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:
LG Electronics MobileComm U.S.A
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632
United States

Date of Testing:
2/23 - 3/16/2015
Test Site/Location:
PCTEST Lab., Columbia, MD, USA
Test Report Serial No.:
0Y1502190493.ZNF

FCC ID : ZNFH631

APPLICANT: LG ELECTRONICS MOBILECOMM U.S.A

Application Type: Class II Permissive Change
FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s): §2; §24; §27
Test Procedure(s): ANSI/TIA-603-C-2004, KDB 971168 v02r02
EUT Type: Portable Handset
Model(s): LG-MS631, H631, LGH631, LG-H631, MS631, LGMS631
Test Device Serial No.: *identical prototype* [S/N: RF1, RF2]
Class II Permissive Change: Please see FCC change document
Original Grant Date: 03/04/2015

Mode	Tx Frequency (MHz)	Emission Designator	Modulation	ERP/EIRP	
				Max. Power (W)	Max. Power (dBm)
LTE Band 12	699.7 - 715.3	1M12G7D	QPSK	0.096	19.81
LTE Band 12	699.7 - 715.3	1M11W7D	16QAM	0.083	19.17
LTE Band 12	700.5 - 714.5	2M71G7D	QPSK	0.110	20.43
LTE Band 12	700.5 - 714.5	2M71W7D	16QAM	0.089	19.49
LTE Band 12	701.5 - 713.5	4M50G7D	QPSK	0.108	20.35
LTE Band 12	701.5 - 713.5	4M51W7D	16QAM	0.086	19.34
LTE Band 12	704 - 711	9M00G7D	QPSK	0.113	20.55
LTE Band 12	704 - 711	8M98W7D	16QAM	0.102	20.07
LTE Band 4	1710.7 - 1754.3	1M12G7D	QPSK	0.336	25.27
LTE Band 4	1710.7 - 1754.3	1M12W7D	16QAM	0.317	25.01
LTE Band 4	1711.5 - 1753.5	2M71G7D	QPSK	0.364	25.61
LTE Band 4	1711.5 - 1753.5	2M71W7D	16QAM	0.313	24.96
LTE Band 4	1712.5 - 1752.5	4M51G7D	QPSK	0.261	24.16
LTE Band 4	1712.5 - 1752.5	4M52W7D	16QAM	0.204	23.09
LTE Band 4	1715 - 1750	8M98G7D	QPSK	0.271	24.32
LTE Band 4	1715 - 1750	8M99W7D	16QAM	0.227	23.56
LTE Band 4	1717.5 - 1747.5	13M5G7D	QPSK	0.299	24.76
LTE Band 4	1717.5 - 1747.5	13M5W7D	16QAM	0.238	23.76
LTE Band 4	1720 - 1745	18M0G7D	QPSK	0.361	25.58
LTE Band 4	1720 - 1745	18M0W7D	16QAM	0.271	24.32
LTE Band 2	1850.7 - 1909.3	1M12G7D	QPSK	0.204	23.09
LTE Band 2	1850.7 - 1909.3	1M12W7D	16QAM	0.163	22.11
LTE Band 2	1851.5 - 1908.5	2M73G7D	QPSK	0.227	23.55
LTE Band 2	1851.5 - 1908.5	2M73W7D	16QAM	0.214	23.30
LTE Band 2	1852.5 - 1907.5	4M51G7D	QPSK	0.213	23.29
LTE Band 2	1852.5 - 1907.5	4M51W7D	16QAM	0.186	22.70
LTE Band 2	1855 - 1905	9M01G7D	QPSK	0.203	23.07
LTE Band 2	1855 - 1905	9M01W7D	16QAM	0.171	22.34
LTE Band 2	1857.5 - 1902.5	13M5G7D	QPSK	0.203	23.07
LTE Band 2	1857.5 - 1902.5	13M5W7D	16QAM	0.189	22.77
LTE Band 2	1860 - 1900	18M0G7D	QPSK	0.210	23.23
LTE Band 2	1860 - 1900	18M0W7D	16QAM	0.159	22.02

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

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

Randy Ortanez
President

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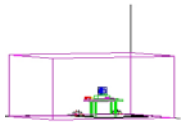
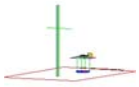


MEASUREMENT REPORT
FCC Part 24 & 27



§2.1033 General Information

APPLICANT:	LG Electronics MobileComm U.S.A
APPLICANT ADDRESS:	1000 Sylvan Avenue Englewood Cliffs, NJ 07632, 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:	LG-MS631
FCC ID:	ZNFH631
FCC CLASSIFICATION:	PCS Licensed Transmitter Held to Ear (PCE)
FREQUENCY TOLERANCE:	±0.00025 % (2.5 ppm)
Test Device Serial No.:	RF1, RF2 ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	2/23 - 3/12/2015
TEST REPORT S/N:	0Y1502190493.ZNF

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.

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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. (*See 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 39° 10'23" N latitude and 76° 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 C63.4-2003 on February 15, 2012.

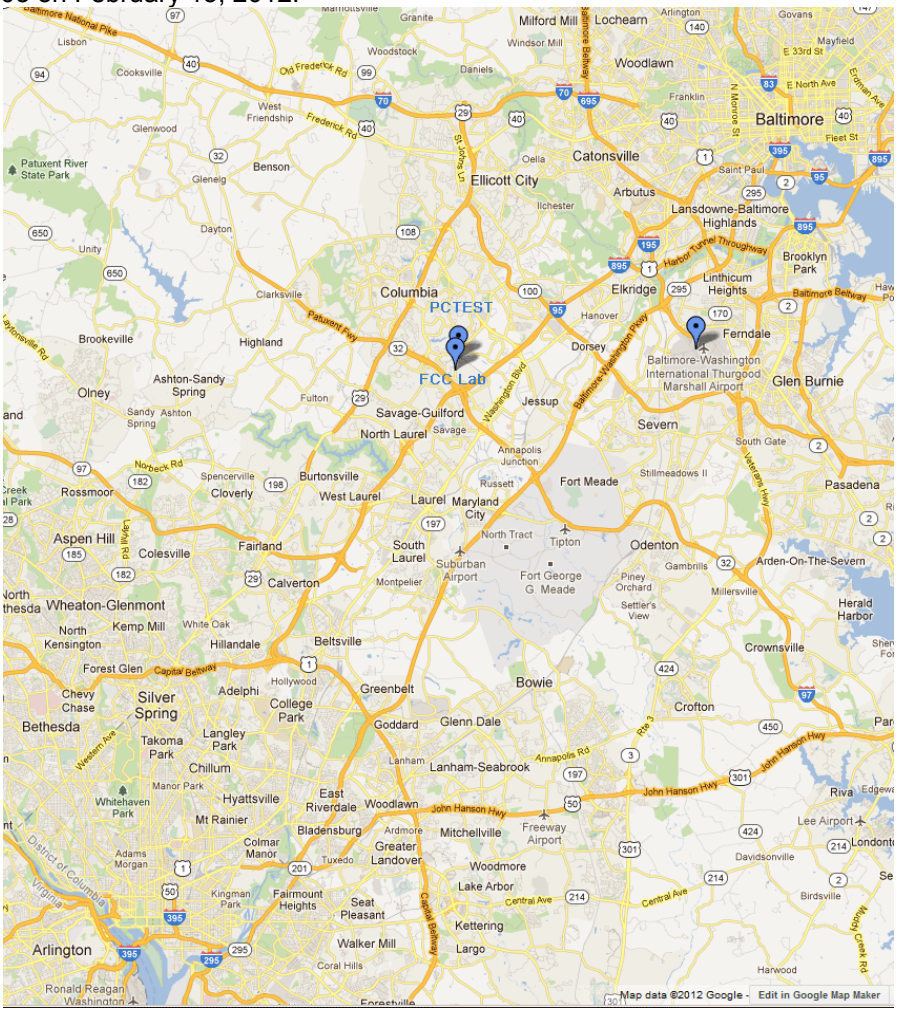

Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **LG Portable Handset FCC ID: ZNFH631**. 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:

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

2.3 EMI Suppression Device(s)/Modifications

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

2.4 Labeling Requirements

Per 2.925

The FCC identifier shall be permanently affixed to the equipment and shall be readily visible to the purchaser at the time of purchase.

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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-C-2004) and "Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems" (KDB 971168) were used in the measurement of the **LG Portable Handset FCC ID: ZNFH631.**

3.2 Block A Frequency Range

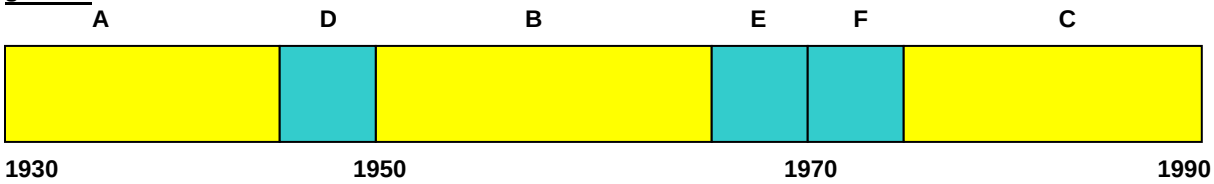
§27.5(c)

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.

3.3 PCS - Base Frequency Blocks

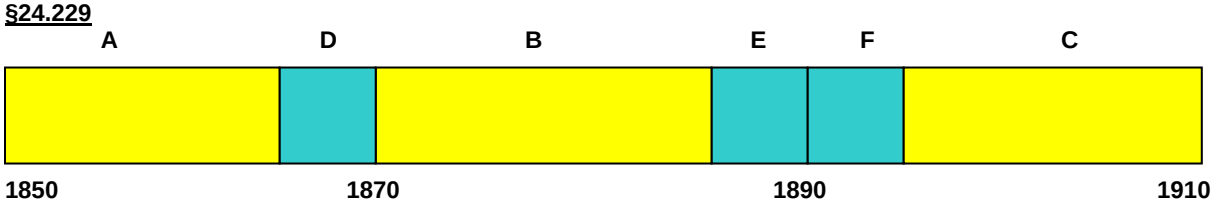
§24.229



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)

3.4 PCS - Mobile Frequency Blocks

§24.229



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)

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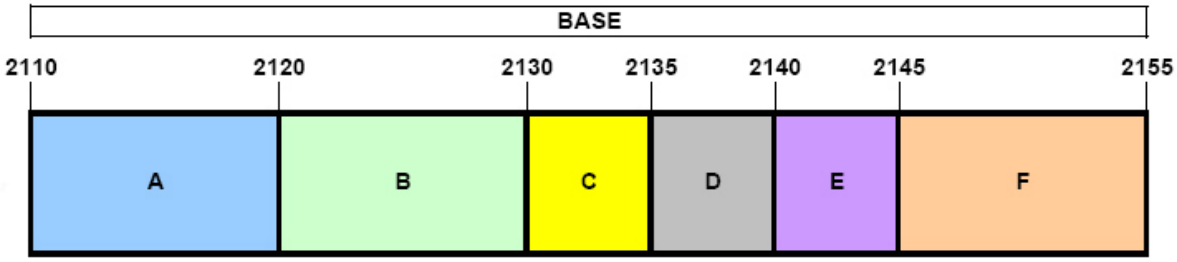
3.5 AWS - Base Frequency Blocks

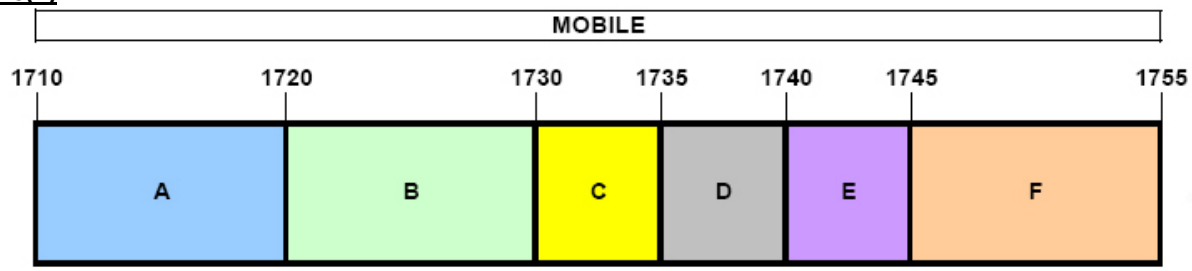
§27.5(h)



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)

3.6 AWS - Mobile Frequency Blocks

§27.5(h)



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)

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3.7 Radiated Power and Radiated Spurious Emissions

§2.1053 §24.232(c) §24.238(a) §27.50(c.10) §27.50(d.4) §27.53(g) §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 C63.4-2009. 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, the absorbers are removed. An ETS Lindgren Model 2188 raised turntable is used for radiated measurement. It 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. A 78cm high PVC support structure is placed on top of the turntable. A ¾" (~1.9cm) sheet of high density polyethylene 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 wooden turntable 80cm above the ground plane and 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 "Channel Power" function with the integration band set to the emissions' occupied bandwidth, a RMS detector, RBW = 100kHz, VBW = 300kHz, and a 1 second sweep time over a minimum of 10 sweeps, per the guidelines of KDB 971168.

Per the guidance of ANSI/TIA-603-C-2004, 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 $43 + 10\log_{10}(\text{Power}_{\,[Watts]})$.

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4.0 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
-	LTx1	Licensed Transmitter Cable Set	10/16/2014	Annual	10/16/2015	N/A
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	10/24/2014	Annual	10/24/2015	N/A
Agilent	8447D	Broadband Amplifier	5/30/2014	Annual	5/30/2015	2443A01900
Agilent	N9020A	MXA Signal Analyzer	10/27/2014	Annual	10/27/2015	US46470561
Espec	ESX-2CA	Environmental Chamber	4/16/2014	Annual	4/16/2015	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	12/1/2014	Annual	12/1/2015	2
K & L	13SH10-1000/U1000	N Type High Pass Filter	12/1/2014	Annual	12/1/2015	1
Mini-Circuits	PWR-SENS-4RMS	USB Power Sensor	4/17/2014	Annual	4/17/2015	11210140001
Mini-Circuits	SSG-4000HP	USB Synthesized Signal Generator	N/A			11208010032
Mini-Circuits	TVA-11-422	RF Power Amp	N/A			QA1303002
Rohde & Schwarz	CMW500	Radio Communication Tester	10/3/2014	Annual	10/3/2015	100976
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	3/27/2014	Annual	3/27/2015	100342
Schwarzbeck	UHA 9105	Dipole Antenna (400 - 1GHz) Rx	11/21/2013	Biennial	11/21/2015	9105-2404
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
VWR	62344-734	Thermometer with Clock	2/20/2014	Biennial	2/20/2016	140140420

Table 4-1. Test Equipment

Note:

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

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5.0 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

16QAM Modulation

Emission Designator = 8M45W7D

LTE BW = 8.45 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

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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6.0 TEST RESULTS

6.1 Summary

Company Name: LG Electronics MobileComm U.S.A
FCC ID: ZNFH631
FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
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 6.2
2.1051 24.238(a) 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		PASS	Section 6.3, 6.4
24.232(d)	Peak-Average Ratio	< 13 dB		PASS	Section 6.5
2.1046	Transmitter Conducted Output Power	N/A		PASS	See RF Exposure Report
2.1055. 24.235 27.54	Frequency Stability	Fundamental emissions stay within authorized frequency block (Part 24, 27)		PASS	Section 6.8
24.232(c)	Equivalent Isotropic Radiated Power (Band 2)	< 2 Watts max. EIRP	RADIATED	PASS	Section 6.6
27.50(d.4)	Equivalent Isotropic Radiated Power (Band 4)	< 1 Watts max. EIRP		PASS	Section 6.6
2.1053 24.238(a) 27.53(g) 27.53(h)	Undesirable Emissions	> 43 + 10log$_{10}$ (P[Watts]) for all out-of-band emissions		PASS	Section 6.7

Table 6-1. Summary of Test Results

Notes:

1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots (Sections 6.2, 6.3, 6.4, 6.5) 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 2.8.
5) The worst case emissions reported in the certification or Class II permissive change reports was spot-checked with the LG Quick Cover installed on the EUT. The data shown in the following sections represents these test results.

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6.2 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 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.

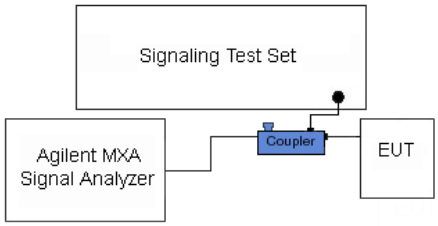

Figure 6-1. Test Instrument & Measurement Setup

Test Notes

None.

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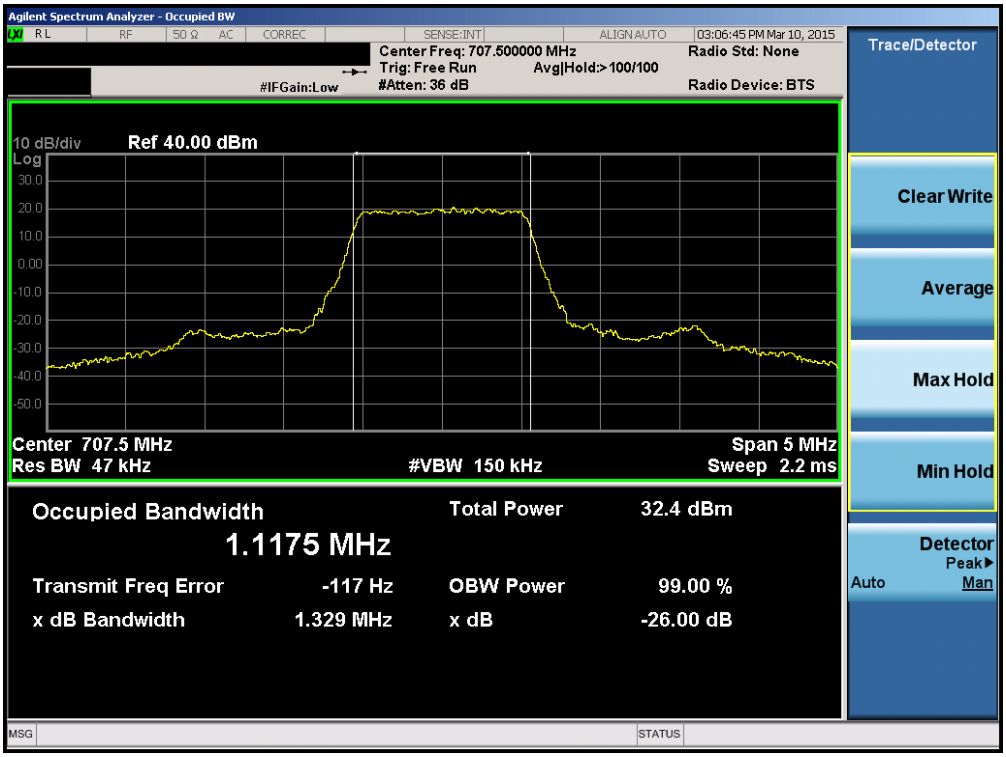
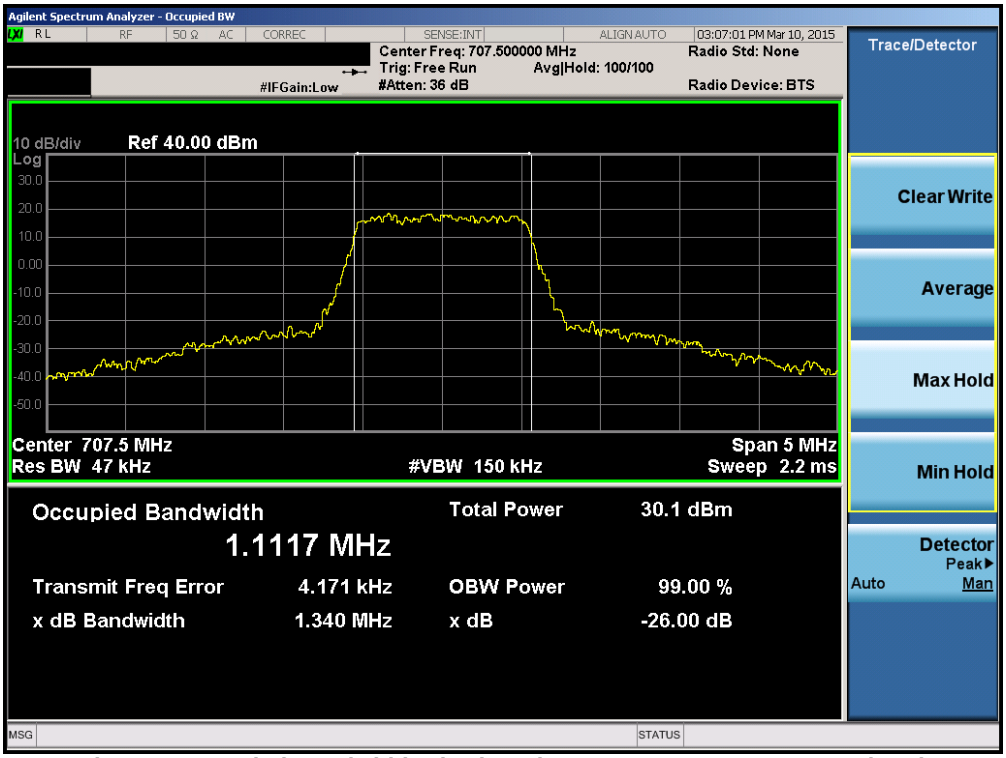


Plot 6-1. Occupied Bandwidth Plot (Band 12 – 1.4MHz QPSK – RB Size 6)



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

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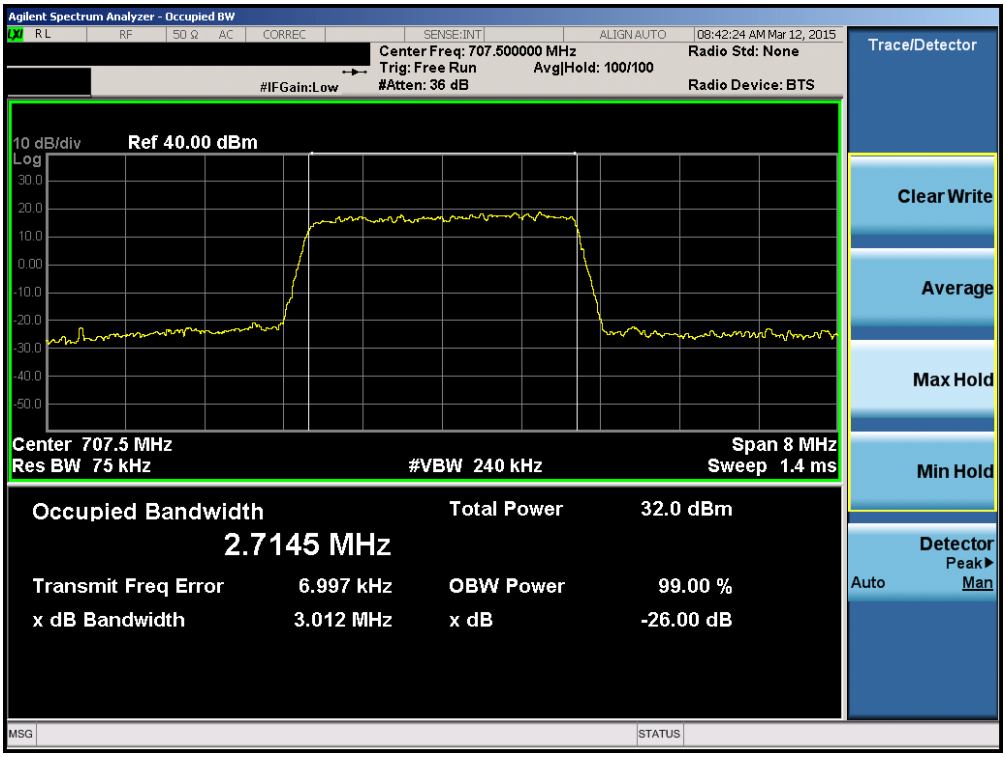
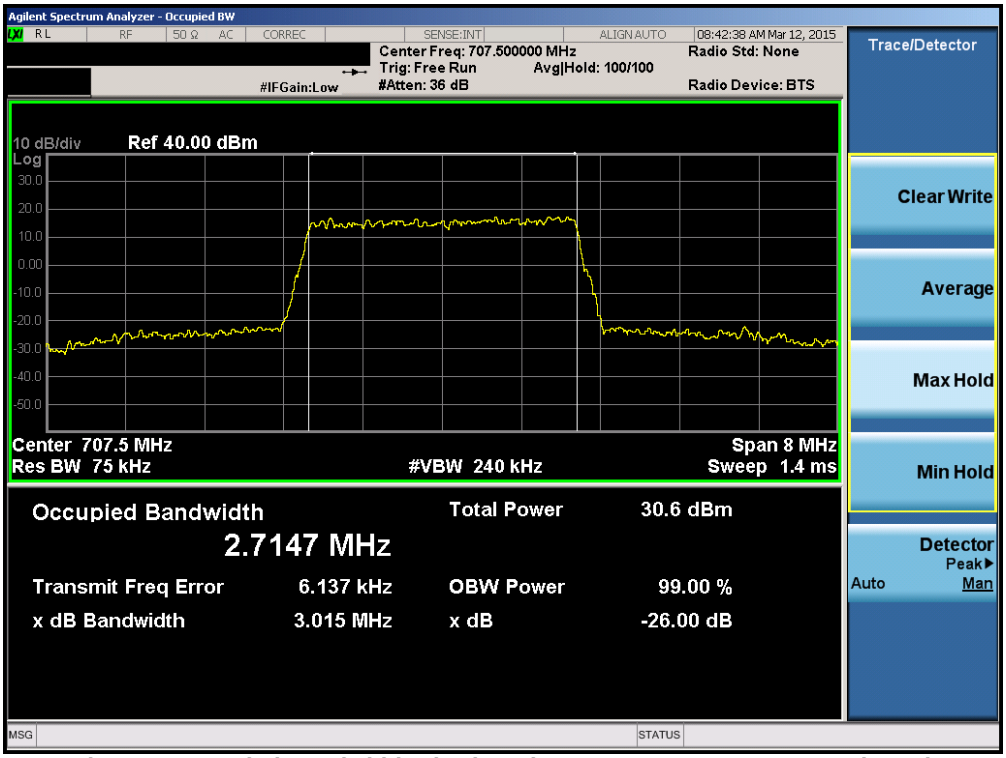


Plot 6-3. Occupied Bandwidth Plot (Band 12 – 3.0MHz QPSK – RB Size 15)



Plot 6-4. Occupied Bandwidth Plot (Band 12 – 3.0MHz 16-QAM – RB Size 15)

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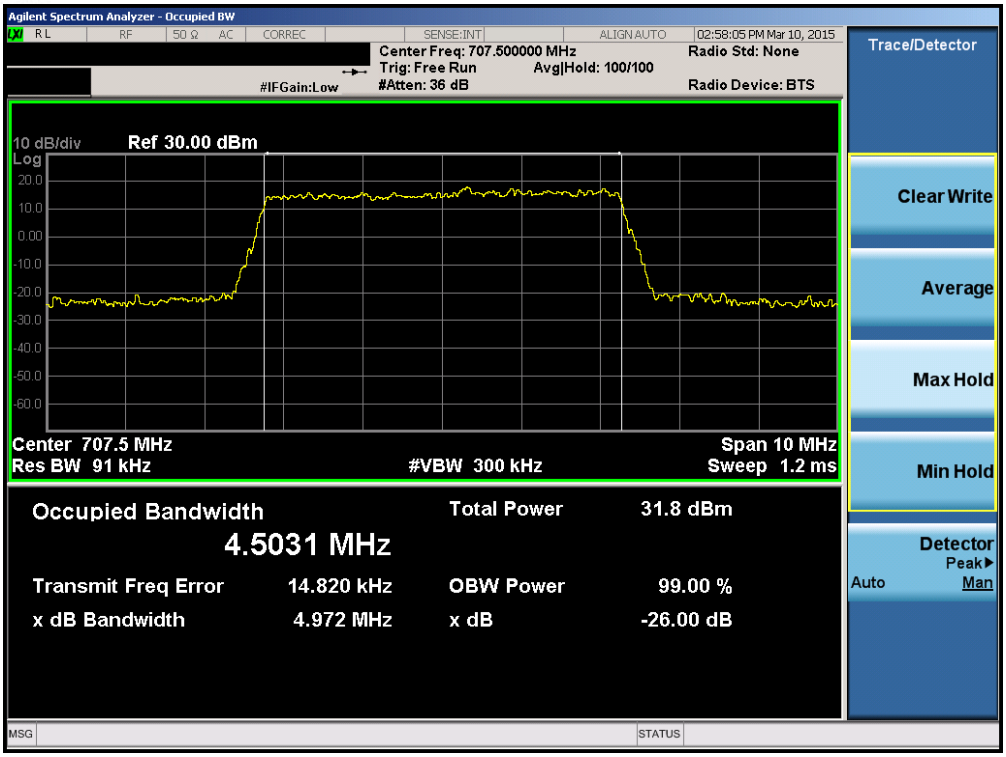
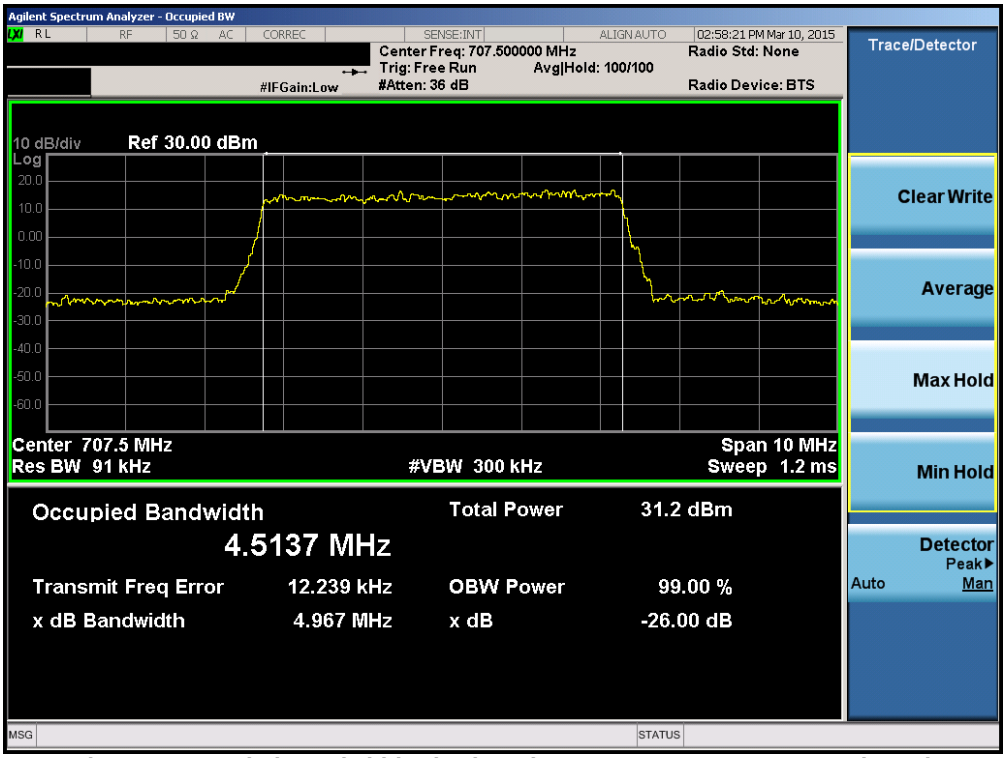


Plot 6-5. Occupied Bandwidth Plot (Band 12 – 5.0MHz QPSK – RB Size 25)



Plot 6-6. Occupied Bandwidth Plot (Band 12 – 5.0MHz 16-QAM – RB Size 25)

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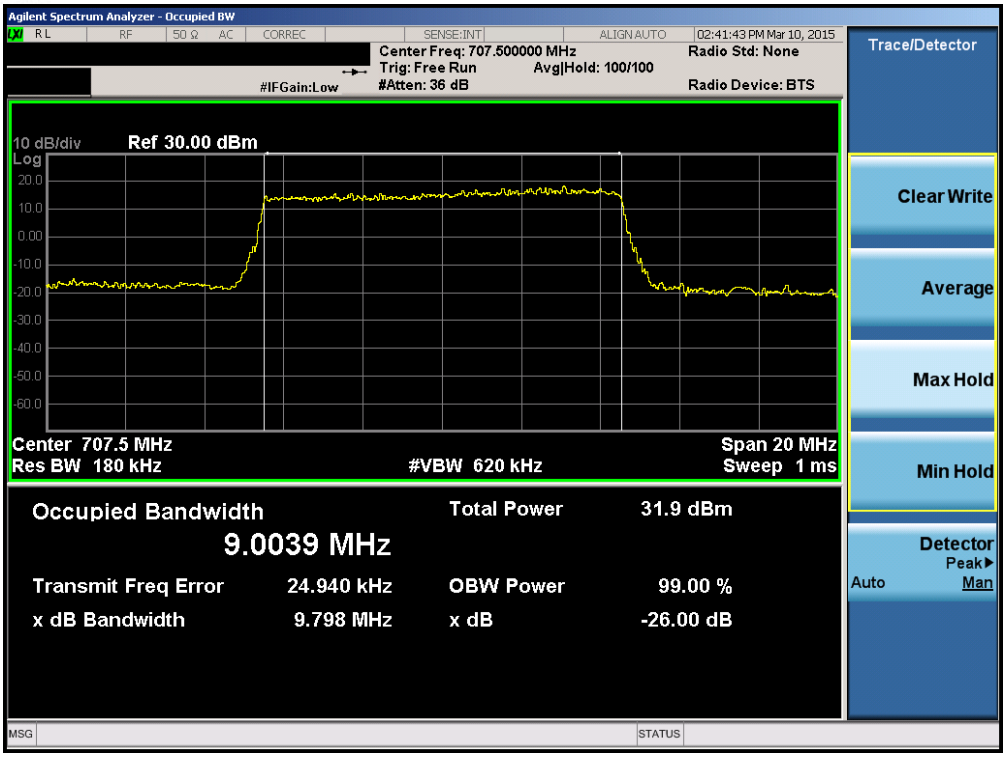
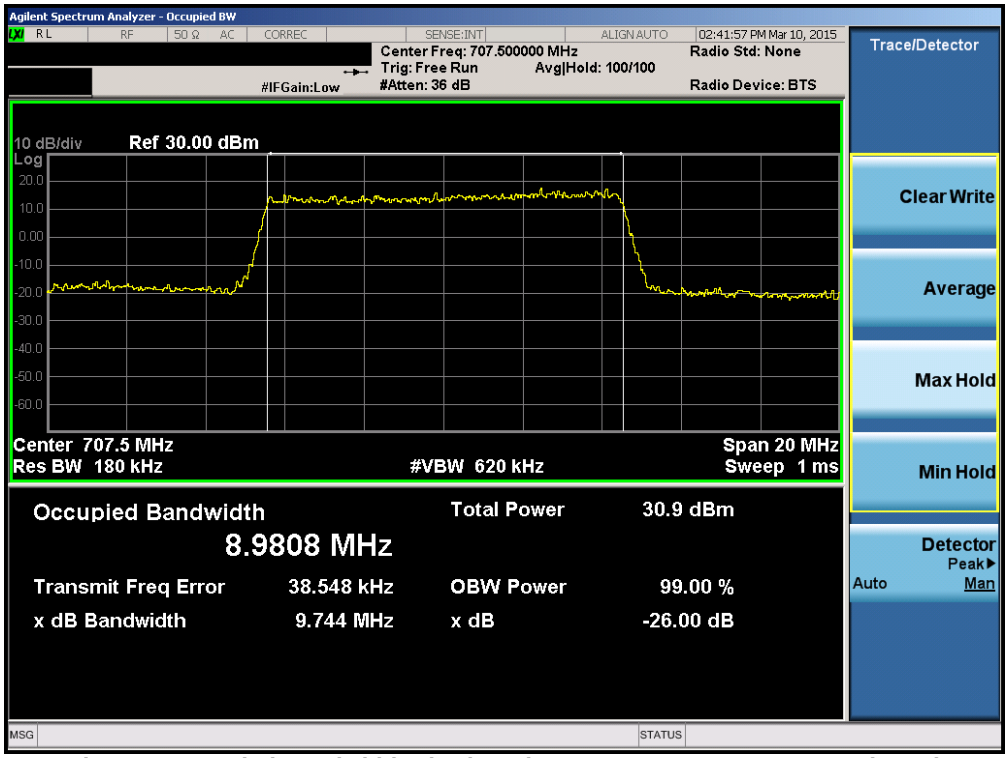


Plot 6-7. Occupied Bandwidth Plot (Band 12 – 10.0MHz QPSK – RB Size 50)



Plot 6-8. Occupied Bandwidth Plot (Band 12 – 10.0MHz 16-QAM – RB Size 50)

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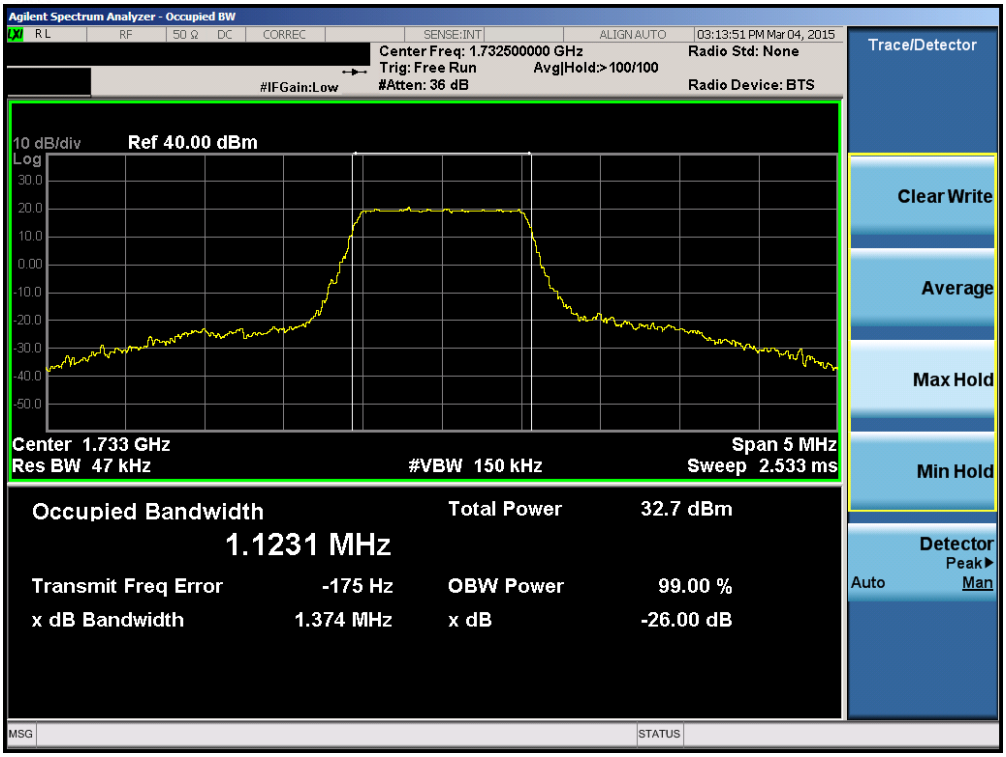
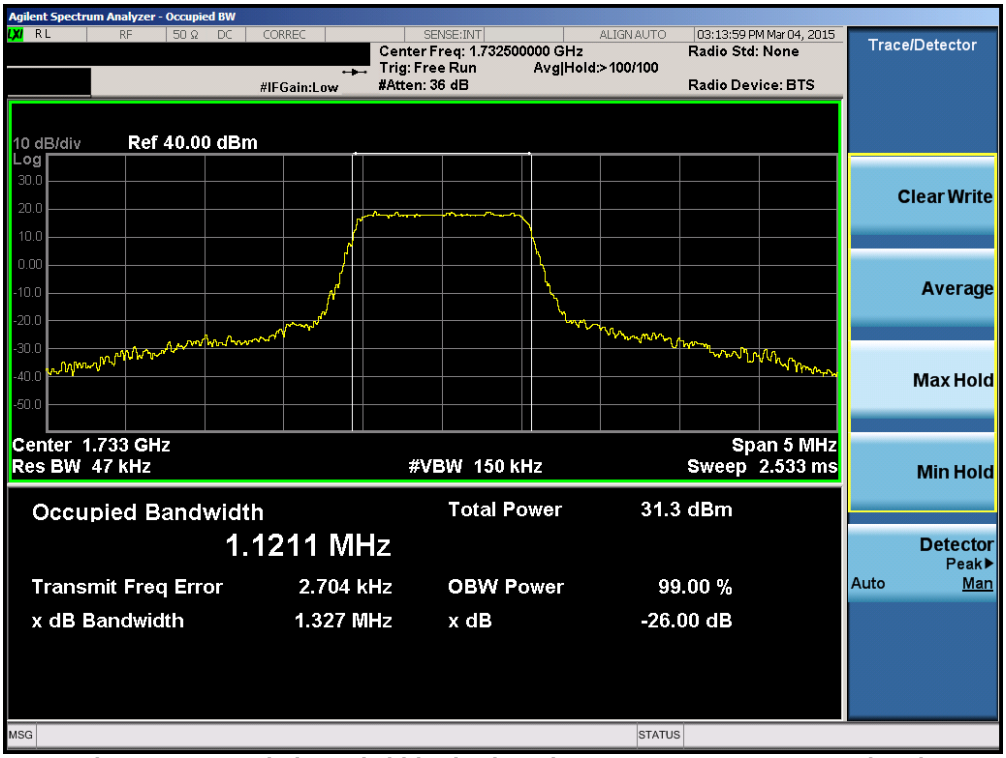


Plot 6-9. Occupied Bandwidth Plot (Band 4 – 1.4MHz QPSK – RB Size 6)



Plot 6-10. Occupied Bandwidth Plot (Band 4 – 1.4MHz 16-QAM – RB Size 6)

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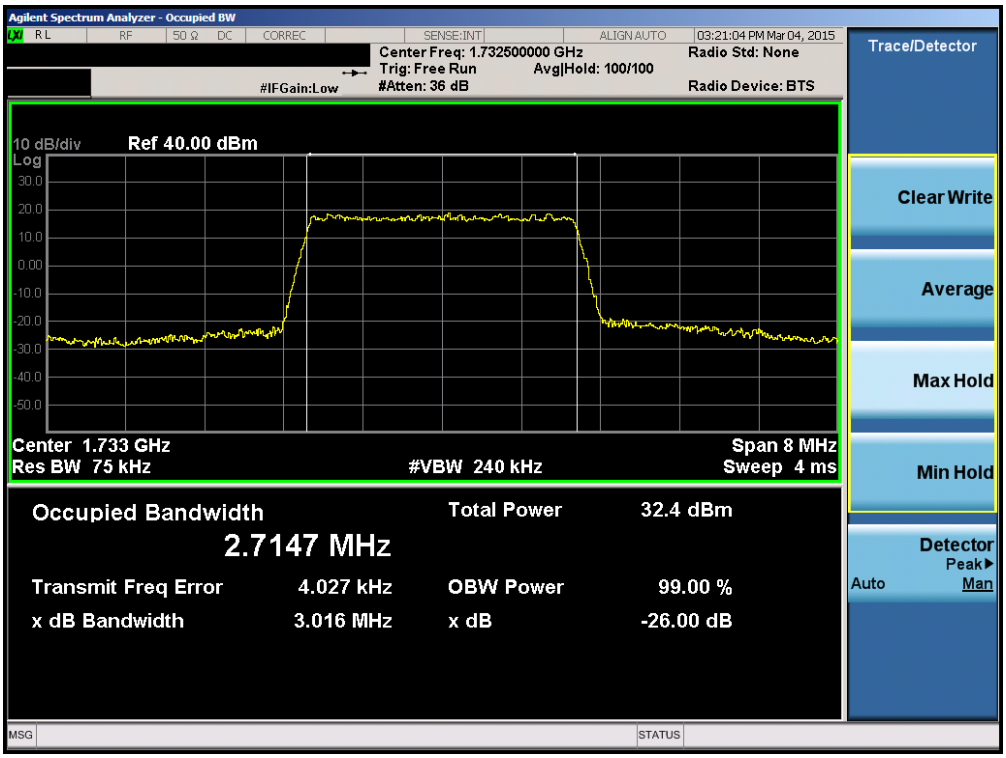
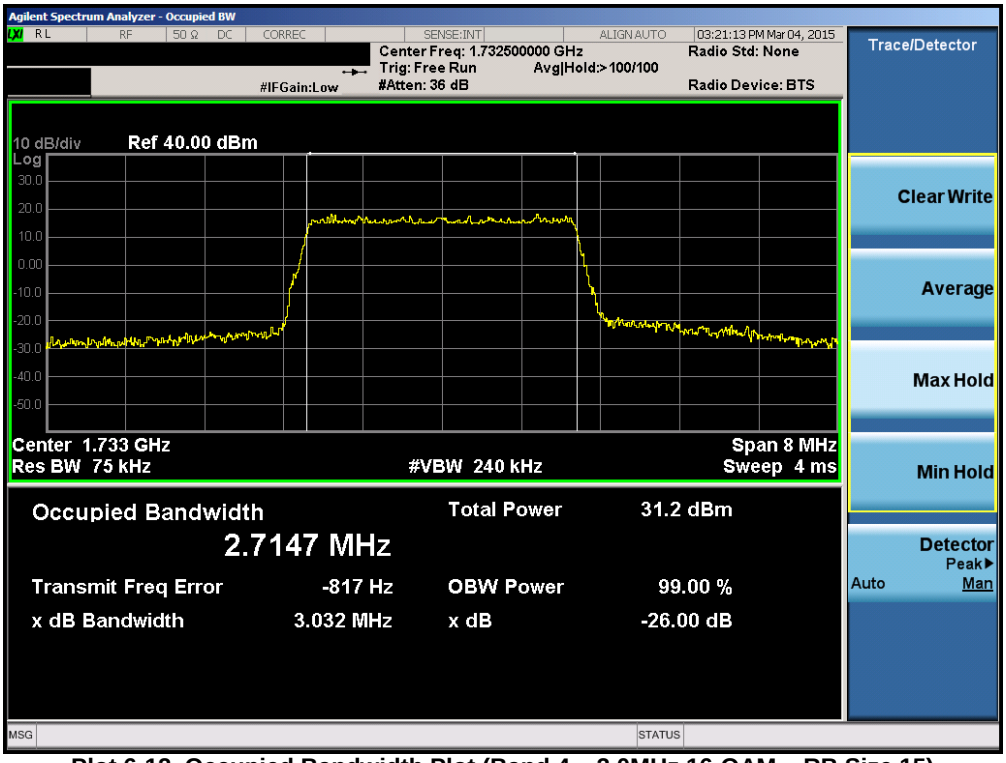


Plot 6-11. Occupied Bandwidth Plot (Band 4 – 3.0MHz QPSK – RB Size 15)



Plot 6-12. Occupied Bandwidth Plot (Band 4 – 3.0MHz 16-QAM – RB Size 15)

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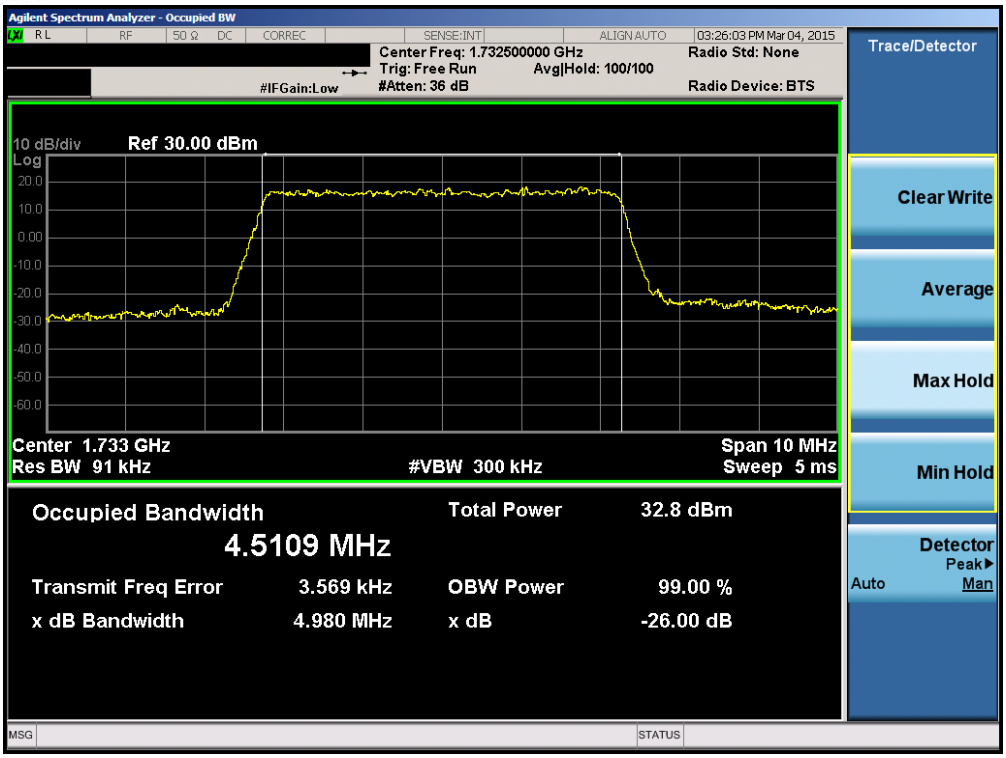
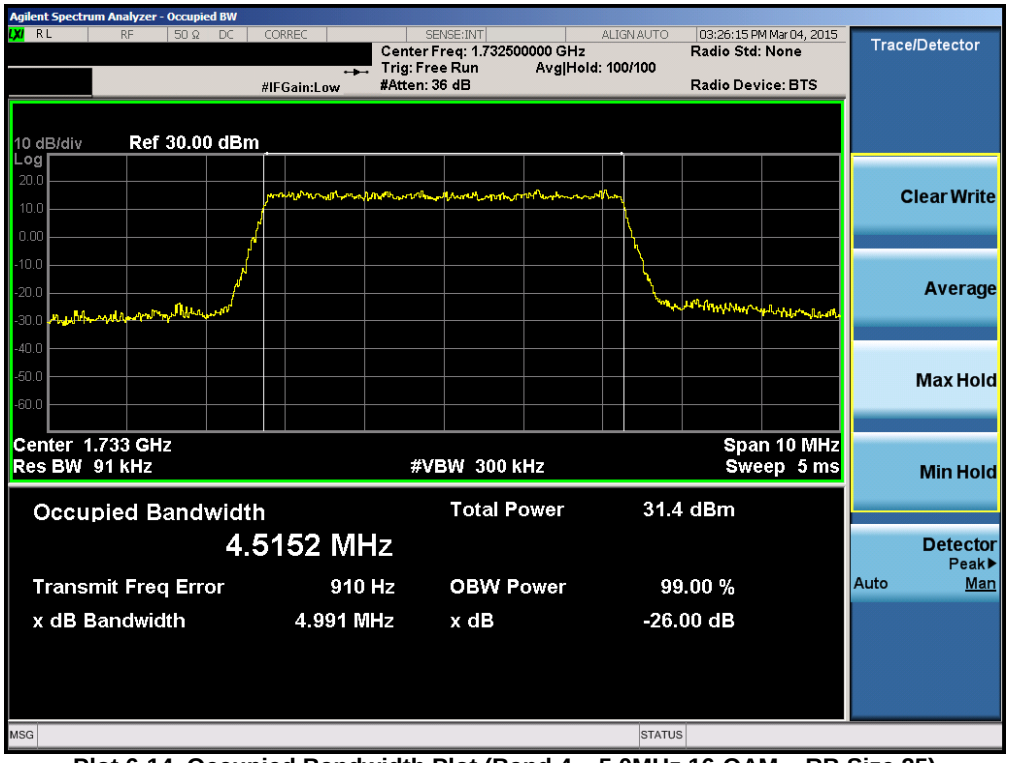


Plot 6-13. Occupied Bandwidth Plot (Band 4 – 5.0MHz QPSK – RB Size 25)



Plot 6-14. Occupied Bandwidth Plot (Band 4 – 5.0MHz 16-QAM – RB Size 25)

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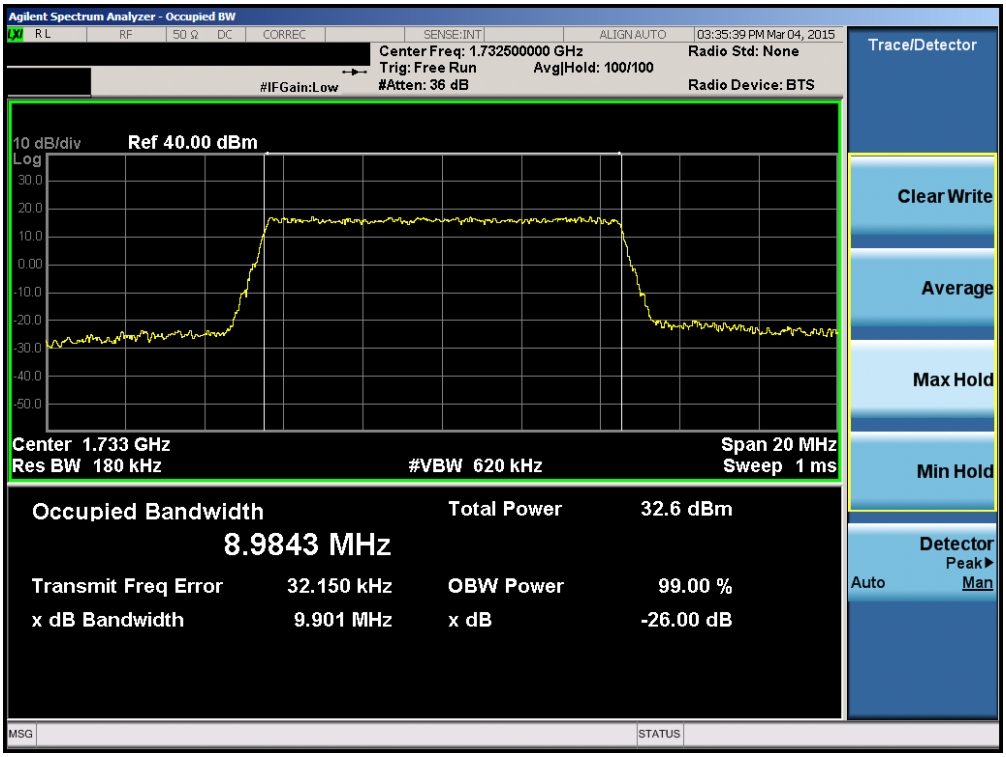
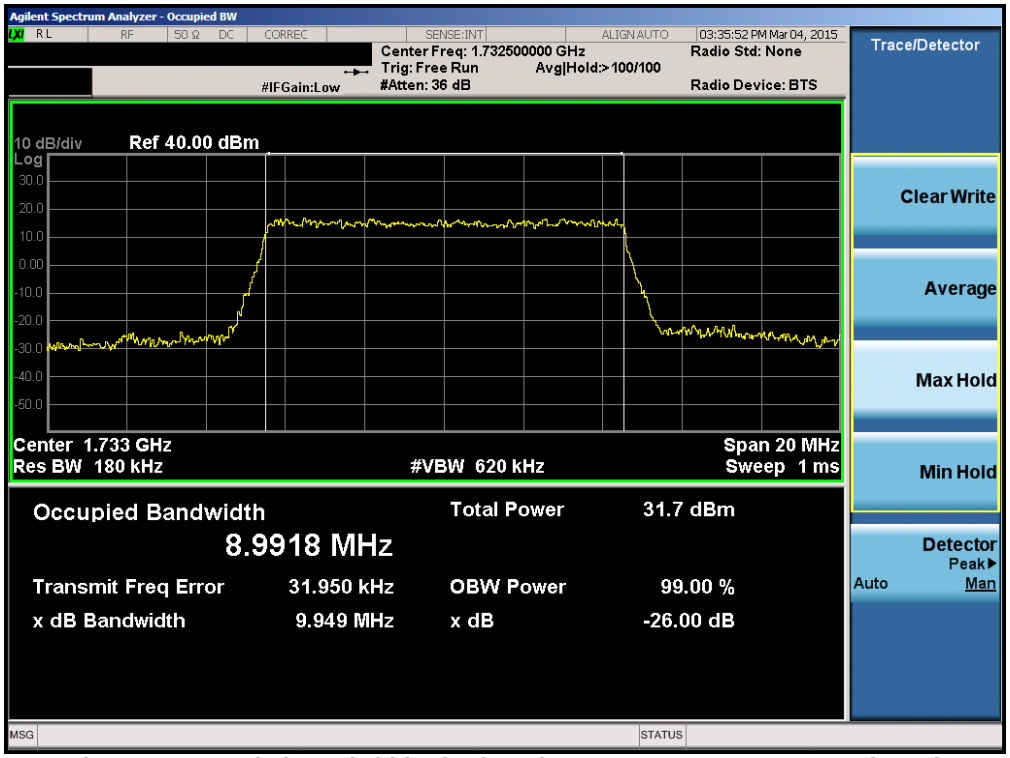


Plot 6-15. Occupied Bandwidth Plot (Band 4 – 10.0MHz QPSK – RB Size 50)



Plot 6-16. Occupied Bandwidth Plot (Band 4 – 10.0MHz 16-QAM – RB Size 50)

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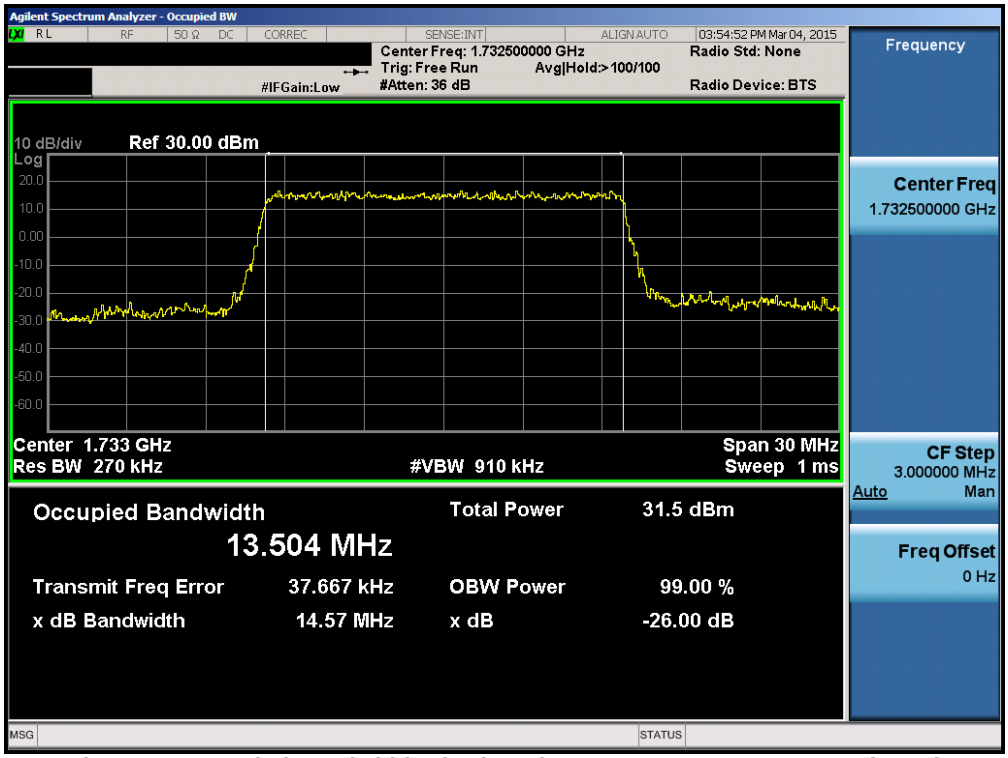
Plot 6-17. Occupied Bandwidth Plot (Band 4 – 15.0MHz QPSK – RB Size 75)



Plot 6-18. Occupied Bandwidth Plot (Band 4 – 15.0MHz 16-QAM – RB Size 75)

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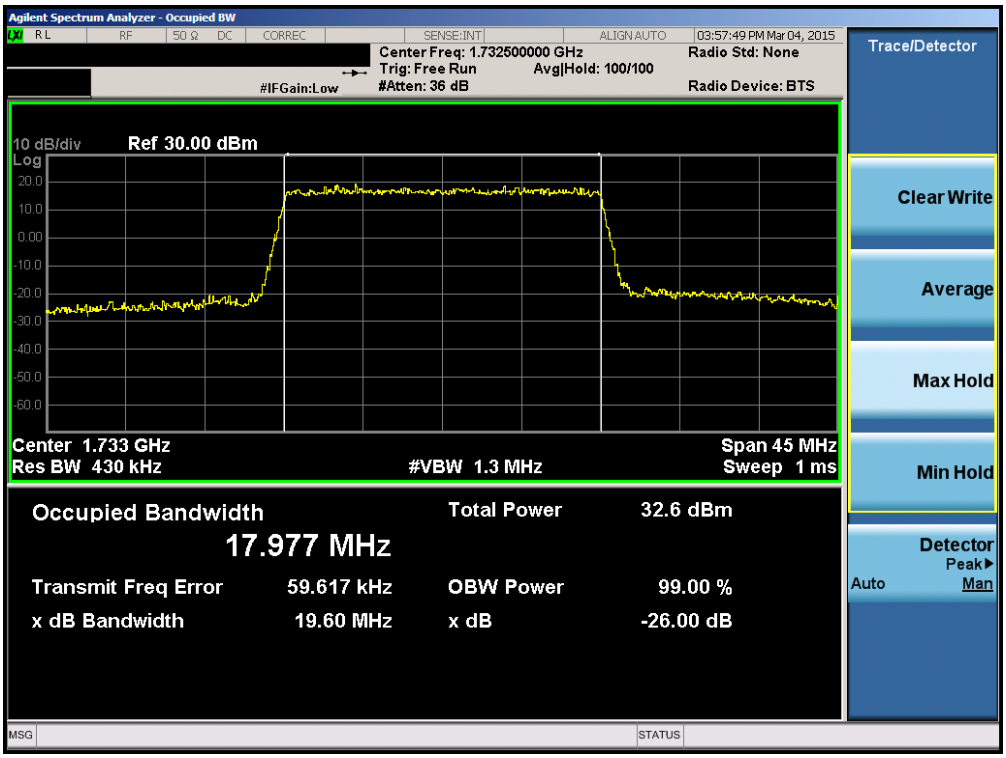
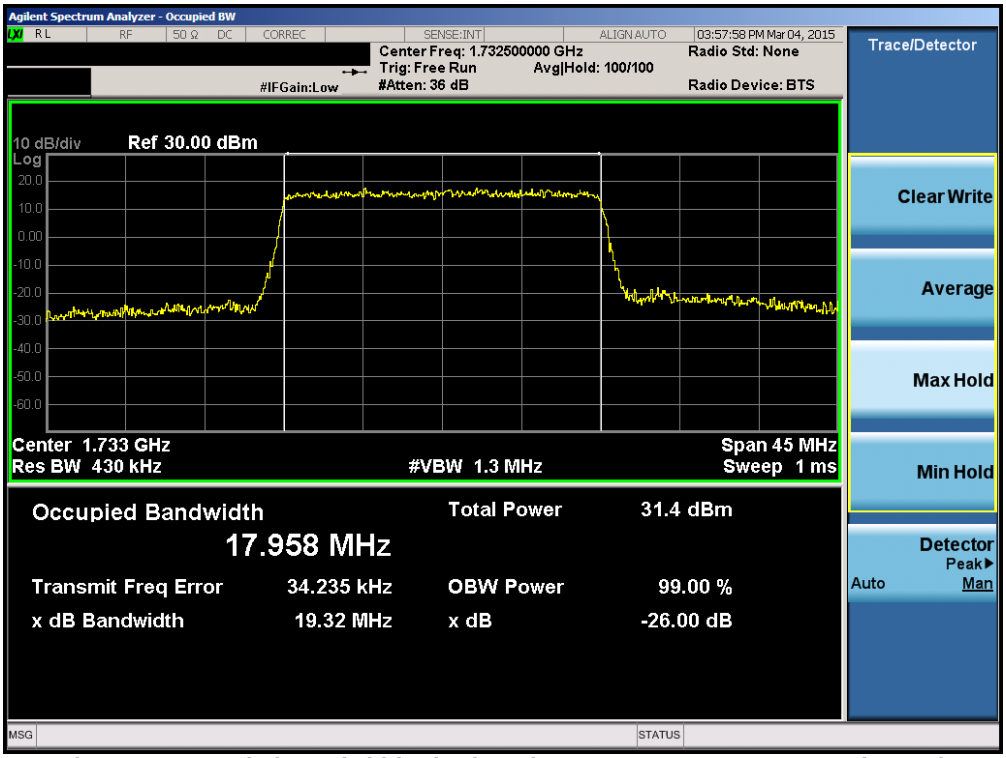


Plot 6-19. Occupied Bandwidth Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



Plot 6-20. Occupied Bandwidth Plot (Band 4 – 20.0MHz 16-QAM – RB Size 100)

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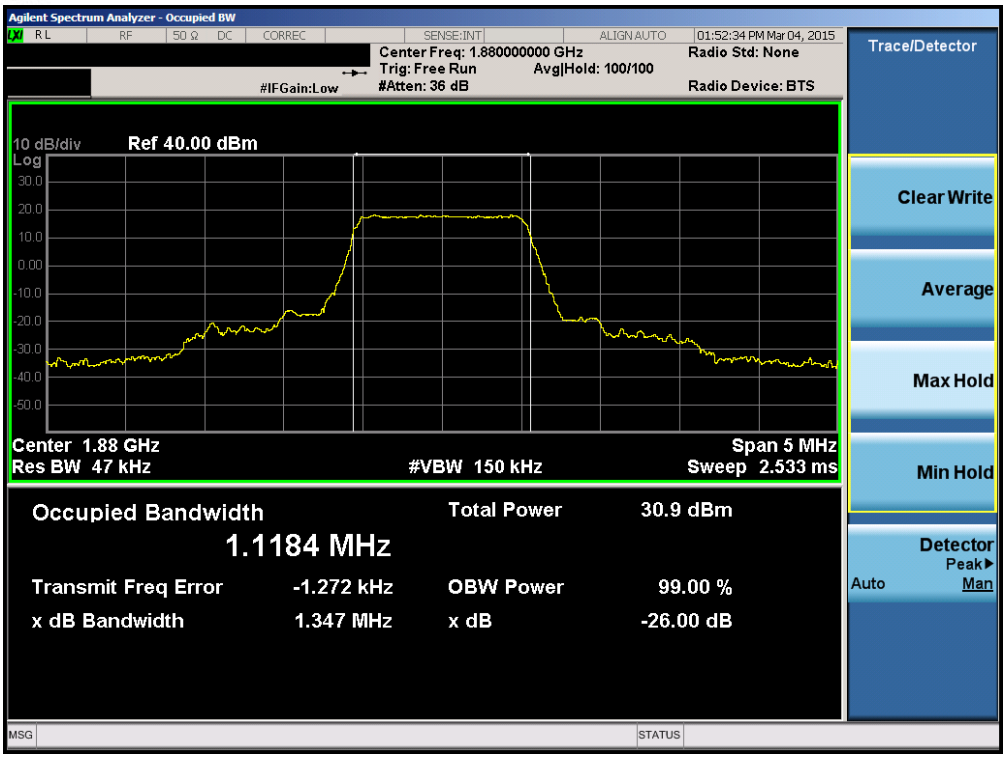
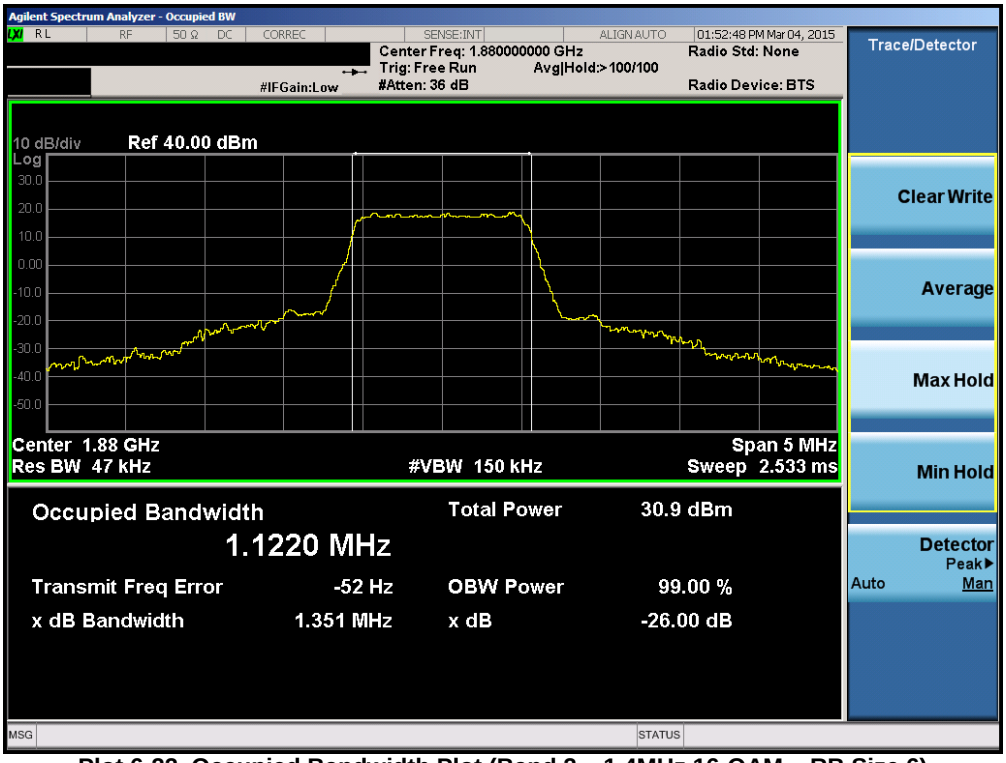


Plot 6-21. Occupied Bandwidth Plot (Band 2 – 1.4MHz QPSK – RB Size 6)



Plot 6-22. Occupied Bandwidth Plot (Band 2 – 1.4MHz 16-QAM – RB Size 6)

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Plot 6-23. Occupied Bandwidth Plot (Band 2 – 3.0MHz QPSK – RB Size 15)

Plot 6-24. Occupied Bandwidth Plot (Band 2 – 3.0MHz 16-QAM – RB Size 15)

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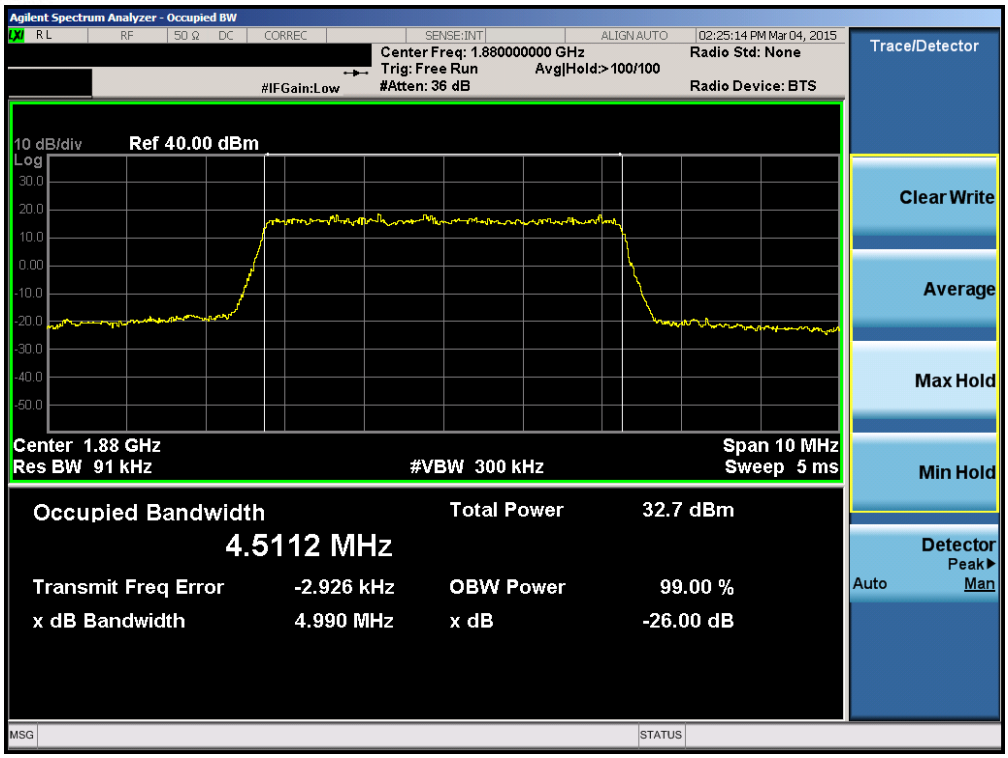

Plot 6-25. Occupied Bandwidth Plot (Band 2 – 5.0MHz QPSK – RB Size 25)

Plot 6-26. Occupied Bandwidth Plot (Band 2 – 5.0MHz 16-QAM – RB Size 25)

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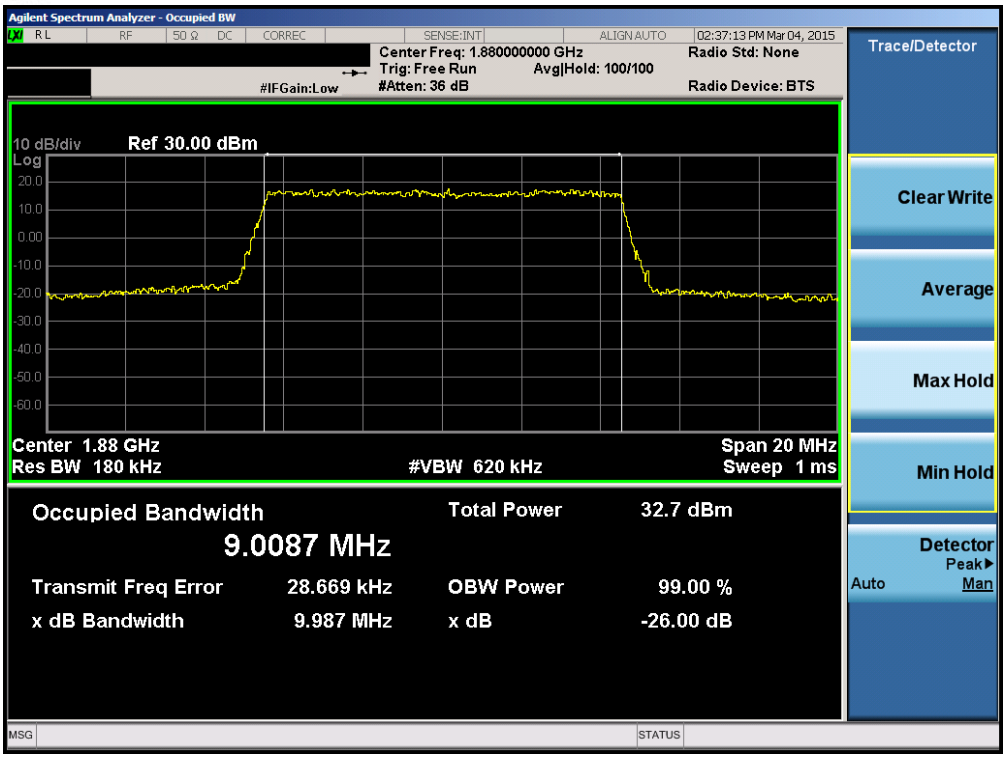
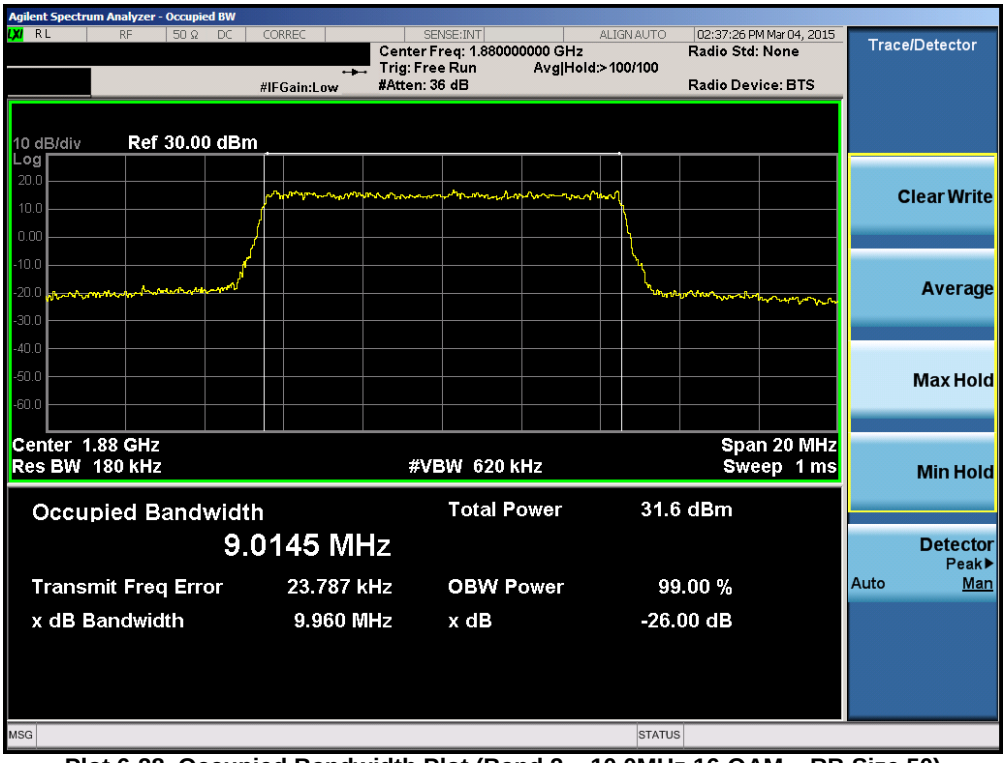


Plot 6-27. Occupied Bandwidth Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



Plot 6-28. Occupied Bandwidth Plot (Band 2 – 10.0MHz 16-QAM – RB Size 50)

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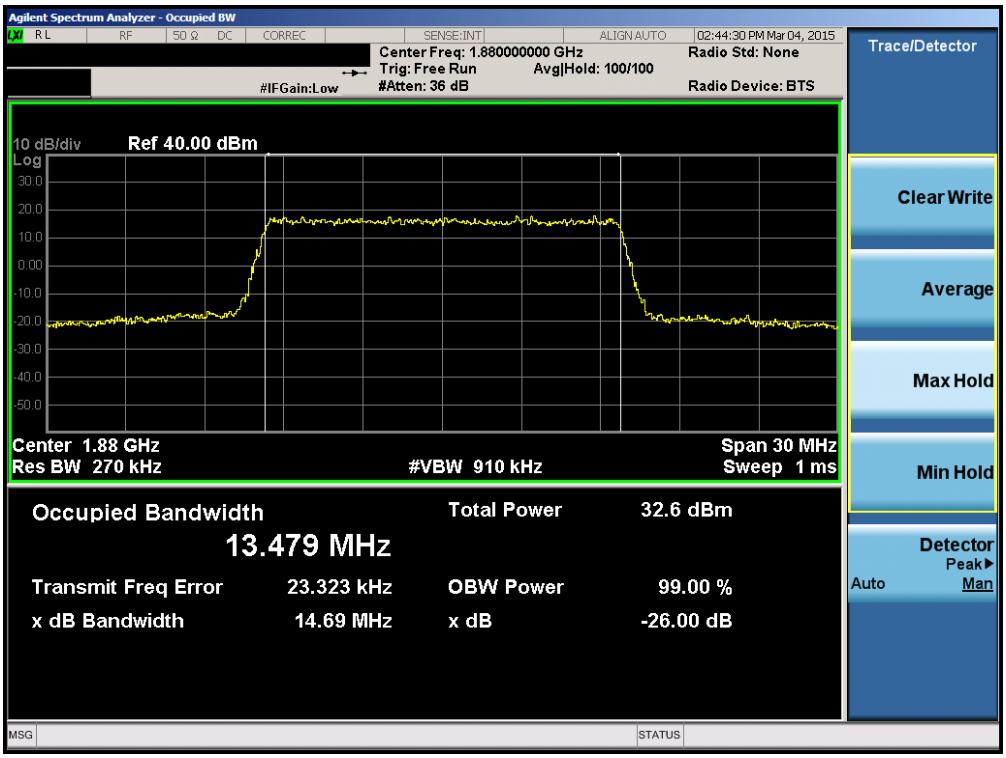
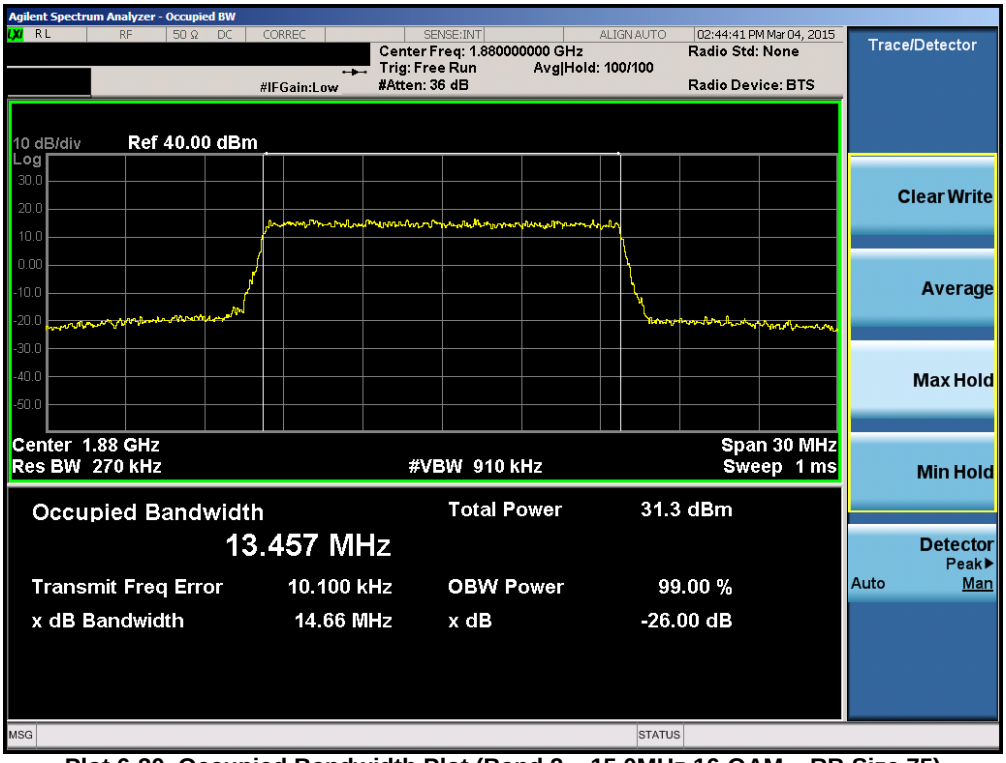


Plot 6-29. Occupied Bandwidth Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



Plot 6-30. Occupied Bandwidth Plot (Band 2 – 15.0MHz 16-QAM – RB Size 75)

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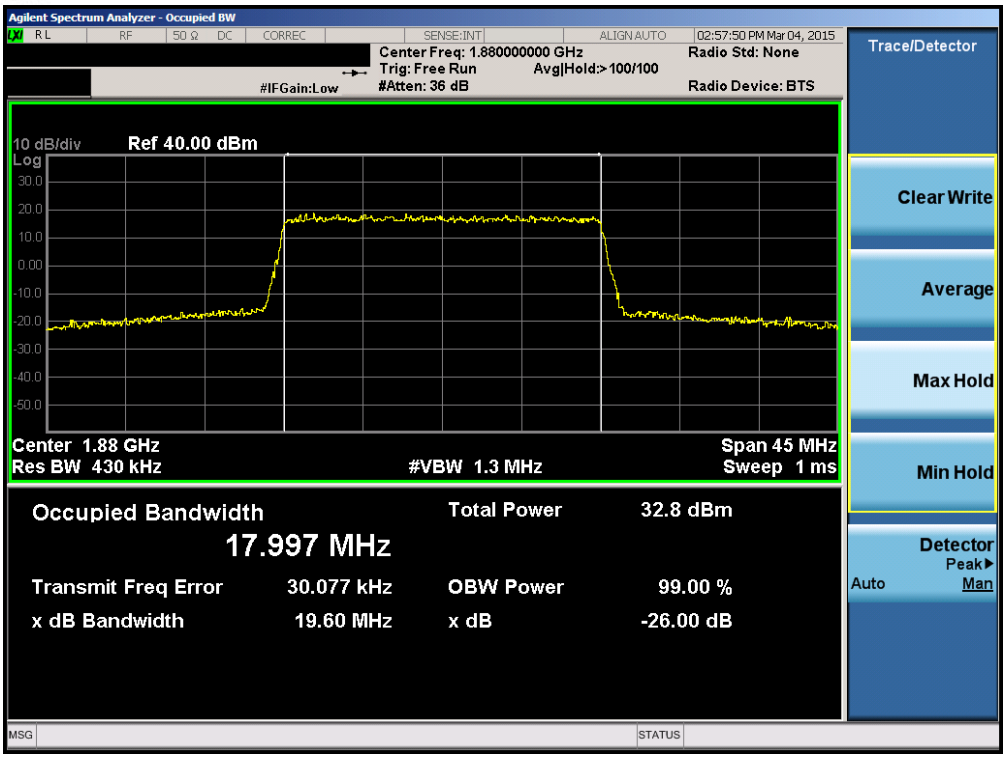
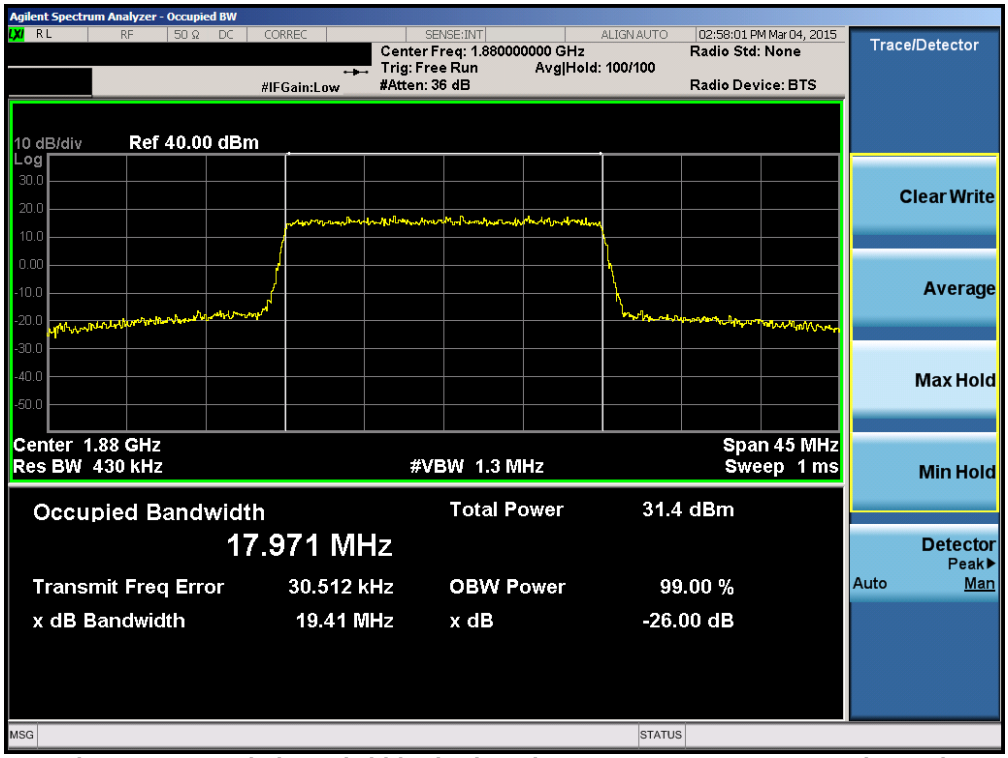


Plot 6-31. Occupied Bandwidth Plot (Band 2 – 20.0MHz QPSK – RB Size 100)



Plot 6-32. Occupied Bandwidth Plot (Band 2 – 20.0MHz 16-QAM – RB Size 100)

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6.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051 §24.238(a) §27.53(g) §27.53(h)

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.

Test Procedure Used

KDB 971168 v02r02 – 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 = max hold
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.

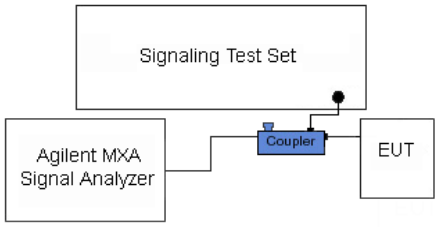

Figure 6-2. Test Instrument & Measurement Setup

Test Notes

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.

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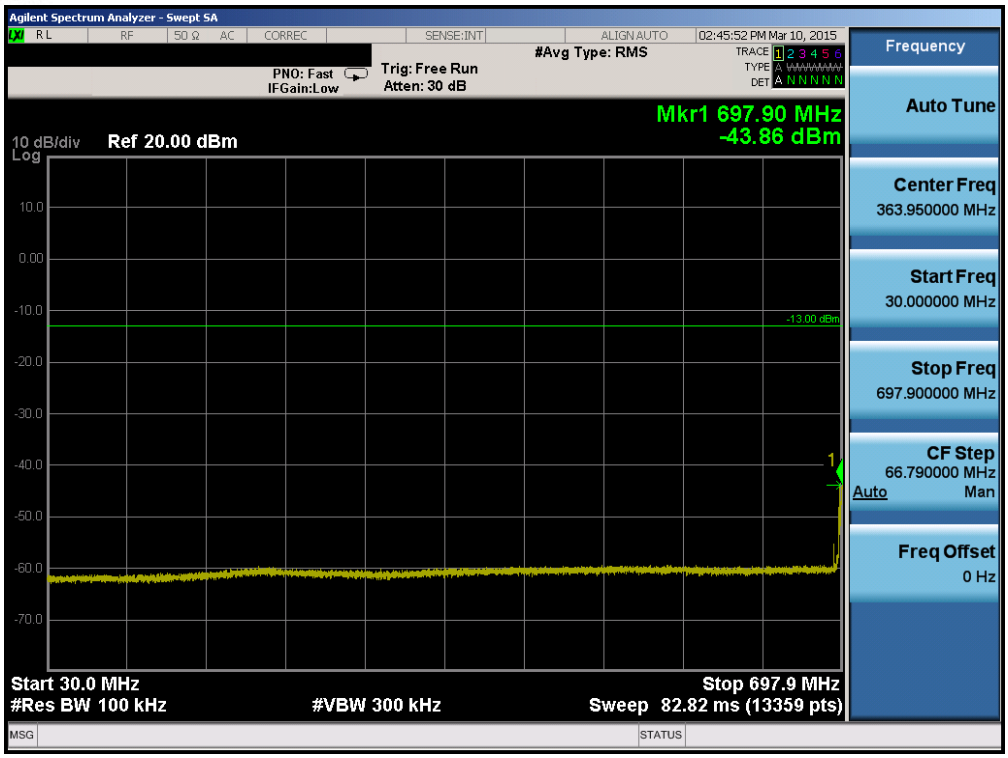
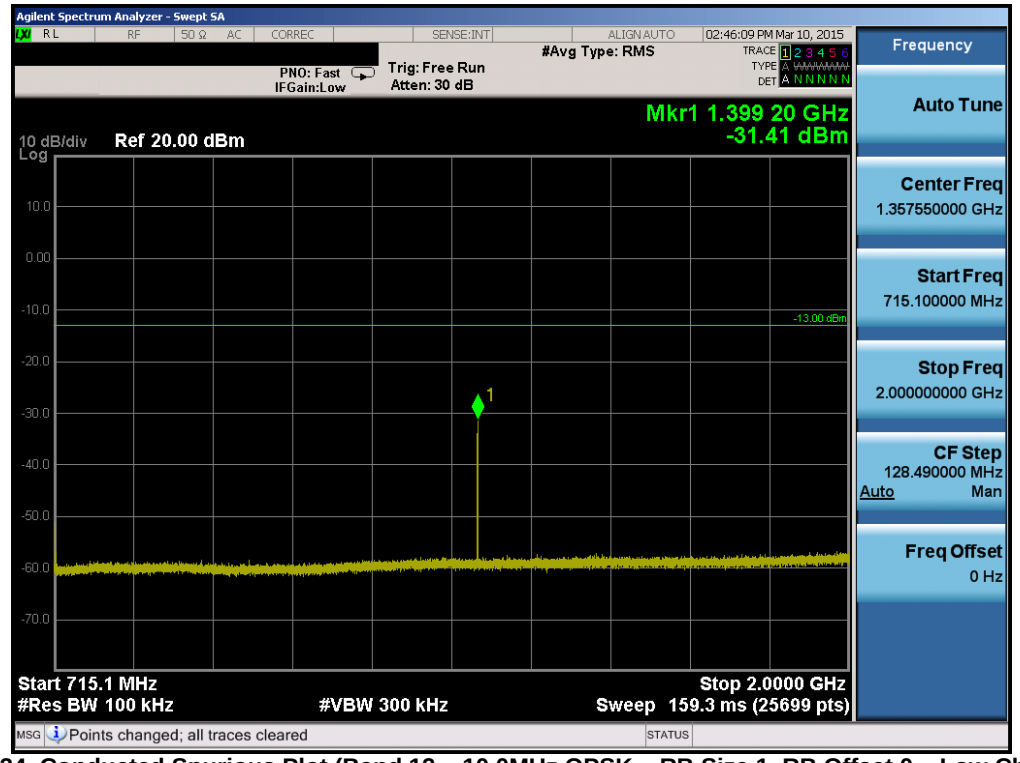


Plot 6-33. Conducted Spurious Plot (Band 12 – 10.0MHz QPSK – RB Size 1, RB Offset 0– Low Channel)



Plot 6-34. Conducted Spurious Plot (Band 12 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

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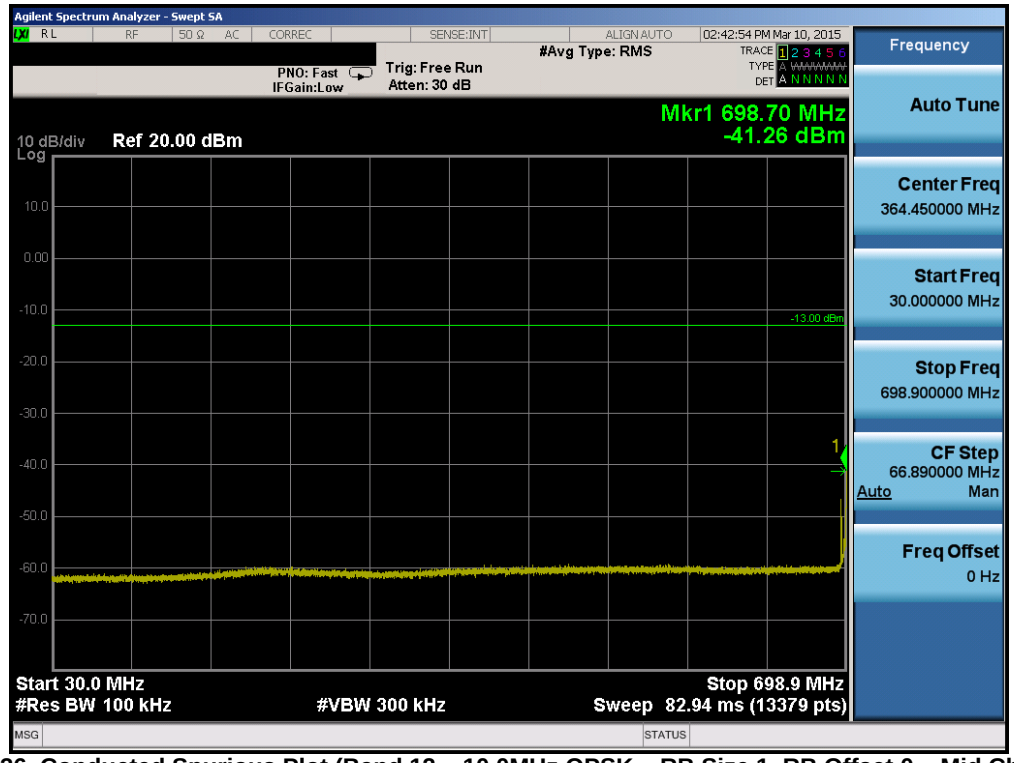
Plot 6-35. Conducted Spurious Plot (Band 12 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)



Plot 6-36. Conducted Spurious Plot (Band 12 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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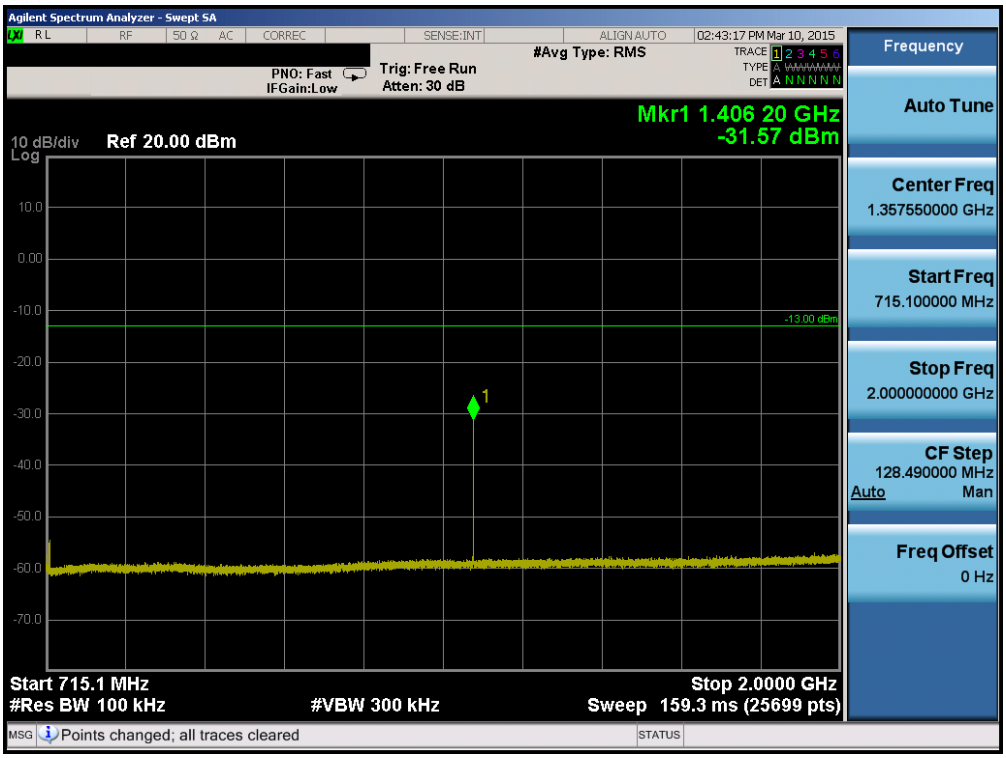
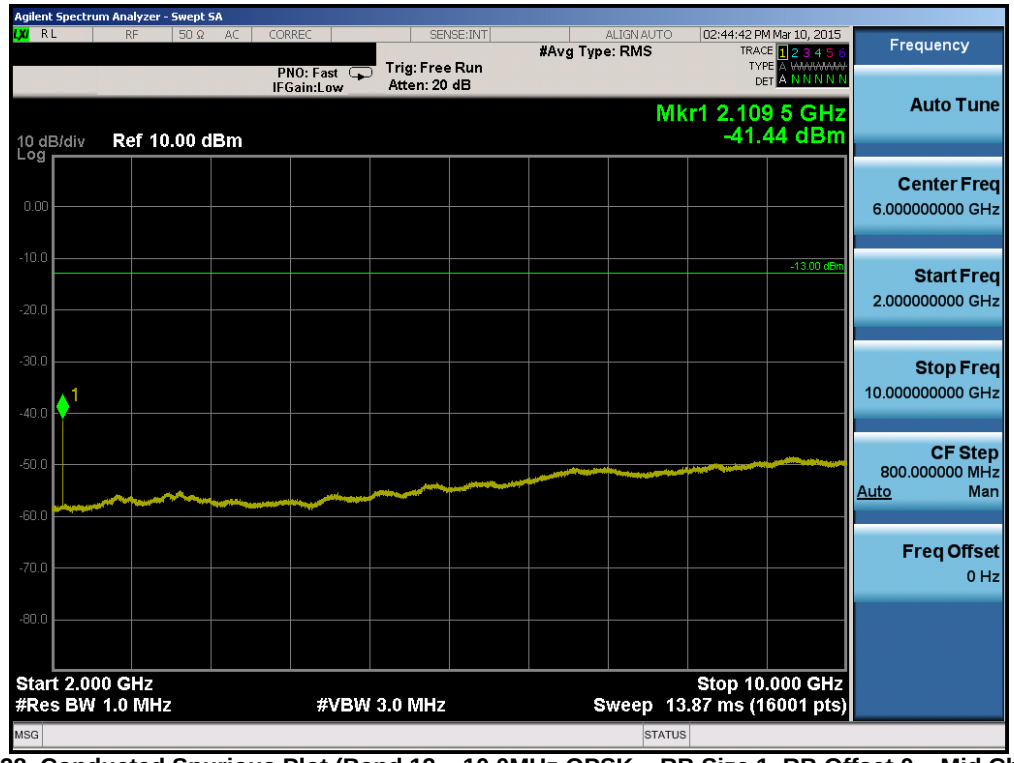


Plot 6-37. Conducted Spurious Plot (Band 12 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 6-38. Conducted Spurious Plot (Band 12 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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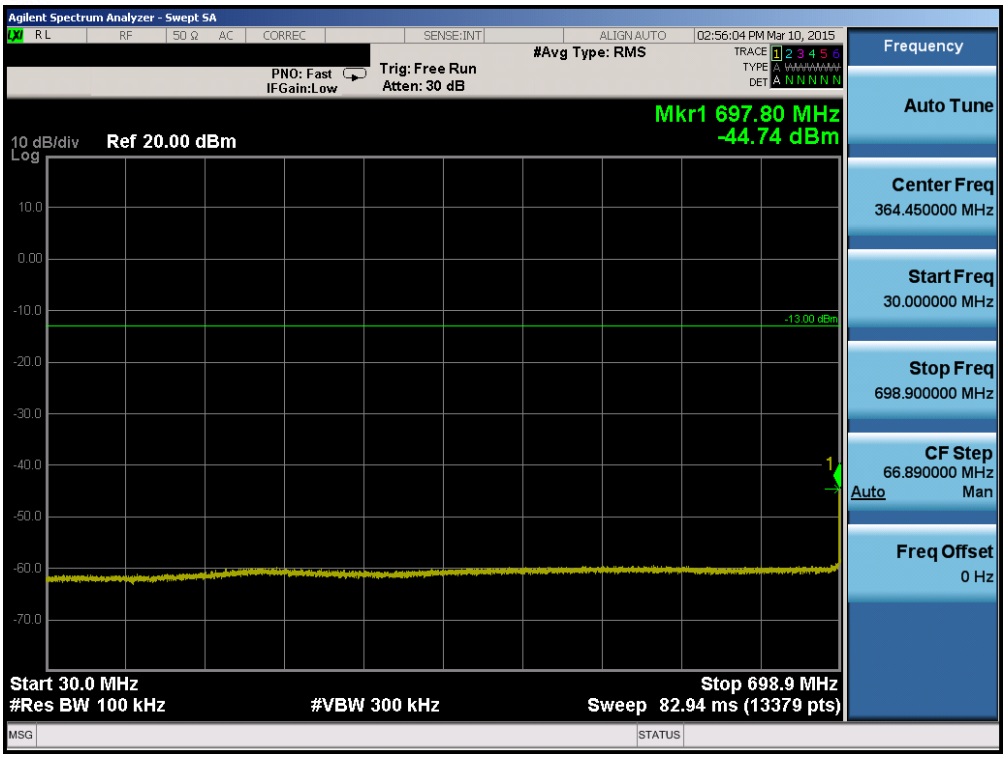
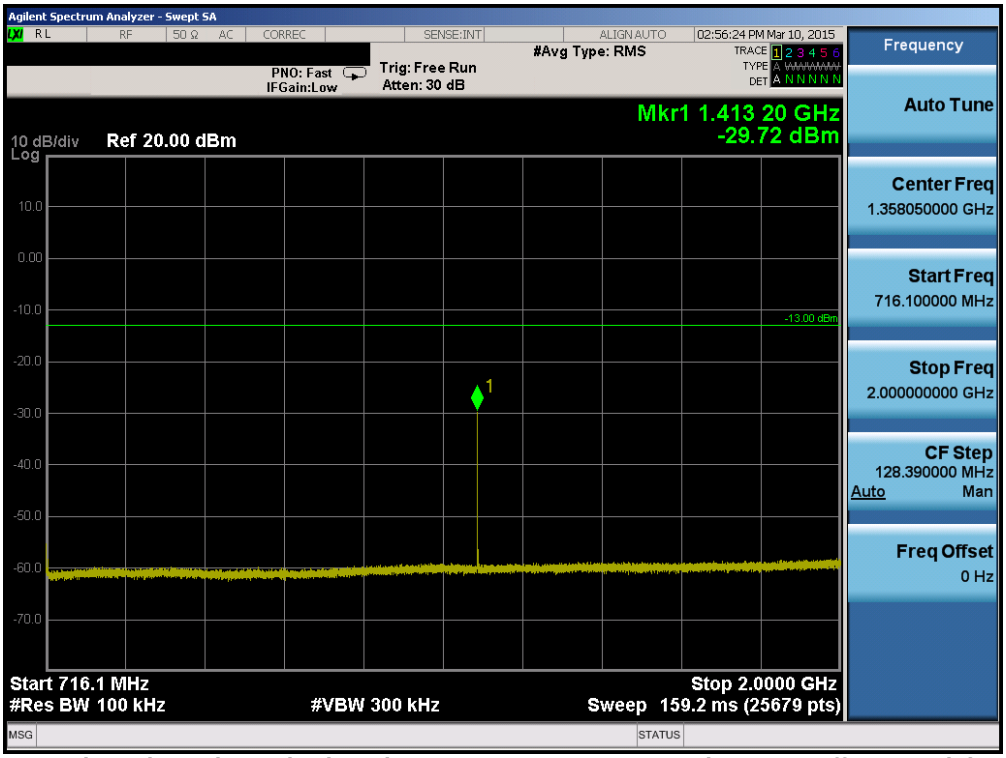


Plot 6-39. Conducted Spurious Plot (Band 12 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 6-40. Conducted Spurious Plot (Band 12 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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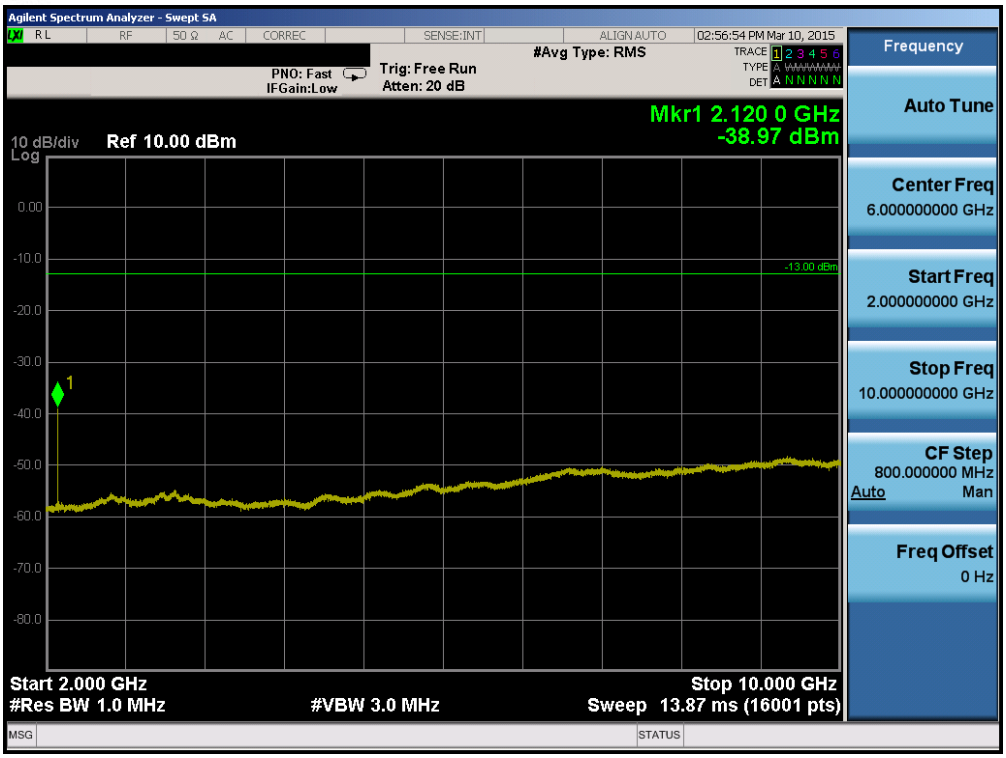
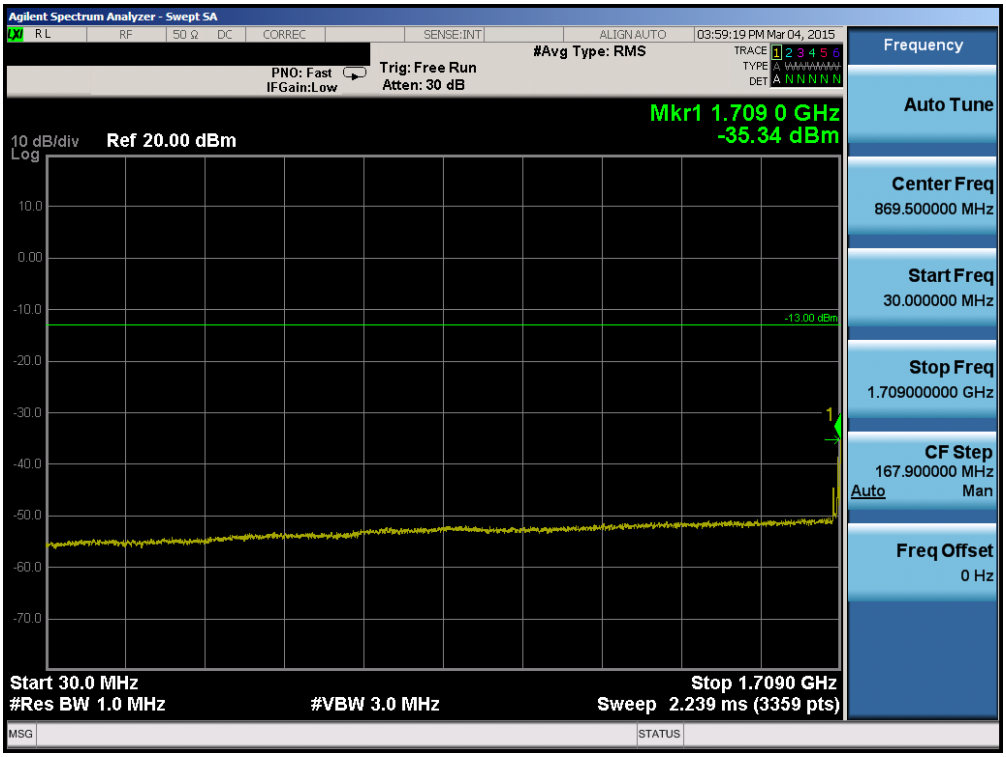


Plot 6-41. Conducted Spurious Plot (Band 12 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 6-42. Conducted Spurious Plot (Band 4 – 20.0MHz QPSK – RB Size 1, RB Offset 0– Low Channel)

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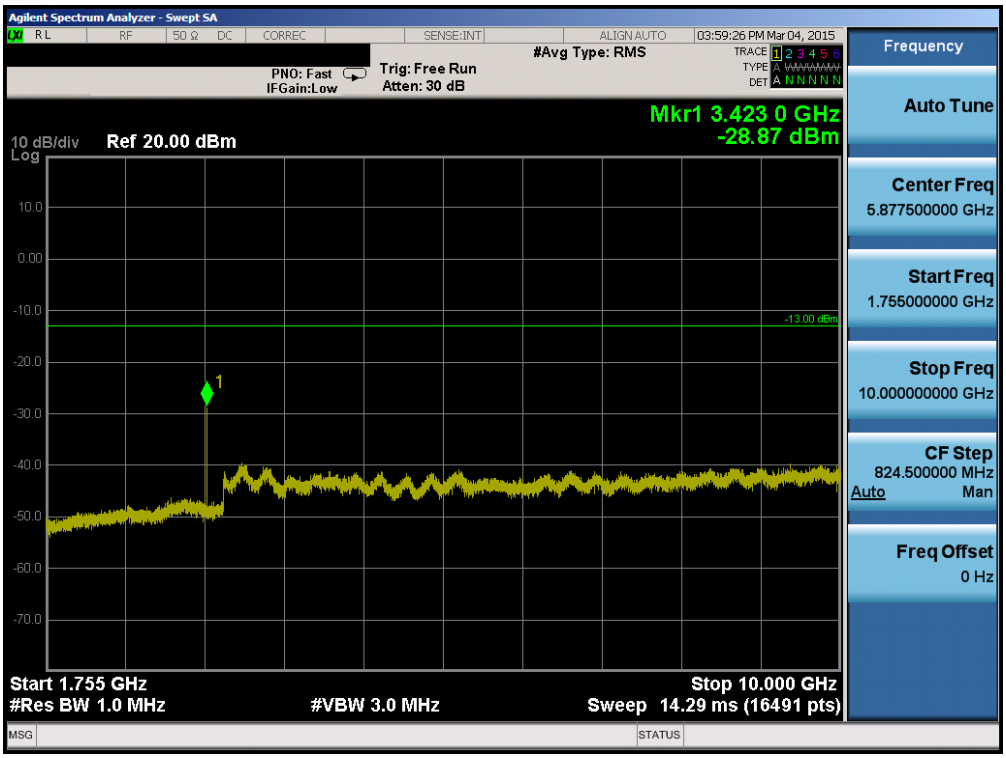
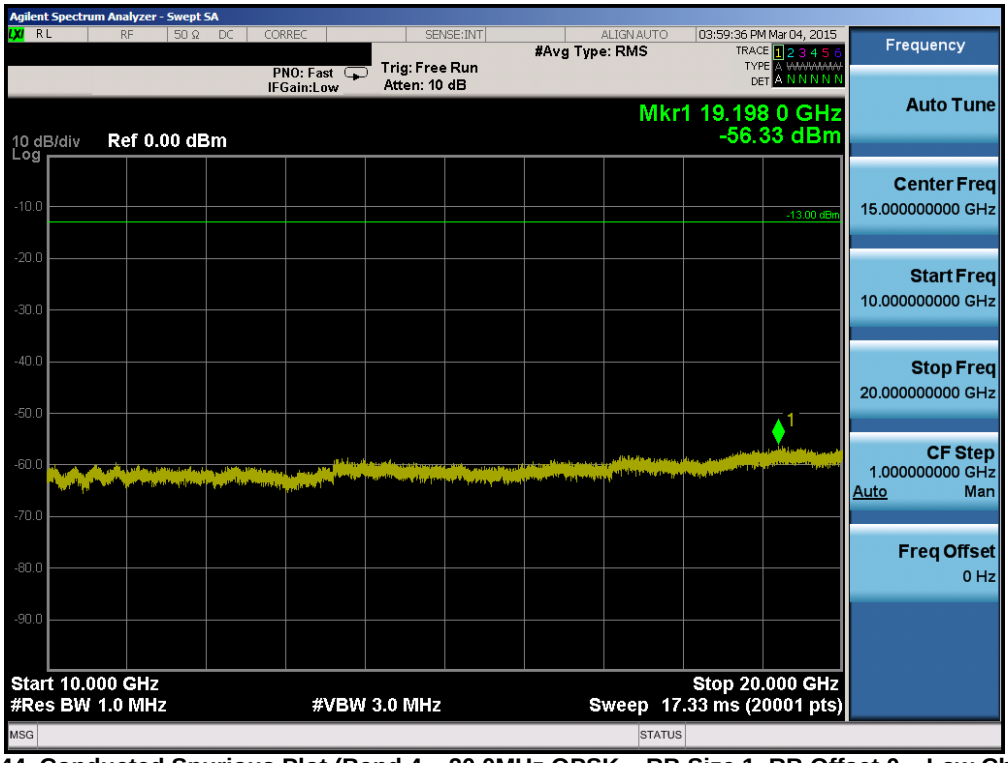


Plot 6-43. Conducted Spurious Plot (Band 4 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)



Plot 6-44. Conducted Spurious Plot (Band 4 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

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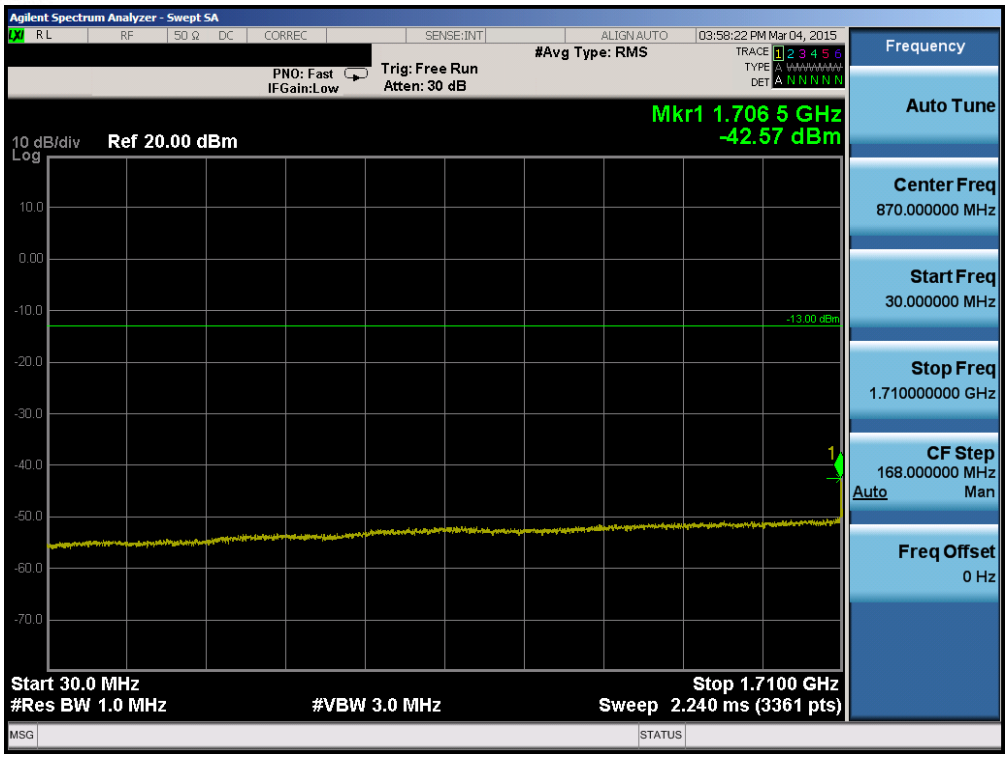
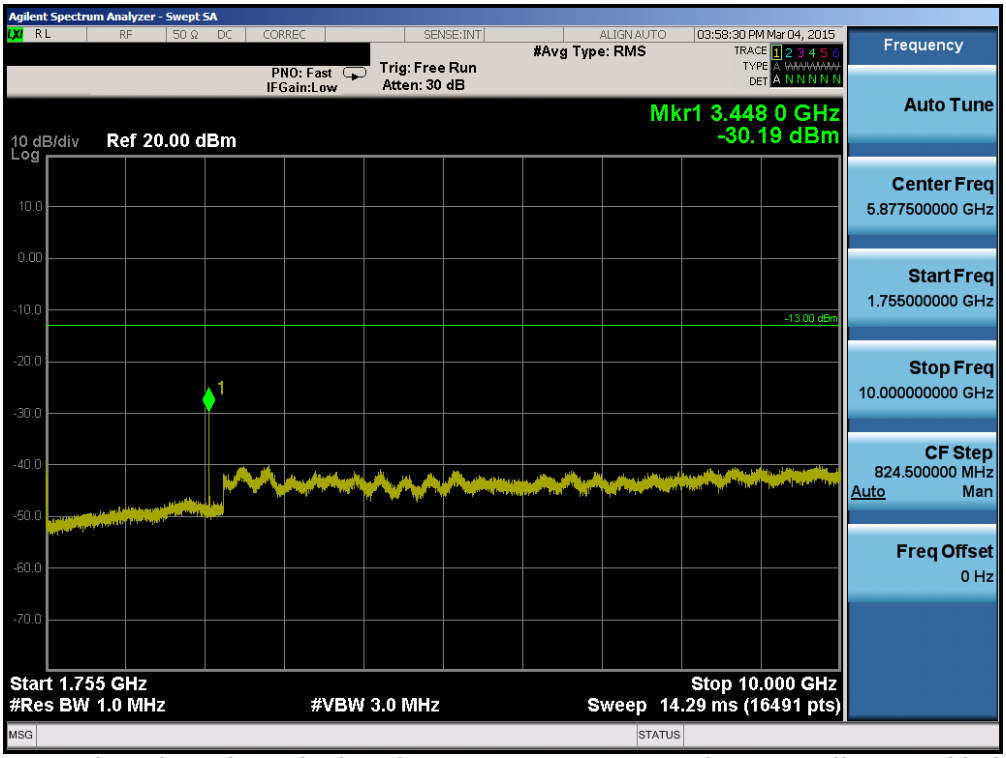


Plot 6-45. Conducted Spurious Plot (Band 4 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 6-46. Conducted Spurious Plot (Band 4 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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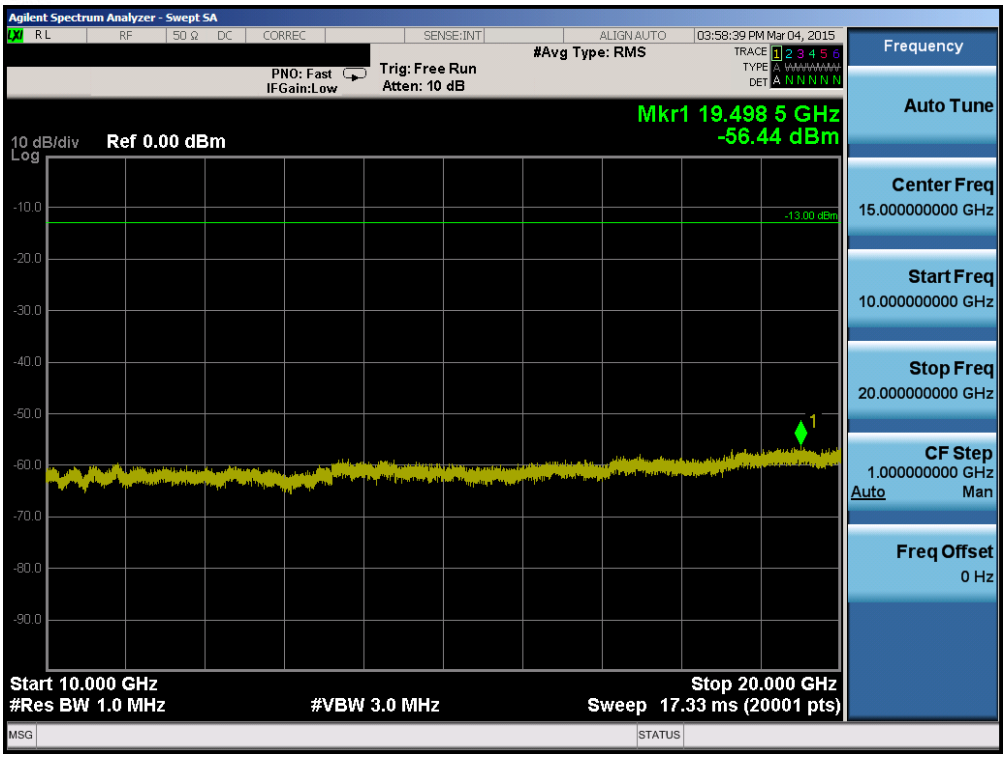
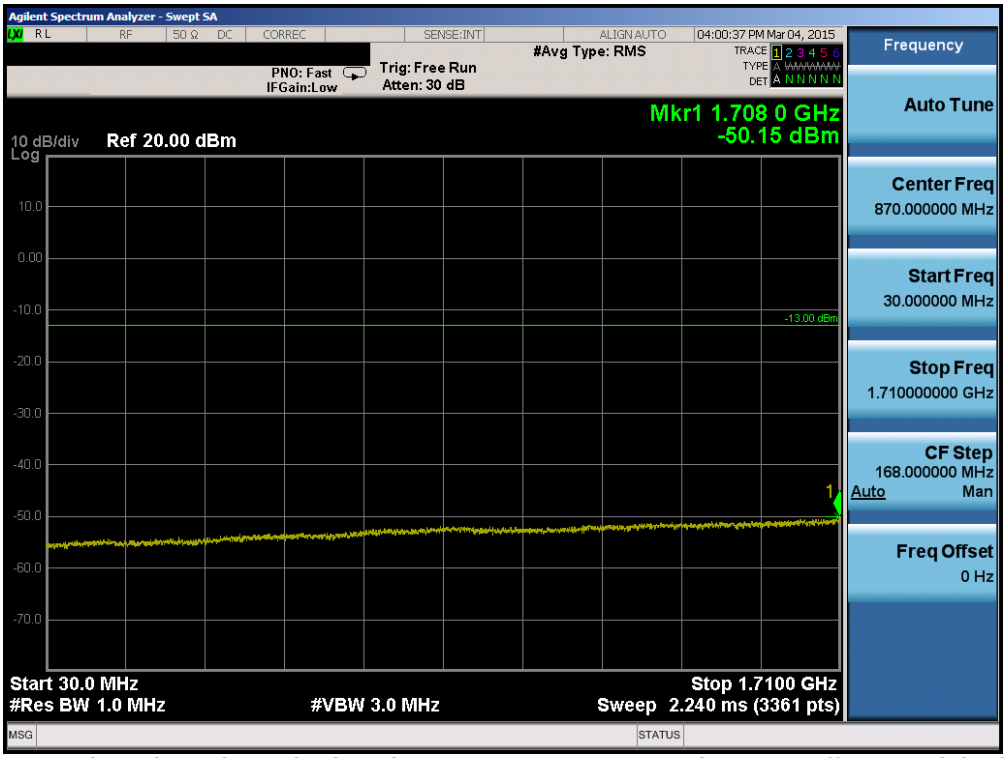


Plot 6-47. Conducted Spurious Plot (Band 4 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 6-48. Conducted Spurious Plot (Band 4 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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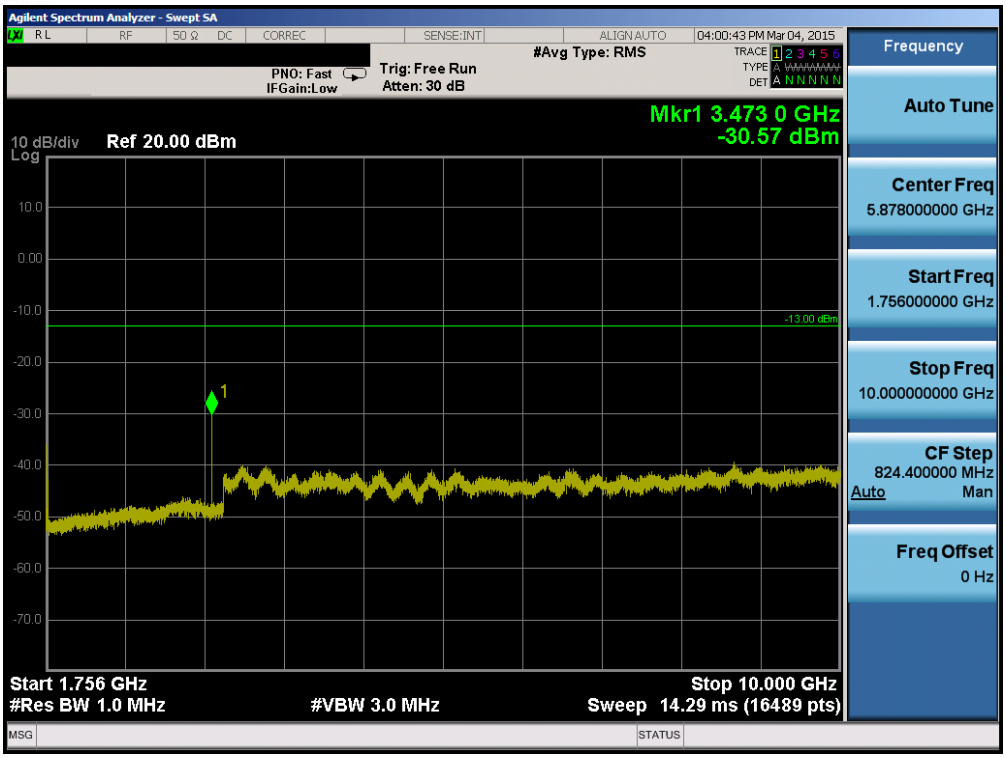
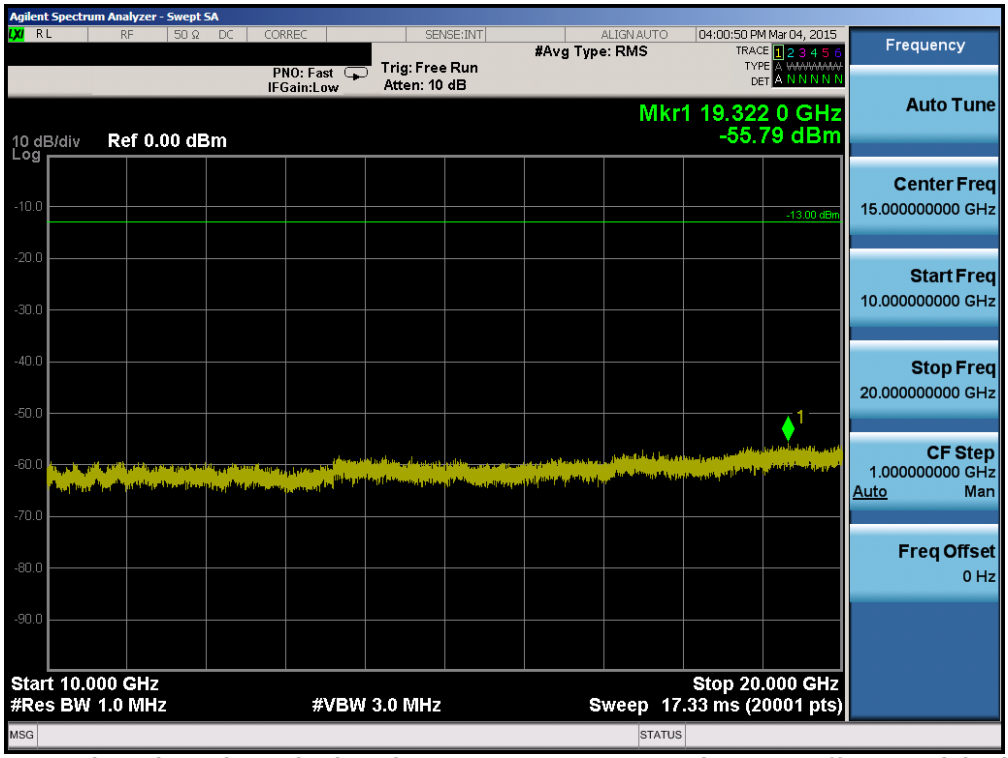


Plot 6-49. Conducted Spurious Plot (Band 4 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 6-50. Conducted Spurious Plot (Band 4 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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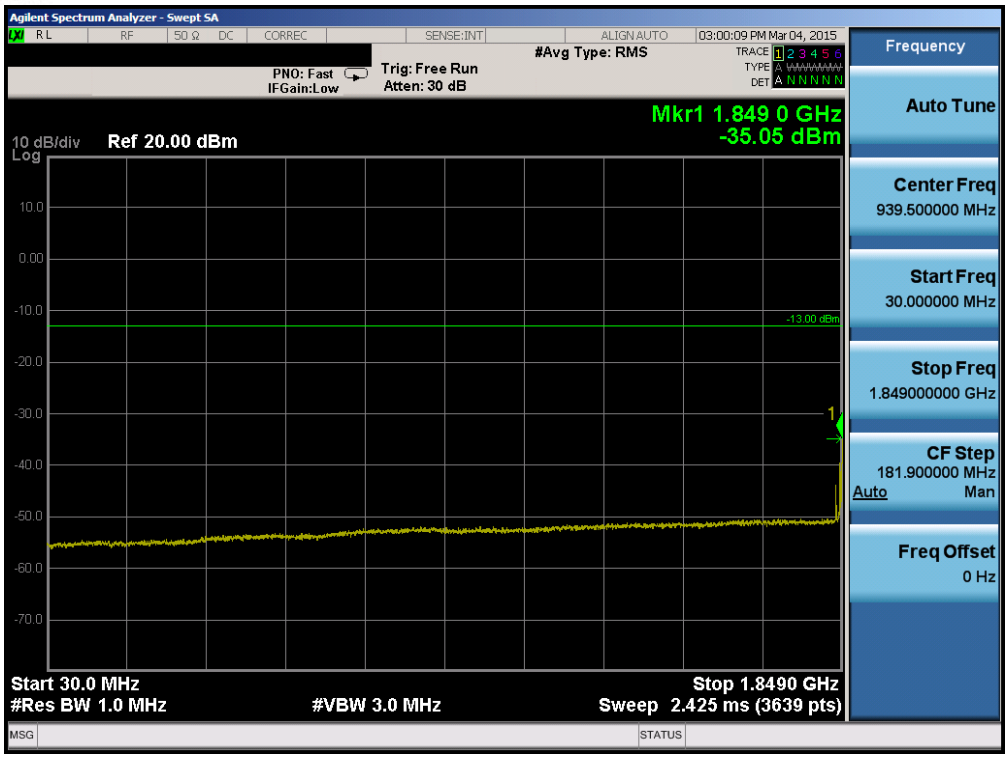
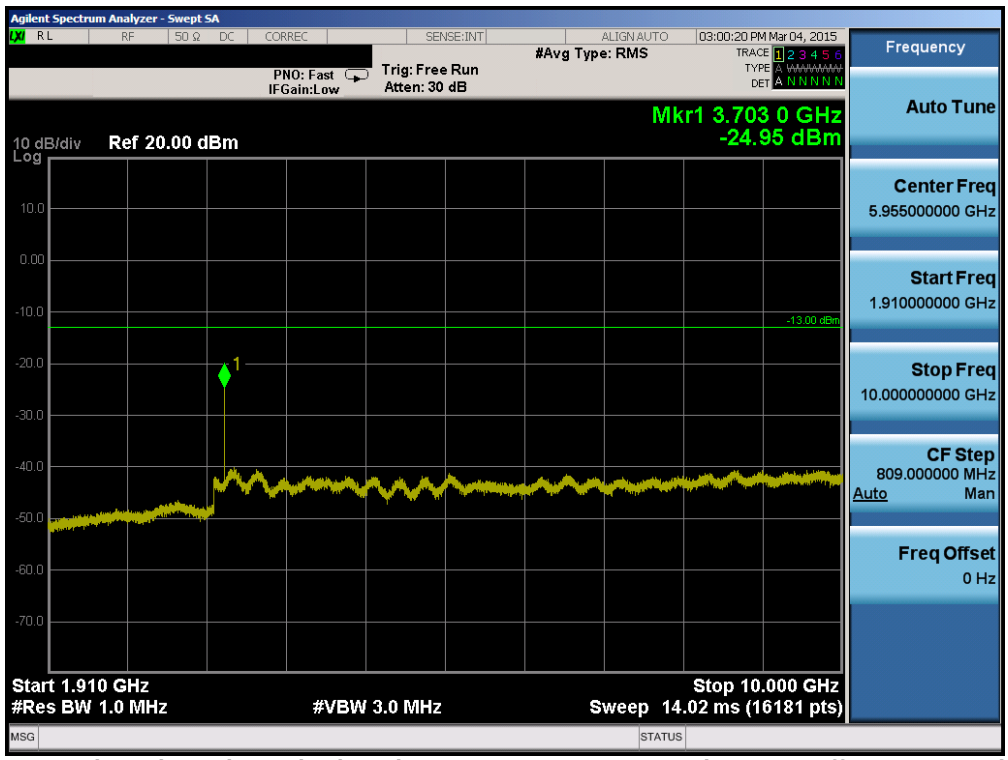


Plot 6-51. Conducted Spurious Plot (Band 2 – 20.0MHz QPSK – RB Size 1, RB Offset 0– Low Channel)



Plot 6-52. Conducted Spurious Plot (Band 2 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

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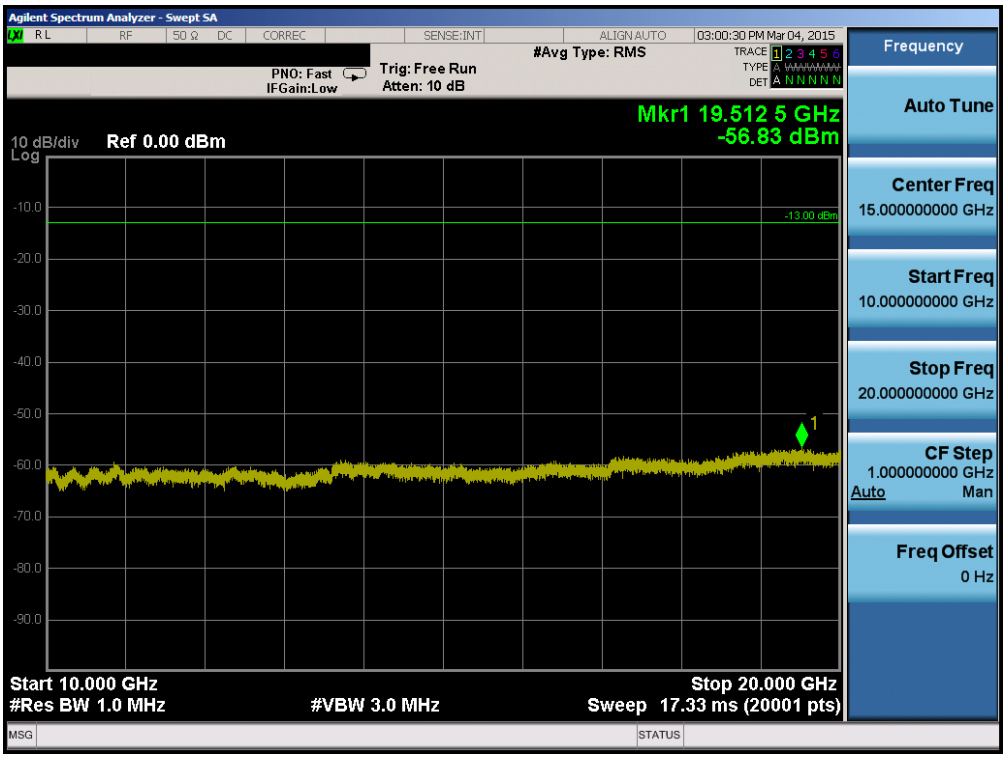
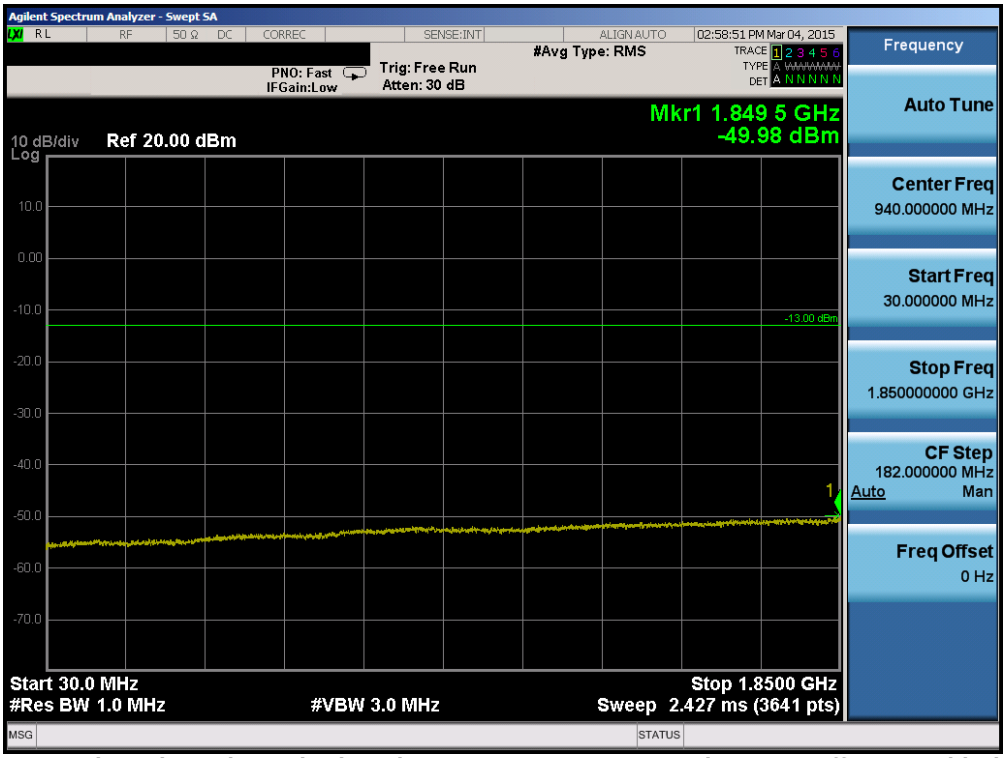


Plot 6-53. Conducted Spurious Plot (Band 2 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)



Plot 6-54. Conducted Spurious Plot (Band 2 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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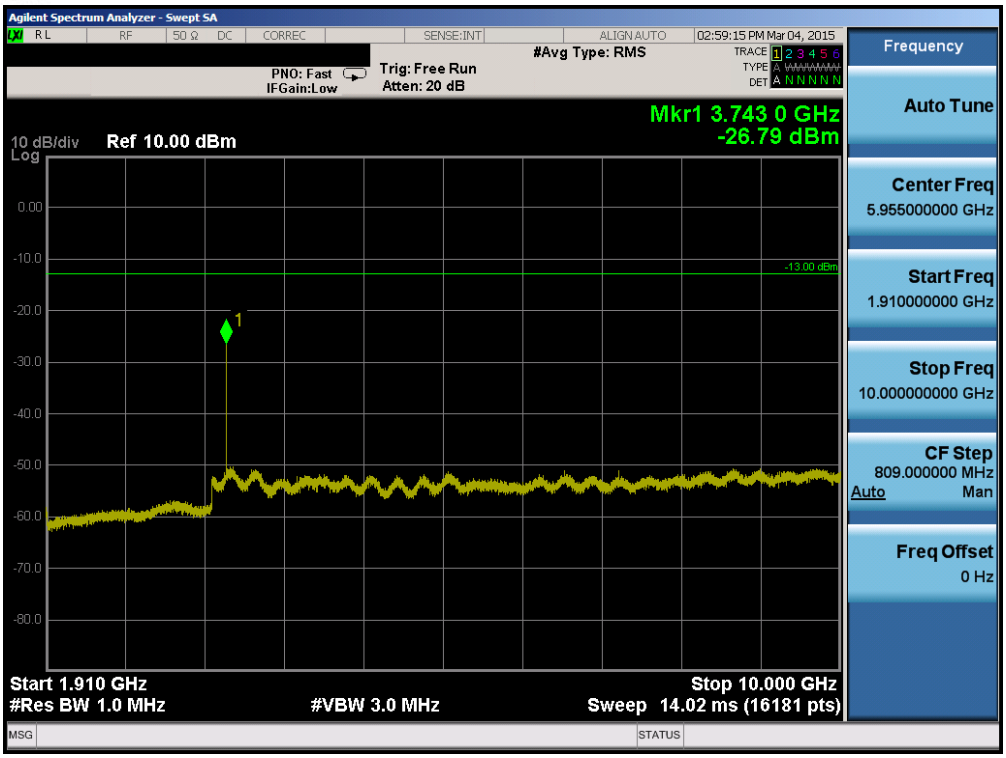
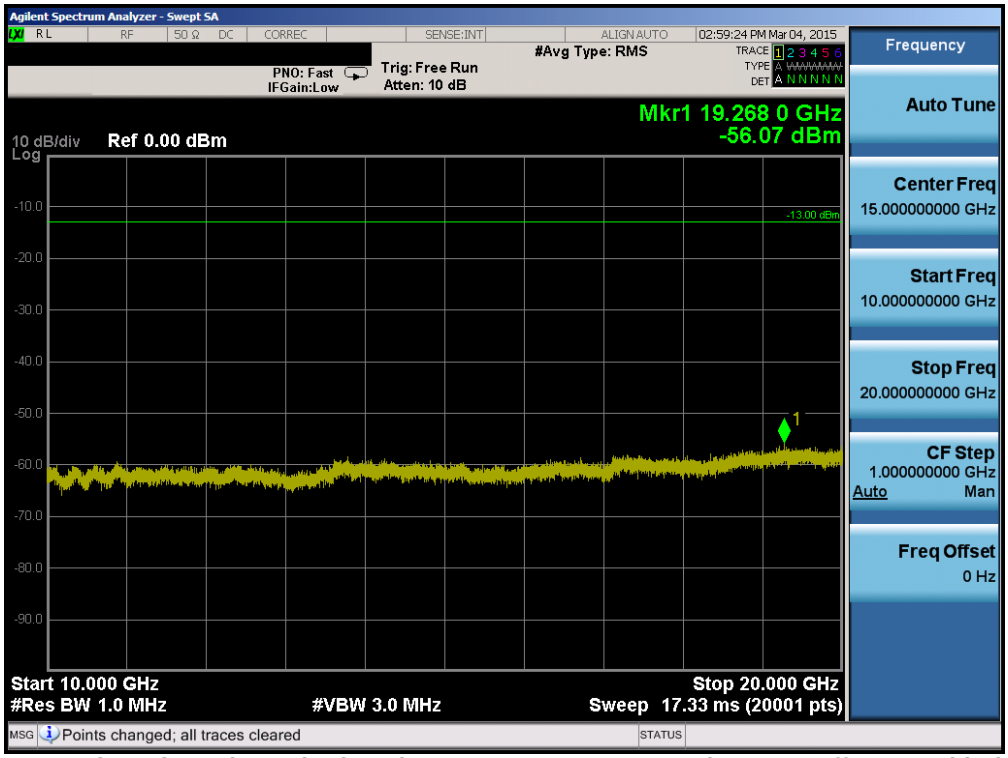


Plot 6-55. Conducted Spurious Plot (Band 2 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 6-56. Conducted Spurious Plot (Band 2 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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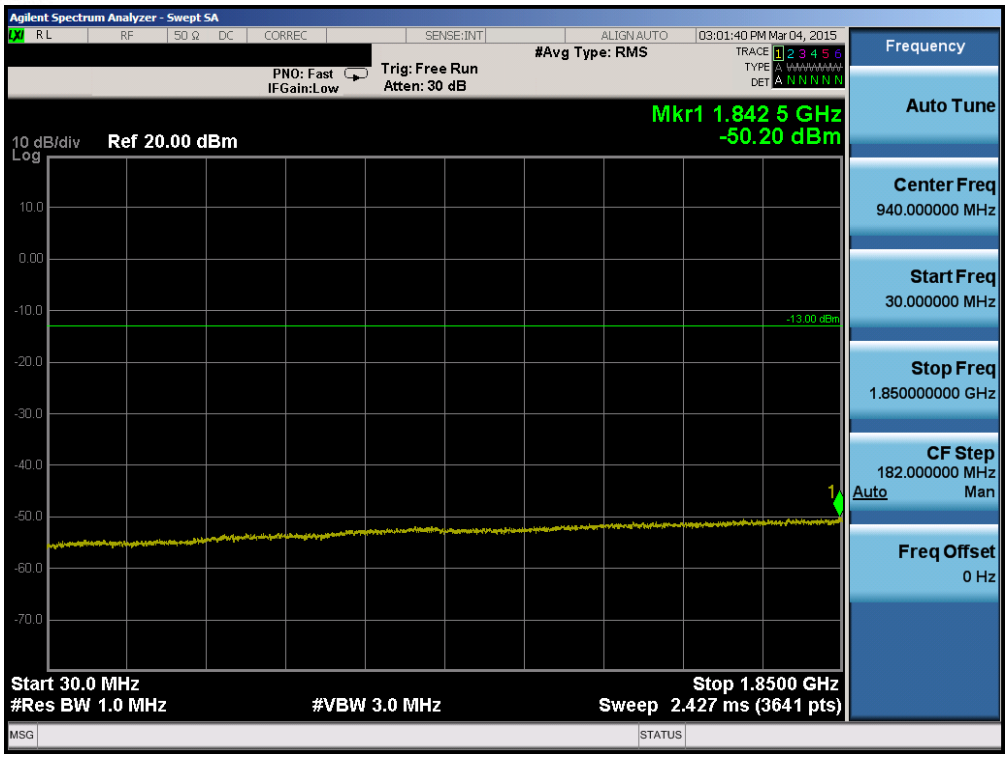
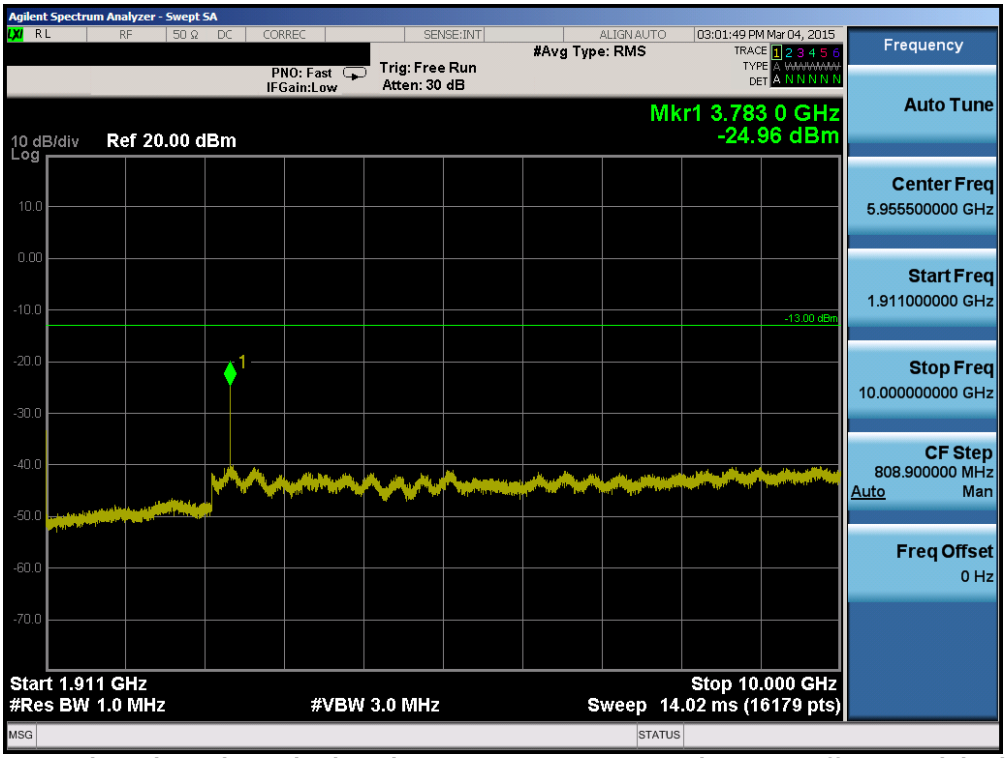


Plot 6-57. Conducted Spurious Plot (Band 2 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 6-58. Conducted Spurious Plot (Band 2 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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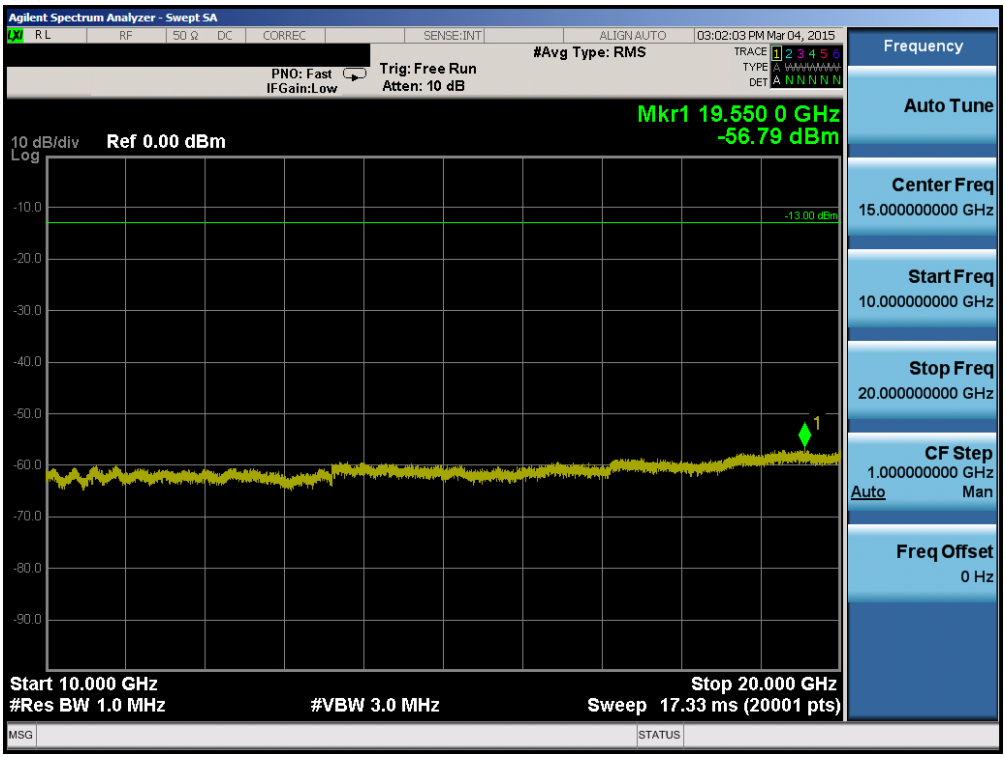

Plot 6-59. Conducted Spurious Plot (Band 2 – 20.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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6.4 Band Edge Emissions at Antenna Terminal

§2.1051 §24.238(a) §27.53(g) §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 v02r02 – Section 6.0

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW ≥ 1% of the emission bandwidth
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = max hold
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.

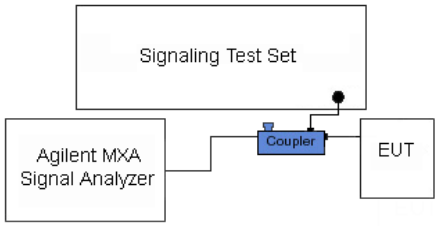

Figure 6-3. Test Instrument & Measurement Setup

Test Notes

Per 22.917(b) 24.238(a) 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.

Per 27.53(g) for operations in the 698-746 MHz band, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 30 kHz may be employed to demonstrate compliance with the out-of-band emissions limit.

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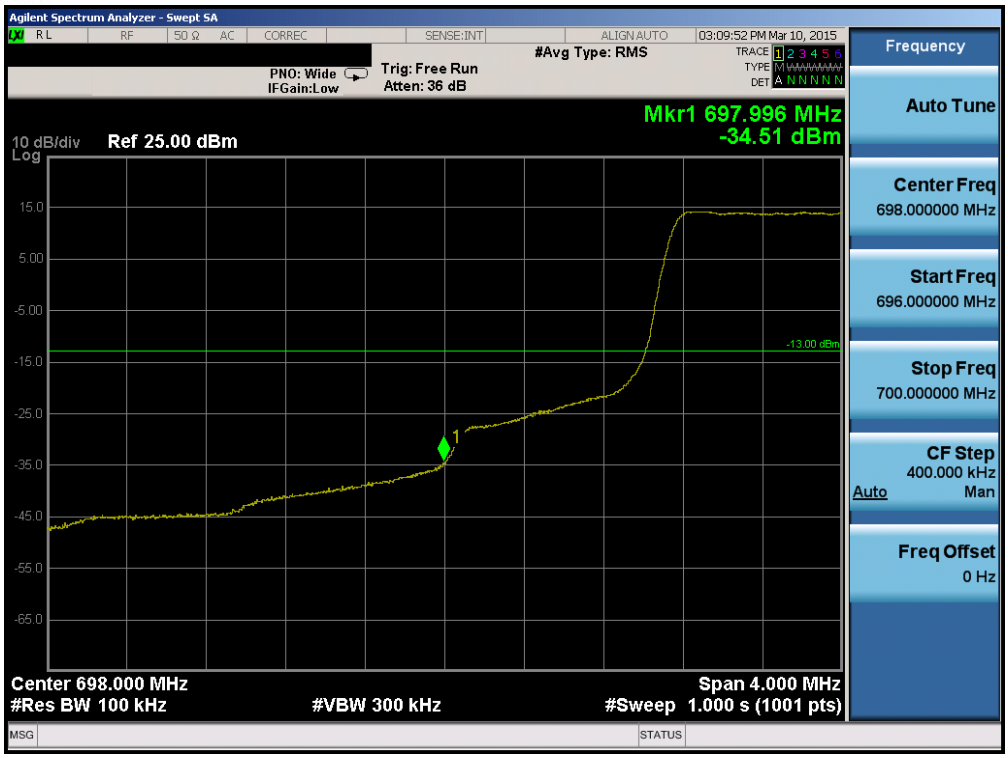
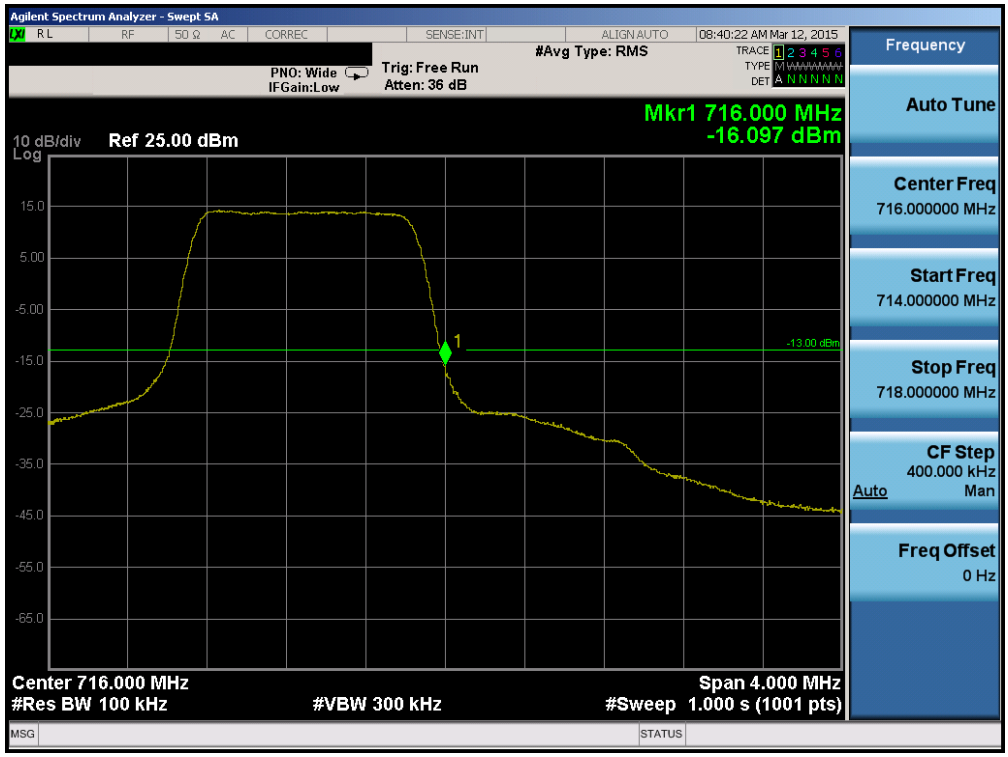


Plot 6-60. Lower Band Edge Plot (Band 12 – 1.4MHz QPSK – RB Size 6)



Plot 6-61. Upper Band Edge Plot (Band 12 – 1.4MHz QPSK – RB Size 6)

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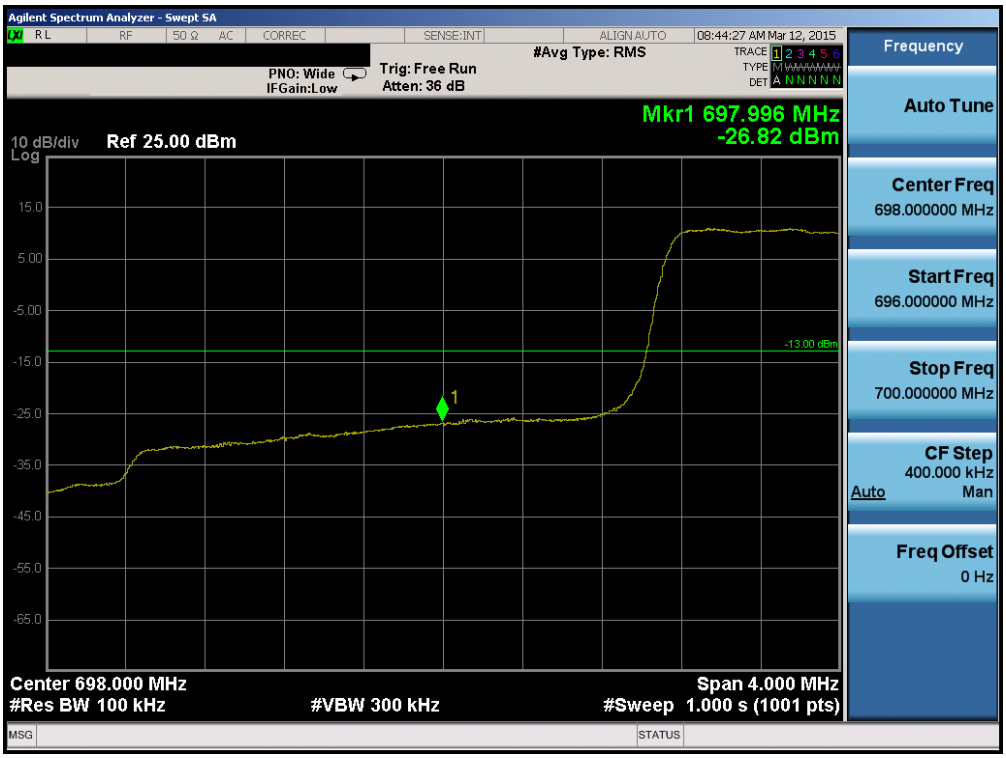

Plot 6-62. Lower Band Edge Plot (Band 12 – 3.0MHz QPSK – RB Size 15)

Plot 6-63. Upper Band Edge Plot (Band 12 – 3.0MHz QPSK – RB Size 15)

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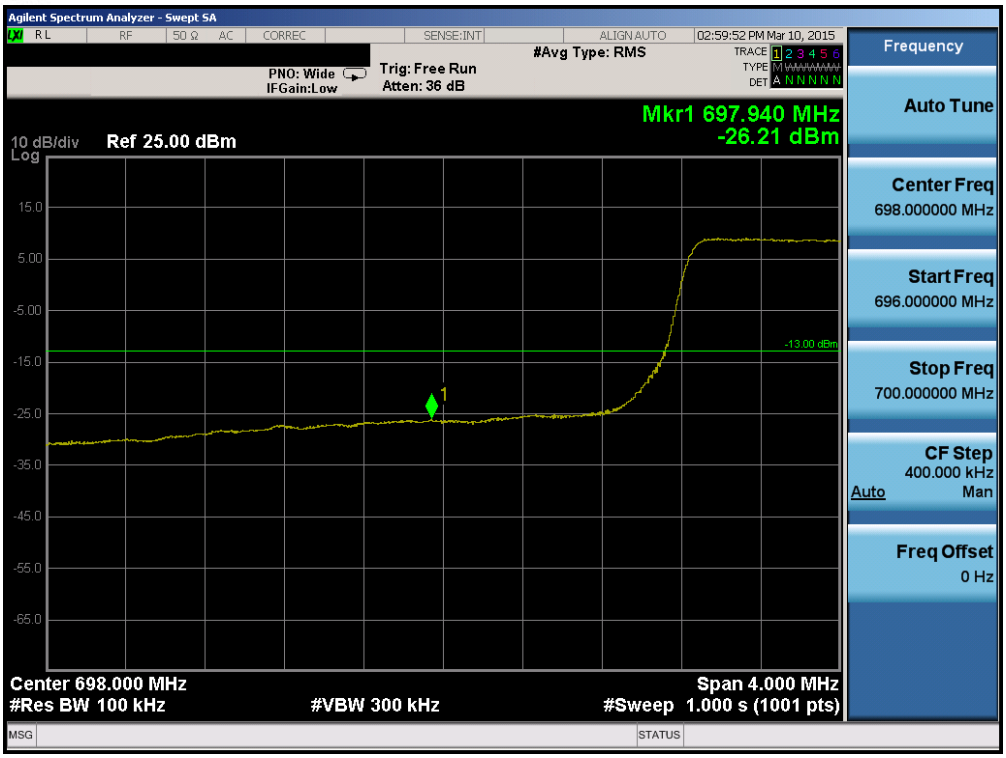

Plot 6-64. Lower Band Edge Plot (Band 12 – 5.0MHz QPSK – RB Size 25)

Plot 6-65. Upper Band Edge Plot (Band 12 – 5.0MHz QPSK – RB Size 25)

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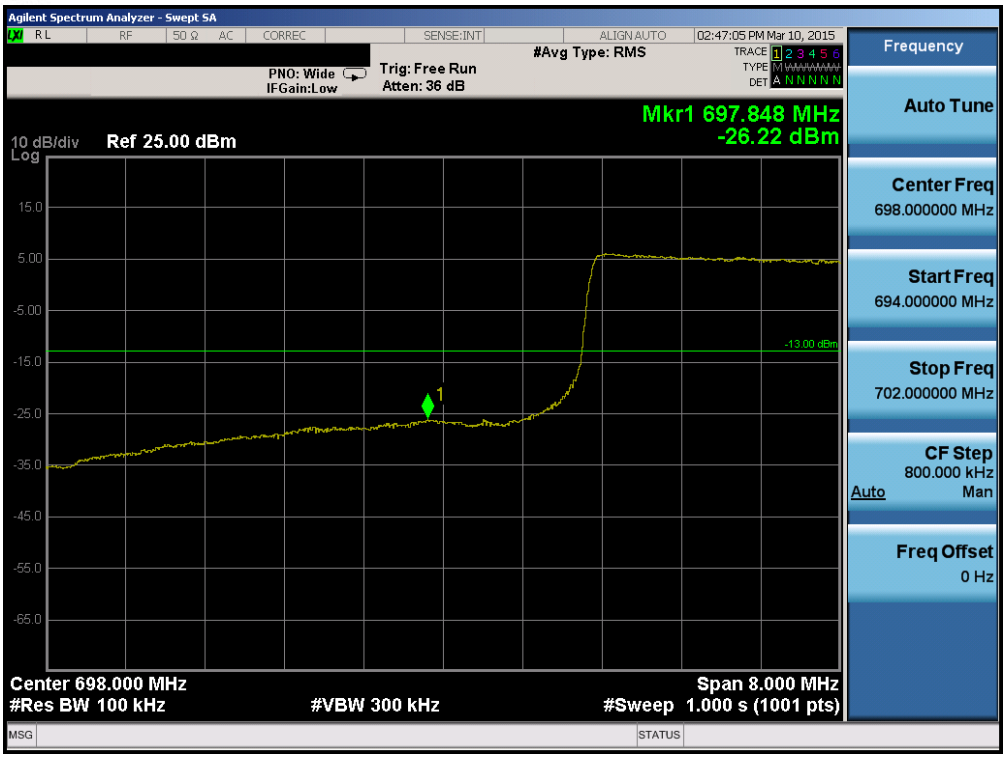

Plot 6-66. Lower Band Edge Plot (Band 12 – 10.0MHz QPSK – RB Size 50)

Plot 6-67. Upper Band Edge Plot (Band 12 – 10.0MHz QPSK – RB Size 50)

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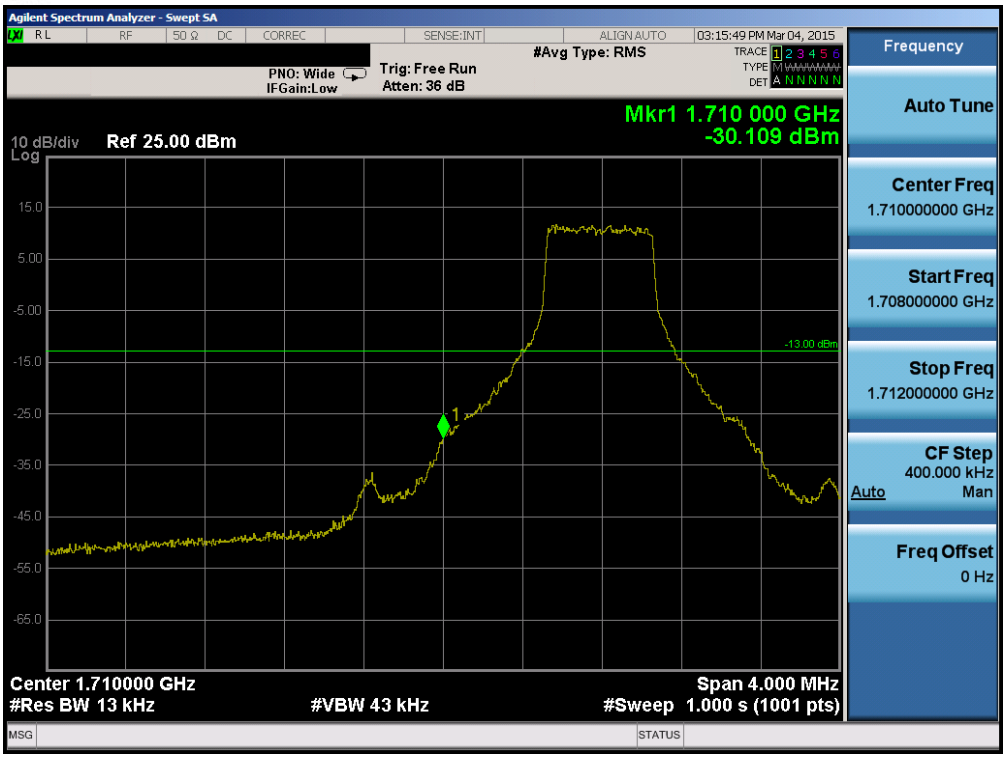

Plot 6-68. Lower Band Edge Plot (Band 4 – 1.4MHz QPSK – RB Size 6)

Plot 6-69. Lower Extended Band Edge Plot (Band 4 – 1.4MHz QPSK – RB Size 6)

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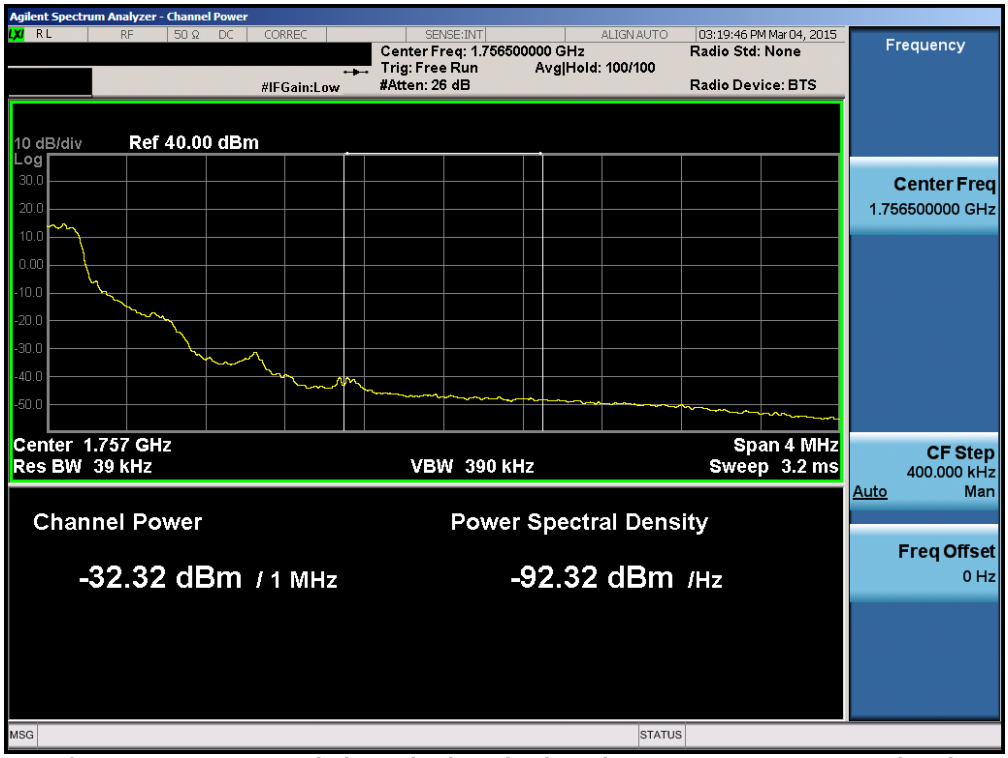
Plot 6-70. Upper Band Edge Plot (Band 4 – 1.4MHz QPSK – RB Size 6)



Plot 6-71. Upper Extended Band Edge Plot (Band 4 – 1.4MHz QPSK – RB Size 6)

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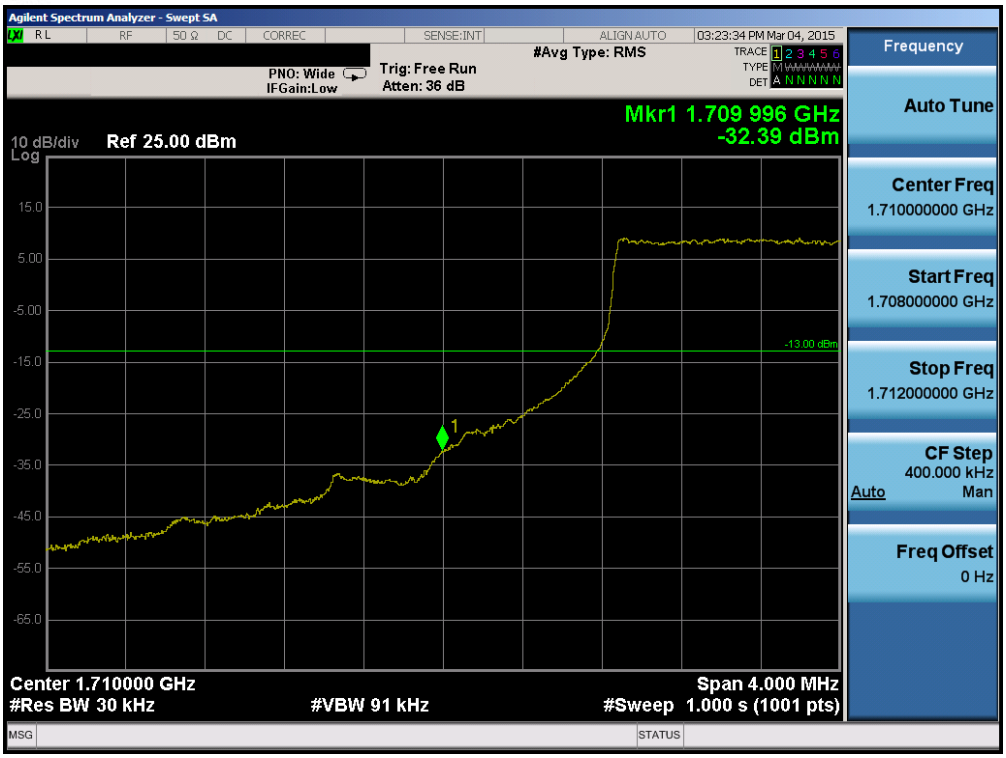

Plot 6-72. Lower Band Edge Plot (Band 4 – 3.0MHz QPSK – RB Size 15)

Plot 6-73. Lower Extended Band Edge Plot (Band 4 – 3.0MHz QPSK – RB Size 15)

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Plot 6-74. Upper Band Edge Plot (Band 4 – 3.0MHz QPSK – RB Size 15)

Plot 6-75. Upper Extended Band Edge Plot (Band 4 – 3.0MHz QPSK – RB Size 15)

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Plot 6-76. Lower Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

Plot 6-77. Lower Extended Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

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Plot 6-78. Upper Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

Plot 6-79. Upper Extended Band Edge Plot (Band 4 – 5.0MHz QPSK – RB Size 25)

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Plot 6-80. Lower Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

Plot 6-81. Lower Extended Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

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Plot 6-82. Upper Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

Plot 6-83. Upper Extended Band Edge Plot (Band 4 – 10.0MHz QPSK – RB Size 50)

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Plot 6-84. Lower Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)

Plot 6-85. Lower Extended Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)

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Plot 6-86. Upper Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)

Plot 6-87. Upper Extended Band Edge Plot (Band 4 – 15.0MHz QPSK – RB Size 75)

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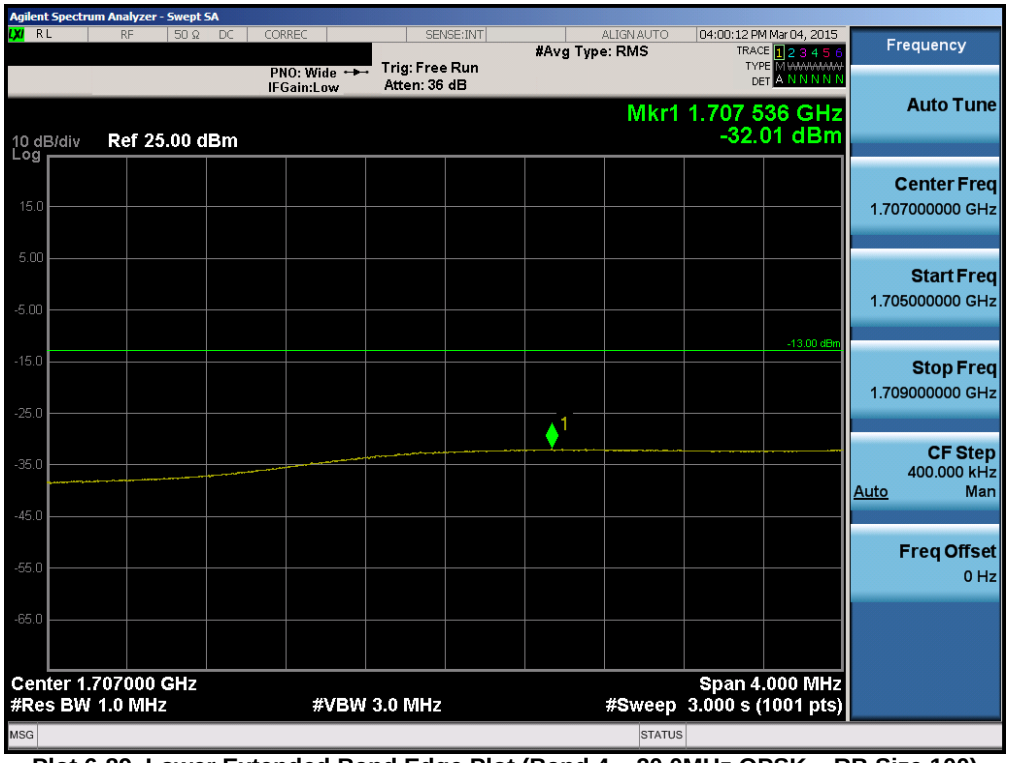
Plot 6-88. Lower Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)



Plot 6-89. Lower Extended Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)

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Plot 6-90. Upper Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)

Plot 6-91. Upper Extended Band Edge Plot (Band 4 – 20.0MHz QPSK – RB Size 100)

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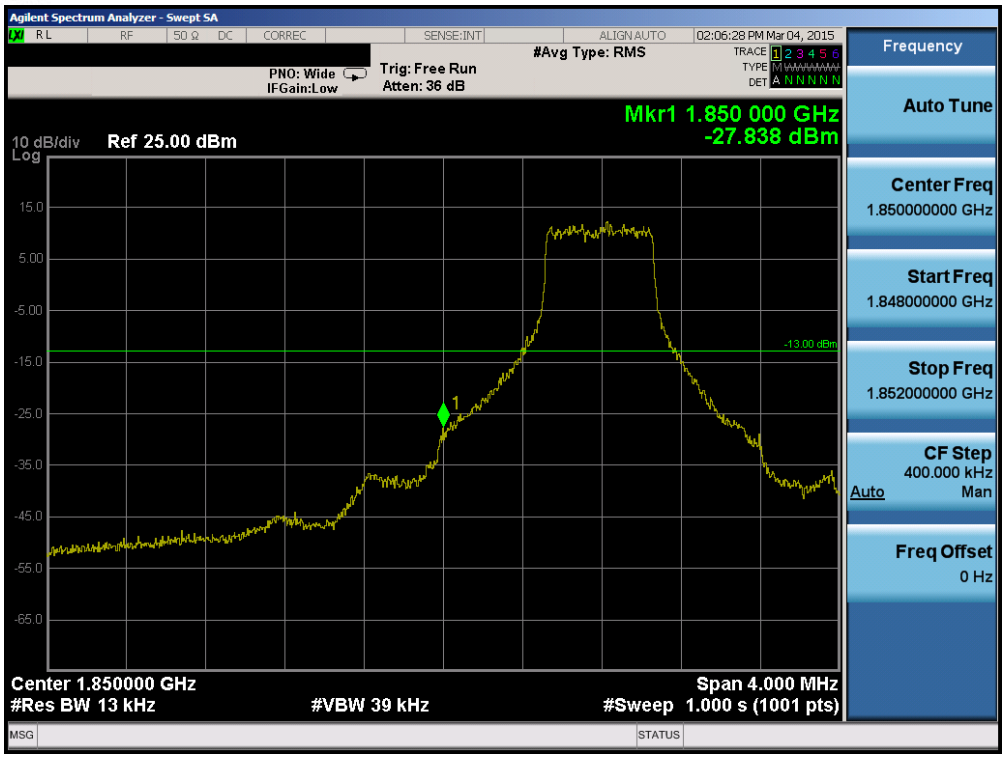
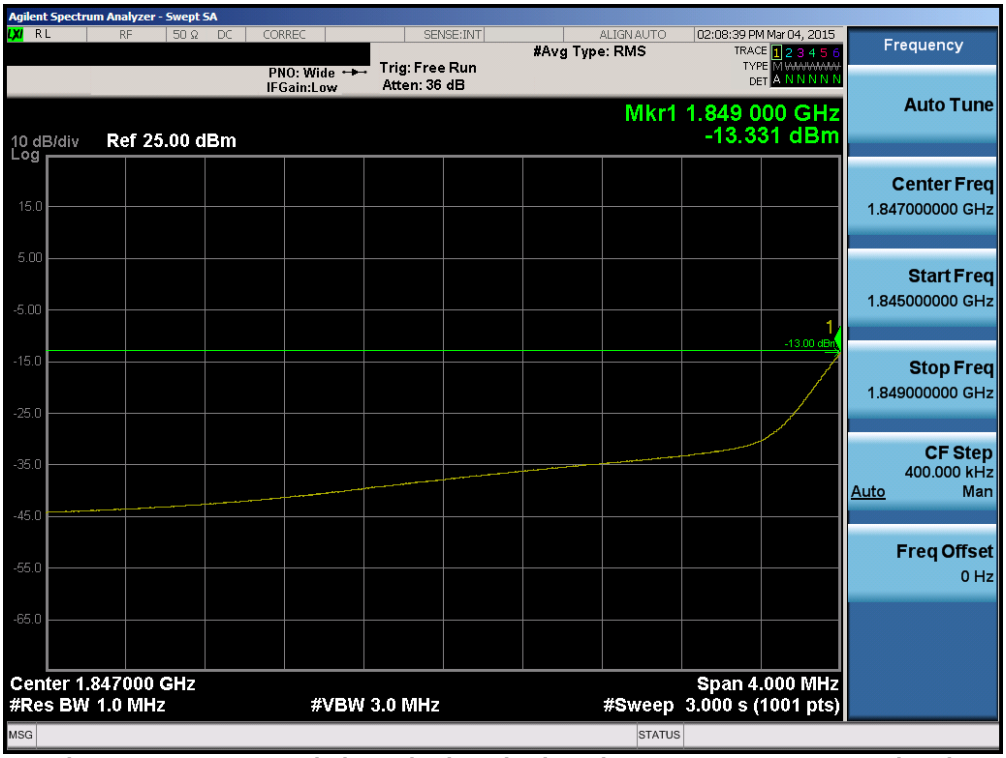


Plot 6-92. Lower Band Edge Plot (Band 2 – 1.4MHz QPSK – RB Size 6)



Plot 6-93. Lower Extended Band Edge Plot (Band 2 – 1.4MHz QPSK – RB Size 6)

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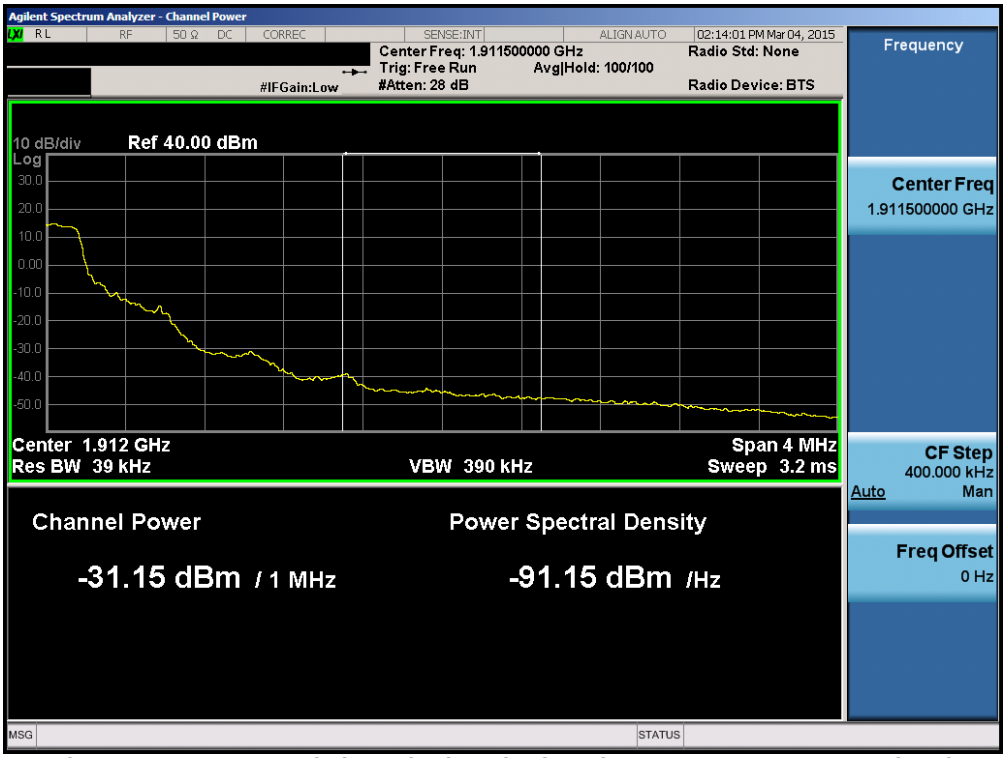
Plot 6-94. Upper Band Edge Plot (Band 2 – 1.4MHz QPSK – RB Size 6)



Plot 6-95. Upper Extended Band Edge Plot (Band 2 – 1.4MHz QPSK – RB Size 6)

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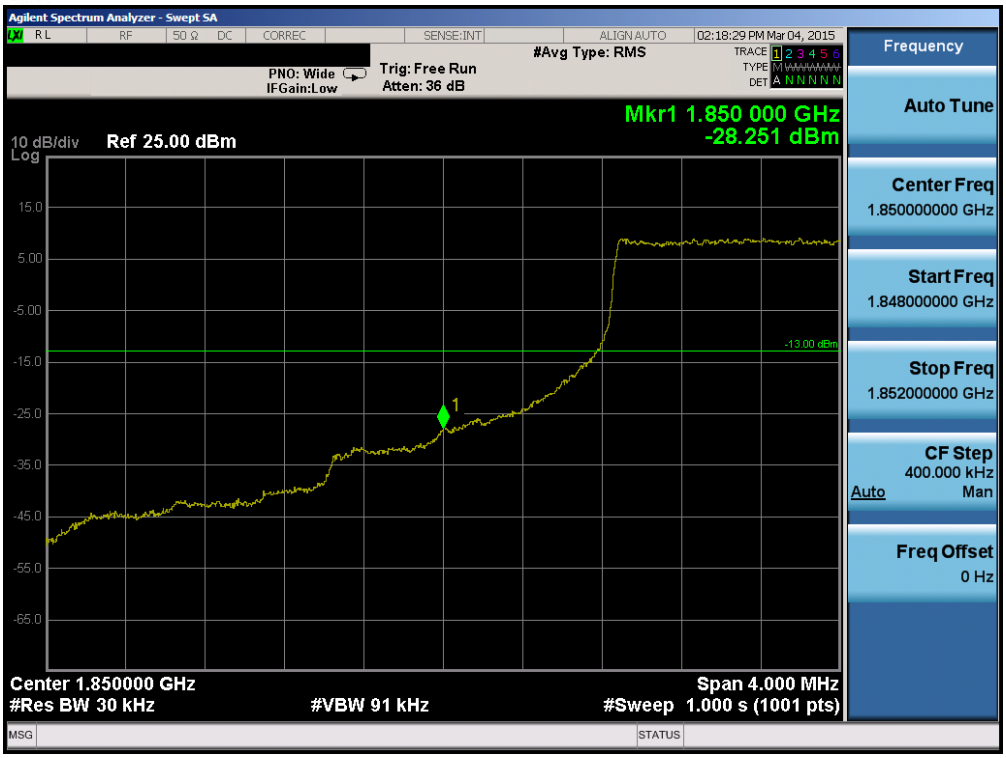
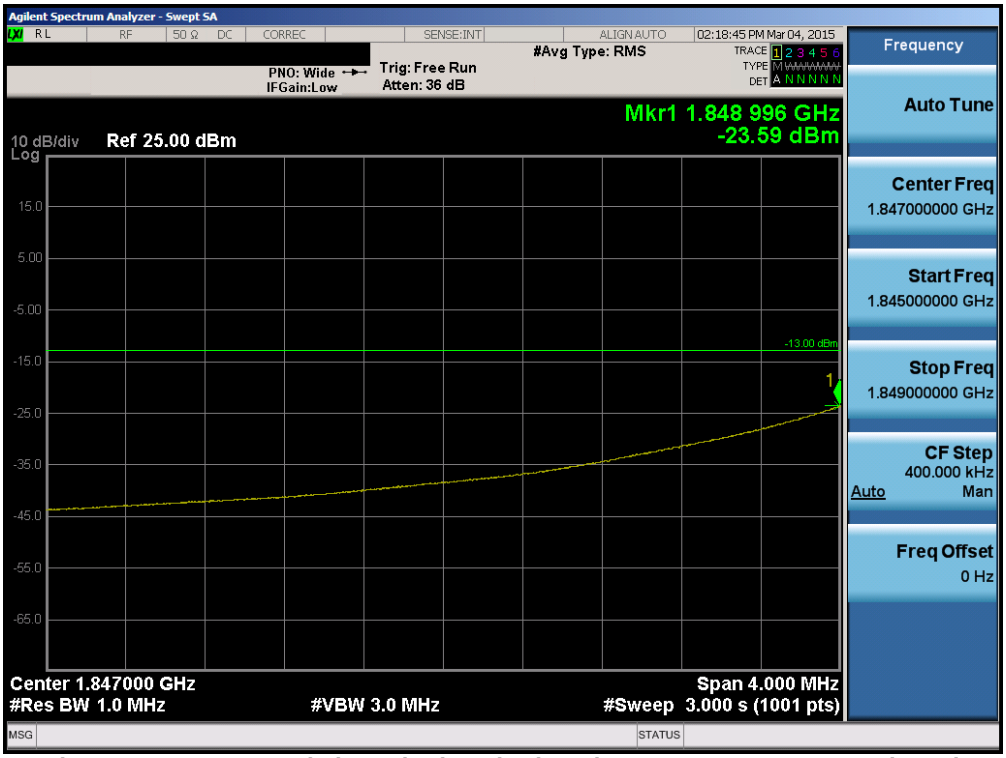


Plot 6-96. Lower Band Edge Plot (Band 2 – 3.0MHz QPSK – RB Size 15)



Plot 6-97. Lower Extended Band Edge Plot (Band 2 – 3.0MHz QPSK – RB Size 15)

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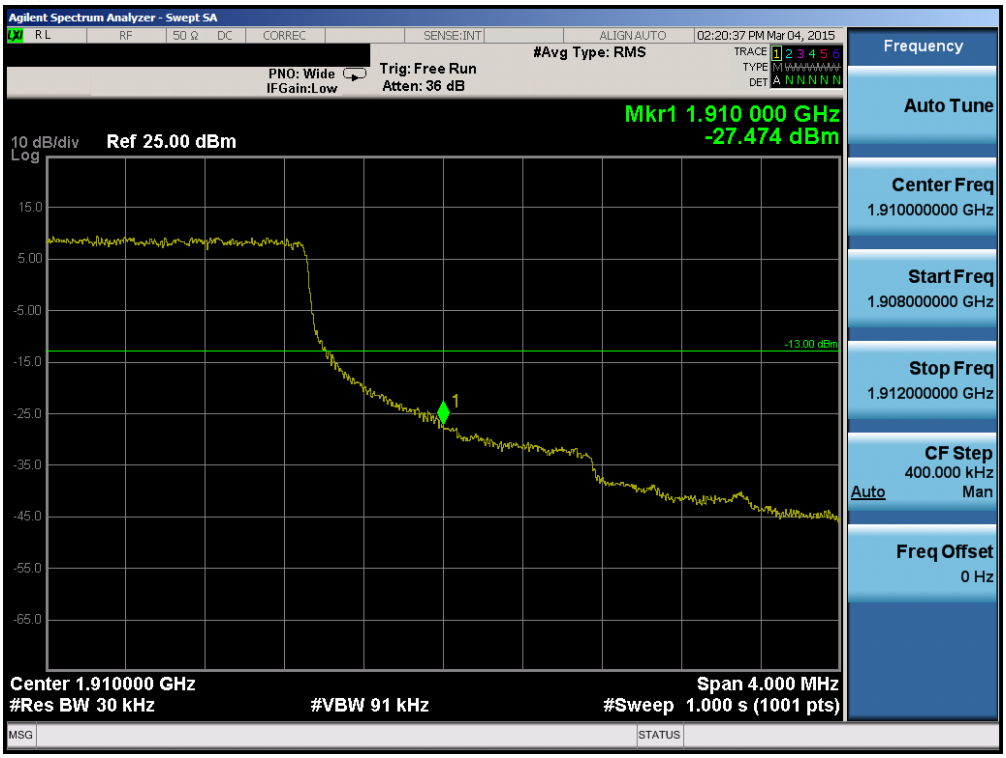
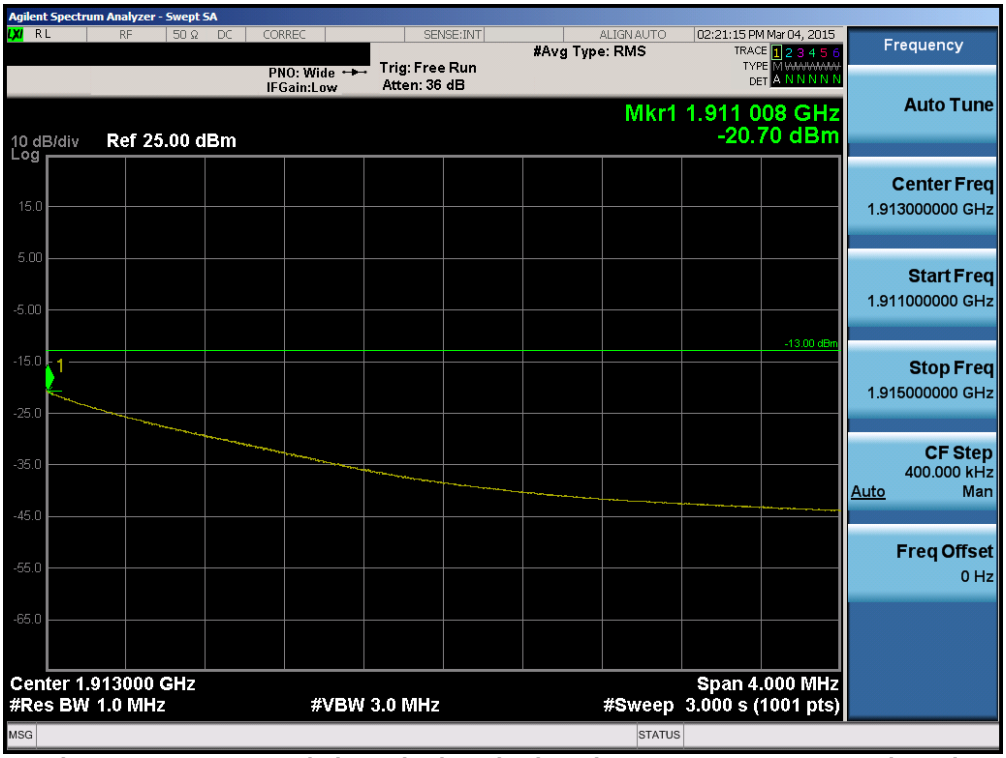


Plot 6-98. Upper Band Edge Plot (Band 2 – 3.0MHz QPSK – RB Size 15)



Plot 6-99. Upper Extended Band Edge Plot (Band 2 – 3.0MHz QPSK – RB Size 15)

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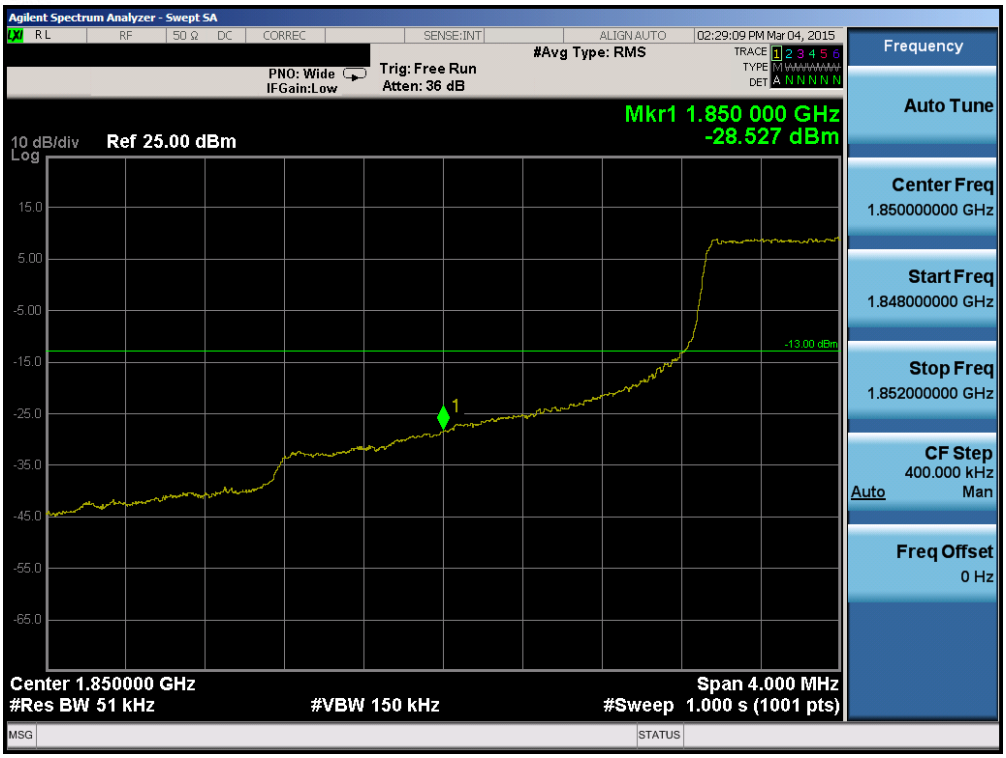
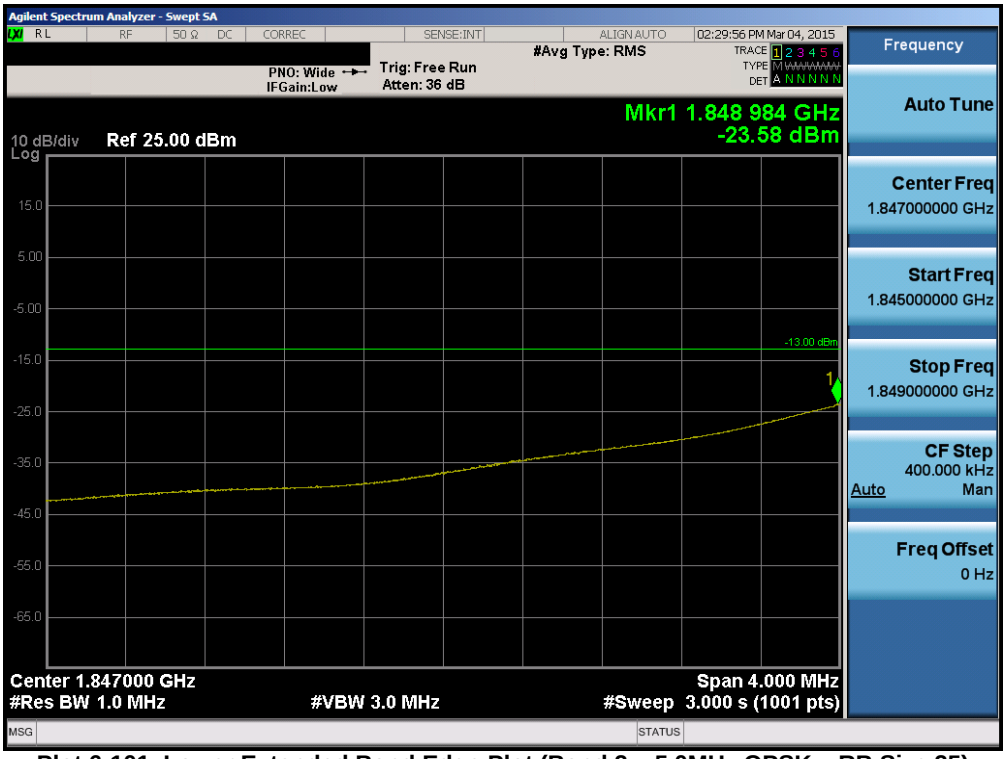


Plot 6-100. Lower Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



Plot 6-101. Lower Extended Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)

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Plot 6-102. Upper Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)

Plot 6-103. Upper Extended Band Edge Plot (Band 2 – 5.0MHz QPSK – RB Size 25)

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Plot 6-104. Lower Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)

Plot 6-105. Lower Extended Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)

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Plot 6-106. Upper Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)

Plot 6-107. Upper Extended Band Edge Plot (Band 2 – 10.0MHz QPSK – RB Size 50)

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Plot 6-108. Lower Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)

Plot 6-109. Lower Extended Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)

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Plot 6-110. Upper Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)

Plot 6-111. Upper Extended Band Edge Plot (Band 2 – 15.0MHz QPSK – RB Size 75)

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Plot 6-112. Lower Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

Plot 6-113. Lower Extended Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

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Plot 6-114. Upper Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

Plot 6-115. Upper Extended Band Edge Plot (Band 2 – 20.0MHz QPSK – RB Size 100)

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6.5 Peak-Average Ratio

§24.232(d)

Test Overview

A peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

Test Procedure Used

KDB 971168 v02r02 – Section 5.7.1

Test Settings

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW > Emission bandwidth of signal
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms.

Test Setup

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

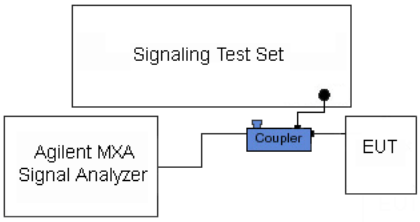

Figure 6-4. Test Instrument & Measurement Setup

Test Notes

None.

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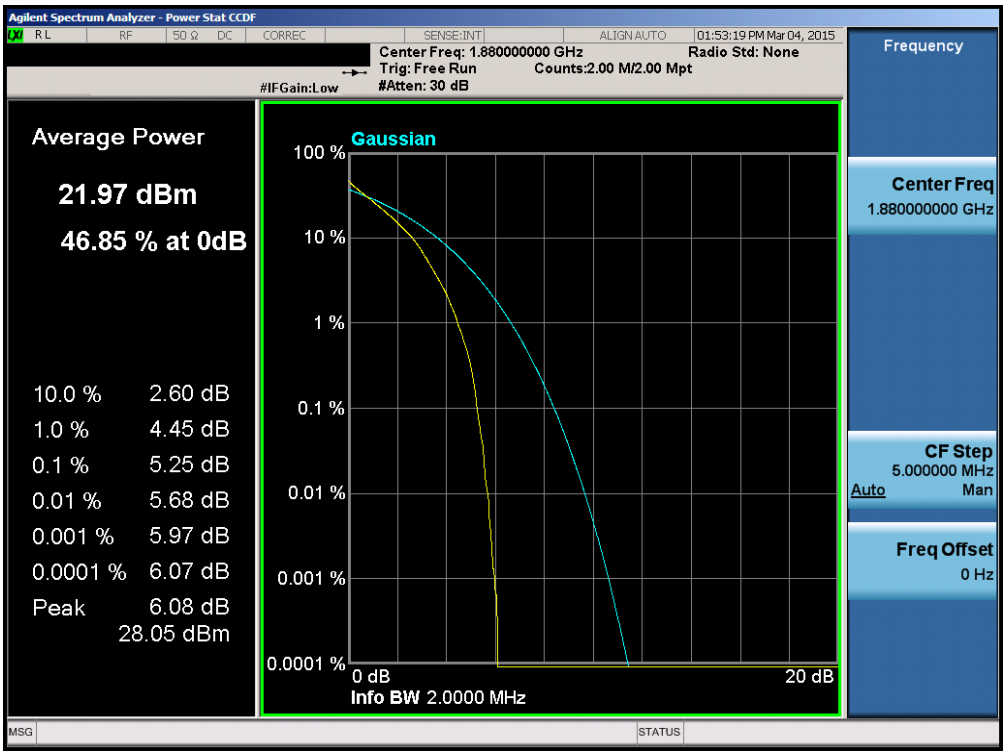
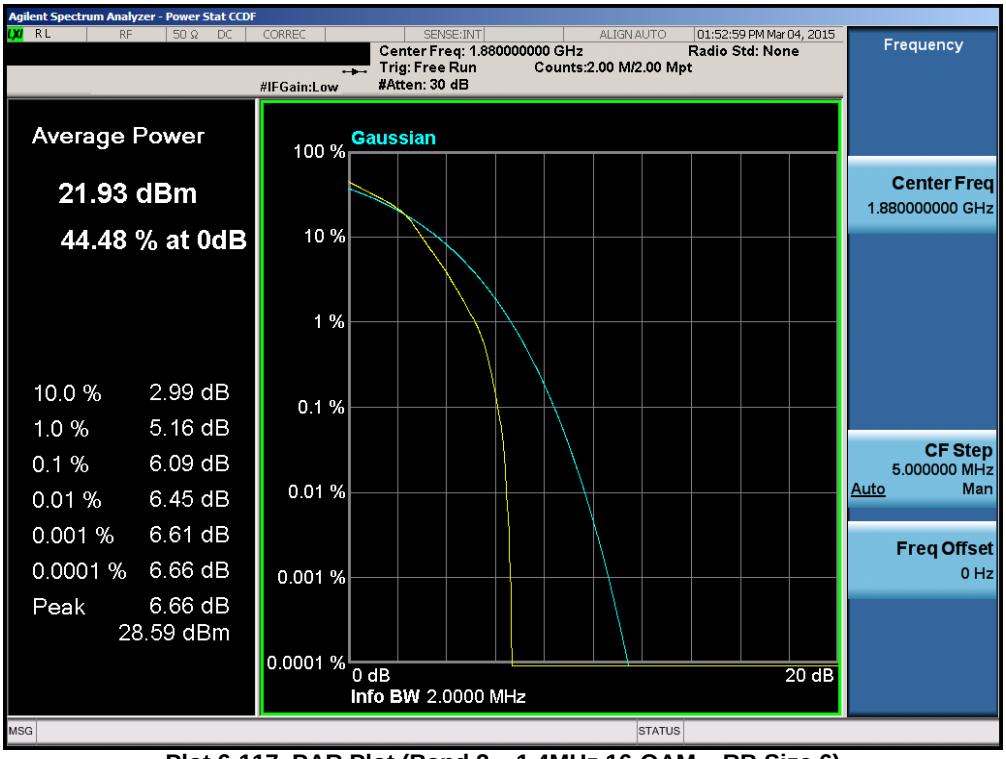


Plot 6-116. PAR Plot (Band 2 – 1.4MHz QPSK – RB Size 6)



Plot 6-117. PAR Plot (Band 2 – 1.4MHz 16-QAM – RB Size 6)

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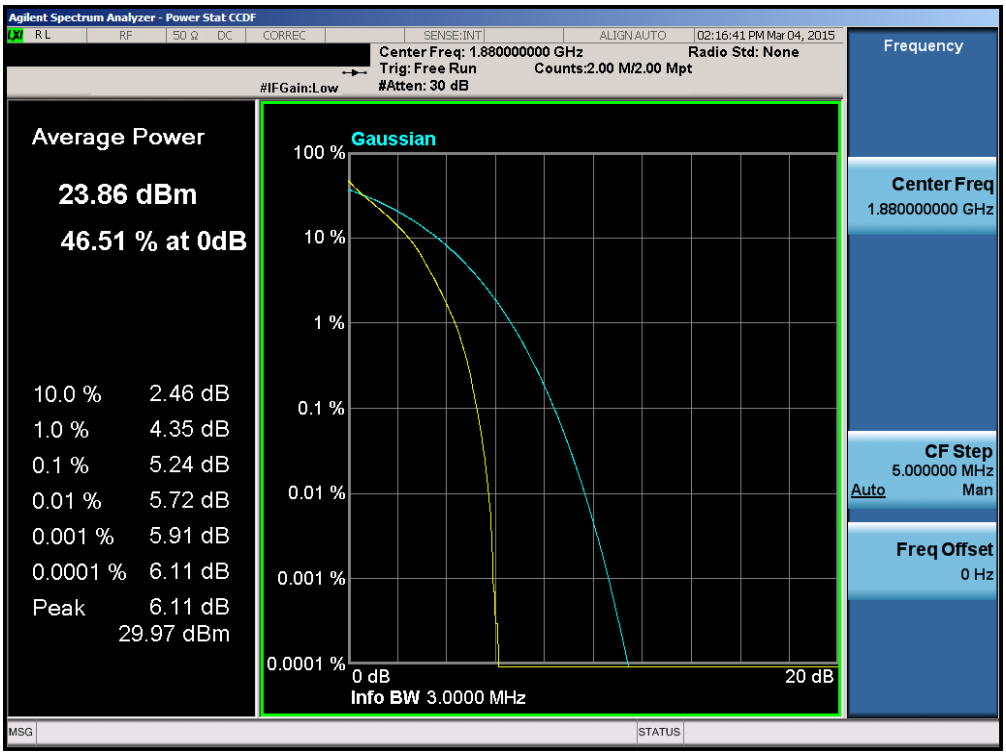
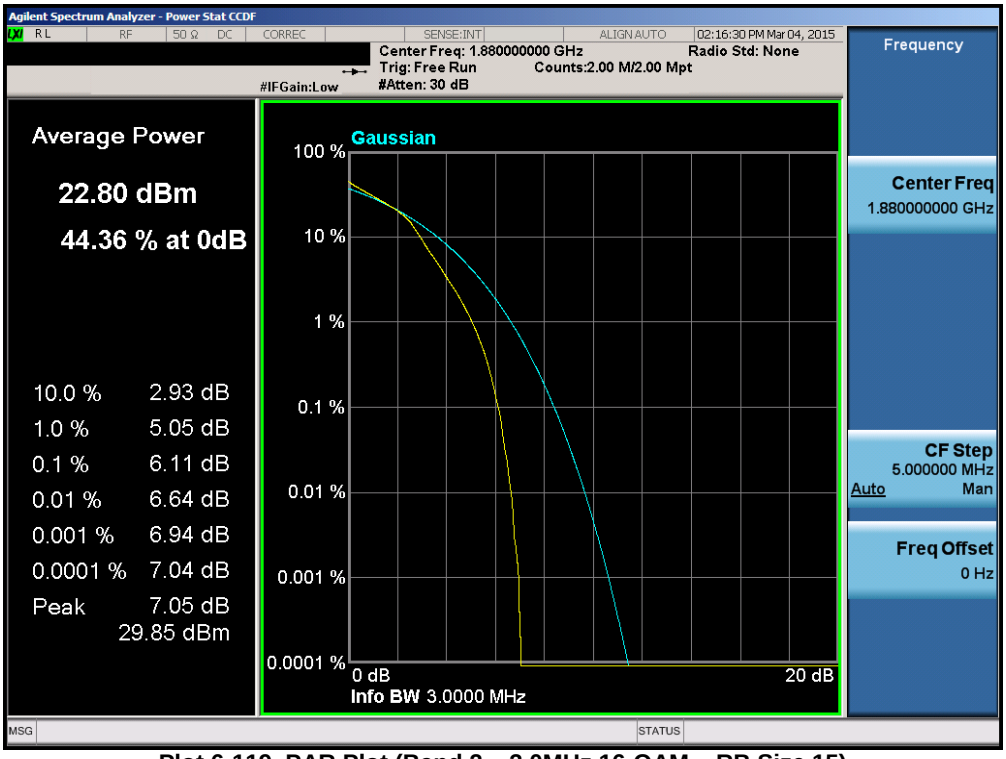


Plot 6-118. PAR Plot (Band 2 – 3.0MHz QPSK – RB Size 15)



Plot 6-119. PAR Plot (Band 2 – 3.0MHz 16-QAM – RB Size 15)

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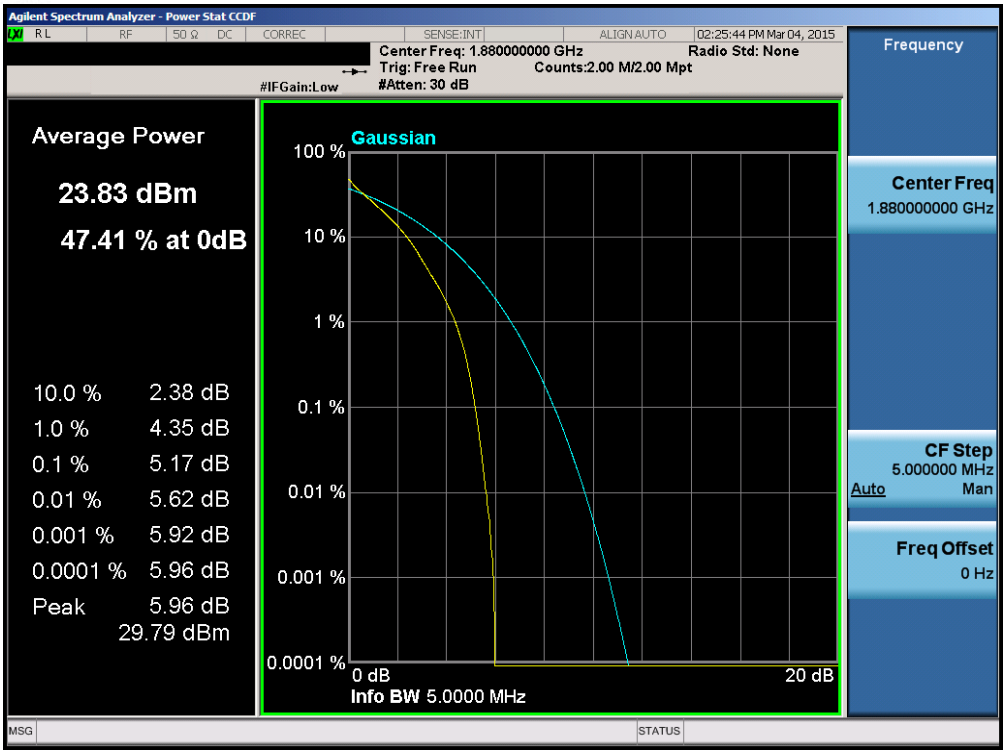
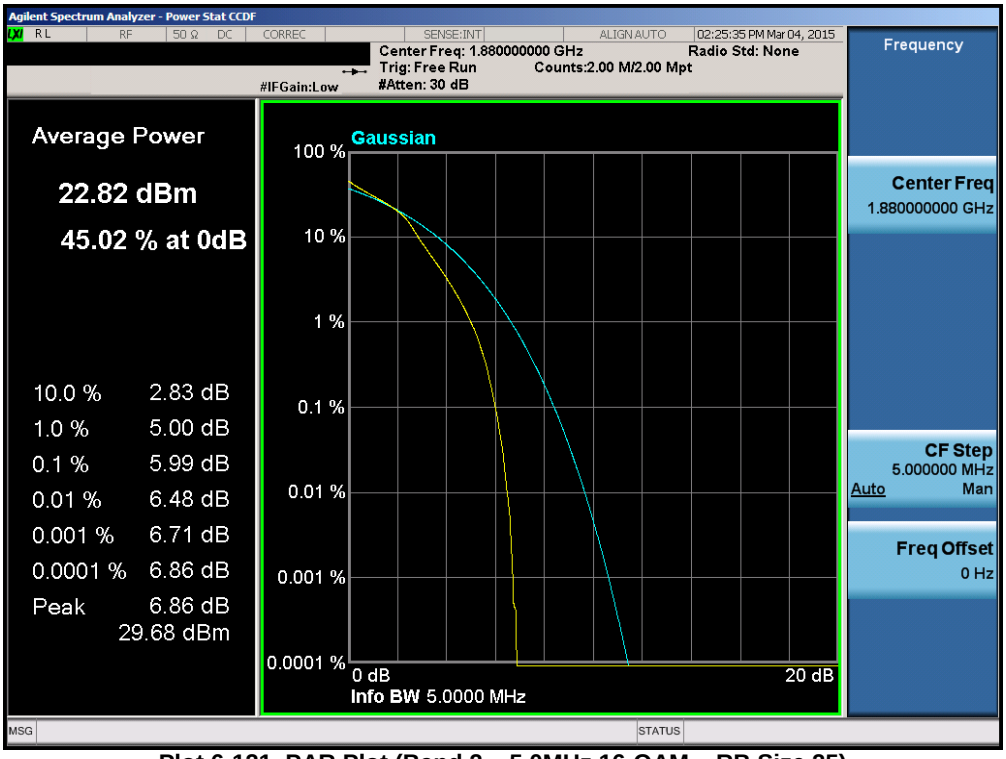


Plot 6-120. PAR Plot (Band 2 – 5.0MHz QPSK – RB Size 25)



Plot 6-121. PAR Plot (Band 2 – 5.0MHz 16-QAM – RB Size 25)

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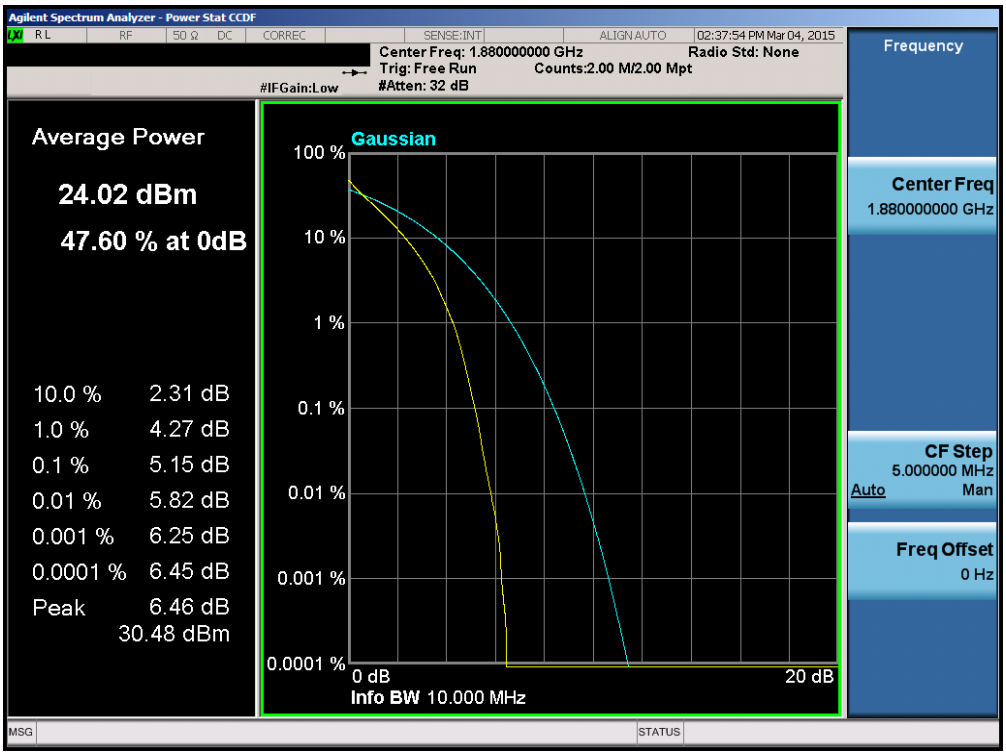
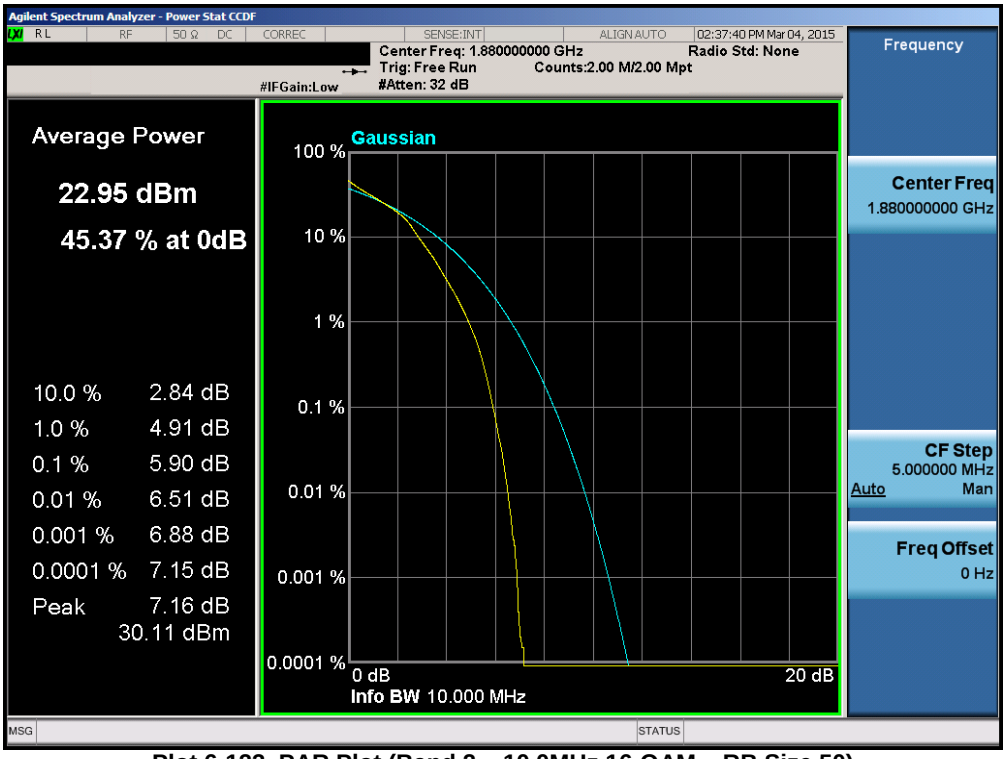


Plot 6-122. PAR Plot (Band 2 – 10.0MHz QPSK – RB Size 50)



Plot 6-123. PAR Plot (Band 2 – 10.0MHz 16-QAM – RB Size 50)

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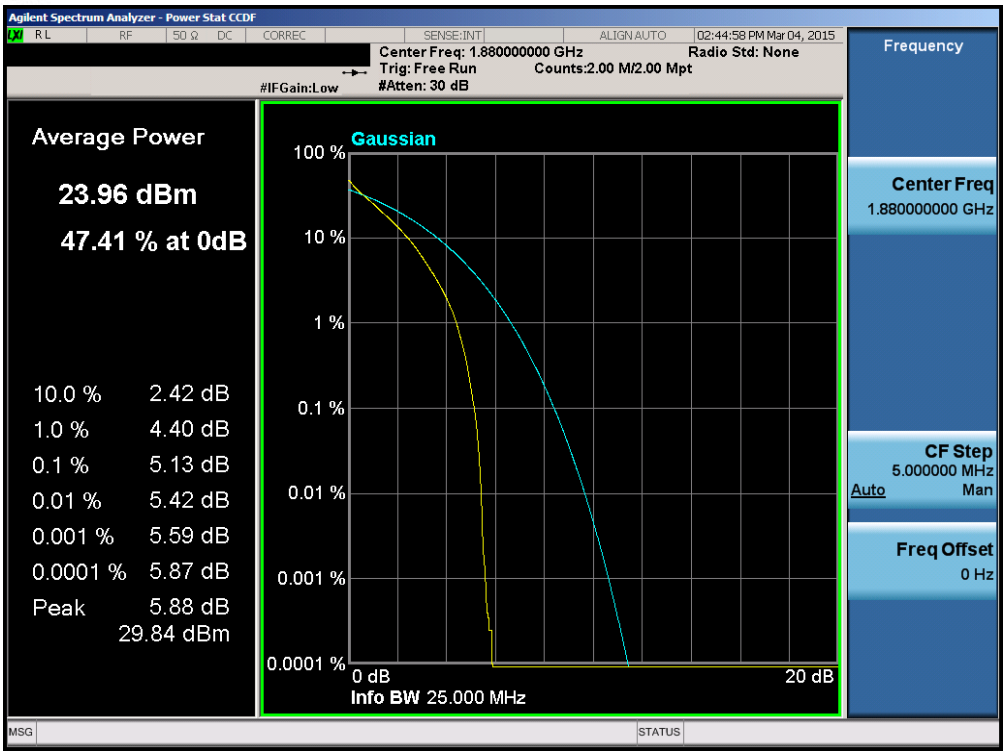
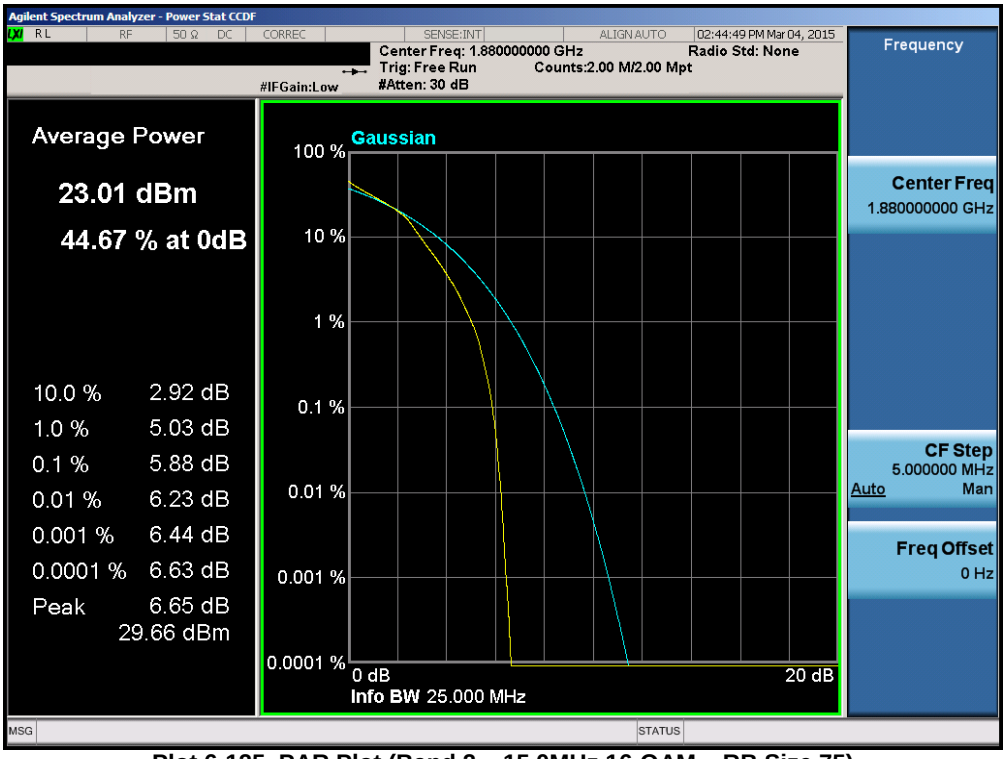


Plot 6-124. PAR Plot (Band 2 – 15.0MHz QPSK – RB Size 75)



Plot 6-125. PAR Plot (Band 2 – 15.0MHz 16-QAM – RB Size 75)

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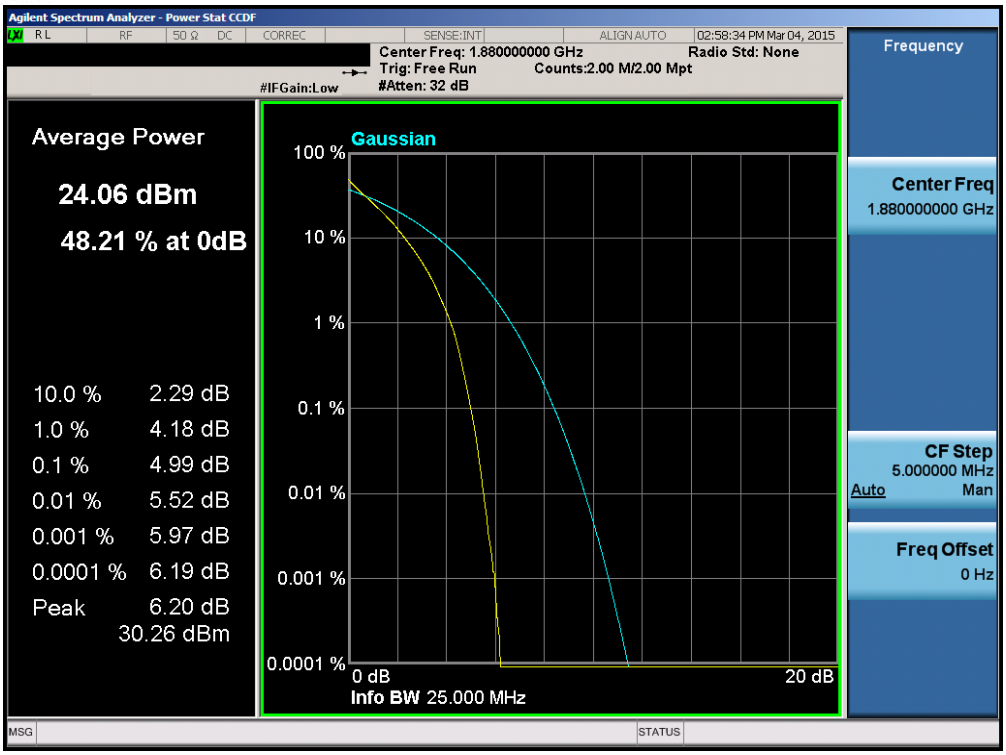
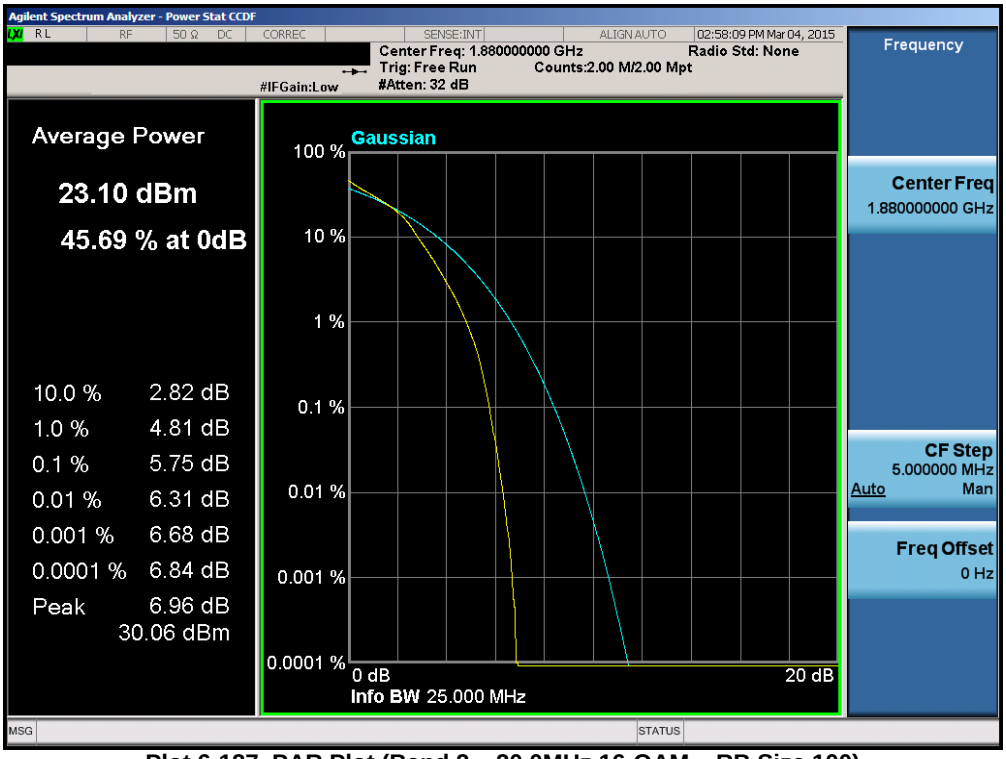


Plot 6-126. PAR Plot (Band 2 – 20.0MHz QPSK – RB Size 100)



Plot 6-127. PAR Plot (Band 2 – 20.0MHz 16-QAM – RB Size 100)

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6.6 Radiated Power (ERP/EIRP)

§24.232(c.2) §27.50(c.10) §27.50(d.4)

Test Overview

Effective Radiated Power (ERP) and Equivalent Isotropic Radiated Power (EIRP) measurements are performed using the substitution method described in ANSI/TIA-603-C-2004 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using vertically polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically polarized broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 v02r02 – Section 5.2.1

ANSI/TIA-603-C-2004 – Section 2.2.17

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW ≥ 3 x RBW
4. Span = 1.5 times the OBW
5. No. of sweep points ≥ 2 x span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto".
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

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Test Setup

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

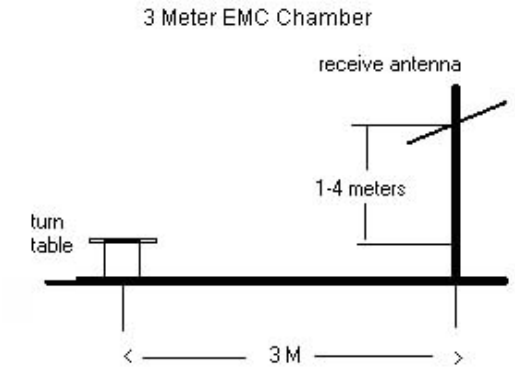

Figure 6-5. Test Instrument & Measurement Setup

Test Notes

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The "H" positioning is defined with the EUT lying flat on the test surface, the "H2" positioning is defined with the EUT standing up on its side, and the "V" positioning is defined with the EUT standing upright. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

2) This unit was tested with its standard battery.

3) The ERP's and EIRP's listed in the tables below were measured using the Class II Permissive Change sample, and were found to be within the measurement tolerances of the original certification samples for radiated power. It has been determined that the output power was not changed for these Class II Permissive Change samples.

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Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Battery	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBd]	Ant. Pol. [H/V]	ERP [dBm]	ERP Limit [dBm]	Margin [dB]
699.70	1.4	QPSK	Standard	3 / 2	16.80	2.71	V	19.51	34.77	-15.26
707.50	1.4	QPSK	Standard	3 / 2	17.10	2.71	V	19.81	34.77	-14.96
715.30	1.4	QPSK	Standard	1 / 0	16.77	2.71	V	19.48	34.771	-15.29
699.70	1.4	16-QAM	Standard	1 / 5	16.44	2.71	V	19.15	34.771	-15.62
707.50	1.4	16-QAM	Standard	1 / 5	16.46	2.71	V	19.17	34.771	-15.60
715.30	1.4	16-QAM	Standard	1 / 0	16.33	2.71	V	19.04	34.771	-15.73
700.50	3	QPSK	Standard	1 / 14	17.72	2.71	V	20.43	34.771	-14.34
707.50	3	QPSK	Standard	1 / 0	17.49	2.71	V	20.20	34.771	-14.57
714.50	3	QPSK	Standard	1 / 0	17.26	2.71	V	19.97	34.771	-14.80
700.50	3	16-QAM	Standard	1 / 14	16.45	2.71	V	19.16	34.771	-15.61
707.50	3	16-QAM	Standard	1 / 0	16.78	2.71	V	19.49	34.771	-15.28
714.50	3	16-QAM	Standard	1 / 0	16.65	2.71	V	19.36	34.771	-15.41
701.50	5	QPSK	Standard	1 / 24	17.64	2.71	V	20.35	34.771	-14.42
707.50	5	QPSK	Standard	1 / 0	17.48	2.71	V	20.19	34.771	-14.58
713.50	5	QPSK	Standard	1 / 0	17.38	2.71	V	20.09	34.771	-14.68
701.50	5	16-QAM	Standard	1 / 24	16.47	2.71	V	19.18	34.771	-15.59
707.50	5	16-QAM	Standard	1 / 0	16.62	2.71	V	19.33	34.771	-15.44
713.50	5	16-QAM	Standard	1 / 0	16.63	2.71	V	19.34	34.771	-15.43
704.00	10	QPSK	Standard	1 / 49	17.32	2.71	V	20.03	34.771	-14.74
707.50	10	QPSK	Standard	1 / 0	17.84	2.71	V	20.55	34.771	-14.22
711.00	10	QPSK	Standard	1 / 0	17.72	2.71	V	20.43	34.771	-14.34
704.00	10	16-QAM	Standard	1 / 49	16.48	2.71	V	19.19	34.771	-15.58
707.50	10	16-QAM	Standard	1 / 0	17.36	2.71	V	20.07	34.771	-14.70
711.00	10	16-QAM	Standard	1 / 0	16.82	2.71	V	19.53	34.771	-15.24

Table 6-2. ERP Data (Band 12)

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Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Battery	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBi]	Ant. Pol. [H/V]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
1710.70	1.4	QPSK	Standard	1 / 0	15.01	9.29	V	24.30	30.000	-5.70
1732.50	1.4	QPSK	Standard	1 / 0	15.93	9.34	V	25.27	30.000	-4.73
1754.30	1.4	QPSK	Standard	1 / 0	15.08	9.38	V	24.46	30.000	-5.54
1710.70	1.4	16-QAM	Standard	1 / 0	14.48	9.29	V	23.77	30.000	-6.23
1732.50	1.4	16-QAM	Standard	1 / 0	15.67	9.34	V	25.01	30.000	-4.99
1754.30	1.4	16-QAM	Standard	1 / 0	13.90	9.38	V	23.28	30.000	-6.72
1711.50	3	QPSK	Standard	1 / 14	15.18	9.30	V	24.48	30.000	-5.52
1732.50	3	QPSK	Standard	1 / 14	16.27	9.34	V	25.61	30.000	-4.39
1753.50	3	QPSK	Standard	1 / 14	15.04	9.38	V	24.42	30.000	-5.58
1711.50	3	16-QAM	Standard	1 / 14	14.06	9.30	V	23.36	30.000	-6.64
1732.50	3	16-QAM	Standard	1 / 14	15.62	9.34	V	24.96	30.000	-5.04
1753.50	3	16-QAM	Standard	1 / 14	14.53	9.38	V	23.91	30.000	-6.09
1712.50	5	QPSK	Standard	1 / 24	14.01	9.30	V	23.31	30.000	-6.69
1732.50	5	QPSK	Standard	1 / 0	14.82	9.34	V	24.16	30.000	-5.84
1752.50	5	QPSK	Standard	1 / 0	13.81	9.38	V	23.19	30.000	-6.81
1712.50	5	16-QAM	Standard	1 / 24	13.14	9.30	V	22.44	30.000	-7.56
1732.50	5	16-QAM	Standard	1 / 0	13.75	9.34	V	23.09	30.000	-6.91
1752.50	5	16-QAM	Standard	1 / 0	12.81	9.38	V	22.19	30.000	-7.81
1715.00	10	QPSK	Standard	1 / 49	14.73	9.30	V	24.03	30.000	-5.97
1732.50	10	QPSK	Standard	1 / 49	14.68	9.34	V	24.02	30.000	-5.98
1750.00	10	QPSK	Standard	1 / 49	14.95	9.37	V	24.32	30.000	-5.68
1715.00	10	16-QAM	Standard	1 / 49	13.76	9.30	V	23.06	30.000	-6.94
1732.50	10	16-QAM	Standard	1 / 49	14.22	9.34	V	23.56	30.000	-6.44
1750.00	10	16-QAM	Standard	1 / 49	13.87	9.37	V	23.24	30.000	-6.76
1717.50	15	QPSK	Standard	1 / 74	14.85	9.31	V	24.16	30.000	-5.84
1732.50	15	QPSK	Standard	1 / 0	15.42	9.34	V	24.76	30.000	-5.24
1747.50	15	QPSK	Standard	1 / 0	14.71	9.37	V	24.08	30.000	-5.92
1717.50	15	16-QAM	Standard	1 / 74	13.90	9.31	V	23.21	30.000	-6.79
1732.50	15	16-QAM	Standard	1 / 0	14.42	9.34	V	23.76	30.000	-6.24
1747.50	15	16-QAM	Standard	1 / 0	14.28	9.37	V	23.65	30.000	-6.35
1720.00	20	QPSK	Standard	1 / 99	15.43	9.31	V	24.74	30.000	-5.26
1732.50	20	QPSK	Standard	1 / 99	16.24	9.34	V	25.58	30.000	-4.42
1745.00	20	QPSK	Standard	1 / 0	15.75	9.36	V	25.11	30.000	-4.89
1720.00	20	16-QAM	Standard	1 / 99	15.01	9.31	V	24.32	30.000	-5.68
1732.50	20	16-QAM	Standard	1 / 99	14.55	9.34	V	23.89	30.000	-6.11
1745.00	20	16-QAM	Standard	1 / 0	14.31	9.36	V	23.67	30.000	-6.33

Table 6-3. EIRP Data (Band 4)

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Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Battery	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBi]	Ant. Pol. [H/V]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
1850.70	1.4	QPSK	Standard	1 / 0	13.46	9.38	V	22.84	33.010	-10.17
1880.00	1.4	QPSK	Standard	1 / 0	13.76	9.33	V	23.09	33.010	-9.92
1909.30	1.4	QPSK	Standard	1 / 0	12.31	9.29	V	21.60	33.010	-11.41
1850.70	1.4	16-QAM	Standard	1 / 0	12.16	9.38	V	21.54	33.010	-11.47
1880.00	1.4	16-QAM	Standard	1 / 0	12.78	9.33	V	22.11	33.010	-10.90
1909.30	1.4	16-QAM	Standard	1 / 0	12.18	9.29	V	21.47	33.010	-11.54
1851.50	3	QPSK	Standard	1 / 0	13.99	9.38	V	23.37	33.010	-9.64
1880.00	3	QPSK	Standard	1 / 0	14.22	9.33	V	23.55	33.010	-9.46
1908.50	3	QPSK	Standard	1 / 14	13.58	9.29	V	22.87	33.010	-10.14
1851.50	3	16-QAM	Standard	1 / 0	13.17	9.38	V	22.55	33.010	-10.46
1880.00	3	16-QAM	Standard	1 / 0	13.97	9.33	V	23.30	33.010	-9.71
1908.50	3	16-QAM	Standard	1 / 14	12.88	9.29	V	22.17	33.010	-10.84
1852.50	5	QPSK	Standard	1 / 0	12.58	9.38	V	21.96	33.010	-11.05
1880.00	5	QPSK	Standard	1 / 24	13.96	9.33	V	23.29	33.010	-9.72
1907.50	5	QPSK	Standard	1 / 0	12.42	9.29	V	21.71	33.010	-11.30
1852.50	5	16-QAM	Standard	1 / 0	11.28	9.38	V	20.66	33.010	-12.35
1880.00	5	16-QAM	Standard	1 / 24	13.37	9.33	V	22.70	33.010	-10.31
1907.50	5	16-QAM	Standard	1 / 0	11.86	9.29	V	21.15	33.010	-11.86
1855.00	10	QPSK	Standard	1 / 49	13.36	9.37	V	22.73	33.010	-10.28
1880.00	10	QPSK	Standard	1 / 49	13.74	9.33	V	23.07	33.010	-9.94
1905.00	10	QPSK	Standard	1 / 49	13.30	9.29	V	22.59	33.010	-10.42
1855.00	10	16-QAM	Standard	1 / 49	12.17	9.37	V	21.54	33.010	-11.47
1880.00	10	16-QAM	Standard	1 / 49	13.01	9.33	V	22.34	33.010	-10.67
1905.00	10	16-QAM	Standard	1 / 49	12.07	9.29	V	21.36	33.010	-11.65
1857.50	15	QPSK	Standard	1 / 74	13.28	9.37	V	22.65	33.010	-10.36
1880.00	15	QPSK	Standard	1 / 0	13.74	9.33	V	23.07	33.010	-9.94
1902.50	15	QPSK	Standard	1 / 0	13.73	9.30	V	23.03	33.010	-9.98
1857.50	15	16-QAM	Standard	1 / 74	12.44	9.37	V	21.81	33.010	-11.20
1880.00	15	16-QAM	Standard	1 / 0	13.44	9.33	V	22.77	33.010	-10.24
1902.50	15	16-QAM	Standard	1 / 0	13.41	9.30	V	22.71	33.010	-10.30
1860.00	20	QPSK	Standard	1 / 99	13.51	9.37	V	22.88	33.010	-10.13
1880.00	20	QPSK	Standard	1 / 0	13.90	9.33	V	23.23	33.010	-9.78
1900.00	20	QPSK	Standard	1 / 0	13.81	9.30	V	23.11	33.010	-9.90
1860.00	20	16-QAM	Standard	1 / 99	12.27	9.37	V	21.64	33.010	-11.37
1880.00	20	16-QAM	Standard	1 / 0	12.58	9.33	V	21.91	33.010	-11.10
1900.00	20	16-QAM	Standard	1 / 0	12.72	9.30	V	22.02	33.010	-10.99

Table 6-4. EIRP Data (Band 2)

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6.7 Radiated Spurious Emissions Measurements

§2.1053 §24.238(a) §27.53(g) §27.53(h)

Test Overview

Radiated spurious emissions measurements are performed using the substitution method described in ANSI/TIA-603-C-2004 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using vertically and horizontally polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as peak measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 v02r02 – Section 5.8

ANSI/TIA-603-C-2004 – Section 2.2.12

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = Peak
6. Trace mode = max hold
7. The trace was allowed to stabilize

Test Setup

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

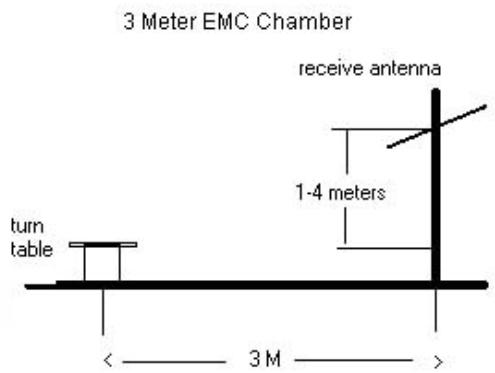

Figure 6-6. Test Instrument & Measurement Setup

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Test Notes

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The "H" positioning is defined with the EUT lying flat on the test surface, the "H2" positioning is defined with the EUT standing up on its side, and the "V" positioning is defined with the EUT standing upright. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

2) This unit was tested with its standard battery.

3) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

4) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

OPERATING FREQUENCY:	704.00	MHz		
CHANNEL:	23060			
MEASURED OUTPUT POWER:	20.03	dBm	=	0.101 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	10.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	33.03	dBc	

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
1408.00	-48.75	5.69	-43.06	H	63.1
2112.00	-62.99	6.67	-56.31	H	76.3
2816.00	-69.56	7.82	-61.74	H	81.8

Table 6-5. Radiated Spurious Data (Band 12 – Low Channel)

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OPERATING FREQUENCY:	707.50	MHz			
CHANNEL:	23095				
MEASURED OUTPUT POWER:	20.55	dBm	=	0.113	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	10.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	33.55	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
1415.00	-51.89	5.73	-46.16	H	66.7
2122.50	-61.57	6.73	-54.84	H	75.4
2830.00	-68.54	7.80	-60.74	H	81.3

Table 6-6. Radiated Spurious Data (Band 12 – Mid Channel)

OPERATING FREQUENCY:	711.00	MHz			
CHANNEL:	23130				
MEASURED OUTPUT POWER:	20.43	dBm	=	0.110	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	10.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	33.43	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
1422.00	-49.88	5.77	-44.11	H	64.5
2133.00	-65.32	6.79	-58.53	H	79.0
2844.00	-69.71	7.78	-61.93	H	82.4

Table 6-7. Radiated Spurious Data (Band 12 – High Channel)

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OPERATING FREQUENCY:	1711.50	MHz		
CHANNEL:	19965			
MEASURED OUTPUT POWER:	24.48	dBm	=	0.280 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	3.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	37.48	dBc	

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
3423.00	-47.38	9.68	-37.69	H	62.2
5134.50	-58.81	10.68	-48.13	H	72.6
6846.00	-45.76	11.74	-34.02	H	58.5
8557.50	-36.57	11.05	-25.52	H	50.0
10269.00	-40.59	12.26	-28.33	H	52.8
11980.50	-50.60	12.47	-38.12	H	62.6
13692.00	-55.35	12.11	-43.24	H	67.7

Table 6-8. Radiated Spurious Data (Band 4 – Low Channel)

OPERATING FREQUENCY:	1732.50	MHz		
CHANNEL:	20175			
MEASURED OUTPUT POWER:	25.61	dBm	=	0.364 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	3.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	38.61	dBc	

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
3465.00	-45.93	9.71	-36.23	H	61.8
5197.50	-56.02	10.59	-45.44	H	71.0
6930.00	-49.73	11.75	-37.98	H	63.6
8662.50	-45.82	11.06	-34.76	H	60.4
10395.00	-50.15	12.37	-37.77	H	63.4
12127.50	-59.22	12.83	-46.39	H	72.0

Table 6-9. Radiated Spurious Data (Band 4 – Mid Channel)

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OPERATING FREQUENCY:	1753.50	MHz			
CHANNEL:	20385				
MEASURED OUTPUT POWER:	24.42	dBm	=	0.277	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	3.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	37.42	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
3507.00	-50.39	9.73	-40.66	H	65.1
5260.50	-55.42	10.64	-44.78	H	69.2
7014.00	-36.15	11.75	-24.40	H	48.8
8767.50	-41.54	11.00	-30.55	H	55.0
10521.00	-41.86	12.48	-29.39	H	53.8
12274.50	-57.12	13.06	-44.07	H	68.5

Table 6-10. Radiated Spurious Data (Band 4 – High Channel)

OPERATING FREQUENCY:	1753.50	MHz			
CHANNEL:	20175				
MEASURED OUTPUT POWER:	24.42	dBm	=	0.277	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	3.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	37.42	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
3507.00	-46.62	9.73	-36.89	H	61.3
5260.50	-63.10	10.64	-52.46	H	76.9
7014.00	-40.89	11.75	-29.14	H	53.6
8767.50	-39.94	11.00	-28.95	H	53.4
10521.00	-40.46	12.48	-27.99	H	52.4
12274.50	-47.99	13.06	-34.94	H	59.4
14028.00	-49.44	11.37	-38.07	H	62.5
15781.50	-58.04	16.66	-41.38	H	65.8

Table 6-11. Radiated Spurious Data with Quick Cover (Band 4 – High Channel)

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OPERATING FREQUENCY:	1851.50	MHz			
CHANNEL:	18615				
MEASURED OUTPUT POWER:	23.37	dBm	=	0.217	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	3.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	36.37	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
3703.00	-53.12	9.43	-43.69	H	67.1
5554.50	-55.65	10.79	-44.86	H	68.2
7406.00	-47.21	10.70	-36.50	H	59.9
9257.50	-55.92	11.58	-44.34	H	67.7
11109.00	-56.73	12.79	-43.94	H	67.3
12960.50	-57.90	13.17	-44.73	H	68.1

Table 6-12. Radiated Spurious Data (Band 2 – Low Channel)

OPERATING FREQUENCY:	1880.00	MHz			
CHANNEL:	18900				
MEASURED OUTPUT POWER:	23.55	dBm	=	0.227	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	3.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	36.55	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
3760.00	-55.26	9.28	-45.98	H	69.5
5640.00	-56.07	11.03	-45.03	H	68.6
7520.00	-47.17	10.97	-36.19	H	59.7
9400.00	-56.54	11.53	-45.01	H	68.6
11280.00	-53.35	12.71	-40.64	H	64.2
13160.00	-55.38	12.74	-42.64	H	66.2

Table 6-13. Radiated Spurious Data (Band 2 – Mid Channel)

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OPERATING FREQUENCY:	1908.50	MHz			
CHANNEL:	19185				
MEASURED OUTPUT POWER:	22.87	dBm	=	0.194	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	3.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	35.87	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	[dBc]
3817.00	-44.17	9.19	-34.98	H	57.8
5725.50	-56.08	11.28	-44.80	H	67.7
7634.00	-37.80	11.17	-26.63	H	49.5
9542.50	-46.05	11.81	-34.24	H	57.1
11451.00	-44.91	12.72	-32.20	H	55.1
13359.50	-55.10	12.47	-42.63	H	65.5

Table 6-14. Radiated Spurious Data (Band 2 – High Channel)

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6.8 Frequency Stability / Temperature Variation

§2.1055 §24.235 §27.54

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-C-2004. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

For Part 22, the frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5 ppm) of the center frequency. For Part 24 and Part 27, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test Procedure Used

ANSI/TIA-603-C-2004

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber.

Test Notes

None

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Band 12 Frequency Stability Measurements

§2.1055 §27.54

OPERATING FREQUENCY:	707,500,000	Hz
CHANNEL:	23790	
REFERENCE VOLTAGE:	3.85	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	707,500,007	7	0.0000010
100 %		- 30	707,500,463	463	0.0000654
100 %		- 20	707,500,140	140	0.0000198
100 %		- 10	707,500,023	23	0.0000033
100 %		0	707,499,638	-362	-0.0000512
100 %		+ 10	707,499,903	-97	-0.0000137
100 %		+ 20	707,499,726	-274	-0.0000387
100 %		+ 30	707,500,347	347	0.0000490
100 %		+ 40	707,499,791	-209	-0.0000295
100 %		+ 50	707,500,070	70	0.0000099
BATT. ENDPOINT	3.45	+ 20	707,499,799	-201	-0.0000284

Table 6-15. Frequency Stability Data (Band 12)

Note:

Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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Band 12 Frequency Stability Measurements

§2.1055 §27.54

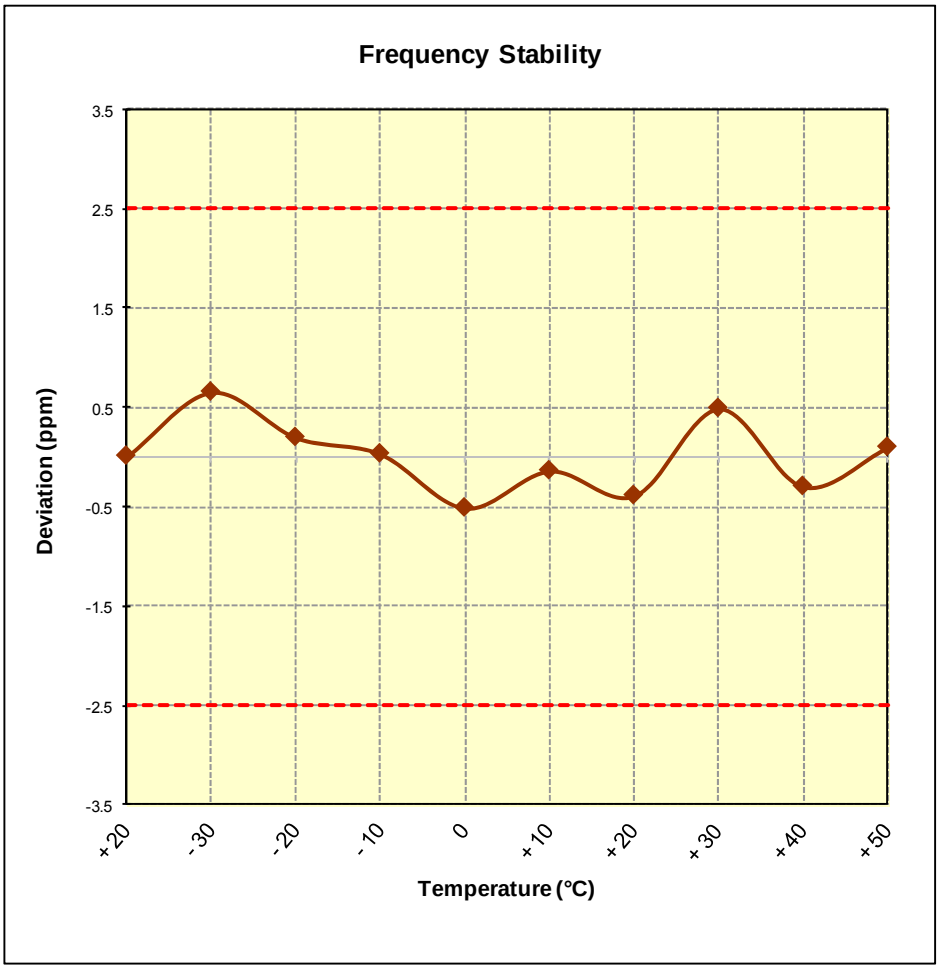

Figure 6-7. Frequency Stability Graph (Band 12)

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Band 4 Frequency Stability Measurements
§2.1055 §§27.54

OPERATING FREQUENCY:	1,732,500,000	Hz
CHANNEL:	20175	
REFERENCE VOLTAGE:	3.85	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	1,732,500,041	41	0.0000024
100 %		- 30	1,732,500,261	261	0.0000151
100 %		- 20	1,732,500,083	83	0.0000048
100 %		- 10	1,732,499,532	-468	-0.0000270
100 %		0	1,732,500,097	97	0.0000056
100 %		+ 10	1,732,499,822	-178	-0.0000103
100 %		+ 20	1,732,500,166	166	0.0000096
100 %		+ 30	1,732,500,198	198	0.0000114
100 %		+ 40	1,732,499,596	-404	-0.0000233
100 %		+ 50	1,732,499,935	-65	-0.0000038
BATT. ENDPOINT	3.45	+ 20	1,732,500,079	79	0.0000046

Table 6-16. Frequency Stability Data (Band 4)

Note:

Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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Band 4 Frequency Stability Measurements

§2.1055 §§27.54

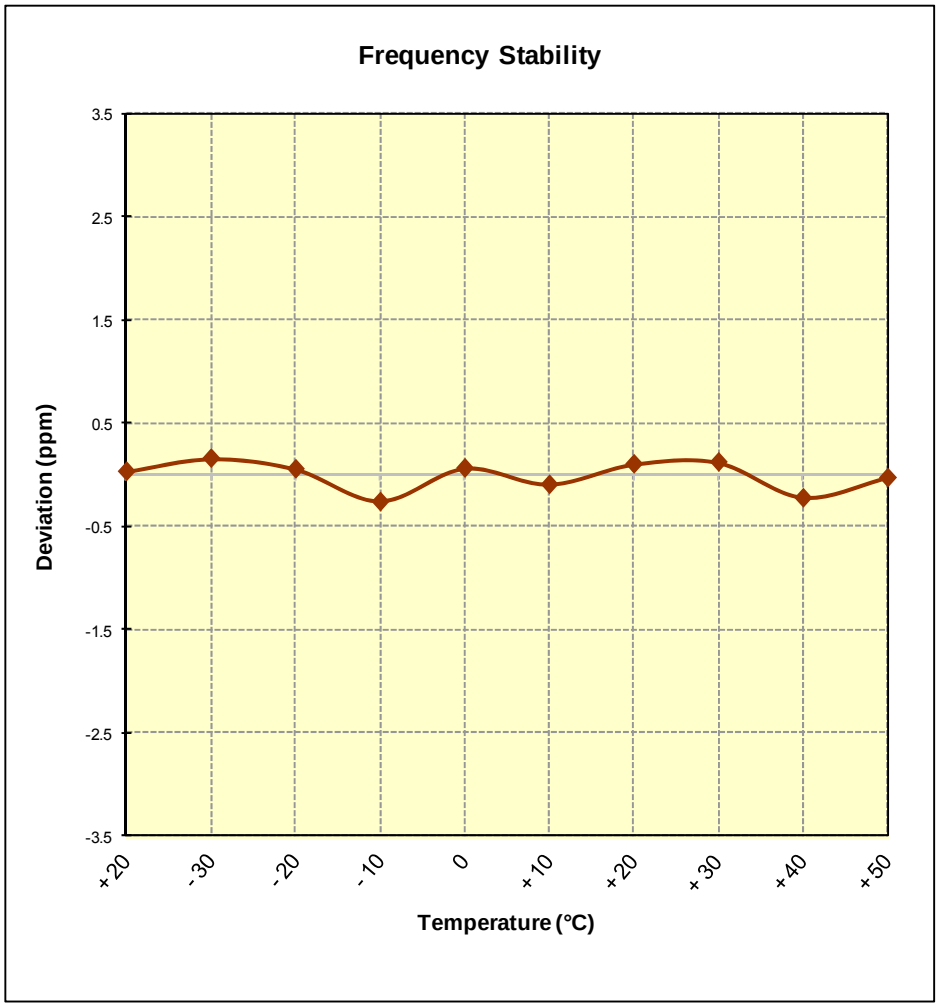

Figure 6-8. Frequency Stability Graph (Band 4)

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Band 2 Frequency Stability Measurements

§2.1055 §24.235

OPERATING FREQUENCY:	1,880,000,000	Hz
CHANNEL:	18900	
REFERENCE VOLTAGE:	3.85	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	1,880,000,028	28	0.0000015
100 %		- 30	1,880,000,122	122	0.0000065
100 %		- 20	1,880,000,209	209	0.0000111
100 %		- 10	1,879,999,991	-9	-0.0000005
100 %		0	1,879,999,838	-162	-0.0000086
100 %		+ 10	1,880,000,148	148	0.0000079
100 %		+ 20	1,880,000,002	2	0.0000001
100 %		+ 30	1,880,000,009	9	0.0000005
100 %		+ 40	1,880,000,159	159	0.0000085
100 %		+ 50	1,880,000,007	7	0.0000004
BATT. ENDPOINT	3.45	+ 20	1,879,999,845	-155	-0.0000082

Table 6-17. Frequency Stability Data (Band 2)

Note:

Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

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Band 2 Frequency Stability Measurements

§2.1055 §24.235

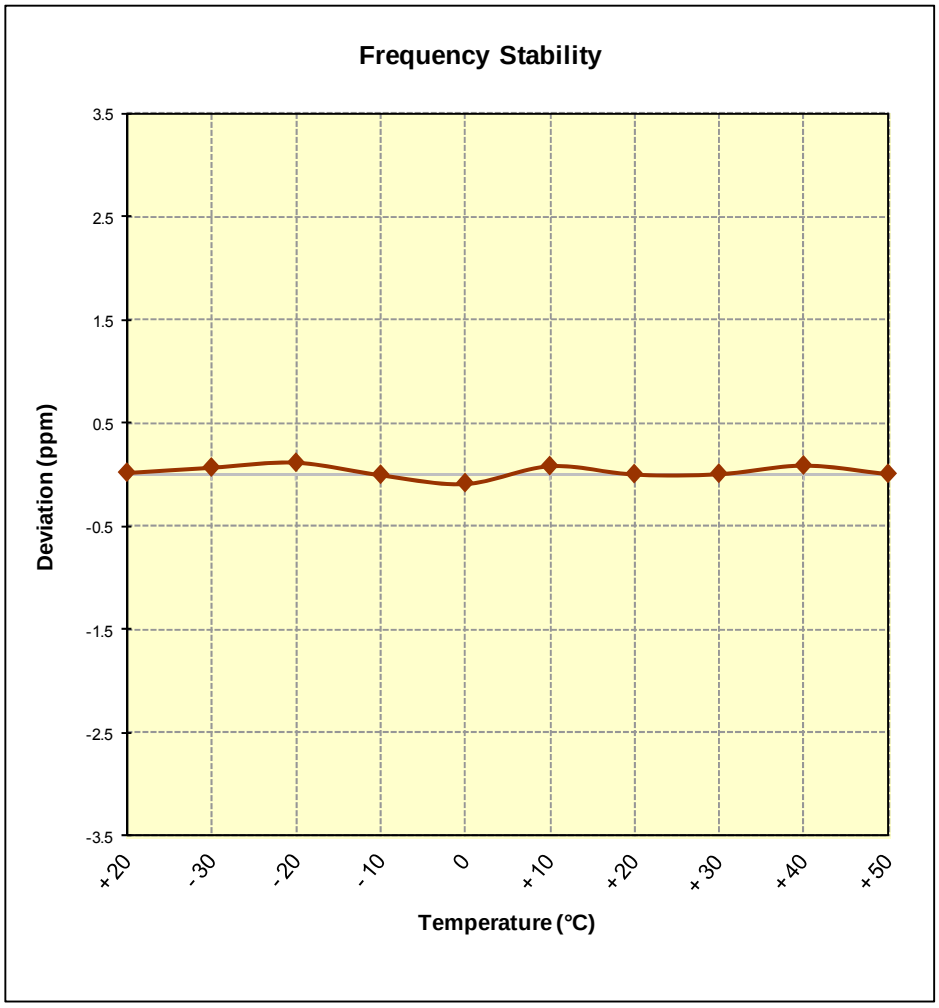

Figure 6-9. Frequency Stability Graph (Band 2)

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7.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **LG Portable Handset FCC ID: ZNFH631** complies with all the requirements of Parts 24 & 27 of the FCC rules for LTE operation only.

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