**MET Laboratories, Inc.** *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313
33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372
3162 BELICK STREET • SANTA CLARA, CA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372
13501 MCCALLEN PASS • AUSTIN, TEXAS 78753 • PHONE (512) 287-2500 • FAX (512) 287-2513

September 28, 2015

Digital Receiver Technology, Inc.
12409 Milestone Center Dr.
Germantown, MD 20876

Dear Steve Hudson,

Enclosed is the EMC Wireless test report for compliance testing of the Digital Receiver Technology, Inc., DRT9955C-3 as tested to the requirements of the FCC Certification rules under Title 47 of the CFR Part 22 Subpart H for Cellular Devices and Part 27 for Broadband Radio Service (BRS) Devices.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Digital Receiver Technology, Inc.\EMC84362-FCC22_27 Rev. 1)

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# Electromagnetic Compatibility Criteria
# Test Report

for the

**Digital Receiver Technology, Inc.**
**Model DRT9955C-3**

**Tested under**
**FCC Certification Rules**
**Title 47 of the CFR,**
**Part 22 Subpart H for Cellular Devices**
**& Part 27**

**MET Report: EMC84362-FCC22_27 Rev. 1**

September 28, 2015

**Prepared For:**

**Digital Receiver Technology, Inc.**
**12409 Milestone Center Dr.**
**Germantown, MD 20876**

**Prepared By:**
**MET Laboratories, Inc.**
914 W. Patapsco Ave
Baltimore, MD 21230

# Electromagnetic Compatibility Criteria
# Test Report

for the

## Digital Receiver Technology, Inc.
## Model DRT9955C-3

**Tested Under**
**FCC Certification Rules**
**Title 47 of the CFR,**
**Part 22 Subpart H for Cellular Devices**
**& Part 27**

Benjamin Taylor
Project Engineer, Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 22 Subpart H and Part 27 of the FCC Rules under normal use and maintenance.

Asad Bajwa,
Director, Electromagnetic Compatibility Lab

# Report Status Sheet

| Revision | Report Date | Reason for Revision |
|---|---|---|
| ∅ | August 31, 2015 | Initial Issue |
| 1 | September 28, 2015 | Updated to include RF Power Output results in tabular format. |

# Table of Contents



# List of Tables



# List of Terms and Abbreviations

| | |
|---|---|
| **AC** | **A**lternating **C**urrent |
| **ACF** | **A**ntenna **C**orrection **F**actor |
| **Cal** | **Cal**ibration |
| ***d*** | **M**easurement **D**istance |
| **dB** | **D**eci**b**els |
| **dBµA** | **D**eci**b**els above one **micro**amp |
| **dBµV** | **D**eci**b**els above one **micro**volt |
| **dBµA/m** | **D**eci**b**els above one **micro**amp **per m**eter |
| **dBµV/m** | **D**eci**b**els above one **micro**volt **per m**eter |
| **DC** | **D**irect **C**urrent |
| **E** | **E**lectric Field |
| **DSL** | **D**igital **S**ubscriber **L**ine |
| **ESD** | **E**lectro**s**tatic **D**ischarge |
| **EUT** | **E**quipment **U**nder **T**est |
| ***f*** | **F**requency |
| **FCC** | **F**ederal **C**ommunications **C**ommission |
| **GRP** | **G**round **R**eference **P**lane |
| **H** | Magnetic Field |
| **HCP** | **H**orizontal **C**oupling **P**lane |
| **Hz** | **H**ert**z** |
| **IEC** | **I**nternational **E**lectrotechnical **C**ommission |
| **kHz** | **k**ilo**h**ert**z** |
| **kPa** | **k**ilo**pa**scal |
| **kV** | **k**ilo**v**olt |
| **LISN** | **L**ine **I**mpedance **S**tabilization **N**etwork |
| **MHz** | **M**ega**h**ertz |
| **µH** | **microh**enry |
| **µ** | **microf**arad |
| **µs** | **micros**econds |
| **NEBS** | **N**etwork **E**quipment-**B**uilding **S**ystem |
| **PRF** | **P**ulse **R**epetition **F**requency |
| **RF** | **R**adio **F**requency |
| **RMS** | **R**oot-**M**ean-**S**quare |
| **TWT** | **T**raveling **W**ave **T**ube |
| **V/m** | **V**olts **per m**eter |
| **VCP** | **V**ertical **C**oupling **P**lane |

# I. Executive Summary

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Digital Receiver Technology, Inc. DRT9955C-3, with the requirements of Part 22 Subpart H and Part 27. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the DRT9955C-3. Digital Receiver Technology, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the DRT9955C-3, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 22 Subpart H and Part 27, in accordance with Digital Receiver Technology, Inc., purchase order number PO-001128.

| Reference | Description | Compliance |
|---|---|---|
| Part 22 Subpart H §2.1046; §22.913; §27.50(d) | RF Power Output | Compliant |
| §2.1047 | Modulation Characteristics | Not Applicable |
| §2.1049 | Occupied Bandwidth | Compliant |
| §2.1051; §22.917; §27.53(h) | Conducted Spurious Emissions at Antenna Terminals | Compliant |
| §2.1053; §22.917; §27.53(h) | Radiated Spurious Emissions from the Cabinet | Compliant |
| §2.1055; §22.355 | Frequency stability | Not Applicable |
| FCC guidance on Amplifiers | Frequency Response | Compliant |
| FCC guidance on Amplifiers | Intermodulation | Compliant |

**Table 1. Executive Summary of EMC ComplianceTesting**

# II. Equipment Configuration

# A. Overview

MET Laboratories, Inc. was contracted by Digital Receiver Technology, Inc. to perform testing on the DRT9955C-3, under Digital Receiver Technology, Inc.'s purchase order number PO-001128.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Digital Receiver Technology, Inc., DRT9955C-3.

The results obtained relate only to the item(s) tested.

| | | |
|---|---|---|
| **Model(s) Tested:** | DRT9955C-3 | |
| **Model(s) Covered:** | DRT9955C-3 | |
| **Filing Status:** | Original | |
| **EUT Specifications:** | Primary Power: 120 VAC, 60 Hz | |
| | FCC ID: XLM9955C3 | |
| | Type of Modulations: | Part 22: GSM, CDMA, and WCDMA<br>Part 27: CDMA, WCDMA |
| | Equipment Code: | AMP |
| | RF Power Output | Single-Channel, high power mode: 44.45dBm<br>Multi-Channel, low power mode: 34.83dBm |
| | EUT Frequency Ranges: | Part 22: 869.2-893.8 MHz (GSM)<br>Part 22: 869.7-893.3 MHz (CDMA)<br>Part 22: 871.4-891.6 MHz (WCDMA)<br>Part 27: 2111-2154 MHz (CDMA)<br>Part 27: 2112-2153 MHz (WCDMA) |
| **Analysis:** | The results obtained relate only to the item(s) tested. | |
| **Environmental Test Conditions:** | Temperature: 15-35º C | |
| | Relative Humidity: 30-60% | |
| | Barometric Pressure: 860-1060 mbar | |
| **Evaluated by:** | Benjamin Taylor | |
| **Date(s):** | September 28, 2015 | |

## B. References

| | |
|---|---|
| **CFR 47, Part 22, Subpart H** | Federal Communication Commission, Code of Federal Regulations, Title 47, Part 22: Rules and Regulations for Cellular Devices. |
| **CFR 47, Part 27** | Federal Communication Commission, Code of Federal Regulations, Title 47, Part 27: Rules and Regulations for Advanced Wireless Services |
| **ANSI C63.4:2014** | Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz |
| **ISO/IEC 17025:2005** | General Requirements for the Competence of Testing and Calibration Laboratories |
| **EIA/TIA-603-A-2001** | Land Mobile FM or PM Communication Equipment Measurement and Performance Standards |

## C. Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

## D. Description of Test Sample

The DRT9955C-3, Equipment Under Test (EUT), along with DRT9955C-1, are dual band RF power amplifiers used with DRT base stations operating in the cellular, PCS, and AWS bands.

The DRT9955C-3 operates in the cellular band with GSM, CDMA, and WCDMA modulation and in the AWS band with CDMA and WCDMA modulation.

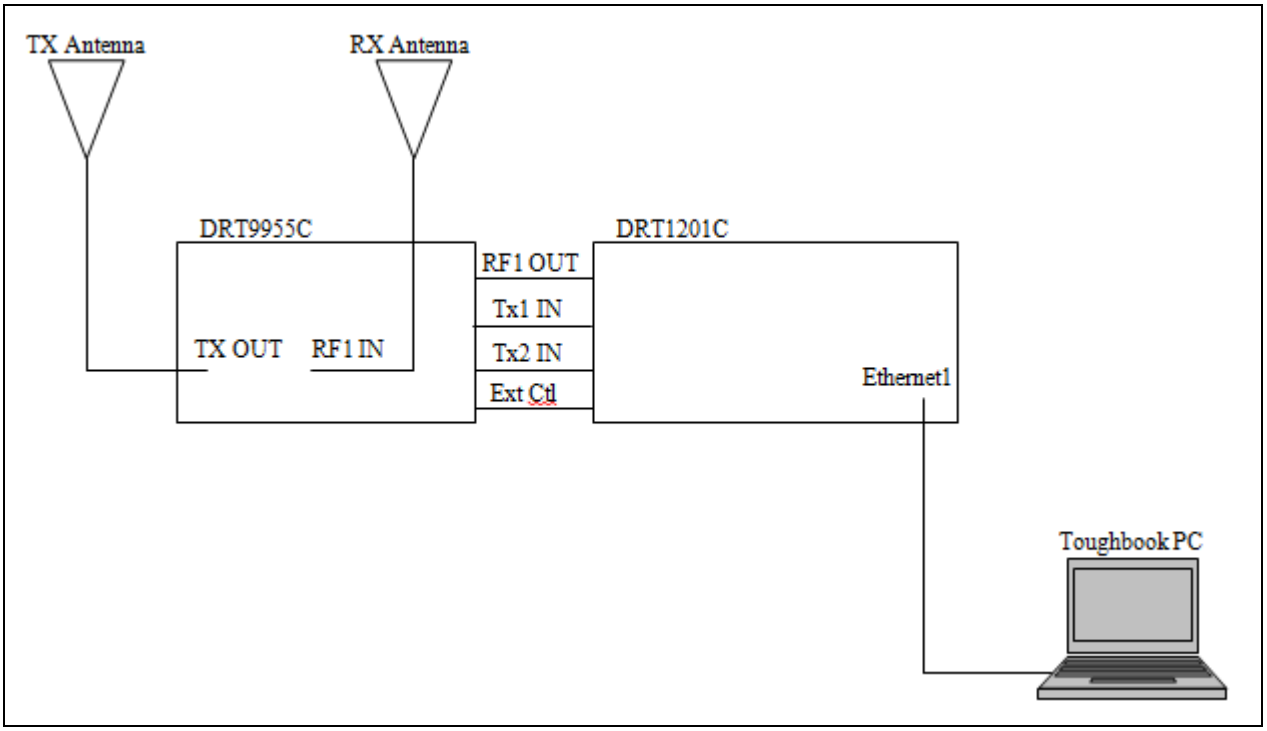



**Figure 1. Block Diagram of Equipment Configuration**

## E. Equipment Configuration

| Name / Description | Model Number | Part Number | Serial Number |
|---|---|---|---|
| TRAM | DRT9955C-3 | -- | 249 |

**Table 2. Equipment Configuration**

## F. Support Equipment

| Ref. ID | Name / Description | Manufacturer | Model Number | Customer Supplied Calibration Data |
|---|---|---|---|---|
| -- | Base Station | DRT | DRT1201C | -- |
| -- | Toughbook PC | Panasonic | CF-19 | -- |

**Table 3. Support Equipment**

## G. Mode of Operation

Operate as an RF power amplifier for DRT mobile base stations in GSM, CDMA, and WCDMA in the Cellular and AWS bands.

The DRT9955C-3 operates in the cellular band with GSM, CDMA, and WCDMA modulation and in the AWS band with CDMA and WCDMA modulation.

## H. Method of Monitoring EUT Operation

Ran control software on a connected PC.

## I. Modifications

**a) Modifications to EUT**

No modifications were made to the EUT.

**b) Modifications to Test Standard**

No modifications were made to the test standard.

## J. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Digital Receiver Technology, Inc.. upon completion of testing.

# III. Electromagnetic Compatibility Criteria for Intentional Radiators

## Electromagnetic Compatibility Criteria for Intentional Radiators

## § 2.1046 RF Power Output

**Test Requirements:** **§ 2.1046 Measurements required: RF power output:**

**§ 2.1046 (a)** For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8).The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

**§ 2.1046 (b)** For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

**§ 2.1046 (c)** For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

**§ 22.913 Power and antenna height limits.**

**§ 22.913(a):** The Effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 watts.

**§27.50(d):**

(2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:

(3) A licensee operating a base or fixed station in the 2110-2155 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must coordinate such operations in advance with all Government and non-Government satellite entities in the 2025-2110 MHz band. Operations with power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with the following licensees authorized to operate within 120 kilometers (75 miles) of the base or fixed station operating in this band: all Broadband Radio Service (BRS) licensees authorized under Part 27 in the 2155-2160 MHz band and all advanced wireless services (AWS) licensees authorized to operate on adjacent frequency blocks in the 2110-2155 MHz band.

**Test Procedures:** As required by 47 CFR 2.1046, RF power output measurements were made at the RF output terminals using an attenuator and spectrum analyzer or power meter. The spectrum analyzer was configured in accordance with the licensed measurement guidance procedure. The "Channel Power" measurement feature of the spectrum analyzer was used. Measurements were taken in both high and low power modes, as permissible by compliance with Intermodulation requirements. Lower power mode must be used when operating in multi-channel mode.

*RF power output measurement* was made at the RF output terminal using a spectrum analyzer, with suitable attenuation where appropriate.

**Test Results:** The EUT complies with the requirements of this section.

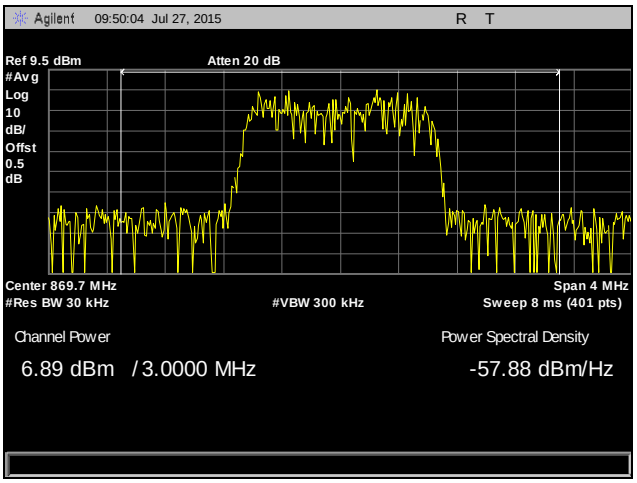
**Test Engineer(s):** Benjamin Taylor

**Test Date(s):** 07/28/15 and 08/06/15

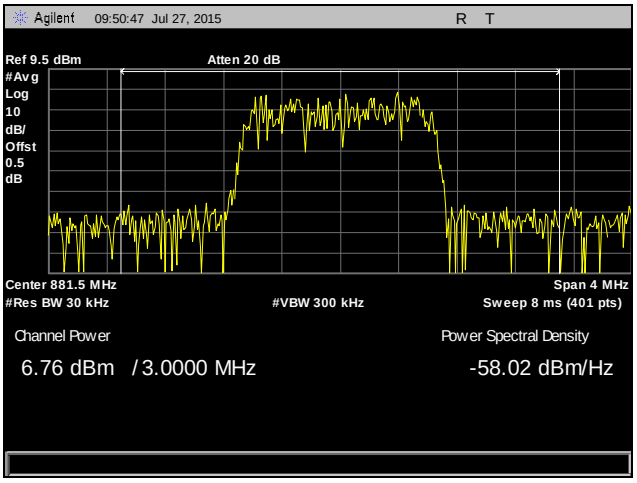
| Rule Part | Modulation | Frequency (MHz) | Mode | Power (dBm) |
|---|---|---|---|---|
| 22 | CDMA | 869.7 | Single Channel | 43.51 |
| 22 | CDMA | 881.5 | Single Channel | 43.13 |
| 22 | CDMA | 893.3 | Single Channel | 42.14 |
| 22 | GSM | 869.2 | Single Channel | 44.08 |
| 22 | GSM | 881.6 | Single Channel | 43.69 |
| 22 | GSM | 893.8 | Single Channel | 43.18 |
| 22 | WCDMA | 871.4 | Single Channel | 44.45 |
| 22 | WCDMA | 881.4 | Single Channel | 43.39 |
| 22 | WCDMA | 891.6 | Single Channel | 42.70 |
| 22 | CDMA | 869.7 | Multi-Channel | 33.41 |
| 22 | CDMA | 881.5 | Multi-Channel | 32.96 |
| 22 | CDMA | 893.3 | Multi-Channel | 33.06 |
| 22 | GSM | 869.2 | Multi-Channel | 34.83 |
| 22 | GSM | 881.6 | Multi-Channel | 33.22 |
| 22 | GSM | 893.8 | Multi-Channel | 32.83 |
| 22 | WCDMA | 871.4 | Multi-Channel | 29.58 |
| 22 | WCDMA | 881.4 | Multi-Channel | 29.51 |
| 22 | WCDMA | 891.6 | Multi-Channel | 28.81 |
| 27 | CDMA | 2111 | Single Channel | 43.09 |
| 27 | CDMA | 2132 | Single Channel | 43.04 |
| 27 | CDMA | 2154 | Single Channel | 43.18 |
| 27 | WCDMA | 2112 | Single Channel | 43.33 |
| 27 | WCDMA | 2132 | Single Channel | 43.40 |
| 27 | WCDMA | 2153 | Single Channel | 43.15 |
| 27 | CDMA | 2111 | Multi-Channel | 30.50 |
| 27 | CDMA | 2132 | Multi-Channel | 31.90 |
| 27 | CDMA | 2154 | Multi-Channel | 32.01 |
| 27 | WCDMA | 2112 | Multi-Channel | 29.63 |
| 27 | WCDMA | 2132 | Multi-Channel | 30.52 |
| 27 | WCDMA | 2153 | Multi-Channel | 30.40 |

**Table 4. RF Power Output, Test Results**

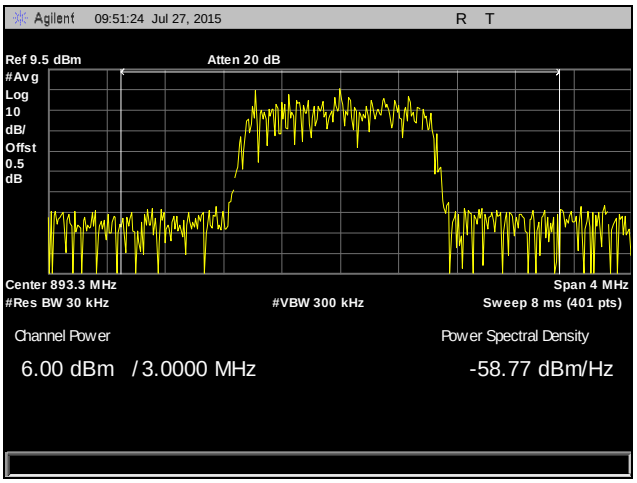
## RF Power Output, Part 22



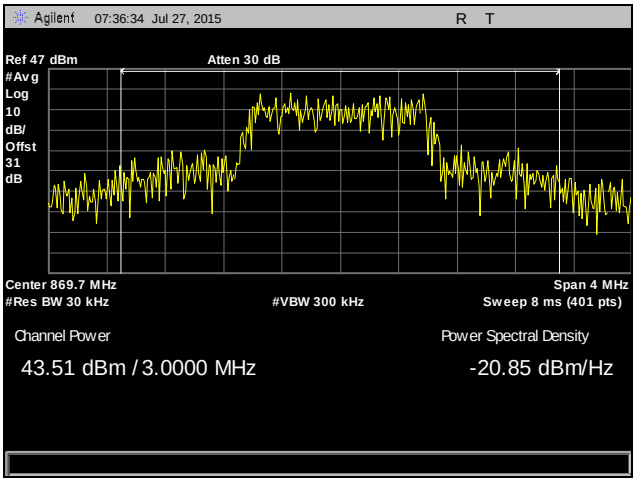

**Plot 1. RF Power, Single Channel Operation – High Power, Input CDMA, Low Channel, Part 22**



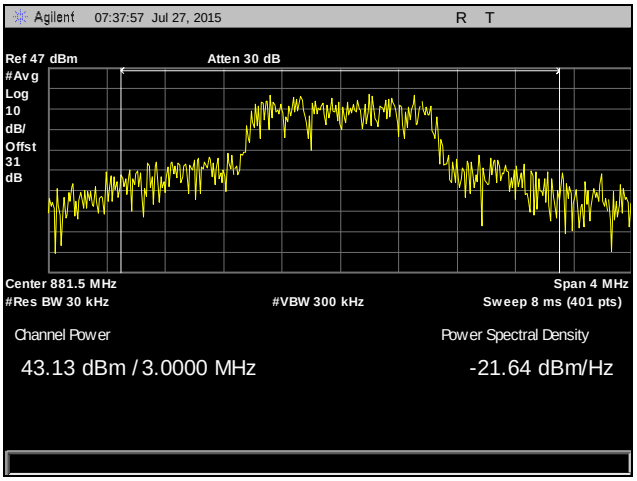

**Plot 2. RF Power, Single Channel Operation – High Power, Input CDMA, Mid Channel, Part 22**



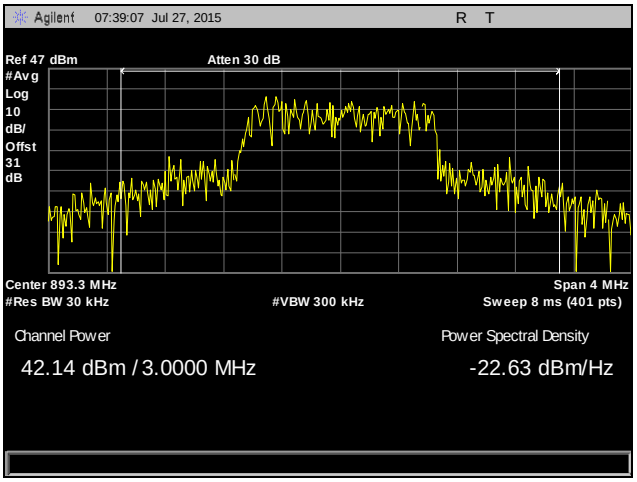

**Plot 3. RF Power, Single Channel Operation – High Power, Input CDMA, High Channel, Part 22**



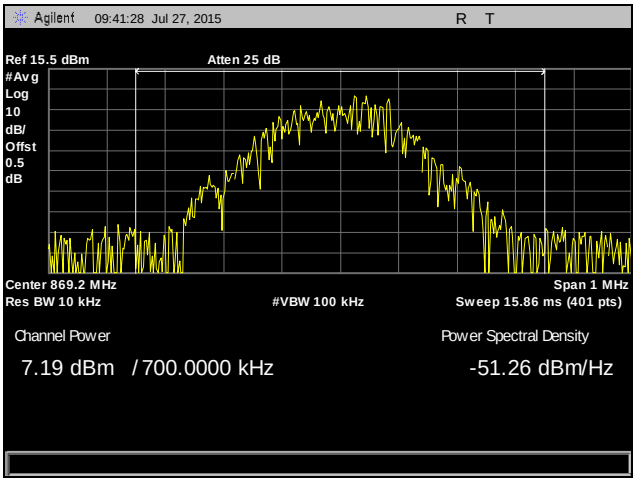

**Plot 4. RF Power, Single Channel Operation – High Power, Output CDMA, Low Channel, Part 22**



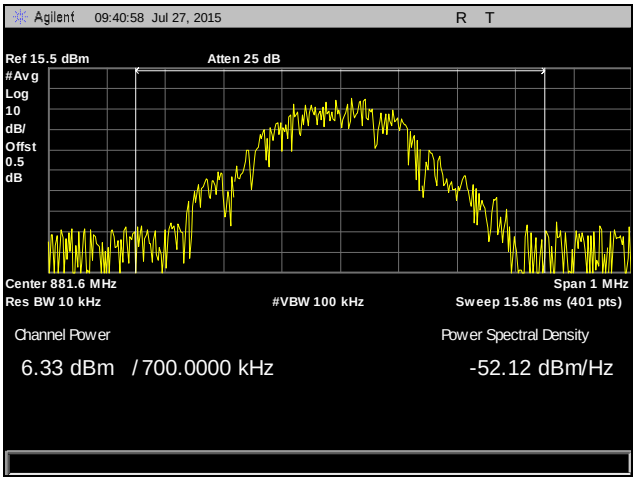

**Plot 5. RF Power, Single Channel Operation – High Power, Output CDMA, Mid Channel, Part 22**



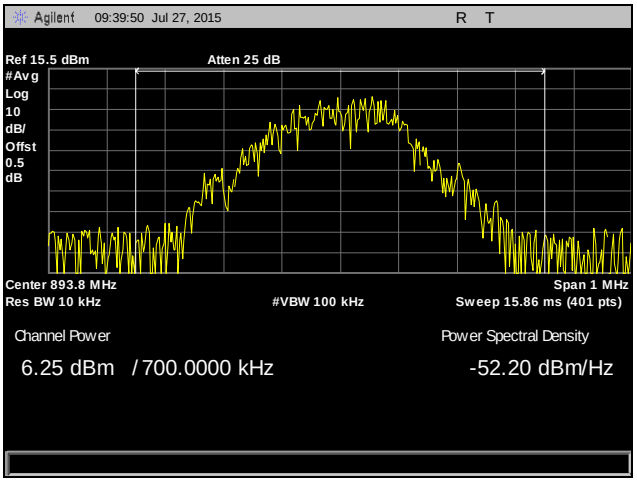

**Plot 6. RF Power, Single Channel Operation – High Power, Output CDMA, High Channel, Part 22**



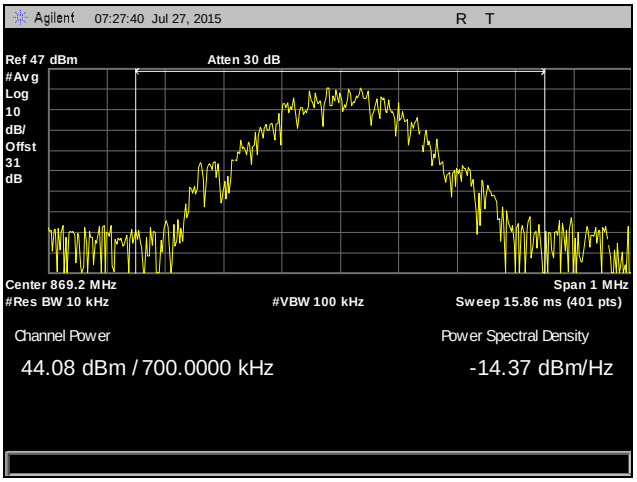

**Plot 7. RF Power, Single Channel Operation – High Power, Input GSM, Low Channel, Part 22**



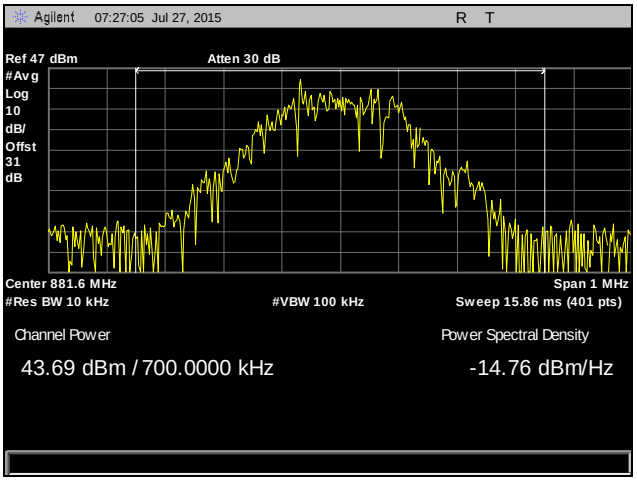

**Plot 8. RF Power, Single Channel Operation – High Power, Input GSM, Mid Channel, Part 22**



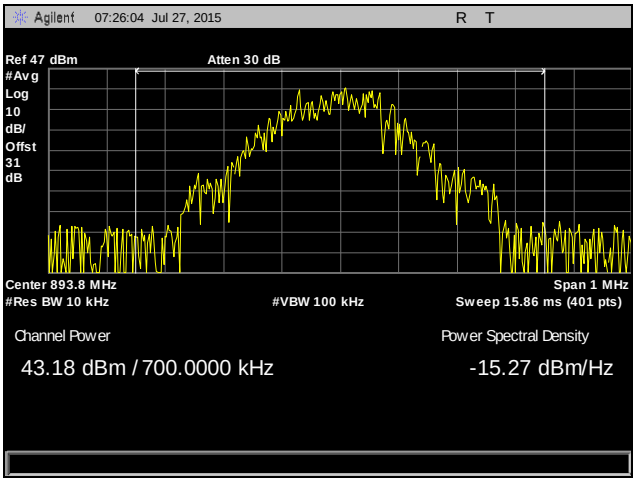

**Plot 9. RF Power, Single Channel Operation – High Power, Input GSM, High Channel, Part 22**



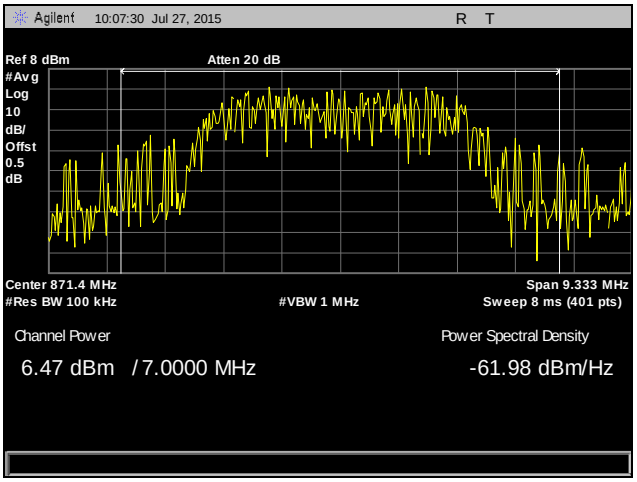

**Plot 10. RF Power, Single Channel Operation – High Power, Output GSM, Low Channel, Part 22**



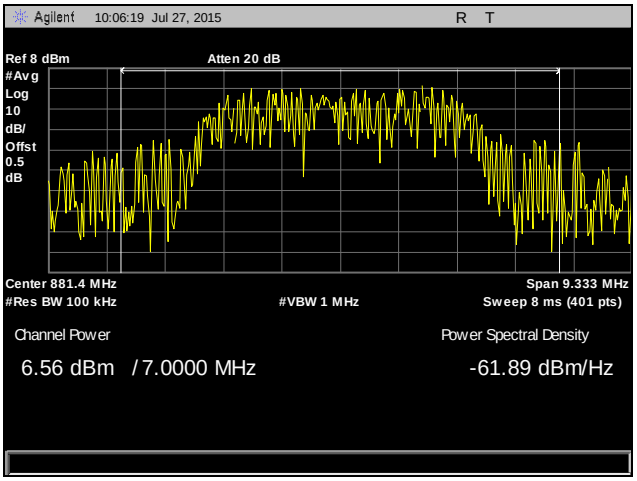

**Plot 11. RF Power, Single Channel Operation – High Power, Output GSM, Mid Channel, Part 22**



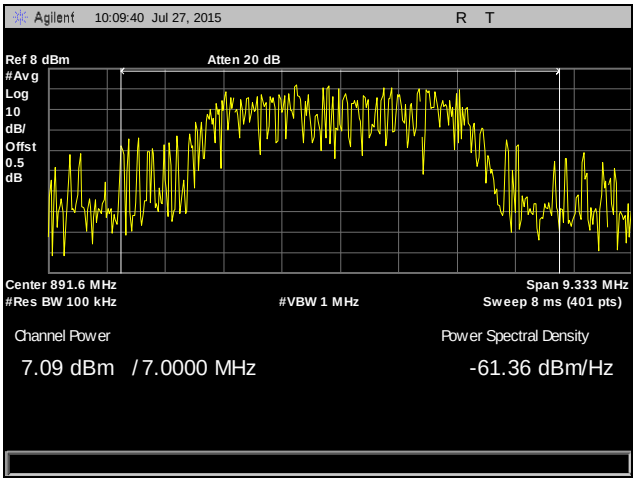

**Plot 12. RF Power, Single Channel Operation – High Power, Output GSM, High Channel, Part 22**



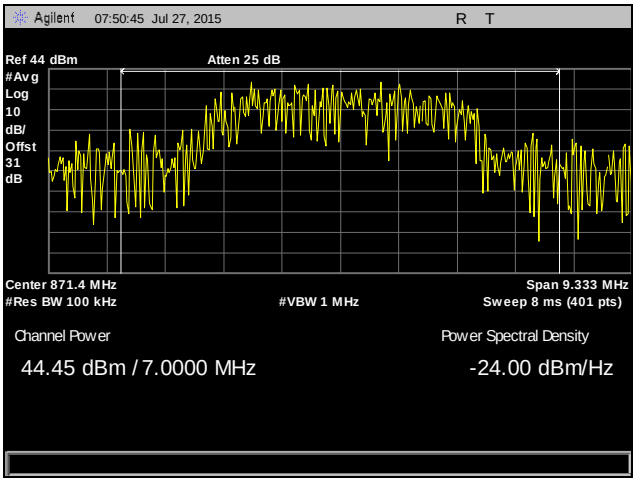

**Plot 13. RF Power, Single Channel Operation – High Power, Input WCDMA, Low Channel, Part 22**



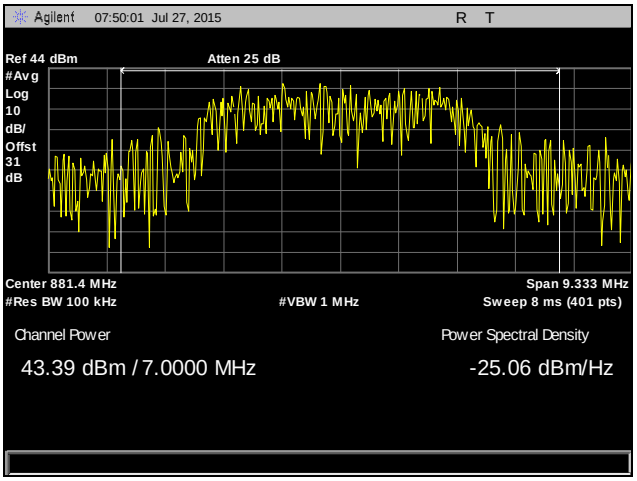

**Plot 14. RF Power, Single Channel Operation – High Power, Input WCDMA, Mid Channel, Part 22**



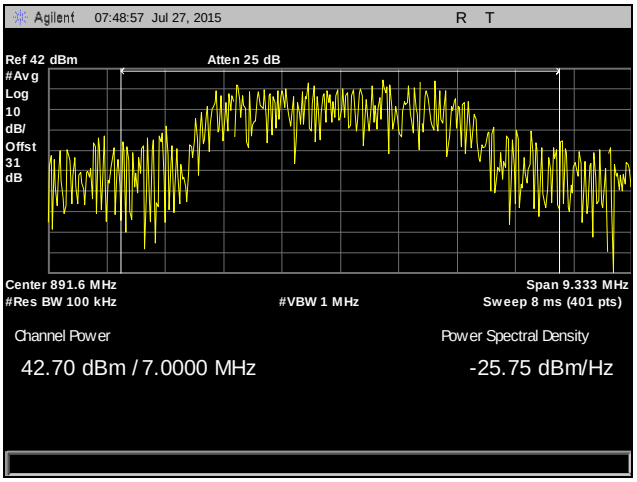

**Plot 15. RF Power, Single Channel Operation – High Power, Input WCDMA, High Channel, Part 22**



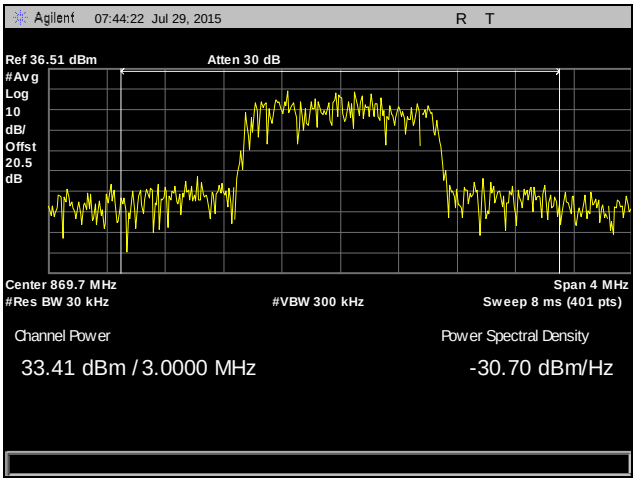

**Plot 16. RF Power, Single Channel Operation – High Power, Output WCDMA, Low Channel, Part 22**



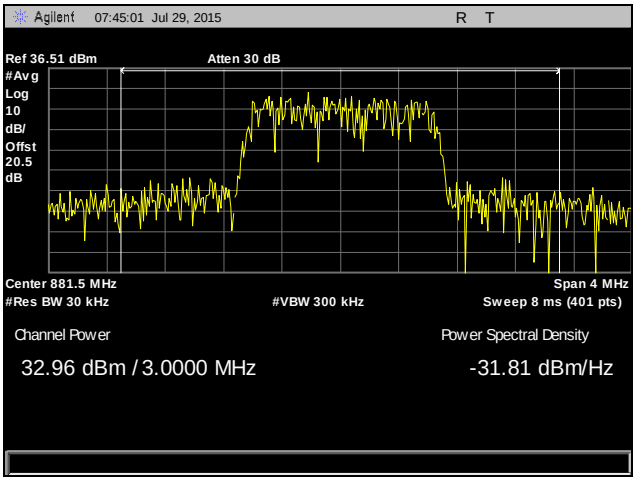

**Plot 17. RF Power, Single Channel Operation – High Power, Output WCDMA, Mid Channel, Part 22**



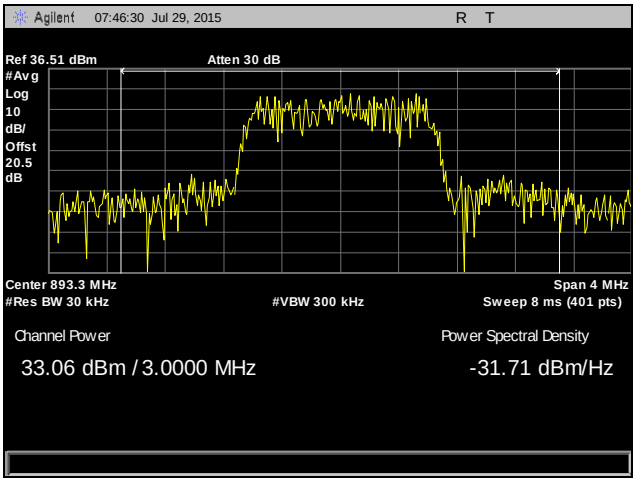

**Plot 18. RF Power, Single Channel Operation – High Power, Output WCDMA, High Channel, Part 22**



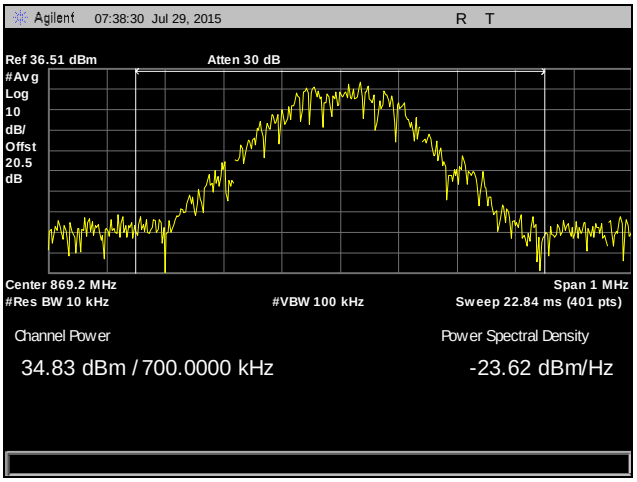

**Plot 19. RF Power, Multi-Channel Operation – Reduced Power, Output CDMA, Low Channel, Part 22**



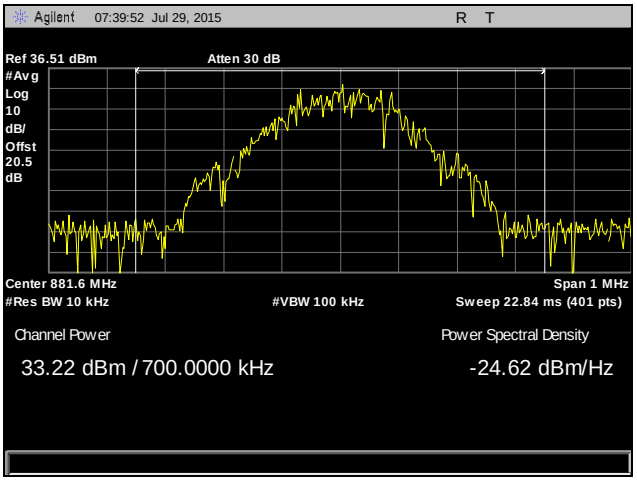

**Plot 20. RF Power, Multi-Channel Operation – Reduced Power, Output CDMA, Mid Channel, Part 22**



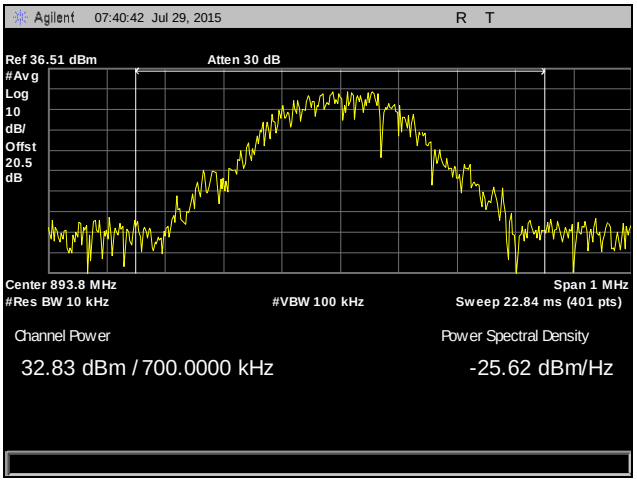

**Plot 21. RF Power, Multi-Channel Operation – Reduced Power, Output CDMA, High Channel, Part 22**



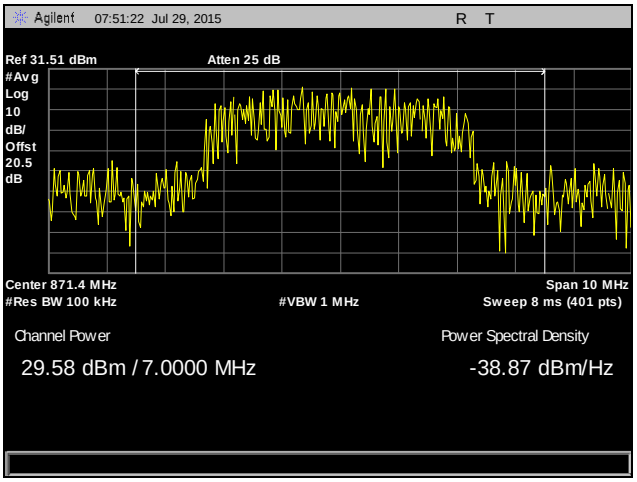

**Plot 22. RF Power, Multi-Channel Operation – Reduced Power, Output GSM, Low Channel, Part 22**



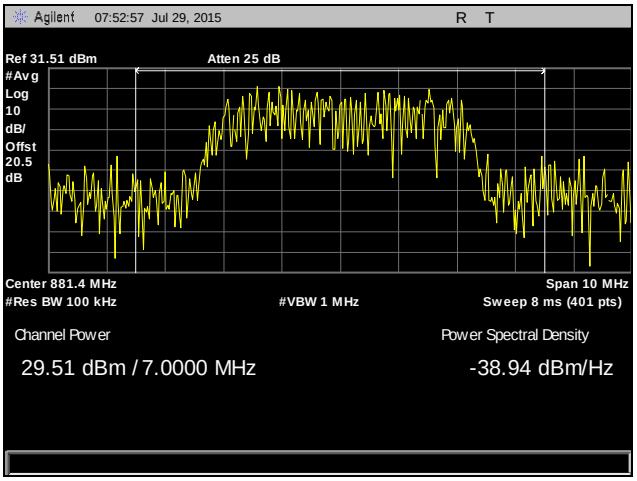

**Plot 23. RF Power, Multi-Channel Operation – Reduced Power, Output GSM, Mid Channel, Part 22**



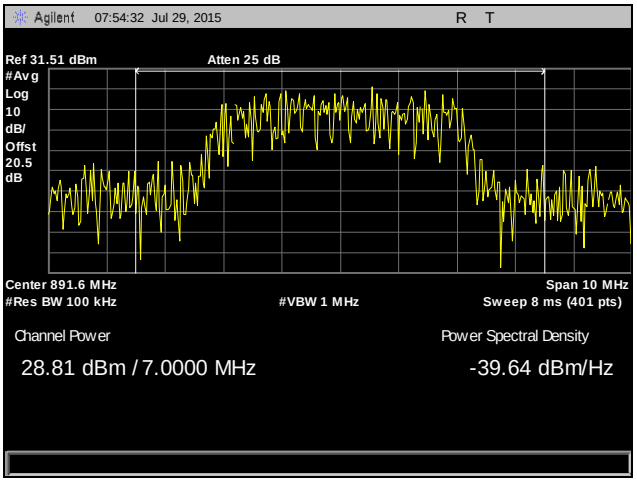

**Plot 24. RF Power, Multi-Channel Operation – Reduced Power, Output GSM, High Channel, Part 22**




**Plot 25. RF Power, Multi-Channel Operation – Reduced Power, Output WCDMA, Low Channel, Part 22**

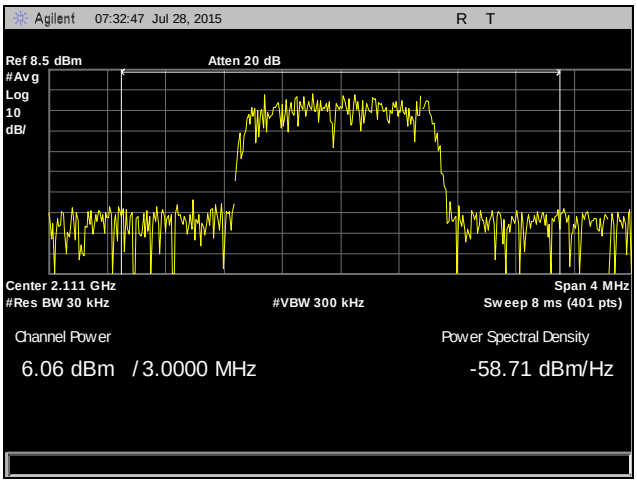



**Plot 26. RF Power, Multi-Channel Operation – Reduced Power, Output WCDMA, Mid Channel, Part 22**

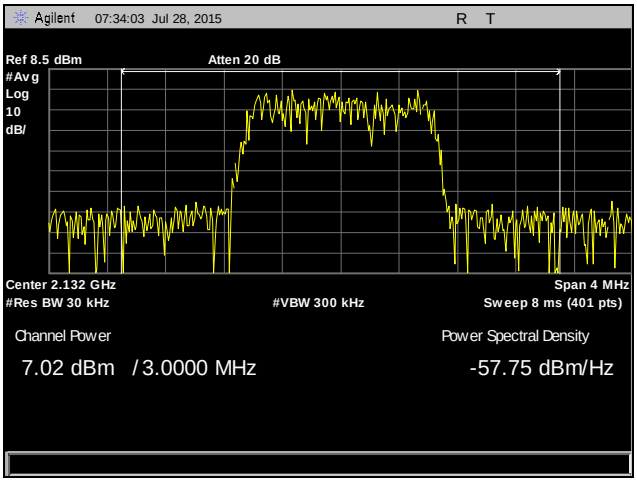



**Plot 27. RF Power, Multi-Channel Operation – Reduced Power, Output WCDMA, High Channel, Part 22**

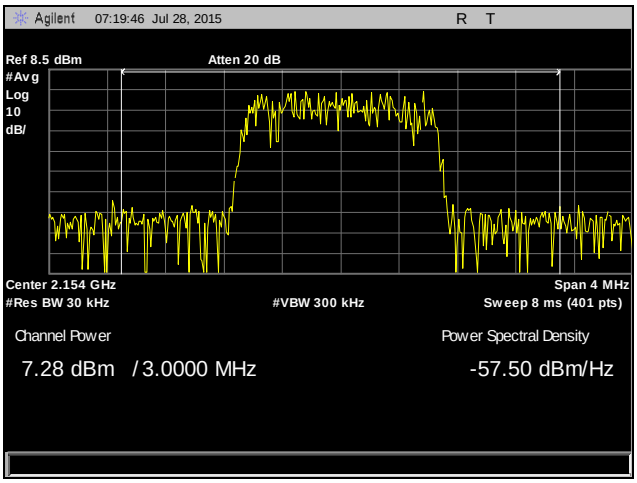
## RF Power Output, Part 27



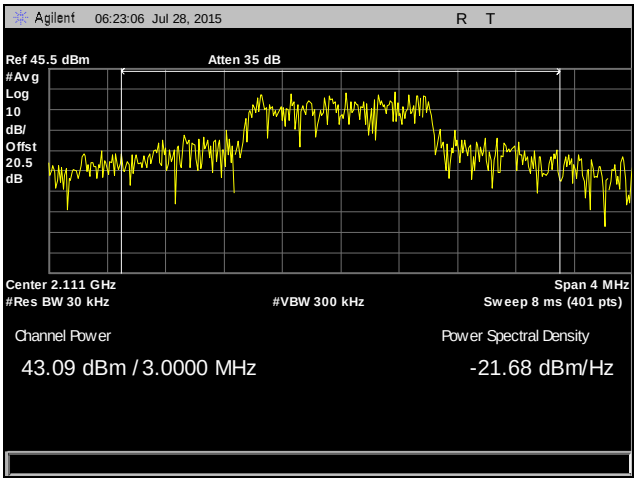

**Plot 28. RF Output Power, Single Channel Operation – High Power, Input CDMA, Low Channel, Part 27**



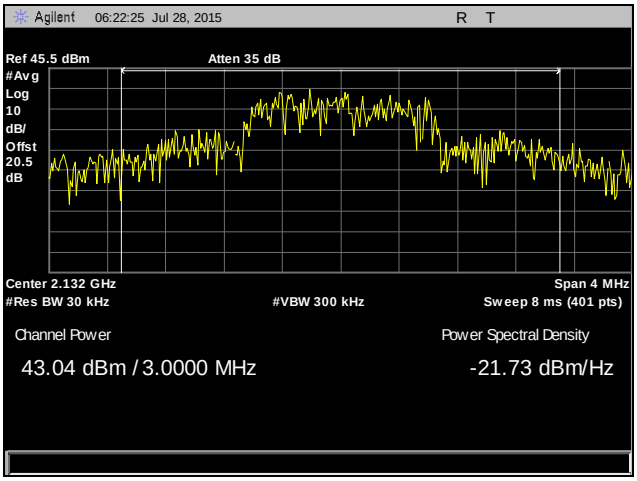

**Plot 29. RF Output Power, Single Channel Operation – High Power, Input CDMA, Mid Channel, Part 27**



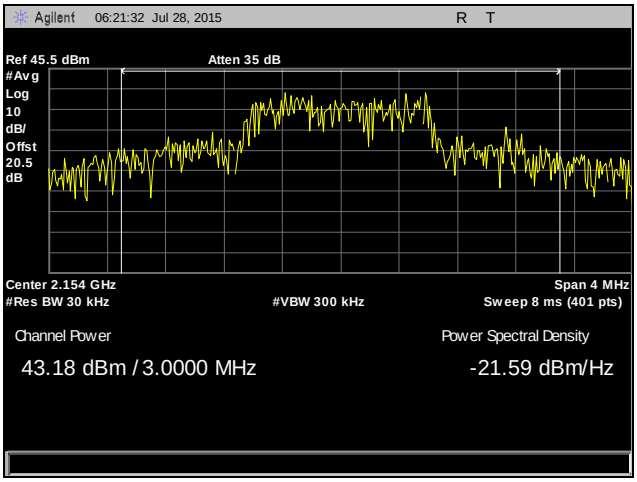

**Plot 30. RF Output Power, Single Channel Operation – High Power, Input CDMA, High Channel, Part 27**



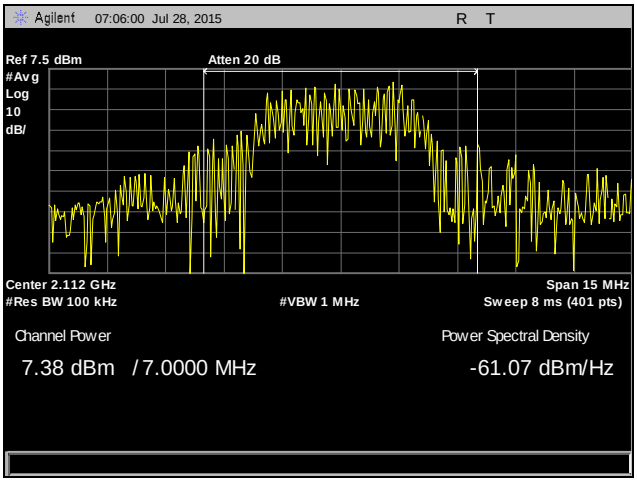

**Plot 31. RF Output Power, Single Channel Operation – High Power, Output CDMA, Low Channel, Part 27**



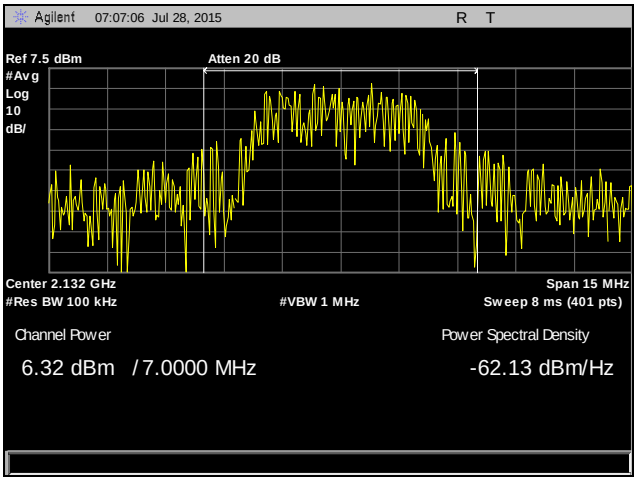

**Plot 32. RF Output Power, Single Channel Operation – High Power, Output CDMA, Mid Channel, Part 27**



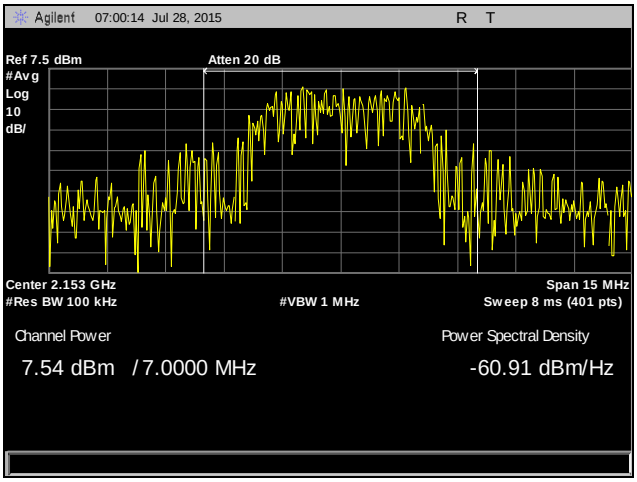

**Plot 33. RF Output Power, Single Channel Operation – High Power, Output CDMA, High Channel, Part 27**



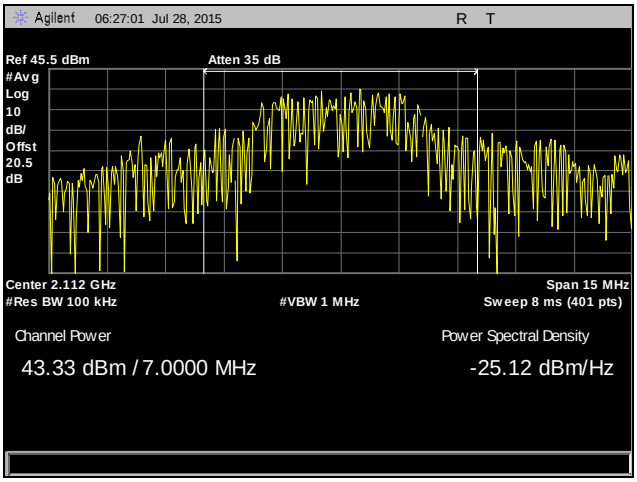

**Plot 34. RF Output Power, Single Channel Operation – High Power, Input WCDMA, Low Channel, Part 27**



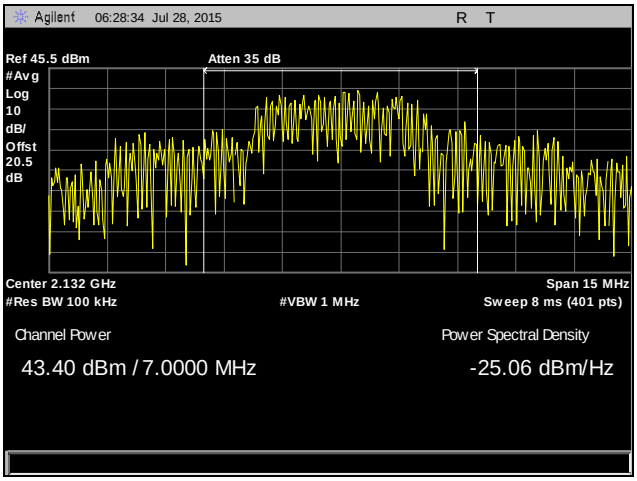

**Plot 35. RF Output Power, Single Channel Operation – High Power, Input WCDMA, Mid Channel, Part 27**



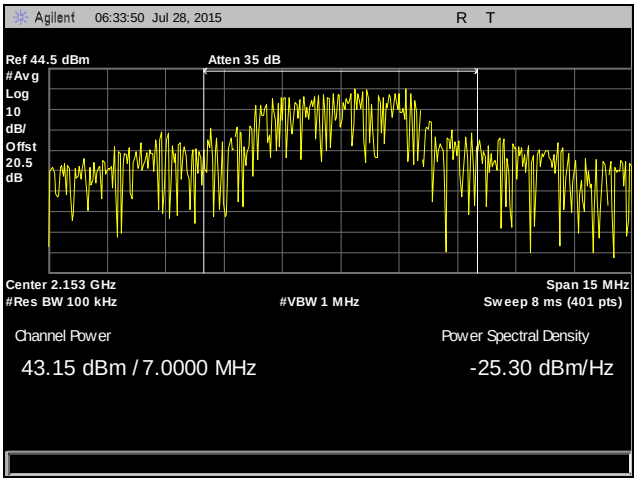

**Plot 36. RF Output Power, Single Channel Operation – High Power, Input WCDMA, High Channel, Part 27**



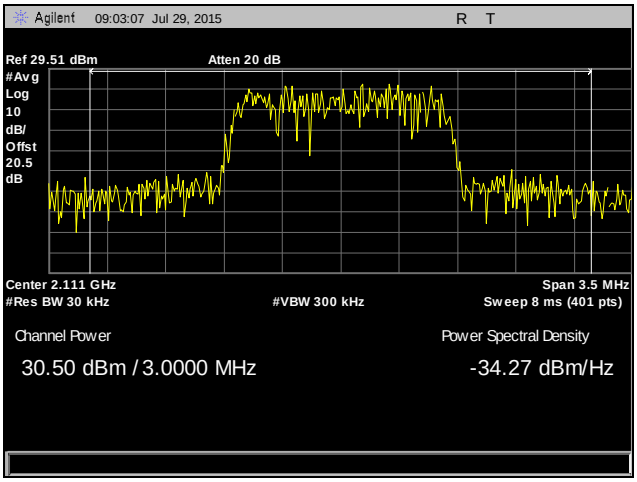

**Plot 37. RF Output Power, Single Channel Operation – High Power, Output WCDMA, Low Channel, Part 27**



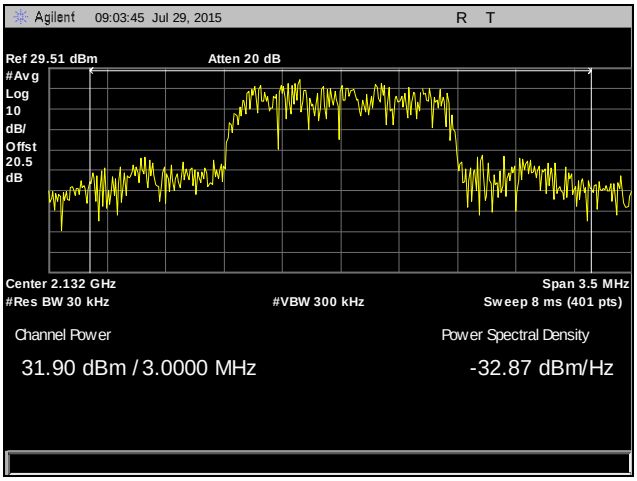

**Plot 38. RF Output Power, Single Channel Operation – High Power, Output WCDMA, Mid Channel, Part 27**



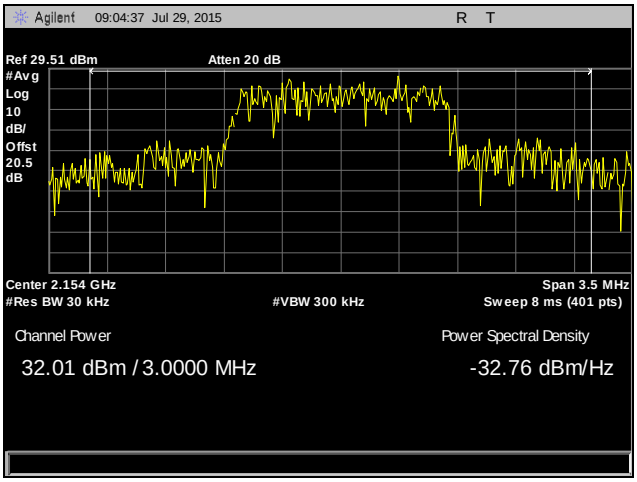

**Plot 39. RF Output Power, Single Channel Operation – High Power, Output WCDMA, High Channel, Part 27**



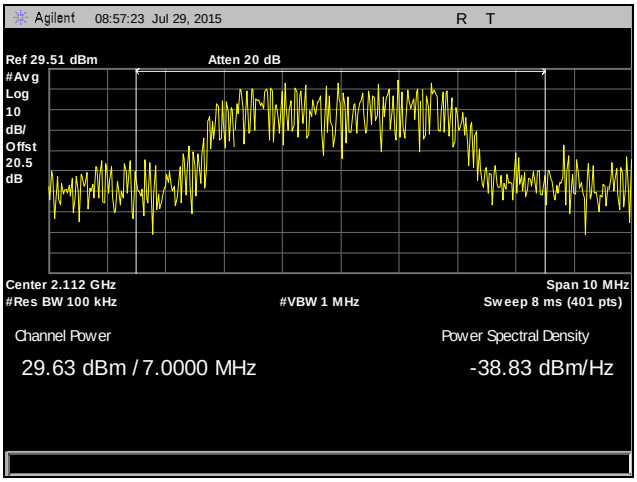

**Plot 40. RF Output Power, Multi-Channel Operation – Reduced Power, CDMA, Low Channel, Part 27**



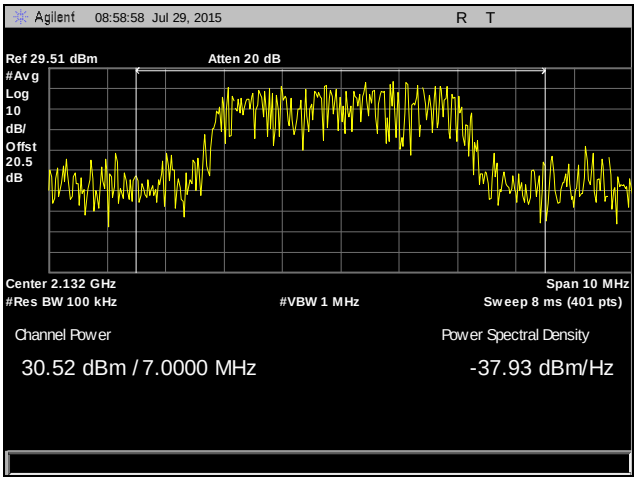

**Plot 41. RF Output Power, Multi-Channel Operation – Reduced Power, CDMA, Mid Channel, Part 27**



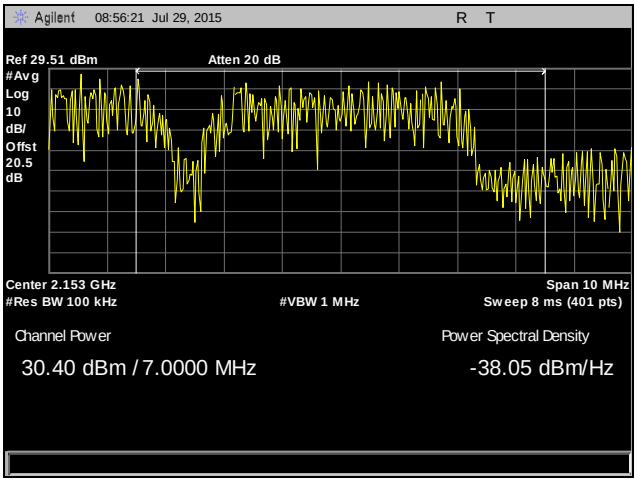

**Plot 42. RF Output Power, Multi-Channel Operation – Reduced Power, CDMA, High Channel, Part 27**




**Plot 43. RF Output Power, Multi-Channel Operation – Reduced Power, WCDMA, Low Channel, Part 27**




**Plot 44. RF Output Power, Multi-Channel Operation – Reduced Power, WCDMA, Mid Channel, Part 27**




**Plot 45. RF Output Power, Multi-Channel Operation – Reduced Power, WCDMA, High Channel, Part 27**

## § 2.1049 Occupied Bandwidth

**Test Requirement(s):** **§ 2.1049 Measurements required: Occupied bandwidth:** 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 under the specified conditions of § 2.1049 (a) through (i) as applicable.

**Test Procedures:** As required by 47 CFR 2.1049, *occupied bandwidth measurements* were made at the RF output terminals using a Spectrum Analyzer.

A laptop was connected to EUT to control the RF frequency channel. The EUT was connected to a Spectrum Analyzer via attenuator. The spectrum analyzer was set in accordance with the licensed measurement procedure guidance. Measurements were carried out at the low, mid, and high channels of the TX band.

Occupied bandwidth measurements were made with a Spectrum Analyzer connected to the RF output of the amplifier, as well as the input to the amplifier.

The modulation characteristics of the base station were measured first at a maximum RF level prescribed by the OEM. The base station was then connected to the input of the amplifier and was operated at the appropriate RF level. The resulting modulated signal through the EUT was measured and compared against the original signal.

**Test Results:** Equipment complies with FCC requirements.

**Test Engineer(s):** Benjamin Taylor

**Test Date(s):** 07/28/15 and 08/06/15

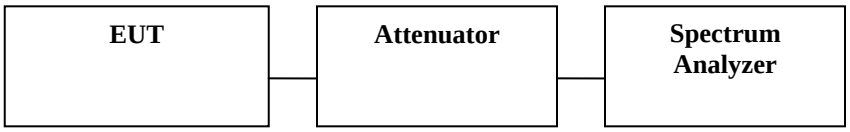
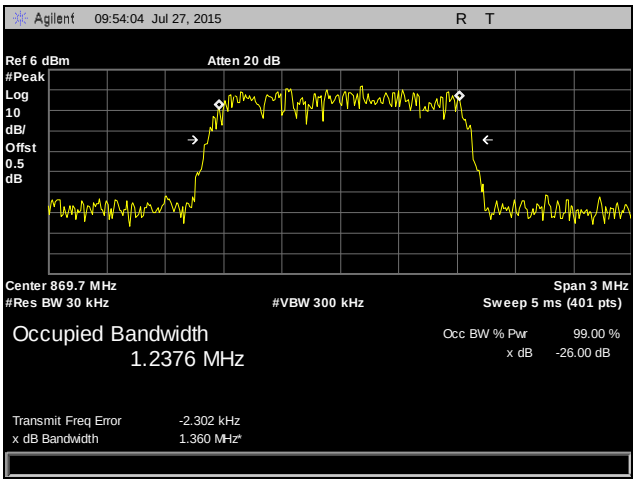
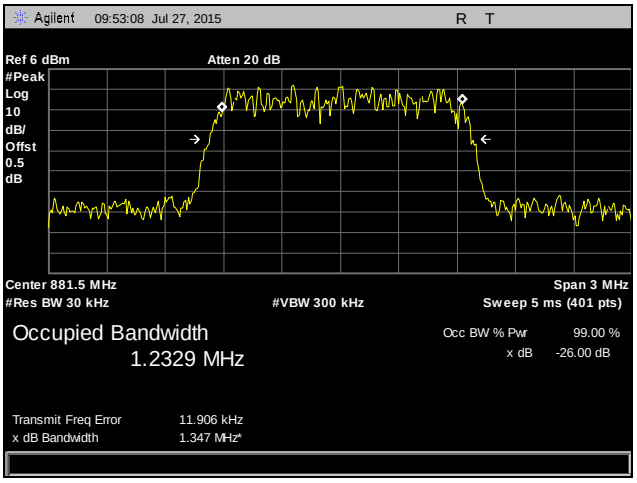



**Figure 2. Occupied Bandwidth Test Setup**

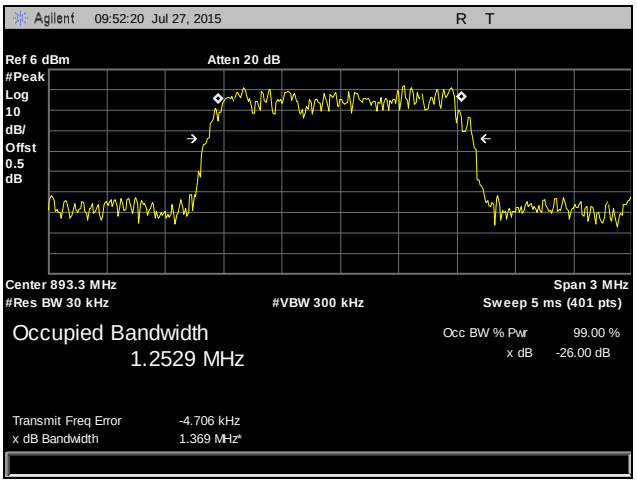
## Occupied Bandwidth, Part 22



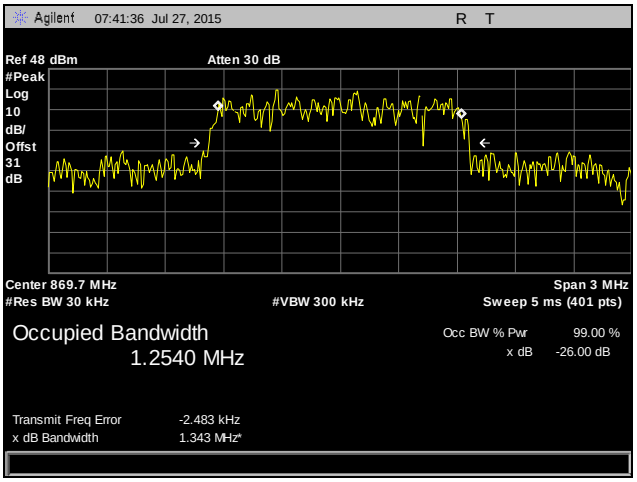

**Plot 46. Occupied Bandwidth, CDMA, Low Channel, Input, Part 22**



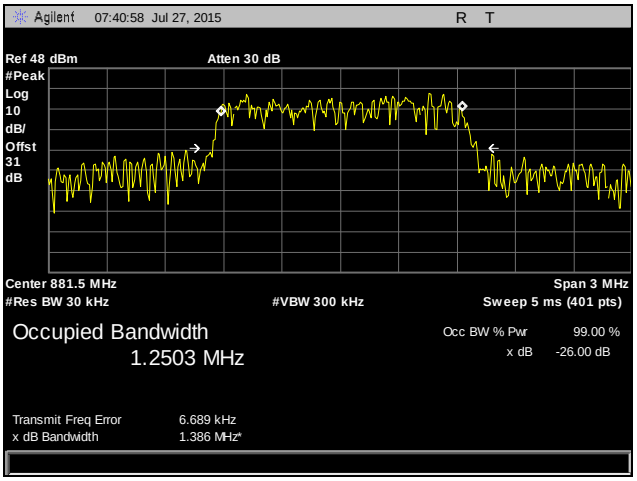

**Plot 47. Occupied Bandwidth, CDMA, Mid Channel, Input, Part 22**



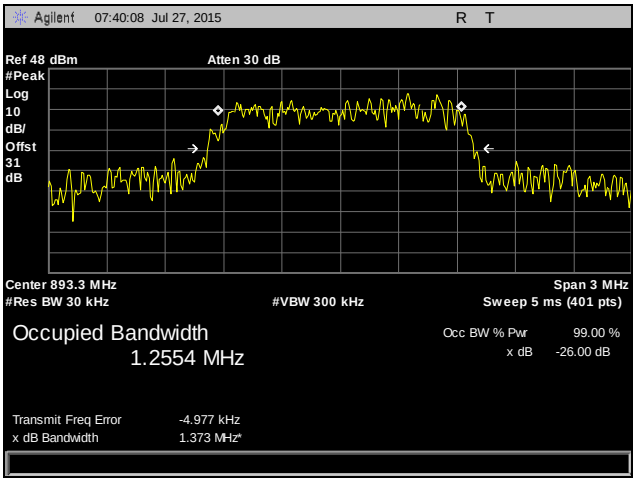

**Plot 48. Occupied Bandwidth, CDMA, High Channel, Input, Part 22**



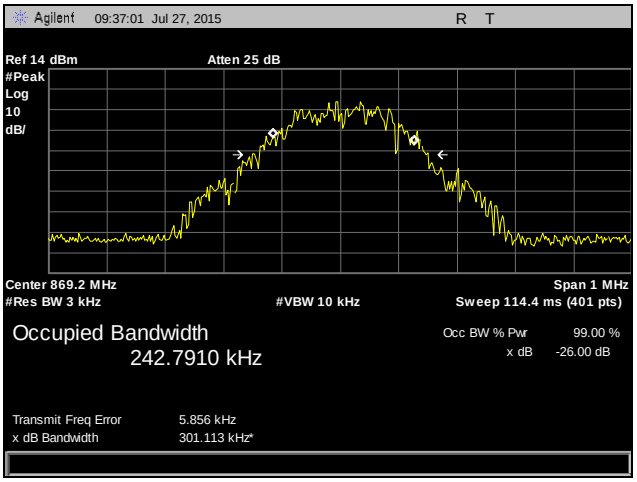

**Plot 49. Occupied Bandwidth, CDMA, Low Channel, Output, Part 22**



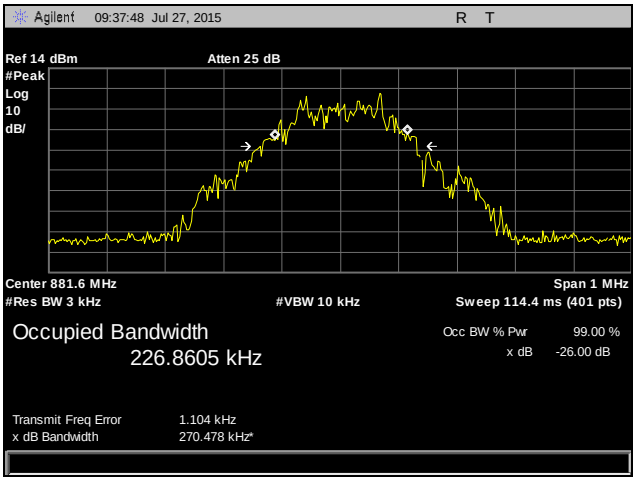

**Plot 50. Occupied Bandwidth, CDMA, Mid Channel, Output, Part 22**



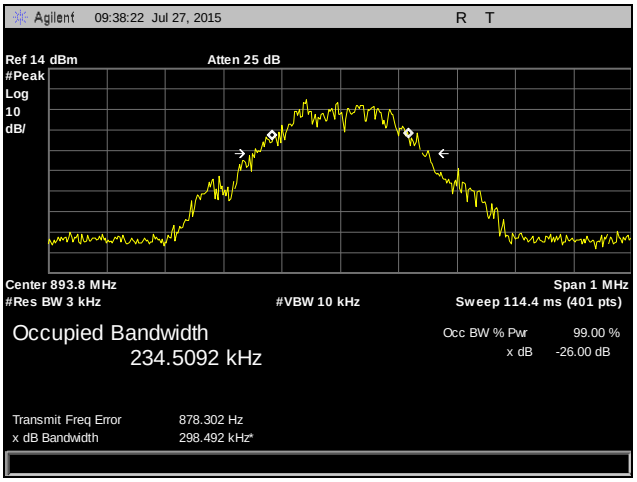

**Plot 51. Occupied Bandwidth, CDMA, High Channel, Output, Part 22**



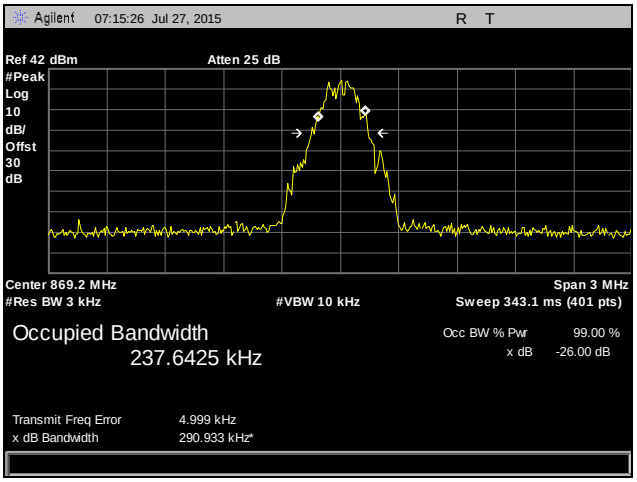

**Plot 52. Occupied Bandwidth, GSM, Low Channel, Input, Part 22**



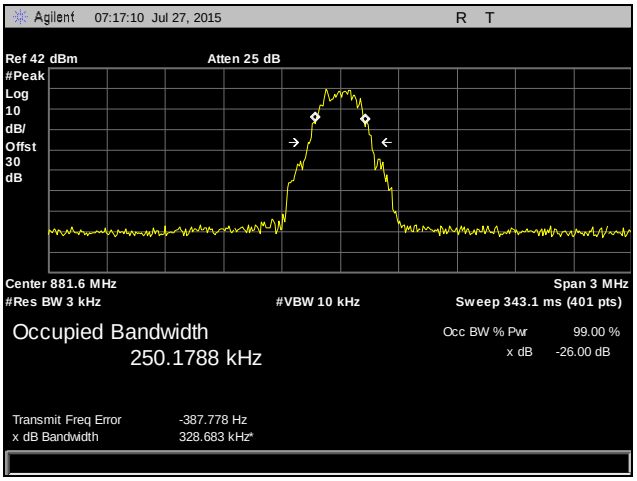

**Plot 53. Occupied Bandwidth, GSM, Mid Channel, Input, Part 22**



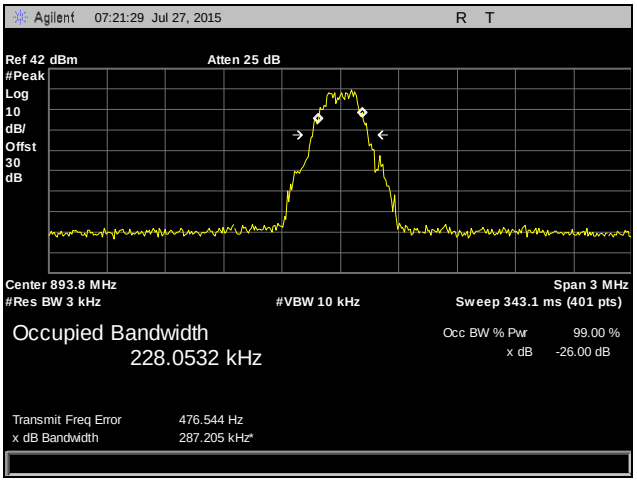

**Plot 54. Occupied Bandwidth, GSM, High Channel, Input, Part 22**



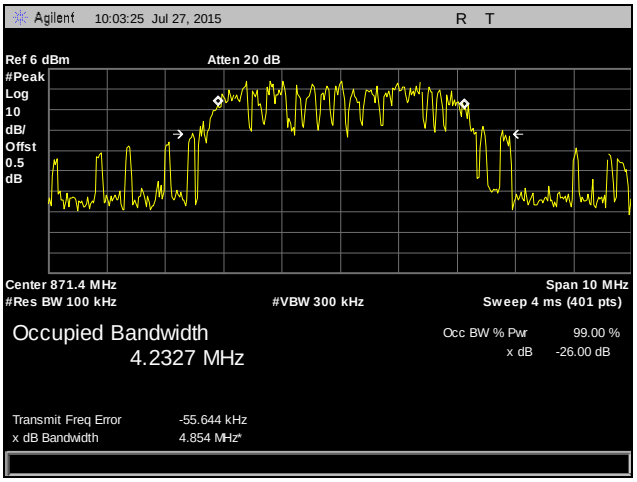

**Plot 55. Occupied Bandwidth, GSM, Low Channel, Output, Part 22**



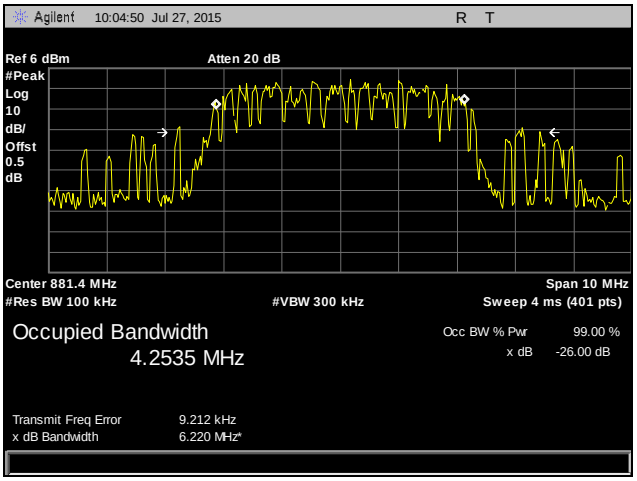

**Plot 56. Occupied Bandwidth, GSM, Mid Channel, Output, Part 22**



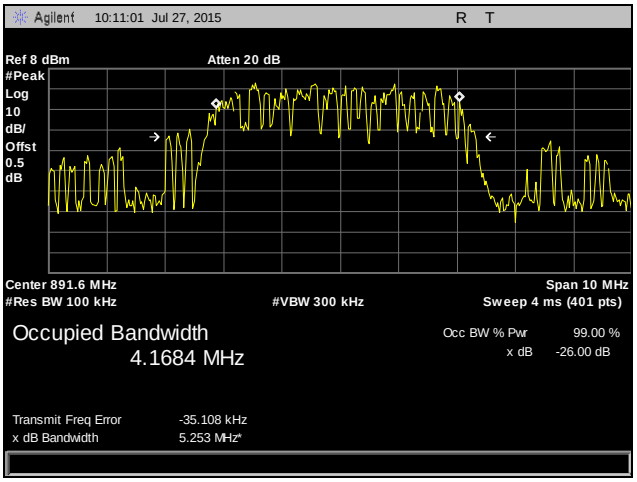

**Plot 57. Occupied Bandwidth, GSM, High Channel, Output, Part 22**



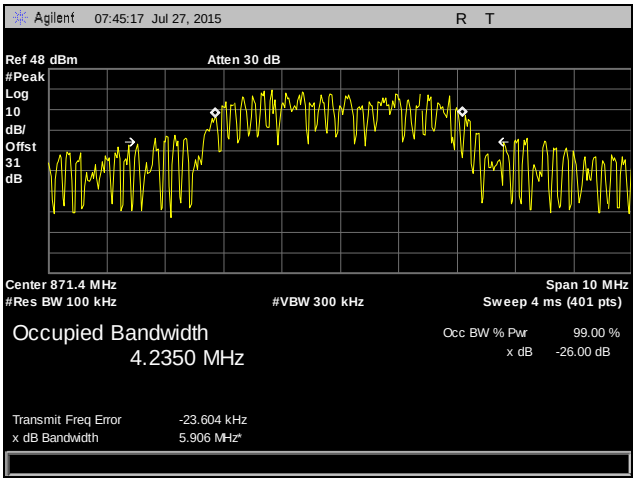

**Plot 58. Occupied Bandwidth, WCDMA, Low Channel, Input, Part 22**



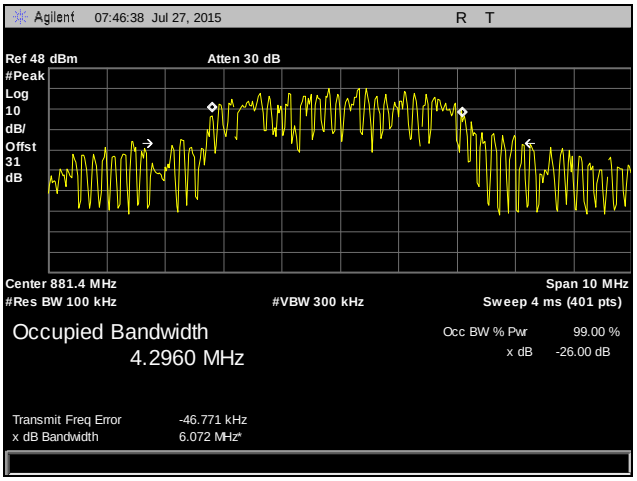

**Plot 59. Occupied Bandwidth, WCDMA, Mid Channel, Input, Part 22**



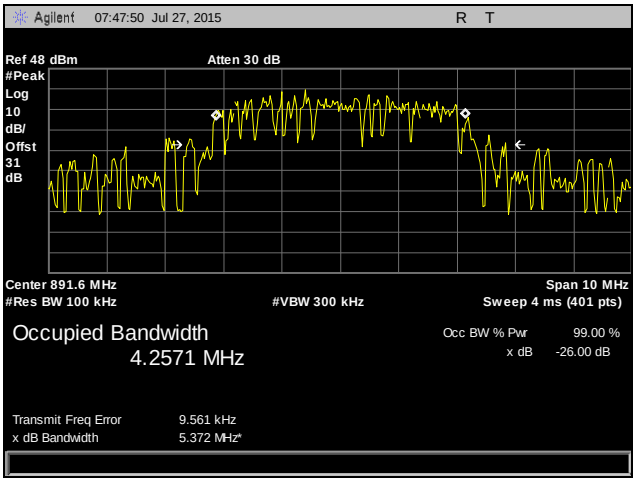

**Plot 60. Occupied Bandwidth, WCDMA, High Channel, Input, Part 22**




**Plot 61. Occupied Bandwidth, WCDMA, Low Channel, Output, Part 22**

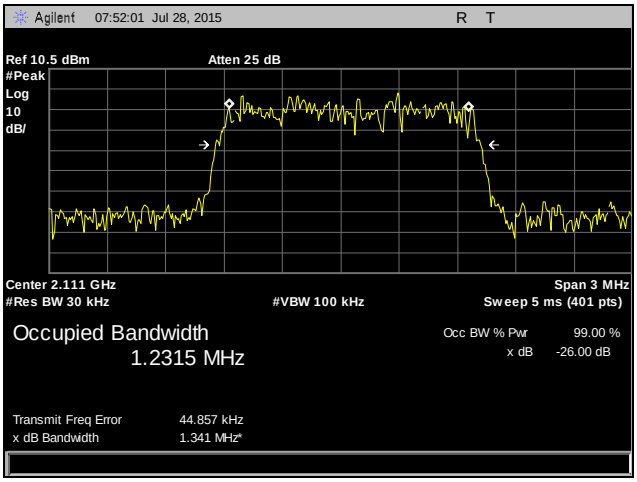



**Plot 62. Occupied Bandwidth, WCDMA, Mid Channel, Output, Part 22**

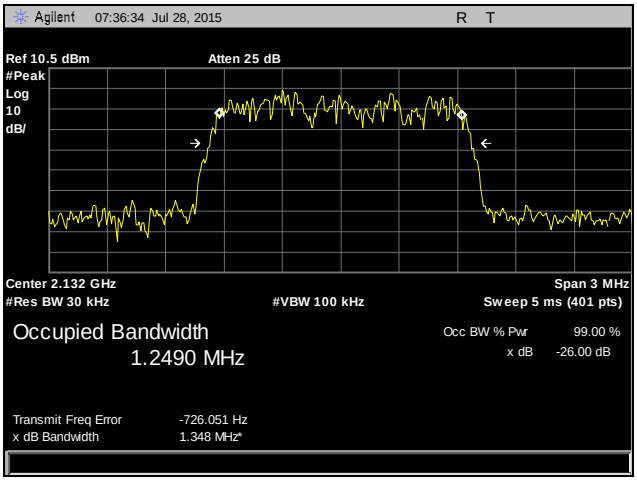



**Plot 63. Occupied Bandwidth, WCDMA, High Channel, Output, Part 22**

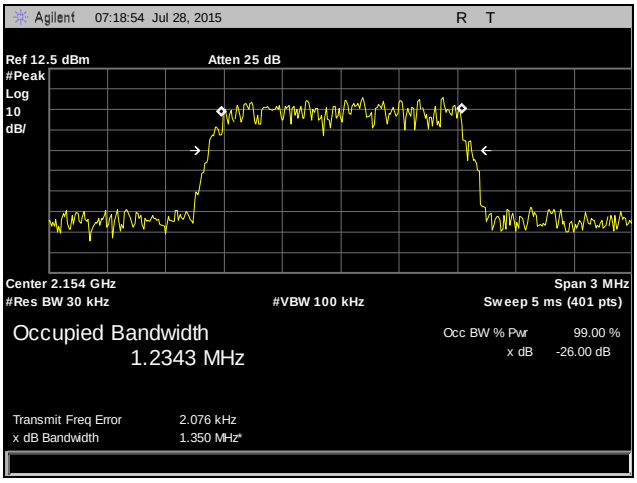
## Occupied Bandwidth, Part 27



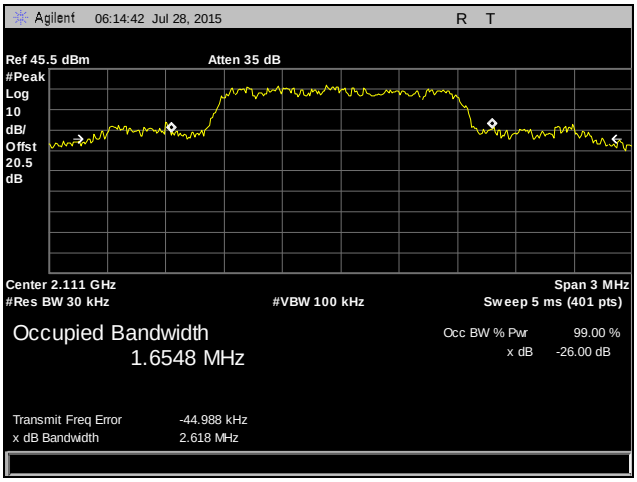

**Plot 64. Occupied Bandwidth, Low Channel, CDMA, Input, Part 27**



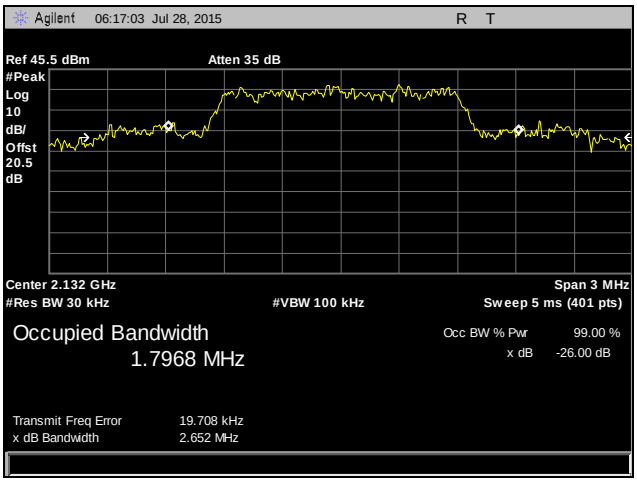

**Plot 65. Occupied Bandwidth, Mid Channel, CDMA, Input, Part 27**



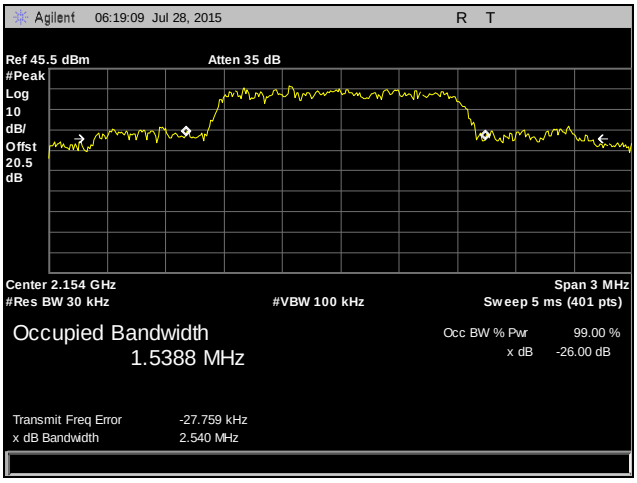

**Plot 66. Occupied Bandwidth, High Channel, CDMA, Input, Part 27**




**Plot 67. Occupied Bandwidth, Low Channel, CDMA, Output, Part 27**

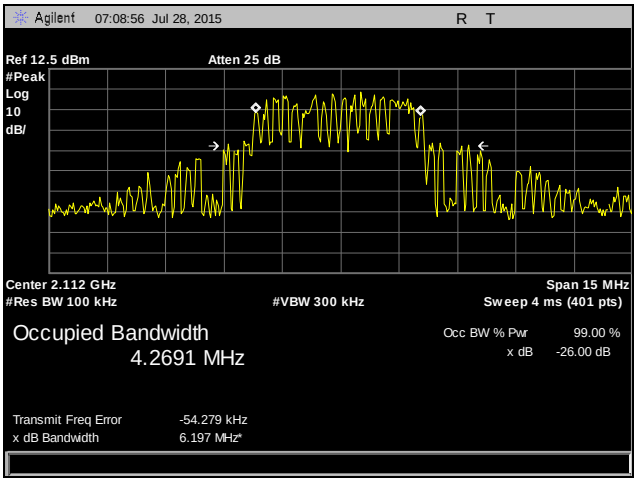



**Plot 68. Occupied Bandwidth, Mid Channel, CDMA, Output, Part 27**

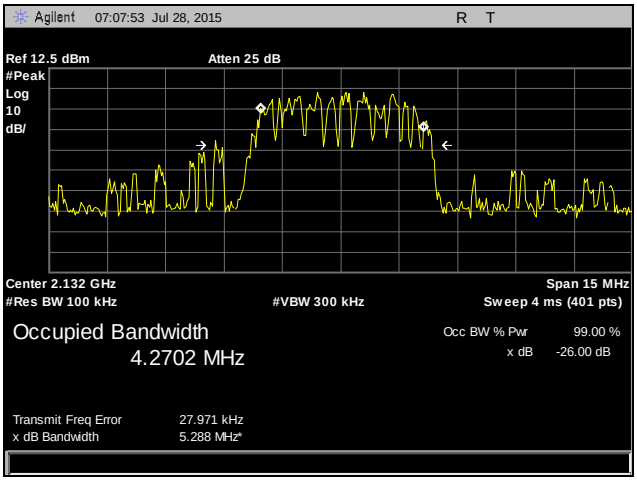



**Plot 69. Occupied Bandwidth, High Channel, CDMA, Output, Part 27**

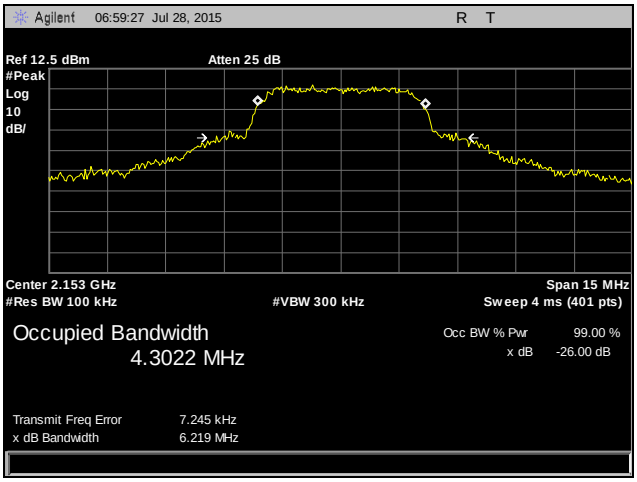
  



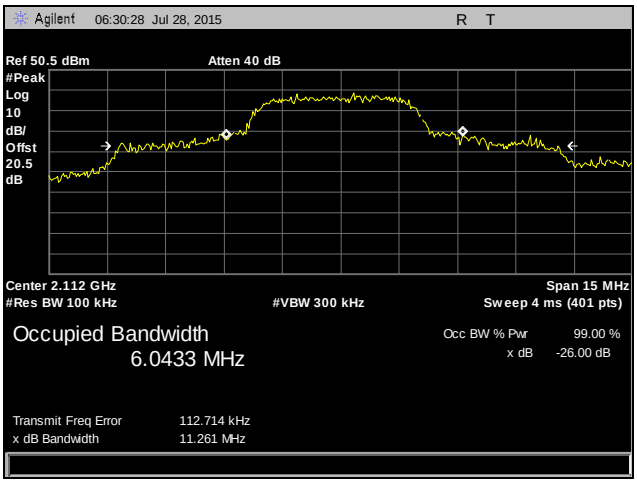

**Plot 70. Occupied Bandwidth, Low Channel, WCDMA, Input, Part 27**



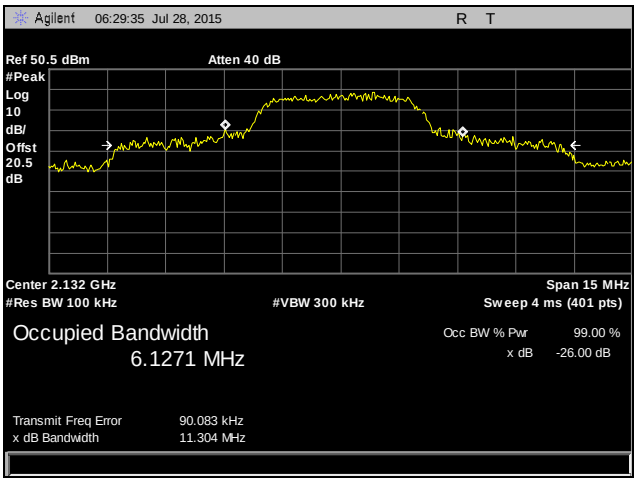

**Plot 71. Occupied Bandwidth, Mid Channel, WCDMA, Input, Part 27**



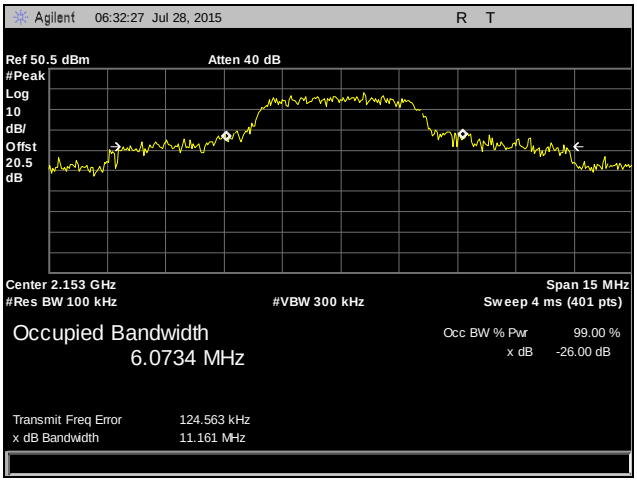

**Plot 72. Occupied Bandwidth, High Channel, WCDMA, Input, Part 27**




**Plot 73. Occupied Bandwidth, Low Channel, WCDMA, Output, Part 27**




**Plot 74. Occupied Bandwidth, Mid Channel, WCDMA, Output, Part 27**




**Plot 75. Occupied Bandwidth, High Channel, WCDMA, Output, Part 27**

## Electromagnetic Compatibility Criteria for Intentional Radiators

## § 2.1053 Radiated Spurious Emissions

**Test Requirement(s):** **§ 2.1053 Measurements required: Field strength of spurious radiation.**

**§ 2.1053 (a)** Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

**§ 2.1053 (b):** The measurements specified in paragraph (a) of this section shall be made for the following equipment:

**(1)** Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

**(2)** All equipment operating on frequencies higher than 25 MHz.

**(3)** All equipment where the antenna is an integral part of, and attached directly to the transmitter.

**(4)** Other types of equipment as required, when deemed necessary by the Commission.

**§ 22.917 Emission limitations Cellular equipment:** The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

**§ 22.917 (a)**: Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P).

**27.53(h) Measurements required: Field strength of spurious radiation.**

For operations in the 1710-1755 MHz and 2110-2155 MHz bands, the power of any emissions outside a licensee's frequency block shall be attenuated below the transmitter power P by at least 43+10log(P).

**Test Procedures:**

As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* was made in accordance with the procedures of TIA/EIA-603-A-2001 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber. The EUT's RF ports were terminated to 50ohm load. The EUT was tested using both modulations and at the low, mid, and high channels. The EUT was rotated about $360^0$ and the receiving antenna scanned from 1-4m in order to capture the maximum emission. The plots are corrected for cable loss, antenna correction factor, and distance correction. The field strength was mathematically corrected to an E.I.R.P. Harmonic emissions up to the $10^{th}$ or 40GHz, which ever was the lesser, were investigated.

The spectrum analyzer was configured in accordance with the licensed measurement guidance, and as per rule Parts 22 and 27.

The distance between the EUT and the test antenna was 3 meters for below 1 GHz and 1m for frequencies above 1 GHz. The EUT's RF ports were connected to a dummy load. The intensities of the radiated emissions were maximized by rotating the turntable 360 degrees and varying the receive antenna from 1 to 4m. Measurements were made with the receive antenna in both horizontal and vertical polarizations.

**Test Results:**

Equipment complies with Section 2.1053. The limit for spurs is -13 dBm. Measurements revealed that no spurs came even close to this limit. Therefore, measurements using substitution method were not performed. Also, testing was performed using a CW signal. The following plots have been corrected.

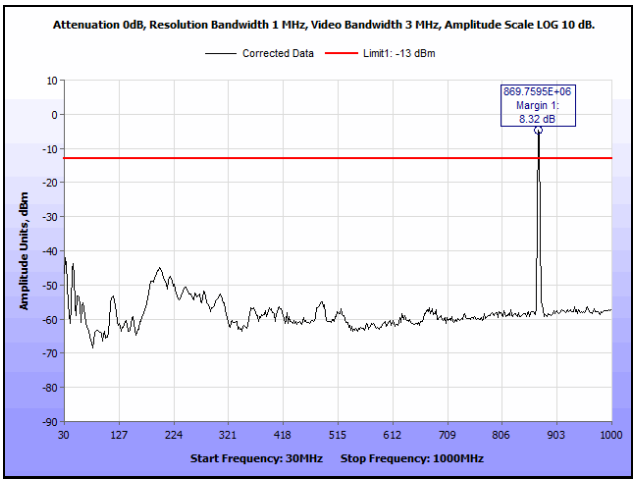
**Test Engineer:**

Benjamin Taylor

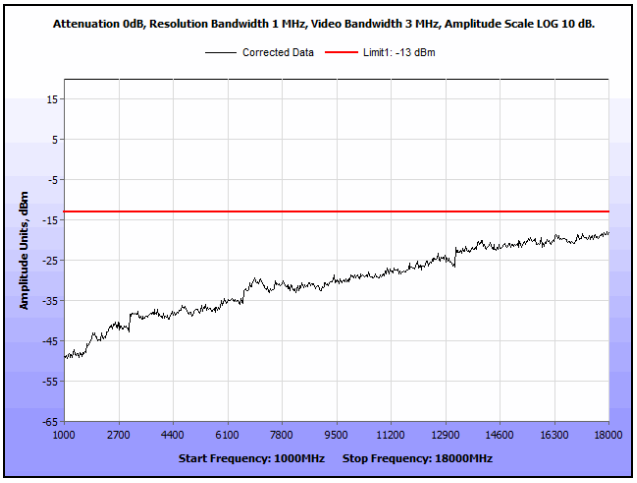
**Test Date(s):**

07/30/15 and 08/06/15

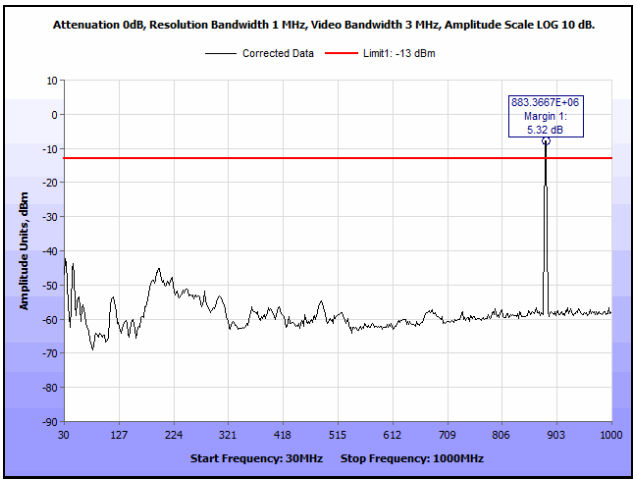
## Radiated Spurious Emissions, Part 22



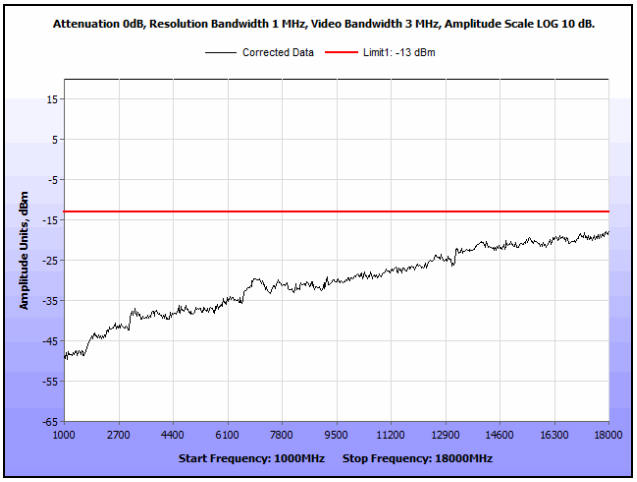

**Plot 76. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, Part 22**



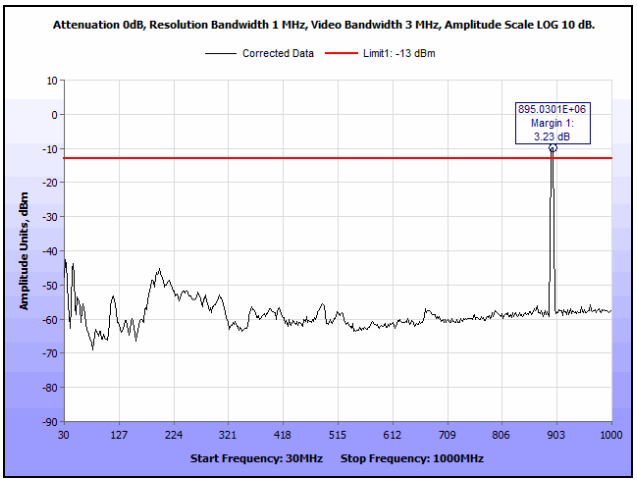

**Plot 77. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, Part 22**



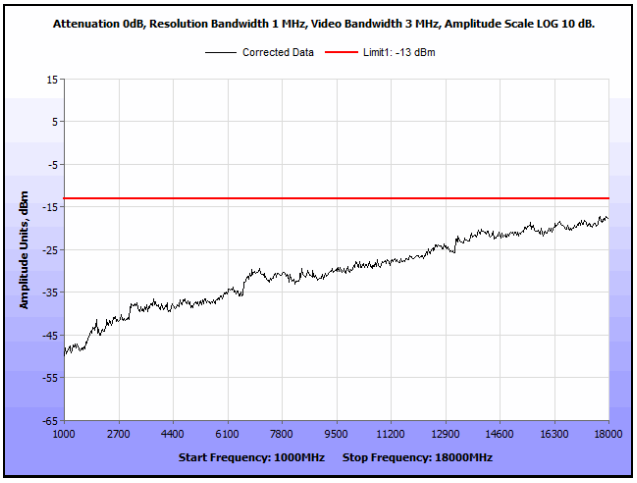

**Plot 78. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, Part 22**




**Plot 79. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz, Part 22**

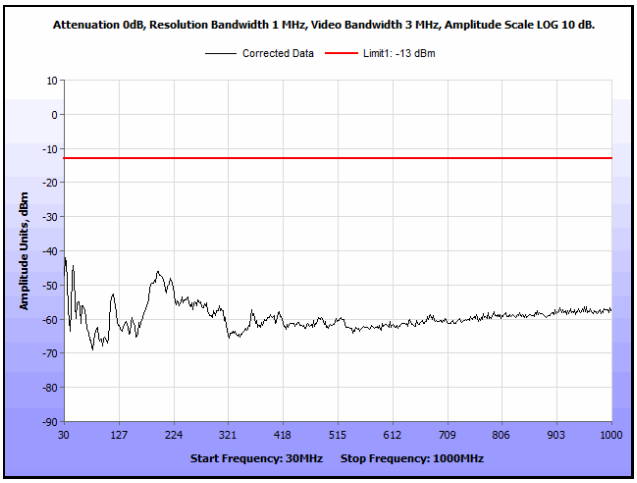



**Plot 80. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, Part 22**

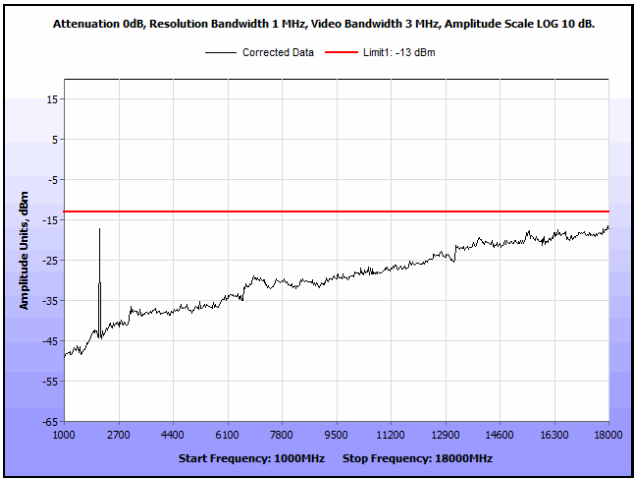



**Plot 81. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, Part 22**

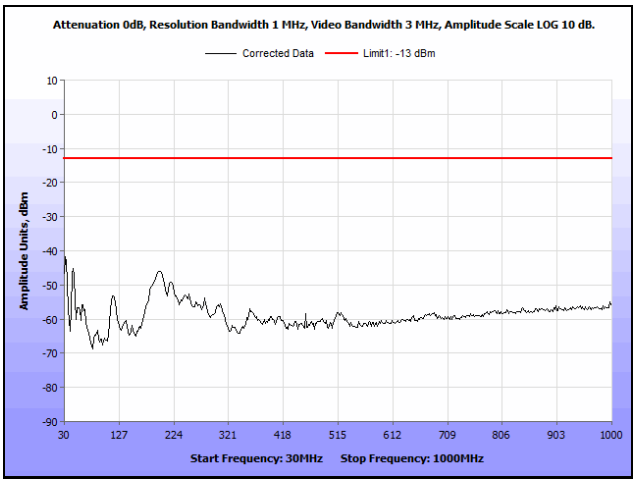
## Radiated Spurious Emissions, Part 27



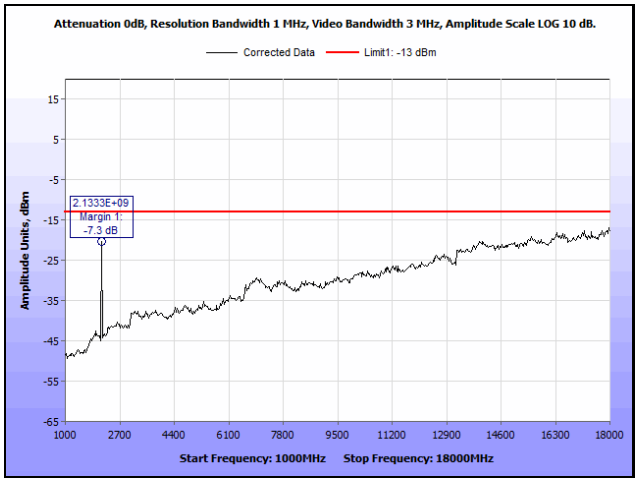

**Plot 82. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, Part 27**



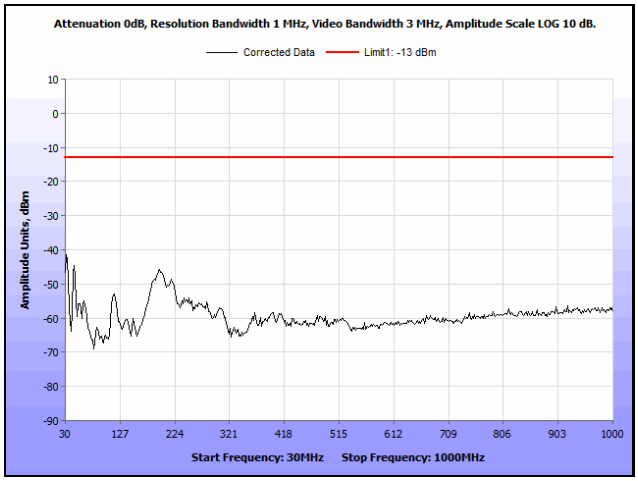

**Plot 83. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, Part 27**



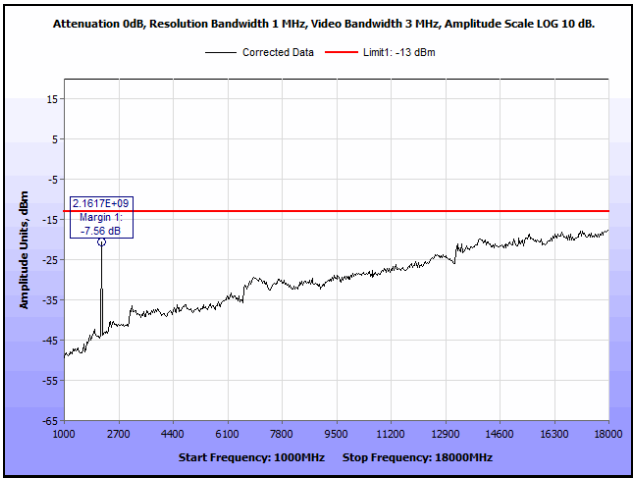

**Plot 84. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, Part 27**




**Plot 85. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz, Part 27**




**Plot 86. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, Part 27**




**Plot 87. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, Part 27**

## Electromagnetic Compatibility Criteria for Intentional Radiators

## § 2.1051 Spurious Emissions at Antenna Terminals

**Test Requirement(s):**

**§ 2.1051 Measurements required: Spurious emissions at antenna terminals:** The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**§ 22.917** The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

**§ 22.917 (a)** Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

**§ 22.917 (b)** *Measurement procedure*. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 30 kHz or more. In the 60 kHz bands immediately outside and adjacent to the authorized frequency range or channel, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy approved the measured power is integrated over the full required measurement bandwidth (i.e., 30 kHz or 1 percent of emission bandwidth, as specified). 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 emissions are attenuated at least 26 dB below the transmitter power.

**27.53(h):** For operations in the 1710-1755 MHz and 2110-2155 MHz bands, the power of any emissions outside a licensee's frequency block shall be attenuated below the transmitter power P by at least 43 + 10log (P).

**Test Procedures:** As required by 47 CFR §2.1051, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a Spectrum Analyzer.

A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer through an attenuator. The Spectrum Analyzer was set to sweep 30 MHz and up to 10th harmonic of the fundamental or 40 GHz whichever is the lesser. Measurements were made in all applicable frequency bands.

A modulated carrier generated by the base station was connected to RF input port at a maximum level as determined by the OEM. A spectrum analyzer was connected to either the RF output port for spurious emissions measurements. The spectrum was investigated from 30MHz to the 10th harmonic of the carrier.

The inter-modulation requirements were performed in a similar manner as described above. The spectrum analyzer was set to 100KHz RBW and 300KHz VBW. Two modulated carriers were injected into the EUT from the base station. The in band spurious emissions were investigated.
The filter response has also be measured and recorded.

Band Edge Plots: If a reduction of power was necessary for compliance at band edges, a second band edge plot was taken at the outermost channel that was compliant at the highest power. The channel number is noted in the caption of those plots.

**Test Results:** Equipment complies with these requirements.

**Test Engineer(s):** Benjamin Taylor

**Test Date(s):** 07/28/15 and 08/06/15

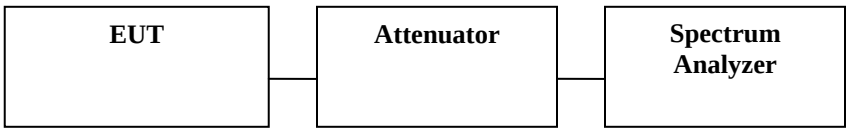
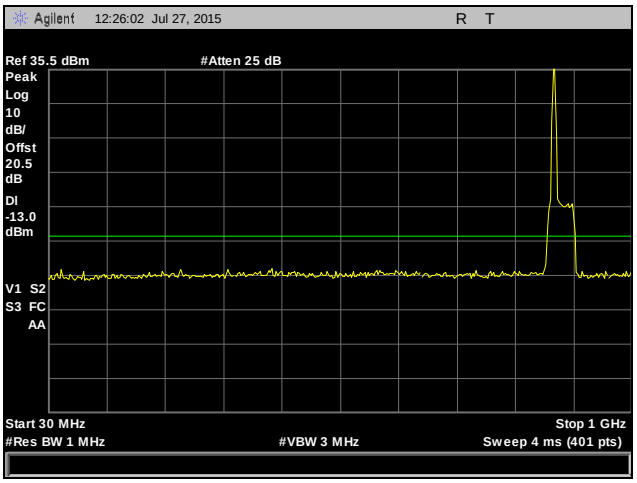
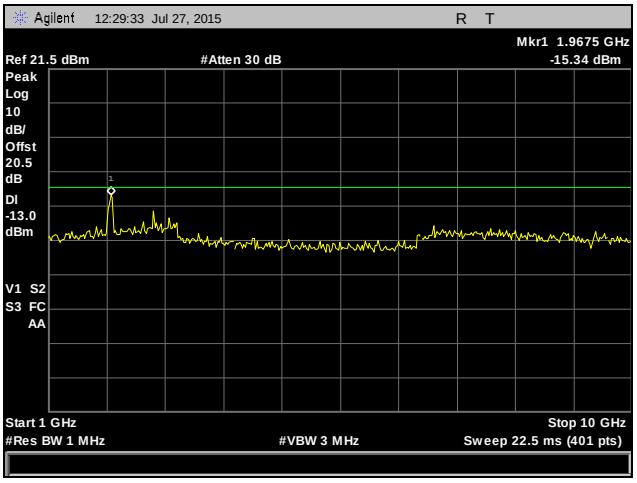



**Figure 3. Spurious Emissions at Antenna Terminals Test Setup**

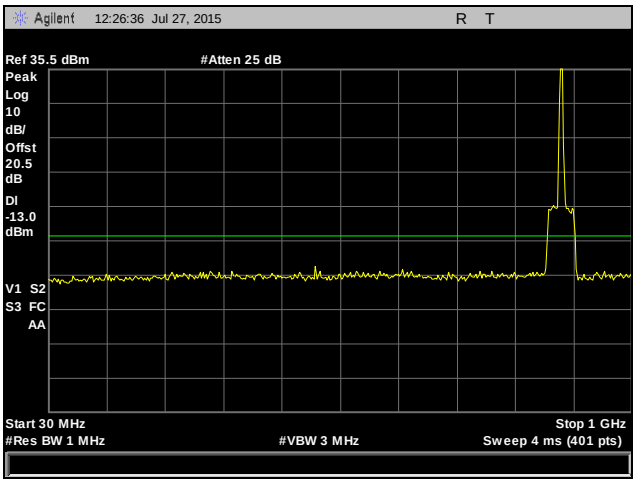
## Conducted Spurious Emissions, Part 22



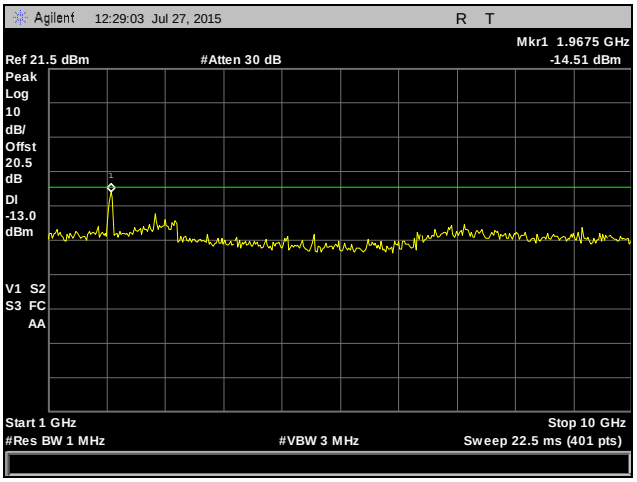

**Plot 88. Conducted Spurious Emissions, CDMA, Low Channel, 30 MHz – 1 GHz, Part 22**



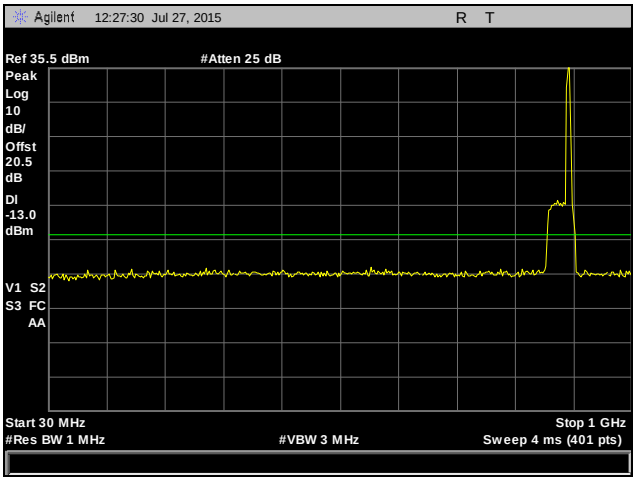

**Plot 89. Conducted Spurious Emissions, CDMA, Low Channel, 1 GHz – 10 GHz, Part 22**



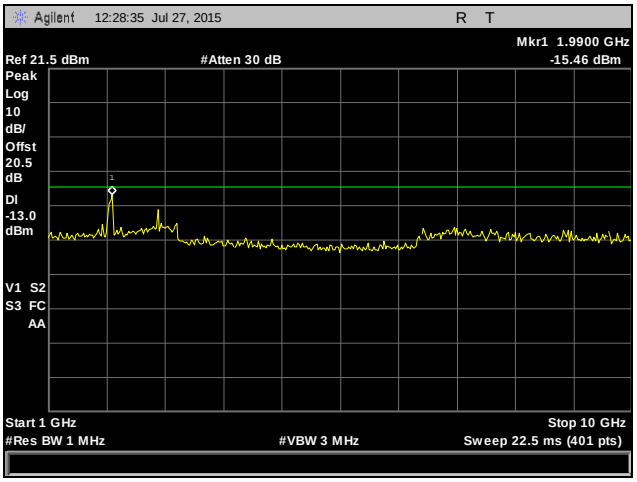

**Plot 90. Conducted Spurious Emissions, CDMA, Mid Channel, 30 MHz – 1 GHz, Part 22**



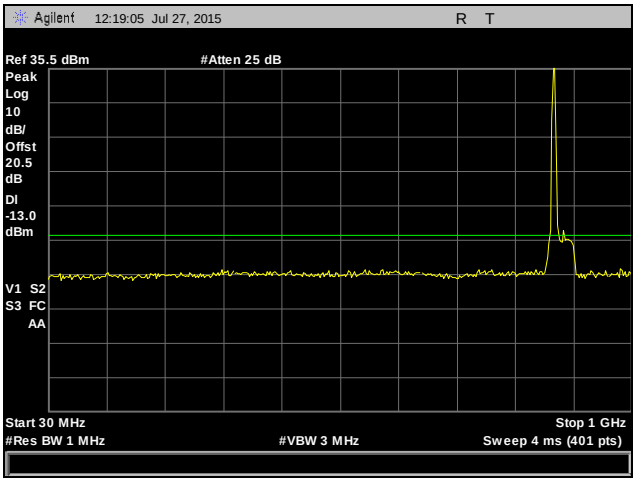

**Plot 91. Conducted Spurious Emissions, CDMA, Mid Channel, 1 GHz – 10 GHz, Part 22**



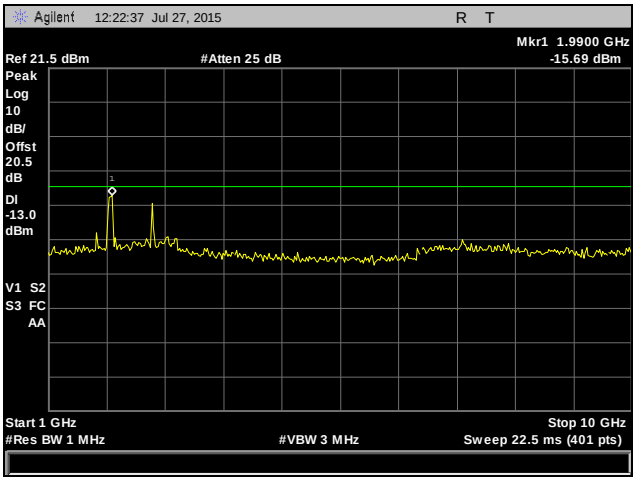

**Plot 92. Conducted Spurious Emissions, CDMA, High Channel, 30 MHz – 1 GHz, Part 22**



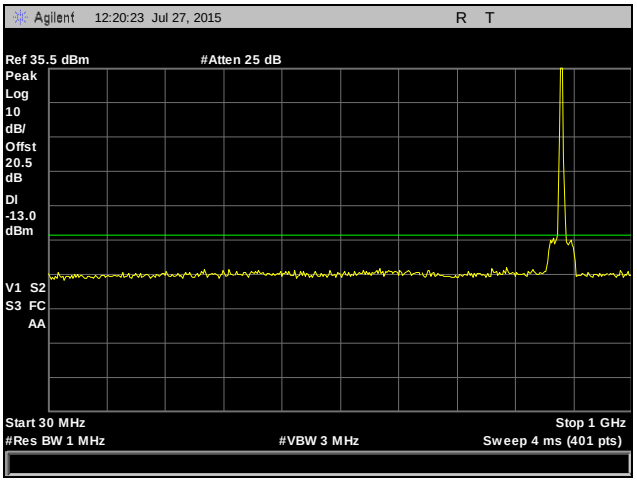

**Plot 93. Conducted Spurious Emissions, CDMA, High Channel, 1 GHz – 10 GHz, Part 22**



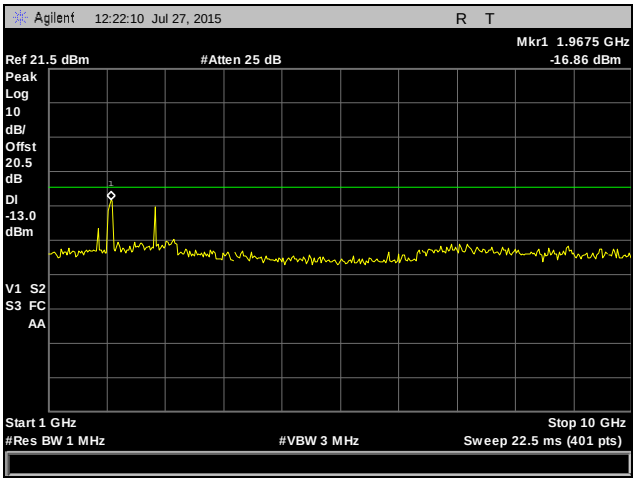

**Plot 94. Conducted Spurious Emissions, GSM, Low Channel, 30 MHz – 1 GHz, Part 22**



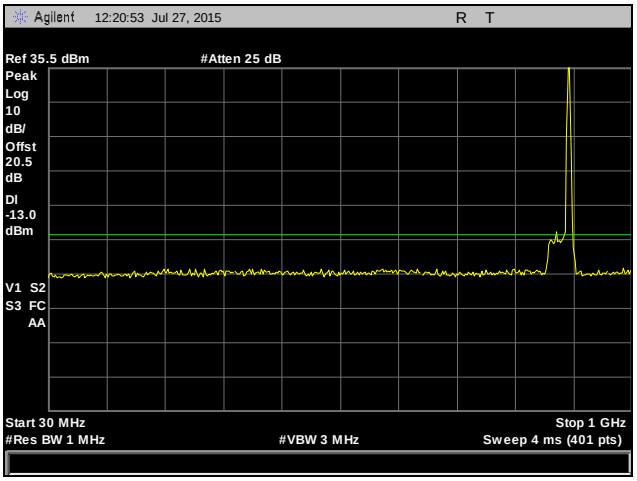

**Plot 95. Conducted Spurious Emissions, GSM, Low Channel, 1 GHz – 10 GHz, Part 22**



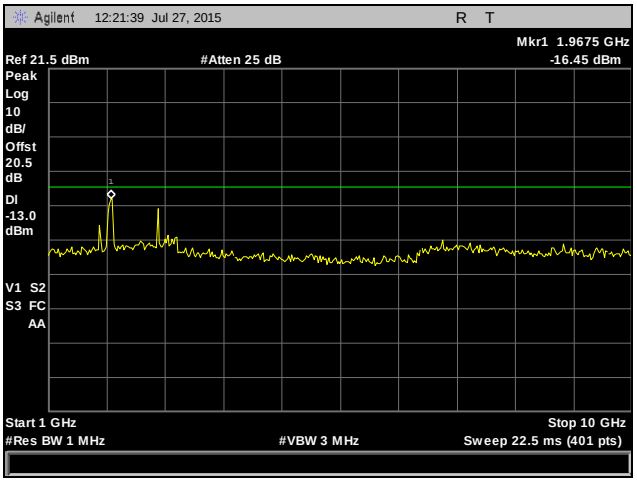

**Plot 96. Conducted Spurious Emissions, GSM, Mid Channel, 30 MHz – 1 GHz, Part 22**



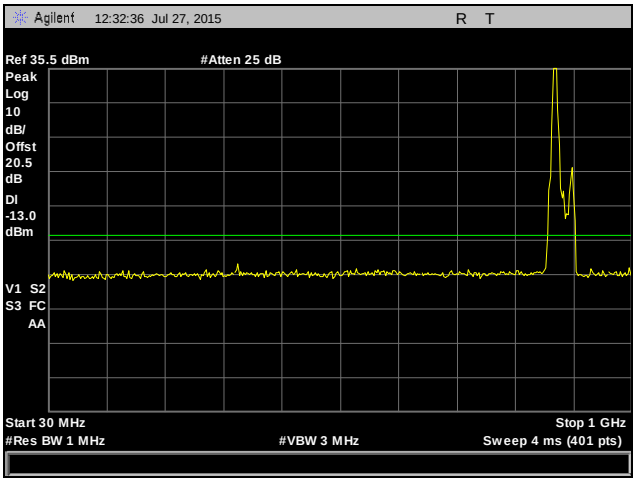

**Plot 97. Conducted Spurious Emissions, GSM, Mid Channel, 1 GHz – 10 GHz, Part 22**



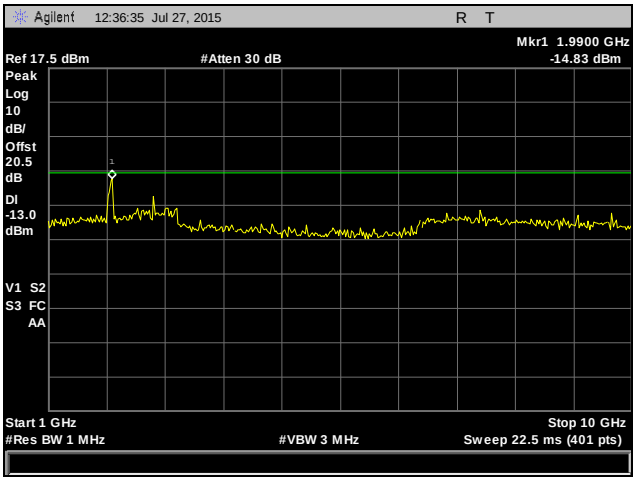

**Plot 98. Conducted Spurious Emissions, GSM, High Channel, 30 MHz – 1 GHz, Part 22**



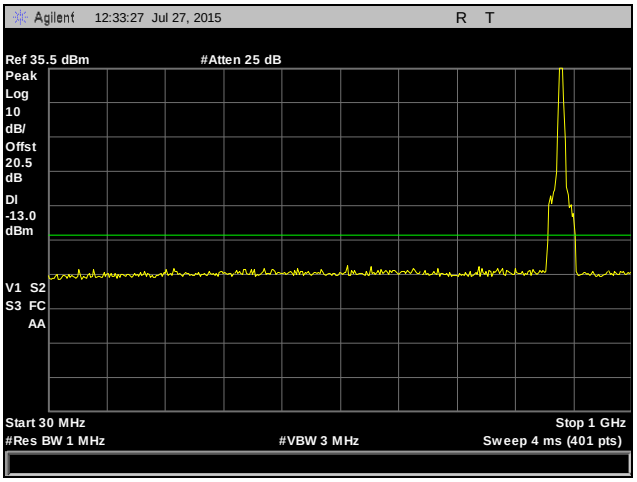

**Plot 99. Conducted Spurious Emissions, GSM, High Channel, 1 GHz – 10 GHz, Part 22**



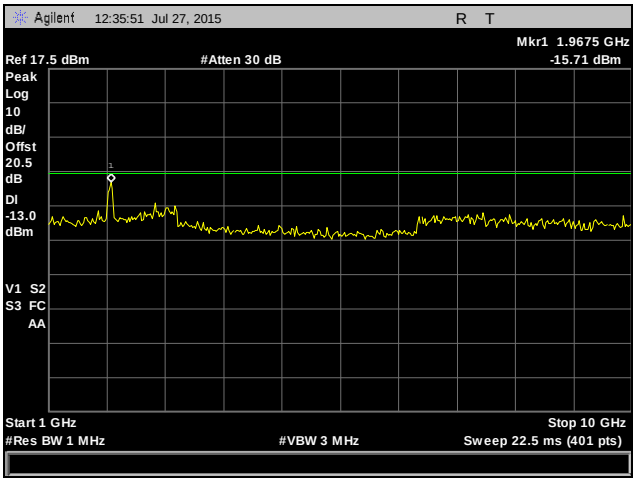

**Plot 100. Conducted Spurious Emissions, WCDMA, Low Channel, 30 MHz – 1 GHz, Part 22**



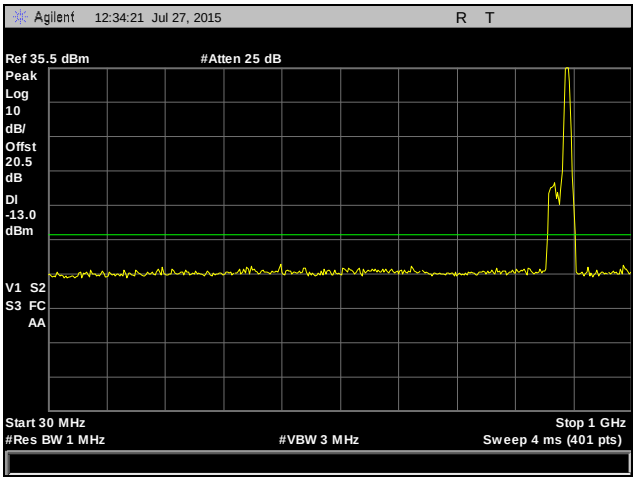

**Plot 101. Conducted Spurious Emissions, WCDMA, Low Channel, 1 GHz – 10 GHz, Part 22**



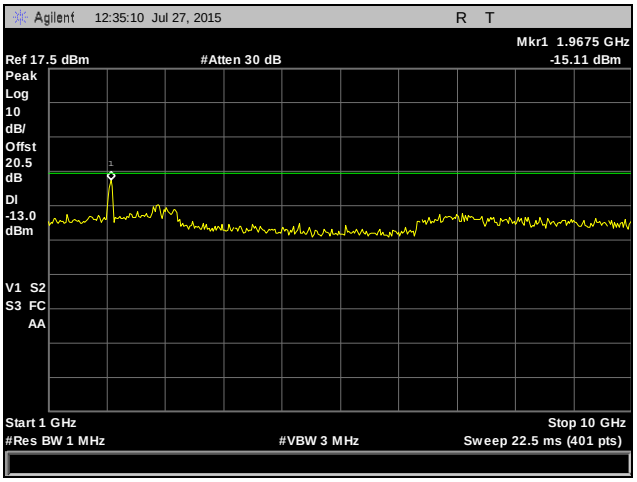

**Plot 102. Conducted Spurious Emissions, WCDMA, Mid Channel, 30 MHz – 1 GHz, Part 22**




**Plot 103. Conducted Spurious Emissions, WCDMA, Mid Channel, 1 GHz – 10 GHz, Part 22**

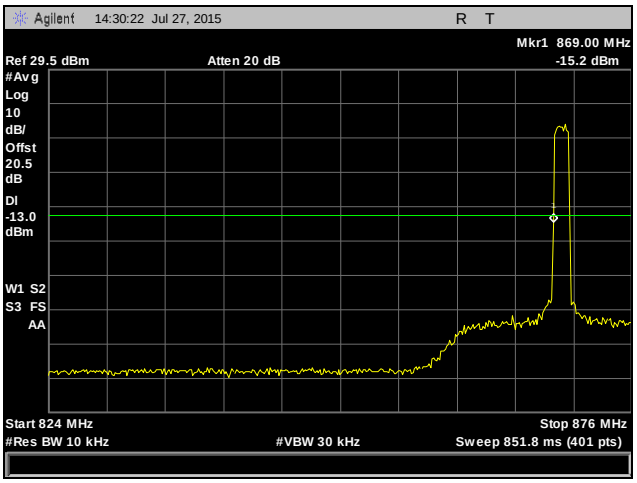



**Plot 104. Conducted Spurious Emissions, WCDMA, High Channel, 30 MHz – 1 GHz, Part 22**

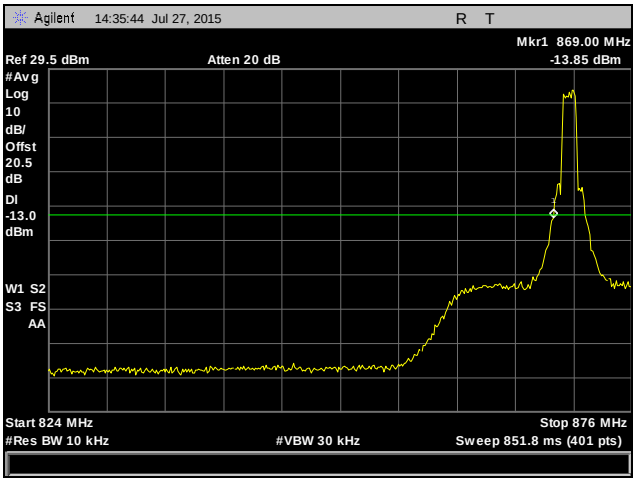



**Plot 105. Conducted Spurious Emissions, WCDMA, High Channel, 1 GHz – 10 GHz, Part 22**

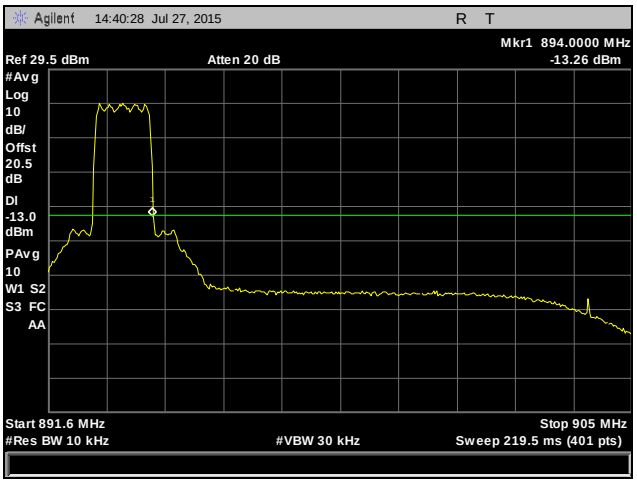
## Conducted Band Edge, Part 22



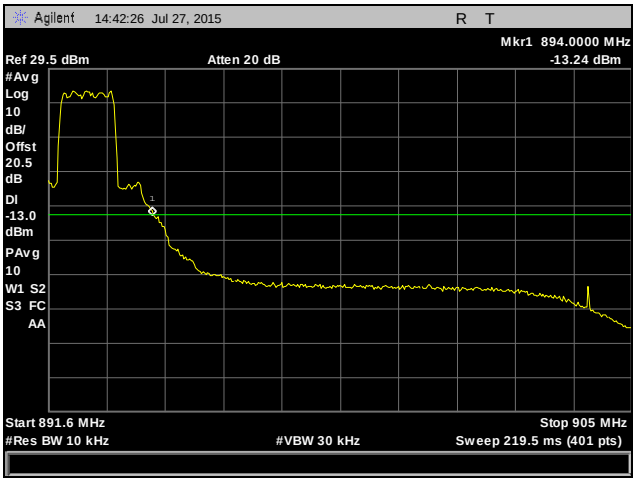

**Plot 106. Conducted Band Edge, CDMA, Low Channel, Part 22**



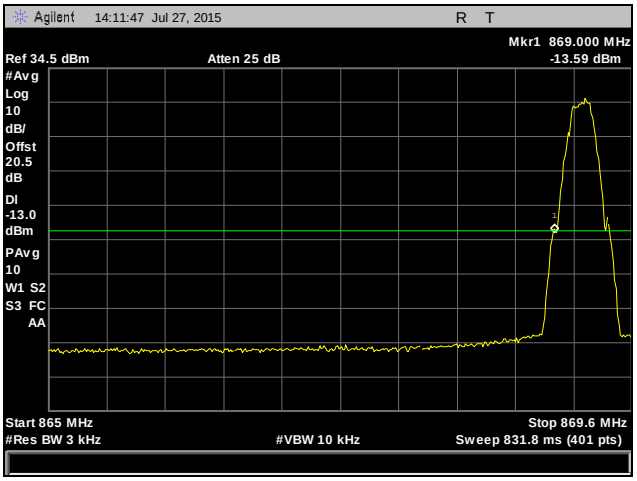

**Plot 107. Conducted Band Edge, CDMA, Low Channel, Channel 14, Part 22**



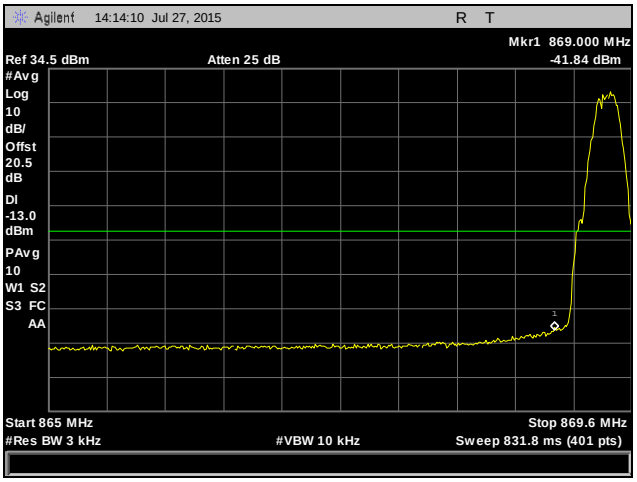

**Plot 108. Conducted Band Edge, CDMA, High Channel, Part 22**



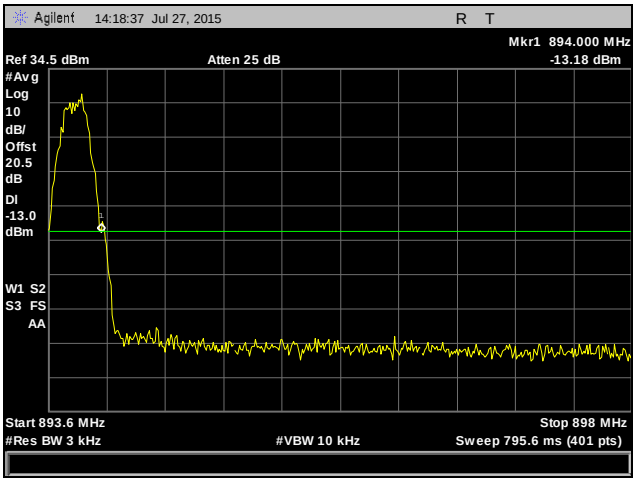

**Plot 109. Conducted Band Edge, CDMA, High Channel, Channel 750, Part 22**



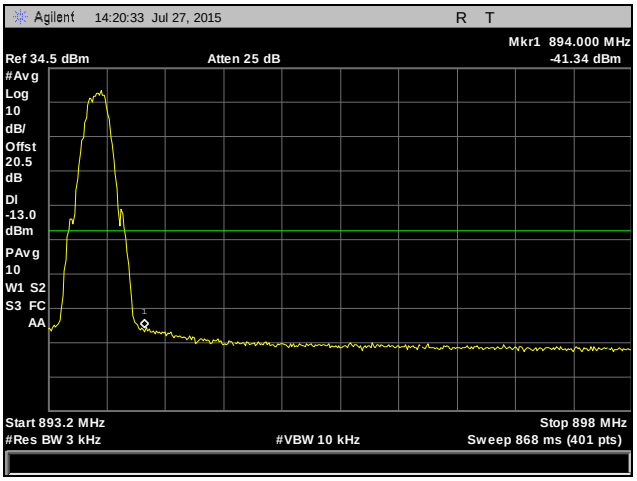

**Plot 110. Conducted Band Edge, GSM, Low Channel, Part 22**



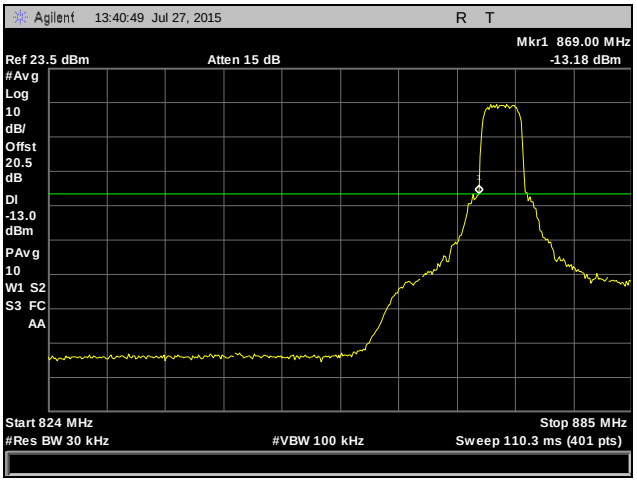

**Plot 111. Conducted Band Edge, GSM, Low Channel, Channel 129, Part 22**



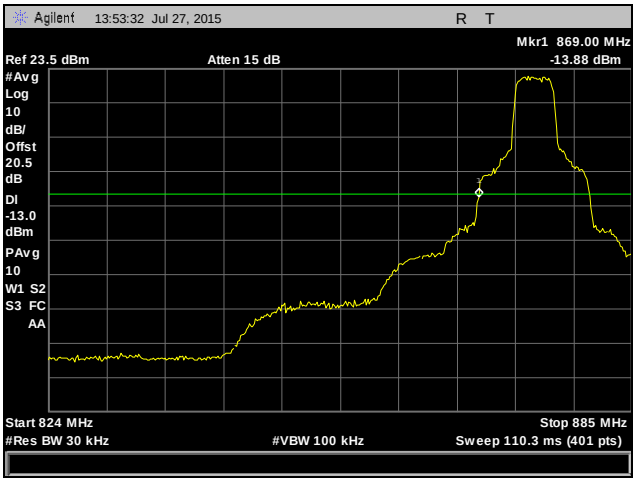

**Plot 112. Conducted Band Edge, GSM, High Channel, Part 22**



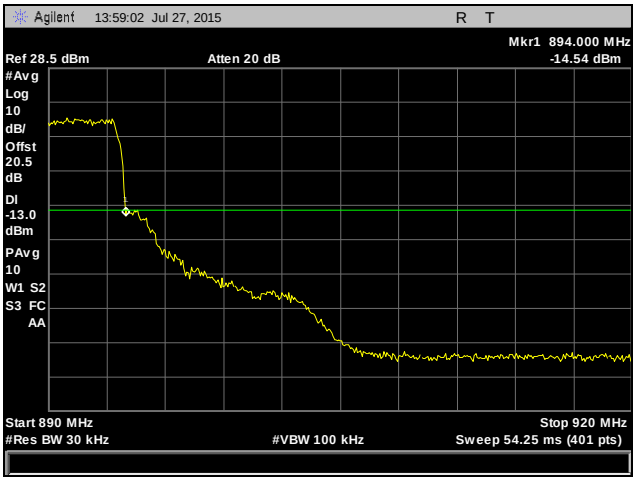

**Plot 113. Conducted Band Edge, GSM, High Channel, Channel 250, Part 22**



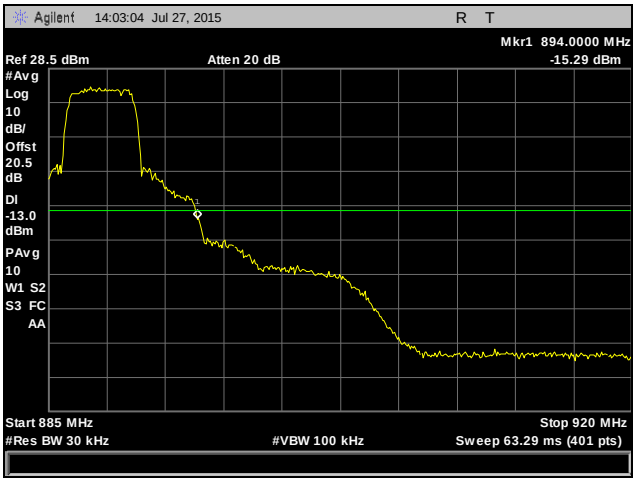

**Plot 114. Conducted Band Edge, WCDMA, Low Channel, Part 22**




**Plot 115. Conducted Band Edge, WCDMA, Low Channel, Channel 4374, Part 22**

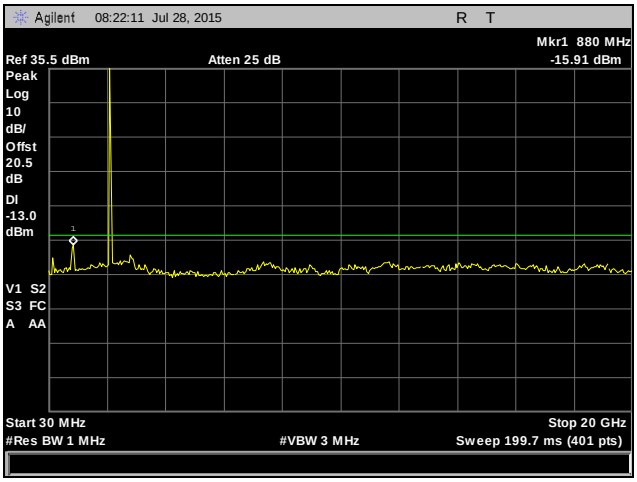



**Plot 116. Conducted Band Edge, WCDMA, High Channel, Part 22**

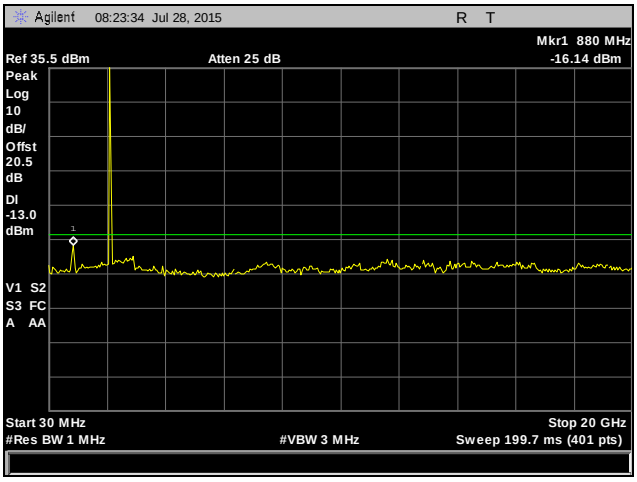



**Plot 117. Conducted Band Edge, WCDMA, High Channel, Channel 4441, Part 22**

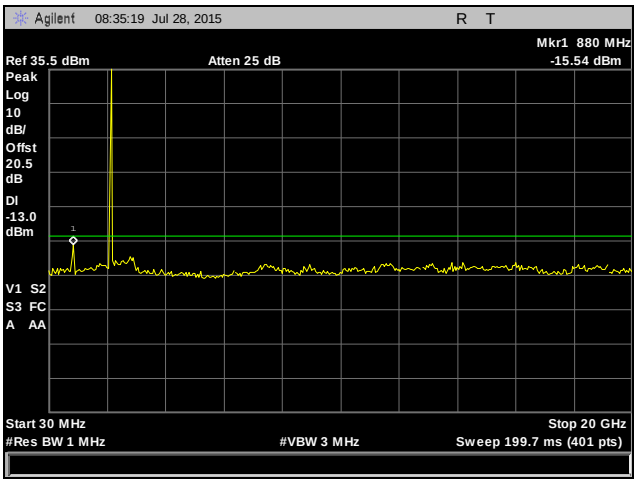
## Conducted Spurious Emissions, Part 27



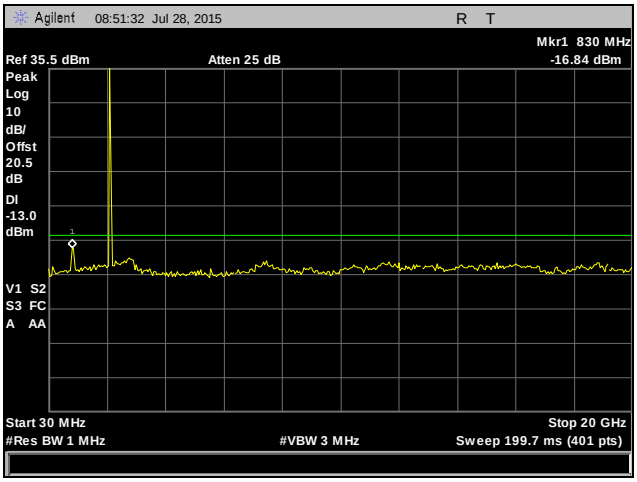

**Plot 118. Conducted Spurious Emissions, CDMA, Low Channel, 30 MHz – 20 GHz, Part 27**



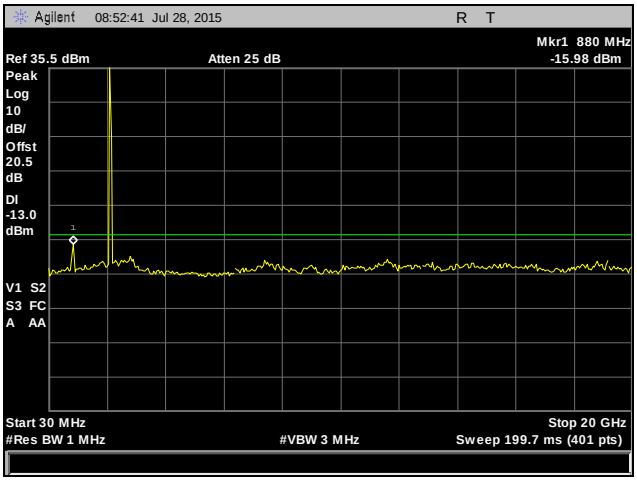

**Plot 119. Conducted Spurious Emissions, CDMA, Mid Channel, 30 MHz – 20 GHz, Part 27**



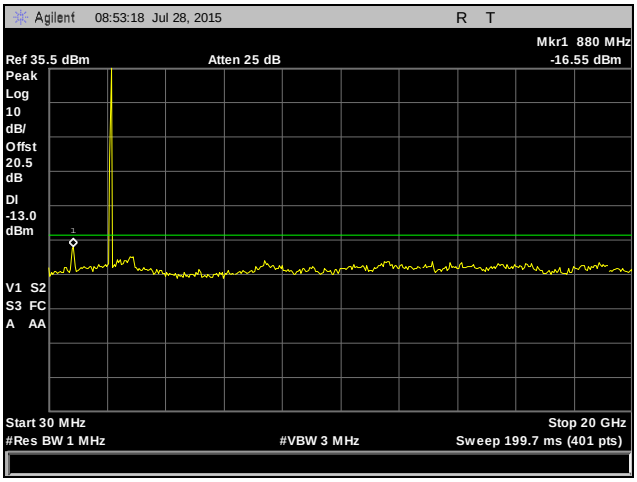

**Plot 120. Conducted Spurious Emissions, CDMA, High Channel, 30 MHz – 20 GHz, Part 27**




**Plot 121. Conducted Spurious Emissions, WCDMA, Low Channel, 30 MHz – 20 GHz, Part 27**

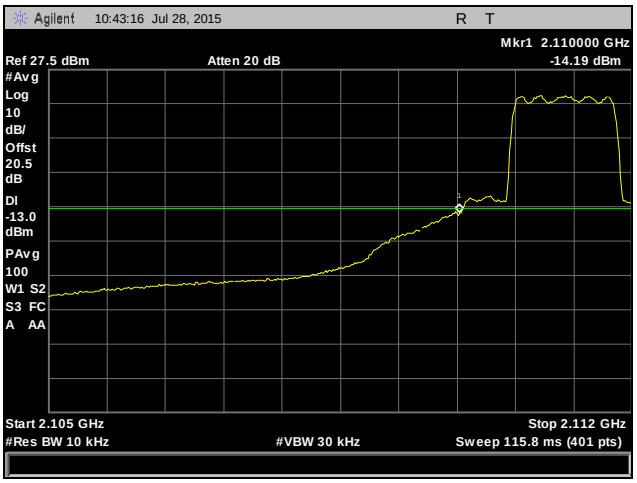



**Plot 122. Conducted Spurious Emissions, WCDMA, Mid Channel, 30 MHz – 20 GHz, Part 27**

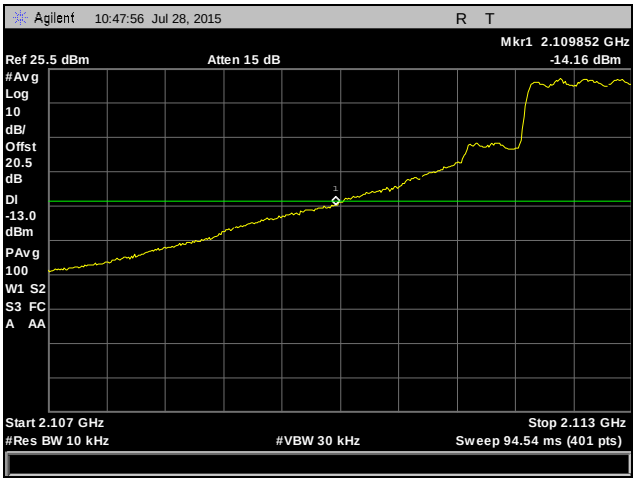



**Plot 123. Conducted Spurious Emissions, WCDMA, High Channel, 30 MHz – 20 GHz, Part 27**

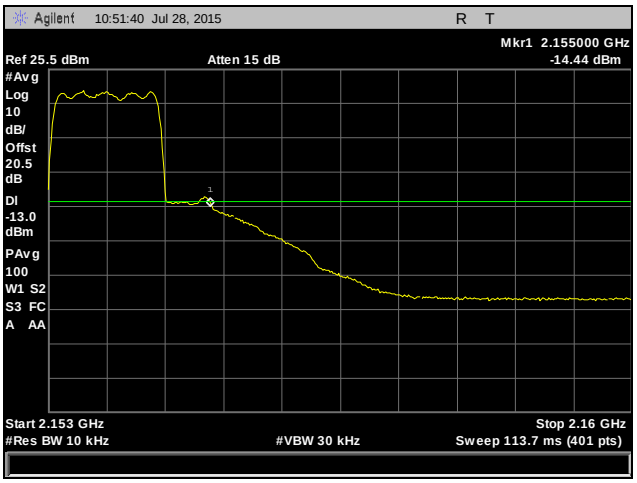
## Conducted Band Edge, Part 27



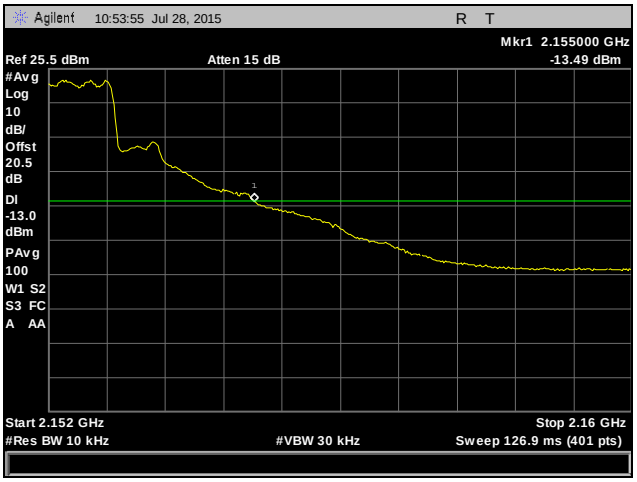

**Plot 124. Conducted Band Edge, CDMA, Low Channel, Part 27**



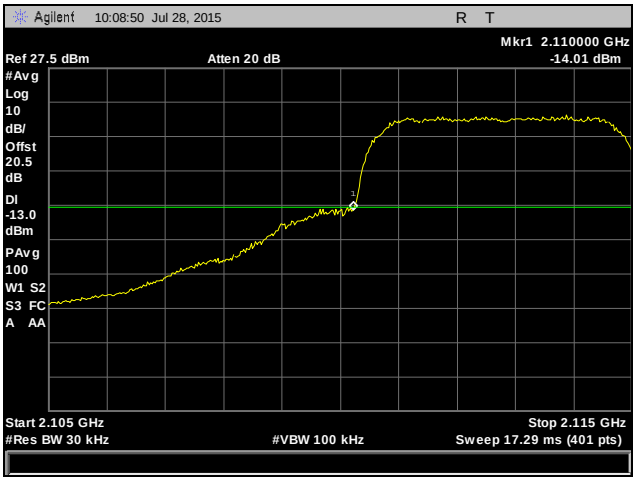

**Plot 125. Conducted Band Edge, CDMA, Low Channel, Channel 47, Part 27**



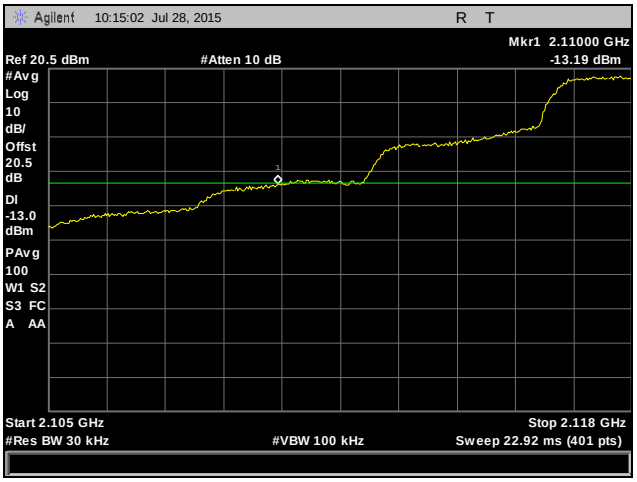

**Plot 126. Conducted Band Edge, CDMA, High Channel, Part 27**



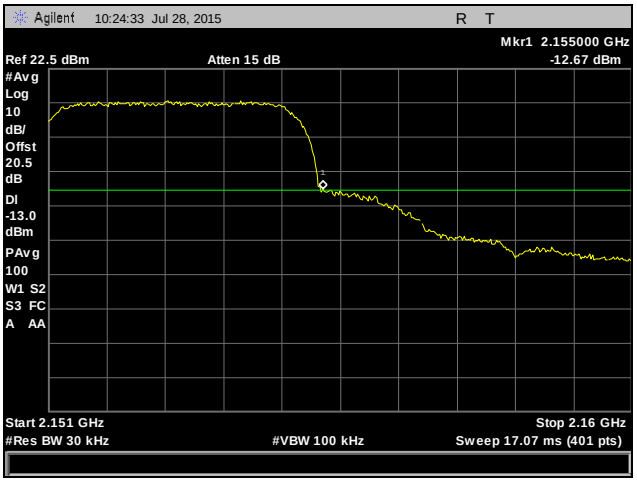

**Plot 127. Conducted Band Edge, CDMA, High Channel, Channel 850, Part 27**



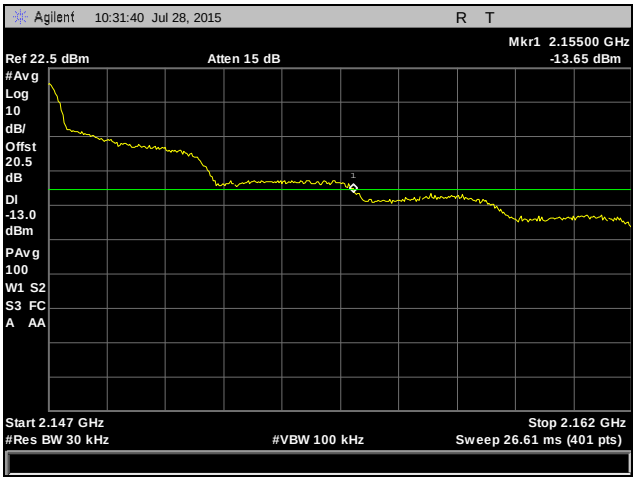

**Plot 128. Conducted Band Edge, WCDMA, Low Channel, Part 27**




**Plot 129. Conducted Band Edge, WCDMA, Low Channel, Channel 1565, Part 27**




**Plot 130. Conducted Band Edge, WCDMA, High Channel, Part 27**




**Plot 131. Conducted Band Edge, WCDMA, High Channel, Channel 1702, Part 27**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## Out of Band Rejection

**Test Requirement(s):** Test for rejection of out-of-band signals

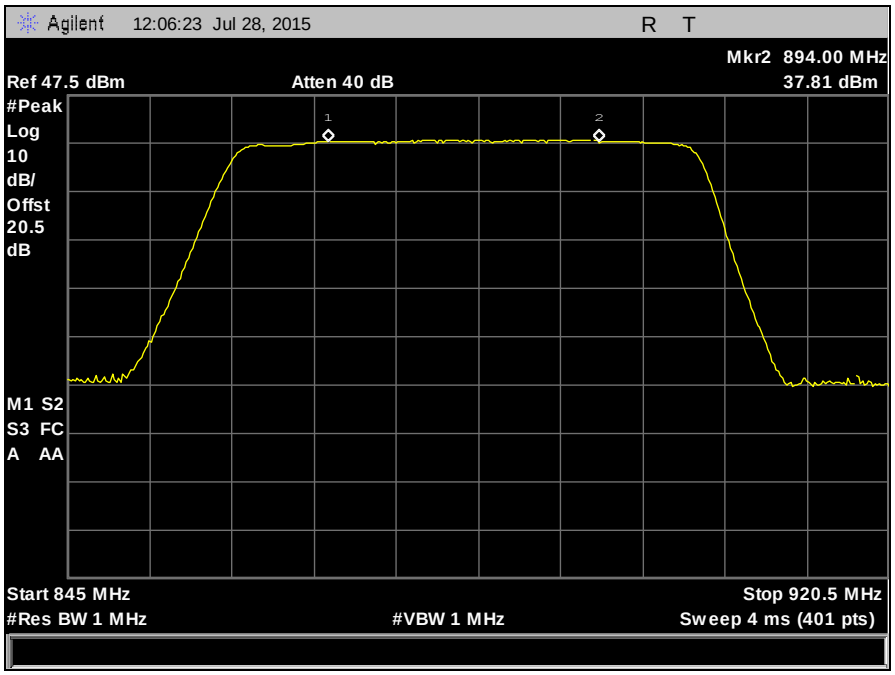
**Test Procedures:** A signal generator was used to drive the input of the EUT. The signal generator was swept across the band of interest. Filter frequency response plots were taken.

**Test Results:** The EUT complies with the requirements of this section.

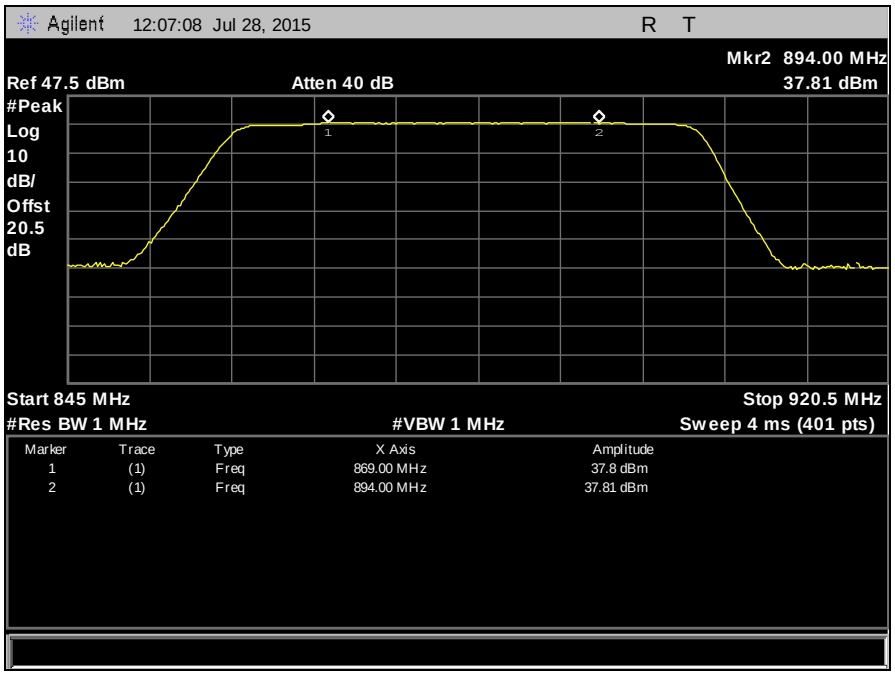
**Test Engineer:** Benjamin Taylor

**Test Date(s):** 07/28/15

## Filter Response, Part 22

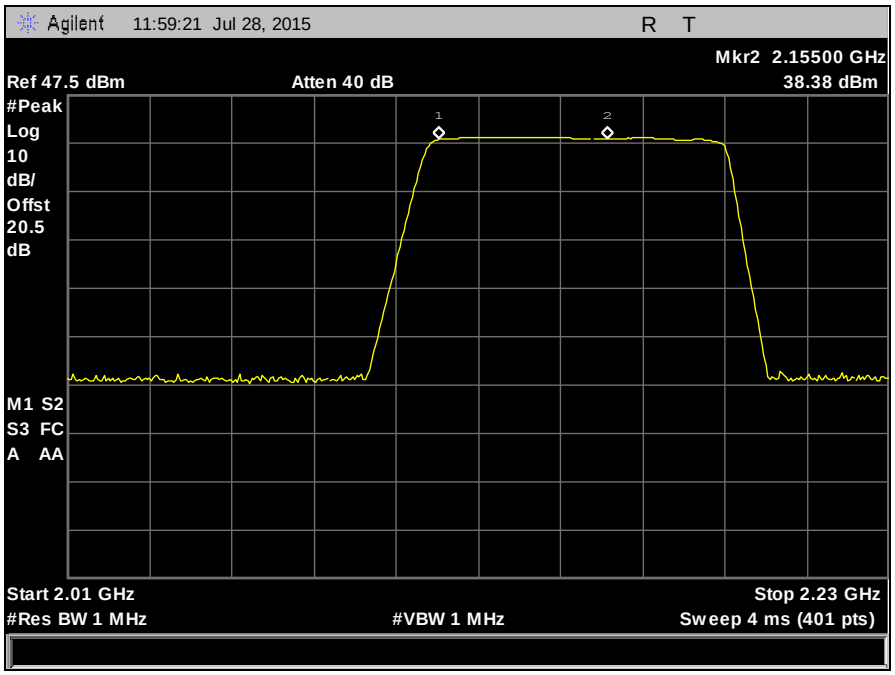



**Plot 132. Filter Response, Part 22**

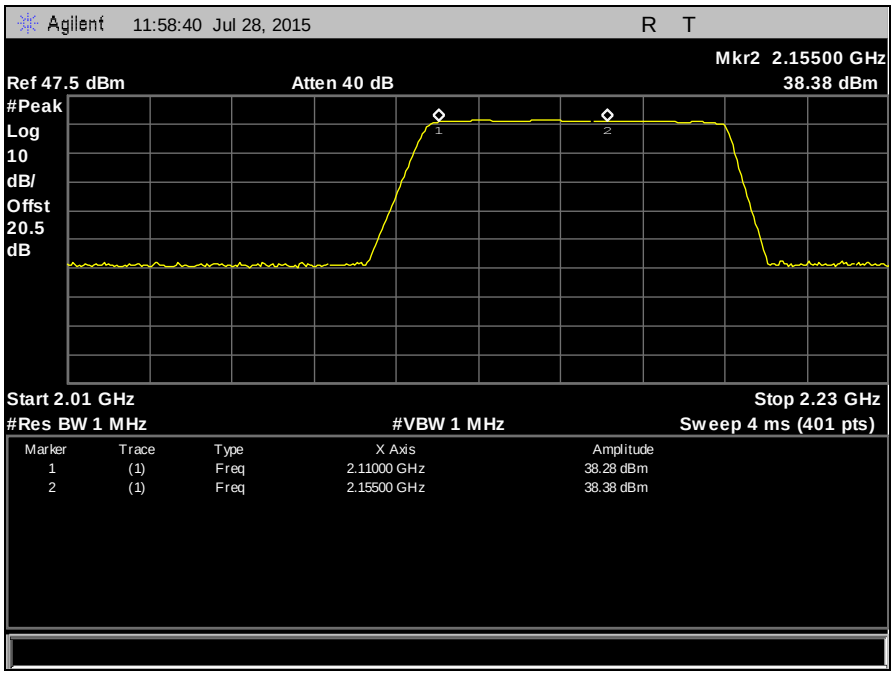



**Plot 133. Filter Response with Marker Table, Part 22**

## Filter Response, Part 27




**Plot 134. Filter Response, Part 27**




**Plot 135. Filter Response with Marker Table, Part 27**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## Intermodulation

**Test Requirement(s):** Intermodulation – Test all modulation types [TDMA, CDMA, and FM (covers GSM and F1D)]

- CW signal rather than typical signal is acceptable (for FM).
- At maximum drive level, for each modulation: one test with three tones, or two tests (High-, low-band edge) with two tones)
- Limit usually is -13 dBm conducted.
- Not needed for Single Channel systems
- Combination of modulation types not needed.

**Test Procedures:** The two tone test method was used. A base station was used to drive the input of the EUT. The EUT was evaluated at the high and low band edge.

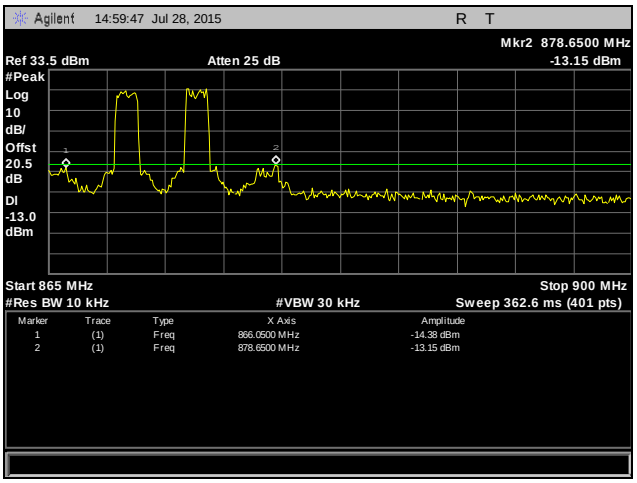
**Test Results:** The EUT complies with the requirements of this section. Inter modulation will only pass for low power setting. Therefore, high power setting cannot be used when there are multiple channels per band.

**Test Engineer(s):** Benjamin Taylor

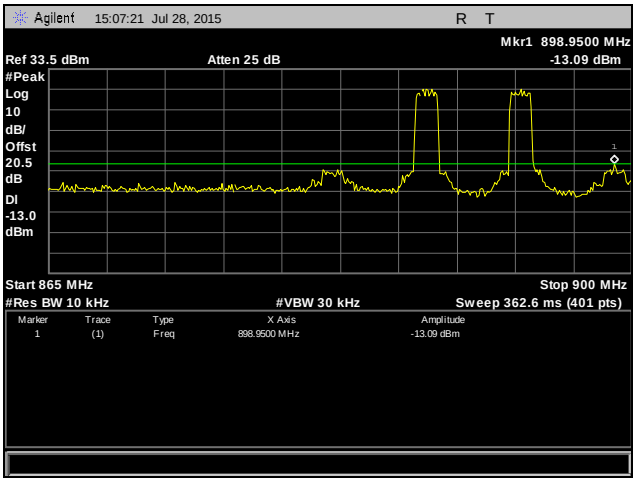
**Test Date(s):** 07/28/15 and 07/29/15

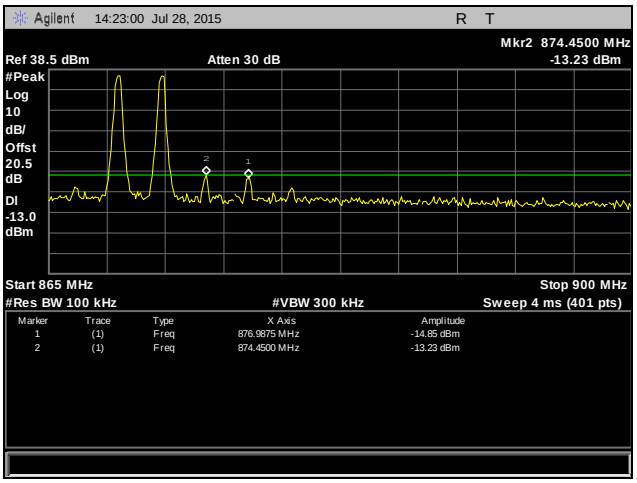
## Intermodulation, Part 22



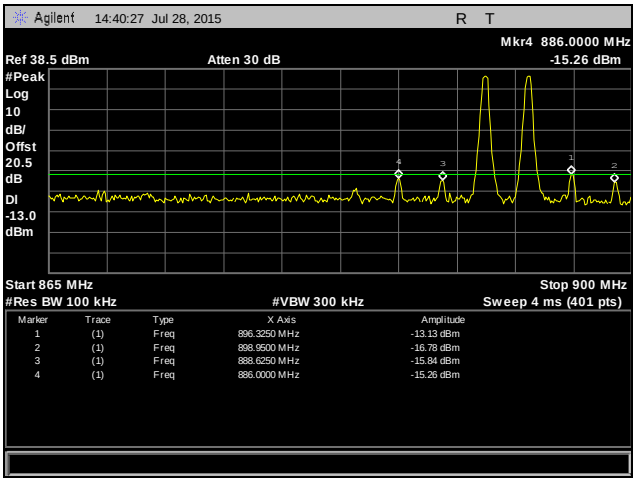

**Plot 136. Intermodulation, CDMA, Low Channel, Part 22**



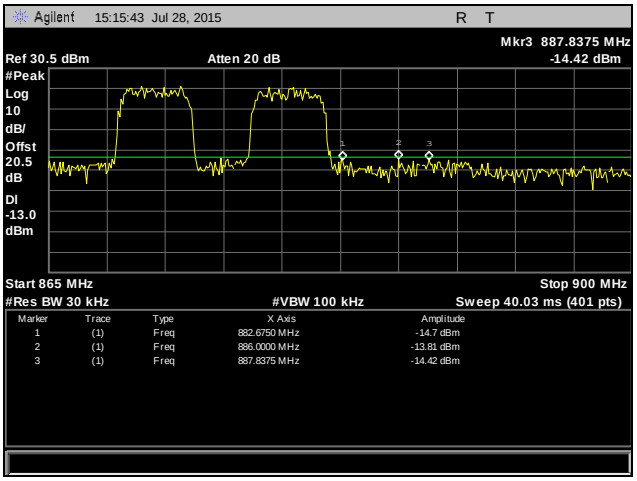

**Plot 137. Intermodulation, CDMA, High Channel, Part 22**



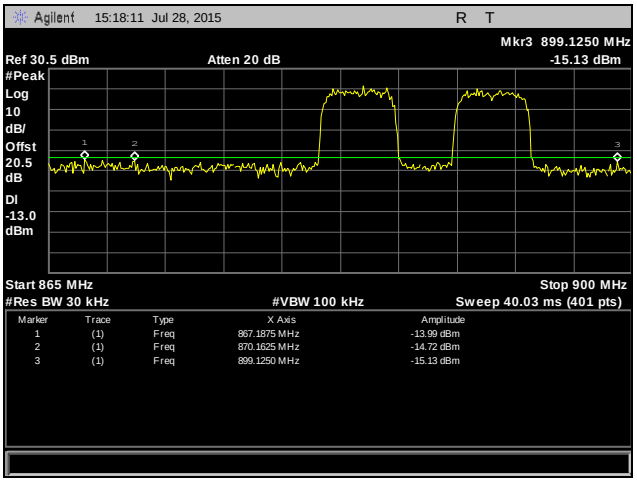

**Plot 138. Intermodulation, GSM, Low Channel, Part 22**




**Plot 139. Intermodulation, GSM, High Channel, Part 22**

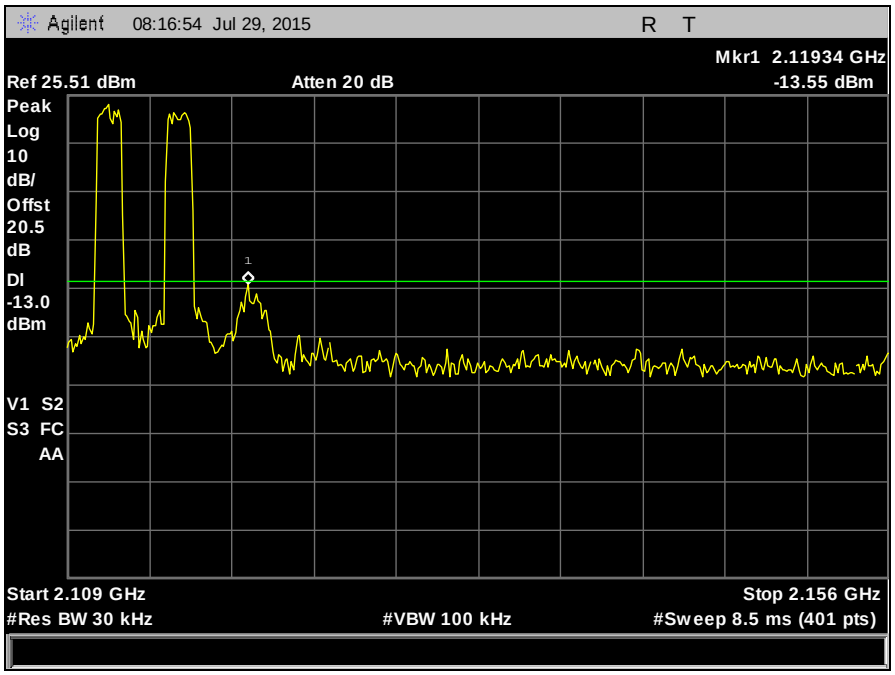



**Plot 140. Intermodulation, WCDMA, Low Channel, Part 22**

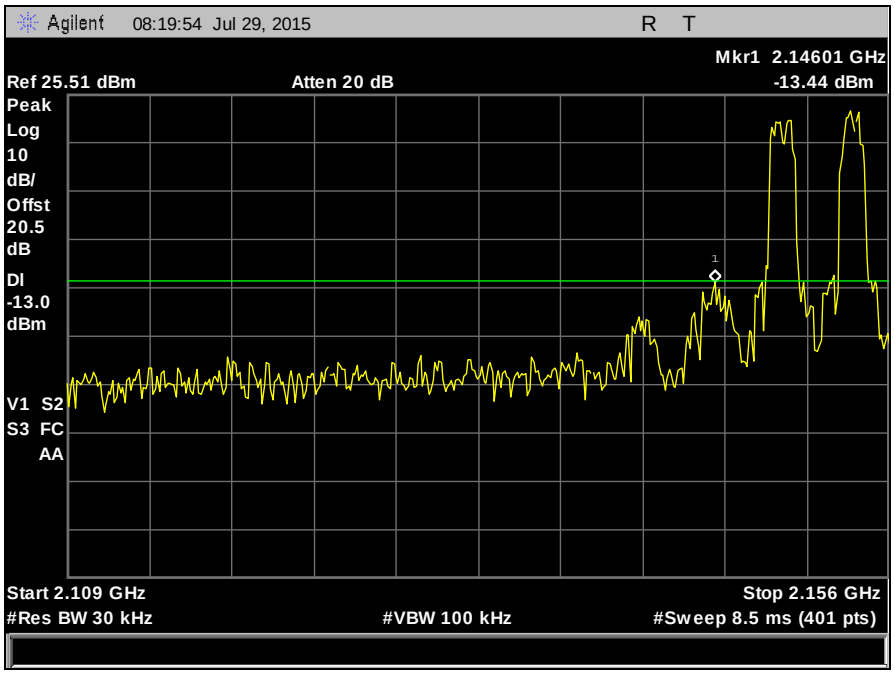



**Plot 141. Intermodulation, WCDMA, High Channel, Part 22**

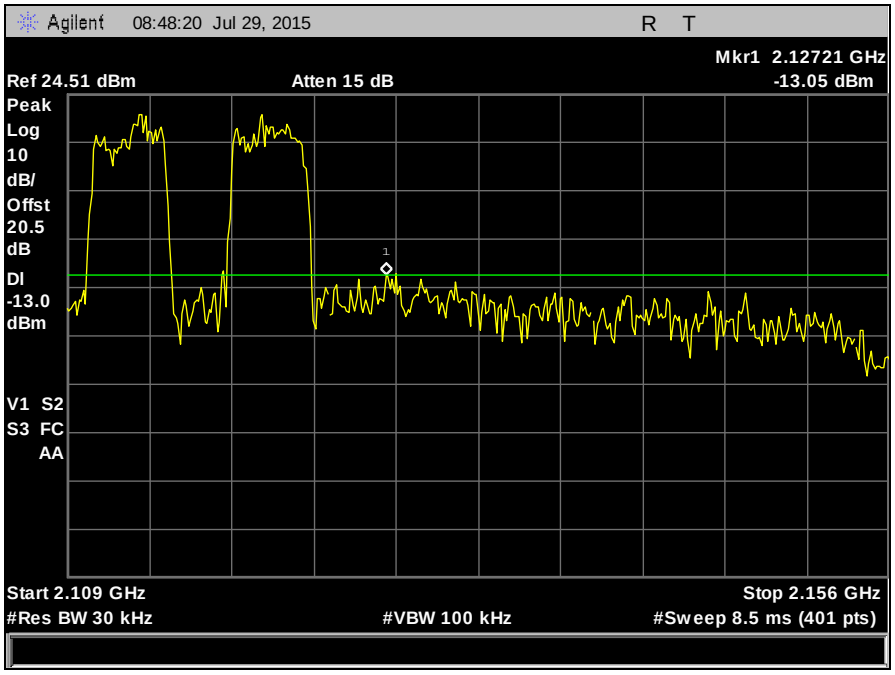
## Intermodulation, Part 27



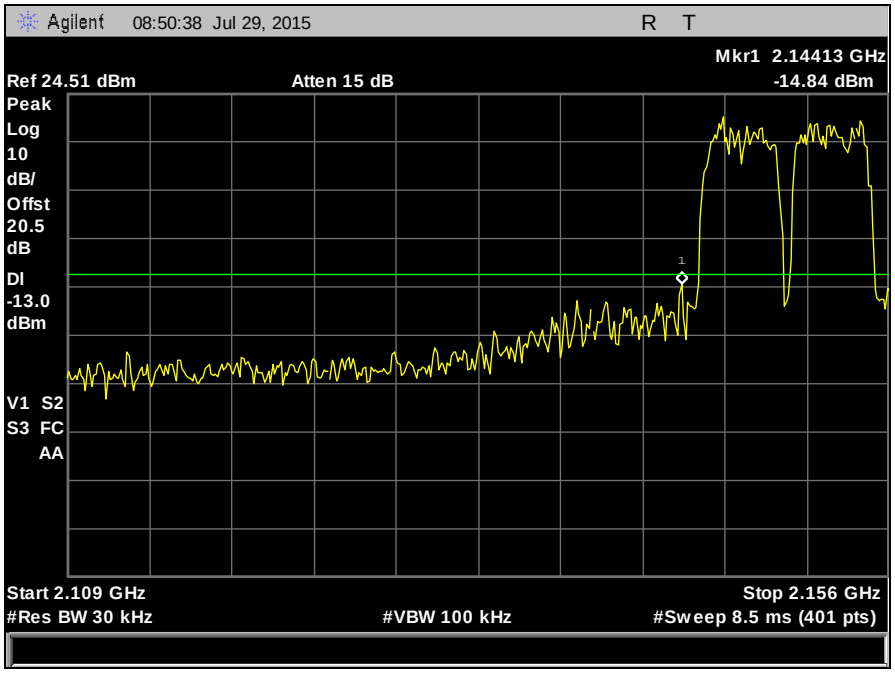

**Plot 142. Intermodulation, CDMA, Low Channel, Part 27**




**Plot 143. Intermodulation, CDMA, High Channel, Part 27**




**Plot 144. Intermodulation, WCDMA, Low Channel, Part 27**




**Plot 145. Intermodulation, WCDMA, High Channel, Part 27**

# IV. Test Equipment

## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| 1T6658 | SPECTRUM ANALYZER | AGILENT | E4407B | 11/05/2014 | 11/05/2015 |
| 1T4497 | SIGNAL GENERATOR | AGILENT TECHNOLOGIES | E4432B | 10/06/2014 | 04/06/2016 |
| 1T4483 | ANTENNA; HORN | ETS-LINDGREN | 3117 | 02/28/2014 | 08/28/2015 |
| 1T4771 | PSA SPECTRUM ANALYZER | AGILENT TECHNOLOGIES | E4446A | 11/25/2014 | 05/25/2016 |
| 1T4300B | SEMI-ANECHOIC 3M CHAMBER # 1 D (2043A-1) (IC) | EMC TEST SYSTEMS | NONE | 01/11/2015 | 01/11/2018 |
| 1T4409 | EMI RECEIVER | ROHDE & SCHWARZ | ESIB7 | 10/29/2014 | 10/29/2016 |
| 1T4751 | ANTENNA - BILOG | SUNOL SCIENCES | JB6 | 07/29/2014 | 01/29/2016 |
| 1T4149 | HIGH-FREQUENCY ANECHOIC CHAMBER | RAY-PROOF | 81 | NOT REQUIRED | |
| 1T4442 | PRE-AMPLIFIER, MICROWAVE | MITEQ | AFS42-01001800-30-10P | SEE NOTE | |
| 1T4859 | DIGITAL BAROMETER, HYGROMETER, THERMOMETER | CONTROL COMPANY | 15-078-198, FB70423, 245CD | 12/19/2013 | 12/19/2015 |

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

# End of Report