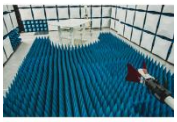
PCTEST
18855 Adams Court, Morgan Hill, CA 95037 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



PART 22 MEASUREMENT REPORT

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
11/29/2021 - 1/17/2022
Test Site/Location:
PCTEST Morgan Hill, CA, USA
Test Report Serial No.:
1C2111150079-01.BCG

FCC ID:	**BCGA2589**
Applicant Name:	**Apple Inc.**

Application Type:	Certification
Model:	A2589(A2591)
EUT Type:	Tablet Device
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part:	22
Test Procedure(s):	ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01 v03r01

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

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

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.02

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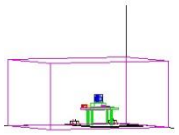
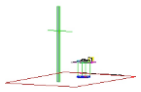


PART 22 MEASUREMENT REPORT



Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	OBW [MHz]	ERP		EIRP		Emission Designator
					Max. Power [W]	Max. Power [dBm]	Max. Power [W]	Max. Power [dBm]	
WCDMA850	5 MHz	Spread Spectrum	826.4 - 846.6	4.1574	0.153	21.85	0.251	24.00	4M16F9W
Band 5	1.4 MHz	QPSK	824.7 - 848.3	1.0874	0.150	21.75	0.245	23.90	1M09G7W
		16QAM	824.7 - 848.3	1.0962	0.127	21.04	0.209	23.19	1M10D7W
		64QAM	824.7 - 848.3	1.0907	0.103	20.15	0.170	22.30	1M09D7W
		256QAM	824.7 - 848.3	1.0893	0.049	16.89	0.080	19.04	1M09D7W
	3 MHz	QPSK	825.5 - 847.5	2.7161	0.156	21.92	0.255	24.07	2M72G7W
		16QAM	825.5 - 847.5	2.7065	0.131	21.16	0.214	23.31	2M71D7W
		64QAM	825.5 - 847.5	2.7075	0.104	20.17	0.171	22.32	2M71D7W
		256QAM	825.5 - 847.5	2.7059	0.051	17.08	0.084	19.23	2M71D7W
	5 MHz	QPSK	826.5 - 846.5	4.5321	0.155	21.89	0.254	24.04	4M53G7W
		16QAM	826.5 - 846.5	4.5157	0.130	21.14	0.213	23.29	4M52D7W
		64QAM	826.5 - 846.5	4.5273	0.101	20.06	0.166	22.21	4M53D7W
		256QAM	826.5 - 846.5	4.5318	0.049	16.93	0.081	19.08	4M53D7W
	10 MHz	QPSK	829.0 - 844.0	9.0248	0.157	21.95	0.257	24.10	9M02G7W
		16QAM	829.0 - 844.0	9.0317	0.132	21.20	0.216	23.35	9M03D7W
		64QAM	829.0 - 844.0	9.0090	0.102	20.08	0.167	22.23	9M01D7W
		256QAM	829.0 - 844.0	9.0058	0.051	17.11	0.084	19.26	9M01D7W
Band 26	1.4 MHz	QPSK	824.7 - 848.3	1.0874	0.155	21.89	0.254	24.04	1M09G7W
		16QAM	824.7 - 848.3	1.0962	0.128	21.07	0.210	23.22	1M10D7W
		64QAM	824.7 - 848.3	1.0907	0.108	20.35	0.178	22.50	1M09D7W
		256QAM	824.7 - 848.3	1.0893	0.049	16.91	0.081	19.06	1M09D7W
	3 MHz	QPSK	825.5 - 847.5	2.7161	0.151	21.79	0.248	23.94	2M72G7W
		16QAM	825.5 - 847.5	2.7065	0.127	21.05	0.209	23.20	2M71D7W
		64QAM	825.5 - 847.5	2.7075	0.109	20.39	0.179	22.54	2M71D7W
		256QAM	825.5 - 847.5	2.7059	0.050	16.98	0.082	19.13	2M71D7W
	5 MHz	QPSK	826.5 - 846.5	4.5321	0.153	21.84	0.251	23.99	4M53G7W
		16QAM	826.5 - 846.5	4.5157	0.134	21.28	0.220	23.43	4M52D7W
		64QAM	826.5 - 846.5	4.5273	0.109	20.36	0.178	22.51	4M53D7W
		256QAM	826.5 - 846.5	4.5318	0.053	17.25	0.087	19.40	4M53D7W
	10 MHz	QPSK	829.0 - 844.0	9.0248	0.151	21.80	0.248	23.95	9M02G7W
		16QAM	829.0 - 844.0	9.0317	0.128	21.07	0.210	23.22	9M03D7W
		64QAM	829.0 - 844.0	9.0090	0.110	20.41	0.180	22.56	9M01D7W
		256QAM	829.0 - 844.0	9.0058	0.051	17.08	0.084	19.23	9M01D7W
ULCA Band 5	10 + 10 MHz	QPSK	834.0 - 839.0	18.8777	0.152	21.82	0.249	23.97	18M9G7W
		16QAM	834.0 - 839.0	18.8384	0.076	18.82	0.125	20.97	18M8D7W
		64QAM	834.0 - 839.0	18.8259	0.077	18.86	0.126	21.01	18M8D7W
		256QAM	834.0 - 839.0	18.8824	0.049	16.87	0.080	19.02	18M9D7W
NR Band n5	5 MHz	π/2 BPSK	826.5 - 846.5	4.5017	0.142	21.54	0.234	23.69	4M50G7W
		QPSK	826.5 - 846.5	4.5216	0.154	21.88	0.253	24.03	4M52G7W
		16QAM	826.5 - 846.5	4.4976	0.117	20.68	0.192	22.83	4M50D7W
		64QAM	826.5 - 846.5	4.4892	0.082	19.15	0.135	21.30	4M49D7W
		256QAM	826.5 - 846.5	4.5200	0.055	17.41	0.090	19.56	4M52D7W
	10 MHz	π/2 BPSK	829.0 - 844.0	8.9674	0.145	21.60	0.237	23.75	8M97G7W
		QPSK	829.0 - 844.0	9.3310	0.151	21.80	0.248	23.95	9M33G7W
		16QAM	829.0 - 844.0	9.3446	0.119	20.75	0.195	22.90	9M34D7W
		64QAM	829.0 - 844.0	9.3330	0.085	19.28	0.139	21.43	9M33D7W
		256QAM	829.0 - 844.0	9.3354	0.052	17.13	0.085	19.28	9M34D7W
	15 MHz	π/2 BPSK	831.5 - 841.5	13.5053	0.145	21.63	0.239	23.78	13M5G7W
		QPSK	831.5 - 841.5	14.1710	0.147	21.67	0.241	23.82	14M2G7W
		16QAM	831.5 - 841.5	14.2190	0.115	20.62	0.189	22.77	14M2D7W
		64QAM	831.5 - 841.5	14.1727	0.084	19.27	0.139	21.42	14M2D7W
		256QAM	831.5 - 841.5	14.1915	0.053	17.21	0.086	19.36	14M2D7W
	20 MHz	π/2 BPSK	834.0 - 839.0	17.9481	0.152	21.82	0.250	23.97	17M9G7W
		QPSK	834.0 - 839.0	18.9874	0.139	21.43	0.228	23.58	19M0G7W
		16QAM	834.0 - 839.0	18.9957	0.120	20.78	0.196	22.93	19M0D7W
		64QAM	834.0 - 839.0	19.0088	0.086	19.33	0.140	21.48	19M0D7W
		256QAM	834.0 - 839.0	18.9567	0.052	17.16	0.085	19.31	19M0D7W

EUT Overview

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 PCTEST Test Location

These measurement tests were conducted at the PCTEST facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST located in Morgan Hill, CA 95037, U.S.A.

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 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.

- PCTEST 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).

- PCTEST facility is a registered (22831) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2589**. 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 22.

Test Device Serial No.: Y257GJ4FH2, MK616422XY, CM9FQFPG4G, DLX1462005314921G

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), WPT

This device supports BT Beamforming

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

Antenna	Simultaneous Tx Config	WLAN	Bluetooth	WCDMA / LTE / FR1 NR	LTE / FR1 NR		UNII
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	Mid Band	High Band	Ultra High Band	802.11 a/n/ac/ax
3A	Config 1	×	✓	×	×	×	✓
3A	Config 2	✓	×	×	✓	×	×
3A	Config 3	×	✓	×	✓	×	×
3A	Config 4	×	✓	×	✓	×	✓
3A	Config 5	×	×	×	✓	×	✓
3A	Config 6	✓	×	✓	×	×	×
3A	Config 7	×	✓	✓	×	×	×
3A	Config 8	×	✓	✓	×	×	✓
3A	Config 9	×	×	✓	×	×	✓
1A	Config 10	✓	×	×	✓	×	×
1A	Config 11	×	✓	×	✓	×	×
1A	Config 12	✓	×	✓	×	×	×
1A	Config 13	×	✓	✓	×	×	×
1B	Config 14	×	×	×	×	✓	✓
2B	Config 15	×	×	×	×	✓	✓

Table 2-1. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

Note:

All the above simultaneous transmission configurations have been tested and the worst case configuration was found to be Config 4 and reported in Bluetooth, UNII OFDM, and Part 27b RF test reports.

Wi-Fi 2.4GHz and Bluetooth 2.4 GHz can transmit simultaneously on separate antennas. 2.4 GHz WLAN Antenna 3a can only transmit simultaneously with 2.4GHz Bluetooth Antenna 1a. In this scenario Wi-Fi max power will not exceed minimum of (13.5dBm, SAR max cap, Regulatory max cap) power.

2.3 Antenna Description

Following antenna gains provided by manufacturer were used for testing.

Band	Antenna Gain (dBi)	
	Antenna 4	Antenna 3b
WCDMA850	-1.4	-2.2
LTE Band5/26		
NR Band n5		

Table 2-2. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook Pro	Model:	A2141	S/N:	C02DV7VKMD6T
	w/AC/DC Adapter	Model:	A2166	S/N:	N/A
2	Apple USB-C Cable	Model:	Chimp	S/N:	420A57
3	Apple USB-C Cable	Model:	Spartan	S/N:	000MKTR02U
4	USB-C Cable	Model:	A146	S/N:	N/A
	w/ AC Adapter	Model:	A2305	S/N:	N/A
5	Apple Pencil	Model:	N/A	S/N:	GQXGSXBJKM9
6	DC Power Supply	Model:	KPS3010D	S/N:	N/A

Table 2-3. Test Support Equipment

2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.26 2015, TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.

2.6 Software and Firmware

The test was conducted with firmware version 19E11500Q installed on the EUT.

2.7 EMI Suppression Device(s)/Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Measurement Procedure

The measurement procedures described in the document titled "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI C63.26-2015/TIA-603-E-2016) and "Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems" (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

Deviation from Measurement Procedure……..None

3.2 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 spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. 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

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

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014.

Per KDB 414788 D01 v01r01, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was used while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

Radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015 and TIA-603-E-2016.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012.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	1.65
Radiated Disturbance (<30MHz)	4.06
Radiated Disturbance (30MHz-1GHz)	4.30
Radiated Disturbance (1-18GHz)	4.78
Radiated Disturbance (>18GHz)	4.79

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 Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	3/31/2021	Annual	3/31/2022	MY49430244
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	8/13/2021	Annual	8/13/2022	T058701-01
ESPEC	SU-241	Tabletop Temperature Chamber	10/26/2021	Annual	10/26/2022	92009574
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	10/21/2021	Annual	10/21/2022	208204
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	10/25/2021	Annual	10/25/2022	227597
Keysight Technology	N9040B	UXA Signal Analyzer	2/8/2022	Annual	2/8/2023	MY57212015
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	1/6/2022	Annual	1/6/2023	102327
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	1/6/2022	Annual	1/6/2023	101639
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	3/16/2021	Annual	3/16/2022	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	6/11/2021	Annual	6/11/2022	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	12/2/2021	Annual	12/2/2022	101570
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/11/2021	Annual	10/11/2022	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	3/15/2021	Annual	3/15/2022	161617
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/29/2021	Annual	4/29/2022	100051
Rohde & Schwarz	HFH2-Z2	Loop Antenna	4/5/2021	Annual	4/5/2022	100519
Rohde & Schwarz	FSVA3030	Signal Analyzer (up to 30 GHz)	4/19/2021	Annual	4/19/2022	100823
Rohde & Schwarz	FSVA3044	Signal Analyzer (up to 44 GHz)	4/26/2021	Annual	4/26/2022	101098

Table 5-1. Test Equipment

Notes:

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

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

6.0 SAMPLE CALCULATIONS

Emission Designator

WCDMA Emission Designator

Emission Designator = 4M16F9W
WCDMA BW = 4.16 MHz
F = Frequency Modulation
9 = Composite Digital Info
W = Combination (Audio/Data)

π/2 BPSK / QPSK Modulation

Emission Designator = 8M62G7W
BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination of Any

QAM Modulation

Emission Designator = 8M45D7W
BW = 8.45 MHz
D = Amplitude/Angle Modulated
7 = Quantized/Digital Info
W = Combination of Any

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: Apple Inc.

FCC ID: BCGA2589

FCC Classification: PCS Licensed Transmitter (PCB)

Mode(s): WCDMA/NR/LTE

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Occupied Bandwidth	2.1049	N/A	N/A	Section 7.2
	Conducted Band Edge / Spurious Emissions	2.1051, 22.917(a)	-13 dBm at Band Edge and for all out-of-band emissions	PASS	Sections 7.3, 7.4
	Transmitter Conducted Output Power	2.1046	N/A	N/A	See RF Exposure Report
	Effective Radiated Power / Equivalent Isotropic Radiated Power	22.913(a)(5)	< 7 Watts max. ERP	PASS	Section 7.5
	Frequency Stability	2.1055, 22.355	±2.5 ppm	PASS	Section 7.7
RADIATED	Radiated Spurious Emissions	2.1053, 22.917(a)	-13 dBm for all out-of-band emissions	PASS	Section 7.6

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 PCTEST EMC Software Tool 1.0.

7.2 Occupied Bandwidth

§2.1049

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. All ports were tested and only the worst case data were reported.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 4.2

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.

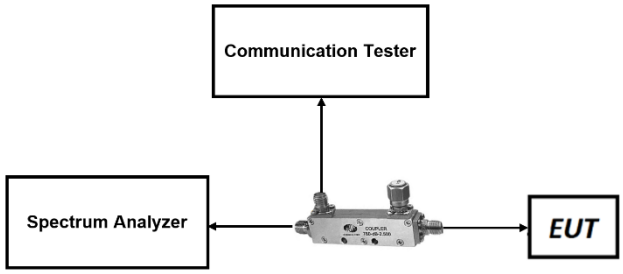
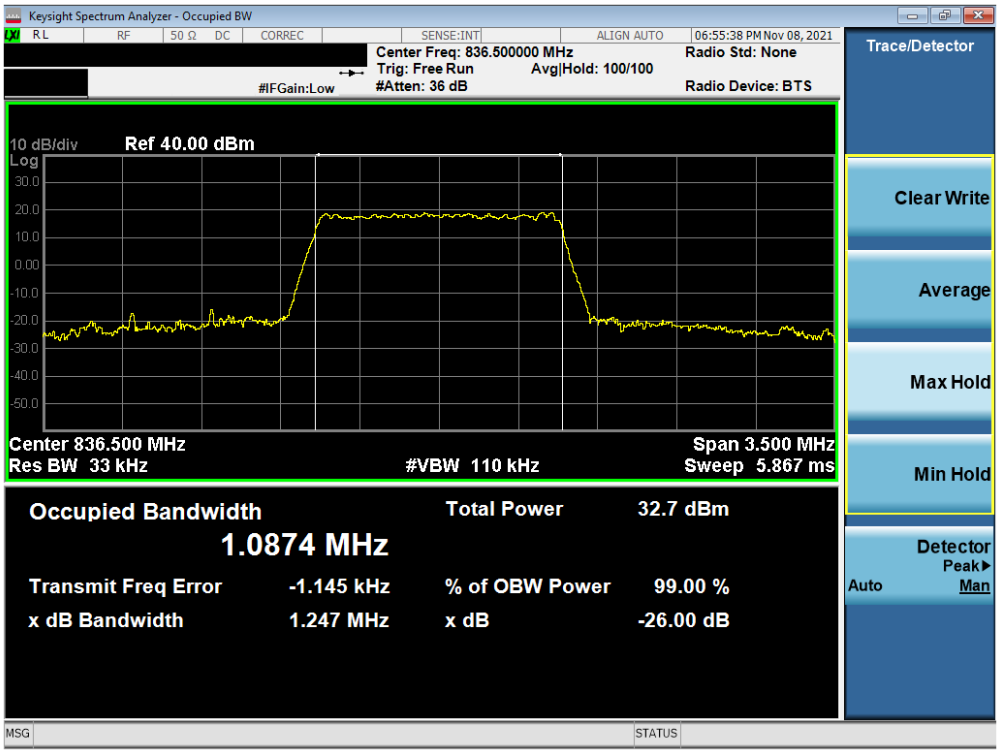


Figure 7-1. Test Instrument & Measurement Setup

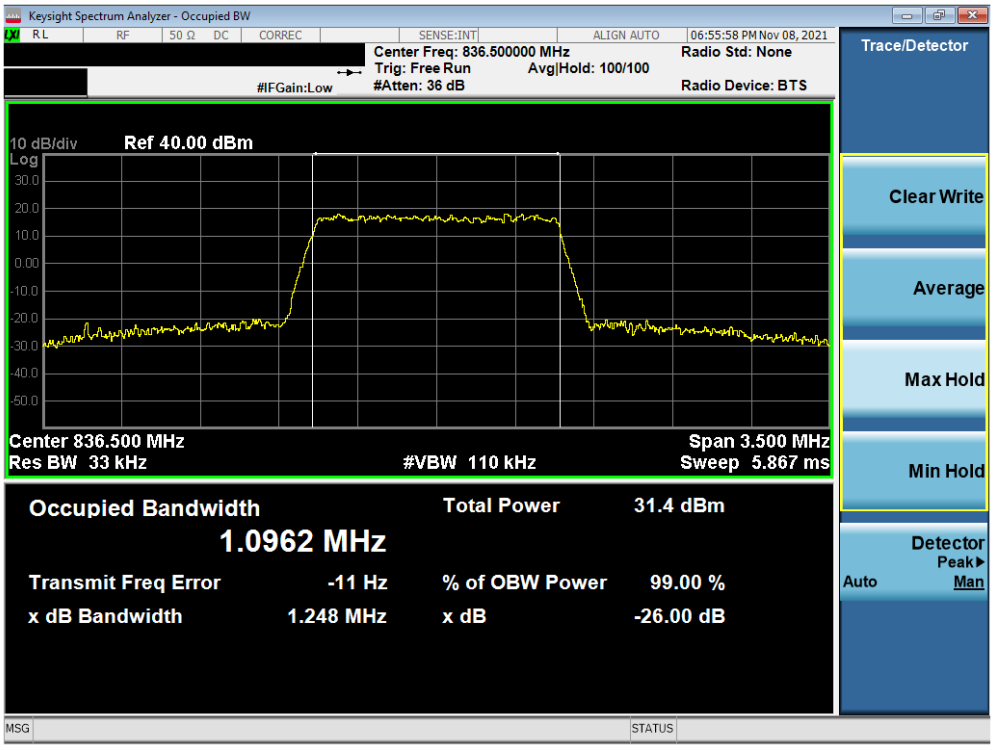
Test Notes

None.

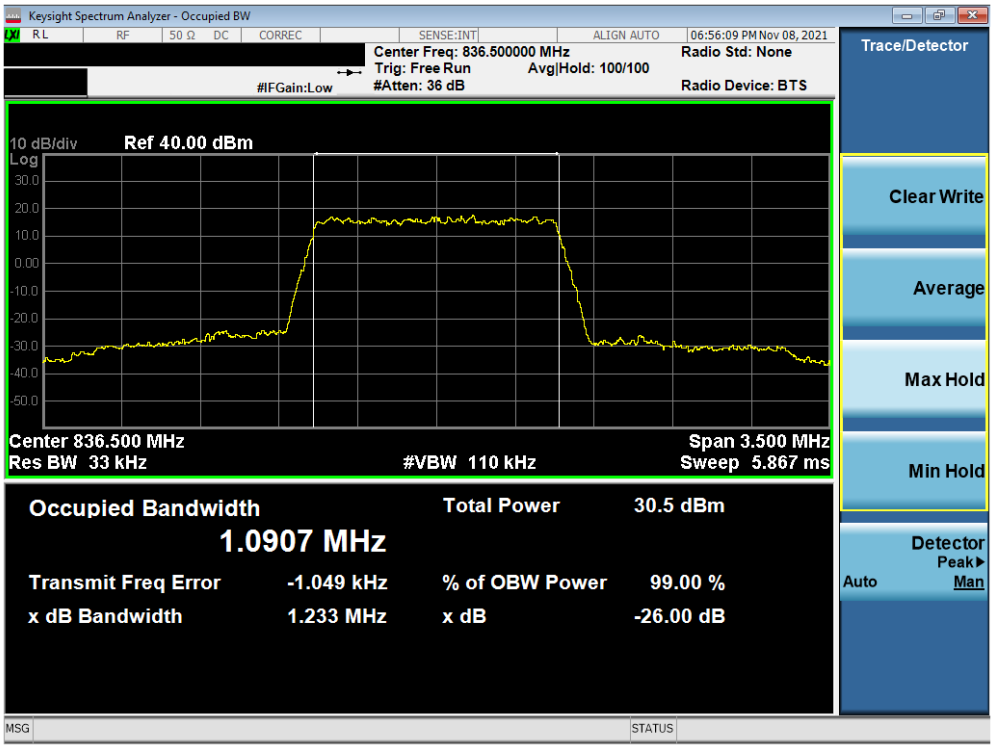
LTE Band 26/5



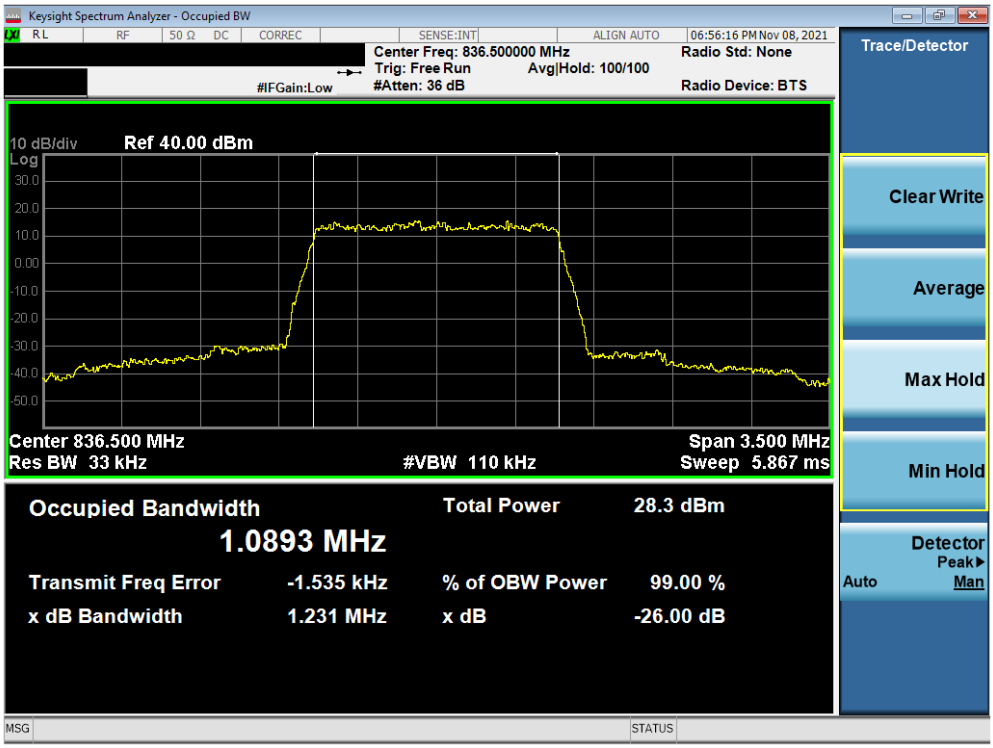
Plot 7-1. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz QPSK - Full RB Configuration)



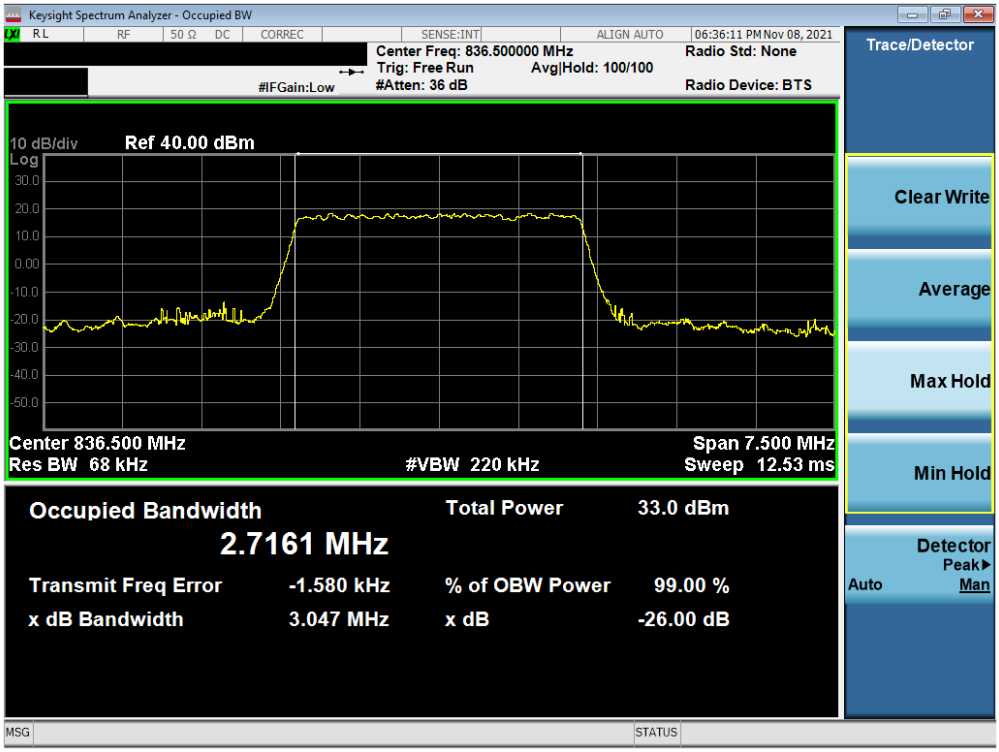
Plot 7-2. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz 16-QAM - Full RB Configuration)



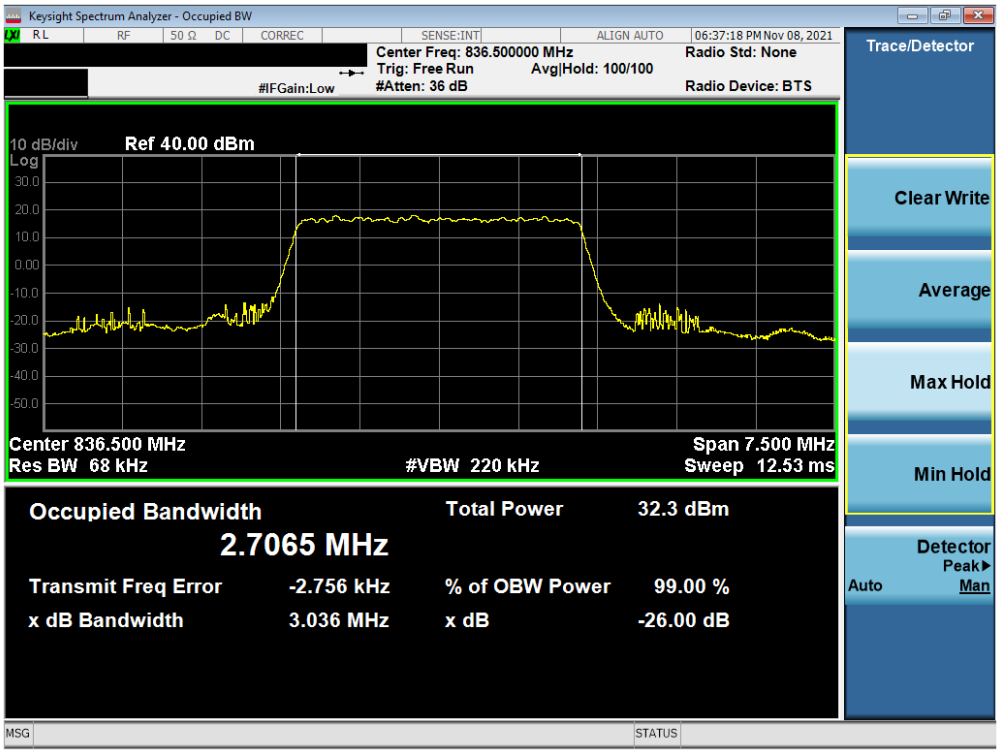
Plot 7-3. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz 64-QAM - Full RB Configuration)



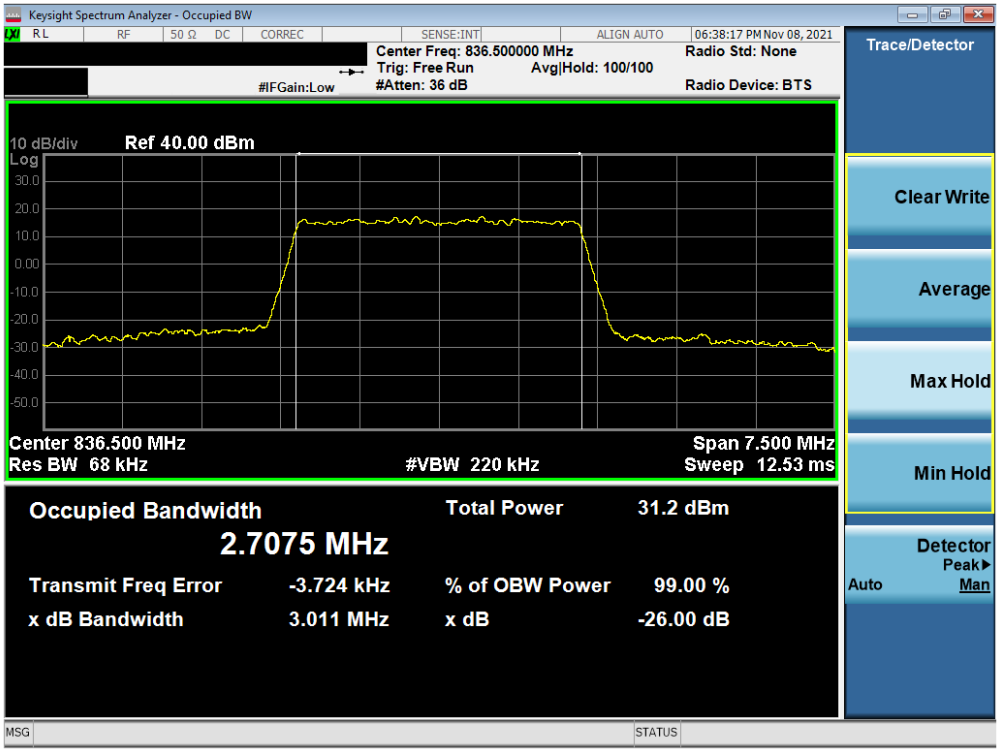
Plot 7-4. Occupied Bandwidth Plot (LTE Band 26/5 - 1.4MHz 256-QAM - Full RB Configuration)



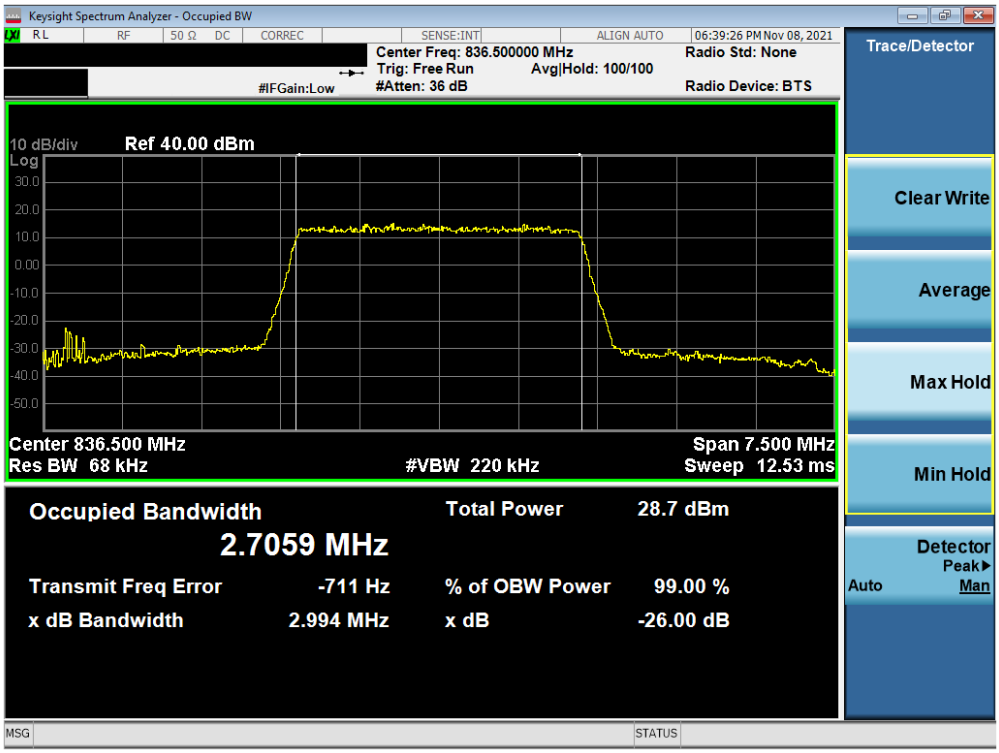
Plot 7-5. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz QPSK - Full RB Configuration)



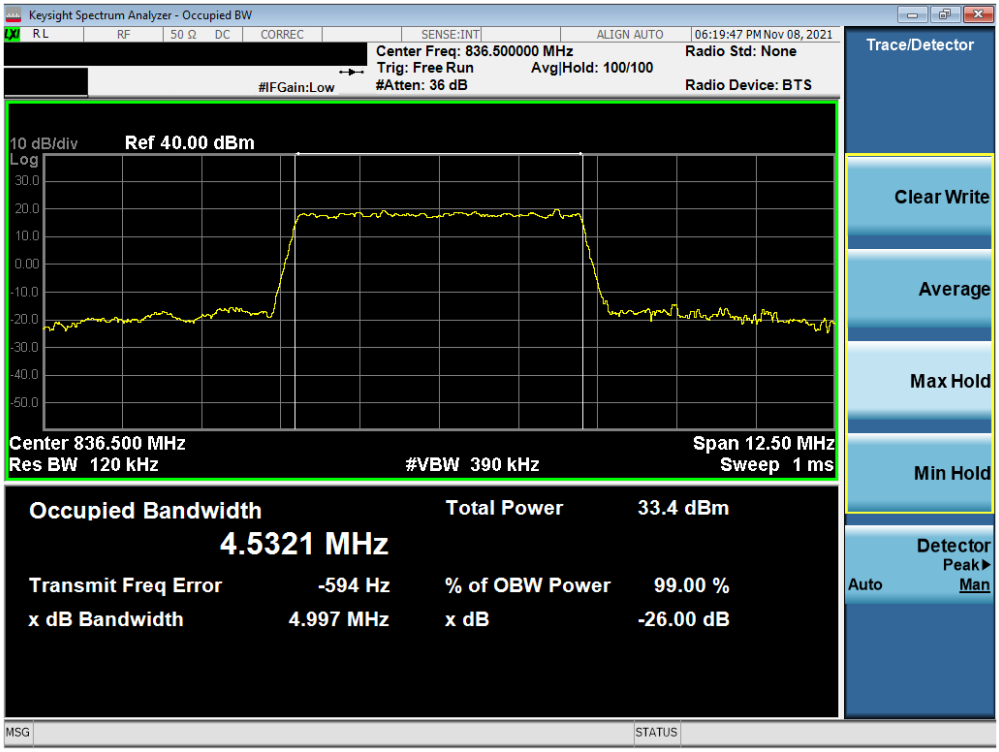
Plot 7-6. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz 16-QAM - Full RB Configuration)



Plot 7-7. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz 64-QAM - Full RB Configuration)

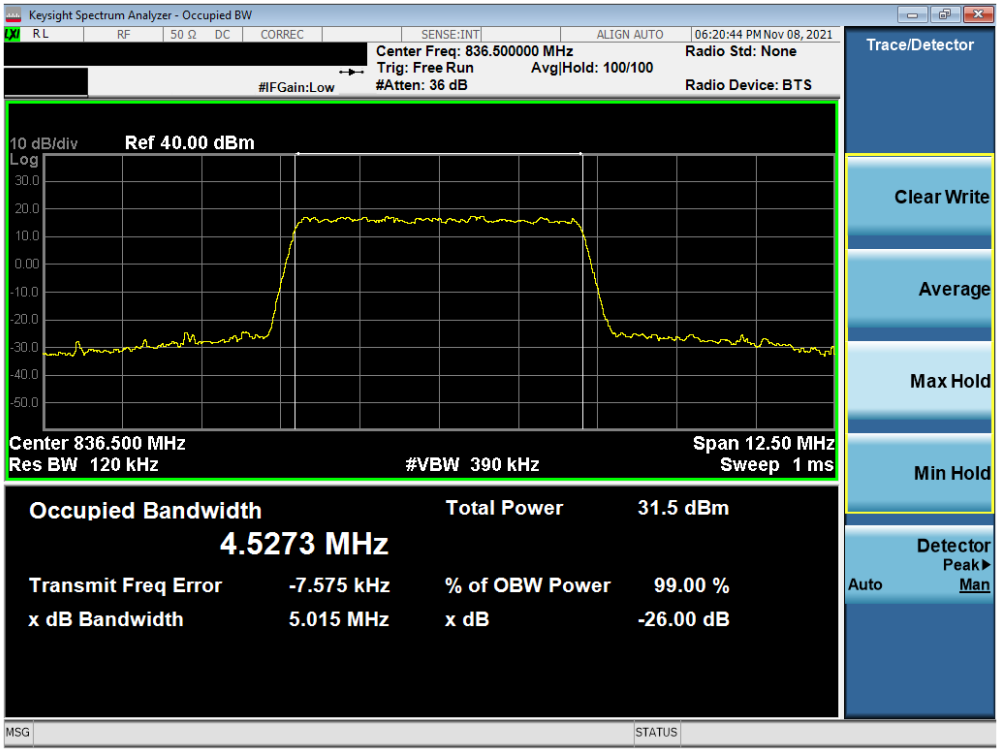


Plot 7-8. Occupied Bandwidth Plot (LTE Band 26/5 - 3MHz 256-QAM - Full RB Configuration)

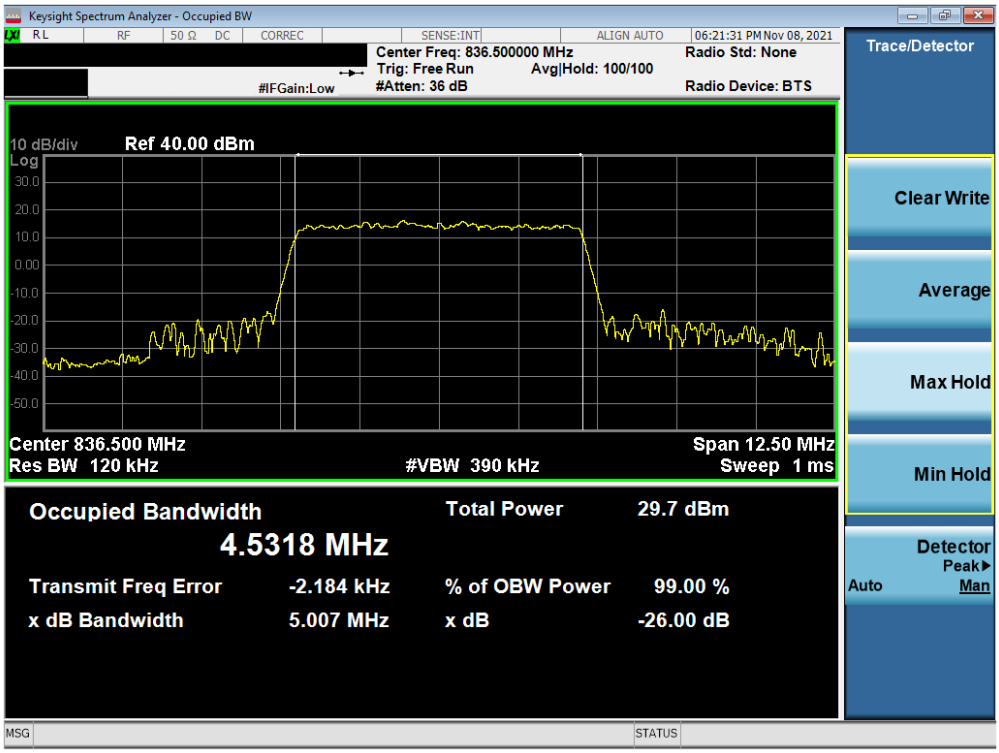


Plot 7-9. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz QPSK - Full RB Configuration)

Plot 7-10. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz 16-QAM - Full RB Configuration)

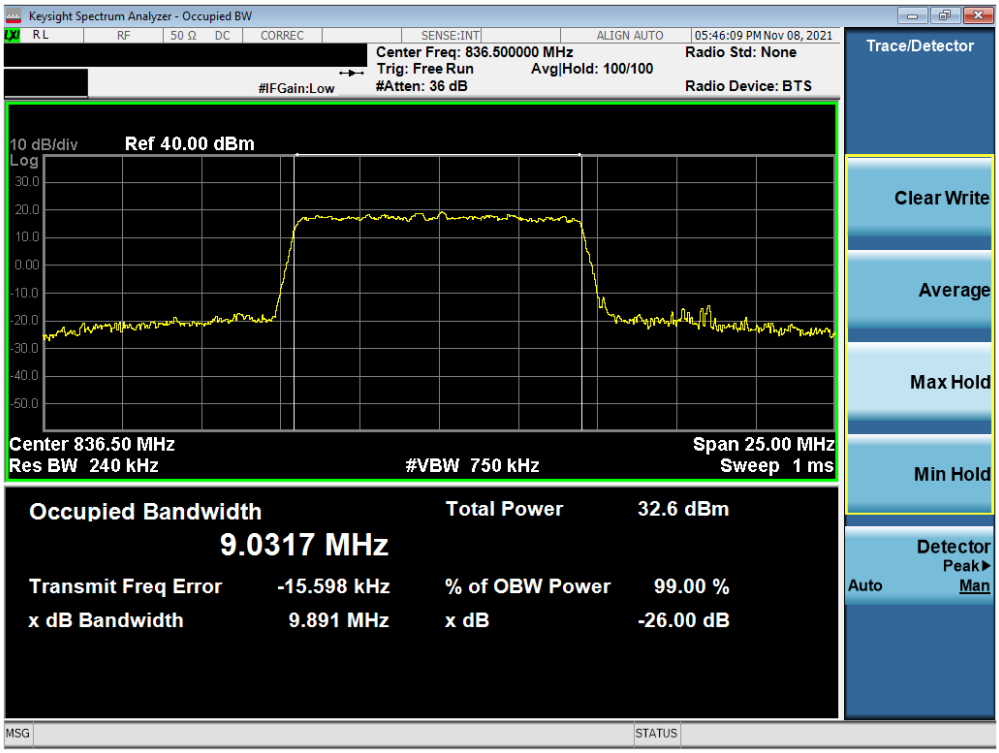


Plot 7-11. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz 64-QAM - Full RB Configuration)

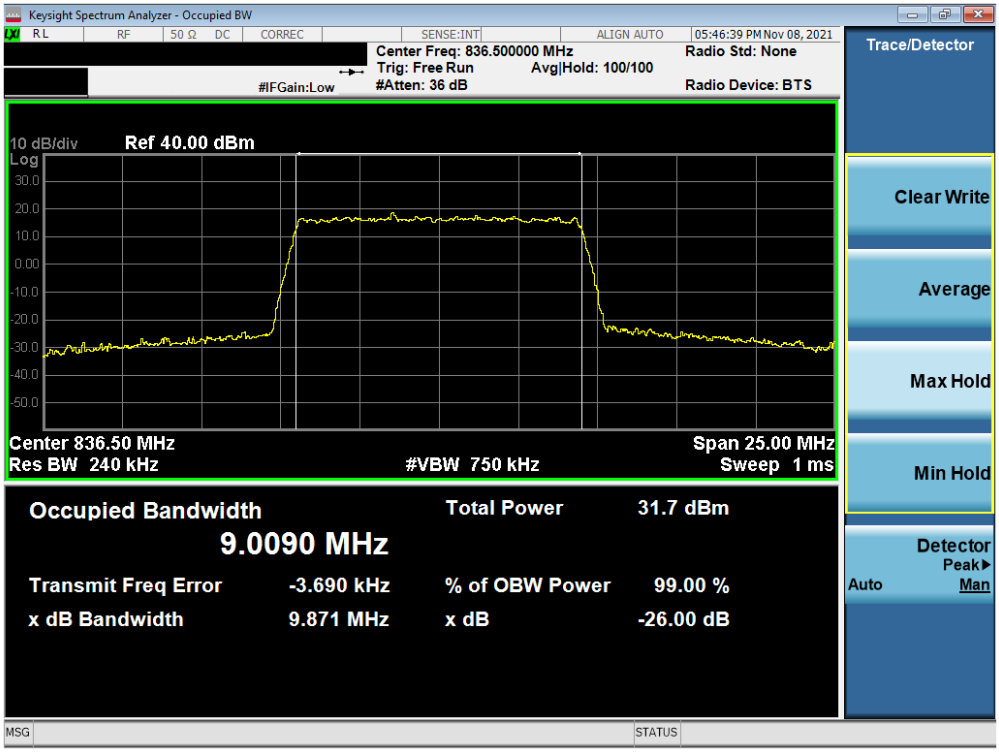


Plot 7-12. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz 256-QAM - Full RB Configuration)

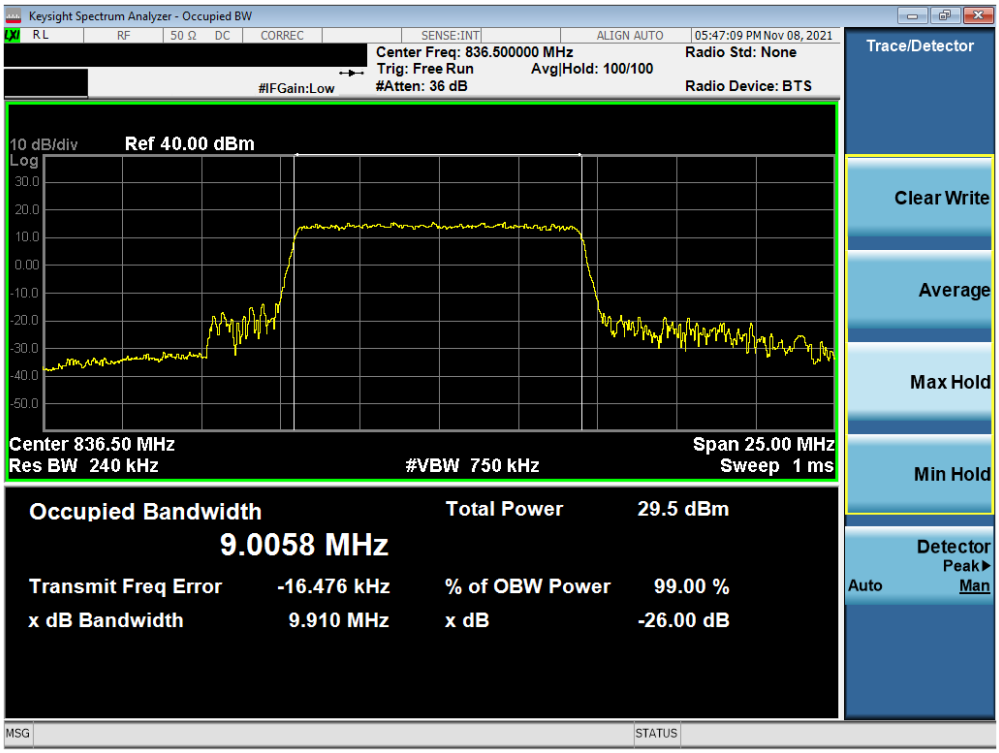
Plot 7-13. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz QPSK - Full RB Configuration)



Plot 7-14. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 16-QAM - Full RB Configuration)

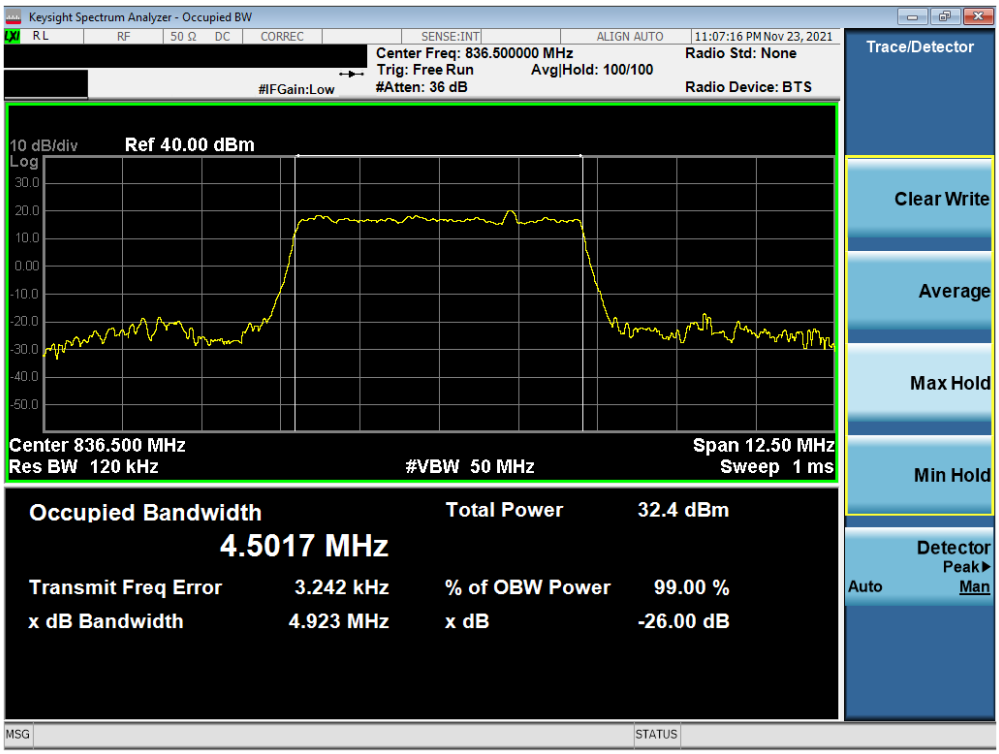


Plot 7-15. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 64-QAM - Full RB Configuration)

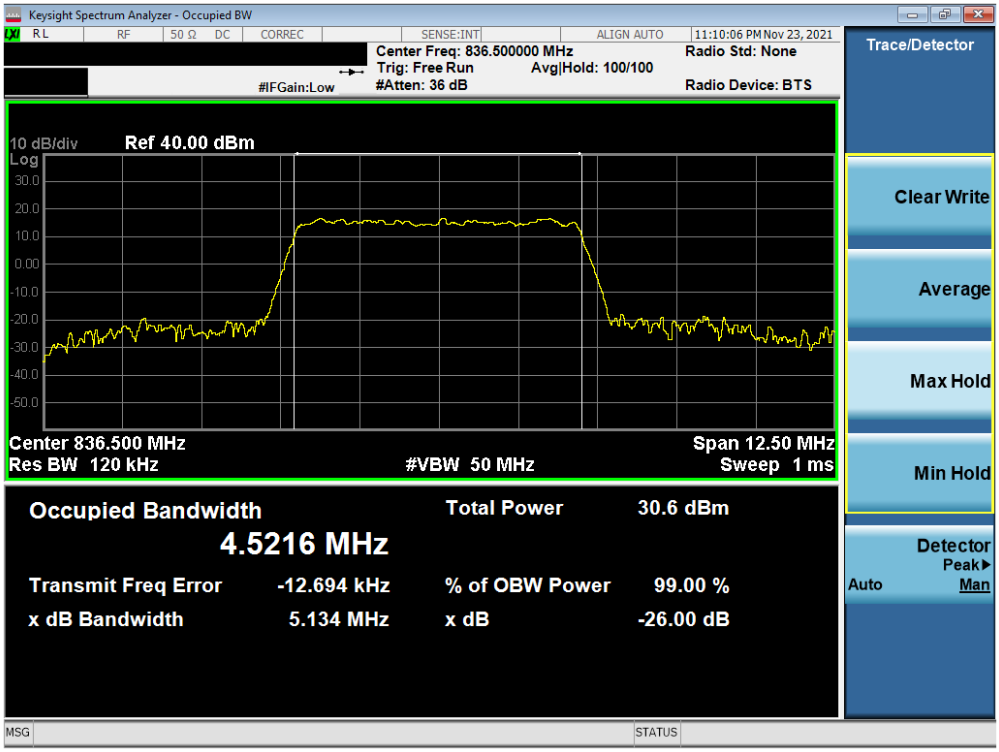


Plot 7-16. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 256-QAM - Full RB Configuration)

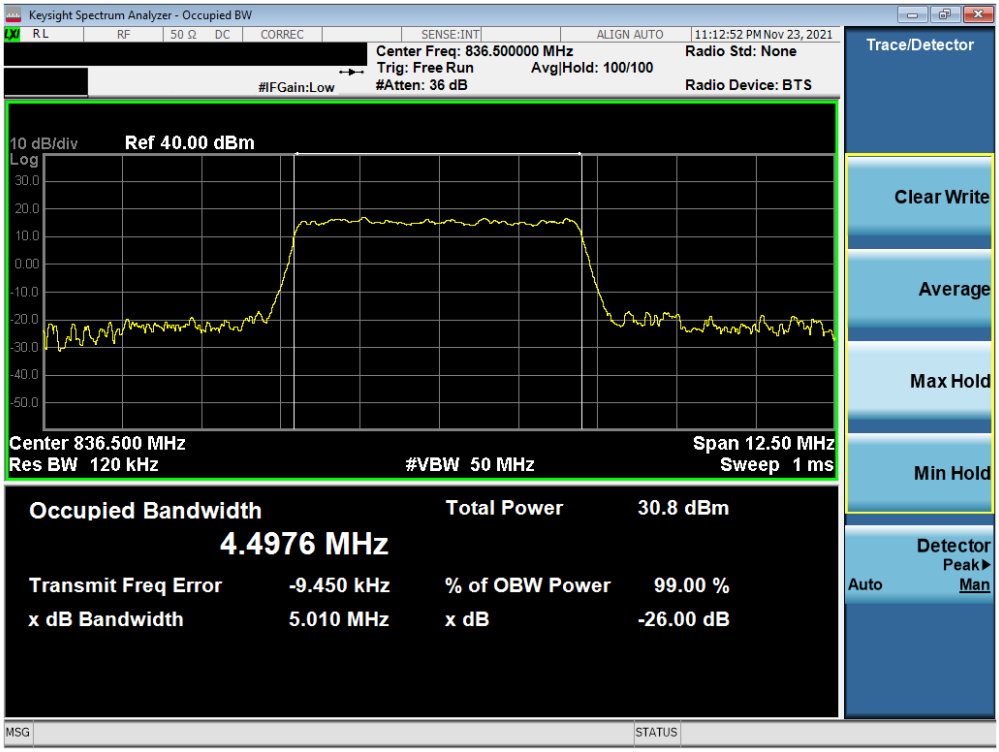
NR Band n5



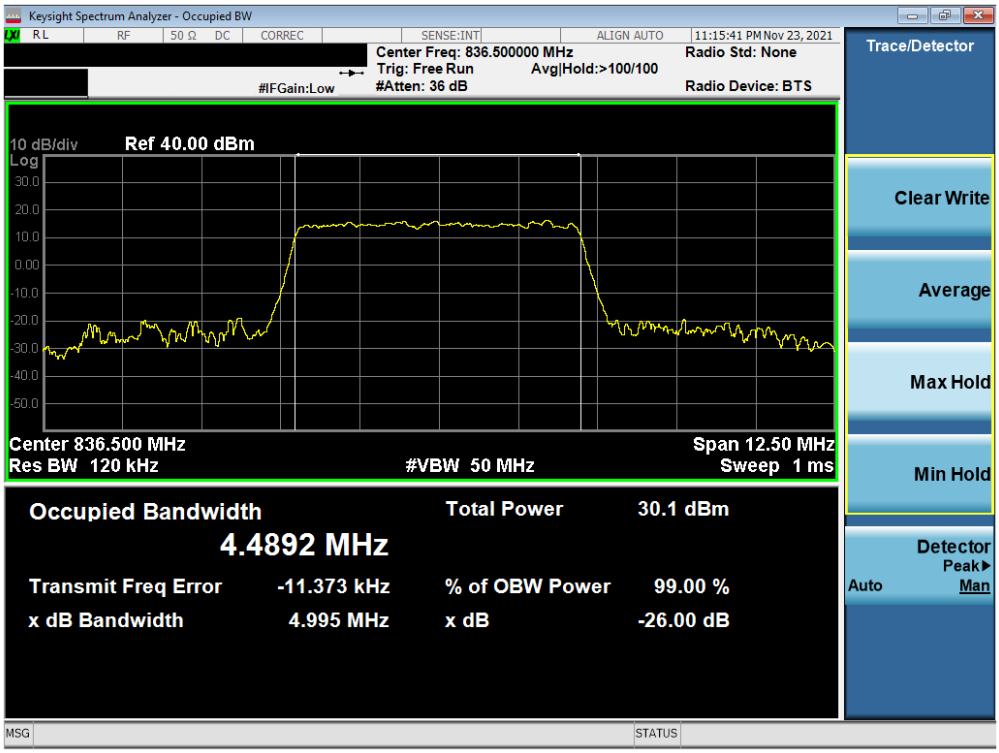
Plot 7-17. Occupied Bandwidth Plot (NR Band n5 - 5MHz DFT-s-OFDM π/2 BPSK - Full RB Configuration)



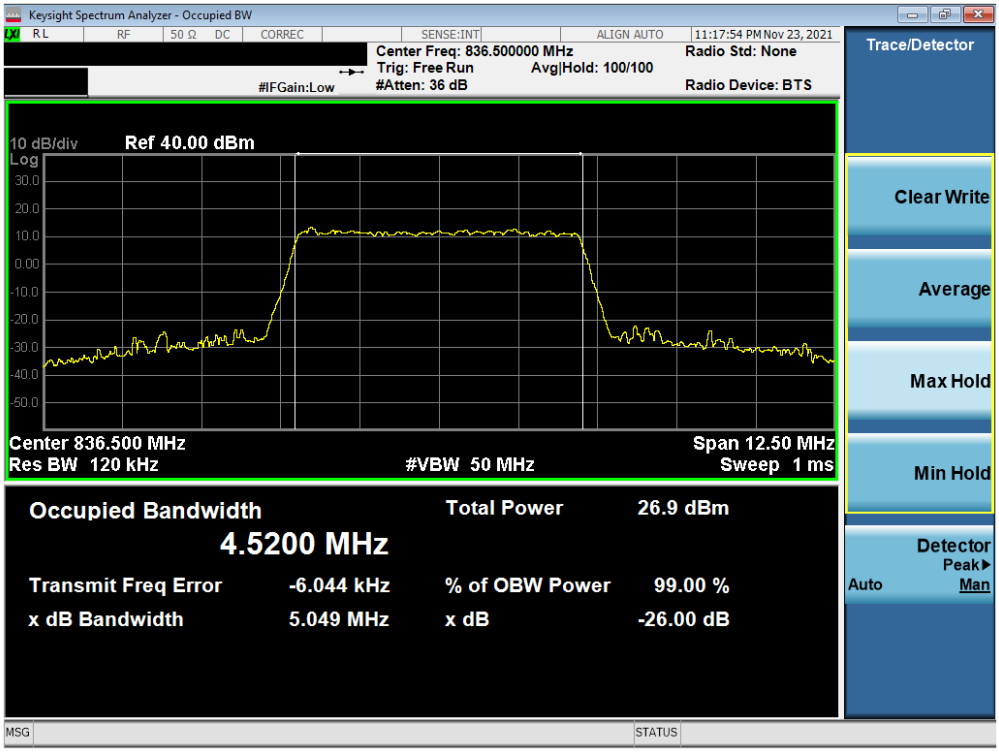
Plot 7-18. Occupied Bandwidth Plot (NR Band n5 - 5MHz CP-OFDM QPSK - Full RB Configuration)



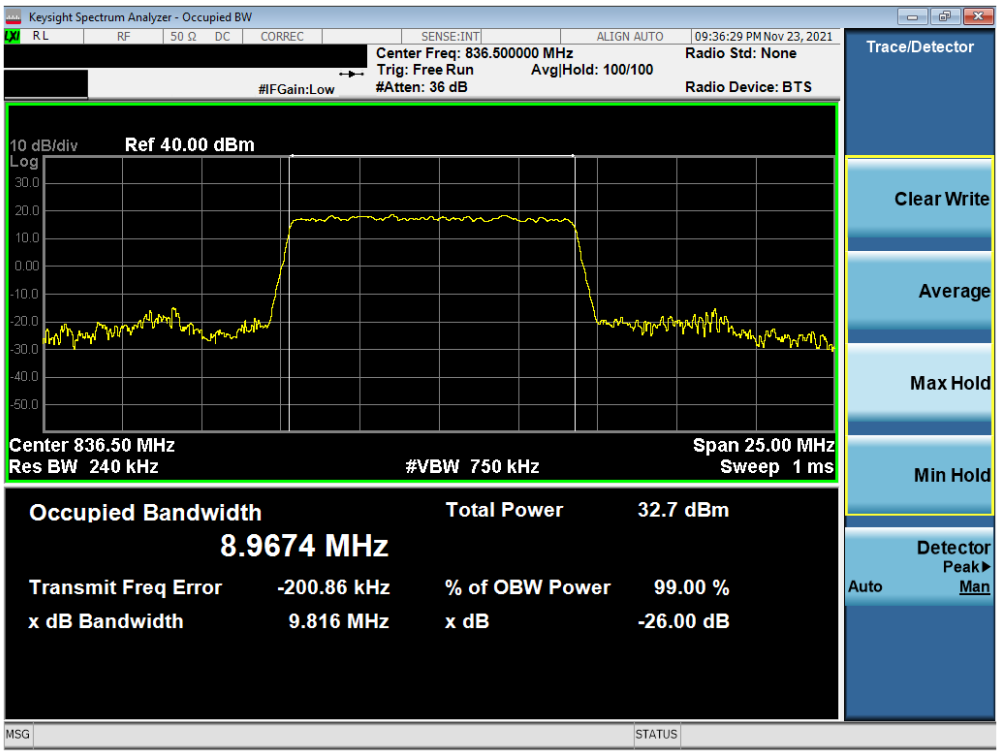
Plot 7-19. Occupied Bandwidth Plot (NR Band n5 - 5MHz CP-OFDM 16-QAM - Full RB Configuration)



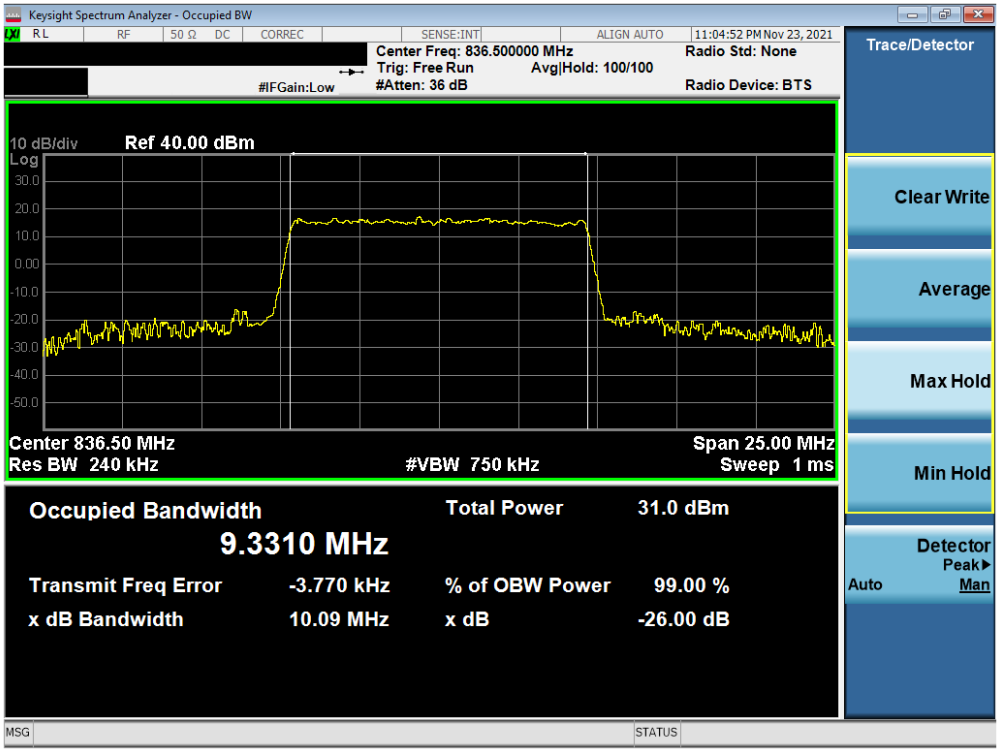
Plot 7-20. Occupied Bandwidth Plot (NR Band n5 - 5MHz CP-OFDM 64-QAM - Full RB Configuration)



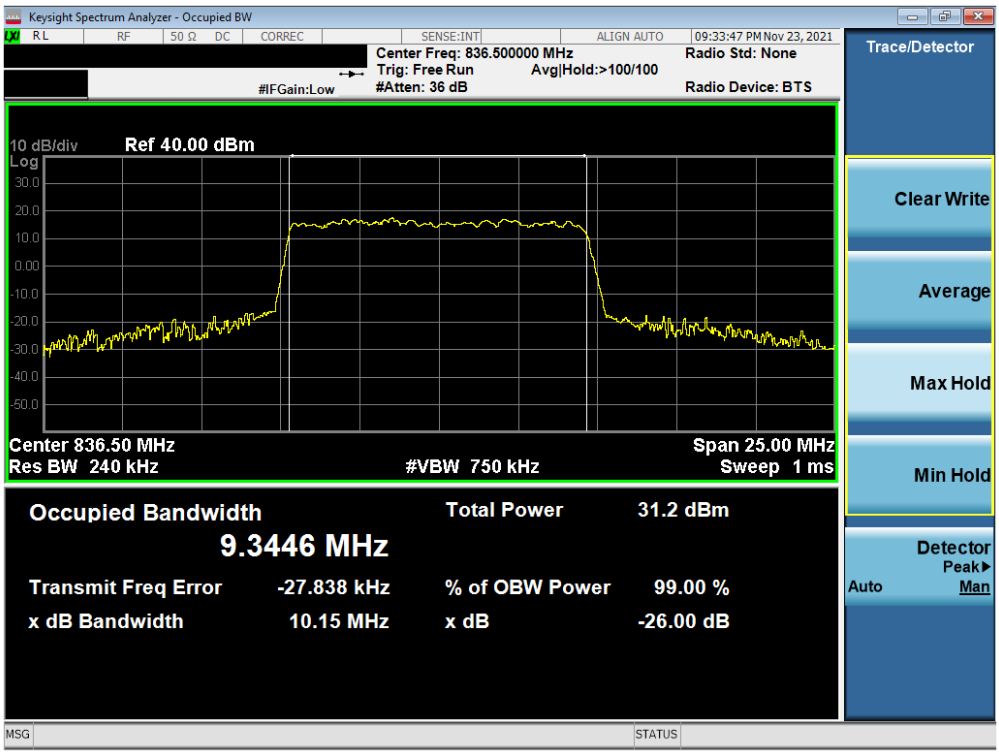
Plot 7-21. Occupied Bandwidth Plot (NR Band n5 - 5MHz CP-OFDM 256-QAM - Full RB Configuration)



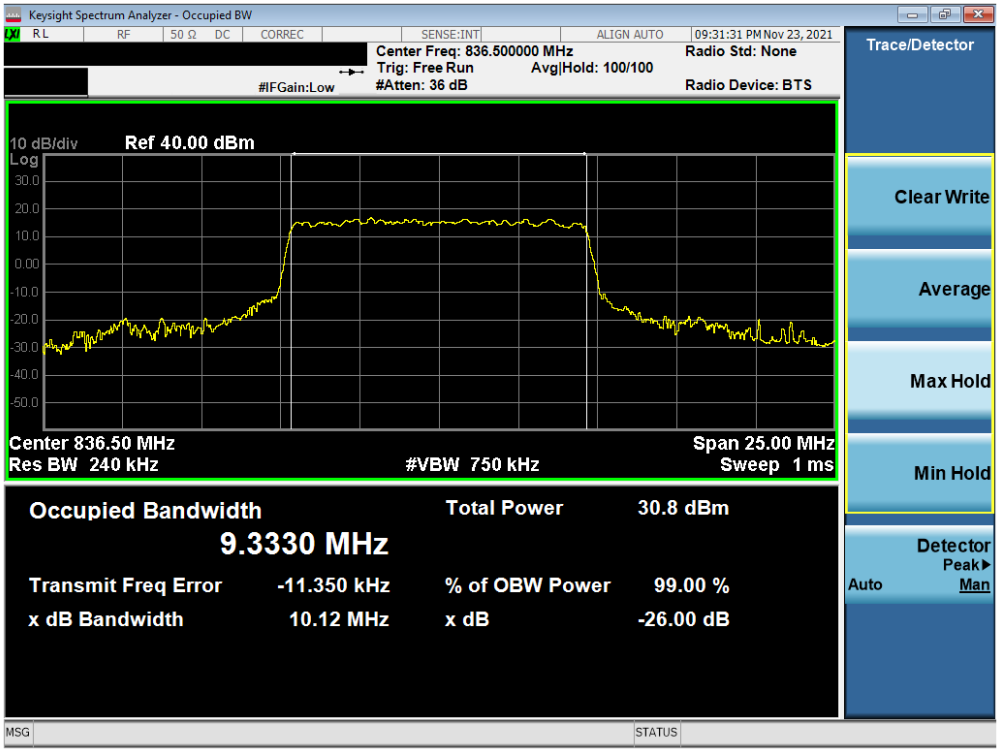
Plot 7-22. Occupied Bandwidth Plot (NR Band n5 - 10MHz DFT-s-OFDM π/2 BPSK - Full RB Configuration)



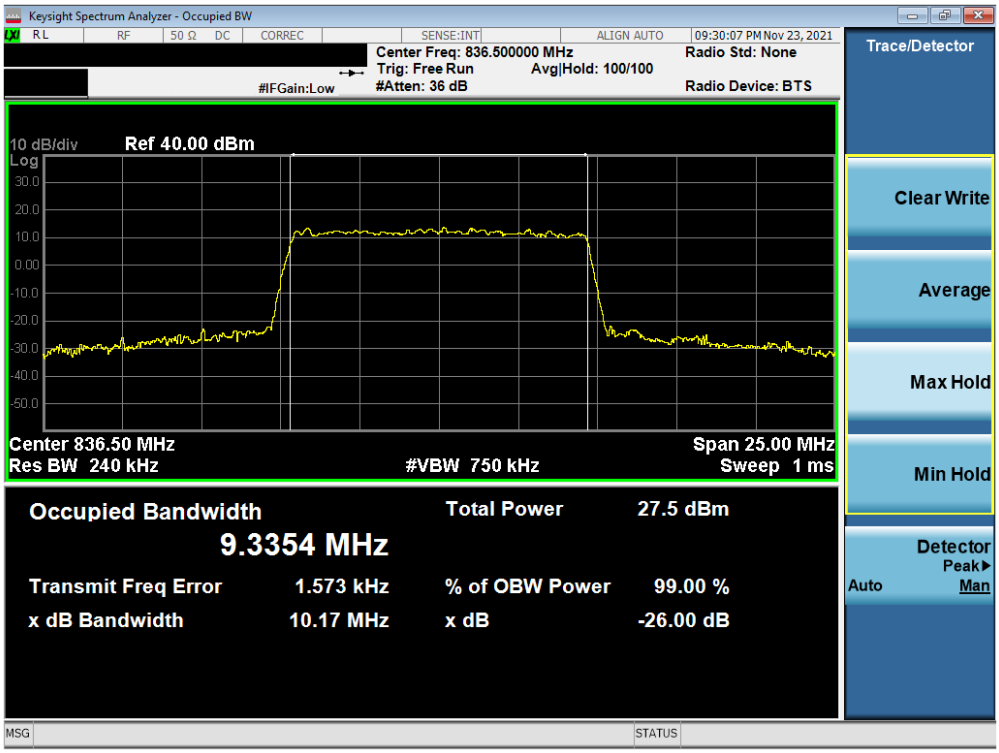
Plot 7-23. Occupied Bandwidth Plot (NR Band n5 - 10MHz CP-OFDM QPSK - Full RB Configuration)



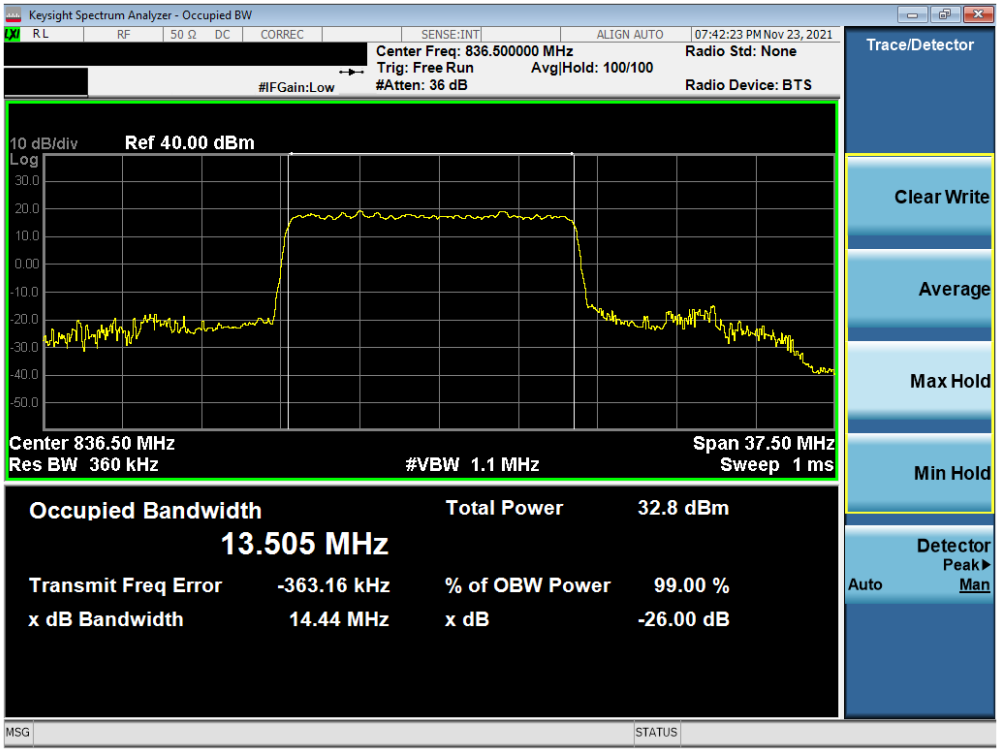
Plot 7-24. Occupied Bandwidth Plot (NR Band n5 - 10MHz CP-OFDM 16-QAM - Full RB Configuration)



Plot 7-25. Occupied Bandwidth Plot (NR Band n5 - 10MHz CP-OFDM 64-QAM - Full RB Configuration)

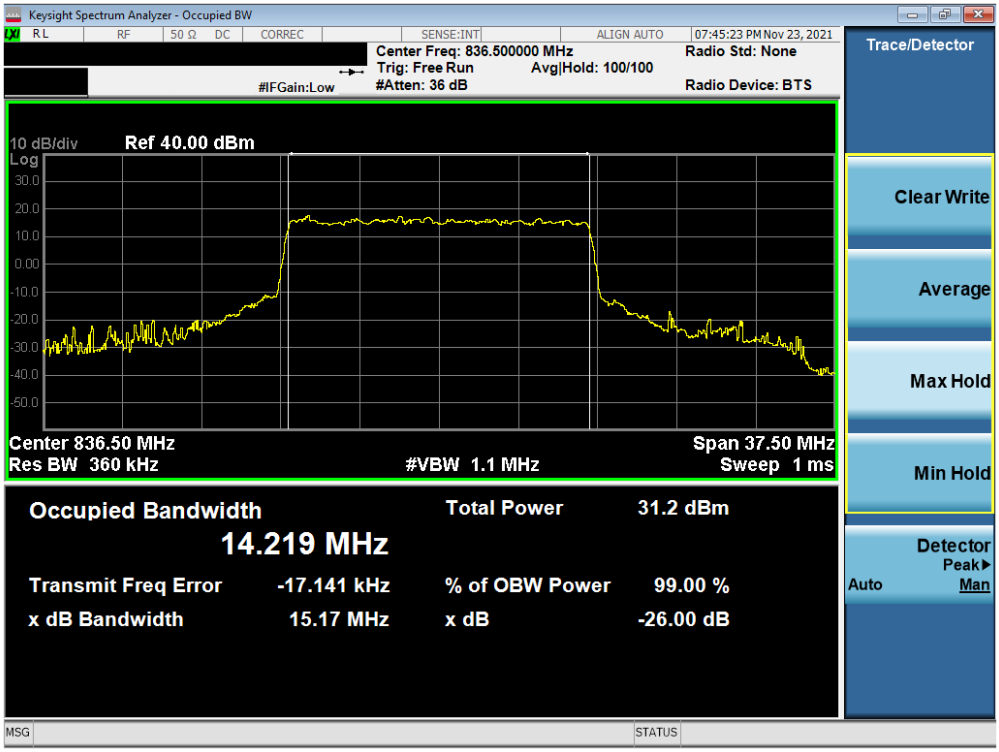


Plot 7-26. Occupied Bandwidth Plot (NR Band n5 - 10MHz CP-OFDM 256-QAM - Full RB Configuration)

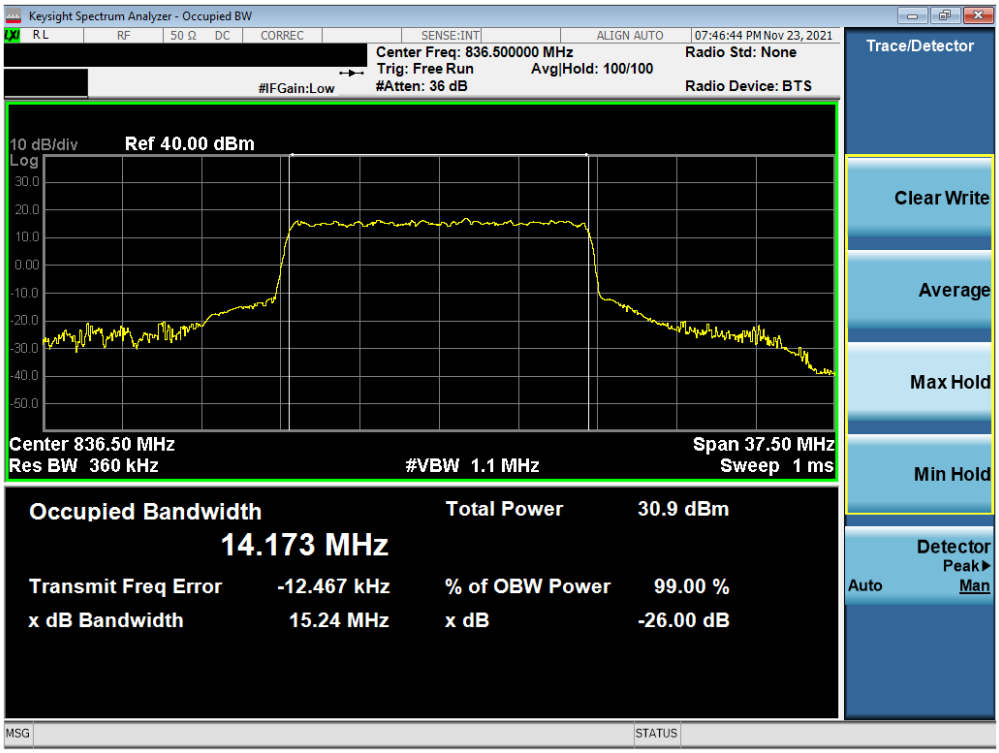


Plot 7-27. Occupied Bandwidth Plot (NR Band n5 - 15MHz DFT-s-OFDM π/2 BPSK - Full RB Configuration)

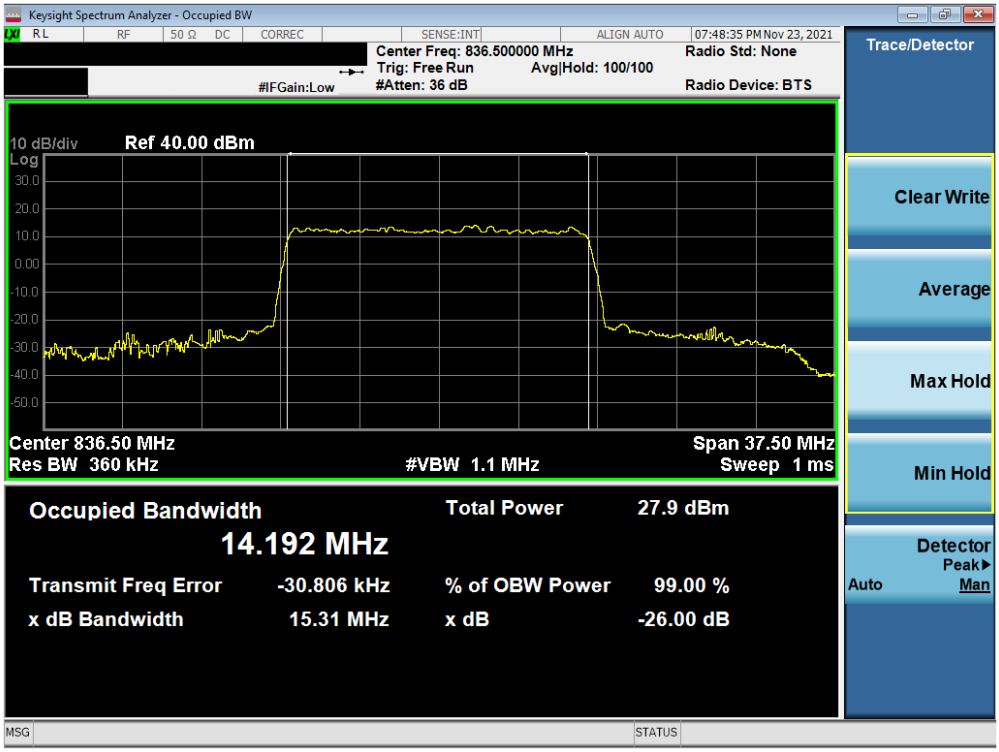
Plot 7-28. Occupied Bandwidth Plot (NR Band n5 - 15MHz CP-OFDM QPSK - Full RB Configuration)



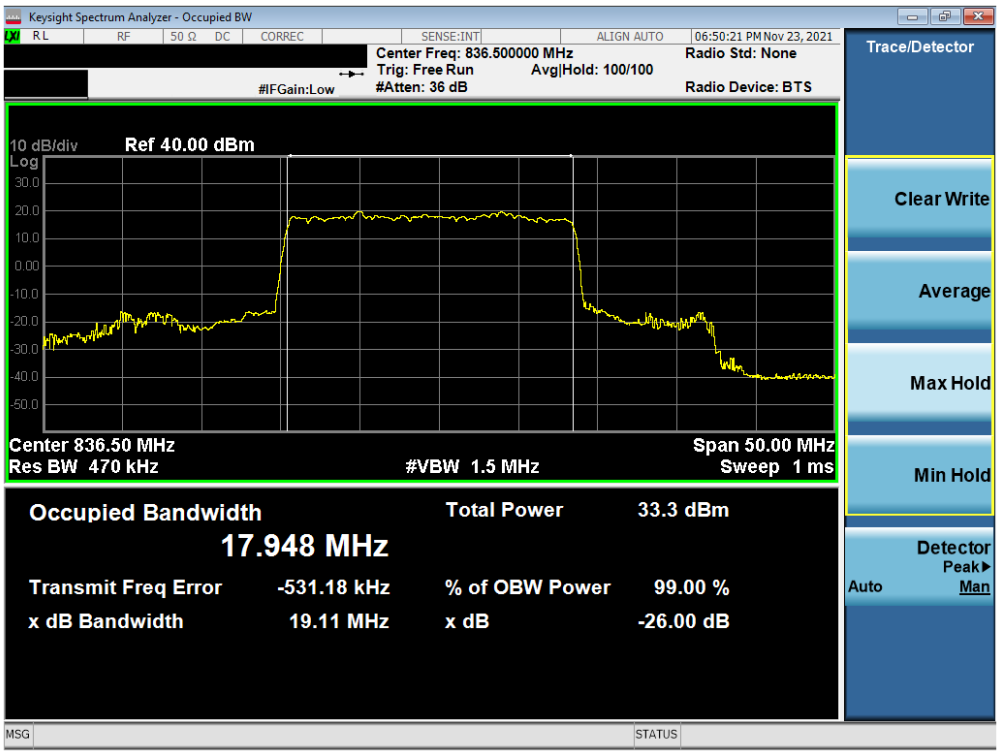
Plot 7-29. Occupied Bandwidth Plot (NR Band n5 - 15MHz CP-OFDM 16-QAM - Full RB Configuration)



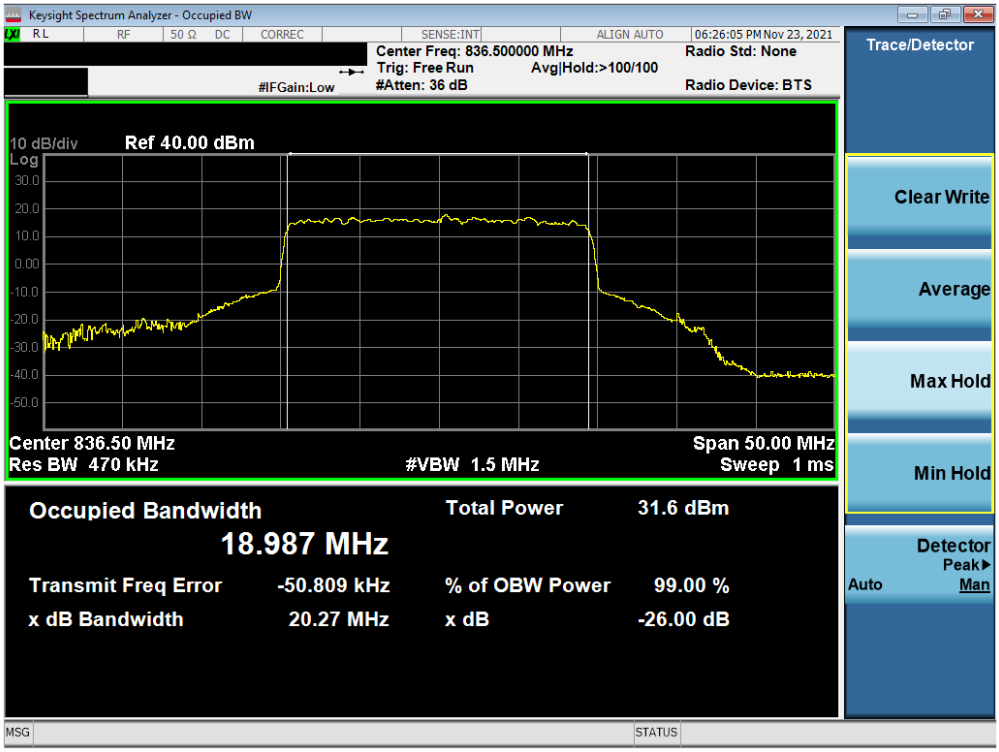
Plot 7-30. Occupied Bandwidth Plot (NR Band n5 - 15MHz CP-OFDM 64-QAM - Full RB Configuration)



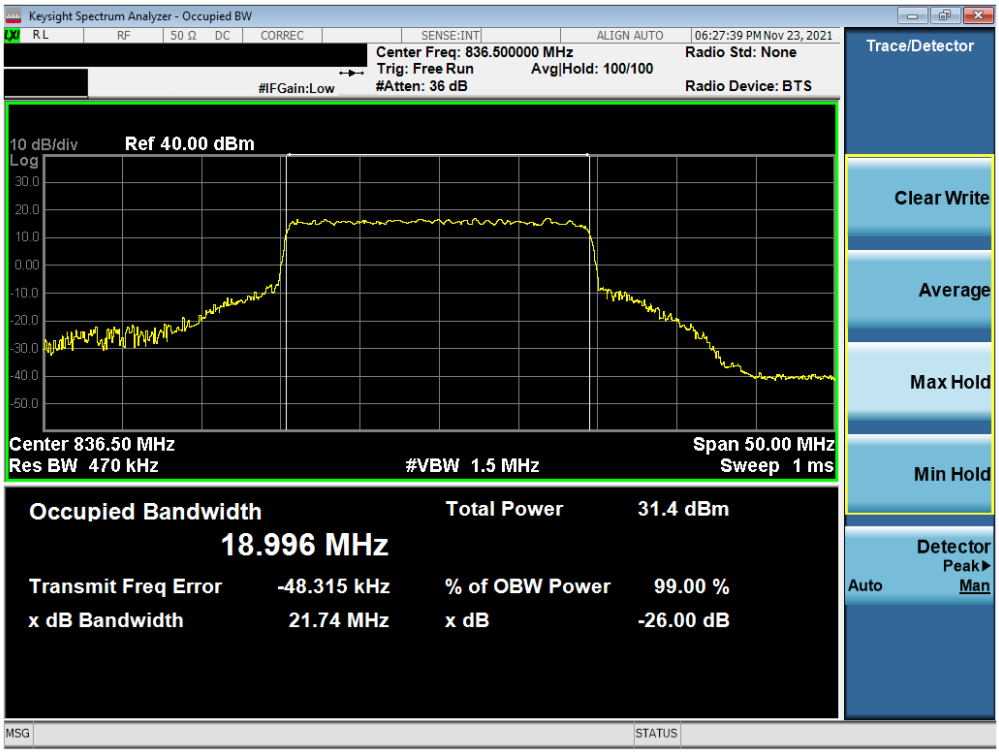
Plot 7-31. Occupied Bandwidth Plot (NR Band n5 - 15MHz CP-OFDM 256-QAM - Full RB Configuration)



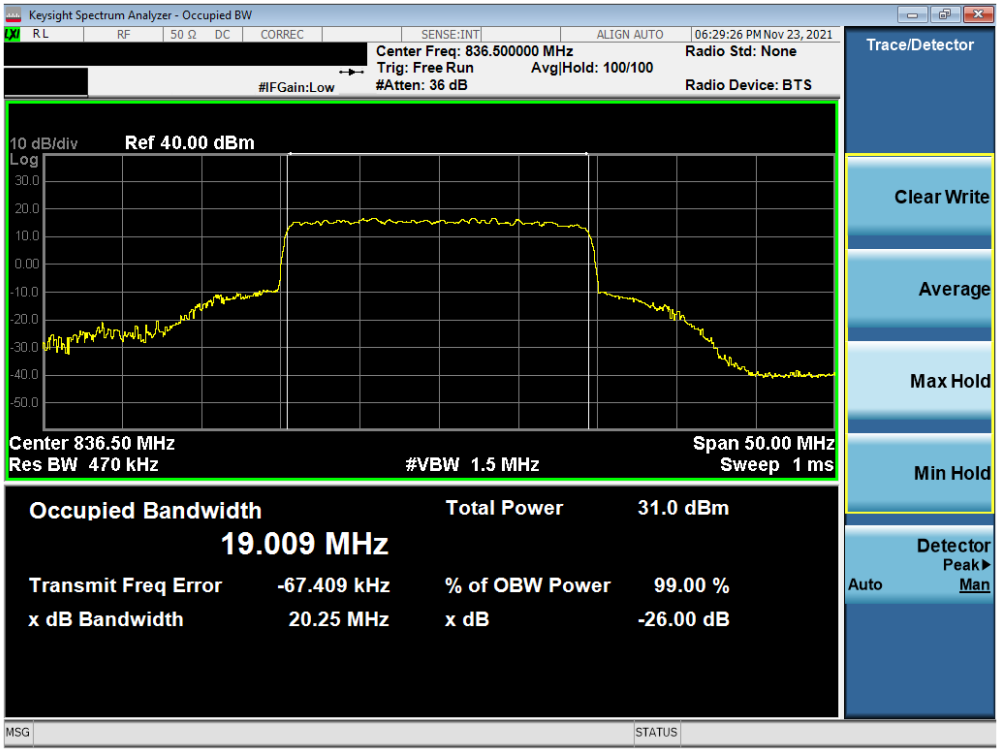
Plot 7-32. Occupied Bandwidth Plot (NR Band n5 - 20MHz DFT-s-OFDM π/2 BPSK - Full RB Configuration)



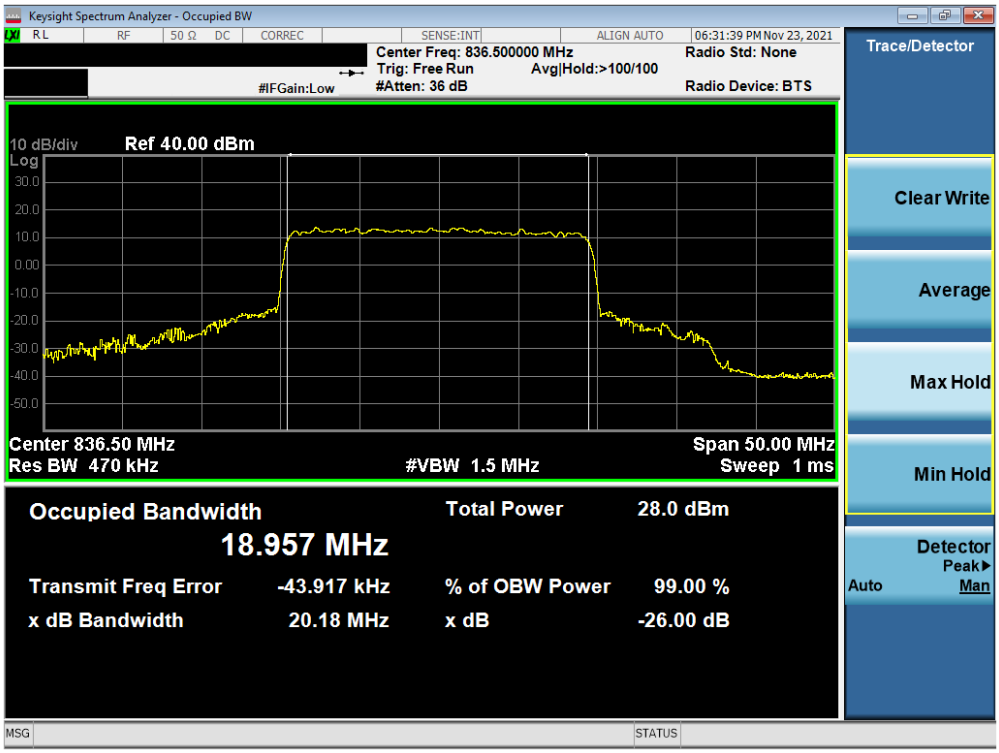
Plot 7-33. Occupied Bandwidth Plot (NR Band n5 - 20MHz CP-OFDM QPSK - Full RB Configuration)



Plot 7-34. Occupied Bandwidth Plot (NR Band n5 - 20MHz CP-OFDM 16-QAM - Full RB Configuration)

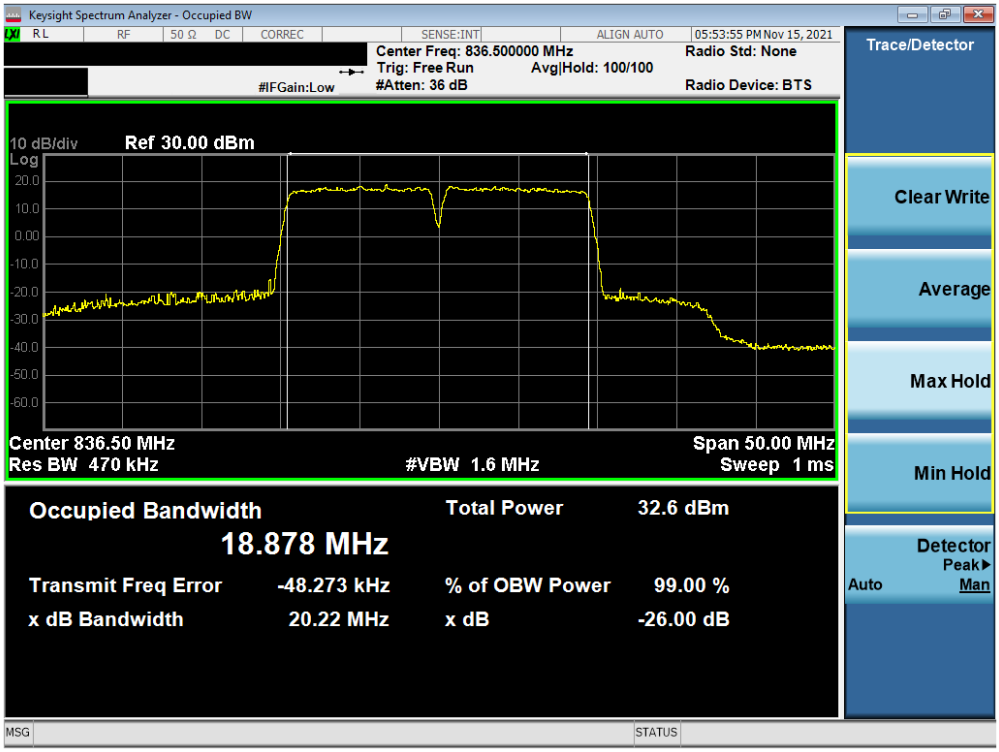


Plot 7-35. Occupied Bandwidth Plot (NR Band n5 - 20MHz CP-OFDM 64-QAM - Full RB Configuration)

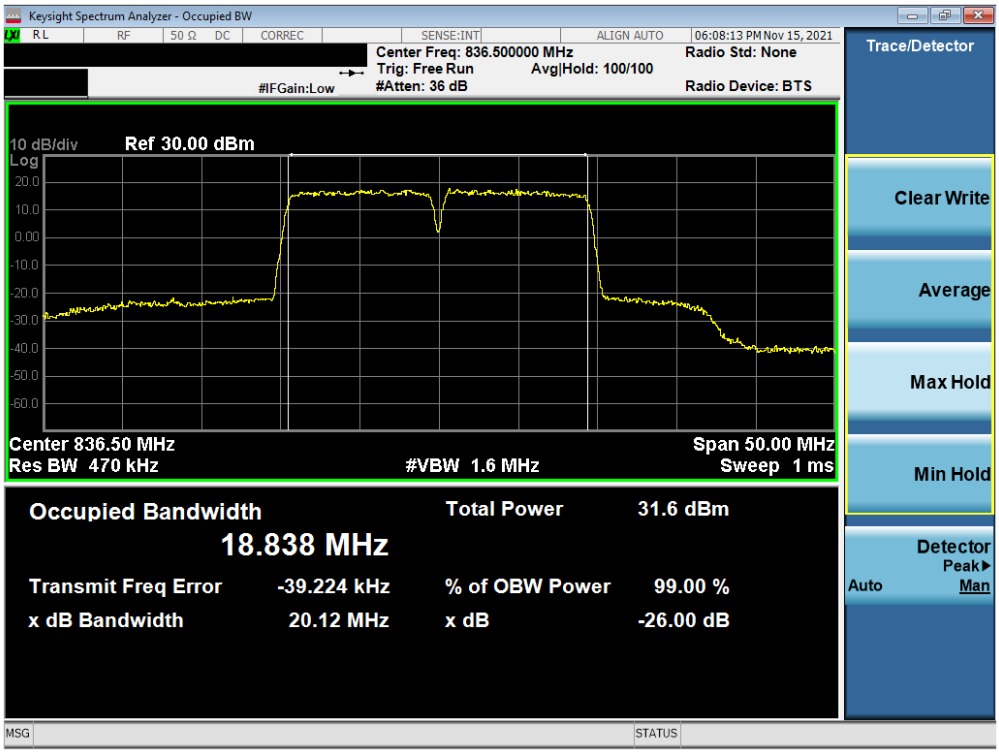


Plot 7-36. Occupied Bandwidth Plot (NR Band n5 - 20MHz CP-OFDM 256-QAM - Full RB Configuration)

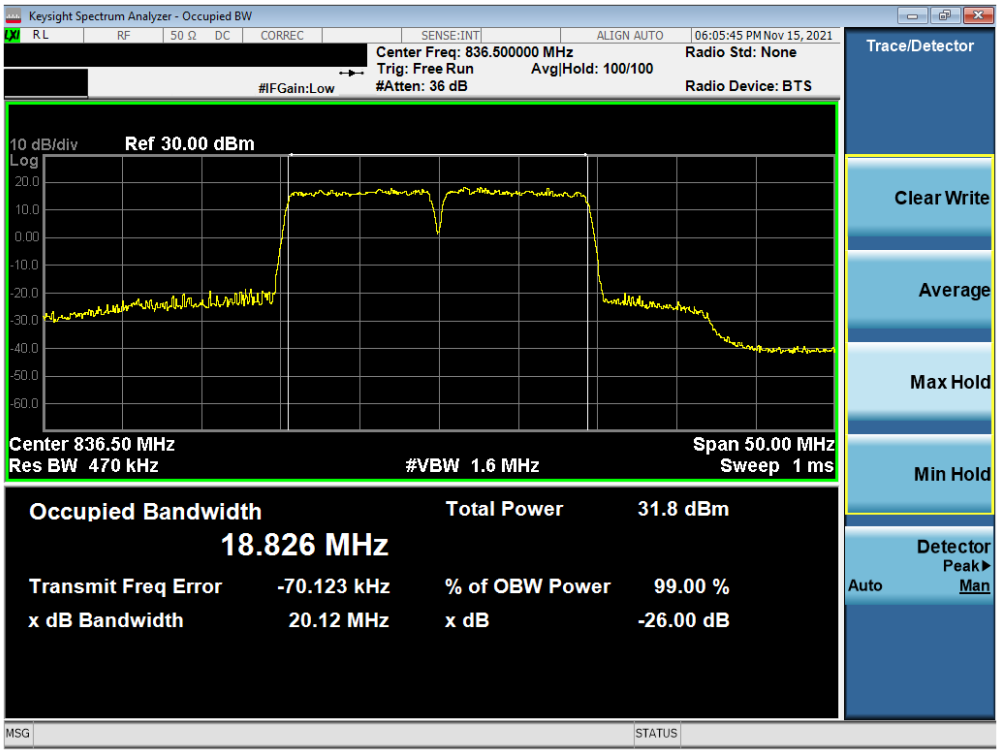
ULCA – LTE Band 5



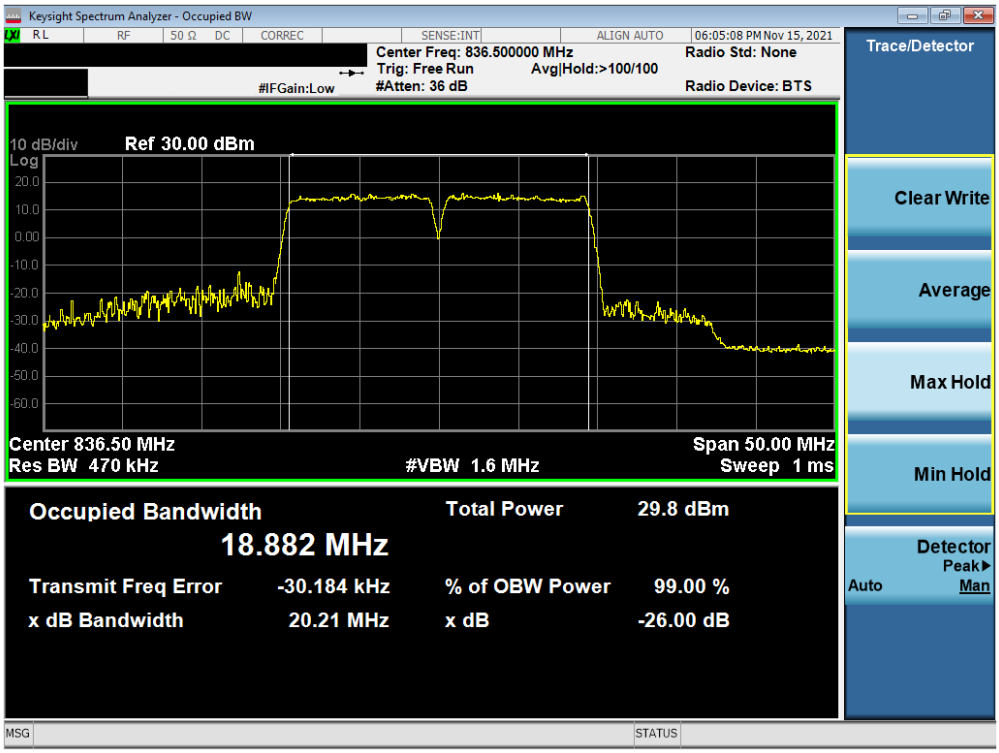
Plot 7-37. Occupied Bandwidth Plot (ULCA LTE Band 5 – (10 + 10)MHz QPSK - Full RB Configuration)



Plot 7-38. Occupied Bandwidth Plot (ULCA LTE Band 5 – (10 + 10)MHz 16-QAM - Full RB Configuration)

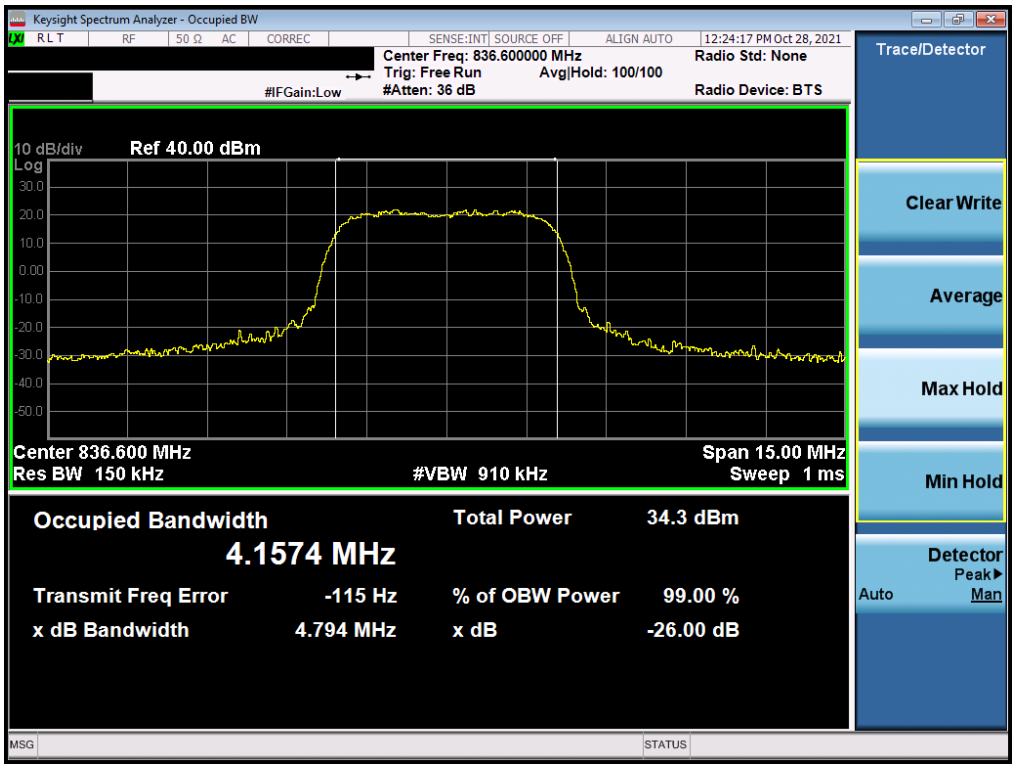


Plot 7-39. Occupied Bandwidth Plot (ULCA LTE Band 5 – (10 + 10)MHz 64-QAM - Full RB Configuration)



Plot 7-40. Occupied Bandwidth Plot (ULCA LTE Band 5 – (10 + 10)MHz 256-QAM - Full RB Configuration)

WCDMA Cell



Plot 7-41. Occupied Bandwidth Plot (WCDMA, Ch. 4183)

7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051, 22.917(a)

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. All ports were tested and only the worst case data were reported.

The minimum permissible attenuation level of any spurious emission is 43 + 10 $log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 10GHz (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.

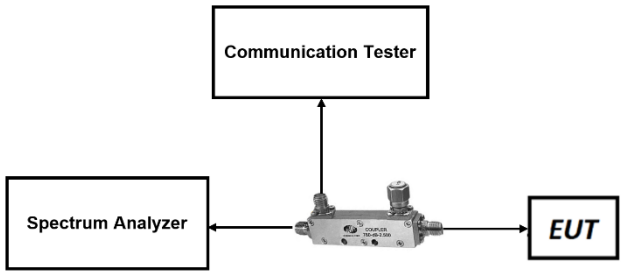


Figure 7-2. Test Instrument & Measurement Setup

Test Notes

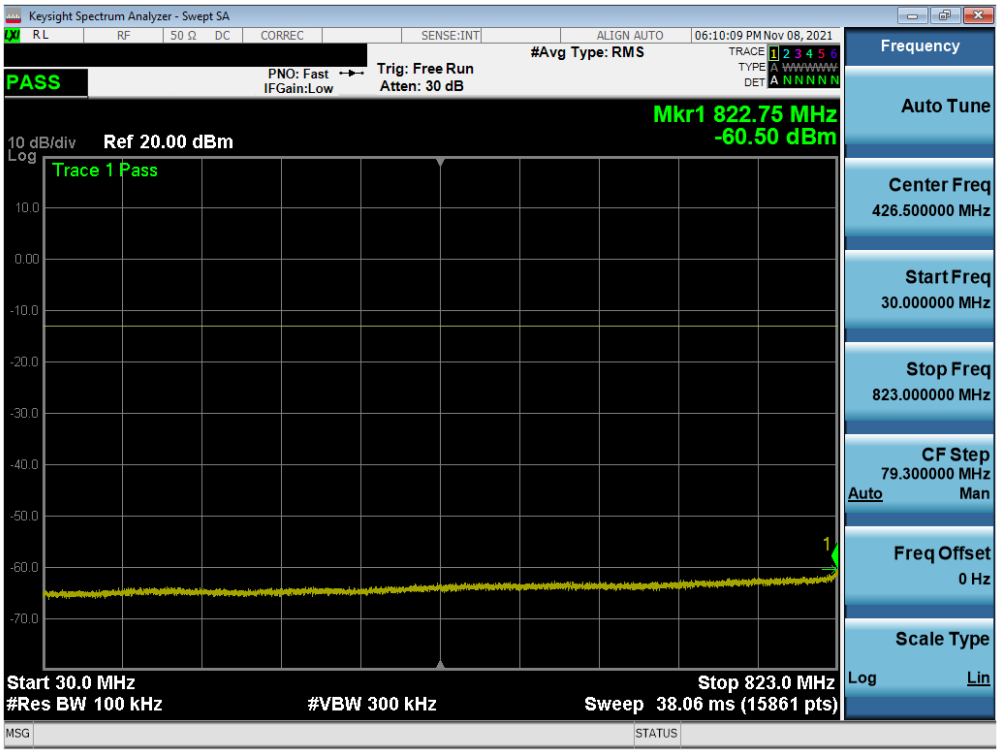
1. Per Part 22, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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 emission are attenuated at least 26 dB below the transmitter power.

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

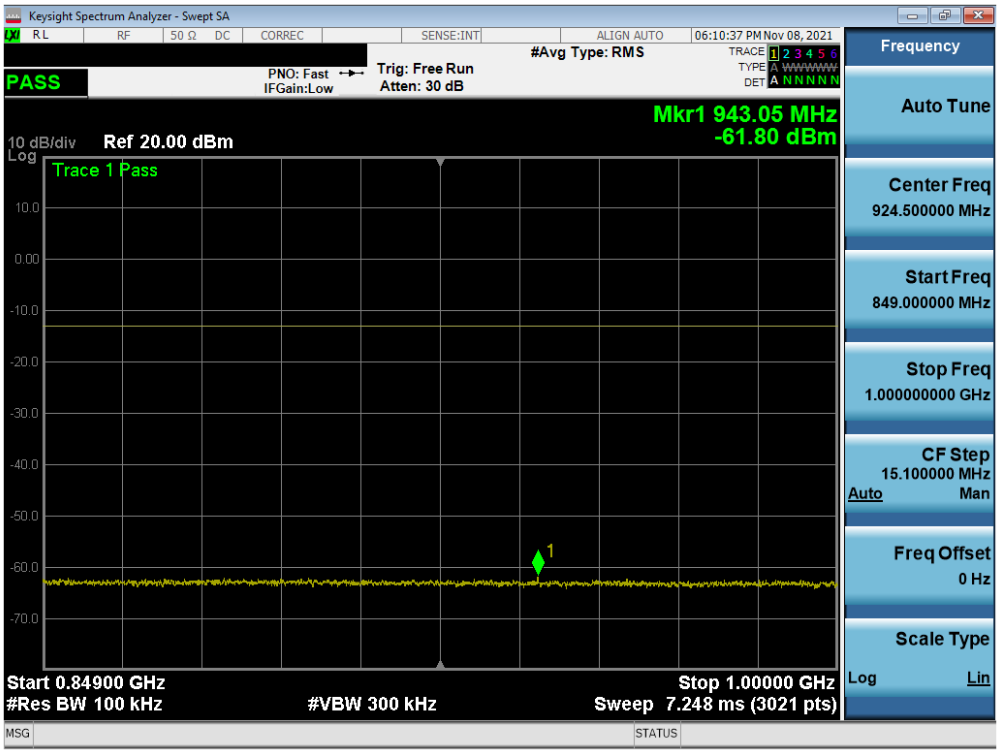
3. Uplink carrier aggregation conducted spurious emissions measurements were evaluated for the two contiguous channels using various combinations of RB size, RB offset, modulation, and channel bandwidth. The worst case (highest) powers were found while operating with QPSK modulation with both carriers set to transmit using 1RB.

4. Uplink carrier aggregation inter-band emission was investigated and found to not be the worst case

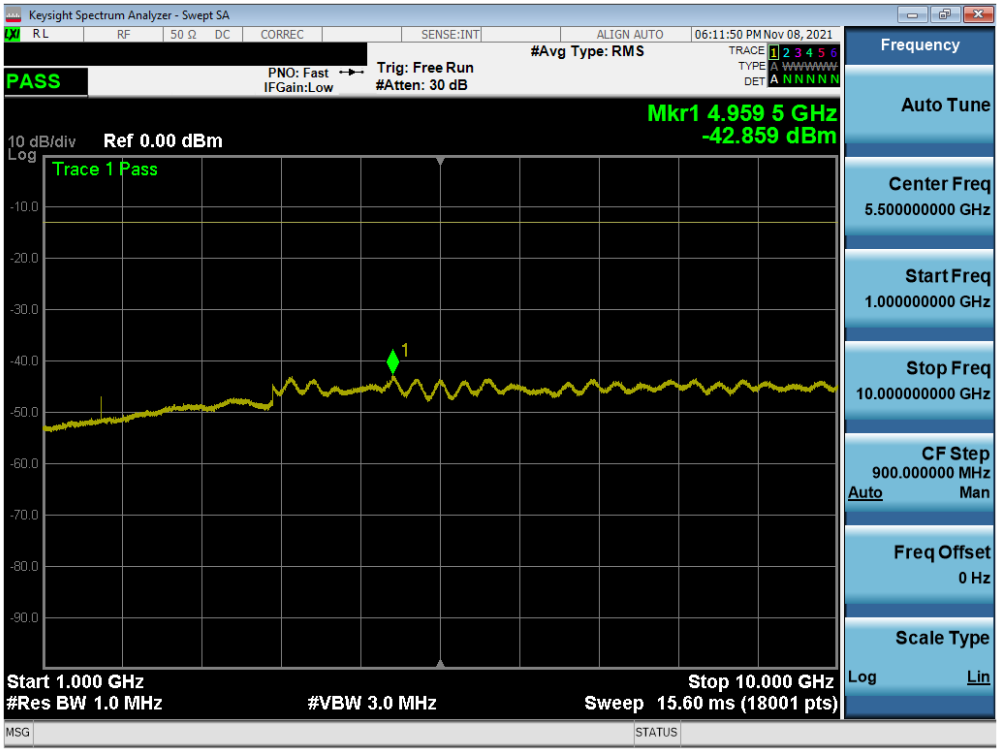
LTE Band 26/5



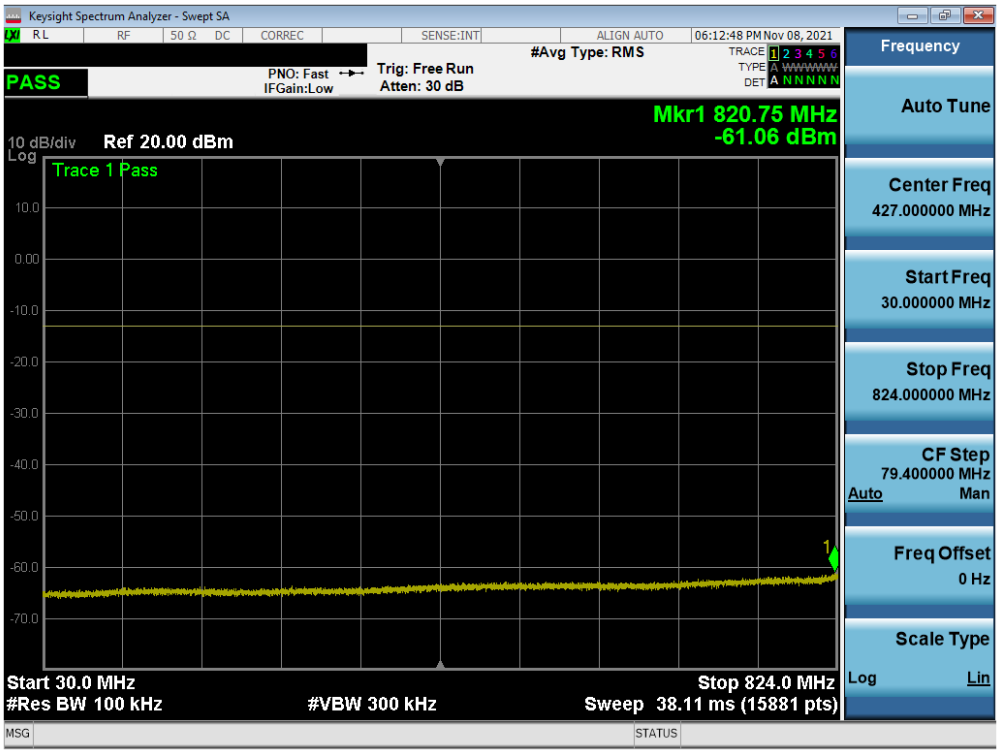
Plot 7-42. CSE (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



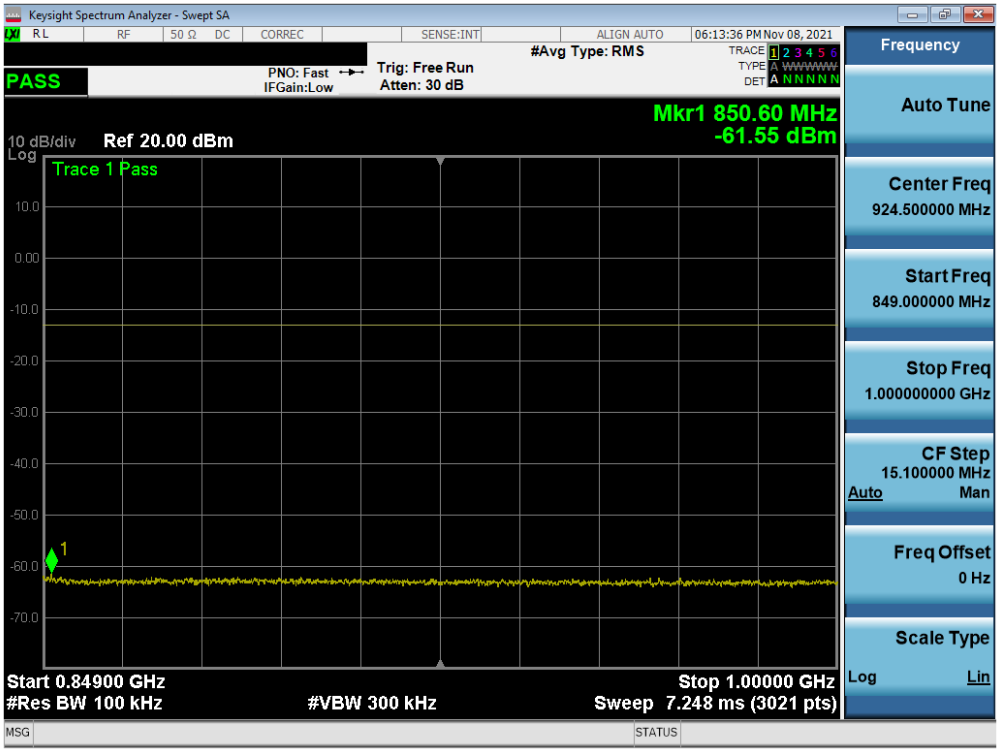
Plot 7-43. CSE (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



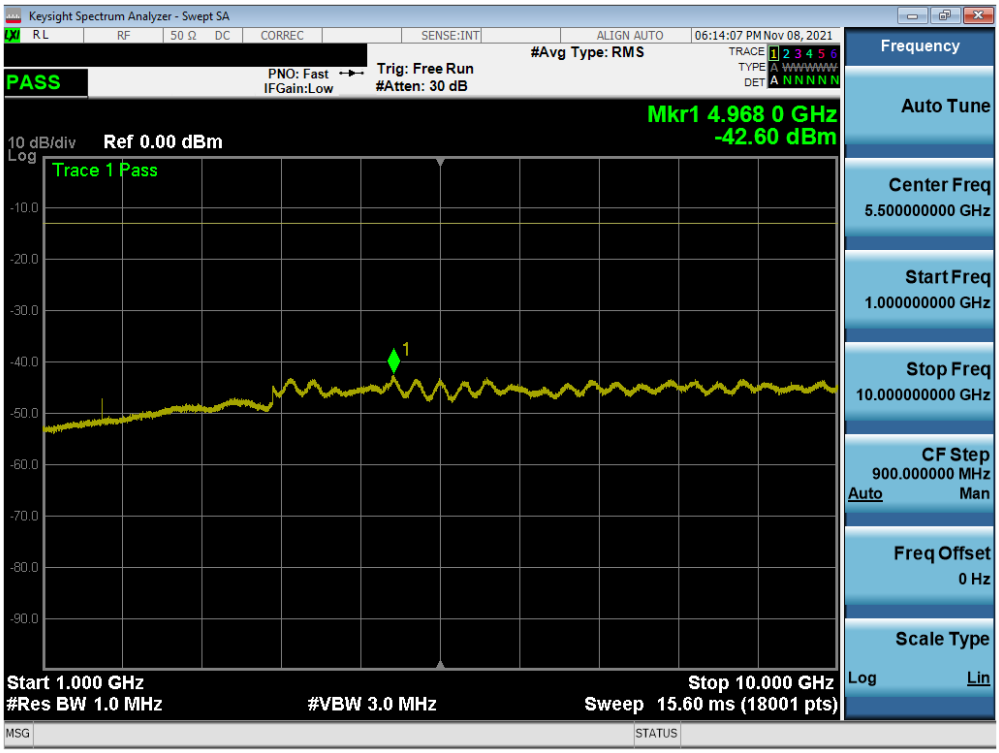
Plot 7-44. CSE (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



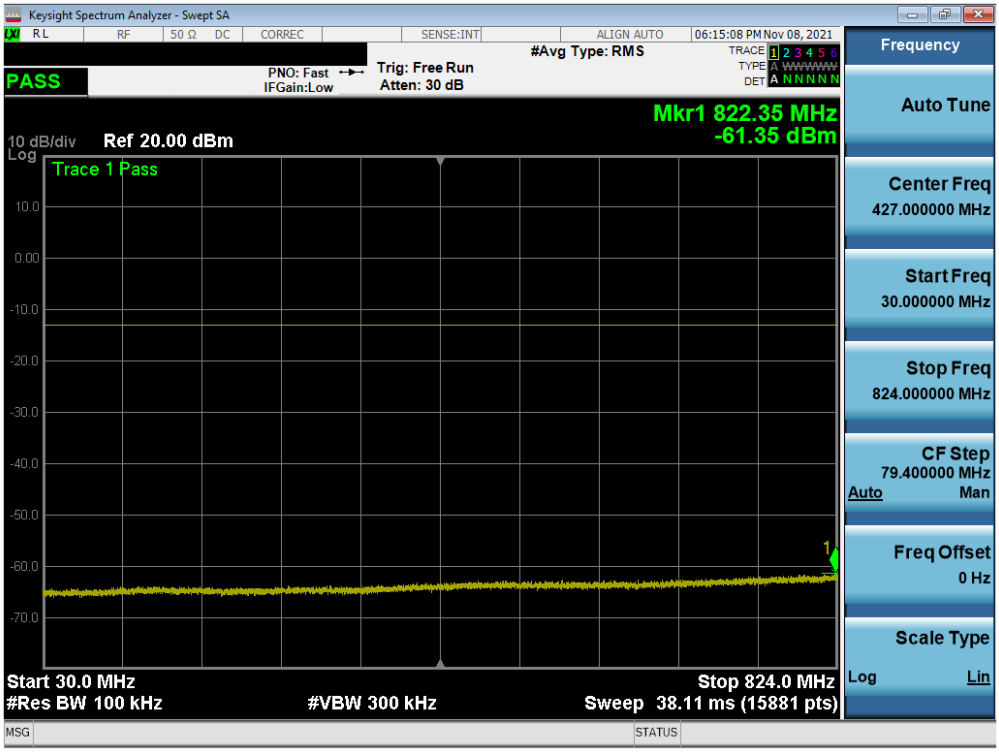
Plot 7-45. CSE (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



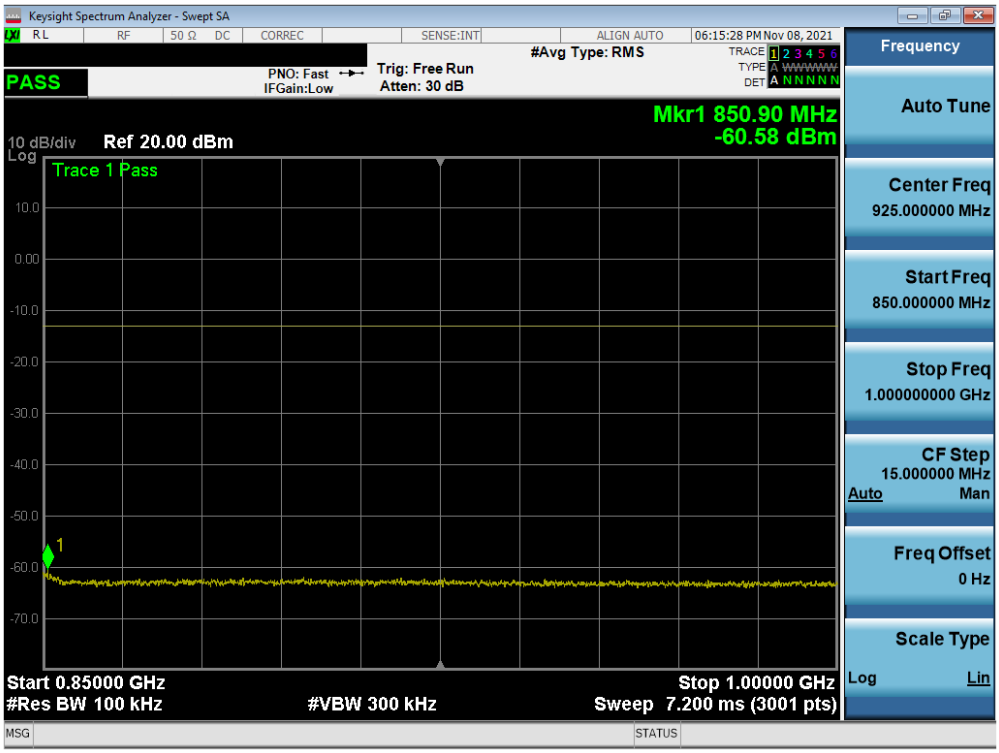
Plot 7-46. CSE (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



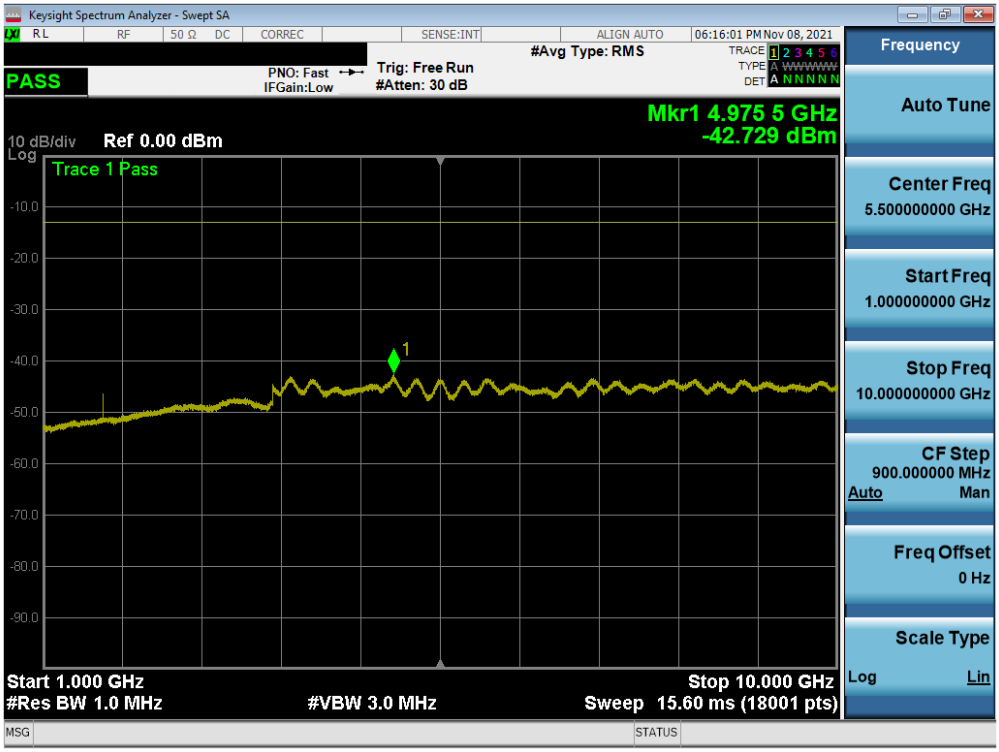
Plot 7-47. CSE (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



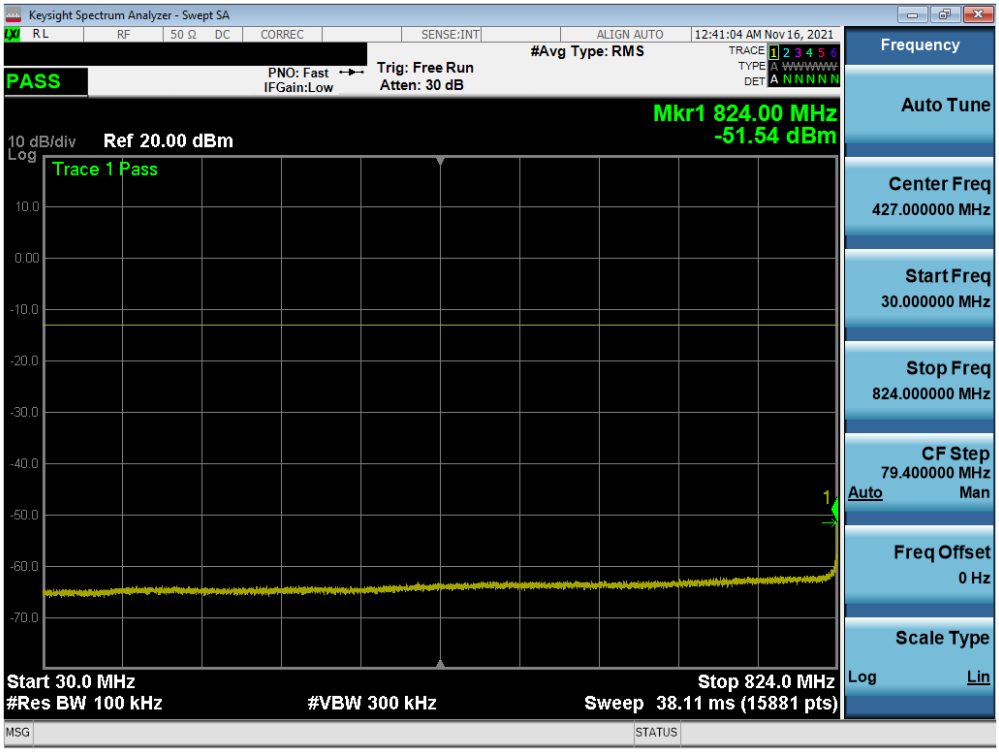
Plot 7-48. CSE (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



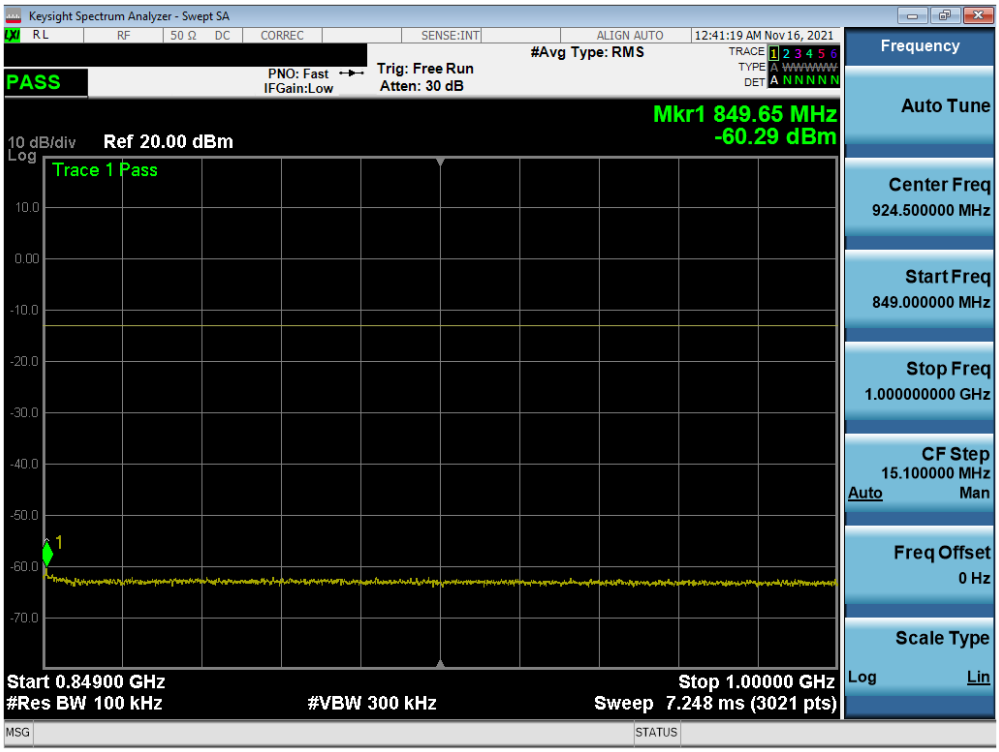
Plot 7-49. CSE (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



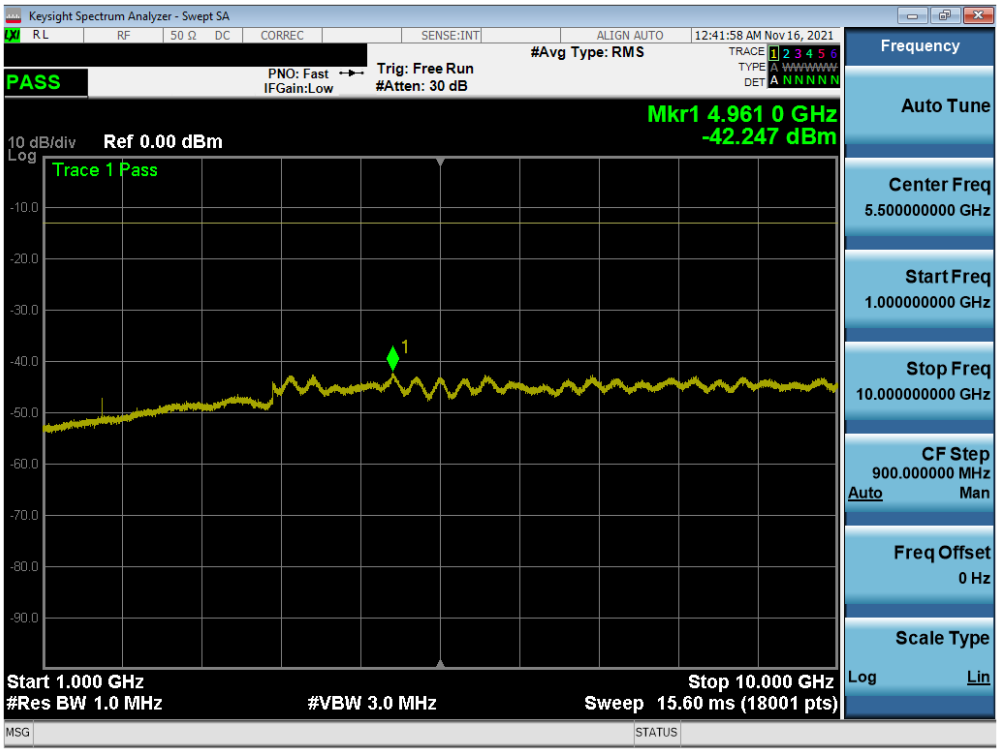
Plot 7-50. CSE (LTE Band 26/5 - 10MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



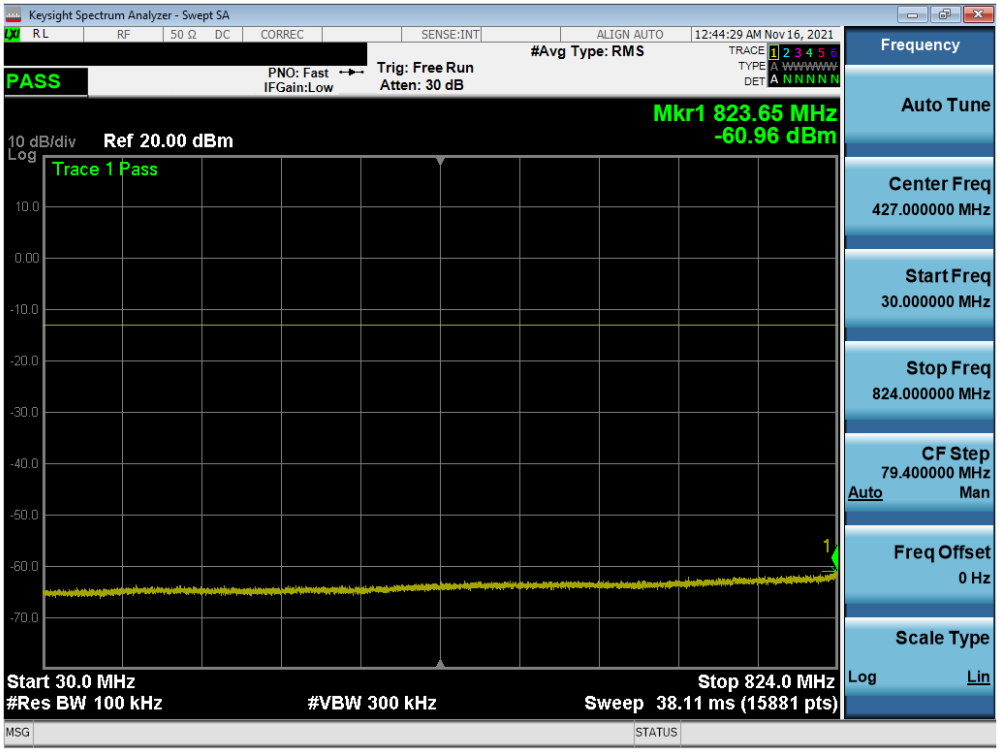
Plot 7-51. CSE (ULCA LTE Band 5 – (10 + 10)MHz QPSK – PCC 1/49 SCC 1/0 - Low Channel)



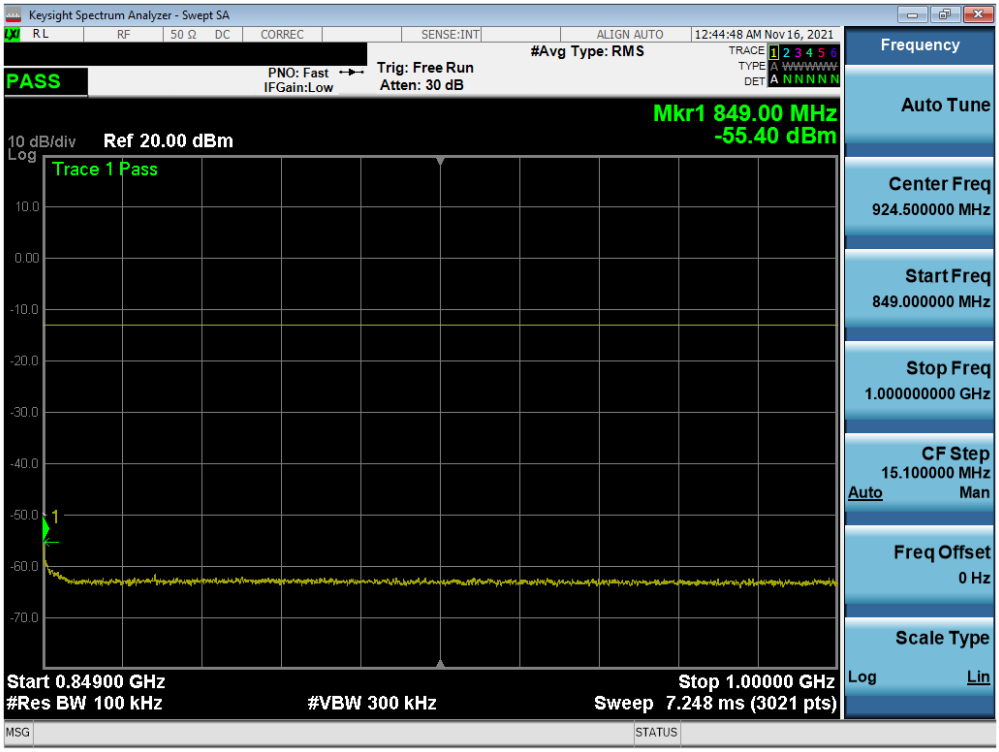
Plot 7-52. CSE (ULCA LTE Band 5 – (10 + 10)MHz QPSK – PCC 1/49 SCC 1/0 - Low Channel)



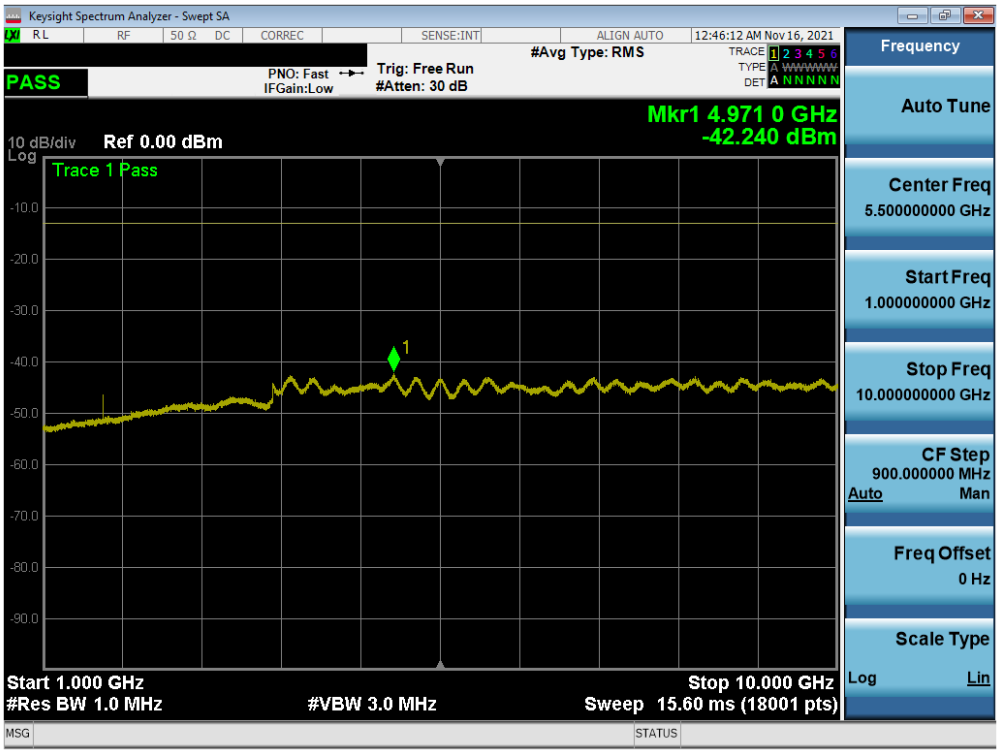
Plot 7-53. CSE (ULCA LTE Band 5 – (10 + 10)MHz QPSK – PCC 1/49 SCC 1/0 - Low Channel)



Plot 7-54. CSE (ULCA LTE Band 5 – (10 + 10)MHz QPSK – PCC 1/0 SCC 1/49 - High Channel)

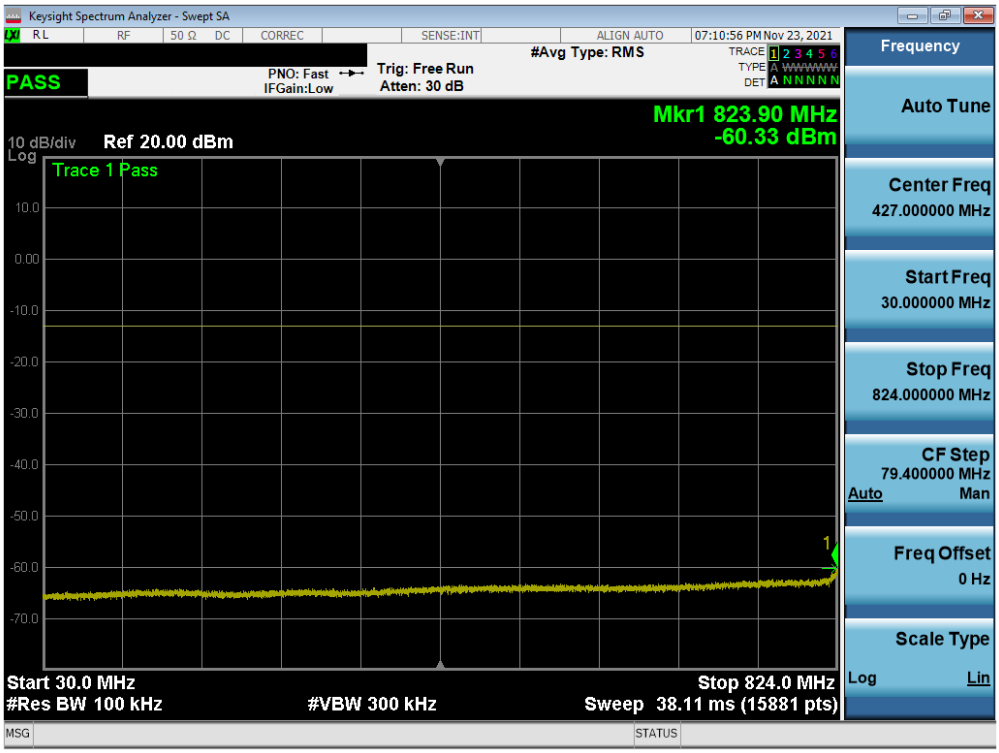


Plot 7-55. CSE (ULCA LTE Band 5 – (10 + 10)MHz QPSK – PCC 1/0 SCC 1/49 - High Channel)

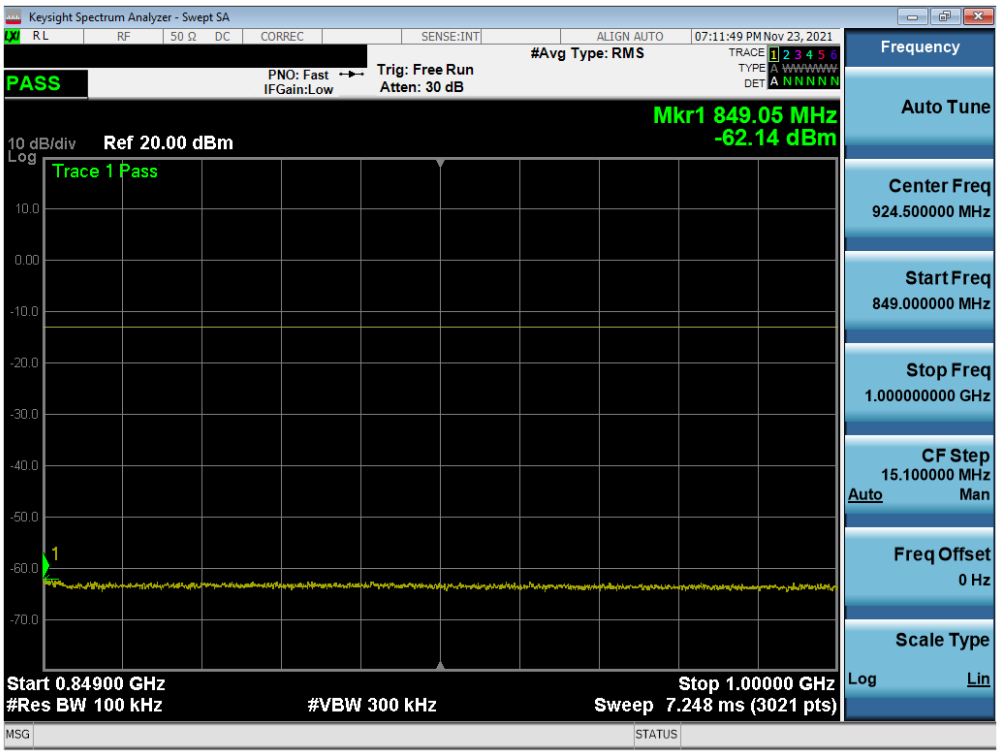


Plot 7-56. CSE (ULCA LTE Band 5 – (10 + 10)MHz QPSK – PCC 1/0 SCC 1/49 - High Channel)

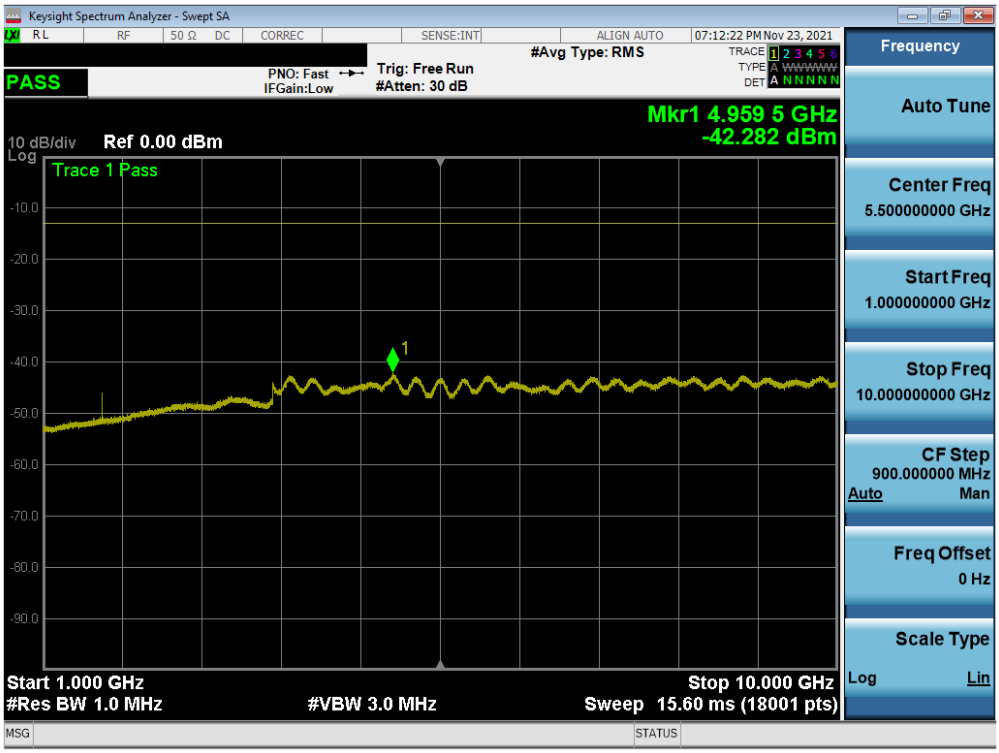
NR Band n5



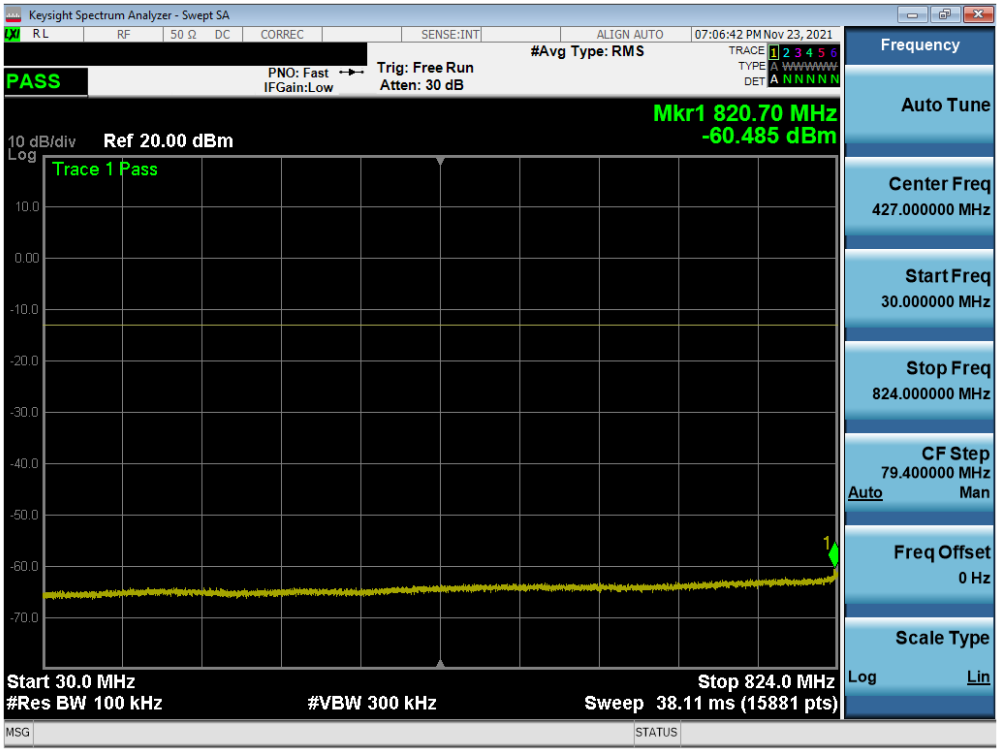
Plot 7-57. CSE (NR Band n5 - 20.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Low Channel)



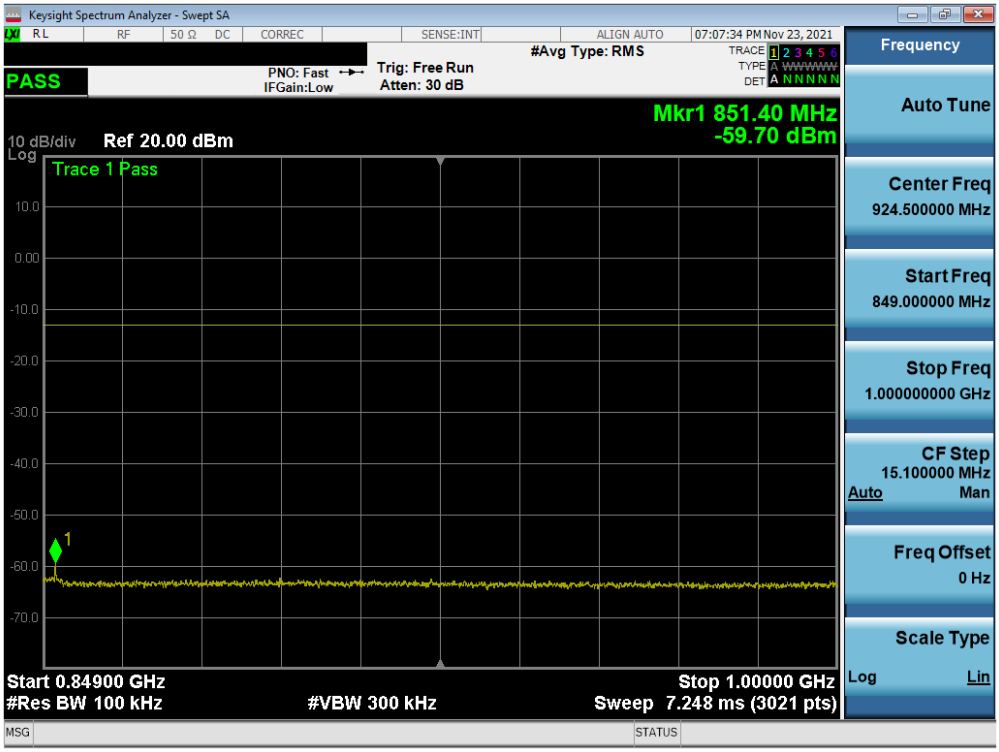
Plot 7-58. CSE (NR Band n5 - 20.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Low Channel)



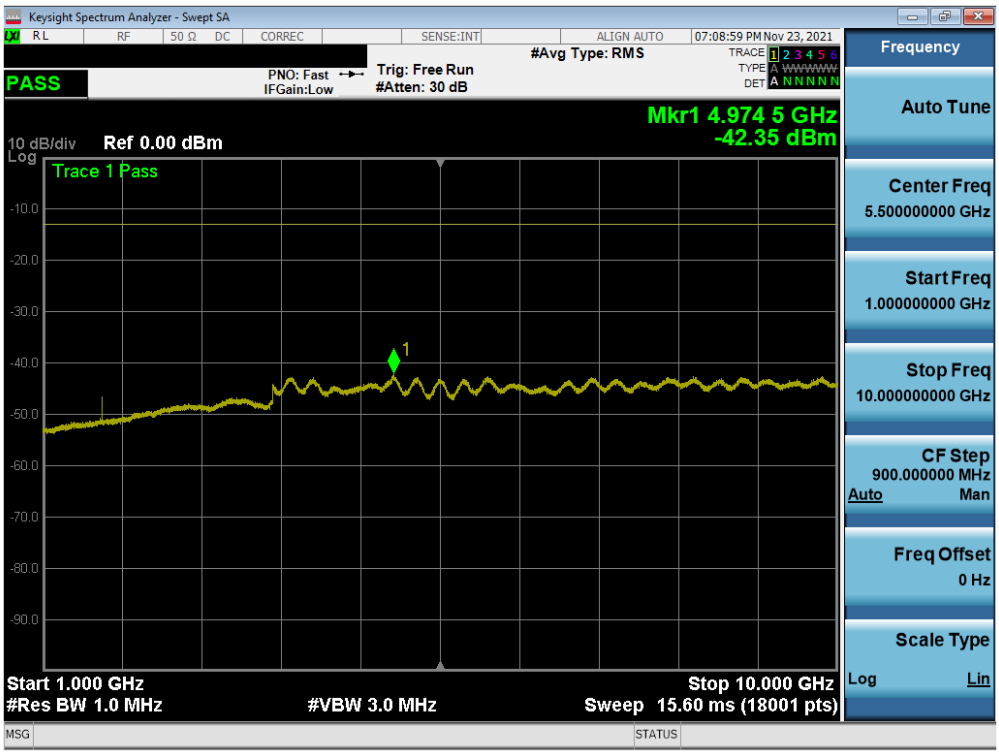
Plot 7-59. CSE (NR Band n5 - 20.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Low Channel)



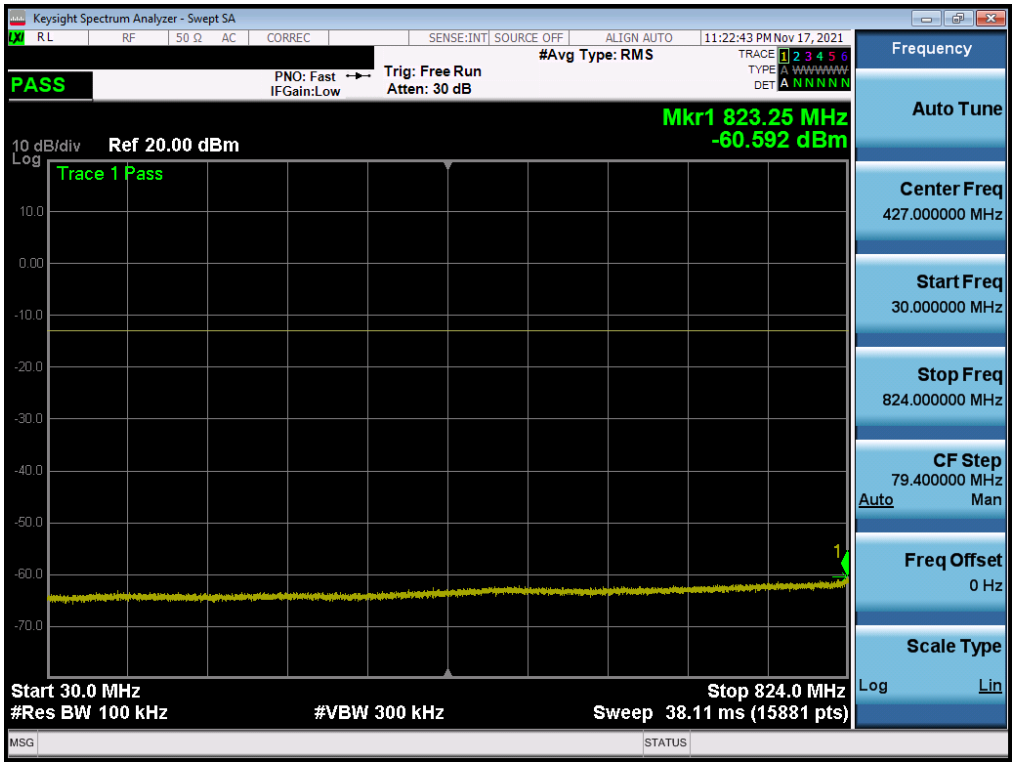
Plot 7-60. CSE (NR Band n5 - 20.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Mid Channel)



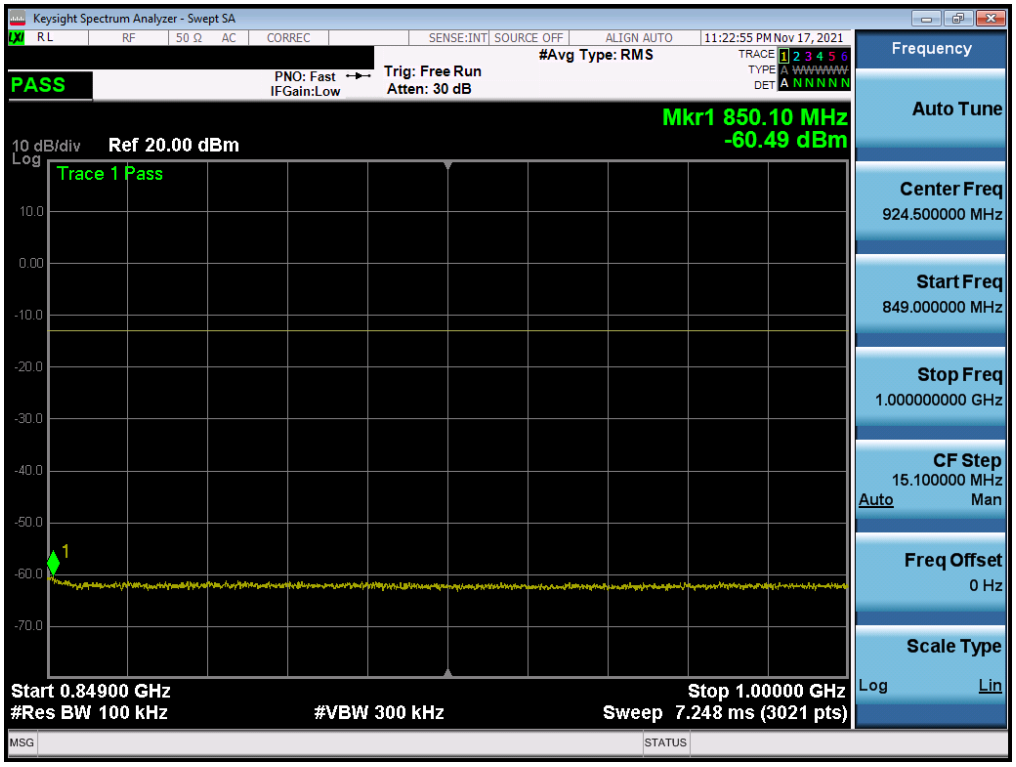
Plot 7-61. CSE (NR Band n5 - 20.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Mid Channel)



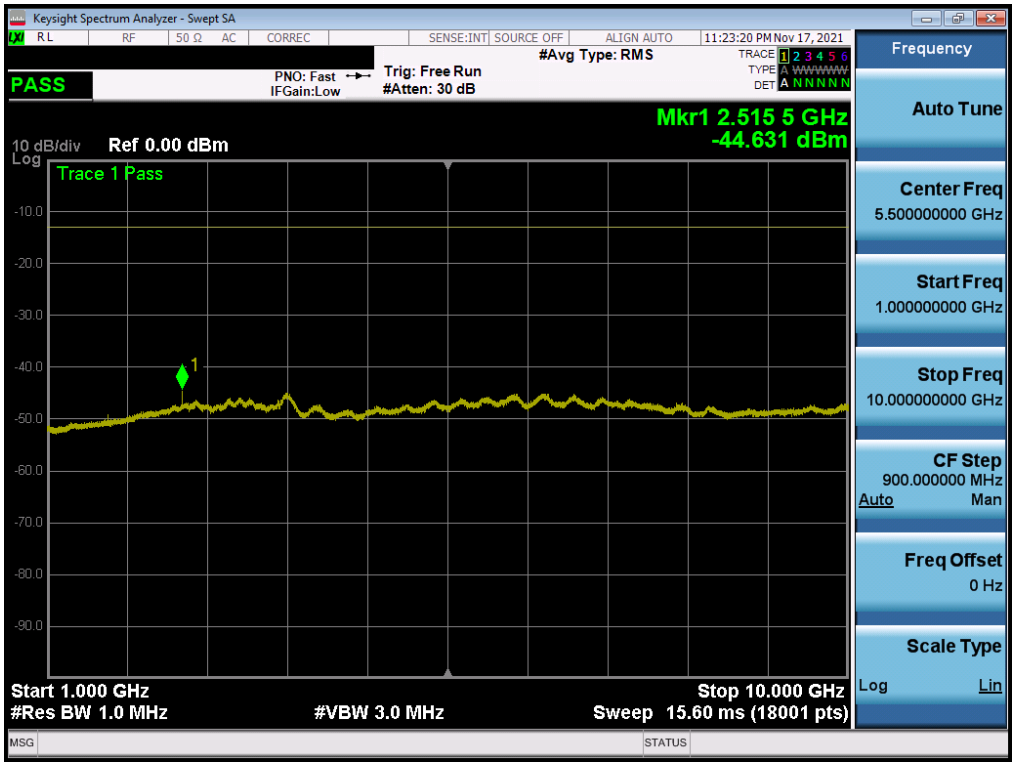
Plot 7-62. CSE (NR Band n5 - 20.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - Mid Channel)



Plot 7-63. CSE (NR Band n5 - 20.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - High Channel)

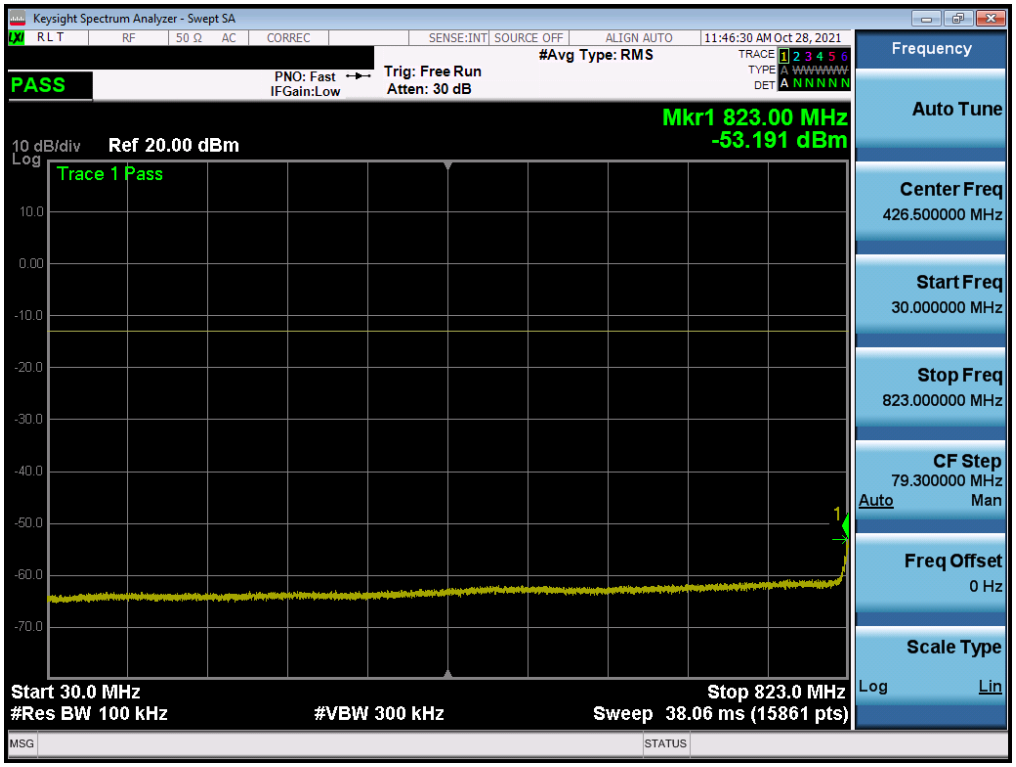


Plot 7-64. CSE (NR Band n5 - 20.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - High Channel)

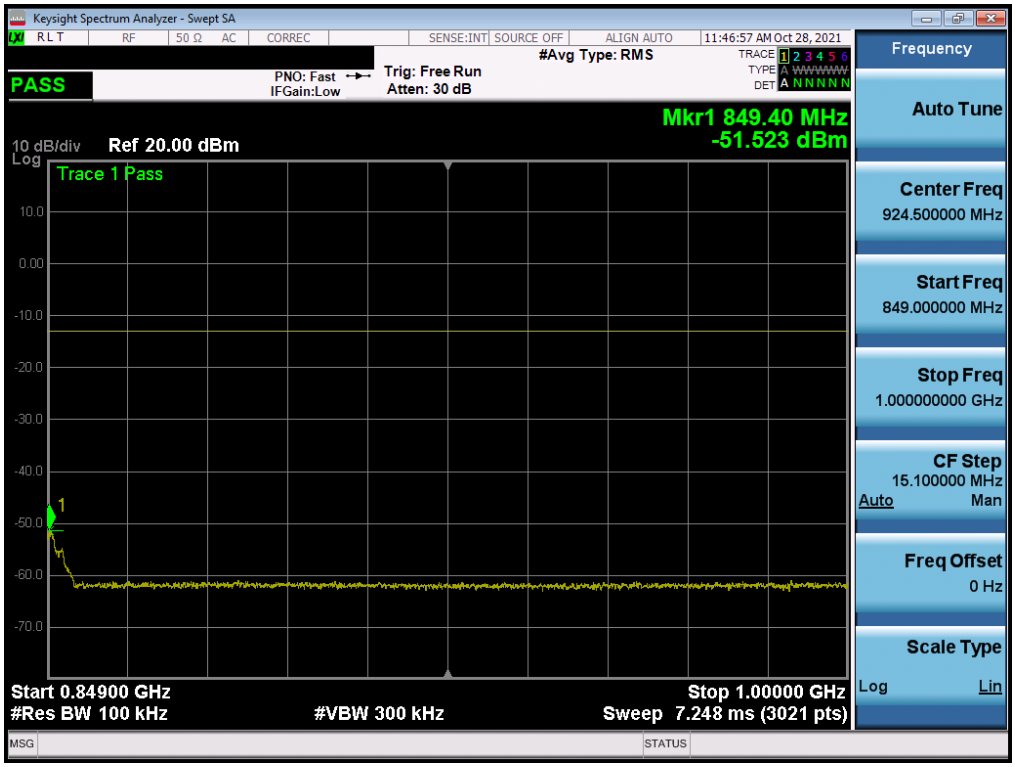


Plot 7-65. CSE (NR Band n5 - 20.0MHz DFT-s-OFDM QPSK - RB Size 1, RB Offset 0 - High Channel)

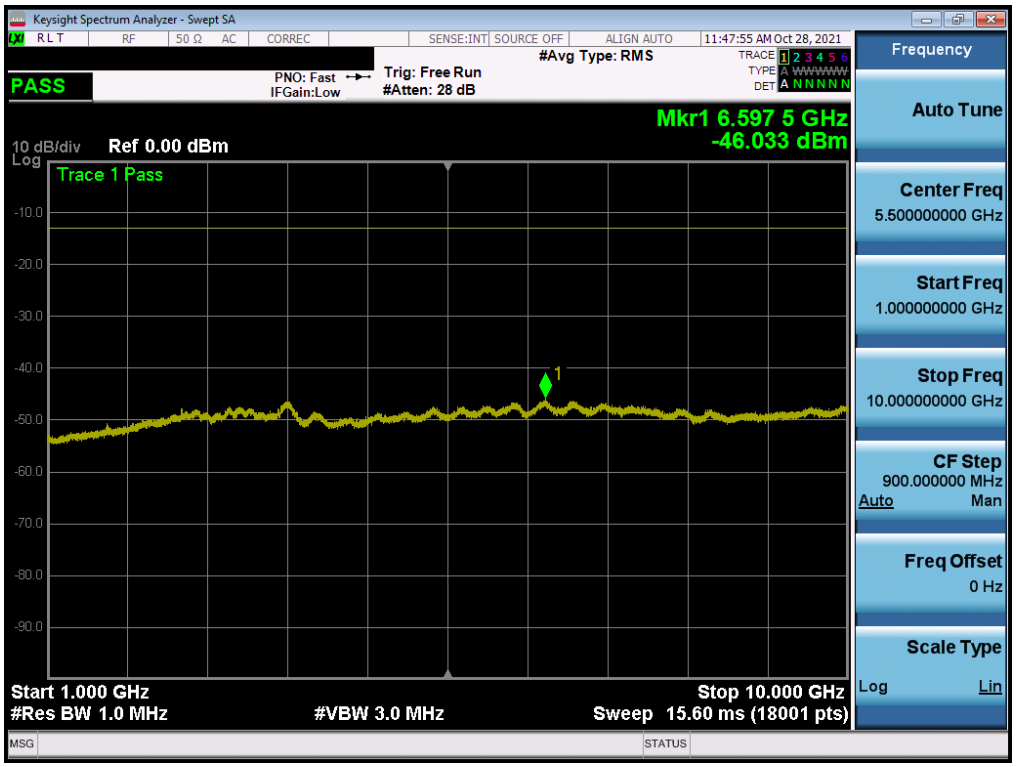
WCDMA Cell



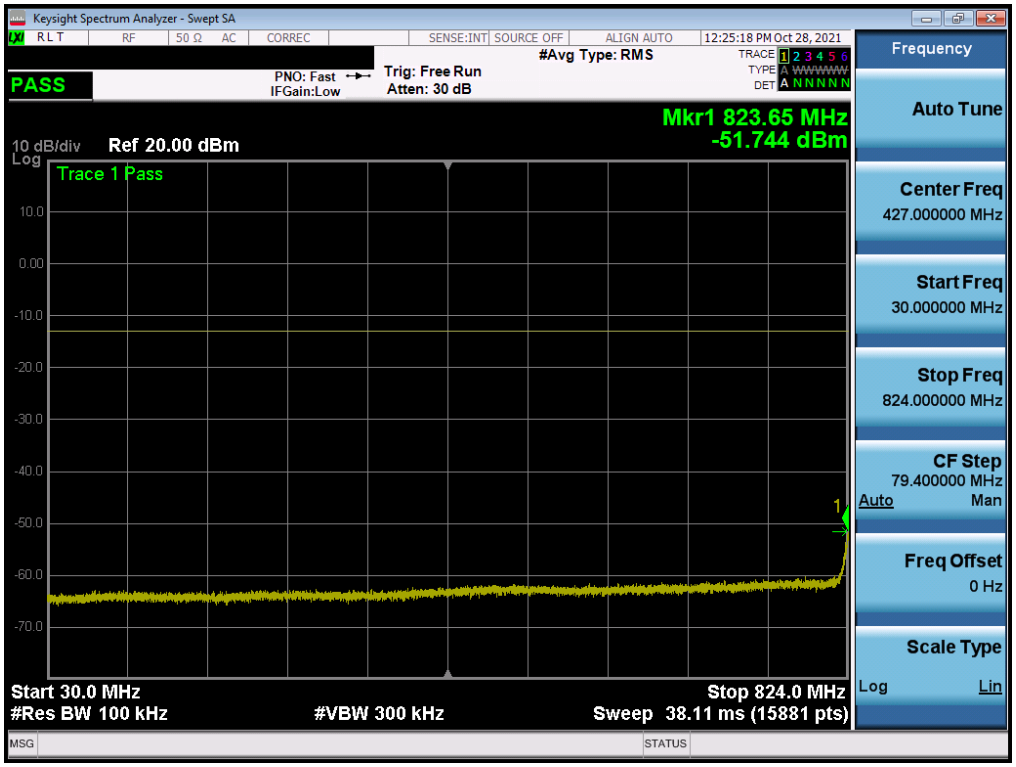
Plot 7-66. CSE (WCDMA Ch. 4132)



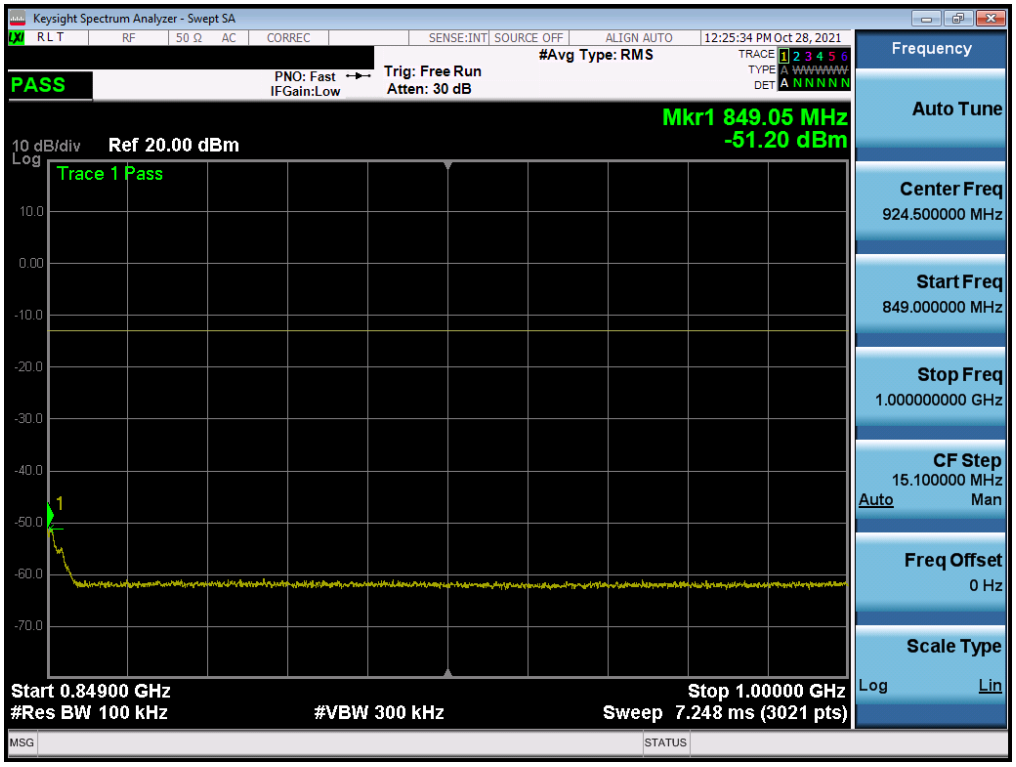
Plot 7-67. CSE (WCDMA Ch. 4132)



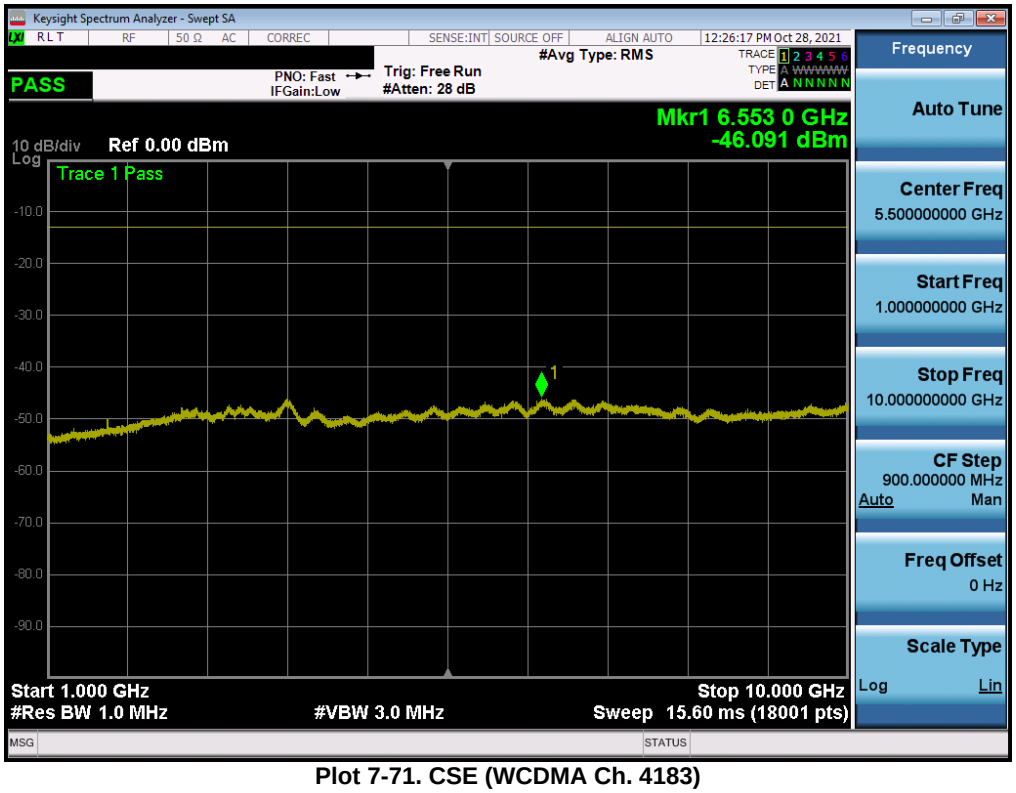
Plot 7-68. CSE (WCDMA Ch. 4132)



Plot 7-69. CSE (WCDMA Ch. 4183)



Plot 7-70. CSE (WCDMA Ch. 4183)



Plot 7-71. CSE (WCDMA Ch. 4183)