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 LTE

Applicant Name:
Samsung Electronics, Co. Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do 443-742, Korea

Date of Testing:
5/27 - 5/29/2014
Test Site/Location:
PCTEST Lab., Columbia, MD, USA
Test Report Serial No.:
0Y1405211045.A3L

FCC ID : A3LSPHL710

APPLICANT: SAMSUNG ELECTRONICS, CO. LTD.

FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s): §2; §24
Test Procedure(s): ANSI/TIA-603-C-2004, KDB 971168 v02r01
EUT Type: Portable Handset
Model(s): SPH-L710
Test Device Serial No.: *identical prototype* [S/N: #18]
Class II Permissive Change: Please see FCC change document
Original Grant Date: 06/01/2012

Mode	Tx Frequency (MHz)	Emission Designator	Modulation	EIRP	
				Max. Power (W)	Max. Power (dBm)
LTE Band 25	1850.7 - 1914.3	1M13G7D	QPSK	0.140	21.45
LTE Band 25	1850.7 - 1914.3	1M13W7D	16QAM	0.115	20.60
LTE Band 25	1851.5 - 1913.5	2M73G7D	QPSK	0.131	21.18
LTE Band 25	1851.5 - 1913.5	2M72W7D	16QAM	0.118	20.72
LTE Band 25	1855 - 1910	8M99G7D	QPSK	0.153	21.86
LTE Band 25	1855 - 1910	8M96W7D	16QAM	0.127	21.04
LTE Band 25	1857.5 - 1907.5	13M5G7D	QPSK	0.145	21.63
LTE Band 25	1857.5 - 1907.5	13M5W7D	16QAM	0.125	20.98
LTE Band 25	1860 - 1905	18M0G7D	QPSK	0.133	21.23
LTE Band 25	1860 - 1905	18M0W7D	16QAM	0.113	20.52

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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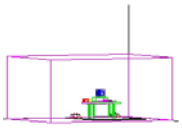
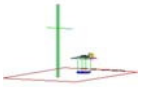


MEASUREMENT REPORT
FCC Part 24

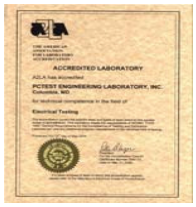


§2.1033 General Information

APPLICANT:	Samsung Electronics, Co. Ltd.
APPLICANT ADDRESS:	129, Samsung-ro, Maetan dong, Yeongtong-gu, Suwon-si, Gyeonggi-do 443-742, Korea
TEST SITE:	PCTEST ENGINEERING LABORATORY, INC.
TEST SITE ADDRESS:	7185 Oakland Mills Road, Columbia, MD 21045 USA
FCC RULE PART(S):	§2; §24
BASE MODEL:	SPH-L710
FCC ID:	A3LSPHL710
FCC CLASSIFICATION:	PCS Licensed Transmitter Held to Ear (PCE)
FREQUENCY TOLERANCE:	±0.00025 % (2.5 ppm)
Test Device Serial No.:	#18 ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	5/27 - 5/29/2014
TEST REPORT S/N:	0Y1405211045.A3L

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. (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 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.

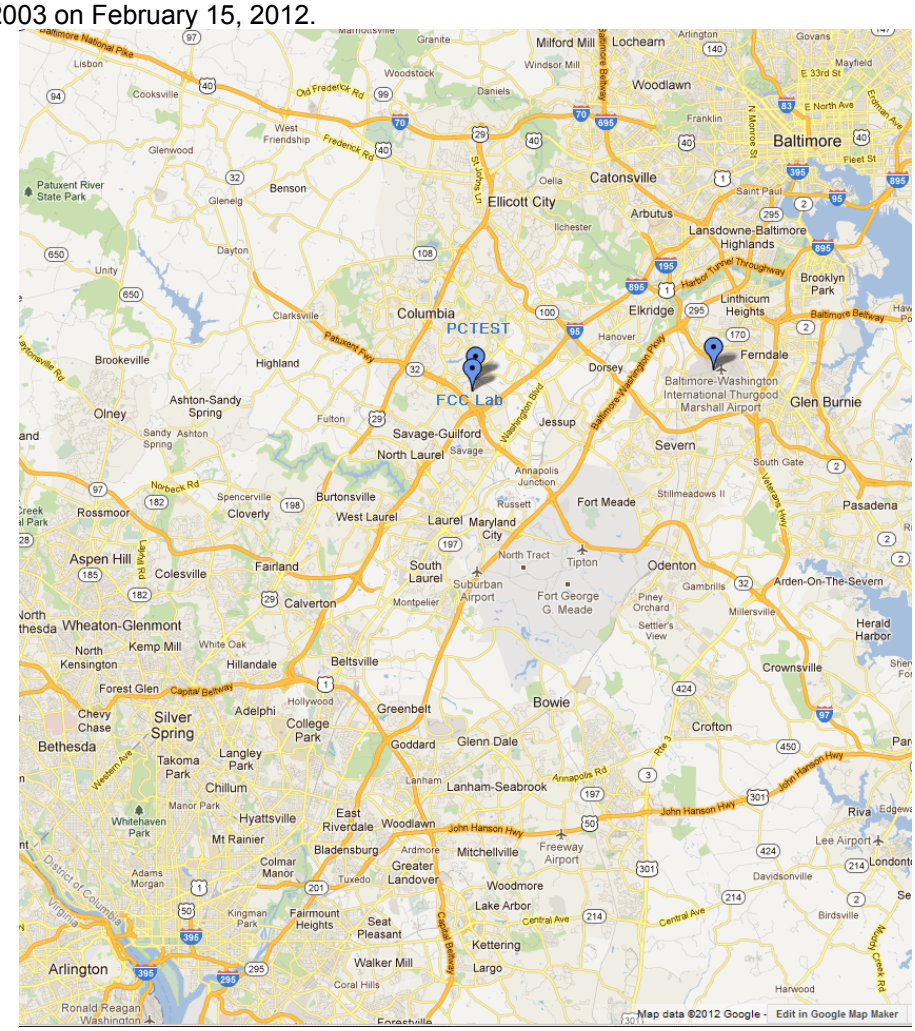

Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSPHL710**. 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 CDMA/EvDO Rev 0 (BC0, BC1, BC10), Single-band LTE, 802.11a/b/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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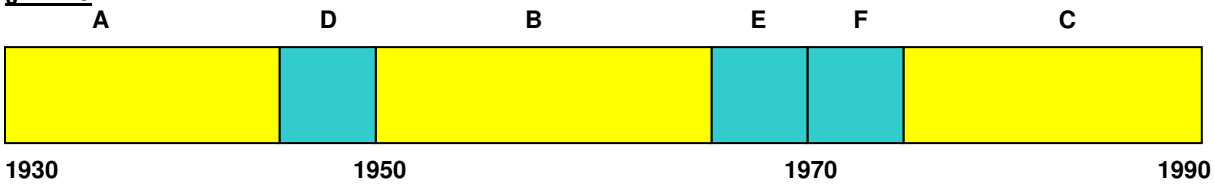
3.0 DESCRIPTION OF TESTS

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 **Samsung Portable Handset FCC ID: A3LSPHL710.**

3.2 PCS - Base Frequency Blocks

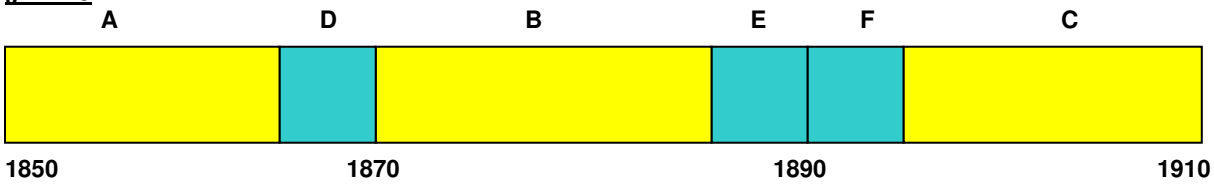
§24.229



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 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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3.4 Radiated Power and Radiated Spurious Emissions

§2.1053 §24.232(c) §24.238(a)

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
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	5/29/2014	Annual	5/29/2015	N/A
Agilent	8447D	Broadband Amplifier	5/30/2014	Annual	5/30/2015	2443A01900
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Agilent	87405C	Pre-amplifier (0.1 - 18 GHz)	3/19/2014	Annual	3/19/2015	MY53010007
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	6/26/2013	Biennial	6/26/2015	121034
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	4/8/2014	Biennial	4/8/2016	125518
ETS Lindgren	3164-08	Quad Ridge Horn Antenna	11/7/2012	Biennial	11/7/2014	128338
K & L	11SH10-3075/U18000	High Pass Filter	5/2/2014	Annual	5/2/2015	2
Mini-Circuits	SSG-4000HP	USB Synthesized Signal Generator	N/A			11208010032
Mini-Circuits	PWR-SENS-4RMS	USB Power Sensor	4/17/2013	Annual	4/17/2014	11210140001
Mini-Circuits	TVA-11-422	RF Power Amp	N/A			QA1303002
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	10/18/2013	Annual	10/18/2014	100976
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	5/21/2014	Annual	5/21/2015	100348
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	1/28/2014	Biennial	1/28/2016	A051107
VWR	62344-734	Thermometer with Clock	2/20/2014	Biennial	2/20/2016	140140420

Table 4-1. 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. For equipment listed above that has a calibration due date that falls within the test date range, care was taken to ensure that this equipment was utilized prior to the calibration due date.

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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 = Amplitude/Angle Modulated

16QAM Modulation

Emission Designator = 8M45W7D

LTE BW = 8.45 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Combination (Audio/Data)

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: Samsung Electronics, Co. Ltd.
FCC ID: A3LSPHL710
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)	Band Edge / Conducted Spurious 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	Frequency Stability	Fundamental emissions stay within authorized frequency block (Part 24)		PASS	Section 6.8
24.232(c)	Equivalent Isotropic Radiated Power (Band 25)	< 2 Watts max. EIRP	RADIATED	PASS	Section 6.6
2.1053 24.238(a)	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 2.2.

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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 v02r01 – 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.

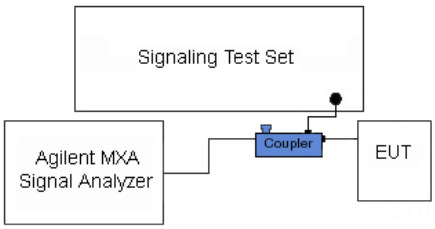

Figure 6-1. Test Instrument & Measurement Setup

Test Notes

None.

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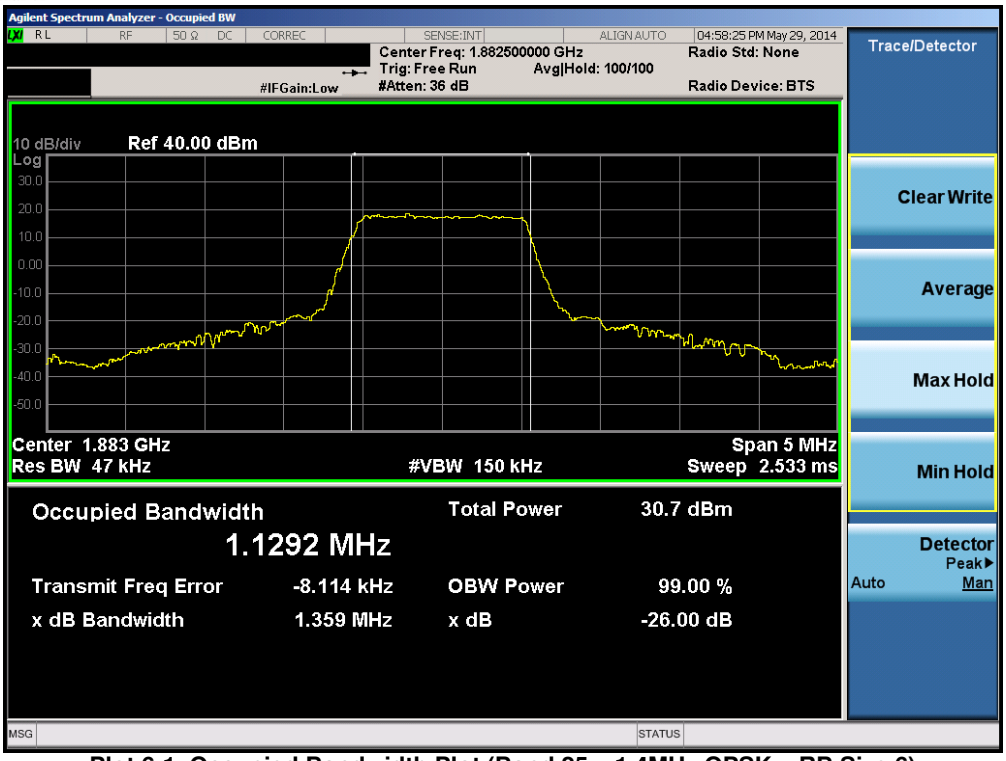
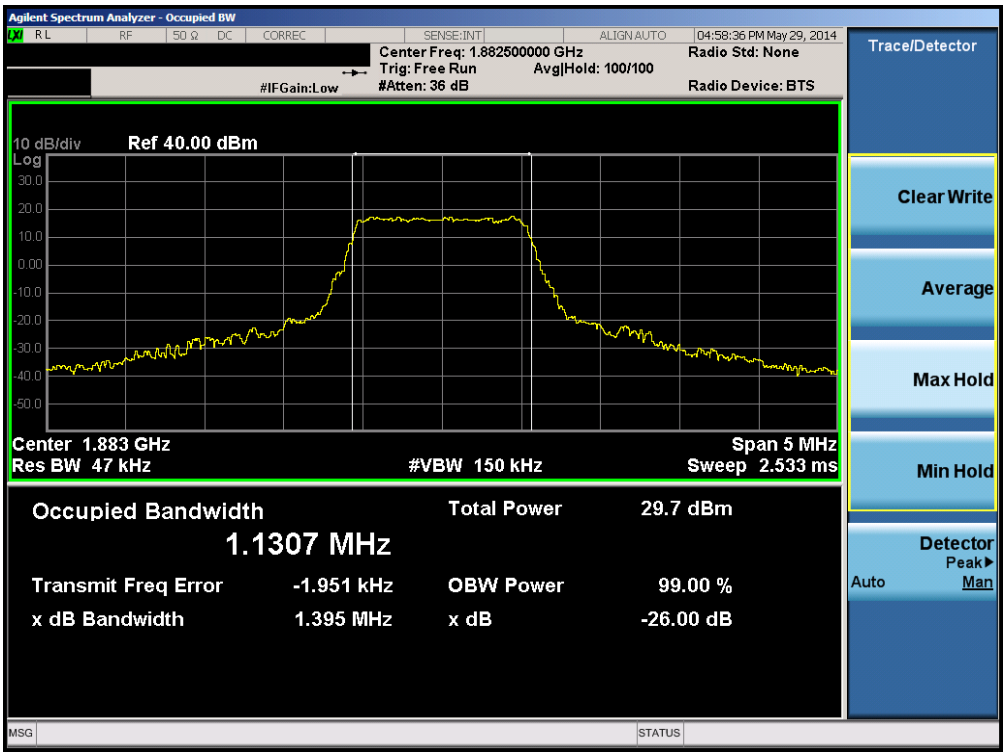


Plot 6-1. Occupied Bandwidth Plot (Band 25 – 1.4MHz QPSK – RB Size 6)



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

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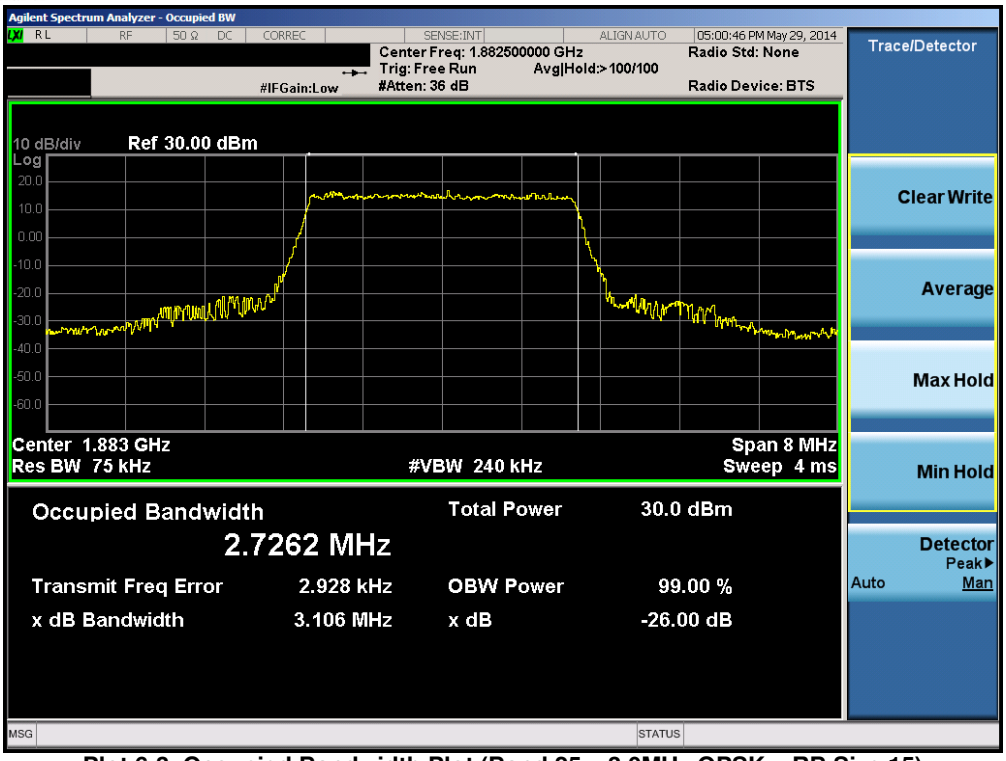
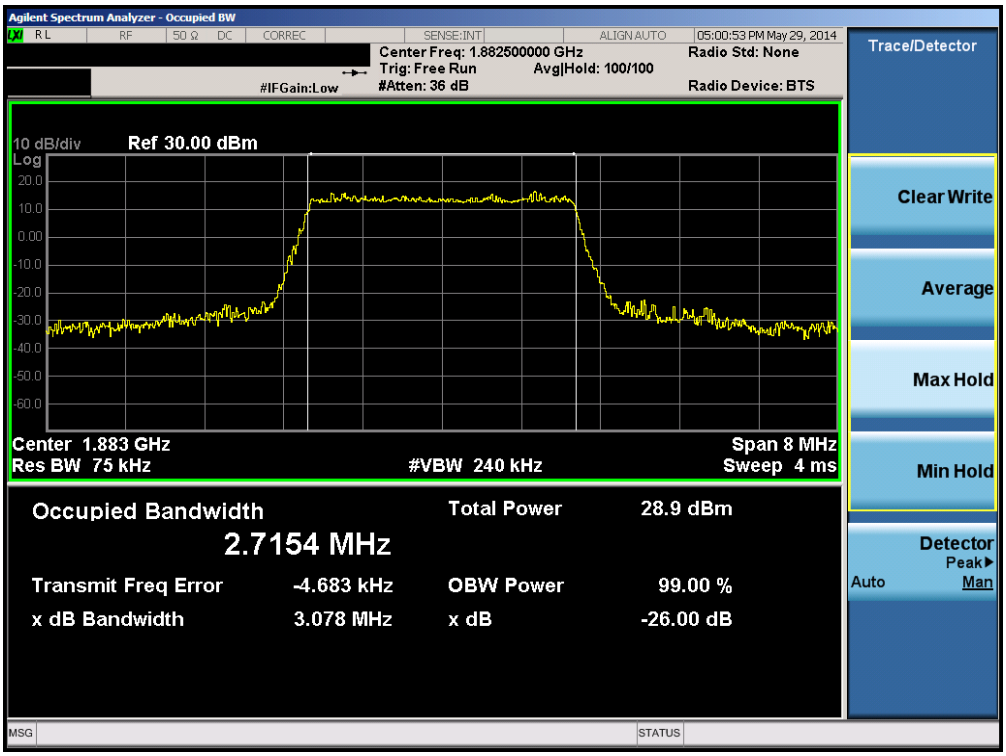


Plot 6-3. Occupied Bandwidth Plot (Band 25 – 3.0MHz QPSK – RB Size 15)



Plot 6-4. Occupied Bandwidth Plot (Band 25 – 3.0MHz 16-QAM – RB Size 15)

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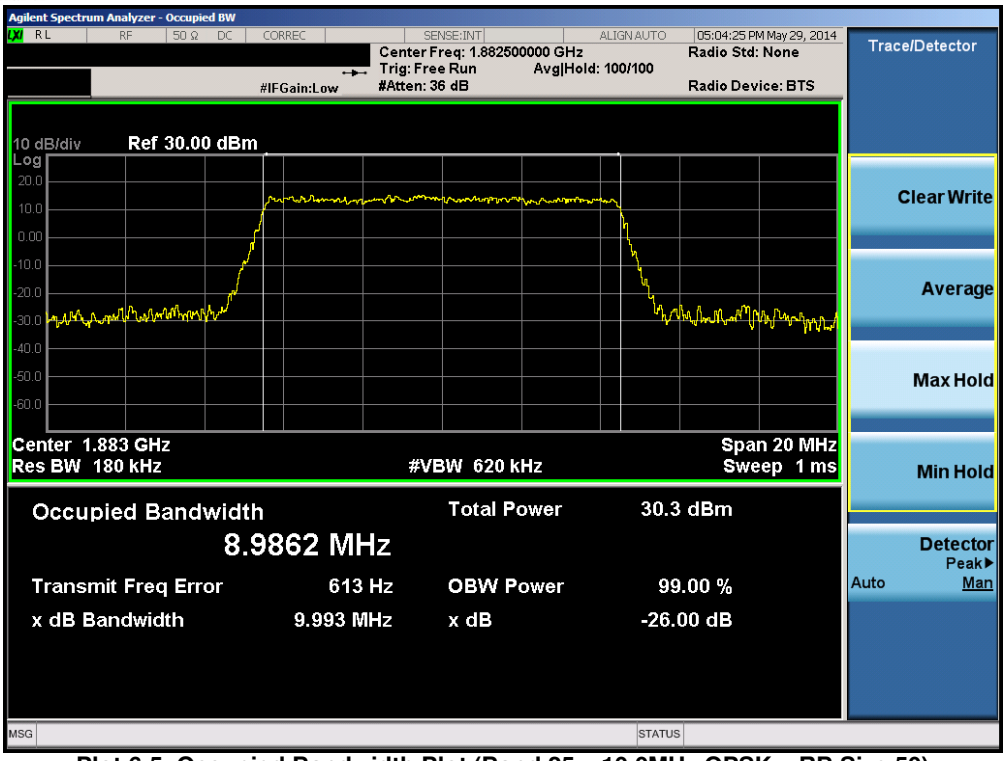
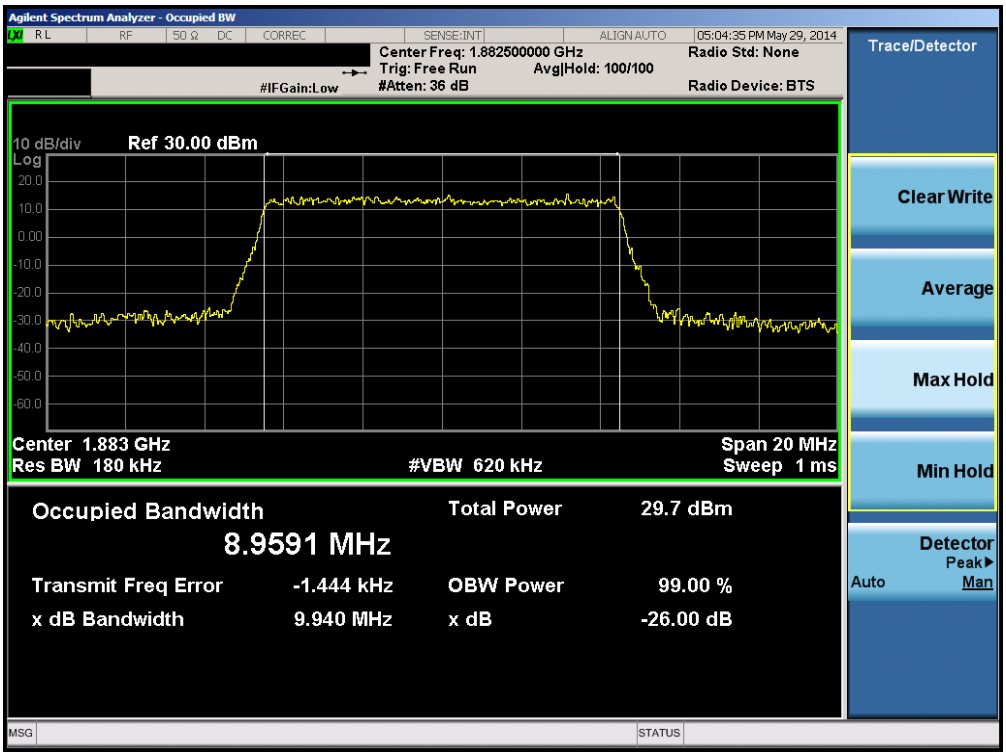


Plot 6-5. Occupied Bandwidth Plot (Band 25 – 10.0MHz QPSK – RB Size 50)



Plot 6-6. Occupied Bandwidth Plot (Band 25 – 10.0MHz 16-QAM – RB Size 50)

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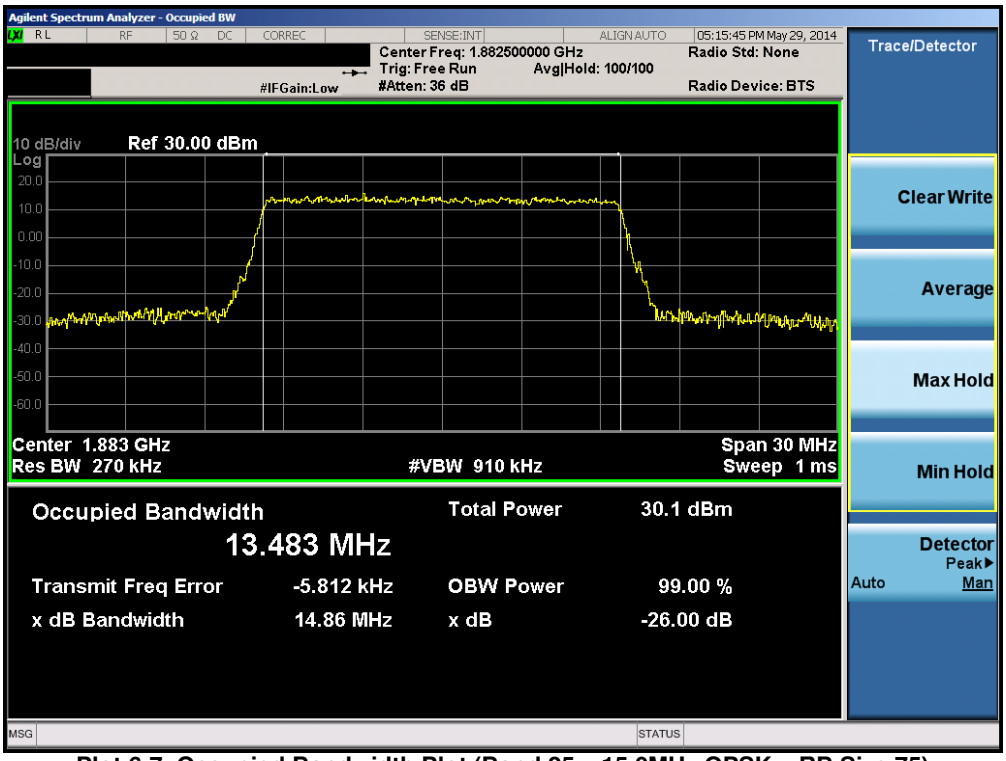
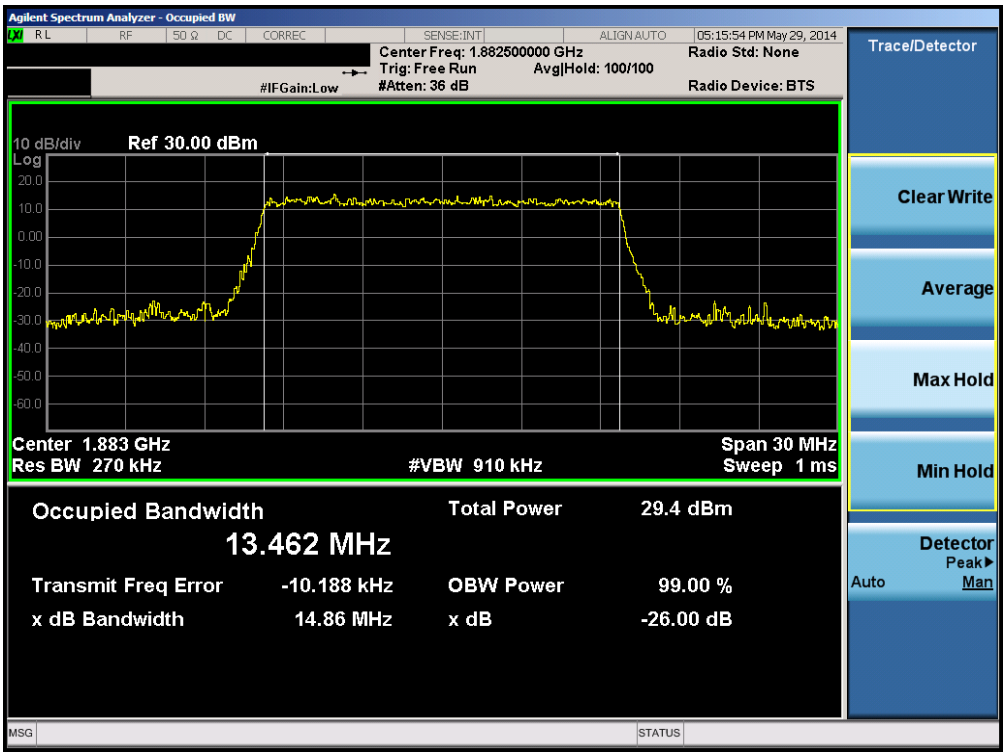


Plot 6-7. Occupied Bandwidth Plot (Band 25 – 15.0MHz QPSK – RB Size 75)



Plot 6-8. Occupied Bandwidth Plot (Band 25 – 15.0MHz 16-QAM – RB Size 75)

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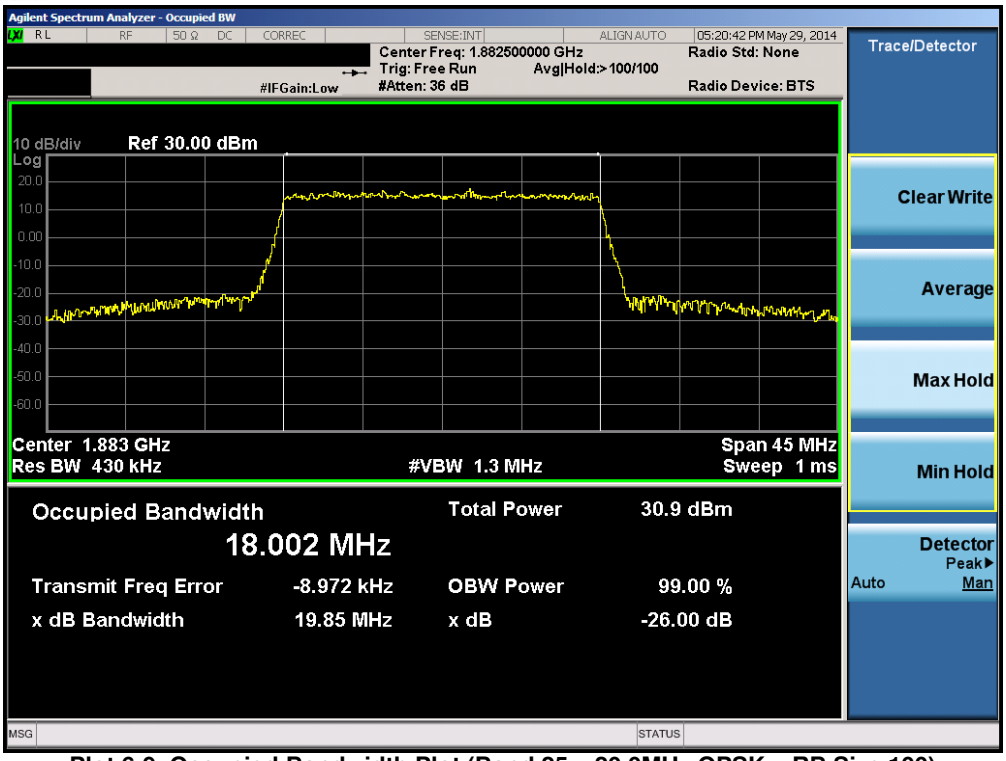
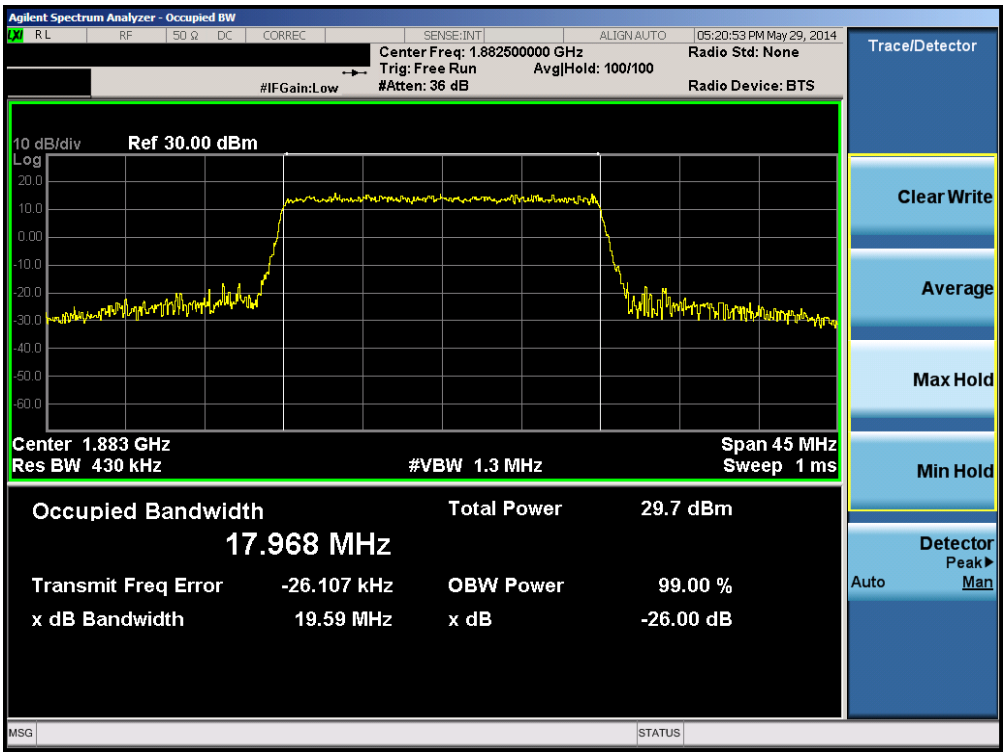


Plot 6-9. Occupied Bandwidth Plot (Band 25 – 20.0MHz QPSK – RB Size 100)



Plot 6-10. Occupied Bandwidth Plot (Band 25 – 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)

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 v02r01 – 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.

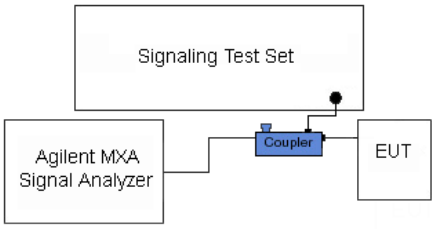

Figure 6-2. Test Instrument & Measurement Setup

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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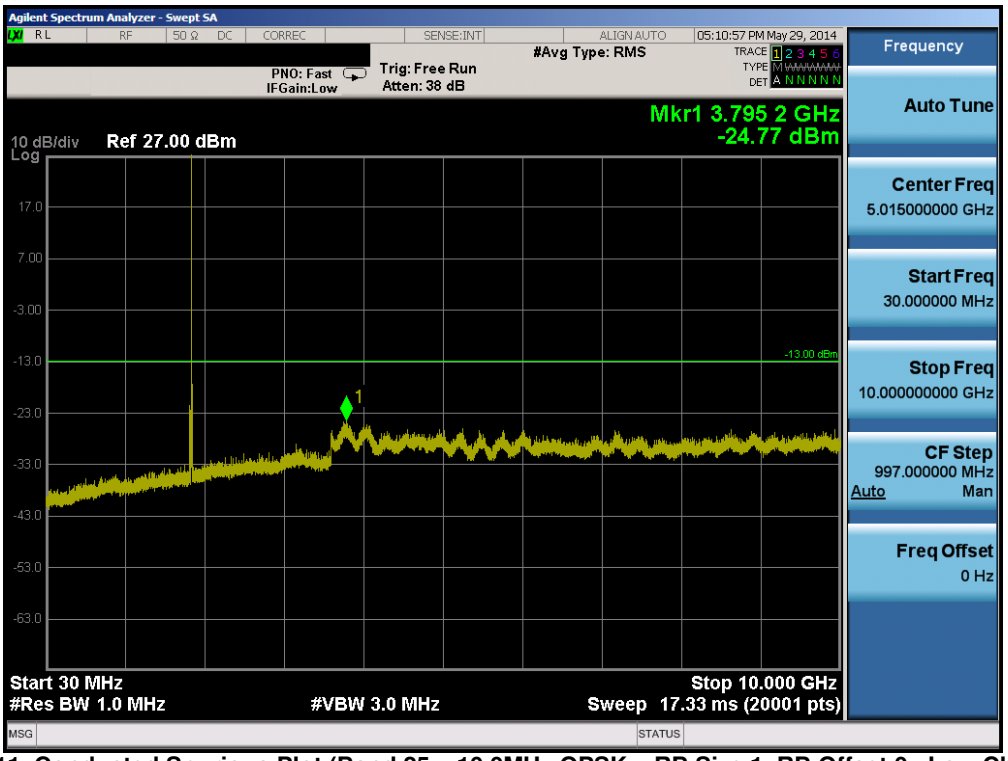
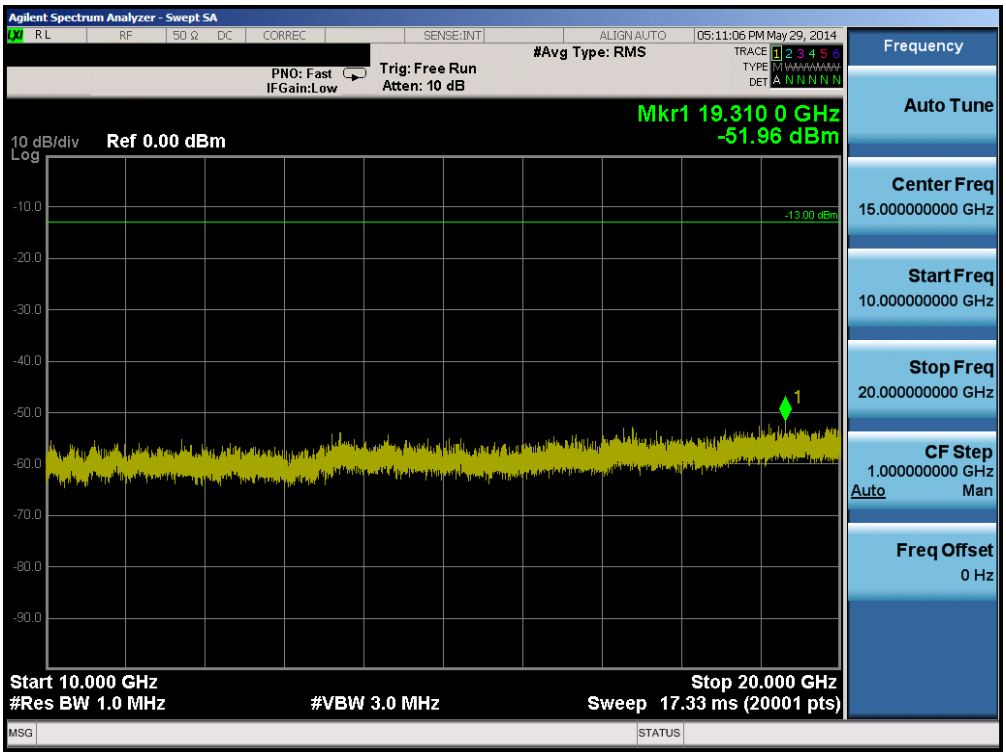


Plot 6-11. Conducted Spurious Plot (Band 25 – 10.0MHz QPSK – RB Size 1, RB Offset 0– Low Channel)



Plot 6-12. Conducted Spurious Plot (Band 25 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

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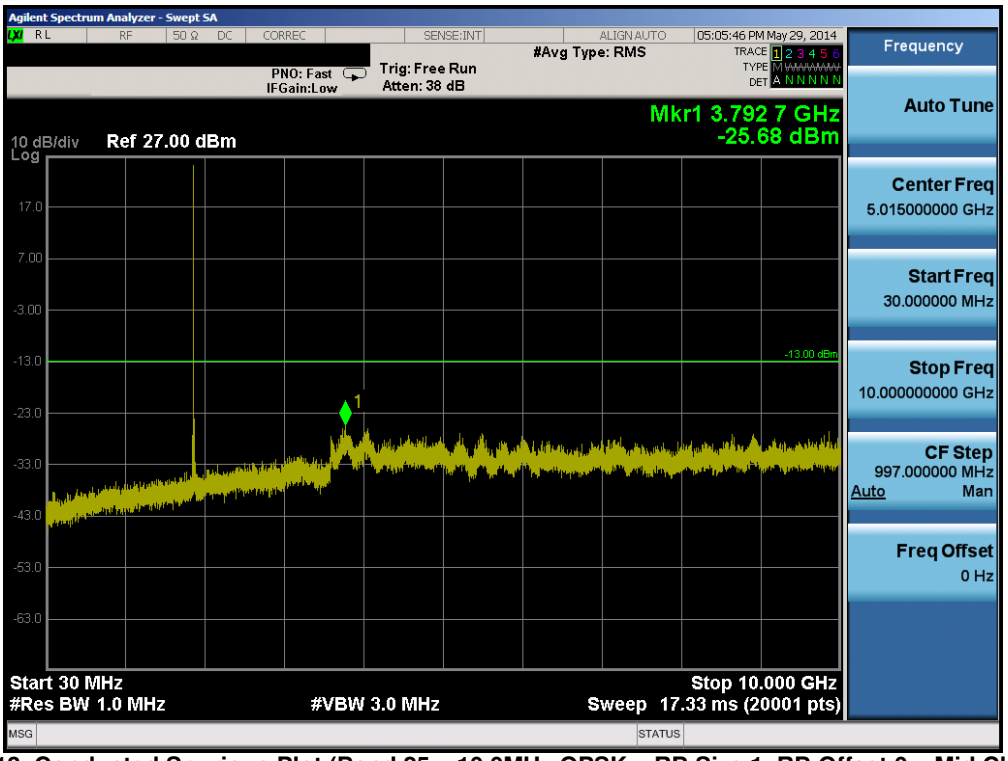
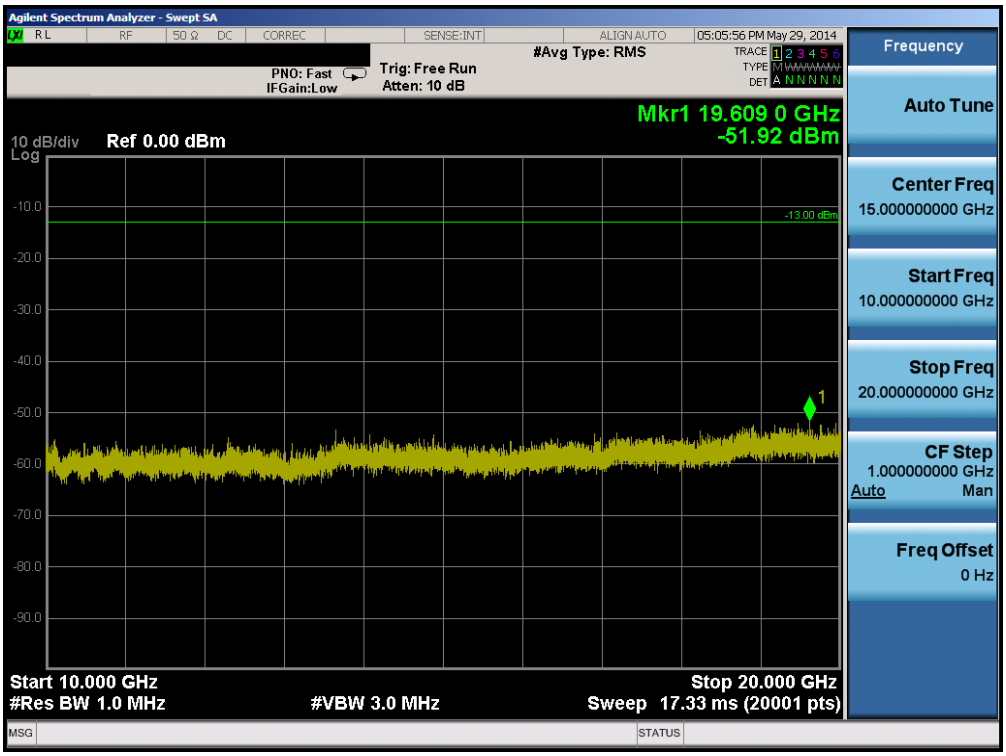


Plot 6-13. Conducted Spurious Plot (Band 25 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 6-14. Conducted Spurious Plot (Band 25 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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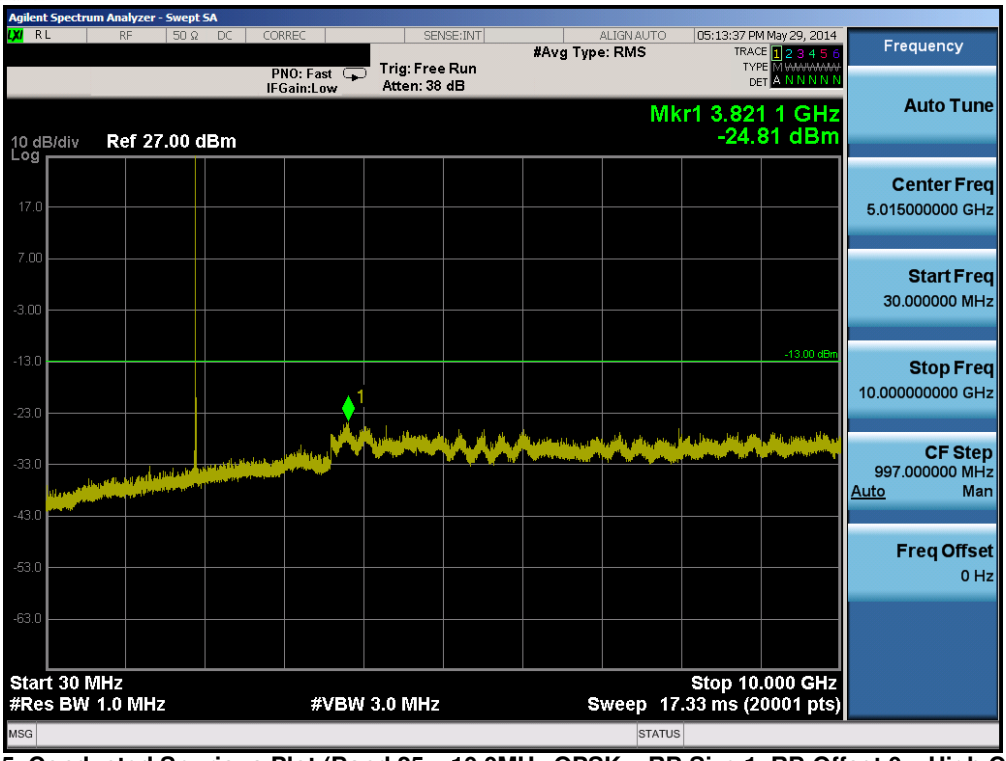
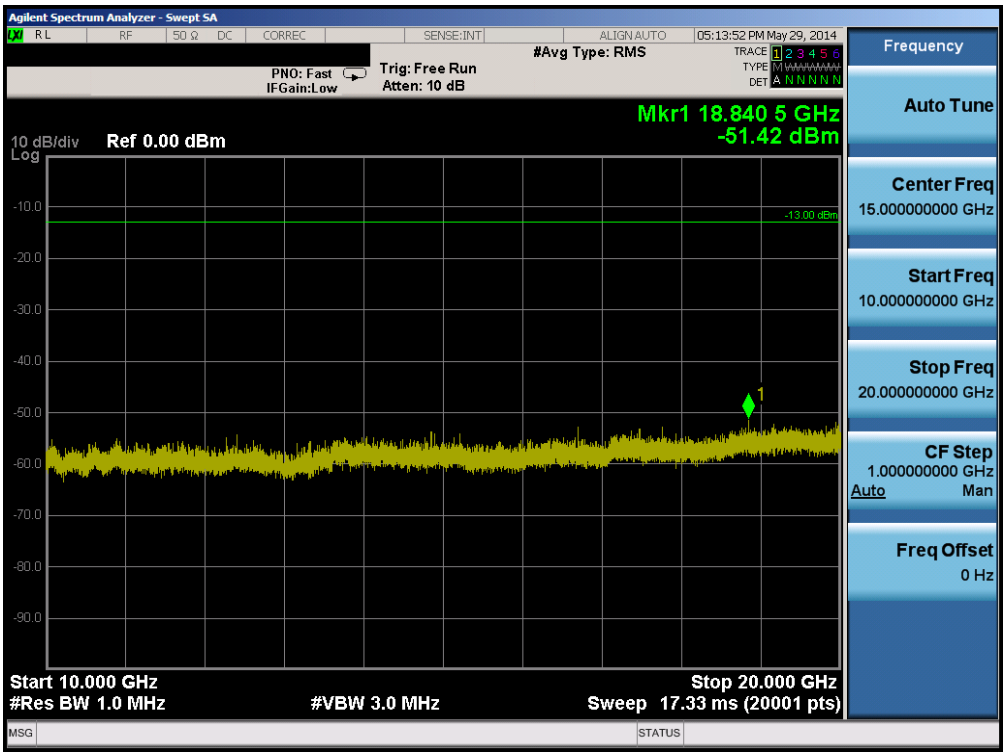


Plot 6-15. Conducted Spurious Plot (Band 25 – 10.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 6-16. Conducted Spurious Plot (Band 25 – 10.0MHz 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)

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 v02r01 – 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.

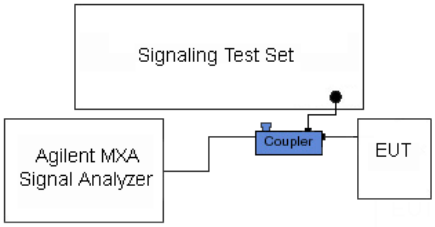

Figure 6-3. Test Instrument & Measurement Setup

Test Notes

Per 24.238(a) in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

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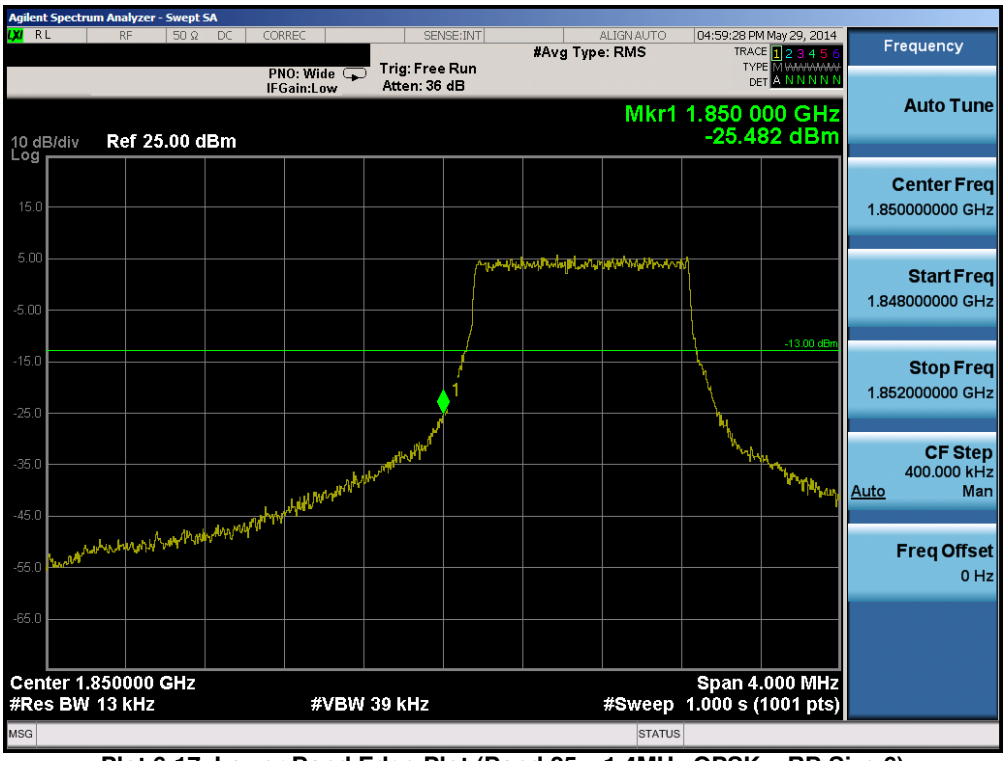
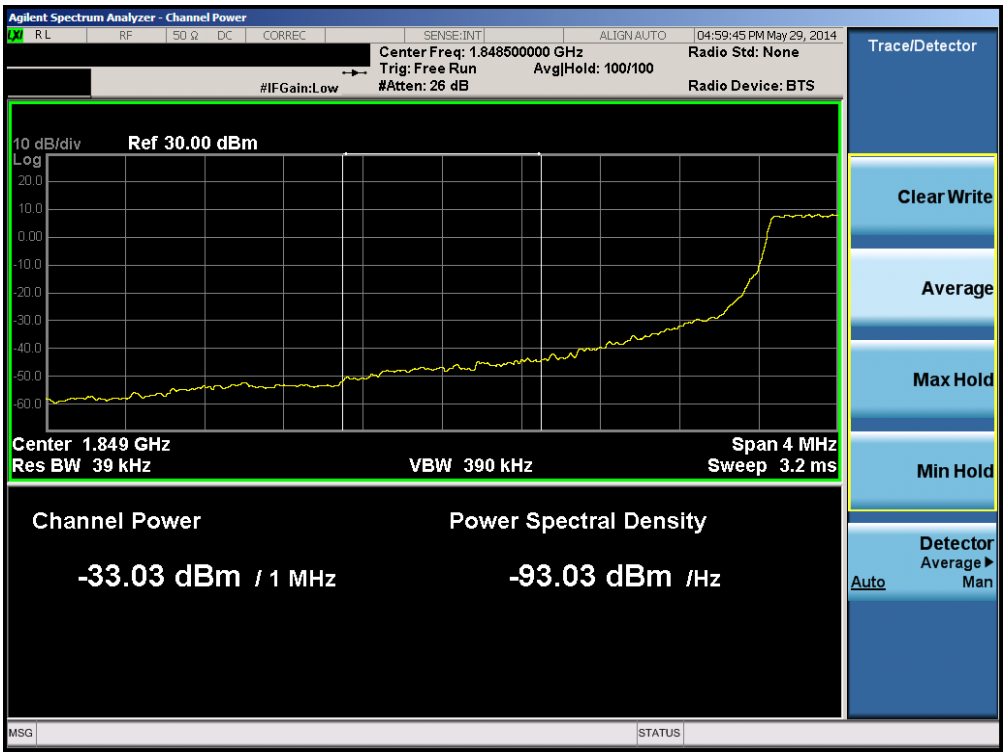


Plot 6-17. Lower Band Edge Plot (Band 25 – 1.4MHz QPSK – RB Size 6)



Plot 6-18. Lower Extended Band Edge Plot (Band 25 – 1.4MHz QPSK – RB Size 6)

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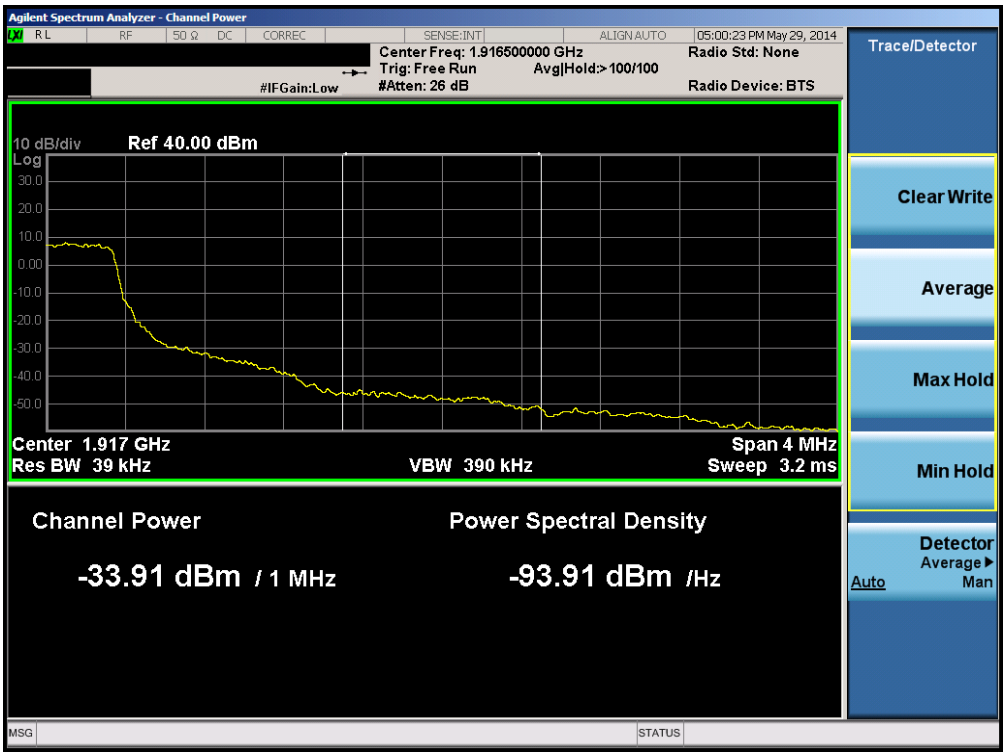
Plot 6-19. Upper Band Edge Plot (Band 25 – 1.4MHz QPSK – RB Size 6)



Plot 6-20. Upper Extended Band Edge Plot (Band 25 – 1.4MHz QPSK – RB Size 6)

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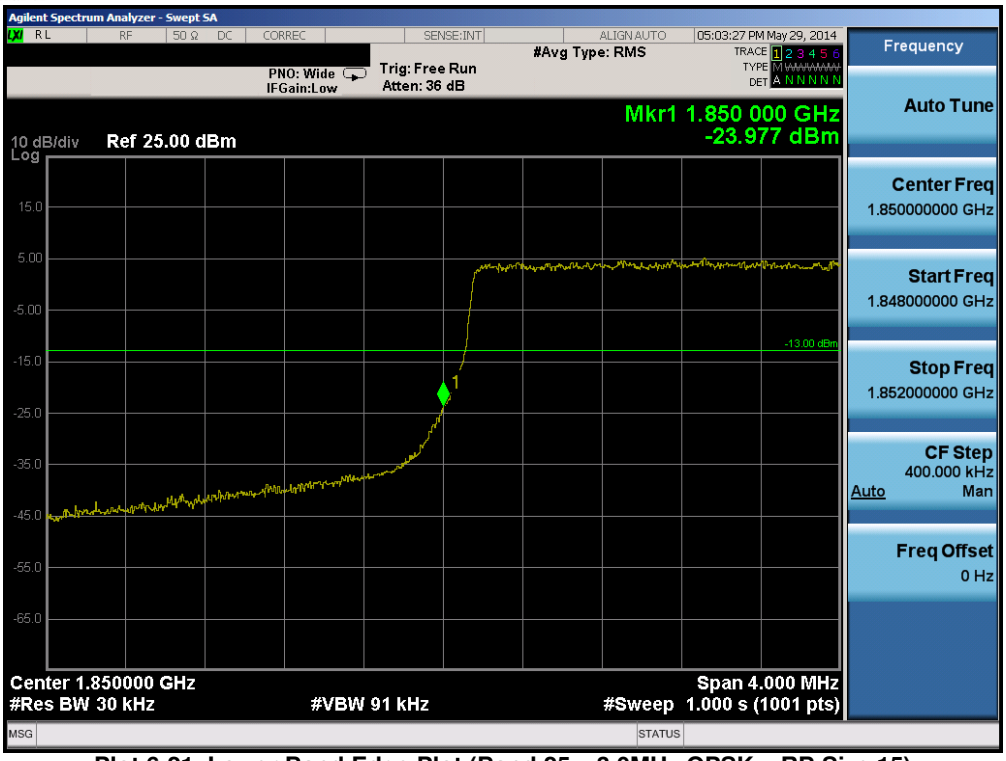
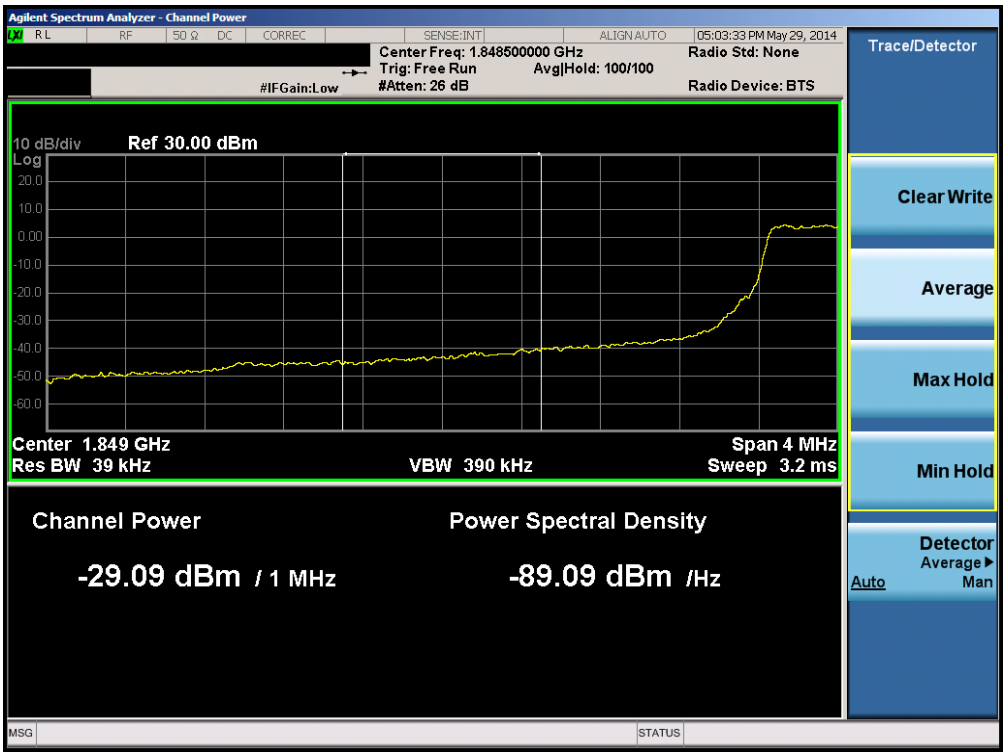


Plot 6-21. Lower Band Edge Plot (Band 25 – 3.0MHz QPSK – RB Size 15)



Plot 6-22. Lower Extended Band Edge Plot (Band 25 – 3.0MHz QPSK – RB Size 15)

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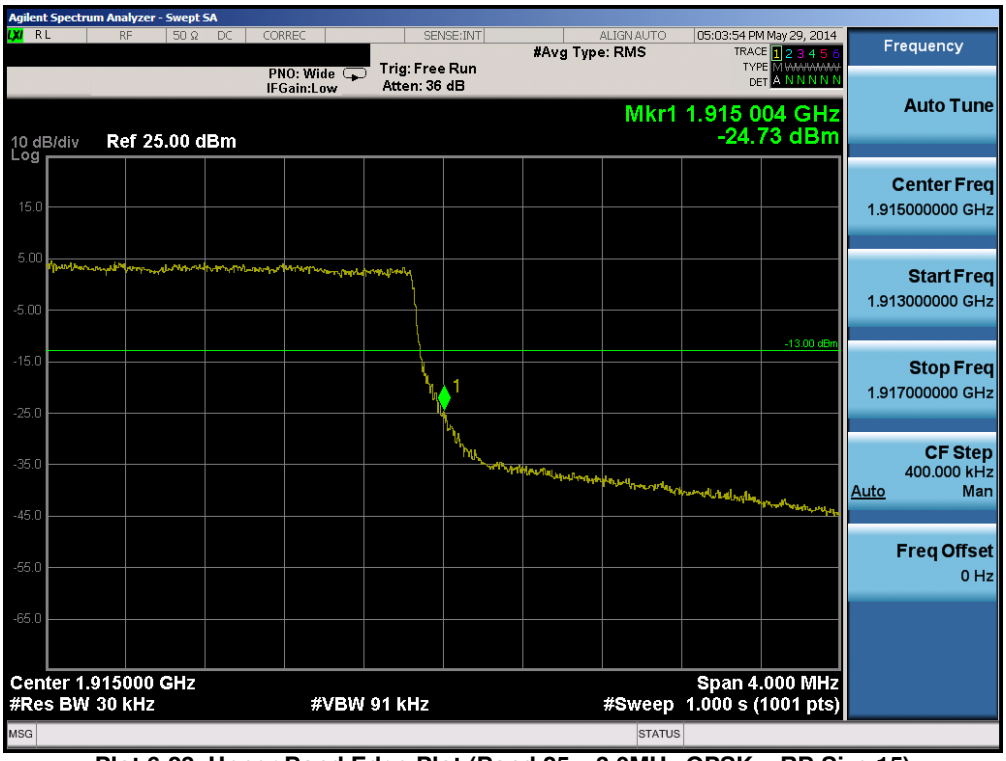
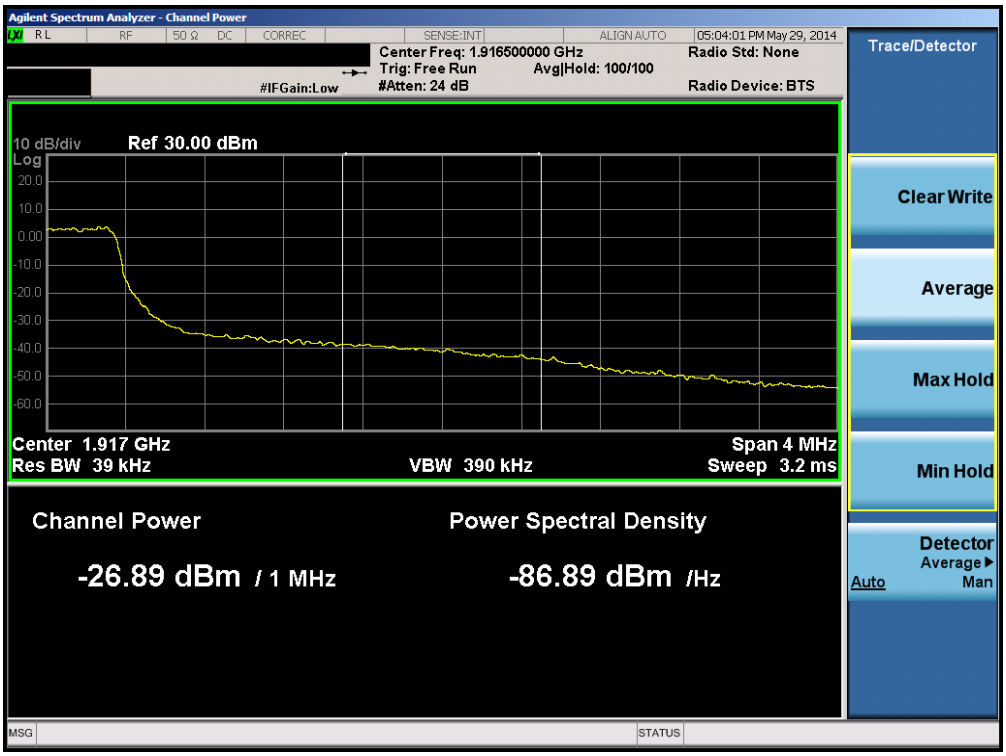


Plot 6-23. Upper Band Edge Plot (Band 25 – 3.0MHz QPSK – RB Size 15)



Plot 6-24. Upper Extended Band Edge Plot (Band 25 – 3.0MHz QPSK – RB Size 15)

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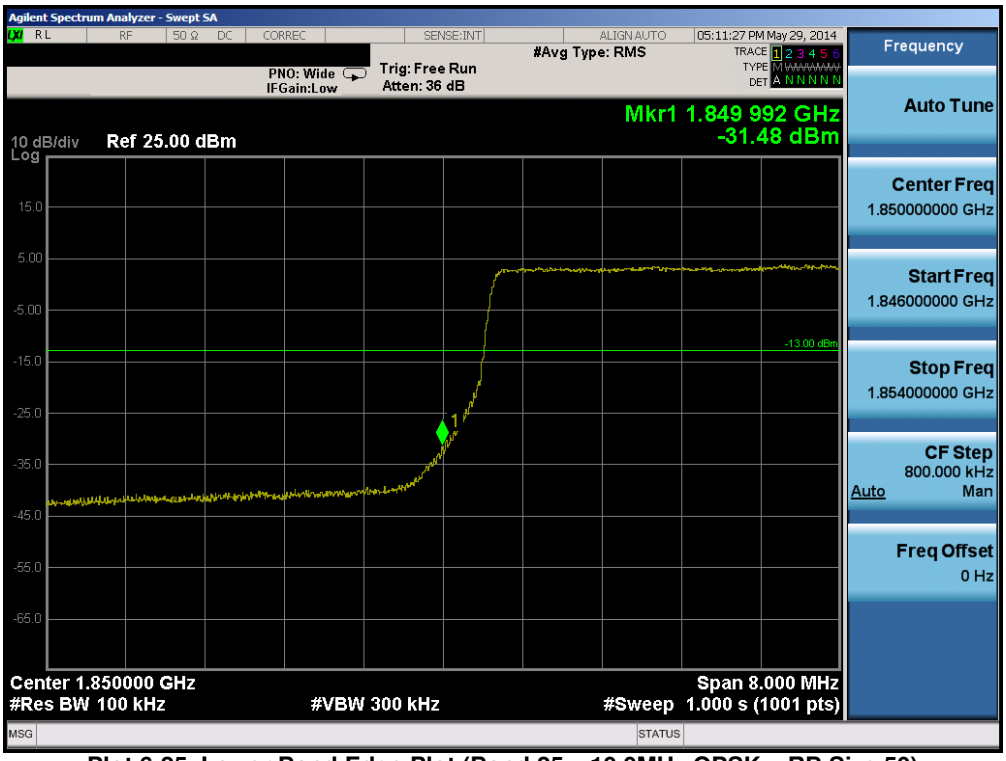
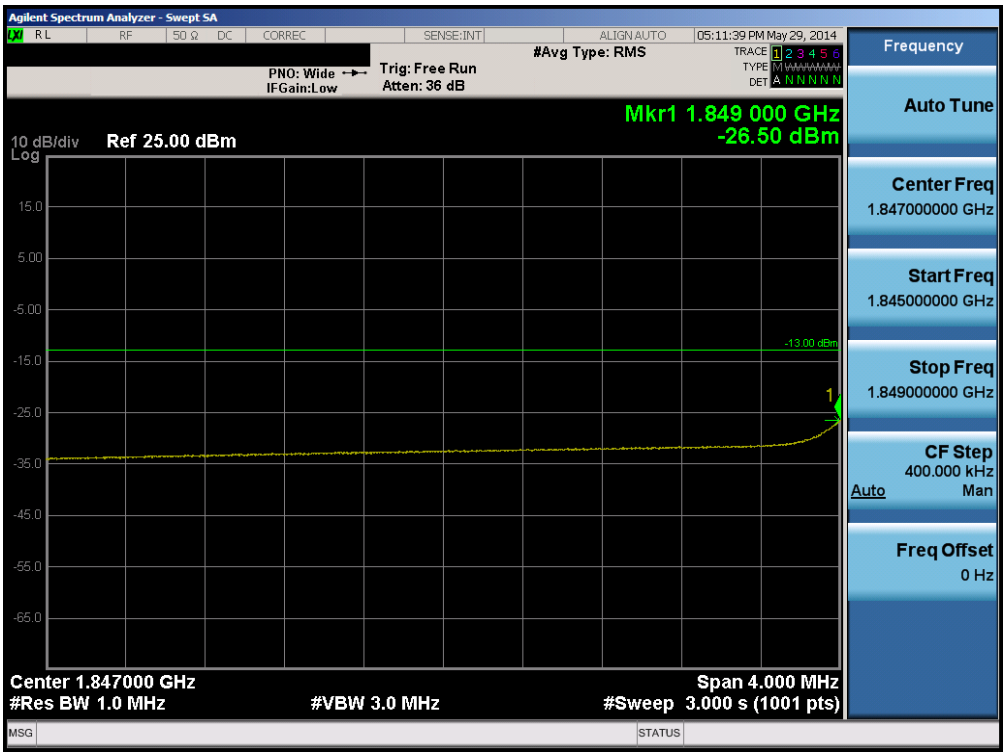


Plot 6-25. Lower Band Edge Plot (Band 25 – 10.0MHz QPSK – RB Size 50)



Plot 6-26. Lower Extended Band Edge Plot (Band 25 – 10.0MHz QPSK – RB Size 50)

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Plot 6-27. Upper Band Edge Plot (Band 25 – 10.0MHz QPSK – RB Size 50)

Plot 6-28. Upper Extended Band Edge Plot (Band 25 – 10.0MHz QPSK – RB Size 50)

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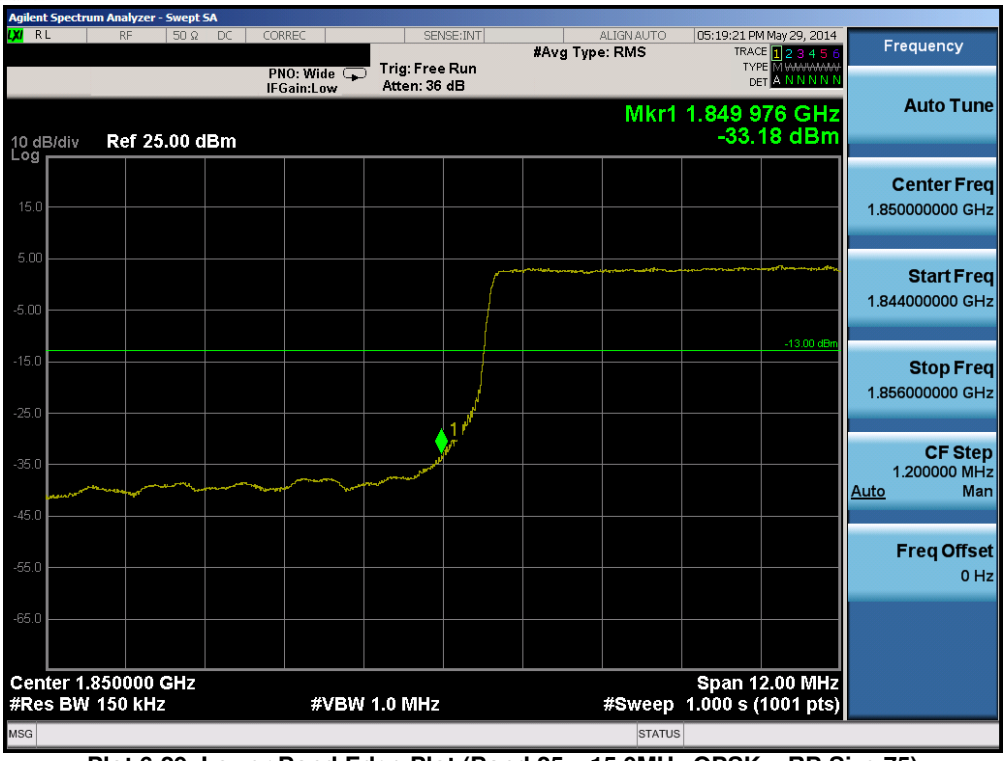
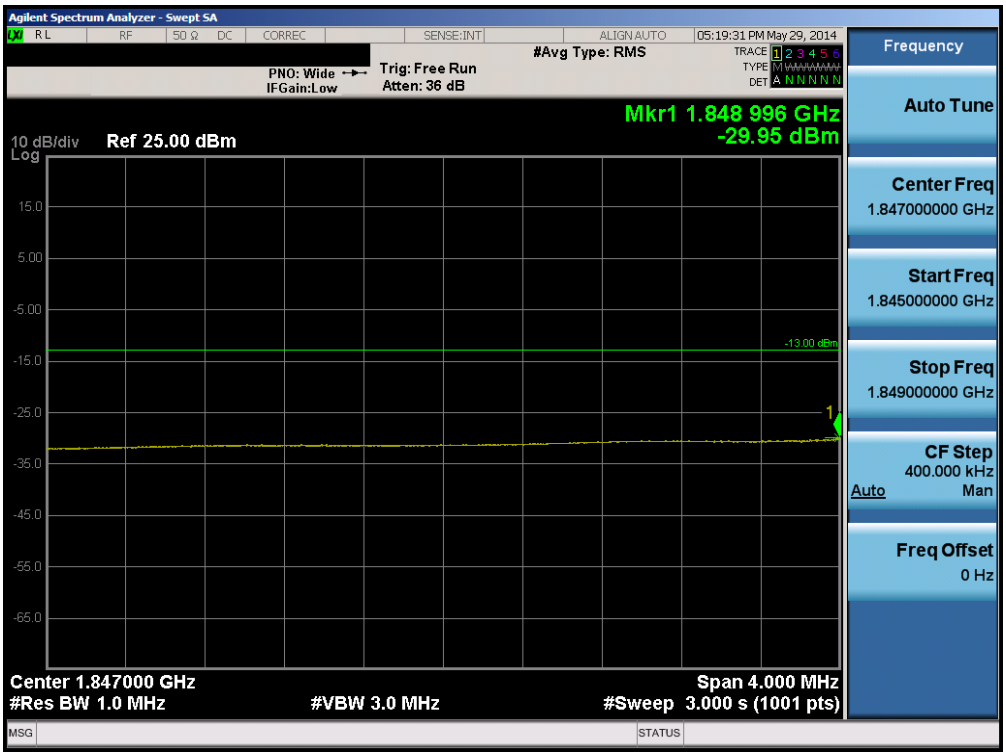


Plot 6-29. Lower Band Edge Plot (Band 25 – 15.0MHz QPSK – RB Size 75)



Plot 6-30. Lower Extended Band Edge Plot (Band 25 – 15.0MHz QPSK – RB Size 75)

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Plot 6-31. Upper Band Edge Plot (Band 25 – 15.0MHz QPSK – RB Size 75)

Plot 6-32. Upper Extended Band Edge Plot (Band 25 – 15.0MHz QPSK – RB Size 75)

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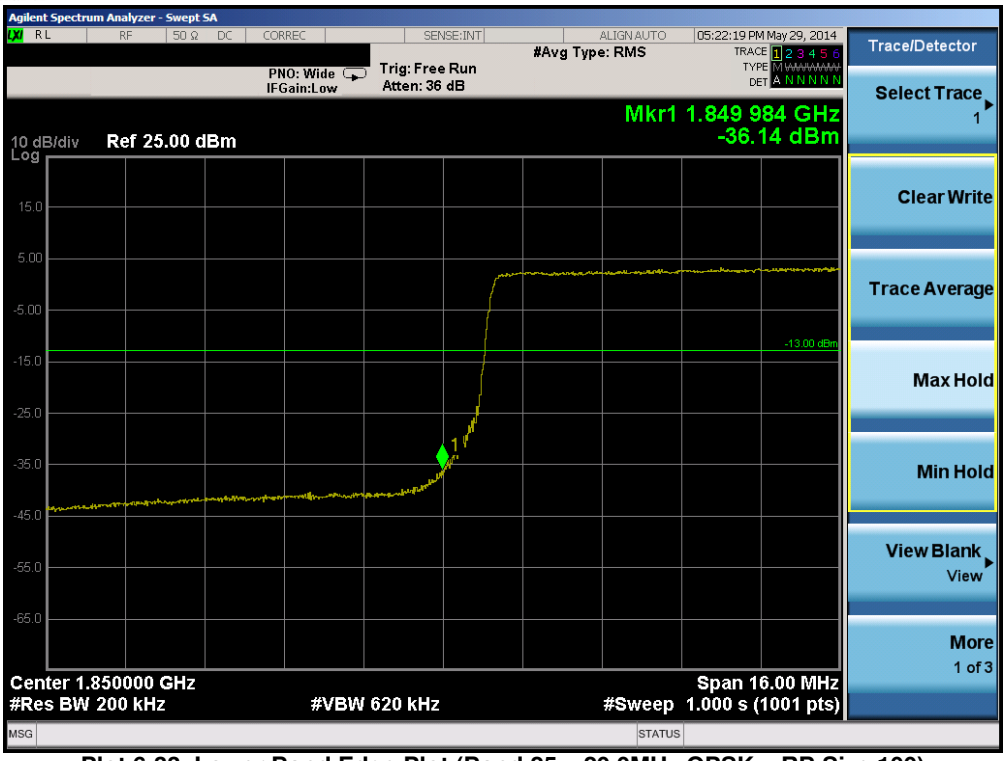
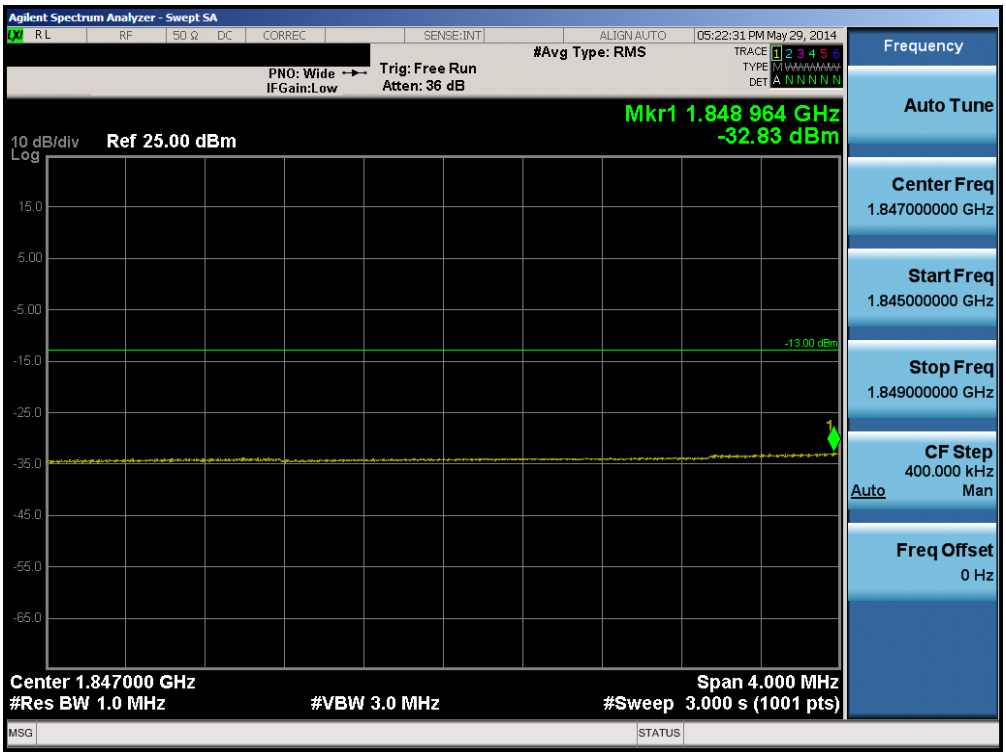


Plot 6-33. Lower Band Edge Plot (Band 25 – 20.0MHz QPSK – RB Size 100)



Plot 6-34. Lower Extended Band Edge Plot (Band 25 – 20.0MHz QPSK – RB Size 100)

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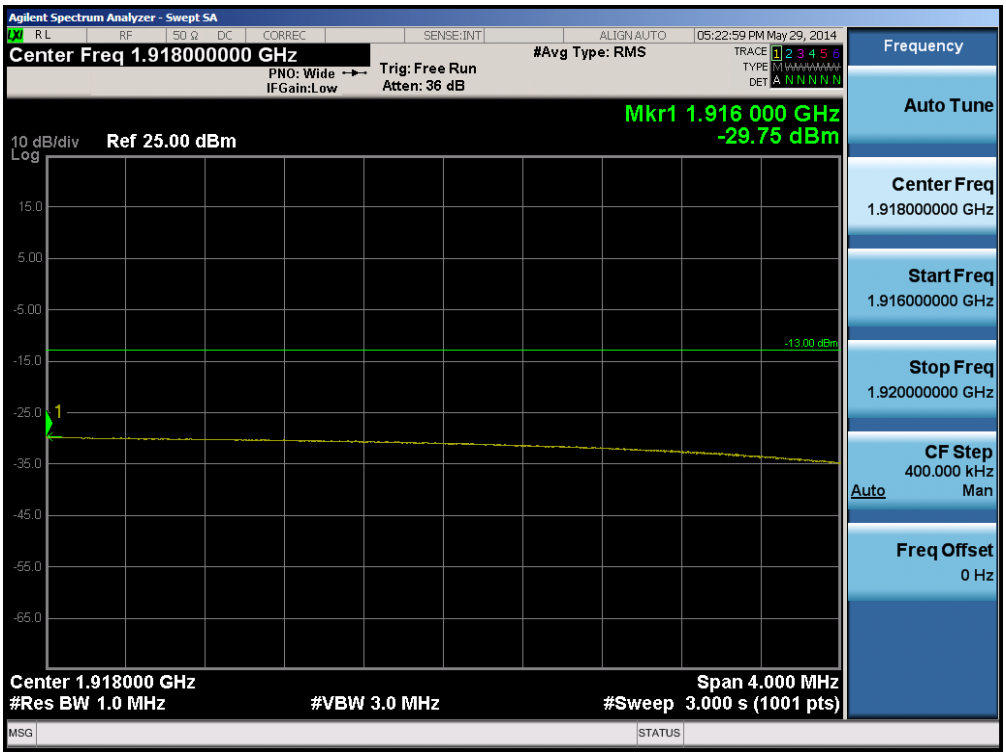
Plot 6-35. Upper Band Edge Plot (Band 25 – 20.0MHz QPSK – RB Size 100)



Plot 6-36. Upper Extended Band Edge Plot (Band 25 – 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 v02r01 – 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. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power

Test Setup

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

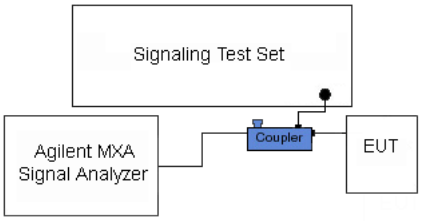

Figure 6-4. Test Instrument & Measurement Setup

Test Notes

None.

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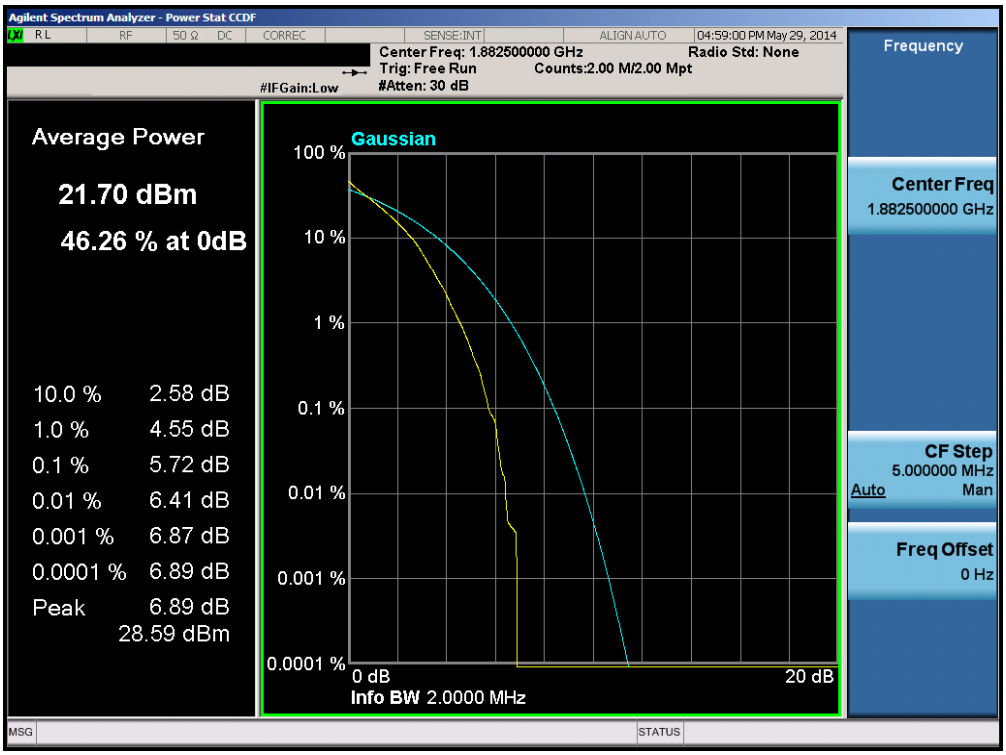
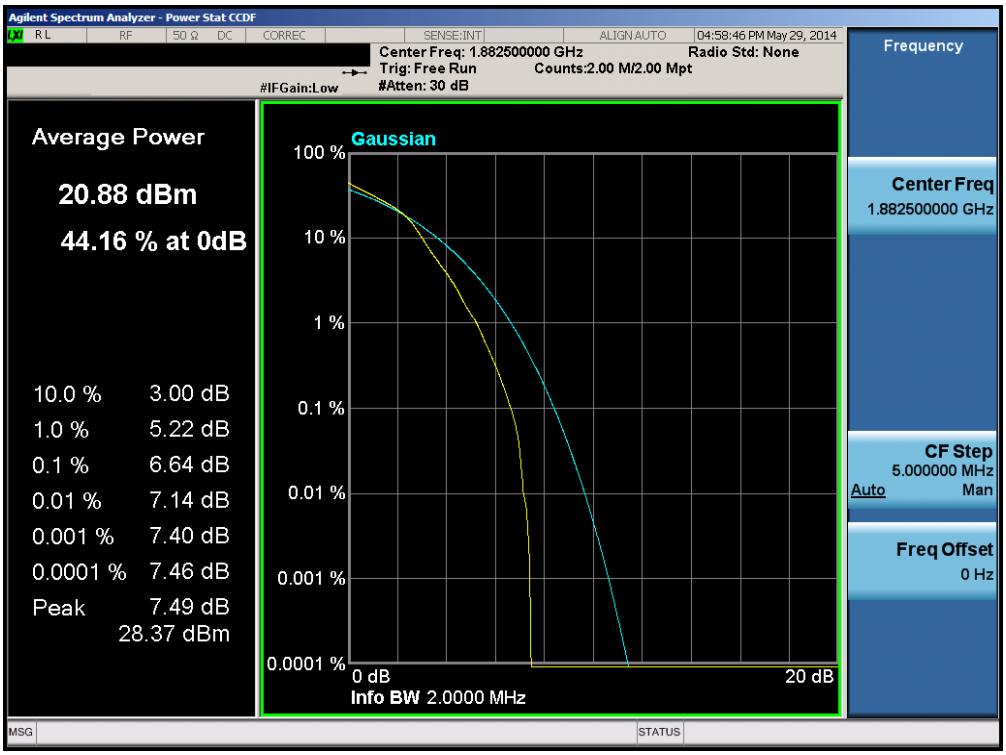


Plot 6-37. PAR Plot (Band 25 – 1.4MHz QPSK – RB Size 6)



Plot 6-38. PAR Plot (Band 25 – 1.4MHz 16-QAM – RB Size 6)

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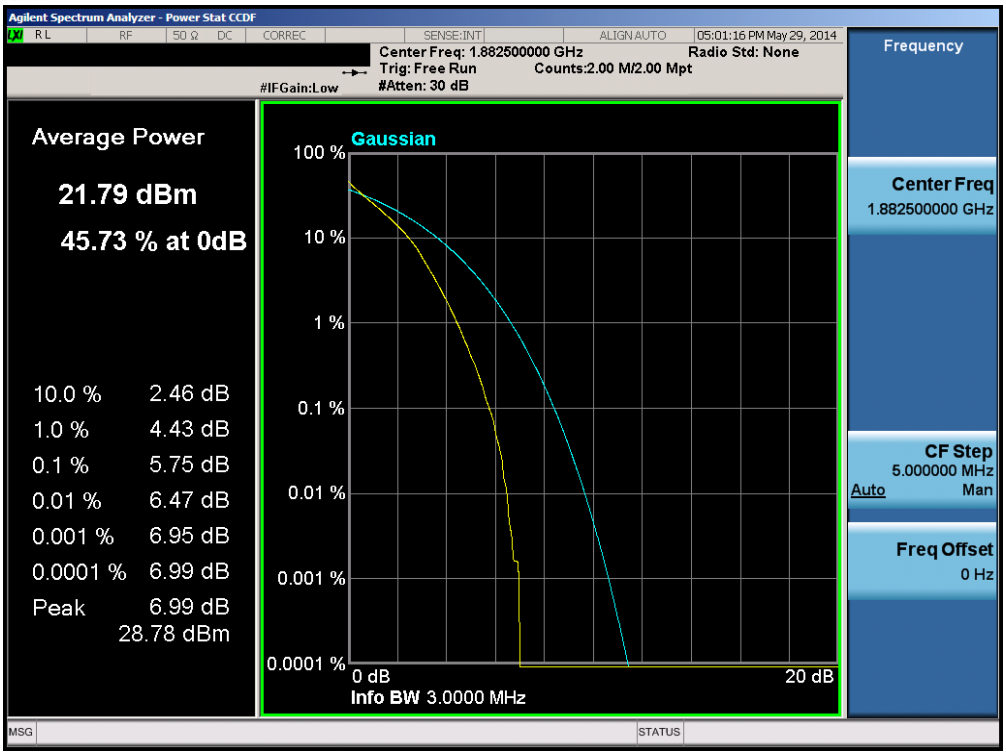
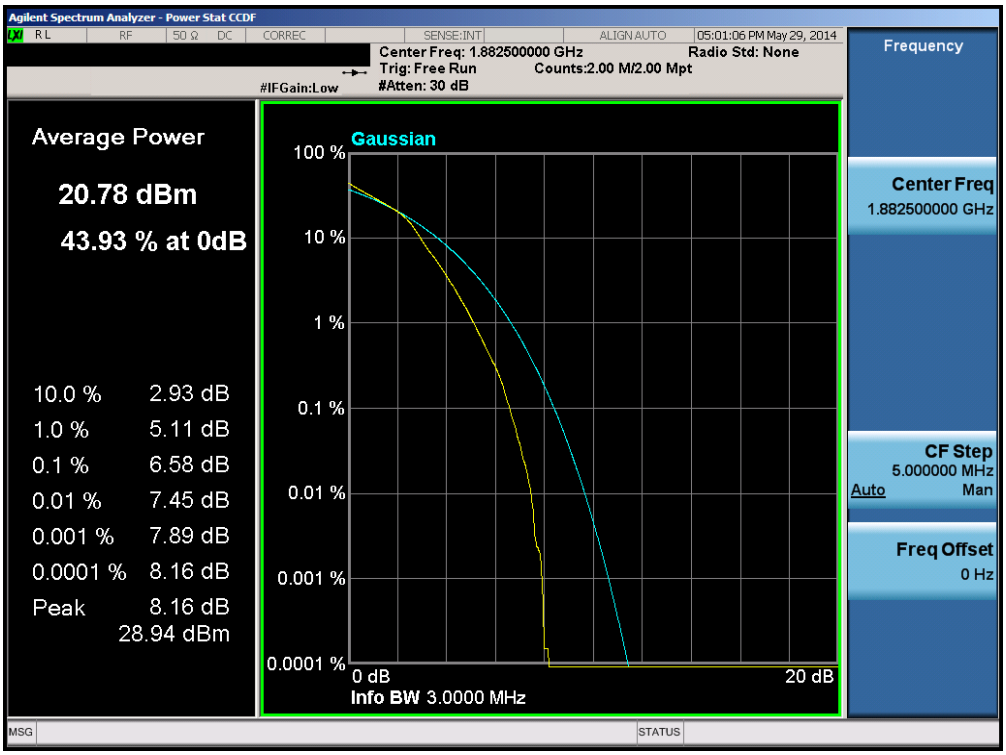


Plot 6-39. PAR Plot (Band 25 – 3.0MHz QPSK – RB Size 15)



Plot 6-40. PAR Plot (Band 25 – 3.0MHz 16-QAM – RB Size 15)

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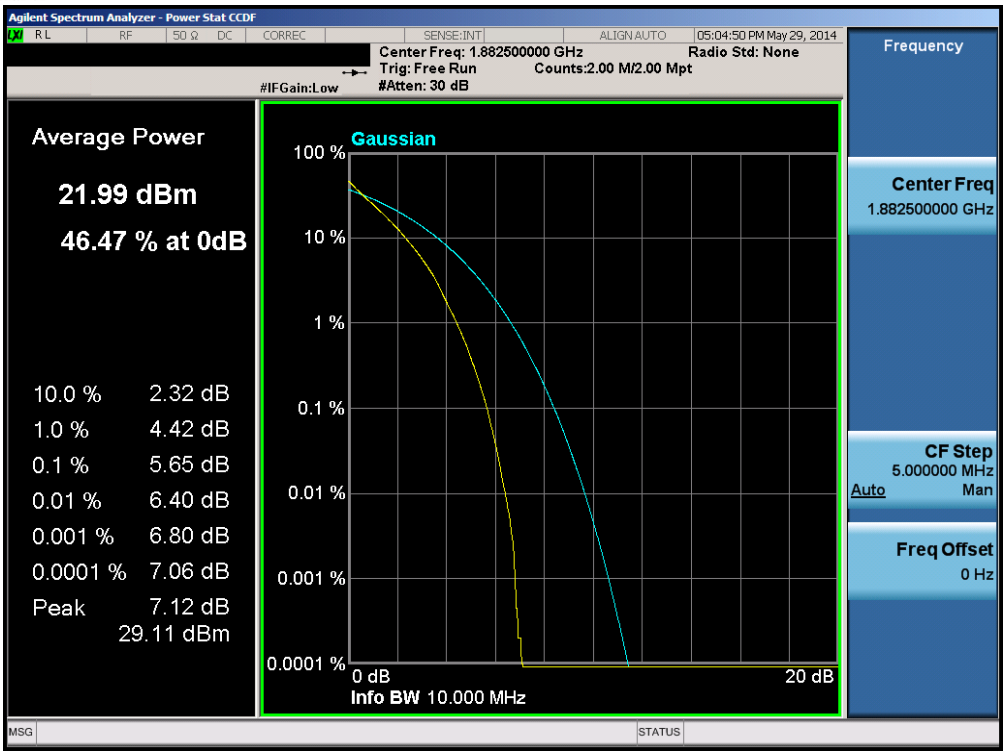
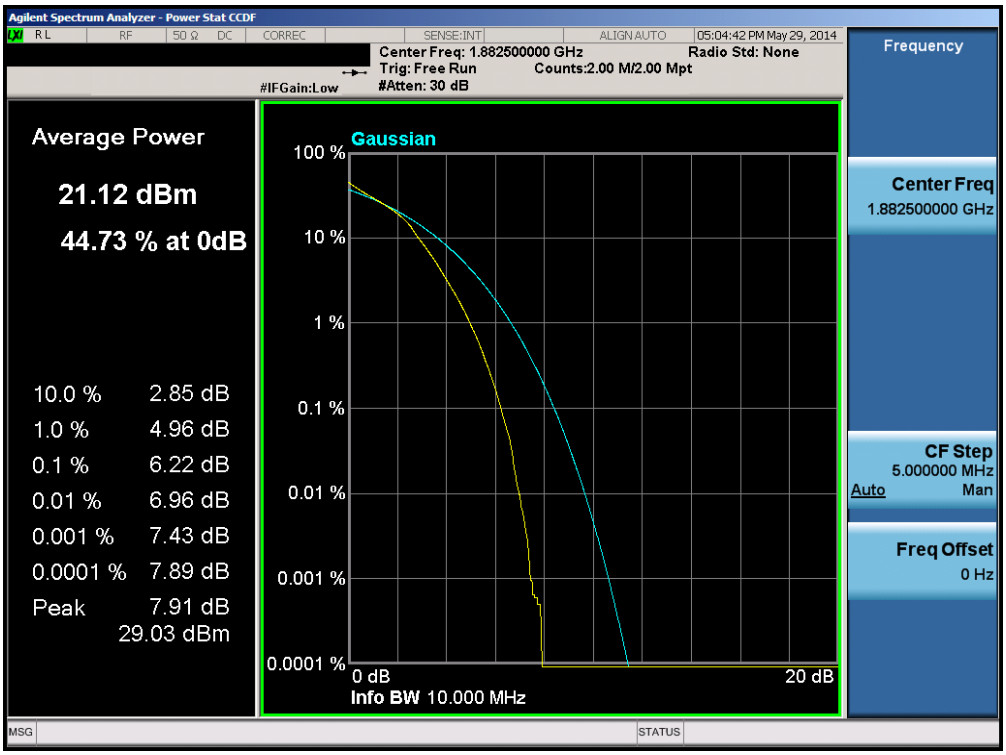


Plot 6-41. PAR Plot (Band 25 – 10.0MHz QPSK – RB Size 50)



Plot 6-42. PAR Plot (Band 25 – 10.0MHz 16-QAM – RB Size 50)

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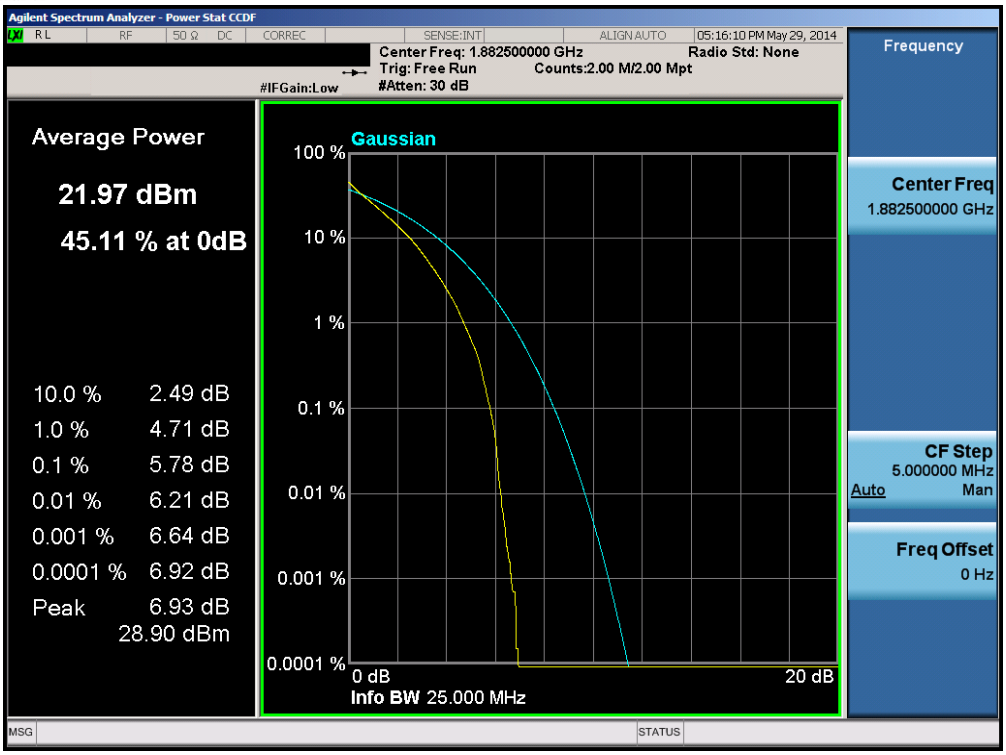
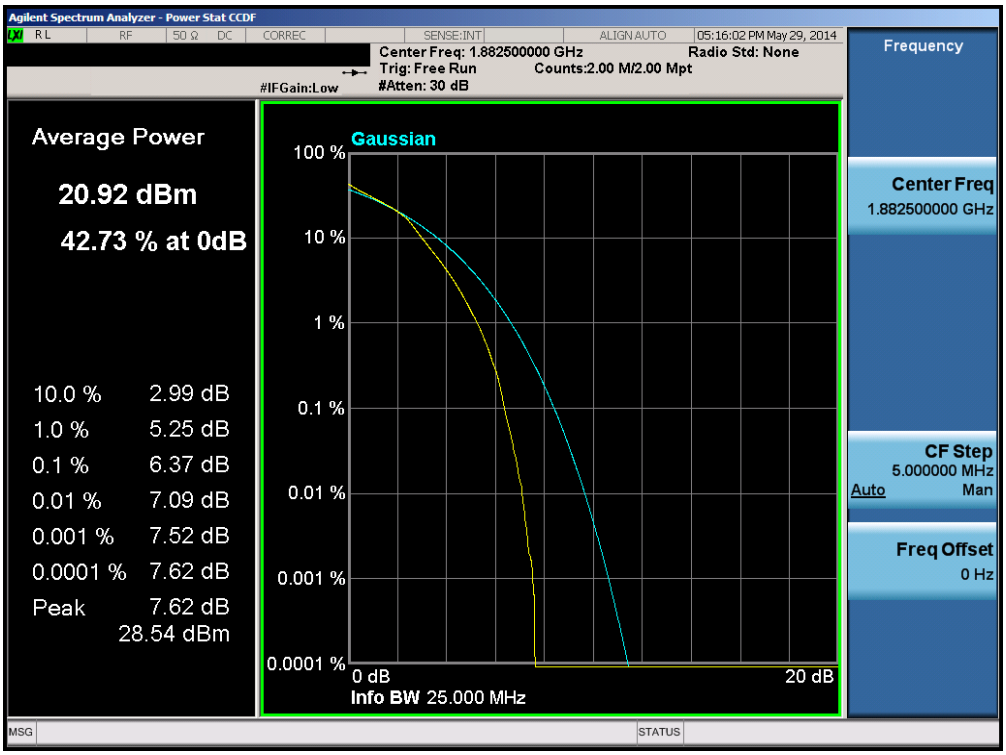


Plot 6-43. PAR Plot (Band 25 – 15.0MHz QPSK – RB Size 75)



Plot 6-44. PAR Plot (Band 25 – 15.0MHz 16-QAM – RB Size 75)

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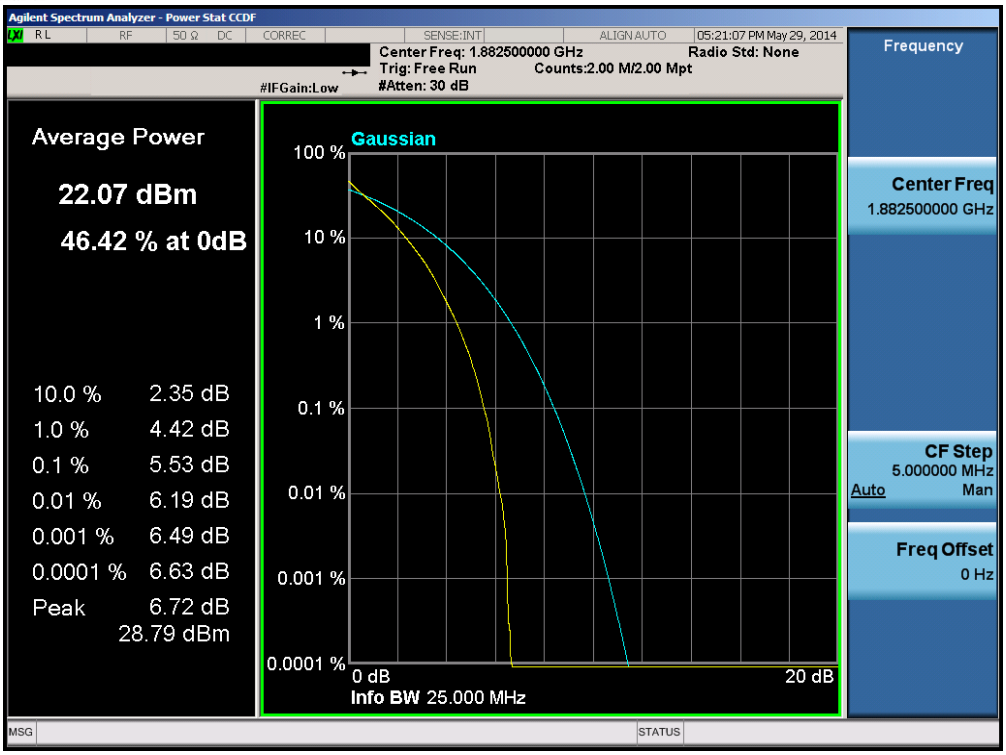
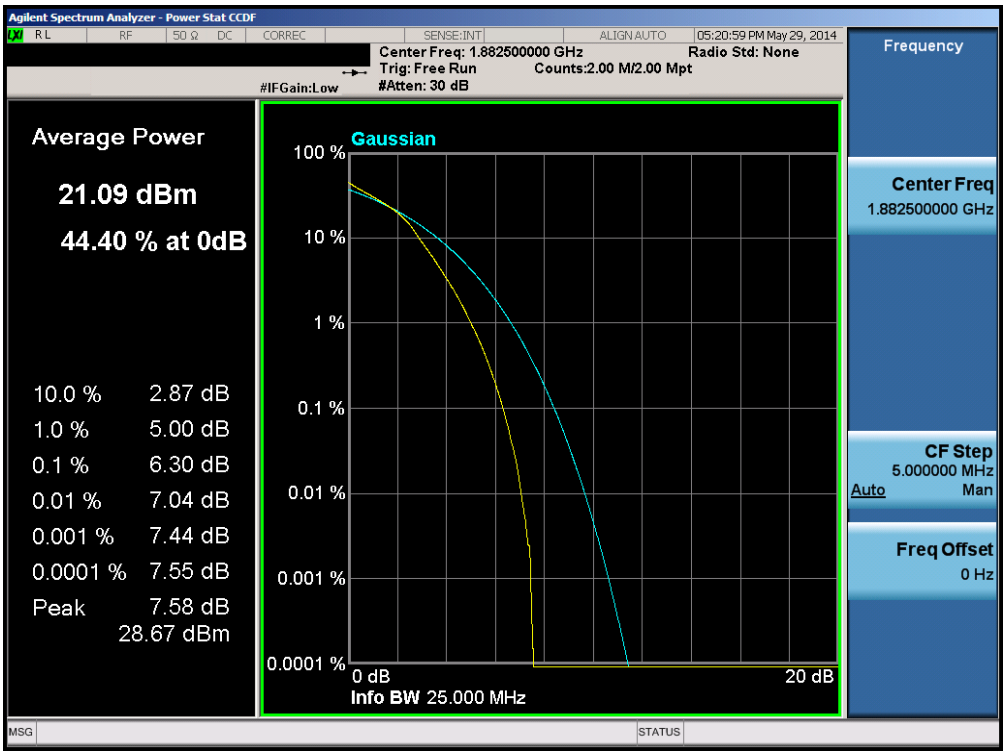


Plot 6-45. PAR Plot (Band 25 – 20.0MHz QPSK – RB Size 100)



Plot 6-46. PAR Plot (Band 25 – 20.0MHz 16-QAM – RB Size 100)

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6.6 Radiated Power (EIRP)

§24.232(c)

Test Overview

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 v02r01 – 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. For signals with burst transmission, the signal analyzer's "time domain power" measurement capability is used
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". Trigger is set to enable triggering only on full power bursts with the sweep time set less than or equal to the transmission burst duration
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation. For signals with burst transmission, the "gating" function was enabled to ensure that measurements are performed during times in which the transmitter is operating at its maximum power
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.

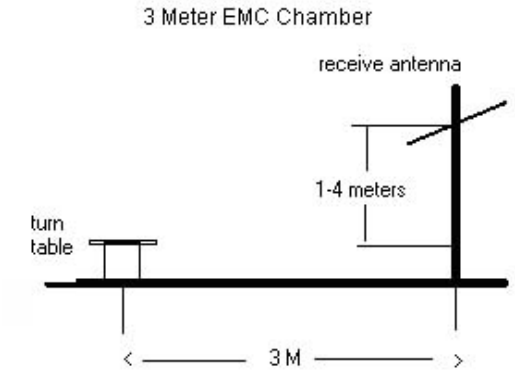

Figure 6-5. Test Instrument & Measurement Setup

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.

2) The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

3) The EUT is supplied with a new/fully-recharged battery. The battery for this model contains an embedded NFC antenna.

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Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Battery	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBi]	Ant. Pol. [H/V]	EUT Pol.	EIRP [dBm]	EIRP [Watts]	Margin [dB]
1850.70	1.4	QPSK	Standard	1 / 0	11.86	9.59	V	V	21.45	0.140	-11.56
1882.50	1.4	QPSK	Standard	1 / 0	11.07	9.53	V	V	20.60	0.115	-12.41
1914.30	1.4	QPSK	Standard	1 / 0	10.59	9.47	V	V	20.06	0.101	-12.95
1850.70	1.4	16-QAM	Standard	1 / 0	11.01	9.59	V	V	20.60	0.115	-12.41
1882.50	1.4	16-QAM	Standard	1 / 0	10.22	9.53	V	V	19.75	0.094	-13.26
1914.30	1.4	16-QAM	Standard	1 / 0	9.75	9.47	V	V	19.22	0.084	-13.79
1851.50	3	QPSK	Standard	1 / 0	11.59	9.59	V	V	21.18	0.131	-11.83
1882.50	3	QPSK	Standard	1 / 0	10.96	9.53	V	V	20.49	0.112	-12.52
1913.50	3	QPSK	Standard	1 / 0	10.41	9.47	V	V	19.88	0.097	-13.13
1851.50	3	16-QAM	Standard	1 / 0	10.75	9.59	V	V	20.34	0.108	-12.67
1882.50	3	16-QAM	Standard	1 / 0	11.19	9.53	V	V	20.72	0.118	-12.29
1913.50	3	16-QAM	Standard	1 / 0	10.52	9.47	V	V	19.99	0.100	-13.02
1855.00	10	QPSK	Standard	1 / 0	12.27	9.59	V	V	21.86	0.153	-11.15
1882.50	10	QPSK	Standard	1 / 0	11.12	9.53	V	V	20.65	0.116	-12.36
1910.00	10	QPSK	Standard	1 / 0	10.75	9.47	V	V	20.22	0.105	-12.79
1855.00	10	16-QAM	Standard	1 / 0	11.45	9.59	V	V	21.04	0.127	-11.97
1882.50	10	16-QAM	Standard	1 / 0	10.31	9.53	V	V	19.84	0.096	-13.17
1910.00	10	16-QAM	Standard	1 / 0	9.94	9.47	V	V	19.41	0.087	-13.60
1857.50	15	QPSK	Standard	1 / 0	12.04	9.59	V	V	21.63	0.145	-11.38
1882.50	15	QPSK	Standard	1 / 0	11.24	9.53	V	V	20.77	0.119	-12.24
1907.50	15	QPSK	Standard	1 / 0	10.09	9.47	V	V	19.56	0.090	-13.45
1857.50	15	16-QAM	Standard	1 / 0	11.39	9.59	V	V	20.98	0.125	-12.03
1882.50	15	16-QAM	Standard	1 / 0	10.41	9.53	V	V	19.94	0.099	-13.07
1907.50	15	16-QAM	Standard	1 / 0	9.25	9.47	V	V	18.72	0.075	-14.29
1860.00	20	QPSK	Standard	1 / 0	11.64	9.59	V	V	21.23	0.133	-11.78
1882.50	20	QPSK	Standard	1 / 0	11.57	9.53	V	V	21.10	0.129	-11.91
1905.00	20	QPSK	Standard	1 / 0	10.41	9.47	V	V	19.88	0.097	-13.13
1860.00	20	16-QAM	Standard	1 / 0	10.79	9.59	V	V	20.38	0.109	-12.63
1882.50	20	16-QAM	Standard	1 / 0	10.99	9.53	V	V	20.52	0.113	-12.49
1905.00	20	16-QAM	Standard	1 / 0	9.51	9.47	V	V	18.98	0.079	-14.03

Table 6-2. EIRP Data (Band 25)

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6.7 Radiated Spurious Emissions Measurements

§2.1053 §24.238(a)

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 vertically 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 v02r01 – 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.

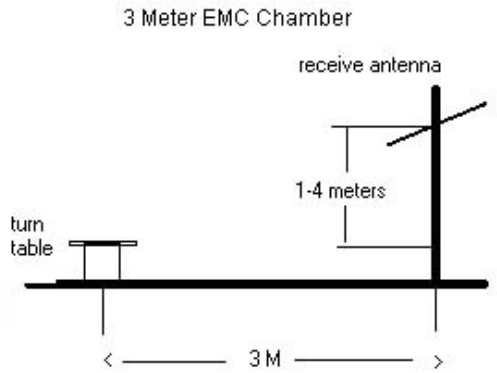

Figure 6-6. Test Instrument & Measurement Setup

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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.

2) The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

3) The EUT is supplied with a new/fully-recharged battery. The battery for this model contains an embedded NFC antenna.

4) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.

5) 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:	1855.00	MHz		
CHANNEL:	26090			
MEASURED OUTPUT POWER:	21.86	dBm	=	0.153 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	10.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	34.86	dBc	

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	EUT Pol. [H/H2/V]	[dBc]
3710.00	-40.79	8.40	-32.39	H	H	54.2
5565.00	-44.69	10.59	-34.11	H	H	56.0
7420.00	-50.54	12.06	-38.48	H	H	60.3
9275.00	-39.44	13.22	-26.23	H	H	48.1
11130.00	-52.14	13.26	-38.87	H	H	60.7
12985.00	-50.79	13.45	-37.34	H	H	59.2

Table 6-3. Radiated Spurious Data (Band 25 – Low Channel)

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OPERATING FREQUENCY:	1882.50	MHz		
CHANNEL:	26365			
MEASURED OUTPUT POWER:	20.65	dBm	=	0.116 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	10			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	33.65	dBc	

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	EUT Pol. [H/H2/V]	[dBc]
3765.00	-38.61	8.38	-30.23	H	H	50.9
5647.50	-47.70	10.70	-37.00	H	H	57.6
7530.00	-51.45	12.11	-39.34	H	H	60.0
9412.50	-41.07	13.19	-27.88	H	H	48.5
11295.00	-52.26	13.32	-38.94	H	H	59.6
13177.50	-50.79	13.59	-37.20	H	H	57.8

Table 6-4. Radiated Spurious Data (Band 25 – Mid Channel)

OPERATING FREQUENCY:	1910.00	MHz		
CHANNEL:	26640			
MEASURED OUTPUT POWER:	20.22	dBm	=	0.105 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	10			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	33.22	dBc	

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	EUT Pol. [H/H2/V]	[dBc]
3820.00	-39.09	8.41	-30.68	H	H	50.9
5730.00	-45.79	10.76	-35.03	H	H	55.3
7640.00	-50.00	12.22	-37.78	H	H	58.0
9550.00	-42.29	13.18	-29.11	H	H	49.3
11460.00	-51.76	13.33	-38.42	H	H	58.6
13370.00	-50.81	13.60	-37.21	H	H	57.4

Table 6-5. Radiated Spurious Data (Band 25 – High Channel)

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6.8 Frequency Stability / Temperature Variation

§2.1055 §24.235

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 24, 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 25 Frequency Stability Measurements

§2.1055 §24.235

OPERATING FREQUENCY:	1,882,500,000	Hz
CHANNEL:	26365	
REFERENCE VOLTAGE:	3.80	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	+ 20 (Ref)	1,882,499,988	-12	-0.0000007
100 %		- 30	1,882,499,987	-13	-0.0000007
100 %		- 20	1,882,499,991	-9	-0.0000005
100 %		- 10	1,882,499,989	-11	-0.0000006
100 %		0	1,882,499,985	-15	-0.0000008
100 %		+ 10	1,882,499,999	-1	-0.0000001
100 %		+ 20	1,882,499,987	-13	-0.0000007
100 %		+ 30	1,882,499,992	-8	-0.0000004
100 %		+ 40	1,882,499,987	-13	-0.0000007
100 %		+ 50	1,882,499,985	-15	-0.0000008
115 %	4.37	+ 20	1,882,499,992	-8	-0.0000004
BATT. ENDPOINT	3.40	+ 20	1,882,499,987	-13	-0.0000007

Table 6-6. Frequency Stability Data (Band 25)

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 25 Frequency Stability Measurements

§2.1055 §24.235

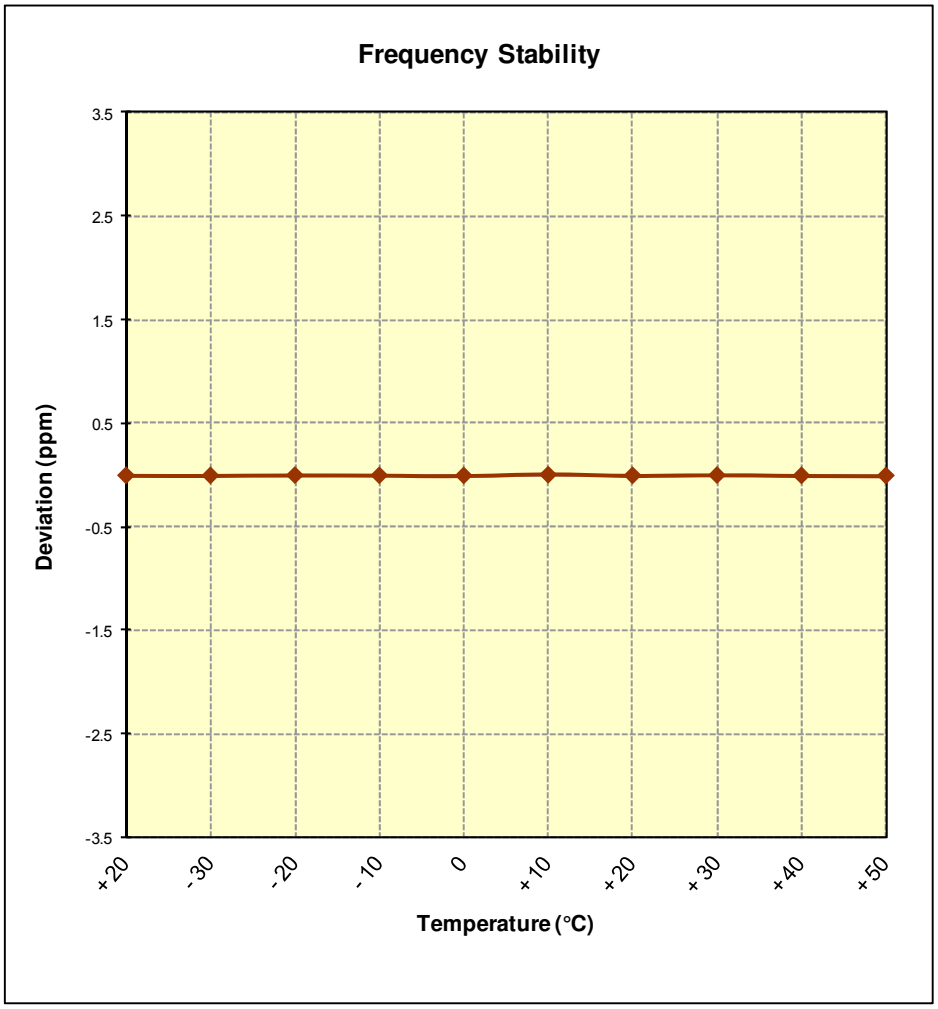

Figure 6-7. Frequency Stability Graph (Band 25)

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7.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSPHL710** complies with all the requirements of Parts 2, 24 of the FCC rules for LTE operation only.

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