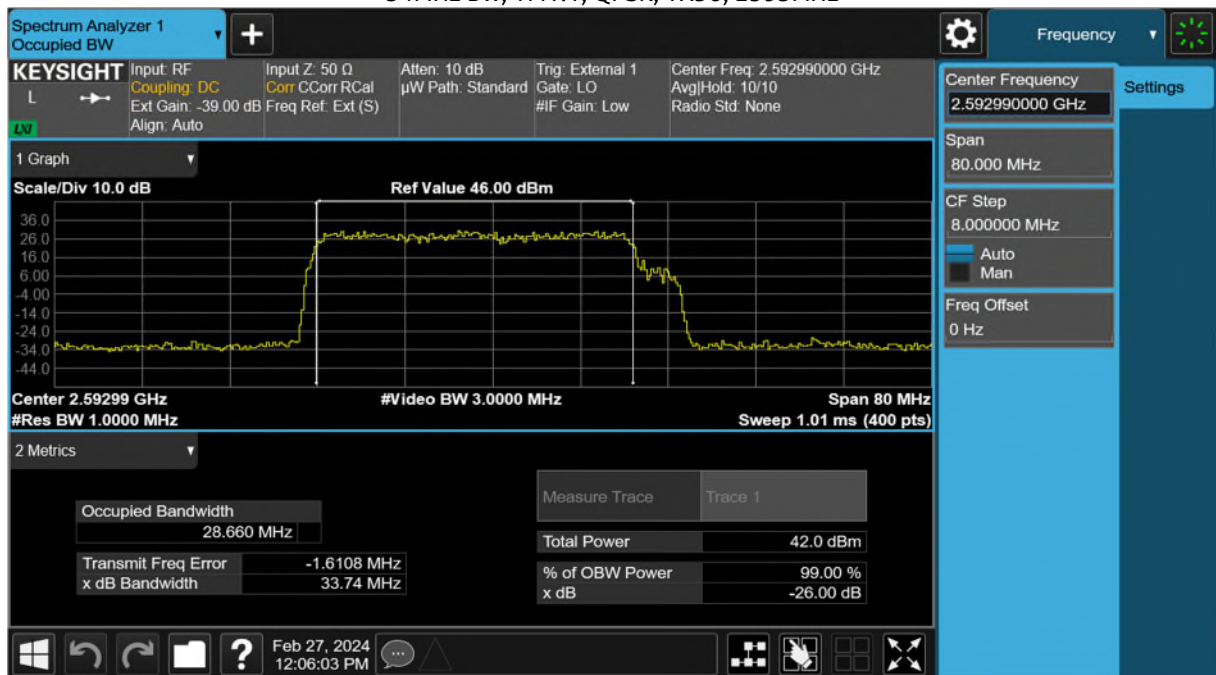
4.2 99% Occupied Bandwidth Plots

NOTE: Only the plot with the maximum bandwidth measured is used in this report. The full suite of raw data resides at the MH, New Jersey location.

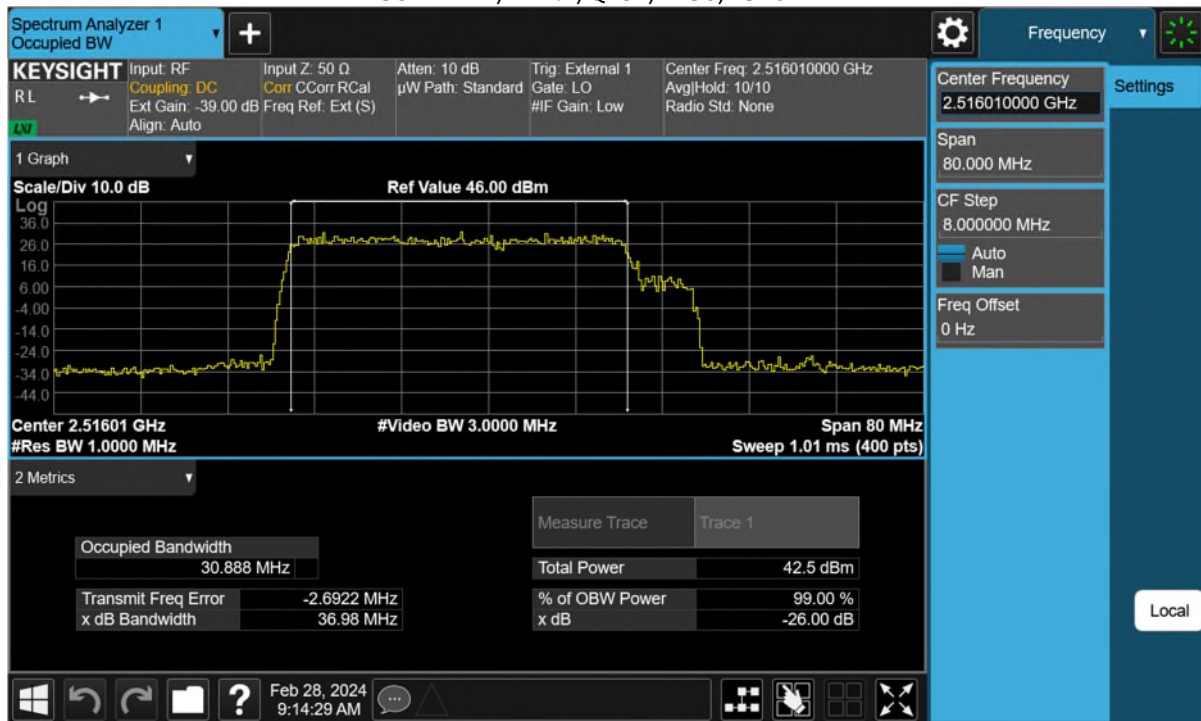
33MHz BW, TM1.1, QPSK, TX50, 2516MHz



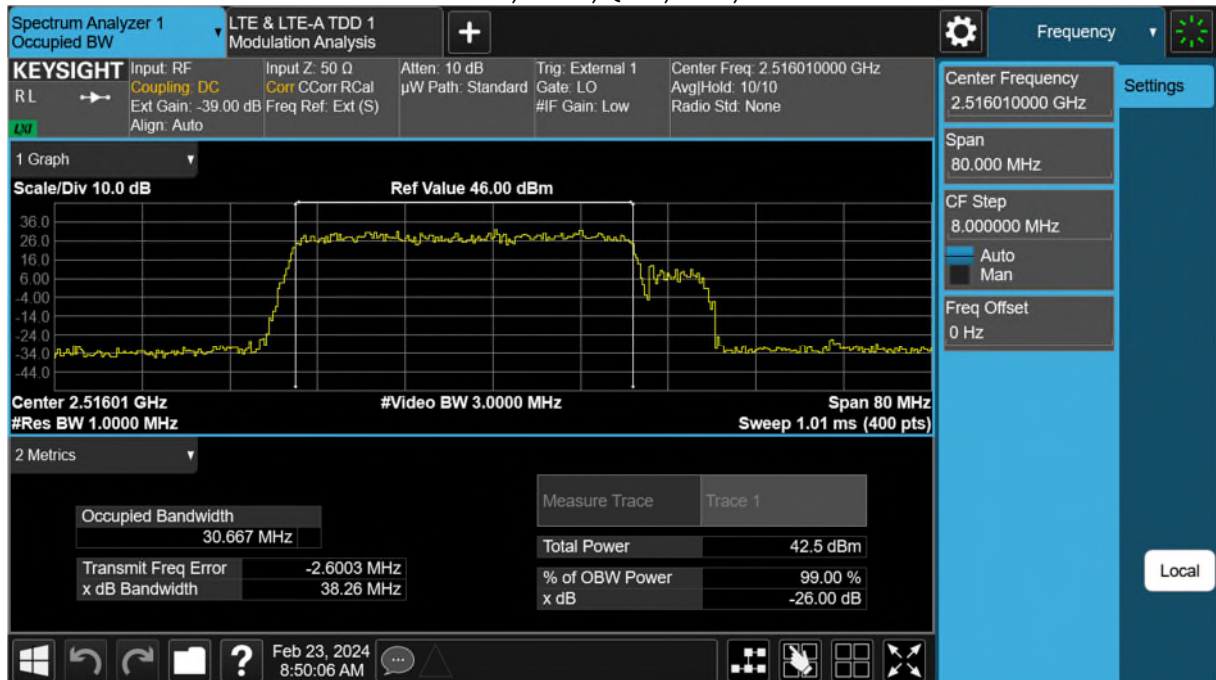
34MHz BW, TM1.1, QPSK, TX50, 2593MHz



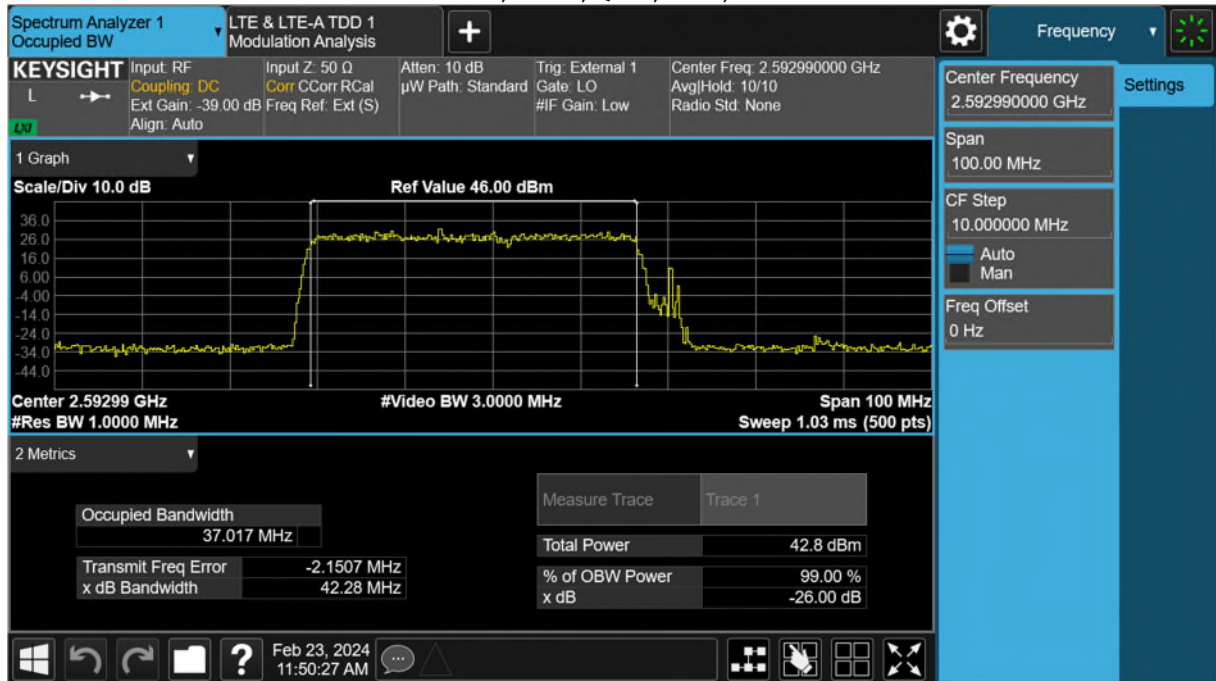
38MHz BW, TM1.1, QPSK, TX50, 2516MHz



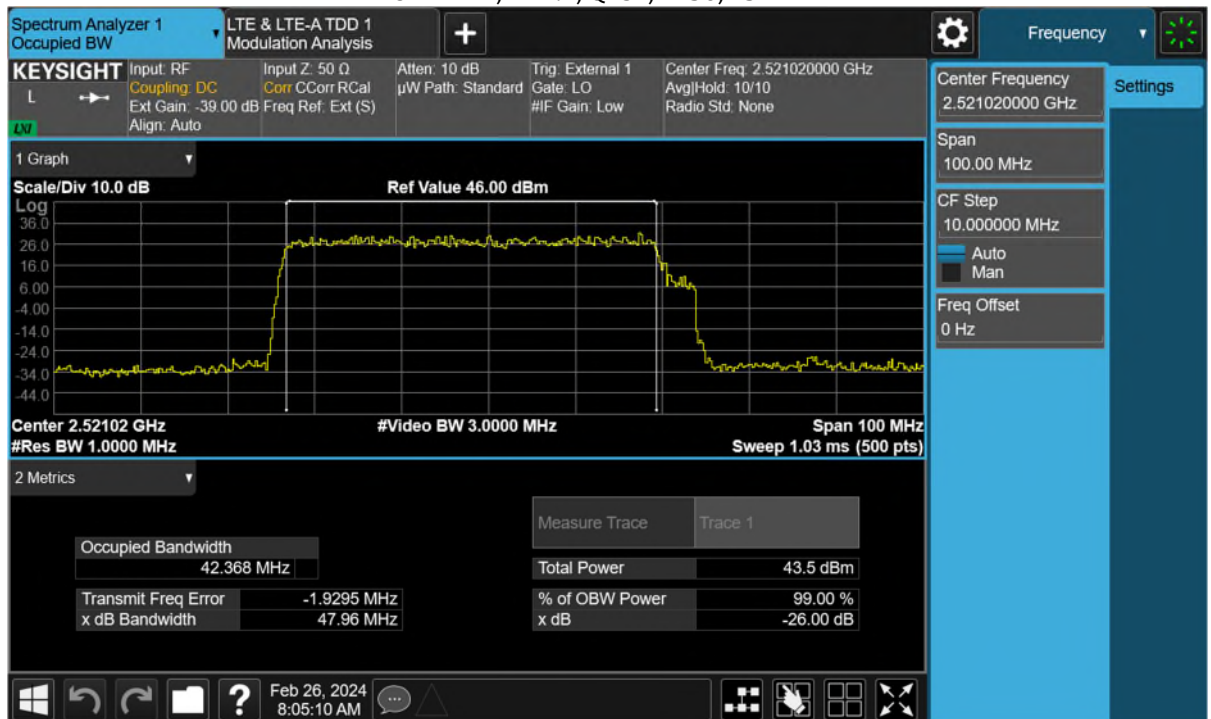
38.5MHz BW, TM1.1, QPSK, TX50, 2516MHz



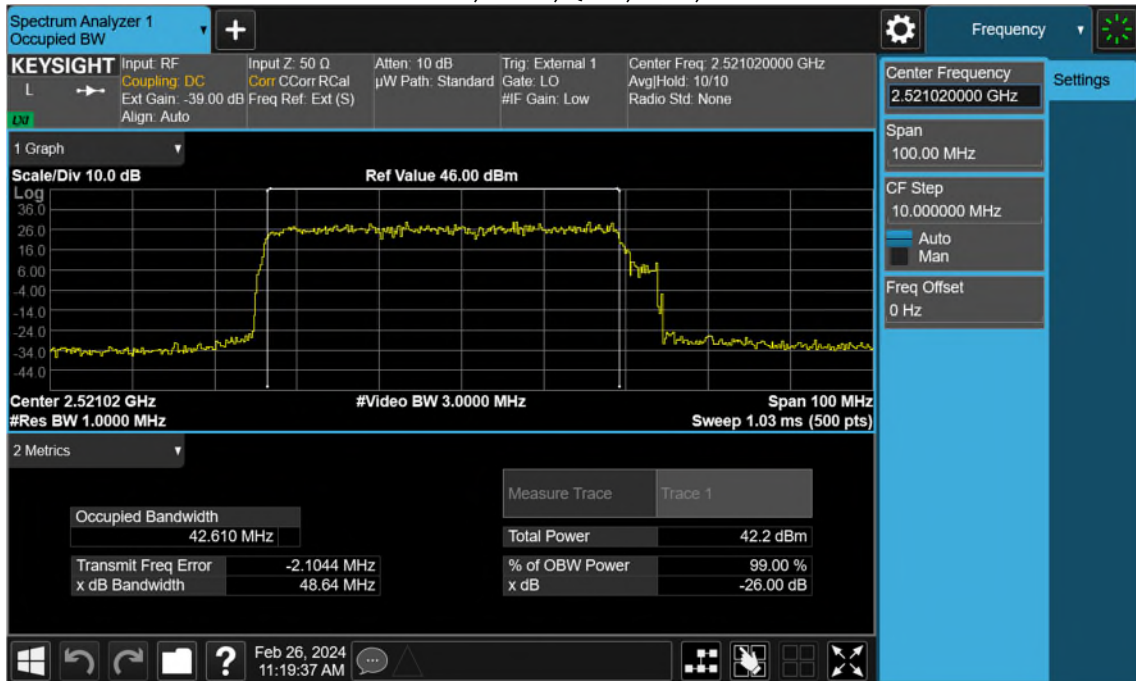
44MHz BW, TM1.1, QPSK, TX50, 2593MHz



49MHz BW, TM1.1, QPSK, TX50, 2521MHz



49.5MHz BW, TM1:1, QPSK, TX50, 2521MHz



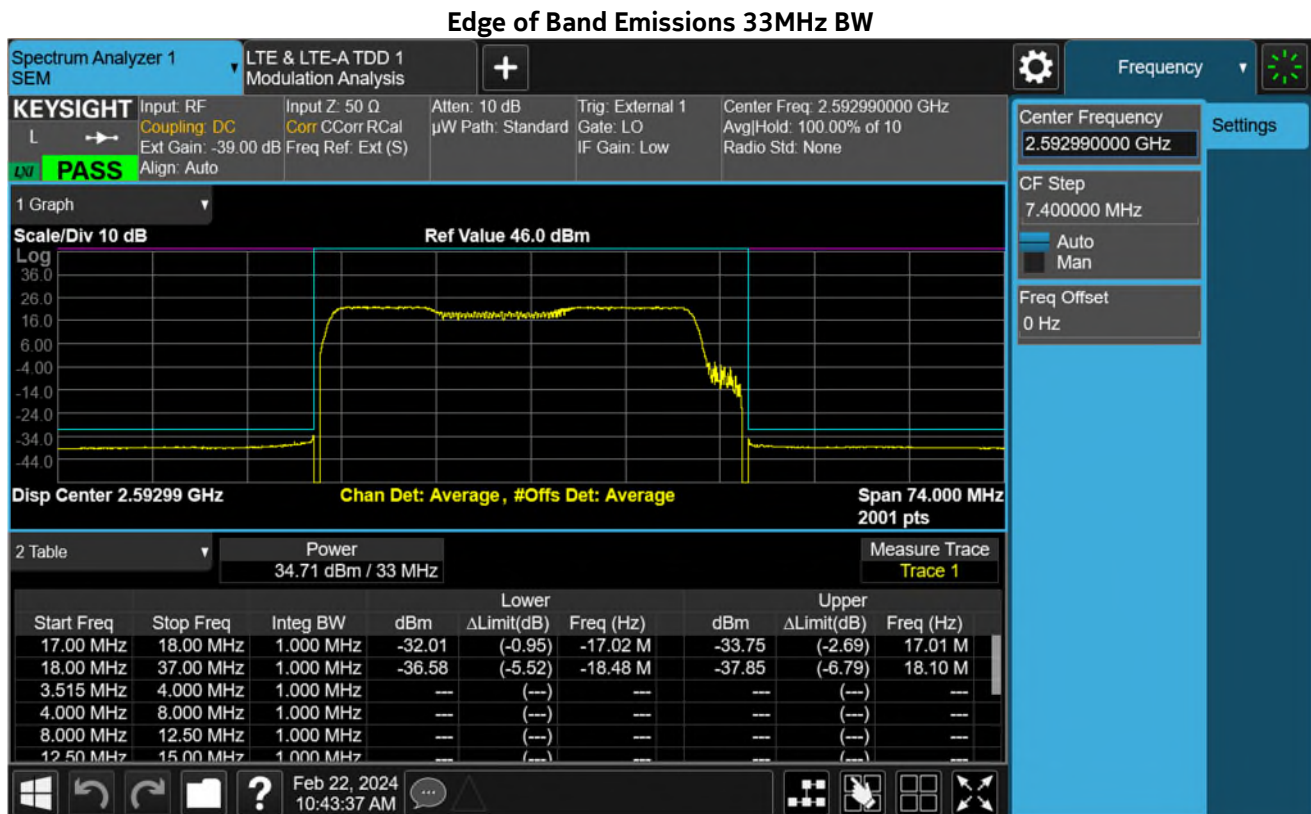
4.3 Edge of band Emissions

The Edge of Band emissions of the EUT at the external antenna connector (EAC) were measured using a Keysight MXA Signal Analyzer. Before measuring the Edge of Band emissions, the RF power level was confirmed with the Keysight MXA Signal Analyzer. 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 RF Switch. 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. In accordance with KDB 662911 D01 Multiple Transmitter Output, the limit of -13 dBm has been adjusted to -31 dBm to reflect $10 \log(n)$ where $n=64$ for the 64x64 MIMO operation.

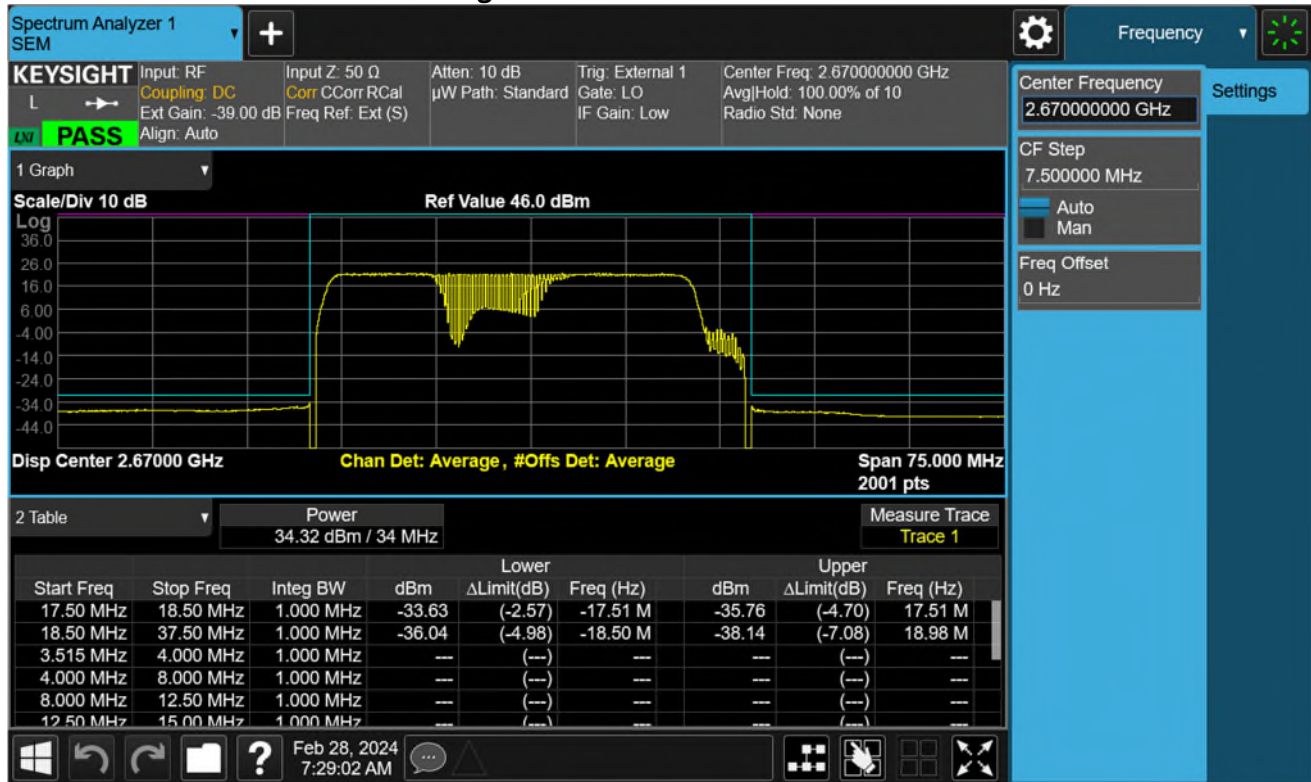
4.3.1 Edge of Band Emissions – Plots

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

NOTE: The full suite of raw data resides at the MH, New Jersey location.



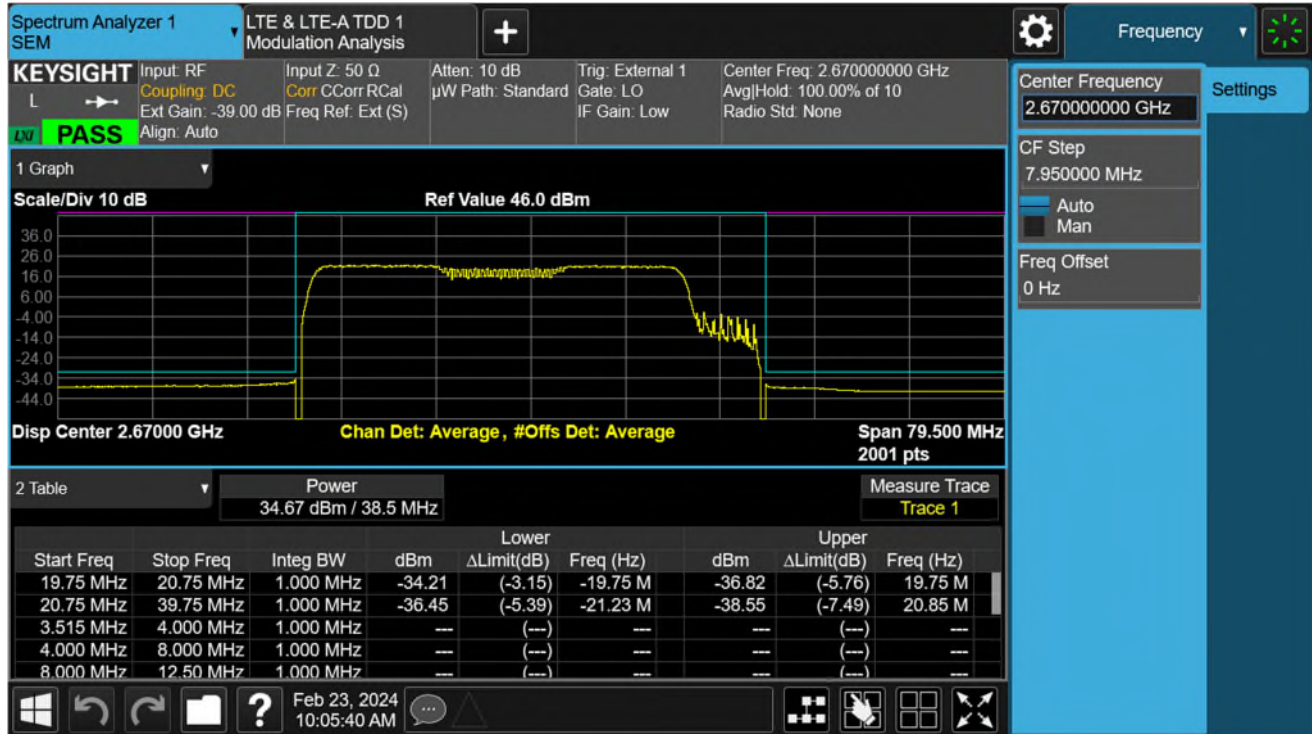
Edge of Band Emissions 34MHz BW



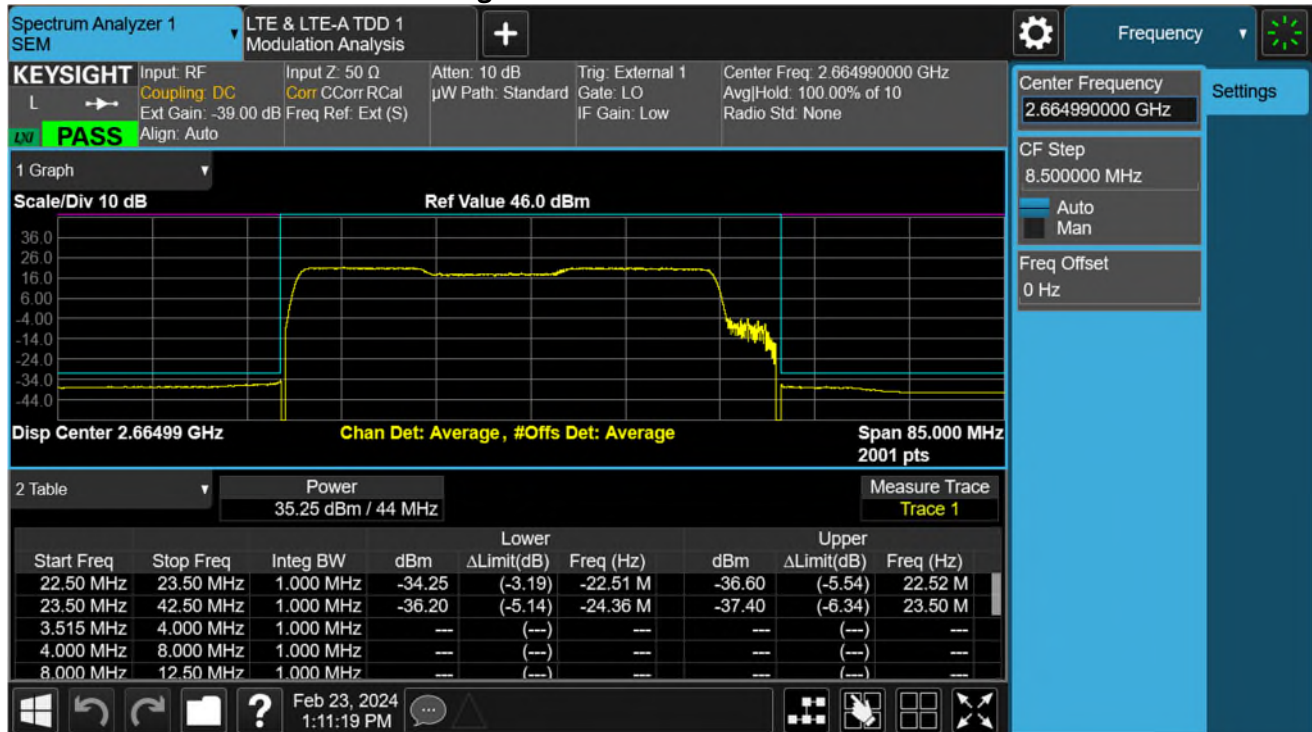
Edge of Band Emissions 38MHz BW



Edge of Band Emissions 38.5MHz BW



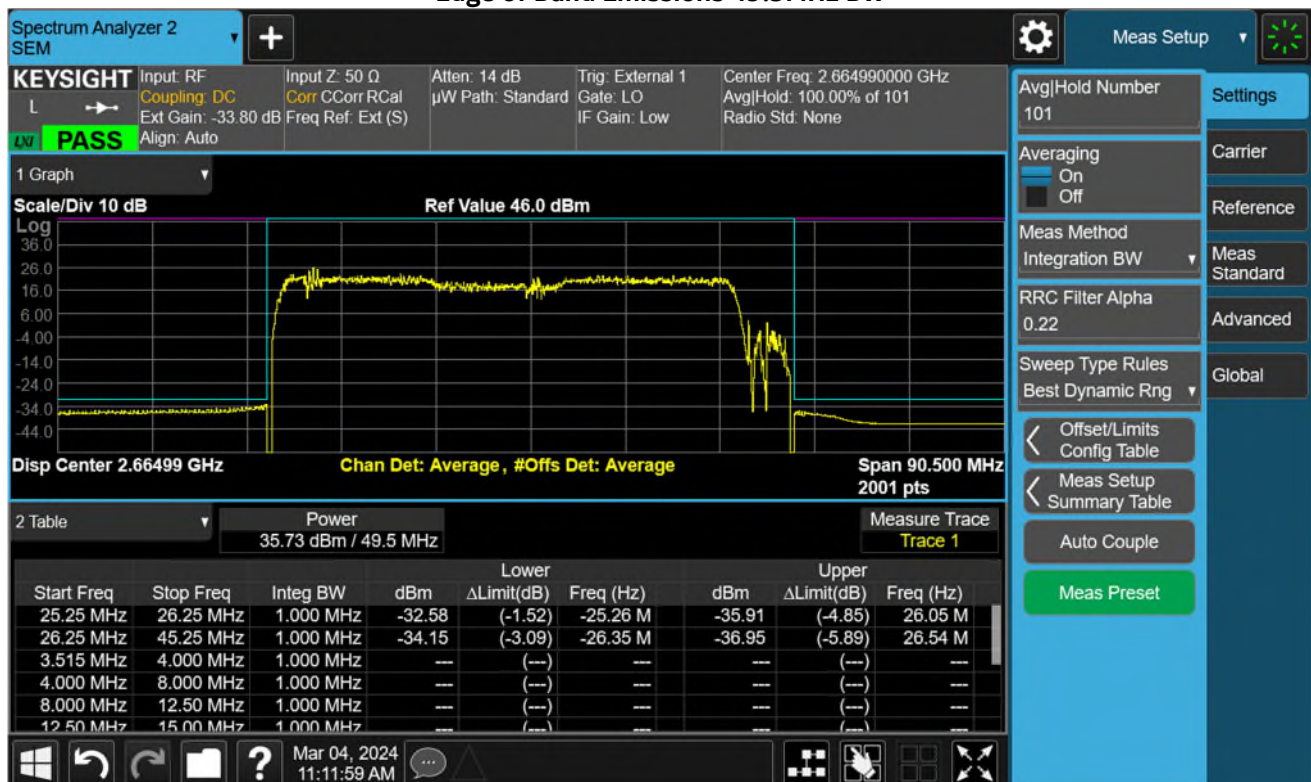
Edge of Band Emissions 44MHz BW



Edge of Band Emissions 49MHz BW



Edge of Band Emissions 49.5MHz BW



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 27 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 Keysight MXA Signal Analyzer.

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 27 GHz.

5.1.1 Spurious Emissions at Tx Port – Plots

NOTES: Only Emissions plots with margin less than 20dBm for each frequency range are included in this report. The full suite of raw data resides at the MH, New Jersey location. The conducted spurious emissions in the frequency range of 150k -30GHz and 30MHz – 1GHz have more than 20dB margins.

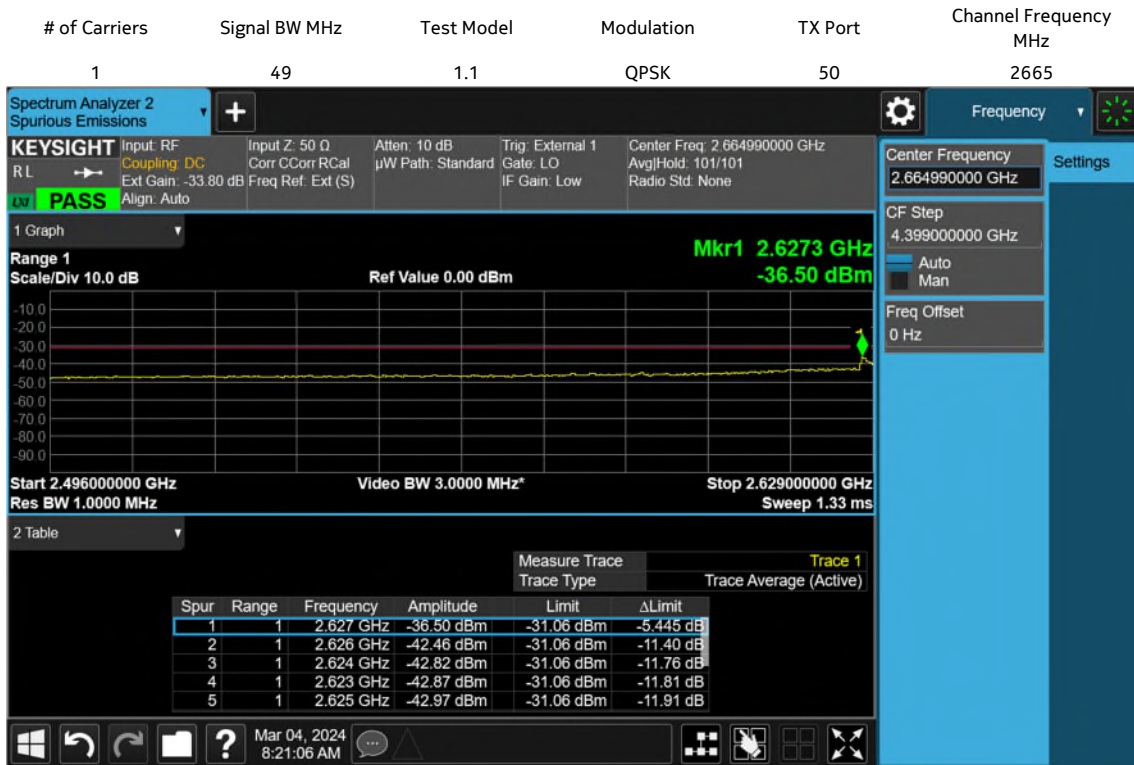
9kHz – 150kHz



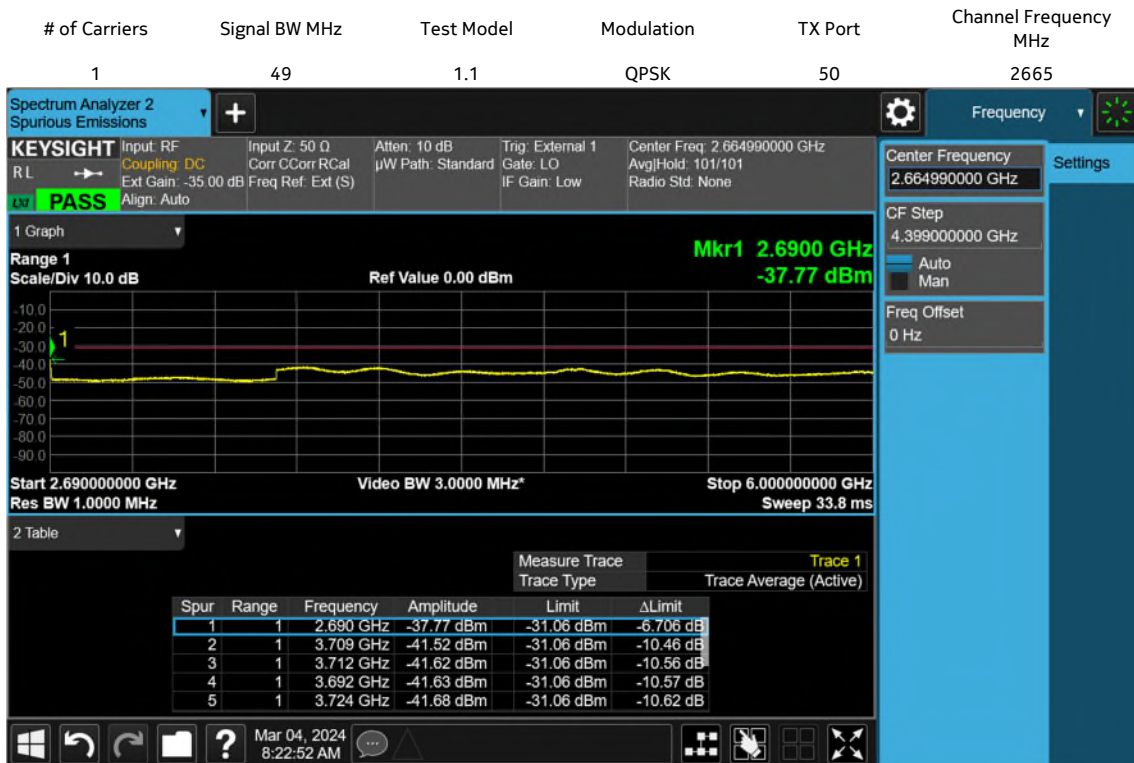
1GHz – 2.496GHz

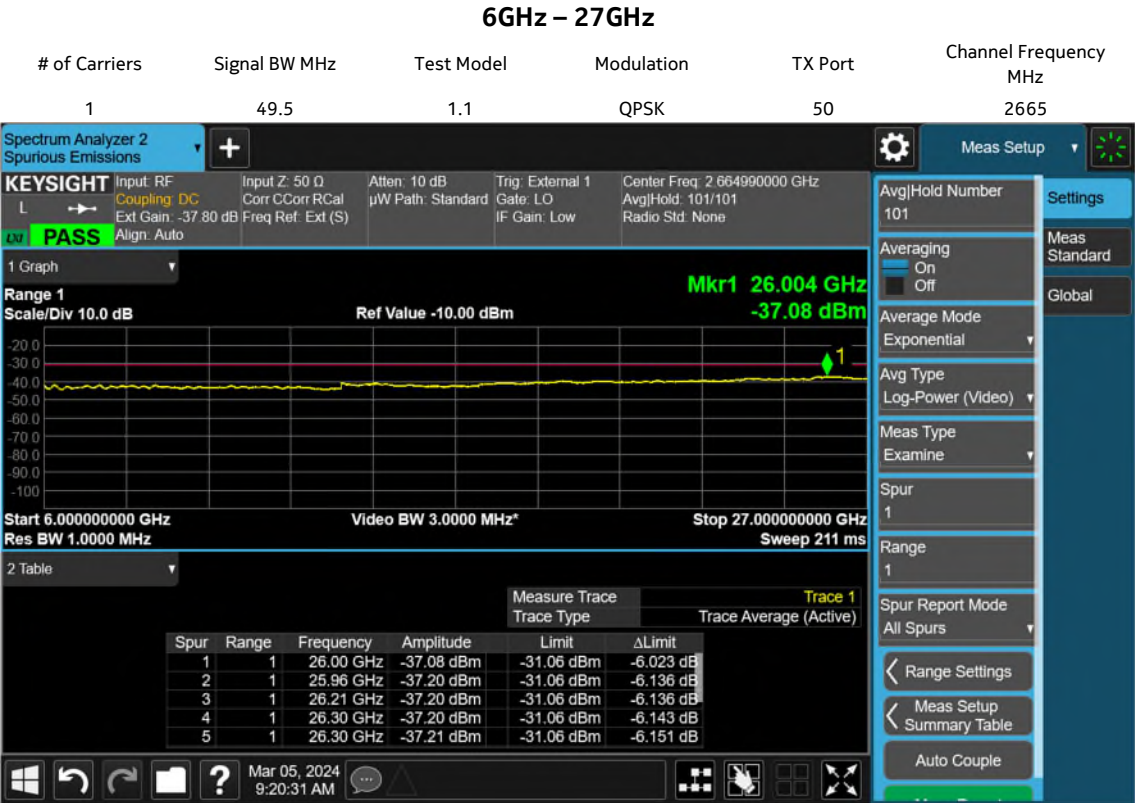


2.496GHz – 2.629GHz



2.69GHz – 6GHz





Photographs

Radio Test Setup



Test Equipment

Radio Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E896	Agilent Technologies	Network Analyzer	10 MHz - 40 GHz, PNA-L Microwave Network Analyzer	N5230C	MY49000897	2023-02-08	2025-02-08
E1154	Weinschel	Attenuator	30dB 25W 0.05GHz-26GHz	74-30-12	1065	CNR-V	CNR-V
E1181	Weinschel	Attenuator	3dB 50MHz-26GHz 25Watts	74-3-12	1059	CNR-V	CNR-V
E1579	KeySight Technologies	MXA Signal Analyzer	10 Hz - 50 GHz	N9021B	MY60080199	2021-11-30	2024-03-30
	Micro Coax Utiflex	RF Cable	MFR-64639-228872-001	UF142A-000400-200-2G0	MFR-64639-228872-001	NA	NA
	Mini Circuit	Modular Test System		ZTS-8SP8T-63	02203170006	NA	NA
	Mini Circuit	Modular Test System		RCM-202	02110200002	NA	NA

CNR-V: Calibration Not Required; Must be Verified.

Test Dates: 2/22/2024 - 3/4/2024.

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, 40 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.

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

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

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:

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

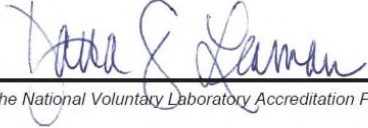
RESULTS:

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 40 GHz), no reportable spurious emissions were detected.

7. FCC Section 2.1055 - Measurement of Frequency Stability

Frequency Stability testing was not performed.

8. 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	
<i>is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:</i>	
Electromagnetic Compatibility & Telecommunications	
<i>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).</i>	
2023-09-07 through 2024-09-30 Effective Dates	  For the National Voluntary Laboratory Accreditation Program