HCT CO.,LTD

74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 FAX: +82-31-645-6401

FCC REPORT

Certification

Applicant Name:
FRTEK CO., LTD.

Address:
1001, Doosan Venture Digm, 415, Heungandaero,
Dongan-Gu, Anyang-Si, Gyeonggi-do, 431-755 Korea

Date of Issue:
December 30, 2016

Test Site/Location:
HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-R-1612-F074

HCT FRN: 0005866421

ISED Registration Number: 5944A-5

FCC ID:	**2AFEGFRRLRL45US**
APPLICANT:	**FRTEK CO., LTD.**

FCC Model(s):	FR-RLRL45US
EUT Type:	1.9GHz ICS Repeater
Frequency Ranges :	DL: 1 930 MHz ~ 1 995 MHz /
	UL:1 850 MHz ~ 1 915 MHz
Conducted Output Power:	Downlink 20 W / Uplink 2 W
Date of Test:	September 07, 2016 ~ December 28, 2016
FCC Rule Part(s):	CFR 47 Part 2, Part 24

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 90 of the FCC Rules under normal use and maintenance.

Report prepared by
: Jung Lae Cho
Test engineer of RF Team

Approved by
: Jong Seok Lee
Manager of RF Team

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1612-F074	December 30, 2016	- First Approval Report

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company	FRTEK CO., LTD. 1001, Doosan Venture Digm, 415, Heungandaero, Dongan-Gu, Anyang-Si, Gyeonggi-do, 431-755 Korea

FCC ID:	2AFEGFRRLRL45US
EUT Type:	1.9GHz ICS Repeater
FCC Model(s):	FR-RLRL45US
Power Supply:	AC 110V ~ 240V
Frequency Ranges :	DL: 1 930 MHz ~ 1 995 MHz / UL:1 850 MHz ~ 1 915 MHz
Conducted Output Power:	Downlink 20 W / Uplink 2 W
Antenna Gain(s):	Manufacturer does not provide an antenna.
Measurement standard(s):	ANSI/TIA-603-C-2004, KDB 971168 D01 v02r02 KDB 935210 D02 v03r02, KDB 935210 D05 v01r01
FCC Rule Part(s):	CFR 47 Part 2, Part 24
Place of Tests:	HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA (ISED Registration Number : 5944A-5)

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, 17383, Rep. of 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 July 07, 2015 (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 SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 24.

Description	Reference (FCC)	Results
Conducted RF Output Power	§2.1046, §24.232	Compliant
Occupied Bandwidth	§2.1049	Compliant
Passband Gain and Bandwidth & Out of Band Rejection	KDB 935210 D05 v01r01	Compliant
Spurious Emissions at Antenna Terminals	§2.1051, §24.238	Compliant
Radiated Spurious Emissions	§2.1053, §24.238	Compliant
Frequency Stability	§2.1055, §24.235	N/A The EUT does not perform frequency translation

3.2. MODE OF OPERATION DURING THE TEST

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.

The device does not supply antenna(s) with the system, so the dummy loads were connected to the RF output ports for radiated spurious emission testing.

3.3. MAXIMUM MEASUREMENT UNCERTAINTY

The value of the measurement uncertainty for the measurement of each parameter.

Coverage factor *k* = 2, Confidence levels of 95 %

Description	Condition	Uncertainty
Conducted RF Output Power	-	± 0.72 dB
Occupied Bandwidth	OBW ≤ 20 MHz	± 52 kHz
Passband Gain and Bandwidth & Out of Band Rejection	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Spurious Emissions at Antenna Terminals	-	± 1.08 dB
Radiated Spurious Emissions	f ≤ 1 GHz f > 1 GHz	± 4.80 dB ± 6.07 dB
Frequency Stability	-	± 1.22 x 10^{-6}

4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

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

5. TEST EQUIPMENT

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	E4438C /Signal Generator	09/02/2016	Annual	MY42082646
Agilent	N5182A /Signal Generator	03/29/2016	Annual	MY50141649
Agilent	N5182A /Signal Generator	05/13/2016	Annual	MY47070230
Agilent	N9030A / Spectrum Analyzer	11/30/2016	Annual	MY49431210
Weinschel	67-30-33 / Fixed Attenuator	02/16/2016	Annual	CC7264
Weinschel	1506A / Power Divider	02/15/2016	Annual	MD793
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/06/2016	Annual	1003030-1
NANGYEUL CO., LTD.	NY-THR18750 / Temperature and Humidity Chamber	10/21/2016	Annual	NY-2009012201A
Innco system	MA4000-EP / Antenna Position Tower	N/A	N/A	N/A
Innco system	CT0800 / Turn Table	N/A	N/A	N/A
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
ETS	2090 / Controller(Turn table)	N/A	N/A	1646
Rohde&Schwarz	Loop Antenna	02/23/2016	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/15/2015	Biennial	255
Schwarzbeck	BBHA 9120D / Horn Antenna	12/11/2015	Biennial	9120D-1191
Rohde & Schwarz	FSP / Spectrum Analyzer	09/29/2016	Annual	836650/016
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/23/2016	Annual	101068-SZ
Wainwright Instruments	WHK1.2/15G-10EF / Highpass Filter	04/11/2016	Annual	4
Wainwright Instruments	WHK3.0/18G-10EF / Highpass Filter	06/24/2016	Annual	8
CERNEX	CBLU1183540 / Power Amplifier	02/01/2016	Annual	24614
CERNEX	CBL06185030 / Power Amplifier	02/01/2016	Annual	24615
CERNEX	CBL18265035 / Power Amplifier	07/11/2016	Annual	22966

6. RF OUTPUT POWER

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output:

(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.

(b) For single sideband, independent sideband, and single channel, controlled carrier radio telephone 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.

(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)(1) Base stations with an emission bandwidth of 1 MHz or less are limited to 1640 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(2) Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; *see* Tables 1 and 2 of this section.

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

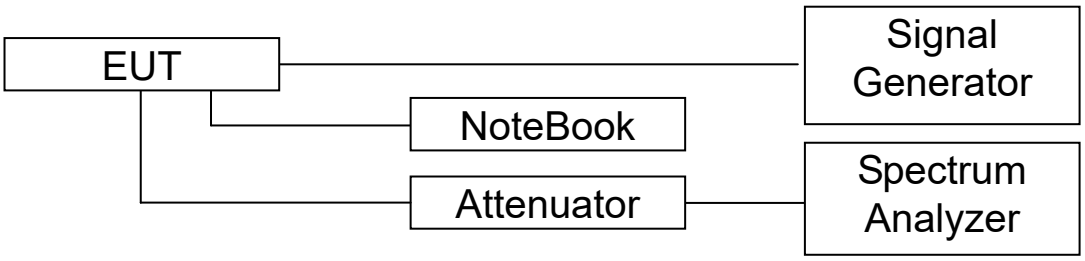
Test Procedures:

Measurements were in accordance with the test methods section 3.5.2 of KDB 935210 D05 v01r01.

a) Connect a signal generator to the input of the EUT.
b) Configure to generate the AWGN (broadband) test signal.
c) The frequency of the signal generator shall be set to the frequency f0 as determined from 3.3.
d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.
f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.
g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.
h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.
i) Repeat steps e) to h) with the narrowband test signal.
j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.

Power measurement Method :

Guidance for performing input/output power measurements using a spectrum or signal analyzer is provided in 5.2 of KDB Publication 971168 D01 v02r02.



Block Diagram 1. RF Power Output Test Setup

Test Results:

Input Signal	Input Level (dBm)		Maximum Amp Gain	
	DL	UL	DL	UL
LTE 5 MHz	-62	-72	105	
LTE 10 MHz				
CDMA				

Single channel Enhancer

* Due to EUT's ALC function (Auto Level Control), even if input signal is increased,

The same output power is transmit.

[Downlink]

	Channel	**Frequency (MHz)**	**Output Power**	
			(dBm)	**(W)**
LTE 5 MHz_ AGC threshold	Low	1932.50	43.01	19.994
	Middle	1962.50	43.00	19.960
	High	1992.50	43.01	20.001
LTE 5 MHz_ +3dB above AGC threshold	Low	1932.50	43.53	22.537
	Middle	1962.50	43.08	20.317
	High	1992.50	43.07	20.260
LTE 10 MHz_ AGC threshold	Low	1935.00	43.04	20.156
	Middle	1962.50	43.01	19.991
	High	1990.00	43.08	20.324
LTE 10 MHz_ +3dB above AGC threshold	Low	1935.00	43.98	25.027
	Middle	1962.50	43.50	22.408
	High	1990.00	43.03	20.078

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
CDMA_ AGC threshold	Low	1931.25	43.05	20.164
	Middle	1962.50	43.04	20.149
	High	1993.75	43.03	20.097
CDMA_ +3dB above AGC threshold	Low	1931.25	43.15	20.650
	Middle	1962.50	43.21	20.928
	High	1993.75	43.24	21.079

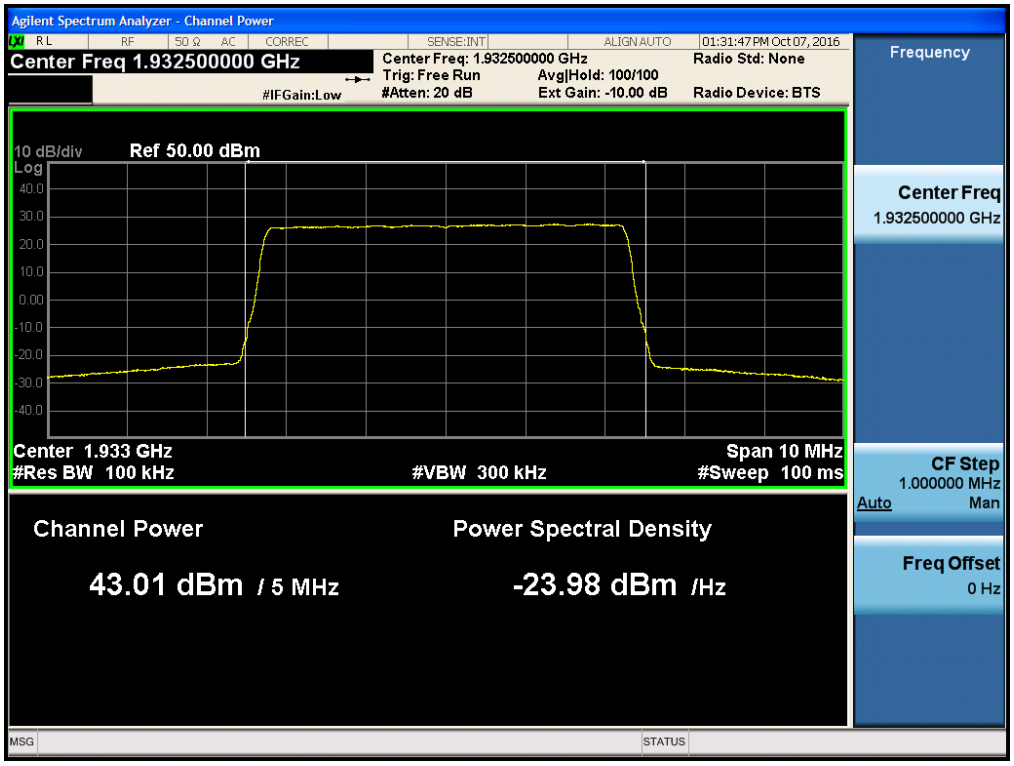
[Uplink]

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
LTE 5 MHz_ AGC threshold	Low	1852.50	33.09	2.039
	Middle	1882.50	33.10	2.042
	High	1912.50	33.01	2.000
LTE 5 MHz_ +3dB above AGC threshold	Low	1852.50	33.15	2.065
	Middle	1882.50	33.10	2.043
	High	1912.50	34.15	2.602
LTE 10 MHz_ AGC threshold	Low	1855.00	33.04	2.015
	Middle	1882.50	33.06	2.025
	High	1910.00	33.09	2.035
LTE 10 MHz_ +3dB above AGC threshold	Low	1855.00	34.11	2.575
	Middle	1882.50	34.01	2.521
	High	1910.00	34.34	2.714
CDMA_ AGC threshold	Low	1851.25	33.06	2.024
	Middle	1882.50	33.07	2.026
	High	1913.75	33.03	2.007
CDMA_ +3dB above AGC threshold	Low	1851.25	33.04	2.015
	Middle	1882.50	33.06	2.023
	High	1913.75	33.66	2.321

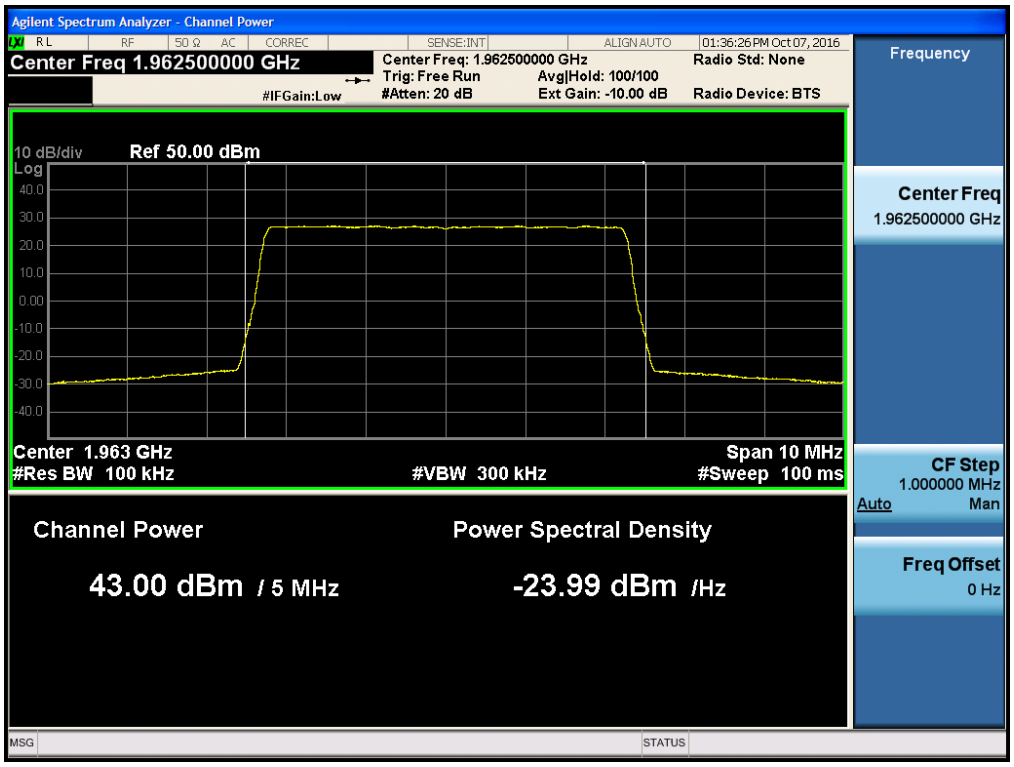
Single channel Enhancer Plots of RF Output Power

LTE 5 MHz DL

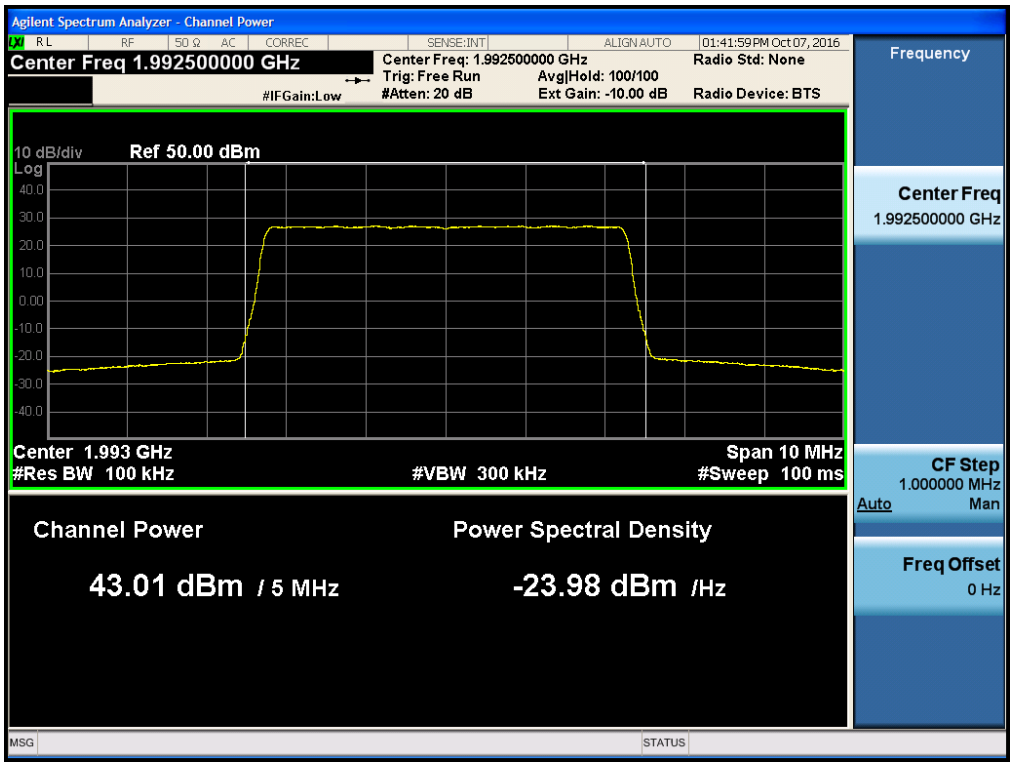
[LTE 5 MHz AGC threshold Downlink Low]



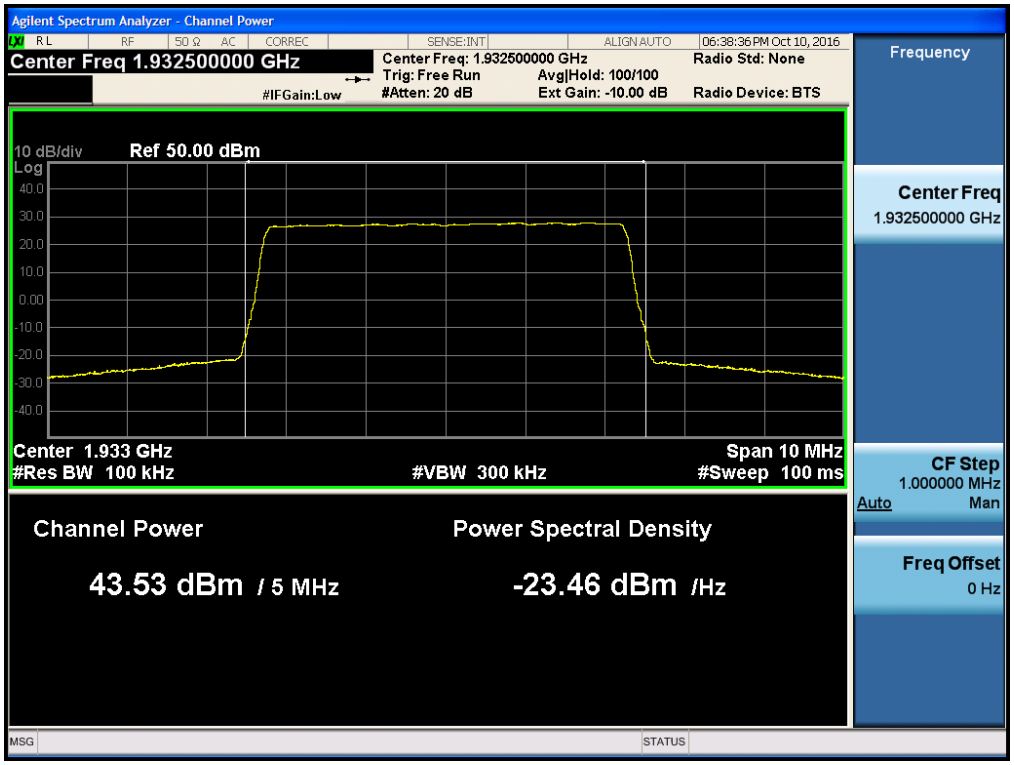
[LTE 5 MHz AGC threshold Downlink Middle]



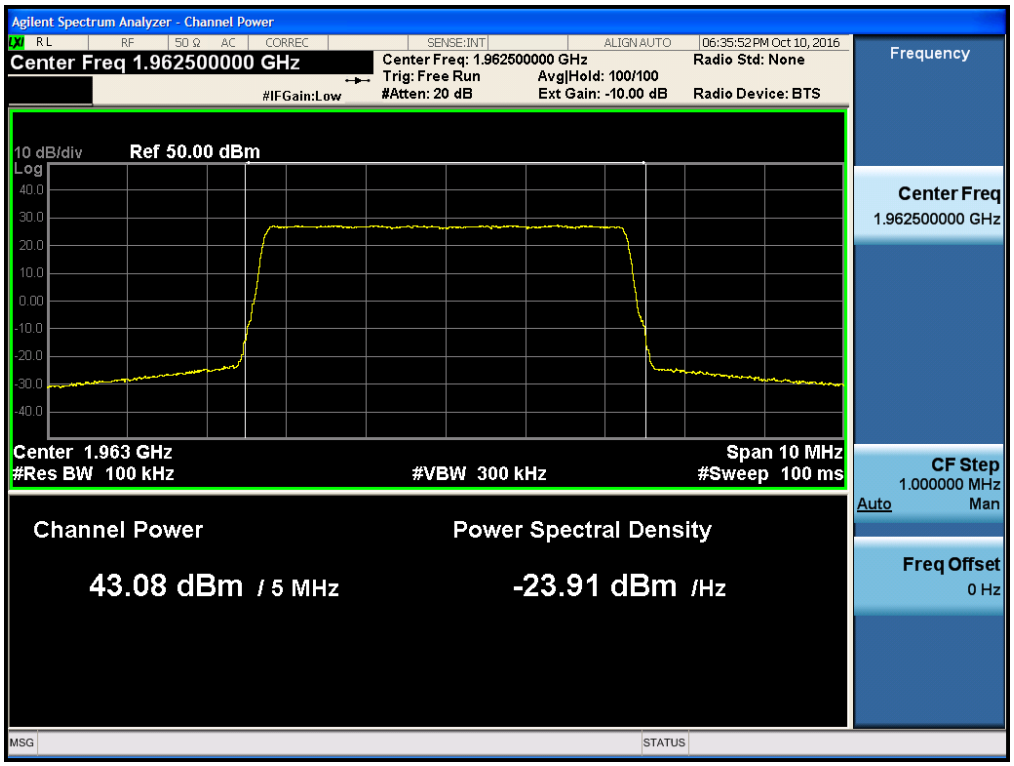
[LTE 5 MHz AGC threshold Downlink High]



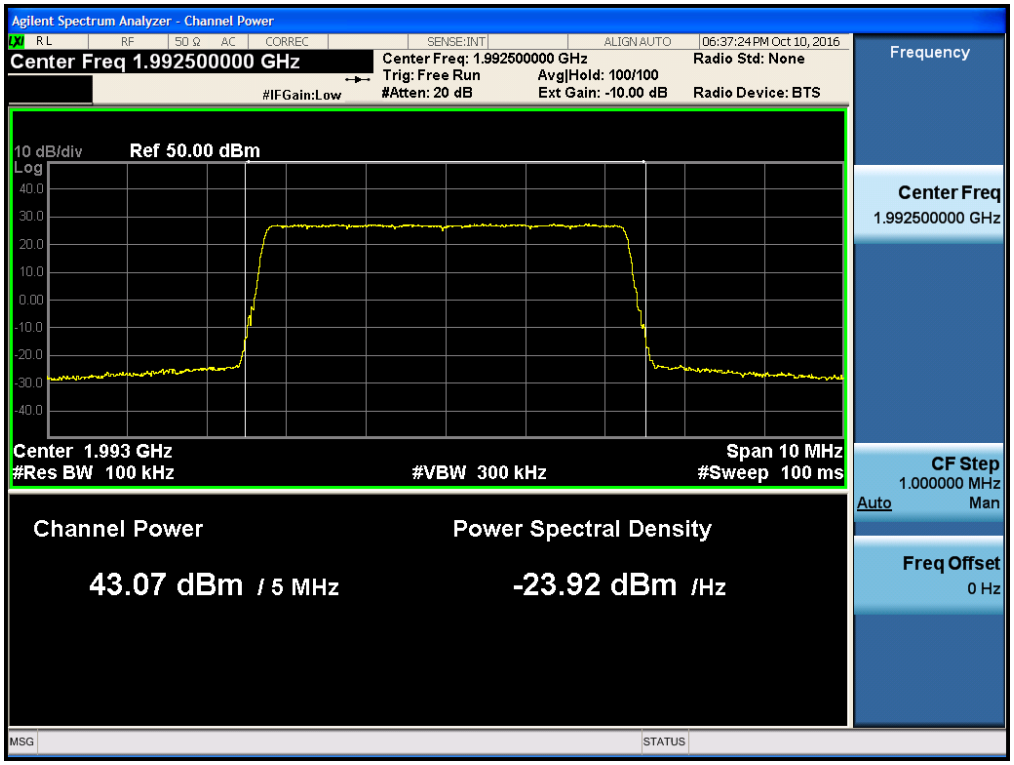
[LTE 5 MHz +3dB above the AGC threshold Downlink Low]



[LTE 5 MHz +3dB above the AGC threshold Downlink Middle]

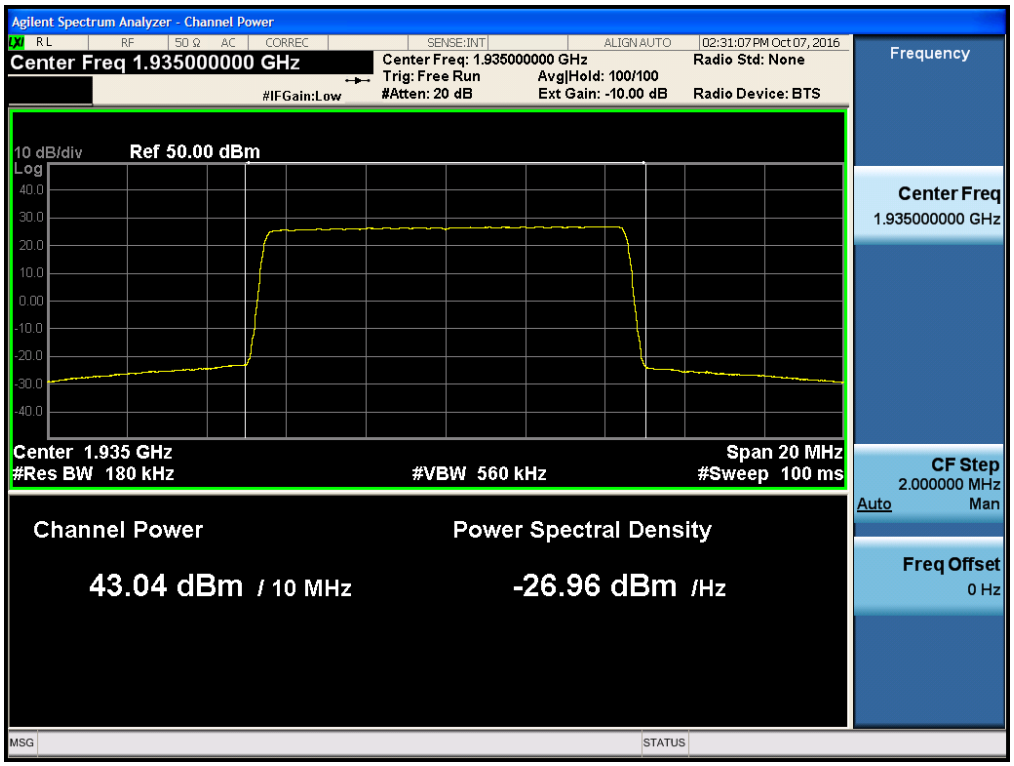


[LTE 5 MHz +3dB above the AGC threshold Downlink High]

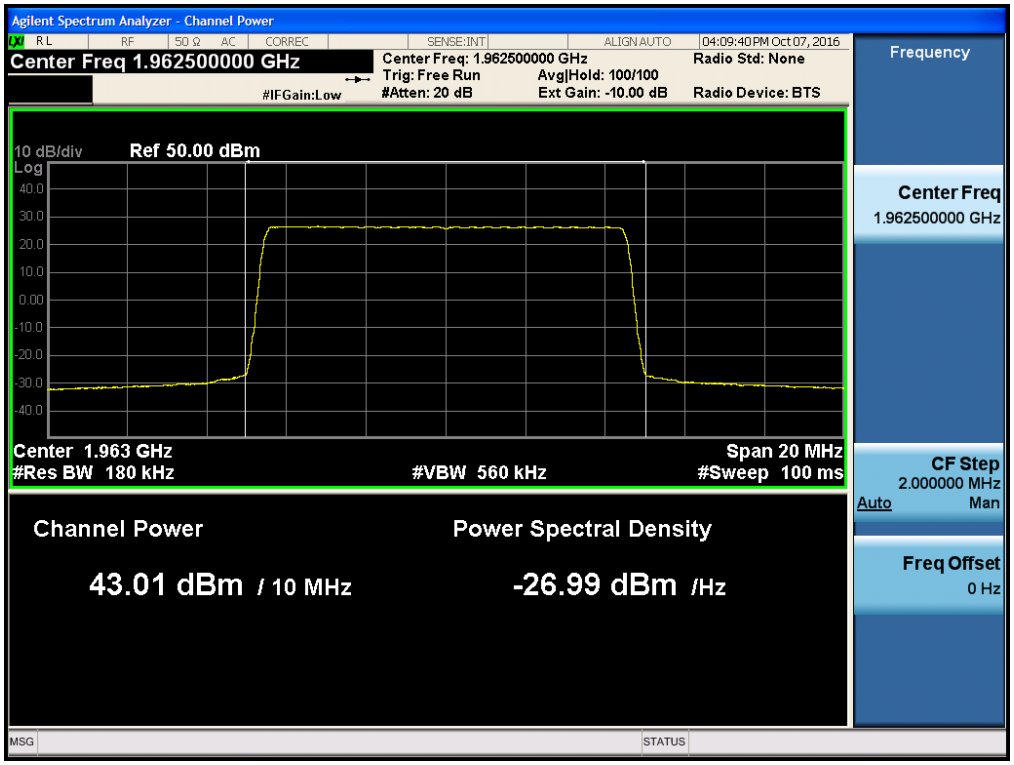


LTE 10 MHz DL

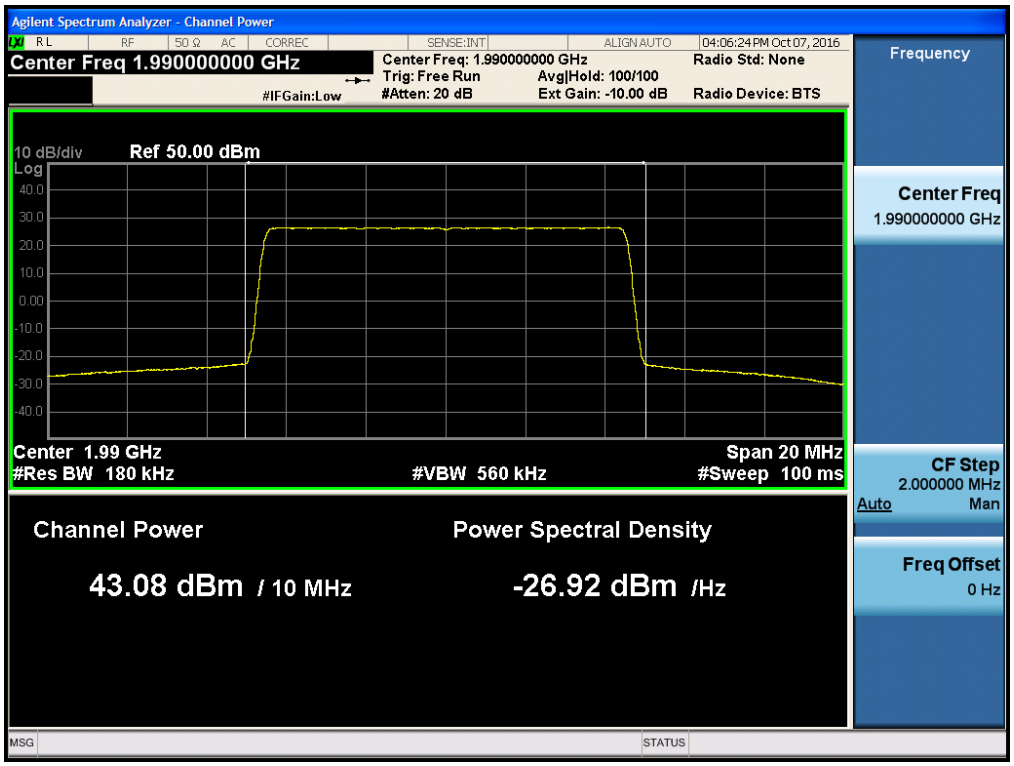
[LTE 10 MHz AGC threshold Downlink Low]



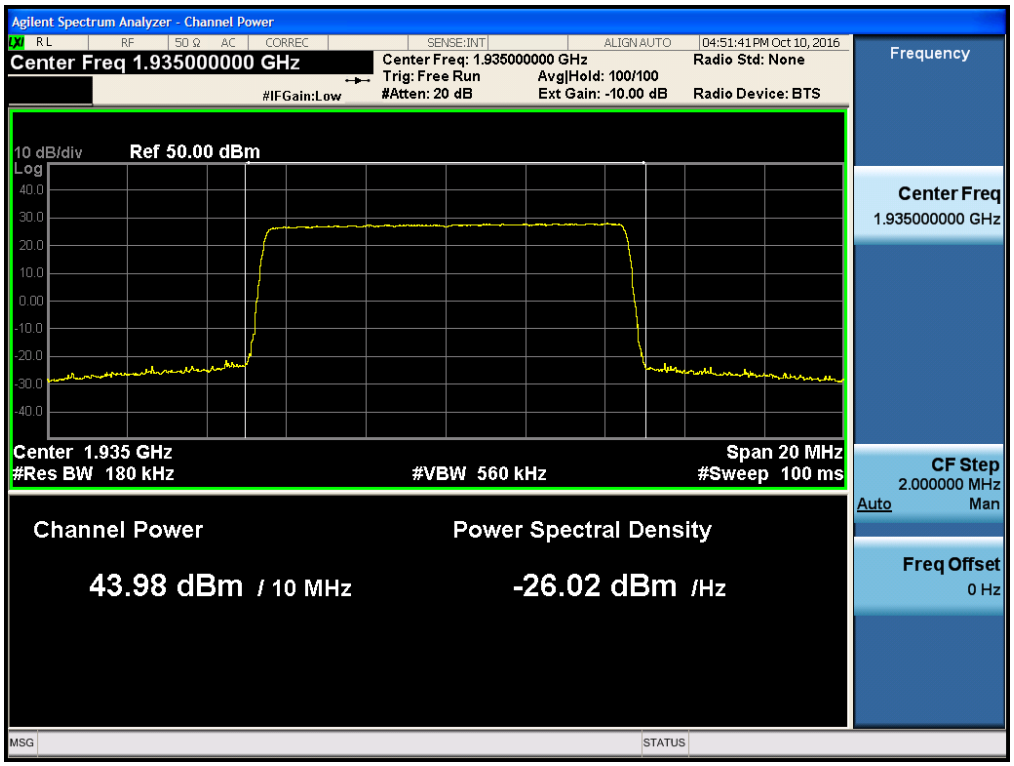
[LTE 10 MHz AGC threshold Downlink Middle]



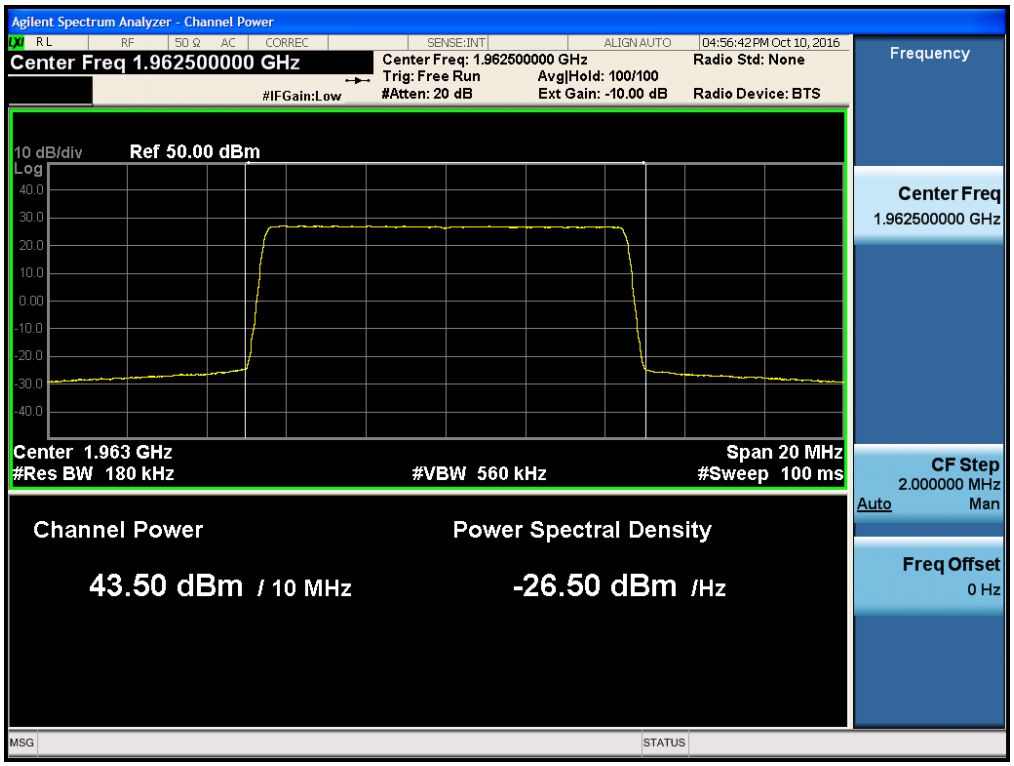
[LTE 10 MHz AGC threshold Downlink High]



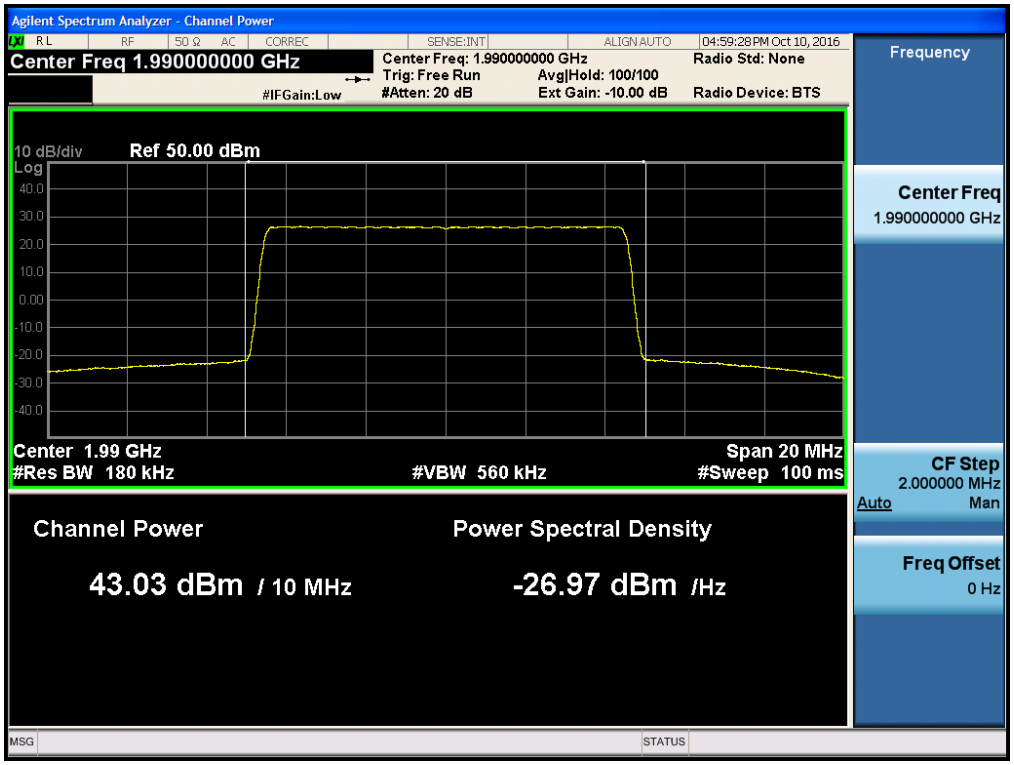
[LTE 10 MHz +3dB above the AGC threshold Downlink Low]



[LTE 10 MHz +3dB above the AGC threshold Downlink Middle]

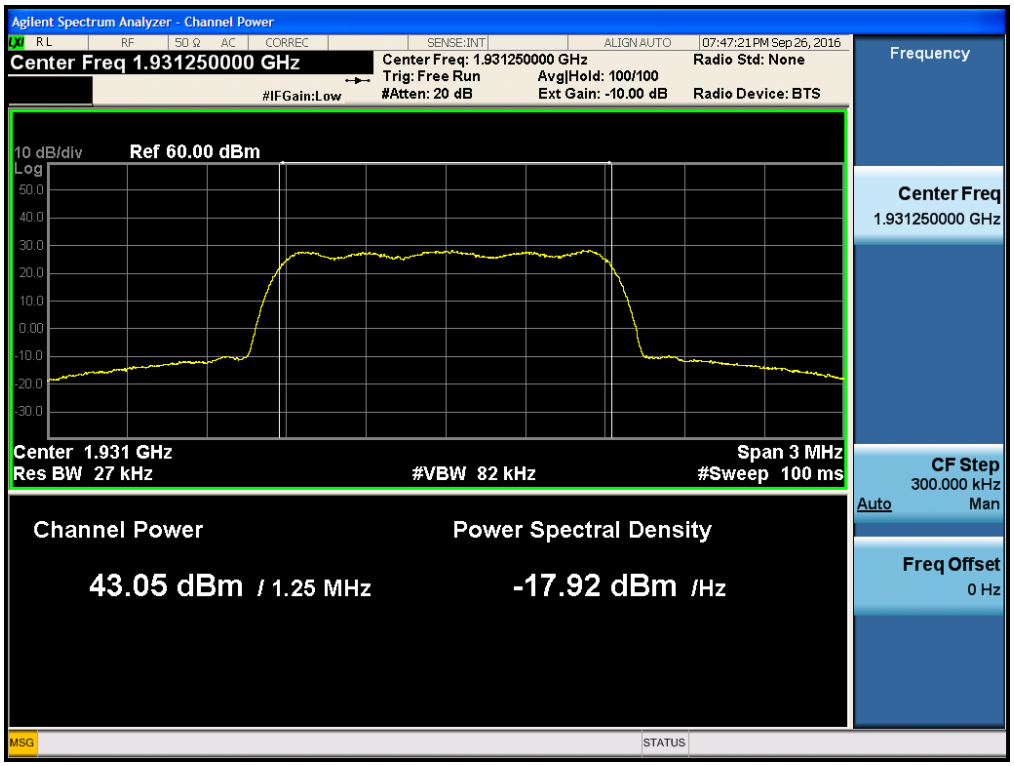


[LTE 10 MHz +3dB above the AGC threshold Downlink High]

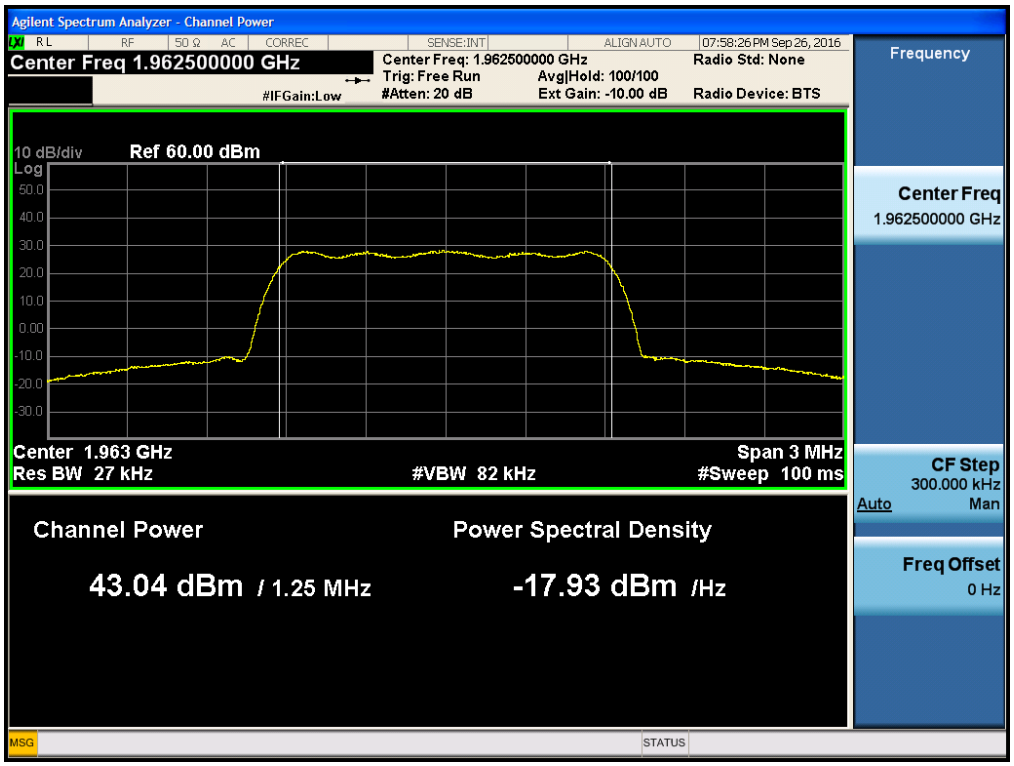


CDMA DL

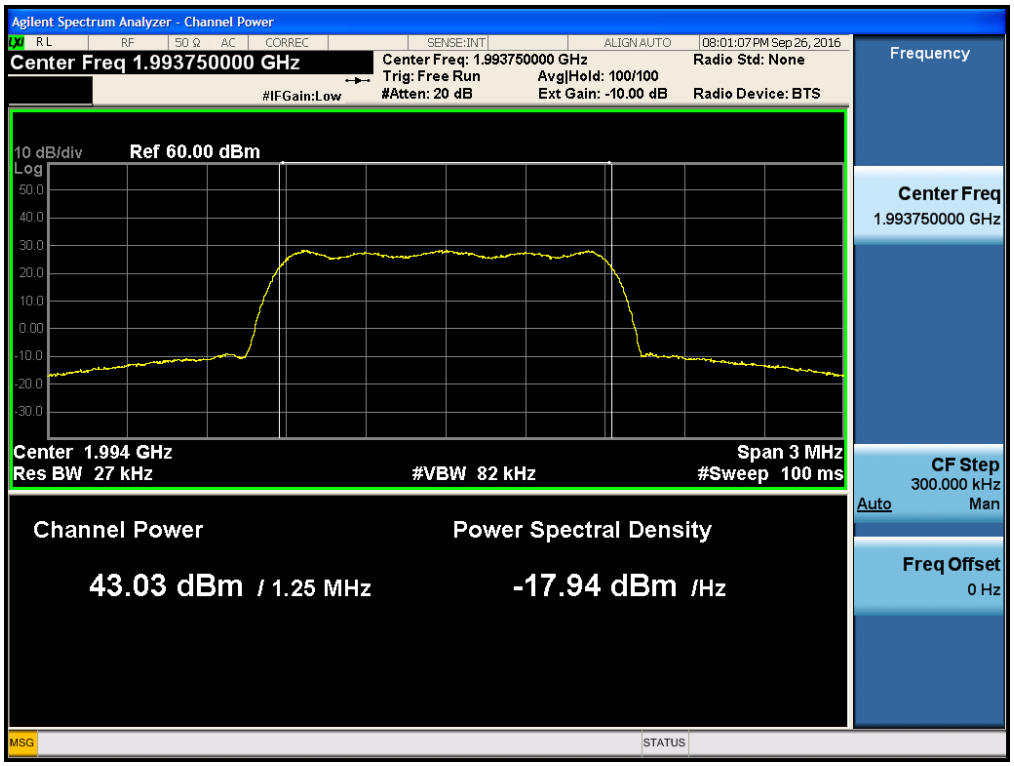
[CDMA AGC threshold Downlink Low]



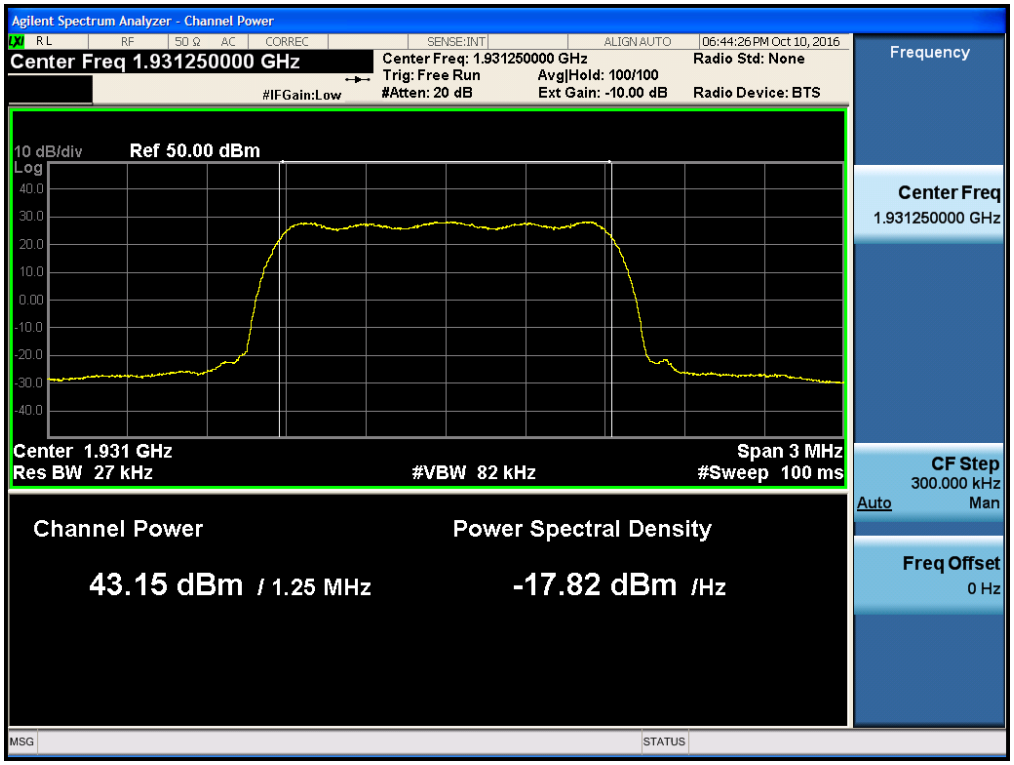
[CDMA AGC threshold Downlink Middle]



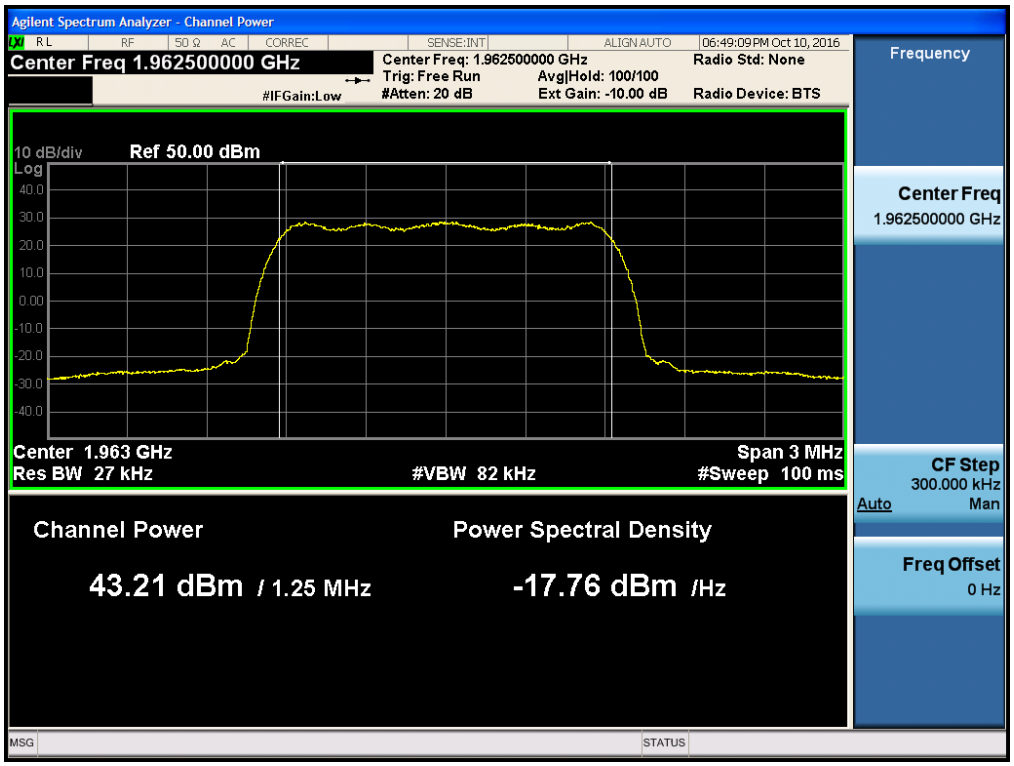
[CDMA AGC threshold Downlink High]



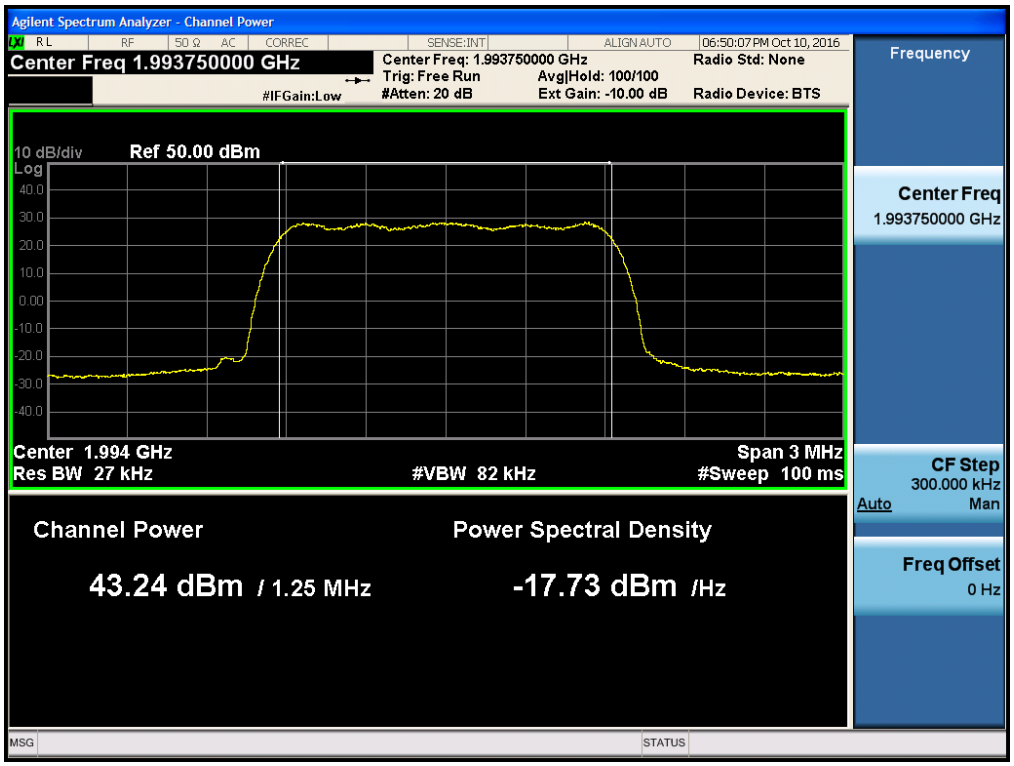
[CDMA +3dB above the AGC threshold Downlink Low]



[CDMA +3dB above the AGC threshold Downlink Middle]

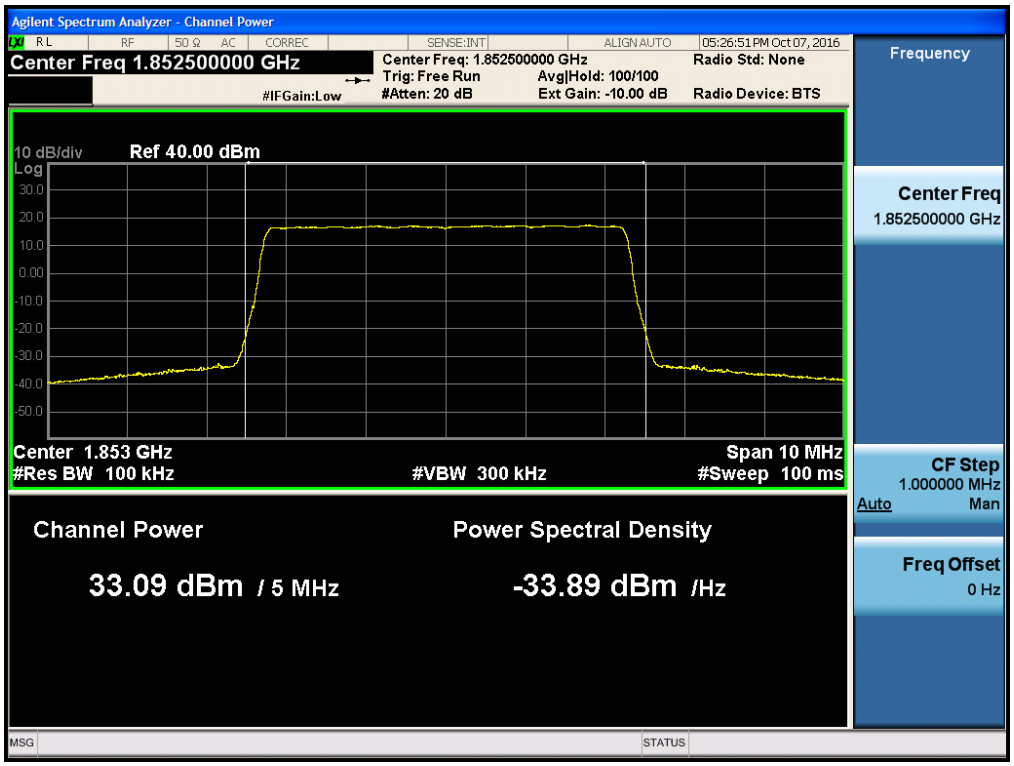


[CDMA +3dB above the AGC threshold Downlink High]

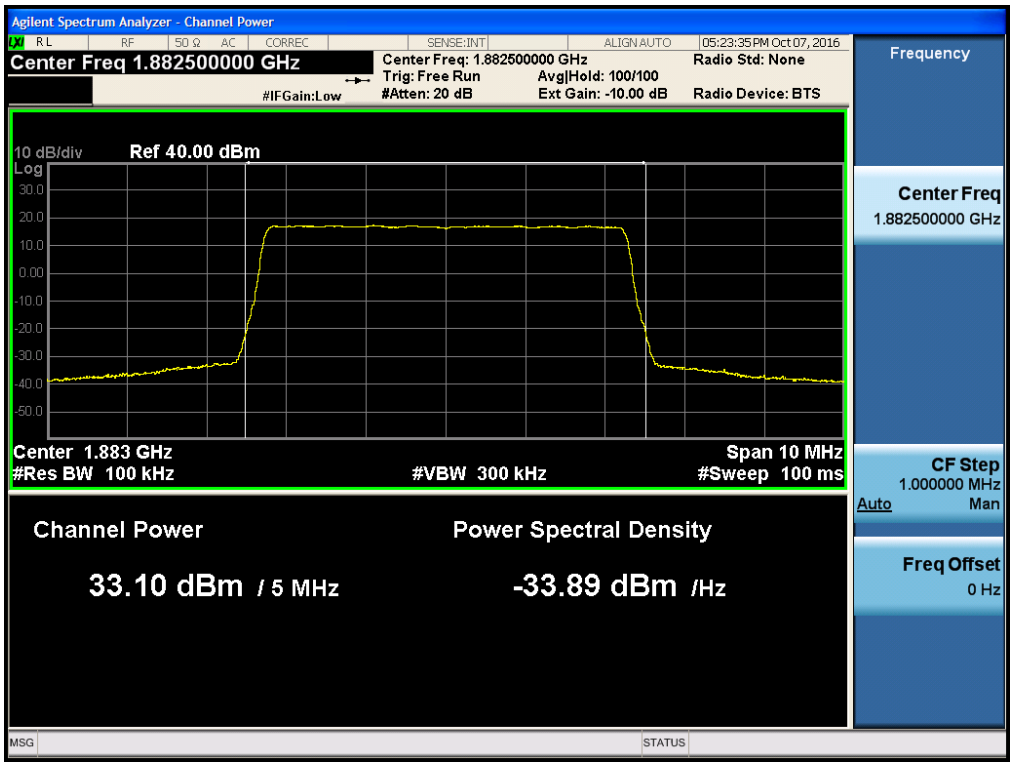


LTE 5 MHz UL

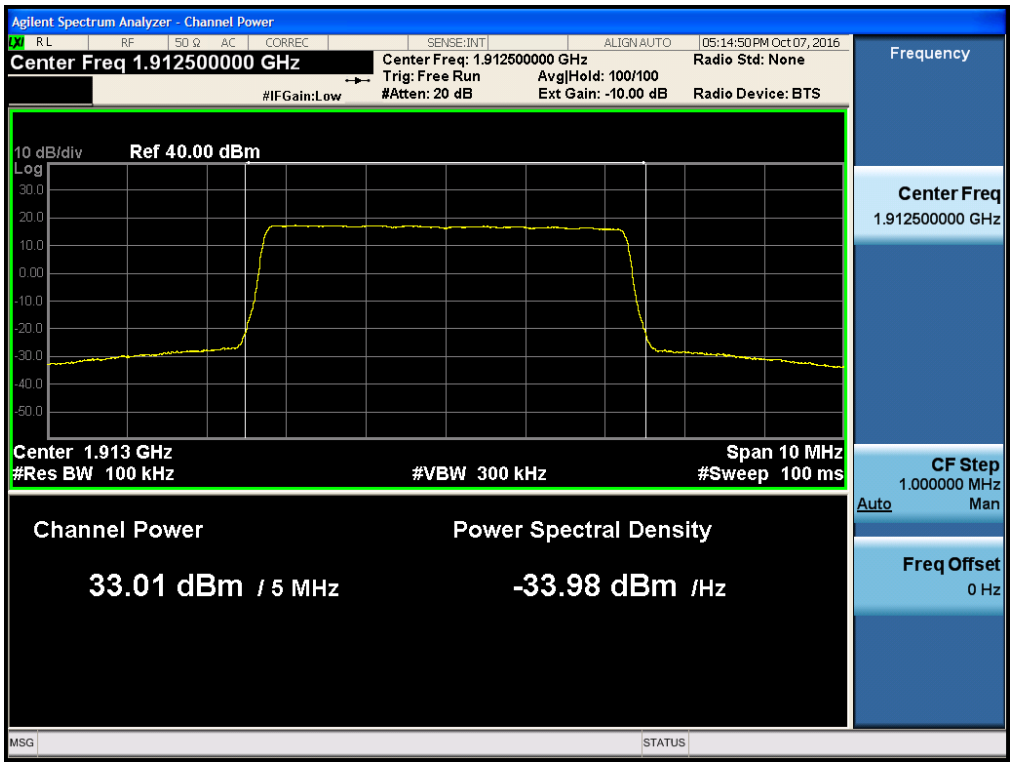
[LTE 5 MHz AGC threshold Uplink Low]



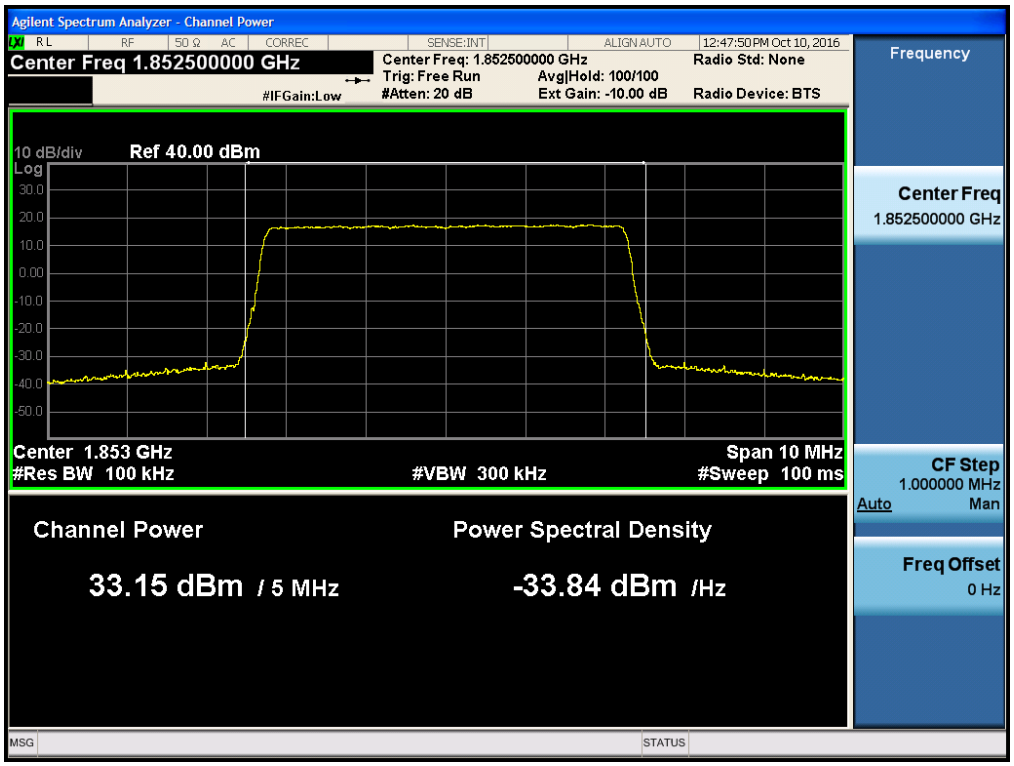
[LTE 5 MHz AGC threshold Uplink Middle]



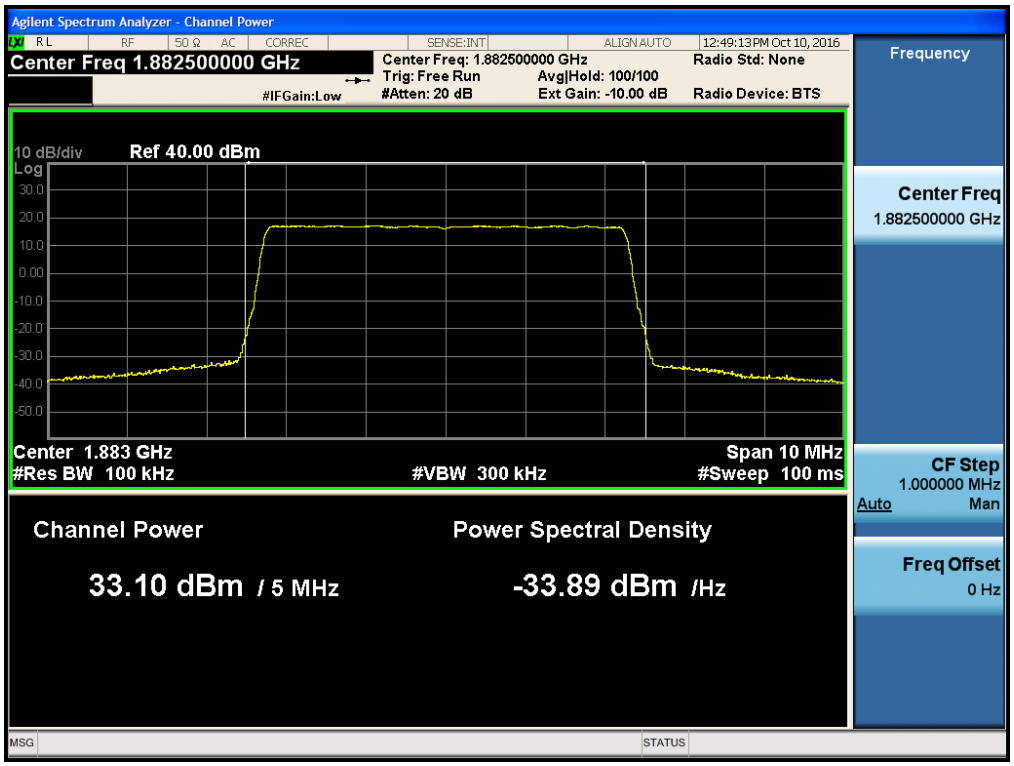
[LTE 5 MHz AGC threshold Uplink High]



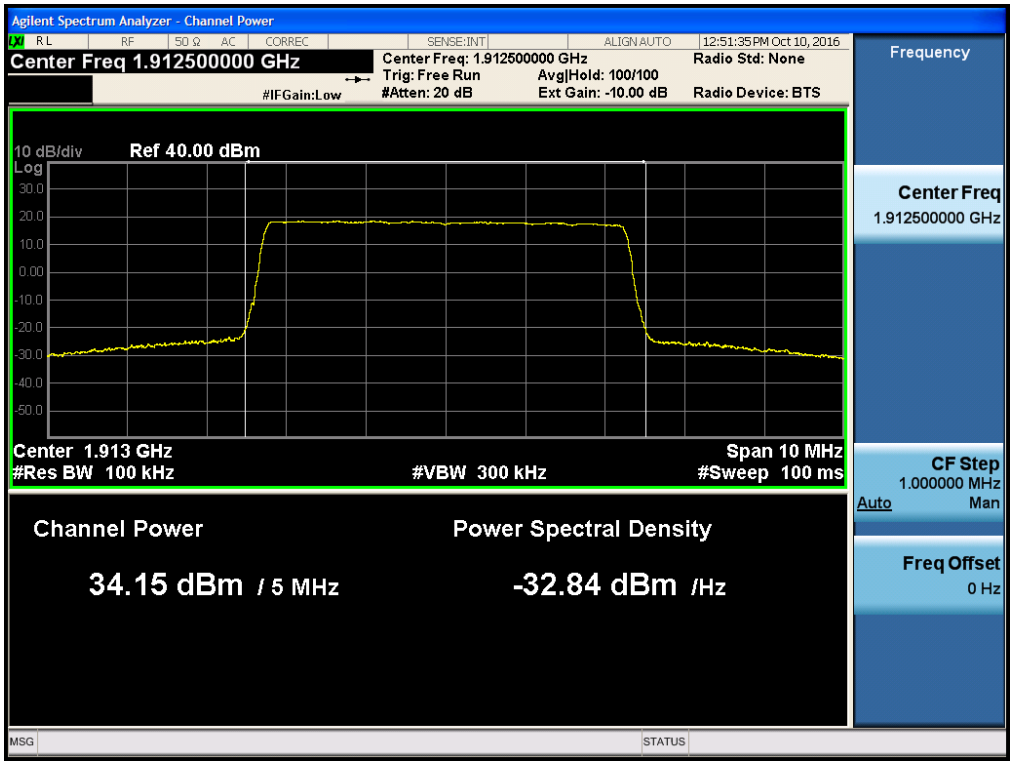
[LTE 5 MHz +3dB above the AGC threshold Uplink Low]



[LTE 5 MHz +3dB above the AGC threshold Uplink Middle]

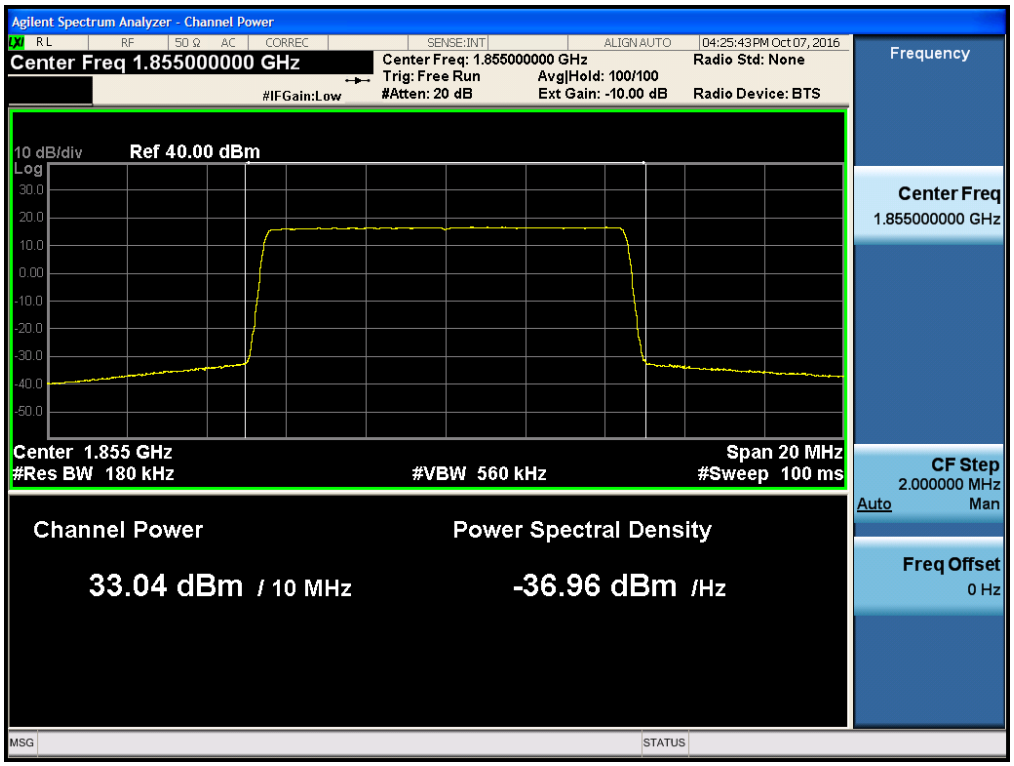


[LTE 5 MHz +3dB above the AGC threshold Uplink High]

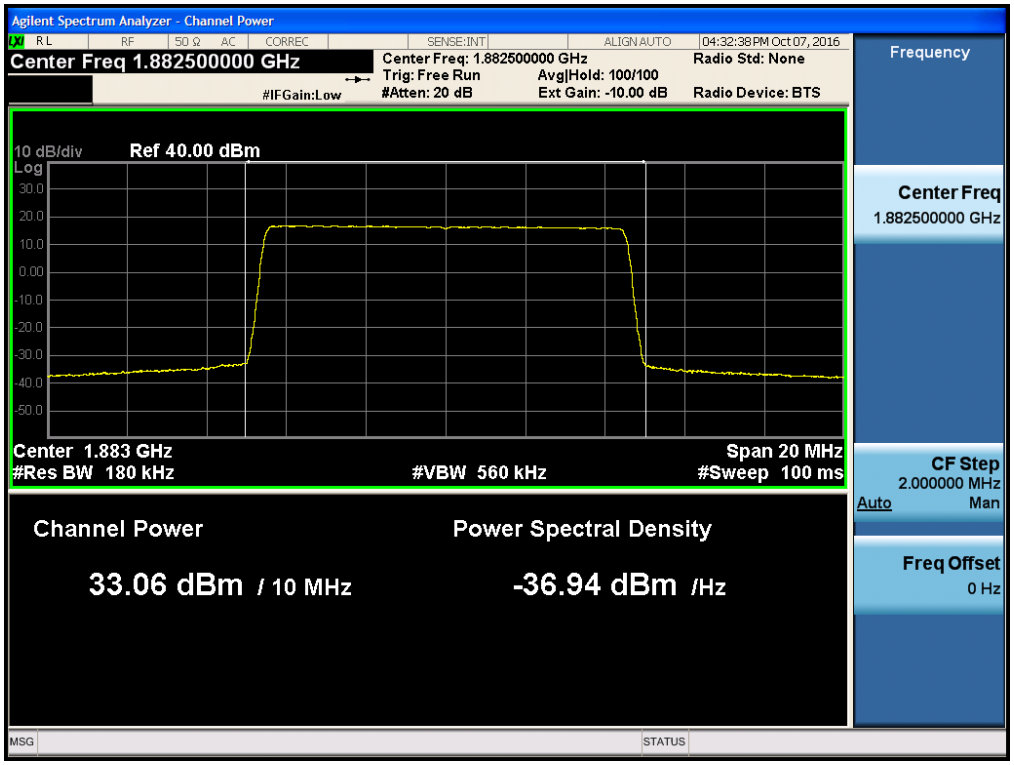


LTE 10 MHz UL

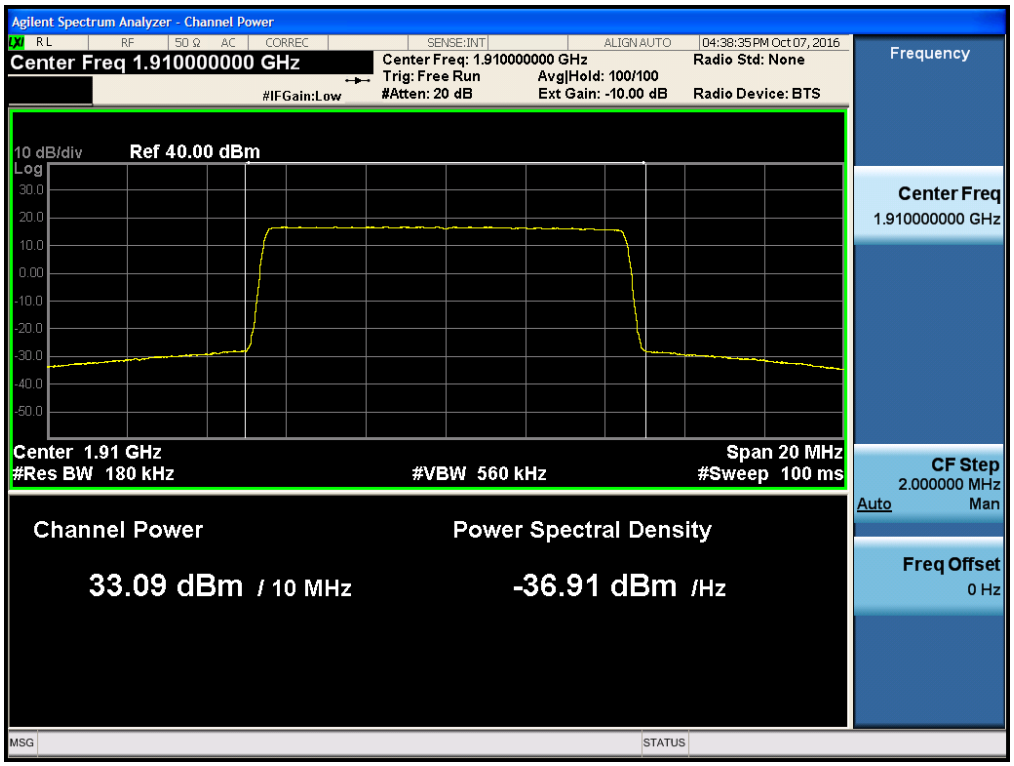
[LTE 10 MHz AGC threshold Uplink Low]



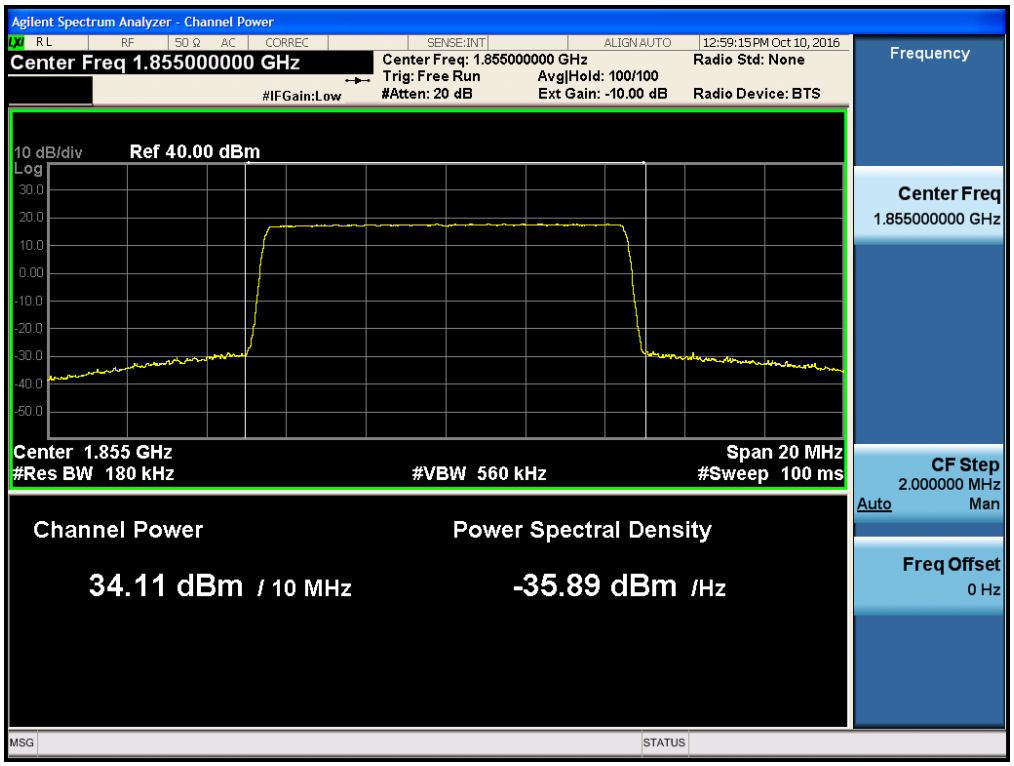
[LTE 10 MHz AGC threshold Uplink Middle]



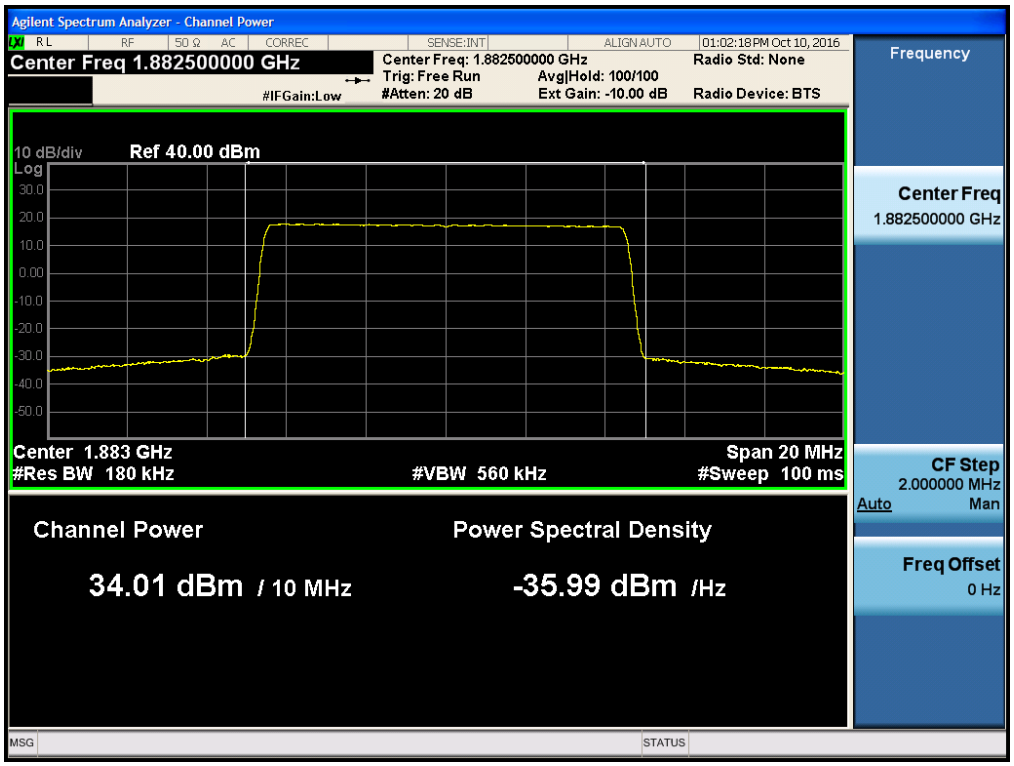
[LTE 10 MHz AGC threshold Uplink High]



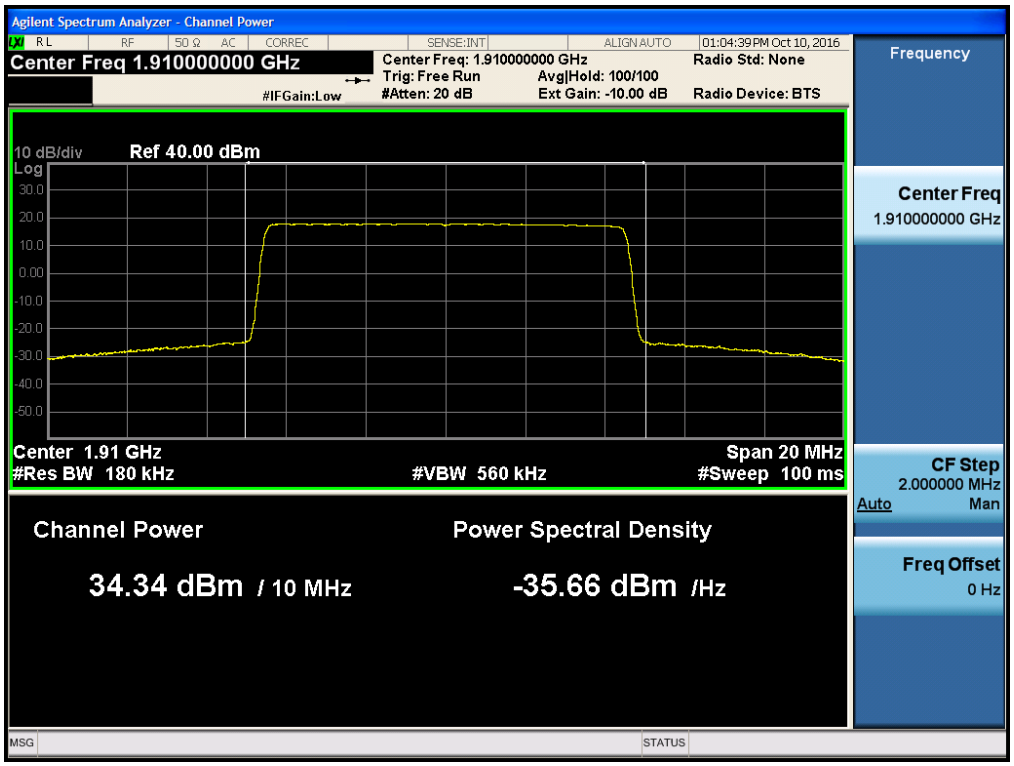
[LTE 10 MHz +3dB above the AGC threshold Uplink Low]



[LTE 10 MHz +3dB above the AGC threshold Uplink Middle]

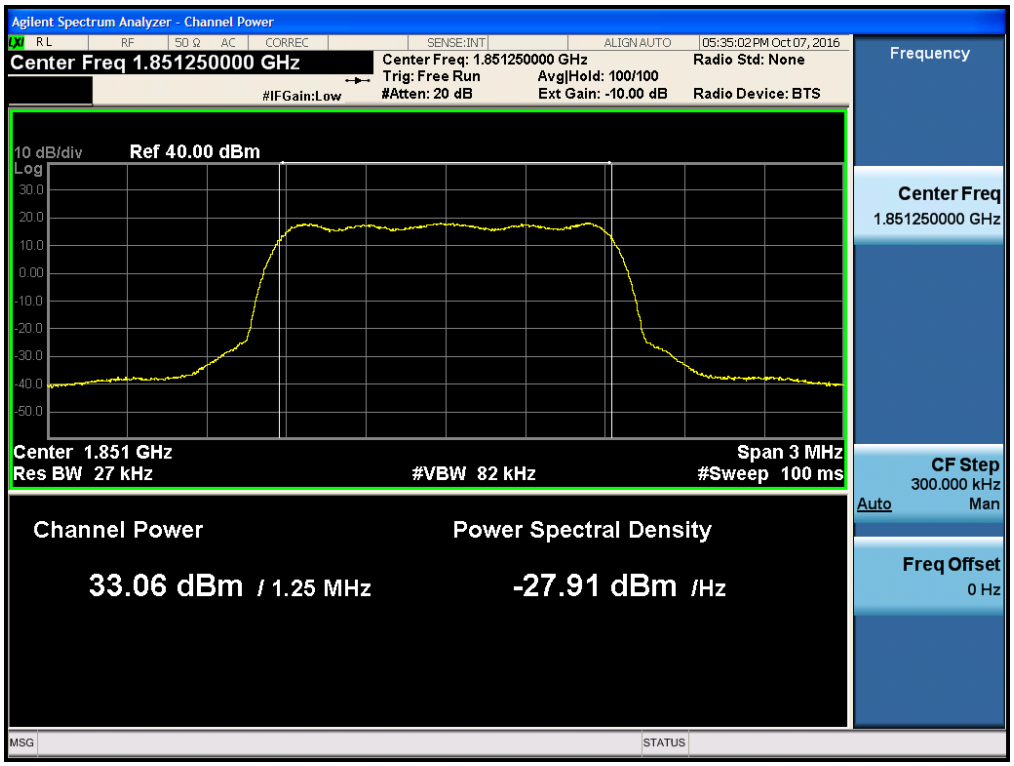


[LTE 10 MHz +3dB above the AGC threshold Uplink High]

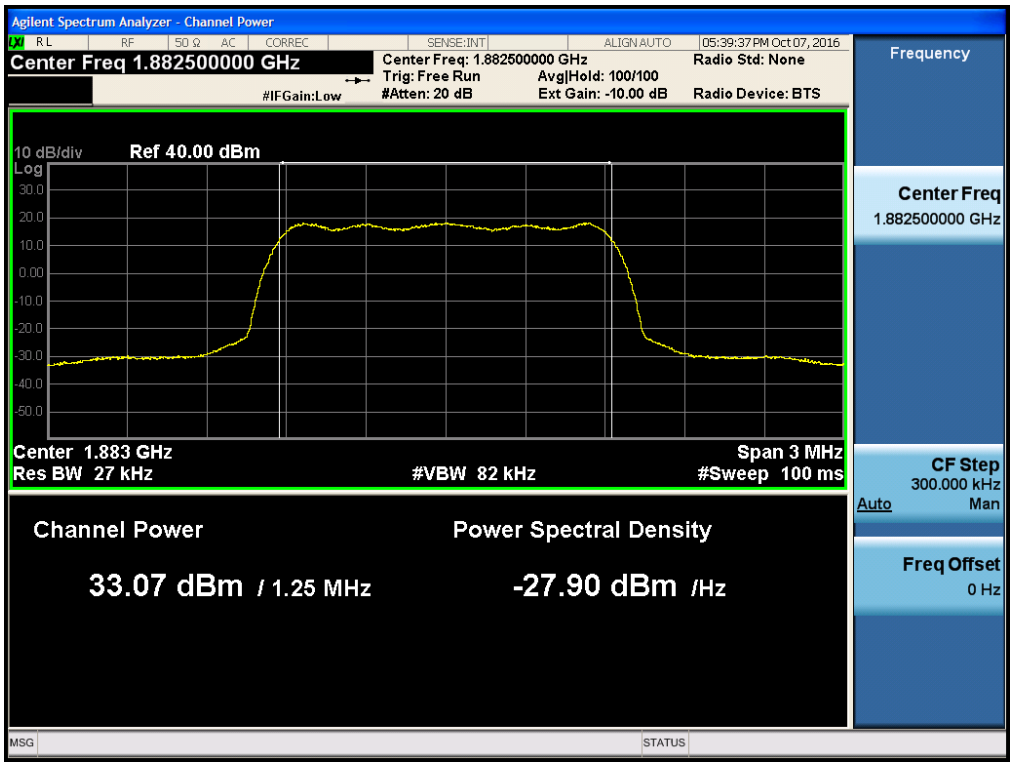


CDMA UL

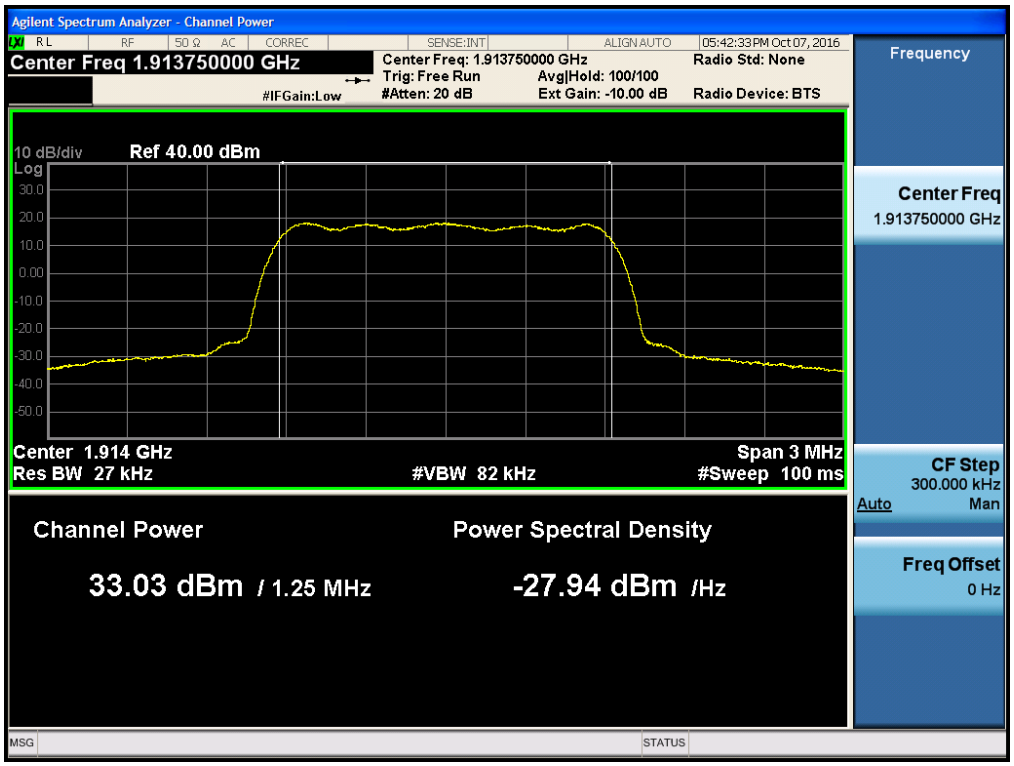
[CDMA AGC threshold Uplink Low]



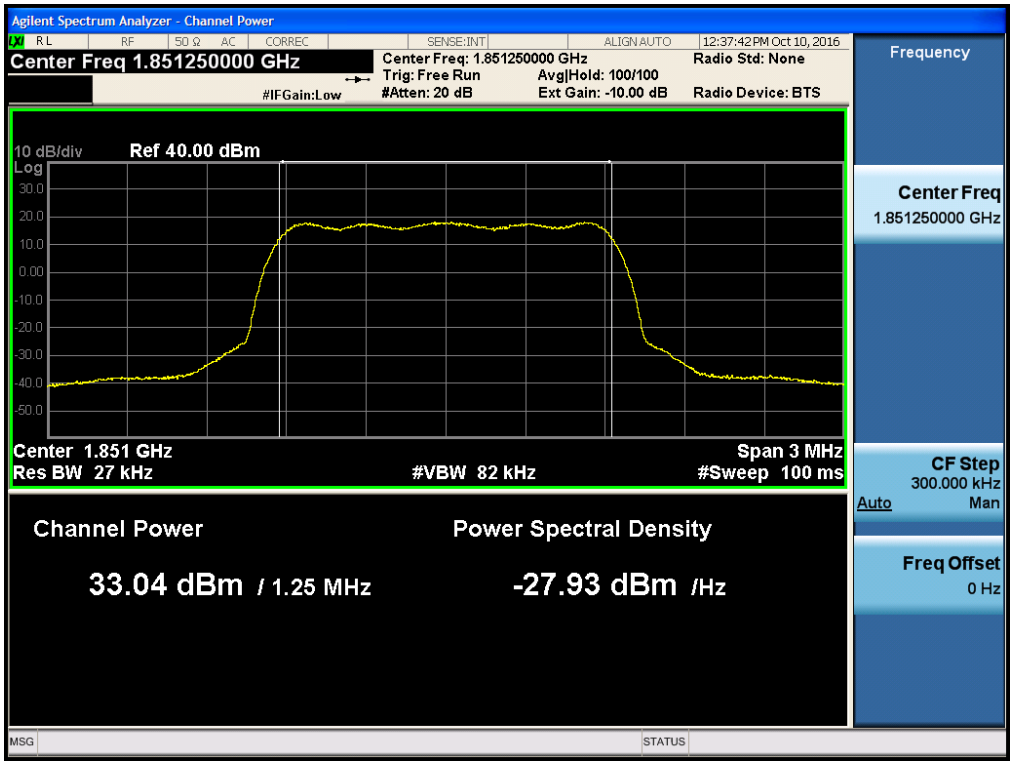
[CDMA AGC threshold Uplink Middle]



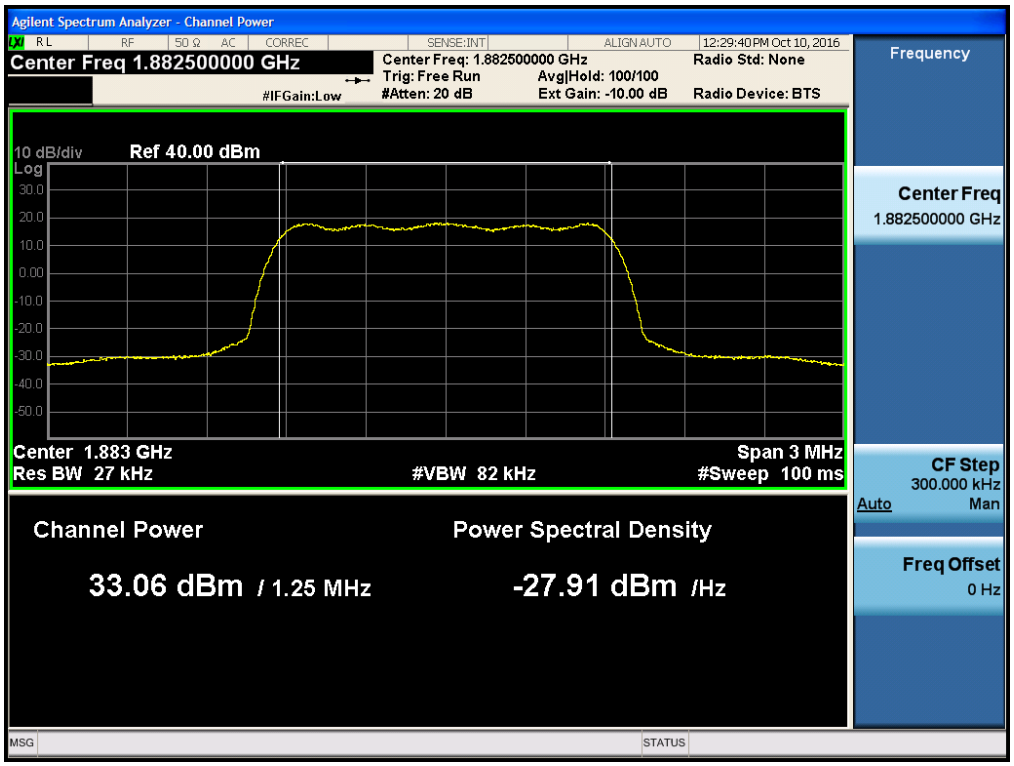
[CDMA AGC threshold Uplink High]



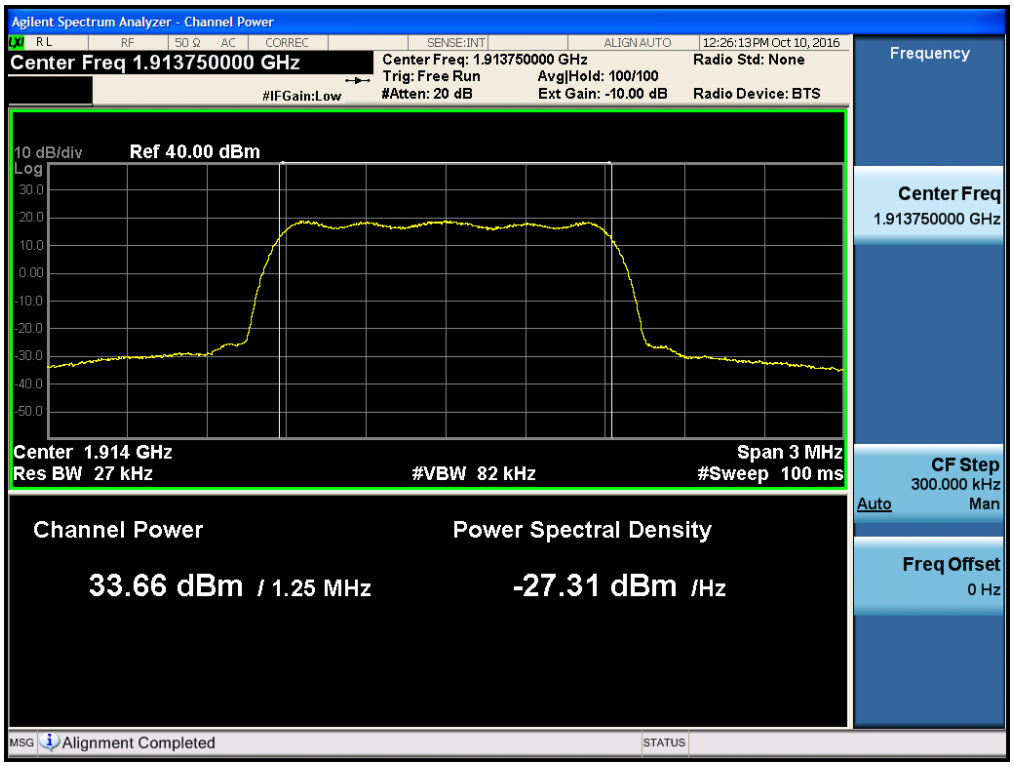
[CDMA +3dB above the AGC threshold Uplink Low]



[CDMA +3dB above the AGC threshold Uplink Middle]



[CDMA +3dB above the AGC threshold Uplink High]



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:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 v01r01 and section 4.2 of KDB 971168 D01 v02r02.

Test is 99% OBW measured and used.

a) Connect a signal generator to the input of the EUT.

b) Configure the signal generator to transmit the AWGN signal.

c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.

d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between 2 times to 5 times the emission bandwidth (EBW) or alternatively, the OBW.

f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be ≥ 3 × RBW.

g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than [10 log (OBW / RBW)] below the reference level.

Steps f) and g) may require iteration to enable adjustments within the specified tolerances.

h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.

i) Set spectrum analyzer detection function to positive peak.

j) Set the trace mode to max hold.

k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency as f_0.

l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the −26 dB down amplitude.

The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the −26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the −26 dB down amplitude point.

m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).

n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.

o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.

p) Repeat steps e) to o) with the signal generator set to the narrowband signal.

q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

Test Results:

The EUT complies with the requirements of this section.

<table>
<tr><th rowspan="2">Input Signal</th><th colspan="2">Input Level (dBm)</th><th colspan="2">Maximum Amp Gain</th></tr>
<tr><th>DL</th><th>UL</th><th>DL</th><th>UL</th></tr>
<tr><td>LTE 5 MHz</td><td rowspan="3">-62</td><td rowspan="3">-72</td><td colspan="2" rowspan="3">105</td></tr>
<tr><td>LTE 10 MHz</td></tr>
<tr><td>CDMA</td></tr>
</table>

[Downlink Output]

	Channel	Frequency (MHz)	OBW (kHz)
LTE 5 MHz AGC threshold	Low	1932.50	4.4899
	Middle	1962.50	4.4958
	High	1992.50	4.4951
LTE 5 MHz +3dB above AGC threshold	Low	1932.50	4.4898
	Middle	1962.50	4.4918
	High	1992.50	4.4933
LTE 10 MHz AGC threshold	Low	1935.00	8.9473
	Middle	1962.50	8.9602
	High	1990.00	8.9637
LTE 10 MHz +3dB above AGC threshold	Low	1935.00	8.9452
	Middle	1962.50	8.9598
	High	1990.00	8.9574
CDMA AGC threshold	Low	1931.25	1.2647
	Middle	1962.50	1.2659
	High	1993.75	1.2685
CDMA +3dB above AGC threshold	Low	1931.25	1.2704
	Middle	1962.50	1.2650
	High	1993.75	1.2691

[Uplink Output]

	Channel	Frequency (MHz)	OBW (kHz)
LTE 5 MHz AGC threshold	Low	1852.50	4.4894
	Middle	1882.50	4.4939
	High	1912.50	4.4920
LTE 5 MHz +3dB above AGC threshold	Low	1852.50	4.4941
	Middle	1882.50	4.4964
	High	1912.50	4.4923
LTE 10 MHz AGC threshold	Low	1855.00	8.9512
	Middle	1882.50	8.9560
	High	1910.00	8.9558
LTE 10 MHz +3dB above AGC threshold	Low	1855.00	8.9491
	Middle	1882.50	8.9576
	High	1910.00	8.9483
CDMA AGC threshold	Low	1851.25	1.2692
	Middle	1882.50	1.2626
	High	1913.75	1.2639
CDMA +3dB above AGC threshold	Low	1851.25	1.2674
	Middle	1882.50	1.2673
	High	1913.75	1.2616

[Downlink Input]

	Channel	Frequency (MHz)	OBW (kHz)
LTE 5 MHz AGC threshold	Low	1932.50	4.5135
	Middle	1962.50	4.5094
	High	1992.50	4.5155
LTE 10 MHz AGC threshold	Low	1935.00	8.9908
	Middle	1962.50	8.9954
	High	1990.00	8.9910
CDMA AGC threshold	Low	1931.25	1.2759
	Middle	1962.50	1.2709
	High	1993.75	1.2717

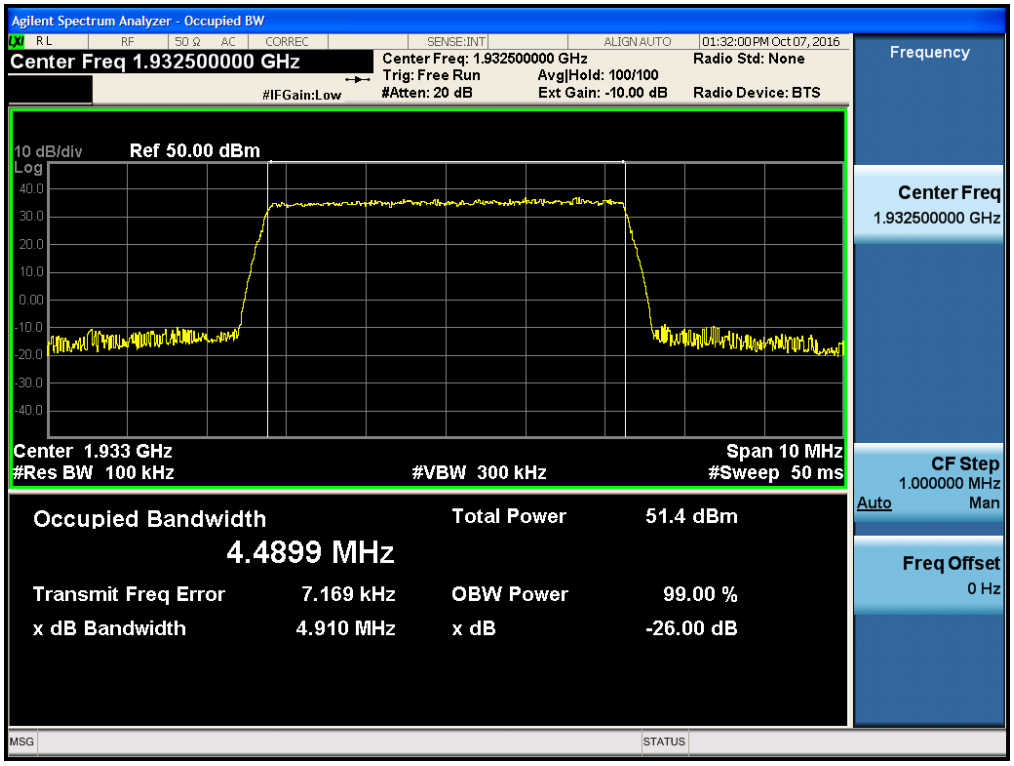
[Uplink Input]

	Channel	Frequency (MHz)	OBW (kHz)
LTE 5 MHz AGC threshold	Low	1852.50	4.5140
	Middle	1882.50	4.5150
	High	1912.50	4.5128
LTE 10 MHz AGC threshold	Low	1855.00	8.9945
	Middle	1882.50	9.0131
	High	1910.00	8.9980
CDMA AGC threshold	Low	1851.25	1.2746
	Middle	1882.50	1.2776
	High	1913.75	1.2775

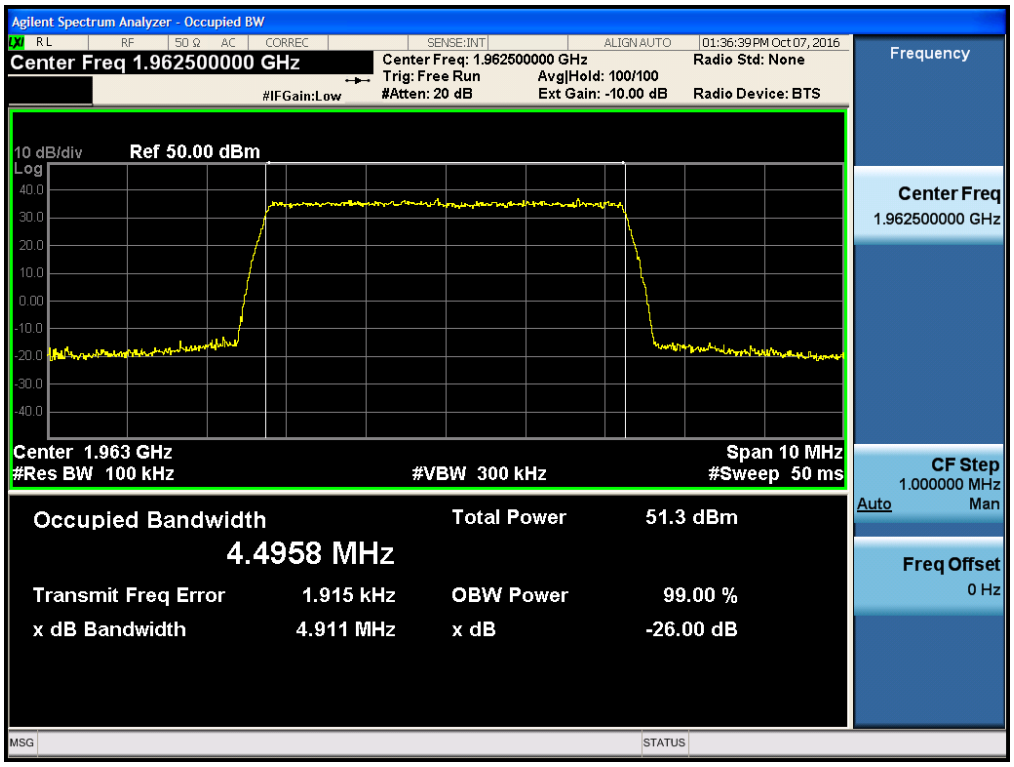
Plots of Occupied Bandwidth

LTE 5 MHz DL_Ouuput

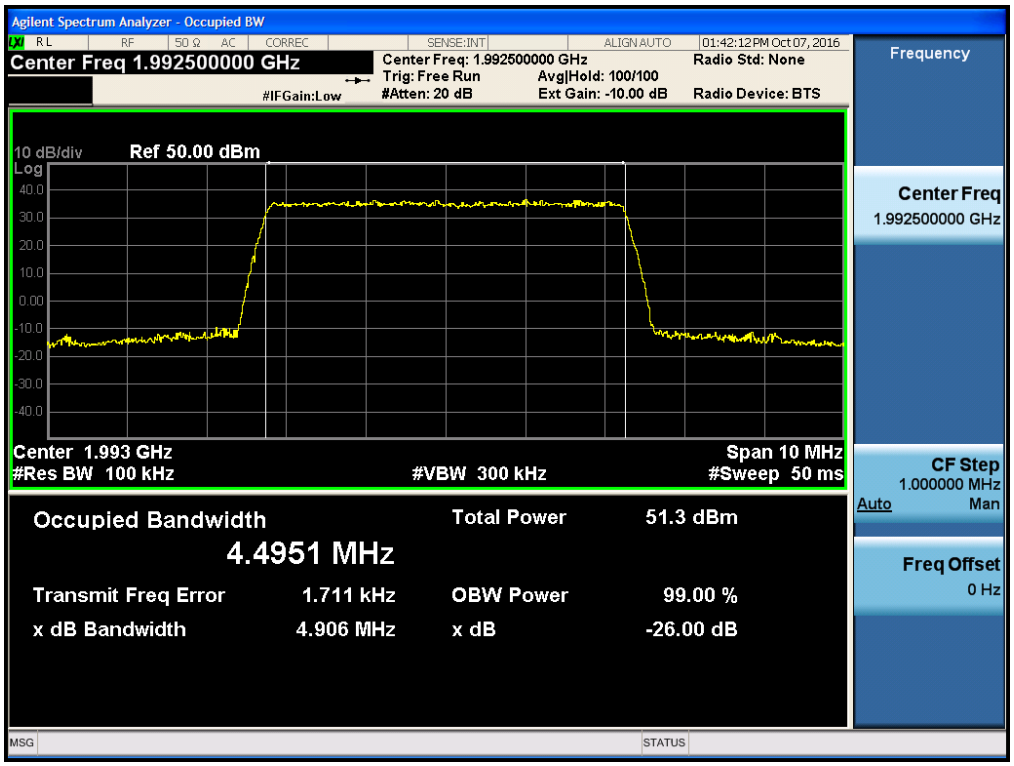
[LTE 5 MHz AGC threshold Downlink Low]



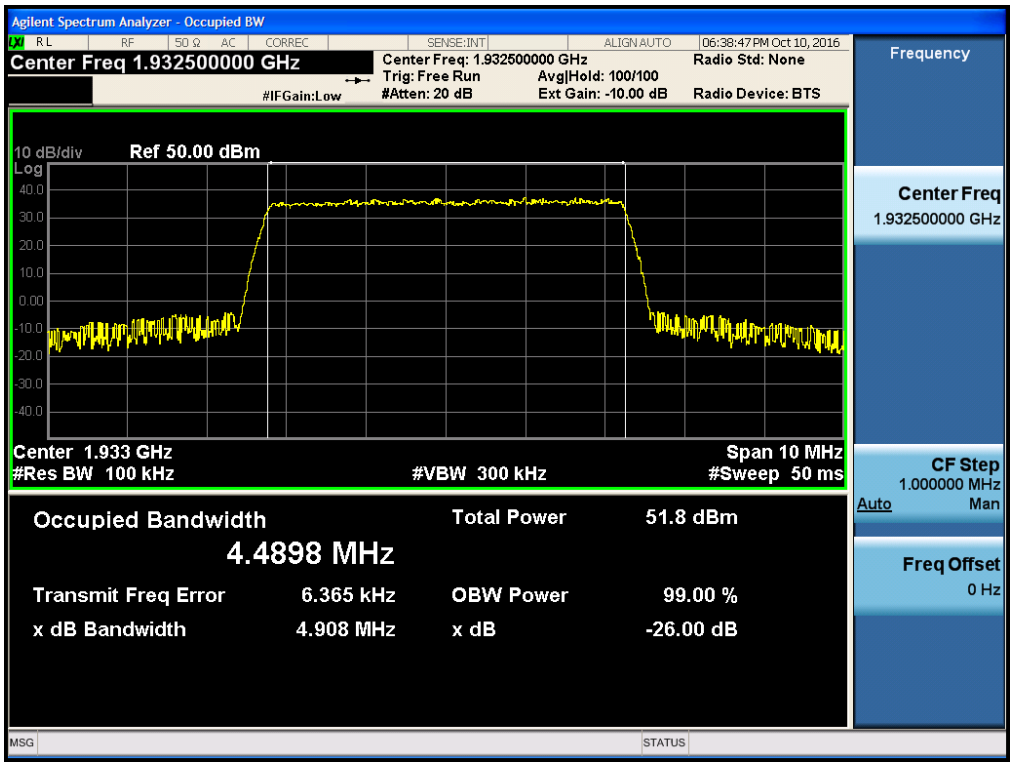
[LTE 5 MHz AGC threshold Downlink Middle]



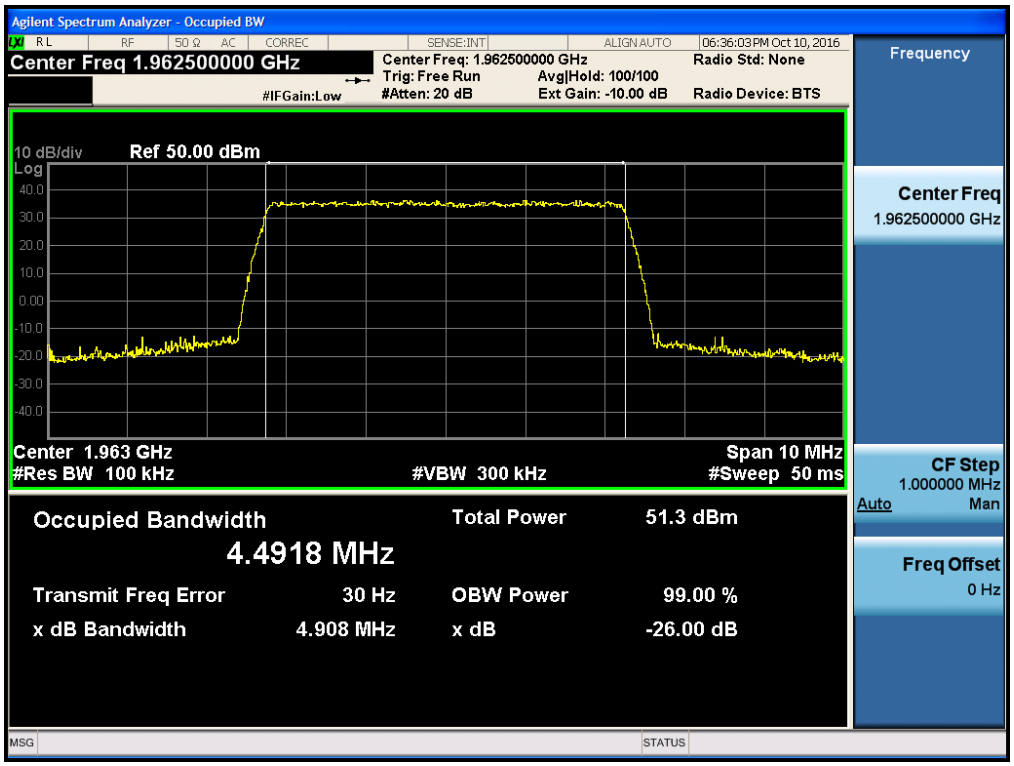
[LTE 5 MHz AGC threshold Downlink High]



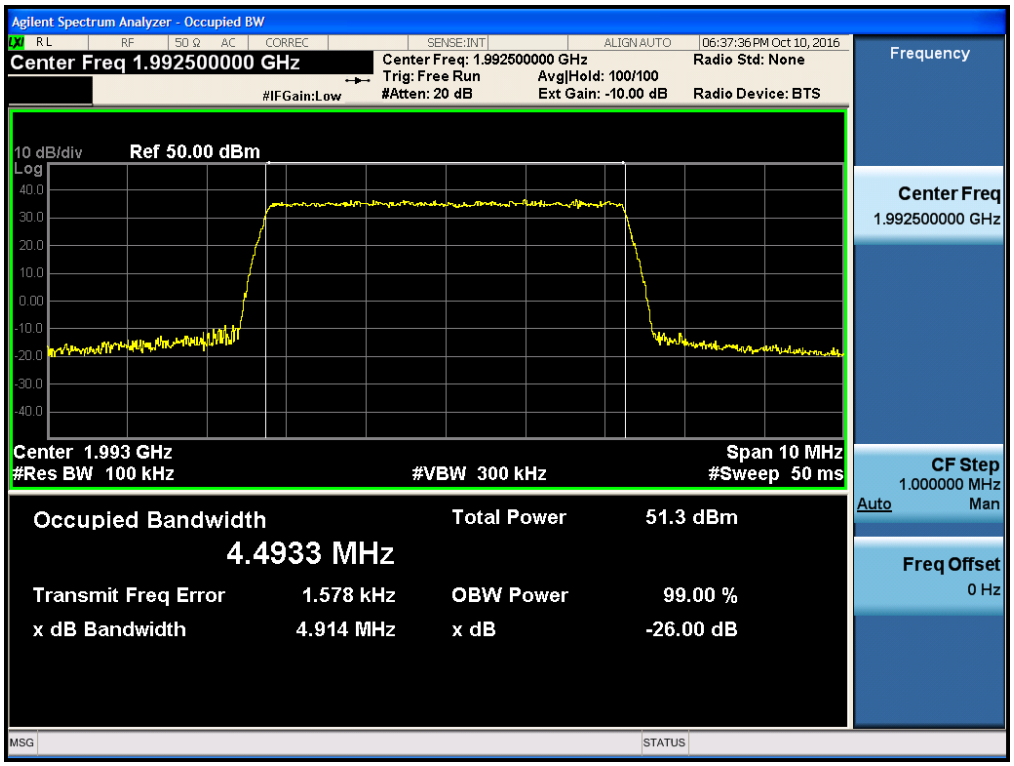
[LTE 5 MHz +3dB above the AGC threshold Downlink Low]



[LTE 5 MHz +3dB above the AGC threshold Downlink Middle]

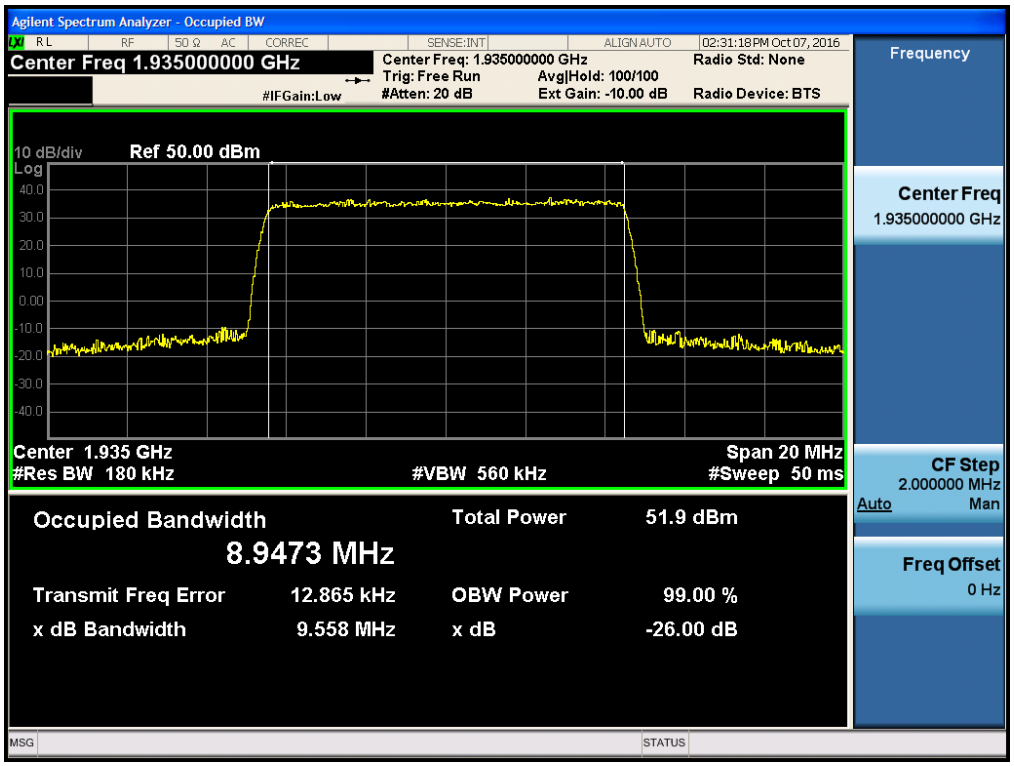


[LTE 5 MHz +3dB above the AGC threshold Downlink High]

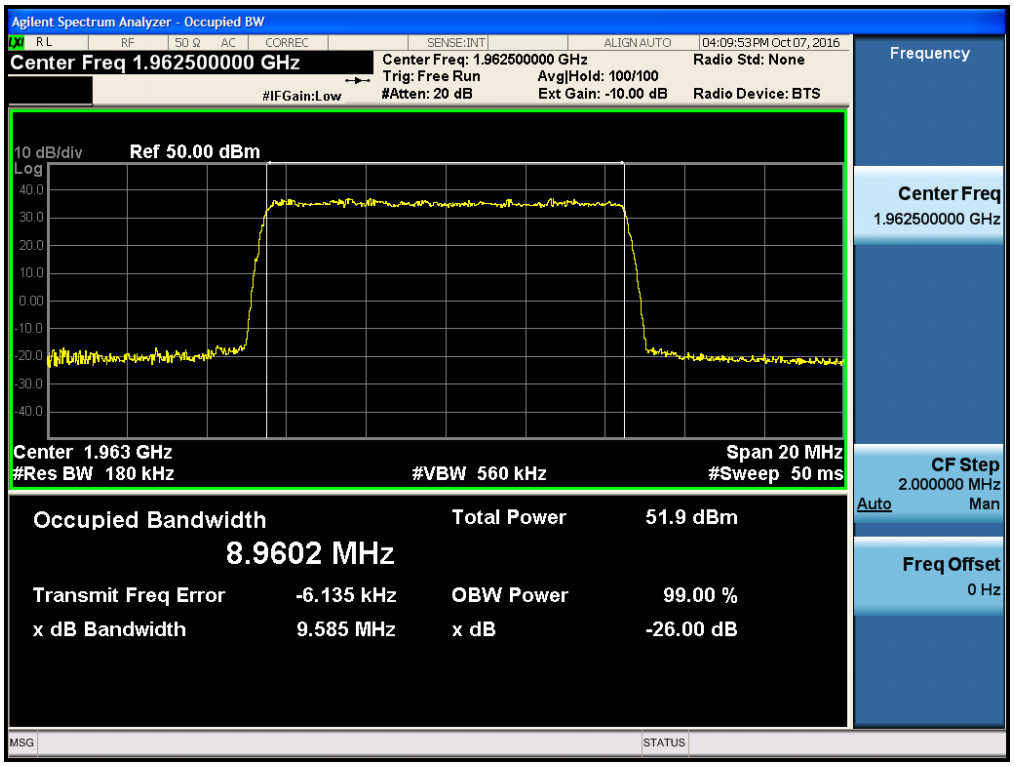


LTE 10 MHz DL_Ouuput

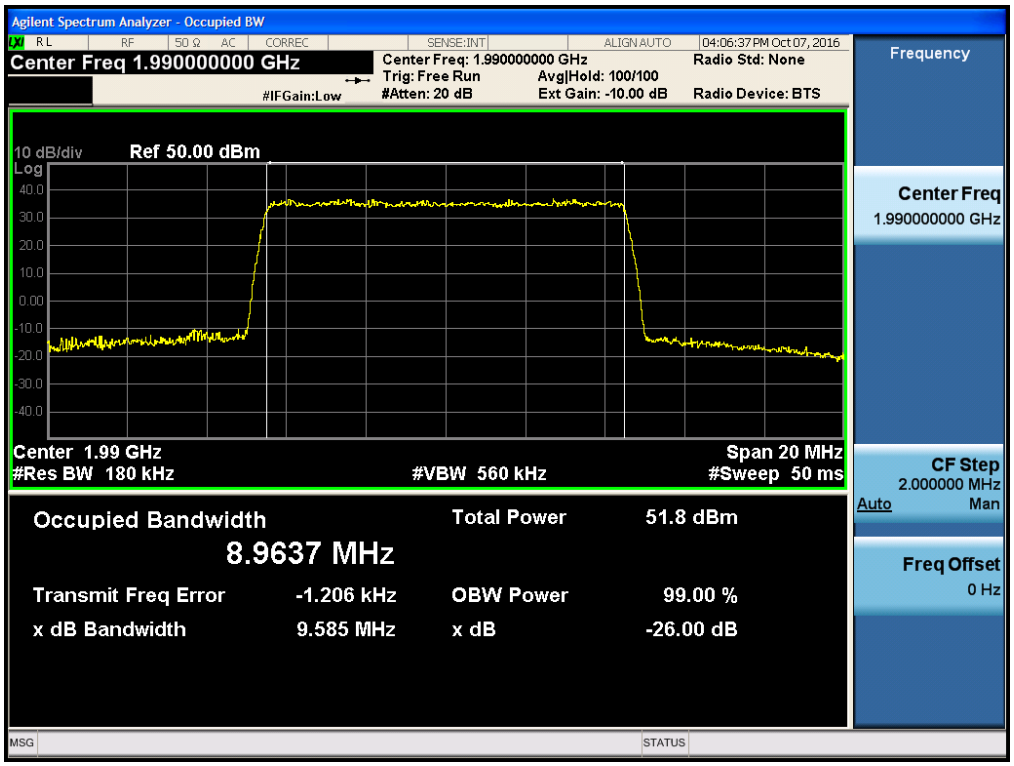
[LTE 10 MHz AGC threshold Downlink Low]



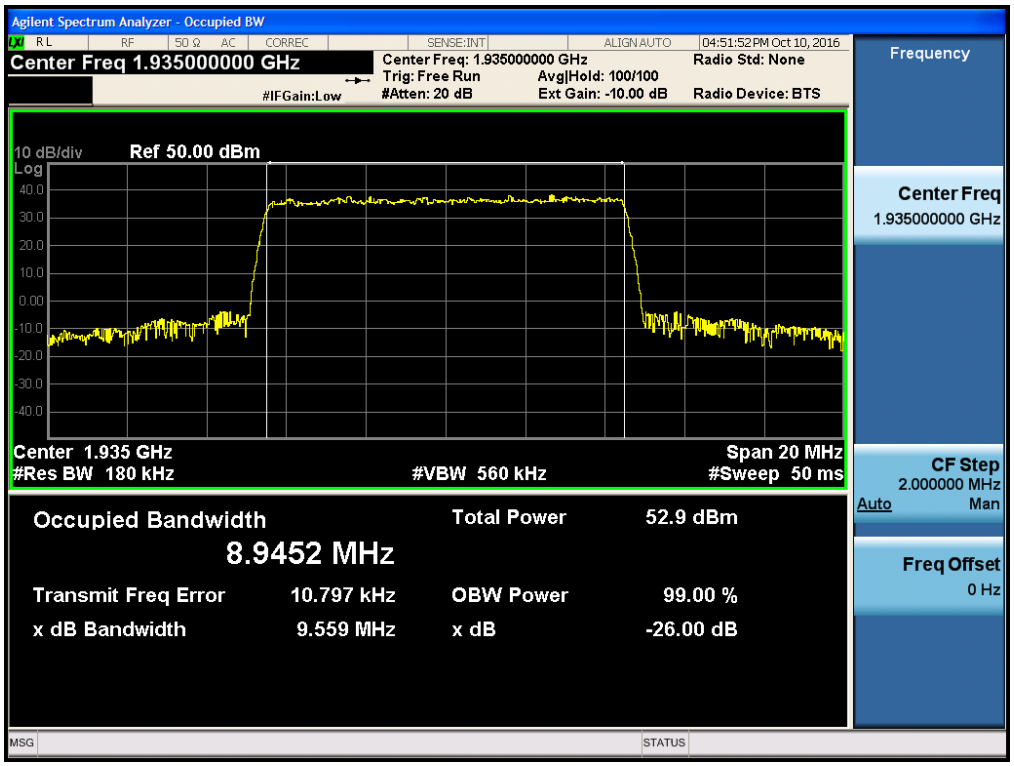
[LTE 10 MHz AGC threshold Downlink Middle]



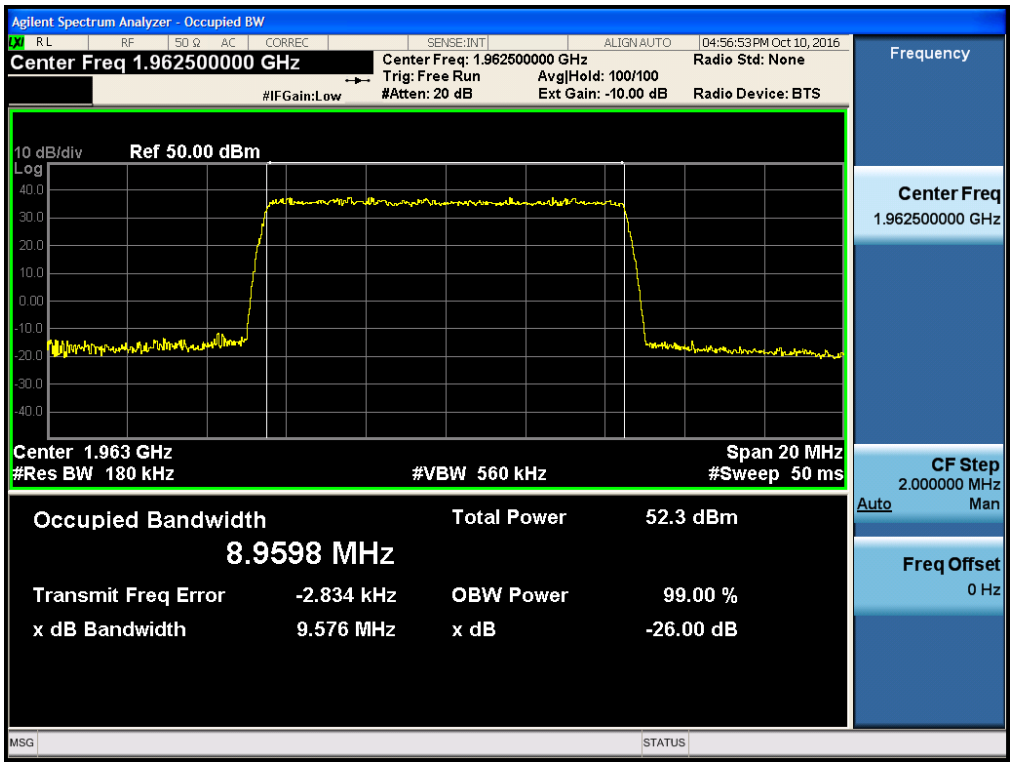
[LTE 10 MHz AGC threshold Downlink High]



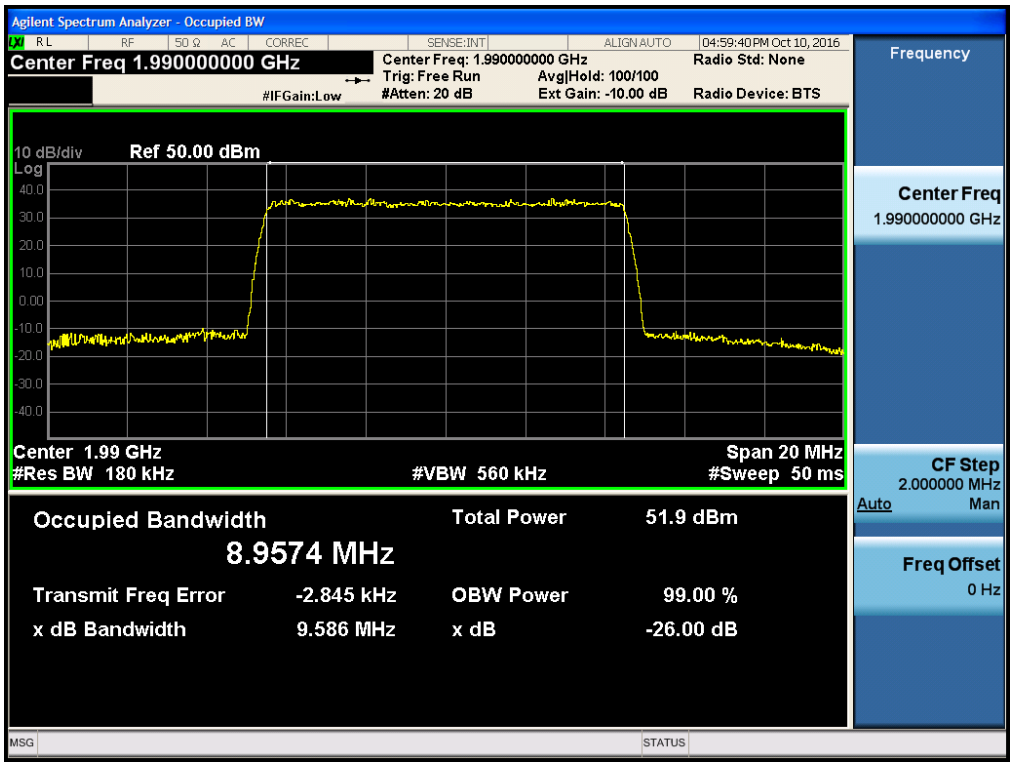
[LTE 10 MHz +3dB above the AGC threshold Downlink Low]



[LTE 10 MHz +3dB above the AGC threshold Downlink Middle]

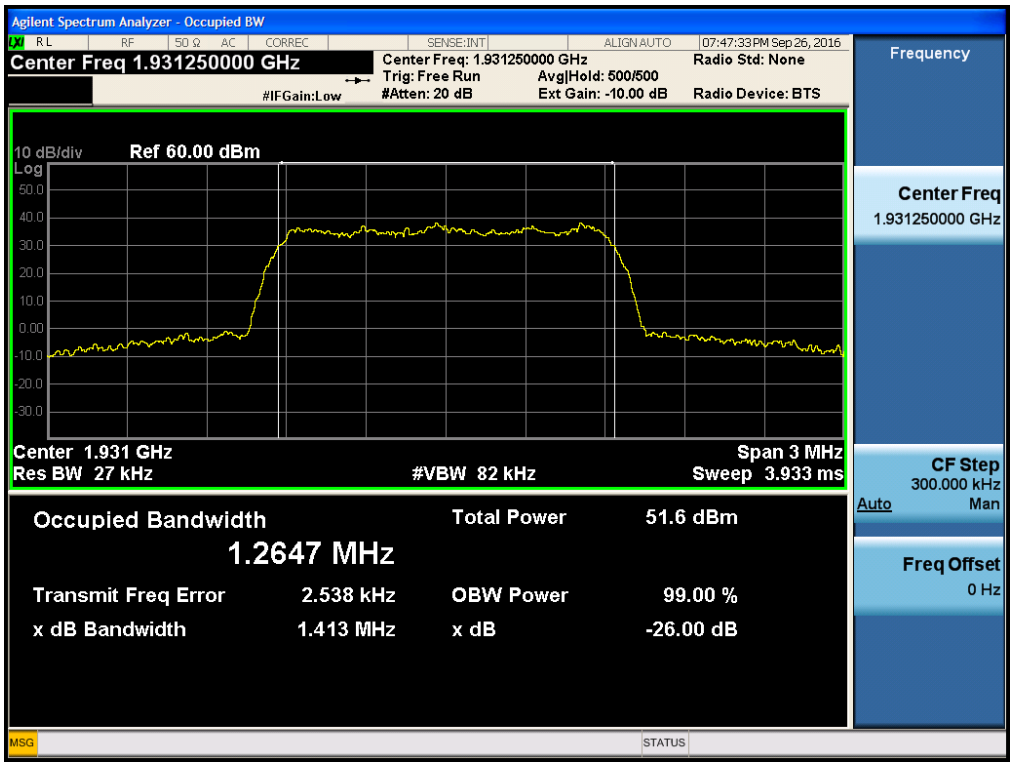


[LTE 10 MHz +3dB above the AGC threshold Downlink High]

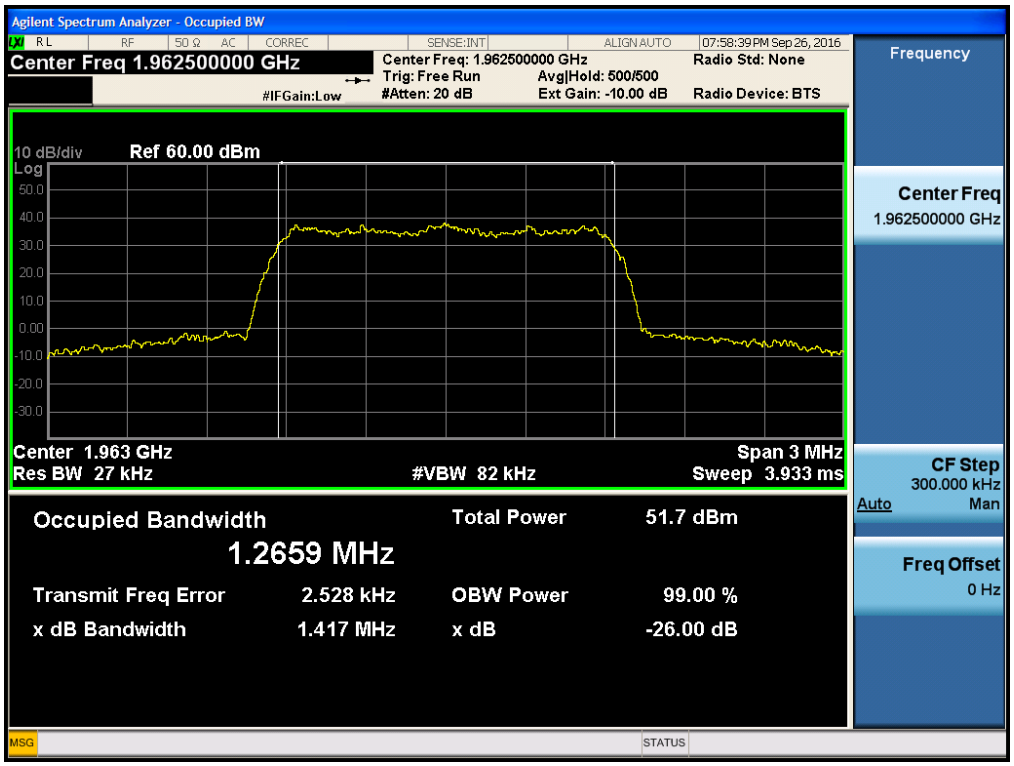


CDMA DL_Ouuput

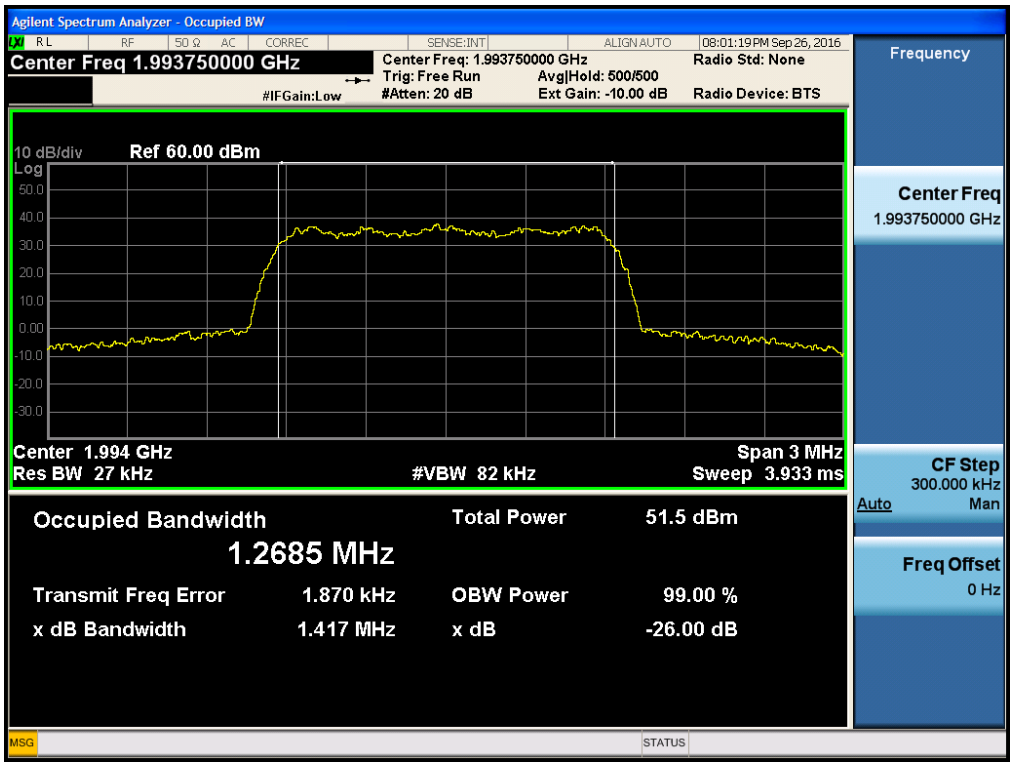
[CDMA AGC threshold Downlink Low]



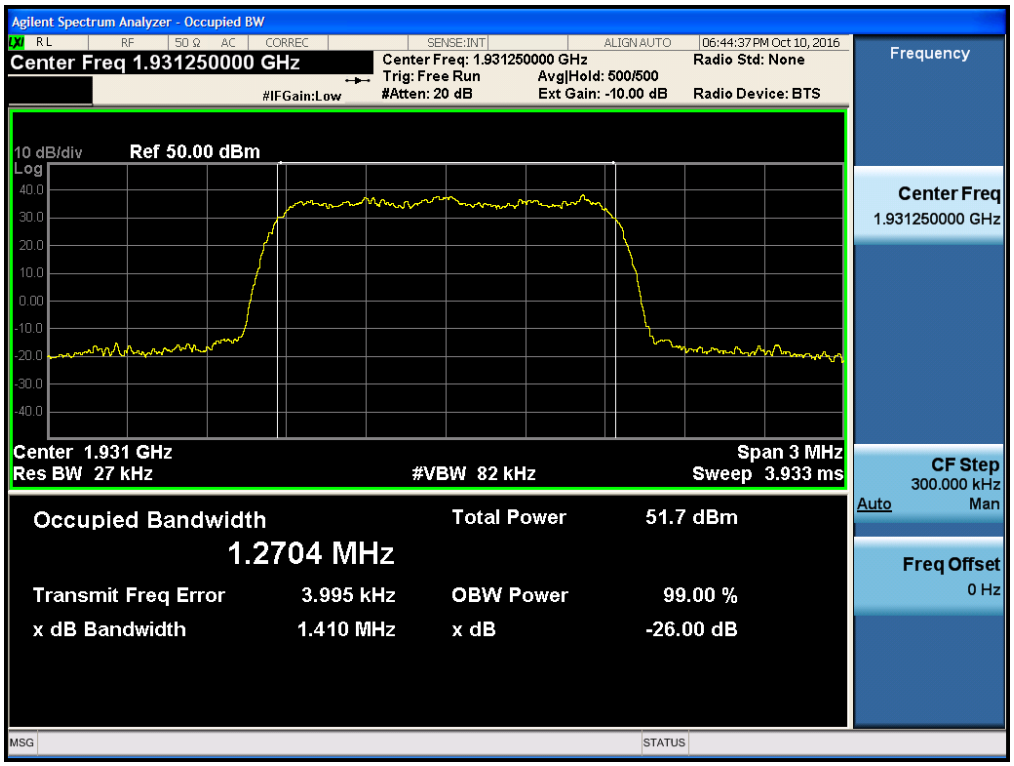
[CDMA AGC threshold Downlink Middle]



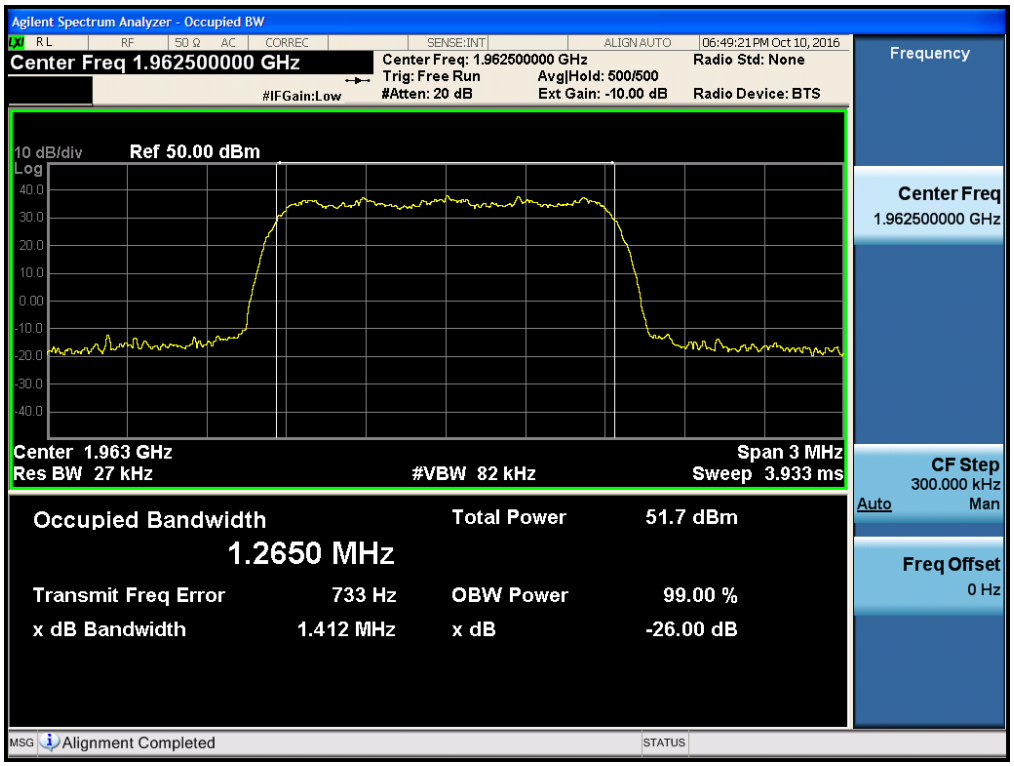
[CDMA AGC threshold Downlink High]



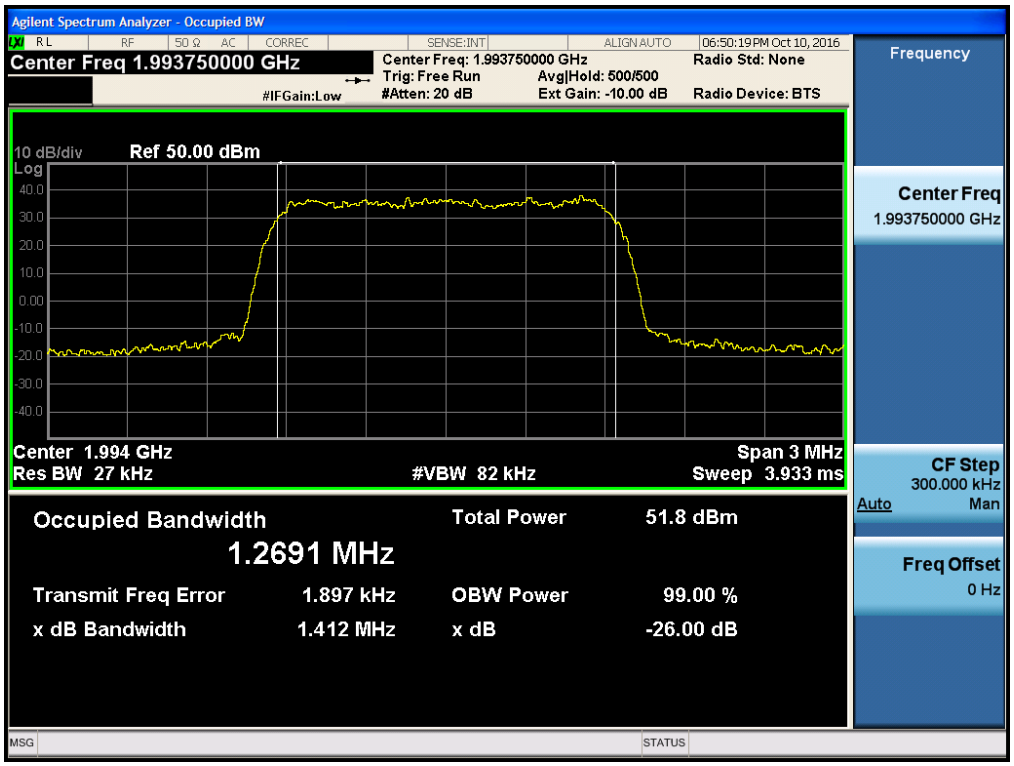
[CDMA +3dB above the AGC threshold Downlink Low]



[CDMA +3dB above the AGC threshold Downlink Middle]

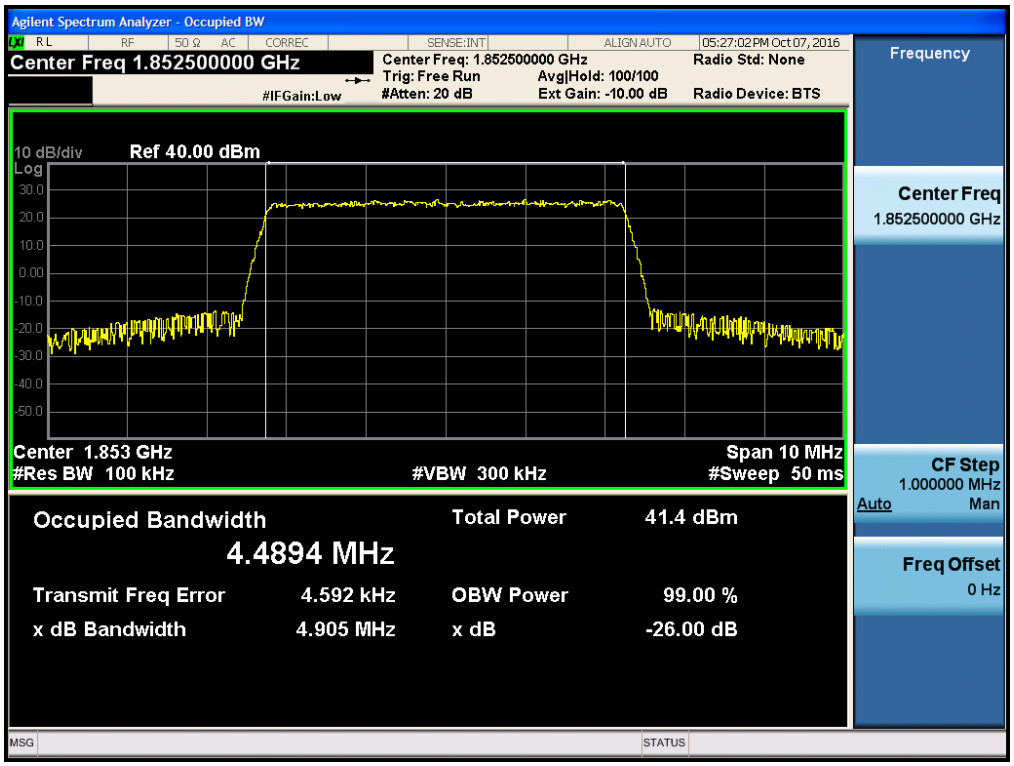


[CDMA +3dB above the AGC threshold Downlink High]

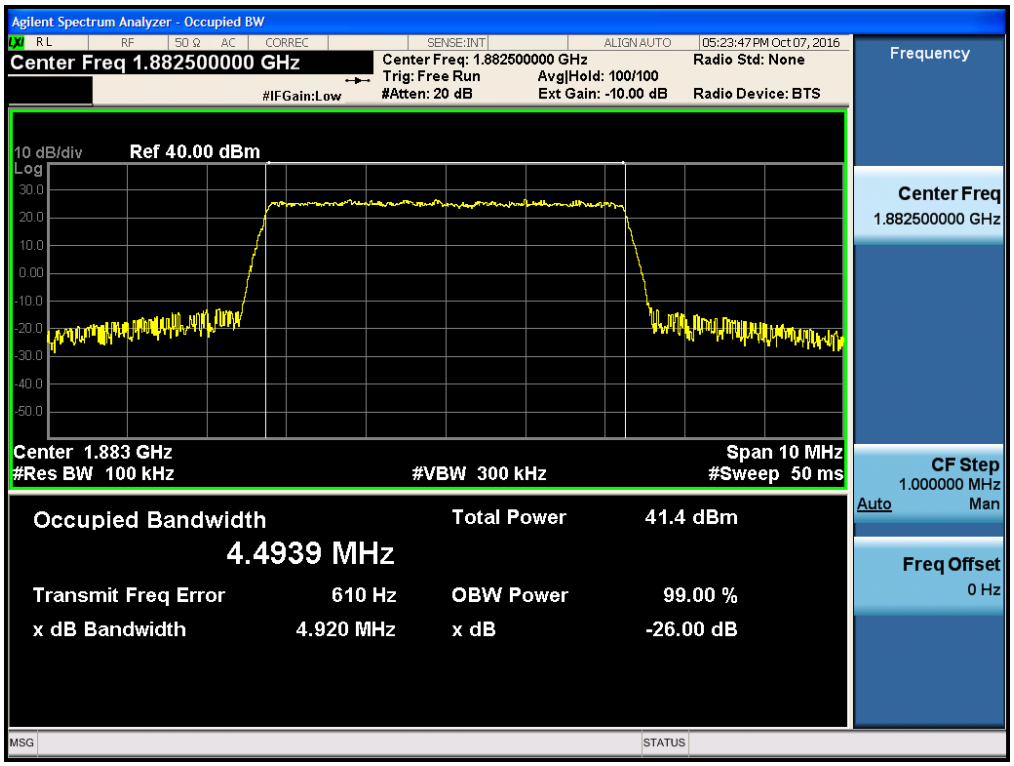


LTE 5 MHz UL_Ouuput

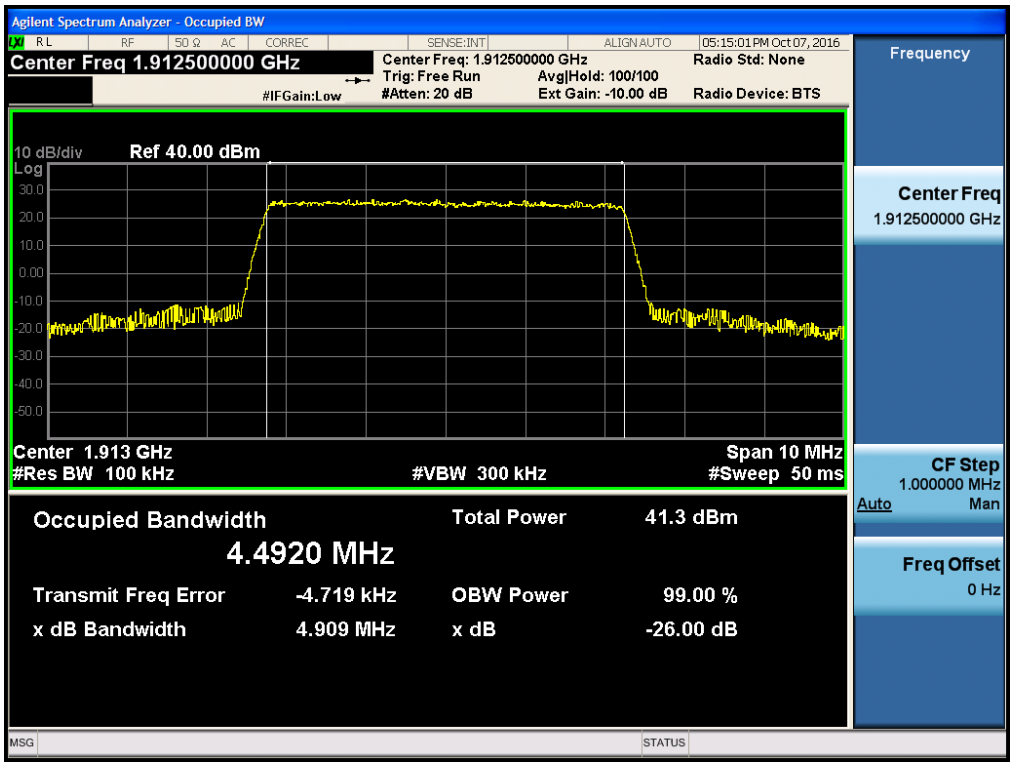
[LTE 5 MHz AGC threshold Uplink Low]



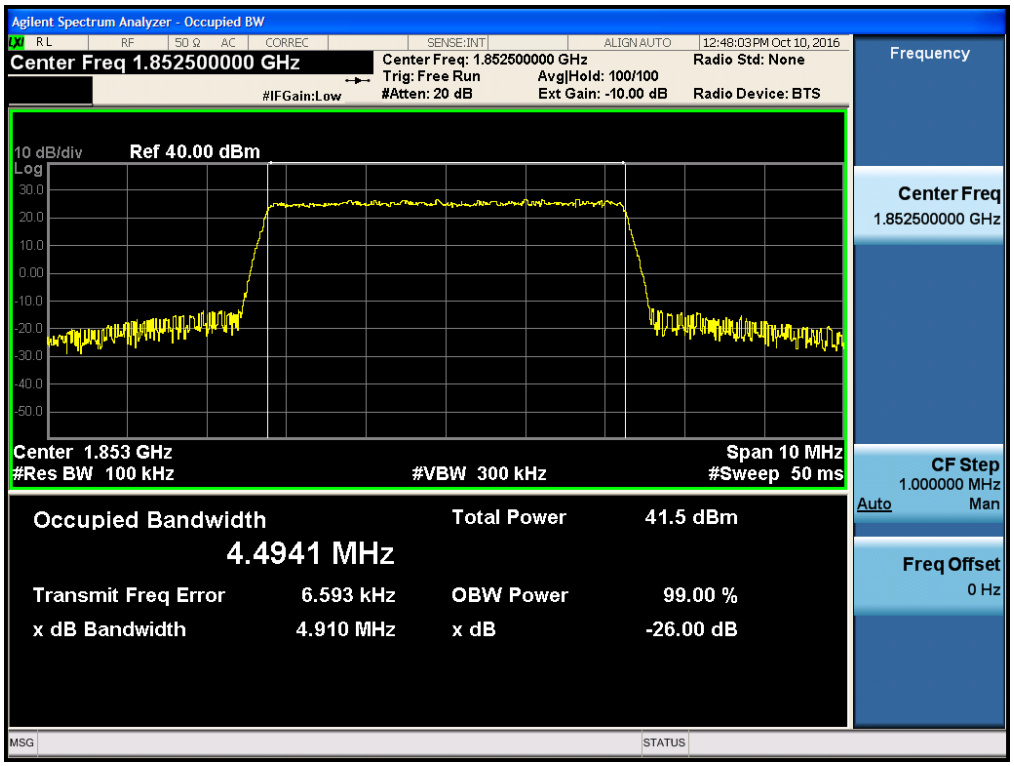
[LTE 5 MHz AGC threshold Uplink Middle]



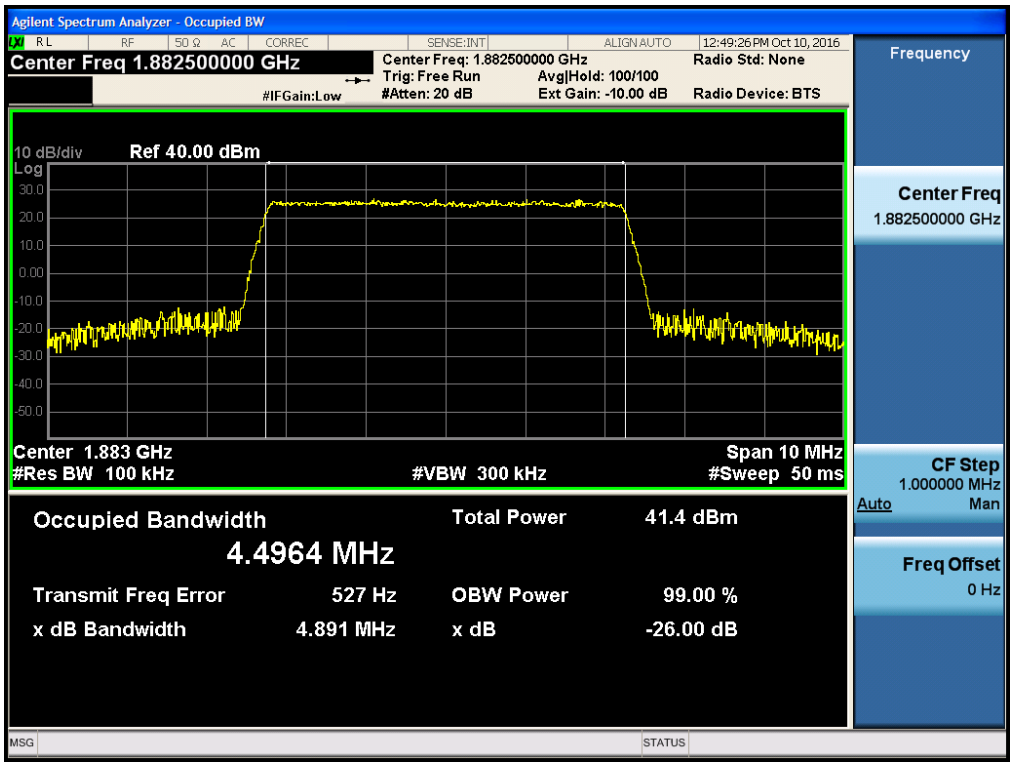
[LTE 5 MHz AGC threshold Uplink High]



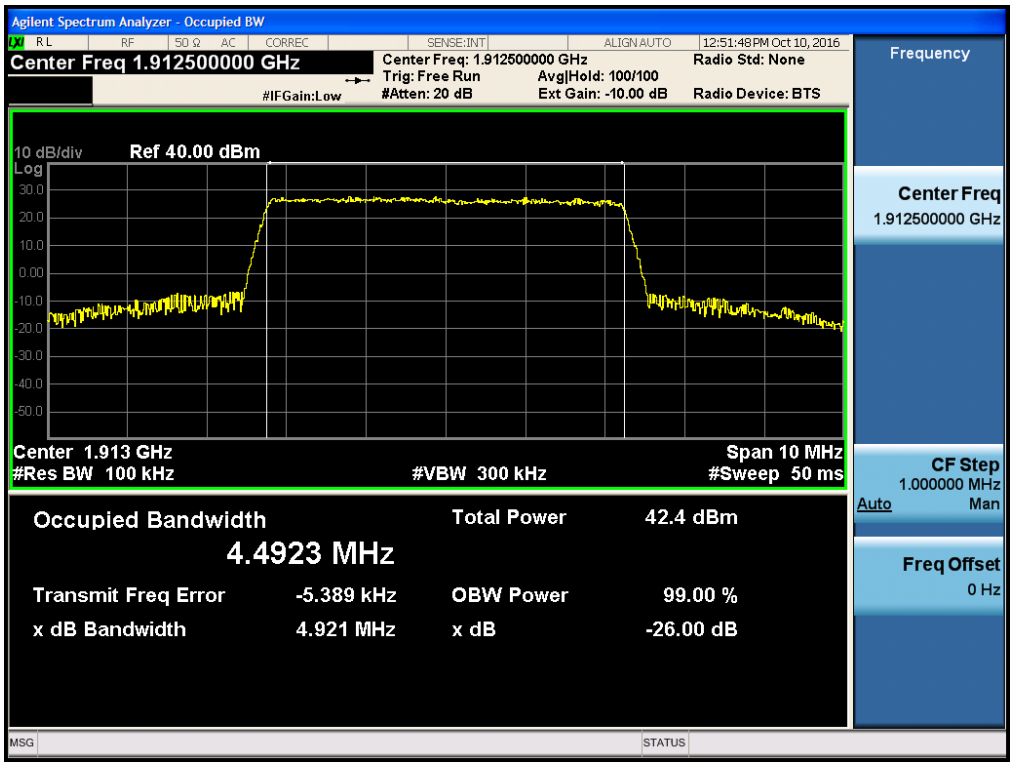
[LTE 5 MHz +3dB above the AGC threshold Uplink Low]



[LTE 5 MHz +3dB above the AGC threshold Uplink Middle]

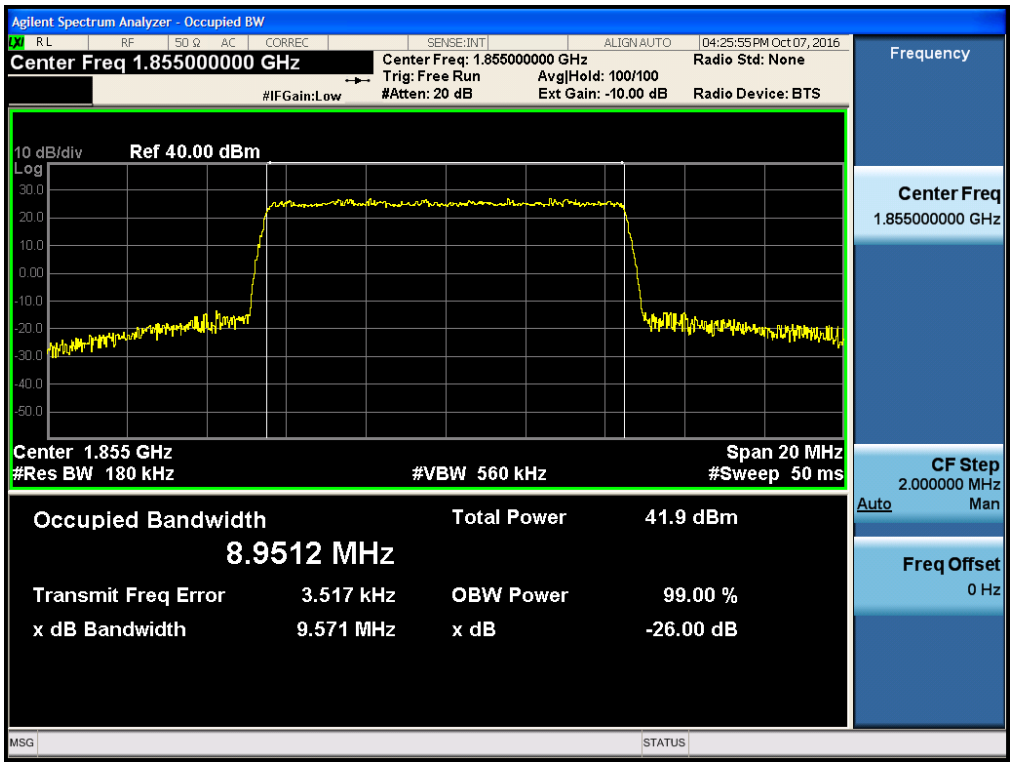


[LTE 5 MHz +3dB above the AGC threshold Uplink High]

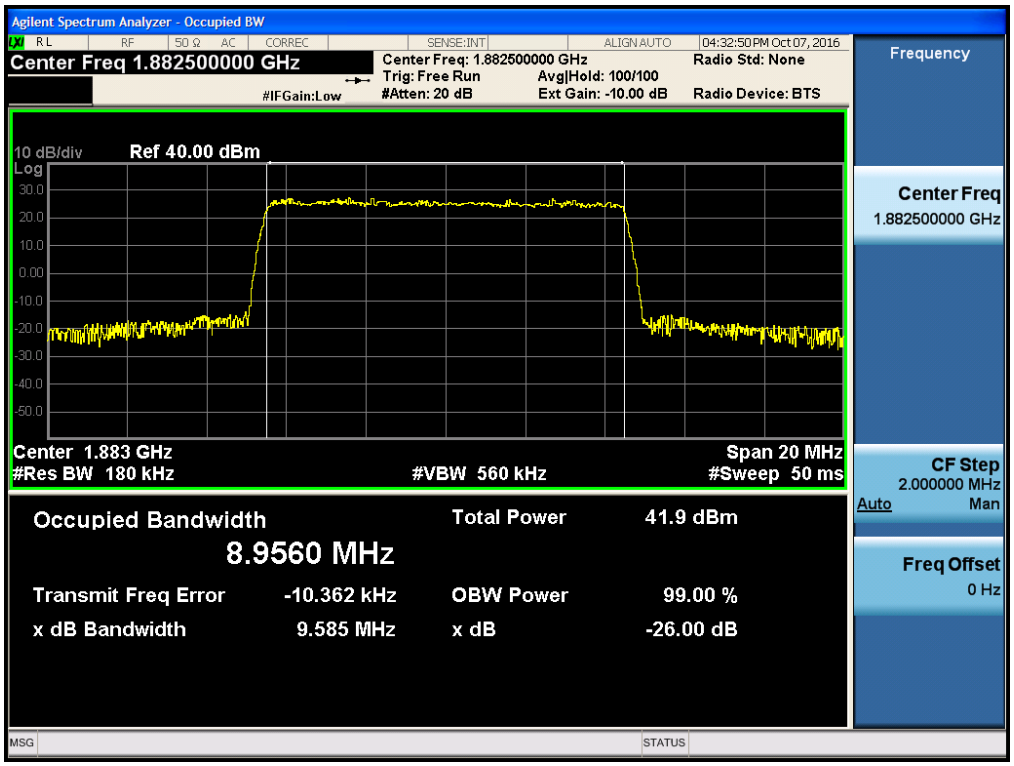


LTE 10 MHz UL_Ouuput

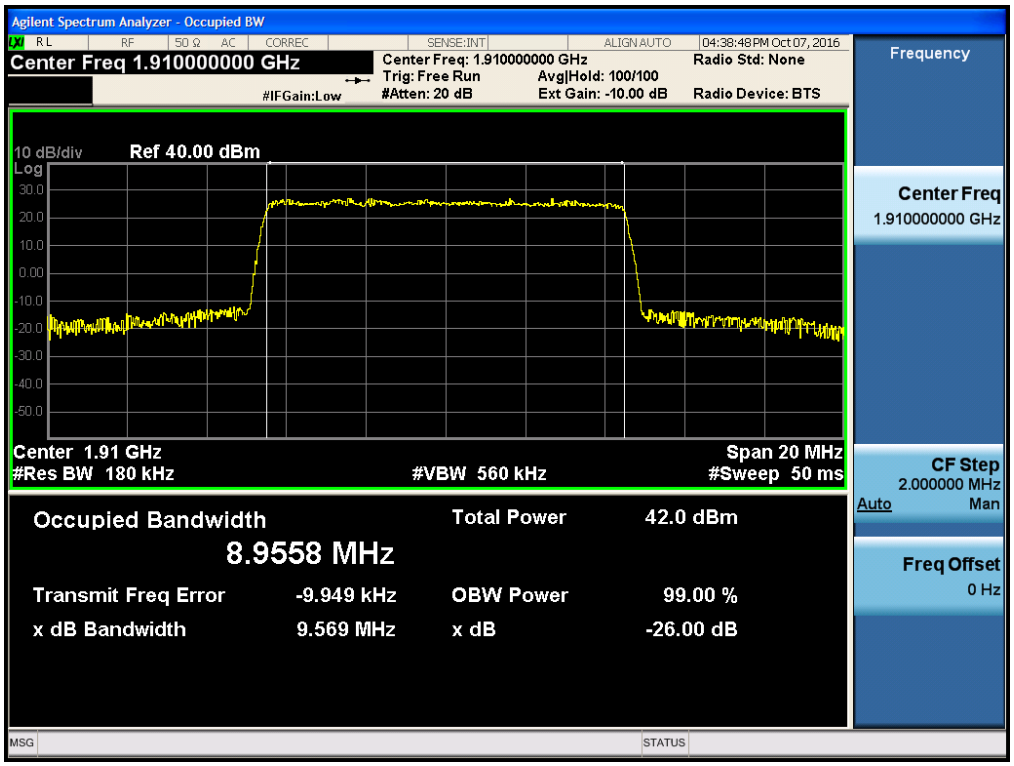
[LTE 10 MHz AGC threshold Uplink Low]



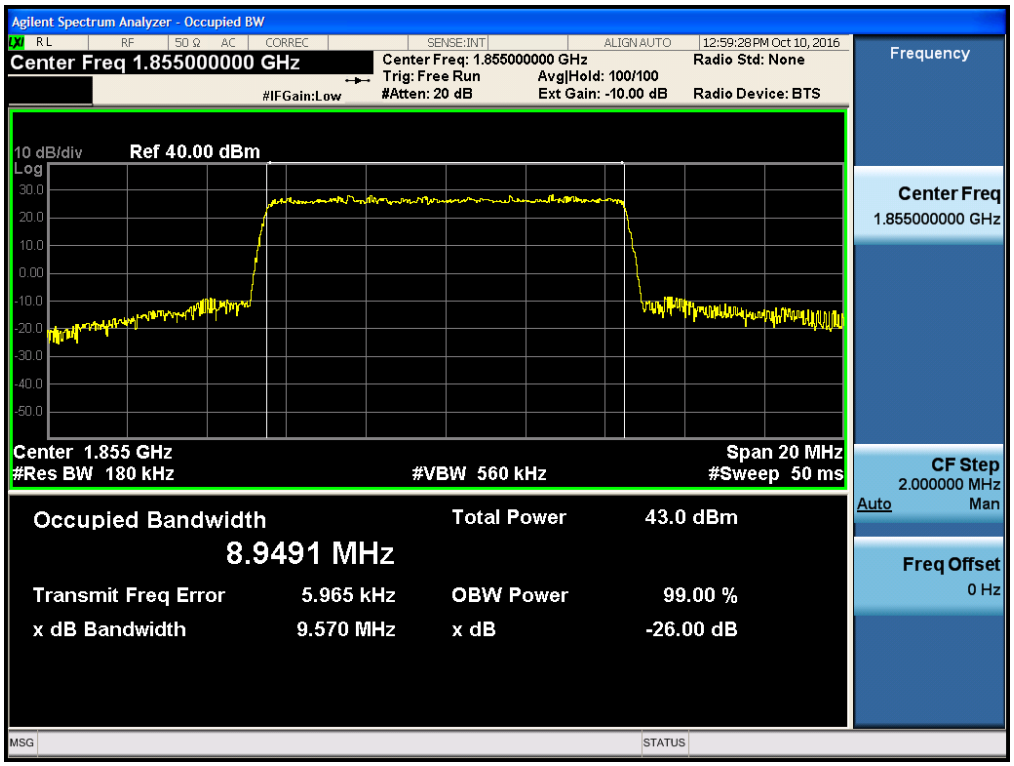
[LTE 10 MHz AGC threshold Uplink Middle]



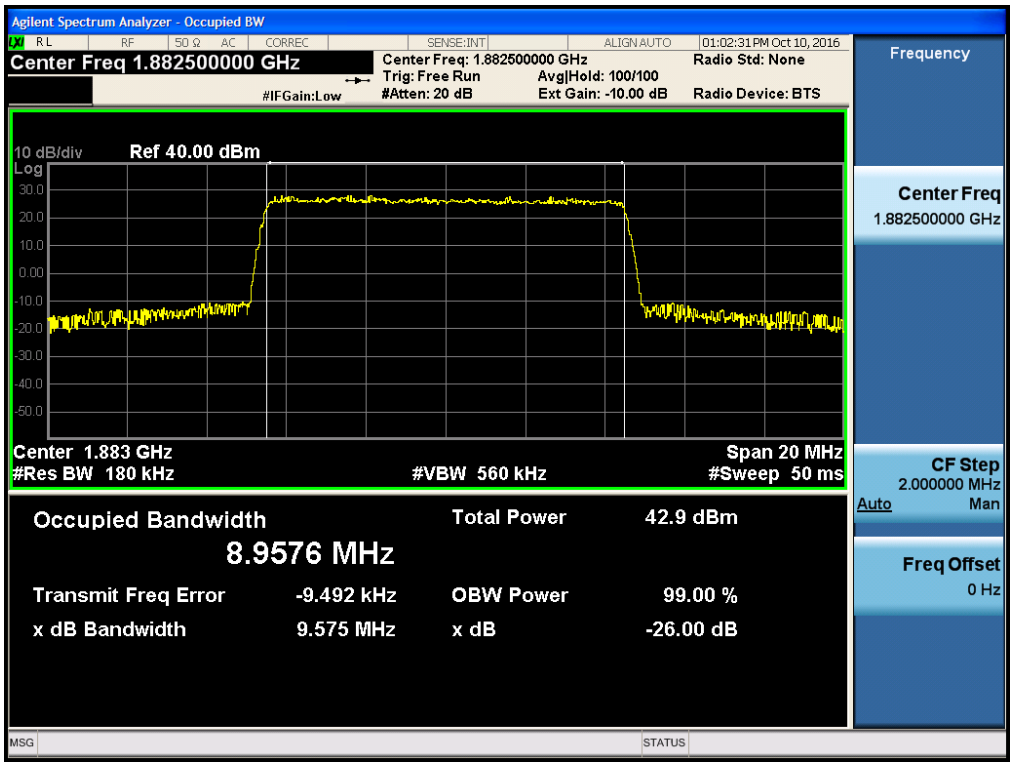
[LTE 10 MHz AGC threshold Uplink High]



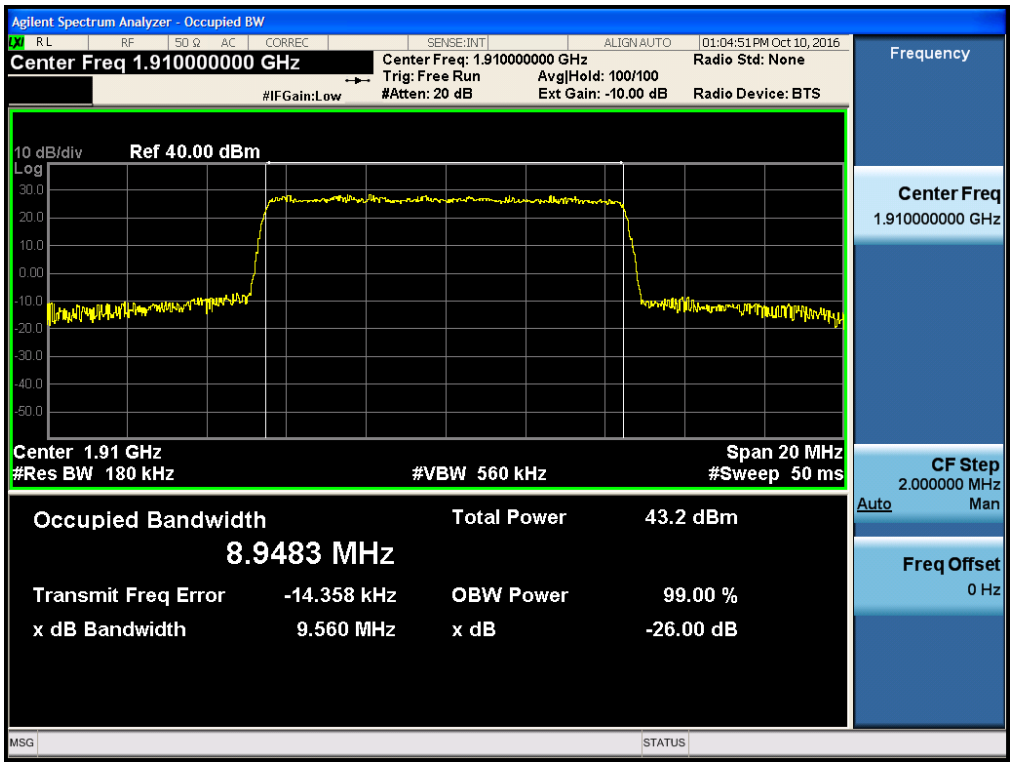
[LTE 10 MHz +3dB above the AGC threshold Uplink Low]



[LTE 10 MHz +3dB above the AGC threshold Uplink Middle]

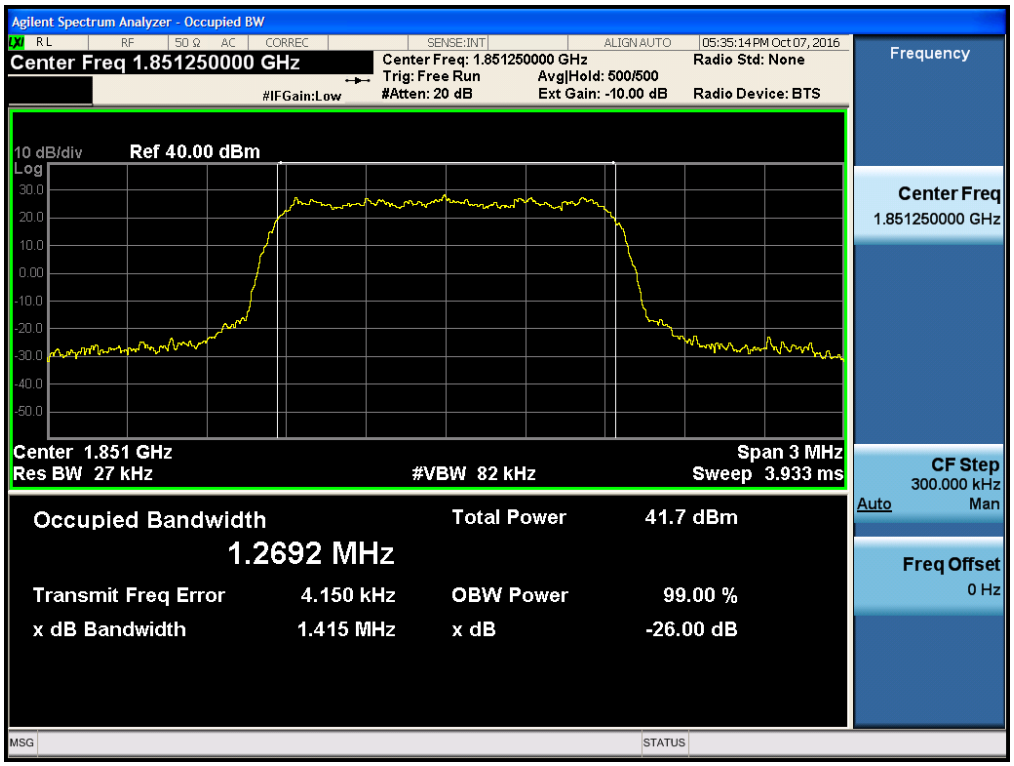


[LTE 10 MHz +3dB above the AGC threshold Uplink High]

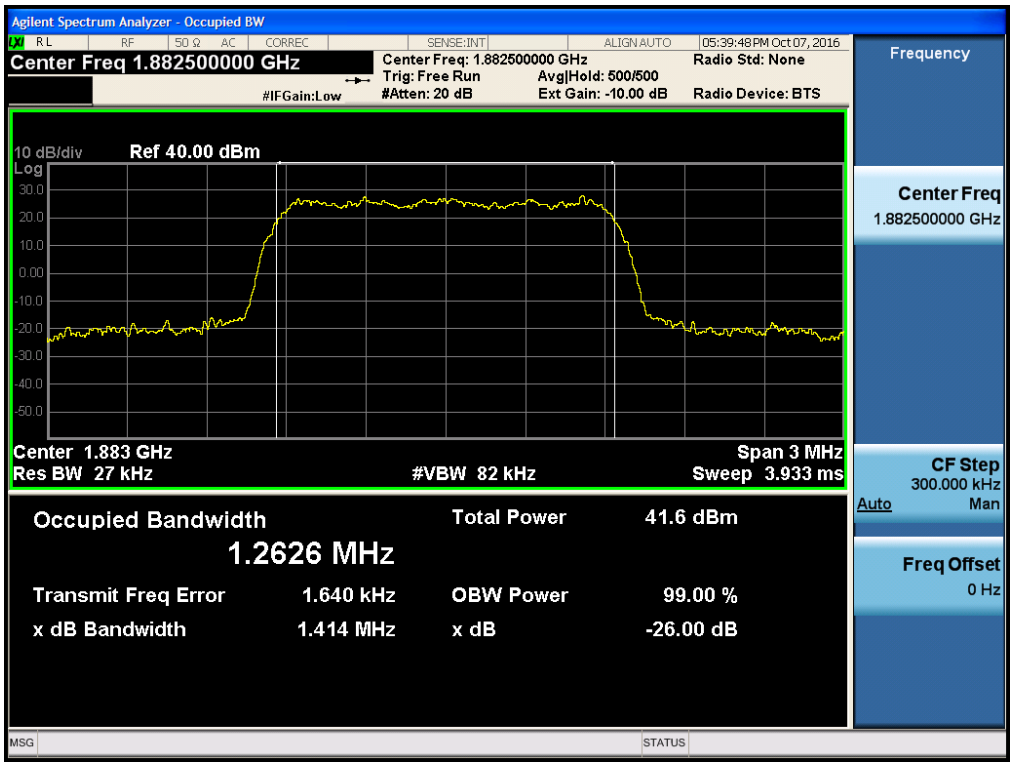


CDMA UL_Ouuput

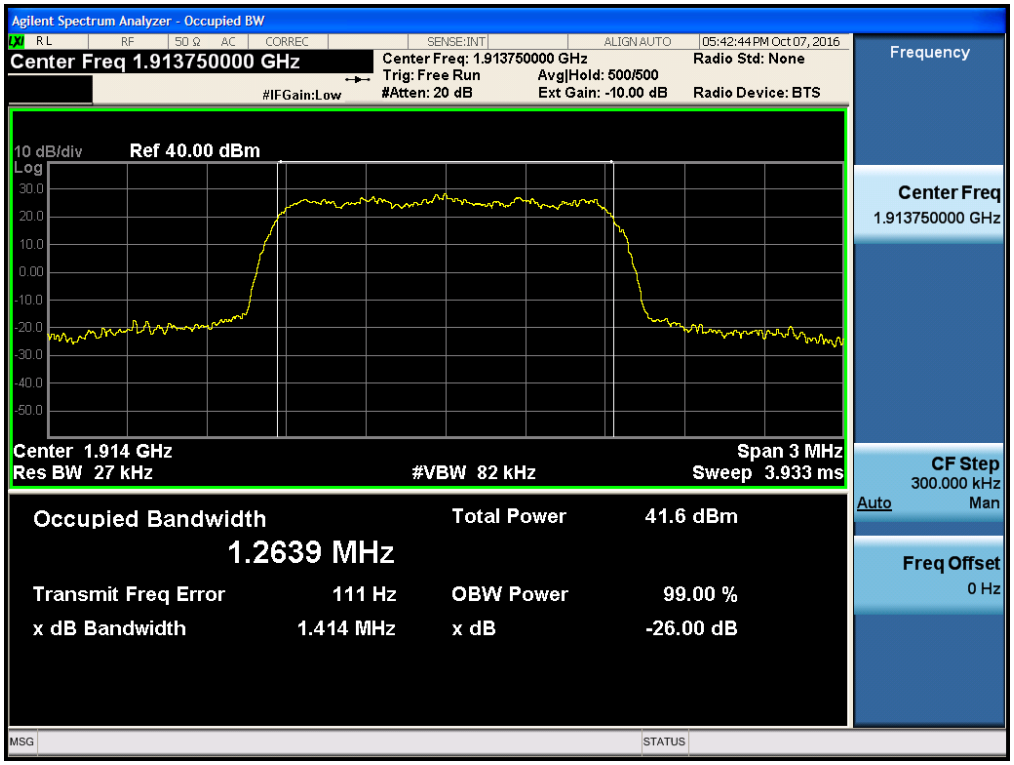
[CDMA AGC threshold Uplink Low]



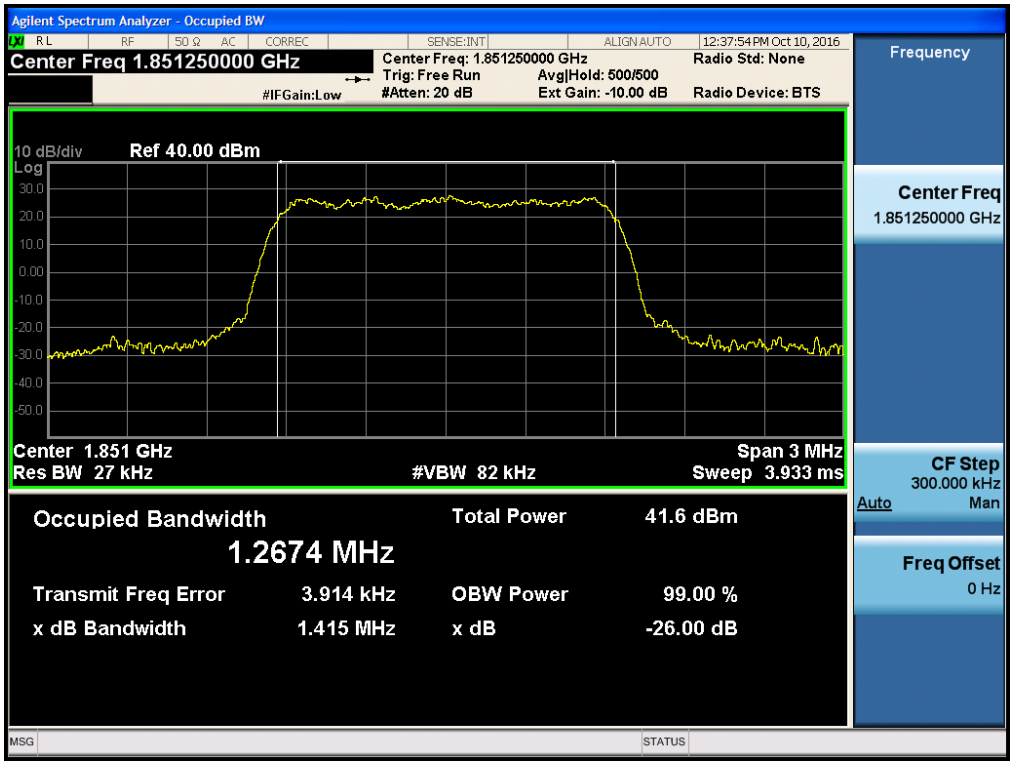
[CDMA AGC threshold Uplink Middle]



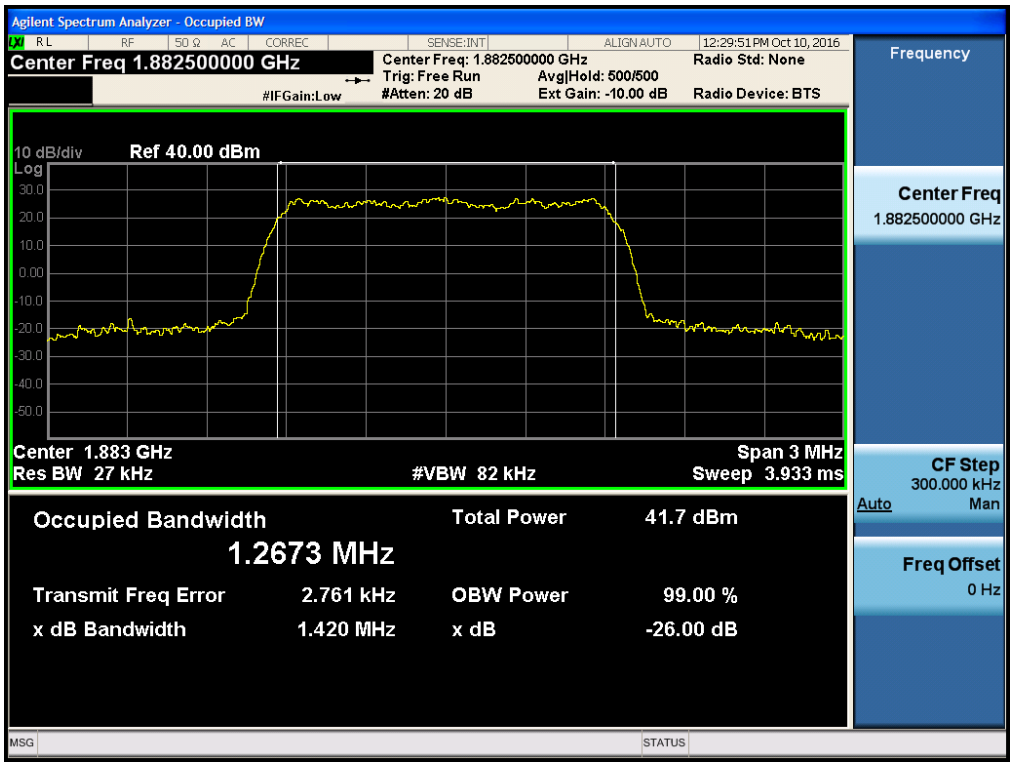
[CDMA AGC threshold Uplink High]



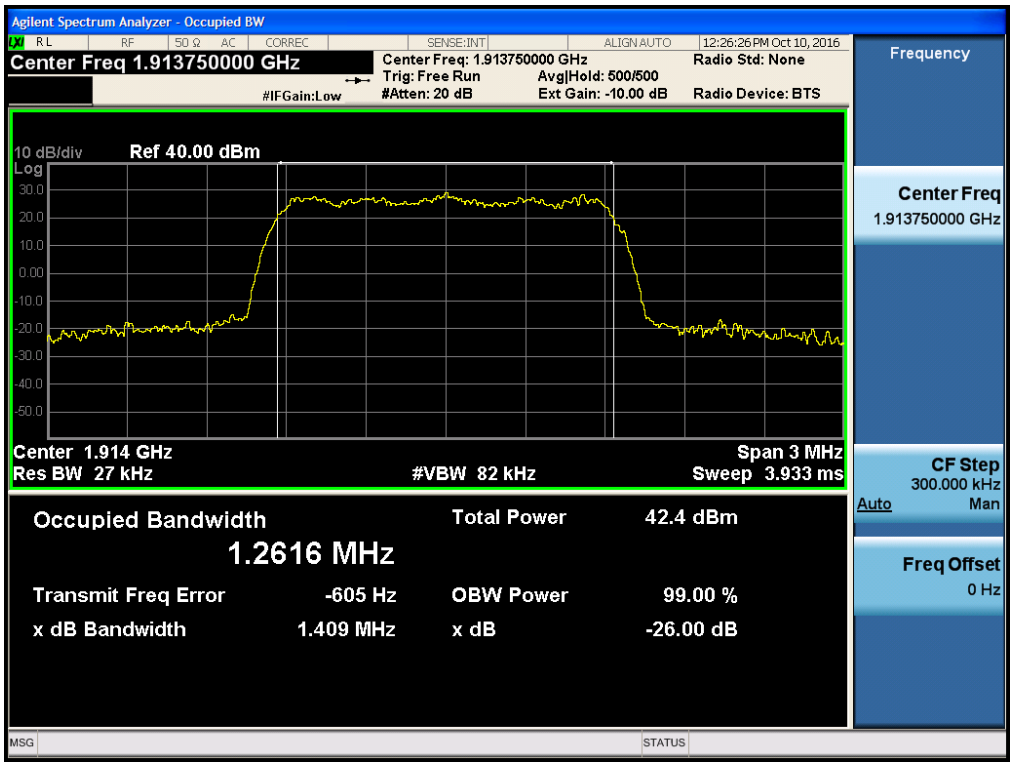
[CDMA +3dB above the AGC threshold Uplink Low]



[CDMA +3dB above the AGC threshold Uplink Middle]

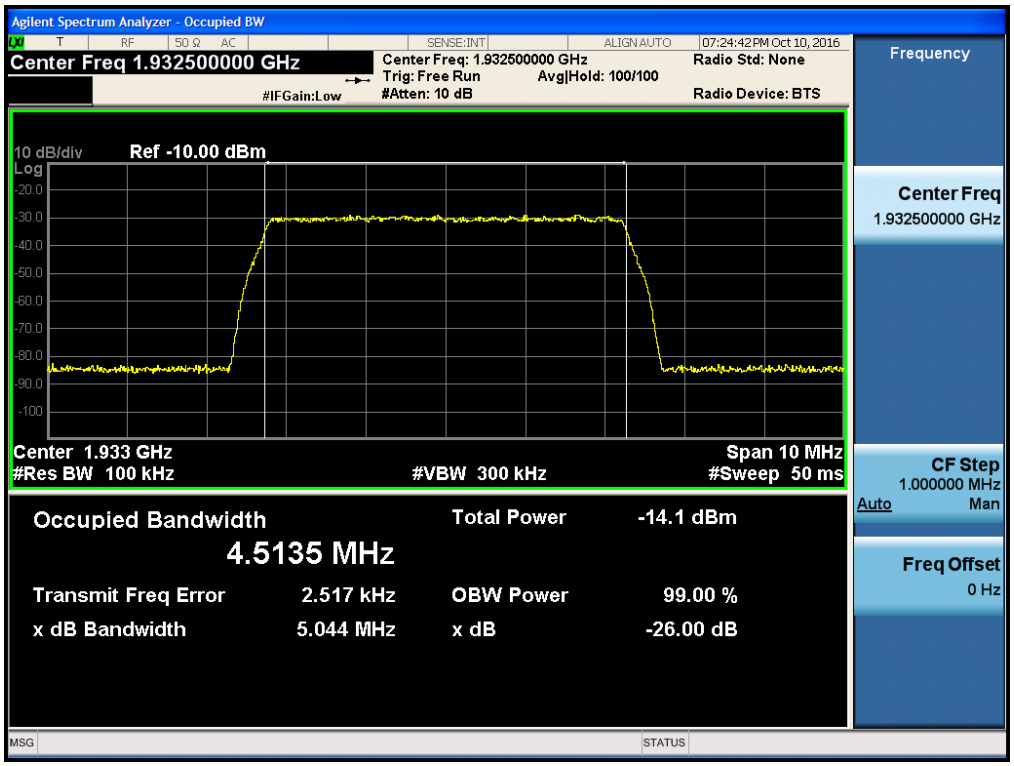


[CDMA +3dB above the AGC threshold Uplink High]

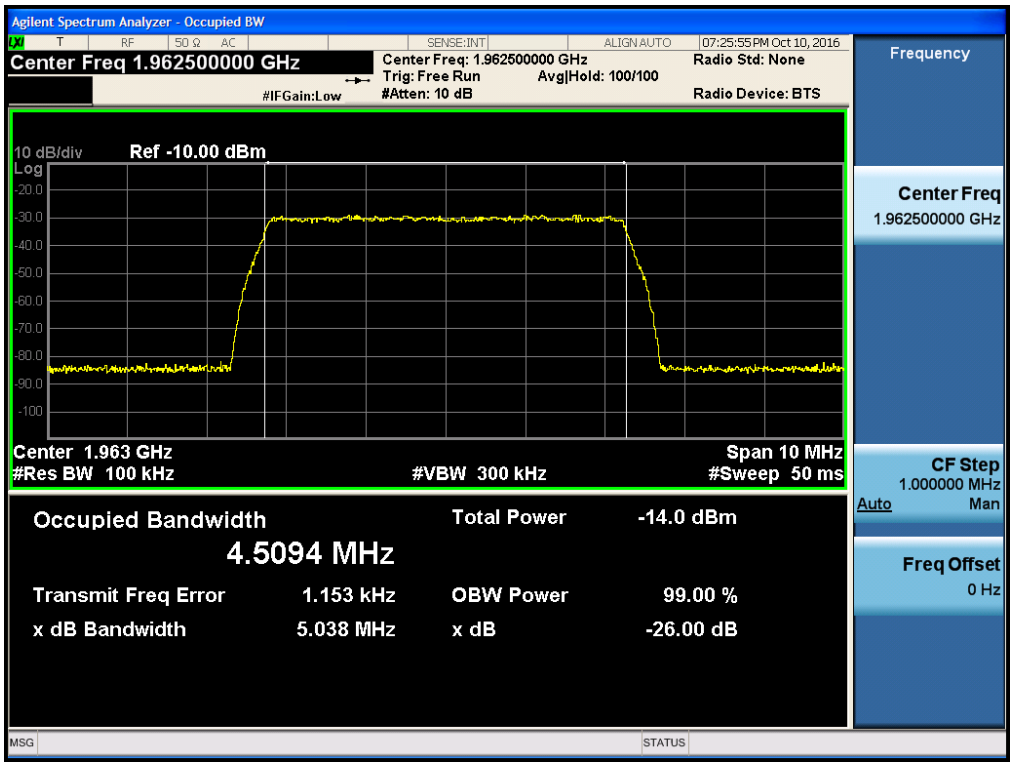


LTE 5 MHz DL_Input

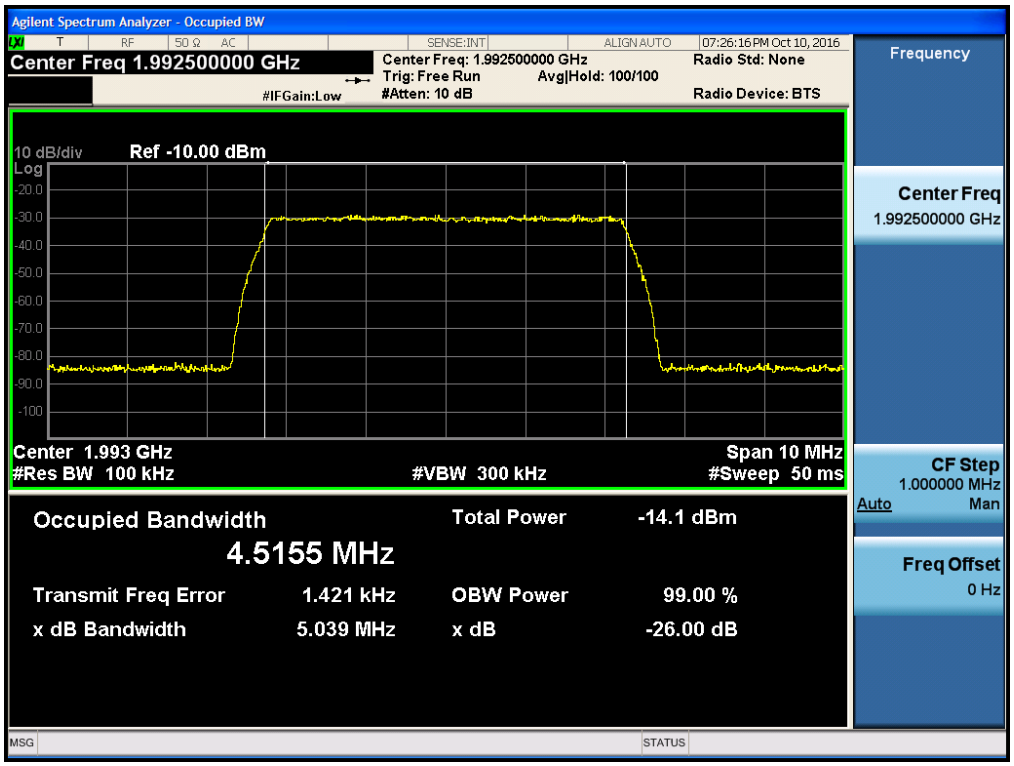
[LTE 5 MHz AGC threshold Downlink Low]



[LTE 5 MHz AGC threshold Downlink Middle]

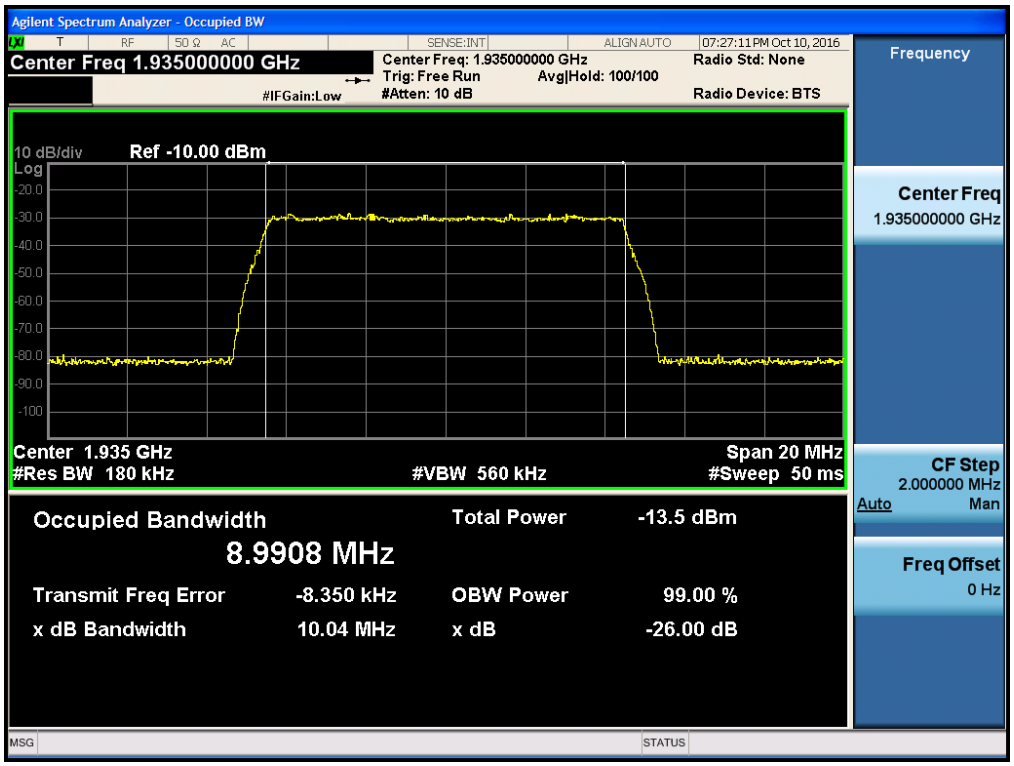


[LTE 5 MHz AGC threshold Downlink High]

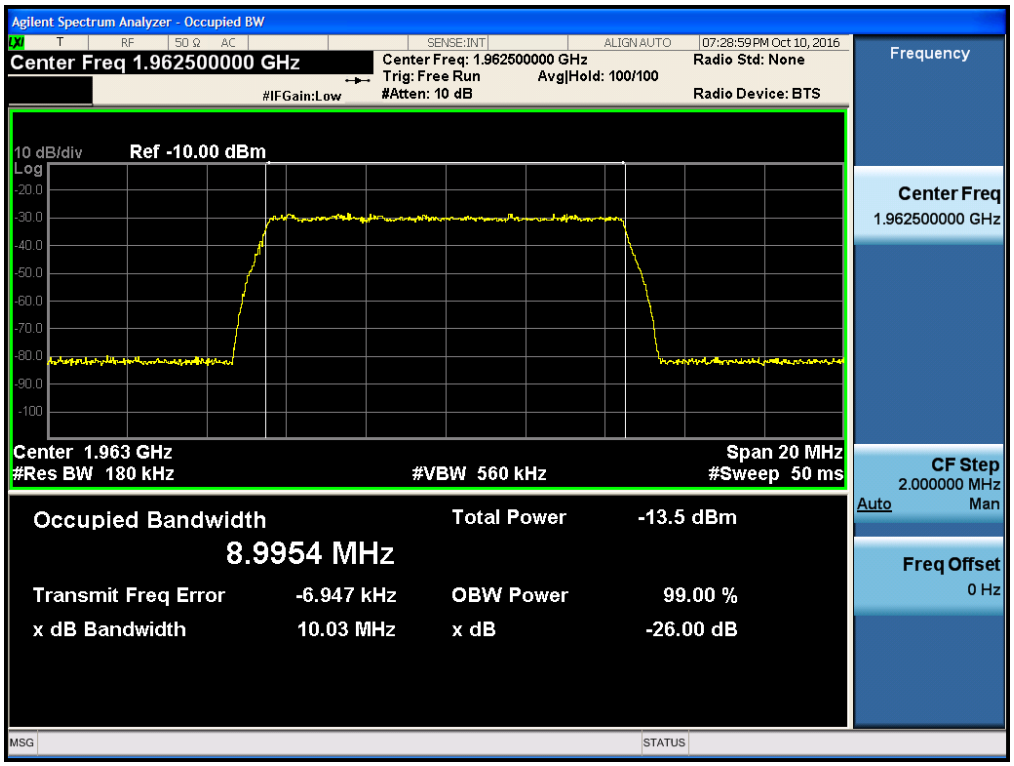


LTE 10 MHz DL_Input

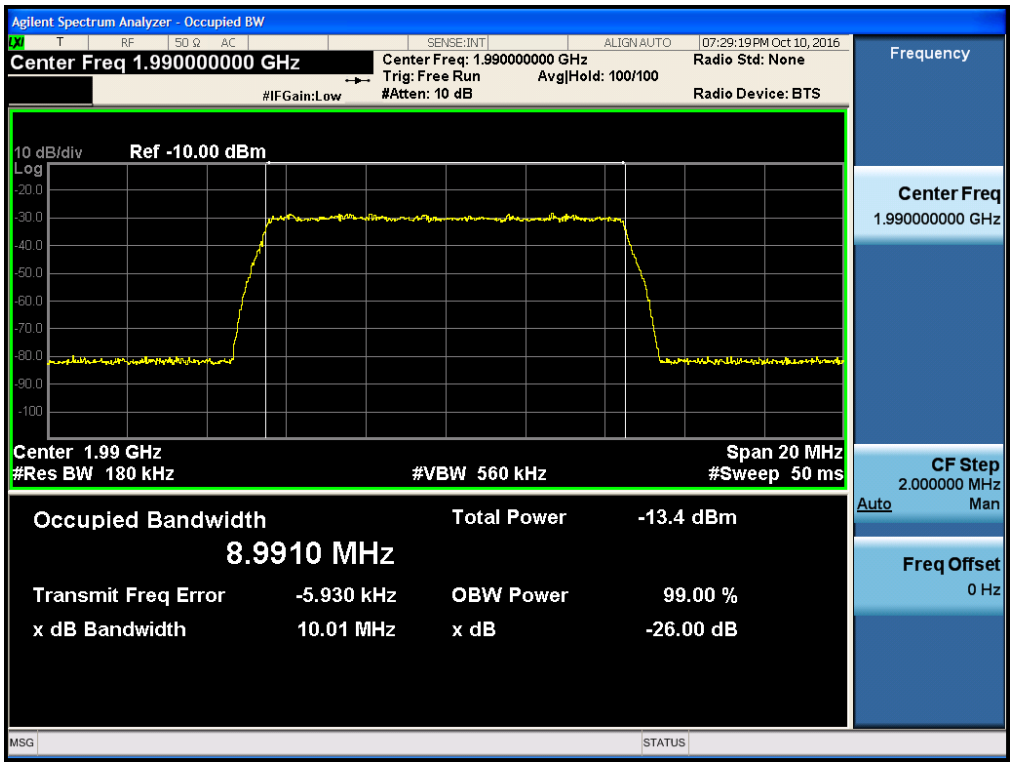
[LTE 10 MHz AGC threshold Downlink Low]



[LTE 10 MHz AGC threshold Downlink Middle]

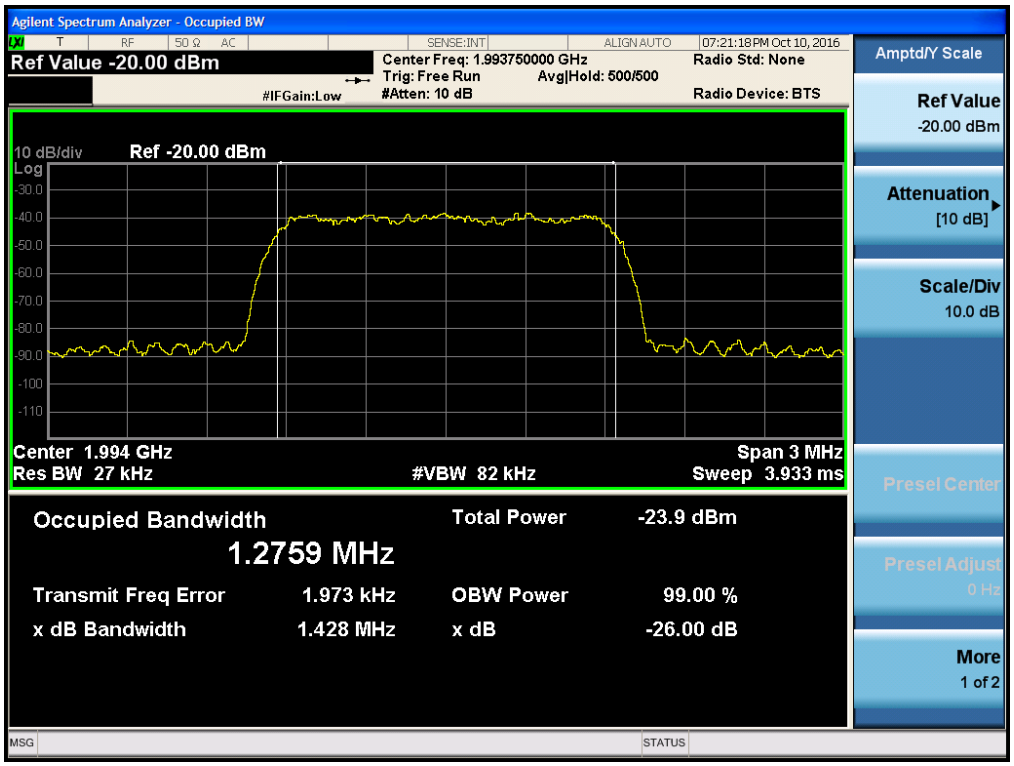


[LTE 10 MHz AGC threshold Downlink High]

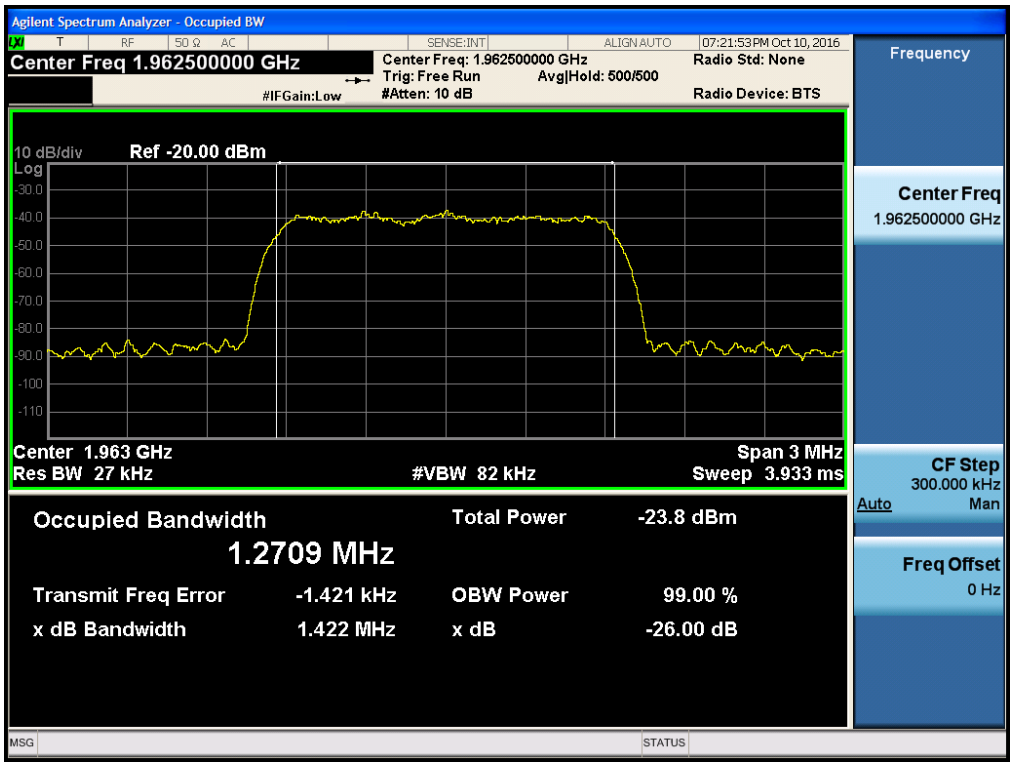


CDMA DL_Input

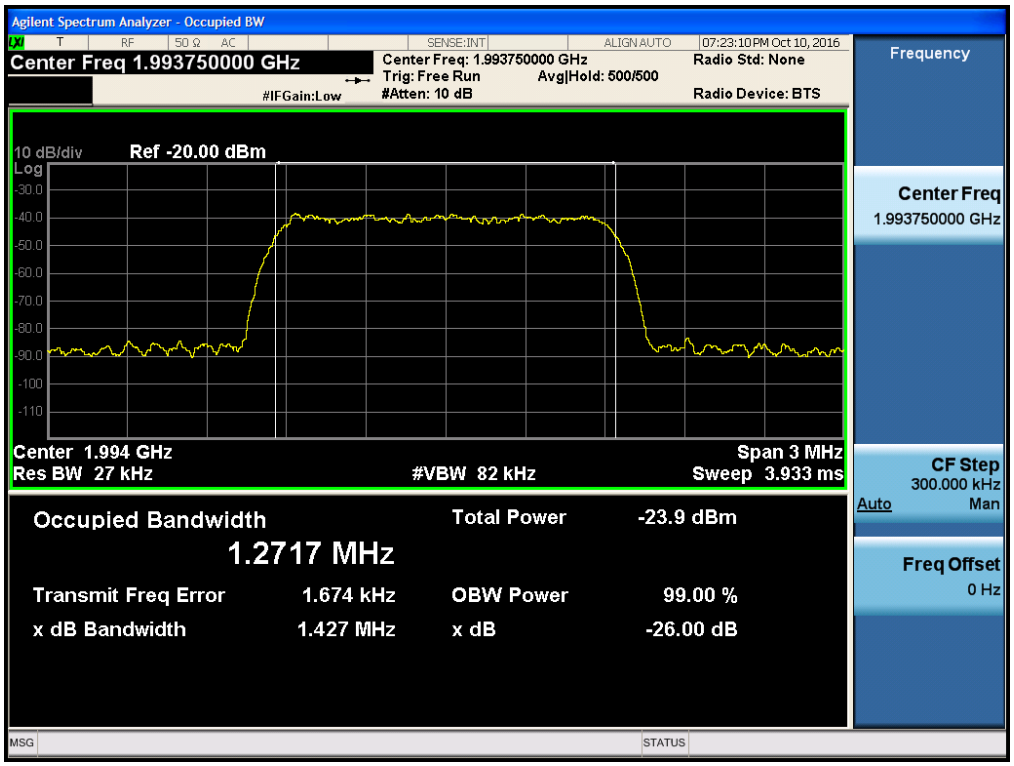
[CDMA AGC threshold Downlink Low]



[CDMA AGC threshold Downlink Middle]

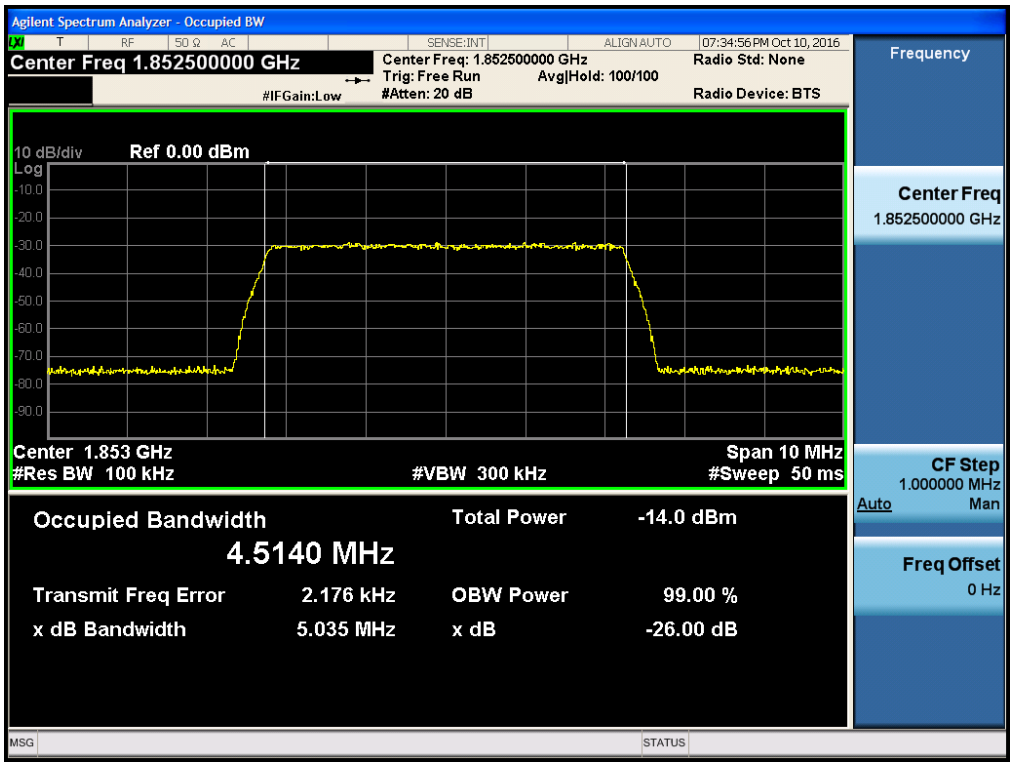


[CDMA AGC threshold Downlink High]

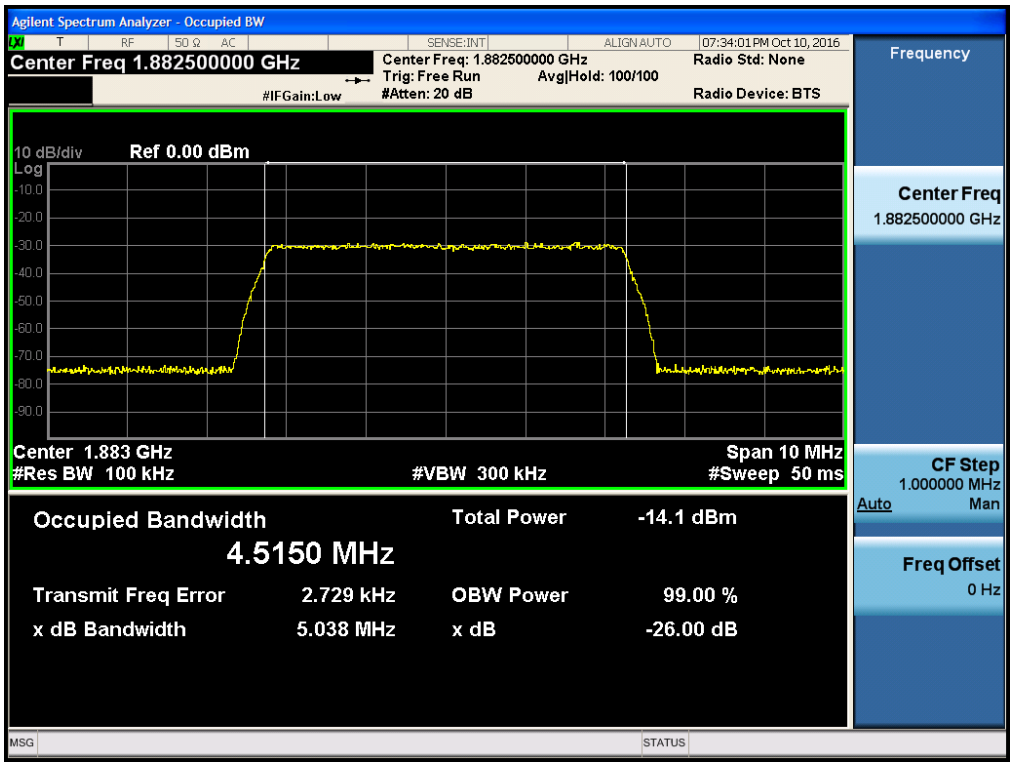


LTE 5 MHz UL_Input

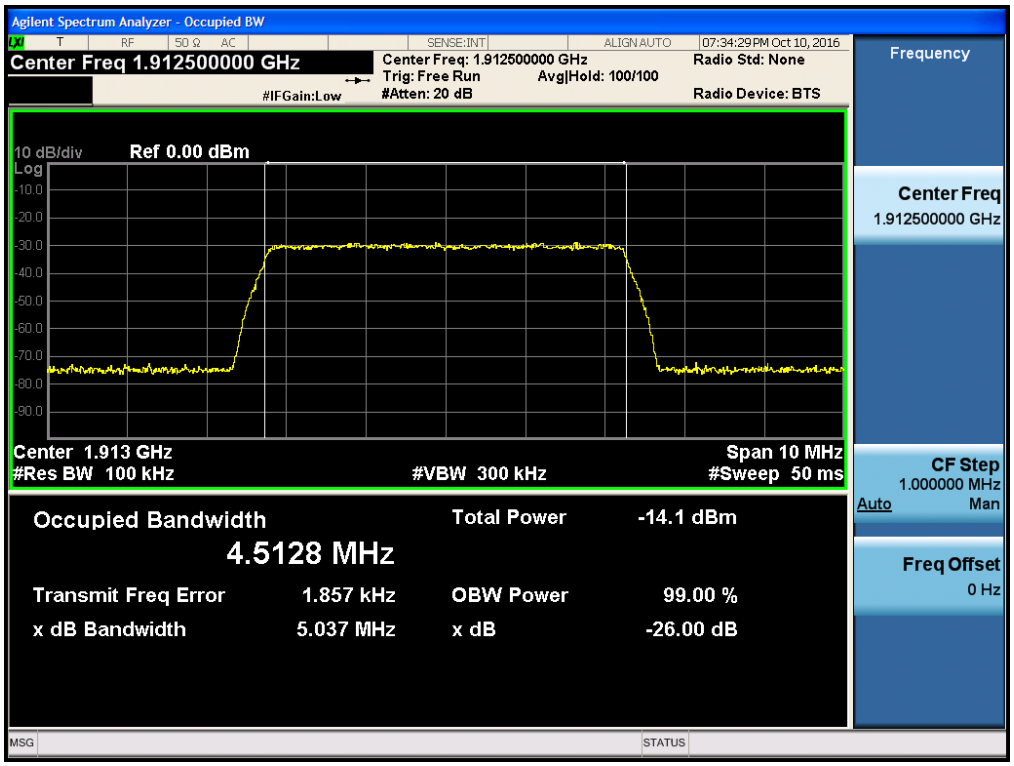
[LTE 5 MHz AGC threshold Uplink Low]



[LTE 5 MHz AGC threshold Uplink Middle]

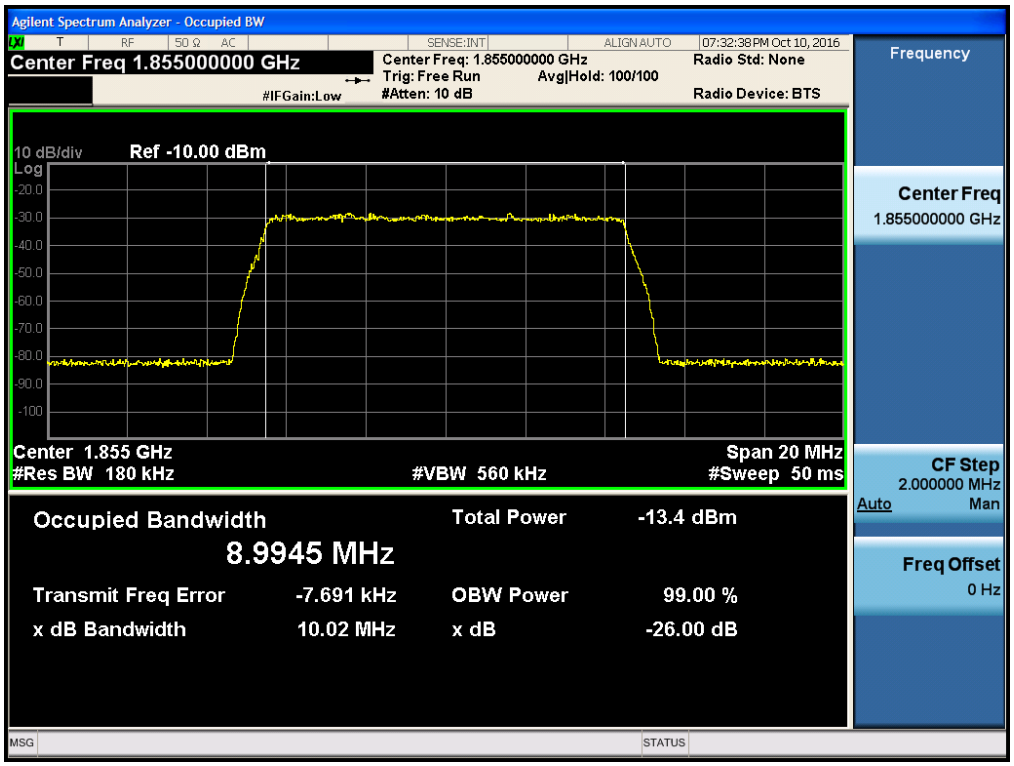


[LTE 5 MHz AGC threshold Uplink High]

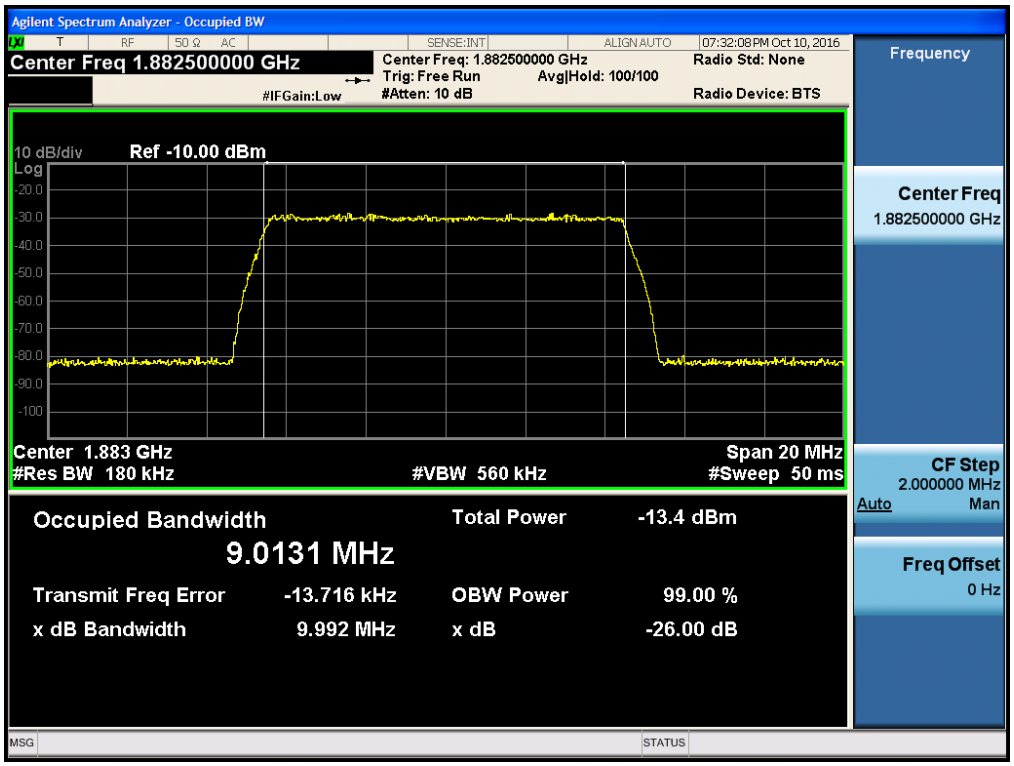


LTE 10 MHz UL_Input

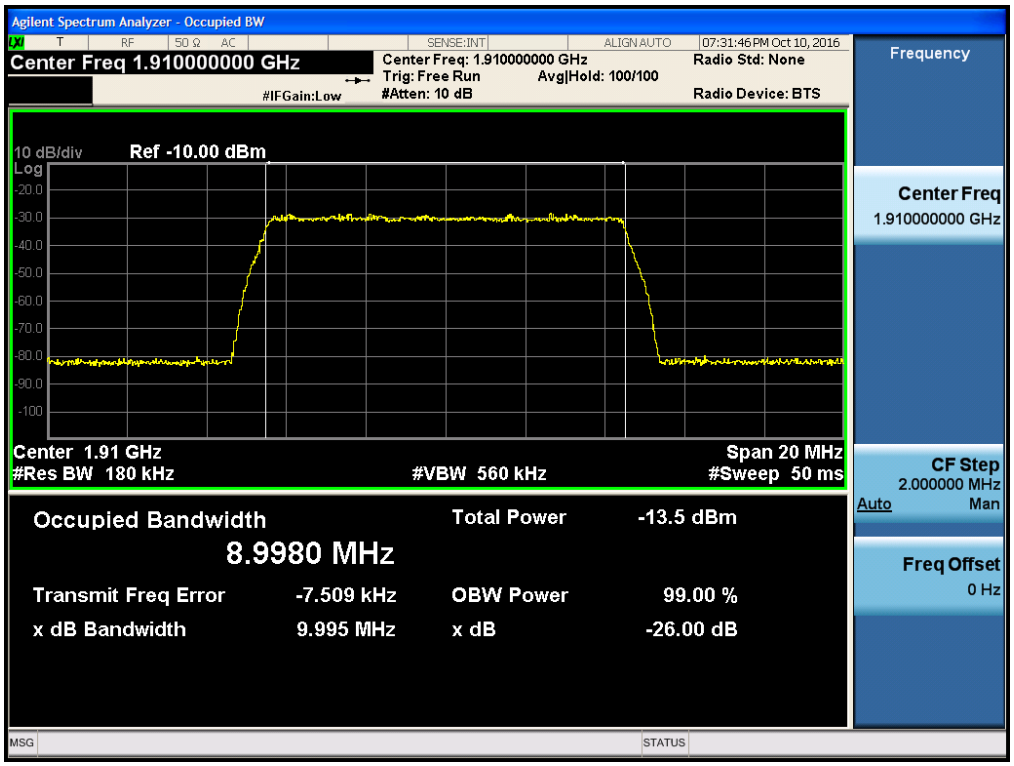
[LTE 10 MHz AGC threshold Uplink Low]



[LTE 10 MHz AGC threshold Uplink Middle]

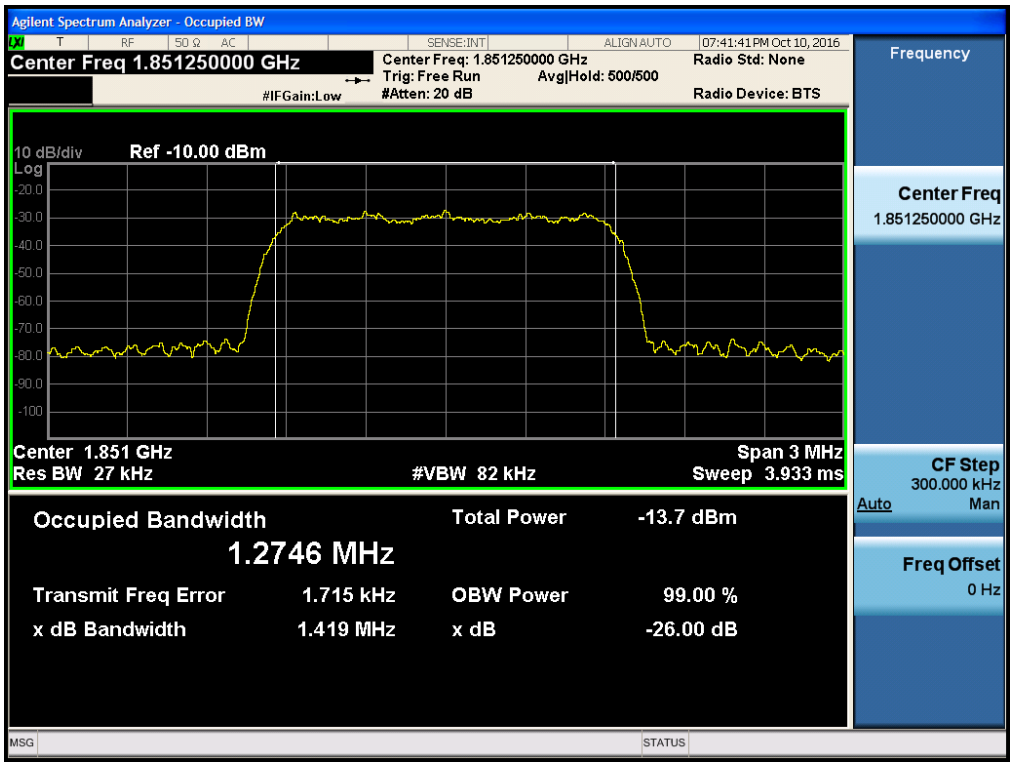


[LTE 10 MHz AGC threshold Uplink High]

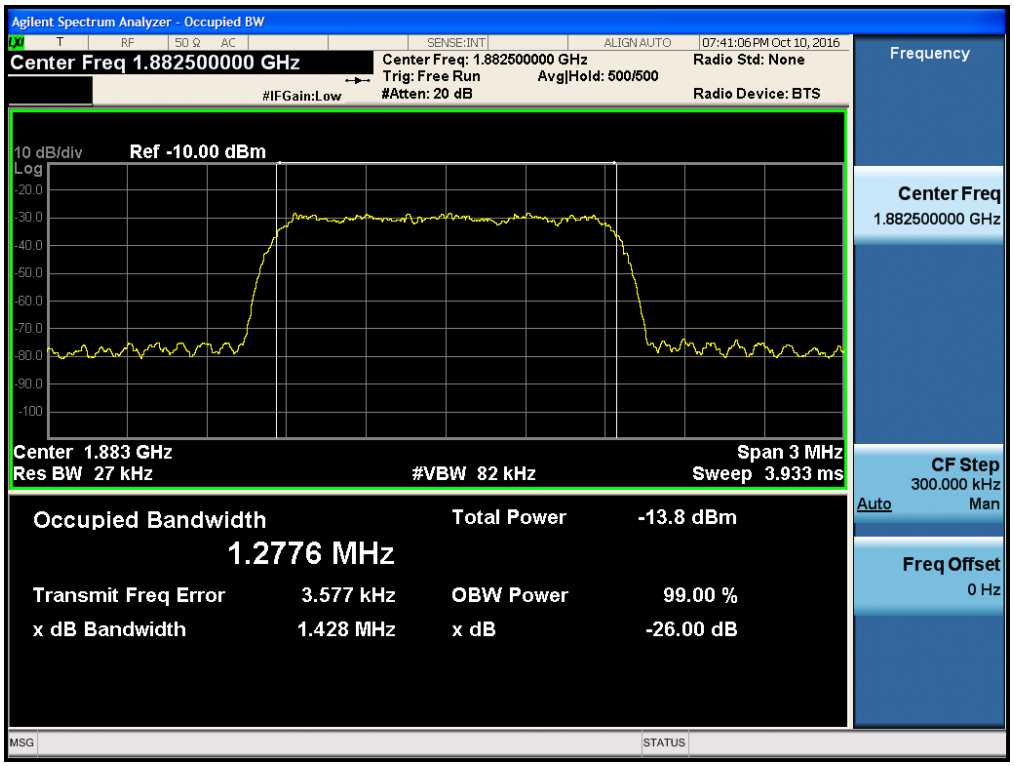


CDMA UL_Input

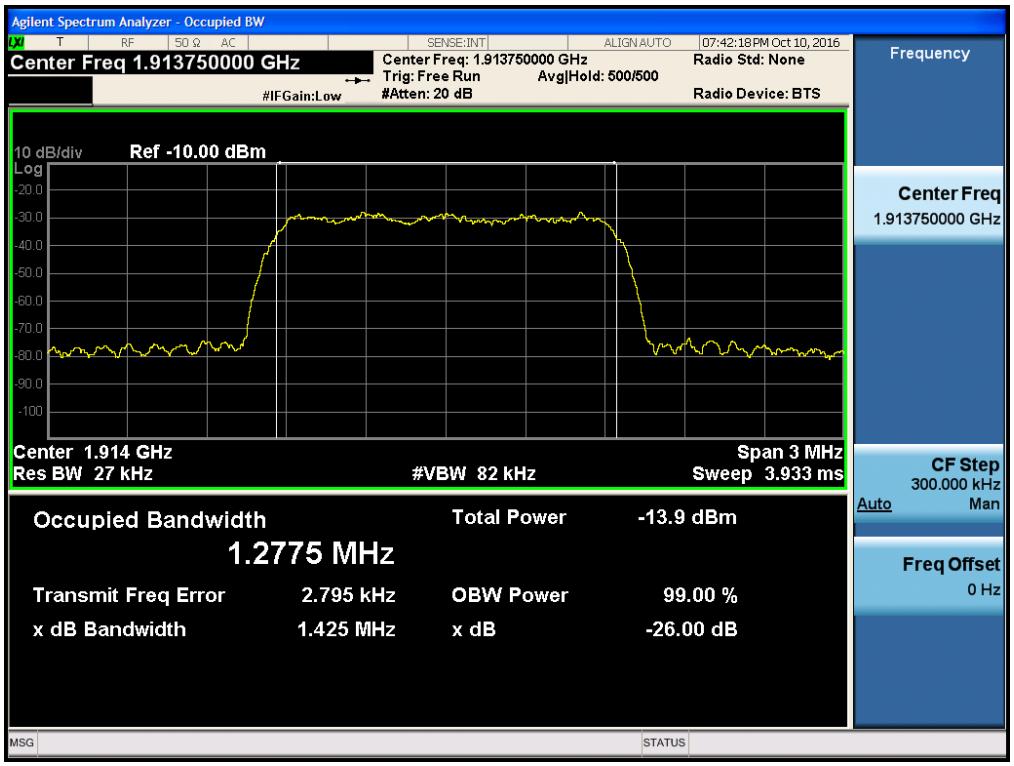
[CDMA AGC threshold Uplink Low]



[CDMA AGC threshold Uplink Middle]



[CDMA AGC threshold Uplink High]



8. OUT OF BAND REJECTION

FCC Rules

Test Requirement(s):

KDB 935210 D05 v01r01

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

Test Procedures:

Measurements were in accordance with the test methods section 3.3, 4.3 of KDB 935210 D05 v01r01.

3.3 Out-of-band rejection

a) Connect a signal generator to the input of the EUT.

b) Configure a swept CW signal with the following parameters:

1) Frequency range = ± 250 % of the passband, for each applicable CMRS band.

2) Level = a sufficient level to affirm that the out-of-band rejection is > 20 dB above the noise floor and will not engage the AGC during the entire sweep.

3) Dwell time = approximately 10 ms.

4) Number of points = SPAN/(RBW/2).

c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.

e) Set the resolution bandwidth (RBW) of the spectrum analyzer to be 1 % to 5 % of the EUT passband, and the video bandwidth (VBW) shall be set to ≥ 3 × RBW.

f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.

g) Place a marker to the peak of the frequency response and record this frequency as f0.

h) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the −20 dB down amplitude, to determine the 20 dB bandwidth.

i) Capture the frequency response of the EUT.

j) Repeat for all frequency bands applicable for use by the EUT.

4.3 Out-of-band rejection

Adjust the internal gain control of the EUT to the maximum gain for which equipment certification is sought.

a) Connect a signal generator to the input of the EUT.

b) Configure a swept CW signal with the following parameters:

1) Frequency range = ± 250 % of the manufacturer's specified pass band.
2) The CW amplitude shall be 3 dB below the AGC threshold (see 4.2), and shall not activate the AGC threshold throughout the test.
3) Dwell time = approximately 10 ms.
4) Frequency step = 50 kHz.

c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.
d) Set the RBW of the spectrum analyzer to between 1 % and 5 % of the manufacturer's rated passband, and VBW = 3 × RBW.
e) Set the detector to Peak and the trace to Max-Hold.
f) After the trace is completely filled, place a marker at the peak amplitude, which is designated as f0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the level has fallen by 20 dB).
g) Capture the frequency response plot for inclusion in the test report.

Test Results:

The EUT complies with the requirements of this section.

Input Signal	Input Level (dBm)		Maximum Amp Gain	
	DL	UL	DL	UL
LTE 5 MHz	-62	-72	105	
LTE 10 MHz				
CDMA				

[Downlink]

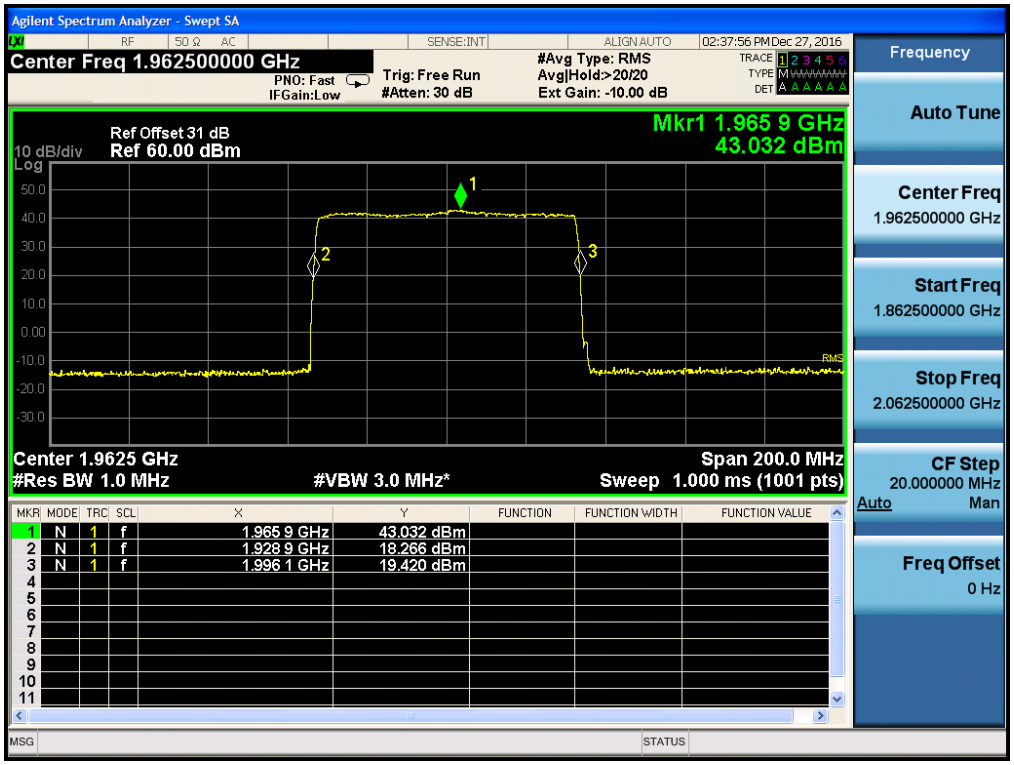
20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
1928.900 ~ 1996.100	43.032	105.032

[Upnlink]

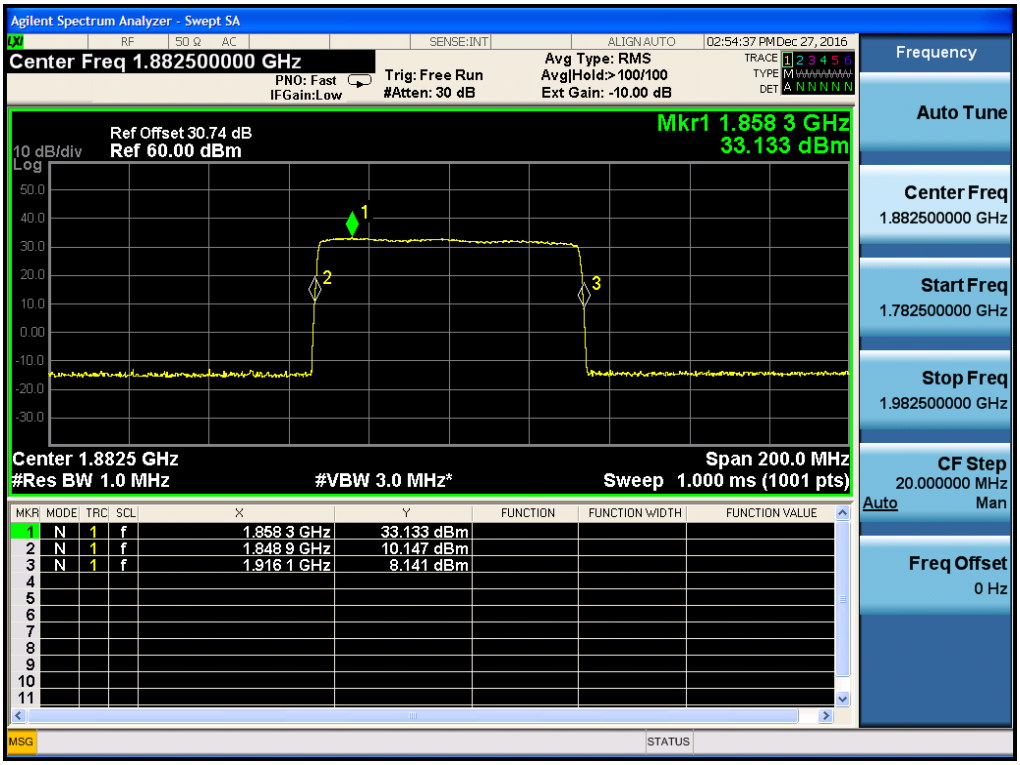
20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
1848.900 ~ 1916.100	33.133	105.133

Plots of Passband Gain and Bandwidth & Out of Band Rejection

[Downlink]



[Uplink]



9. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

FCC Rules

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.

§ 24.238 Emission limitations for Broadband PCS equipment.

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(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.

(b) *Measurement procedure.* Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 1 MHz 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.

(c) *Alternative out of band emission limit.* Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

(d) *Interference caused by out of band emissions.* If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

Test Procedures:

Measurements were in accordance with the test methods section 3.6 and 4.7 of KDB 935210 D05 v01r01.

3.6.1. General

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle and high channels or frequencies within each authorized frequency band of operation. Out-of-band/block emissions (including intermodulation products) shall be measured under each of the following two stimulus conditions:

a) two adjacent test signals sequentially tuned to the lower and upper frequency band/block edges;

b) a single test signal, sequentially tuned to the lowest and highest frequencies or channels within the frequency band/block under examination.

NOTE—Single channel boosters that cannot accommodate two simultaneous signals within the passband, can be excluded from the test stipulated in step a).

3.6.2. Out-of-band/out-of-block emissions conducted measurements

a) Connect a signal generator to the input of the EUT.

If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.

b) Set the signal generator to produce two AWGN signals as previously described.

c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168 [R8], but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168 [R8].

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the EBW or 100 kHz or 1 MHz)

g) Set the VBW = 3 × RBW.

h) Set the detector to power averaging (rms) detector.

i) Set the Sweep time = auto-couple.

j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.

k) Trace average at least 100 traces in power averaging (rms) mode.

l) Use the marker function to find the maximum power level.

m) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.

o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.

p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.

q) Repeat steps k) to n).

r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.

s) Repeat steps a) to r) with the narrowband test signal.

t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

3.6.3. Spurious emissions conducted measurements

a) Connect a signal generator to the input of the EUT.

b) Set the signal generator to produce the broadband test signal as previously described.

c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.

d) Set the EUT input power to a level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).

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g) Set the VBW ≥ 3 × RBW.

h) Set the Sweep time = auto-couple.

i) Set the spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

The number of measurement points in each sweep must be ≥ (2 × span/RBW), which may require that the measurement range defined by the start and stop frequencies be

subdivided, depending on the available number of measurement points provided by the spectrum analyzer.2

j) Select the power averaging (rms) detector function.

k) Trace average at least 10 traces in power averaging (rms) mode.

l) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.

m) Reset the spectrum analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to 10 times the highest frequency of the fundamental emission (see § 2.1057). The number of measurement points in each sweep must be ≥ (2 × span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

n) Trace average at least 10 traces in power averaging (rms) mode.

o) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report; also provide tabular data, if required.

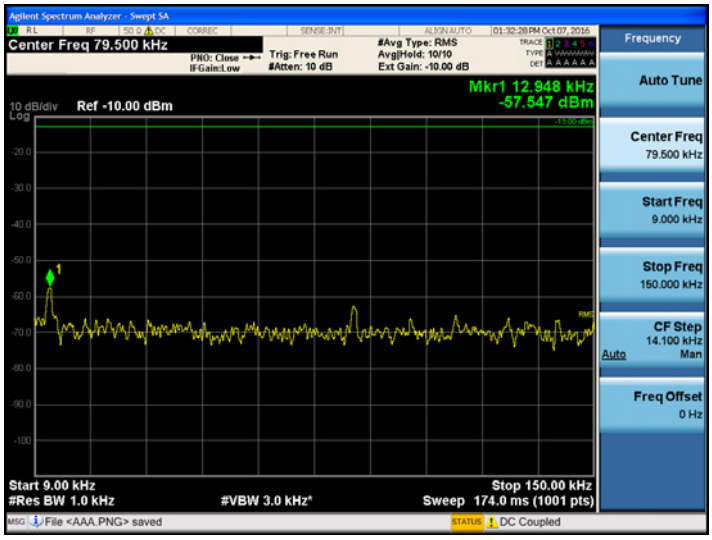
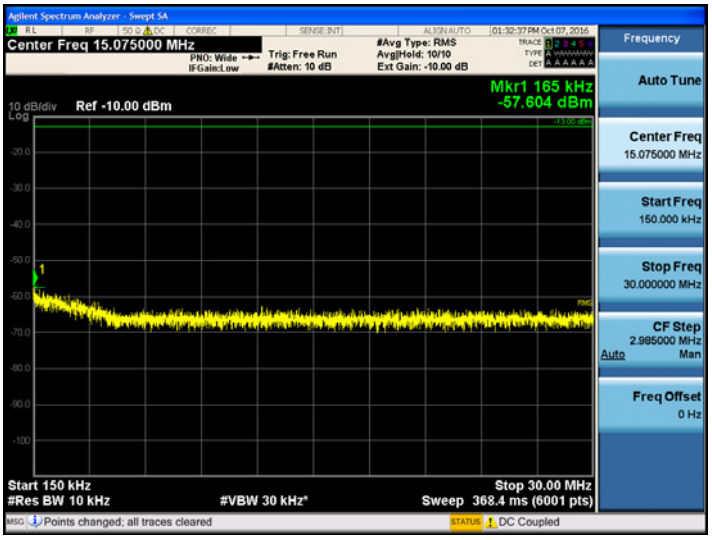
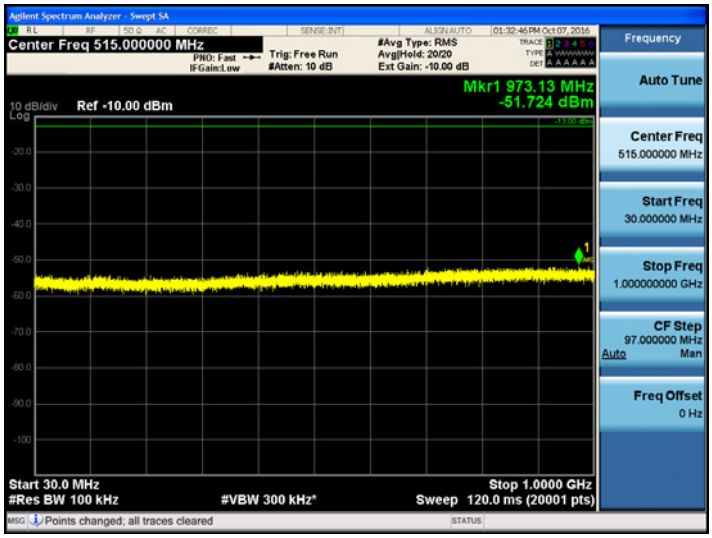
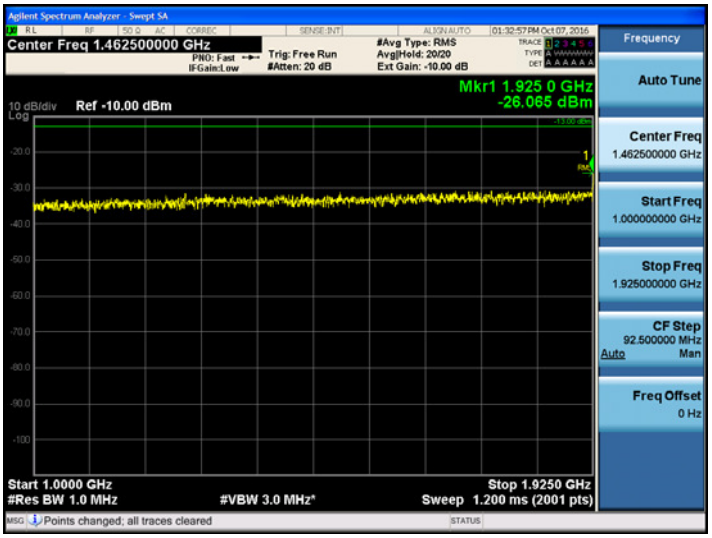
Notes:

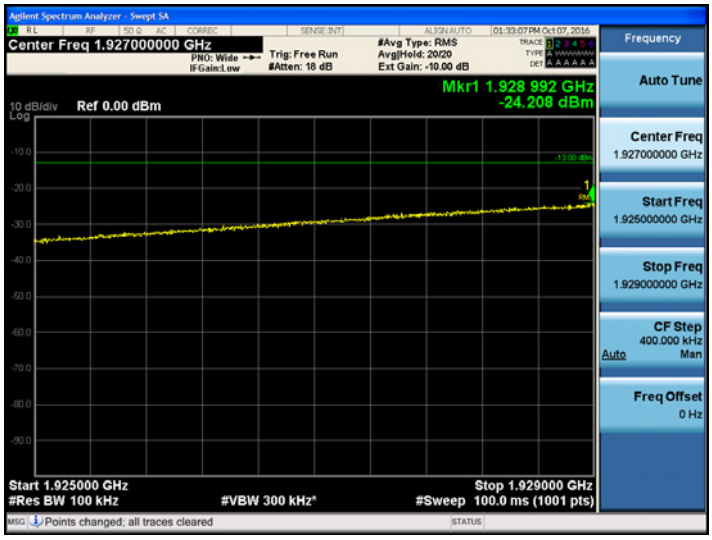
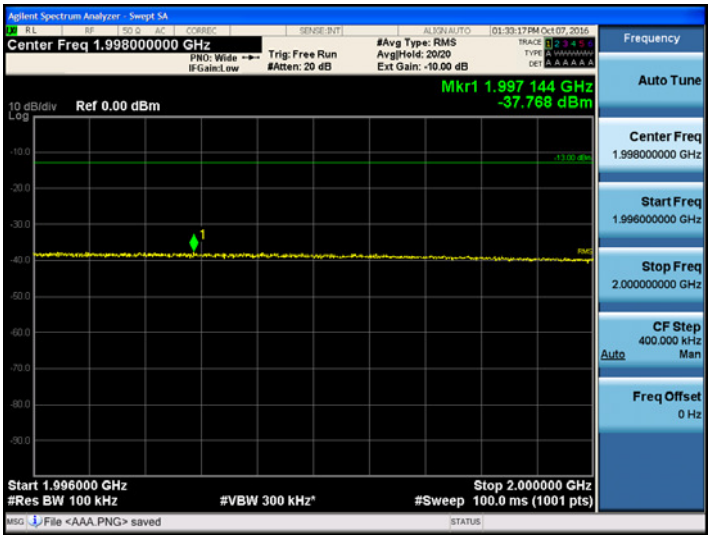
In 9 KHz-150 KHz and 150 KHz-30 MHz bands, RBW was reduced to 1% and 10% of the reference bandwidth for measuring unwanted emission level(typically, 100KHz if the authorized frequency band is below 1GHz) and power was integrated. (1% = +20 dB, 10% = +10 dB)

Single channel Enhancer Plots of Spurious Emission

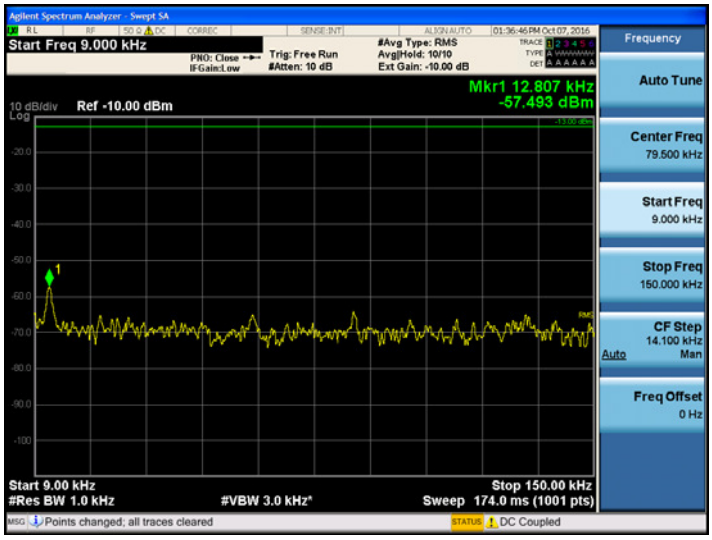
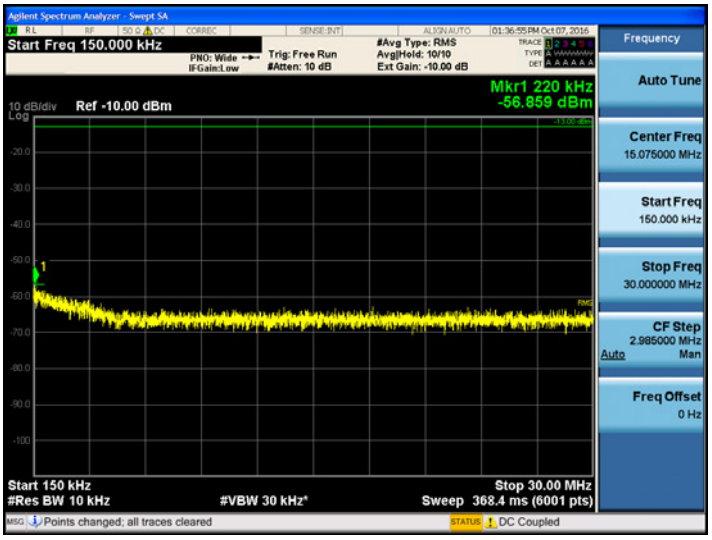
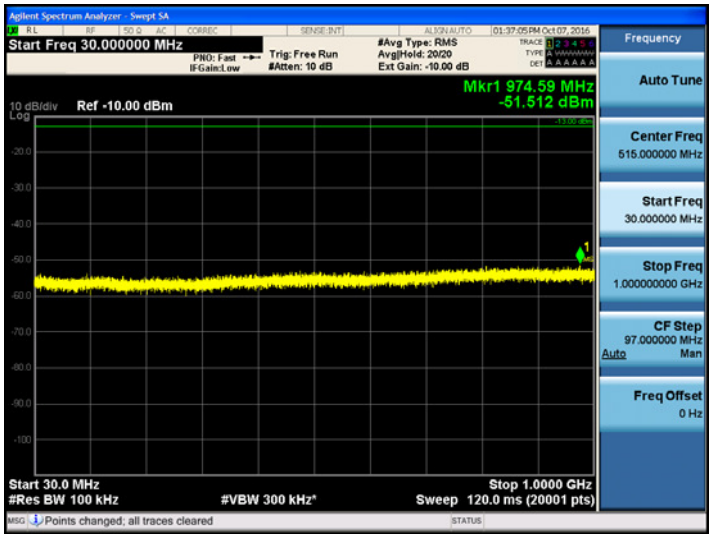
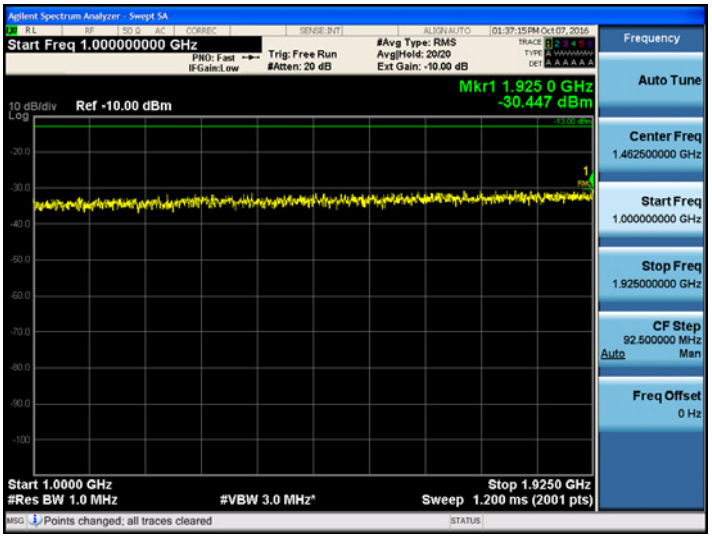
LTE 5 MHz

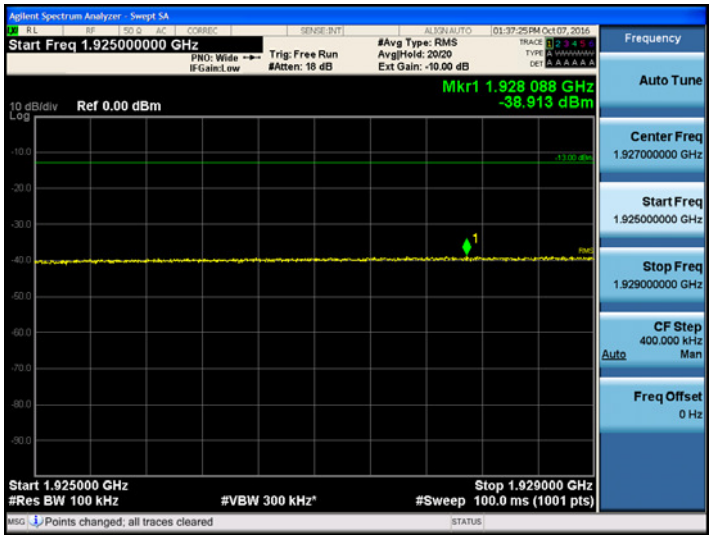
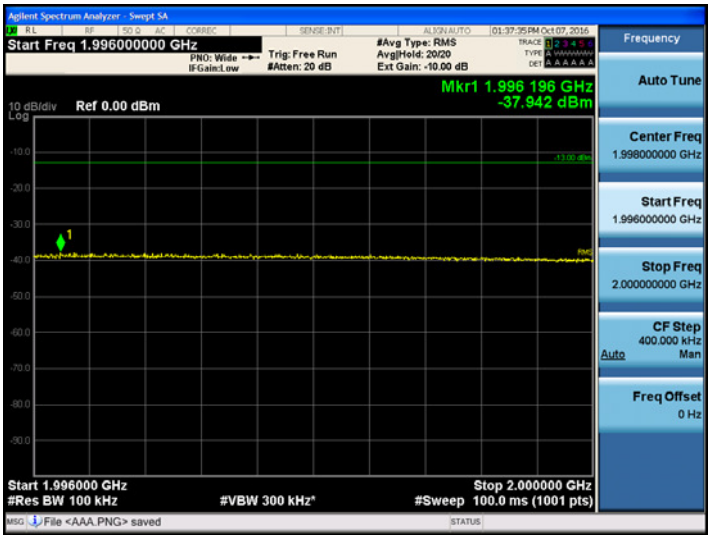
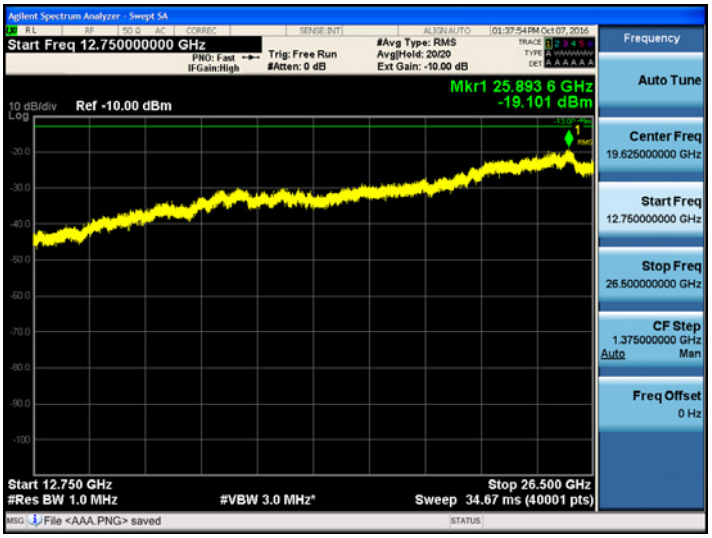
[Downlink_Low]

9㎑ ~ 150㎑	150㎑ ~ 30㎒
	
30㎒ ~ 1㎓	**1 ㎓ ~ 1.925 ㎓**
	

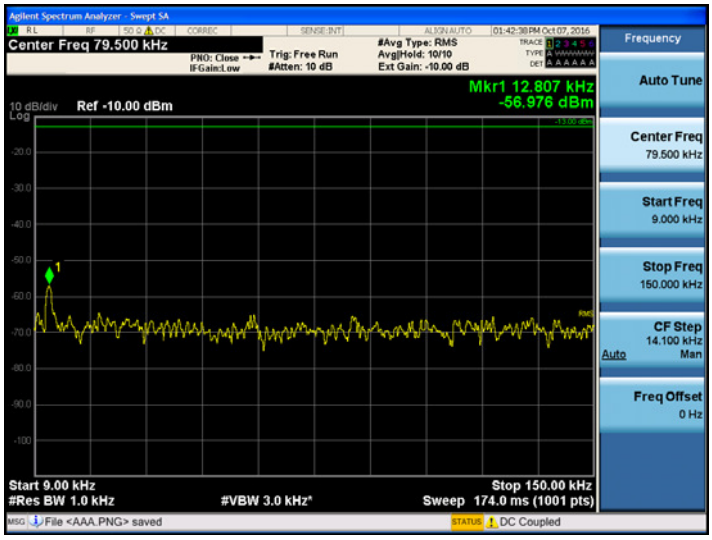
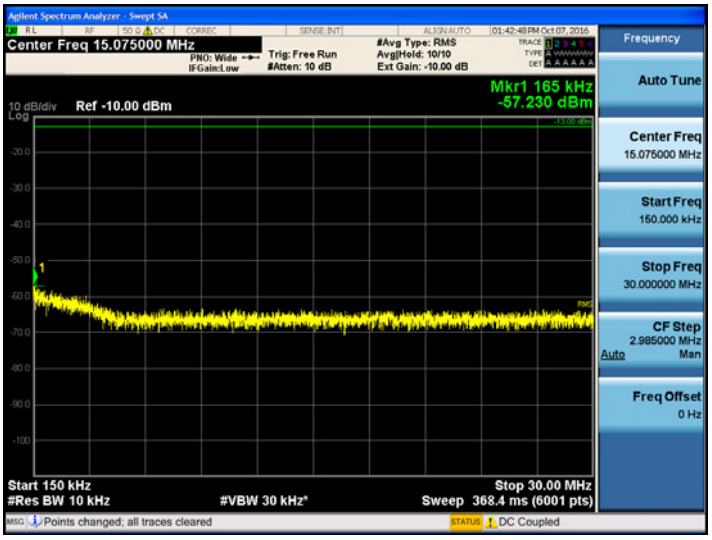
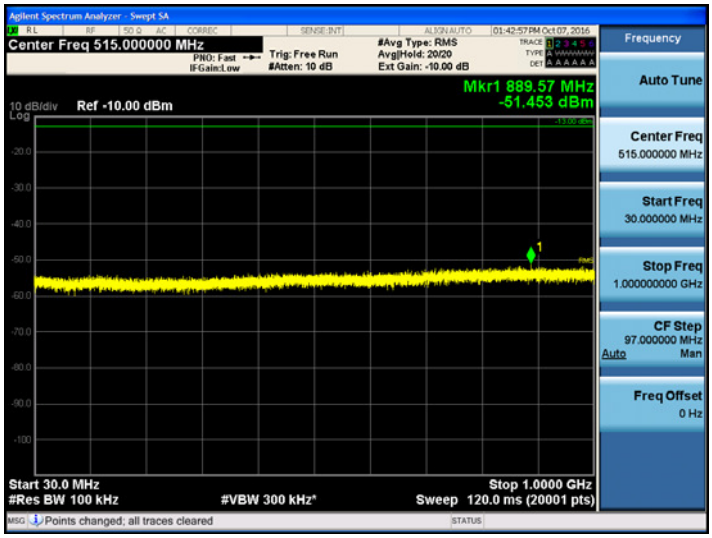
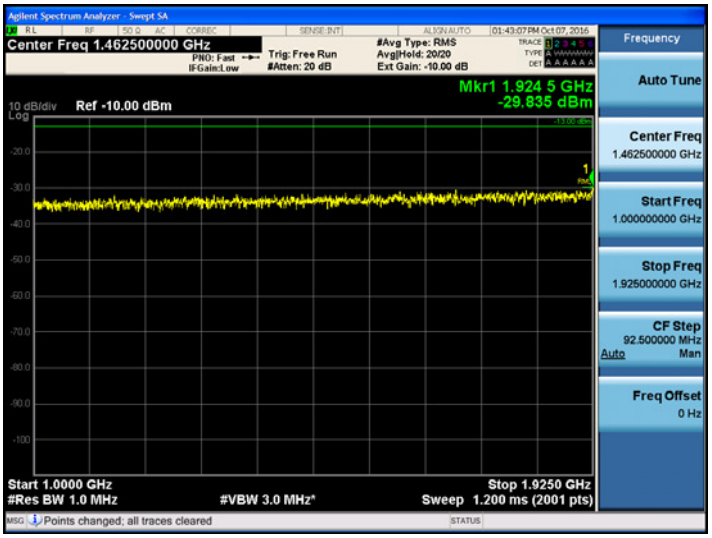
1.925 GHz ~ 1.929 GHz	1.996 GHz ~ 2 GHz
	
2 GHz ~ 12.75 GHz	**12.75 GHz ~ 26.5 GHz**

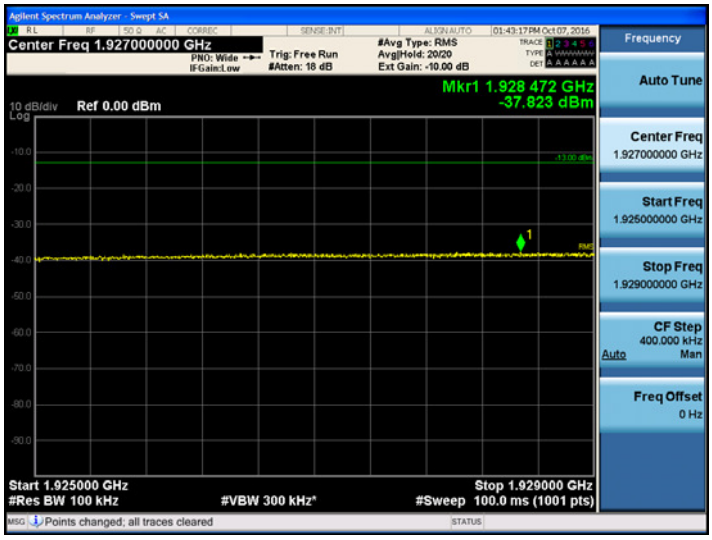
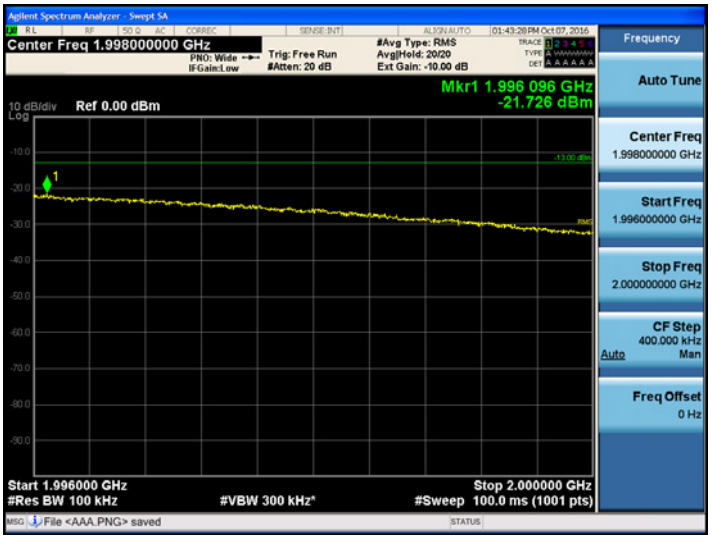
[Downlink_Middle]

9kHz ~ 150kHz	150kHz ~ 30MHz
	
30MHz ~ 1GHz	**1 GHz ~ 1.925 GHz**
	

1.925 GHz ~ 1.929 GHz	1.996 GHz ~ 2 GHz
	
2 GHz ~ 12.75 GHz	**12.75 GHz ~ 26.5 GHz**
	

[Downlink_High]

9kHz ~ 150kHz	150kHz ~ 30MHz
	
30MHz ~ 1GHz	**1 GHz ~ 1.925 GHz**
	

1.925 GHz ~ 1.929 GHz	1.996 GHz ~ 2 GHz
	
2 GHz ~ 12.75 GHz	**12.75 GHz ~ 26.5 GHz**