

FCC LTE/CDMA REPORT

FCC Certification

Applicant Name:
GS Instruments Co.,Ltd.

Address:
1385-14, Juan-Dong, Nam-Ku, Incheon, 402-200,
Korea

Date of Issue:

April 24, 2015

Test Site/Location:

HCT CO., LTD., 74, Seoicheon-ro 578beon-gil,
Majang-myeon, Icheon-si, Gyeonggi-do, Korea

Report No.: HCT-R-1504-F030

HCT FRN: 0005866421

FCC ID: U88-SMR-IP10-S

FCC APPLICANT: GS Instruments Co.,Ltd.

FCC Model(s): SMR-IP10-S

EUT Type: In-Building RF Repeater

Frequency Ranges: 800 MHz : Downlink : 862 MHz ~ 869 MHz
1 900 MHz: Downlink : 1 930 MHz ~ 1 995 MHz

Conducted Output Power: 0.01 W (10 dBm)

Date of Test : April 13, 2015 ~ April 21, 2015

FCC Rules Part(s): CFR 47, Part 24, Part 90

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 24, Part 90 of the FCC Rules under normal use and maintenance.



Report prepared by
: Yong Hyun Lee
Test engineer of RF Team



Approved by
: Sang Jun Lee
Manager of RF Team

This report only responds to the tested sample and may not be reproduced, except in full, without written approval of the HCT Co., Ltd.

Version

| TEST REPORT NO. | DATE | DESCRIPTION |
|-----------------|-----------------|-------------------------|
| HCT-R-1504-F030 | April 24 , 2015 | - First Approval Report |
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Table of Contents

| | |
|---|----|
| 1. CLIENT INFORMATION..... | 4 |
| 2. FACILITIES AND ACCREDITATIONS | 5 |
| 2.1. FACILITIES | 5 |
| 2.2. EQUIPMENT | 5 |
| 3. TEST SUMMARY | 6 |
| 3.1. STANDARDS | 6 |
| 3.2. MODE OF OPERATION DURING THE TEST | 7 |
| 4. STANDARDS ENVIRONMENTAL TEST CONDITIONS | 8 |
| 5. TEST EQUIPMENT | 9 |
| 6. RF OUTPUT POWER..... | 10 |
| 7. OCCUPIED BANDWIDTH..... | 13 |
| 8. OUT OF BAND REJECTION | 26 |
| 9. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL | 29 |
| 10. RADIATED SPURIOUS EMISSIONS | 59 |
| 11. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS | 62 |

1. CLIENT INFORMATION

The EUT has been tested by request of

| | |
|---------------|--|
| Company | GS Instruments Co.,Ltd. 1385-14, Juan-Dong, Nam-Ku, Incheon, 402-200, Korea |
| Contact Point | Attention: Yung-Il Kim Tel./ Fax. : +82-32-870-5621/ +82-32-876-3495 |

- **FCC ID:** U88-SMR-IP10-S
- **APPLICANT:** GS Instruments Co.,Ltd.
- **EUT Type:** In-Building RF Repeater
- **Model:** SMR-IP10-S
- **Frequency Ranges:**
800 MHz: Downlink : 862 MHz ~ 869 MHz
1900 MHz: Downlink : 1 930 MHz ~ 1 995 MHz
- **Conducted Output Power:** 0.01 W (10 dBm)
- **Antenna Gain(s) :** 800 MHz: 1.5 dBi, 1900 MHz: 3.5 dBi
- **FCC Rules Part(s):** CFR 47, Part 24, 90
- **Measurement standard(s):** ANSI/TIA-603-C-2004, KDB 971168 D01 v02r02,
KDB 935210 D03 v02r01
- **Place of Tests:** 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea.

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2003) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated February 28, 2014 (Registration Number: 90661).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

3. TEST SUMMARY

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part24 , Part 90.

| Description | Reference | Results |
|--|----------------------------|-----------|
| RF Output Power | §2.1046, §90.635 , §24.232 | Compliant |
| Occupied Bandwidth | §2.1049 | Compliant |
| Out of Band Rejection | KDB 935210 D03 v02r01 | Compliant |
| Spurious Emissions at Antenna Terminals | §2.1051, §90.691, §24.238 | Compliant |
| Radiated Spurious Emissions | §2.1053, §90.691, §24.238 | Compliant |
| Frequency Stability | §2.1055, §90.213, §24.235 | Compliant |

* Note

The EUT was operated in a manner representative of the typical usage of the equipment.

During all testing, system components were manipulated within the confines of typical usage to maximize each emission.

3.2. MODE OF OPERATION DURING THE TEST

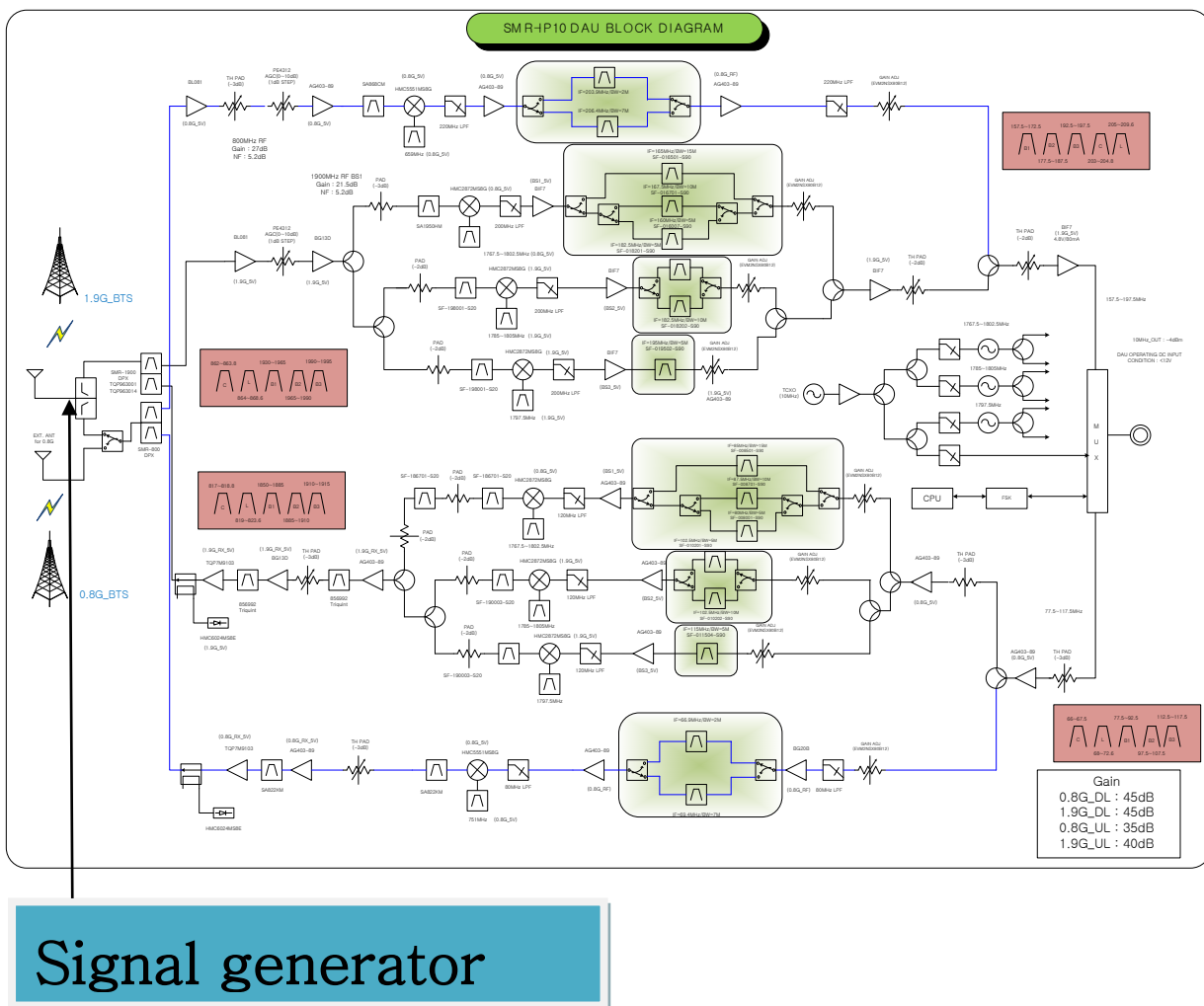
SMR-IP10 consists of DAU (Donor Antenna Unit) and SAU (Service Antenna Unit) which are connected via RG174 cable. Both DAU and SAU have built-in antenna and amplifier.

Downlink and Uplink signals in DAU are transmitted via 800/1900MHz Dual Built-in antenna from/toward Base Station. If 800MHz and 1900MHz BTS directions are different, installer may connect DAU to 800MHz external antenna for receiving and transmitting signals from 800MHz Base Station.

SMR-IP10's SAU has External Port which allows connecting external antenna to the repeater if it is necessary. SMR-IP10's flexible design allows extending network coverage in various environments.

The EUT has been tested under specific configuration for testing directly connecting to DAU (Donor Antenna Unit) into RF signals from the signal generator without the built-in antenna.

Refer to below the block diagram.



4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

| | |
|--------------------|------------------------|
| Temperature : | + 15 °C to + 35 °C |
| Relative humidity: | 30 % to 60 % |
| Air pressure | 860 mbar to 1 060 mbar |

5. TEST EQUIPMENT

| Manufacturer | Model / Equipment | Cal Interval | Calibration Date | Serial No. |
|--------------------|---|--------------|------------------|----------------|
| Agilent | E4438C /Signal Generator | Annual | 09/11/2014 | MY42082646 |
| Agilent | N5182A /Signal Generator | Annual | 05/22/2014 | MY47070230 |
| Agilent | N1911A /Power Meter | Annual | 01/15/2015 | MY45100523 |
| Agilent | N1921A/ Power Sensor | Annual | 07/09/2014 | MY45241059 |
| NANGYEUL CO., LTD. | NY-THR18750/ Temperature and Humidity Chamber | Annual | 10/29/2014 | NY-2009012201A |
| Agilent | N9020A /Signal Analyzer | Annual | 04/10/2015 | US46220219 |
| Weinschel | 2-10 / Fixed Attenuator | Annual | 11/12/2014 | BR0554 |
| Weinschel | AF9003-69-31 / Step Attenuator | Annual | 10/24/2014 | 11787 |
| HD | MA240/ Antenna Position Tower | N/A | N/A | 556 |
| EMCO | 1050/ Turn Table | N/A | N/A | 114 |
| HD GmbH | HD 100/ Controller | N/A | N/A | 13 |
| HD GmbH | KMS 560/ SlideBar | N/A | N/A | 12 |
| MITEQ | AMF-6D-001180-35-20P/AMP | Annual | 09/04/2014 | 1081666 |
| Schwarzbeck | BBHA 9120D/ Horn Antenna | Biennial | 07/05/2013 | 1151 |
| Schwarzbeck | BBHA 9120D/ Horn Antenna | Biennial | 09/01/2014 | 147 |
| Schwarzbeck | VULB 9160/TRILOG Antenna | Biennial | 11/17/2014 | 3150 |

6. RF OUTPUT POWER

FCC Rules

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.

§ 24.232 Power and antenna height limits. (a) Base stations are limited to 1640 watts peak equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below. See §24.53 for HAAT calculation method. Base station antenna heights may exceed 300 meters with a corresponding reduction in power; see Table 1 of this section.

The service area boundary limit and microwave protection criteria specified in §24.236 and §24.237 apply.

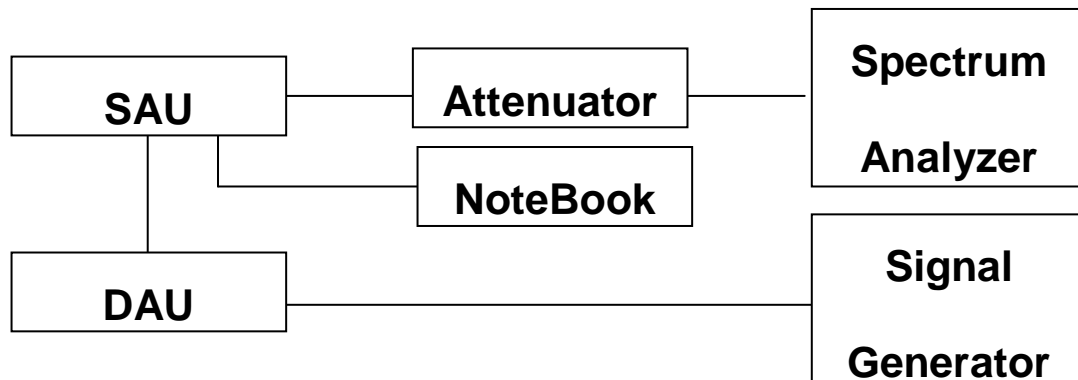
§ 90.635 Limitations on power and antenna height. (a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

| | |
|--|---|
| Antenna height (AAT) in meters (feet) | Effective radiated power (watts) |
|--|---|

| | |
|----------------------------------|------|
| Above 1372 (4500) | 65 |
| Above 1220 (4000) To 1372 (4500) | 70 |
| Above 1067 (3500) To 1220 (4000) | 75 |
| Above 915 (3000) To 1067 (3500) | 100 |
| Above 763 (2500) To 915 (3000) | 140 |
| Above 610 (2000) To 763 (2500) | 200 |
| Above 458 (1500) To 610 (2000) | 350 |
| Above 305 (1000) To 458 (1500) | 600 |
| Up to 305 (1000) | 1000 |

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. This test was performed in all applicable modulations.



Block Diagram 1. RF Power Output Test Setup

Test Results:

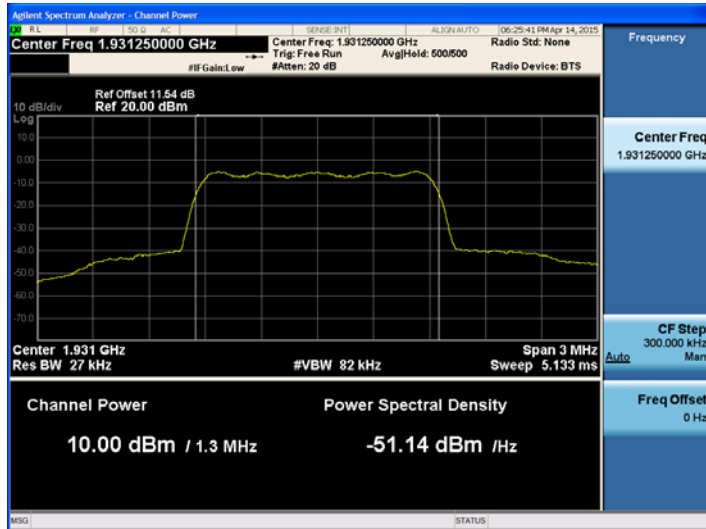
| Input Signal | Input Level (dBm) | Maximum Amp Gain |
|--|-------------------|------------------|
| CDMA CDMA EVDO LTE 5 MHz LTE + CMDA | DL : -65 dBm | DL : 75 dB |

– 1900 MHz band

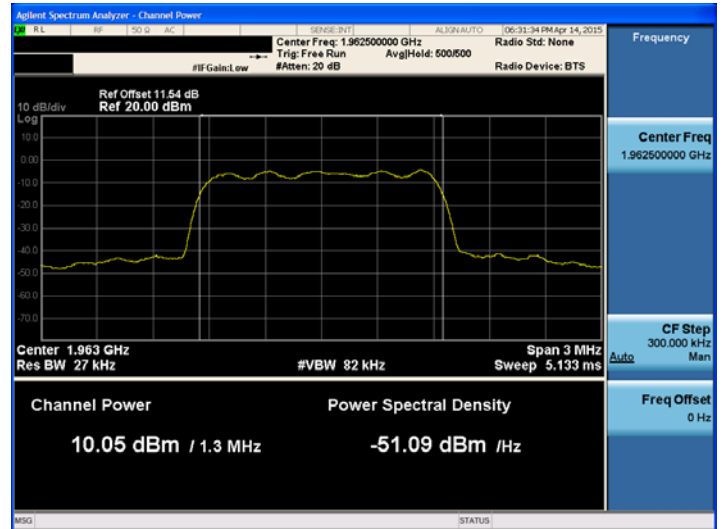
| | | Frequency (MHz) | Output Power | |
|--------------|--------|--------------------|--------------|---------|
| | | | (dBm) | (W) |
| CDMA | Low | 1931.25 | 10.00 | 0.01000 |
| | Middle | 1962.50 | 10.05 | 0.01011 |
| | High | 1993.75 | 10.00 | 0.00999 |
| CDMA EVDO | Low | 1931.25 | 9.98 | 0.00995 |
| | Middle | 1962.50 | 9.99 | 0.00998 |
| | High | 1993.75 | 9.98 | 0.00995 |
| LTE 5 MHz | Low | 1932.50 | 10.00 | 0.00999 |
| | Middle | 1962.50 | 10.00 | 0.01000 |
| | High | 1992.50 | 10.01 | 0.01003 |

TEST Plot for 1900 MHz band RF Output Power
CDMA Downlink

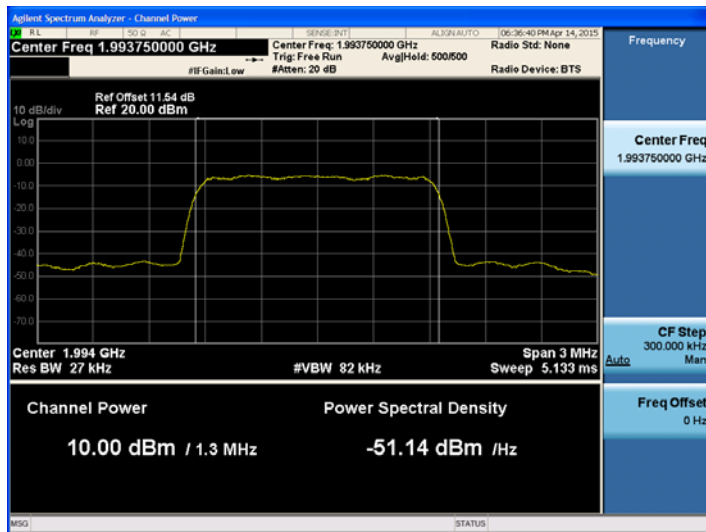
1900 MHz band CDMA Downlink Low



1900 MHz band CDMA Downlink Mid

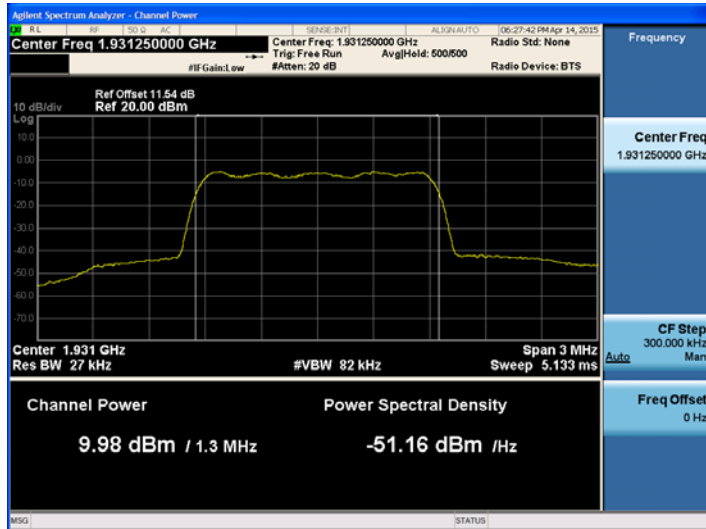


1900 MHz band CDMA Downlink High

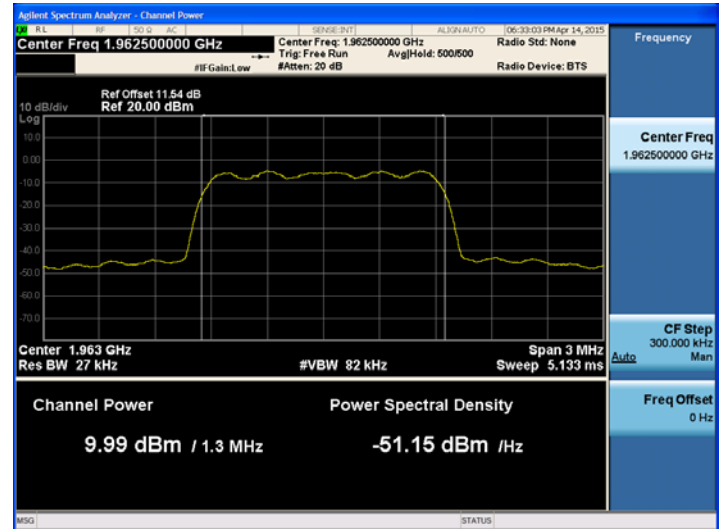


TEST Plot for 1900 MHz band RF Output Power
CDMA EVDO Downlink

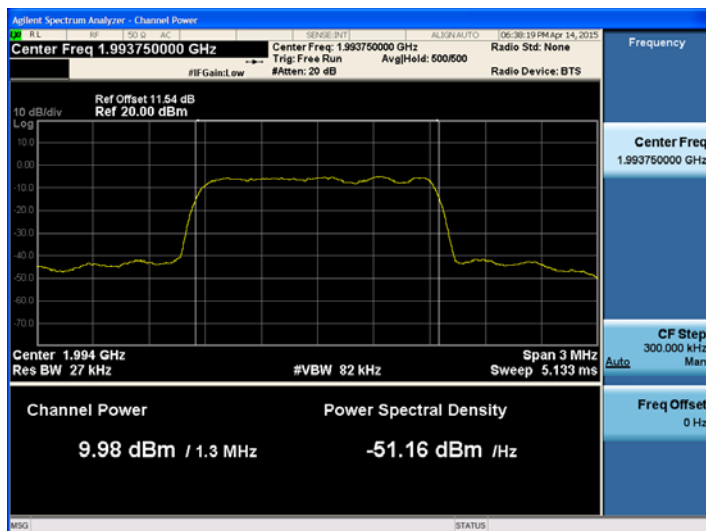
1900 MHz band CDMA EVDO Downlink Low



1900 MHz band CDMA EVDO Downlink Mid

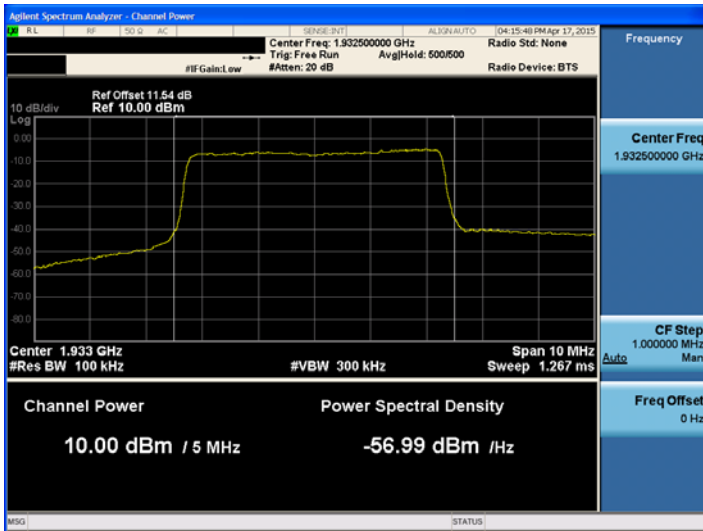


1900 MHz band CDMA EVDO Downlink High

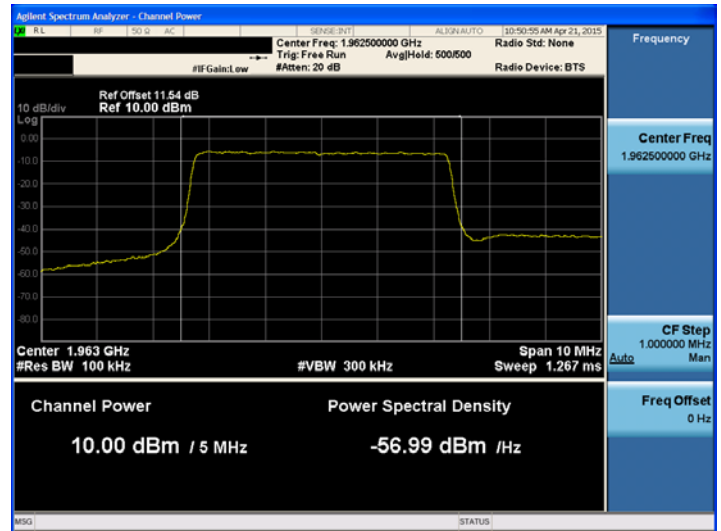


TEST Plot for 1900 MHz band RF Output Power
LTE 5MHz Downlink

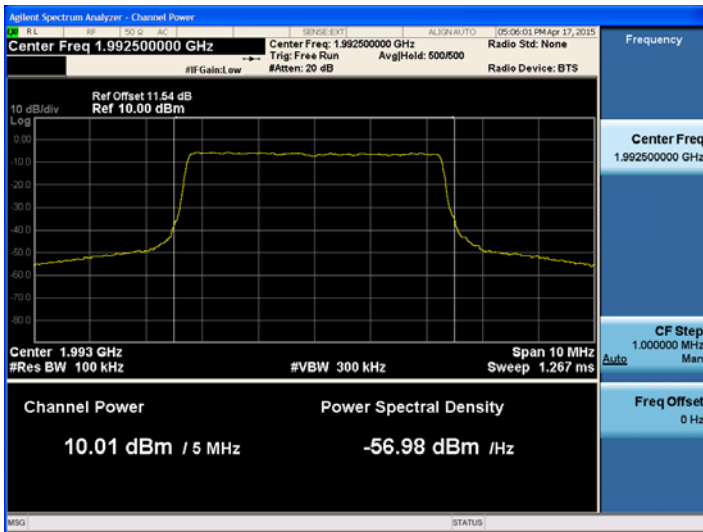
1900 MHz band LTE 5MHz Downlink Low



1900 MHz band LTE 5MHz Downlink Mid



1900 MHz band LTE 5MHz Downlink High



– 800 MHz band

| | Frequency (MHz) | Output Power | |
|----------------|--------------------|--------------|----------|
| | | (dBm) | (W) |
| CDMA | 863.00 | 9.997 | 0.009993 |
| LTE 5 MHz | 866.50 | 10.021 | 0.01005 |
| CDMA+ LTE 5MHz | 865.50 | 10.027 | 0.01006 |

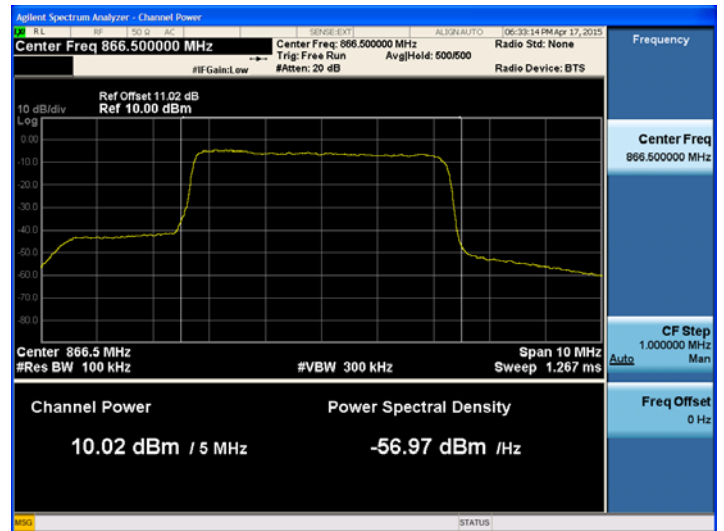
■ TEST Plot for 800 MHz band RF Output Power

Downlink

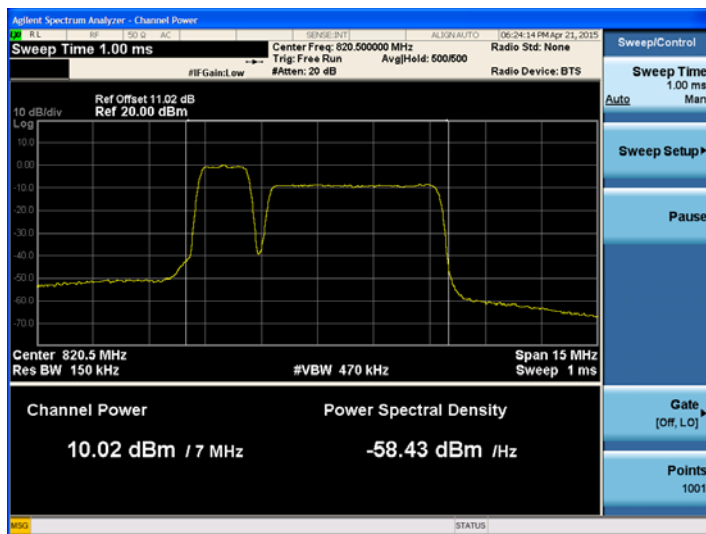
800 MHz band CDMA Downlink



800 MHz band LTE 5MHz Downlink



800 MHz band CDMA+LTE 5MHz Downlink



7.OCCUPIED BANDWIDTH

FCC Rules

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 with a Spectrum Analyzer connected to the RF ports for both Downlink and Downlink. The modulation characteristics of signal generator's carrier was measured first at a maximum RF level prescribed by the OEM. The signal generator was then connected to either the Downlink or Downlink input at the appropriate RF level. The resulting modulated signal through the EUT was measured and compared against the original signal.

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

| Input Signal | Input Level (dBm) | Maximum Amp Gain |
|--|-------------------|------------------|
| CDMA CDMA EVDO LTE 5 MHz LTE + CMDA | DL : -65 dBm | DL : 75 dB |

– 1900 MHz band

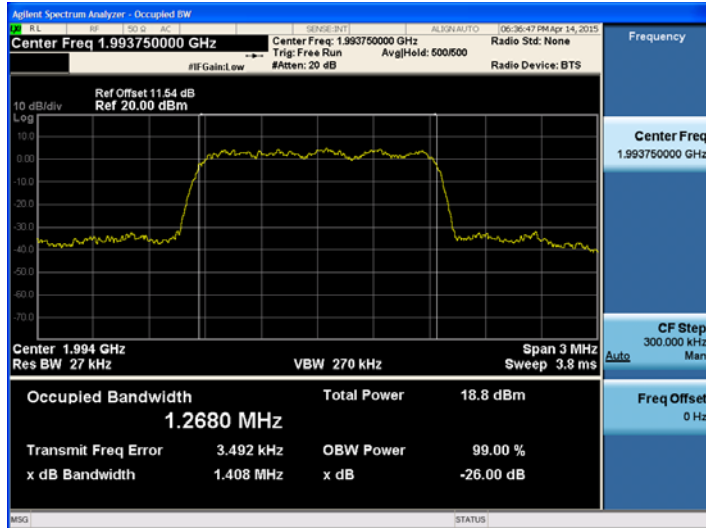
[Downlink Output]

| | | Frequency (MHz) | OBW (MHz) |
|--------------|--------|--------------------|--------------|
| CDMA | Low | 1931.25 | 1.264 |
| | Middle | 1962.50 | 1.258 |
| | High | 1993.75 | 1.268 |
| CDMA EVDO | Low | 1931.25 | 1.262 |
| | Middle | 1962.50 | 1.261 |
| | High | 1993.75 | 1.259 |
| LTE 5 MHz | Low | 1932.50 | 4.498 |
| | Middle | 1962.50 | 4.514 |
| | High | 1992.50 | 4.517 |

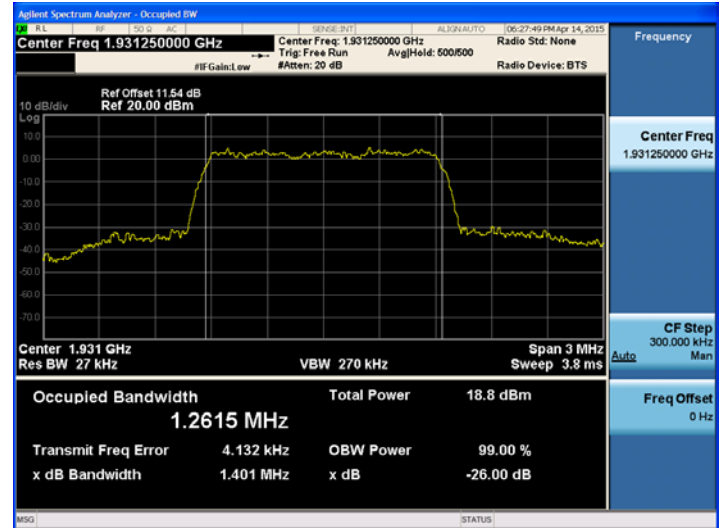
■ TEST Plot for 1900 MHz band OCCUPIED BANDWIDTH

[Downlink Output]

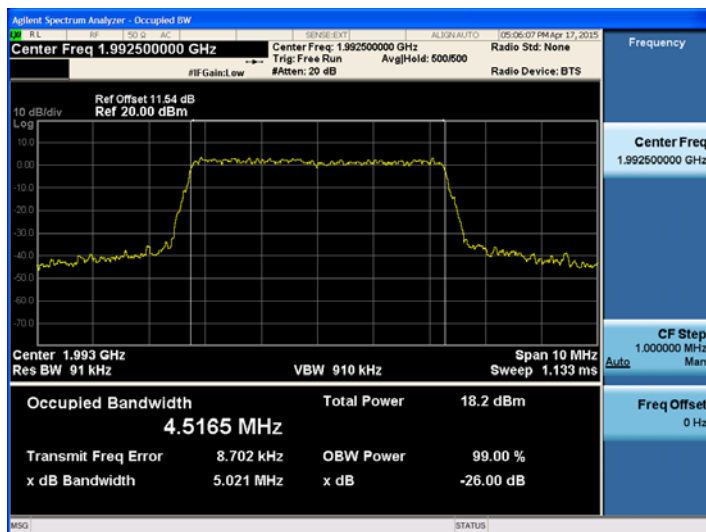
1900 MHz band CDMA Downlink Output



1900 MHz band CDMA EVDO Downlink Output



1900 MHz band LTE 5MHz Downlink Output



1900 MHz band OCCUPIED BANDWIDTH

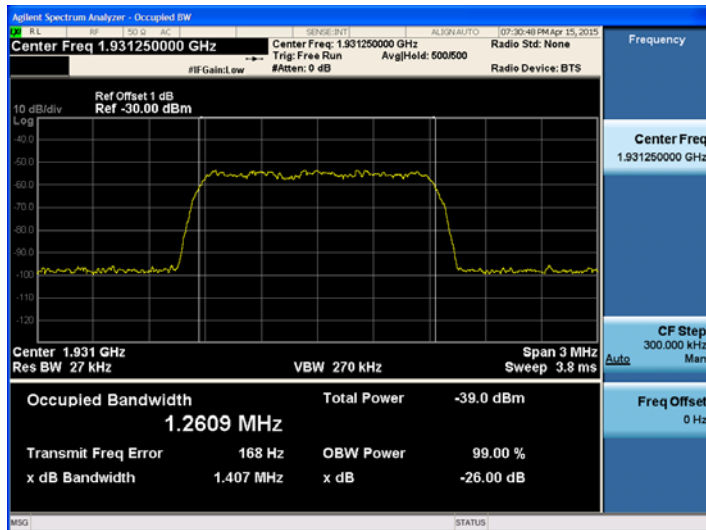
[Downlink Input]

| | | Frequency (MHz) | OBW (MHz) |
|--------------|--------|--------------------|--------------|
| CDMA | Low | 1931.25 | 1.263 |
| | Middle | 1962.50 | 1.261 |
| | High | 1993.75 | 1.263 |
| CDMA EVDO | Low | 1931.25 | 1.262 |
| | Middle | 1962.50 | 1.259 |
| | High | 1993.75 | 1.268 |
| LTE 5 MHz | Low | 1932.50 | 4.513 |
| | Middle | 1962.50 | 4.517 |
| | High | 1992.50 | 4.509 |

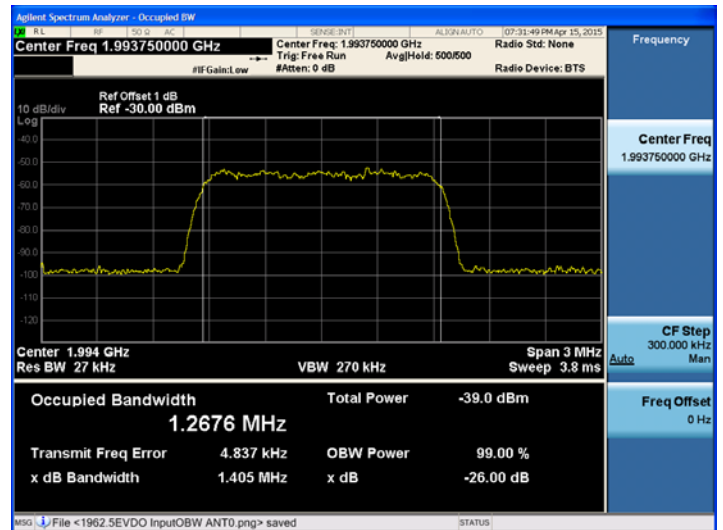
■ TEST Plot for 1900 MHz band OCCUPIED BANDWIDTH

[Downlink Input]

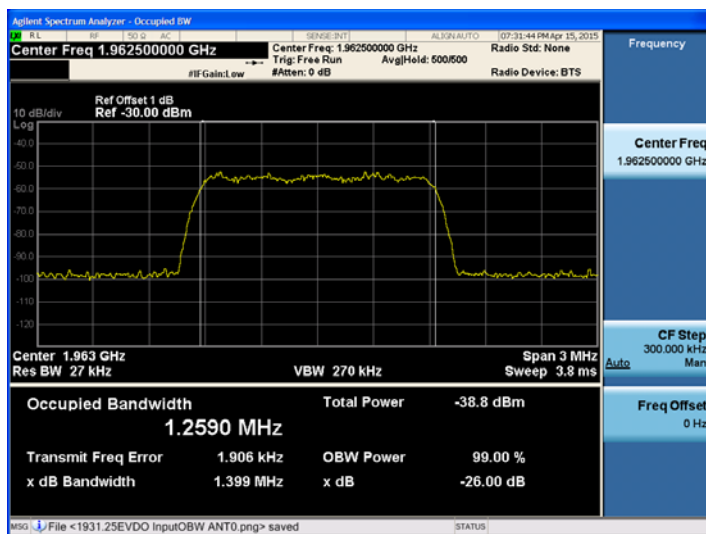
1900 MHz band CDMA Downlink Input



1900 MHz band CDMA EVDO Downlink Input



1900 MHz band LTE 5MHz Downlink Input



800 MHz band OCCUPIED BANDWIDTH

[Downlink Output]

| | Frequency (MHz) | OBW (MHz) |
|----------------|--------------------|-----------|
| CDMA | 863.00 | 1.268 |
| LTE 5 MHz | 866.50 | 4.463 |
| CDMA+ LTE 5MHz | 865.50 | 6.305 |

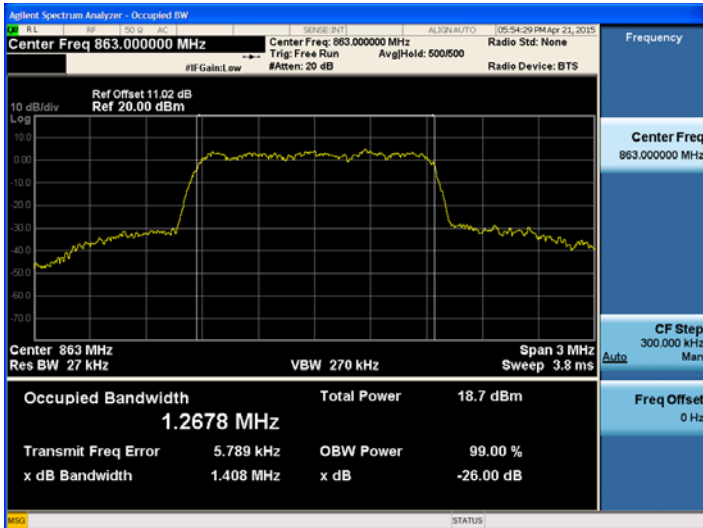
[Downlink Input]

| | Frequency (MHz) | OBW (MHz) |
|----------------|--------------------|-----------|
| CDMA | 863.00 | 1.267 |
| LTE 5 MHz | 866.50 | 4.509 |
| CDMA+ LTE 5MHz | 865.50 | 6.395 |

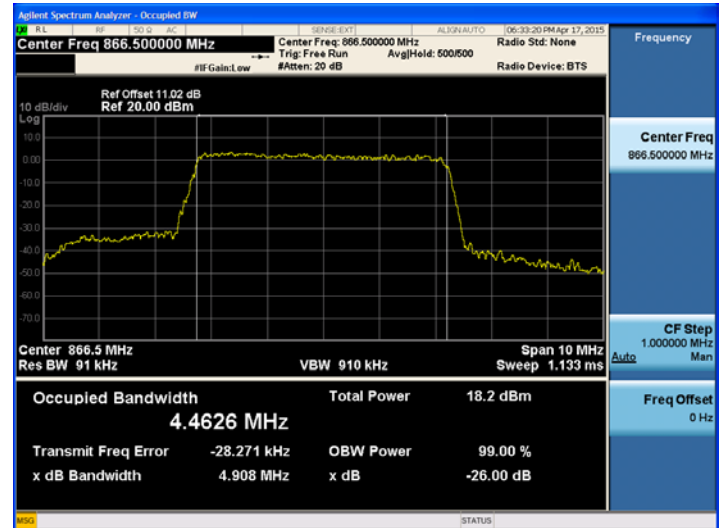
■ TEST Plot for 800 MHz band OCCUPIED BANDWIDTH

[Downlink Output]

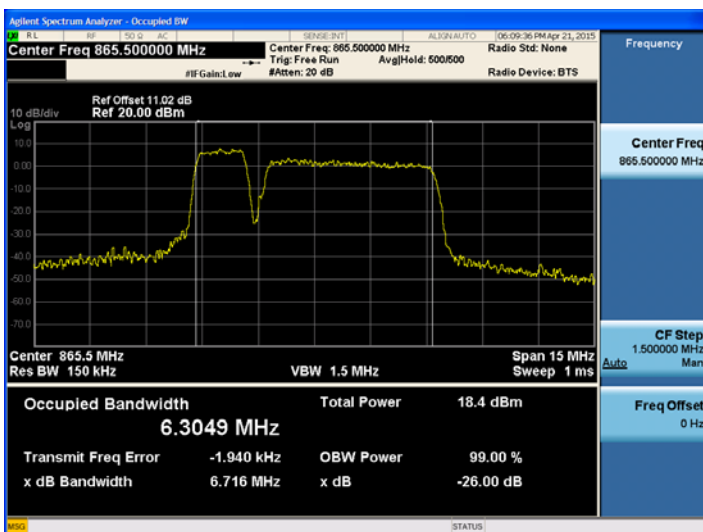
800 MHz band CDMA Downlink Output



800 MHz band LTE 5MHz Downlink Output

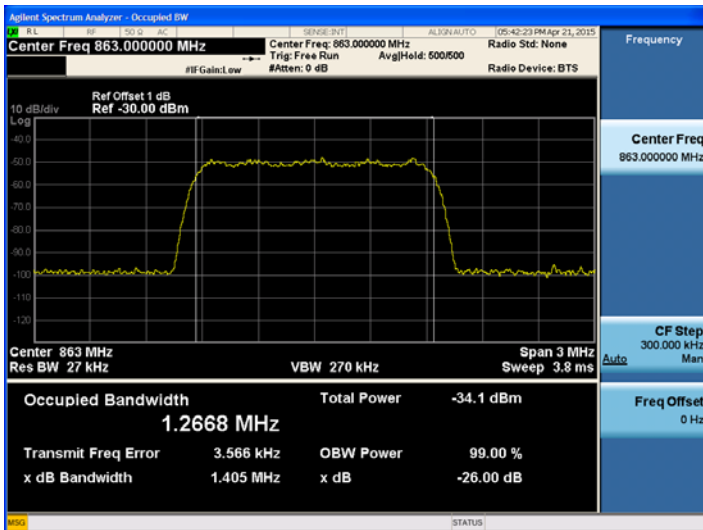


800 MHz band CDMA+LTE 5MHz Downlink Output

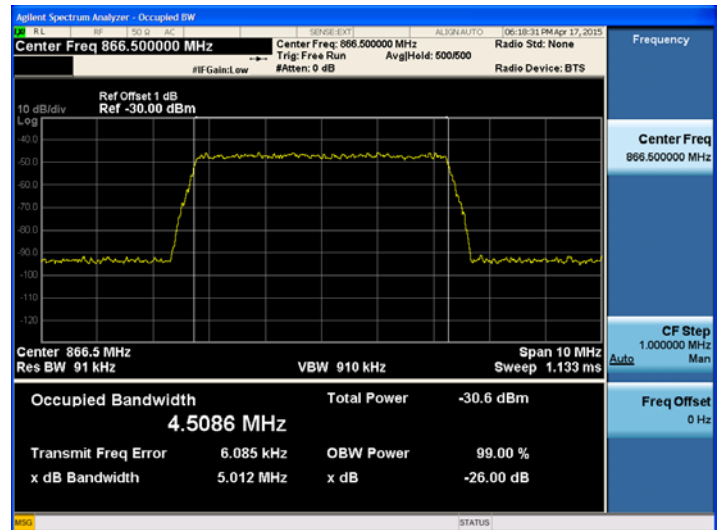


[Downlink Input]

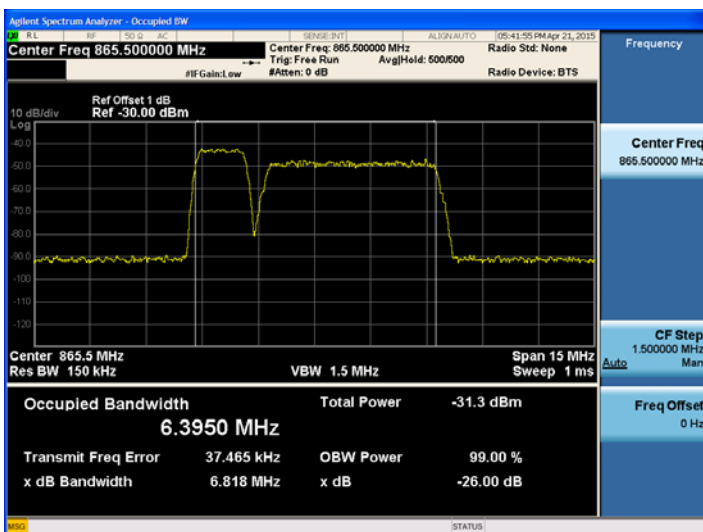
800 MHz band CDMA Downlink Input



800 MHz band LTE 5MHz Downlink Input



800 MHz band CDMA+LTE 5MHz Downlink Input



8. OUT OF BAND REJECTION

FCC Rules

Test Requirement(s): KDB 935210 D03 v02r01

Out of Band Rejection – Test for rejection of out of band signals. Filter freq. response plots are acceptable.

Test Procedures: A modulated carrier generated by the signal generator carrier was connected to either the Downlink or Downlink RF port at a maximum level as determined by the spectrum analyzer was connected to either the Downlink or Downlink port depending on the circuitry being measured. Signal generator sweep from the frequency more lower than the operating frequency to the frequency more higher than it, find the product band filter characteristic

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

| Input Signal | Input Level (dBm) | Maximum Amp Gain |
|--------------|-------------------|------------------|
| Sinusoidal | DL : -65 dBm | DL : 75 dB |

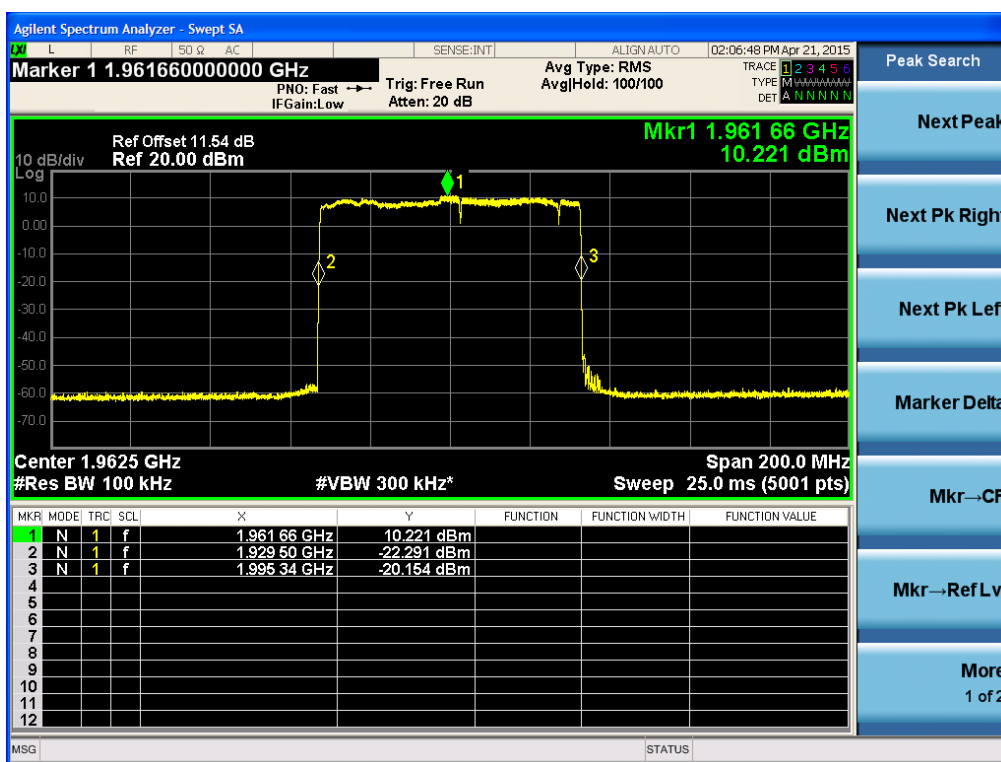
1900 MHz band

[Downlink]

| 20 dB point frequency (MHz) | Output power (dBm) | Gain (dB) |
|-----------------------------------|-----------------------|-----------|
| 1929.50~1995.34 | 10.22 | 75.22 |

Plots of Out of Band Rejection

[Downlink]



800 MHz band

[Downlink]

| 20 dB point frequency (MHz) | Output power (dBm) | Gain (dB) |
|-----------------------------------|-----------------------|-----------|
| 861.482 ~ 869.105 | 10.05 | 75.05 |

