PCTEST ENGINEERING LABORATORY, INC.
7185 Oakland Mills Road, Columbia, MD 21046 USA
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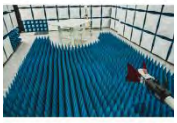

MEASUREMENT REPORT
GSM / GPRS / EDGE / CDMA / WCDMA

Applicant Name:
LG Electronics USA, Inc.
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632
United States

Date of Testing:
10/28 – 11/26/2019
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M1910280174-02-R1.ZNF

FCC ID:	**ZNFL455DL**
APPLICANT:	**LG Electronics USA, Inc.**

Application Type:	Certification
Model:	LG L455DL
Additional Model(s):	LG-L455DL, LM-K400UM, LM-K400MM, LM-K400QM, LM-K400VPP, LM-K400QM5, LM-K400QM6, LGL455DL, LMK400UM, LMK400MM, LMK400QM, LMK400QM5, LMK400QM6, LMK400VPP, L455DL, K400UM, K400MM, K400QM, K400QM5, K400QM6, K400VPP
EUT Type:	Portable Handset
FCC Classification:	PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part(s):	22, 24, & 27
Test Procedure(s):	ANSI C63.26-2015, ANSI/TIA-603-E-2016, KDB 971168 D01 v03r01

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.

Note: This revised Test Report (S/N: 1M1910280174-02-R1.ZNF) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.01

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TABLE OF CONTENTS

1.0 INTRODUCTION 4
- 1.1 Scope 4
- 1.2 PCTEST Test Location 4
- 1.3 Test Facility / Accreditations 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 AWS - Base Frequency Blocks 7
- 3.7 AWS - Mobile Frequency Blocks 7
- 3.8 Radiated Measurements 8

4.0 MEASUREMENT UNCERTAINTY 9

5.0 TEST EQUIPMENT CALIBRATION DATA 10

6.0 SAMPLE CALCULATIONS 11

7.0 TEST RESULTS 12
- 7.1 Summary 12
- 7.2 Occupied Bandwidth 13
- 7.3 Spurious and Harmonic Emissions at Antenna Terminal 19
- 7.4 Band Edge Emissions at Antenna Terminal 55
- 7.5 Peak-Average Ratio 68
- 7.6 Radiated Power (ERP/EIRP) 74
- 7.7 Radiated Spurious Emissions Measurements 79
- 7.8 Frequency Stability / Temperature Variation 96

8.0 CONCLUSION 111

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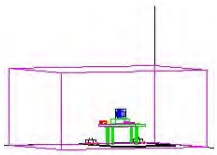
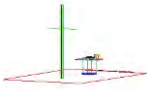


MEASUREMENT REPORT
GSM / GPRS / EDGE / CDMA / WCDMA



Mode	FCC Rule Part	Tx Frequency (MHz)	ERP		EIRP		Emission Designator
			Max. Power (W)	Max. Power (dBm)	Max. Power (W)	Max. Power (dBm)	
GPRS850	22H	824.2 - 848.8	0.706	28.49	1.159	30.64	247KGXW
EDGE850	22H	824.2 - 848.8	0.173	22.38	0.284	24.53	247KG7W
CDMA850	22H	824.70 - 848.31	0.067	18.23	0.109	20.38	1M28F9W
WCDMA850	22H	826.4 - 846.6	0.061	17.85	0.100	20.00	4M22F9W
WCDMA1700	27	1712.4 - 1752.6			0.178	22.51	4M19F9W
GPRS1900	24E	1850.2 - 1909.8			1.159	30.64	247KGXW
EDGE1900	24E	1850.2 - 1909.8			0.564	27.51	250KG7W
CDMA1900	24E	1851.25 - 1908.75			0.156	21.92	1M28F9W
WCDMA1900	24E	1852.4 - 1907.6			0.237	23.75	4M22F9W

EUT Overview

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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) 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 Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

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

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **LG Portable Handset FCC ID: ZNFL455DL**. The test data contained in this report pertains only to the emissions due to the EUT's 2G/3G licensed transmitters.

Test Device Serial No.: 00350, 00368, 00376, 00384

2.2 Device Capabilities

This device contains the following capabilities:

800/850/1900 CDMA/EvDO Rev0/A, 1x Advanced (BC0, BC1, BC10), 850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE)

2.3 Test Configuration

The EUT was tested per the guidance of ANSI/TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

2.4 EMI Suppression Device(s)/Modifications

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

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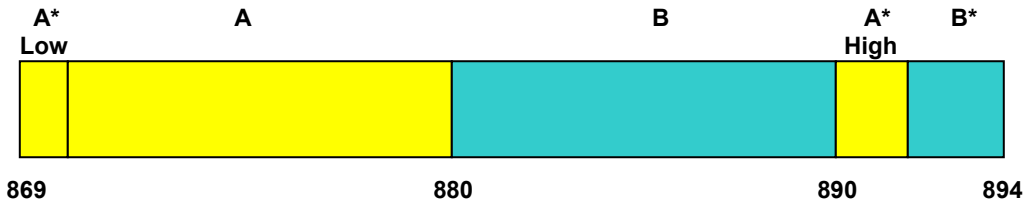
3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI/TIA-603-E-2016) and "Measurement Guidance for Certification of Licensed Digital Transmitters" (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

Deviation from Measurement Procedure……..None

3.2 Cellular - Base Frequency Blocks



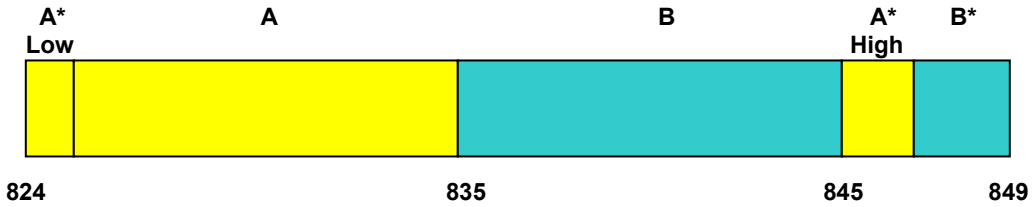
BLOCK 1: 869 – 880 MHz (A* Low + A)

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



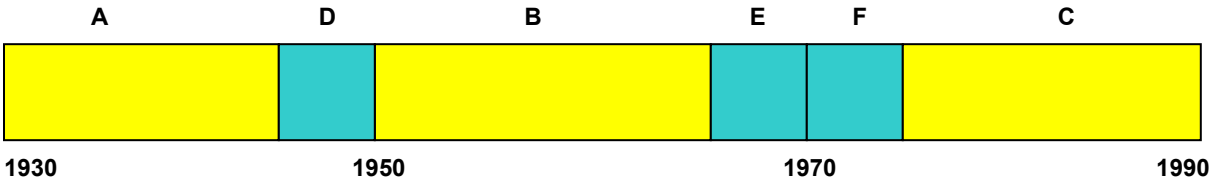
BLOCK 1: 824 – 835 MHz (A* Low + A)

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



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)

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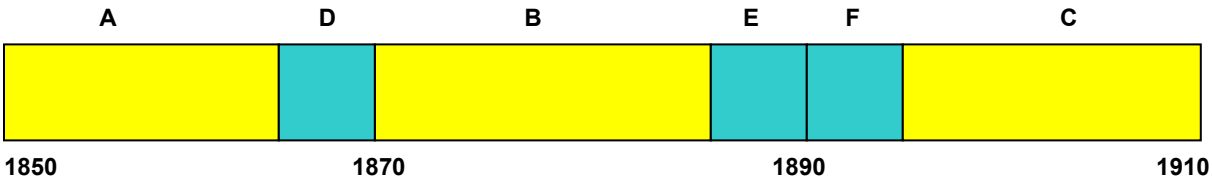
3.5 PCS - Mobile Frequency Blocks



BLOCK 1: 1850 – 1865 MHz (A)

BLOCK 2: 1865 – 1870 MHz (D)

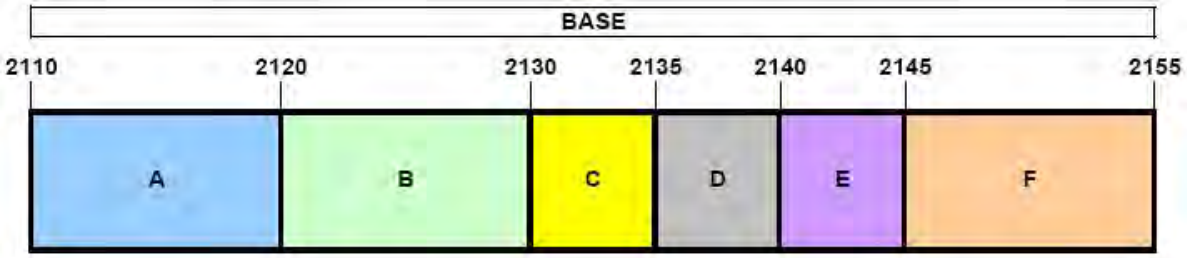
BLOCK 3: 1870 – 1885 MHz (B)

BLOCK 4: 1885 – 1890 MHz (E)

BLOCK 5: 1890 – 1895 MHz (F)

BLOCK 6: 1895 – 1910 MHz (C)

3.6 AWS - Base Frequency Blocks



BLOCK 1: 2110 – 2120 MHz (A)

BLOCK 2: 2120 – 2130 MHz (B)

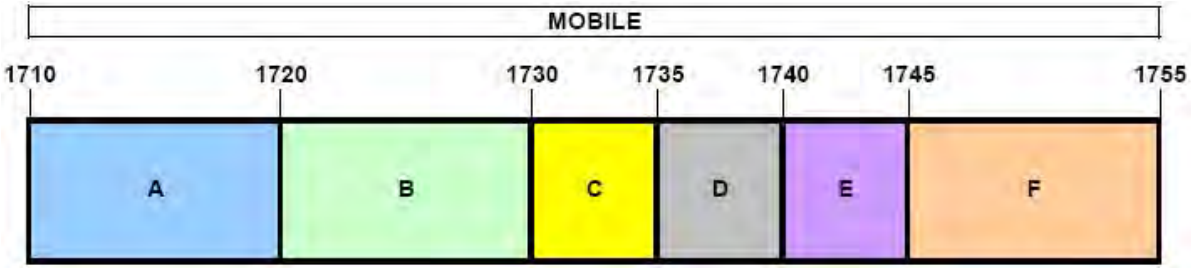
BLOCK 3: 2130 – 2135 MHz (C)

BLOCK 4: 2135 – 2140 MHz (D)

BLOCK 5: 2140 – 2145 MHz (E)

BLOCK 6: 2145 – 2155 MHz (F)

3.7 AWS - Mobile Frequency Blocks



BLOCK 1: 1710 – 1720 MHz (A)

BLOCK 2: 1720 – 1730 MHz (B)

BLOCK 3: 1730 – 1735 MHz (C)

BLOCK 4: 1735 – 1740 MHz (D)

BLOCK 5: 1740 – 1745 MHz (E)

BLOCK 6: 1745 – 1755 MHz (F)

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3.8 Radiated Measurements

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 Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table 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. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

Per the guidance of ANSI/TIA-603-E-2016, 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 $_{[dB]}$.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 474788 D01.

Radiated power and radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI/TIA-603-E-2016.

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4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	LTx1	Licensed Transmitter Cable Set	6/4/2019	Annual	6/4/2020	LTx1
-	LTx3	LIcensed Transmitter Cable Set	6/3/2019	Annual	6/3/2020	LTx3
Agilent	N9020A	MXA Signal Analyzer	4/20/2019	Annual	4/20/2020	US46470561
Agilent	N9030A	PXA Signal Analyzer (44GHz)	6/12/2019	Annual	6/12/2020	MY52350166
Com-Power	PAM-103	Pre-Amplifier (1-1000MHz)	5/10/2019	Annual	5/10/2020	441112
Emco	3115	Horn Antenna (1-18GHz)	3/28/2018	Biennial	3/28/2020	9704-5182
EMCO	3160-09	Small Horn (18 - 26.5GHz)	8/9/2018	Biennial	8/9/2020	135427
ETS Lindgren	3164-08	Quad Ridge Horn Antenna	2/22/2019	Biennial	2/22/2021	128338
Mini Circuits	TVA-11-422	RF Power Amp	N/A			QA1317001
Mini Circuits	PWR-SEN-4GHS	USB Power Sensor	4/19/2019	Annual	4/19/2020	11401010036
Rohde & Schwarz	CMW500	Radio Communication Tester	N/A			100976
Rohde & Schwarz	CMW500	Radio Communication Tester	N/A			112347
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	6/5/2019	Annual	6/5/2020	100342
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/11/2019	Annual	7/11/2020	102134
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/8/2019	Annual	7/8/2020	102133
Seekonk	NC-100	Torque Wrench (8" lb)	5/10/2018	Biennial	5/10/2020	N/A
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	4/19/2018	Biennial	4/19/2020	A051107

Table 5-1. Test Equipment

Notes:

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

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6.0 SAMPLE CALCULATIONS

GPRS Emission Designator

Emission Designator = 250KGXW

GPRS 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)

CDMA Emission Designator

Emission Designator = 1M25F9W

CDMA BW = 1.25 MHz
F = Frequency Modulation
9 = Composite 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)

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.

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7.0 TEST RESULTS

7.1 Summary

Company Name: LG Electronics USA, Inc.

FCC ID: ZNFL455DL

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

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

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	RSS-Gen (4.6.1) RSS-133(2.3) RSS-139(2.3)	Occupied Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
2.1051 22.917(a) 24.238(a) 27.53(h)	RSS-132(5.5) RSS-133(6.5) RSS-139(6.6)	Conducted Band Edge / Spurious Emissions	> 43 + 10 $\log_{10}$ (P[Watts]) at Band Edge and for all out-of-band emissions		PASS	Sections 7.3, 7.4
24.232(d) 27.50(d)	RSS-132(5.4) RSS-133(6.4) RSS-139(6.5)	Peak-Average Ratio	< 13 dB		PASS	Section 7.5
2.1046	RSS-132(5.4) RSS-133(4.1) RSS-139(4.1)	Transmitter Conducted Output Power	N/A		PASS	RF Exposure Report
2.1055 22.355 24.235 27.54	RSS-132(5.3) RSS-133(6.3) RSS-139(6.4)	Frequency Stability	< 2.5 ppm (Part 22) Emission must remain in band (Part 24, 27)		PASS	Section 7.8
22.913(a)(5)	RSS-132(5.4)	Effective Radiated Power	< 7 Watts max. ERP	RADIATED	PASS	Section 7.6
24.232(c)	RSS-133(6.4)	Equivalent Isotropic Radiated Power	< 2 Watts max. EIRP		PASS	Section 7.6
27.50(d)(4)	RSS-139(6.5)	Equivalent Isotropic Radiated Power	< 1 Watts max. EIRP		PASS	Section 7.6
2.1053 22.917(a) 24.238(a) 27.53(h)	RSS-132(5.5) RSS-133(6.5) RSS-139(6.6)	Radiated Spurious Emissions	> 43 + 10 $\log_{10}$ (P[Watts]) for all out-of-band emissions		PASS	Section 7.7

Table 7-1. 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 4.2.

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7.2 Occupied Bandwidth

Test Overview

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

Test Procedure Used

KDB 971168 D01 v03r01 – Section 4.2

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

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

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

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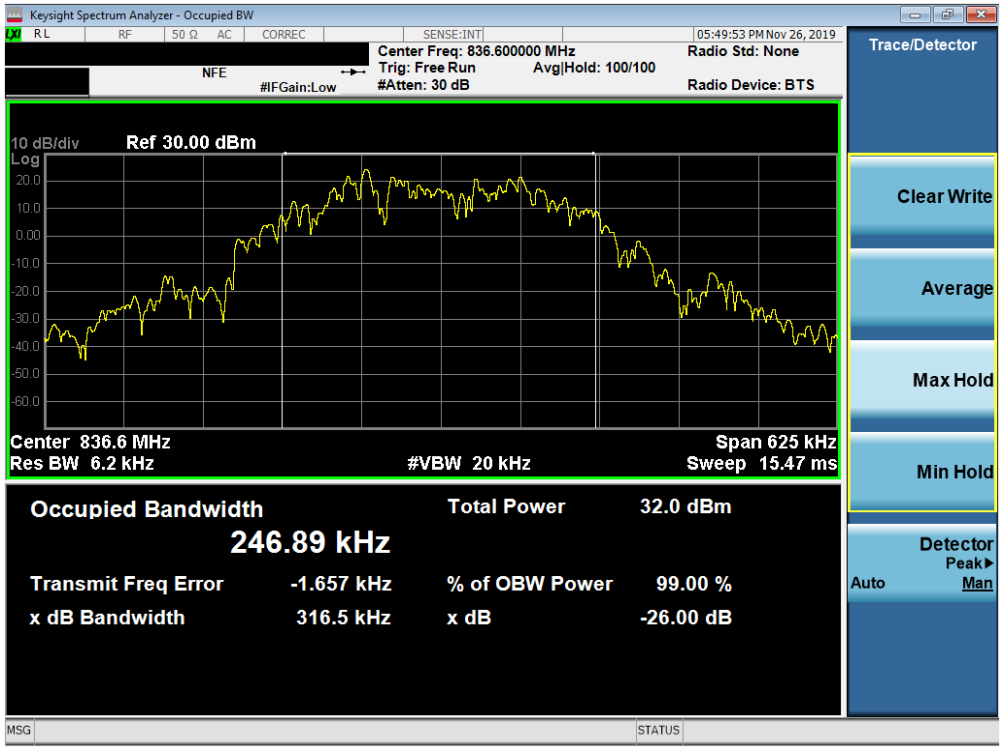
Plot 7-1. Occupied Bandwidth Plot (Cellular GPRS Mode)



Plot 7-2. Occupied Bandwidth Plot (EDGE850 Mode)

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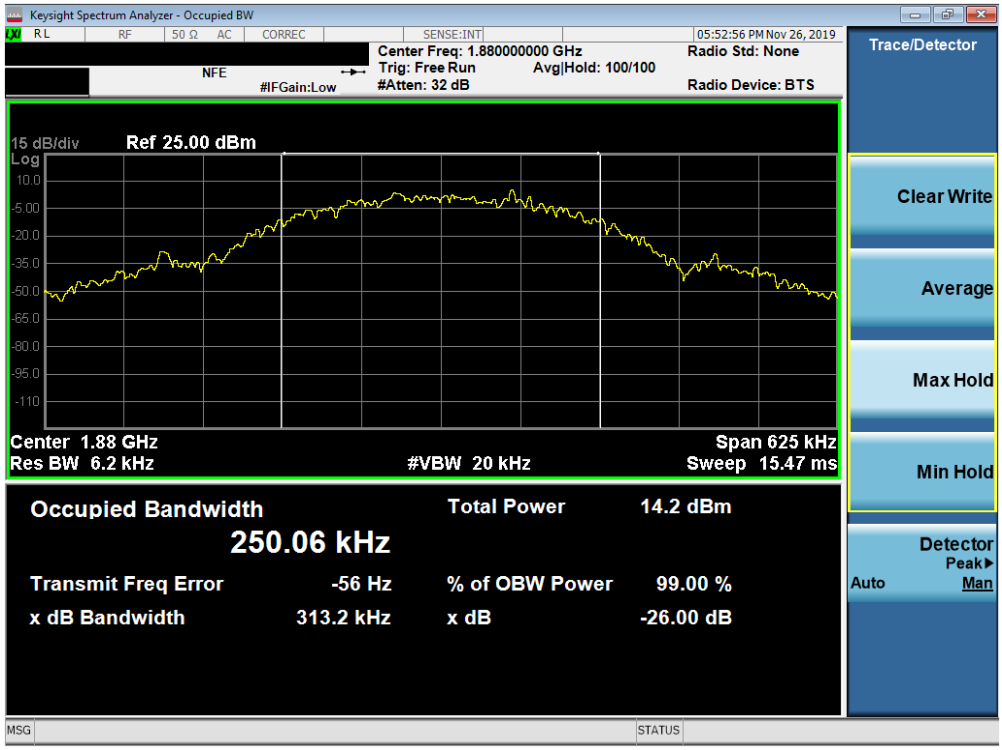
Plot 7-3. Occupied Bandwidth Plot (PCS GPRS Mode)



Plot 7-4. Occupied Bandwidth Plot (EDGE1900 Mode)

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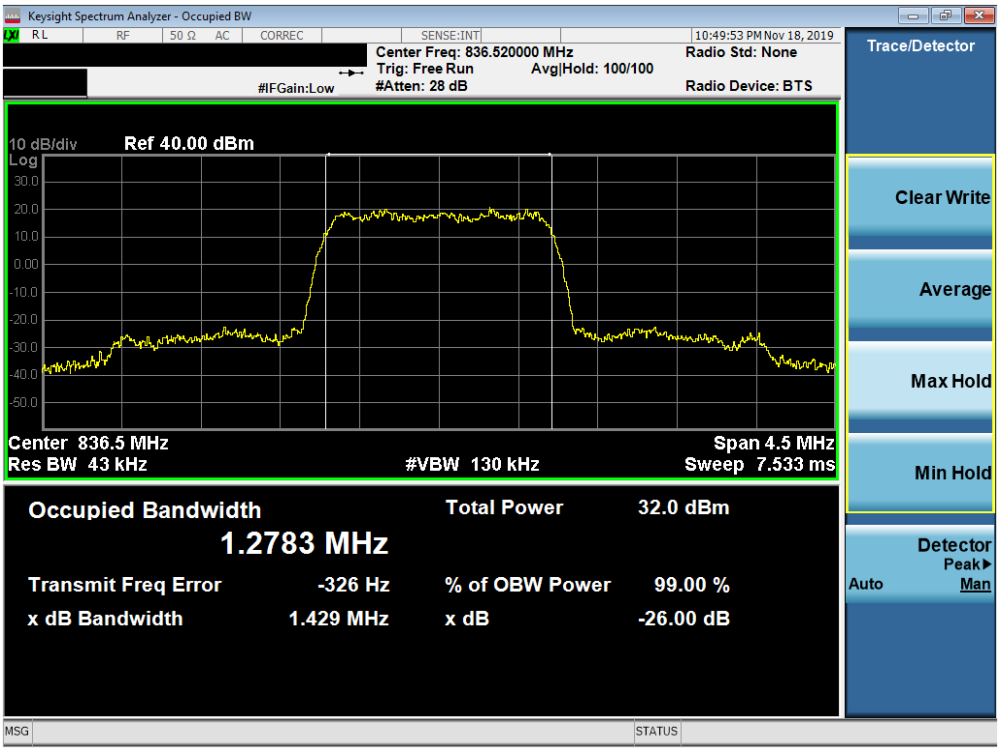
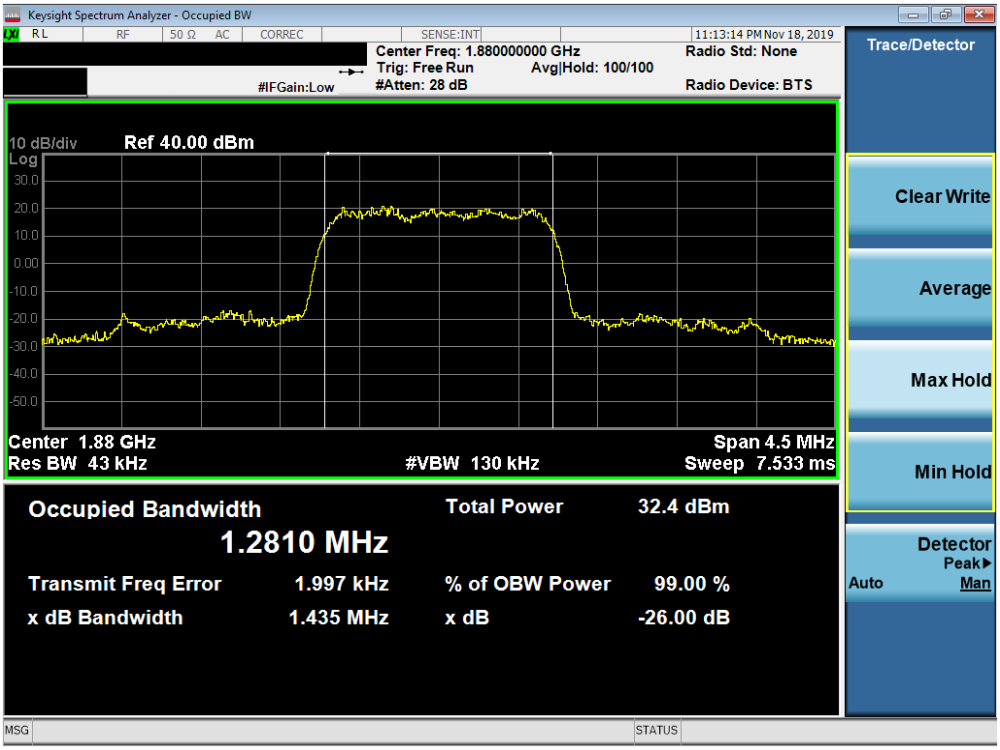


Plot 7-5. Occupied Bandwidth Plot (Cellular CDMA Mode)



Plot 7-6. Occupied Bandwidth Plot (PCS CDMA Mode)

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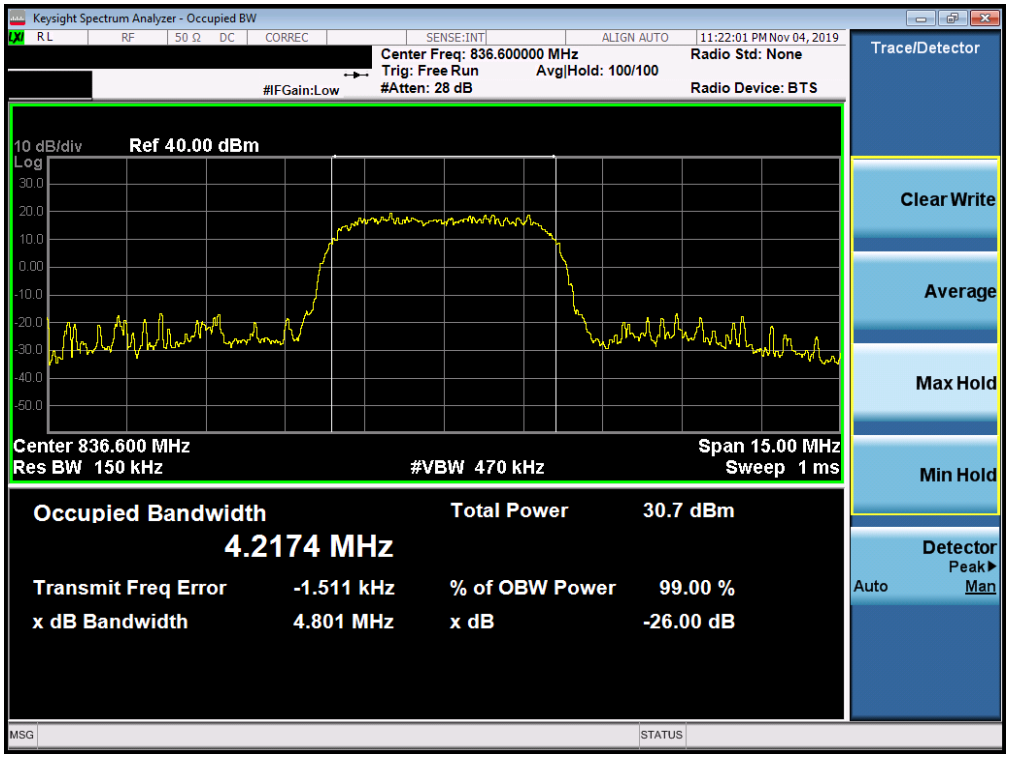
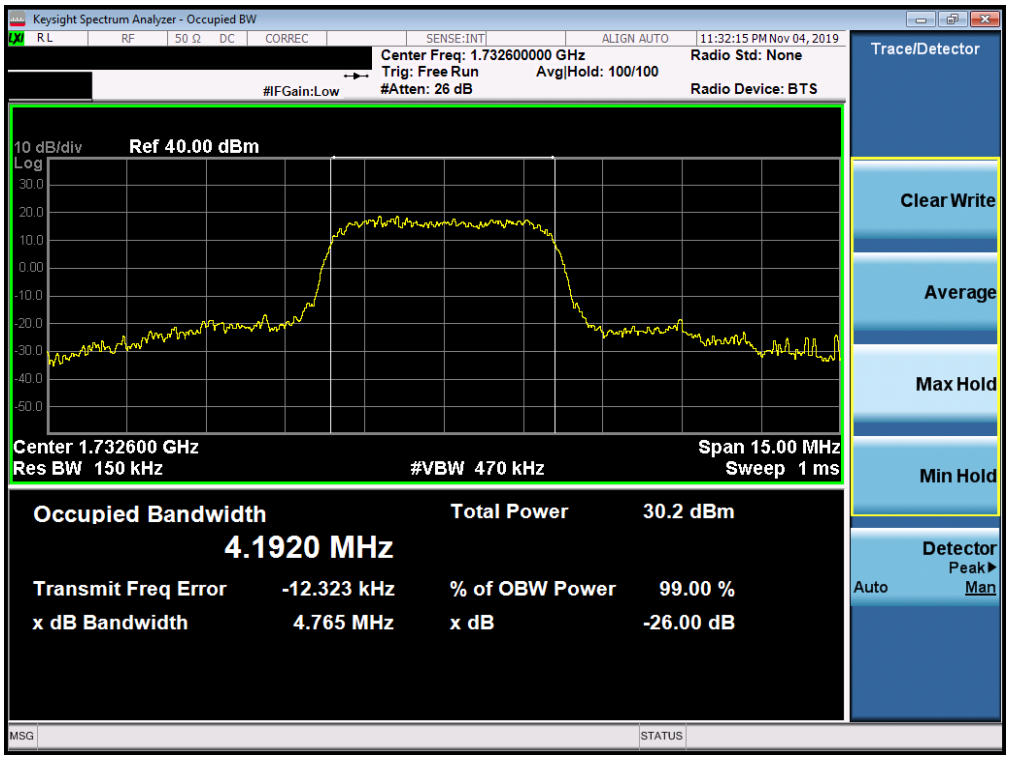


Plot 7-7. Occupied Bandwidth Plot (Cellular WCDMA Mode)



Plot 7-8. Occupied Bandwidth Plot (AWS WCDMA Mode)

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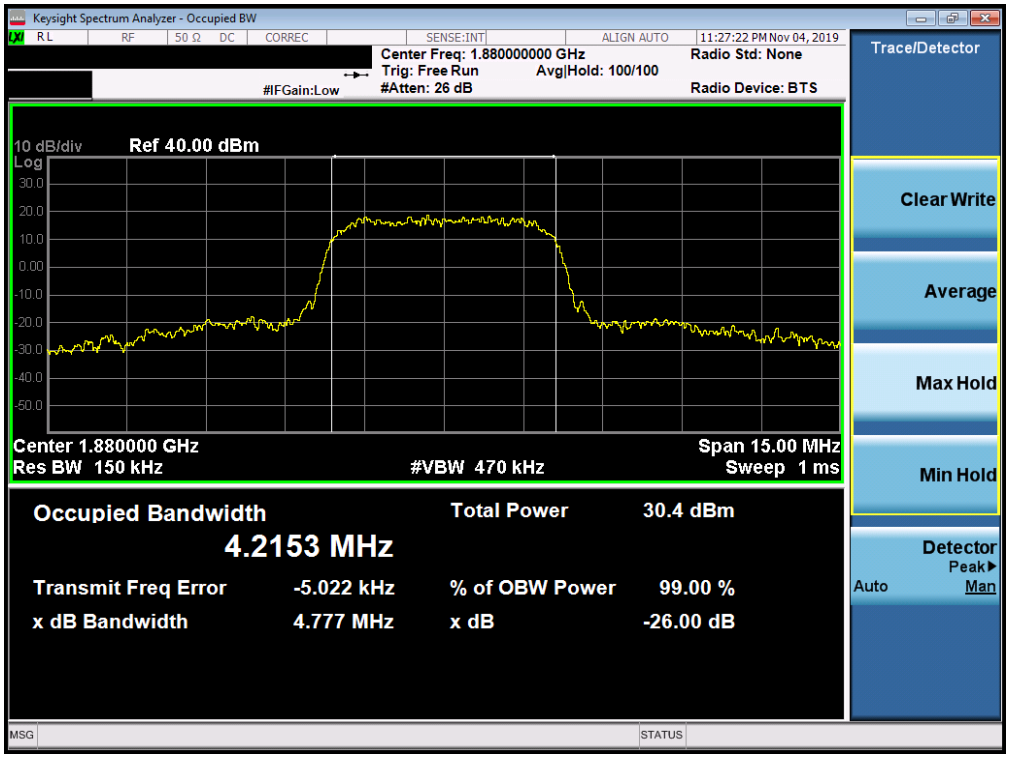

Plot 7-9. Occupied Bandwidth Plot (PCS WCDMA Mode)

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7.3 Spurious and Harmonic Emissions at Antenna Terminal

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 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 + 10log$_{10}$(P$_{[Watts]}$), where P is the transmitter power in Watts.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 10GHz for Cell, 20GHz for AWS, 20GHz for PCS (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
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 7-2. Test Instrument & Measurement Setup

Test Notes

Per 24.238(b), 27.53(h)(3), and RSS-133(6.5), RSS-139(6.5), compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 1MHz, and 100 kHz or greater for Part 22 and RSS-132 measurements below 1GHz. 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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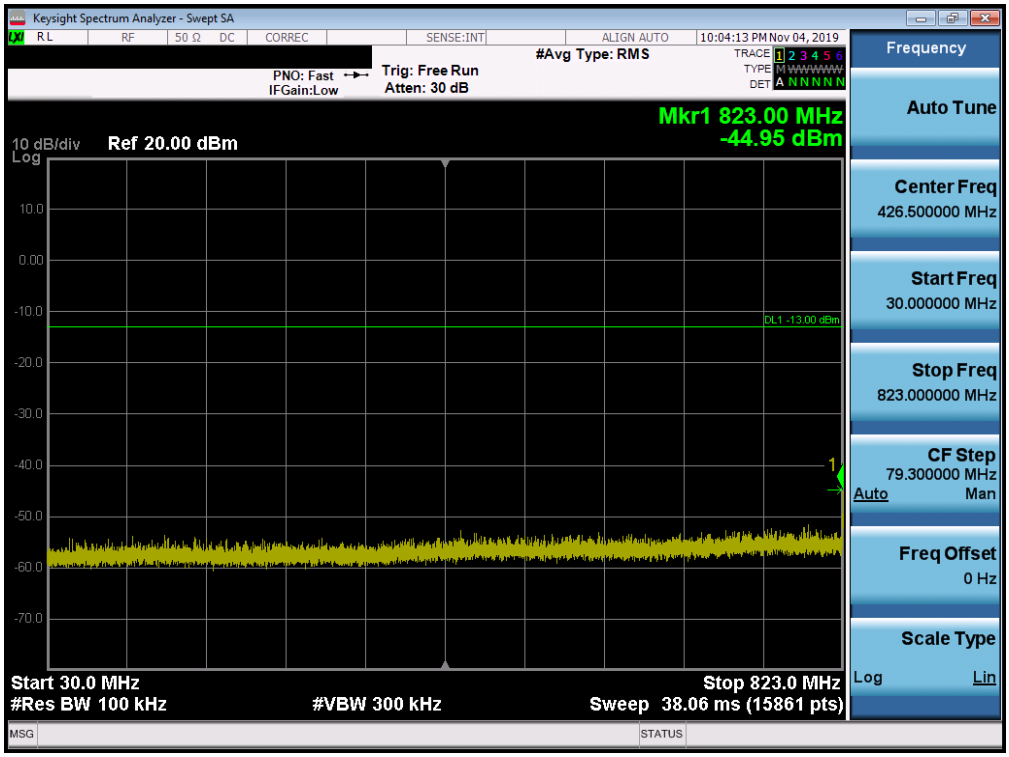
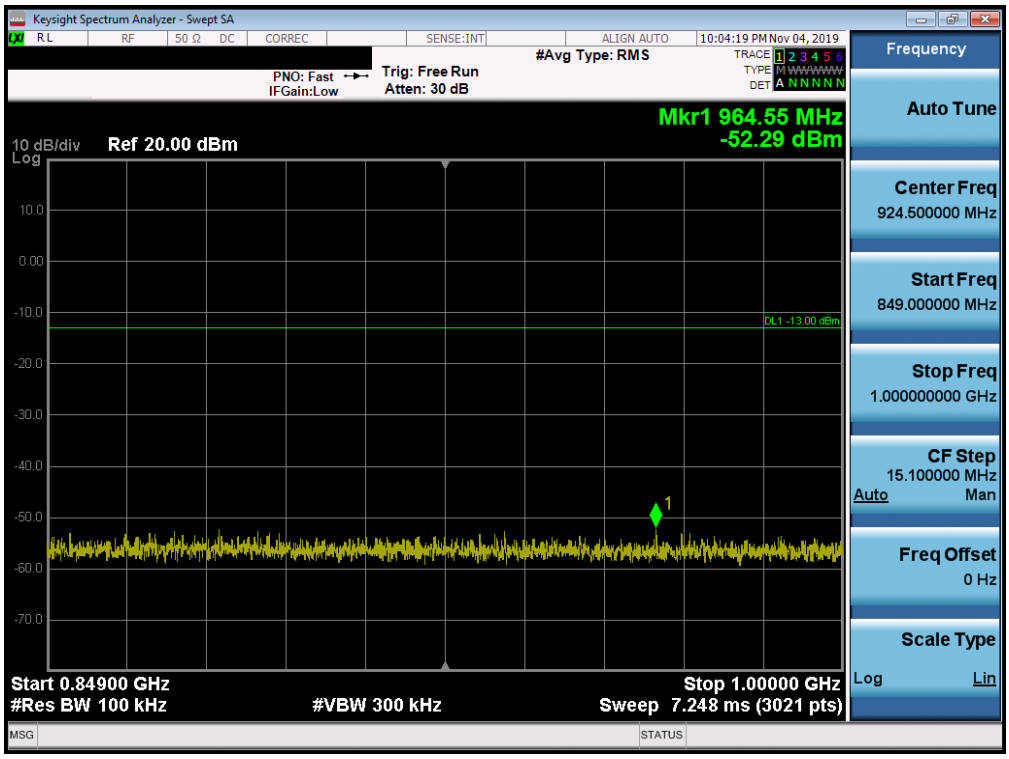
Cellular GPRS Mode



Plot 7-10. Conducted Spurious Plot (Cellular GPRS Mode - Low Channel)



Plot 7-11. Conducted Spurious Plot (Cellular GPRS Mode - Low Channel)

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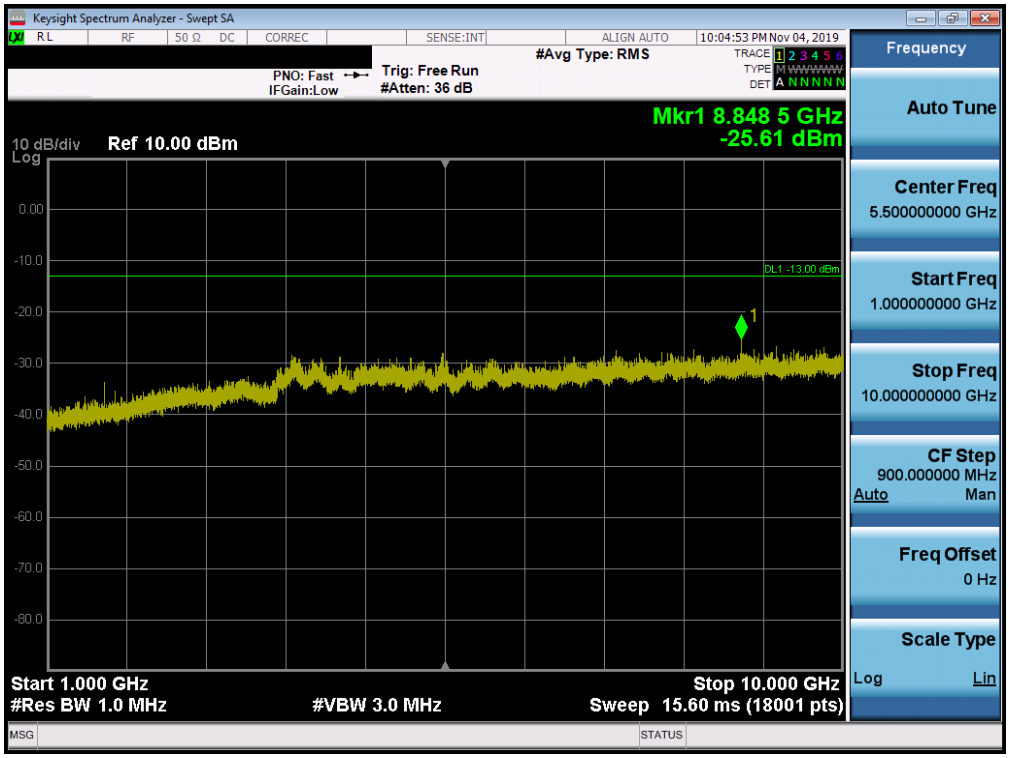
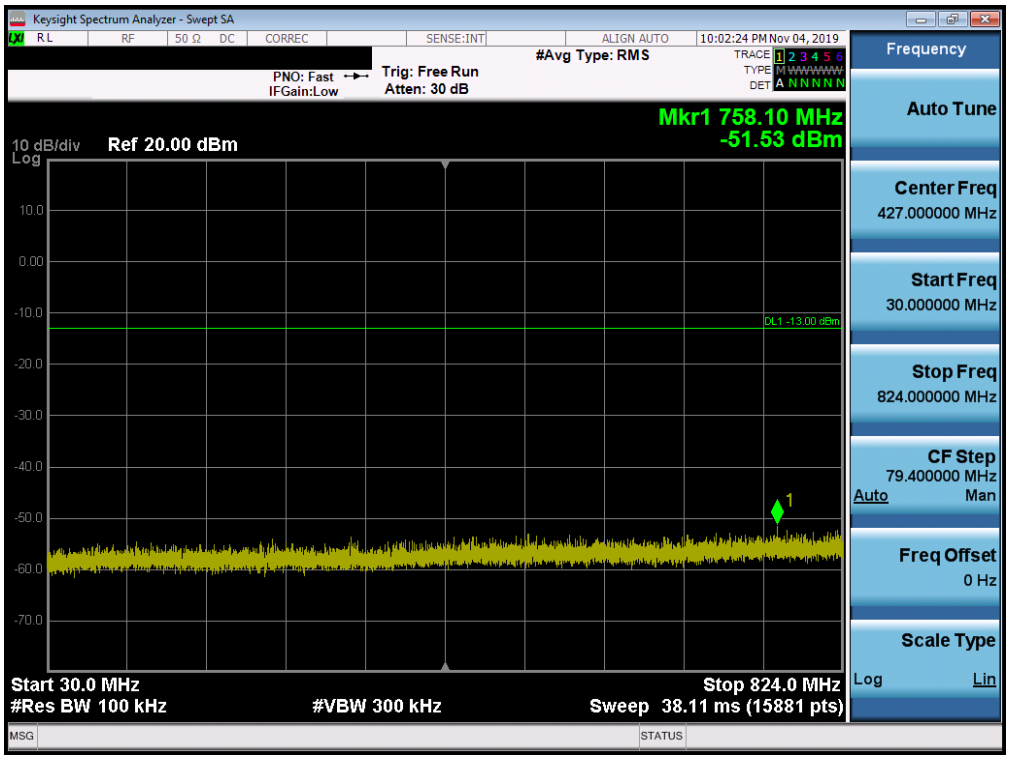


Plot 7-12. Conducted Spurious Plot (Cellular GPRS Mode - Low Channel)



Plot 7-13. Conducted Spurious Plot (Cellular GPRS Mode - Mid Channel)

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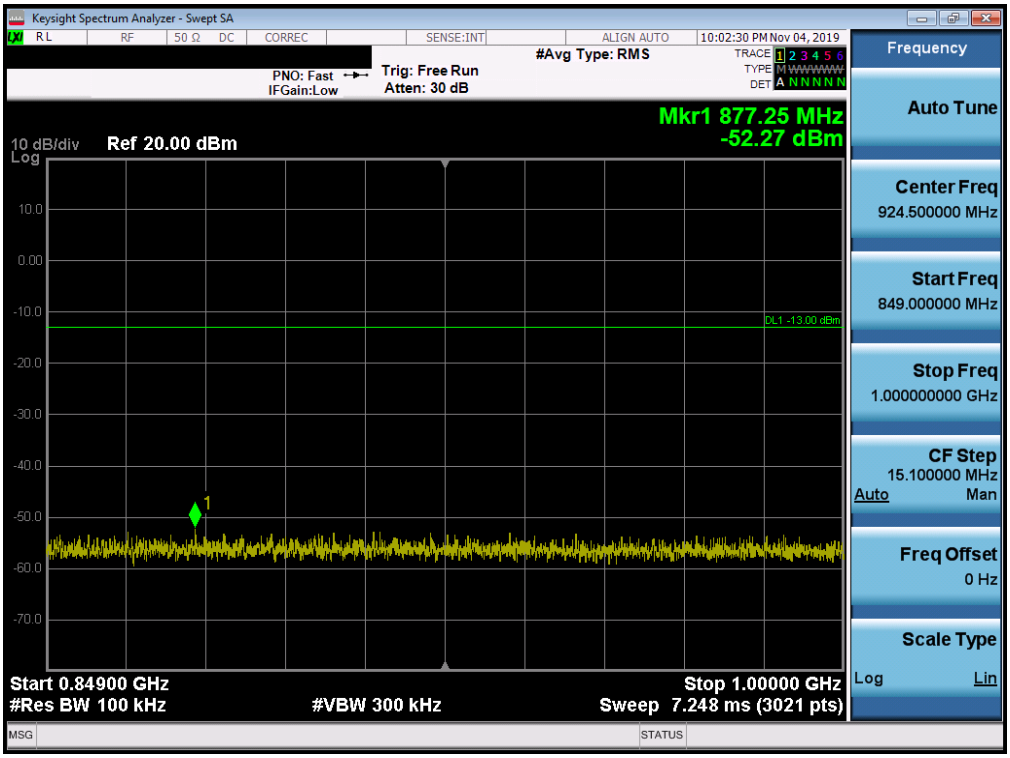
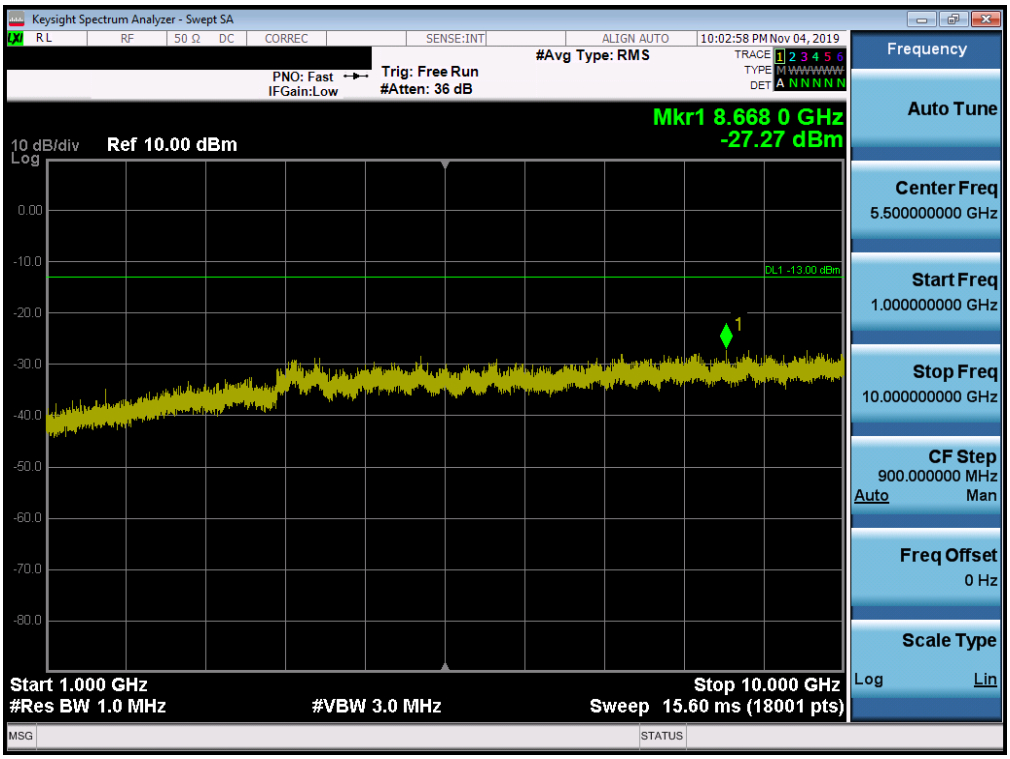


Plot 7-14. Conducted Spurious Plot (Cellular GPRS Mode - Mid Channel)



Plot 7-15. Conducted Spurious Plot (Cellular GPRS Mode - Mid Channel)

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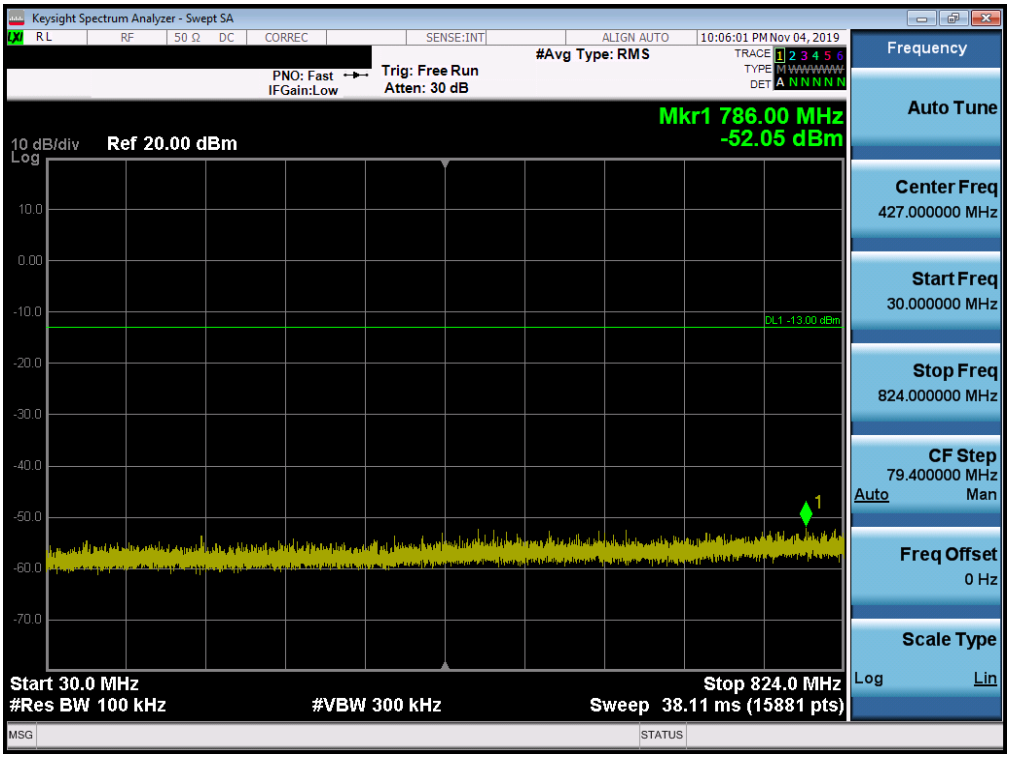
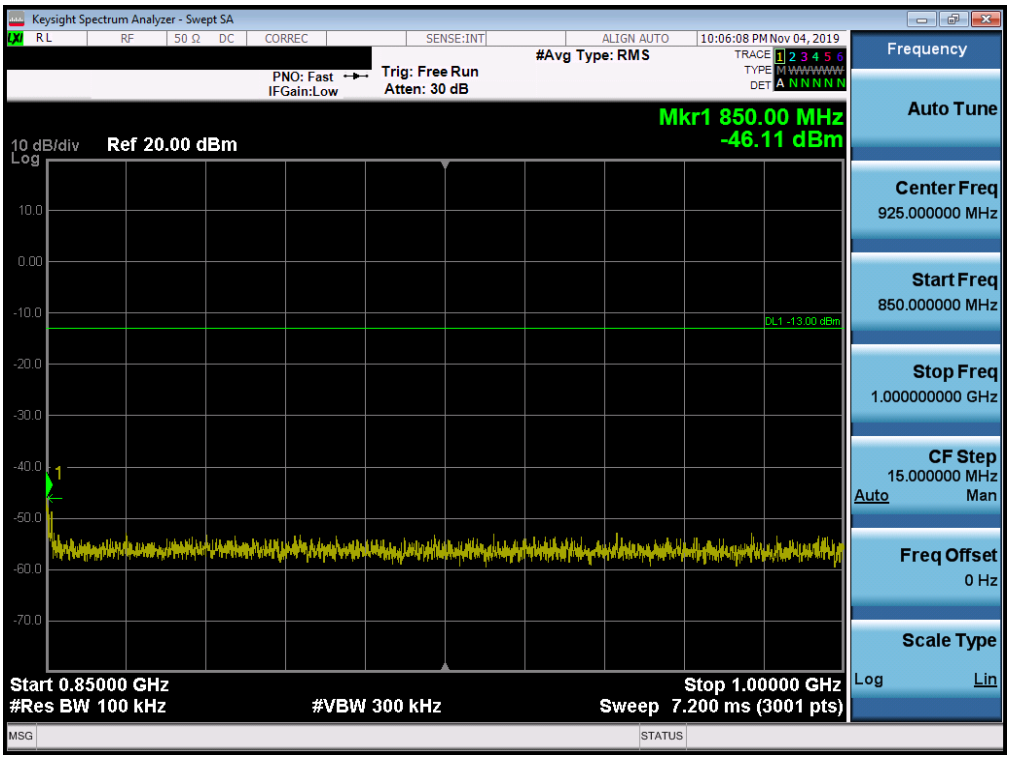


Plot 7-16. Conducted Spurious Plot (Cellular GPRS Mode - High Channel)



Plot 7-17. Conducted Spurious Plot (Cellular GPRS Mode - High Channel)

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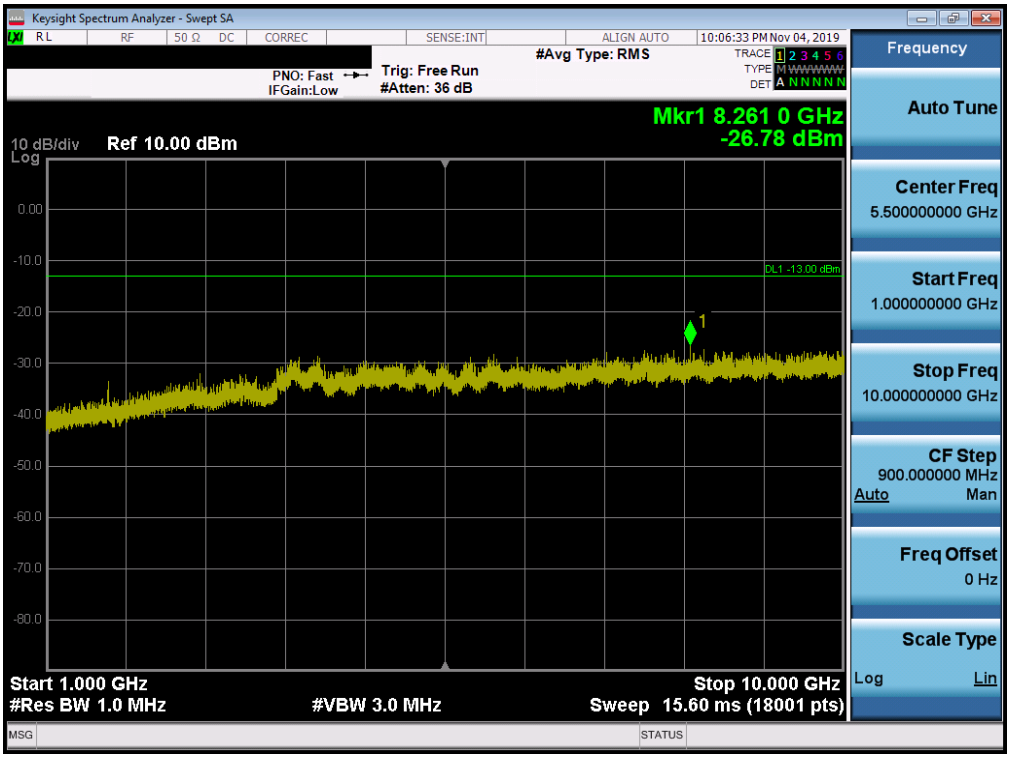

Plot 7-18. Conducted Spurious Plot (Cellular GPRS Mode - High Channel)

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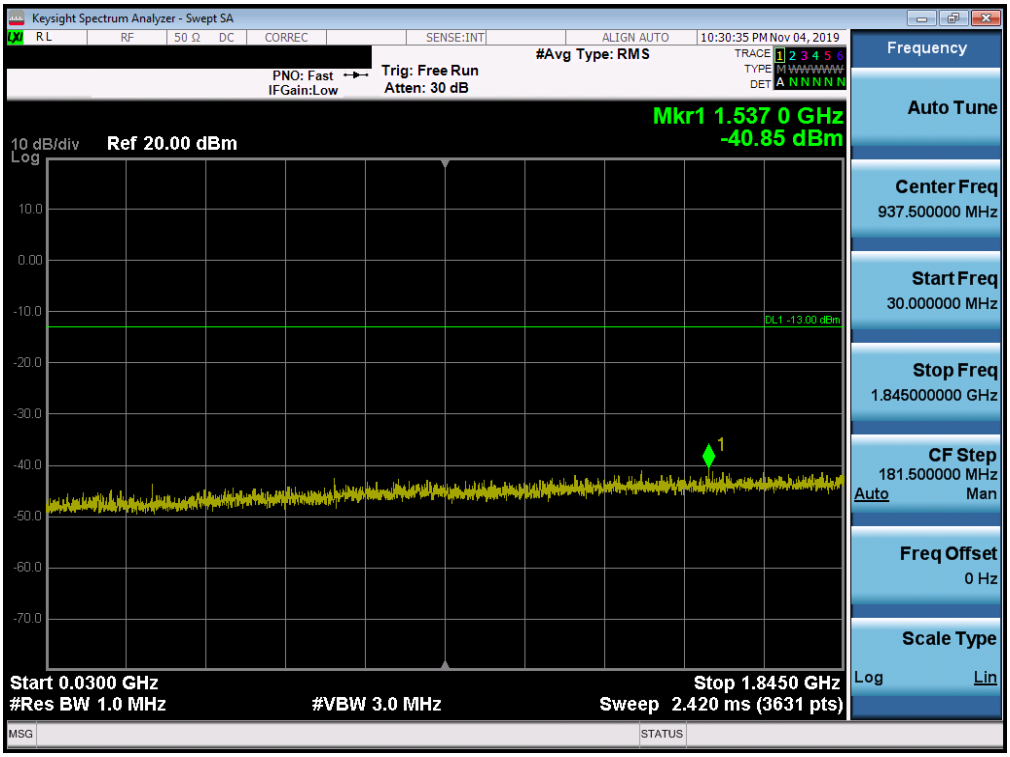
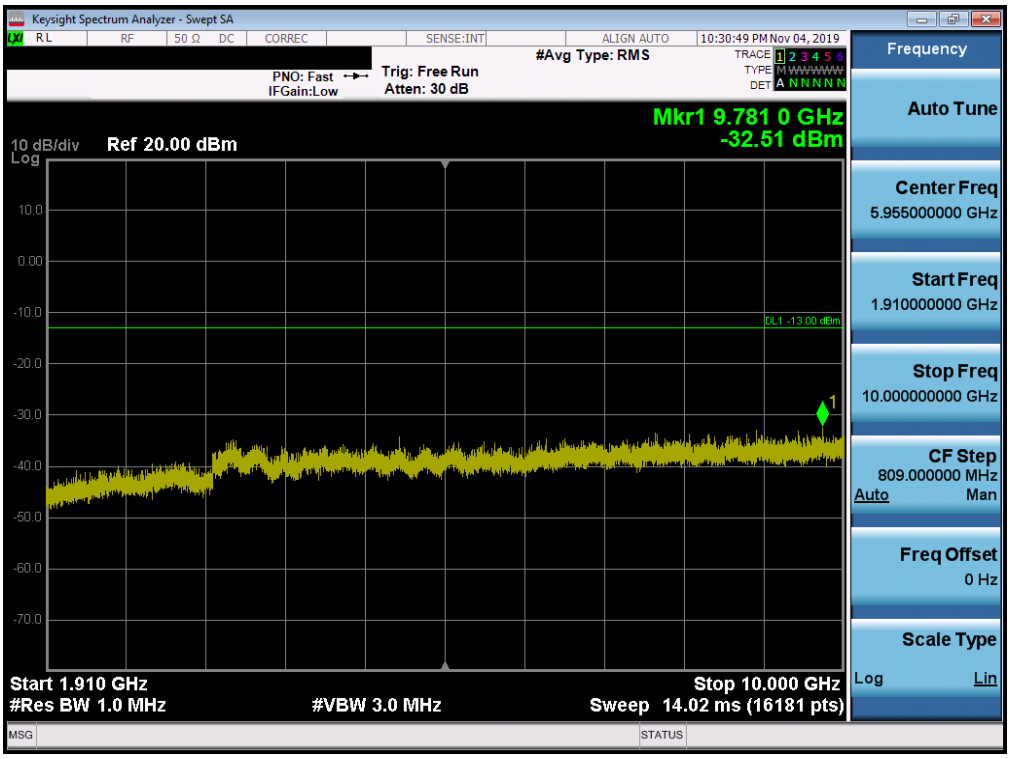
PCS GPRS Mode



Plot 7-19. Conducted Spurious Plot (PCS GPRS Mode - Low Channel)



Plot 7-20. Conducted Spurious Plot (PCS GPRS Mode - Low Channel)

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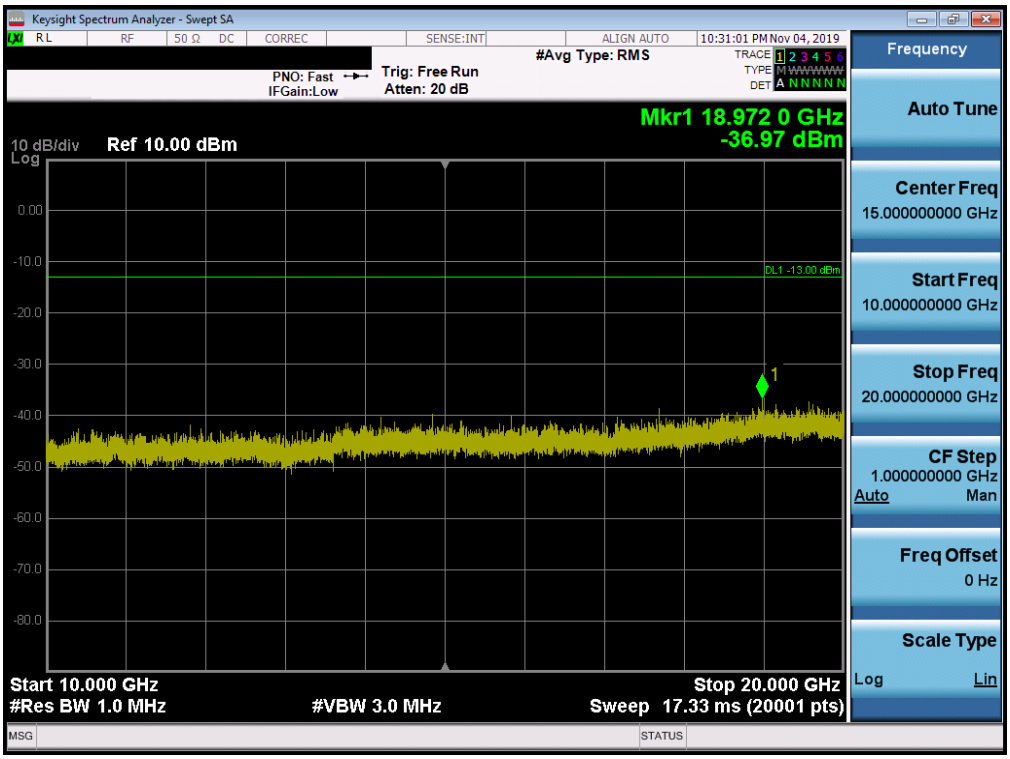
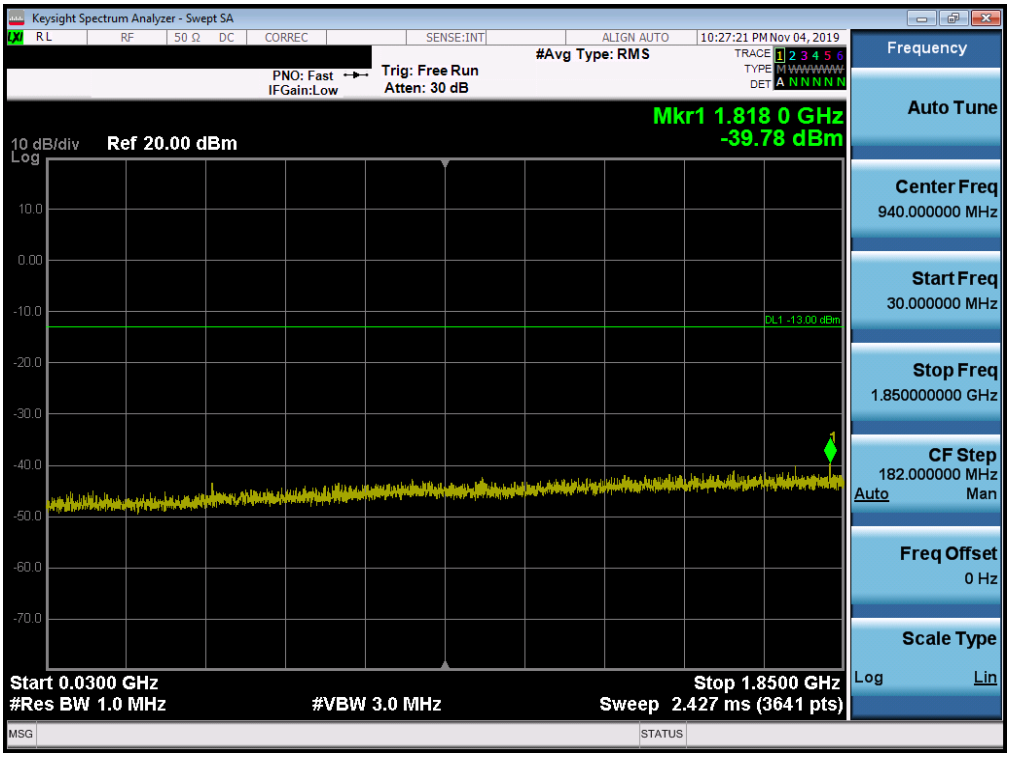


Plot 7-21. Conducted Spurious Plot (PCS GPRS Mode - Low Channel)



Plot 7-22. Conducted Spurious Plot (PCS GPRS Mode - Mid Channel)

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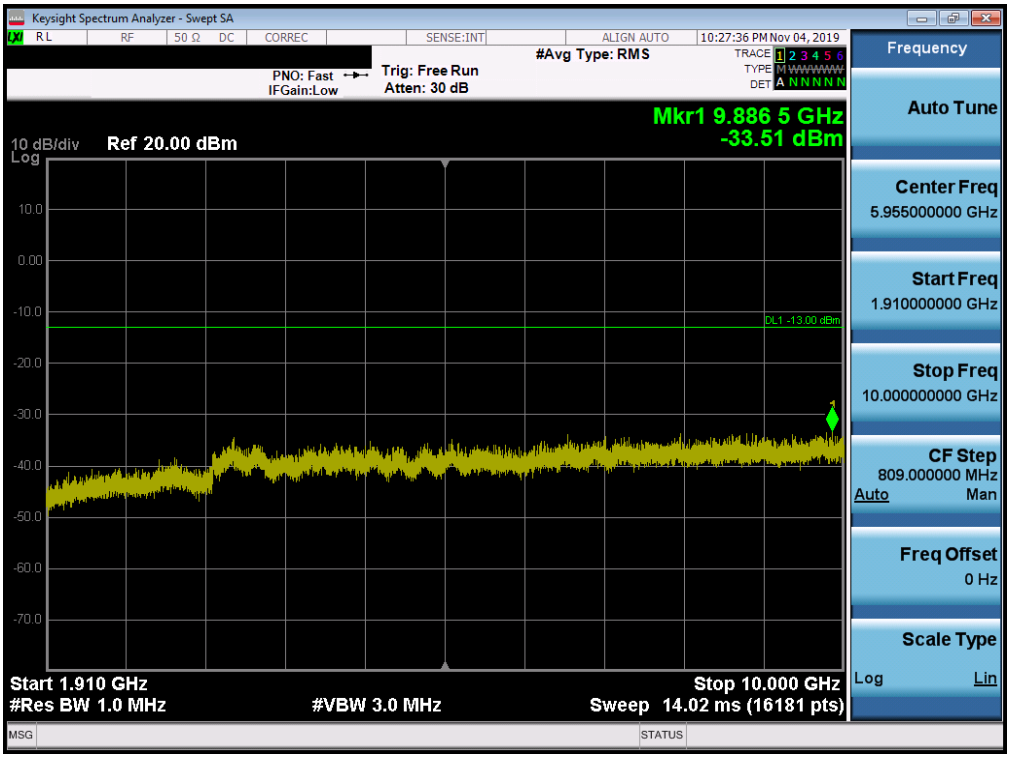
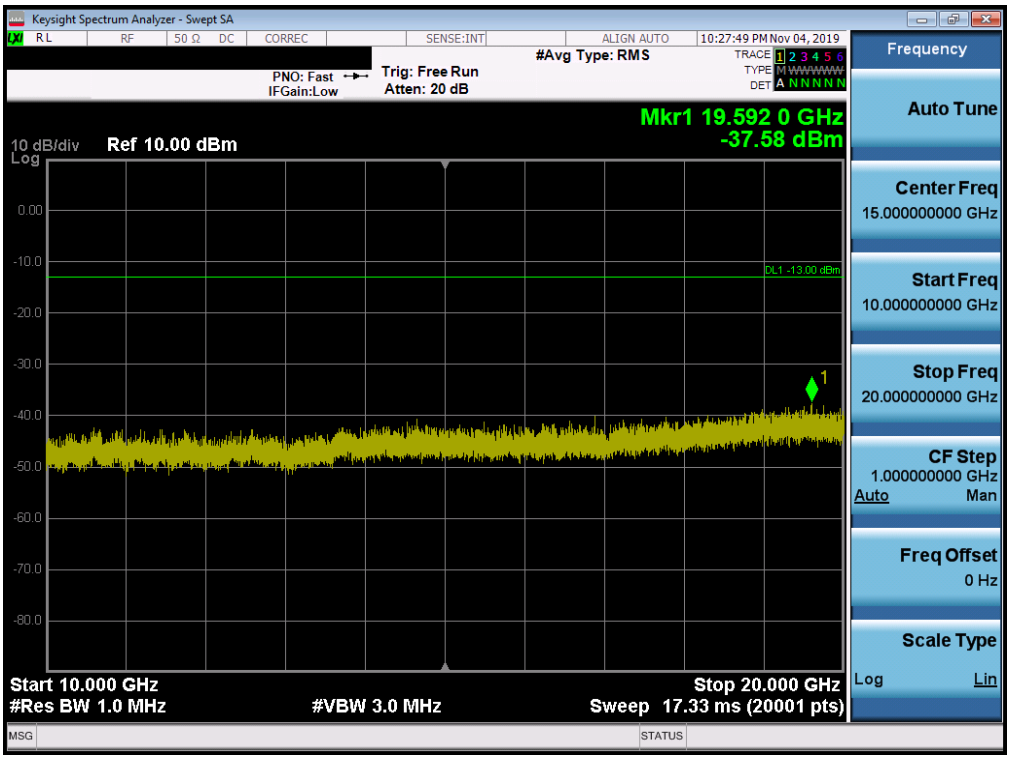


Plot 7-23. Conducted Spurious Plot (PCS GPRS Mode - Mid Channel)



Plot 7-24. Conducted Spurious Plot (PCS GPRS Mode - Mid Channel)

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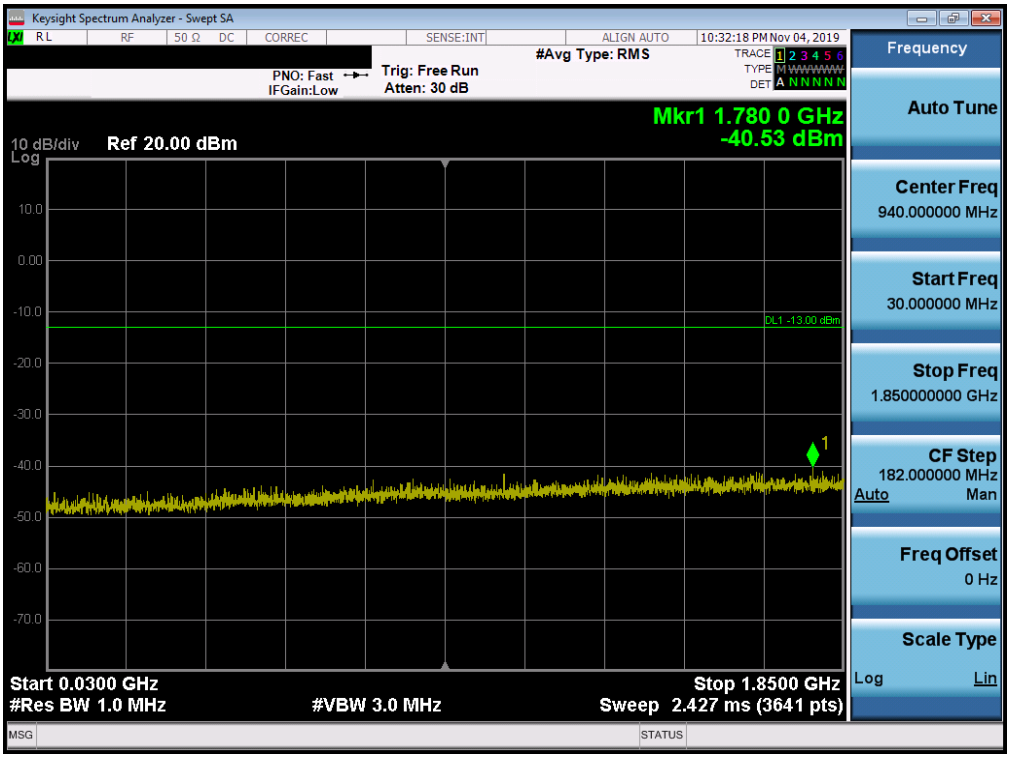
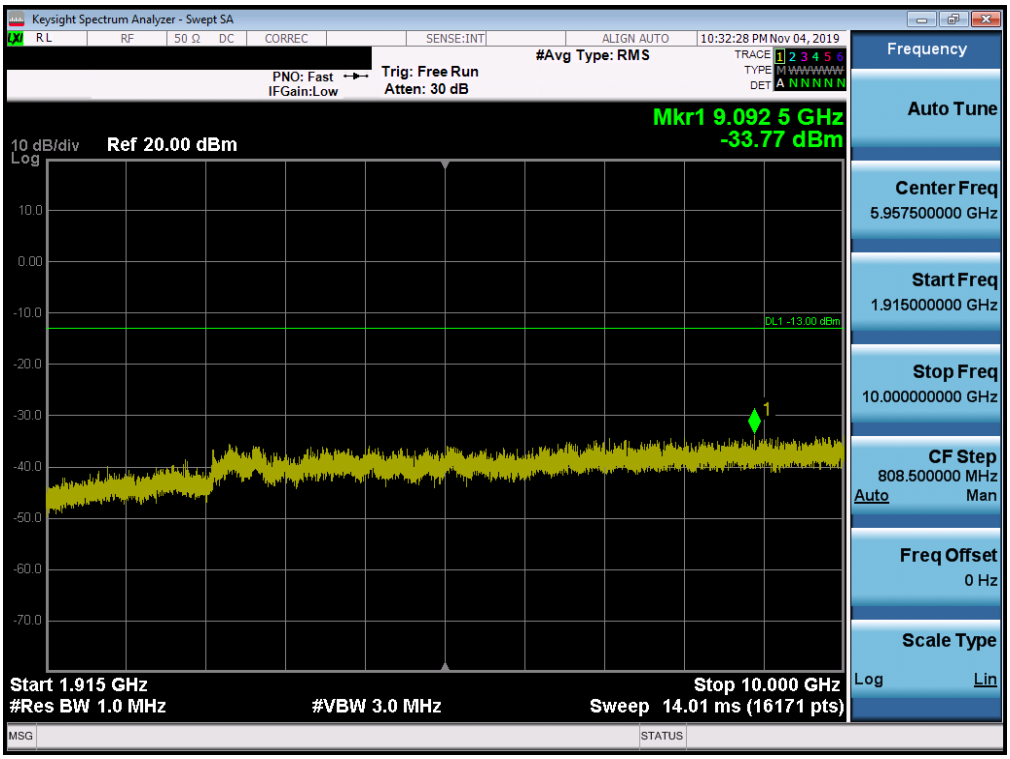


Plot 7-25. Conducted Spurious Plot (PCS GPRS Mode - High Channel)



Plot 7-26. Conducted Spurious Plot (PCS GPRS Mode - High Channel)

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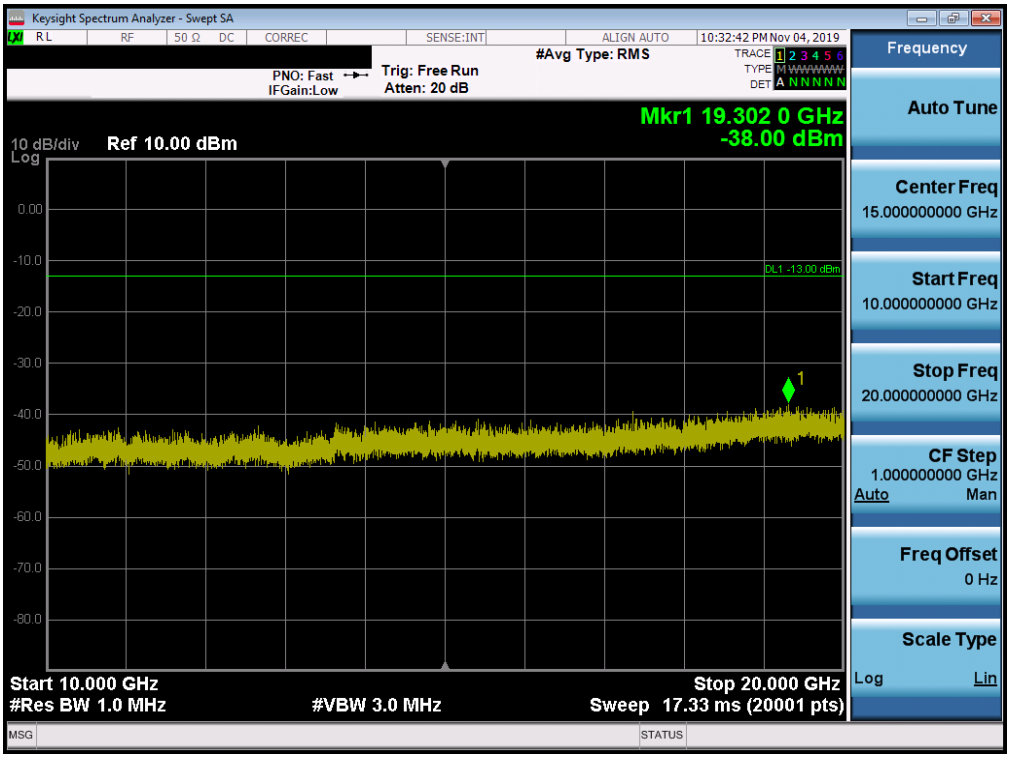

Plot 7-27. Conducted Spurious Plot (PCS GPRS Mode - High Channel)

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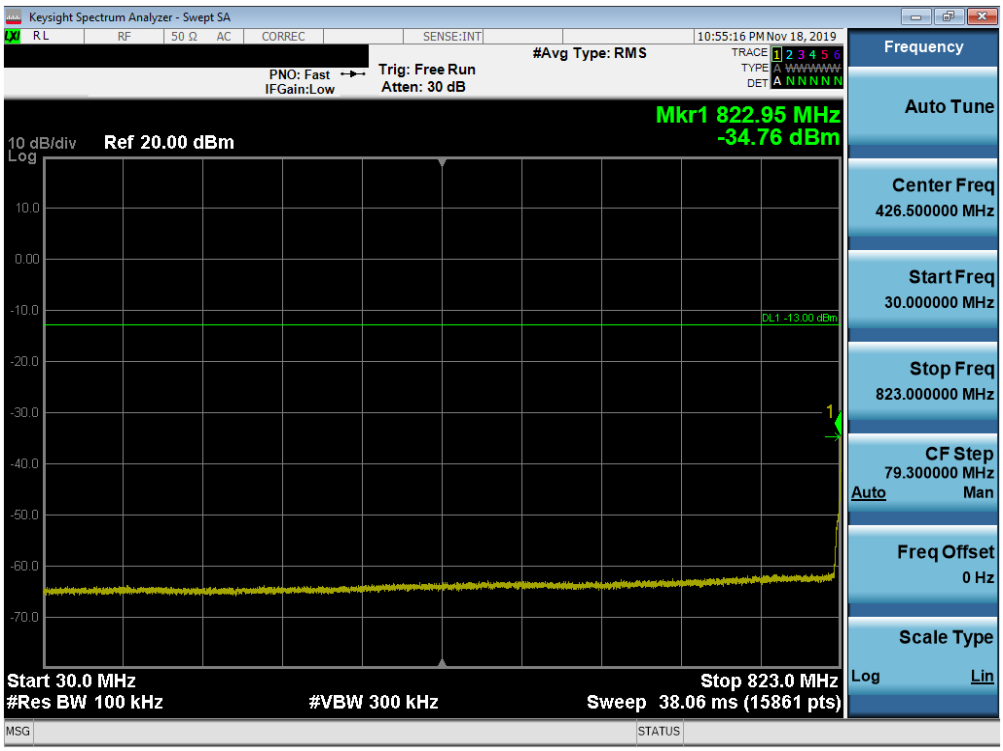
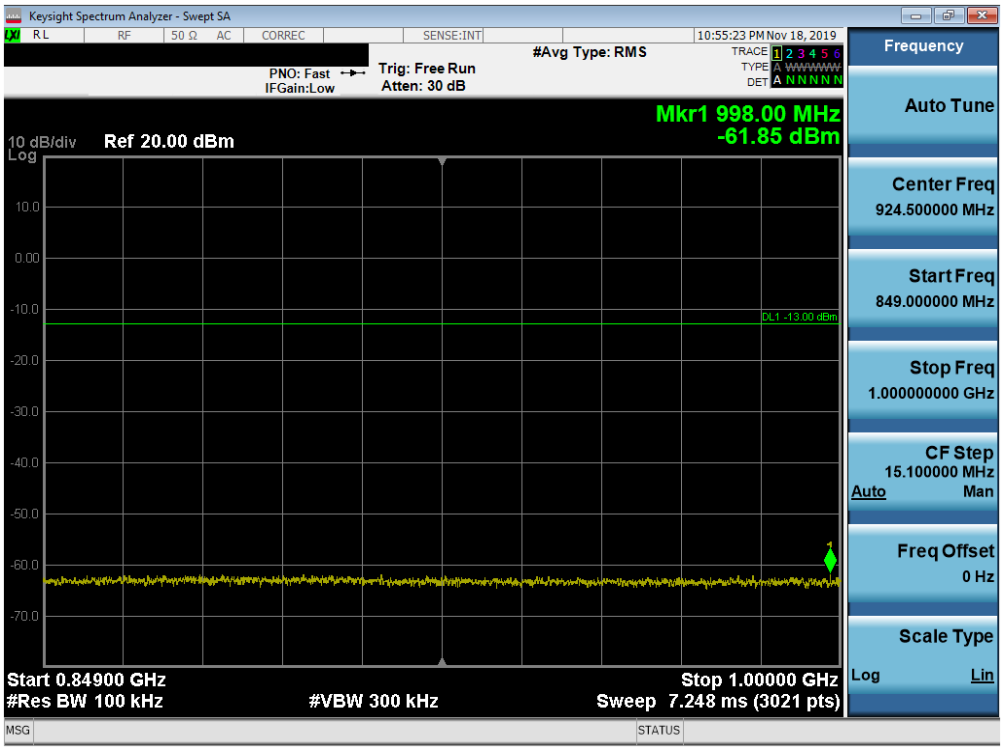
Cellular CDMA Mode



Plot 7-28. Conducted Spurious Plot (Cellular CDMA Mode - Low Channel)



Plot 7-29. Conducted Spurious Plot (Cellular CDMA Mode - Low Channel)

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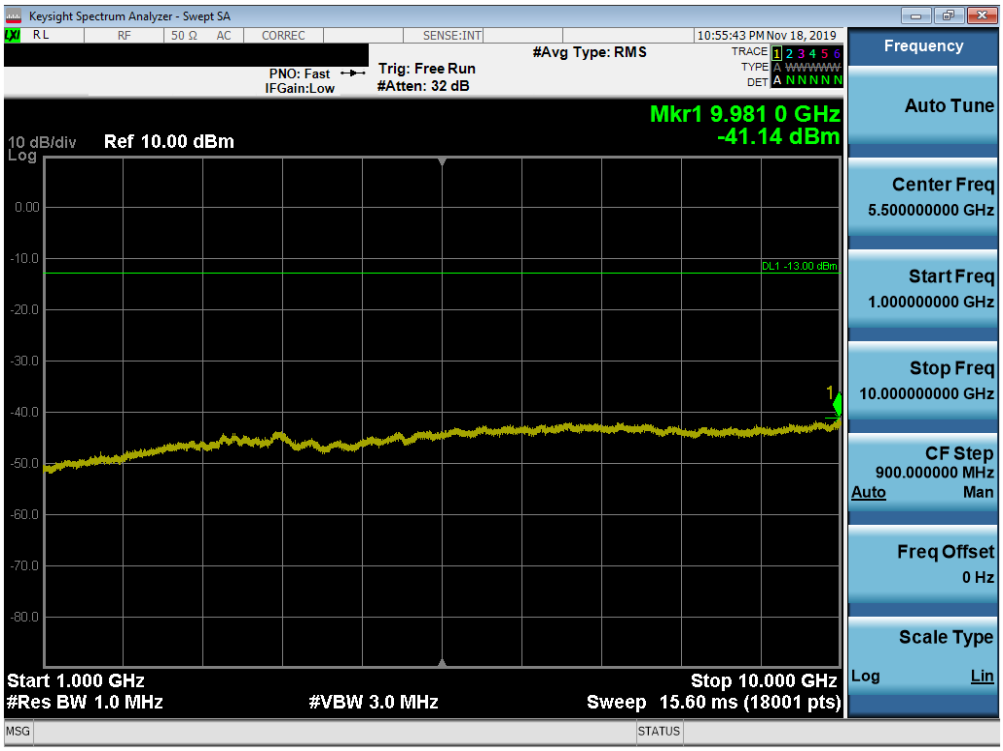
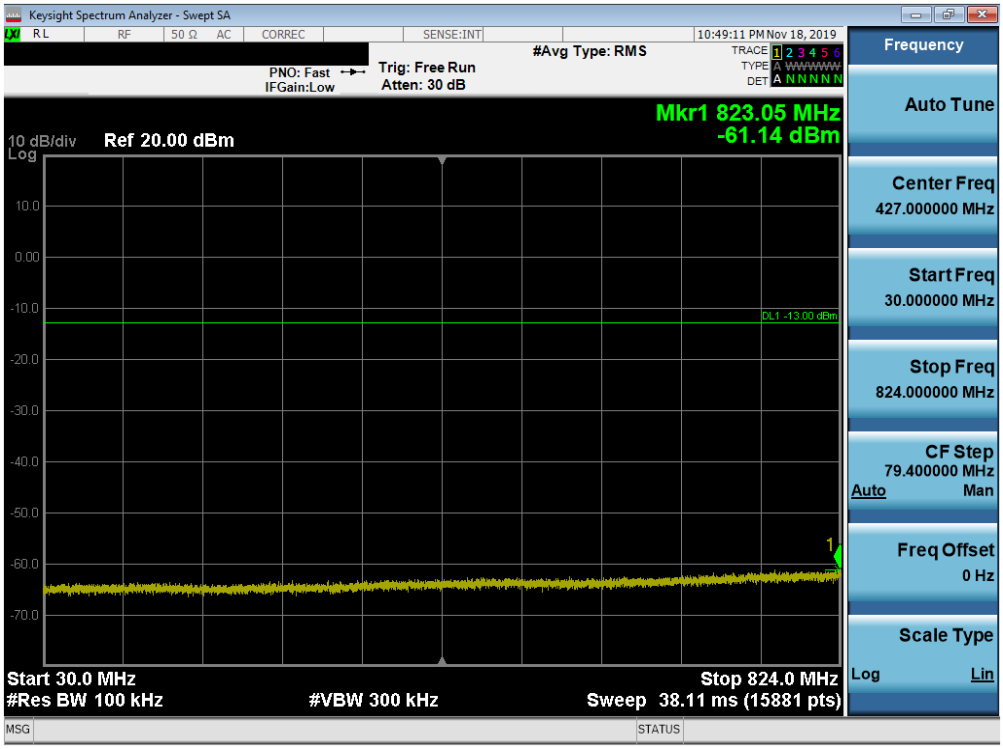


Plot 7-30. Conducted Spurious Plot (Cellular CDMA Mode - Low Channel)



Plot 7-31. Conducted Spurious Plot (Cellular CDMA Mode - Mid Channel)

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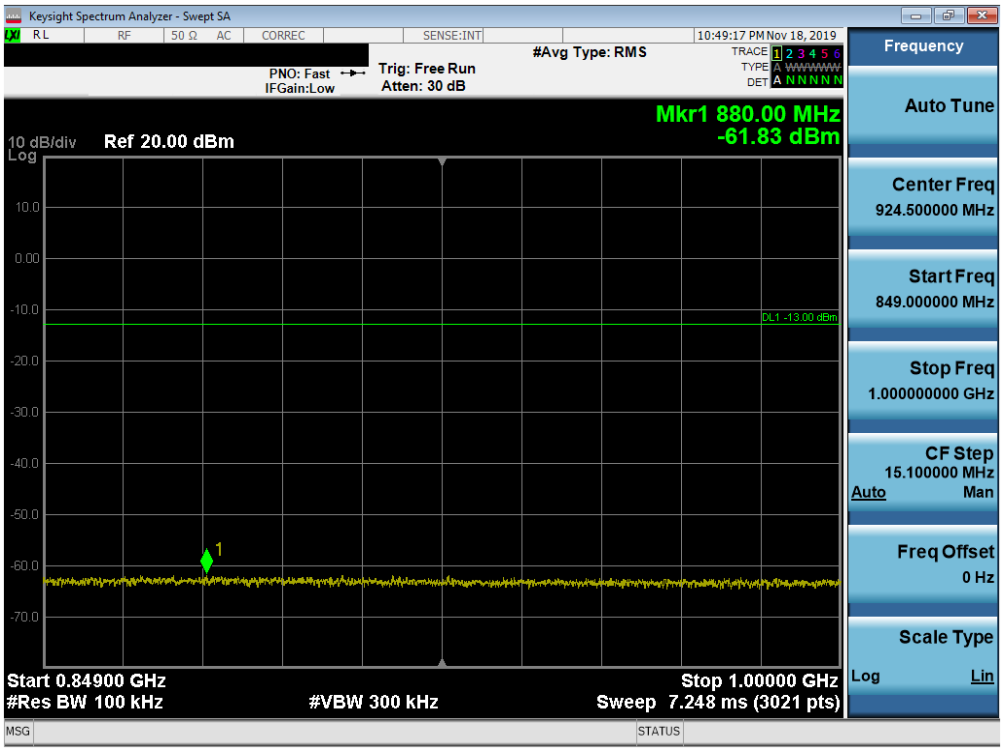
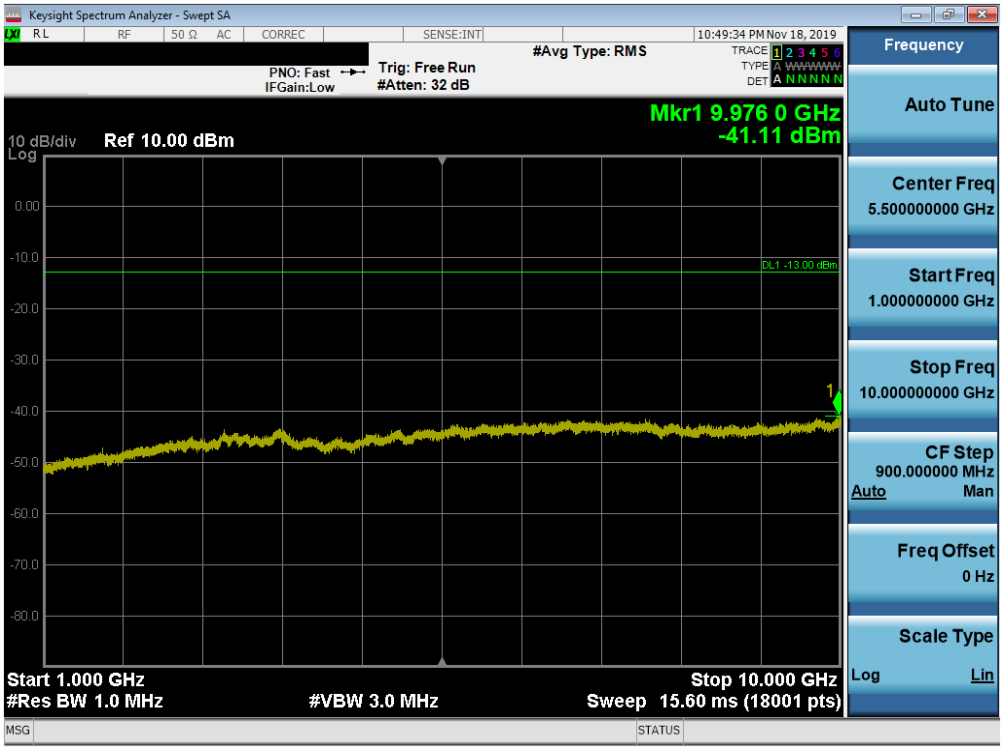


Plot 7-32. Conducted Spurious Plot (Cellular CDMA Mode - Mid Channel)



Plot 7-33. Conducted Spurious Plot (Cellular CDMA Mode - Mid Channel)

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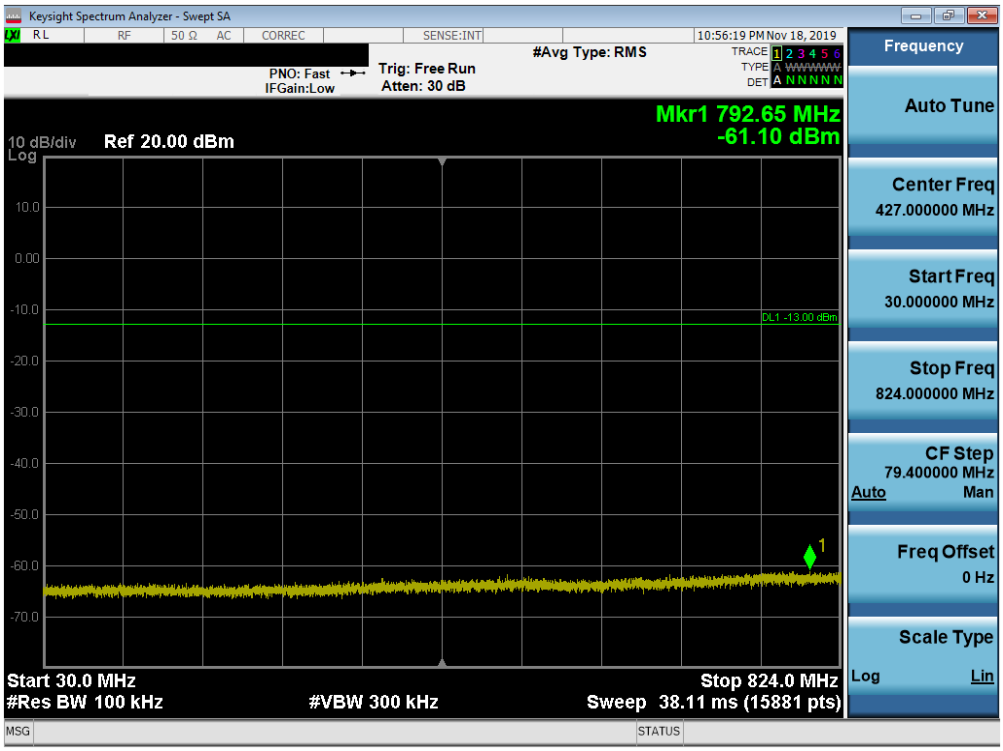
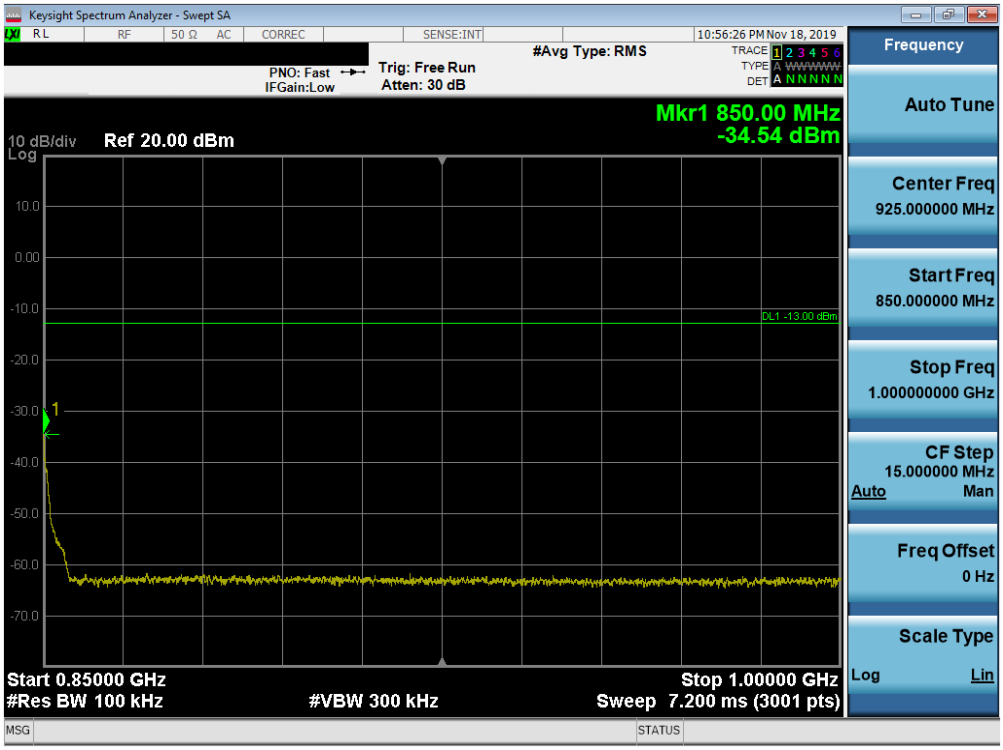


Plot 7-34. Conducted Spurious Plot (Cellular CDMA Mode - High Channel)



Plot 7-35. Conducted Spurious Plot (Cellular CDMA Mode - High Channel)

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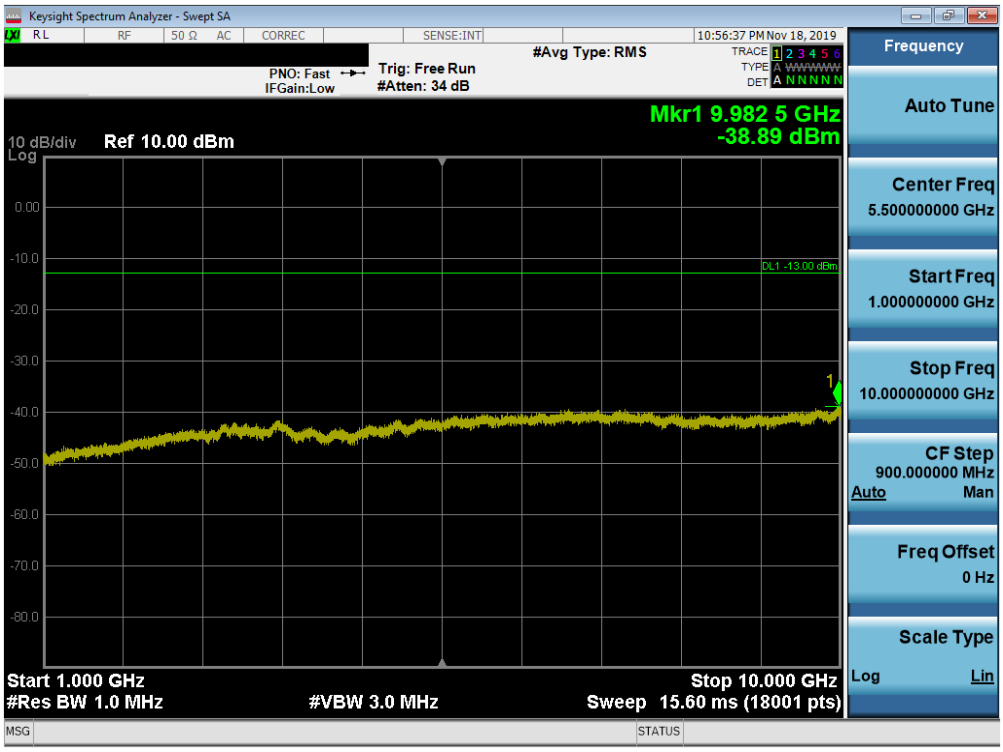

Plot 7-36. Conducted Spurious Plot (Cellular CDMA Mode - High Channel)

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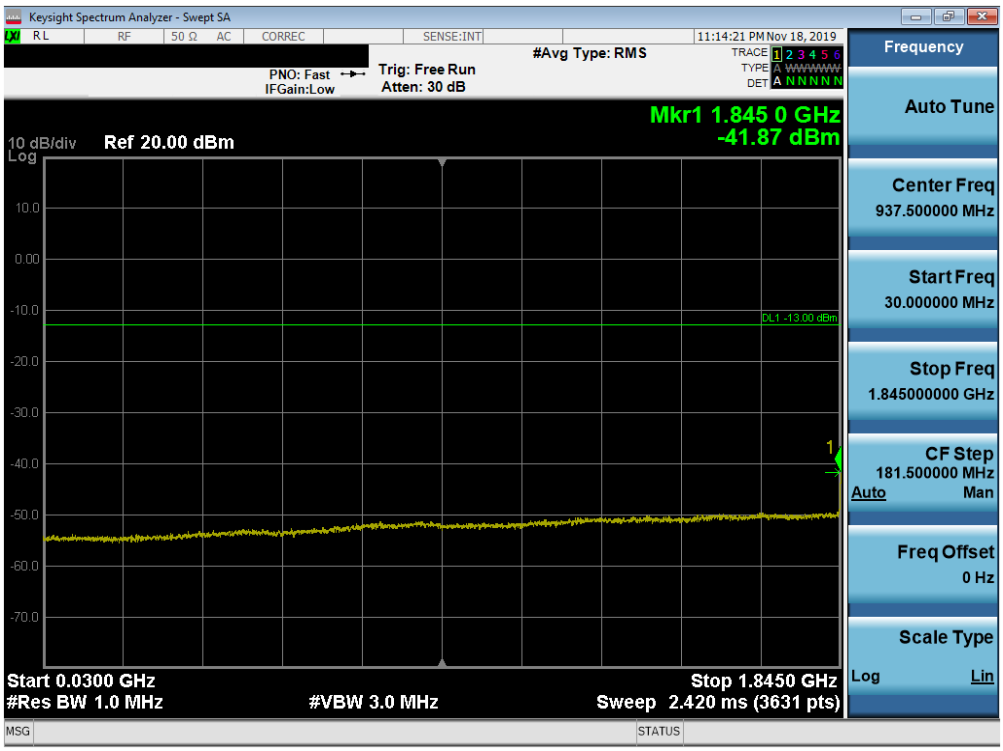
PCS CDMA Mode



Plot 7-37. Conducted Spurious Plot (PCS CDMA Mode - Low Channel)

Plot 7-38. Conducted Spurious Plot (PCS CDMA Mode - Low Channel)

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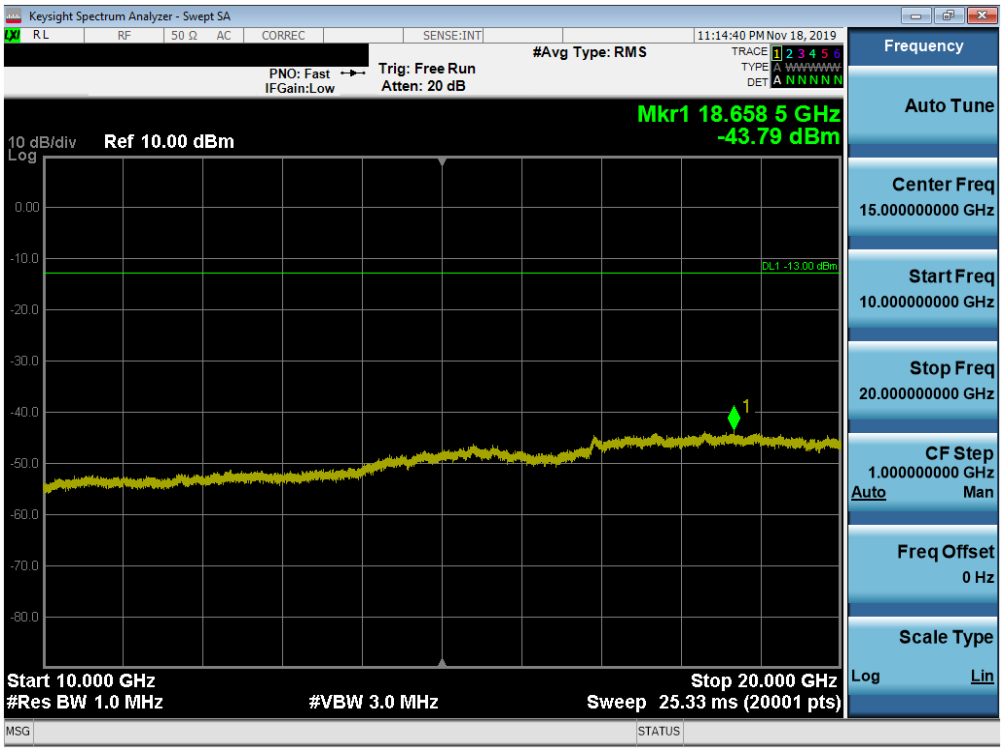
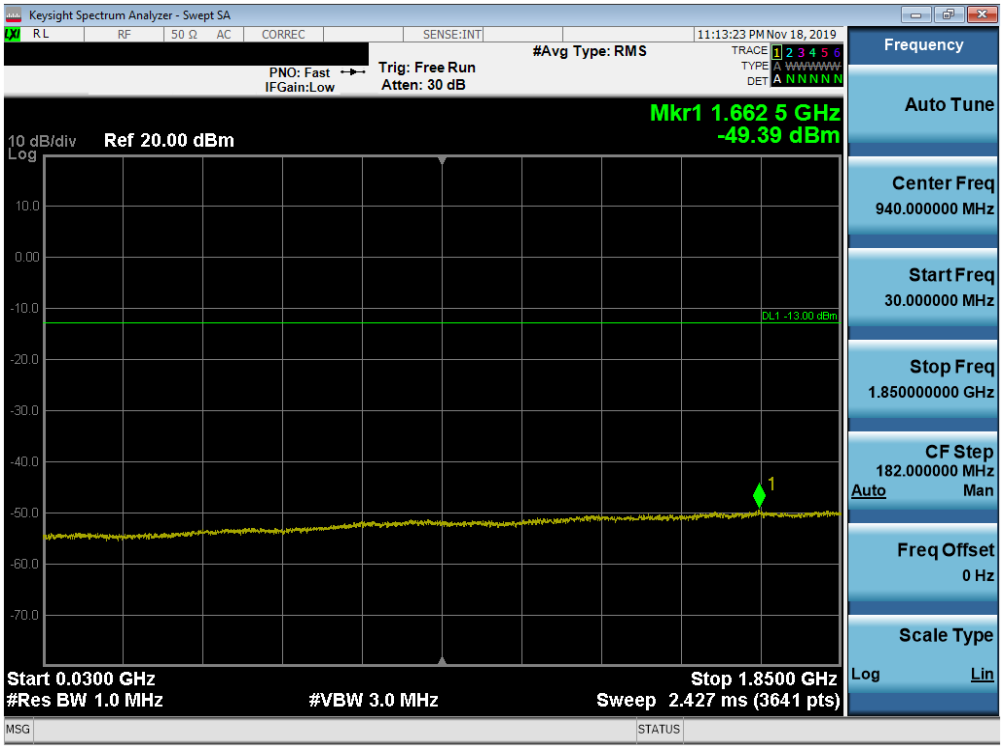


Plot 7-39. Conducted Spurious Plot (PCS CDMA Mode - Low Channel)



Plot 7-40. Conducted Spurious Plot (PCS CDMA Mode - Mid Channel)

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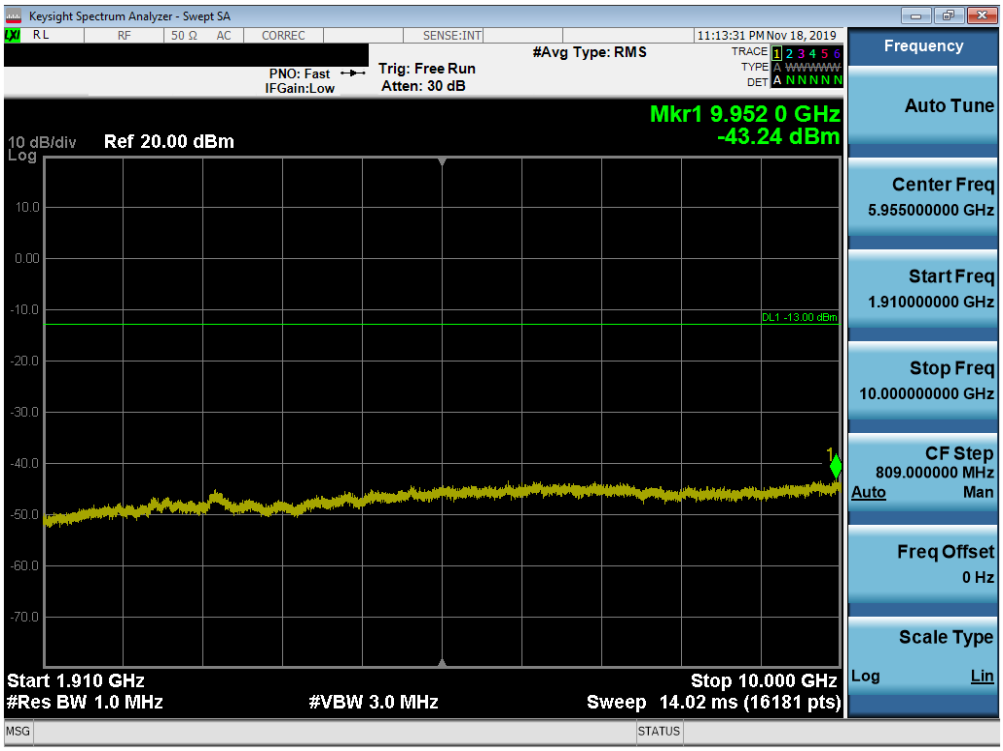
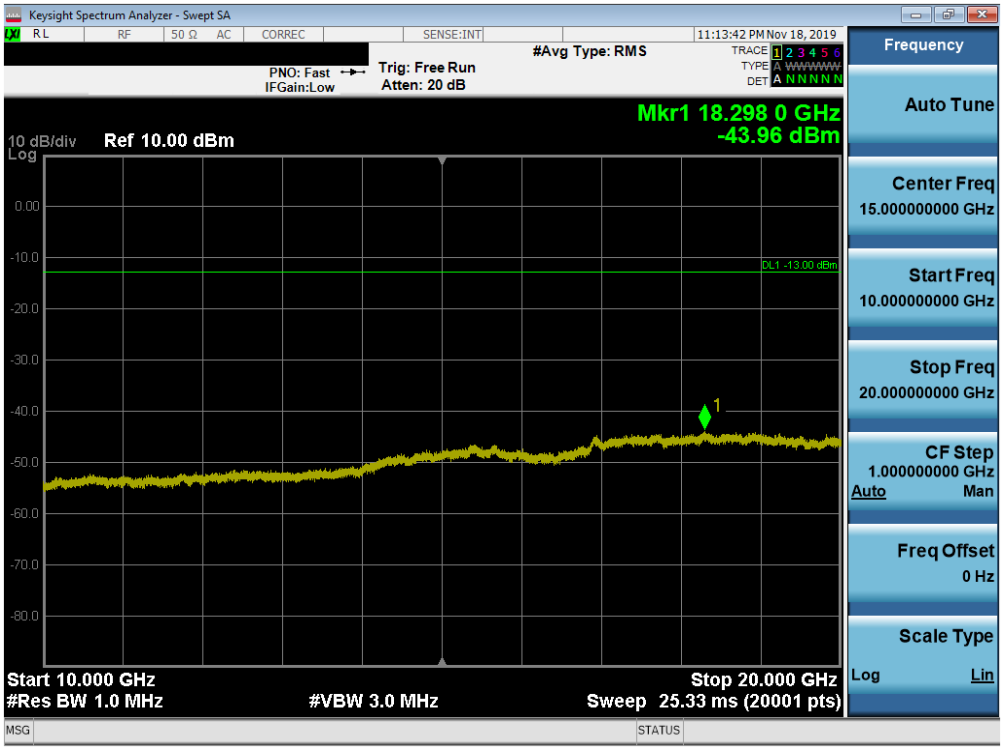


Plot 7-41. Conducted Spurious Plot (PCS CDMA Mode - Mid Channel)



Plot 7-42. Conducted Spurious Plot (PCS CDMA Mode - Mid Channel)

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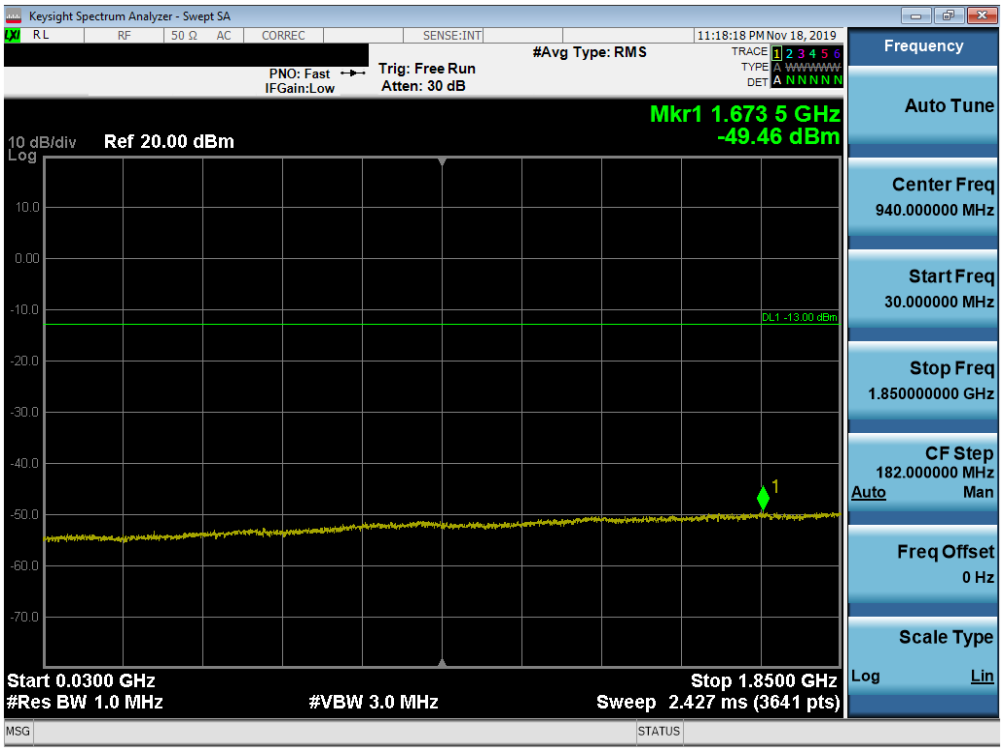
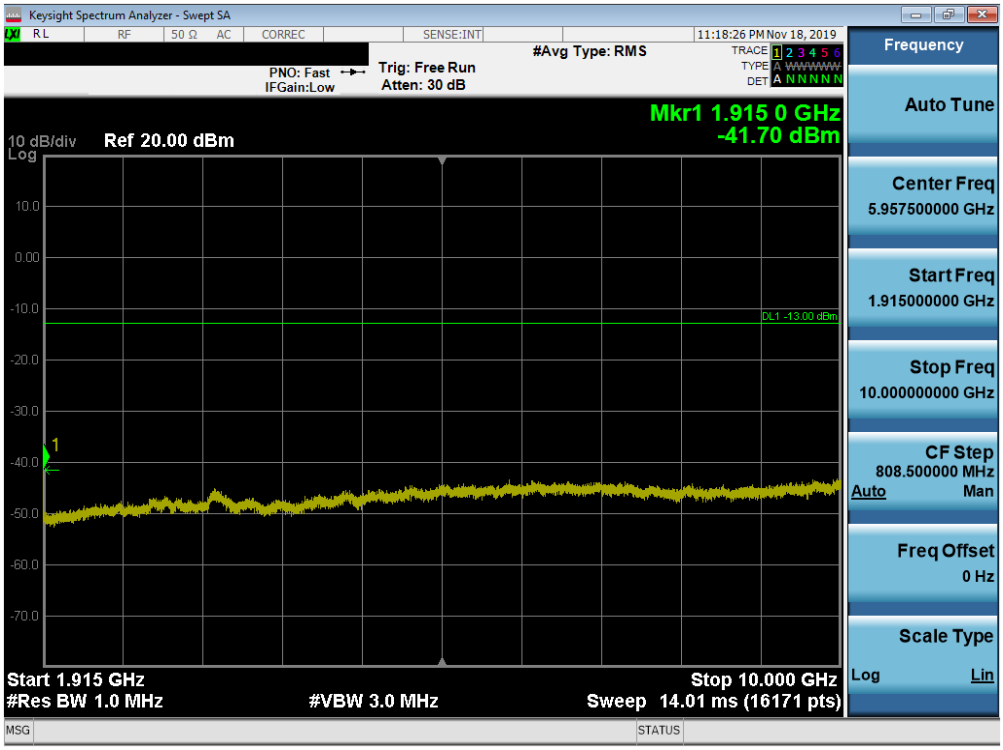


Plot 7-43. Conducted Spurious Plot (PCS CDMA Mode - High Channel)



Plot 7-44. Conducted Spurious Plot (PCS CDMA Mode - High Channel)

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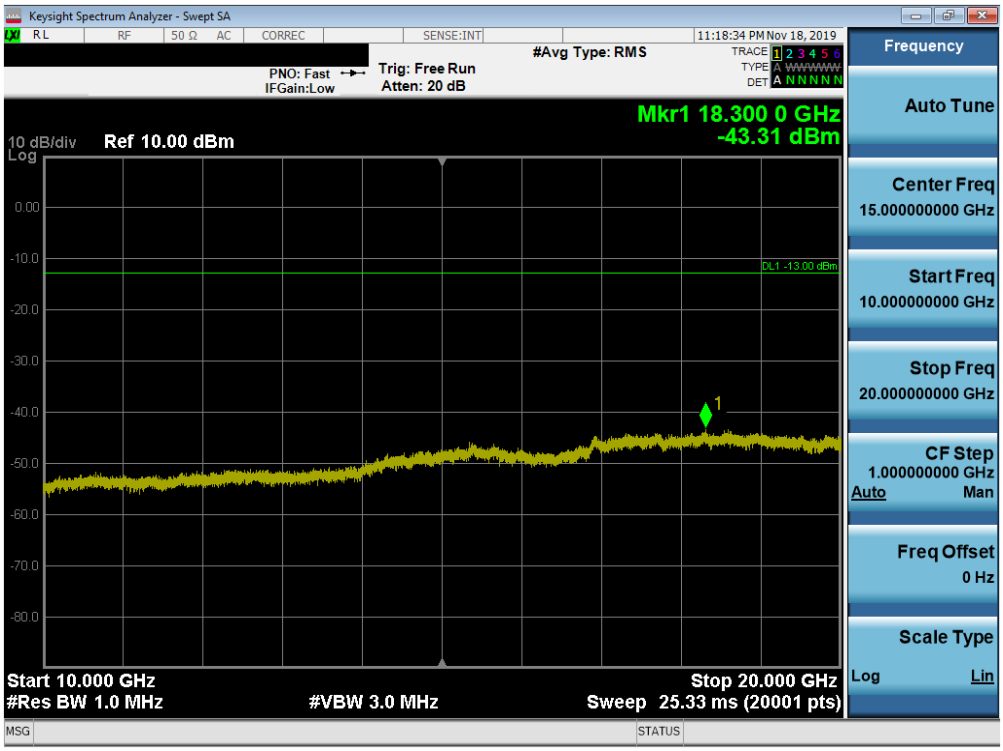

Plot 7-45. Conducted Spurious Plot (PCS CDMA Mode - High Channel)

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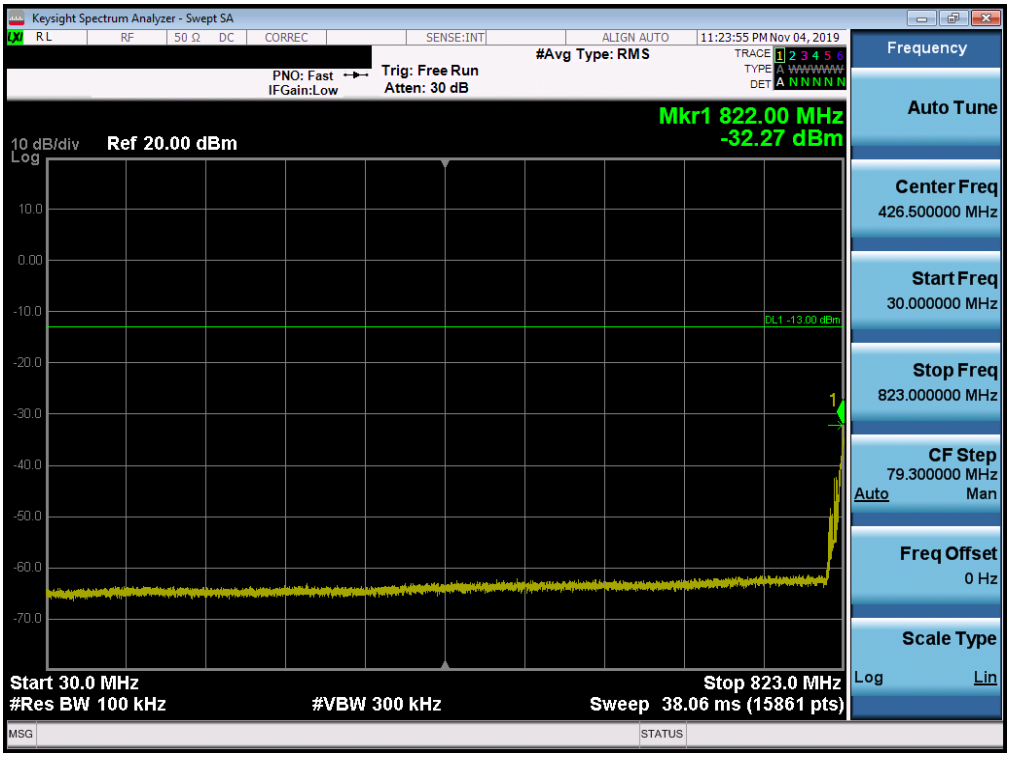
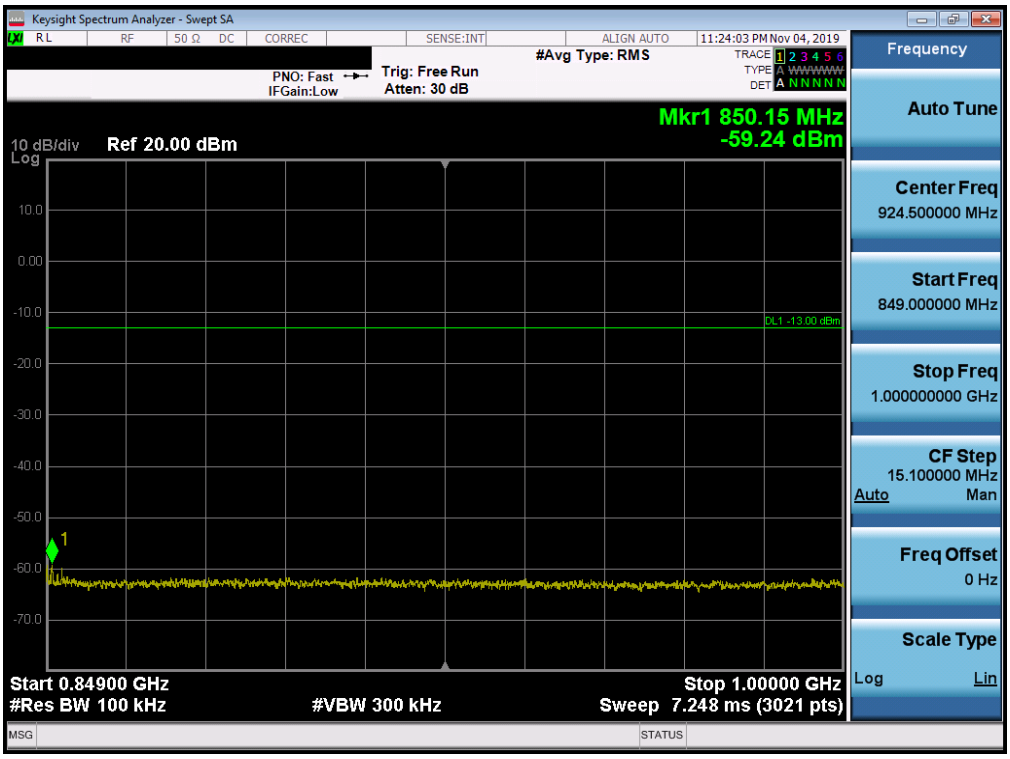
Cellular WCDMA Mode



Plot 7-46. Conducted Spurious Plot (Cellular WCDMA Mode - Low Channel)



Plot 7-47. Conducted Spurious Plot (Cellular WCDMA Mode - Low Channel)

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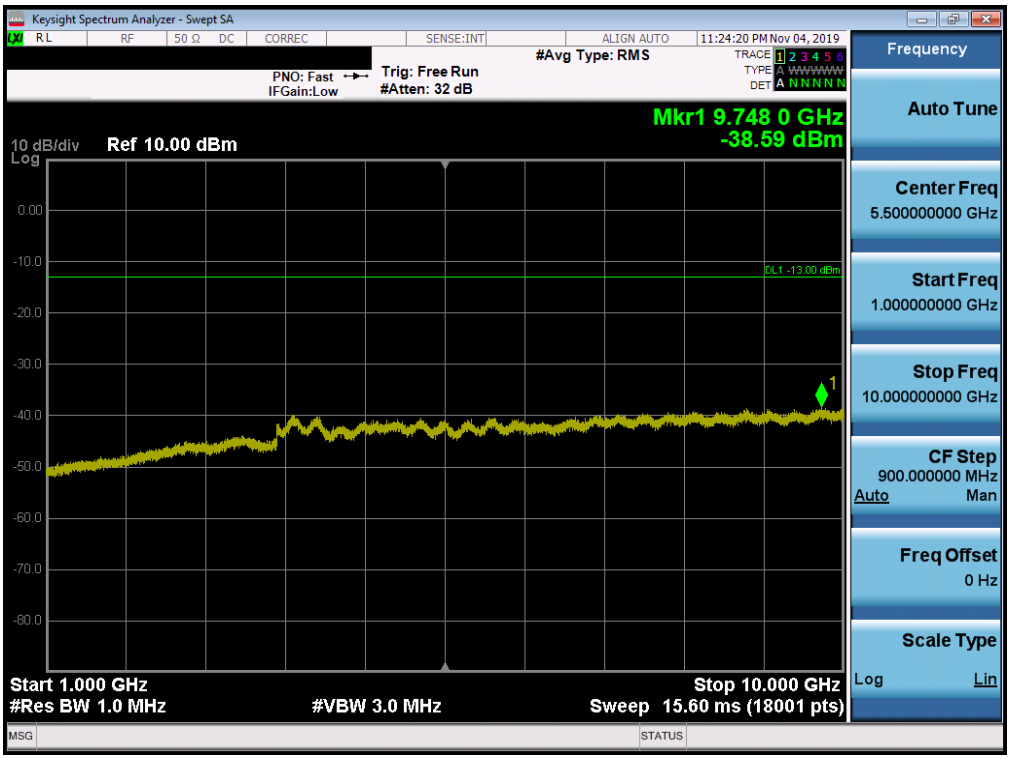
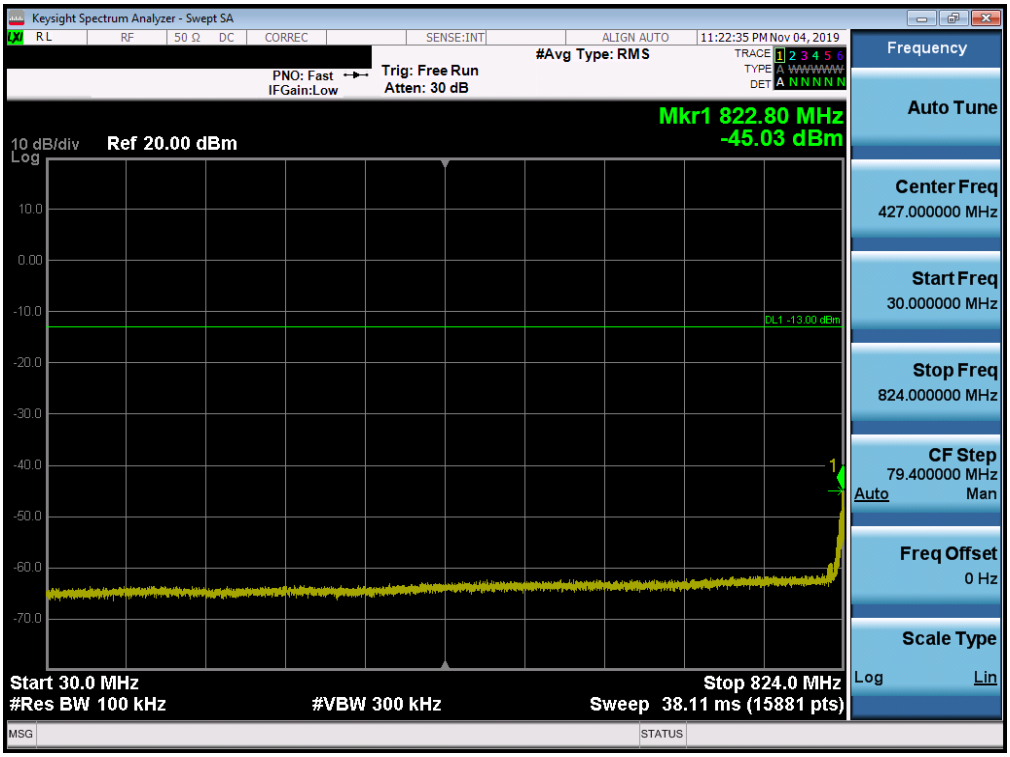


Plot 7-48. Conducted Spurious Plot (Cellular WCDMA Mode - Low Channel)



Plot 7-49. Conducted Spurious Plot (Cellular WCDMA Mode - Mid Channel)

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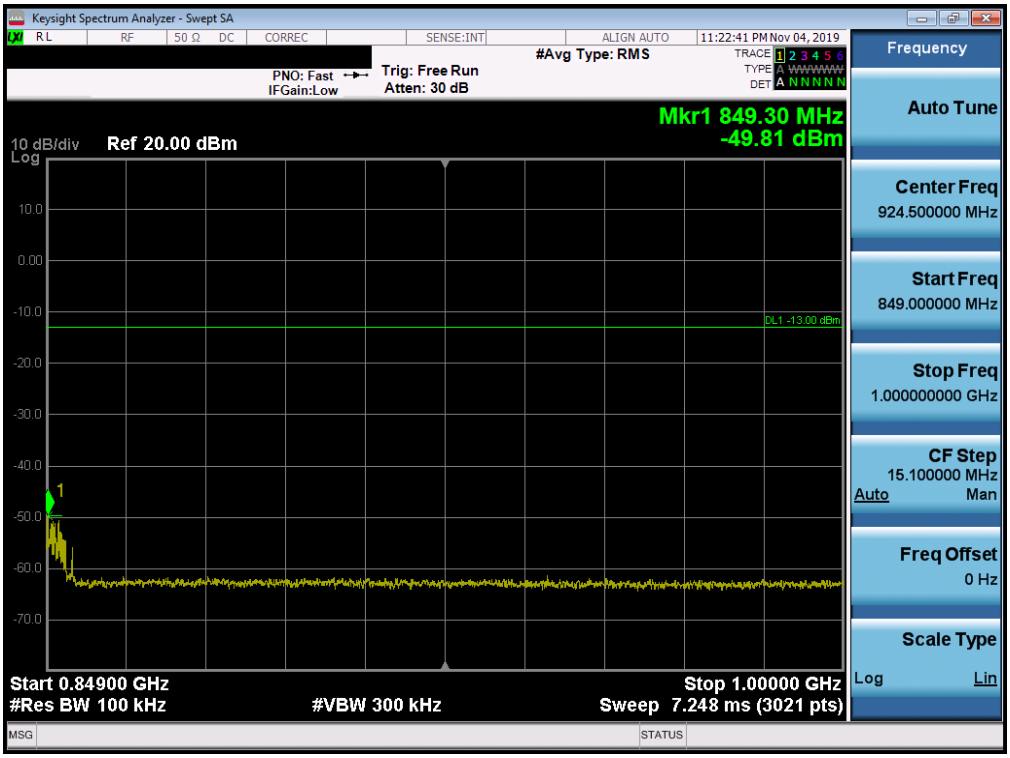

Plot 7-50. Conducted Spurious Plot (Cellular WCDMA Mode - Mid Channel)

Plot 7-51. Conducted Spurious Plot (Cellular WCDMA Mode - Mid Channel)

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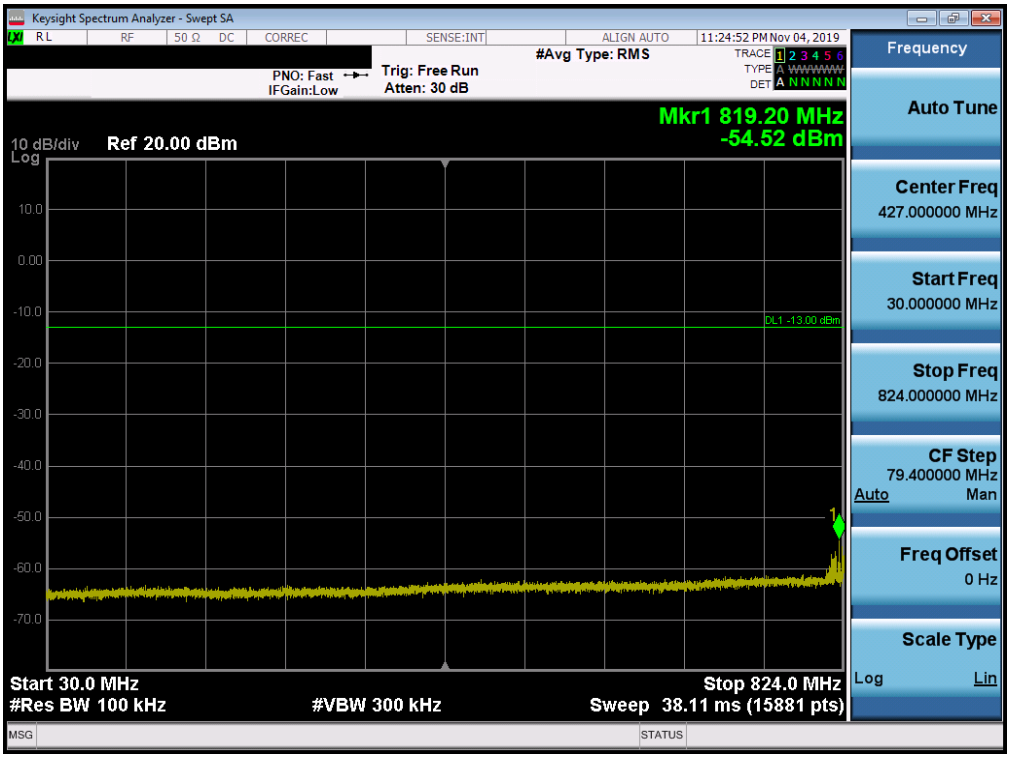
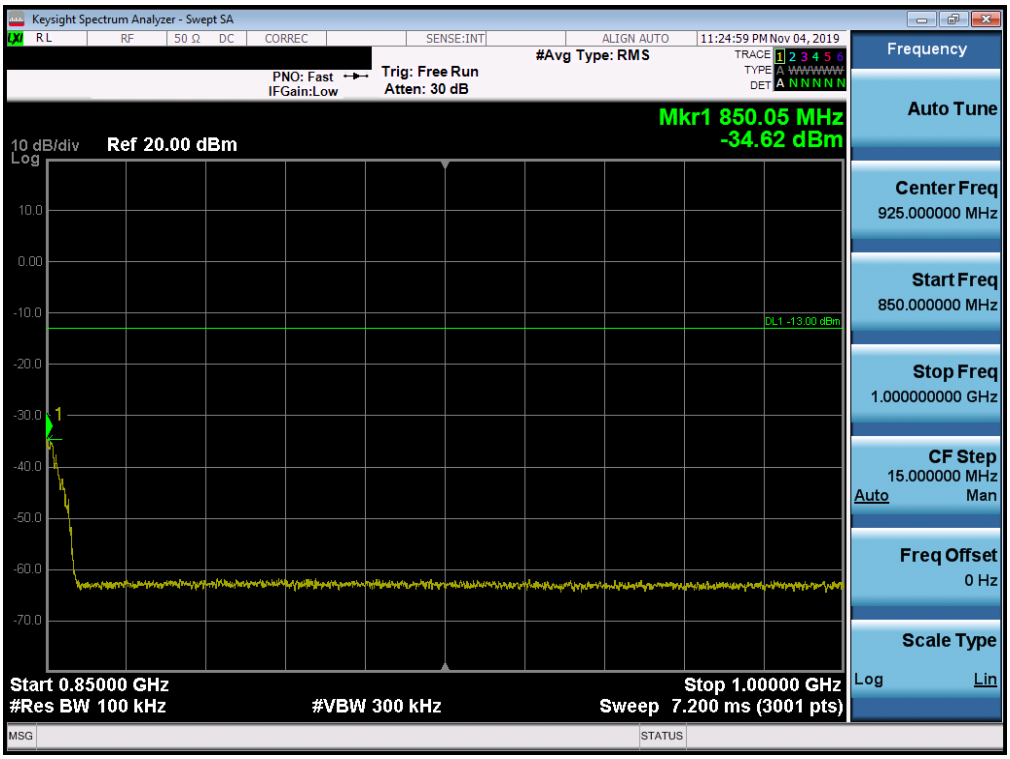


Plot 7-52. Conducted Spurious Plot (Cellular WCDMA Mode - High Channel)



Plot 7-53. Conducted Spurious Plot (Cellular WCDMA Mode - High Channel)

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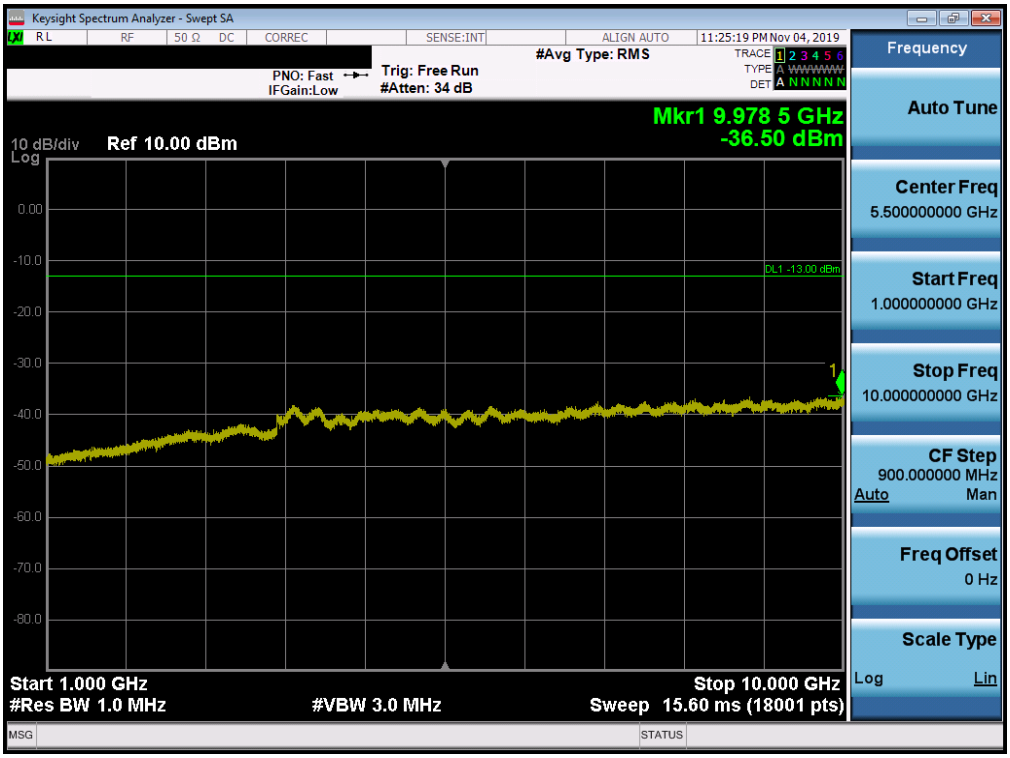

Plot 7-54. Conducted Spurious Plot (Cellular WCDMA Mode - High Channel)

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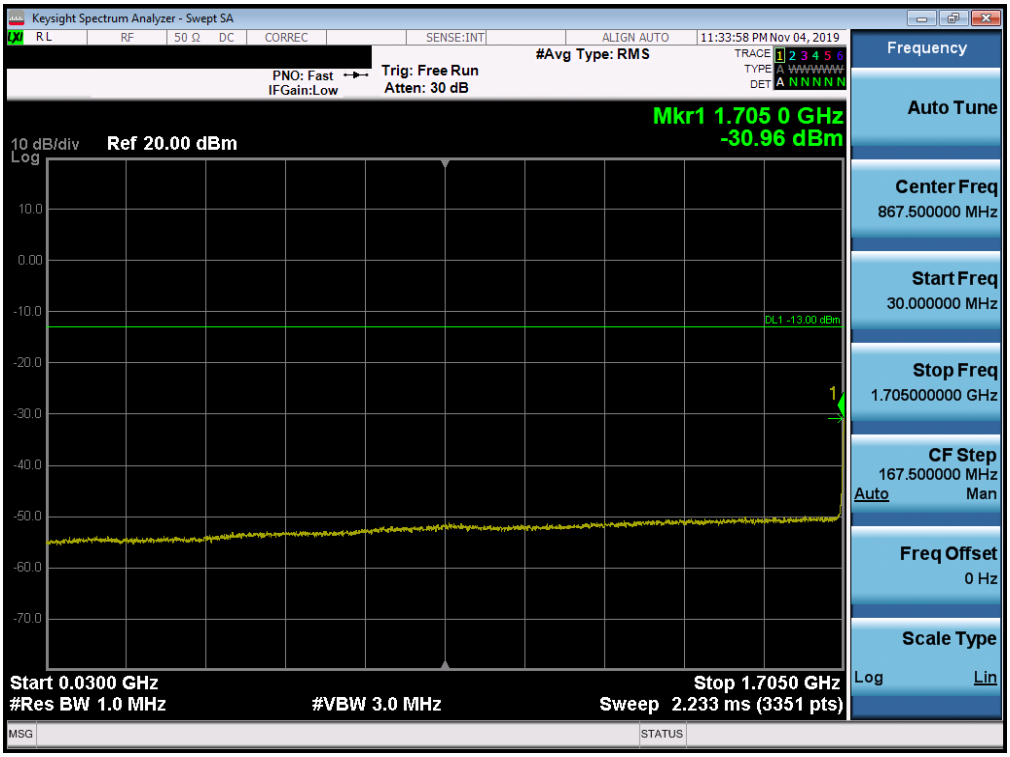
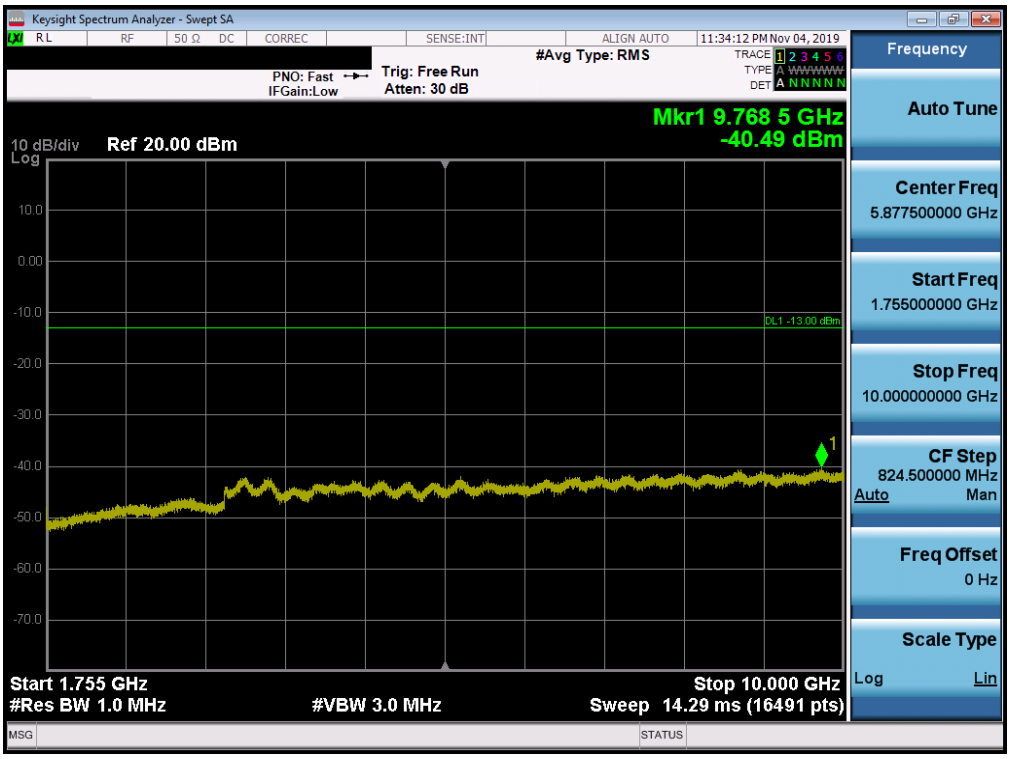
AWS WCDMA Mode



Plot 7-55. Conducted Spurious Plot (AWS WCDMA Mode - Low Channel)



Plot 7-56. Conducted Spurious Plot (AWS WCDMA Mode - Low Channel)

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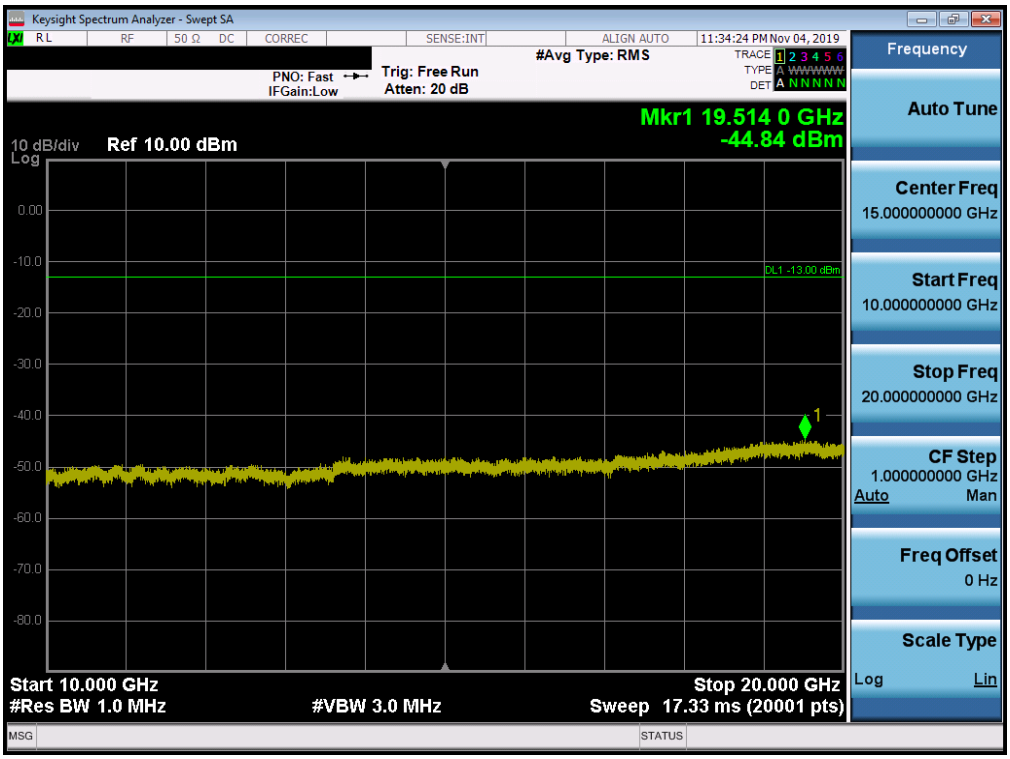
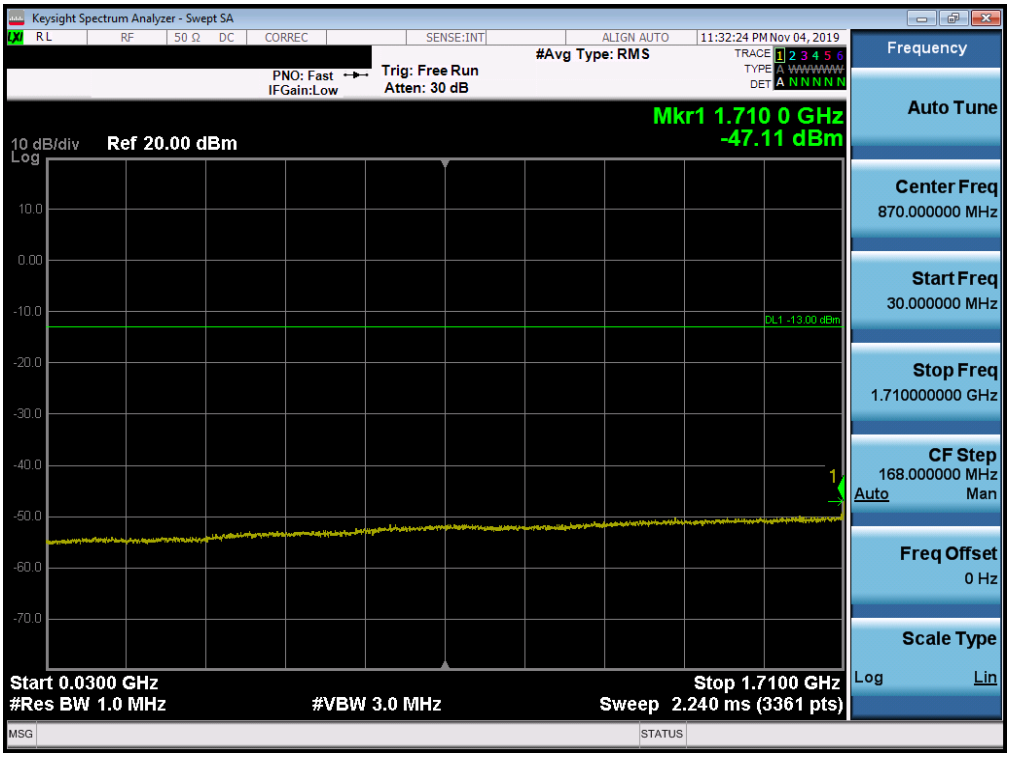


Plot 7-57. Conducted Spurious Plot (AWS WCDMA Mode - Low Channel)



Plot 7-58. Conducted Spurious Plot (AWS WCDMA Mode - Mid Channel)

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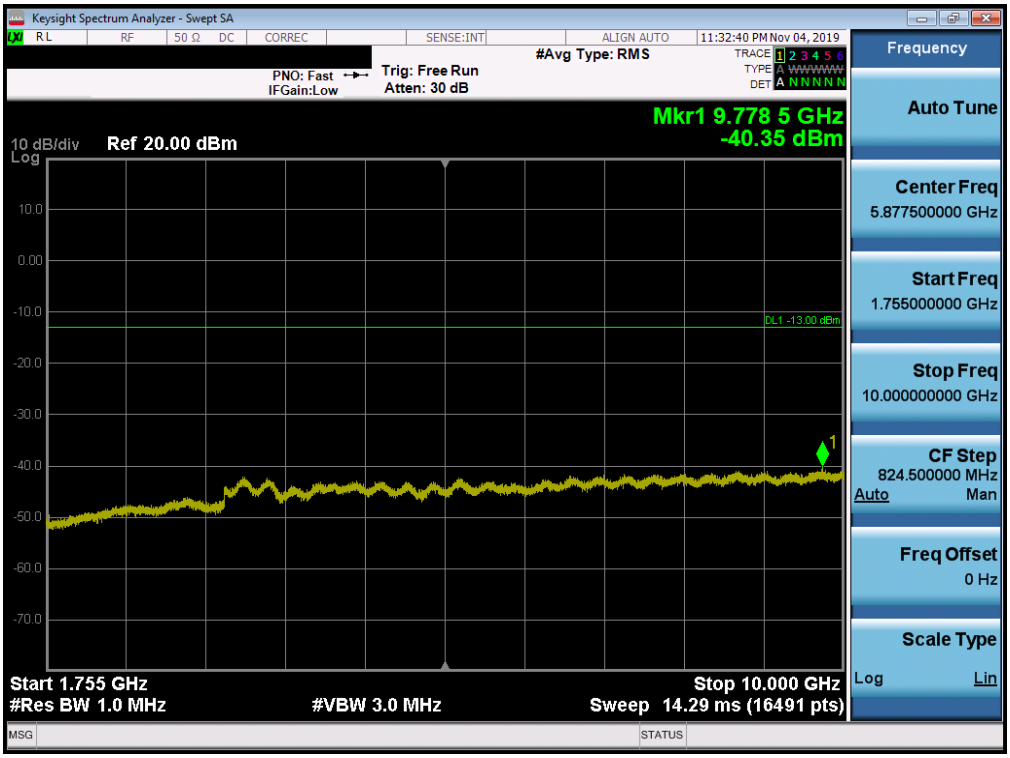
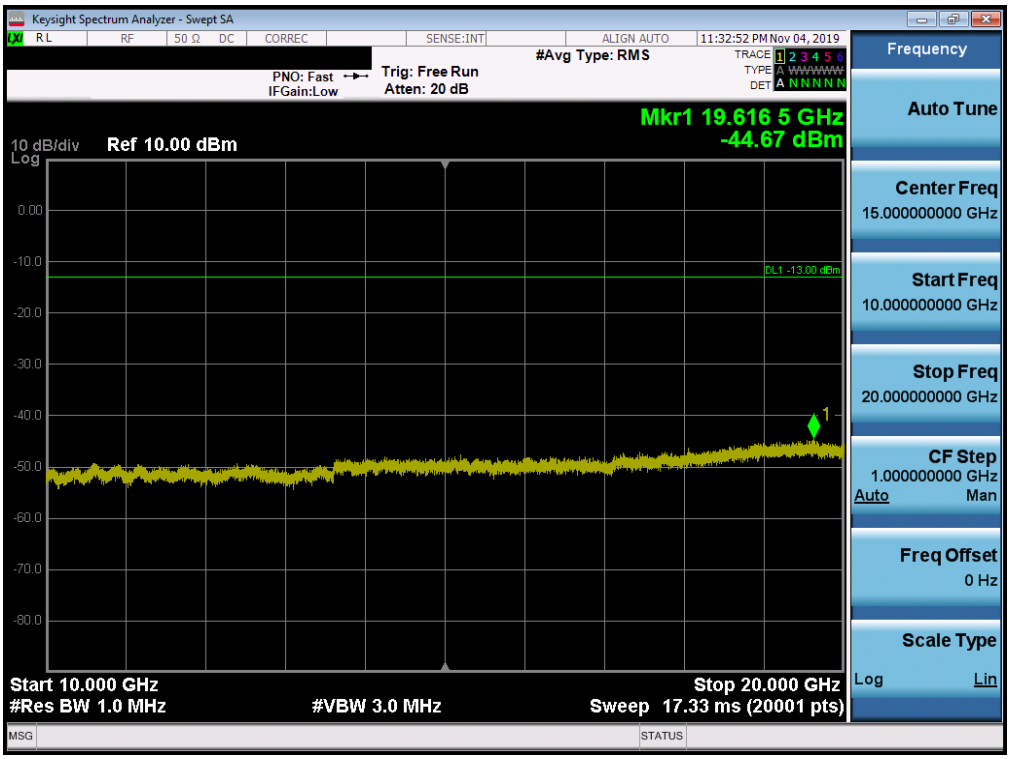


Plot 7-59. Conducted Spurious Plot (AWS WCDMA Mode - Mid Channel)



Plot 7-60. Conducted Spurious Plot (AWS WCDMA Mode - Mid Channel)

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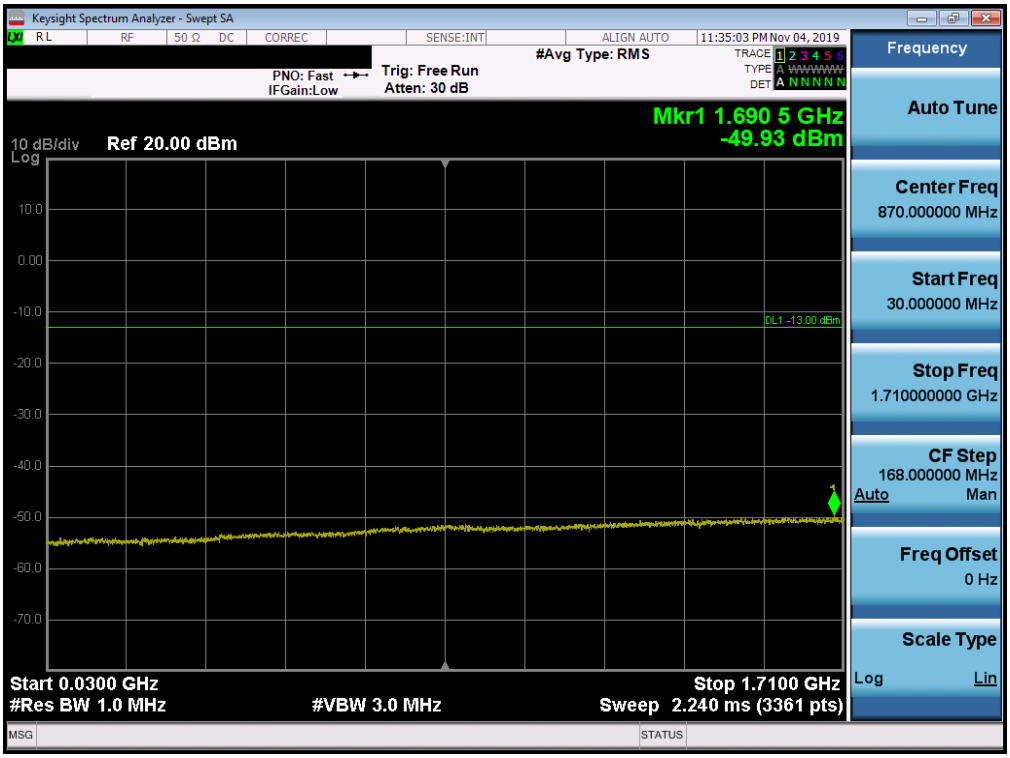
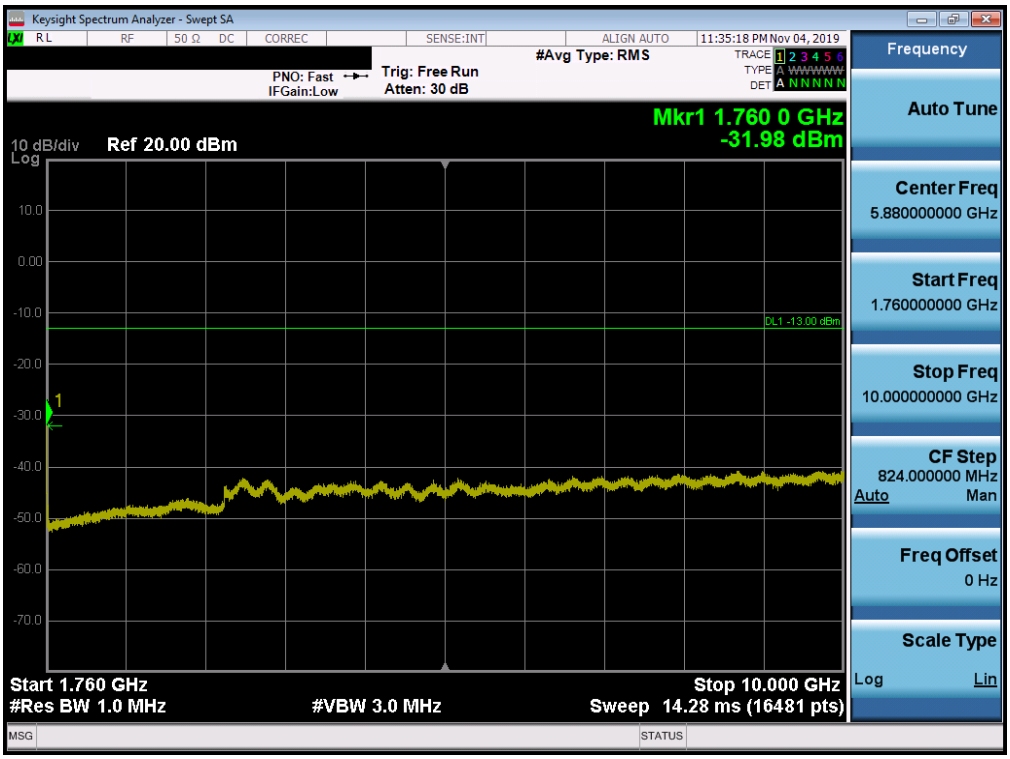


Plot 7-61. Conducted Spurious Plot (AWS WCDMA Mode - High Channel)



Plot 7-62. Conducted Spurious Plot (AWS WCDMA Mode - High Channel)

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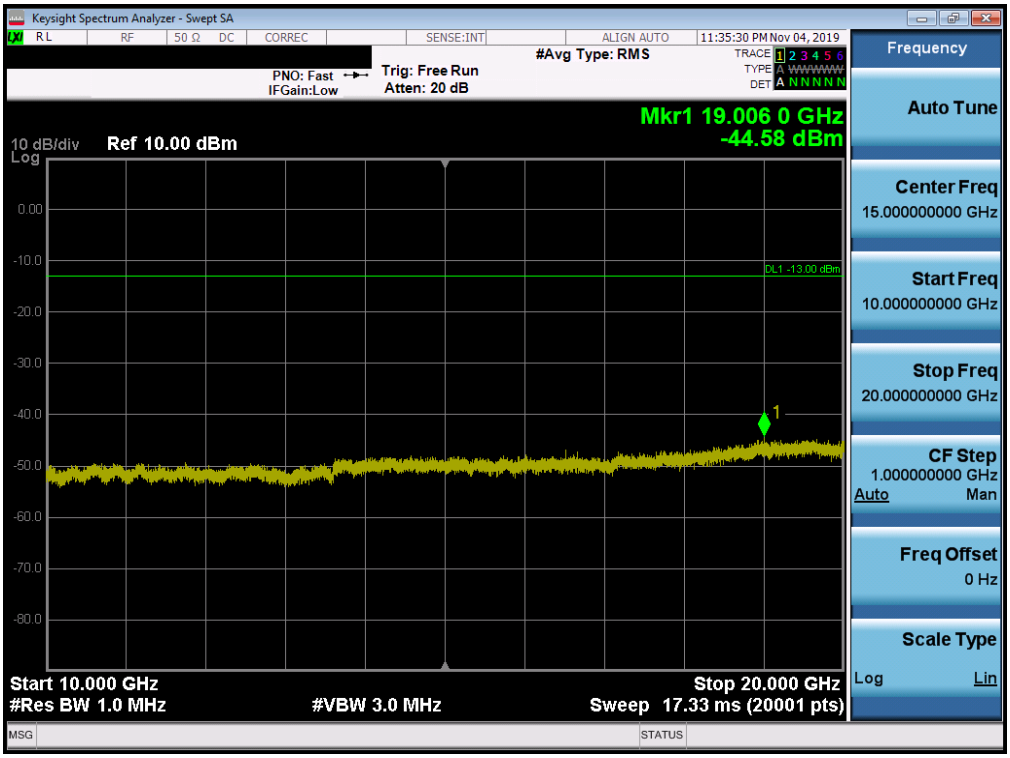

Plot 7-63. Conducted Spurious Plot (AWS WCDMA Mode - High Channel)

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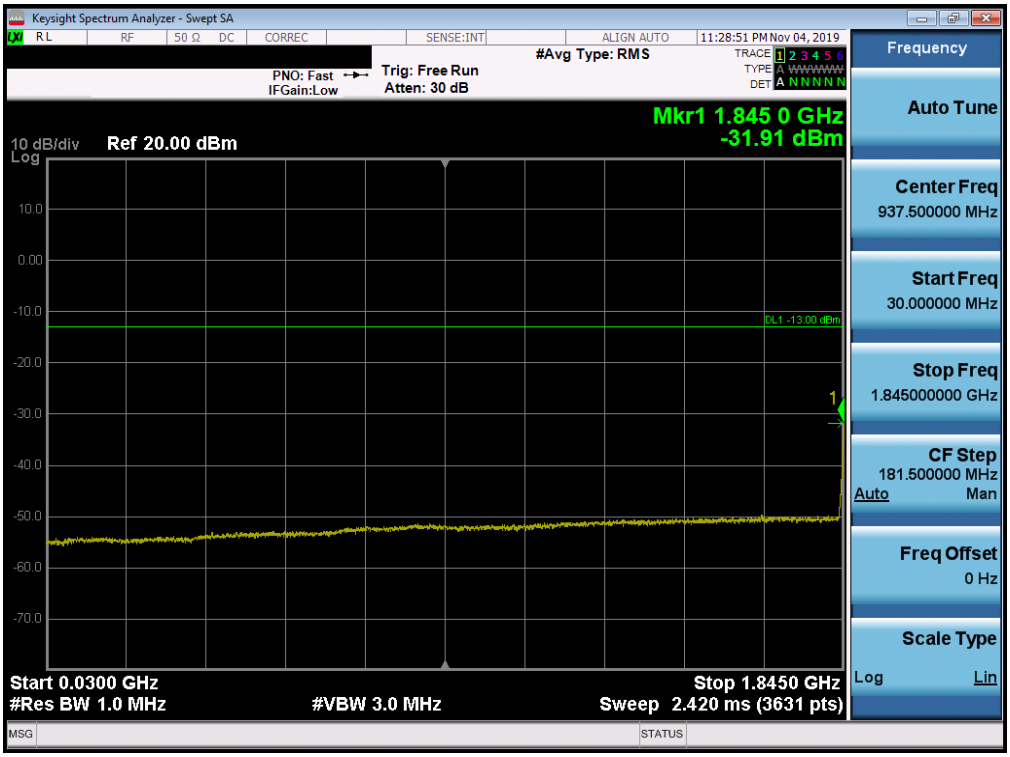
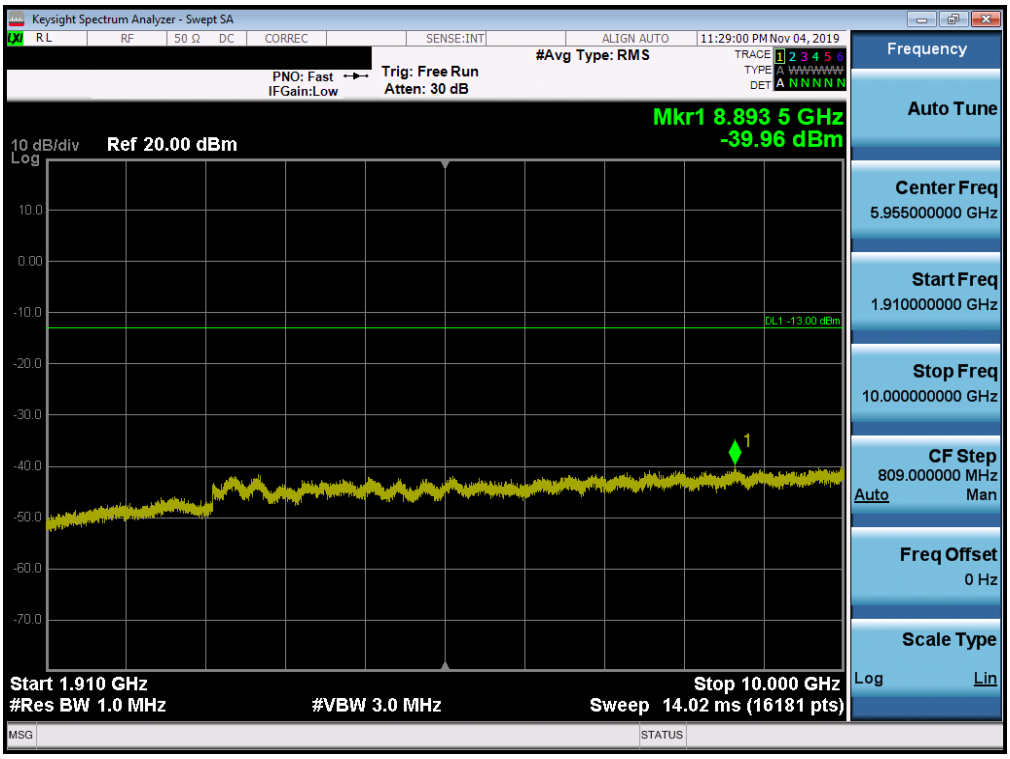
PCS WCDMA Mode



Plot 7-64. Conducted Spurious Plot (PCS WCDMA Mode - Low Channel)



Plot 7-65. Conducted Spurious Plot (PCS WCDMA Mode - Low Channel)

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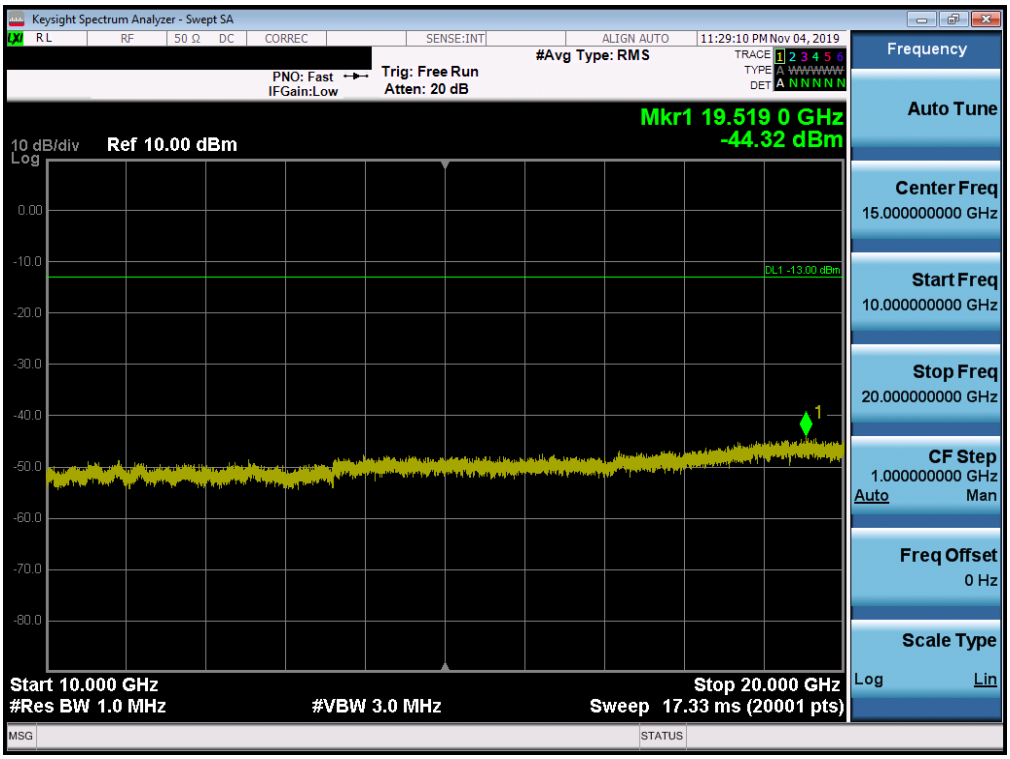
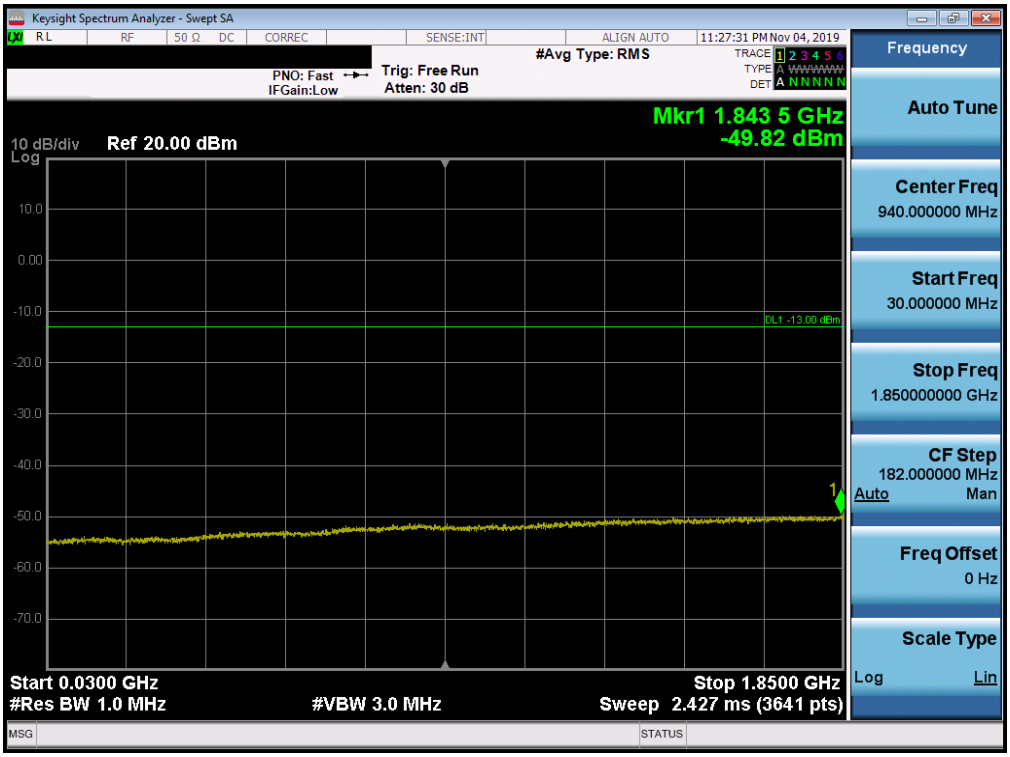


Plot 7-66. Conducted Spurious Plot (PCS WCDMA Mode - Low Channel)



Plot 7-67. Conducted Spurious Plot (PCS WCDMA Mode - Mid Channel)

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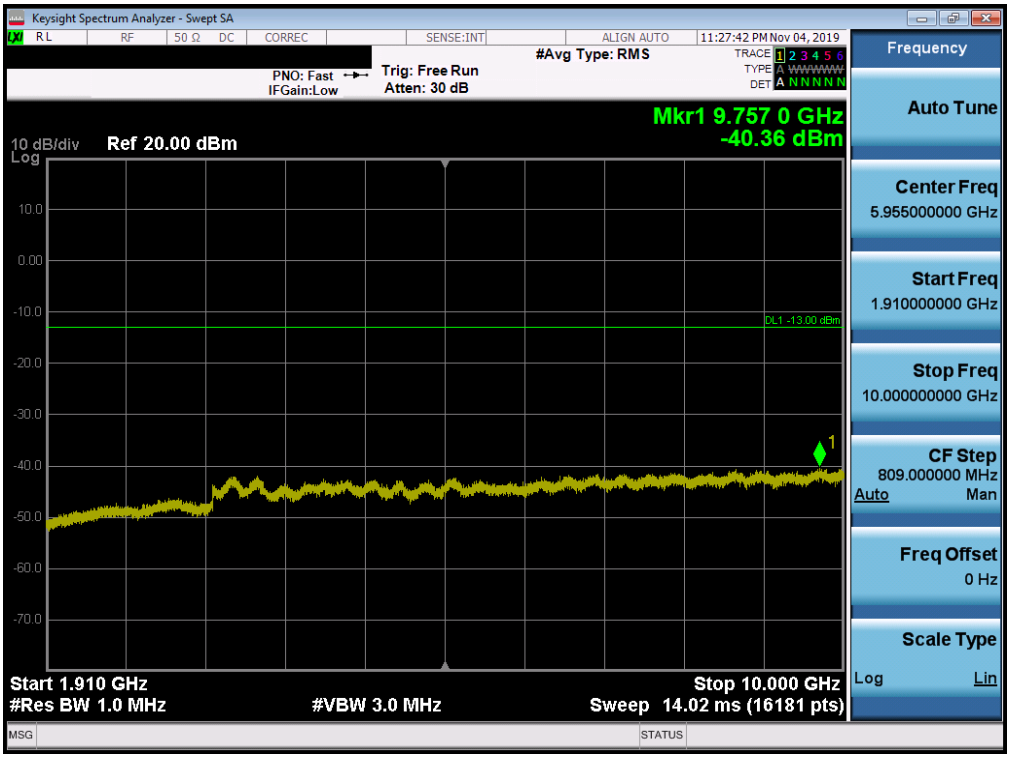
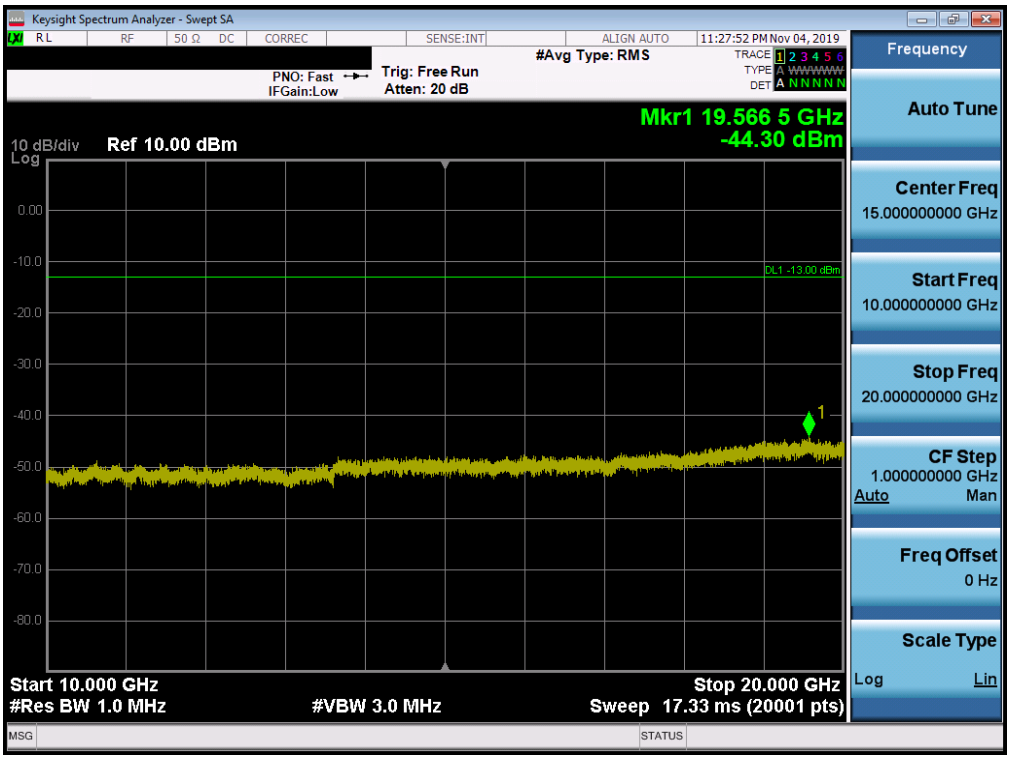


Plot 7-68. Conducted Spurious Plot (PCS WCDMA Mode - Mid Channel)



Plot 7-69. Conducted Spurious Plot (PCS WCDMA Mode - Mid Channel)

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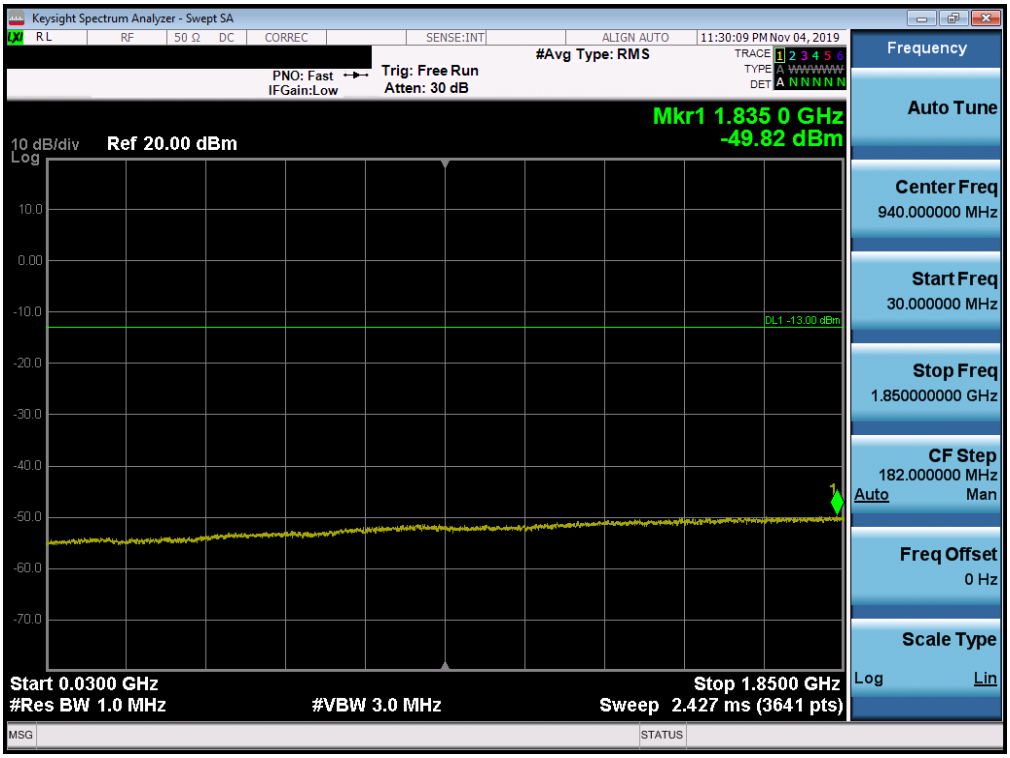
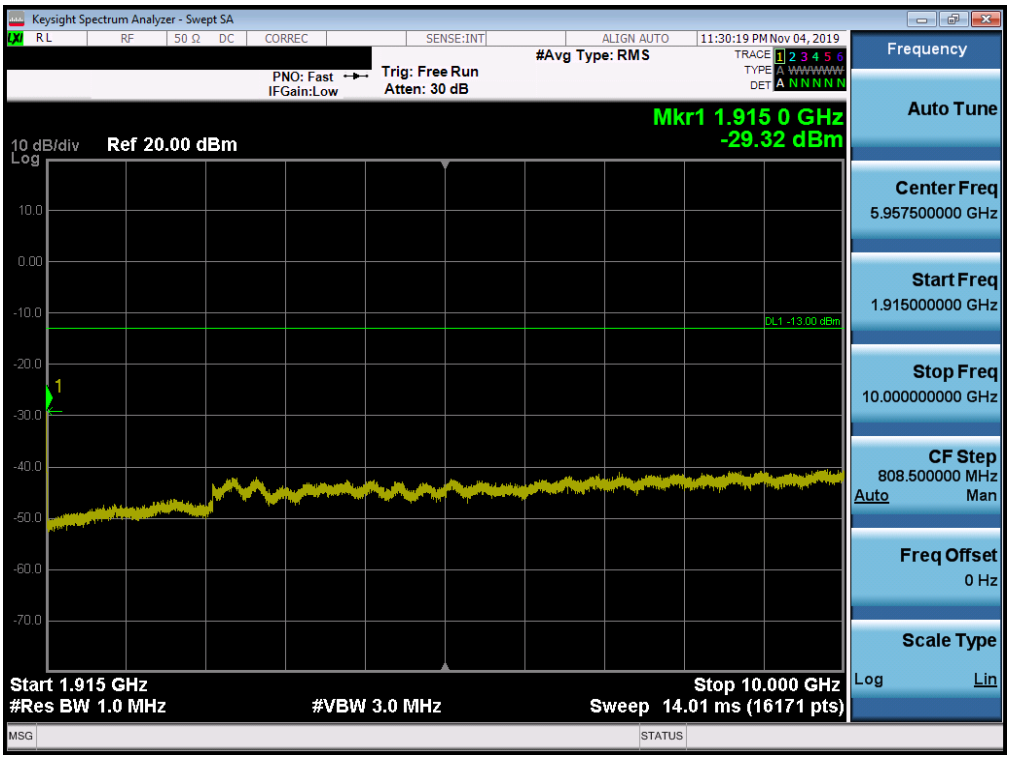


Plot 7-70. Conducted Spurious Plot (PCS WCDMA Mode - High Channel)



Plot 7-71. Conducted Spurious Plot (PCS WCDMA Mode - High Channel)

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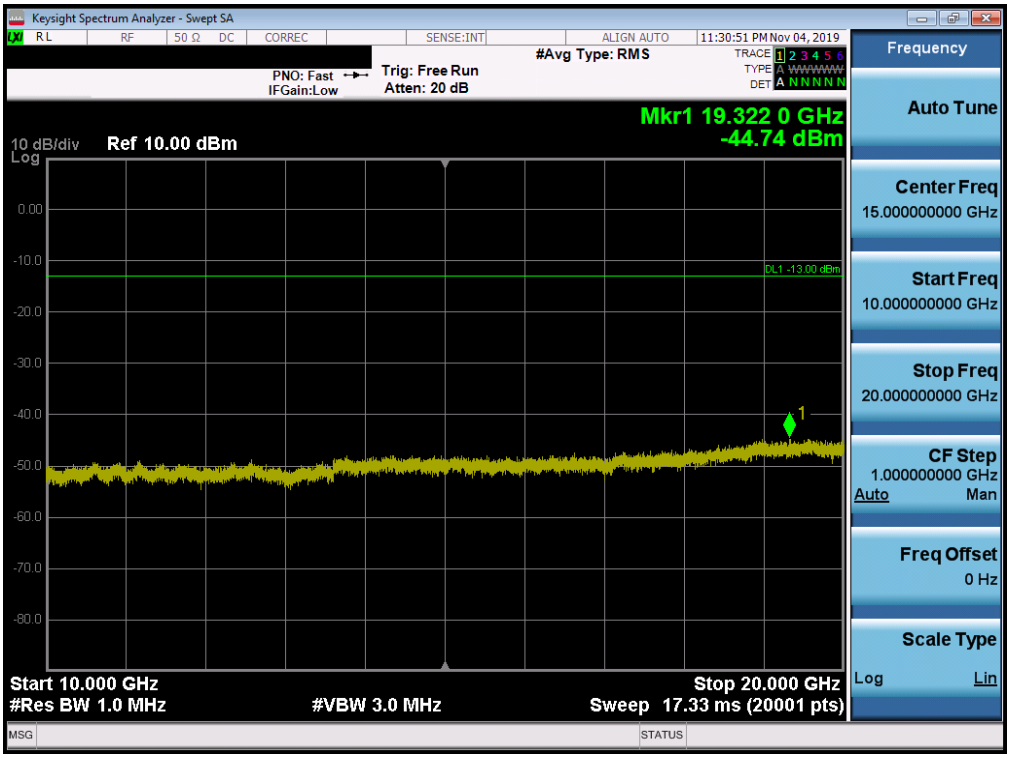

Plot 7-72. Conducted Spurious Plot (PCS WCDMA Mode - High Channel)

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7.4 Band Edge Emissions at Antenna Terminal

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 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 + 10 $\log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

KDB 971168 D01 v03r01 – 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 = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

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

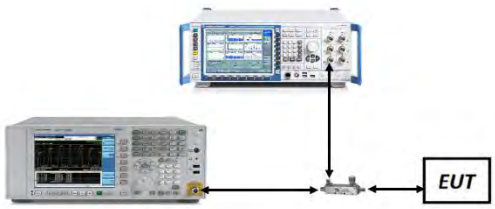

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

Per 22.917(b), 24.238(b), 27.53(h)(3), and RSS-132(5.5), RSS-133(6.5), RSS-139(6.5), 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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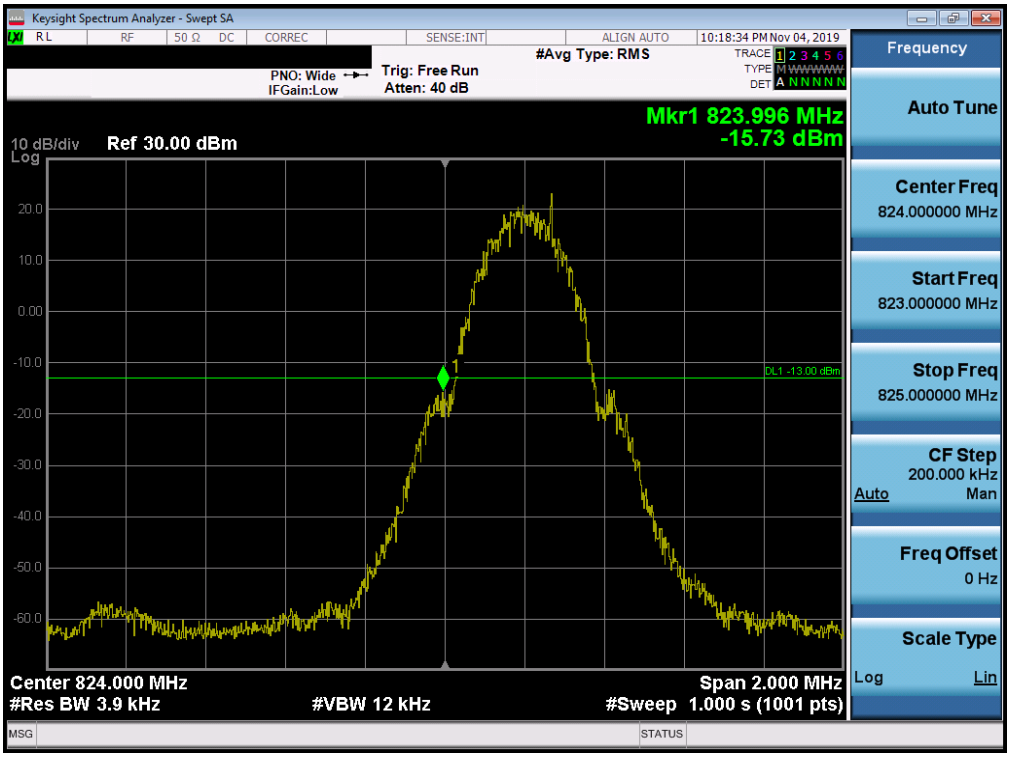
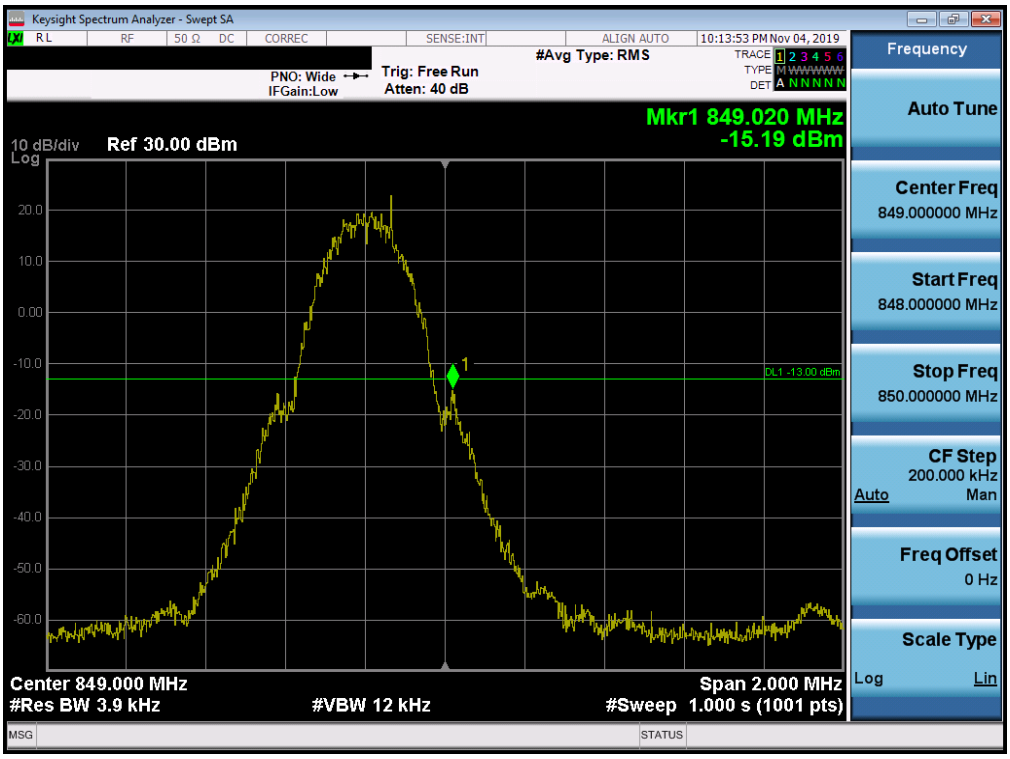
Cellular GSM Mode



Plot 7-73. Band Edge Plot (Cellular GSM Mode - Low Channel)



Plot 7-74. Band Edge Plot (Cellular GSM Mode - High Channel)

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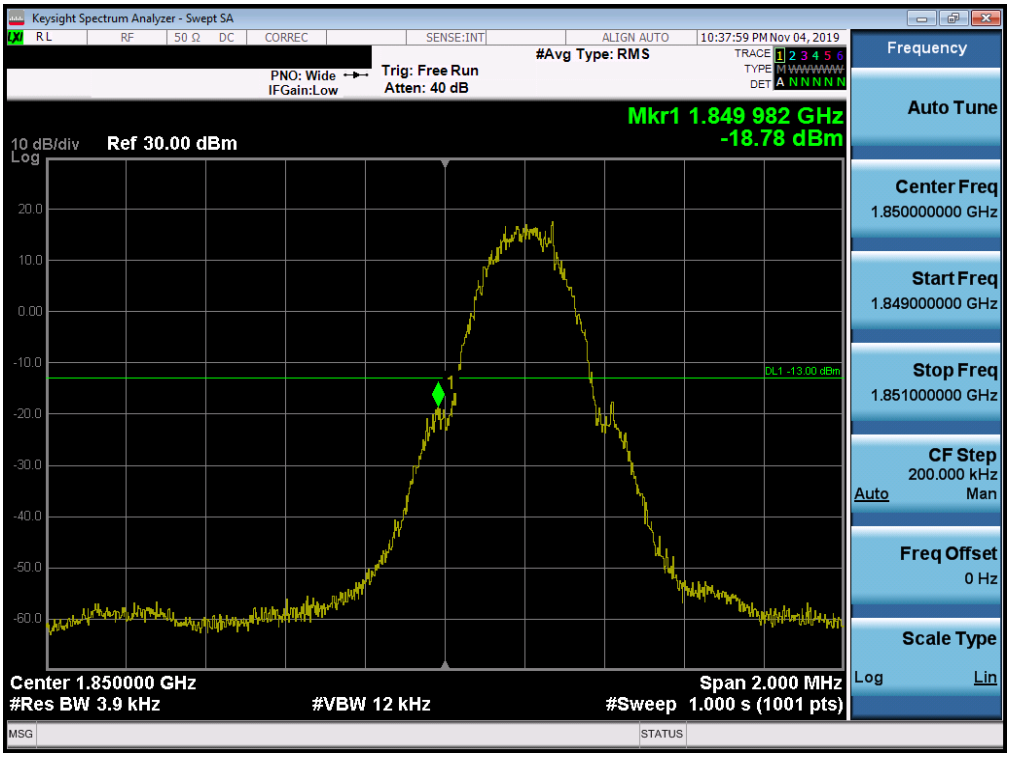
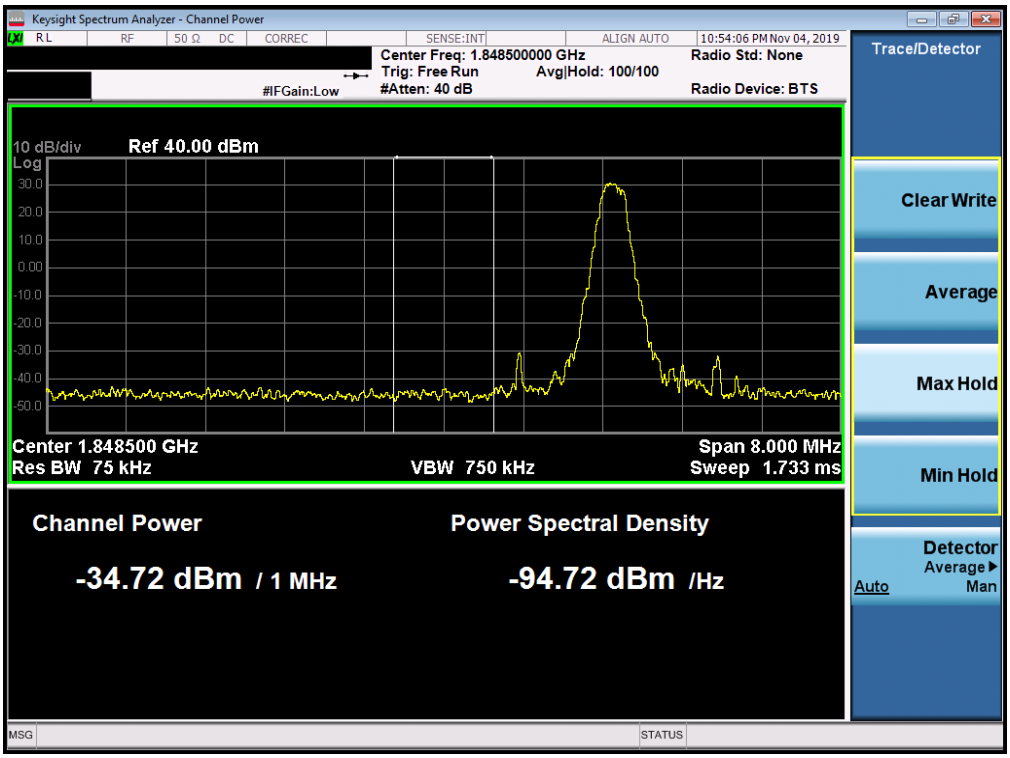
PCS GSM Mode



Plot 7-75. Band Edge Plot (PCS GSM Mode - Low Channel)



Plot 7-76. 8MHz Span Plot (PCS GSM Mode - Low Channel)

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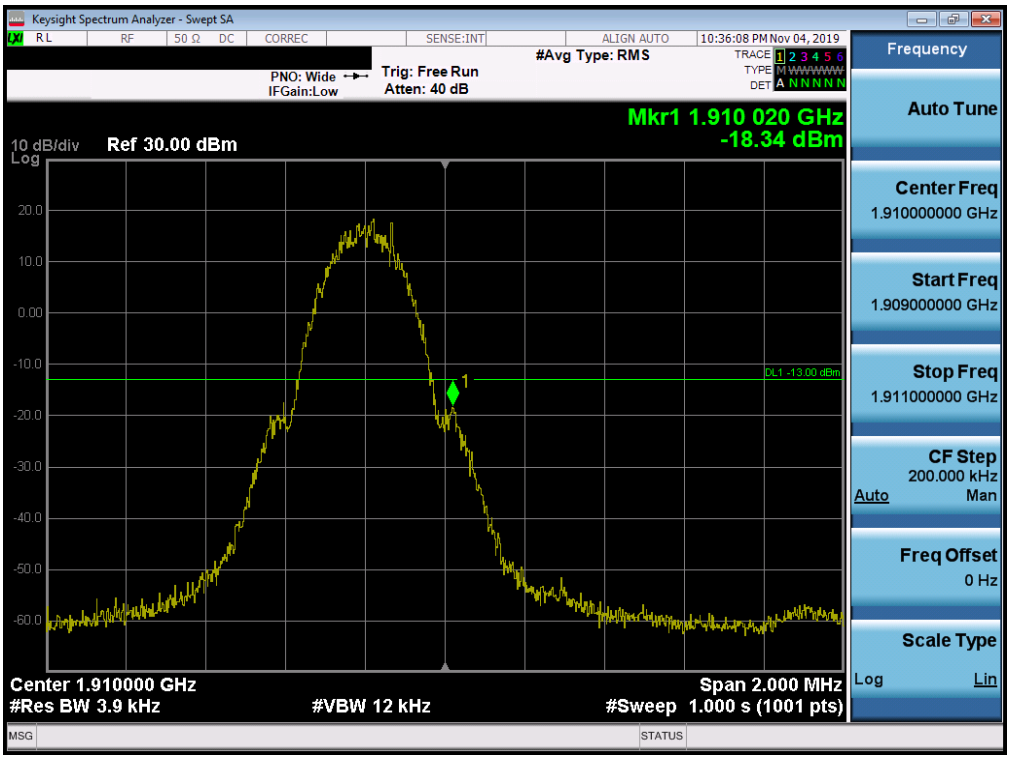
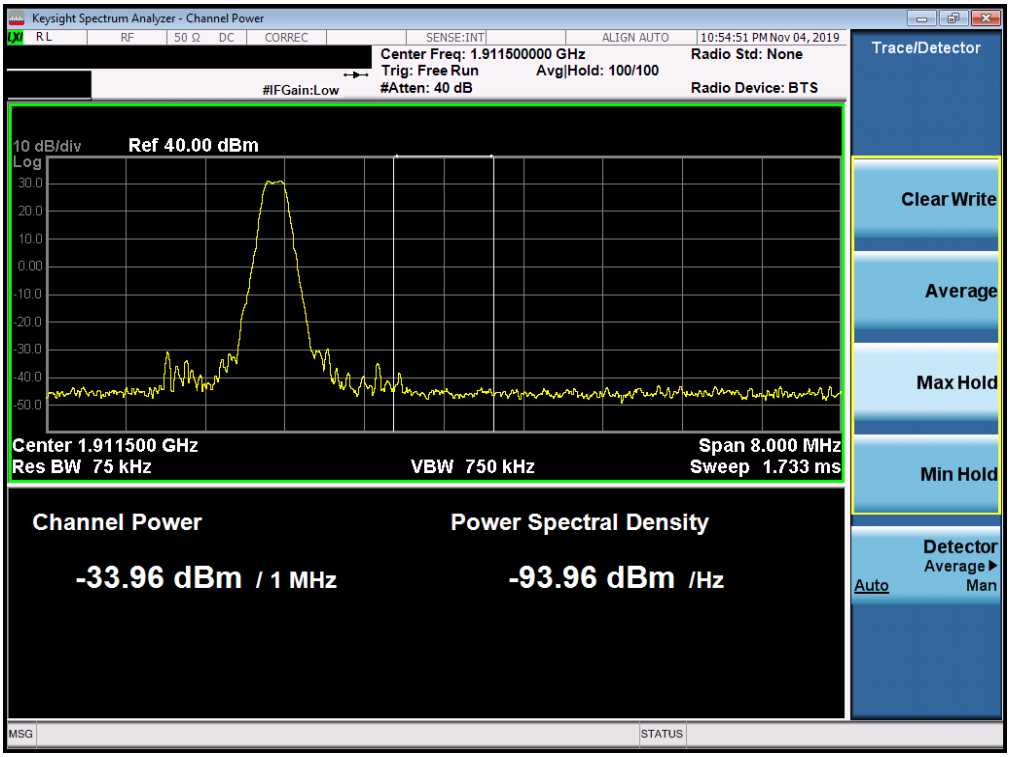


Plot 7-77. Band Edge Plot (PCS GSM Mode - High Channel)



Plot 7-78. 8MHz Span Plot (PCS GSM Mode - High Channel)

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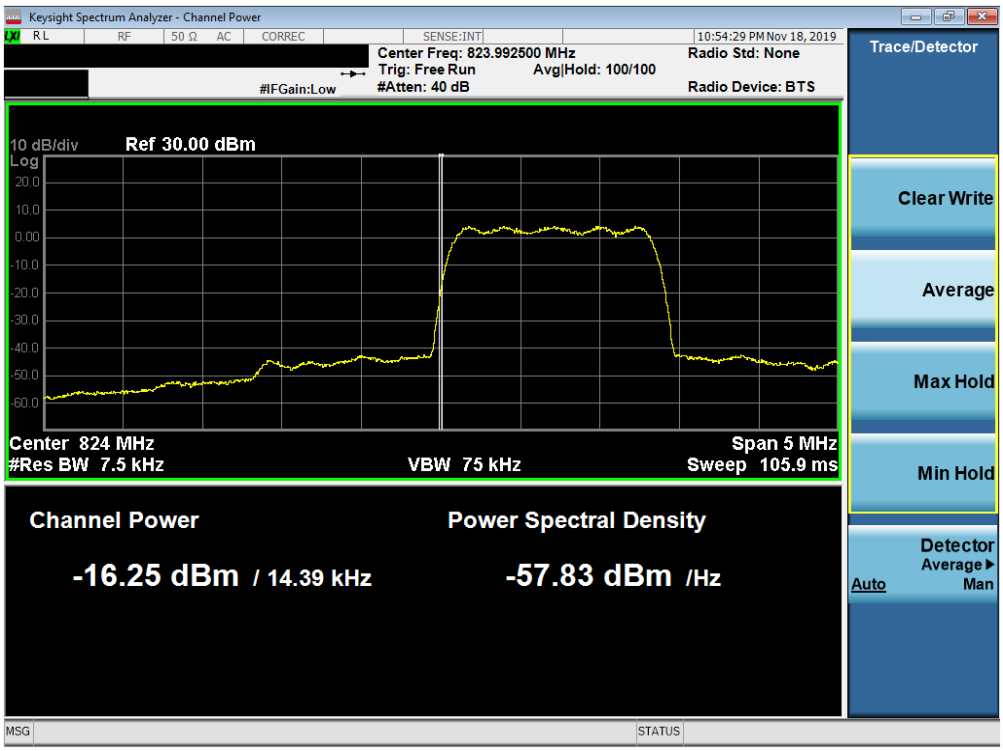
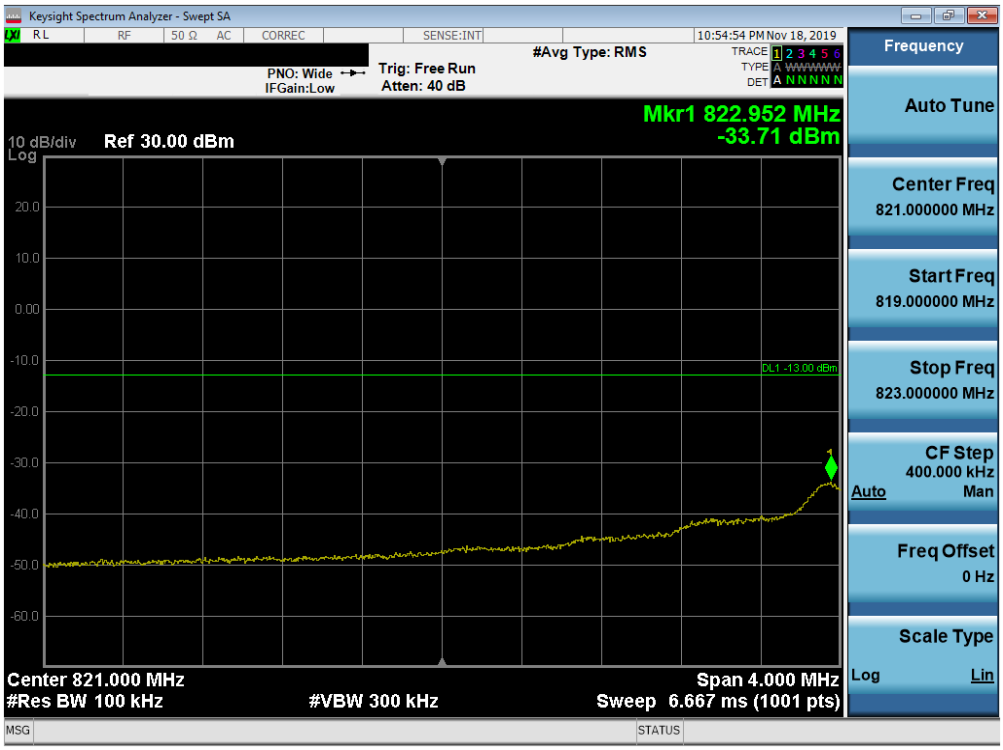
Cellular CDMA Mode



Plot 7-79. Band Edge Plot (Cellular CDMA Mode - Low Channel)



Plot 7-80. 4MHz Span Plot (Cellular CDMA Mode - Low Channel)

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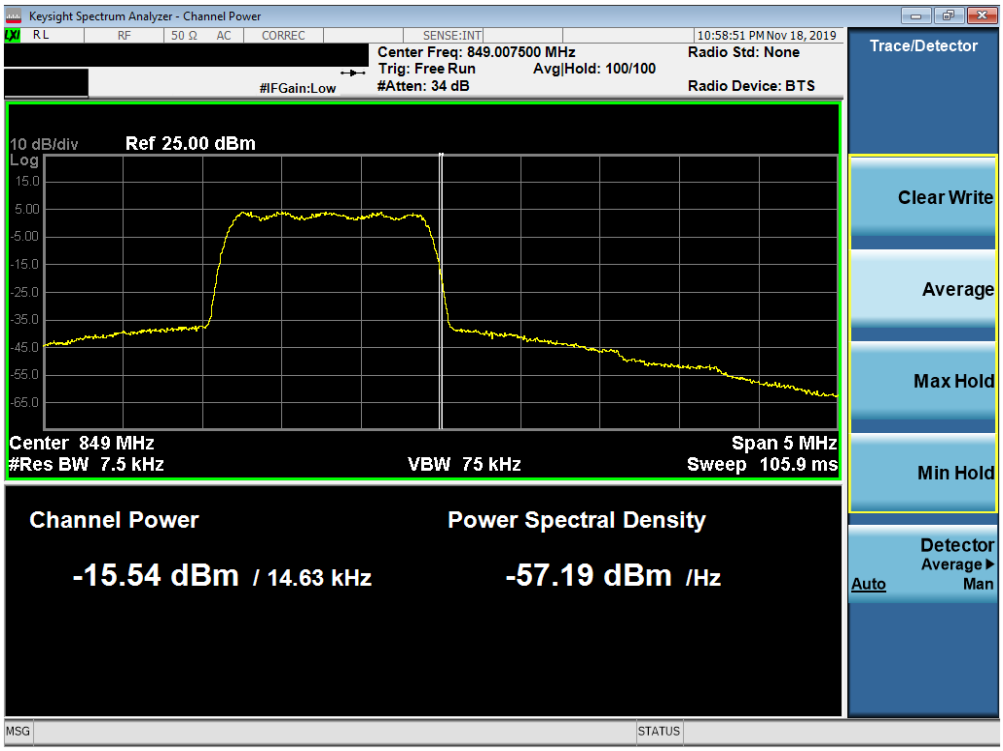
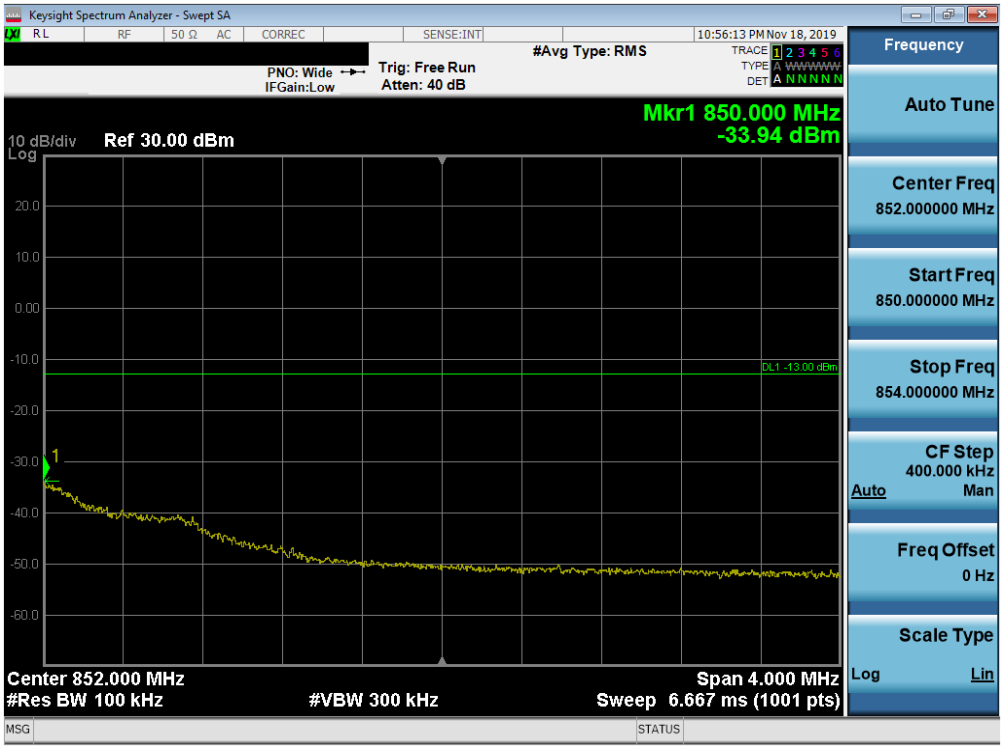


Plot 7-81. Band Edge Plot (Cellular CDMA Mode - High Channel)



Plot 7-82. 4MHz Span Plot (Cellular CDMA Mode - High Channel)

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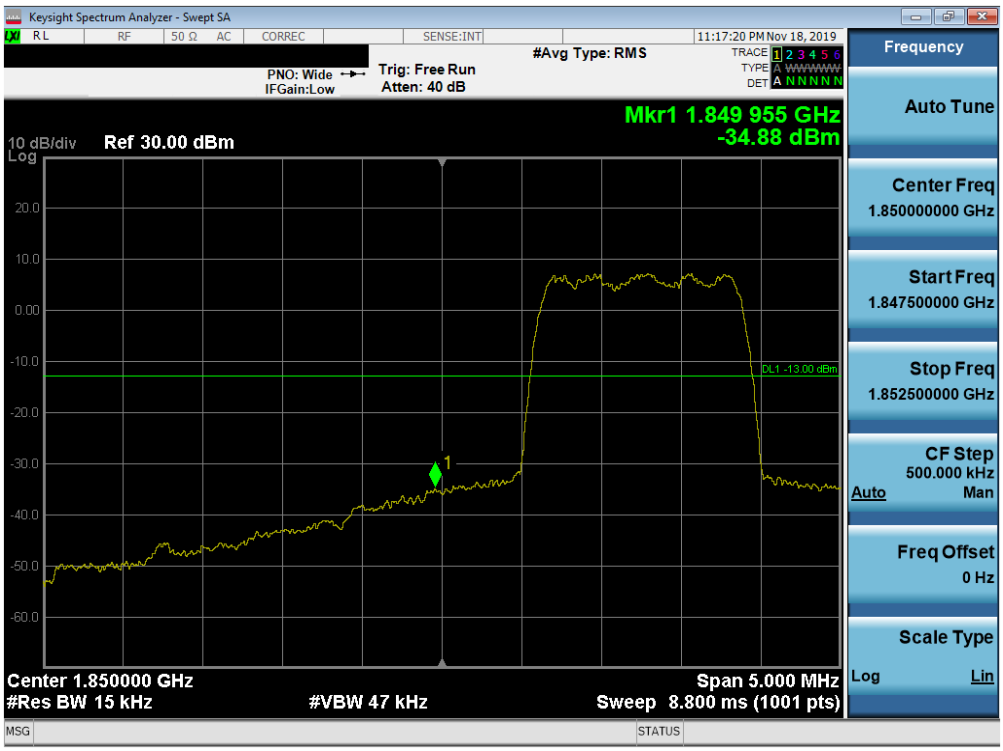
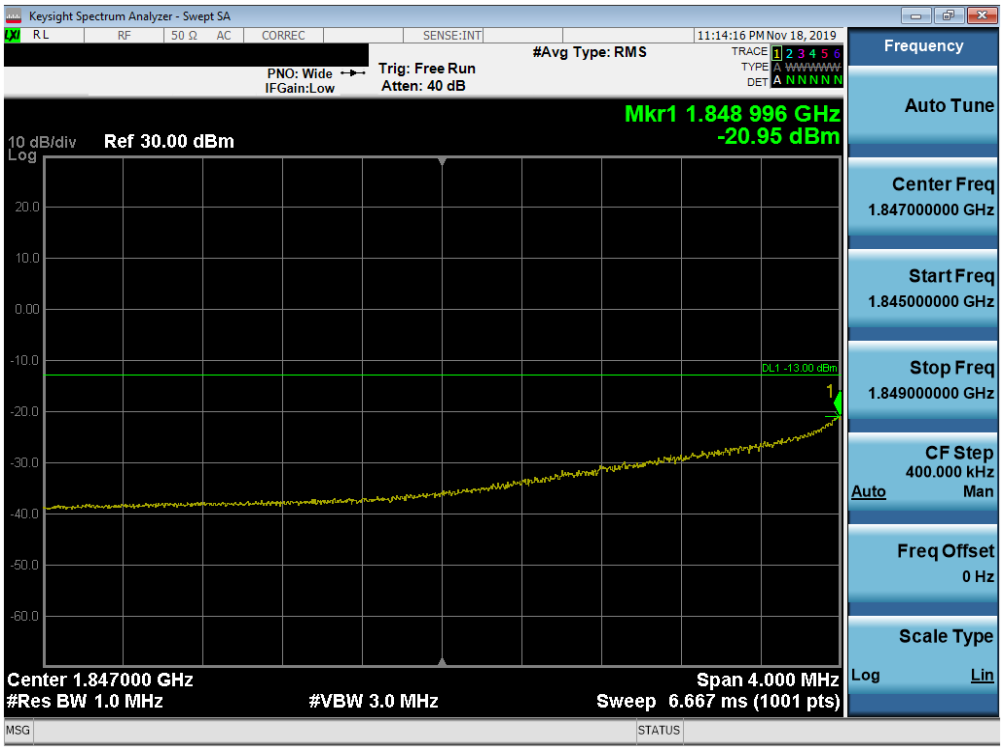
PCS CDMA Mode



Plot 7-83. Band Edge Plot (PCS CDMA Mode - Low Channel)



Plot 7-84. 4MHz Span Plot (PCS CDMA Mode - Low Channel)

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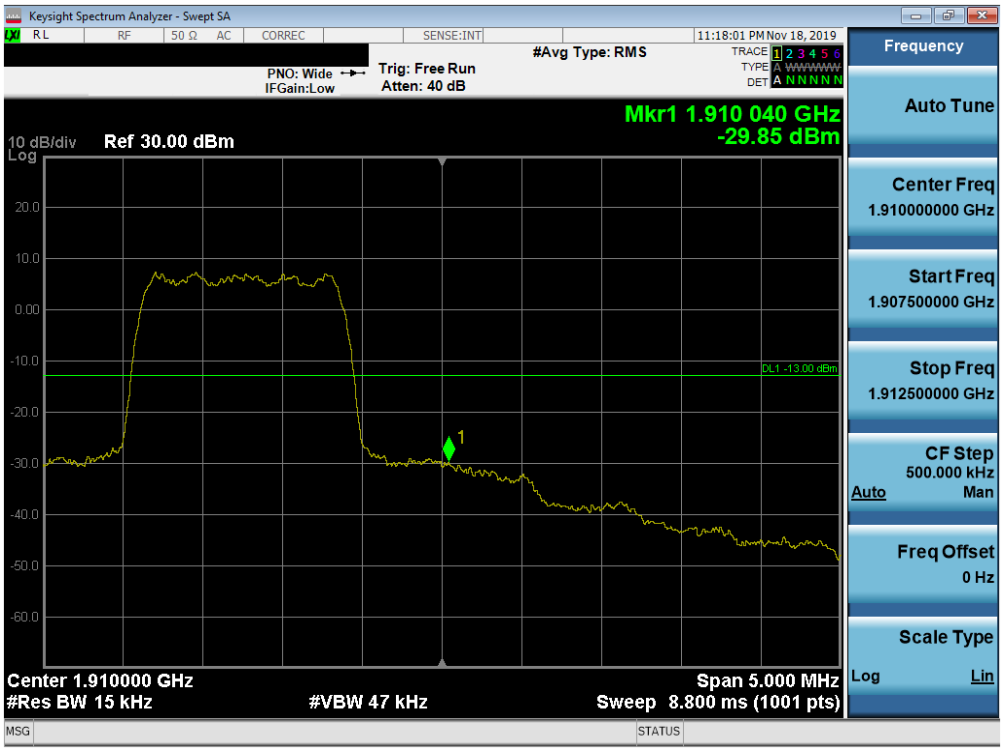
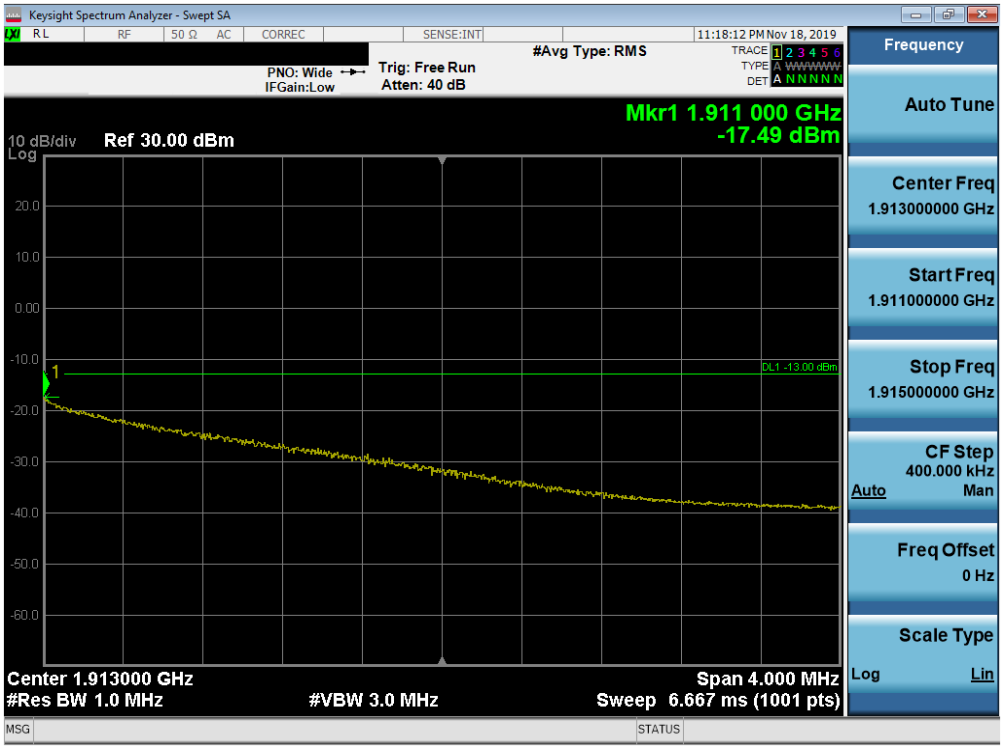


Plot 7-85. Band Edge Plot (PCS CDMA Mode - High Channel)



Plot 7-86. 4MHz Span Plot (PCS CDMA Mode - High Channel)

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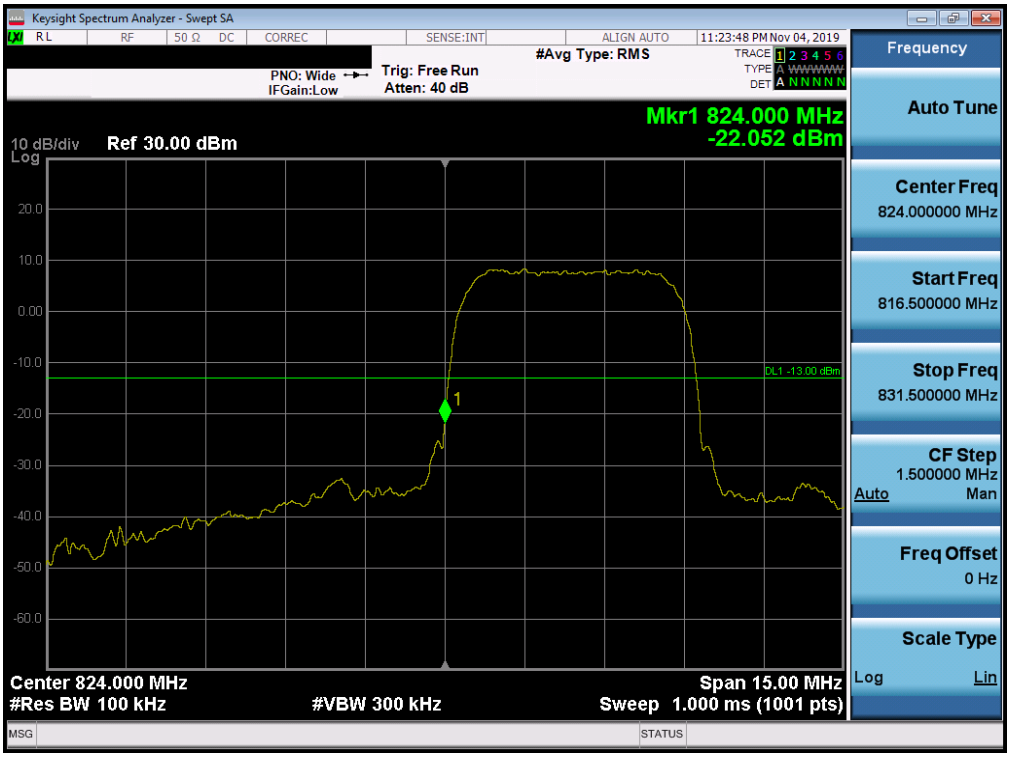
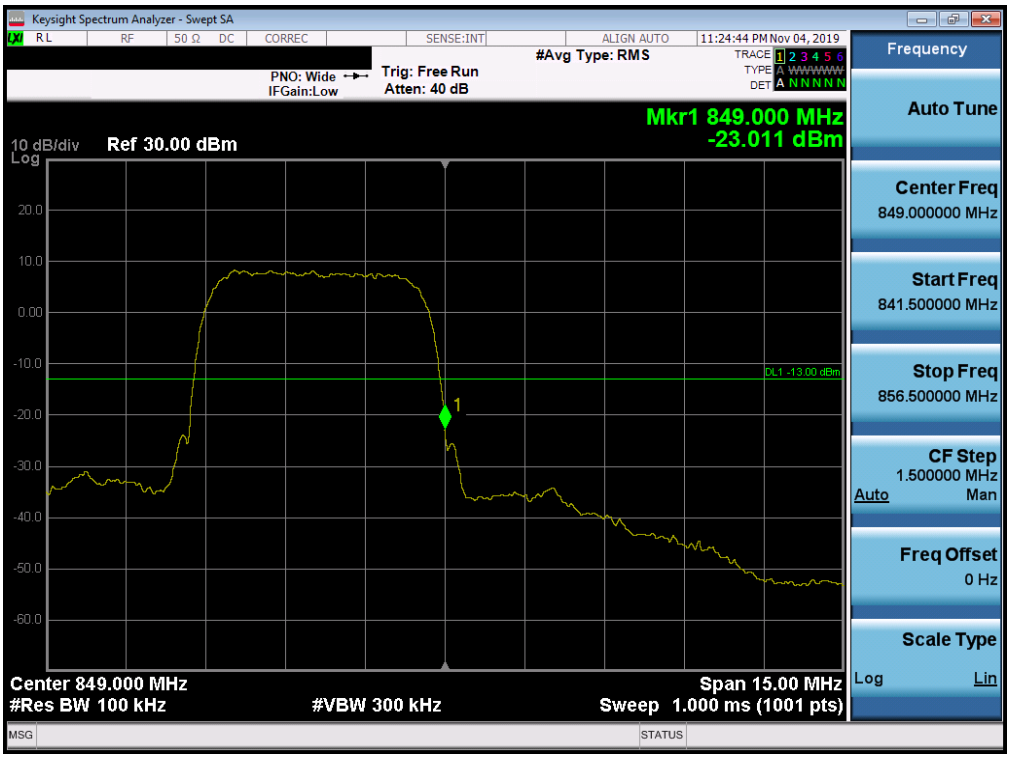
Cellular WCDMA Mode



Plot 7-87. Band Edge Plot (Cellular WCDMA Mode - Low Channel)



Plot 7-88. Band Edge Plot (Cellular WCDMA Mode - High Channel)

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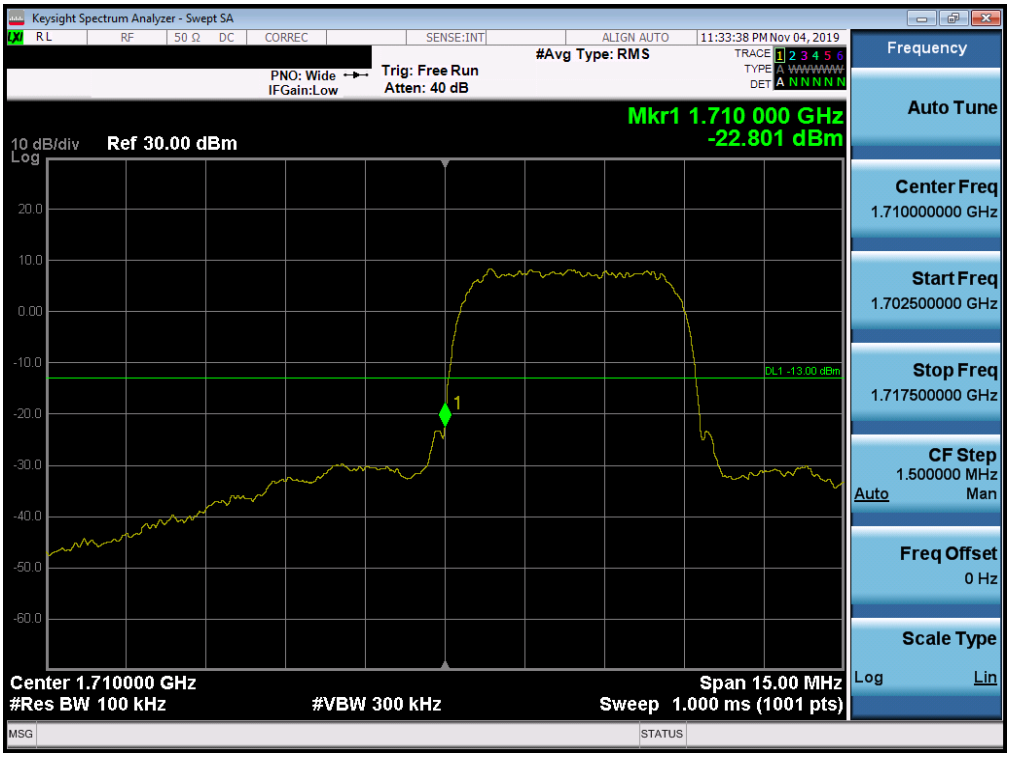
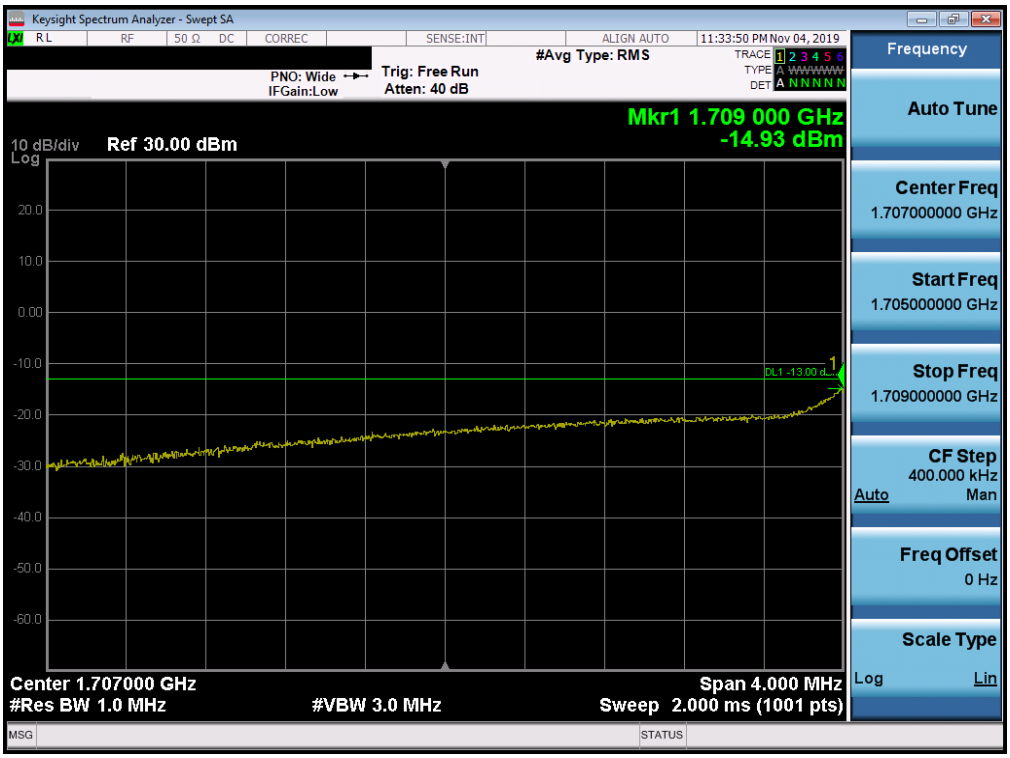
AWS WCDMA Mode



Plot 7-89. Band Edge Plot (AWS WCDMA Mode - Low Channel)



Plot 7-90. 4MHz Span Plot (AWS WCDMA Mode - Low Channel)

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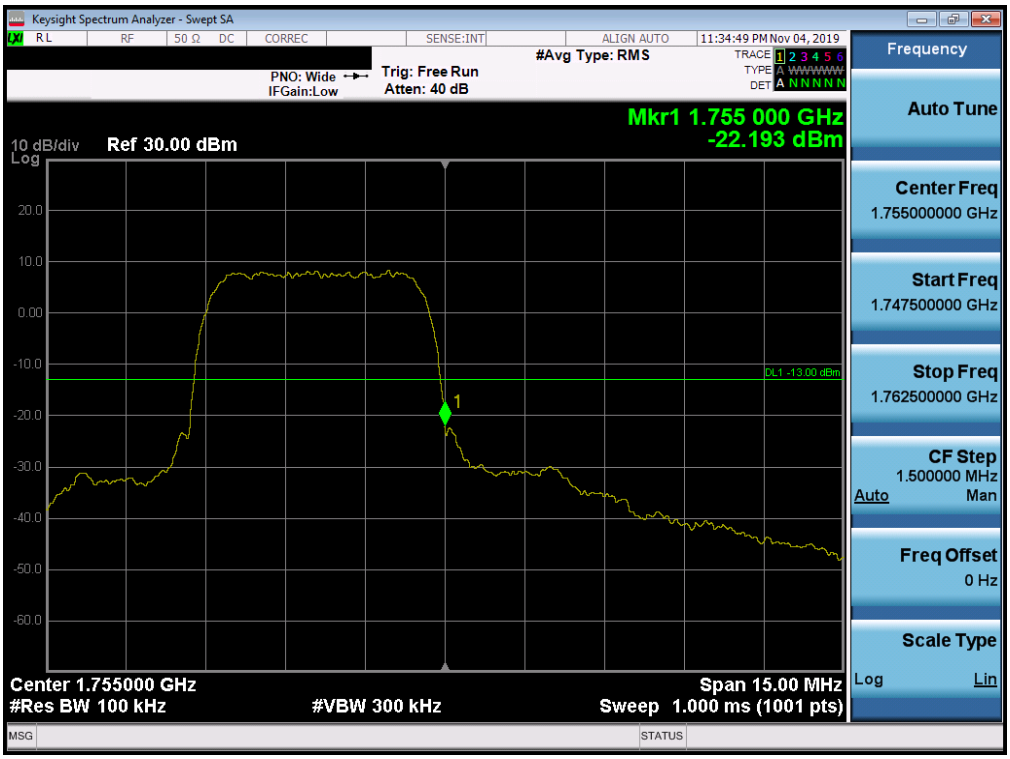
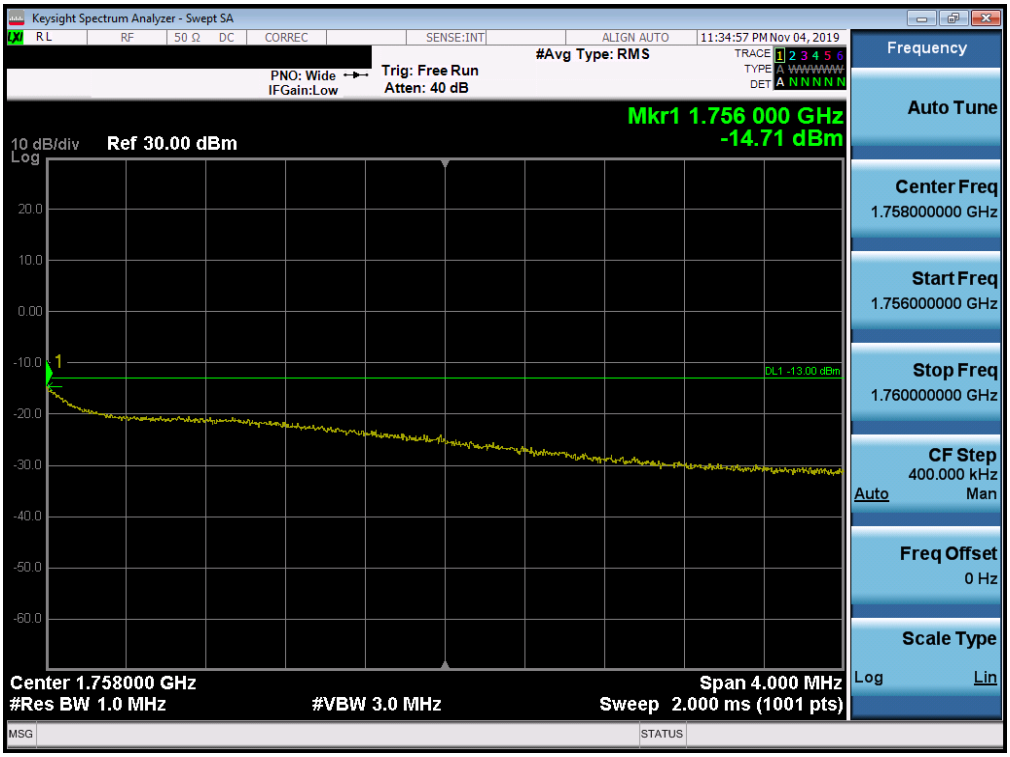


Plot 7-91. Band Edge Plot (AWS WCDMA Mode - High Channel)



Plot 7-92. 4MHz Span Plot (AWS WCDMA Mode - High Channel)

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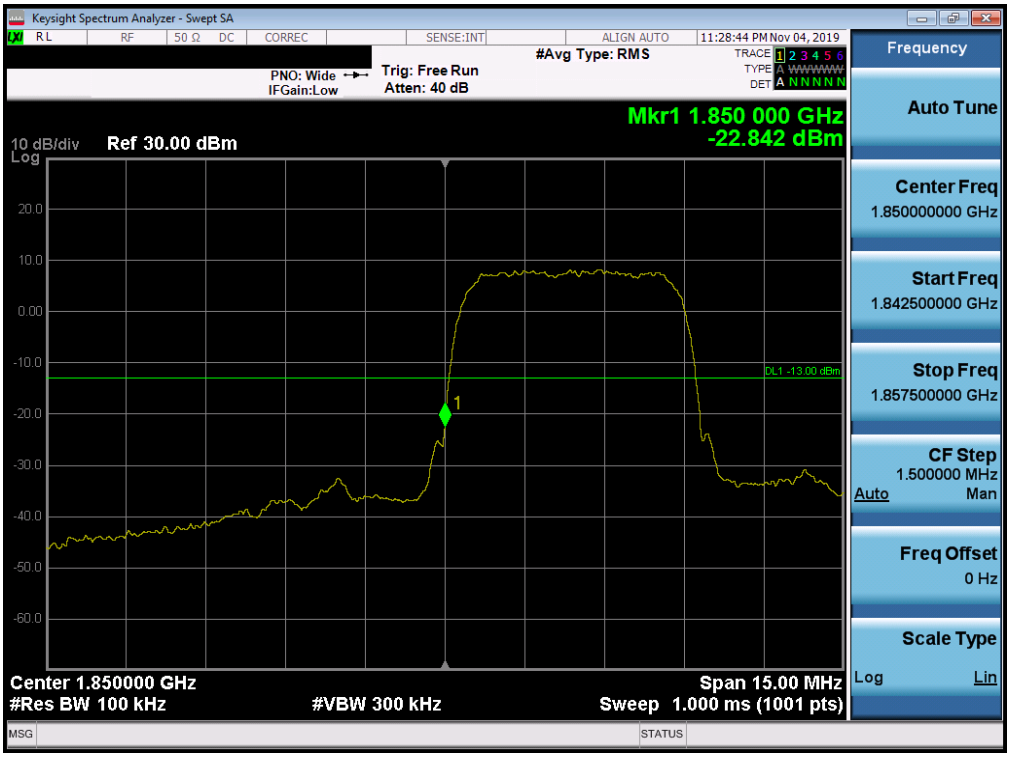
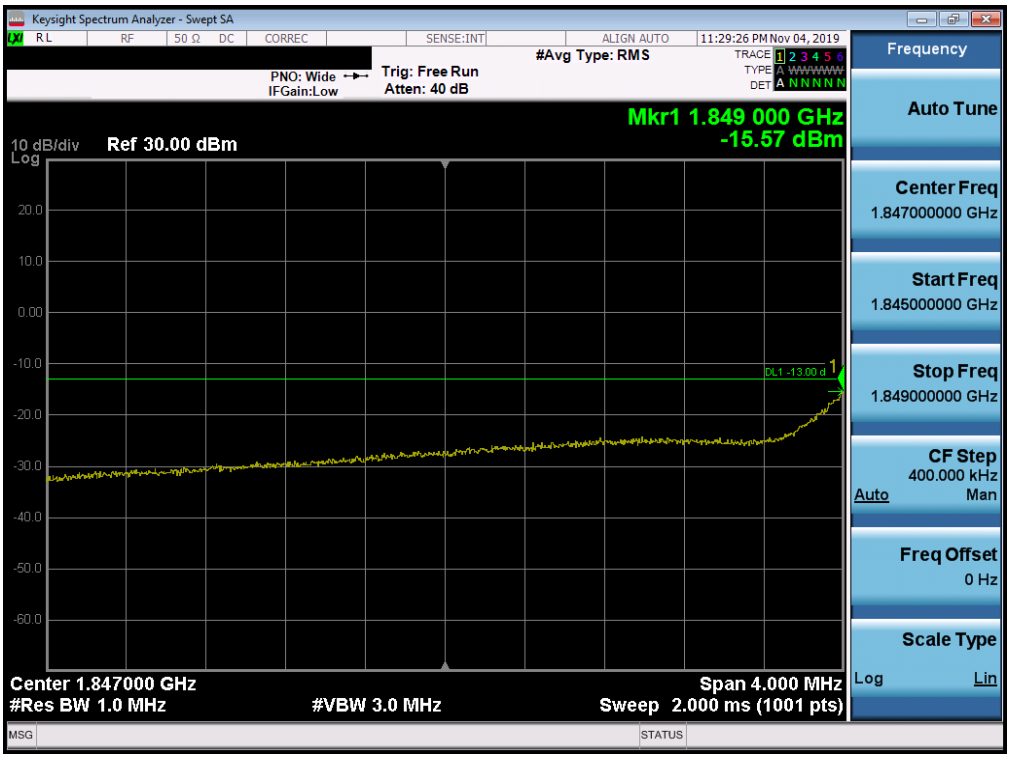
PCS WCDMA Mode



Plot 7-93. Band Edge Plot (PCS WCDMA Mode - Low Channel)



Plot 7-94. 4MHz Span Plot (PCS WCDMA Mode - Low Channel)

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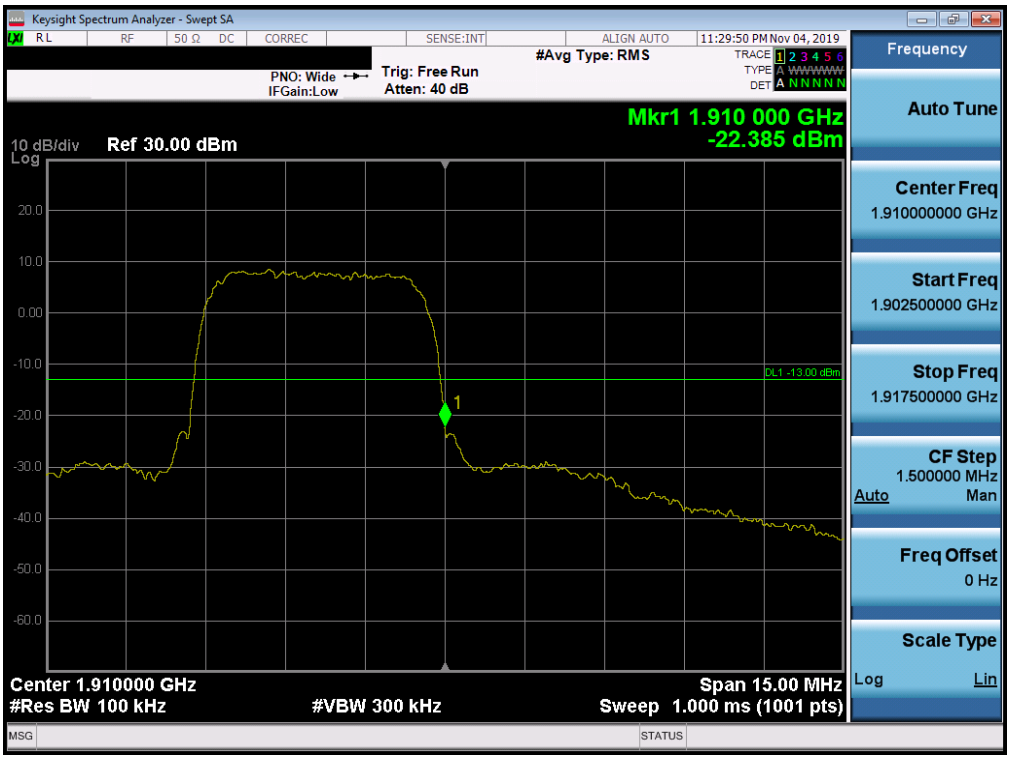
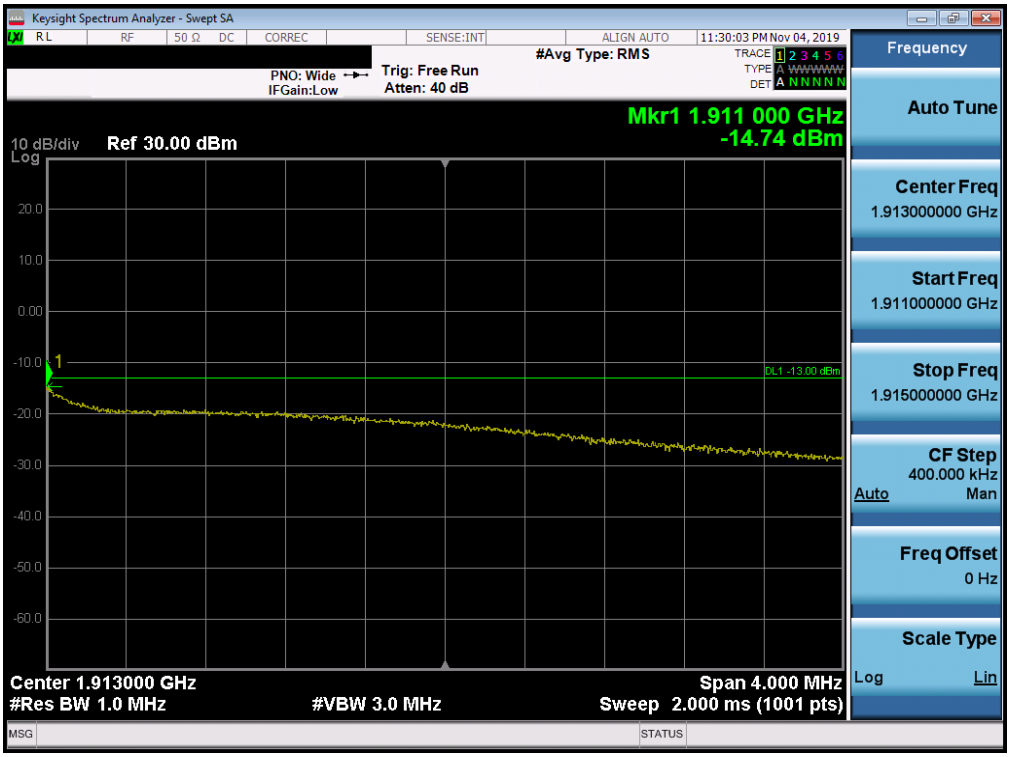


Plot 7-95. Band Edge Plot (PCS WCDMA Mode - High Channel)



Plot 7-96. 4MHz Span Plot (PCS WCDMA Mode - High Channel)

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7.5 Peak-Average Ratio

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 D01 v03r01 – 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.

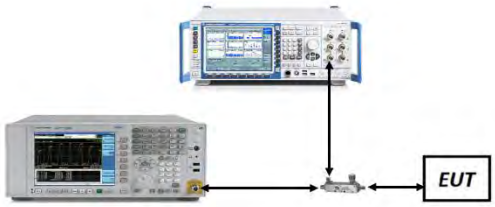

Figure 7-4. Test Instrument & Measurement Setup

Test Notes

None

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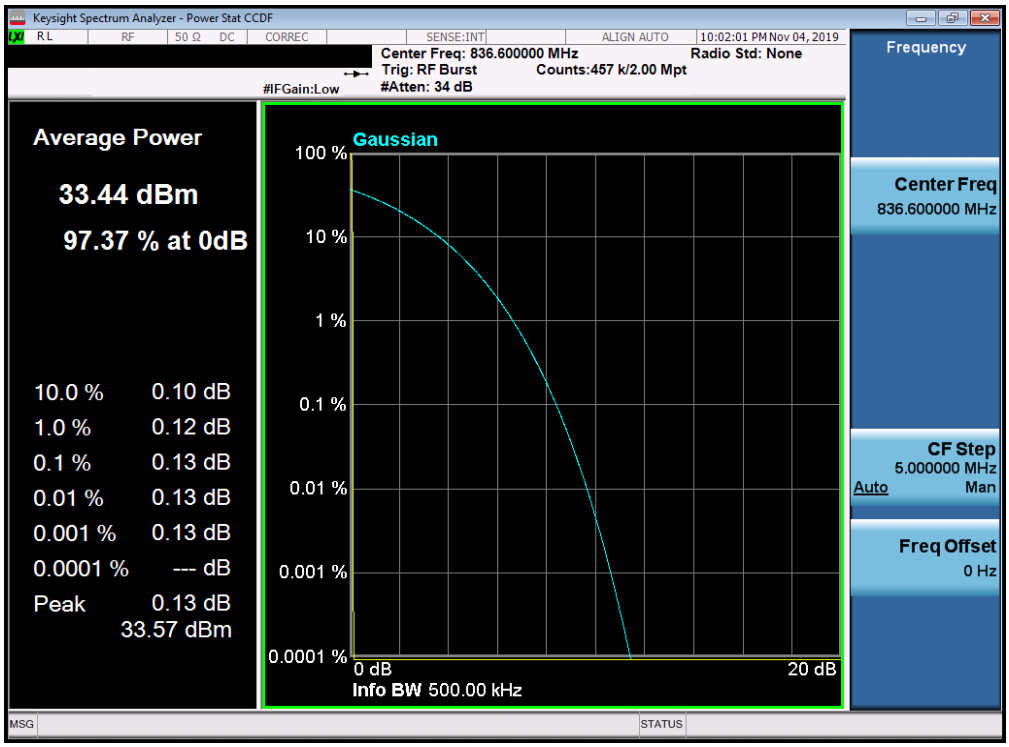
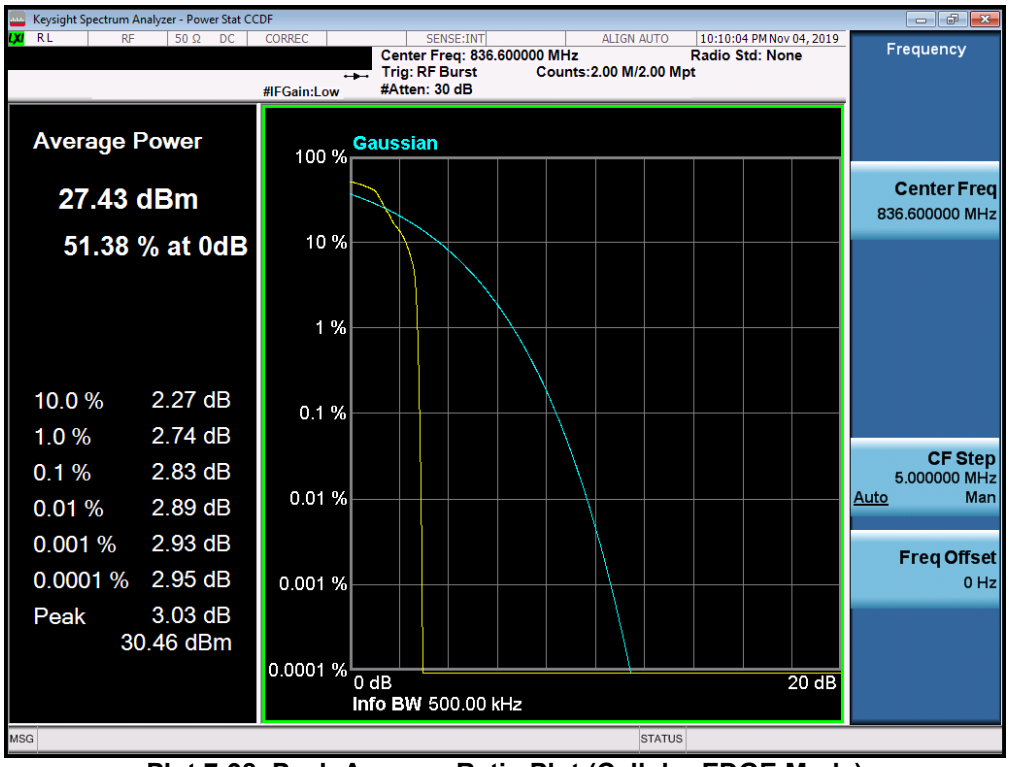


Plot 7-97. Peak-Average Ratio Plot (Cellular GPRS Mode)



Plot 7-98. Peak-Average Ratio Plot (Cellular EDGE Mode)

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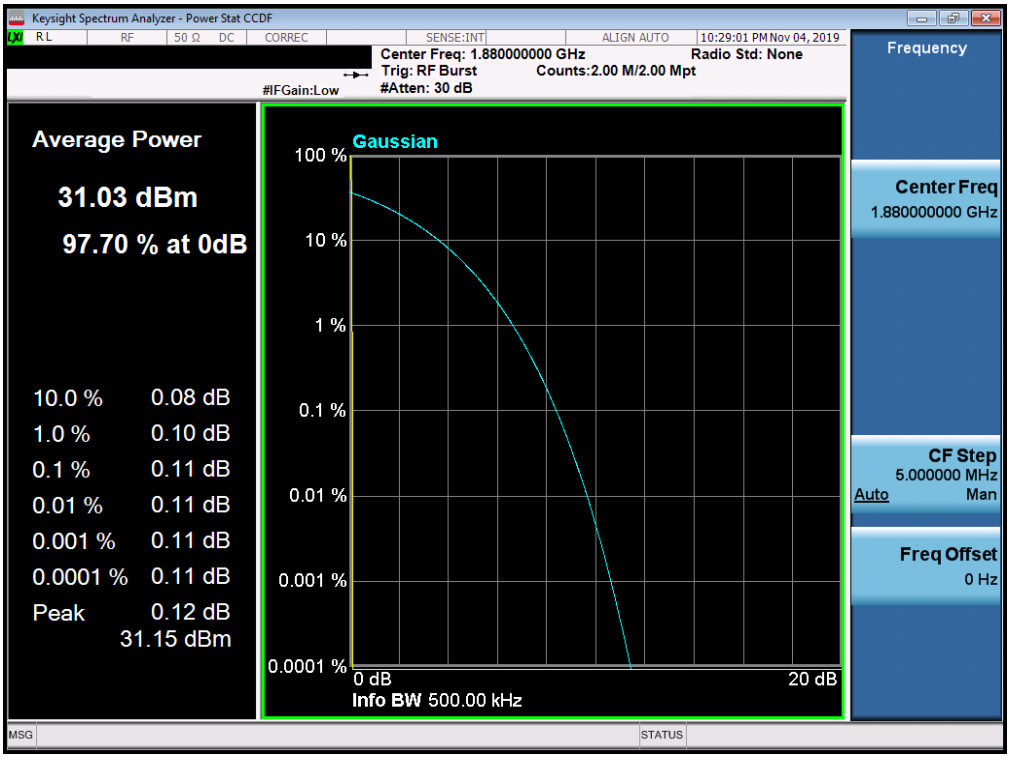
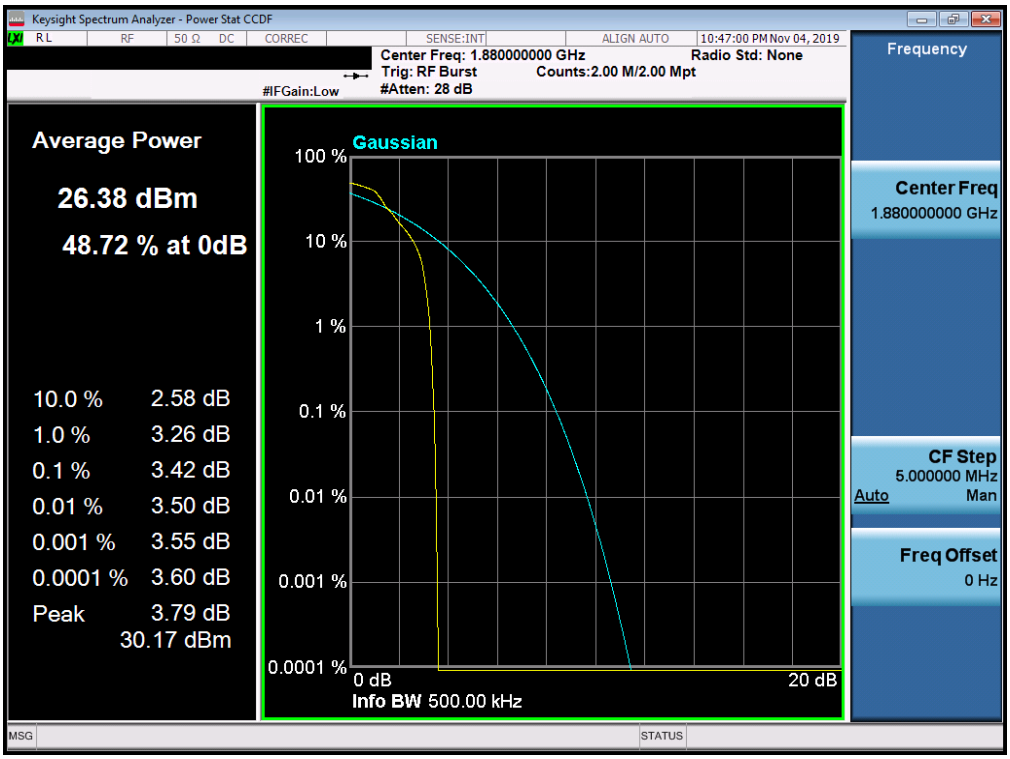


Plot 7-99. Peak-Average Ratio Plot (PCS GPRS Mode)



Plot 7-100. Peak-Average Ratio Plot (PCS EDGE Mode)

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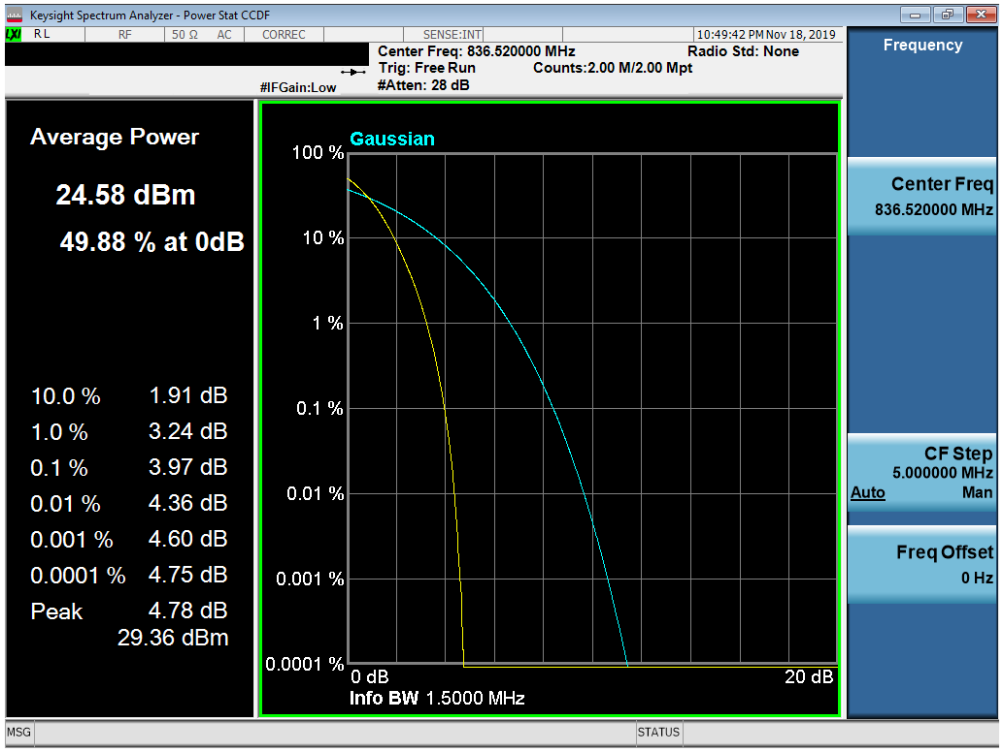
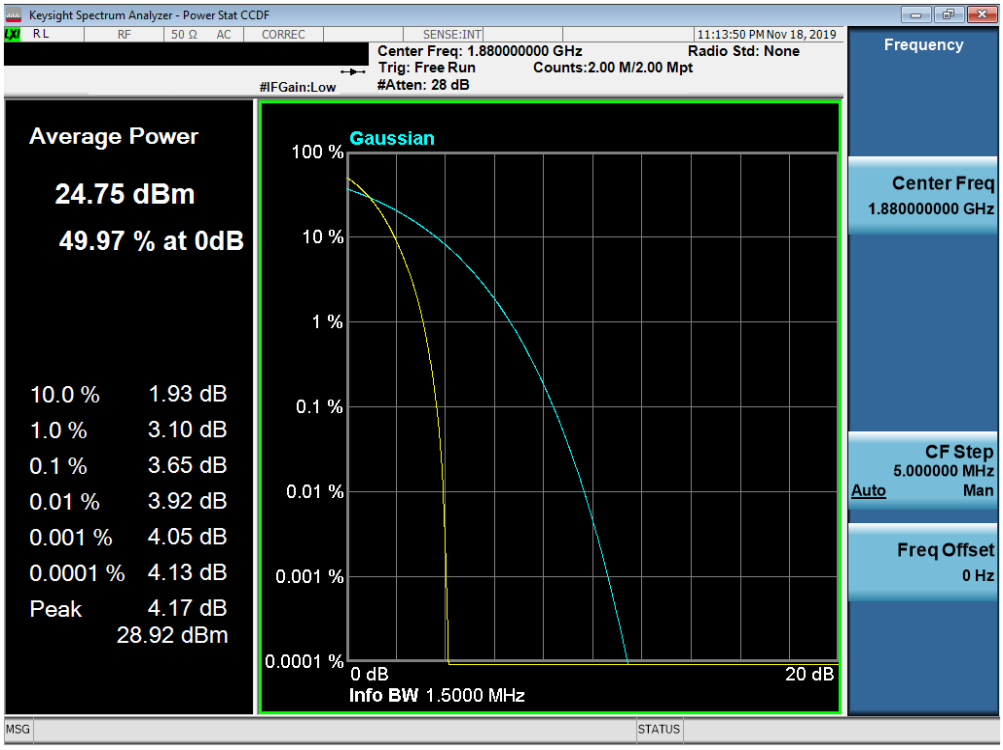


Plot 7-101. Peak-Average Ratio Plot (Cellular CDMA Mode)



Plot 7-102. Peak-Average Ratio Plot (PCS CDMA Mode)

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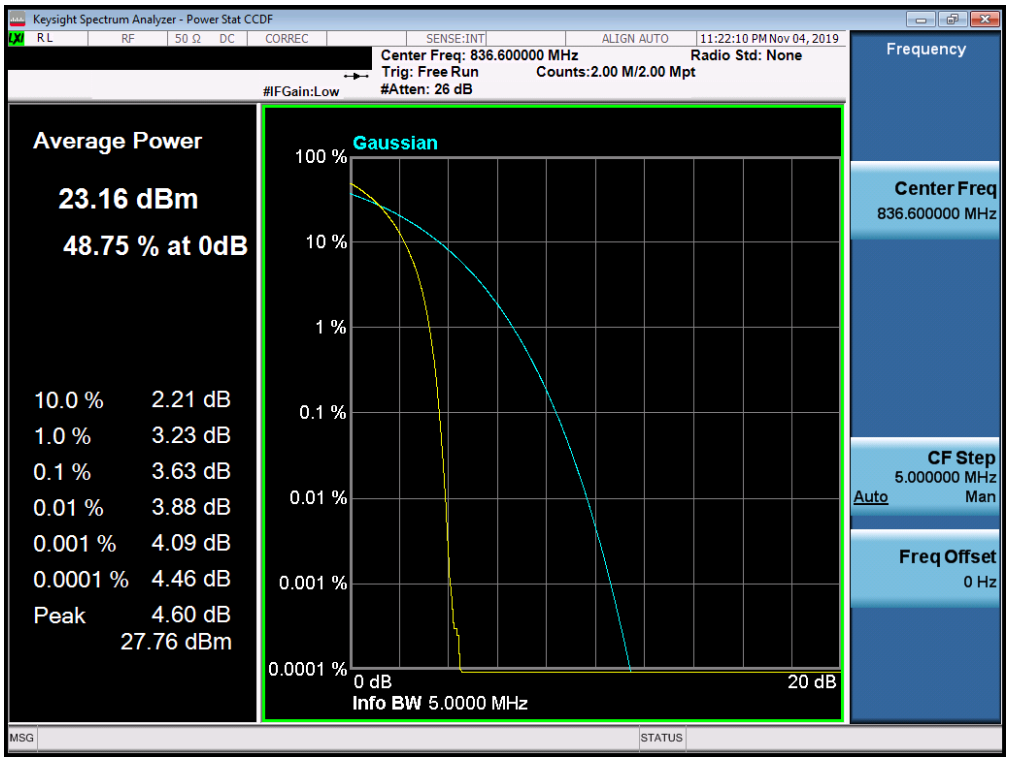
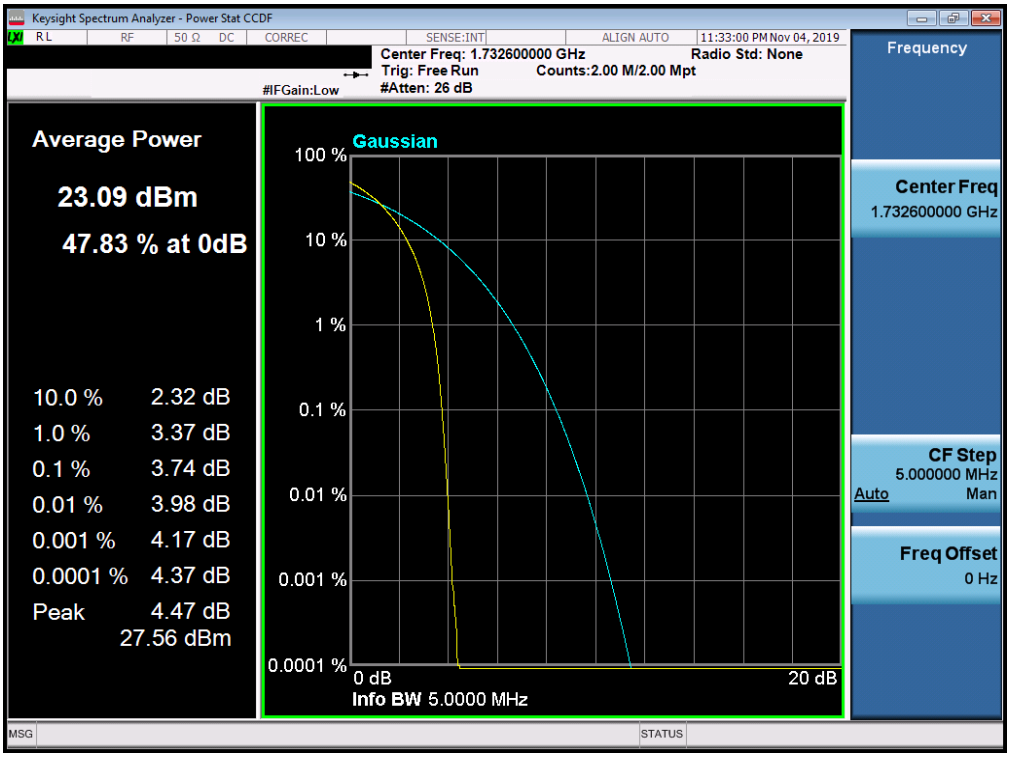


Plot 7-103. Peak-Average Ratio Plot (Cellular WCDMA Mode)



Plot 7-104. Peak-Average Ratio Plot (AWS WCDMA Mode)

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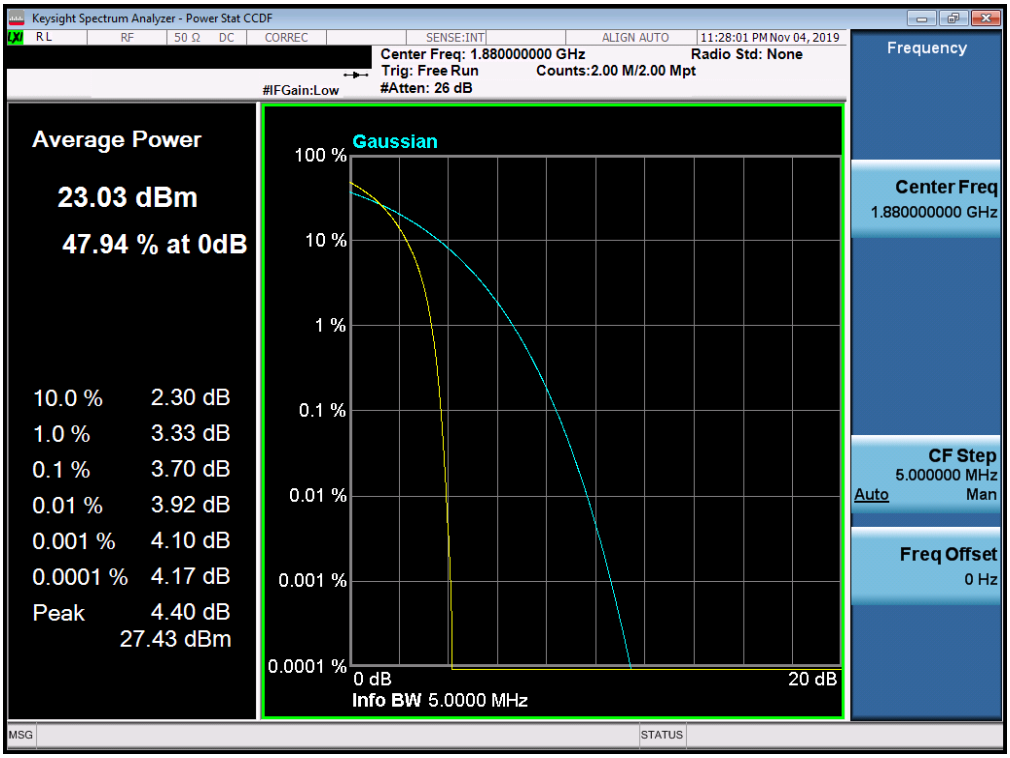

Plot 7-105. Peak-Average Ratio Plot (PCS WCDMA Mode)

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7.6 Radiated Power (ERP/EIRP)

Test Overview

Effective Radiated Power (ERP) and Equivalent Isotropic Radiated Power (EIRP) measurements are performed using the substitution method described in ANSI/TIA-603-E-2016 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using vertically and horizontally polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.2.1

ANSI/TIA-603-E-2016 – Section 2.2.17

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation. For signals with burst transmission, the signal analyzer's "time domain power" measurement capability is used
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW ≥ 3 x RBW
4. Span = 1.5 times the OBW
5. No. of sweep points ≥ 2 x span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto". Trigger is set to enable triggering only on full power bursts with the sweep time set less than or equal to the transmission burst duration
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation. For signals with burst transmission, the "gating" function was enabled to ensure that measurements are performed during times in which the transmitter is operating at its maximum power
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

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Test Setup

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

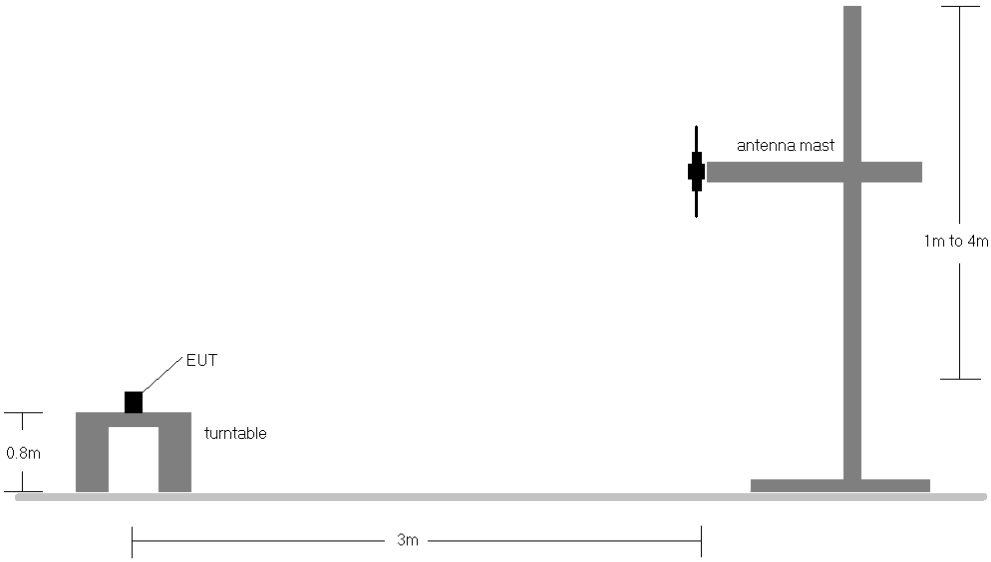

Figure 7-5. Radiated Test Setup <1GHz

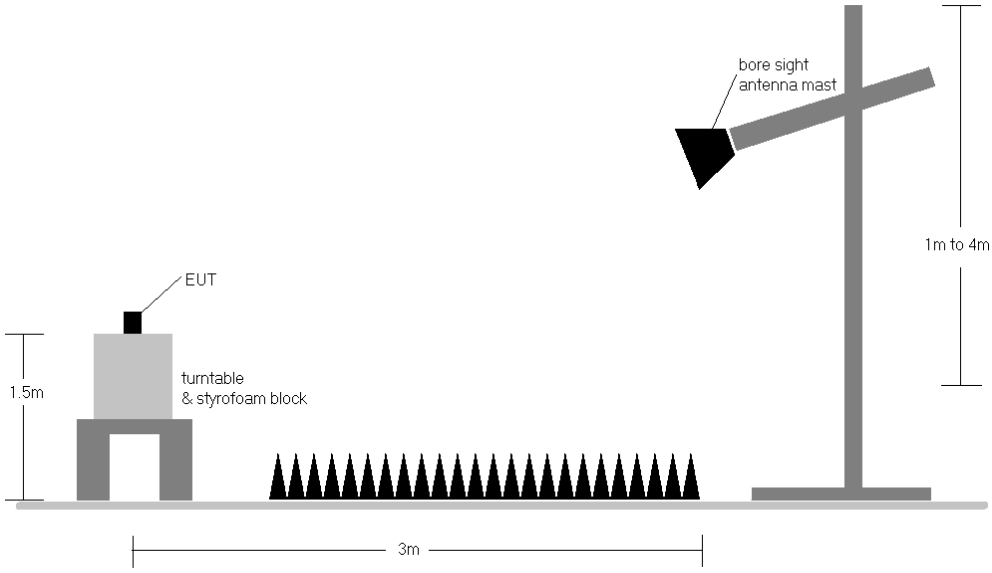

Figure 7-6. Radiated Test Setup >1GHz

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Test Notes

1) This device employs GSM, GPRS, and EDGE capabilities. The EUT 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 device was tested under all RC and SO combinations and the worst case is reported with RC3/SO55 with "All Up" power control bits.

4) This unit was tested with its standard battery.

5) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case setup is reported in the tables below.

Frequency [MHz]	Mode	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Substitute Level [dBm]	Ant. Gain [dBi]	ERP [dBm]	ERP Limit [dBm]	Margin [dB]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
824.20	GPRS850	H	219	299	23.85	6.70	28.40	38.45	-10.05	30.55	40.61	-10.06
836.60	GPRS850	H	204	298	23.94	6.70	**28.49**	38.45	-9.96	**30.64**	40.61	-9.97
848.80	GPRS850	H	208	296	23.52	6.70	28.07	38.45	-10.38	30.22	40.61	-10.39
836.60	GPRS850	V	147	13	22.45	6.40	26.70	38.45	-11.75	28.85	40.61	-11.76
836.60	EDGE850	H	204	298	17.83	6.70	**22.38**	38.45	-16.07	**24.53**	40.61	-16.08

Table 7-2. ERP/EIRP (Cellular GPRS)

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Frequency [MHz]	Mode	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Substitute Level [dBm]	Ant. Gain [dBi]	ERP [dBm]	ERP Limit [dBm]	Margin [dB]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
824.70	CDMA850	H	8	10	12.20	6.70	16.75	38.45	-21.70	18.90	40.61	-21.71
836.52	CDMA850	H	202	171	13.28	6.70	17.83	38.45	-20.62	19.98	40.61	-20.63
848.31	CDMA850	H	210	164	13.68	6.70	**18.23**	38.45	-20.22	**20.38**	40.61	-20.23
848.31	CDMA850	V	147	174	12.62	6.70	17.17	38.45	-21.28	19.32	40.61	-21.29

Table 7-3. ERP/EIRP (Cellular CDMA)

Frequency [MHz]	Mode	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Substitute Level [dBm]	Ant. Gain [dBi]	ERP [dBm]	ERP Limit [dBm]	Margin [dB]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
826.40	WCDMA850	H	147	174	11.43	6.70	15.98	38.45	-22.47	18.13	40.61	-22.48
836.60	WCDMA850	H	193	163	13.30	6.70	**17.85**	38.45	-20.60	**20.00**	40.61	-20.61
846.60	WCDMA850	H	161	164	11.29	6.60	15.74	38.45	-22.71	17.89	40.61	-22.72
836.60	WCDMA850	V	149	219	12.85	6.70	17.40	38.45	-21.05	19.55	40.61	-21.06

Table 7-4. ERP/EIRP (Cellular WCDMA)

Frequency [MHz]	Mode	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Substitute Level [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
1712.40	WCDMA1700	H	139	11	13.01	9.43	22.44	30.00	-7.56
1732.60	WCDMA1700	H	133	29	13.20	9.31	**22.51**	30.00	-7.49
1752.60	WCDMA1700	H	148	21	12.67	9.21	21.88	30.00	-8.12
1732.60	WCDMA1700	V	100	90	12.66	9.19	21.85	30.00	-8.15

Table 7-5. EIRP (AWS WCDMA)

Frequency [MHz]	Mode	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Substitute Level [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
1850.20	GPRS1900	H	120	13	20.01	9.48	29.49	33.01	-3.52
1880.00	GPRS1900	H	118	13	20.74	9.90	**30.64**	33.01	-2.37
1909.80	GPRS1900	H	192	5	19.68	10.26	29.94	33.01	-3.07
1880.00	GPRS1900	V	158	141	19.59	10.10	29.69	33.01	-3.32
1880.00	EDGE1900	H	118	13	17.61	9.90	**27.51**	33.01	-5.50

Table 7-6. EIRP (PCS GPRS)

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Frequency [MHz]	Mode	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Substitute Level [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
1851.25	CDMA1900	V	107	133	11.63	9.49	21.12	33.01	-11.89
1880.00	CDMA1900	V	138	89	10.87	9.90	20.77	33.01	-12.24
1908.75	CDMA1900	V	133	57	11.67	10.25	**21.92**	33.01	-11.09
1908.75	CDMA1900	H	158	2	11.59	10.25	21.84	33.01	-11.17

Table 7-7. EIRP (PCS CDMA)

Frequency [MHz]	Mode	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Substitute Level [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP Limit [dBm]	Margin [dB]
1852.40	WCDMA1900	H	128	361	13.37	9.51	22.88	33.01	-10.13
1880.00	WCDMA1900	H	125	367	13.85	9.90	**23.75**	33.01	-9.26
1907.60	WCDMA1900	H	116	369	13.39	10.24	23.63	33.01	-9.38
1880.00	WCDMA1900	V	140	134	12.64	10.10	22.74	33.01	-10.27

Table 7-8. EIRP (PCS WCDMA)

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7.7 Radiated Spurious Emissions Measurements

Test Overview

Radiated spurious emissions measurements are performed using the substitution method described in ANSI/TIA-603-E-2016 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using horizontally 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 D01 v03r01 – Section 5.8

ANSI/TIA-603-E-2016 – 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 = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

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Test Setup

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

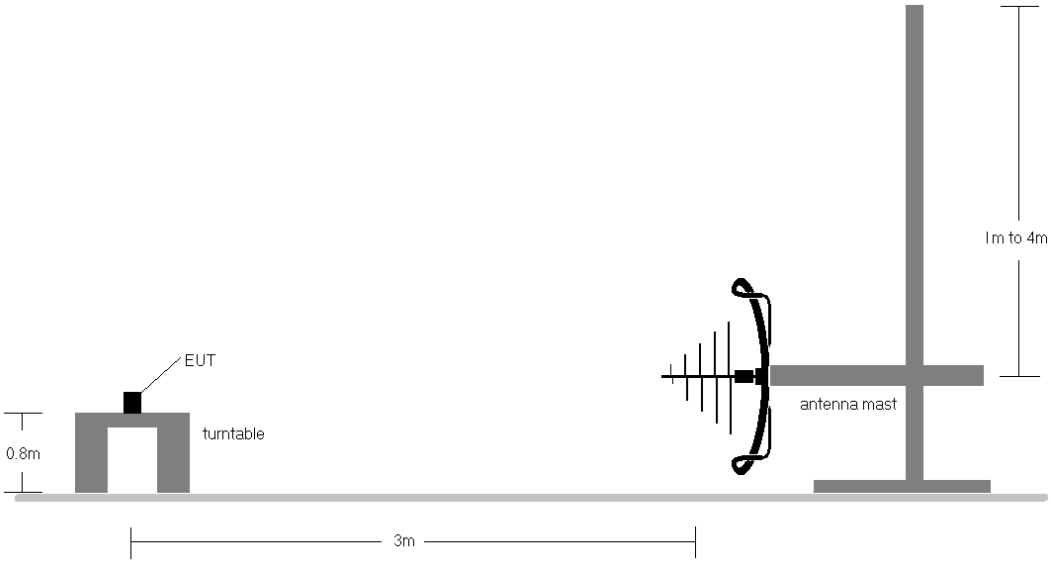

Figure 7-7. Test Instrument & Measurement Setup < 1GHz

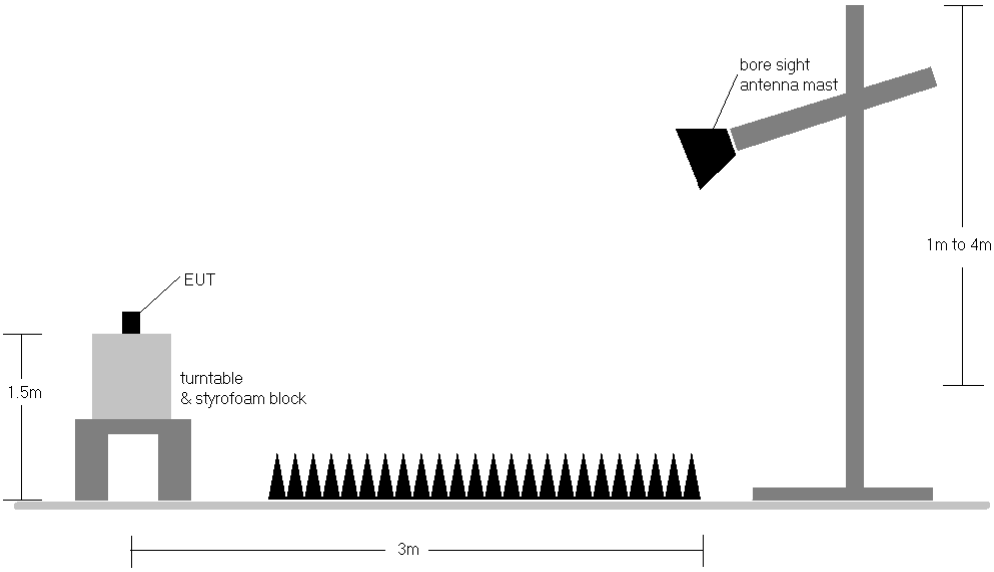

Figure 7-8. Test Instrument & Measurement Setup >1 GHz

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Test Notes

1) This device employs GSM, GPRS, and EDGE capabilities. The EUT 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 device was tested under all RC and SO combinations and the worst case is reported with RC3/SO55 with "All Up" power control bits.

4) This unit was tested with its standard battery.

5) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case setup is reported in the tables below.

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

7) 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.

8) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

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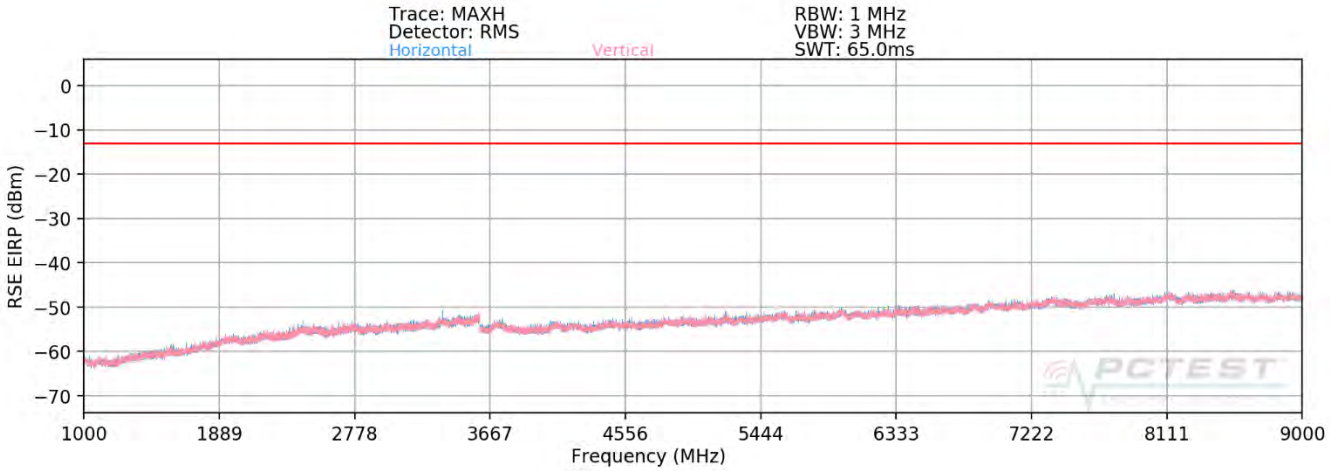
Cellular GPRS Mode



Plot 7-106. Radiated Spurious Plot above 1GHz (Cellular GPRS Mode)

OPERATING FREQUENCY: 824.20 MHz
MODULATION SIGNAL: GPRS (GMSK)
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1648.40	V	149	94	-43.05	3.61	-39.45	-26.4
2472.60	V	136	94	-51.44	4.21	-47.23	-34.2
3296.80	V	147	108	-58.89	5.77	-53.12	-40.1
4121.00	V	160	94	-63.26	7.59	-55.67	-42.7
4945.20	V	-	-	-64.64	8.56	-56.08	-43.1
5769.40	V	-	-	-63.84	8.81	-55.03	-42.0

Table 7-9. Radiated Spurious Data (Cellular GPRS Mode – Ch. 128)

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OPERATING FREQUENCY: 836.60 MHz
MODULATION SIGNAL: GPRS (GMSK)
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1673.20	V	143	96	-44.68	3.62	-41.06	-28.1
2509.80	V	154	90	-47.89	4.34	-43.55	-30.6
3346.40	V	140	94	-59.26	5.92	-53.34	-40.3
4183.00	V	-	-	-64.41	7.70	-56.71	-43.7
5019.60	V	-	-	-64.97	8.56	-56.41	-43.4

Table 7-10. Radiated Spurious Data (Cellular GPRS Mode – Ch. 190)

OPERATING FREQUENCY: 848.80 MHz
MODULATION SIGNAL: GPRS (GMSK)
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1697.60	V	161	99	-45.50	3.63	-41.87	-28.9
2546.40	V	169	101	-48.29	4.56	-43.74	-30.7
3395.20	V	-	-	-59.38	6.14	-53.25	-40.2
4244.00	V	-	-	-64.69	7.80	-56.89	-43.9

Table 7-11. Radiated Spurious Data (Cellular GPRS Mode – Ch. 251)

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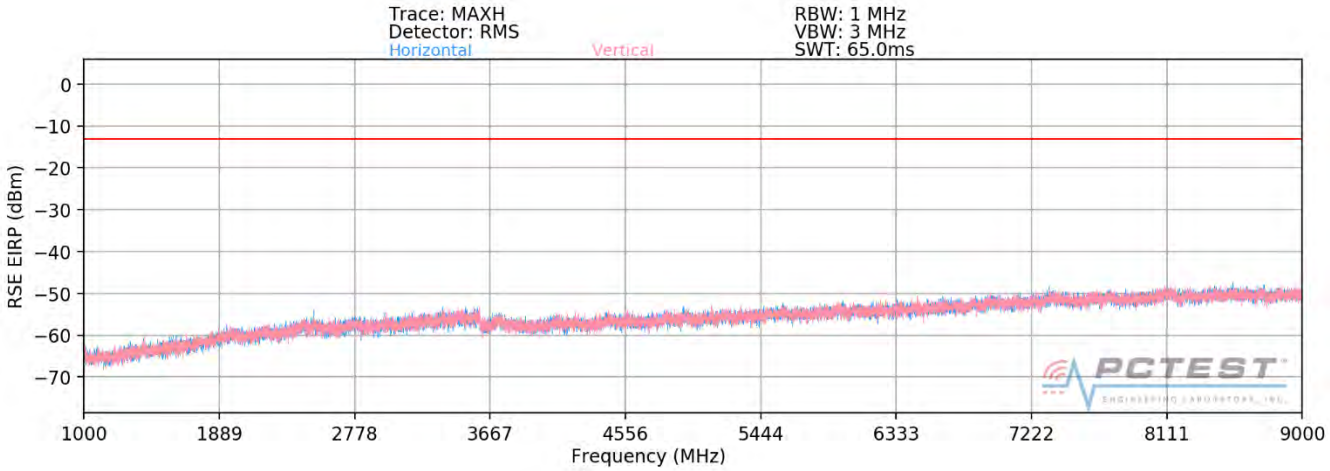
Cellular CDMA Mode



Plot 7-107. Radiated Spurious Plot above 1GHz (Cellular CDMA Mode)

OPERATING FREQUENCY: 824.70 MHz
MODULATION SIGNAL: CDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1649.40	H	153	188	-63.24	3.61	-59.63	-46.6
2474.10	H	166	323	-52.61	4.22	-48.39	-35.4
3298.80	H	-	-	-67.49	5.78	-61.71	-48.7
4123.50	H	-	-	-68.50	7.60	-60.90	-47.9

Table 7-12. Radiated Spurious Data (Cellular CDMA Mode – Ch. 1013)

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OPERATING FREQUENCY: 836.52 MHz
MODULATION SIGNAL: CDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1673.04	H	150	184	-63.74	3.62	-60.12	-47.1
2509.56	H	161	322	-53.36	4.33	-49.03	-36.0
3346.08	H	-	-	-66.97	5.92	-61.05	-48.0
4182.60	H	-	-	-68.62	7.69	-60.93	-47.9

Table 7-13. Radiated Spurious Data (Cellular CDMA Mode – Ch. 384)

OPERATING FREQUENCY: 848.31 MHz
MODULATION SIGNAL: CDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1696.62	H	145	181	-66.52	3.63	-62.89	-49.9
2544.93	H	153	319	-51.60	4.55	-47.05	-34.1
3393.24	H	-	-	-67.67	6.13	-61.55	-48.5
4241.55	H	-	-	-68.60	7.79	-60.81	-47.8

Table 7-14. Radiated Spurious Data (Cellular CDMA Mode – Ch. 777)

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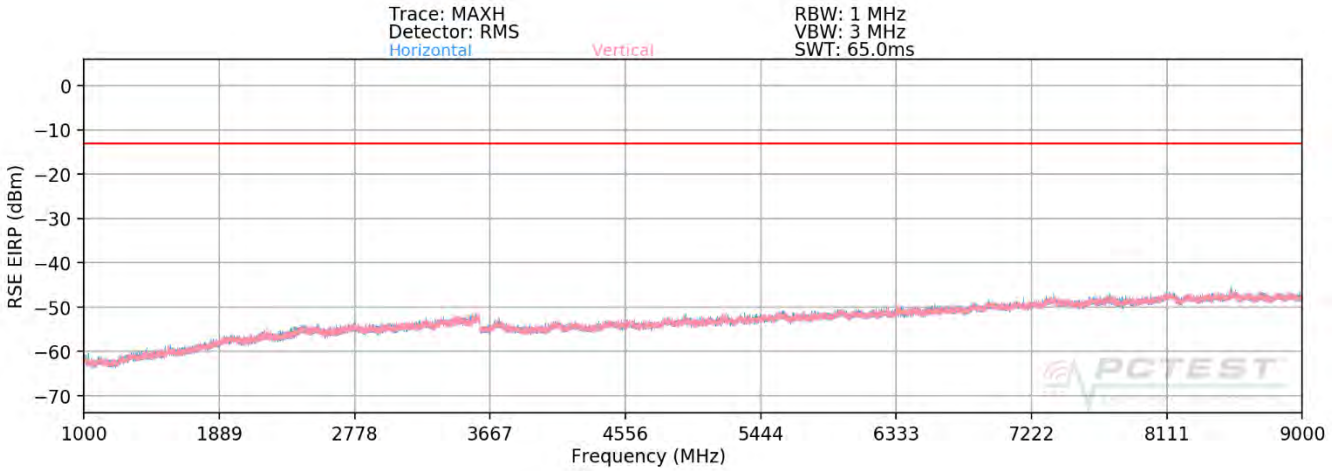
Cellular WCDMA Mode



Plot 7-108. Radiated Spurious Plot above 1GHz (Cellular WCDMA Mode)

OPERATING FREQUENCY:	826.40	MHz
MODULATION SIGNAL:	WCDMA	
DISTANCE:	3	meters
LIMIT:	-13	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1652.80	V	389	54	-63.40	3.61	-59.79	-46.8
2479.20	V	-	-	-60.74	4.23	-56.51	-43.5
3305.60	V	-	-	-61.40	5.80	-55.61	-42.6

Table 7-15. Radiated Spurious Data (Cellular WCDMA Mode – Ch. 4132)

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OPERATING FREQUENCY: 836.60 MHz
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1673.20	V	262	225	-62.94	3.62	-59.32	-46.3
2509.80	V	-	-	-60.80	4.34	-56.46	-43.5
3346.40	V	-	-	-60.58	5.92	-54.66	-41.7

Table 7-16. Radiated Spurious Data (Cellular WCDMA Mode – Ch. 4183)

OPERATING FREQUENCY: 846.60 MHz
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1693.20	V	275	110	-62.76	3.63	-59.14	-46.1
2539.80	V	-	-	-60.61	4.52	-56.10	-43.1
3386.40	V	-	-	-61.32	6.10	-55.23	-42.2

Table 7-17. Radiated Spurious Data (Cellular WCDMA Mode – Ch. 4233)

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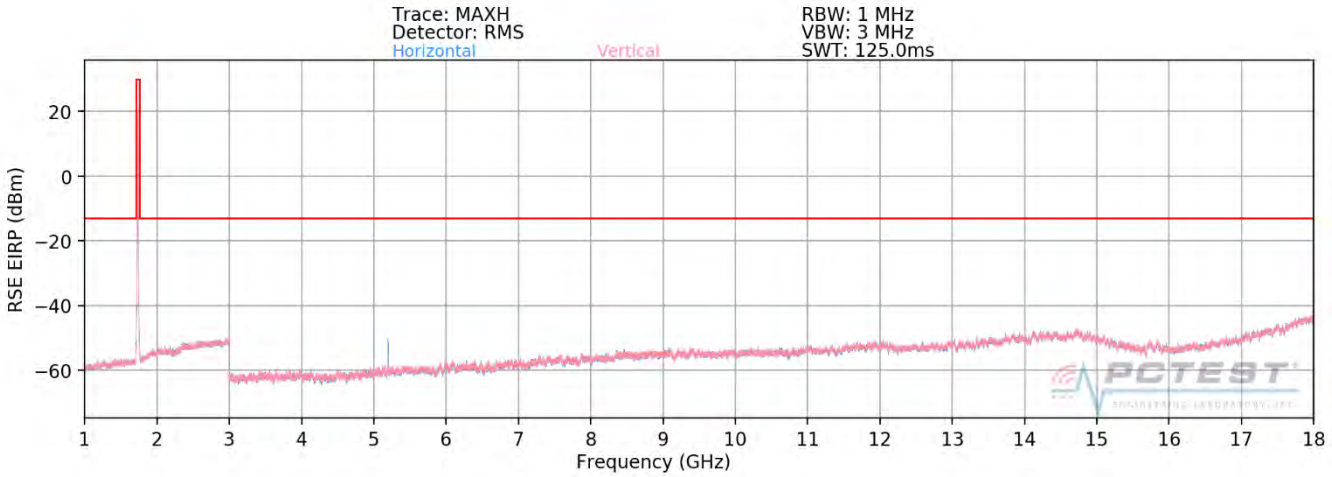
AWS WCDMA Mode



Plot 7-109. Radiated Spurious Plot above 1GHz (AWS WCDMA Mode)

OPERATING FREQUENCY: 1712.40 MHz
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3424.80	H	131	35	-68.39	6.20	-62.19	-49.2
5137.20	H	-	-	-70.34	8.66	-61.68	-48.7

Table 7-18. Radiated Spurious Data (AWS WCDMA Mode – Ch. 1312)

OPERATING FREQUENCY: 1732.60 MHz
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3465.20	H	118	247	-70.00	6.27	-63.73	-50.7
5197.80	H	-	-	-70.49	8.71	-61.78	-48.8

Table 7-19. Radiated Spurious Data (AWS WCDMA Mode – Ch. 1413)

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OPERATING FREQUENCY: 1752.60 MHz
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3505.20	H	114	28	-68.33	6.34	-61.99	-49.0
5257.80	H	122	269	-58.21	8.72	-49.50	-36.5
7010.40	H	-	-	-68.16	8.75	-59.41	-46.4

Table 7-20. Radiated Spurious Data (AWS WCDMA Mode – Ch. 1513)

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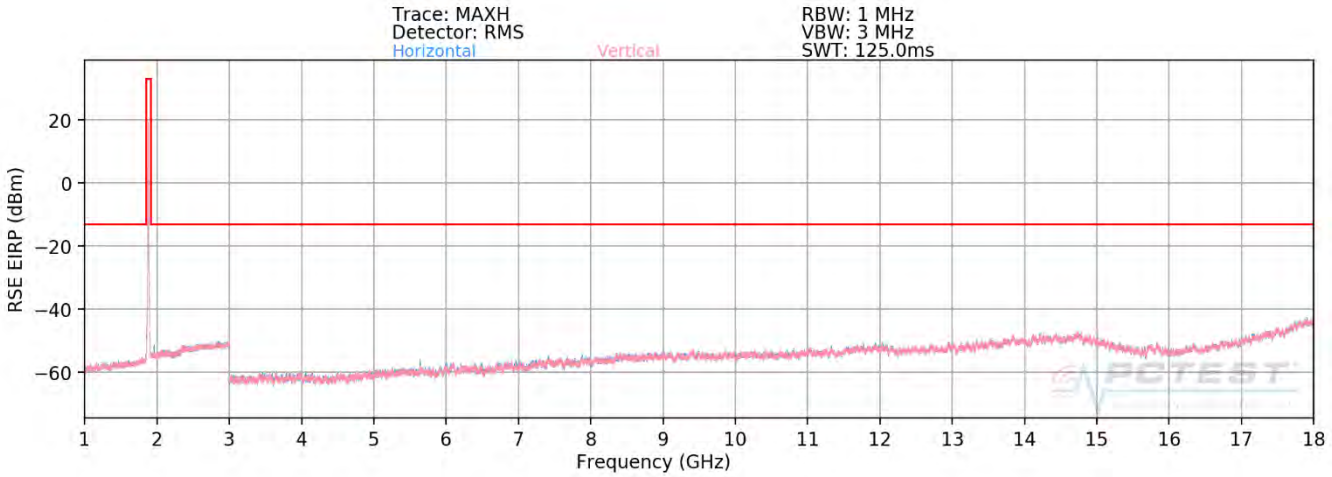
PCS GPRS Mode



Plot 7-110. Radiated Spurious Plot above 1GHz (PCS GPRS Mode)

OPERATING FREQUENCY: 1850.20 MHz
MODULATION SIGNAL: GPRS (GMSK)
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3700.40	V	116	59	-55.89	6.56	-49.33	-36.3
5550.60	V	388	370	-46.28	8.72	-37.56	-24.6
7400.80	V	400	14	-53.94	8.41	-45.53	-32.5
9251.00	V	299	349	-59.40	9.47	-49.93	-36.9
11101.20	V	393	334	-60.49	9.31	-51.19	-38.2
12951.40	V	-	-	-61.59	8.99	-52.59	-39.6

Table 7-21. Radiated Spurious Data (PCS GPRS Mode – Ch. 512)

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OPERATING FREQUENCY: 1880.00 MHz
MODULATION SIGNAL: GPRS (GMSK)
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3760.00	V	119	333	-52.77	6.67	-46.11	-33.1
5640.00	V	398	23	-45.29	8.81	-36.48	-23.5
7520.00	V	383	291	-58.95	8.48	-50.46	-37.5
9400.00	V	196	326	-62.15	9.32	-52.83	-39.8
11280.00	V	269	348	-54.55	9.24	-45.31	-32.3
13160.00	V	-	-	-62.63	9.07	-53.57	-40.6

Table 7-22. Radiated Spurious Data (PCS GPRS Mode – Ch. 661)

OPERATING FREQUENCY: 1909.80 MHz
MODULATION SIGNAL: GPRS (GMSK)
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3819.60	V	114	337	-52.71	7.00	-45.72	-32.7
5729.40	V	112	6	-51.95	8.77	-43.18	-30.2
7639.20	V	255	9	-59.04	8.54	-50.50	-37.5
9549.00	V	-	-	-65.84	9.43	-56.41	-43.4

Table 7-23. Radiated Spurious Data (PCS GPRS Mode – Ch. 810)

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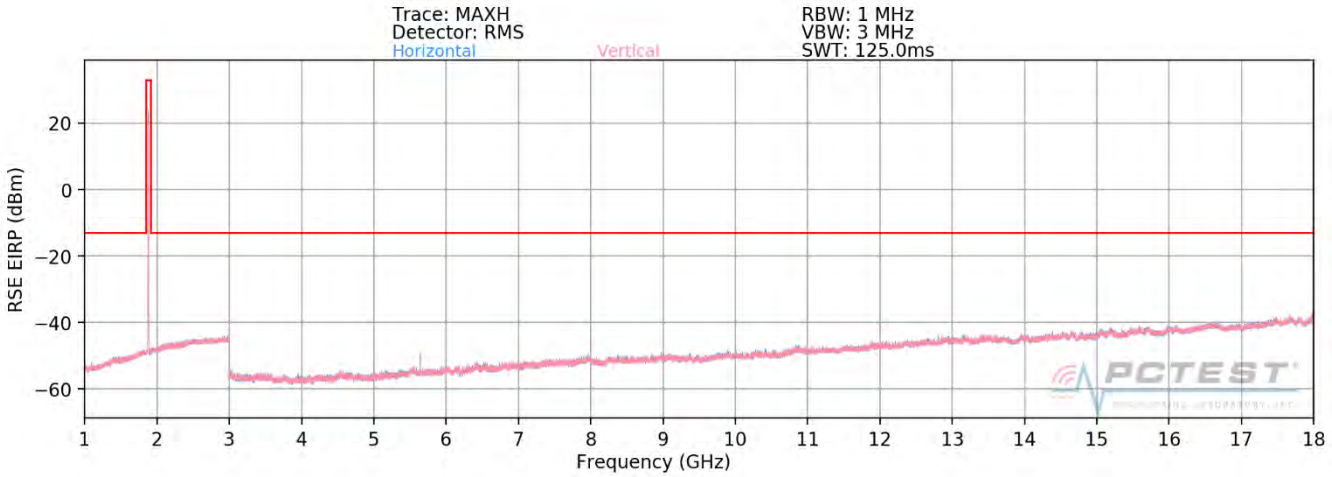
PCS CDMA Mode



Plot 7-111. Radiated Spurious Plot above 1GHz (PCS CDMA Mode)

OPERATING FREQUENCY: 1851.25 MHz
MODULATION SIGNAL: CDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3702.50	H	-	-	-68.12	6.56	-61.55	-48.6
5553.75	H	109	14	-66.38	8.72	-57.66	-44.7
7405.00	H	-	-	-65.07	8.41	-56.67	-43.7
9256.25	H	-	-	-64.25	9.45	-54.79	-41.8

Table 7-24. Radiated Spurious Data (PCS CDMA Mode – Ch. 25)

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OPERATING FREQUENCY: 1880.00 MHz
MODULATION SIGNAL: CDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3760.00	H	-	-	-68.19	6.67	-61.52	-48.5
5640.00	H	105	297	-66.68	8.81	-57.87	-44.9
7520.00	H	-	-	-65.32	8.48	-56.84	-43.8
9400.00	H	-	-	-64.87	9.32	-55.55	-42.6

Table 7-25. Radiated Spurious Data (PCS CDMA Mode – Ch. 600)

OPERATING FREQUENCY: 1908.75 MHz
MODULATION SIGNAL: CDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3817.50	H	-	-	-67.84	6.98	-60.85	-47.9
5726.25	H	100	60	-65.82	8.77	-57.05	-44.1
7635.00	H	-	-	-65.13	8.53	-56.59	-43.6
9543.75	H	-	-	-65.19	9.42	-55.77	-42.8

Table 7-26. Radiated Spurious Data (PCS CDMA Mode – Ch. 1175)

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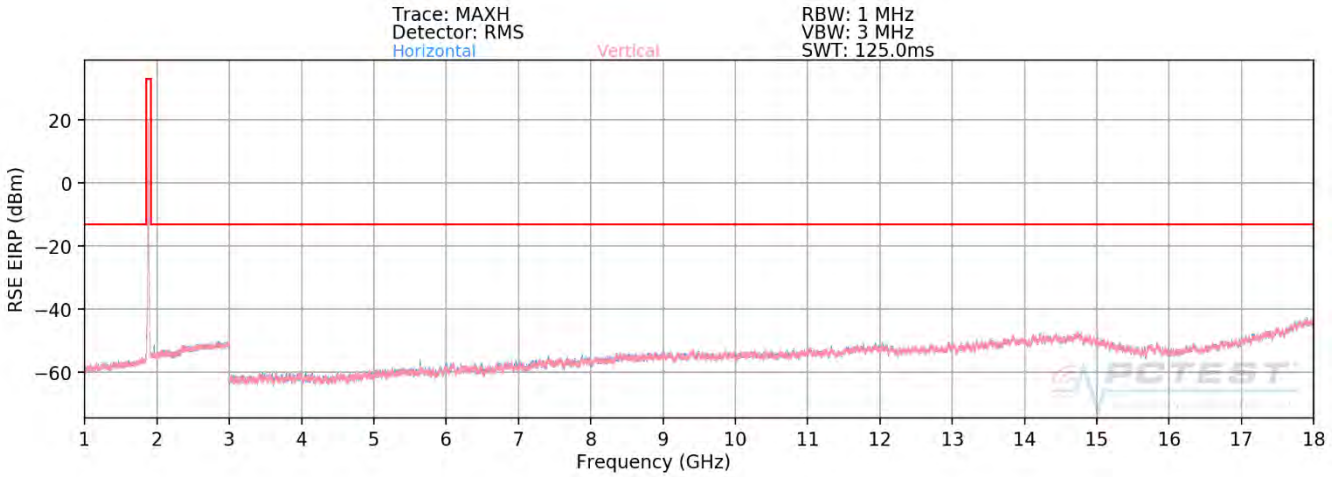
PCS WCDMA Mode



Plot 7-112. Radiated Spurious Plot above 1GHz (PCS WCDMA Mode)

OPERATING FREQUENCY: 1852.40 MHz
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3704.80	V	120	74	-69.56	6.57	-63.00	-50.0
5557.20	V	275	321	-59.95	8.72	-51.22	-38.2
7409.60	V	128	24	-66.23	8.41	-57.82	-44.8
9262.00	V	-	-	-65.86	9.44	-56.42	-43.4

Table 7-27. Radiated Spurious Data (PCS WCDMA Mode – Ch. 9262)

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OPERATING FREQUENCY: 1880.00 MHz
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3760.00	V	118	70	-70.40	6.67	-63.74	-50.7
5640.00	V	274	316	-59.56	8.81	-50.75	-37.7
7520.00	V	396	353	-65.56	8.48	-57.07	-44.1
9400.00	V	-	-	-64.44	9.32	-55.12	-42.1

Table 7-28. Radiated Spurious Data (PCS WCDMA Mode – Ch. 9400)

OPERATING FREQUENCY: 1907.60 MHz
MODULATION SIGNAL: WCDMA
DISTANCE: 3 meters
LIMIT: -13 dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3815.20	V	400	89	-70.07	6.97	-63.10	-50.1
5722.80	V	140	328	-66.93	8.77	-58.16	-45.2
7630.40	V	-	-	-67.64	8.52	-59.12	-46.1

Table 7-29. Radiated Spurious Data (PCS WCDMA Mode – Ch. 9538)

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7.8 Frequency Stability / Temperature Variation

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-E-2016. 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, RSS-132, and RSS-133, the frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5 ppm) of the center frequency. For Part 24, Part 27, and RSS-139, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test Procedure Used

ANSI/TIA-603-E-2016

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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Frequency Stability / Temperature Variation

OPERATING FREQUENCY:	836,600,000	Hz
CHANNEL:	190	
REFERENCE VOLTAGE:	4.25	VDC
DEVIATION LIMIT:	± 0.00025 % or 2.5 ppm	

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	4.25	- 30	836,600,218	218	0.0000261
100 %		- 20	836,600,058	58	0.0000069
100 %		- 10	836,599,843	-157	-0.0000188
100 %		0	836,600,325	325	0.0000388
100 %		+ 10	836,599,973	-27	-0.0000032
100 %		+ 20	836,599,996	-4	-0.0000005
100 %		+ 30	836,599,978	-22	-0.0000026
100 %		+ 40	836,600,343	343	0.0000410
100 %		+ 50	836,600,167	167	0.0000200
BATT. ENDPOINT	2.78	+ 20	836,599,968	-32	-0.0000038

Table 7-30. Frequency Stability Data (Cellular GPRS Mode – Ch. 190)

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Frequency Stability / Temperature Variation

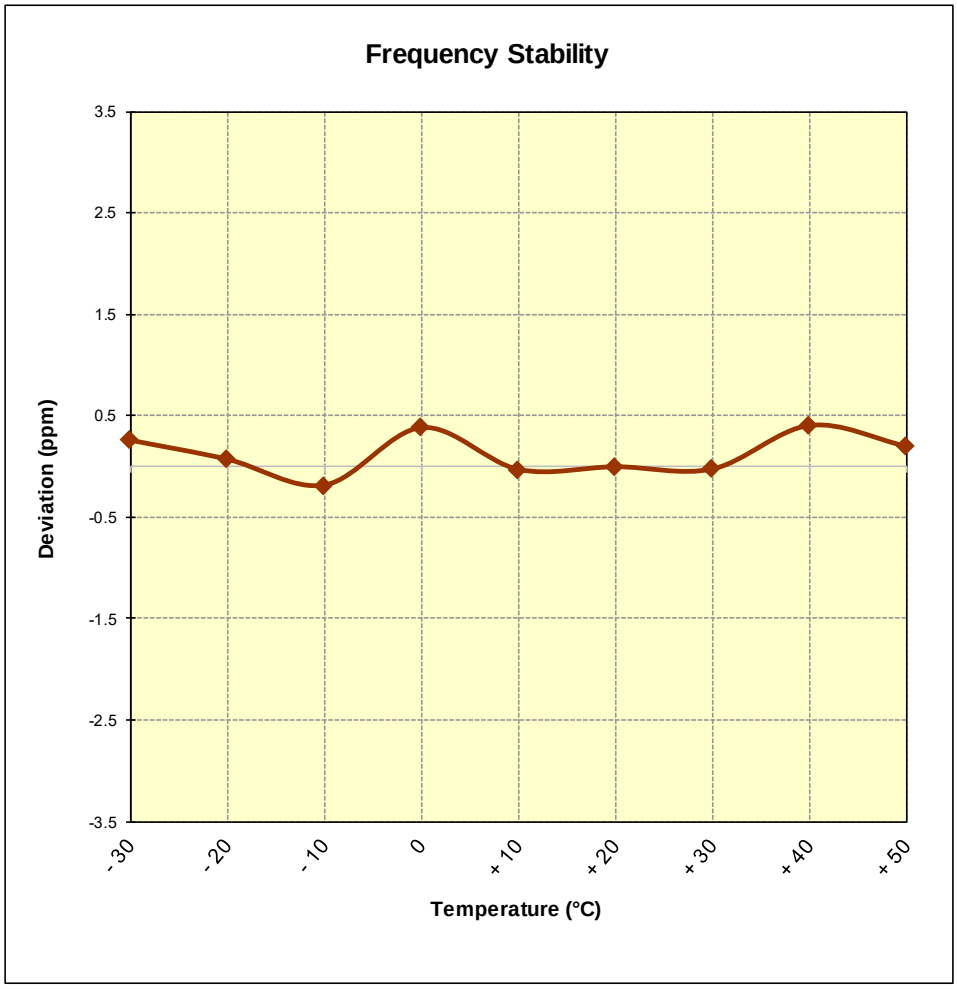

Figure 7-9. Frequency Stability Graph (Cellular GPRS Mode – Ch. 190)

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Frequency Stability / Temperature Variation

OPERATING FREQUENCY:	836,520,000	Hz
CHANNEL:	384	
REFERENCE VOLTAGE:	4.25	VDC
DEVIATION LIMIT:	± 0.00025 % or 2.5 ppm	

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	4.25	- 30	836,519,992	-8	-0.0000010
100 %		- 20	836,519,899	-101	-0.0000121
100 %		- 10	836,520,136	136	0.0000163
100 %		0	836,520,280	280	0.0000335
100 %		+ 10	836,519,911	-89	-0.0000106
100 %		+ 20	836,519,935	-65	-0.0000078
100 %		+ 30	836,519,864	-136	-0.0000163
100 %		+ 40	836,520,386	386	0.0000461
100 %		+ 50	836,519,793	-207	-0.0000247
BATT. ENDPOINT	2.78	+ 20	836,520,080	80	0.0000096

Table 7-31. Frequency Stability Data (Cellular CDMA Mode – Ch. 384)

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Frequency Stability / Temperature Variation

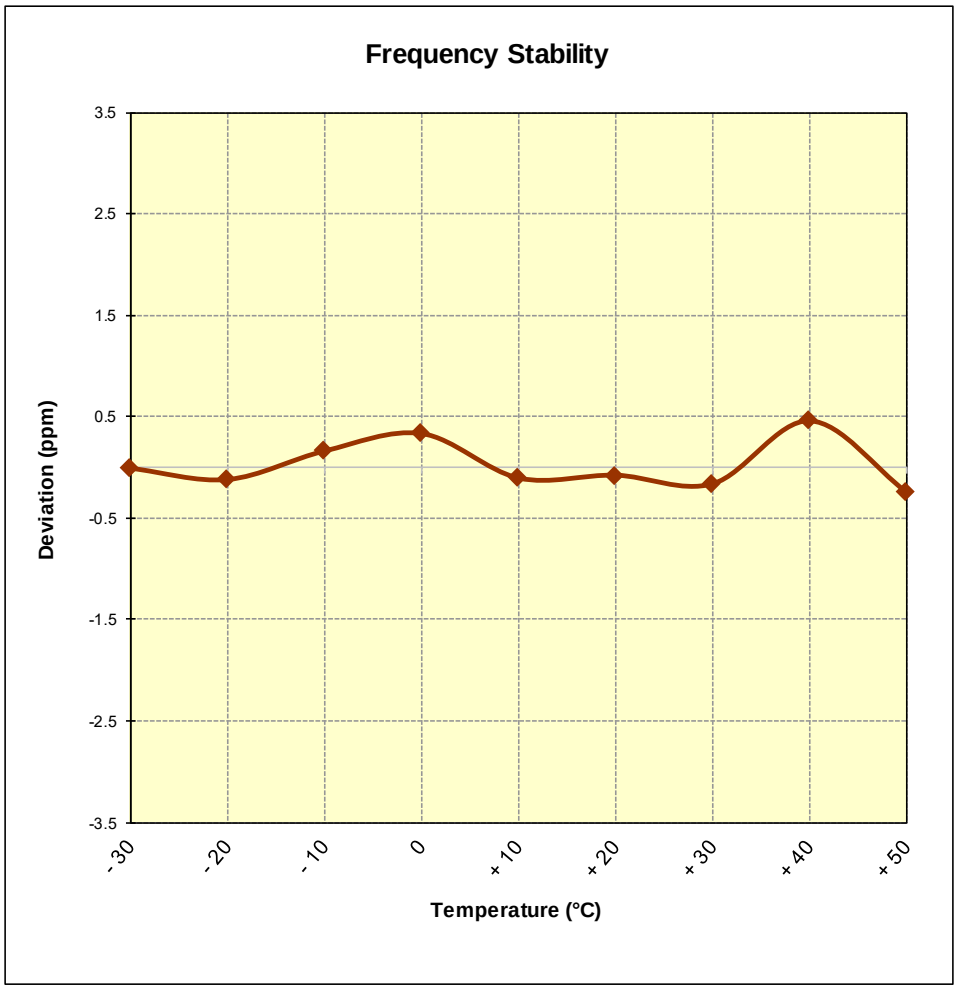

Figure 7-10. Frequency Stability Graph (Cellular CDMA Mode – Ch. 384)

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Frequency Stability / Temperature Variation

OPERATING FREQUENCY:	836,600,000	Hz
CHANNEL:	4183	
REFERENCE VOLTAGE:	4.25	VDC
DEVIATION LIMIT:	± 0.00025 % or 2.5 ppm	

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	4.25	- 30	836,599,961	-39	-0.0000047
100 %		- 20	836,600,177	177	0.0000212
100 %		- 10	836,600,066	66	0.0000079
100 %		0	836,600,042	42	0.0000050
100 %		+ 10	836,599,703	-297	-0.0000355
100 %		+ 20	836,600,283	283	0.0000338
100 %		+ 30	836,599,638	-362	-0.0000433
100 %		+ 40	836,600,050	50	0.0000060
100 %		+ 50	836,599,939	-61	-0.0000073
BATT. ENDPOINT	2.78	+ 20	836,599,992	-8	-0.0000010

Table 7-32. Frequency Stability Data (Cellular WCDMA Mode – Ch. 4183)

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Frequency Stability / Temperature Variation

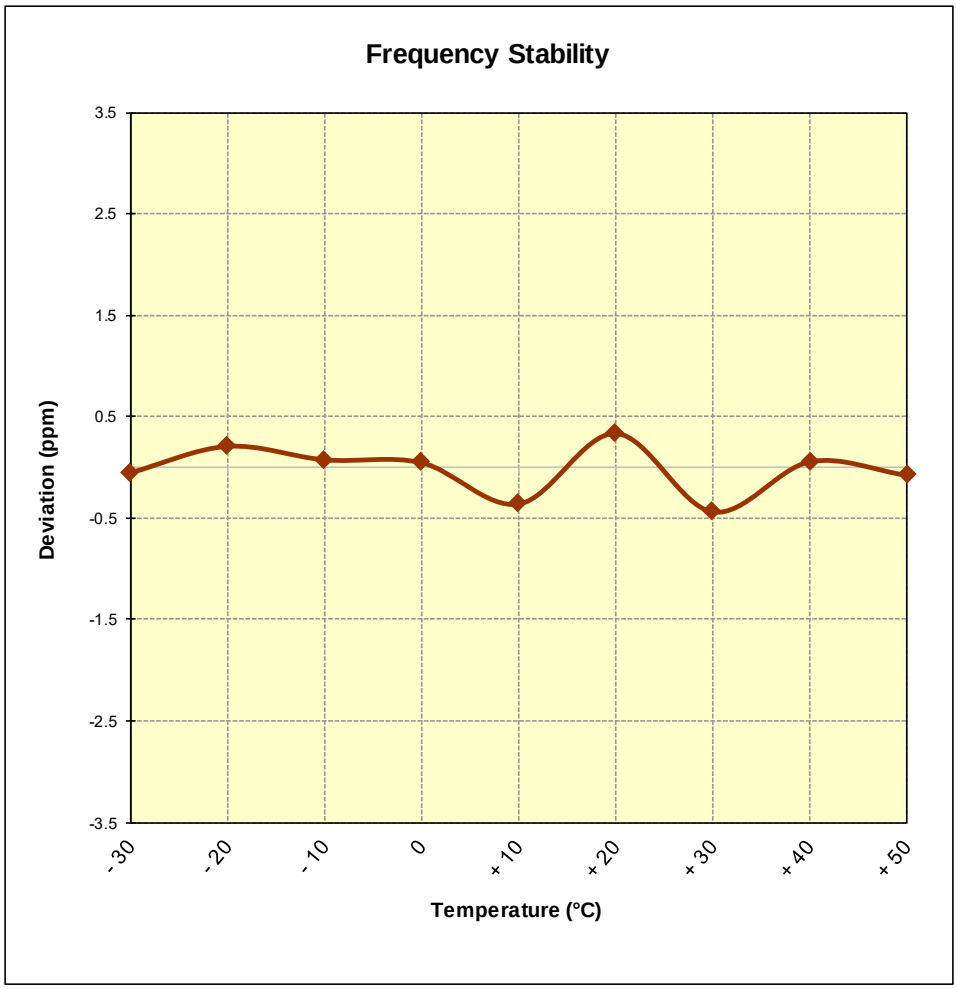

Figure 7-11. Frequency Stability Graph (Cellular WCDMA Mode – Ch. 4183)

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Frequency Stability / Temperature Variation

OPERATING FREQUENCY:	1,732,600,000	Hz
CHANNEL:	1413	
REFERENCE VOLTAGE:	4.25	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	4.25	- 30	1,732,600,016	16	0.0000009
100 %		- 20	1,732,600,083	83	0.0000048
100 %		- 10	1,732,600,097	97	0.0000056
100 %		0	1,732,600,071	71	0.0000041
100 %		+ 10	1,732,600,095	95	0.0000055
100 %		+ 20	1,732,600,126	126	0.0000073
100 %		+ 30	1,732,600,363	363	0.0000210
100 %		+ 40	1,732,599,931	-69	-0.0000040
100 %		+ 50	1,732,599,705	-295	-0.0000170
BATT. ENDPOINT	2.78	+ 20	1,732,600,286	286	0.0000165

Table 7-33. Frequency Stability Data (AWS WCDMA Mode – Ch. 1413)

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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Frequency Stability / Temperature Variation

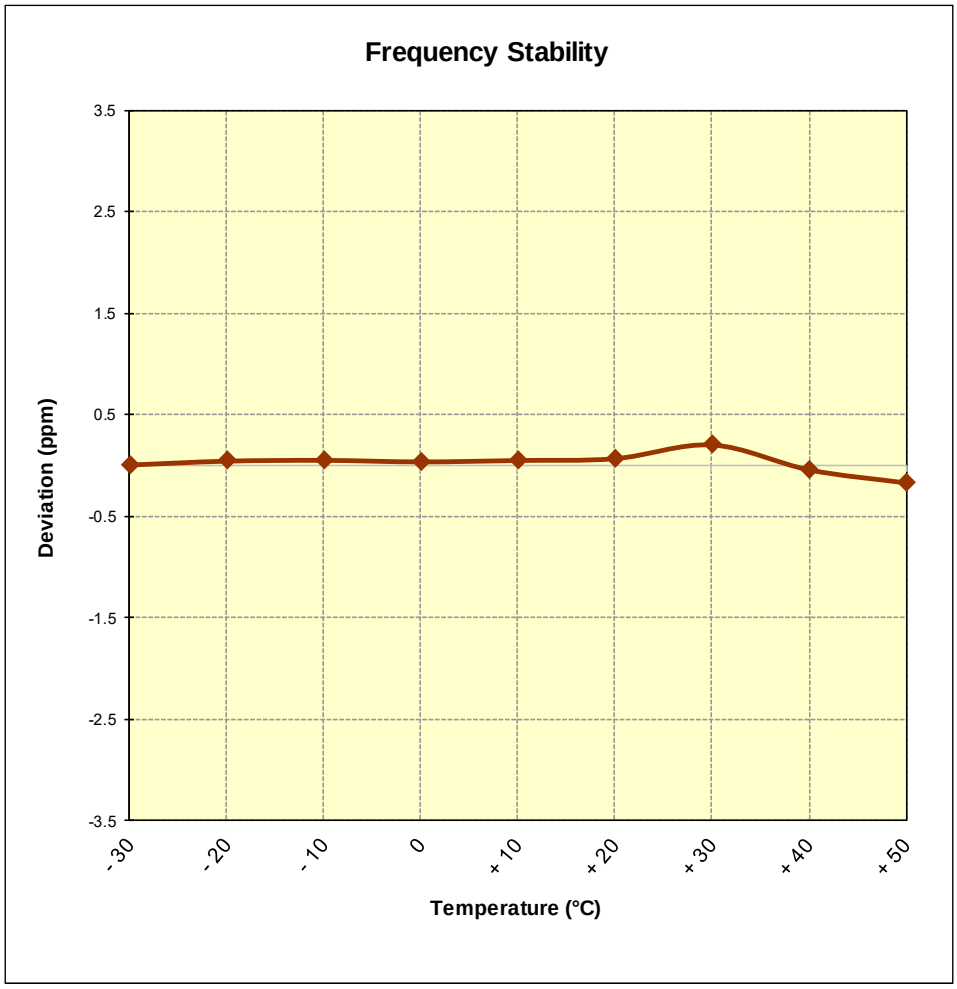

Figure 7-12. Frequency Stability Graph (AWS WCDMA Mode – Ch. 1413)

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Frequency Stability / Temperature Variation

OPERATING FREQUENCY:	1,880,000,000	Hz
CHANNEL:	661	
REFERENCE VOLTAGE:	4.25	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	4.25	- 30	1,880,000,206	206	0.0000110
100 %		- 20	1,879,999,882	-118	-0.0000063
100 %		- 10	1,879,999,880	-120	-0.0000064
100 %		0	1,880,000,143	143	0.0000076
100 %		+ 10	1,879,999,911	-89	-0.0000047
100 %		+ 20	1,880,000,059	59	0.0000031
100 %		+ 30	1,879,999,930	-70	-0.0000037
100 %		+ 40	1,879,999,958	-42	-0.0000022
100 %		+ 50	1,879,999,935	-65	-0.0000035
BATT. ENDPOINT	2.78	+ 20	1,880,000,338	338	0.0000180

Table 7-34. Frequency Stability Data (PCS GPRS 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.

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Frequency Stability / Temperature Variation

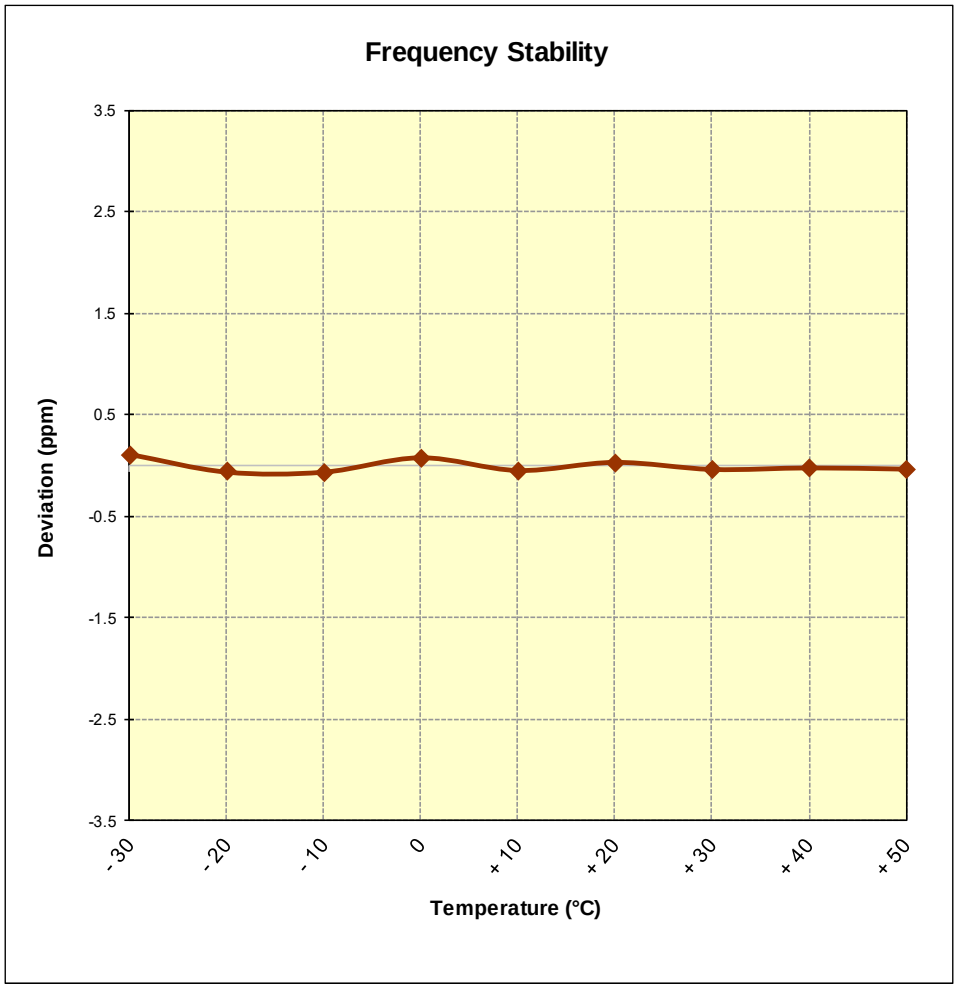

Figure 7-13. Frequency Stability Graph (PCS GPRS Mode – Ch. 661)

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Frequency Stability / Temperature Variation

OPERATING FREQUENCY:	1,880,000,000	Hz
CHANNEL:	600	
REFERENCE VOLTAGE:	4.25	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	4.25	- 30	1,879,999,965	-35	-0.0000019
100 %		- 20	1,880,000,022	22	0.0000012
100 %		- 10	1,880,000,155	155	0.0000082
100 %		0	1,879,999,961	-39	-0.0000021
100 %		+ 10	1,880,000,072	72	0.0000038
100 %		+ 20	1,880,000,188	188	0.0000100
100 %		+ 30	1,880,000,101	101	0.0000054
100 %		+ 40	1,880,000,124	124	0.0000066
100 %		+ 50	1,879,999,918	-82	-0.0000044
BATT. ENDPOINT	2.78	+ 20	1,879,999,701	-299	-0.0000159

Table 7-35. Frequency Stability Data (PCS CDMA Mode – Ch. 600)

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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Frequency Stability / Temperature Variation

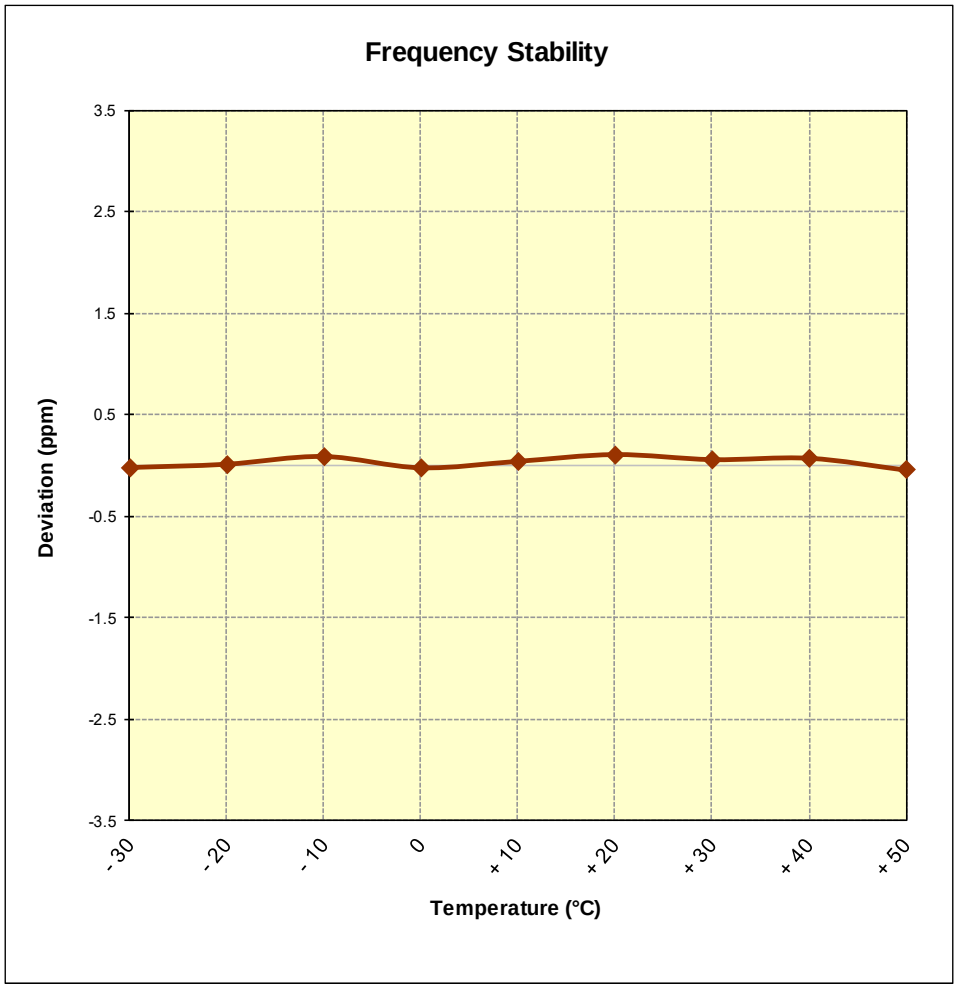

Figure 7-14. Frequency Stability Graph (PCS CDMA Mode – Ch. 600)

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Frequency Stability / Temperature Variation

OPERATING FREQUENCY:	1,880,000,000	Hz
CHANNEL:	9400	
REFERENCE VOLTAGE:	4.25	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	4.25	- 30	1,879,999,672	-328	-0.0000174
100 %		- 20	1,880,000,034	34	0.0000018
100 %		- 10	1,879,999,720	-280	-0.0000149
100 %		0	1,879,999,993	-7	-0.0000004
100 %		+ 10	1,879,999,921	-79	-0.0000042
100 %		+ 20	1,879,999,963	-37	-0.0000020
100 %		+ 30	1,879,999,948	-52	-0.0000028
100 %		+ 40	1,880,000,020	20	0.0000011
100 %		+ 50	1,880,000,010	10	0.0000005
BATT. ENDPOINT	2.78	+ 20	1,880,000,103	103	0.0000055

Table 7-36. 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.

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Frequency Stability / Temperature Variation

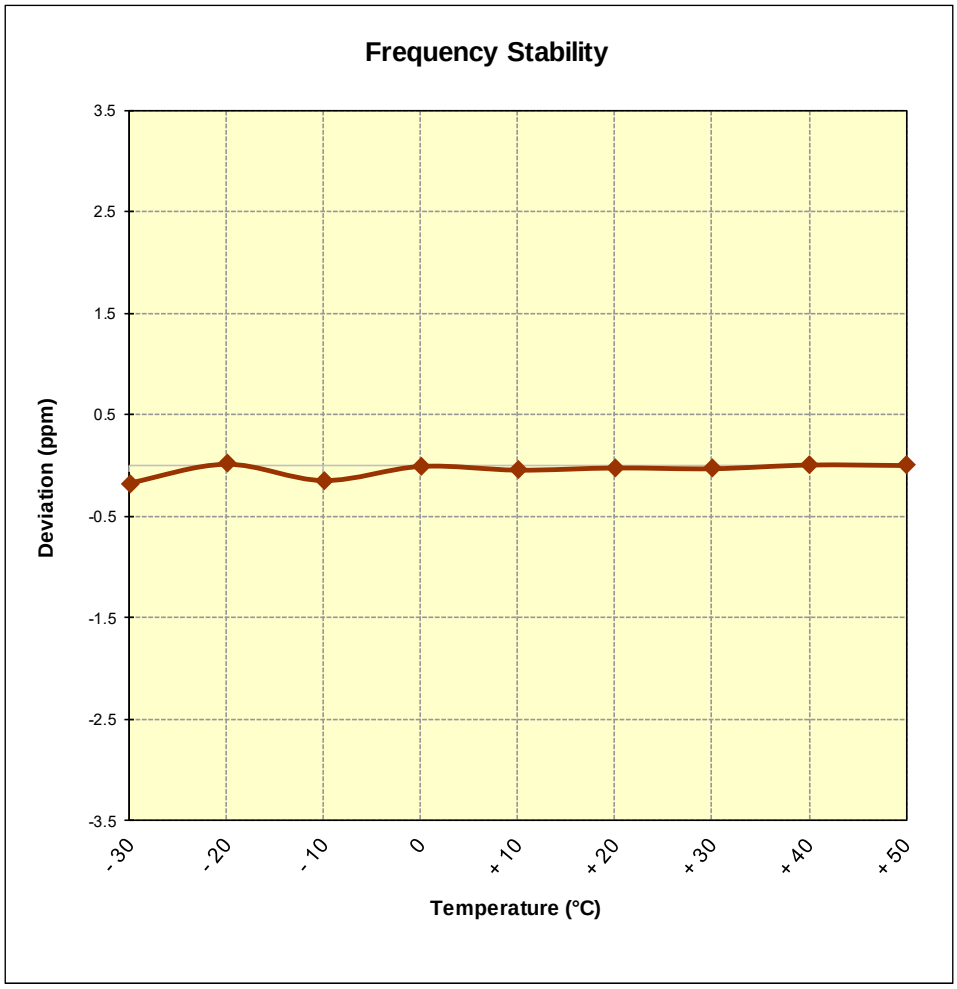

Figure 7-15. Frequency Stability Graph (PCS WCDMA Mode – Ch. 9400)

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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **LG Portable Handset FCC ID: ZNFL455DL** complies with all the requirements of Part 22, 24, & 27 of the FCC Rules.

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