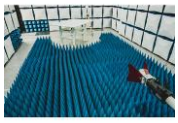
PCTEST
18855 Adams Court, Morgan Hill, CA 95037 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



DATA REFERENCE REPORT
PART 24

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

Date of Testing:
12/15/2020 - 02/20/2021
Test Site/Location:
PCTEST Lab. Morgan Hill, CA, USA
Test Report Serial No.:
1C2101020006-04-R1.BCG

FCC ID:	**BCGA2461**
Applicant Name:	**Apple Inc.**

Reference Model:	A2379
Variant Model:	A2461, A2462
EUT Type:	Tablet Device
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part:	24
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.

This revised Test Report (S/N: 1C2101020006-04-R1.BCG Report SNs) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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

Randy Ortanez
President

ACCREDITED
CERT #2041.02

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1.0 INTRODUCTION

1.1 Scope

Per manufacturer declaration, there are two tablet device models, A2379 and A2461(A2462), with high degree of similarity, reference model FCC ID: BCGA2379 and variant model **FCC ID: BCGA2461**. The reference model supports mmWave operations, while the variant model has the mmWave components/antennas removed. Both models share the same material, form factor, circuit design, and components, including antennas and their locations. The reference and variant models use the same power tables and have same tune-up tolerances.

Per FCC approved Data Referencing Test Plan, testing was done fully on the reference model FCC ID: BCGA2379, while radiated spot-check verification has been performed on variant model **FCC ID: BCGA2461**. Additionally, due to Antenna 4a location being close to the depopulated mmWave components, full radiated testing has been done for all supported technologies on Antenna 4a. Spot-check measurements were conducted, all measurements were investigated and found to be within acceptable tolerance.

Equipment Class	Reference Model FCC ID	Reference Report	Report Title
PCE	BCGA2379	1C2101020005-03-R1.BCG	RF Part 24 Test Report

Table 1-1. Reference Model Details

Reference model FCC ID: BCGA2379 test report has been included in Appendix A

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

- 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:BCGA2461**. 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 24.

Test Device Serial No.: JP76RWY2XR, XW3JN32D9W

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 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	GSM / WCDMA	LTE / FR1 NR			UNII
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	Mid Band	Mid Band	High Band	Ultra High Band	802.11 a/n/ac/ax
2a	Config 1	✓	×	×	×	×	✓	×
2a	Config 2	×	✓	×	×	×	✓	×
4a	Config 3	✓	×	×	×	×	✓	×
4a	Config 4	×	✓	×	×	×	✓	×
4b	Config 5	×	×	✓	×	×	×	✓
4b	Config 6	×	×	×	✓	×	×	✓
4b	Config 7	×	×	×	×	✓	×	✓

Table 2-1. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

2.3 Antenna Description

Following antenna gains provided by manufacturer were used for the testing.

Band	Antenna Gain (dBi)			
	Antenna 3	Antenna 1	Antenna 4b	Antenna 2b
GPRS1900	-0.1	1.5	-1.9	-0.5
EDGE1900				
WCDMA1900				
LTE Band 2/25				
NR Band n2/n25				

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	USB-C Cable	Model:	A146	S/N:	N/A
	w/ AC Adapter	Model:	A2305	S/N:	N/A
4	Apple Pencil	Model:	N/A	S/N:	GQXYGSXBJKM9
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 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 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.

Per FCC Approved Data Referencing Test Plan, spot-check measurements have been conducted and reported. Spot-check Test Plan can be referred to below Table 2-4.

Technology	Test Case	FCC ID: BCGA2461	
		Mode	Channel
GSM, WCDMA, LTE, FR1 Single Carrier & IntraBand ULCA	Radiated Spurious Emissions	Antenna 3 LTE Band 5, 2, 7 Max BW, 1RB, QPSK	M

Table 2-4. FCC Approved Spot-Check Test Plan

Output powers were measured and confirmed to be consistent between Reference and Variant models prior to testing.

2.6 Software and Firmware

The test was conducted with firmware version 18E20700y 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.

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

$$EIRP_{[dBm]} = E_{[dB\mu V/m]} + 20\log D - 104.8;$$

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)
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	3/4/2020	Annual	3/4/2021	MY49430244
Keysight Technology	N9040B	UXA Signal Analyzer	12/19/2020	Annual	12/19/2021	MY57212015
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	8/11/2020	Annual	8/11/2021	T058701-01
ESPEC	SU-241	Tabletop Temperature Chamber	9/28/2020	Annual	9/28/2021	92009574
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	9/15/2020	Annual	9/15/2021	208204
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	4/21/2020	Annual	4/21/2021	205956
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	7/15/2020	Annual	7/15/2021	102356
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	12/3/2020	Annual	12/3/2021	101648
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	3/2/2020	Annual	3/2/2021	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	6/8/2020	Annual	6/8/2021	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	8/6/2020	Annual	8/6/2021	101668
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/13/2020	Annual	10/13/2021	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	9/24/2020	Annual	9/24/2021	151888
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/23/2020	Annual	4/23/2021	100052
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	10/2/2020	Annual	10/2/2021	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/12/2020	Annual	3/12/2021	100546

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.

6.0 SAMPLE CALCULATIONS

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 (SPOT-CHECK DATA)

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCGA2461

FCC Classification: PCS Licensed Transmitter (PCB)

Mode(s): GSM/GPRS/EDGE/WCDMA/LTE/NR

Technology	Test Configurations					Reference Model	Variant Model	Delta
	Test Description	Modulation	BW / RB Config	Channel	Measurement Frequency [MHz]	FCC ID: BCGA2379	FCC ID: BCGA2461	
						Average [dBm]	Average [dBm]	Average [dB]
LTE Band 2	Radiated Spurious Emissions	QPSK	20MHz / 1/50 RB	M	5647.5	-48.53	-47.91	0.62

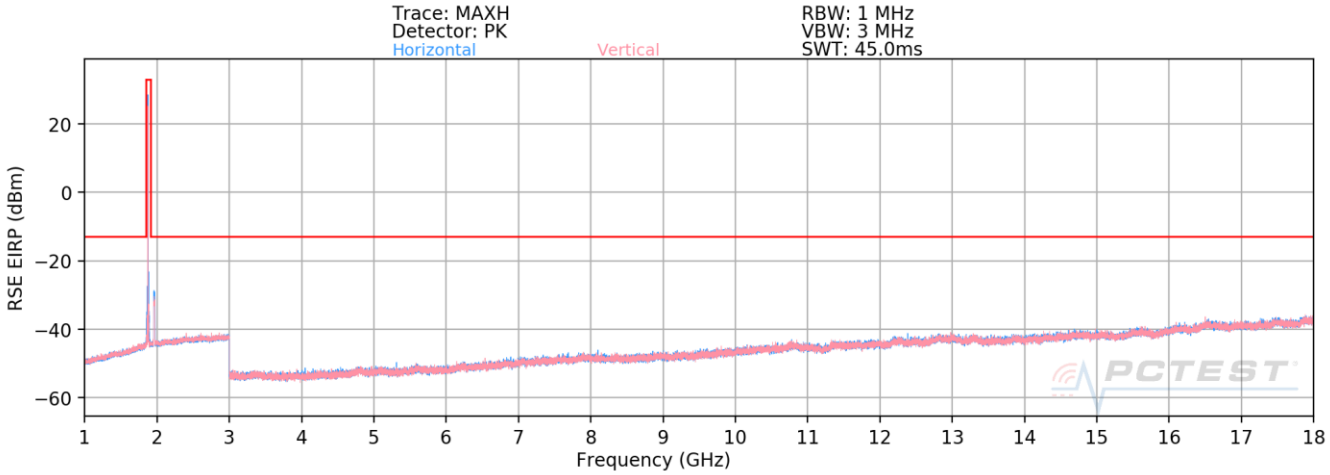
Table 7-1. Worst Case Spot-Check Results

Spot-checks were conducted, all measurements were investigated and found to be within acceptable tolerance in accordance with FCC Approved Data Referencing Test Plan.

7.2 Radiated Spurious Emissions

§2.1053, 24.238(a)

LTE Band 2



Plot 7-1. Radiated Spurious Emission above 1GHz (LTE Band 2)

Bandwidth (MHz):	20
Frequency (MHz):	1882.5
RB / Offset:	1 / 50

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3765.0	V	-	-	-75.69	7.01	38.32	-56.94	-13.00	-43.94
5647.5	V	143	150	-69.41	9.75	47.34	-47.91	-13.00	-34.91
7530.0	V	-	-	-76.33	10.81	41.48	-53.78	-13.00	-40.78
9412.5	V	-	-	-76.64	12.97	43.33	-51.93	-13.00	-38.93

Table 7-2. Radiated Spurious Data (LTE Band 2 – Mid Channel)

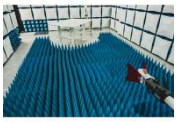
8.0 CONCLUSION

The spot-check data measured for variant model **FCC ID: BCGA2461** is in tolerance with reference model FCC ID: BCGA2379 per FCC Approved Data Referencing Test Plan.

9.0 APPENDIX A: REFERENCE MODEL TEST REPORT

Attached is the test report (1C2101020005-03-R1.BCG) from reference model FCC ID: BCGA2379, which includes referenced data results.

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



PART 24 MEASUREMENT REPORT

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

Date of Testing:
12/15/2020 - 02/20/2021
Test Site/Location:
PCTEST Lab. Morgan Hill, CA, USA
Test Report Serial No.:
1C2101020005-03-R1.BCG

FCC ID:	**BCGA2379**
Applicant Name:	**Apple Inc.**

Application Type:	Certification
Model:	A2379
EUT Type:	Tablet Device
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part:	24
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.

This revised Test Report (S/N: 1C2101020005-03-R1.BCG Report SNs) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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

Randy Ortanez
President

ACCREDITED
CERT #2041.02

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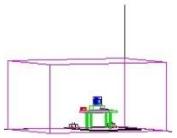
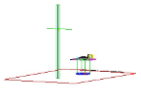


PART 24 MEASUREMENT REPORT



Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	OBW [MHz]	PAR at 0.1% [dB]	EIRP		Emission Designator
						Max. Power [W]	Max. Power [dBm]	
GSM/GPRS 1900	250 kHz	GMSK	1850.2 - 1909.8	0.2426	0.32	1.230	30.90	243KGXW
EDGE 1900		8-PSK	1850.2 - 1909.8	0.2404	5.46	0.371	25.69	240KG7W
WCDMA 1900	5 MHz	Spread Spectrum	1852.4 - 1907.6	4.1647	2.83	0.348	25.41	4M16F9W
LTE Band 2	20 MHz	QPSK	1860 - 1900	18.0331	5.31	0.363	25.60	18M0G7W
		16QAM	1861 - 1900	18.0504	6.09	0.325	25.12	18M1D7W
		64QAM	1862 - 1900	18.0030	6.67	0.277	24.42	18M0D7W
		256QAM	1863 - 1900	18.0124	6.68	0.137	21.36	18M0D7W
	15 MHz	QPSK	1857.5 - 1902.5	13.5051	5.56	0.363	25.60	13M5G7W
		16QAM	1857.5 - 1902.5	13.5353	6.25	0.304	24.83	13M5D7W
		64QAM	1857.5 - 1902.5	13.5164	6.73	0.259	24.13	13M5D7W
		256QAM	1857.5 - 1902.5	13.4912	6.73	0.148	21.70	13M5D7W
	10MHz	QPSK	1855 - 1905	9.0179	5.29	0.363	25.60	9M02G7W
		16QAM	1856 - 1905	9.0276	6.08	0.324	25.10	9M03D7W
		64QAM	1857 - 1905	8.9968	6.70	0.274	24.37	9M00D7W
		256QAM	1858 - 1905	8.9952	6.76	0.150	21.75	9M00D7W
	5 MHz	QPSK	1858 - 1905	4.5397	5.27	0.363	25.60	4M54G7W
		16QAM	1858 - 1905	4.5239	6.21	0.326	25.13	4M52D7W
		64QAM	1858 - 1905	4.5369	6.77	0.279	24.45	4M54D7W
		256QAM	1858 - 1905	4.5346	6.71	0.136	21.34	4M53D7W
	3 MHz	QPSK	1851.5 - 1908.5	2.7173	5.26	0.363	25.60	2M72G7W
		16QAM	1851.5 - 1908.5	2.7118	6.12	0.311	24.93	2M71D7W
		64QAM	1851.5 - 1908.5	2.7126	6.74	0.266	24.25	2M71D7W
		256QAM	1851.5 - 1908.5	2.7088	6.86	0.145	21.62	2M71D7W
	1.4 MHz	QPSK	1850.7 - 1909.3	1.0877	5.44	0.363	25.60	1M09G7W
		16QAM	1850.7 - 1909.3	1.0959	6.21	0.313	24.95	1M10D7W
		64QAM	1850.7 - 1909.3	1.0927	6.82	0.264	24.22	1M09D7W
		256QAM	1850.7 - 1909.3	1.0964	6.93	0.132	21.20	1M10D7W
LTE Band 25	20 MHz	QPSK	1860 - 1905	18.0331	5.29	0.363	25.60	18M0G7W
		16QAM	1860 - 1905	18.0504	6.08	0.337	25.27	18M1D7W
		64QAM	1860 - 1905	18.0030	6.66	0.283	24.52	18M0D7W
		256QAM	1860 - 1905	18.0124	6.65	0.122	20.86	18M0D7W
	15 MHz	QPSK	1857.5 - 1907.5	13.5051	5.52	0.363	25.60	13M5G7W
		16QAM	1857.5 - 1907.5	13.5353	6.21	0.303	24.82	13M5D7W
		64QAM	1857.5 - 1907.5	13.5164	6.65	0.260	24.15	13M5D7W
		256QAM	1857.5 - 1907.5	13.4912	6.71	0.133	21.24	13M5D7W
	10 MHz	QPSK	1855 - 1910	9.0179	5.31	0.363	25.60	9M02G7W
		16QAM	1855 - 1910	9.0276	6.03	0.315	24.98	9M03D7W
		64QAM	1855 - 1910	8.9968	6.59	0.251	23.99	9M00D7W
		256QAM	1855 - 1910	8.9952	6.70	0.134	21.26	9M00D7W
	5 MHz	QPSK	1852.5 - 1912.5	4.5397	5.24	0.363	25.60	4M54G7W
		16QAM	1852.5 - 1912.5	4.5239	6.18	0.327	25.14	4M52D7W
		64QAM	1852.5 - 1912.5	4.5369	6.71	0.257	24.10	4M54D7W
		256QAM	1852.5 - 1912.5	4.5346	6.66	0.123	20.89	4M53D7W
	3 MHz	QPSK	1851.5 - 1913.5	2.7173	5.29	0.363	25.60	2M72G7W
		16QAM	1851.5 - 1913.5	2.7118	6.20	0.321	25.07	2M71D7W
		64QAM	1851.5 - 1913.5	2.7126	6.62	0.242	23.84	2M71D7W
		256QAM	1851.5 - 1913.5	2.7088	6.78	0.133	21.25	2M71D7W
	1.4 MHz	QPSK	1850.7 - 1914.3	1.0877	5.46	0.363	25.60	1M09G7W
		16QAM	1850.7 - 1914.3	1.0959	6.27	0.317	25.01	1M10D7W
		64QAM	1850.7 - 1914.3	1.0927	6.65	0.240	23.81	1M09D7W
		256QAM	1850.7 - 1914.3	1.0964	6.69	0.119	20.74	1M10D7W
NR Band n2	20 MHz	π/2 BPSK	1860 - 1900	17.9480	3.85	0.363	25.60	17M9G7W
		QPSK	1860 - 1900	19.0390	5.22	0.349	25.43	19M0G7W
		16QAM	1860 - 1900	19.0050	6.09	0.248	23.94	19M0D7W
		64QAM	1860 - 1900	19.0660	6.48	0.198	22.96	19M1D7W
		256QAM	1860 - 1900	18.9720	6.71	0.120	20.78	19M0D7W
	15 MHz	π/2 BPSK	1857.5 - 1902.5	13.4880	3.95	0.343	25.35	13M5G7W
		QPSK	1857.5 - 1902.5	14.1990	5.28	0.363	25.60	14M2G7W
		16QAM	1857.5 - 1902.5	14.1760	6.17	0.275	24.39	14M2D7W
		64QAM	1857.5 - 1902.5	14.2240	6.60	0.186	22.69	14M2D7W
		256QAM	1857.5 - 1902.5	14.1670	6.62	0.128	21.07	14M2D7W
	10 MHz	π/2 BPSK	1855 - 1905	9.0150	4.03	0.349	25.43	9M02G7W
		QPSK	1855 - 1905	9.3370	5.47	0.341	25.33	9M34G7W
		16QAM	1855 - 1905	9.3339	6.20	0.254	24.05	9M33D7W
		64QAM	1855 - 1905	9.3515	6.43	0.196	22.93	9M35D7W
		256QAM	1855 - 1905	9.3143	6.86	0.120	20.80	9M31D7W
	5 MHz	π/2 BPSK	1852.5 - 1902.5	4.4869	3.85	0.363	25.60	4M49G7W
		QPSK	1852.5 - 1902.5	4.5055	5.15	0.332	25.21	4M51G7W
		16QAM	1852.5 - 1902.5	4.5104	6.14	0.252	24.02	4M51D7W
		64QAM	1852.5 - 1902.5	4.4990	6.47	0.194	22.89	4M50D7W
		256QAM	1852.5 - 1902.5	4.5150	6.55	0.129	21.12	4M52D7W
NR Band n25	20 MHz	π/2 BPSK	1860 - 1905	17.9480	3.90	0.363	25.60	17M9G7W
		QPSK	1860 - 1905	19.0390	5.27	0.362	25.59	19M0G7W
		16QAM	1860 - 1905	19.0050	6.17	0.325	25.12	19M0D7W
		64QAM	1860 - 1905	19.0660	6.45	0.244	23.87	19M1D7W
		256QAM	1860 - 1905	18.9720	6.96	0.156	21.93	19M0D7W
	15 MHz	π/2 BPSK	1857.5 - 1907.5	13.4880	4.08	0.362	25.59	13M5G7W
		QPSK	1857.5 - 1907.5	14.1990	5.35	0.363	25.60	14M2G7W
		16QAM	1857.5 - 1907.5	14.1760	6.28	0.318	25.02	14M2D7W
		64QAM	1857.5 - 1907.5	14.2240	6.56	0.231	23.64	14M2D7W
		256QAM	1857.5 - 1907.5	14.1670	6.69	0.161	22.06	14M2D7W
	10 MHz	π/2 BPSK	1855 - 1910	9.0150	4.16	0.350	25.45	9M02G7W
		QPSK	1855 - 1910	9.3370	5.47	0.363	25.60	9M34G7W
		16QAM	1855 - 1910	9.3339	6.23	0.311	24.92	9M33D7W
		64QAM	1855 - 1910	9.3515	6.54	0.231	23.63	9M35D7W
		256QAM	1855 - 1910	9.3143	6.70	0.152	21.81	9M31D7W
	5 MHz	π/2 BPSK	1852.5 - 1912.5	4.4869	3.92	0.362	25.59	4M49G7W
		QPSK	1852.5 - 1912.5	4.5055	5.19	0.363	25.60	4M51G7W
		16QAM	1852.5 - 1912.5	4.5104	6.37	0.309	24.90	4M51D7W
		64QAM	1852.5 - 1912.5	4.4990	6.73	0.219	23.40	4M50D7W
		256QAM	1852.5 - 1912.5	4.5150	7.01	0.154	21.87	4M52D7W

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

- 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:BCGA2379**. 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 24.

Test Device Serial No.: H4MTX492NT, NN63X069PP

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1/FR2), 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	GSM / WCDMA	LTE / FR1 NR			UNII
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	Mid Band	Mid Band	High Band	Ultra High Band	802.11 a/n/ac/ax
2a	Config 1	✓	×	×	×	×	✓	×
2a	Config 2	×	✓	×	×	×	✓	×
4a	Config 3	✓	×	×	×	×	✓	×
4a	Config 4	×	✓	×	×	×	✓	×
4b	Config 5	×	×	✓	×	×	×	✓
4b	Config 6	×	×	×	✓	×	×	✓
4b	Config 7	×	×	×	×	✓	×	✓

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 7 and reported in UNII (OFDMA) and Part 27b test reports.

2.3 Antenna Description

Following antenna gains provided by manufacturer were used for the testing.

Band	Antenna Gain (dBi)			
	Antenna 3	Antenna 1	Antenna 4b	Antenna 2b
GPRS1900	-0.1	1.5	-1.9	-0.5
EDGE1900				
WCDMA1900				
LTE Band 2/25				
NR Band n2/n25				

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	USB-C Cable	Model:	A146	S/N:	N/A
	w/ AC Adapter	Model:	A2305	S/N:	N/A
4	Apple Pencil	Model:	N/A	S/N:	GQXYGSXBJKM9
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.

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.

2.6 Software and Firmware

The test was conducted with firmware version 18E20700y 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.

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

$$EIRP_{[dBm]} = E_{[dB\mu V/m]} + 20\log D - 104.8;$$

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 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	PXA Signal Analyzer (3Hz - 26.5 GHz)	7/24/2020	Annual	7/24/2021	MY55330128
Keysight Technology	N9040B	UXA Signal Analyzer	12/19/2020	Annual	12/19/2021	MY57212015
Keysight Technology	E7515B	UXM 5G Wireless Test Platform	11/14/2020	Annual	11/14/2021	MY60192562
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	8/11/2020	Annual	8/11/2021	T058701-01
ESPEC	SU-241	Tabletop Temperature Chamber	9/28/2020	Annual	9/28/2021	92009574
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	9/15/2020	Annual	9/15/2021	208204
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	4/21/2020	Annual	4/21/2021	205956
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	7/15/2020	Annual	7/15/2021	102356
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	12/3/2020	Annual	12/3/2021	101648
Rohde & Schwarz	ESW26	EMI Test Receiver	6/8/2020	Annual	6/8/2021	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	8/6/2020	Annual	8/6/2021	101668
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	10/13/2020	Annual	10/13/2021	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/16/2020	Annual	4/16/2021	166869
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	4/23/2020	Annual	4/23/2021	100052
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	10/2/2020	Annual	10/2/2021	101063
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/12/2020	Annual	3/12/2021	100546

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.

6.0 SAMPLE CALCULATIONS

GSM Emission Designator

Emission Designator = 250KGXW
GSM BW = 250 kHz
G = Phase Modulation
X = Cases not otherwise covered
W = Combination (Audio/Data)

EDGE Emission Designator

Emission Designator = 250KG7W
EDGE BW = 250 kHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination (Audio/Data)

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: BCGA2379

FCC Classification: PCS Licensed Transmitter (PCB)

Mode(s): GSM/GPRS/EDGE/WCDMA/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, 24.238(a)	> 43 + 10log$_{10}$(P[Watts]) at Band Edge and for all out-of-band emissions	PASS	Sections 7.3, 7.4
	Peak-Average Ratio	24.232(d)	< 13 dB	PASS	Section 7.5
	Transmitter Conducted Output Power	2.1046	N/A	N/A	See RF Exposure Report
	Frequency Stability	2.1055, 24.235	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	24.232(c)	< 2 Watts max. EIRP	PASS	Section 7.6
RADIATED	Radiated Spurious Emissions	2.1053, 24.238(a)	> 43 + 10 log$_{10}$ (P[Watts]) for all out-of-band emissions	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 are PCTEST 2G/3G Automation Version 4.5 and LTE Automation Version 5.3.

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.

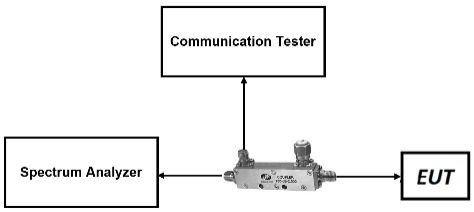
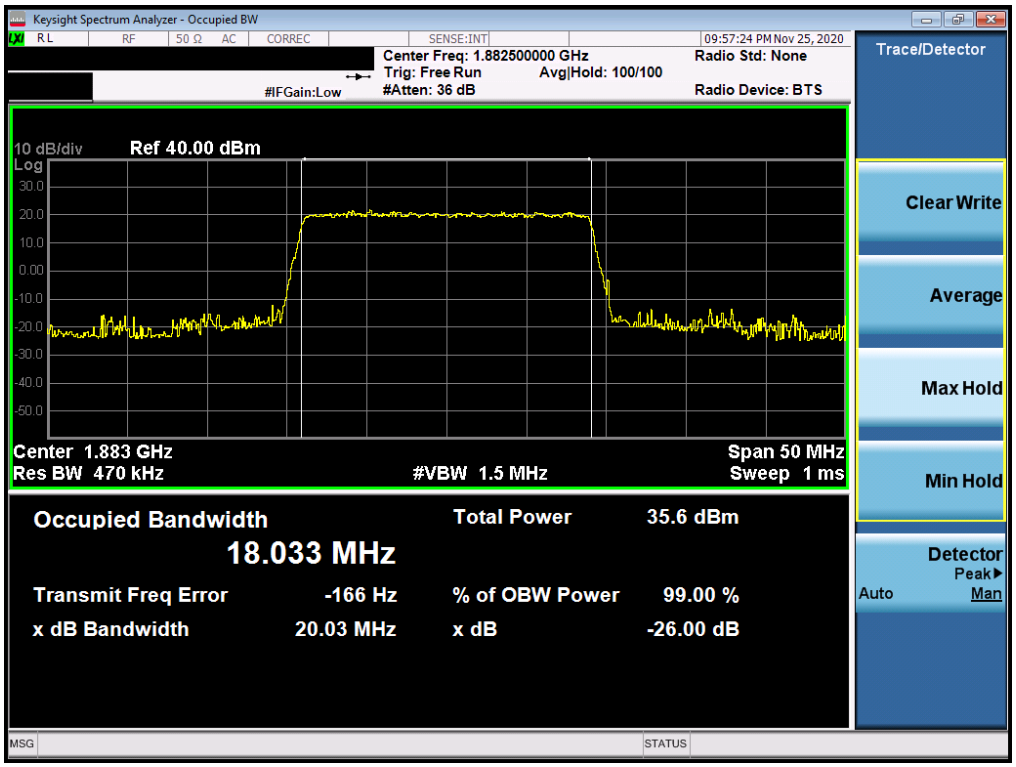


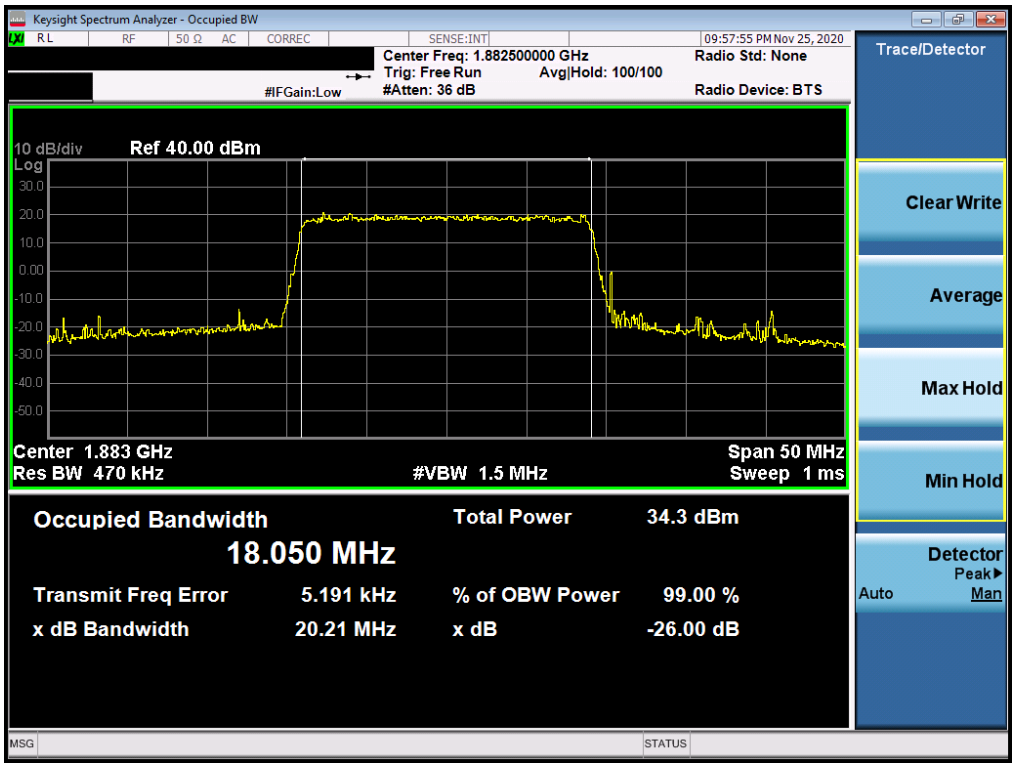
Figure 7-1. Test Instrument & Measurement Setup

Test Notes

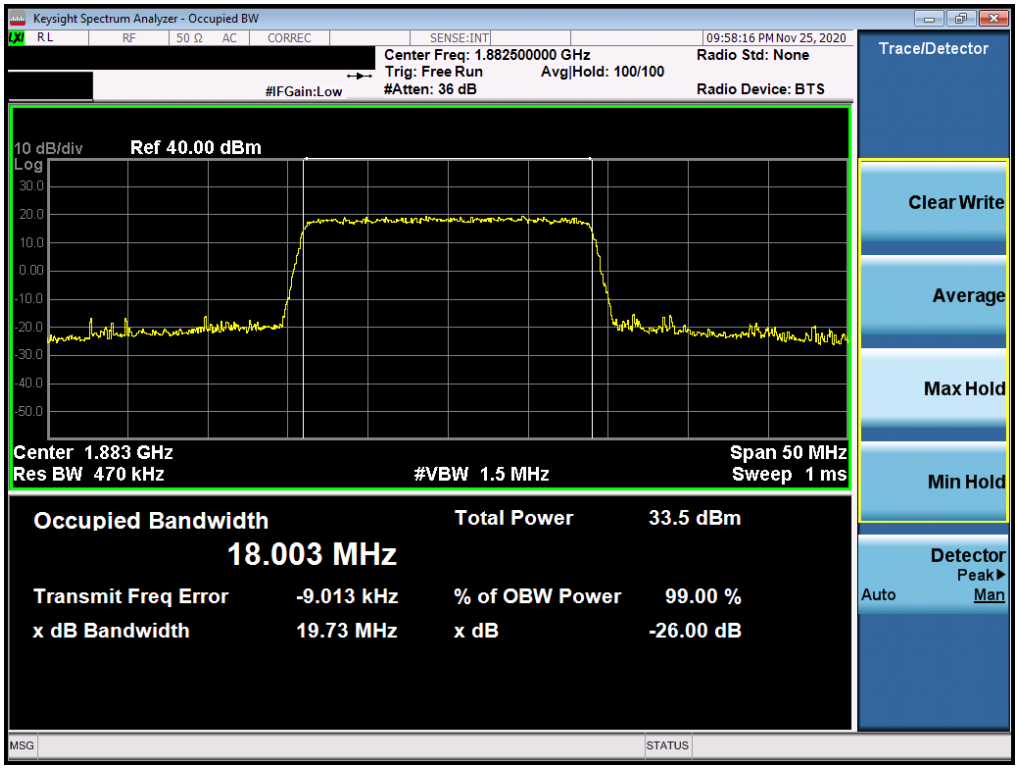
None.



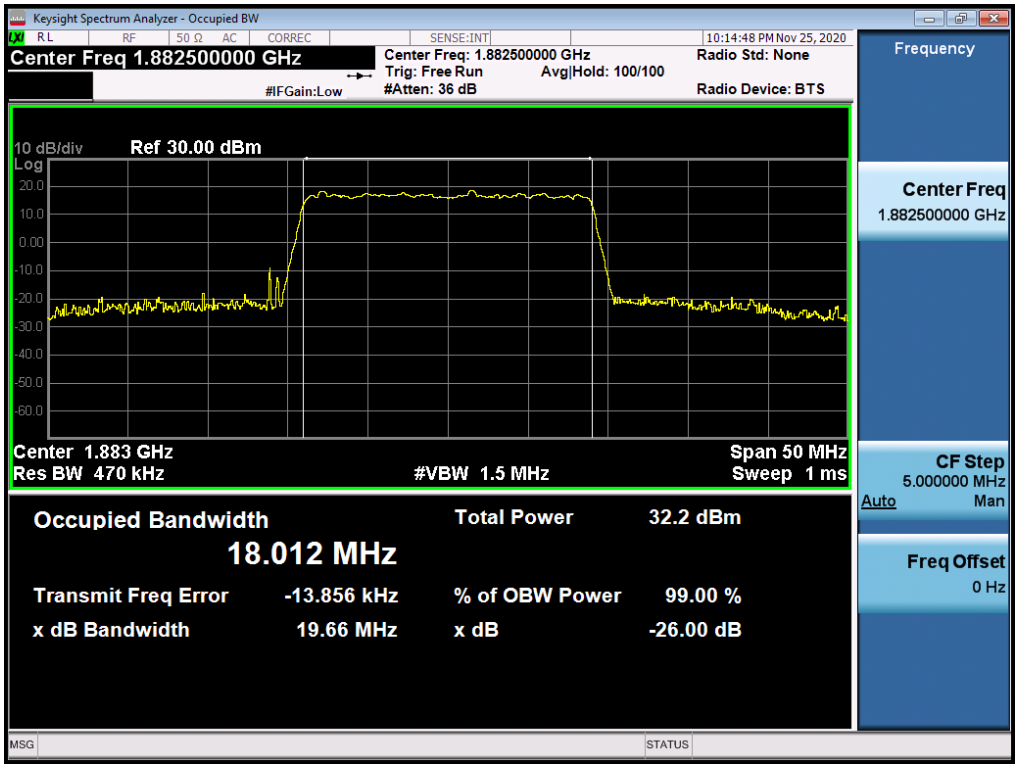
Plot 7-1. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz QPSK - Full RB Configuration)



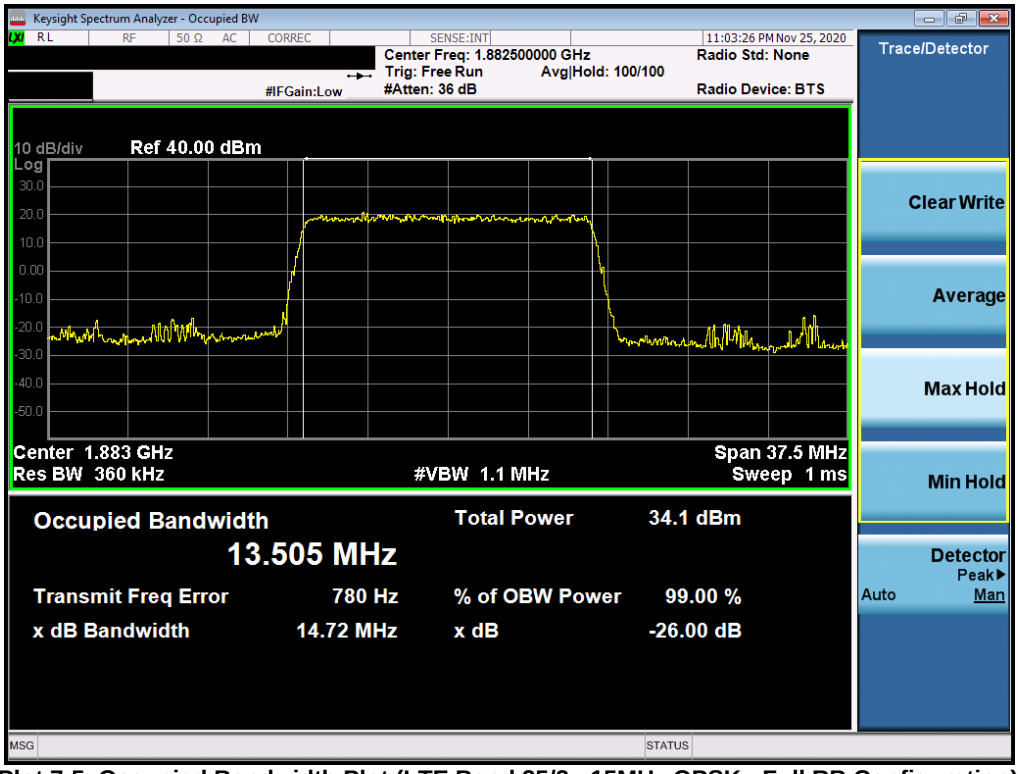
Plot 7-2. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz 16-QAM - Full RB Configuration)



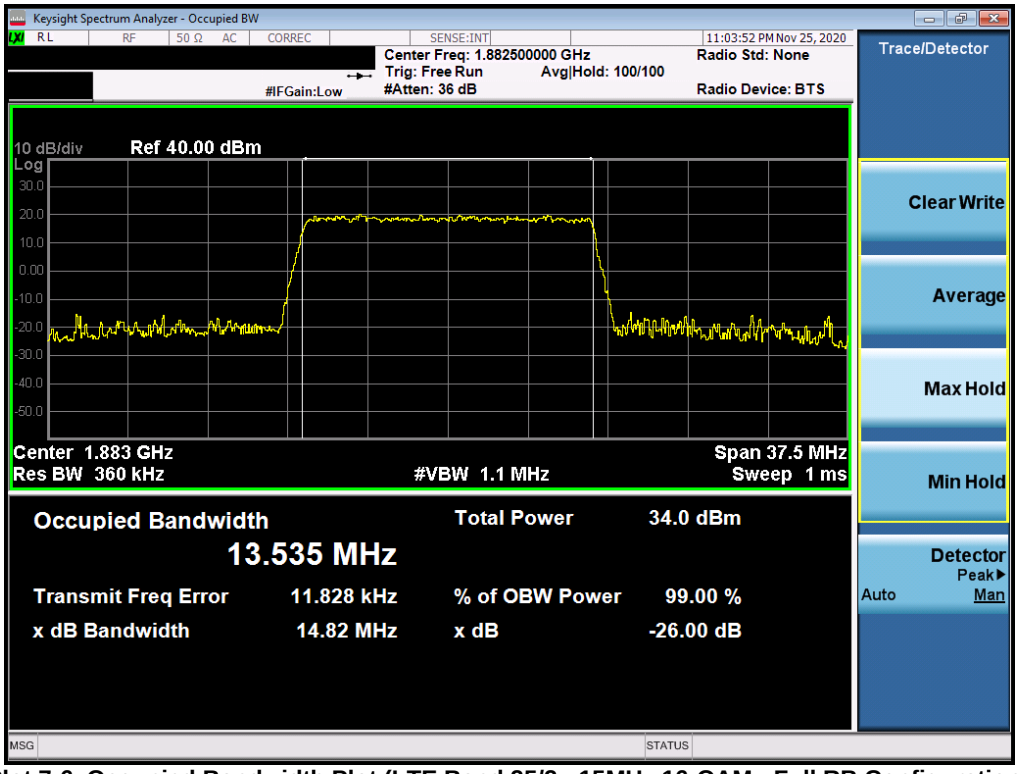
Plot 7-3. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz 64-QAM - Full RB Configuration)



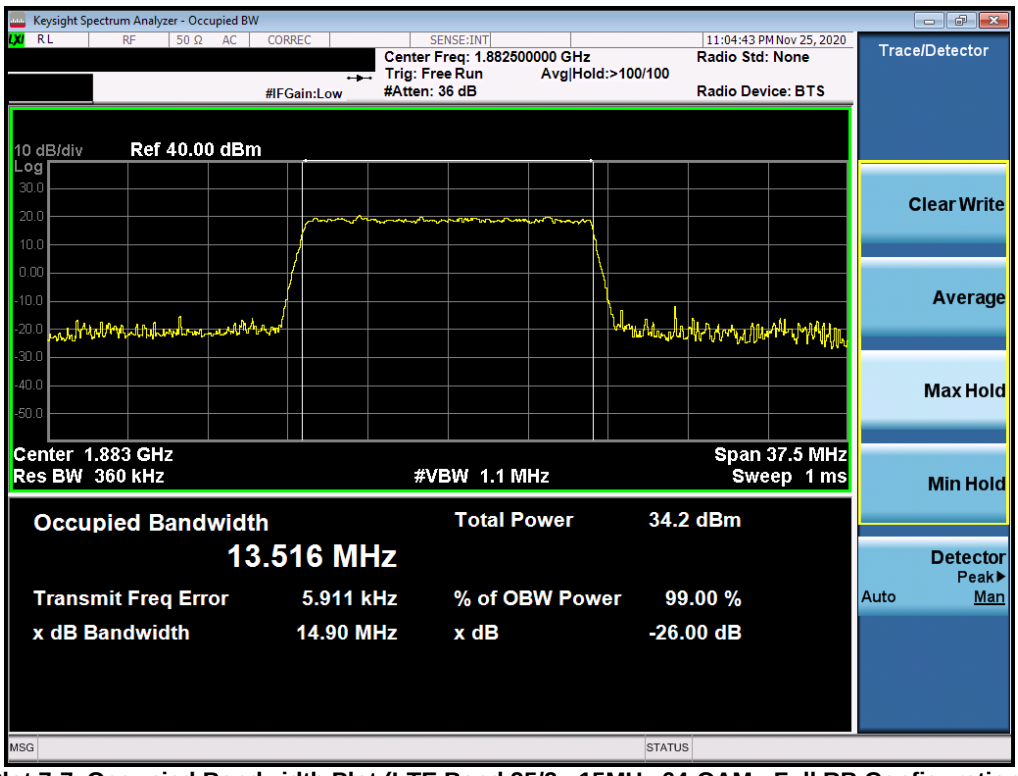
Plot 7-4. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz 256-QAM - Full RB Configuration)



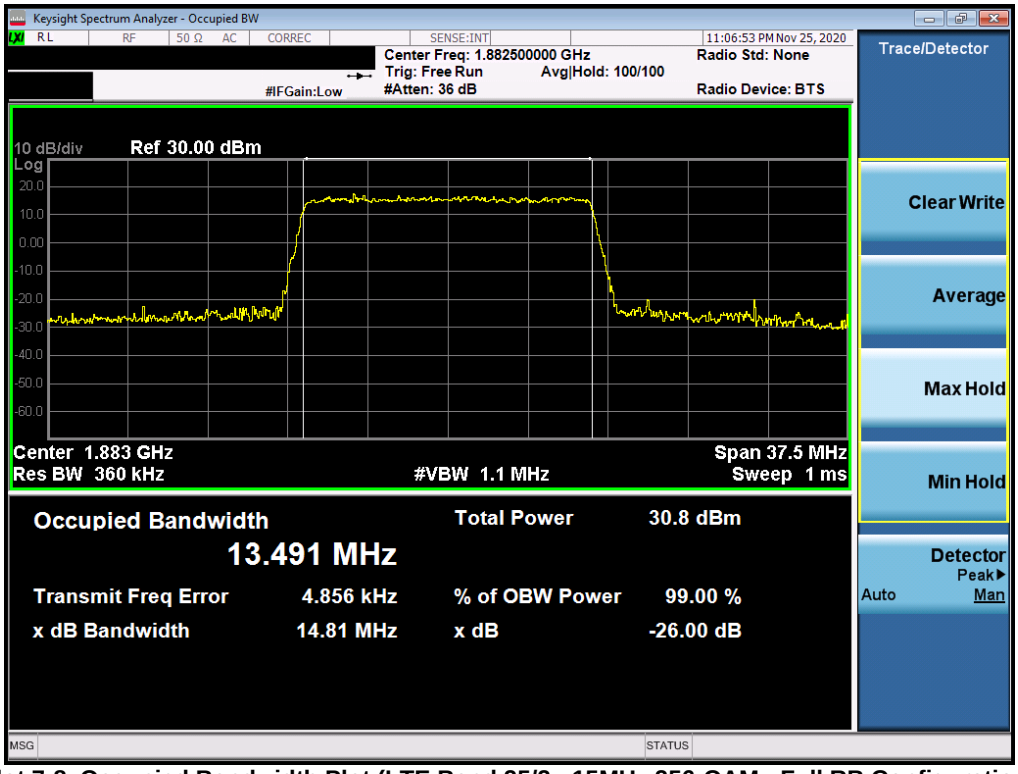
Plot 7-5. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz QPSK - Full RB Configuration)



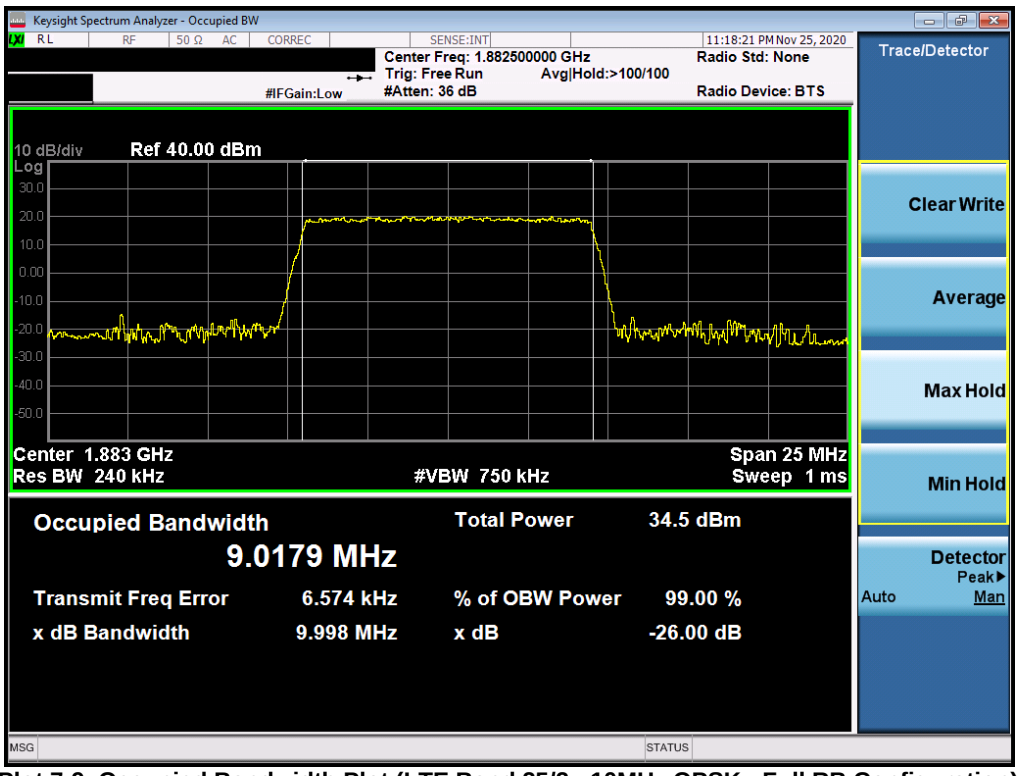
Plot 7-6. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz 16-QAM - Full RB Configuration)



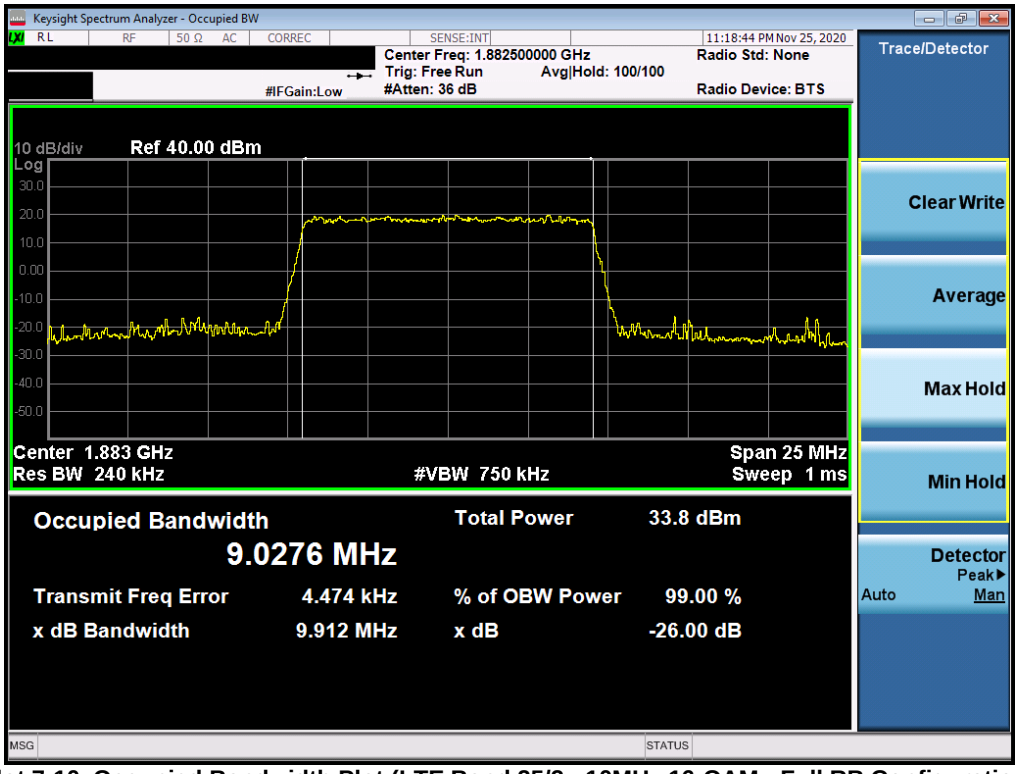
Plot 7-7. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz 64-QAM - Full RB Configuration)



Plot 7-8. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz 256-QAM - Full RB Configuration)

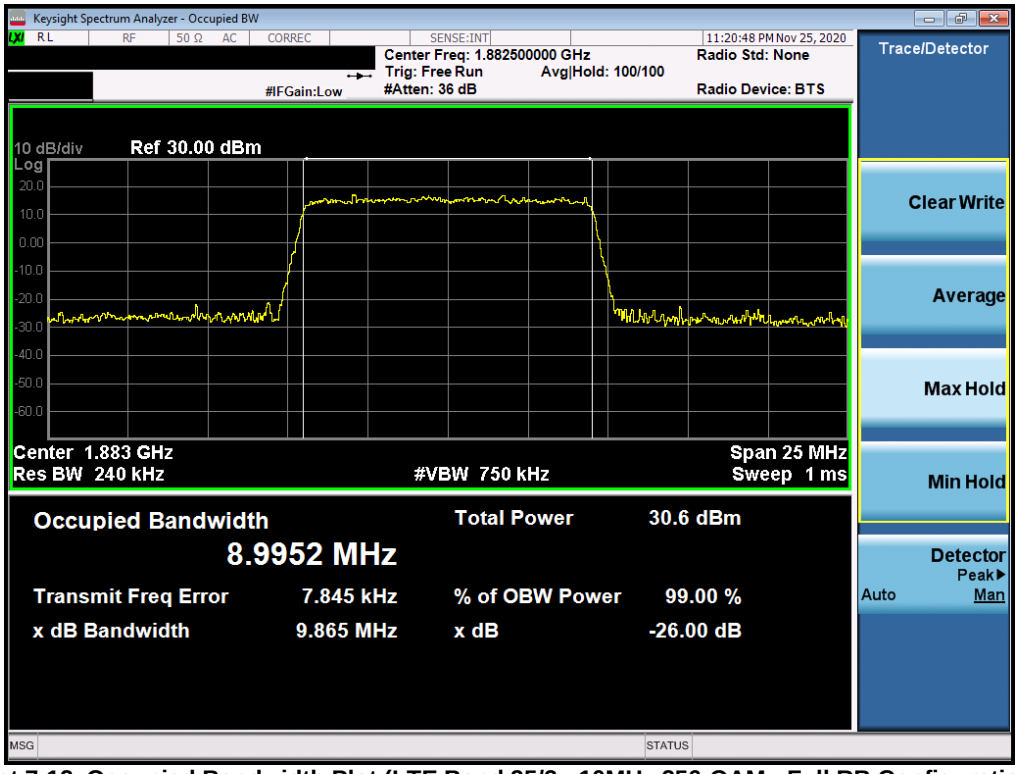


Plot 7-9. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz QPSK - Full RB Configuration)

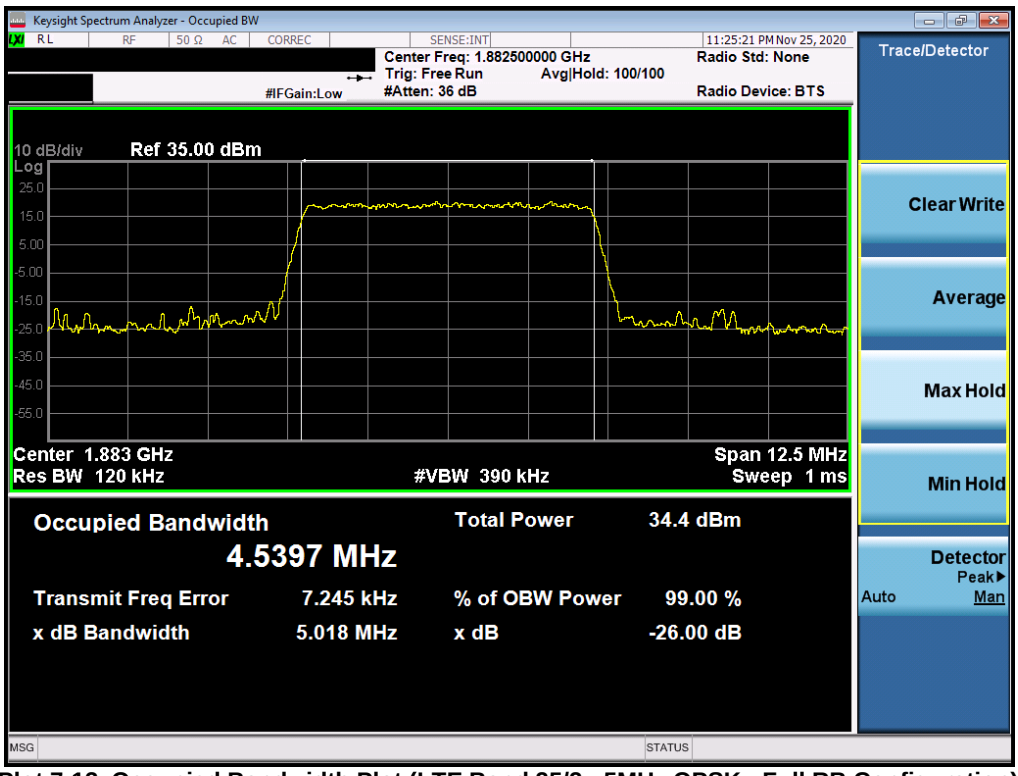


Plot 7-10. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz 16-QAM - Full RB Configuration)

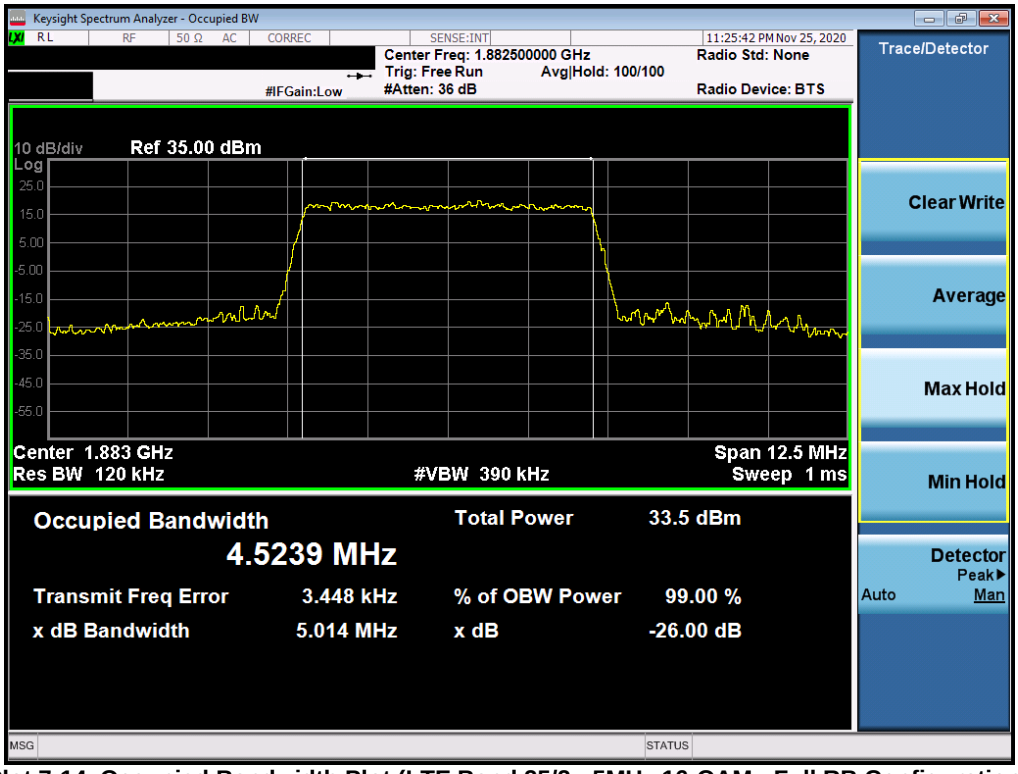
Plot 7-11. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz 64-QAM - Full RB Configuration)



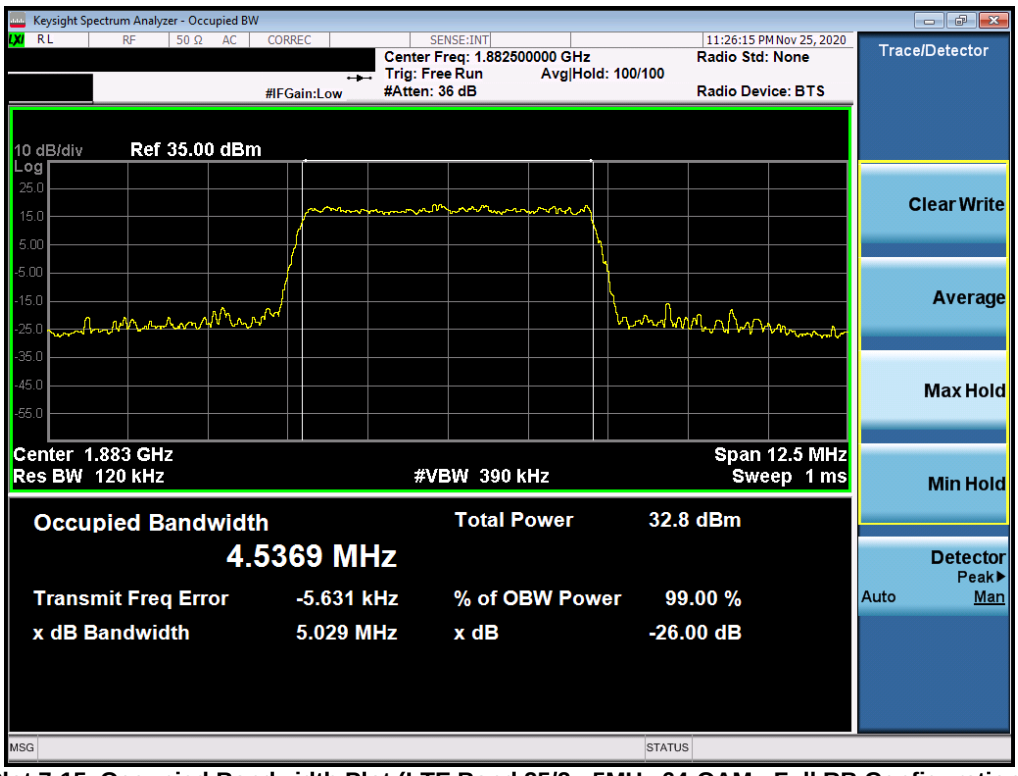
Plot 7-12. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz 256-QAM - Full RB Configuration)



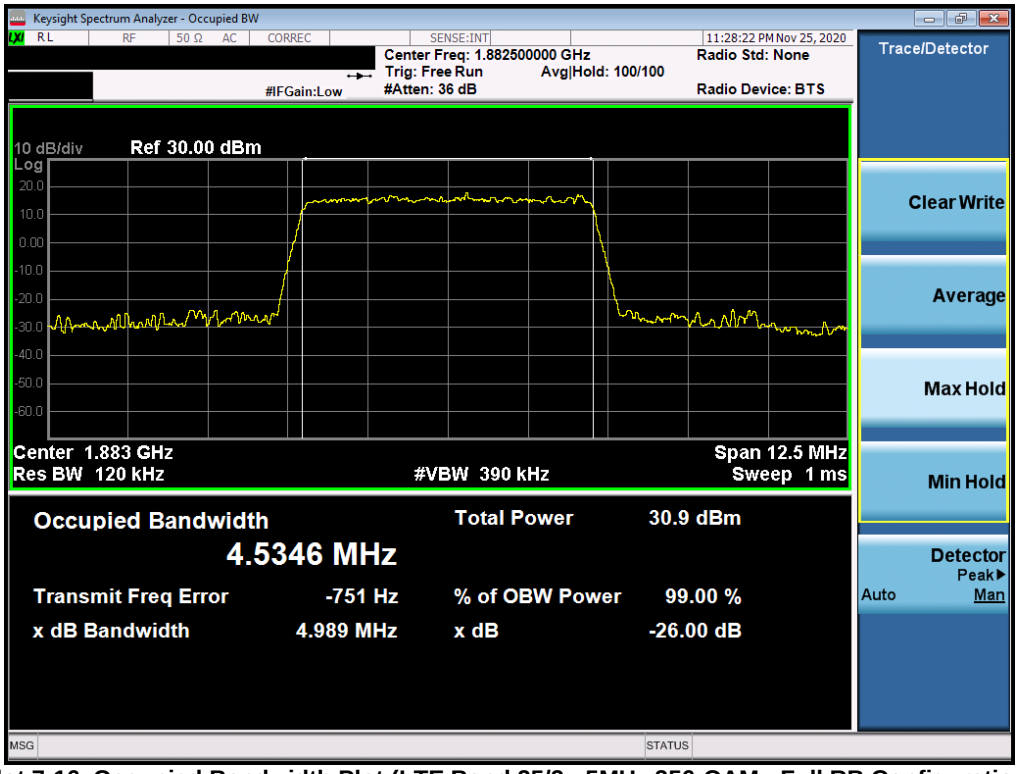
Plot 7-13. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz QPSK - Full RB Configuration)



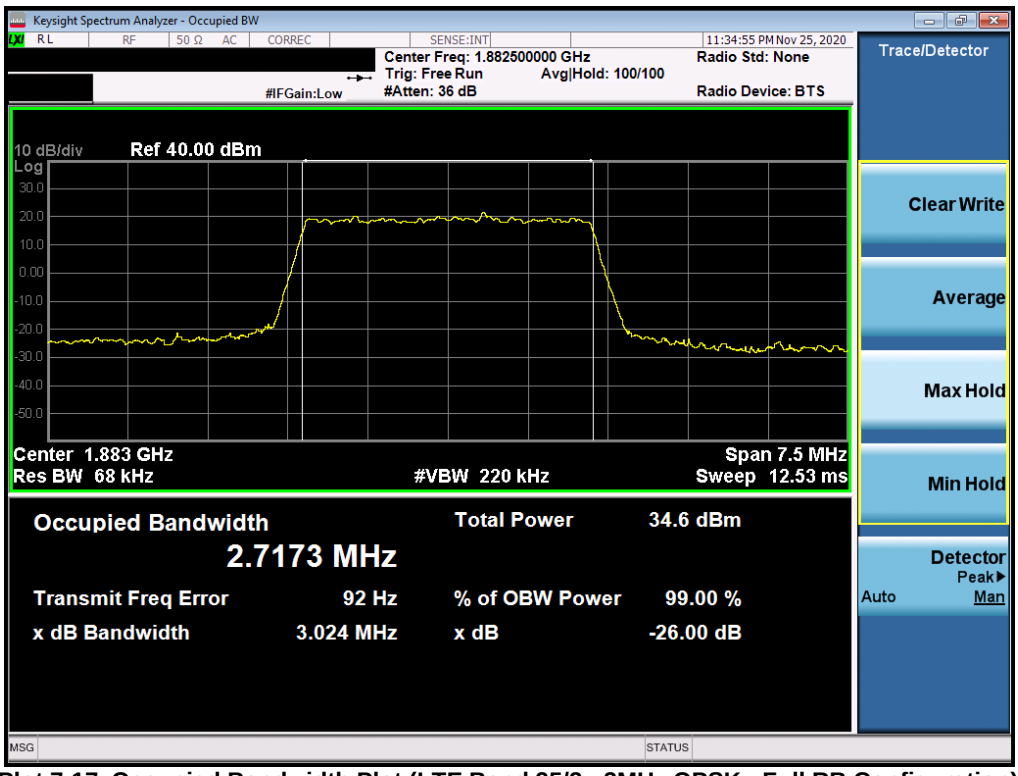
Plot 7-14. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz 16-QAM - Full RB Configuration)



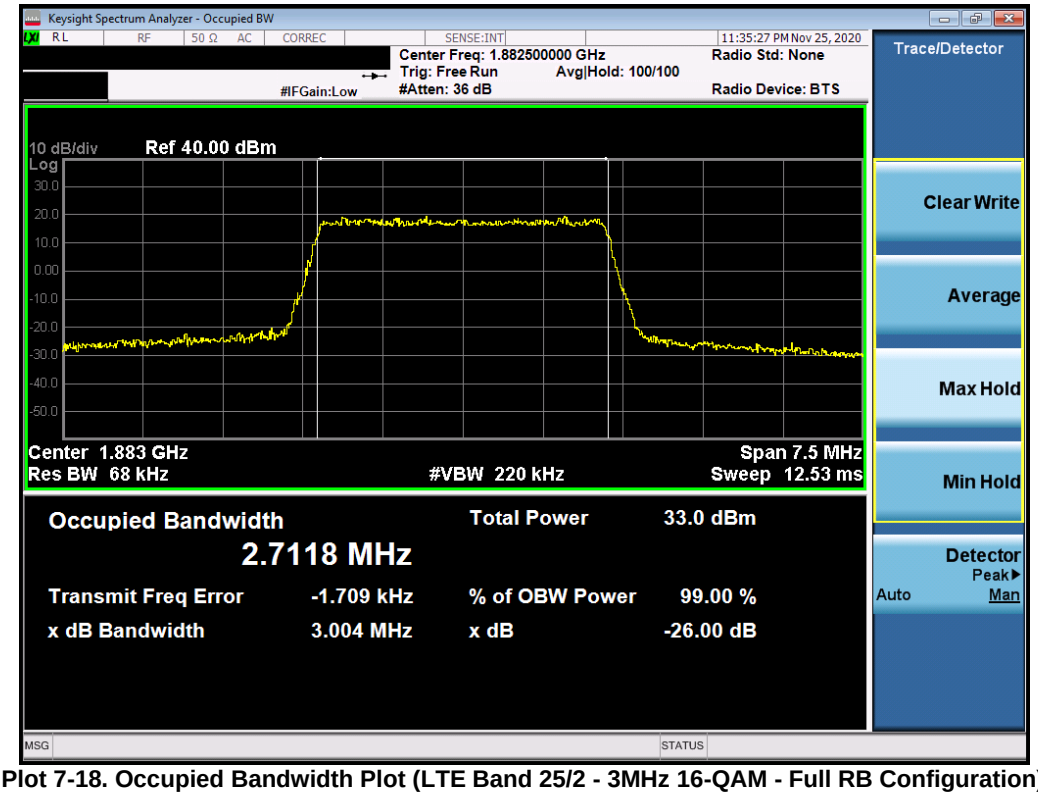
Plot 7-15. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz 64-QAM - Full RB Configuration)



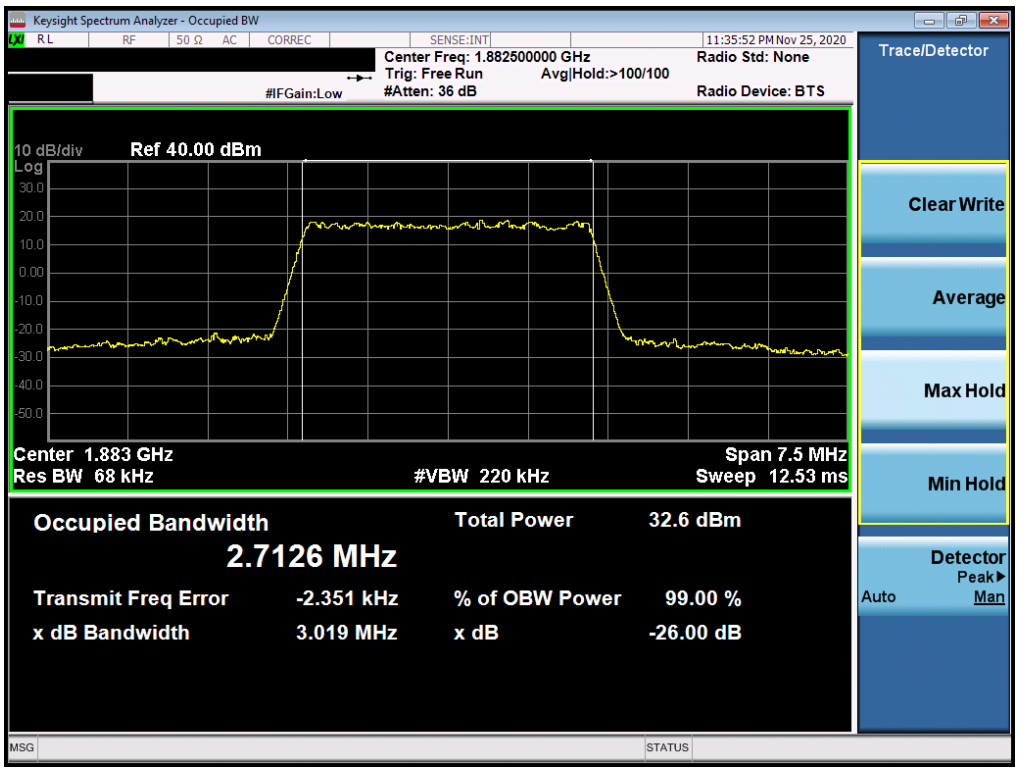
Plot 7-16. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz 256-QAM - Full RB Configuration)



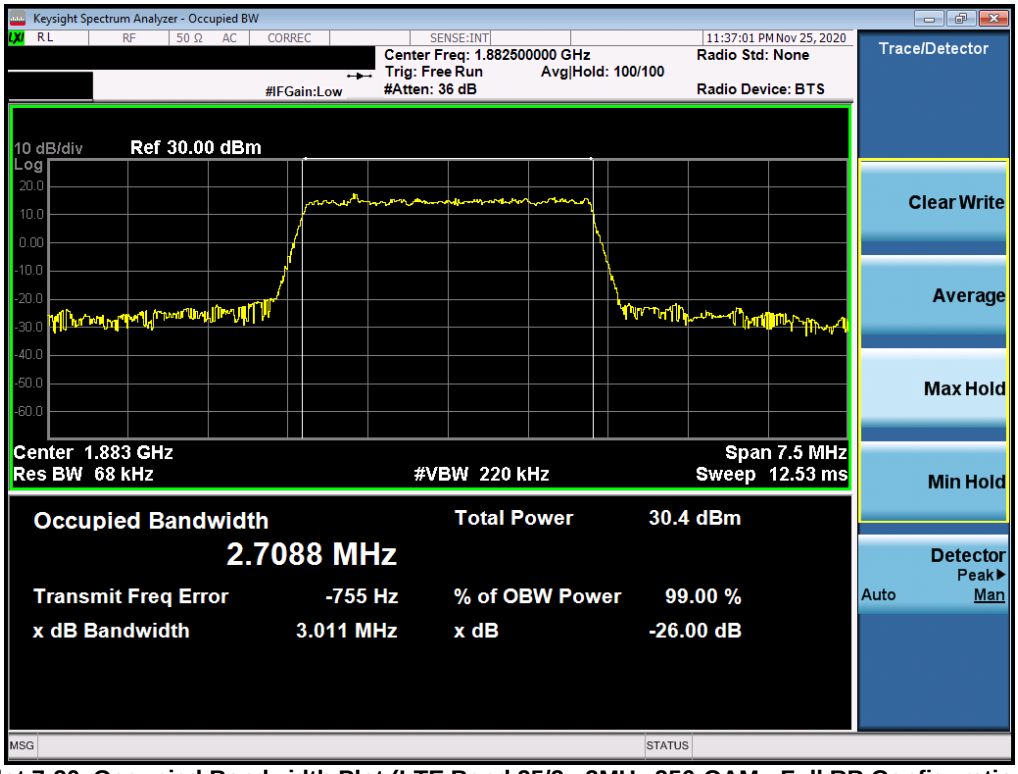
Plot 7-17. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz QPSK - Full RB Configuration)



Plot 7-18. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz 16-QAM - Full RB Configuration)

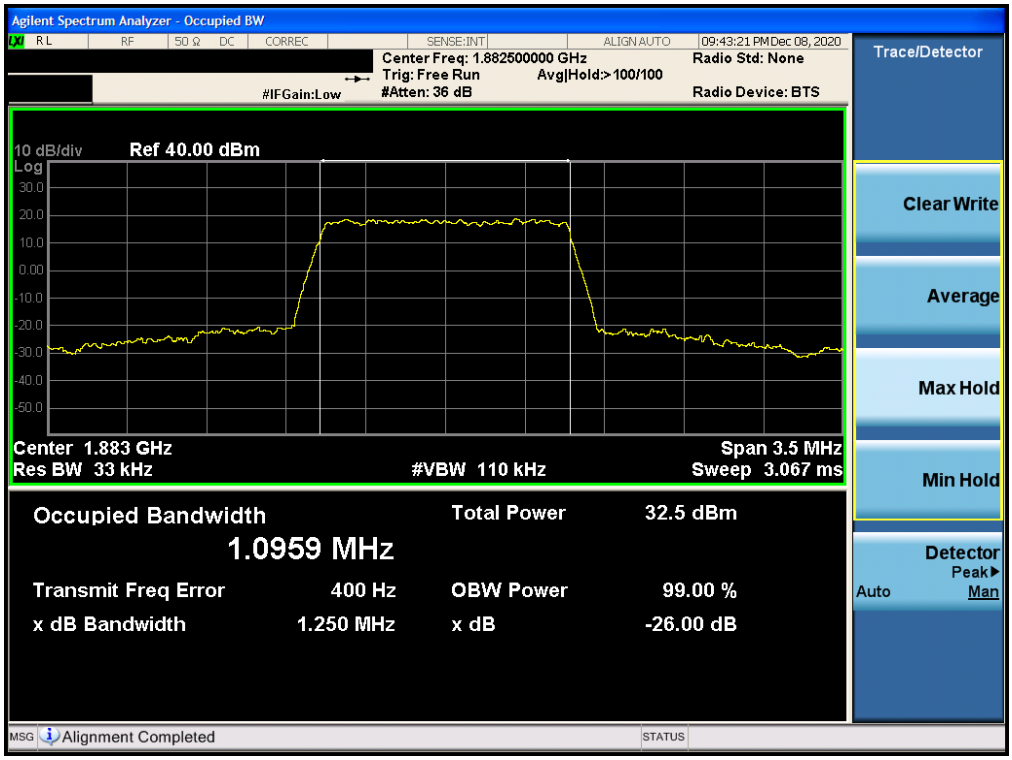


Plot 7-19. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz 64-QAM - Full RB Configuration)

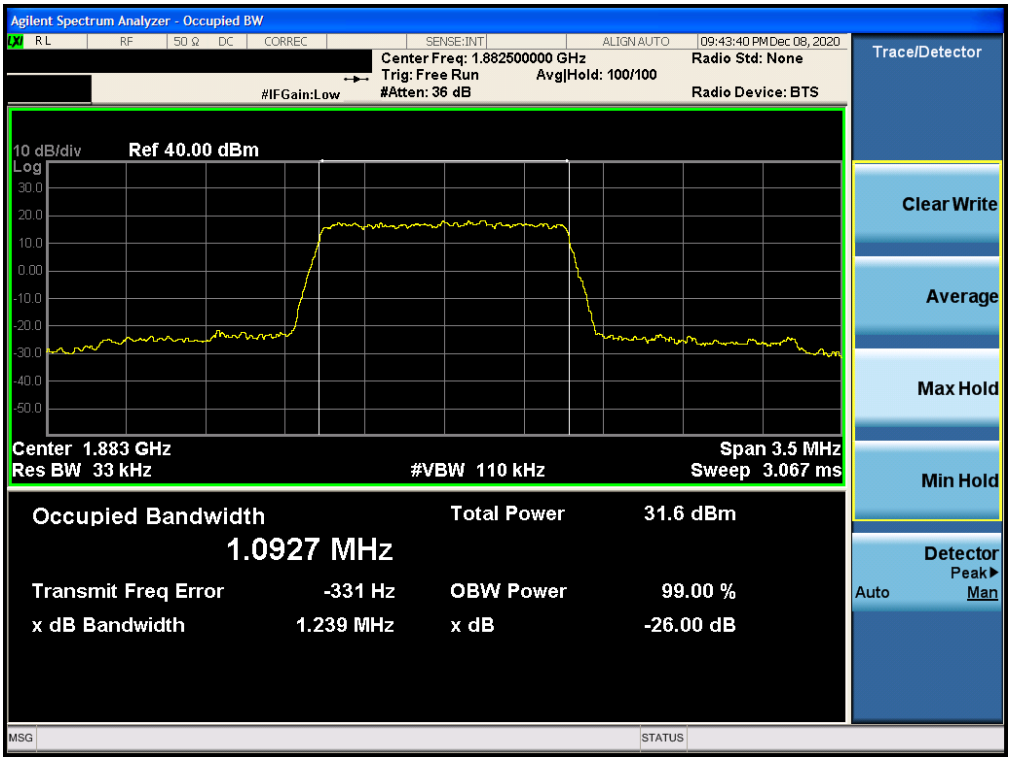


Plot 7-20. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz 256-QAM - Full RB Configuration)

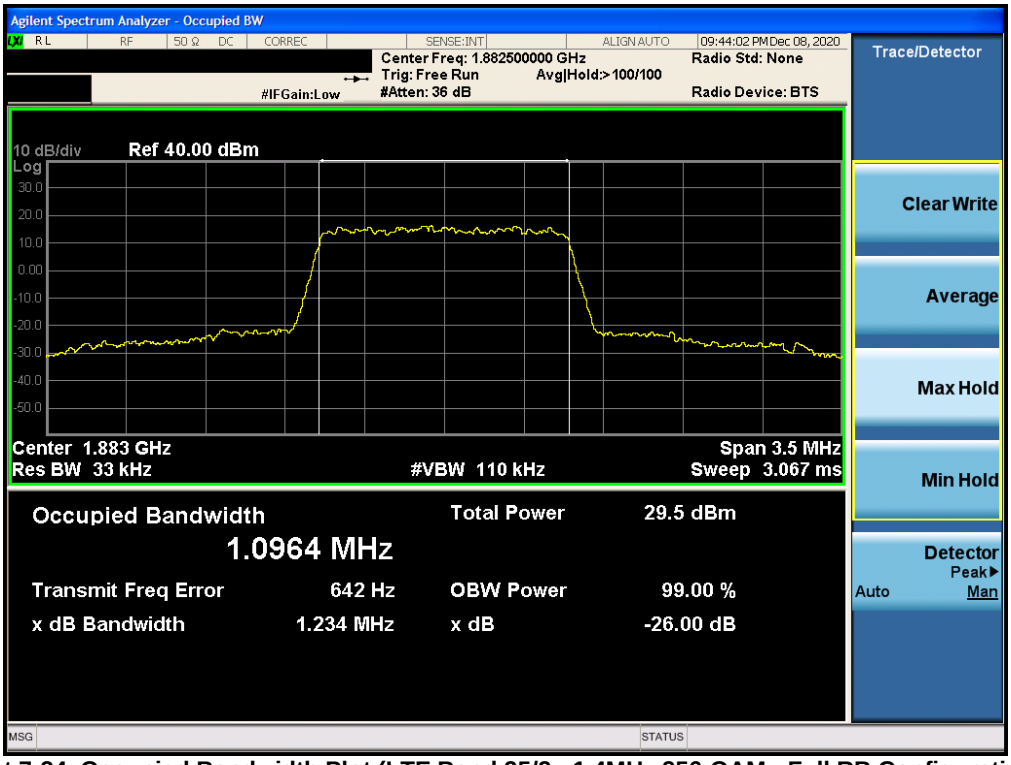
Plot 7-21. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz QPSK - Full RB Configuration)



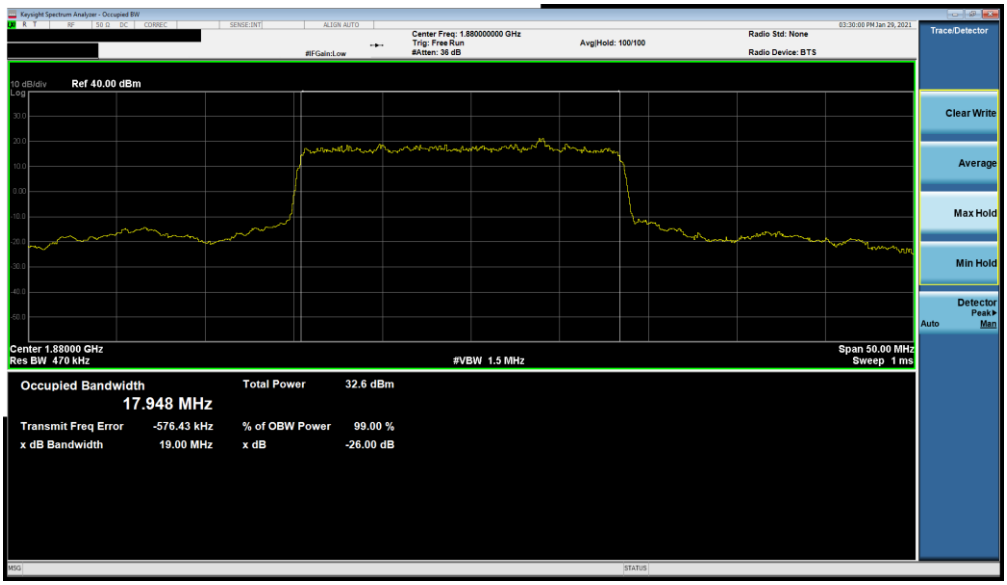
Plot 7-22. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz 16-QAM - Full RB Configuration)



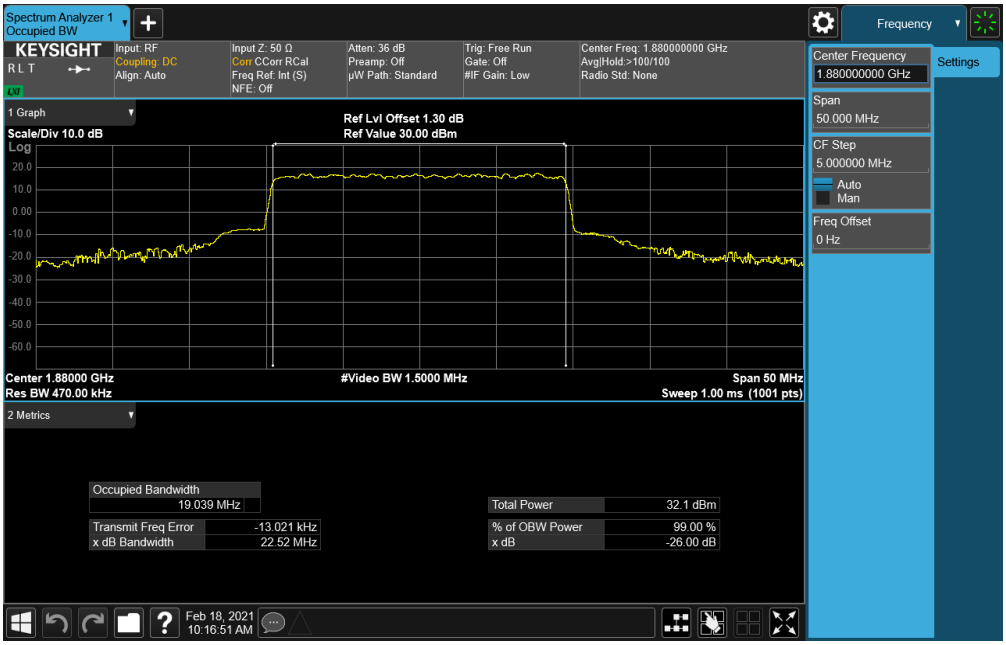
Plot 7-23. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz 64-QAM - Full RB Configuration)



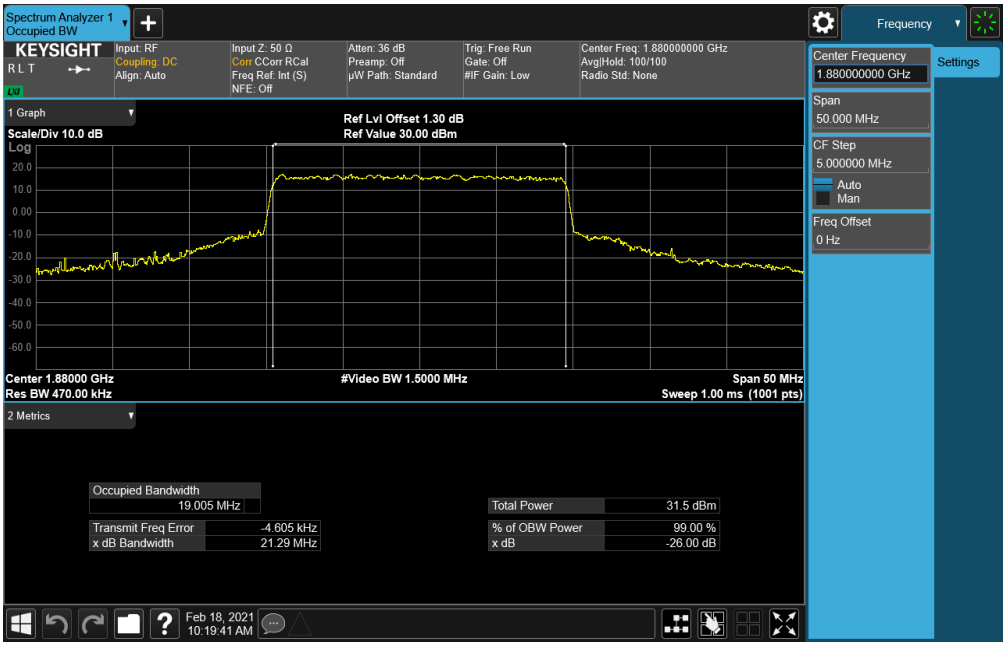
Plot 7-24. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz 256-QAM - Full RB Configuration)



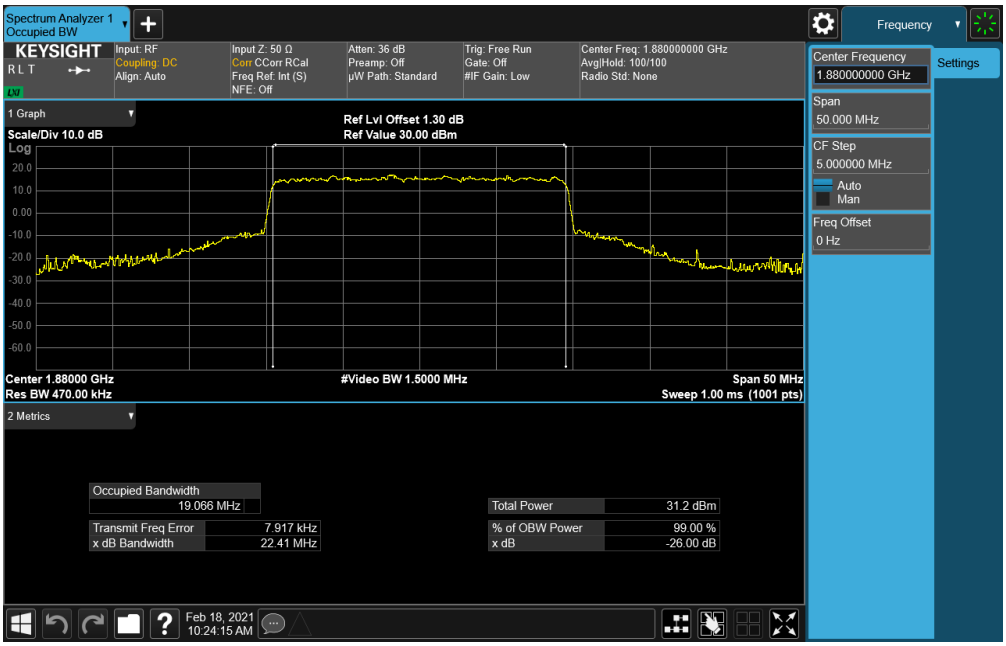
Plot 7-25. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz DFT-s-OFDM π/2 BPSK - Full RB)



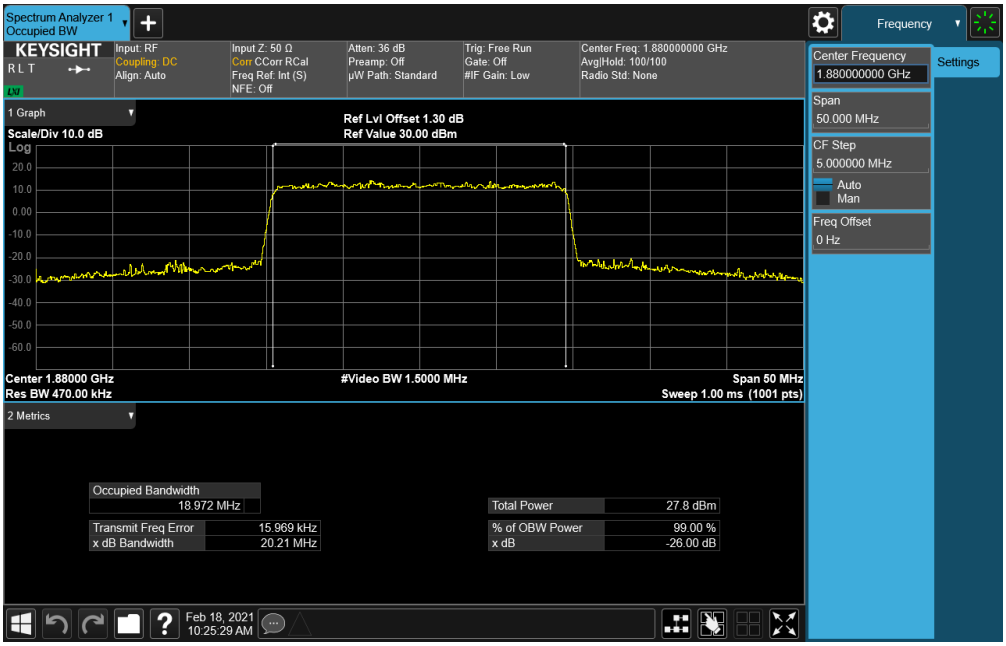
Plot 7-26. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz CP-OFDM QPSK - Full RB)



Plot 7-27. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz CP-OFDM 16QAM - Full RB)

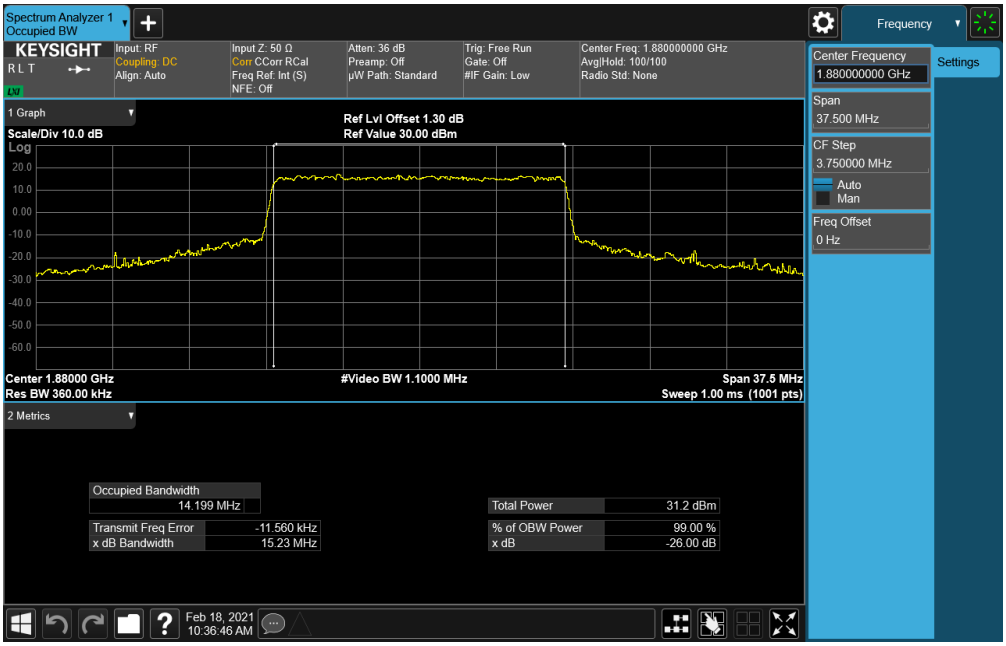


Plot 7-28. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz CP-OFDM 64QAM - Full RB)

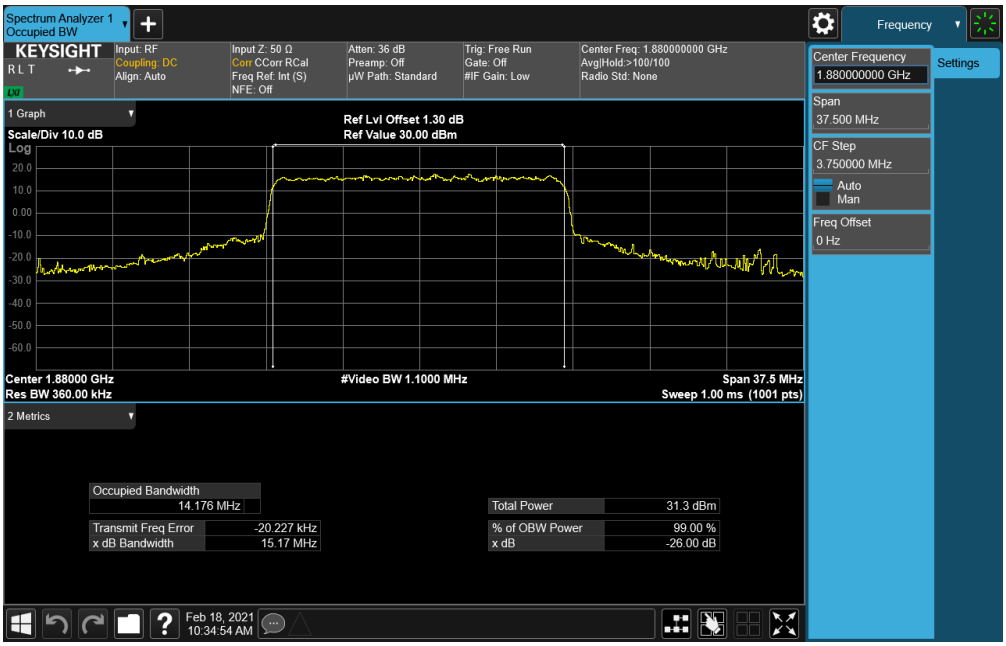


Plot 7-29. Occupied Bandwidth Plot (NR Band n25/n2 - 20.0MHz CP-OFDM 256QAM - Full RB)

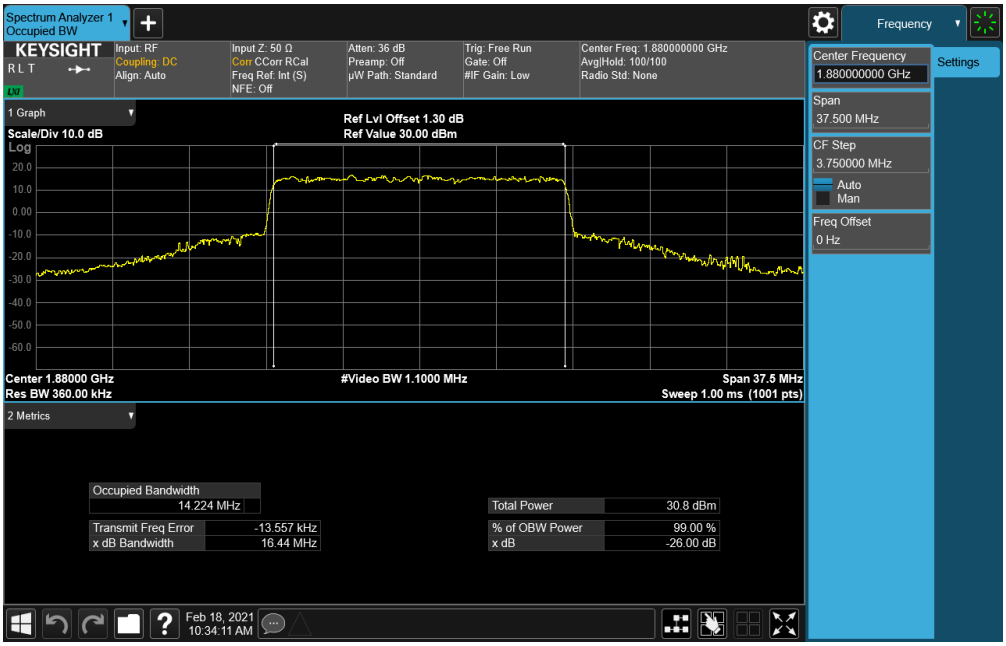
Plot 7-30. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz DFT-s-OFDM π/2 BPSK - Full RB)



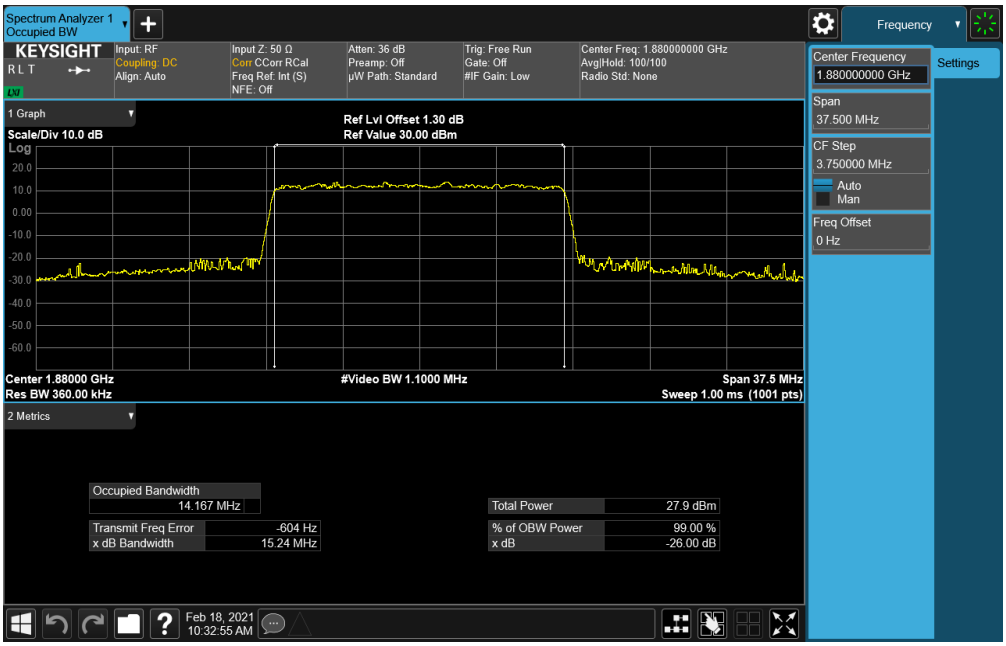
Plot 7-31. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz CP-OFDM QPSK - Full RB)



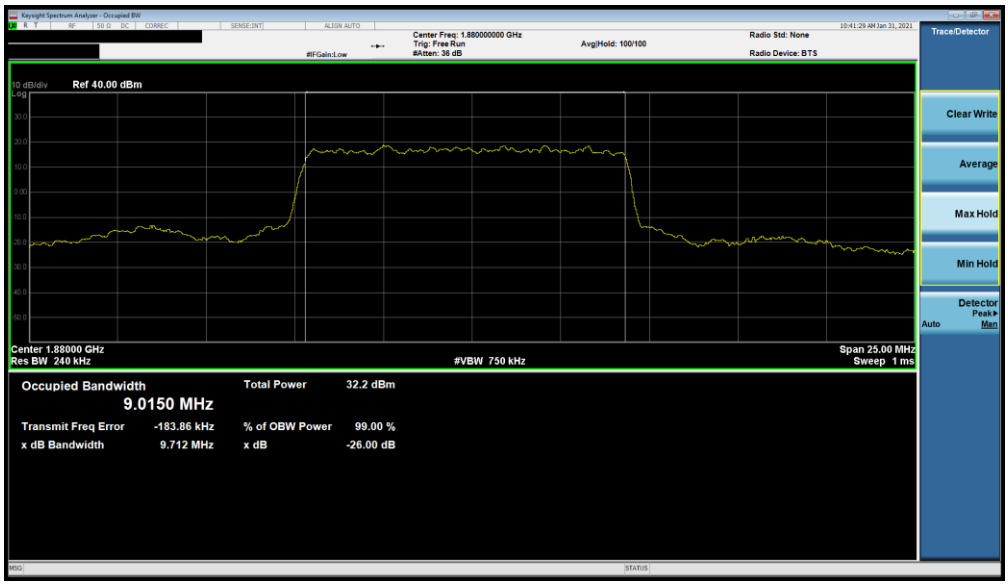
Plot 7-32. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz CP-OFDM 16QAM - Full RB)



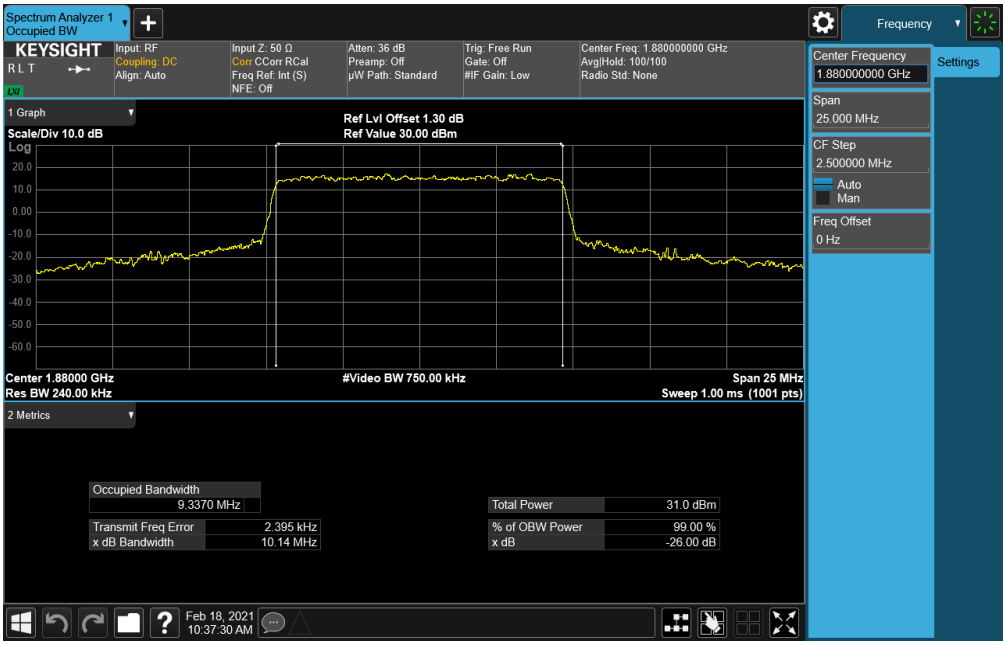
Plot 7-33. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz CP-OFDM 64QAM - Full RB)



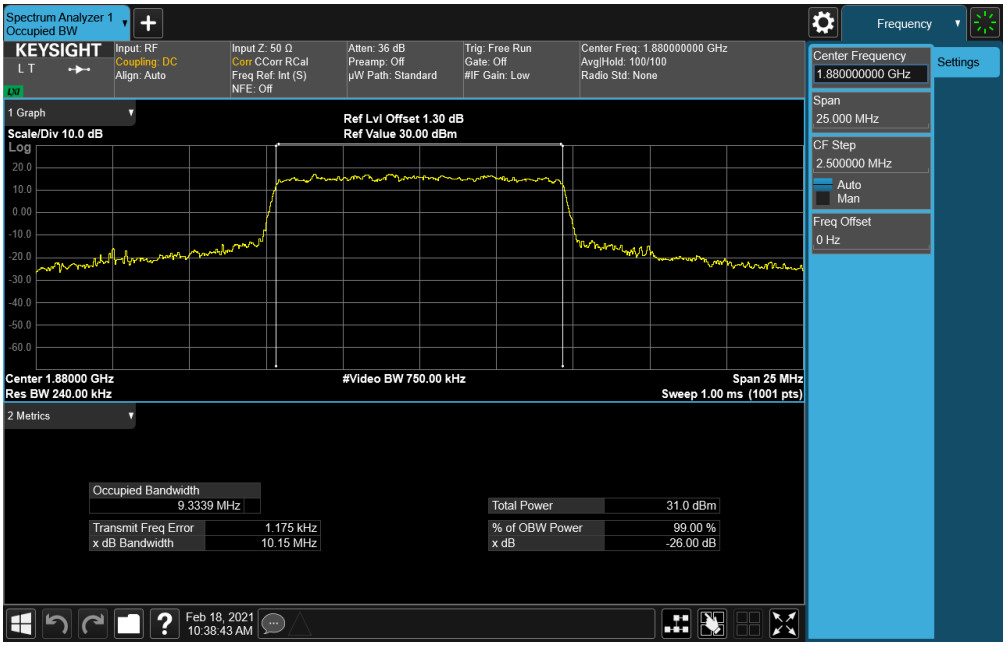
Plot 7-34. Occupied Bandwidth Plot (NR Band n25/n2 - 15.0MHz CP-OFDM 256QAM - Full RB)



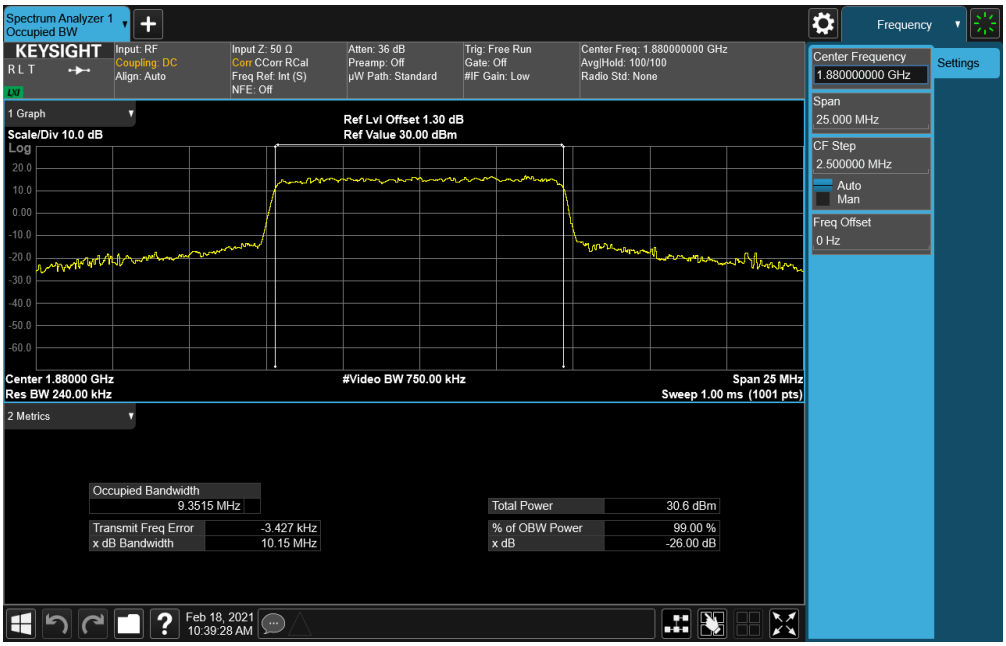
Plot 7-35. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz DFT-s-OFDM π/2 BPSK - Full RB)



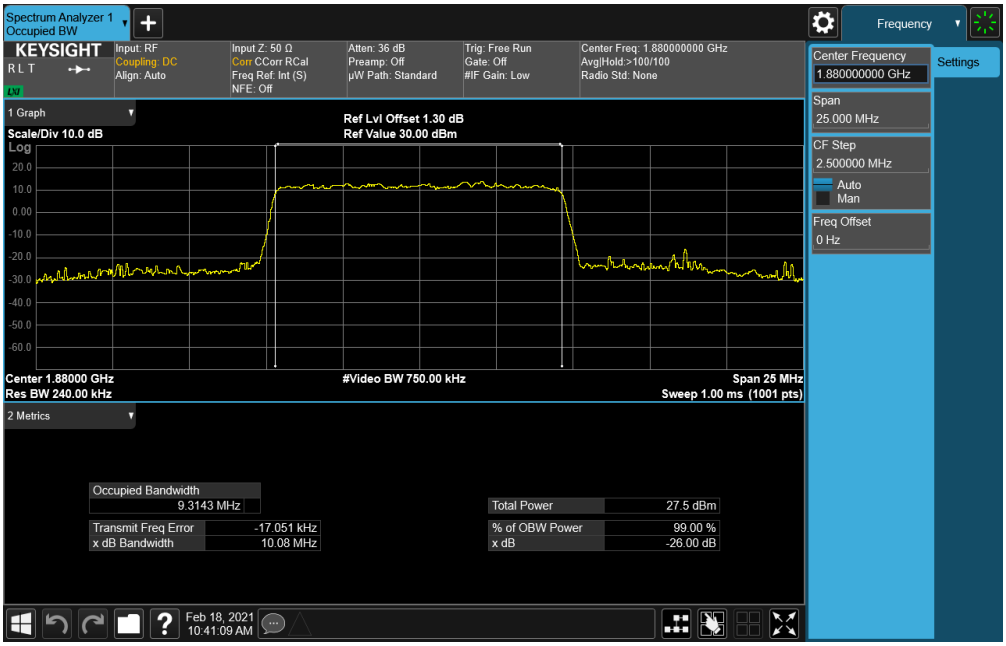
Plot 7-36. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz CP-OFDM QPSK - Full RB)



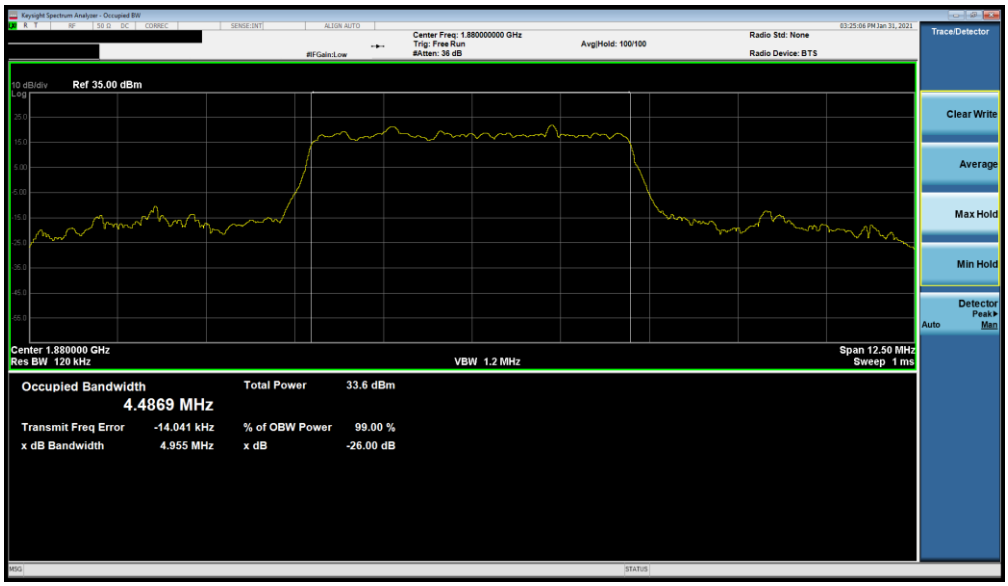
Plot 7-37. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz CP-OFDM 16QAM - Full RB)



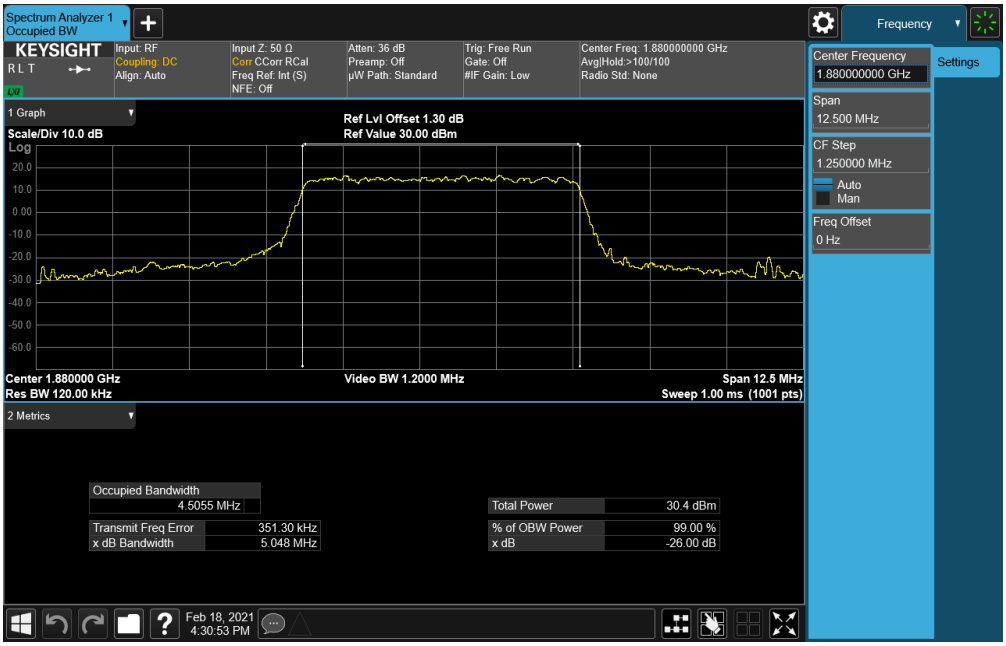
Plot 7-38. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz CP-OFDM 64QAM - Full RB)



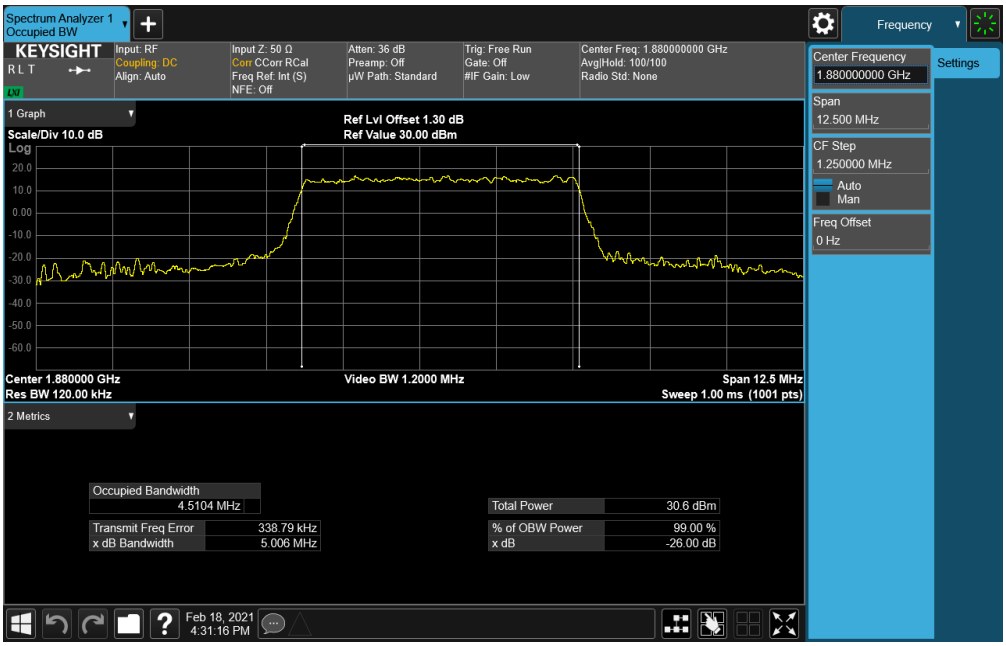
Plot 7-39. Occupied Bandwidth Plot (NR Band n25/n2 - 10.0MHz CP-OFDM 256QAM - Full RB)



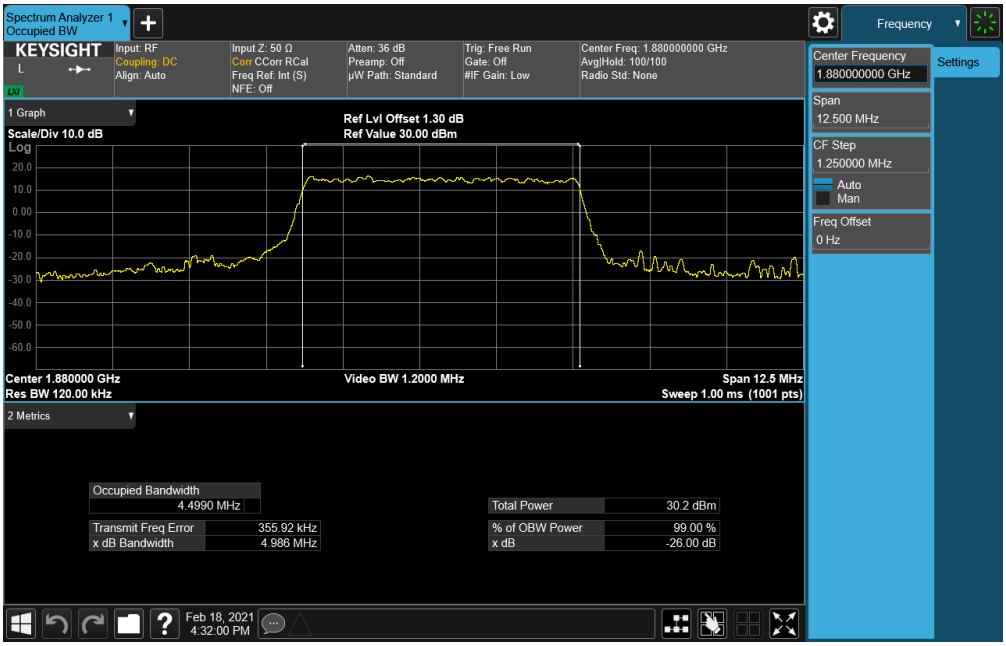
Plot 7-40. Occupied Bandwidth Plot (NR Band n25/n2 - 5.0MHz DFT-s-OFDM π/2 BPSK - Full RB)



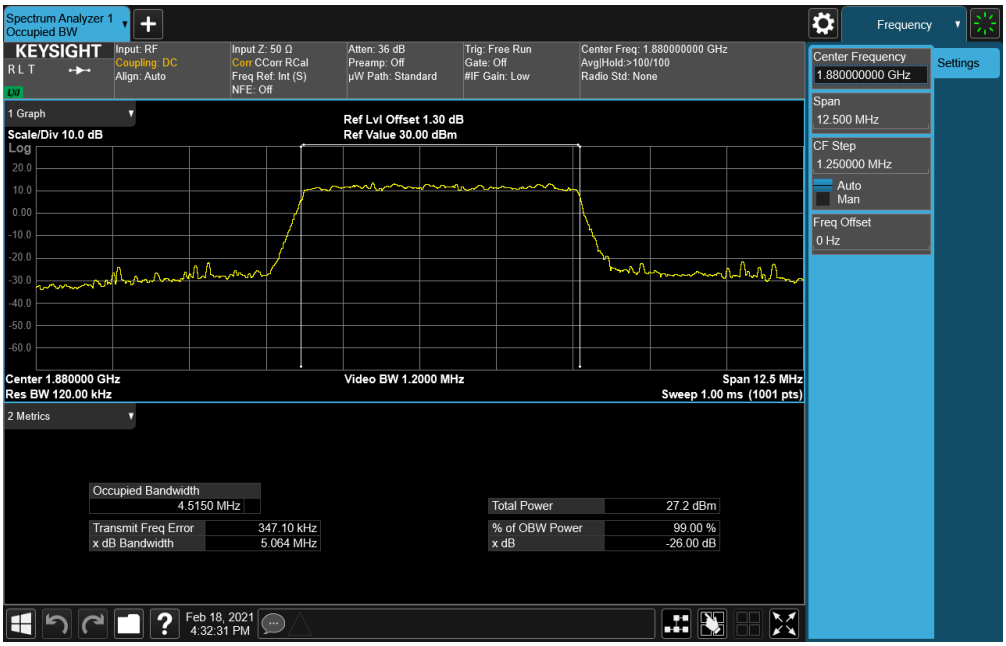
Plot 7-41. Occupied Bandwidth Plot (NR Band n25/n2 - 5.0MHz CP-OFDM QPSK - Full RB)



Plot 7-42. Occupied Bandwidth Plot (NR Band n25/n2 - 5.0MHz CP-OFDM 16QAM - Full RB)

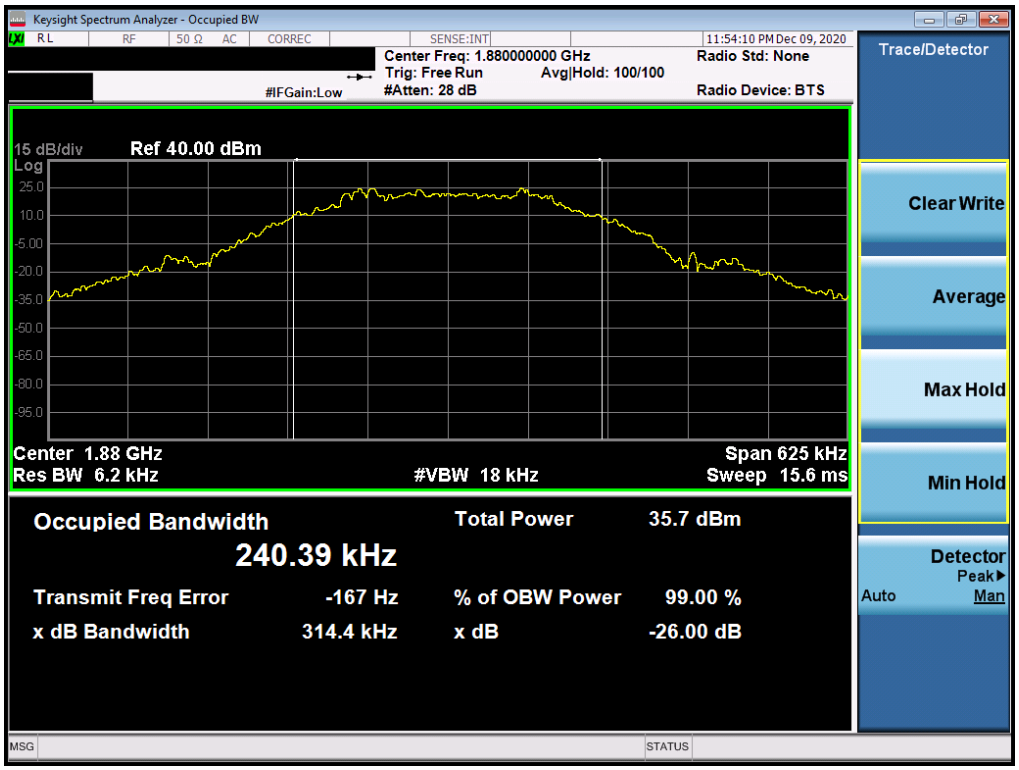


Plot 7-43. Occupied Bandwidth Plot (NR Band n25/n2 - 5.0MHz CP-OFDM 64QAM - Full RB)



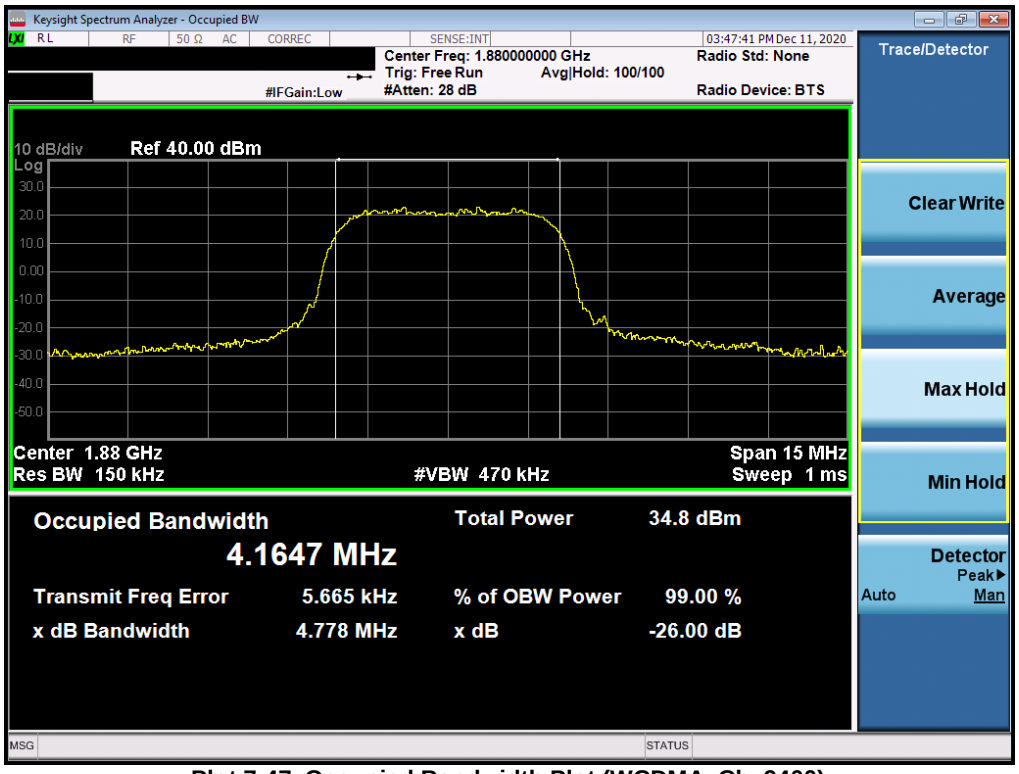
Plot 7-44. Occupied Bandwidth Plot (NR Band n25/n2 - 5.0MHz CP-OFDM 256QAM - Full RB)

Plot 7-45. Occupied Bandwidth Plot (GPRS, Ch. 661)



Plot 7-46. Occupied Bandwidth Plot (EDGE, Ch. 661)

WCDMA PCS



Plot 7-47. Occupied Bandwidth Plot (WCDMA, Ch. 9400)

7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051, §24.238(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 20GHz (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.

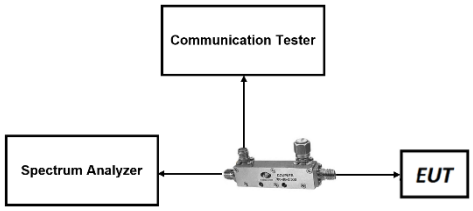
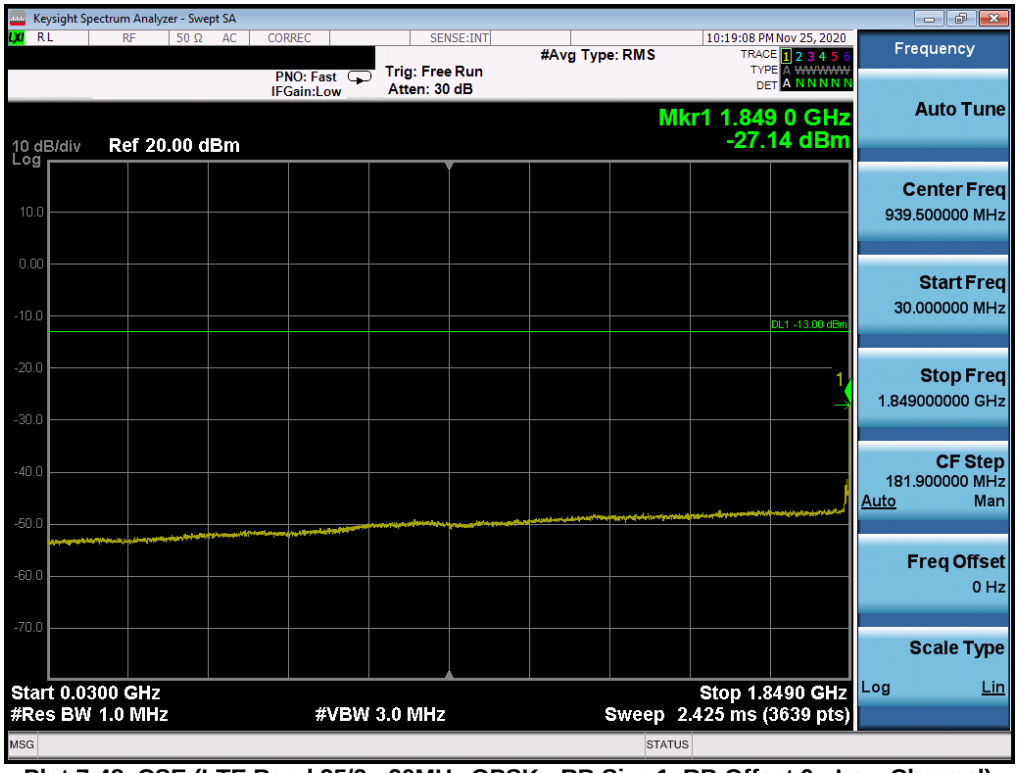


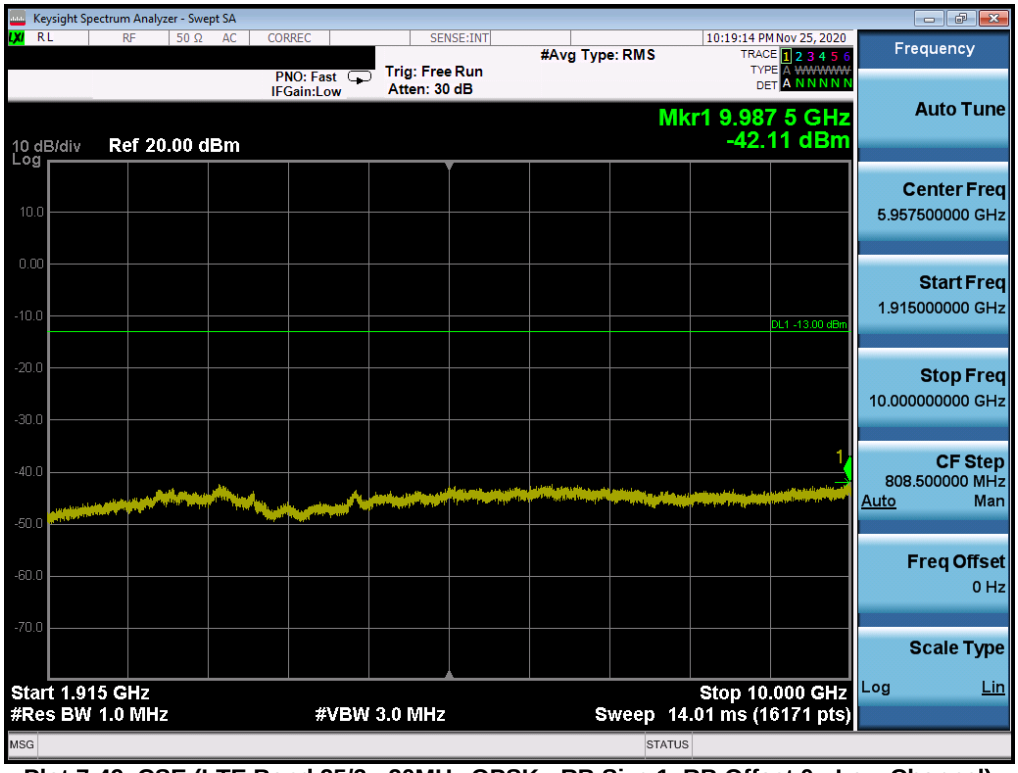
Figure 7-2. Test Instrument & Measurement Setup

Test Notes

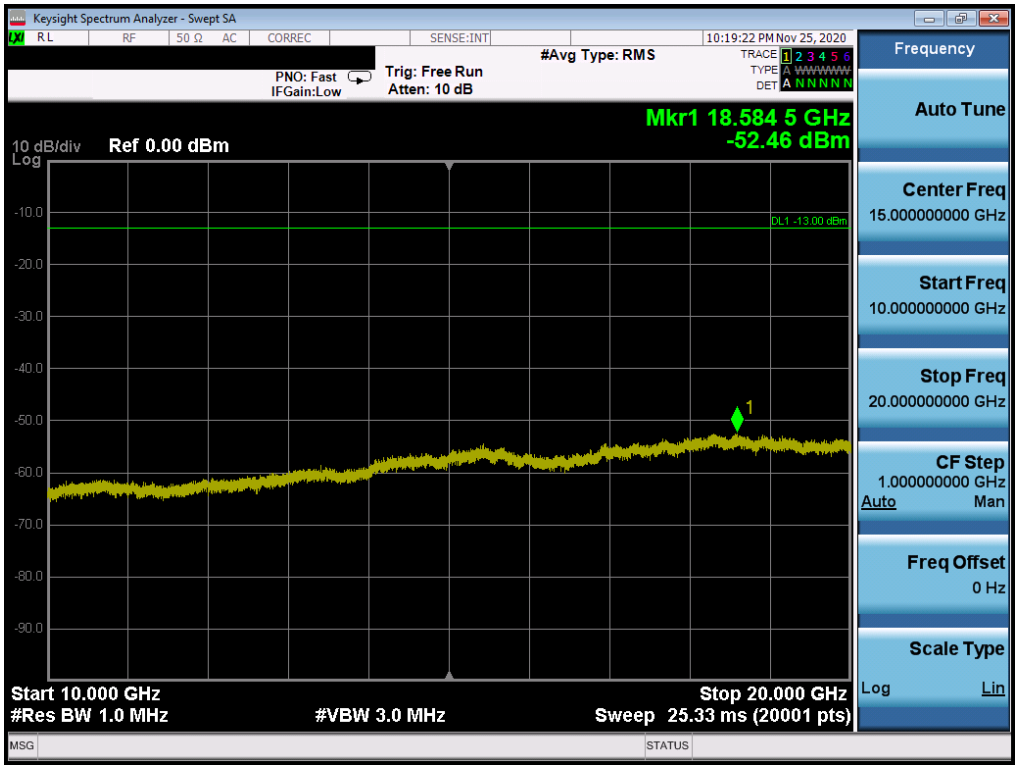
1. Per Part 24, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 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.



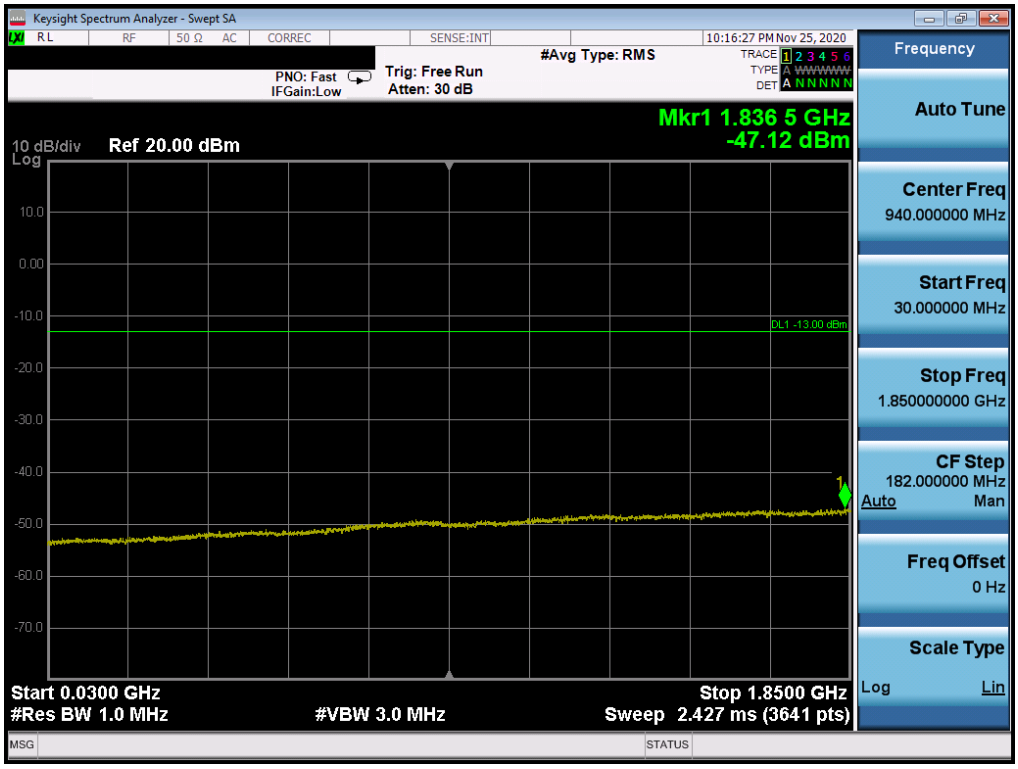
Plot 7-48. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



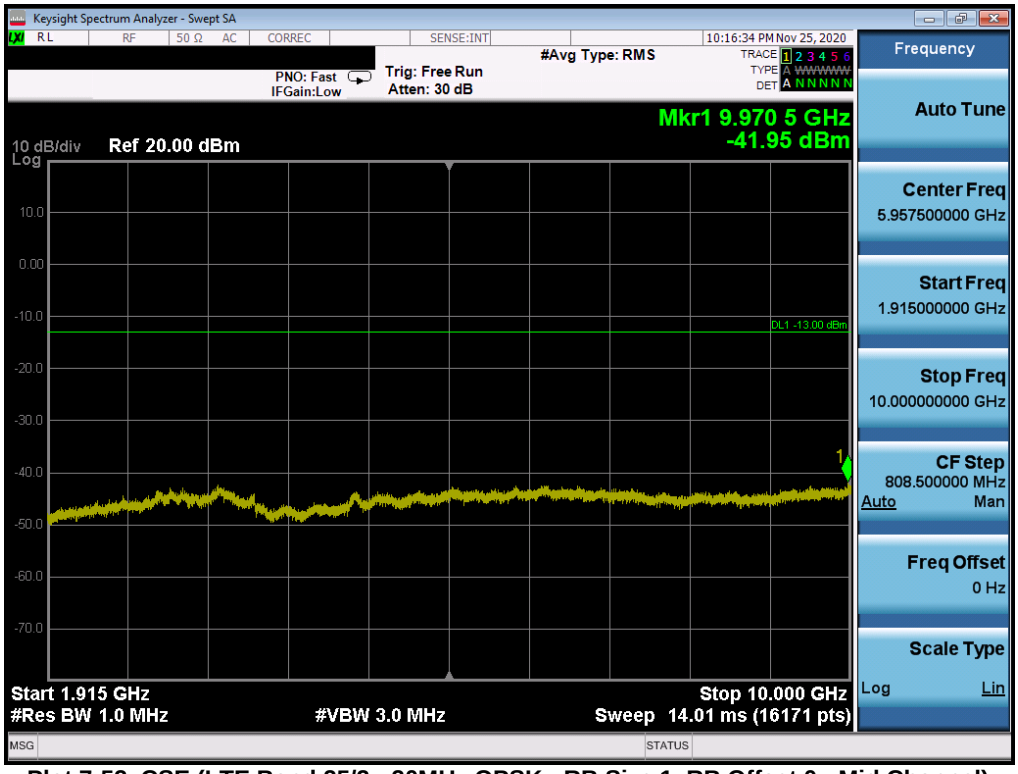
Plot 7-49. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



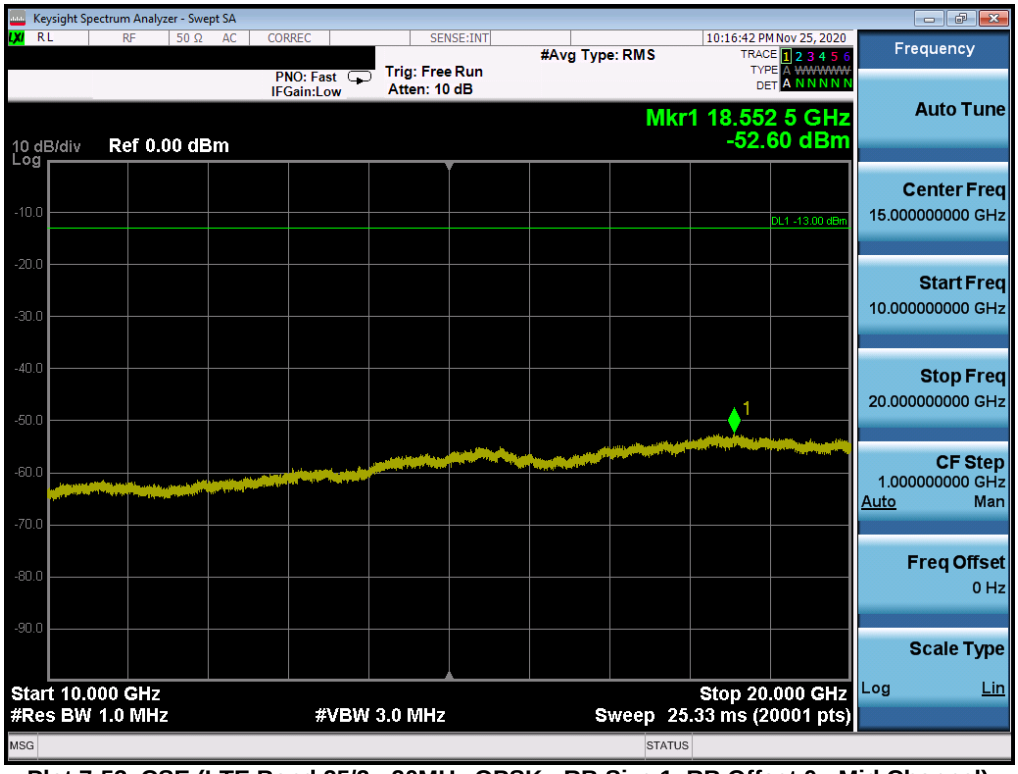
Plot 7-50. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



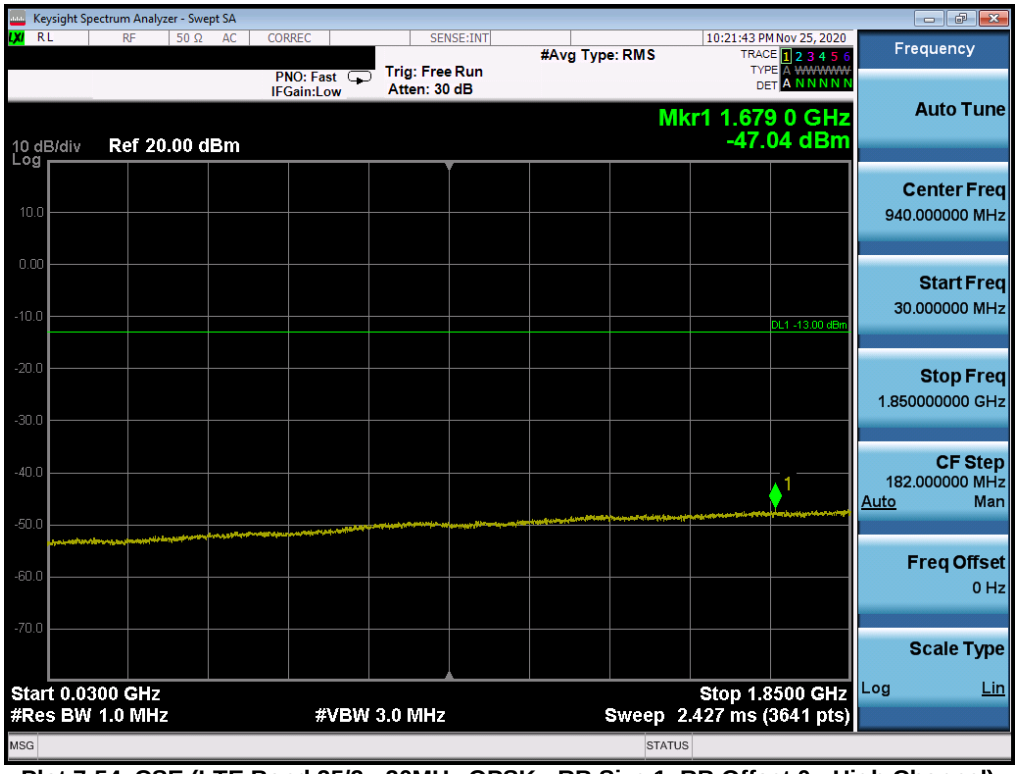
Plot 7-51. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



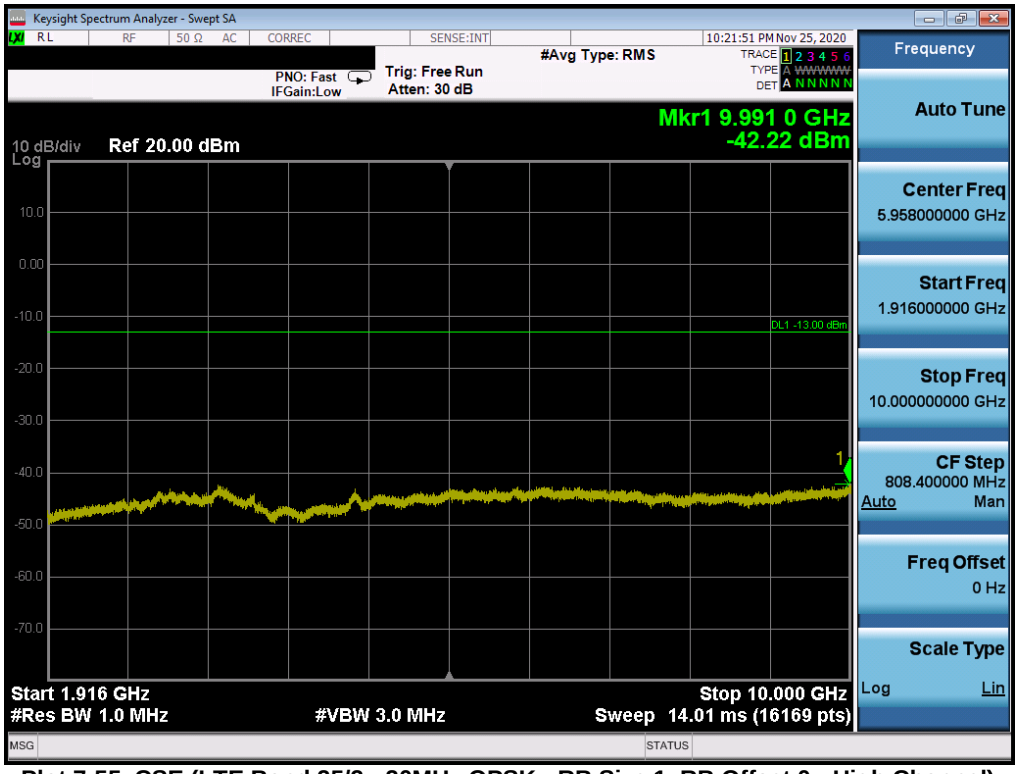
Plot 7-52. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



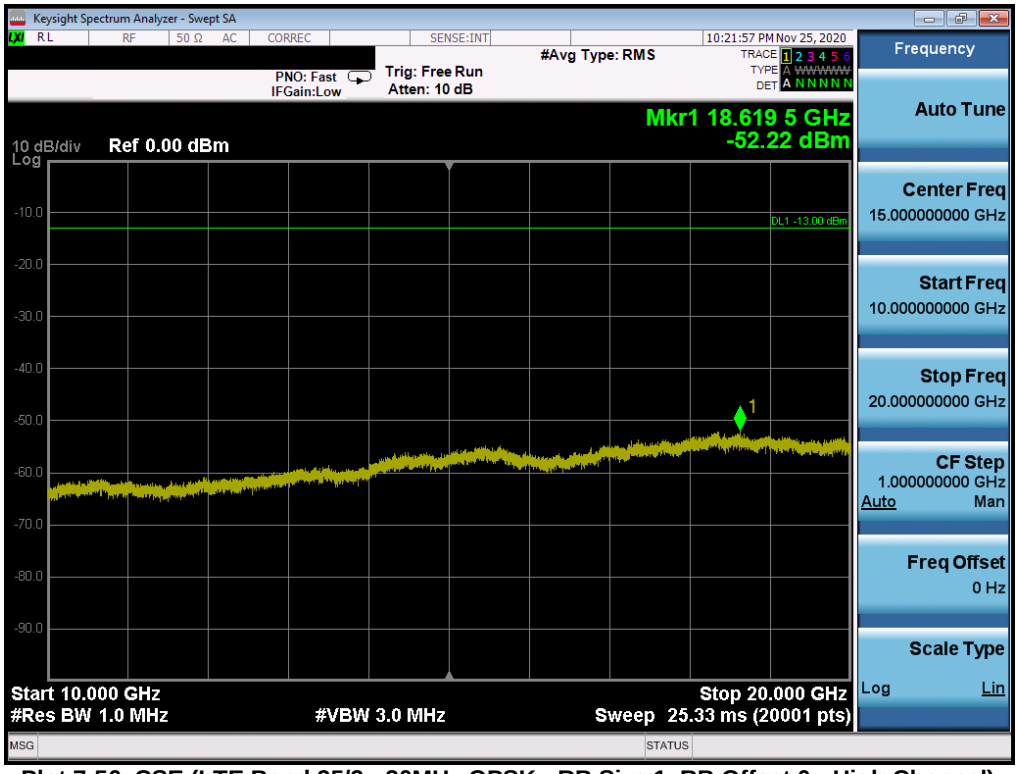
Plot 7-53. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



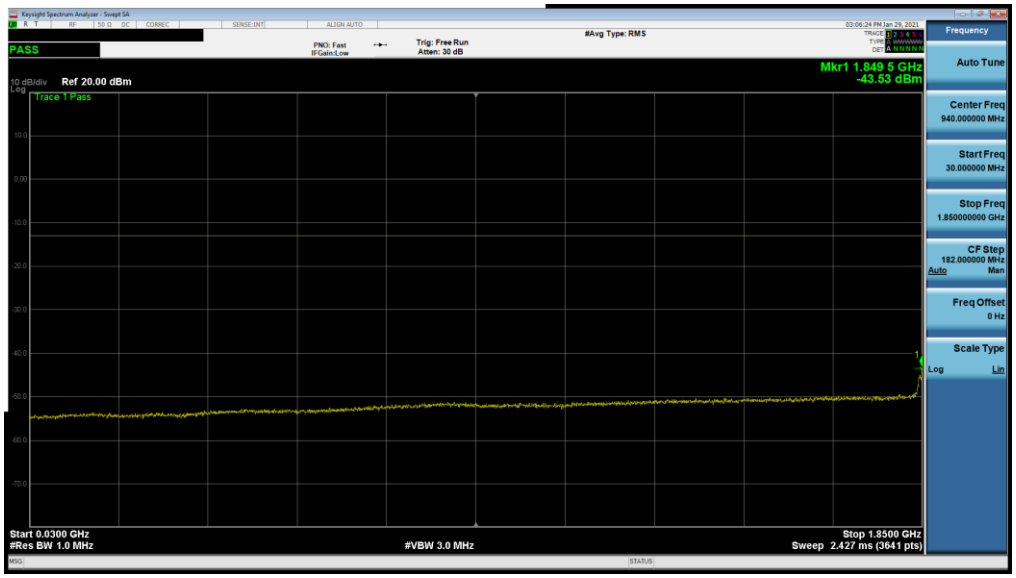
Plot 7-54. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



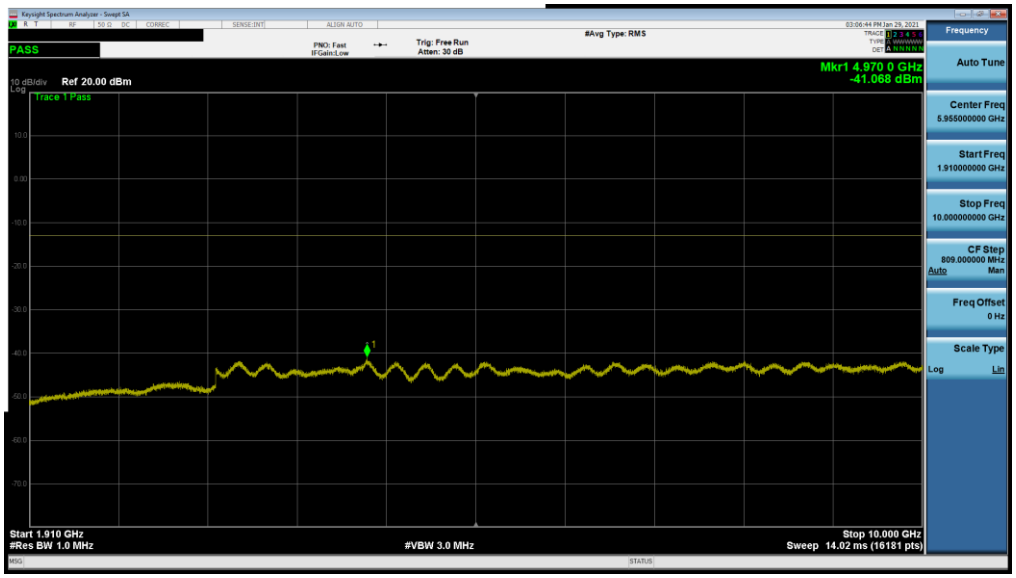
Plot 7-55. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



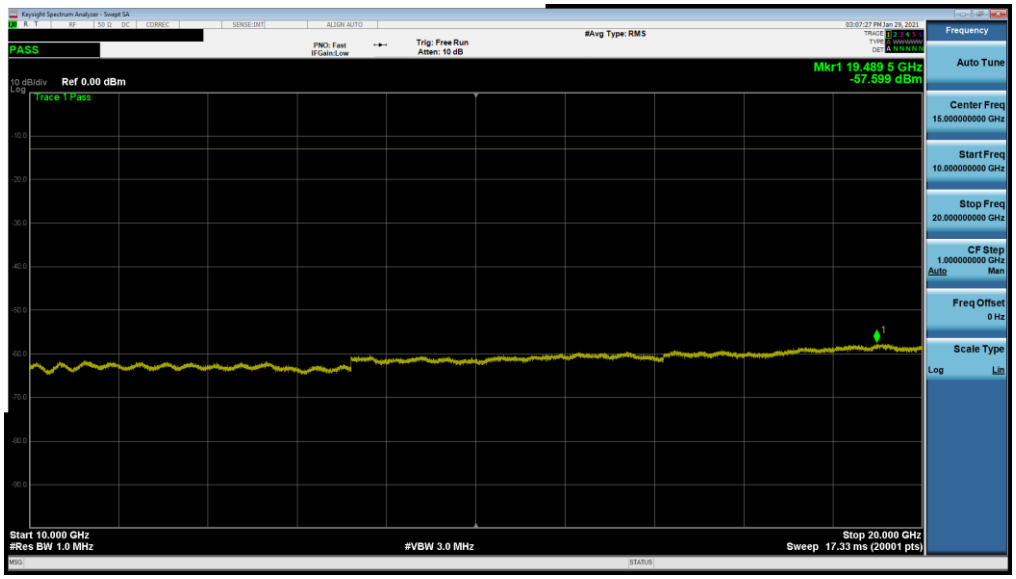
Plot 7-56. CSE (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



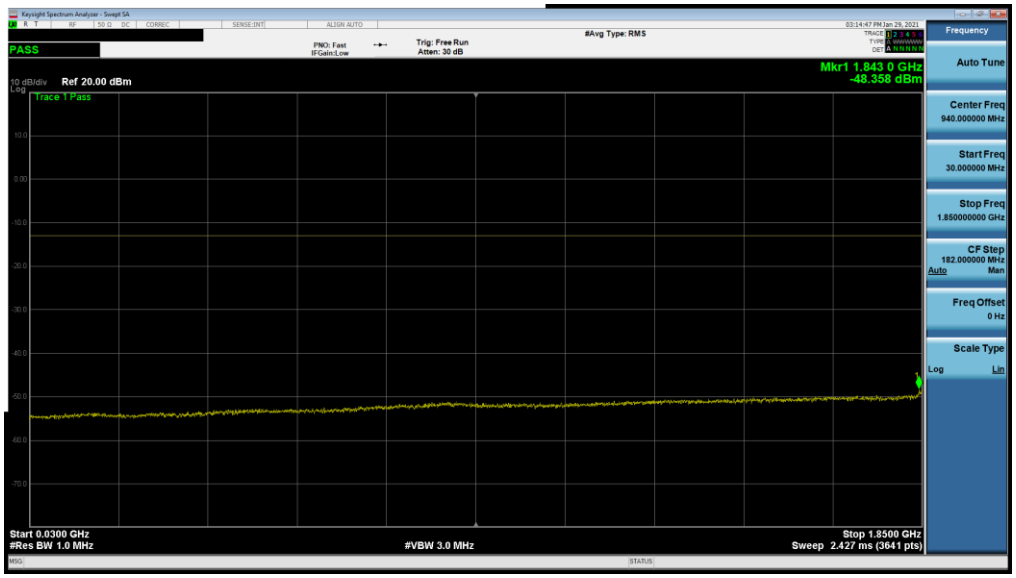
Plot 7-57. CSE (NR Band n25/2 -20.0MHz DFT-s-OFDM π/2 BPSK - RB Size 1, RB Offset 0 - Low Channel)



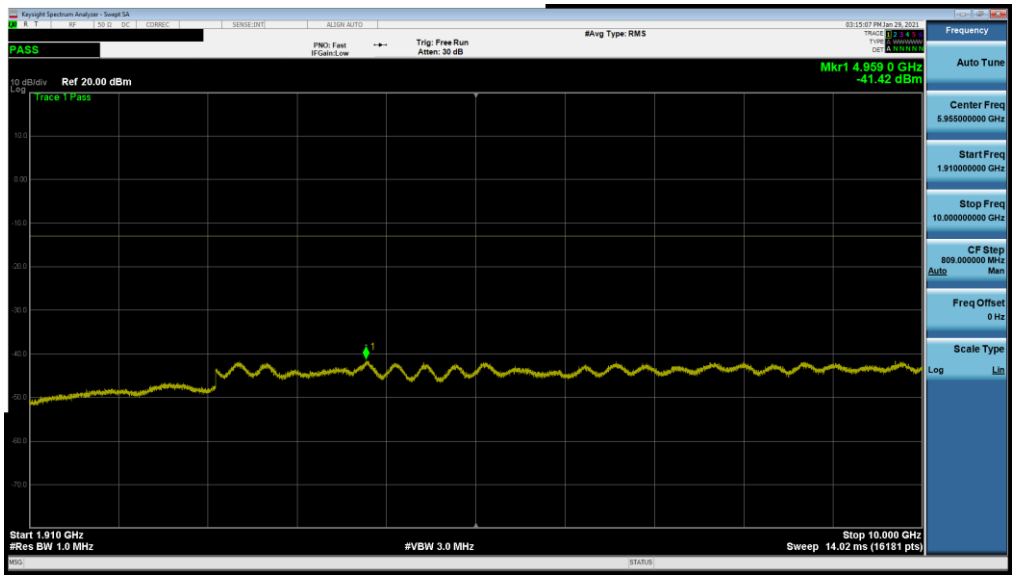
Plot 7-58. CSE (NR Band n25/2 - 20.0MHz DFT-s-OFDM π/2 BPSK - RB Size 1, RB Offset 0 - Low Channel)



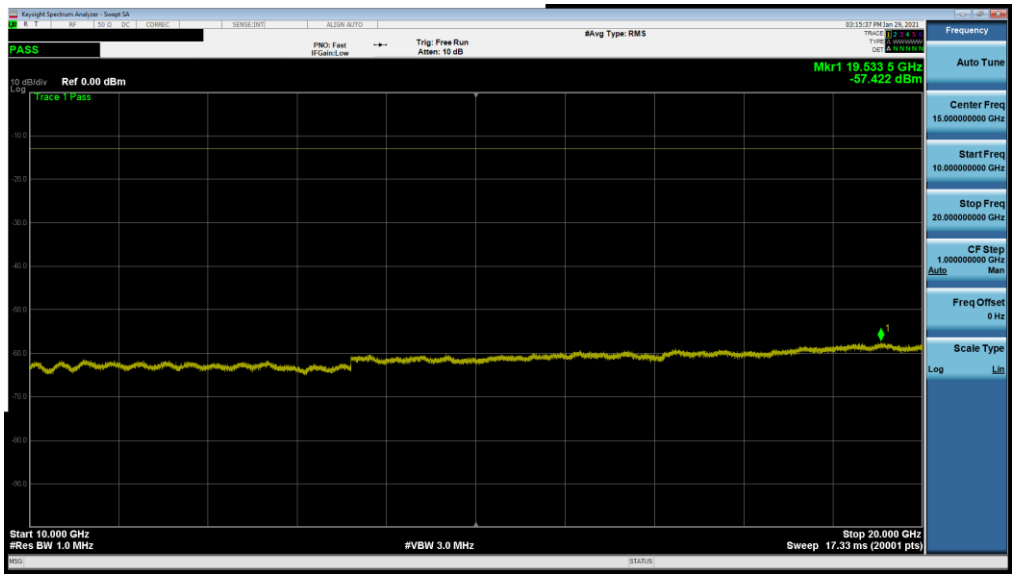
Plot 7-59. CSE (NR Band n25/2 - 20.0MHz DFT-s-OFDM π/2 BPSK - RB Size 1, RB Offset 0 - Low Channel)



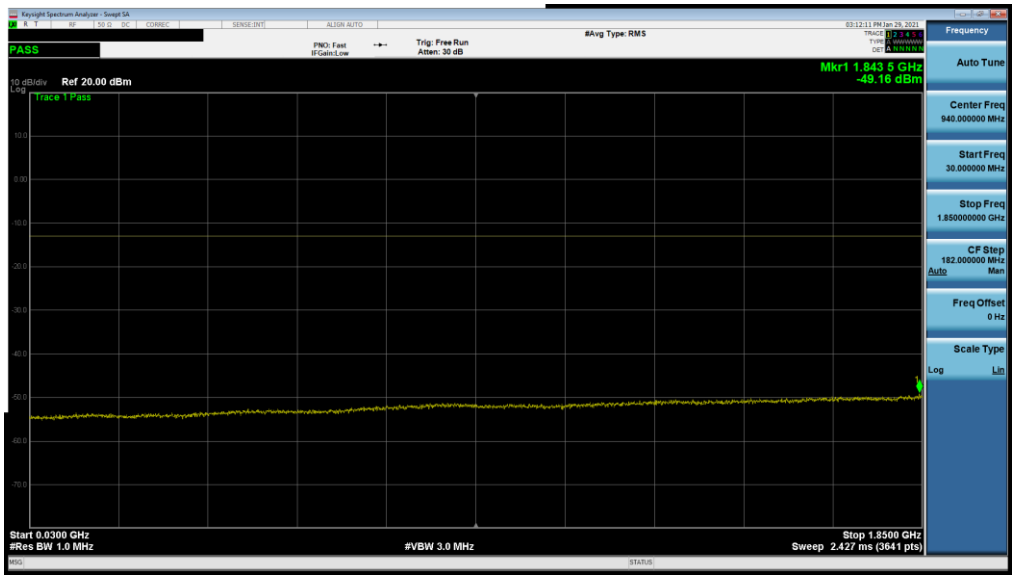
Plot 7-60. CSE (NR Band n25/2 - 20.0MHz DFT-s-OFDM π/2 BPSK - RB Size 1, RB Offset 0 - Mid Channel)



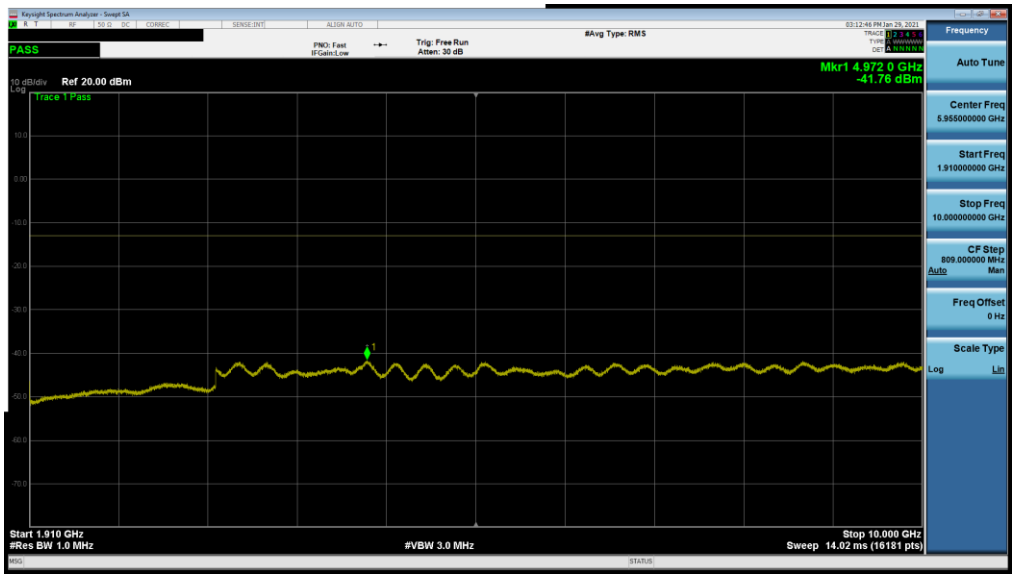
Plot 7-61. CSE (NR Band n25/2 - 20.0MHz DFT-s-OFDM π/2 BPSK - RB Size 1, RB Offset 0 - Mid Channel)



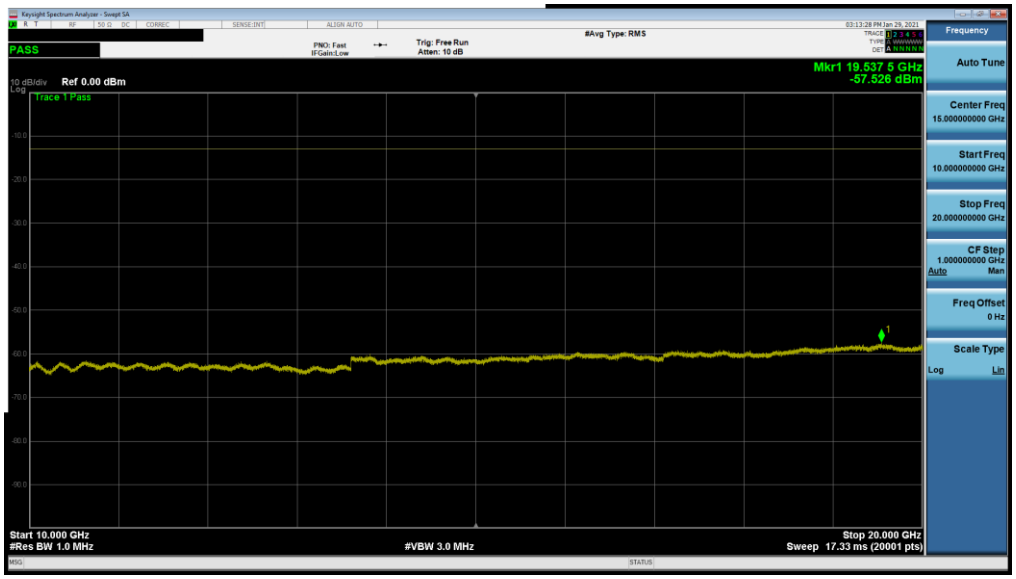
Plot 7-62. CSE (NR Band n25/2 - 20.0MHz DFT-s-OFDM π/2 BPSK - RB Size 1, RB Offset 0 - Mid Channel)



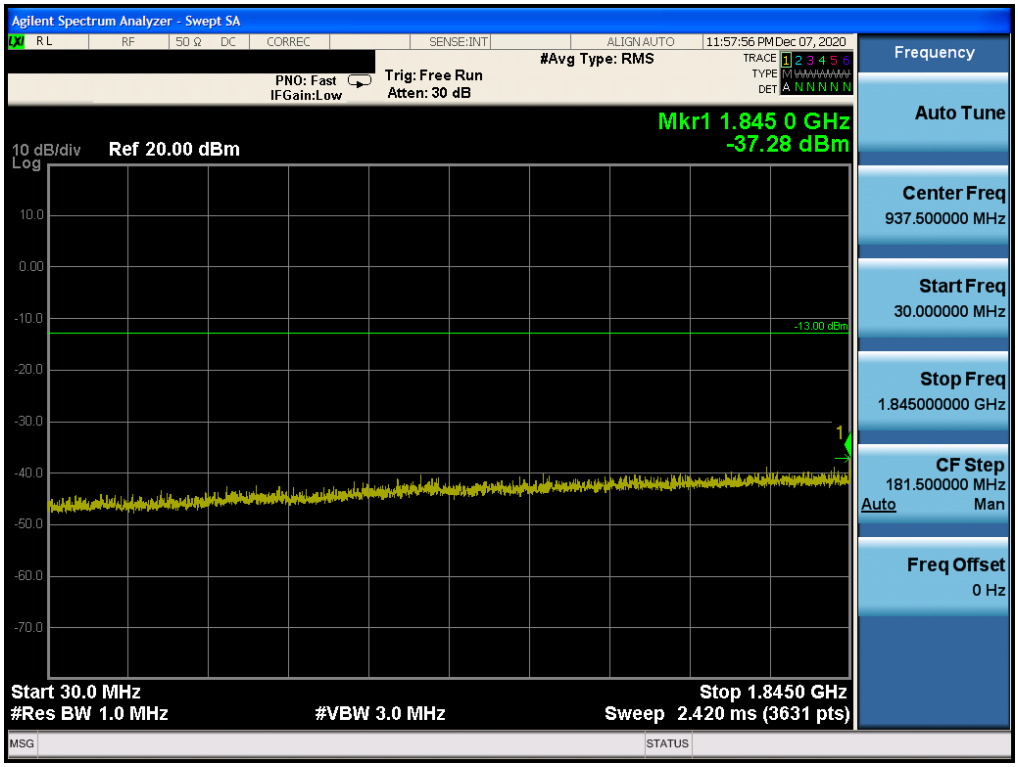
Plot 7-63. CSE (NR Band n25/2 - 20.0MHz DFT-s-OFDM π/2 BPSK - RB Size 1, RB Offset 0 - High Channel)



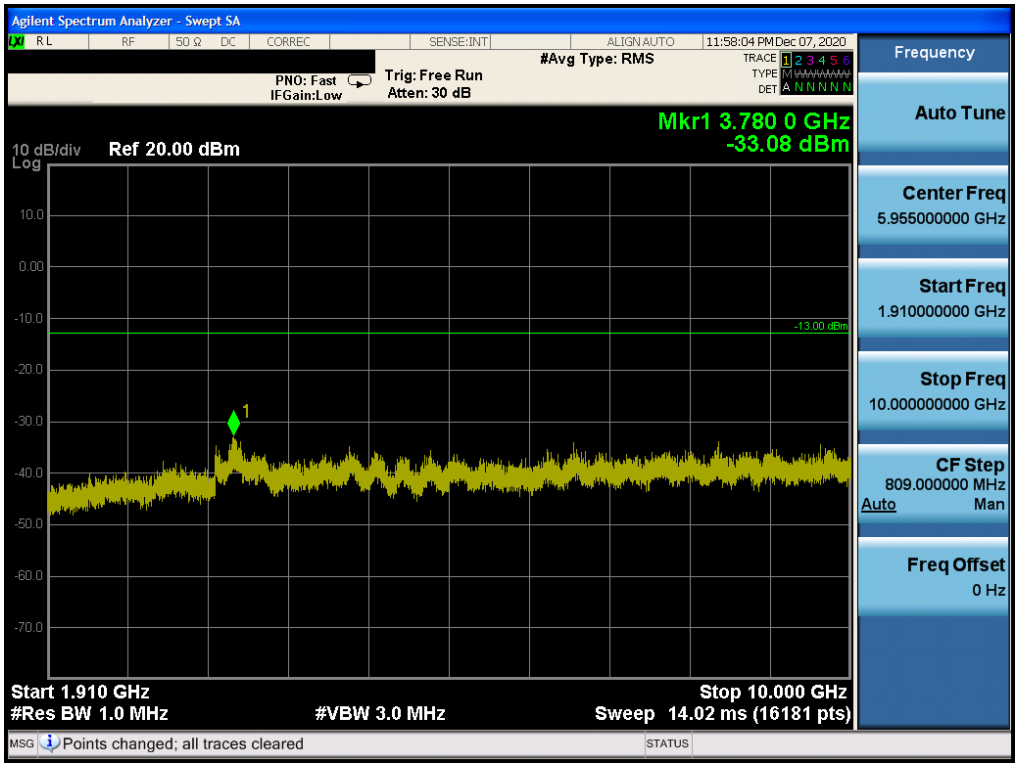
Plot 7-64. CSE (NR Band n25/2 - 20.0MHz DFT-s-OFDM π/2 BPSK - RB Size 1, RB Offset 0 - High Channel)



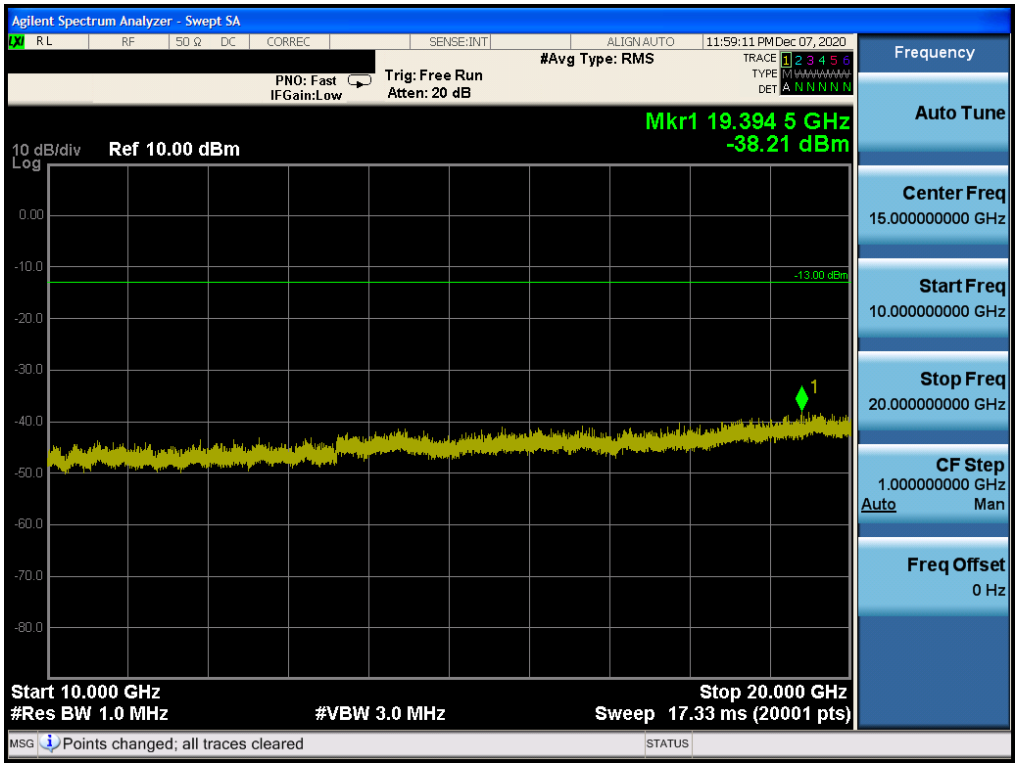
Plot 7-65. CSE (NR Band n25/2 - 20.0MHz DFT-s-OFDM π/2 BPSK - RB Size 1, RB Offset 0 - High Channel)



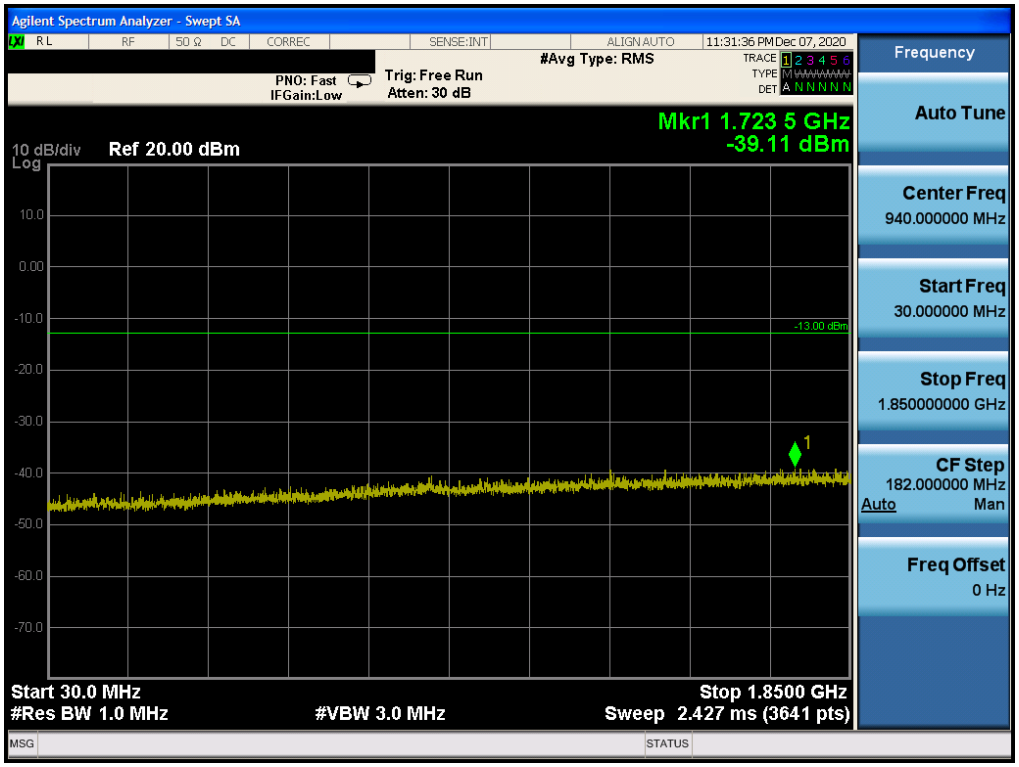
Plot 7-66. CSE (GPRS Ch. 512)



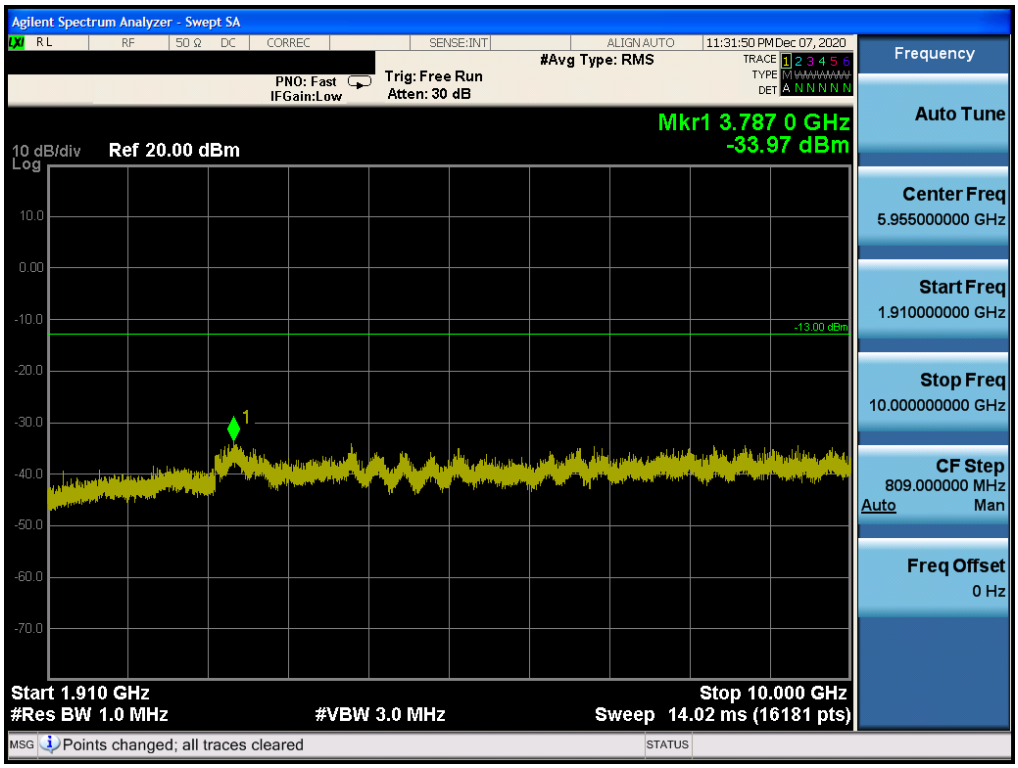
Plot 7-67. CSE (GPRS Ch. 512)



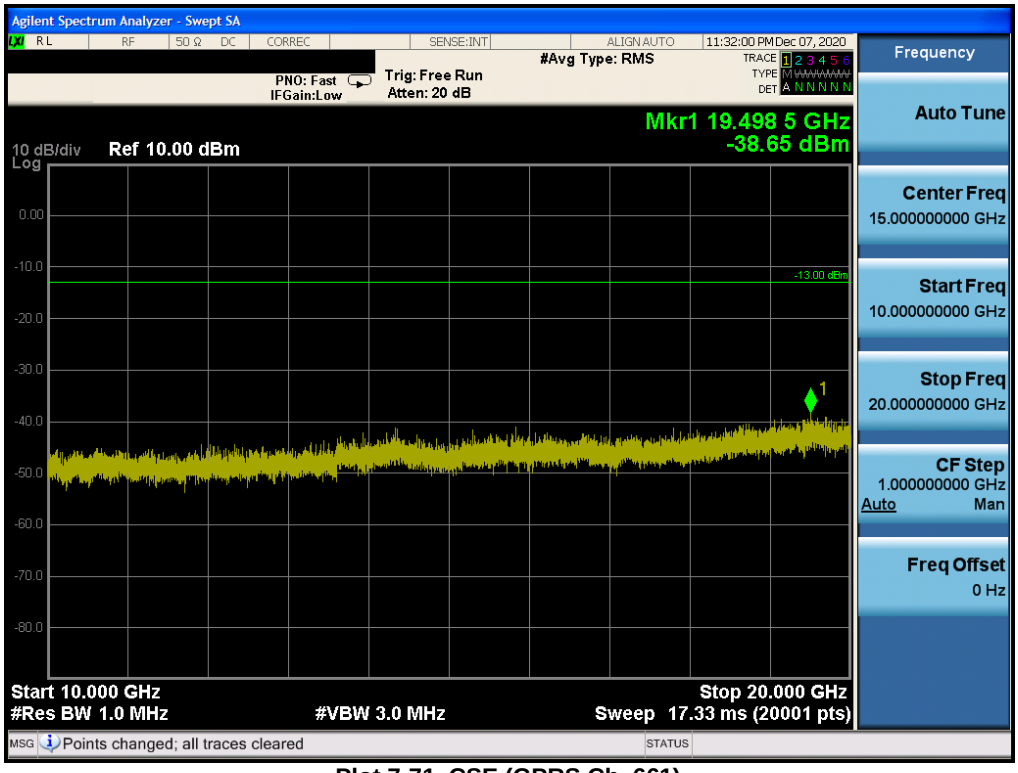
Plot 7-68. CSE (GPRS Ch. 512)



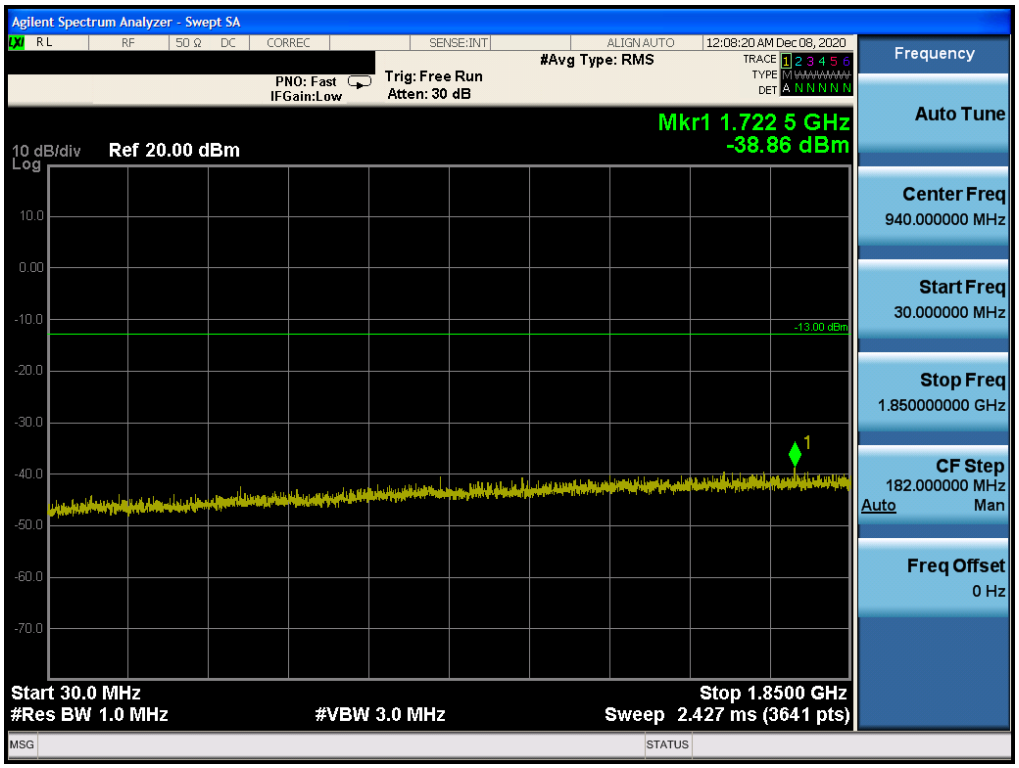
Plot 7-69. CSE (GPRS Ch. 661)



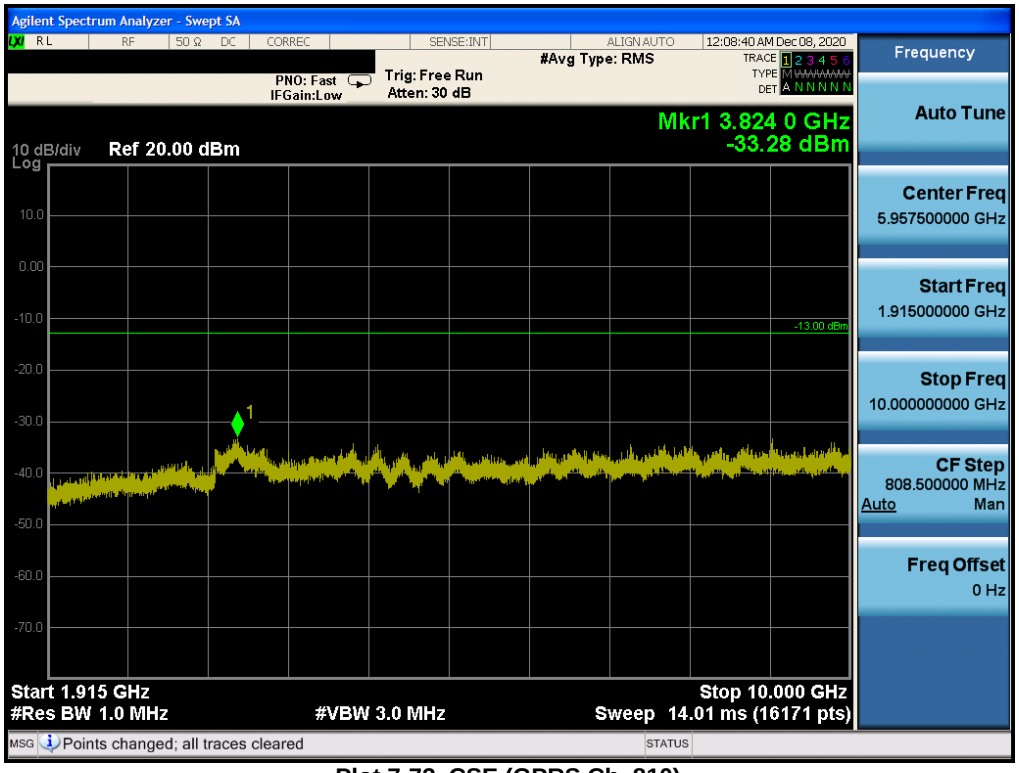
Plot 7-70. CSE (GPRS Ch. 661)



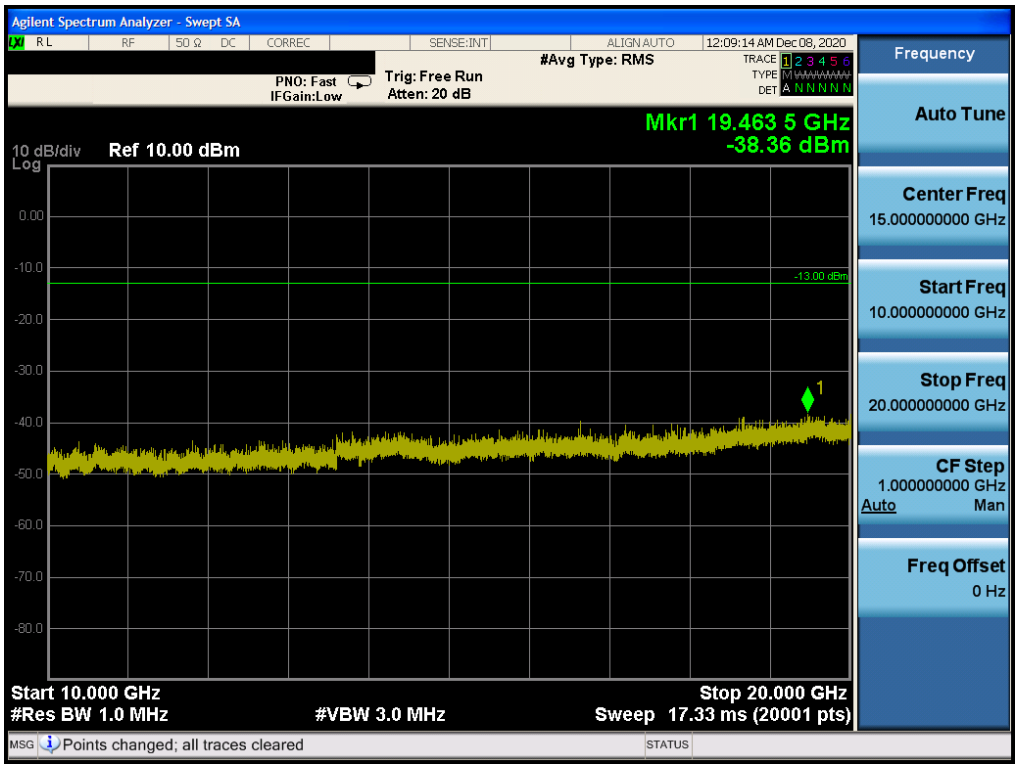
Plot 7-71. CSE (GPRS Ch. 661)



Plot 7-72. CSE (GPRS Ch. 810)

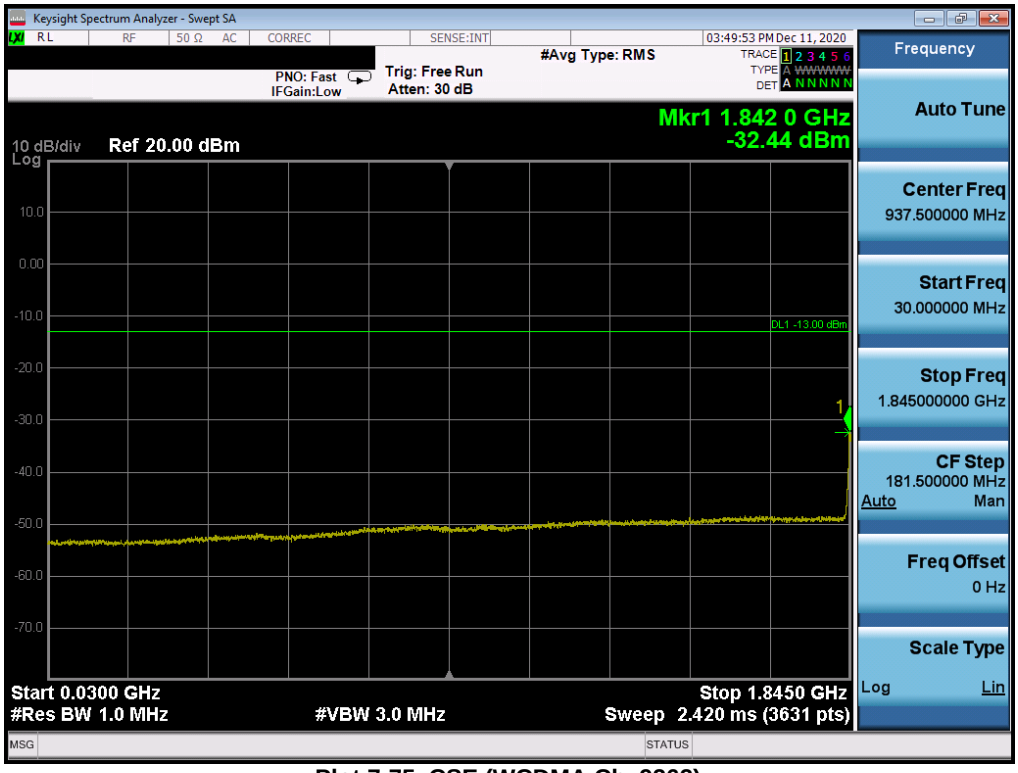


Plot 7-73. CSE (GPRS Ch. 810)



Plot 7-74. CSE (GPRS Ch. 810)

WCDMA PCS



Plot 7-75. CSE (WCDMA Ch. 9262)

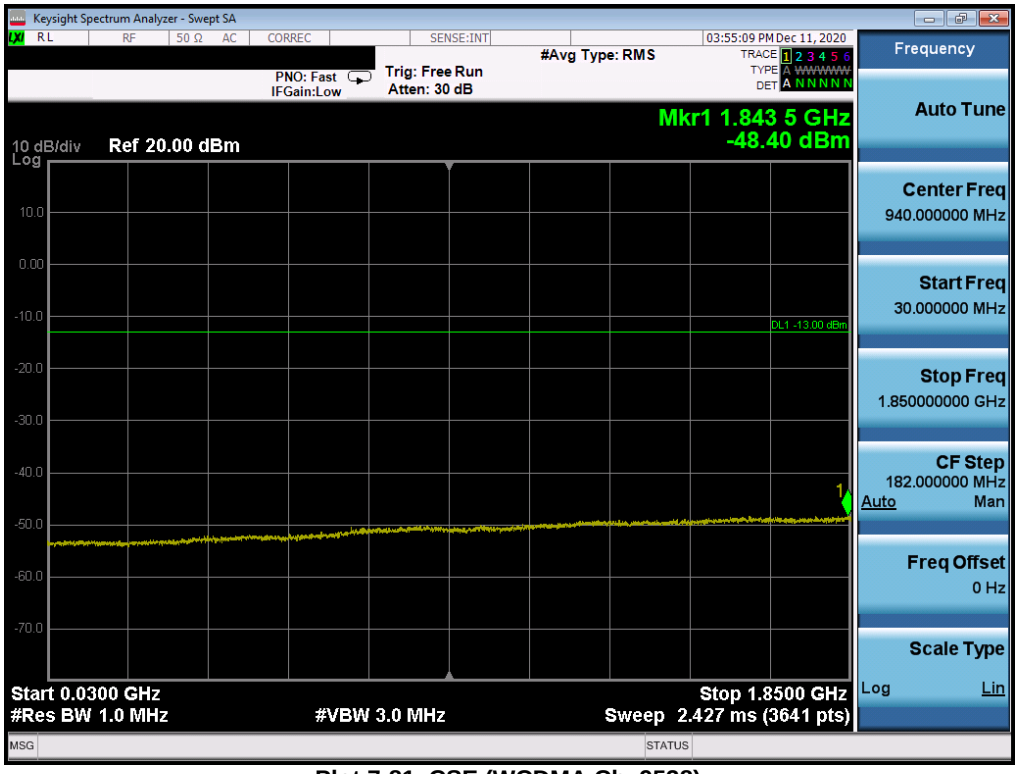
Plot 7-76. CSE (WCDMA Ch. 9262)

Plot 7-77. CSE (WCDMA Ch. 9262)

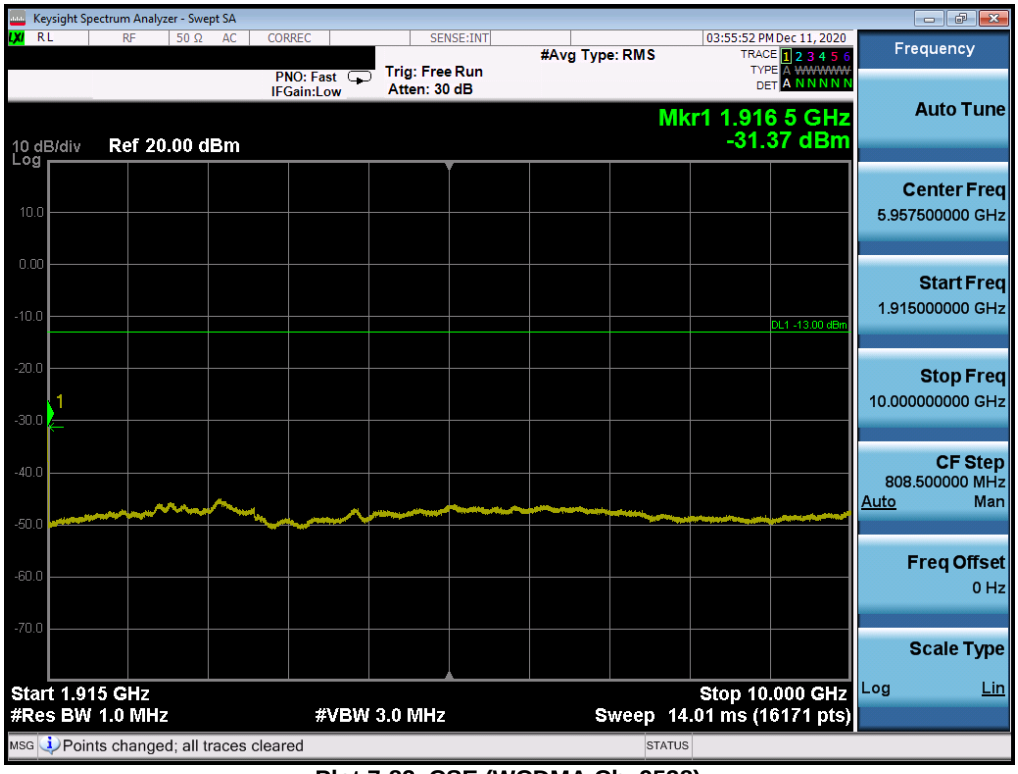
Plot 7-78. CSE (WCDMA Ch. 9400)

Plot 7-79. CSE (WCDMA Ch. 9400)

Plot 7-80. CSE (WCDMA Ch. 9400)



Plot 7-81. CSE (WCDMA Ch. 9538)



Plot 7-82. CSE (WCDMA Ch. 9538)

Plot 7-83. CSE (WCDMA Ch. 9538)

7.4 Band Edge Emissions at Antenna Terminal

§2.1051, §24.238(a)

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section. All ports were tested and only the worst case data was 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 and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW ≥ 1% of the emission bandwidth
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

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

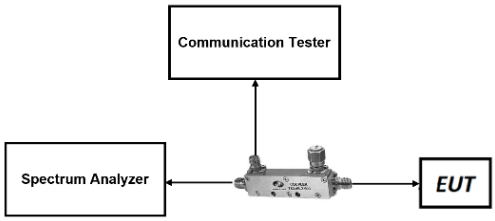


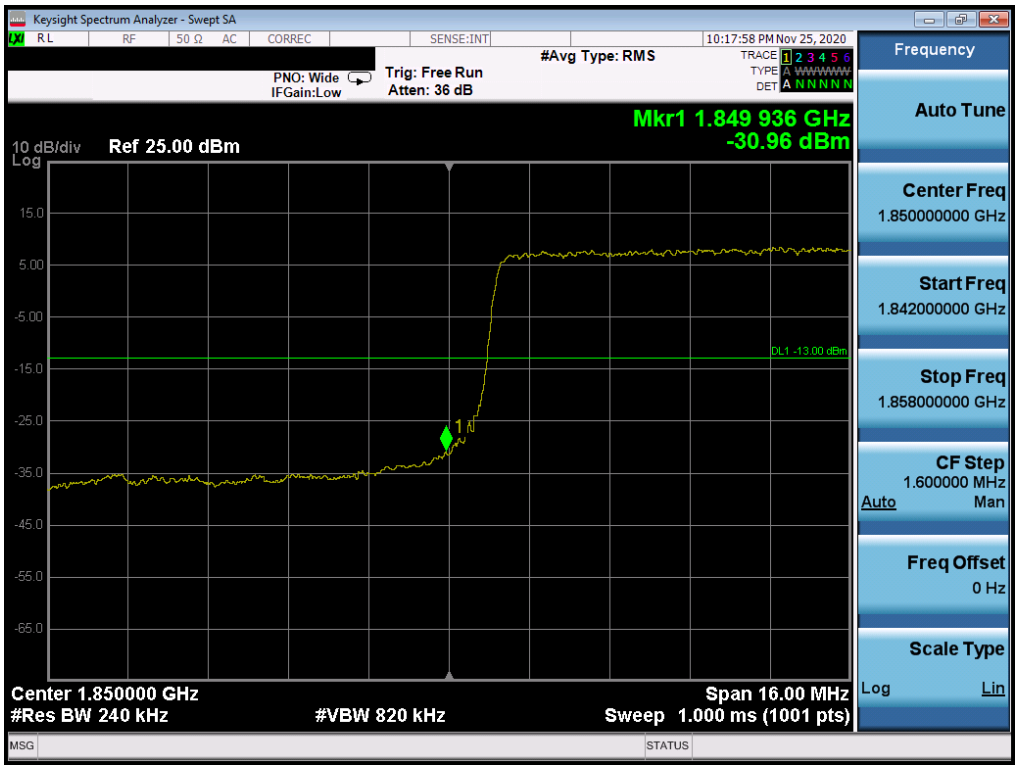
Figure 7-3. Test Instrument & Measurement Setup

Test Notes

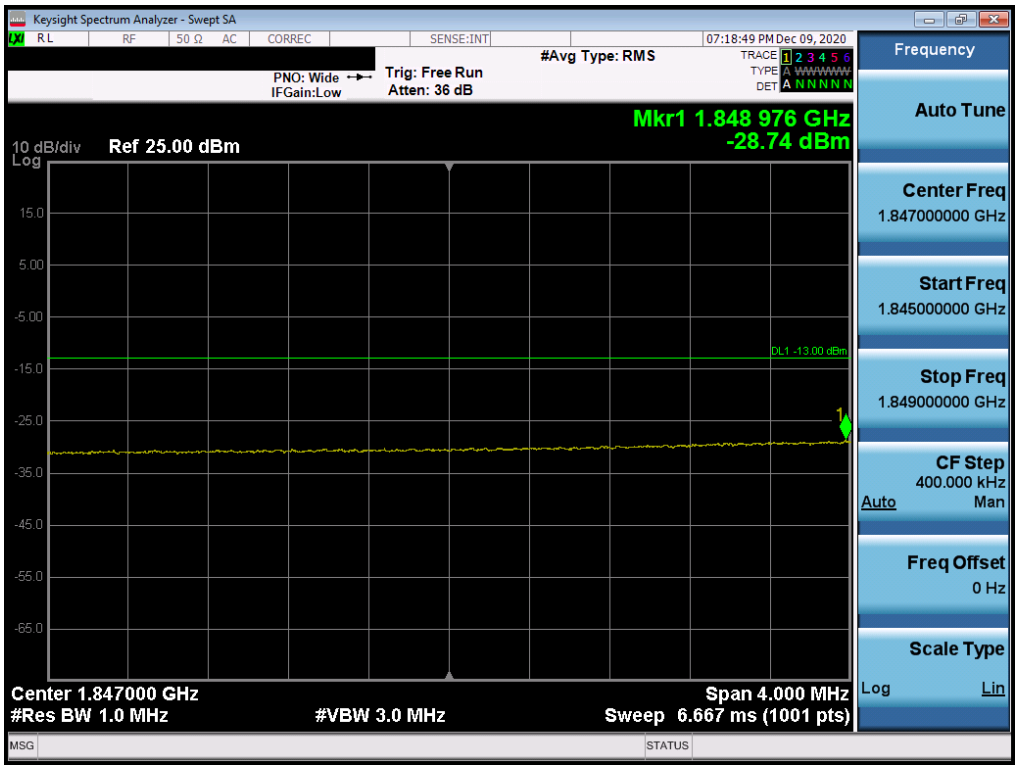
1. Per 24.238(a), in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission 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.

LTE Band 25



Plot 7-84. Lower Band Edge Plot (LTE Band 25 - 20MHz QPSK – Full RB Configuration)



Plot 7-85. Extended Lower Band Edge Plot (LTE Band 25 - 20MHz QPSK – Full RB Configuration)