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Part 96 MEASUREMENT REPORT

Applicant Name:
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Gyeonggi-do, 16677, Korea

Date of Testing:
06/10/2024 - 07/18/2024
Test Report Issue Date:
08/02/2024
Test Site/Location:
Element lab., Gyeonggi-do, South Korea
Test Report Serial No.:
1M2405140039-07.A3L

FCC ID:	**A3LSMX828U**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-X828U
EUT Type:	Portable Tablet
FCC Classification:	Citizens Band End User Devices (CBE)
FCC Rule Part(s):	96
Test Procedure(s):	ANSI C63.26-2015, KDB 940660 D01 v03, WINNF-TS-0122 v1.0.2

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.

Prepared by

Reviewed by

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MEASUREMENT REPORT
FCC Part 96

Antenna-1						
Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
LTE Band 48 ULCA	40 MHz	QPSK	3570.0 - 3680.0	0.102	20.10	37M6G7D
		16QAM	3570.0 - 3680.0	0.074	18.67	37M8W7D
	35 MHz	QPSK	3567.5 - 3682.5	0.108	20.35	32M8G7D
		16QAM	3567.5 - 3682.5	0.073	18.66	32M8W7D
	30 MHz	QPSK	3565.0 - 3685.0	0.106	20.25	27M8G7D
		16QAM	3565.0 - 3685.0	0.075	18.75	27M9W7D
	25 MHz	QPSK	3562.5 - 3687.5	0.125	20.96	23M0G7D
		16QAM	3562.5 - 3687.5	0.093	19.67	23M0W7D
LTE Band 48	20 MHz	QPSK	3560.0 - 3690.0	0.153	21.83	18M0G7D
		16QAM	3560.0 - 3690.0	0.141	21.48	18M0W7D
	15 MHz	QPSK	3557.5 - 3692.5	0.153	21.84	13M4G7D
		16QAM	3557.5 - 3692.5	0.141	21.48	13M5W7D
	10 MHz	QPSK	3555.0 - 3695.0	0.153	21.84	9M03G7D
		16QAM	3555.0 - 3695.0	0.140	21.46	9M03W7D
	5 MHz	QPSK	3552.5 - 3697.5	0.153	21.84	4M51G7D
		16QAM	3552.5 - 3697.5	0.138	21.40	4M48W7D
NR Band n48	40 MHz	π/2 BPSK	3570.0 - 3680.0	0.147	21.68	35M9G7D
		QPSK	3570.0 - 3680.0	0.133	21.24	38M1G7D
		16QAM	3570.0 - 3680.0	0.114	20.57	38M0W7D
	30 MHz	π/2 BPSK	3565.0 - 3685.0	0.152	21.83	26M9G7D
		QPSK	3565.0 - 3685.0	0.136	21.35	27M9G7D
		16QAM	3565.0 - 3685.0	0.117	20.67	28M0W7D
	20 MHz	π/2 BPSK	3560.0 - 3690.0	0.151	21.79	18M0G7D
		QPSK	3560.0 - 3690.0	0.135	21.30	18M3G7D
		16QAM	3560.0 - 3690.0	0.116	20.64	18M3W7D
	15 MHz	π/2 BPSK	3557.5 - 3692.5	0.149	21.74	13M0G7D
		QPSK	3557.5 - 3692.5	0.134	21.28	13M7G7D
		16QAM	3557.5 - 3692.5	0.115	20.61	13M6W7D
	10 MHz	π/2 BPSK	3555.0 - 3695.0	0.147	21.69	8M60G7D
		QPSK	3555.0 - 3695.0	0.132	21.20	8M62G7D
		16QAM	3555.0 - 3695.0	0.114	20.58	8M63W7D

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Antenna-S2					
Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP	
				Max. Power [W]	Max. Power [dBm]
NR Band n48	40 MHz	π/2 BPSK	3570.0 - 3680.0	0.062	17.91
		QPSK	3570.0 - 3680.0	0.062	17.91
		16QAM	3570.0 - 3680.0	0.060	17.76

EUT Overview

Antenna-M2					
Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP	
				Max. Power [W]	Max. Power [dBm]
NR Band n48	40 MHz	π/2 BPSK	3570.0 - 3680.0	0.148	21.70
		QPSK	3570.0 - 3680.0	0.147	21.67
		16QAM	3570.0 - 3680.0	0.135	21.31

EUT Overview

Antenna-S3					
Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP	
				Max. Power [W]	Max. Power [dBm]
NR Band n48	40 MHz	π/2 BPSK	3570.0 - 3680.0	0.145	21.62
		QPSK	3570.0 - 3680.0	0.144	21.58
		16QAM	3570.0 - 3680.0	0.121	20.81

EUT Overview

Note: EIRP levels shown in the table above are measured over the full channel bandwidth. These values will appear on the Grant of Authorization.

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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 Suwon Laboratory located at 13, Heungdeok 1-ro, Giheung-gu, Yongin-si, Gyeonggi-do, 16954, South Korea. 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 Materials Technology Suwon, Ltd. located in Yongin-si, Gyeonggi-do, 16954, South Korea.

- Element Materials Technology Suwon, Ltd. is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation(A2LA) with Certificate number 2041.04 for Specific Absorption Rate (SAR), and Electromagnetic Compatibility (EMC) & Telecommunications testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Materials Technology Suwon, Ltd. facility is accredited, designated, and recognized in accordance with the provision of Radio Wave Act and International Standard ISO/IEC 17025:2017 under the National Radio Research Agency.

  - Designation Number / CABID: KR0169
  - Test Firm Registration Number of FCC: 417945
  - Test Firm Registration Number of ISED: 26168

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Tablet FCC ID: A3LSMX828U**. The test data contained in this report pertains only to the emissions due to the EUT's LTE 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.: 0172M, 0377M, 0393M, 2004M, 2052M

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-band LTE, Multi-band 5G NR (FR1 and FR2), 802.11b/g/n/ac/ax WLAN, 802.11a/n/ac/ax UNII (5GHz and 6GHz), Bluetooth (1x, EDR, LE), Wireless Power Transfer

This device uses a tuner circuit that dynamically updates the antenna impedance parameters to optimize antenna performance for certain bands and modes of operation. The tuner for this device was set to simulate a "free space" condition where the transmit antenna is matched to the medium into which it is transmitting and, thus, the power is at its maximum level.

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 X828USQU0AXFE 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.

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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.

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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	1.95
Radiated Disturbance (<1GHz)	4.10
Radiated Disturbance (>1GHz)	4.82
Radiated Disturbance (>18GHz)	4.96

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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
Agilent	N9030B	PXA Signal Analyzer	2024-07-08	Annual	2025-07-08	MY57143278
Anritsu	S820E	Cable and Antenna Analyzer	2024-07-09	Annual	2025-07-08	1839097
Anritsu	MA24106A	USB Power Sensor	2024-07-09	Annual	2025-07-08	1244512
Anritsu	MT8000A	Radio Communication Test Station	2023-09-04	Annual	2024-09-04	6272337405
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	2022-10-21	Biennial	2024-10-20	10160045
Espec	SH-242	Environmental Chamber	2024-07-09	Annual	2025-07-08	93011064
Fairview Microwave	FM2CP1122-10	2.92mm Directional Coupler	2024-07-09	Annual	2025-07-08	1946
Keysight Technologies	N9030B	MXA Signal Analyzer	2024-07-09	Annual	2025-07-08	MY57143276
Mini-Circuits	BW-N10W5+	Attenuator	2024-04-08	Annual	2025-04-07	TEMPNO.01-151
Mini-Circuits	BW-N10W5+	Attenuator	2024-04-08	Annual	2025-04-07	TEMPNO.01-150
NARDA	180-442A-KF	Horn Antenna (small)	2024-01-16	Annual	2025-01-15	T058701-03
Rohde & Schwarz	SMB100A03	Signal Generator	2024-01-11	Annual	2025-01-10	182487
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2024-01-11	Annual	2025-01-10	171075
Rohde & Schwarz	FSW43	Signal and Spectrum Analyzer	2024-01-11	Annual	2025-01-10	101955
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2024-01-11	Annual	2025-01-10	102131
Schwarzbeck	VULB9162	Broadband TRILOG Antenna	2023-06-01	Biennial	2025-05-31	9162-217
Sunol	DRH-118	Horn Antenna	2023-01-26	Biennial	2025-01-25	A060215

Table 5-1. Test Equipment

Notes:

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.

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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.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMX828U

FCC Classification: Citizens Band End User Devices (CBE)

Mode(s): LTE/NR

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Conducted Power	2.1046(a), 2.1046(c)	N/A	PASS	Section 7.2
	Occupied Bandwidth	2.1049(h)	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions (CBSD)	2.1051, 96.41(e)(i)	-13 dBm/MHz at frequencies within 0-10 MHz of above the upper SAS-assigned channel edge and within 0-10MHz below the lower SAS-assigned channel edge -25 dBm/MHz at frequencies greater than 10 MHz above and below channel edge -emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz	PASS	Sections 7.4, 7.5
	Frequency Stability	2.1055	Fundamental emissions stay within authorized frequency block	PASS	Section 7.9
	End User Device Additional Requirements (CBSD Protocol)	96.47	End User Devices may operate only if they can positively receive and decode an authorization signal transmitted by a CBSD, including the frequencies and power limits for their operation. An End User Device must discontinue operations, change frequencies, or change its operational power level within 10 seconds of receiving instructions from its associated CBSD.	PASS	Section 7.10
RADIATED	Equivalent Isotropic Radiated Power (EIRP) (EUD)	96.41(b)	23 dBm/10MHz	PASS	Section 7.6
	Uplink Carrier Aggregation	96.47	> 43 + 10log(P[Watts]) at Band Edge and for all out-of band emissions	PASS	Section 7.7
	Radiated Spurious Emissions	2.1053, 96.41(e)	-40 dBm/MHz	PASS	Section 7.8

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.

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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 v1.2.2.

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7.2 Conducted Output Power Data

Test Overview

The EUT is set up to transmit at maximum power for LTE. 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.

A-MPR is implemented in this device per the A-MPR specification in 3GPP TS 36.101. The conducted powers are shown herein to cover the different A-MPR levels specified in the standard. Measurement equipment was set up with triggering/gating on the spectrum analyzer such that powers were measured only during the on-time of the signal.

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 across the OBW of the signal

Test Setup

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

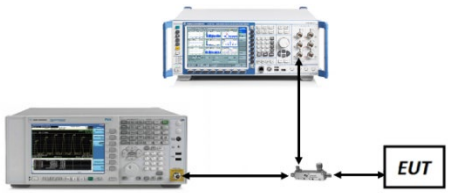

Figure 7-1. Test Instrument & Measurement Setup

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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. All other conducted power measurements are contained in the RF exposure report for this filing.

3. Conducted power was found to reduce for the higher order QAM modulations when compared to 16QAM. Due to this trend, only the worst-case QAM (16QAM) powers are included in this section.

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Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]
40 MHz	π/2 BPSK	638000	3570.0	1 / 104	22.92
		641666	3625.0	1 / 53	23.34
		645332	3680.0	1 / 104	23.05
	QPSK	638000	3570.0	1 / 104	22.84
		641666	3625.0	1 / 53	23.31
		645332	3680.0	1 / 104	23.07
	16-QAM	641666	3625.0	1 / 53	22.10
30 MHz	π/2 BPSK	637666	3565.0	1 / 76	23.10
		641666	3625.0	1 / 39	23.38
		645666	3685.0	1 / 76	23.19
	QPSK	637666	3565.0	1 / 76	23.08
		641666	3625.0	1 / 39	23.31
		645666	3685.0	1 / 76	23.17
	16-QAM	641666	3625.0	1 / 39	22.07
20 MHz	π/2 BPSK	637334	3560.0	1 / 49	23.08
		641666	3625.0	1 / 25	23.54
		646000	3690.0	1 / 49	23.15
	QPSK	637334	3560.0	1 / 49	23.09
		641666	3625.0	1 / 25	23.54
		646000	3690.0	1 / 49	23.12
	16-QAM	641666	3625.0	1 / 25	22.34
15 MHz	π/2 BPSK	637166	3557.5	1 / 36	23.02
		641666	3625.0	1 / 19	23.44
		646166	3692.5	1 / 36	23.10
	QPSK	637166	3557.5	1 / 36	23.01
		641666	3625.0	1 / 19	23.45
		646166	3692.5	1 / 36	23.10
	16-QAM	641666	3625.0	1 / 19	22.19
10 MHz	π/2 BPSK	637000	3555.0	1 / 22	22.97
		641666	3625.0	1 / 12	23.45
		646332	3695.0	1 / 22	23.05
	QPSK	637000	3555.0	1 / 22	22.96
		641666	3625.0	1 / 12	23.43
		646332	3695.0	1 / 22	23.02
	16-QAM	641666	3625.0	1 / 12	22.06

Table 7-2. Conducted Power Output Data (NR Band n48 – Sub 4)

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]
40 MHz	π/2 BPSK	638000	3570.0	1 / 1	19.92
		641666	3625.0	1 / 53	19.47
		645332	3680.0	1 / 1	19.74
	QPSK	638000	3570.0	1 / 1	19.98
		641666	3625.0	1 / 53	19.63
		645332	3680.0	1 / 1	19.97
	16-QAM	638000	3570.0	1 / 1	19.68

Table 7-3. Conducted Power Output Data (NR Band n48 – Sub 2)

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Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]
40 MHz	π/2 BPSK	638000	3570.0	1 / 104	19.86
		641666	3625.0	1 / 104	20.42
		645332	3680.0	1 / 1	20.96
	QPSK	638000	3570.0	1 / 104	20.05
		641666	3625.0	1 / 104	20.58
		645332	3680.0	1 / 1	20.97
	16-QAM	645332	3680.0	1 / 1	19.76

Table 7-4. Conducted Power Output Data (NR Band n48 – Main 2)

Bandwidth	Modulation	Channel	Frequency [MHz]	RB Size/Offset	Conducted Power [dBm]
40 MHz	π/2 BPSK	638000	3570.0	1 / 104	22.39
		641666	3625.0	1 / 104	23.07
		645332	3680.0	1 / 1	23.37
	QPSK	638000	3570.0	1 / 104	22.50
		641666	3625.0	1 / 104	23.25
		645332	3680.0	1 / 1	23.49
	16-QAM	645332	3680.0	1 / 1	22.15

Table 7-5. Conducted Power Output Data (NR Band n48 – Sub 3)

Bandwidth	Modulation	PCC			SCC			Conducted Power [dBm]
		Bandwidth [MHz]	Frequency [MHz]	RB / Offset	Bandwidth [MHz]	Frequency [MHz]	RB / Offset	
40 MHz	QPSK	20	3560.0	1 / 99	20	3579.8	1 / 0	21.78
		20	3625.0	1 / 99	20	3644.8	1 / 0	22.56
		20	3690.0	1 / 0	20	3670.2	1 / 99	22.40
	16-QAM	20	3560.0	1 / 99	20	3579.8	1 / 0	21.23
35 MHz	QPSK	20	3560.0	1 / 99	15	3577.1	1 / 0	22.37
		20	3625.0	1 / 99	15	3642.1	1 / 0	22.73
		20	3690.0	1 / 0	15	3672.9	1 / 74	22.08
	16-QAM	20	3560.0	1 / 99	15	3577.1	1 / 0	21.22
30 MHz	QPSK	20	3560.0	1 / 99	10	3574.4	1 / 0	22.27
		20	3625.0	1 / 99	10	3639.4	1 / 0	22.61
		20	3690.0	1 / 0	10	3675.6	1 / 49	22.72
	16-QAM	20	3560.0	1 / 99	10	3574.4	1 / 0	21.31
25 MHz	QPSK	20	3560.0	1 / 99	5	3571.7	1 / 0	22.98
		20	3625.0	1 / 99	5	3636.7	1 / 0	23.01
		20	3690.0	1 / 0	5	3678.3	1 / 24	23.14
	16-QAM	20	3560.0	1 / 99	5	3571.7	1 / 0	22.23

Table 7-6. Conducted Power Output Data (ULCA Band 48)

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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.

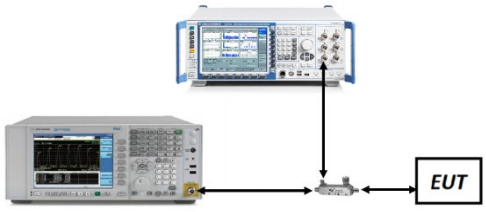

Figure 7-2. Test Instrument & Measurement Setup

Test Notes

Occupied Bandwidth was only measured on the antenna n48 (Sub 4) with the highest power for each band.

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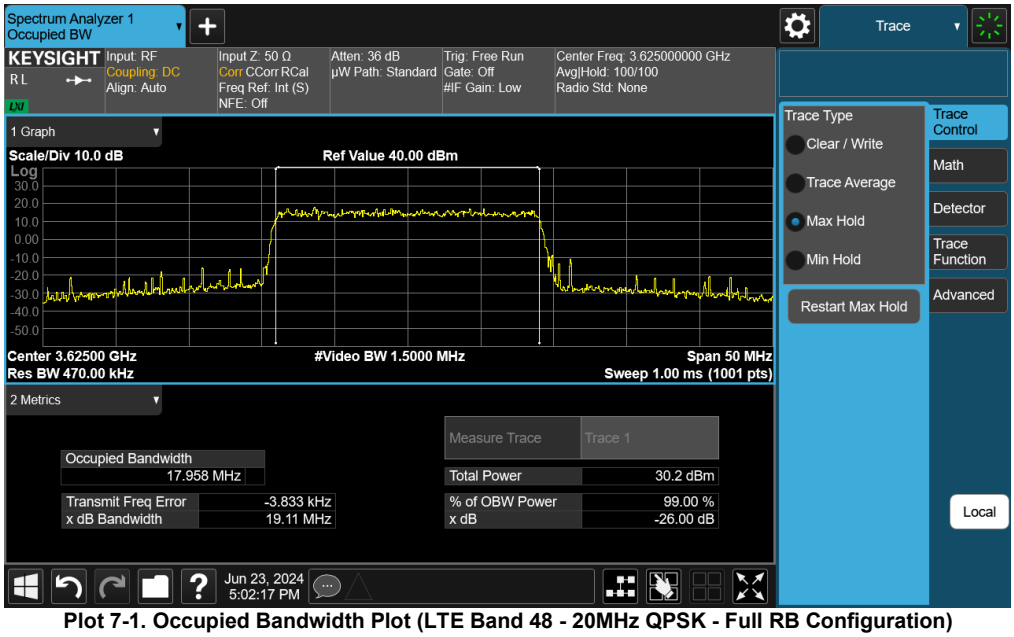
LTE Band 48

Mode	Bandwidth	Modulation	OBW [MHz]
LTE B48	20MHz	QPSK	17.96
		16QAM	17.99
	15MHz	QPSK	13.42
		16QAM	13.48
	10MHz	QPSK	9.03
		16QAM	9.03
	5MHz	QPSK	4.51
		16QAM	4.48

Table 7-7. Occupied Bandwidth Test Results (LTE Band 48)



Plot 7-1. Occupied Bandwidth Plot (LTE Band 48 - 20MHz QPSK - Full RB Configuration)

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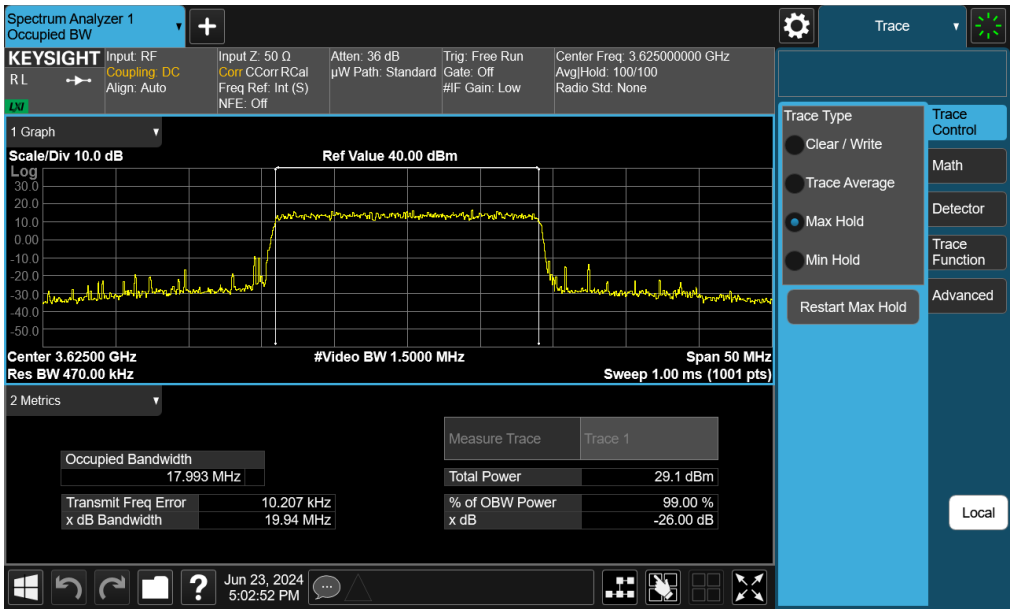
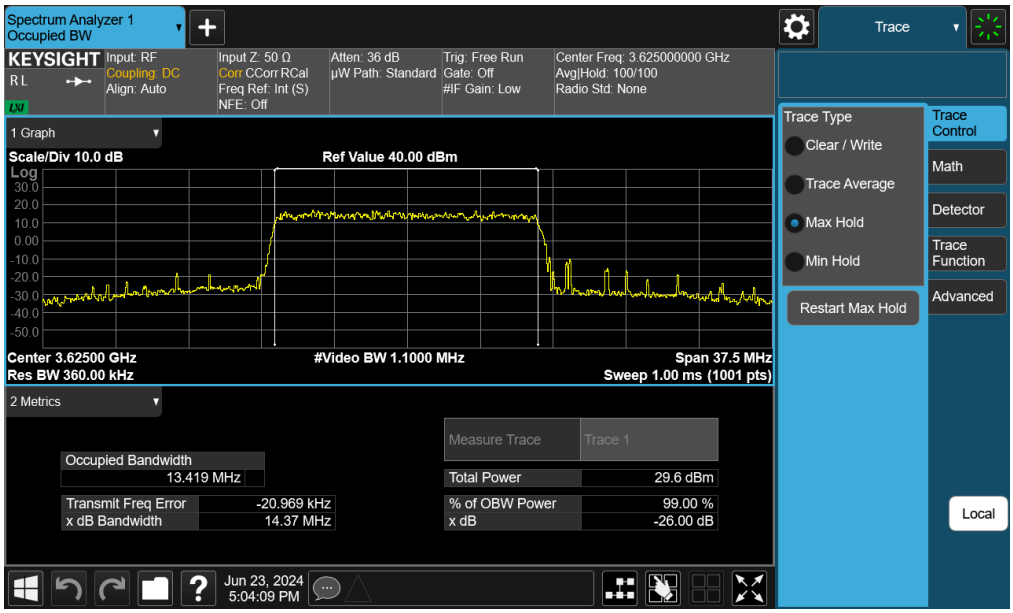


Plot 7-2. Occupied Bandwidth Plot (LTE Band 48 - 20MHz 16-QAM - Full RB Configuration)



Plot 7-3. Occupied Bandwidth Plot (LTE Band 48 - 15MHz QPSK - Full RB Configuration)

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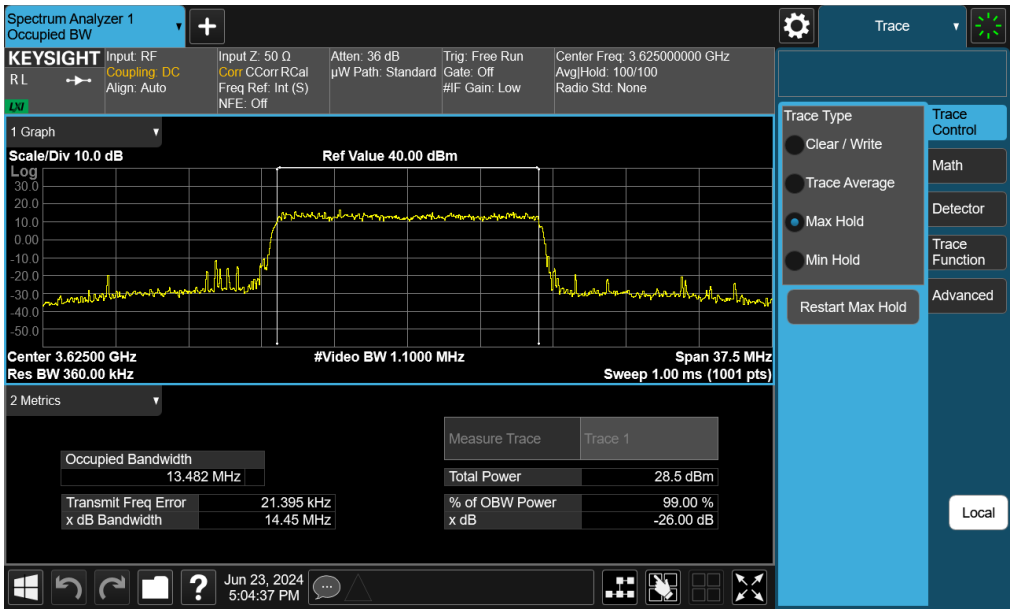
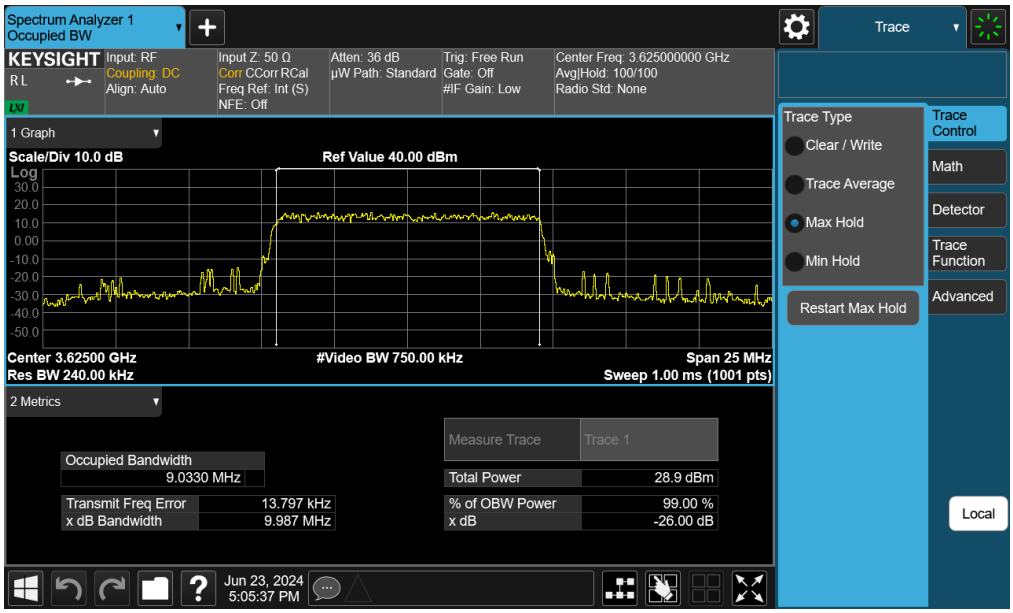


Plot 7-4. Occupied Bandwidth Plot (LTE Band 48 - 15MHz 16-QAM - Full RB Configuration)



Plot 7-5. Occupied Bandwidth Plot (LTE Band 48 - 10MHz QPSK - Full RB Configuration)

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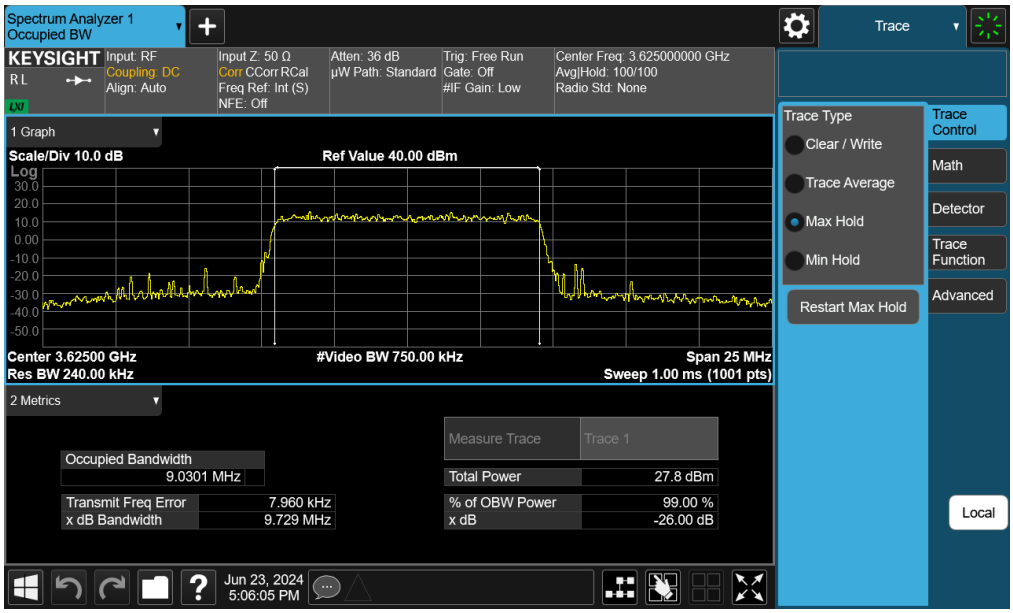
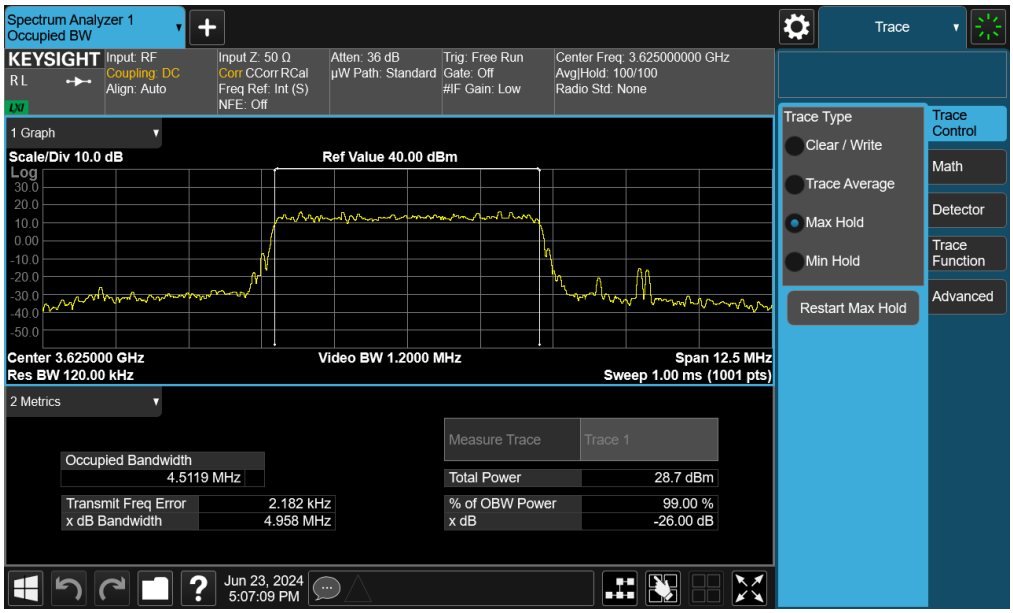


Plot 7-6. Occupied Bandwidth Plot (LTE Band 48 - 10MHz 16-QAM - Full RB Configuration)



Plot 7-7. Occupied Bandwidth Plot (LTE Band 48 - 5MHz QPSK - Full RB Configuration)

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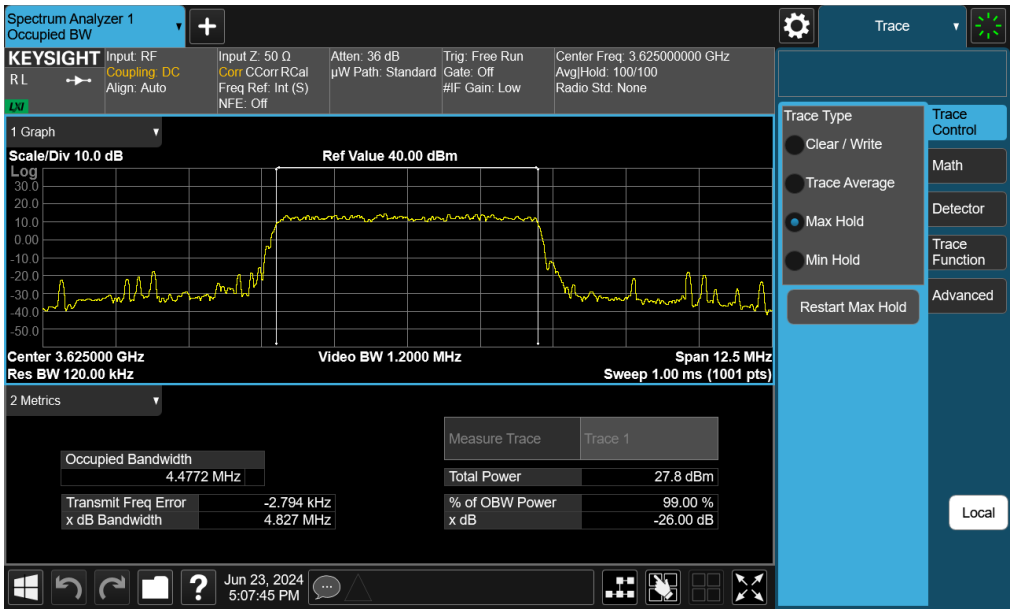

Plot 7-8. Occupied Bandwidth Plot (LTE Band 48 - 5MHz 16-QAM - Full RB Configuration)

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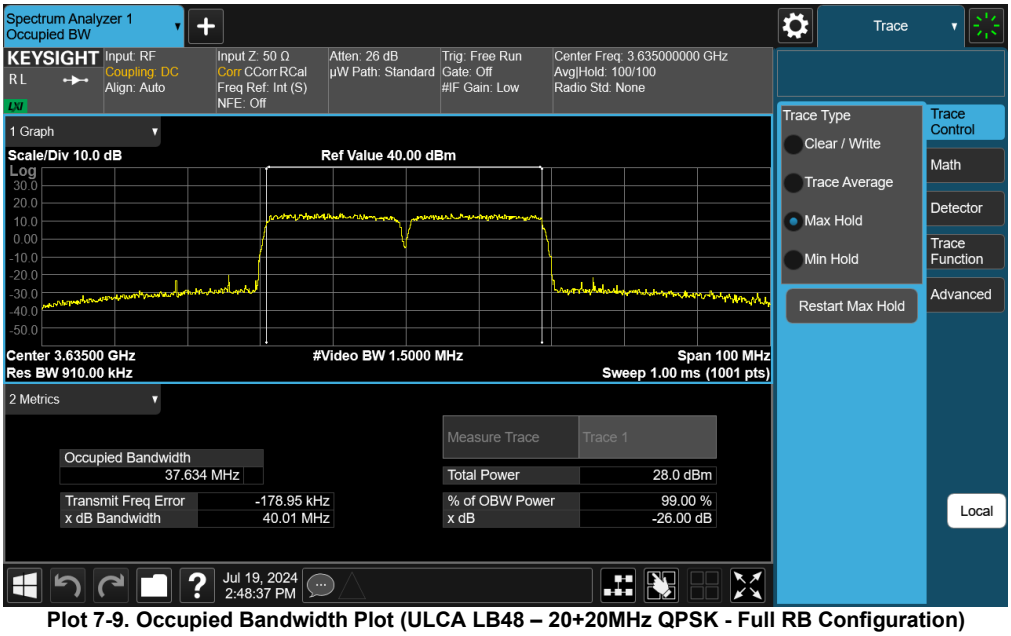
ULCA LTE Band 48

Mode	Bandwidth	Modulation	OBW [MHz]
ULCA LTE B48	20+20MHz	QPSK	37.63
		16QAM	37.79
	20+15MHz	QPSK	32.84
		16QAM	32.82
	20+10MHz	QPSK	27.80
		16QAM	27.86
	20+5MHz	QPSK	22.96
		16QAM	22.99

Table 7-8. Occupied Bandwidth Test Results (ULCA LTE Band 48)



Plot 7-9. Occupied Bandwidth Plot (ULCA LB48 – 20+20MHz QPSK - Full RB Configuration)

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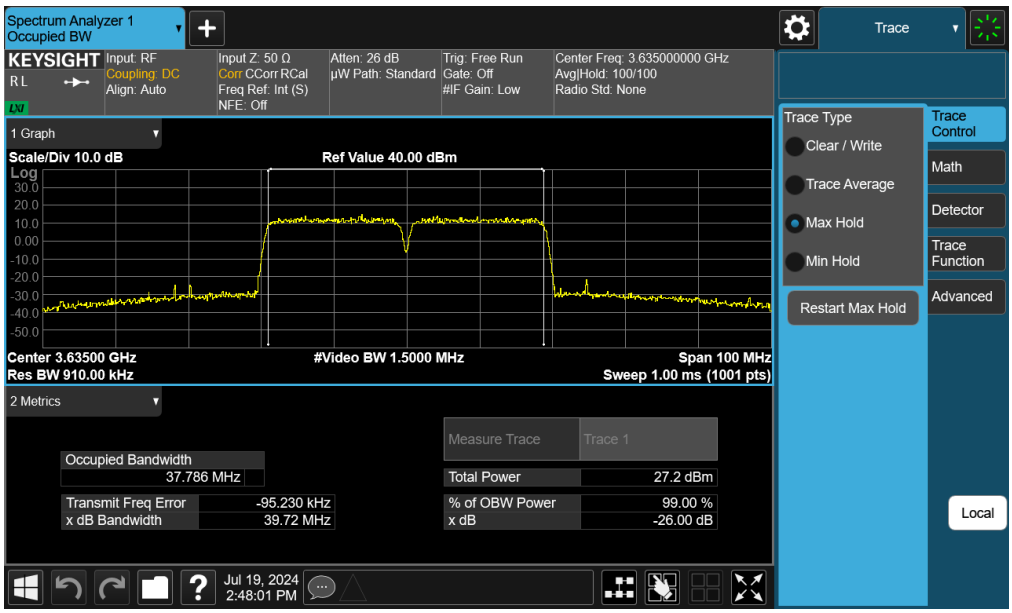

Plot 7-10. Occupied Bandwidth Plot (ULCA LB48 – 20+20MHz 16-QAM - Full RB Configuration)

Plot 7-11. Occupied Bandwidth Plot (ULCA LB48 – 20+15MHz QPSK - Full RB Configuration)

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Plot 7-12. Occupied Bandwidth Plot (ULCA LB48 – 20+15MHz 16-QAM - Full RB Configuration)

Plot 7-13. Occupied Bandwidth Plot (ULCA LB48 – 20+10MHz QPSK - Full RB Configuration)

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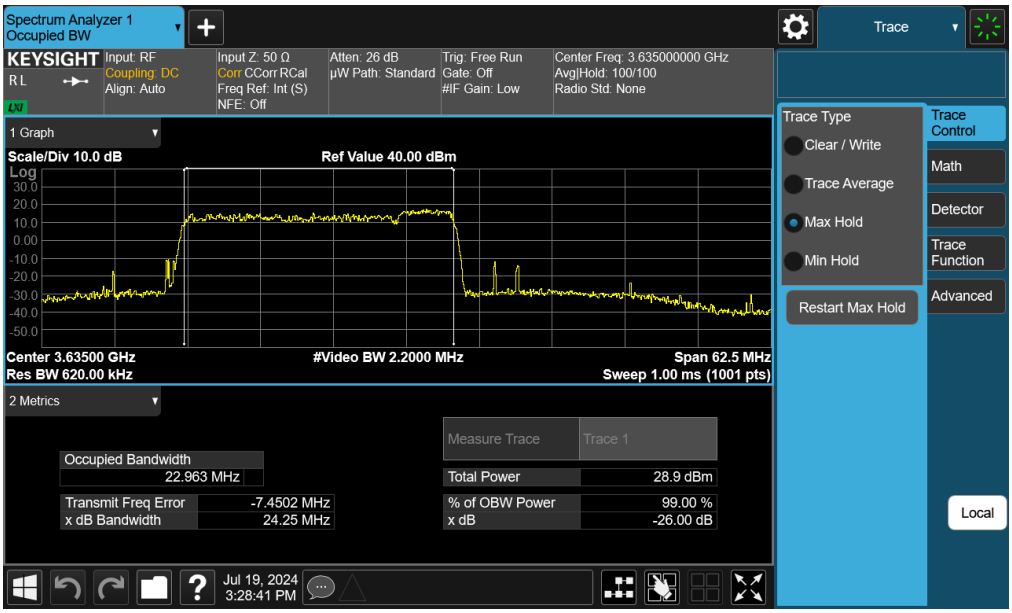
Plot 7-14. Occupied Bandwidth Plot (ULCA LB48 – 20+10MHz 16-QAM - Full RB Configuration)



Plot 7-15. Occupied Bandwidth Plot (ULCA LB48 – 20+5MHz QPSK - Full RB Configuration)

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Plot 7-16. Occupied Bandwidth Plot (ULCA LB48 – 20+5MHz 16-QAM - Full RB Configuration)

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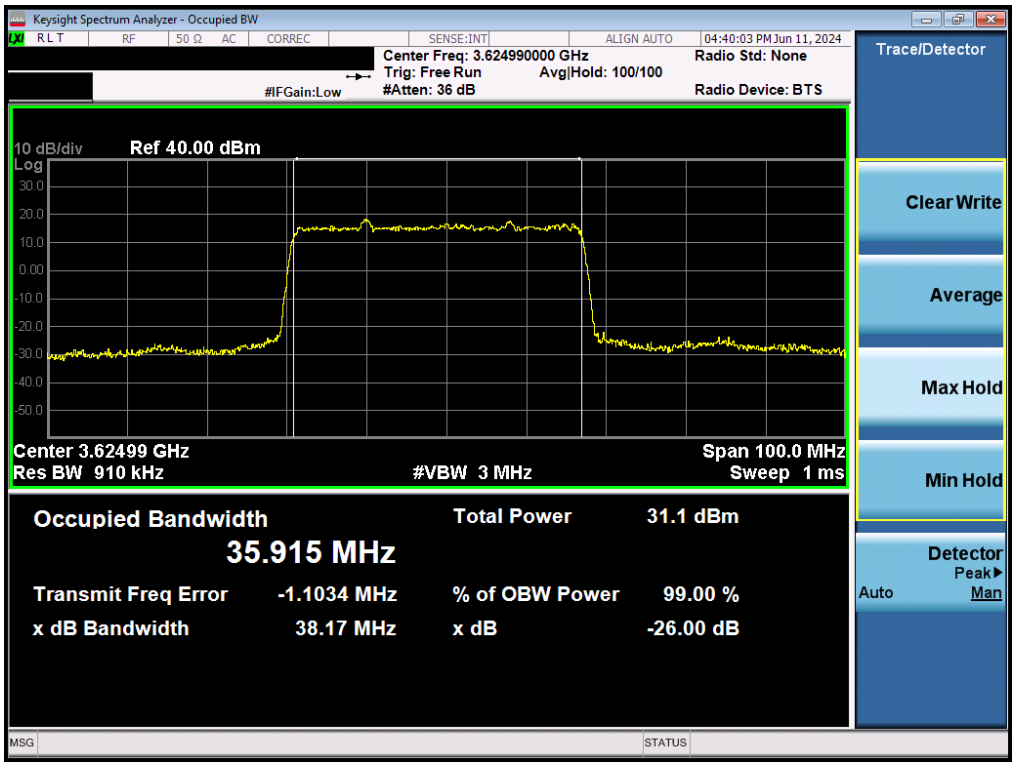
NR Band n48

Mode	Bandwidth	Modulation	OBW [MHz]
NR-n48	40MHz	π/2 BPSK	35.91
		QPSK	38.09
		16QAM	37.98
	30MHz	π/2 BPSK	26.88
		QPSK	27.92
		16QAM	28.01
	20MHz	π/2 BPSK	17.99
		QPSK	18.26
		16QAM	18.35
	15MHz	π/2 BPSK	12.98
		QPSK	13.67
		16QAM	13.64
	10MHz	π/2 BPSK	8.60
		QPSK	8.62
		16QAM	8.63

Table 7-9. Occupied Bandwidth Test Results (NR Band n48)



Plot 7-17. Occupied Bandwidth Plot (NR Band n48 - 40MHz π/2 BPSK - Full RB Configuration)

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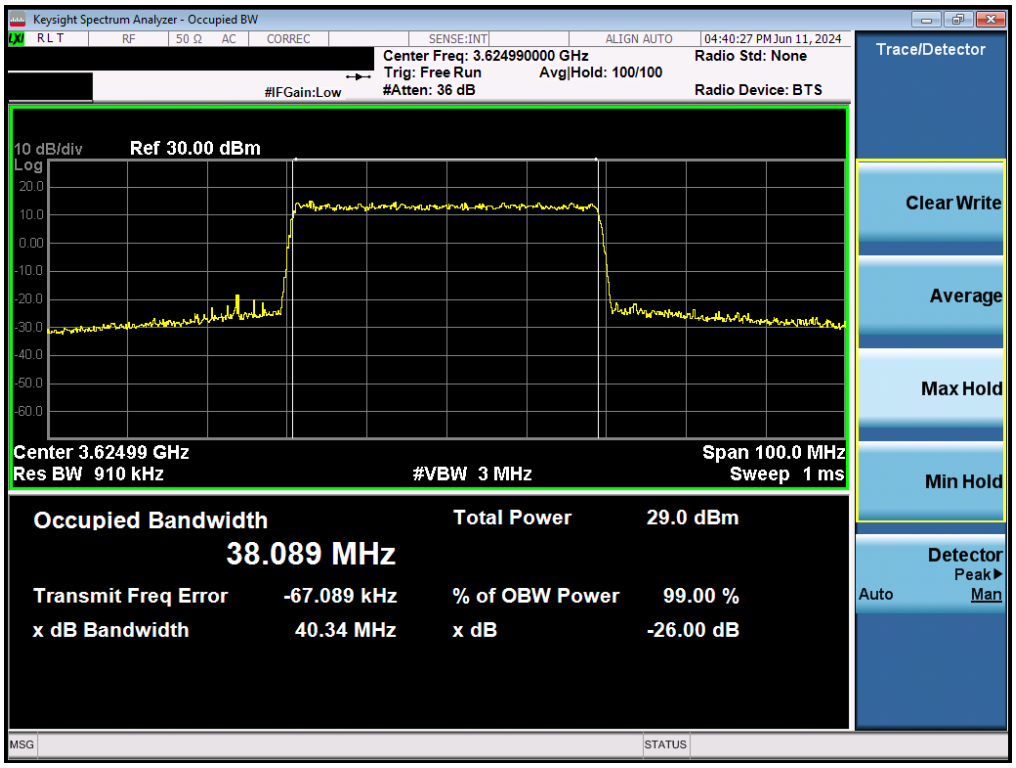
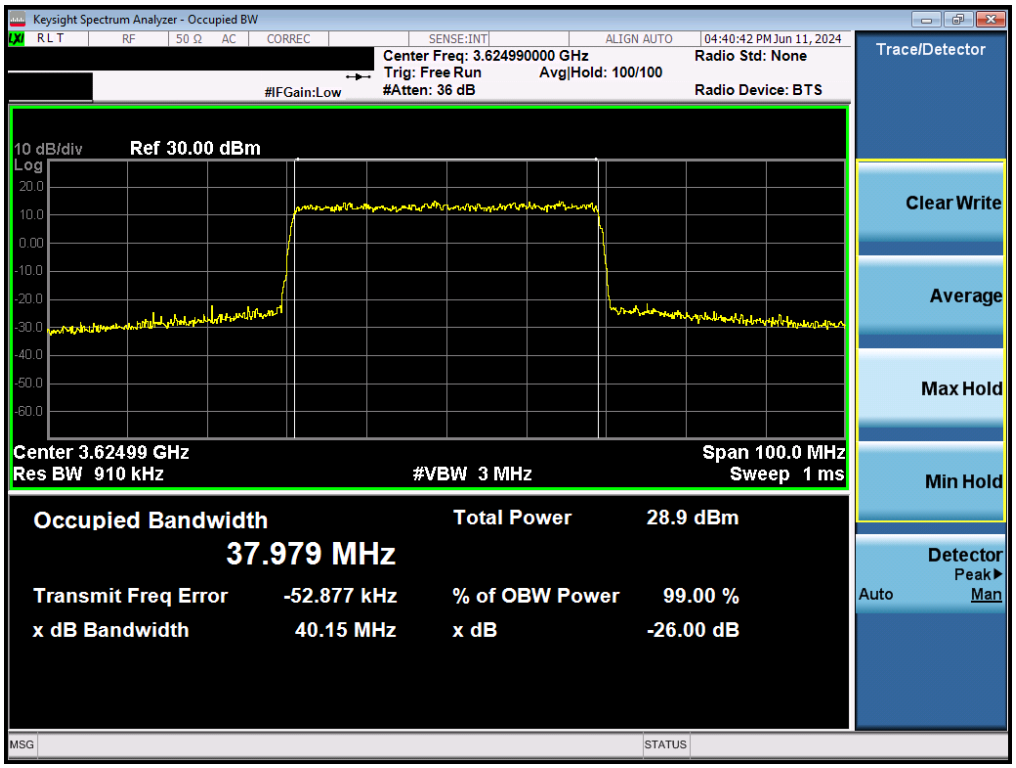


Plot 7-18. Occupied Bandwidth Plot (NR Band n48 - 40MHz QPSK - Full RB Configuration)



Plot 7-19. Occupied Bandwidth Plot (NR Band n48 - 40MHz 16-QAM - Full RB Configuration)

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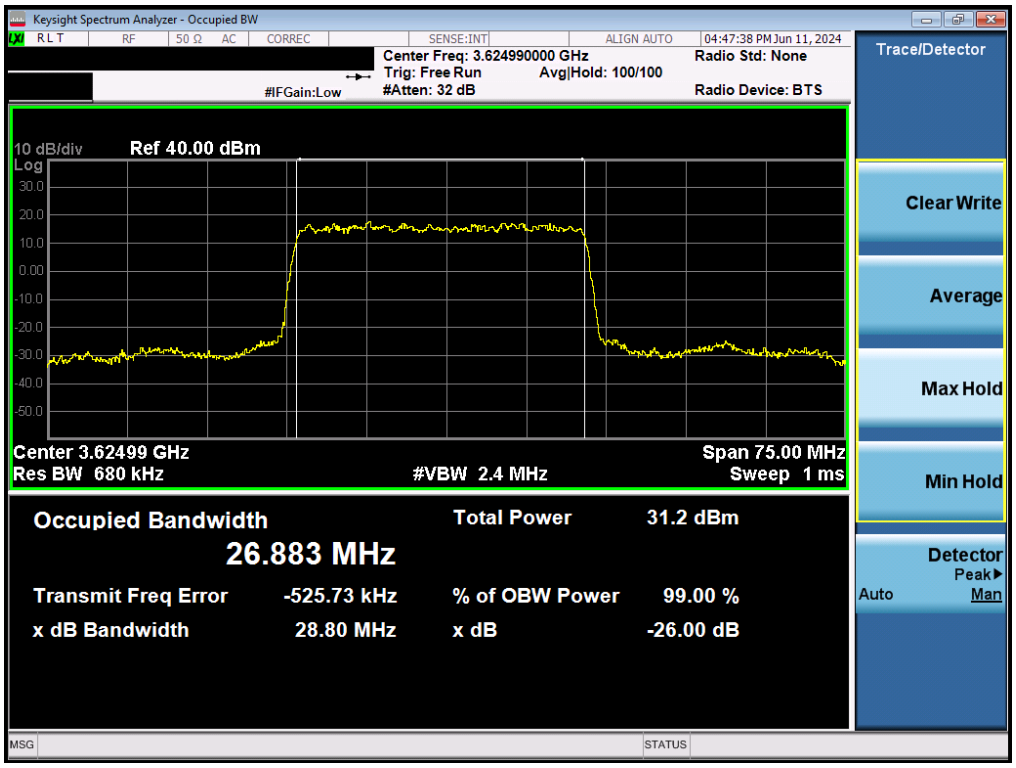
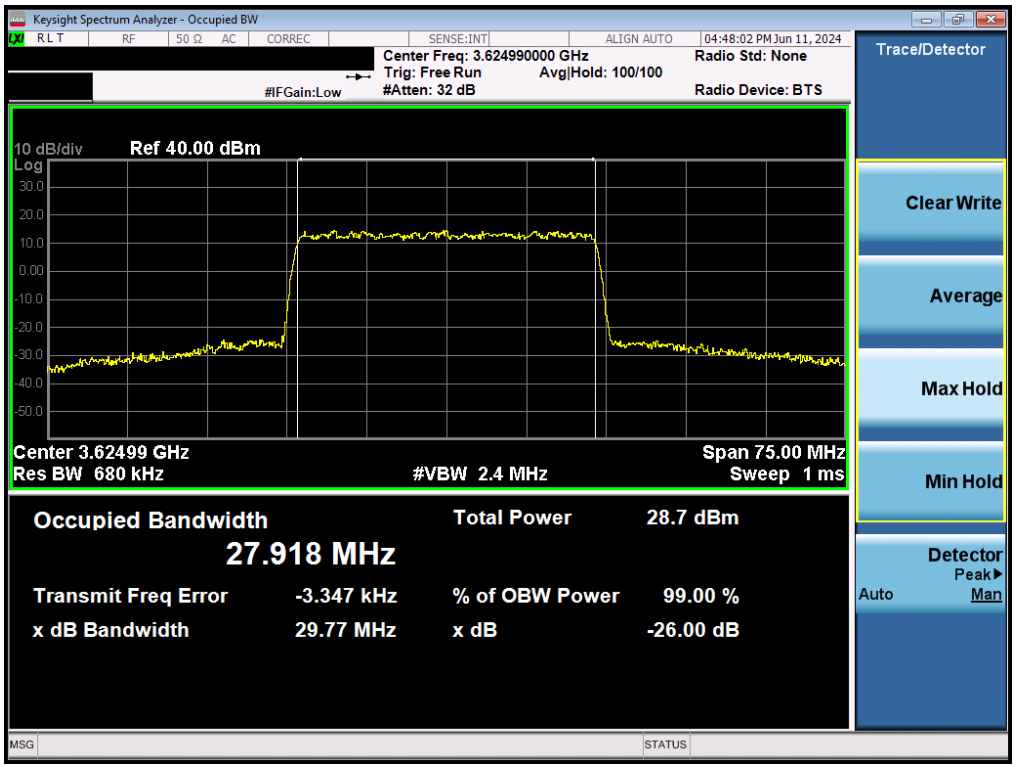


Plot 7-20. Occupied Bandwidth Plot (NR Band n48 - 30MHz π/2 BPSK - Full RB Configuration)



Plot 7-21. Occupied Bandwidth Plot (NR Band n48 - 30MHz QPSK - Full RB Configuration)

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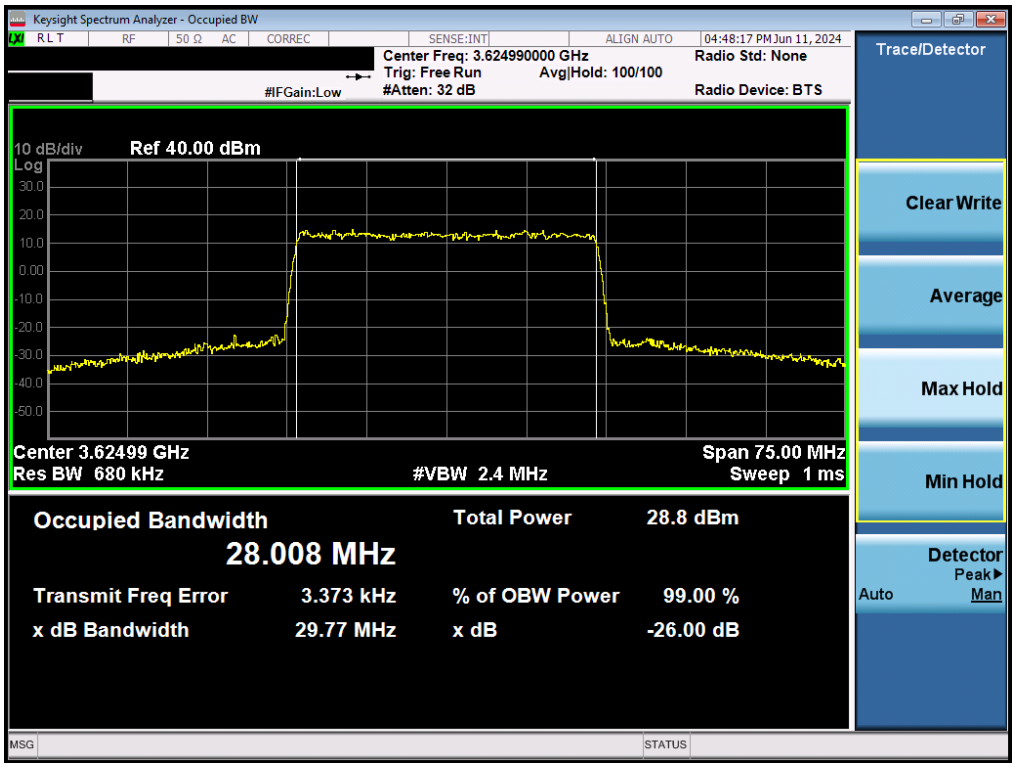
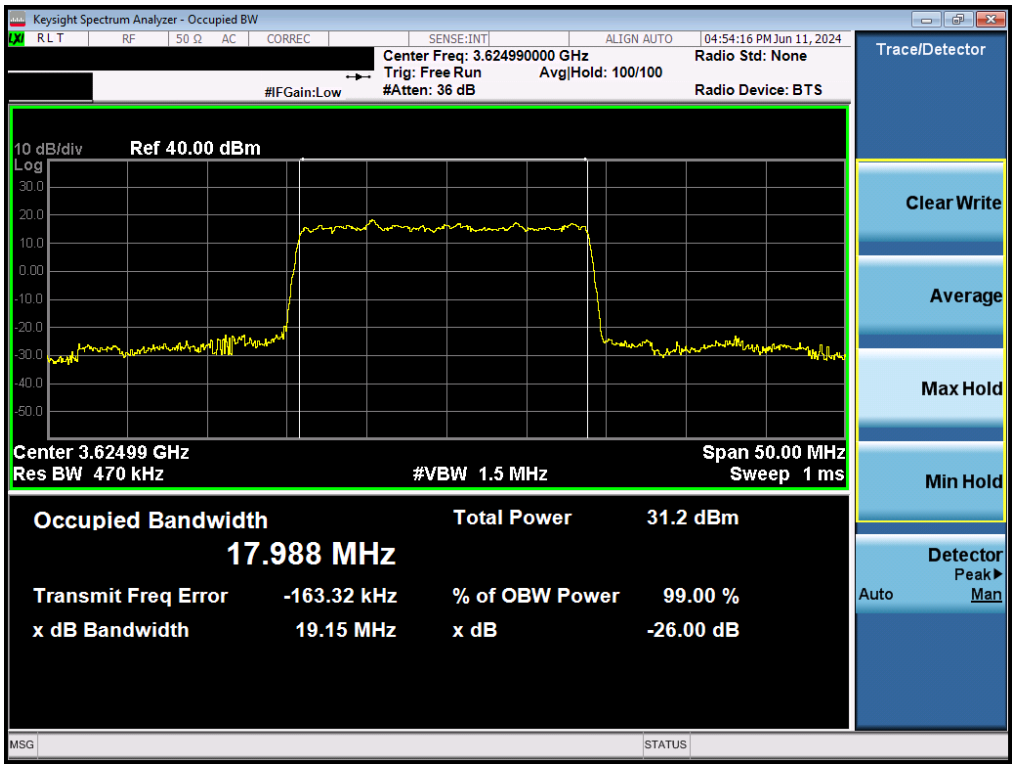


Plot 7-22. Occupied Bandwidth Plot (NR Band n48 - 30MHz 16-QAM - Full RB Configuration)



Plot 7-23. Occupied Bandwidth Plot (NR Band n48 - 20MHz π/2 BPSK - Full RB Configuration)

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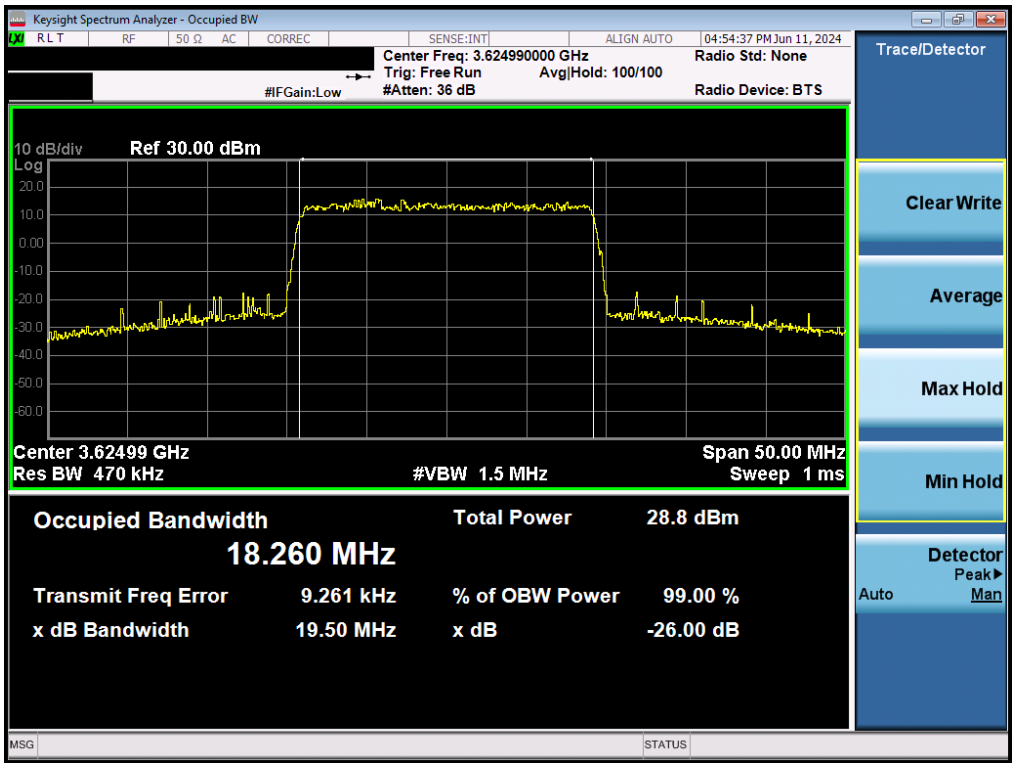
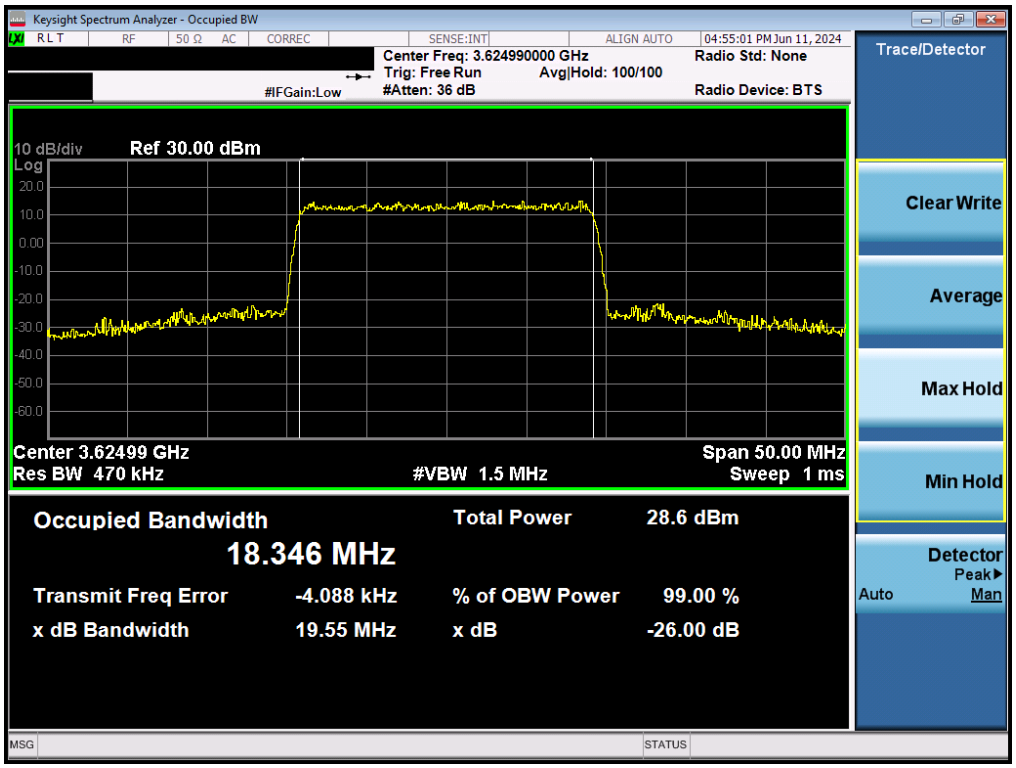


Plot 7-24. Occupied Bandwidth Plot (NR Band n48 - 20MHz QPSK - Full RB Configuration)



Plot 7-25. Occupied Bandwidth Plot (NR Band n48 - 20MHz 16-QAM - Full RB Configuration)

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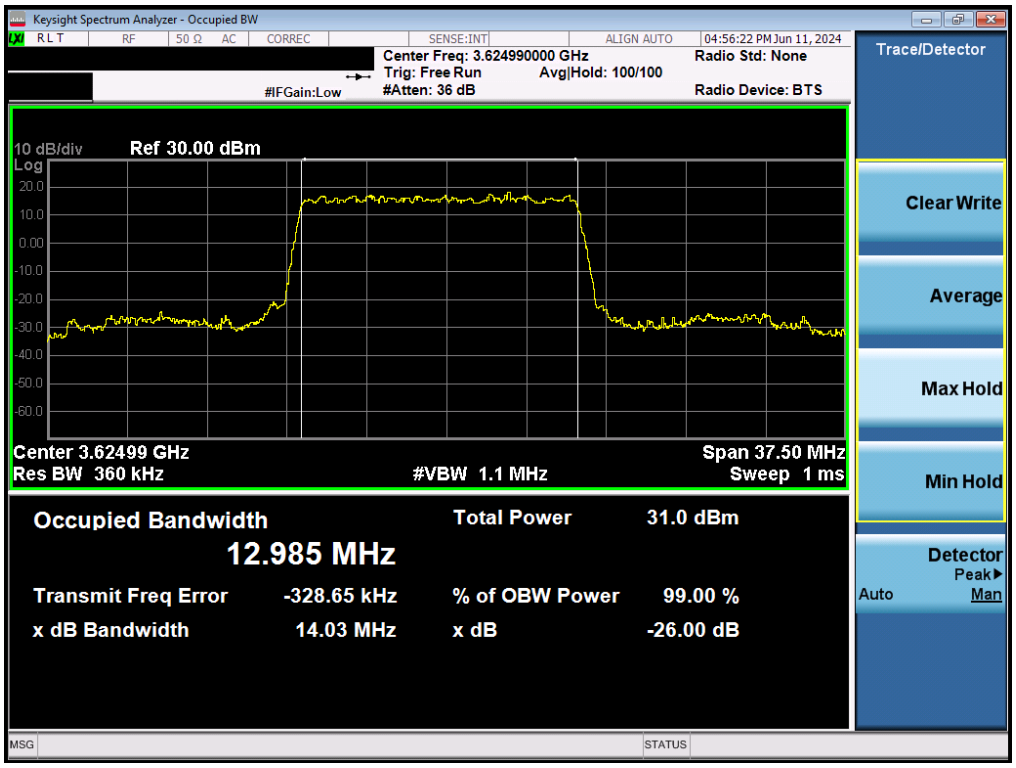
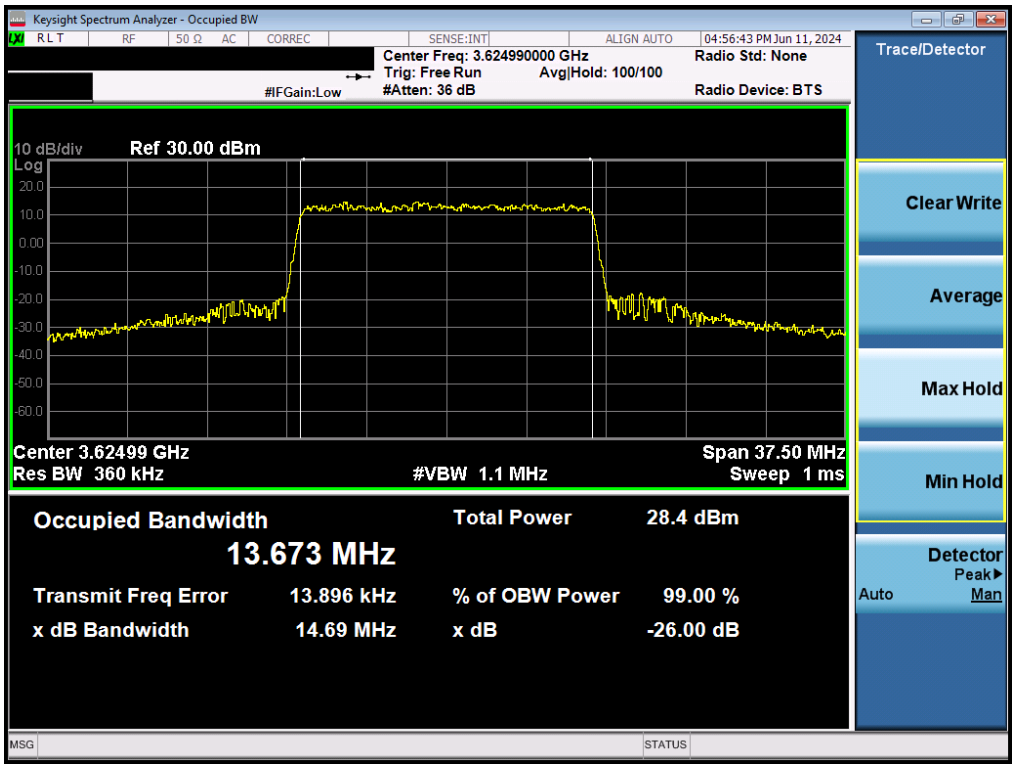


Plot 7-26. Occupied Bandwidth Plot (NR Band n48 - 15MHz π/2 BPSK - Full RB Configuration)



Plot 7-27. Occupied Bandwidth Plot (NR Band n48 - 15MHz QPSK - Full RB Configuration)

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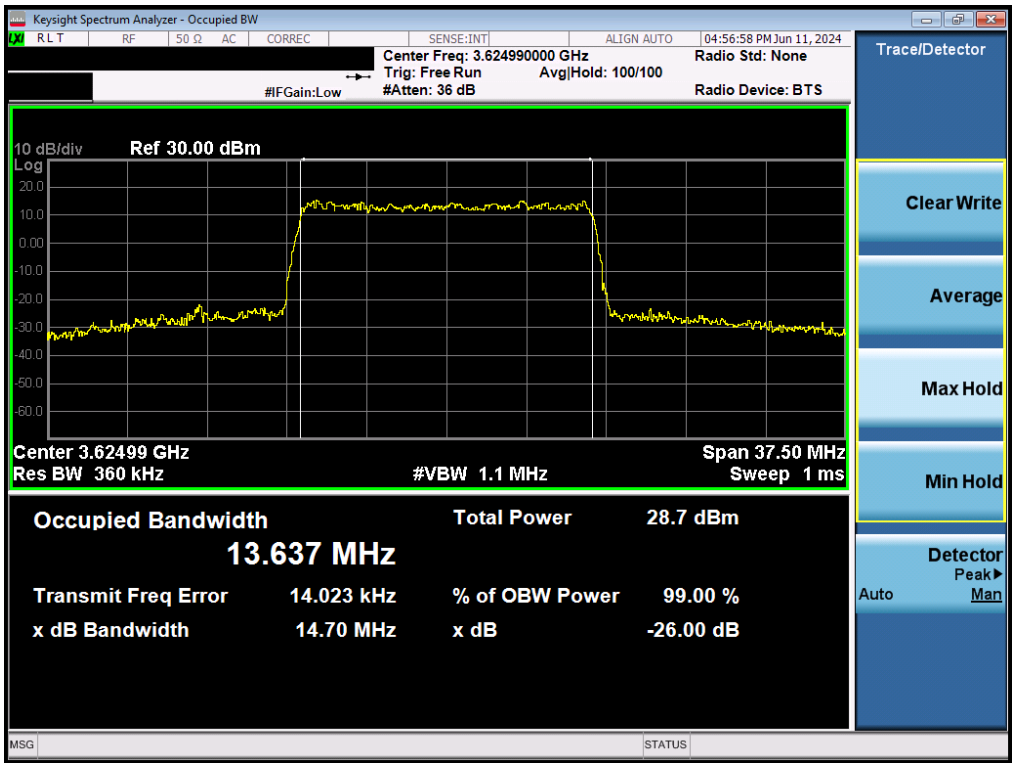
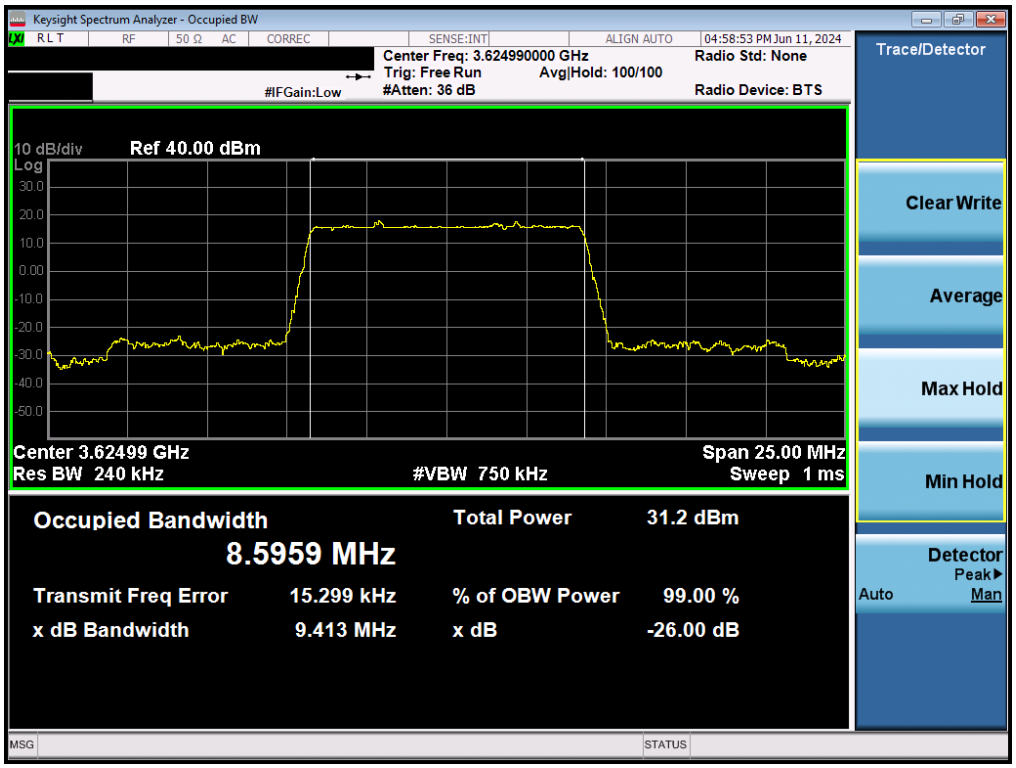


Plot 7-28. Occupied Bandwidth Plot (NR Band n48 - 15MHz 16-QAM - Full RB Configuration)



Plot 7-29. Occupied Bandwidth Plot (NR Band n48 - 10MHz π/2 BPSK - Full RB Configuration)

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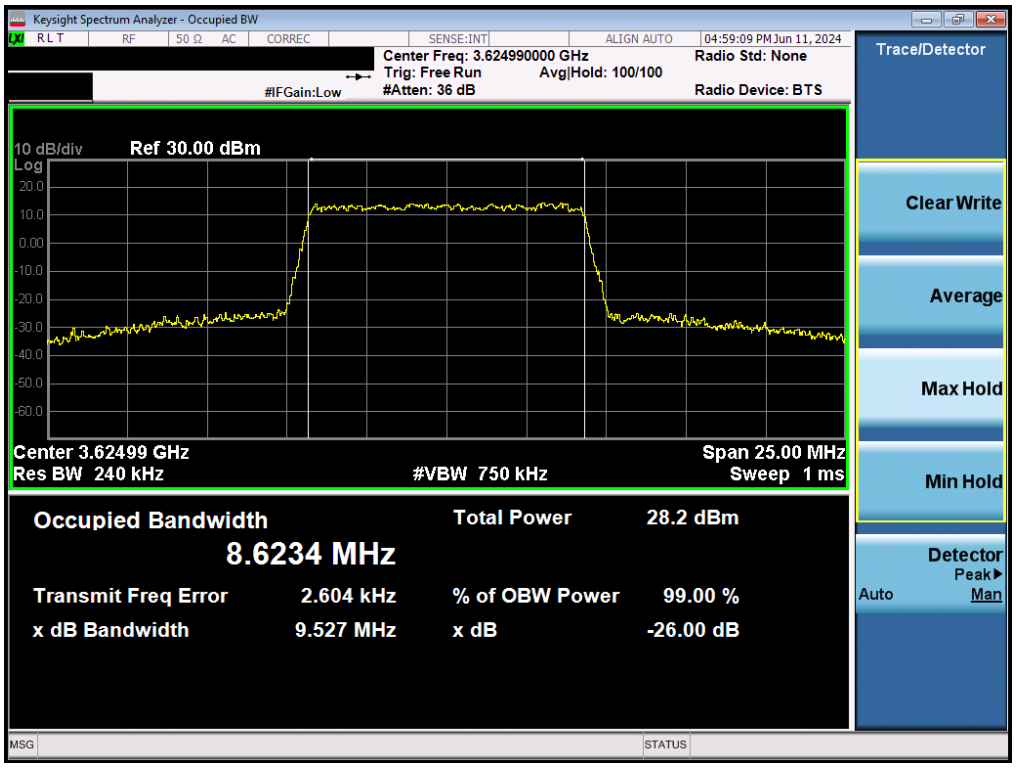
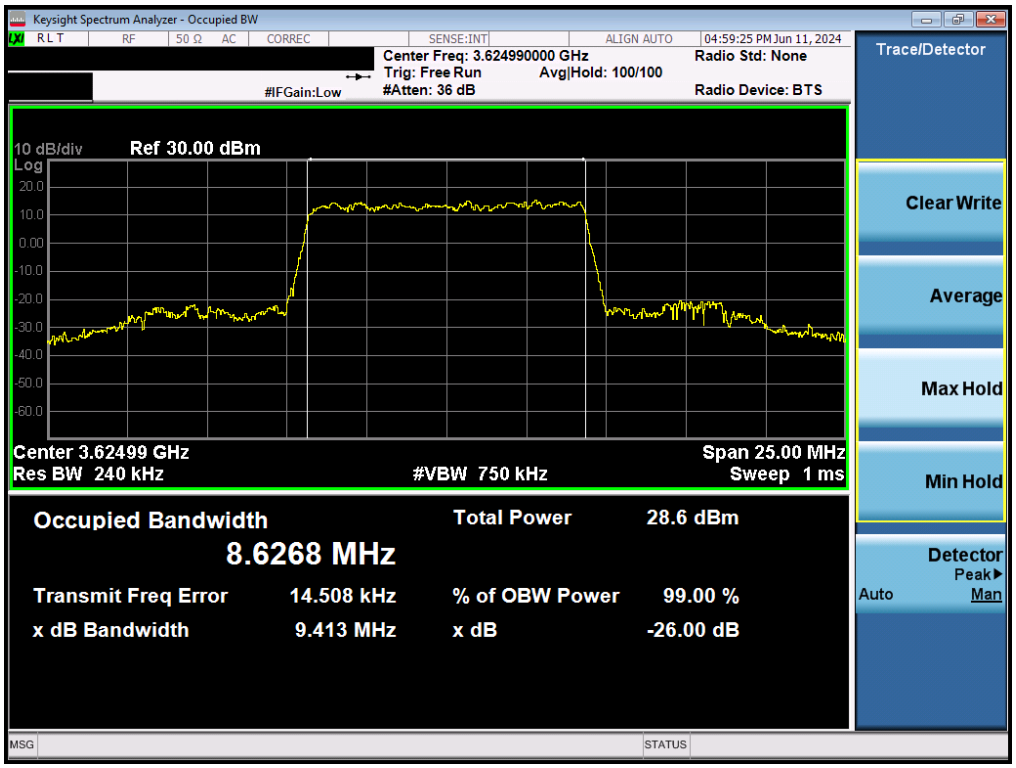


Plot 7-30. Occupied Bandwidth Plot (NR Band n48 - 10MHz QPSK - Full RB Configuration)



Plot 7-31. Occupied Bandwidth Plot (NR Band n48 - 10MHz 16-QAM - Full RB Configuration)

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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.

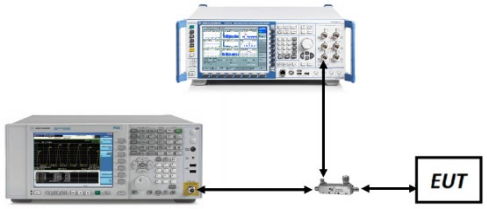

Figure 7-3. Test Instrument & Measurement Setup

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.

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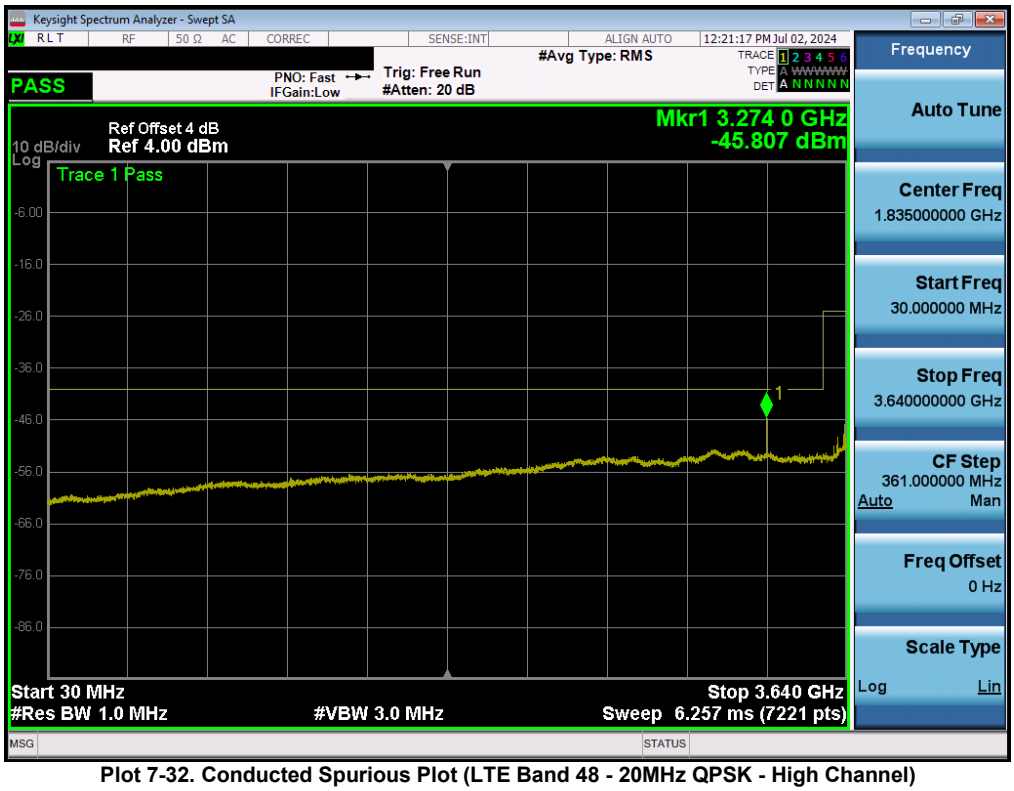
LTE Band 48

Mode	Bandwidth	Channel	Range [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
LTE-B48	20MHz	Low	30.0 - 3510.0	-47.67	-40.0	-7.67
		Low	3610.0 - 15000.0	-48.1	-40.0	-8.10
		Low	15000.0 - 27000.0	-63.29	-40.0	-23.29
		Low	27000.0 - 40000.0	-56.97	-40.0	-16.97
		Mid	30.0 - 35750.0	-47.46	-40.0	-7.46
		Mid	3675.0 - 15000.0	-49.94	-40.0	-9.94
		Mid	15000.0 - 27000.0	-63.09	-40.0	-23.09
		Mid	27000.0 - 40000.0	-56.07	-40.0	-16.07
		High	30.0 - 3640.0	-45.81	-40.0	-5.81
		High	3740.0 - 15000.0	-50.67	-40.0	-10.66
		High	15000.0 - 27000.0	-63.39	-40.0	-23.39
		High	27000.0 - 40000.0	-56.28	-40.0	-16.28

Table 7-10. Conducted Emission Test Results



Plot 7-32. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - High Channel)

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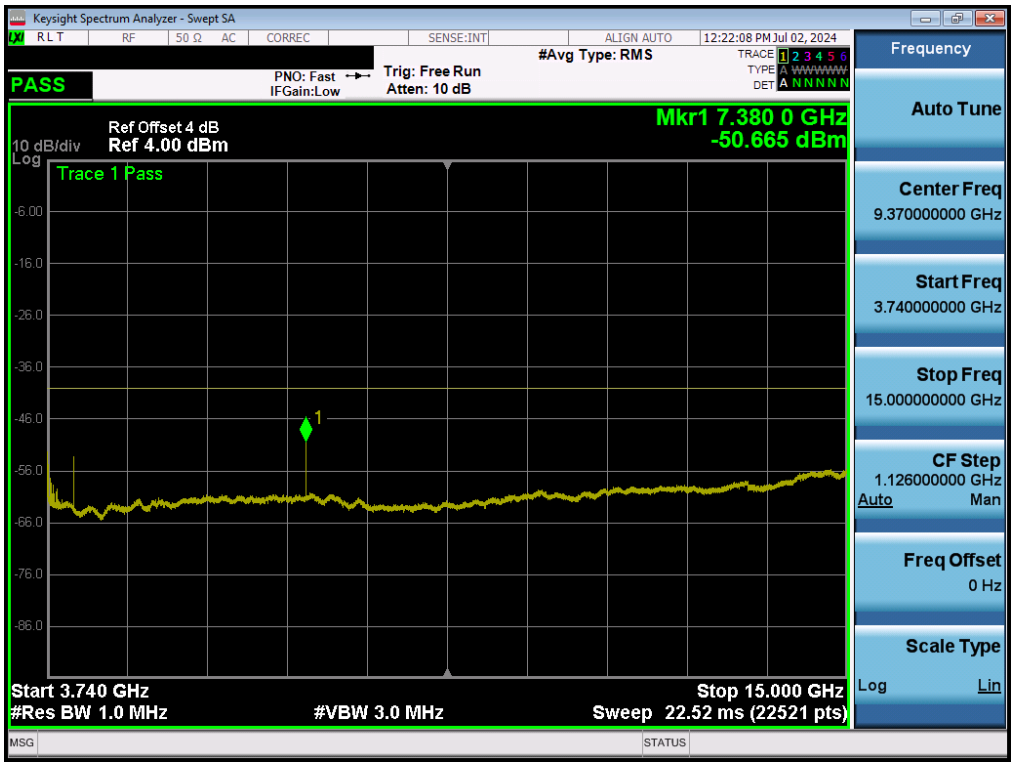
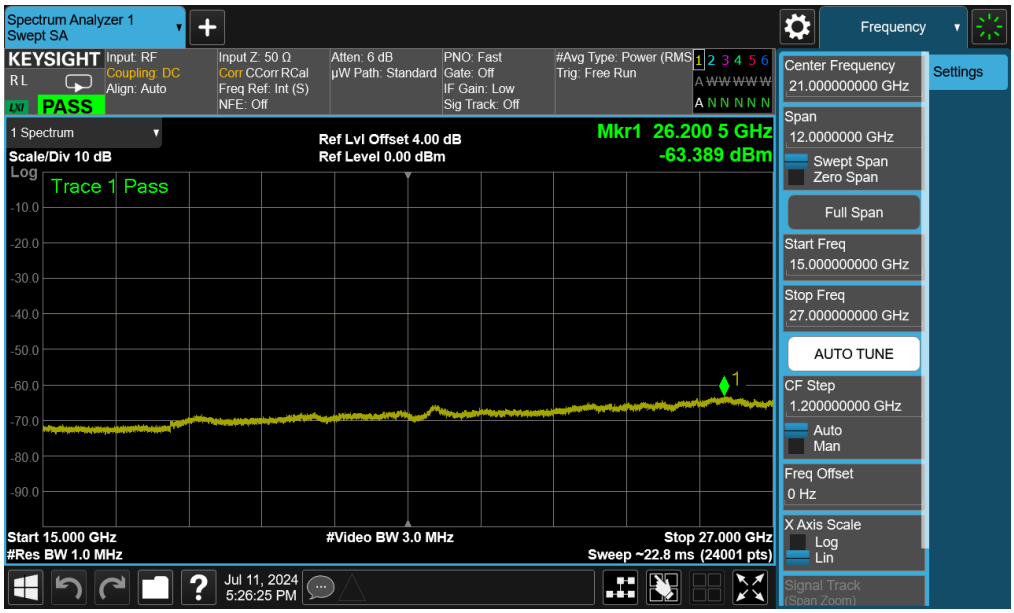


Plot 7-33. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - High Channel)



Plot 7-34. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - High Channel)

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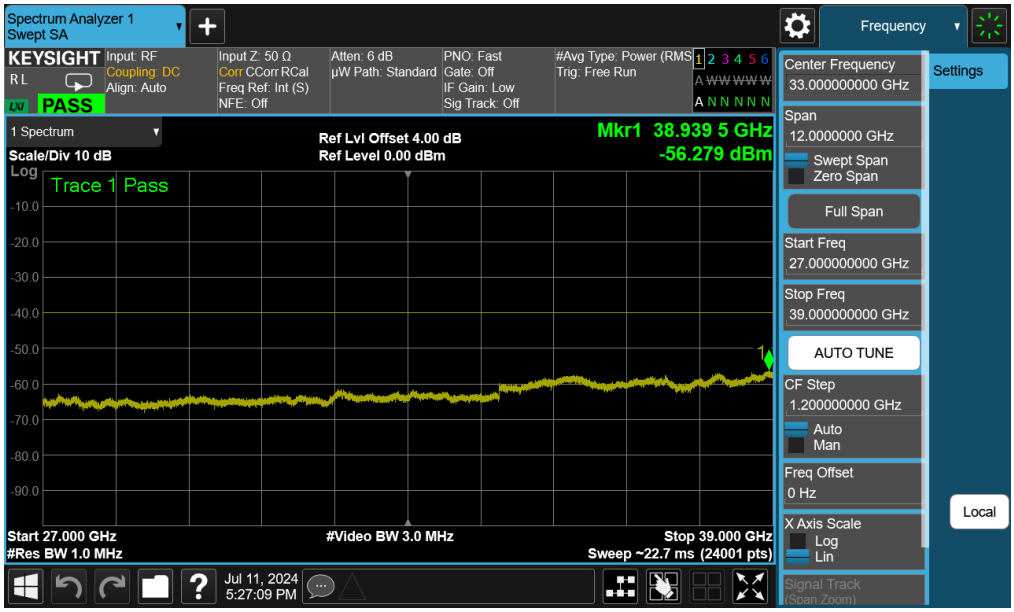

Plot 7-35. Conducted Spurious Plot (LTE Band 48 - 20MHz QPSK - High Channel)

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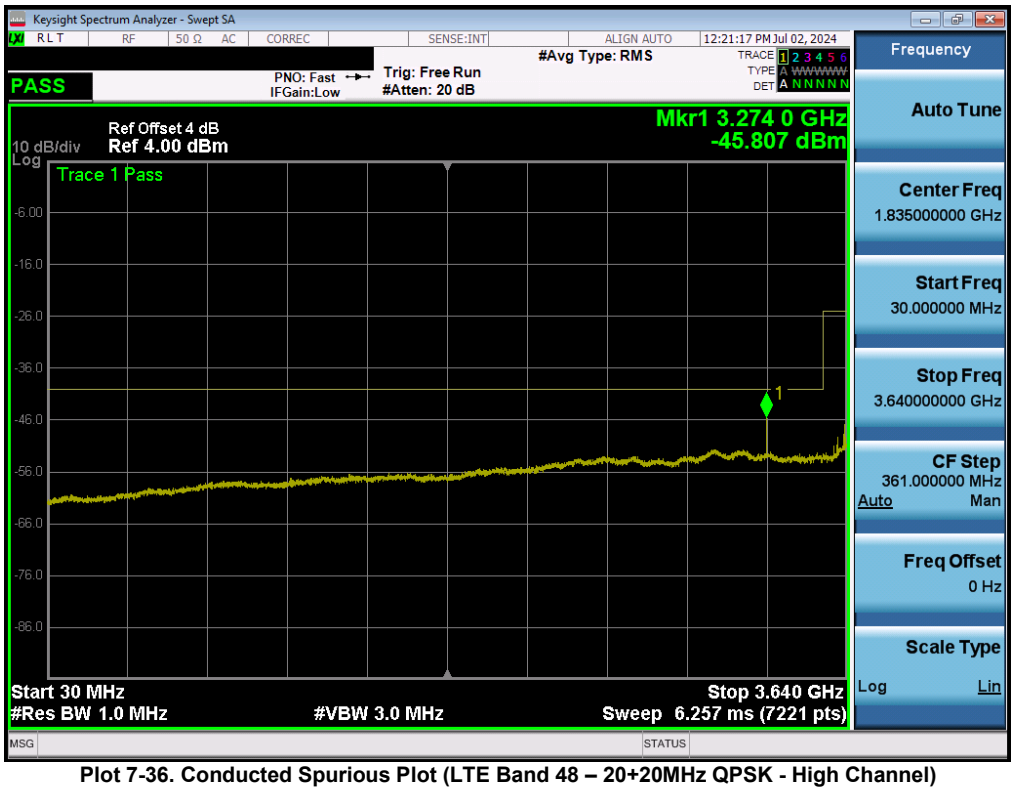
ULCA LB48

Mode	Bandwidth	Channel	Range [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
LTE Band 48 ULCA	20+20MHz	Low	30.0 - 3510.0	-50.86	-40.0	-10.86
		Low	3610.0 - 15000.0	-51.64	-40.0	-11.64
		Low	15000.0 - 27000.0	-63.26	-40.0	-23.26
		Low	27000.0 - 40000.0	-57.71	-40.0	-17.71
		Mid	30.0 - 3575.0	-50.04	-40.0	-10.04
		Mid	3675.0 - 15000.0	-52.17	-40.0	-12.17
		Mid	15000.0 - 27000.0	-63.09	-40.0	-23.09
		Mid	27000.0 - 40000.0	-57.09	-40.0	-17.09
		High	30.0 - 3640.0	-45.81	-40.0	-5.81
		High	3740.0 - 15000.0	-50.60	-40.0	-10.60
		High	15000.0 - 27000.0	-62.94	-40.0	-22.94
		High	27000.0 - 40000.0	-57.27	-40.0	-17.27

Table 7-11. Conducted Emission Test Results



Plot 7-36. Conducted Spurious Plot (LTE Band 48 – 20+20MHz QPSK - High Channel)

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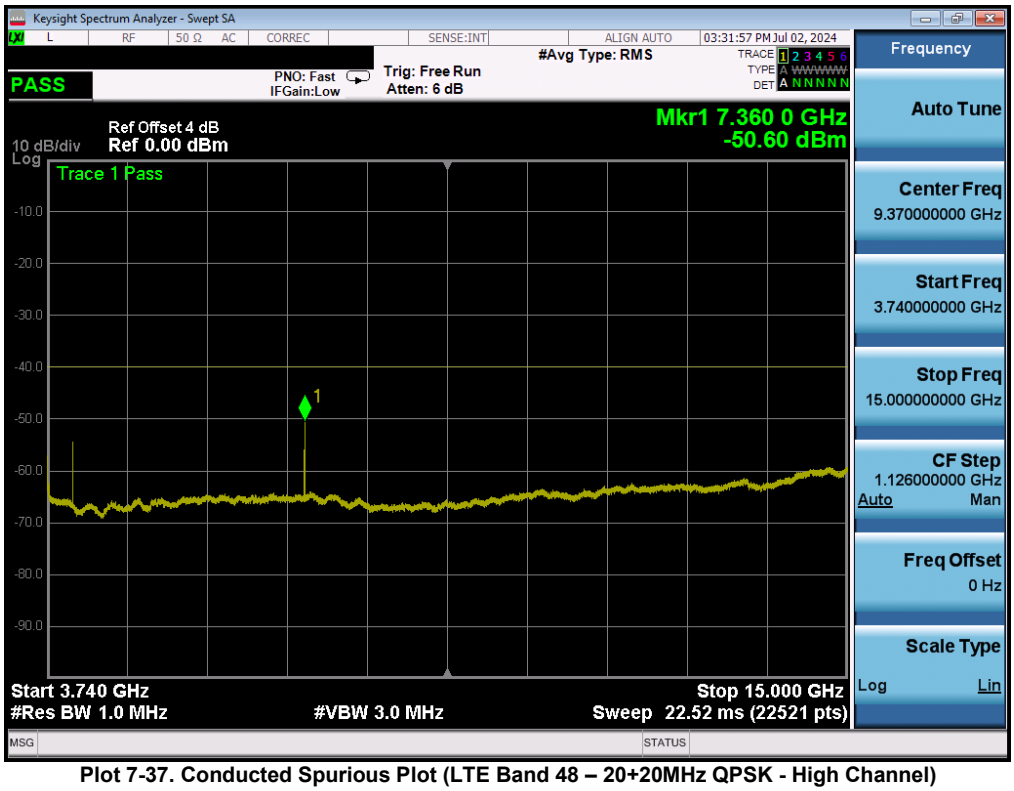
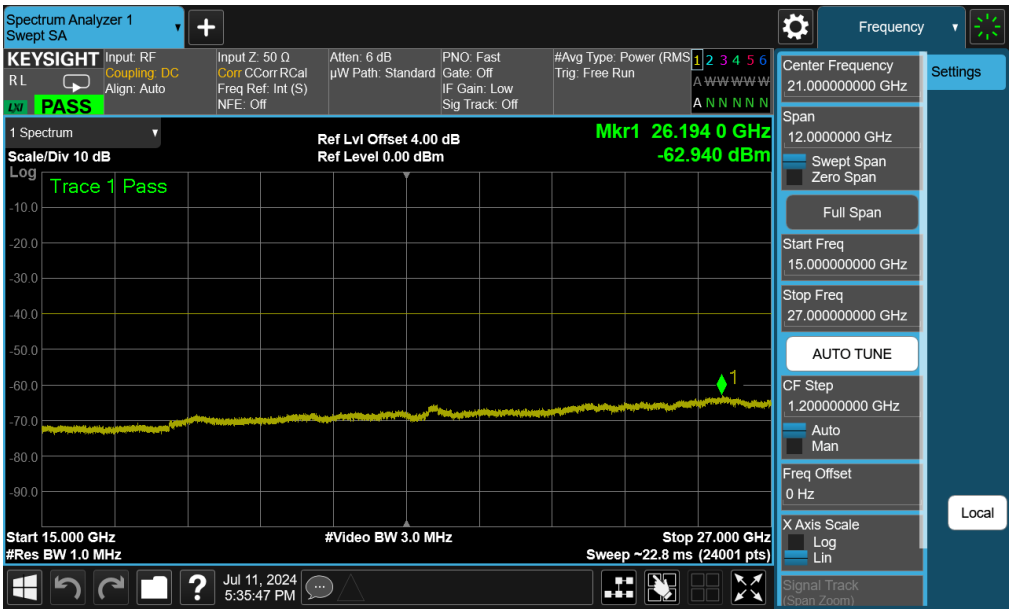


Plot 7-37. Conducted Spurious Plot (LTE Band 48 – 20+20MHz QPSK - High Channel)



Plot 7-38. Conducted Spurious Plot (LTE Band 48 – 20+20MHz QPSK - High Channel)

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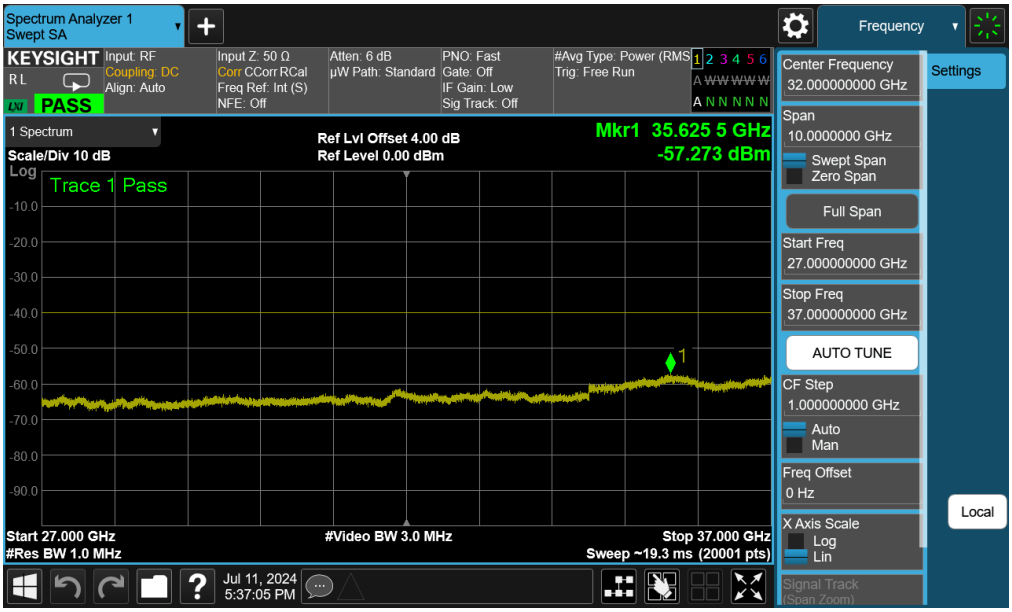

Plot 7-39. Conducted Spurious Plot (LTE Band 48 – 20+20MHz QPSK - High Channel)

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NR Band n48 – Ant S4

Mode	Bandwidth	Channel	Range [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
NR-n48	40MHz	Low	30.0 - 3510.0	-47.63	-40.0	-7.62
		Low	3610.0 - 15000.0	-56.26	-40.0	-16.26
		Low	15000.0 - 27000.0	-59.8	-40.0	-19.80
		Low	27000.0 - 40000.0	-54.06	-40.0	-14.05
		Mid	30.0 - 35750.0	-45.55	-40.0	-5.55
		Mid	3675.0 - 15000.0	-48.16	-40.0	-8.16
		Mid	15000.0 - 27000.0	-59.94	-40.0	-19.94
		Mid	27000.0 - 40000.0	-53.14	-40.0	-13.14
		High	30.0 - 3640.0	-48.43	-40.0	-8.43
		High	3740.0 - 15000.0	-48.38	-40.0	-8.38
		High	15000.0 - 27000.0	-59.99	-40.0	-19.99
		High	27000.0 - 40000.0	-53.33	-40.0	-13.33

Table 7-12. Conducted Emission Test Results

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

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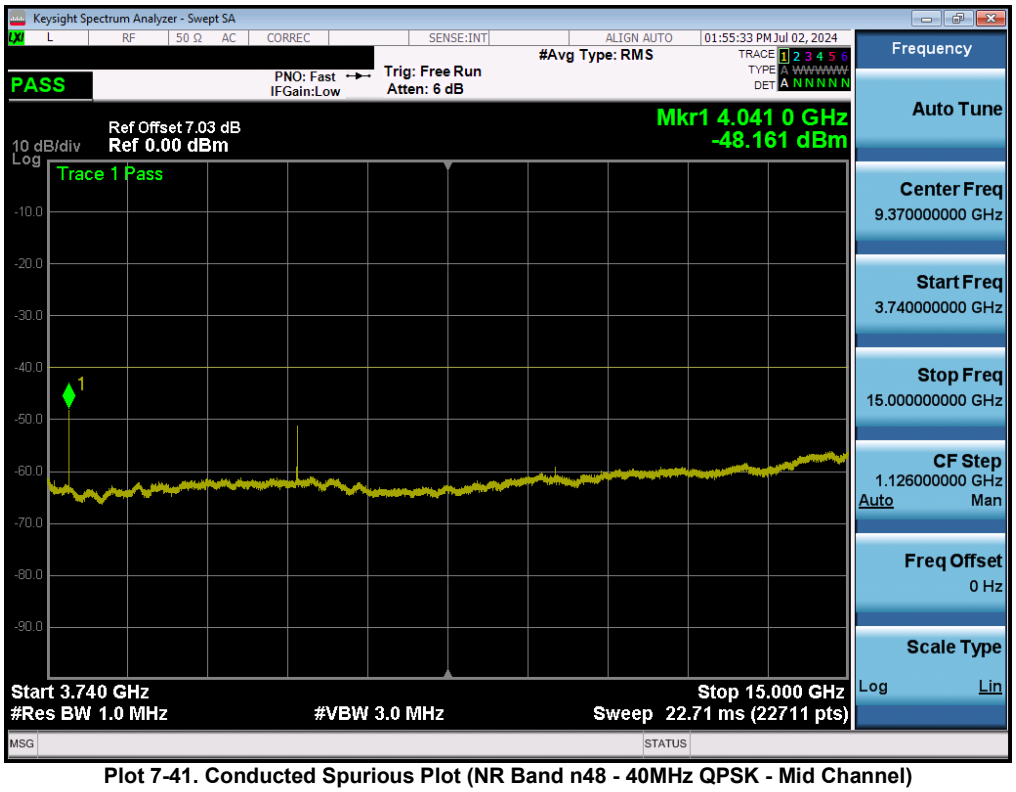
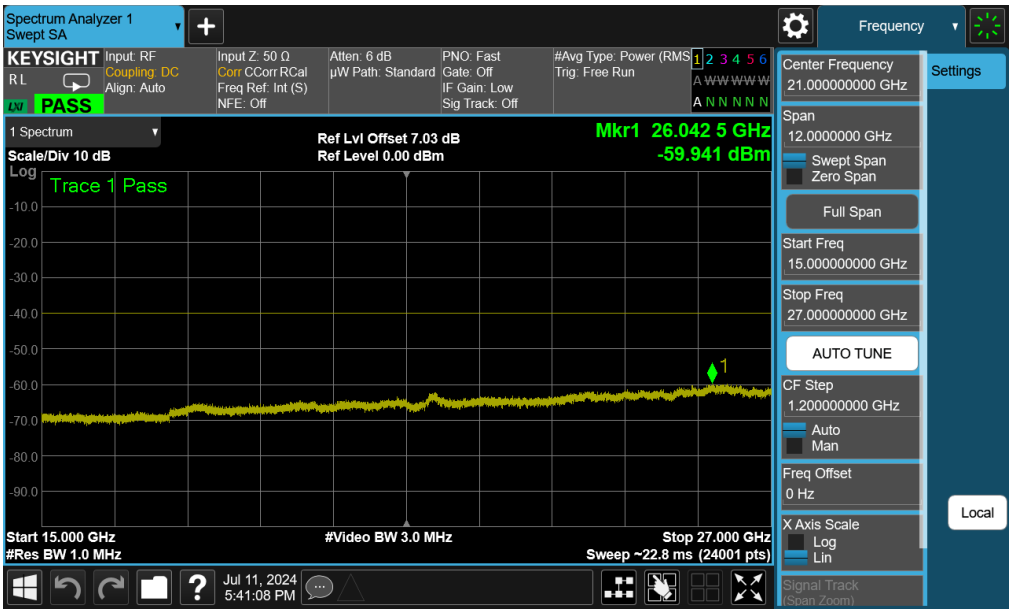


Plot 7-41. Conducted Spurious Plot (NR Band n48 - 40MHz QPSK - Mid Channel)



Plot 7-42. Conducted Spurious Plot (NR Band n48 - 40MHz QPSK - Mid Channel)

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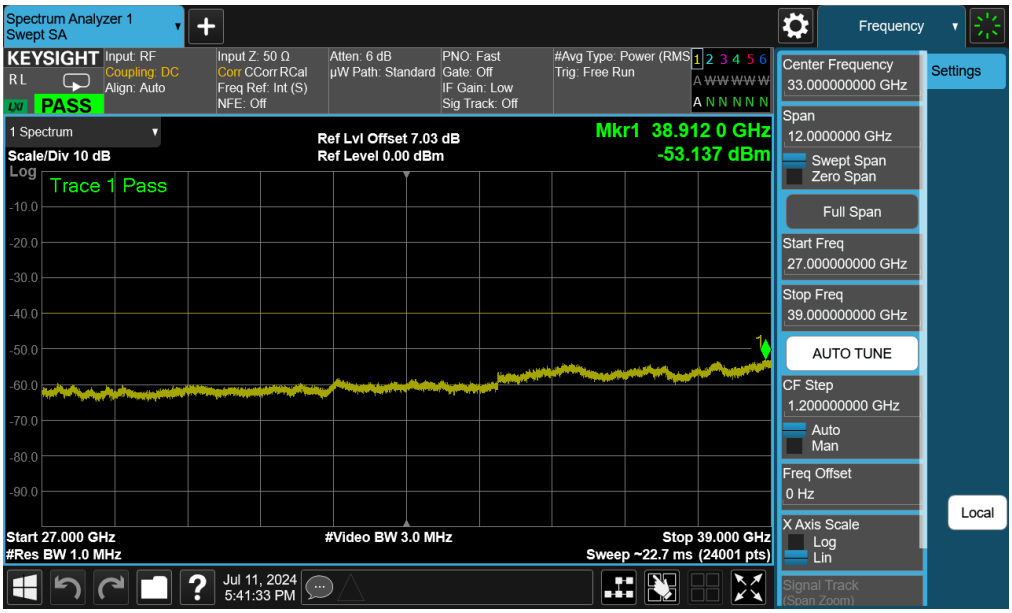

Plot 7-43. Conducted Spurious Plot (NR Band n48 - 40MHz QPSK - Mid Channel)

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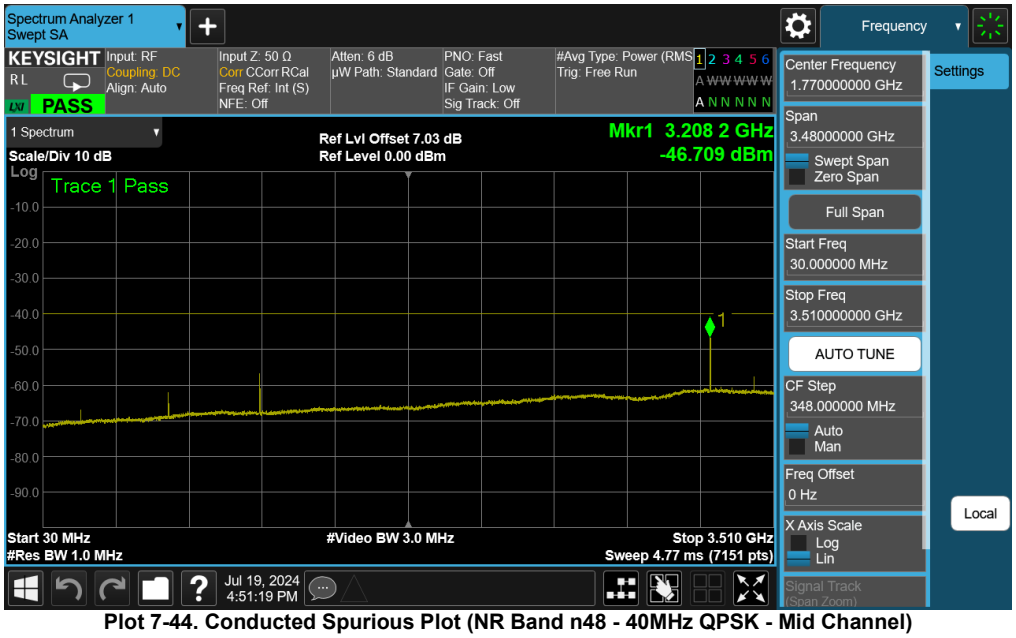
NR Band n48 – Ant S2

Mode	Bandwidth	Channel	Range [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
NR-n48	40MHz	Low	30.0 - 3510.0	-46.97	-40.0	-6.97
		Low	3610.0 - 15000.0	-46.96	-40.0	-6.96
		Low	15000.0 - 27000.0	-59.64	-40.0	-19.64
		Low	27000.0 - 40000.0	-53.83	-40.0	-13.83
		Mid	30.0 - 35750.0	-46.71	-40.0	-6.71
		Mid	3675.0 - 15000.0	-44.13	-40.0	-4.13
		Mid	15000.0 - 27000.0	-59.35	-40.0	-19.35
		Mid	27000.0 - 40000.0	-52.46	-40.0	-12.46
		High	30.0 - 3640.0	-47.2	-40.0	-7.20
		High	3740.0 - 15000.0	-45.19	-40.0	-5.19
		High	15000.0 - 27000.0	-59.53	-40.0	-19.53
		High	27000.0 - 40000.0	-52.8	-40.0	-12.80

Table 7-13. Conducted Emission Test Results



Plot 7-44. Conducted Spurious Plot (NR Band n48 - 40MHz QPSK - Mid Channel)

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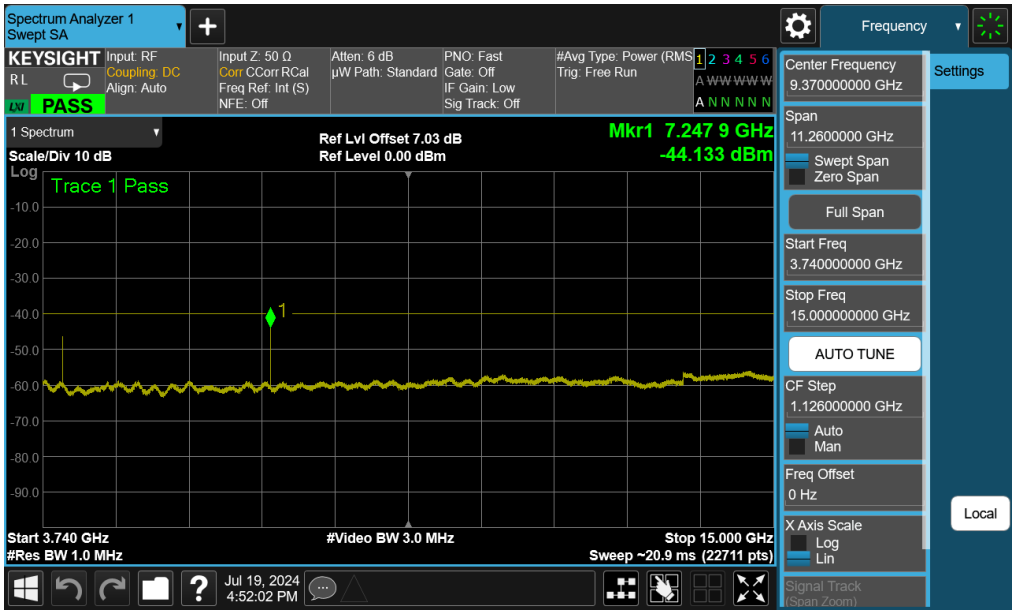
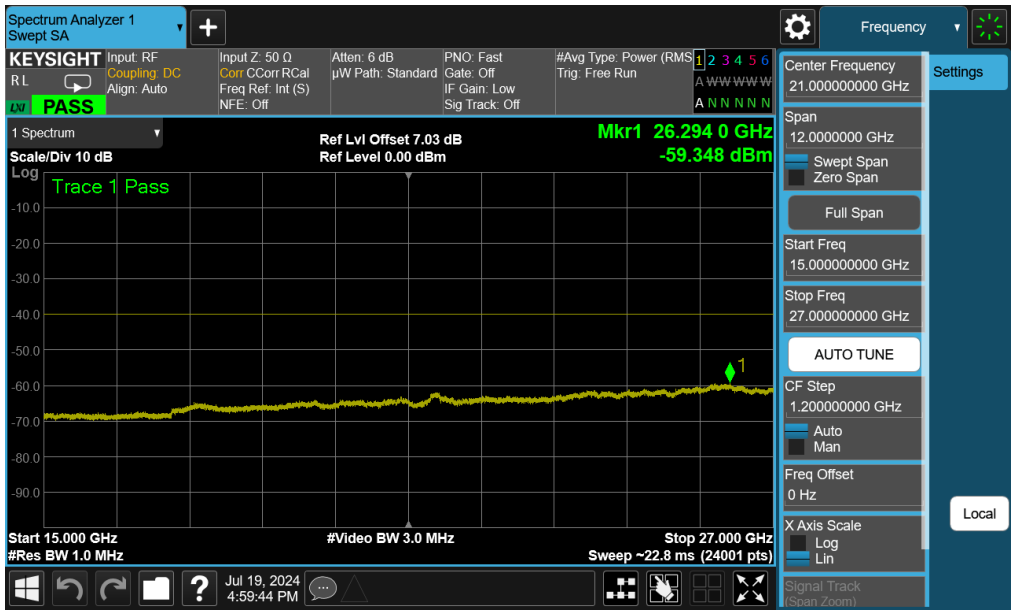


Plot 7-45. Conducted Spurious Plot (NR Band n48 - 40MHz QPSK - Mid Channel)



Plot 7-46. Conducted Spurious Plot (NR Band n48 - 40MHz QPSK - Mid Channel)

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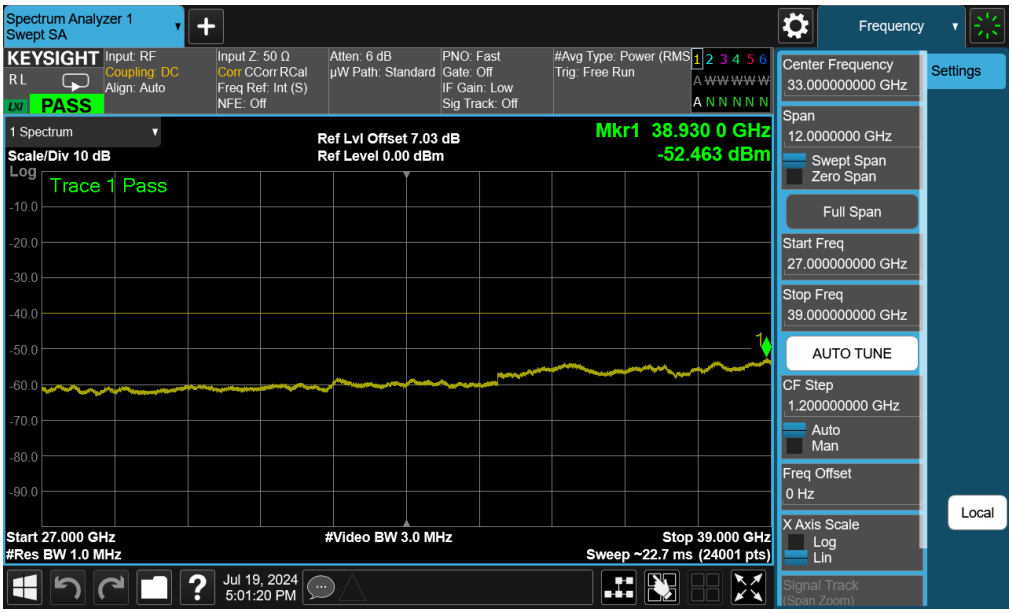

Plot 7-47. Conducted Spurious Plot (NR Band n48 - 40MHz QPSK - Mid Channel)

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