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PART 27 MEASUREMENT REPORT

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

Date of Testing:
07/09/2023-09/13/2023
Test Report Issue Date:
09/21/2023
Test Site/Location:
Element lab., Columbia, MD, USA
Test Report Serial No.:
1M2306220083-03-R1.R17

FCC ID:	**RI7FN990A40**
Applicant Name:	**Telit Communications S.p.A.**

Application Type:	Class II Permissive Change
Model:	FN990A40
EUT Type:	Module
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part:	27(Q)
Test Procedure(s):	ANSI C63.26-2015
Class II Permissive Change:	Adding 10MHz bandwidth support 5G NR n78 band
Original Grant Date:	12/19/2022

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.

This revised Test Report (S/N: 1M2306220083-03-R1.R17) supersedes and replaces the previously issued test report (S/N: 1M2306220083-03.R17) on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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 n78 (3450 - 3550MHz)	10 MHz	π/2 BPSK	3455.0 - 3545.0	0.780	28.92	8M71G7D
		QPSK	3455.0 - 3545.0	0.773	28.88	8M74G7D
		16QAM	3455.0 - 3545.0	0.608	27.84	8M77W7D
		64QAM	3455.0 - 3545.0	0.442	26.45	8M75W7D
		256QAM	3455.0 - 3545.0	0.266	24.25	8M68W7D

Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
UL-MIMO NR Band n78 Antenna 1	10 MHz	QPSK	3455.0 - 3545.0	0.476	26.78	8M64G7D
		16QAM	3455.0 - 3545.0	0.455	26.58	8M66W7D
		64QAM	3455.0 - 3545.0	0.313	24.96	-
		256QAM	3455.0 - 3545.0	0.153	21.86	-

Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
UL-MIMO NR Band n78 Antenna 3	10 MHz	QPSK	3455.0 - 3545.0	0.476	26.78	8M67G7D
		16QAM	3455.0 - 3545.0	0.455	26.58	8M62W7D
		64QAM	3455.0 - 3545.0	0.313	24.96	-
		256QAM	3455.0 - 3545.0	0.153	21.86	-

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 and the Innovation, Science and Economic Development Canada.

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 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: RI7FN990A40.** The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 27.

Test Device Serial No.: MD01

2.2 Device Capabilities

The following capabilities were assessed in this report for this permissive change filing:

5G NR (n78, including UL-MIMO for n78)

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 version M0R.010003 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 Evaluation 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

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

Example: Spurious emission at 3700.40 MHz

The receive 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 analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 3700.40 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.50 dBm so this harmonic was 25.50 dBm – (-24.80) = 50.3 dBc.

7.0 TEST RESULTS

7.1 Summary

Company Name: Telit Communications S.p.A.

FCC ID: RI7FN990A40

Mode(s): NR

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Transmitter Conducted Output Power / Equivalent Isotropic Radiated Power	2.1046(a), 2.1046(c), 27.50(k)(3)	1 Watt	PASS	Section 7.2
	Occupied Bandwidth	2.1049(h)	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions (NR Band n78)	2.1051, 27.53(n)(2)	≤ -13 dBm / MHz	PASS	Sections 7.4, 7.5
	Peak-to-Average Ratio (NR Band n78)	27.50(k)(4)	≤ 13 dB	PASS	Section 7.6
RADIATED	Radiated Spurious Emissions (NR Band n78)	2.1053, 27.53(n)(2)	≤ -13 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) All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is EMC Software Tool v1.1.

7.2 Conducted Output Power Data and EIRP

Test Overview

All 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.

Test Procedure Used

ANSI C63.26-2015 – Section 5.2

Test Settings

1. Span = 2 x OBW to 3 x OBW
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
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.

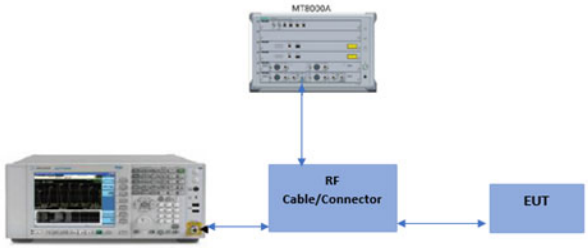


Figure 7-1. Test Instrument & Measurement Setup

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 n78 EIRP is calculated with conducted power and antenna gain.

NR Band n78- HPUE

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm]	Margin [dB]
10 MHz	π/2 BPSK	630334	3455.01	1 / 1	26.19	2.50	28.69	0.740	30.00	-1.31
		633334	3500.01	1 / 22	26.27	2.50	28.77	0.753	30.00	-1.23
		636332	3544.98	1 / 1	26.42	2.50	28.92	0.780	30.00	-1.08
	QPSK	630334	3455.01	1 / 1	26.20	2.50	28.70	0.741	30.00	-1.30
		633334	3500.01	1 / 22	26.25	2.50	28.75	0.750	30.00	-1.25
		636332	3544.98	1 / 1	26.38	2.50	28.88	0.773	30.00	-1.12
	16-QAM	630334	3455.01	1 / 1	25.19	2.50	27.69	0.587	30.00	-2.31
		633334	3500.01	1 / 1	25.31	2.50	27.81	0.604	30.00	-2.19
		636332	3544.98	1 / 22	25.34	2.50	27.84	0.608	30.00	-2.16
	64-QAM	630334	3455.01	1 / 1	23.73	2.50	26.23	0.420	30.00	-3.77
		633334	3500.01	1 / 1	23.60	2.50	26.10	0.407	30.00	-3.90
		636332	3544.98	1 / 12	23.95	2.50	26.45	0.442	30.00	-3.55
	256-QAM	630334	3455.01	1 / 1	21.57	2.50	24.07	0.255	30.00	-5.93
		633334	3500.01	1 / 22	21.60	2.50	24.10	0.257	30.00	-5.90
		636332	3544.98	1 / 22	21.75	2.50	24.25	0.266	30.00	-5.75

Table 7-2. Conducted Power Output Data and EIRP Data (NR Band n78 HPUE)

NR Band n78- PC3

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]	Ant Gain [dBi]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm]	Margin [dB]
10 MHz	π/2 BPSK	630334	3455.01	1 / 22	23.21	2.50	25.71	0.37	30.00	-4.29
		633334	3500.01	1 / 22	23.33	2.50	25.83	0.38	30.00	-4.17
		636332	3544.98	1 / 22	23.40	2.50	25.90	0.39	30.00	-4.10
	QPSK	630334	3455.01	1 / 22	22.80	2.50	25.30	0.34	30.00	-4.70
		633334	3500.01	1 / 22	23.32	2.50	25.82	0.38	30.00	-4.18
		636332	3544.98	1 / 22	23.31	2.50	25.81	0.38	30.00	-4.19
	16-QAM	630334	3455.01	1 / 22	22.17	2.50	24.67	0.29	30.00	-5.33
		633334	3500.01	1 / 22	22.28	2.50	24.78	0.30	30.00	-5.22
		636332	3544.98	1 / 22	22.31	2.50	24.81	0.30	30.00	-5.19
	64-QAM	630334	3455.01	1 / 12	21.21	2.50	23.71	0.23	30.00	-6.29
		633334	3500.01	1 / 22	20.69	2.50	23.19	0.21	30.00	-6.81
		636332	3544.98	1 / 22	20.89	2.50	23.39	0.22	30.00	-6.61
	256-QAM	630334	3455.01	1 / 22	19.55	2.50	22.05	0.16	30.00	-7.95
		633334	3500.01	1 / 22	19.63	2.50	22.13	0.16	30.00	-7.87
		636332	3544.98	1 / 22	19.67	2.50	22.17	0.16	30.00	-7.83

Table 7-3. Conducted Power Output Data and EIRP Data (NR Band n78 PC3)

UL-MIMO NR Band n78

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]	Margin [dB]
10 MHz	QPSK	630336	3455.04	1/12	21.28	1/12	21.25	24.28	2.50	26.78	0.476	30.00	-3.22
		636666	3549.99	1/1	21.04	1/1	21.32	24.19	2.50	26.69	0.467	30.00	-3.31
	16-QAM	630336	3455.04	1/12	21.01	1/12	21.13	24.08	2.50	26.58	0.455	30.00	-3.42
		636666	3549.99	1/1	21.03	1/1	21.04	24.05	2.50	26.55	0.451	30.00	-3.45
	64-QAM	630336	3455.04	1/12	19.23	1/12	19.16	22.21	2.50	24.71	0.295	30.00	-5.29
		636666	3549.99	1/1	19.46	1/1	19.44	22.46	2.50	24.96	0.313	30.00	-5.04
		643000	3645.00	1/22	19.26	1/22	19.54	22.41	0.50	22.91	0.196	30.00	-7.09
	256-QAM	630336	3455.04	1/12	16.25	1/12	16.21	19.24	2.50	21.74	0.149	30.00	-8.26
		636666	3549.99	1/1	16.36	1/1	16.34	19.36	2.50	21.86	0.153	30.00	-8.14

Table 7-4. Conducted Power Output Data (UL-MIMO NR Band n78)

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.

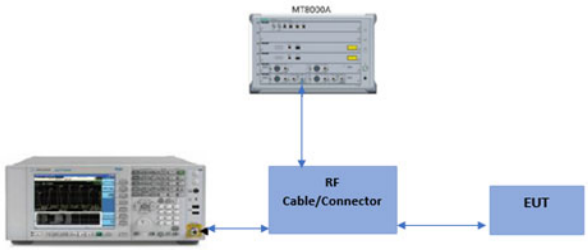
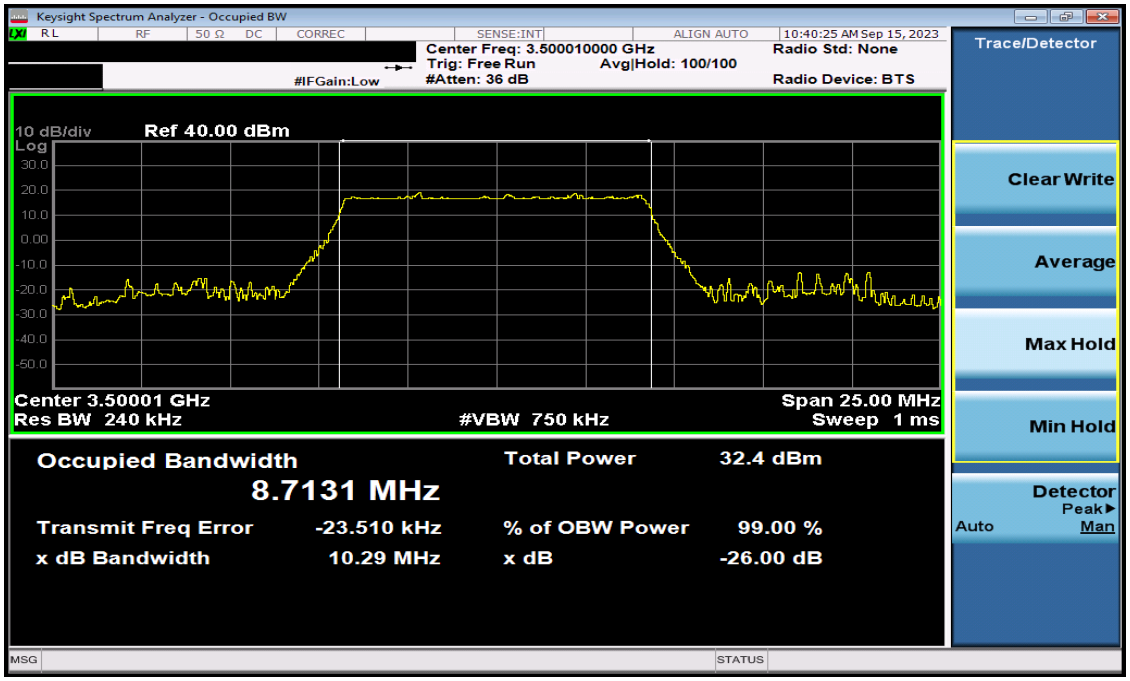


Figure 7-2. Test Instrument & Measurement Setup

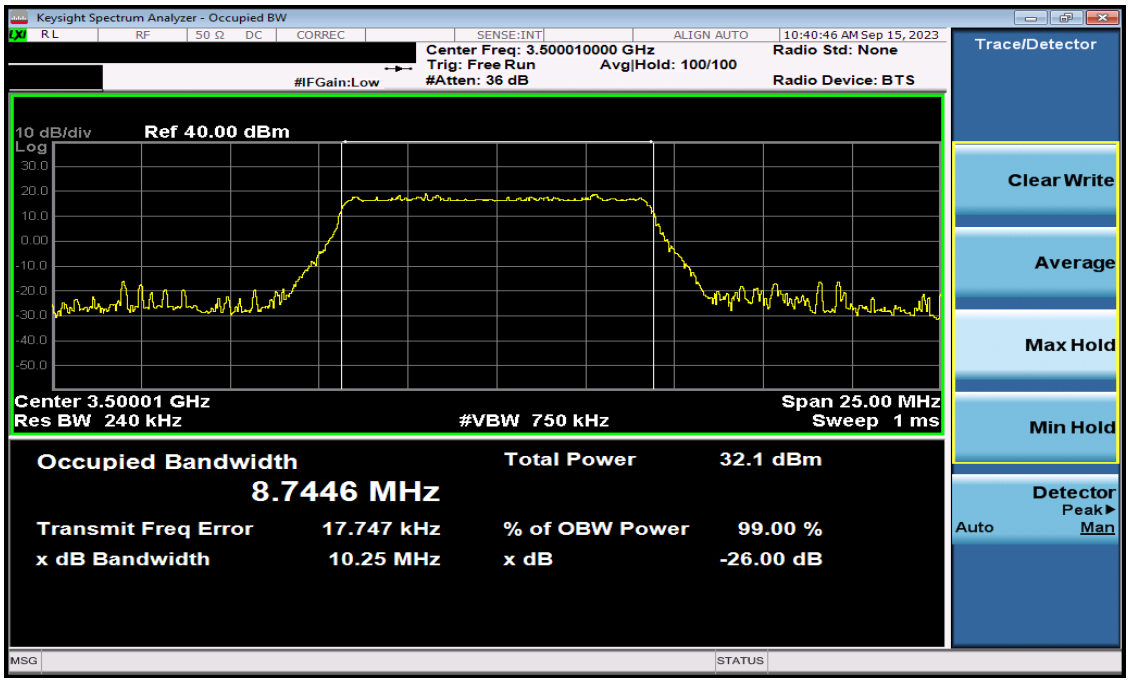
Test Notes

In this section, the UL-MIMO NR band n78 (Antenna 1 and Antenna 3) plots were measured individually

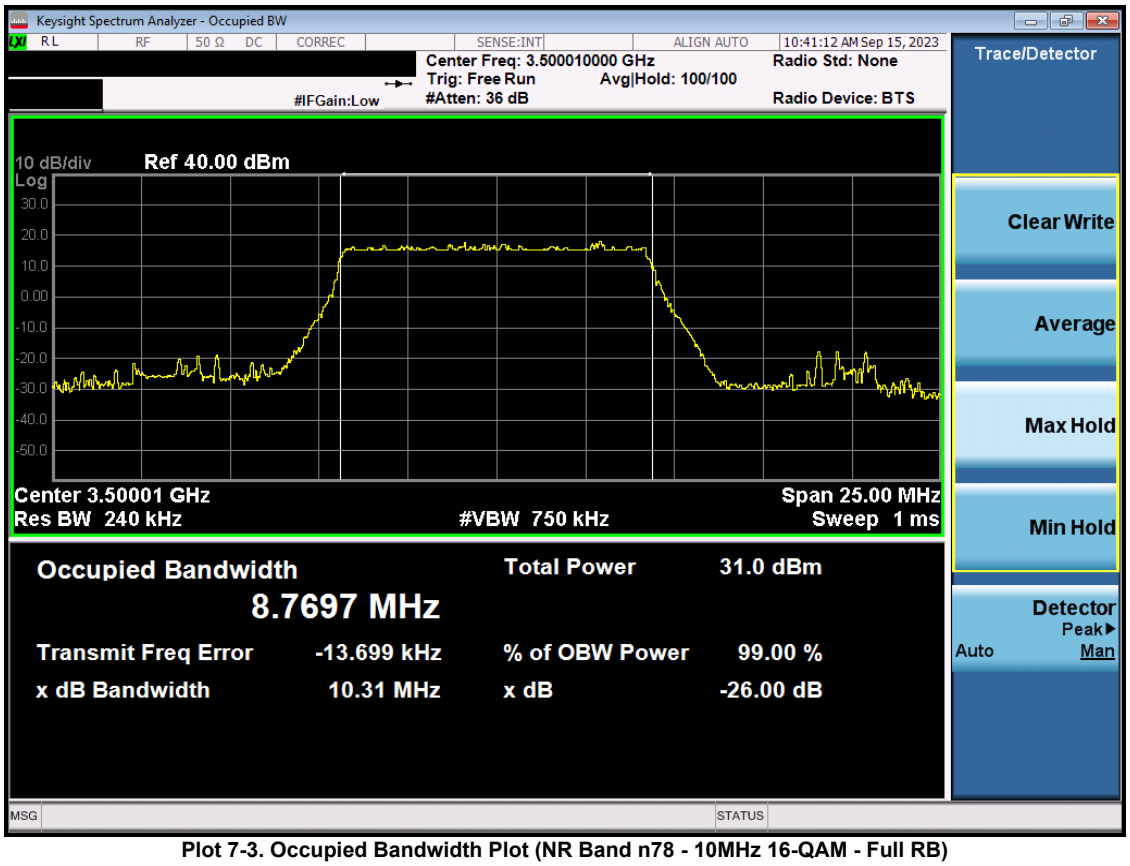
NR Band n78- HPUE



Plot 7-1. Occupied Bandwidth Plot (NR Band n78 - 10MHz π/2 BPSK - Full RB)

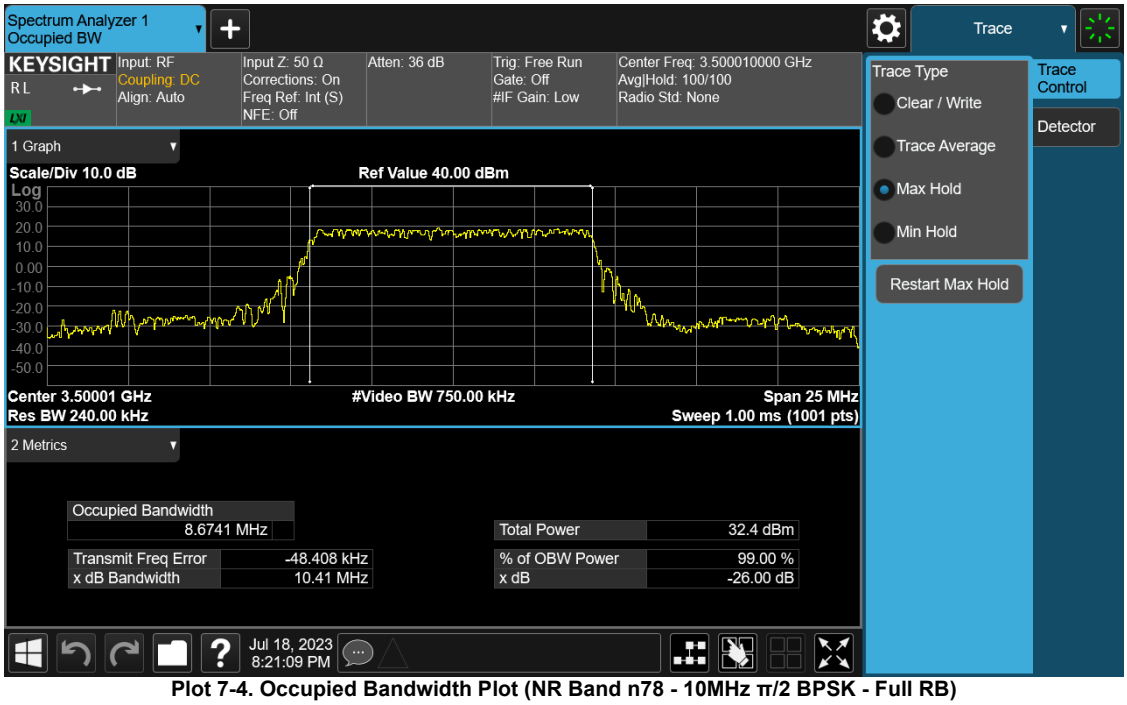


Plot 7-2. Occupied Bandwidth Plot (NR Band n78 - 10MHz QPSK - Full RB)

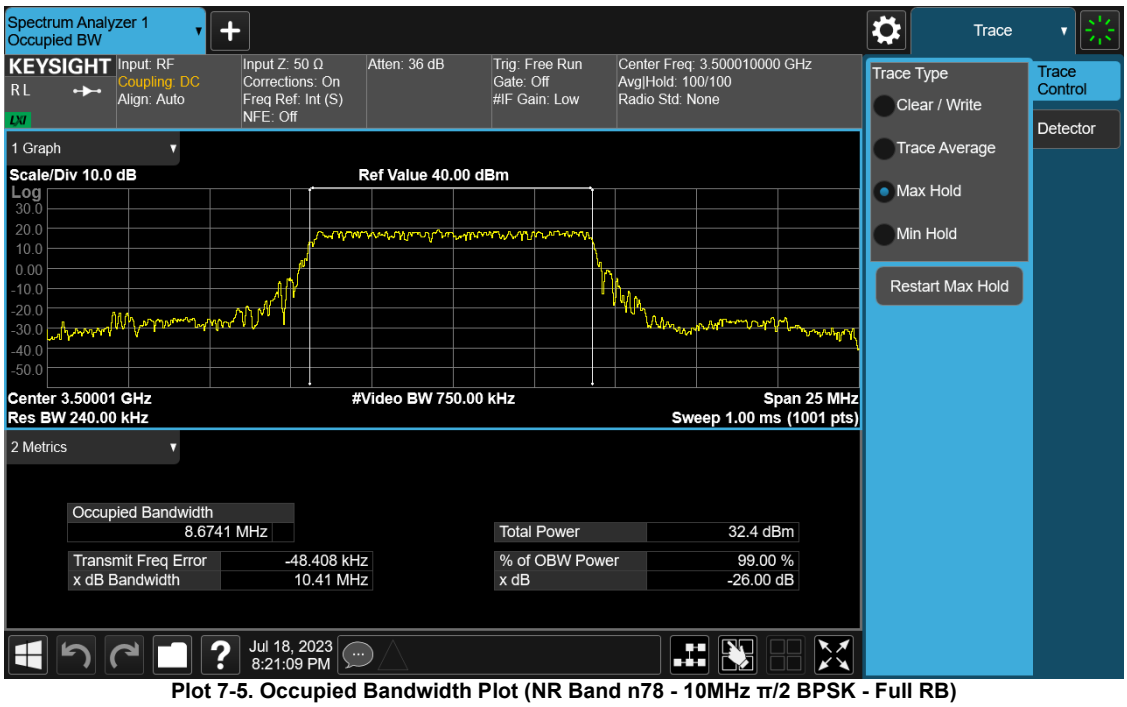


Plot 7-3. Occupied Bandwidth Plot (NR Band n78 - 10MHz 16-QAM - Full RB)

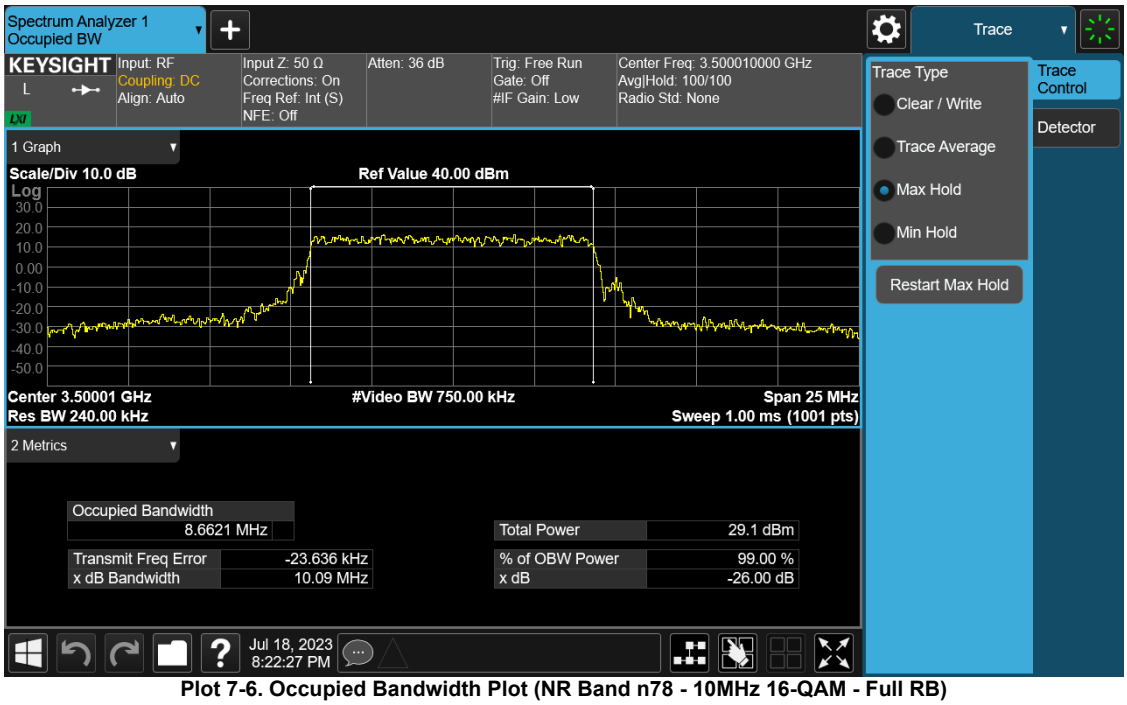
NR Band n78- PC3



Plot 7-4. Occupied Bandwidth Plot (NR Band n78 - 10MHz π/2 BPSK - Full RB)

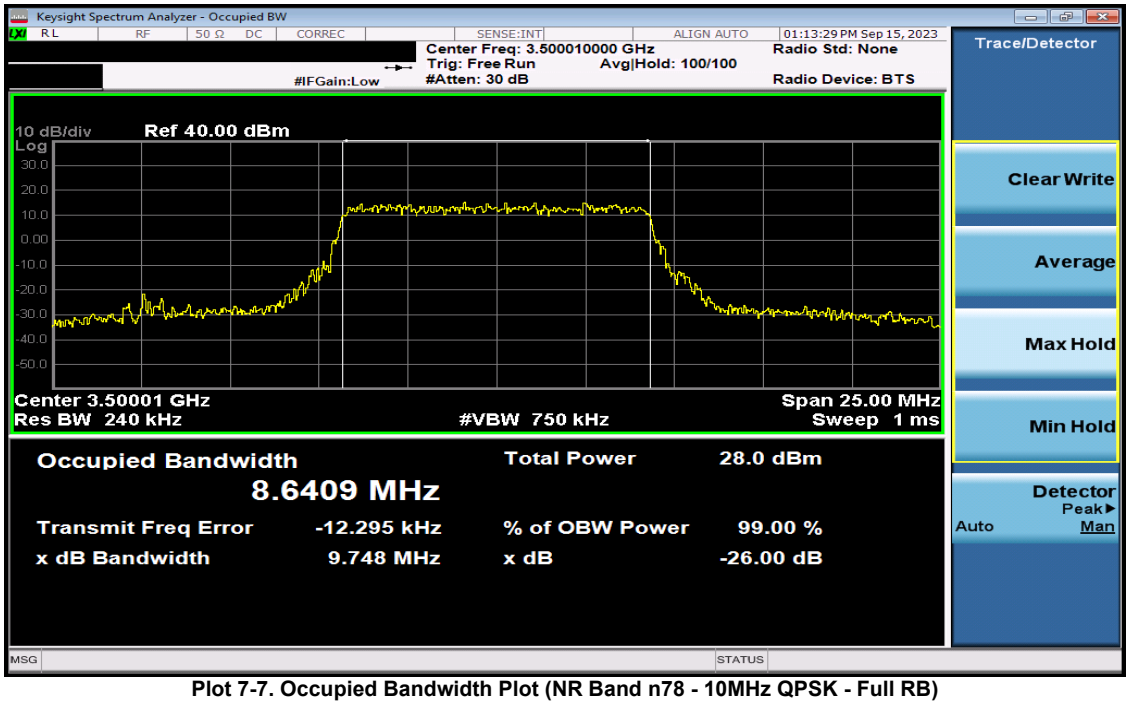


Plot 7-5. Occupied Bandwidth Plot (NR Band n78 - 10MHz π/2 BPSK - Full RB)

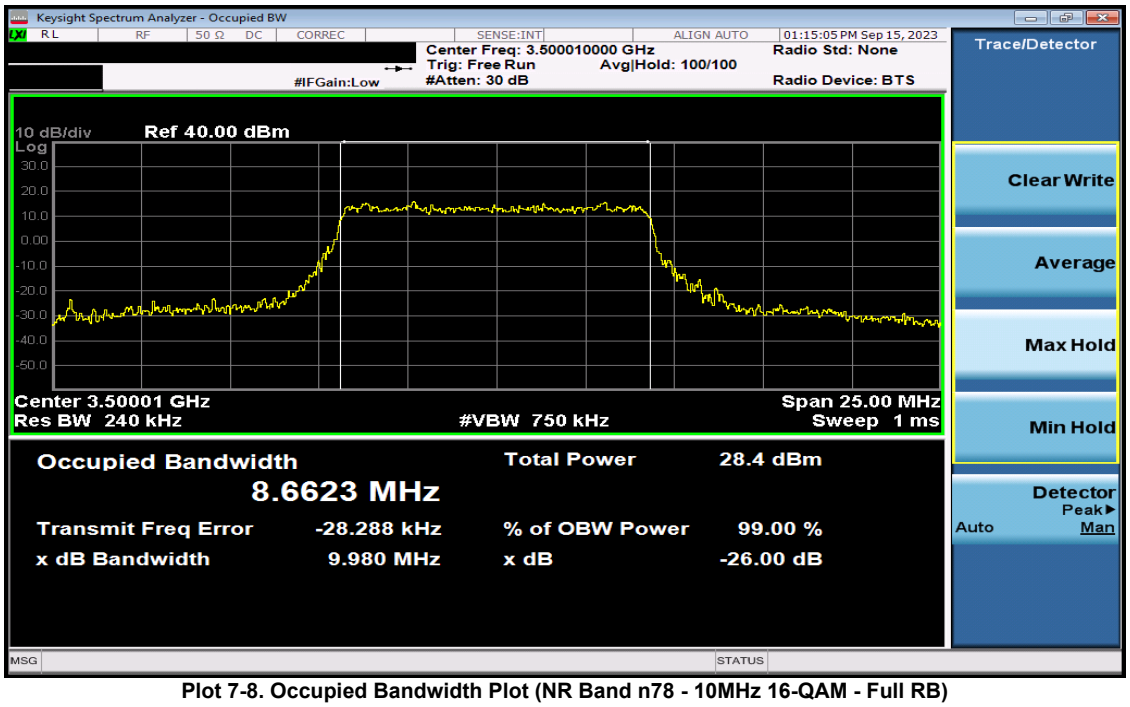


Plot 7-6. Occupied Bandwidth Plot (NR Band n78 - 10MHz 16-QAM - Full RB)

UL-MIMO NR Band n78 – Antenna 1

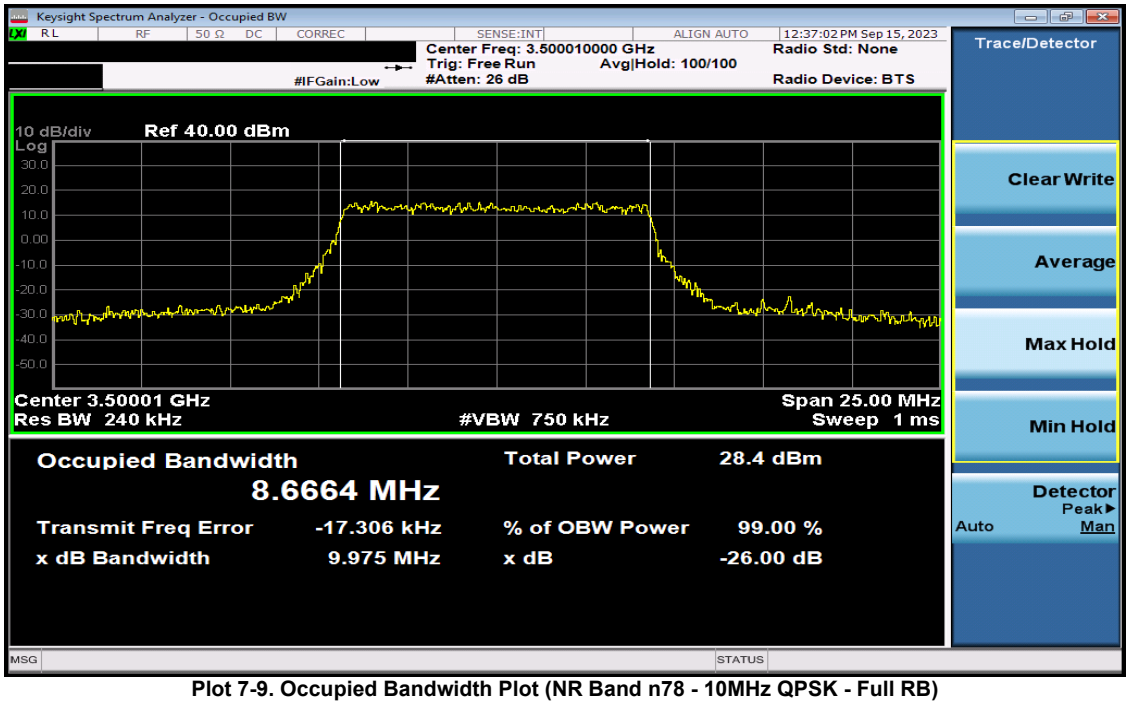


Plot 7-7. Occupied Bandwidth Plot (NR Band n78 - 10MHz QPSK - Full RB)

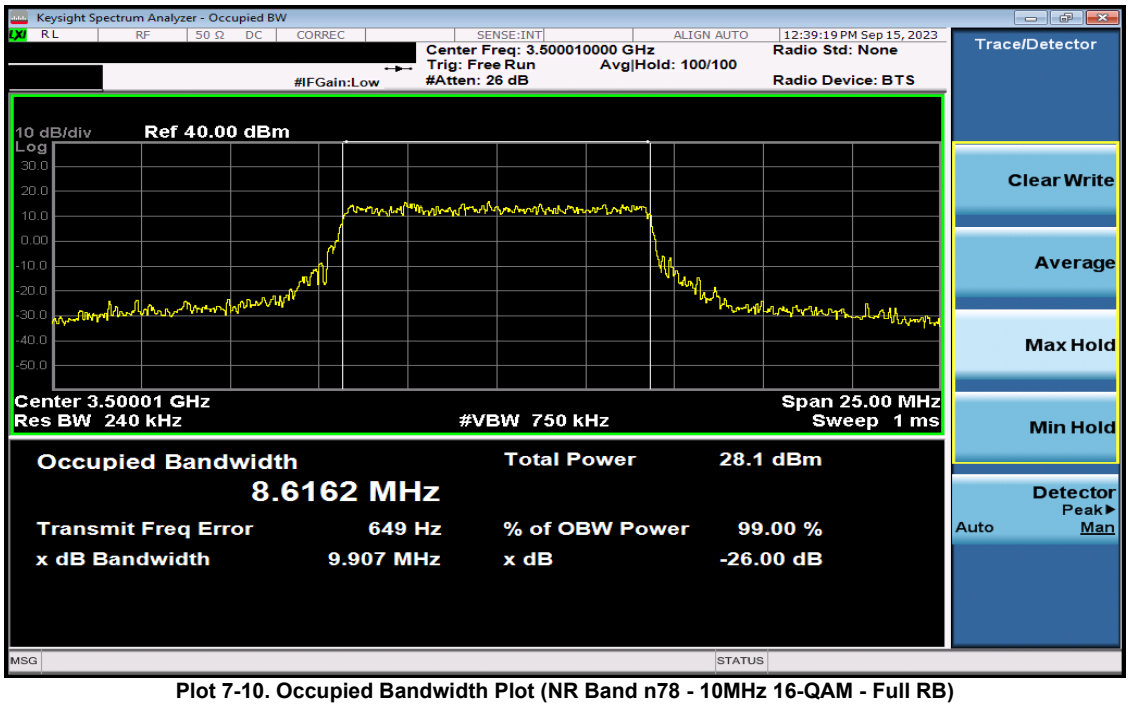


Plot 7-8. Occupied Bandwidth Plot (NR Band n78 - 10MHz 16-QAM - Full RB)

UL-MIMO NR Band n78 – Antenna 3



Plot 7-9. Occupied Bandwidth Plot (NR Band n78 - 10MHz QPSK - Full RB)



Plot 7-10. Occupied Bandwidth Plot (NR Band n78 - 10MHz 16-QAM - Full RB)

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 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 operations in the 3450 – 3550MHz band, the maximum permissible conducted power level of any spurious emission is -13dBm/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 the tenth harmonic of the highest transmit frequency (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
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.

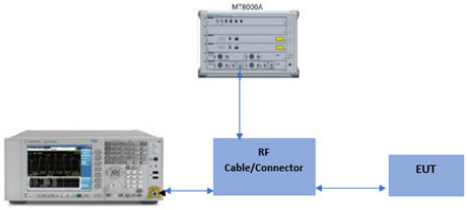


Figure 7-3. Test Instrument & Measurement Setup

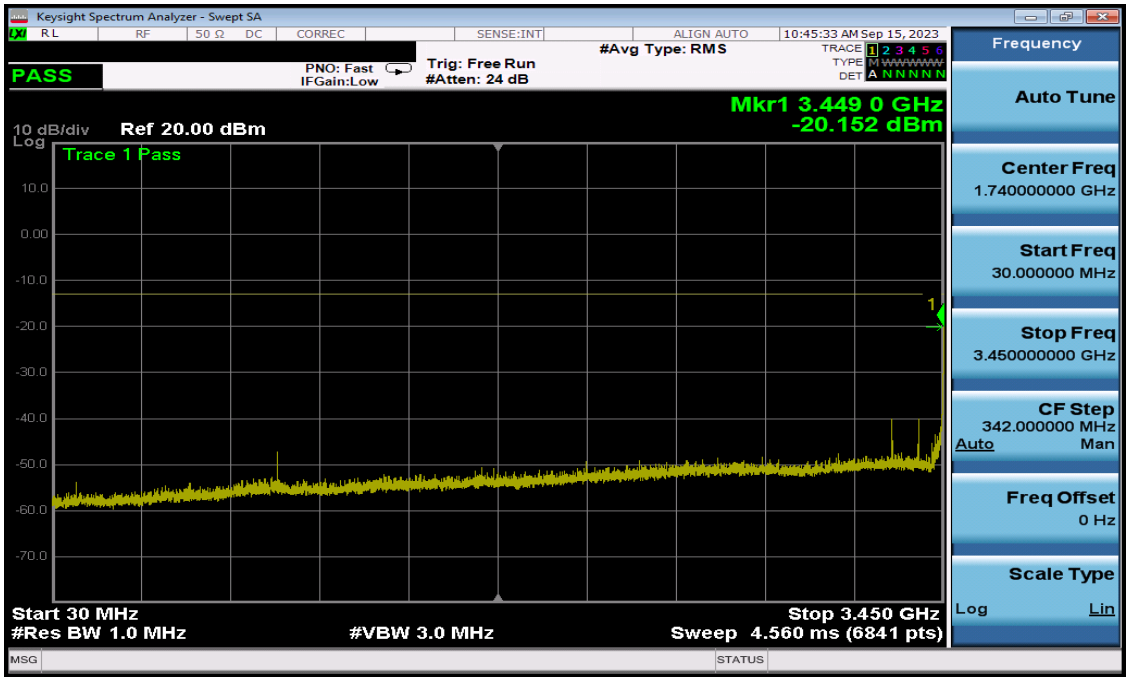
Test Notes

1. Per FCC Part 27.53 (n), compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz.

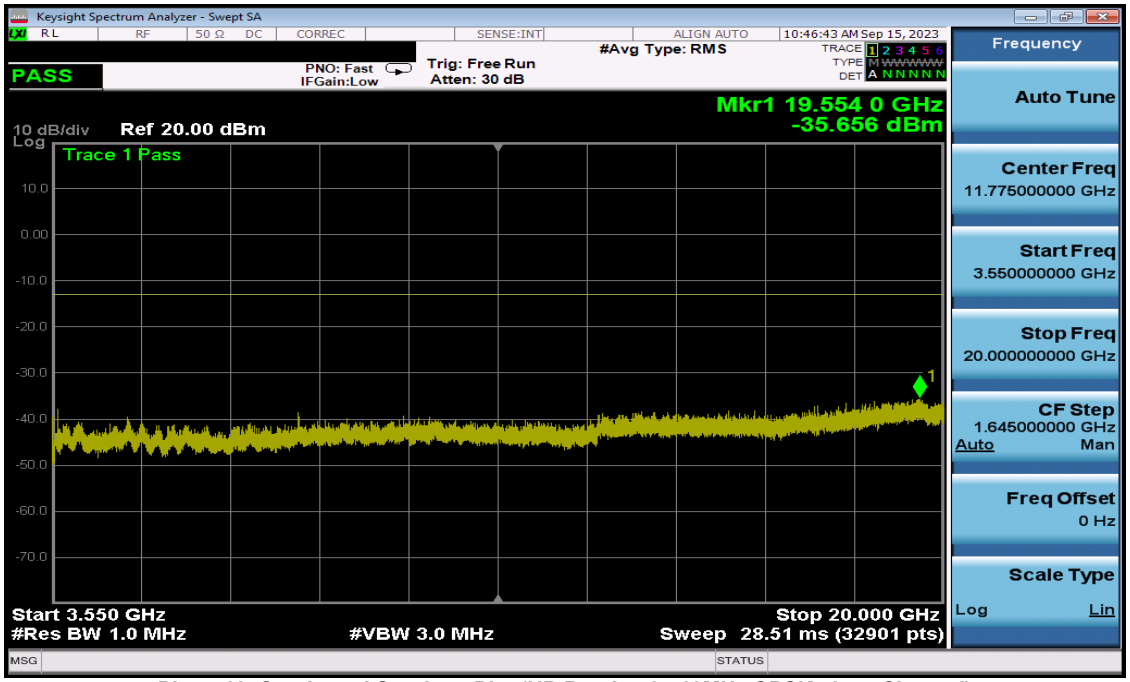
2. For NR operation, all subcarrier spacings (SCS) and transmission schemes (e.g. CP-OFDM and DFT-s-OFDM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst-case configuration results are reported in this section.

3. In this section, the UL-MIMO NR band n78 (Antenna 1 and Antenna 3) plots has a 3dB correction applied to the individual plots to address the MIMO requirements in ANSI C63.26.

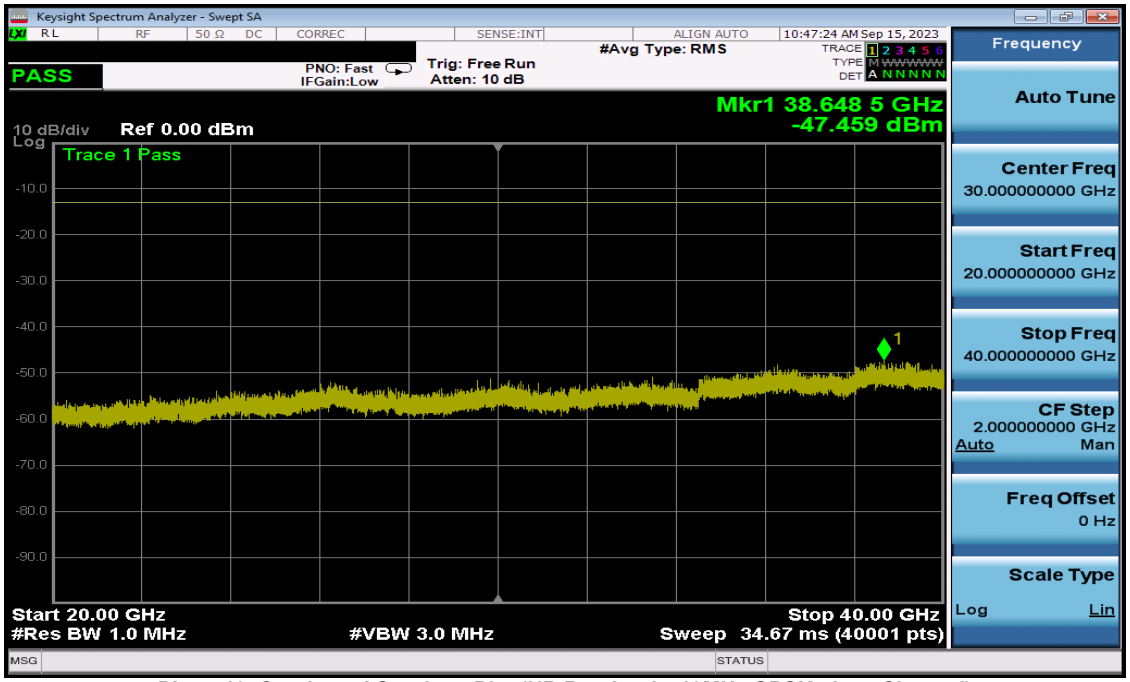
NR Band n78- HPUE



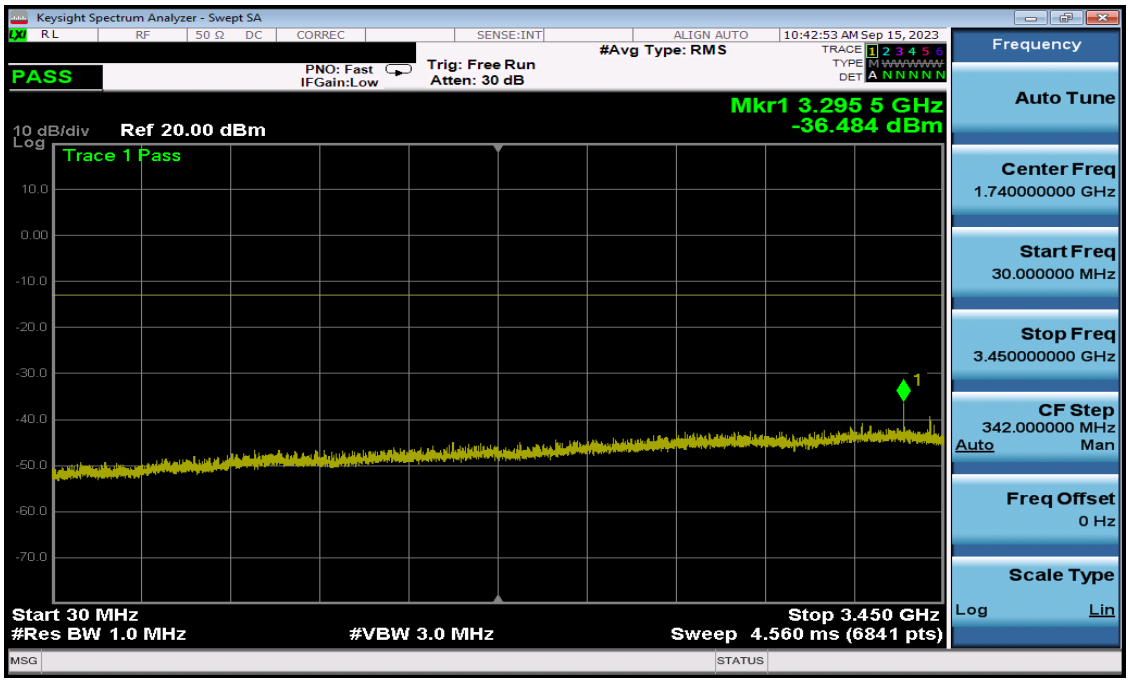
Plot 7-11. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



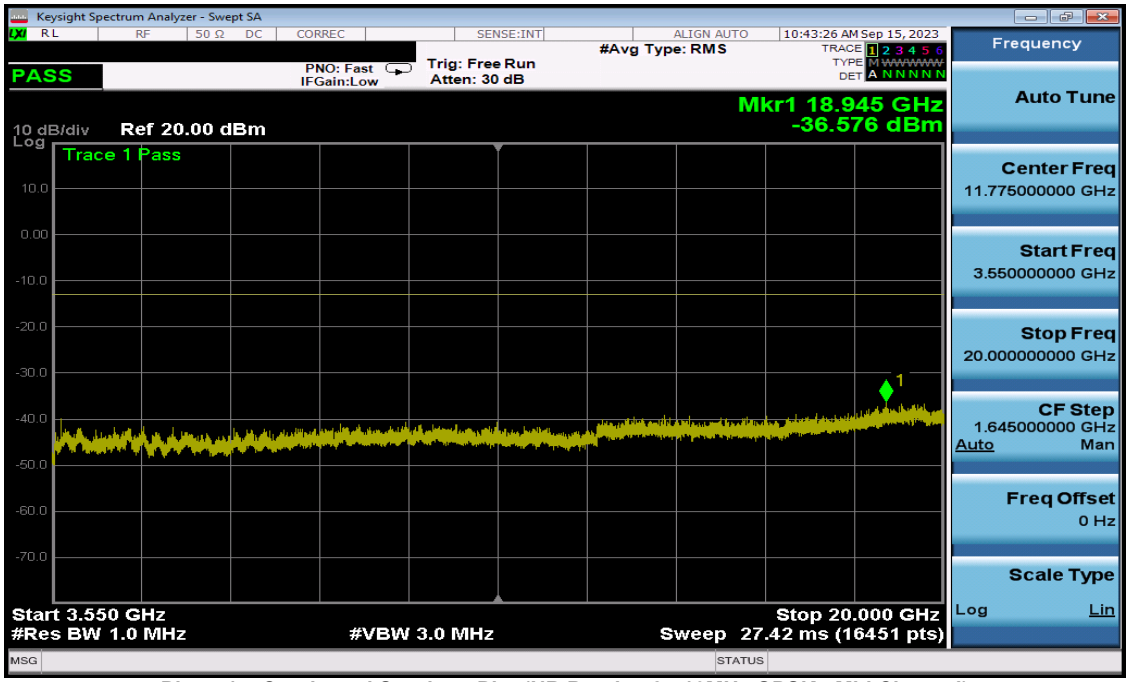
Plot 7-12. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



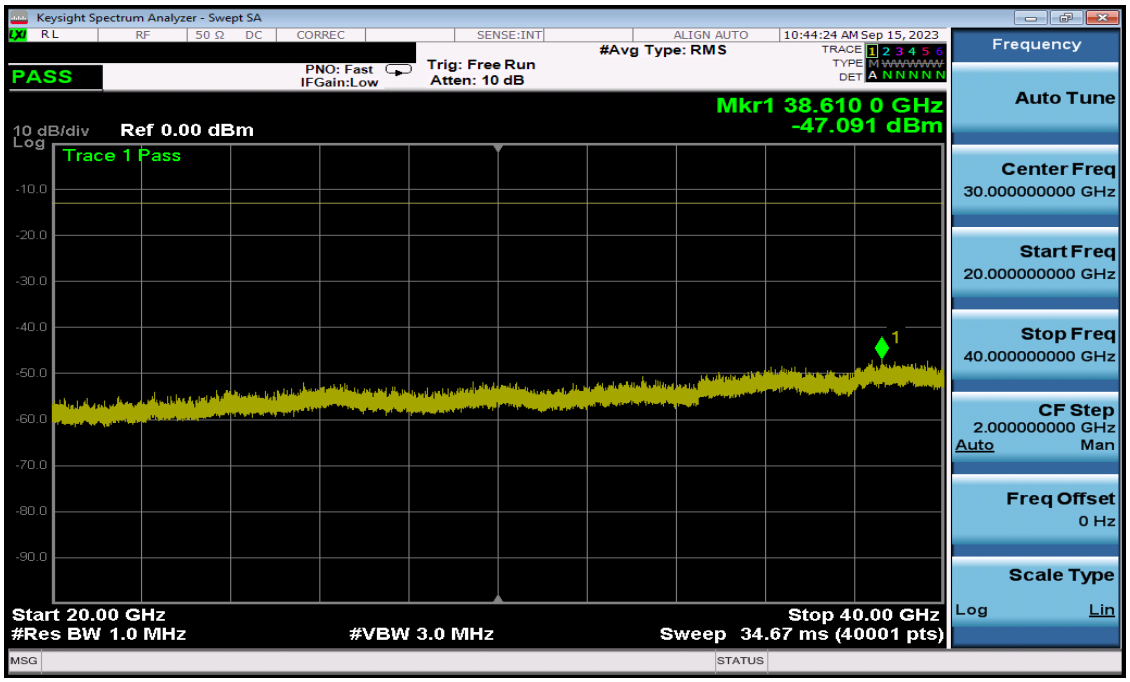
Plot 7-13. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



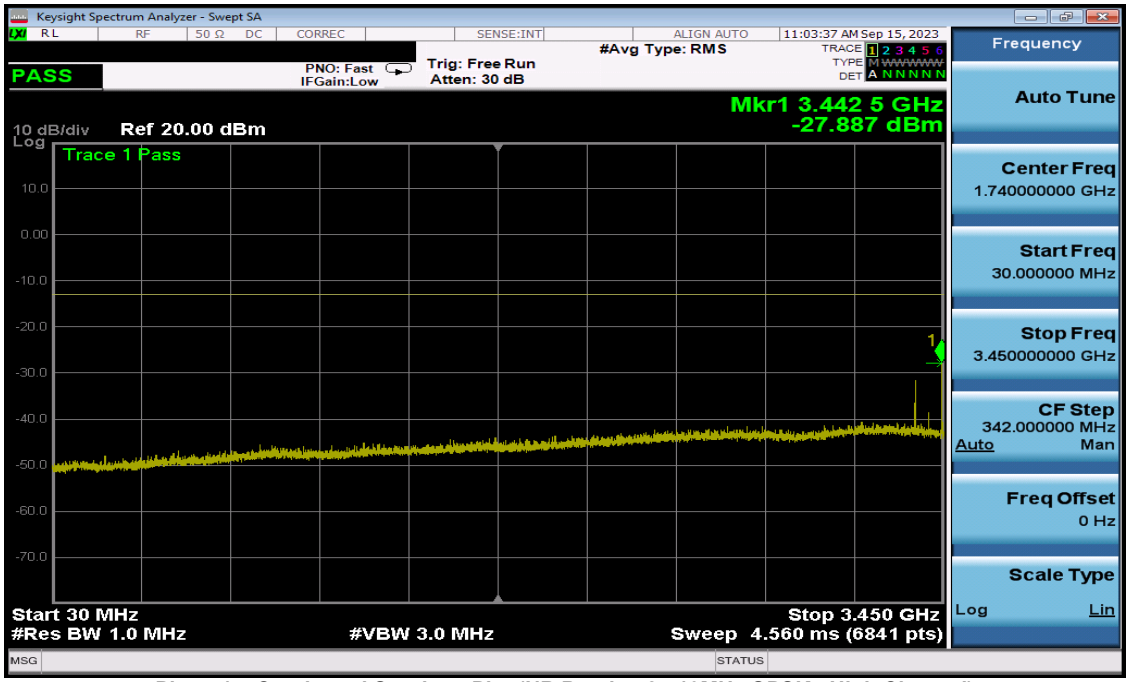
Plot 7-14. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Mid Channel)



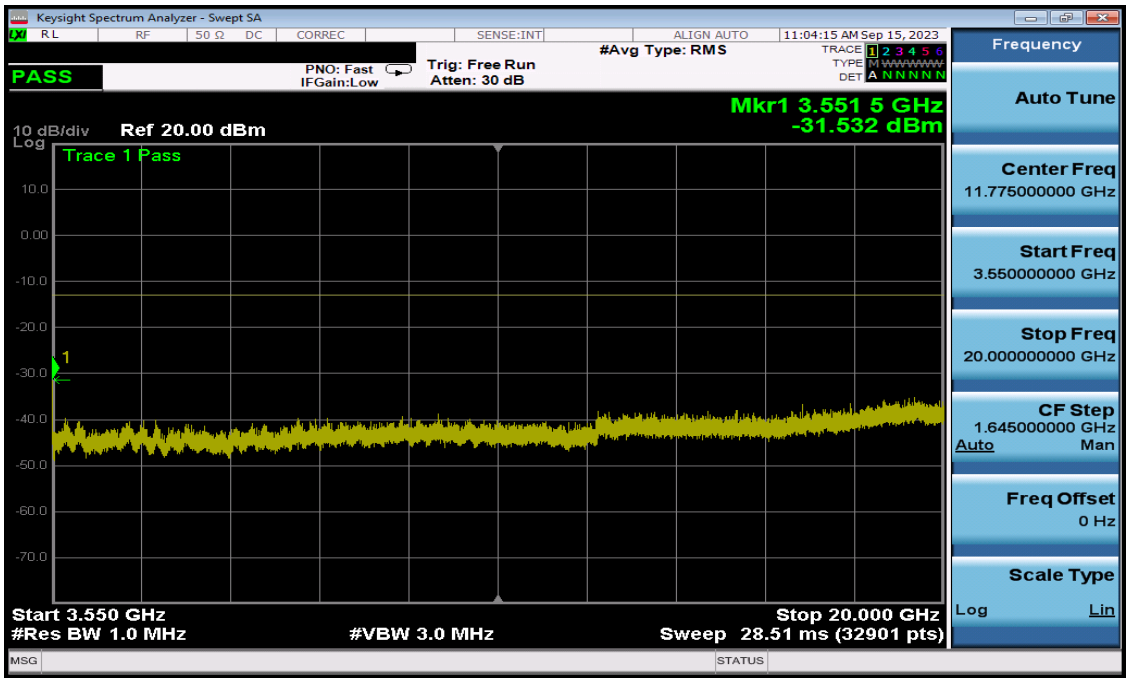
Plot 7-15. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Mid Channel)



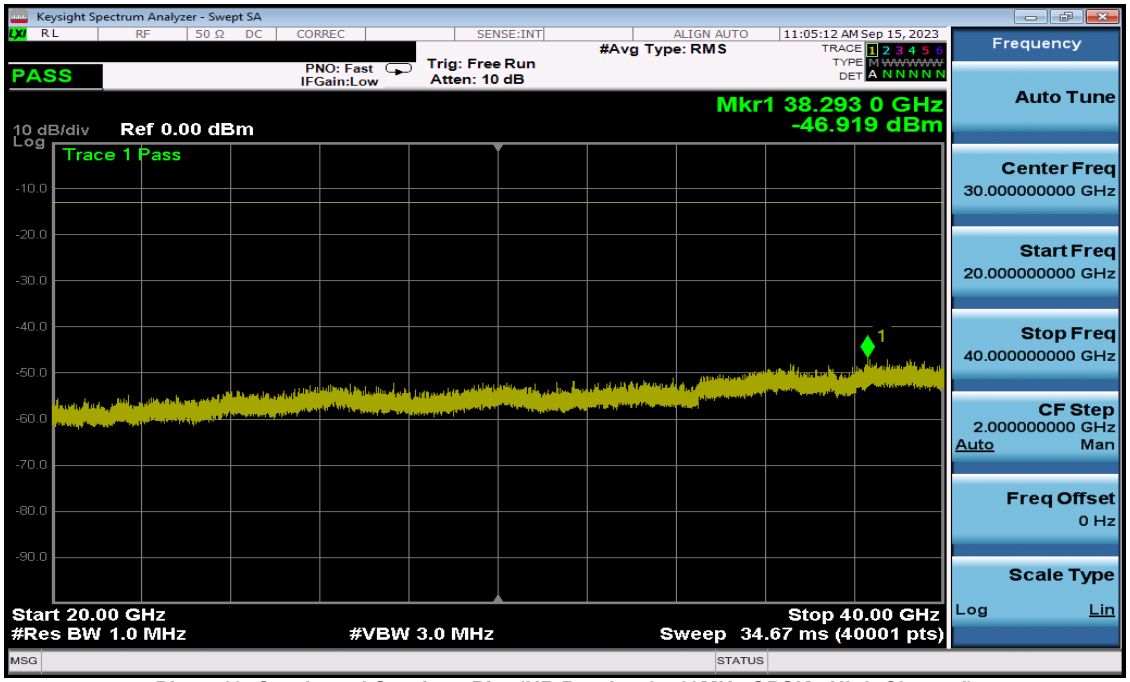
Plot 7-16. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Mid Channel)



Plot 7-17. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)

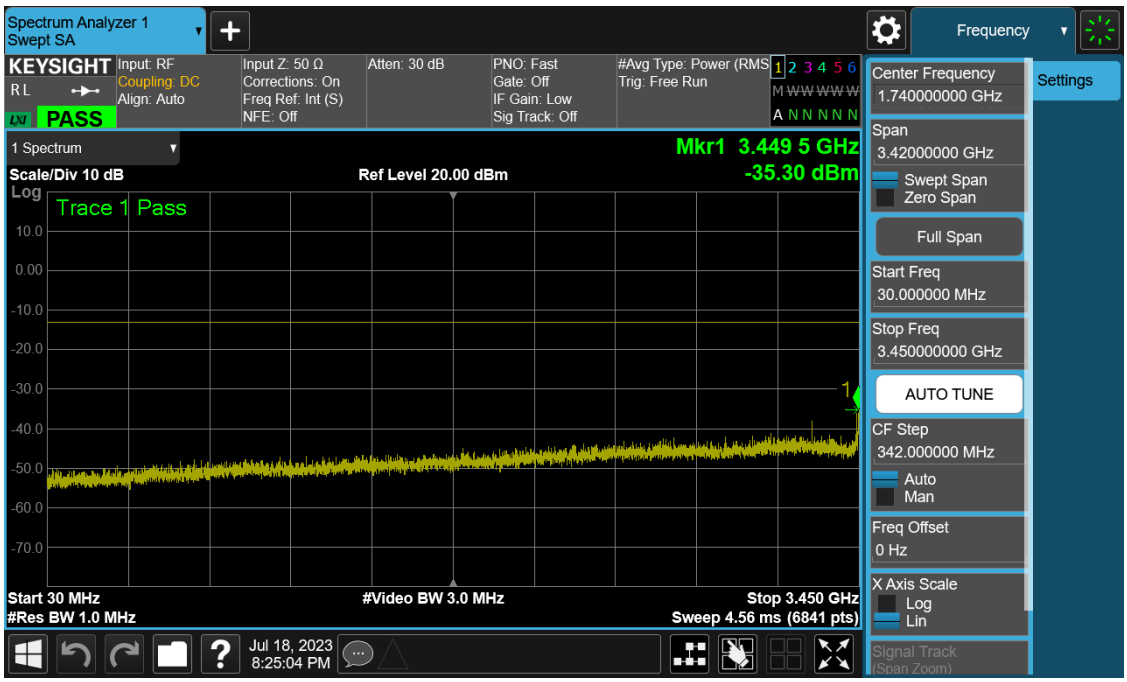


Plot 7-18. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)

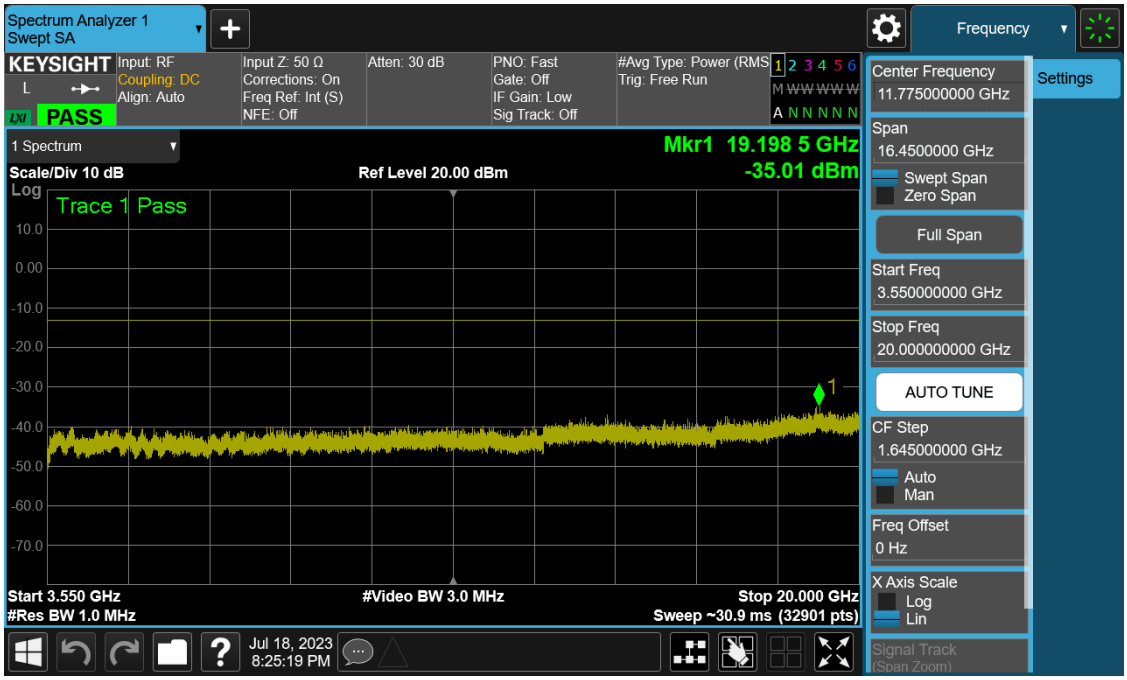


Plot 7-19. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)

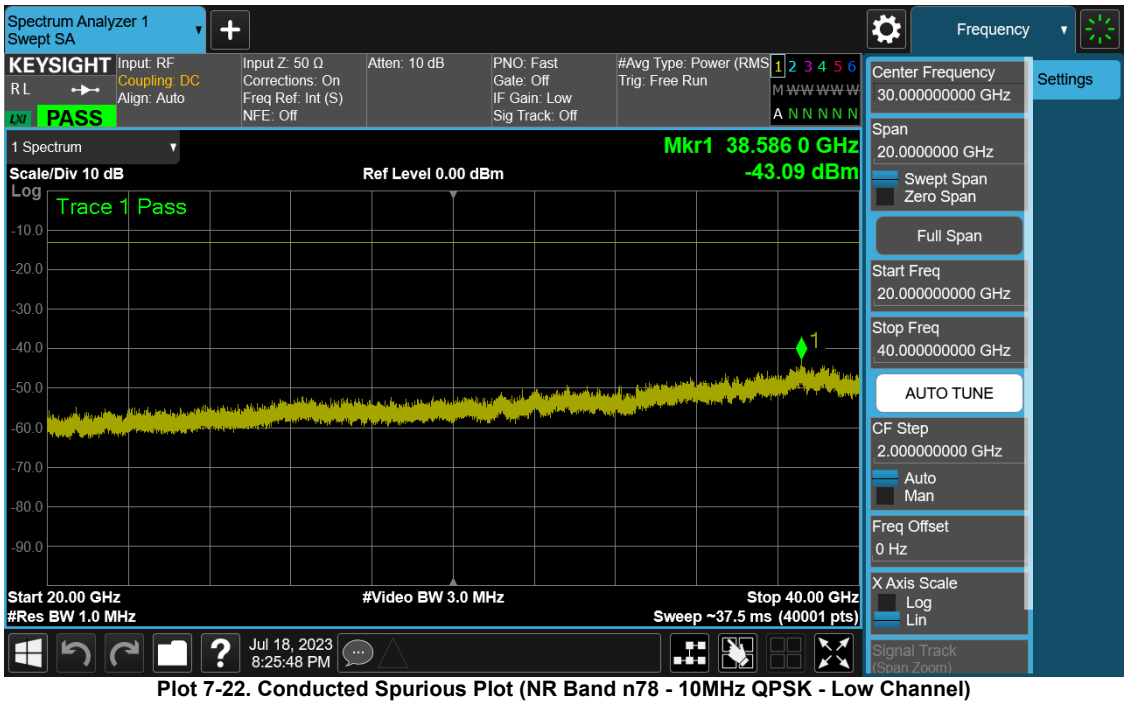
NR Band n78- PC3



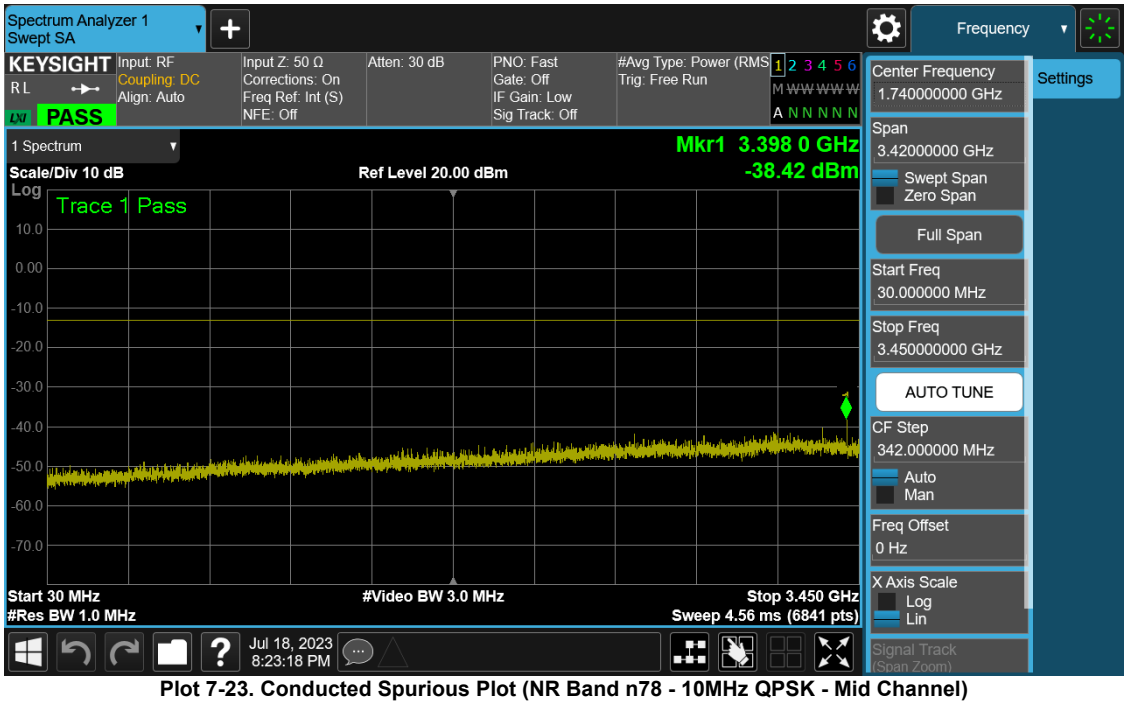
Plot 7-20. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



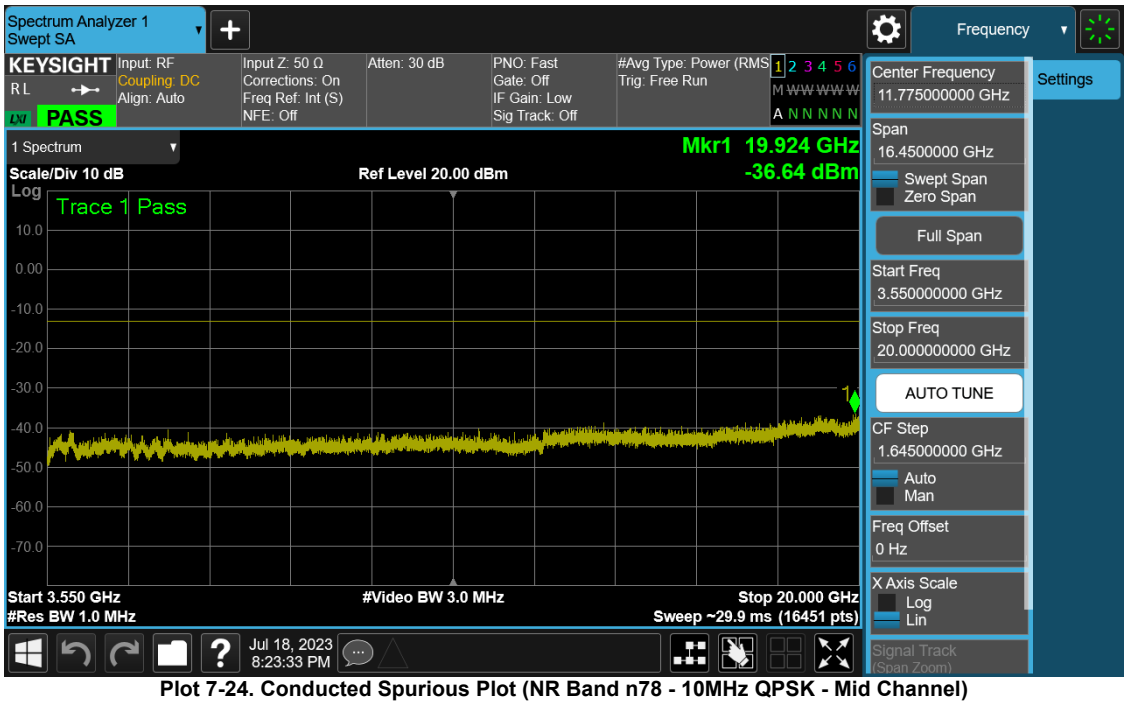
Plot 7-21. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



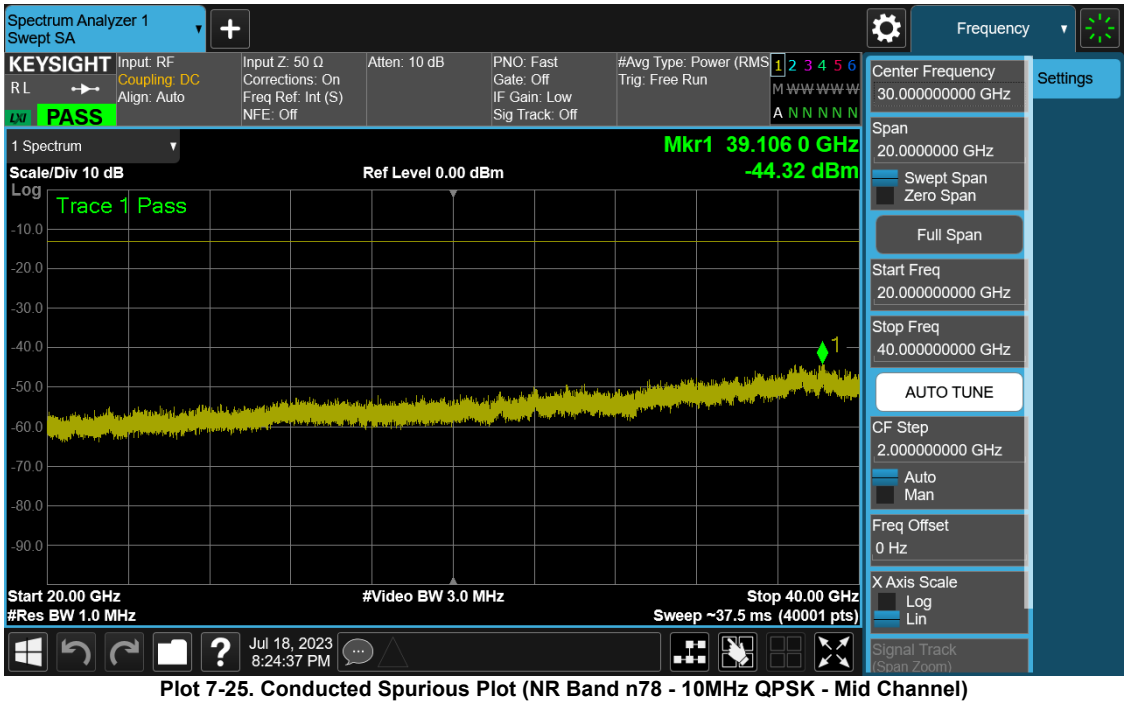
Plot 7-22. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



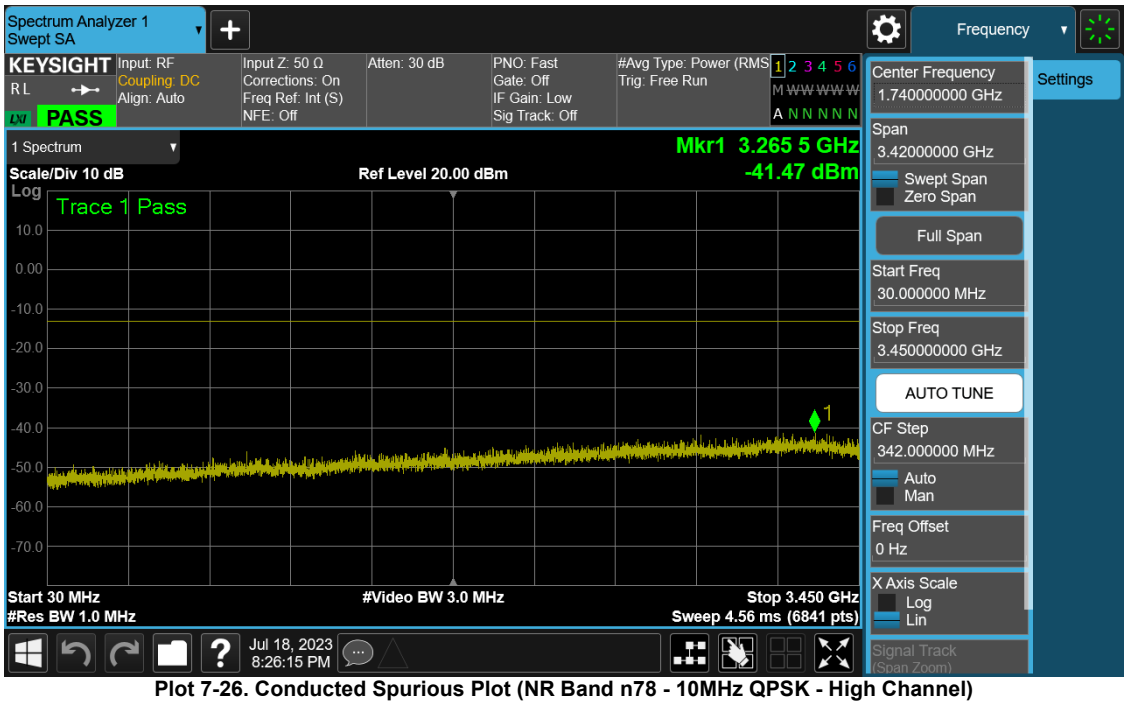
Plot 7-23. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Mid Channel)



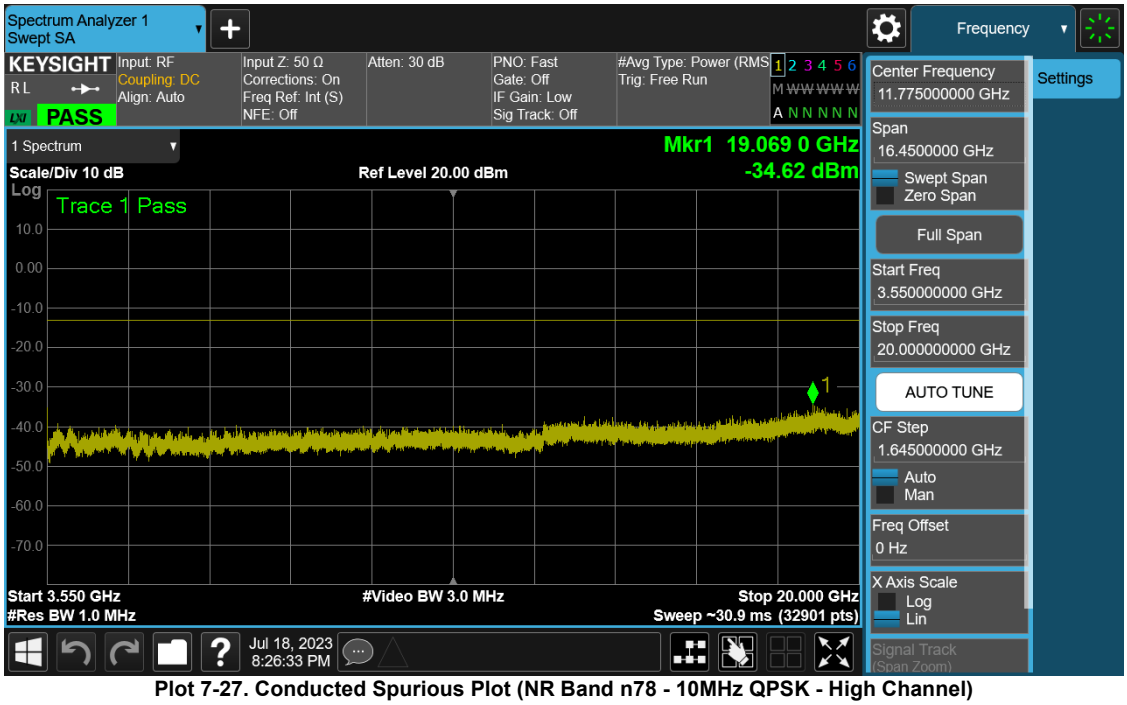
Plot 7-24. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Mid Channel)



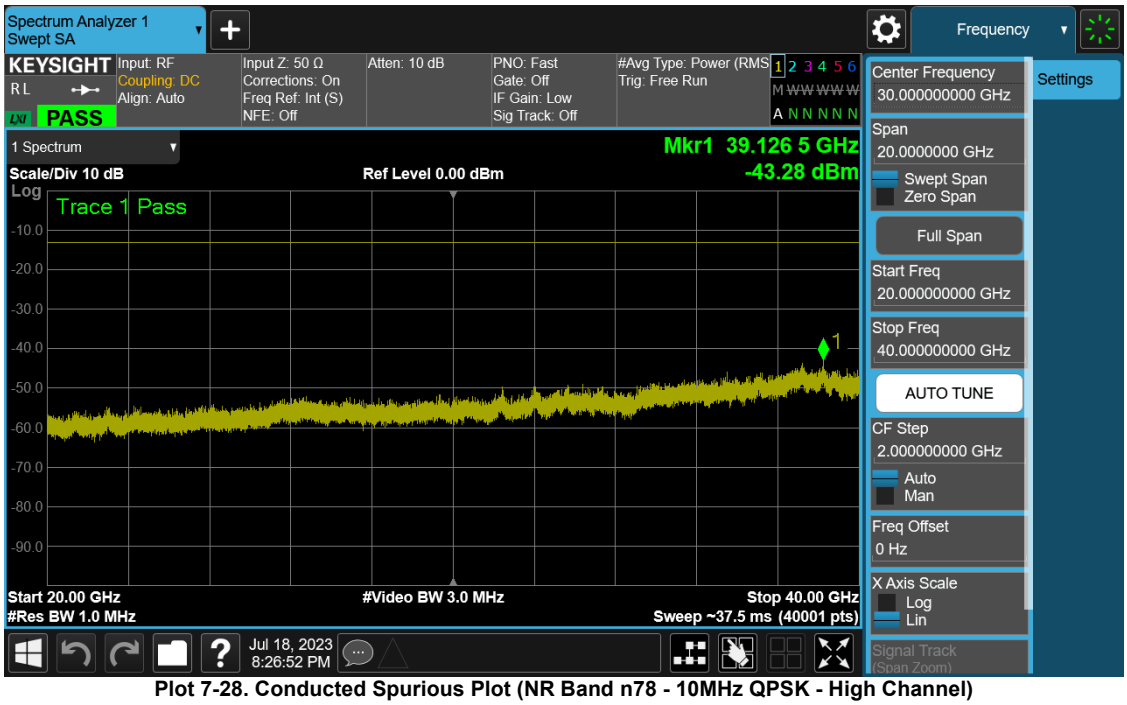
Plot 7-25. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Mid Channel)



Plot 7-26. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)

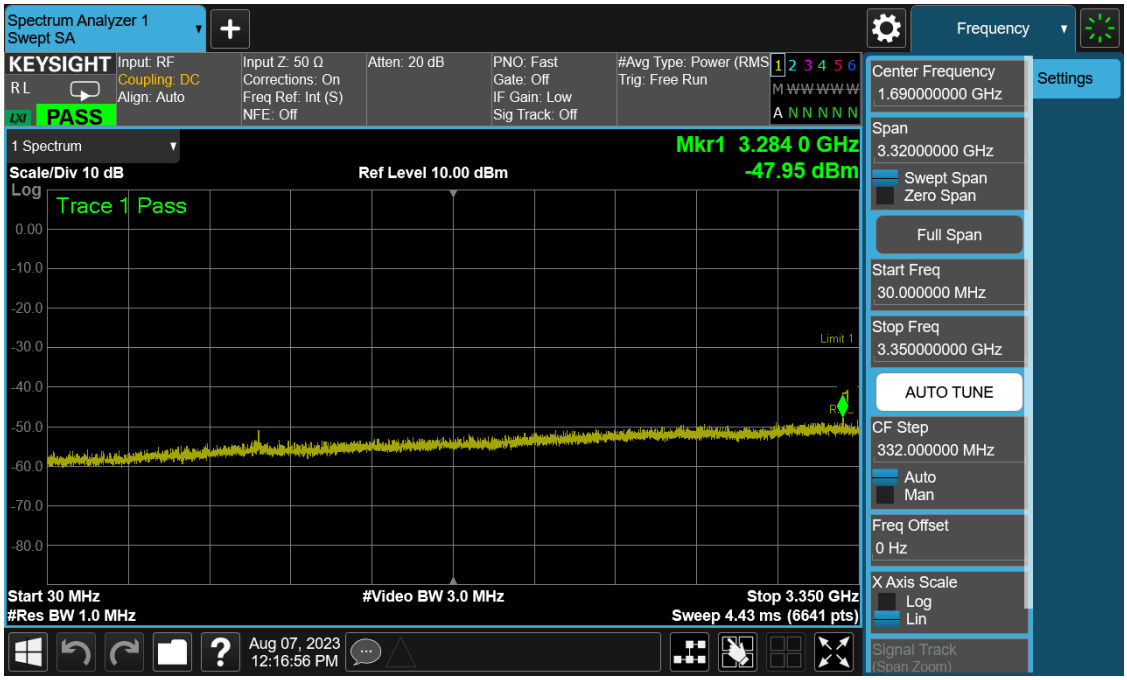


Plot 7-27. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)

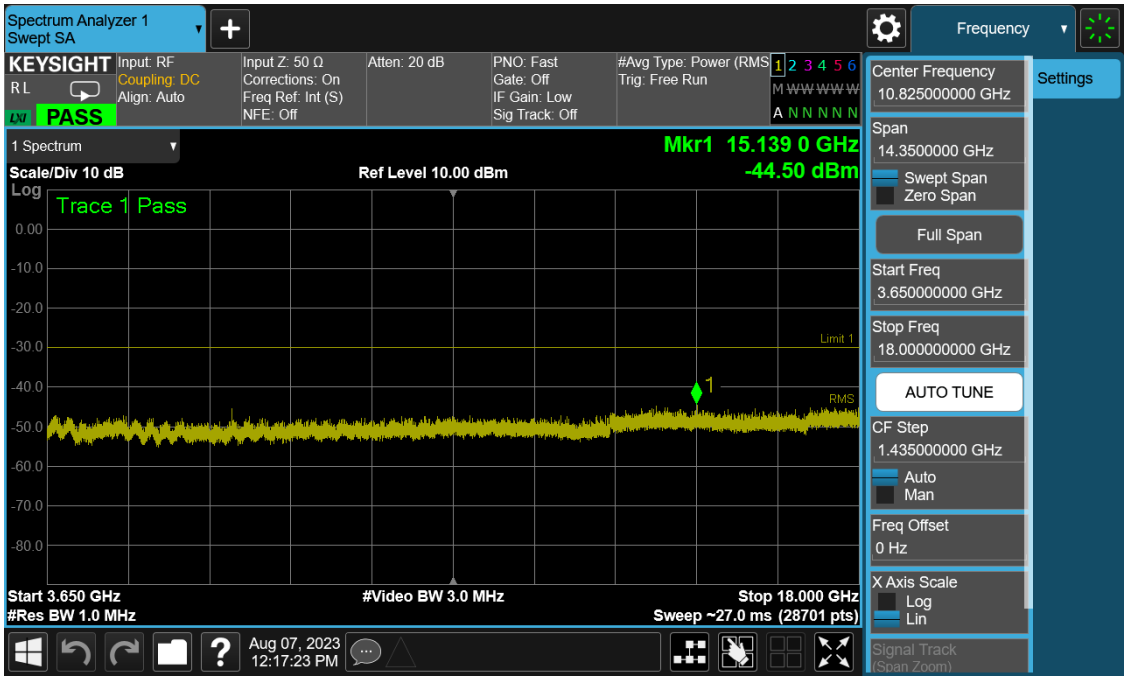


Plot 7-28. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)

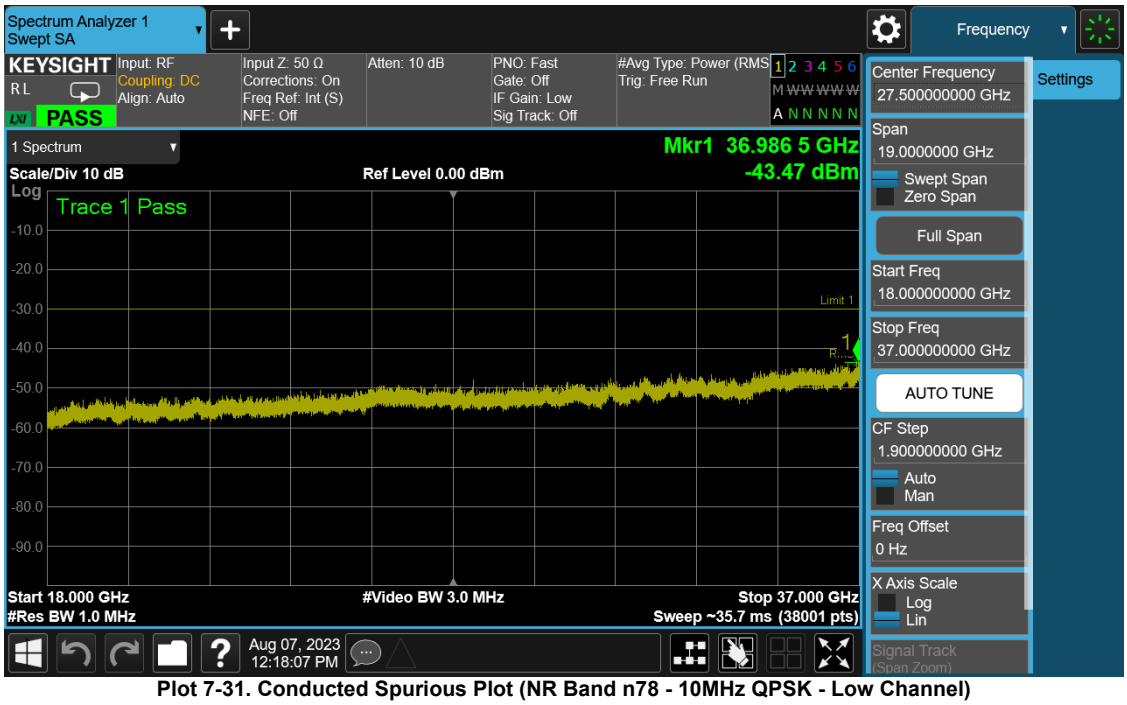
UL-MIMO NR Band n78 – Antenna 1



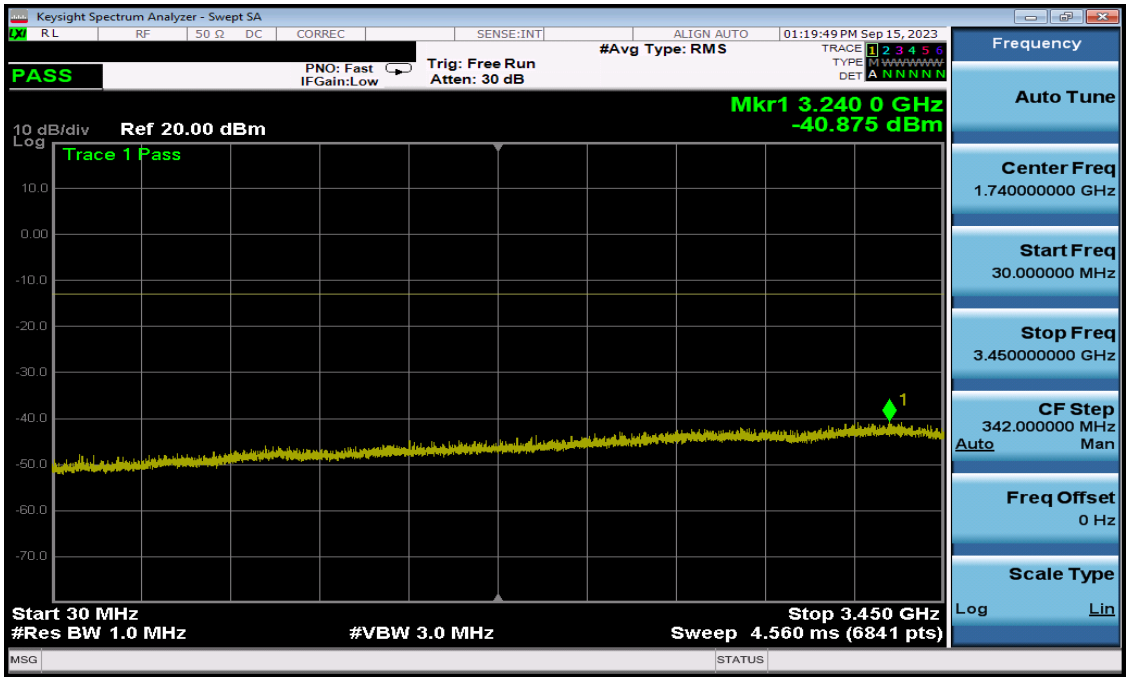
Plot 7-29. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



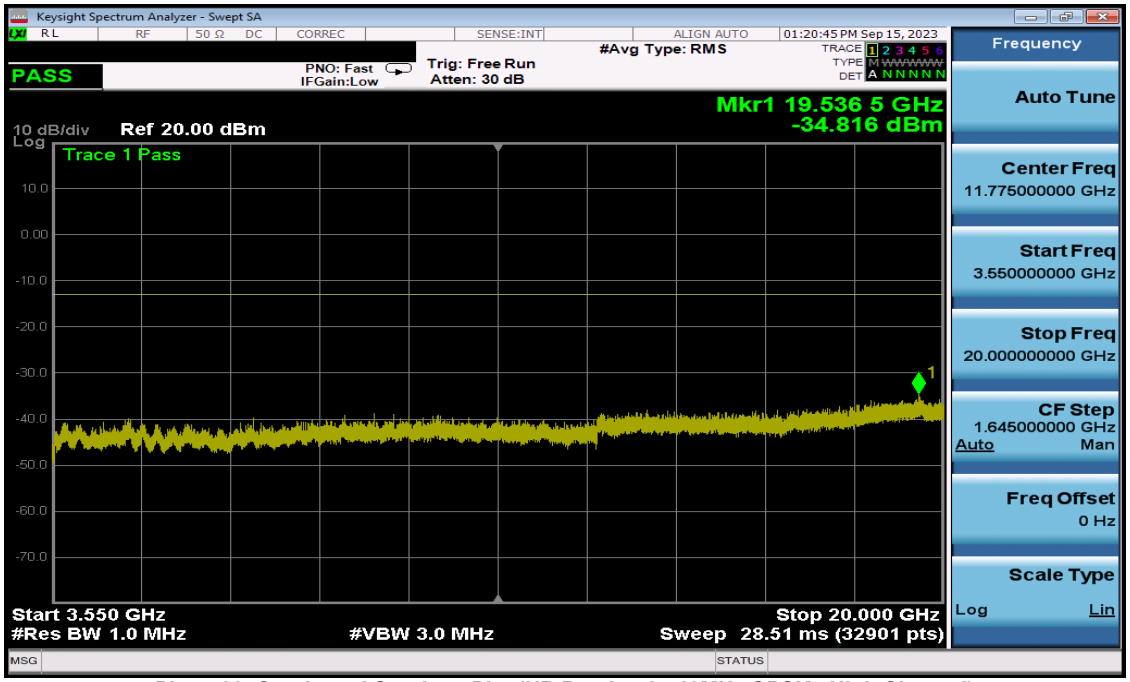
Plot 7-30. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



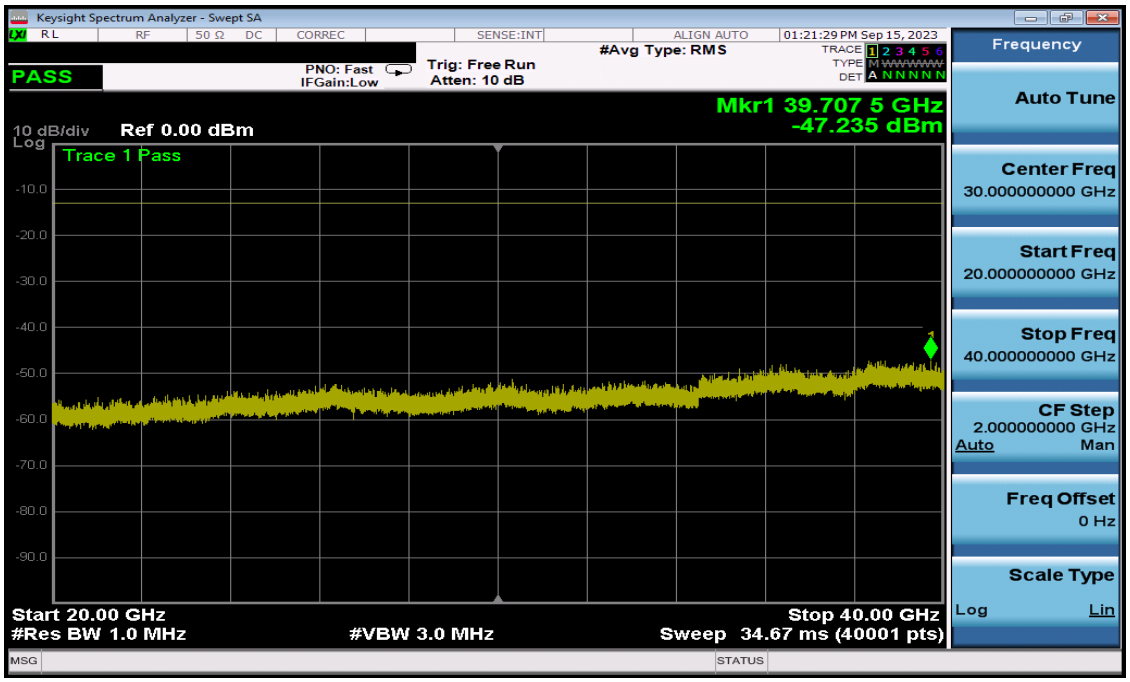
Plot 7-31. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



Plot 7-32. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)

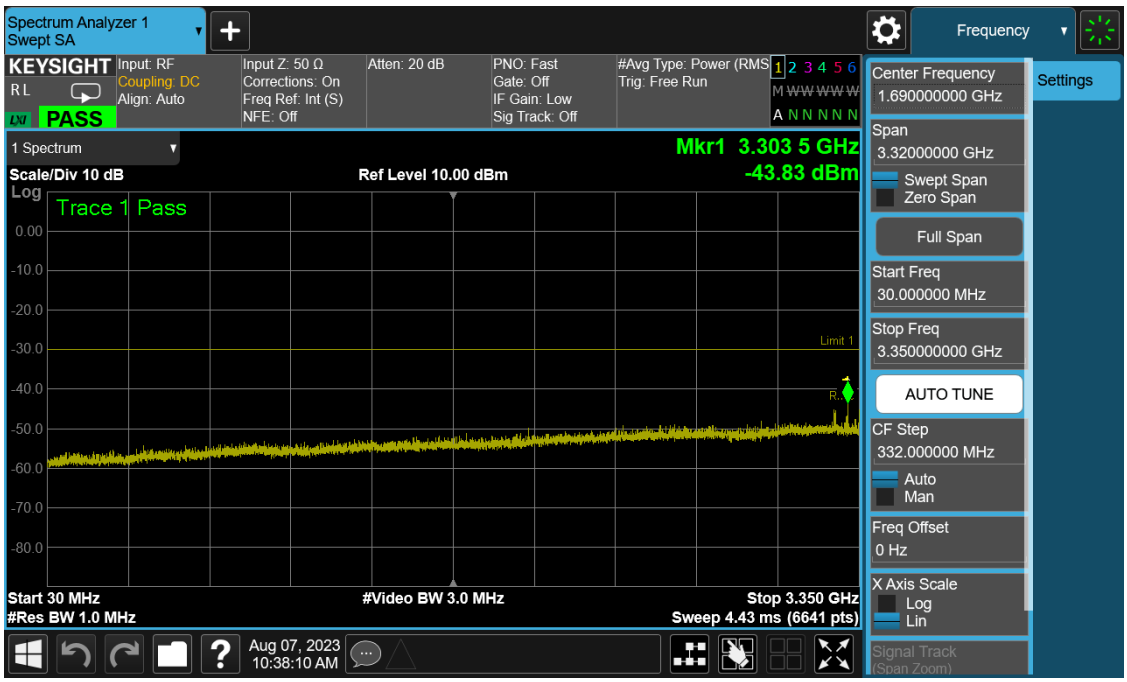


Plot 7-33. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)

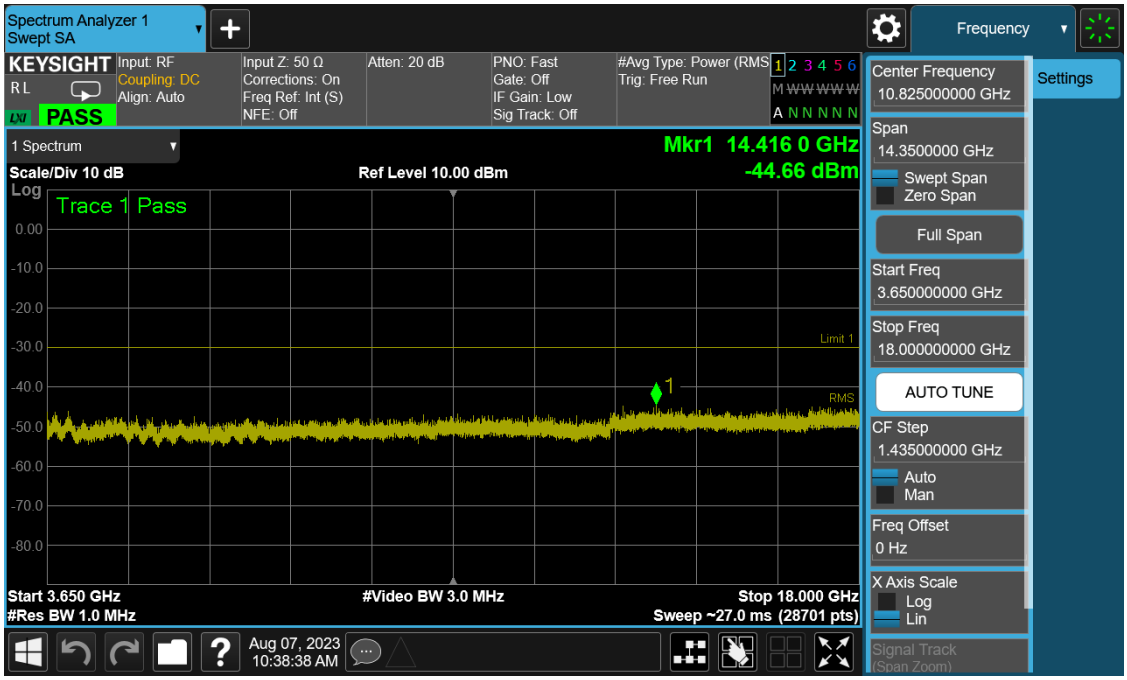


Plot 7-34. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)

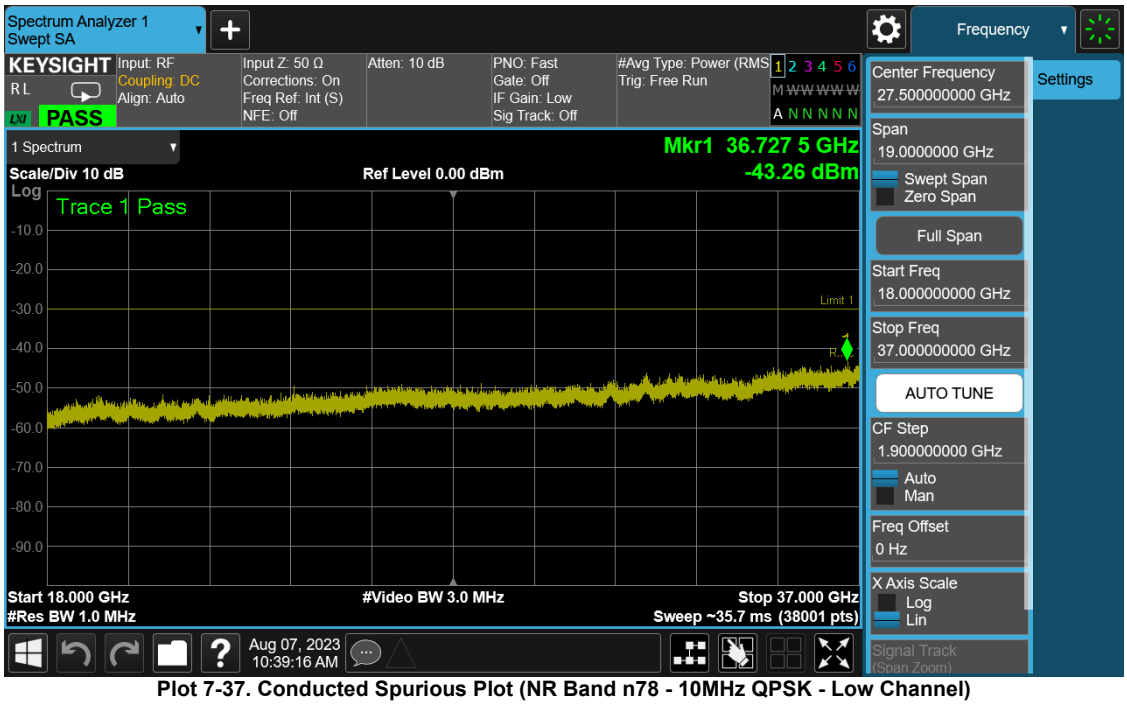
UL-MIMO NR Band n78 – Antenna 3



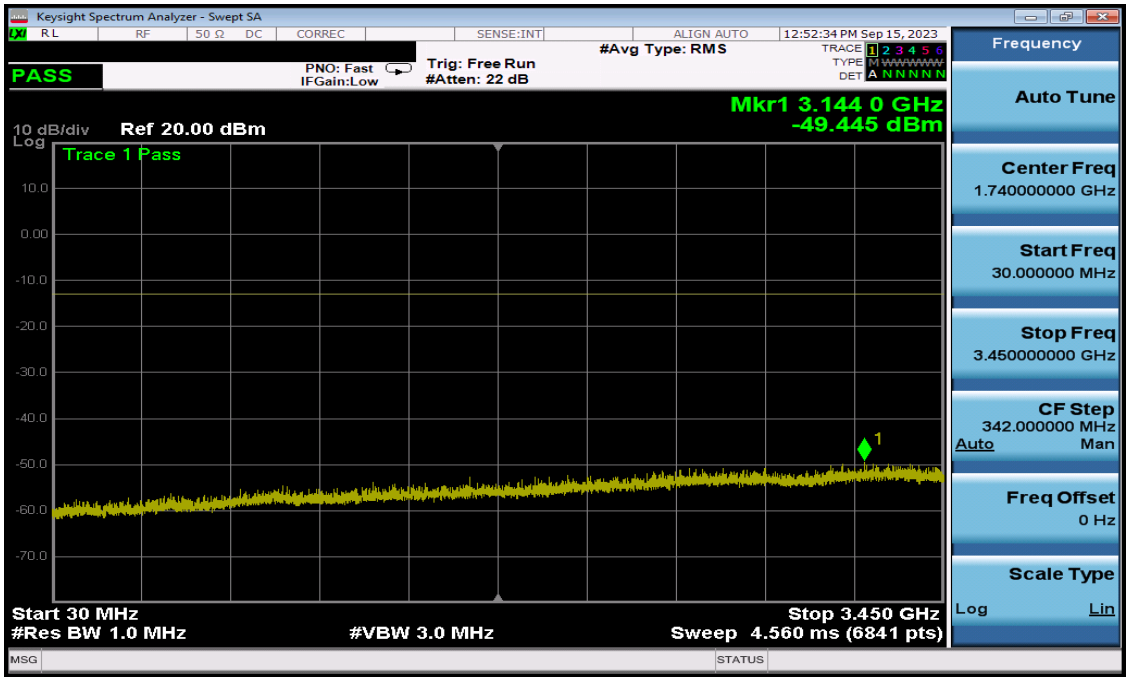
Plot 7-35. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



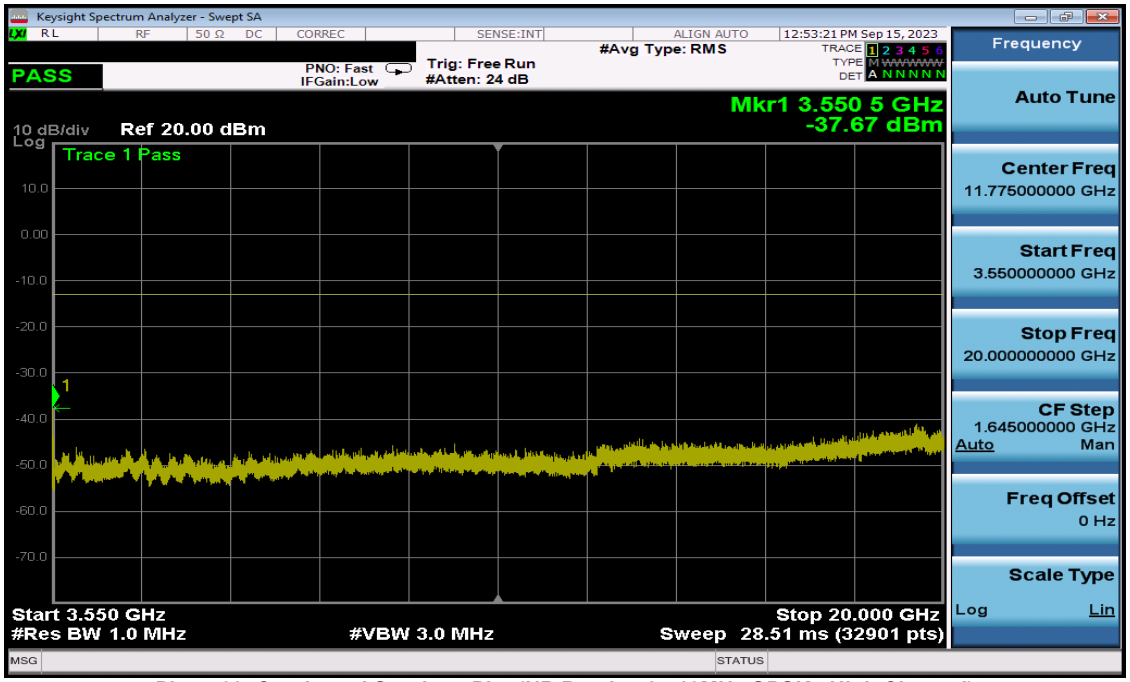
Plot 7-36. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



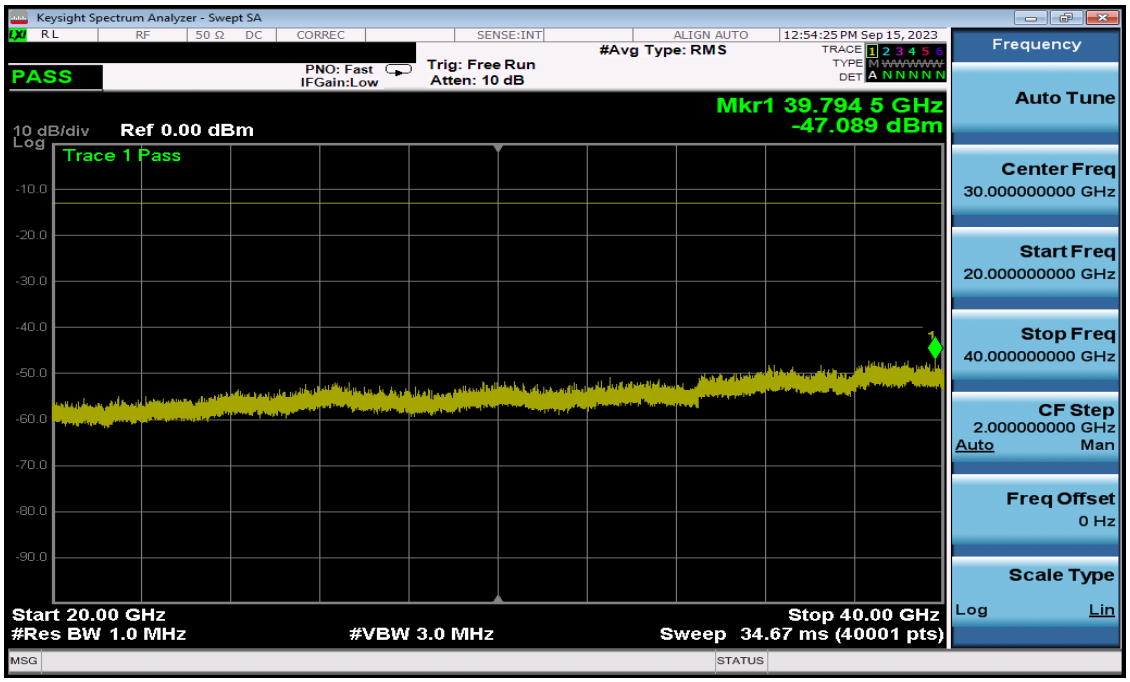
Plot 7-37. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - Low Channel)



Plot 7-38. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)



Plot 7-39. Conducted Spurious Plot (NR Band n78 - 10MHz QPSK - High Channel)



Plot 7-40. Conducted Spurious Plot (NR Band n78 - 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 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 operations in the 3450 – 3550MHz band, the maximum permissible conducted power level of any out-of-band emission is -13dBm/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 for continuous emissions, max hold for pulse emissions
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.

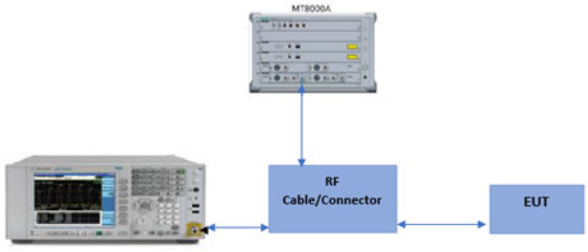


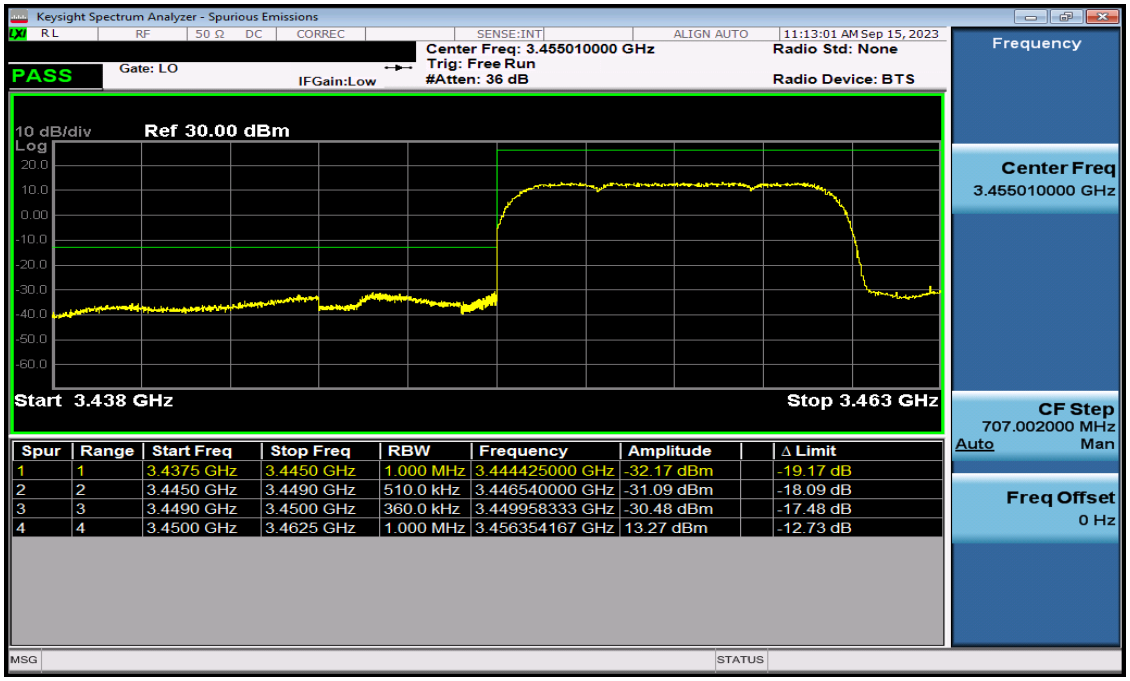
Figure 7-4. Test Instrument & Measurement Setup

Test Notes

1. Per Part 27.53(n), compliance with the -13dBm/MHz conducted power limit for out-of-band emissions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, but limited to a maximum of 200 kHz. In the bands between 1 and 5 MHz removed from the licensee's frequency block, the minimum resolution bandwidth for the measurement shall be 500 kHz.

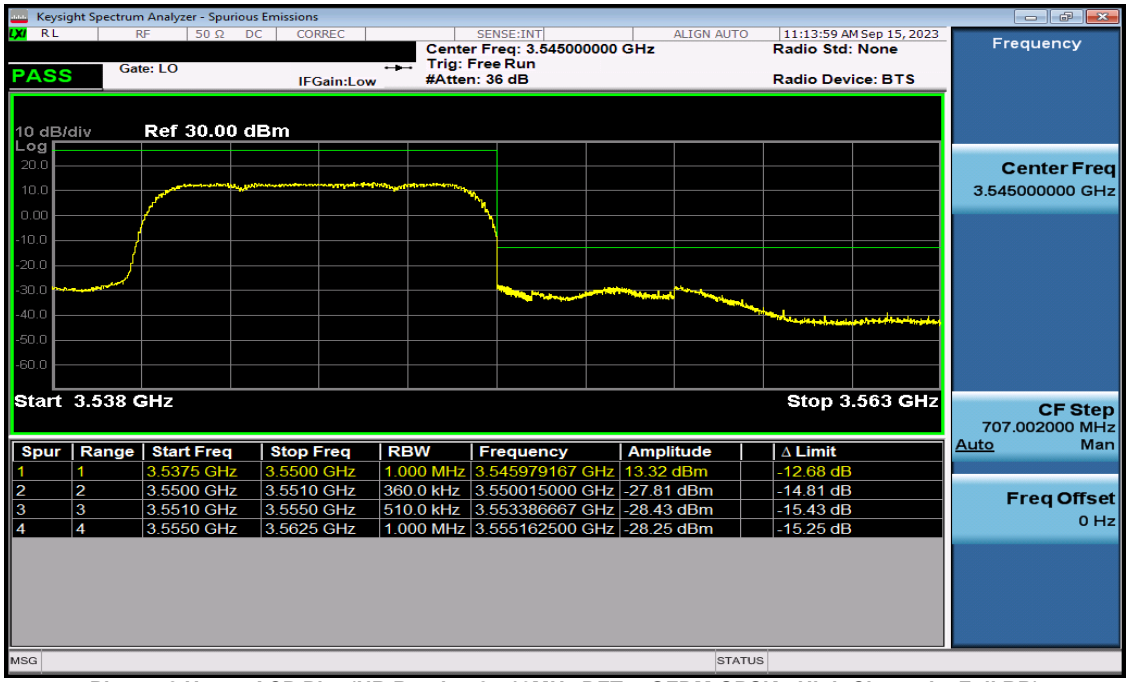
2. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

NR Band n78- HPUE



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	3.4375 GHz	3.4450 GHz	1.000 MHz	3.444425000 GHz	-32.17 dBm	-19.17 dB
2	2	3.4450 GHz	3.4490 GHz	510.0 kHz	3.446540000 GHz	-31.09 dBm	-18.09 dB
3	3	3.4490 GHz	3.4500 GHz	360.0 kHz	3.449958333 GHz	-30.48 dBm	-17.48 dB
4	4	3.4500 GHz	3.4625 GHz	1.000 MHz	3.456354167 GHz	13.27 dBm	-12.73 dB

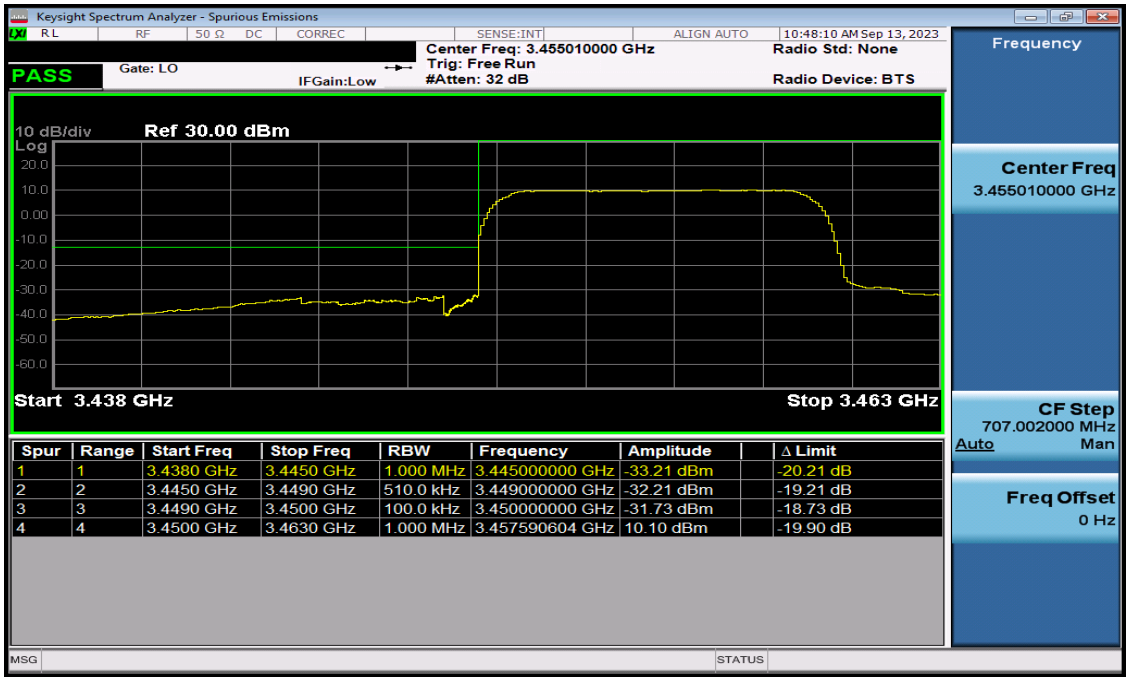
Plot 7-41.Lower ACP Plot (NR Band n78 - 10MHz DFT-s-OFDM QPSK - Low Channel – Full RB)



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	3.5375 GHz	3.5500 GHz	1.000 MHz	3.545979167 GHz	13.32 dBm	-12.68 dB
2	2	3.5500 GHz	3.5510 GHz	360.0 kHz	3.550015000 GHz	-27.81 dBm	-14.81 dB
3	3	3.5510 GHz	3.5550 GHz	510.0 kHz	3.553386667 GHz	-28.43 dBm	-15.43 dB
4	4	3.5550 GHz	3.5625 GHz	1.000 MHz	3.555162500 GHz	-28.25 dBm	-15.25 dB

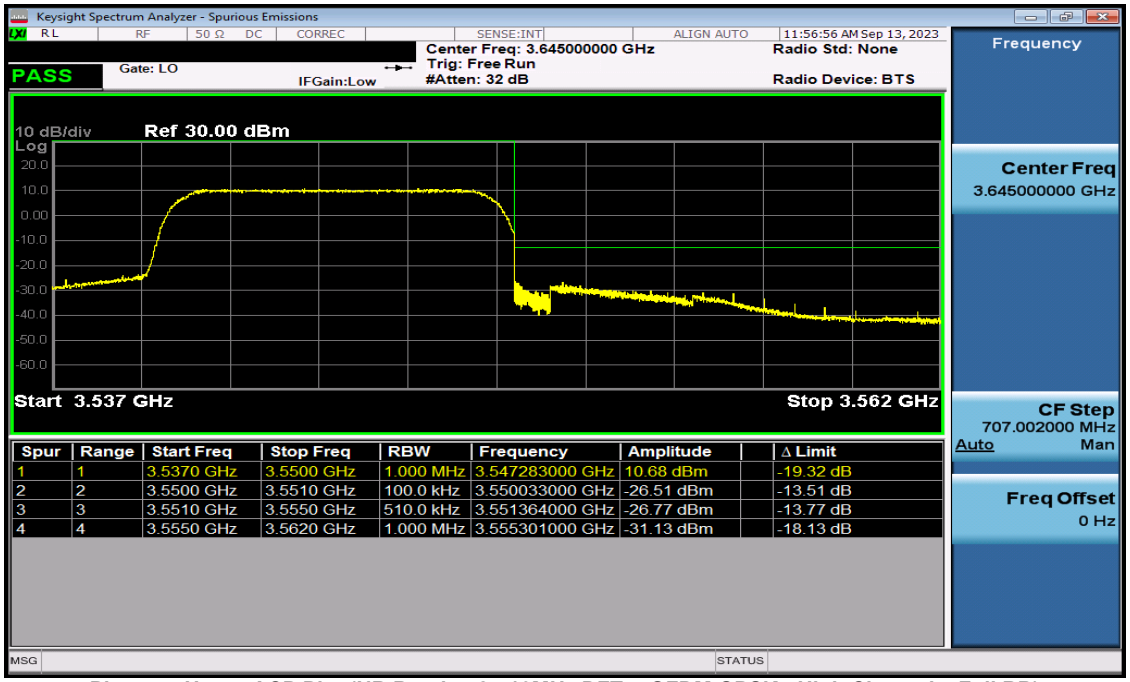
Plot 7-42.Upper ACP Plot (NR Band n78 - 10MHz DFT-s-OFDM QPSK - High Channel – Full RB)

NR Band n78- PC3



Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	3.4380 GHz	3.4450 GHz	1.000 MHz	3.445000000 GHz	-33.21 dBm	-20.21 dB
2	2	3.4450 GHz	3.4490 GHz	510.0 kHz	3.449000000 GHz	-32.21 dBm	-19.21 dB
3	3	3.4490 GHz	3.4500 GHz	100.0 kHz	3.450000000 GHz	-31.73 dBm	-18.73 dB
4	4	3.4500 GHz	3.4630 GHz	1.000 MHz	3.457590604 GHz	10.10 dBm	-19.90 dB

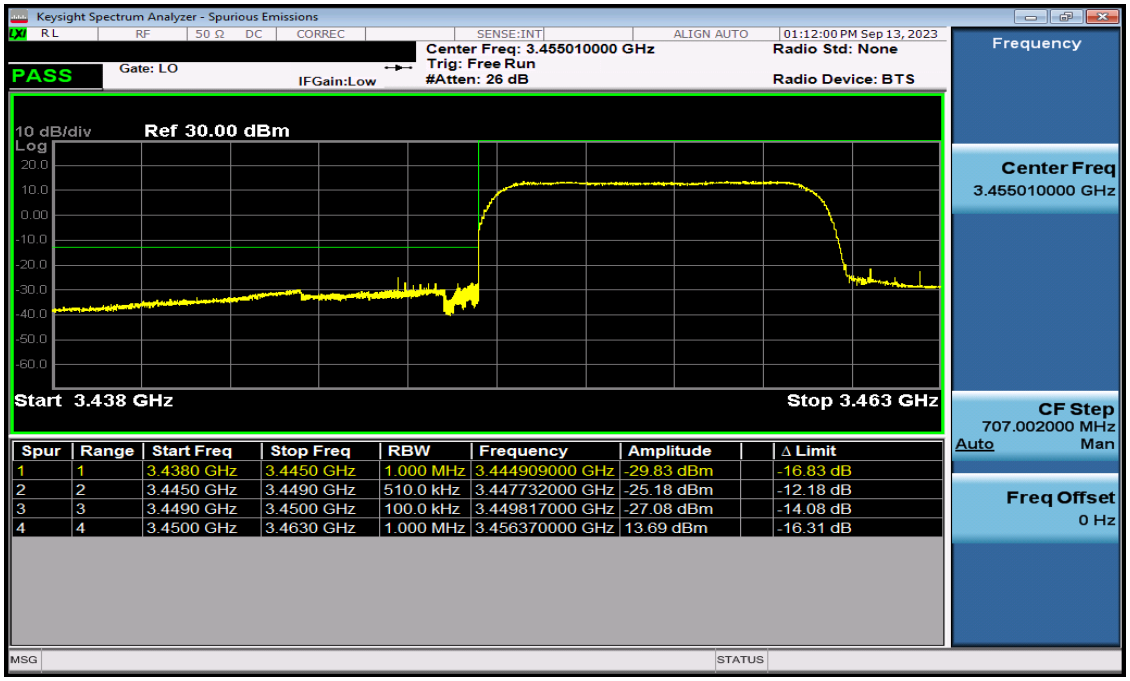
Plot 7-43.Lower ACP Plot (NR Band n78 - 10MHz DFT-s-OFDM QPSK - Low Channel – Full RB)



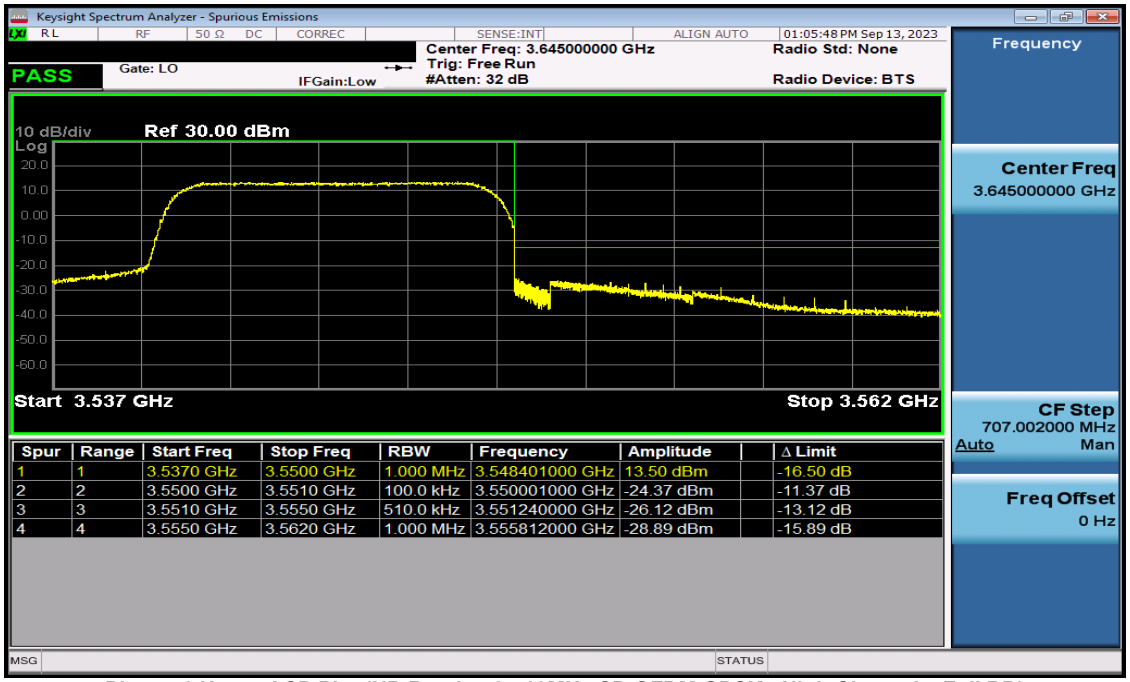
Spur	Range	Start Freq	Stop Freq	RBW	Frequency	Amplitude	Δ Limit
1	1	3.5370 GHz	3.5500 GHz	1.000 MHz	3.547283000 GHz	10.68 dBm	-19.32 dB
2	2	3.5500 GHz	3.5510 GHz	100.0 kHz	3.550033000 GHz	-26.51 dBm	-13.51 dB
3	3	3.5510 GHz	3.5550 GHz	510.0 kHz	3.551364000 GHz	-26.77 dBm	-13.77 dB
4	4	3.5550 GHz	3.5620 GHz	1.000 MHz	3.555301000 GHz	-31.13 dBm	-18.13 dB

Plot 7-44.Upper ACP Plot (NR Band n78 - 10MHz DFT-s-OFDM QPSK - High Channel – Full RB)

UL-MIMO NR Band n78 – Antenna 1

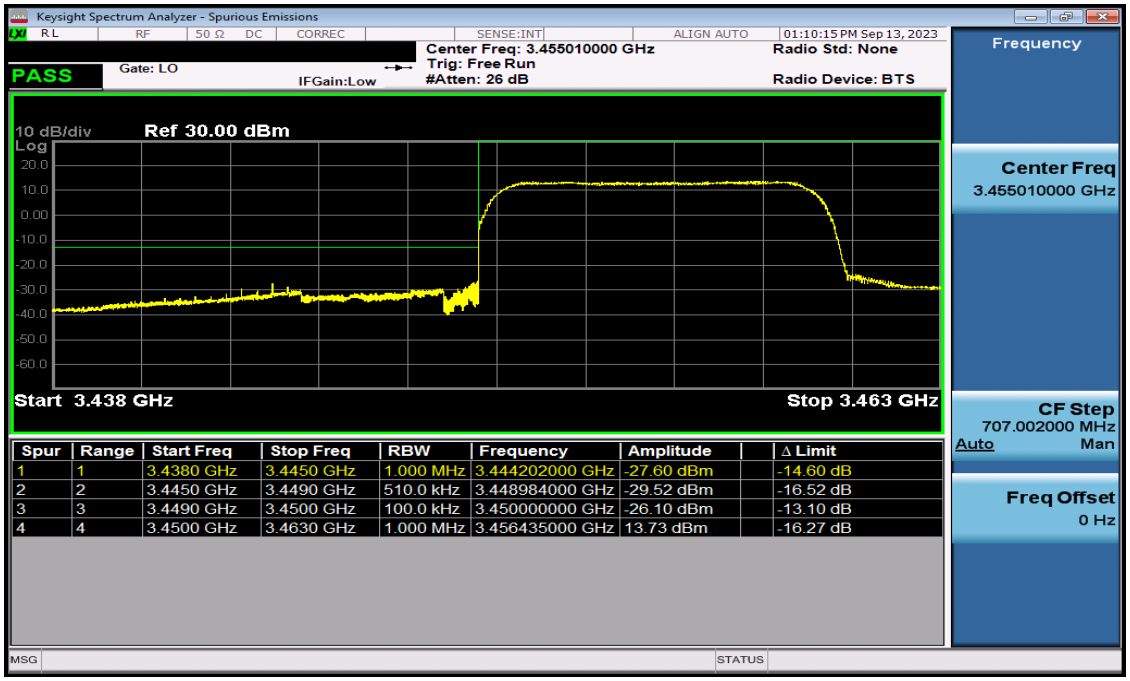


Plot 7-45.Lower ACP Plot (NR Band n78 - 10MHz CP-OFDM QPSK - Low Channel – Full RB)

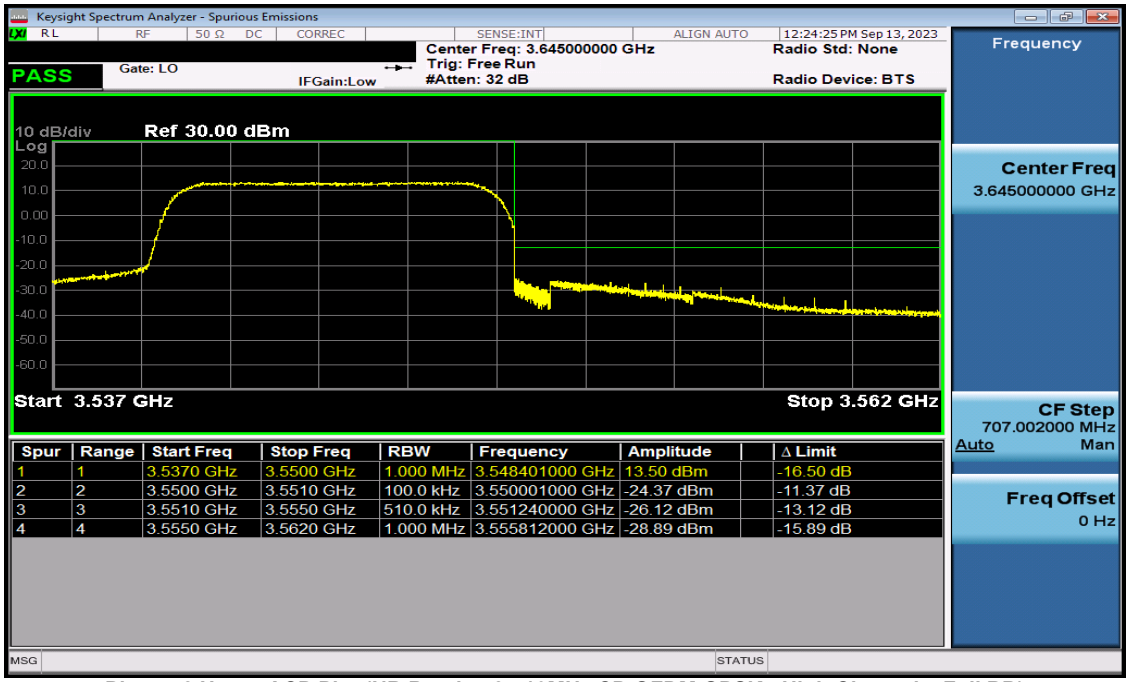


Plot 7-46.Upper ACP Plot (NR Band n78 - 10MHz CP-OFDM QPSK - High Channel – Full RB)

UL-MIMO NR Band n78 – Antenna 3



Plot 7-47.Lower ACP Plot (NR Band n78 - 10MHz CP-OFDM QPSK - Low Channel – Full RB)



Plot 7-48.Upper ACP Plot (NR Band n78 - 10MHz CP-OFDM QPSK - High Channel – Full RB)

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.

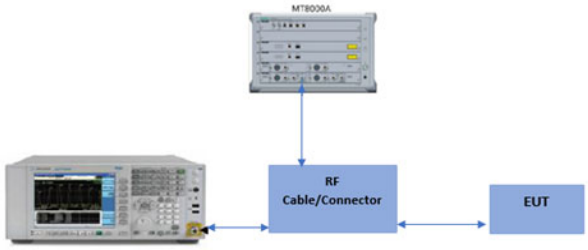


Figure 7-5. Test Instrument & Measurement Setup

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.

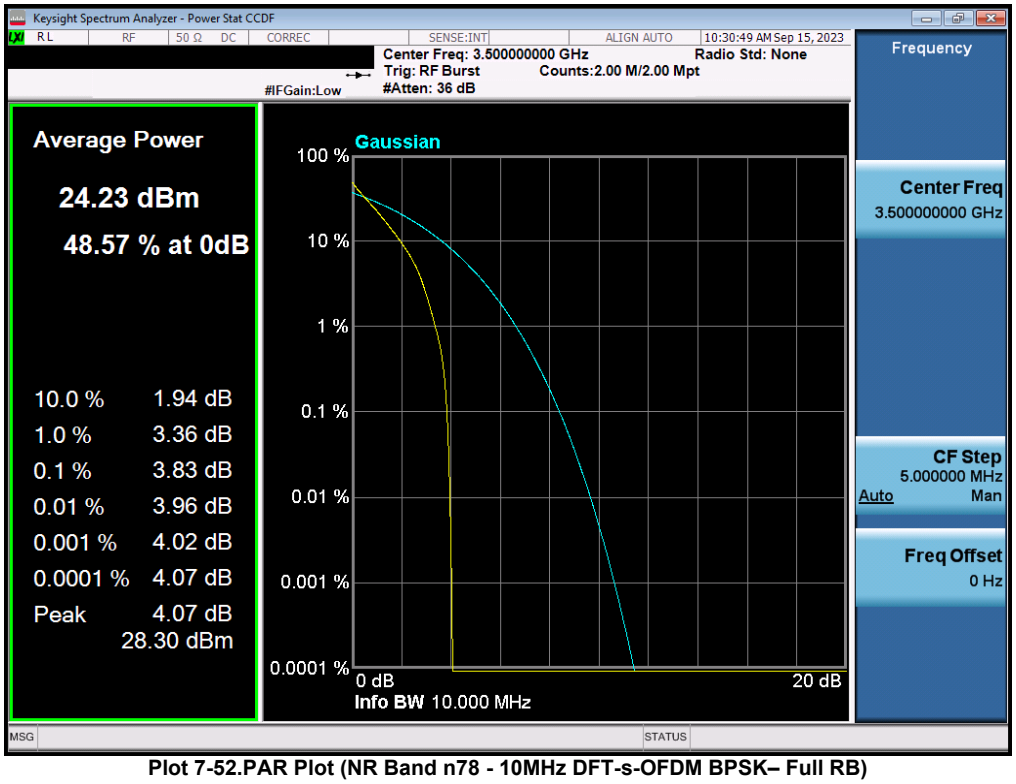
NR Band n78- HPUE

Plot 7-49.PAR Plot (NR Band n78 - 10MHz DFT-s-OFDM BPSK– Full RB)

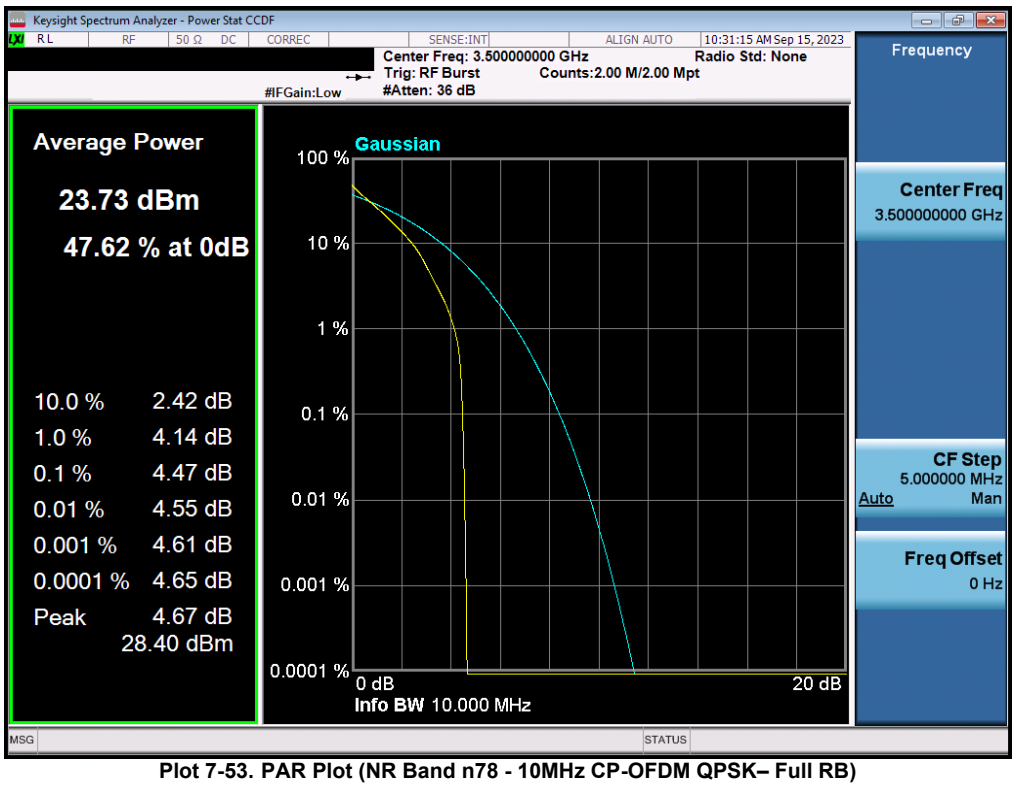
Plot 7-50. PAR Plot (NR Band n78 - 10MHz CP-OFDM QPSK– Full RB)

Plot 7-51. PAR Plot (NR Band n78 - 10MHz CP-OFDM 256-QAM– Full RB)

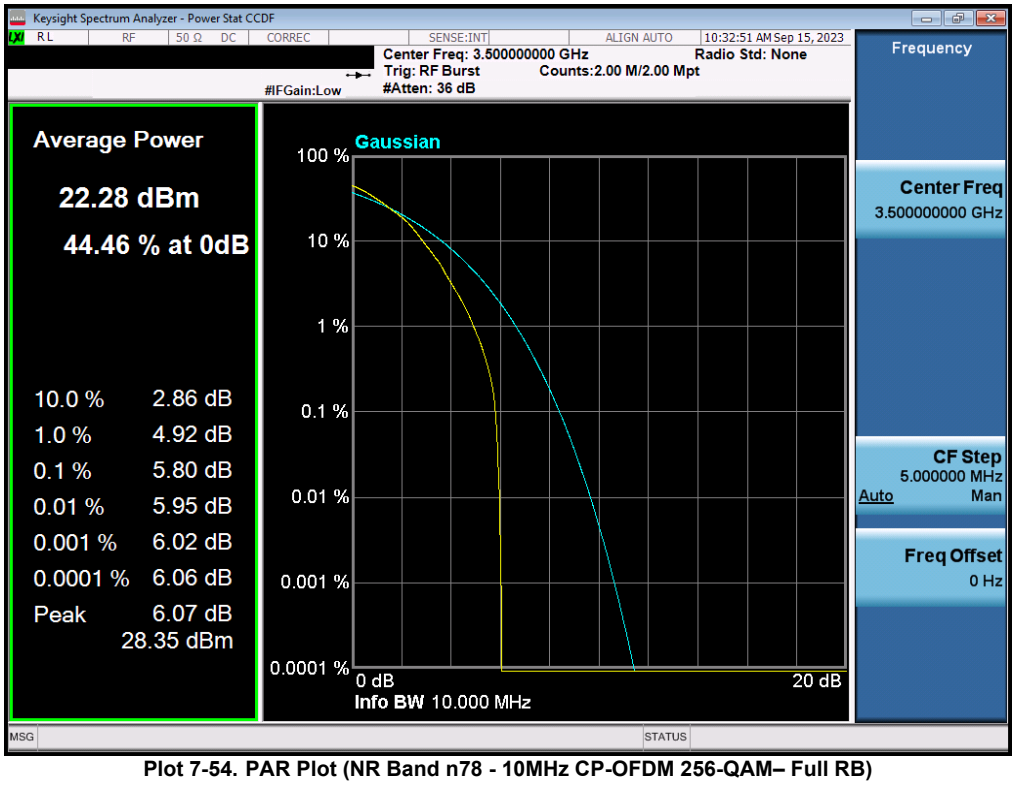
NR Band n78- PC3



Plot 7-52.PAR Plot (NR Band n78 - 10MHz DFT-s-OFDM BPSK– Full RB)

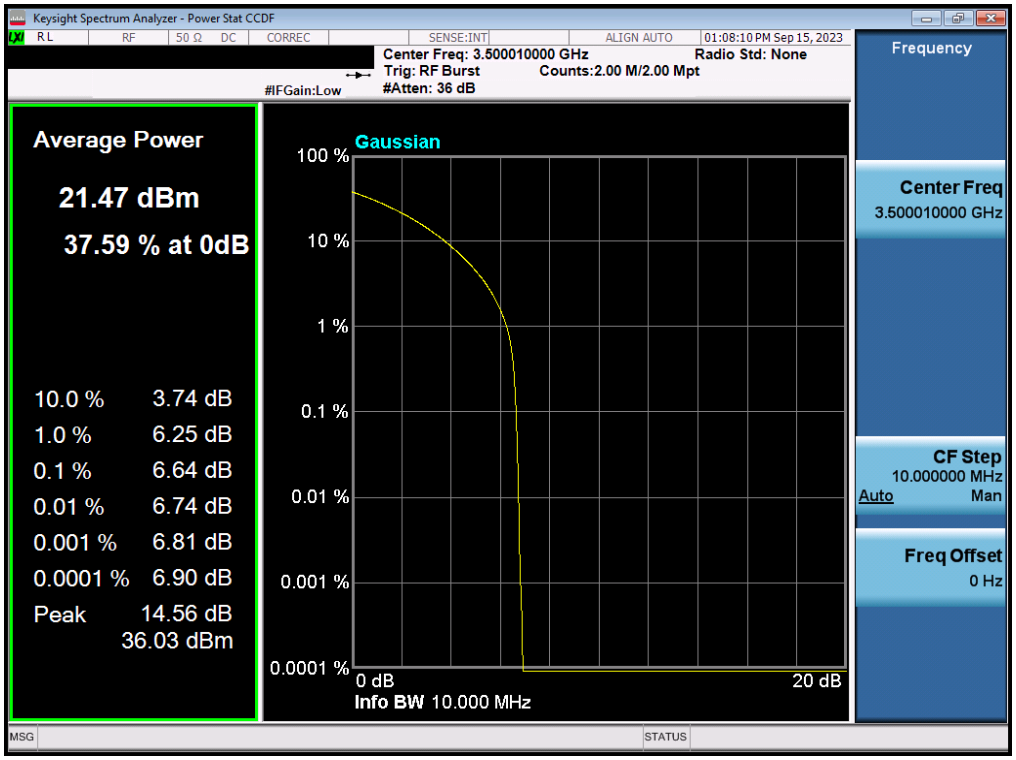


Plot 7-53. PAR Plot (NR Band n78 - 10MHz CP-OFDM QPSK– Full RB)

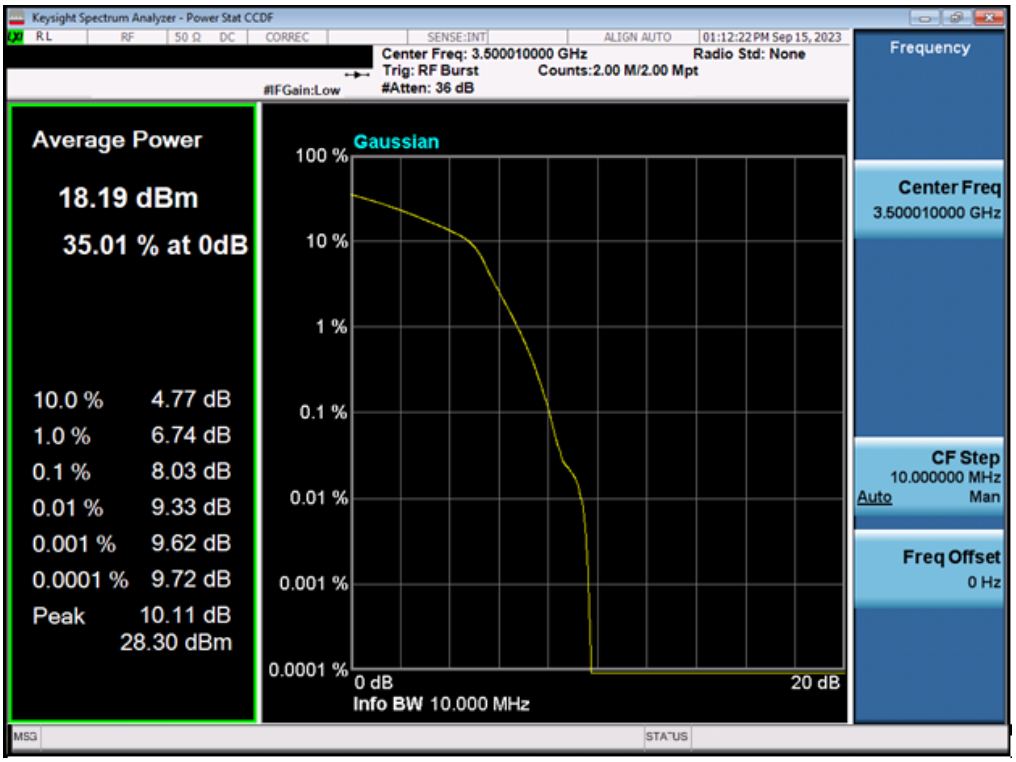


Plot 7-54. PAR Plot (NR Band n78 - 10MHz CP-OFDM 256-QAM– Full RB)

UL-MIMO NR Band n78 – Antenna 1

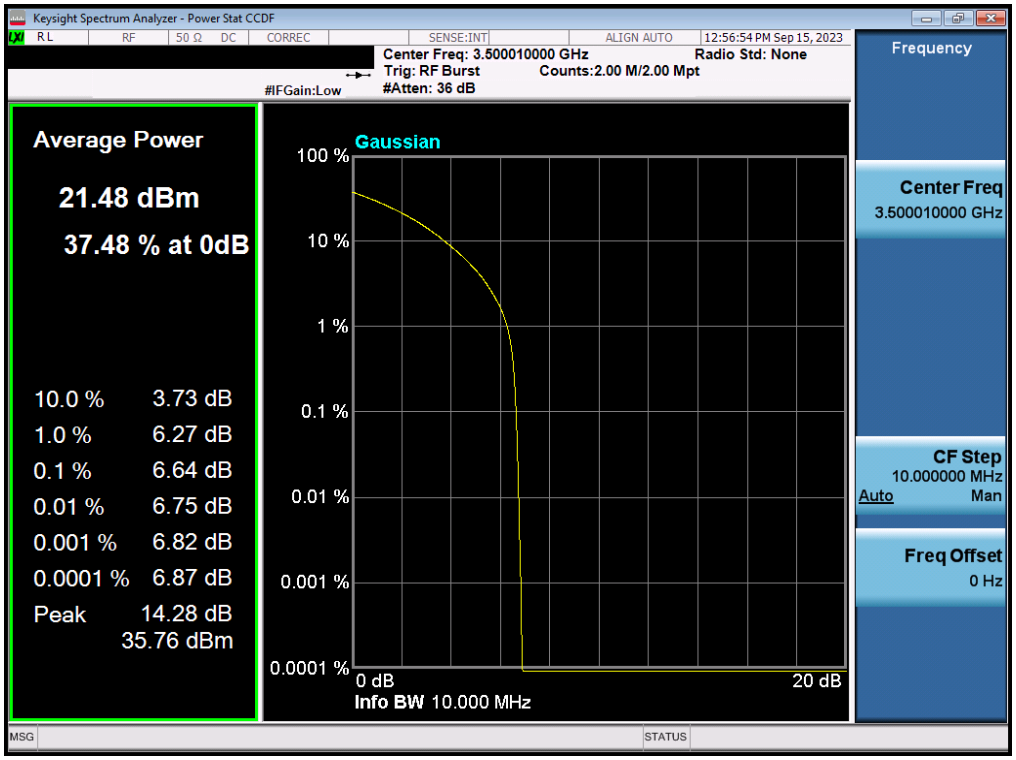


Plot 7-55. PAR Plot (NR Band n78 - 10MHz CP-OFDM QPSK– Full RB)

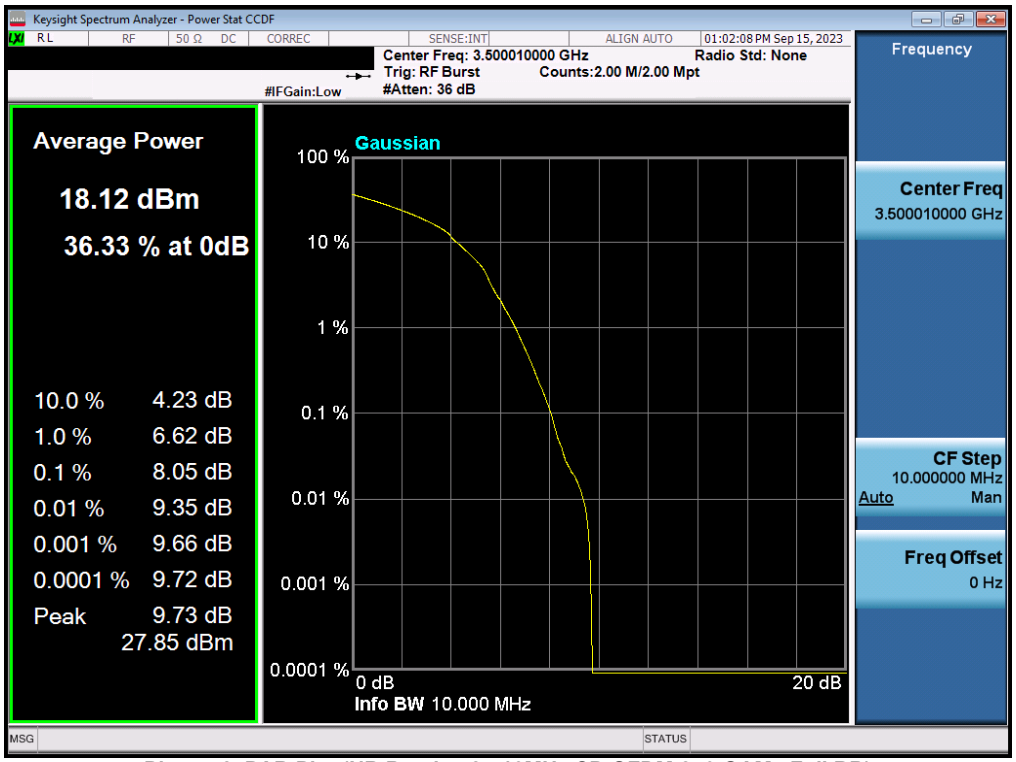


Plot 7-56. PAR Plot (NR Band n78 - 10MHz CP-OFDM 256-QAM– Full RB)

UL-MIMO NR Band n78 – Antenna 3



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)

7.7 Radiated Spurious Emissions Measurements

Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in ANSI C63.26-2015 with the EUT transmitting into an external antenna. Measurements on signals operating below 1GHz are performed using hybrid (biconical/log) antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

ANSI C63.26-2015 – Section 5.5.4

Test Settings

1. RBW = 1MHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

Test Setup

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

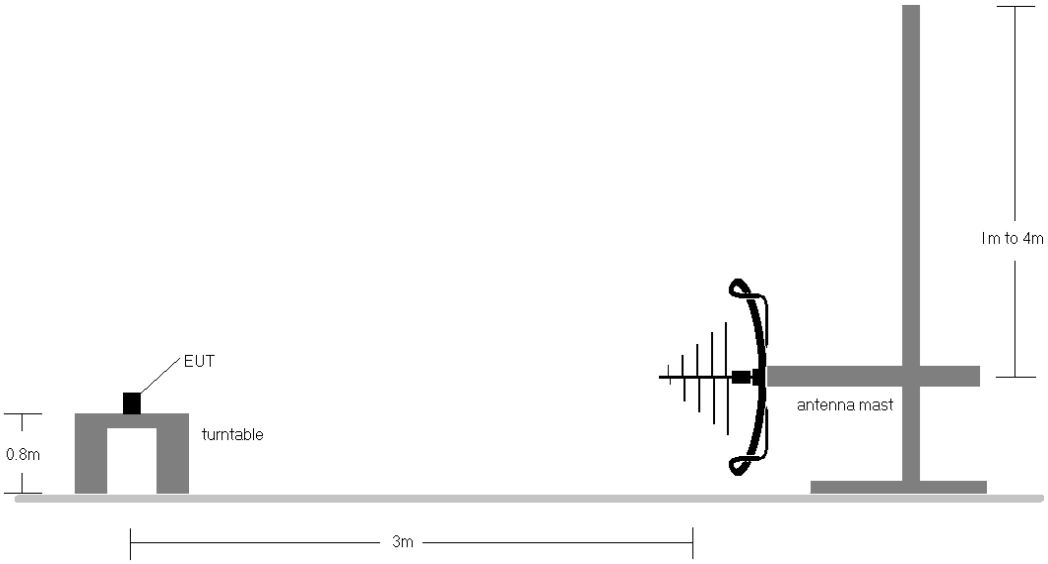


Figure 7-6. Test Instrument & Measurement Setup < 1GHz

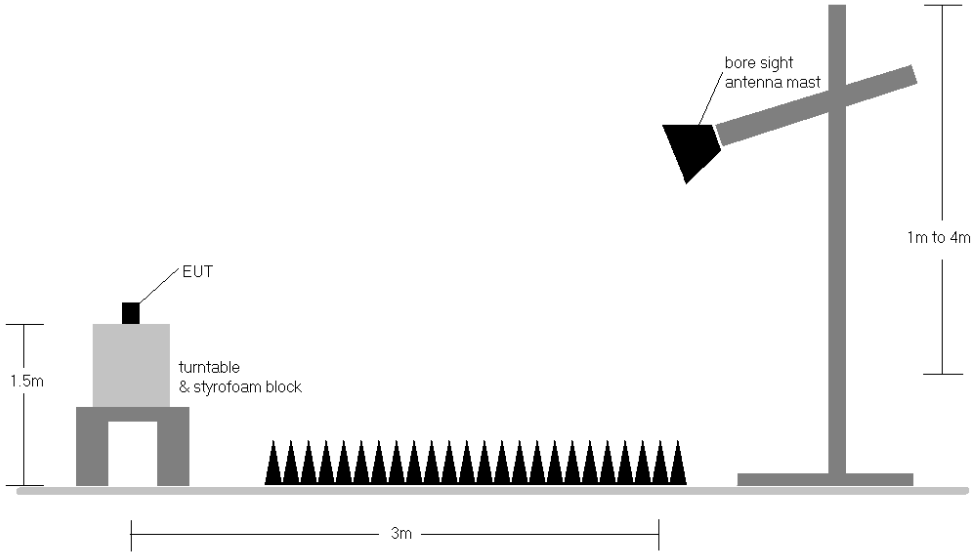


Figure 7-7. Test Instrument & Measurement Setup >1 GHz

Test Notes

1) Field strengths are calculated using the Measurement quantity conversions in ANSI C63.26-2015 Section 5.2.7:

   b) E(dBµV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m)
   d) EIRP (dBm) = E(dBµV/m) + 20logD – 104.8; where D is the measurement distance in meters.

2) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

3) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

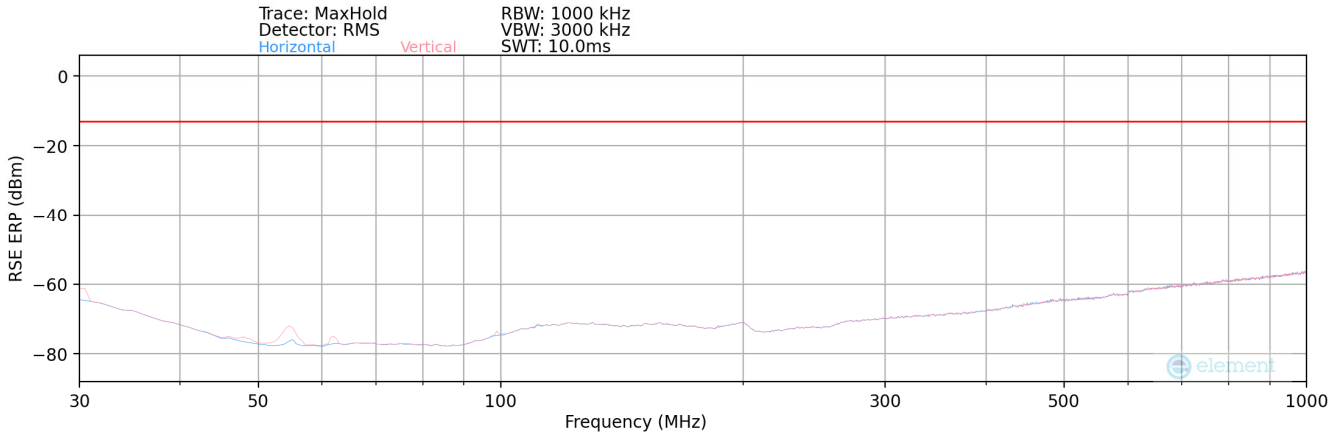
4) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

5) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

6) 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.

7) Spurious emissions shown in this section are measured while operating in EN-DC mode with Sub 6GHz NR carrier as well as an LTE carrier (anchor). Spurious emissions from the NR carrier device, is subject to the rules under which the NR carrier operates. Spurious emissions caused by the LTE carrier must meet the requirements of the rules under which the LTE carrier operates.

NR Band n78

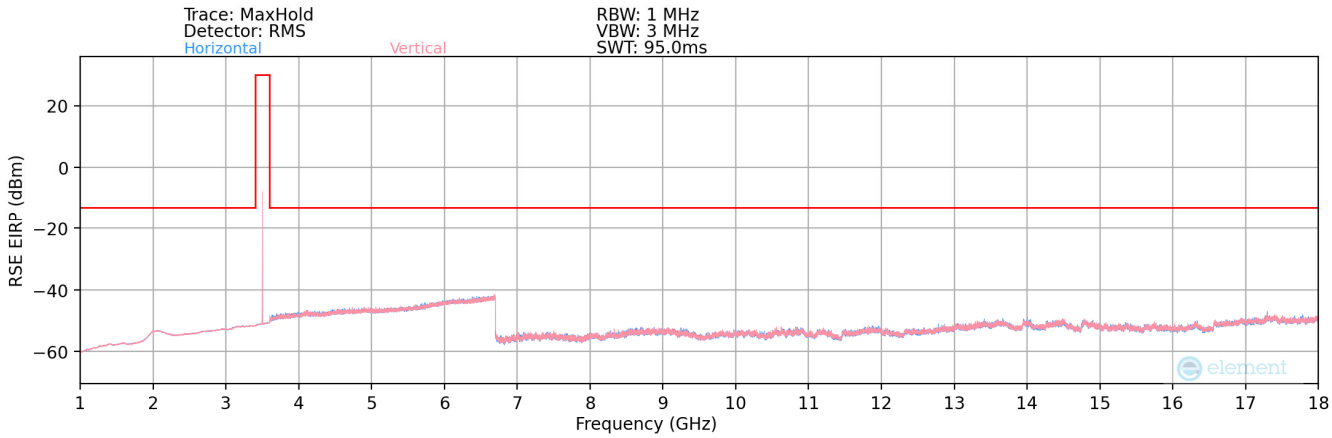


Plot 7-59. Radiated Spurious Plot Below 1GHz (NR Band 78)

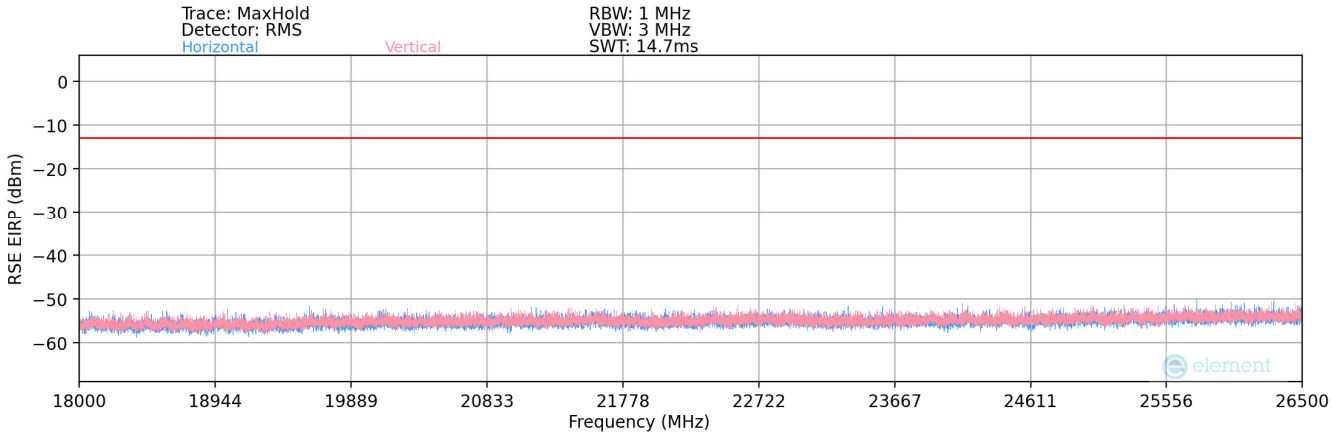
Bandwidth (MHz):	10
Frequency (MHz):	3545.00
RB / Offset:	1 / 12
Mode:	Stand Alone

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	ERP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
108.40	V	-	-	-80.46	19.18	45.72	-51.69	-13.00	-38.69

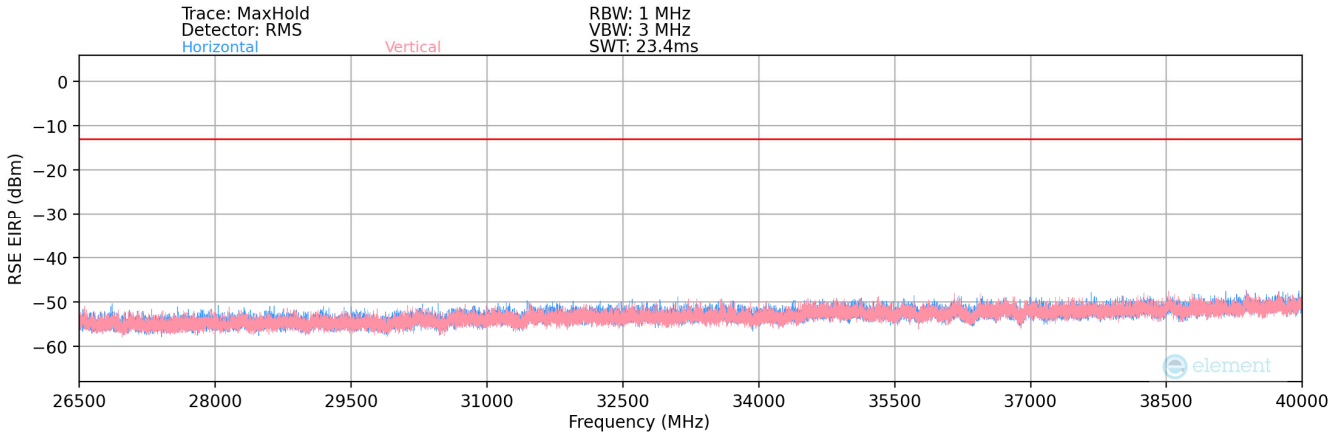
Table 7-4. Radiated Spurious Data (NR Band n78)



Plot 7-60. Radiated Spurious Plot Above 1GHz (NR Band 78)



Plot 7-61. Radiated Spurious Plot Above 18GHz (NR Band 78)



Plot 7-62. Radiated Spurious Plot Above 26.5GHz (NR Band 78)

Bandwidth (MHz):	10
Frequency (MHz):	3455.00
RB / Offset:	1 / 12
Mode:	Stand Alone

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
6910.00	V	-	-	-76.60	8.91	39.31	-55.95	-13.00	-42.95
10365.00	V	372	241	-66.67	11.67	52.00	-43.26	-13.00	-30.26
13820.00	V	333	290	-76.06	15.83	46.77	-48.49	-13.00	-35.49
17275.00	V	-	-	-78.31	17.27	45.96	-49.29	-13.00	-36.29
20730.00	V	-	-	-56.01	3.52	54.51	-50.29	-13.00	-37.29
24185.00	V	-	-	-56.37	4.45	55.08	-49.72	-13.00	-36.72

Table 7-5. Radiated Spurious Data (NR Band n78 – Low Channel)

Bandwidth (MHz):	10
Frequency (MHz):	3500.00
RB / Offset:	1 / 12
Mode:	Stand Alone

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
7000.00	V	-	-	-76.25	8.71	39.46	-55.80	-13.00	-42.80
10500.00	V	263	60	-68.59	11.97	50.38	-44.88	-13.00	-31.88
14000.00	V	389	58	-77.56	15.96	45.40	-49.86	-13.00	-36.86
17500.00	V	-	-	-78.40	17.31	45.91	-49.35	-13.00	-36.35
21000.00	V	-	-	-56.68	3.66	53.98	-50.82	-13.00	-37.82
24500.00	V	-	-	-56.66	4.10	54.44	-50.36	-13.00	-37.36

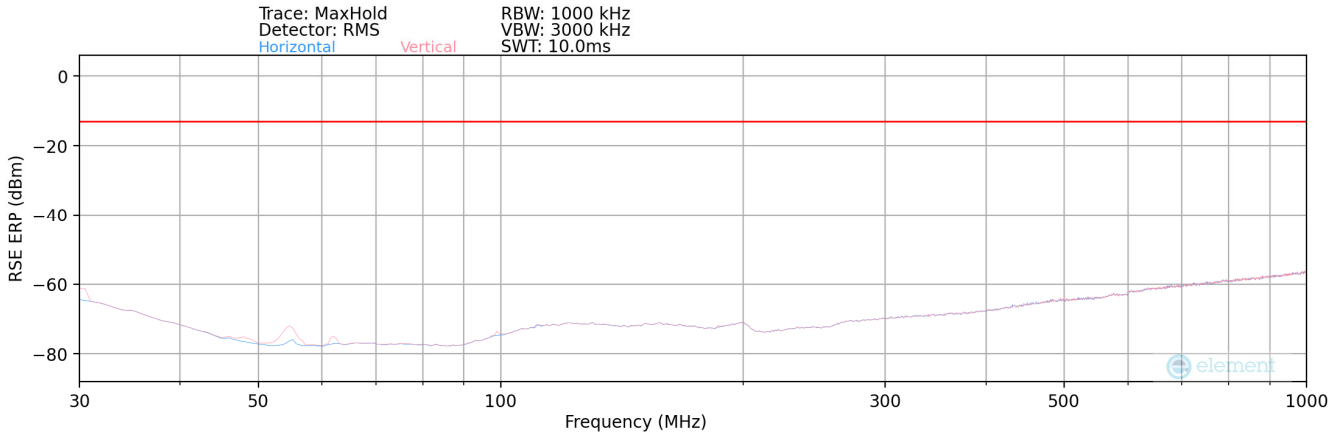
Table 7-6. Radiated Spurious Data (NR Band n78 – Mid Channel)

Bandwidth (MHz):	10
Frequency (MHz):	3545.00
RB / Offset:	1 / 12
Mode:	Stand Alone

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
7090.00	V	-	-	-76.14	8.61	39.47	-55.79	-13.00	-42.79
10635.00	V	394	59	-68.65	13.06	51.41	-43.85	-13.00	-30.85
14180.00	V	-	-	-78.55	15.68	44.13	-51.13	-13.00	-38.13
17725.00	V	-	-	-78.78	16.92	45.14	-50.11	-13.00	-37.11
21270.00	V	-	-	-55.17	3.97	55.80	-49.00	-13.00	-36.00

Table 7 -7. Radiated Spurious Data (NR Band n78 – High Channel)

UL-MIMO NR Band n78

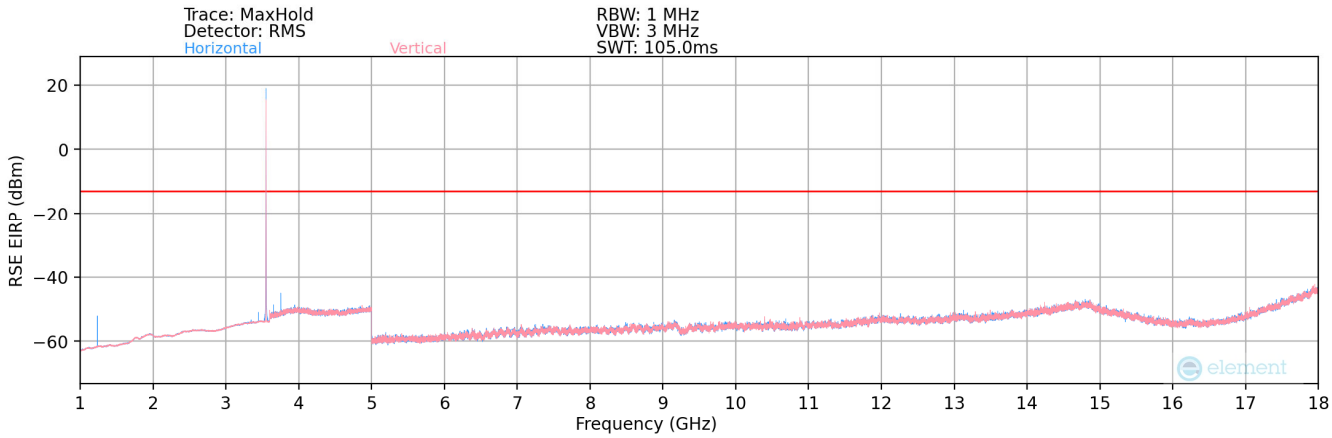


Plot 7-63. Radiated Spurious Plot Below 1GHz (UL-MIMO NR Band 78)

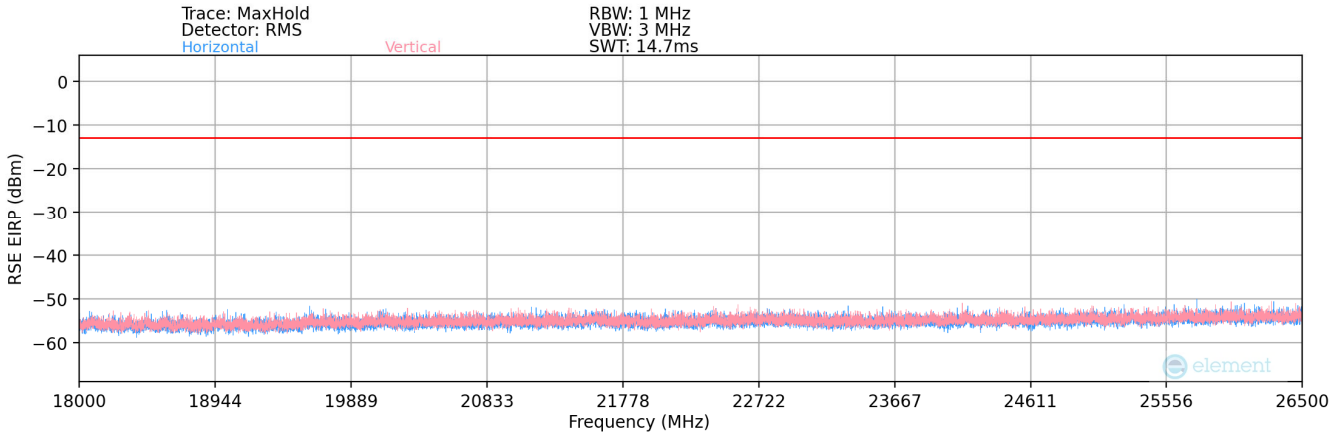
Bandwidth (MHz):	10
Frequency (MHz):	3550.00
RB / Offset:	1/12
Mode:	UL-MIMO

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	ERP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
532.00	H	-	-	-86.20	25.96	46.76	-50.65	-13.00	-37.65

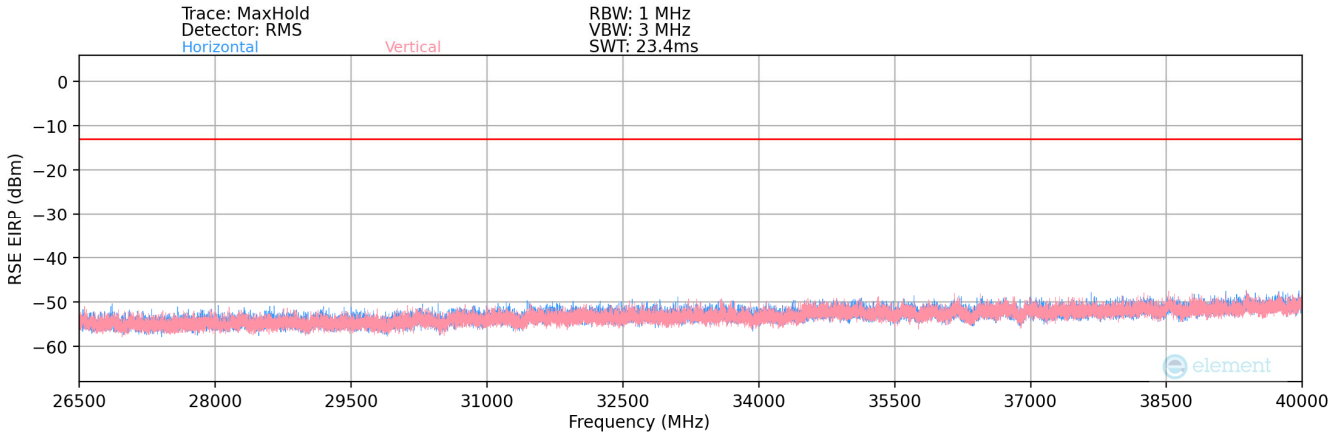
Table 7-8. Radiated Spurious Data (UL-MIMO NR Band n78)



Plot 7-64. Radiated Spurious Plot Above 1GHz (UL-MIMO NR Band 78)



Plot 7-65. Radiated Spurious Plot Above 18GHz (UL-MIMO NR Band 78)



Plot 7-66. Radiated Spurious Plot Above 26.5GHz (UL-MIMO NR Band 78)

Bandwidth (MHz):	10
Frequency (MHz):	3455.00
RB / Offset:	1/12
Mode:	UL-MIMO

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
6910.00	H	113	4	-71.91	2.86	37.95	-57.31	-13.00	-44.31
10365.00	H	-	-	-76.56	7.47	37.91	-57.35	-13.00	-44.35
13820.00	H	-	-	-75.86	10.67	41.81	-53.44	-13.00	-40.44
17275.00	H	-	-	-75.27	12.04	43.77	-51.49	-13.00	-38.49

Table 7-9. Radiated Spurious Data (UL-MIMO NR Band n78 – Low Channel)

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Telit Module FCC ID: RI7FN990A40** complies with all the requirements of Part 27 of the FCC rules.