ELEMENT WASHINGTON DC LLC
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Part 96 MEASUREMENT REPORT

Applicant Name:
Telit Communications S.p.A.
Viale Stazione di Prosecco 5/b
Trieste, 34010
Italy

Date of Testing:
07/10/2023 - 08/16/2023
Test Report Issue Date:
09/25/2023
Test Site/Location:
Element lab., Columbia, MD, USA
Test Report Serial No.:
1M2306220084-02.R17

FCC ID:	**RI7FN990A28**
APPLICANT:	**Telit Communications S.p.A.**

Application Type:	Class II Permissive Change
Model:	FN990A28
EUT Type:	Module
FCC Classification:	Citizens Band End User Devices (CBE)
FCC Rule Part(s):	96
Test Procedure(s):	ANSI C63.26-2015
Class II Permissive Change:	Adding 10MHz bandwidth support for 5G NR n48 band
Original Grant Date:	12/20/2022

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.01

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Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
NR Band n48	10 MHz	π/2 BPSK	3555.0 - 3695.0	0.166	22.19	8M59G7D
		QPSK	3555.0 - 3695.0	0.165	22.17	8M66G7D
		16QAM	3555.0 - 3695.0	0.130	21.13	8M66W7D
		64QAM	3555.0 - 3695.0	0.093	19.68	8M69W7D
		256QAM	3555.0 - 3695.0	0.058	17.60	8M61W7D

Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
UL-MIMO NR Band n48 Antenna 1	10 MHz	QPSK	3555.0 - 3695.0	0.136	21.35	8M65G7D
		16QAM	3555.0 - 3695.0	0.123	20.89	8M61W7D
		64QAM	3555.0 - 3695.0	0.083	19.20	-
		256QAM	3555.0 - 3695.0	0.043	16.37	-

Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
UL-MIMO NR Band n48 Antenna 3	10 MHz	QPSK	3555.0 - 3695.0	0.136	21.35	8M66G7D
		16QAM	3555.0 - 3695.0	0.123	20.89	8M63W7D
		64QAM	3552.5 - 3697.5	0.083	19.20	-
		256QAM	3552.5 - 3697.5	0.043	16.37	-

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.

1.2 Element Test Location

These measurement tests were conducted at the Element laboratory located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at Element lab located in Columbia, MD 21046, U.S.A.

- Element Washington DC LLC is a OnGo Alliance Approved Test Lab (ATL)
- Element Washington DC LLC is a WInnForum Approved Test Lab
- Element Washington DC LLC is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- Element Washington DC LLC facility is a registered (2451B) test laboratory with the site description on file with ISED.
- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreement.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Telit Module FCC ID: RI7FN990A28**. The test data contained in this report pertains only to the emissions due to the EUT's NR Band 48 operation in the CBRS band. Per FCC Part 96, this device is evaluated as a Citizens Band End User Devices (CBE).

Test Device Serial No.: MD12

2.2 Device Capabilities

This device contains the following capabilities:

Multi-band LTE and NR, UL-MIMO for n48

2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

2.4 Software and Firmware

Testing was performed on device(s) using software/firmware version 45.00.003-B001 installed on the EUT.

2.5 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Measurement Procedure

The measurement procedures described in the "American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services" (ANSI C63.26-2015) were used in the measurement of the EUT**.**

Deviation from Measurement Procedure……..None

3.2 Radiated Power and Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated power measurements, substitution method is used per the guidance of ANSI C63.26-2015. For emissions below 1GHz, a half-wave dipole is substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

$$P_{d\ [dBm]} = P_{g\ [dBm]} - \text{cable loss}_{\ [dB]} + \text{antenna gain}_{\ [dBd/dBi]};$$

where P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to $P_{g\ [dBm]}$ – cable loss $_{[dB]}$.

For radiated spurious emissions measurements, the field strength conversion method is used per the formulas in Section 5.2.7 of ANSI C63.26-2015. Field Strength (EIRP) is calculated using the following formulas:

$$E_{[dB\mu V/m]} = \text{Measured amplitude level}_{[dBm]} + 107 + \text{Cable Loss}_{[dB]} + \text{Antenna Factor}_{[dB/m]}$$

And

$$EIRP_{[dBm]} = E_{[dB\mu V/m]} + 20\log D - 104.8;$$ where D is the measurement distance in meters.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 414788 D01 v01r01.

Radiated power and radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	ETS-001	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-001
-	MVG	EMC Cable and Switch System	1/12/2023	Annual	1/12/2024	MVG
-	LTx6	LIcensed Transmitter Cable Set	1/12/2023	Annual	1/12/2024	LTx6
-	WL25-1	Conducted Cable Set (25GHz)	1/12/2023	Annual	1/12/2024	WL25-1
-	WL25-1	Conducted Cable Set (40GHz)	1/12/2023	Annual	1/12/2024	WL40-1
Agilent	N9030A	50GHz PXA Signal Analyzer	9/9/2022	Annual	9/9/2023	US51350301
Anritsu	MT8000A	Radio Communication Test Station	6/15/2023	Annual	6/15/2024	6261914237
Emco	3115	Horn Antenna (1-18GHz)	8/8/2022	Biennial	8/8/2024	9704-5182
Emco	3116	Horn Antenna (18 - 40GHz)	2/27/2023	Biennial	2/27/2025	9203-2178
Espec	SCP-220	Envionmental Chamber	5/25/2022	Biennial	5/25/2024	OCPS5H0612K05
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	3/15/2023	Annual	3/15/2024	MY52350166
Keysight Technologies	N9030B	PXA Signal Analyzer, Multi-touch	7/29/2022	Annual	7/29/2023	MY57141001
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	8/29/2022	Annual	8/29/2023	100342
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	8/30/2022	Biennial	8/30/2024	A051107
Sunol	JB6	LB6 Antenna	3/2/2023	Biennial	3/2/2025	A082816

Table 5-1. Test Equipment

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

2. Equipment with a calibration date of “N/A” shown in this list was not used to make direct calibrated measurements.

6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 8M62G7D

LTE BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

QAM Modulation

Emission Designator = 8M45W7D

LTE BW = 8.45 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

Spurious Radiated Emission – LTE Band

Example: Middle Channel LTE Mode 2nd Harmonic (7250 MHz)

The average spectrum analyzer reading at 3 meters with the EUT on the turntable was –81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of –81.0 dBm on the spectrum analzyer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 1564 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.501 dBm so this harmonic was 25.501 dBm – (-24.80) = 50.3 dBc.

7.0 TEST RESULTS

7.1 Summary

Company Name: Telit Communications S.p.A.

FCC ID: RI7FN990A28

FCC Classification: Citizens Band End User Devices (CBE)

Mode(s): NR

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Conducted Power Equivalent Isotropic Radiated Power (NR Band n48)	2.1046(a), 2.1046(c) 96.41(b)	23 dBm/10MHz	PASS	Section 7.2
	Occupied Bandwidth	2.1049(h)	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions (EUD)	2.1051, 96.41(e)(1)(ii), 96.41(e)(2)	-13 dBm/MHz at frequencies within 0-B MHz of channel edge (where B is the bandwidth of the assigned channel) -25 dBm/MHz at frequencies greater than B MHz above and below channel edge -40 dBm/MHz at frequencies below 3530 MHz and above 3720 MHz	PASS	Sections 7.4, 7.5
	Peak-to-Average Ratio	96.41(g)	< 13dB	PASS	Section 7.6
RADIATED	Radiated Spurious Emissions	2.1053, 96.41(e)	-40 dBm/MHz	PASS	Section 7.7

Table 7-1. Summary of Test Results

Notes:

1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is EMC Software Tool v1.1.
5) Since the two antenna ports are uncorrelated, the antenna gain for MIMO operations shown throughout this section is just the gain of one antenna per the guidance of KDB 662911.

7.2 Conducted Output Power Data and EIRP

Test Overview

The EUT is set up to transmit at maximum power for 5G NR. All power levels are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 – Section 5.2

Test Settings

1. Span = 2 x OBW to 3 x OBW
2. RBW = 1% to 5% of the OBW
3. Number of measurement points in sweep ≥ 2 x span / RBW
4. Sweep = auto-couple (less than transmission burst duration)
5. Detector = RMS (power)
6. Trigger was set to enable power measurements only on full power bursts
7. Trace was allowed to stabilize
8. Spectrum analyzer's "Channel Power" function was used to compute the power by integrating the spectrum over 10MHz for direct comparison to the limit specified in 96.41(b)

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

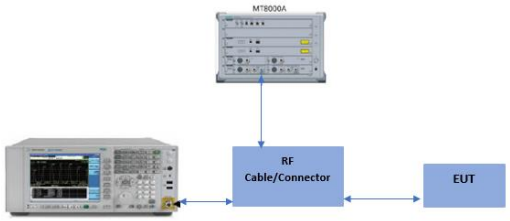


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

1. Conducted power measurements were evaluated using various combinations of RB size, RB offset, modulation, and channel bandwidth. Channel bandwidth data is shown in the tables below based only on the channel bandwidths that were supported in this device.

2. NR Band n48 EIRP is calculated with conducted power and antenna gain.

NR Band n48

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm/10MHz]	Margin [dB]
10 MHz	π/2 BPSK	637000	3555.0	1 / 1	21.46	0.50	21.96	0.157	23.00	-1.04
		641666	3625.0	1 / 22	21.69	0.50	22.19	0.166	23.00	-0.81
		646332	3695.0	1 / 22	21.45	0.50	21.95	0.157	23.00	-1.05
	QPSK	637000	3555.0	1 / 22	21.46	0.50	21.96	0.157	23.00	-1.04
		641666	3625.0	1 / 22	21.67	0.50	22.17	0.165	23.00	-0.83
		646332	3695.0	1 / 22	21.46	0.50	21.96	0.157	23.00	-1.04
	16-QAM	637000	3555.0	1 / 12	20.48	0.50	20.98	0.125	23.00	-2.02
		641666	3625.0	1 / 22	20.63	0.50	21.13	0.130	23.00	-1.87
		646332	3695.0	1 / 22	20.39	0.50	20.89	0.123	23.00	-2.11
	64-QAM	637000	3555.0	1 / 22	18.86	0.50	19.36	0.086	23.00	-3.64
		641666	3625.0	1 / 22	19.18	0.50	19.68	0.093	23.00	-3.32
		646332	3695.0	1 / 12	18.93	0.50	19.43	0.088	23.00	-3.57
	256-QAM	637000	3555.0	1 / 1	16.74	0.50	17.24	0.053	23.00	-5.76
		641666	3625.0	1 / 22	17.10	0.50	17.60	0.058	23.00	-5.40
		646332	3695.0	1 / 12	16.78	0.50	17.28	0.053	23.00	-5.72

Table 7-2. Conducted Power Output Data and EIRP Data (NR Band n48)

UL-MIMO NR Band n48

Bandwidth	Modulation	Channel	Frequency [MHz]	Ant 1 RB Size/Offset	Ant 1 Conducted Power [dBm]	Ant 3 RB Size/Offset	Ant 3 Conducted Power [dBm]	UL-MIMO Conducted Power [dBm]	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm/10MHz]	Margin [dB]
10 MHz	QPSK	637000	3555.0	1/12	17.31	1/12	17.20	20.27	0.50	20.77	0.119	23.00	-2.23
		641666	3625.0	1/1	18.04	1/1	17.63	20.85	0.50	21.35	0.136	23.00	-1.65
		646332	3695.0	1/22	17.49	1/22	17.50	20.51	0.50	21.01	0.126	23.00	-1.99
	16-QAM	637000	3555.0	1/1	16.75	1/1	16.83	19.80	0.50	20.30	0.107	23.00	-2.70
		641666	3625.0	1/22	17.37	1/22	17.38	20.39	0.50	20.89	0.123	23.00	-2.11
		646332	3695.0	1/22	17.37	1/22	17.17	20.04	0.50	20.54	0.113	23.00	-2.46
	64-QAM	637000	3555.0	1/22	15.28	1/22	15.02	18.16	0.50	18.66	0.073	23.00	-4.34
		641666	3625.0	1/12	15.92	1/12	15.44	18.70	0.50	19.20	0.083	23.00	-3.80
		646332	3695.0	1/1	15.87	1/1	15.44	18.46	0.50	18.96	0.079	23.00	-4.04
	256-QAM	637000	3555.0	1/22	12.42	1/22	12.14	15.29	0.50	15.79	0.038	23.00	-7.21
		641666	3625.0	1/1	13.04	1/1	12.68	15.87	0.50	16.37	0.043	23.00	-6.63
		646332	3695.0	1/12	12.59	1/12	12.53	15.57	0.50	16.07	0.040	23.00	-6.93

Table 7-3. Conducted Power Output Data (NR Band n48 UL-MIMO Ant1 and Ant3)

7.3 Occupied Bandwidth

Test Overview

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. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.4

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

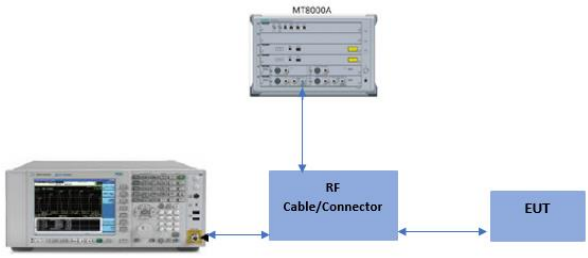
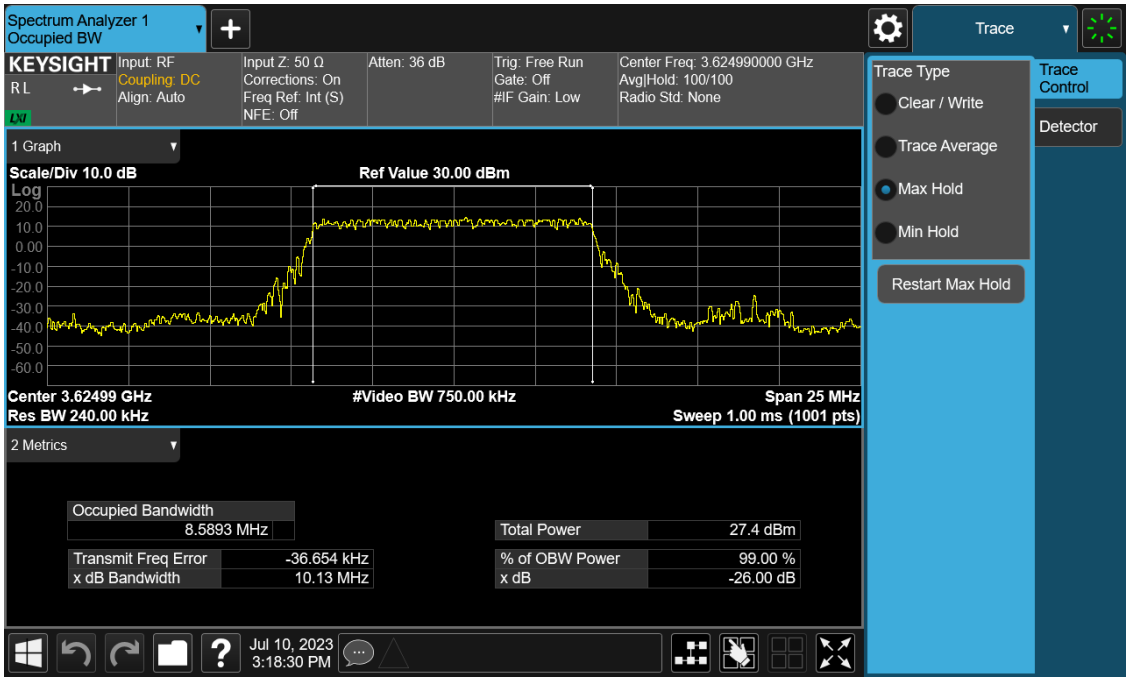


Figure 7-2. Test Instrument & Measurement Setup

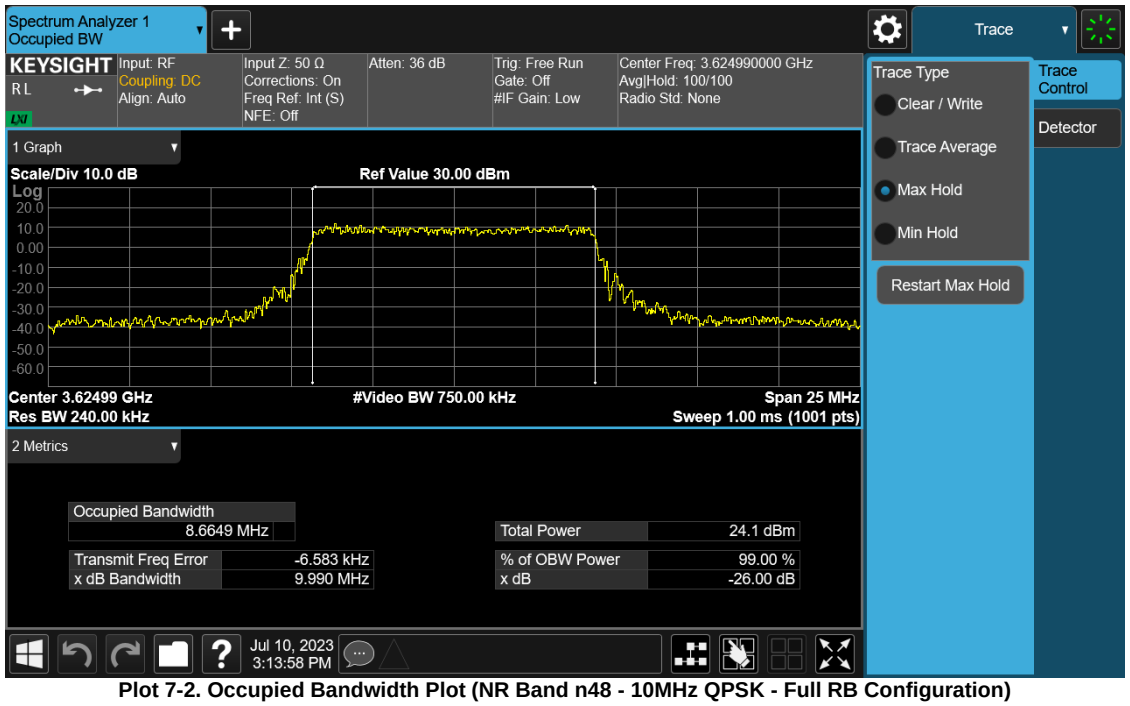
Test Notes

In this section, the UL-MIMO NR band n48 (Antenna 1 and Antenna 3) plots were measured individually

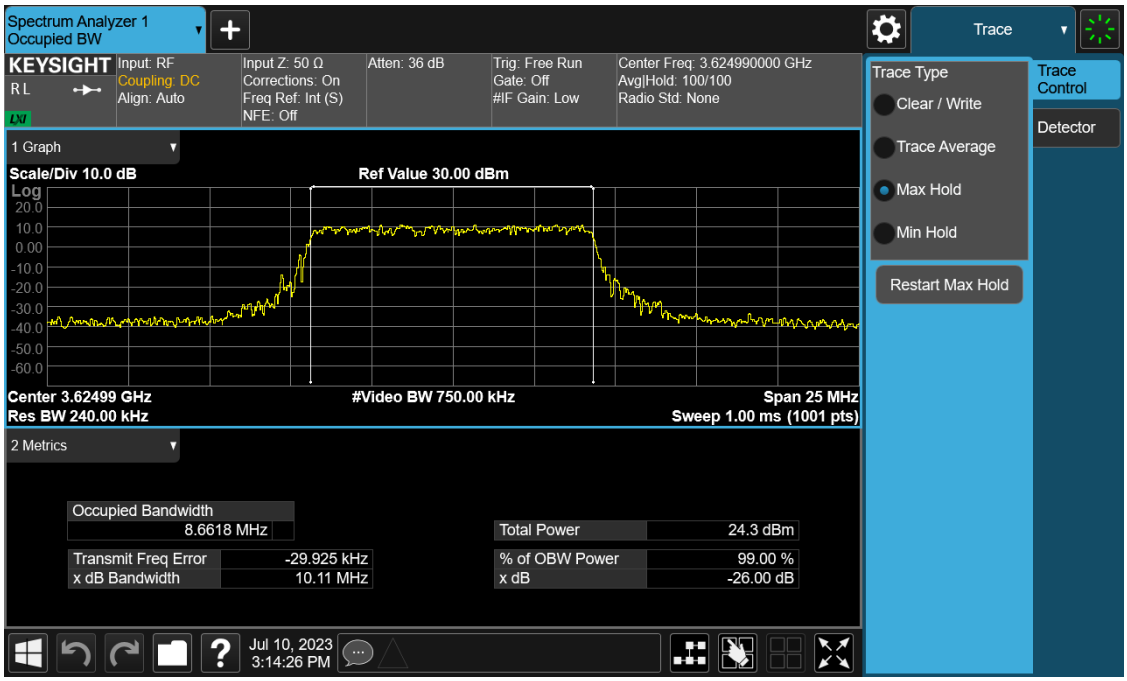
NR Band n48



Plot 7-1. Occupied Bandwidth Plot (NR Band n48 - 10MHz π/2 BPSK - Full RB Configuration)

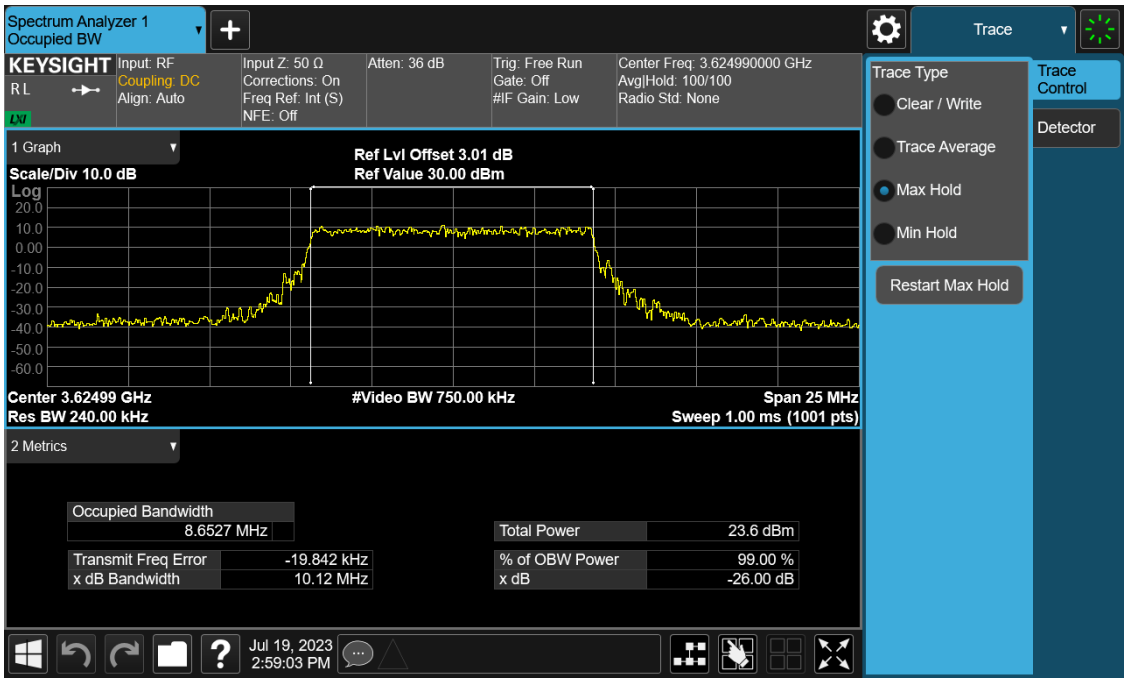


Plot 7-2. Occupied Bandwidth Plot (NR Band n48 - 10MHz QPSK - Full RB Configuration)

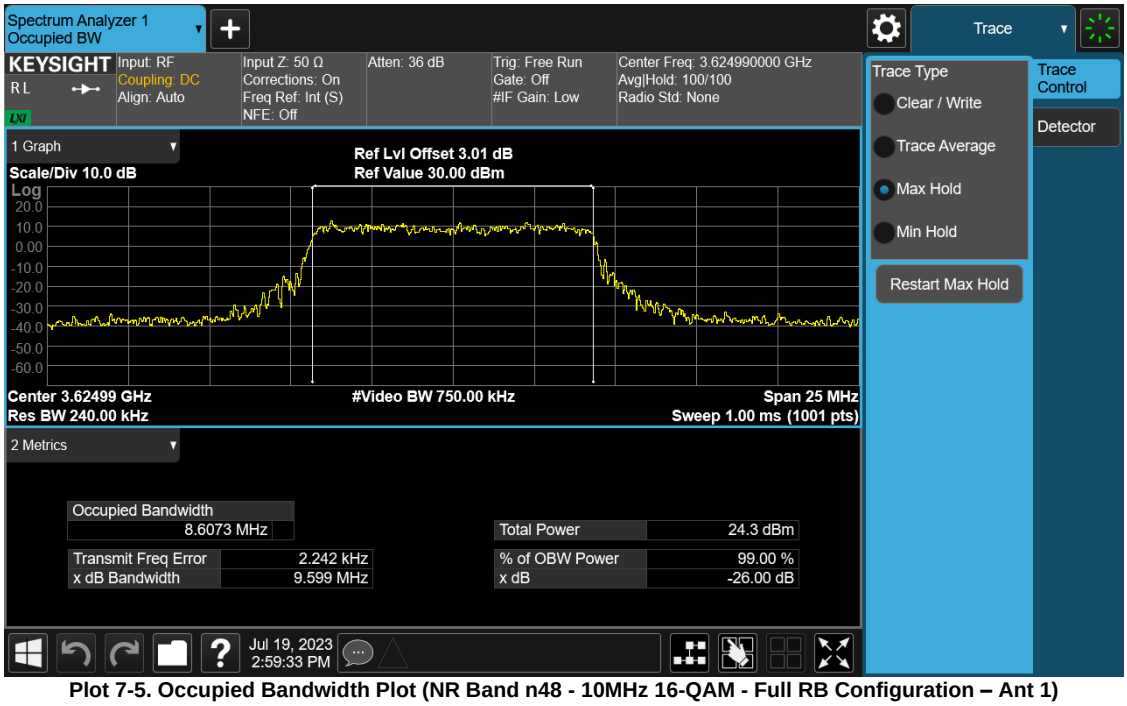


Plot 7-3. Occupied Bandwidth Plot (NR Band n48 - 10MHz 16-QAM - Full RB Configuration)

UL-MIMO NR Band n48 – Antenna 1

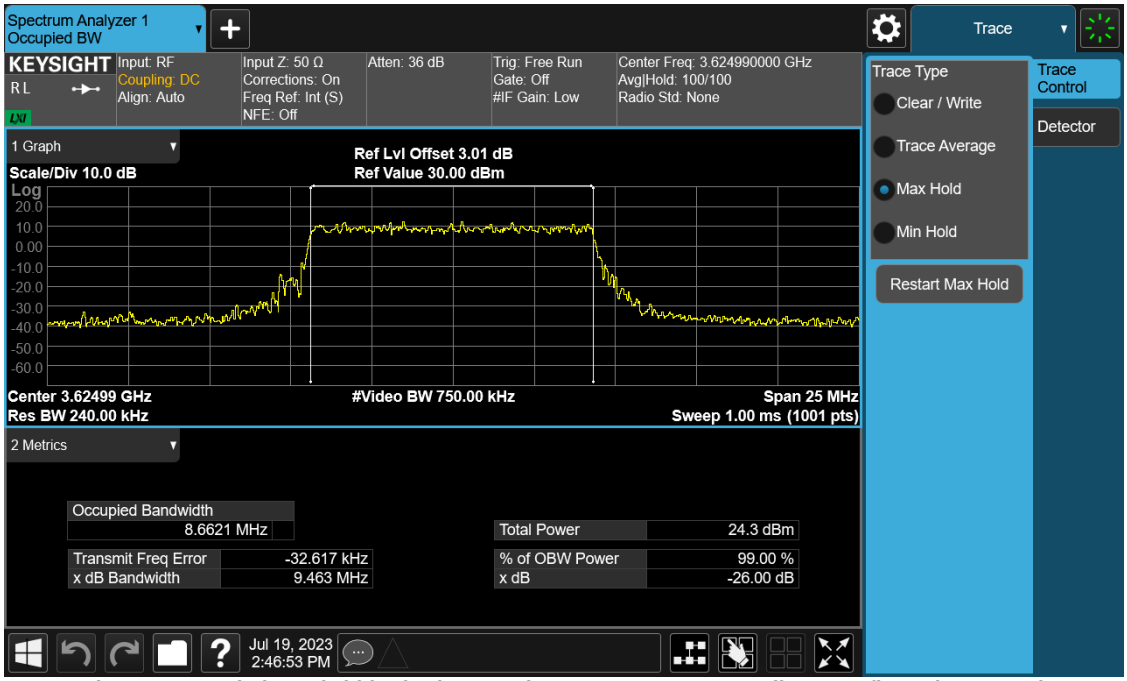


Plot 7-4. Occupied Bandwidth Plot (NR Band n48 - 10MHz QPSK - Full RB Configuration - Ant 1)

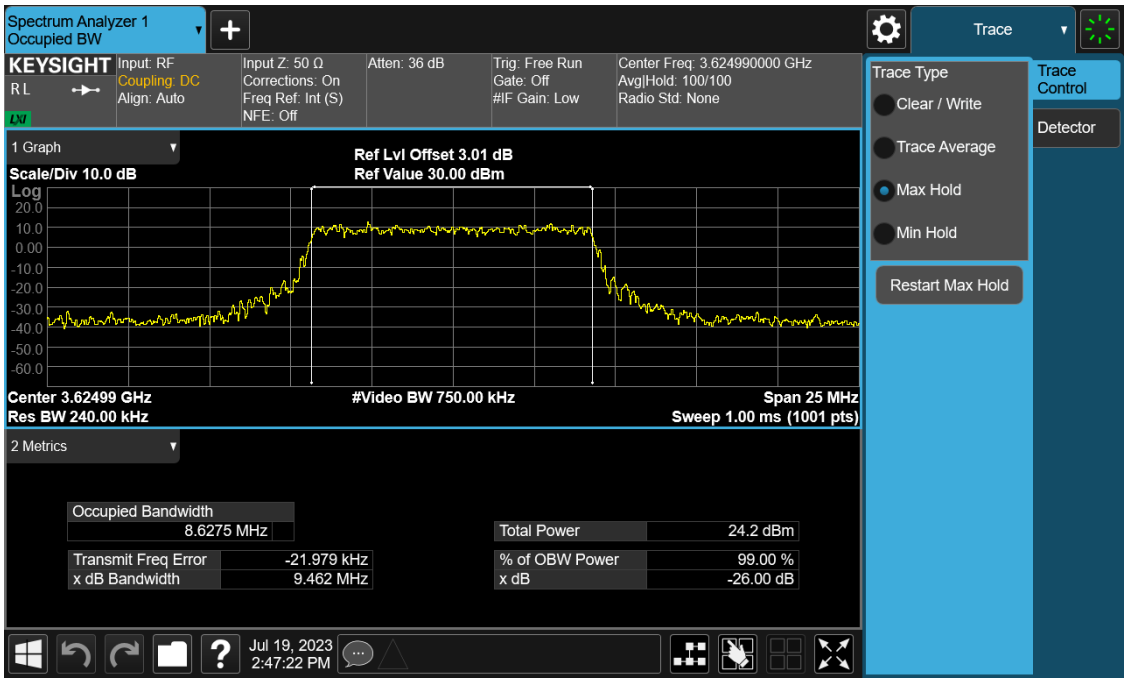


Plot 7-5. Occupied Bandwidth Plot (NR Band n48 - 10MHz 16-QAM - Full RB Configuration – Ant 1)

UL-MIMO NR Band n48 – Antenna 3



Plot 7-6. Occupied Bandwidth Plot (NR Band n48 - 10MHz QPSK - Full RB Configuration - Ant 3)



Plot 7-7. Occupied Bandwidth Plot (NR Band n48 - 10MHz 16-QAM - Full RB Configuration – Ant 3)

7.4 Spurious and Harmonic Emissions at Antenna Terminal

Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

The conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40 dBm/MHz.

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.4

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to at least 10 * the fundamental frequency (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = Max Hold
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

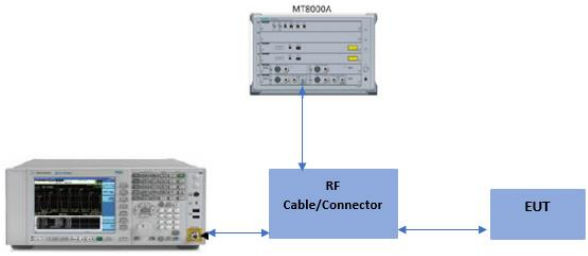


Figure 7-3. Test Instrument & Measurement Setup

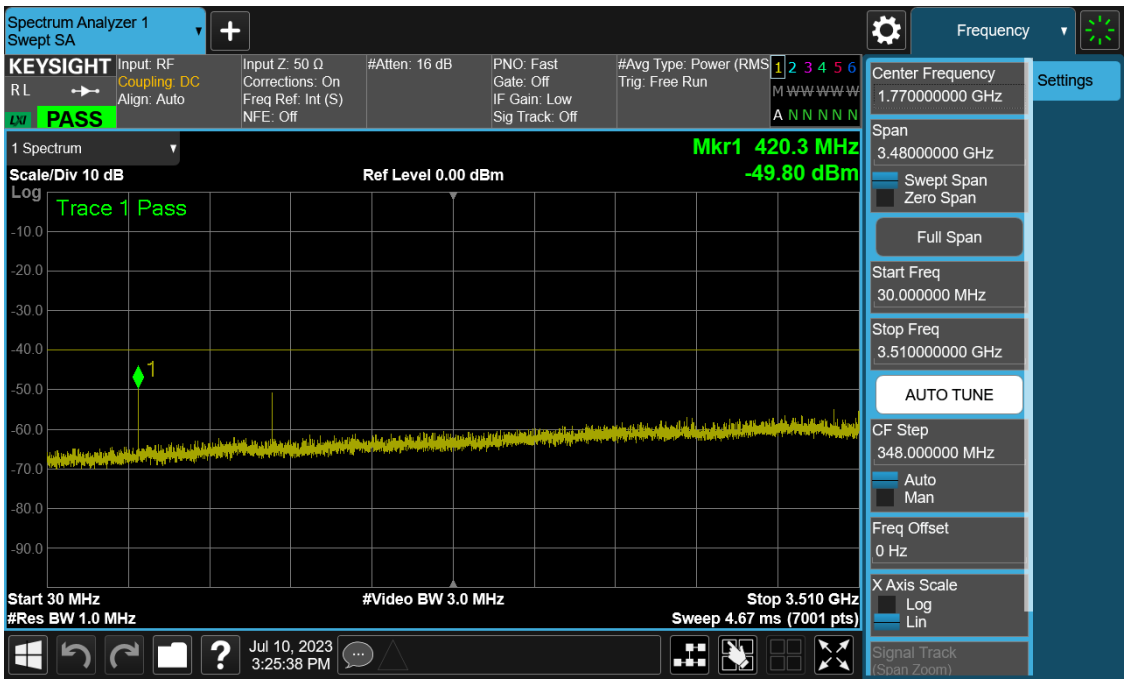
Test Notes

1. Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz.

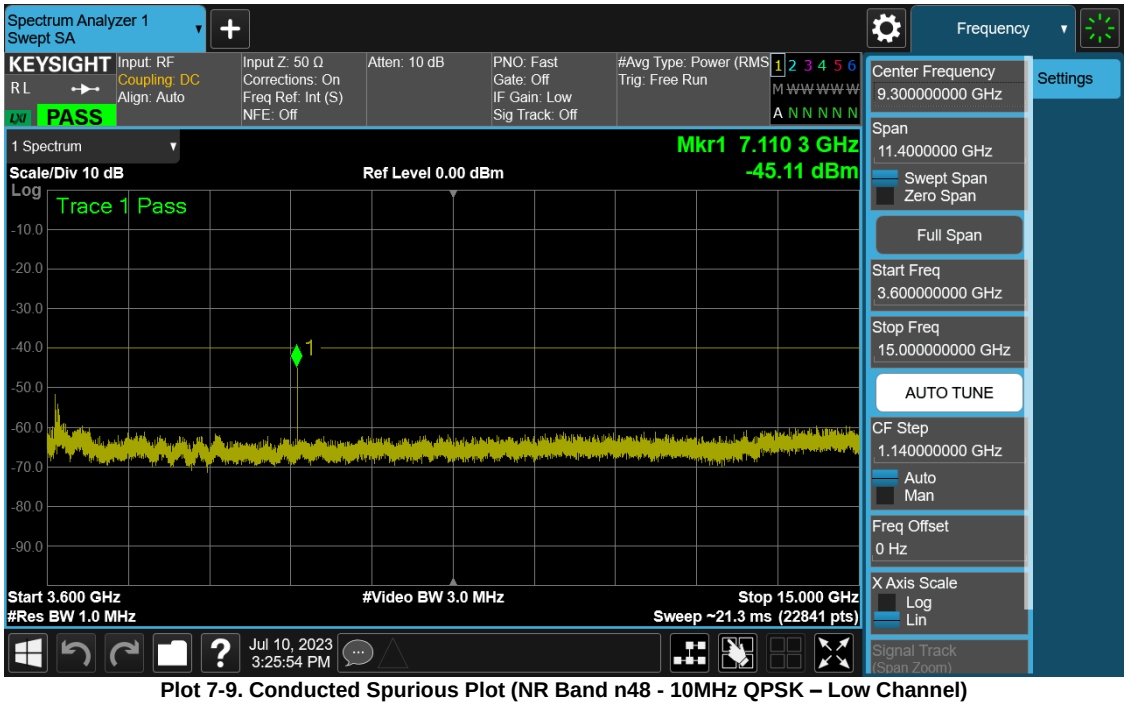
2. For NR operation, all subcarrier spacings (SCS) and transmission schemes (e.g. CP-OFDM and DFT-s-OFDM) were investigated to determine the worst-case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

3. In this section, the UL-MIMO NR band n48 (Antenna 1 and Antenna 3) plots has a 3dB correction applied to the individual plots to address the MIMO requirements in ANSI C63.26.

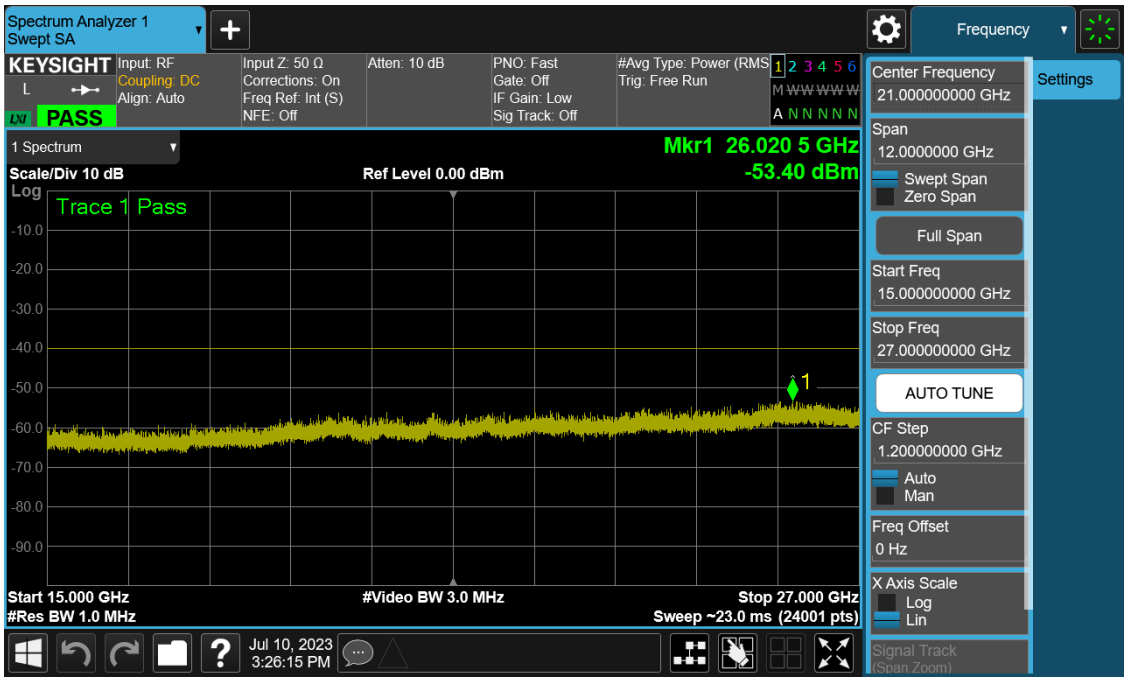
NR Band n48



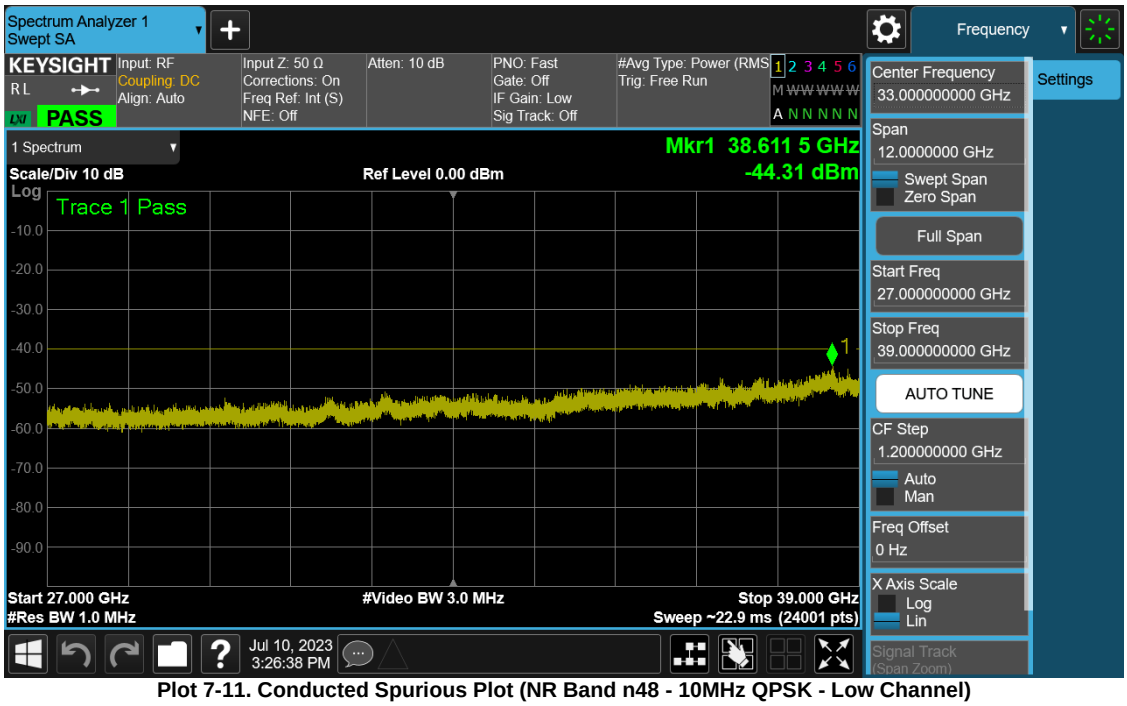
Plot 7-8. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK – Low Channel)



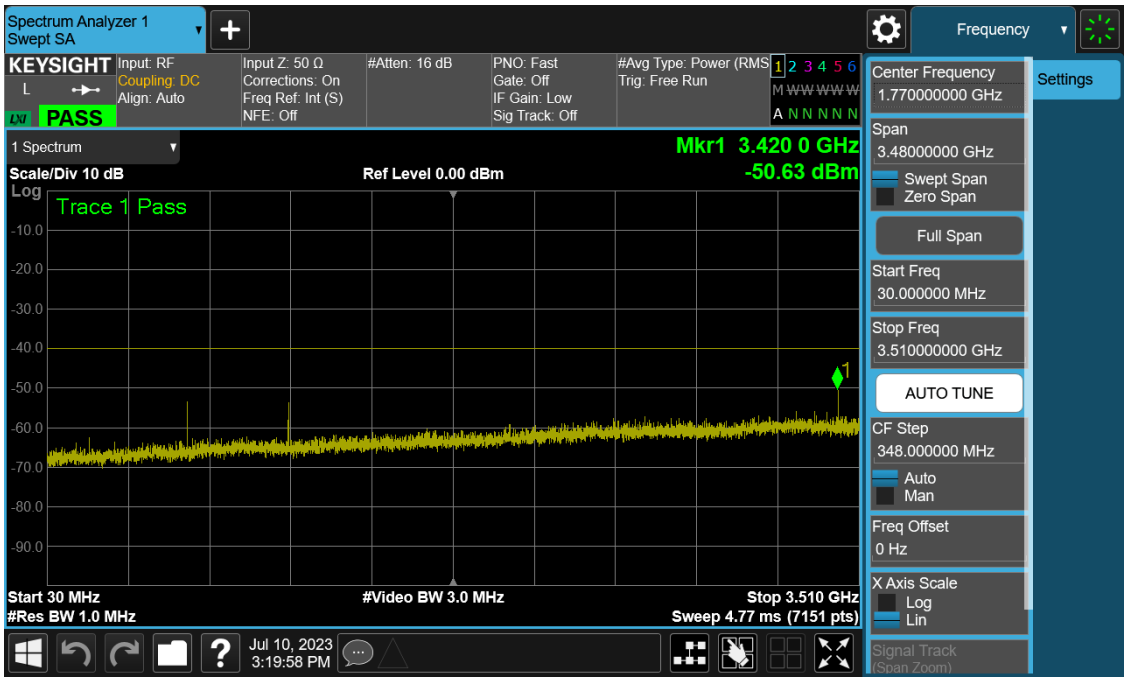
Plot 7-9. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK – Low Channel)



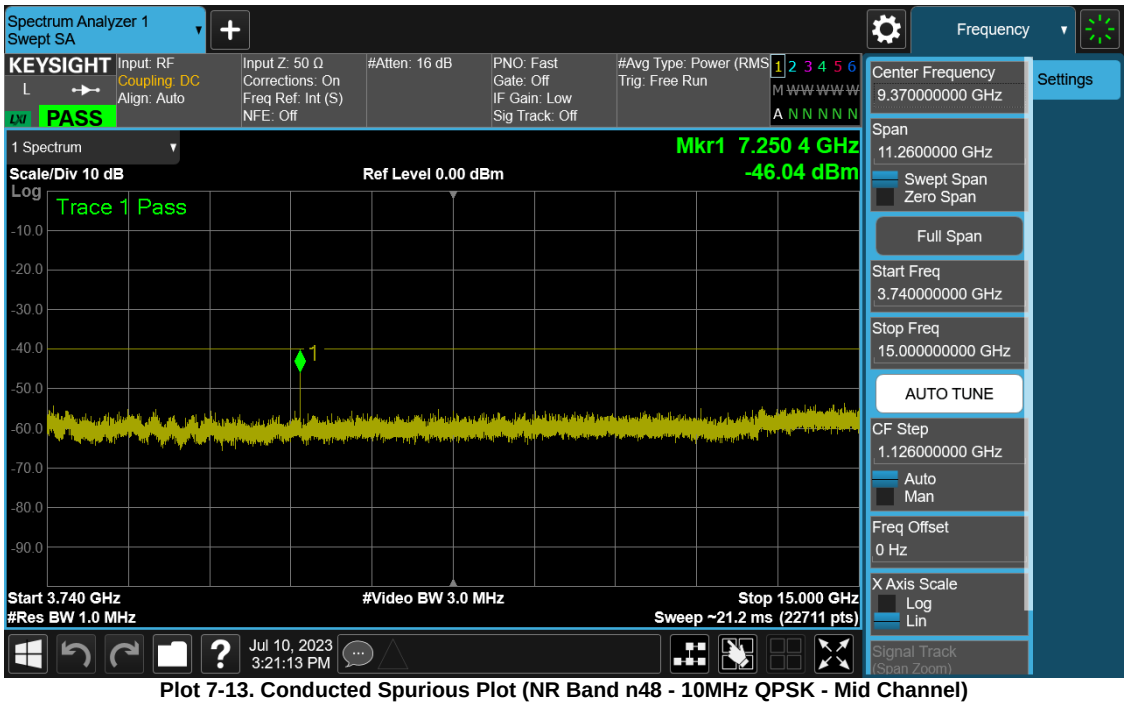
Plot 7-10. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Low Channel)



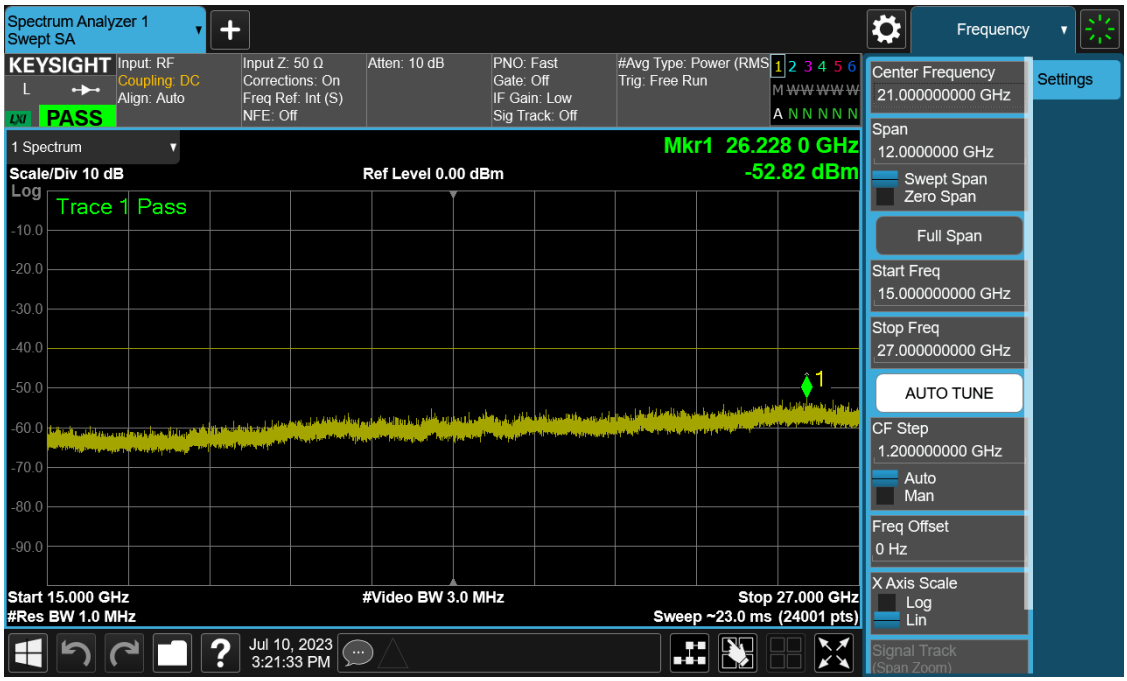
Plot 7-11. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Low Channel)



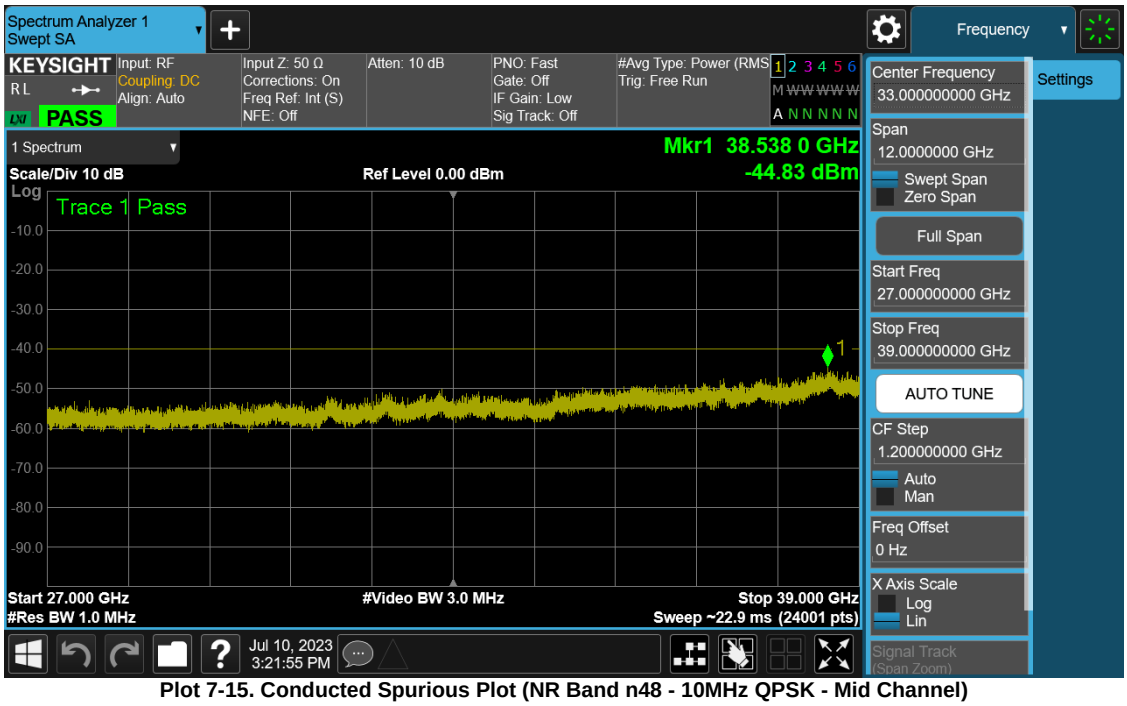
Plot 7-12. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



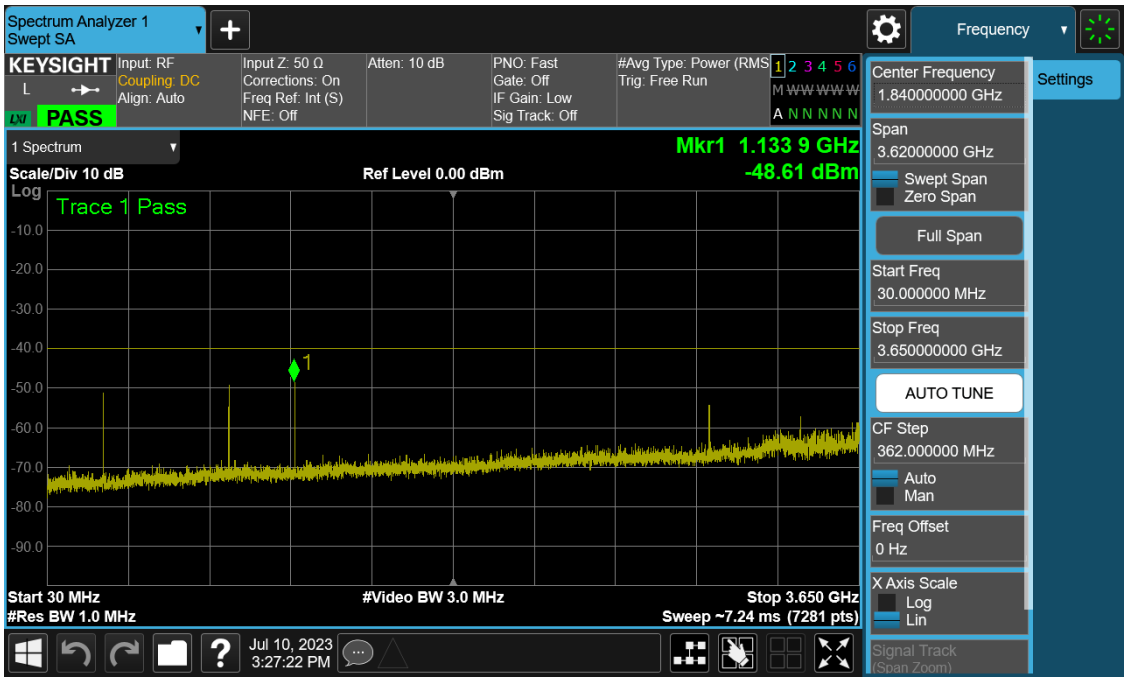
Plot 7-13. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



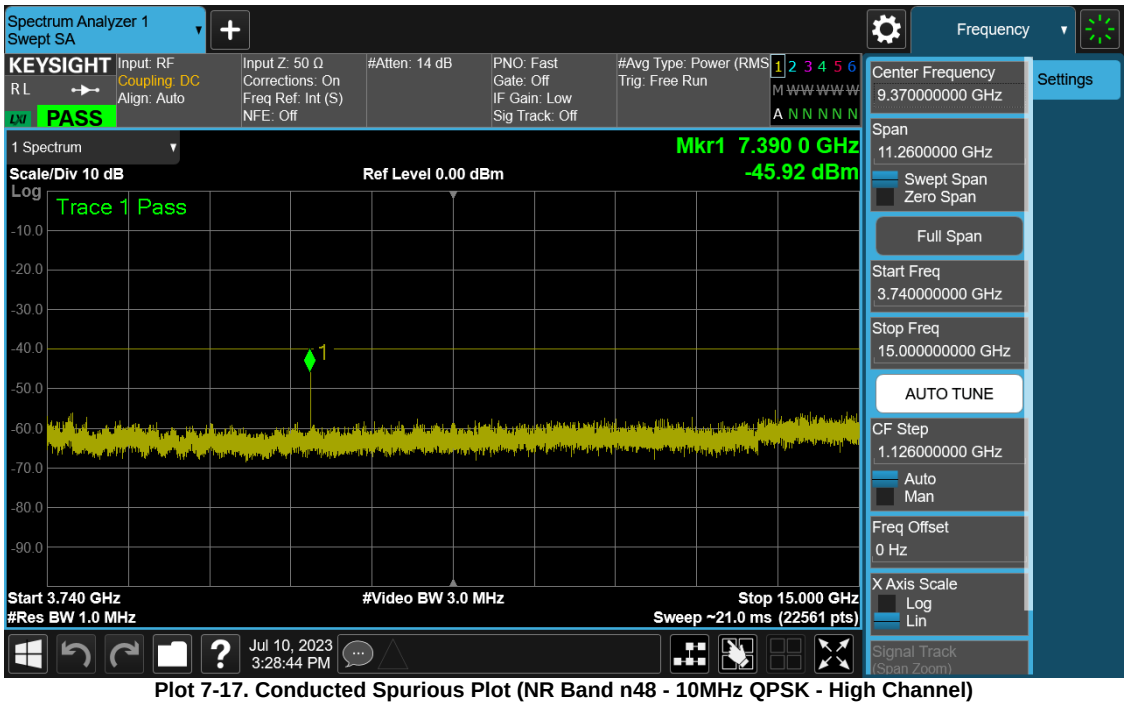
Plot 7-14. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



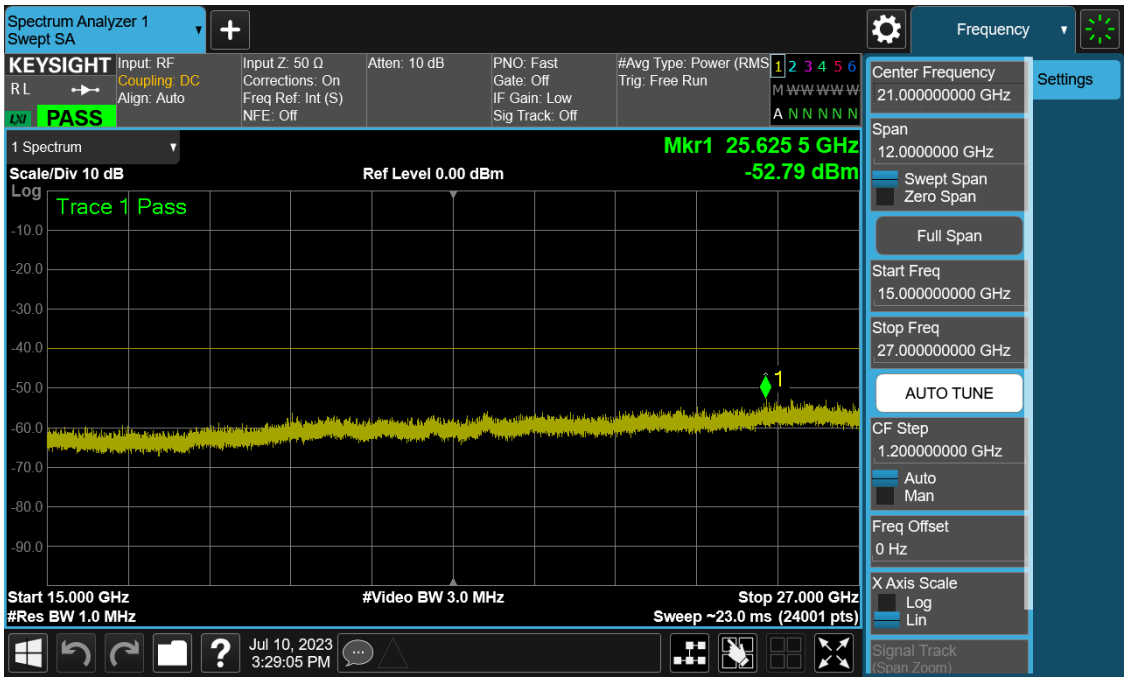
Plot 7-15. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



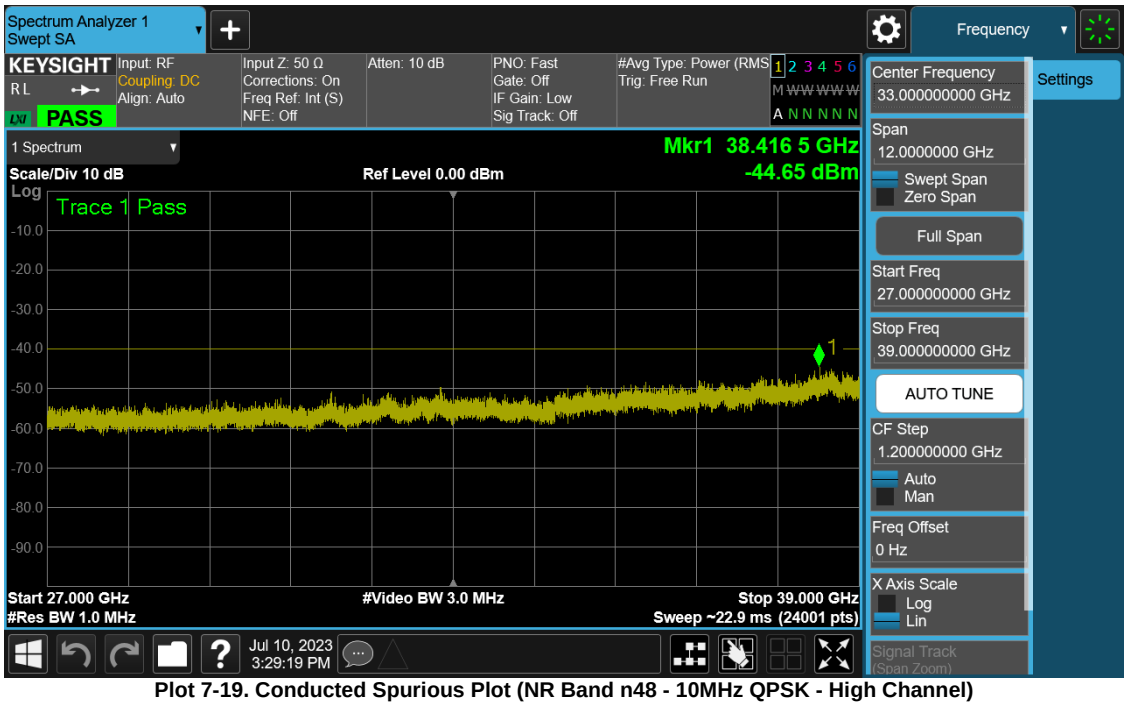
Plot 7-16. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)



Plot 7-17. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)

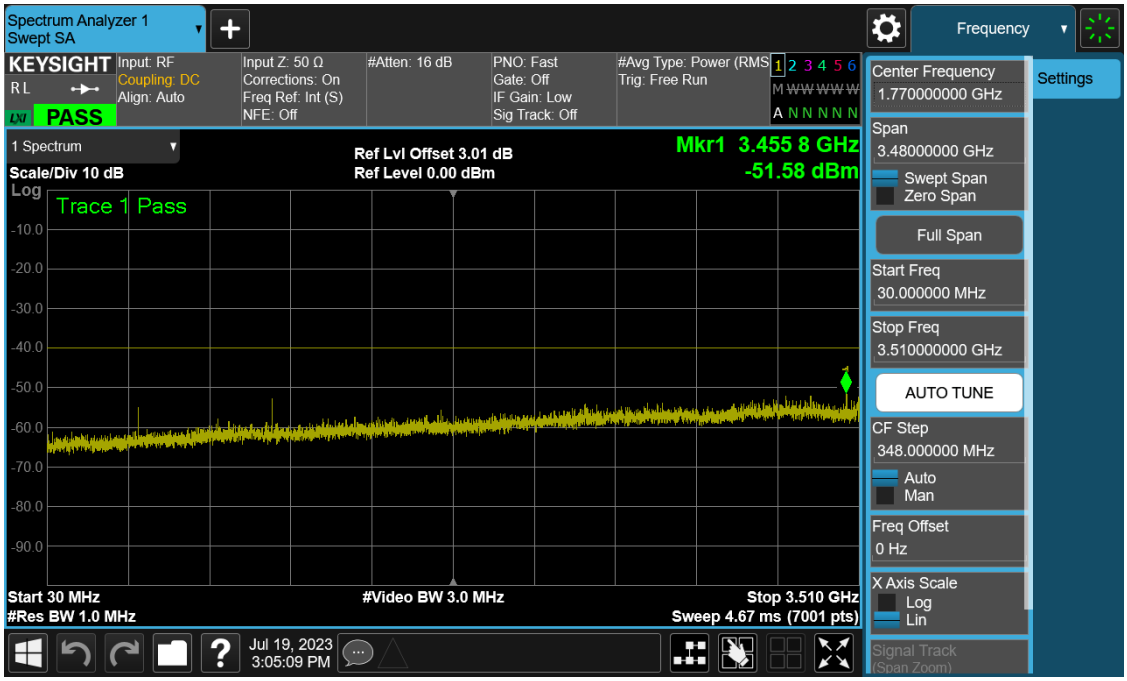


Plot 7-18. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)

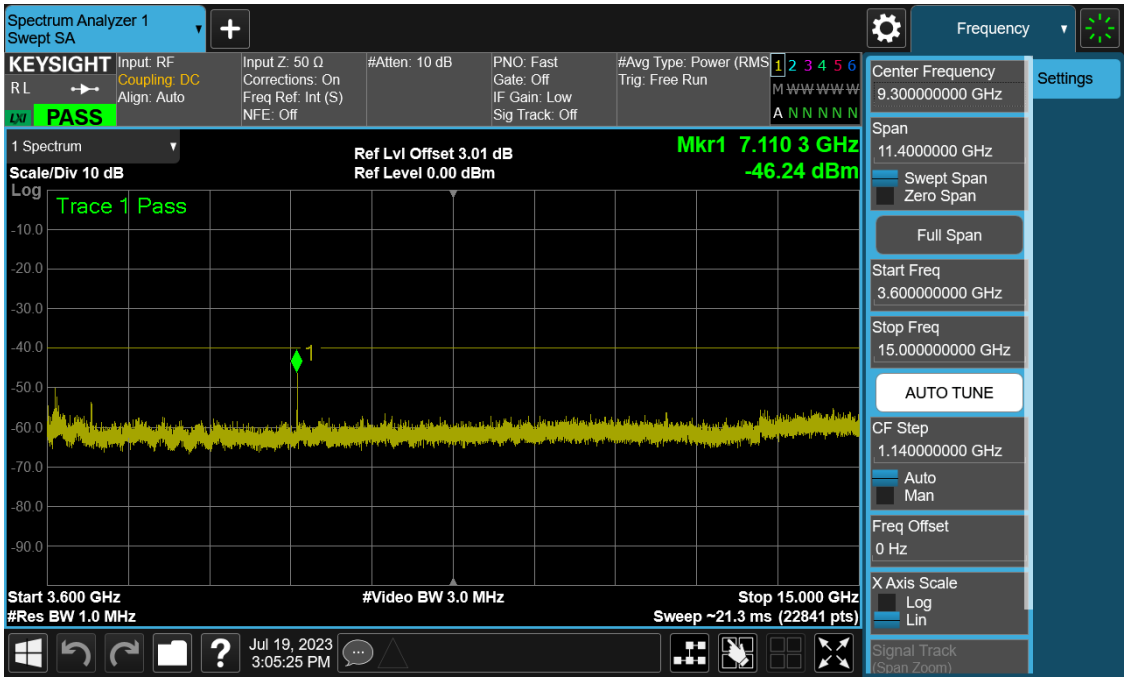


Plot 7-19. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)

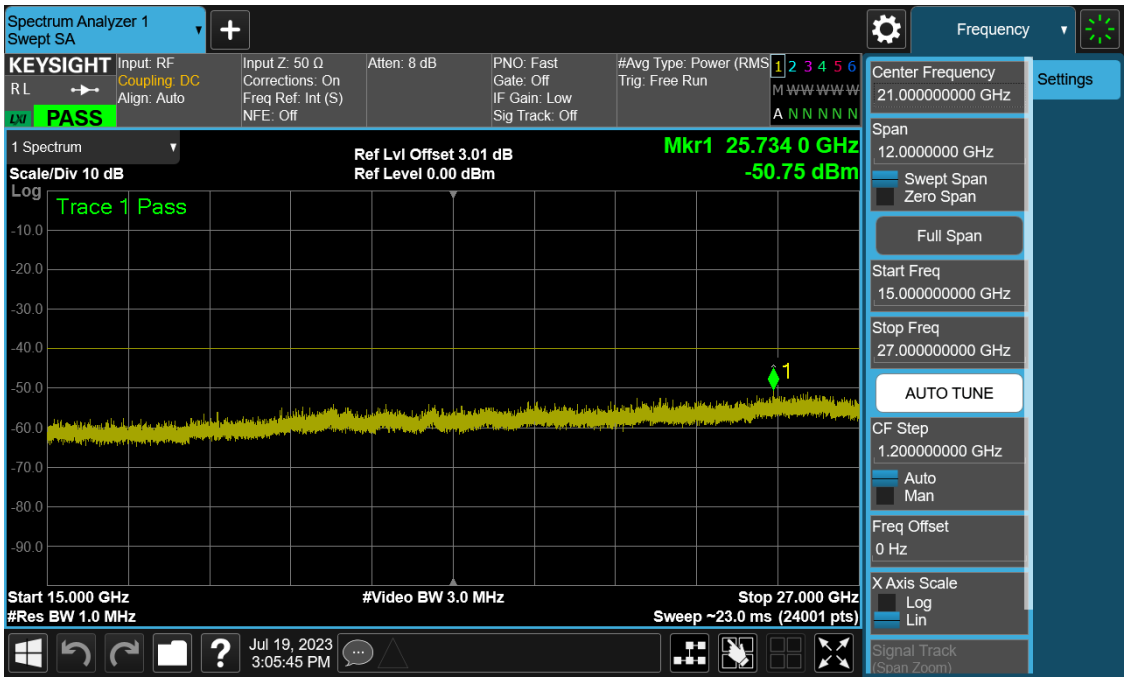
UL-MIMO NR Band n48 – Antenna 1



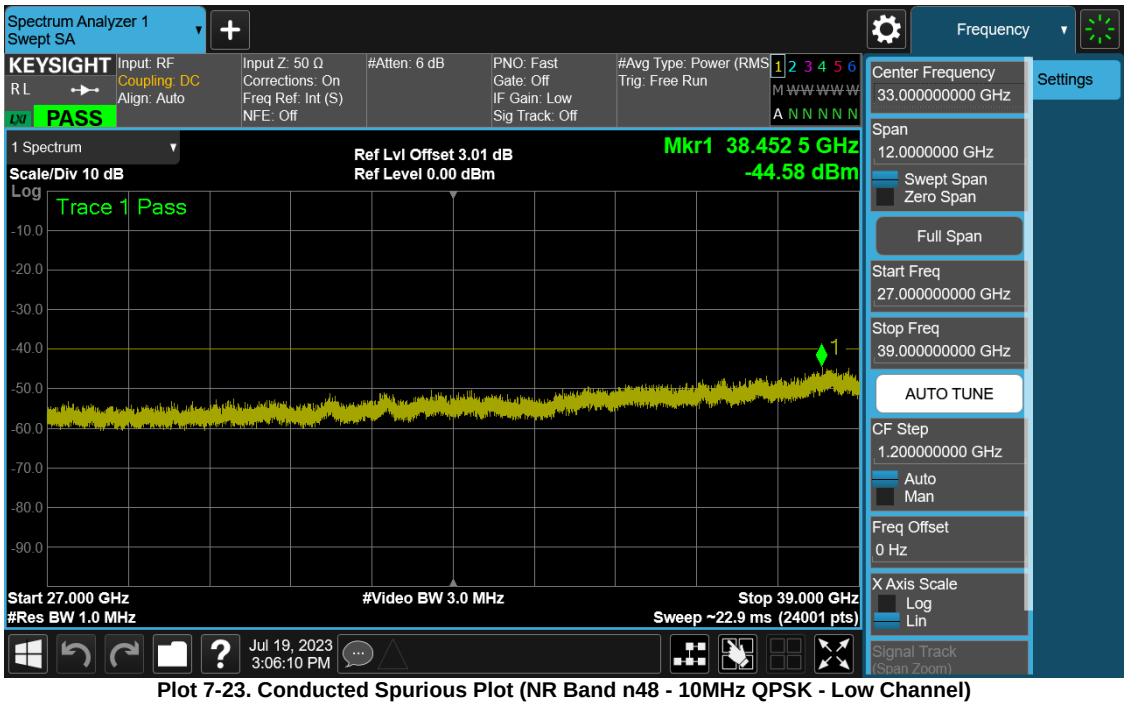
Plot 7-20. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK – Low Channel)



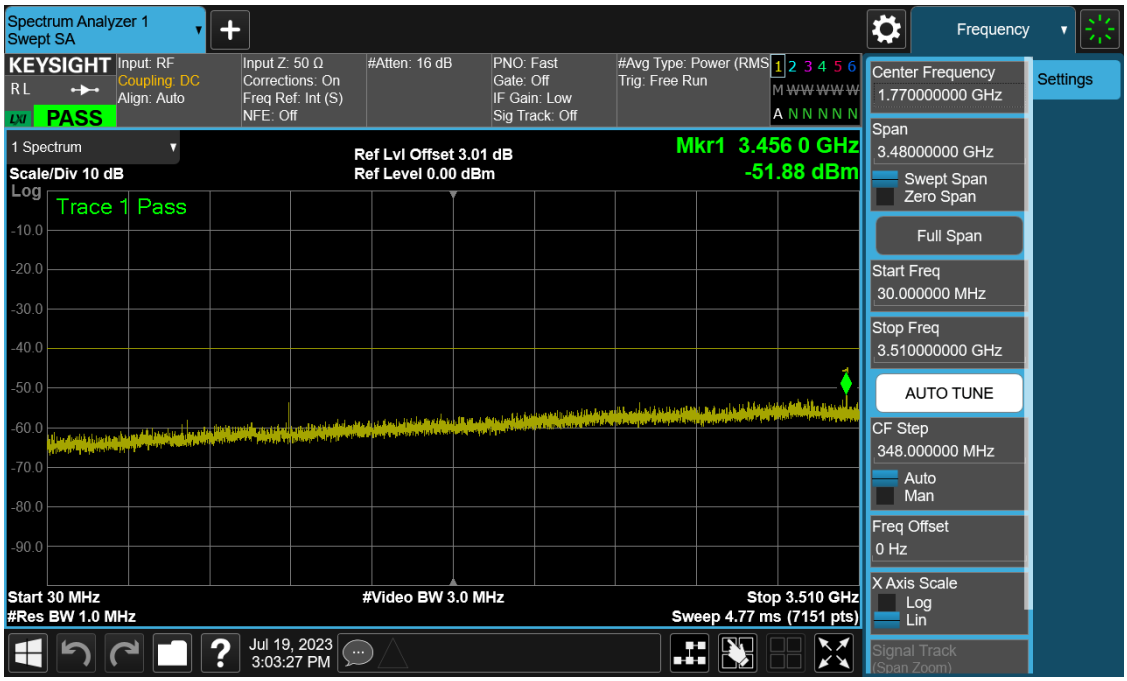
Plot 7-21. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK – Low Channel)



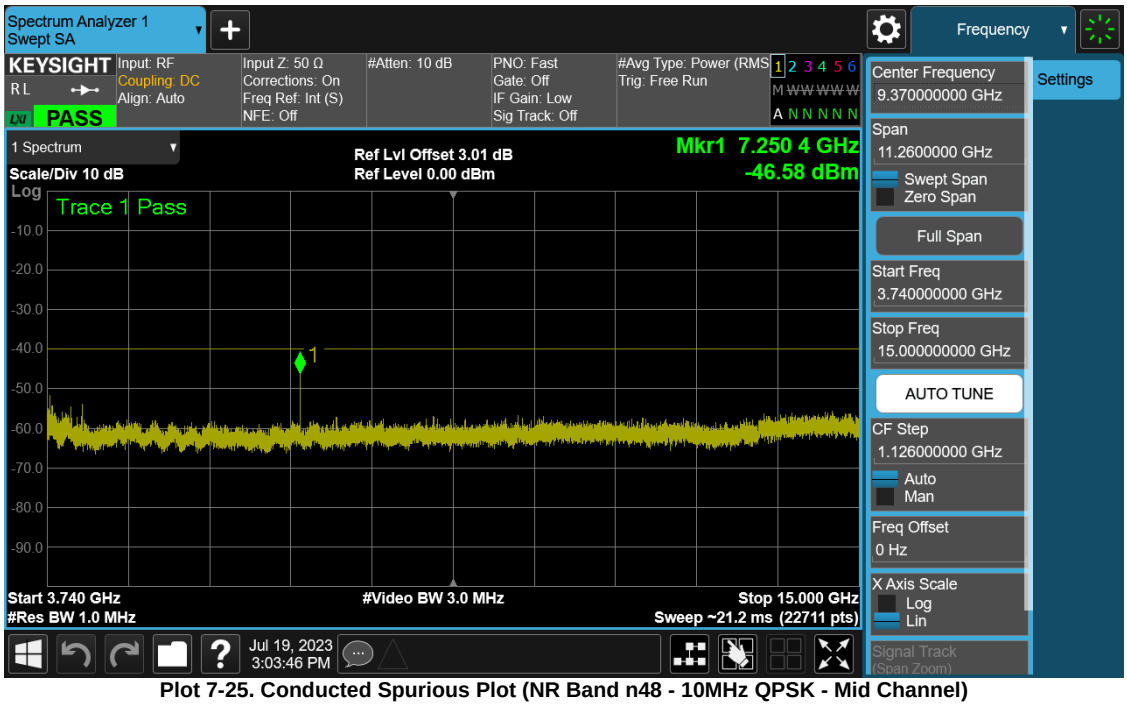
Plot 7-22. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Low Channel)



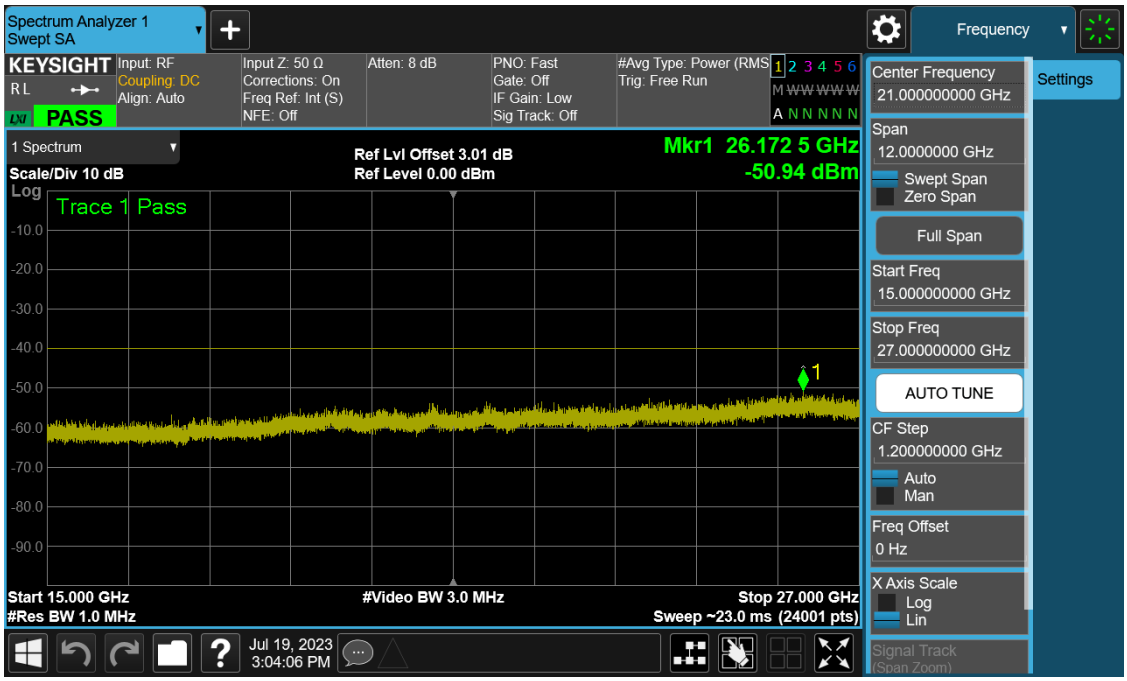
Plot 7-23. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Low Channel)



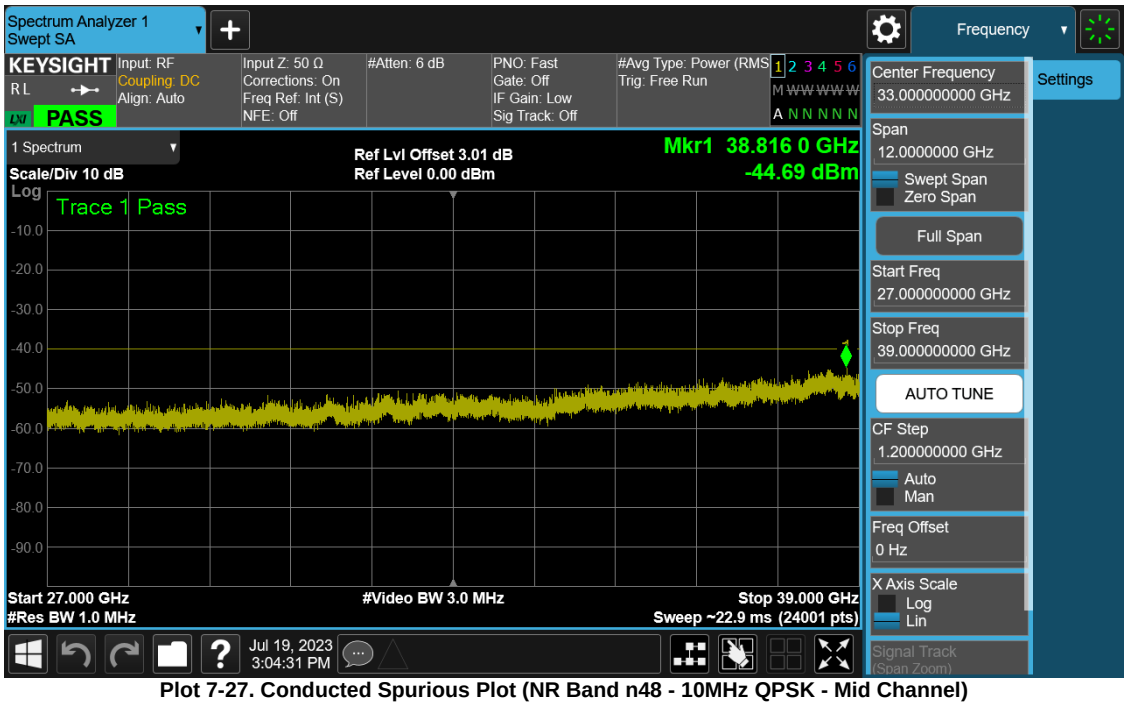
Plot 7-24. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



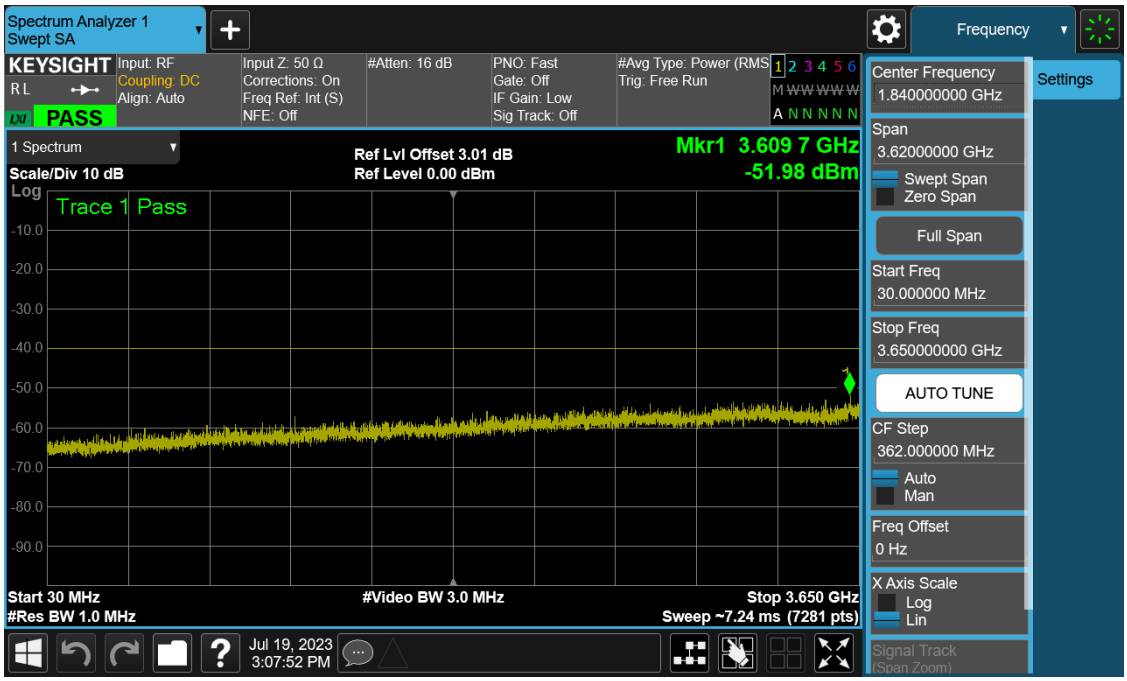
Plot 7-25. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



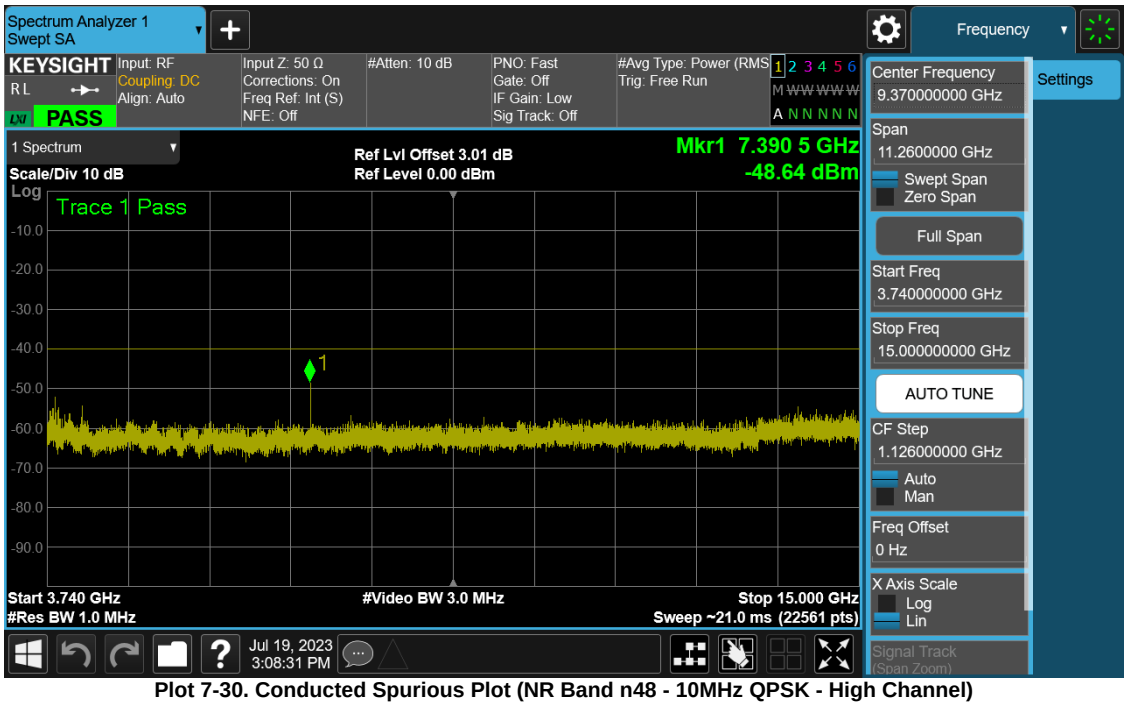
Plot 7-26. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



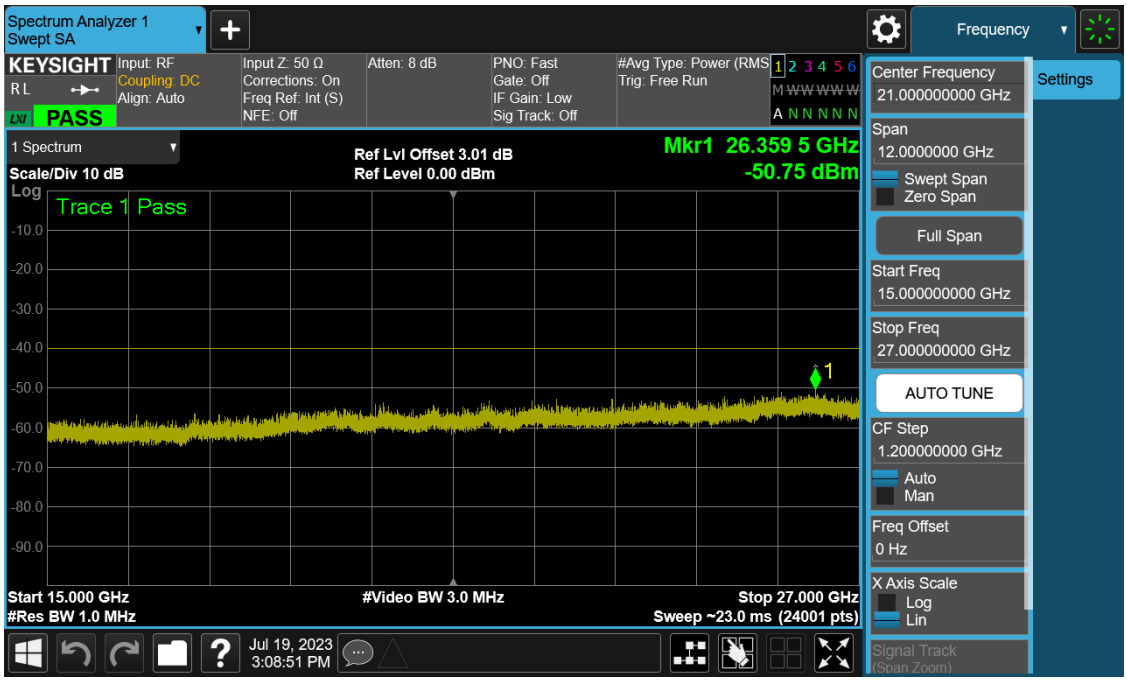
Plot 7-27. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



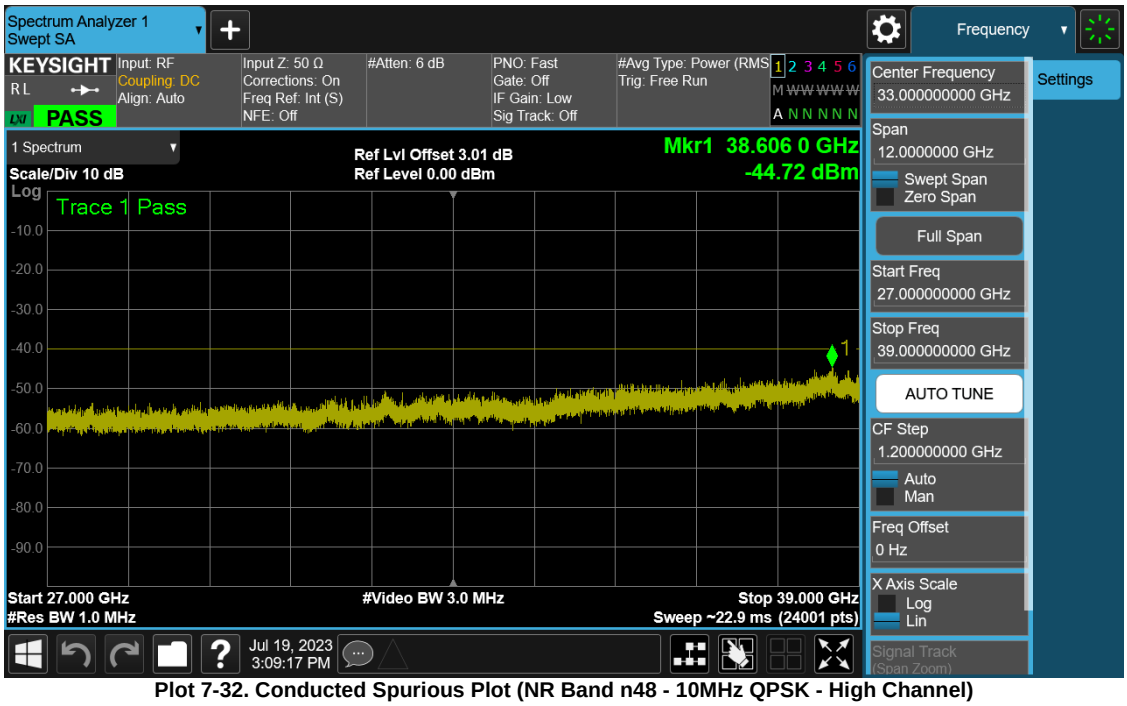
Plot 7-29. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)



Plot 7-30. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)

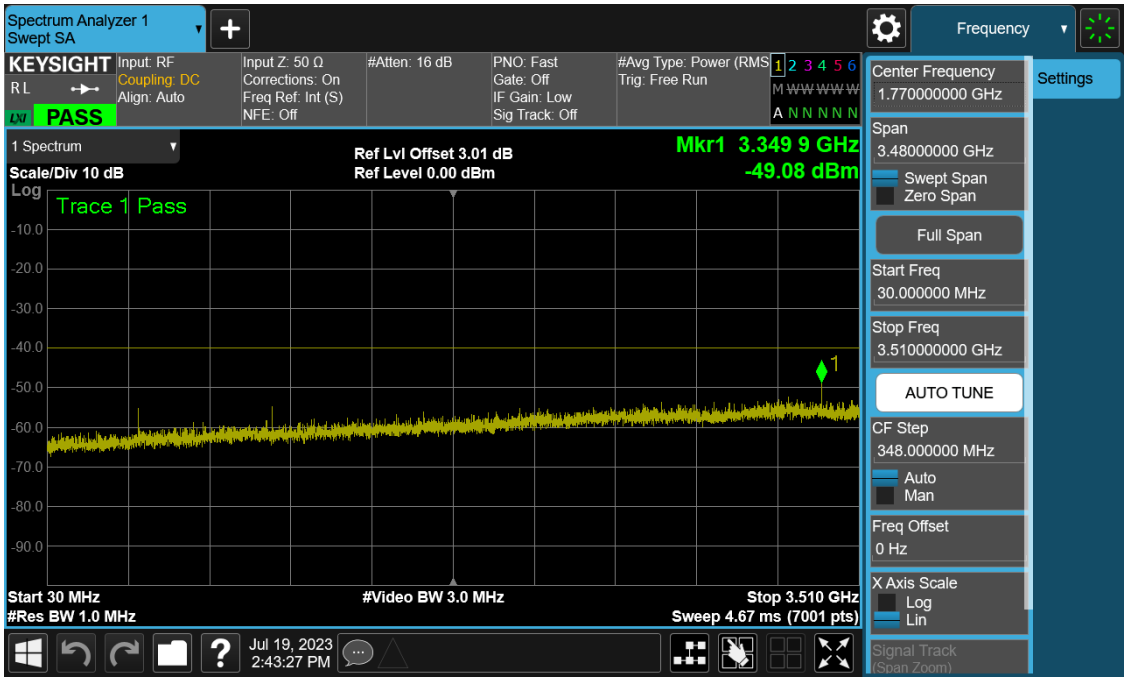


Plot 7-31. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)

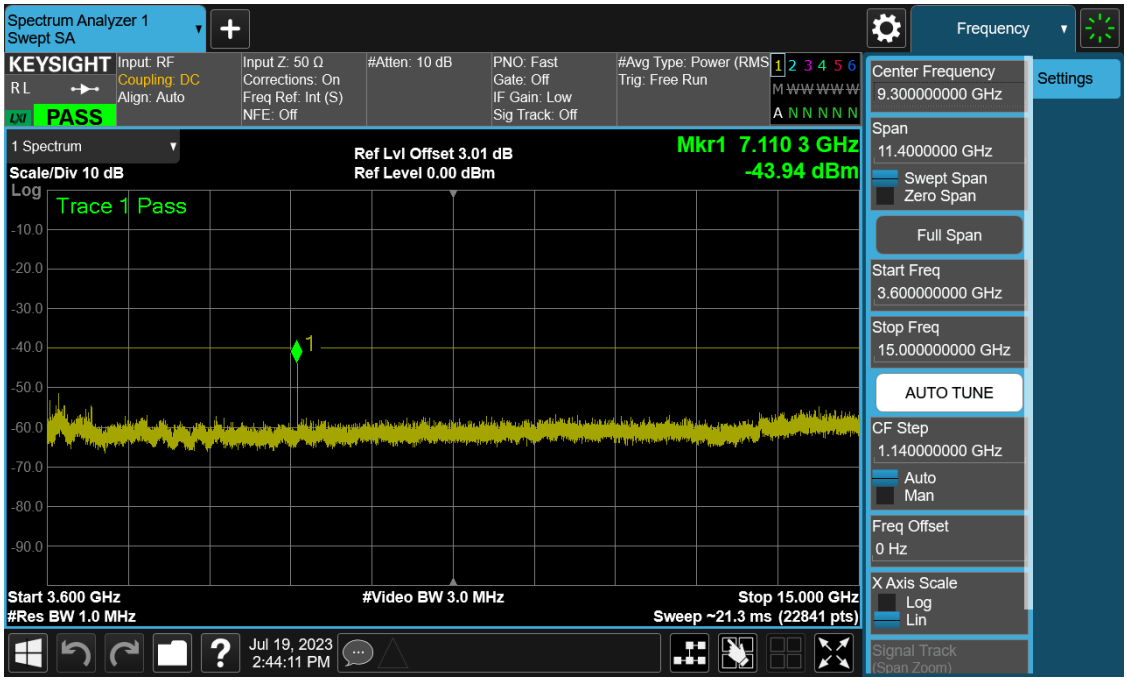


Plot 7-32. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)

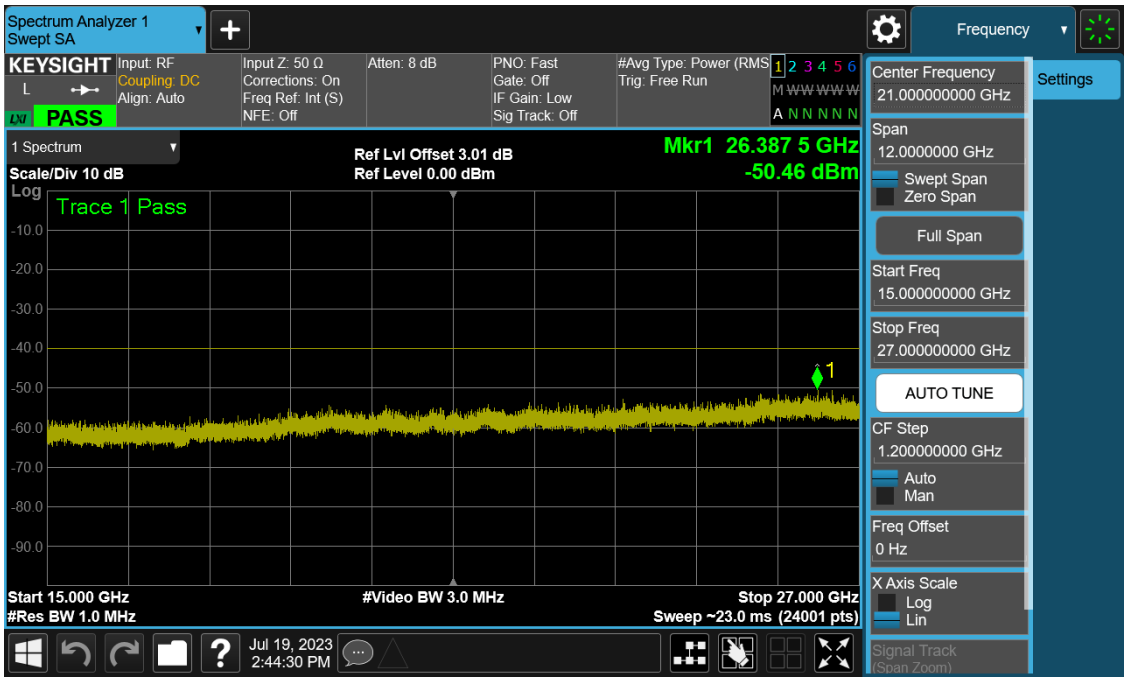
UL-MIMO NR Band n48 – Antenna 3



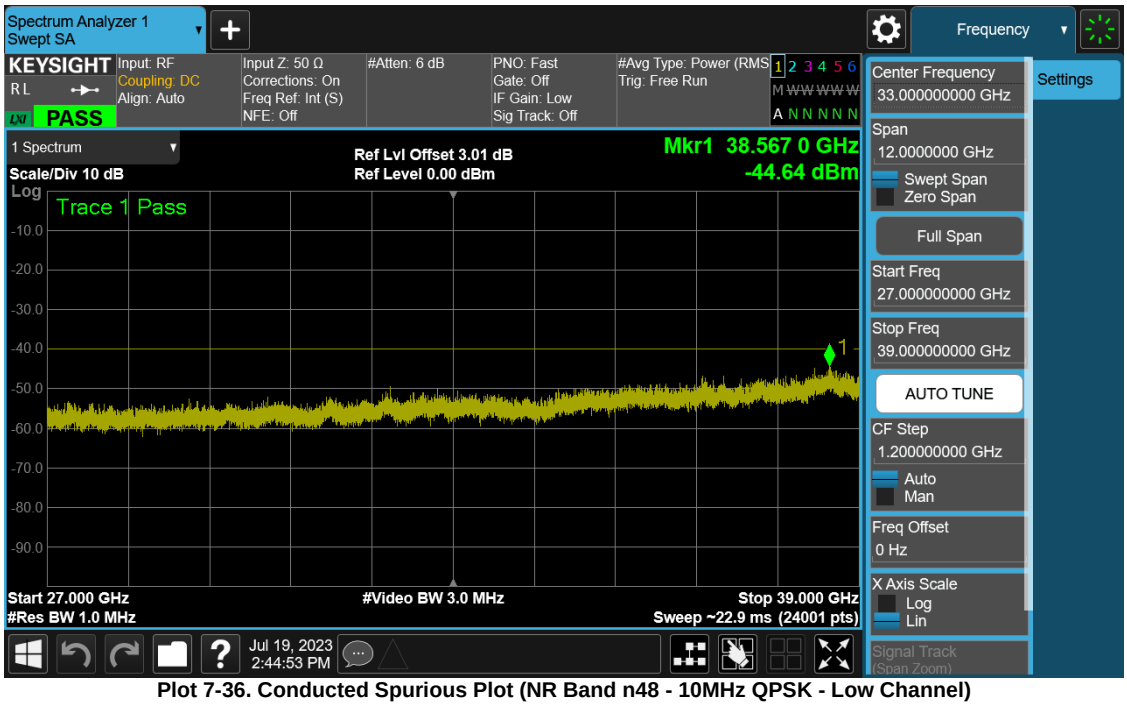
Plot 7-33. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK – Low Channel)



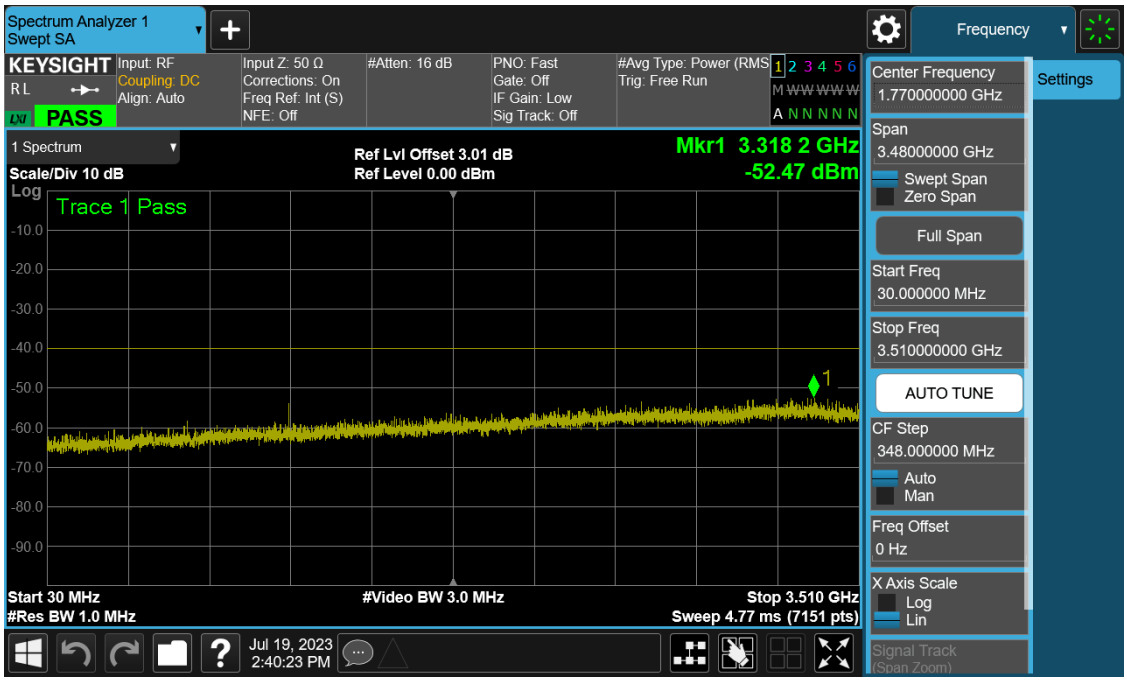
Plot 7-34. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK – Low Channel)



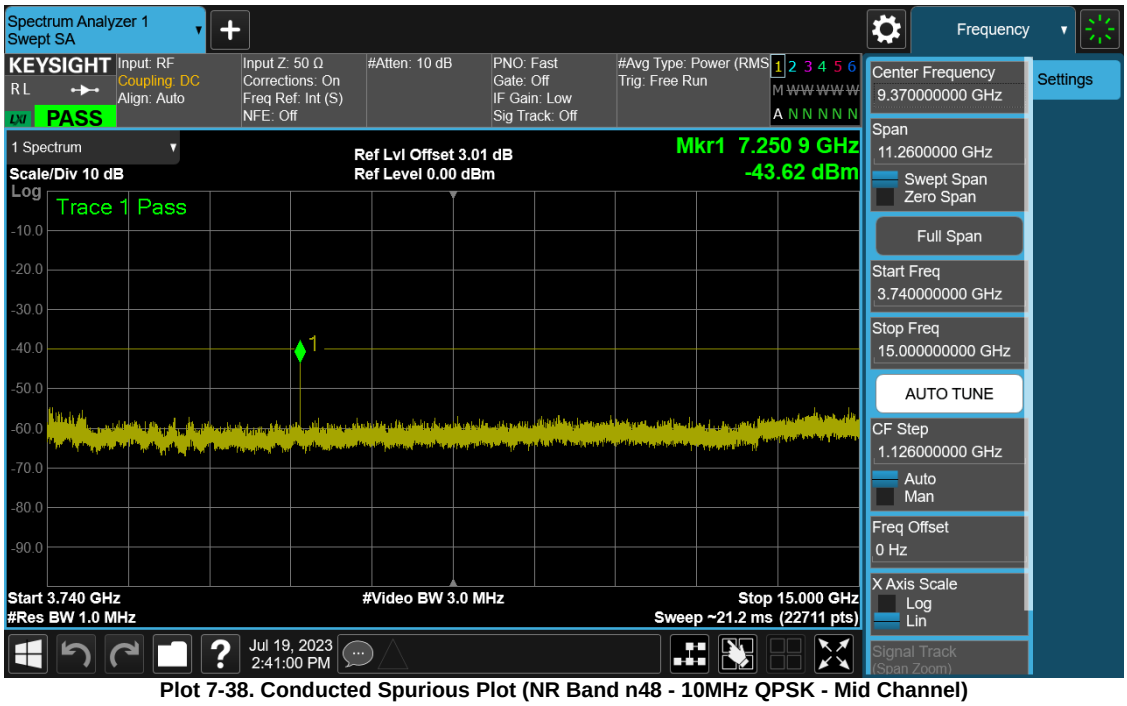
Plot 7-35. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Low Channel)



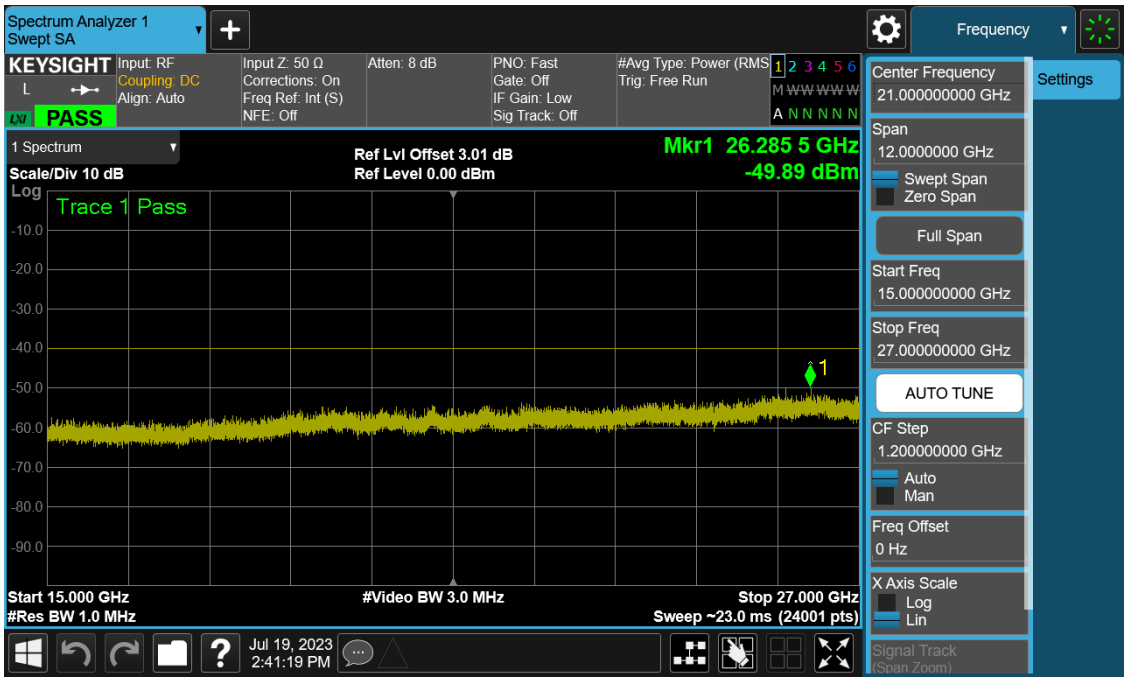
Plot 7-36. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Low Channel)



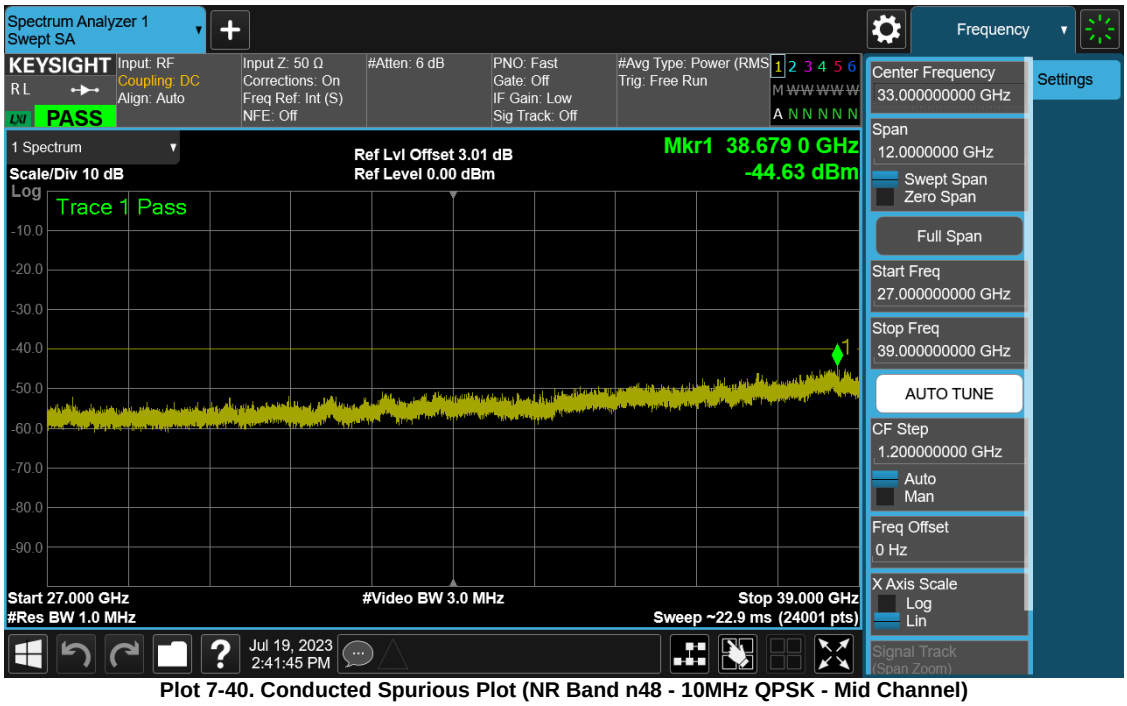
Plot 7-37. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



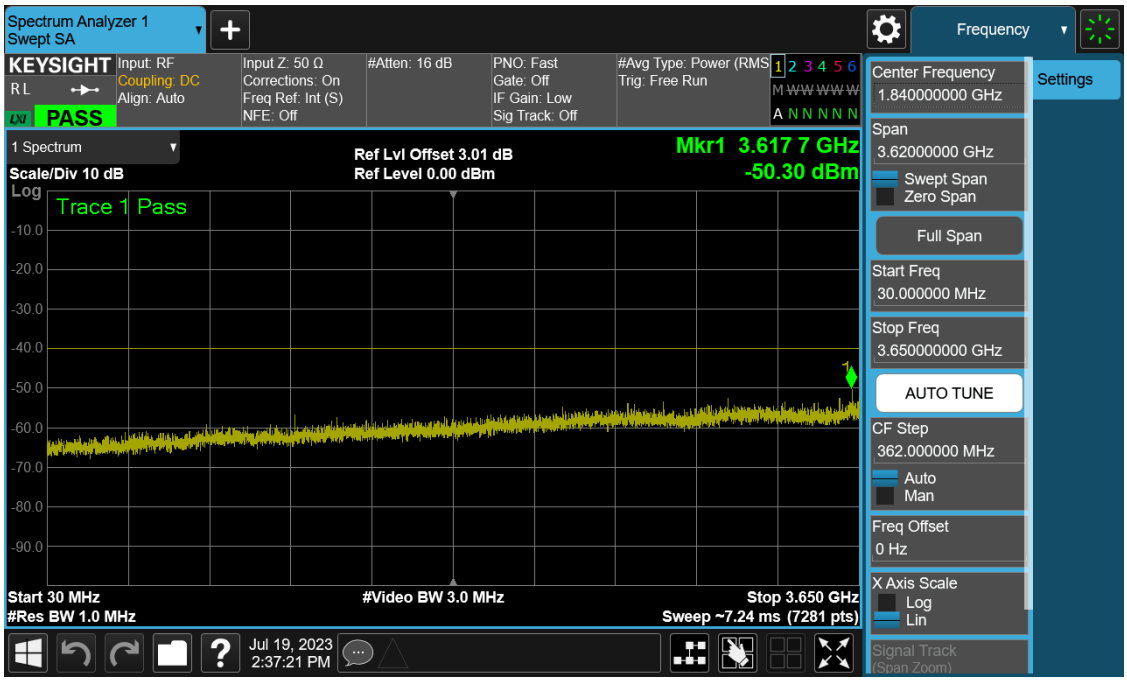
Plot 7-38. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



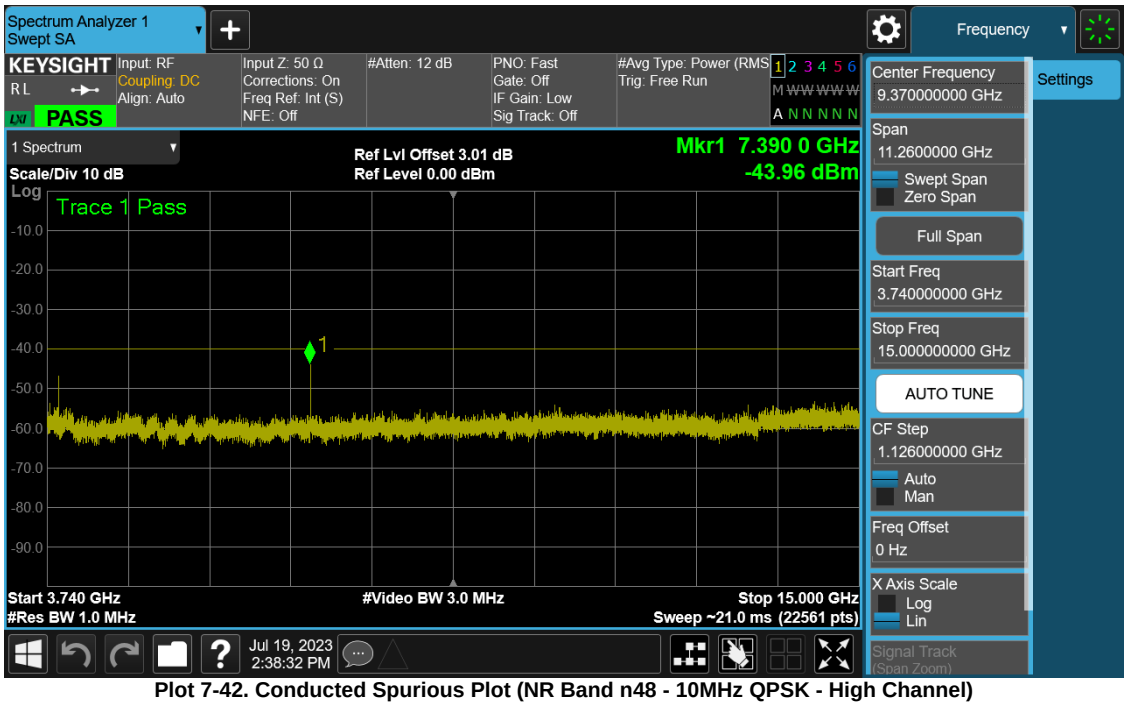
Plot 7-39. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



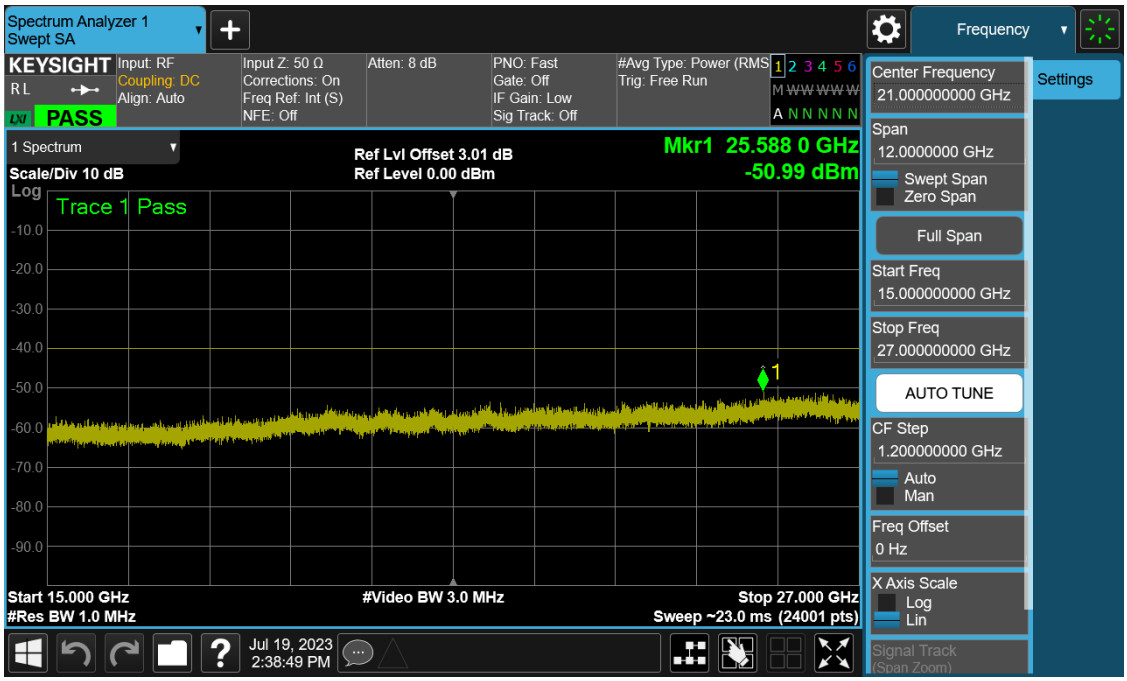
Plot 7-40. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



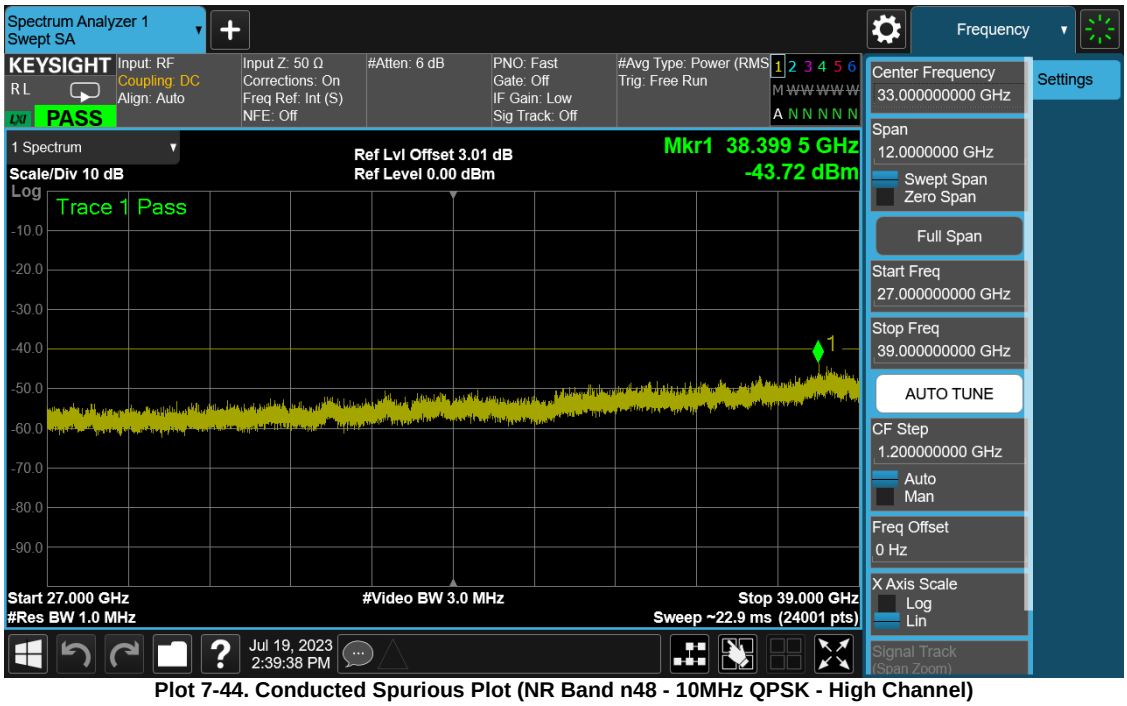
Plot 7-41. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)



Plot 7-42. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)



Plot 7-43. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)



Plot 7-44. Conducted Spurious Plot (NR Band n48 - 10MHz QPSK - High Channel)

7.5 Band Edge Emissions at Antenna Terminal

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

For an End User Device, the conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed −13 dBm/MHz within 0 to B MHz (where B is the bandwidth in MHz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B MHz below the lower CBSD-assigned channel edge. At all frequencies greater than B MHz above the upper CBSD assigned channel edge and less than B MHz below the lower CBSD-assigned channel edge, the conducted power of any end user device emission shall not exceed −25 dBm/MHz. The conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.3

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW ≥ 1% of the emission bandwidth
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

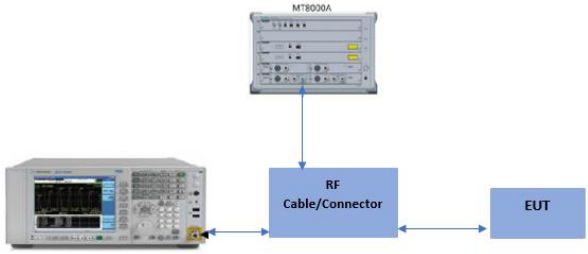


Figure 7-4. Test Instrument & Measurement Setup

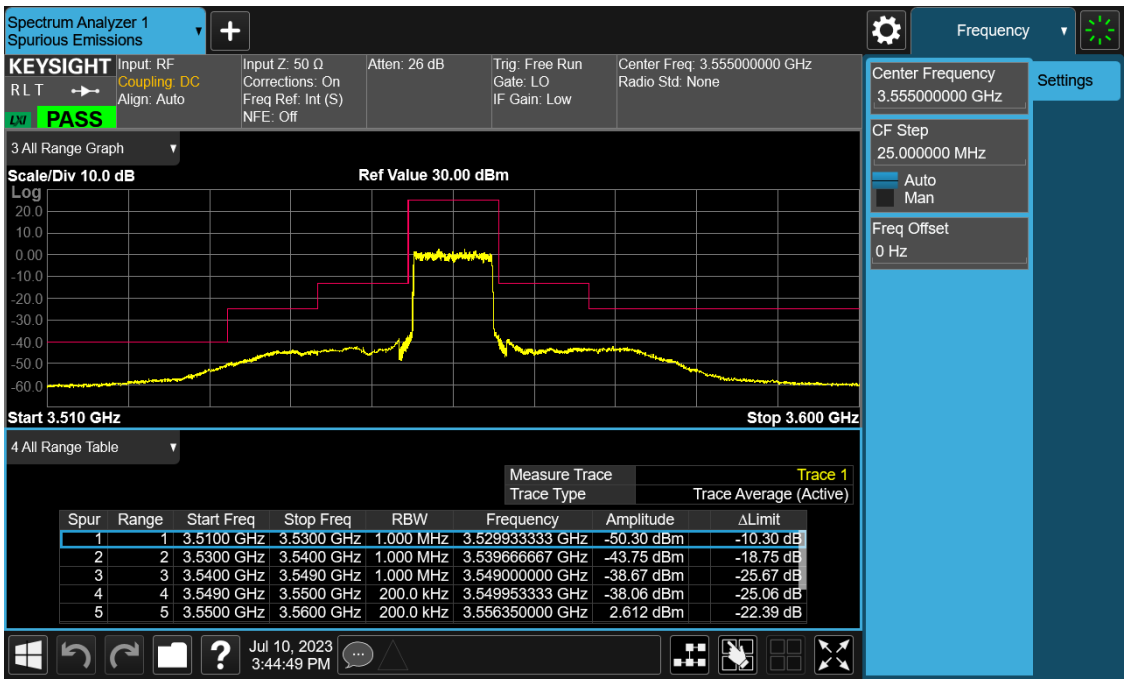
Test Notes

1. Per 96.41(e)(3)(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.

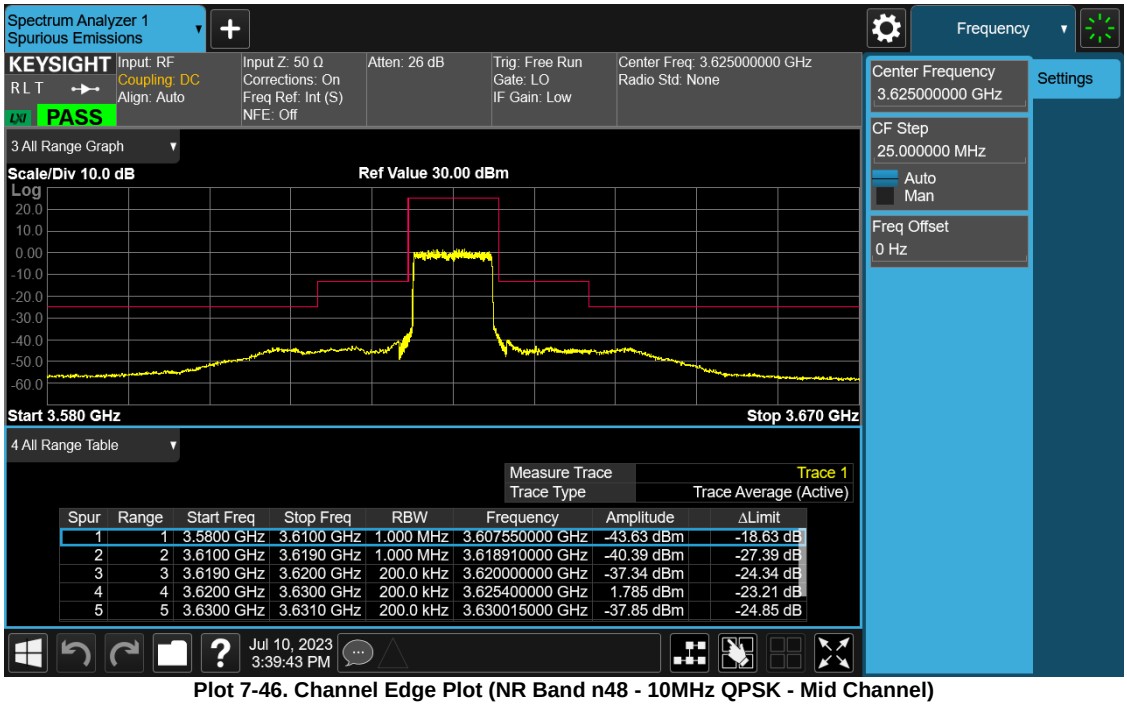
2. For NR operation, all subcarrier spacings (SCS) and transmission schemes (e.g. CP-OFDM and DFT-s-OFDM) were investigated to determine the worst-case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

3. In this section, the UL-MIMO NR band n48 (Antenna 1 and Antenna 3) plots has a 3dB correction applied to the individual plots to address the MIMO requirements in ANSI C63.26.

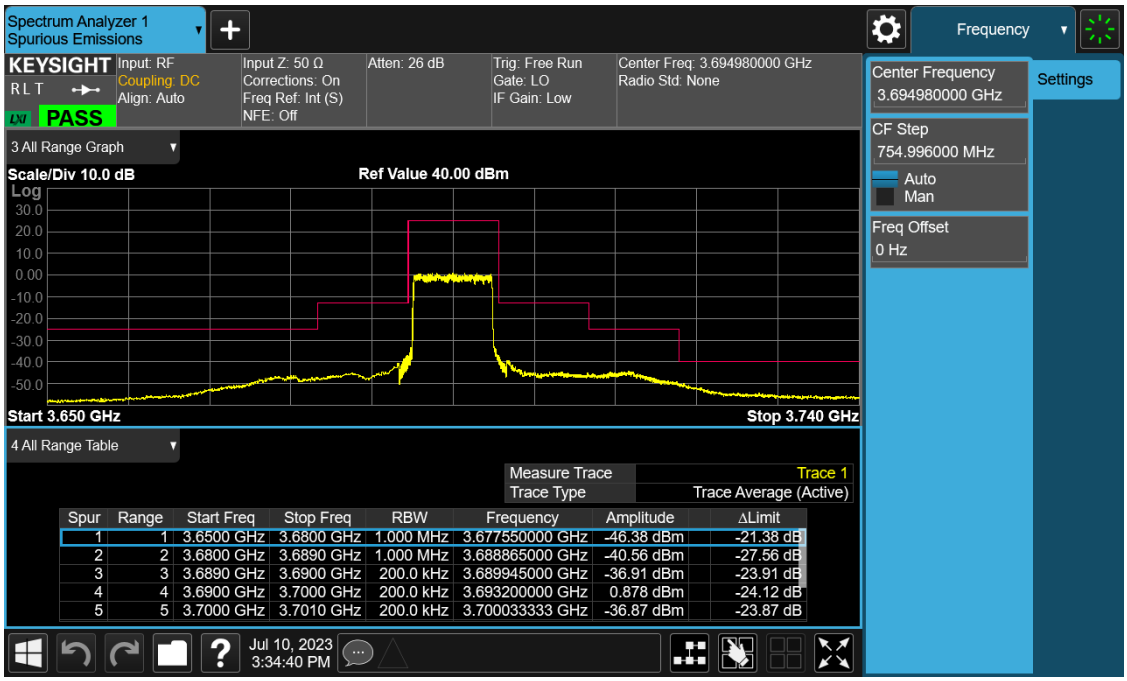
NR Band n48



Plot 7-45. Channel Edge Plot (NR Band n48 - 10MHz QPSK - Low Channel)

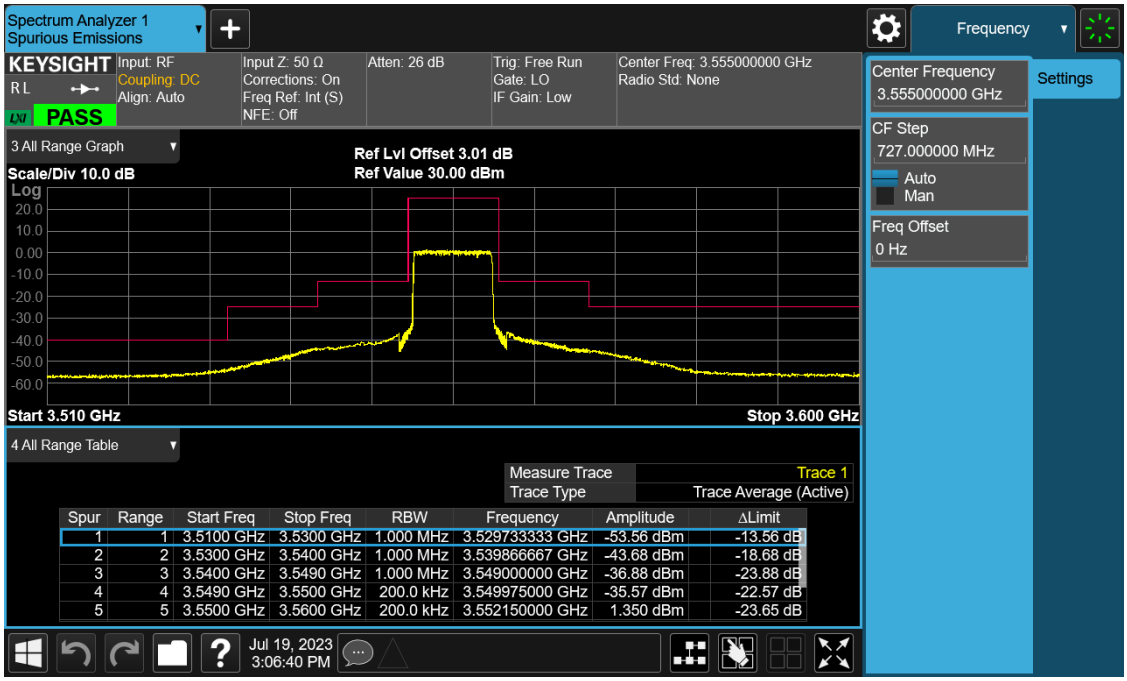


Plot 7-46. Channel Edge Plot (NR Band n48 - 10MHz QPSK - Mid Channel)

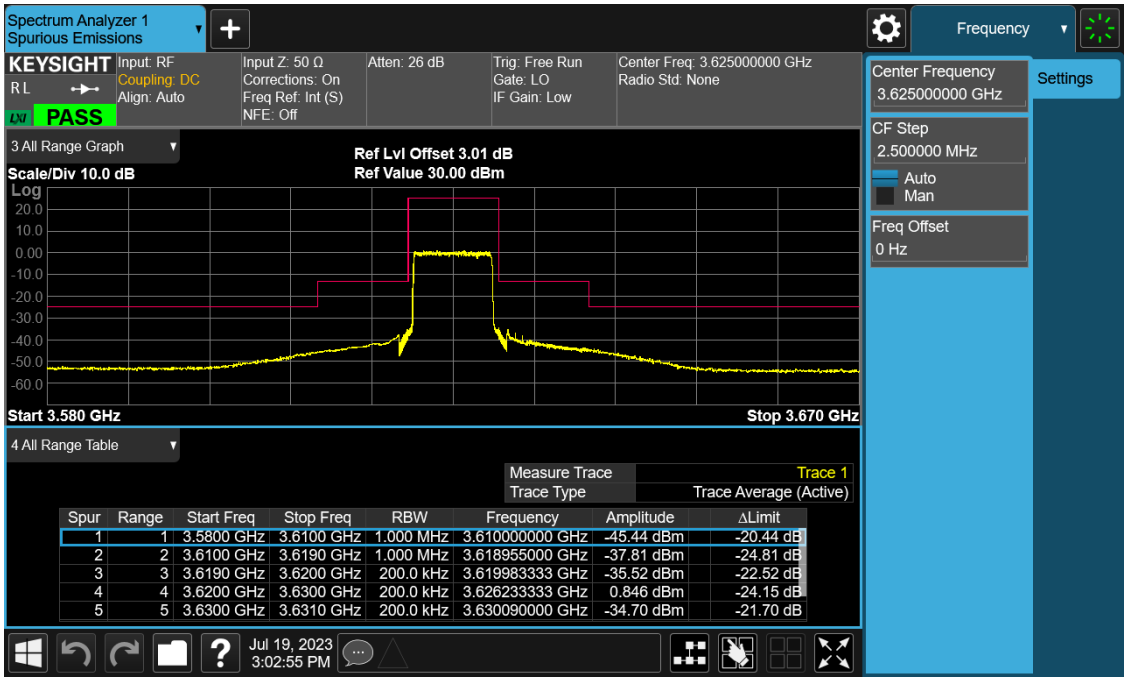


Plot 7-47. Channel Edge Plot (NR Band n48 - 10MHz QPSK - High Channel)

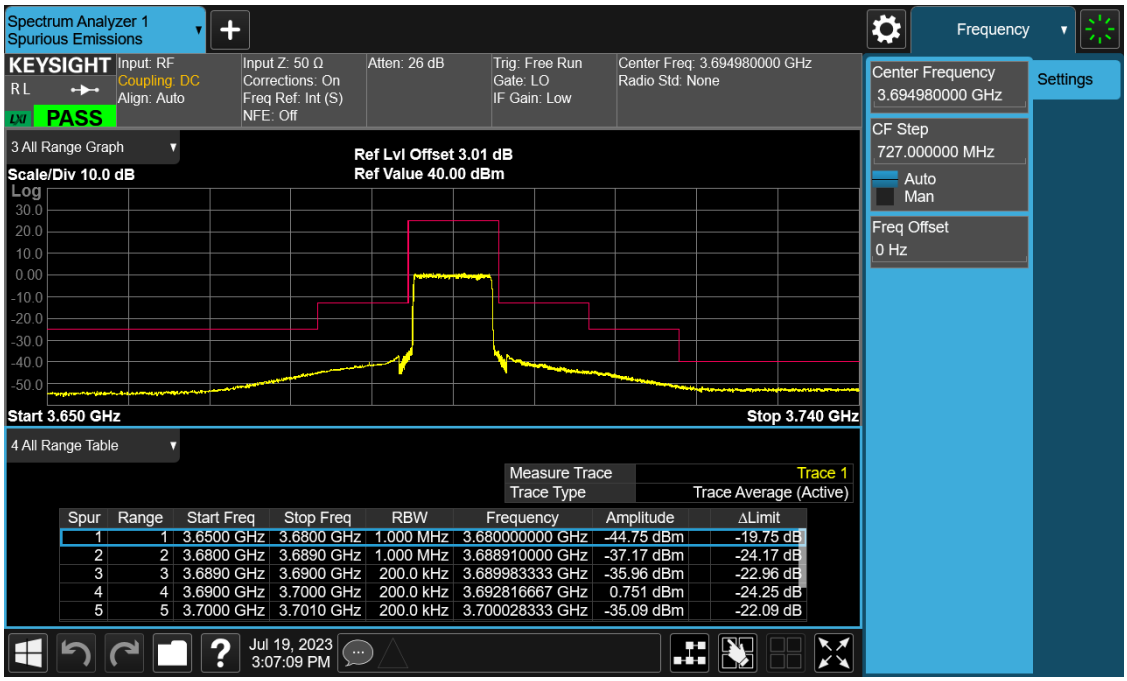
UL-MIMO NR Band n48 – Antenna 1



Plot 7-48. Channel Edge Plot (NR Band n48 - 10MHz QPSK - Low Channel)

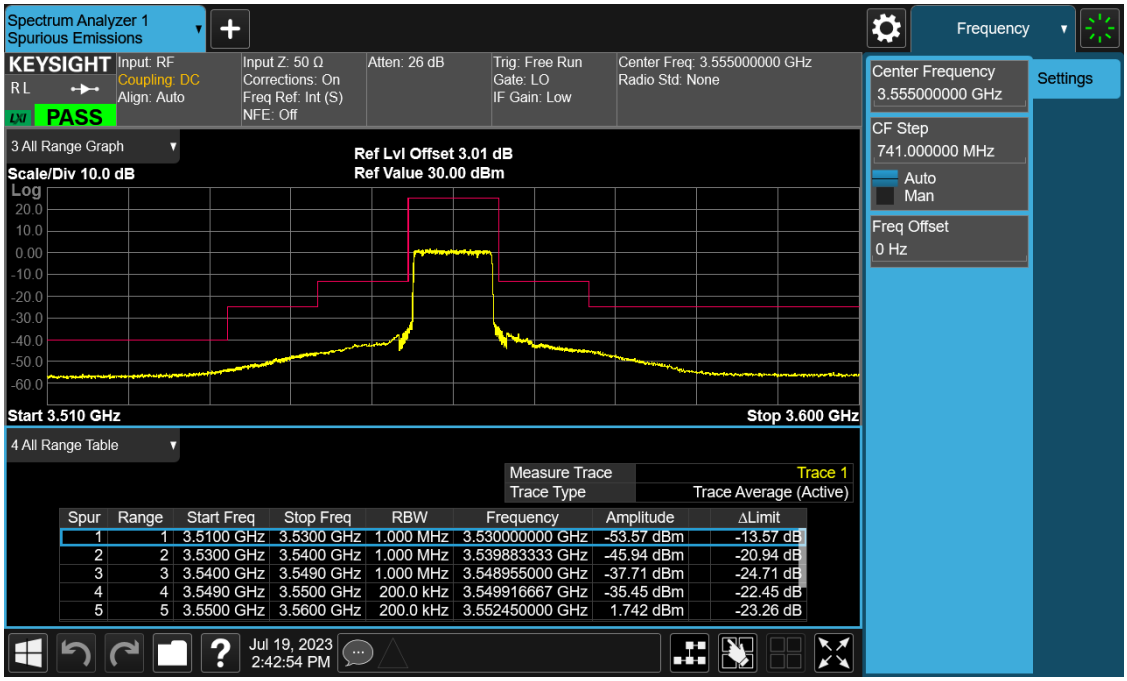


Plot 7-49. Channel Edge Plot (NR Band n48 - 10MHz QPSK - Mid Channel)

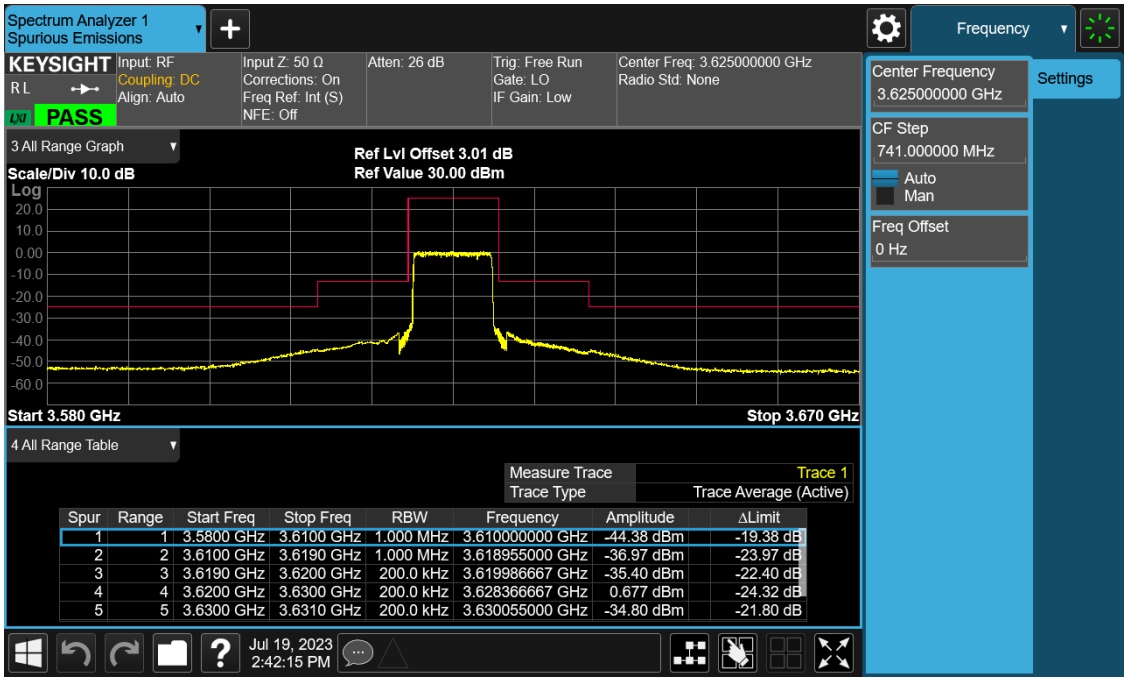


Plot 7-50. Channel Edge Plot (NR Band n48 - 10MHz QPSK - High Channel)

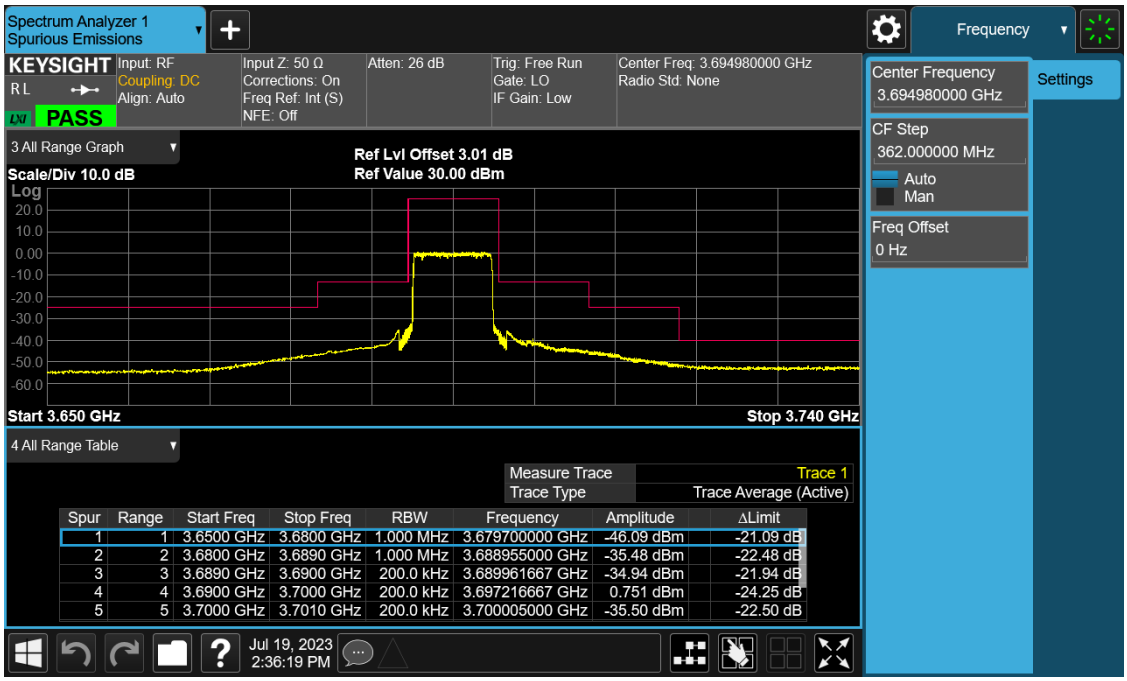
UL-MIMO NR Band n48 – Antenna 3



Plot 7-51. Channel Edge Plot (NR Band n48 - 10MHz QPSK - Low Channel)



Plot 7-52. Channel Edge Plot (NR Band n48 - 10MHz QPSK - Mid Channel)



Plot 7-53. Channel Edge Plot (NR Band n48 - 10MHz QPSK - High Channel)

7.6 Peak-Average Ratio

Test Overview

A peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB.

Test Procedure Used

ANSI C63.26-2015 – Section 5.2.3.4

Test Settings

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW ≥ OBW or specified reference bandwidth
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

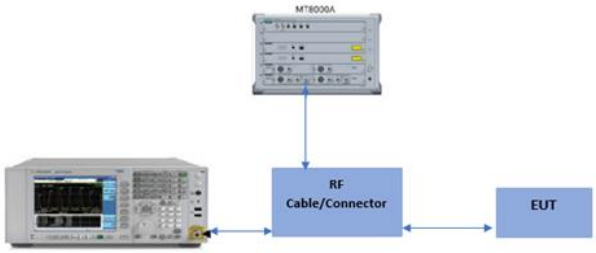


Figure 7-5. Test Instrument & Measurement Setup

Test Notes

For the QAM modulations, 256QAM was found to have the worst-case peak-to-average ratio so it is the only QAM measurement included in this section.

NR Band n48

Plot 7-54.PAR Plot (NR Band n78 - 10MHz DFT-s-OFDM BPSK– Full RB)

Plot 7-55. PAR Plot (NR Band n78 - 10MHz CP-OFDM QPSK– Full RB)

Plot 7-56. PAR Plot (NR Band n78 - 10MHz CP-OFDM 256-QAM– Full RB)

UL-MIMO NR Band n48 – Antenna 1

Plot 7-57. PAR Plot (NR Band n78 - 10MHz CP-OFDM QPSK– Full RB)

Plot 7-58. PAR Plot (NR Band n78 - 10MHz CP-OFDM 256-QAM– Full RB)