

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-F029

HCT FRN: 0005866421

FCC ID: U88-SMR-IP10-D

FCC APPLICANT: GS Instruments Co.,Ltd.

FCC Model(s): SMR-IP10-D

EUT Type: In-Building RF Repeater

Frequency Ranges: 800 MHz : Uplink : 817 MHz ~ 824 MHz
1 900 MHz: Uplink : 1 850 MHz ~ 1 915 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

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1504-F029	April 24 , 2015	- First Approval Report

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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-D
- **APPLICANT:** GS Instruments Co.,Ltd.
- **EUT Type:** In-Building RF Repeater
- **Model:** SMR-IP10-D
- **Frequency Ranges:**
800 MHz: Uplink : 817 MHz ~ 824 MHz
1900 MHz: Uplink : 1 850 MHz ~ 1 915 MHz
- **Conducted Output Power:** 0.01 W (10 dBm)
- **Antenna Gain(s) :** 800 MHz: 7 dBi, 1900 MHz: 9 dBi
- **FCC Rules Part(s):** CFR 47, Part 24, Part 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 Part 24 , 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

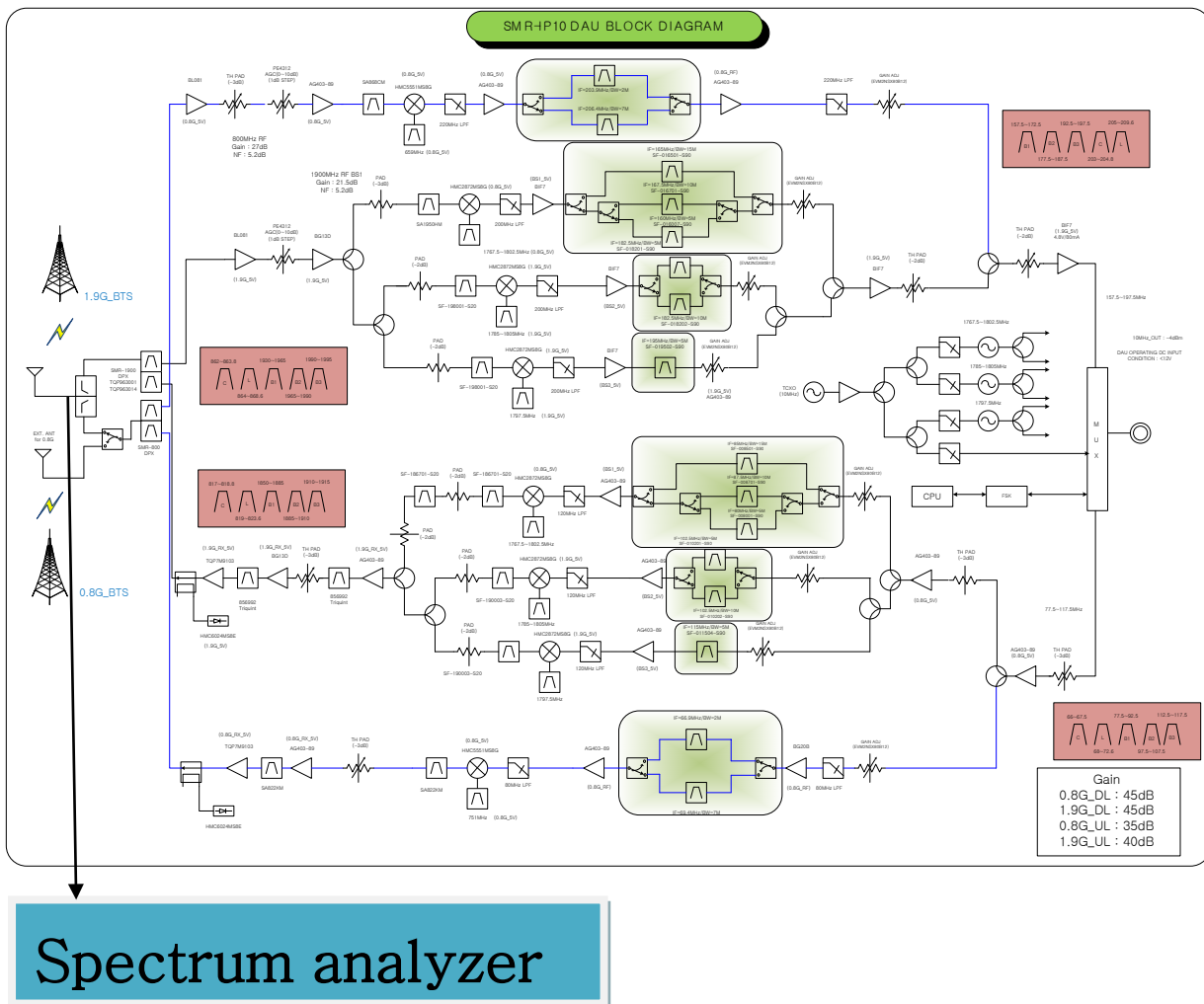
SMR-IP10 consists of DAU (Donor Antenna Unit) and SAU (Service Antenna Unit) which are connected via RG174 cable. Both DAU and SAU have built-in antenna and amplifier.

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 the spectrum analyzer without the built-in antenna.

Refer to below the block diagram.



4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	+ 15 °C to + 35
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.

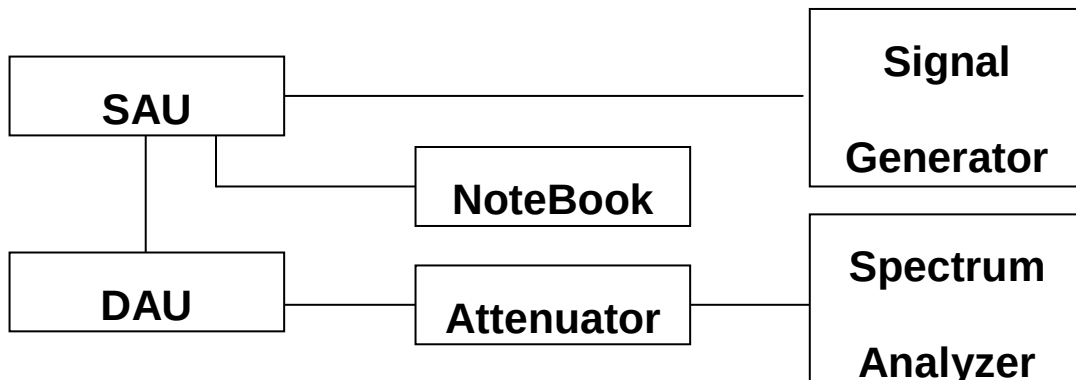
§ 90.635 Limitations on power and antenna height. (a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values,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

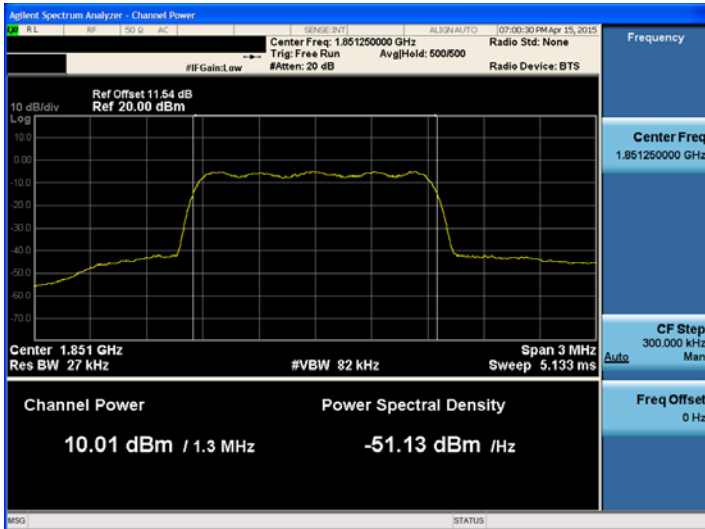
Input Signal	Input Level (dBm)	Maximum Amp Gain
CDMA CDMA EVDO LTE 5 MHz LTE + CMDA	UL : -65 dBm	75 dB

– 1900 MHz Band Output Power

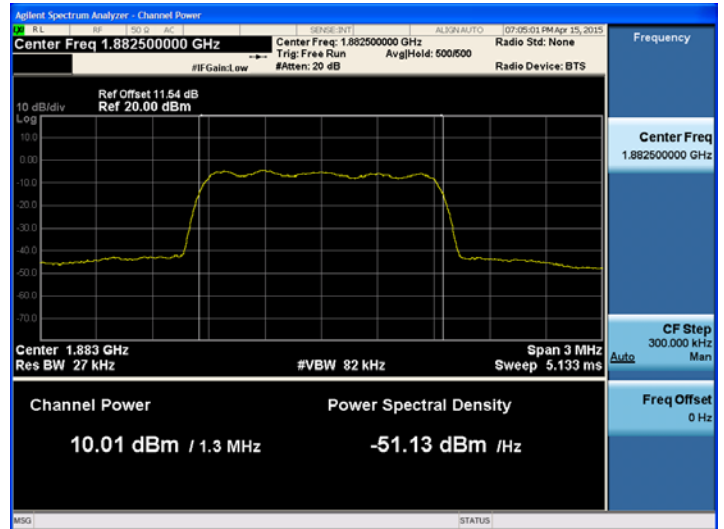
		Frequency (MHz)	Output Power	
			(dBm)	(W)
CDMA	Low	1851.25	10.010	0.010020
	Middle	1882.50	10.010	0.010030
	High	1913.75	10.000	0.009990
CDMA EVDO	Low	1851.25	9.993	0.009980
	Middle	1882.50	9.999	0.010000
	High	1913.75	9.990	0.009980
LTE 5 MHz	Low	1852.50	10.008	0.01002
	Middle	1882.50	10.007	0.01002
	High	1912.50	10.033	0.01008

TEST Plot for 1900 MHz band RF Output Power
CDMA Uplink

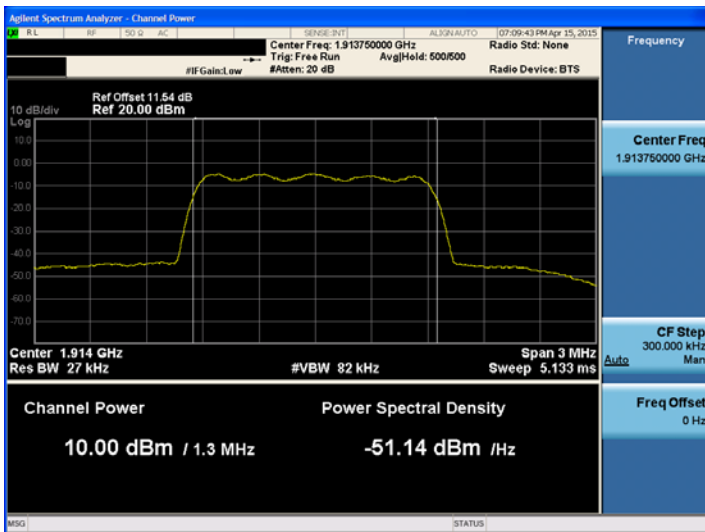
1900 MHz band CDMA Uplink Low



1900 MHz band CDMA Uplink Mid

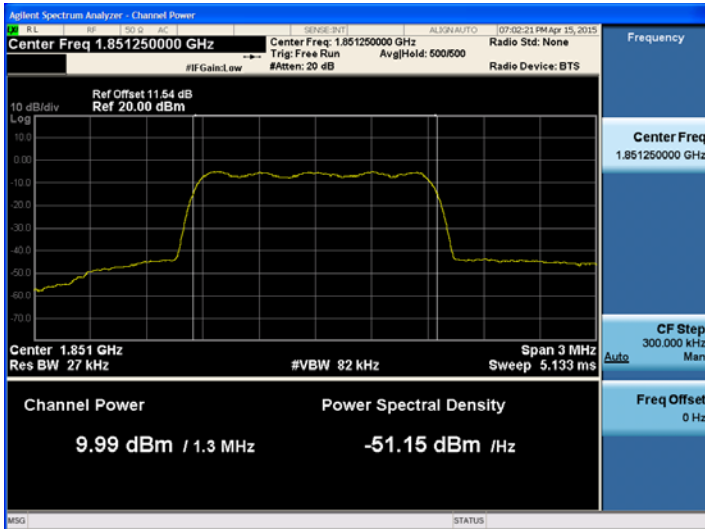


1900 MHz band CDMA Uplink High

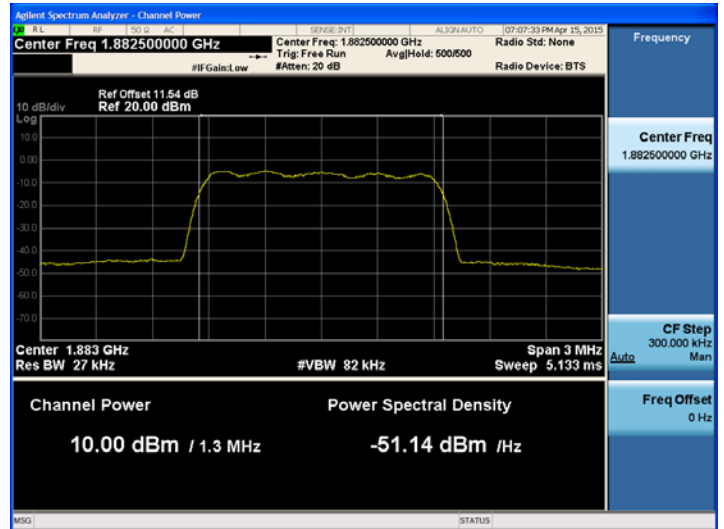


TEST Plot for 1900 MHz band RF Output Power
CDMA EVDO Uplink

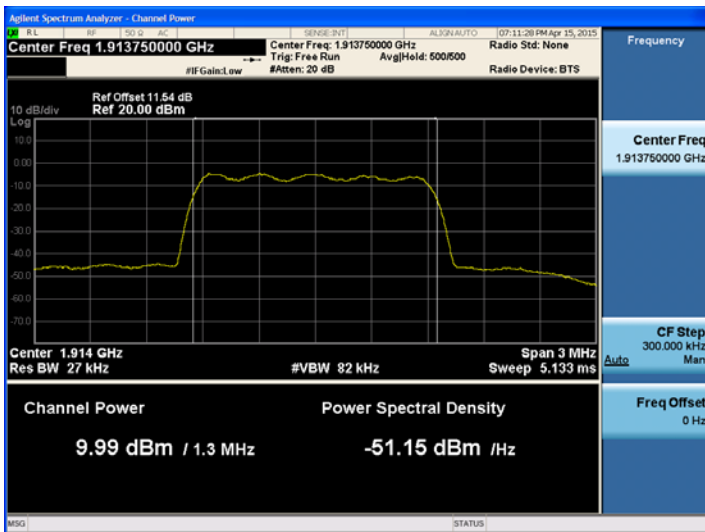
1900 MHz band CDMA EVDO Uplink Low



1900 MHz band CDMA EVDO Uplink Mid



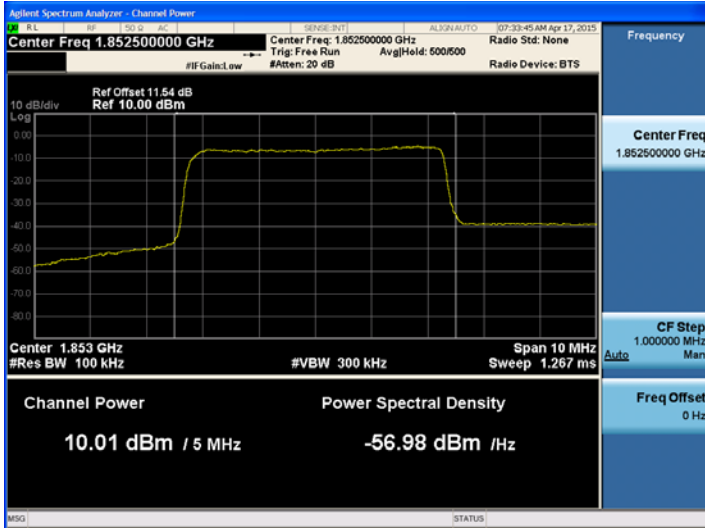
1900 MHz band CDMA EVDO Uplink High



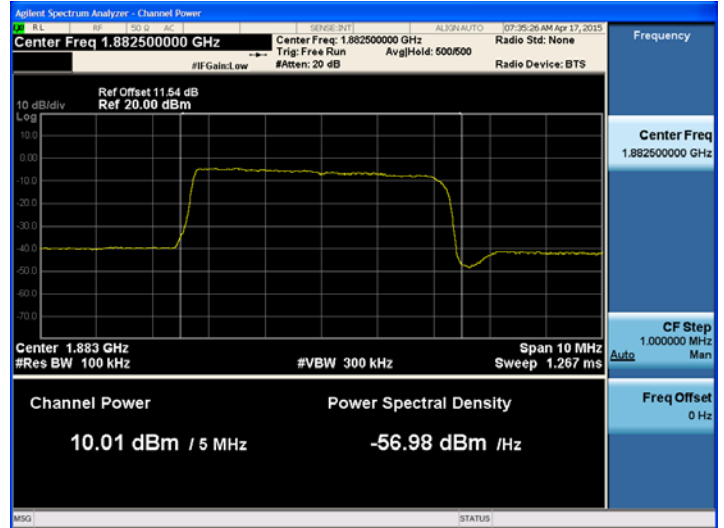
TEST Plot for 1900 MHz band RF Output Power

LTE 5MHz Uplink

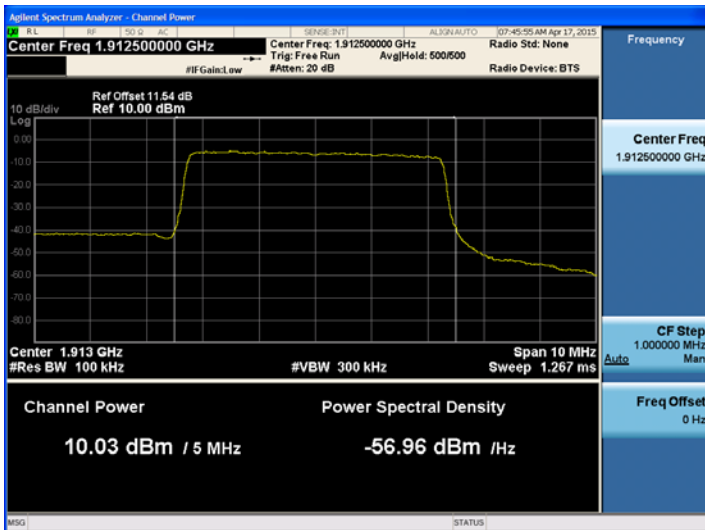
1900 MHz band LTE 5MHz Uplink Low



1900 MHz band LTE 5MHz Uplink Mid



1900 MHz band LTE 5MHz Uplink High



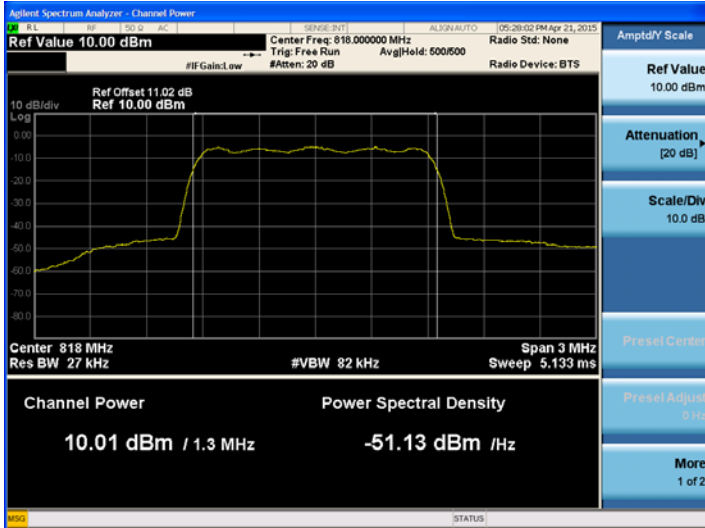
- 800 MHz band RF Output Power

	Frequency (MHz)	Output Power	
		(dBm)	(W)
CDMA	818.00	10.010	0.010021
LTE 5 MHz	821.50	10.006	0.01001
CDMA+ LTE 5MHz	820.50	10.021	0.01005

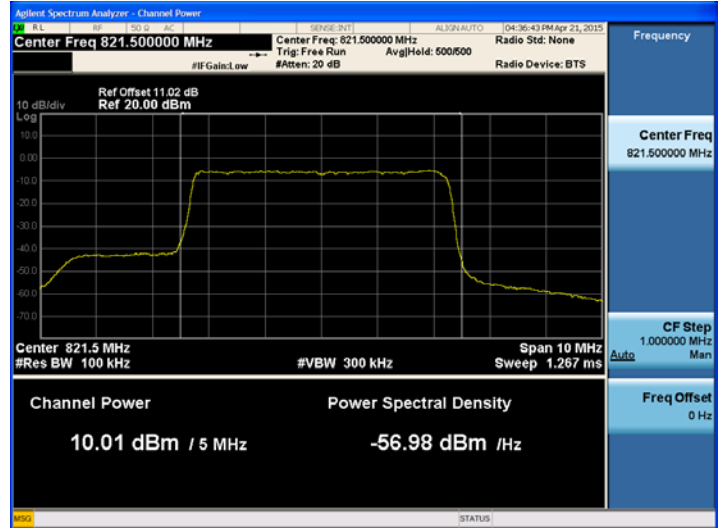
■ TEST Plot for 800 MHz band RF Output Power

Uplink

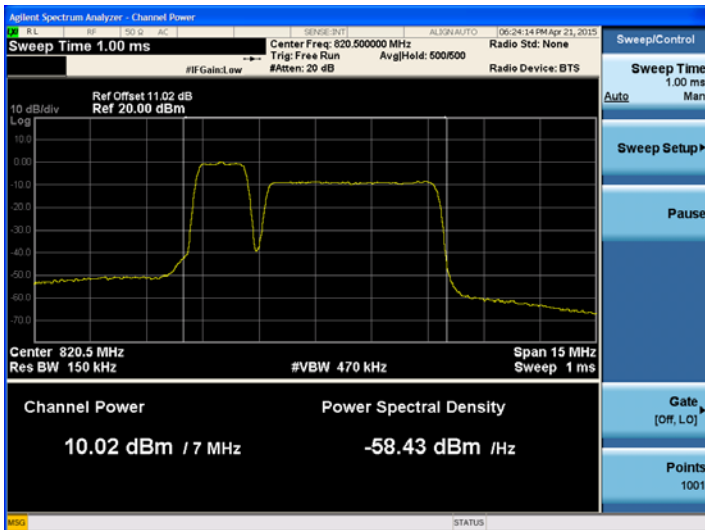
800 MHz band CDMA Uplink



800 MHz band LTE 5MHz Uplink



800 MHz band CDMA+LTE 5MHz Uplink



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 Uplink 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 Uplink 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	UL : -65 dBm	75 dB

– 1900 MHz band OCCUPIED BANDWIDTH

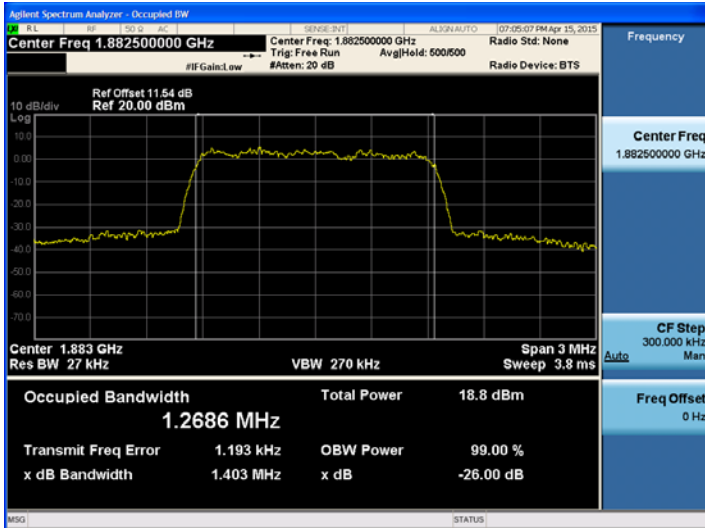
[Uplink Output]

		Frequency (MHz)	OBW (MHz)
CDMA	Low	1851.25	1.263
	Middle	1882.50	1.269
	High	1913.75	1.258
CDMA EVDO	Low	1851.25	1.261
	Middle	1882.50	1.260
	High	1913.75	1.259
LTE 5 MHz	Low	1852.50	4.478
	Middle	1882.50	4.435
	High	1912.50	4.490

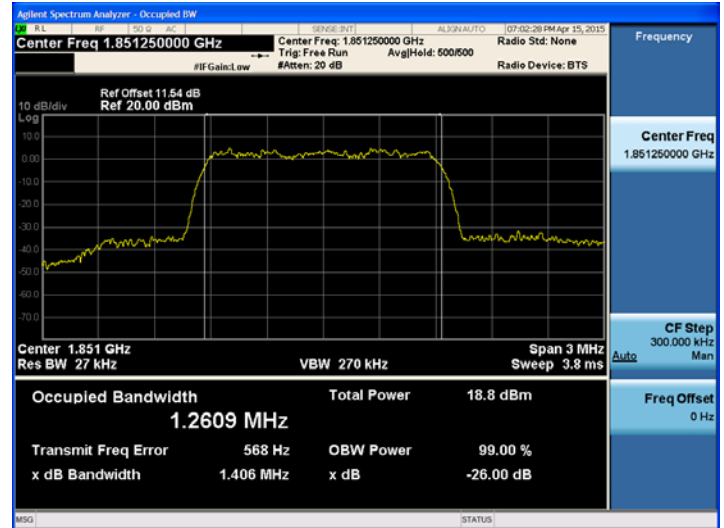
■ TEST Plot for 1900 MHz band OCCUPIED BANDWIDTH

[Uplink Output]

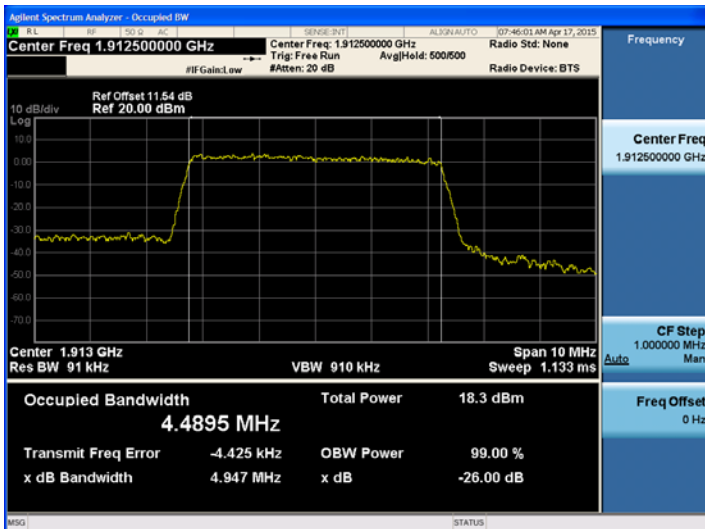
1900 MHz band CDMA Uplink Output



1900 MHz band CDMA EVDO Uplink Output



1900 MHz band LTE 5MHz Uplink Output



1900 MHz band OCCUPIED BANDWIDTH

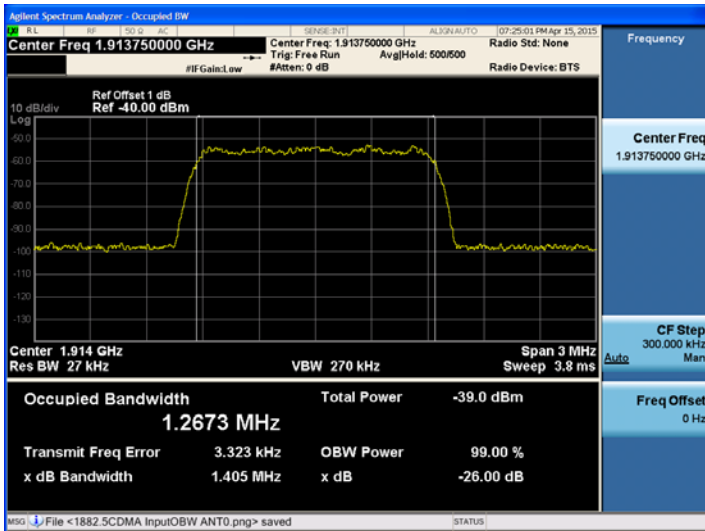
[Uplink Input]

		Frequency (MHz)	OBW (MHz)
CDMA	Low	1851.25	1.264
	Middle	1882.50	1.267
	High	1913.75	1.267
CDMA EVDO	Low	1851.25	1.262
	Middle	1882.50	1.264
	High	1913.75	1.261
LTE 5 MHz	Low	1852.50	4.507
	Middle	1882.50	4.515
	High	1912.50	4.520

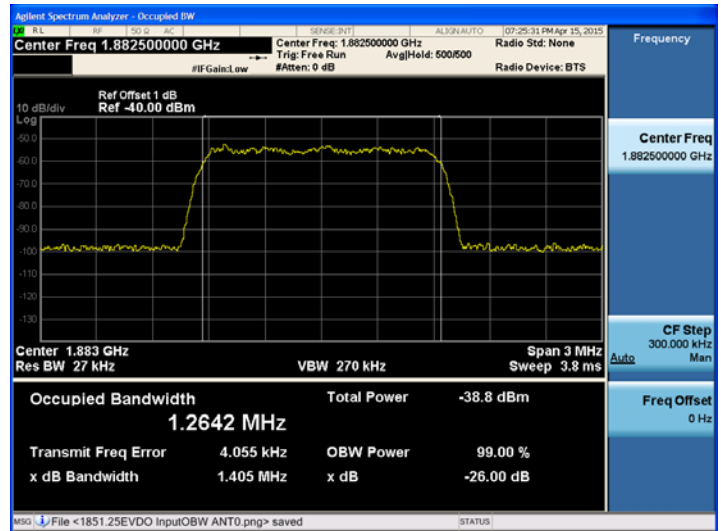
1900 MHz band OCCUPIED BANDWIDTH

[Uplink Input]

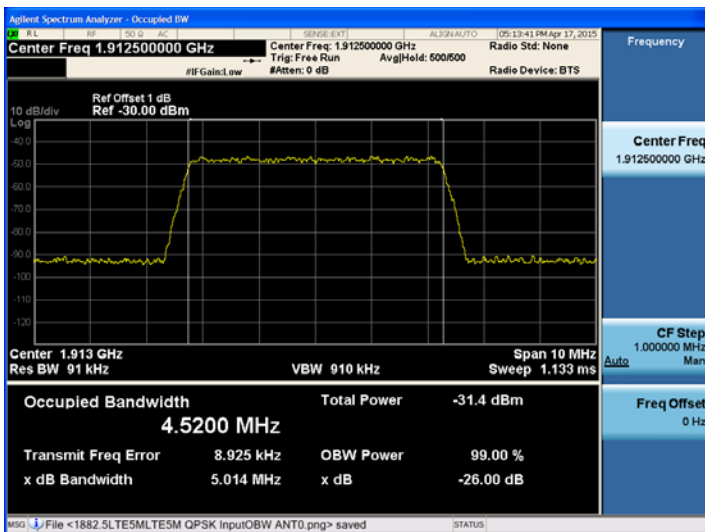
1900 MHz band CDMA Uplink Input



1900 MHz band CDMA EVDO Uplink Input



1900 MHz band LTE 5MHz Uplink Input



800 MHz band OCCUPIED BANDWIDTH

[Uplink Output]

	Frequency (MHz)	OBW (MHz)
CDMA	818.00	1.267
LTE 5 MHz	821.50	4.496
CDMA+ LTE 5MHz	820.50	6.338

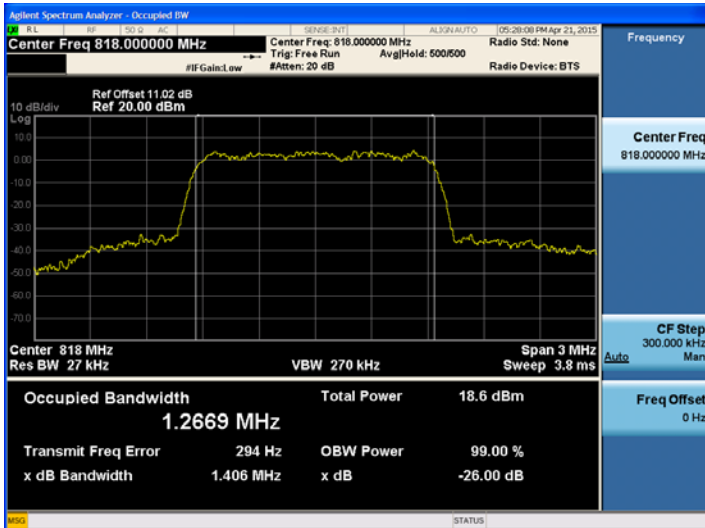
[Uplink Input]

	Frequency (MHz)	OBW (MHz)
CDMA	818.00	1.259
LTE 5 MHz	821.50	4.496
CDMA+ LTE 5MHz	820.50	6.396

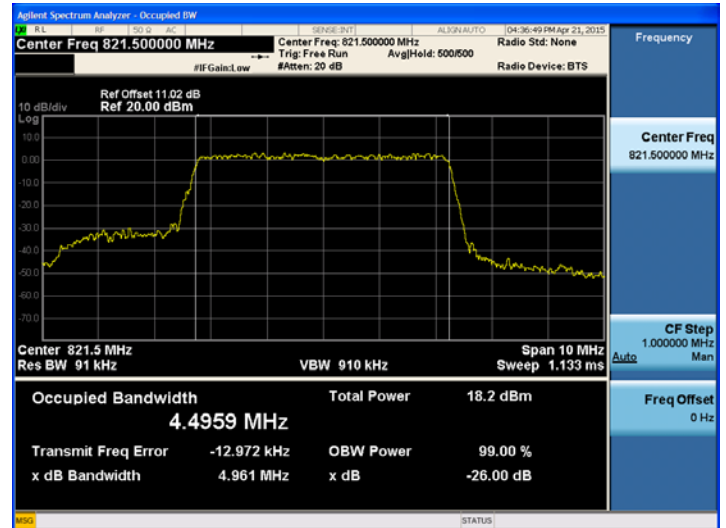
■ TEST Plot for 800 MHz band OCCUPIED BANDWIDTH

[Uplink Output]

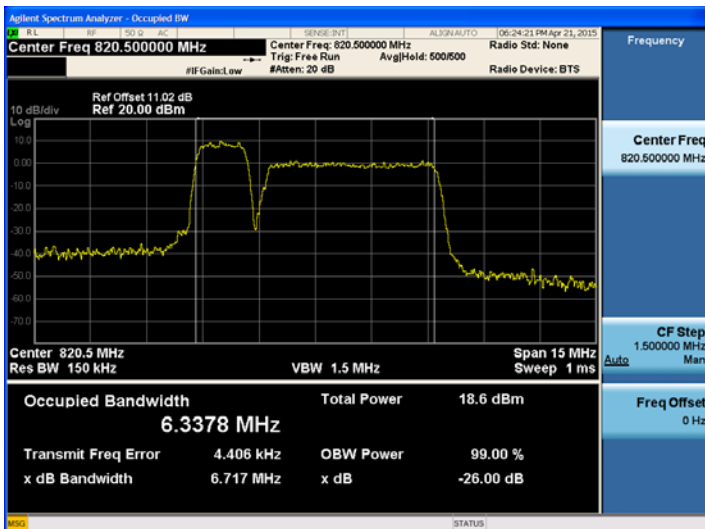
800 MHz band CDMA Uplink Output



800 MHz band LTE 5MHz Uplink Output



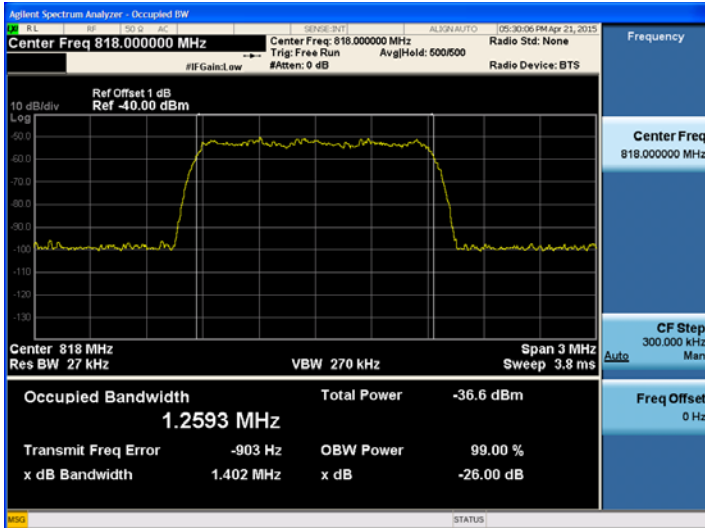
800 MHz band CDMA+LTE 5MHz Uplink Output



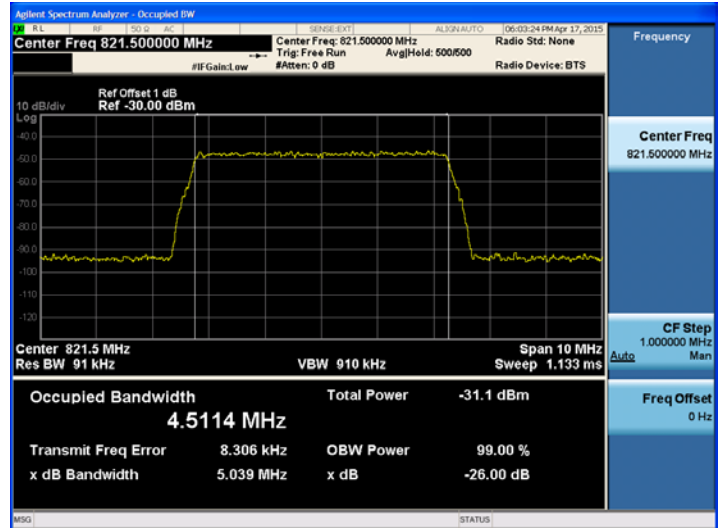
800 MHz band OCCUPIED BANDWIDTH

[Uplink Input]

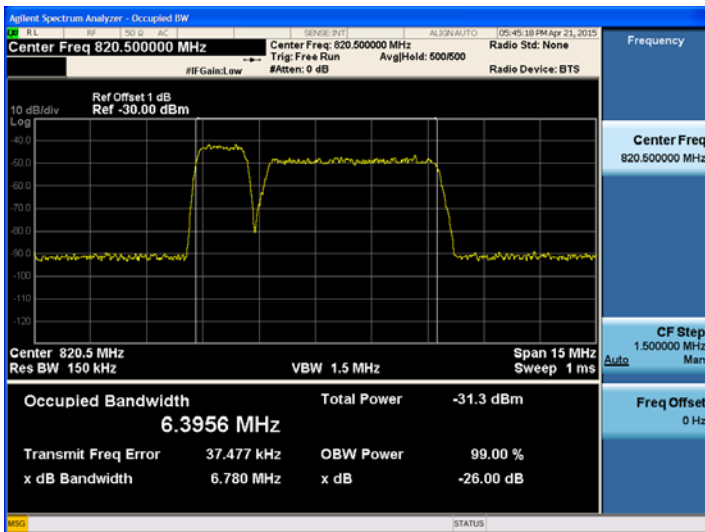
800 MHz band CDMA Uplink Input



800 MHz band LTE 5MHz Uplink Input



800 MHz band CDMA+LTE 5MHz Uplink 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 Uplink or Downlink RF port at a maximum level as determined by the spectrum analyzer was connected to either the Uplink 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	UL : -65 dBm	75 dB

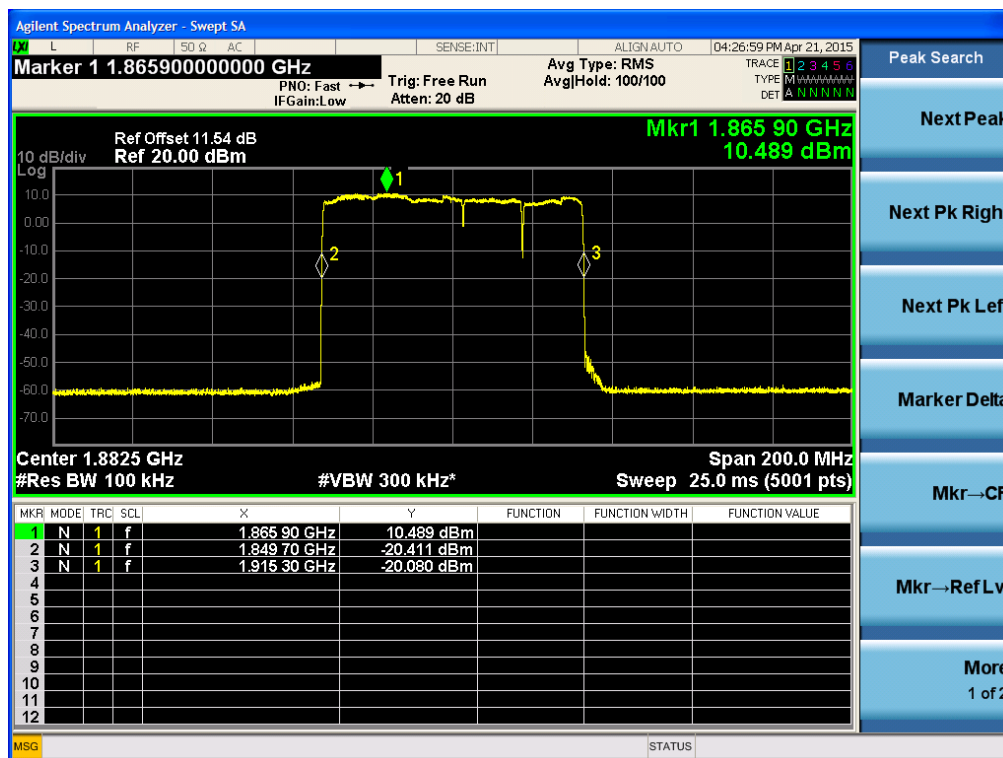
1900 MHz band

[Uplink]

20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
1849.70 ~ 1915.30	10.49	75.49

Plots of Out of Band Rejection

[Uplink]



800 MHz band

[Uplink]

20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
816.587 ~ 824.203	10.02	75.02

