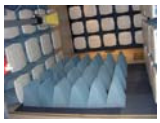
PCTEST ENGINEERING LABORATORY, INC.
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctestlab.com



MEASUREMENT REPORT
FCC Part 24 & 27 LTE

Applicant Name:
Qualcomm Technologies, Inc.
5775 Morehouse Drive
San Diego, CA 92121
United States

Date of Testing:
12/23/2015-3/5/2016
Test Site/Location:
PCTEST Lab., Columbia, MD, USA
Test Report Serial No.:
0Y1607131257-R2.J9C

FCC ID :	**J9CMTP9900LAA**
APPLICANT:	**QUALCOMM TECHNOLOGIES, INC.**

Application Type:	Certification
Model(s):	MTP9900LAA
EUT Type:	LAA Release 13 Small Cell
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part(s):	§2; §24; §27
Test Procedure(s):	ANSI/TIA-603-D-2010, KDB 971168 D01 v02r02, KDB 662911 D01 v02r01
Test Device Serial No.:	*identical prototype* [S/N: 49173051545004]

Mode	Tx Frequency (MHz)	Emission Designator	Modulation	EIRP	
				Max. Power (W)	Max. Power (dBm)
LTE Band 4	2112.5 - 2152.5	4M44G7D	QPSK	4.194	36.23
LTE Band 4	2115 - 2150	8M74G7D	QPSK	4.386	36.42
LTE Band 4	2117.5 - 2147.5	13M3G7D	QPSK	4.421	36.46
LTE Band 4	2120 - 2145	18M0G7D	QPSK	4.356	36.39
LTE Band 2	1932.5 - 1987.5	4M35G7D	QPSK	3.709	35.69
LTE Band 2	1935 - 1985	8M73G7D	QPSK	4.336	36.37
LTE Band 2	1937.5 - 1982.5	13M3G7D	QPSK	4.150	36.18
LTE Band 2	1940 - 1980	17M8G7D	QPSK	4.321	36.36

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: 0Y1607131257-R2.J9C) supersedes and replaces the previously issued test report (S/N: 0Y1607131257-R1.J9C) 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

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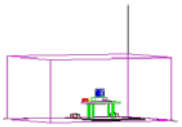
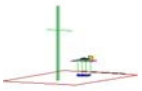


MEASUREMENT REPORT
FCC Part 24 & 27

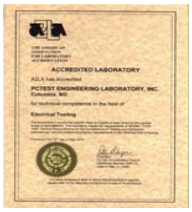


§2.1033 General Information

APPLICANT:	Qualcomm Technologies, Inc.
APPLICANT ADDRESS:	5775 Morehouse Drive
	San Diego, CA 92121, United States
TEST SITE:	PCTEST ENGINEERING LABORATORY, INC.
TEST SITE ADDRESS:	7185 Oakland Mills Road, Columbia, MD 21045 USA
FCC RULE PART(S):	§2; §24; §27
BASE MODEL:	MTP9900LAA
SKU NUMBER:	65-F5230-910
MCN NUMBER:	10-F5230-006
FCC ID:	J9CMTP9900LAA
FCC CLASSIFICATION:	PCS Licensed Transmitter (PCB)
FREQUENCY TOLERANCE:	±0.00025 % (2.5 ppm)
Test Device Serial No.:	49173051545004 ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	12/23/2015-3/5/2016
TEST REPORT S/N:	0Y1607131257-R2.J9C

Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.



- PCTEST facility is an FCC registered (PCTEST Reg. No. 159966) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (2451B-1).
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing Aid Compatibility (HAC) testing, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (2451B-1) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS, CDMA, and EvDO wireless devices and for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO, and CDMA 1xRTT.

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EME) 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 Industry Canada Certification and Engineering Bureau.

1.2 Testing Facility

The map below shows the location of the PCTEST LABORATORY, its proximity to the FCC Laboratory, the Columbia vicinity, the Baltimore-Washington Internt'l (BWI) airport, the city of Baltimore and the Washington, DC area. (S*ee Figure 1-1*).

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The site coordinates are 39º 10'23" N latitude and 76º 49'50" W longitude. The facility is 0.4 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2014 on January 22, 2015.

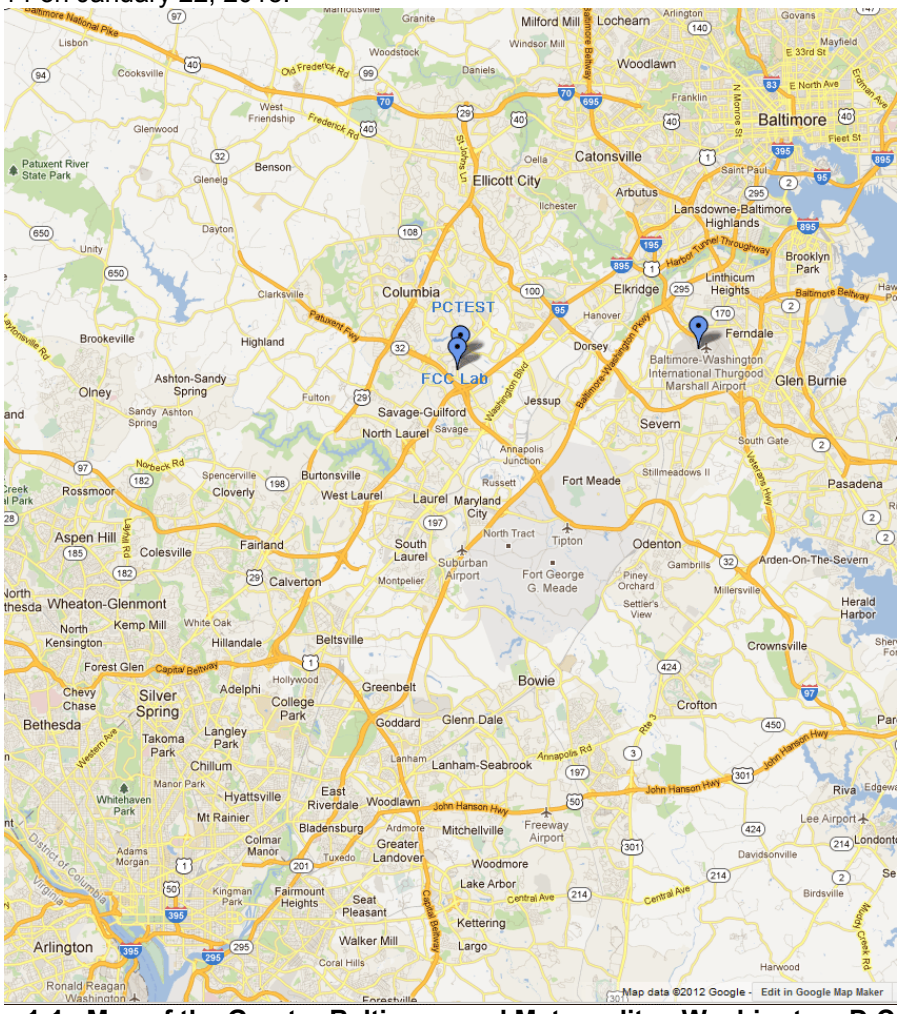


Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Qualcomm LAA Release 13 Small Cell FCC ID: J9CMTP9900LAA**. The test hardware SKU identification number is 65-F5230-910. The test data contained in this report pertains only to the emissions due to the EUT's LTE function.

2.2 Device Capabilities

This device contains the following capabilities:

LTE Band 2 (5/10/15/20MHz BW), LTE Band 4 (5/10/15/20MHz BW), LAA (5GHz - UNII-1, UNII-3 (20/40MHz BW)), 802.11a (20MHz BW)

Both LAA and LTE portion of the device are of 2x2 MIMO.

2.3 Test Configuration

The Qualcomm LAA Release 13 Small Cell FCC ID: J9CMTP9900LAA was tested per the guidance of ANSI/TIA-603-D-2010 and KDB 971168 D01 v02r02. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

During LTE testing, one LTE carrier operates in either Band 2 (1930 – 1990MHz) or Band 4 (2110 – 2155MHz) while the other LTE carrier operates in the UNII 1 Band (5150 – 5250MHz) or the UNII 3 Band (5725 – 5850MHz). MIMO operation is considered while two LTE carriers are active (Chain0 and Chain1) in the same band on the same channel.

2.4 EMI Suppression Device(s)/Modifications

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

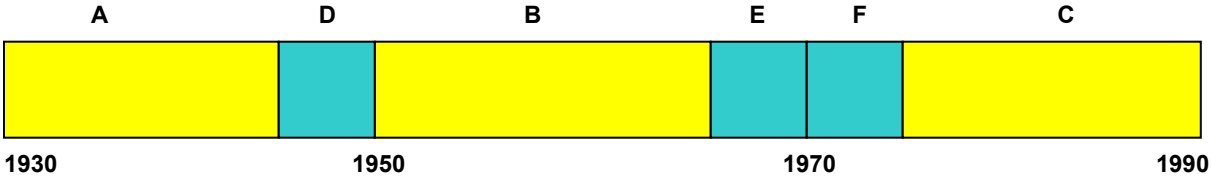
3.0 DESCRIPTION OF TESTS

3.1 Measurement Procedure

The measurement procedures described in the document titled "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI/TIA-603-D-2010) and "Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems" (KDB 971168 D01 v02r02) were used in the measurement of the **Qualcomm LAA Release 13 Small Cell FCC ID: J9CMTP9900LAA.**

3.2 PCS - Base Frequency Blocks

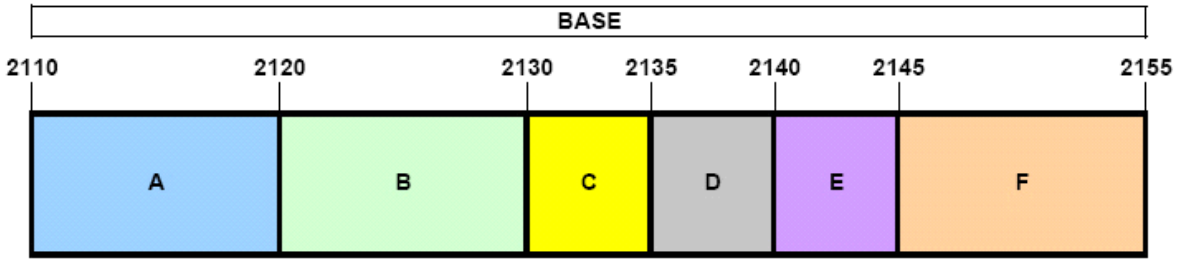
§24.229



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)

3.3 AWS - Base Frequency Blocks

§27.5(h)



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)

3.4 Radiated Power and Radiated Spurious Emissions

§2.1053, §24.232(c), §24.238(a), §27.50(d), §27.53(h)

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 Clause 5, Figure 5.7 of ANSI C63.4-2014. For measurements above 1GHz 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 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 below 1GHz, a 72.4cm high PVC support structure is placed on top of the turntable. A 3" (~7.6cm) sheet of high density polystyrene is used as the table top and is placed on top of the PVC supports to bring the total height of the table to 80cm.

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. Radiated power levels are also investigated with the receive antenna horizontally and vertically polarized. The maximized power level is recorded using the spectrum analyzer, per the guidelines of KDB 971168.

Per the guidance of ANSI/TIA-603-D-2010, 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 $43 + 10\log_{10}(\text{Power}_{[Watts]})$.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of CISPR 16-4-2. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement data shown herein 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	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST).

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	4/28/2015	Annual	4/28/2016	RE1
-	WL40-1	Conducted Cable Set (40GHz)	4/20/2015	Annual	4/20/2016	WL40-1
Agilent	8447D	Broadband Amplifier	6/12/2015	Annual	6/12/2016	1937A03348
Agilent	N5183A	MXG Analog Signal Generator	3/16/2014	Biennial	3/16/2016	MY50141900
Agilent	N9030A	PXA Signal Analyzer (44GHz)	3/24/2015	Annual	3/24/2016	MY52350166
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	7/30/2015	Biennial	7/30/2017	121034
Emco	3115	Horn Antenna (1-18GHz)	3/30/2014	Biennial	3/30/2016	9704-5182
Espec	ESX-2CA	Environmental Chamber	3/17/2015	Annual	3/17/2016	17620
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	4/8/2014	Biennial	4/8/2016	125518
ETS Lindgren	3160-09	18-26.5 GHz Standard Gain Horn	6/17/2014	Biennial	6/17/2016	135427
ETS Lindgren	3164-08	Quad Ridge Horn Antenna	3/12/2014	Biennial	3/12/2016	128337
K & L	11SH10-3075/U18000	High Pass Filter	7/18/2015	Annual	7/18/2016	11SH10-3075/U18000-2
K & L	11SH10-6000/T18000	High Pass Filter	7/18/2015	Annual	7/18/2016	11SH10-6000/T18000-1
Mini Circuits	TVA-11-422	RF Power Amp	N/A		N/A	QA1317001
Mini Circuits	PWR-SEN-4GHS	USB Power Sensor	3/11/2015	Annual	3/11/2016	11401010036
Mini-Circuits	SSG-4000HP	Synthesized Signal Generator	N/A		N/A	11208010032
Rhode & Schwarz	TS-PR18	Pre-Amplifier	3/5/2015	Annual	3/5/2016	101622
Rohde & Schwarz	TS-PR18	1-18 GHz Pre-Amplifier	3/5/2015	Annual	3/5/2016	100071
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	3/3/2015	Annual	3/3/2016	100040
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	3/12/2015	Annual	3/12/2016	100342
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	6/2/2015	Annual	6/2/2016	103200
Schwarzbeck	UHA 9105	Dipole Antenna (400 - 1GHz) Tx	11/18/2015	Biennial	11/18/2017	91052522TX
Schwarzbeck	UHA 9105	Dipole Antenna (400 - 1GHz) Rx	11/18/2015	Biennial	11/18/2017	91052523RX
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	3/28/2014	Biennial	3/28/2016	A051107
VWR	62344-734	Thermometer with Clock	2/20/2014	Biennial	3/20/2016	140140336

Table 5-1. Test Equipment

Notes:

1. Equipment with a calibration date of "N/A" shown in this list was not used to make direct calibrated measurements.
2. Items whose calibration date lies within the test date range (e.g. TS-PR26 and TS-PR40) were not used to make calibrated measurements after their calibration due date.

6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 8M62G7D

LTE BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

Spurious Radiated Emission – LTE Band

Example: LTE Harmonic at 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 25.50 dBm so this harmonic was 25.50 dBm – (-24.80).

7.0 TEST RESULTS

7.1 Summary

Company Name: Qualcomm Technologies, Inc.
FCC ID: J9CMTP9900LAA
FCC Classification: PCS Licensed Transmitter (PCB)
Mode(s): LTE

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Result	Reference
TRANSMITTER MODE (TX)					
2.1049	Occupied Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
2.1046	Transmitter Conducted Output Power	N/A		PASS	Section 7.3
24.232(a)(2), 27.50(d)	Equivalent Isotropic Radiated Power (Band 4, Band 2)	< 1640 Watts/MHz max. EIRP		PASS	Section 7.3
2.1051, 24.238(a), 27.53(h)	Out of Band Emissions	> 43 + 10log$_{10}$ (P[Watts]) attenuation from fundamental power at Band Edge and for all out-of-band emissions		PASS	Section 7.4, 7.5
24.232(d), 27.50(b)	Peak-Average Ratio	< 13 dB		PASS	Section 7.6
2.1055, 24.235, 27.54	Frequency Stability	Fundamental emissions must stay within authorized frequency block (Part 24, 27)		PASS	Section 7.7
2.1053, 24.238(a), 27.53(h)	Cabinet Radiated Emissions	> 43 + 10log$_{10}$ (P[Watts]) attenuation from fundamental power for all out-of-band emissions	CABINET RADIATED	PASS	Section 7.8

Table 7-1. Summary of Test Results

Notes:

1. This device was evaluated for compliance using conducted measurements along with cabinet radiated emissions measurements, per KDB 971168.
2. All channels, modes, modulations, and channel bandwidths were investigated. The test results shown in the following sections represent the worst case emissions.
3. The analyzer plots (Sections 7.2, 7.4, 7.5, 7.6) were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the spectrum analyzer and the EUT at all frequencies of interest. Also included in the correction table were offsets to account for array gain which is comprised of the maximum antenna gain of 6dBi and an additional 3dB due to two antennas transmitting simultaneously.
4. All antenna port conducted emissions testing was performed on a test bench with the antenna ports of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

7.2 Occupied Bandwidth

§2.1049

Test Overview

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

Test Procedure Used

KDB 971168 D01 v02r02 – 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.

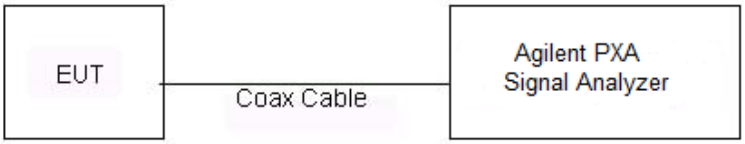
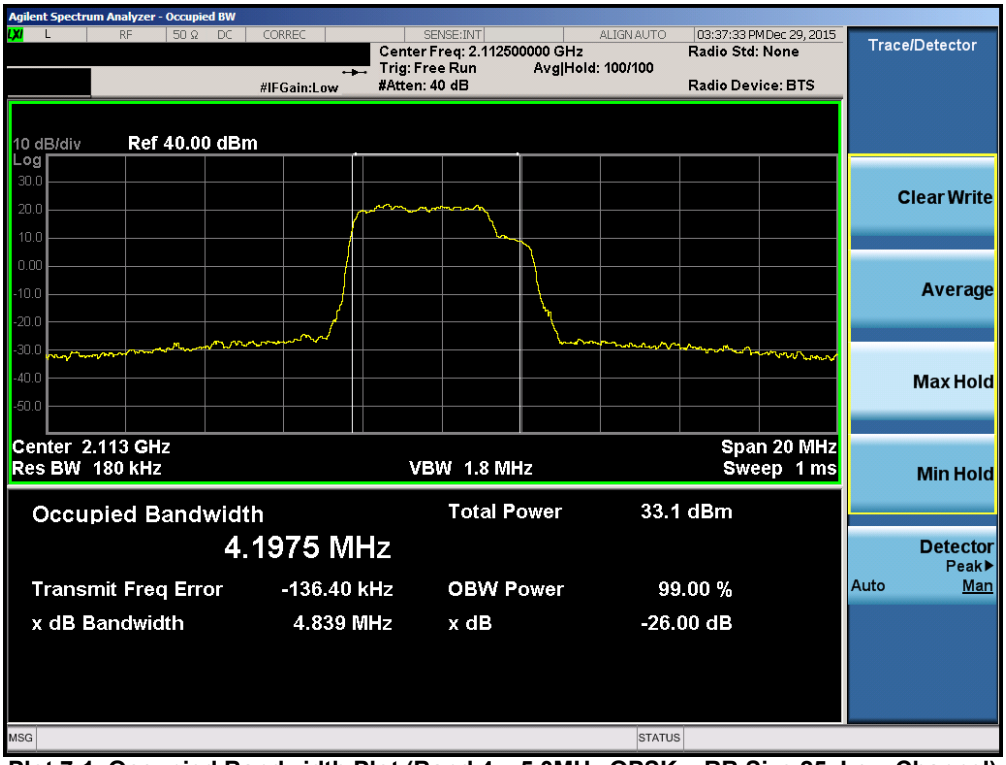


Figure 7-1. Test Instrument & Measurement Setup

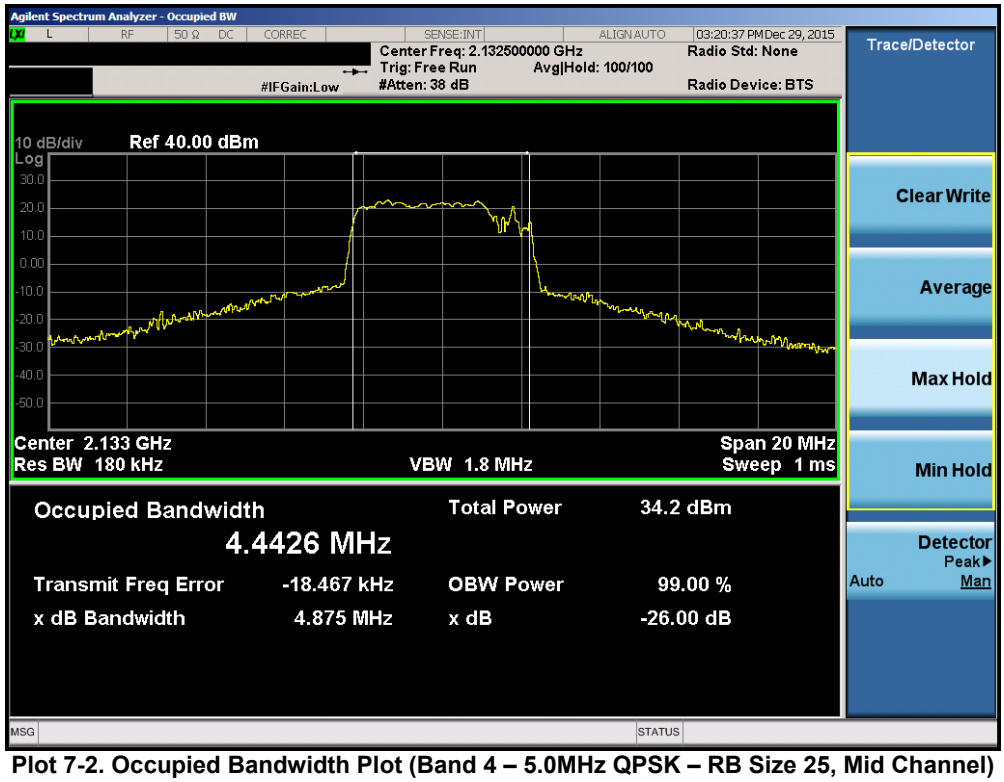
Test Notes

None

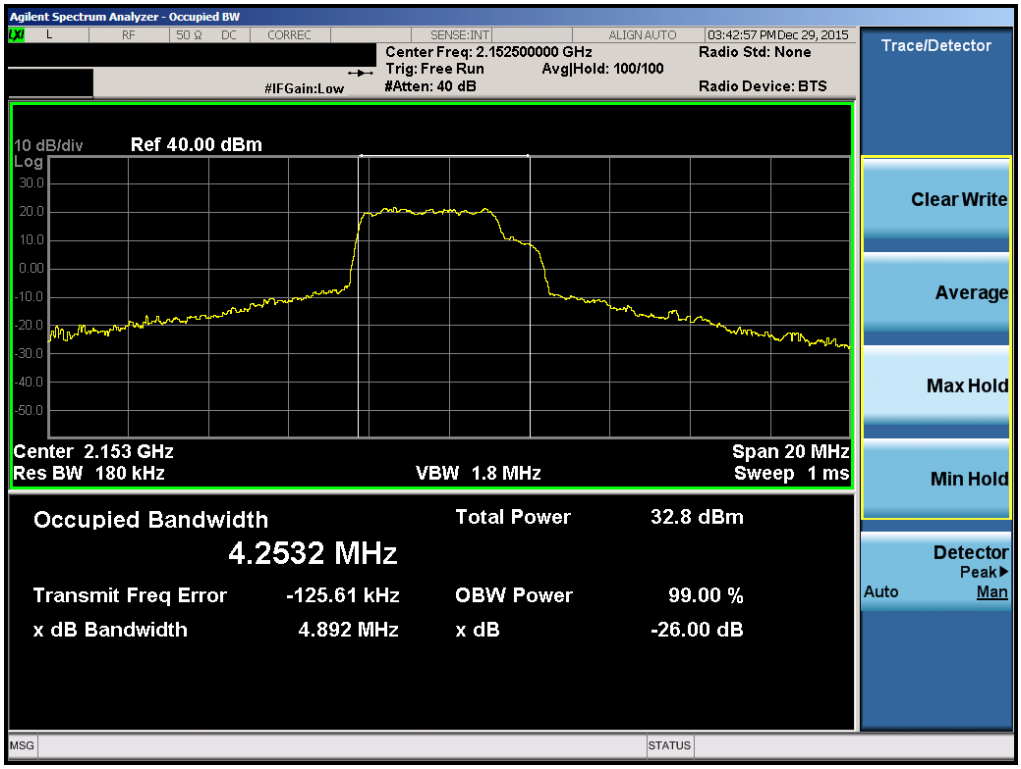
Chain0



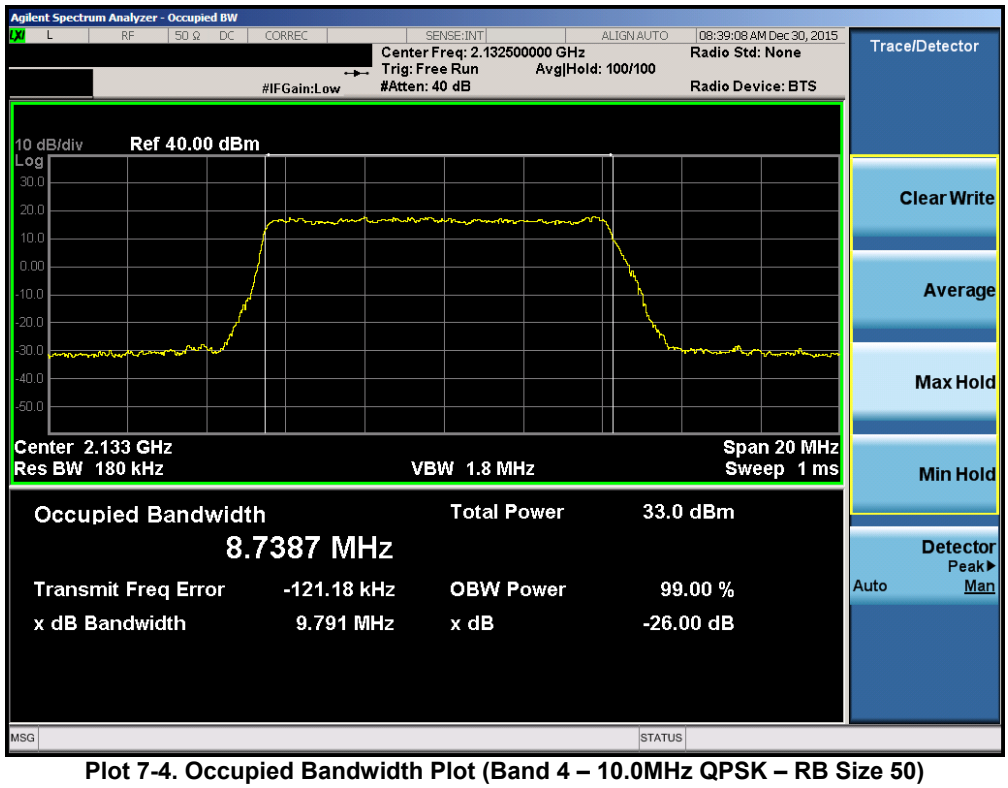
Plot 7-1. Occupied Bandwidth Plot (Band 4 – 5.0MHz QPSK – RB Size 25, Low Channel)



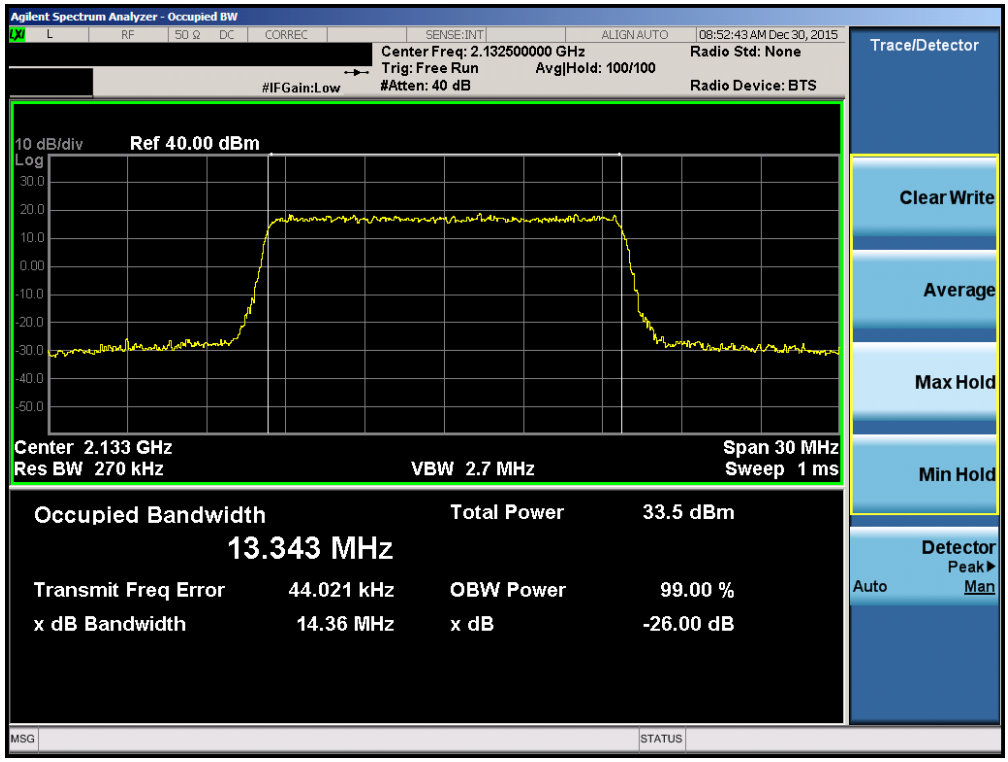
Plot 7-2. Occupied Bandwidth Plot (Band 4 – 5.0MHz QPSK – RB Size 25, Mid Channel)



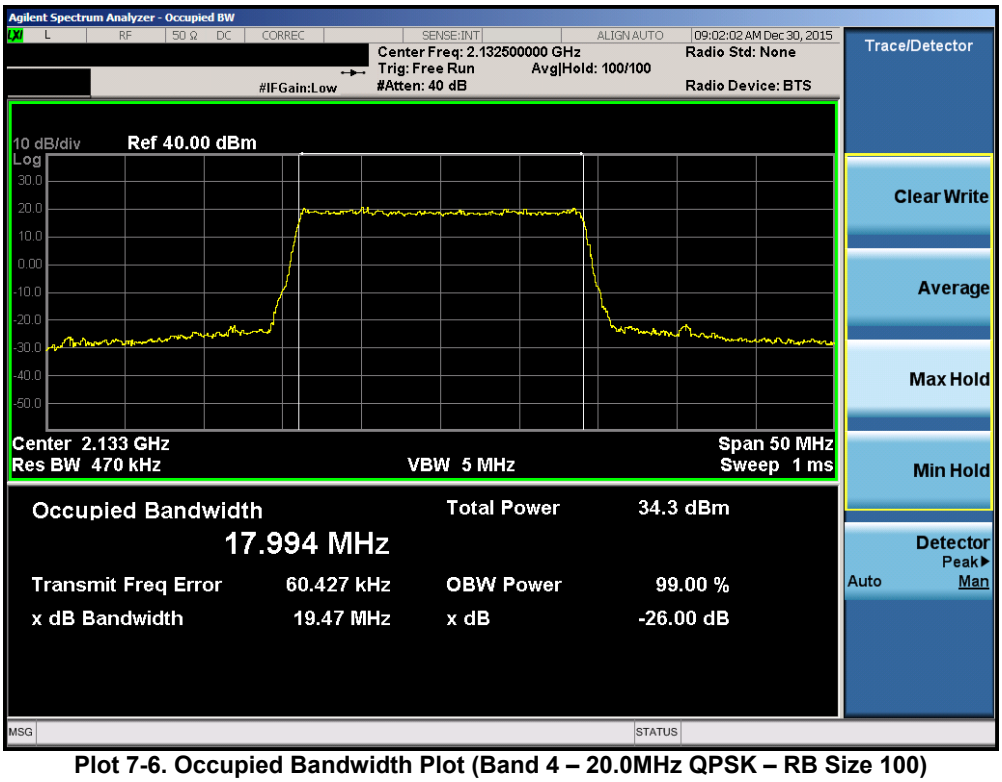
Plot 7-3. Occupied Bandwidth Plot (Band 4 – 5.0MHz QPSK – RB Size 25, High Channel)



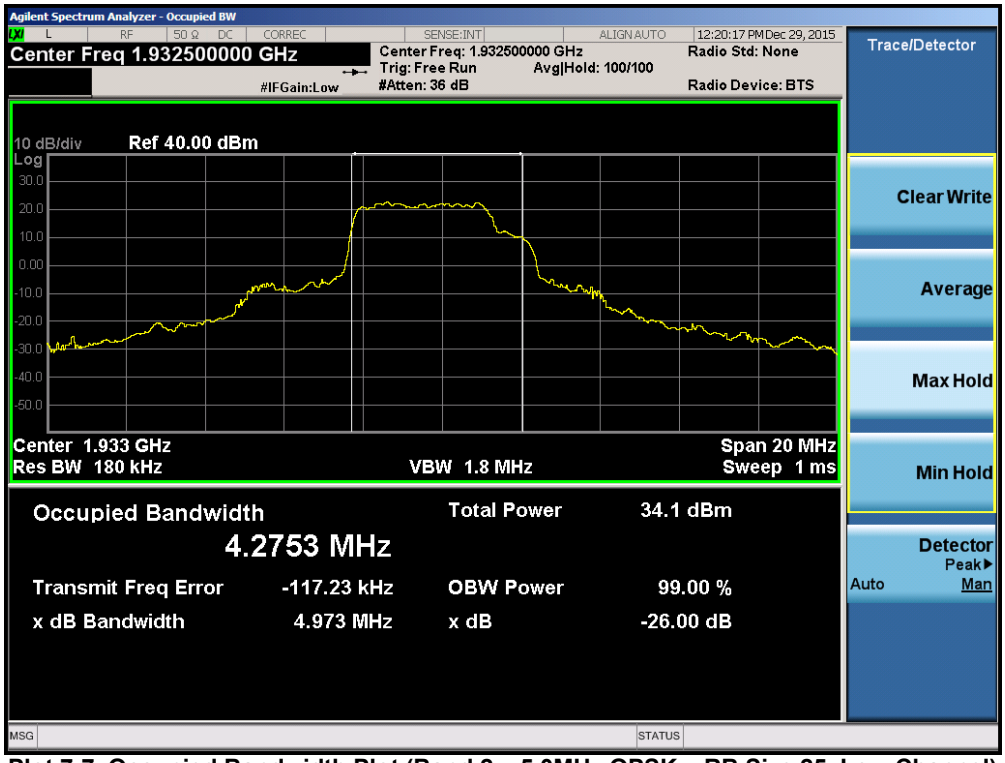
Plot 7-4. Occupied Bandwidth Plot (Band 4 – 10.0MHz QPSK – RB Size 50)



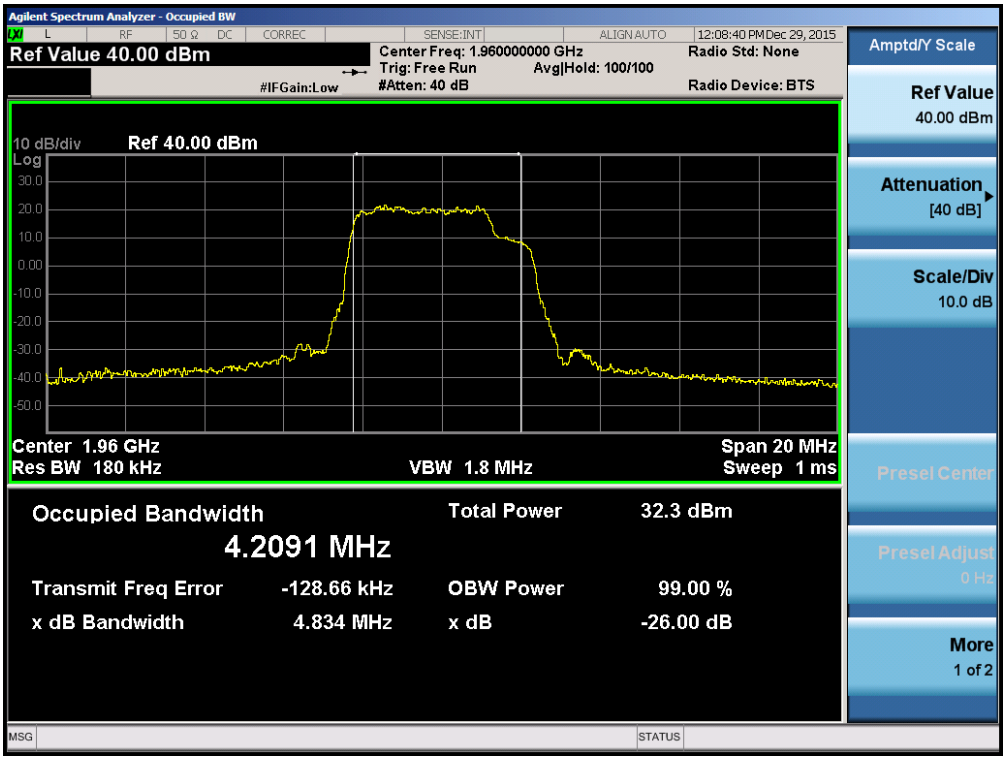
Plot 7-5. Occupied Bandwidth Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



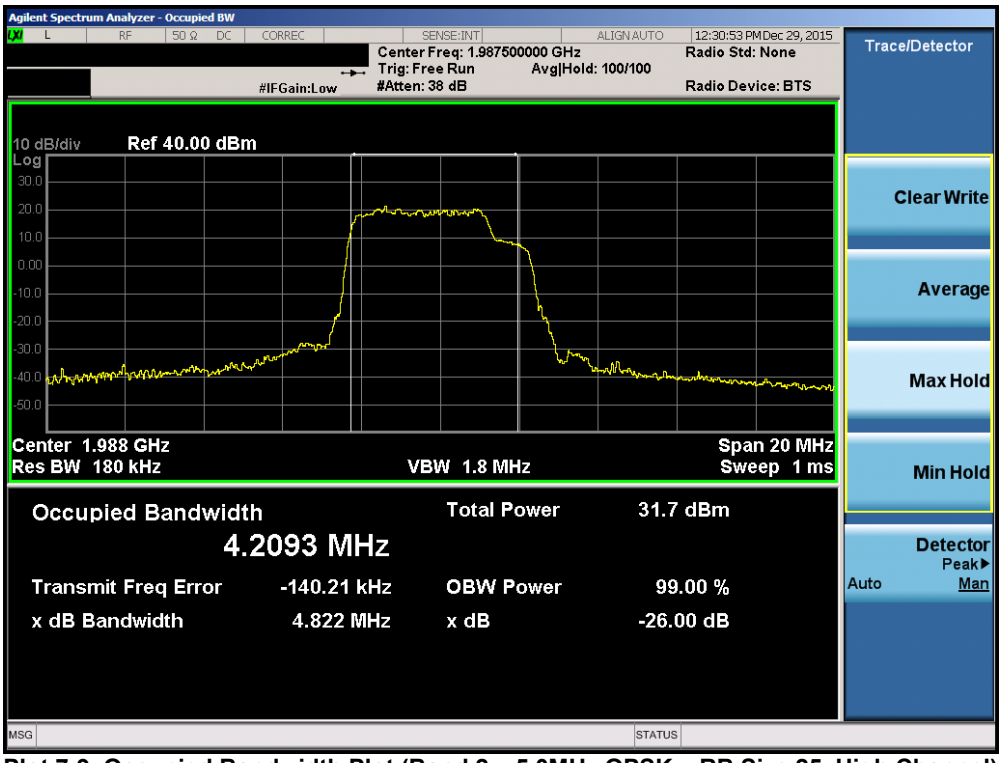
Plot 7-6. Occupied Bandwidth Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



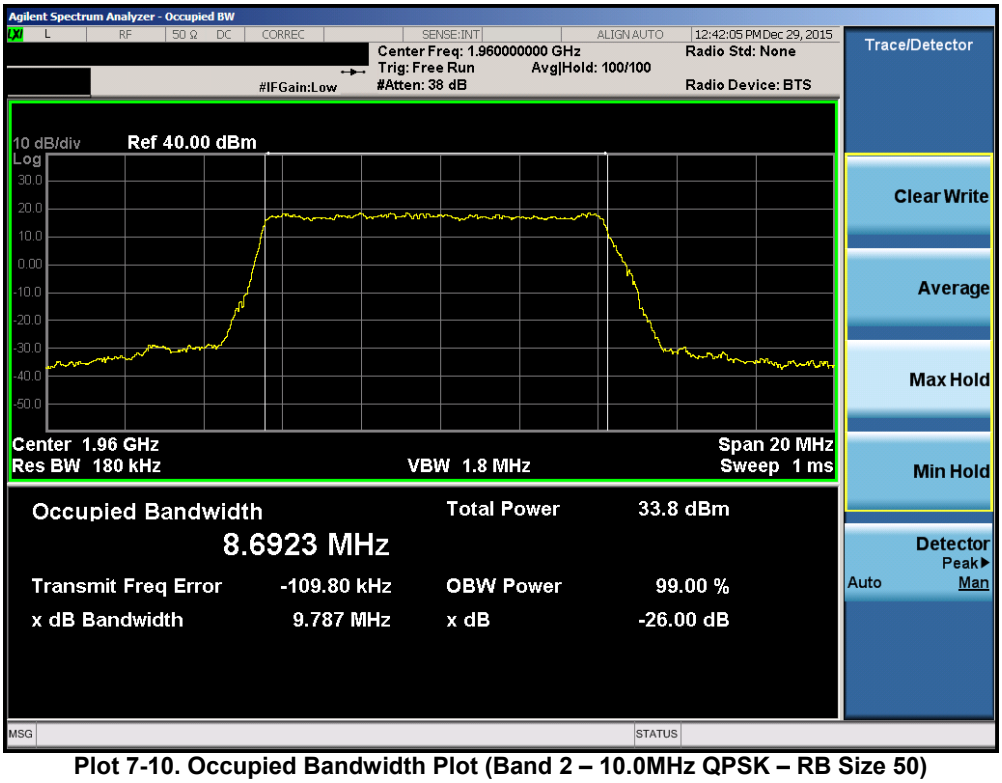
Plot 7-7. Occupied Bandwidth Plot (Band 2 – 5.0MHz QPSK – RB Size 25, Low Channel)



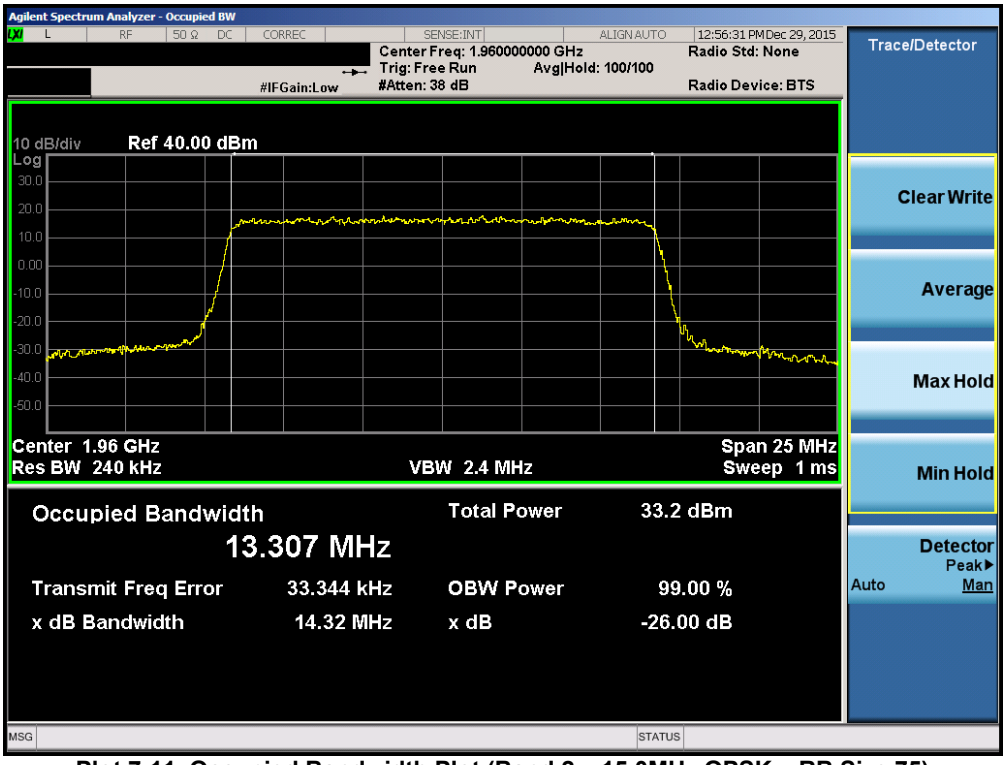
Plot 7-8. Occupied Bandwidth Plot (Band 2 – 5.0MHz QPSK – RB Size 25, Mid Channel)



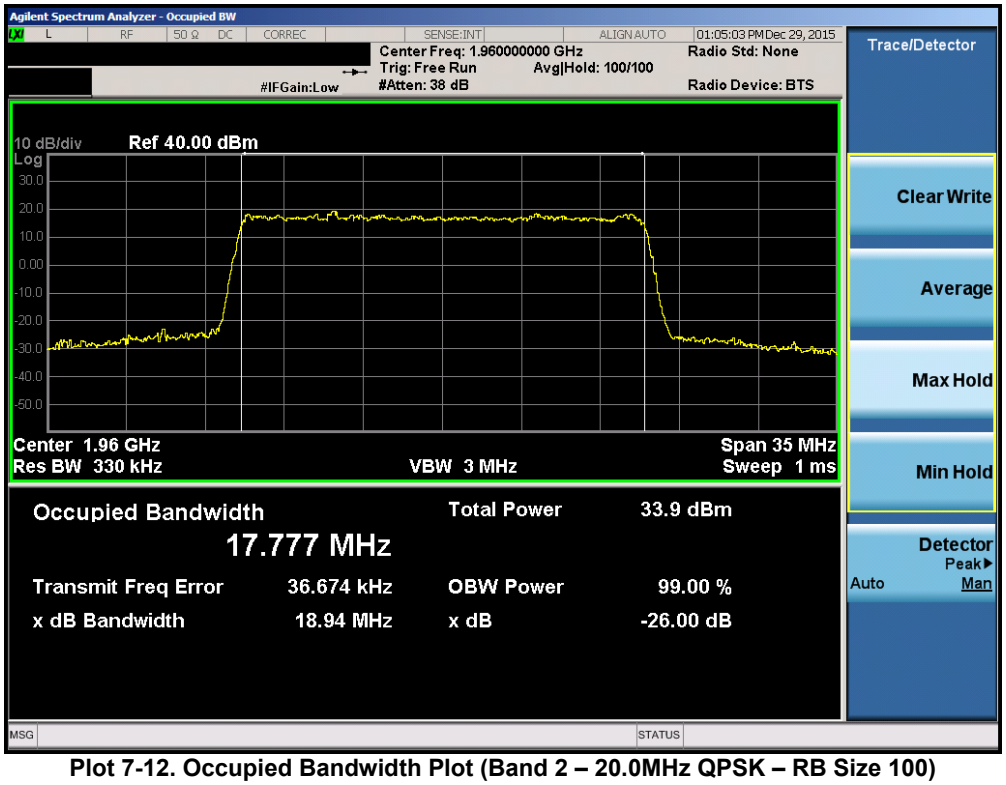
Plot 7-9. Occupied Bandwidth Plot (Band 2 – 5.0MHz QPSK – RB Size 25, High Channel)



Plot 7-10. Occupied Bandwidth Plot (Band 2 – 10.0MHz QPSK – RB Size 50)

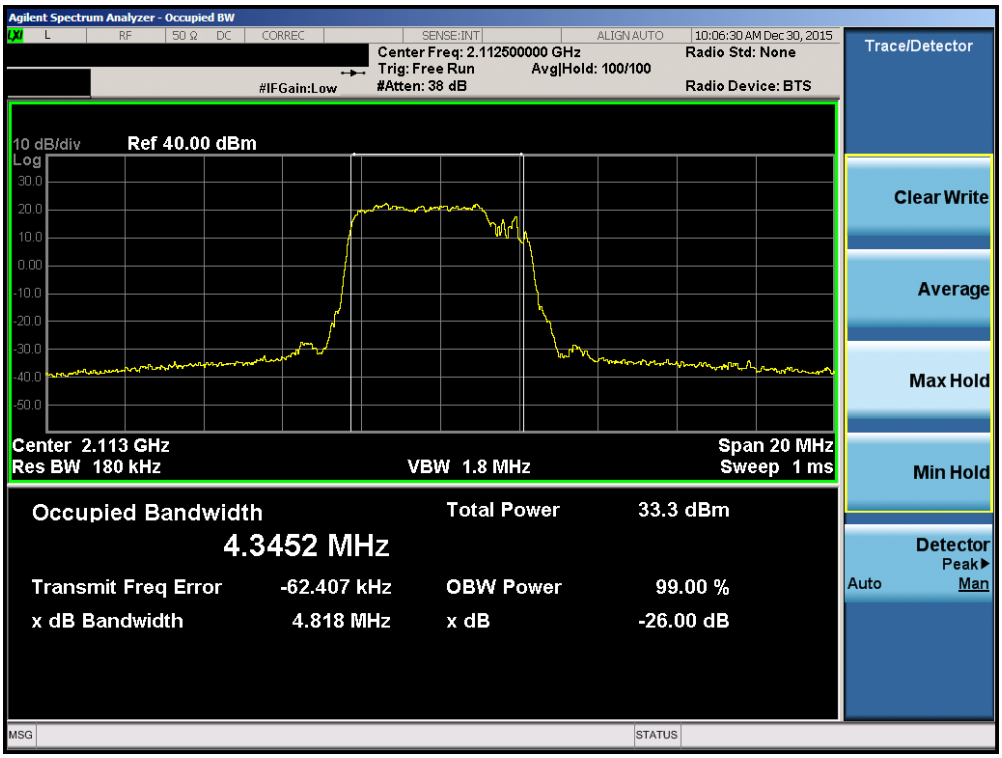


Plot 7-11. Occupied Bandwidth Plot (Band 2 – 15.0MHz QPSK – RB Size 75)

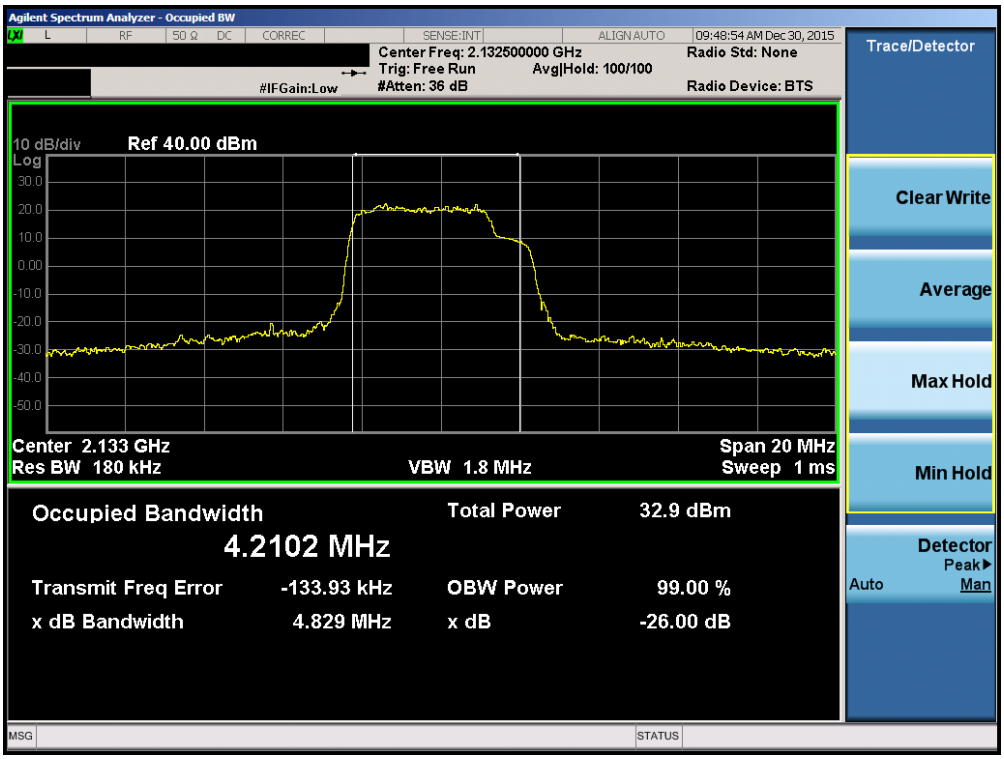


Plot 7-12. Occupied Bandwidth Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

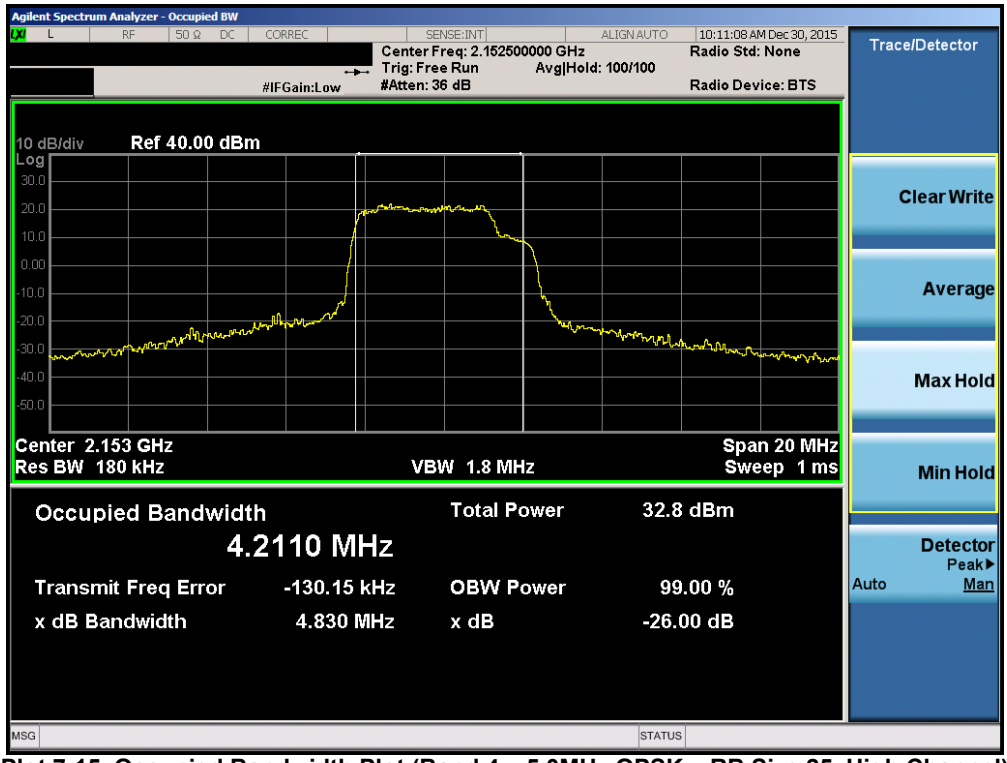
Chain1



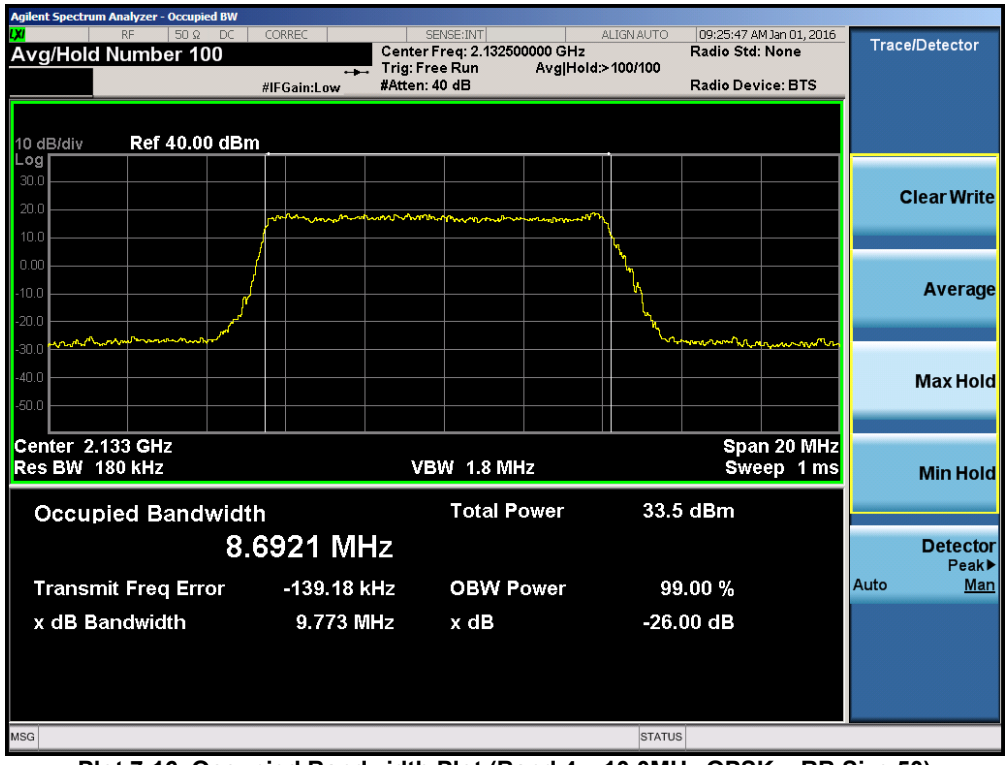
Plot 7-13. Occupied Bandwidth Plot (Band 4 – 5.0MHz QPSK – RB Size 25, Low Channel)



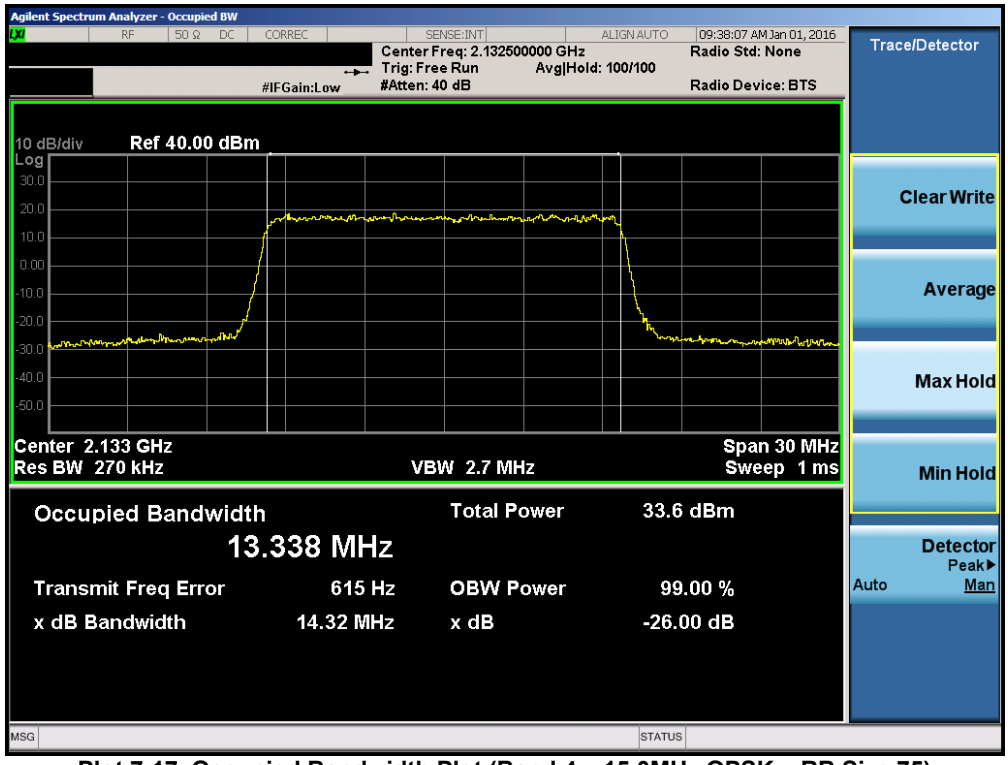
Plot 7-14. Occupied Bandwidth Plot (Band 4 – 5.0MHz QPSK – RB Size 25, Mid Channel)



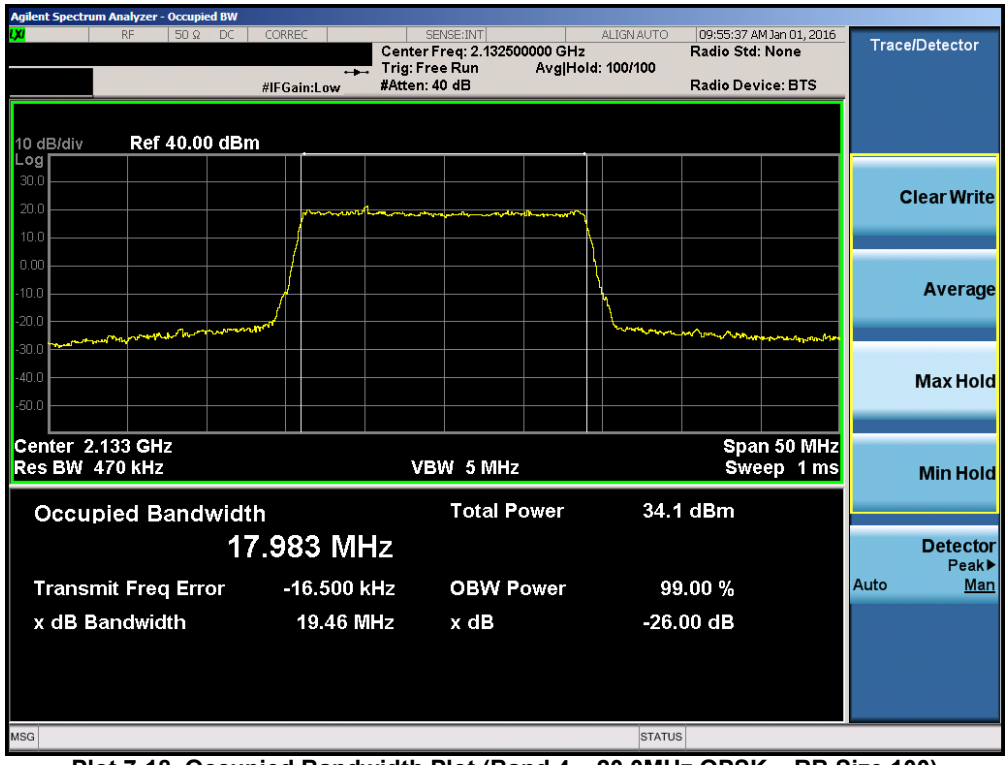
Plot 7-15. Occupied Bandwidth Plot (Band 4 – 5.0MHz QPSK – RB Size 25, High Channel)



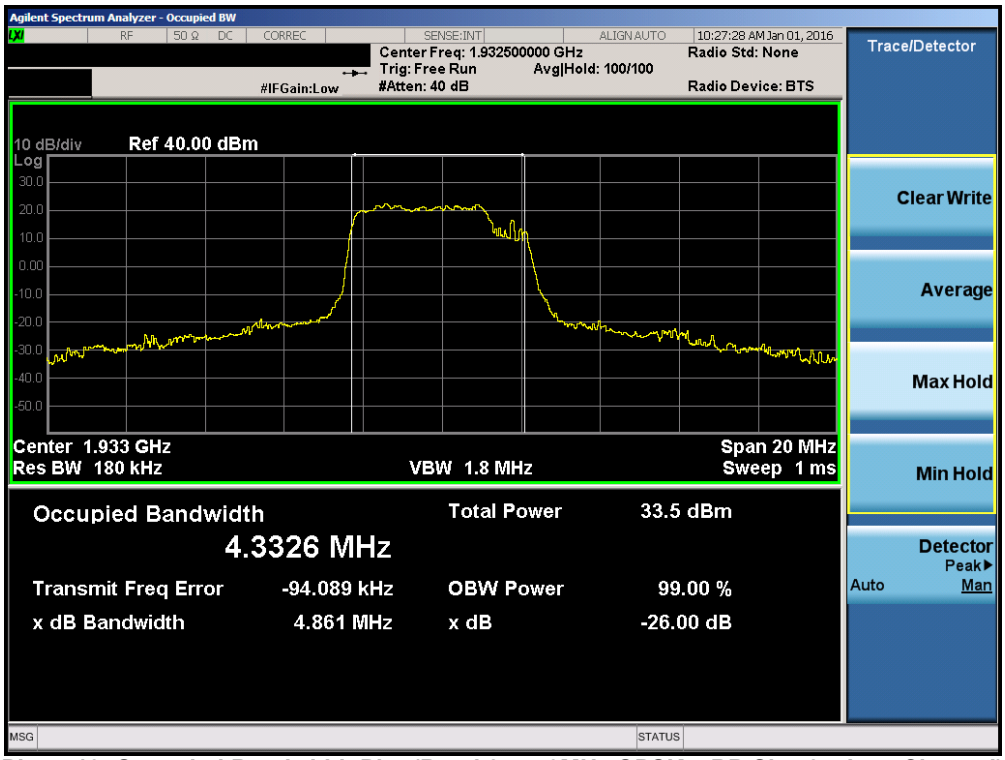
Plot 7-16. Occupied Bandwidth Plot (Band 4 – 10.0MHz QPSK – RB Size 50)



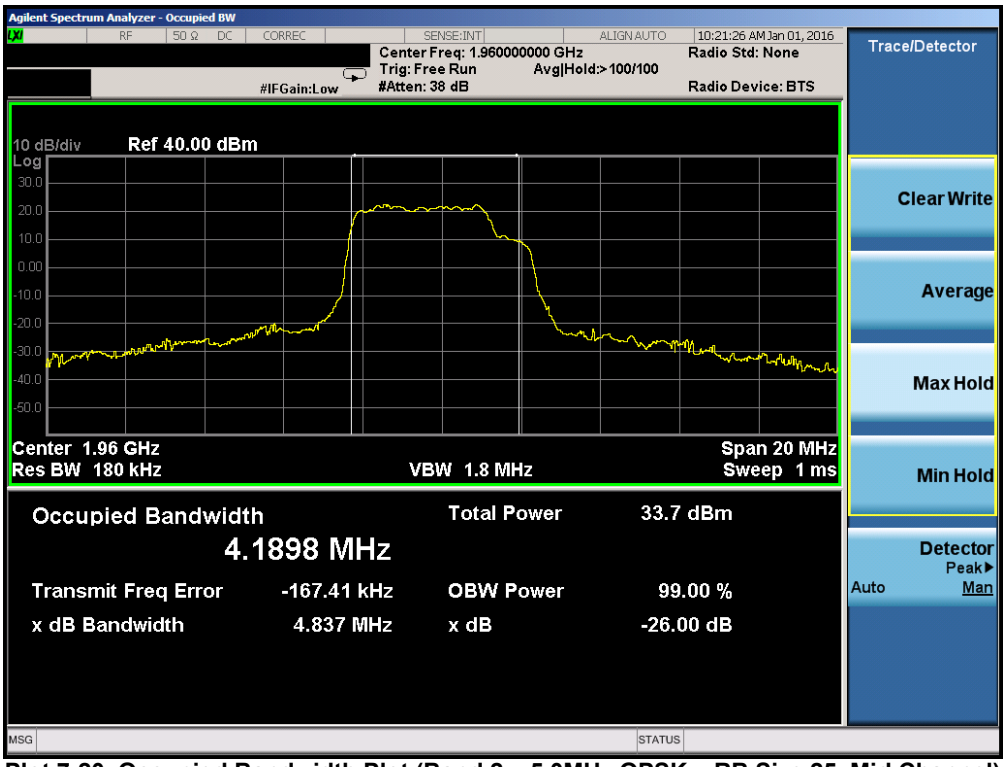
Plot 7-17. Occupied Bandwidth Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



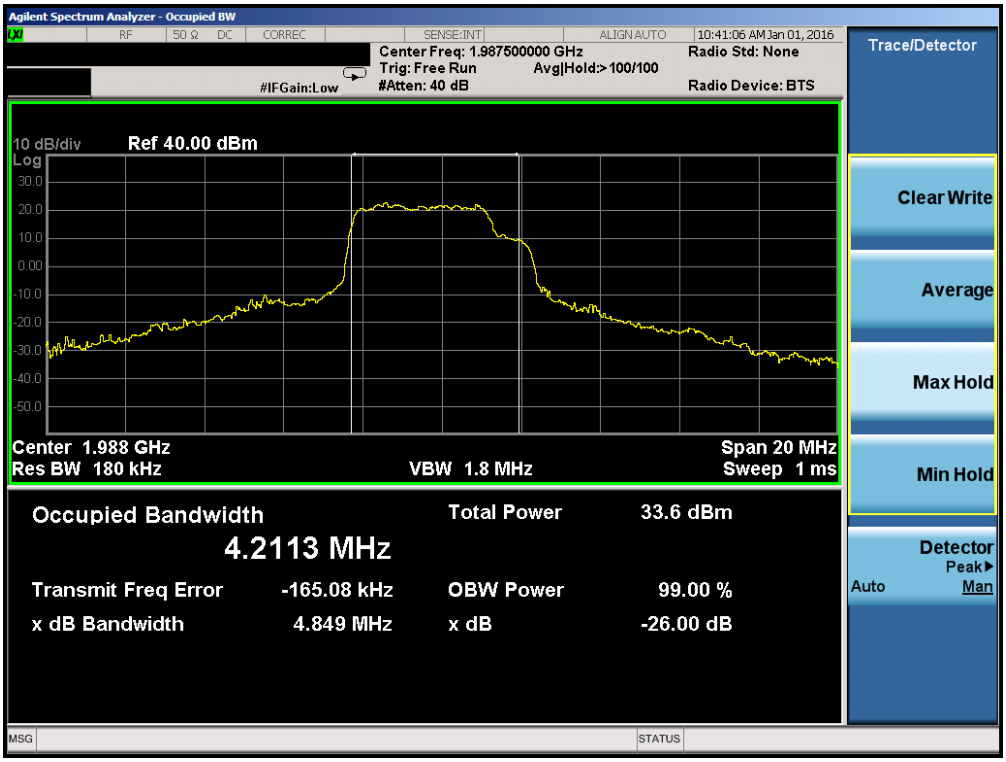
Plot 7-18. Occupied Bandwidth Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



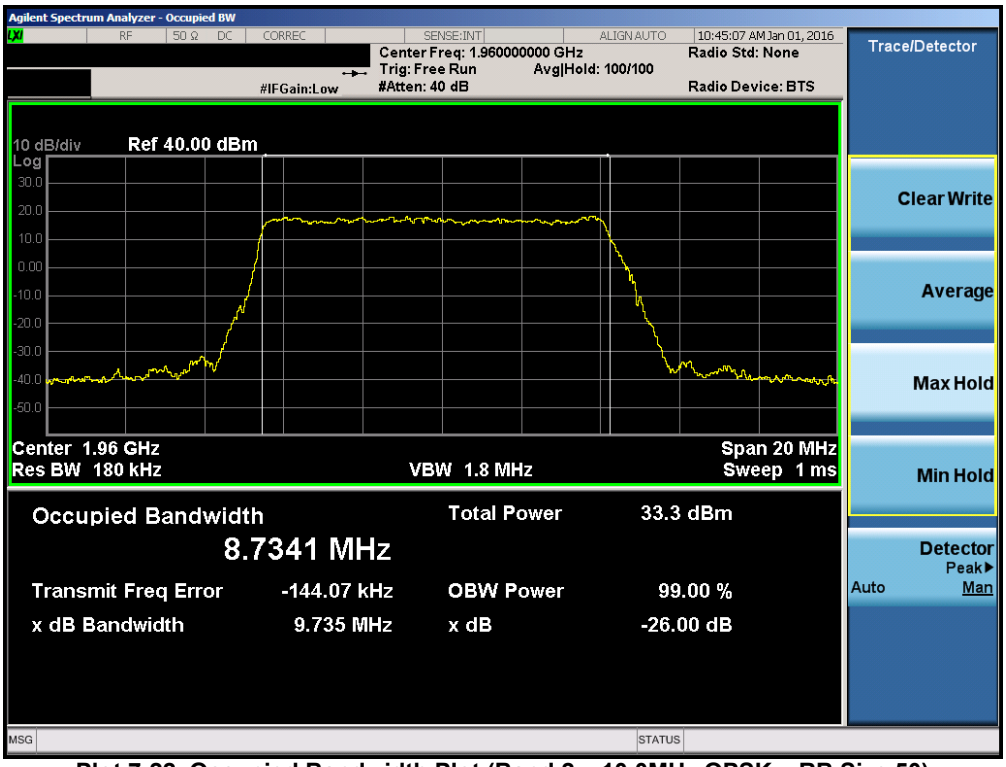
Plot 7-19. Occupied Bandwidth Plot (Band 2 – 5.0MHz QPSK – RB Size 25, Low Channel)



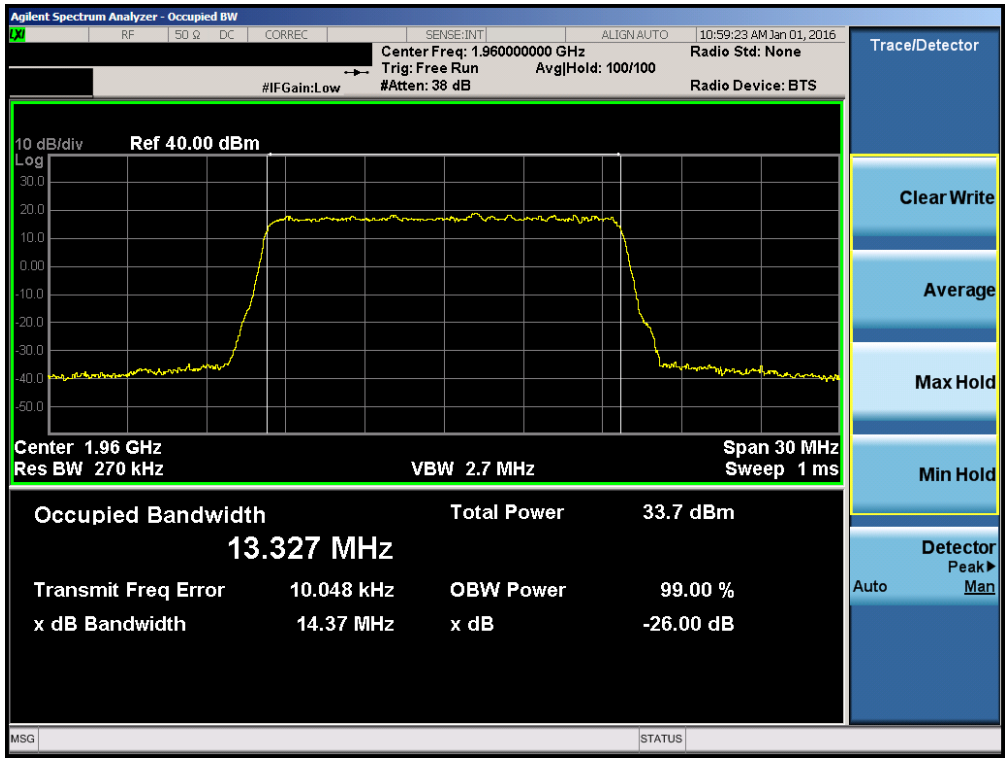
Plot 7-20. Occupied Bandwidth Plot (Band 2 – 5.0MHz QPSK – RB Size 25, Mid Channel)



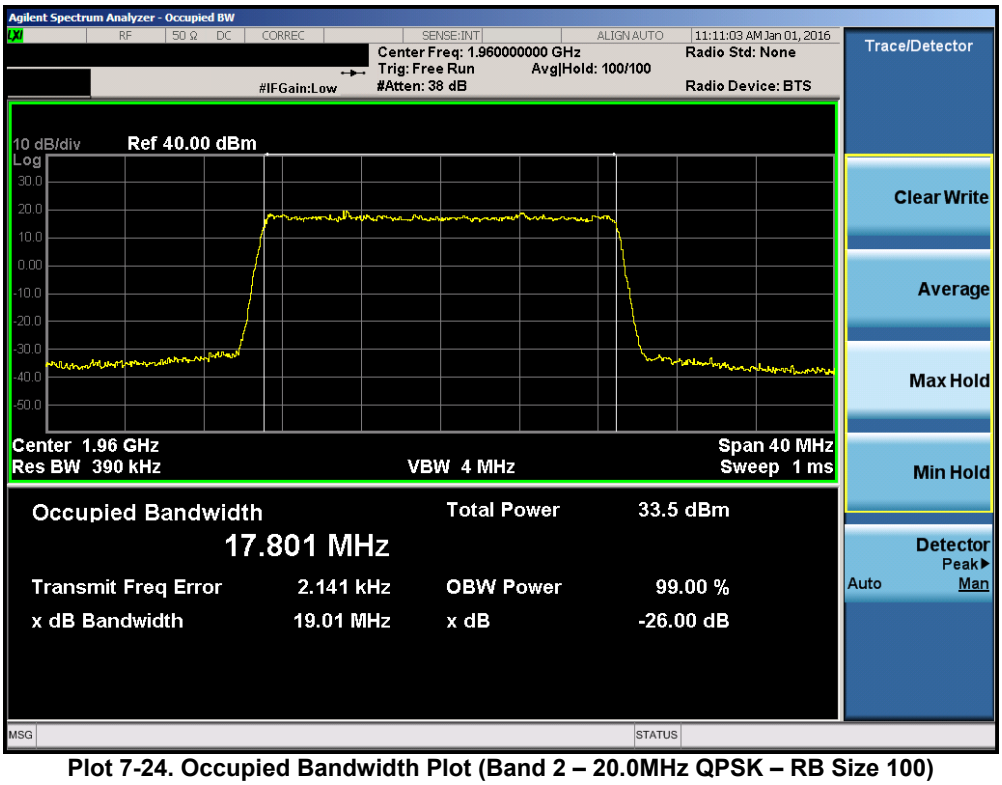
Plot 7-21. Occupied Bandwidth Plot (Band 2 – 5.0MHz QPSK – RB Size 25, High Channel)



Plot 7-22. Occupied Bandwidth Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



Plot 7-23. Occupied Bandwidth Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



Plot 7-24. Occupied Bandwidth Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

7.3 Equivalent Isotropic Radiated Power

§2.1046, §24.232(a), §27.50(d)

Test Overview

A transmitter antenna terminal of the EUT is connected to the input of a broadband spectrum analyzer. Measurement is made using the analyzer while the EUT is operating at its maximum output power level and at the appropriate frequencies.

For MIMO measurements, the conducted average (RMS) output powers are added linearly via the "Measure and Sum" technique in KDB 662911 D01 v02r01. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

KDB 971168 D01 v02r02 – Section 5.2
KDB 662911 D01 v02r01 – Section E)1)

Test Settings

1. The signal analyzer's automatic "Channel Power" function was used to perform the conducted output power measurements. The integration bandwidth is set to at least the emission bandwidth.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Number of sweep points ≥ 2 x (span/RBW)
5. Sweep = auto couple
6. Detector = Average (RMS)
7. Trace mode = trace averaging
8. Trigger was set to "free run" for all modes
9. The trace was allowed to stabilize

Test Setup

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

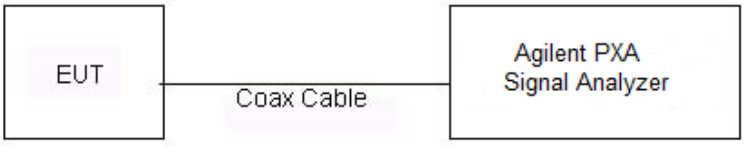


Figure 7-2. Test Instrument & Measurement Setup

Test Notes

The total directional gain is calculated from the maximum 6dBi antenna gain and the 3dB from N_{ant} = 2 (two antennas transmitting simultaneously), per KDB 662911. EIRP compliance is assessed while taking the total directional gain of 9dB into account.

Equivalent Isotropic Radiated Power (Cont'd)

§2.1046, §24.232(a), §27.50(d)

Chain0 + Chain1 (Total Power) – EIRP Calculation

LTE Band	BW	Channel Frequency (MHz)	3GPP Channel Number(s)	Directional Gain (dBi)	Chain0 Avg. Conducted Power (dBm)	Chain1 Avg. Conducted Power (dBm)	Total Conducted Power (dBm)	Total EIRP (dBm)	Limit (dBm)	Margin (dB)
Band 4	5 MHz	2112.5	1975	9.0	23.53	23.69	26.62	35.62	62.15	-35.53
		2132.5	2175	9.0	24.12	24.31	27.23	36.23	62.15	-34.92
		2152.5	2375	9.0	21.03	23.74	25.60	34.60	62.15	-36.55
	10MHz	2115	2000	9.0	24.47	24.35	27.42	36.42	62.15	-34.73
		2132.5	2175	9.0	24.11	24.18	27.16	36.16	62.15	-34.99
		2150	2350	9.0	22.12	24.31	26.36	35.36	62.15	-35.79
	15 MHz	2117.5	2025	9.0	24.47	24.42	27.46	36.46	62.15	-34.69
		2132.5	2175	9.0	24.16	24.25	27.22	36.22	62.15	-34.93
		2147.5	2325	9.0	22.19	24.01	26.20	35.20	62.15	-35.94
	20 MHz	2120	2050	9.0	24.47	24.29	27.39	36.39	62.15	-34.76
		2132.5	2175	9.0	24.32	24.37	27.36	36.36	62.15	-34.79
		2145	2300	9.0	24.49	23.82	27.18	36.18	62.15	-34.97
Band 2	5 MHz	1932.5	625	9.0	23.13	23.42	26.29	35.29	62.15	-35.86
		1960	900	9.0	23.28	24.05	26.69	35.69	62.15	-35.46
		1987.5	1175	9.0	23.22	23.35	26.30	35.30	62.15	-35.85
	10MHz	1935	650	9.0	23.81	24.45	27.15	36.15	62.15	-35.00
		1960	900	9.0	24.32	24.4	27.37	36.37	62.15	-34.78
		1985	1150	9.0	23.96	24.37	27.18	36.18	62.15	-34.97
	15 MHz	1937.5	675	9.0	23.74	24.47	27.13	36.13	62.15	-35.02
		1960	900	9.0	24.21	24.13	27.18	36.18	62.15	-34.97
		1982.5	1125	9.0	24.10	24.04	27.08	36.08	62.15	-35.07
	20 MHz	1940	700	9.0	24.39	24.3	27.36	36.36	62.15	-34.79
		1960	900	9.0	24.33	24.01	27.18	36.18	62.15	-34.97
		1980	1100	9.0	24.28	24.04	27.17	36.17	62.15	-34.98

Table 7-25. EIRP (Total Power) Calculations (LTE Bands 2 and 4)

Note:

Per KDB 662911 v02r01 Section E)2), the output power at Chain0 and Chain1 were first measured separately. The measured values were then summed in linear power units then converted back to dBm.

Directional Gain = G_{ant} + $10\log_{10}(N_{ant})$ = 9dBi, where G_{ant} = 6dBi and N_{ant} = 2

7.4 Band Edge Emissions at Antenna Terminal

§2.1051, §24.238(a), §27.53(h)

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 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.

Test Procedure Used

KDB 971168 D01 v02r02 – Section 6.0
KDB 662911 D01 v02r01 – Section E)3)a)iii)

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.

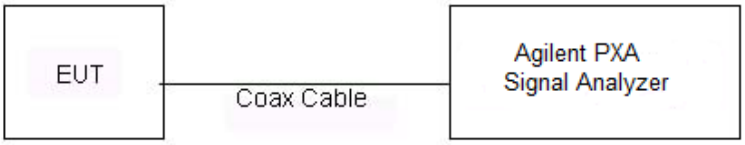


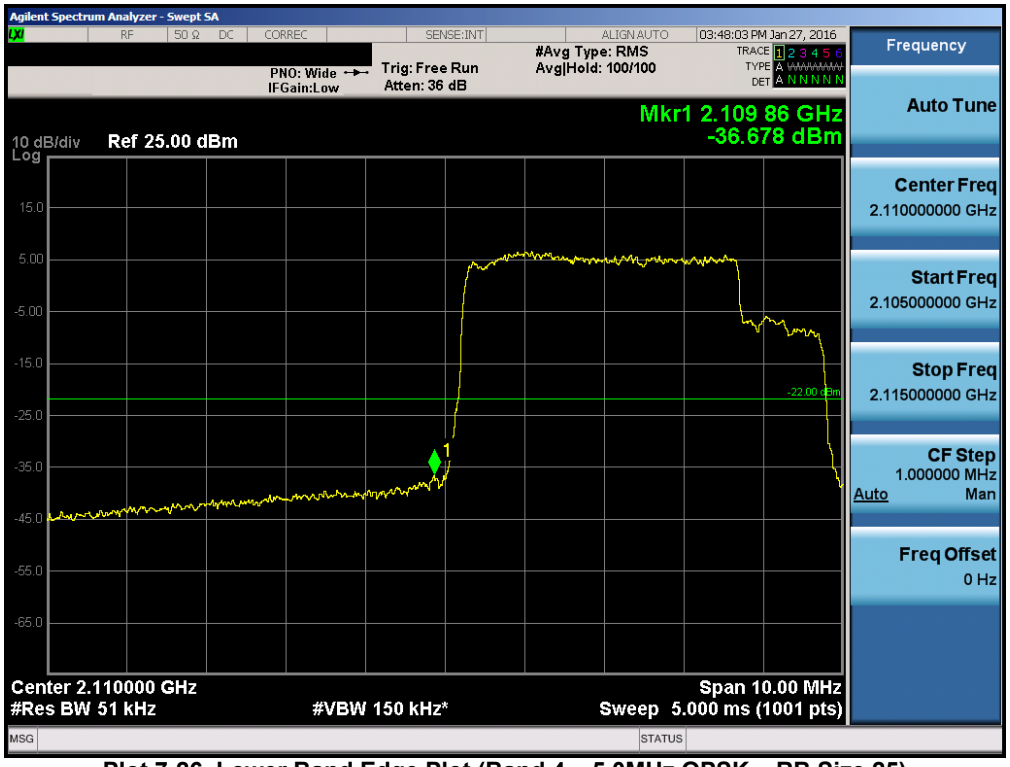
Figure 7-3. Test Instrument & Measurement Setup

Test Notes

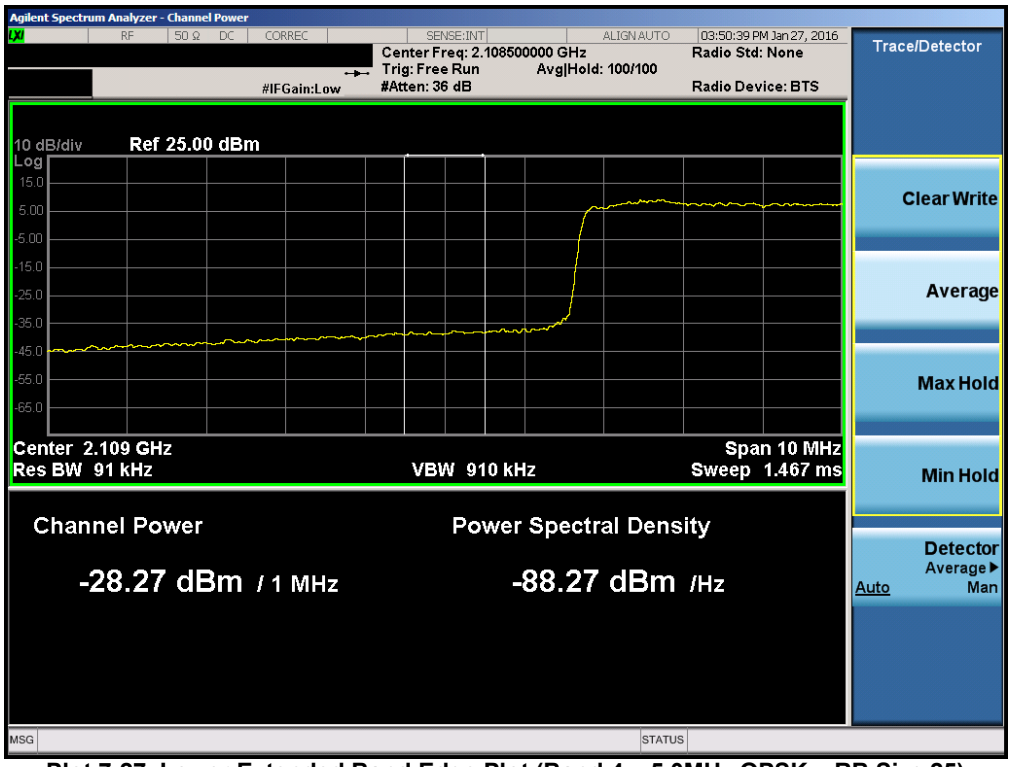
1. Per 24.238(a) and 27.53(h), in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. 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. Per 24.238(a) and 27.53(h), the spurious emission limit is -13dBm. Since this device transmits from two antennas simultaneously, applying the "Measure and add 10 log(N_{ant}) dB", where N_{ant} = 2, guidance from KDB 662911 D01 v02r01 yields an additional correction to the limit of -3dB. The correct out of band conducted emission limit is -13dBm + (-3dB) = **-16dBm**.

Chain0

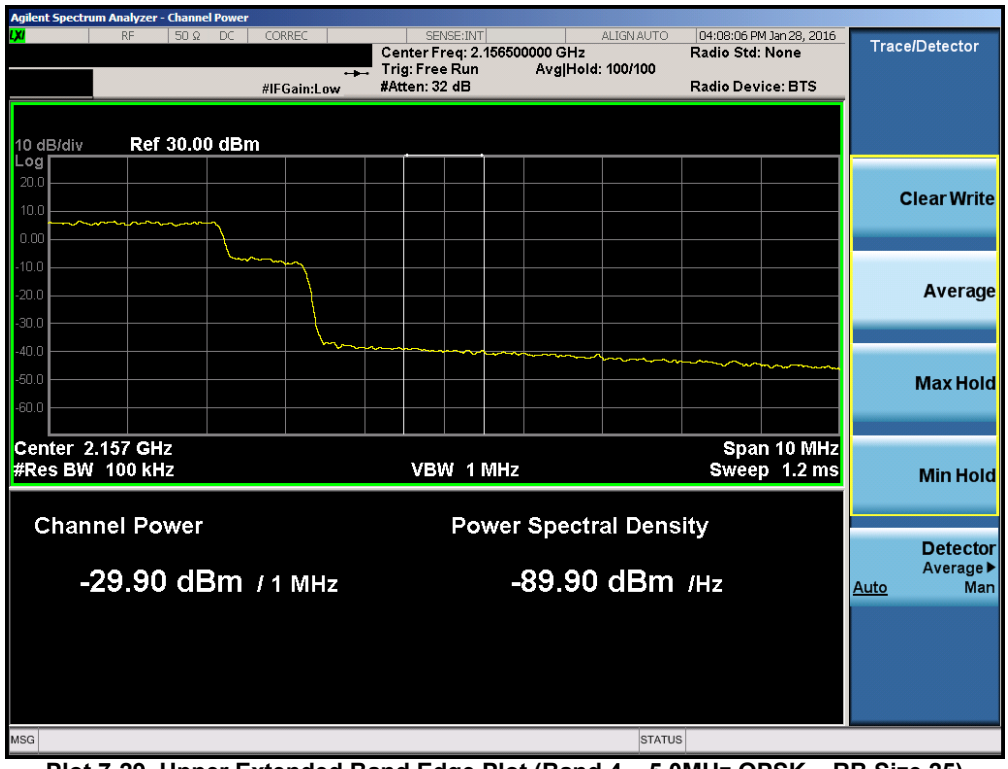


Plot 7-26. Lower Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

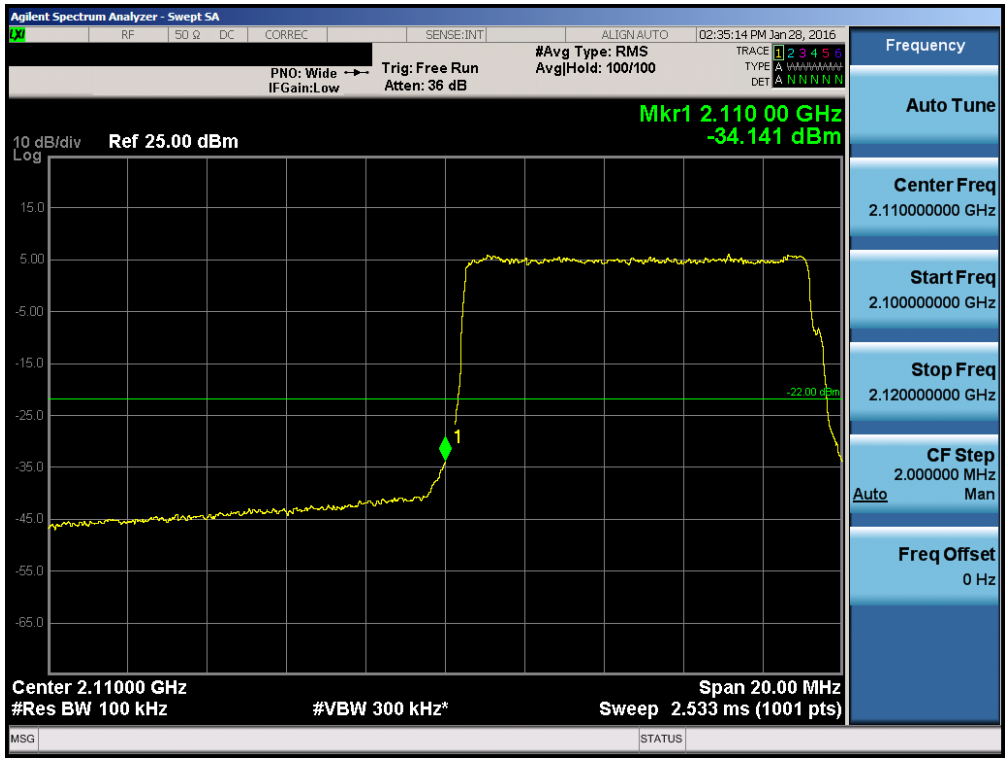


Plot 7-27. Lower Extended Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

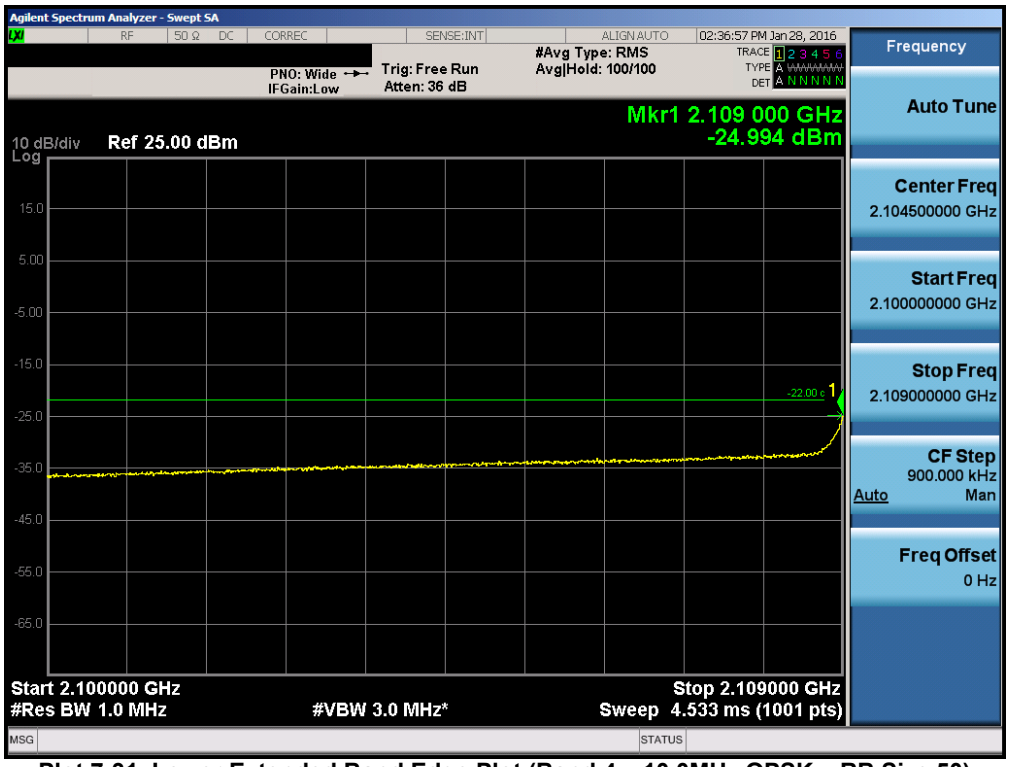
Plot 7-28. Upper Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)



Plot 7-29. Upper Extended Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

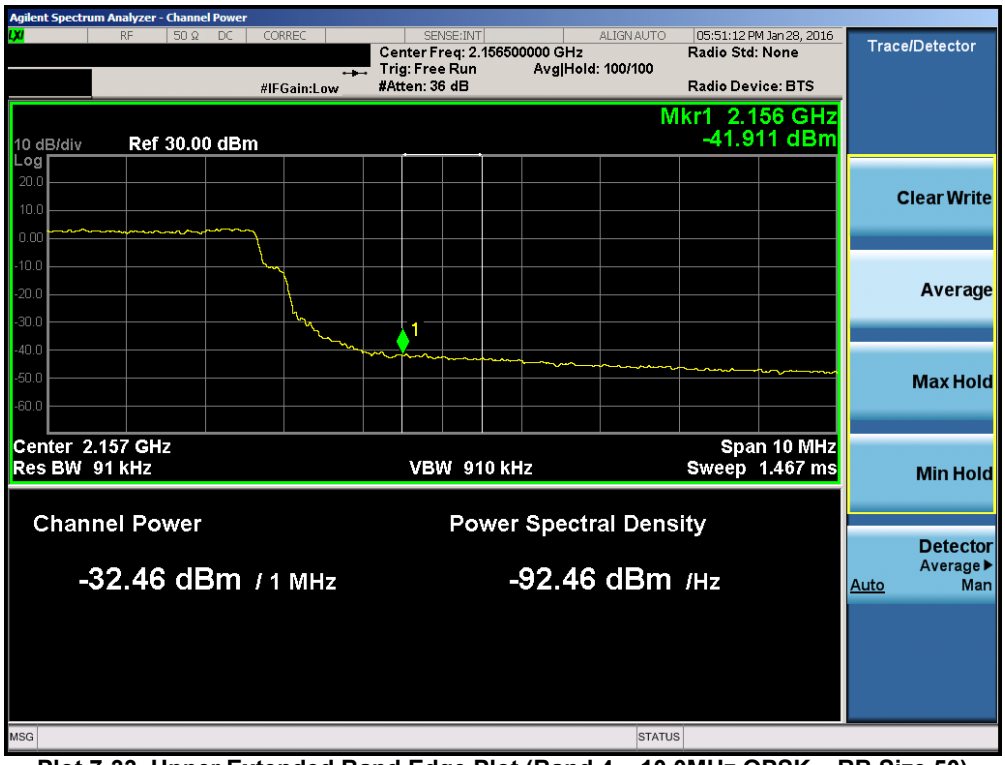


Plot 7-30. Lower Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

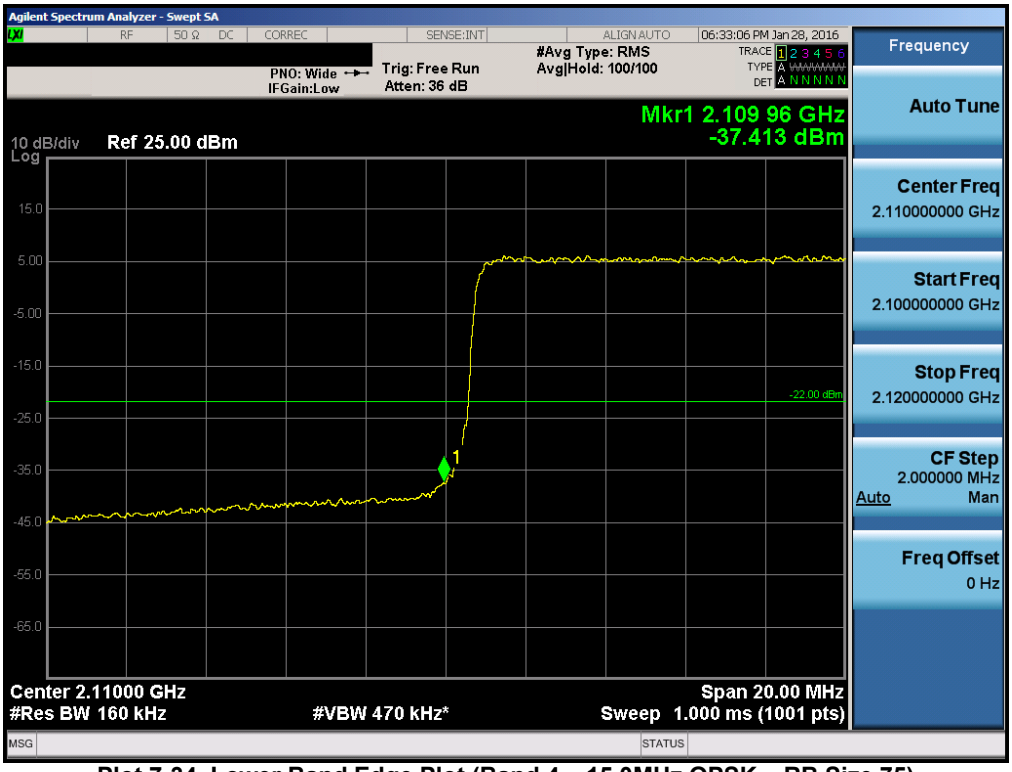


Plot 7-31. Lower Extended Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

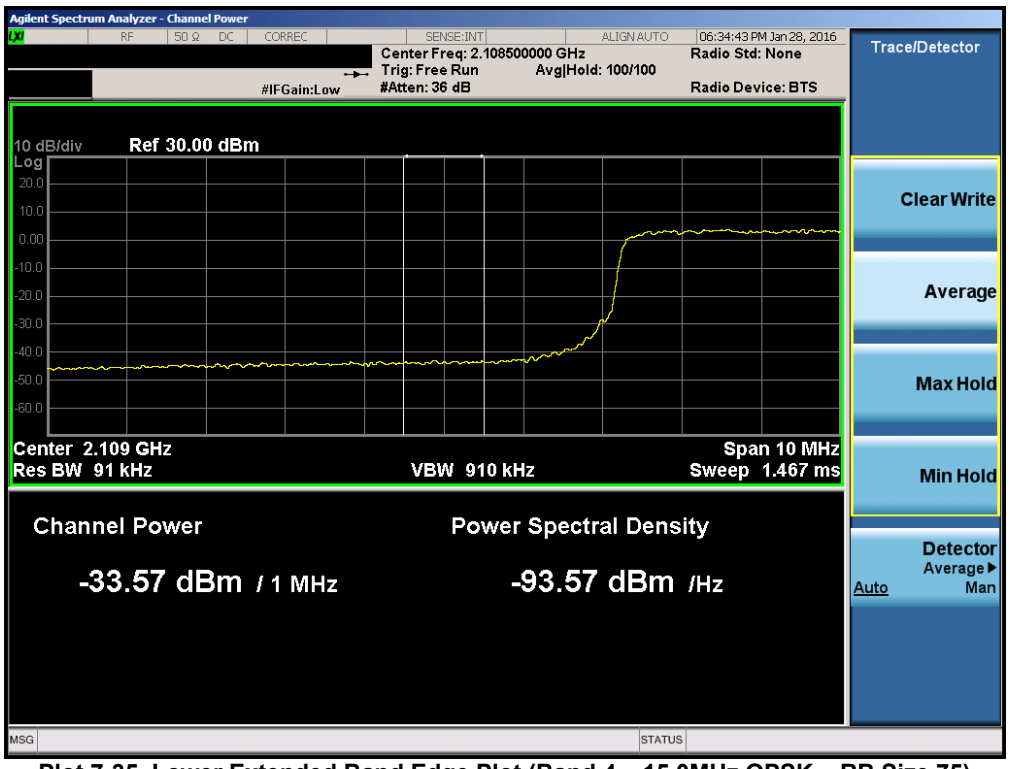
Plot 7-32. Upper Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)



Plot 7-33. Upper Extended Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

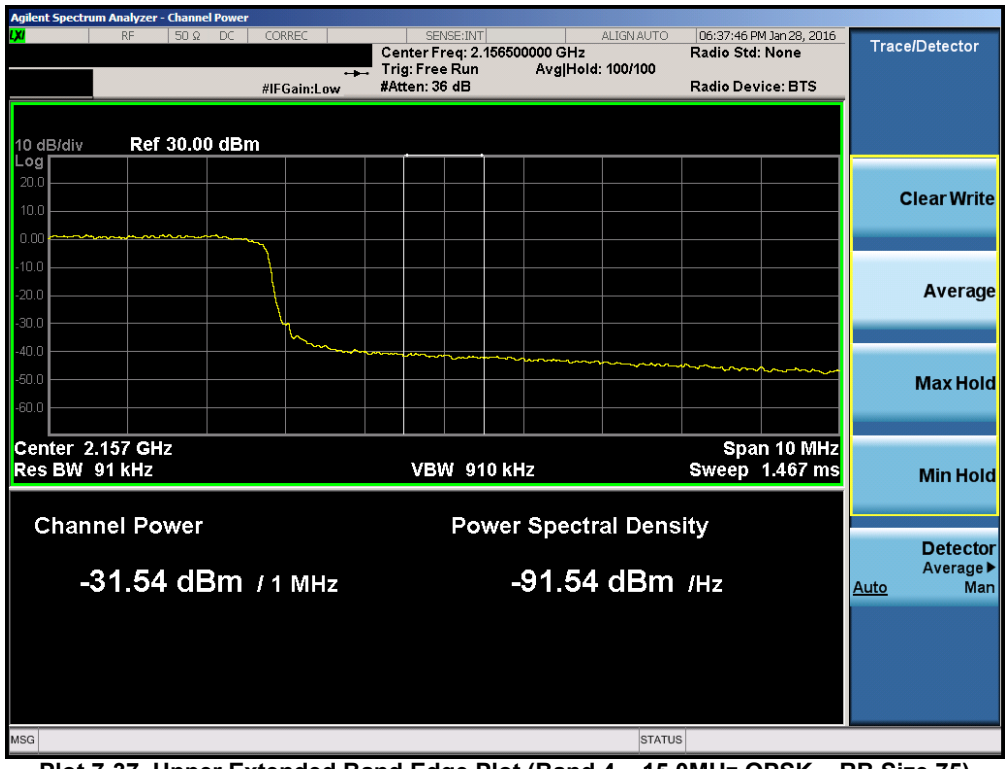


Plot 7-34. Lower Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)

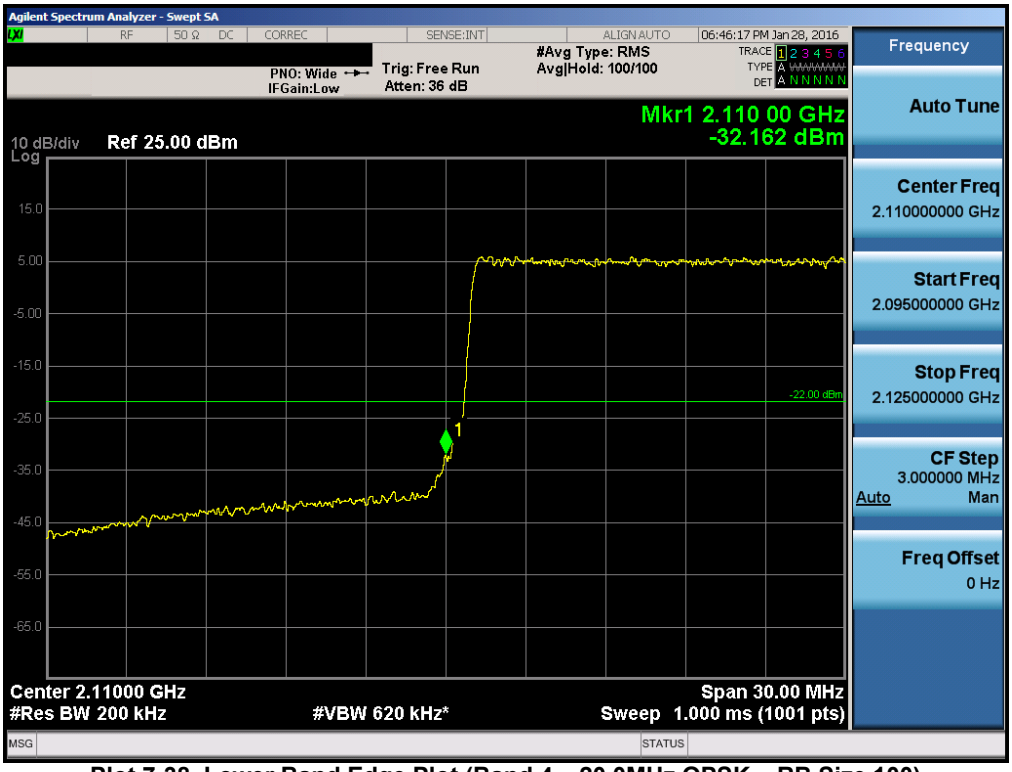


Plot 7-35. Lower Extended Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)

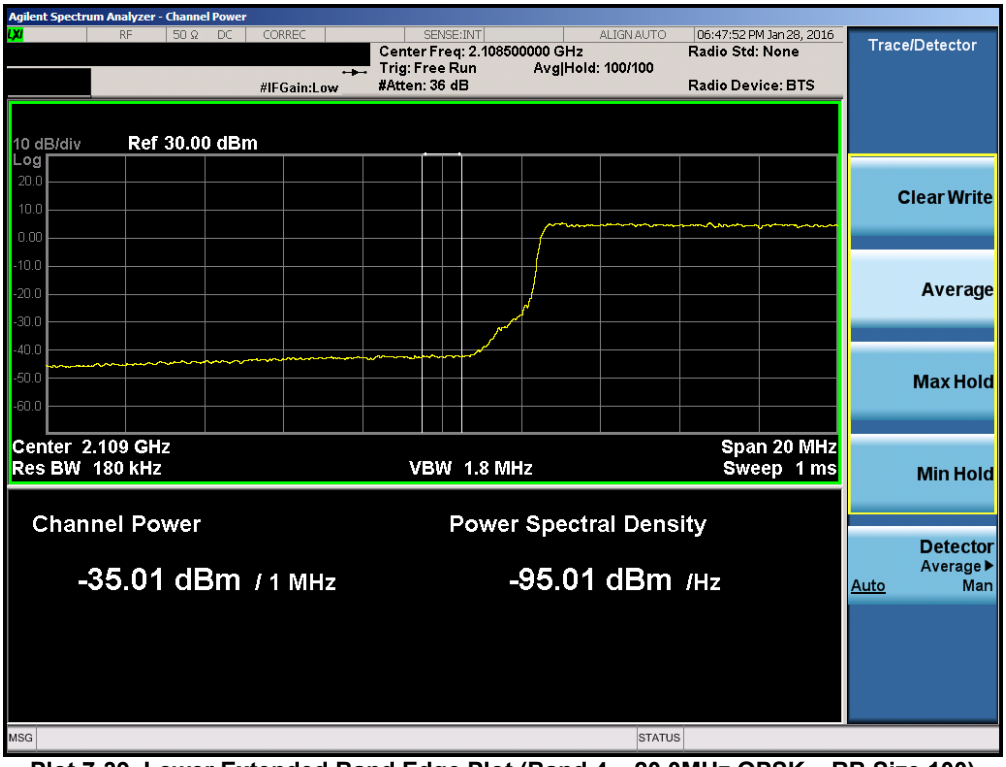
Plot 7-36. Upper Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



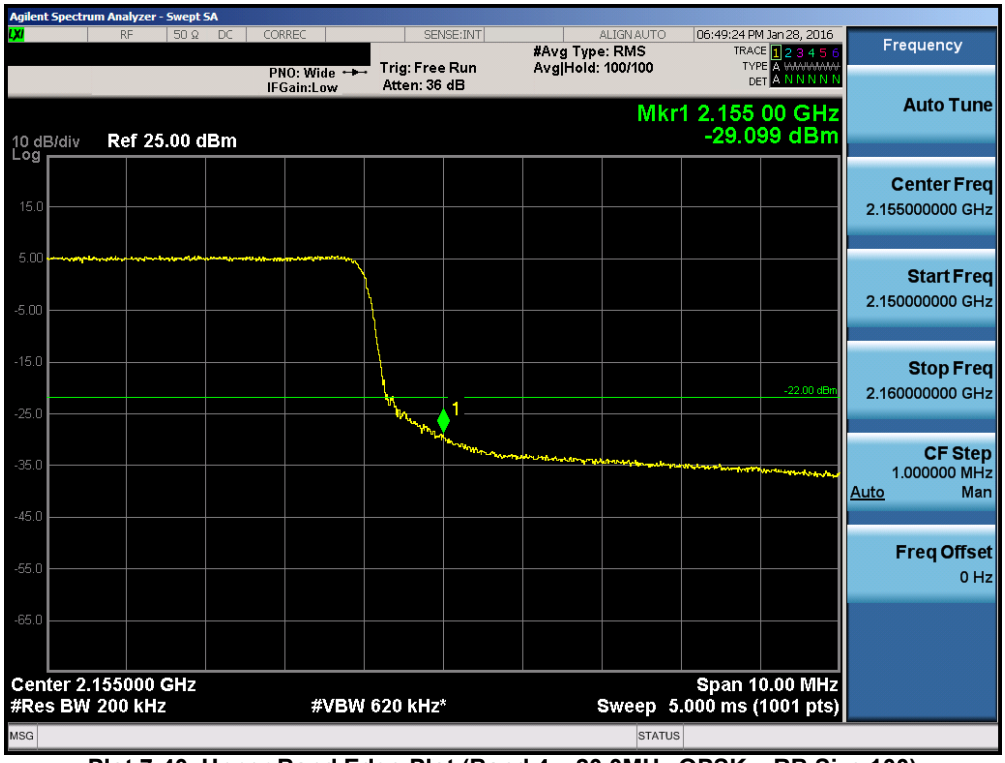
Plot 7-37. Upper Extended Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



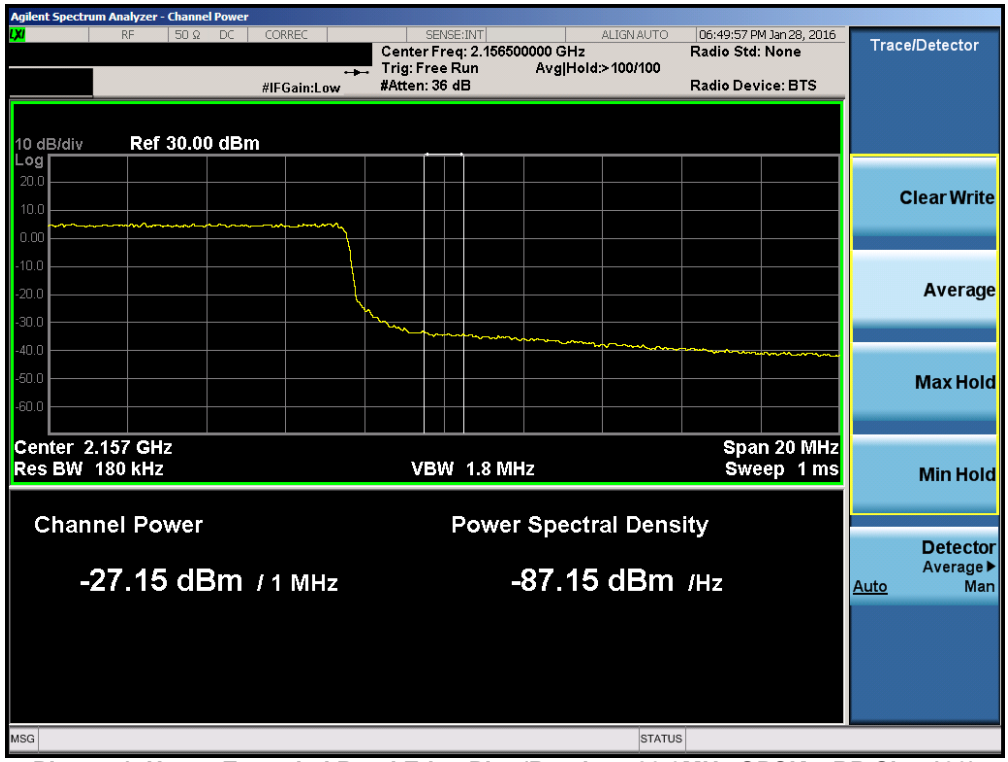
Plot 7-38. Lower Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



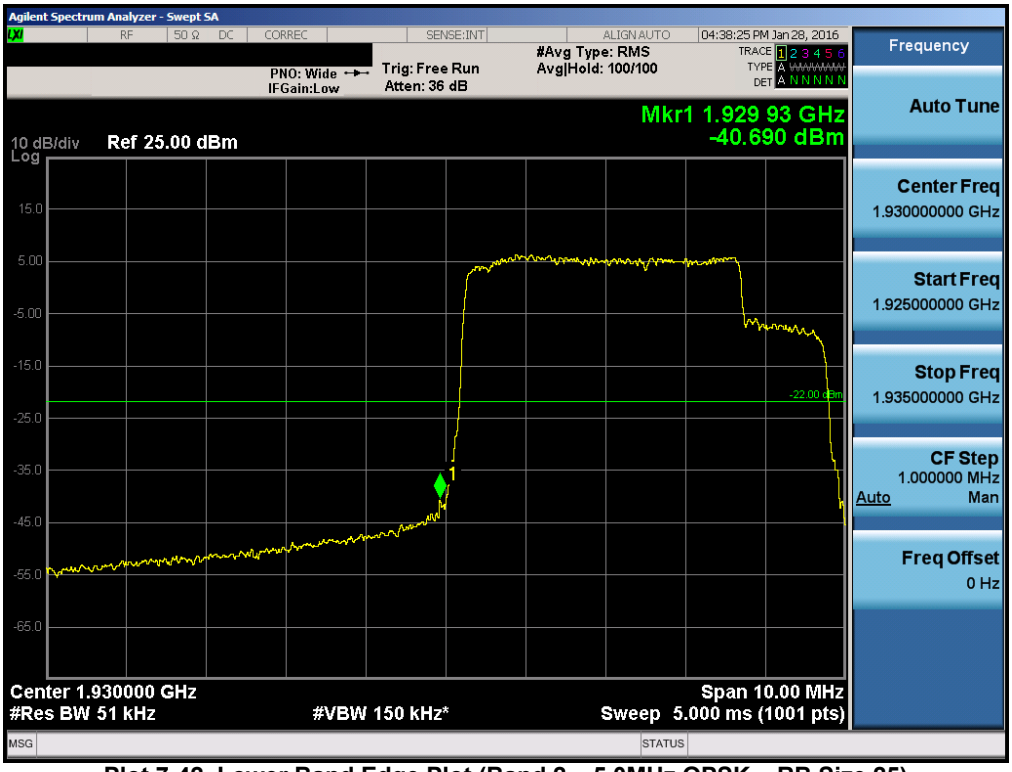
Plot 7-39. Lower Extended Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



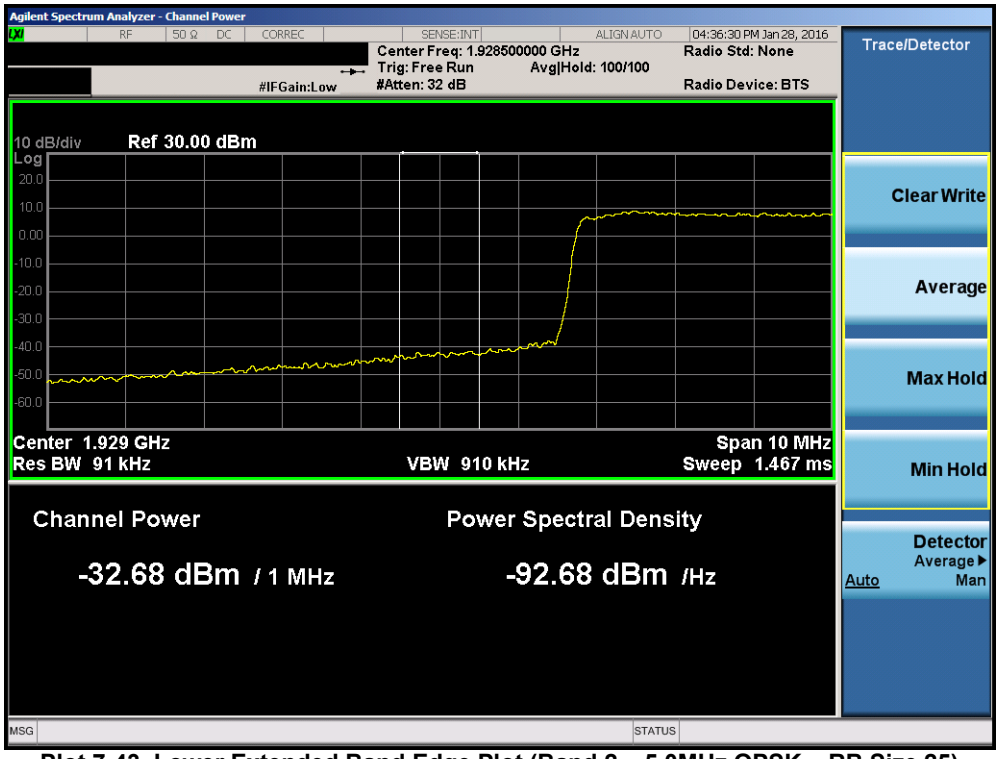
Plot 7-40. Upper Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



Plot 7-41. Upper Extended Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)

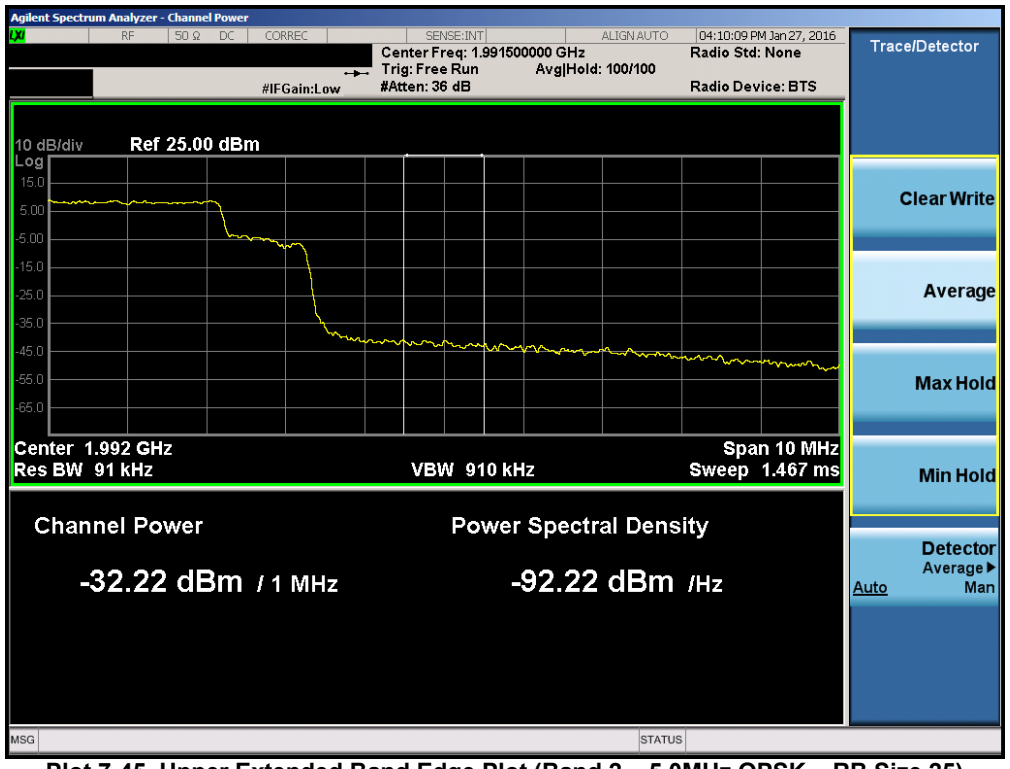


Plot 7-42. Lower Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)

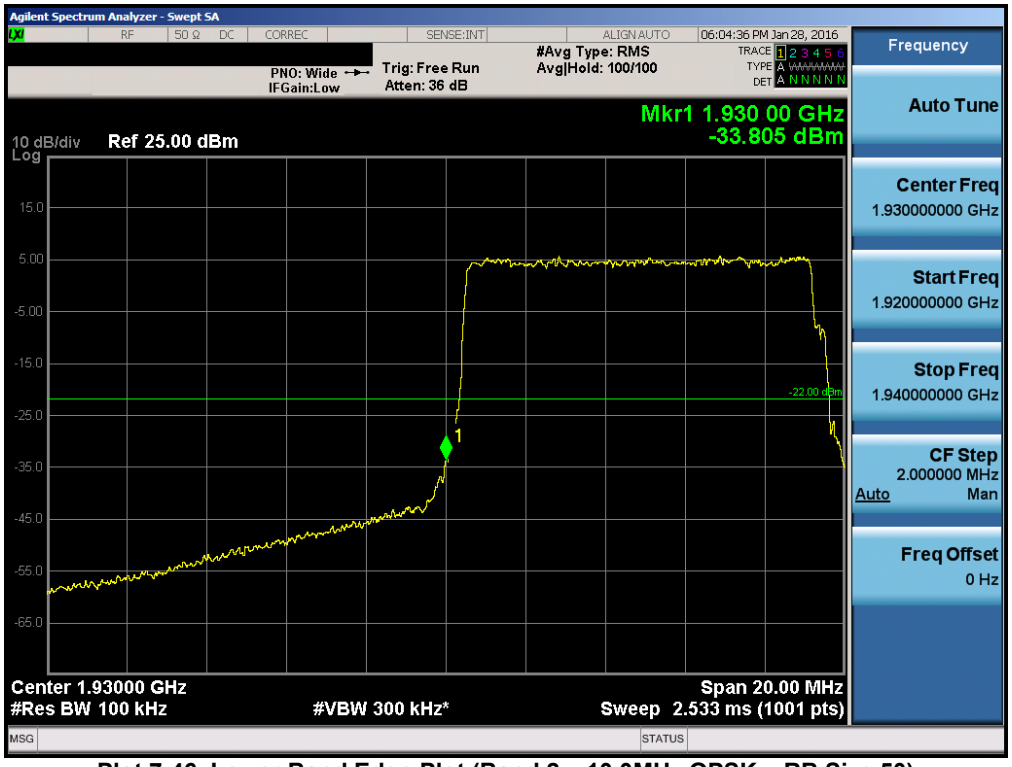


Plot 7-43. Lower Extended Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)

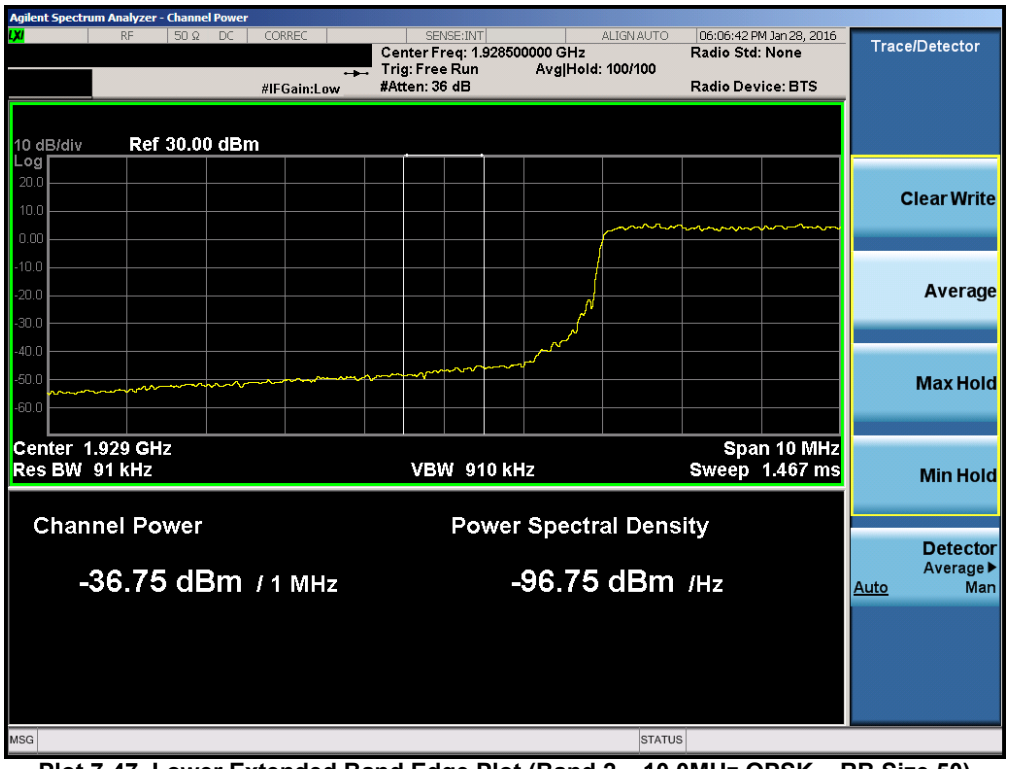
Plot 7-44. Upper Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



Plot 7-45. Upper Extended Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)

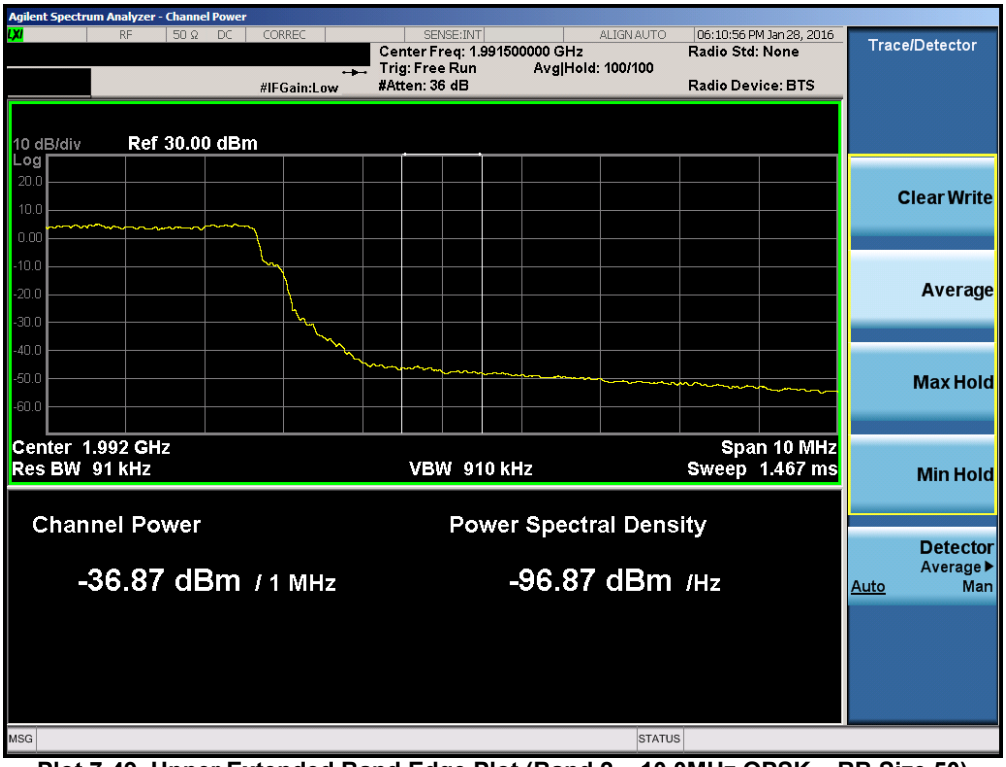


Plot 7-46. Lower Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)

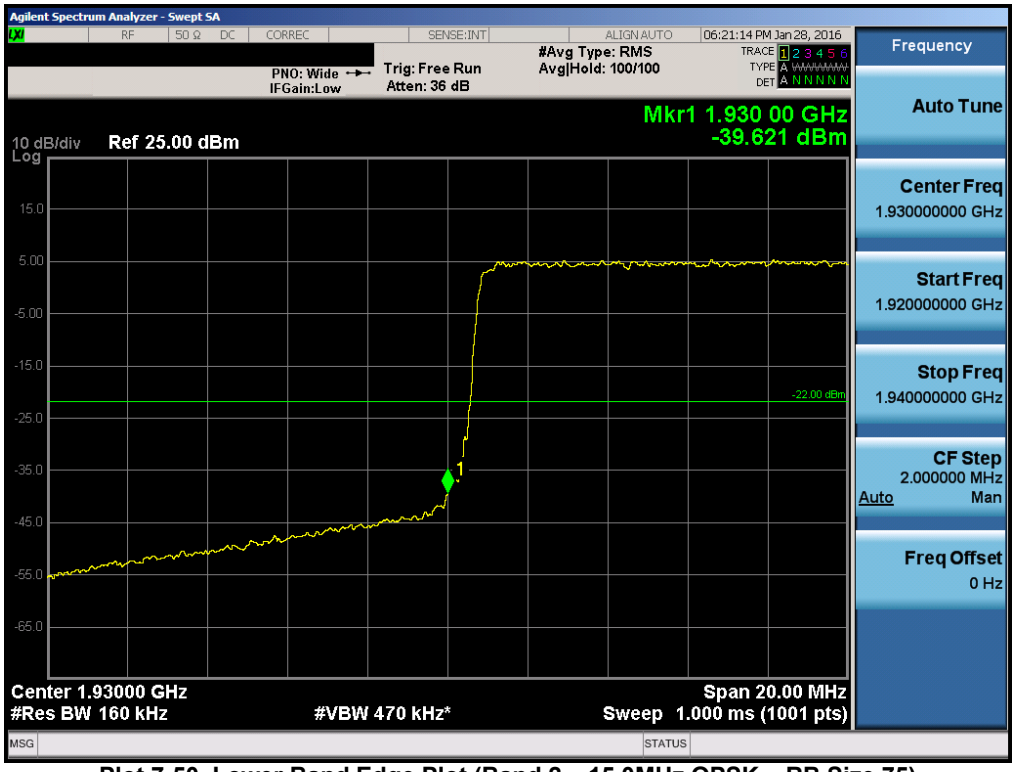


Plot 7-47. Lower Extended Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)

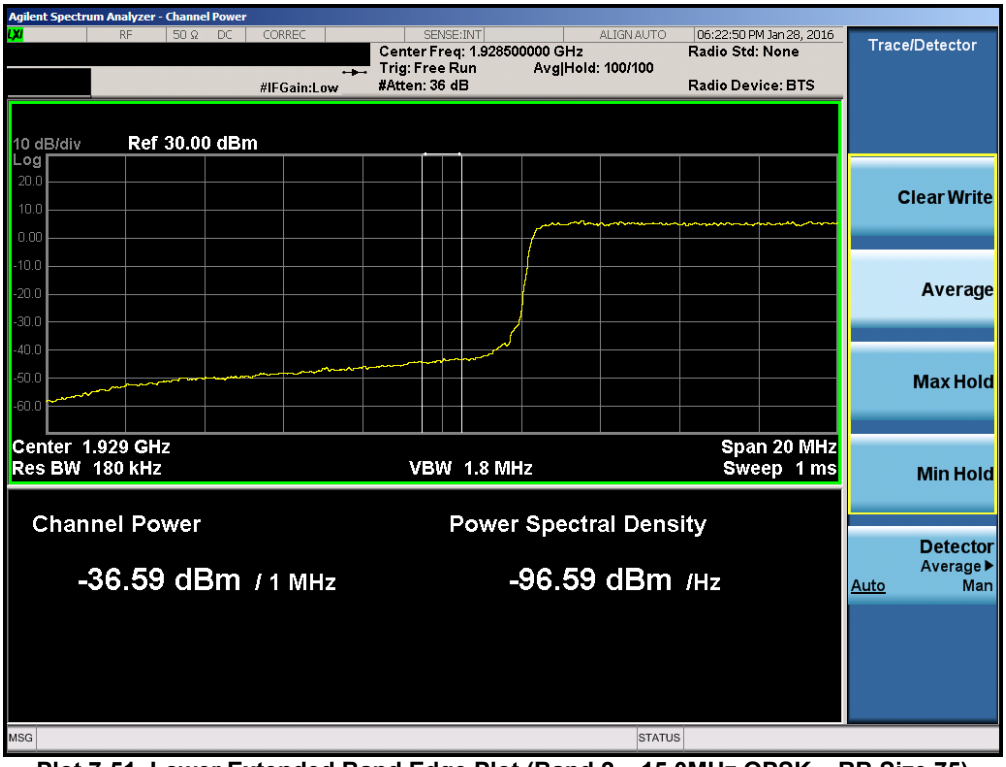
Plot 7-48. Upper Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



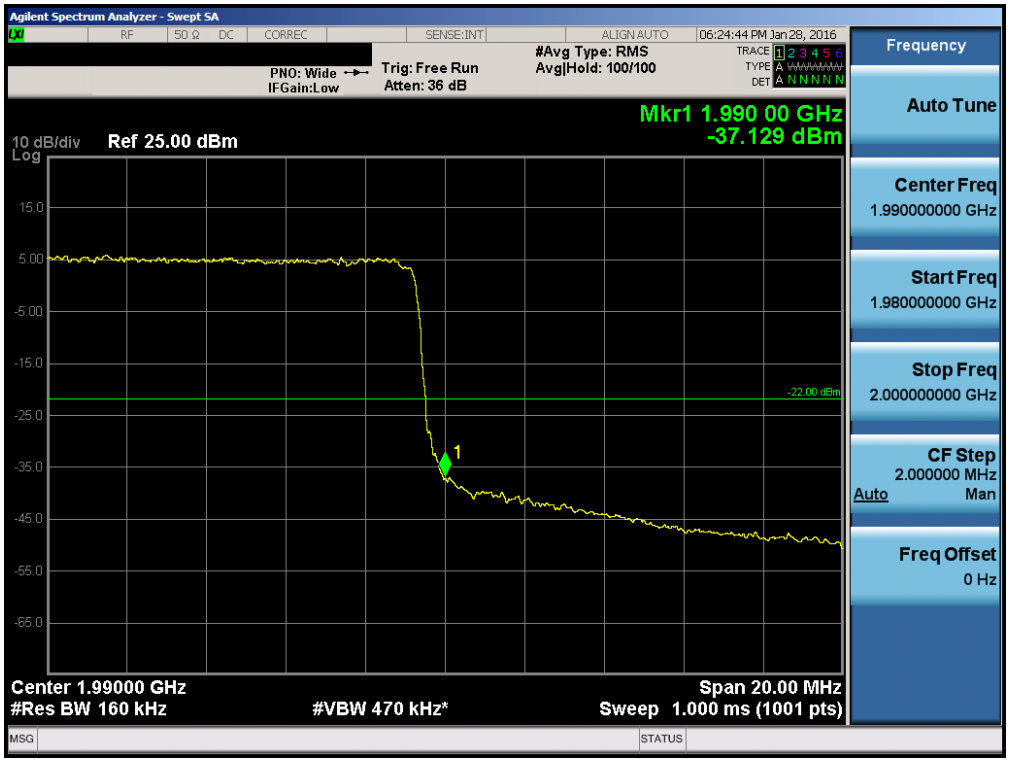
Plot 7-49. Upper Extended Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



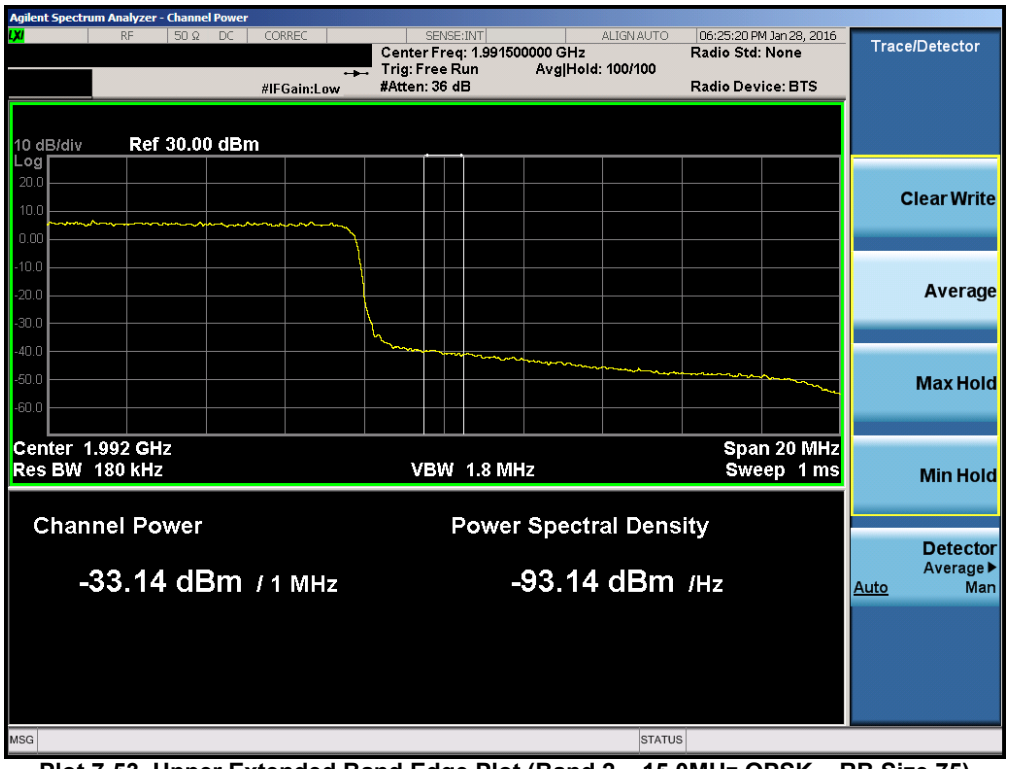
Plot 7-50. Lower Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



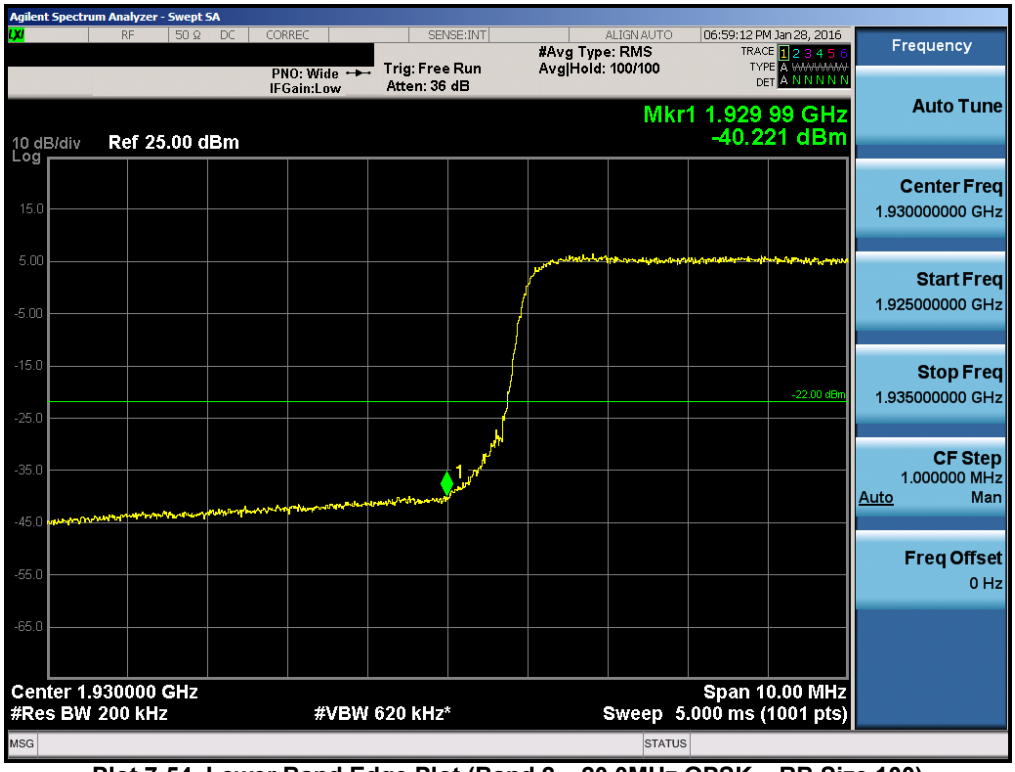
Plot 7-51. Lower Extended Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



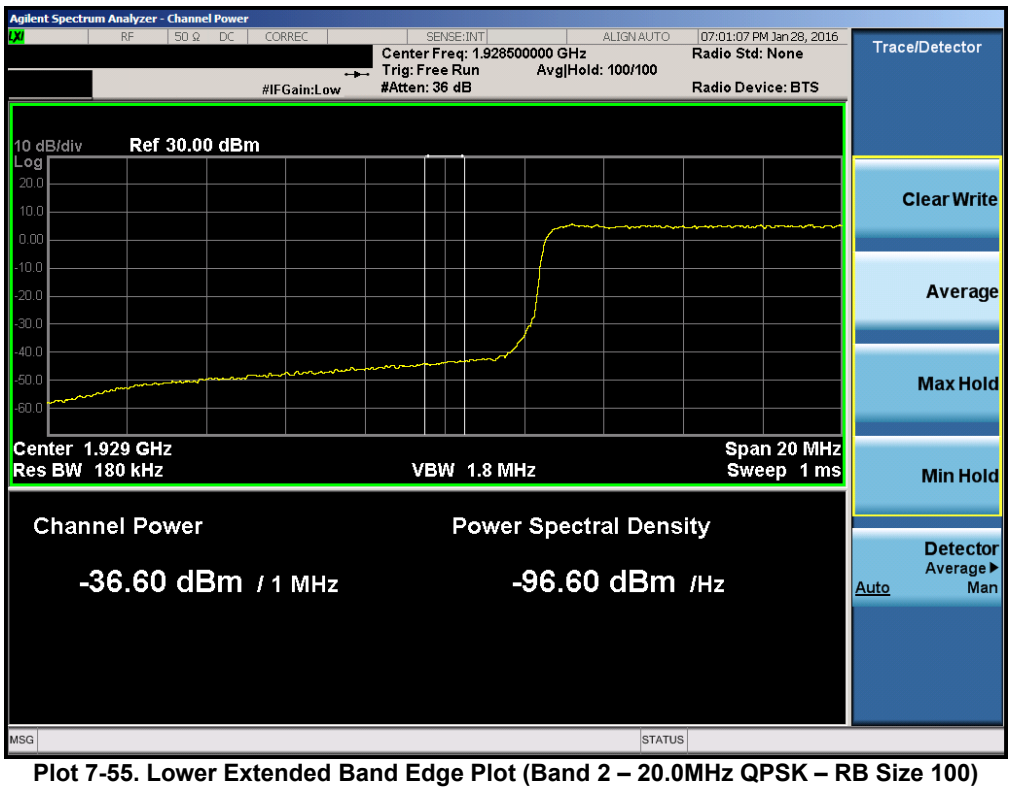
Plot 7-52. Upper Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



Plot 7-53. Upper Extended Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)

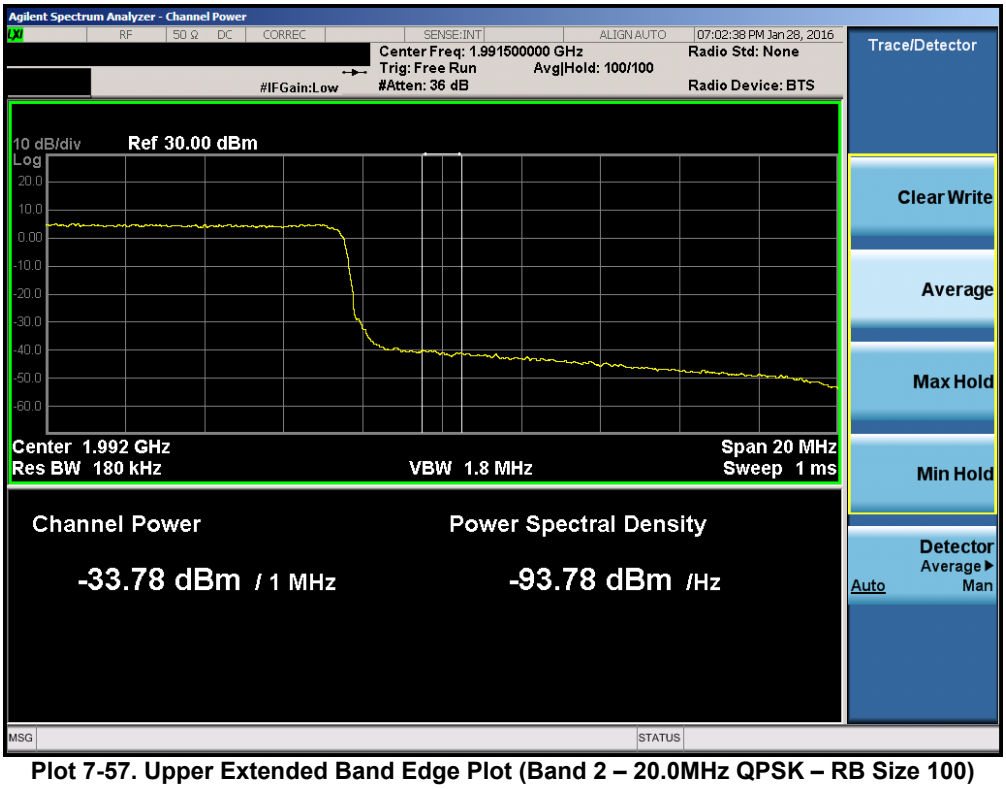


Plot 7-54. Lower Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)



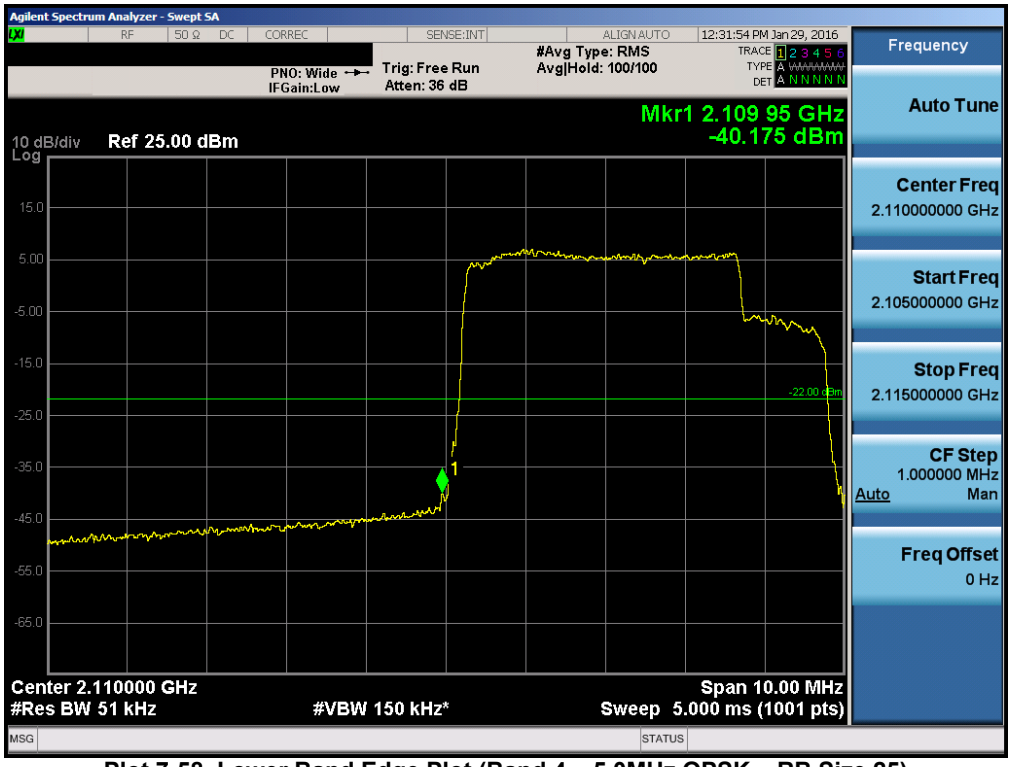
Plot 7-55. Lower Extended Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

Plot 7-56. Upper Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

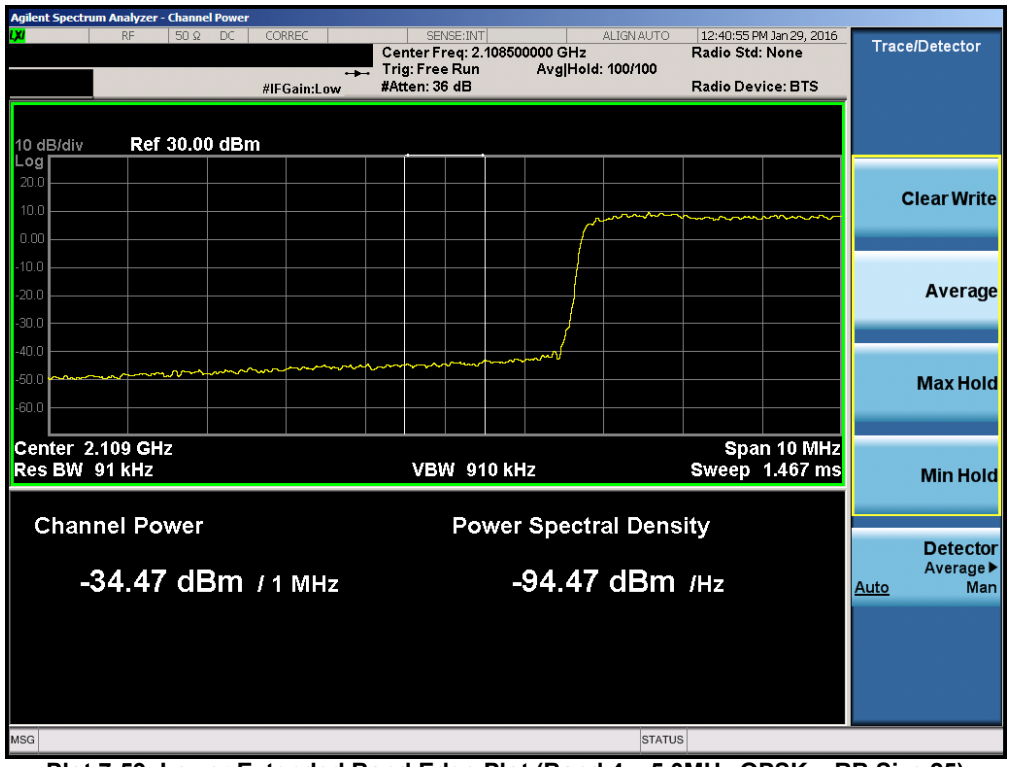


Plot 7-57. Upper Extended Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

Chain1

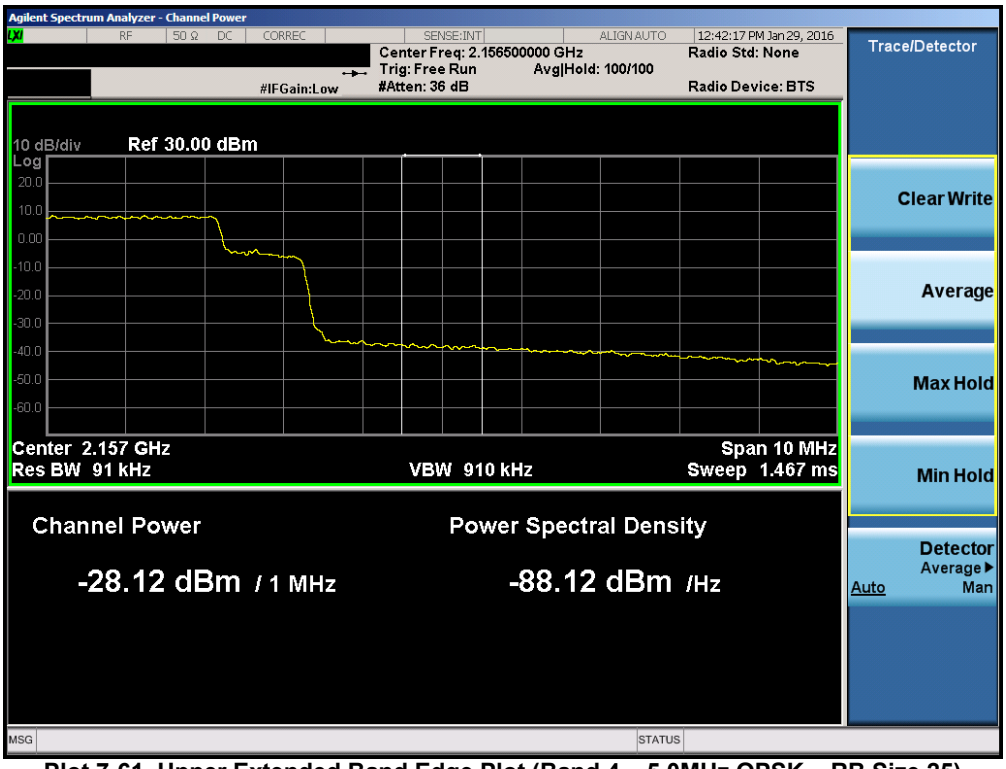


Plot 7-58. Lower Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

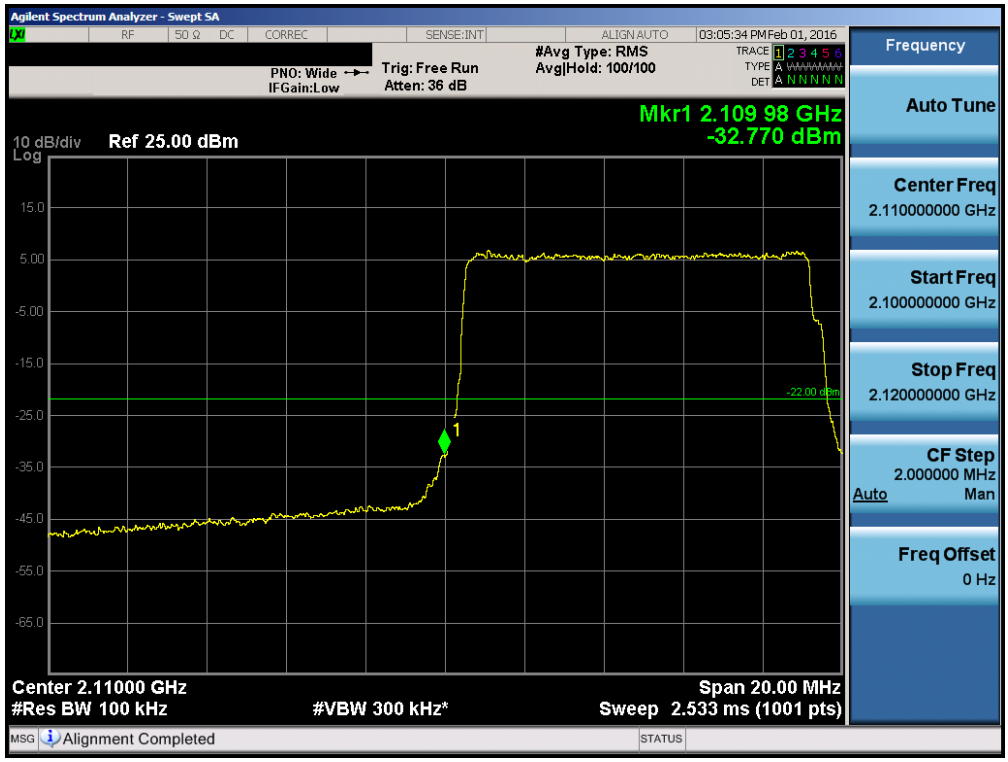


Plot 7-59. Lower Extended Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

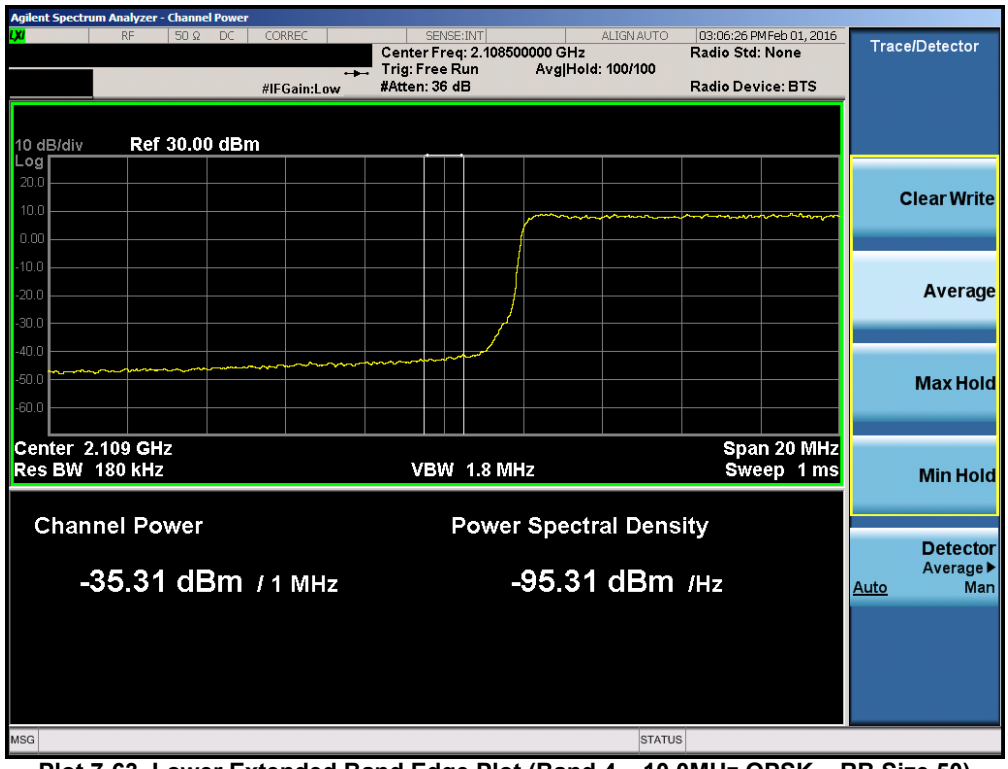
Plot 7-60. Upper Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)



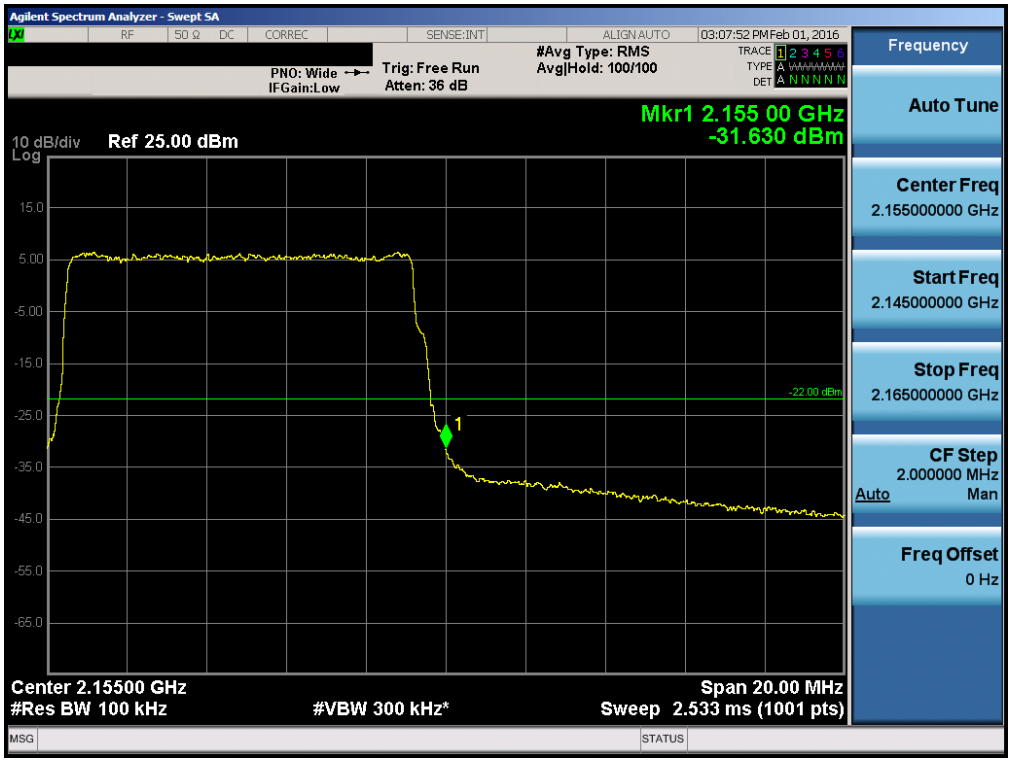
Plot 7-61. Upper Extended Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)



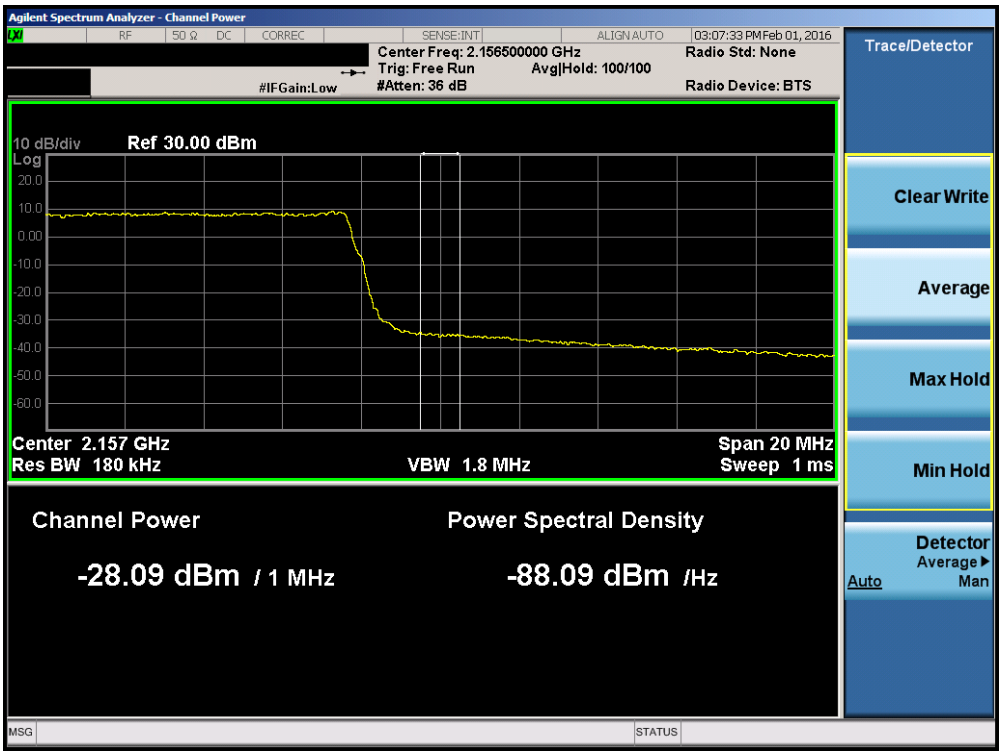
Plot 7-62. Lower Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)



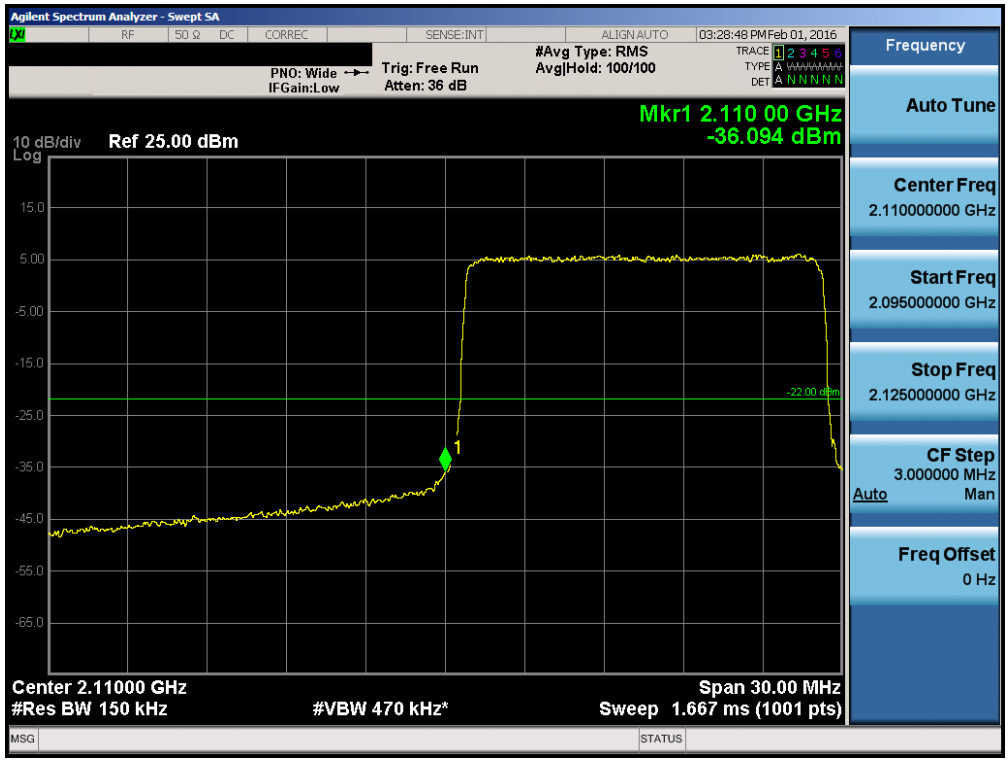
Plot 7-63. Lower Extended Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)



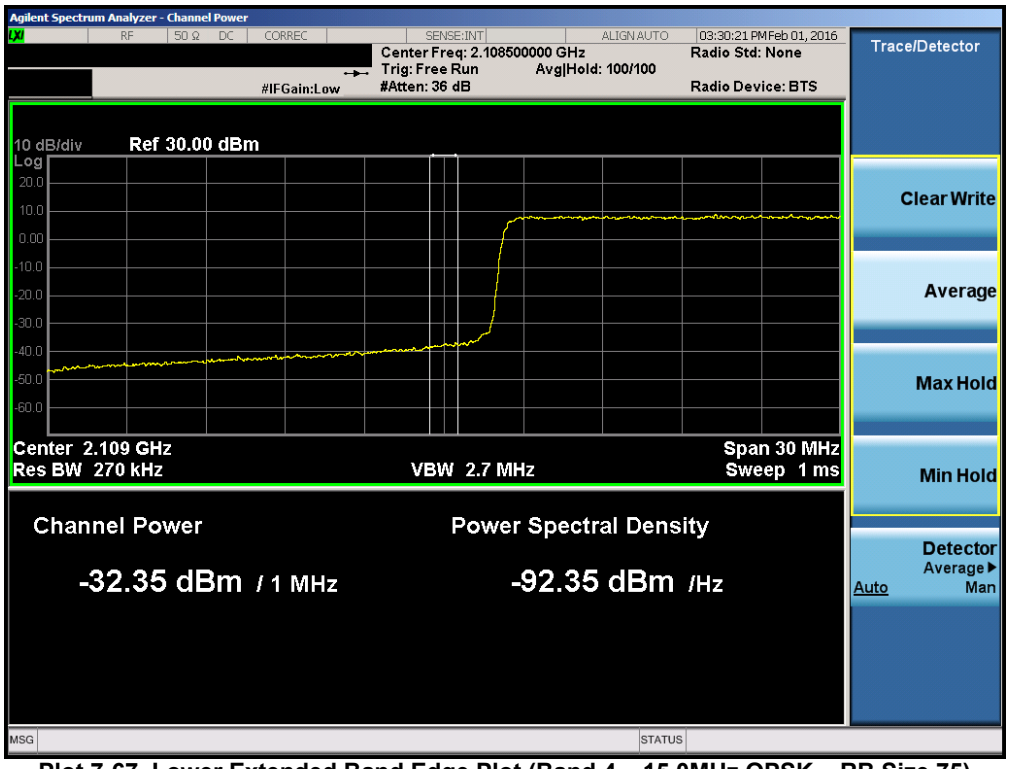
Plot 7-64. Upper Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)



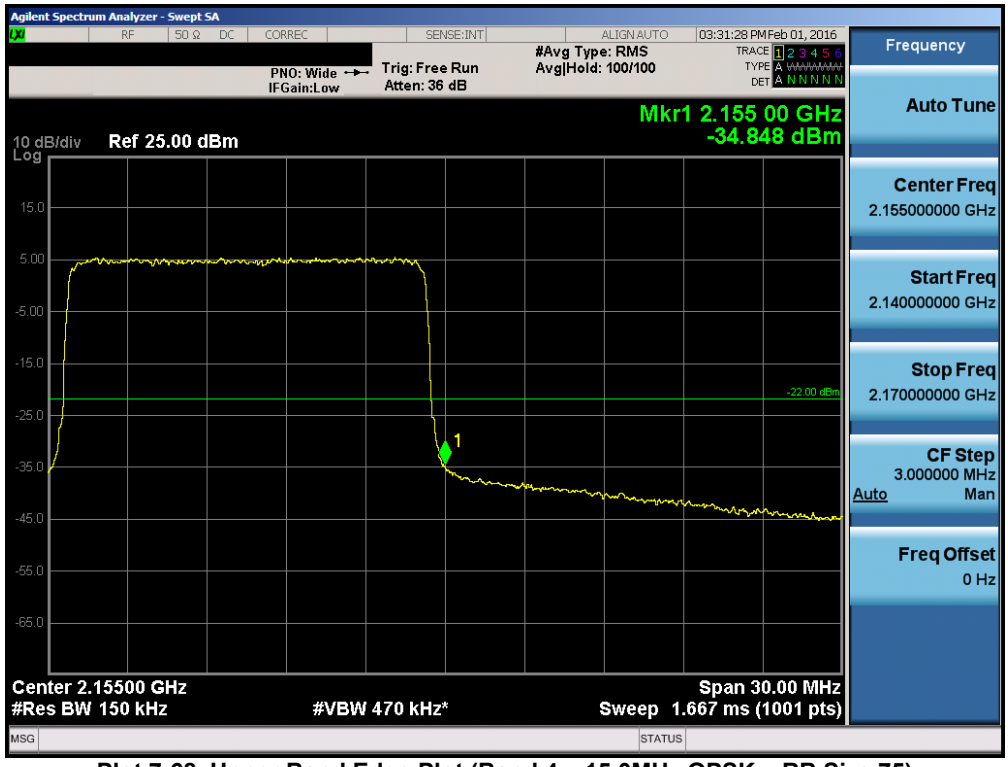
Plot 7-65. Upper Extended Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)



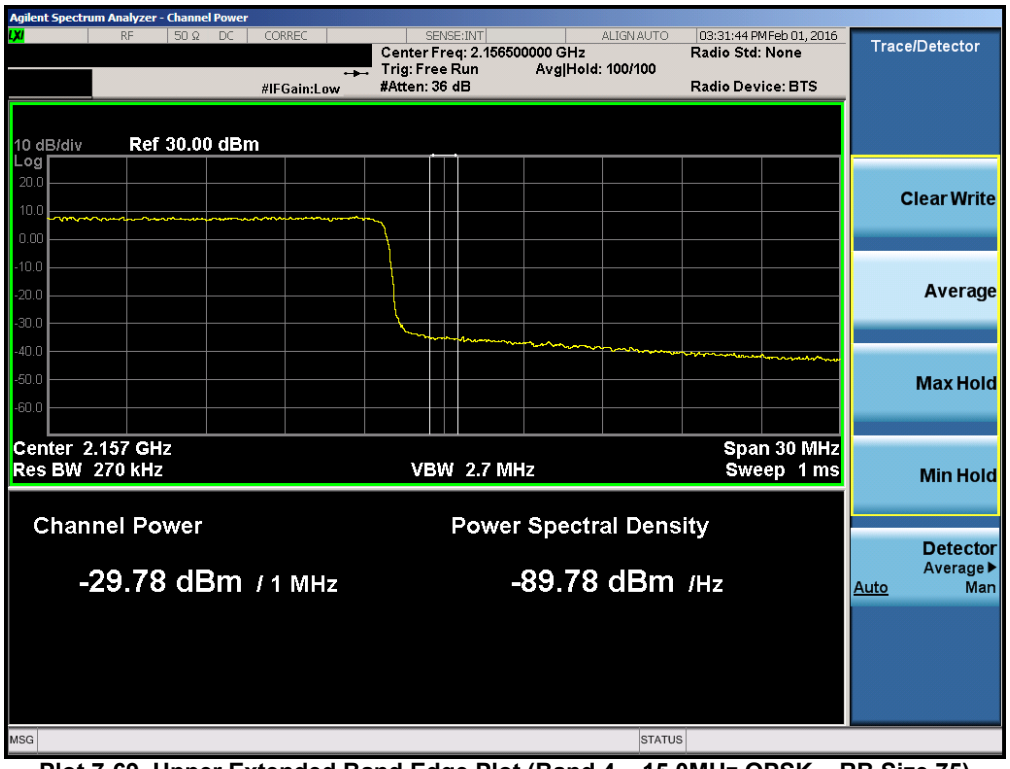
Plot 7-66. Lower Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



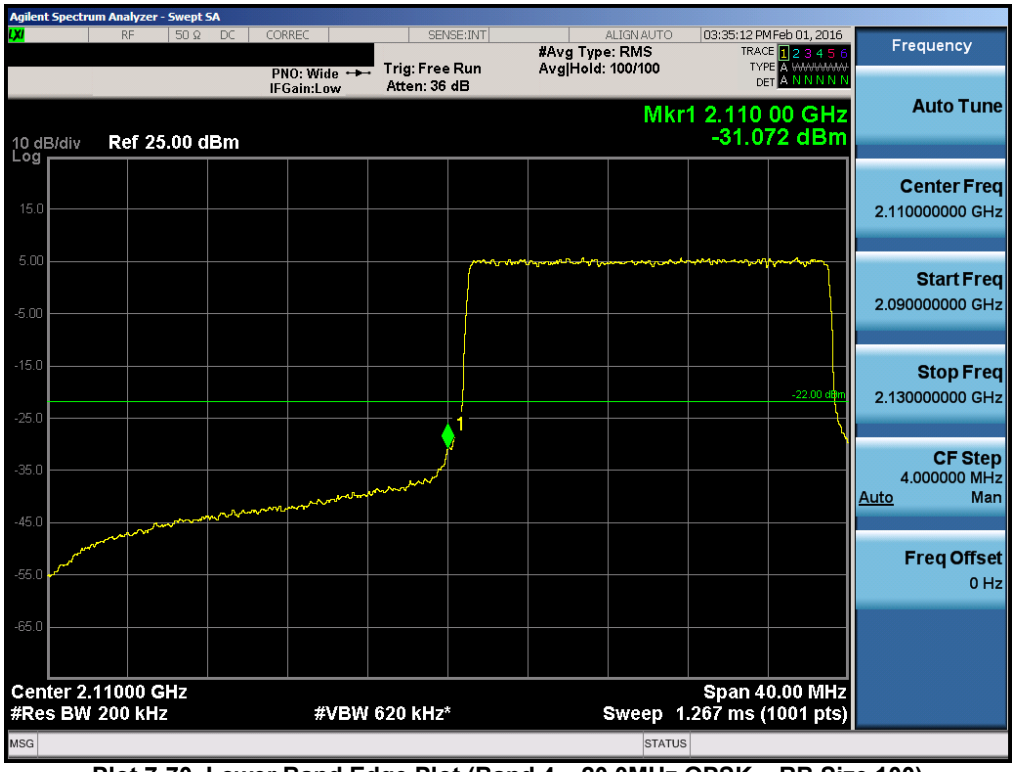
Plot 7-67. Lower Extended Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



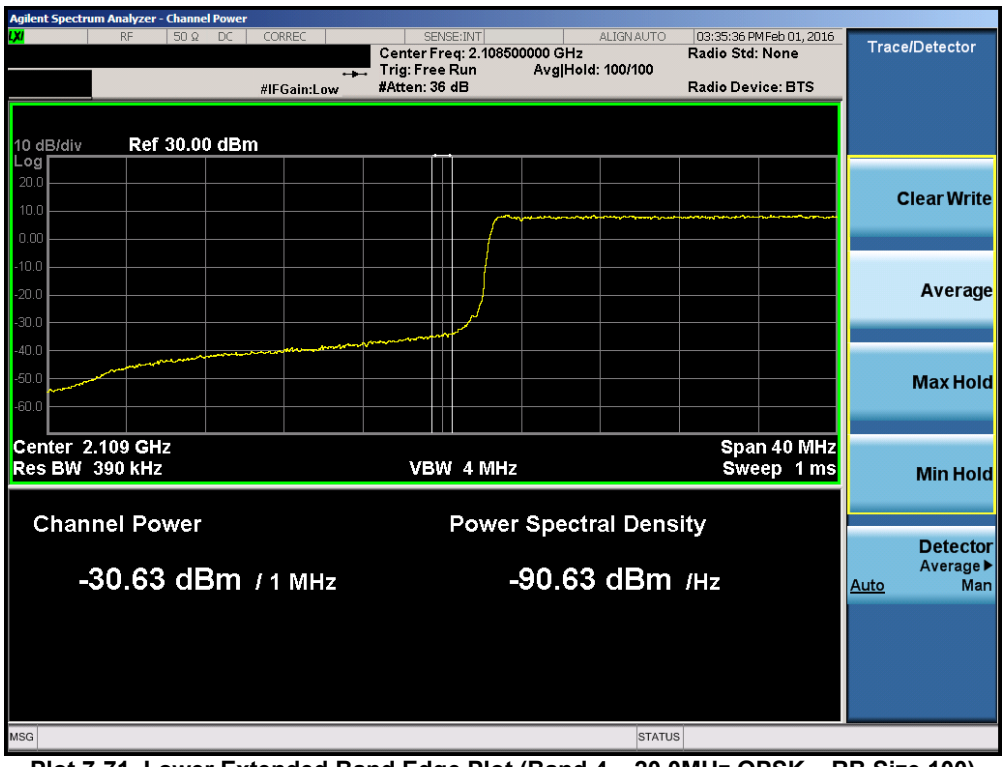
Plot 7-68. Upper Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



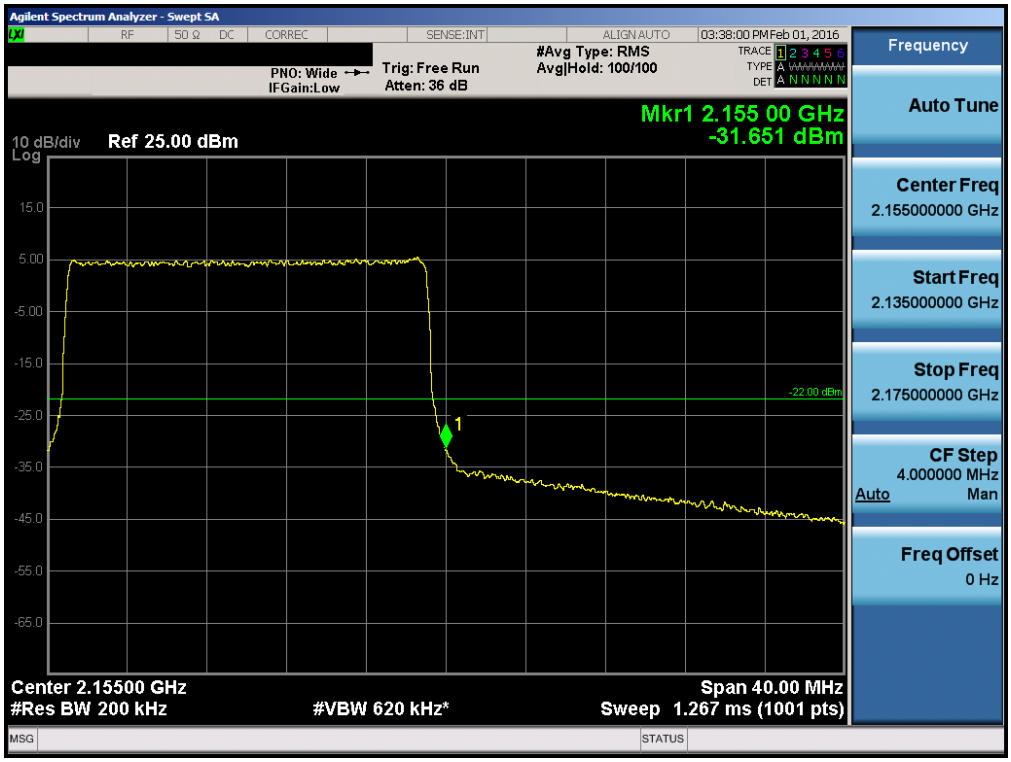
Plot 7-69. Upper Extended Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



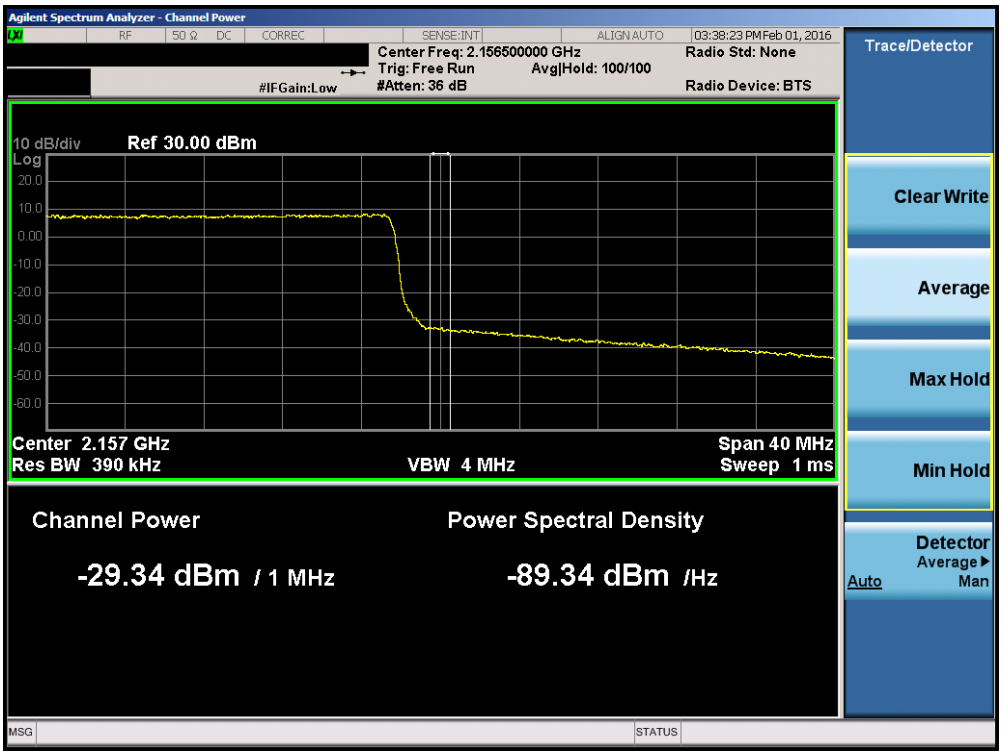
Plot 7-70. Lower Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



Plot 7-71. Lower Extended Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)

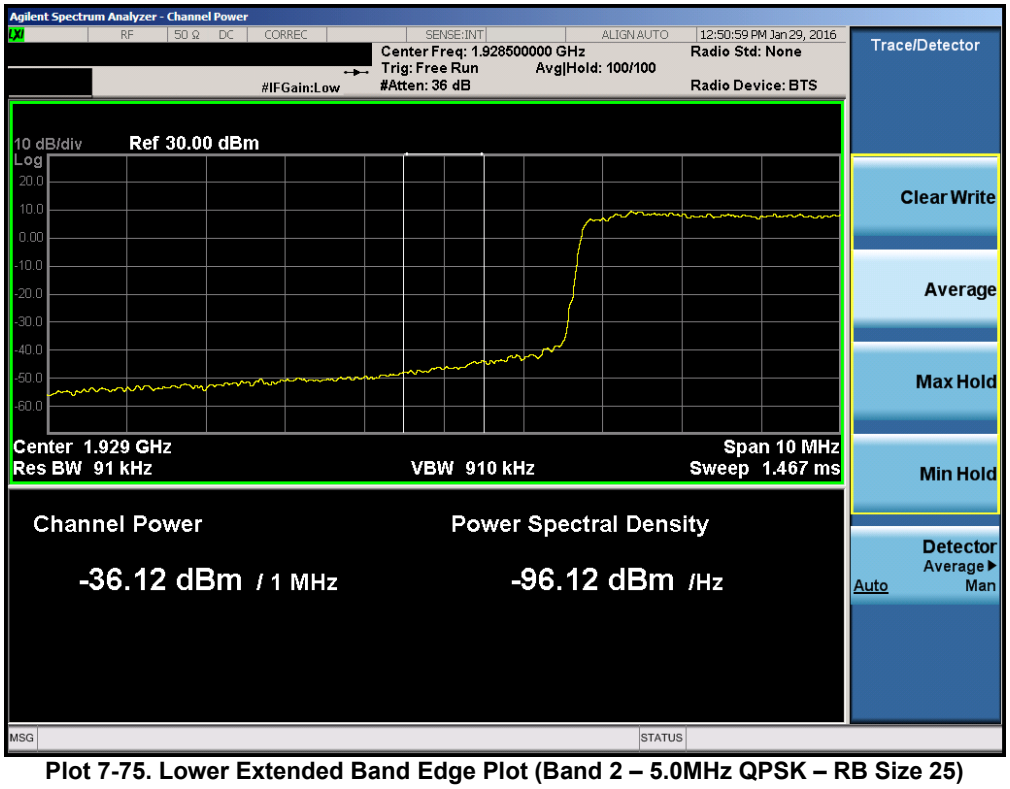


Plot 7-72. Upper Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



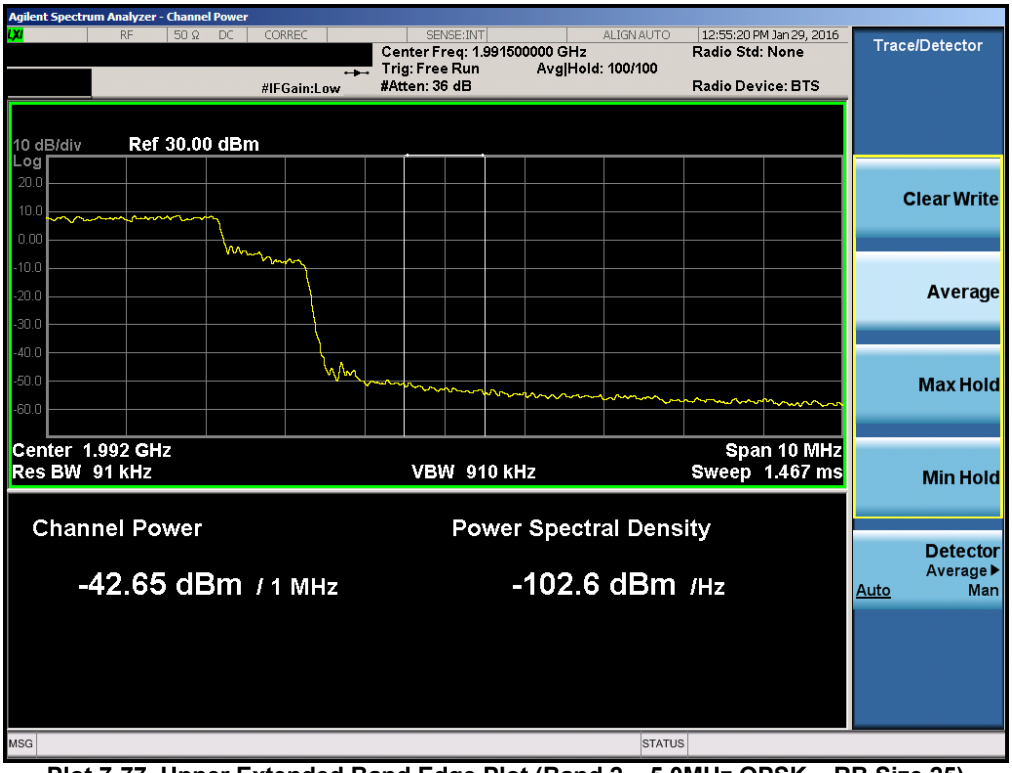
Plot 7-73. Upper Extended Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)

Plot 7-74. Lower Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)

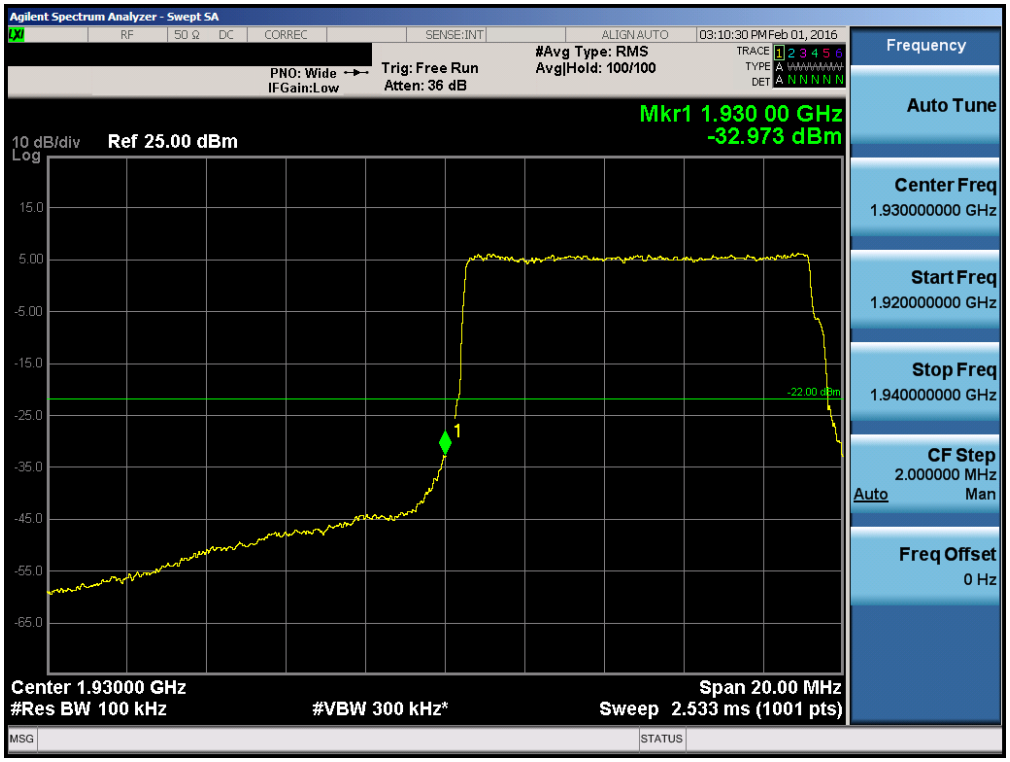


Plot 7-75. Lower Extended Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)

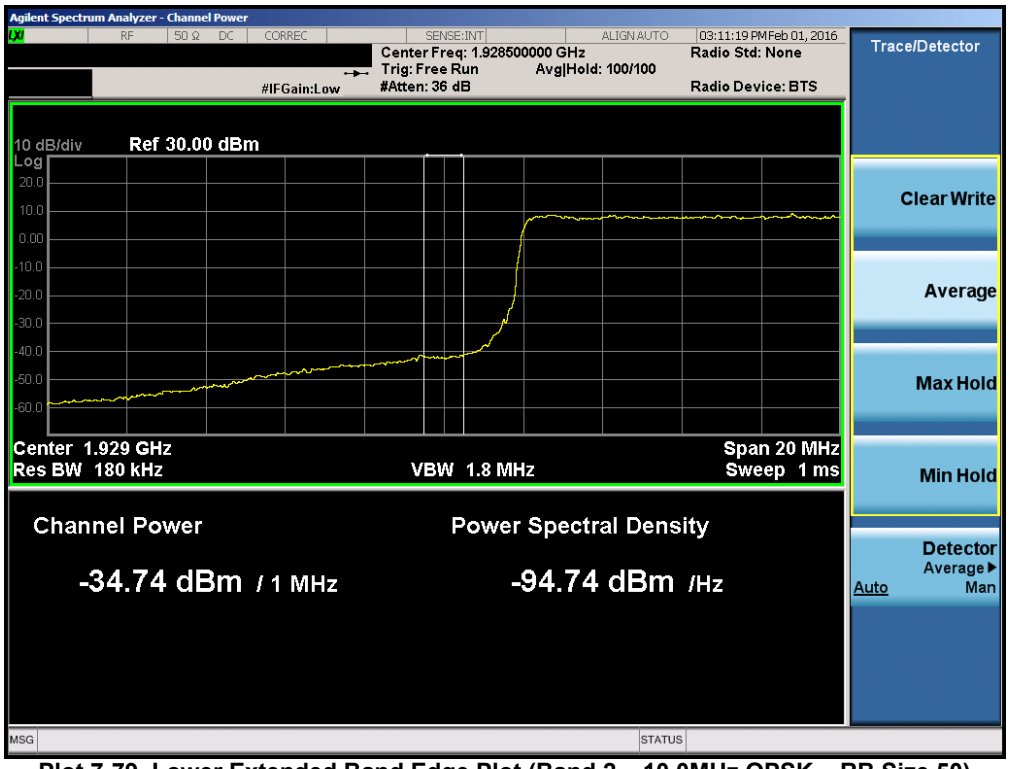
Plot 7-76. Upper Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



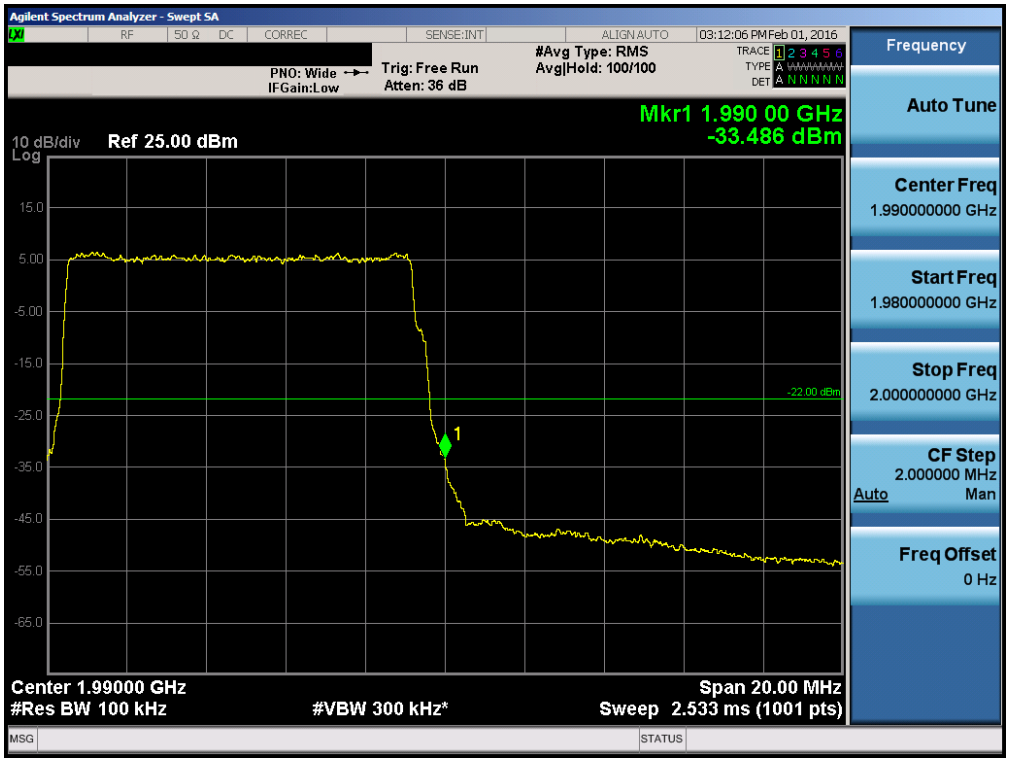
Plot 7-77. Upper Extended Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



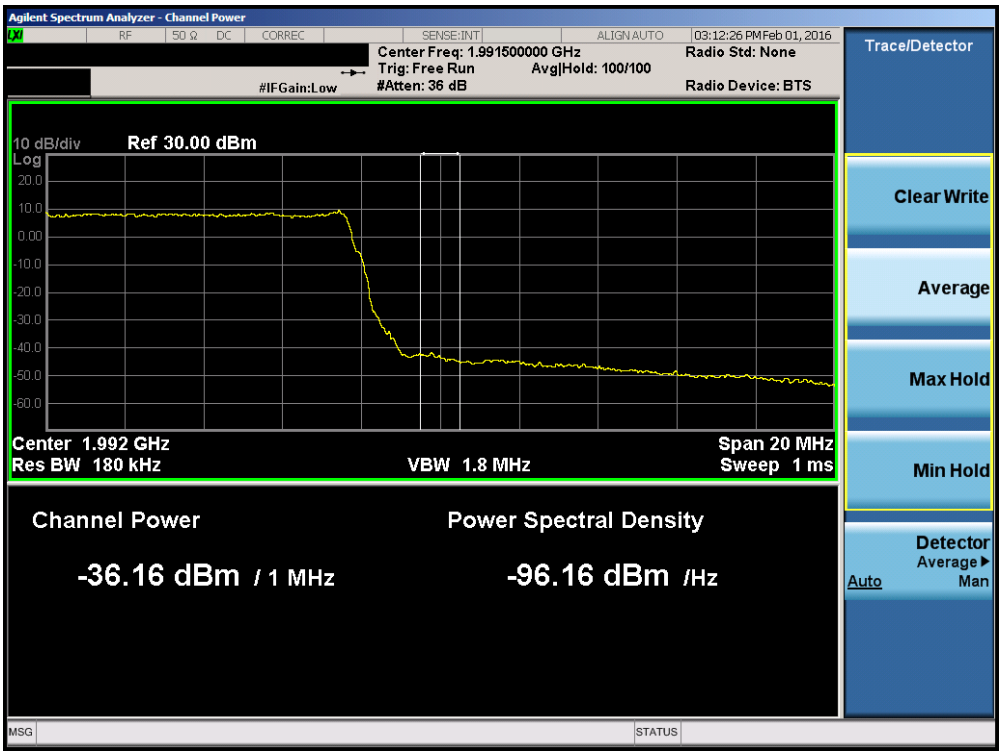
Plot 7-78. Lower Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



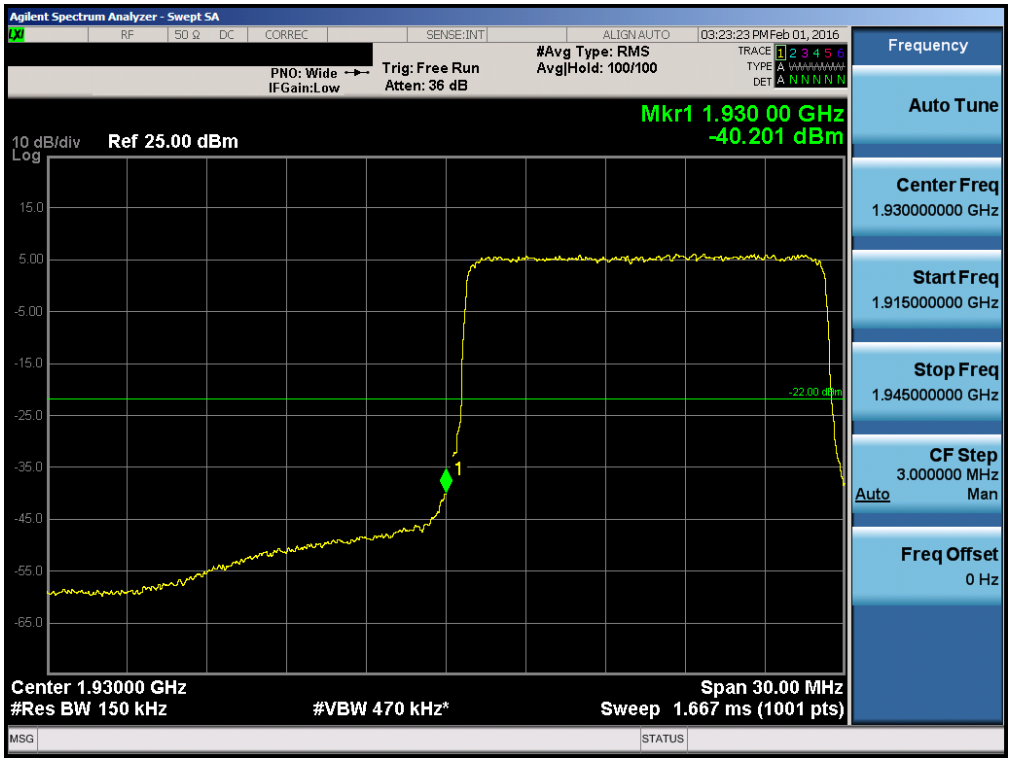
Plot 7-79. Lower Extended Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



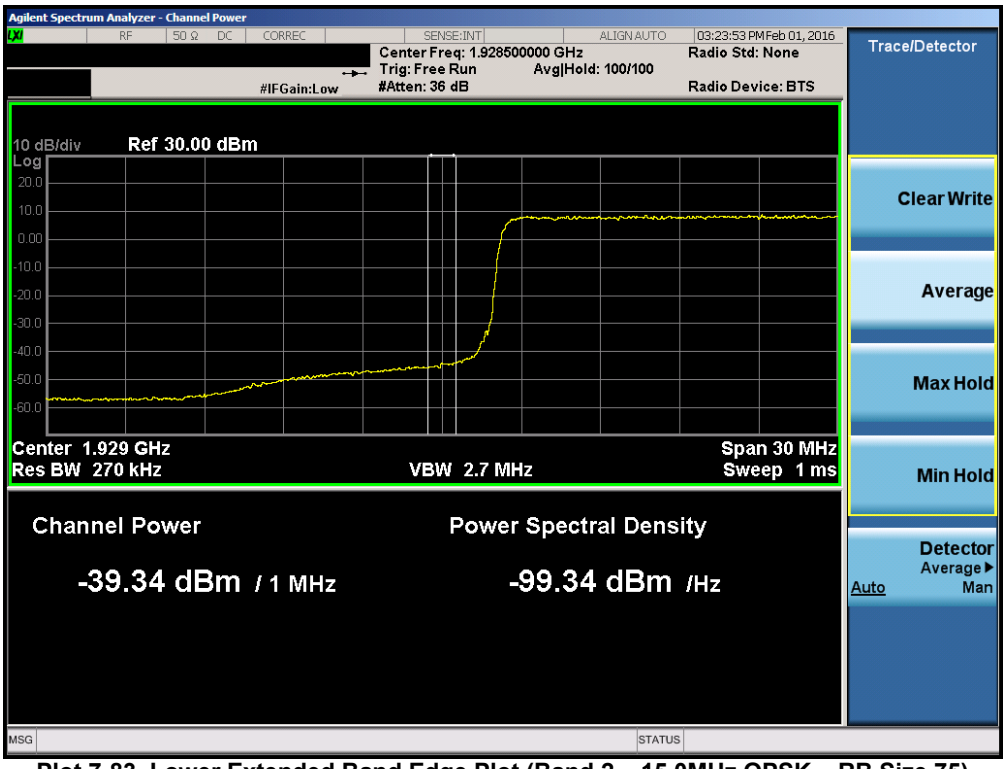
Plot 7-80. Upper Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



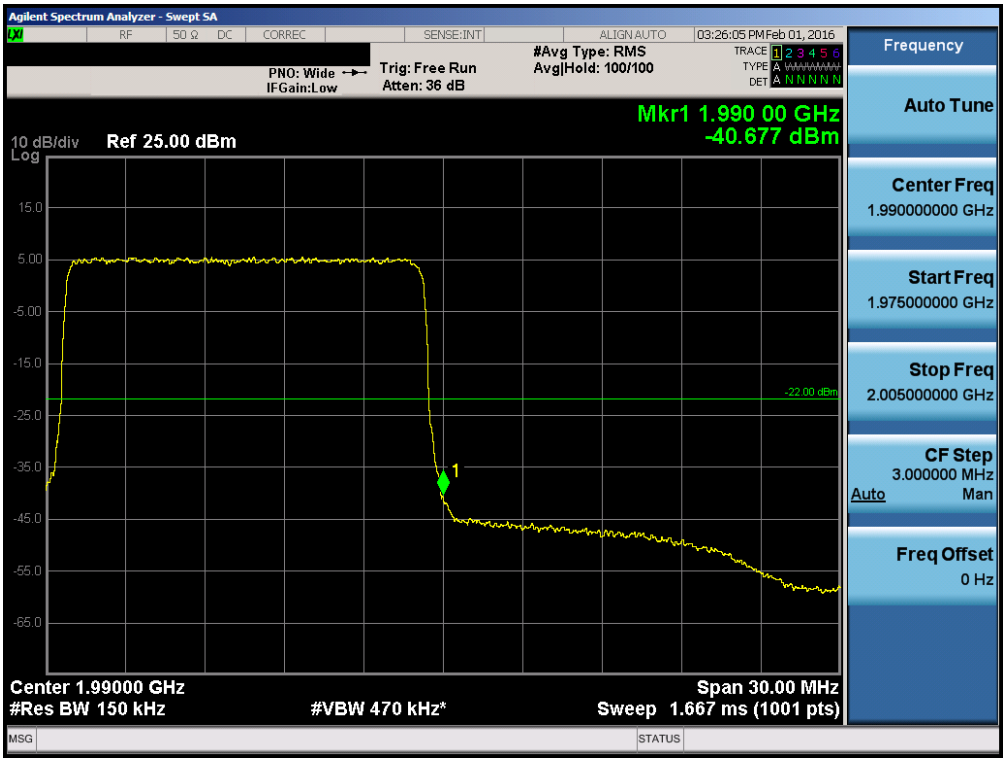
Plot 7-81. Upper Extended Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



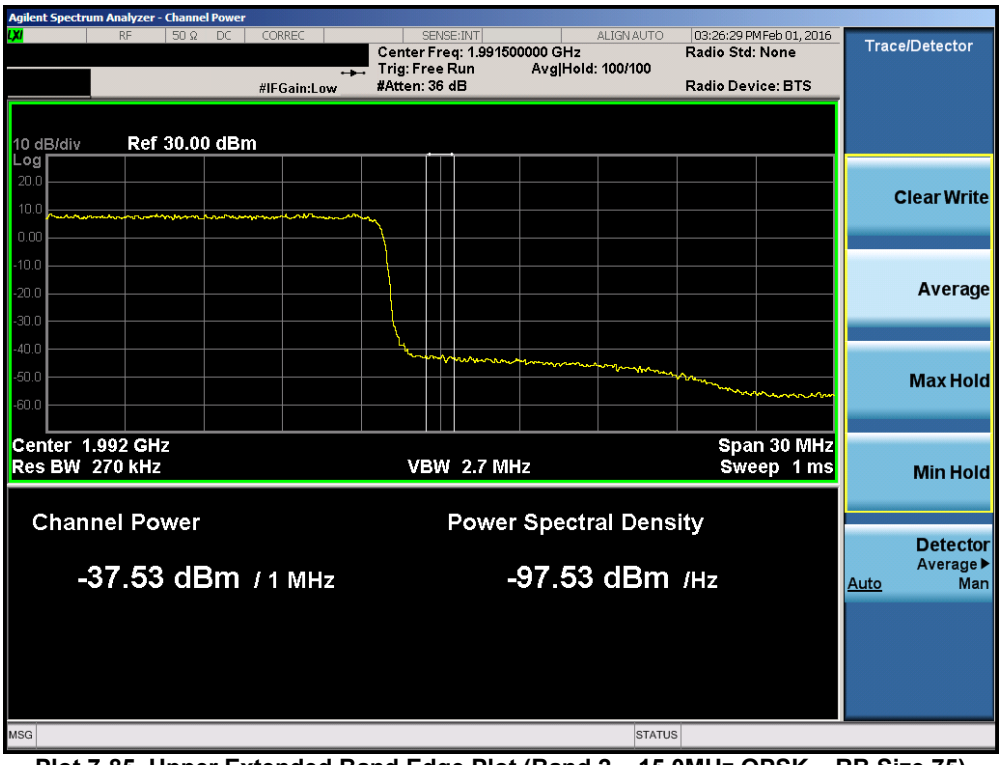
Plot 7-82. Lower Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



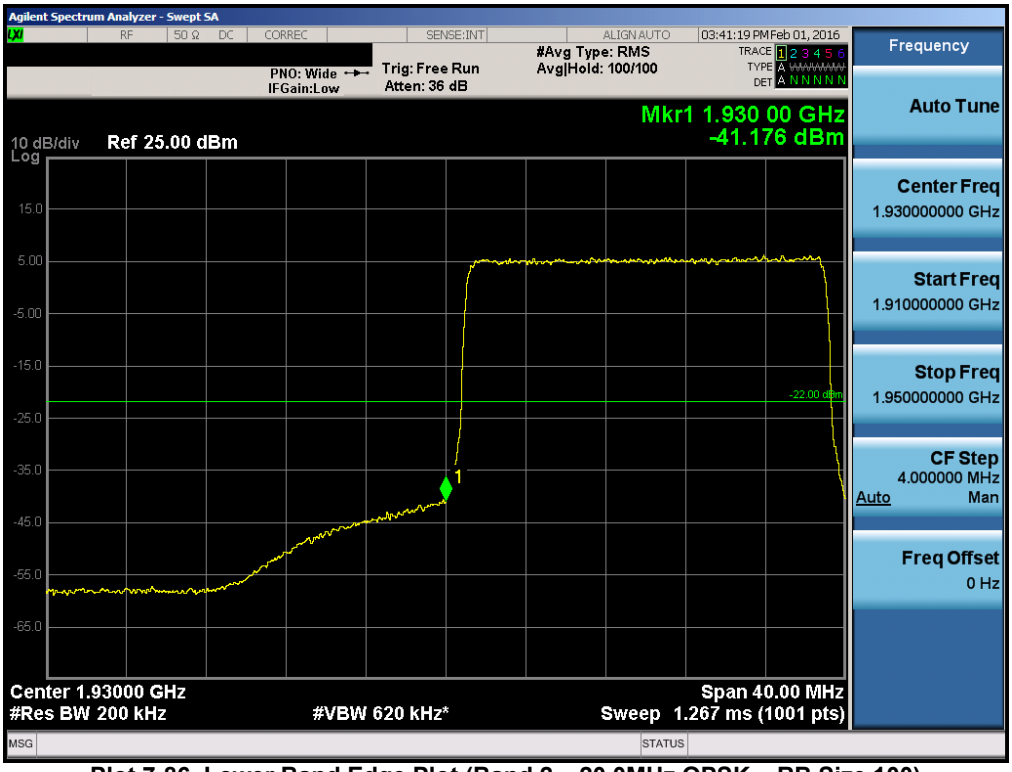
Plot 7-83. Lower Extended Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



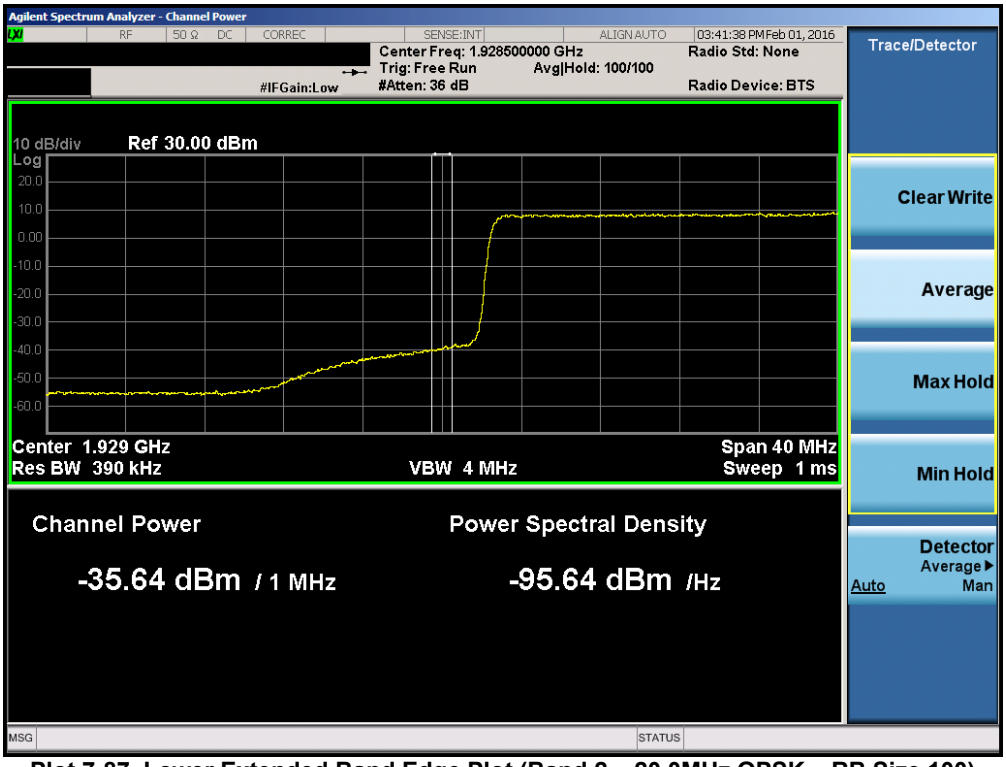
Plot 7-84. Upper Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



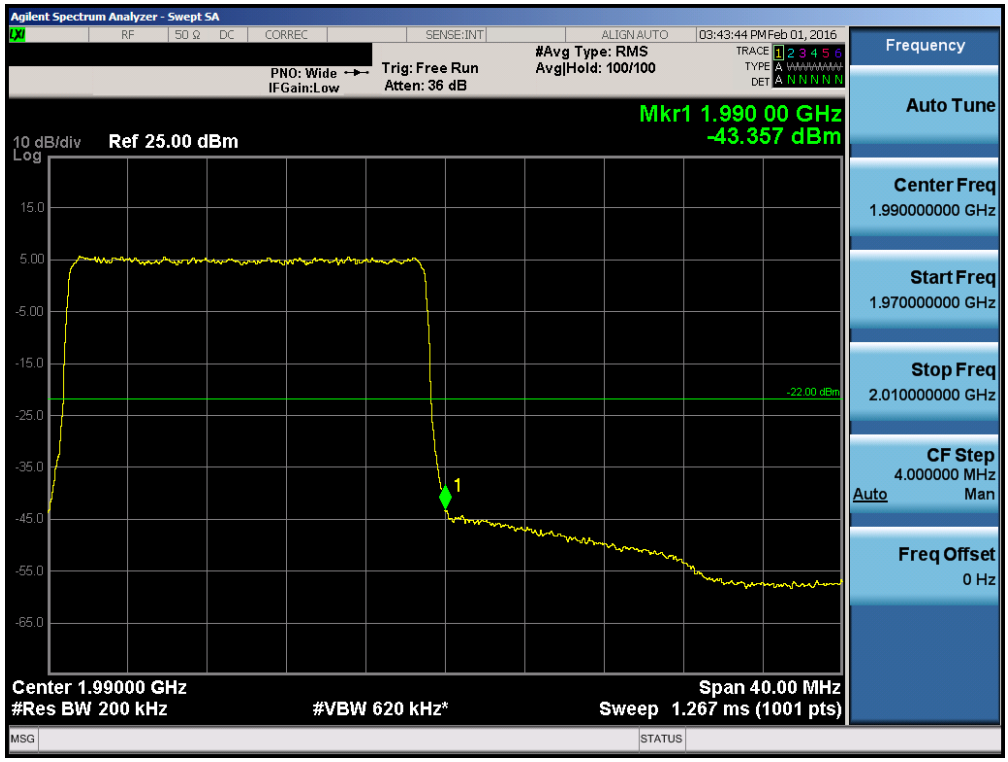
Plot 7-85. Upper Extended Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



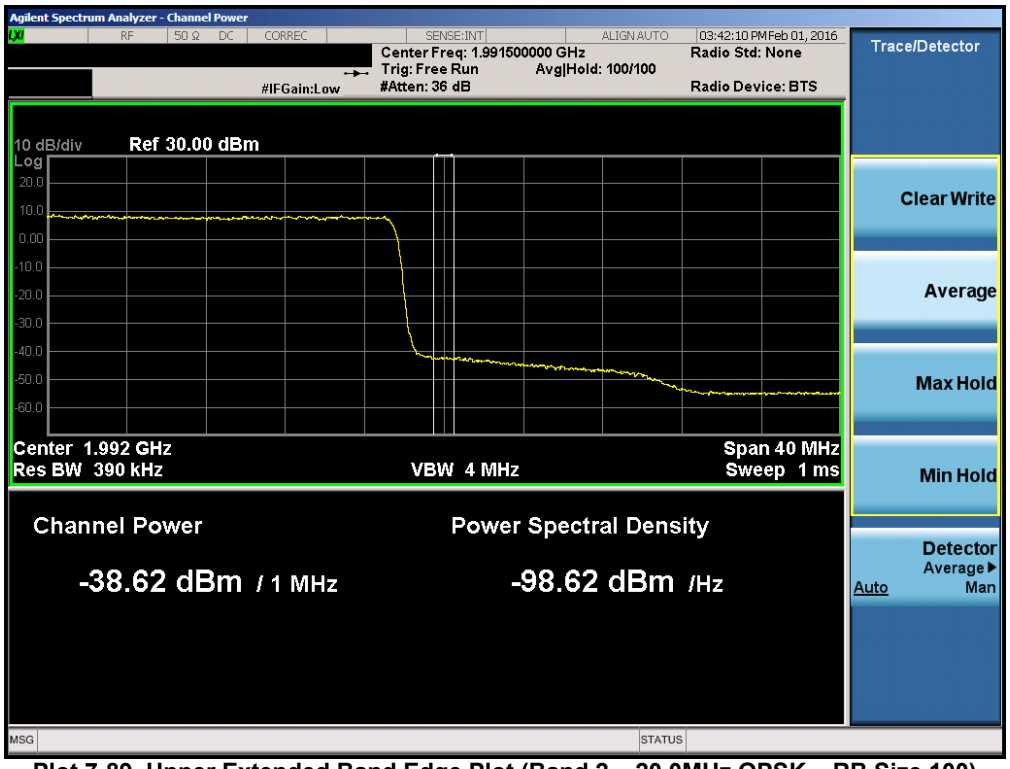
Plot 7-86. Lower Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)



Plot 7-87. Lower Extended Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)



Plot 7-88. Upper Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)



Plot 7-89. Upper Extended Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)