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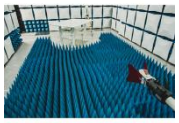

MEASUREMENT REPORT
LTE

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

Date of Testing:
12/10/2019 - 02/25/2020
Test Site/Location:
PCTEST. Morgan Hill, CA, USA
Test Report Serial No.:
1C1912170055-03-R1.BCG

FCC ID:	**BCGA2232**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model:	A2232, A2233
EUT Type:	Tablet Device
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part(s):	22, 24, & 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.

This revised Test Report (1C1912170055-03-R1.BCG) 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
TESTING CERT#2041.02

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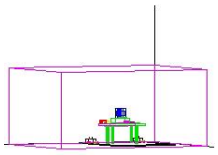
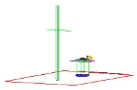


MEASUREMENT REPORT
FCC Part 22, 24, & 27



Mode	FCC Rule Part	Tx Frequency (MHz)	ERP		EIRP		Emission Designator	Modulation
			Max. Power (W)	Max. Power (dBm)	Max. Power (W)	Max. Power (dBm)		
LTE Band 12	27	699.7 - 715.3	0.133	21.25	0.219	23.40	1M11G7W	QPSK
LTE Band 12	27	699.7 - 715.3	0.111	20.46	0.182	22.61	1M11D7W	16QAM
LTE Band 12	27	699.7 - 715.3	0.092	19.62	0.150	21.77	1M11D7W	64QAM
LTE Band 12	27	700.5 - 714.5	0.132	21.19	0.216	23.34	2M72G7W	QPSK
LTE Band 12	27	700.5 - 714.5	0.110	20.42	0.181	22.57	2M72D7W	16QAM
LTE Band 12	27	700.5 - 714.5	0.091	19.60	0.150	21.75	2M72D7W	64QAM
LTE Band 12	27	701.5 - 713.5	0.133	21.25	0.219	23.40	4M54G7W	QPSK
LTE Band 12	27	701.5 - 713.5	0.109	20.37	0.179	22.52	4M54D7W	16QAM
LTE Band 12	27	701.5 - 713.5	0.093	19.70	0.153	21.85	4M53D7W	64QAM
LTE Band 12	27	704 - 711	0.131	21.16	0.214	23.31	9M05G7W	QPSK
LTE Band 12	27	704 - 711	0.106	20.27	0.175	22.42	9M04D7W	16QAM
LTE Band 12	27	704 - 711	0.094	19.75	0.155	21.90	9M05D7W	64QAM
LTE Band 17	27	706.5 - 713.5	0.133	21.25	0.219	23.40	4M54G7W	QPSK
LTE Band 17	27	706.5 - 713.5	0.112	20.50	0.184	22.65	4M54D7W	16QAM
LTE Band 17	27	706.5 - 713.5	0.091	19.58	0.149	21.73	4M53D7W	64QAM
LTE Band 17	27	709 - 711	0.133	21.24	0.218	23.39	9M05G7W	QPSK
LTE Band 17	27	709 - 711	0.112	20.50	0.184	22.65	9M04D7W	16QAM
LTE Band 17	27	709 - 711	0.089	19.48	0.146	21.63	9M05D7W	64QAM
LTE Band 13	27	779.5 - 784.5	0.133	21.25	0.219	23.40	4M54G7W	QPSK
LTE Band 13	27	779.5 - 784.5	0.108	20.35	0.178	22.50	4M54D7W	16QAM
LTE Band 13	27	779.5 - 784.5	0.087	19.42	0.144	21.57	4M53D7W	64QAM
LTE Band 13	27	782	0.133	21.25	0.219	23.40	9M04G7W	QPSK
LTE Band 13	27	782	0.111	20.47	0.183	22.62	9M03D7W	16QAM
LTE Band 13	27	782	0.092	19.63	0.151	21.78	9M03D7W	64QAM
LTE Band 5	22H	824.7 - 848.3	0.146	21.65	0.240	23.80	1M11G7W	QPSK
LTE Band 5	22H	824.7 - 848.3	0.129	21.11	0.212	23.26	1M11D7W	16QAM
LTE Band 5	22H	824.7 - 848.3	0.101	20.05	0.166	22.20	1M11D7W	64QAM
LTE Band 5	22H	825.5 - 847.5	0.146	21.65	0.240	23.80	2M73G7W	QPSK
LTE Band 5	22H	825.5 - 847.5	0.129	21.10	0.211	23.25	2M73D7W	16QAM
LTE Band 5	22H	825.5 - 847.5	0.104	20.15	0.170	22.30	2M73D7W	64QAM
LTE Band 5	22H	826.5 - 846.5	0.146	21.65	0.240	23.80	4M55G7W	QPSK
LTE Band 5	22H	826.5 - 846.5	0.130	21.14	0.213	23.29	4M55D7W	16QAM
LTE Band 5	22H	826.5 - 846.5	0.106	20.26	0.174	22.41	4M54D7W	64QAM
LTE Band 5	22H	829 - 844	0.145	21.62	0.238	23.77	9M07G7W	QPSK
LTE Band 5	22H	829 - 844	0.126	21.01	0.207	23.16	9M08D7W	16QAM
LTE Band 5	22H	829 - 844	0.102	20.07	0.167	22.22	9M05D7W	64QAM
LTE Band 26	22H	824.7 - 848.3	0.146	21.65	0.240	23.80	1M11G7W	QPSK
LTE Band 26	22H	824.7 - 848.3	0.142	21.53	0.233	23.68	1M11D7W	16QAM
LTE Band 26	22H	824.7 - 848.3	0.099	19.96	0.163	22.11	1M11D7W	64QAM
LTE Band 26	22H	825.5 - 847.5	0.145	21.62	0.238	23.77	2M73G7W	QPSK
LTE Band 26	22H	825.5 - 847.5	0.140	21.45	0.229	23.60	2M73D7W	16QAM
LTE Band 26	22H	825.5 - 847.5	0.100	20.02	0.165	22.17	2M73D7W	64QAM
LTE Band 26	22H	826.5 - 846.5	0.144	21.57	0.236	23.72	4M55G7W	QPSK
LTE Band 26	22H	826.5 - 846.5	0.134	21.28	0.220	23.43	4M55D7W	16QAM
LTE Band 26	22H	826.5 - 846.5	0.092	19.62	0.150	21.77	4M54D7W	64QAM
LTE Band 26	22H	829 - 844	0.141	21.50	0.232	23.65	9M07G7W	QPSK
LTE Band 26	22H	829 - 844	0.134	21.27	0.220	23.42	9M08D7W	16QAM
LTE Band 26	22H	829 - 844	0.090	19.53	0.147	21.68	9M05D7W	64QAM

EUT Overview (Low Bands)

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Mode	FCC Rule Part	Tx Frequency (MHz)	EIRP		Emission Designator	Modulation
			Max. Power (W)	Max. Power (dBm)		
LTE Band 4	27	1710.7 - 1754.3	0.239	23.78	1M11G7W	QPSK
LTE Band 4	27	1710.7 - 1754.3	0.190	22.78	1M10D7W	16QAM
LTE Band 4	27	1710.7 - 1754.3	0.165	22.18	1M11D7W	64QAM
LTE Band 4	27	1711.5 - 1753.5	0.234	23.70	2M72G7W	QPSK
LTE Band 4	27	1711.5 - 1753.5	0.199	22.99	2M72D7W	16QAM
LTE Band 4	27	1711.5 - 1753.5	0.168	22.26	2M72D7W	64QAM
LTE Band 4	27	1712.5 - 1752.5	0.238	23.77	4M54G7W	QPSK
LTE Band 4	27	1712.5 - 1752.5	0.200	23.02	4M53D7W	16QAM
LTE Band 4	27	1712.5 - 1752.5	0.165	22.17	4M53D7W	64QAM
LTE Band 4	27	1715 - 1750	0.234	23.70	9M06G7W	QPSK
LTE Band 4	27	1715 - 1750	0.186	22.70	9M03D7W	16QAM
LTE Band 4	27	1715 - 1750	0.149	21.73	9M04D7W	64QAM
LTE Band 4	27	1717.5 - 1747.5	0.228	23.58	13M6G7W	QPSK
LTE Band 4	27	1717.5 - 1747.5	0.190	22.78	13M6D7W	16QAM
LTE Band 4	27	1717.5 - 1747.5	0.149	21.73	13M6D7W	64QAM
LTE Band 4	27	1720 - 1745	0.236	23.72	18M1G7W	QPSK
LTE Band 4	27	1720 - 1745	0.196	22.93	18M1D7W	16QAM
LTE Band 4	27	1720 - 1745	0.155	21.91	18M1D7W	64QAM
LTE Band 66	27	1710.7 - 1779.3	0.232	23.65	1M11G7W	QPSK
LTE Band 66	27	1710.7 - 1779.3	0.185	22.67	1M10D7W	16QAM
LTE Band 66	27	1710.7 - 1779.3	0.149	21.74	1M11D7W	64QAM
LTE Band 66	27	1711.5 - 1778.5	0.232	23.66	2M72G7W	QPSK
LTE Band 66	27	1711.5 - 1778.5	0.190	22.78	2M72D7W	16QAM
LTE Band 66	27	1711.5 - 1778.5	0.152	21.81	2M72D7W	64QAM
LTE Band 66	27	1712.5 - 1777.5	0.235	23.71	4M54G7W	QPSK
LTE Band 66	27	1712.5 - 1777.5	0.191	22.80	4M53D7W	16QAM
LTE Band 66	27	1712.5 - 1777.5	0.157	21.97	4M53D7W	64QAM
LTE Band 66	27	1715 - 1775	0.240	23.80	9M06G7W	QPSK
LTE Band 66	27	1715 - 1775	0.192	22.83	9M03D7W	16QAM
LTE Band 66	27	1715 - 1775	0.153	21.84	9M04D7W	64QAM
LTE Band 66	27	1717.5 - 1772.5	0.240	23.80	13M6G7W	QPSK
LTE Band 66	27	1717.5 - 1772.5	0.194	22.87	13M6D7W	16QAM
LTE Band 66	27	1717.5 - 1772.5	0.153	21.85	13M6D7W	64QAM
LTE Band 66	27	1720 - 1770	0.240	23.80	18M1G7W	QPSK
LTE Band 66	27	1720 - 1770	0.194	22.88	18M1D7W	16QAM
LTE Band 66	27	1720 - 1770	0.164	22.14	18M1D7W	64QAM
LTE Band 2	24E	1850.7 - 1909.3	0.294	24.68	1M11G7W	QPSK
LTE Band 2	24E	1850.7 - 1909.3	0.246	23.91	1M11D7W	16QAM
LTE Band 2	24E	1850.7 - 1909.3	0.200	23.01	1M11D7W	64QAM
LTE Band 2	24E	1851.5 - 1908.5	0.294	24.68	2M73G7W	QPSK
LTE Band 2	24E	1851.5 - 1908.5	0.252	24.01	2M73D7W	16QAM
LTE Band 2	24E	1851.5 - 1908.5	0.200	23.00	2M72D7W	64QAM
LTE Band 2	24E	1852.5 - 1907.5	0.294	24.68	4M54G7W	QPSK
LTE Band 2	24E	1852.5 - 1907.5	0.252	24.01	4M53D7W	16QAM
LTE Band 2	24E	1852.5 - 1907.5	0.203	23.08	4M55D7W	64QAM
LTE Band 2	24E	1855 - 1905	0.295	24.70	9M04G7W	QPSK
LTE Band 2	24E	1855 - 1905	0.251	23.99	9M03D7W	16QAM
LTE Band 2	24E	1855 - 1905	0.213	23.29	9M02D7W	64QAM
LTE Band 2	24E	1857.5 - 1902.5	0.302	24.80	13M6G7W	QPSK
LTE Band 2	24E	1857.5 - 1902.5	0.256	24.08	13M5D7W	16QAM
LTE Band 2	24E	1857.5 - 1902.5	0.202	23.06	13M6D7W	64QAM
LTE Band 2	24E	1860 - 1900	0.295	24.70	18M1G7W	QPSK
LTE Band 2	24E	1860 - 1900	0.252	24.01	18M1D7W	16QAM
LTE Band 2	24E	1860 - 1900	0.200	23.00	18M1D7W	64QAM
LTE Band 25	24E	1850.7 - 1914.3	0.302	24.80	1M11G7W	QPSK
LTE Band 25	24E	1850.7 - 1914.3	0.256	24.09	1M11D7W	16QAM
LTE Band 25	24E	1850.7 - 1914.3	0.201	23.04	1M11D7W	64QAM
LTE Band 25	24E	1851.5 - 1913.5	0.298	24.74	2M73G7W	QPSK
LTE Band 25	24E	1851.5 - 1913.5	0.231	23.63	2M73D7W	16QAM
LTE Band 25	24E	1851.5 - 1913.5	0.194	22.88	2M72D7W	64QAM
LTE Band 25	24E	1852.5 - 1912.5	0.302	24.80	4M54G7W	QPSK
LTE Band 25	24E	1852.5 - 1912.5	0.270	24.31	4M53D7W	16QAM
LTE Band 25	24E	1852.5 - 1912.5	0.207	23.17	4M55D7W	64QAM
LTE Band 25	24E	1855 - 1910	0.302	24.80	9M04G7W	QPSK
LTE Band 25	24E	1855 - 1910	0.261	24.16	9M03D7W	16QAM
LTE Band 25	24E	1855 - 1910	0.205	23.12	9M02D7W	64QAM
LTE Band 25	24E	1857.5 - 1907.5	0.302	24.80	13M6G7W	QPSK
LTE Band 25	24E	1857.5 - 1907.5	0.262	24.18	13M5D7W	16QAM
LTE Band 25	24E	1857.5 - 1907.5	0.208	23.19	13M6D7W	64QAM
LTE Band 25	24E	1860 - 1905	0.302	24.80	18M1G7W	QPSK
LTE Band 25	24E	1860 - 1905	0.266	24.25	18M1D7W	16QAM
LTE Band 25	24E	1860 - 1905	0.214	23.30	18M1D7W	64QAM

EUT Overview (Mid Bands)

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Mode	FCC Rule Part	Tx Frequency (MHz)	EIRP		Emission Designator	Modulation
			Max. Power (W)	Max. Power (dBm)		
LTE Band 30	27	2307.5 - 2312.5	0.202	23.05	4M54G7W	QPSK
LTE Band 30	27	2307.5 - 2312.5	0.172	22.36	4M54D7W	16QAM
LTE Band 30	27	2307.5 - 2312.5	0.138	21.40	4M55D7W	64QAM
LTE Band 30	27	2310	0.202	23.05	9M05G7W	QPSK
LTE Band 30	27	2310	0.175	22.42	9M09D7W	16QAM
LTE Band 30	27	2310	0.138	21.40	9M04D7W	64QAM
LTE Band 7	27	2502.5 - 2567.5	0.434	26.37	4M56G7W	QPSK
LTE Band 7	27	2502.5 - 2567.5	0.389	25.90	4M54D7W	16QAM
LTE Band 7	27	2502.5 - 2567.5	0.296	24.72	4M56D7W	64QAM
LTE Band 7	27	2505 - 2565	0.437	26.40	9M09G7W	QPSK
LTE Band 7	27	2505 - 2565	0.393	25.94	9M07D7W	16QAM
LTE Band 7	27	2505 - 2565	0.290	24.63	9M06D7W	64QAM
LTE Band 7	27	2507.5 - 2562.5	0.437	26.40	13M6G7W	QPSK
LTE Band 7	27	2507.5 - 2562.5	0.373	25.72	13M6D7W	16QAM
LTE Band 7	27	2507.5 - 2562.5	0.299	24.75	13M6D7W	64QAM
LTE Band 7	27	2510 - 2560	0.437	26.40	18M1G7W	QPSK
LTE Band 7	27	2510 - 2560	0.400	26.02	18M1D7W	16QAM
LTE Band 7	27	2510 - 2560	0.288	24.59	18M1D7W	64QAM
LTE Band 41 (PC2)	27	2498.5 - 2687.5	0.867	29.38	4M56G7W	QPSK
LTE Band 41 (PC2)	27	2498.5 - 2687.5	0.701	28.46	4M55D7W	16QAM
LTE Band 41 (PC2)	27	2498.5 - 2687.5	0.568	27.54	4M58D7W	64QAM
LTE Band 41 (PC2)	27	2501 - 2685	0.841	29.25	9M09G7W	QPSK
LTE Band 41 (PC2)	27	2501 - 2685	0.701	28.46	9M10D7W	16QAM
LTE Band 41 (PC2)	27	2501 - 2685	0.552	27.42	9M08D7W	64QAM
LTE Band 41 (PC2)	27	2503.5 - 2682.5	0.845	29.27	13M6G7W	QPSK
LTE Band 41 (PC2)	27	2503.5 - 2682.5	0.701	28.46	13M6D7W	16QAM
LTE Band 41 (PC2)	27	2503.5 - 2682.5	0.558	27.47	13M6D7W	64QAM
LTE Band 41 (PC2)	27	2506 - 2680	0.861	29.35	18M2G7W	QPSK
LTE Band 41 (PC2)	27	2506 - 2680	0.723	28.59	18M1D7W	16QAM
LTE Band 41 (PC2)	27	2506 - 2680	0.587	27.69	18M1D7W	64QAM
LTE Band 41 (PC3)	27	2498.5 - 2687.5	0.433	26.36	4M56G7W	QPSK
LTE Band 41 (PC3)	27	2498.5 - 2687.5	0.356	25.51	4M55D7W	16QAM
LTE Band 41 (PC3)	27	2498.5 - 2687.5	0.313	24.95	4M58D7W	64QAM
LTE Band 41 (PC3)	27	2501 - 2685	0.435	26.38	9M09G7W	QPSK
LTE Band 41 (PC3)	27	2501 - 2685	0.391	25.92	9M10D7W	16QAM
LTE Band 41 (PC3)	27	2501 - 2685	0.306	24.86	9M08D7W	64QAM
LTE Band 41 (PC3)	27	2503.5 - 2682.5	0.437	26.40	13M6G7W	QPSK
LTE Band 41 (PC3)	27	2503.5 - 2682.5	0.386	25.87	13M6D7W	16QAM
LTE Band 41 (PC3)	27	2503.5 - 2682.5	0.299	24.76	13M6D7W	64QAM
LTE Band 41 (PC3)	27	2506 - 2680	0.437	26.40	18M2G7W	QPSK
LTE Band 41 (PC3)	27	2506 - 2680	0.385	25.85	18M1D7W	16QAM
LTE Band 41 (PC3)	27	2506 - 2680	0.311	24.93	18M1D7W	64QAM

EUT Overview (High Bands)

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1.0 INTRODUCTION

1.1 Scope

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

1.2 PCTEST Test Location

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

1.3 Test Facility / Accreditations

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

- PCTEST is an ISO 17025-2005 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.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2232**. The test data contained in this report pertains only to the emissions due to the EUT's LTE function.

Test Device Serial No.: DLXZN00JP57G, DLXZN002P57G

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE, HDR4, HDR8)

LTE Band 12 (698 - 716 MHz) overlaps the entire frequency range of LTE Band 17 (704 - 716 MHz). Therefore, test data provided in this report covers Band 17 as well as Band 12.

LTE Band 26 (814.7 – 849 MHz) overlaps the entire frequency range of LTE Band 5 (824 – 849 MHz). Therefore, test data provided in this report covers Band 5 and the portion of Band 26 subject to Part 22.

LTE Band 66 (1710 - 1780 MHz) overlaps the entire frequency range of LTE Band 4 (1710 - 1755 MHz). Therefore, test data provided in this report covers Band 4 as well as Band 66.

LTE Band 25 (1850 - 1915 MHz) overlaps the entire frequency range of LTE Band 2 (1850 - 1910 MHz). Therefore, test data provided in this report covers Band 2 as well as Band 25.

LTE Band 41 (2496 - 2690 MHz) overlaps the entire frequency range of LTE Band 38 (2570 - 2620 MHz). Therefore, test data provided in this report covers Band 38 as well as Band 41.

This device supports BT Beamforming

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

Simultaneous Tx	Antenna							
	4a				2a			
	Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8
WIFI 2.4GHz	✓	✓	×	×	✓	✓	×	×
Bluetooth (1x, EDR, LE, HDR4, HDR8)	×	×	✓	✓	×	×	✓	✓
LTE Mid Bands	✓	×	✓	×	✓	×	✓	×
LTE High Bands	×	✓	×	✓	×	✓	×	✓

Table 2-1. Simultaneous Tx Configurations

✓= Support ; × = NOT Support

Worst Case Configuration

Description	Bluetooth BDR	LTE
Antenna	4a	4a
Channel	78	39750
Operating Frequency (MHz)	2480	2506
Mode/Modulation	GFSK ePA	QPSK/1RB/20MHz

Table 2-2. Worst Case Configuration

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2.3 Antenna Description

Following antennas were used for the testing.

Frequency [MHz]	Antennas			
	Port A	Port B	Port C	Port D
650-800	ANT 3	ANT 1	N/A	
820-960				
1700-1800	ANT 4b	ANT 2b	ANT 4a	ANT 2a
1820-2100				
2300-2320				
2400-2700				

Table 2-3. Antennas vs Ports

Frequency [MHz]	Antenna Gain (dBi)					
	ANT 3	ANT 1	ANT 4b	ANT 2b	ANT 4a	ANT 2a
650-800	-2.3	-2.0	N/A			
820-960	-1.9	-1.5				
1700-1800	N/A		-2.8	-3.2	-1.2	-0.4
1820-2100			-0.9	-1.7	-0.3	0.3
2300-2320			0.5	-0.2	-0.3	0.2
2400-2700			0.7	0.8	-1.3	-0.2

Table 2-4. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook	Model:	A1398	S/N:	C2QKP008F6F3
	w/ AC/DC Adapter	Model:	A1435	S/N:	C04325505K1F288BG
2	Apple USB-C Cable	Model:	Chimp	S/N:	304523
3	USB-C Cable	Model:	A1997	S/N:	N/A
	w / AC/DC Adapter	Model:	A1720	S/N:	C3D9274B06YLHDAE
4	Apple Pencil	Model:	A2051	S/N:	GQXYGSXCJKM9
5	DC Power Supply	Model:	KPS3010D	S/N	N/A

Table 2-5. Test Support Equipment Used

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2.5 Test Configuration

The EUT was tested per the guidance of ANSI/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 channel and the worst case configuration.

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 17E228 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.

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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/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 Block C Frequency Range

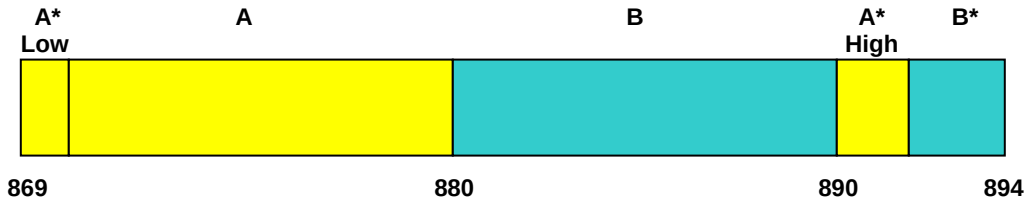
Two paired channels of 11 megahertz each are available for assignment in Block C in the 746-757 MHz and 776-787 MHz bands. In the event that no licenses for two channels in this Block C are assigned based on the results of the first auction in which such licenses were offered because the auction results do not satisfy the applicable reserve price, the spectrum in the 746-757 MHz and 776-787 MHz bands will instead be made available for assignment at a subsequent auction as follows: (i) Two paired channels of 6 megahertz each available for assignment in Block C1 in the 746-752 MHz and 776-782 MHz bands. (ii) Two paired channels of 5 megahertz each available for assignment in Block C2 in the 752-757 MHz and 782-787 MHz bands.

3.3 Block A Frequency Range

698-746 MHz band. The following frequencies are available for licensing pursuant to this part in the 698-746 MHz band: (1) Three paired channel blocks of 12 megahertz each are available for assignment as follows:

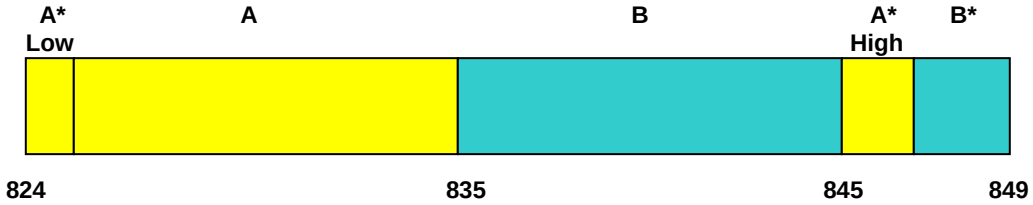
Block A: 698-704 MHz and 728-734 MHz;
Block B: 704-710 MHz and 734-740 MHz; and
Block C: 710-716 MHz and 740-746 MHz.

3.4 Cellular - Base Frequency Blocks



BLOCK 1: 869 – 880 MHz (A* Low + A)
BLOCK 2: 880 – 890 MHz (B)
BLOCK 3: 890 – 891.5 MHz (A* High)
BLOCK 4: 891.5 – 894 MHz (B*)

3.5 Cellular - Mobile Frequency Blocks



BLOCK 1: 824 – 835 MHz (A* Low + A)
BLOCK 2: 835 – 845 MHz (B)
BLOCK 3: 845 – 846.5 MHz (A* High)
BLOCK 4: 846.5 – 849 MHz (B*)

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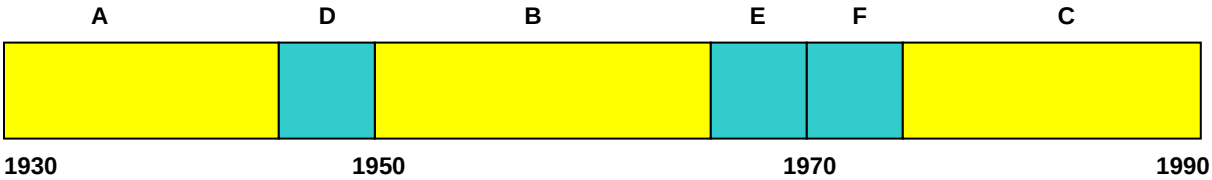
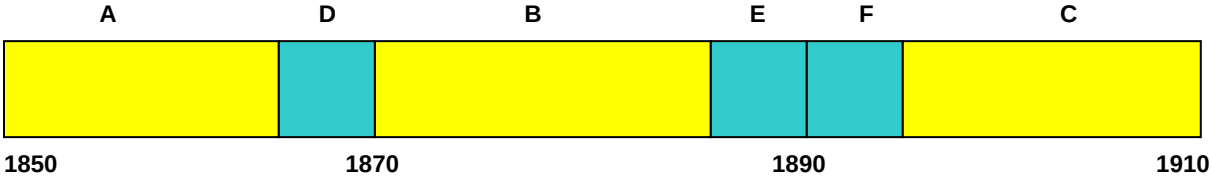
3.6 PCS - Base Frequency Blocks



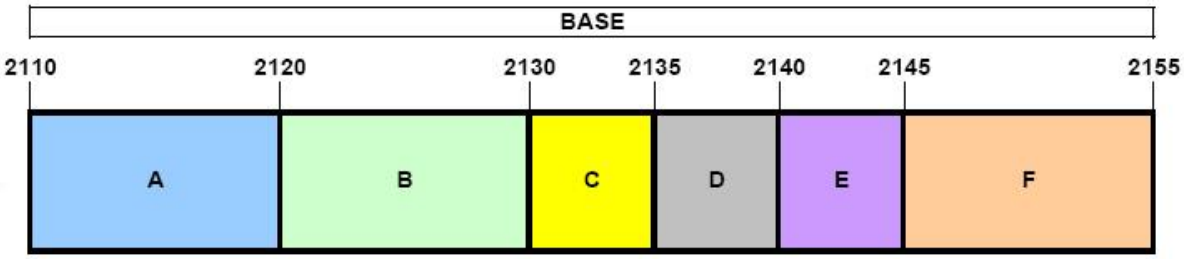
BLOCK 1: 1930 – 1945 MHz (A)
BLOCK 2: 1945 – 1950 MHz (D)
BLOCK 3: 1950 – 1965 MHz (B)
BLOCK 4: 1965 – 1970 MHz (E)
BLOCK 5: 1970 – 1975 MHz (F)
BLOCK 6: 1975 – 1990 MHz (C)

3.7 PCS - Mobile Frequency Blocks



BLOCK 1: 1850 – 1865 MHz (A)
BLOCK 2: 1865 – 1870 MHz (D)
BLOCK 3: 1870 – 1885 MHz (B)
BLOCK 4: 1885 – 1890 MHz (E)
BLOCK 5: 1890 – 1895 MHz (F)
BLOCK 6: 1895 – 1910 MHz (C)

3.8 AWS - Base Frequency Blocks



BLOCK 1: 2110 – 2120 MHz (A)
BLOCK 2: 2120 – 2130 MHz (B)
BLOCK 3: 2130 – 2135 MHz (C)
BLOCK 4: 2135 – 2140 MHz (D)
BLOCK 5: 2140 – 2145 MHz (E)
BLOCK 6: 2145 – 2155 MHz (F)

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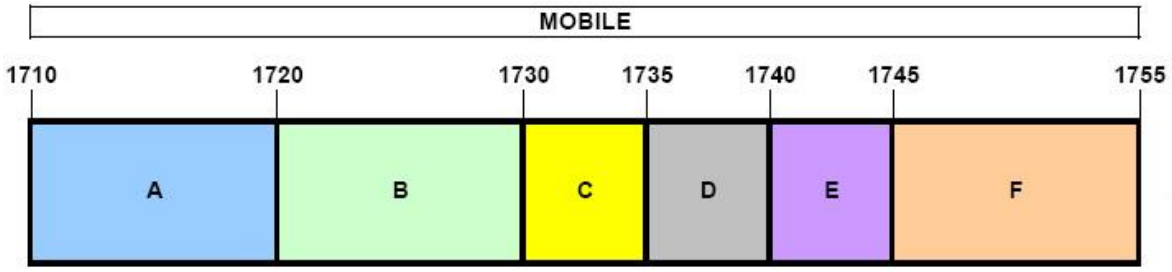
3.9 AWS - Mobile Frequency Blocks



BLOCK 1: 1710 – 1720 MHz (A)
BLOCK 2: 1720 – 1730 MHz (B)
BLOCK 3: 1730 – 1735 MHz (C)
BLOCK 4: 1735 – 1740 MHz (D)
BLOCK 5: 1740 – 1745 MHz (E)
BLOCK 6: 1745 – 1755 MHz (F)

3.10 WCS – Mobile/Base Frequency Blocks

The following frequencies are available for WCS in the 2305-2320 MHz and 2345-2360 MHz bands:

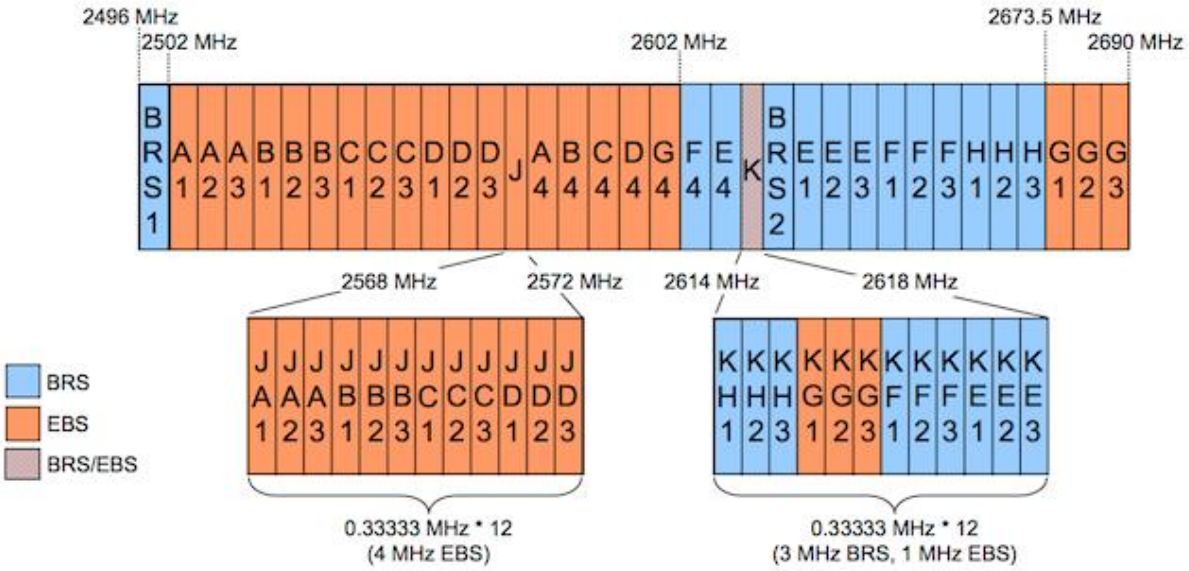
BLOCK 1: 2305-2310 and 2350-2355 MHz (A)

BLOCK 2: 2310-2315 and 2355-236 MHz (B)

BLOCK 3: 2315-2320 MHz (C)

BLOCK 4: 2345-2350 MHz (D)

3.11 BRS/EBS Frequency Block



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3.12 Radiated Power and Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer. Per the guidelines of KDB 412172 D01 v01r01, radiated power levels are measured using the following formula:

$$\text{ERP or EIRP} = P_T + G_T - L_C$$

Where P_T is the transmitter output power, expressed in dBm, G_T is the gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP), and L_C signal attenuation in the connecting cable between the transmitter and antenna in dB.

Per the guidance of ANSI/TIA-603-E-2016, a half-wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

$$P_{d\,[dBm]} = P_{g\,[dBm]} - \text{cable loss}_{\,[dB]} + \text{antenna gain}_{\,[dBd/dBi]}$$

Where, P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to $P_{g\,[dBm]}$ – cable loss $_{[dB]}$.

The calculated P_d levels are then compared to the absolute spurious emission limit of -13dBm which is equivalent to the required minimum attenuation of 43 + $10\log_{10}$(Power $_{[Watts]}$). For Band 7 and 41, the calculated P_d levels are compared to the absolute spurious emission limit of -25dBm which is equivalent to the required minimum attenuation of 55 + $10\log_{10}$(Power $_{[Watts]}$). For Band 30, the calculated P_d levels are compared to the absolute spurious emission limit of -40dBm which is equivalent to the required minimum attenuation of 70 + $10\log_{10}$(Power $_{[Watts]}$).

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4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.29
Radiated Disturbance (<1GHz)	4.15
Radiated Disturbance (>1GHz)	4.70
Radiated Disturbance (>18GHz)	5.01
Temperature	0.01

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5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	3/13/2019	Annual	3/13/2020	MY49430244
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	10/29/2019	Annual	10/29/2020	T058701-02
ESPEC	SU-241	Tabletop Temperature Chamber	9/3/2019	Annual	9/3/2020	92009574
ETS-Lindgren	3142E–PA	Pre-Amplifier (30MHz - 6GHz)	9/19/2019	Annual	9/19/2020	213236
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	8/14/2019	Annual	8/14/2020	224569
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	3/12/2019	Annual	3/12/2020	205956
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	2/27/2019	Annual	2/27/2020	101619
Rohde & Schwarz	ESW26	EMI Test Receiver	5/21/2019	Annual	5/21/2020	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	7/27/2019	Annual	7/27/2020	101668
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/20/2019	Annual	4/20/2020	161617
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	8/8/2019	Annual	8/8/2020	151888
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	9/19/2019	Annual	9/19/2020	100051
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	11/14/2019	Annual	11/14/2020	101057
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/21/2019	Annual	3/21/2020	100519

Table 5-1. Test Equipment

Notes:

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

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6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 8M62G7W

LTE 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
D = Amplitude/Angle Modulated
7 = Quantized/Digital Info
W = Combination of any

Spurious Radiated Emission – LTE Band

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).

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7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCGA2232

FCC Classification: PCS Licensed Transmitter (PCB)

Mode(s): LTE

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	Occupied Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
2.1051 2.917(a) 24.238(a) 27.53(c) 27.53(g) 27.53(h)	Out of Band Emissions	> 43 + 10log$_{10}$ (P[Watts]) at Band Edge and for all out-of-band emissions			Section 7.3, 7.4
27.53(m)	Out of Band Emissions	Undesirable emissions must meet the limits detailed in 27.53(m)			Section 7.3, 7.4
27.53(a)	Out of Band Emissions	Undesirable emissions must meet the limits detailed in 27.53(a)			Section 7.3, 7.4
24.232(d) 27.50(d)(5)	Peak-Average Ratio	< 13 dB			Section 7.5
2.1046	Transmitter Conducted Output Power	N/A			Section 7.8
2.1046	Additional Maximum Power Reduction (A-MPR)	N/A			Section 7.6
27.53(m)	Uplink Carrier Aggregation	N/A			Section 7.7
2.1055 22.355 24.235 27.54	Frequency Stability	< 2.5 ppm (Part 22) and fundamental emissions stay within authorized frequency block (Part 24, 27)			Section 7.11

Table 7-1. Summary of Conducted Test Results

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FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
22.913(a)(5)	Effective Radiated Power / Equivalent Isotropic Radiated Power (Band 5, 26)	< 7 Watts max. ERP	RADIATED	PASS	Section 7.8
27.50(b)(10) 27.50(c)(10)	Effective Radiated Power / Equivalent Isotropic Radiated Power (Band 12, 17, 13)	< 3 Watts max. ERP			Section 7.8
24.232(c) 27.50(h)(2)	Equivalent Isotropic Radiated Power (Band 2, 25, 7, 41)	< 2 Watts max. EIRP			Section 7.8
27.50(d)(4)	Equivalent Isotropic Radiated Power (Band 4, 66)	< 1 Watts max. EIRP			Section 7.8
27.50(a)(3)	Equivalent Isotropic Radiated Power (Band 30)	< 0.25 Watts max. EIRP			Section 7.8
2.1053 22.917(a) 24.238(a) 27.53(c) 27.53(g) 27.53(h)	Undesirable Emissions	> 43 + $10\log_{10}$ (P[Watts]) for all out-of-band emissions			Section 7.9
27.53(f)	Undesirable Emissions (Band 13)	< -70 dBW/MHz (for wideband signals) < -80 dBW (for discrete emissions less than 700Hz BW) For all emissions in the band 1559 – 1610 MHz			Section 7.9
27.53(a)	Undesirable Emissions (Band 30)	> 70 + $10\log_{10}$ (P[Watts])			Section 7.9
27.53(m)	Undesirable Emissions	Undesirable emissions must meet the limits detailed in 27.53(m)			Section 7.9

Table 7-2. Summary of Radiated 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 (Sections 7.2, 7.3, 7.4, 7.5) 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) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "LTE Automation," Version 5.3.

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7.2 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

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.

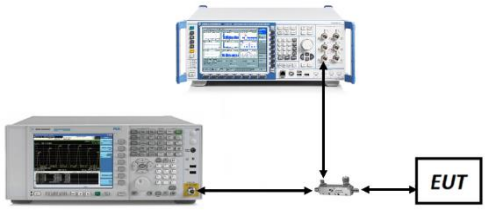

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

1. All ports were tested and only the worst case data were reported.
2. Refer to Table 2-1 Section 2.3 of this test report for correlation between Antennas and Ports.

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Mode	BW (MHz)	Modulation	Occupied BW [kHz]
LTE Band 12	1.4	QPSK	1111.1
LTE Band 12	1.4	16QAM	1105.0
LTE Band 12	1.4	64QAM	1106.2
LTE Band 12	3	QPSK	2722.7
LTE Band 12	3	16QAM	2720.4
LTE Band 12	3	64QAM	2723.5
LTE Band 12	5	QPSK	4536.2
LTE Band 12	5	16QAM	4535.3
LTE Band 12	5	64QAM	4530.0
LTE Band 12	10	QPSK	9046.0
LTE Band 12	10	16QAM	9035.1
LTE Band 12	10	64QAM	9052.7
LTE Band 17	5	QPSK	4536.2
LTE Band 17	5	16QAM	4535.3
LTE Band 17	5	64QAM	4530.0
LTE Band 17	10	QPSK	9046.0
LTE Band 17	10	16QAM	9035.1
LTE Band 17	10	64QAM	9052.7
LTE Band 13	5	QPSK	4543.5
LTE Band 13	5	16QAM	4540.4
LTE Band 13	5	64QAM	4533.7
LTE Band 13	10	QPSK	9038.6
LTE Band 13	10	16QAM	9033.3
LTE Band 13	10	64QAM	9032.5
LTE Band 5	1.4	QPSK	1109.5
LTE Band 5	1.4	16QAM	1107.1
LTE Band 5	1.4	64QAM	1107.6
LTE Band 5	3	QPSK	2734.9
LTE Band 5	3	16QAM	2734.6
LTE Band 5	3	64QAM	2731.0
LTE Band 5	5	QPSK	4552.8
LTE Band 5	5	16QAM	4550.2
LTE Band 5	5	64QAM	4542.6
LTE Band 5	10	QPSK	9074.5
LTE Band 5	10	16QAM	9077.5
LTE Band 5	10	64QAM	9051.6
LTE Band 26	1.4	QPSK	1109.5
LTE Band 26	1.4	16QAM	1107.1
LTE Band 26	1.4	64QAM	1107.6
LTE Band 26	3	QPSK	2734.9
LTE Band 26	3	16QAM	2734.6
LTE Band 26	3	64QAM	2731.0
LTE Band 26	5	QPSK	4552.8
LTE Band 26	5	16QAM	4550.2
LTE Band 26	5	64QAM	4542.6
LTE Band 26	10	QPSK	9074.5
LTE Band 26	10	16QAM	9077.5
LTE Band 26	10	64QAM	9051.6

Table 7-3. Occupied Band Width Results (Low Bands)

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Mode	BW (MHz)	Modulation	Occupied BW [kHz]
LTE Band 4	1.4	QPSK	1107.7
LTE Band 4	1.4	16QAM	1104.3
LTE Band 4	1.4	64QAM	1107.1
LTE Band 4	3	QPSK	2724.3
LTE Band 4	3	16QAM	2720.5
LTE Band 4	3	64QAM	2718.2
LTE Band 4	5	QPSK	4538.9
LTE Band 4	5	16QAM	4528.8
LTE Band 4	5	64QAM	4525.8
LTE Band 4	10	QPSK	9056.3
LTE Band 4	10	16QAM	9026.3
LTE Band 4	10	64QAM	9040.9
LTE Band 4	15	QPSK	13578.7
LTE Band 4	15	16QAM	13563.2
LTE Band 4	15	64QAM	13568.3
LTE Band 4	20	QPSK	18126.4
LTE Band 4	20	16QAM	18084.2
LTE Band 4	20	64QAM	18077.5
LTE Band 66	1.4	QPSK	1107.7
LTE Band 66	1.4	16QAM	1104.3
LTE Band 66	1.4	64QAM	1107.1
LTE Band 66	3	QPSK	2724.3
LTE Band 66	3	16QAM	2720.5
LTE Band 66	3	64QAM	2718.2
LTE Band 66	5	QPSK	4538.9
LTE Band 66	5	16QAM	4528.8
LTE Band 66	5	64QAM	4525.8
LTE Band 66	10	QPSK	9056.3
LTE Band 66	10	16QAM	9026.3
LTE Band 66	10	64QAM	9040.9
LTE Band 66	15	QPSK	13578.7
LTE Band 66	15	16QAM	13563.2
LTE Band 66	15	64QAM	13568.3
LTE Band 66	20	QPSK	18126.4
LTE Band 66	20	16QAM	18084.2
LTE Band 66	20	64QAM	18077.5
LTE Band 2	1.4	QPSK	1107.7
LTE Band 2	1.4	16QAM	1109.2
LTE Band 2	1.4	64QAM	1106.6
LTE Band 2	3	QPSK	2725.6
LTE Band 2	3	16QAM	2726.1
LTE Band 2	3	64QAM	2723.2
LTE Band 2	5	QPSK	4536.6
LTE Band 2	5	16QAM	4527.9
LTE Band 2	5	64QAM	4554.8
LTE Band 2	10	QPSK	9042.2
LTE Band 2	10	16QAM	9029.7
LTE Band 2	10	64QAM	9020.2
LTE Band 2	15	QPSK	13567.0
LTE Band 2	15	16QAM	13536.0
LTE Band 2	15	64QAM	13591.0
LTE Band 2	20	QPSK	18079.0
LTE Band 2	20	16QAM	18078.0
LTE Band 2	20	64QAM	18062.0
LTE Band 25	1.4	QPSK	1107.7
LTE Band 25	1.4	16QAM	1109.2
LTE Band 25	1.4	64QAM	1106.6
LTE Band 25	3	QPSK	2725.6
LTE Band 25	3	16QAM	2726.1
LTE Band 25	3	64QAM	2723.2
LTE Band 25	5	QPSK	4536.6
LTE Band 25	5	16QAM	4527.9
LTE Band 25	5	64QAM	4554.8
LTE Band 25	10	QPSK	9042.2
LTE Band 25	10	16QAM	9029.7
LTE Band 25	10	64QAM	9020.2
LTE Band 25	15	QPSK	13567.0
LTE Band 25	15	16QAM	13536.0
LTE Band 25	15	64QAM	13591.0
LTE Band 25	20	QPSK	18079.0
LTE Band 25	20	16QAM	18078.0
LTE Band 25	20	64QAM	18062.0

Table 7-4. Occupied Band Width Results (Mid Bands)

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Mode	BW (MHz)	Modulation	Occupied BW [kHz]
LTE Band 30	5	QPSK	4540.6
LTE Band 30	5	16QAM	4538.7
LTE Band 30	5	64QAM	4547.0
LTE Band 30	10	QPSK	9047.9
LTE Band 30	10	16QAM	9085.6
LTE Band 30	10	64QAM	9041.6
LTE Band 7	5	QPSK	4556.1
LTE Band 7	5	16QAM	4543.1
LTE Band 7	5	64QAM	4557.7
LTE Band 7	10	QPSK	9089.8
LTE Band 7	10	16QAM	9071.5
LTE Band 7	10	64QAM	9062.6
LTE Band 7	15	QPSK	13614.4
LTE Band 7	15	16QAM	13606.0
LTE Band 7	15	64QAM	13577.3
LTE Band 7	20	QPSK	18148.6
LTE Band 7	20	16QAM	18103.3
LTE Band 7	20	64QAM	18063.1
LTE Band 41	5	QPSK	4563.1
LTE Band 41	5	16QAM	4553.3
LTE Band 41	5	64QAM	4577.1
LTE Band 41	10	QPSK	9094.9
LTE Band 41	10	16QAM	9103.9
LTE Band 41	10	64QAM	9077.3
LTE Band 41	15	QPSK	13612.9
LTE Band 41	15	16QAM	13633.7
LTE Band 41	15	64QAM	13601.5
LTE Band 41	20	QPSK	18151.0
LTE Band 41	20	16QAM	18106.0
LTE Band 41	20	64QAM	18126.0

Table 7-5. Occupied Band Width Results (High Bands)

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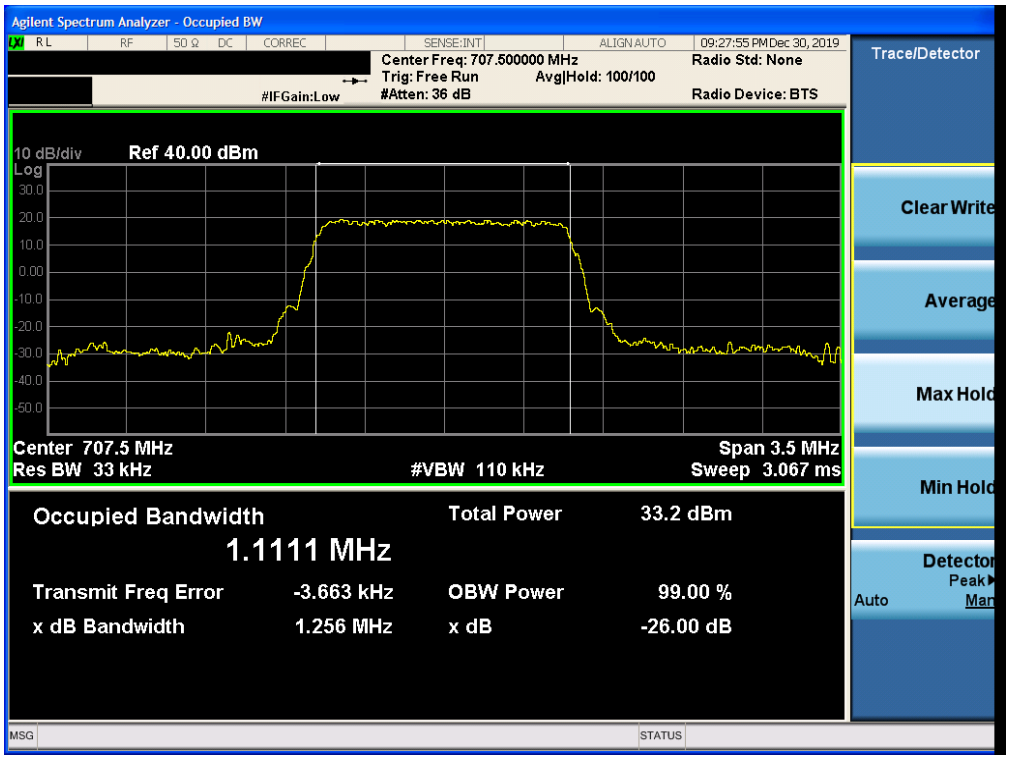
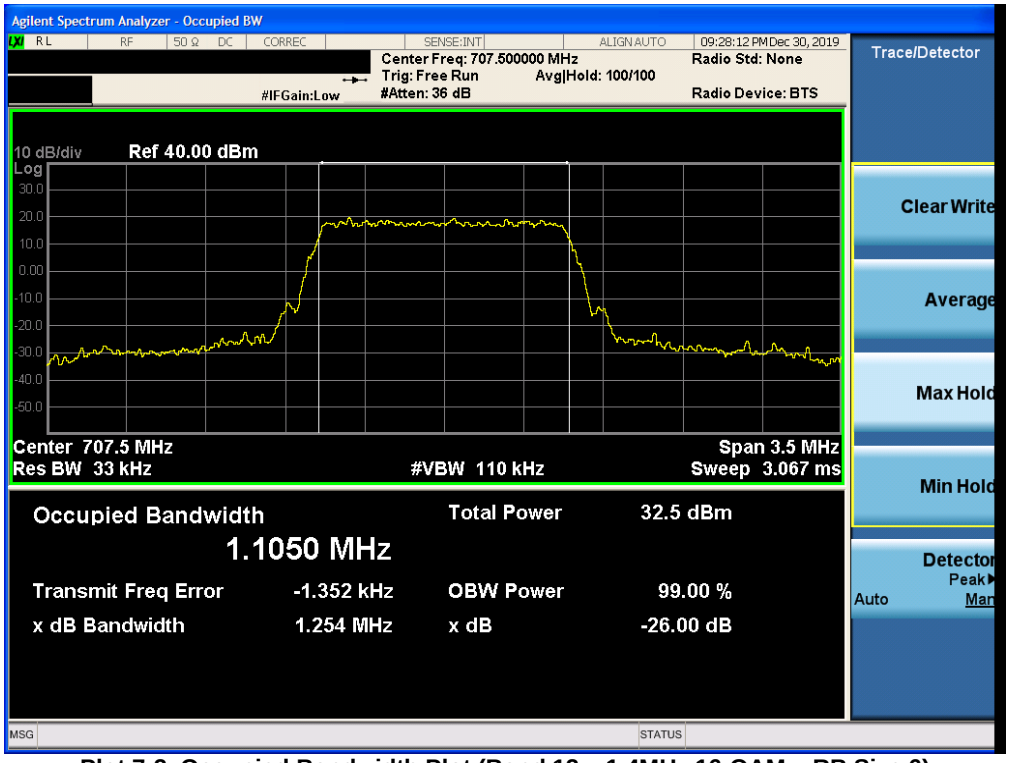
Band 12/17



Plot 7-1. Occupied Bandwidth Plot (Band 12 – 1.4MHz QPSK – RB Size 6)



Plot 7-2. Occupied Bandwidth Plot (Band 12 – 1.4MHz 16-QAM – RB Size 6)

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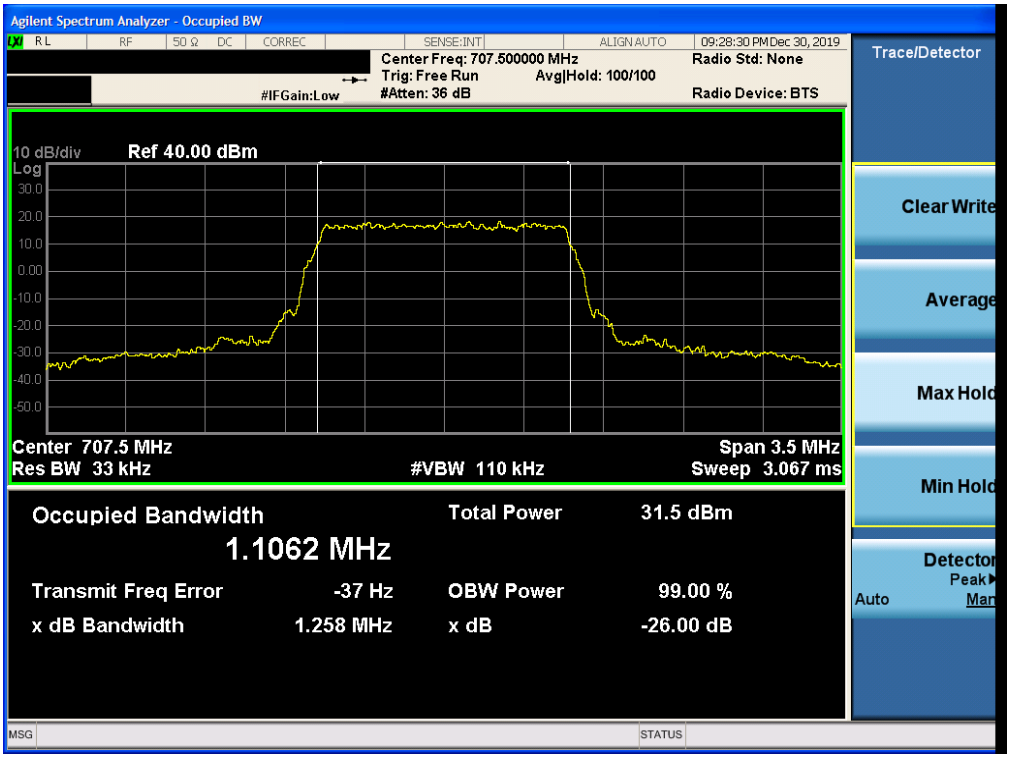
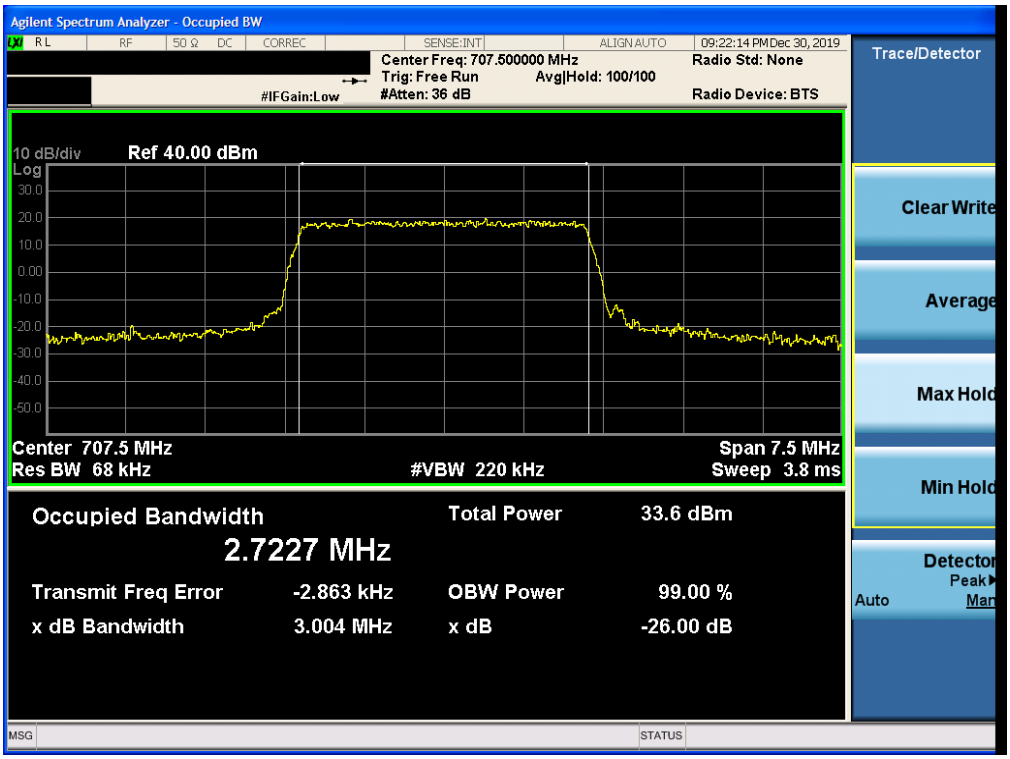


Plot 7-3. Occupied Bandwidth Plot (Band 12 – 1.4MHz 64-QAM – RB Size 6)



Plot 7-4. Occupied Bandwidth Plot (Band 12 – 3.0MHz QPSK – RB Size 15)

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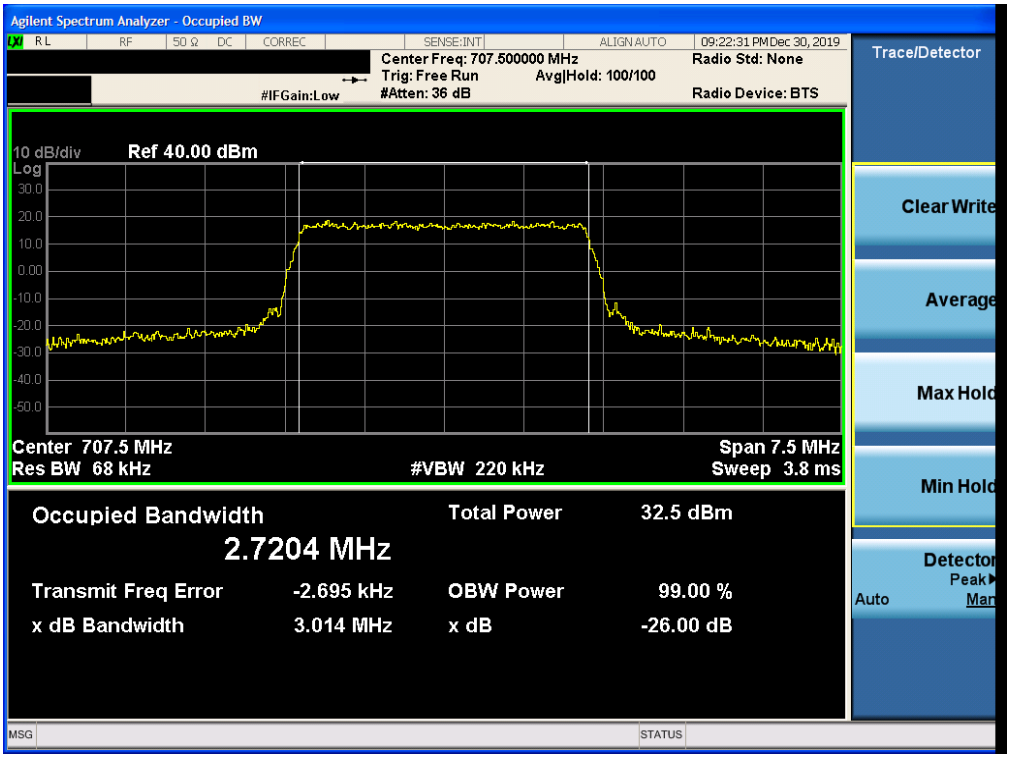
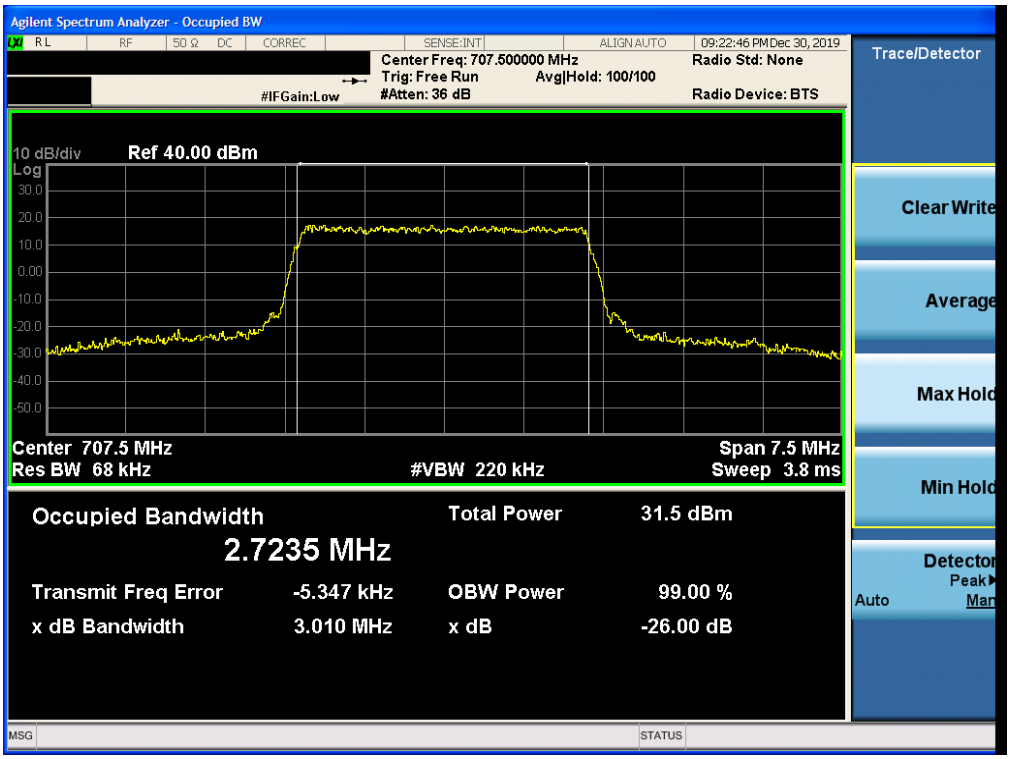


Plot 7-5. Occupied Bandwidth Plot (Band 12 – 3.0MHz 16-QAM – RB Size 15)



Plot 7-6. Occupied Bandwidth Plot (Band 12 – 3.0MHz 64-QAM – RB Size 15)

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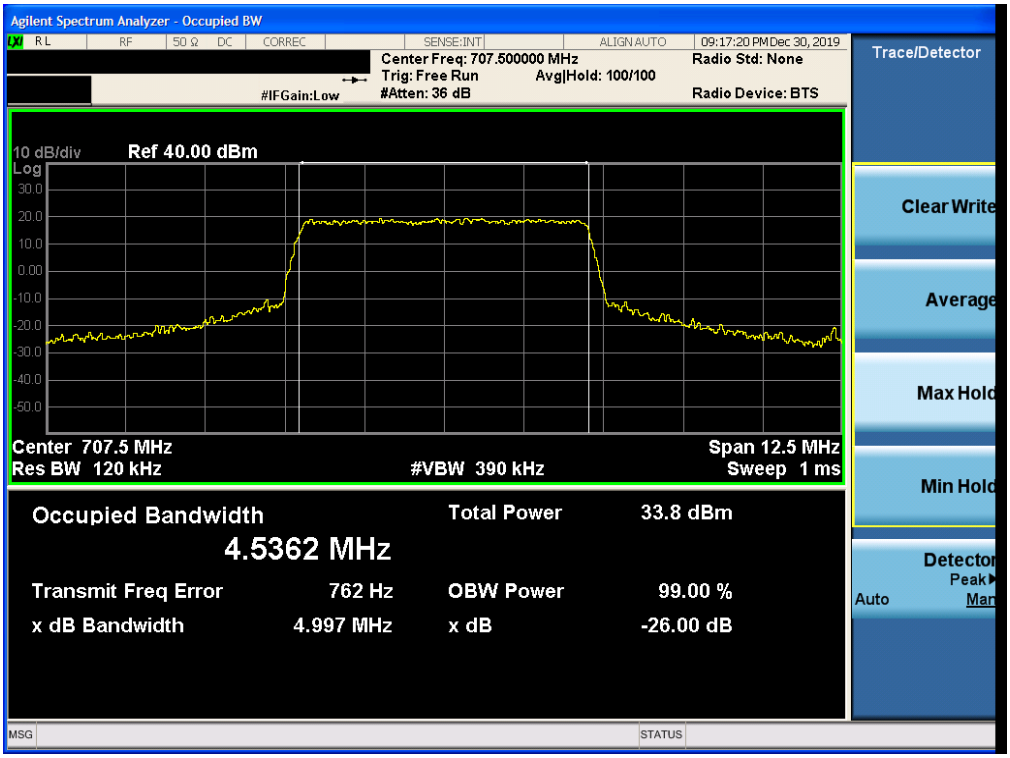
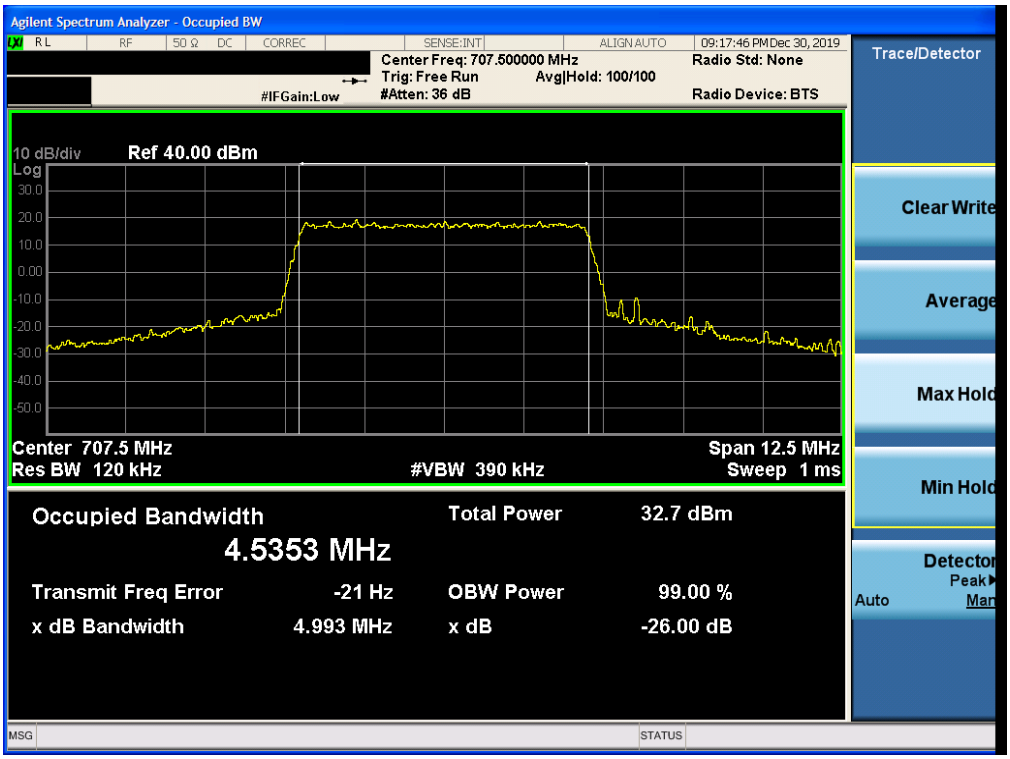


Plot 7-7. Occupied Bandwidth Plot (Band 12/17 – 5.0MHz QPSK – RB Size 25)



Plot 7-8. Occupied Bandwidth Plot (Band 12/17 – 5.0MHz 16-QAM – RB Size 25)

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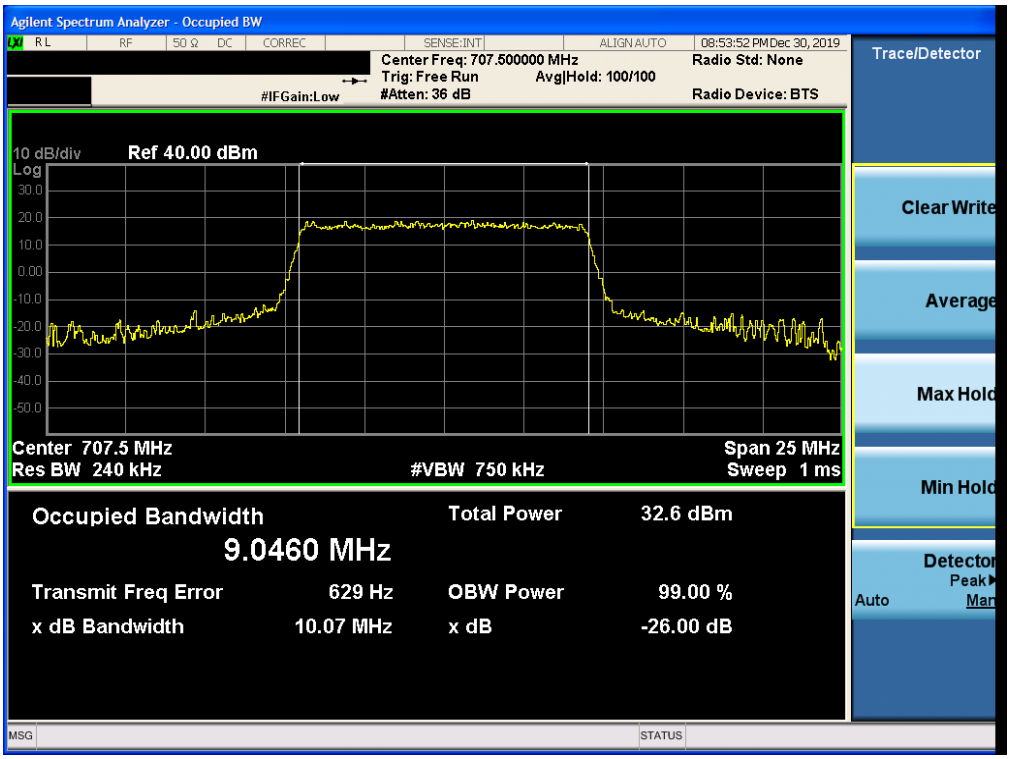
Plot 7-9. Occupied Bandwidth Plot (Band 12/17 – 5.0MHz 64-QAM – RB Size 25)



Plot 7-10. Occupied Bandwidth Plot (Band 12/17 – 10.0MHz QPSK – RB Size 50)

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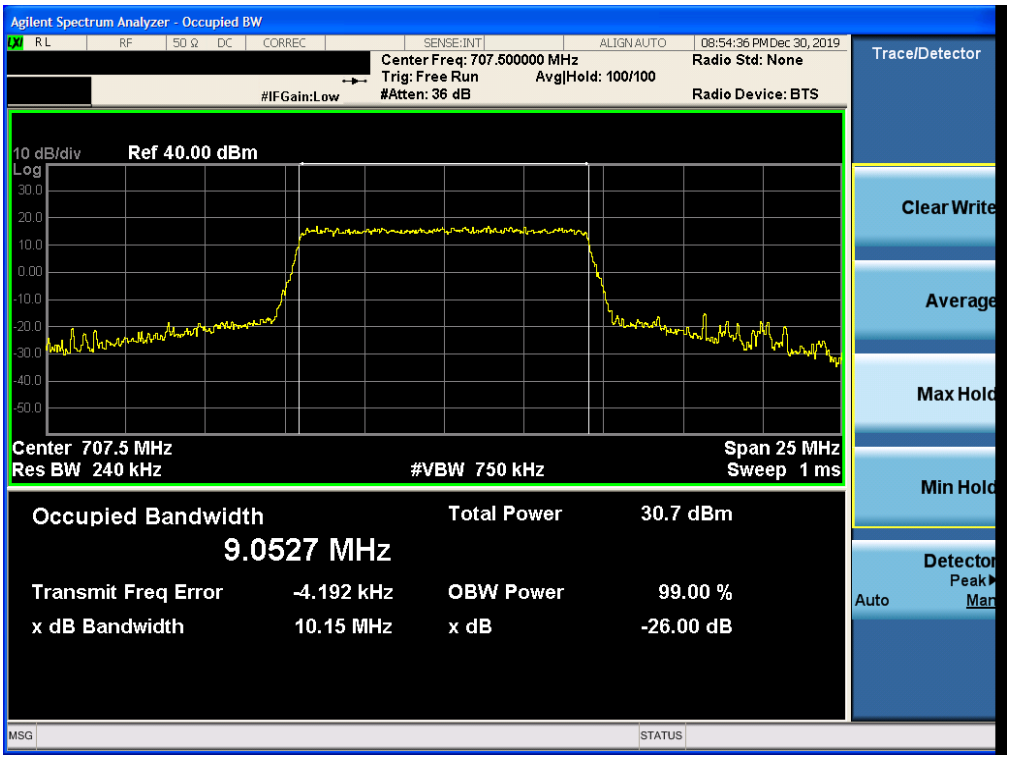
Plot 7-11. Occupied Bandwidth Plot (Band 12/17 – 10.0MHz 16-QAM – RB Size 50)



Plot 7-12. Occupied Bandwidth Plot (Band 12/17 – 10.0MHz 64-QAM – RB Size 50)

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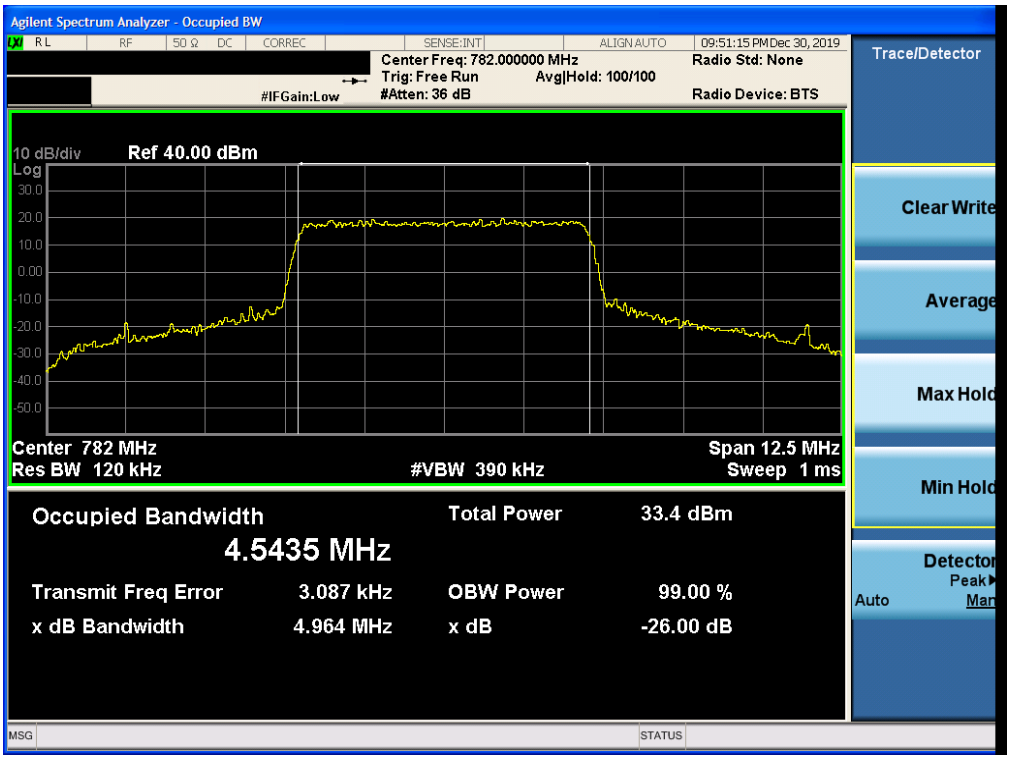
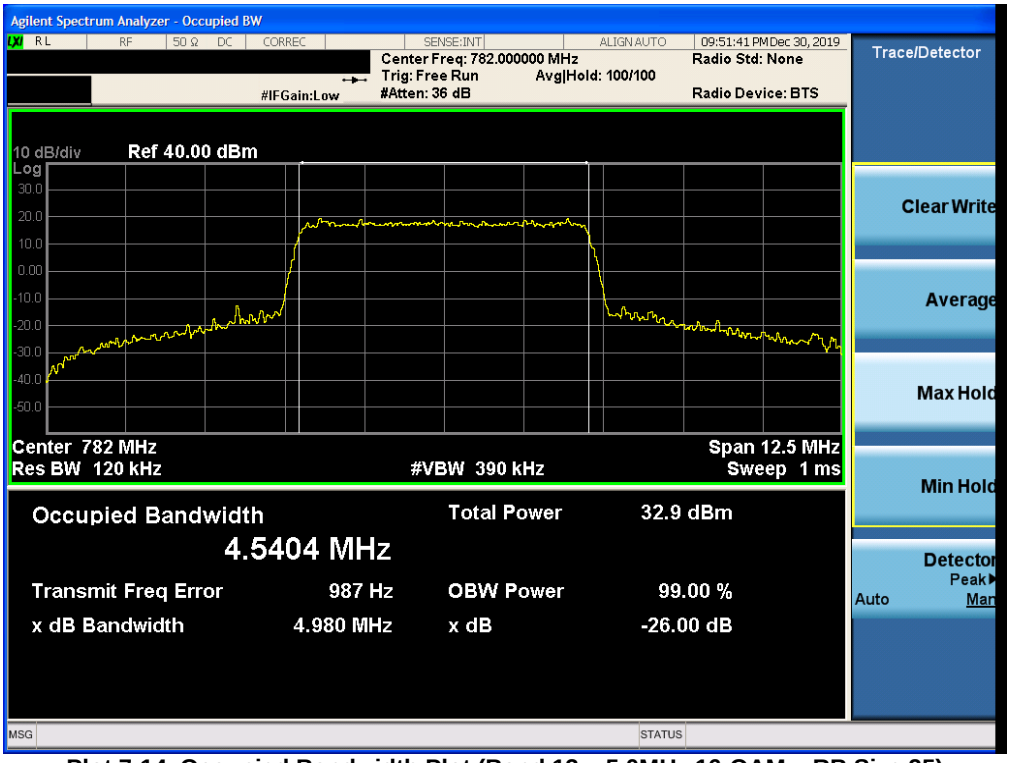
Band 13



Plot 7-13. Occupied Bandwidth Plot (Band 13 – 5.0MHz QPSK – RB Size 25)



Plot 7-14. Occupied Bandwidth Plot (Band 13 – 5.0MHz 16-QAM – RB Size 25)

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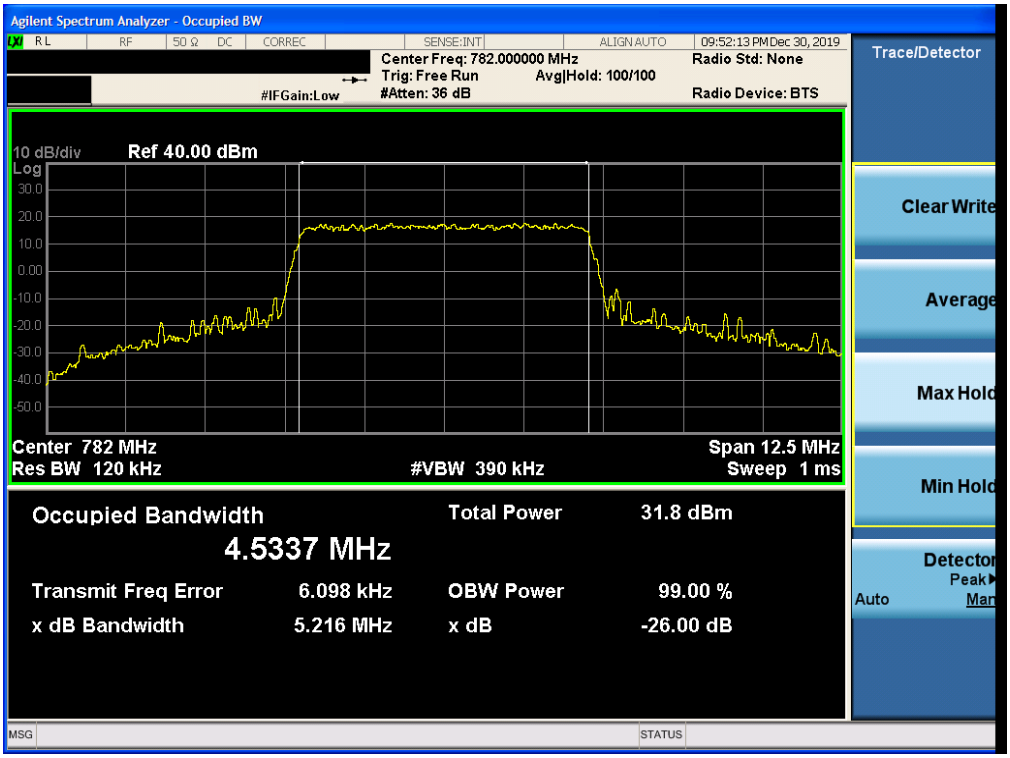
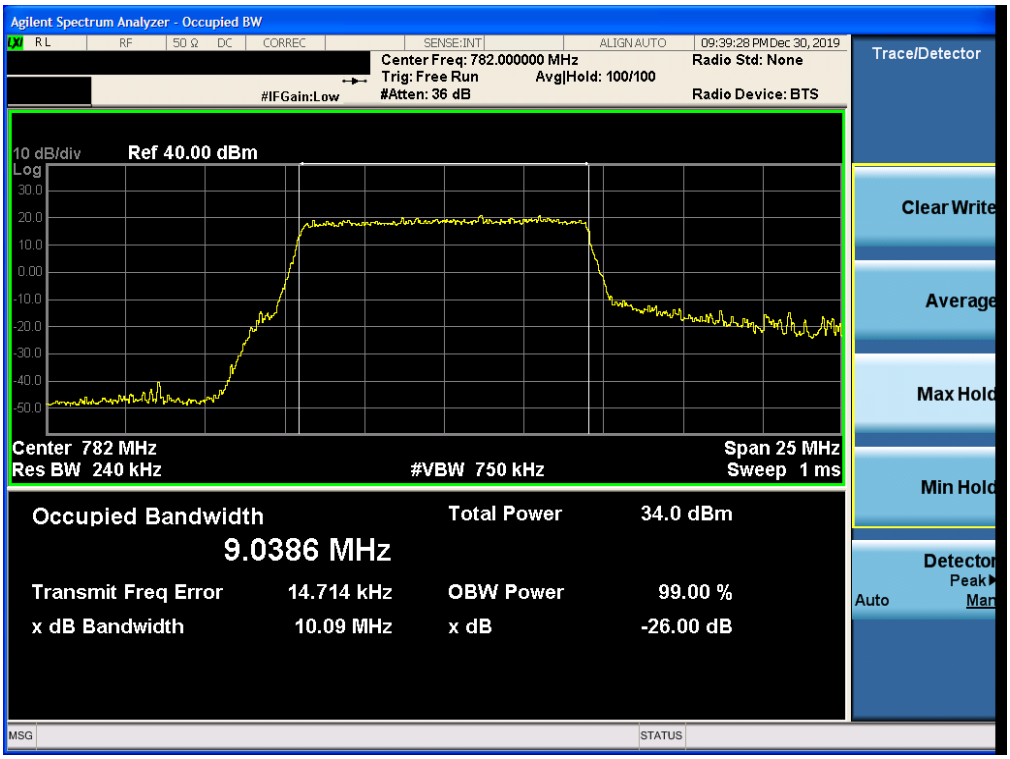


Plot 7-15. Occupied Bandwidth Plot (Band 13 – 5.0MHz 64-QAM – RB Size 25)



Plot 7-16. Occupied Bandwidth Plot (Band 13 – 10.0MHz QPSK – RB Size 50)

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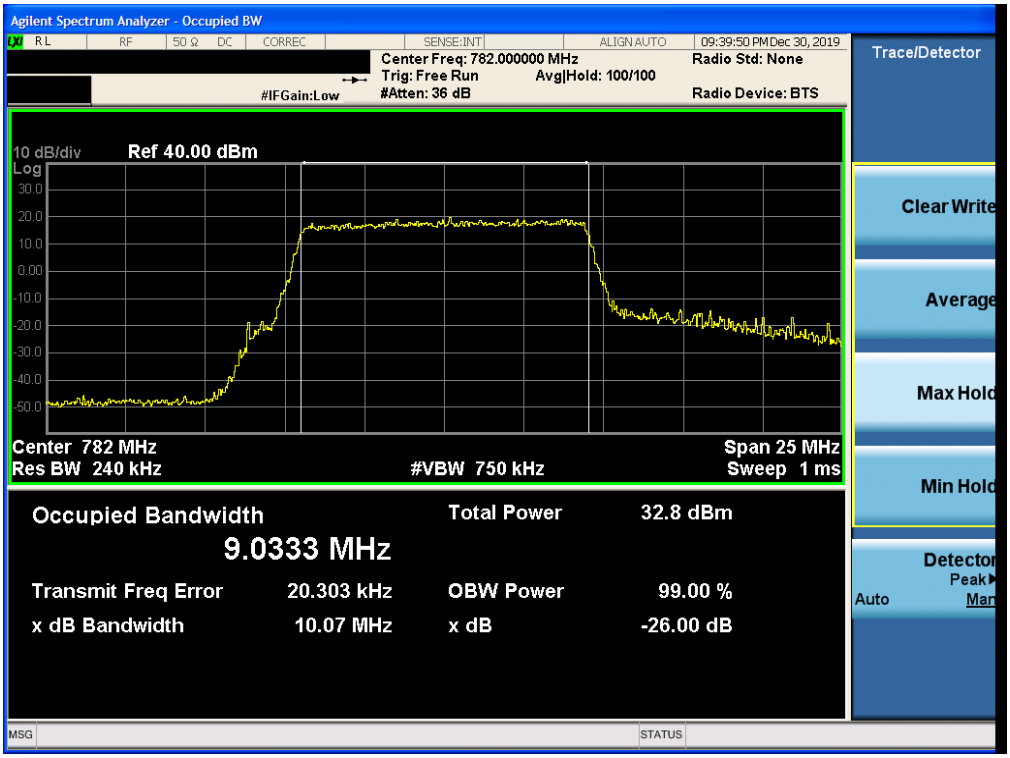

Plot 7-17. Occupied Bandwidth Plot (Band 13 – 10.0MHz 16-QAM – RB Size 50)

Plot 7-18. Occupied Bandwidth Plot (Band 13 – 10.0MHz 64-QAM – RB Size 50)

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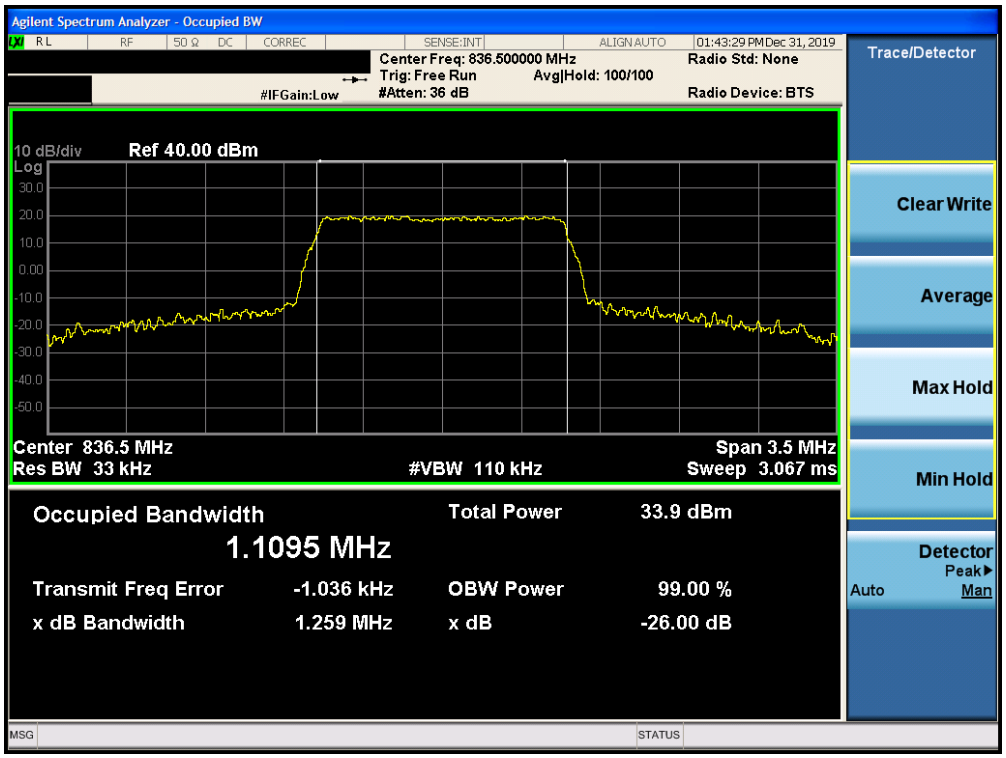
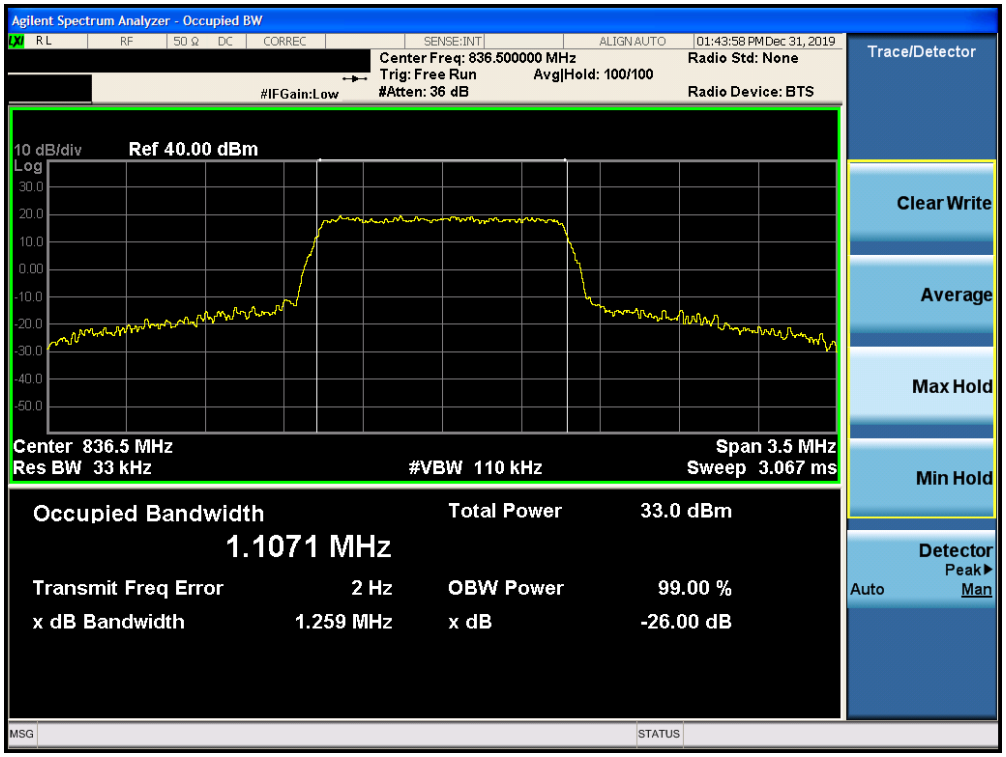
Band 26/5



Plot 7-19. Occupied Bandwidth Plot (Band 26/5 – 1.4MHz QPSK – RB Size 6)



Plot 7-20. Occupied Bandwidth Plot (Band 26/5 – 1.4MHz 16-QAM – RB Size 6)

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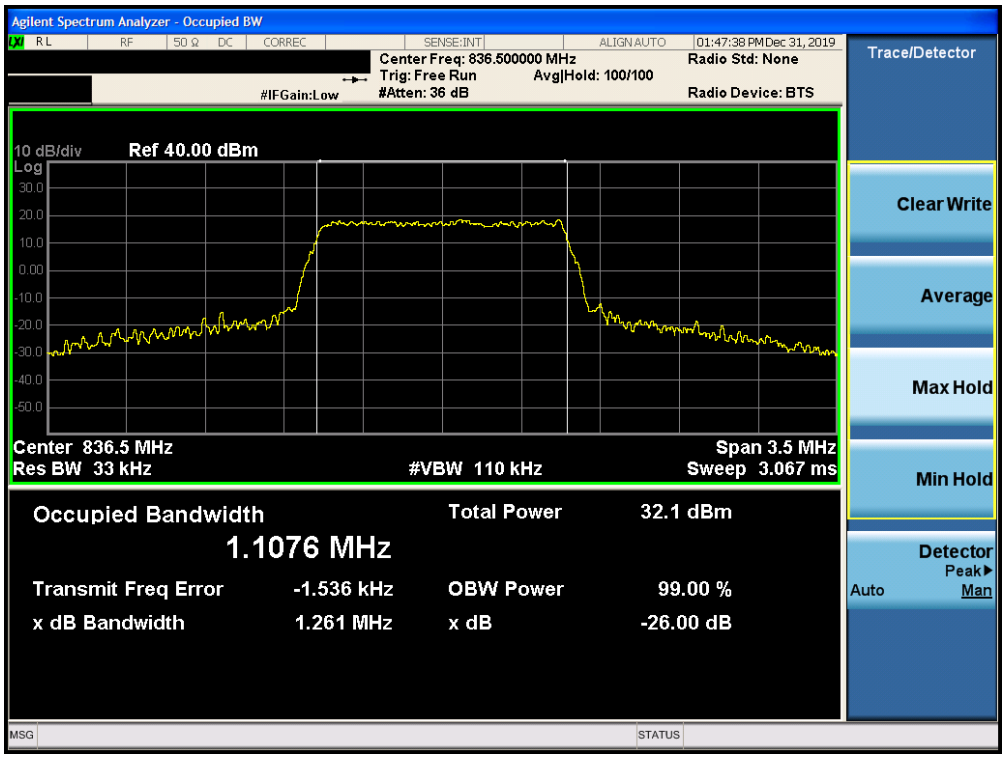
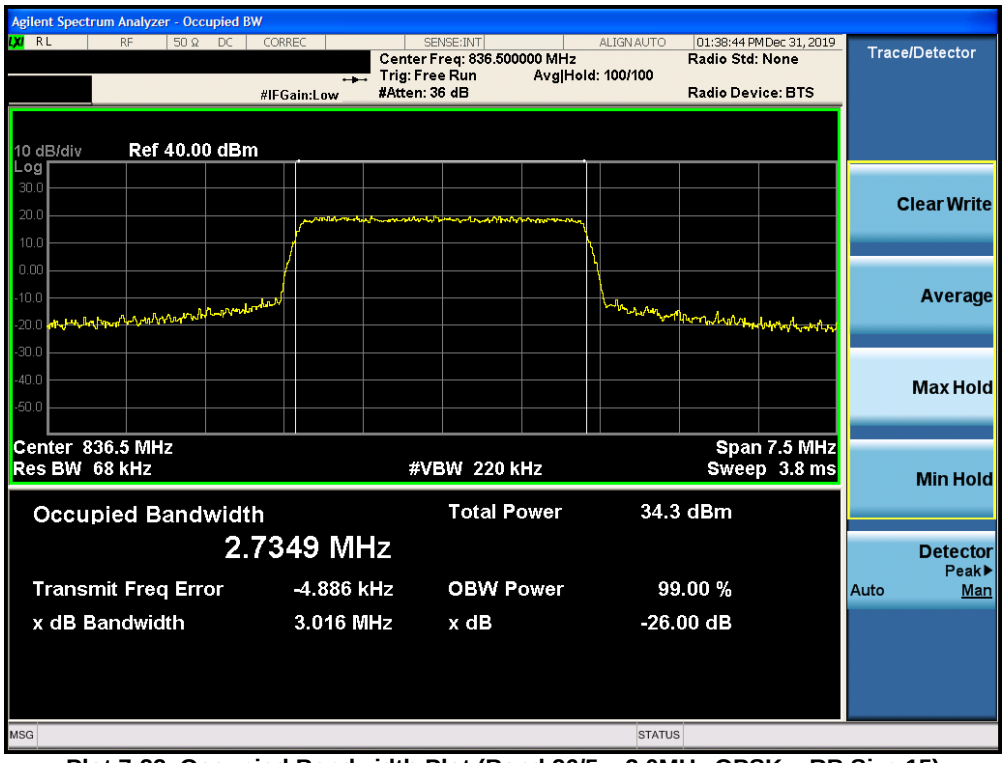


Plot 7-21. Occupied Bandwidth Plot (Band 26/5 – 1.4MHz 64-QAM – RB Size 6)



Plot 7-22. Occupied Bandwidth Plot (Band 26/5 – 3.0MHz QPSK – RB Size 15)

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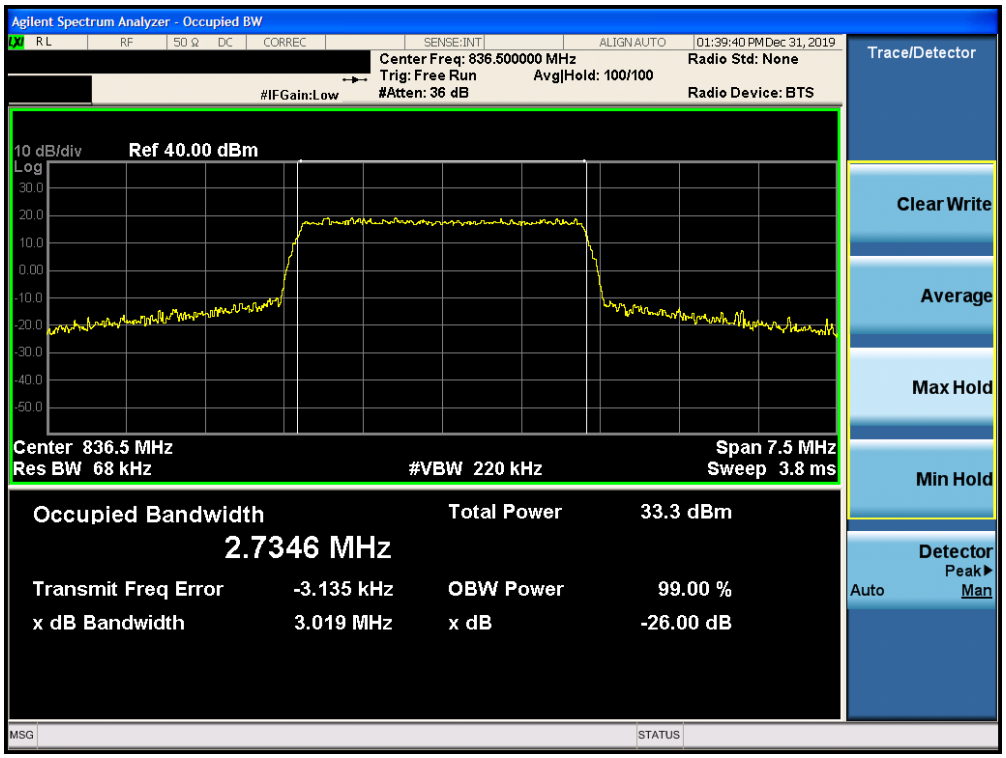
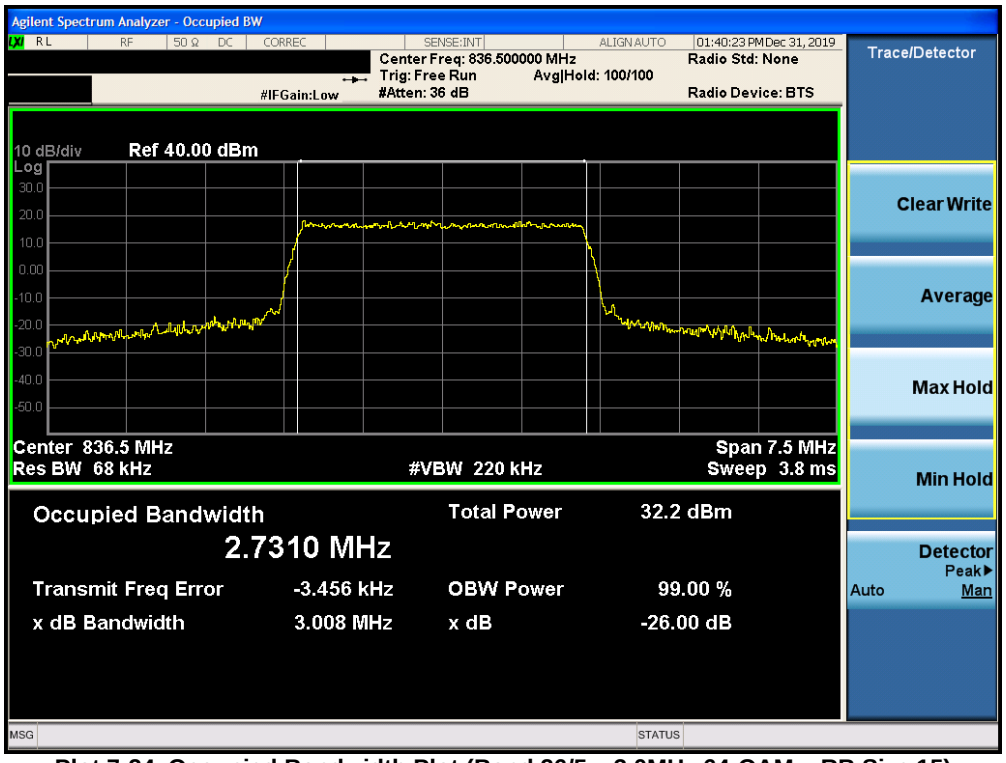


Plot 7-23. Occupied Bandwidth Plot (Band 26/5 – 3.0MHz 16-QAM – RB Size 15)



Plot 7-24. Occupied Bandwidth Plot (Band 26/5 – 3.0MHz 64-QAM – RB Size 15)

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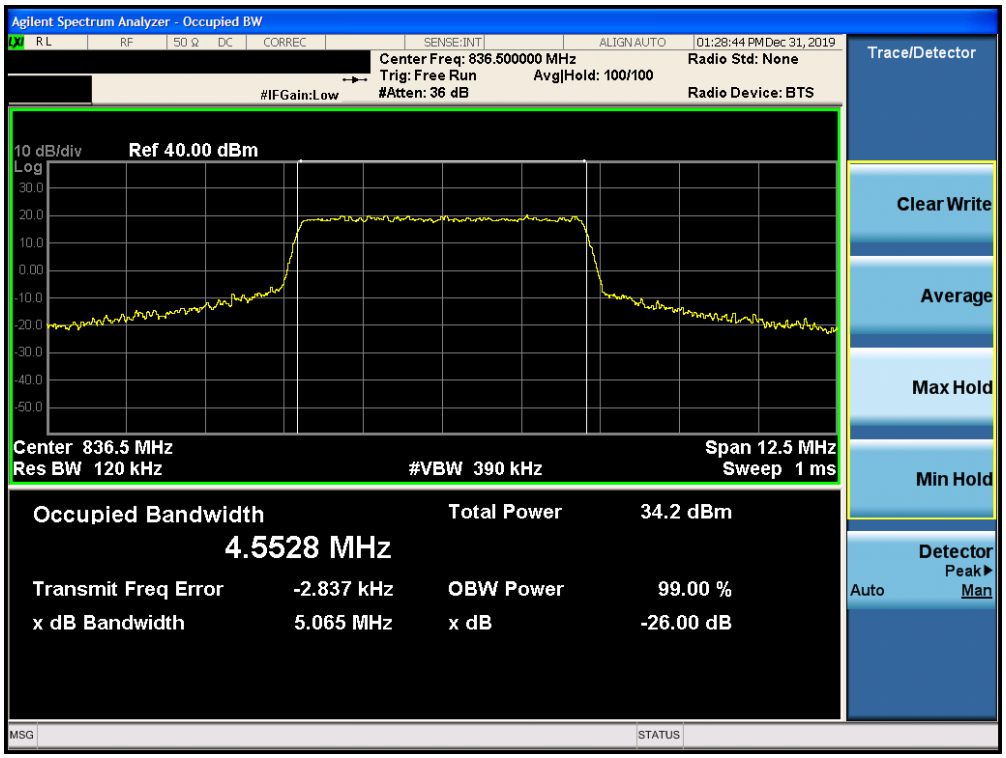
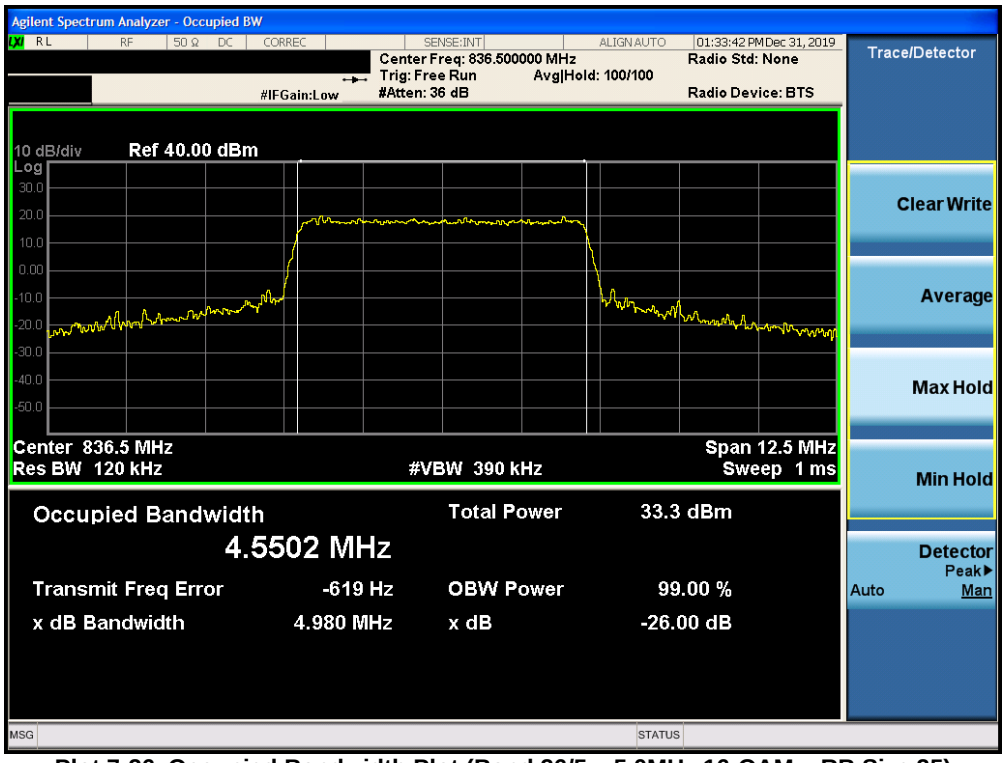


Plot 7-25. Occupied Bandwidth Plot (Band 26/5 – 5.0MHz QPSK – RB Size 25)



Plot 7-26. Occupied Bandwidth Plot (Band 26/5 – 5.0MHz 16-QAM – RB Size 25)

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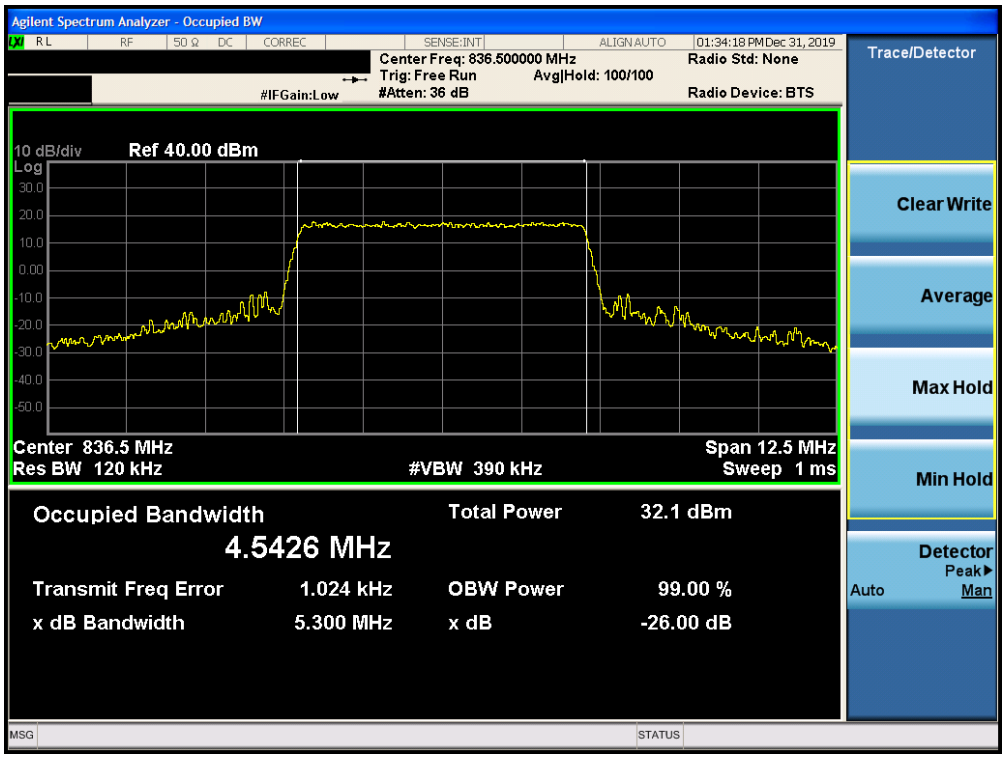
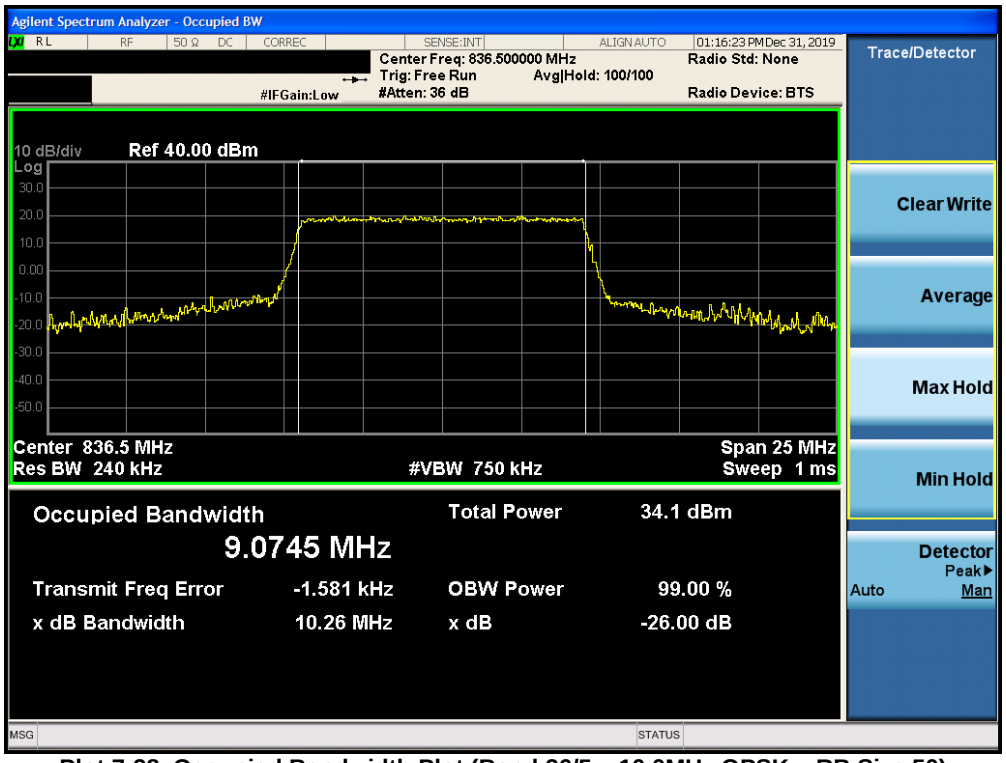


Plot 7-27. Occupied Bandwidth Plot (Band 26/5 – 5.0MHz 64-QAM – RB Size 25)



Plot 7-28. Occupied Bandwidth Plot (Band 26/5 – 10.0MHz QPSK – RB Size 50)

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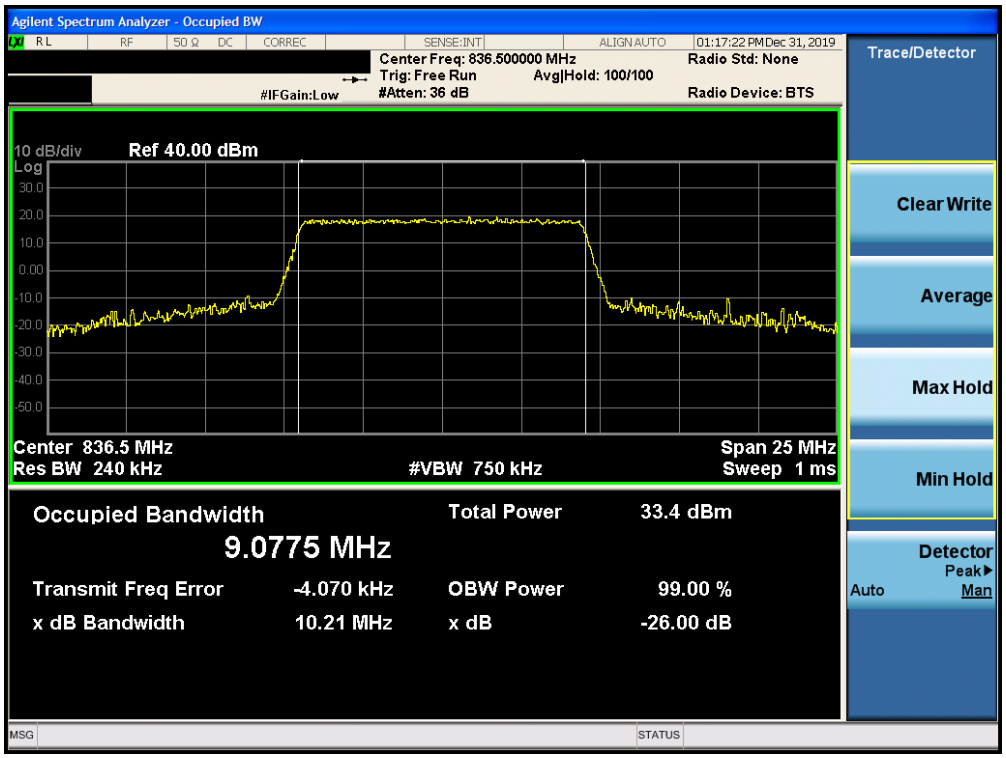
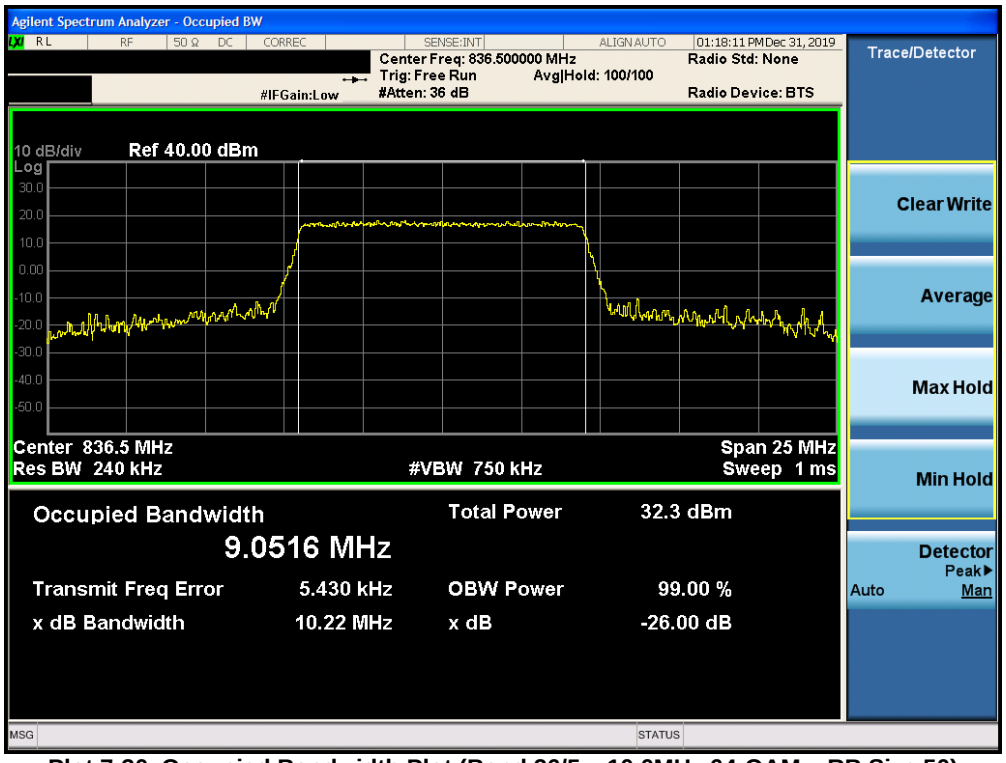


Plot 7-29. Occupied Bandwidth Plot (Band 26/5 – 10.0MHz 16-QAM – RB Size 50)



Plot 7-30. Occupied Bandwidth Plot (Band 26/5 – 10.0MHz 64-QAM – RB Size 50)

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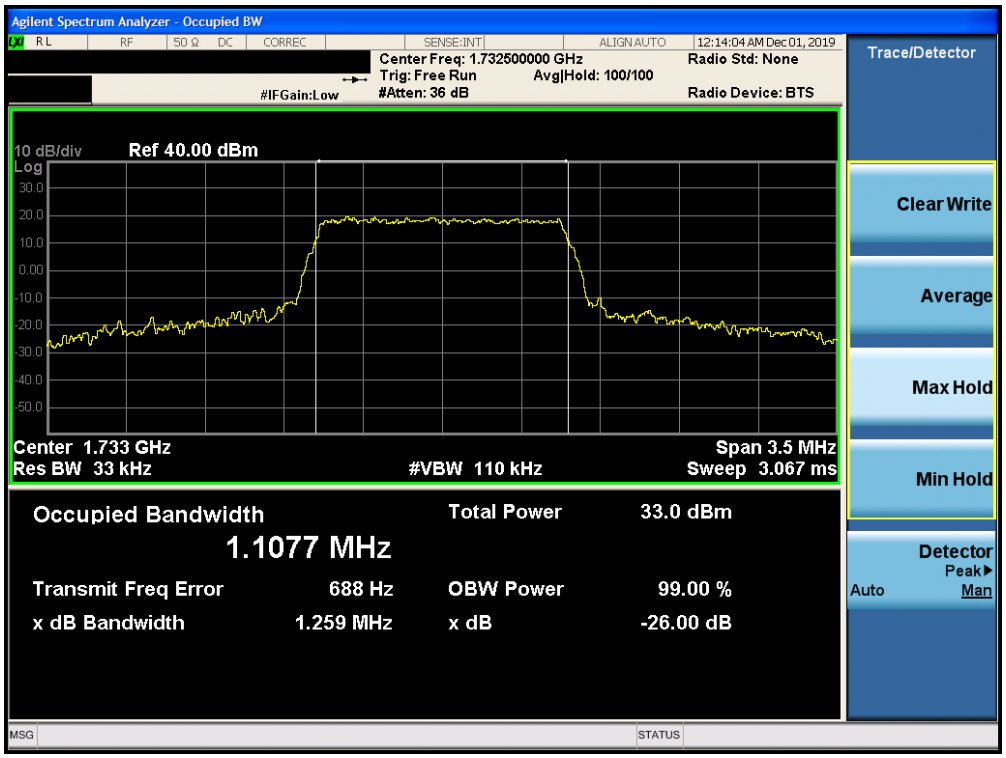
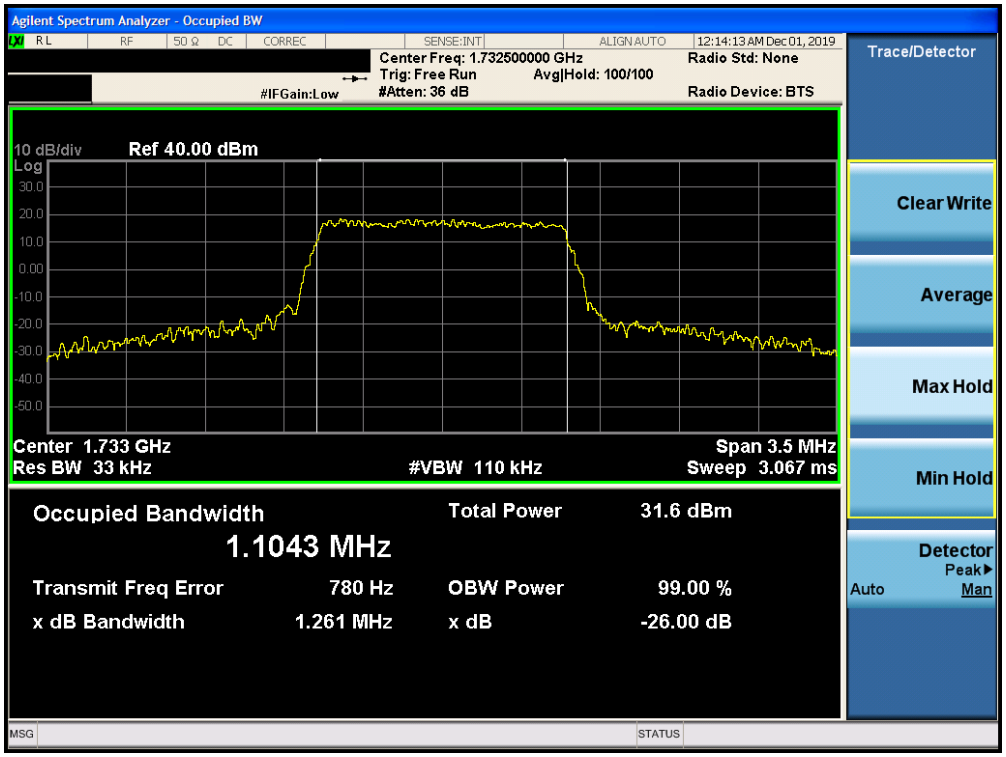
Band 66/4



Plot 7-31. Occupied Bandwidth Plot (Band 66/4 – 1.4MHz QPSK – RB Size 6)



Plot 7-32. Occupied Bandwidth Plot (Band 66/4 – 1.4MHz 16-QAM – RB Size 6)

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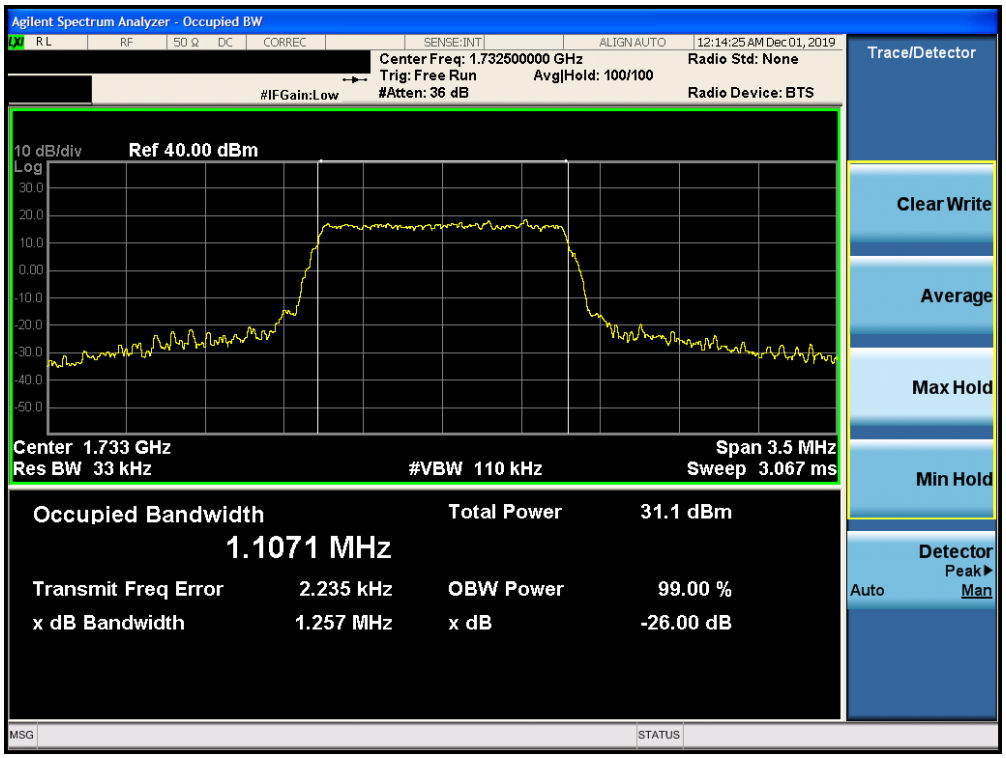
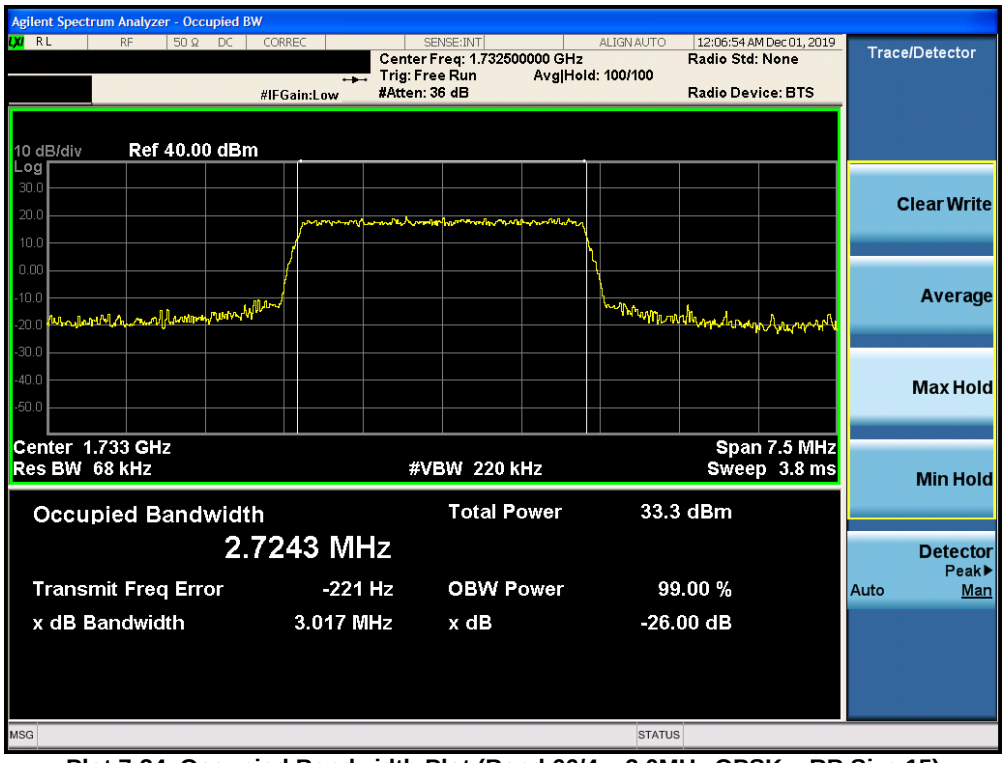


Plot 7-33. Occupied Bandwidth Plot (Band 66/4 – 1.4MHz 64-QAM – RB Size 6)



Plot 7-34. Occupied Bandwidth Plot (Band 66/4 – 3.0MHz QPSK – RB Size 15)

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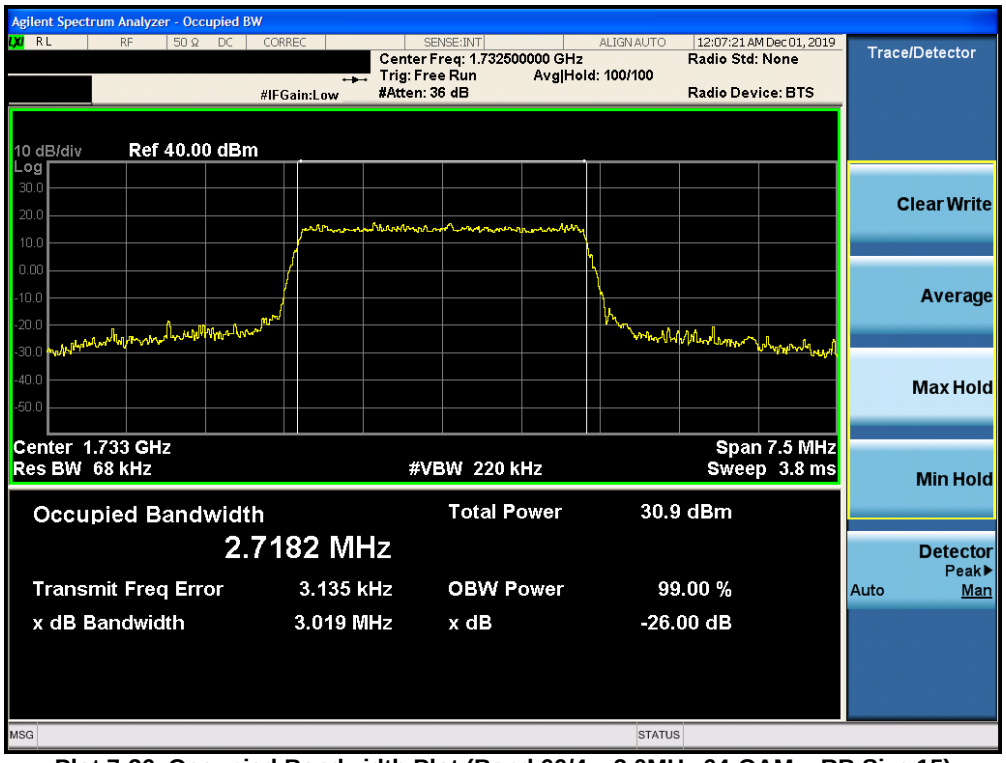
Plot 7-35. Occupied Bandwidth Plot (Band 66/4 – 3.0MHz 16-QAM – RB Size 15)



Plot 7-36. Occupied Bandwidth Plot (Band 66/4 – 3.0MHz 64-QAM – RB Size 15)

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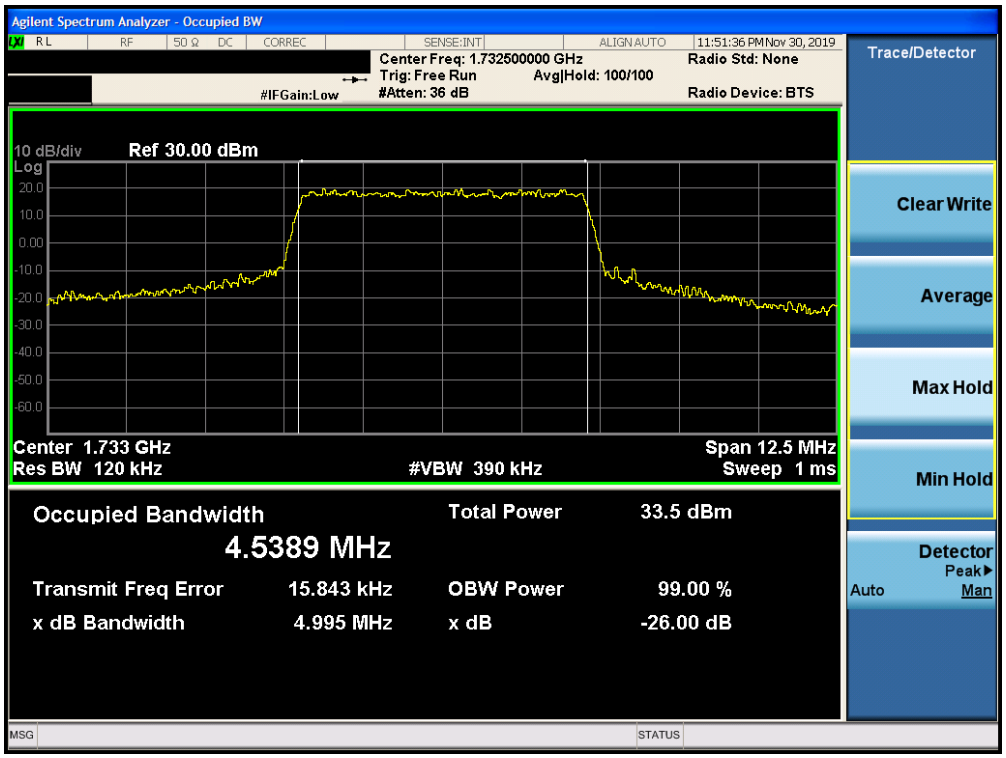
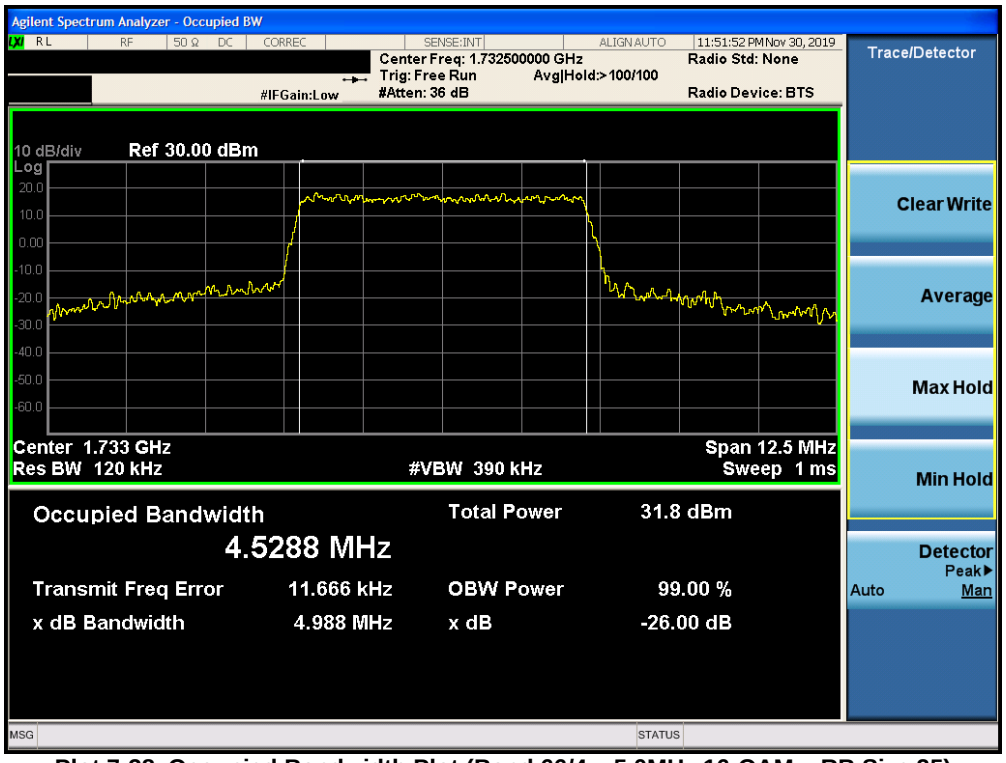


Plot 7-37. Occupied Bandwidth Plot (Band 66/4 – 5.0MHz QPSK – RB Size 25)



Plot 7-38. Occupied Bandwidth Plot (Band 66/4 – 5.0MHz 16-QAM – RB Size 25)

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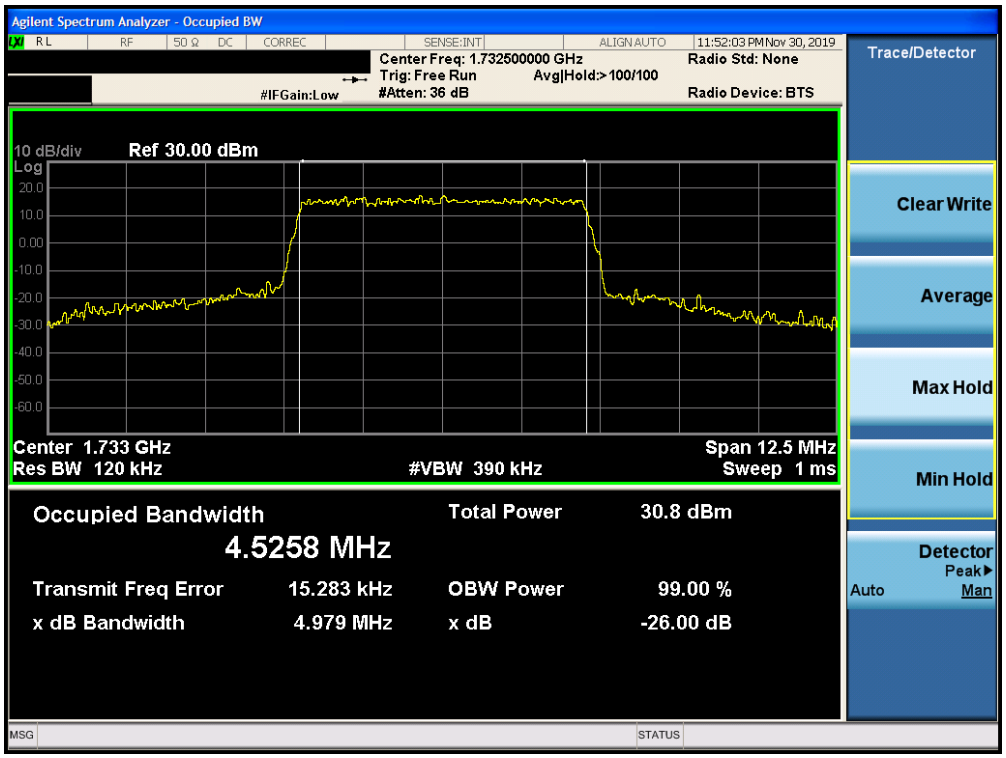
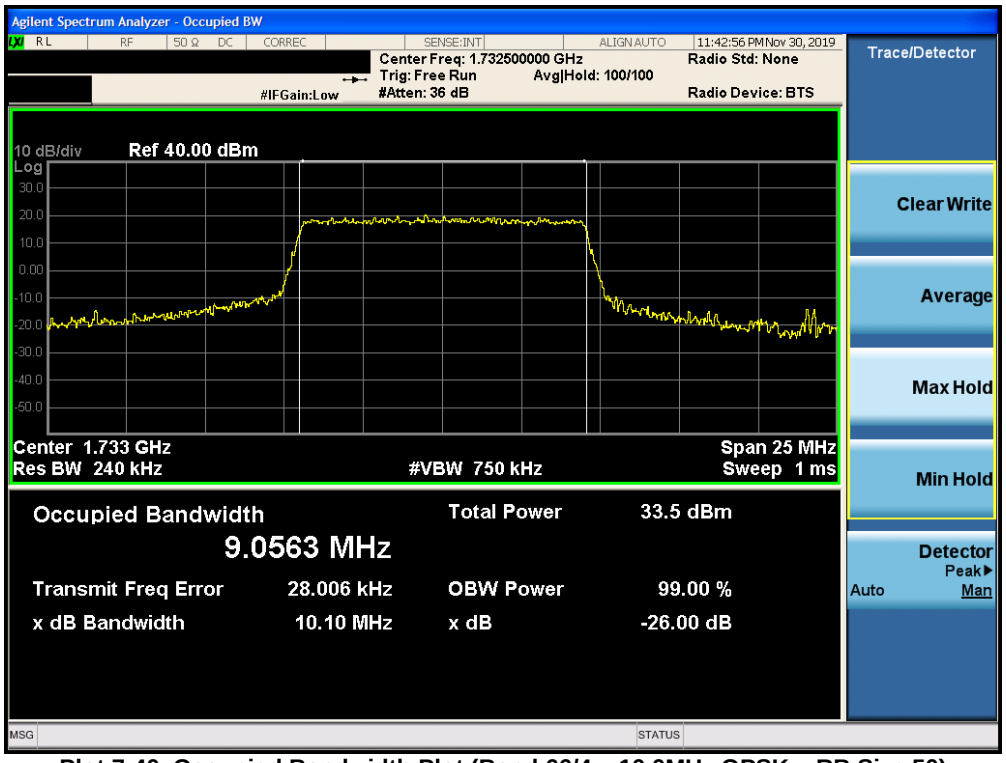


Plot 7-39. Occupied Bandwidth Plot (Band 66/4 – 5.0MHz 64-QAM – RB Size 25)



Plot 7-40. Occupied Bandwidth Plot (Band 66/4 – 10.0MHz QPSK – RB Size 50)

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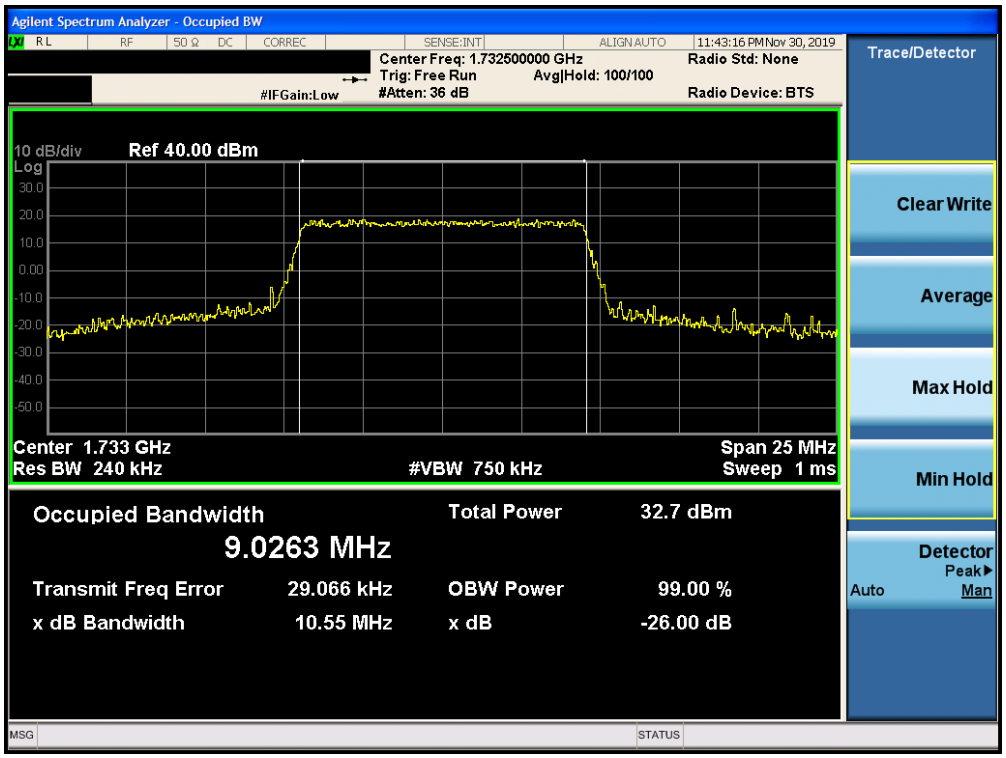
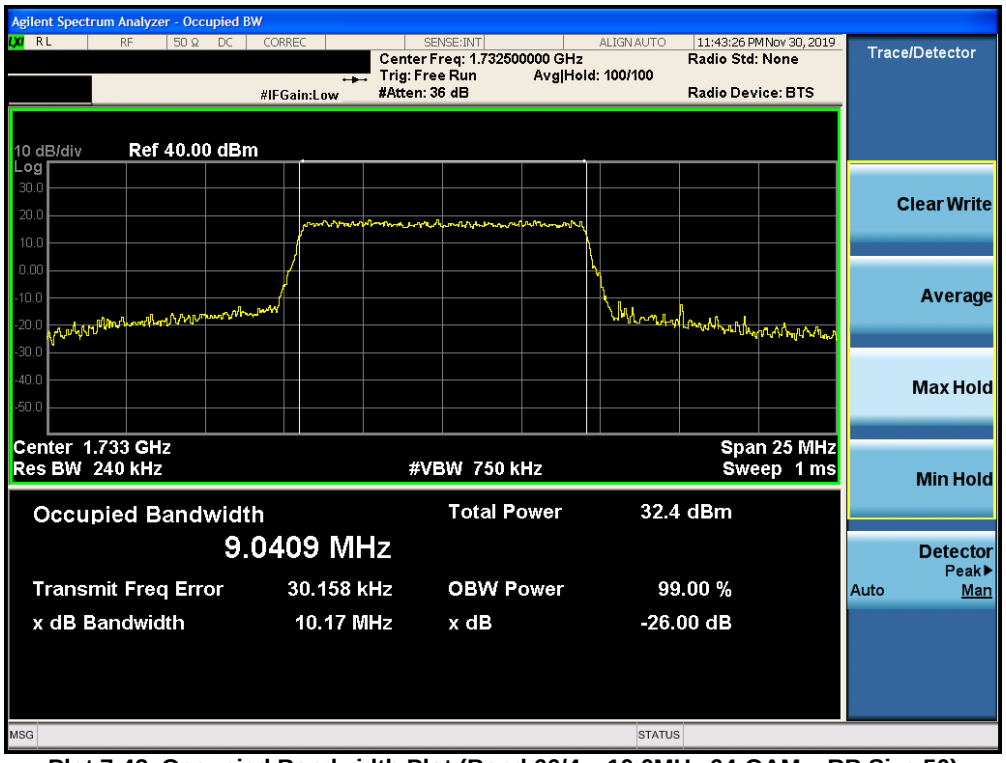


Plot 7-41. Occupied Bandwidth Plot (Band 66/4 – 10.0MHz 16-QAM – RB Size 50)



Plot 7-42. Occupied Bandwidth Plot (Band 66/4 – 10.0MHz 64-QAM – RB Size 50)

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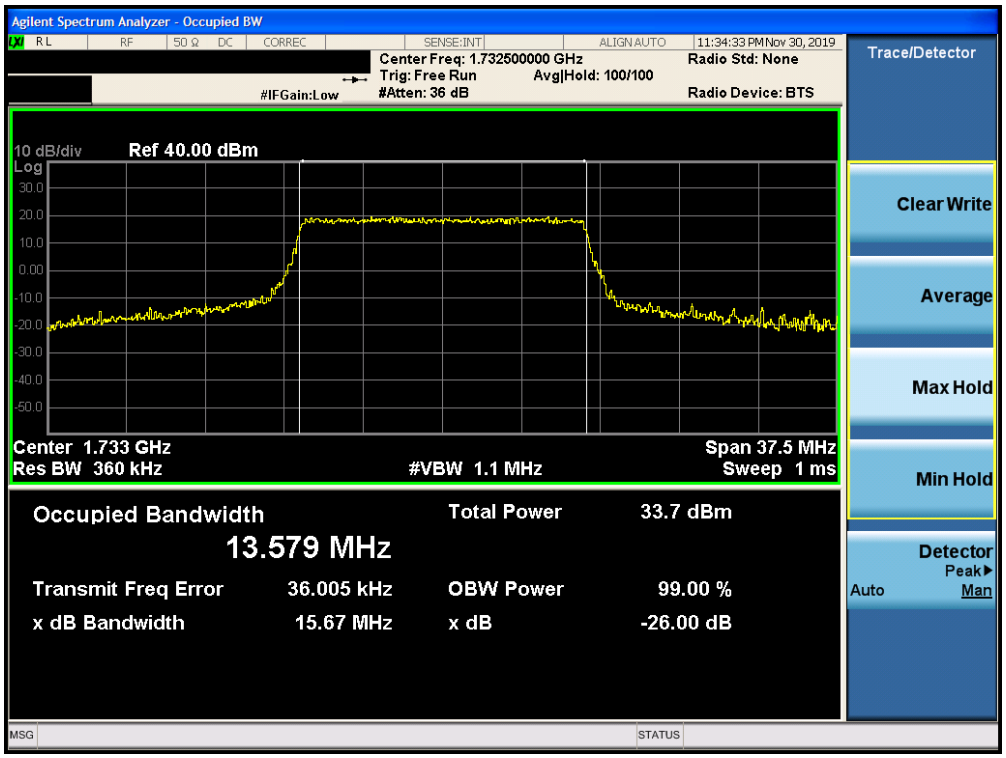
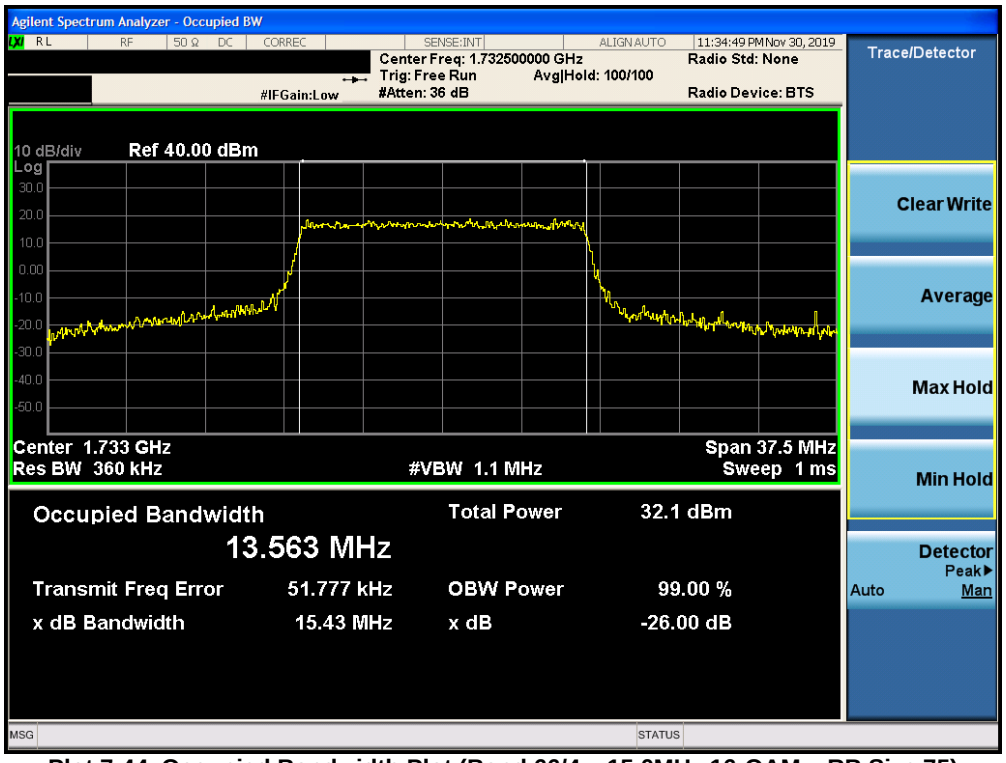


Plot 7-43. Occupied Bandwidth Plot (Band 66/4 – 15.0MHz QPSK – RB Size 75)



Plot 7-44. Occupied Bandwidth Plot (Band 66/4 – 15.0MHz 16-QAM – RB Size 75)

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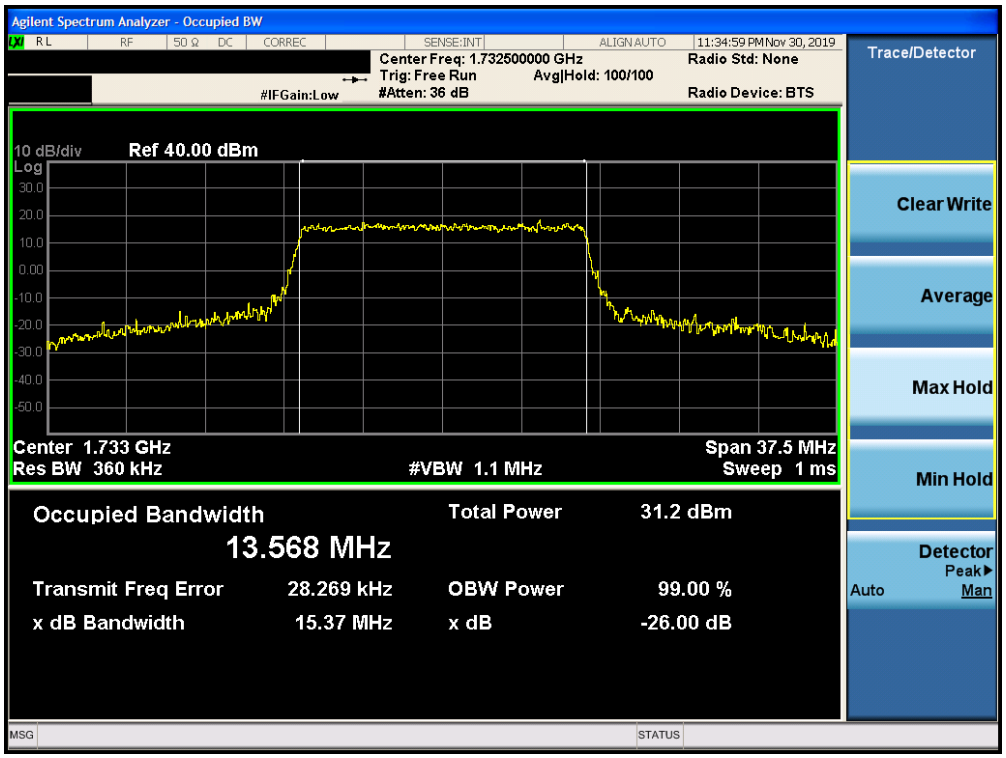
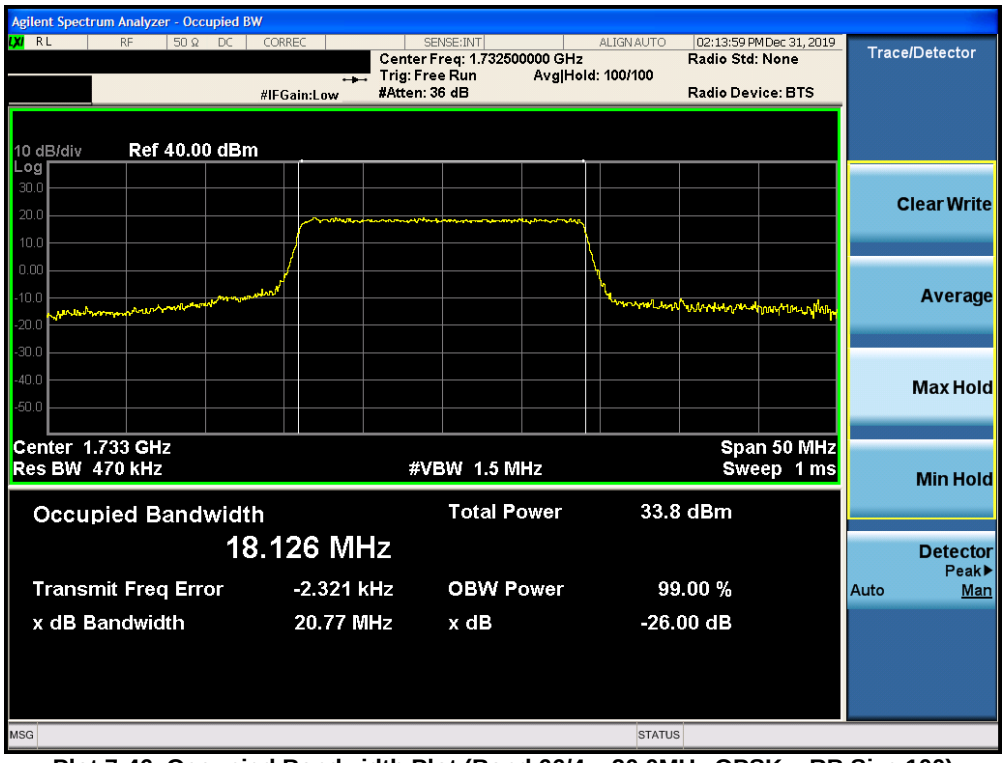


Plot 7-45. Occupied Bandwidth Plot (Band 66/4 – 15.0MHz 64-QAM – RB Size 75)



Plot 7-46. Occupied Bandwidth Plot (Band 66/4 – 20.0MHz QPSK – RB Size 100)

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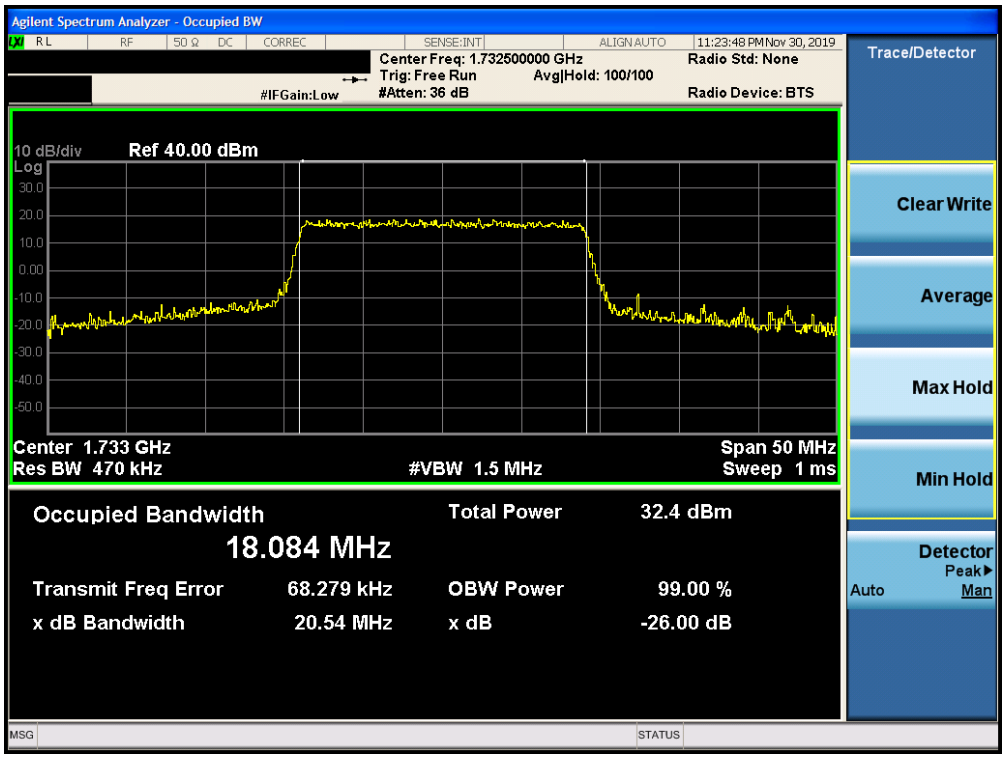
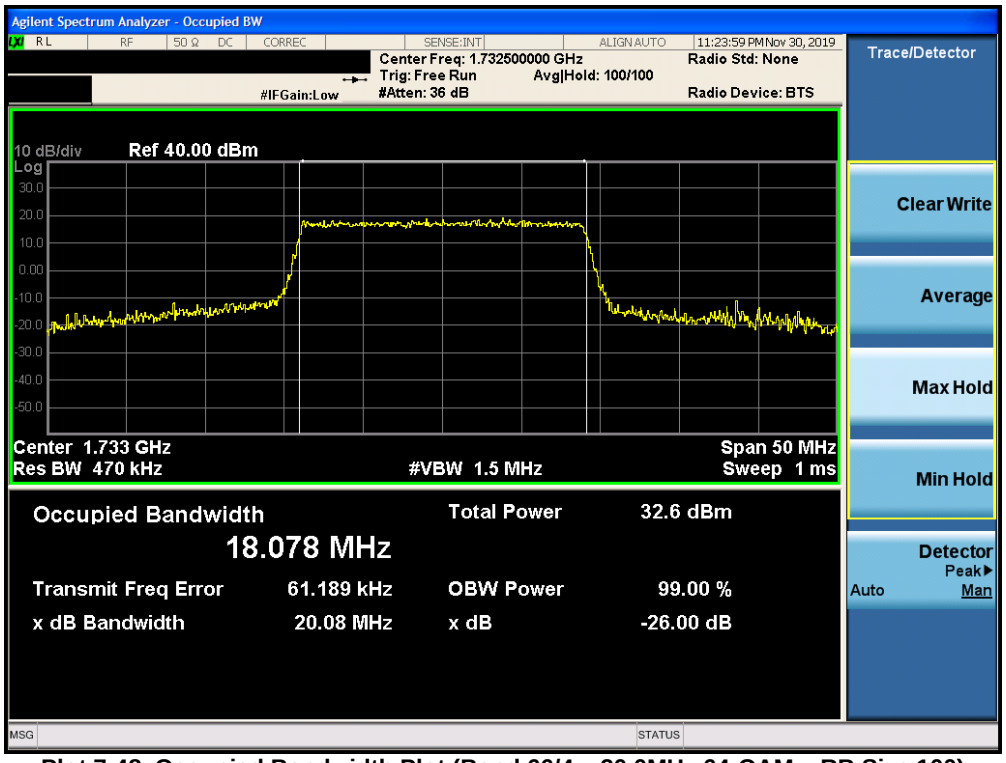


Plot 7-47. Occupied Bandwidth Plot (Band 66/4 – 20.0MHz 16-QAM – RB Size 100)



Plot 7-48. Occupied Bandwidth Plot (Band 66/4 – 20.0MHz 64-QAM – RB Size 100)

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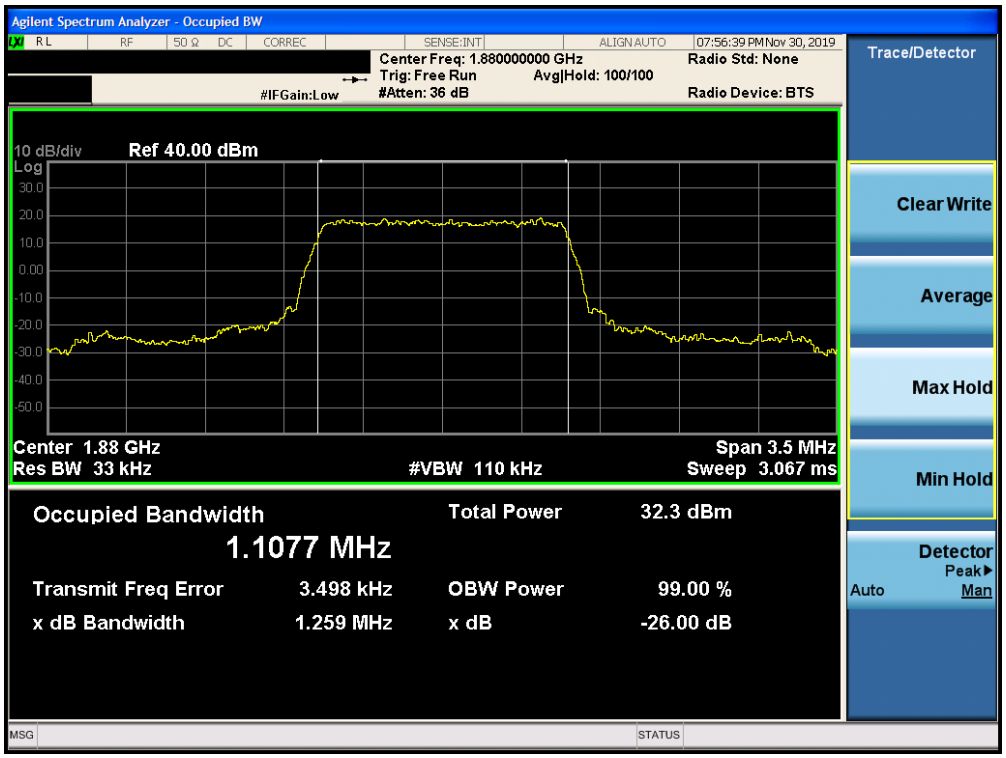
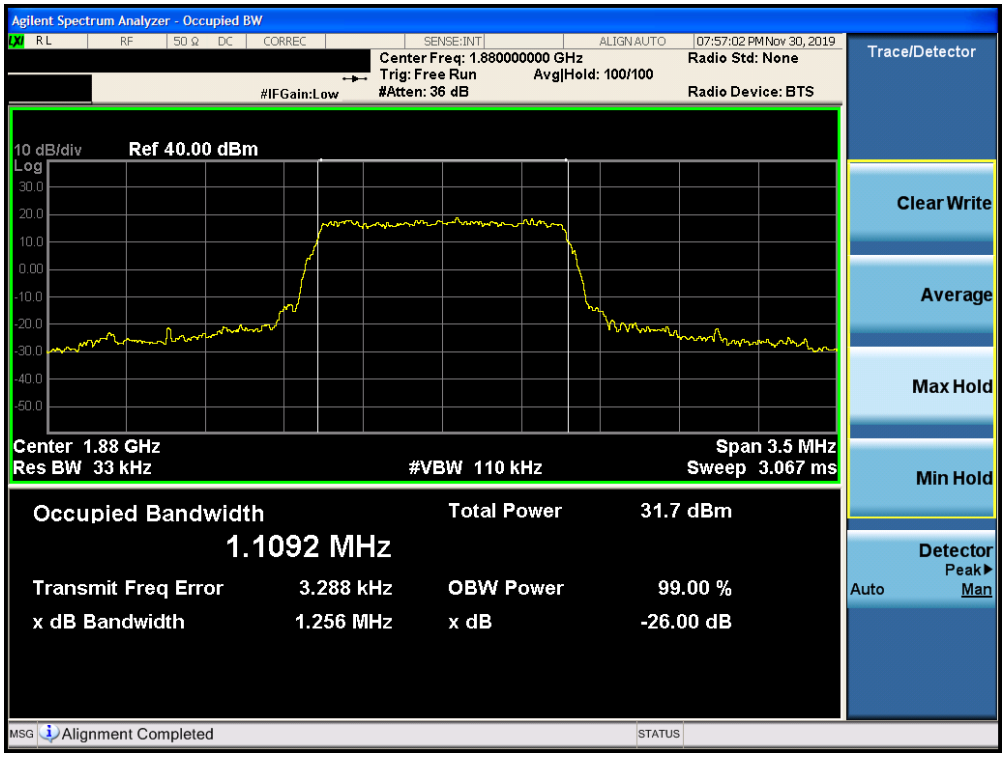
Band 25/2



Plot 7-49. Occupied Bandwidth Plot (Band 25/2 – 1.4MHz QPSK – RB Size 6)



Plot 7-50. Occupied Bandwidth Plot (Band 25/2 – 1.4MHz 16-QAM – RB Size 6)

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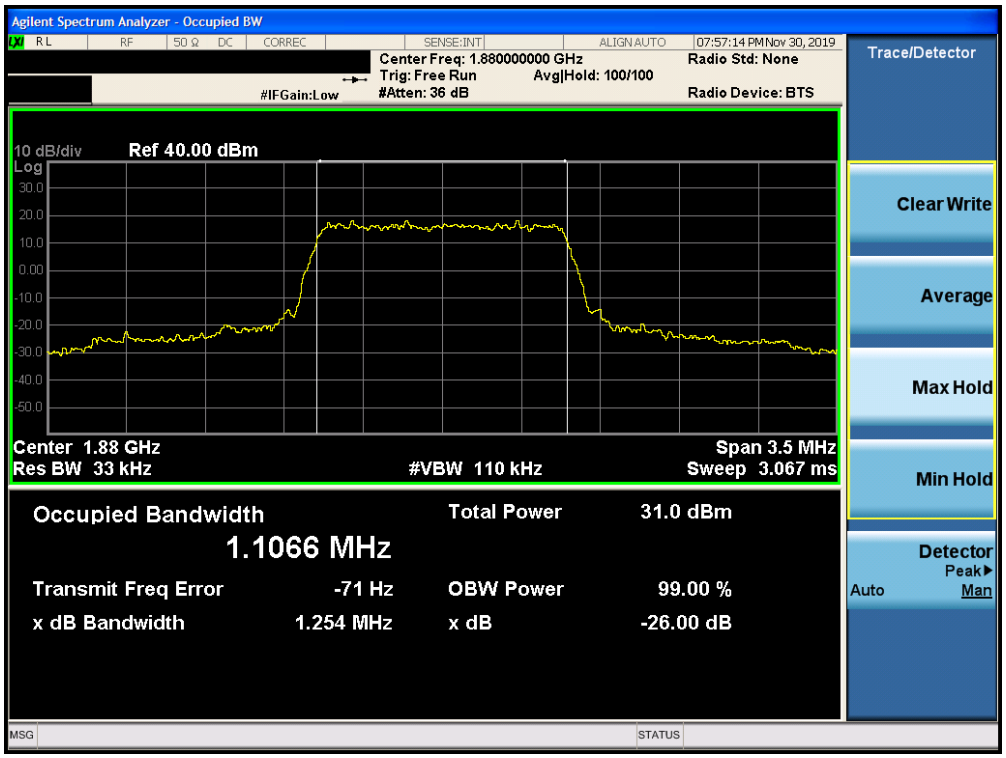
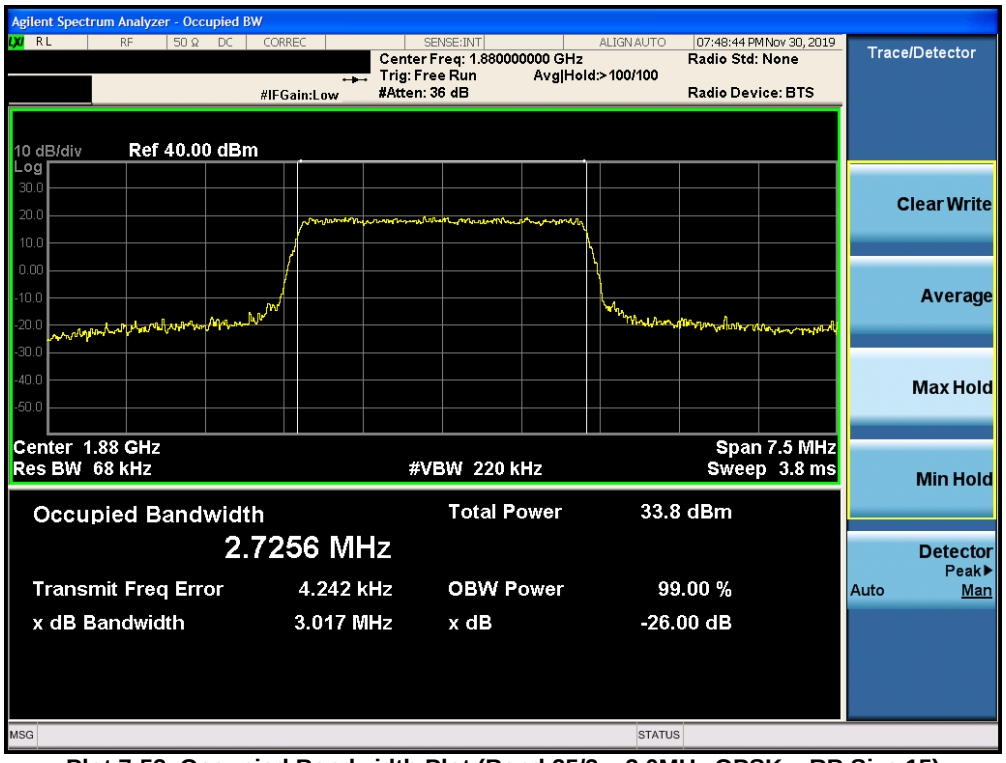


Plot 7-51. Occupied Bandwidth Plot (Band 25/2 – 1.4MHz 64-QAM – RB Size 6)



Plot 7-52. Occupied Bandwidth Plot (Band 25/2 – 3.0MHz QPSK – RB Size 15)

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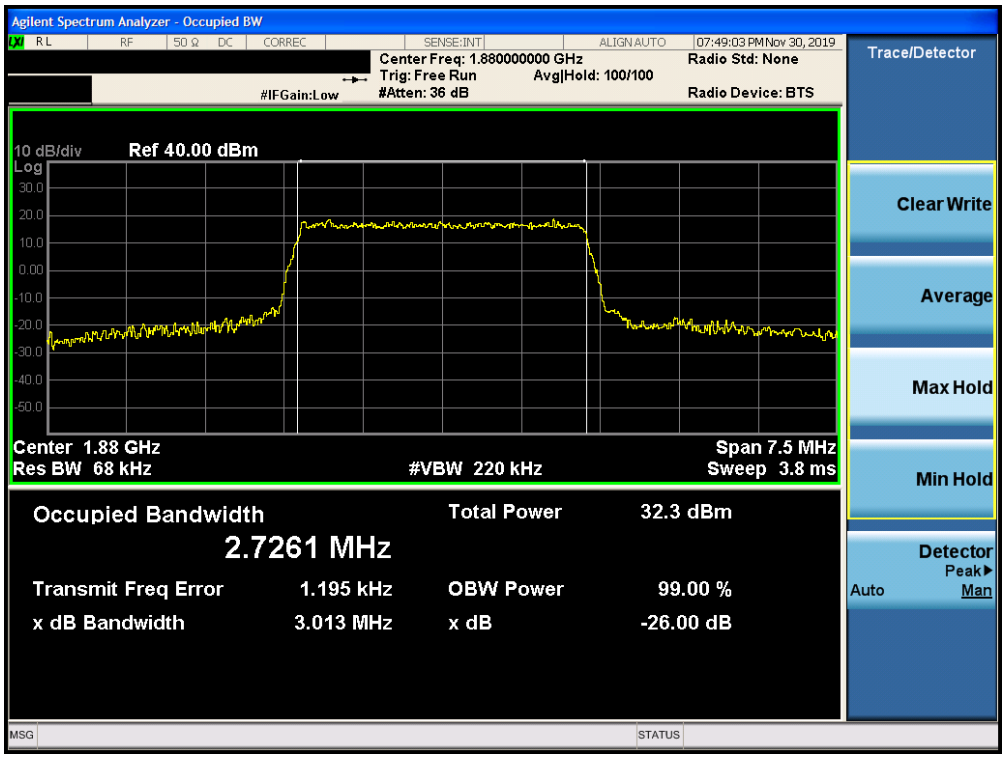
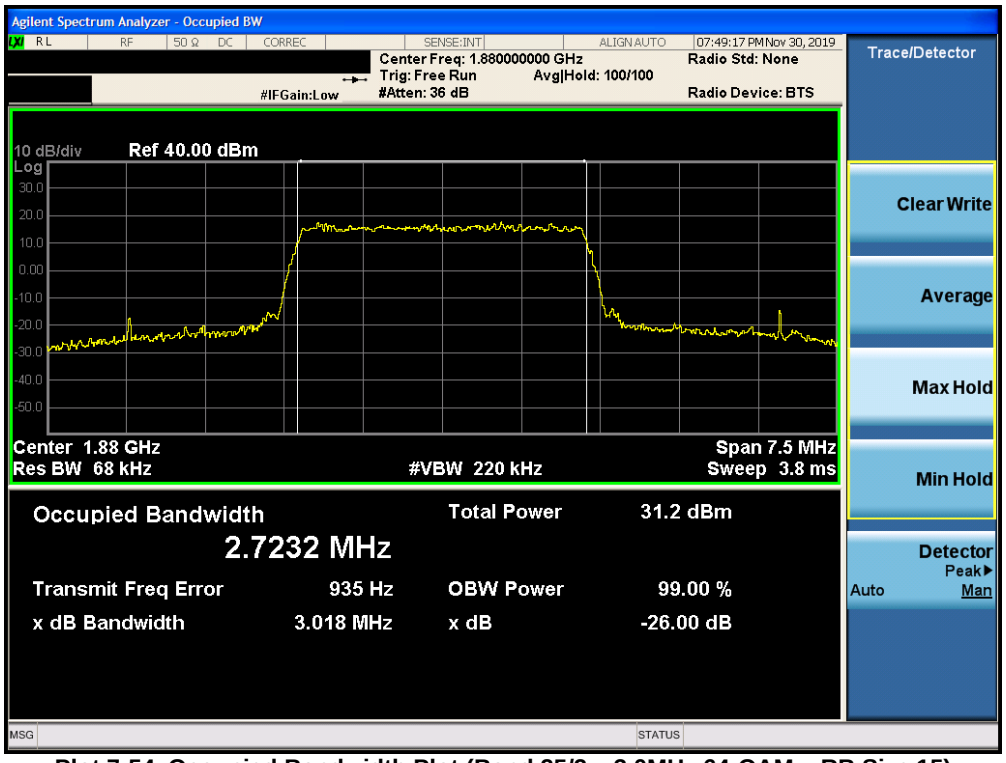


Plot 7-53. Occupied Bandwidth Plot (Band 25/2 – 3.0MHz 16-QAM – RB Size 15)



Plot 7-54. Occupied Bandwidth Plot (Band 25/2 – 3.0MHz 64-QAM – RB Size 15)

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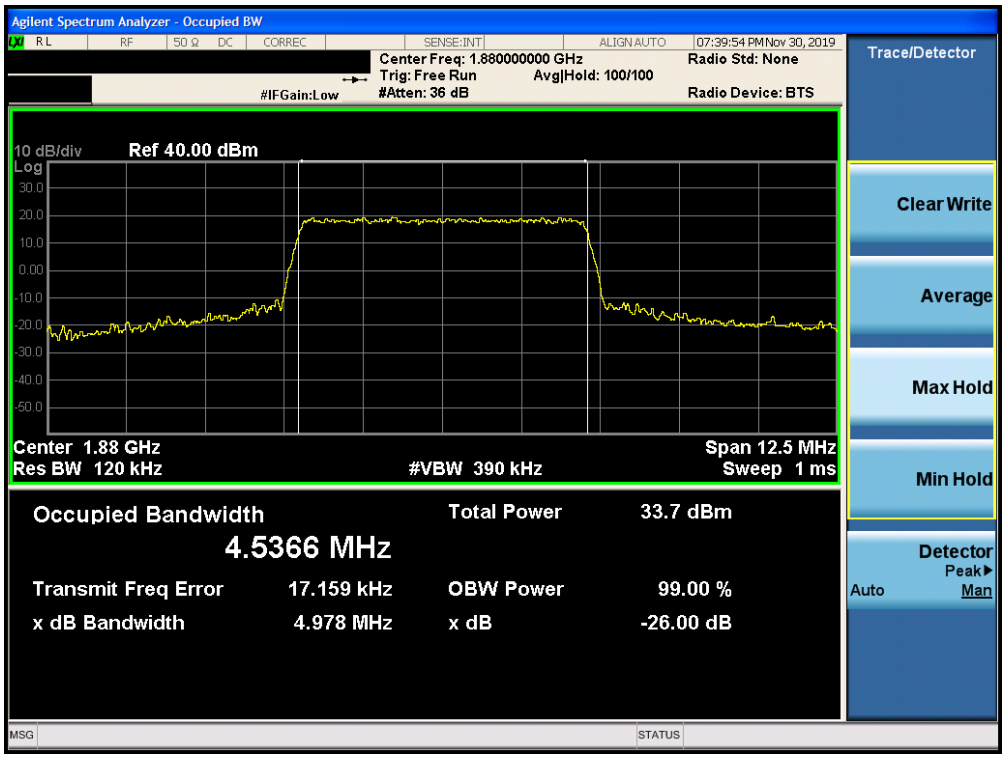
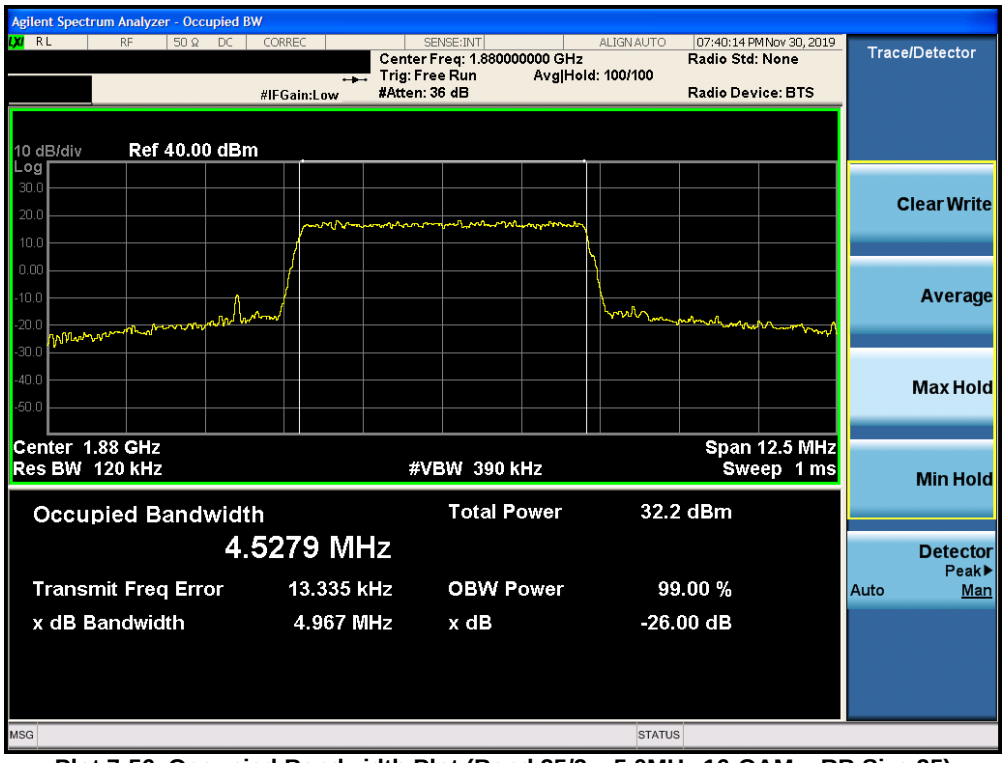


Plot 7-55. Occupied Bandwidth Plot (Band 25/2 – 5.0MHz QPSK – RB Size 25)



Plot 7-56. Occupied Bandwidth Plot (Band 25/2 – 5.0MHz 16-QAM – RB Size 25)

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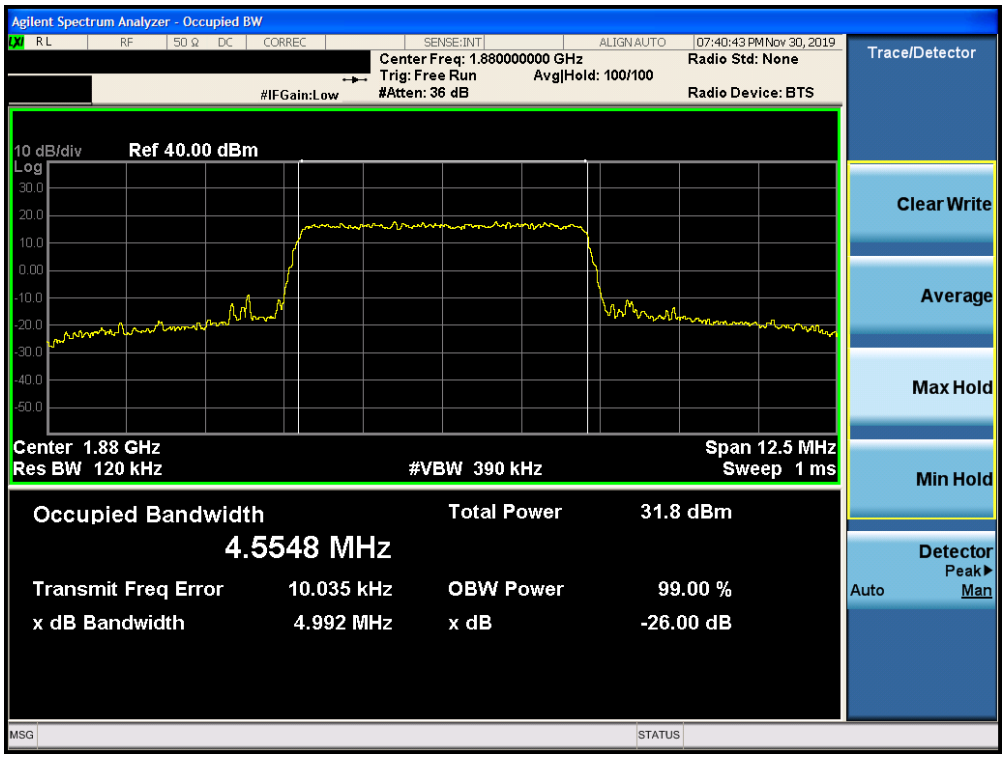
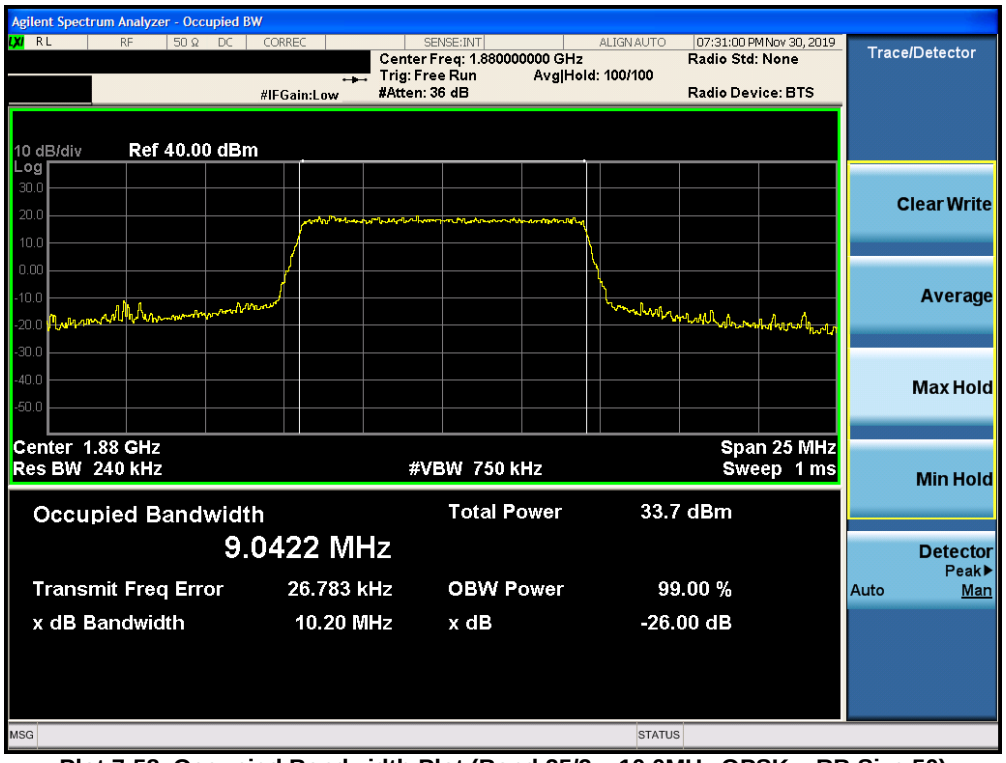


Plot 7-57. Occupied Bandwidth Plot (Band 25/2 – 5.0MHz 64-QAM – RB Size 25)



Plot 7-58. Occupied Bandwidth Plot (Band 25/2 – 10.0MHz QPSK – RB Size 50)

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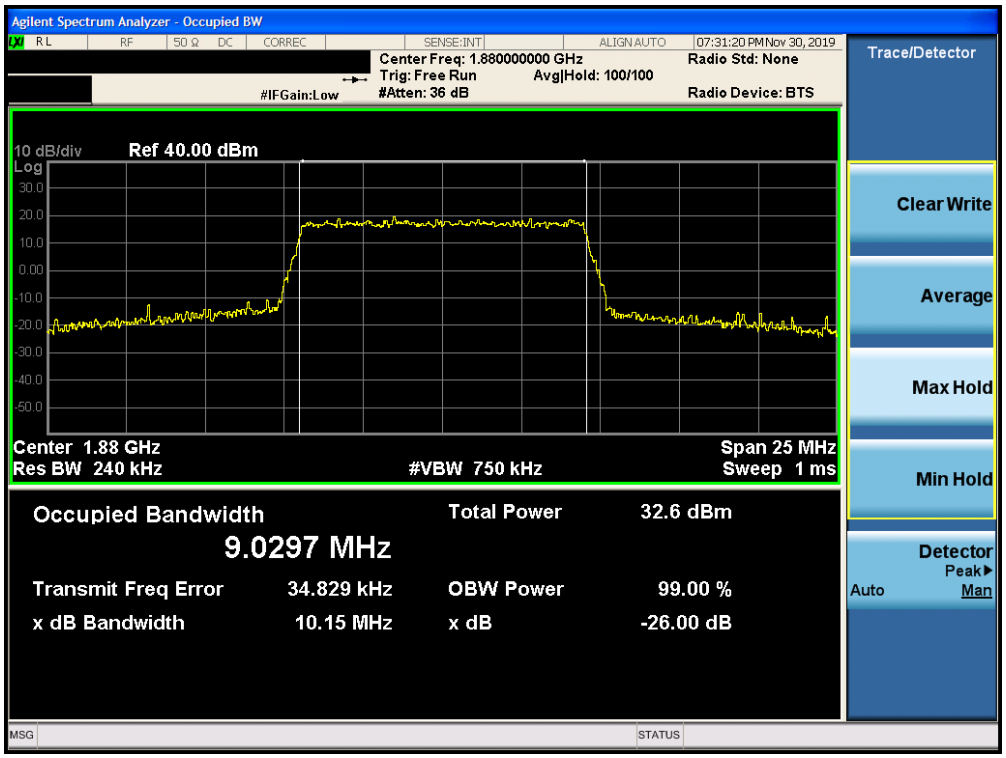
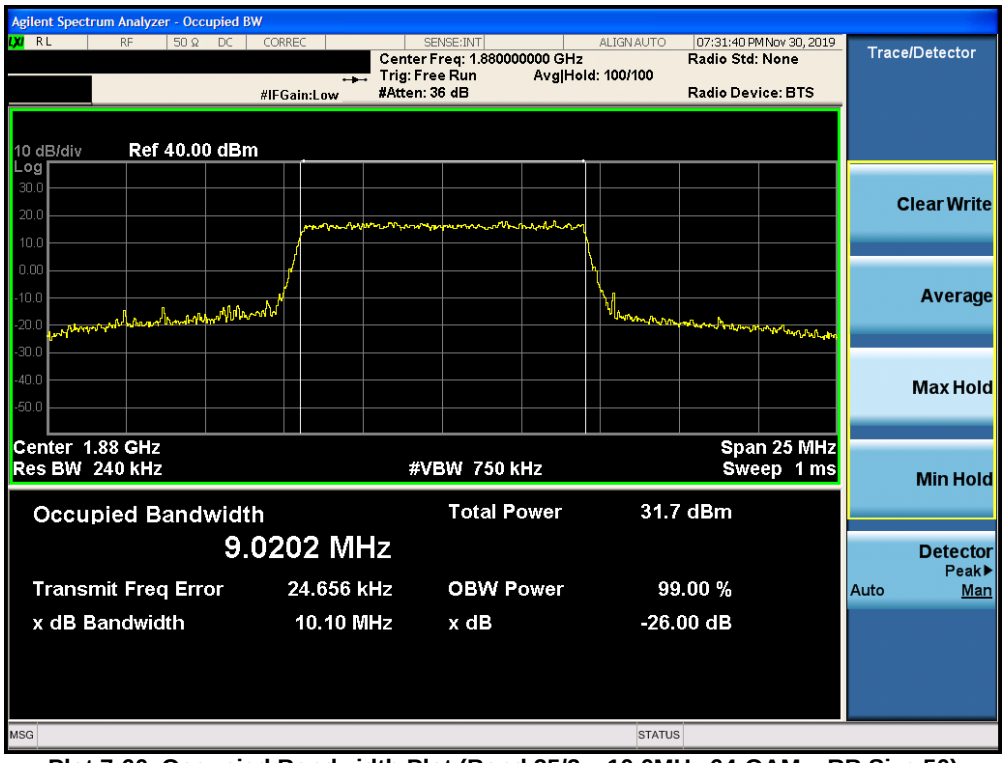


Plot 7-59. Occupied Bandwidth Plot (Band 25/2 – 10.0MHz 16-QAM – RB Size 50)



Plot 7-60. Occupied Bandwidth Plot (Band 25/2 – 10.0MHz 64-QAM – RB Size 50)

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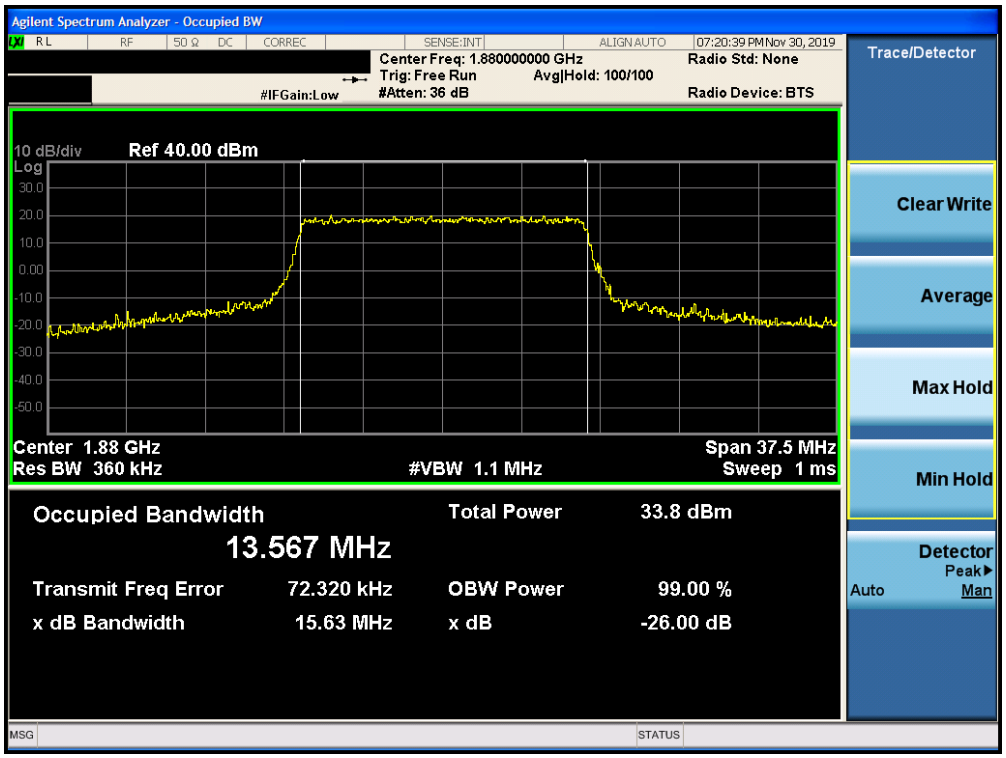
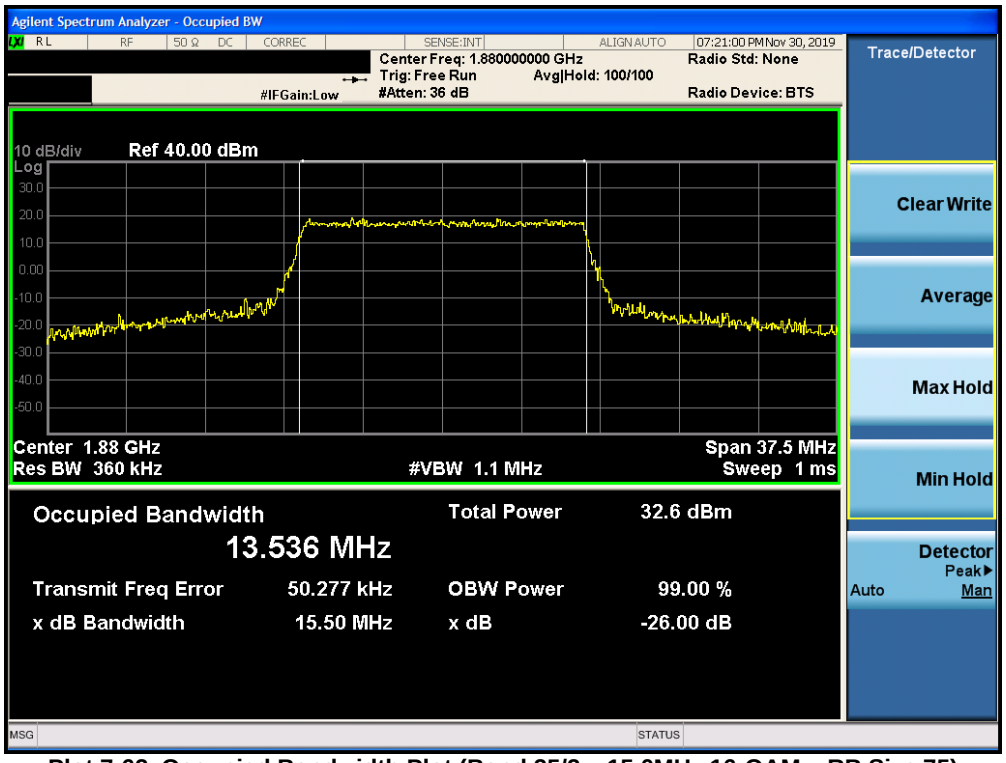


Plot 7-61. Occupied Bandwidth Plot (Band 25/2 – 15.0MHz QPSK – RB Size 75)



Plot 7-62. Occupied Bandwidth Plot (Band 25/2 – 15.0MHz 16-QAM – RB Size 75)

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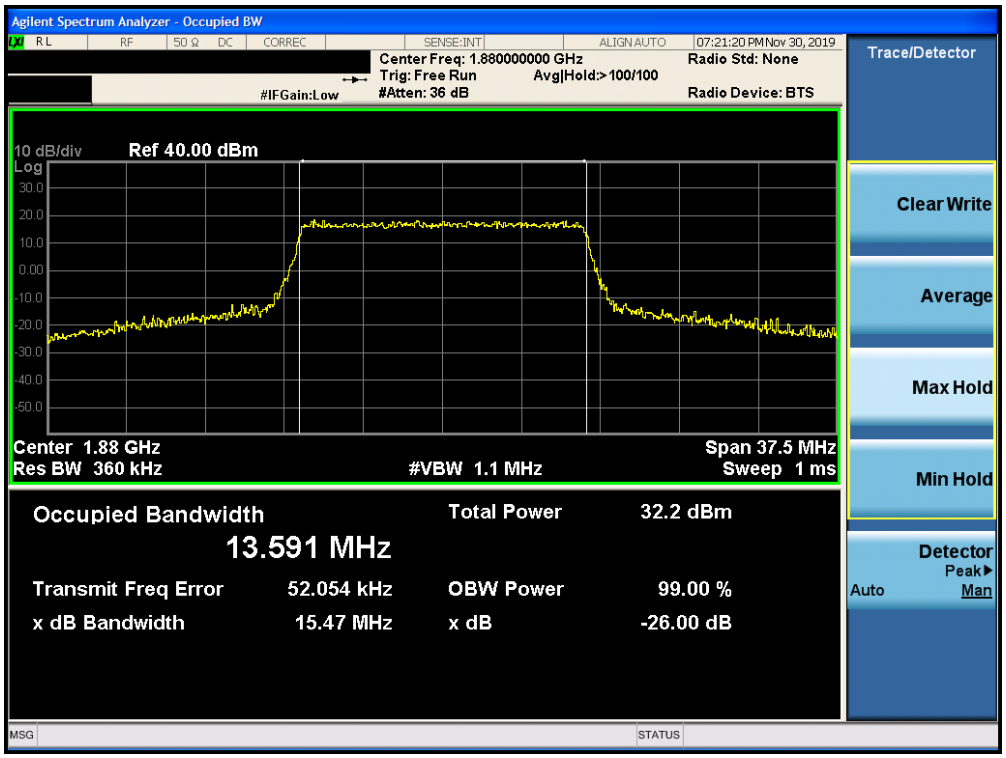
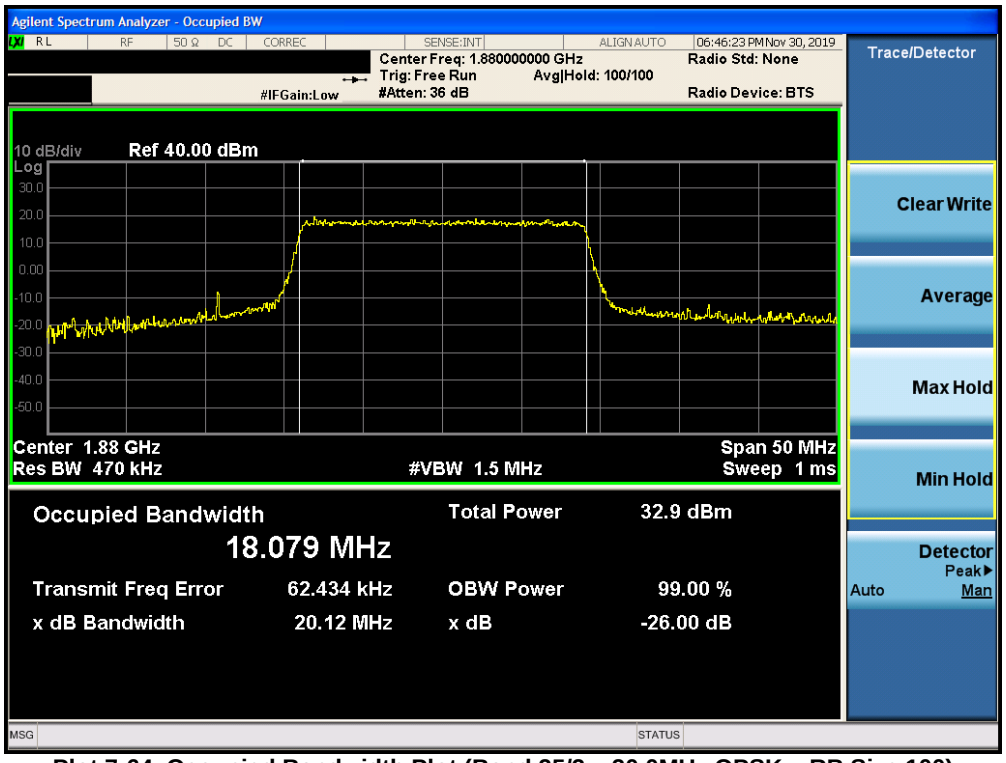


Plot 7-63. Occupied Bandwidth Plot (Band 25/2 – 15.0MHz 64-QAM – RB Size 75)



Plot 7-64. Occupied Bandwidth Plot (Band 25/2 – 20.0MHz QPSK – RB Size 100)

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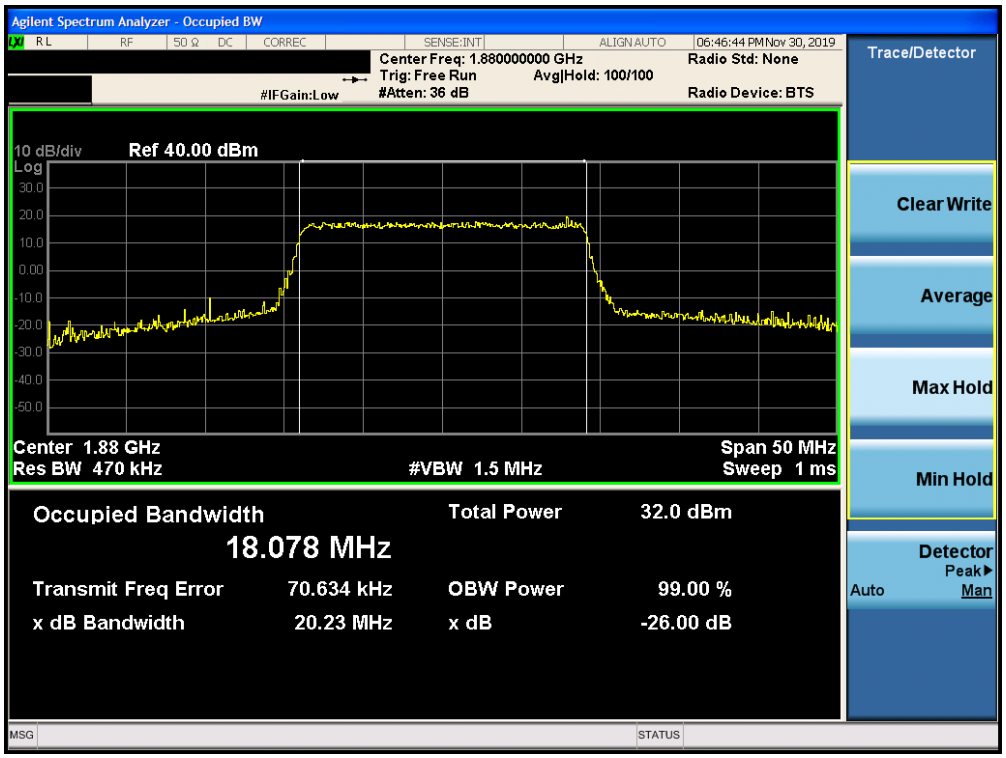
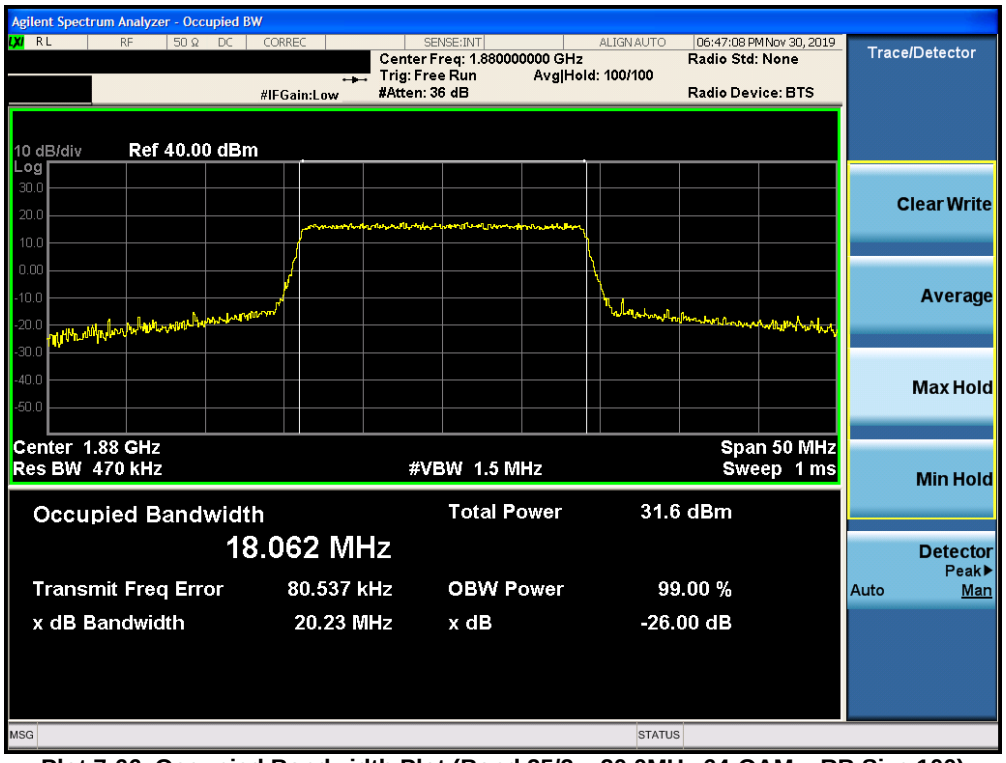


Plot 7-65. Occupied Bandwidth Plot (Band 25/2 – 20.0MHz 16-QAM – RB Size 100)



Plot 7-66. Occupied Bandwidth Plot (Band 25/2 – 20.0MHz 64-QAM – RB Size 100)

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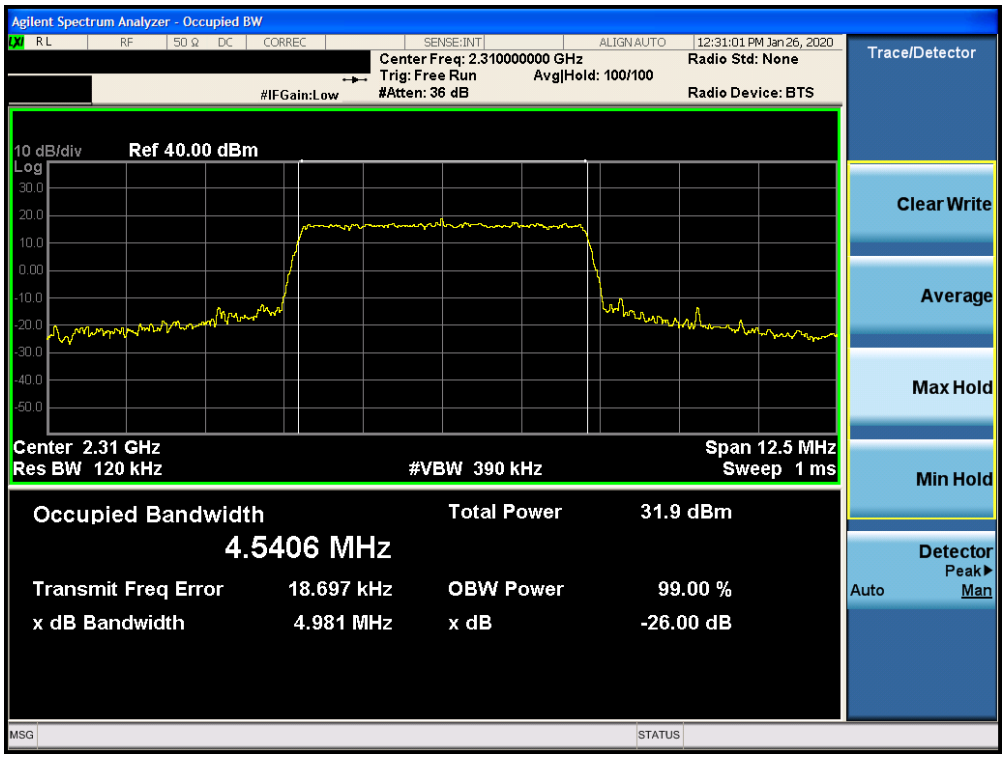
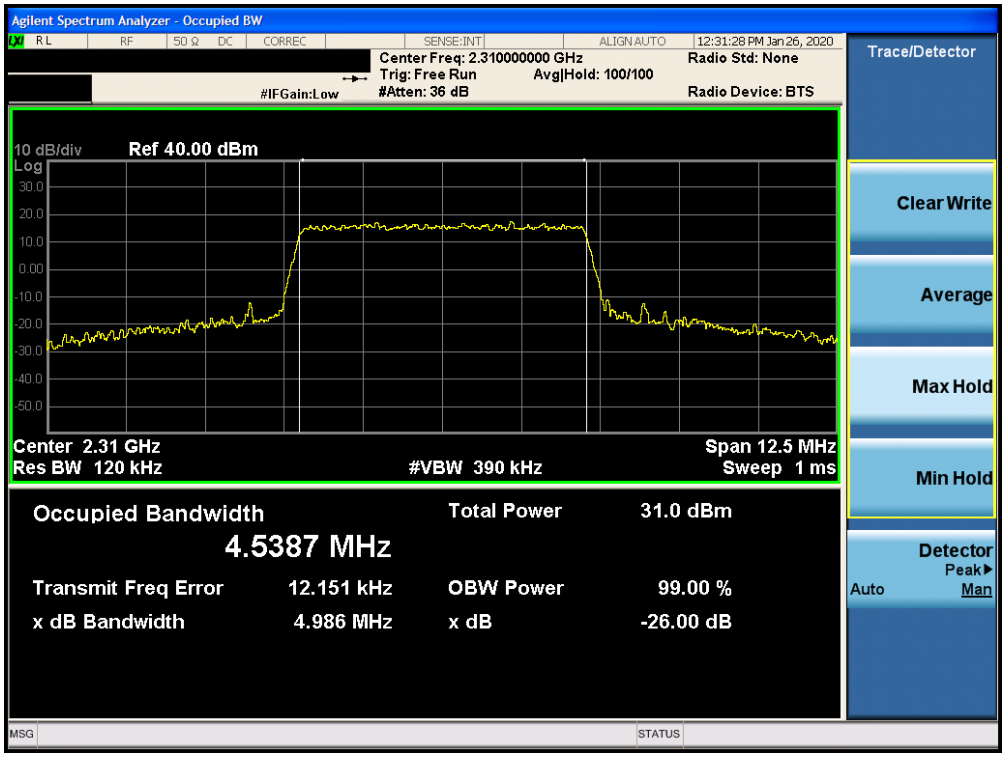
Band 30



Plot 7-67. Occupied Bandwidth Plot (Band 30 – 5.0MHz QPSK – RB Size 25)



Plot 7-68. Occupied Bandwidth Plot (Band 30 – 5.0MHz 16-QAM – RB Size 25)

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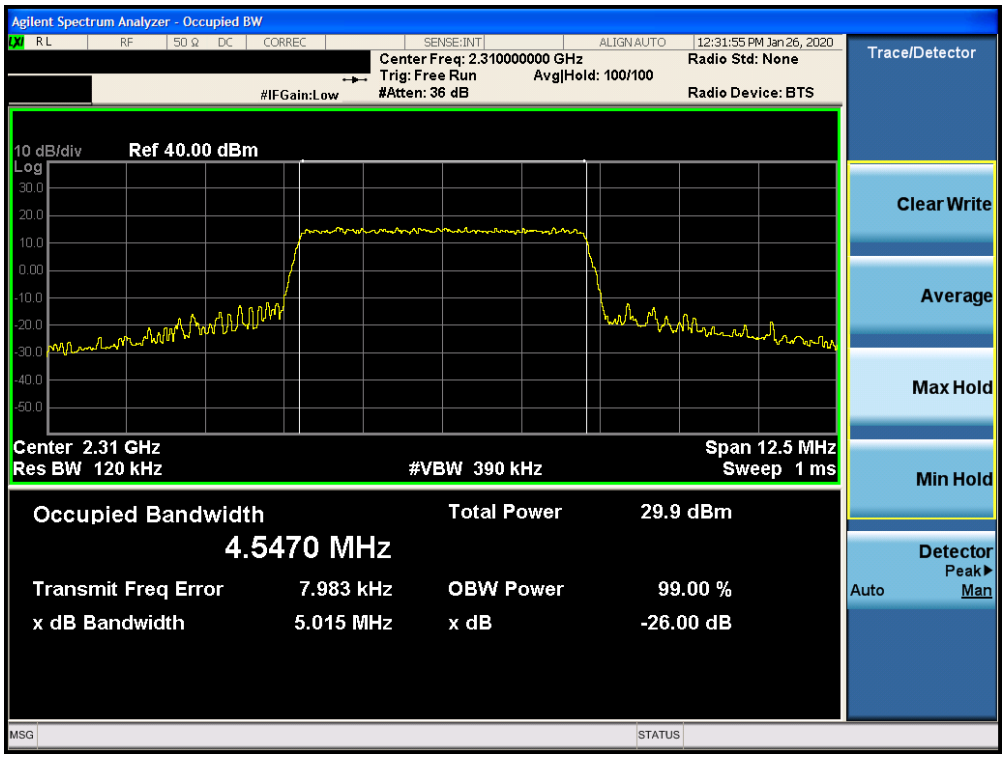
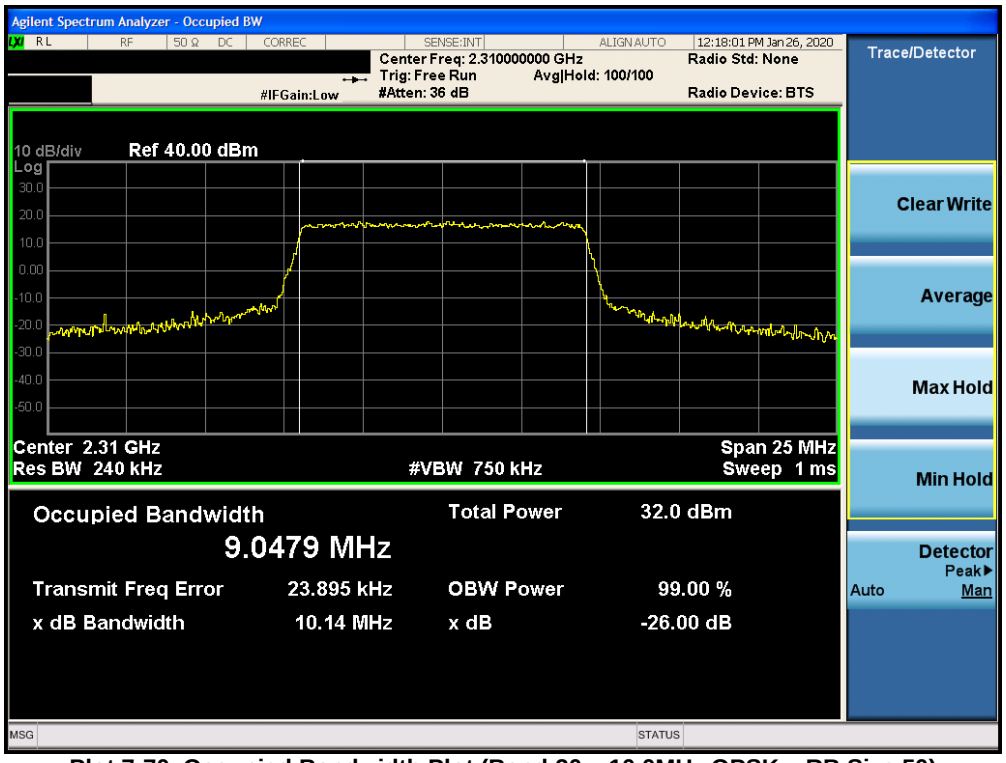


Plot 7-69. Occupied Bandwidth Plot (Band 30 – 5.0MHz 64-QAM – RB Size 25)



Plot 7-70. Occupied Bandwidth Plot (Band 30 – 10.0MHz QPSK – RB Size 50)

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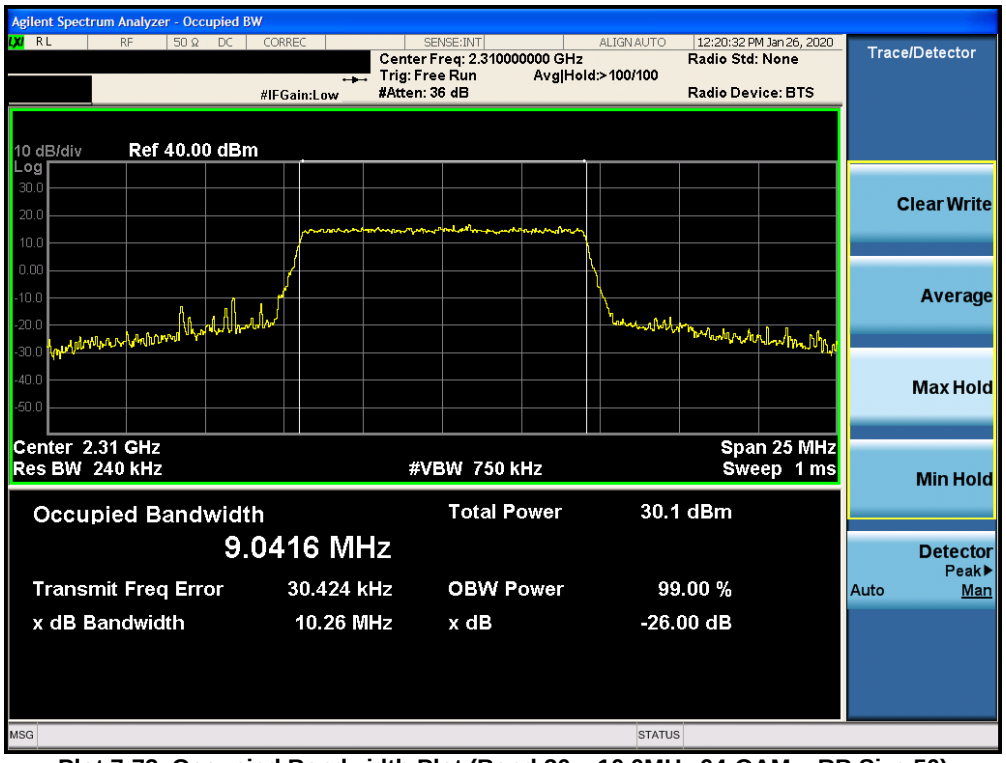
Plot 7-71. Occupied Bandwidth Plot (Band 30 – 10.0MHz 16-QAM – RB Size 50)



Plot 7-72. Occupied Bandwidth Plot (Band 30 – 10.0MHz 64-QAM – RB Size 50)

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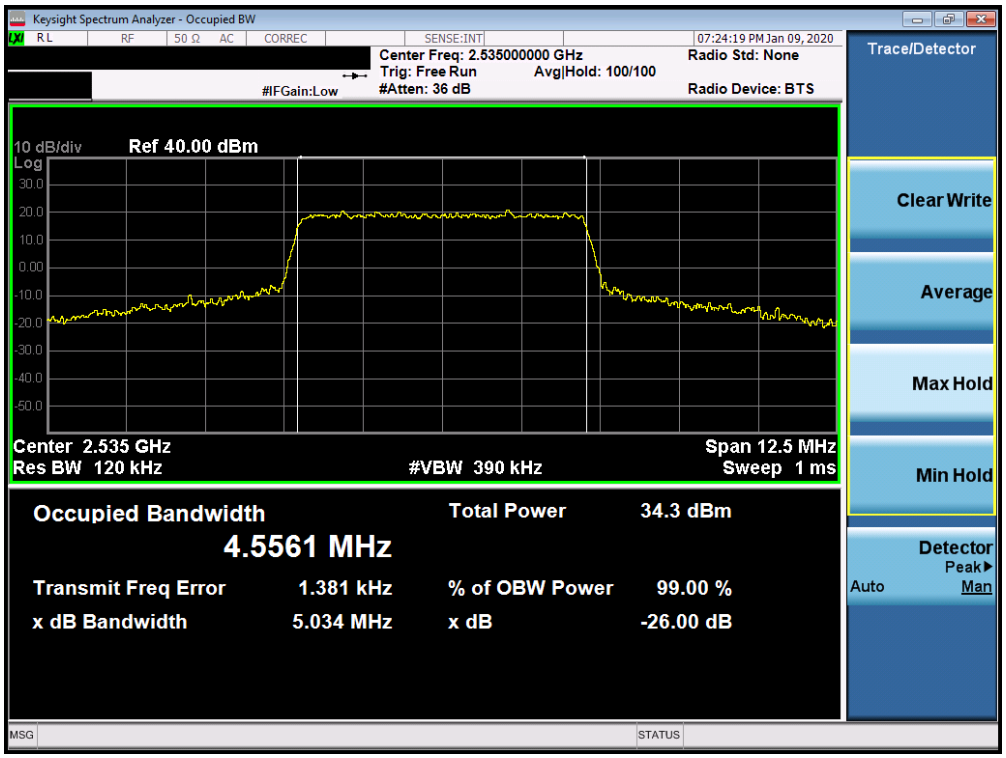
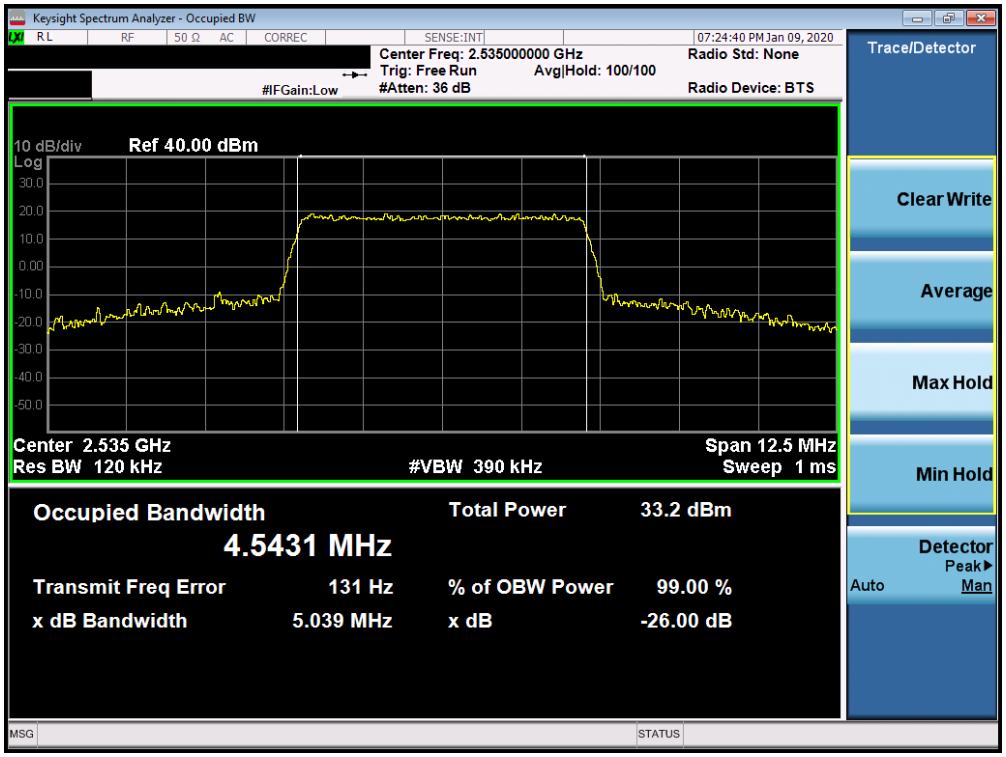
Band 7



Plot 7-73. Occupied Bandwidth Plot (Band 7 – 5.0MHz QPSK – RB Size 25)



Plot 7-74. Occupied Bandwidth Plot (Band 7 – 5.0MHz 16-QAM – RB Size 25)

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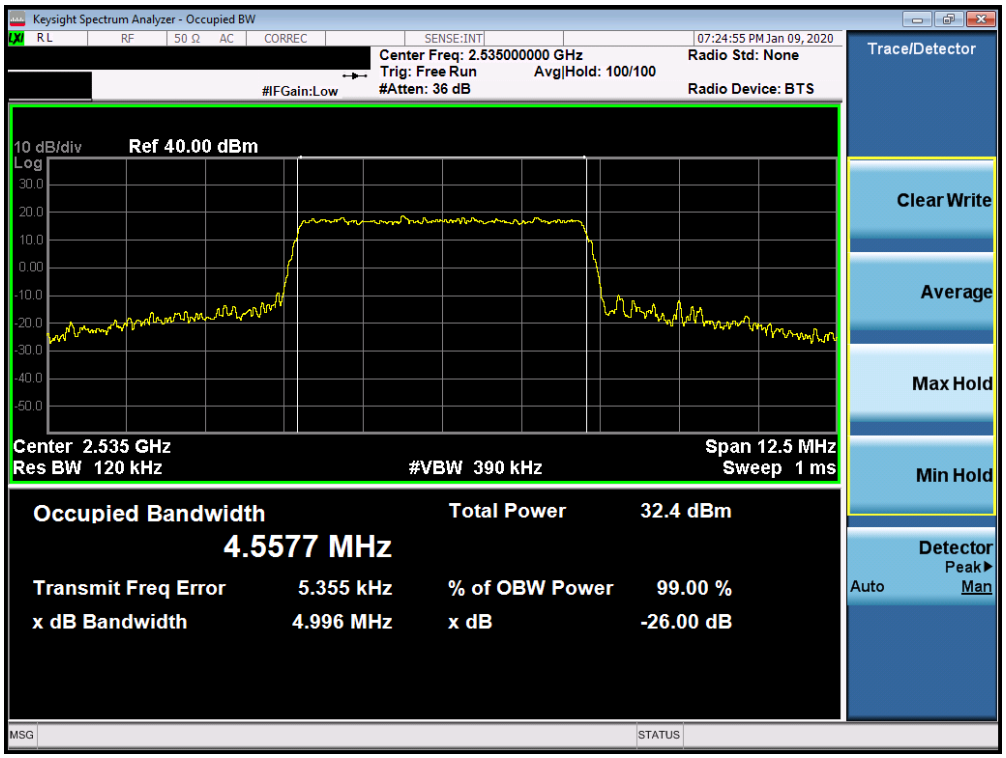
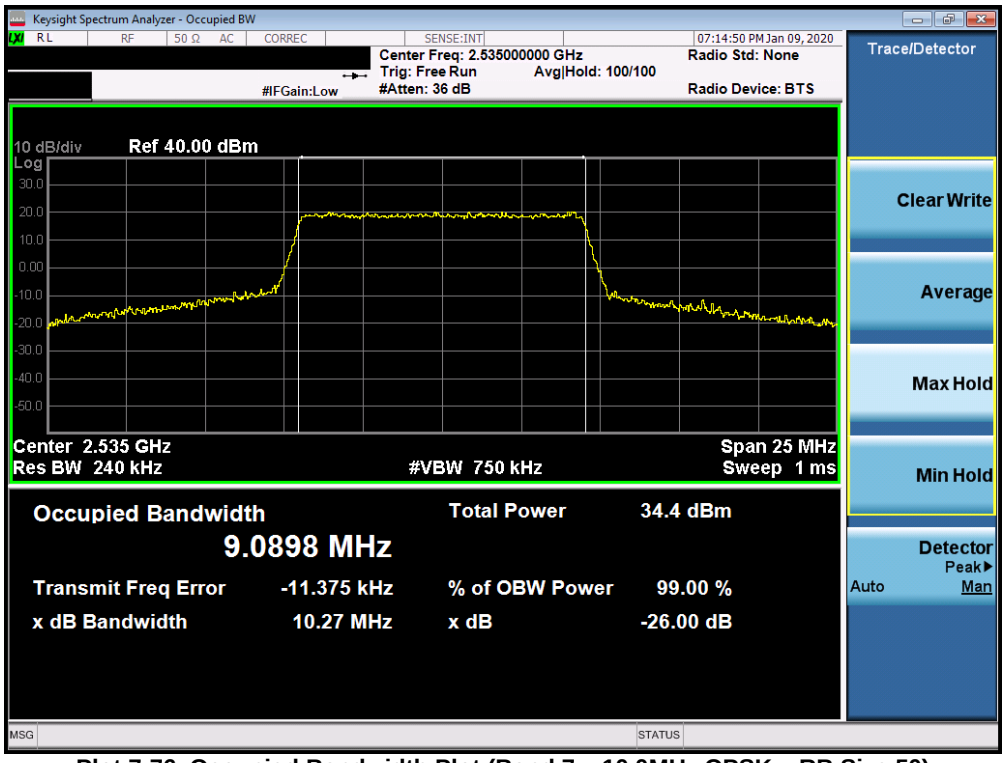


Plot 7-75. Occupied Bandwidth Plot (Band 7 – 5.0MHz 64-QAM – RB Size 25)



Plot 7-76. Occupied Bandwidth Plot (Band 7 – 10.0MHz QPSK – RB Size 50)

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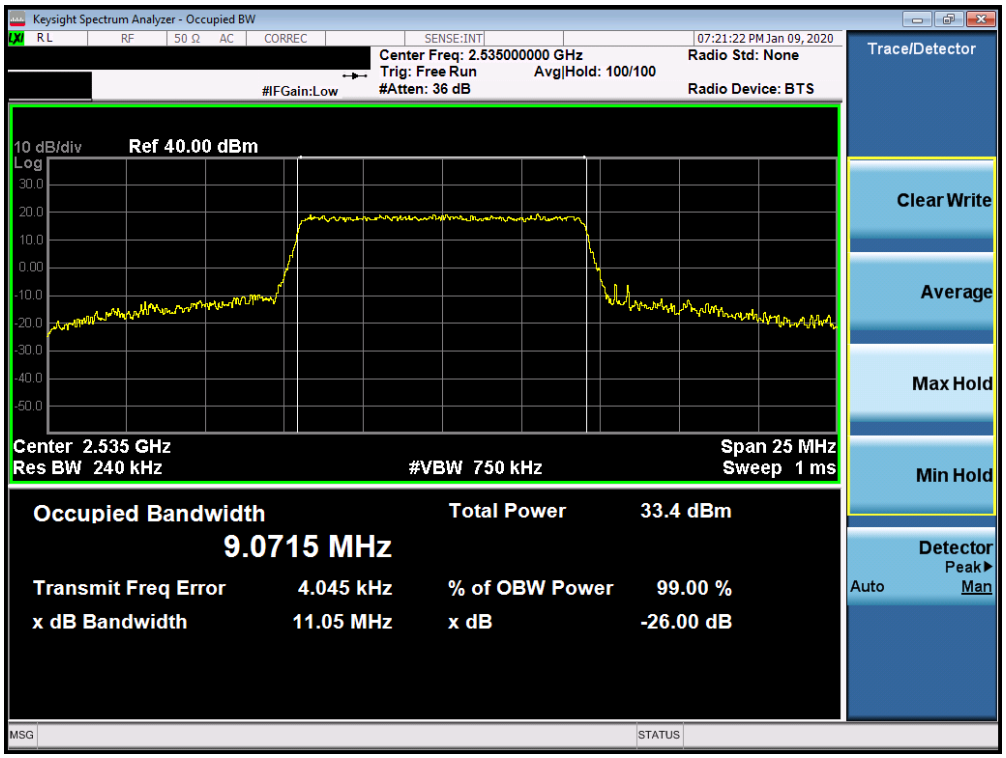
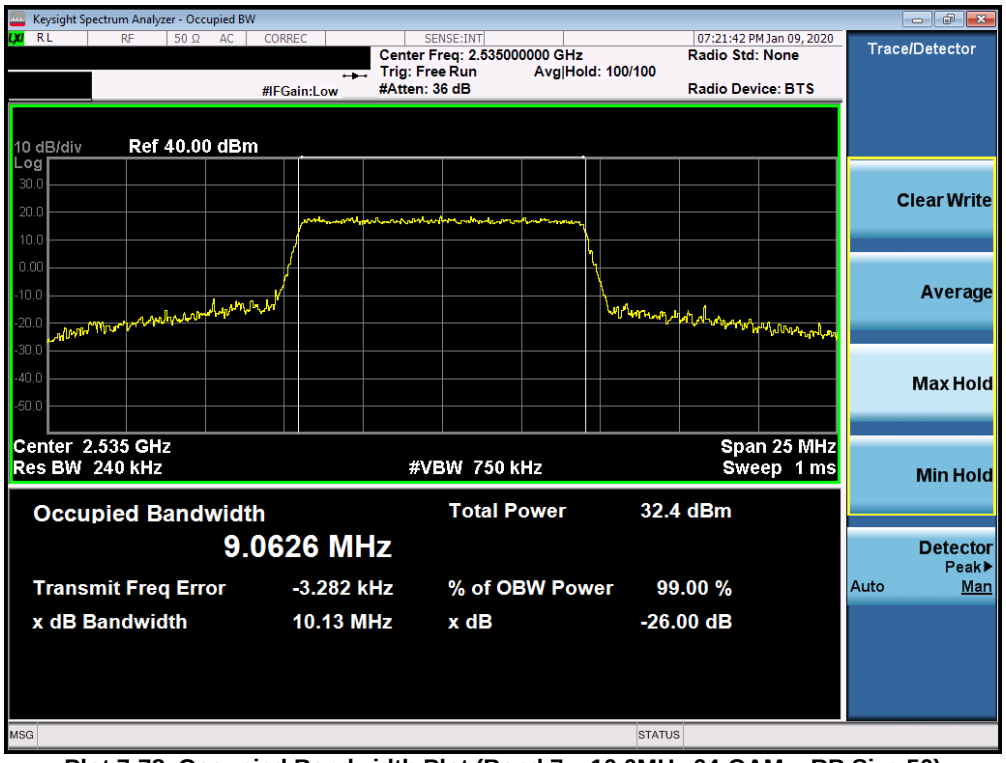


Plot 7-77. Occupied Bandwidth Plot (Band 7 – 10.0MHz 16-QAM – RB Size 50)



Plot 7-78. Occupied Bandwidth Plot (Band 7 – 10.0MHz 64-QAM – RB Size 50)

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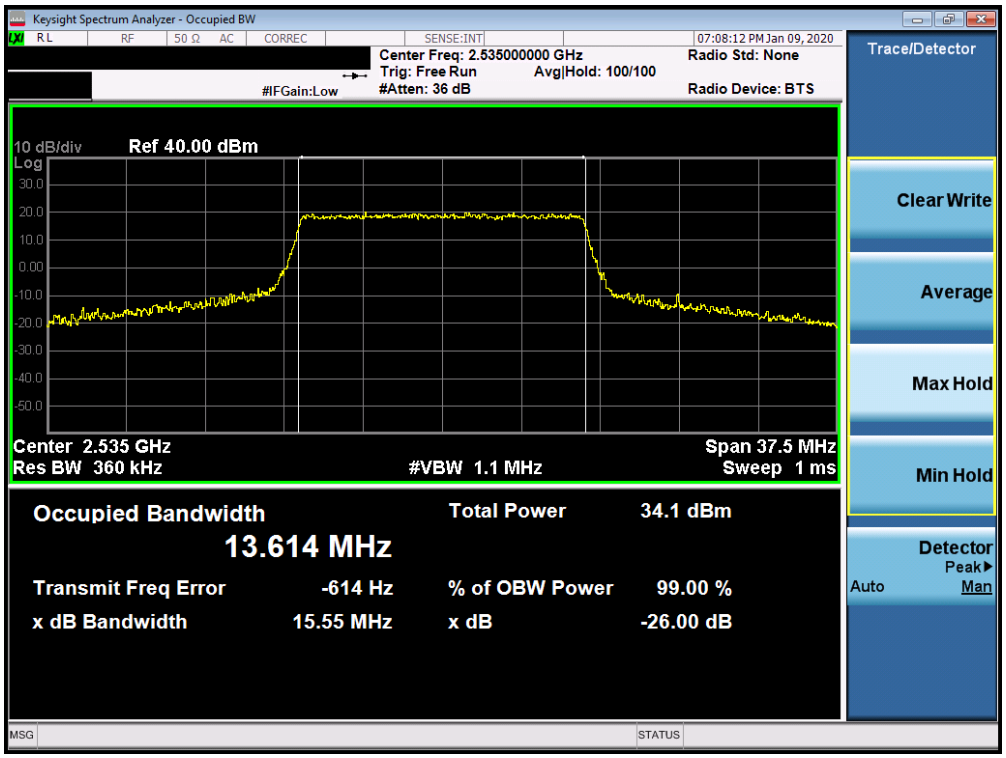
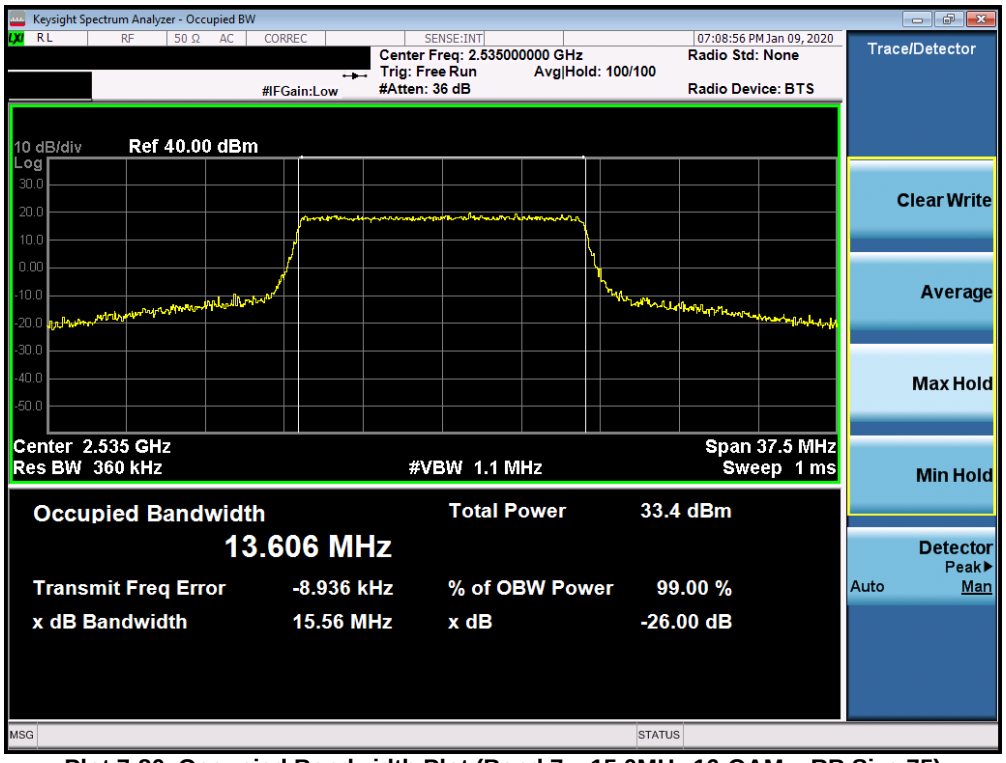


Plot 7-79. Occupied Bandwidth Plot (Band 7 – 15.0MHz QPSK – RB Size 75)



Plot 7-80. Occupied Bandwidth Plot (Band 7 – 15.0MHz 16-QAM – RB Size 75)

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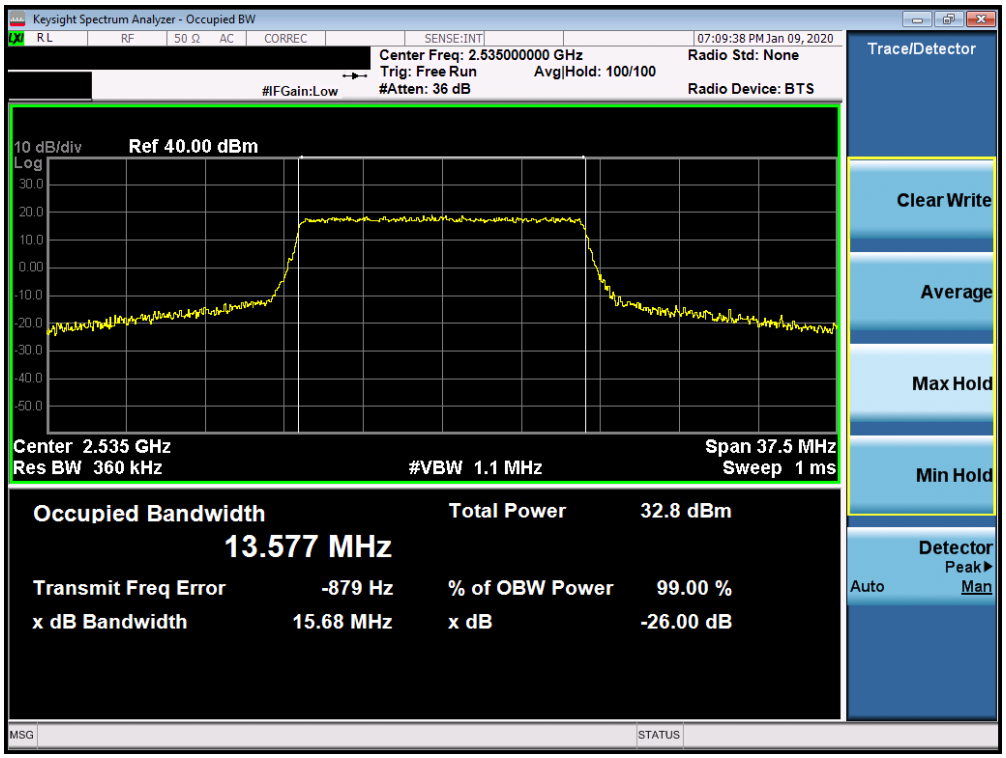
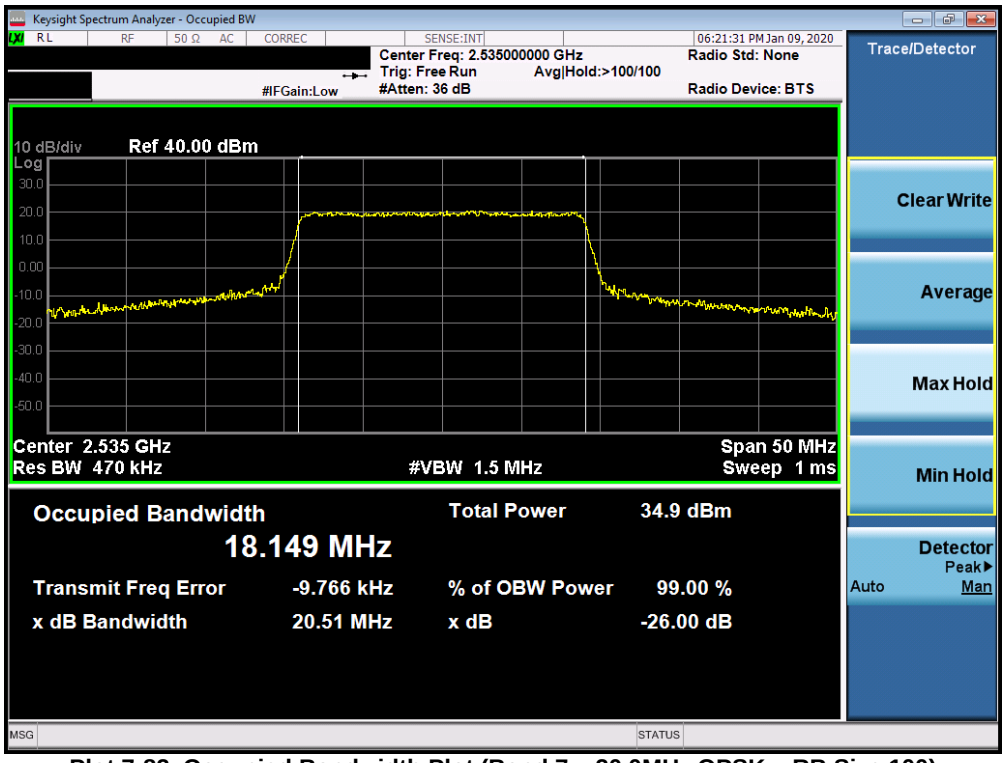


Plot 7-81. Occupied Bandwidth Plot (Band 7 – 15.0MHz 64-QAM – RB Size 75)



Plot 7-82. Occupied Bandwidth Plot (Band 7 – 20.0MHz QPSK – RB Size 100)

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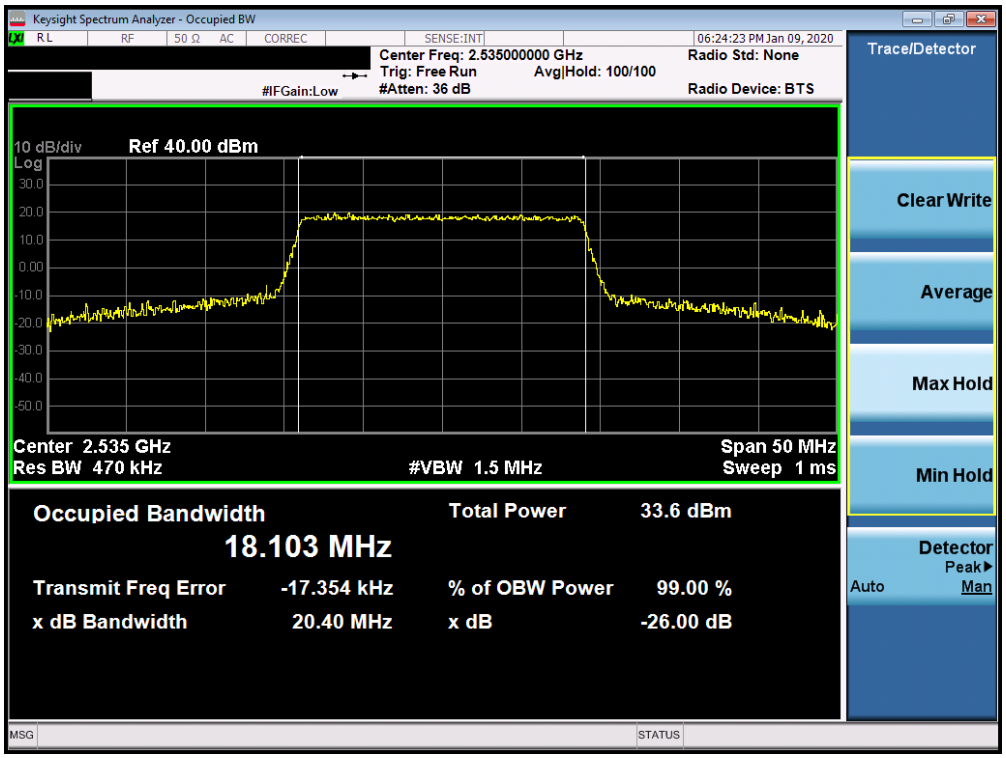
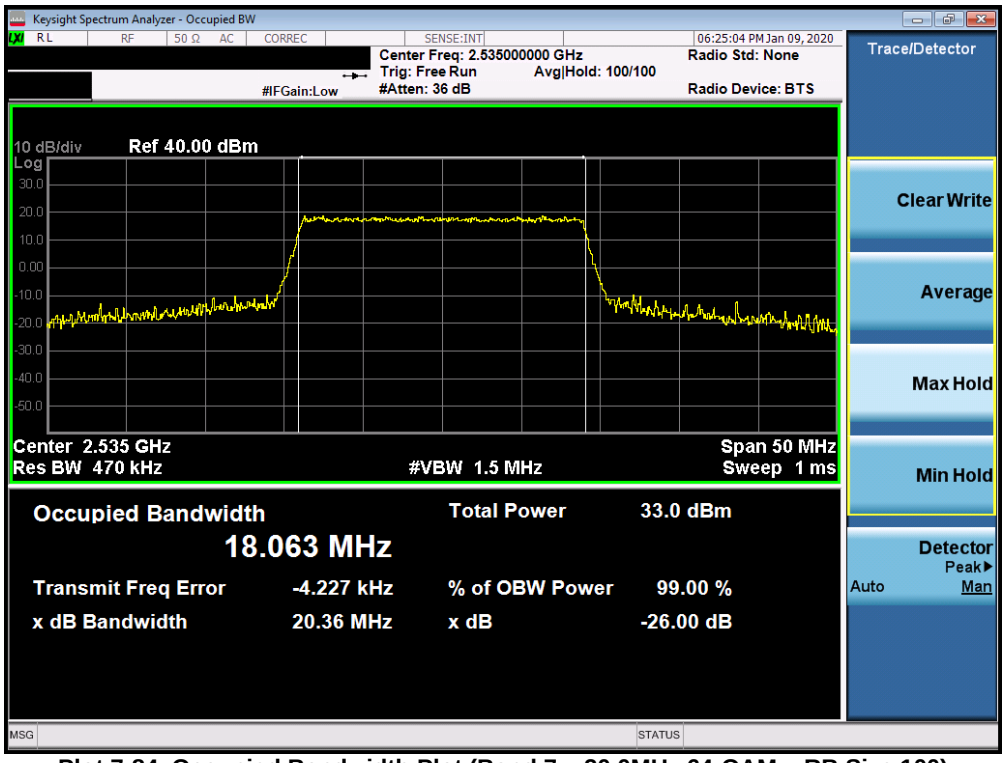


Plot 7-83. Occupied Bandwidth Plot (Band 7 – 20.0MHz 16-QAM – RB Size 100)



Plot 7-84. Occupied Bandwidth Plot (Band 7 – 20.0MHz 64-QAM – RB Size 100)

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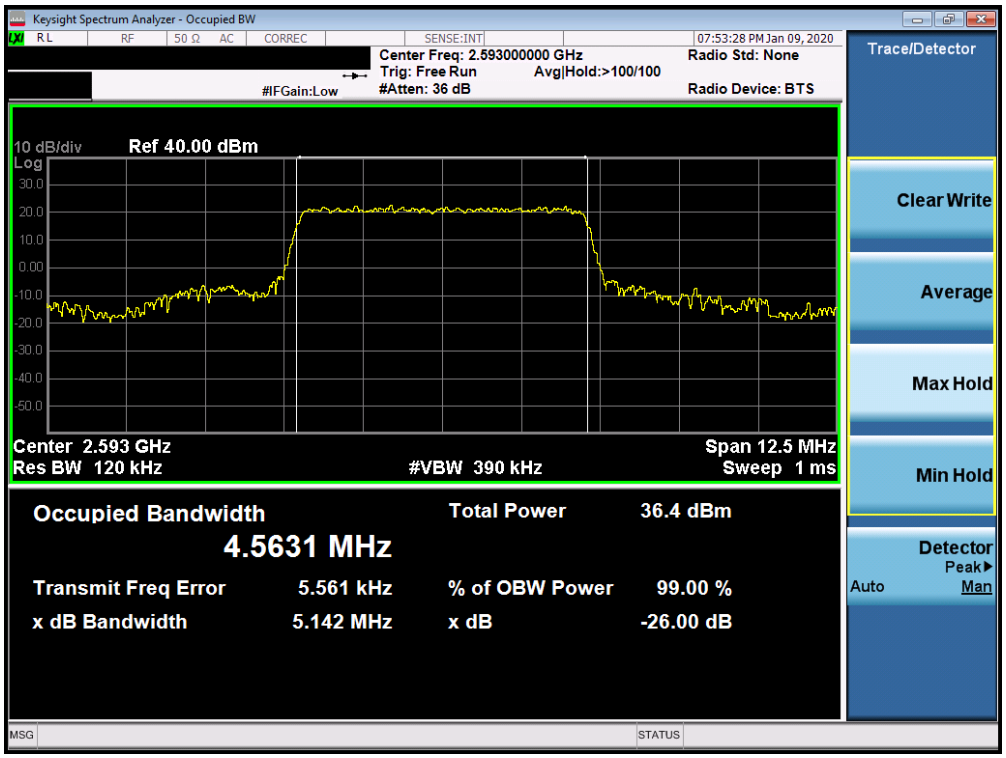
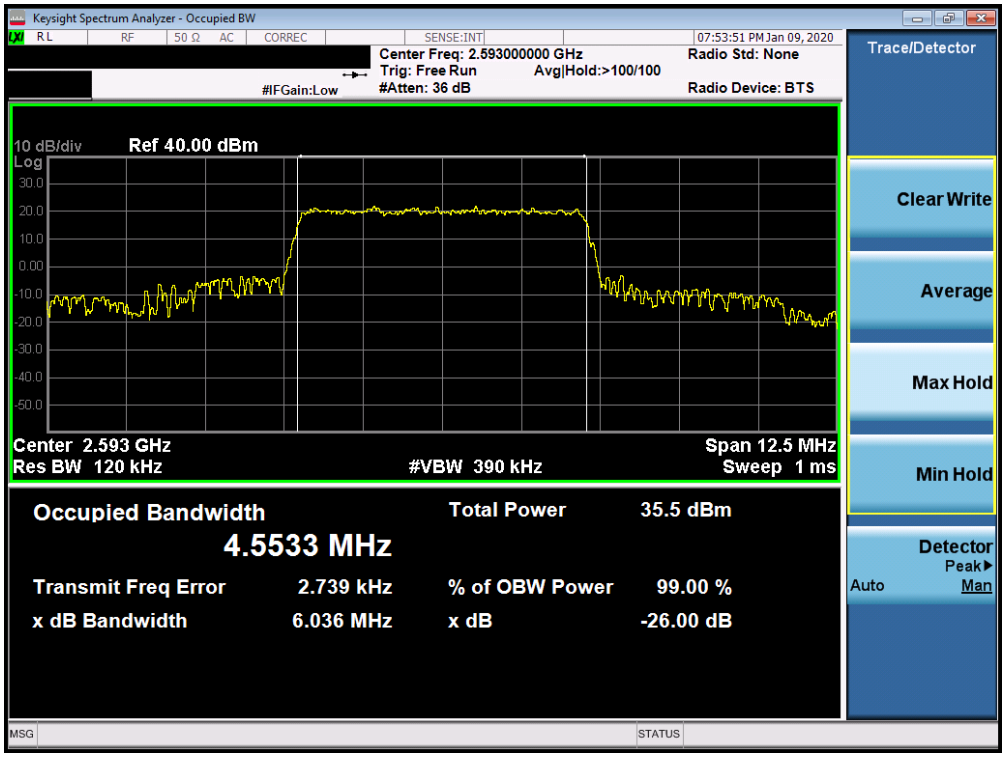
Band 41



Plot 7-85. Occupied Bandwidth Plot (Band 41 – 5.0MHz QPSK – RB Size 25)



Plot 7-86. Occupied Bandwidth Plot (Band 41 – 5.0MHz 16-QAM – RB Size 25)

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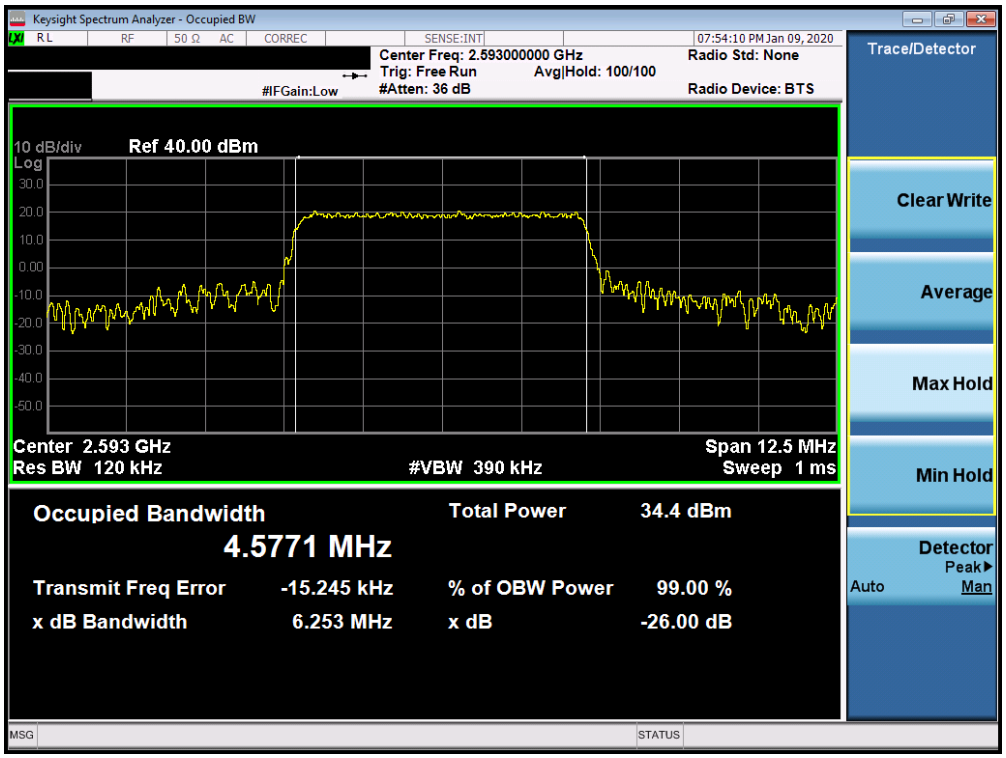
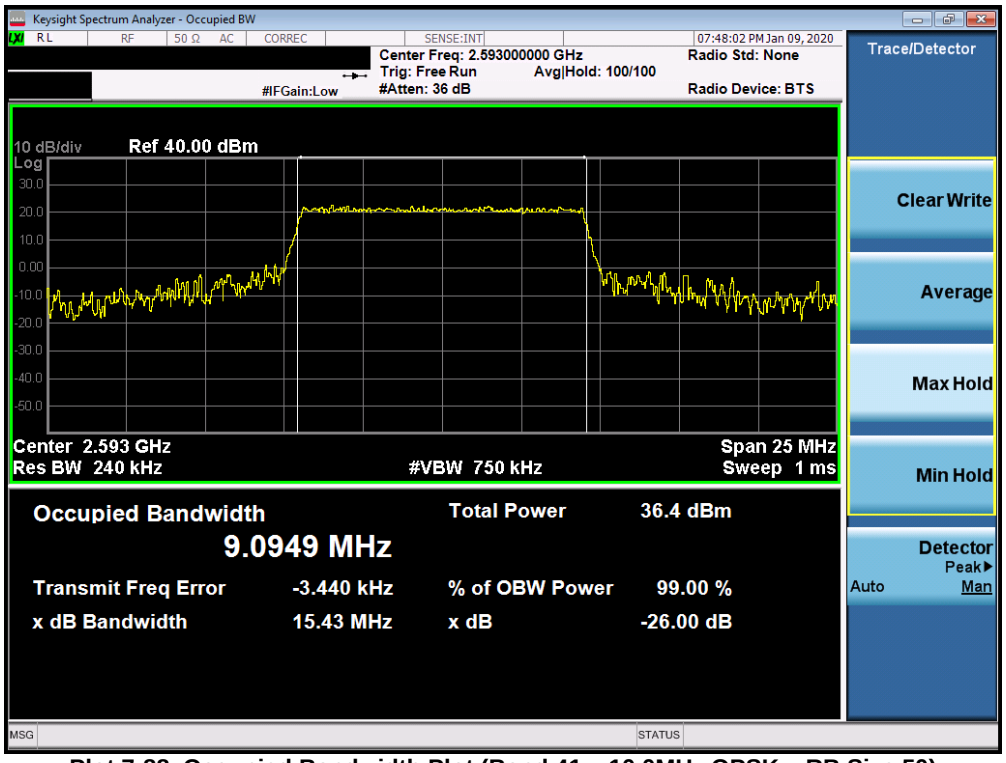


Plot 7-87. Occupied Bandwidth Plot (Band 41 – 5.0MHz 64-QAM – RB Size 25)



Plot 7-88. Occupied Bandwidth Plot (Band 41 – 10.0MHz QPSK – RB Size 50)

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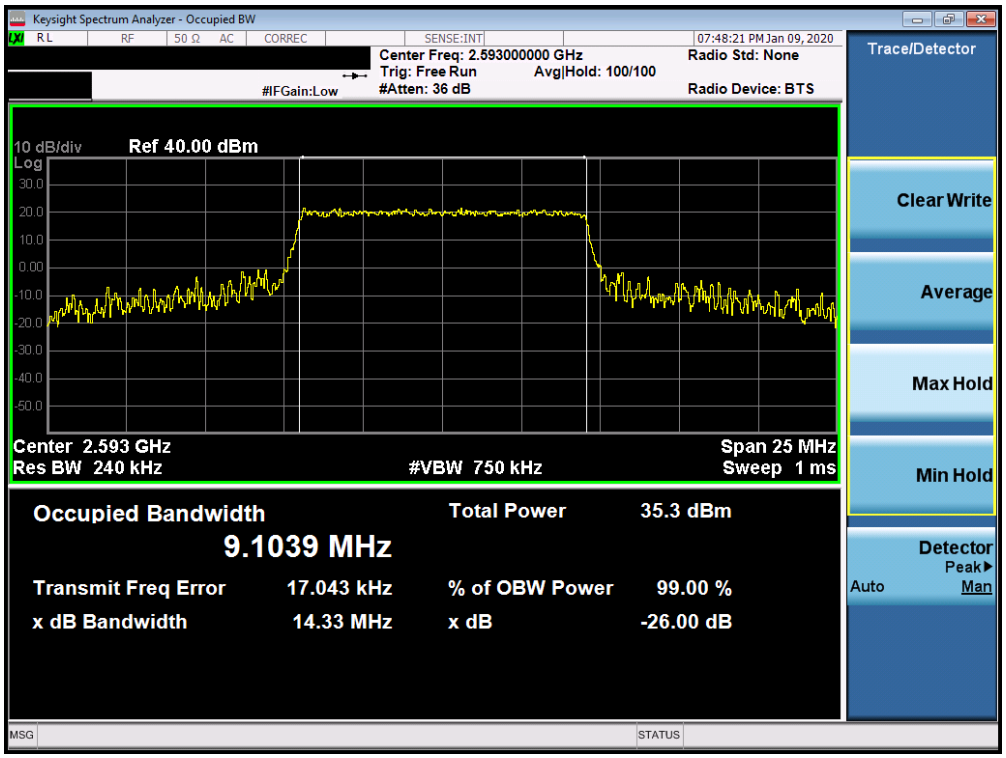
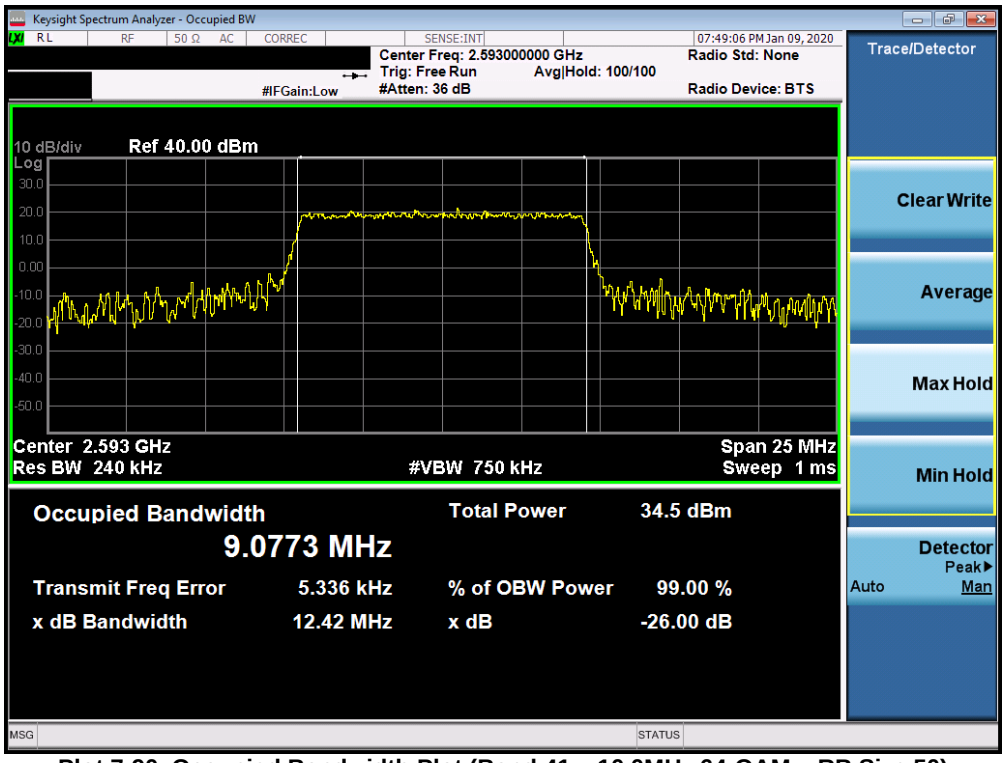


Plot 7-89. Occupied Bandwidth Plot (Band 41 – 10.0MHz 16-QAM – RB Size 50)



Plot 7-90. Occupied Bandwidth Plot (Band 41 – 10.0MHz 64-QAM – RB Size 50)

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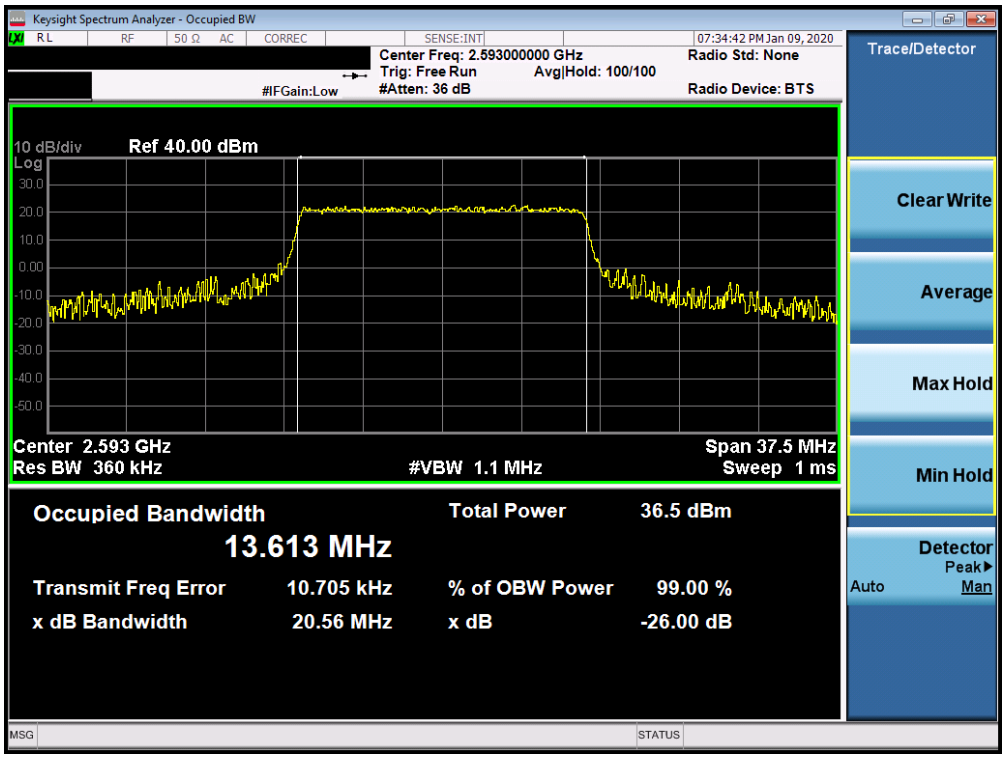
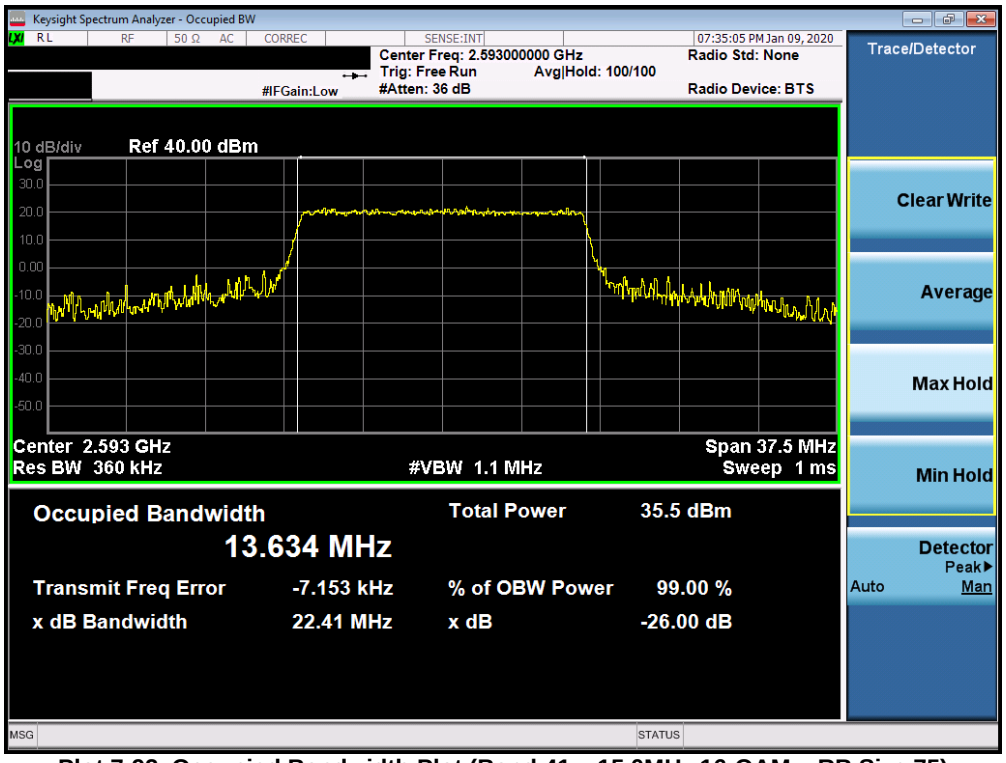


Plot 7-91. Occupied Bandwidth Plot (Band 41 – 15.0MHz QPSK – RB Size 75)



Plot 7-92. Occupied Bandwidth Plot (Band 41 – 15.0MHz 16-QAM – RB Size 75)

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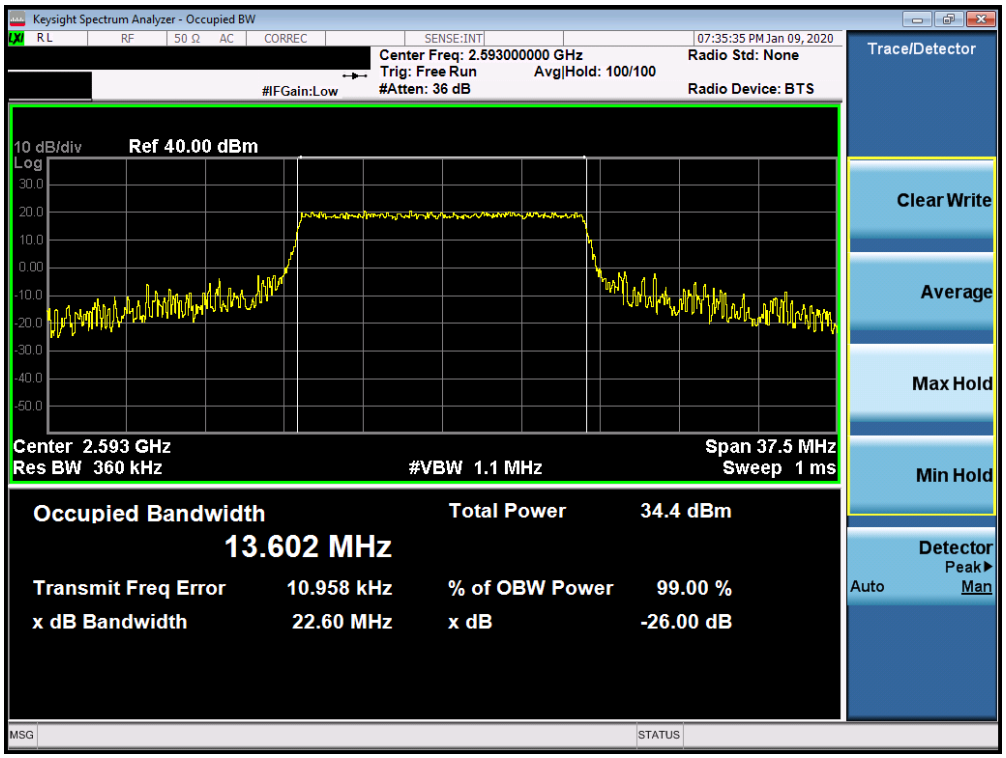
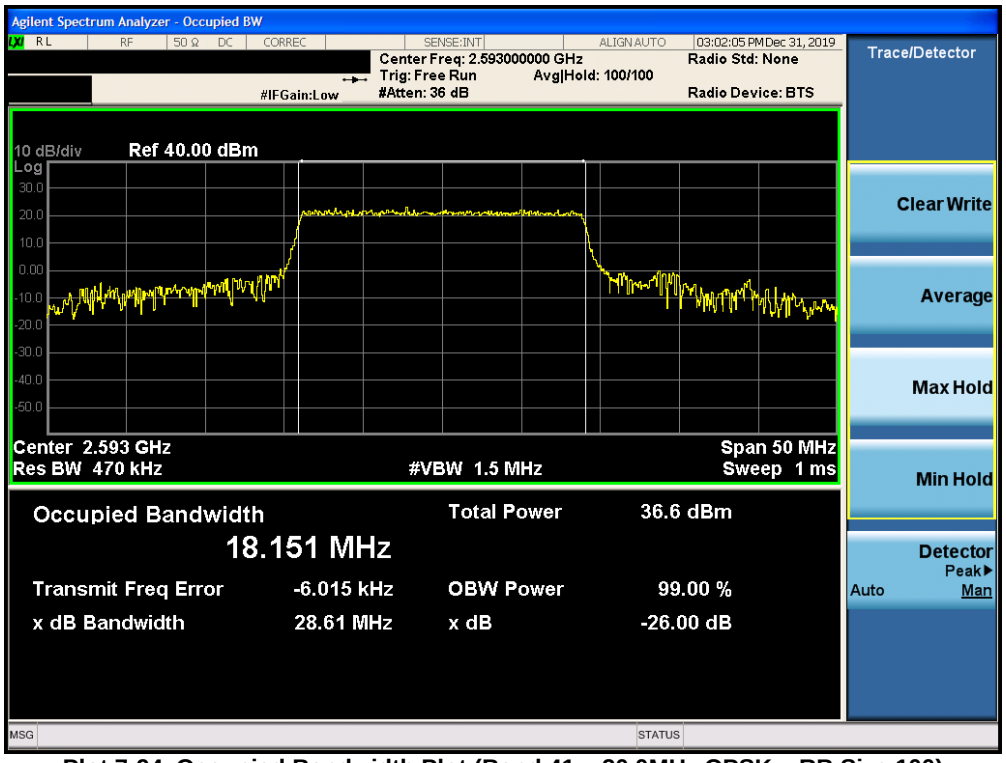


Plot 7-93. Occupied Bandwidth Plot (Band 41 – 15.0MHz 64-QAM – RB Size 75)



Plot 7-94. Occupied Bandwidth Plot (Band 41 – 20.0MHz QPSK – RB Size 100)

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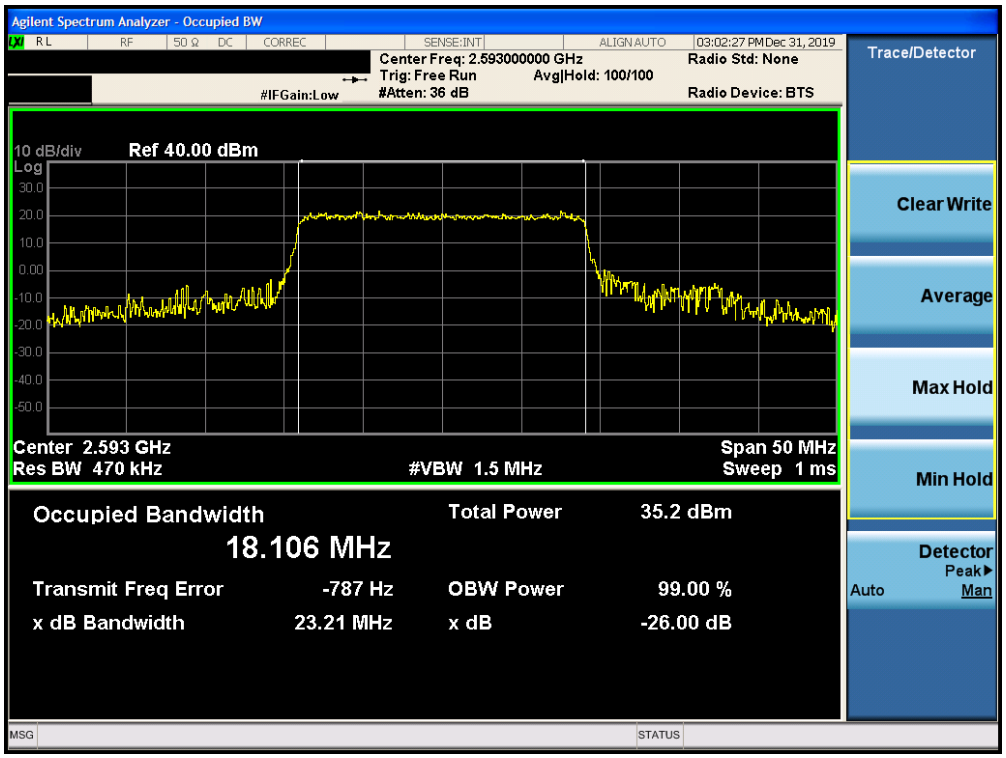
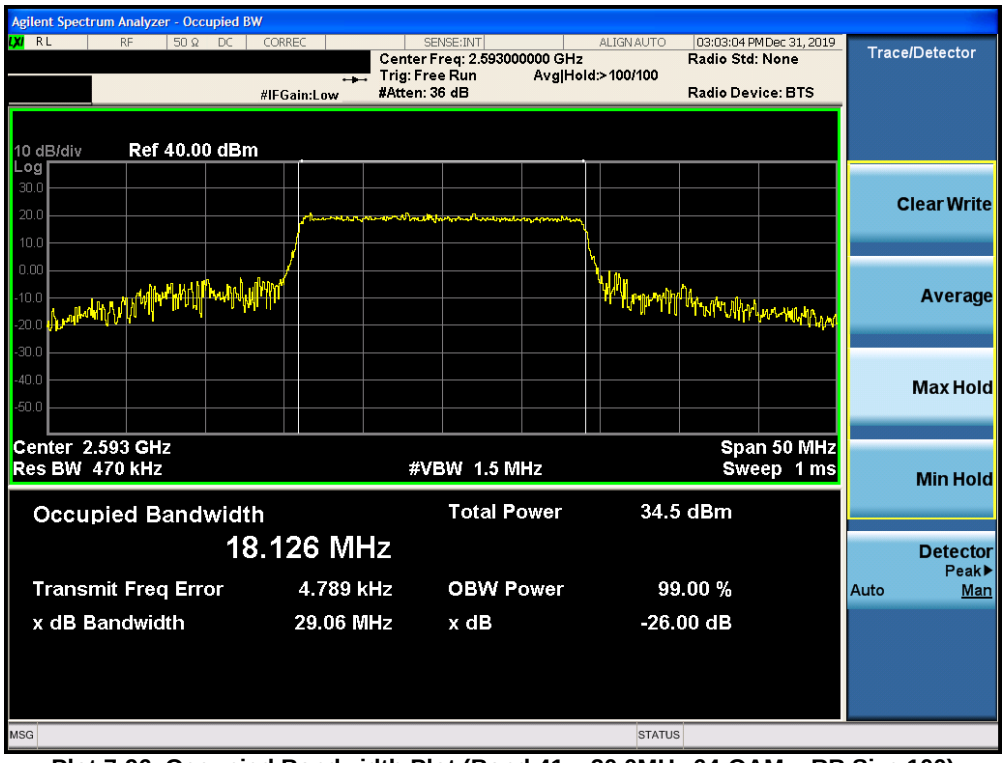


Plot 7-95. Occupied Bandwidth Plot (Band 41 – 20.0MHz 16-QAM – RB Size 100)



Plot 7-96. Occupied Bandwidth Plot (Band 41 – 20.0MHz 64-QAM – RB Size 100)

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7.3 Spurious and Harmonic Emissions at Antenna Terminal

Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

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

For Band 30, the minimum permissible attenuation level of any spurious emission <2288MHz and >2365MHz is 70 + $\log_{10}(P_{[Watts]})$.

For Band 7 and 41, the minimum permissible attenuation level of any spurious emission is 55 + $\log_{10}(P_{[Watts]})$.

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 at least 10 * the fundamental frequency (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

Test Setup

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

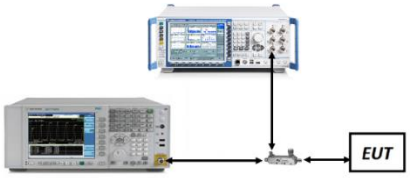

Figure 7-2. Test Instrument & Measurement Setup

Test Notes

1. Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for frequencies less than 1 GHz and 1 MHz or greater for frequencies greater than 1 GHz. 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. All ports were tested and only the worst case data were reported.
3. Refer to Table 2-1 Section 2.3 of this test report for correlation between Antennas and Ports.

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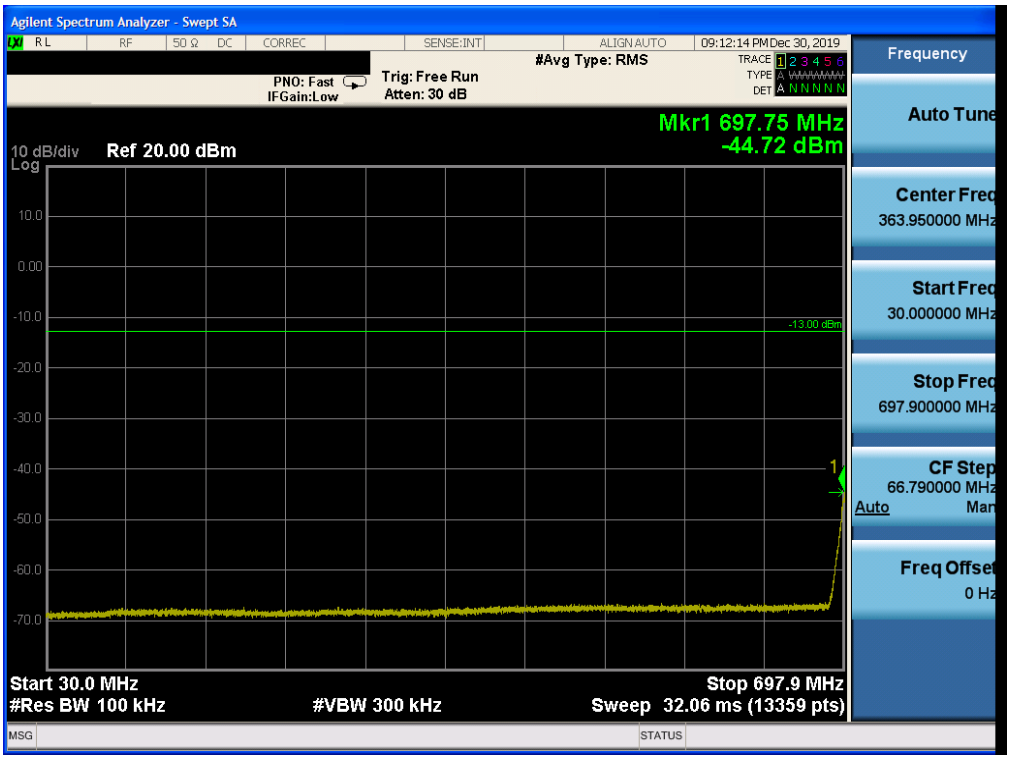
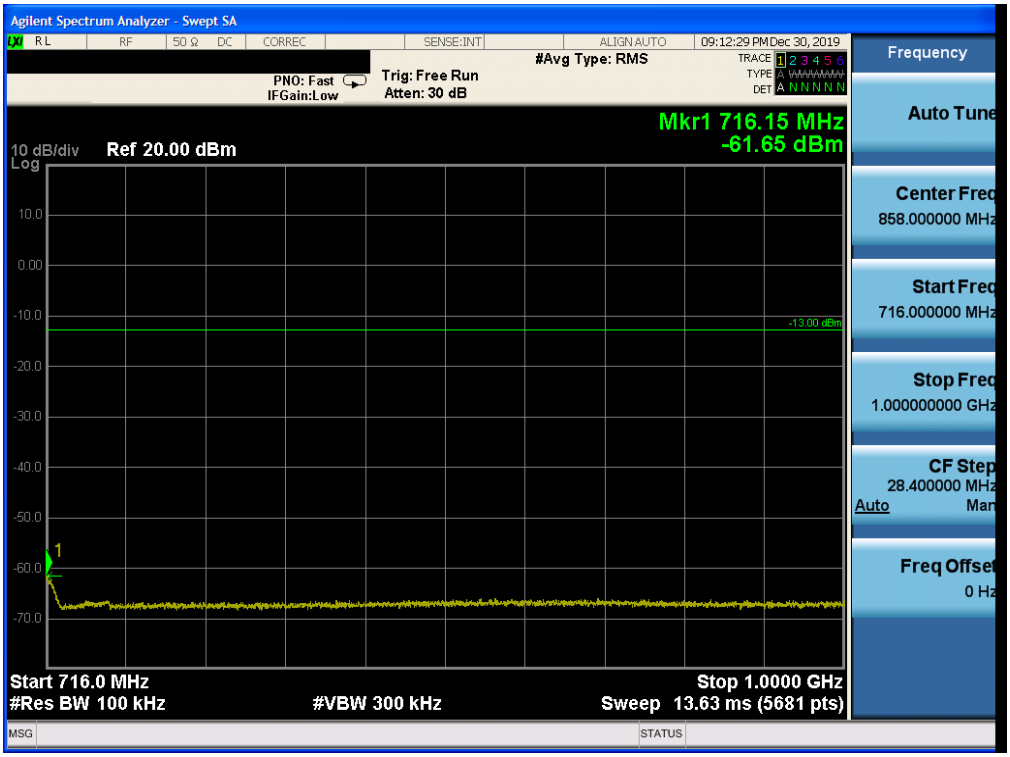
Band 12/17



Plot 7-97. Conducted Spurious Plot (Band 12/17 – 10.0MHz QPSK – RB Size 1, RB Offset 0– Low Channel)



Plot 7-98. Conducted Spurious Plot (Band 12/17 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

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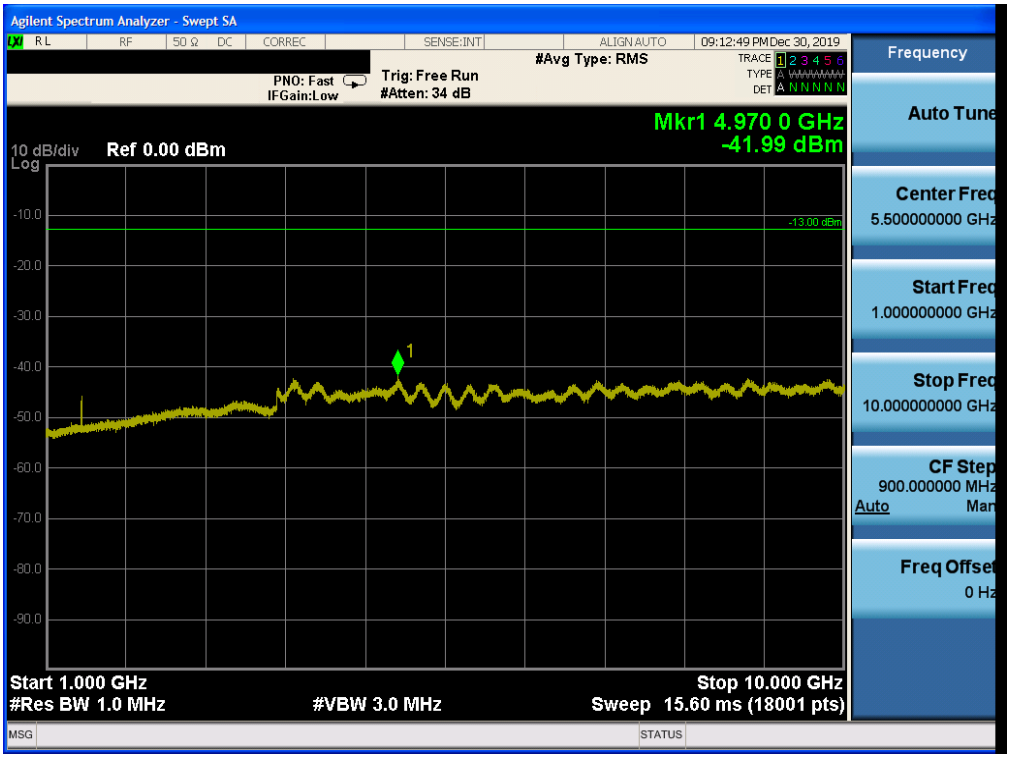
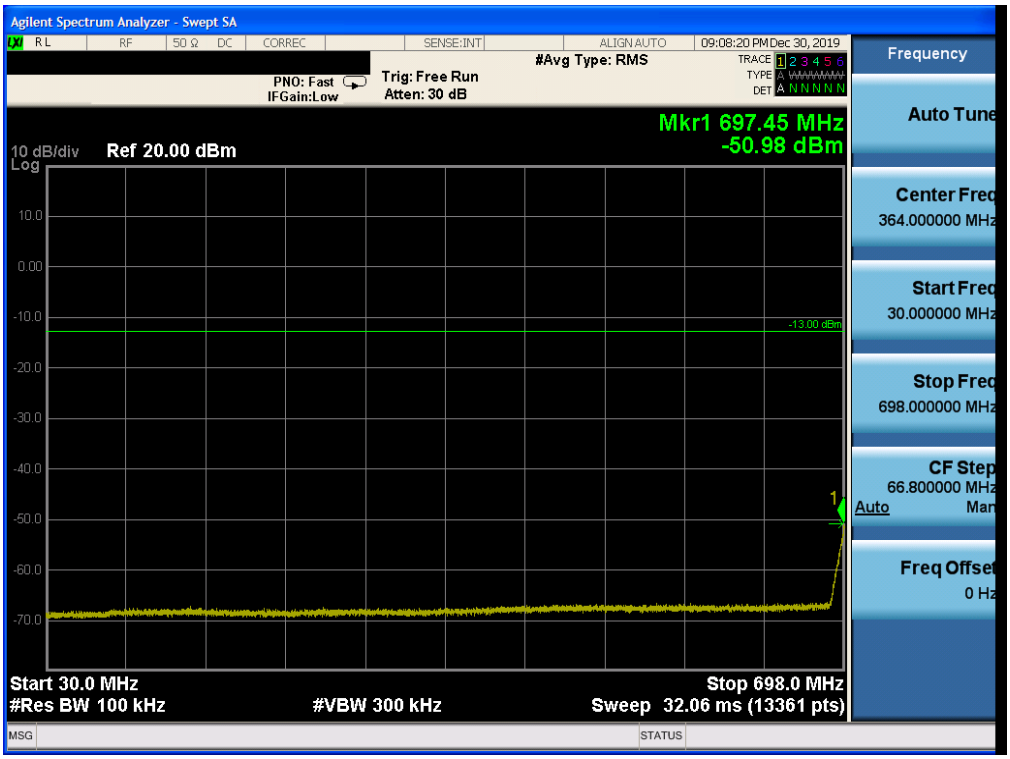


Plot 7-99. Conducted Spurious Plot (Band 12/17 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)



Plot 7-100. Conducted Spurious Plot (Band 12/17 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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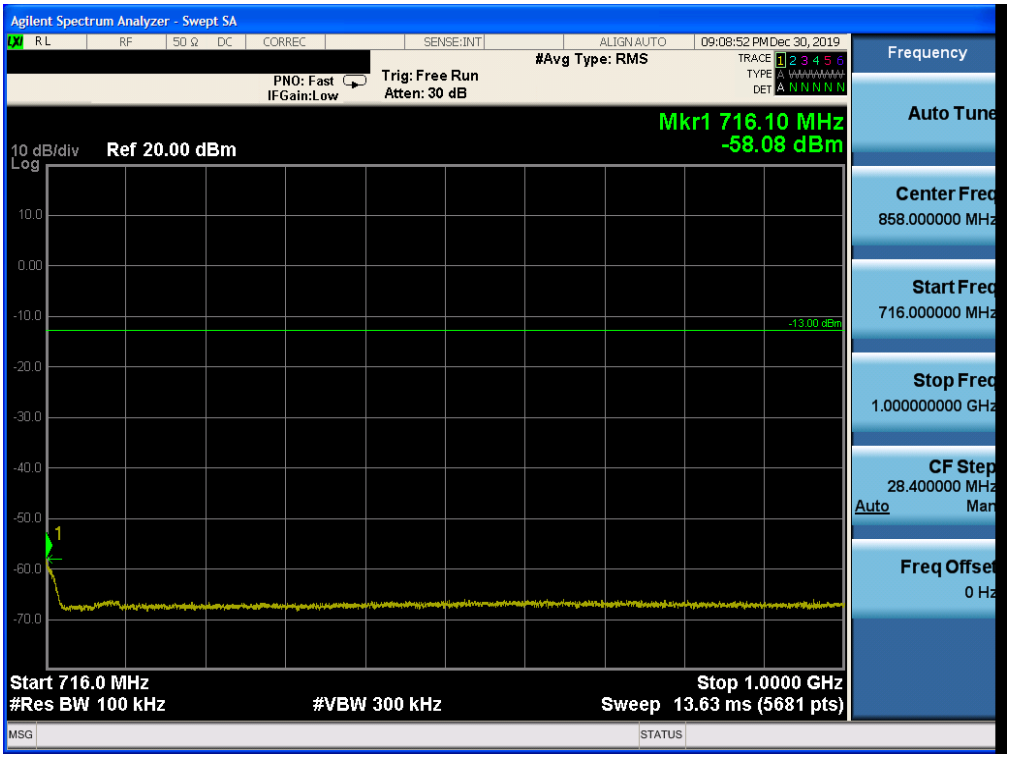
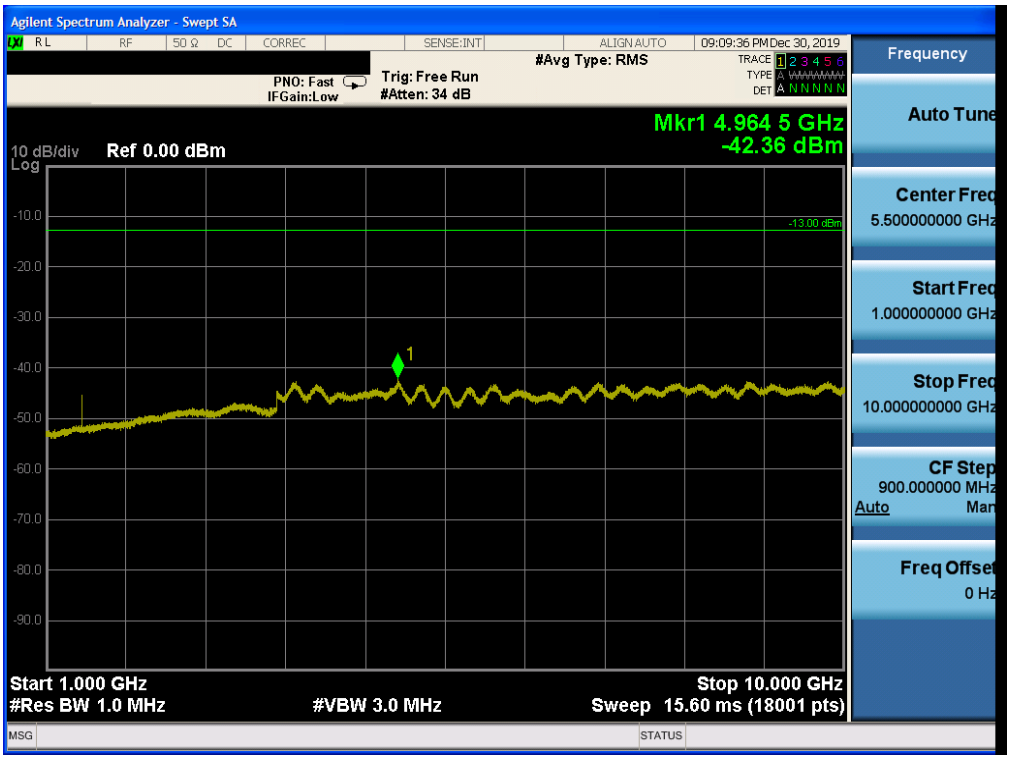


Plot 7-101. Conducted Spurious Plot (Band 12/17 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 7-102. Conducted Spurious Plot (Band 12/17 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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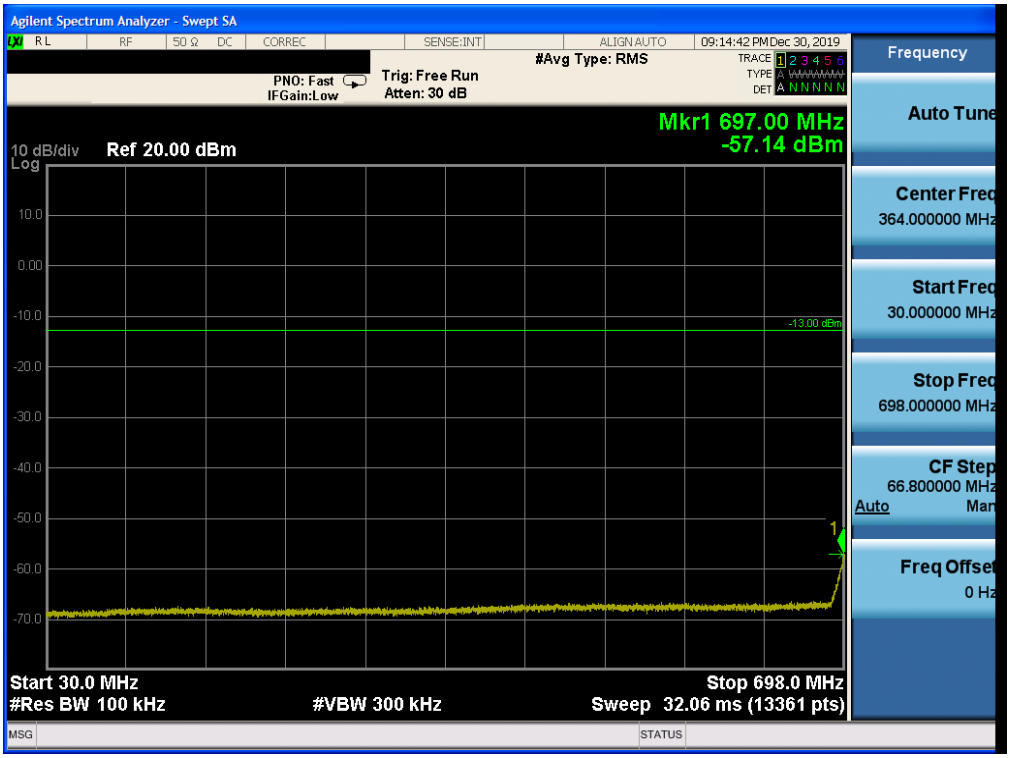
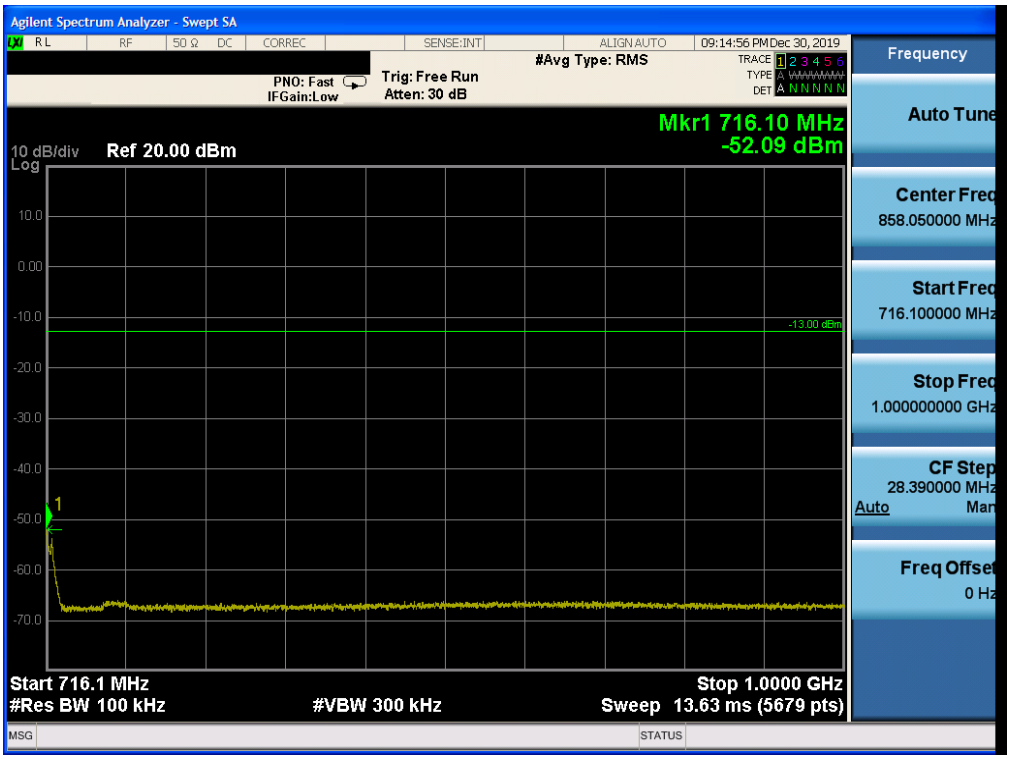


Plot 7-103. Conducted Spurious Plot (Band 12/17 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 7-104. Conducted Spurious Plot (Band 12/17 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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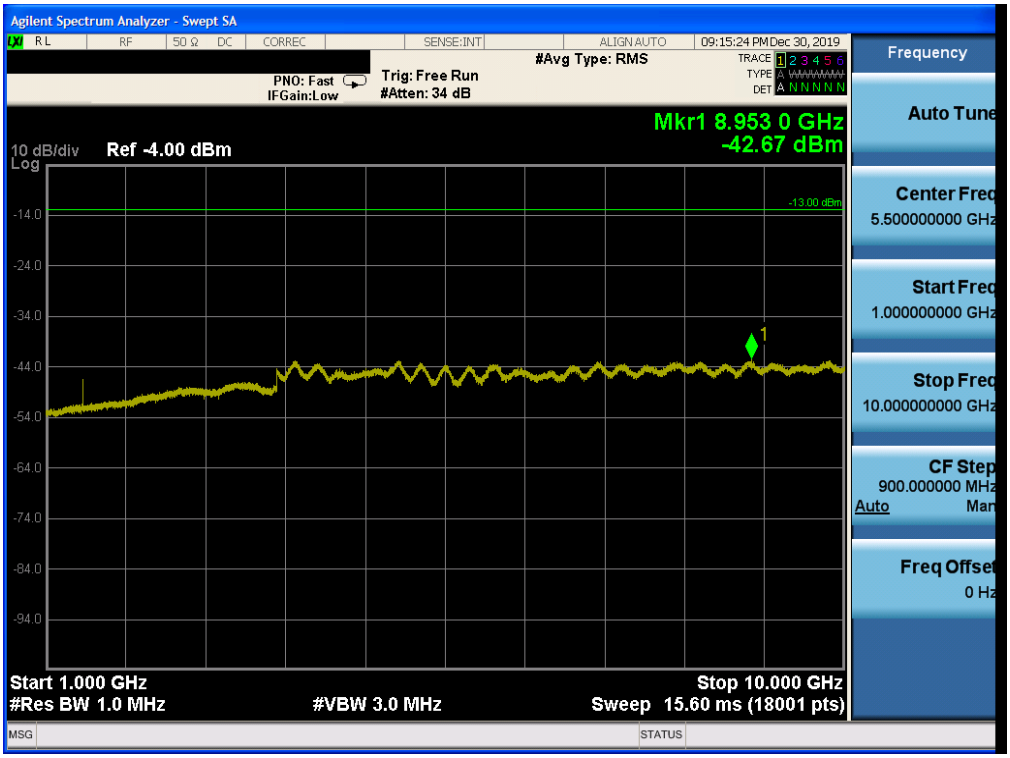

Plot 7-105. Conducted Spurious Plot (Band 12/17 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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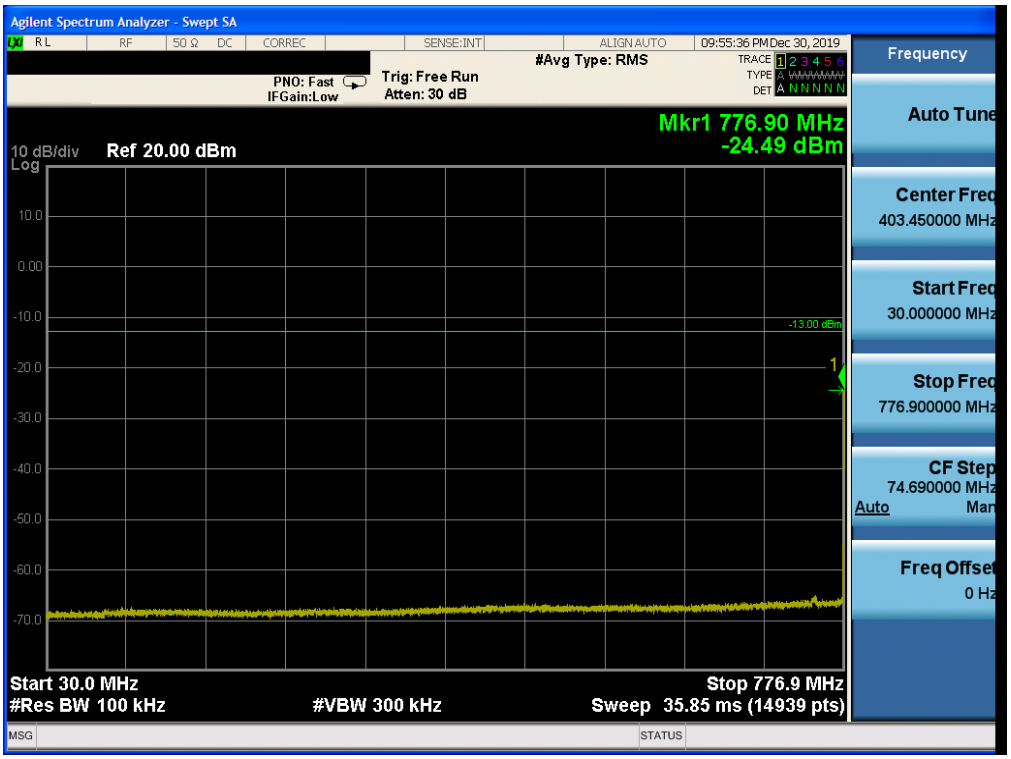
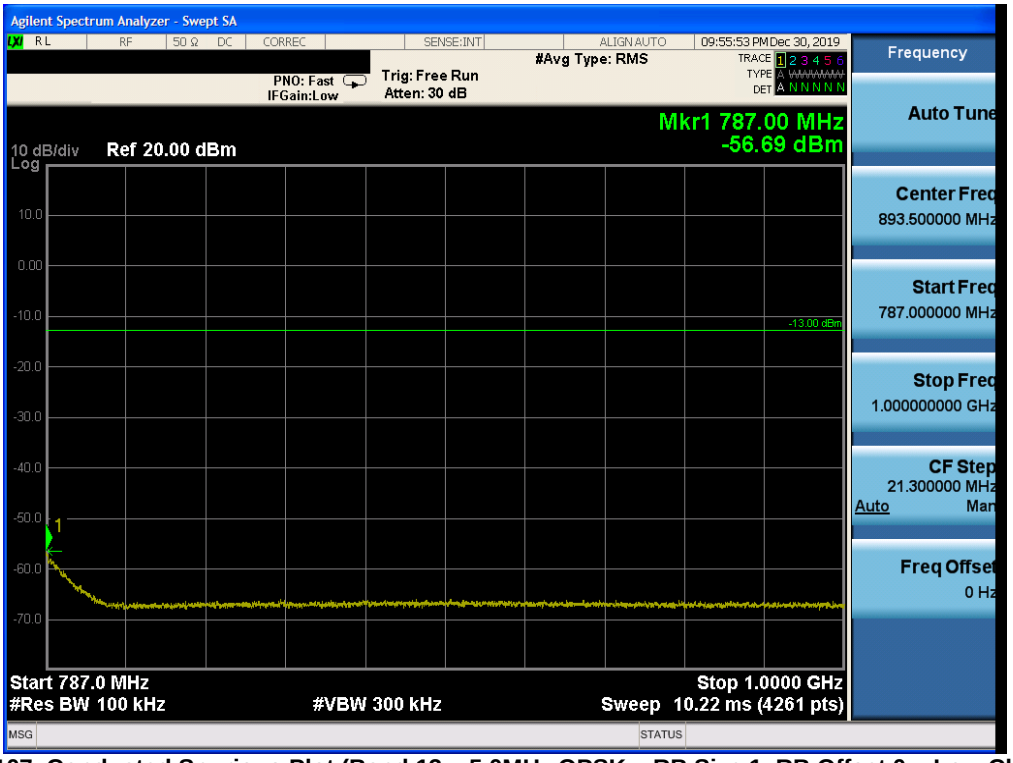
Band 13



Plot 7-106. Conducted Spurious Plot (Band 13 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)



Plot 7-107. Conducted Spurious Plot (Band 13 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

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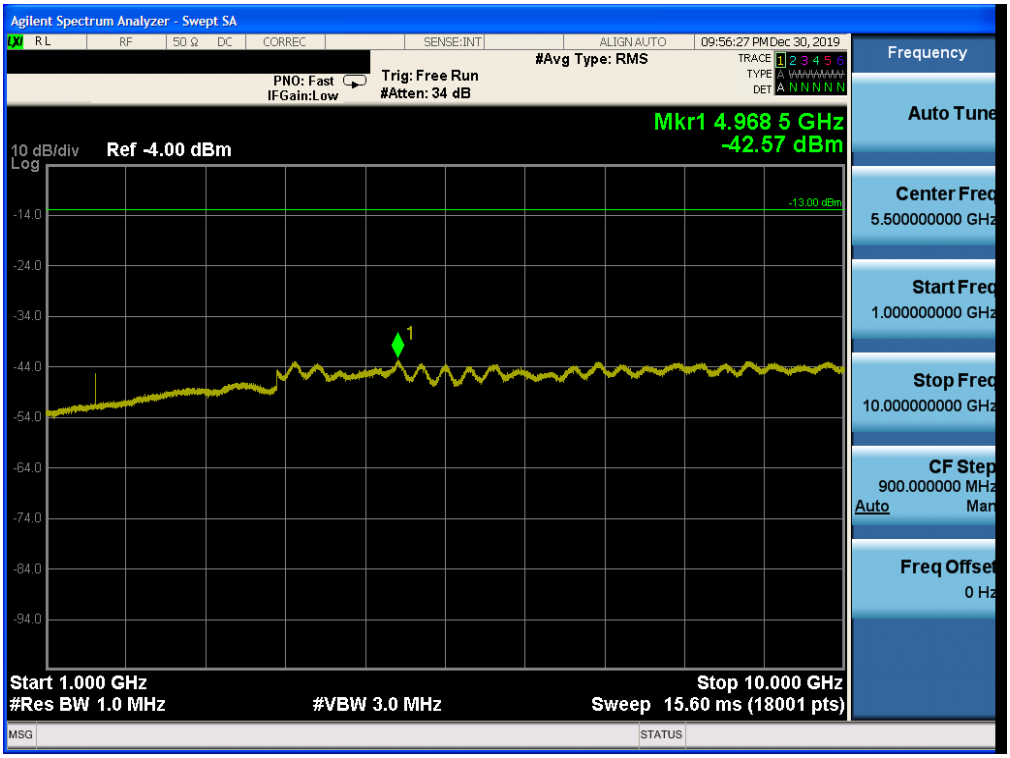
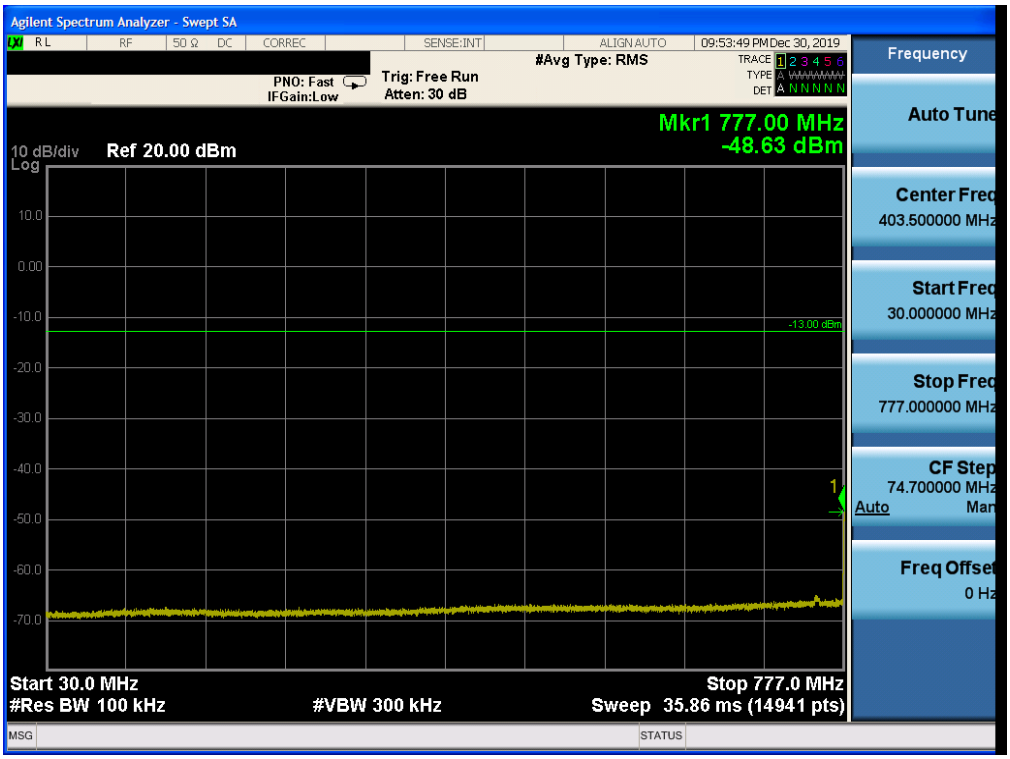


Plot 7-108. Conducted Spurious Plot (Band 13 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)



Plot 7-109. Conducted Spurious Plot (Band 13 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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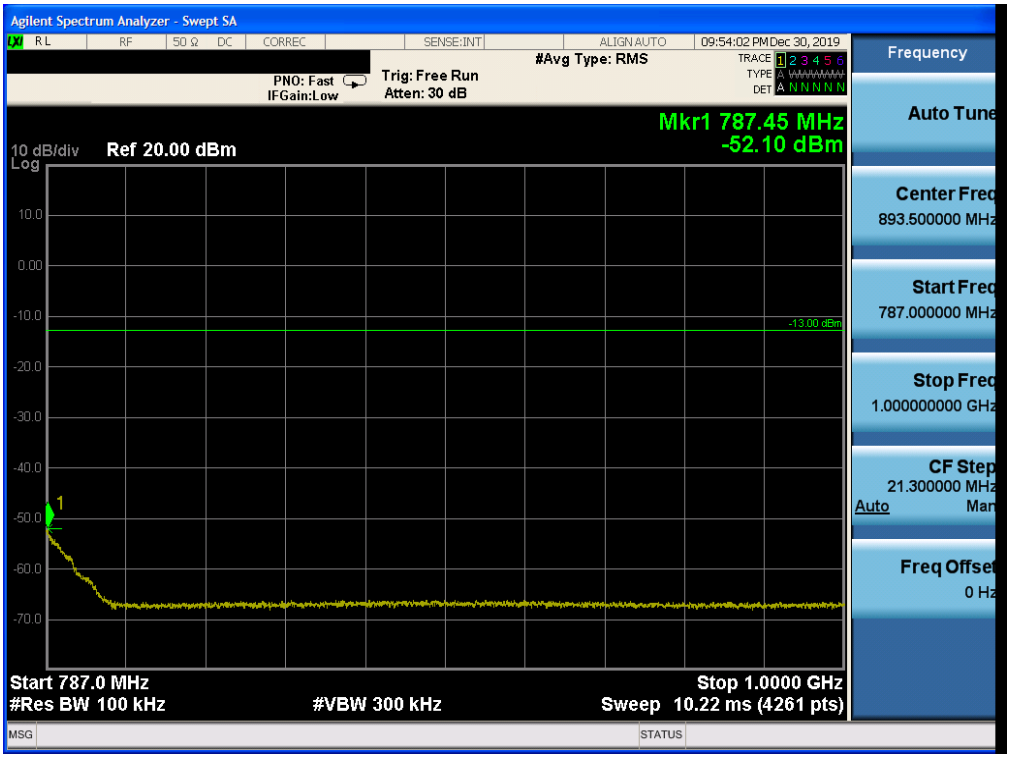
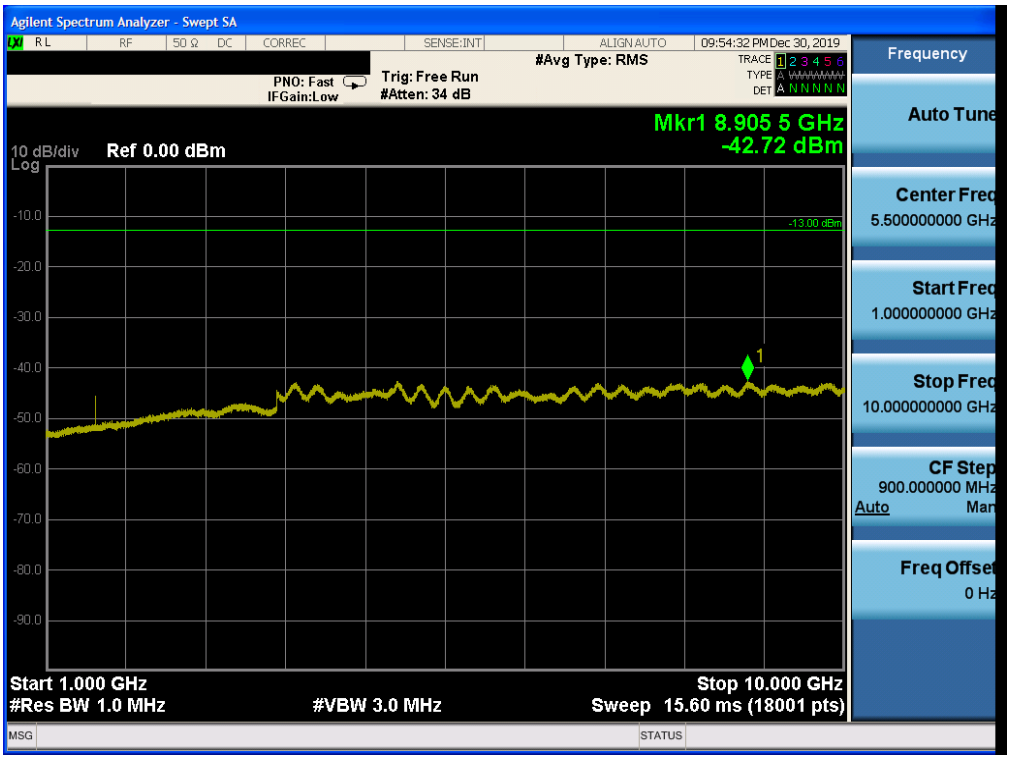


Plot 7-110. Conducted Spurious Plot (Band 13 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 7-111. Conducted Spurious Plot (Band 13 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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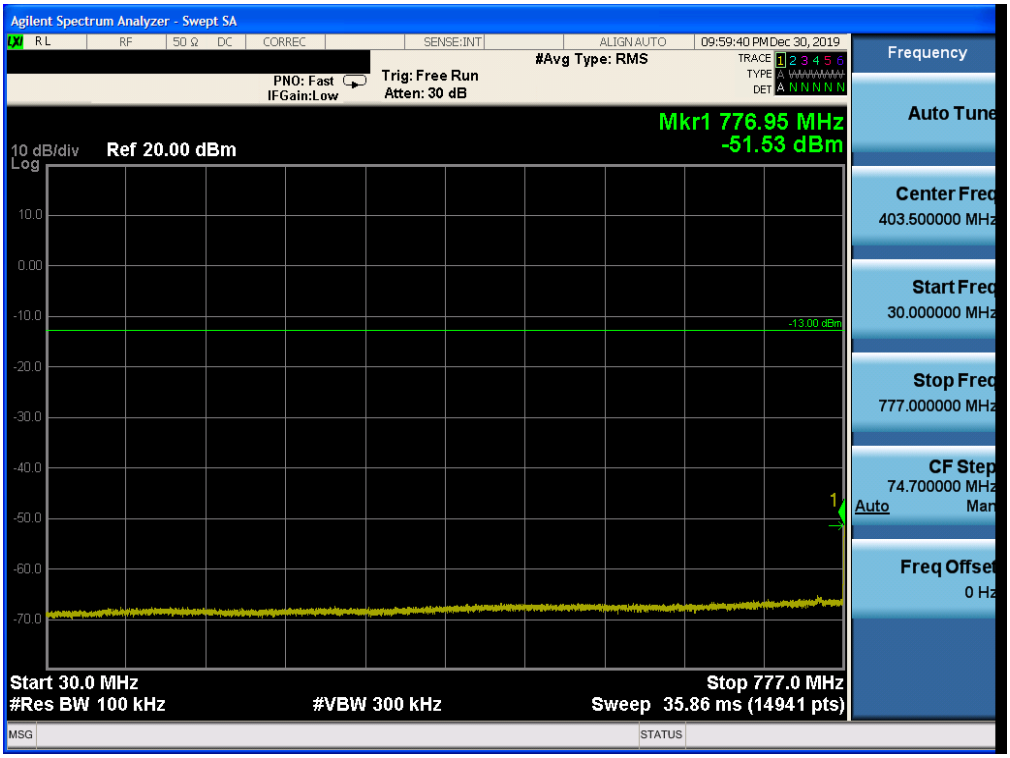
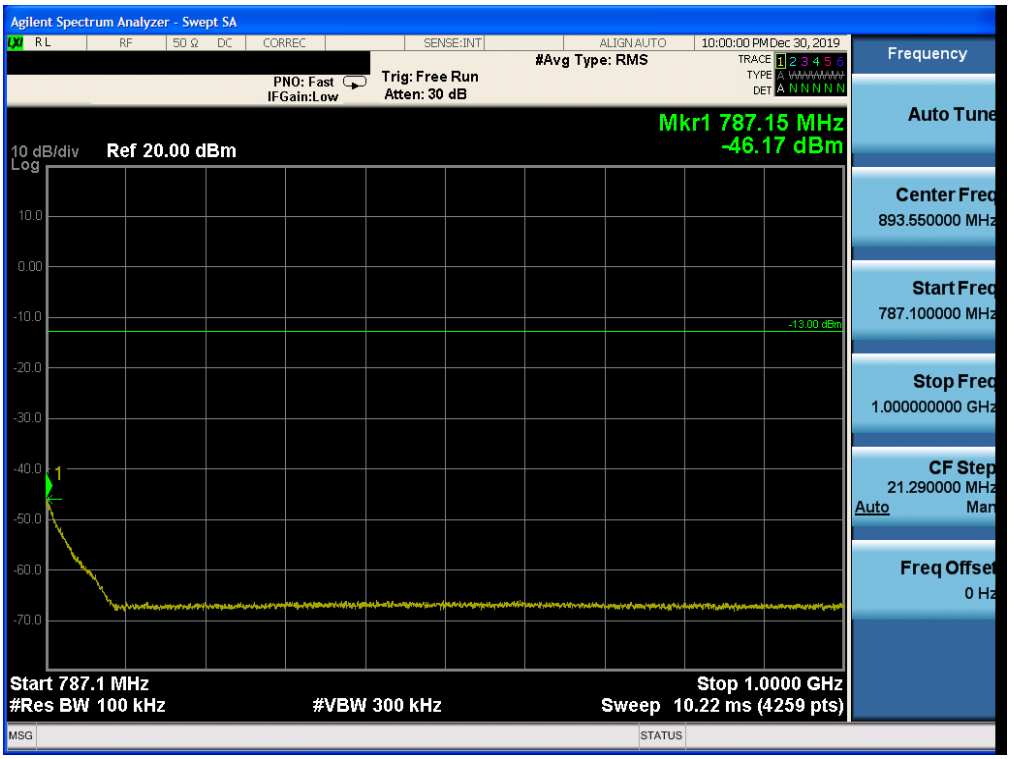


Plot 7-112. Conducted Spurious Plot (Band 13 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 7-113. Conducted Spurious Plot (Band 13 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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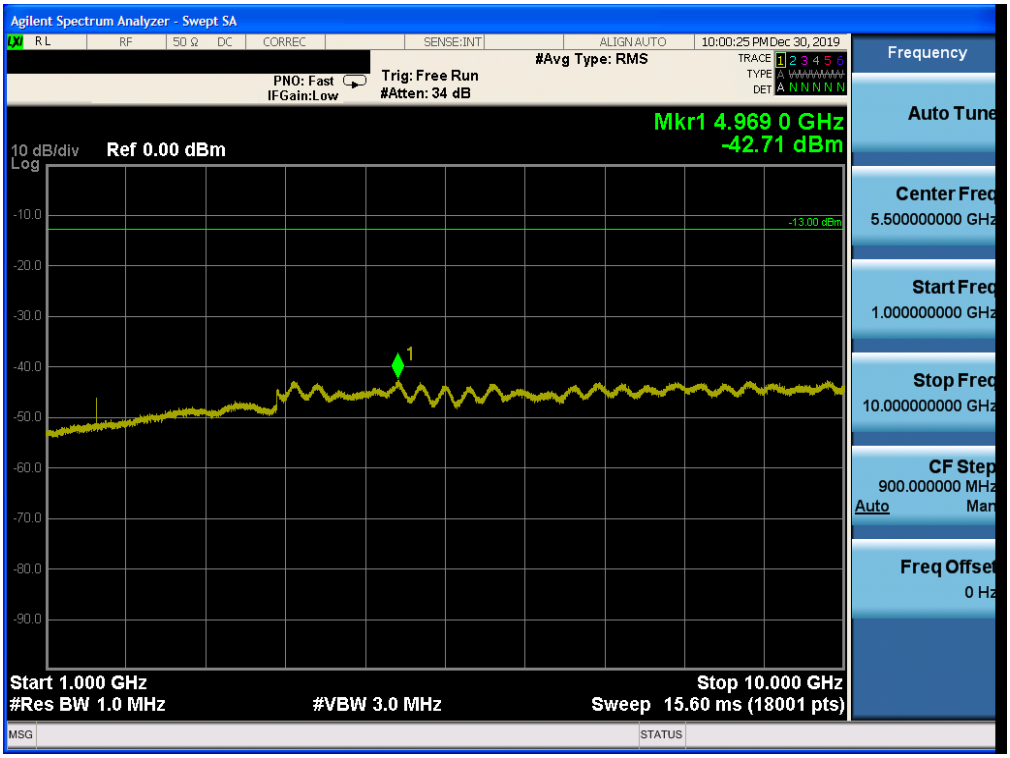

Plot 7-114. Conducted Spurious Plot (Band 13 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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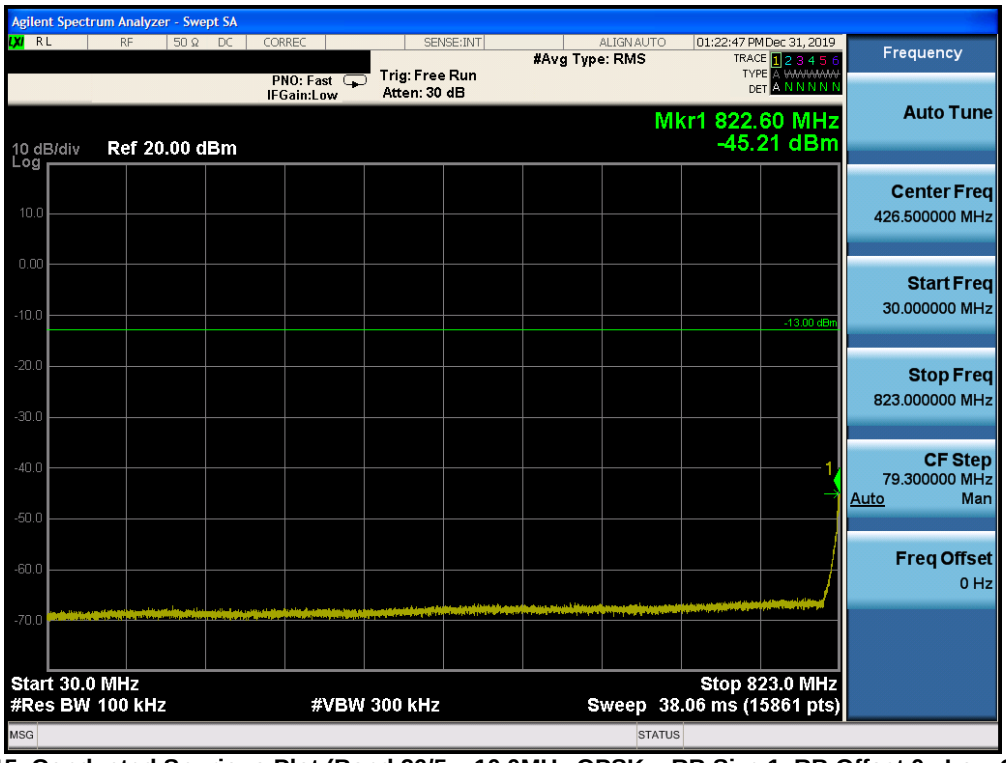
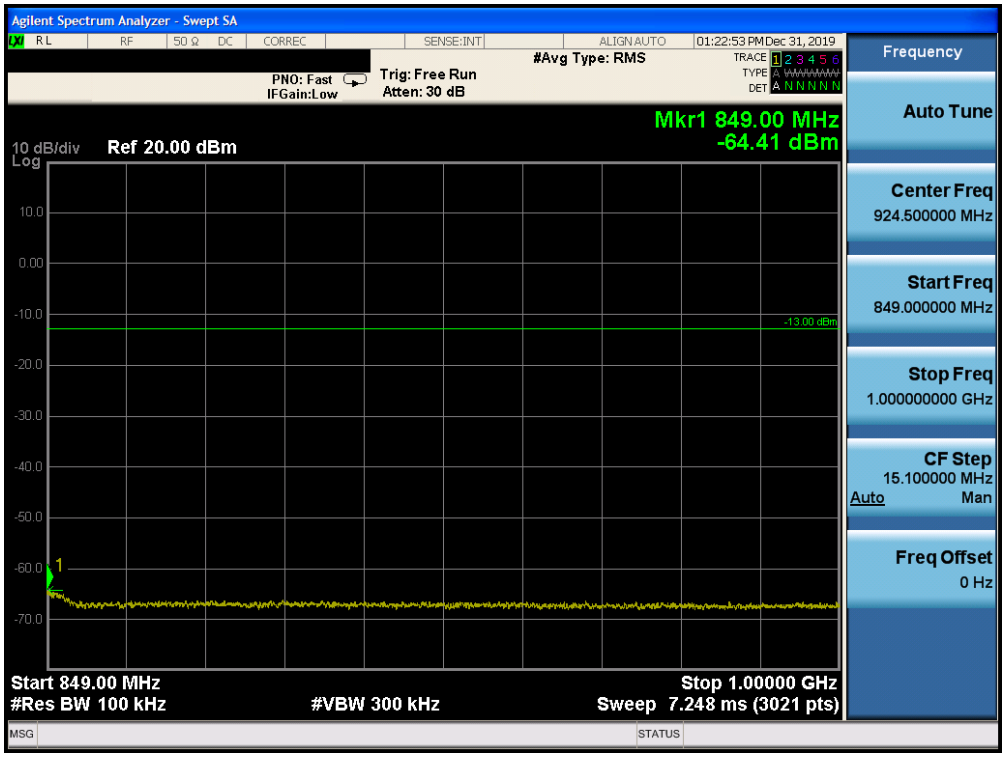
Band 26/5



Plot 7-115. Conducted Spurious Plot (Band 26/5 – 10.0MHz QPSK – RB Size 1, RB Offset 0– Low Channel)



Plot 7-116. Conducted Spurious Plot (Band 26/5 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

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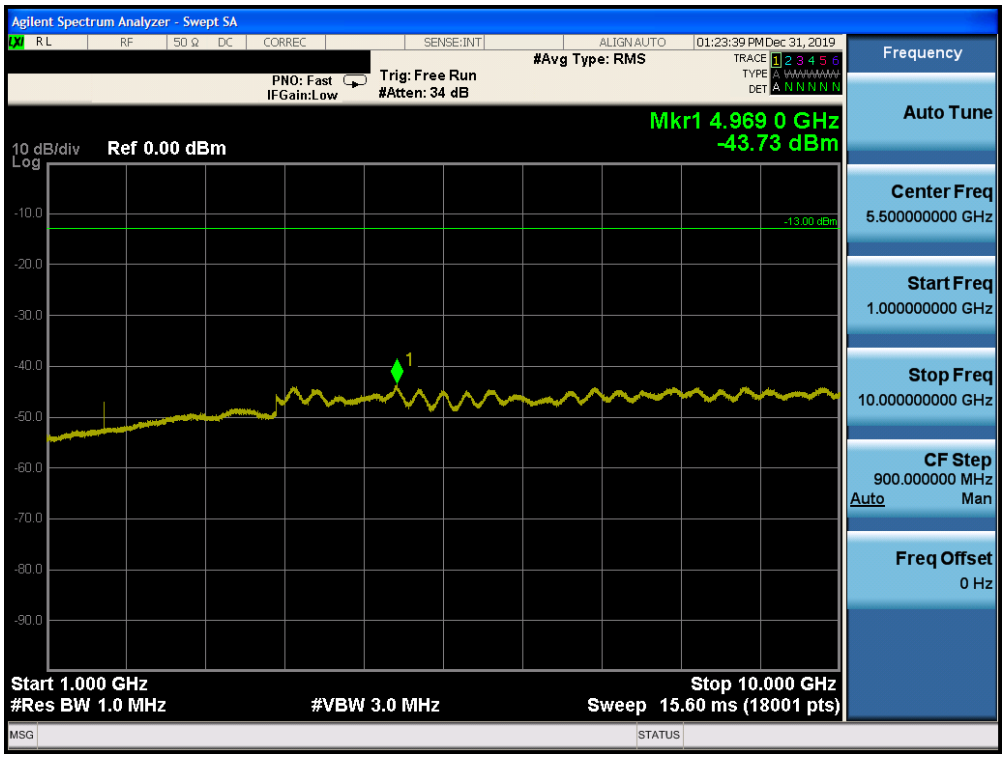
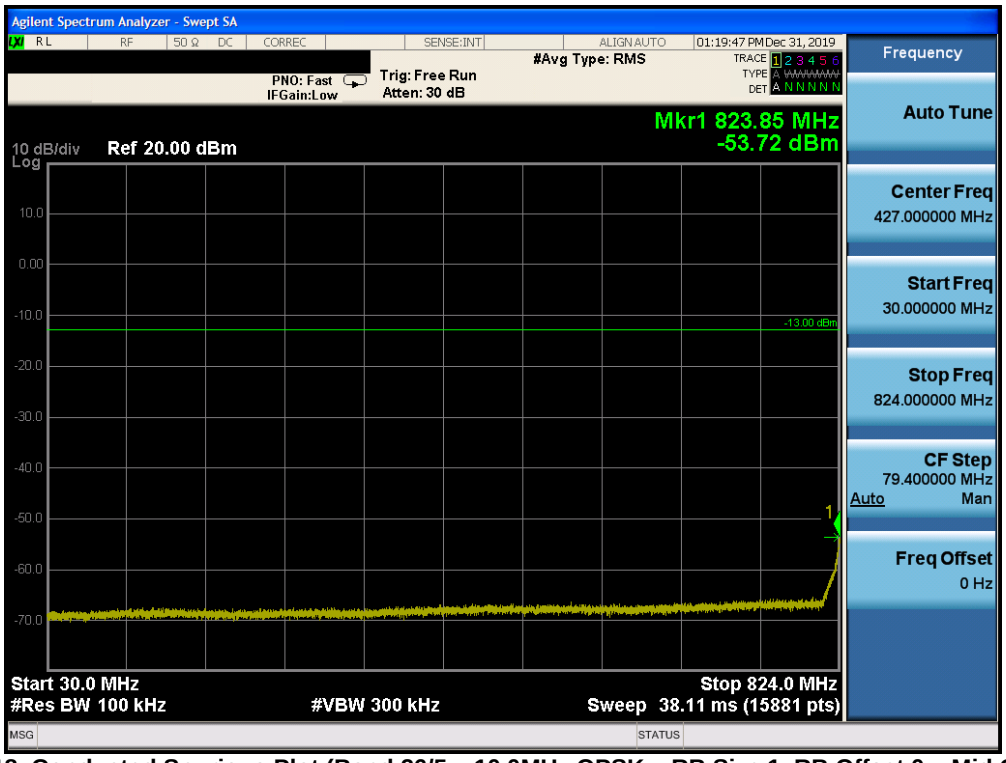


Plot 7-117. Conducted Spurious Plot (Band 26/5 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)



Plot 7-118. Conducted Spurious Plot (Band 26/5 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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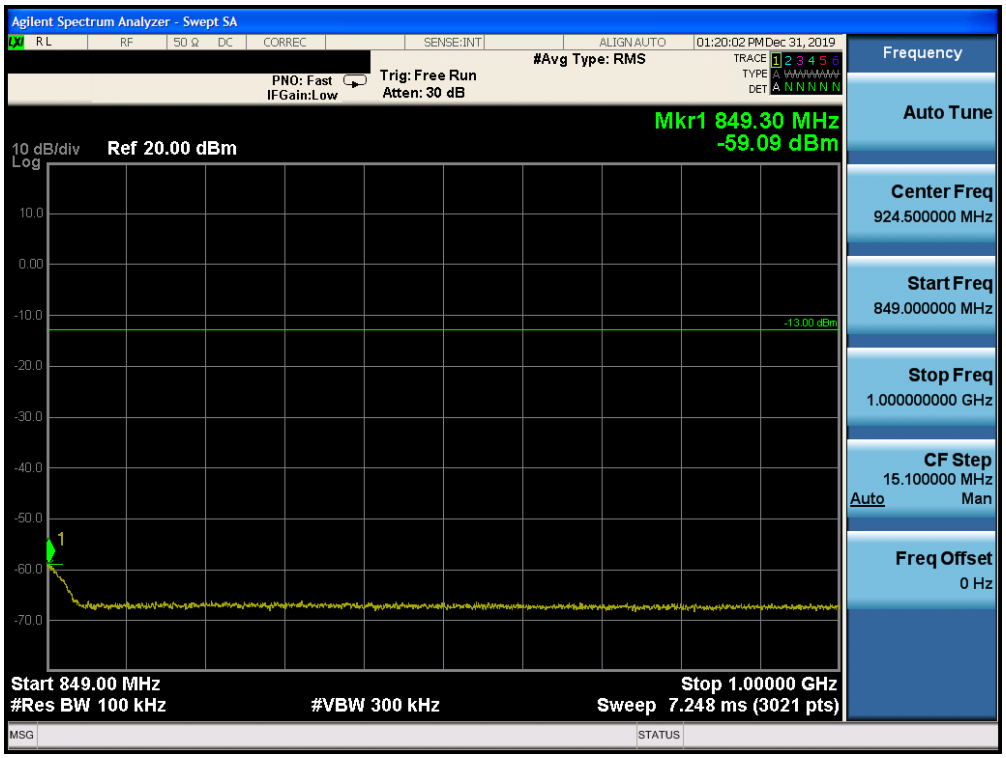
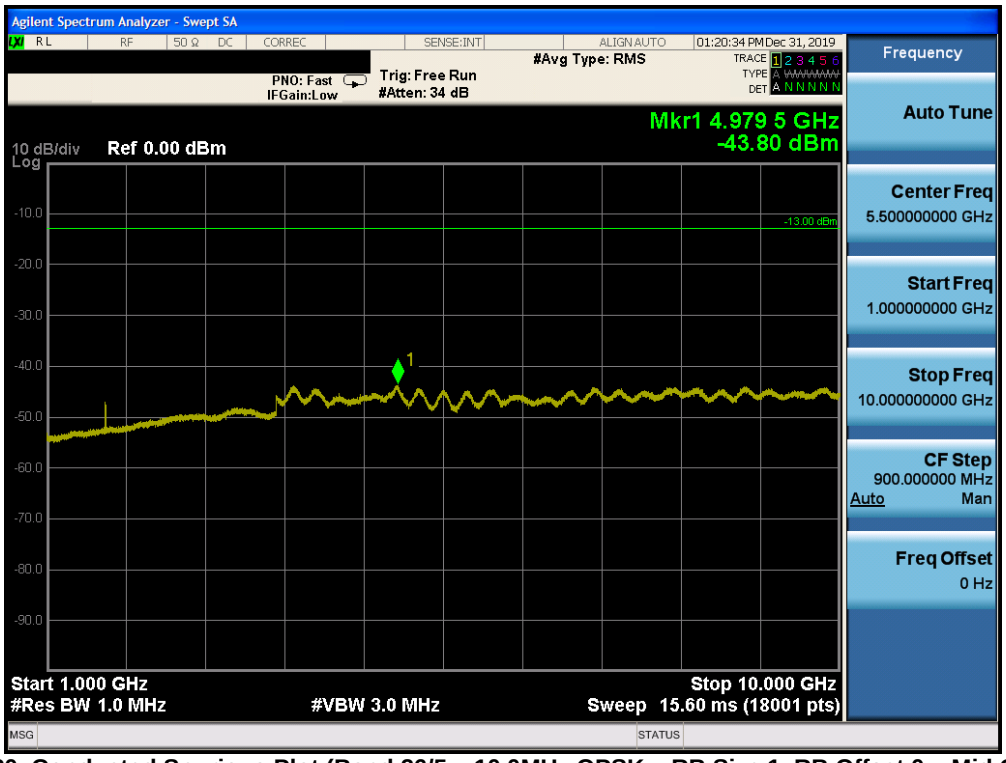


Plot 7-119. Conducted Spurious Plot (Band 26/5 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 7-120. Conducted Spurious Plot (Band 26/5 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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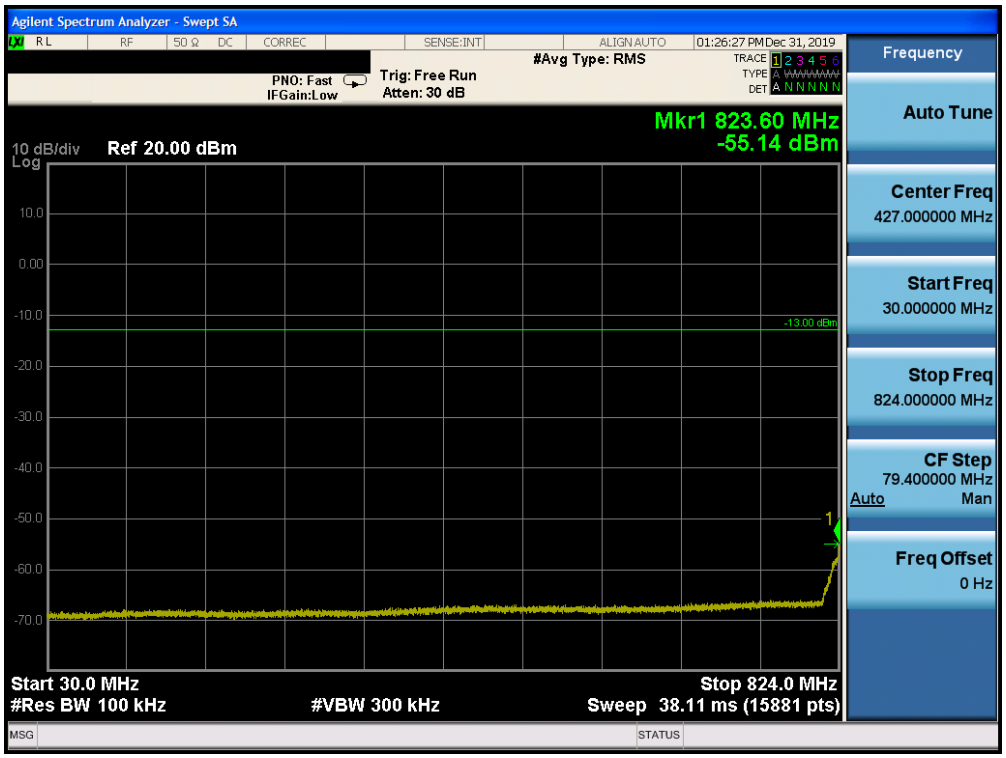
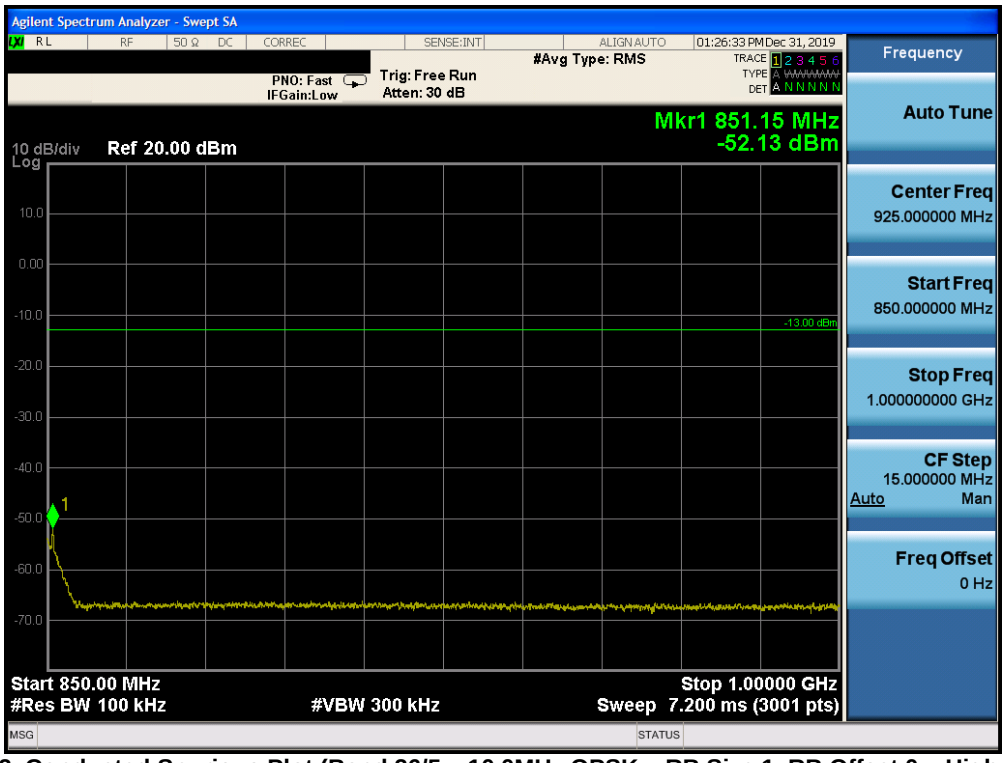


Plot 7-121. Conducted Spurious Plot (Band 26/5 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 7-122. Conducted Spurious Plot (Band 26/5 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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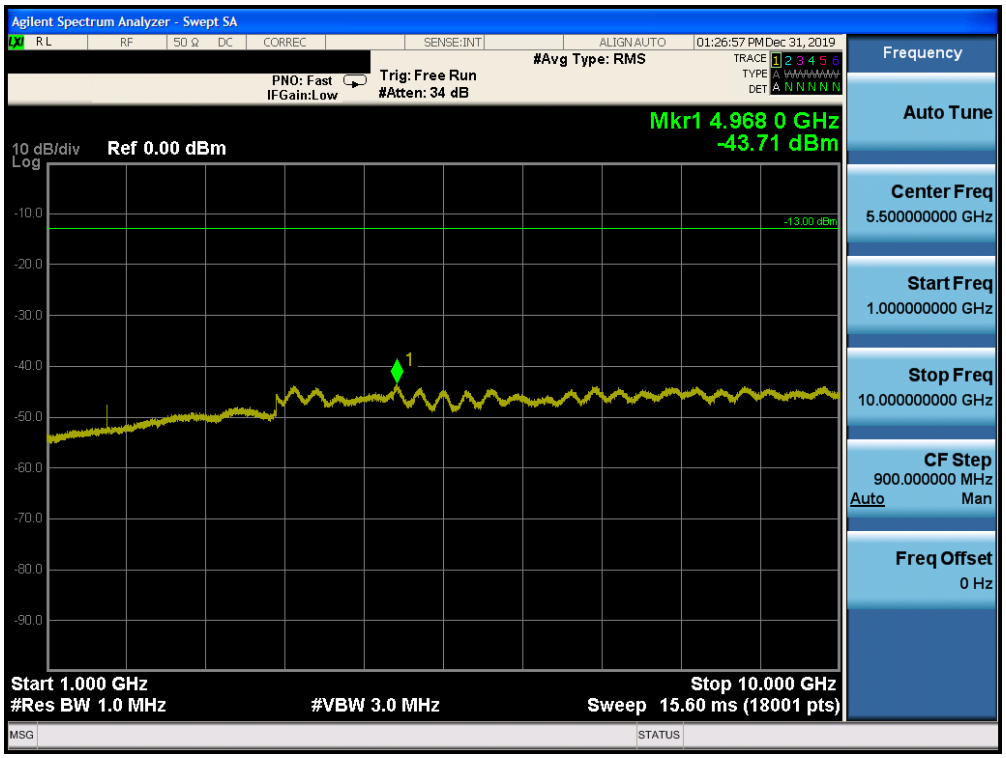

Plot 7-123. Conducted Spurious Plot (Band 26/5 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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