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

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 Micro RRH 3.5GHz 4T/4R 20W (AZQC)

Report Number:
TR-2022-0077-FCC96

Date Issued:
July 24, 2022

Table of Contents

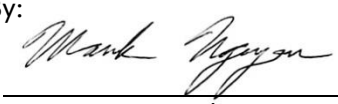
Revisions

Date	Revision	Section	Change
7/24/2022	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:  7/24/2022

Mark Nguyen
Compliance Engineer
NVLAP Signatory
mark.nguyen@nokia-bell-labs.com

Approved By:

Signed:  7/24/2022

Raymond Johnson
Technical Manager
NVLAP Signatory
ray.johnson@nokia-bell-labs.com

Reviewed By:

Signed:  7/24/2022

Steve Gordon
EMC Engineer
NVLAP Signatory
steve.gordon@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 Micro RRH 3.5GHz 4T/4R 20W (AZQC)
Serial Number:	1M181624805
FCC ID:	2AD8UAZQCRH1
Hardware Version:	474156A.101
Software Version:	SBTS22R3
Frequency Range:	3550 - 3700 MHz
GPCL Project Number:	2022-0077
Manufacturer:	NOKIA SOLUTIONS AND NETWORKS OY KARAKAARI 7, FI-02610 ESPOO FINLAND
Applicant:	Nokia Solutions and Networks, OY 200 Lucent Lane Naperville, Illinois 60563
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):	6/21/2022 – 6/24/2022 (Radio) 7/5/2022 – 7/8/2022 (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):	Norman Albrecht, 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 Micro RRH 3.5GHz 4T/4R 20W (AZQC), hereinafter referred to as the Equipment Under Test (EUT).

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.

This Class II permissive change is to demonstrate compliance for the **AirScale Micro RRH 3.5GHz 4T/4R 20W (AZQC)** product for the addition of multicarrier mode of operation. The change added 2x20 5G-NR Multicarrier (Contiguous and Non-Contiguous) operation to the Grant. The AZQC was previously certified for LTE 10 and 20 MHz and 5G-NR 20 MHz bandwidth operations. No software changes have been made to the product that would necessitate a repeat of the Spectrum Allocation Server (SAS) testing.

1.3 EUT Details

1.3.1 Specifications

Specification Items	Description
Product Type	AirScale Micro RRH 3.5GHz 4T/4R 20W (AZQC)
Radio Type	Intentional Transceiver
CBSD Category	Category B CBSD Device
Power Type	DC: -48V
Modulation	5G-NR with QPSK, 16QAM, 64QAM and 256QAM
Operating Frequency Range	CBRS (Tx/Rx: 3550-3700 MHz)
Channel Bandwidth	20 MHz
Max Conducted Power (Rated)	Up to 4x5W (37.0 dBm) per TX path (0.1 dB steps down to 50mW)
Antenna Gain	6.0 dBi
Operating Mode	4T4R
Software Version	SBTS22R3
Hardware Version	474156A.101
Antenna(s)	Refer to Section 1.3.2

1.3.2 EIRP/ PSD Compliance and Antenna Information.

The product does not incorporate integrated antennas and is not supplied with antennas. Externally mounted antennas must be connected to the unit and mounted remotely. This product requires Certified Professional Installation. The antenna gain/ cable loss and other the parameters of the installation will be resident in the unit and in the SAS.

1.3.3 Photographs

Serial Number

Radio Unit

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[1]

[1] Testing was performed in GPCL project 2018-0097.

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 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

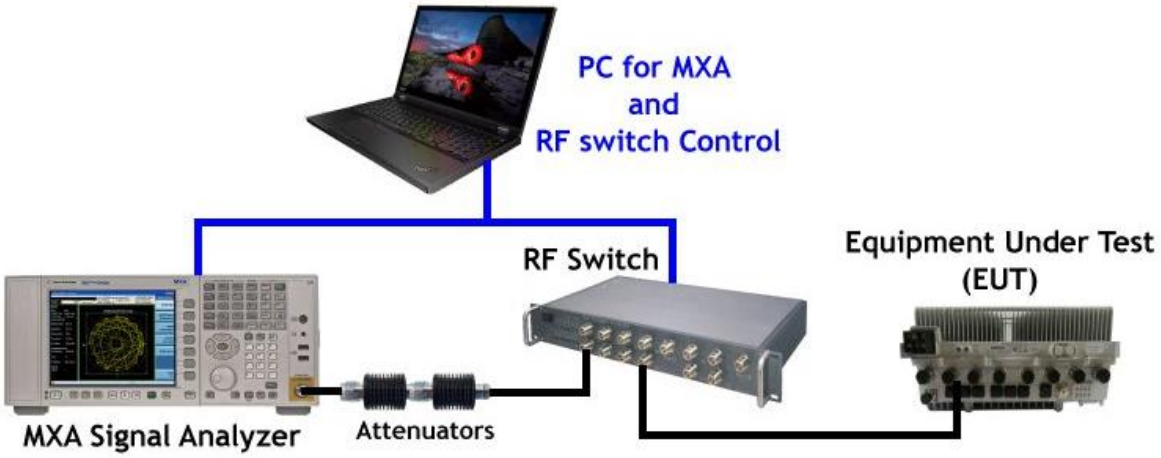
1.7 Executive Summary

Requirement 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	NT

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

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 Micro RRH 3.5GHz 4T/4R 20W (AZQC), is specified to provide a maximum power output of 5W/37 dBm per transmit port for a sum total of 20 Watts /43 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 B CBSD maximum EIRP of 47 dBm/10 MHz with a PSD of 37 dBm/MHz.

The unit is supplied with externally mounted Omni antennas for use on the B48 transmit ports. This antenna has a nominal gain of 6 dBi.

In the event the customer wants to use a different antenna, the maximum gain + cable loss cannot exceed 10.98 dBi when operating at full power in order to stay within the EIRP limits for the band.

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).

2.1.1 RF Power Output Measurements

Power measurements of the 5G transmit signal were conducted with an MXA Signal analyzer per KDB 971168 D01 using the gated RF Channel Power Function.

The applied signal from the AirScale Micro RRH 3.5GHz 4T/4R 20W (AZQC), met the recommended characteristics as defined in 3GPP TS 36.141 V14.1.0 (2016-09) Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing (Release 14).

The maximum rated mean power at the antenna transmitting terminal was measured at the Left, Center and Right side of the 3550-3700 CBRS frequency range for three different modulation modes. These were 3GPP standard base station test models for QPSK+16QAM, 64QAM and 256QAM modulation. This power level was documented on each data sheet for Occupied bandwidth.

2.1.2 RF Power Output Results

Table 2.1 RF Power Output Results

Test Model	Modulation	Signal BW MHz	TX Port	Carrier	Channel Frequency MHz	Channel Power dBm/20MHz	Total Channel Power dBm/40MHz
3.2	QPSK/16QAM	20 + 20	1	1	3560	33.79	**36.83**
				2	3579	33.85	
			2	1	3560	33.19	36.24
				2	3579	33.26	
			3	1	3560	33.05	36.09
				2	3579	33.11	
			4	1	3560	33.30	36.35
				2	3579	33.38	
3.2	QPSK/16QAM	20 + 20	1	1	3625	34.16	**37.28**
				2	3645	34.39	
			2	1	3625	33.54	36.67
				2	3645	33.78	
			3	1	3625	33.38	36.51
				2	3645	33.62	
			4	1	3625	33.65	36.79
				2	3645	33.89	
3.1a	256QAM	20 + 20	1	1	3670	34.82	**37.18**
				2	3690	33.41	
			2	1	3670	34.20	36.56
				2	3690	32.79	
			3	1	3670	33.99	36.35
				2	3690	32.58	
			4	1	3670	34.31	36.67
				2	3690	32.90	

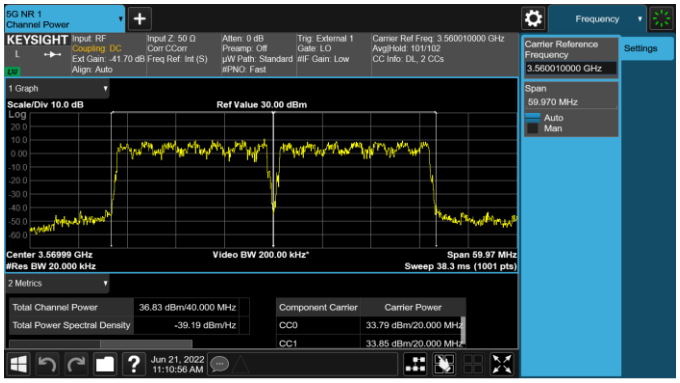
Table 2.1a RF Power Output Results (Non-Contiguous)

Test Model	Modulation	Signal BW MHz	TX Port	Carrier	Channel Frequency MHz	Channel Power dBm/20MHz	Total Channel Power dBm/40MHz
3.2	QPSK/16QAM	20 + 20	1	1	3560	34.20	37.11
				2	3650	33.99	
			2	1	3560	34.22	37.15
				2	3650	34.06	
			3	1	3560	31.85	36.85
				2	3650	35.19	
			4	1	3560	34.95	**37.20**
				2	3650	34.95	

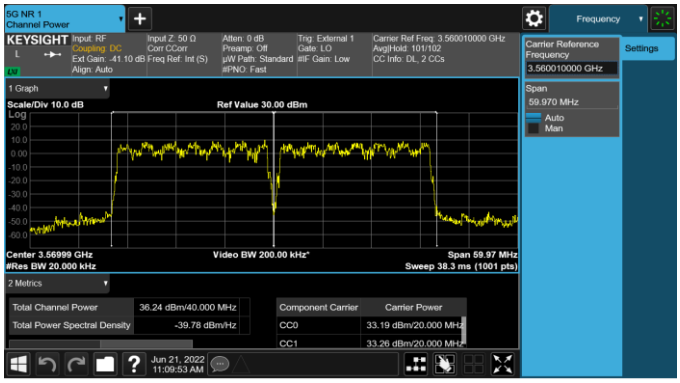
2.1.3 Maximum RF Conducted Output Power Plots

Test Model 3.2
Modulation QPSK/16QAM
20+20MHz BW
Channel Frequency 3561 + 3579MHz

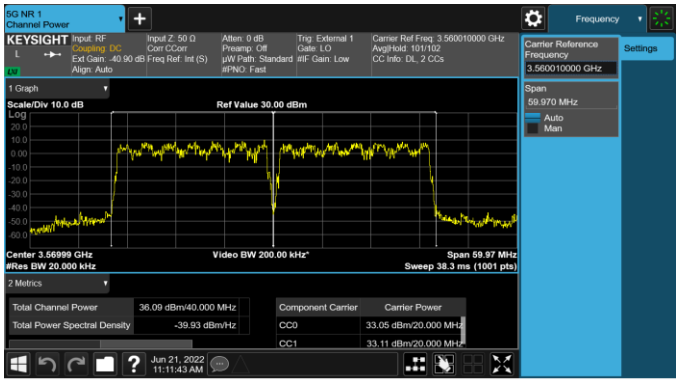
TX Port 1



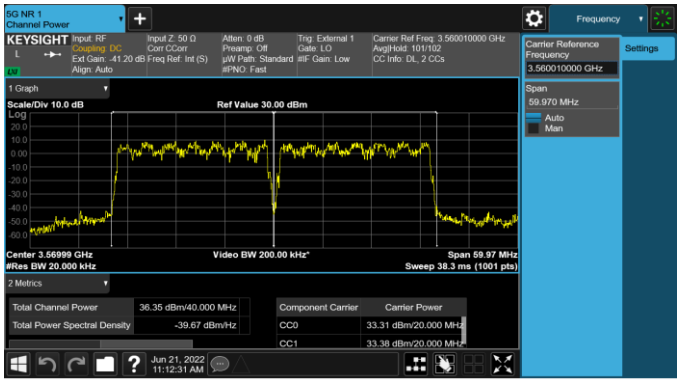
TX Port 2



TX Port 3

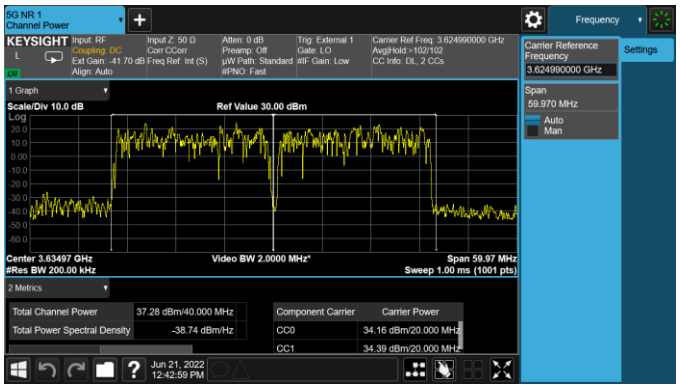


TX Port 4

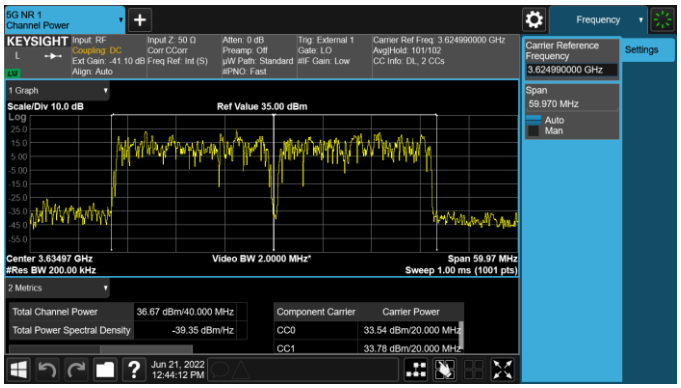


Test Model 3.2
Modulation QPSK/16QAM
20+20MHz BW
Channel Frequency 3625 + 3645MHz

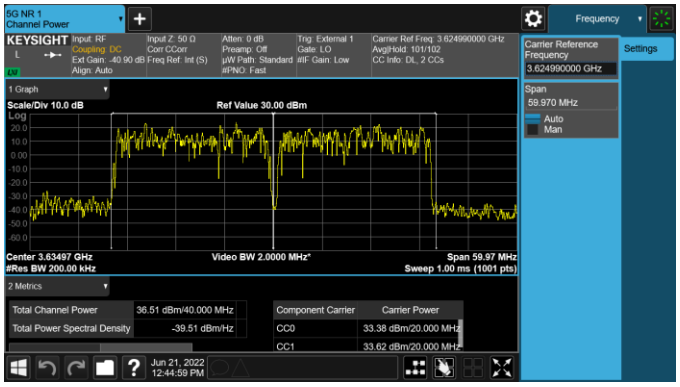
TX Port 1



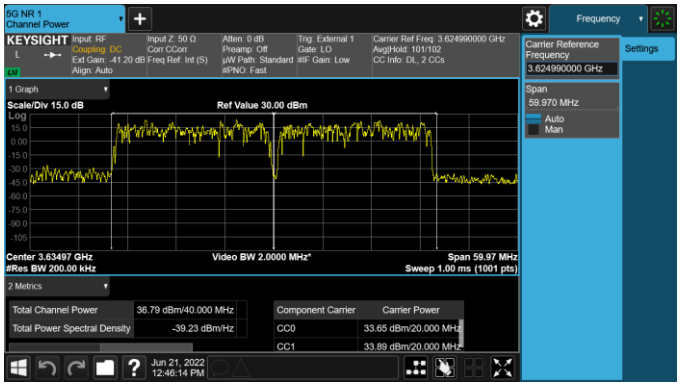
TX Port 2



TX Port 3

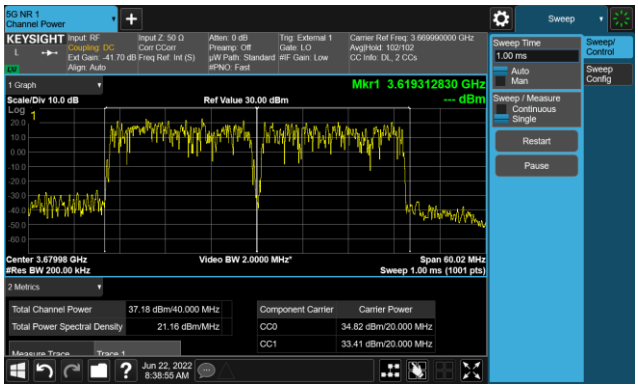


TX Port 4



Test Model 3.1a
Modulation 256QAM
20+20MHz BW
Channel Frequency 3670 + 3690MHz

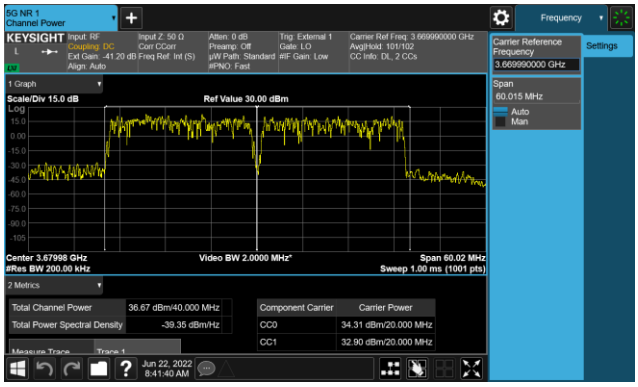
TX Port 1



TX Port 2

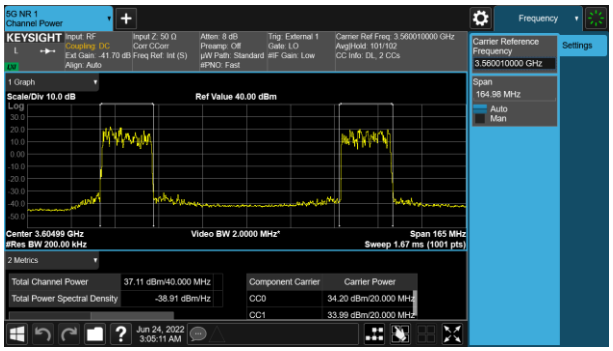
TX Port 3

TX Port 4

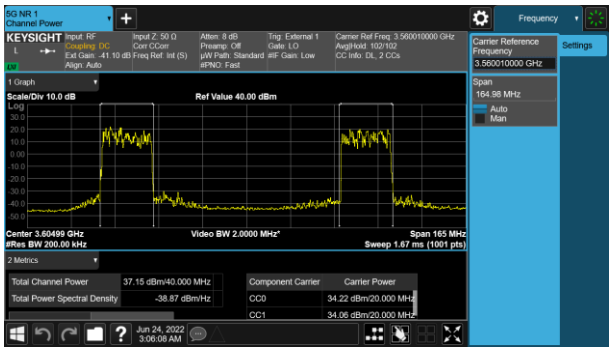


Test Model 3.2
Modulation QPSK/16QAM
20+20MHz BW
Channel Frequency 3560 + 3650MHz (Non-Contiguous)

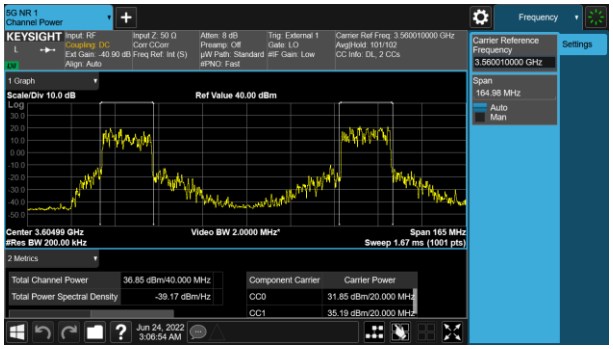
TX Port 1



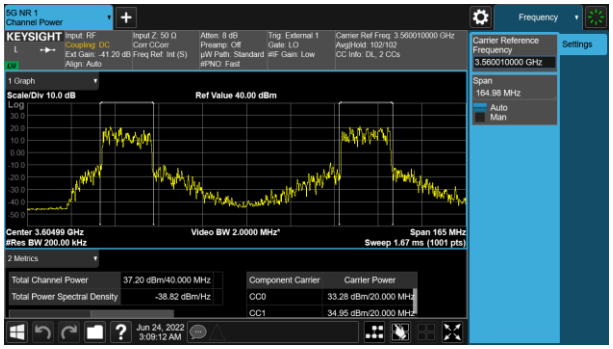
TX Port 2



TX Port 3



TX Port 4



2.2 EIRP Compliance

The product does not incorporate integrated antennas. Externally mounted antennas can be attached to the unit or mounted remotely. The unit is supplied with unit mounted Omni antennas for use on the B48 transmit ports. This antenna has a nominal gain of 6 dBi. Compliance with the supplied antennas is documented in Table 2.2 for EIRP.

Under Part 96.41 the product is limited to a maximum Effective Isotropically Radiated Power (EIRP) of 47 dBm/10 MHz. Compliance with the EIRP requirements of Part 96.41 is tabulated in Table 2.2 below.

When set to the maximum total output power of 37 dBm the maximum allowable antenna gain is 10.98 dBi.

In the event the customer wants to use a different antenna, the maximum gain + cable loss cannot exceed 10.98 dBi when operating at full power in order to stay within the EIRP limits for the band.

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).

Table 2.2 Effective Isotropically Radiated Power (EIRP) Compliance

Transmit Signal Bandwidth	Total 4x MIMO Transmit Power	Antenna Gain	EIRP Bandwidth Correction for /10 MHz	Total Product EIRP	Part 96.41 EIRP Limit	Margin to Part 96 EIRP Limit.	EIRP Compliance
MHz	dBm	dBi	dB	dBm/10 MHz	dBm/ 10 MHz	dB	Pass/Fail
20 + 20	43.29	6.0	-6.01	43.28	47.00	3.72	Pass

2.3 Power Spectral Density

The Power Spectral Density (PSD) of the EUT was measured per KDB 971168 D01 the Channel Power Measurement feature of the MXA Analyzer. The signal bandwidths, modulations and transmit channels identified in Table 2.3 were evaluated.

The FCC Part 96 requirement for PSD is that the Power Spectral Density (PSD) of the EUT shall not exceed 37 dBm/MHz.

2.3.1 Results

The maximum Power Spectral Density (PSD) of the EUT measured at its antenna transmitting terminals were measured to be 21.29 dBm/MHz plus 6.02 dBm adjustment for 4 ports. **The measured values are in Table 2.3 below and provide a maximum allowable antenna gain that satisfies the requirement**

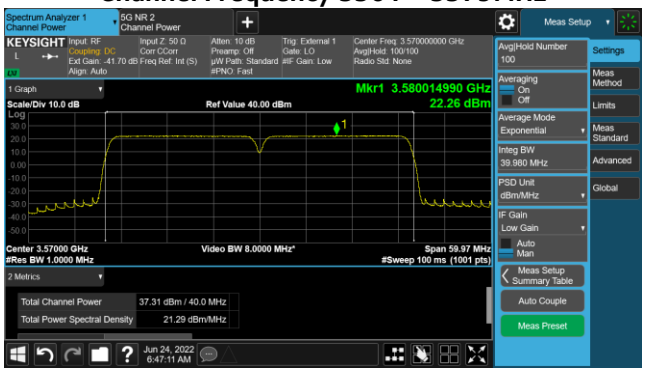
Table 2.4 Power Spectral Density Results

Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	PSD dBm/MHz (1 Port)	Total PSD dBm/MHz (4 Ports)	Max Allowable Ant Gain	PSD Limit dBm/MHz	PSD Results
1.1	QPSK	1	3561 + 3579	20 + 20	**21.29**	27.31	9.69	37	Pass
1.1	QPSK	1	3625 + 3645	20 + 20	**21.29**	27.31	9.69	37	Pass
1.1	QPSK	1	3670 + 3690	20 + 20	20.85	26.87	10.13	37	Pass
1.1	QPSK	2	3560*	20	19.18	25.20	11.8	37	Pass
1.1	QPSK	2	3650*	20	21.17	27.19	9.81	37	Pass

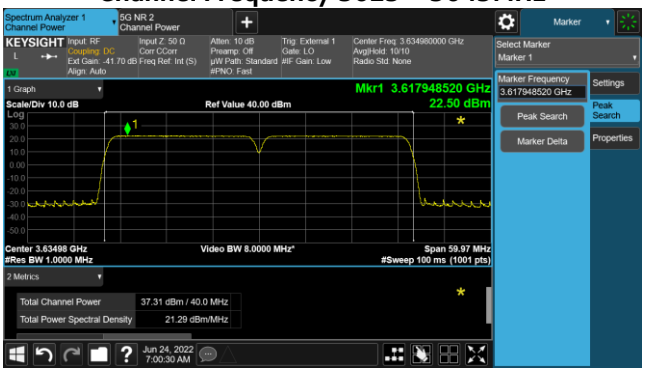
*Non-Contiguous

2.3.2 PSD Plots

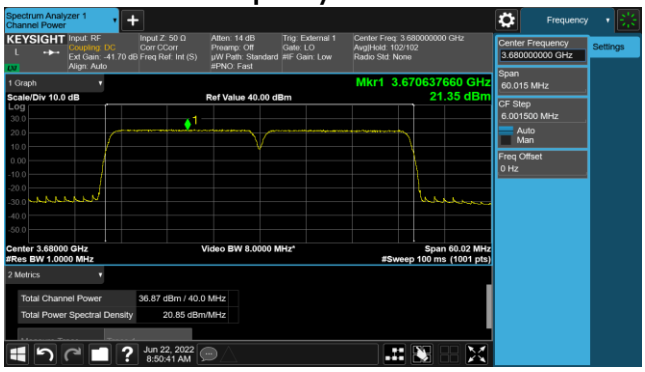
Test Model 3.2
Modulation QPSK/16QAM
20+20MHz BW
Channel Frequency 3561 + 3579MHz



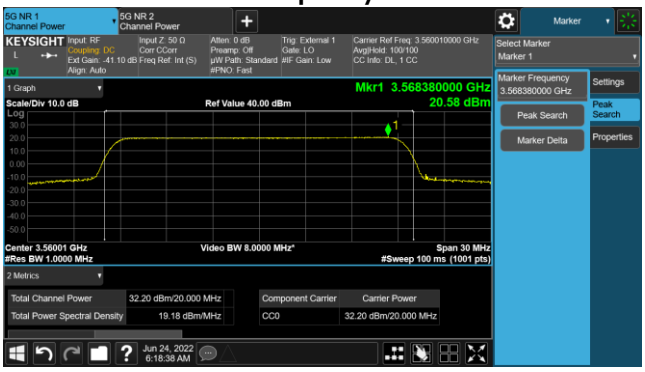
Test Model 3.2
Modulation QPSK/16QAM
20+20MHz BW
Channel Frequency 3625 + 3645MHz



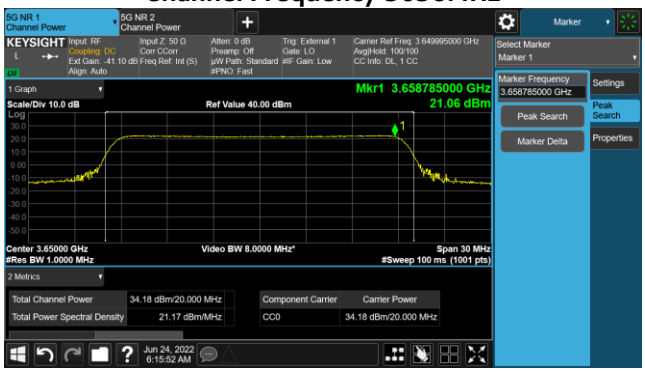
Test Model 3.1a
Modulation 256QAM
20+20MHz BW
Channel Frequency 3670 + 3690MHz



Test Model 3.2
Modulation QPSK/16QAM
20MHz BW
Channel Frequency 3560MHz



Test Model 3.2
Modulation QPSK/16QAM
20MHz BW
Channel Frequency 3650MHz



2.4 Peak-to-Average Power Ratio (PAPR)

The Peak-to-Average Power Ratio (PAPR) of the EUT was measured per KDB 971168 D01 using the Power Complementary Cumulative Distribution Function (CCDF) feature of the MXA Analyzer. The PAPR measurements are tabulated in Table 2.4.

The FCC requirement for PAPR is that the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission. The maximum PAPR value for each measured configuration is given in Table 2.4.

2.4.1 Peak-to-Average Power Ratio Results:

The maximum Peak-to-Average Power Ratio (PAPR) of the EUT measured at its antenna transmitting terminals was measured to be 8.64dB maximum, which is in full compliance with the requirement to not exceed 13 dB as specified by the FCC. The representative data sets exact values are listed in Table 2.4 below.

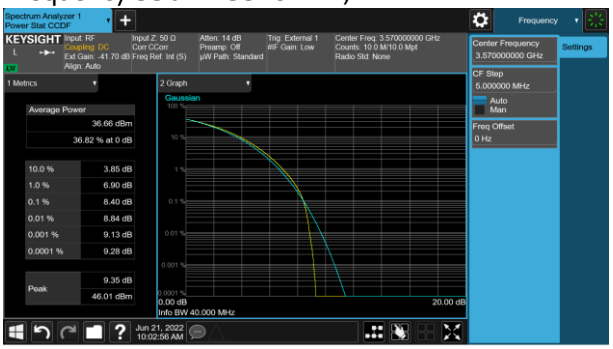
Table 2.5 Peak to Average Power Ratio

Test Model	Modulation	TX Port	Center Frequency MHz	Signal BW MHz	PAR at 0.1% Limit - 13 dB
3.2	QPSK/16QAM	1	3561 + 3579	20 + 20	8.40
3.2	QPSK/16QAM	1	3625 + 3645	20 + 20	**8.64**
3.1a	256QAM	1	3670 + 3690	20 + 20	8.38
3.2	QPSK/16QAM	2	3560*	20	8.43
3.2	QPSK/16QAM	2	3650*	20	8.14

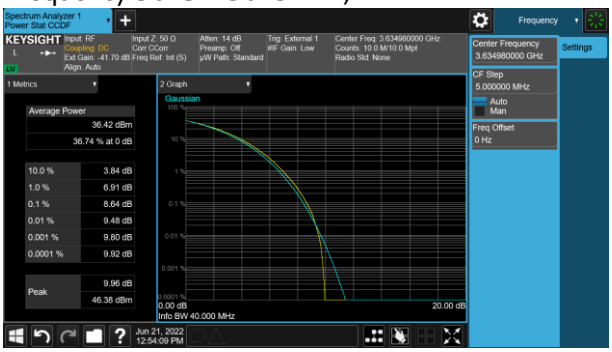
*Non-Contiguous

2.4.2 Peak-to-Average Power Ratio Plots

Test Model 3.2, Modulation QPSK/16QAM, Frequency 3561 + 3579MHz, TX1



Test Model 3.2, Modulation QPSK/16QAM, Frequency 3625 + 3645MHz, TX1



Test Model 3.1a, Modulation 256QAM, Frequency 3670 + 3690MHz, TX1

Test Model 3.2, Modulation QPSK/16QAM, Frequency 3560MHz (Non-Contiguous), TX2

Test Model 3.2, Modulation QPSK/16QAM, Frequency 3650MHz (Non-Contiguous), TX2

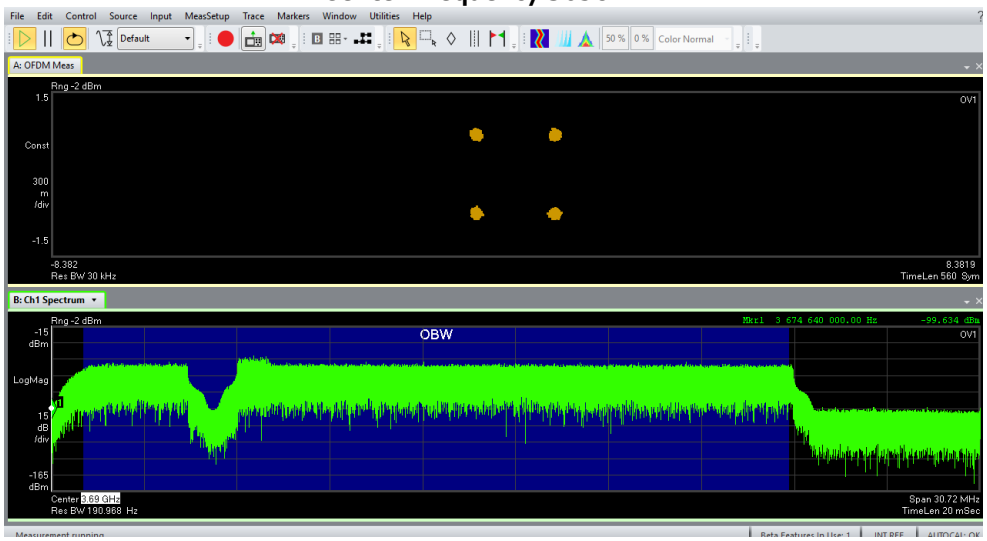
3. FCC Section 2.1047 - Modulation Characteristics

3.1 Modulation Characteristics

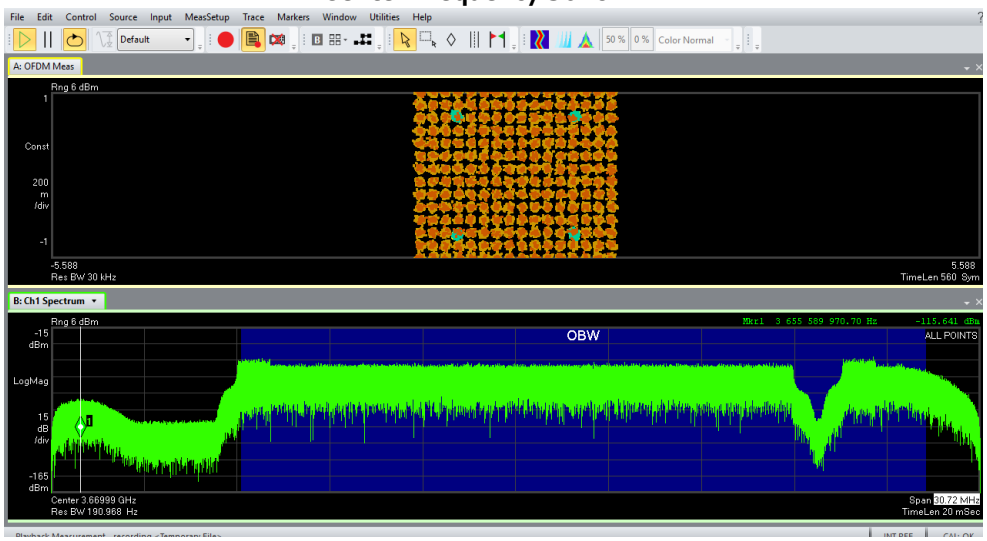
The RF signal at the antenna port was demodulated and verified for correctness of the modulation signal used before each test was performed.

3.1.1 Modulation Characteristics – Plots

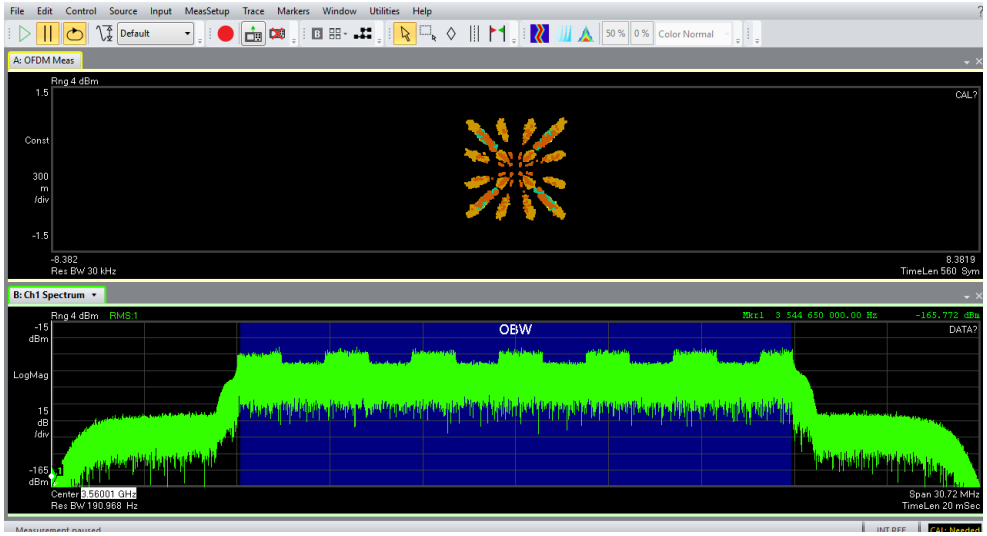
Modulation QPSK TM1.1
Center Frequency 3690MHz



Modulation 256QAM TM3.1a
Center Frequency 3670MHz



Modulation QPSK/16QAM TM3.2
Center Frequency 3560MHz



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.

4.1.1 Occupied Bandwidth (Signal Bandwidth) Results

The 99% occupied bandwidth and -26 dB relative bandwidth was measured with an Agilent/Keysight MXA signal analyzer for the emission designators. The results are tabulated in Table 4.1 and example plots are in section 4.1.2 and shows that the measured signals are within the parameters of the emissions designator for the FCC.

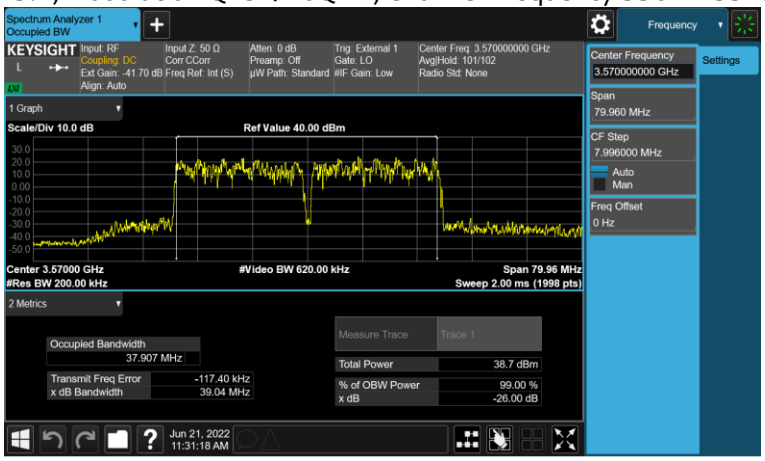
Table 4.1: 99% Occupied Bandwidth

Test Model	Modulation	TX Port	Center Frequency MHz	Signal BW MHz	Occupied BW MHz
3.2	QPSK/16QAM	1	3561 + 3579	20 + 20	37.907
3.2	QPSK/16QAM	1	3625 + 3645	20 + 20	37.908
3.1a	256QAM	1	3670 + 3690	20 + 20	37.697
3.2	QPSK/16QAM	2	3560 + 3650*	20 + 20	18.273 + 18.139

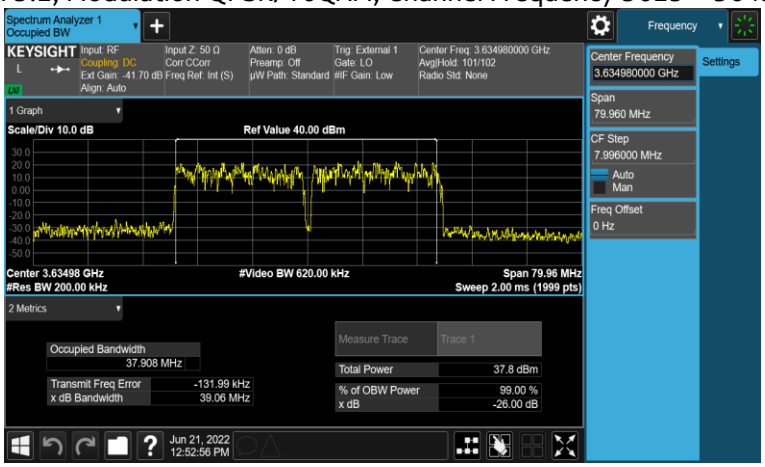
*Non-Contiguous

4.1.2 Occupied Bandwidth – Plots

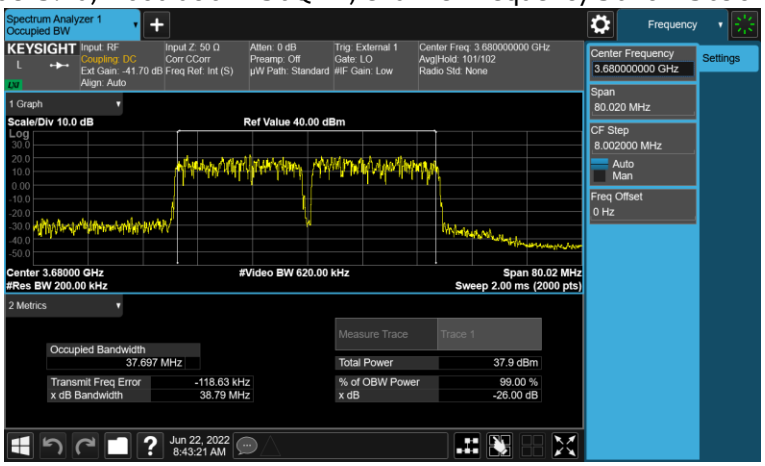
Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3561 + 3579MHz, TX1



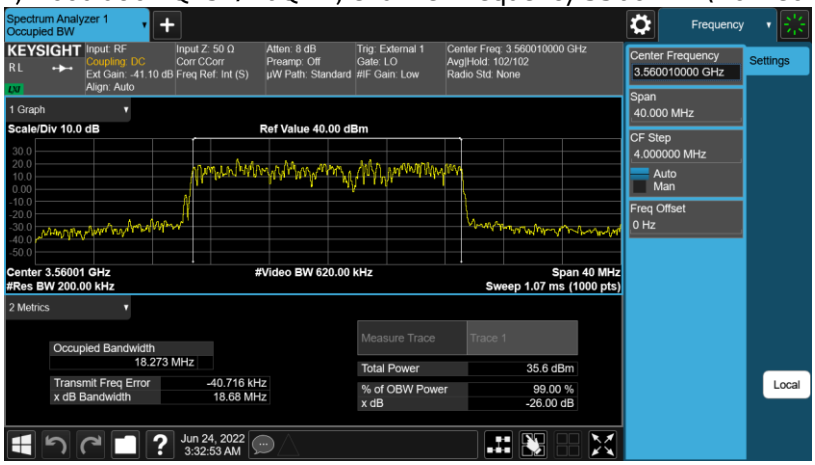
Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3625 + 3645MHz, TX1



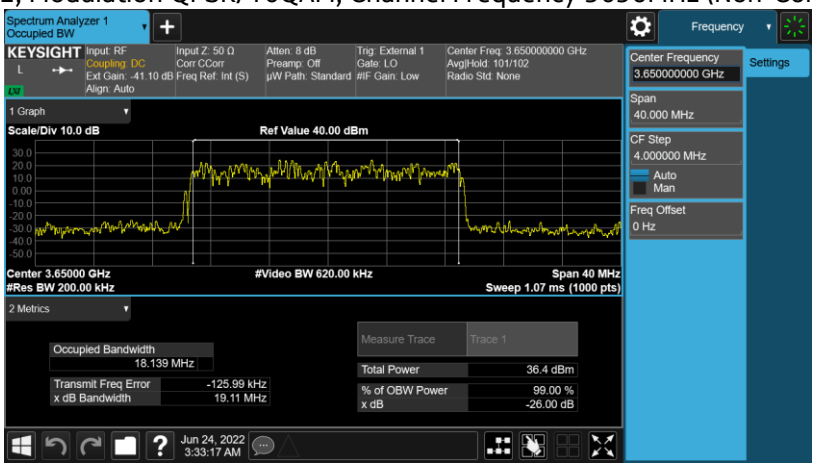
Test Model 3.1a, Modulation 256QAM, Channel Frequency 3670 + 3690MHz, TX1



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3560MHz (Non-Contiguous), TX2



Test Model 3.2, Modulation QPSK/16QAM, Channel Frequency 3650MHz (Non-Contiguous), TX2



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 band 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.

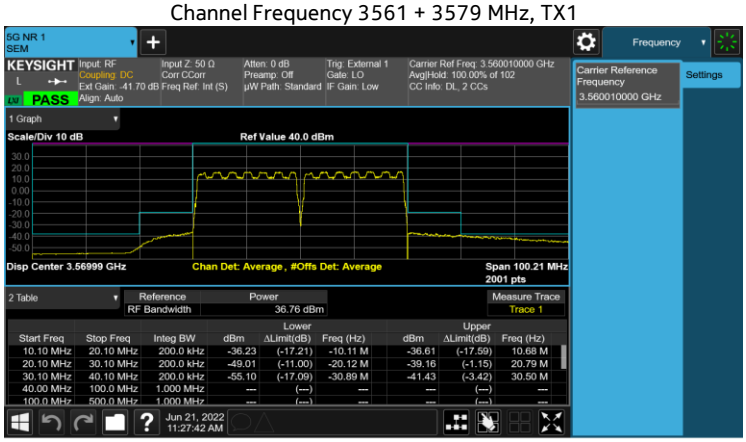
KDB 940660 D01 Section 3.2 (b)(6) specified that measurements must be performed for low, mid, and high channels. It is acceptable to apply the procedures in Section 5.7 of ANSI C63.26-2015. When antenna-port conducted measurements are performed to demonstrate compliance to the applicable unwanted emission 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. The Top of Mask corresponds to the set rated power level as confirmed by the RF power meter.

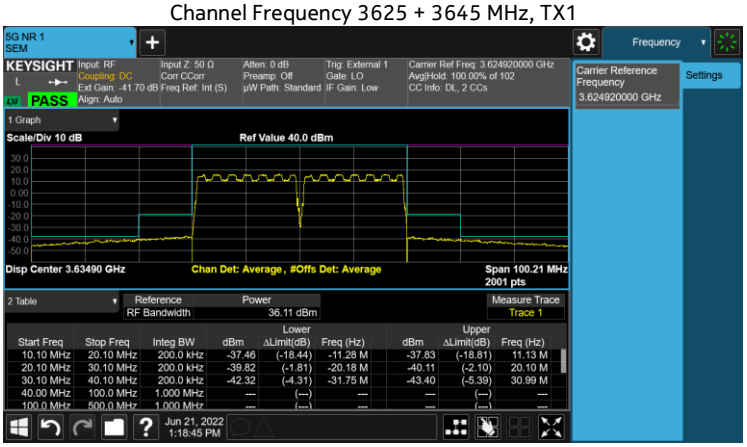
4.2.1 Edge of Band Emissions - Plots

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.

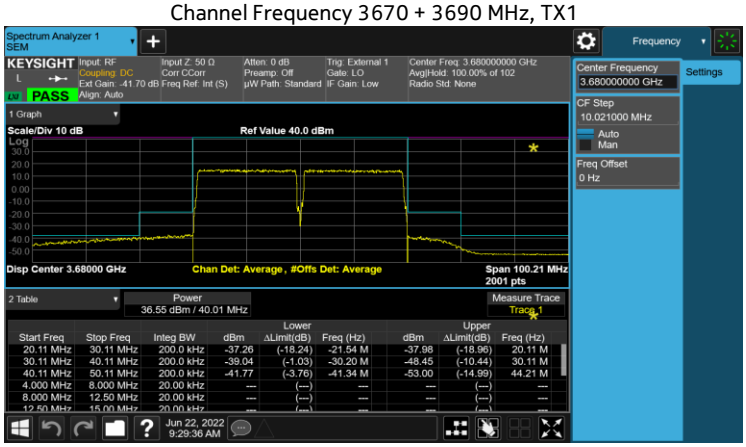
Test Model 3.2, Modulation QPSK/16QAM,
Channel Frequency 3561 + 3579 MHz, TX1



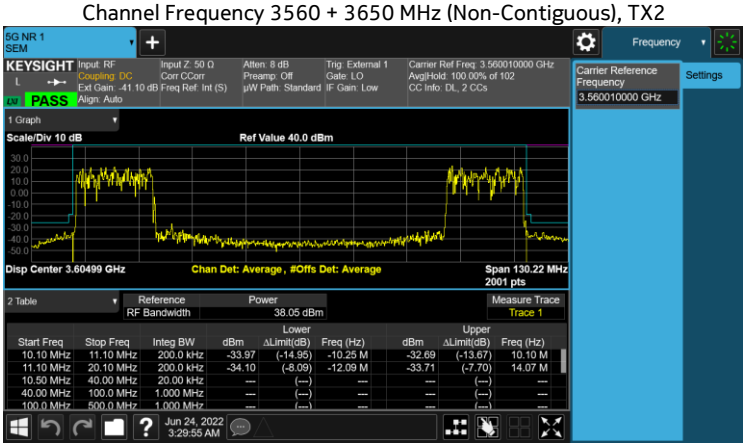
Test Model 3.2, Modulation QPSK/16QAM,
Channel Frequency 3625 + 3645 MHz, TX1



Test Model 3.1a, Modulation 256QAM,
Channel Frequency 3670 + 3690 MHz, TX1



Test Model 3.2, Modulation QPSK/16QAM,
Channel Frequency 3560 + 3650 MHz (Non-Contiguous), TX2



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

This test measures the emissions of spurious signals which may come from harmonic, parasitic, intermodulation and frequency conversion products and are outside the necessary bandwidth but excludes Edge-of-Band emissions.

5.1 Section 2.1051 Spurious Emissions at Antenna Terminals

Spurious Emissions at the antenna terminals were investigated per 47CFR Section 2.1057(a)(1) over the frequency range of 10 MHz to 37 GHz which is beyond the 10th harmonic of the carrier frequency. A test coupler which incorporates a low intermod broadband RF attenuator was used to reduce the transceiver's amplitude to a level usable by the spectrum analyzer. The test configuration is shown in Figure 4.4.1 which documents the test set up used for the measurements. In this set up the complete RF test path was calibrated over the 10 MHz-37 GHz range.

The spurious measurements were made using an MXA Signal Analyzer. These measurements are performed in compliance with ANSI C63.26 and our ISO17025 process. The measurement meets the ANSI C63.26 requirements in paragraphs 5.2.4.4.1 and 5.7 which requires that the number of points in the sweep be > 2 × Span/RBW. The MXA signal analyzer measurements examine the 10 MHz to 37 GHz range.

Measurements were performed for all of the test configurations in Table 5.1 and these match the test configurations used for Occupied Bandwidth / Edge of Band Emissions, RF Power and modulation.

5.2 Required Limit

The required emission limitation specified in **47CFR 96.41 (e)** was applied to these tests. Based upon the criterion given in Section 96 of the Code and as developed in 4.3.3, the required emission limit for emissions outside a licensee's frequency block is:

47CFR 96.41 (e)(2) *Additional protection levels.* Notwithstanding paragraph (e)(1) of this section, the conducted power of any emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

In order to account for the spectral adding of identical signals from the primary and diversity ports, per KDB 662911 D01 Multiple Transmitter Output v01r01, the level needs be adjusted by 10LOG(n) where n= number of outputs.

The adjustment for n=4 is: 6.02 dB = 10Log (4)

Therefore, the limit for emissions below 3540 MHz or above 3710 MHz frequency block when measured with a RBW of 1 MHz is:

-25 dBm - 6.02 dB = -31.02 dBm for 4x MIMO

Therefore, the limit for emissions below 3530 MHz or above 3720 MHz frequency block when measured with a RBW of 1 MHz is:

-40 dBm - 6.02 dB = -46.02 dBm for 4x MIMO

5.3 Spurious Emissions at Antenna Terminals Results

Over the required frequency spectrum investigated for the EUT, no reportable out-of-block spurious emissions were detected. The measurement results demonstrate that the subject of the application is in full compliance with the Rules of the Commission.

Table 5.1: Spurious Emissions at Antenna Terminals

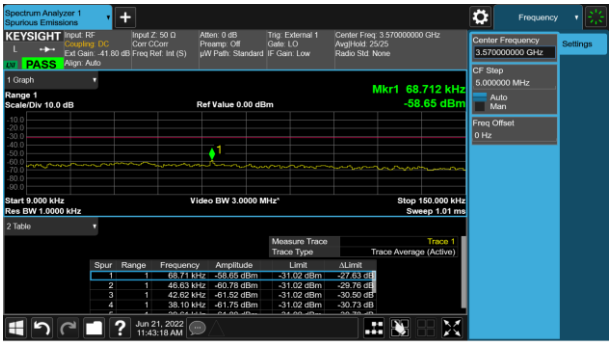
Test Model	Modulation	TX Port	Channel Frequency MHz	Signal BW MHz	Conducted Spurious Emissions Results Pass/ Fail
3.2	QPSK/16QAM	1	3561 + 3579	20 + 20	Pass
3.2	QPSK/16QAM	1	3625 + 3645	20 + 20	Pass
3.1a	256QAM	1	3670 + 3690	20 + 20	Pass
3.2	QPSK/16QAM	2	3560 + 3650*	20 + 20	Pass

*Non-Contiguous

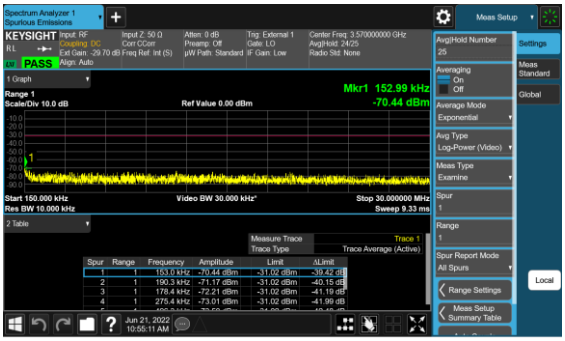
5.4 Spurious Emissions Plots

Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.2	QPSK/16QAM	1	3561 + 3579	20 + 20

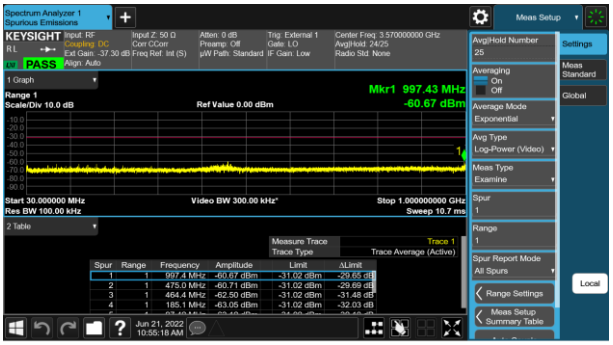
9 kHz – 150 kHz



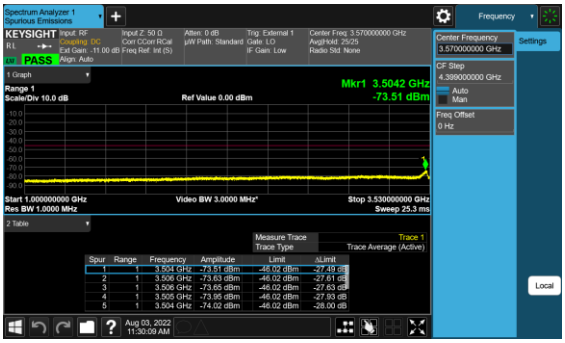
150 kHz – 30 MHz



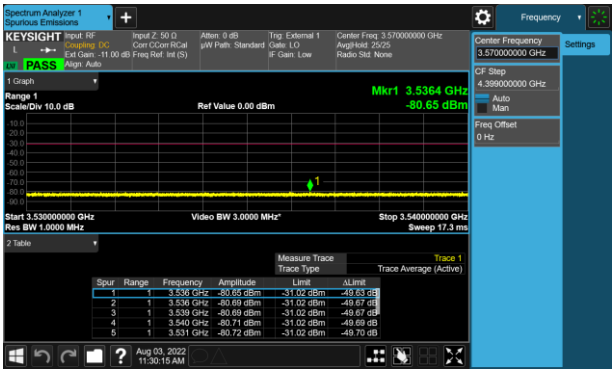
30 MHz – 1 GHz



1 GHz – 3.53 GHz



3.53 GHz – 3.54 GHz

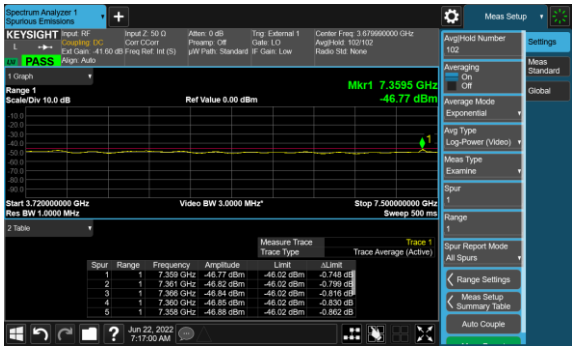


Note: The limit for frequency ranges below 3530 MHz in the plots above is -46dBm, and the minimum margin is -27.63 dBm - 15.0 = 12.63 dBm. All other measurements in these plots have greater margin.

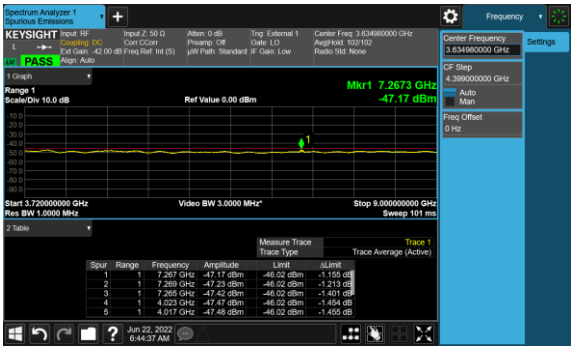
3.6 GHz – 3.72 GHz

3.72 GHz – 4 GHz

3.72 GHz – 7.5 GHz

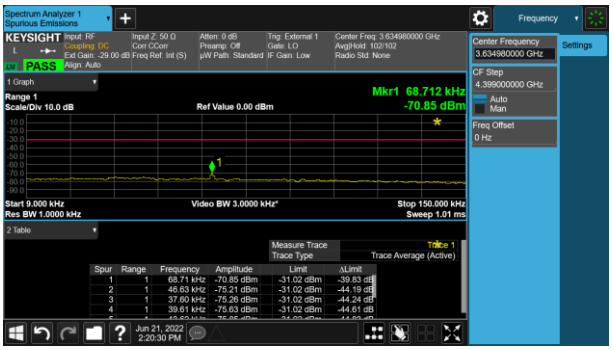


3.72 GHz – 9 GHz

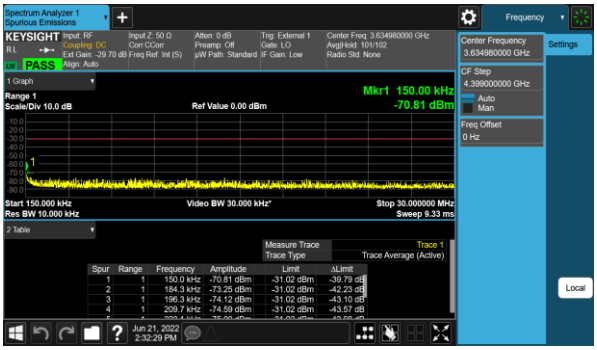


Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.2	QPSK/16QAM	1	3625 + 3645	20 + 20

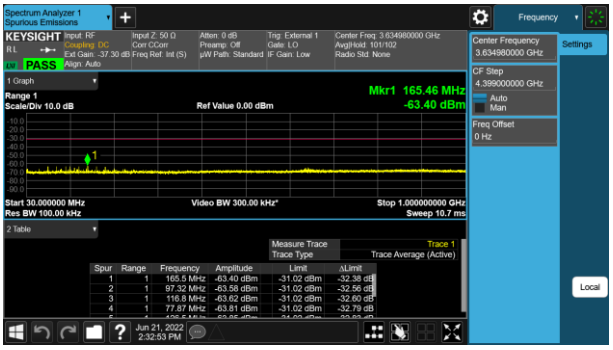
9 kHz – 150 kHz



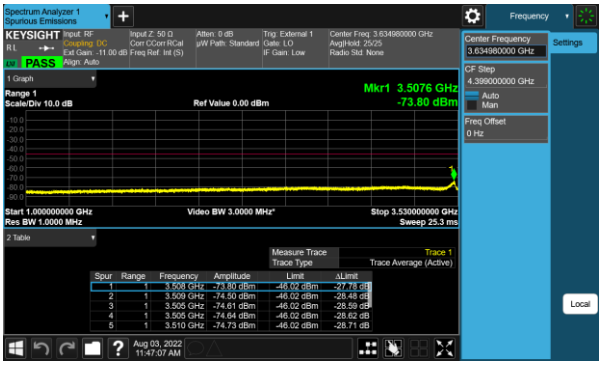
150 kHz – 30 MHz



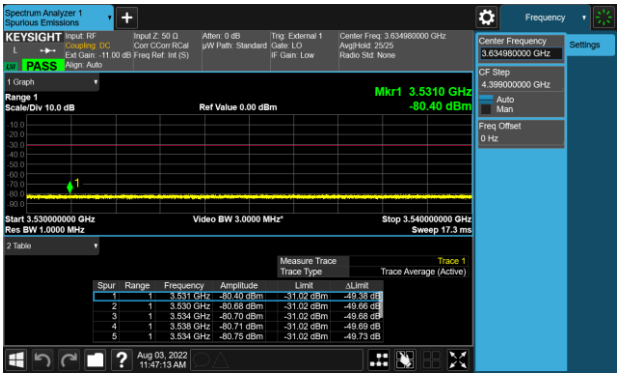
30 MHz – 1 GHz



1 GHz – 3.53 GHz

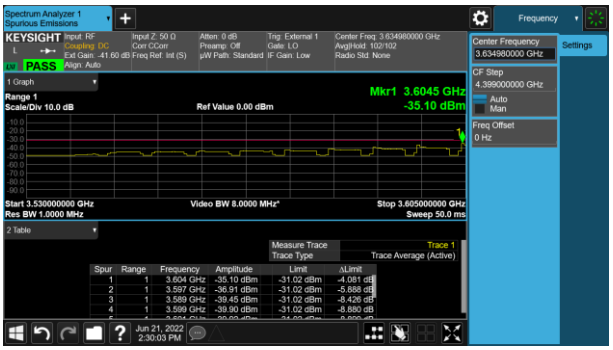


3.53 GHz – 3.54 GHz

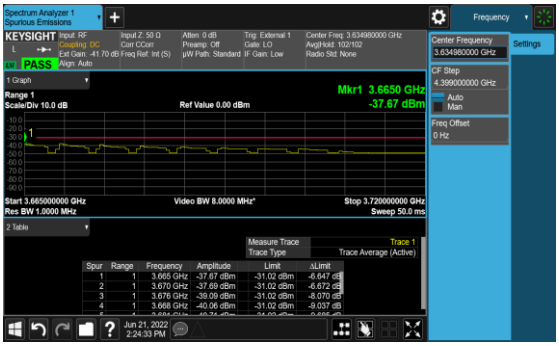


Note: The limit for frequency ranges below 3530 MHz in the plots above is -46dBm, and the minimum margin is -32.38 dBm - 15.0 = 17.38 dBm. All other measurements in these plots have greater margin.

3.53 GHz – 3.605 GHz

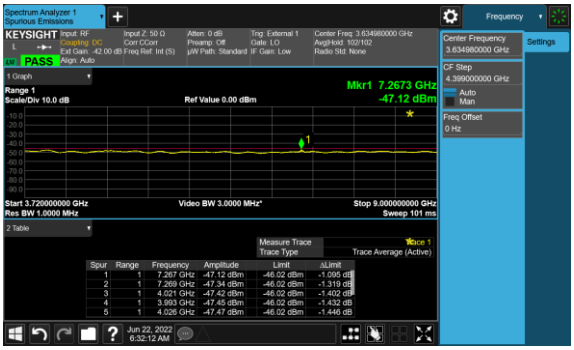


3.665 GHz – 3.72 GHz

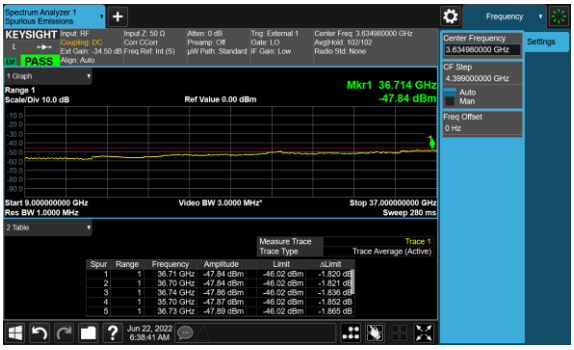


3.72 GHz – 4 GHz

3.72 GHz – 9 GHz

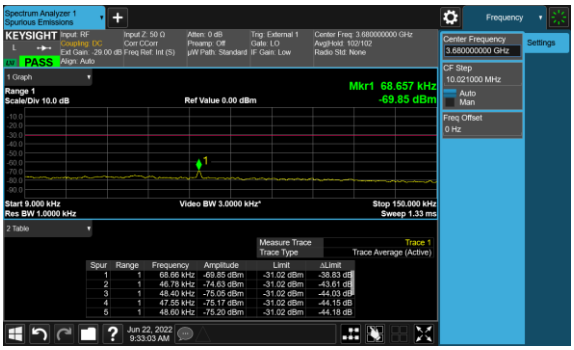


9 GHz – 37 GHz

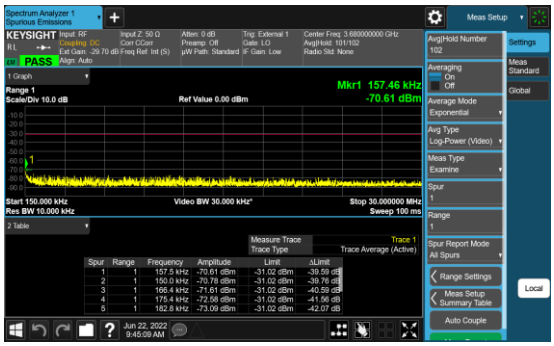


Test Model	Modulation	TX Port	Channel Frequency (MHz)	Signal BW (MHz)
3.1a	256QAM	1	3670 + 3690	20 + 20

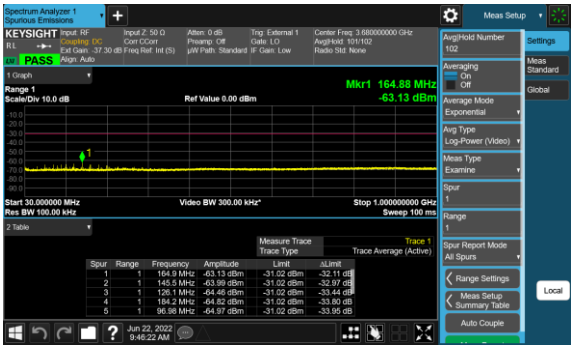
9 kHz – 150 kHz



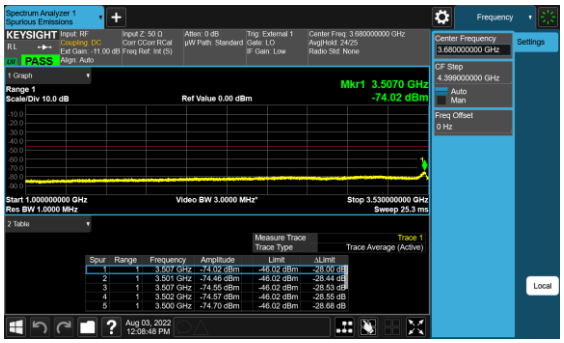
150 kHz – 30 MHz



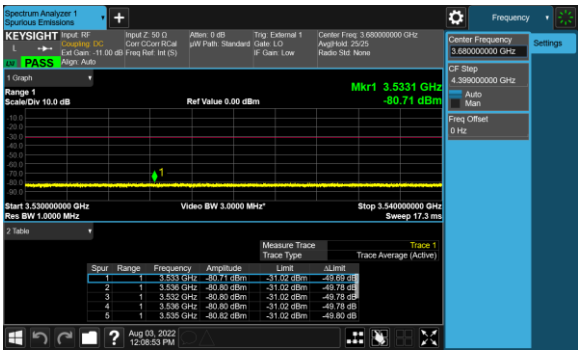
30 MHz – 1 GHz



1 GHz – 3.53 GHz

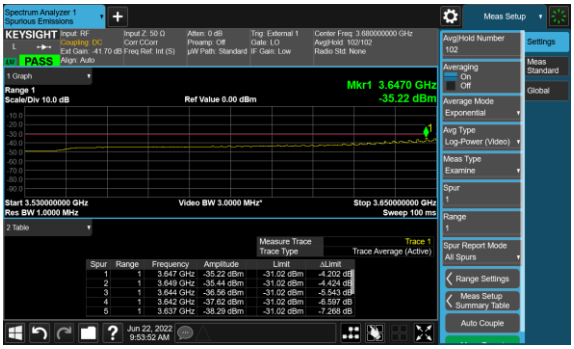


3.53 GHz – 3.54 GHz

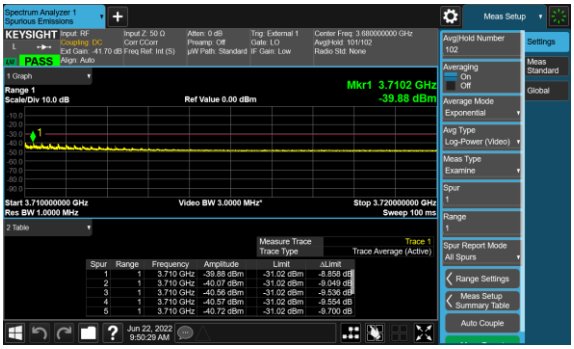


Note: The limit for frequency ranges below 3530 MHz in the plots above is -46dBm, and the minimum margin is -32.11 dBm – 15.0 = 17.11 dBm. All other measurements in these plots have greater margin.

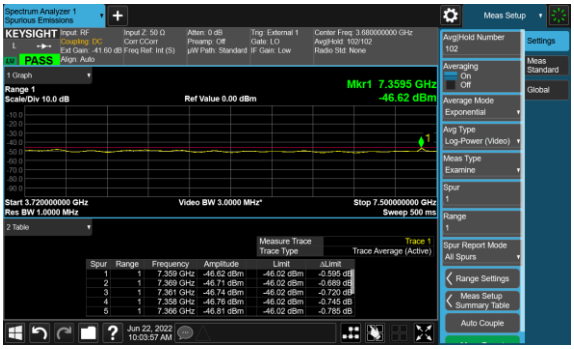
3.53 GHz – 3.65 GHz



3.71 GHz – 3.72 GHz



3.72 GHz – 7.5 GHz



7.5 GHz – 9 GHz