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 22, 24

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

Date of Testing:
2/17 - 2/18/2014, 4/28 - 5/13/2014
Test Site/Location:
PCTEST Lab., Columbia, MD, USA
Test Report Serial No.:
0Y1404250855.A3L

FCC ID: A3LSMG9008W

APPLICANT: SAMSUNG ELECTRONICS, CO. LTD.

Application Type: Certification
Model(s): SM-G9008W
EUT Type: Portable Handset
FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s): §2 §22(H) §24(E)
Test Procedure(s): ANSI/TIA-603-C-2004, KDB 971168 v02r01
Test Device Serial No.: *identical prototype* [S/N: 9176E, FL-137-A]

Mode	Tx Frequency (MHz)	Master Antenna			Slave Antenna		
		Emission Designator	ERP/EIRP		Emission Designator	ERP/EIRP	
			Max. Power (W)	Max. Power (dBm)		Max. Power (W)	Max. Power (dBm)
GSM850	824.2 - 848.8	242KGXW	0.807	29.07	243KGXW	0.608	27.84
EDGE850	824.2 - 848.8	244KG7W	0.314	24.97	239KG7W	0.124	20.95
GSM1900	1850.2 - 1909.8	241KGXW	1.239	30.93	247KGXW	0.947	29.76
EDGE1900	1850.2 - 1909.8	248KG7W	0.501	27.00	241KG7W	0.330	25.18
WCDMA850	826.4 - 846.6	4M16F9W	0.039	15.92	N/A	N/A	N/A
WCDMA1900	1852.4 - 1907.6	4M18F9W	0.264	24.21	N/A	N/A	N/A

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

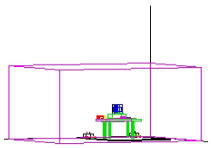
ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

© 2014 PCTEST Engineering Laboratory, Inc.

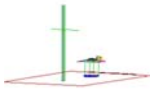
TABLE OF CONTENTS

FCC PART 22, 24 MEASUREMENT REPORT 3
1.0 INTRODUCTION 4
1.1 SCOPE 4
1.2 TESTING FACILITY 4
2.0 PRODUCT INFORMATION 5
2.1 EQUIPMENT DESCRIPTION 5
2.2 DEVICE CAPABILITIES 5
2.3 TEST CONFIGURATION 5
2.4 EMI SUPPRESSION DEVICE(S)/MODIFICATIONS 5
3.0 DESCRIPTION OF TESTS 6
3.1 EVALUATION PROCEDURE 6
3.2 CELLULAR - BASE FREQUENCY BLOCKS 6
3.3 CELLULAR - MOBILE FREQUENCY BLOCKS 6
3.4 PCS - BASE FREQUENCY BLOCKS 6
3.5 PCS - MOBILE FREQUENCY BLOCKS 7
3.6 RADIATED MEASUREMENTS 8
4.0 TEST EQUIPMENT CALIBRATION DATA 9
5.0 SAMPLE CALCULATIONS 10
6.0 TEST RESULTS 11
6.1 SUMMARY 11
6.2 OCCUPIED BANDWIDTH 12
6.3 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL 18
6.4 BAND EDGE EMISSIONS AT ANTENNA TERMINAL 40
6.5 PEAK-AVERAGE RATIO 48
6.6 RADIATED POWER (ERP/EIRP) 52
6.7 RADIATED SPURIOUS EMISSIONS MEASUREMENTS 56
6.8 FREQUENCY STABILITY / TEMPERATURE VARIATION 67
7.0 CONCLUSION 76

© 2014 PCTEST Engineering Laboratory, Inc.



MEASUREMENT REPORT
FCC Part 22, 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 21046 USA
FCC RULE PART(S):	§2 §22(H) §24(E)
BASE MODEL:	SM-G9008W
FCC ID:	A3LSMG9008W
FCC CLASSIFICATION:	PCS Licensed Transmitter Held to Ear (PCE)
MODE:	GSM / GPRS / EDGE / WCDMA
FREQUENCY TOLERANCE:	±0.00025 % (2.5 ppm)
Test Device Serial No.:	9176E, FL-137-A ☐ Production ☒ Pre-Production ☐ Engineering
DATE(S) OF TEST:	2/17 - 2/18/2014, 4/28 - 5/13/2014
TEST REPORT S/N:	0Y1404250855.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.

© 2014 PCTEST Engineering Laboratory, Inc.

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 C63.4-2009 on February 15, 2012.

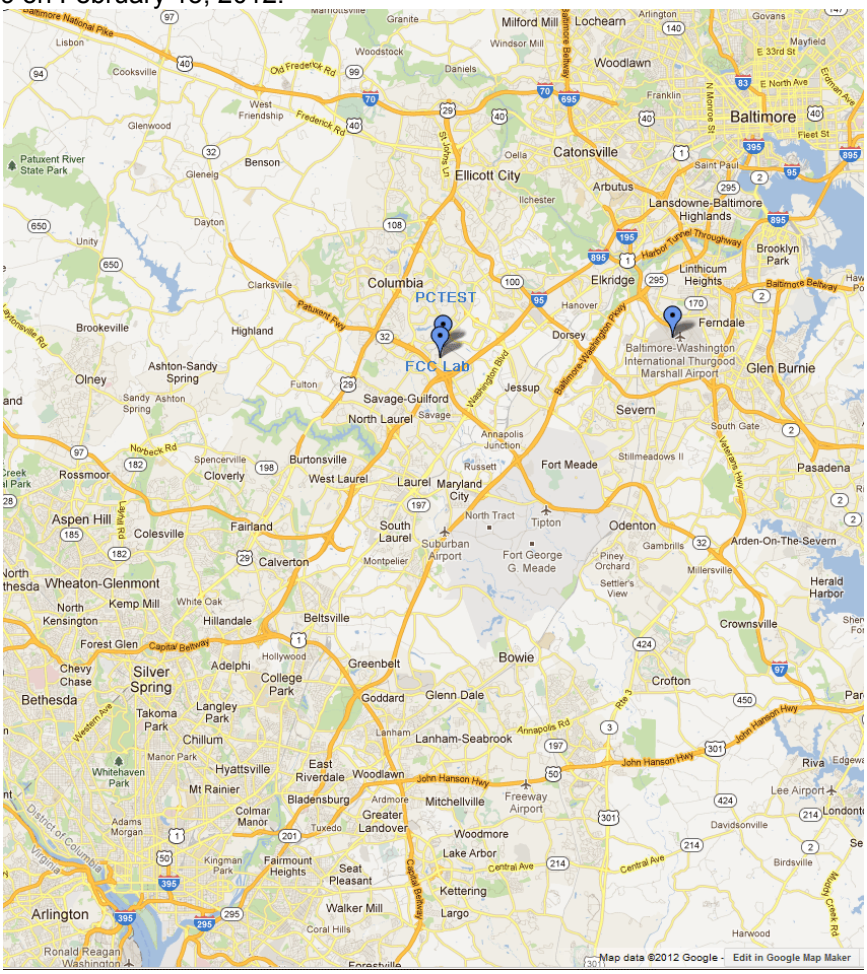


Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

© 2014 PCTEST Engineering Laboratory, Inc.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMG9008W**. The test data contained in this report pertains only to the emissions due to the EUT's 2G/3G licensed transmitters.

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1900 WCDMA/HSPA, 802.11a/b/g/n/ac WLAN (DTS/NII), Bluetooth (1x,EDR, LE), NFC, ANT+

This device supports two separate transmit antennas for 850/1900 GSM/GPRS/EDGE. This report will contain data for both antennas. These two antennas will be referred to as 'Master' and 'Slave'.

2.3 Test Configuration

The Samsung Portable Handset FCC ID: A3LSMG9008W was tested per the guidance of ANSI/TIA-603-C-2004 and KDB 971168 v02r01. See Section 6.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

The data shown in this report for 850/1900 GSM/GPRS/EDGE (Master antenna) and 850/1900 WCDMA/HSPA was taken from a previously certified device (FCC ID: A3LSMG9008V) whose circuitry is electrically identical to this device.

2.4 EMI Suppression Device(s)/Modifications

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

© 2014 PCTEST Engineering Laboratory, Inc.

3.0 DESCRIPTION OF TESTS

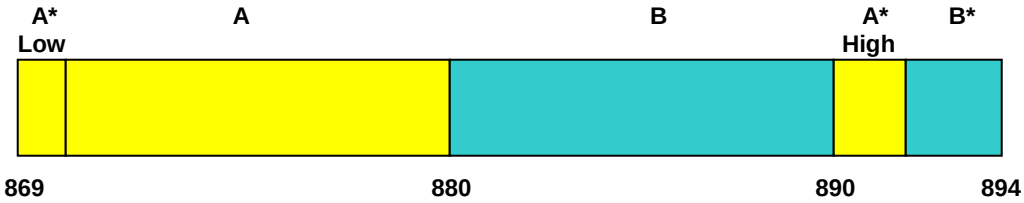
3.1 Evaluation Procedure

The measurement procedures described in the "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI/TIA-603-C-2004) and "Measurement Guidance for Certification of Licensed Digital Transmitters" (KDB 971168 v02r01) were used in the measurement of the **Samsung Portable Handset FCC ID: A3LSMG9008W.**

Deviation from Measurement Procedure……None

3.2 Cellular - Base Frequency Blocks

§22.905



BLOCK 1: 869 – 880 MHz (A* Low + A)

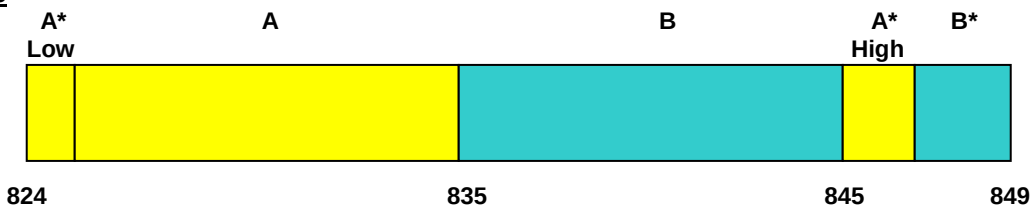
BLOCK 2: 880 – 890 MHz (B)

BLOCK 3: 890 – 891.5 MHz (A* High)

BLOCK 4: 891.5 – 894 MHz (B*)

3.3 Cellular - Mobile Frequency Blocks

§22.905



BLOCK 1: 824 – 835 MHz (A* Low + A)

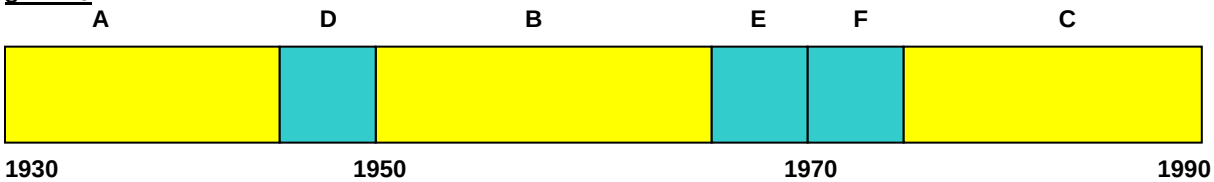
BLOCK 2: 835 – 845 MHz (B)

BLOCK 3: 845 – 846.5 MHz (A* High)

BLOCK 4: 846.5 – 849 MHz (B*)

3.4 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)

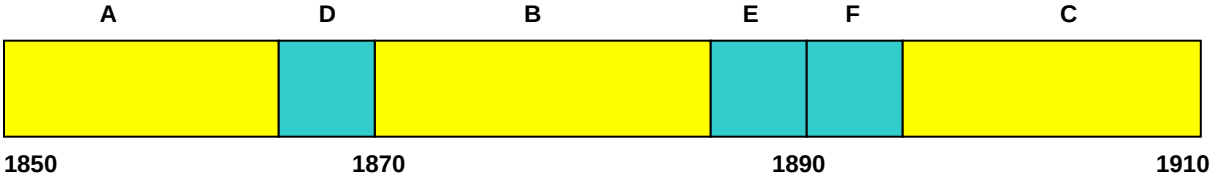
BLOCK 5: 1970 – 1975 MHz (F)

BLOCK 6: 1975 – 1990 MHz (C)

© 2014 PCTEST Engineering Laboratory, Inc.

3.5 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)

© 2014 PCTEST Engineering Laboratory, Inc.

3.6 Radiated Measurements

§2.1053 §22.913(a.2) §22.917(a) §24.232(c) §24.238(a) RSS-132(4.4) RSS-132(4.5.1) RSS-133(6.4) RSS-133(6.5.1)

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. 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. For the EUT positioning, "H" is defined with the EUT lying flat on the test surface, "H2" is defined with the EUT standing up on its side, and "V" is defined with the EUT standing upright.

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 $_{[dB]}$.

Radiated power levels are investigated with the receive antenna vertically polarized while radiated spurious emissions levels are investigated with the receive antenna horizontally and vertically polarized per ANSI/TIA-603-C-2004.

© 2014 PCTEST Engineering Laboratory, Inc.

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	Bi-annual	7/29/2014	N/A
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	3/29/2013	Annual	3/29/2014	N/A
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Espec	ESX-2CA	Environmental Chamber	4/16/2013	Annual	4/16/2014	17620
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	7/24/2013	Biennial	7/24/2015	125518
ETS Lindgren	3160-09	18-26.5 GHz Standard Gain Horn	5/30/2012	Biennial	5/30/2014	135427
ETS Lindgren	3164-08	Quad Ridge Horn Antenna	11/7/2012	Biennial	11/7/2014	128338
Mini-Circuits	VHF-1200+	High Pass Filter	1/29/2014	Bi-annual	7/29/2014	30923
Mini-Circuits	VHF-3100+	High Pass Filter	1/29/2014	Bi-annual	7/29/2014	30841
Mini-Circuits	PWR-SEN-4RMS	USB Power Sensor	4/17/2013	Annual	4/17/2014	11210140001
Rohde & Schwarz	CMU200	Base Station Simulator	5/3/2013	Annual	5/3/2014	836371/0079
Rohde & Schwarz	TS-PR18	1-18 GHz Pre-Amplifier	5/31/2013	Annual	5/31/2014	100071
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	5/31/2013	Annual	5/31/2014	100040
Rohde & Schwarz	ESU26	EMI Test Receiver	2/25/2013	Annual	2/25/2014	100342
Schwarzbeck	UHA 9105	Dipole Antenna (400 - 1GHz) Rx	11/21/2013	Biennial	11/21/2015	9105-2404
Schwarzbeck	UHA 9105	Dipole Antenna (400 - 1GHz) Tx	11/21/2013	Biennial	11/21/2015	9105-2403
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	1/28/2014	Biennial	1/28/2016	A051107

Table 4-1. Test Equipment used 2/17 – 2/18/2014

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)	3/25/2014	Annual	3/25/2015	N/A
Agilent	8447D	Broadband Amplifier	5/31/2013	Annual	5/31/2014	2443A01900
Agilent	E4448A	PSA (3Hz-50GHz) Spectrum Analyzer	4/16/2014	Annual	4/16/2015	US42510244
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Anritsu	MA2411B	Pulse Sensor	4/8/2014	Annual	4/8/2015	846215
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	6/26/2013	Annual	6/26/2014	121034
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	5/30/2012	Biennial	5/30/2014	135427
ETS Lindgren	3164-08	Quad Ridge Horn Antenna	3/12/2014	Biennial	3/12/2016	128337
Mini-Circuits	VHF-1200+	High Pass Filter	1/27/2014	Annual	1/27/2015	30923
Mini-Circuits	VHF-3100+	High Pass Filter	1/27/2014	Annual	1/27/2015	30841
Rohde & Schwarz	CMU200	Base Station Simulator	9/23/2013	Annual	9/23/2014	109892
Rohde & Schwarz	TS-PR18	1-18 GHz Pre-Amplifier	5/31/2013	Annual	5/31/2014	100071
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	5/31/2013	Annual	5/31/2014	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
Schwarzbeck	UHA 9105	Dipole Antenna (400 - 1GHz) Tx	11/21/2013	Biennial	11/21/2015	9105-2403
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	1/28/2014	Biennial	1/28/2016	A051107

Table 4-2. Test Equipment used 4/28 – 5/13/2014

© 2014 PCTEST Engineering Laboratory, Inc.

5.0 SAMPLE CALCULATIONS

GSM Emission Designator

Emission Designator = 250KGXW

GSM BW = 250 kHz
G = Phase Modulation
X = Cases not otherwise covered
W = Combination (Audio/Data)

EDGE Emission Designator

Emission Designator = 250KG7W

EDGE BW = 250 kHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination (Audio/Data)

WCDMA Emission Designator

Emission Designator = 4M16F9W

WCDMA BW = 4.16 MHz
F = Frequency Modulation
9 = Composite Digital Info
W = Combination (Audio/Data) (Measured at the 99.75% power bandwidth)

Spurious Radiated Emission

Example: Spurious emission at 3700.40 MHz

The receive 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 analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 3700.40 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.50 dBm so this harmonic was 25.50 dBm – (-24.80) = 50.3 dBc.

© 2014 PCTEST Engineering Laboratory, Inc.

6.0 TEST RESULTS

6.1 Summary

Company Name: Samsung Electronics, Co. Ltd.

FCC ID: A3LSMG9008W

FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)

Mode(s): GSM / GPRS / EDGE / WCDMA

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
TRANSMITTER MODE (TX)					
2.1049	Occupied Bandwidth	N/A	CONDUCTED	PASS	Section 6.2
2.1051 22.917(a) 24.238(a)	Conducted Band Edge / Spurious Emissions	> 43 + $\log_{10}$ (P[Watts]) at Band Edge and for all out-of-band emissions		PASS	Sections 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	RF Exposure Report
2.1055 22.355 24.235	Frequency Stability	< 2.5 ppm (Part 22) Emission must remain in band (Part 24)		PASS	Section 6.8
22.913(a.2)	Effective Radiated Power	< 7 Watts max. ERP	RADIATED	PASS	Section 6.6
24.232(c)	Equivalent Isotropic Radiated Power	< 2 Watts max. EIRP		PASS	Section 6.6
2.1053 22.917(a) 24.238(a)	Radiated Spurious Emissions	> 43 + $\log_{10}$ (P[Watts]) for all out-of-band emissions		PASS	Section6.7

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 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 "2G/3G Automation", Version 2.3.

© 2014 PCTEST Engineering Laboratory, Inc.

6.2 Occupied Bandwidth

§2.1049 RSS-Gen(4.6.1) RSS-133(2.3)

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.

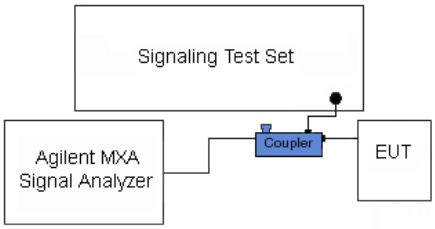
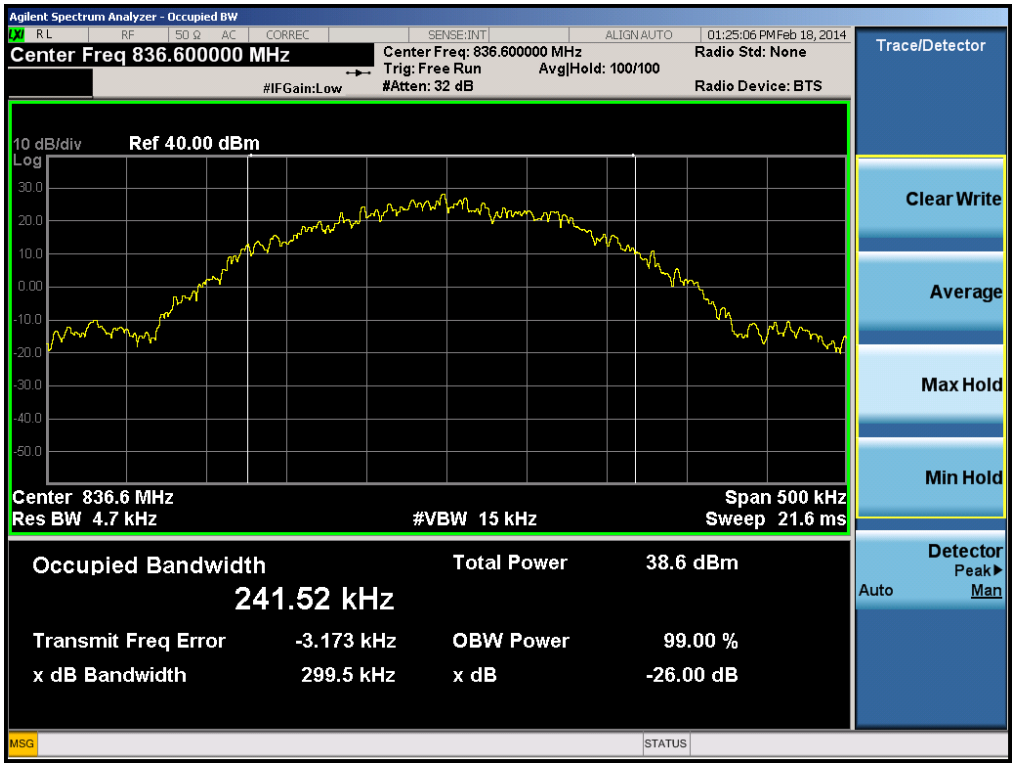


Figure 6-1. Test Instrument & Measurement Setup

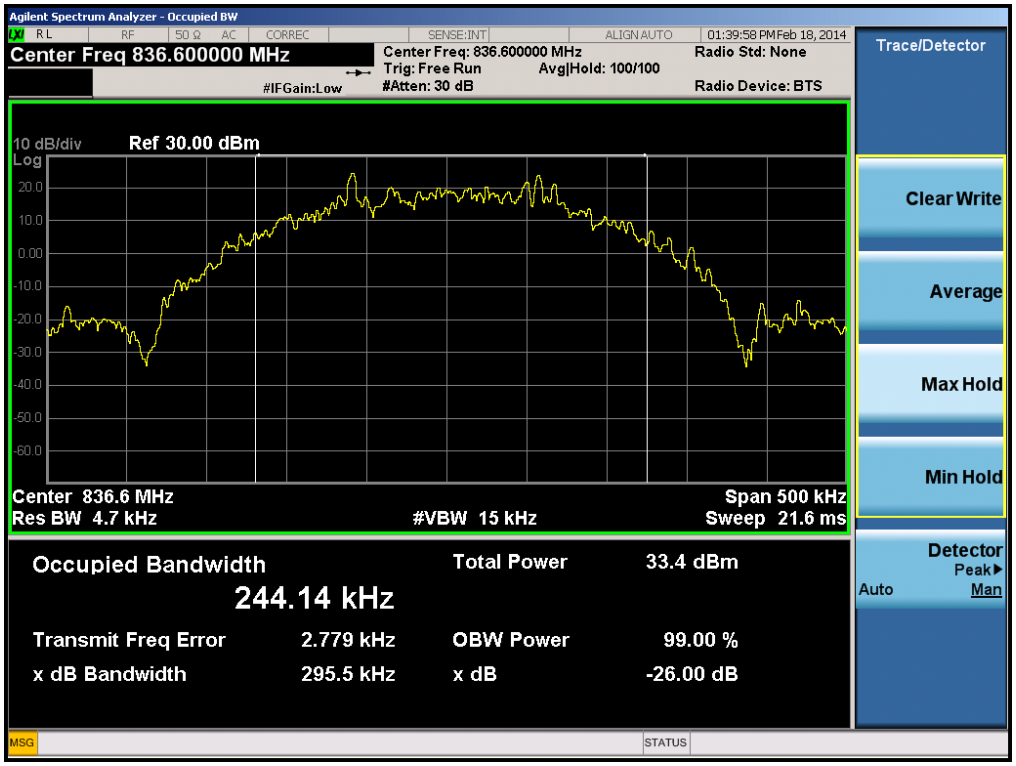
Test Notes

None.

© 2014 PCTEST Engineering Laboratory, Inc.



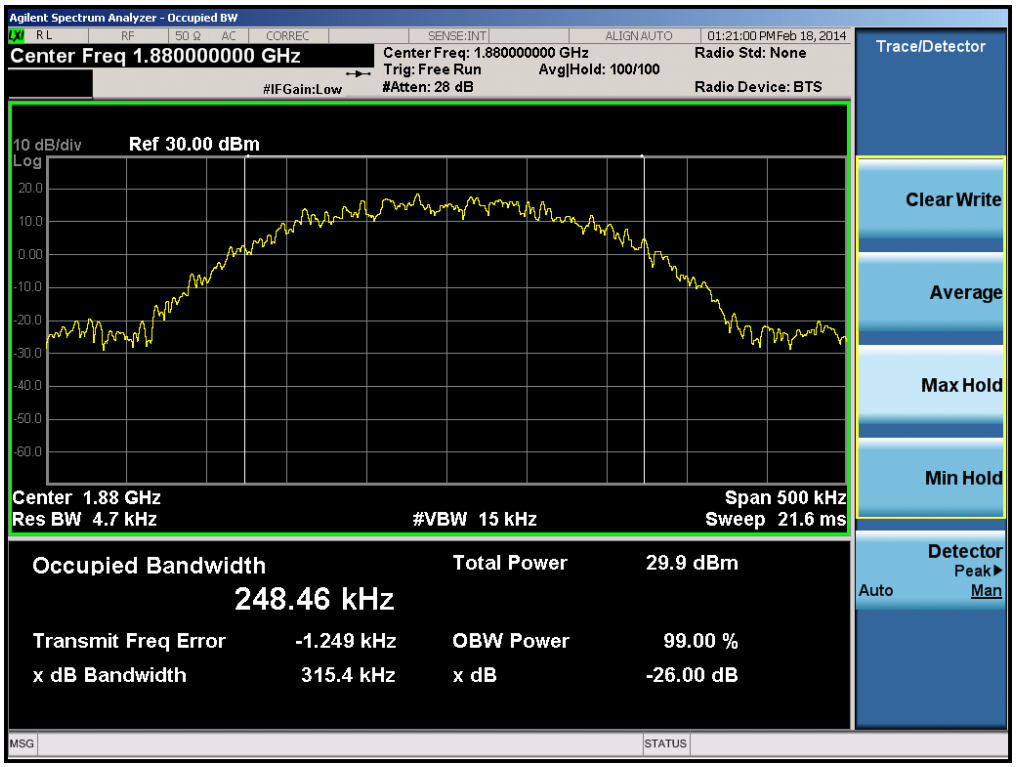
Plot 6-1. Occupied Bandwidth Plot (Cellular GSM Mode, Master – Ch. 190)



Plot 6-2. Occupied Bandwidth Plot (EDGE850 Mode, Master – Ch. 190)

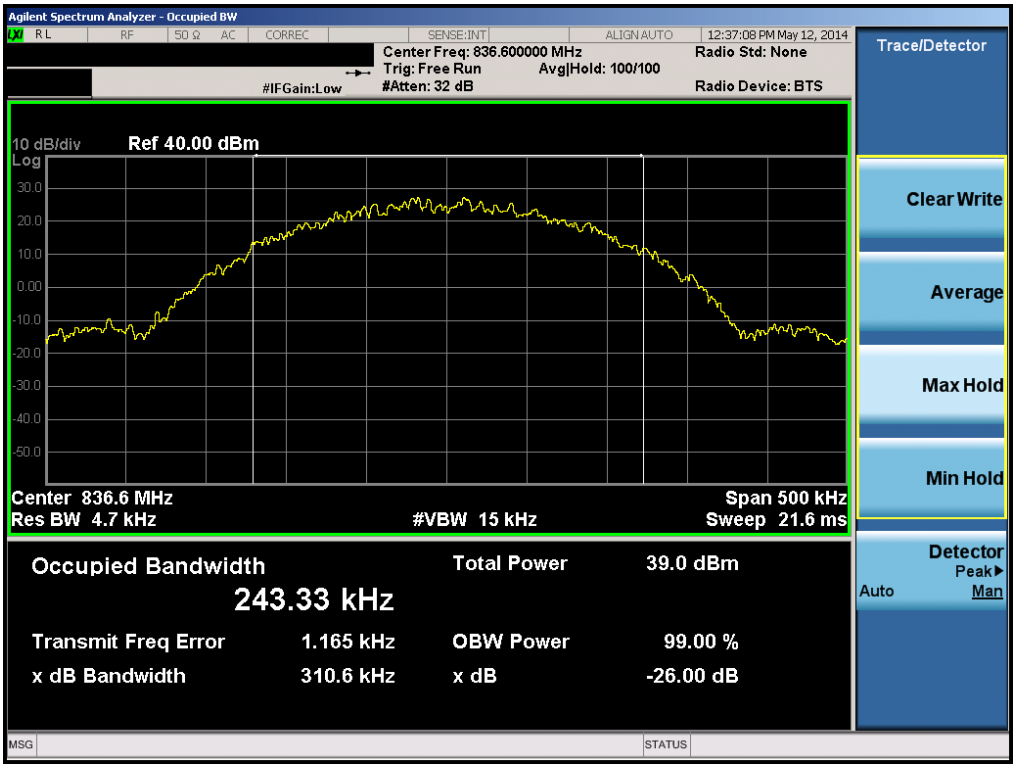
© 2014 PCTEST Engineering Laboratory, Inc.

Plot 6-3. Occupied Bandwidth Plot (PCS GSM Mode, Master – Ch. 661)

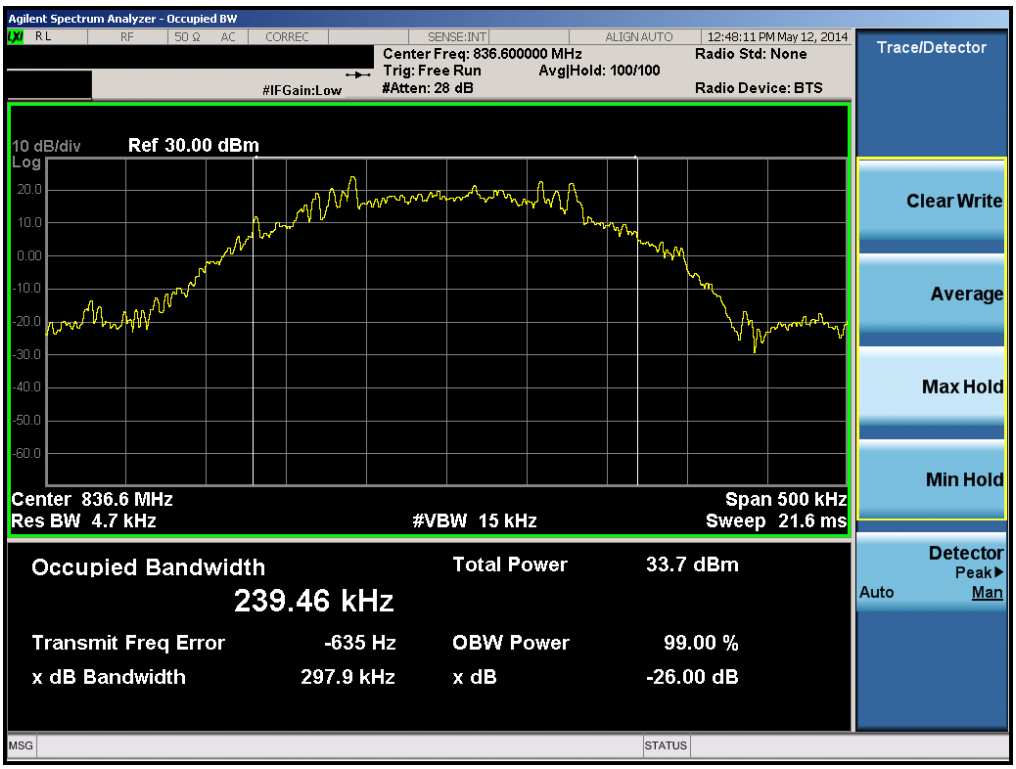


Plot 6-4. Occupied Bandwidth Plot (EDGE1900 Mode, Master – Ch. 661)

© 2014 PCTEST Engineering Laboratory, Inc.



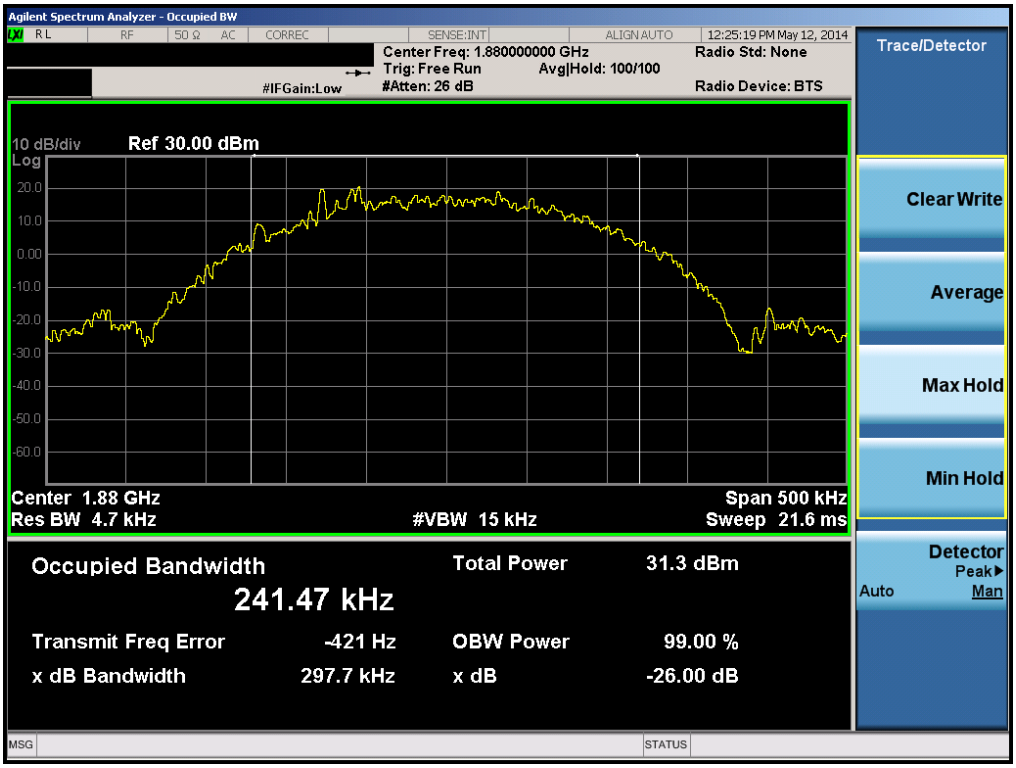
Plot 6-5. Occupied Bandwidth Plot (Cellular GSM Mode, Slave – Ch. 190)



Plot 6-6. Occupied Bandwidth Plot (EDGE850 Mode, Slave – Ch. 190)

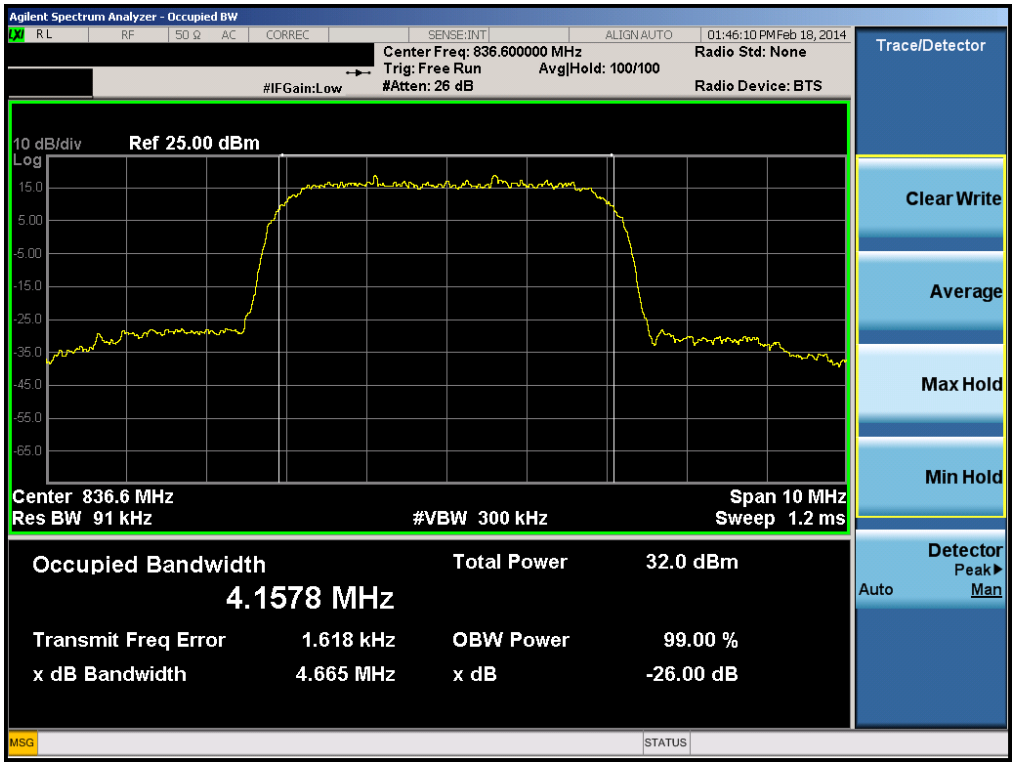
© 2014 PCTEST Engineering Laboratory, Inc.

Plot 6-7. Occupied Bandwidth Plot (PCS GSM Mode, Slave – Ch. 661)

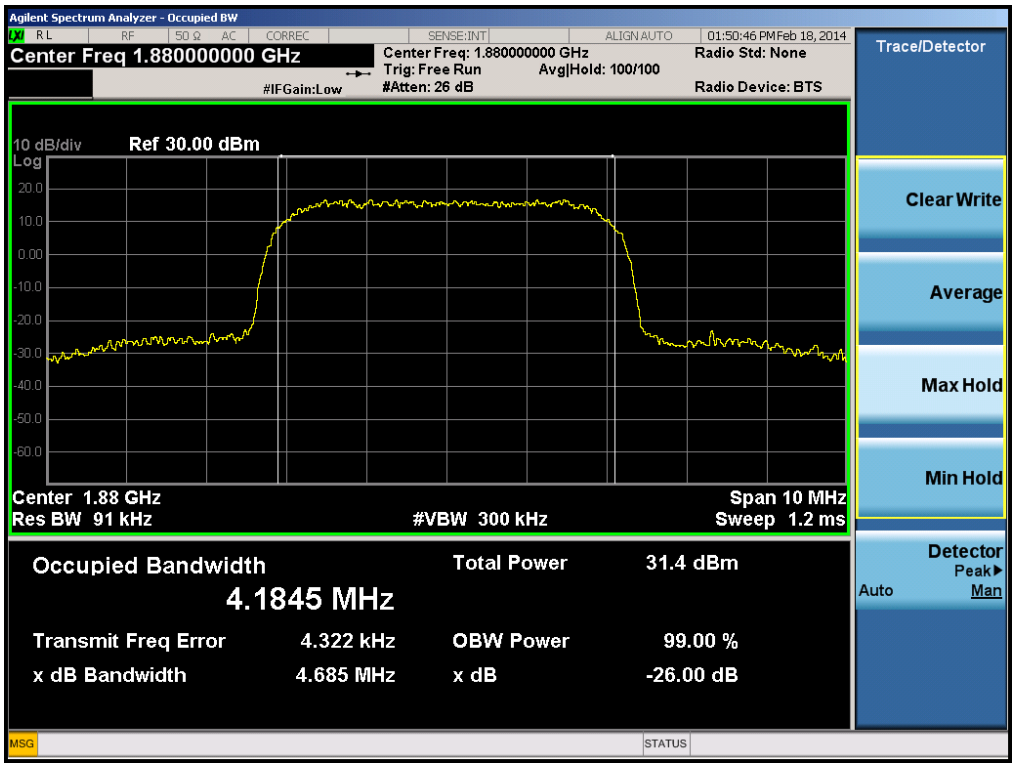


Plot 6-8. Occupied Bandwidth Plot (EDGE1900 Mode, Slave – Ch. 661)

© 2014 PCTEST Engineering Laboratory, Inc.



Plot 6-9. Occupied Bandwidth Plot (Cellular WCDMA Mode – Ch. 4183)



Plot 6-10. Occupied Bandwidth Plot (PCS WCDMA Mode – Ch. 9400)

© 2014 PCTEST Engineering Laboratory, Inc.

6.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051 §22.917(a) §24.238(a) RSS-132(4.5.1) RSS-133(6.5.1)

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 10GHz for Cellular band and 20GHz for PCS band (separated into at least two plots per channel)
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = RMS
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

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

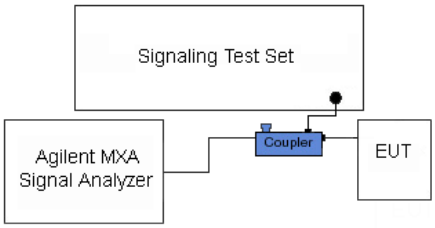
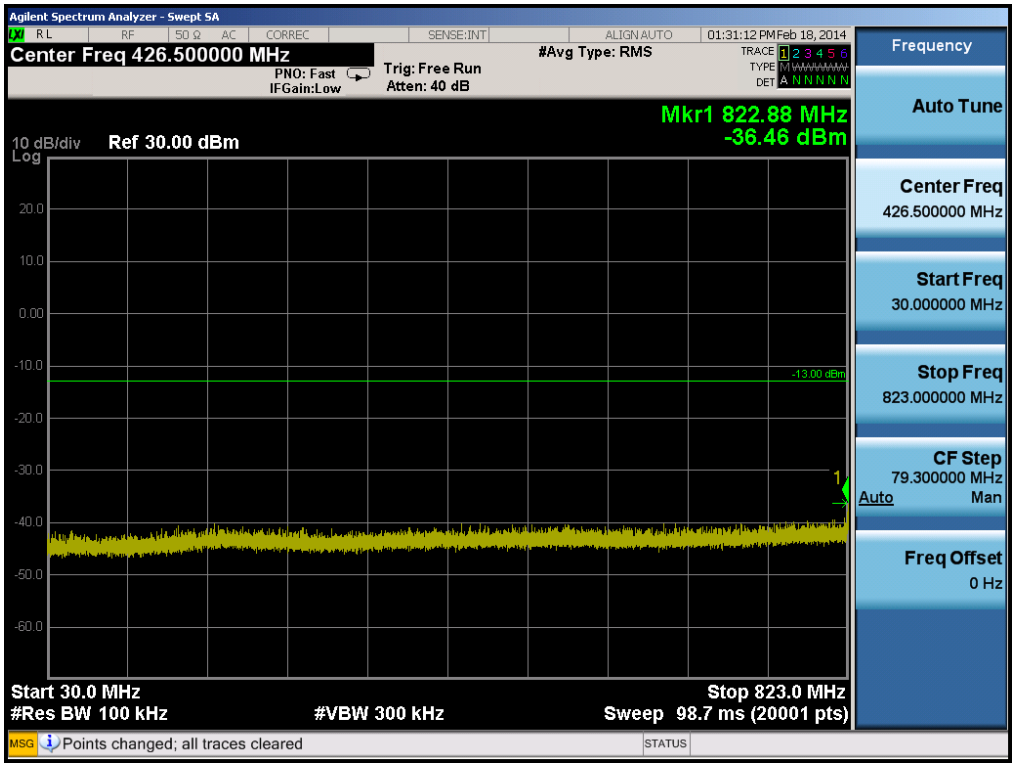


Figure 6-2. Test Instrument & Measurement Setup

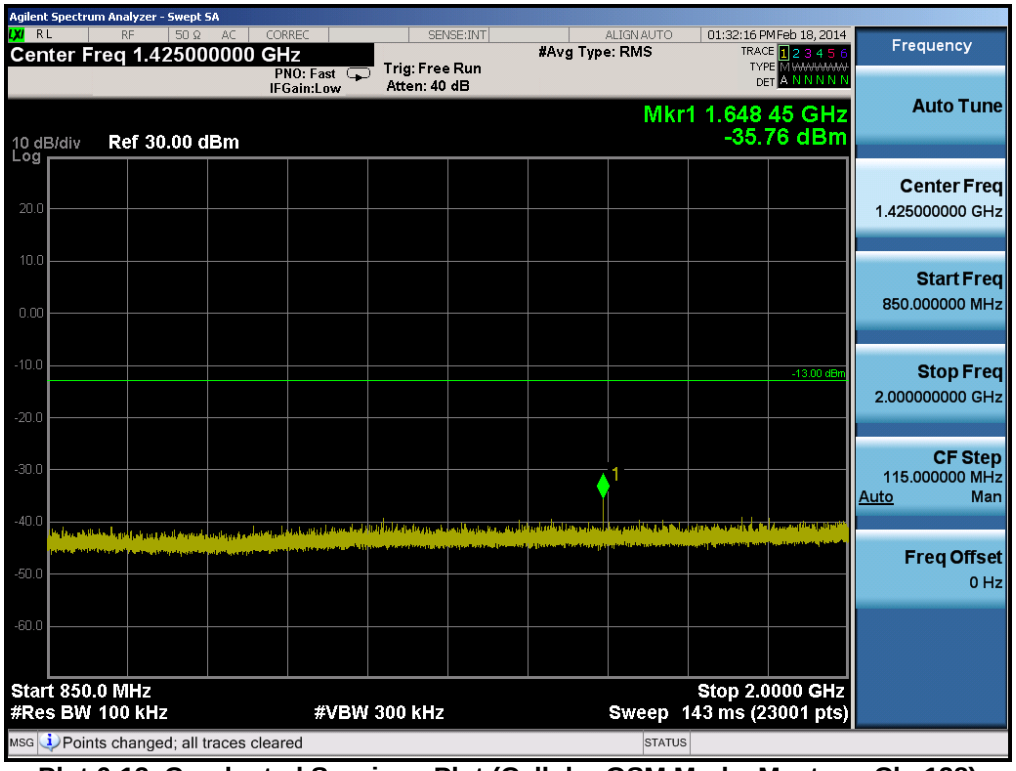
Test Notes

Compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for Part 22 and 1 MHz or greater for Part 24. 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.

© 2014 PCTEST Engineering Laboratory, Inc.

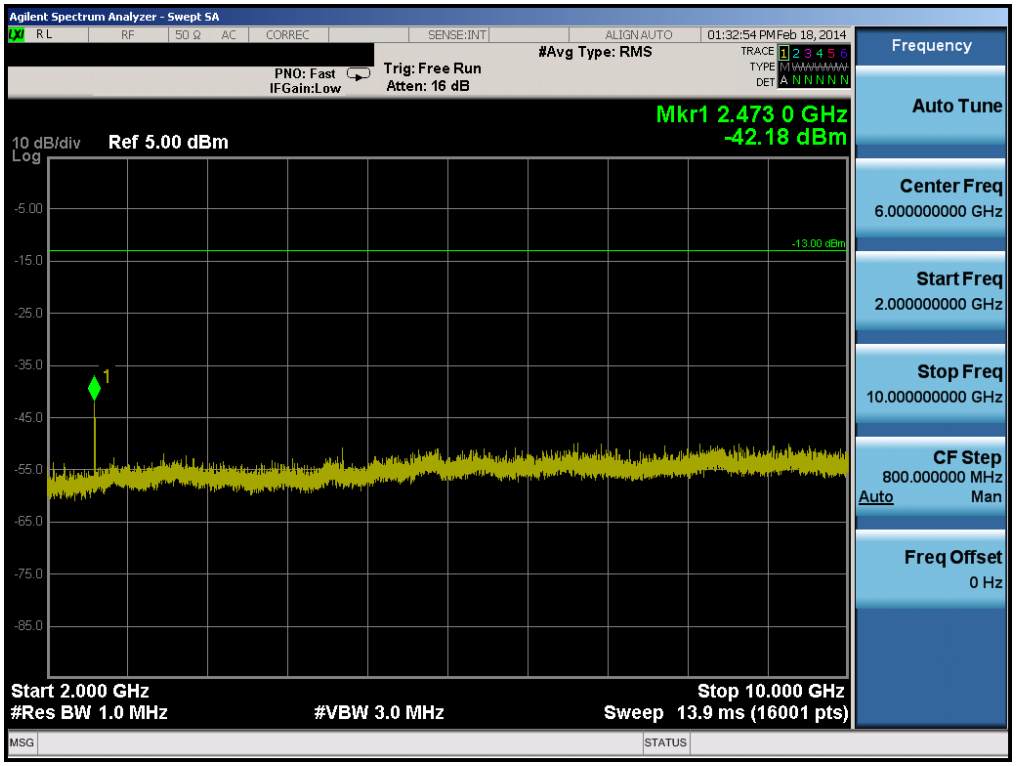


Plot 6-11. Conducted Spurious Plot (Cellular GSM Mode, Master – Ch. 128)

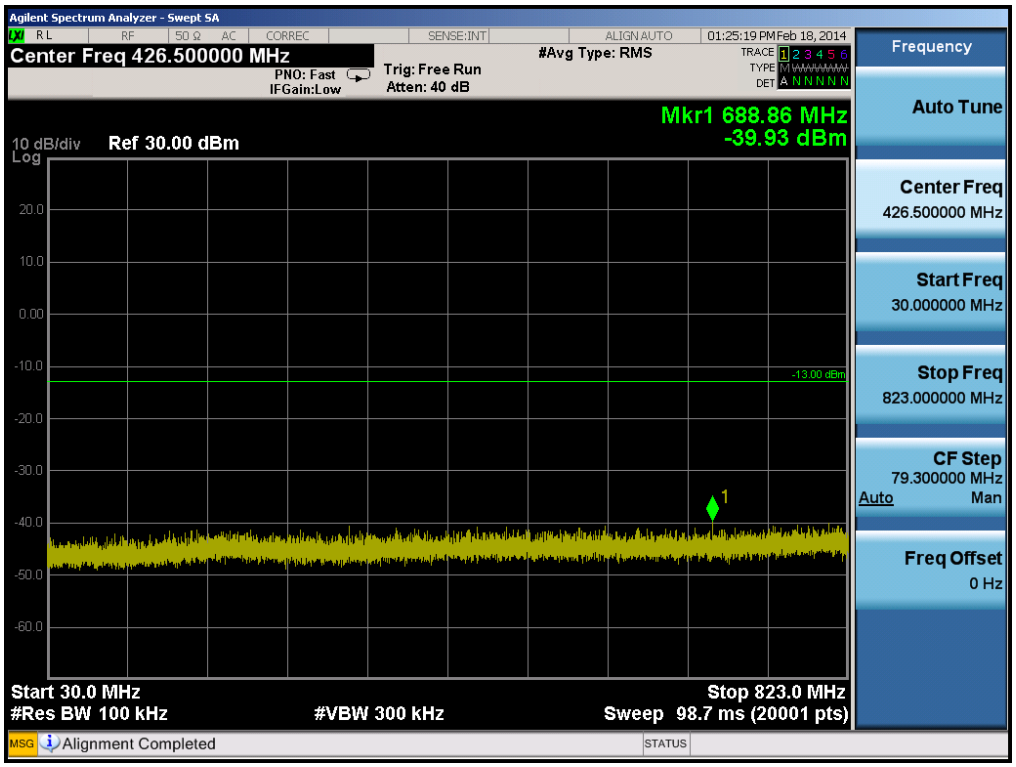


Plot 6-12. Conducted Spurious Plot (Cellular GSM Mode, Master – Ch. 128)

© 2014 PCTEST Engineering Laboratory, Inc.

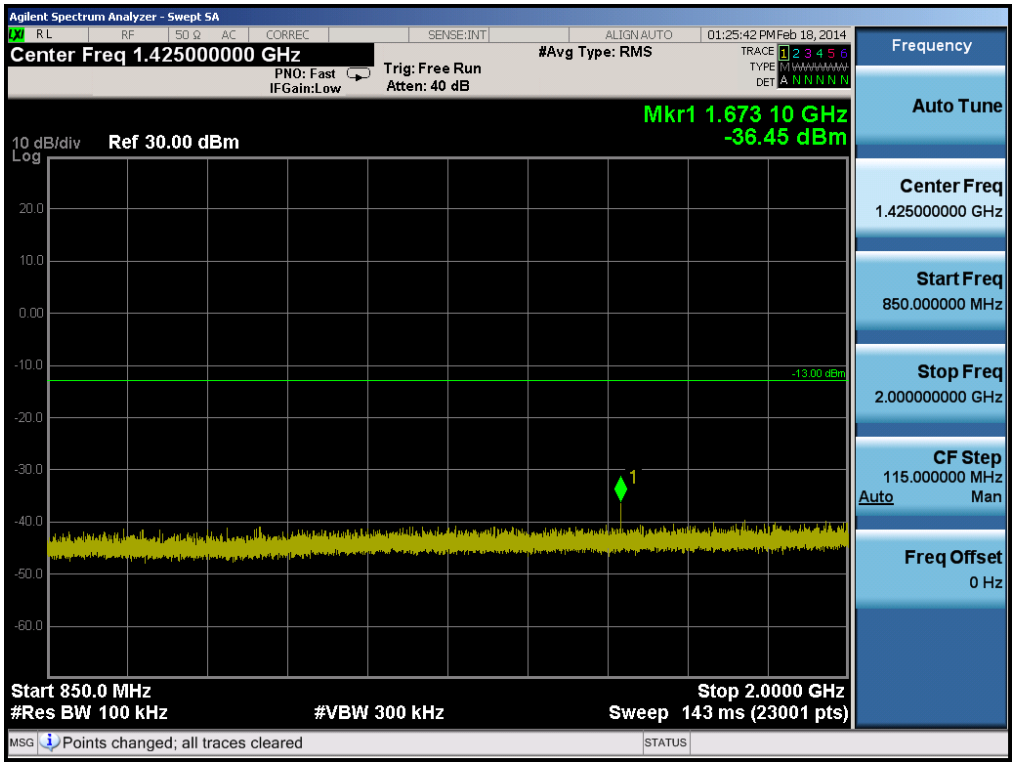


Plot 6-13. Conducted Spurious Plot (Cellular GSM Mode, Master – Ch. 128)

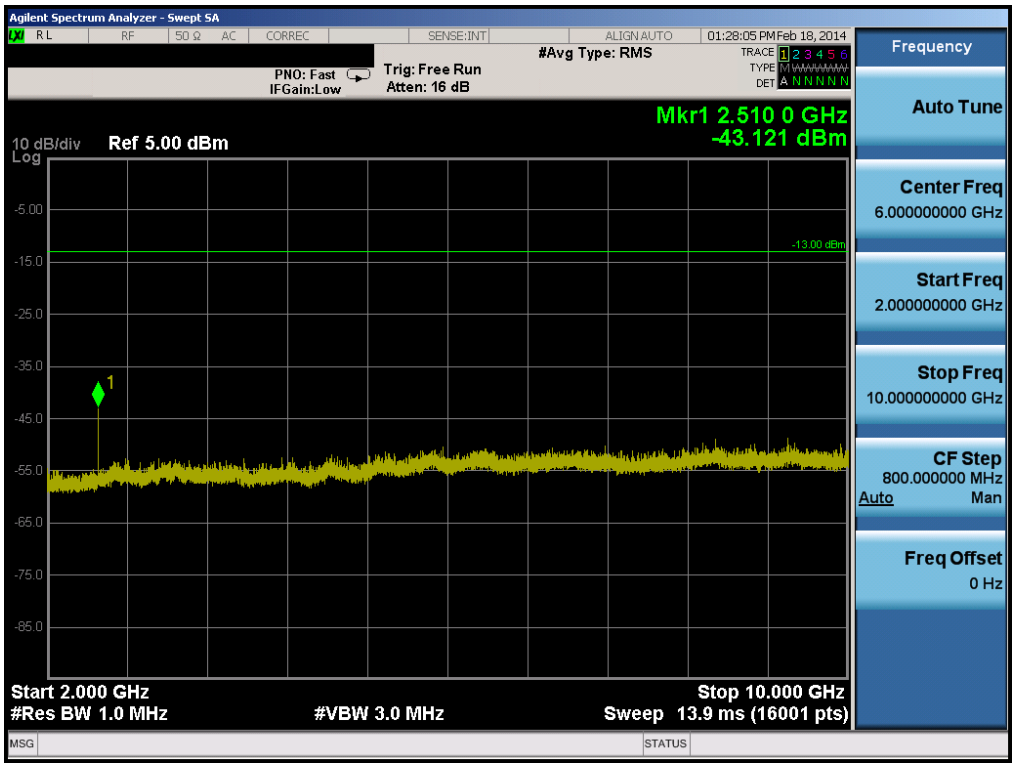


Plot 6-14. Conducted Spurious Plot (Cellular GSM Mode, Master – Ch. 190)

© 2014 PCTEST Engineering Laboratory, Inc.

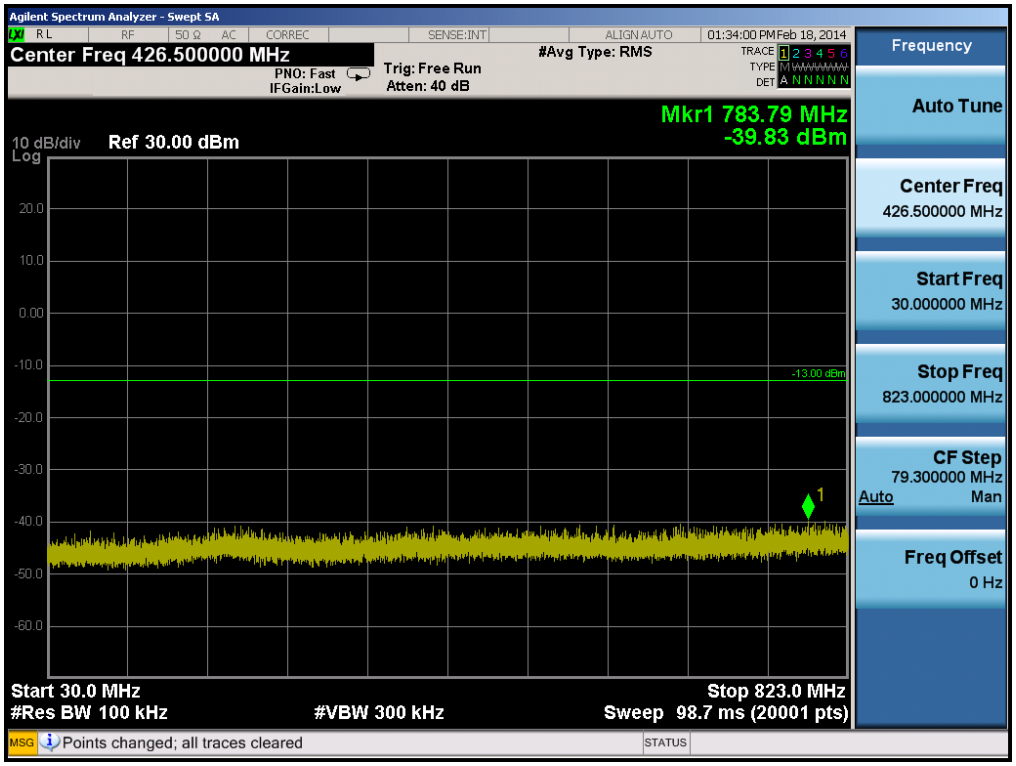


Plot 6-15. Conducted Spurious Plot (Cellular GSM Mode, Master – Ch. 190)

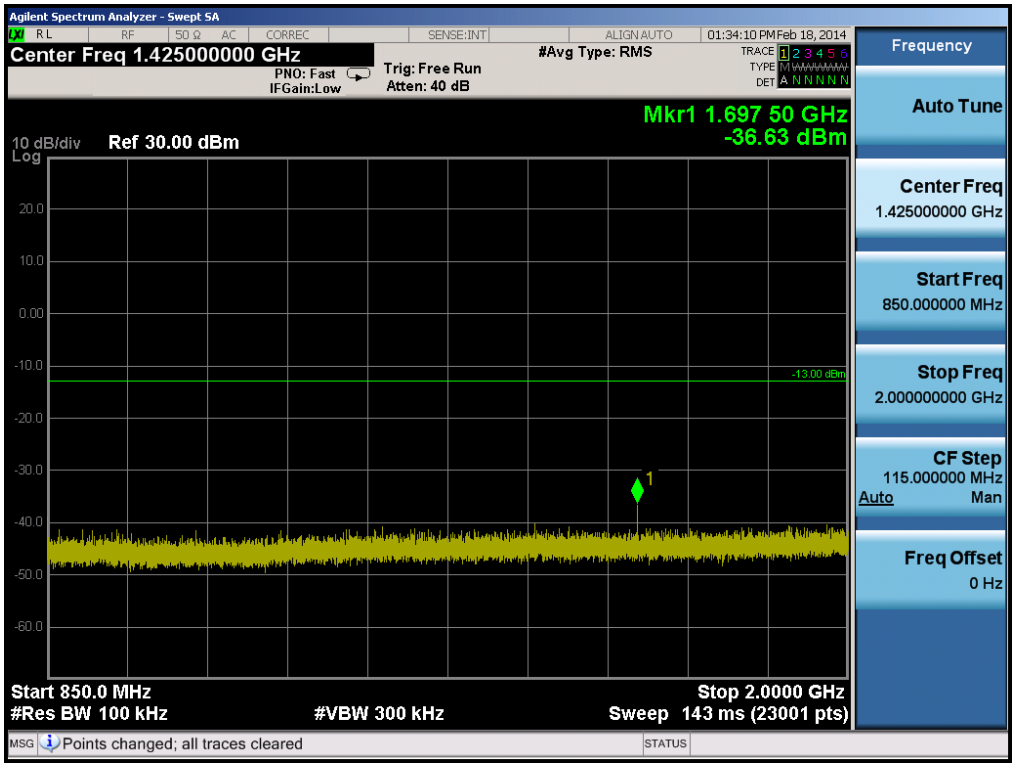


Plot 6-16. Conducted Spurious Plot (Cellular GSM Mode, Master – Ch. 190)

© 2014 PCTEST Engineering Laboratory, Inc.

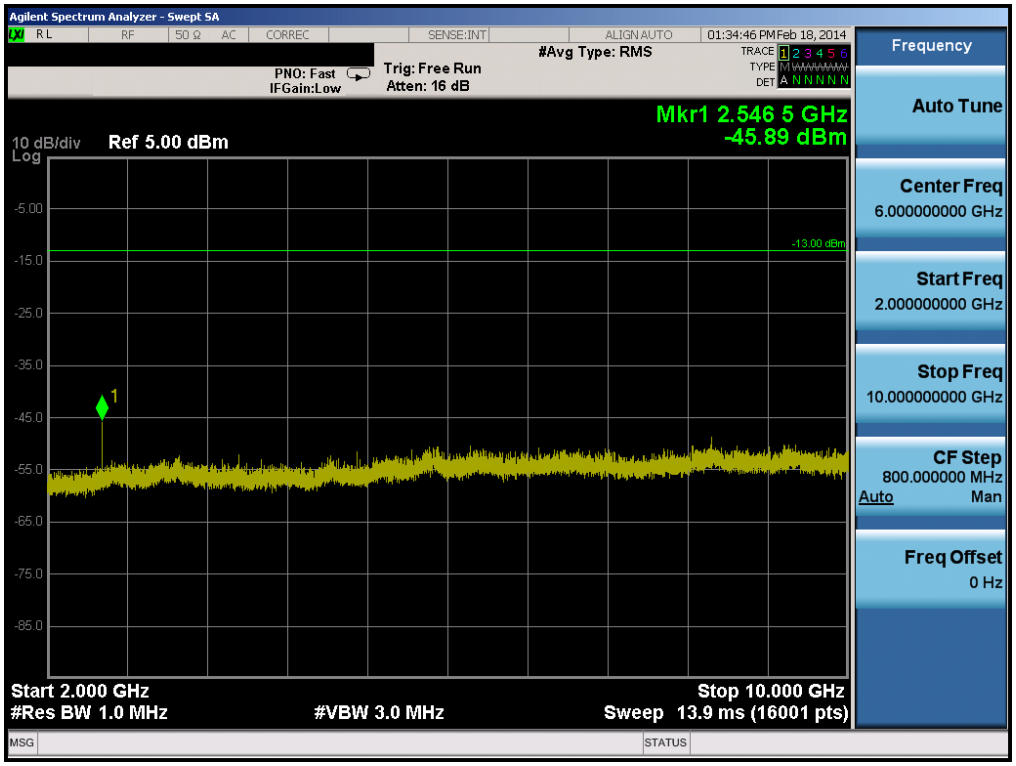


Plot 6-17. Conducted Spurious Plot (Cellular GSM Mode, Master – Ch. 251)

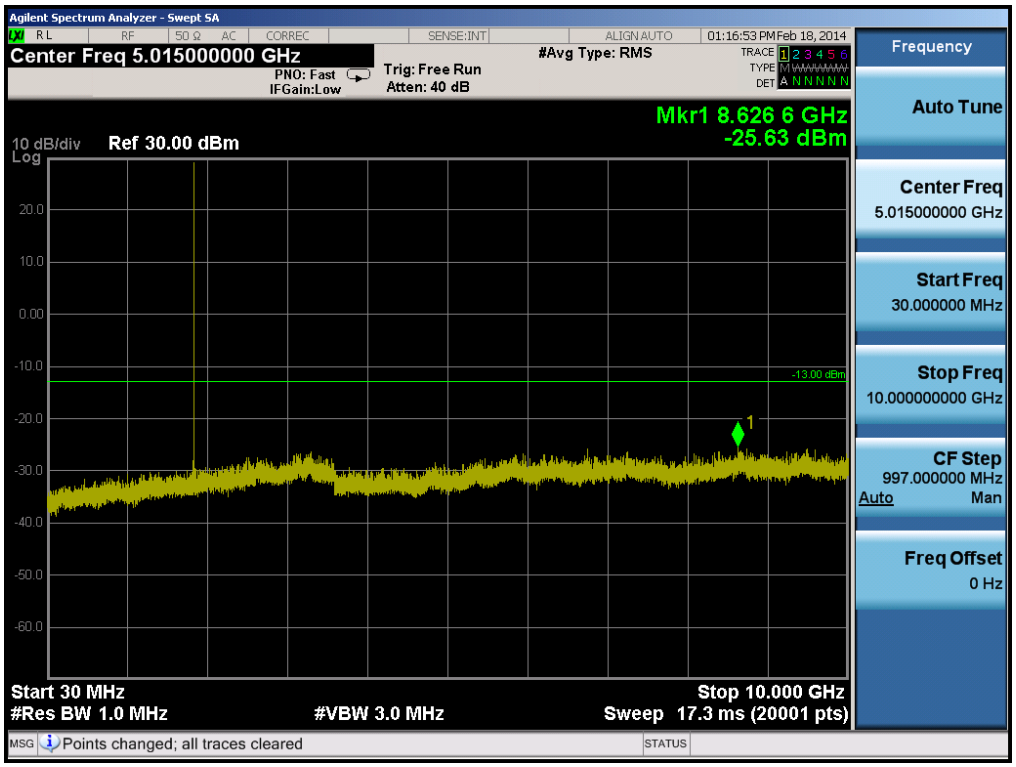


Plot 6-18. Conducted Spurious Plot (Cellular GSM Mode, Master – Ch. 251)

© 2014 PCTEST Engineering Laboratory, Inc.

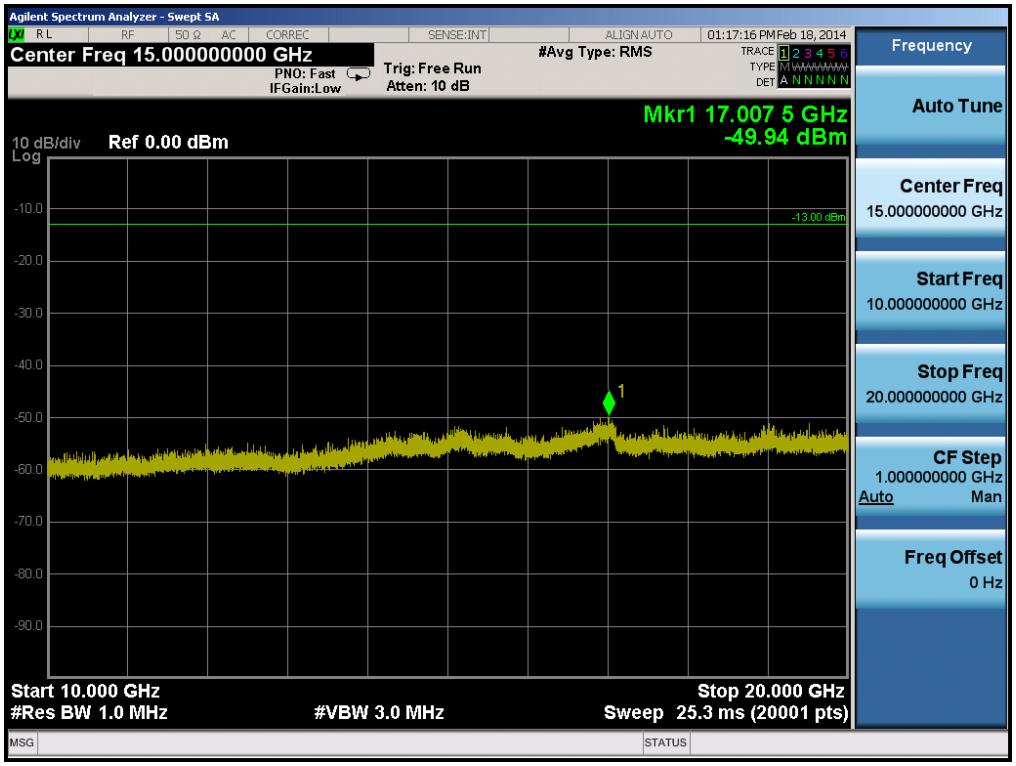


Plot 6-19. Conducted Spurious Plot (Cellular GSM Mode, Master – Ch. 251)

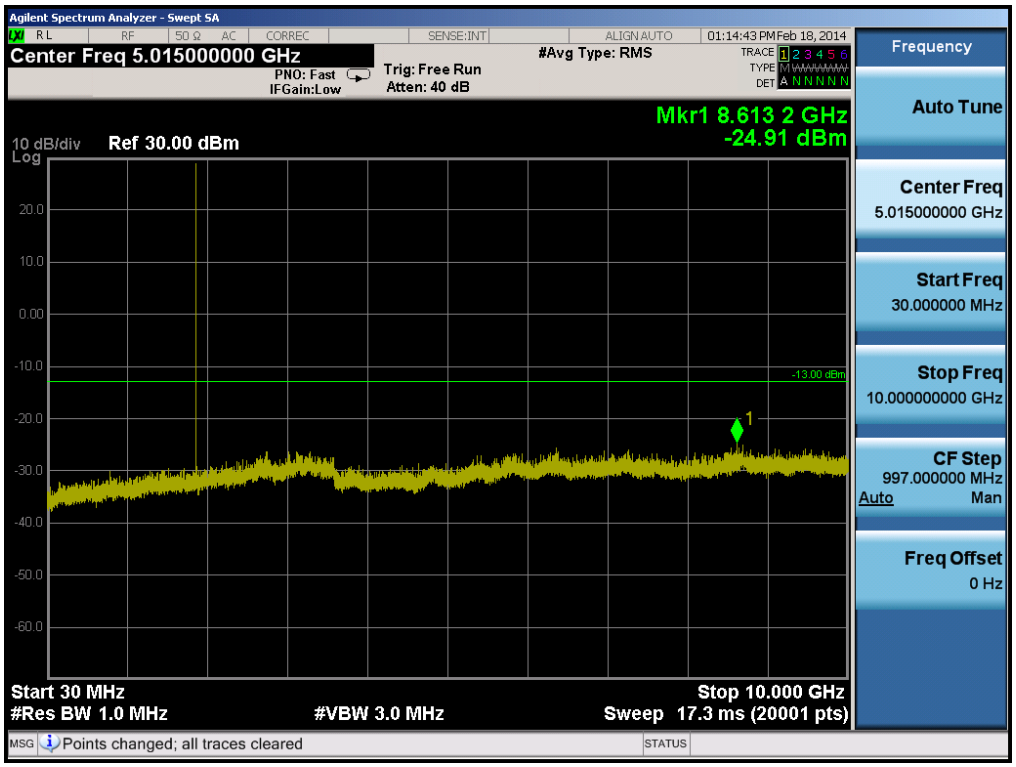


Plot 6-20. Conducted Spurious Plot (PCS GSM Mode, Master – Ch. 512)

© 2014 PCTEST Engineering Laboratory, Inc.

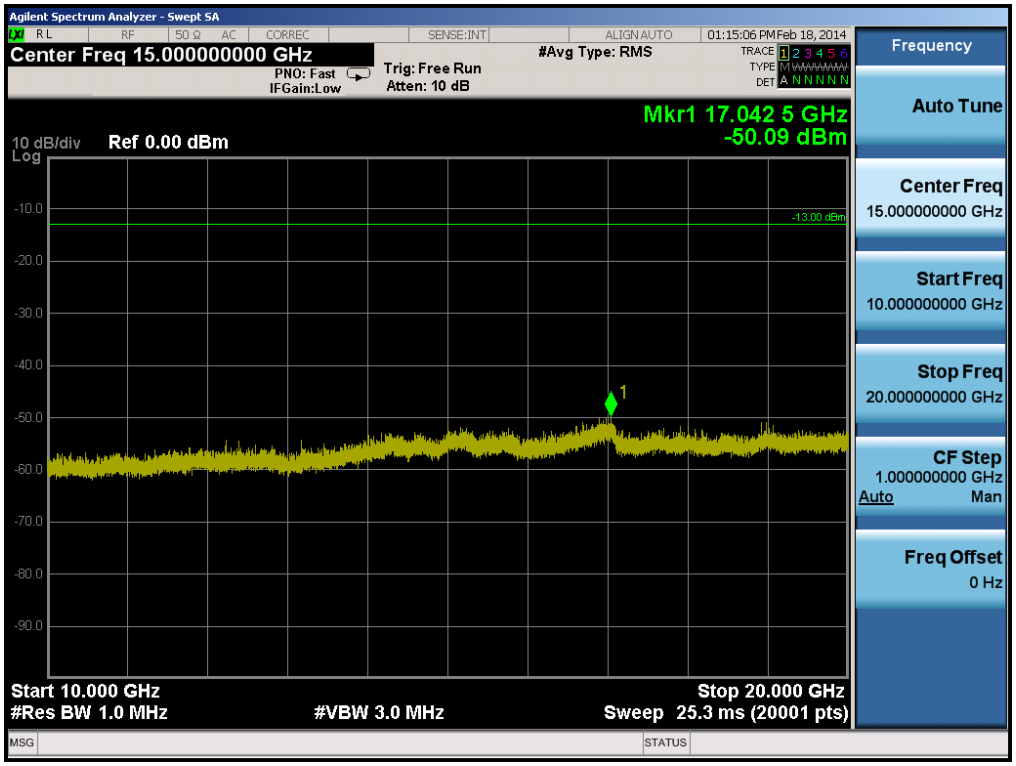


Plot 6-21. Conducted Spurious Plot (PCS GSM Mode, Master – Ch. 512)

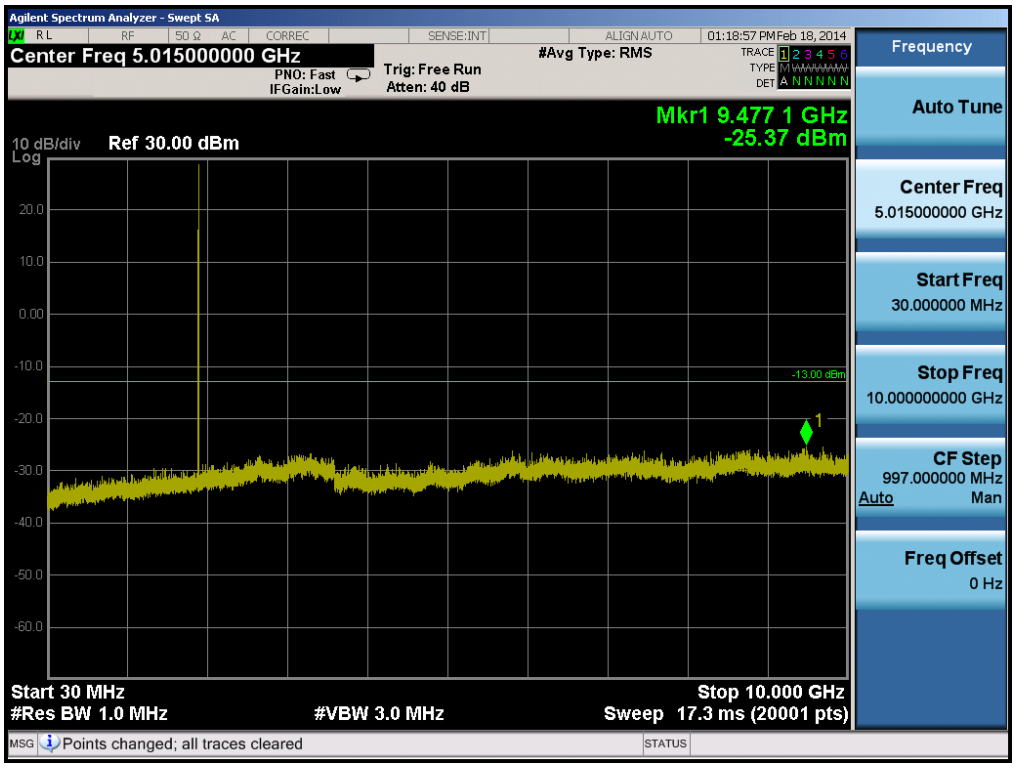


Plot 6-22. Conducted Spurious Plot (PCS GSM Mode, Master – Ch. 661)

© 2014 PCTEST Engineering Laboratory, Inc.

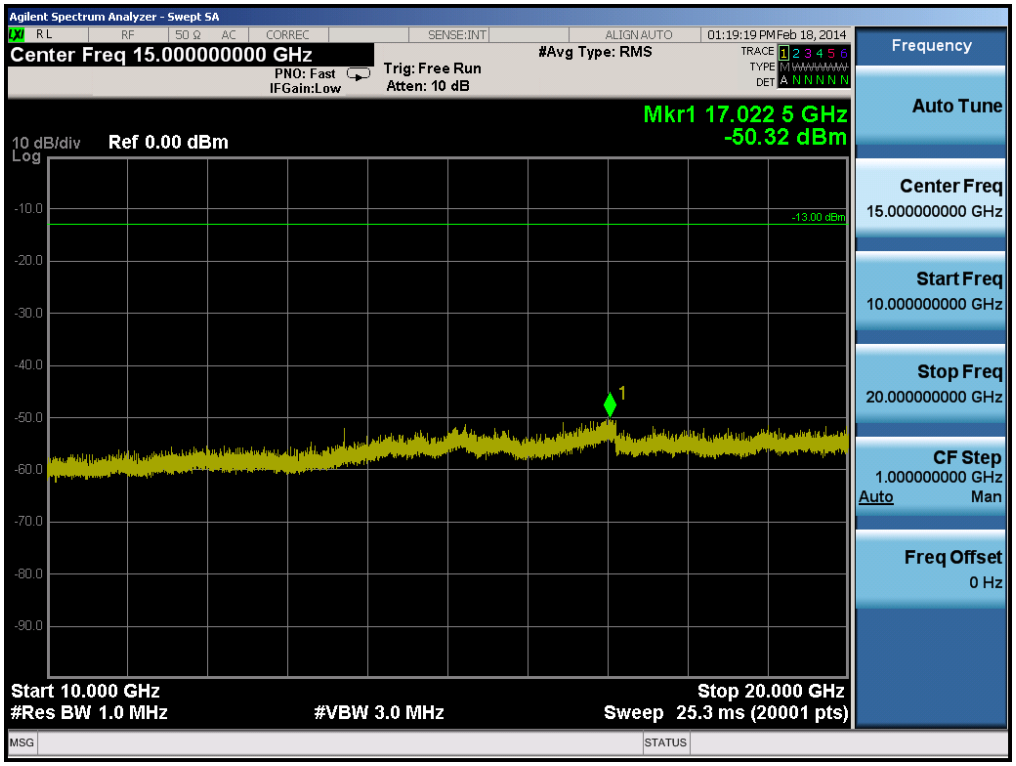


Plot 6-23. Conducted Spurious Plot (PCS GSM Mode, Master – Ch. 661)

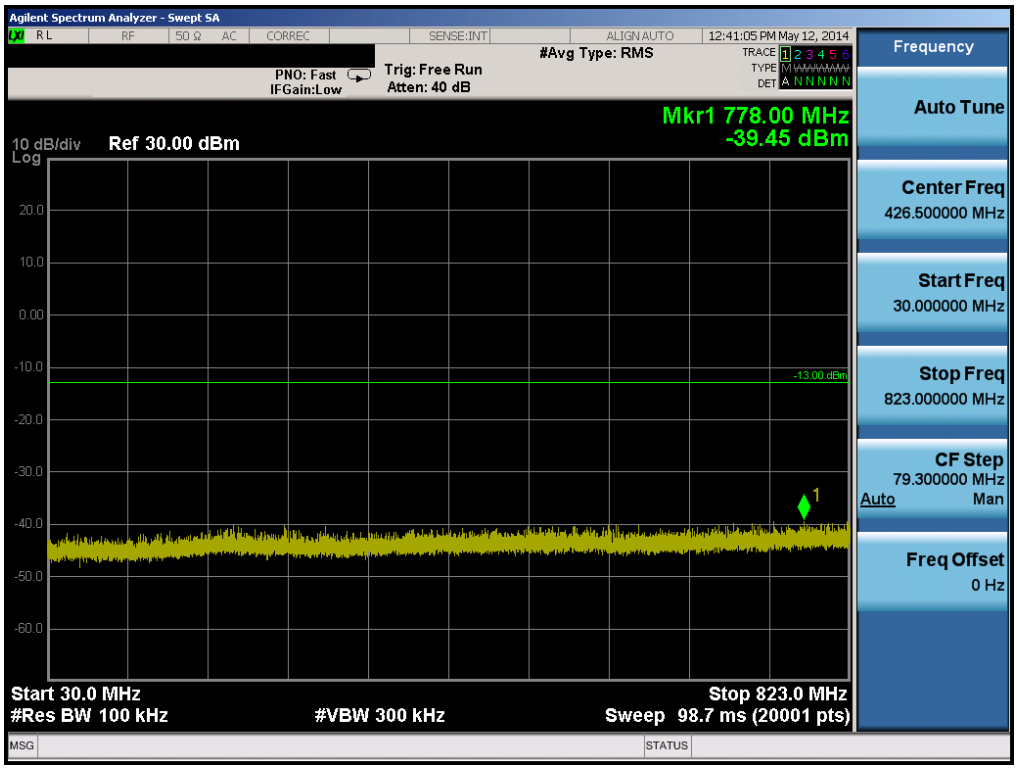


Plot 6-24. Conducted Spurious Plot (PCS GSM Mode, Master – Ch. 810)

© 2014 PCTEST Engineering Laboratory, Inc.

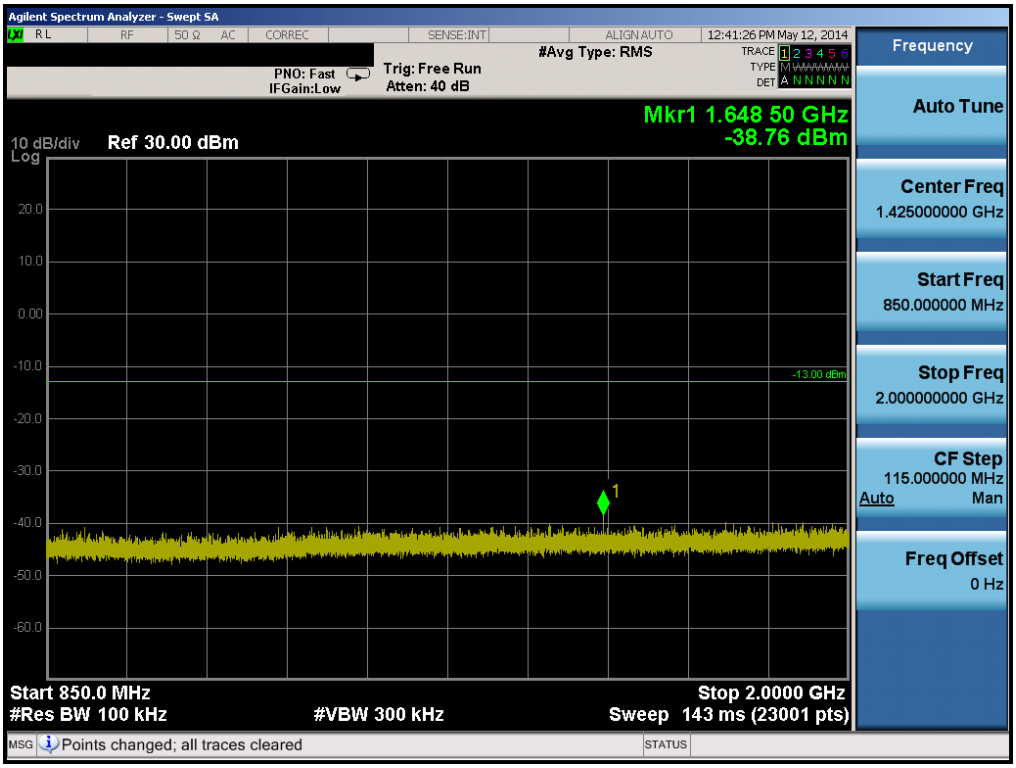


Plot 6-25. Conducted Spurious Plot (PCS GSM Mode, Master – Ch. 810)

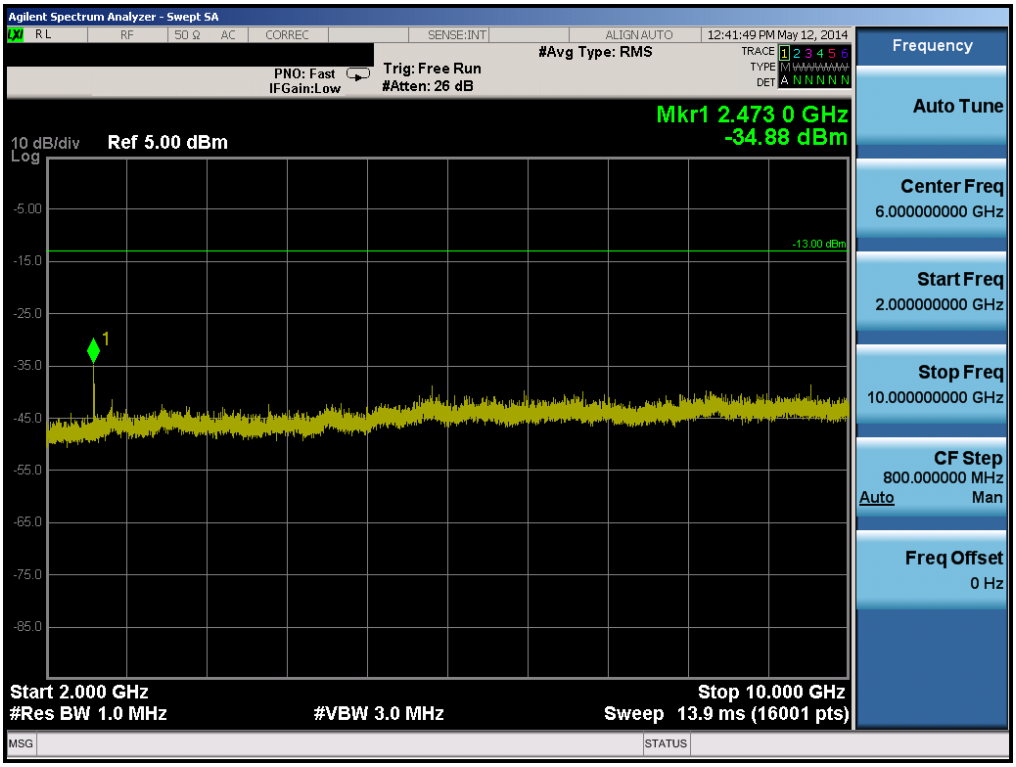


Plot 6-26. Conducted Spurious Plot (Cellular GSM Mode, Slave – Ch. 128)

© 2014 PCTEST Engineering Laboratory, Inc.

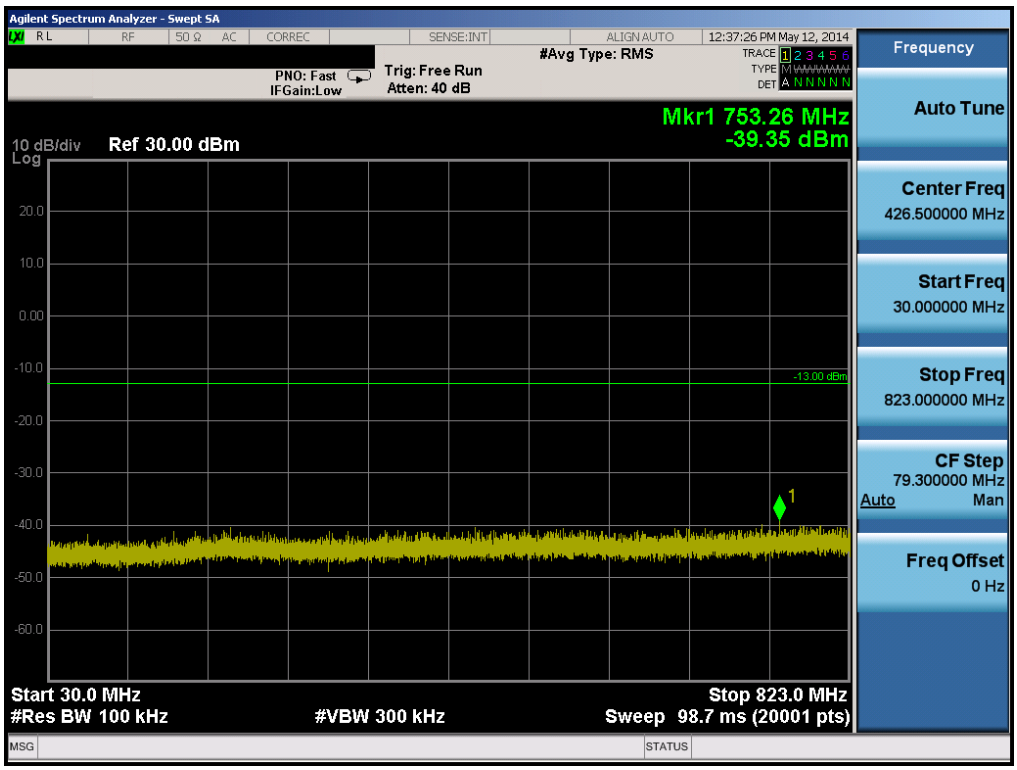


Plot 6-27. Conducted Spurious Plot (Cellular GSM Mode, Slave – Ch. 128)

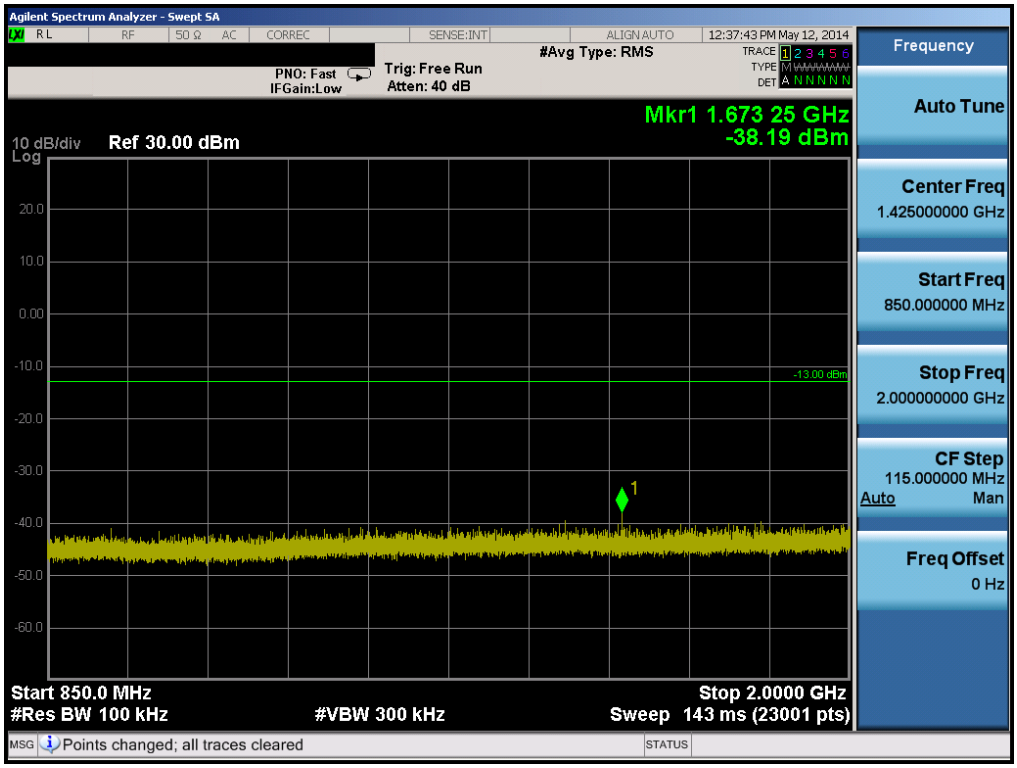


Plot 6-28. Conducted Spurious Plot (Cellular GSM Mode, Slave – Ch. 128)

© 2014 PCTEST Engineering Laboratory, Inc.

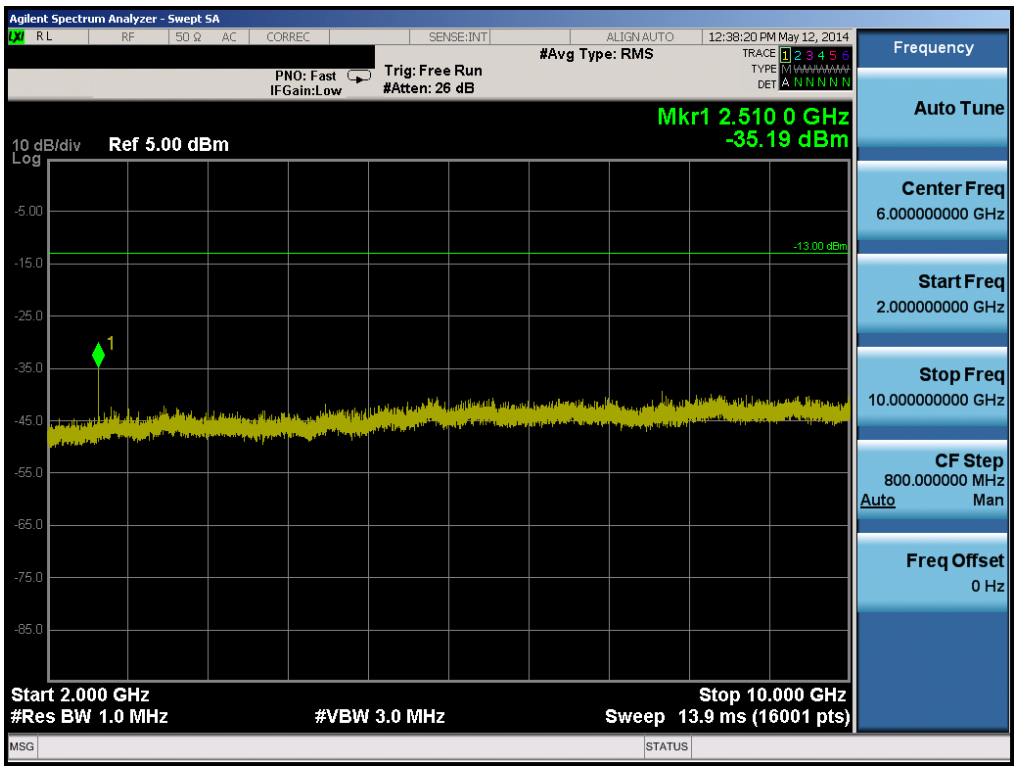


Plot 6-29. Conducted Spurious Plot (Cellular GSM Mode, Slave – Ch. 190)

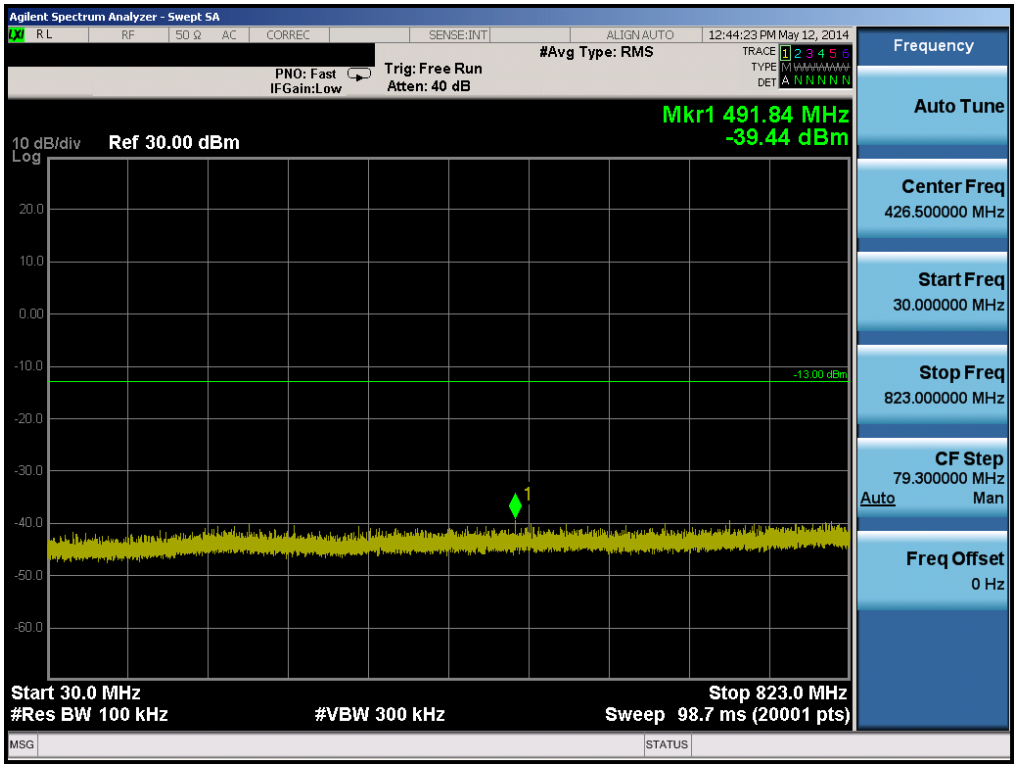


Plot 6-30. Conducted Spurious Plot (Cellular GSM Mode, Slave – Ch. 190)

© 2014 PCTEST Engineering Laboratory, Inc.

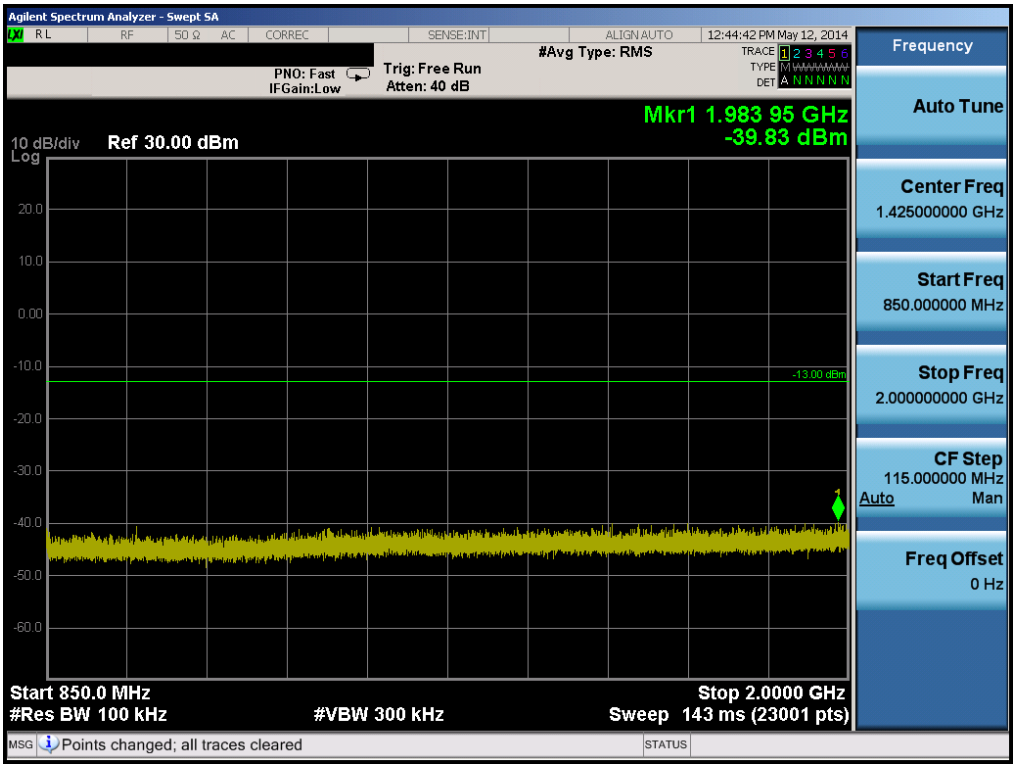


Plot 6-31. Conducted Spurious Plot (Cellular GSM Mode, Slave – Ch. 190)

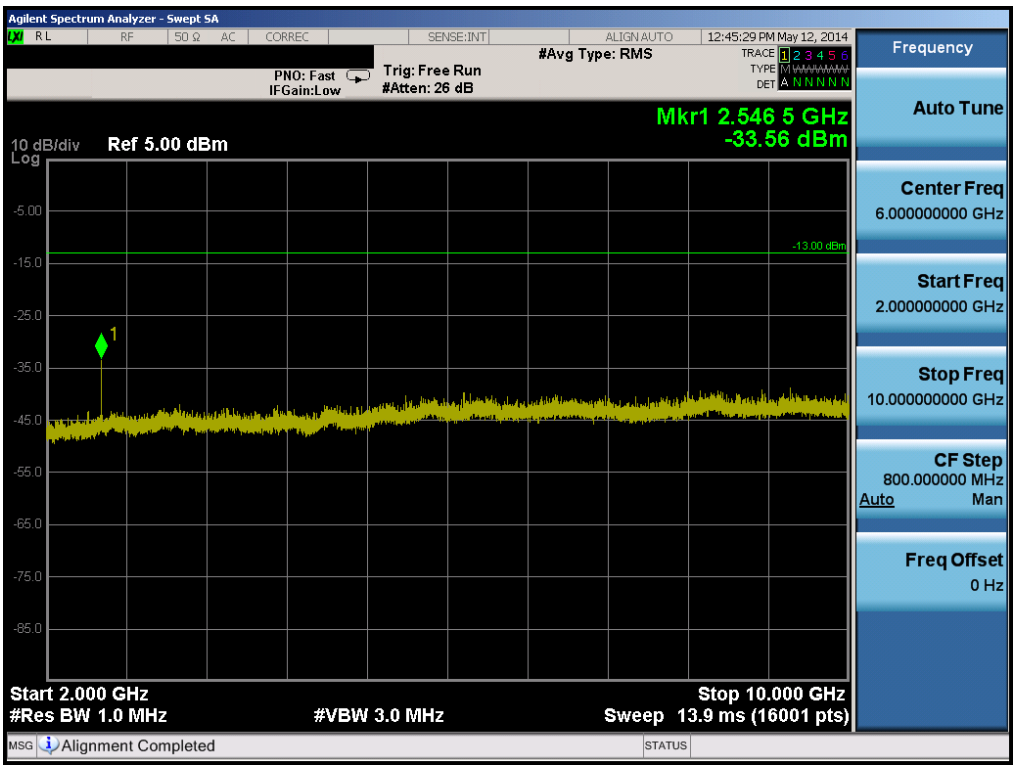


Plot 6-32. Conducted Spurious Plot (Cellular GSM Mode, Slave – Ch. 251)

© 2014 PCTEST Engineering Laboratory, Inc.

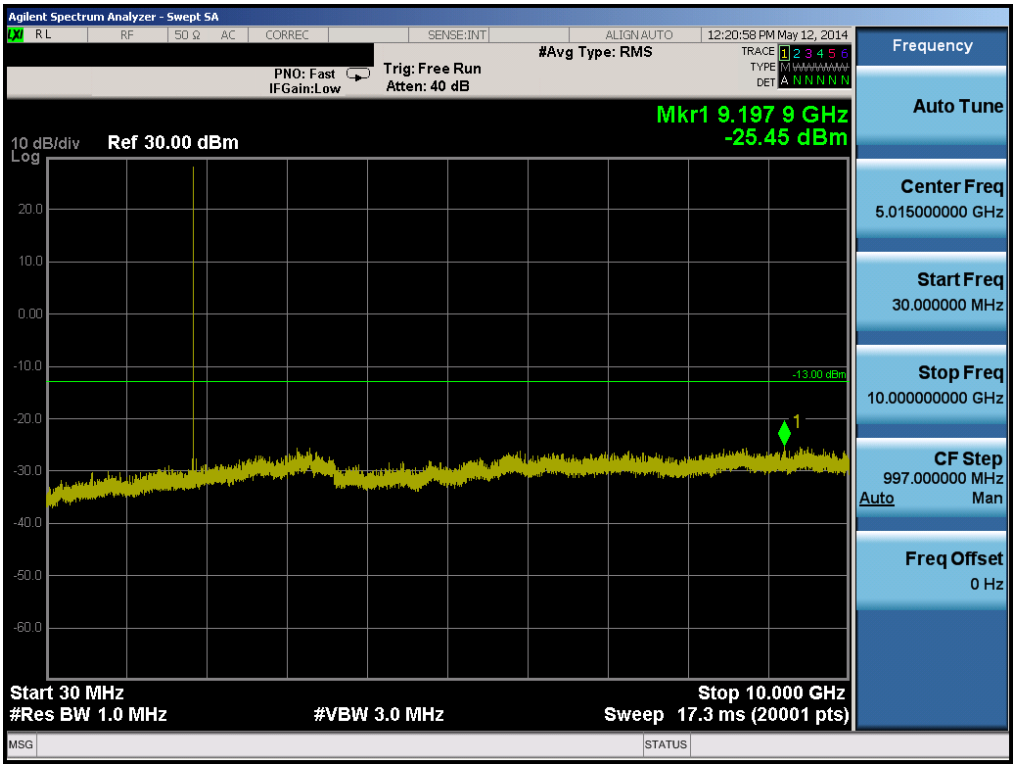


Plot 6-33. Conducted Spurious Plot (Cellular GSM Mode, Slave – Ch. 251)

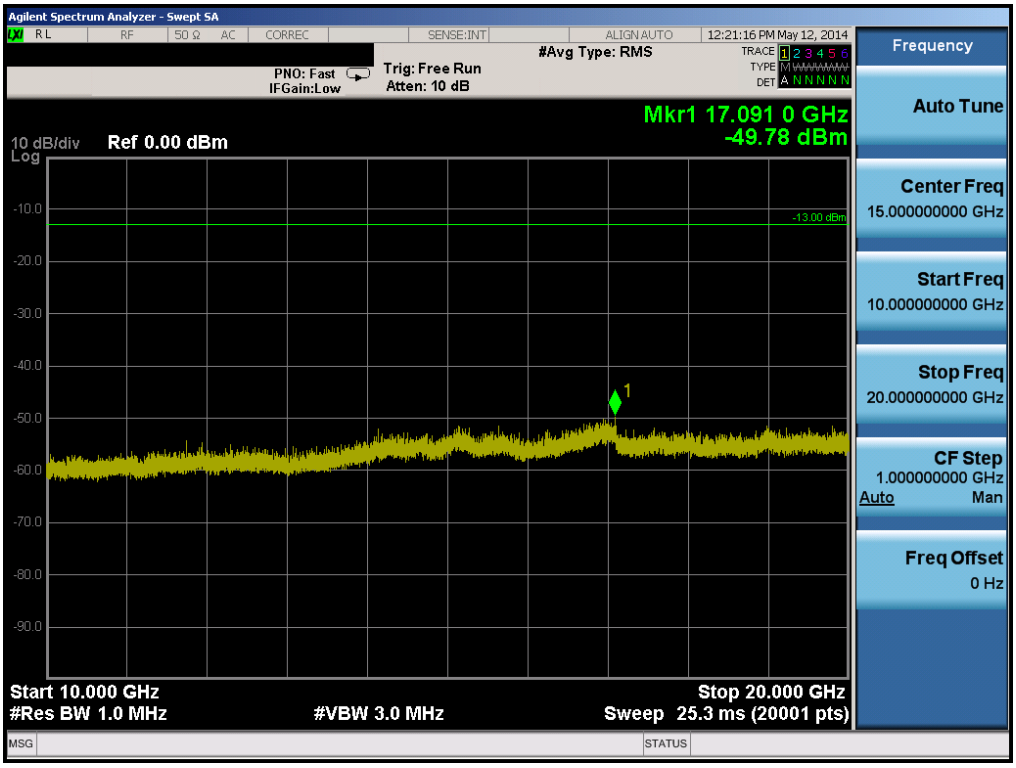


Plot 6-34. Conducted Spurious Plot (Cellular GSM Mode, Slave – Ch. 251)

© 2014 PCTEST Engineering Laboratory, Inc.

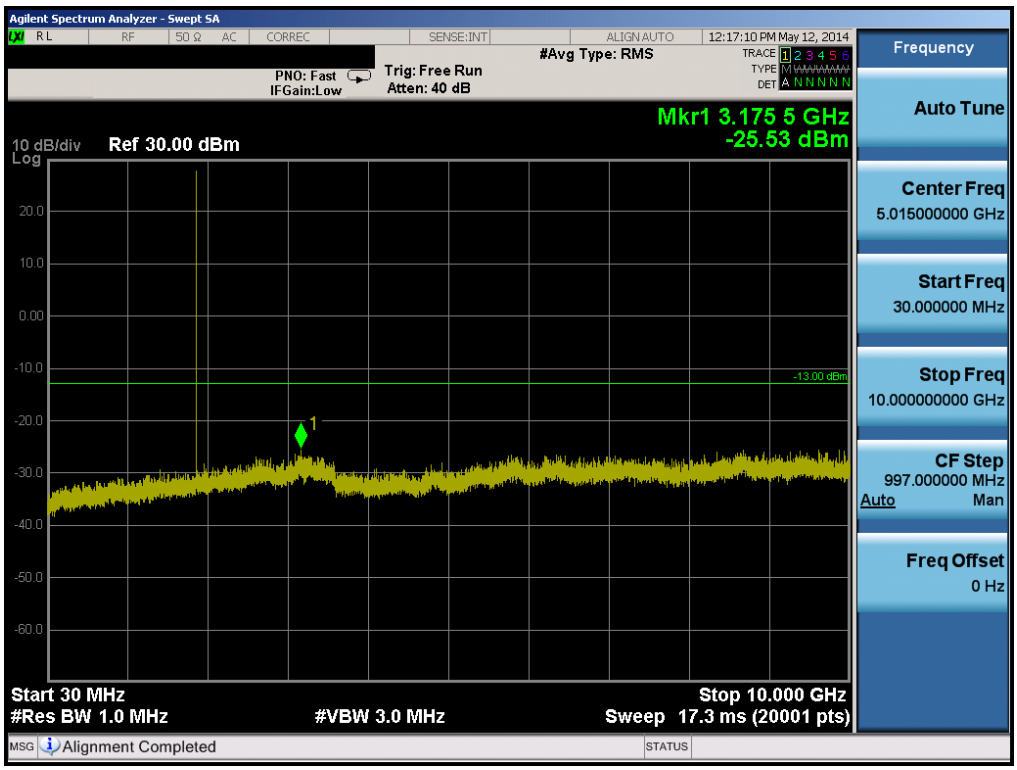


Plot 6-35. Conducted Spurious Plot (PCS GSM Mode, Slave – Ch. 512)

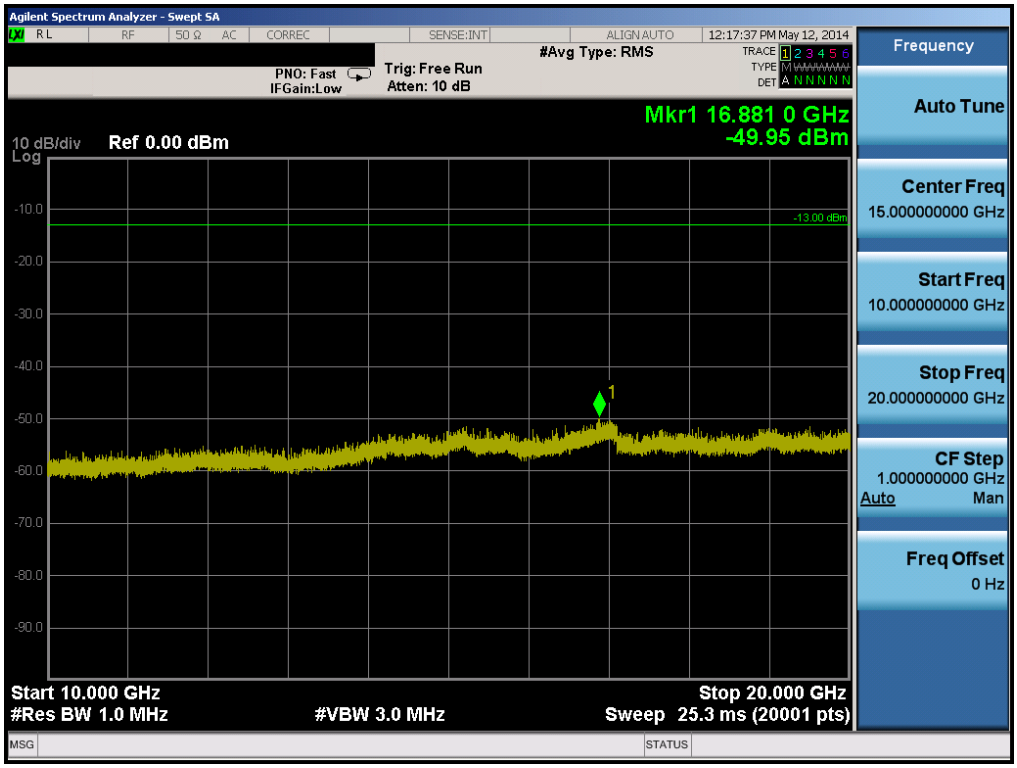


Plot 6-36. Conducted Spurious Plot (PCS GSM Mode, Slave – Ch. 512)

© 2014 PCTEST Engineering Laboratory, Inc.

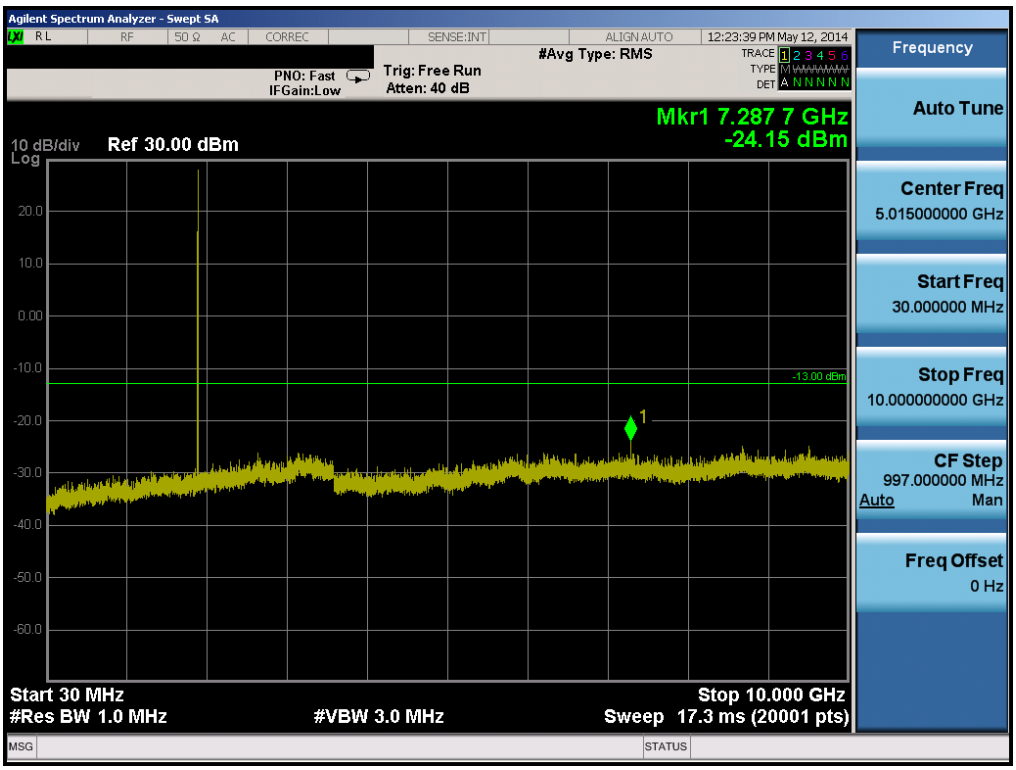


Plot 6-37. Conducted Spurious Plot (PCS GSM Mode, Slave – Ch. 661)

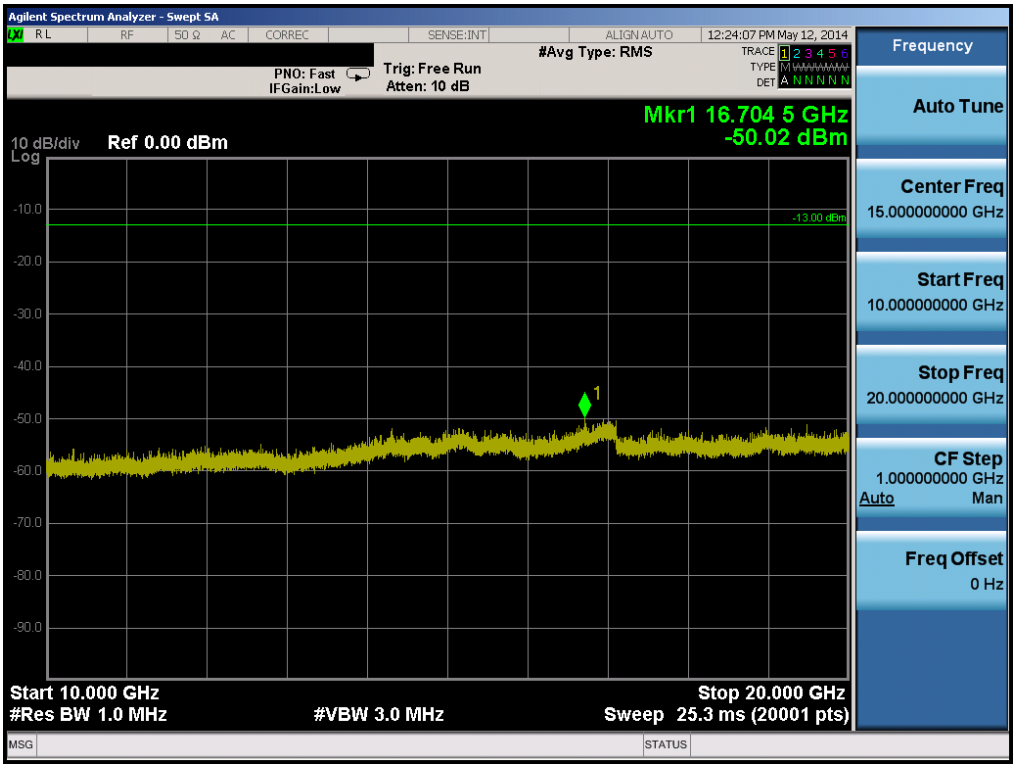


Plot 6-38. Conducted Spurious Plot (PCS GSM Mode, Slave – Ch. 661)

© 2014 PCTEST Engineering Laboratory, Inc.

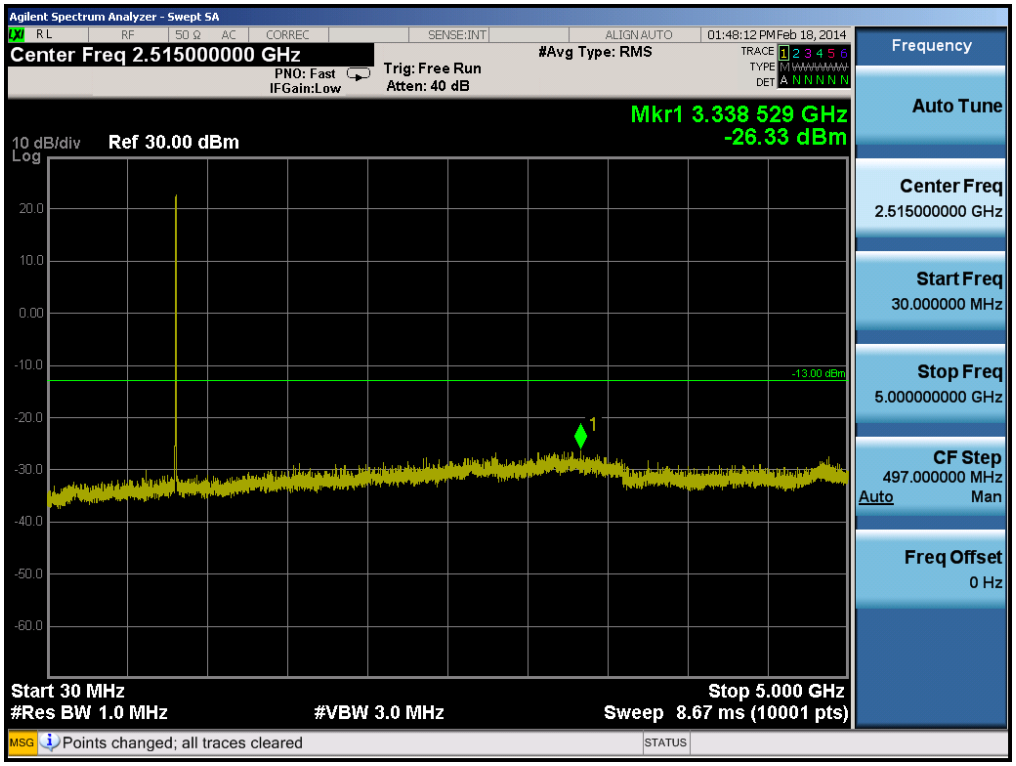


Plot 6-39. Conducted Spurious Plot (PCS GSM Mode, Slave – Ch. 810)

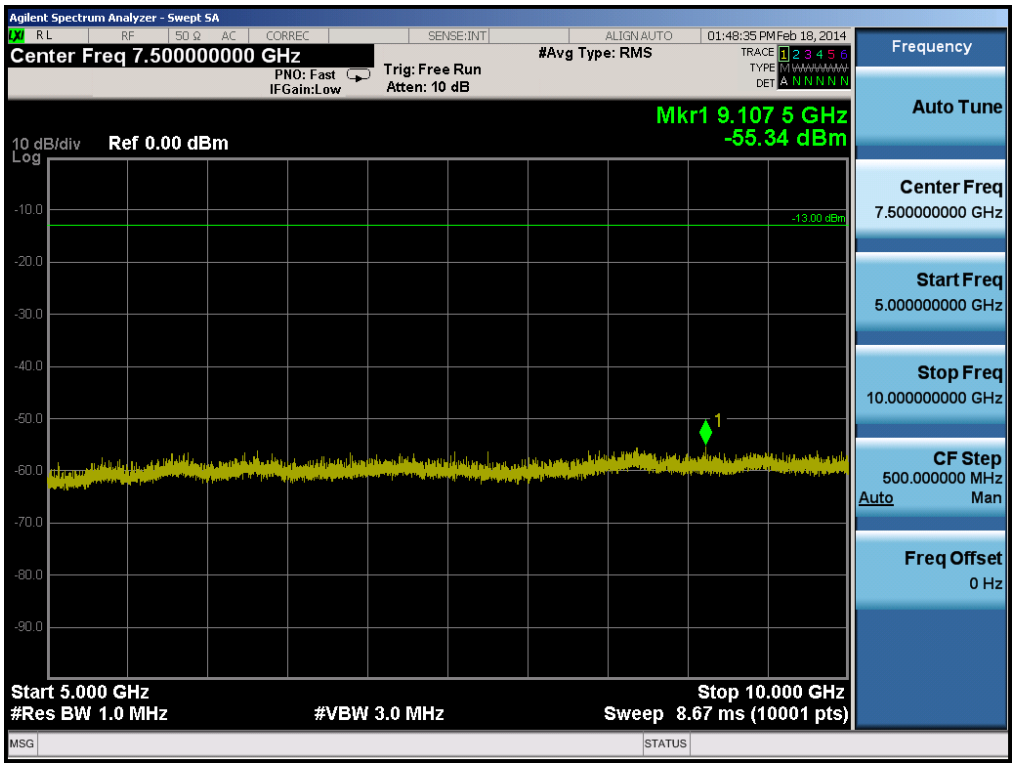


Plot 6-40. Conducted Spurious Plot (PCS GSM Mode, Slave – Ch. 810)

© 2014 PCTEST Engineering Laboratory, Inc.

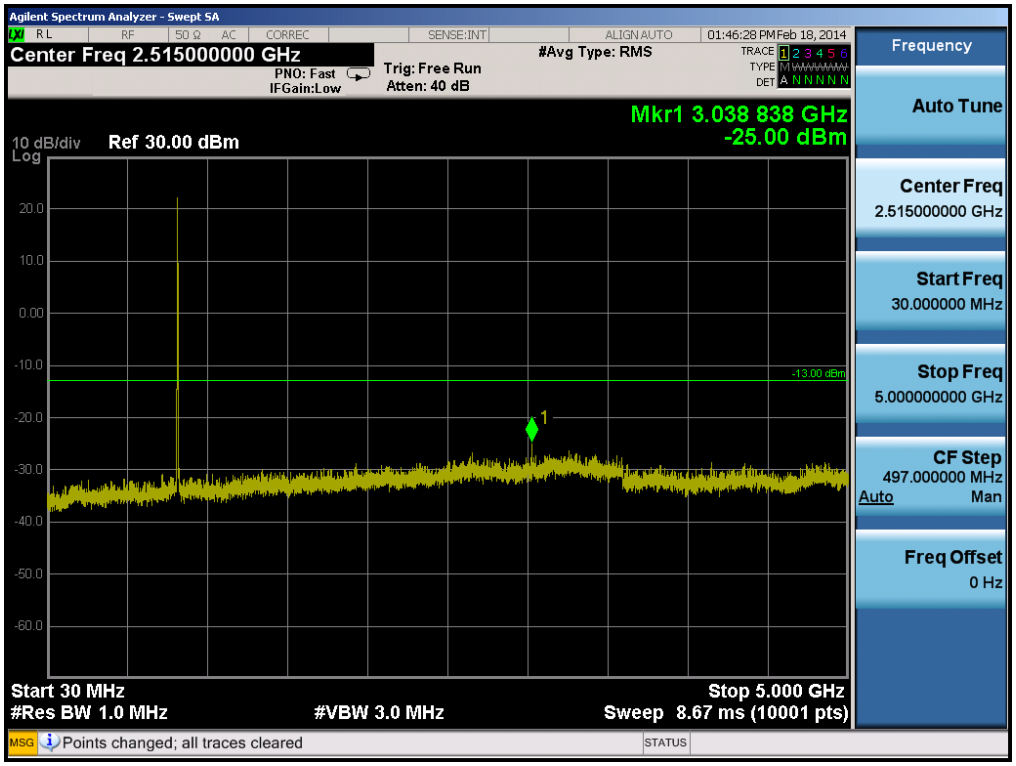


Plot 6-41. Conducted Spurious Plot (Cellular WCDMA Mode – Ch. 4132)

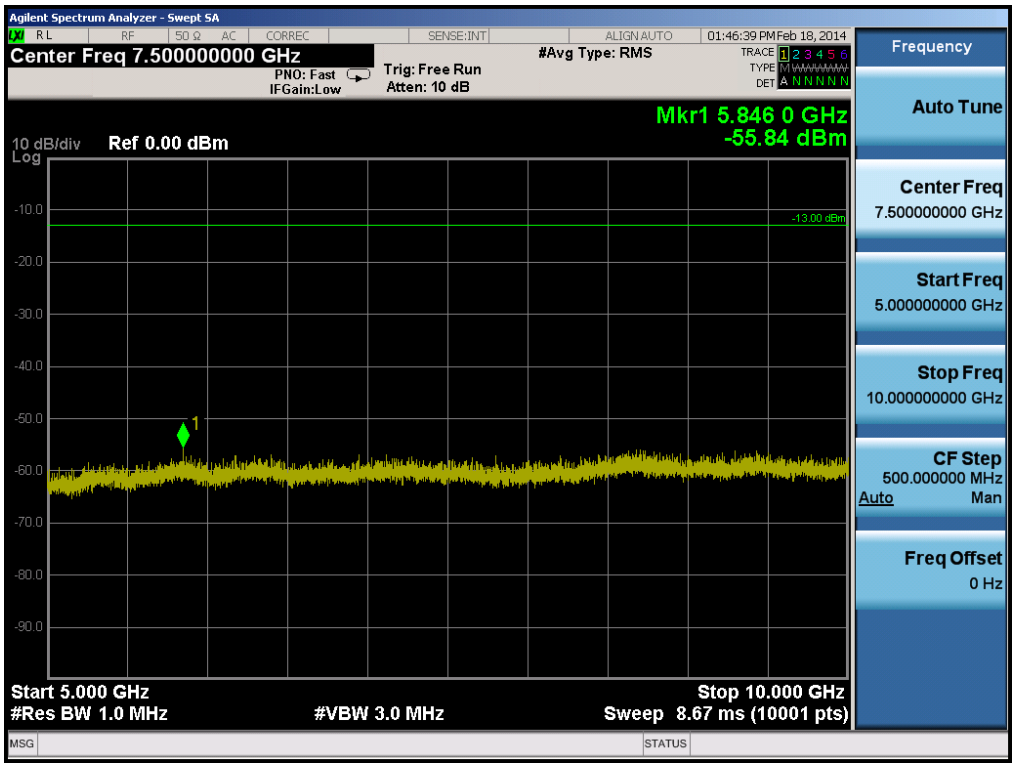


Plot 6-42. Conducted Spurious Plot (Cellular WCDMA Mode – Ch. 4132)

© 2014 PCTEST Engineering Laboratory, Inc.

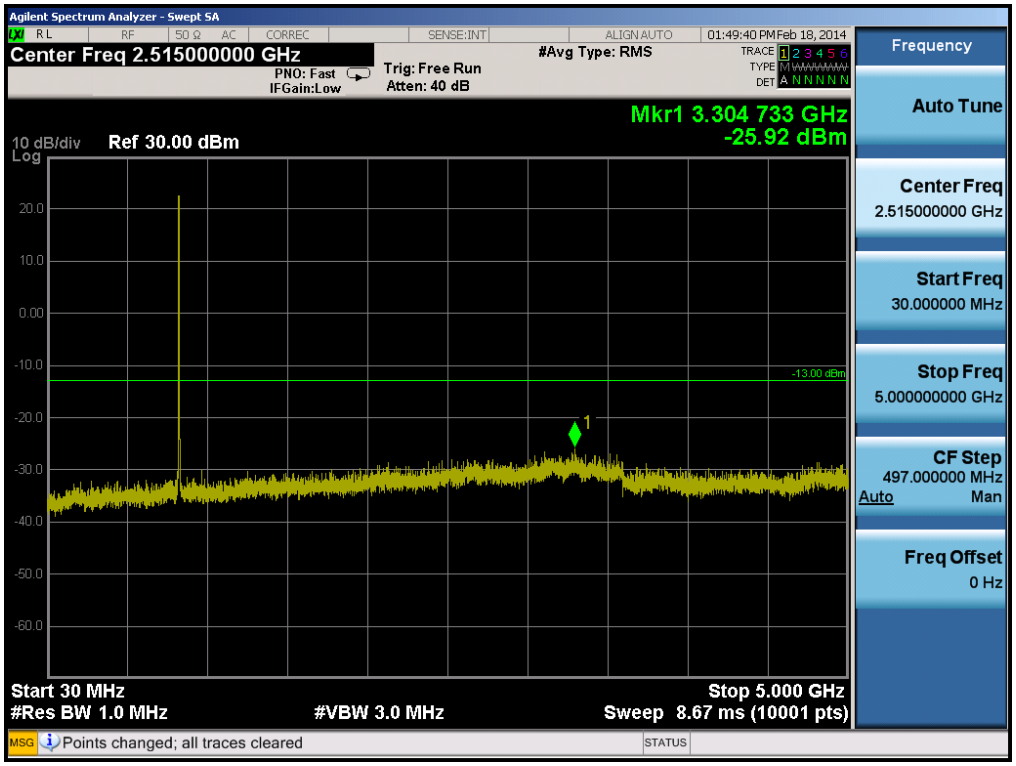


Plot 6-43. Conducted Spurious Plot (Cellular WCDMA Mode – Ch. 4183)

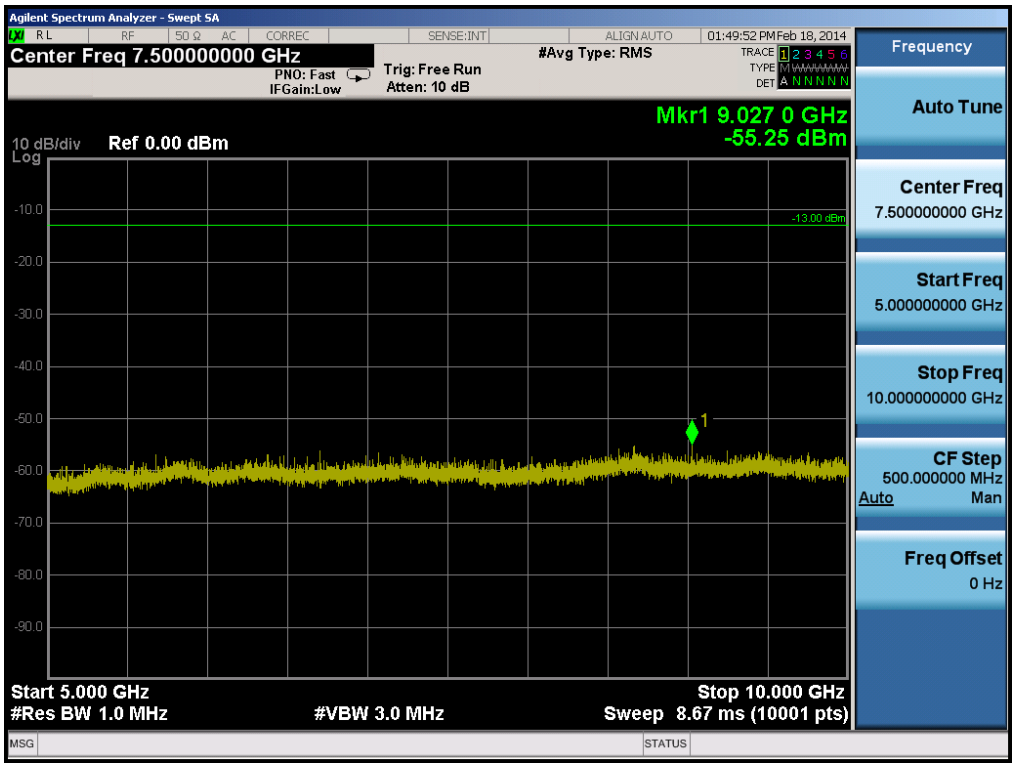


Plot 6-44. Conducted Spurious Plot (Cellular WCDMA Mode – Ch. 4183)

© 2014 PCTEST Engineering Laboratory, Inc.

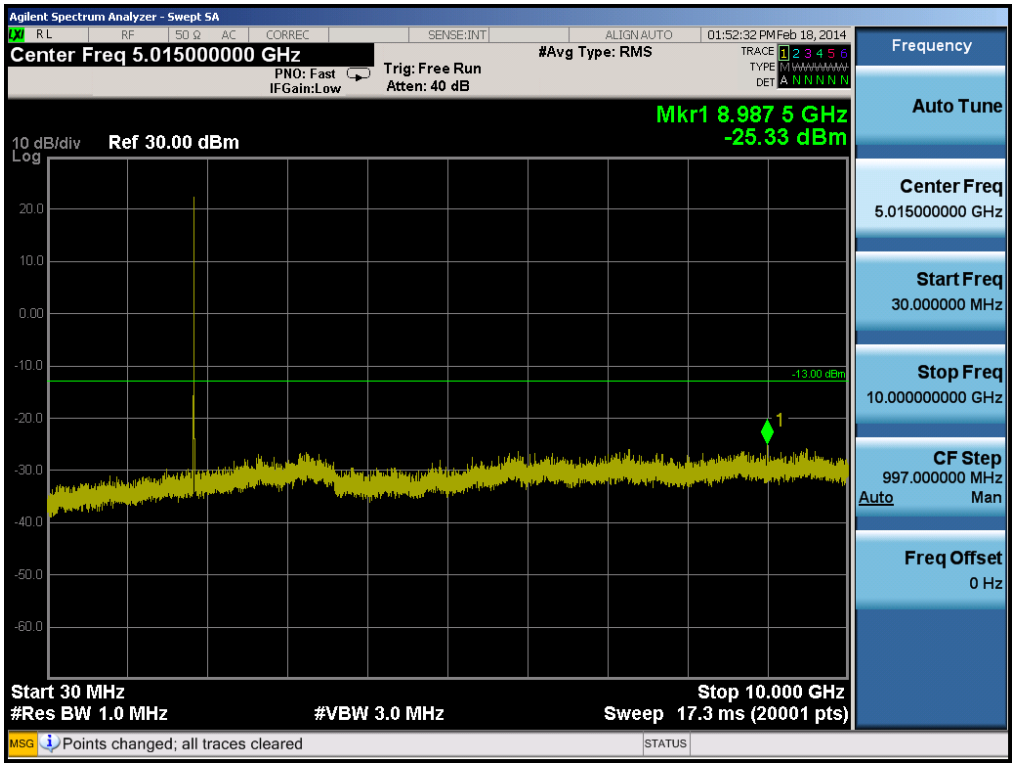


Plot 6-45. Conducted Spurious Plot (Cellular WCDMA Mode – Ch. 4233)

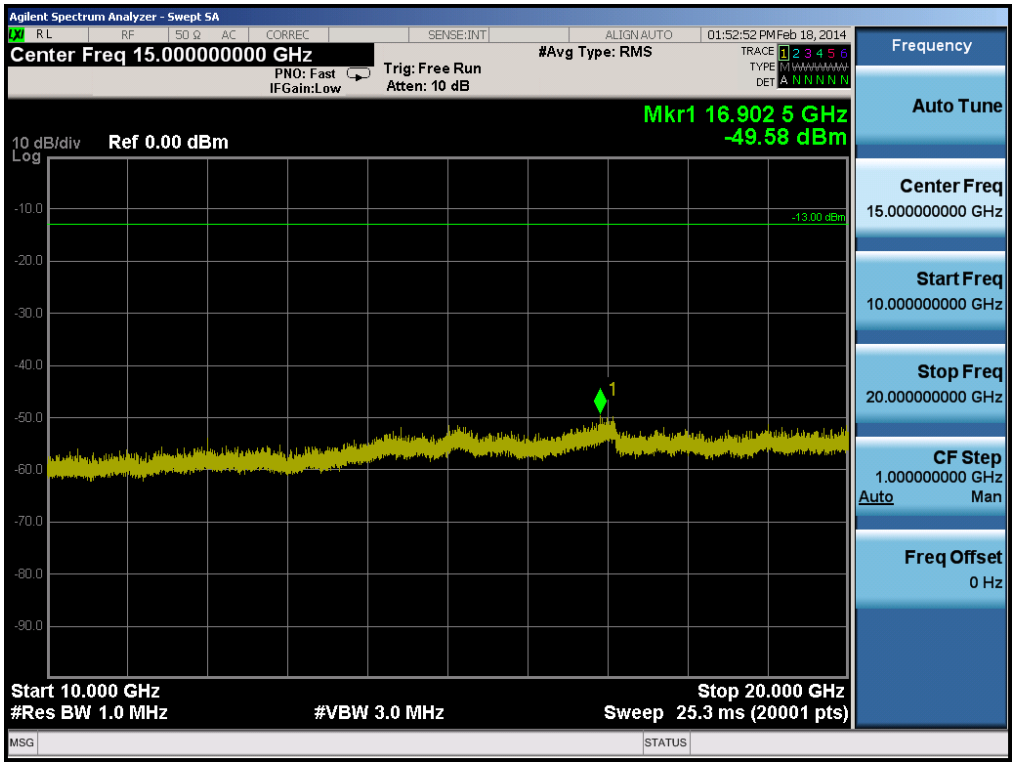


Plot 6-46. Conducted Spurious Plot (Cellular WCDMA Mode – Ch. 4233)

© 2014 PCTEST Engineering Laboratory, Inc.

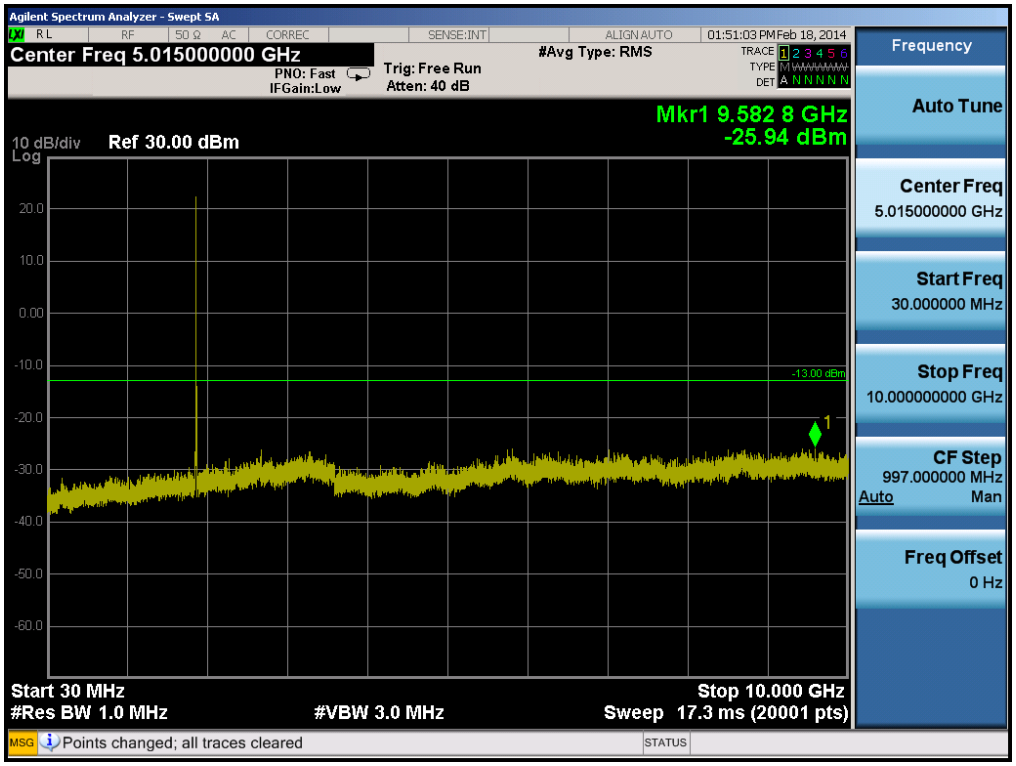


Plot 6-47. Conducted Spurious Plot (PCS WCDMA Mode – Ch. 9262)

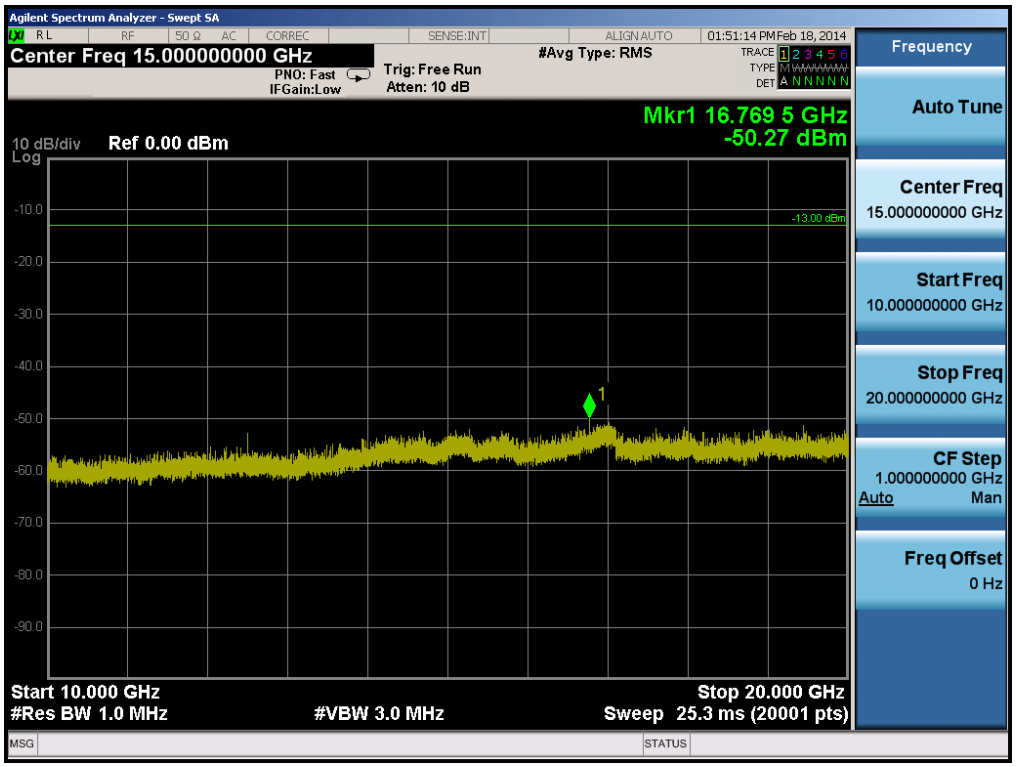


Plot 6-48. Conducted Spurious Plot (PCS WCDMA Mode – Ch. 9262)

© 2014 PCTEST Engineering Laboratory, Inc.

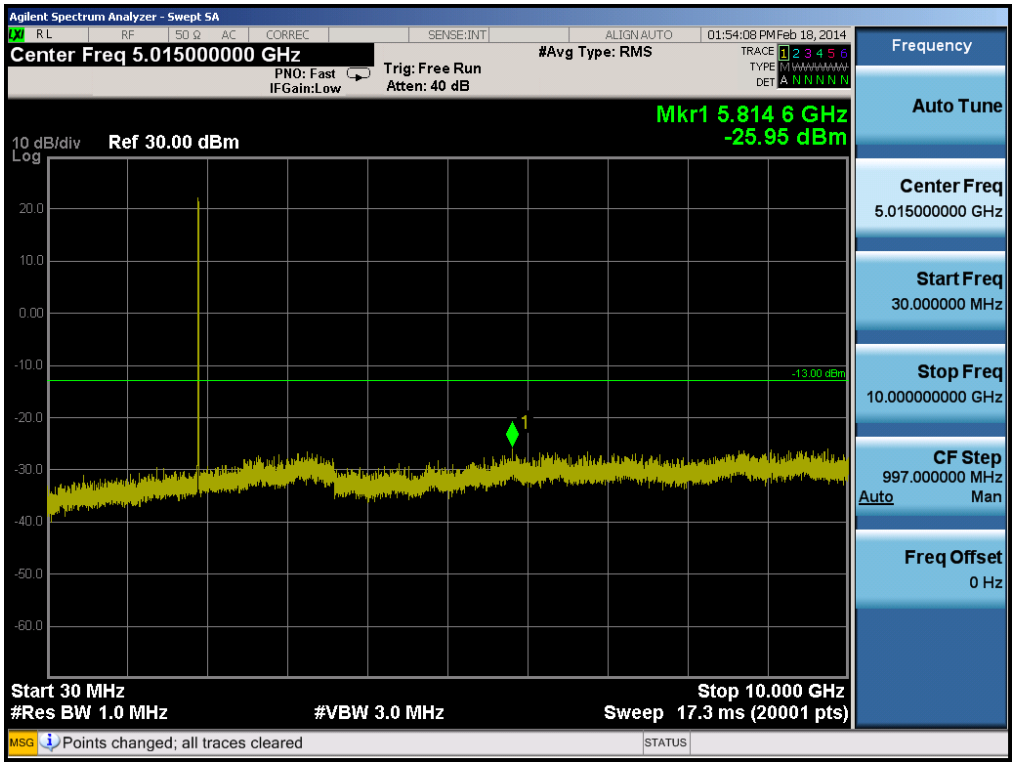


Plot 6-49. Conducted Spurious Plot (PCS WCDMA Mode – Ch. 9400)

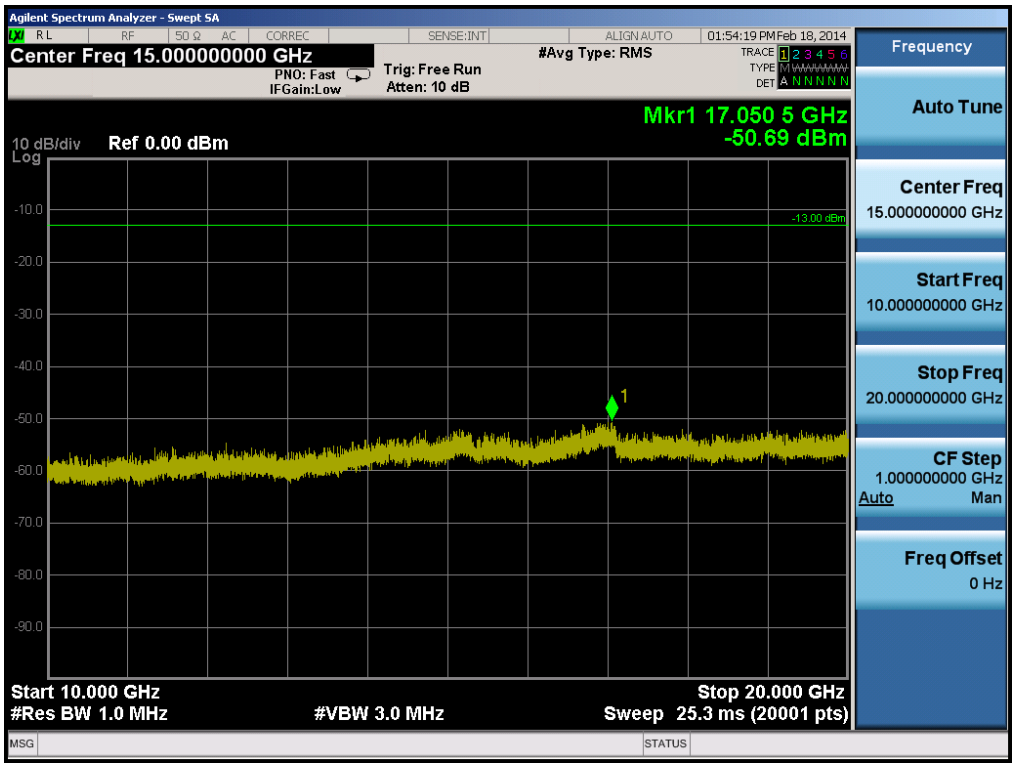


Plot 6-50. Conducted Spurious Plot (PCS WCDMA Mode – Ch. 9400)

© 2014 PCTEST Engineering Laboratory, Inc.



Plot 6-51. Conducted Spurious Plot (PCS WCDMA Mode – Ch. 9538)



Plot 6-52. Conducted Spurious Plot (PCS WCDMA Mode – Ch. 9538)

© 2014 PCTEST Engineering Laboratory, Inc.

6.4 Band Edge Emissions at Antenna Terminal

§2.1051 §22.917(a) §24.238(a) RSS-132(4.5.1) RSS-133(6.5.1)

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 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.

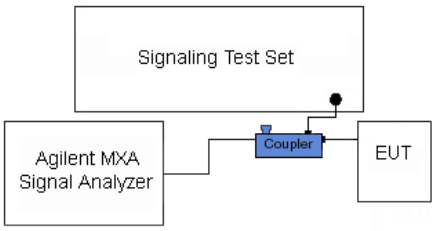
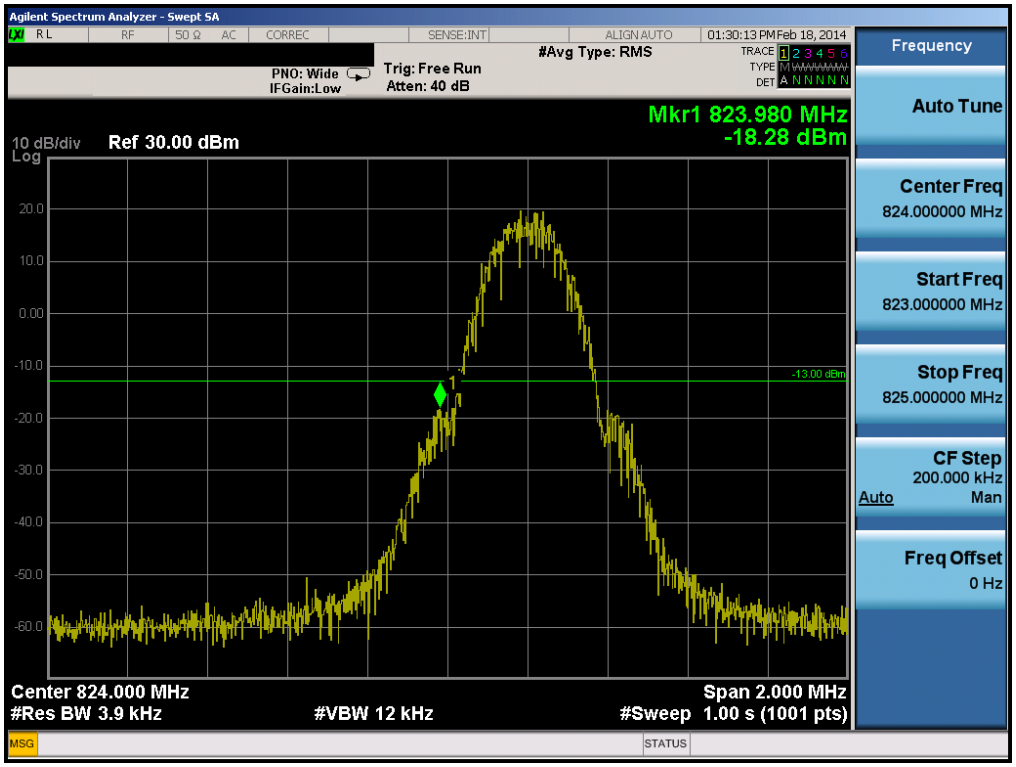


Figure 6-3. Test Instrument & Measurement Setup

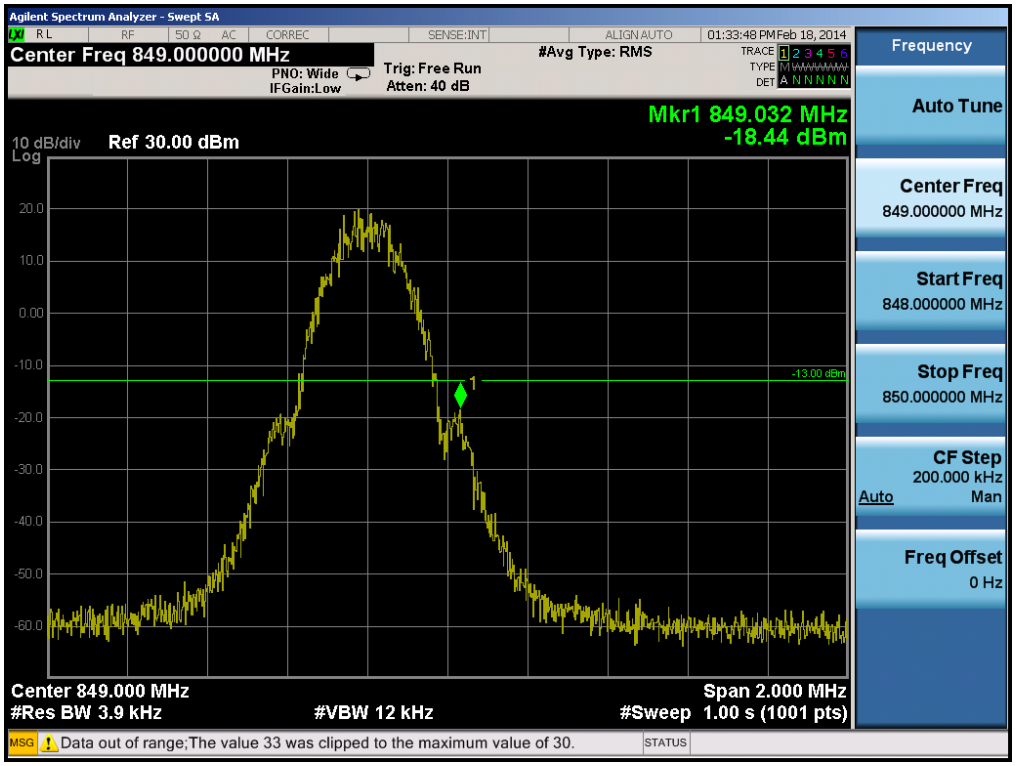
Test Notes

Per 22.917(b) and 24.238(b) 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.

© 2014 PCTEST Engineering Laboratory, Inc.

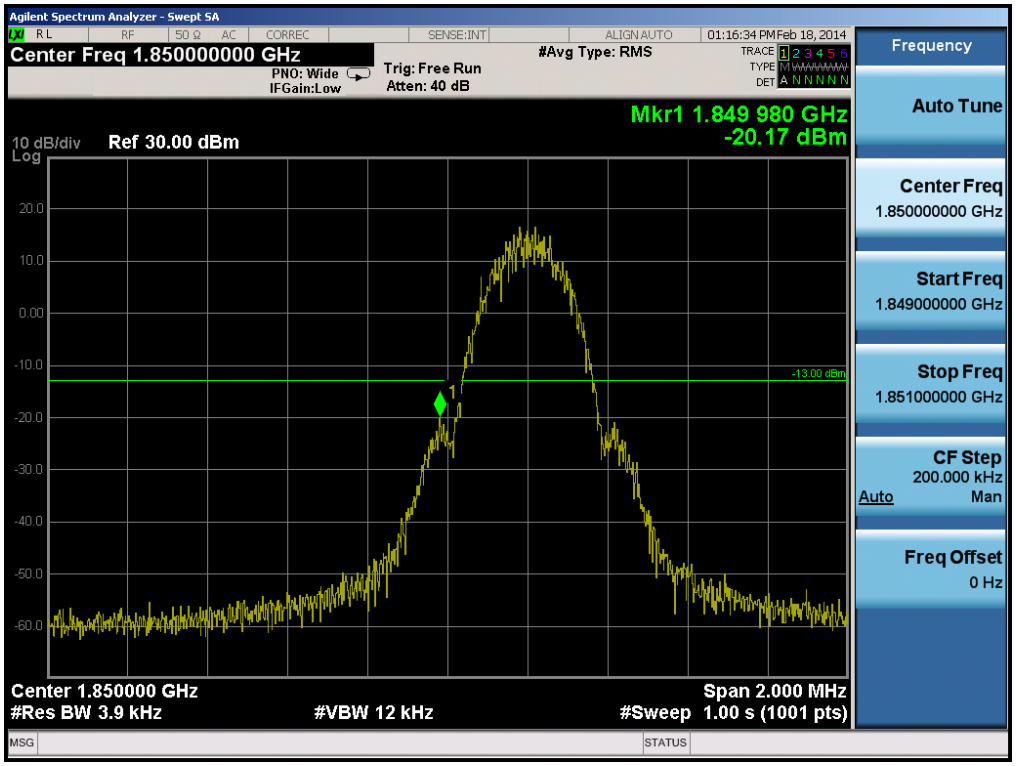


Plot 6-53. Band Edge Plot (Cellular GSM Mode, Master – Ch. 128)

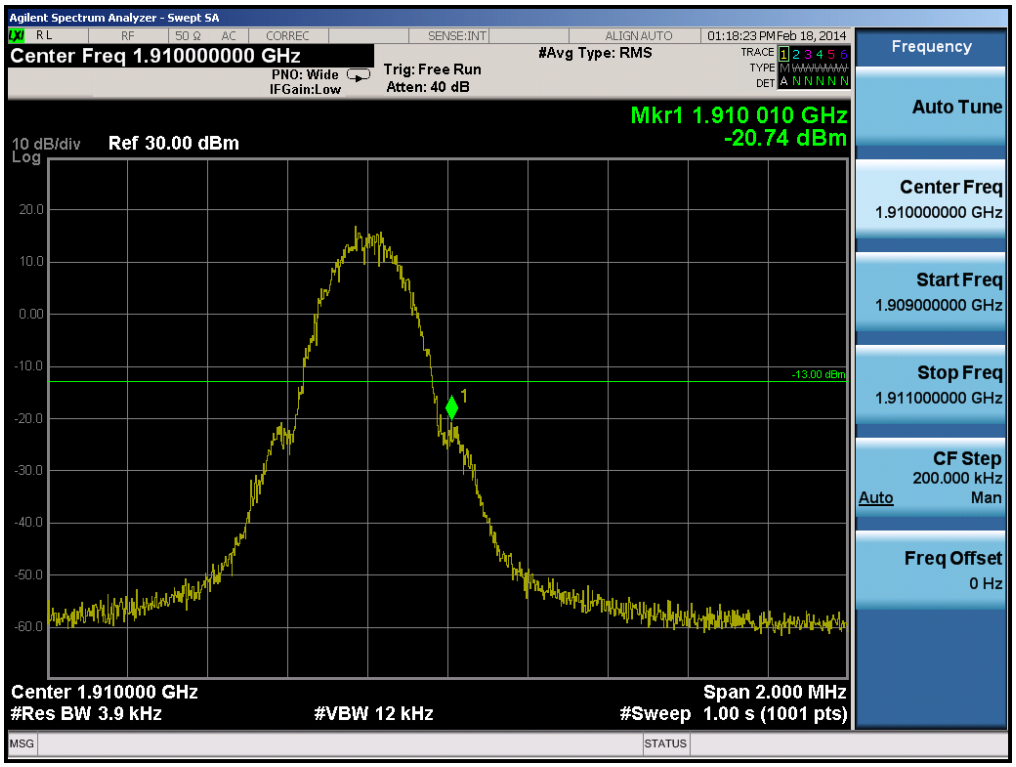


Plot 6-54. Band Edge Plot (Cellular GSM Mode, Master – Ch. 251)

© 2014 PCTEST Engineering Laboratory, Inc.

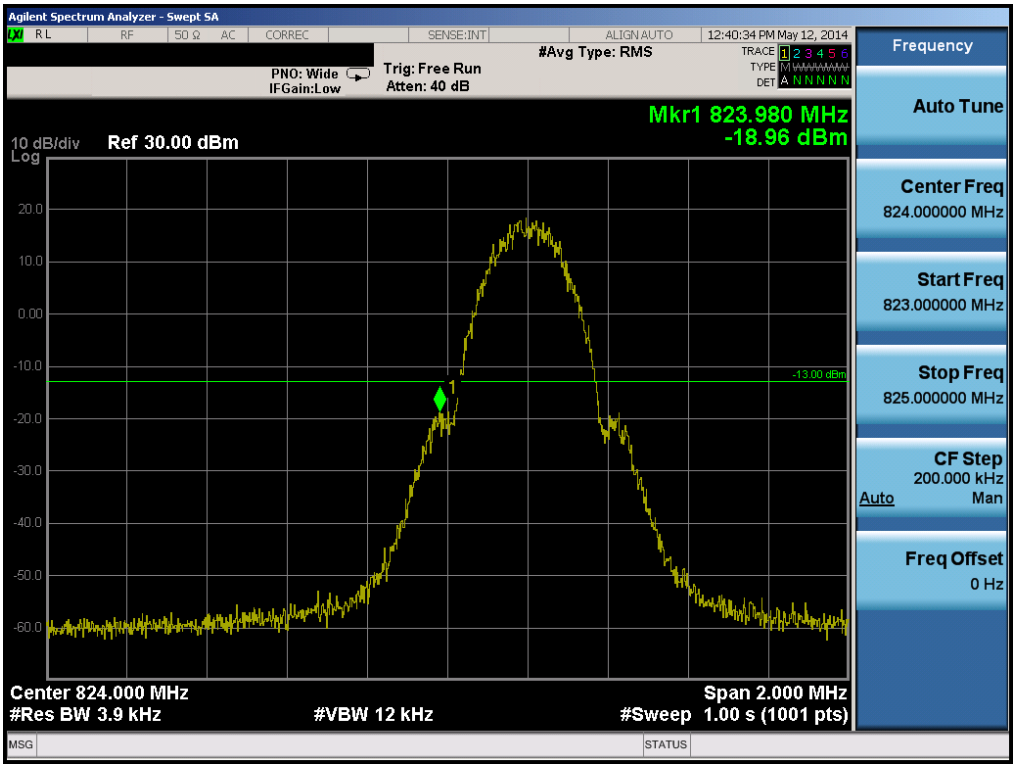


Plot 6-55. Band Edge Plot (PCS GSM Mode, Master – Ch. 512)

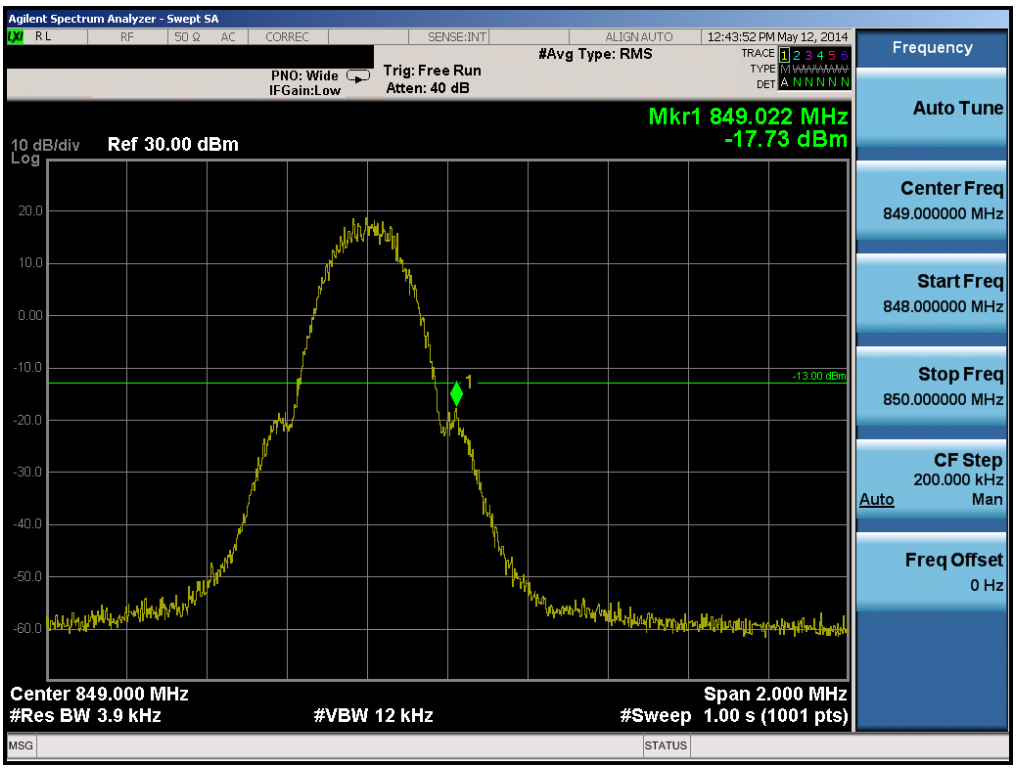


Plot 6-56. Band Edge Plot (PCS GSM Mode, Master – Ch. 810)

© 2014 PCTEST Engineering Laboratory, Inc.

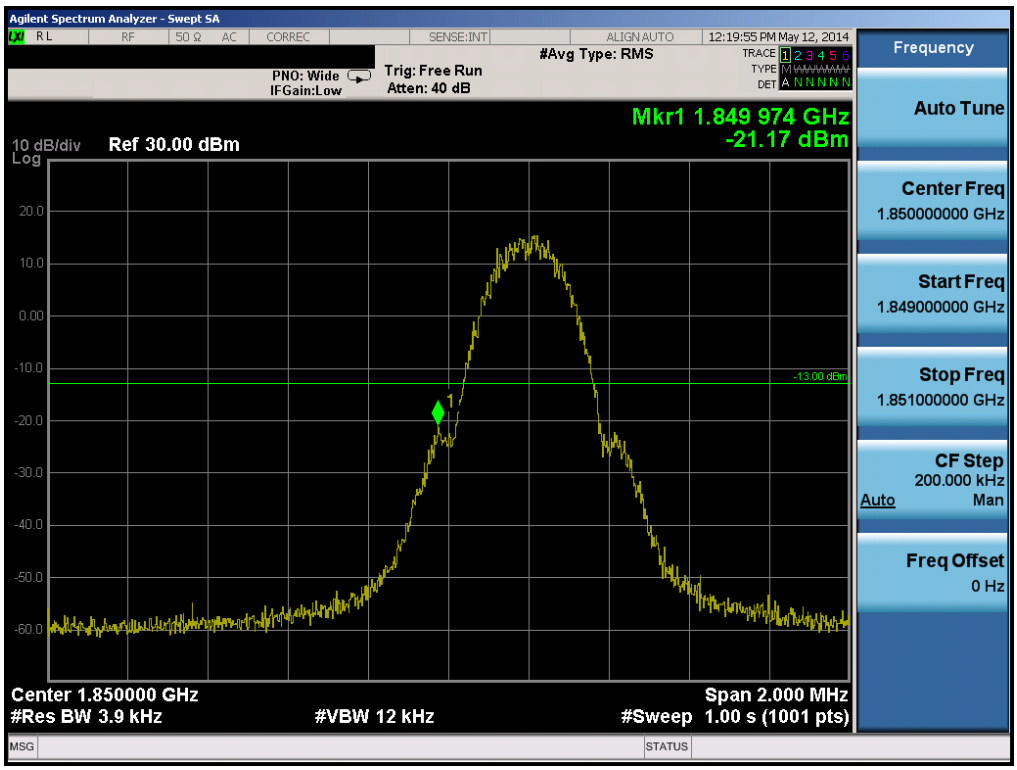


Plot 6-57. Band Edge Plot (Cellular GSM Mode, Slave – Ch. 128)

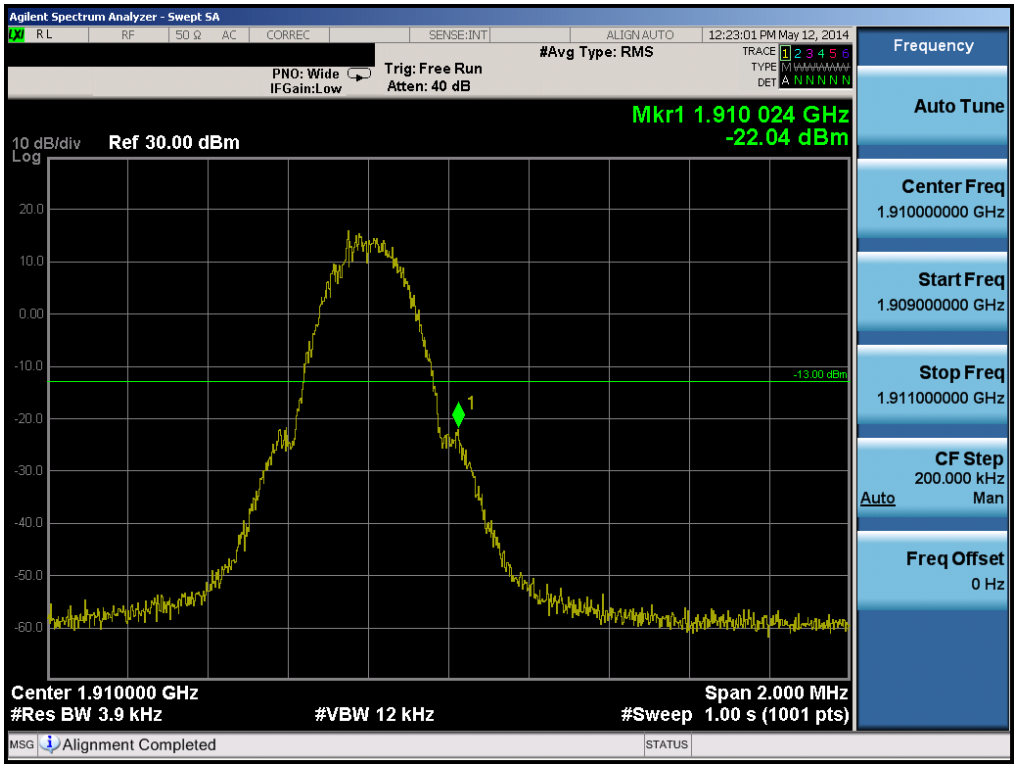


Plot 6-58. Band Edge Plot (Cellular GSM Mode, Slave – Ch. 251)

© 2014 PCTEST Engineering Laboratory, Inc.



Plot 6-59. Band Edge Plot (PCS GSM Mode, Slave – Ch. 512)



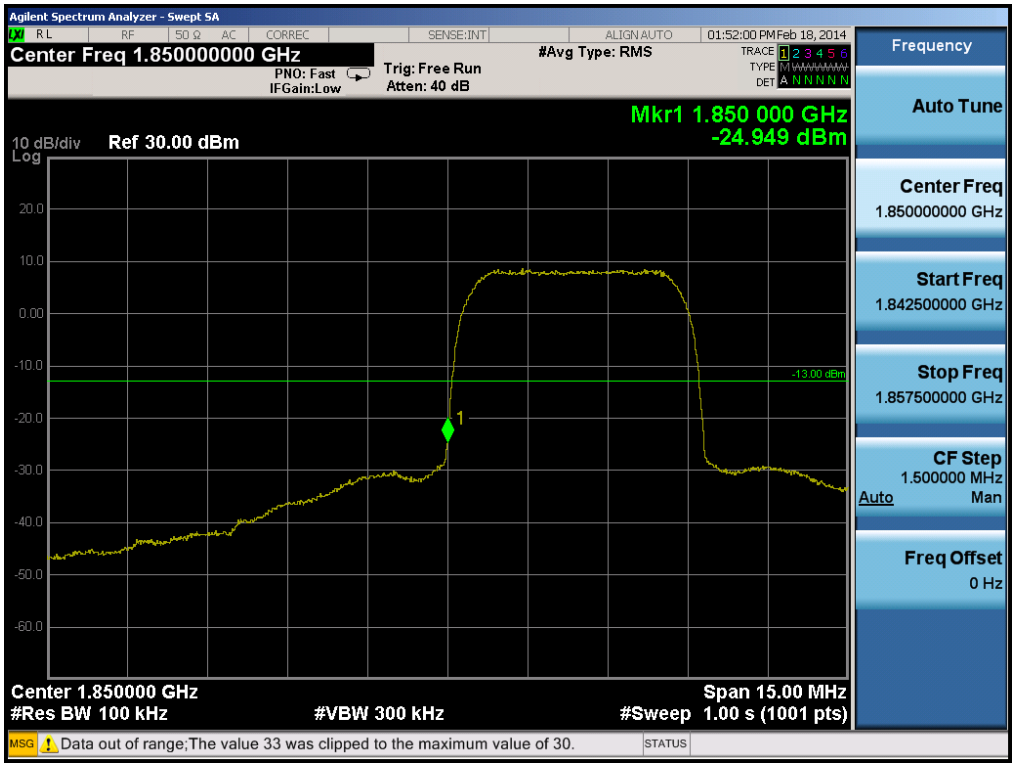
Plot 6-60. Band Edge Plot (PCS GSM Mode, Slave – Ch. 810)

© 2014 PCTEST Engineering Laboratory, Inc.

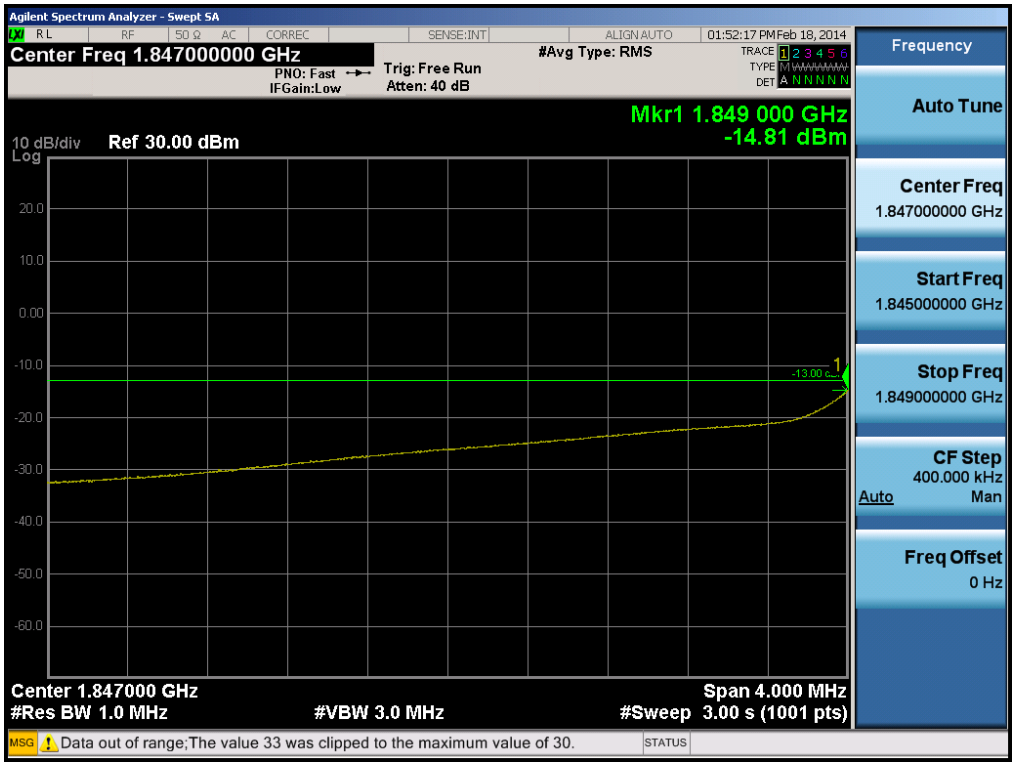
Plot 6-61. Band Edge Plot (Cellular WCDMA Mode – Ch. 4132)

Plot 6-62. Band Edge Plot (Cellular WCDMA Mode – Ch. 4233)

© 2014 PCTEST Engineering Laboratory, Inc.

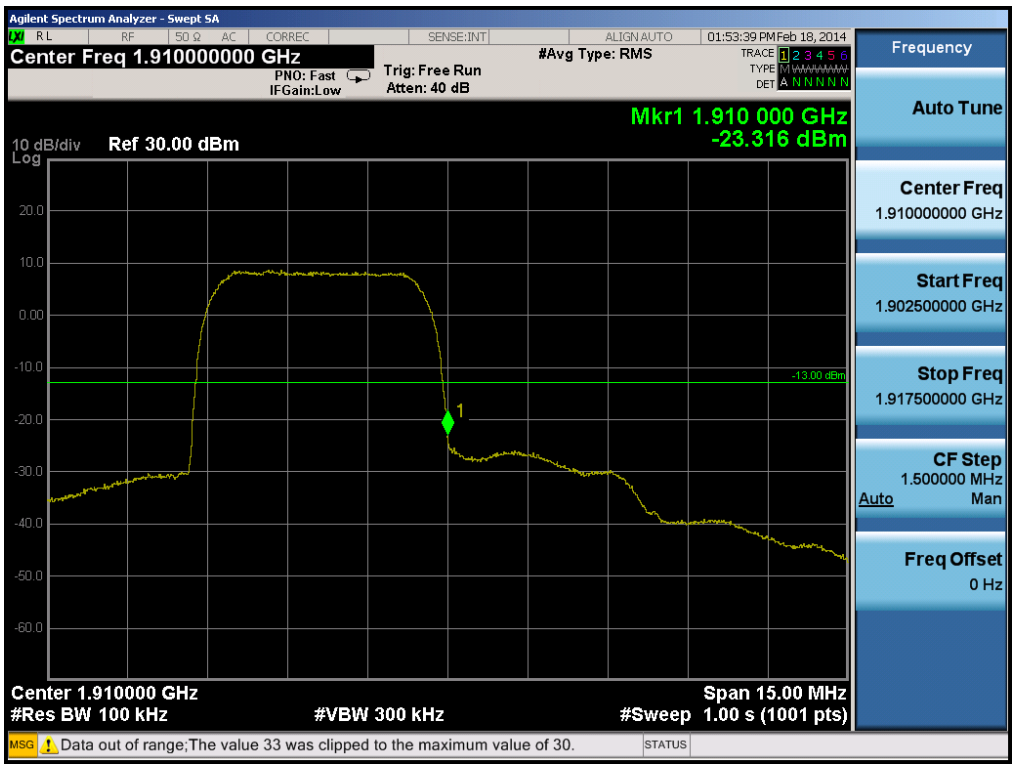


Plot 6-63. Band Edge Plot (PCS WCDMA Mode – Ch. 9262)



Plot 6-64. 4MHz Span Plot (PCS WCDMA Mode – Ch. 9262)

© 2014 PCTEST Engineering Laboratory, Inc.



Plot 6-65. Band Edge Plot (PCS WCDMA Mode – Ch. 9538)

Plot 6-66. 4MHz Span Plot (PCS WCDMA Mode – Ch. 9538)

© 2014 PCTEST Engineering Laboratory, Inc.

6.5 Peak-Average Ratio
§24.232(d) RSS-132(5.4) RSS-133(6.4)

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.

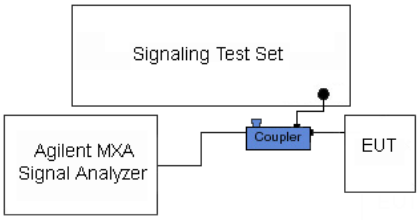
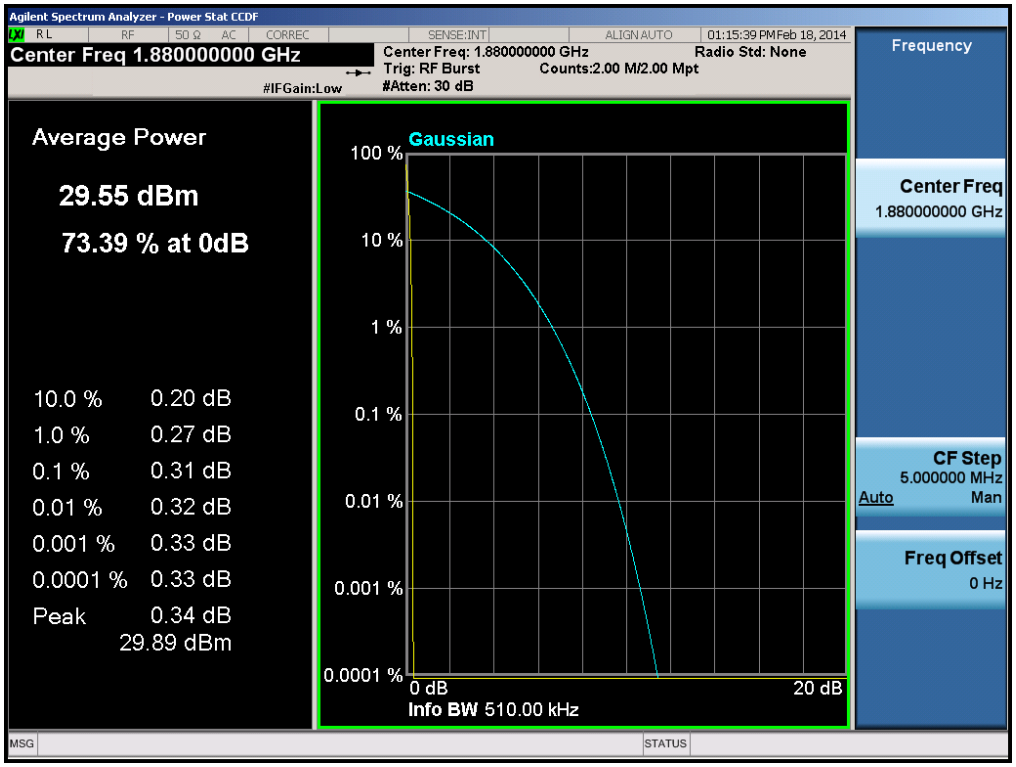


Figure 6-4. Test Instrument & Measurement Setup

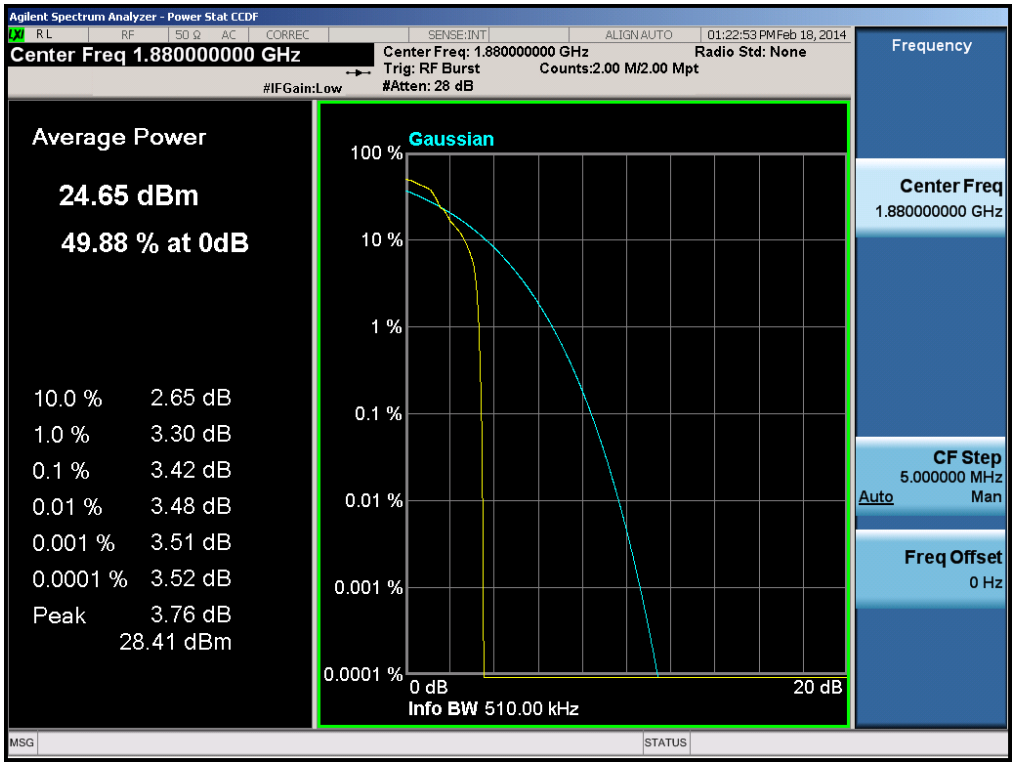
Test Notes

None.

© 2014 PCTEST Engineering Laboratory, Inc.

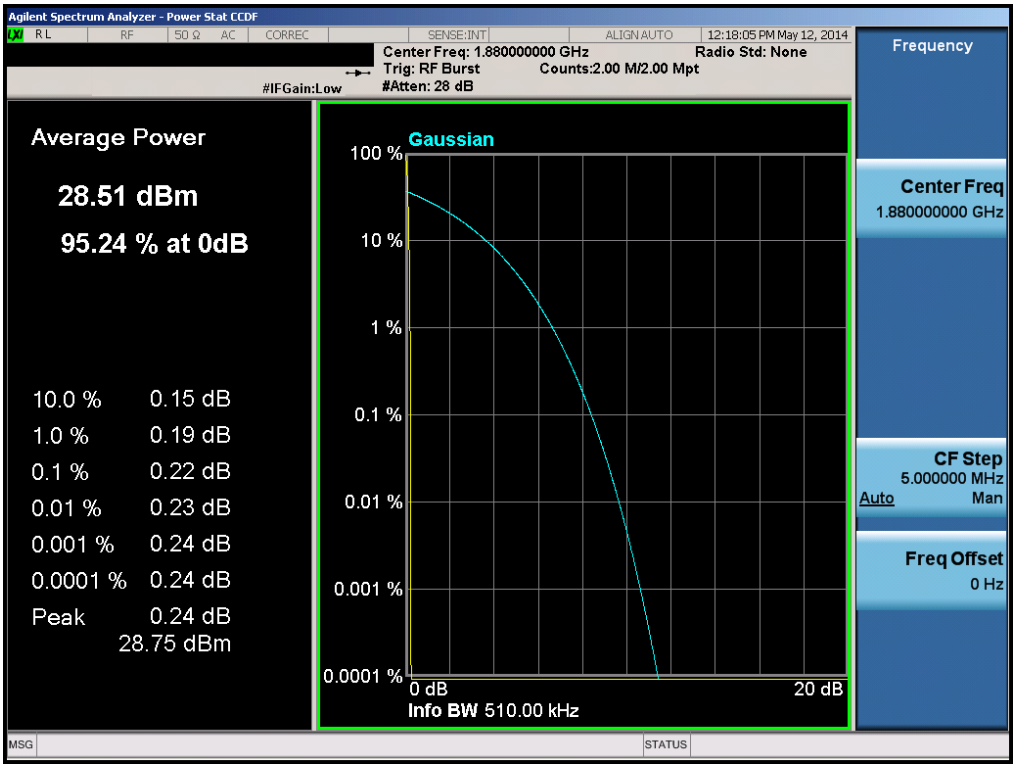


Plot 6-67. Peak-Average Ratio Plot (PCS GSM Mode, Master – Ch. 661)

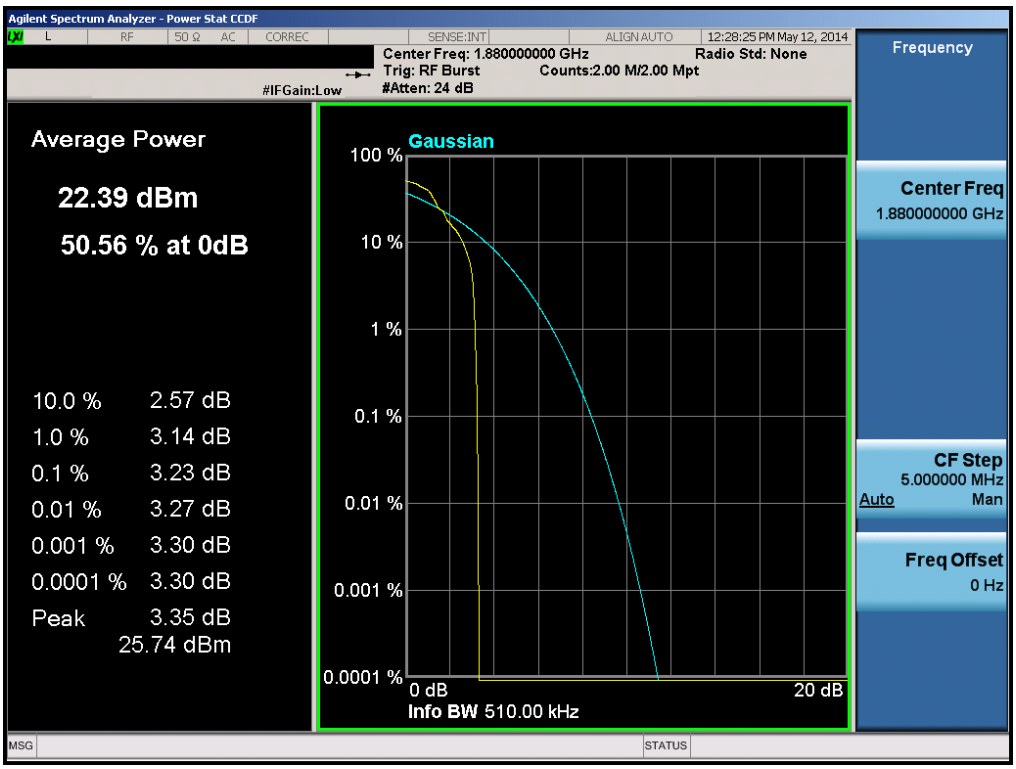


Plot 6-68. Peak-Average Ratio Plot (EDGE1900 Mode, Master – Ch. 661)

© 2014 PCTEST Engineering Laboratory, Inc.

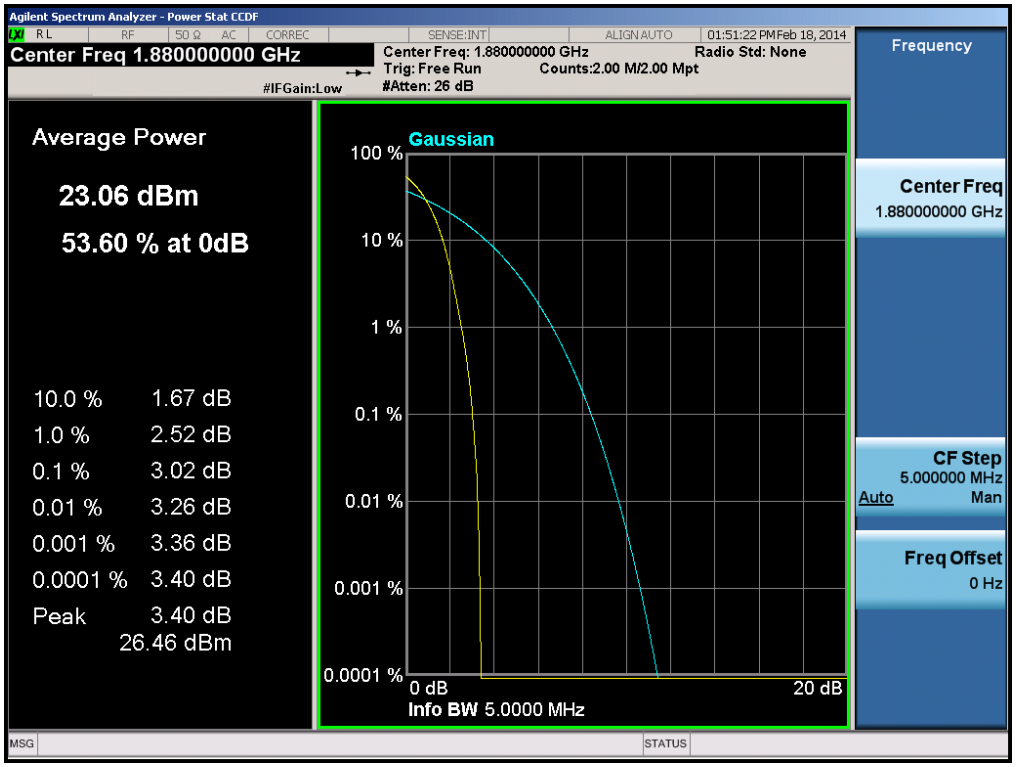


Plot 6-69. Peak-Average Ratio Plot (PCS GSM Mode, Slave – Ch. 661)



Plot 6-70. Peak-Average Ratio Plot (EDGE1900 Mode, Slave – Ch. 661)

© 2014 PCTEST Engineering Laboratory, Inc.



Plot 6-71. Peak-Average Ratio Plot (PCS WCDMA Mode – Ch. 9400)

© 2014 PCTEST Engineering Laboratory, Inc.

6.6 Radiated Power (ERP/EIRP)

§22.913(a)(2) RSS-132(4.4) [SRSP-503(5.1.3)]

Test Overview

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

Test Procedures Used

KDB 971168 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

© 2014 PCTEST Engineering Laboratory, Inc.

Test Setup

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

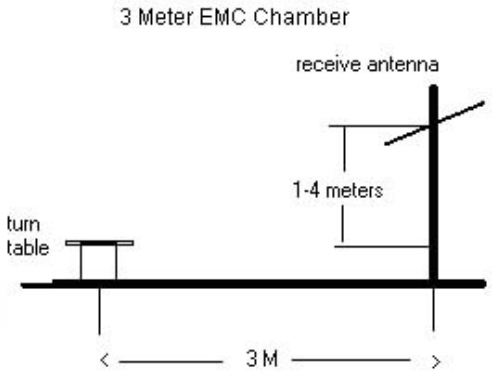


Figure 6-5. Test Instrument & Measurement Setup

Test Notes

1) This device was tested under all configurations and the highest power is reported in GPRS mode while transmitting with one slot active.

2) This device employs UMTS technology with WCDMA (AMR/RMC), HSDPA, and HSUPA capabilities. For WCDMA and HSUPA transmission, all configurations were investigated and the worst case UMTS emissions were found in RMC WCDMA mode at 12.2kbps with HSDPA inactive and TPC bits all set to “1."

3) This unit was tested with its standard battery. The battery for this model (EB-BG900BBE) contains an embedded NFC antenna.

4) The highest radiated power was found in the Vertical configuration for Cellular Band, and in the H2 (EUT lying on its side) configuration for the PCS Band.

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency [MHz]	Mode	Battery Type	Substitute Level [dBm]	Antenna Gain [dBd]	EUT Pol [H/V]	ERP [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
824.20	GSM850	Standard	20.52	4.59	V	25.11	0.324	38.45	-13.34
836.60	GSM850	Standard	23.02	4.82	V	27.84	0.608	38.45	-10.61
848.80	GSM850	Standard	24.02	5.05	V	29.07	0.807	38.45	-9.38
848.80	EDGE850	Standard	19.92	5.05	V	24.97	0.314	38.45	-13.48

Table 6-2. ERP (Cellular GSM, Master)

Frequency [MHz]	Mode	Battery Type	Substitute Level [dBm]	Antenna Gain [dBd]	EUT Pol. [H/V]	ERP [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
824.20	GSM850	Standard	21.09	4.59	V	25.68	0.370	38.45	-12.77
836.60	GSM850	Standard	21.96	4.82	V	26.78	0.477	38.45	-11.67
848.80	GSM850	Standard	22.79	5.05	V	27.84	0.608	38.45	-10.61
848.80	EDGE850	Standard	15.90	5.05	V	20.95	0.124	38.45	-17.50

Table 6-3. ERP (Cellular GSM, Slave)

Frequency [MHz]	Mode	Battery Type	Substitute Level [dBm]	Antenna Gain [dBd]	EUT Pol [H/V]	ERP [dBm]	ERP [Watts]	ERP Limit [dBm]	Margin [dB]
826.40	WCDMA850	Standard	10.22	4.63	V	14.85	0.031	38.45	-23.60
836.60	WCDMA850	Standard	11.12	4.80	V	15.92	0.039	38.45	-22.54
846.60	WCDMA850	Standard	10.42	5.01	V	15.43	0.035	38.45	-23.02

Table 6-4. ERP (Cellular WCDMA)

Frequency [MHz]	Mode	Battery Type	Substitute Level [dBm]	Antenna Gain [dBi]	EUT Pol [H/V]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm]	Margin [dB]
1850.20	GSM1900	Standard	21.33	9.60	H2	30.93	1.239	33.01	-2.08
1880.00	GSM1900	Standard	20.30	9.53	H2	29.83	0.962	33.01	-3.18
1909.80	GSM1900	Standard	19.30	9.47	H2	28.77	0.753	33.01	-4.24
1850.20	EDGE1900	Standard	17.40	9.60	H2	27.00	0.501	33.01	-6.01

Table 6-5. EIRP (PCS GSM, Master)

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency [MHz]	Mode	Battery Type	Substitute Level [dBm]	Ant. Gain [dBi]	EUT Pol.	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm]	Margin [dB]
1850.20	GSM1900	Standard	20.14	9.60	H2	29.74	0.942	33.01	-3.27
1880.00	GSM1900	Standard	19.65	9.53	H2	29.18	0.828	33.01	-3.83
1909.80	GSM1900	Standard	20.29	9.47	H2	29.76	0.947	33.01	-3.25
1909.80	EDGE1900	Standard	15.71	9.47	H2	25.18	0.330	33.01	-7.83

Table 6-6. EIRP (PCS GSM, Slave)

Frequency [MHz]	Mode	Battery Type	Substitute Level [dBm]	Antenna Gain [dBi]	EUT Pol [H/V]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm]	Margin [dB]
1852.40	WCDMA1900	Standard	14.62	9.59	H2	24.21	0.264	33.01	-8.80
1880.00	WCDMA1900	Standard	13.92	9.53	H2	23.45	0.221	33.01	-9.56
1907.60	WCDMA1900	Standard	13.12	9.48	H2	22.60	0.182	33.01	-10.41

Table 6-7. EIRP (PCS WCDMA)

© 2014 PCTEST Engineering Laboratory, Inc.

6.7 Radiated Spurious Emissions Measurements

§2.1053 §22.917(a) RSS-132(4.5.1)

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 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.

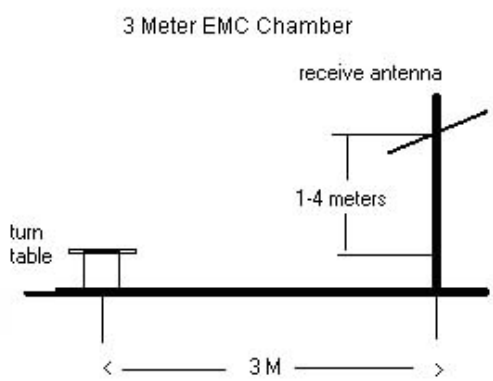


Figure 6-6. Test Instrument & Measurement Setup

© 2014 PCTEST Engineering Laboratory, Inc.

Test Notes

1) This device was tested under all configurations and the highest power is reported in GPRS mode while transmitting with one slot active.

2) This device employs UMTS technology with WCDMA (AMR/RMC), HSDPA, and HSUPA capabilities. For WCDMA and HSUPA transmission, all configurations were investigated and the worst case UMTS emissions were found in RMC WCDMA mode at 12.2kbps with HSDPA inactive and TPC bits all set to “1."

3) This unit was tested with its standard battery. The battery for this model (EB-BG900BBE) contains an embedded NFC antenna.

4) The worst case test configuration is displayed in the tables below. The data reported in the tables below was measured in this test setup.

5) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.

6) 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.

© 2014 PCTEST Engineering Laboratory, Inc.

OPERATING FREQUENCY:	824.20			MHz
CHANNEL:	128			
MEASURED OUTPUT POWER:	25.11	dBm	=	0.324 W
MODULATION SIGNAL:	GSM (GMSK)			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	38.11		dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBd)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
1648.40	-42.60	3.75	-38.85	H	64.0
2472.60	-47.09	3.61	-43.48	H	68.6
3296.80	-83.28	5.58	-77.69	H	102.8
4121.00	-83.25	6.88	-76.37	H	101.5
4945.20	-82.06	7.78	-74.28	H	99.4

Table 6-8. Radiated Spurious Data (Cellular GSM Mode, Master – Ch. 128)

OPERATING FREQUENCY:	836.60			MHz
CHANNEL:	190			
MEASURED OUTPUT POWER:	27.84	dBm	=	0.608 W
MODULATION SIGNAL:	GSM (GMSK)			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	40.84		dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBd)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
1673.20	-38.43	3.67	-34.76	H	62.6
2509.80	-42.25	3.65	-38.60	H	66.4
3346.40	-83.43	5.74	-77.69	H	105.5
4183.00	-83.41	7.04	-76.37	H	104.2
5019.60	-81.97	7.90	-74.07	H	101.9

Table 6-9. Radiated Spurious Data (Cellular GSM Mode, Master – Ch. 190)

© 2014 PCTEST Engineering Laboratory, Inc.

OPERATING FREQUENCY: 848.80 MHz
CHANNEL: 251
MEASURED OUTPUT POWER: 29.07 dBm = 0.807 W
MODULATION SIGNAL: GSM (GMSK)
DISTANCE: 3 meters
LIMIT: 43 + 10 $\log_{10}$ (W) = 42.07 dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBd)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
1697.60	-46.47	3.58	-42.88	H	72.0
2546.40	-48.82	3.76	-45.06	H	74.1
3395.20	-83.57	5.89	-77.68	H	106.7
4244.00	-83.45	7.15	-76.30	H	105.4
5092.80	-81.71	7.95	-73.76	H	102.8

Table 6-10. Radiated Spurious Data (Cellular GSM Mode, Master – Ch. 251)

OPERATING FREQUENCY: 824.20 MHz
CHANNEL: 128
MEASURED OUTPUT POWER: 25.68 dBm = 0.370 W
MODULATION SIGNAL: GSM (GMSK)
DISTANCE: 3 meters
LIMIT: 43 + 10 $\log_{10}$ (W) = 38.68 dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
1648.40	-51.59	6.56	-45.03	H	70.7
2472.60	-53.35	7.29	-46.06	H	71.7
3296.80	-61.86	7.37	-54.49	H	80.2
4121.00	-59.99	8.02	-51.97	H	77.7

Table 6-11. Radiated Spurious Data (Cellular GSM Mode, Slave – Ch. 128)

© 2014 PCTEST Engineering Laboratory, Inc.

OPERATING FREQUENCY:	836.60			MHz	
CHANNEL:	190				
MEASURED OUTPUT POWER:	26.78	dBm	=	0.477	W
MODULATION SIGNAL:	GSM (GMSK)				
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	39.78		dBc	

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
1673.20	-49.27	6.55	-42.72	H	69.5
2509.80	-55.19	7.34	-47.85	H	74.6
3346.40	-61.06	7.44	-53.62	H	80.4
4183.00	-60.02	8.20	-51.82	H	78.6

Table 6-12. Radiated Spurious Data (Cellular GSM Mode, Slave – Ch. 190)

OPERATING FREQUENCY:	848.80			MHz	
CHANNEL:	251				
MEASURED OUTPUT POWER:	27.84	dBm	=	0.608	W
MODULATION SIGNAL:	GSM (GMSK)				
DISTANCE:	3	meters			
LIMIT:	43 + 10 $\log_{10}$ (W) =	40.84		dBc	

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
1697.60	-45.69	6.55	-39.15	H	67.0
2546.40	-52.76	7.36	-45.40	H	73.2
3395.20	-61.10	7.51	-53.59	H	81.4
4244.00	-61.08	8.40	-52.68	H	80.5

Table 6-13. Radiated Spurious Data (Cellular GSM Mode, Slave – Ch. 251)

© 2014 PCTEST Engineering Laboratory, Inc.

OPERATING FREQUENCY: 826.40 MHz
CHANNEL: 4132
MEASURED OUTPUT POWER: 14.85 dBm = 0.031 W
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: 43 + 10 $\log_{10}$ (W) = 27.85 dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBd)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
1652.80	-55.95	3.74	-52.21	H	67.1
2479.20	-82.53	3.61	-78.92	H	93.8
3305.60	-83.30	5.61	-77.69	H	92.5
4132.00	-83.28	6.91	-76.37	H	91.2
4958.40	-82.05	7.81	-74.25	H	89.1

Table 6-14. Radiated Spurious Data (Cellular WCDMA Mode – Ch. 4132)

OPERATING FREQUENCY: 836.60 MHz
CHANNEL: 4183
MEASURED OUTPUT POWER: 15.92 dBm = 0.039 W
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: 43 + 10 $\log_{10}$ (W) = 28.92 dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBd)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
1673.20	-54.89	3.68	-51.21	H	67.1
2509.80	-82.56	3.64	-78.92	H	94.8
3346.40	-83.41	5.72	-77.69	H	93.6
4183.00	-83.39	7.02	-76.37	H	92.3
5019.60	-82.15	7.90	-74.25	H	90.2

Table 6-15. Radiated Spurious Data (Cellular WCDMA Mode – Ch. 4183)

© 2014 PCTEST Engineering Laboratory, Inc.

OPERATING FREQUENCY:	846.60	MHz		
CHANNEL:	4233			
MEASURED OUTPUT POWER:	15.43	dBm	=	0.035 W
MODULATION SIGNAL:	WCDMA			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	28.43	dBc	

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBd)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
1693.20	-55.61	3.60	-52.01	H	67.4
2539.80	-82.66	3.74	-78.92	H	94.4
3386.40	-83.56	5.86	-77.69	H	93.1
4233.00	-83.51	7.14	-76.37	H	91.8
5079.60	-82.19	7.94	-74.25	H	89.7

Table 6-16. Radiated Spurious Data (Cellular WCDMA Mode – Ch. 4233)

OPERATING FREQUENCY:	1850.20	MHz		
CHANNEL:	512			
MEASURED OUTPUT POWER:	30.93	dBm	=	1.239 W
MODULATION SIGNAL:	GSM (GMSK)			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	43.93	dBc	

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
3700.40	-51.93	8.29	-43.63	H	74.6
5550.60	-82.97	10.57	-72.41	H	103.3
7400.80	-82.21	11.94	-70.27	H	101.2
9251.00	-80.96	13.17	-67.79	H	98.7
11101.20	-78.41	13.25	-65.17	H	96.1

Table 6-17. Radiated Spurious Data (PCS GSM Mode, Master – Ch. 512)

© 2014 PCTEST Engineering Laboratory, Inc.

OPERATING FREQUENCY: 1880.00 MHz
CHANNEL: 661
MEASURED OUTPUT POWER: 29.83 dBm = 0.962 W
MODULATION SIGNAL: GSM (GMSK)
DISTANCE: 3 meters
LIMIT: 43 + 10 $\log_{10}$ (W) = 42.83 dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
3760.00	-49.08	8.32	-40.76	H	70.6
5640.00	-54.87	10.67	-44.19	H	74.0
7520.00	-82.14	12.05	-70.09	H	99.9
9400.00	-80.73	13.16	-67.58	H	97.4
11280.00	-78.10	13.32	-64.77	H	94.6

Table 6-18. Radiated Spurious Data (PCS GSM Mode, Master – Ch. 661)

OPERATING FREQUENCY: 1909.80 MHz
CHANNEL: 810
MEASURED OUTPUT POWER: 28.77 dBm = 0.753 W
MODULATION SIGNAL: GSM (GMSK)
DISTANCE: 3 meters
LIMIT: 43 + 10 $\log_{10}$ (W) = 41.77 dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
3819.60	-47.68	8.37	-39.31	H	68.1
5729.40	-82.90	10.73	-72.17	H	100.9
7639.20	-81.99	12.13	-69.86	H	98.6
9549.00	-80.44	13.14	-67.30	H	96.1
11458.80	-77.91	13.36	-64.56	H	93.3

Table 6-19. Radiated Spurious Data (PCS GSM Mode, Master – Ch. 810)

© 2014 PCTEST Engineering Laboratory, Inc.

OPERATING FREQUENCY:	1850.20			MHz
CHANNEL:	512			
MEASURED OUTPUT POWER:	29.74	dBm	= 0.942	W
MODULATION SIGNAL:	GSM (GMSK)			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	42.74		

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
3700.40	-55.11	9.46	-45.65	H	75.4
5550.60	-59.15	10.80	-48.35	H	78.1
7400.80	-55.85	10.67	-45.18	H	74.9
9251.00	-59.43	11.57	-47.86	H	77.6
11101.20	-54.18	12.80	-41.38	H	71.1

Table 6-20. Radiated Spurious Data (PCS GSM Mode, Slave – Ch. 128)

OPERATING FREQUENCY:	1880.00			MHz
CHANNEL:	661			
MEASURED OUTPUT POWER:	29.18	dBm	= 0.828	W
MODULATION SIGNAL:	GSM (GMSK)			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	42.18		

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
3760.00	-52.76	9.29	-43.47	H	73.2
5640.00	-58.41	11.05	-47.36	H	77.1
7520.00	-56.63	10.97	-45.66	H	75.4
9400.00	-58.56	11.55	-47.01	H	76.7
11280.00	-50.90	12.72	-38.18	H	67.9

Table 6-21. Radiated Spurious Data (PCS GSM Mode, Slave – Ch. 190)

© 2014 PCTEST Engineering Laboratory, Inc.

OPERATING FREQUENCY:	1909.80	MHz		
CHANNEL:	810			
MEASURED OUTPUT POWER:	29.76	dBm	=	0.947 W
MODULATION SIGNAL:	GSM (GMSK)			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	42.76		

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
3819.60	-53.38	9.20	-44.18	H	73.9
5729.40	-58.90	11.30	-47.59	H	77.3
7639.20	-56.36	11.16	-45.20	H	74.9
9549.00	-57.52	11.84	-45.69	H	75.4
11458.80	-52.18	12.72	-39.46	H	69.2

Table 6-22. Radiated Spurious Data (PCS GSM Mode, Slave – Ch. 251)

OPERATING FREQUENCY:	1852.40	MHz		
CHANNEL:	9262			
MEASURED OUTPUT POWER:	24.21	dBm	=	0.264 W
MODULATION SIGNAL:	WCDMA			
DISTANCE:	3	meters		
LIMIT:	43 + 10 $\log_{10}$ (W) =	37.21	dBc	

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
3704.80	-56.63	8.30	-48.33	H	72.5
5557.20	-82.98	10.58	-72.40	H	96.6
7409.60	-82.20	11.95	-70.25	H	94.5
9262.00	-80.94	13.17	-67.77	H	92.0
11114.40	-78.38	13.25	-65.13	H	89.3

Table 6-23. Radiated Spurious Data (PCS WCDMA Mode – Ch. 9262)

© 2014 PCTEST Engineering Laboratory, Inc.

OPERATING FREQUENCY: 1880.00 MHz
CHANNEL: 9400
MEASURED OUTPUT POWER: 23.45 dBm = 0.221 W
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: 43 + 10 $\log_{10}$ (W) = 36.45 dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
3760.00	-56.75	8.32	-48.43	H	71.9
5640.00	-83.08	10.67	-72.40	H	95.9
7520.00	-82.31	12.05	-70.25	H	93.7
9400.00	-80.93	13.16	-67.77	H	91.2
11280.00	-78.46	13.32	-65.13	H	88.6

Table 6-24. Radiated Spurious Data (PCS WCDMA Mode – Ch. 9400)

OPERATING FREQUENCY: 1907.60 MHz
CHANNEL: 9538
MEASURED OUTPUT POWER: 22.60 dBm = 0.182 W
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: 43 + 10 $\log_{10}$ (W) = 35.60 dBc

FREQUENCY (MHz)	LEVEL @ ANTENNA TERMINALS (dBm)	SUBSTITUTE ANTENNA GAIN (dBi)	SPURIOUS EMISSION LEVEL (dBm)	EUT POL (H/V)	(dBc)
3815.20	-56.99	8.36	-48.63	H	71.2
5722.80	-83.13	10.73	-72.40	H	95.0
7630.40	-82.38	12.12	-70.25	H	92.9
9538.00	-80.91	13.14	-67.77	H	90.4
11445.60	-78.49	13.36	-65.13	H	87.7

Table 6-25. Radiated Spurious Data (PCS WCDMA Mode – Ch. 9538)

© 2014 PCTEST Engineering Laboratory, Inc.

6.8 Frequency Stability / Temperature Variation

§2.1055 §22.355 §24.229 §24.235 RSS-132(4.3) RSS-133(6.3)

Test Overview and Limit

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

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

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

For Part 22, the frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5 ppm) of the center frequency. For Part 24, 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

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency Stability / Temperature Variation (Cont'd)

§2.1055 §22.355 §24.229 §24.235 RSS-132(4.3) RSS-133(6.3)

OPERATING FREQUENCY: 836,600,000 Hz

CHANNEL: 190

REFERENCE VOLTAGE: 3.8 VDC

DEVIATION LIMIT: ± 0.00025 % or 2.5 ppm

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	+ 20 (Ref)	836,600,003	3	0.0000003
100 %		- 30	836,600,016	16	0.0000020
100 %		- 20	836,600,019	19	0.0000023
100 %		- 10	836,600,000	0	0.0000001
100 %		0	836,600,003	3	0.0000003
100 %		+ 10	836,600,015	15	0.0000018
100 %		+ 20	836,600,002	2	0.0000002
100 %		+ 30	836,600,013	13	0.0000016
100 %		+ 40	836,600,015	15	0.0000018
100 %		+ 50	836,600,013	13	0.0000016
115 %	4.37	+ 20	836,600,002	2	0.0000003
BATT. ENDPOINT	3.40	+ 20	836,600,002	2	0.0000002

Table 6-26. Frequency Stability Data (Cellular GSM Mode – Ch. 190)

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency Stability / Temperature Variation (Cont'd)

§2.1055 §22.355 RSS-132(4.3)

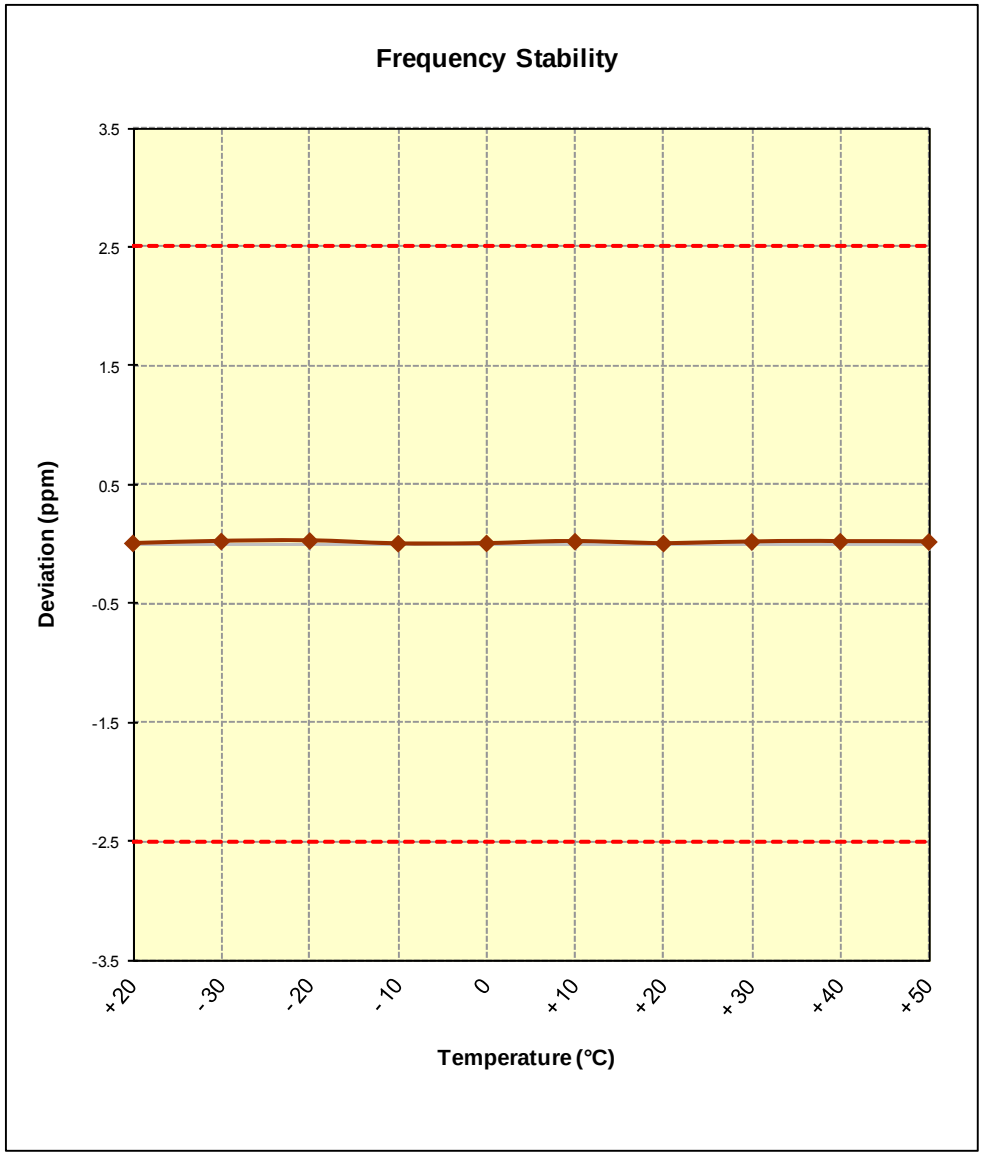


Figure 6-7. Frequency Stability Graph (Cellular GSM Mode – Ch. 190)

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency Stability / Temperature Variation (Cont'd)

§2.1055 §22.355 RSS-132(4.3)

OPERATING FREQUENCY: 836,600,000 Hz

CHANNEL: 4183

REFERENCE VOLTAGE: 3.8 VDC

DEVIATION LIMIT: ± 0.00025 % or 2.5 ppm

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	+ 20 (Ref)	836,600,010	10	0.0000012
100 %		- 30	836,600,005	5	0.0000006
100 %		- 20	836,600,016	16	0.0000019
100 %		- 10	836,600,003	3	0.0000003
100 %		0	836,600,002	2	0.0000003
100 %		+ 10	836,600,012	12	0.0000015
100 %		+ 20	836,600,020	20	0.0000024
100 %		+ 30	836,600,016	16	0.0000019
100 %		+ 40	836,600,007	7	0.0000008
100 %		+ 50	836,600,003	3	0.0000004
115 %	4.37	+ 20	836,600,008	8	0.0000010
BATT. ENDPOINT	3.40	+ 20	836,600,003	3	0.0000004

Table 6-27. Frequency Stability Data (Cellular WCDMA Mode – Ch. 4183)

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency Stability / Temperature Variation (Cont'd)

§2.1055 §22.355 RSS-132(4.3)

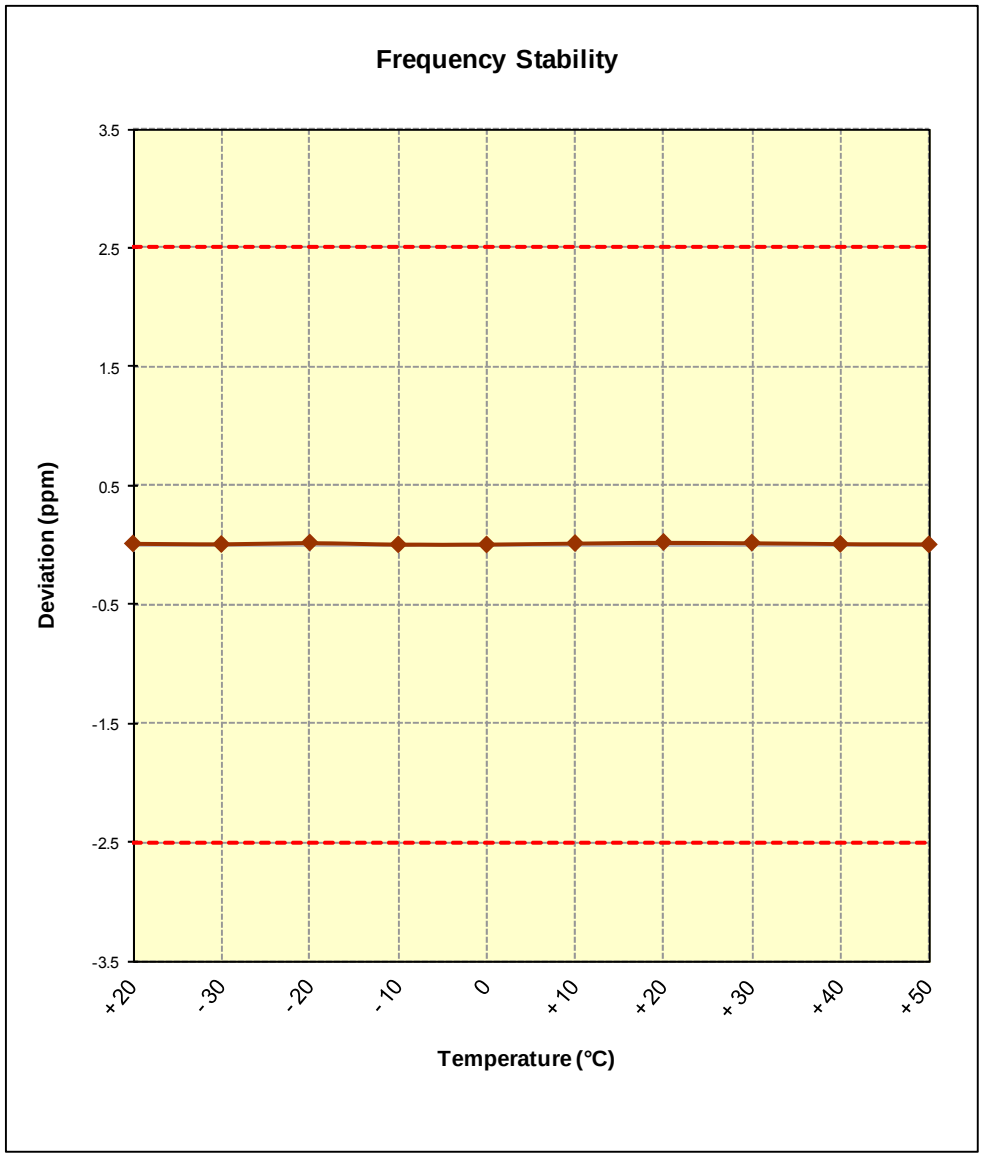


Figure 6-8. Frequency Stability Graph (Cellular WCDMA Mode – Ch. 4183)

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency Stability / Temperature Variation (Cont'd)

§2.1055 §24.235

OPERATING FREQUENCY: 1,880,000,000 Hz

CHANNEL: 661

REFERENCE VOLTAGE: 3.8 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	+ 20 (Ref)	1,880,000,017	17	0.0000009
100 %		- 30	1,880,000,004	4	0.0000002
100 %		- 20	1,880,000,018	18	0.0000010
100 %		- 10	1,880,000,007	7	0.0000004
100 %		0	1,880,000,013	13	0.0000007
100 %		+ 10	1,880,000,008	8	0.0000004
100 %		+ 20	1,880,000,001	1	0.0000001
100 %		+ 30	1,880,000,010	10	0.0000005
100 %		+ 40	1,880,000,001	1	0.0000000
100 %		+ 50	1,880,000,008	8	0.0000004
115 %	4.37	+ 20	1,880,000,001	1	0.0000000
BATT. ENDPOINT	3.40	+ 20	1,880,000,005	5	0.0000003

Table 6-28. Frequency Stability Data (PCS GSM Mode – Ch. 661)

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.

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency Stability / Temperature Variation (Cont'd)

§2.1055 §24.235

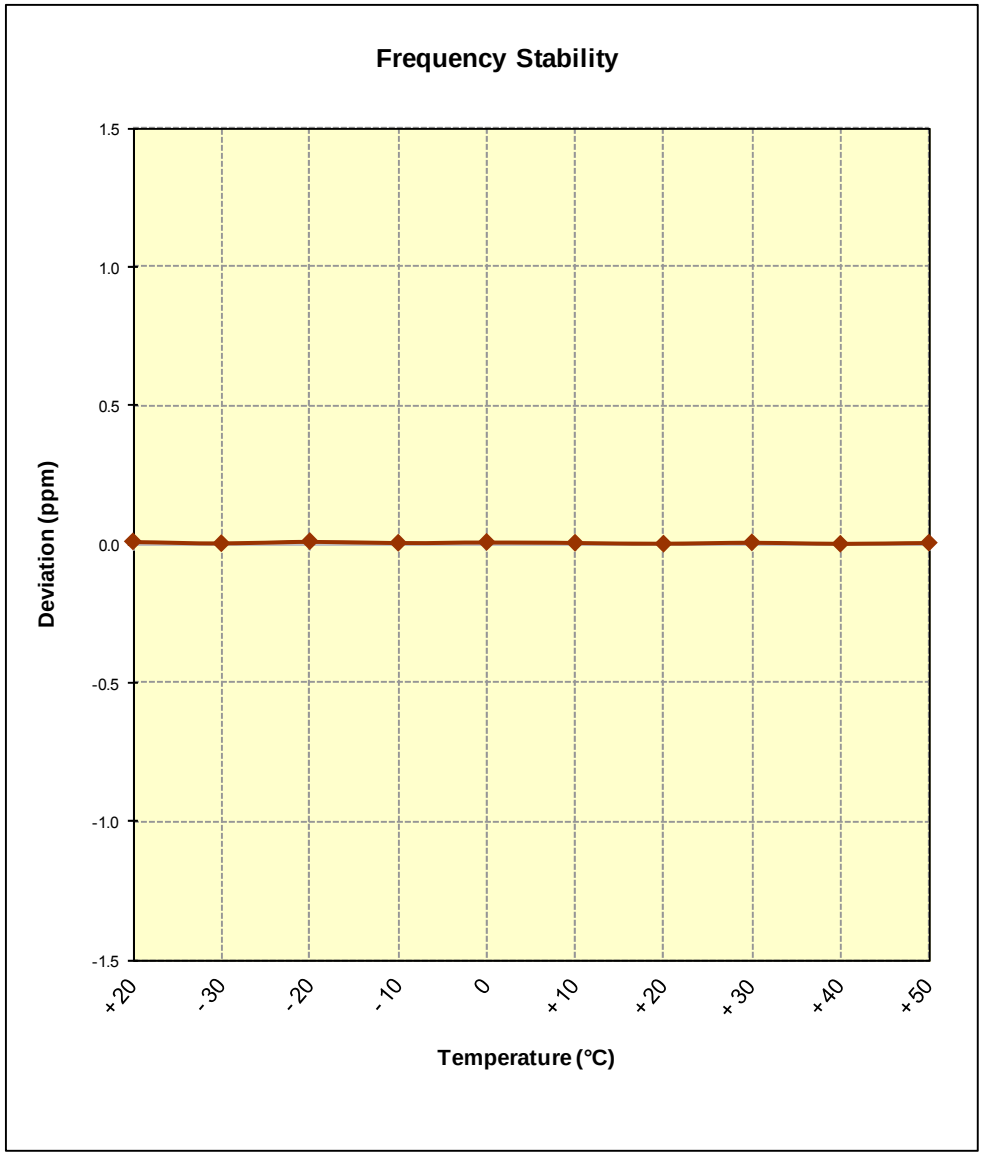


Figure 6-9. Frequency Stability Graph (PCS GSM Mode – Ch. 661)

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency Stability / Temperature Variation (Cont'd)

§2.1055 §24.235

OPERATING FREQUENCY: 1,880,000,000 Hz

CHANNEL: 9400

REFERENCE VOLTAGE: 3.8 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.80	+ 20 (Ref)	1,880,000,012	12	0.0000006
100 %		- 30	1,880,000,011	11	0.0000006
100 %		- 20	1,880,000,016	16	0.0000009
100 %		- 10	1,880,000,017	17	0.0000009
100 %		0	1,880,000,006	6	0.0000003
100 %		+ 10	1,880,000,015	15	0.0000008
100 %		+ 20	1,880,000,002	2	0.0000001
100 %		+ 30	1,880,000,004	4	0.0000002
100 %		+ 40	1,880,000,008	8	0.0000004
100 %		+ 50	1,880,000,016	16	0.0000008
115 %	4.37	+ 20	1,880,000,002	2	0.0000001
BATT. ENDPOINT	3.40	+ 20	1,880,000,010	10	0.0000005

Table 6-29. Frequency Stability Data (PCS WCDMA Mode – Ch. 9400)

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.

© 2014 PCTEST Engineering Laboratory, Inc.

Frequency Stability / Temperature Variation (Cont'd)

§2.1055 §24.235

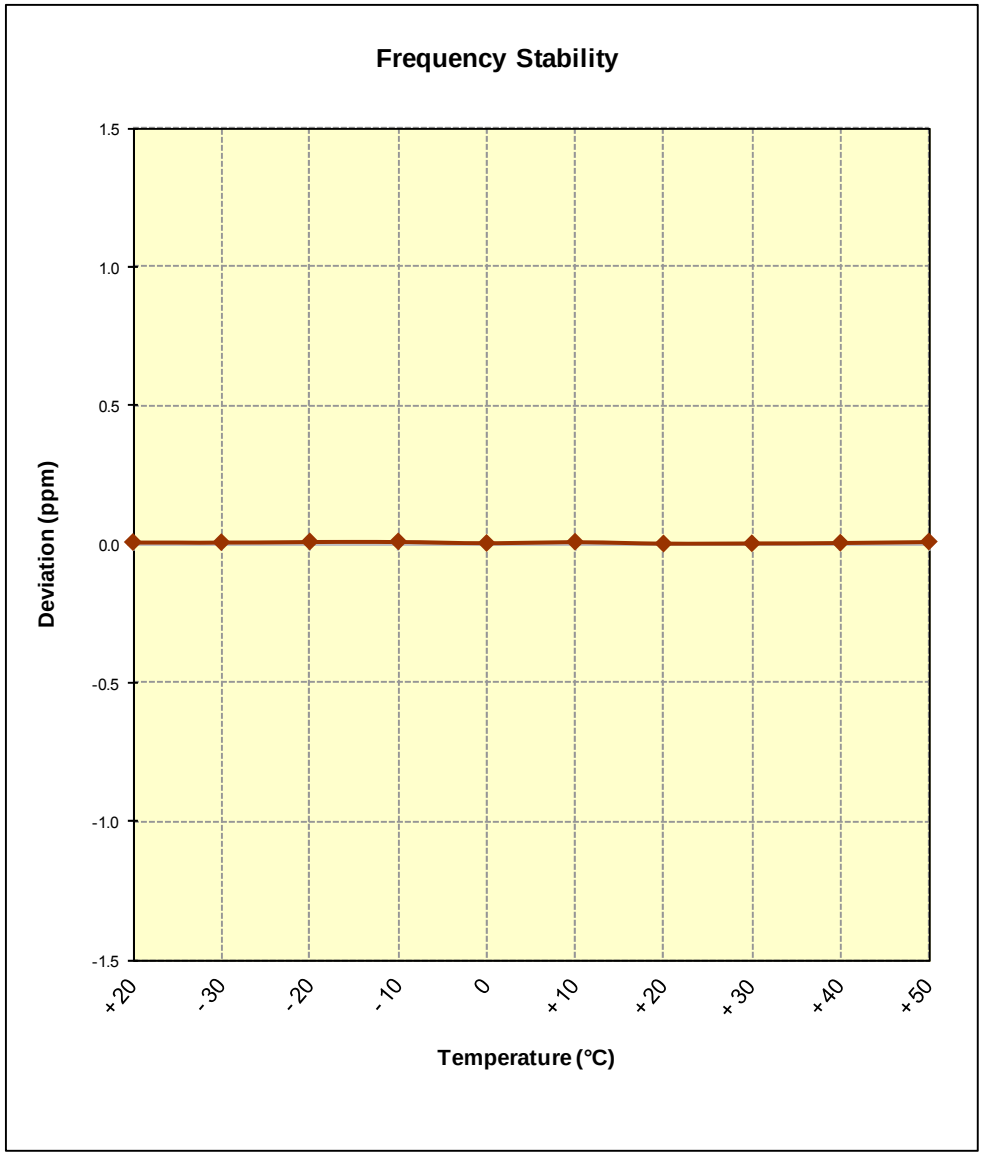


Figure 6-10. Frequency Stability Graph (PCS WCDMA Mode – Ch. 9400)

© 2014 PCTEST Engineering Laboratory, Inc.

7.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMG9008W** complies with all the requirements of Parts 2, 22, 24 of the FCC rules.

© 2014 PCTEST Engineering Laboratory, Inc.