Element Materials Technology
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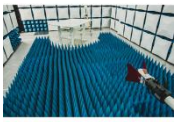

PART 27 MEASUREMENT REPORT

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

Date of Testing:
01/17/2025 - 07/14/2025
Test Report Issue Date:
8/4/2025
Test Site/Location:
Element Materials Technology, Morgan Hill, CA, USA
Test Report Serial No.:
1C2503270029-05.BCG

FCC ID:	**BCG-A3281**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model:	A3281, A3282
EUT Type:	Watch
FCC Classification:	PCS Licensed Transmitter Worn on Body (PCT)
FCC Rule Part:	27
Test Procedure(s):	ANSI C63.26-2015, ANSI/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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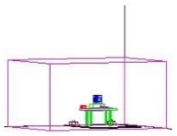
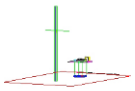


PART 27 MEASUREMENT REPORT



Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	OBW [MHz]	ERP		Emission Designator
					Max. Power [mW]	Max. Power [dBm]	
LTE Band 71	5 MHz	QPSK	665.5 - 695.5	4.5542	0.596	-2.25	4M55G7W
		16QAM	665.5 - 695.5	4.5219	0.472	-3.26	4M52D7W
	10 MHz	QPSK	668.0 - 693.0	9.0233	0.593	-2.27	9M02G7W
		16QAM	668.0 - 693.0	5.0793	0.475	-3.23	5M08D7W
	15 MHz	QPSK	670.5 - 690.5	13.5330	0.593	-2.27	13M5G7W
		16QAM	670.5 - 690.5	5.3138	0.472	-3.26	5M31D7W
	20 MHz	QPSK	673.0 - 688.0	18.0170	0.593	-2.27	18M0G7W
		16QAM	673.0 - 688.0	5.5682	0.475	-3.23	5M57D7W
LTE Band 12	1.4 MHz	QPSK	699.7 - 715.3	1.0960	0.841	-0.75	1M10G7W
		16QAM	699.7 - 715.3	1.1104	0.661	-1.80	1M11D7W
	3 MHz	QPSK	700.5 - 714.5	2.7131	0.822	-0.85	2M71G7W
		16QAM	700.5 - 714.5	2.7096	0.671	-1.73	2M71D7W
	5 MHz	QPSK	701.5 - 713.5	4.5472	0.841	-0.75	4M55G7W
		16QAM	701.5 - 713.5	4.5197	0.665	-1.77	4M52D7W
	10 MHz	QPSK	704.0 - 711.0	9.0251	0.841	-0.75	9M03G7W
		16QAM	704.0 - 711.0	5.0883	0.671	-1.73	5M09D7W
LTE Band 17	5 MHz	QPSK	706.5 - 713.5	4.5472	0.838	-0.77	4M55G7W
		16QAM	706.5 - 713.5	4.5197	0.668	-1.75	4M52D7W
	10 MHz	QPSK	709.0 - 711.0	9.0251	0.841	-0.75	9M03G7W
		16QAM	709.0 - 711.0	5.0883	0.671	-1.73	5M09D7W
LTE Band 13	5 MHz	QPSK	779.5 - 784.5	4.5446	0.624	-2.05	4M54G7W
		16QAM	779.5 - 784.5	4.5202	0.497	-3.04	4M52D7W
	10 MHz	QPSK	782.0	8.9993	0.611	-2.14	9M00G7W
		16QAM	782.0	5.1024	0.495	-3.05	5M10D7W
NR Band n71	5 MHz	π/2 BPSK	665.5 - 695.5	4.4674	0.596	-2.25	4M47G7W
		QPSK	665.5 - 695.5	4.4669	0.579	-2.37	4M47G7W
		16QAM	665.5 - 695.5	4.4443	0.471	-3.27	4M44D7W
		64QAM	665.5 - 695.5	4.4876	0.373	-4.28	4M49D7W
	10 MHz	π/2 BPSK	668.0 - 693.0	8.9354	0.596	-2.25	8M94G7W
		QPSK	668.0 - 693.0	9.2950	0.586	-2.32	9M30G7W
		16QAM	668.0 - 693.0	9.3141	0.474	-3.24	9M31D7W
		64QAM	668.0 - 693.0	9.2781	0.365	-4.38	9M28D7W
	15 MHz	π/2 BPSK	670.5 - 690.5	13.4370	0.594	-2.26	13M4G7W
		QPSK	670.5 - 690.5	14.1180	0.596	-2.25	14M1G7W
		16QAM	670.5 - 690.5	14.0910	0.474	-3.24	14M1D7W
		64QAM	670.5 - 690.5	14.1790	0.378	-4.23	14M2D7W
	20 MHz	π/2 BPSK	673.0 - 688.0	17.8630	0.592	-2.28	17M9G7W
		QPSK	673.0 - 688.0	18.9480	0.596	-2.25	18M9G7W
		16QAM	673.0 - 688.0	18.9520	0.472	-3.26	19M0D7W
		64QAM	673.0 - 688.0	18.9670	0.376	-4.25	19M0D7W
NR Band n12	5 MHz	π/2 BPSK	701.5 - 713.5	4.4843	0.841	-0.75	4M48G7W
		QPSK	701.5 - 713.5	4.4858	0.839	-0.76	4M49G7W
		16QAM	701.5 - 713.5	4.4685	0.650	-1.87	4M47D7W
		64QAM	701.5 - 713.5	4.4989	0.531	-2.75	4M50D7W
	10 MHz	π/2 BPSK	704.0 - 711.0	8.9679	0.836	-0.78	8M97G7W
		QPSK	704.0 - 711.0	9.3301	0.841	-0.75	9M33G7W
		16QAM	704.0 - 711.0	9.3009	0.671	-1.73	9M30D7W
		64QAM	704.0 - 711.0	9.3090	0.530	-2.76	9M31D7W
	15 MHz	π/2 BPSK	706.5 - 708.5	13.4320	0.830	-0.81	13M4G7W
		QPSK	706.5 - 708.5	14.0840	0.841	-0.75	14M1G7W
		16QAM	706.5 - 708.5	14.0770	0.661	-1.80	14M1D7W
		64QAM	706.5 - 708.5	14.1740	0.531	-2.75	14M2D7W

Overview Table (<1GHz Band)

Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	OBW [MHz]	PAR at 0.1% [dB]	EIRP		Emission Designator
						Max. Power [mW]	Max. Power [dBm]	
LTE Band 4	1.4 MHz	QPSK	1710.7 - 1754.3	1.0972	5.13	32.063	15.06	1M10G7W
		16QAM	1710.7 - 1754.3	1.1088	5.90	27.164	14.34	1M11D7W
	3 MHz	QPSK	1711.5 - 1753.5	2.7119	5.23	32.063	15.06	2M71G7W
		16QAM	1711.5 - 1753.5	2.7077	5.88	27.102	14.33	2M71D7W
	5 MHz	QPSK	1712.5 - 1752.5	4.4561	5.34	32.063	15.06	4M46G7W
		16QAM	1712.5 - 1752.5	4.5175	5.88	28.249	14.51	4M52D7W
	10MHz	QPSK	1715.0 - 1750.0	9.0240	5.39	32.063	15.06	9M02G7W
		16QAM	1715.0 - 1750.0	5.0919	5.64	26.915	14.30	5M09D7W
	15 MHz	QPSK	1717.5 - 1747.5	13.5240	5.34	32.063	15.06	13M5G7W
		16QAM	1717.5 - 1747.5	5.3438	5.42	28.119	14.49	5M34D7W
	20 MHz	QPSK	1720.0 - 1745.0	18.0330	5.21	32.063	15.06	18M0G7W
		16QAM	1720.0 - 1745.0	5.5788	5.31	28.054	14.48	5M58D7W
LTE Band 66	1.4 MHz	QPSK	1710.7 - 1779.3	1.0972	5.18	32.659	15.14	1M10G7W
		16QAM	1710.7 - 1779.3	1.1088	6.09	26.915	14.30	1M11D7W
	3 MHz	QPSK	1711.5 - 1778.5	2.7119	5.25	32.063	15.06	2M71G7W
		16QAM	1711.5 - 1778.5	2.7077	5.92	26.977	14.31	2M71D7W
	5 MHz	QPSK	1712.5 - 1777.5	4.4561	5.34	31.623	15.00	4M46G7W
		16QAM	1712.5 - 1777.5	4.5175	5.92	27.733	14.43	4M52D7W
	10 MHz	QPSK	1715.0 - 1775.0	9.0240	5.37	32.063	15.06	9M02G7W
		16QAM	1715.0 - 1775.0	5.0919	5.68	26.792	14.28	5M09D7W
	15 MHz	QPSK	1717.5 - 1772.5	13.5240	5.38	32.063	15.06	13M5G7W
		16QAM	1717.5 - 1772.5	5.3438	5.78	28.314	14.52	5M34D7W
	20 MHz	QPSK	1720.0 - 1770.0	18.0330	5.24	32.063	15.06	18M0G7W
		16QAM	1720.0 - 1770.0	5.5788	5.70	27.164	14.34	5M58D7W
NR Band n66	5 MHz	π/2 BPSK	1712.5 - 1777.5	4.4780	4.32	32.063	15.06	4M48G7W
		QPSK	1712.5 - 1777.5	4.4760	5.31	32.063	15.06	4M48G7W
		16QAM	1712.5 - 1777.5	4.4909	5.96	25.293	14.03	4M49D7W
		64QAM	1712.5 - 1777.5	4.4965	6.42	20.277	13.07	4M50D7W
	10 MHz	π/2 BPSK	1715.0 - 1775.0	8.9482	4.27	32.063	15.06	8M95G7W
		QPSK	1715.0 - 1775.0	9.2945	5.44	31.333	14.96	9M29G7W
		16QAM	1715.0 - 1775.0	9.2799	6.09	25.586	14.08	9M28D7W
		64QAM	1715.0 - 1775.0	9.2522	6.37	20.324	13.08	9M25D7W
	15 MHz	π/2 BPSK	1717.5 - 1772.5	13.4580	4.17	31.189	14.94	13M5G7W
		QPSK	1717.5 - 1772.5	14.1360	5.27	32.063	15.06	14M1G7W
		16QAM	1717.5 - 1772.5	14.1040	6.07	25.410	14.05	14M1D7W
		64QAM	1717.5 - 1772.5	14.1730	6.17	19.055	12.80	14M2D7W
	20 MHz	π/2 BPSK	1720.0 - 1770.0	17.9100	4.21	31.623	15.00	17M9G7W
		QPSK	1720.0 - 1770.0	18.8960	5.31	32.063	15.06	18M9G7W
		16QAM	1720.0 - 1770.0	18.9810	5.96	25.763	14.11	19M0D7W
		64QAM	1720.0 - 1770.0	19.0140	6.47	20.137	13.04	19M0D7W

Overview Table (>1GHz Bands)

1.0 INTRODUCTION

1.1 Scope

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

1.2 Element Materials Technology Test Location

These measurement tests were conducted at the Element Materials Technology 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 Element Materials Technology located in Morgan Hill, CA 95037, U.S.A.

- Element Materials Technology 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.

- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

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

- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Agreements (MRAs).

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID: BCG-A3281**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 27.

Test Device Serial No.: FN6HG1000GN0000VL1, FN6HG1000DF0000VL1, W7Y9YP320W, YMHWMV7H7D, T262Q5T4CQ

2.2 Device Capabilities

This device contains the following capabilities:

Multi-band LTE, 5G NR (FR1), 802.11b/g/n WLAN, 802.11a/n UNII, 802.15.4ab-NB, Bluetooth (1x, EDR, HDR4, HDR8, LE1M, LE2M), NFC, UWB, 60.5GHz Transmitter, Mobile Satellite Service (MSS).

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.

Simultaneous Tx Config	Antenna FCM					
	WLAN	Bluetooth	802.15.4ab - NB	LTE/FR1	UNII	UWB
	802.11b/g/n	BDR, EDR, HDR4/8, LE1/2M	O-QPSK	Mid/High Band	802.11a/n	Ch.5/Ch.9
Config 1	✓	×	×	✓	×	✓
Config 2	×	✓	×	✓	×	✓
Config 3	×	✓	✓	✓	×	×
Config 4	✓	×	✓	✓	×	×
Config 5	×	✓	×	✓	✓	×
Config 6	×	✓	×	✓	×	✓
Config 7	✓	×	×	✓	×	×
Config 8	✓	×	✓	×	×	×
Config 9	✓	×	×	×	×	✓
Config 10	×	✓	×	×	✓	×
Config 11	×	✓	×	✓	×	×
Config 12	×	✓	✓	×	×	×
Config 13	×	✓	×	×	×	✓
Config 14	×	×	✓	✓	×	×
Config 15	×	×	×	✓	✓	×
Config 16	×	×	×	✓	×	✓

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 5 and reported in RF Bluetooth, RF UNII OFDM, and RF FCC Part 27b test reports.

2.3 Antenna Description

The following antenna gains provided by manufacturer were used for testing.

Frequency [MHz]	Antenna Gain [dBi]	
	Antenna BCM	Antenna FCM
LTE Band 12/17	-24.30	-
NR Band n12	-24.30	-
LTE Band 13	-25.60	-
LTE Band 71	-25.80	-
NR Band n71	-25.80	-
LTE Band 4/66	-	-10.14
NR Band n66	-	-10.14

Table 2-2. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple Macbook	Model:	A1398	S/N:	FVFDHG8TP3XY
	w/AC/DC Adapter	Model:	A1435	S/N:	N/A
2	Apple USB-C cable	Model:	N/A	S/N:	N/A
	w/ Charging Dock	Model:	A2921	S/N:	DQ8137601MY08V22F
	w/ Cradle	Model:	N/A	S/N:	CYV142700BEE1EN01MP1P
3	Apple Magnetic Charger	Model:	A2515	S/N:	DLC313306ZQ1NR1A7
	Apple Magnetic Charger	Model:	A2879	S/N:	DLCH5T0012A00000WB
4	Pathfinder Davenport	Model:	920-15901-01	S/N:	DLCH640006H0000QA0
	SiP Socket	Model:	P2 N230 PF 238	S/N:	DLCHB60007Q0000Q45
5	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.

The worst case configuration was investigated for the various types of wristbands, metal and non-metal wristbands. The EUT was also investigated with and without wireless charger. The worst case configuration found was used for all testing.

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

All possible simultaneous transmission configurations have been investigated and the worst case config has been reported.

This device only supports 27RBs or less for LTE 16-QAM uplink.

2.6 Software and Firmware

The test was conducted with firmware version watchOS 26 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 Evaluation Procedure

The measurement procedures described in the documents titled “American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services” (ANSI C63.26-2015 and 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	2.07
Radiated Disturbance (<30MHz)	4.12
Radiated Disturbance (30MHz-1GHz)	4.85
Radiated Disturbance (1-18GHz)	5.08
Radiated Disturbance (>18GHz)	5.22

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-26.5GHz PXA Signal Analyzer	10/31/2024	Annual	10/31/2025	MY55330128
ATM	180-442-KF	20dB Nominal Gain Horn Antenna	3/24/2025	Annual	3/24/2026	T058601-02
ESPEC	SU-241	Tabletop Temperature Chamber	10/24/2024	Annual	10/24/2025	92009574
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	9/25/2024	Annual	9/25/2025	240109
Fairview Microwave	FMCA1975-36	30MHz-40GHz Conducted Cable *	6/17/2025	Annual	6/17/2026	-
Fairview Microwave	M2CP1122-10	30MHz-40GHz Conducted Coupler *	6/17/2025	Annual	6/17/2026	1946
Keysight Technology	N9040B	UXA Signal Analyzer	6/9/2025	Annual	6/9/2026	MY57212015
MCL	BW-K10-2W44+	Attenuator *	6/17/2025	Annual	6/17/2026	-
Rohde & Schwarz	ESW44	EMI Test Receiver	10/17/2024	Annual	10/17/2025	101668
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	5/20/2025	Annual	5/20/2026	101619
Rohde & Schwarz	FSW67	Signal and Spectrum Analyzer (2Hz-67GHz)	1/7/2025	Annual	1/7/2026	101366
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	8/14/2024	Annual	8/14/2025	101648
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	12/10/2024	Annual	12/10/2025	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	3/4/2025	Annual	3/4/2026	164715
Rohde & Schwarz	HFH2-Z2	Loop Antenna	5/12/2025	Annual	5/12/2026	100546
Rohde & Schwarz	HFH2-Z2	Loop Antenna	6/26/2025	Annual	6/26/2026	100519
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	6/3/2025	Annual	6/3/2026	100052
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	11/15/2024	Annual	11/15/2025	102326
Schwarzbeck	VULB 9162	Bilog Antenna (30MHz - 6GHz)	9/18/2024	Annual	9/18/2025	358

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. * denotes passive equipment that has been internally verified/calibrated.

6.0 SAMPLE CALCULATIONS

Emission Designator

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
LTE BW = 8.45 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
W = Combination of Any

Spurious Radiated Emission

Example: Middle Channel LTE Mode 2nd Harmonic (1564 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).

7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCG-A3281

FCC Classification: PCS Licensed Transmitter Worn on Body (PCT)

Mode(s): LTE/NR

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, 27.53	-13 dBm at Band Edge and for all out-of-band emissions	PASS	Sections 7.3, 7.4
	Peak-Average Ratio	27.50(d)(5)	< 13 dB	PASS	Section 7.5
	Transmitter Conducted Output Power	2.1046	N/A	N/A	See RF Exposure Report
	Frequency Stability	2.1055, 27.54	Fundamental emissions stay within authorized frequency block over the temperature and voltage range as tested	PASS	Section 7.8
	Effective Radiated Power / Equivalent Isotropic Radiated Power (LTE Band 71)	27.50(b)(10)	< 3 Watts max. ERP	PASS	Section 7.6
	Effective Radiated Power / Equivalent Isotropic Radiated Power (NR Band n71)			PASS	Section 7.6
	Effective Radiated Power / Equivalent Isotropic Radiated Power (LTE Band 12/17)			PASS	Section 7.6
	Effective Radiated Power / Equivalent Isotropic Radiated Power (NR Band 12)			PASS	Section 7.6
	Effective Radiated Power / Equivalent Isotropic Radiated Power (LTE Band 13)	27.50(c)(10)	< 3 Watts max. ERP	PASS	Section 7.6
	Equivalent Isotropic Radiated Power (NR Band n66)	27.50(d)(4)	< 1 Watts max. EIRP	PASS	Section 7.6
	Equivalent Isotropic Radiated Power (LTE Band 4/66)			PASS	Section 7.6
RADIATED	Radiated Spurious Emissions (LTE Band 13)	2.1053, 27.53(f)	< -70 dBW/MHz (for wideband signals) < -80 dBW (for discrete emissions less than 700Hz BW) For all emissions in the band 1559 - 1610 MHz	PASS	Section 7.7
	Radiated Spurious Emissions (LTE Band 71)	2.1053, 27.53	-13 dBm for all out-of-band emissions	PASS	Section 7.7
	Radiated Spurious Emissions (NR Band n71)			PASS	Section 7.7
	Radiated Spurious Emissions (LTE Band 12/17)			PASS	Section 7.7
	Radiated Spurious Emissions (NR Band 12)			PASS	Section 7.7

Table 7-1. Summary of Test Results

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.

2. The analyzer plots were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.

3. All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.

4. All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is Element EMC Software Tool EMC Software Tool v1.1.

5. For radiated emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "Chamber Automation," Version 3.4.2.

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.

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.

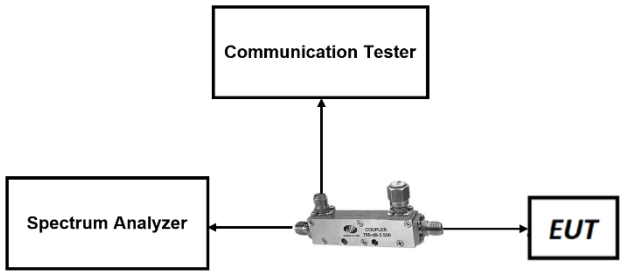


Figure 7-1. LTE Test Instrument & Measurement Setup

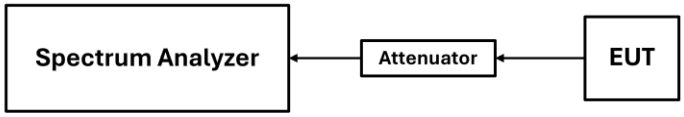
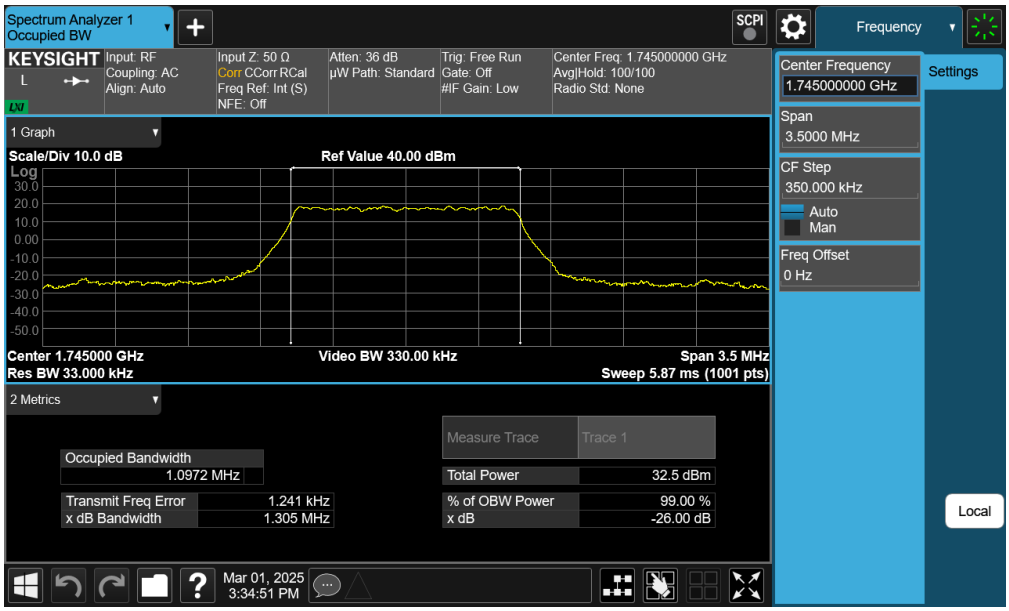


Figure 7-2. FR1 Test Instrument & Measurement Setup

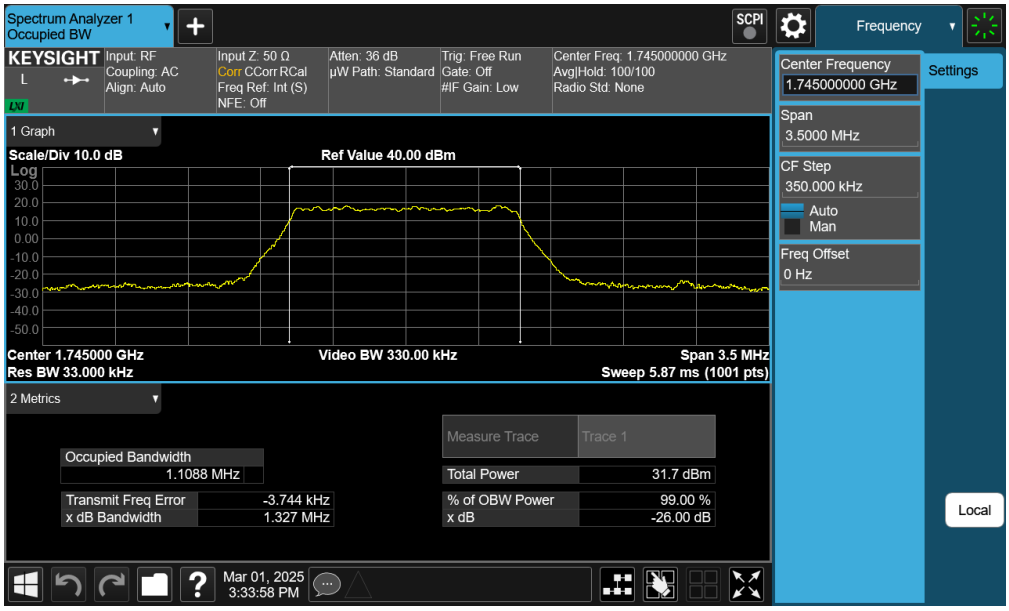
Test Notes

1. 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.

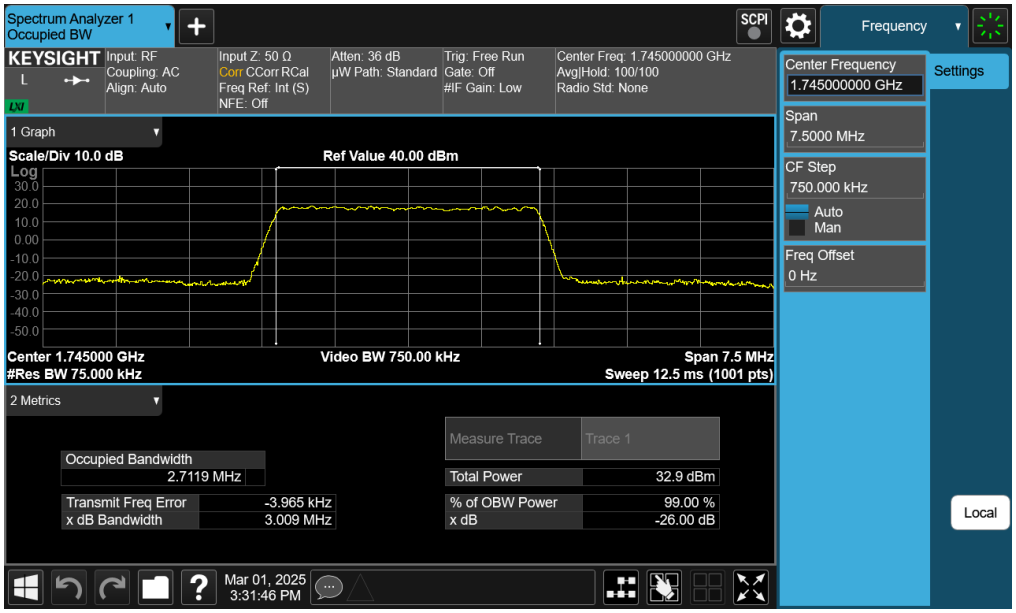
LTE Band 66/4



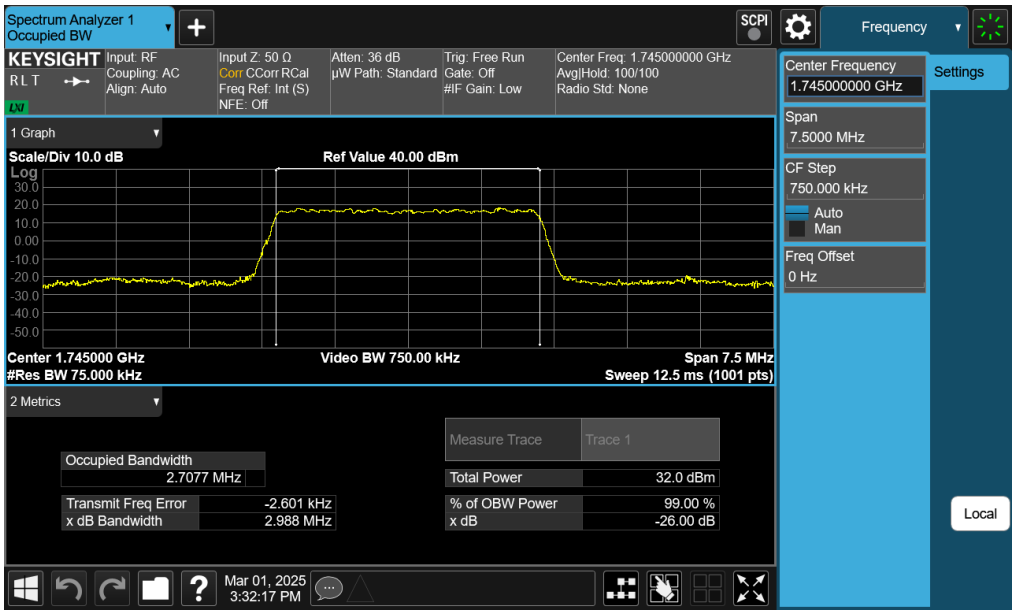
Plot 7-1. Occupied Bandwidth Plot (LTE Band 66/4 - 1.4MHz QPSK - Full RB)



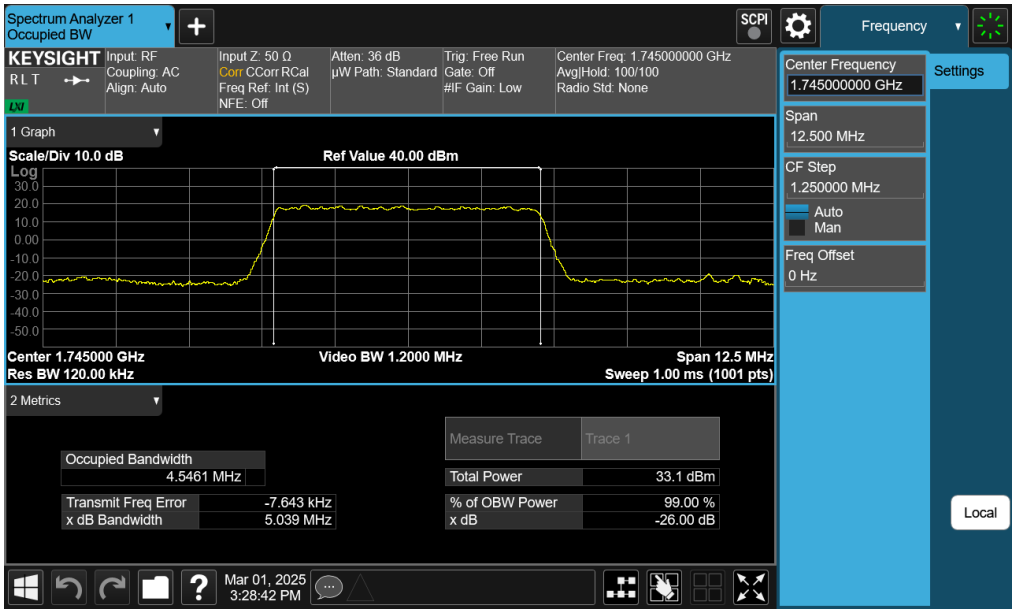
Plot 7-2. Occupied Bandwidth Plot (LTE Band 66/4 - 1.4MHz 16-QAM - Full RB)



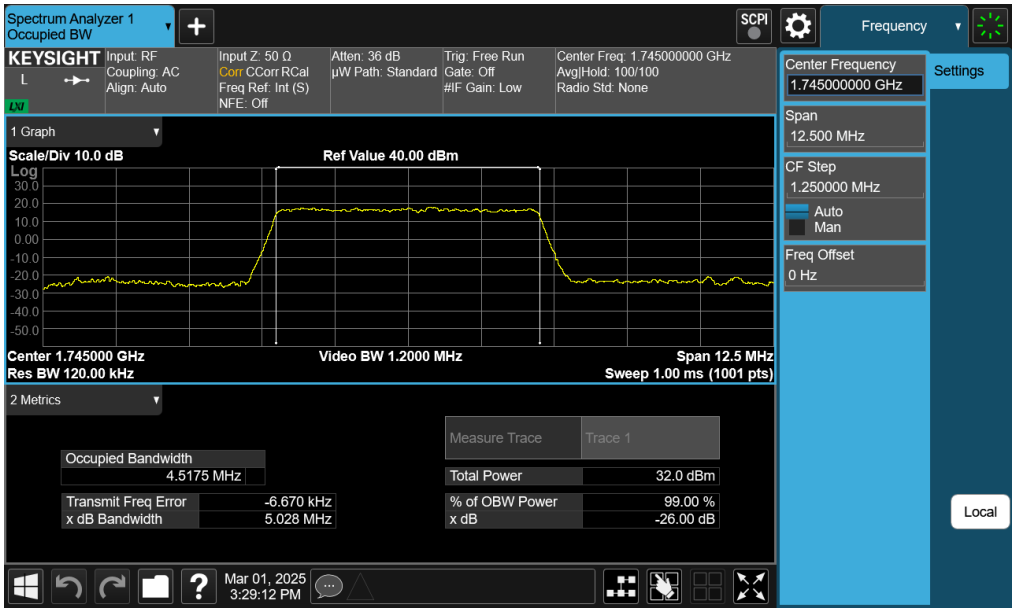
Plot 7-3. Occupied Bandwidth Plot (LTE Band 66/4 - 3MHz QPSK - Full RB)



Plot 7-4. Occupied Bandwidth Plot (LTE Band 66/4 - 3MHz 16-QAM - Full RB)

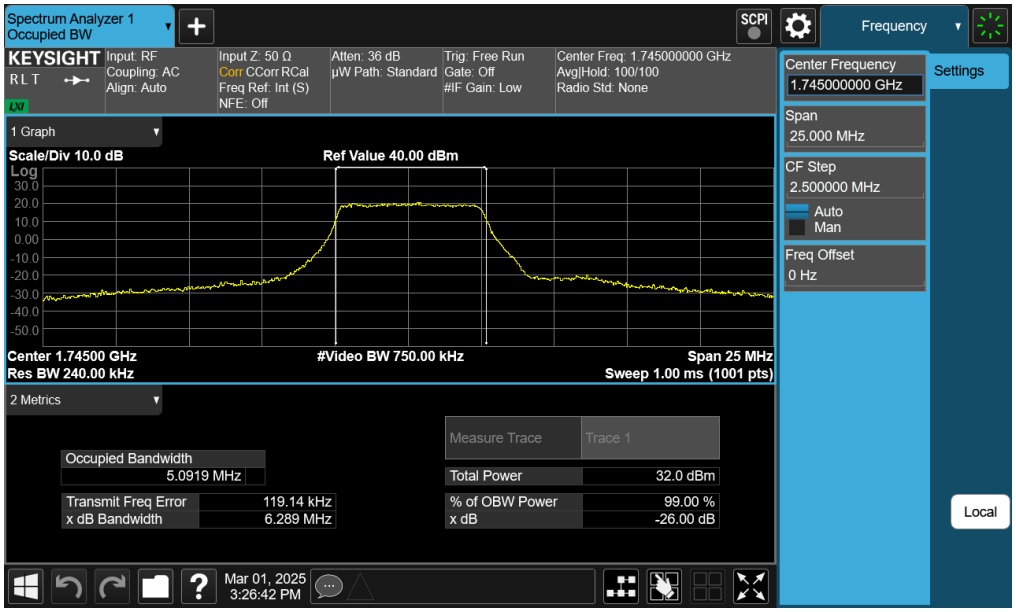


Plot 7-5. Occupied Bandwidth Plot (LTE Band 66/4 - 5MHz QPSK - Full RB)

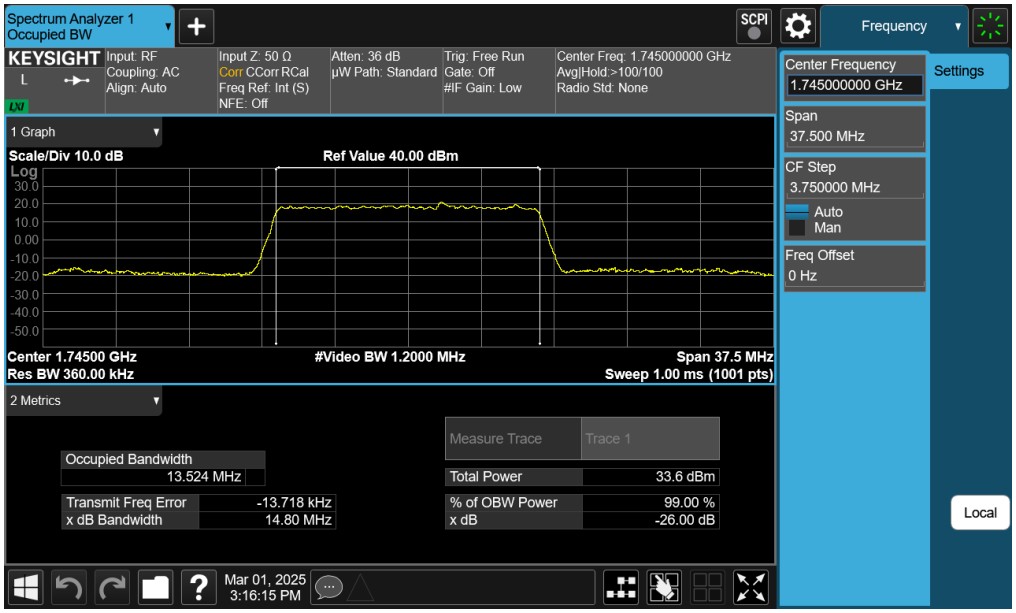


Plot 7-6. Occupied Bandwidth Plot (LTE Band 66/4 - 5MHz 16-QAM - Full RB)

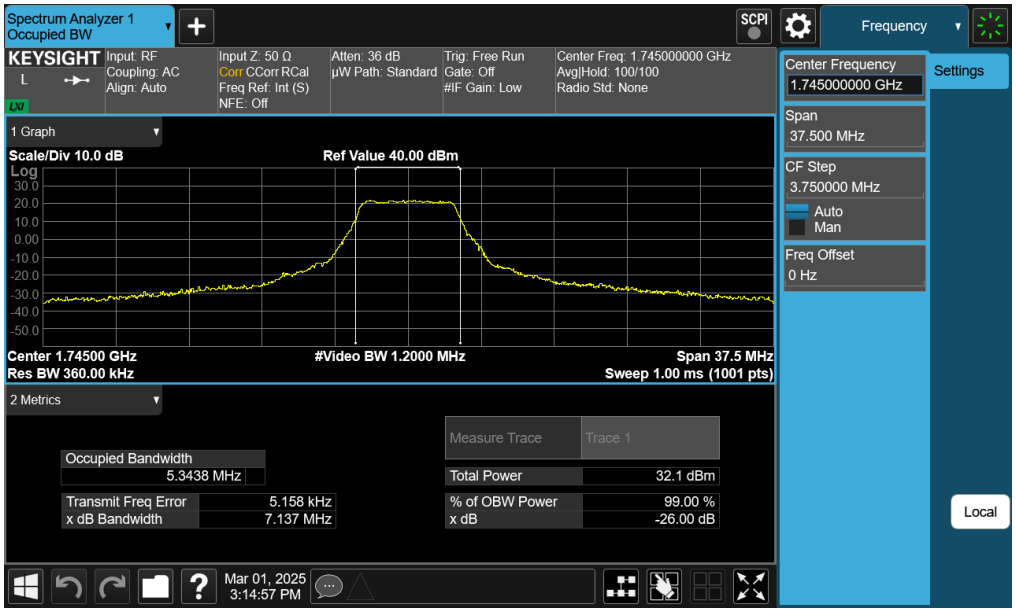
Plot 7-7. Occupied Bandwidth Plot (LTE Band 66/4 - 10MHz QPSK - Full RB)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 66/4 - 10MHz 16-QAM - Full RB)

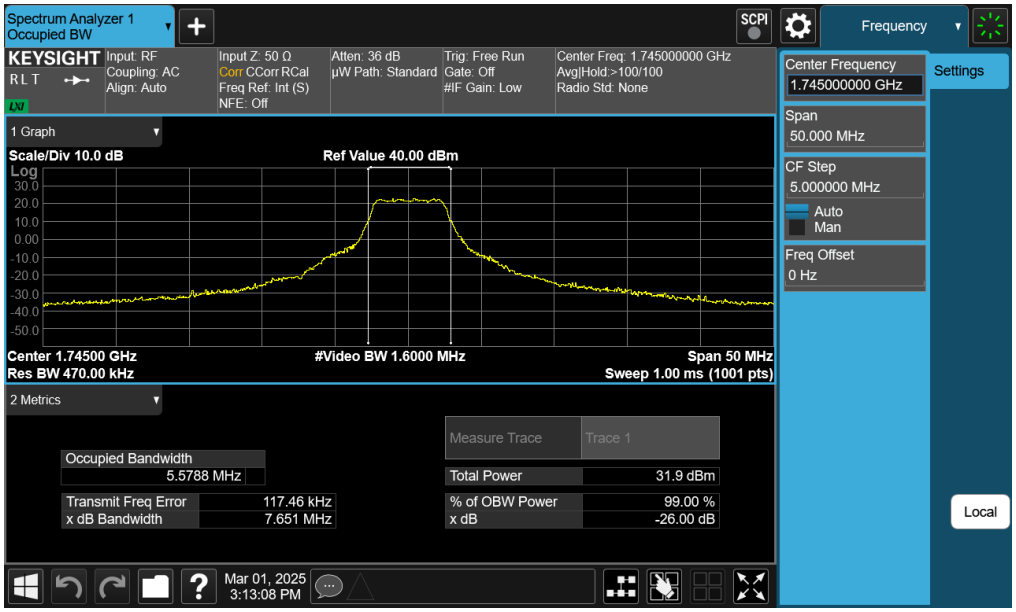


Plot 7-9. Occupied Bandwidth Plot (LTE Band 66/4 - 15MHz QPSK - Full RB)



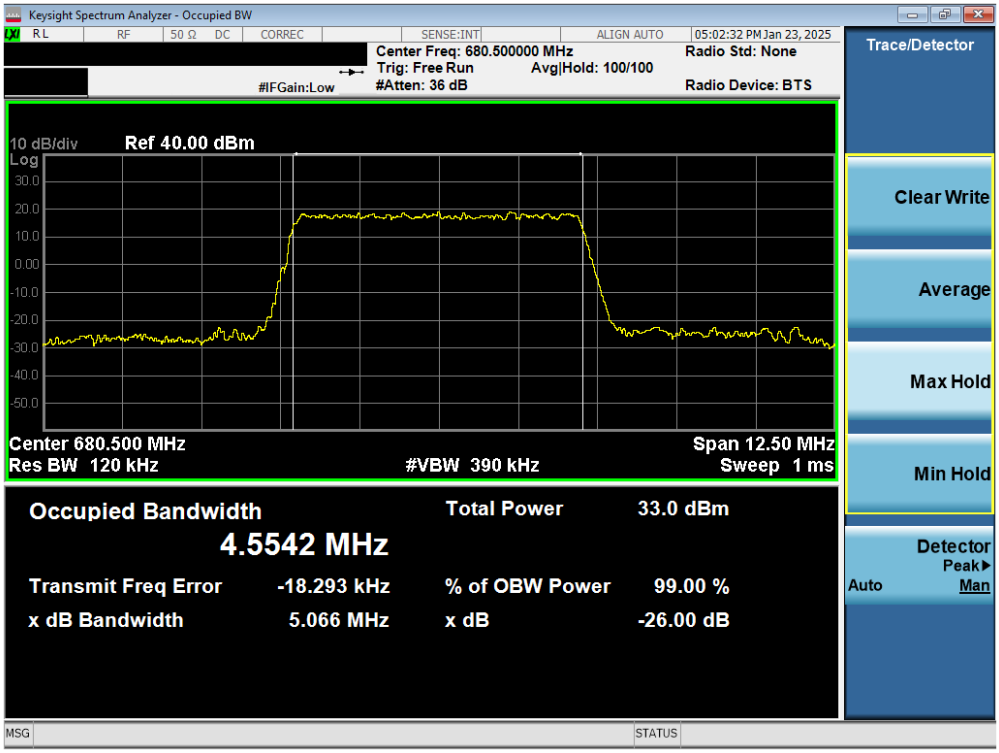
Plot 7-10. Occupied Bandwidth Plot (LTE Band 66/4 - 15MHz 16-QAM - Full RB)

Plot 7-11. Occupied Bandwidth Plot (LTE Band 66/4 - 20MHz QPSK - Full RB)

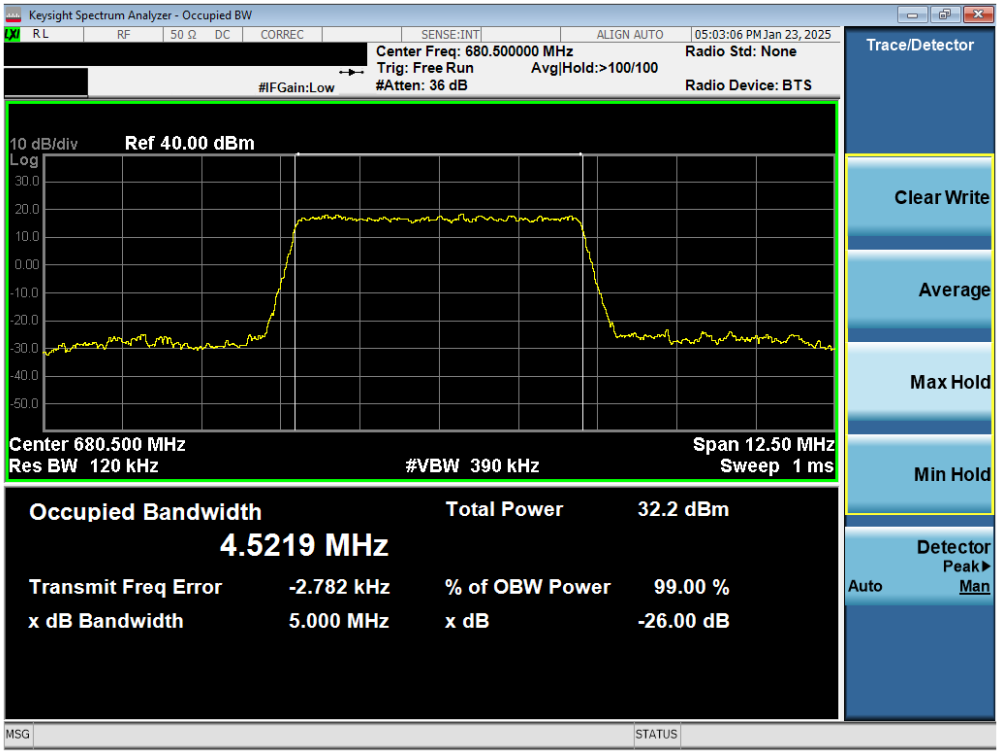


Plot 7-12. Occupied Bandwidth Plot (LTE Band 66/4 - 20MHz 16-QAM - Full RB)

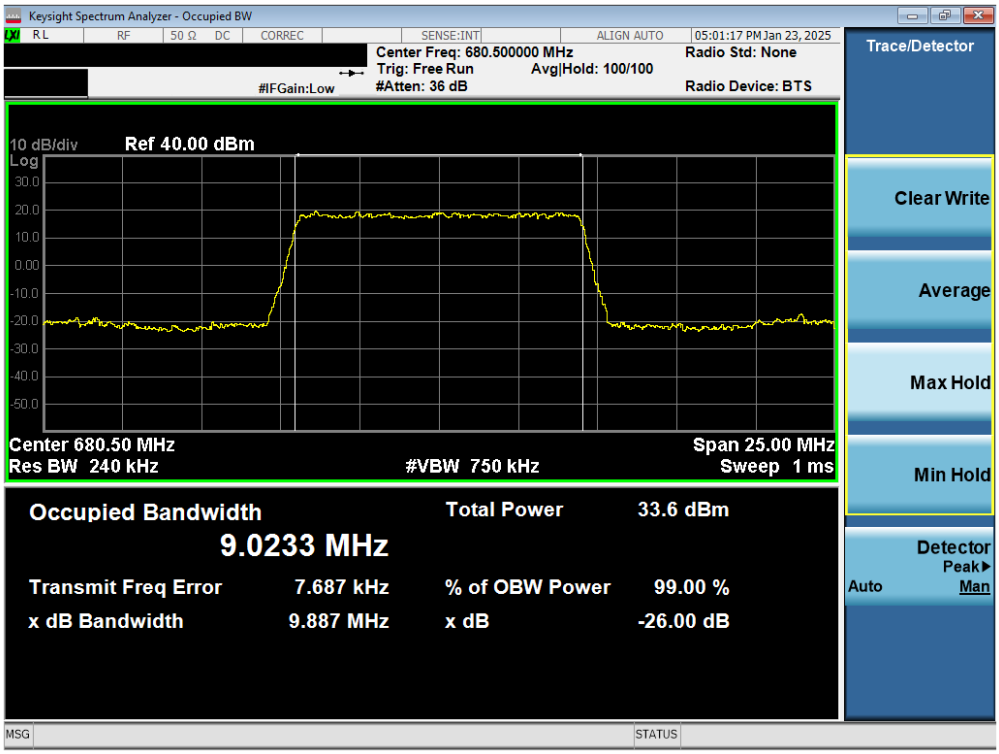
LTE Band 71



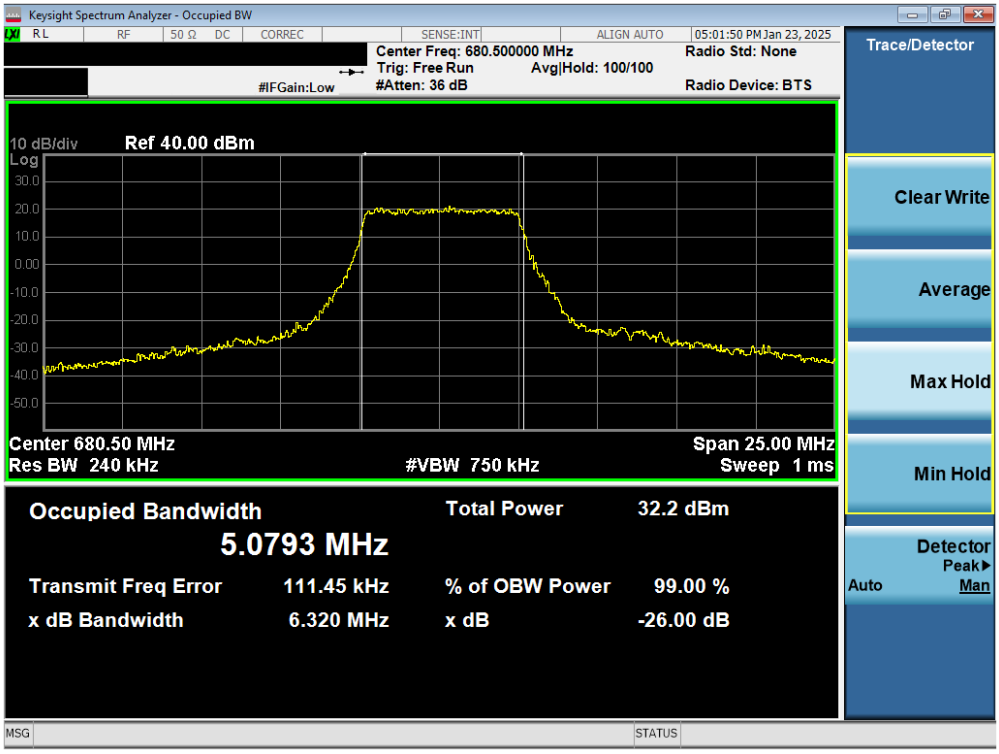
Plot 7-13. Occupied Bandwidth Plot (LTE Band 71 - 5MHz QPSK - Full RB)



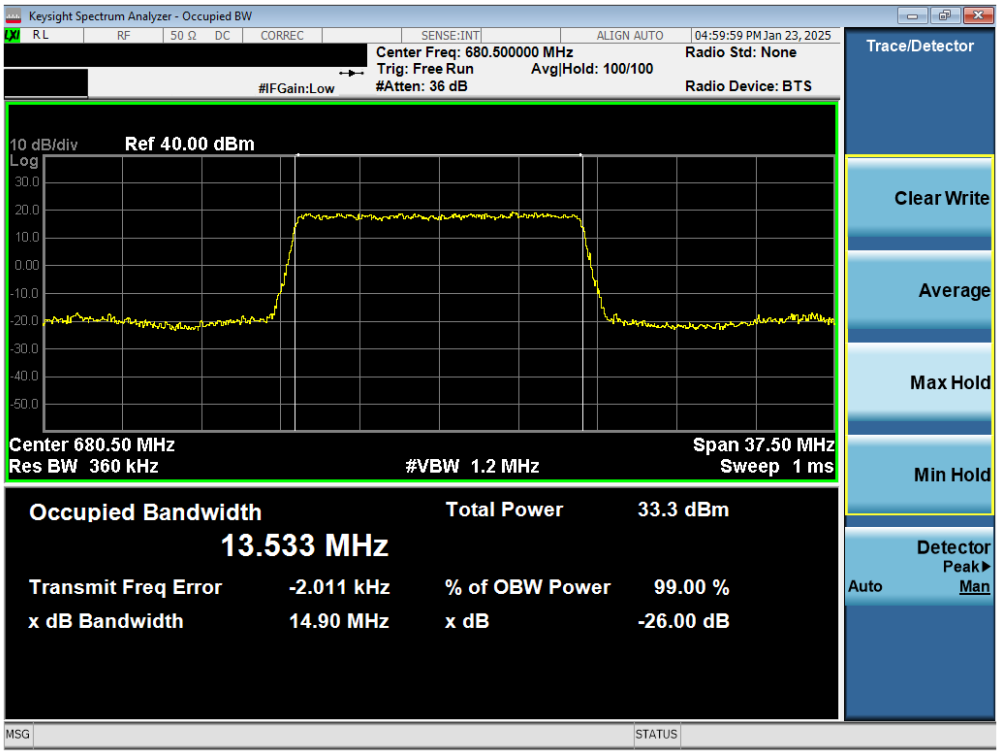
Plot 7-14. Occupied Bandwidth Plot (LTE Band 71 - 5MHz 16-QAM - Full RB)



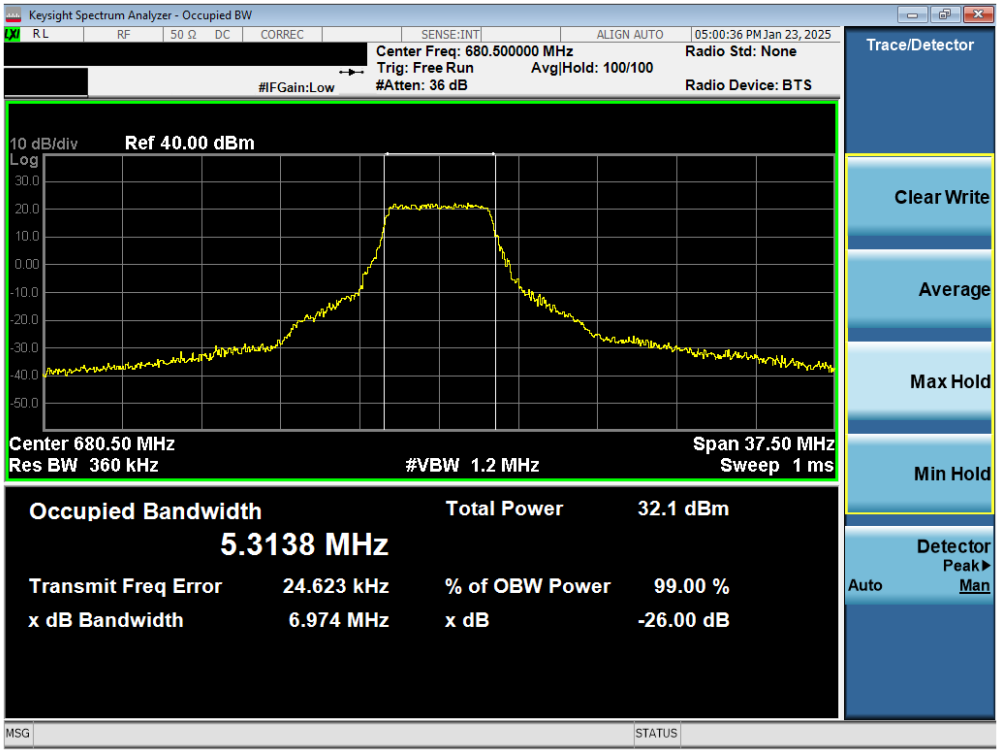
Plot 7-15. Occupied Bandwidth Plot (LTE Band 71 - 10MHz QPSK - Full RB)



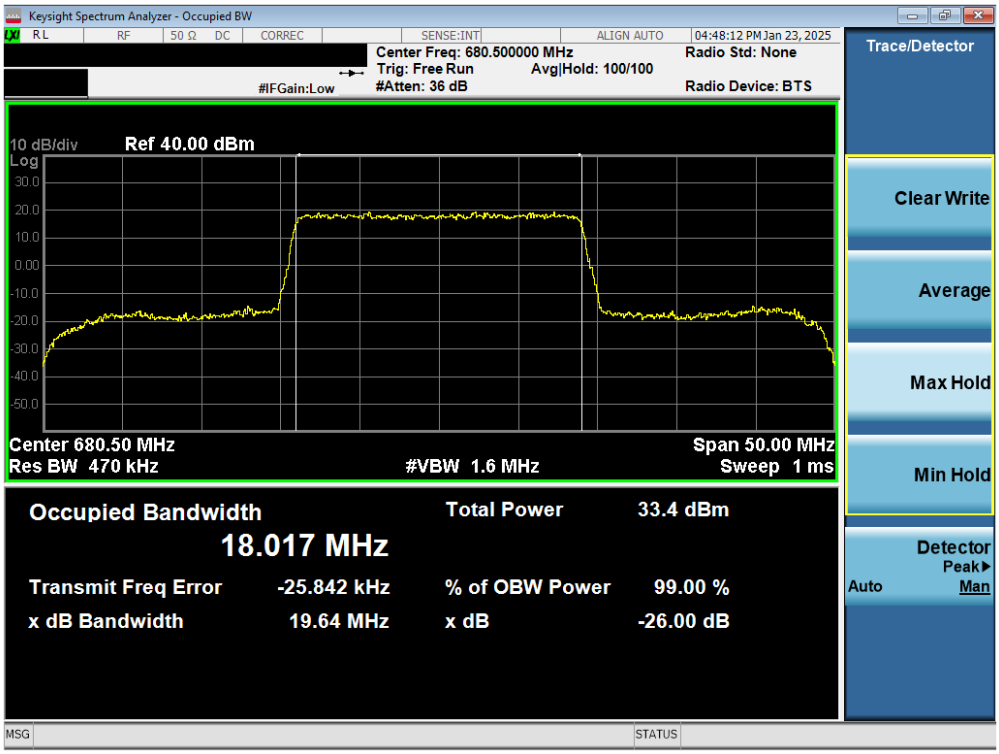
Plot 7-16. Occupied Bandwidth Plot (LTE Band 71 - 10MHz 16-QAM - Full RB)



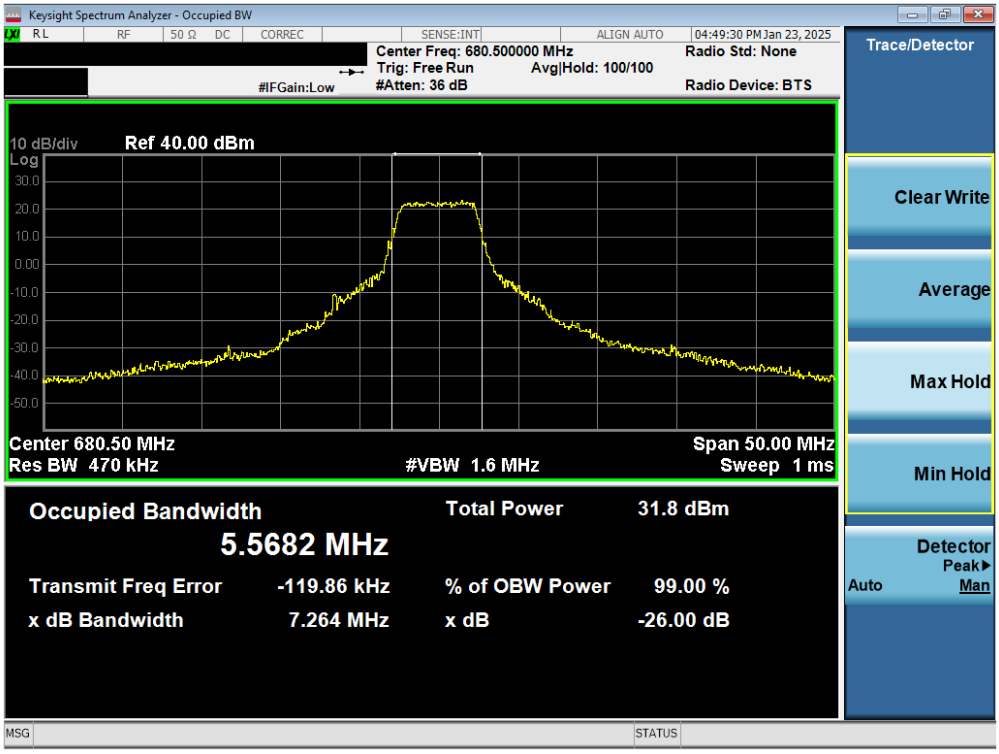
Plot 7-17. Occupied Bandwidth Plot (LTE Band 71 - 15MHz QPSK - Full RB)



Plot 7-18. Occupied Bandwidth Plot (LTE Band 71 - 15MHz 16-QAM - Full RB)

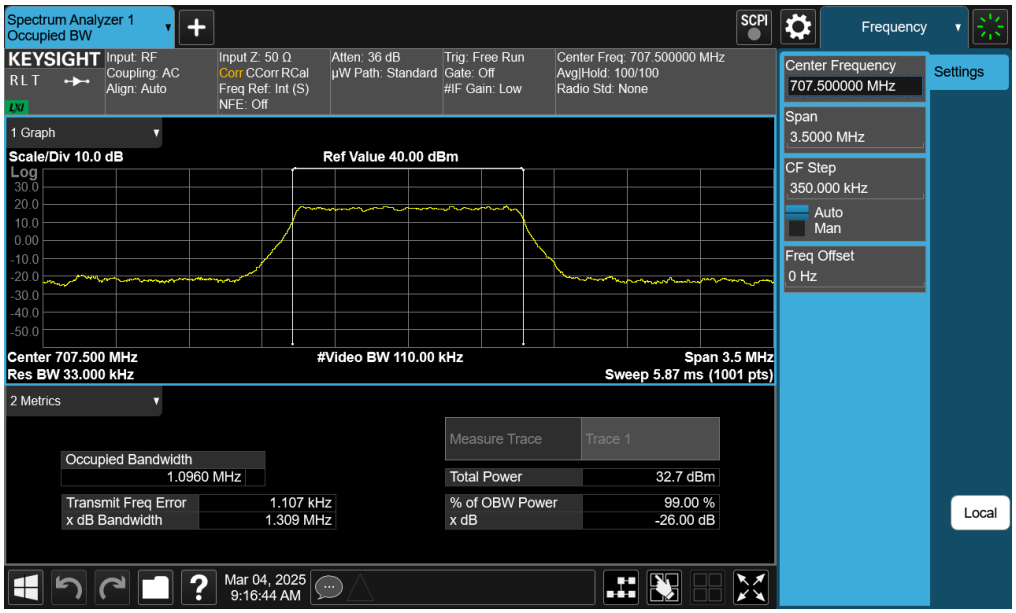


Plot 7-19. Occupied Bandwidth Plot (LTE Band 71 - 20MHz QPSK - Full RB)



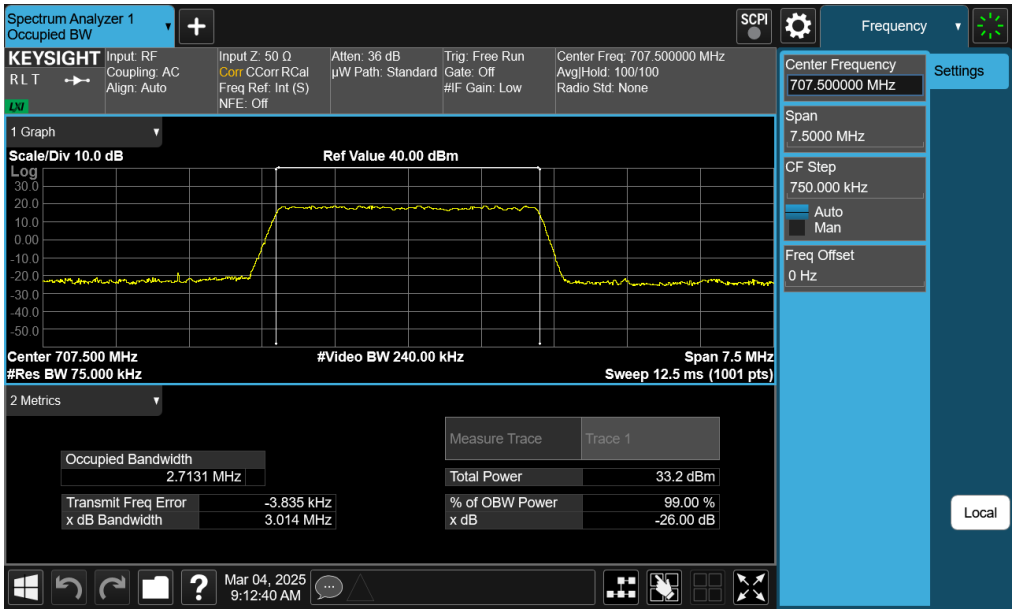
Plot 7-20. Occupied Bandwidth Plot (LTE Band 71 - 20MHz 16-QAM - Full RB)

LTE Band 12/17

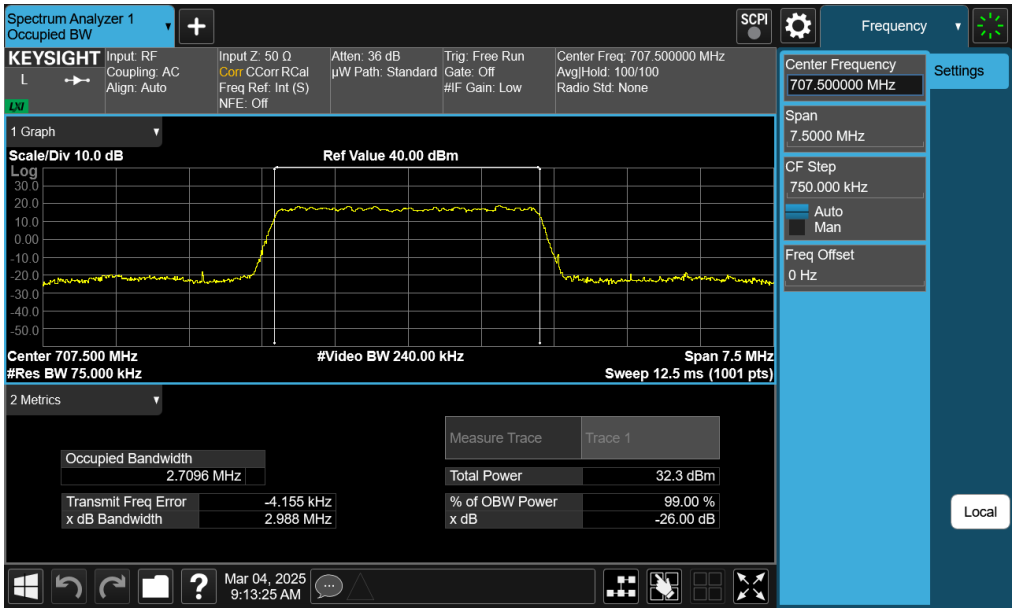


Plot 7-21. Occupied Bandwidth Plot (LTE Band 12 – 1.4MHz QPSK - Full RB)

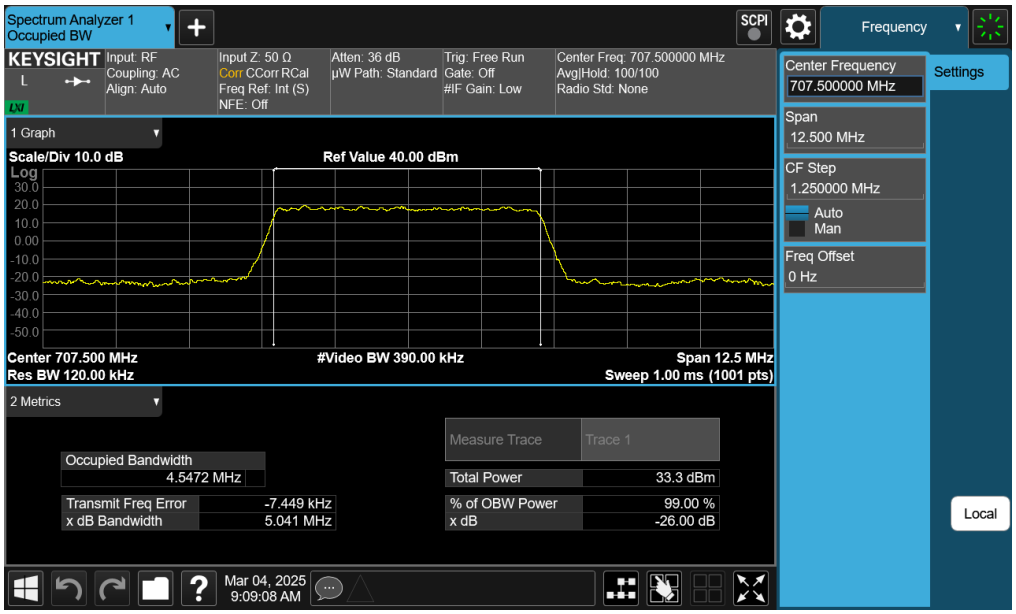
Plot 7-22. Occupied Bandwidth Plot (LTE Band 12 – 1.4MHz 16-QAM - Full RB)



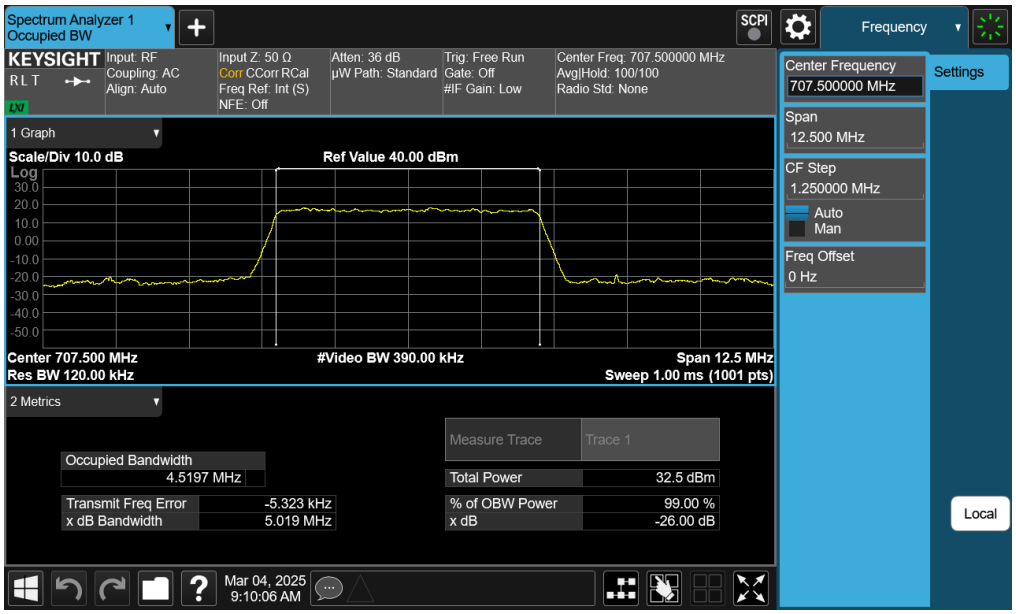
Plot 7-23. Occupied Bandwidth Plot (LTE Band 12 - 3MHz QPSK - Full RB)



Plot 7-24. Occupied Bandwidth Plot (LTE Band 12 - 3MHz 16-QAM - Full RB)



Plot 7-25. Occupied Bandwidth Plot (LTE Band 12/17 - 5MHz QPSK - Full RB)

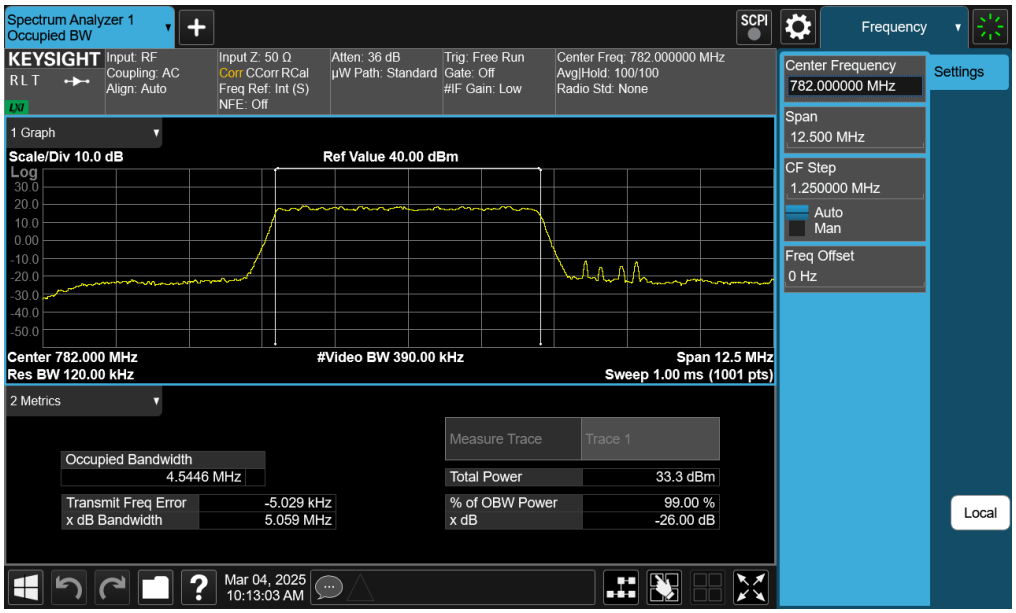


Plot 7-26. Occupied Bandwidth Plot (LTE Band 12/17 - 5MHz 16-QAM - Full RB)

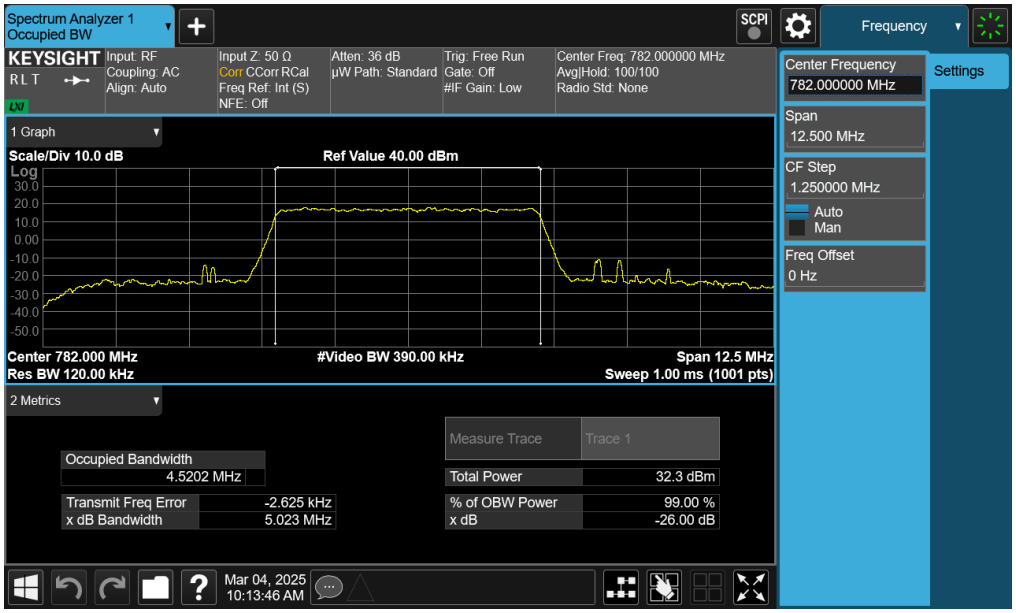
Plot 7-27. Occupied Bandwidth Plot (LTE Band 12/17 - 10MHz QPSK - Full RB)

Plot 7-28. Occupied Bandwidth Plot (LTE Band 12/17 - 10MHz 16-QAM - Full RB)

LTE Band 13



Plot 7-29. Occupied Bandwidth Plot (LTE Band 13 - 5MHz QPSK - Full RB)

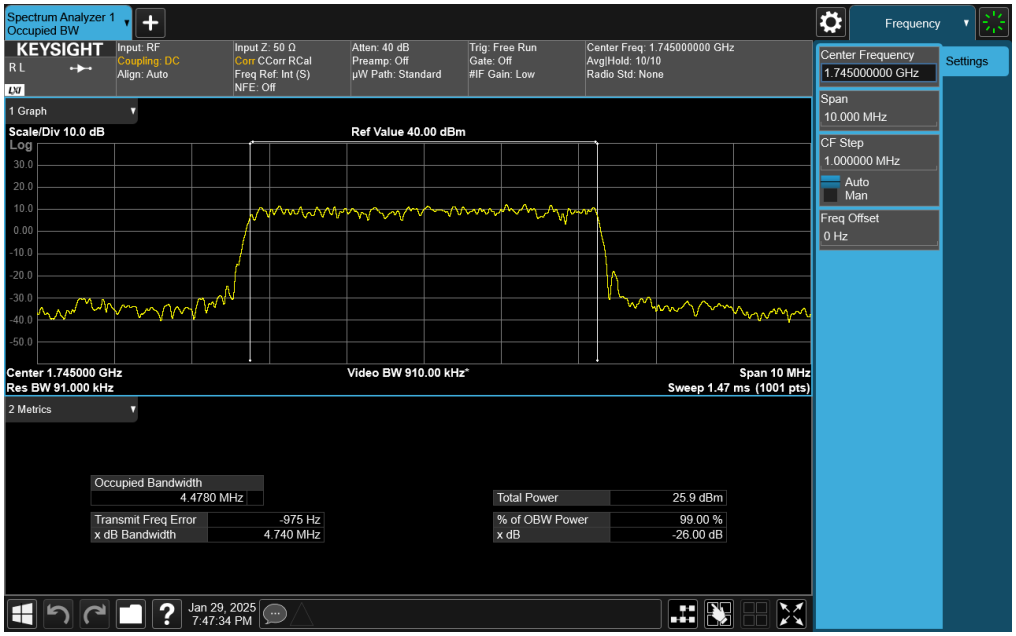


Plot 7-30. Occupied Bandwidth Plot (LTE Band 13 - 5MHz 16-QAM - Full RB)

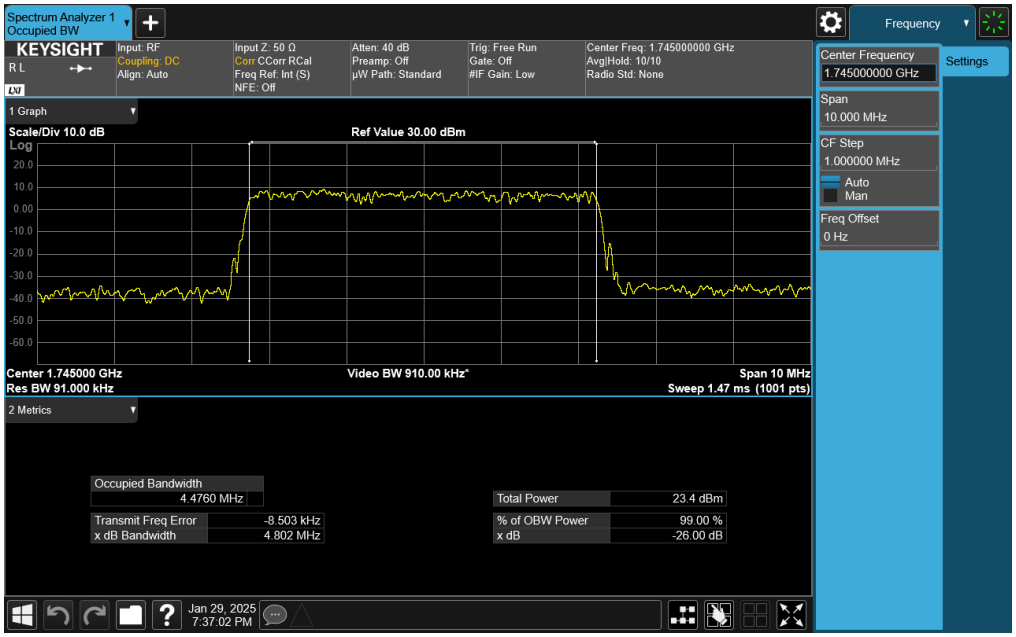
Plot 7-31. Occupied Bandwidth Plot (LTE Band 13 - 10MHz QPSK - Full RB)

Plot 7-32. Occupied Bandwidth Plot (LTE Band 13 - 10MHz 16-QAM - Full RB)

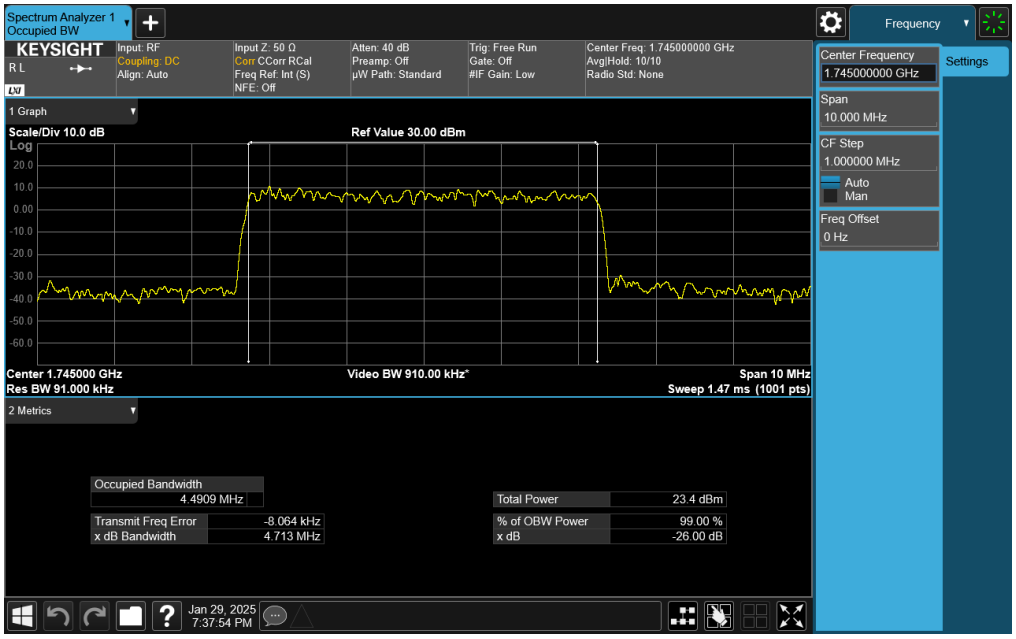
NR Band n66



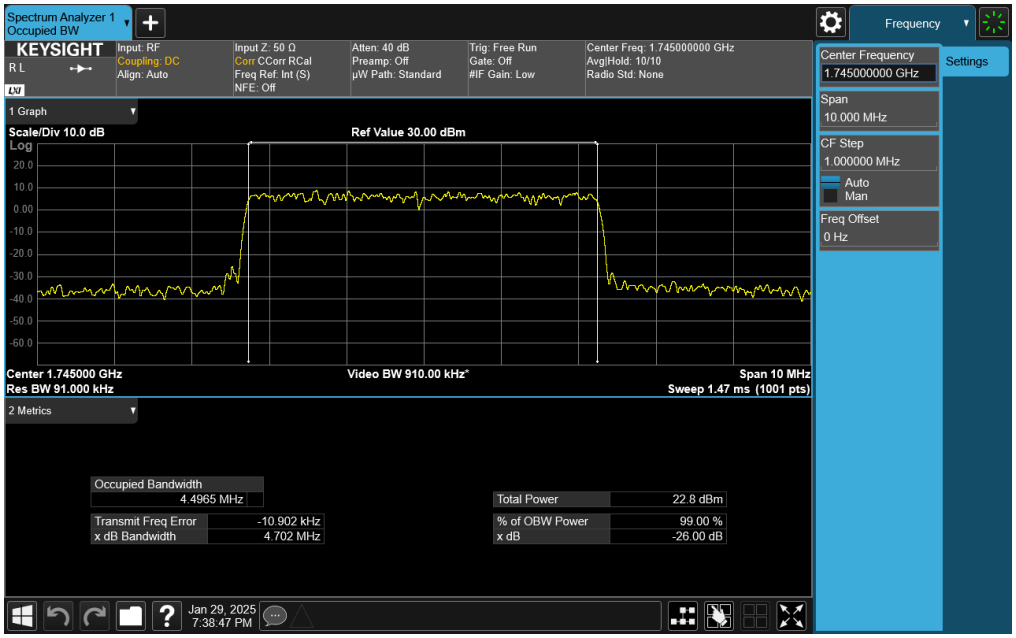
Plot 7-33. Occupied Bandwidth Plot (NR Band n66 - 5.0MHz DFT-s-OFDM π/2 BPSK - Full RB)



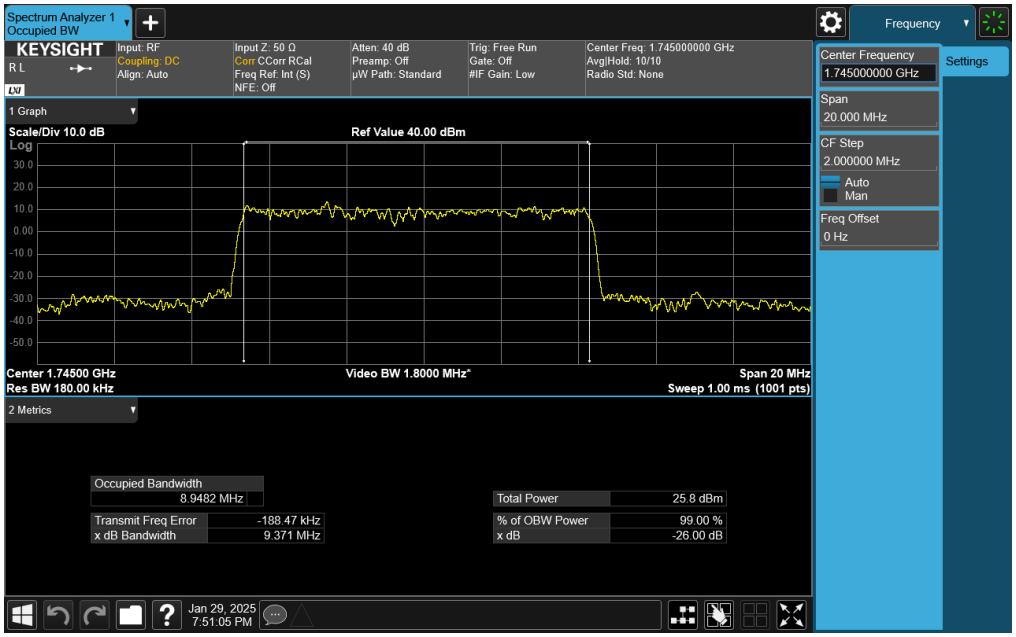
Plot 7-34. Occupied Bandwidth Plot (NR Band n66 - 5.0MHz CP-OFDM QPSK - Full RB)



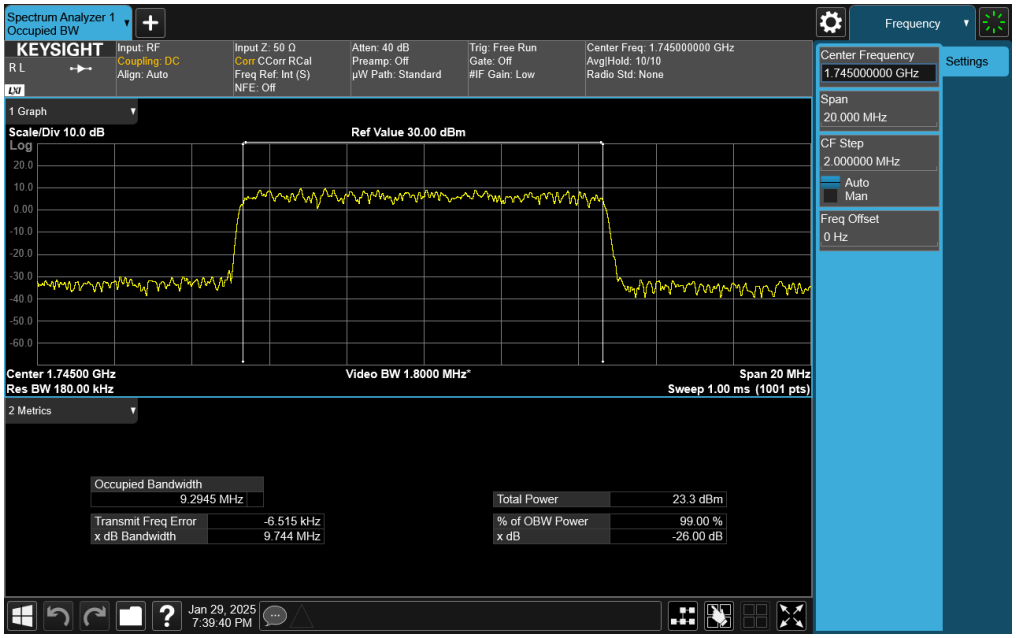
Plot 7-35. Occupied Bandwidth Plot (NR Band n66 - 5.0MHz CP-OFDM 16QAM - Full RB)



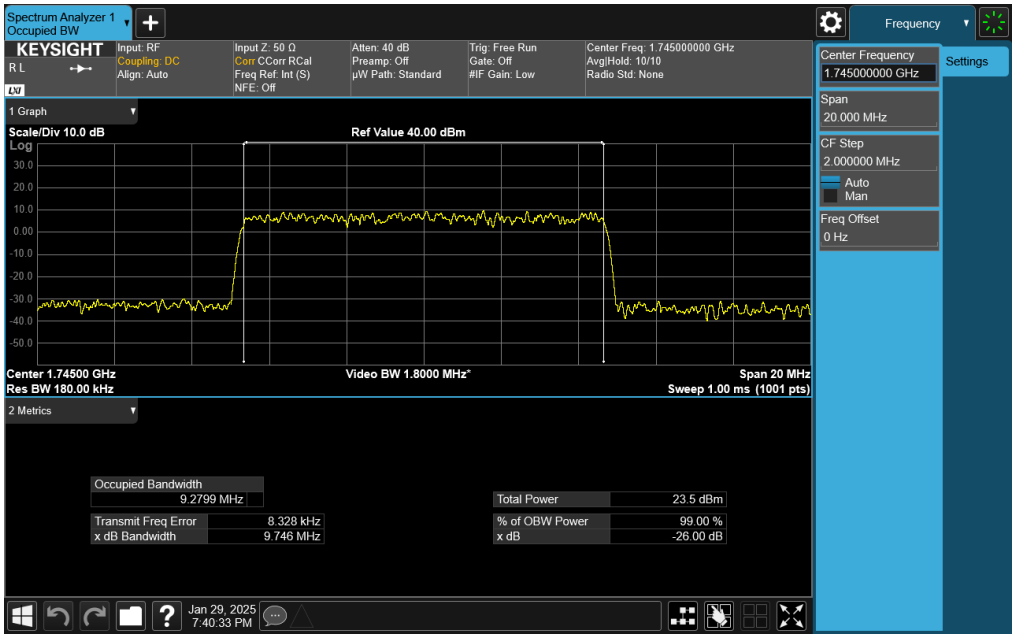
Plot 7-36. Occupied Bandwidth Plot (NR Band n66 - 5.0MHz CP-OFDM 64QAM - Full RB)



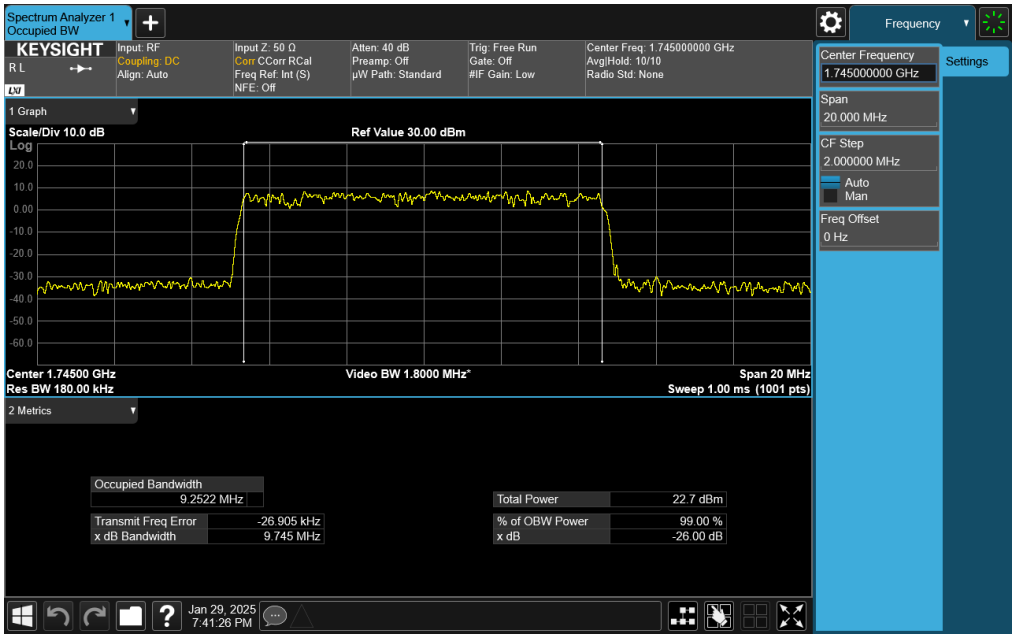
Plot 7-37. Occupied Bandwidth Plot (NR Band n66 - 10.0MHz DFT-s-OFDM π/2 BPSK - Full RB)



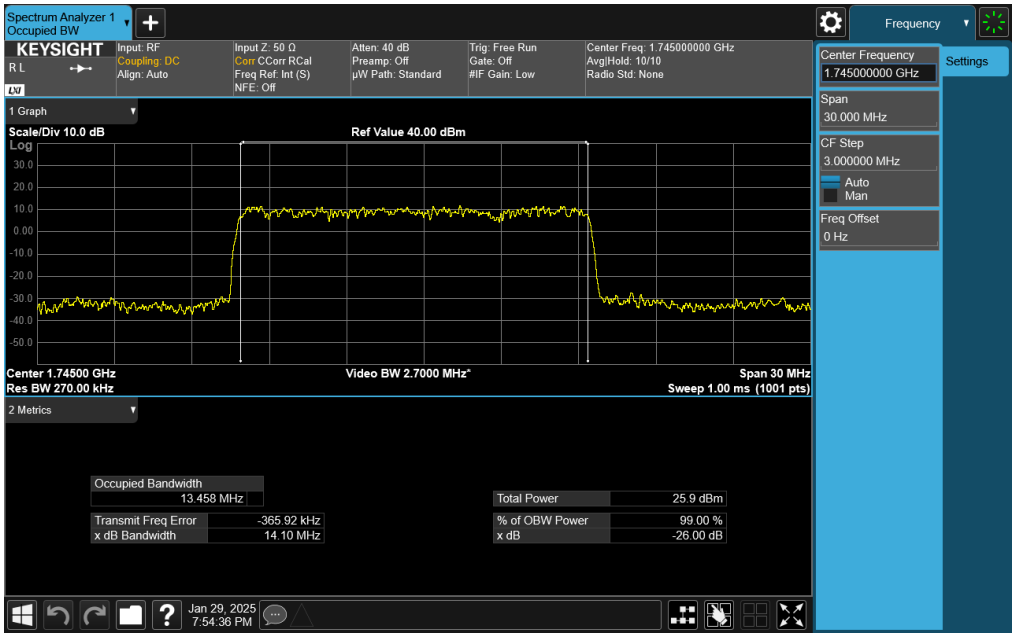
Plot 7-38. Occupied Bandwidth Plot (NR Band n66 - 10.0MHz CP-OFDM QPSK - Full RB)



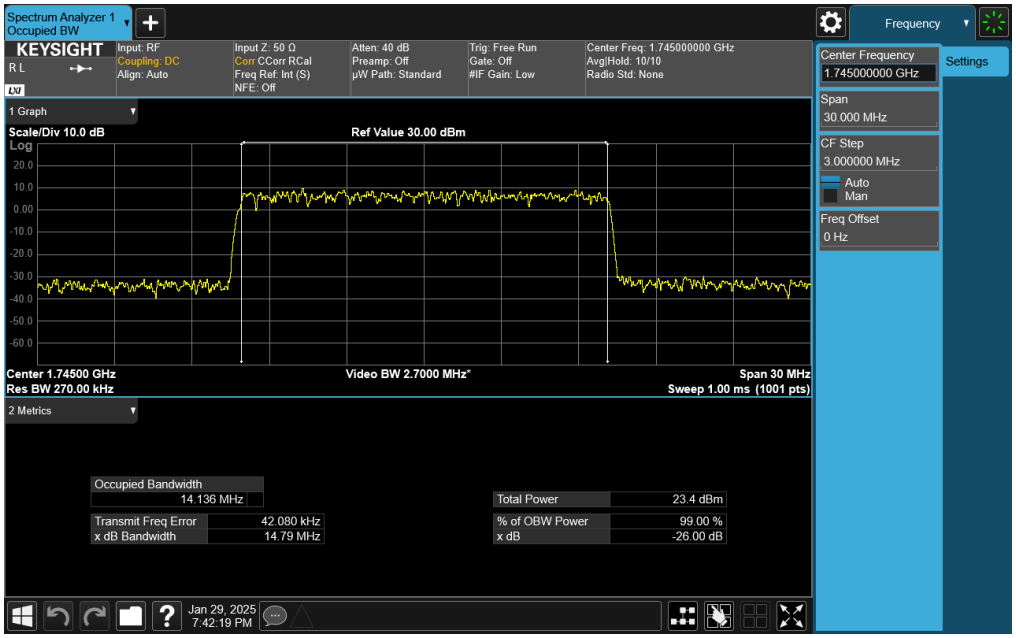
Plot 7-39. Occupied Bandwidth Plot (NR Band n66 - 10.0MHz CP-OFDM 16QAM - Full RB)



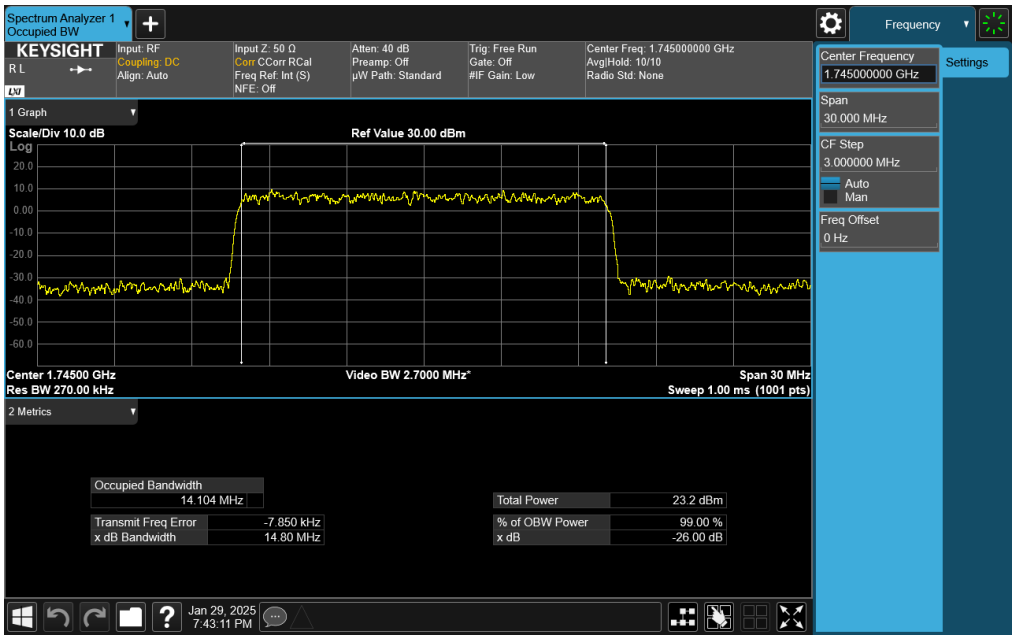
Plot 7-40. Occupied Bandwidth Plot (NR Band n66 - 10.0MHz CP-OFDM 64QAM - Full RB)



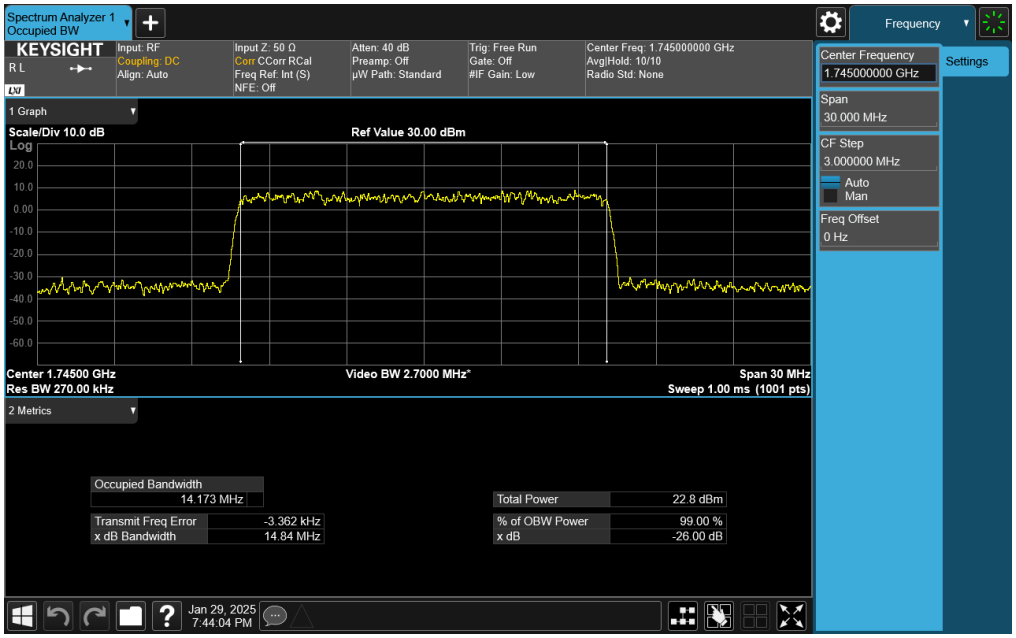
Plot 7-41. Occupied Bandwidth Plot (NR Band n66 - 15.0MHz DFT-s-OFDM π/2 BPSK - Full RB)



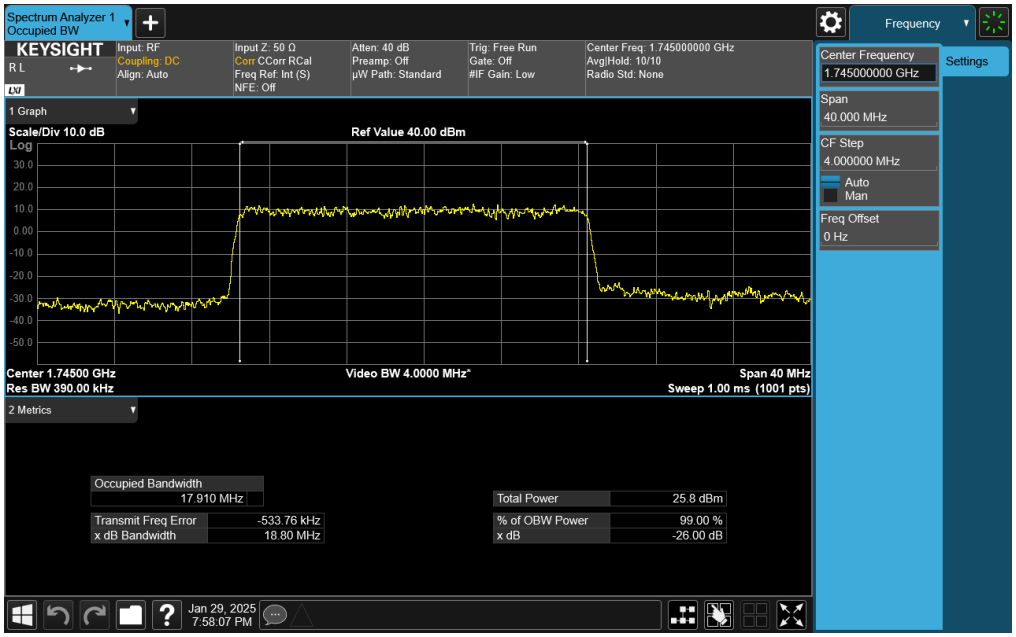
Plot 7-42. Occupied Bandwidth Plot (NR Band n66 - 15.0MHz CP-OFDM QPSK - Full RB)



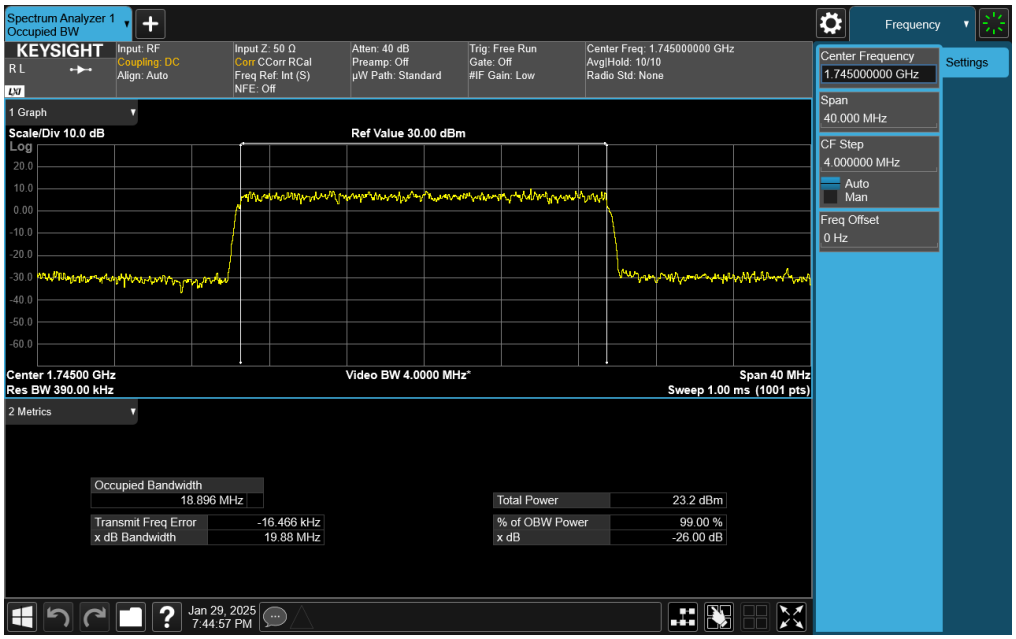
Plot 7-43. Occupied Bandwidth Plot (NR Band n66 - 15.0MHz CP-OFDM 16QAM - Full RB)



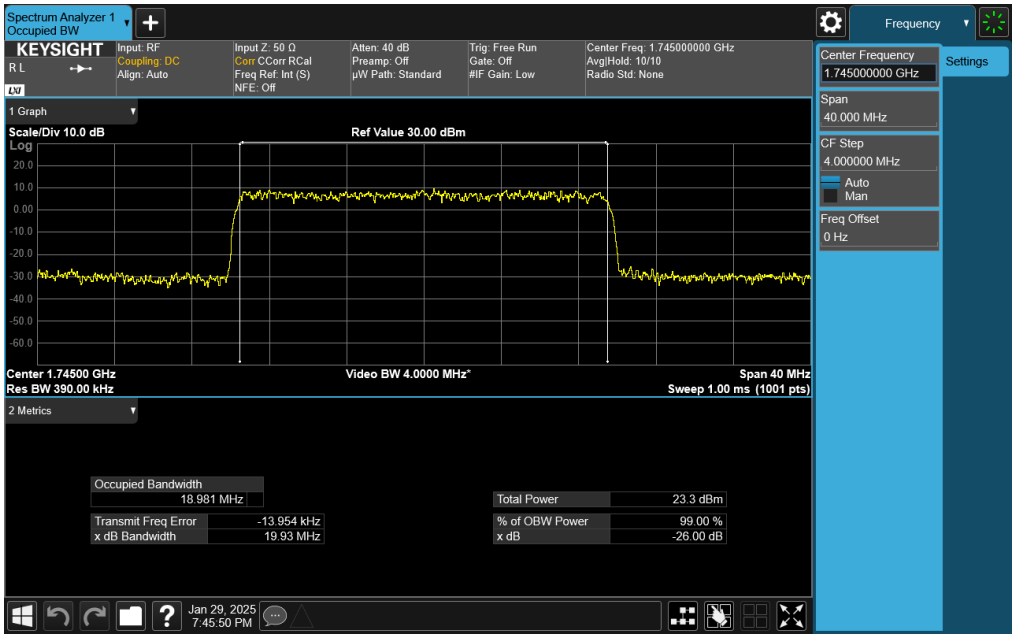
Plot 7-44. Occupied Bandwidth Plot (NR Band n66 - 15.0MHz CP-OFDM 64QAM - Full RB)



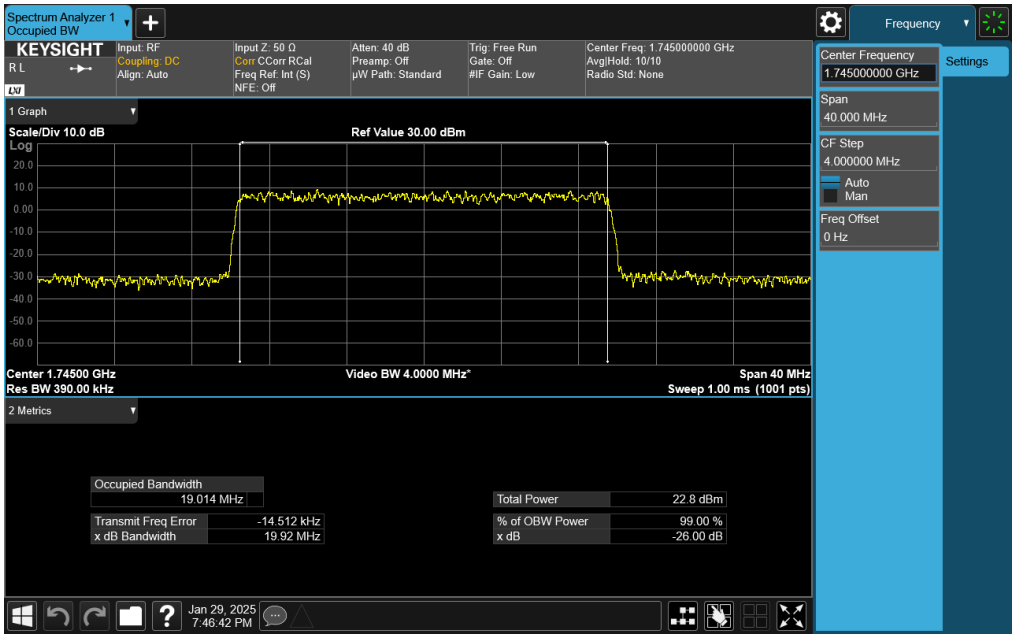
Plot 7-45. Occupied Bandwidth Plot (NR Band n66 - 20.0MHz DFT-s-OFDM π/2 BPSK - Full RB)



Plot 7-46. Occupied Bandwidth Plot (NR Band n66 - 20.0MHz CP-OFDM QPSK - Full RB)

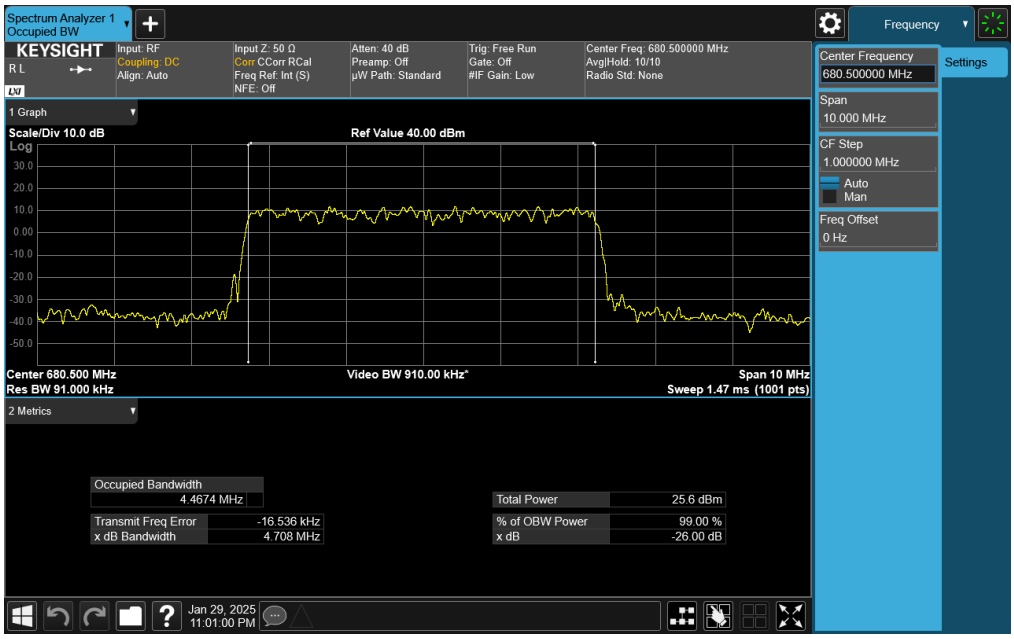


Plot 7-47. Occupied Bandwidth Plot (NR Band n66 - 20.0MHz CP-OFDM 16QAM - Full RB)

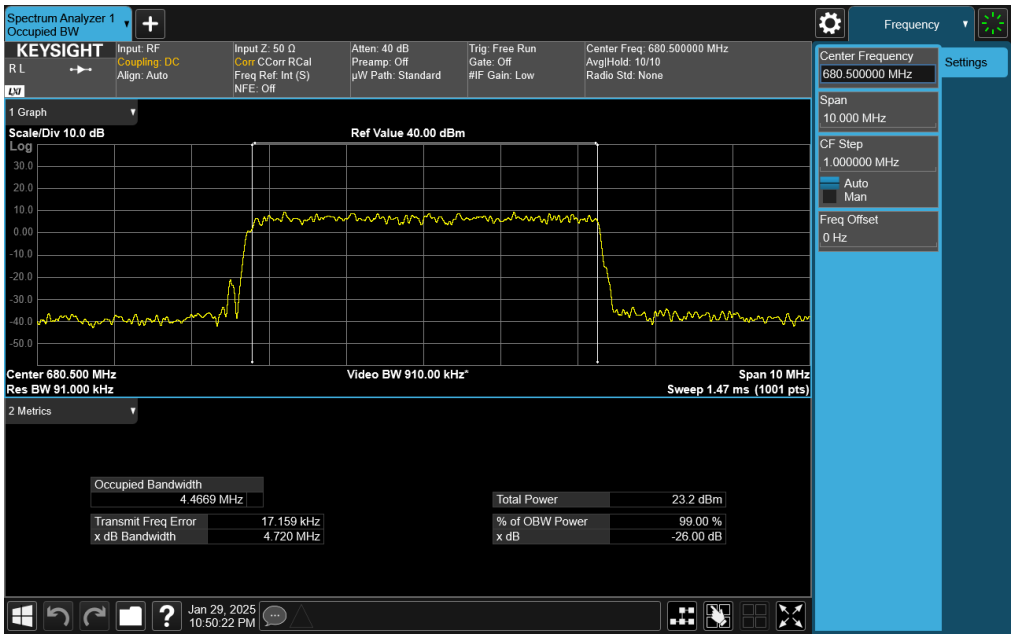


Plot 7-48. Occupied Bandwidth Plot (NR Band n66 - 20.0MHz CP-OFDM 64QAM - Full RB)

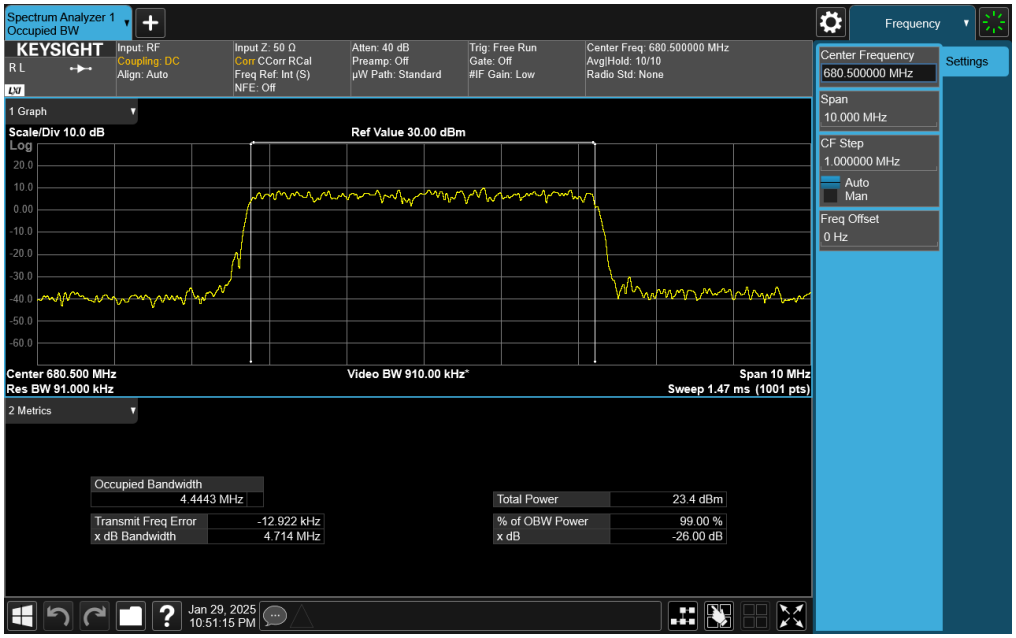
NR Band n71



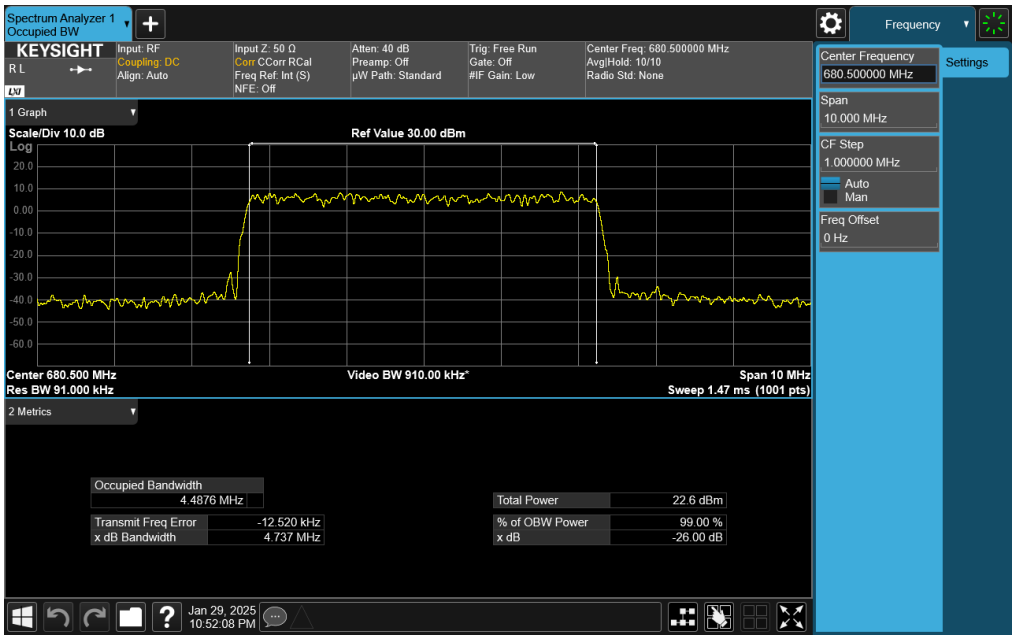
Plot 7-49. Occupied Bandwidth Plot (NR Band n71 - 5MHz DFT-s-OFDM π/2 BPSK - Full RB)



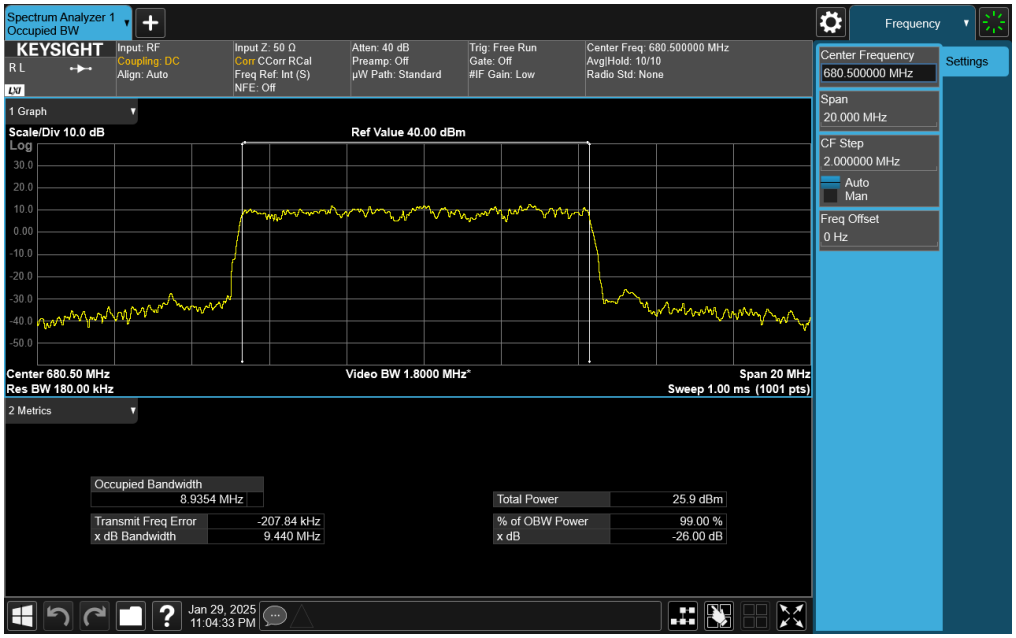
Plot 7-50. Occupied Bandwidth Plot (NR Band n71 - 5MHz CP-OFDM QPSK - Full RB)



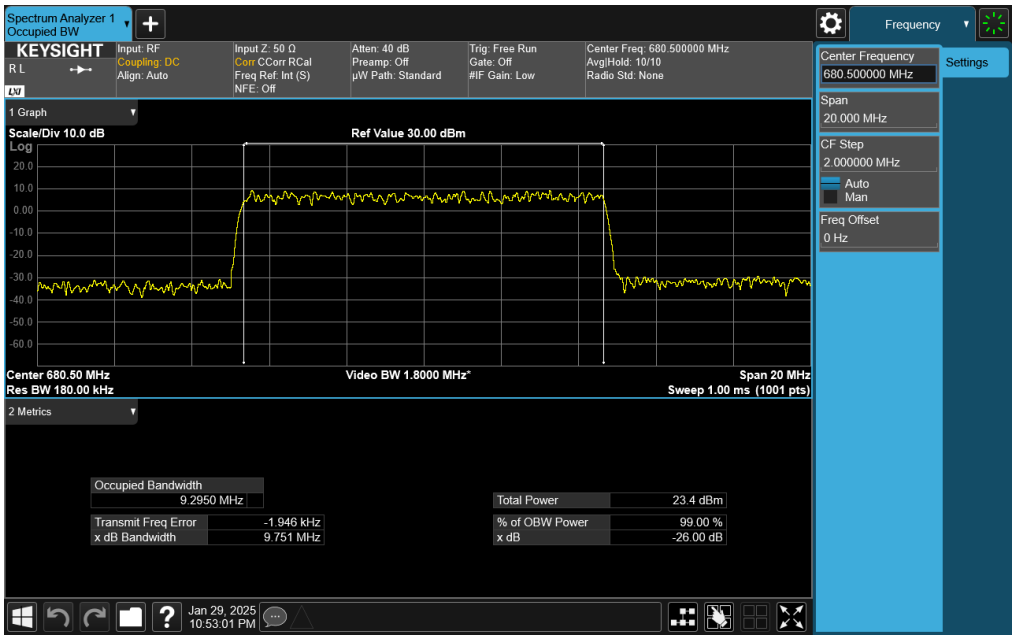
Plot 7-51. Occupied Bandwidth Plot (NR Band n71 - 5MHz CP-OFDM 16-QAM - Full RB)



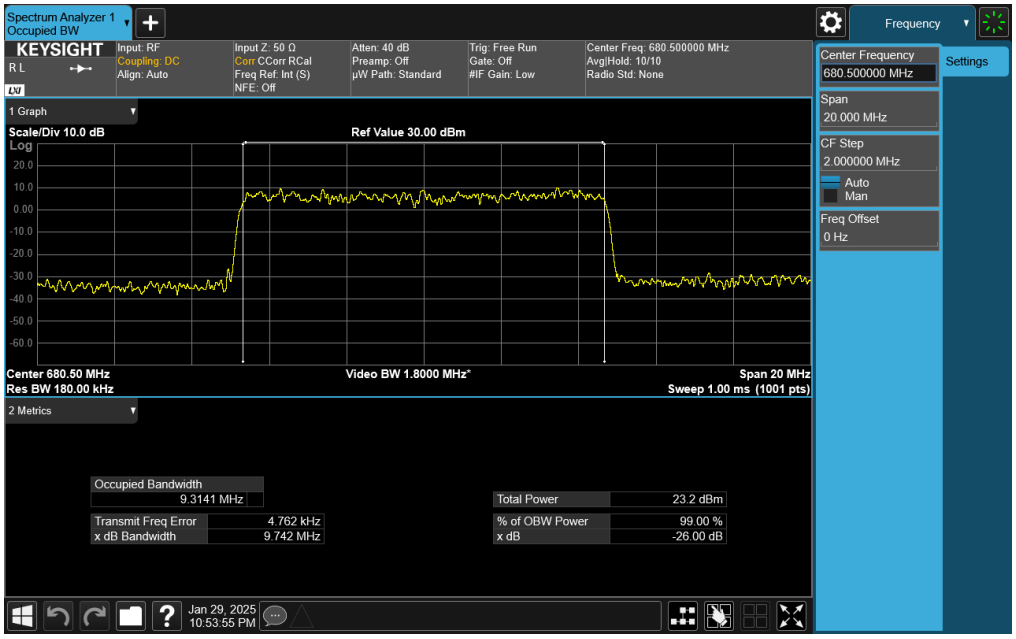
Plot 7-52. Occupied Bandwidth Plot (NR Band n71 - 5MHz CP-OFDM 64-QAM - Full RB)



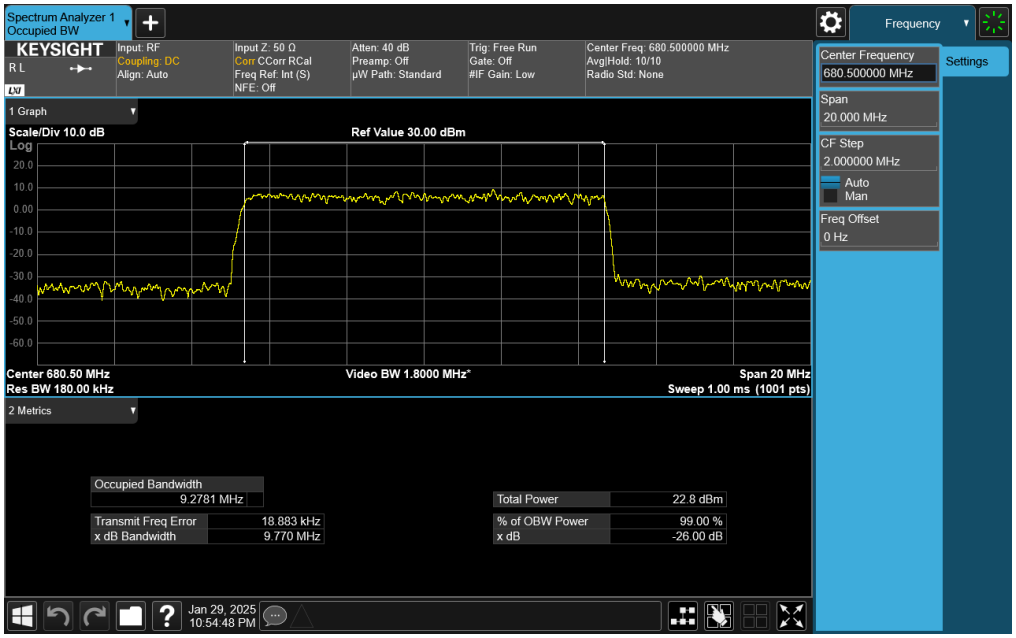
Plot 7-53. Occupied Bandwidth Plot (NR Band n71 - 10MHz DFT-s-OFDM π/2 BPSK - Full RB)



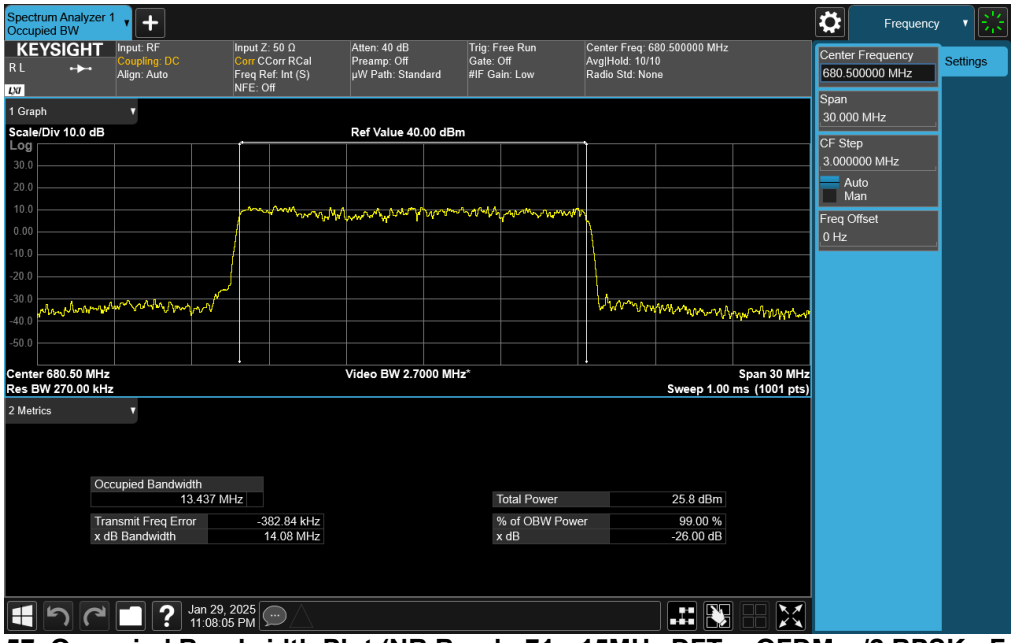
Plot 7-54. Occupied Bandwidth Plot (NR Band n71 - 10MHz CP-OFDM QPSK - Full RB)



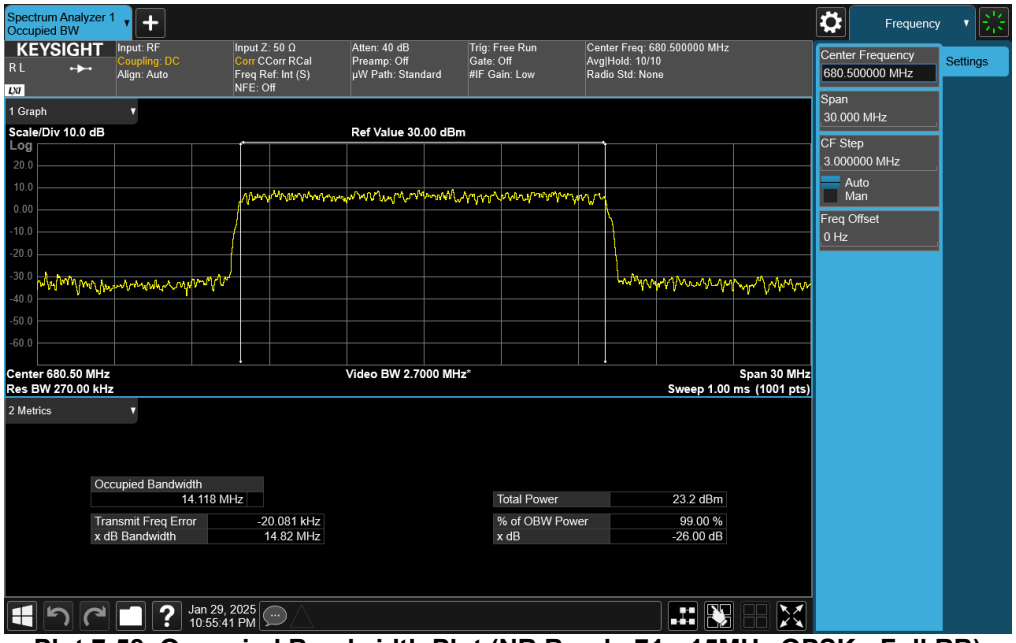
Plot 7-55. Occupied Bandwidth Plot (NR Band n71 - 10MHz CP-OFDM 16-QAM - Full RB)



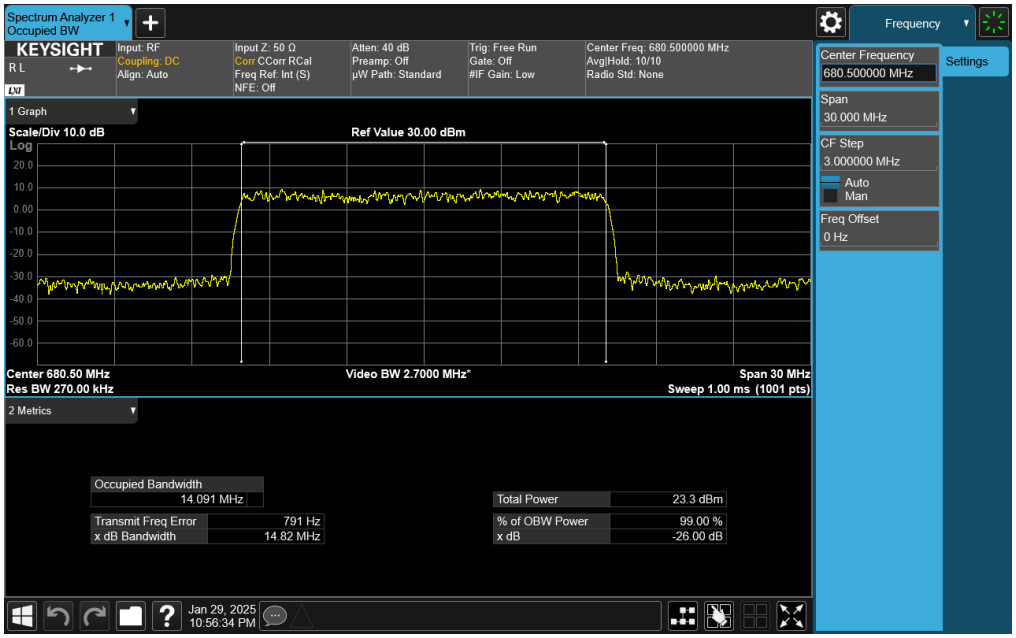
Plot 7-56. Occupied Bandwidth Plot (NR Band n71 - 10MHz CP-OFDM 64-QAM - Full RB)



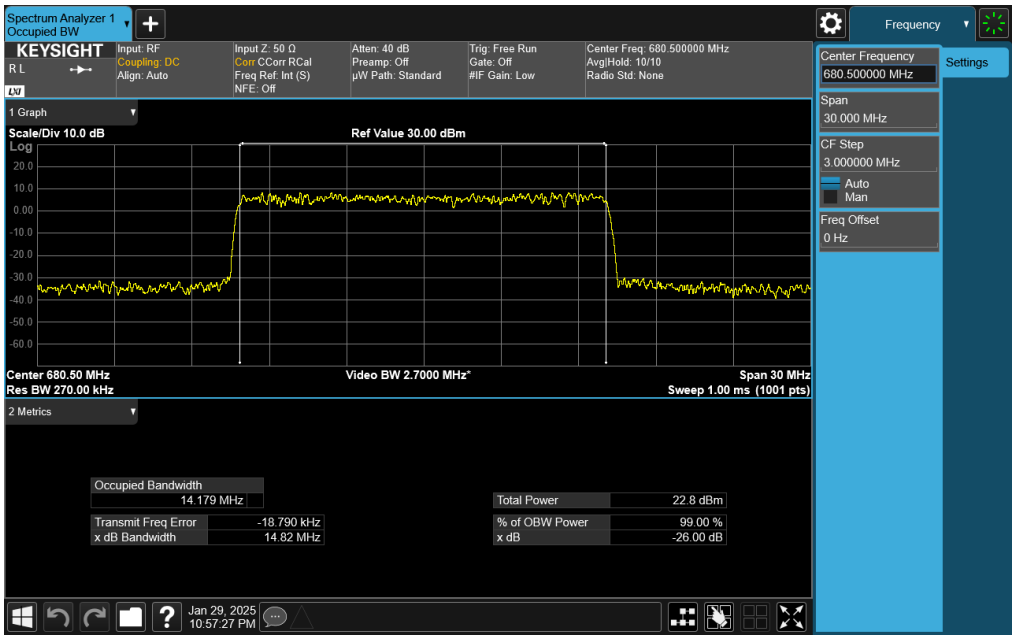
Plot 7-57. Occupied Bandwidth Plot (NR Band n71 - 15MHz DFT-s-OFDM π/2 BPSK - Full RB)



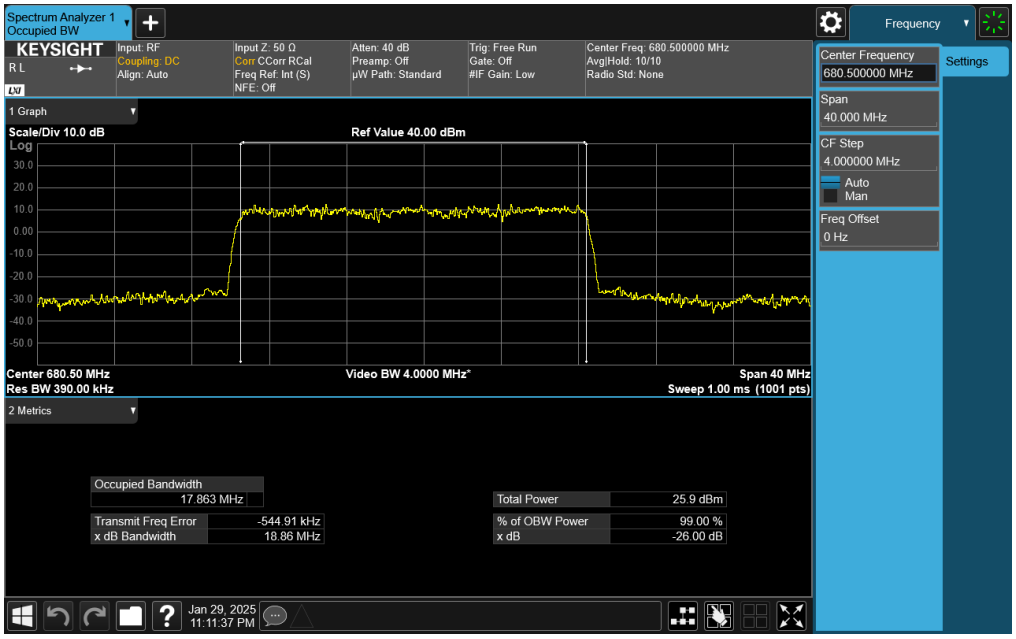
Plot 7-58. Occupied Bandwidth Plot (NR Band n71 - 15MHz QPSK - Full RB)



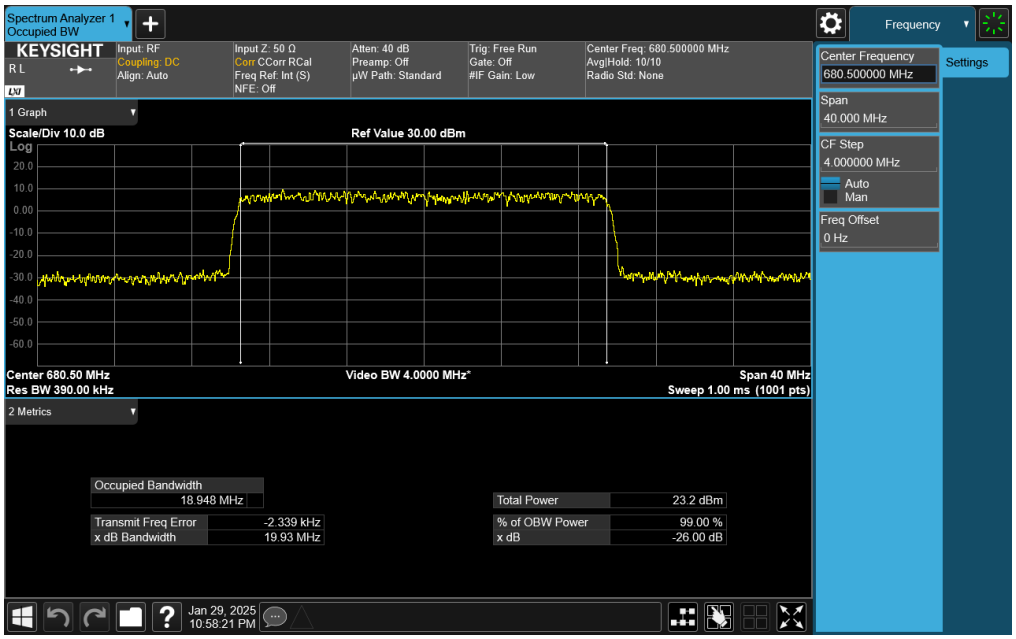
Plot 7-59. Occupied Bandwidth Plot (NR Band n71 - 15MHz CP-OFDM 16-QAM - Full RB)



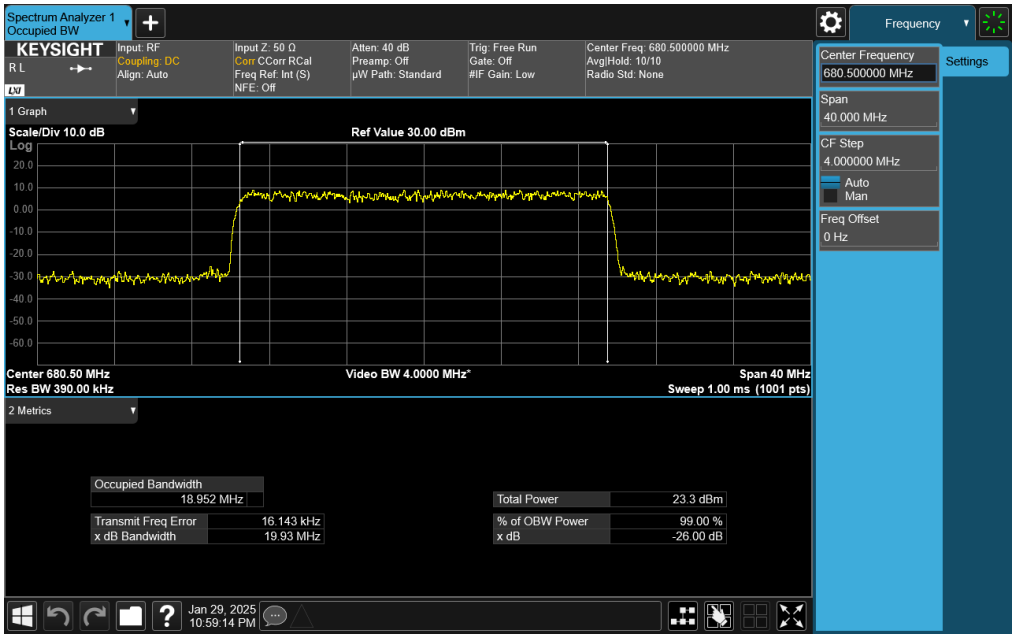
Plot 7-60. Occupied Bandwidth Plot (NR Band n71 - 15MHz CP-OFDM 64-QAM - Full RB)



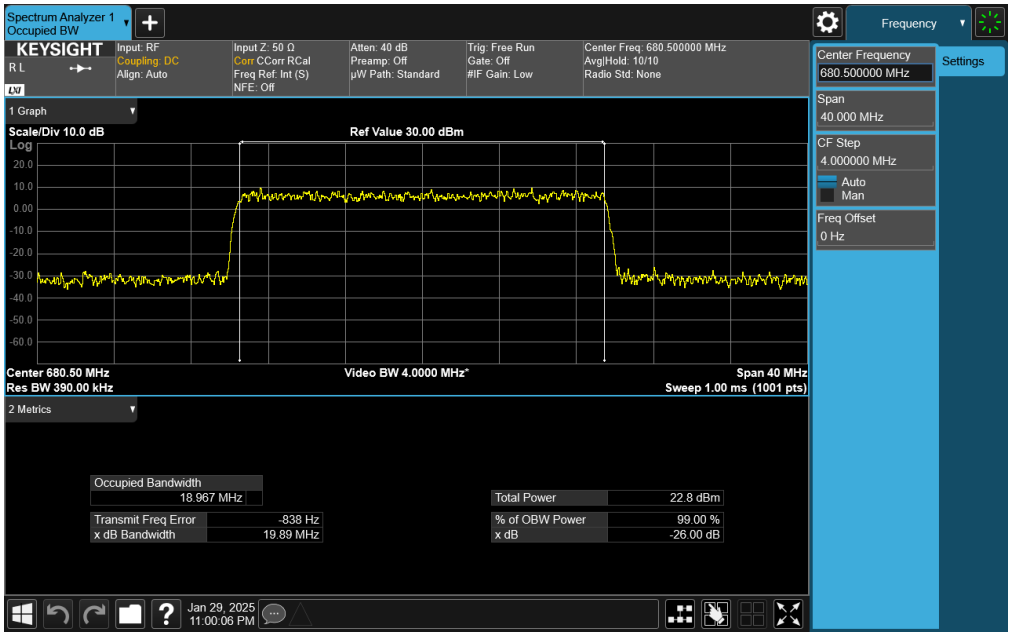
Plot 7-61. Occupied Bandwidth Plot (NR Band n71 - 20MHz DFT-s-OFDM π/2 BPSK - Full RB)



Plot 7-62. Occupied Bandwidth Plot (NR Band n71 - 20MHz CP-OFDM QPSK - Full RB)



Plot 7-63. Occupied Bandwidth Plot (NR Band n71 - 20MHz CP-OFDM 16-QAM - Full RB)



Plot 7-64. Occupied Bandwidth Plot (NR Band n71 - 20MHz CP-OFDM 64-QAM - Full RB)