Global Product Compliance Laboratory
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TESTING
NVLAP LAB CODE: 100275-0

Title 47 Code of Federal Regulations Test Report

Regulation:
Title 47 CFR FCC Part 96

Client:
NOKIA SOLUTIONS AND NETWORKS, OY

Product Evaluated:
AirScale Indoor pico RRH 4T4R n48 AWPQY/Z

Report Number:
TR-2023-0049-FCC96

Date Issued:
June 30, 2023

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Table of Contents

Revisions

Date	Revision	Section	Change
6/30/2023	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 Indoor pico RRH 4T4R n48 AWPQY/Z
Serial Number:	Refer to Section 1.3.2
Hardware Version:	Refer to Section 1.3.2
Software Version:	SBTS23R3
Frequency Range:	3550 - 3700 MHz
GPCL Project Number:	2023-0049
Manufacturer:	NOKIA SOLUTIONS AND NETWORKS OY KARAKAARI 7, FI-02610 ESPOO FINLAND
Applicant:	NOKIA SOLUTIONS AND NETWORKS, OY 3201 Olympus Blvd Dallas, Texas 75019 Lee Klindenborg
Test Requirement(s):	Title 47 CFR Part96
Test Standards:	Refer to Section 1.5.1
Measurement Procedure(s):	Refer to Section 1.5.2
Test Date(s):	4/17/2023 – 6/12/2023 (Radio) 6/6/2023 – 6/13/2023 (Radiated Emission)
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):	Norberto Batista, Chris Polanco, Mike Soli, Jaideep Yadav
Test Results: The EUT, *as tested* 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 Indoor pico RRH 4T4R n48 AWPQY/Z, hereinafter referred to as the Equipment Under Test (EUT).

The Nokia AWPQY/Z is a 4 port radio head that transmits 0.25 Watts per port over the B48/n48 spectrum (3550 – 3700 MHz). This product supports LTE 10MHz & 20MHz single carriers, and up to 4 carriers for multicarrier operation. It also supports 5G-NR 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 MHz single carriers and up to 4 carriers for multicarrier operation. The product utilizes QPSK, 16QAM, 64QAM and 256QAM modulation formats.

1.2 Purpose and Scope

This document is to provide the testing data required for qualifying the EUT in compliance with FCC Part 96 measured in accordance with the procedures set out in Section 2.1033 (c) (14) of the Rules.

FCC testing for Part 96 Class II certification was performed on two models (AWPQY and AWPQZ). The testing added 10 MHz 5G-NR and multicarrier configurations for 3 and 4 carrier 5G-NR LTE at maximum power. This report will demonstrate compliance to Category A power requirements with integral and optional external antenna specified by the manufacturer for the product.

Radiated Emissions testing was performed on the Single Carrier and Multi-Carrier configurations with similar results. This report only contains the Radiated Emissions results for the Single Carrier configuration.

The AWPQY/Z was previously certified under FCC ID: 2AD8UAWPQYAWPQZ01.

1.3 EUT Details

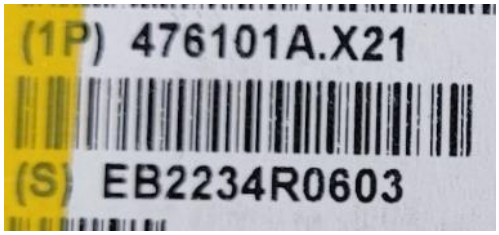
1.3.1 Specifications

Standard	3GPP / WINNF / CBRS Alliance / FCC Part 96 FCC (Category A CBSD)
Band	3GPP band B48/n48
Spectrum Range	3550–3700MHz
IBW	150MHz
OBW	150MHz
Carriers	Up to 4 contiguous or non-contiguous LTE or NR carriers with 4T4R antenna configuration
Carrier Bandwidths	10/20/ MHz LTE carrier 10/20/30/40/50/60/70/80/90 /100 MHz 5G-NR carrier
RF Chain	4T4R
RF Power	50 to 250mW per path
Total TX Power	1W
Antenna	Configuration: 4 Tx/ 4 Rx AWPQY: Integrated omni AWPQZ: External antenna (SMA female)
MIMO layers	4x4DL MIMO
Modulation Schemes	QPSK 16QAM 64QAM 256QAM

1.3.2 Photographs

Serial Number (Radio Tests)

Serial Number (Radiated Emissions Tests)



AWPQZ

1.4 Test Requirements

Each required measurement is listed below:

47 CFR FCC Sections	Description of Tests	Test Required
2.1046, 96.41 (b) 96.41(g)	RF Power Output (b) Power Limits, EIRP, PSD (g) Peak-to-Average Power Ratio	Yes
2.1047, 96.41(a)	Modulation Characteristics	Yes
2.1049, 96.41(e)(2)(3)	(a) Occupied Bandwidth (b) Out-of-Band Emissions	Yes
2.1051, 96.41(e)	Spurious Emissions at Antenna Terminals	Yes
2.1053, 96.41(e)(2)(3)	Field Strength of Spurious Radiation	Yes
2.1055, 96.41(e)(2)(3)	Measurement of Frequency Stability	No*

*Previously Tested and Passed; Refer to GPCL Project 2022-0137.

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 96.
- KDB 940660 D01 Certification And Test Procedures For Citizens Broadband Radio Service Devices Authorized Under Part 96, v03, Oct 29, 2020
- 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, 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 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

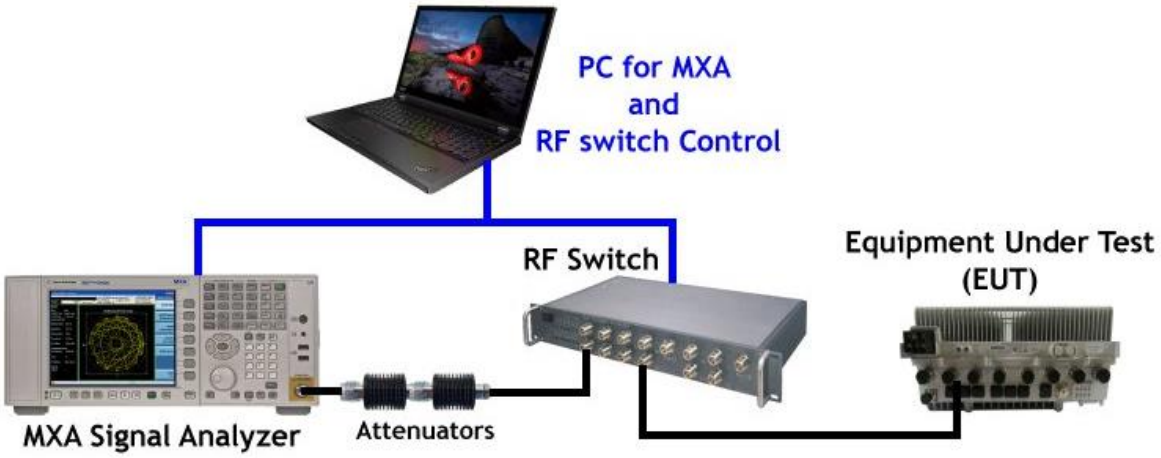
Requirement **47 CFR FCC Parts 2 and 96**	**Description of Tests**	**Result**
2.1046, 96.41 (b) 96.41(g)	RF Power Output (b) Power Limits, EIRP, PSD (g) Peak-to-Average Power Ratio	COMPLIES
2.1047, 96.41(a)	Modulation Characteristics	COMPLIES
2.1049, 96.41(e)(2)(3)	(a) Occupied Bandwidth (b) Out-of-Band Emissions	COMPLIES
2.1051, 96.41(e)	Spurious Emissions at Antenna Terminals	COMPLIES
2.1053, 96.41(e)	Field Strength of Spurious Radiation	COMPLIES
2.1055	Measurement of Frequency Stability	N/A*

*Previously Tested and Passed; Refer to GPCL Project 2022-0137

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 and Power Spectral Density

2.1 RF Power Output

2.1.1 Limits

This test is a measurement of the total RF power level transmitted at the antenna-transmitting terminal. The product was allowed to warm up and stabilize per KDB 971168 D01 and ANSI C63.26.

For 5G-NR transmit carrier operation, the AirScale Indoor pico RRH 4T4R n48 AWPQY/Z, is specified to provide a maximum power output of 0.25W/24 dBm per transmit port for a sum total of 1 Watts /30 dBm per transmit module.

The power is under digital control. The product is designed to operate under Part 96 rules for Band 48.

Under Part 96 the product is limited to the Category A CBSD maximum EIRP of 30 dBm/10 MHz with a PSD of 20 dBm/MHz.

This unit can operate with an integrated antenna with an average peak gain of 5.5 dBi, or with the following externally mounted Omni antennas:

Antenna gains are Amphenol (5 dBi), Spinner (4.5 dBi), Amplitec (6.0 dBi), Commscope (5.2 dBi), and Huber Suhner (4.5 dBi).

The EIRP data provided for the external antenna is the worst-case data based on the Commscope external antenna with a gain of 5.2 dBi.

If the product is installed with other antenna(s), then per FCC Rules the RF exposure compliance shall be addressed at the time of licensing, as required by the responsible FCC Bureau(s), including antenna co-location requirements of Part 1.1307(b)(3).

2.1.2 Results

Power measurements of the TDD transmit signal were conducted with an MXA Signal analyzer per KDB 971168 D01 and ANSI C63.26. The applied signal from the **AirScale Indoor pico RRH 4T4R n48 AWPQY/Z**, met the recommended characteristics as defined in 3GPP TS 36.141 V16.9.0 (2021-04) Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing (Release 14). The Channel power was measured when the product was set to provide the maximum rated power at the antenna transmitting terminals. The output power of the EUT was measured per ANSI C63.26 methods and procedures and the Channel Power Measurement feature of the MXA Analyzer.

The measured output power at antenna ports was documented in the table below. The Maximum Average RF Power Values are bolded in each configuration.

2.1.2.1 Channel RF Power 5G-NR Results

Table 2.1.1 – 1 Carrier

Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Channel Power dBm/BW
3.1	64QAM	1	3555	10	16.90
3.1	64QAM	2	3555	10	17.10
3.1	64QAM	3	3555	10	16.70
3.1	64QAM	4	3555	10	**17.16**
3.2	QPSK/16QAM	1	3625	10	15.98
3.2	QPSK/16QAM	2	3625	10	**16.79**
3.2	QPSK/16QAM	3	3625	10	16.48
3.2	QPSK/16QAM	4	3625	10	16.23
3.1a	256QAM	1	3695	10	16.55
3.1a	256QAM	2	3695	10	**17.06**
3.1a	256QAM	3	3695	10	16.57
3.1a	256QAM	4	3695	10	16.50

Table 2.1.2 – 4 Carriers

Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Channel Power dBm/BW
3.1a	256QAM	1	3600 + 3654 + 3669 + 3689	100 + 10 + 20 +20	23.16
3.1a	256QAM	2	3600 + 3654 + 3669 + 3689	100 + 10 + 20 +20	**23.64**
3.1a	256QAM	3	3600 + 3654 + 3669 + 3689	100 + 10 + 20 +20	23.29
3.1a	256QAM	4	3600 + 3654 + 3669 + 3689	100 + 10 + 20 +20	23.29

2.1.2.2 Channel RF Power LTE Results

Table 2.1.3 – 4 Carrier

Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Channel Power dBm/BW
3.1	64QAM	1	3555 + 3565 + 3575 + 3585	10 +10 + 10 + 10	23.00
3.1	64QAM	2	3555 + 3565 + 3575 + 3585	10 +10 + 10 + 10	**23.35**
3.1	64QAM	3	3555 + 3565 + 3575 + 3585	10 +10 + 10 + 10	22.97
3.1	64QAM	4	3555 + 3565 + 3575 + 3585	10 +10 + 10 + 10	22.81
3.2	QPSK/16QAM	1	3625 +3635 + 3645 + 3655	10 +10 + 10 + 10	**23.95**
3.2	QPSK/16QAM	2	3625 +3635 + 3645 + 3655	10 +10 + 10 + 10	24.63
3.2	QPSK/16QAM	3	3625 +3635 + 3645 + 3655	10 +10 + 10 + 10	24.26
3.2	QPSK/16QAM	4	3625 +3635 + 3645 + 3655	10 +10 + 10 + 10	24.00
3.1a	256QAM	1	3665 + 3675 + 3685 + 3695	10 +10 + 10 + 10	23.85
3.1a	256QAM	2	3665 + 3675 + 3685 + 3695	10 +10 + 10 + 10	**24.43**
3.1a	256QAM	3	3665 + 3675 + 3685 + 3695	10 +10 + 10 + 10	23.99
3.1a	256QAM	4	3665 + 3675 + 3685 + 3695	10 +10 + 10 + 10	24.08

Table 2.1.4 – 4 Carrier

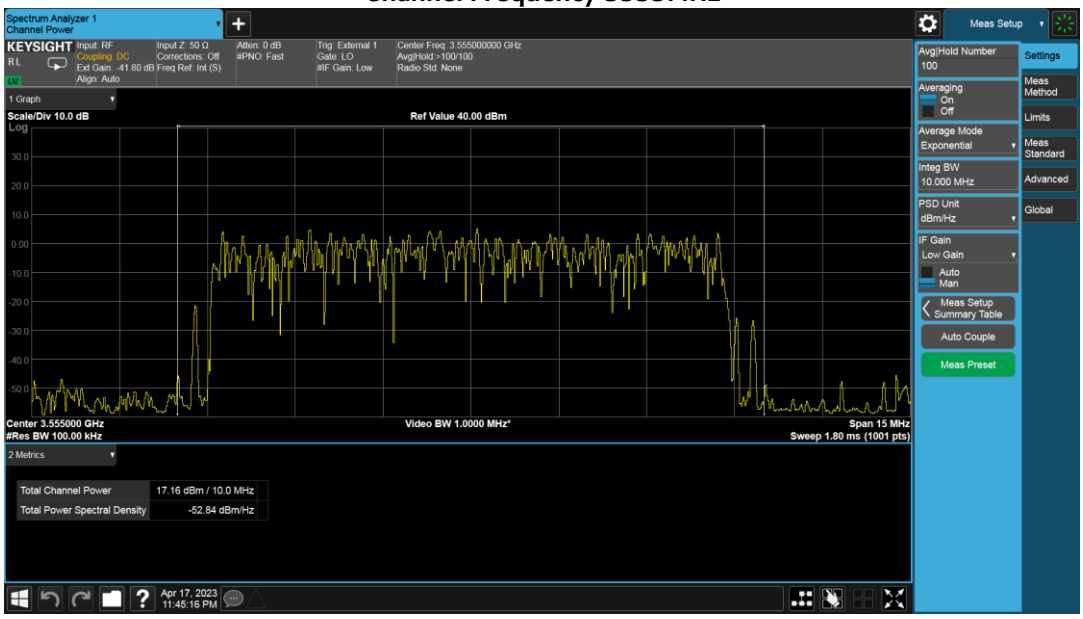
Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Channel Power dBm/BW
3.1	64QAM	1	3555 + 3570 + 3680 + 3695	10 +20 + 20 + 10	22.97
3.1	64QAM	2	3555 + 3570 + 3680 + 3695	10 +20 + 20 + 10	**23.46**
3.1	64QAM	3	3555 + 3570 + 3680 + 3695	10 +20 + 20 + 10	23.06
3.1	64QAM	4	3555 + 3570 + 3680 + 3695	10 +20 + 20 + 10	23.08

2.1.3 Maximum RF Conducted Output Power Plots

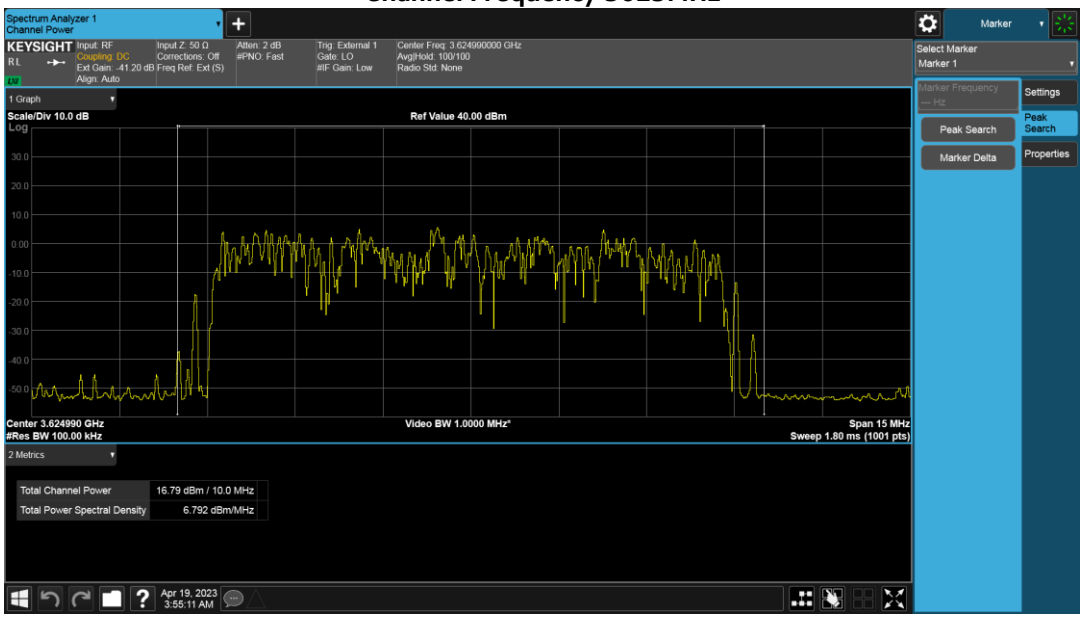
NOTE: Only a sample of the plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

2.1.3.1 5G-NR Plots

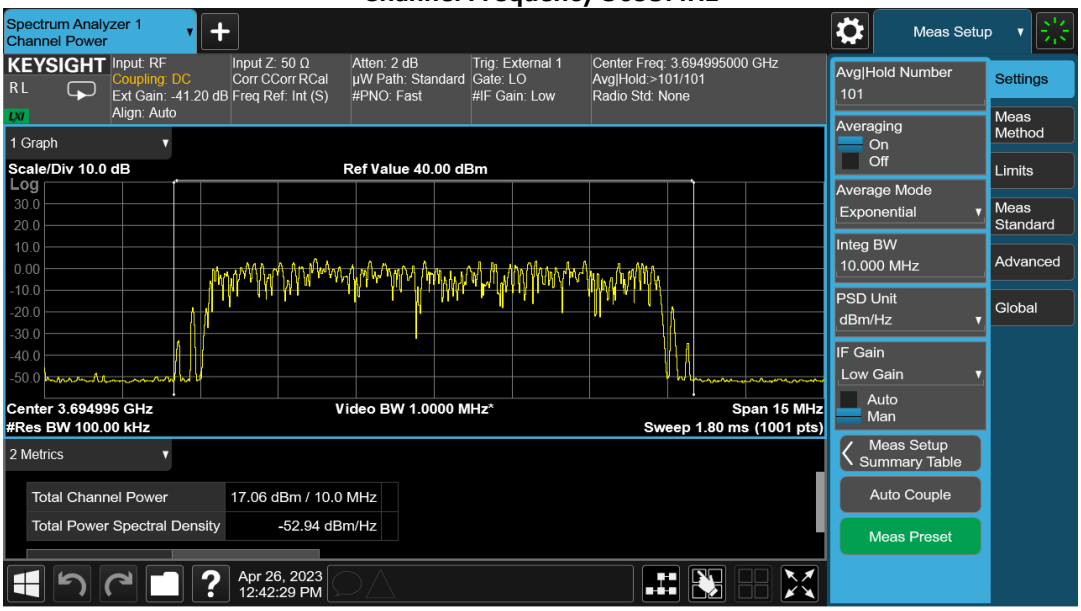
Signal BW 10MHz, TM 3.1, 64QAM, TX4
Channel Frequency 3555MHz



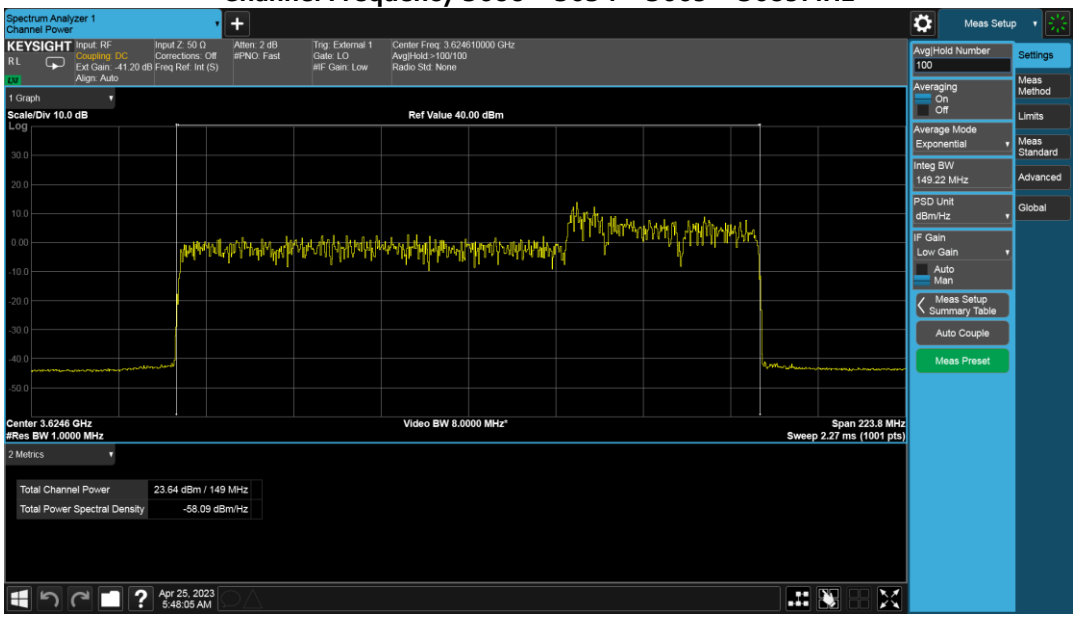
Signal BW 10MHz, TM 3.2, QPSK/16QAM, TX2
Channel Frequency 3625MHz



Signal BW 10MHz, TM 3.1a, 256QAM, TX2
Channel Frequency 3695MHz

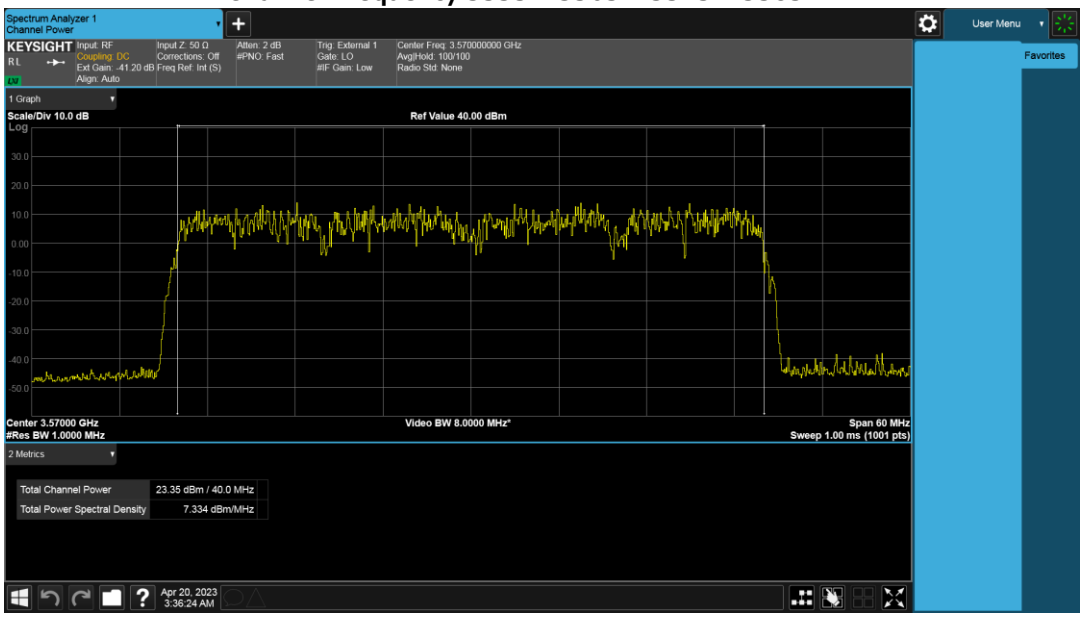


Signal BW 100+10+20+20MHz, TM 3.1a, 256QAM, TX2
Channel Frequency 3600 + 3654 + 3669 + 3689MHz

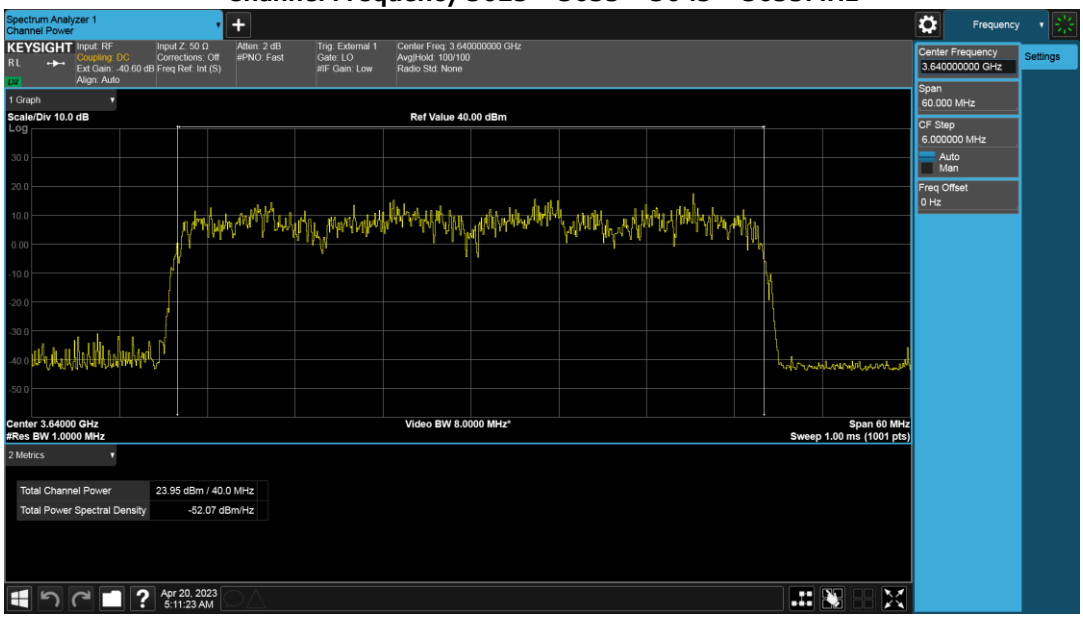


2.1.3.2 LTE Plots

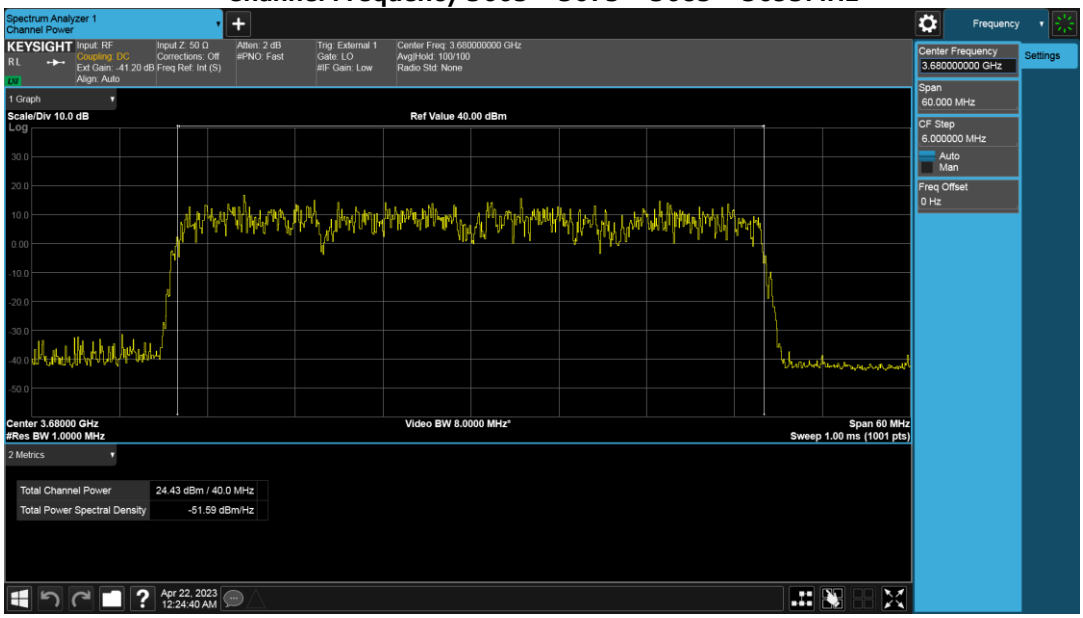
Signal BW 10+10+10+10MHz, TM 3.1, 64QAM, TX2
Channel Frequency 3555 + 3565 + 3575 + 3585MHz



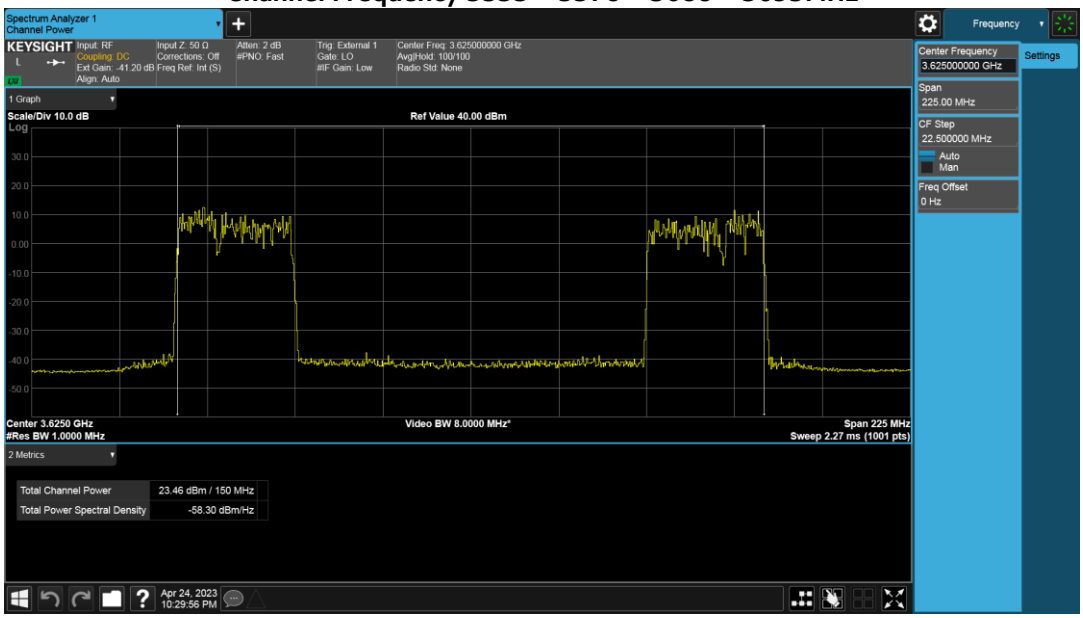
Signal BW 10+10+10+10MHz, TM 3.2, QPSK/16QAM, TX1
Channel Frequency 3625 + 3635 + 3645 + 3655MHz



Signal BW 10+10+10+10MHz, TM 3.1a, 256QAM, TX2
Channel Frequency 3665 + 3675 + 3685 + 3695MHz



Signal BW 10+20+20+10MHz, TM 3.1, 64QAM, TX2
Channel Frequency 3555 + 3570 + 3680 + 3695MHz



2.2 Power Spectral Density

2.2.1 Results

The PSD of the EUT was measured per ANSI C63.26 methods and procedures and the PSD Measurement feature of the MXA Analyzer. The PSD was measured when the product was set to provide the maximum rated power at the antenna transmitting terminals. The signal bandwidths, modulations and transmit channels identified in Table below were evaluated. The measured power spectral density level was documented in the table below.

Table 2.4 Power Spectral Density Results

Total PSD (Summing Method) – (5G-NR)

Transmit Signal Bandwidth (MHz)	Freq (MHz)	Port	PSD measured dBm/MHz	Average Peak Antenna gain	PSD EIRP dBm/MHz
10	3550	1	8.339		
10	3550	2	8.402		
10	3550	3	8.024		
10	3550	4	**8.606**		
			Sum = 14.368 dBm	5.5	19.868
Transmit Signal Bandwidth (MHz)	**Freq (MHz)**	**Port**	**PSD measured dBm/MHz**	**Average Peak Antenna gain**	**PSD EIRP dBm/MHz**
10	3625	1	7.914		
10	3625	2	**8.760**		
10	3565	3	8.448		
10	3565	4	8.251		
			Sum = 14.375 dBm	5.5	19.875
Transmit Signal Bandwidth (MHz)	**Freq (MHz)**	**Port**	**PSD measured dBm/MHz**	**Average Peak Antenna gain**	**PSD EIRP dBm/MHz**
10	3690	1	7.34		
10	3690	2	**7.84**		
10	3690	3	7.34		
10	3690	4	7.33		
			Sum = 13.489 dBm	5.5	18.989
				Total PSD	**17.689< 20**

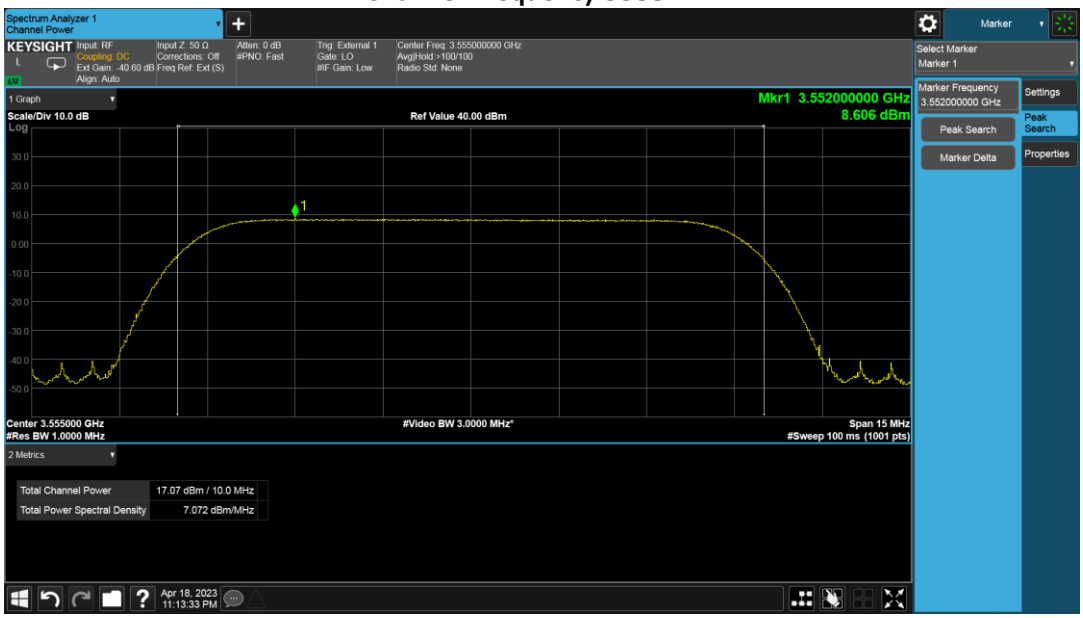
Total PSD (Summing Method) – (LTE)

Transmit Signal Bandwidth (MHz)	Freq (MHz)	Port	PSD measured dBm/MHz	Average Peak Antenna gain	TM1.1 PSD EIRP dBm/MHz
10+10+10+10	3625+3635+3645+3655	1	7.423		
10+10+10+10	3625+3635+3645+3655	2	**7.964**		
10+10+10+10	3625+3635+3645+3655	3	7.353		
10+10+10+10	3625+3635+3645+3655	4	7.314		
			Sum = 13.542 dBm	5.5	19.042
				Total PSD	**19.042< 20**

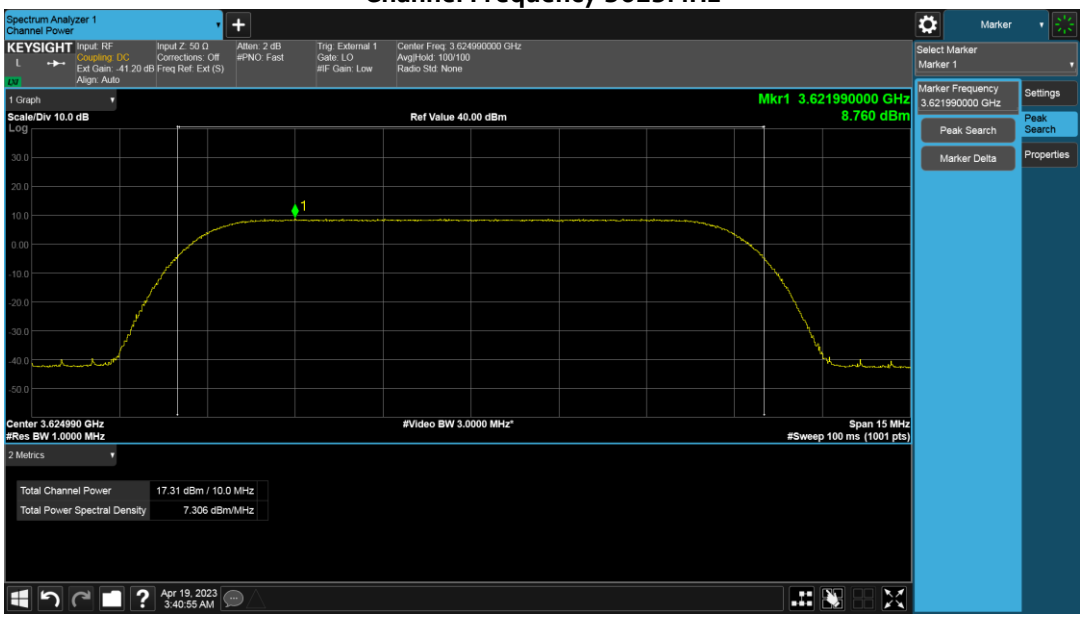
2.2.2 Maximum Conducted PSD Plots

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.

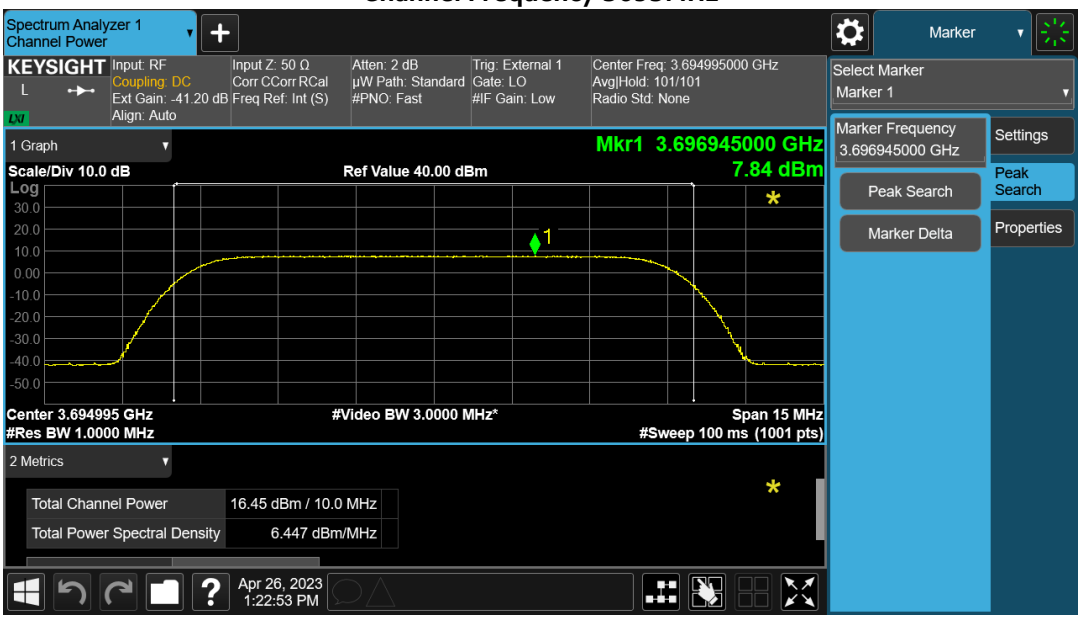
5G-NR, 10MHz BW, TM1.1
Channel Frequency 3555MHz



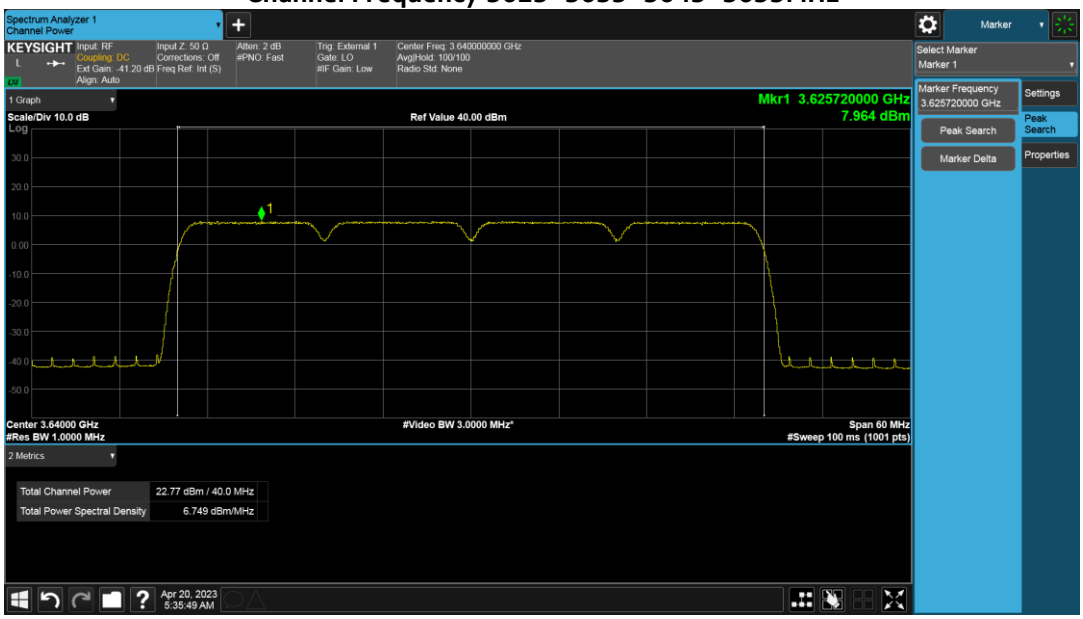
5G-NR, 10MHz BW, TM1.1
Channel Frequency 3625MHz



5G-NR, 10MHz BW, TM3.1a
Channel Frequency 3695MHz



LTE, 10+10+10+10MHz BW, TM3.2
Channel Frequency 3625+3635+3645+3655MHz



2.3 EIRP Compliance

Table 2.5 Maximum Total EIRP Measured (5G-NR) Integrated Antenna

Transmit Signal Bandwidth	Maxi Output Power per Port* (dBm)	Maxi Total Conducted Output Power (dBm) for 4 Ports	Effective Average Antenna Gain (dBi)	Total EIRP (dBm/W)	EIRP Bandwidth Correction for /10 MHz	Total EIRP (dBm/10MHz	Total EIRP Limit (dBm/10MHz Cat A	Results
10 MHz	17.16	23.18	5.50	28.68/0.738	0	28.68	30	Pass
150 MHz	23.64	29.66	5.50	35.16/3.28	-11.76	23.40	30	Pass

The sample calculation for the maximum EIRP as follows,

The maximum Conducted Output Power per port = 23.64 dBm
The maximum Total Conducted Output Power (4X MIMO) = 23.64 + 10 x log (4) = 29.66 dBm
The maximum total EIRP = 29.66 + 5.50 (antenna gain) = 35.16 dBm.
Correction for /10MHz = 35.16 dBm – 10 x log (15) = 23.40 dBm

Table 2.6 Maximum Total EIRP Measured (LTE Multicarrier) Integrated Antenna

Transmit Signal Bandwidth	Maxi Output Power per Port* (dBm)	Maxi Total Conducted Output Power (dBm) for 4 Ports	Effective Average Antenna Gain (dBi	Total EIRP (dBm/W)	EIRP Bandwidth Correction for /10 MHz	Total EIRP (dBm/10MHz	Total EIRP Limit (dBm/10MHz Cat A	Results
4 x 10 MHz	24.43	30.45	5.50	35.95/3.935	-6.02	29.93	30	Pass
10+20+20+ 10 MHz	23.46	29.48	5.50	34.98/3.148	-7.78	27.20	30	Pass

The sample calculation for the maximum EIRP as follows,

The maximum Conducted Output Power per port = 24.43 dBm
The maximum Total Conducted Output Power (4X MIMO) = 24.43 + 10 x log (4) = 30.45 dBm
The maximum total EIRP = 30.45 + 5.50 (antenna gain) = 35.95 dBm.
Correction for /10MHz = 35.95 dBm – 10 x log (4) = 29.93 dBm

2.4 Peak-to-Average Power Ratio (PAPR)

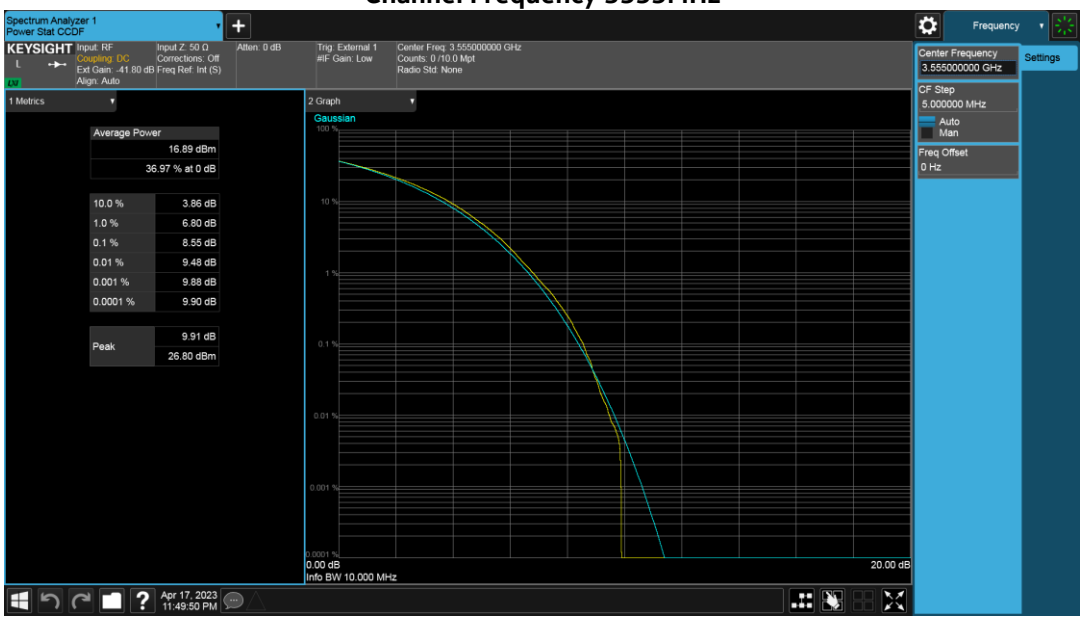
The Peak-to-Average Power Ratio (PAPR) was evaluated per ANSI C63.26. The PAPR values of all carriers measured are below 13dB.

Table 2.4.1 Peak to Average Power Ratio

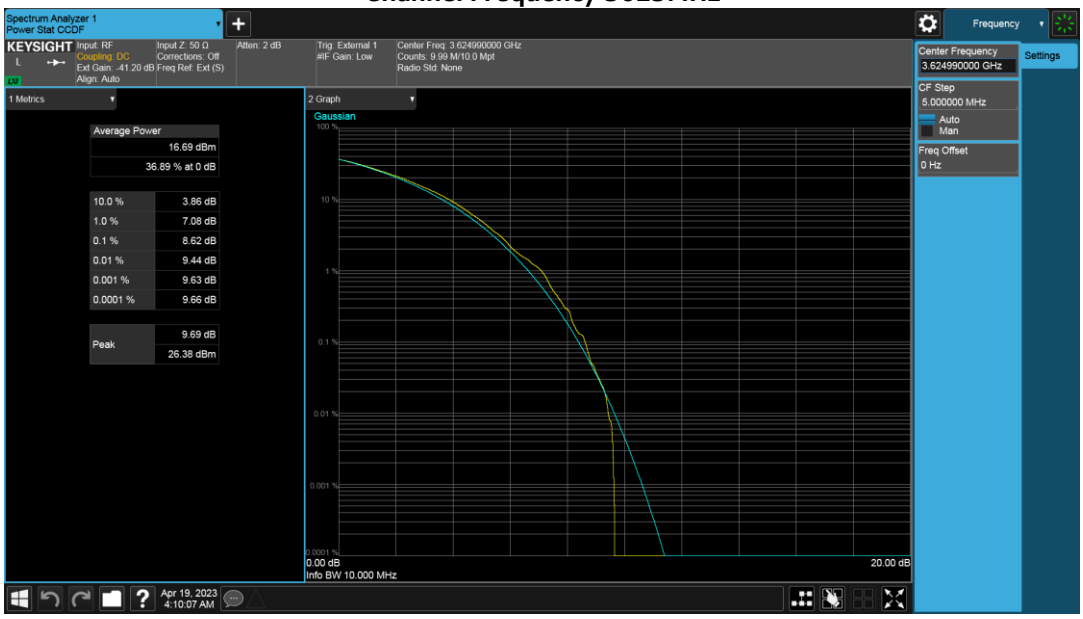
Radio Technology	Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	PAR at 0.1% Limit - 13 dB
5G-NR	3.1	64QAM	4	3555	10	8.55
5G-NR	3.2	QPSK/16QAM	2	3625	10	8.62
5G-NR	3.1a	256QAM	2	3690	10	8.58
5G-NR	3.1a	256QAM	2	3600 + 3654 + 3669 + 3689	100+10+20+20	8.48
LTE	3.1	64QAM	2	3555 + 3565 + 3575 + 3585	10+10+10+10	8.30
LTE	3.2	QPSK/16QAM	2	3625 +3635 + 3645 + 3655	10+10+10+10	8.33
LTE	3.1a	256QAM	2	3665 + 3675 + 3685 + 3695	10+10+10+10	8.25
LTE	3.1	64QAM	2	3555 + 3570 + 3680 + 3695	10+20+20+10	8.20 / 8.26

2.4.1 5G-NR PAPR Plots

10MHz BW, TM3.1
Channel Frequency 3555MHz

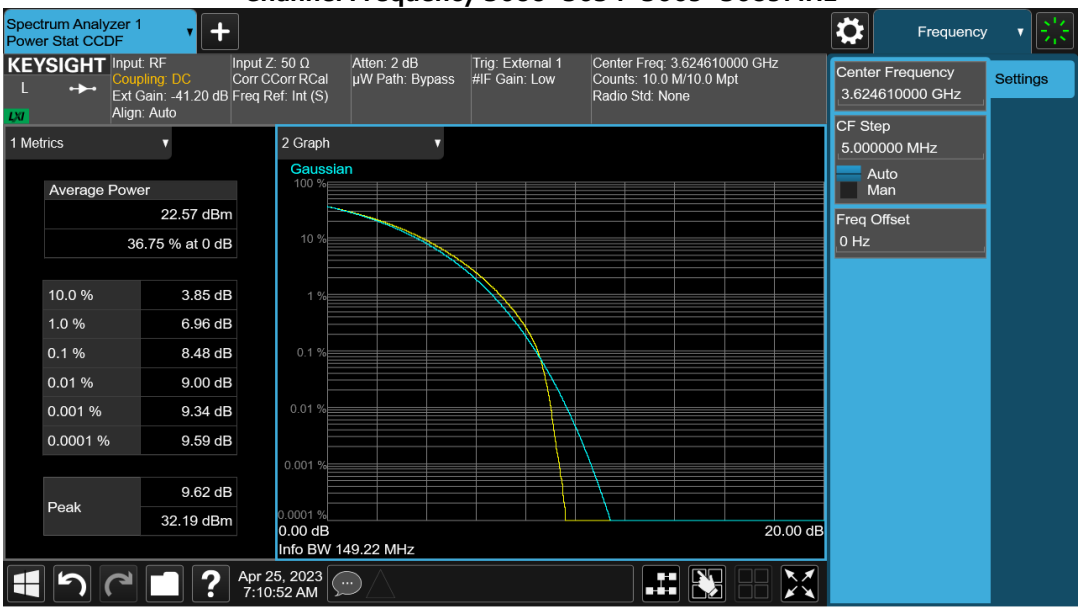


10MHz BW, TM3.2
Channel Frequency 3625MHz



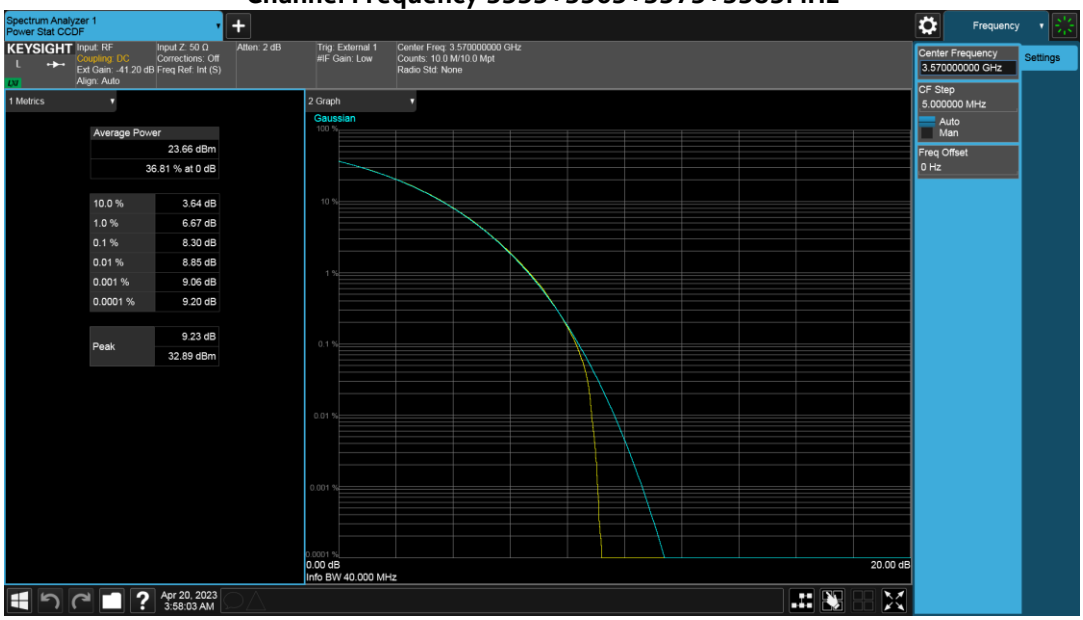
10MHz BW, TM3.1a
Channel Frequency 3690MHz

10MHz BW, TM3.1a
Channel Frequency 3600+3654+3669+3689MHz

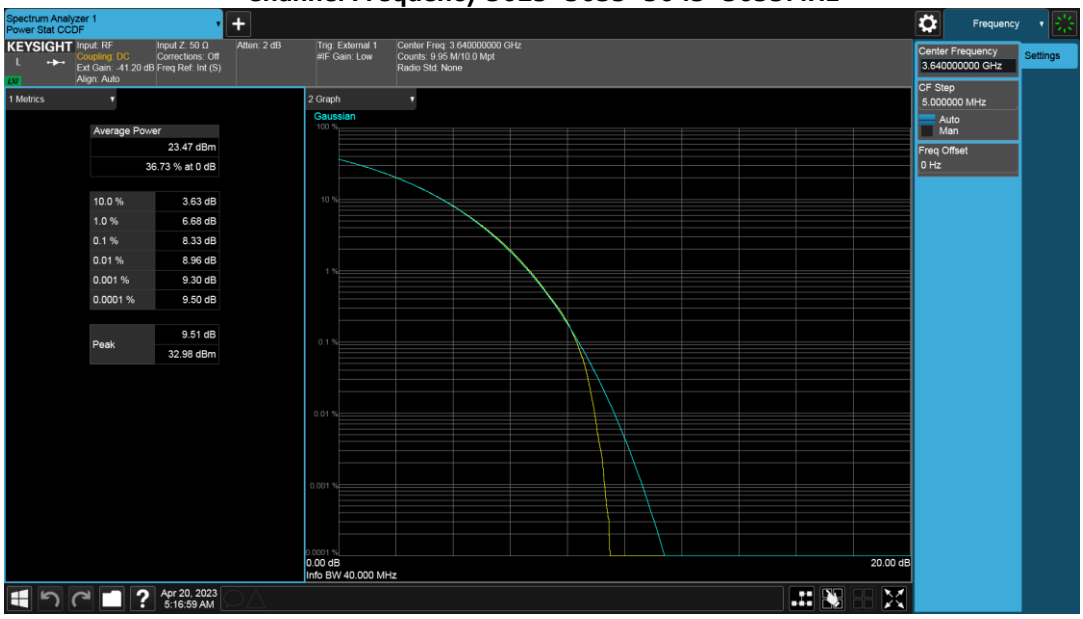


2.4.2 LTE PAPR Plots

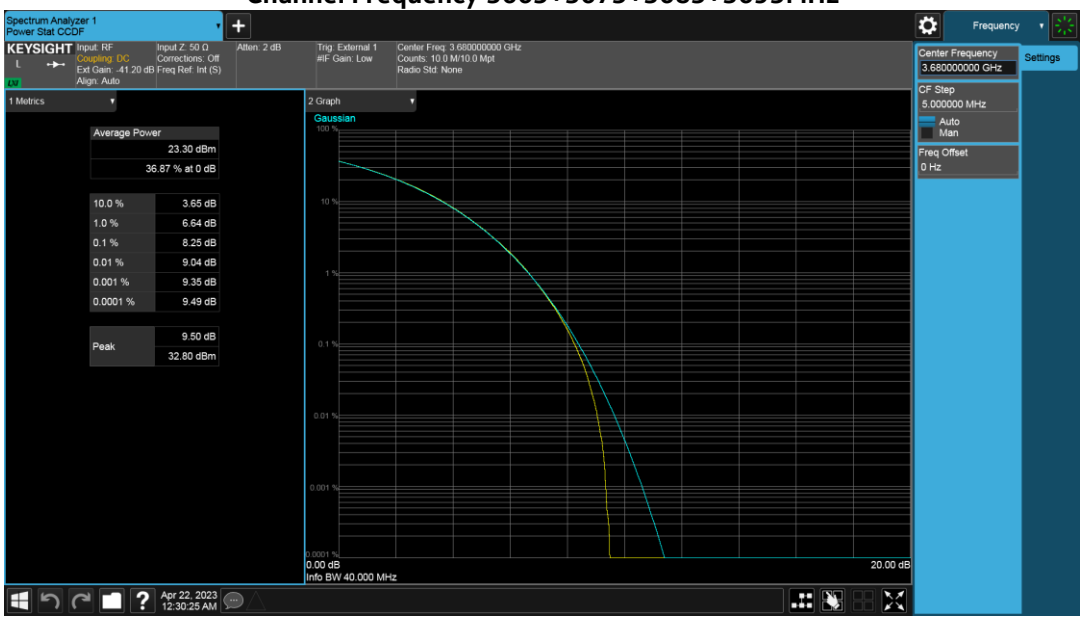
10+10+10+10MHz BW, TM3.1
Channel Frequency 3555+3565+3575+3585MHz



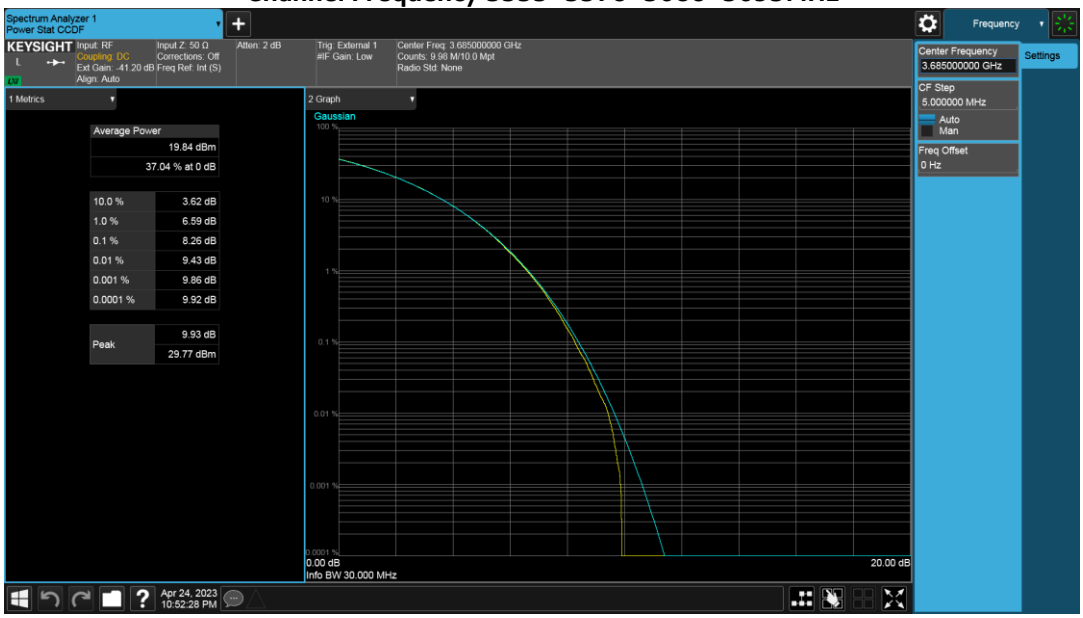
10+10+10+10MHz BW, TM3.2
Channel Frequency 3625+3635+3645+3655MHz



10+10+10+10MHz BW, TM3.1a
Channel Frequency 3665+3675+3685+3695MHz



10+20+20+10MHz BW, TM3.1a
Channel Frequency 3555+3570+3680+3695MHz



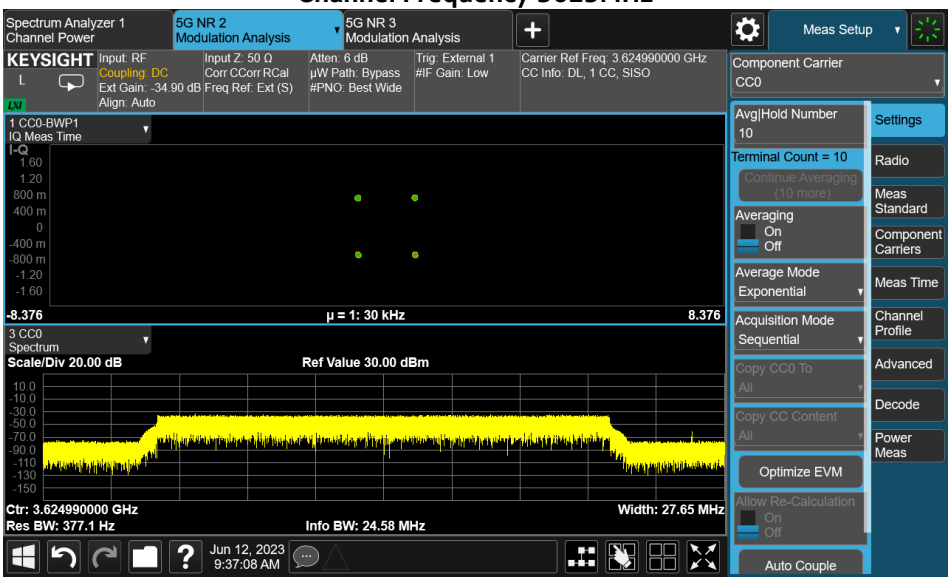
3. FCC Section 2.1047 - Modulation Characteristics

3.1 Modulation Characteristics

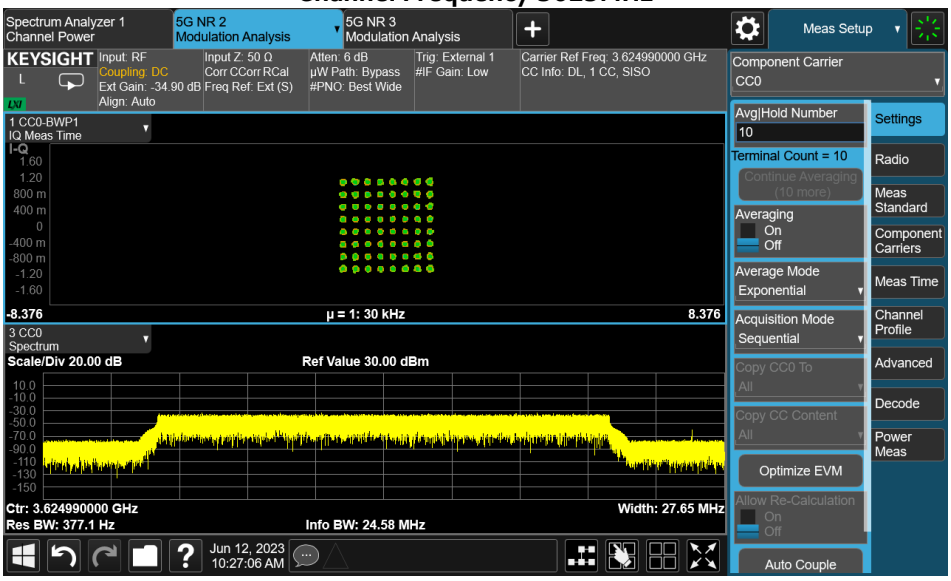
The RF signal at the antenna port was demodulated and verified for correctness of the modulation signal used before each test was performed.

3.1.1 Modulation Characteristics – Plots

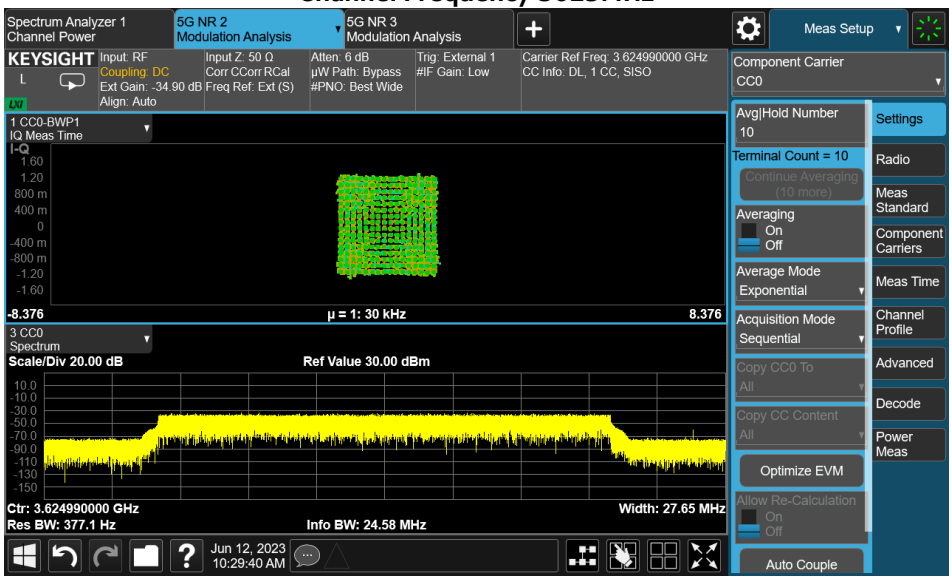
Modulation QPSK TM1.1
Channel Frequency 3625MHz



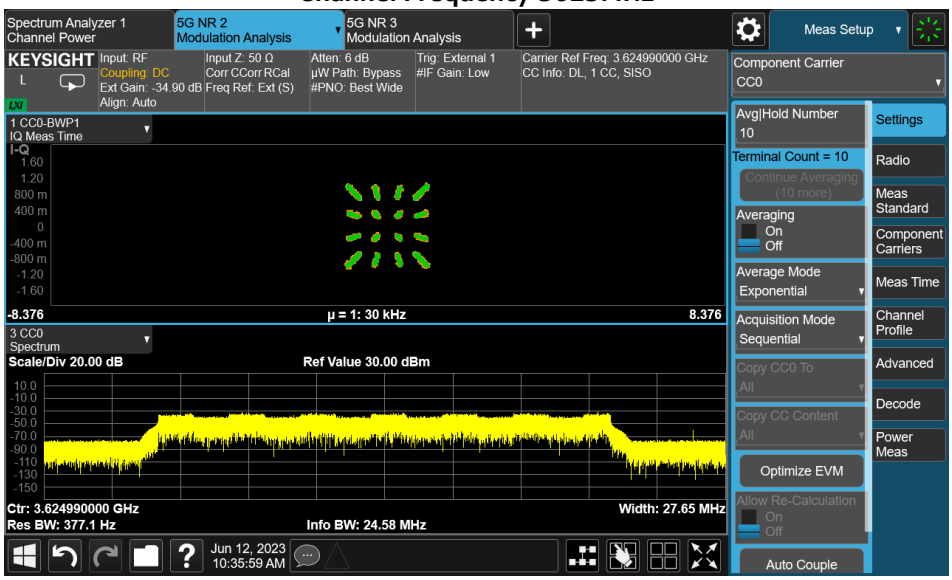
Modulation 64QAM TM3.1
Channel Frequency 3625MHz



Modulation 256QAM TM3.1a
Channel Frequency 3625MHz



Modulation QPSK/16QAM TM3.2
Channel Frequency 3625MHz



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.

Part 96.41e(3) specified that the fundamental emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

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

Table 4.1.1 AWPQY AWPQZ 99% Occupied Bandwidth

Radio Technology	Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Occupied BW MHz
5G-NR	3.1	64QAM	4	3555	10	8.6319
5G-NR	3.2	QPSK/16QAM	1	3625	10	8.5830
5G-NR	3.1a	256QAM	1	3695	10	8.5121
5G-NR	3.1a	256QAM	2	3600+3654+3669+3689	100+10+20+20	144.73
LTE	3.1	64QAM	2	3555+3565+3575+3585	10+10+10+10	38.917
LTE	3.2	QPSK/16QAM	2	3625+3635+3645+3655	10+10+10+10	38.442
LTE	3.1a	256QAM	2	3665+3675+3685+3695	10+10+10+10	39.295
LTE	3.1	64QAM	2	3555+3570+3680+3695	10+20+20+10	28.583+28.499

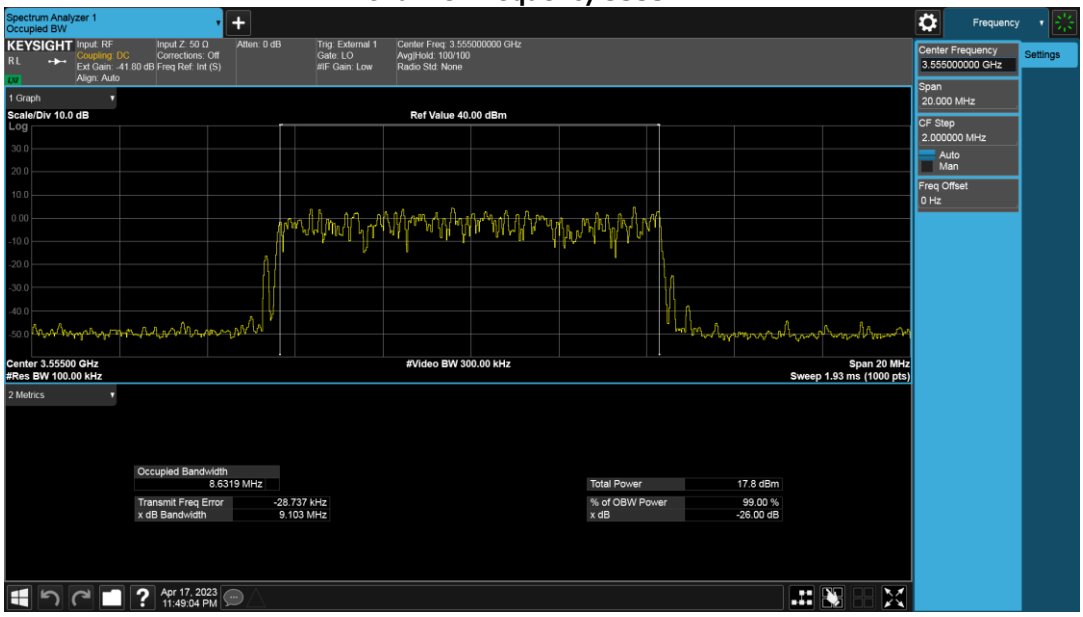
Table 4.1.2 AWPQY AWPQZ 26dB Emission Bandwidth

Radio Technology	Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Occupied BW MHz
5G-NR	3.1	64QAM	4	3555	10	9.103
5G-NR	3.2	QPSK/16QAM	1	3625	10	9.337
5G-NR	3.1a	256QAM	1	3695	10	9.301
5G-NR	3.1a	256QAM	2	3600+3654+3669+3689	100+10+20+20	149.1
LTE	3.1	64QAM	2	3555+3565+3575+3585	10+10+10+10	41.13
LTE	3.2	QPSK/16QAM	2	3625+3635+3645+3655	10+10+10+10	40.75
LTE	3.1a	256QAM	2	3665+3675+3685+3695	10+10+10+10	40.80
LTE	3.1	64QAM	2	3555+3570+3680+3695	10+20+20+10	30.41+30.38

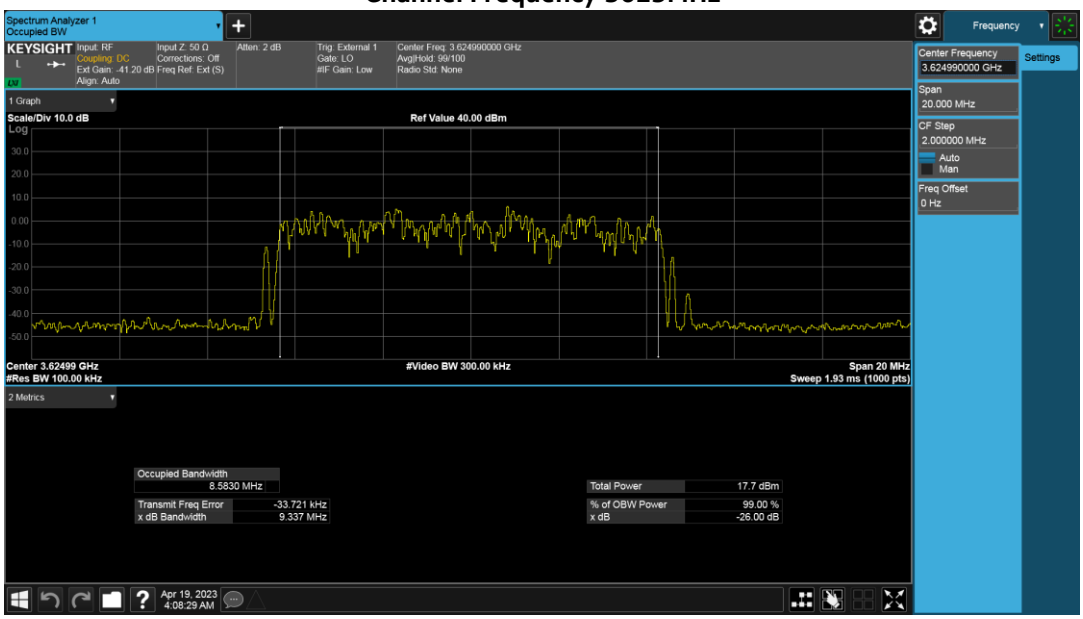
4.1.1 Occupied Bandwidth – Plots

4.1.1.1 Occupied Bandwidth Plots (5G-NR)

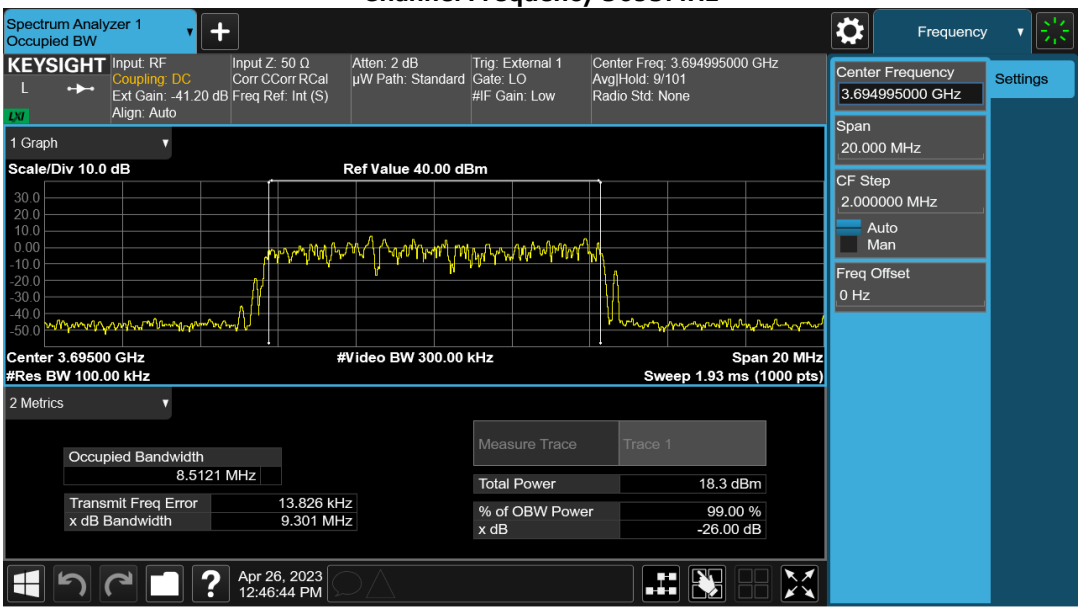
10MHz BW, TM3.1
Channel Frequency 3555MHz



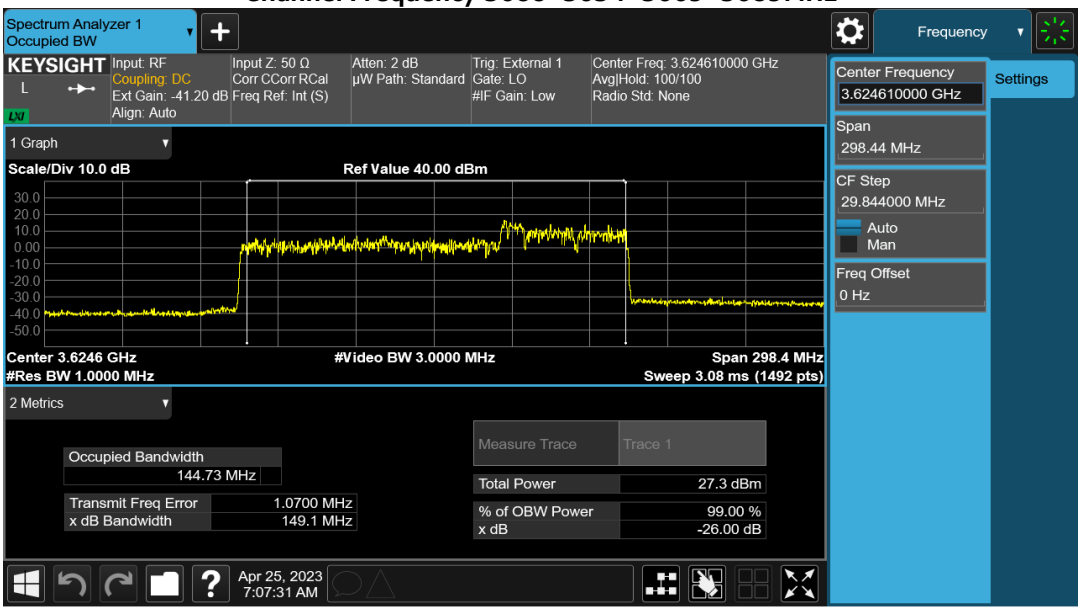
10MHz BW, TM3.2
Channel Frequency 3625MHz



10MHz BW, TM3.1a
Channel Frequency 3695MHz

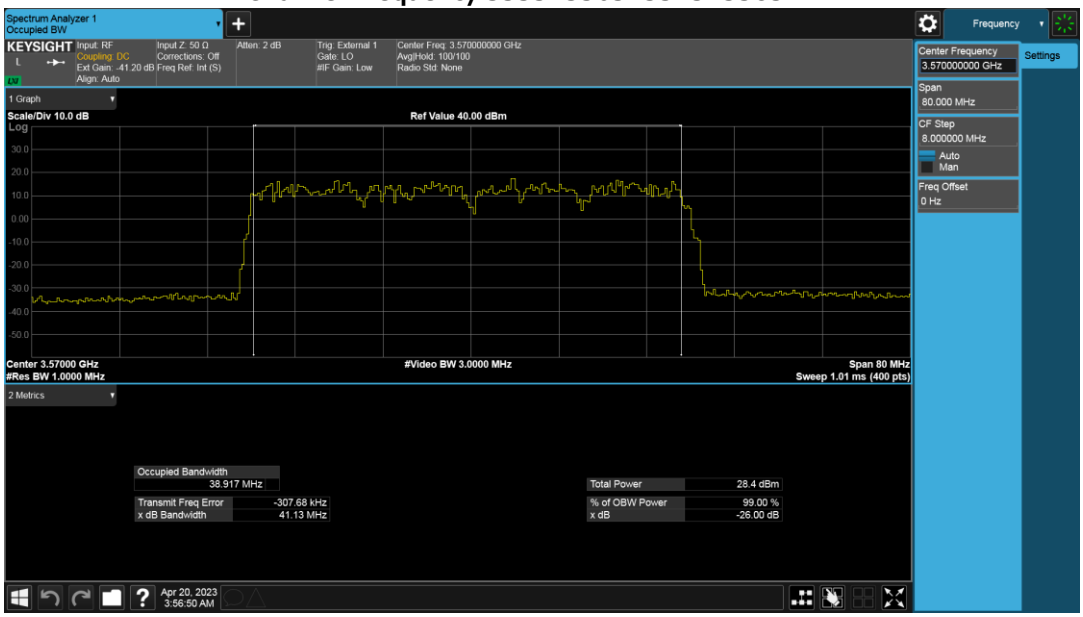


100+10+20+20MHz BW, TM3.1a
Channel Frequency 3600+3654+3669+3689MHz

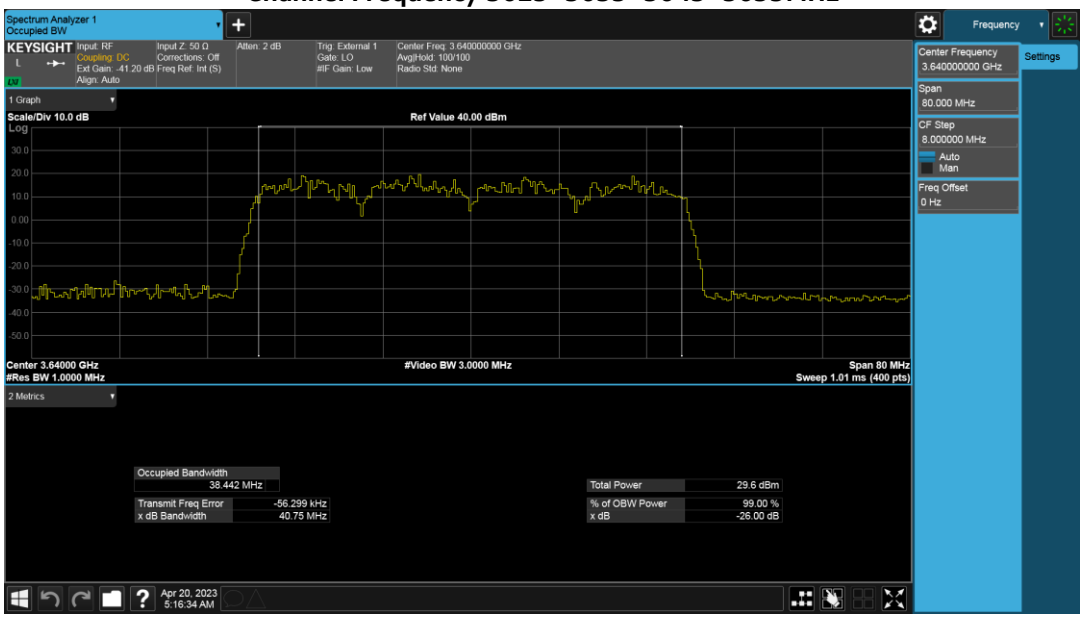


4.1.1.2 Occupied Bandwidth Plots (LTE)

10+10+10+10MHz BW, TM3.1
Channel Frequency 3555+3565+3575+3585MHz



10+10+10+10MHz BW, TM3.2
Channel Frequency 3625+3635+3645+3655MHz



10+10+10+10MHz BW, TM3.1a
Channel Frequency 3665+3675+3685+3695MHz

10+20+20+10MHz BW, TM3.1
Channel Frequency 3555+3570+3680+3695MHz

4.2 Edge of band Emissions

47CFR 96.41 (e)(1) (i) and KDB 940660 D01 Section 3.2 (b)(6) specified that the limits for the emissions outside the fundamental are as follows.

- within 0 MHz to 10 MHz above and below the assigned channel ⩽ −13 dBm/MHz,
- greater than 10 MHz above and below the assigned channel ⩽ −25 dBm/MHz,
- any emission below 3530 MHz and above 3720 MHz ⩽ −40 dBm/MHz.

47CFR 96.41 (e)(3) and KDB 940660 D01 Section 3.2 (b)(6) specified stated that (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 Megahertz bands immediately outside and adjacent to the licensee's authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (*i.e.,* 1 MHz or 1 percent of emission bandwidth, as specified). The fundamental emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. (ii) When measuring unwanted emissions to demonstrate compliance with the limits, the CBSD and End User Device nominal carrier frequency/channel shall be adjusted as close to the licensee's authorized frequency block edges, both upper and lower, as the design permits. (iii) Compliance with emission limits shall be demonstrated using either average (RMS)-detected or peak-detected power measurement techniques.

KDB 940660 D01 Section 3.2 (b)(6) specified that measurements must be performed for low, mid, and high channels. It is acceptable to apply the procedures in Section 5.7 of ANSI C63.26-2015. When antenna-port conducted measurements are performed to demonstrate compliance to the applicable unwanted emission limits (Section 2.1051), a separate radiated measurement is required to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation (Section 2.1053). The Section 96.41(e) limits generally also apply to radiated unwanted emissions.

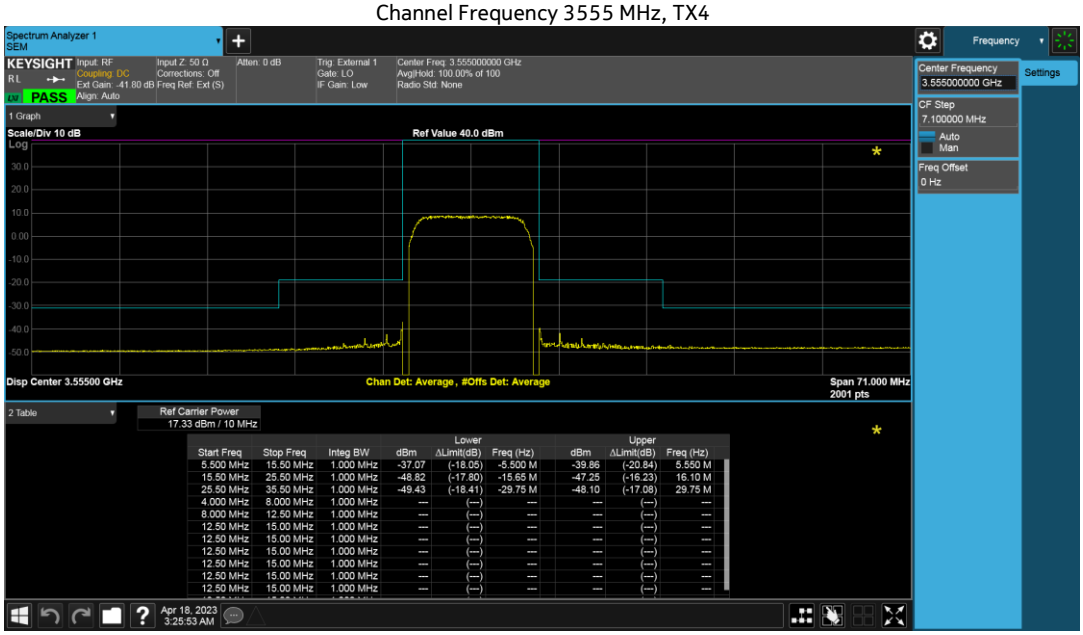
The Edge of Band emissions of the EUT at the external antenna connector (EAC) were measured using a Keysight MXA Signal Analyzer. The RF power level was continuously measured using a RF broadband power meter. The RF output from the EAC port to signal analyzer was reduced (to an amplitude usable by the 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.

4.2.1 Edge of Band Emissions - Plots.

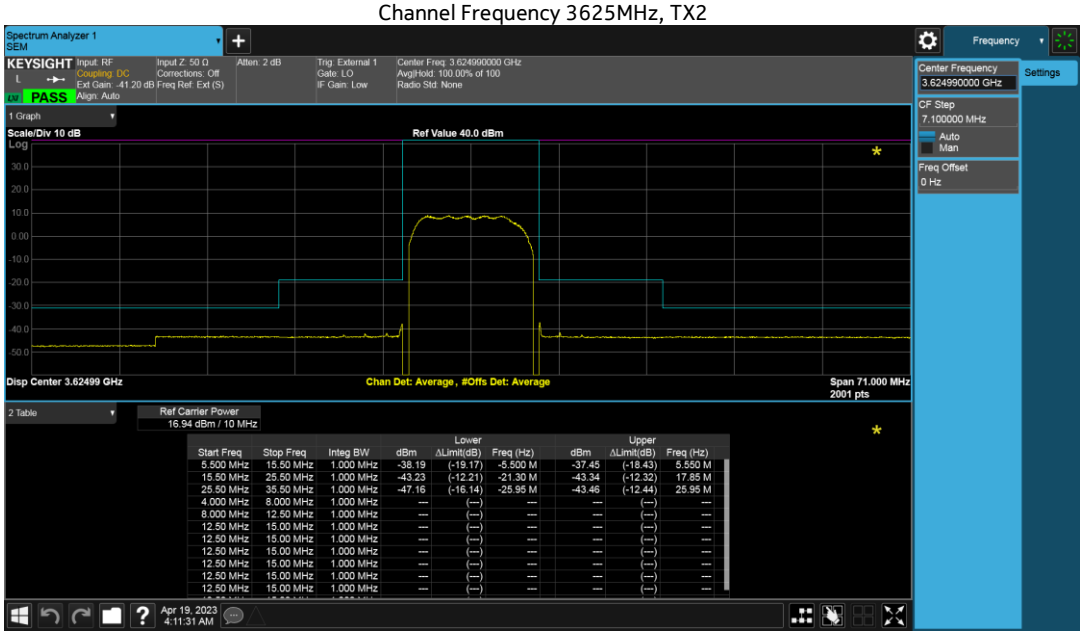
All of the measurements met the requirements of Part 96.41(e)(1) and KDB 940660 D01 Section 3.2 (b)(6) when measured per Part 2.1049.

4.2.1.1 5G-NR Plots

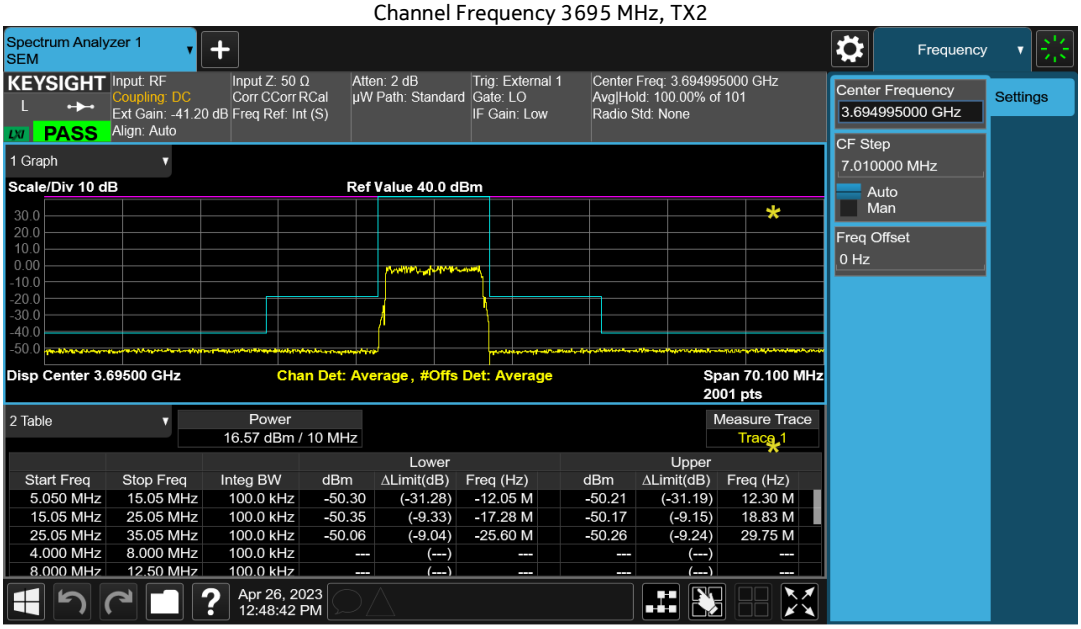
Test Model 3.1, Modulation 64QAM, 10MBW
Channel Frequency 3555 MHz, TX4



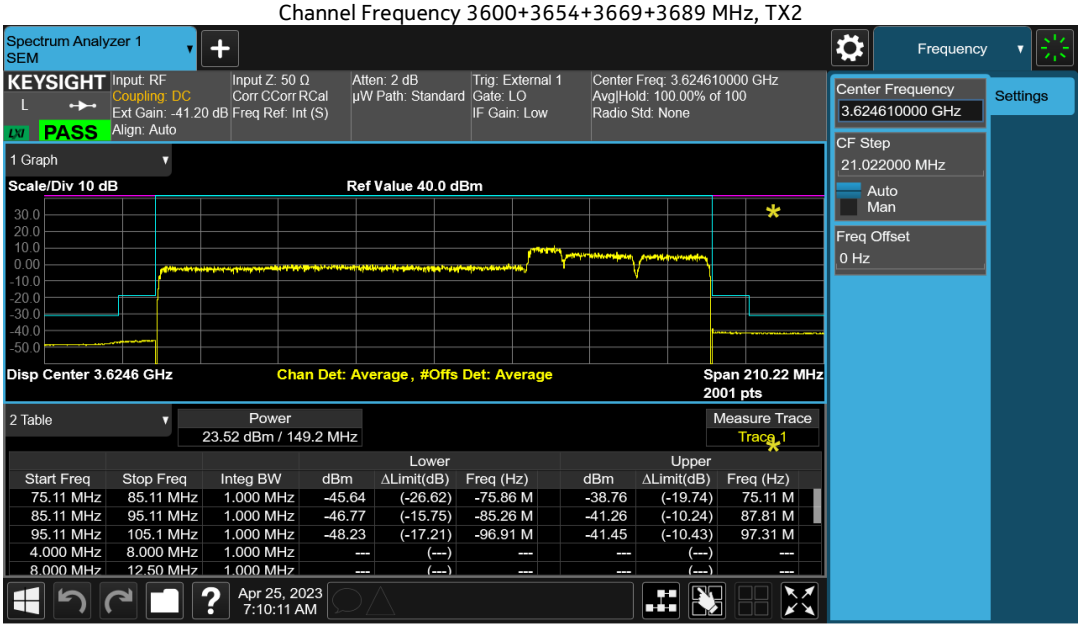
Test Model 3.2, Modulation QPSK/16QAM, 10MBW
Channel Frequency 3625MHz, TX2



Test Model 3.1a, Modulation 256QAM, 10MBW
Channel Frequency 3695 MHz, TX2

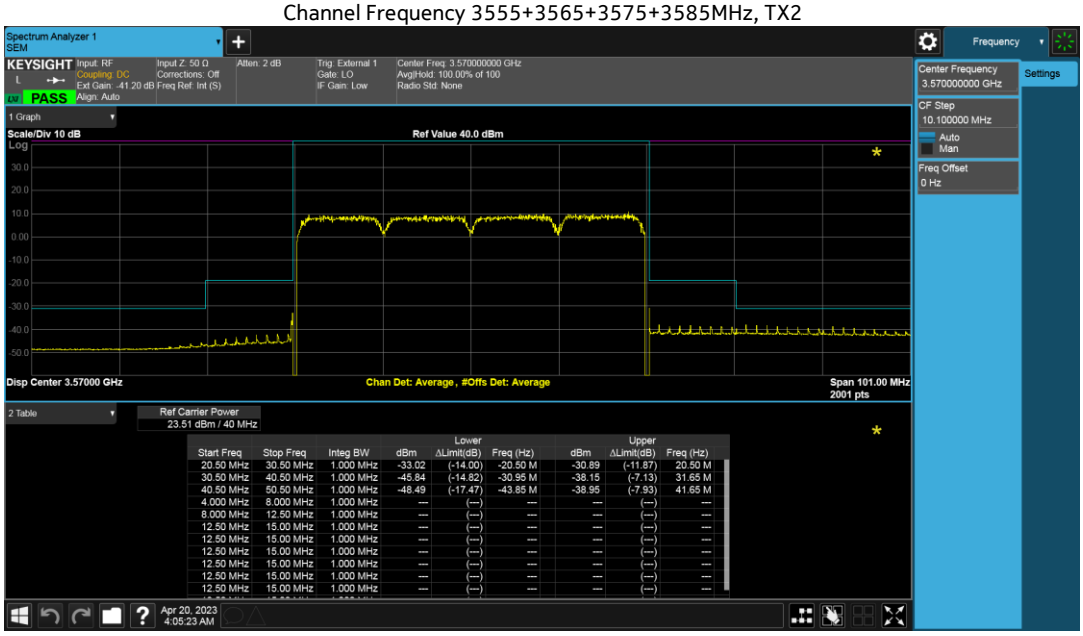


Test Model 3.1a, Modulation 256QAM, 10MBW
Channel Frequency 3600+3654+3669+3689 MHz, TX2



4.2.1.2 LTE Plots

Test Model 3.1, Modulation 64QAM, 10+10+10+10MBW
Channel Frequency 3555+3565+3575+3585MHz, TX2



Test Model 3.2, Modulation QPSK/16QAM, 10+10+10+10MBW
Channel Frequency 3625+3635+3645+3655MHz, TX2