PCTEST ENGINEERING LABORATORY, INC.
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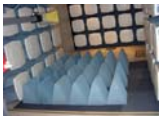

MEASUREMENT REPORT
FCC Part 22 & 27 LTE

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

Date of Testing:
7/28-9/16/2014
Test Site/Location:
PCTEST Lab., Columbia, MD, USA
Test Report Serial No.:
0Y1408261766.A3L

FCC ID : A3LSMN915KOR

APPLICANT: SAMSUNG ELECTRONICS, CO. LTD.

Application Type: Certification
FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s): §2; §22; §27
Test Procedure(s): ANSI/TIA-603-C-2004, KDB 971168 v02r01
EUT Type: Portable Handset
Model(s): SM-N915S, SM-N915K, SM-N915L
Test Device Serial No.: *identical prototype* [S/N: F3756]

Mode	Tx Frequency (MHz)	Emission Designator	Modulation	ERP/EIRP	
				Max. Power (W)	Max. Power (dBm)
LTE Band 17	706.5 - 713.5	4M50G7D	QPSK	0.068	18.30
LTE Band 17	706.5 - 713.5	4M51W7D	16QAM	0.050	16.98
LTE Band 17	709 - 711	8M99G7D	QPSK	0.048	16.79
LTE Band 17	709 - 711	8M99W7D	16QAM	0.036	15.53
LTE Band 5	824.7 - 848.3	1M14G7D	QPSK	0.006	7.43
LTE Band 5	824.7 - 848.3	1M14W7D	16QAM	0.004	6.35
LTE Band 5	825.5 - 847.5	2M74G7D	QPSK	0.006	7.70
LTE Band 5	825.5 - 847.5	2M73W7D	16QAM	0.005	6.67
LTE Band 5	826.5 - 846.5	4M51G7D	QPSK	0.007	8.66
LTE Band 5	826.5 - 846.5	4M51W7D	16QAM	0.005	6.79
LTE Band 5	829 - 844	8M98G7D	QPSK	0.007	8.17
LTE Band 5	829 - 844	8M98W7D	16QAM	0.005	6.85

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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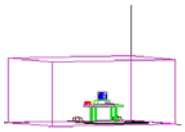
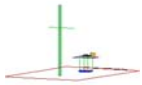


MEASUREMENT REPORT
FCC Part 22 & 27



§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; §22; §27
BASE MODEL:	SM-N915S
FCC ID:	A3LSMN915KOR
FCC CLASSIFICATION:	PCS Licensed Transmitter Held to Ear (PCE)
FREQUENCY TOLERANCE:	±0.00025 % (2.5 ppm)
Test Device Serial No.:	F3756 ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	7/28-9/16/2014
TEST REPORT S/N:	0Y1408261766.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. (*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.

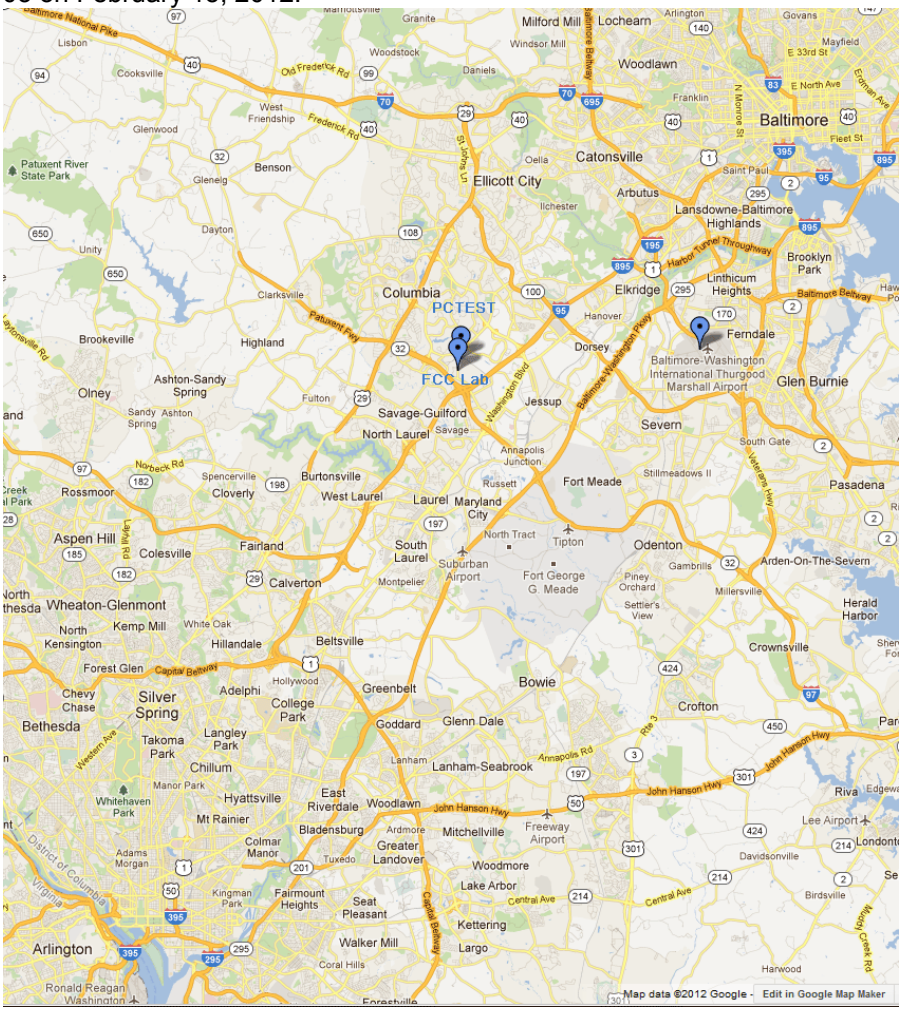

Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMN915KOR**. The test data contained in this report pertains only to the emissions due to the EUT's LTE function.

The antenna port conducted emission measurements shown in this report were taken from a previously certified device, bearing the FCC ID: A3LSMN910KOR, whose circuitry is electrically identical to this device.

2.2 Device Capabilities

This device contains the following capabilities:

1900 GSM/GPRS, 850/1900 WCDMA/HSDPA, Multi-band LTE, 802.11a/b/g/n/ac WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), NFC, ANT+

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: A3LSMN915KOR.**

3.2 Block A Frequency Range

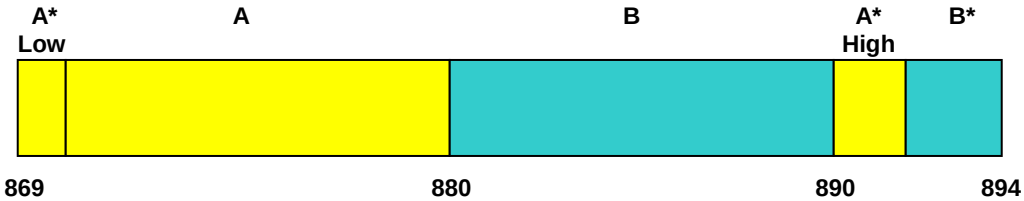
§27.5(c)

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 Cellular - Base Frequency Blocks

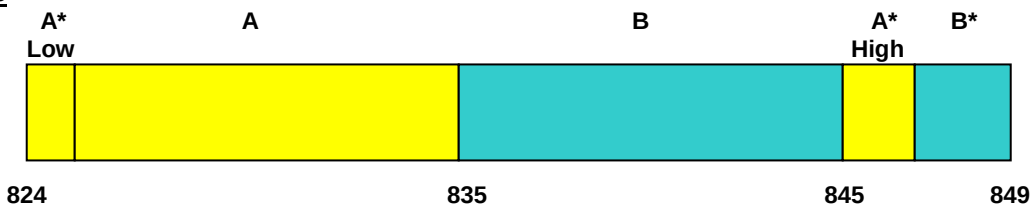
§22.905



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

3.4 Cellular - Mobile Frequency Blocks

§22.905



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

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3.5 Radiated Power and Radiated Spurious Emissions

§2.1053 §22.913(a.2) §22.917(a) §27.50(c.10) §27.53(g)

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	1/29/2014	Annual	1/29/2015	N/A
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	5/29/2014	Annual	5/29/2015	N/A
Agilent	8447D	Broadband Amplifier	6/2/2014	Annual	6/2/2015	1937A03348
Agilent	E4448A	PSA (3Hz-50GHz) Spectrum Analyzer	4/16/2014	Annual	4/16/2015	US42510244
Agilent	E5515C	Wireless Communications Test Set	3/18/2014	Annual	3/18/2015	GB46110872
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Agilent	N9030A	PXA Signal Analyzer (26.5GHz)	5/8/2014	Annual	5/8/2015	MY49432391
Anritsu	MT8820C	Radio Communication Analyzer	12/12/2013	Annual	12/12/2014	6200901190
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	6/26/2013	Biennial	6/26/2015	121034
Emco	3115	Horn Antenna (1-18GHz)	1/30/2014	Biennial	1/30/2016	9704-5182
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	11SH10-4000/12000	High Pass Filter	1/31/2014	Annual	1/31/2015	2
K & L	13SH10-1000/U1000	N Type High Pass Filter	5/22/2014	Annual	5/22/2015	1
K & L	11SH10-3075/U18000	High Pass Filter	5/2/2014	Annual	5/2/2015	2
Mini Circuits	PWR-SEN-4GHS	USB Power Sensor	4/9/2014	Annual	4/9/2015	11401010036
Mini-Circuits	SSG-4000HP	USB Synthesized Signal Generator	N/A			11208010032
Mini-Circuits	PWR-SENS-4RMS	USB Power Sensor	4/17/2014	Annual	4/17/2015	11210140001
Mini-Circuits	TVA-11-422	RF Power Amp	N/A			QA1303002
Rhode & Schwarz	TS-PR18	Pre-Amplifier	6/12/2014	Annual	6/12/2015	101622
Rohde & Schwarz	TS-PR18	1-18 GHz Pre-Amplifier	3/5/2014	Annual	3/5/2015	100071
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	3/12/2014	Annual	3/12/2015	100040
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	1/27/2014	Annual	1/27/2015	100342
Schwarzbeck	UHA 9105	Dipole Antenna (400 - 1GHz) Rx	11/21/2013	Biennial	11/21/2015	9105-2404
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	1/28/2014	Biennial	1/28/2016	A051107
Sunol	DRH-118	Horn Antenna (1-18 GHz)	6/19/2013	Biennial	6/19/2015	A042511
VWR	62344-734	Thermometer with Clock	2/20/2014	Biennial	2/20/2016	140140336

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.

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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: Samsung Electronics, Co. Ltd.
FCC ID: A3LSMN915KOR
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 22.917(a) 27.53(g)	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
2.1046	Transmitter Conducted Output Power	N/A		PASS	See RF Exposure Report
2.1055. 22.355 27.54	Frequency Stability	< 2.5 ppm (Part 22) and fundamental emissions stay within authorized frequency block (Part 27)		PASS	Section 6.7
22.913(a.2)	Effective Radiated Power (Band 5)	< 7 Watts max. ERP	RADIATED	PASS	Section 6.5
27.50(c.10)	Effective Radiated Power (Band 17)	< 3 Watts max. ERP		PASS	Section 6.5
2.1053 22.917(a) 27.53(g)	Undesirable Emissions	> 43 + 10log$_{10}$ (P[Watts]) for all out-of-band emissions		PASS	Section 6.6

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) 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 2.4.

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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.

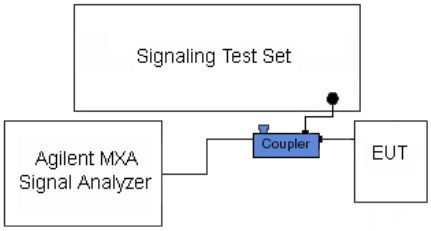

Figure 6-1. Test Instrument & Measurement Setup

Test Notes

None.

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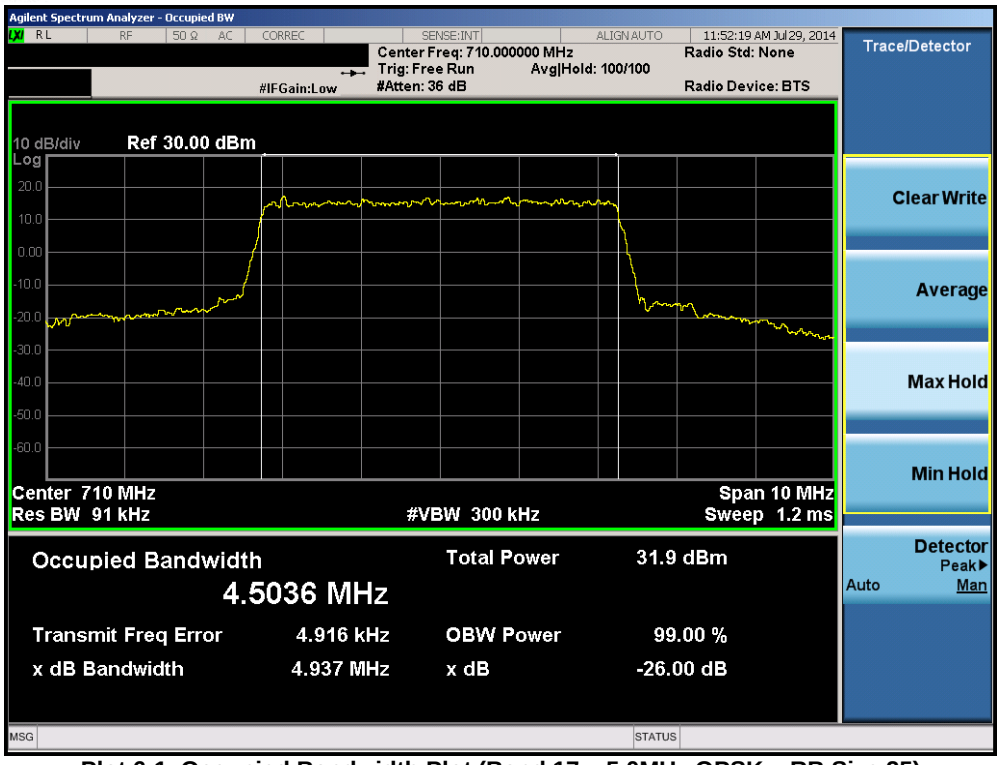
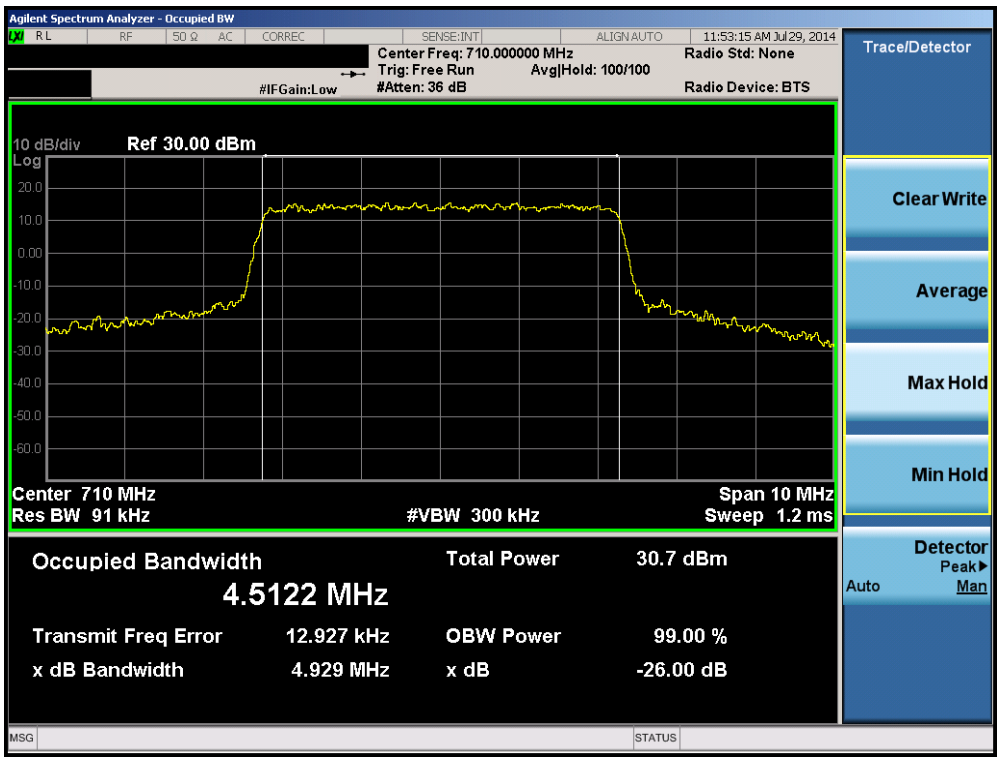


Plot 6-1. Occupied Bandwidth Plot (Band 17 – 5.0MHz QPSK – RB Size 25)



Plot 6-2. Occupied Bandwidth Plot (Band 17 – 5.0MHz 16-QAM – RB Size 25)

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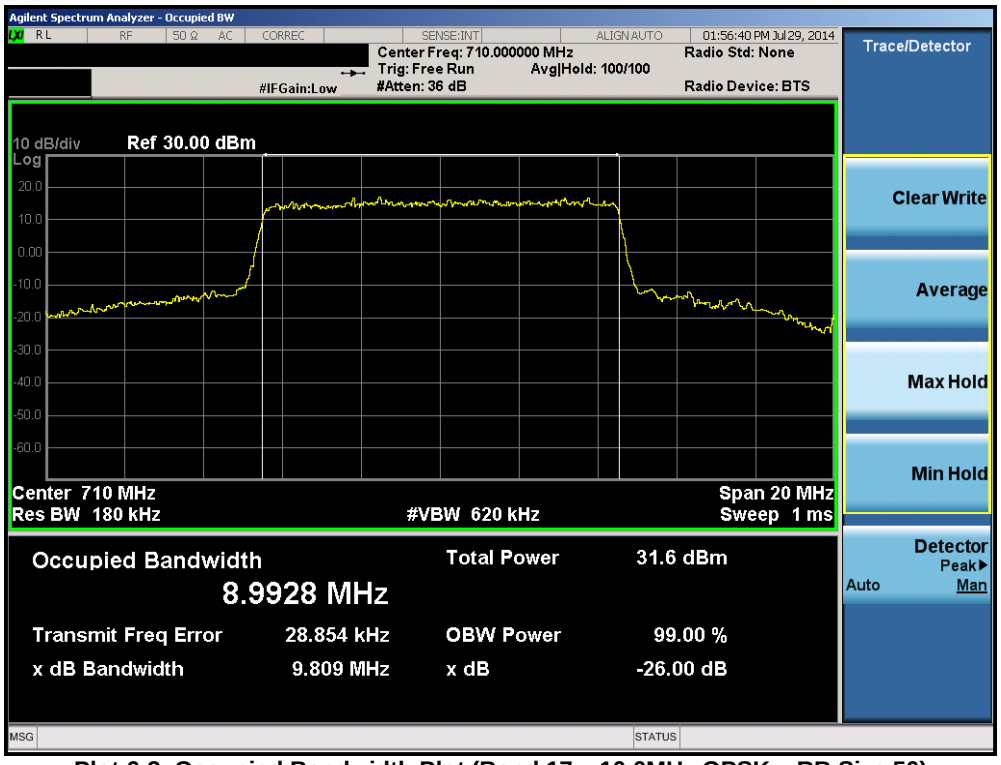
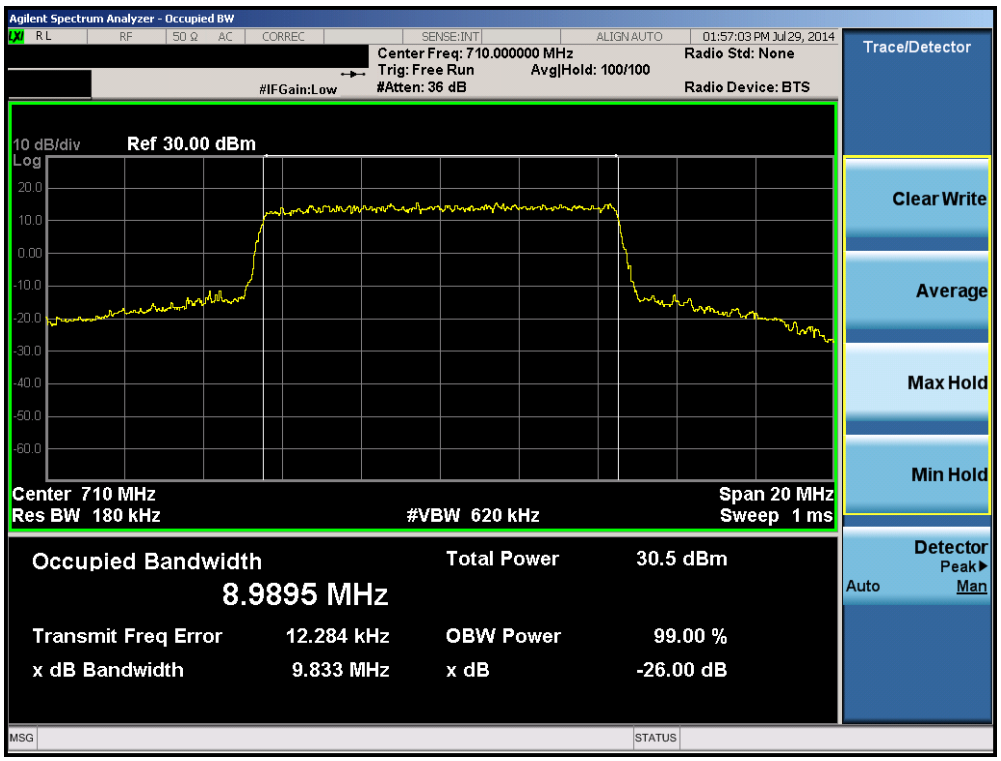


Plot 6-3. Occupied Bandwidth Plot (Band 17 – 10.0MHz QPSK – RB Size 50)



Plot 6-4. Occupied Bandwidth Plot (Band 17 – 10.0MHz 16-QAM – RB Size 50)

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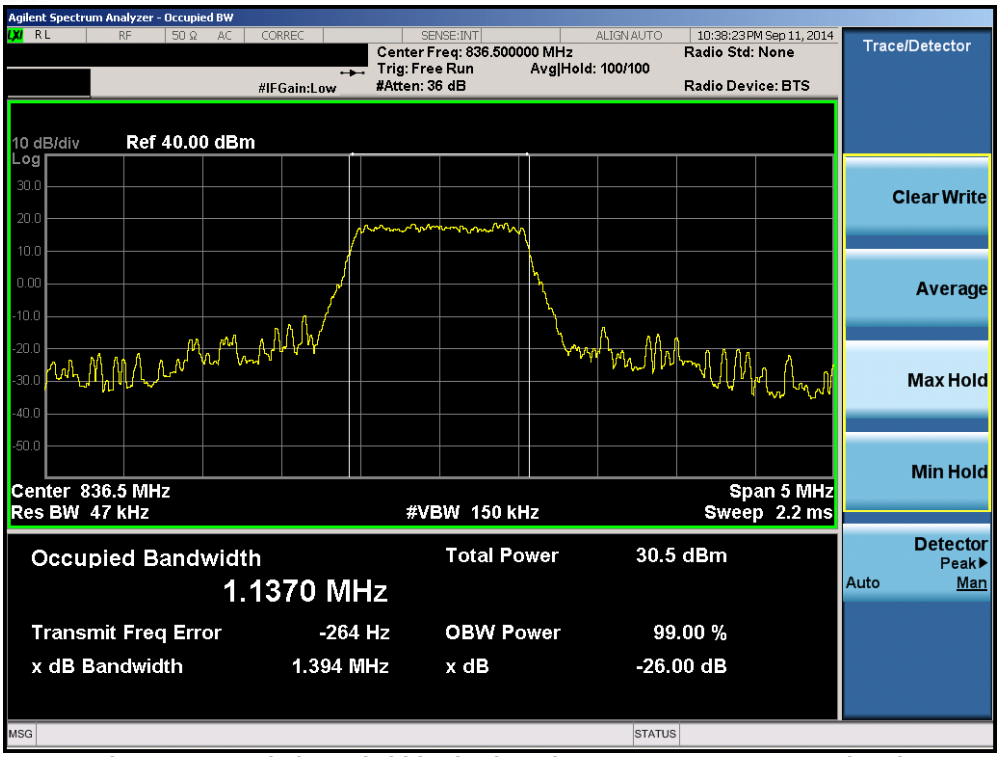
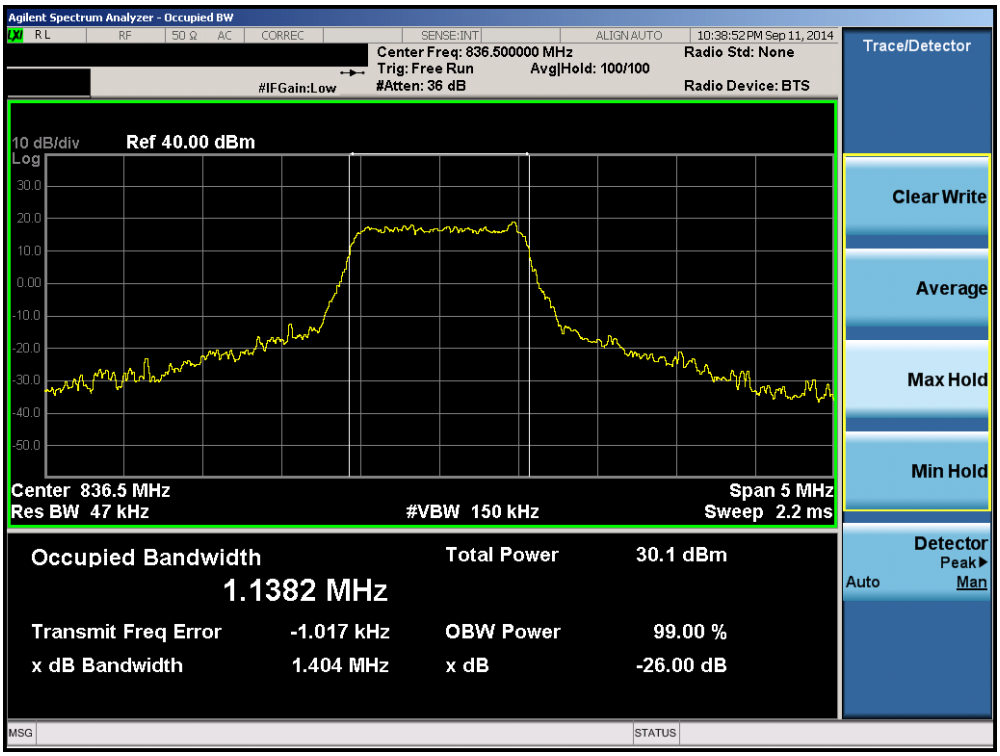


Plot 6-5. Occupied Bandwidth Plot (Band 5 – 1.4MHz QPSK – RB Size 6)



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

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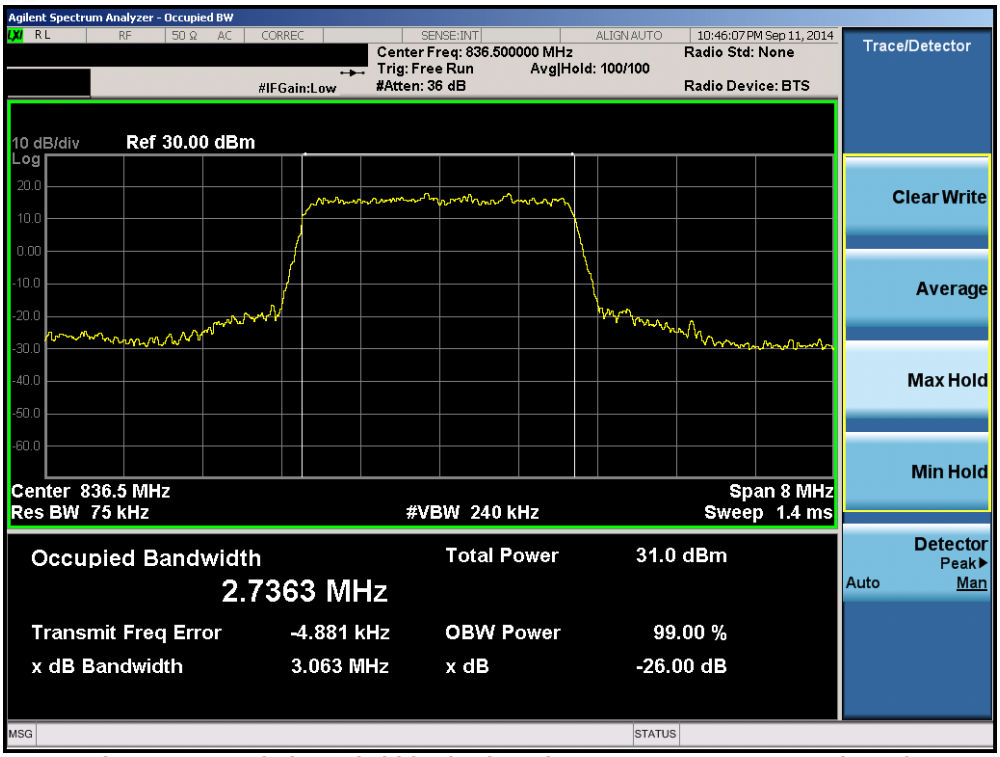

Plot 6-7. Occupied Bandwidth Plot (Band 5 – 3.0MHz QPSK – RB Size 15)

Plot 6-8. Occupied Bandwidth Plot (Band 5 – 3.0MHz 16-QAM – RB Size 15)

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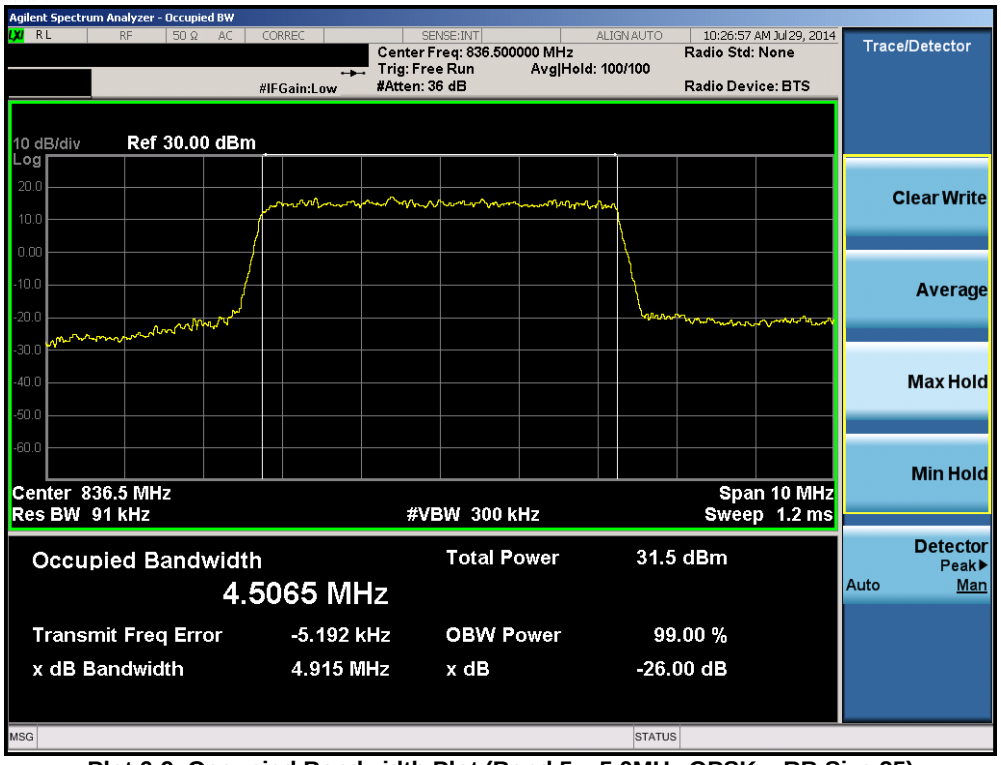
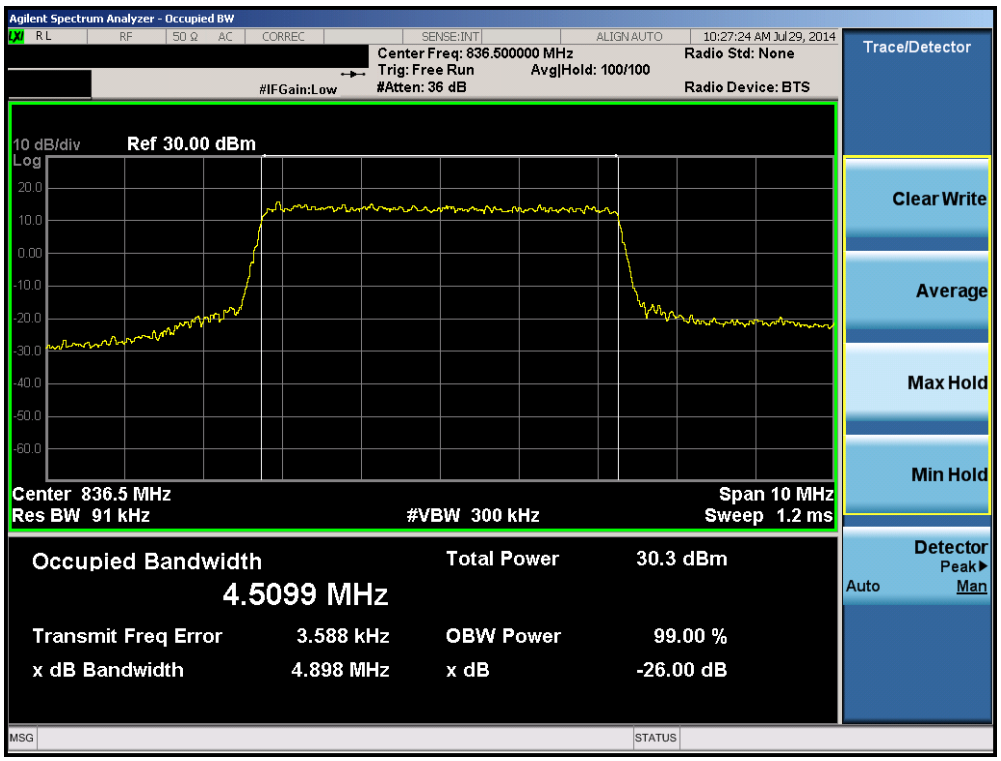


Plot 6-9. Occupied Bandwidth Plot (Band 5 – 5.0MHz QPSK – RB Size 25)



Plot 6-10. Occupied Bandwidth Plot (Band 5 – 5.0MHz 16-QAM – RB Size 25)

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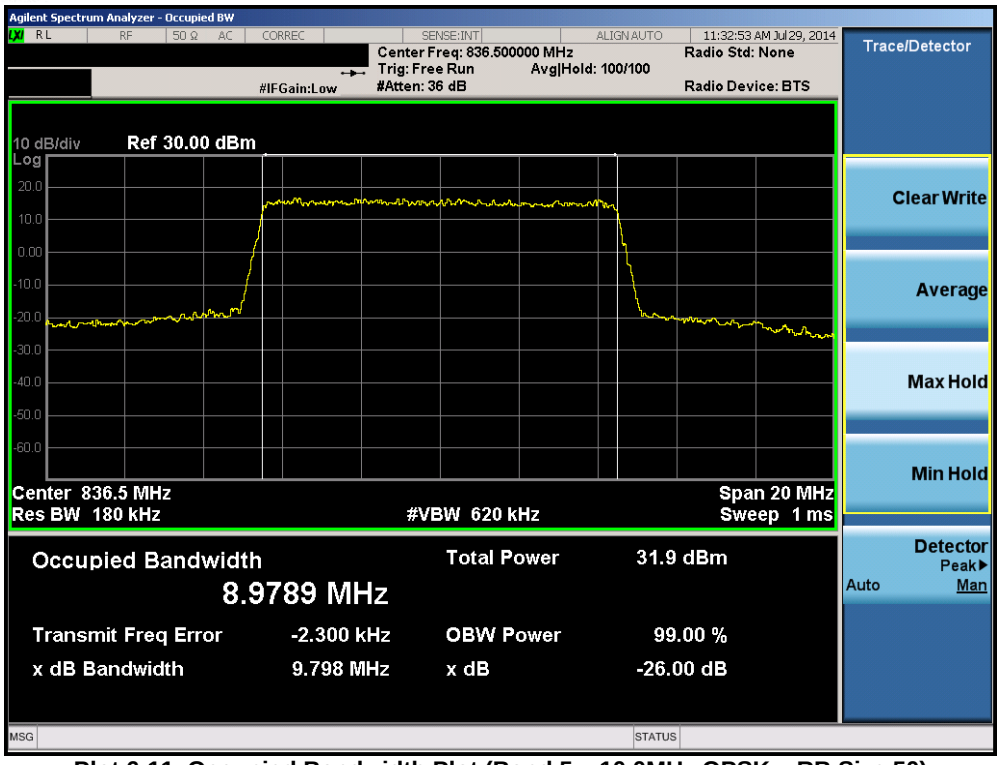
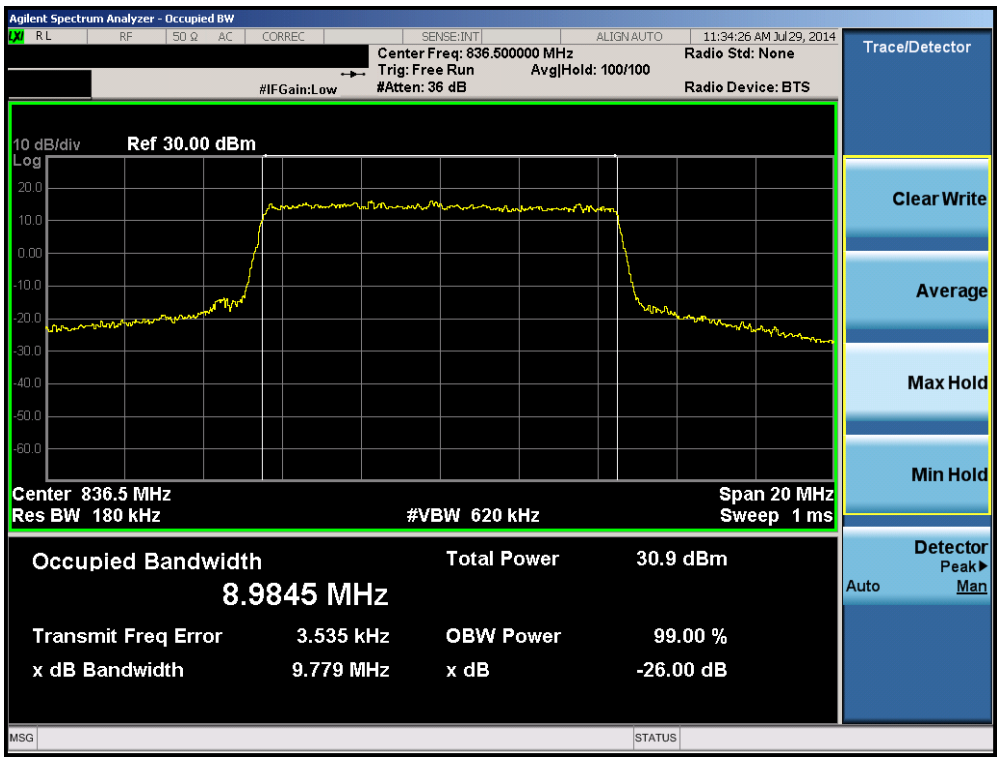


Plot 6-11. Occupied Bandwidth Plot (Band 5 – 10.0MHz QPSK – RB Size 50)



Plot 6-12. Occupied Bandwidth Plot (Band 5 – 10.0MHz 16-QAM – RB Size 50)

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6.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051 §22.917(a) §27.53(g)

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.

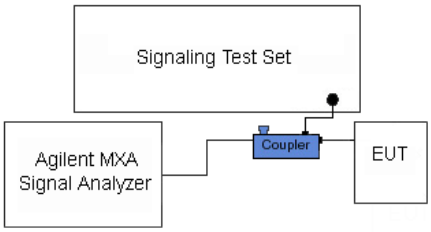

Figure 6-2. Test Instrument & Measurement Setup

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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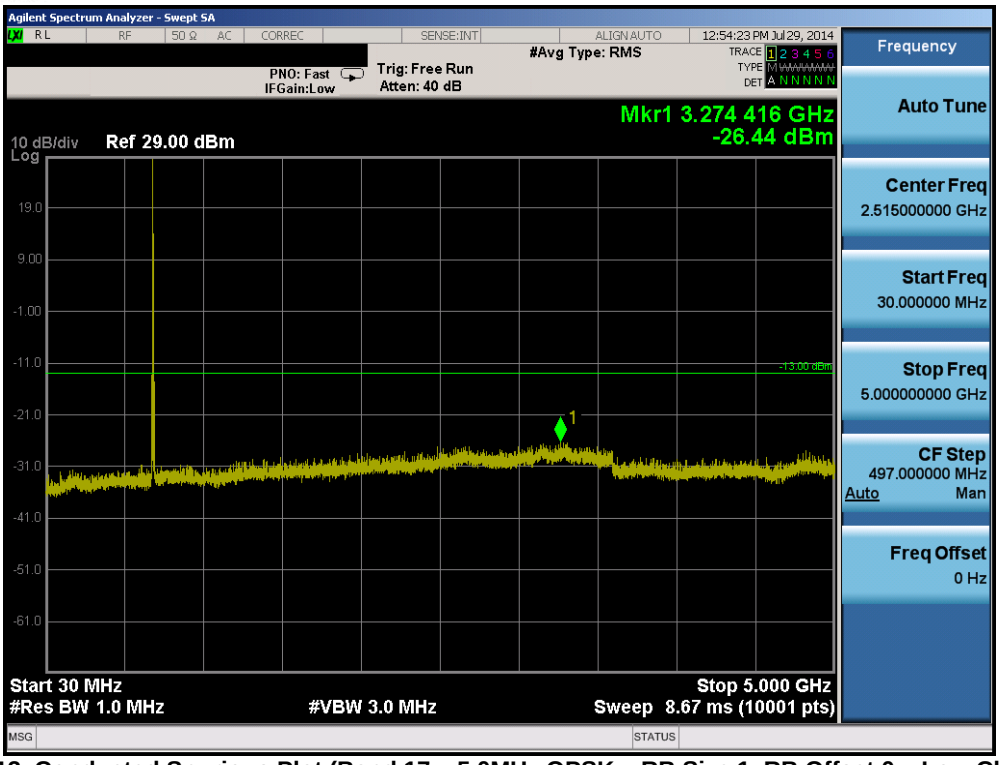
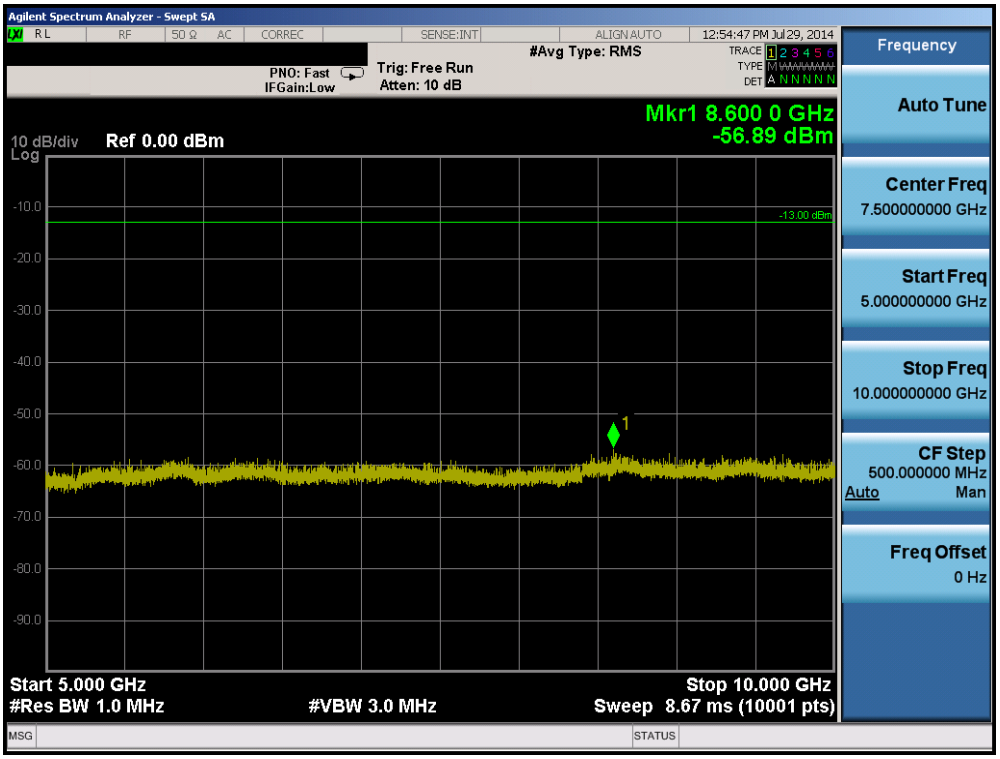


Plot 6-13. Conducted Spurious Plot (Band 17 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)



Plot 6-14. Conducted Spurious Plot (Band 17 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

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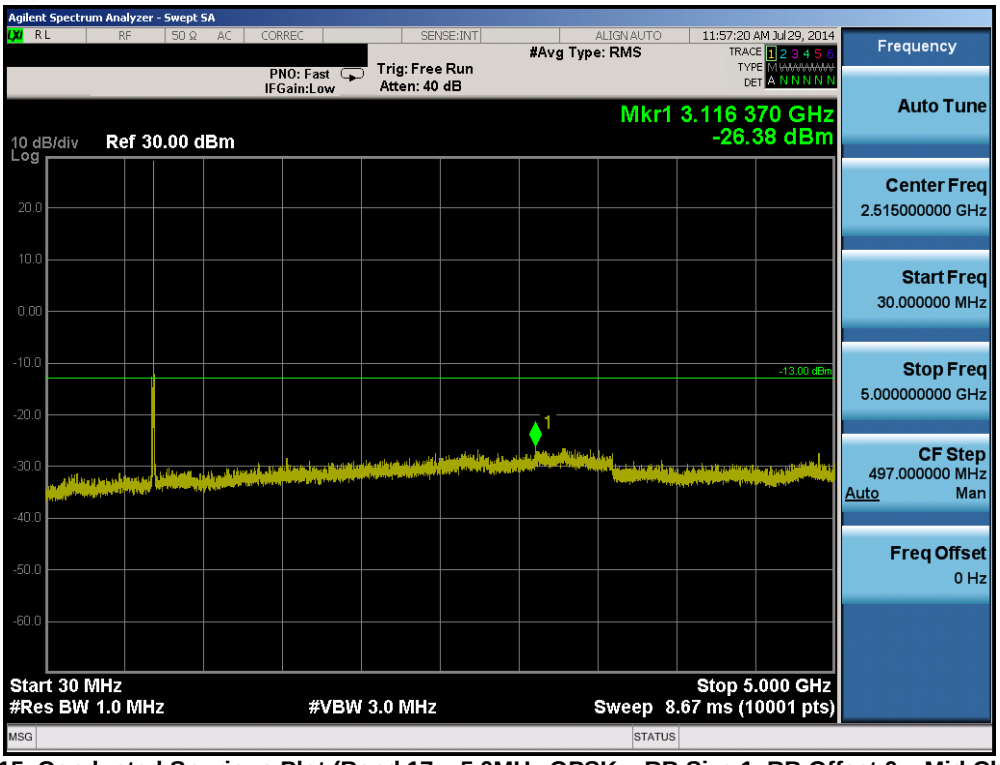
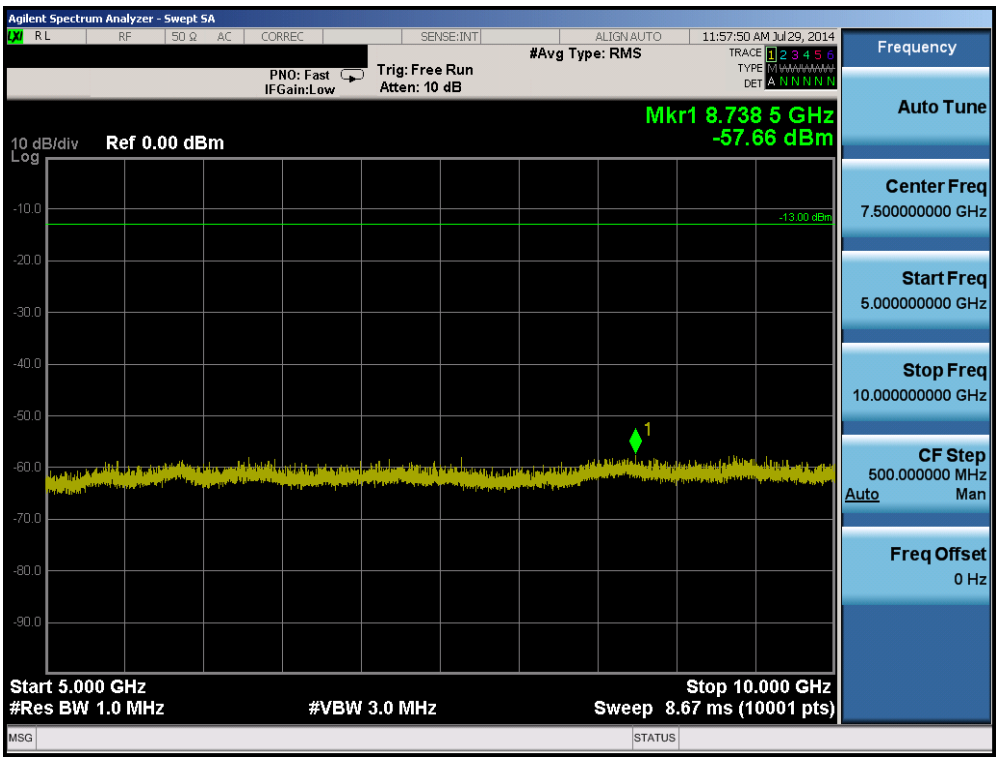


Plot 6-15. Conducted Spurious Plot (Band 17 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 6-16. Conducted Spurious Plot (Band 17 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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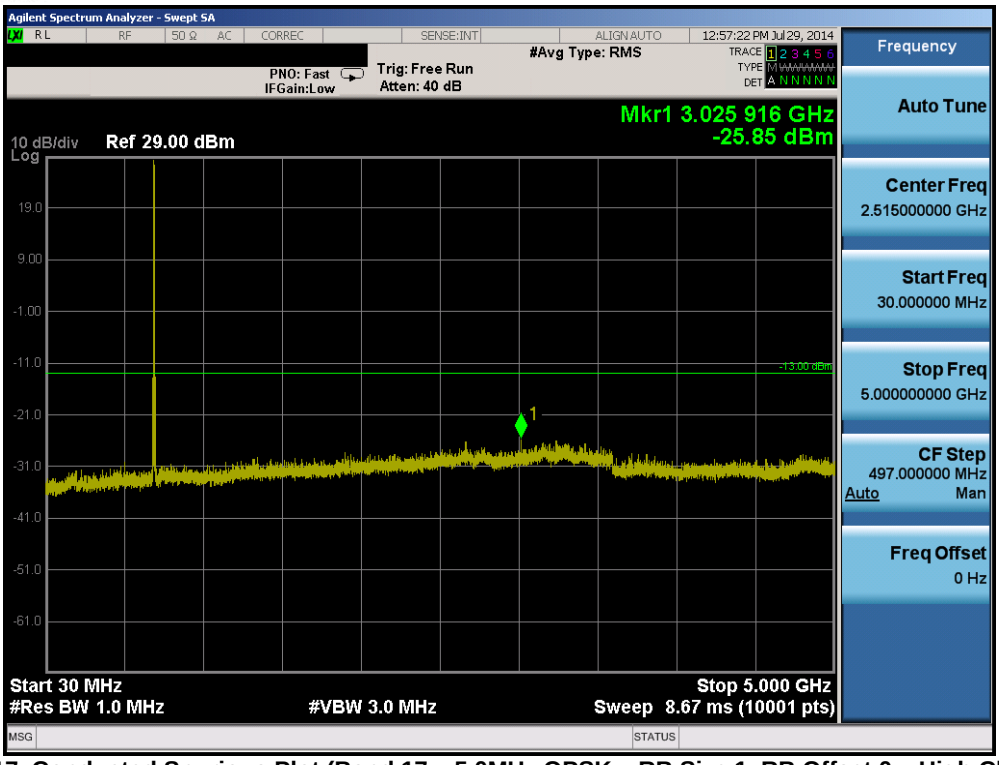
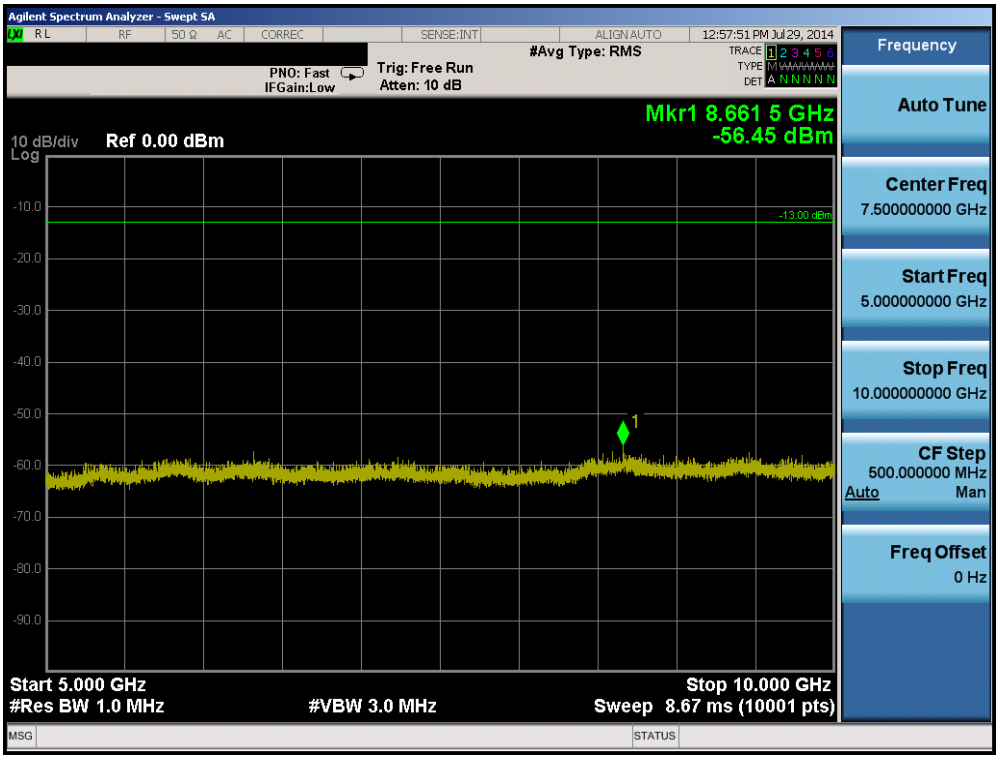


Plot 6-17. Conducted Spurious Plot (Band 17 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 6-18. Conducted Spurious Plot (Band 17 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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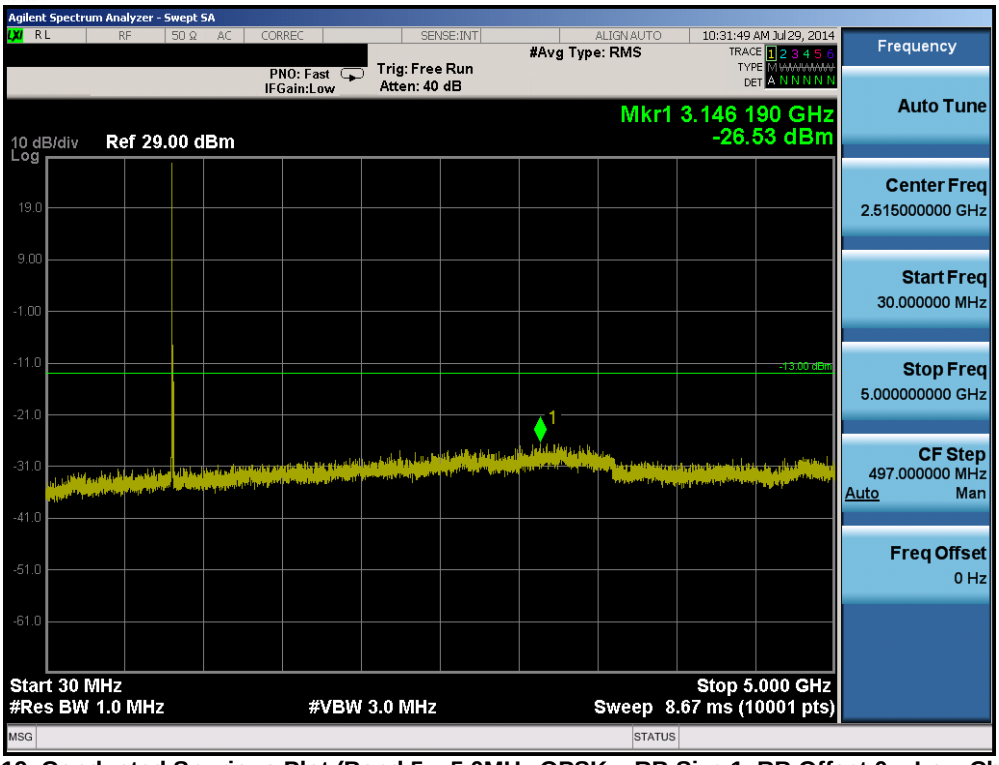
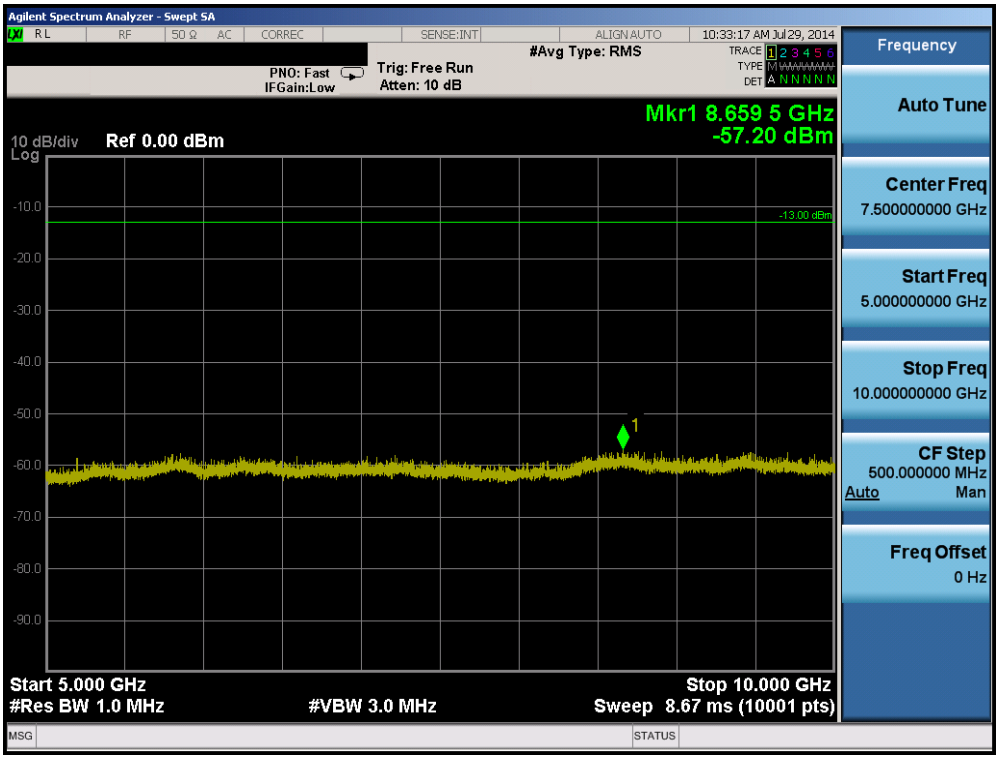


Plot 6-19. Conducted Spurious Plot (Band 5 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)



Plot 6-20. Conducted Spurious Plot (Band 5 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Low Channel)

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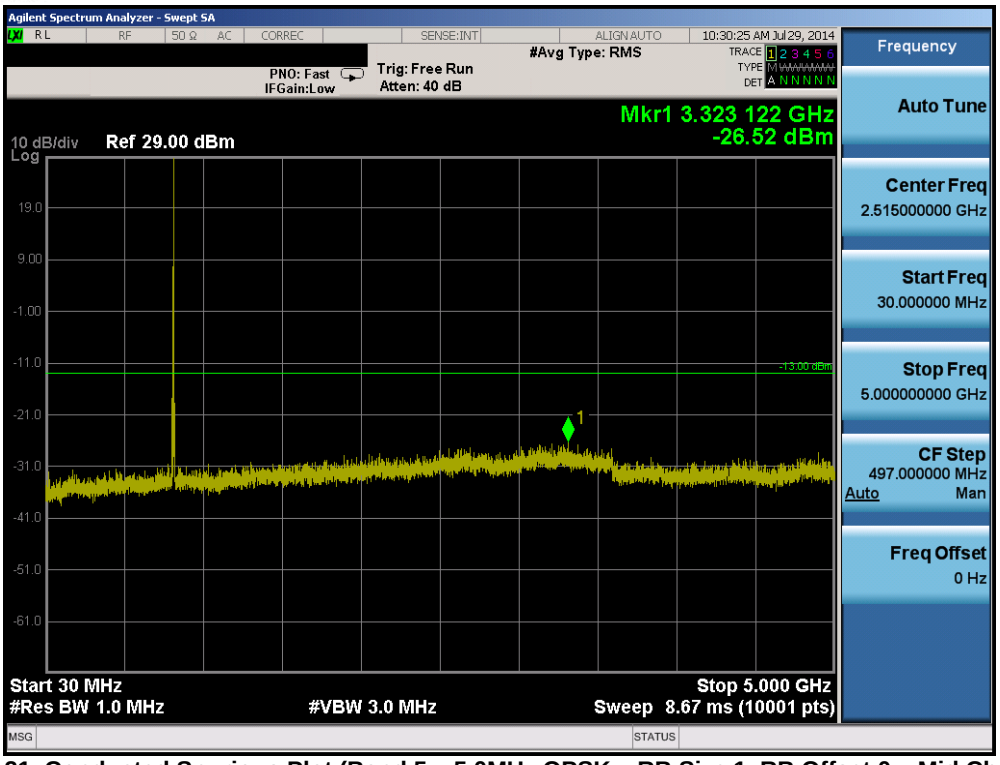
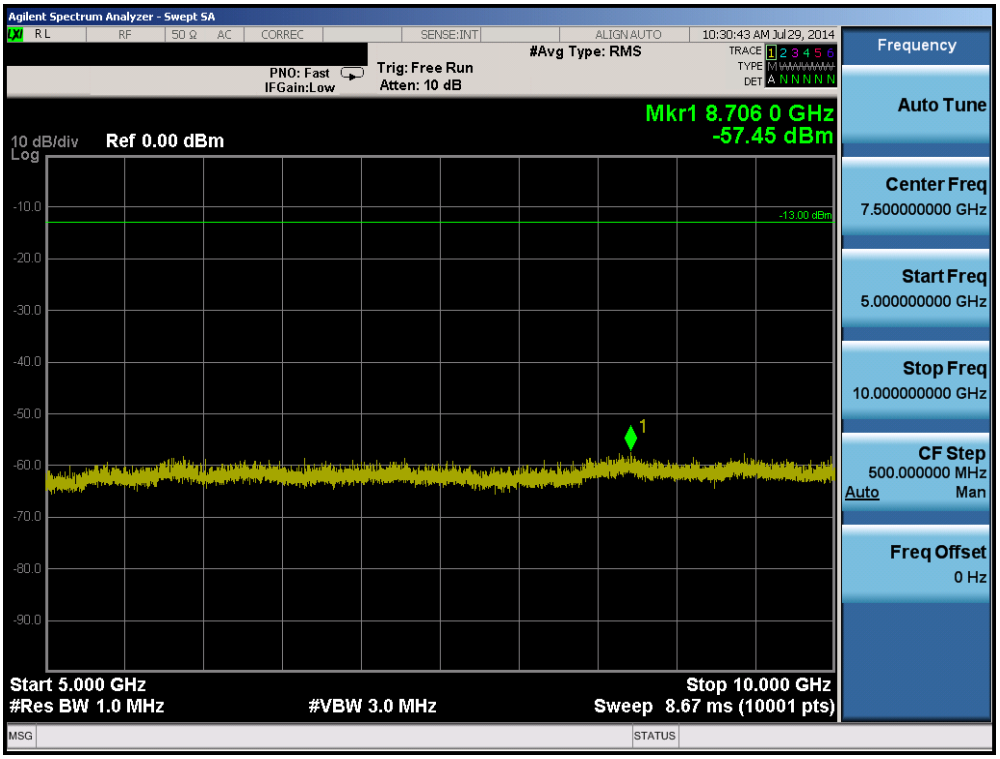


Plot 6-21. Conducted Spurious Plot (Band 5 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)



Plot 6-22. Conducted Spurious Plot (Band 5 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – Mid Channel)

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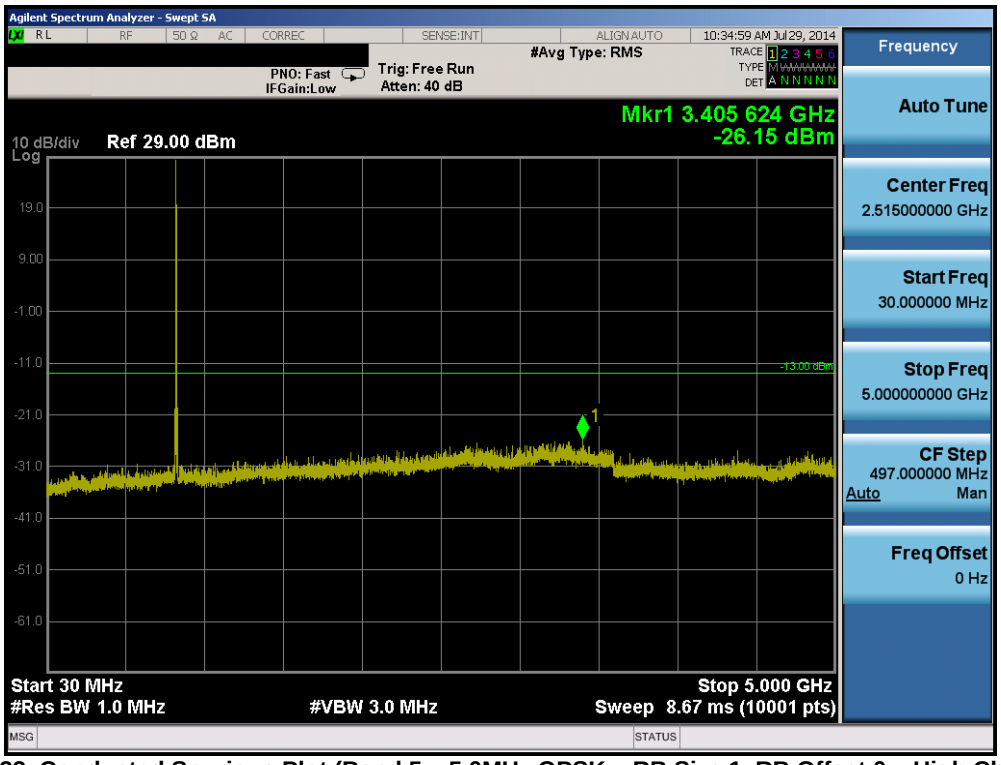
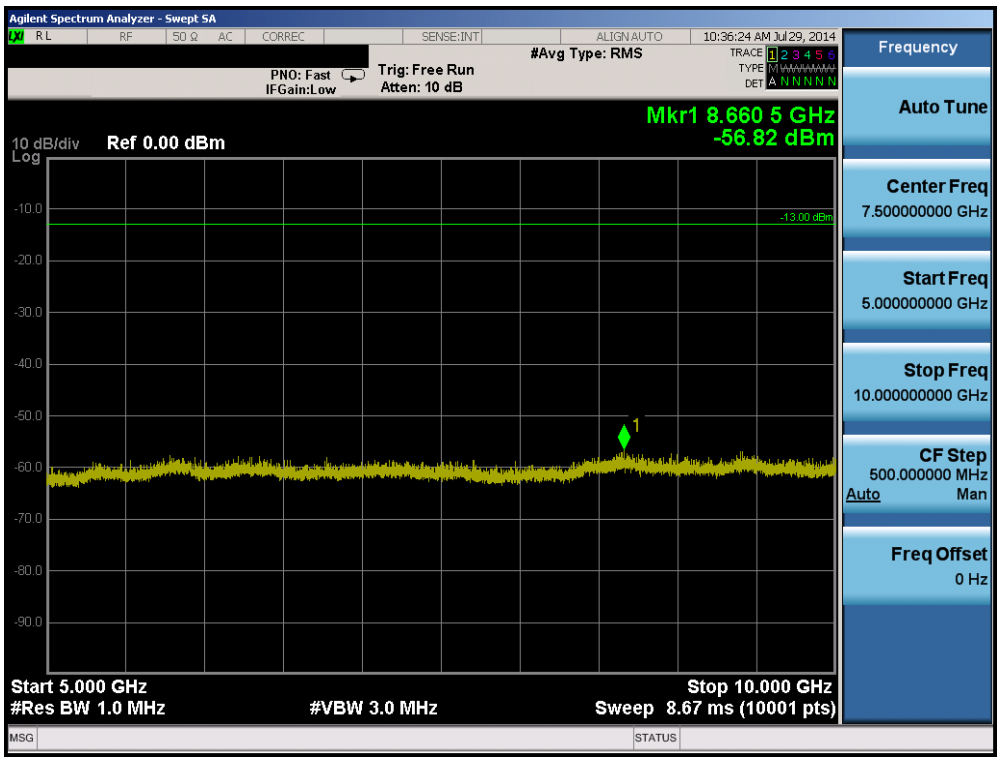


Plot 6-23. Conducted Spurious Plot (Band 5 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)



Plot 6-24. Conducted Spurious Plot (Band 5 – 5.0MHz QPSK – RB Size 1, RB Offset 0 – High Channel)

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6.4 Band Edge Emissions at Antenna Terminal

§2.1051 §22.917(a) §27.53(g)

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.

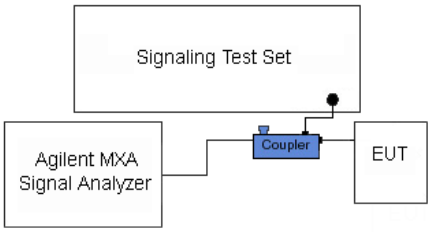

Figure 6-3. Test Instrument & Measurement Setup

Test Notes

Per 22.917(b) and 27.53(h)(3) 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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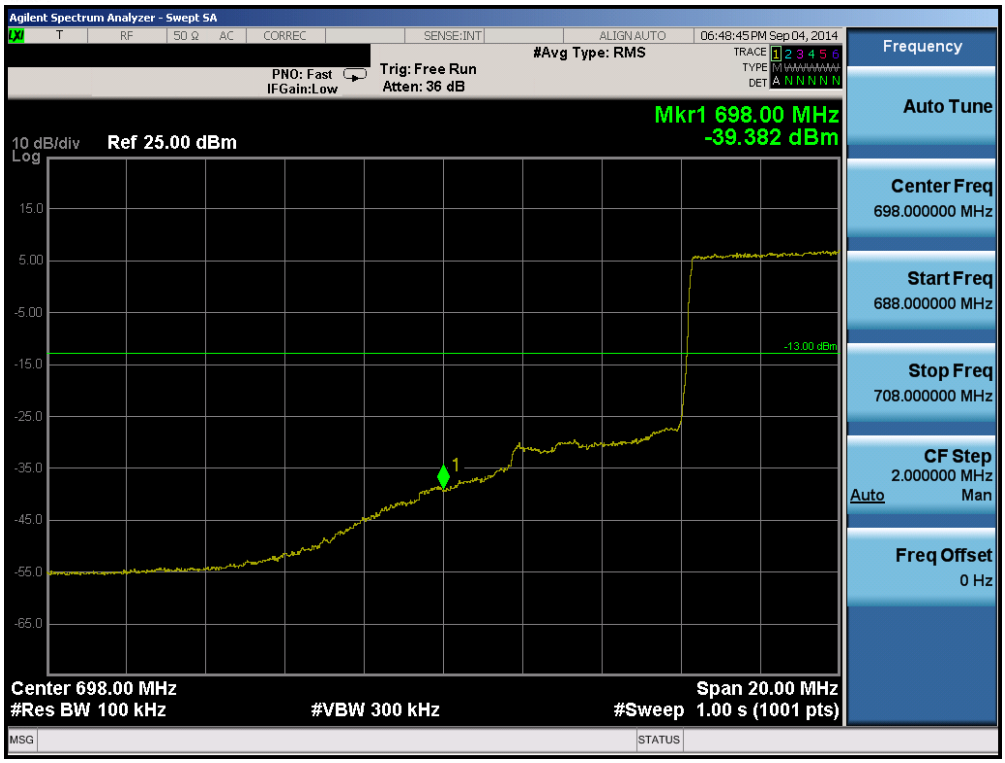

Plot 6-25. Lower Band Edge Plot (Band 17 – 5.0MHz QPSK – RB Size 25)

Plot 6-26. Upper Band Edge Plot (Band 17 – 5.0MHz QPSK – RB Size 25)

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Plot 6-27. Lower Band Edge Plot (Band 17 – 10.0MHz QPSK – RB Size 50)

Plot 6-28. Upper Band Edge Plot (Band 17 – 10.0MHz QPSK – RB Size 50)

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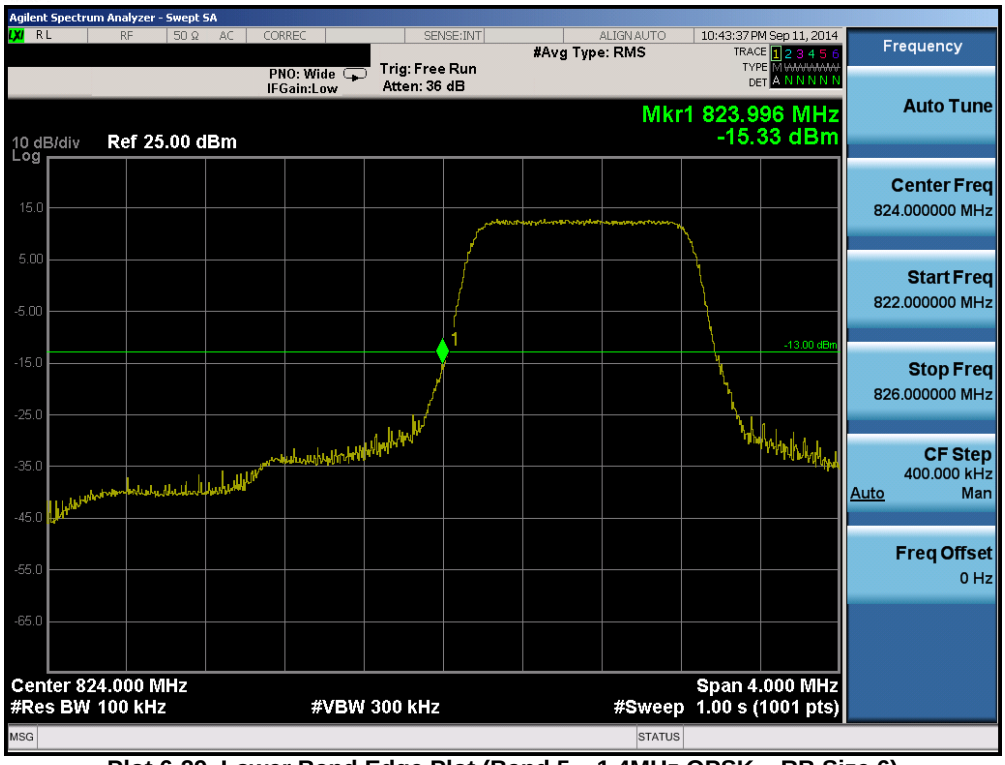
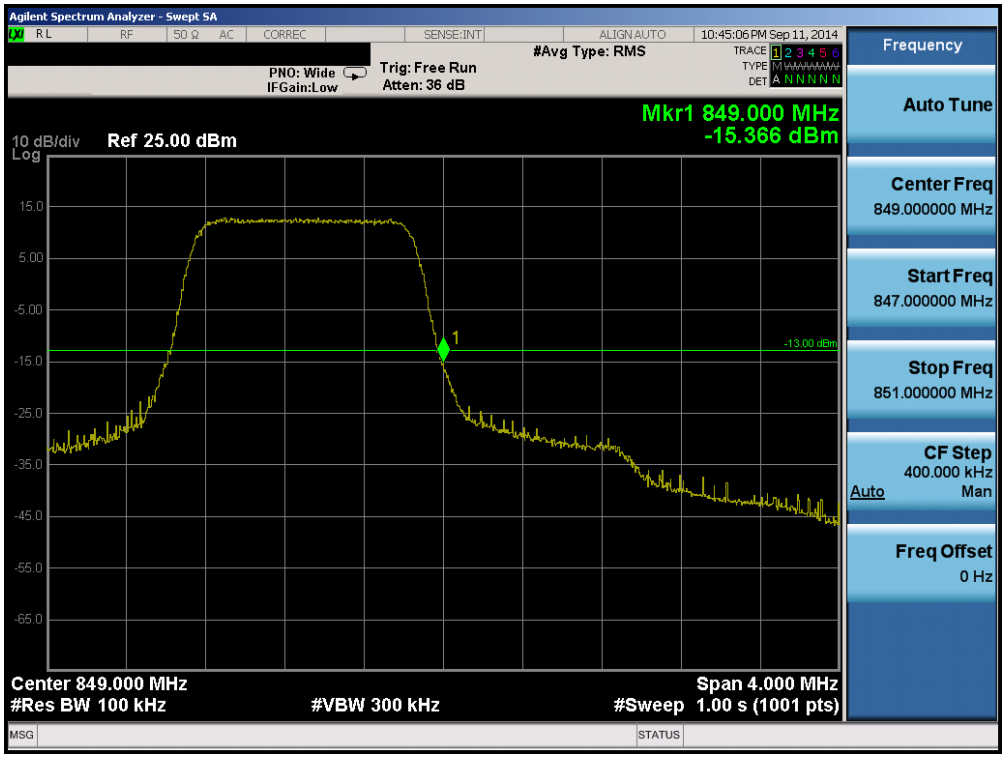


Plot 6-29. Lower Band Edge Plot (Band 5 – 1.4MHz QPSK – RB Size 6)



Plot 6-30. Upper Band Edge Plot (Band 5 – 1.4MHz QPSK – RB Size 6)

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Plot 6-31. Lower Band Edge Plot (Band 5 – 3.0MHz QPSK – RB Size 15)

Plot 6-32. Upper Band Edge Plot (Band 5 – 3.0MHz QPSK – RB Size 15)

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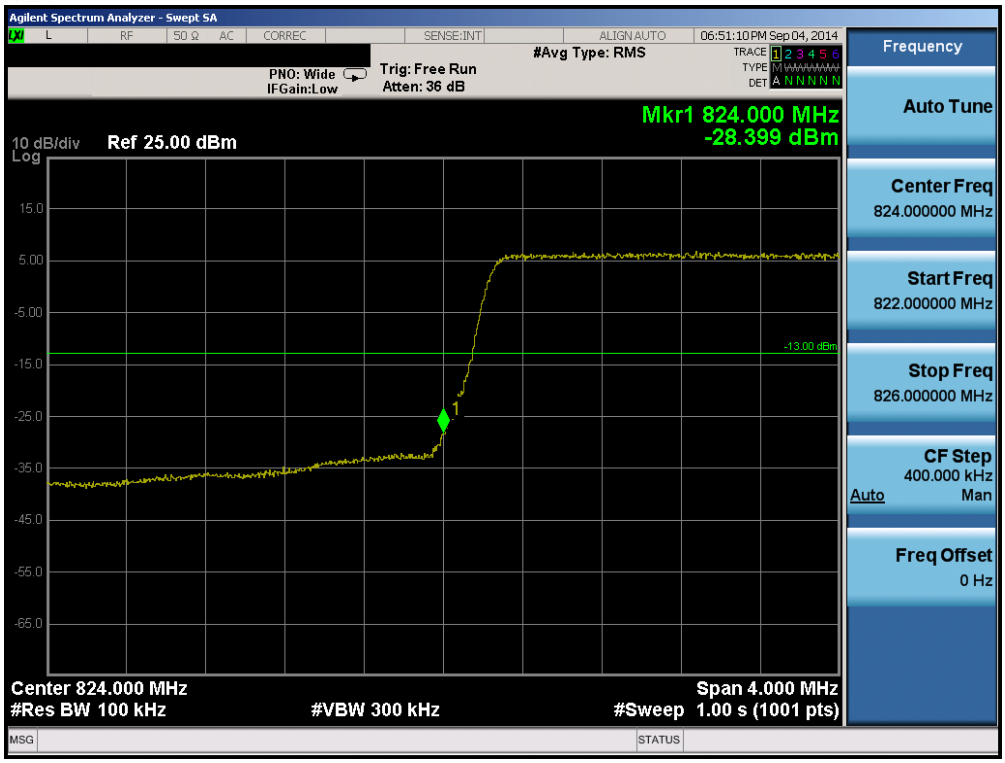
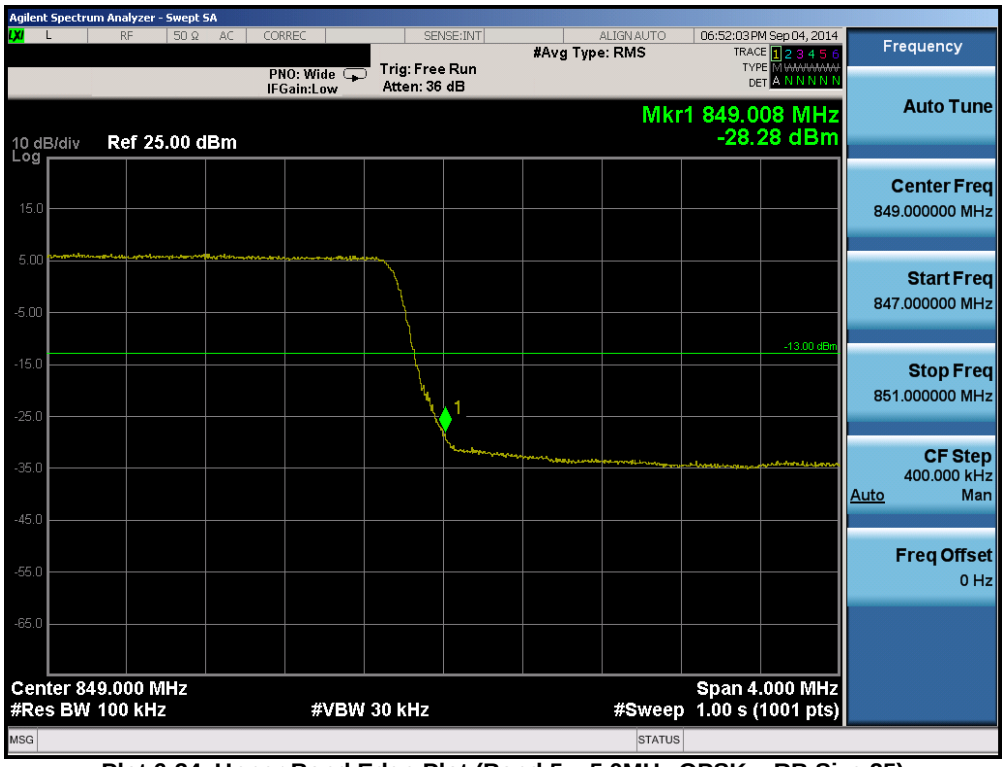


Plot 6-33. Lower Band Edge Plot (Band 5 – 5.0MHz QPSK – RB Size 25)



Plot 6-34. Upper Band Edge Plot (Band 5 – 5.0MHz QPSK – RB Size 25)

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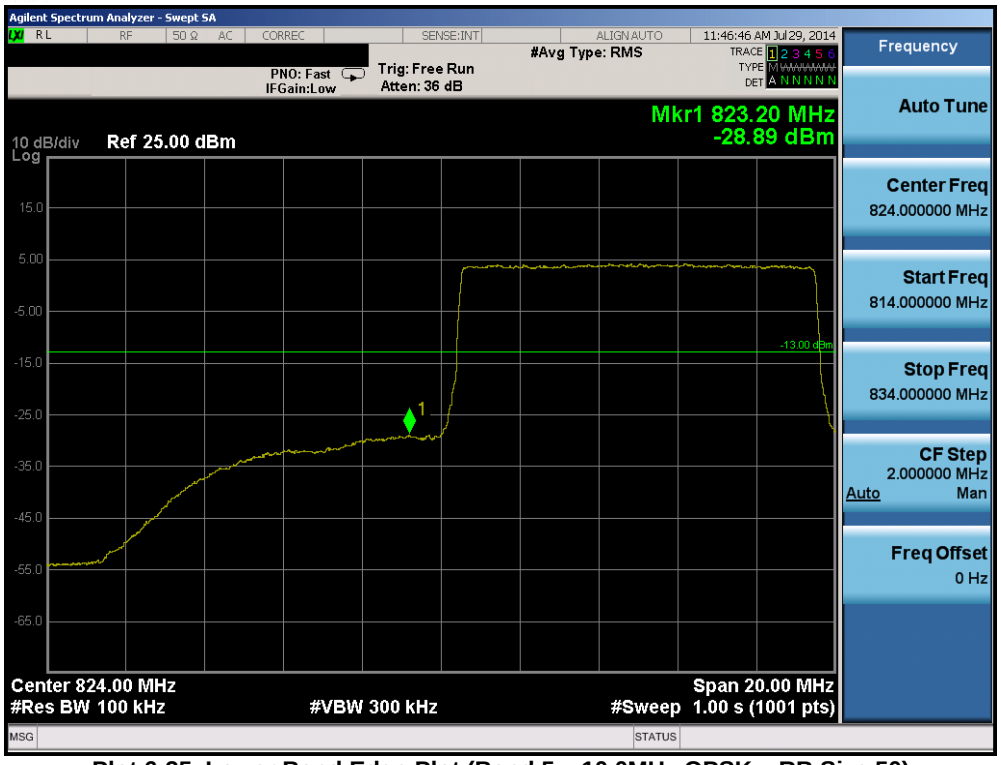

Plot 6-35. Lower Band Edge Plot (Band 5 – 10.0MHz QPSK – RB Size 50)

Plot 6-36. Upper Band Edge Plot (Band 5 – 10.0MHz QPSK – RB Size 50)

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6.5 Radiated Power (ERP)

§22.913(a.2) §27.50(c.10)

Test Overview

Effective Radiated Power (ERP) 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. 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.
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

Test Setup

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

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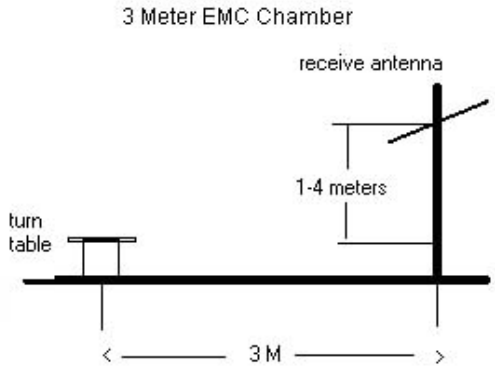

Figure 6-4. Test Instrument & Measurement Setup

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) The battery used with this device for testing (Model: EB-BN915BBK) contains an embedded NFC antenna

Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Battery	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBd]	Ant. Pol. [H/V]	EUT Pol.	ERP [dBm]	ERP [Watts]	Margin [dB]
706.50	5	QPSK	Standard	1 / 24	14.61	3.62	V	V	18.23	0.067	-16.54
710.00	5	QPSK	Standard	1 / 0	13.75	3.65	V	V	17.40	0.055	-17.37
713.50	5	QPSK	Standard	1 / 0	14.63	3.67	V	V	18.30	0.068	-16.47
706.50	5	16-QAM	Standard	1 / 24	13.36	3.62	V	V	16.98	0.050	-17.79
710.00	5	16-QAM	Standard	1 / 24	12.23	3.65	V	V	15.88	0.039	-18.89
713.50	5	16-QAM	Standard	1 / 0	12.57	3.67	V	V	16.24	0.042	-18.53
709.00	10	QPSK	Standard	1 / 0	13.09	3.64	V	V	16.73	0.047	-18.04
710.00	10	QPSK	Standard	1 / 0	13.04	3.65	V	V	16.69	0.047	-18.08
711.00	10	QPSK	Standard	1 / 0	13.13	3.66	V	V	16.79	0.048	-17.99
709.00	10	16-QAM	Standard	1 / 0	11.79	3.64	V	V	15.43	0.035	-19.34
710.00	10	16-QAM	Standard	25 / 12	11.82	3.65	V	V	15.47	0.035	-19.30
711.00	10	16-QAM	Standard	1 / 0	11.87	3.66	V	V	15.53	0.036	-19.25

Table 6-2. ERP Data (Band 17)

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Frequency [MHz]	Channel Bandwidth [MHz]	Mod.	Battery	RB Size/Offset	Substitute Level [dBm]	Ant. Gain [dBd]	Ant. Pol. [H/V]	EUT Pol.	ERP [dBm]	ERP [Watts]	Margin [dB]
824.70	1.4	QPSK	Standard	1 / 0	2.66	4.42	V	V	7.08	0.005	-31.37
836.50	1.4	QPSK	Standard	1 / 0	2.60	4.50	V	V	7.10	0.005	-31.35
848.30	1.4	QPSK	Standard	1 / 5	2.84	4.59	V	V	7.43	0.006	-31.02
824.70	1.4	16-QAM	Standard	1 / 0	1.46	4.42	V	V	5.88	0.004	-32.57
836.50	1.4	16-QAM	Standard	1 / 0	1.59	4.50	V	V	6.09	0.004	-32.36
848.30	1.4	16-QAM	Standard	1 / 5	1.76	4.59	V	V	6.35	0.004	-32.10
825.50	3	QPSK	Standard	1 / 0	2.80	4.42	V	V	7.22	0.005	-31.23
836.50	3	QPSK	Standard	1 / 0	2.58	4.50	V	V	7.08	0.005	-31.37
847.50	3	QPSK	Standard	1 / 0	3.12	4.58	V	V	7.70	0.006	-30.75
825.50	3	16-QAM	Standard	1 / 0	1.11	4.42	V	V	5.53	0.004	-32.92
836.50	3	16-QAM	Standard	1 / 0	1.43	4.50	V	V	5.93	0.004	-32.52
847.50	3	16-QAM	Standard	1 / 0	2.09	4.58	V	V	6.67	0.005	-31.78
826.50	5	QPSK	Standard	1 / 24	4.23	4.43	V	V	8.66	0.007	-29.79
836.50	5	QPSK	Standard	1 / 0	3.70	4.50	V	V	8.20	0.007	-30.25
846.50	5	QPSK	Standard	1 / 0	2.28	4.58	V	V	6.86	0.005	-31.60
826.50	5	16-QAM	Standard	1 / 0	2.36	4.43	V	V	6.79	0.005	-31.66
836.50	5	16-QAM	Standard	1 / 0	1.89	4.50	V	V	6.39	0.004	-32.06
846.50	5	16-QAM	Standard	1 / 0	0.56	4.58	V	V	5.14	0.003	-33.32
829.00	10	QPSK	Standard	1 / 0	3.72	4.45	V	V	8.17	0.007	-30.28
836.50	10	QPSK	Standard	1 / 0	3.62	4.50	V	V	8.12	0.006	-30.33
844.00	10	QPSK	Standard	1 / 0	2.46	4.56	V	V	7.02	0.005	-31.43
829.00	10	16-QAM	Standard	1 / 0	2.32	4.45	V	V	6.77	0.005	-31.68
836.50	10	16-QAM	Standard	1 / 0	2.35	4.50	V	V	6.85	0.005	-31.60
844.00	10	16-QAM	Standard	1 / 0	1.03	4.56	V	V	5.59	0.004	-32.86

Table 6-3. ERP Data (Band 5)

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6.6 Radiated Spurious Emissions Measurements

§2.1053 §22.917(a) §27.53(g)

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. 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.

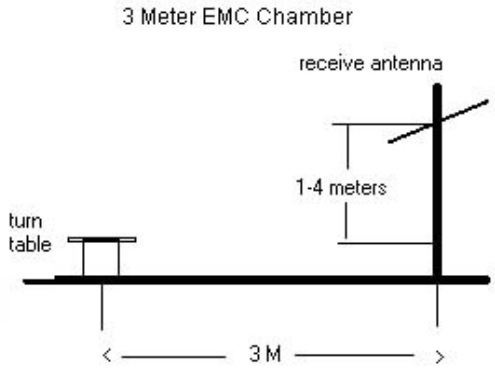

Figure 6-5. Test Instrument & Measurement Setup

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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) The battery used with this device for testing (Model: EB-BN915BBK) contains an embedded NFC antenna

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:	706.50	MHz		
CHANNEL:	23755			
MEASURED OUTPUT POWER:	18.23	dBm	=	0.067 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	5.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	31.23	dBc	

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	EUT Pol. [H/H2/V]	[dBc]
1413.00	-59.58	5.72	-53.86	H	H	72.1
2119.50	-53.18	6.71	-46.47	H	H	64.7
2826.00	-63.42	7.81	-55.61	H	H	73.8
3532.50	-50.56	7.59	-42.97	H	H	61.2
4239.00	-50.86	8.39	-42.48	H	H	60.7

Table 6-4. Radiated Spurious Data (Band 17 – Low Channel)

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OPERATING FREQUENCY:	710.00	MHz			
CHANNEL:	23790				
MEASURED OUTPUT POWER:	17.40	dBm	=	0.055	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	5.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	30.40	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	EUT Pol. [H/H2/V]	[dBc]
1420.00	-61.88	5.76	-56.12	H	H	73.5
2130.00	-52.22	6.77	-45.45	H	H	62.8
2840.00	-63.50	7.78	-55.71	H	H	73.1
3550.00	-51.63	7.59	-44.04	H	H	61.4

Table 6-5. Radiated Spurious Data (Band 17 – Mid Channel)

OPERATING FREQUENCY:	713.50	MHz			
CHANNEL:	23825				
MEASURED OUTPUT POWER:	18.30	dBm	=	0.068	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	5.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	31.30	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	EUT Pol. [H/H2/V]	[dBc]
1427.00	-60.83	5.80	-55.03	H	H	73.3
2140.50	-53.41	6.83	-46.58	H	H	64.9
2854.00	-59.43	7.76	-51.66	H	H	70.0
3567.50	-48.30	7.60	-40.70	H	H	59.0
4281.00	-62.40	8.53	-53.87	H	H	72.2
4994.50	-51.68	8.78	-42.91	H	H	61.2

Table 6-6. Radiated Spurious Data (Band 17 – High Channel)

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OPERATING FREQUENCY:	826.50	MHz		
CHANNEL:	20425			
MEASURED OUTPUT POWER:	8.66	dBm	=	0.007 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	5.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	21.66	dBc	

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	EUT Pol. [H/H2/V]	[dBc]
1653.00	-52.40	6.59	-45.80	V	V	54.5
2479.50	-55.22	7.29	-47.93	V	V	56.6

Table 6-7. Radiated Spurious Data (Band 5 – Low Channel)

OPERATING FREQUENCY:	836.50	MHz		
CHANNEL:	20525			
MEASURED OUTPUT POWER:	8.20	dBm	=	0.007 W
MODULATION SIGNAL:	QPSK			
BANDWIDTH:	5.0	MHz		
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	21.20	dBc	

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	EUT Pol. [H/H2/V]	[dBc]
1673.00	-50.43	6.59	-43.84	V	V	52.0
2509.50	-57.29	7.34	-49.95	V	V	58.2

Table 6-8. Radiated Spurious Data (Band 5 – Mid Channel)

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OPERATING FREQUENCY:	846.50	MHz			
CHANNEL:	20625				
MEASURED OUTPUT POWER:	6.86	dBm	=	0.005	W
MODULATION SIGNAL:	QPSK				
BANDWIDTH:	5.0	MHz			
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	19.86	dBc		

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	Spurious Emission Level [dBm]	Ant. Pol. [H/V]	EUT Pol. [H/H2/V]	[dBc]
1693.00	-47.08	6.58	-40.49	V	V	47.3
2539.50	-56.03	7.36	-48.67	V	V	55.5

Table 6-9. Radiated Spurious Data (Band 5 – High Channel)

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6.7 Frequency Stability / Temperature Variation

§2.1055 §22.355 §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 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 17 Frequency Stability Measurements

§2.1055 §27.54

OPERATING FREQUENCY: 710,000,000 Hz

CHANNEL: 23090

REFERENCE VOLTAGE: 3.85 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	710,000,015	15	0.0000021
100 %		- 30	710,000,025	25	0.0000035
100 %		- 20	710,000,001	1	0.0000001
100 %		- 10	710,000,021	21	0.0000030
100 %		0	709,999,972	-28	-0.0000039
100 %		+ 10	710,000,019	19	0.0000027
100 %		+ 20	710,000,002	2	0.0000003
100 %		+ 30	710,000,028	28	0.0000039
100 %		+ 40	709,999,996	-4	-0.0000006
100 %		+ 50	710,000,015	15	0.0000021
BATT. ENDPOINT	3.45	+ 20	709,999,987	-13	-0.0000018

Table 6-10. Frequency Stability Data (Band 17)

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 17 Frequency Stability Measurements

§2.1055 §27.54

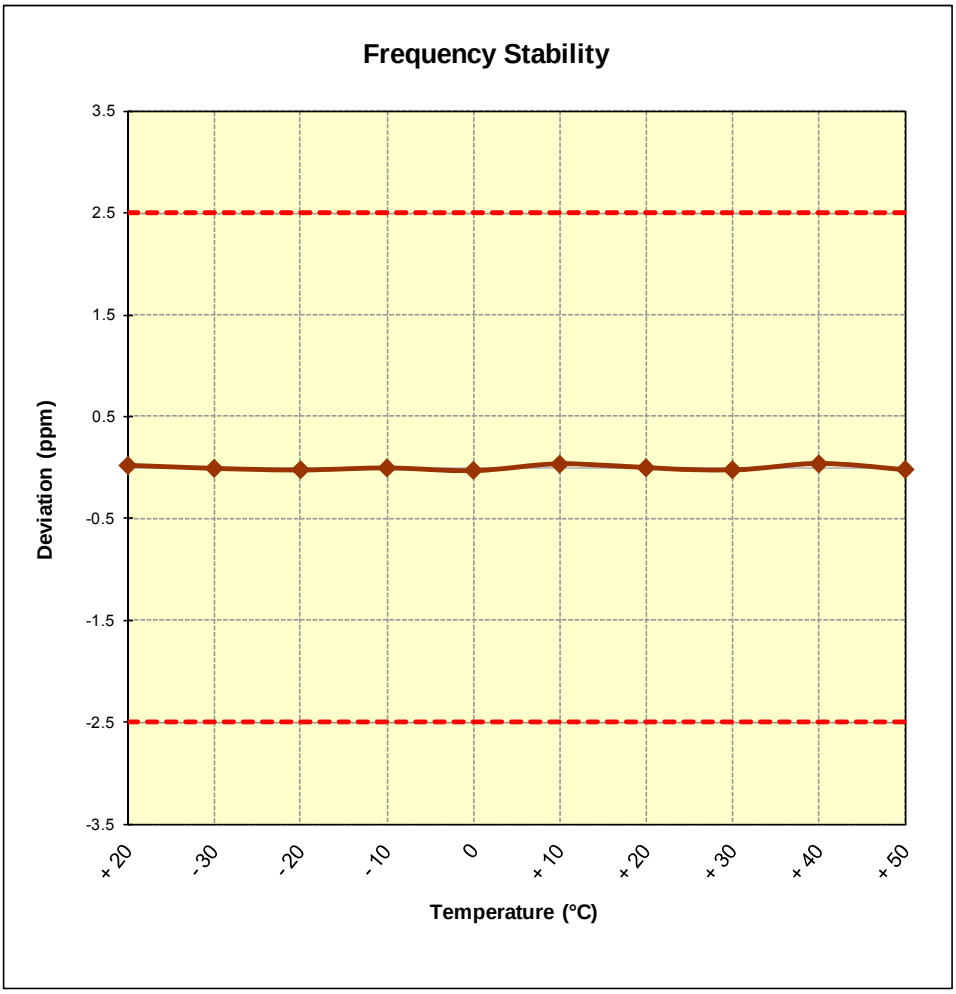

Figure 6-6. Frequency Stability Graph (Band 17)

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Band 5 Frequency Stability Measurements

§2.1055 §22.355

OPERATING FREQUENCY: 836,500,000 Hz

CHANNEL: 20525

REFERENCE VOLTAGE: 3.85 VDC

DEVIATION LIMIT: ± 0.00025 % or 2.5 ppm

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.85	+ 20 (Ref)	836,500,014	14	0.0000017
100 %		- 30	836,500,025	25	0.0000030
100 %		- 20	836,499,984	-16	-0.0000019
100 %		- 10	836,500,005	5	0.0000006
100 %		0	836,499,977	-23	-0.0000027
100 %		+ 10	836,500,011	11	0.0000013
100 %		+ 20	836,499,999	-1	-0.0000001
100 %		+ 30	836,499,984	-16	-0.0000019
100 %		+ 40	836,499,974	-26	-0.0000031
100 %		+ 50	836,499,986	-14	-0.0000017
BATT. ENDPOINT	3.45	+ 20	836,499,971	-29	-0.0000035

Table 6-11. Frequency Stability Data (Band 5)

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Band 5 Frequency Stability Measurements

§2.1055 §22.355

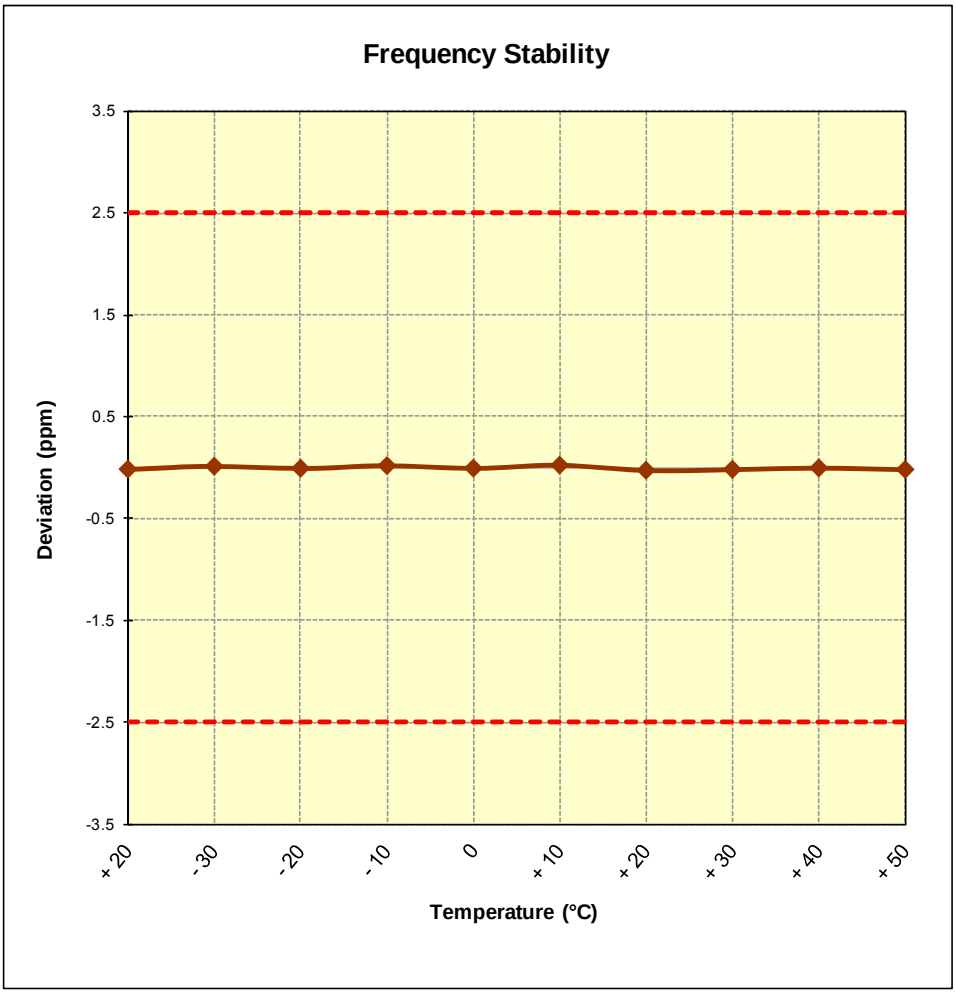

Figure 6-7. Frequency Stability Graph (Band 5)

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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: A3LSMN915KOR** complies with all the requirements of Parts 22 & 27 of the FCC rules for LTE operation only.

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