HCT CO., LTD.

CERTIFICATION DIVISION
105-1, JANGAM-RI, MAJANG-MYEON, ICHEON-SI, GYEONGGI-DO, KOREA
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CERTIFICATE OF COMPLIANCE

FCC PART 27 Certification

Applicant Name: **GS Instruments Co.,Ltd.** **Address: 1385-14, Juan-Dong, Nam-Ku, Incheon, 402-200, Korea**	**Date of Issue: November 12, 2012** **Test Site/Location:** HCT CO., LTD., 105-1, Jangam-ri, Majang-Myeon, Icheon-si, Gyeonggi-Do, Korea **Test Report No.:** HCTR1210FR13-1 **HCT FRN:** 0005866421 **IC Recognition No.:** 5944A-3

FCC ID	**:**	**U88-SMT-A33**
IC	**: :**	**8137A-SMT-A33**
APPLICANT	**:**	**GS Instruments Co.,Ltd.**

EUT Type:	**CDMA In-Building RF Repeater**
Model:	**SMT-A33**
Frequency Ranges:	**DL : 2145 MHz ~ 2155 MHz** **UL : 1745 MHz ~ 1755 MHz**
Conducted Output Power:	**DL : 2.04 W , UL : 2.03 W**
FCC Rules Part(s):	**CFR 47, Part 27**
IC Rules Part(s):	**RSS-131, RSS-GEN**

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 27 of the FCC Rules under normal use and maintenance.

Report prepared by
:Chang Seok Choi
Test engineer of RF Team

Approved by
: Sang Jun Lee
Manager of RF Team

Revision

TEST REPORT NO.	DATE	DESCRIPTION
HCTR1210FR13	October 11, 2012	First Approval Report
HCTR1210FR13-1	November 12, 2012	Some comments for KDB935210 were added.

CONTENTS

1. CLIENT INFORMATION

The EUT has been tested by request of

Company	GS Instrumnets Co.,Ltd. 1385-14, Juan-Dong, Nam-Ku, Incheon, 402-200, Korea
Contact Point	Attention: Young Il Kim Tel. : +82-32-870-5545

■ **FCC ID:**	**U88-SMT-A33**
■ **APPLICANT:**	**GS Instruments Co.,Ltd.**
■ **EUT Type:**	**CDMA In-Building RF Repeater**
■ **Model:**	**SMT-A33**
■**Frequency Ranges:**	**DL : 2145 MHz ~ 2155 MHz** **UL : 1745 MHz ~ 1755 MHz**
■ **Conducted Output Power:**	**DL : 33.11 dBm** **UL : 33.09 dBm**
■ **Antenna Gain(s):**	**DL : 3 dBi , UL : 9 dBi**
■ **FCC Rules Part(s):**	**CFR Title 47 Part 27**
■ **IC Rules Part(s):**	**RSS-131, RSS-GEN**
■ **Place of Tests:**	**105-1, Jangam-ri , Majang-Myeon, Icheon-si, Gyeonggi-Do, 467-811, KOREA. (IC Recognition No. : 5944A-3)**

2. TEST SPECIFICATIONS

Description	Reference (FCC)	Reference (IC)	Results
RF Power Output	§2.1046; §27.50	RSS-131, Section 6.2	Compliant
Occupied Bandwidth Passband Gain	§2.1049	RSS-131, Section 6.1 RSS-GEN, Section 4.6.1	Compliant
Spurious Emissions at Antenna Terminals	§2.1053, §27.53	RSS-131, Section 6.3 RSS-131, Section 6.4	Compliant
Radiated Spurious Emissions	§2.1053, §27.53	-	Compliant
Frequency Stability	§2.1055, §27.54	RSS-131, Section 6.5	Compliant

※ We refered to KDB935210 to test the EUT.

※ According to KDB935210, for spurious emissions and bandwidth both maximum input at the highest gain setting (-57dBm input, 90dB gain) and maximum input level (-27dBm) is checked and the worst case (-57dBm/90dB gain) of the two is contained in the test report

3. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	**+ 15 ℃ to + 35 ℃**
Relative humidity:	**30 % to 60 %**
Air pressure	**860 mbar to 1 060 mbar**

4. TEST EQUIPMENT

Manufacturer	Model / Equipment	Serial No.	Calibration Due
Schwarzbeck	BBHA 9120D / Double Ridged Horn Antenna	147	05/15/2014
Schwarzbeck	BBHA 9120D / Double Ridged Horn Antenna	937	10/17/2013
Schwarzbeck	VULB 9168 / TRILOG Antenna	9168-200	02/19/2013
HD	MA240 / Antenna Position Tower	556	N/A
EMCO	1050 / Turn Table	114	N/A
HD GmbH	HD 100 / Controller	13	N/A
HD GmbH	KMS 560 / SlideBar	12	N/A
MITEQ	AMF-6B-180265-35-10P / POWER AMP	667624	04/16/2013
Agilent	N9020A /Signal Analyzer	US46220219	05/02/2013
Agilent	6674A / DC Power Supply	3501A00901	05/02/2013
WEINSCHEL	67-30-33 / Attenuator	BU5347	11/07/2012
WEINSCHEL	AF9003-69-31 / Attenuator	5701	11/07/2012
Nang-Yeoul	NY-THR18750 / Temperature Chamber	NY-2009012201A	11/08/2012

5. RF OUTPUT POWER

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.

§ 27.50 Power limits and duty cycle.

(d) The following power and antenna height requirements apply to stations transmitting in the 1710–1755 MHz and 2110–2155 MHz bands:

(1) The power of each fixed or base station transmitting in the 2110–2155 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:

(A) an equivalent isotropically radiated power (EIRP) of 3280 watts when transmitting with an emission bandwidth of 1 MHz or less;

(B) an EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710–1755 MHz band are

limited to 1 watt EIRP. Fixed stations operating in this band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in this band must employ a means for limiting power to the minimum necessary for successful communications.

Test Requirements: RSS-131 6.2

The manufacturer's output power rating Prated MUST NOT be greater than Pmean for all types of enhancers.

Additional Power Back-off Condition for Multiple Carrier Operations:

An example of a single carrier operation is a band translator that incorporates an (IF) filter of a passband equal to one channel bandwidth. Another example of a single carrier operation is the use of an enhancer, before the connection to the antenna, to boost a low power transmitter (single carrier) to a higher power.

An example of a multiple carrier operation is the use of an enhancer to amplify off-air signals that contain the wanted carrier and two (or more) adjacent band carriers. If the enhancer passband is wide enough to pass more than the wanted channel bandwidth, the enhancer output stage will be loaded by the multiple carriers.

Examination: with 3 carrier signals (of assumed equal level), the peak voltage will be 3 times the single carrier voltage. The corresponding Peak Envelope Power (PEP) will be 3**2** times greater than a single carrier or 9/4 = 2.25 times greater than 2 tones PEP. Therefore the permissible wanted signal operating point has to be backed off by 3.5 dB (i.e. **Ppermissible = Prated - 3.5 dB**).

Note 1: All enhancers will be classified in the Radio Equipment List (REL) for a single carrier operation.

Note 2: For a multiple carrier operation, the rating must be reduced by 3.5 dB or more.

Note 3: If there are more than 3 carriers present at the amplifier input point, greater power back-off may be required. This can be examined on a case-by-case basis.

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.

Test Procedures: RSS-131 4.3

4.3.1 Multi-channel Enhancer

The following subscript "o" denotes a parameter at the enhancer output point.

Connect two signal generators to the input of the Device Under Test (DUT), via a proper impedance matching network (and preferably via a variable attenuator) so that the two input signals are equal sinusoids (and can be raised equally).

Connect a dummy load of suitable load rating to the enhancer output point. Connect also a

spectrum analyser to this output point via a coupling network and attenuator, so that only a portion of the output signal is coupled to the spectrum analyser. The coupling attenuation shall be stated in the test report.

Set the two generator frequencies f1 and f2 such that they and their third-order intermodulation product frequencies, f3= 2f1-f2 and f4 = 2f2 - f1, are all within the passband of the DUT.

Raise the input level to the DUT while observing the output tone levels, Po1 and Po2, and the intermodulation product levels, Po3 and Po4.

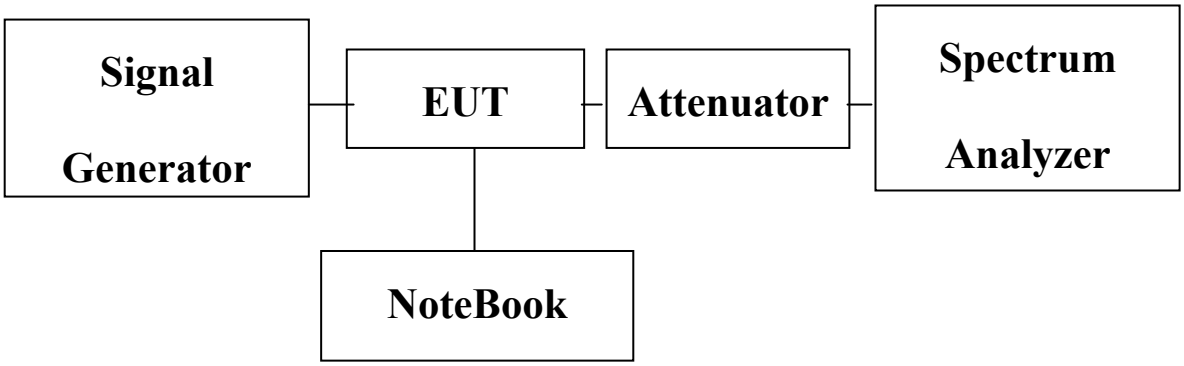
For enhancers rated 500 watts or less: Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, Po3 or Po4, equals -43 dBW.

For enhancers rated over 500 watts: Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, Po3 or Po4, is 67 dB below the level of either output tone level, Po1 or Po2.

Record all signal levels and their frequencies. Calculate the mean output power (Pmean) under this testing condition using Pmean = Po1 + 3 dB.

4.3.2 Single Channel Enhancer

A suitably modulated signal, representative of the technology for which certification is sought, is applied to the input of the amplifier. The input power level is increased until the manufacturer's rated input power level is achieved or until a 2 dB increase in input level results in a 1 dB increase in output level (i.e. compression begins). Record the output power in the 99% emission bandwidth using any suitable means.



Block Diagram 1. RF Power Output Test Setup

Test Results:

※ According to KDB935210, both cases (Maximum input rating and Maximum gain setting) were looked at and the test result (Output Power and Spectral Shape) were almost same in uplink and downlink.

If we input a higher value than regulated value, the EUT is shut down to prevent itself.

The Test report was recorded the result of maximum gain setting mode only because it was a little

worst case for EUT.

Sample Calculation

Output Power = Reading Value + ATT loss + Cable loss

1. Spectrum reading values are not plot data. The power results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss (35.36 dB at downlink, 34.63 dB at uplink)
3. Actual value of loss for the attenuator and cable combination is 35.36 dB at 2150 MHz , 35.34 dB at 2145 MHz, 35.36 dB at 2155 MHz, 34.63 dB at 1750 MHz, 34.61 dB at 1745 MHz, and 34.65 dB at 1755 MHz.

Input Signal	Modulation	Level (dBm)
CDMA	QPSK	-56.8
LTE	16QAM	-57.4

[Downlink]

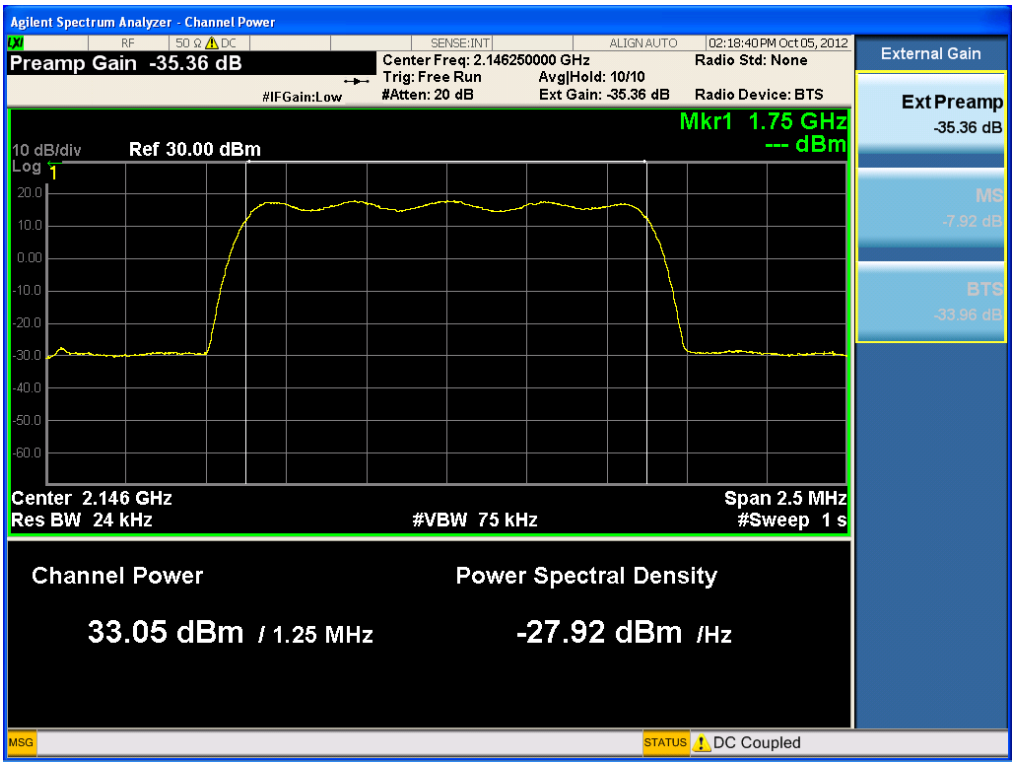
	Channel	Frequency (MHz)	Output Power (dBm)
CDMA	Low	2146.25	33.05
	Middle	2150.00	33.06
	High	2153.75	33.03
LTE	Low_5 MHz	2147.50	33.06
	High_5 MHz	2152.50	33.11
	Middle_10 MHz	2150.00	33.04

[Uplink]

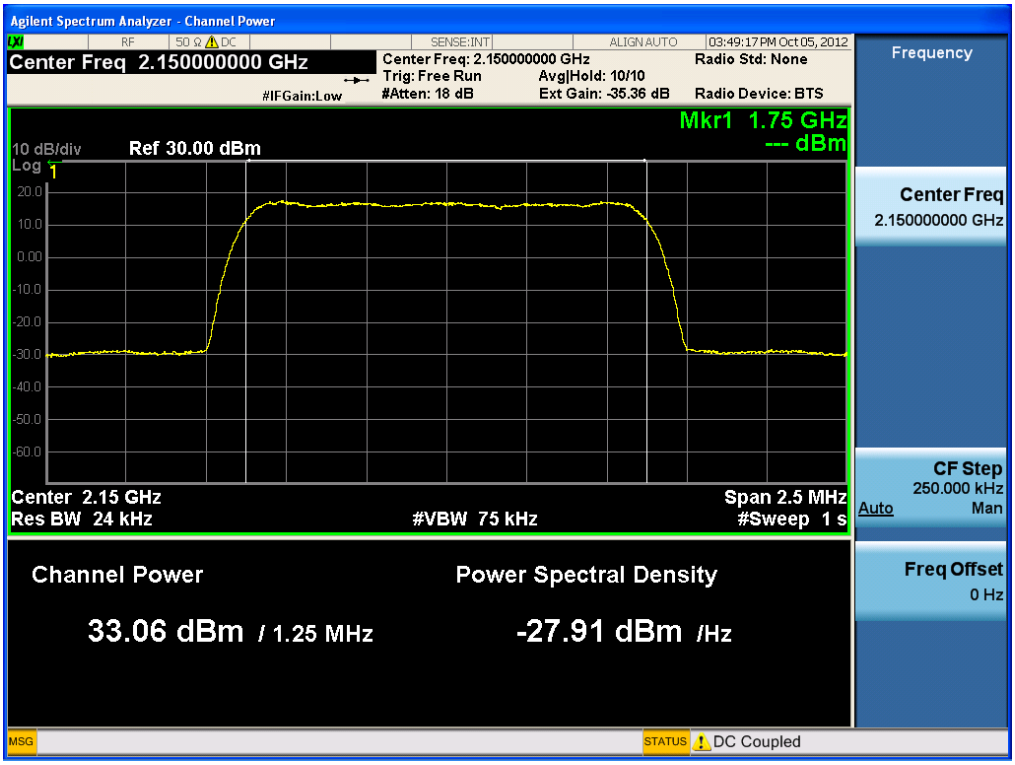
	Channel	Frequency (MHz)	Output Power (dBm)
CDMA	Low	1746.25	33.09
	Middle	1750.00	33.09
	High	1753.75	33.02
LTE	Low_5 MHz	1747.50	33.03
	High_5 MHz	1752.50	33.02
	Middle_10 MHz	1750.00	33.02

Plots of RF Output Power

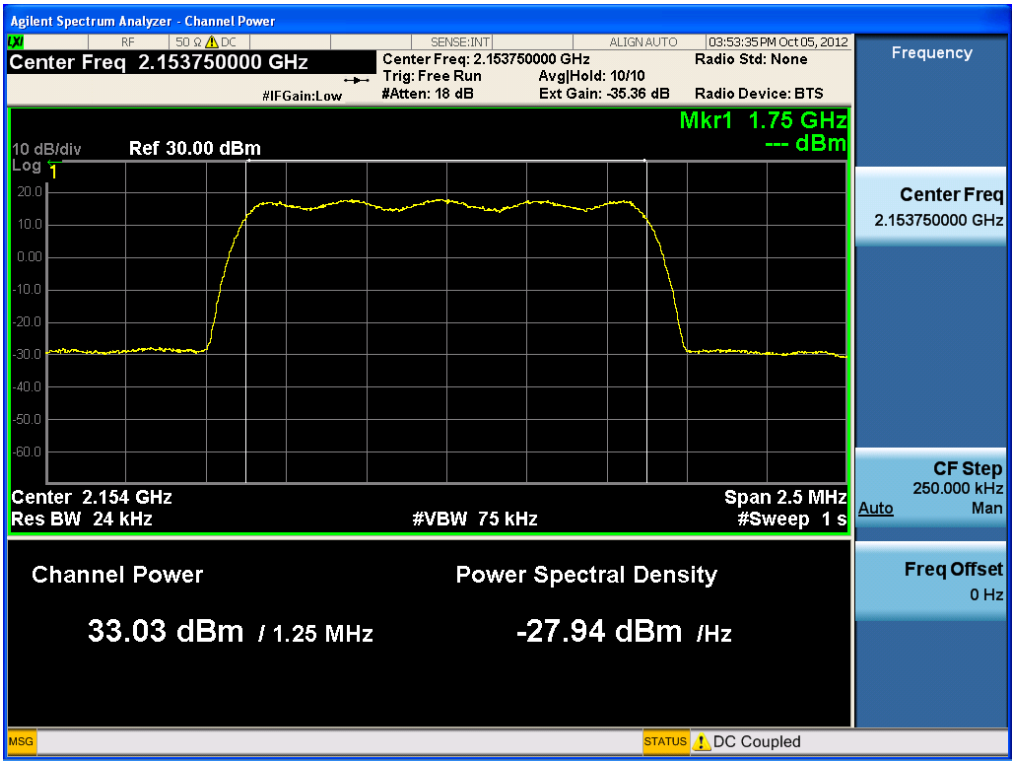
[CDMA Downlink Low]



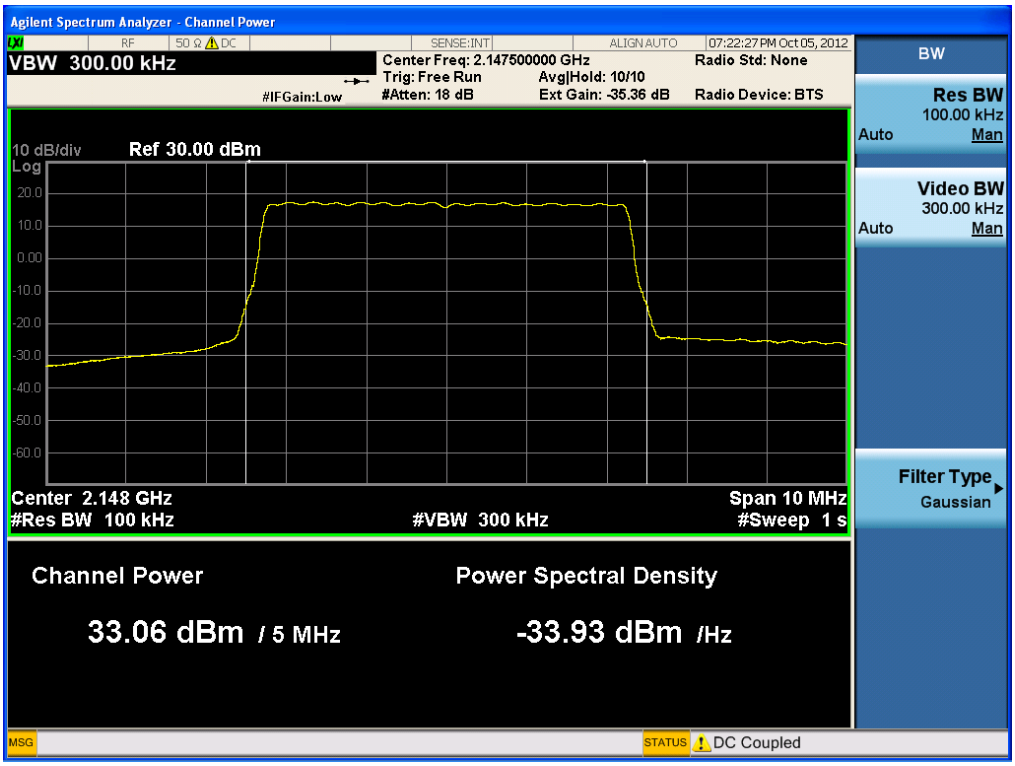
[CDMA Downlink Middle]



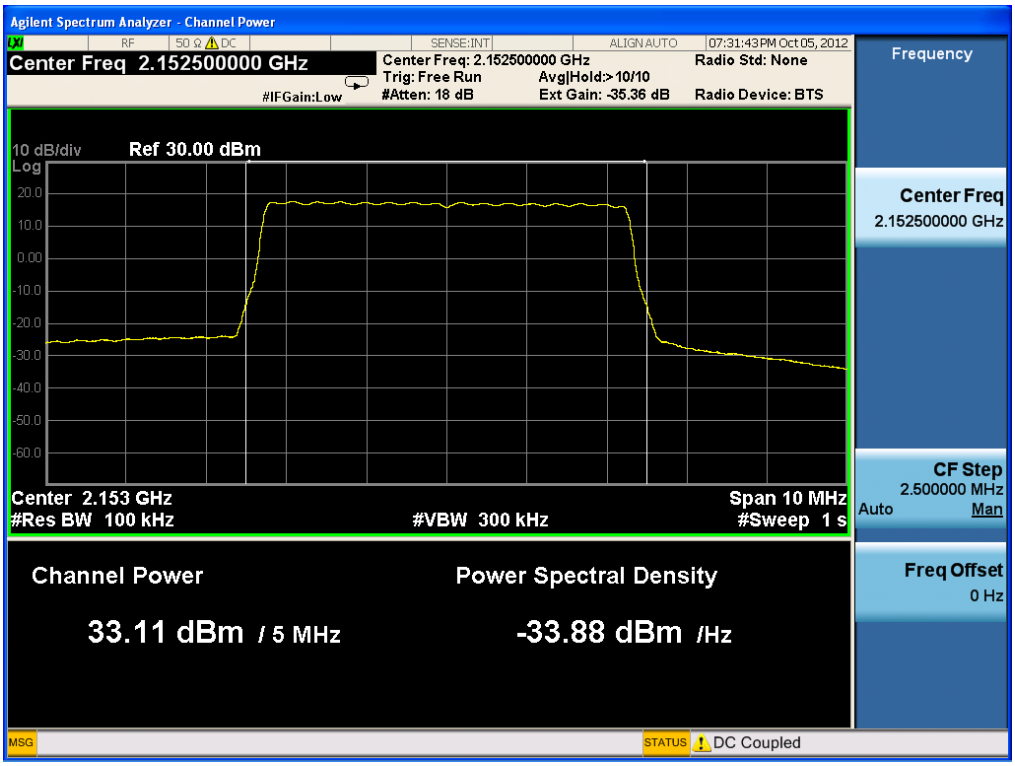
[CDMA Downlink High]



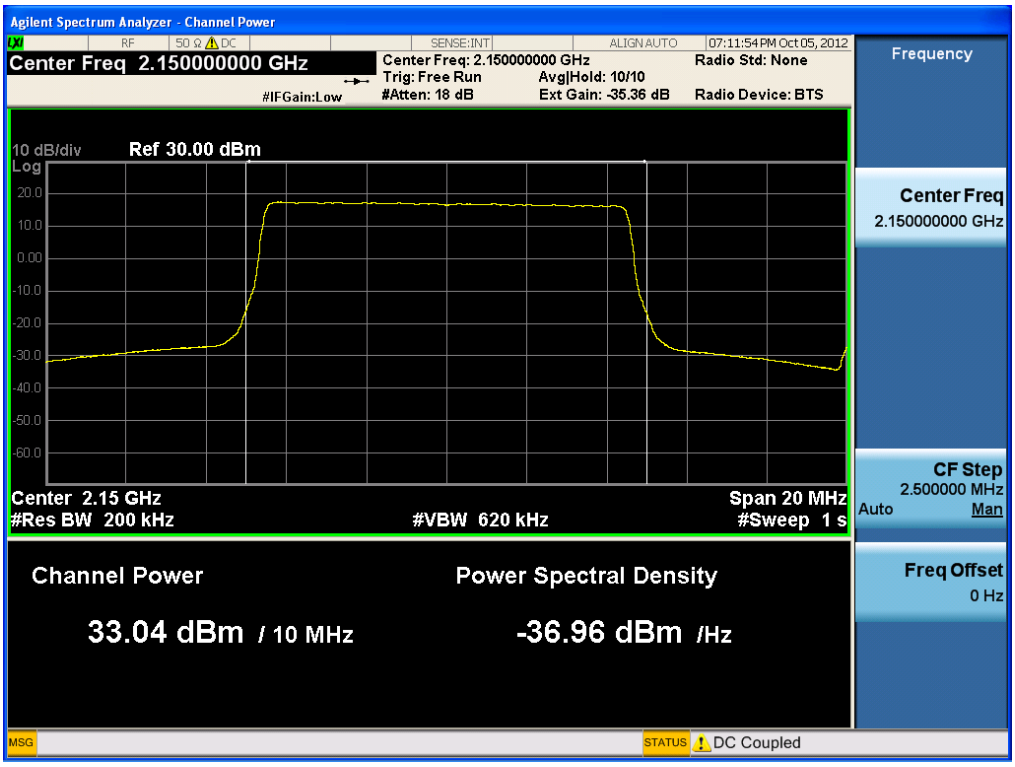
[LTE Downlink Low_5MHz]



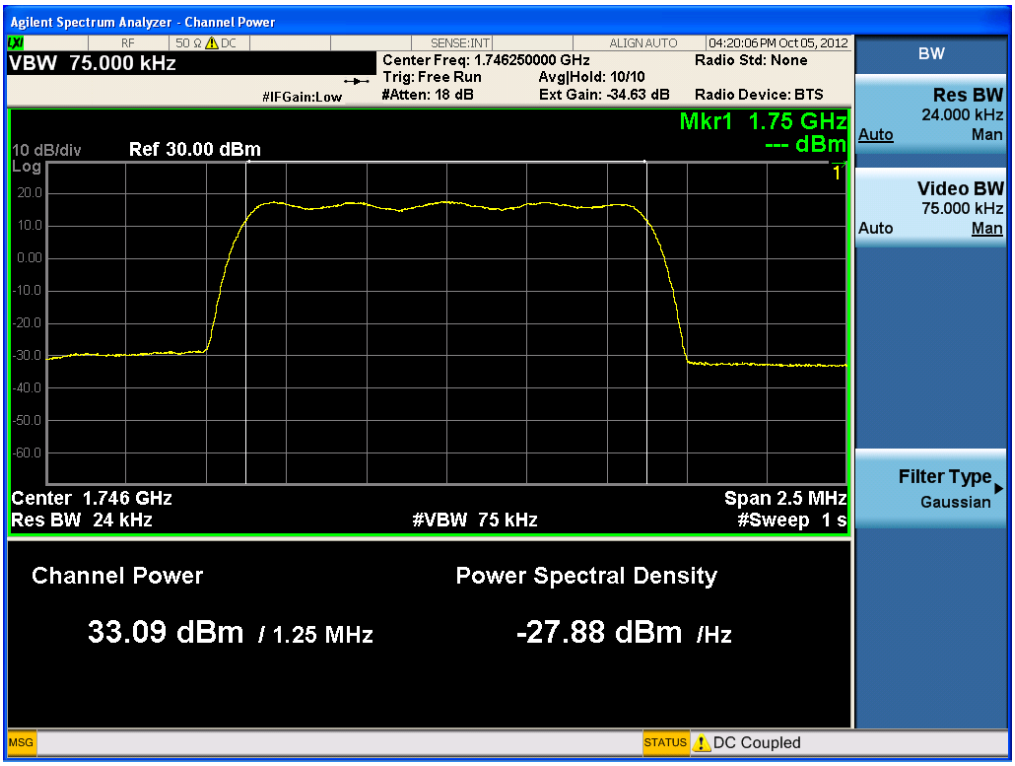
[LTE Downlink High_5MHz]



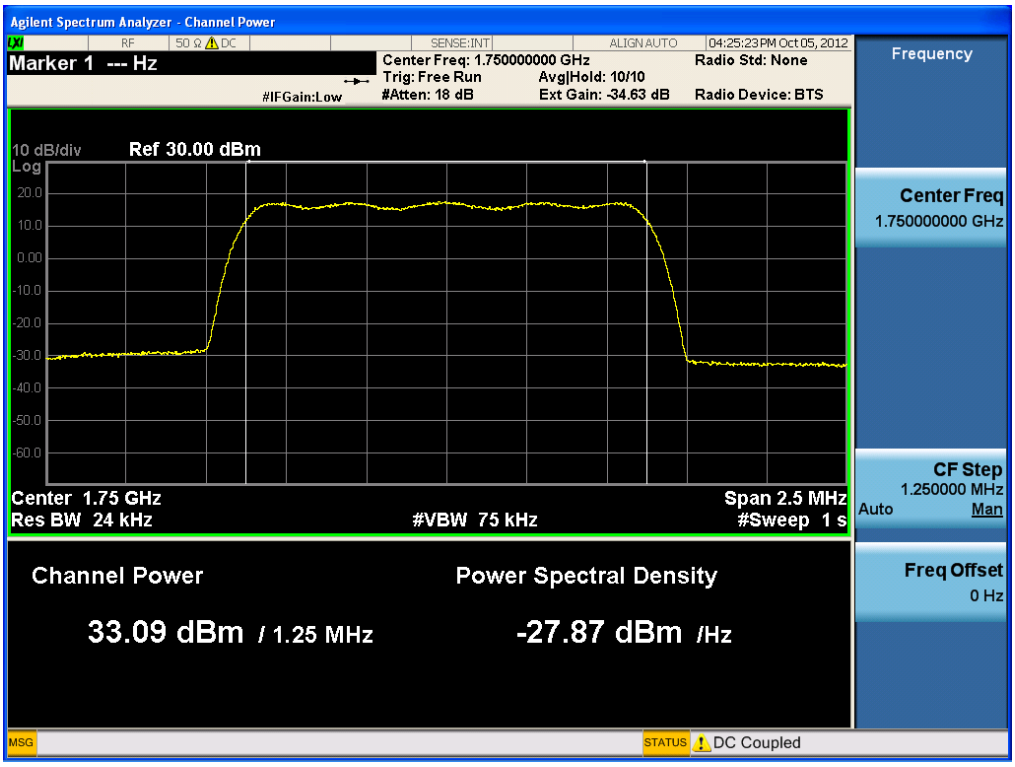
[LTE Downlink Middle_10MHz]



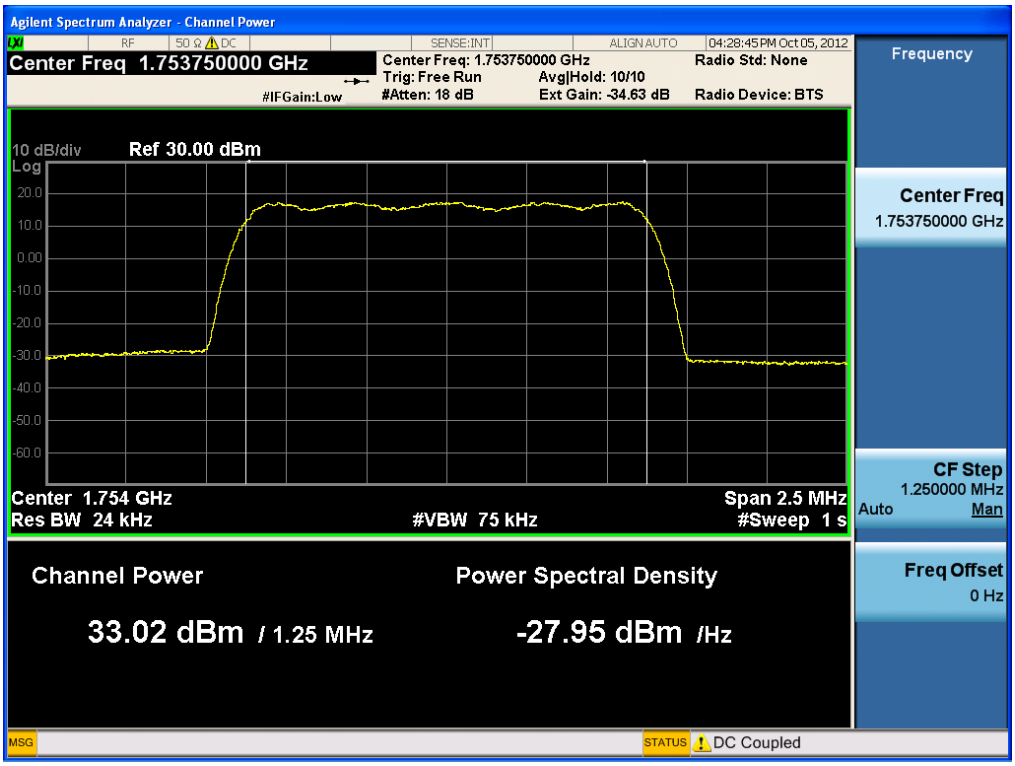
[CDMA Uplink Low]



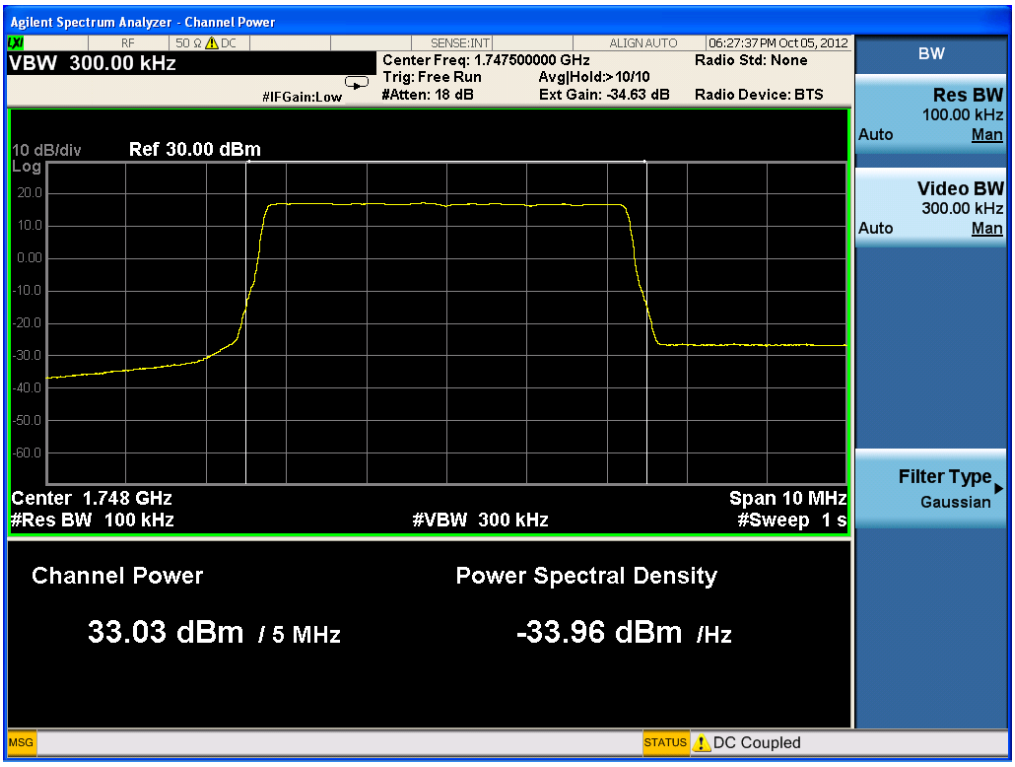
[CDMA Uplink Middle]



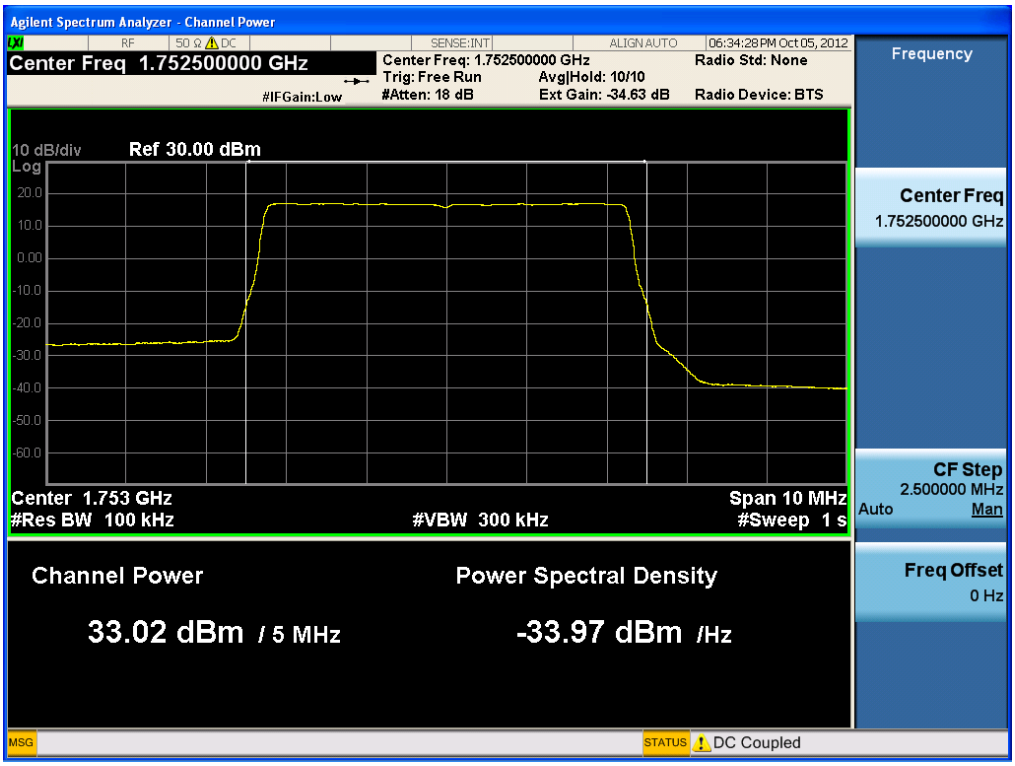
[CDMA Uplink High]



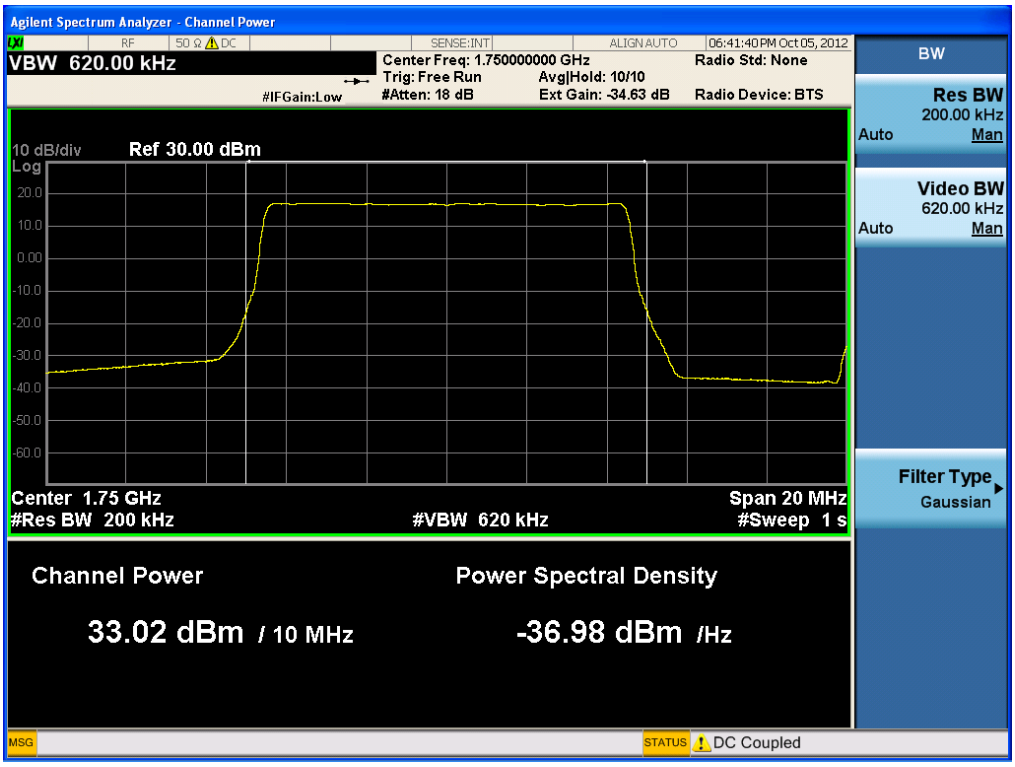
[LTE Uplink Low_5MHz]



[LTE Uplink High_5MHz]

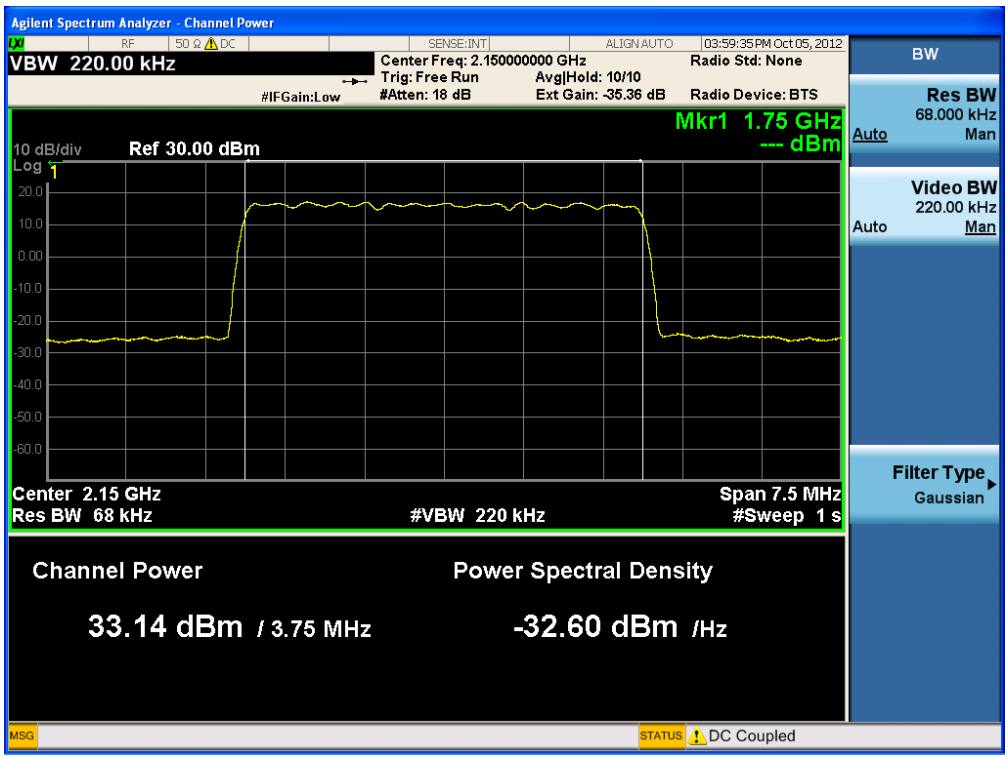


[LTE Uplink Middle_10MHz]

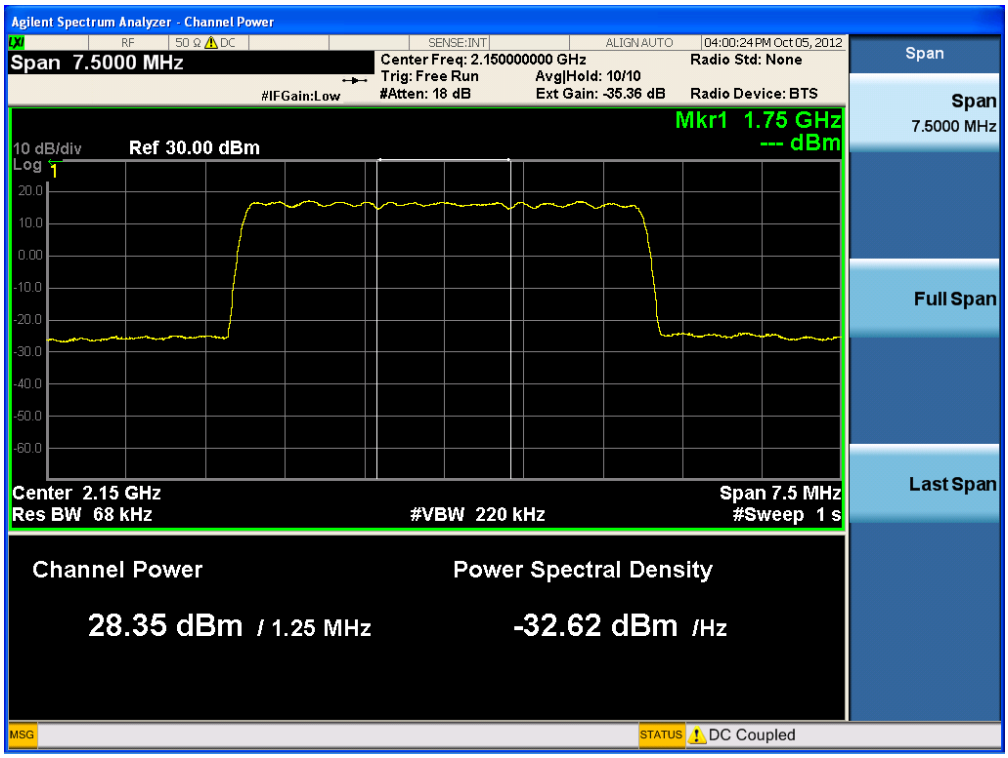


*** RSS-131 6.2 Power Back-off : 33.14 – 28.35 = 4.79 dB**

[Downlink 3 carriers]

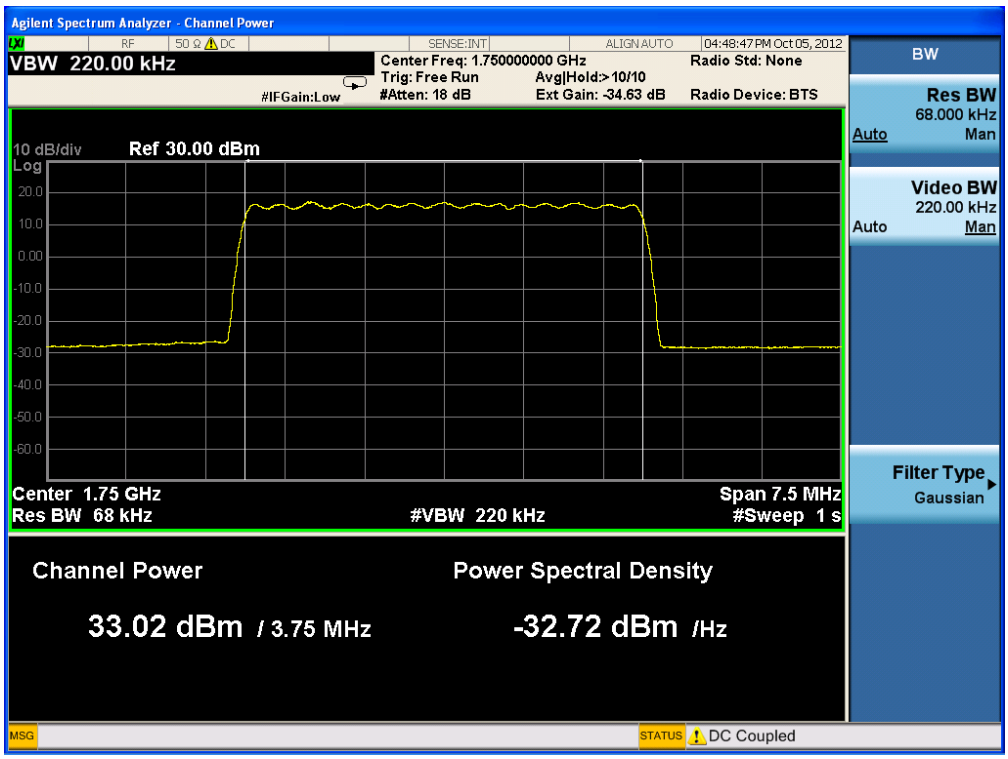


[Downlink 1 carrier]

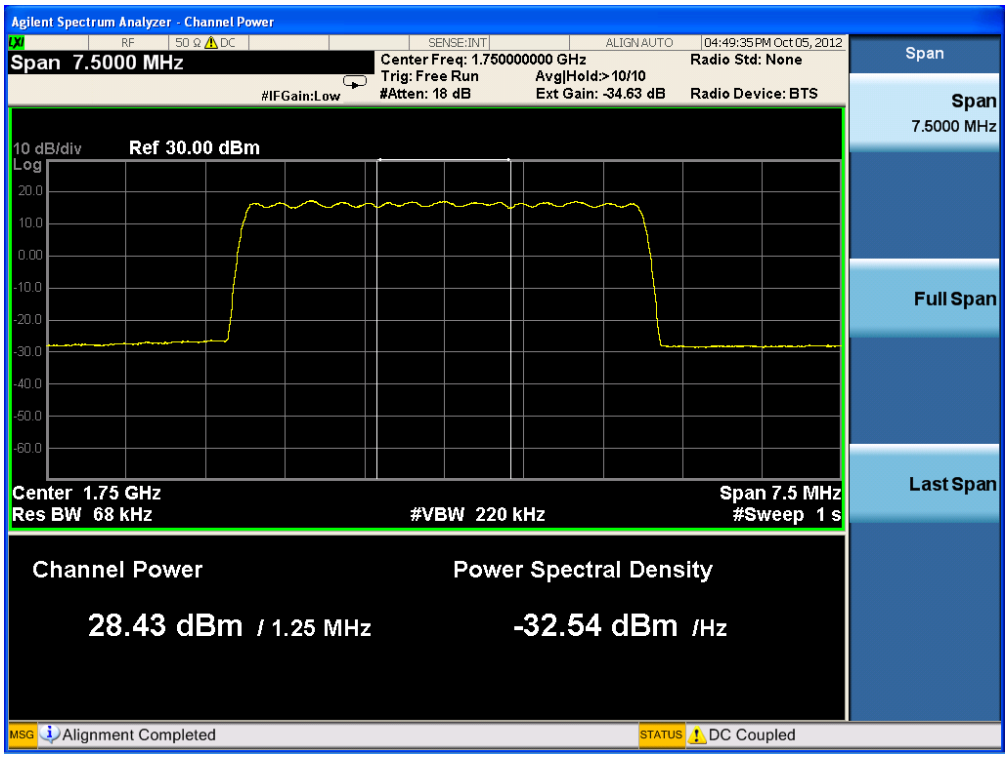


*** RSS-131 6.2 Power Back-off : 33.02 – 28.43 = 4.59 dB**

[Uplink 3 carriers]



[Uplink 1 carrier]



6. 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 Requirements: RSS-131 6.1

The passband gain shall not exceed the nominal gain by more than 1.0 dB. The 20 dB bandwidth shall not exceed the nominal bandwidth that is stated by the manufacturer. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point.

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 Procedures: RSS-131 4.2

Adjust the internal gain control of the equipment under test to the nominal gain for which equipment certification is sought.

With the aid of a signal generator and spectrum analyser, measure the 20 dB bandwidth of the amplifier (i.e. at the point where the gain has fallen by 20 dB). Measure the gain-versus-frequency response of the amplifier from the midband frequency f0 of the passband up to at least f0 + 250% of the 20 dB bandwidth.

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

Input Signal	Modulation	Level (dBm)
CDMA	QPSK	-56.8
LTE	16QAM	-57.4

[Downlink]

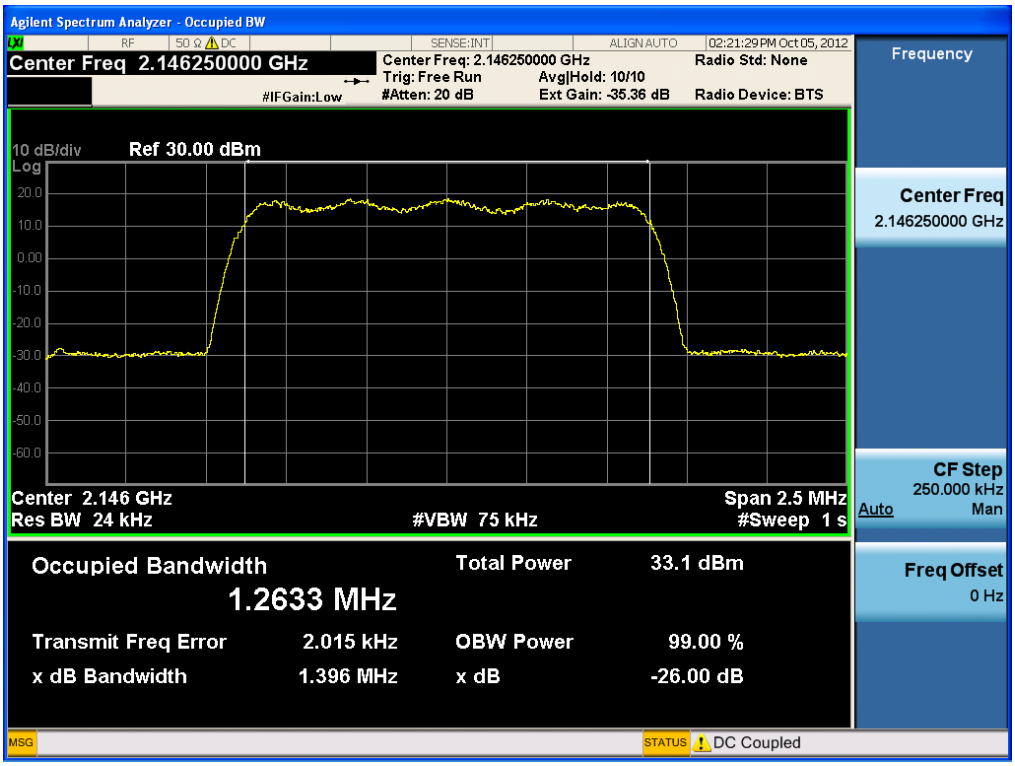
	Channel	Frequency MHz	OBW (Output) MHz	OBW (Input) MHz
CDMA	Low	2146.25	1.2633	1.2627
	Middle	2150.00	1.2594	1.2623
	High	2153.75	1.2634	1.2622
LTE	Low_5 MHz	2147.50	4.5060	4.5025
	High_5 MHz	2152.50	4.5057	4.5026
	Middle_10 MHz	2150.00	8.9846	8.9869

[Uplink]

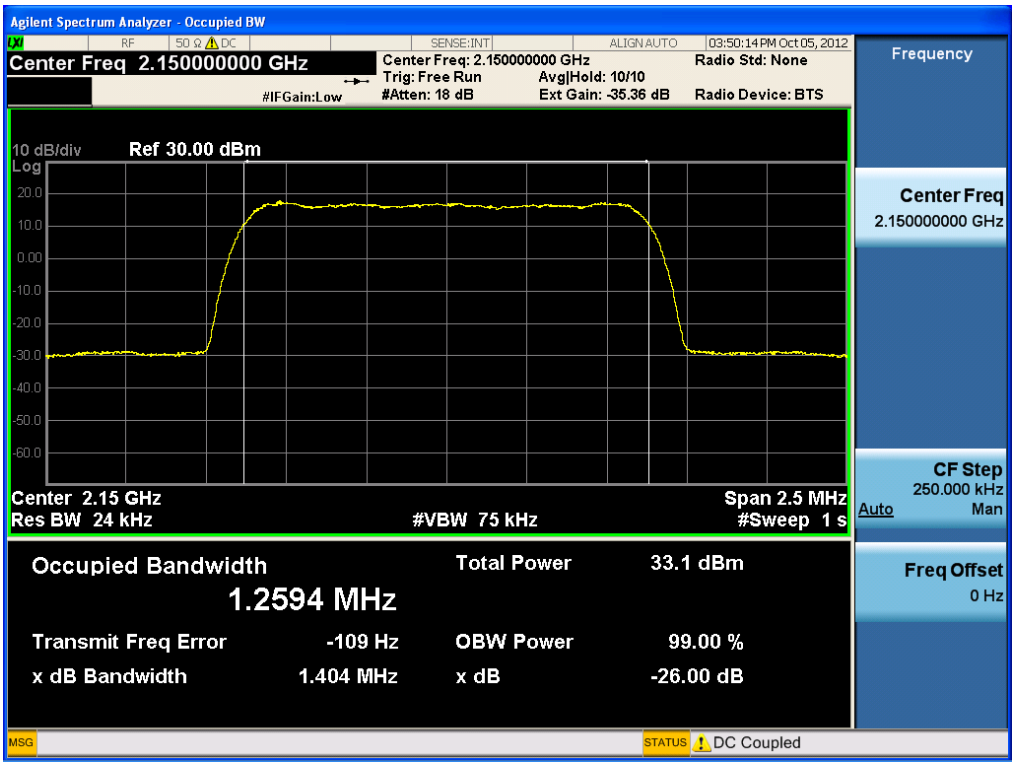
	Channel	Frequency MHz	OBW (Output) MHz	OBW (Input) MHz
CDMA	Low	1746.25	1.2621	1.2629
	Middle	1750.00	1.2604	1.2617
	High	1753.75	1.2619	1.2619
LTE	Low_5 MHz	1747.50	4.4993	4.5018
	High_5 MHz	1752.50	4.5027	4.5017
	Middle_10 MHz	1750.00	8.9800	8.9837

Plots of Occupied Bandwidth

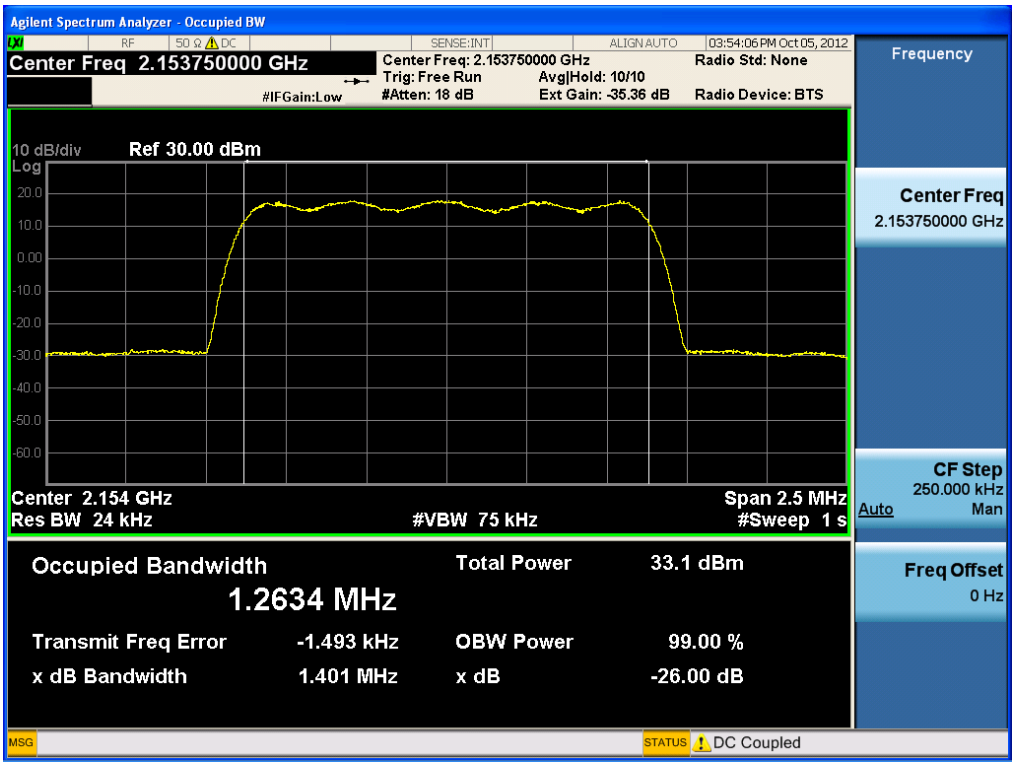
[Output CDMA Downlink Low]



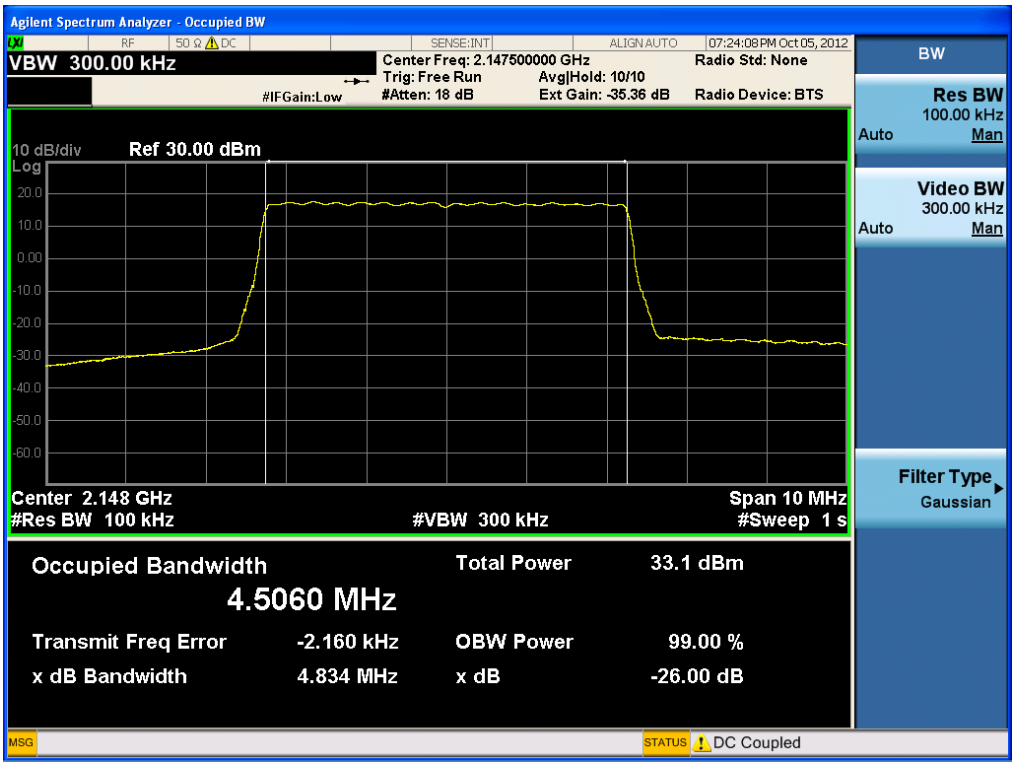
[Output CDMA Downlink Middle]



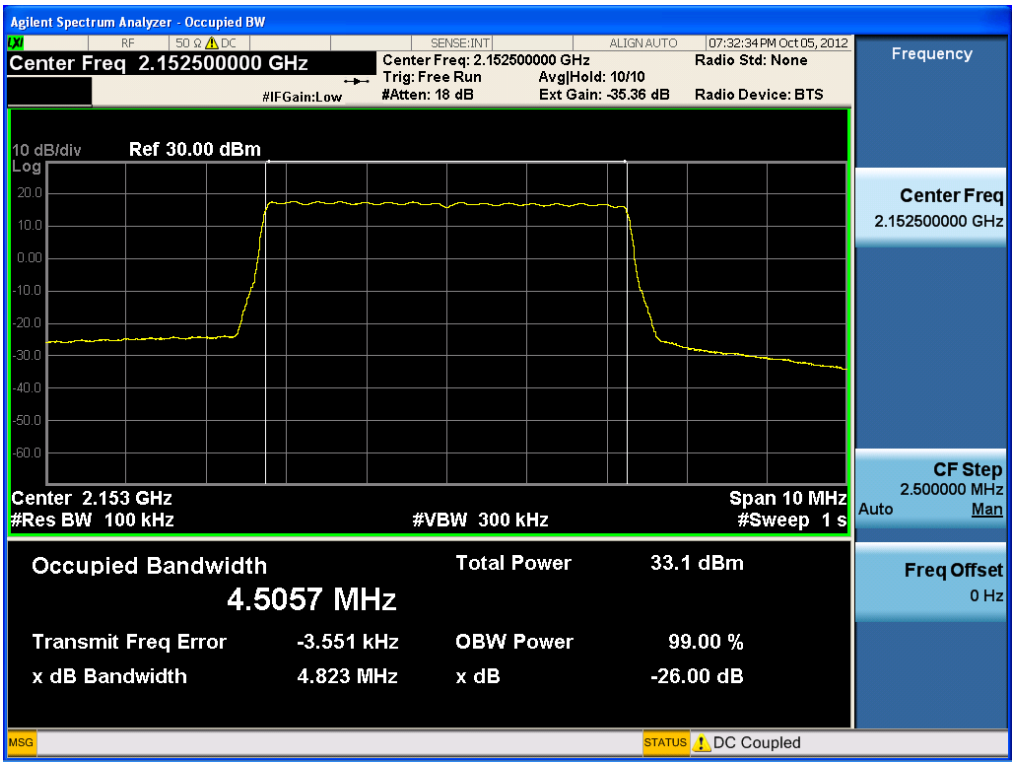
[Output CDMA Downlink High]



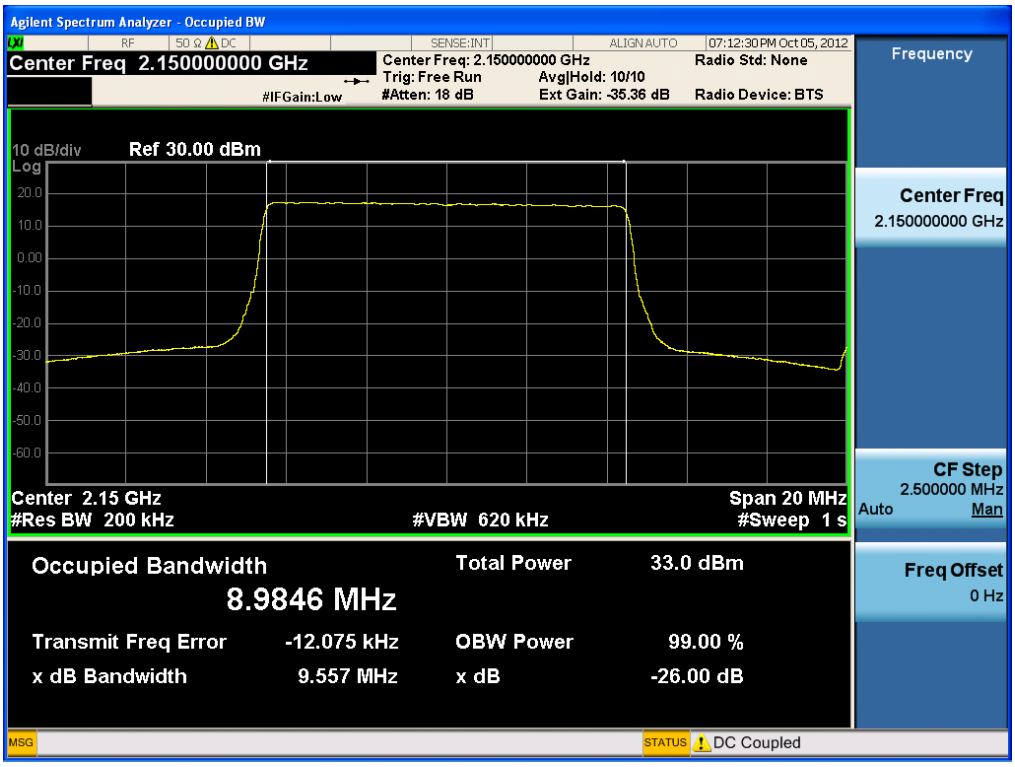
[Output LTE Downlink Low_5MHz]



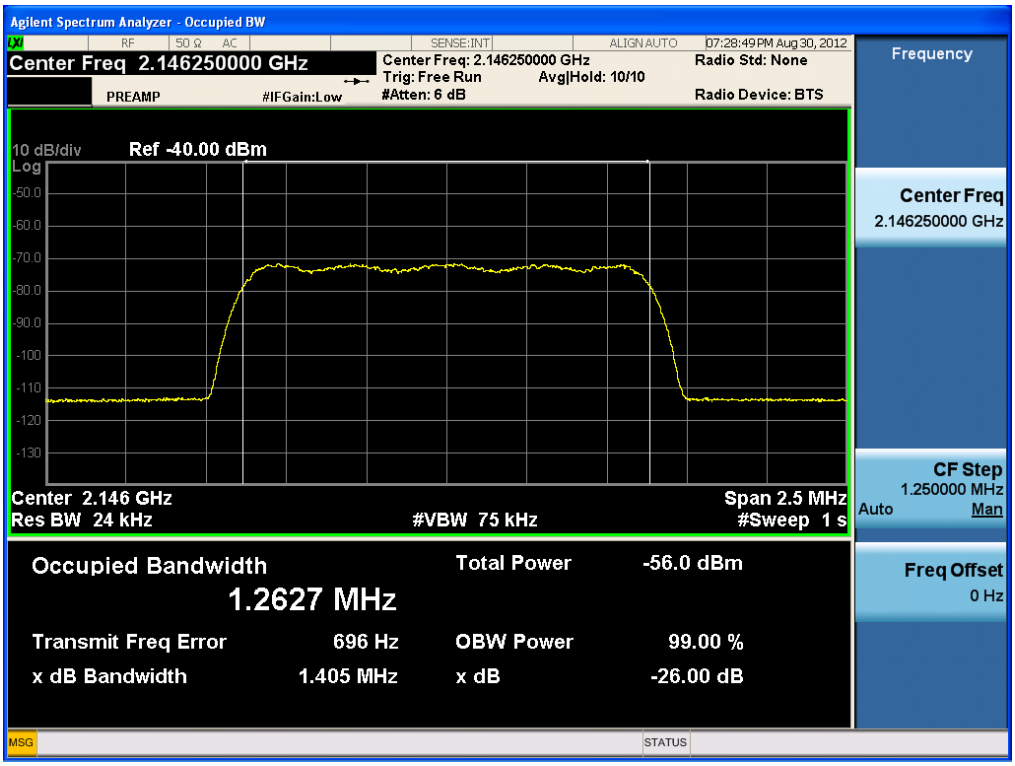
[Output LTE Downlink High_5MHz]



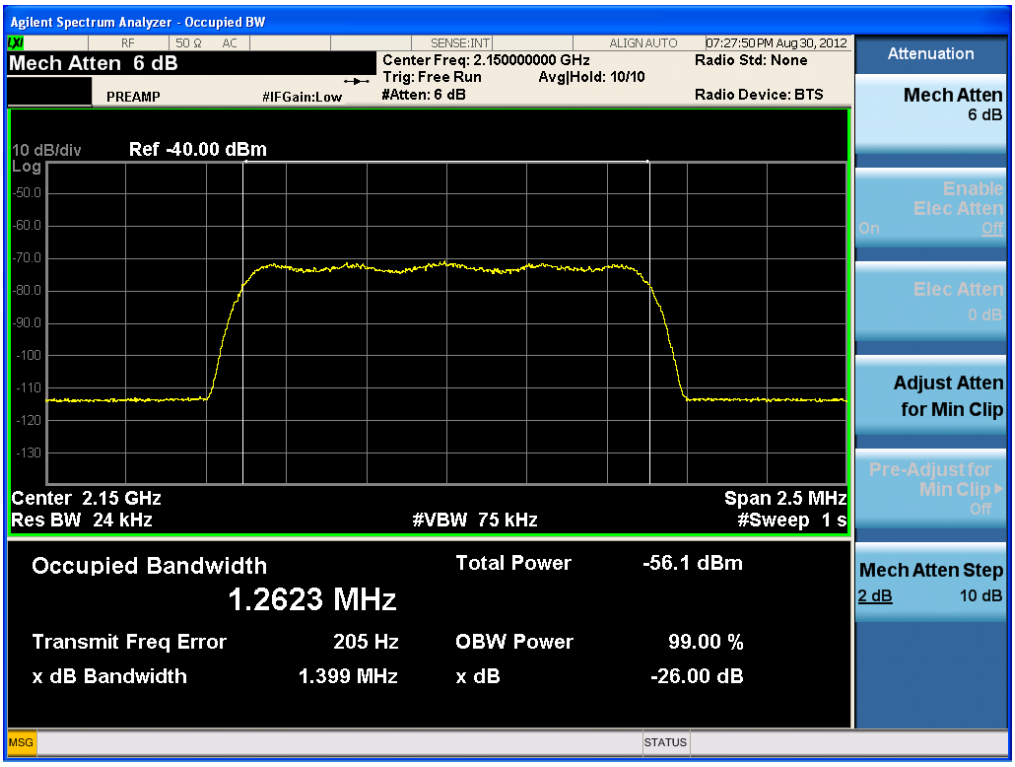
[Output LTE Downlink 10MHz]



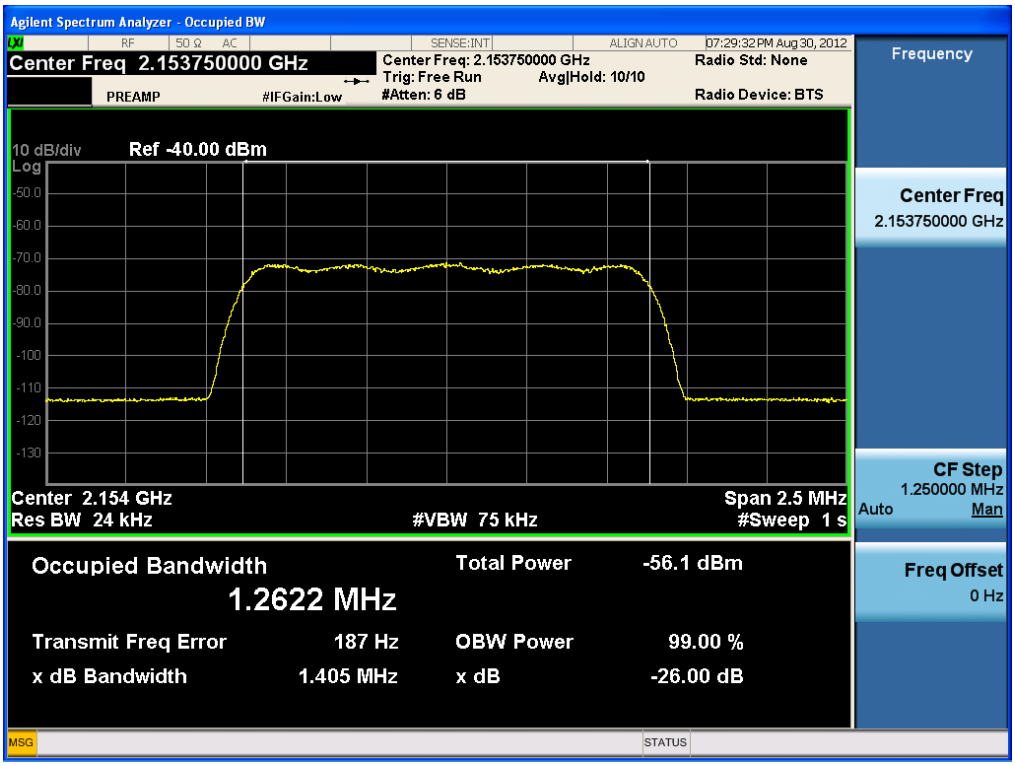
[Input CDMA Downlink Low]



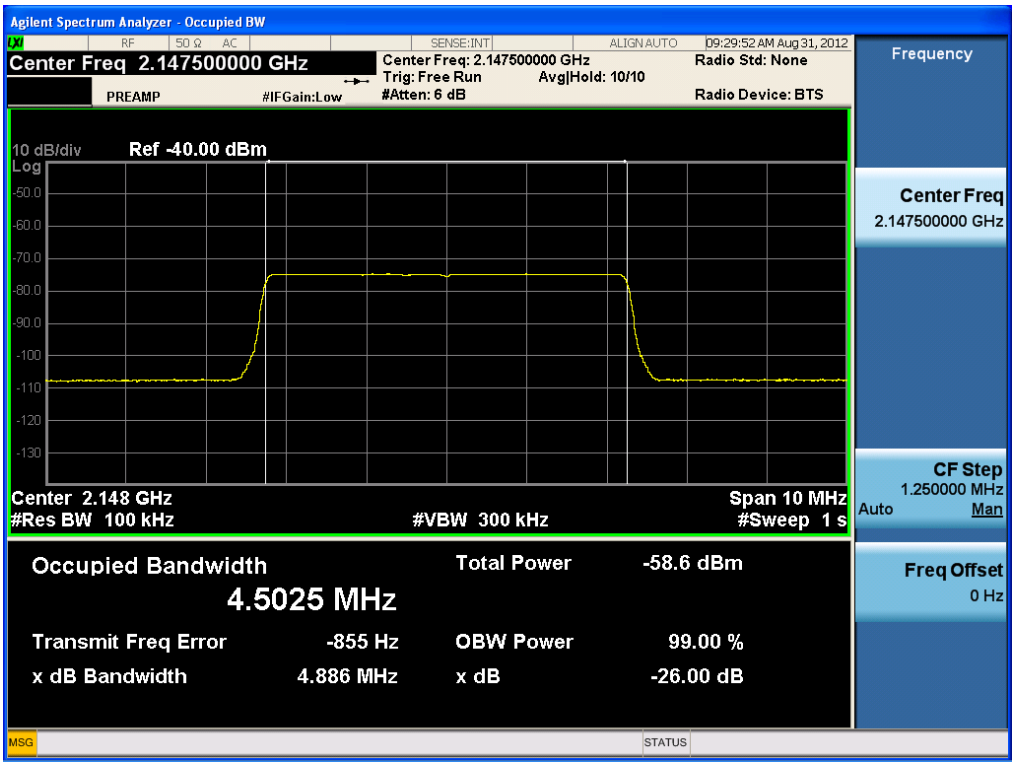
[Input CDMA Downlink Middle]



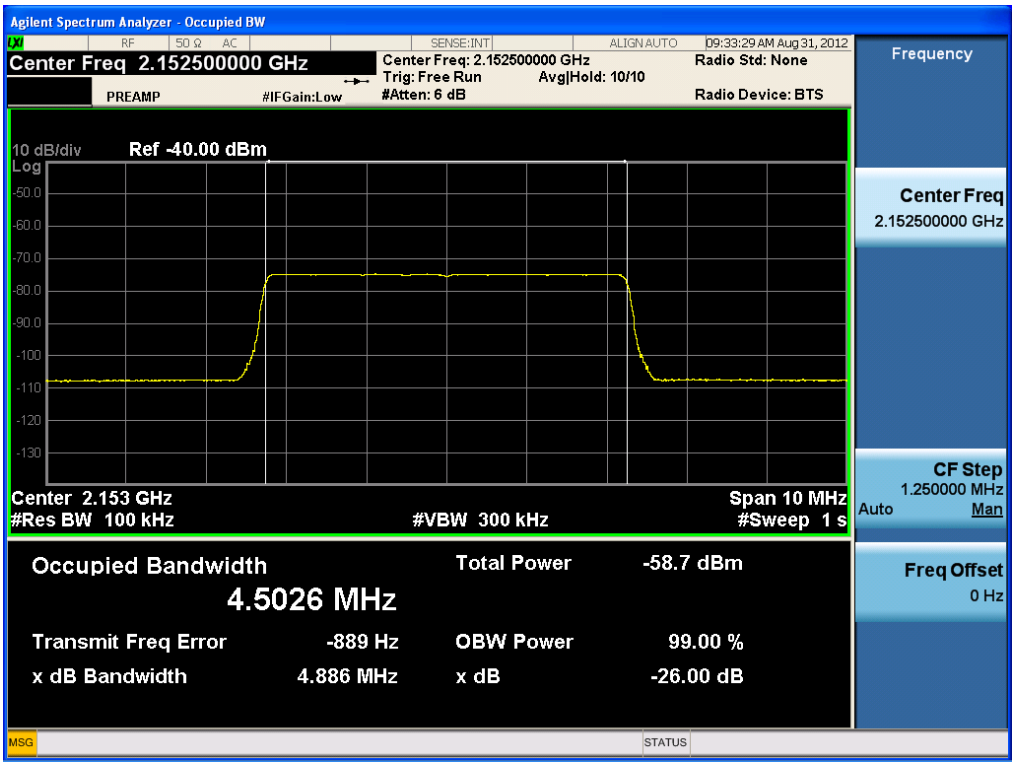
[Input CDMA Downlink High]



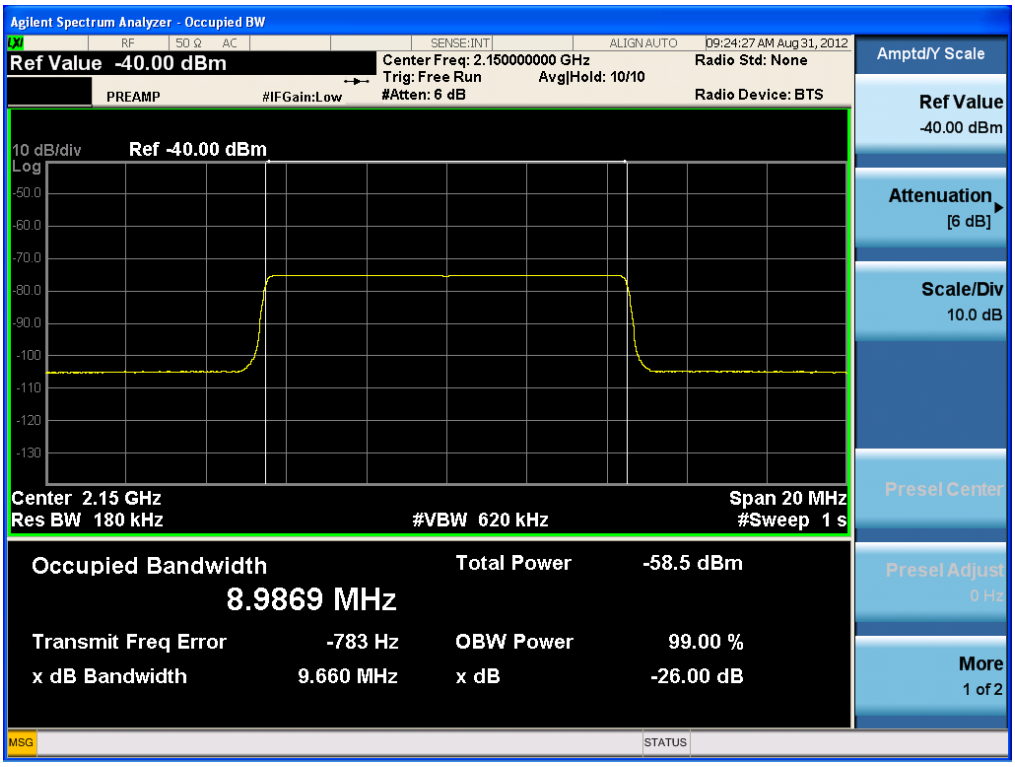
[Input LTE Downlink Low_5MHz]



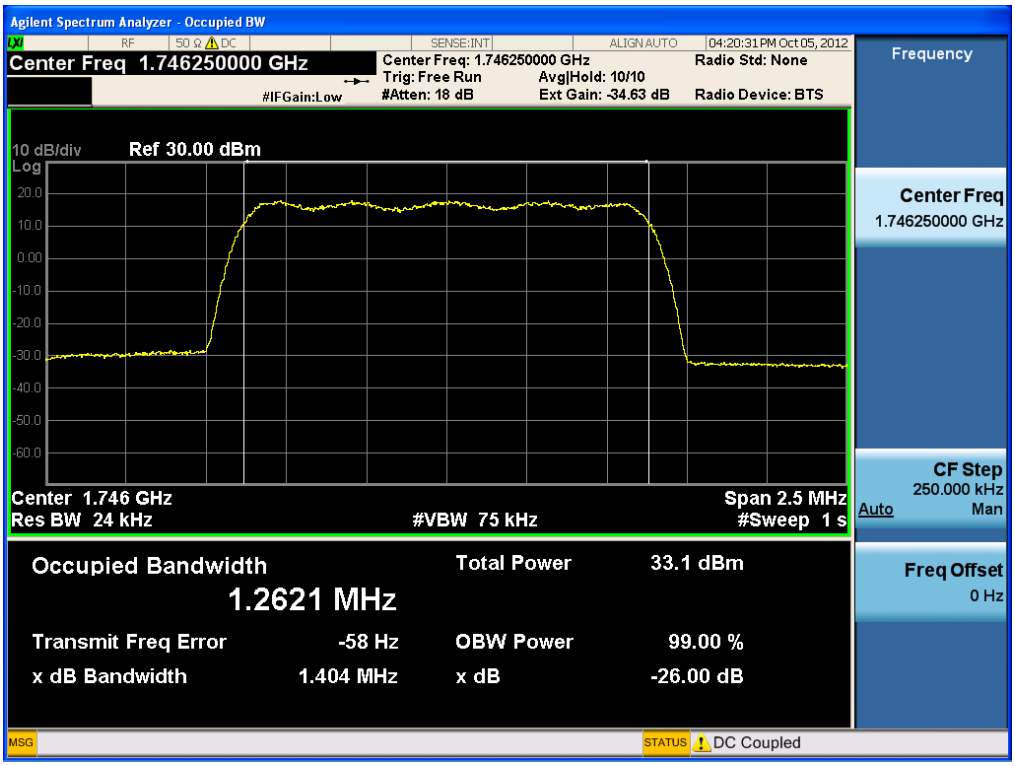
[Input LTE Downlink High_5MHz]



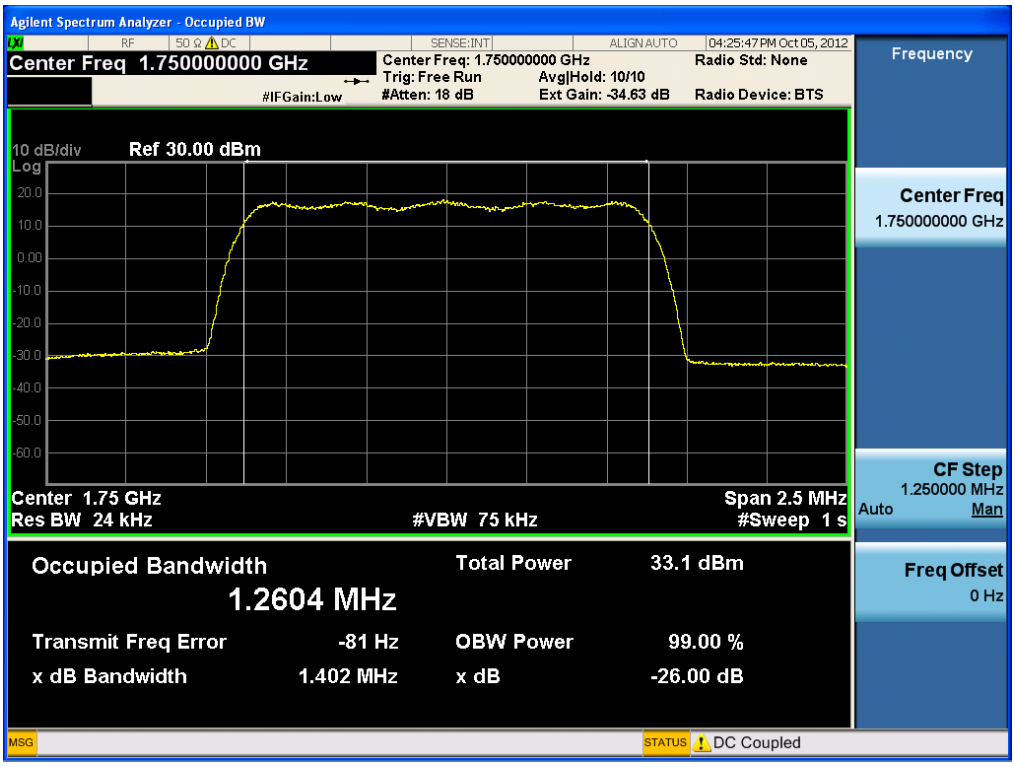
[Input LTE Downlink 10MHz]



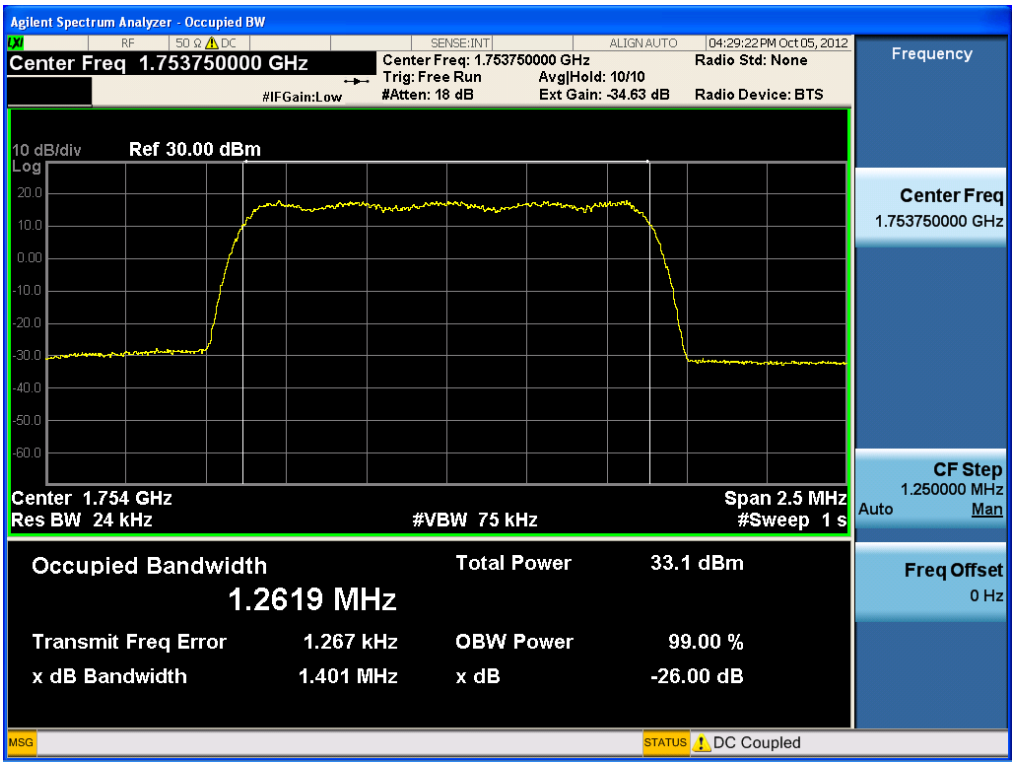
[Output CDMA Uplink Low]



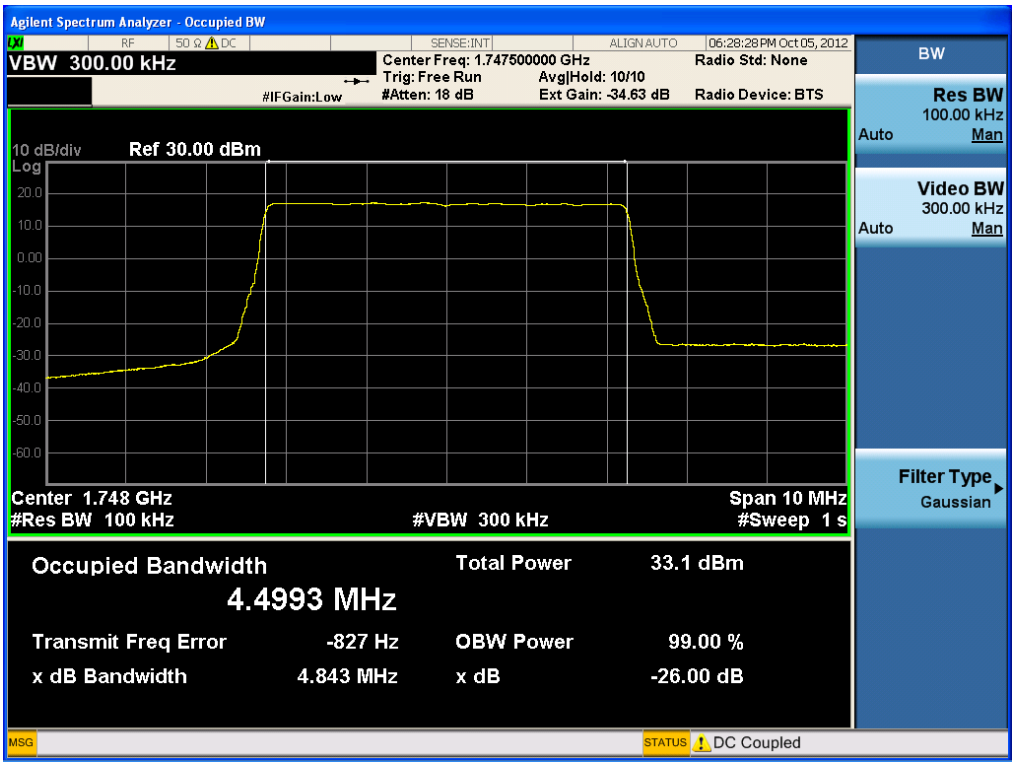
[Output CDMA Uplink Middle]



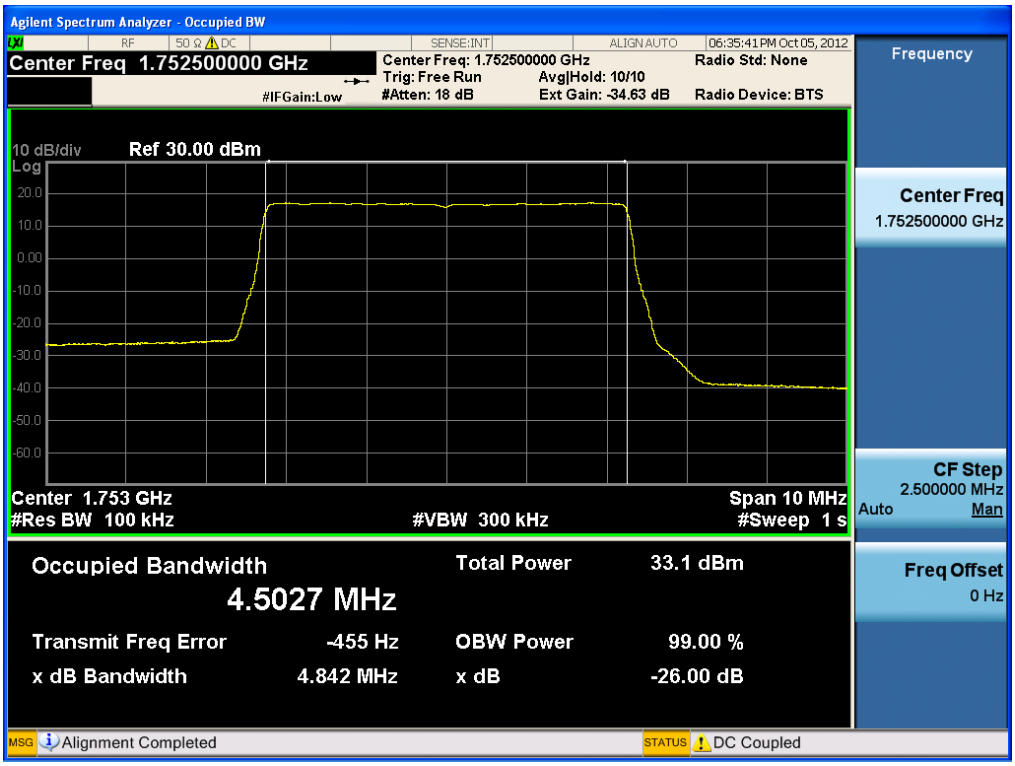
[Output CDMA Uplink High]



[Output LTE Uplink Low_5MHz]

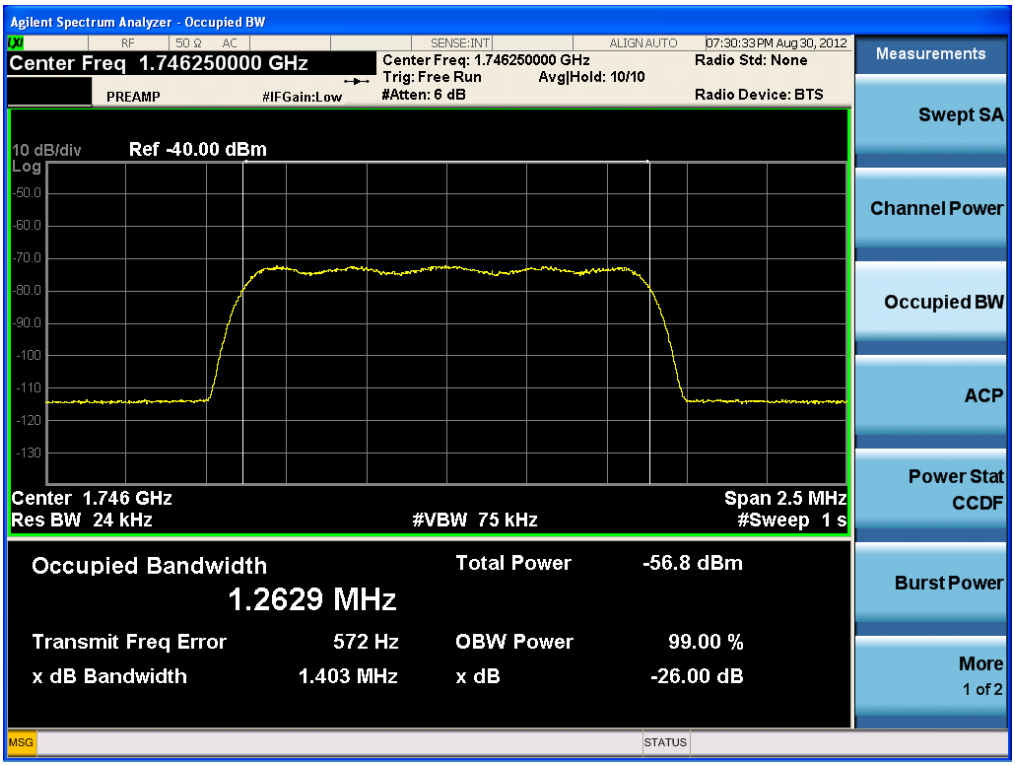


[Output LTE Uplink High_5MHz]

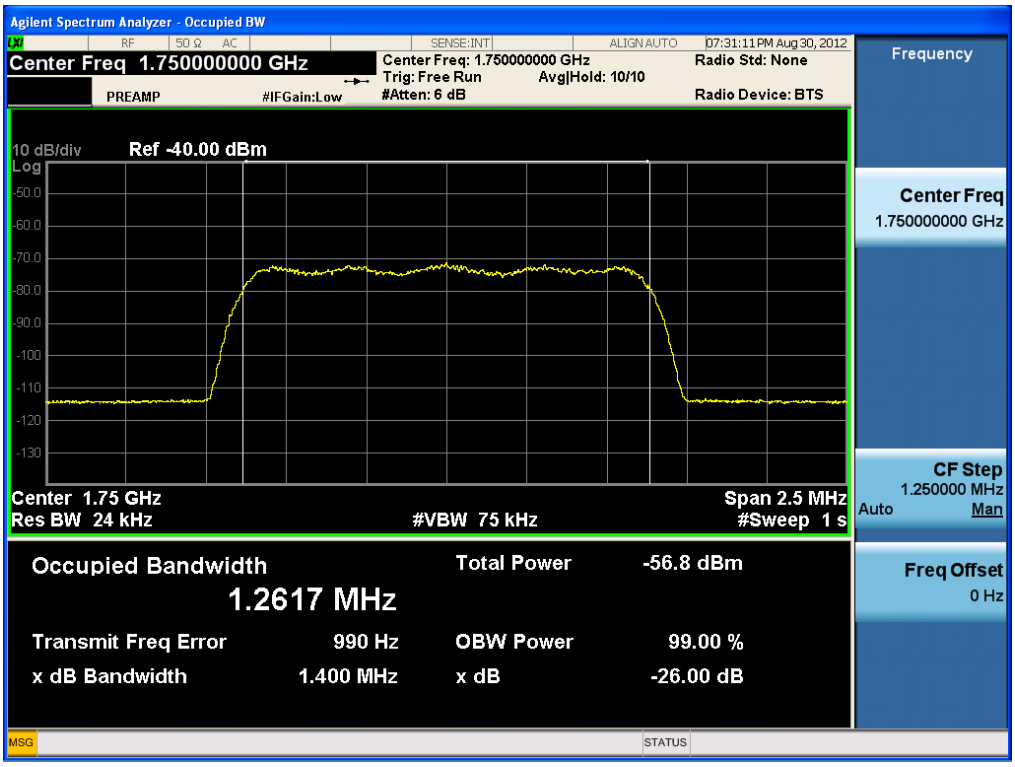


[Output LTE Uplink 10MHz]

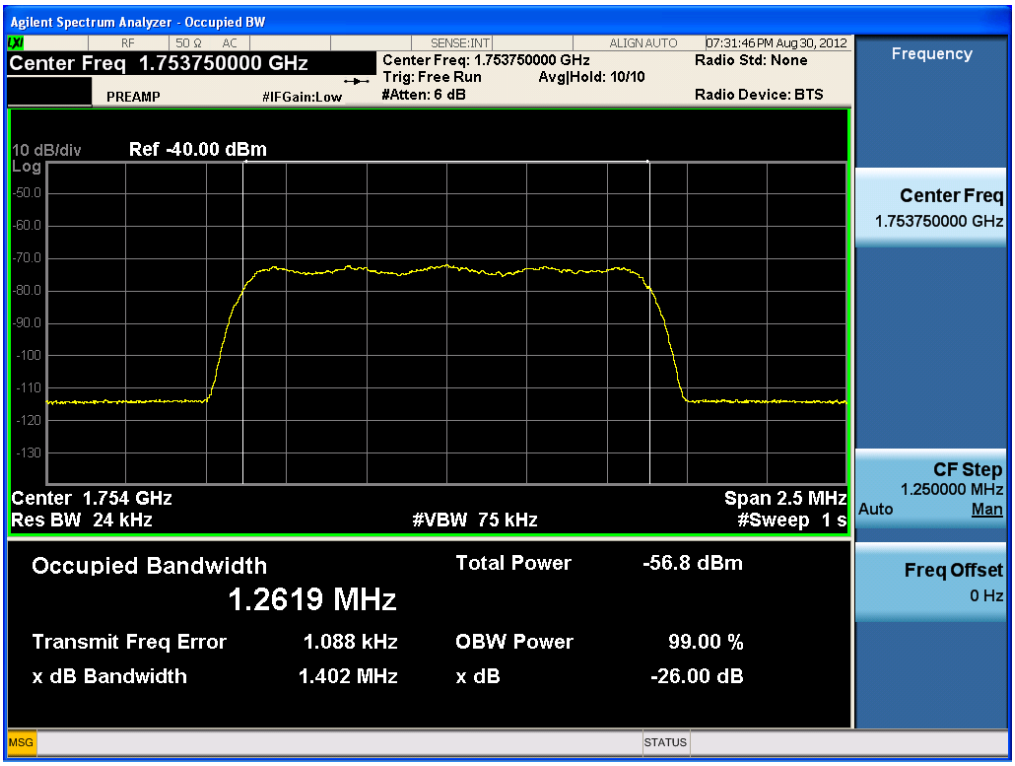
[Input CDMA Uplink Low]



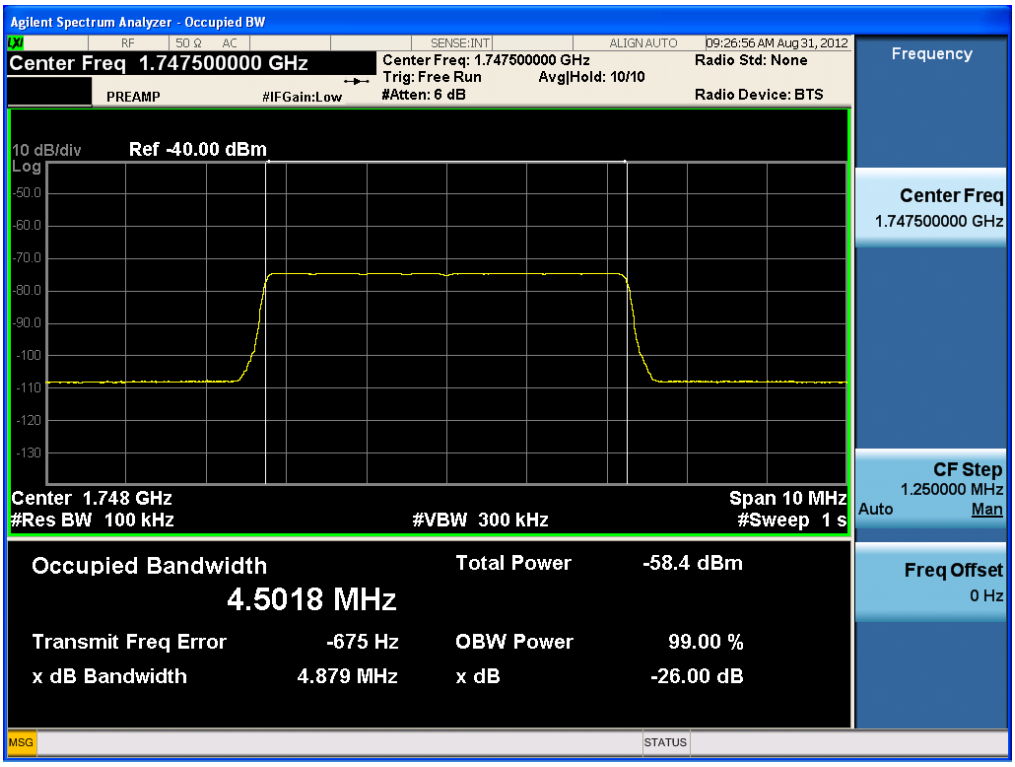
[Input CDMA Uplink Middle]



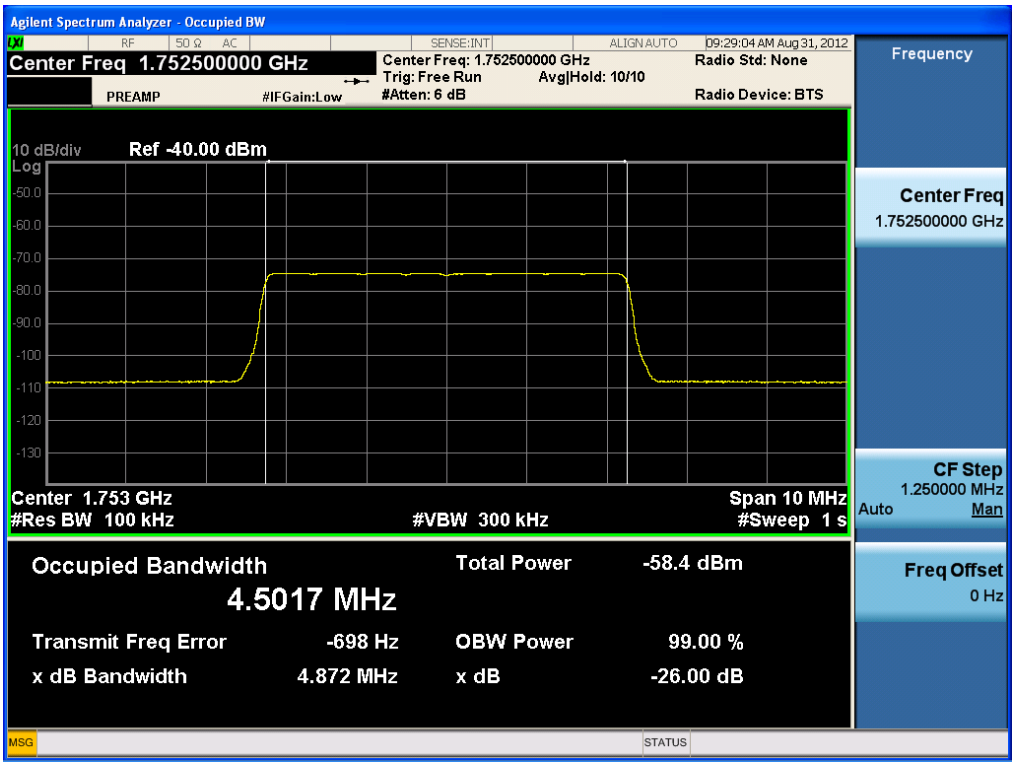
[Input CDMA Uplink High]



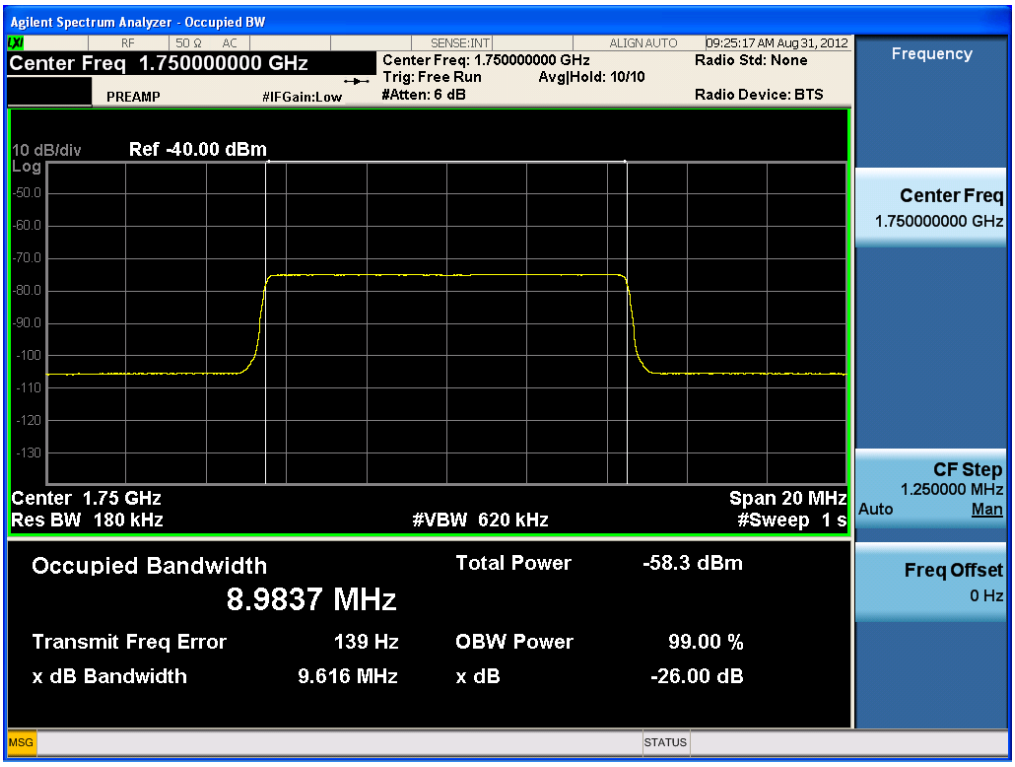
[Input LTE Uplink Low_5MHz]

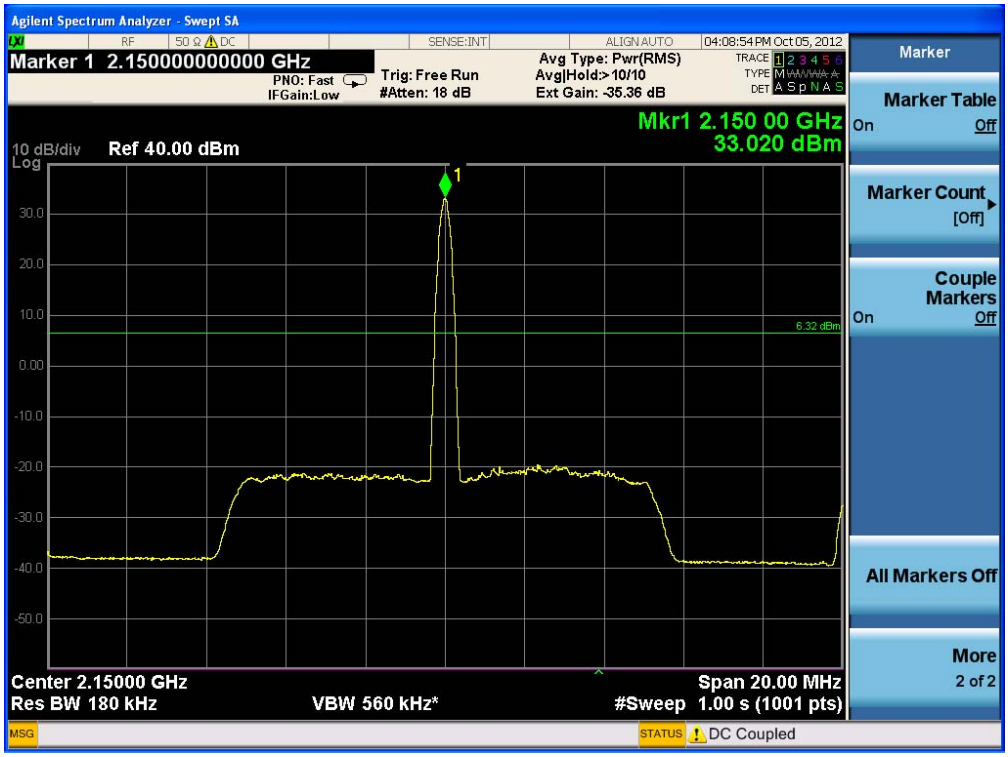


[Input LTE Uplink High_5MHz]

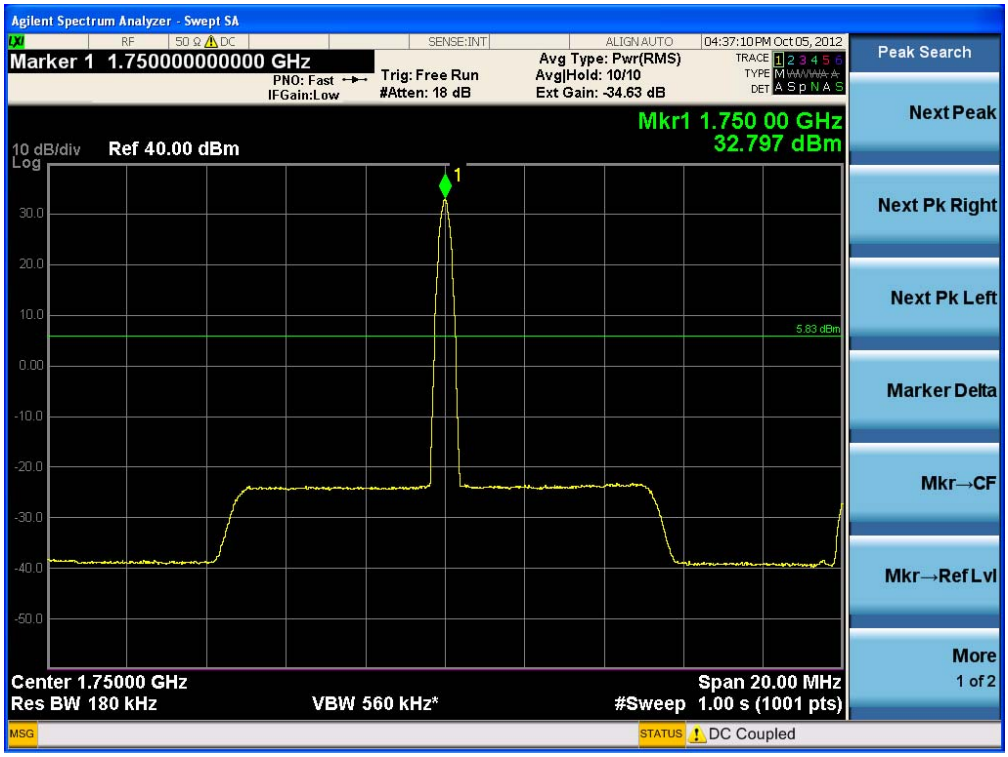


[Input LTE Uplink 10MHz]

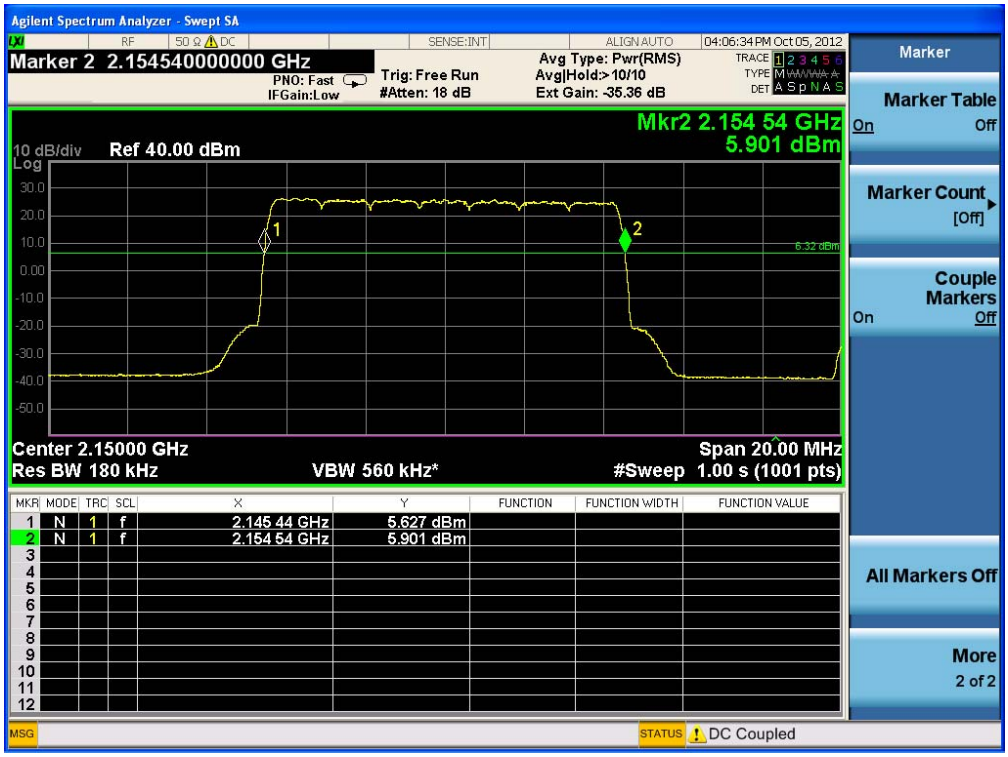




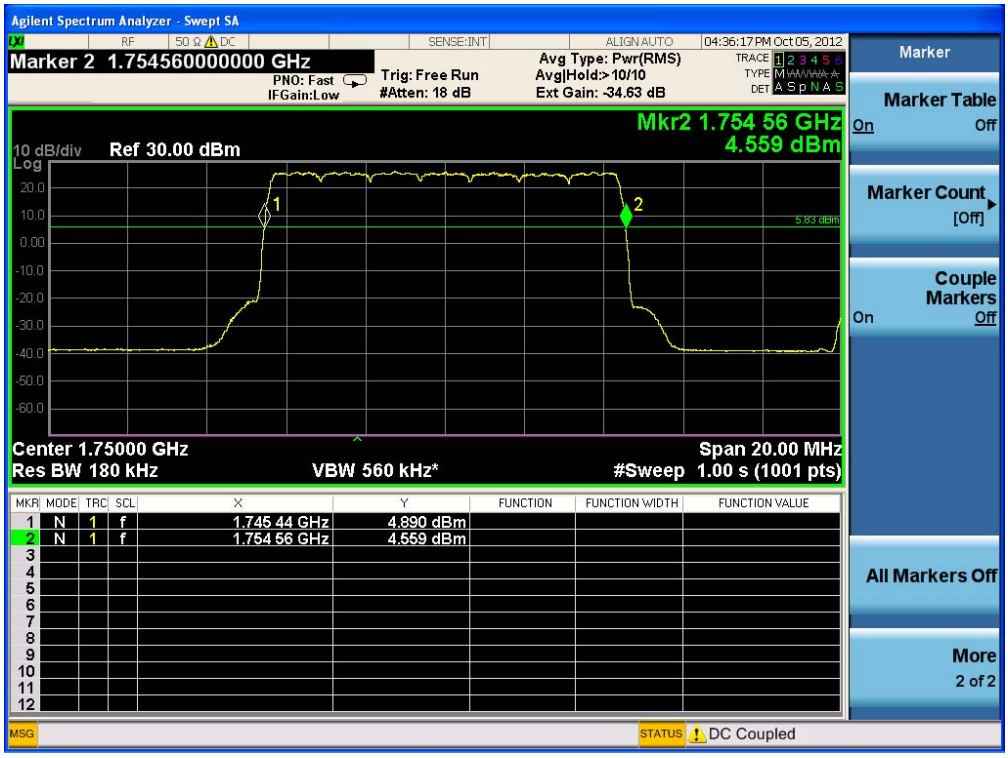
- **Downlink Passband Gain : 33.02- (-56.8) = 89.82 dB < nominal gain 90 dB**



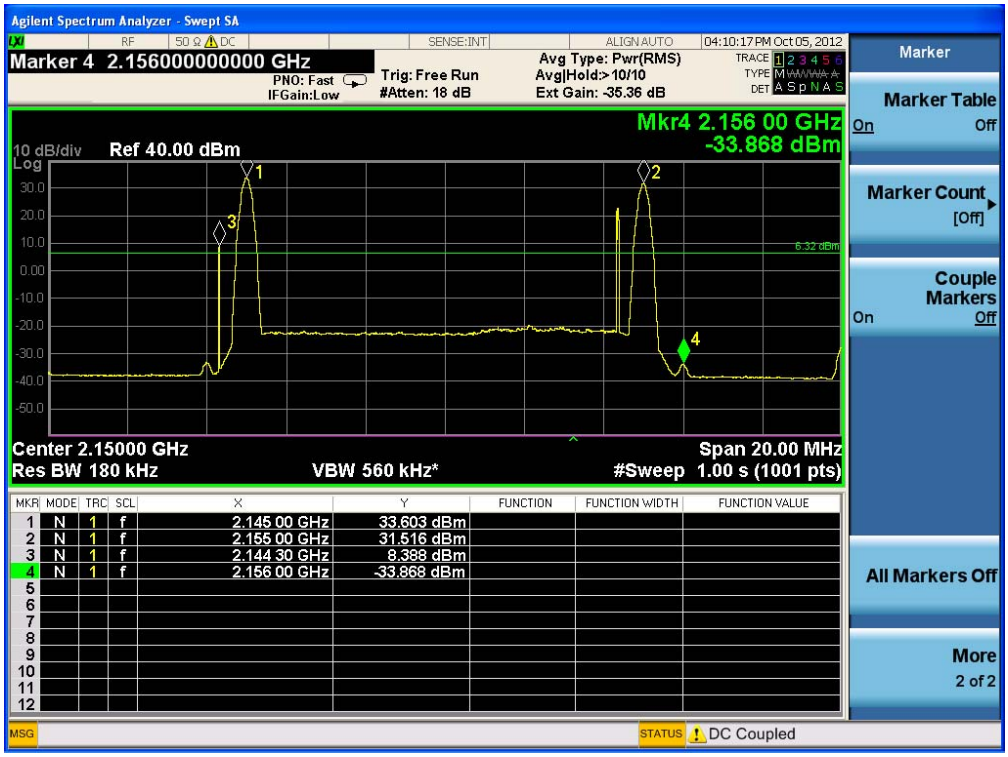
- **Uplink Passband Gain : 32.797- (-56.8) = 89.597 dB < nominal gain 90 dB**



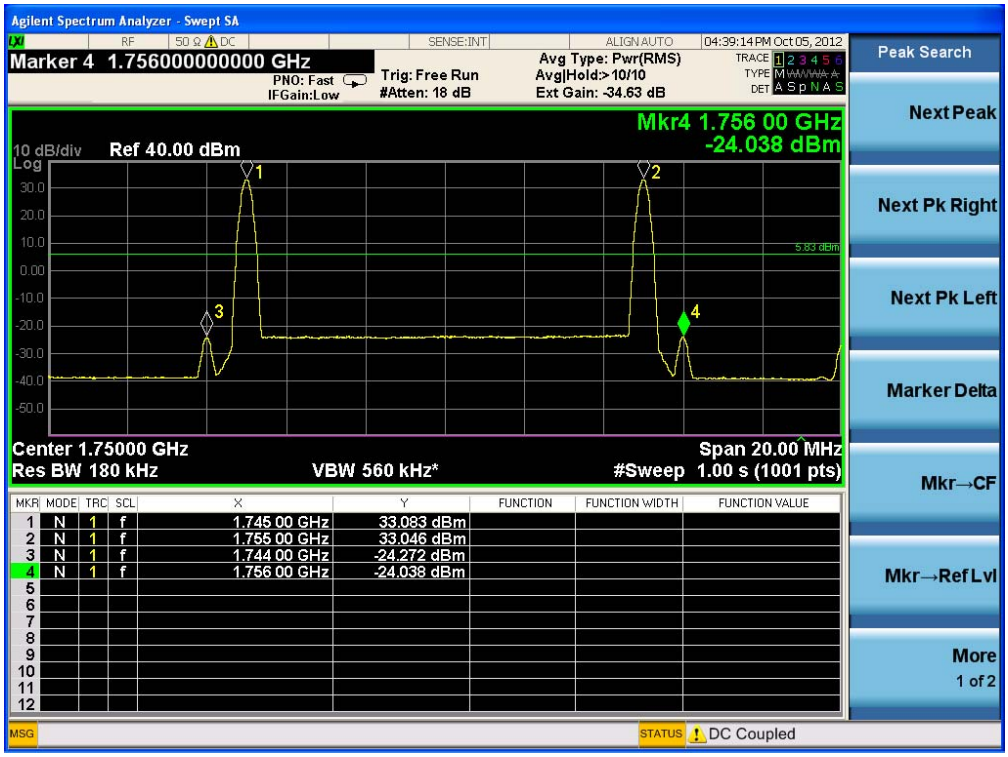
- **20 dB Bandwidth : 2154.54 – 2145.44 = 9.1 MHz < Nominal Bandwidth 10 MHz**



- **20 dB Bandwidth : 1754.56 – 1745.44 = 9.12 MHz < Nominal Bandwidth 10 MHz**



- **Out of 20 dB Bandwidth Gain is less than 20 dB Bandwidth Gain by 25.215 dB**



- **Out of 20 dB Bandwidth Gain is less than 20 dB Bandwidth Gain by 57.084 dB**

7. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

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.

§ 27.53 Emission limits

(h) For operations in the 1710-1755 MHz and 2110-2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}$ (P) dB.

(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(3) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

Test Requirement(s): RSS-GEN 4.9 Transmitter Unwanted Emissions , RSS-131 4.4 Spurious Emisson

The measurement method shall be described in the test report. The same parameter, peak power or average power, used for the transmitter output power measurement shall be used for unwanted emission measurements.

The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency), or from 30 MHz, whichever is the lower, to the 5th harmonic of the highest frequency

generated without exceeding 40 GHz.

Unless otherwise specified, compliance with the emission limits shall be demonstrated using a CISPR quasi-peak detector and the related measurement bandwidth for emissions below 1000 MHz and, an average detector with a minimum resolution bandwidth of 1 MHz for emissions above 1 GHz.

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.

The spectrum was investigated from 30 MHz to the 26.5 GHz of the carrier.

Test Results: The EUT complies with the requirements of this section. There were no detectable Spurious emissions for this EUT.

Sample Calculation

Output Power = Reading Value + ATT loss + Cable loss

1. Spectrum reading values are not plot data. The power results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss (35.36 dB at downlink, 34.63 dB at uplink)
3. Actual value of loss for the attenuator and cable combination is 35.36 dB at 2150 MHz , 35.34 dB at 2145 MHz, 35.36 dB at 2155 MHz, 34.63 dB at 1750 MHz, 34.61 dB at 1745 MHz, and 34.65 dB at 1755 MHz.

※ The Test Report's Intermodulation test result was executed at Maximum gain setting mode because it is a little worst case for the EUT.