HCT CO.,LTD

74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
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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:
October 15, 2015

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-1509-F041-2

HCT FRN: 0005866421

FCC ID:	**2AFEGFRWL40ROU21**
APPLICANT:	**FRTEK CO., LTD.**

FCC Model(s):	FRWL40ROU21
EUT Type:	MODAS(Multi-Operator DAS)
Frequency Ranges:	2110 MHz – 2155 MHz
Conducted Output Power:	10 W (40 dBm)
Date of Test:	August 07, 2015 ~ September 17, 2015 October 13, 2015
FCC Rule Part(s):	CFR 47, Part 27

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
: Yong Hyun Lee
Test engineer of RF Team

Approved by
: Sang Jun Lee
Manager of RF Team

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1509-F041	September 16, 2015	- First Approval Report
HCT-R-1509-F041-1	September 18, 2015	-Add WCDMA Test Results
HCT-R-1509-F041-2	October 15, 2015	- Added the measurement uncertainty - Revised test plots : 9 kHz ~ 150 kHz spurious emission.

Table of Contents

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:	2AFEGFRWL40ROU21
EUT Type:	MODAS(Multi-Operator DAS)
FCC Model(s):	FRWL40ROU21
Frequency Ranges:	2110 MHz – 2155 MHz
Conducted Output Power:	10 W (40 dBm)
Antenna Gain(s):	Manufacturer does not provide an antenna.
Measurement standard(s):	ANSI/TIA-603-C-2004, KDB 971168 D01 v02r02 KDB 935210 D02 v03, KDB 935210 D05 v01, KDB 662911 D01 v02r01
FCC Rule Part(s):	CFR Title 47 Part 27
Place of Tests:	HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA (IC Recognition No. : 5944A-3)

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 27.

Description	Reference	Results
RF Output Power	§2.1046; §27.50	Compliant
Occupied Bandwidth	§2.1049	Compliant
Out of Band Rejection	KDB 935210 D02 v03	Compliant
Spurious Emissions at Antenna Terminals	§2.1051, §27.53	Compliant
Radiated Spurious Emissions	§2.1053, §27.53	Compliant
Frequency Stability	§2.1055, §27.54	Compliant

Note 1

The device is available in combination with the same device.

Therefore, calculated the MIMO test results to a single test result.

MIMO Calculation methods.

RF Output Power : KDB 662911 D01, section E)2)c)

Out-of-Band and Spurious Emission : KDB 662911 D01, section E)3)a)(iii)

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	Cal Interval	Calibration Date	Serial No.
Agilent	E4438C /Signal Generator	Annual	09/02/2015	MY42082646
Agilent	N5182A /Signal Generator	Annual	04/07/2015	MY50141649
NANGYEUL CO., LTD.	NY-THR18750/ Temperature and Humidity Chamber	Annual	10/29/2014	NY-2009012201A
Agilent	N9020A /Signal Analyzer	Annual	04/10/2015	US46220219
WEINSCHEL	67-30-33 / Fixed Attenuator	Annual	11/04/2014	BU5347
Weinschel	AF9003-69-31 / Step Attenuator	Annual	10/24/2014	11787
DEAYOUNG ENT	DFSS60 / AC Power Supply	Annual	04/01/2015	1003030-1
Agilent	6674A / DC Power Supply	Annual	07/27/2015	3501A00901
Rohde & Schwarz	FSP / Spectrum Analyzer	Annual	10/21/2014	836650/016
Innco	CO3000/ Controller	N/A	N/A	842/35030115/L
ETS	2090/ Turn Table	N/A	N/A	1646
CERNEX, Inc	CBLU1183540/AMP	Annual	02/12/2015	24614
Schwarzbeck	BBHA 9120D/ Horn Antenna	Biennial	09/01/2014	147
Schwarzbeck	VULB 9160/TRILOG Antenna	Biennial	11/17/2014	3150

6. 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 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(1) The power of each fixed or base station transmitting in the 1995-2000 MHz, 2110-2155 MHz, 2155-2180 MHz or 2180-2200 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:

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

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

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

(i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(3) A licensee operating a base or fixed station in the 2110-2155 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must coordinate such operations in advance with all Government and non-Government satellite entities in the 2025-2110 MHz band. A licensee operating a base or fixed station in the 2110-2180 MHz band utilizing power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with the following licensees authorized to operate within 120 kilometers (75 miles) of the base or fixed station operating in this band: All Broadband Radio Service (BRS) licensees authorized under this part in the 2155-2160 MHz band and all advanced wireless services (AWS) licensees authorized to operate on adjacent frequency blocks in the 2110-2180 MHz band.

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.

Test Procedures:

Measurements were in accordance with the test methods section 3.5.2 of KDB 935210 D05 v01.

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 of (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.

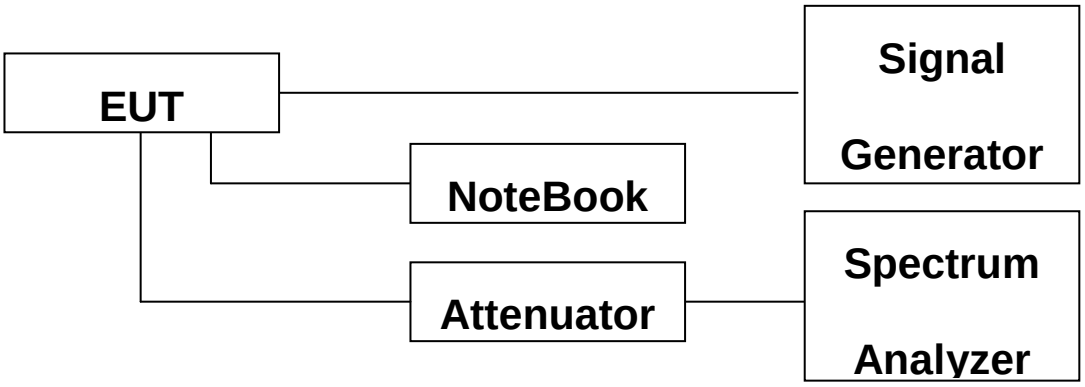
f) Measure the output power of the EUT and record (Power measurement with a spectrum analyzer).

g) Remove the EUT from the measurement setup and using the same signal generator settings, repeat the power measurement on the input signal to the EUT and record as input power.

h) Repeat the procedure with the narrowband test signal.

i) Repeat the procedure for both test signals with input signal amplitude set to 3 dB above the AGC threshold level.
j) Repeat 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.



Block Diagram 1. RF Power Output Test Setup

Test Results:

AWS Band

Input Signal	Input Level (dBm)	Maximum Amp Gain
LTE 5 MHz	DL: -30 dBm	DL : 70 dB
LTE 10 MHz		
WCDMA		

[Downlink]

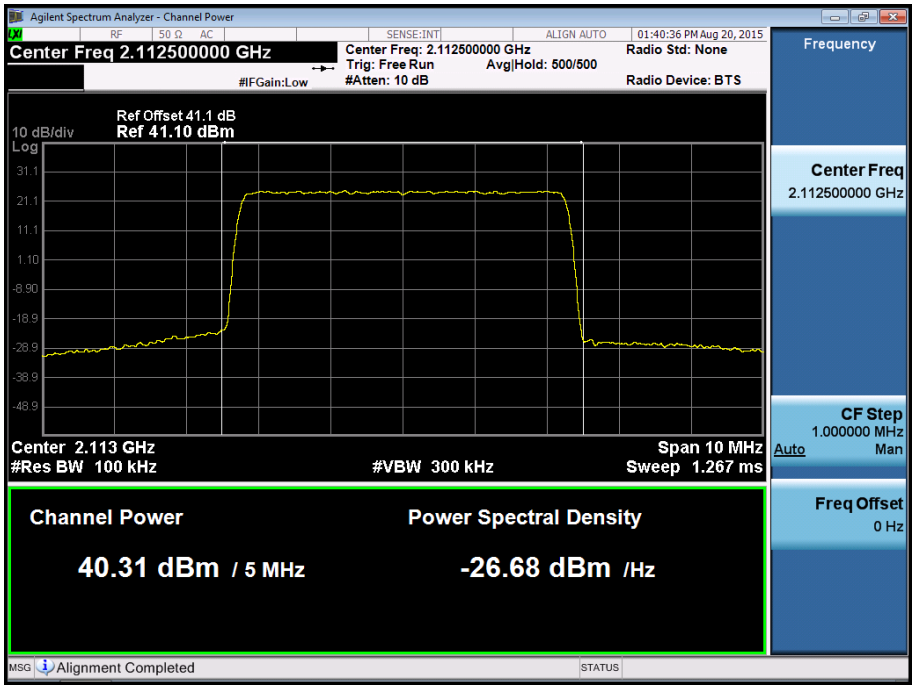
	Channel	Frequency (MHz)	Output Power		MIMO Calculation	
			(dBm)	(W)	(dBm)	(W)
AGC threshold LTE 5 MHz	Low	2112.50	40.31	10.740	43.31	21.429
	Middle	2132.50	40.43	11.041	43.43	22.029
	High	2152.50	40.48	11.169	43.48	22.284
AGC threshold LTE 10 MHz	Low	2115.00	40.17	10.399	43.17	20.749
	Middle	2125.00	40.22	10.520	43.22	20.989
	High	2150.00	40.57	11.402	43.57	22.751
AGC threshold WCDMA	Low	2112.50	40.71	11.776	43.71	23.496
	Middle	2132.50	40.54	11.324	43.54	22.594
	High	2152.50	40.67	11.668	43.67	23.281

[Downlink]

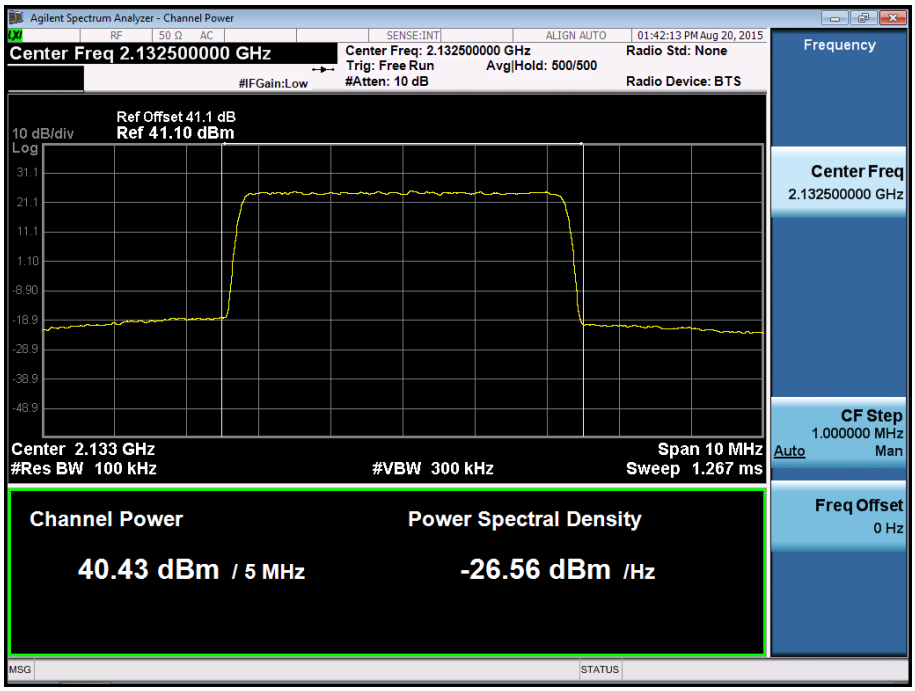
	Channel	Frequency (MHz)	Output Power		MIMO Calculation	
			(dBm)	(W)	(dBm)	(W)
+3dB above the AGC threshold LTE 5 MHz	Low	2112.50	40.27	10.641	43.27	21.232
	Middle	2132.50	40.39	10.940	43.39	21.827
	High	2152.50	40.46	11.117	43.46	22.182
+3dB above the AGC threshold LTE 10 MHz	Low	2115.00	40.18	10.423	43.18	20.797
	Middle	2125.00	40.24	10.568	43.24	21.086
	High	2150.00	40.59	11.455	43.59	22.856
+3dB above the AGC threshold WCDMA	Low	2112.50	40.77	11.940	43.77	23.823
	Middle	2132.50	40.55	11.350	43.55	22.646
	High	2152.50	40.70	11.749	43.70	23.442

Plots of RF Output Power

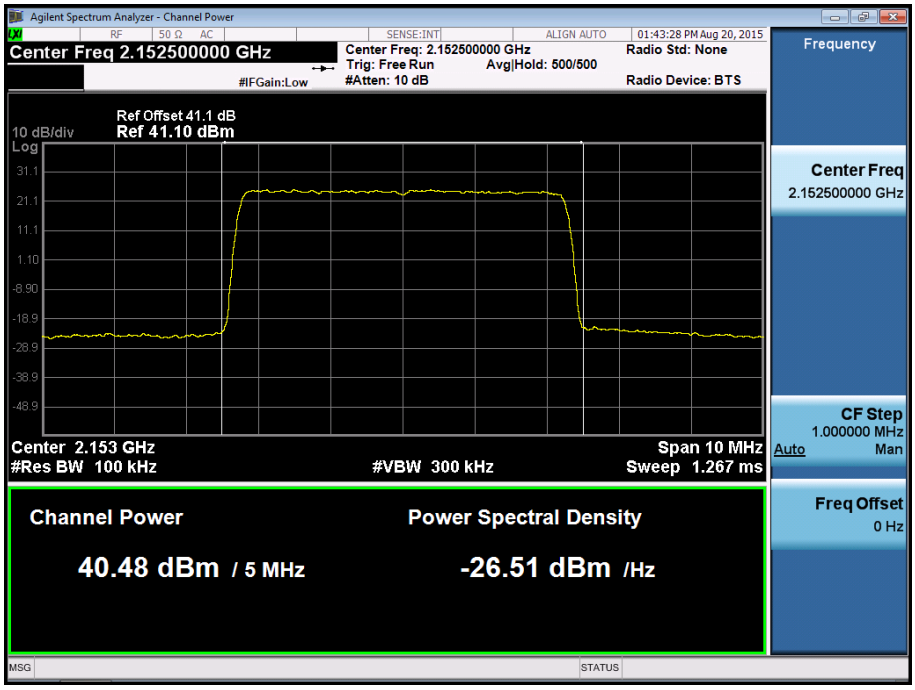
[AGC threshold Downlink LTE 5 MHz Low]



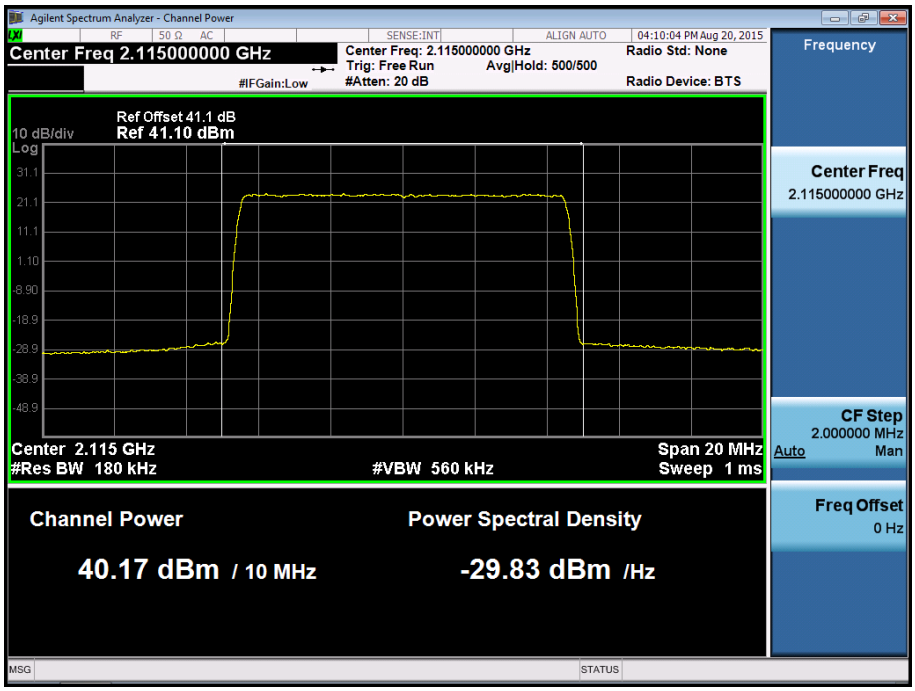
[AGC threshold Downlink LTE 5 MHz Middle]



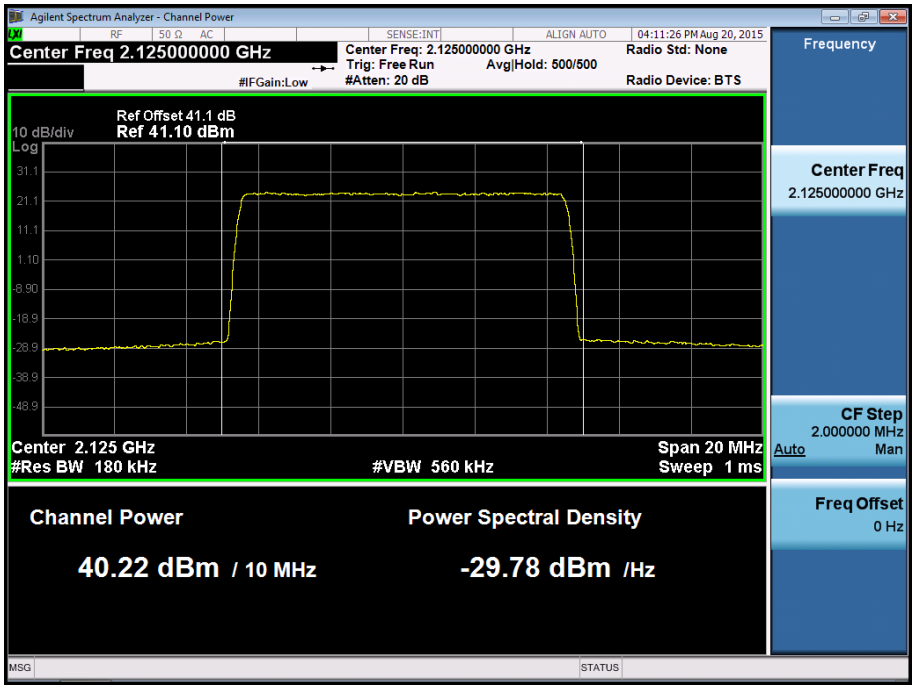
[AGC threshold Downlink LTE 5 MHz High]



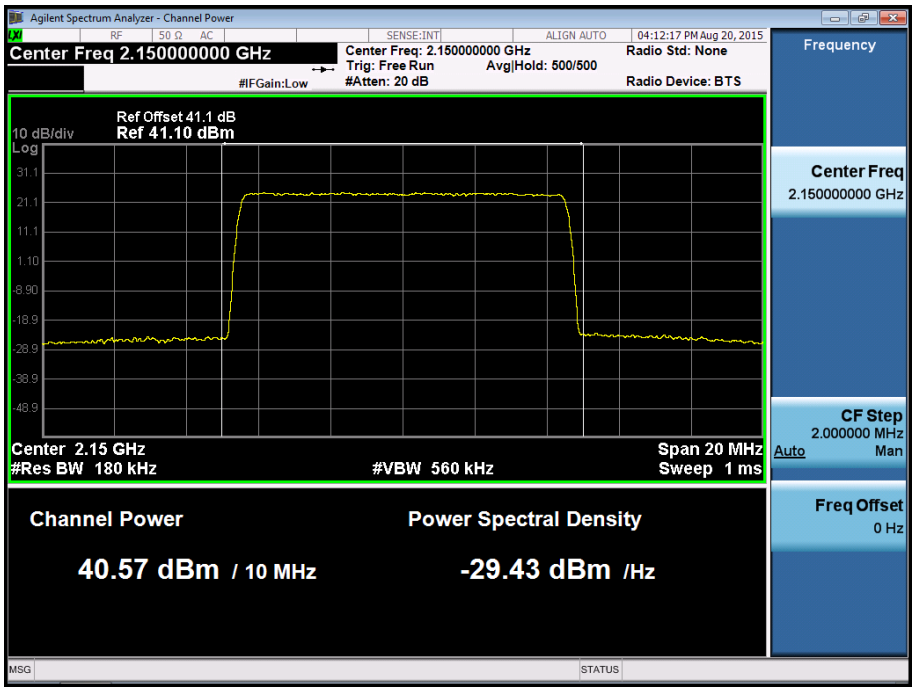
[AGC threshold Downlink LTE 10 MHz Low]



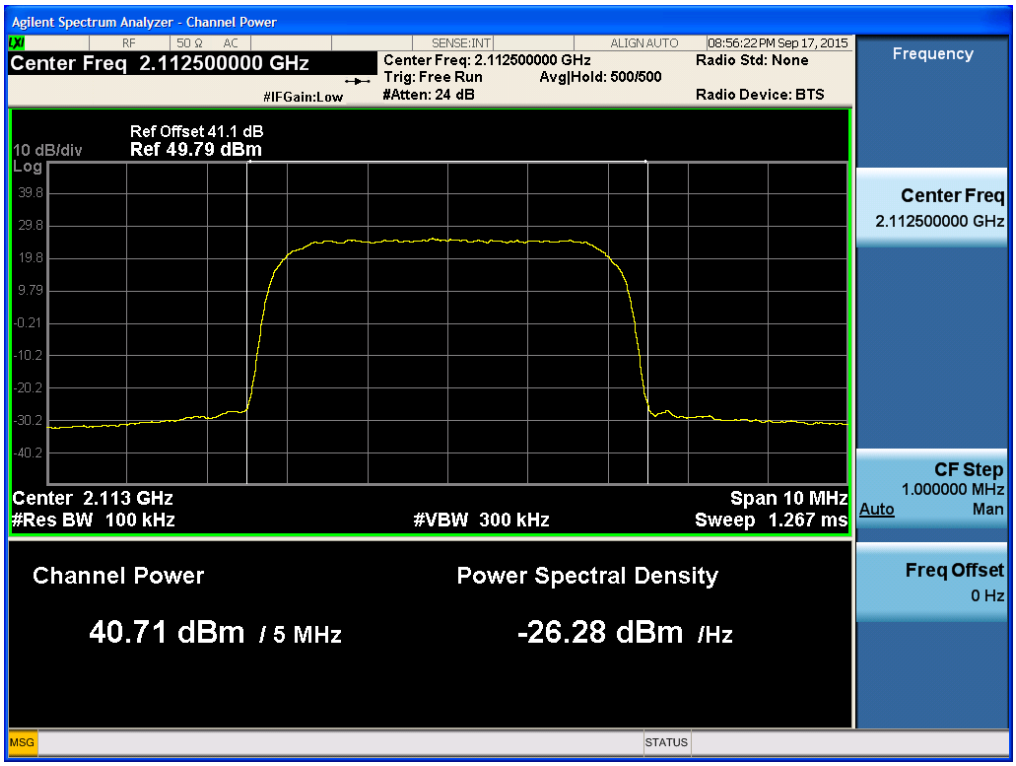
[AGC threshold Downlink LTE 10 MHz Middle]



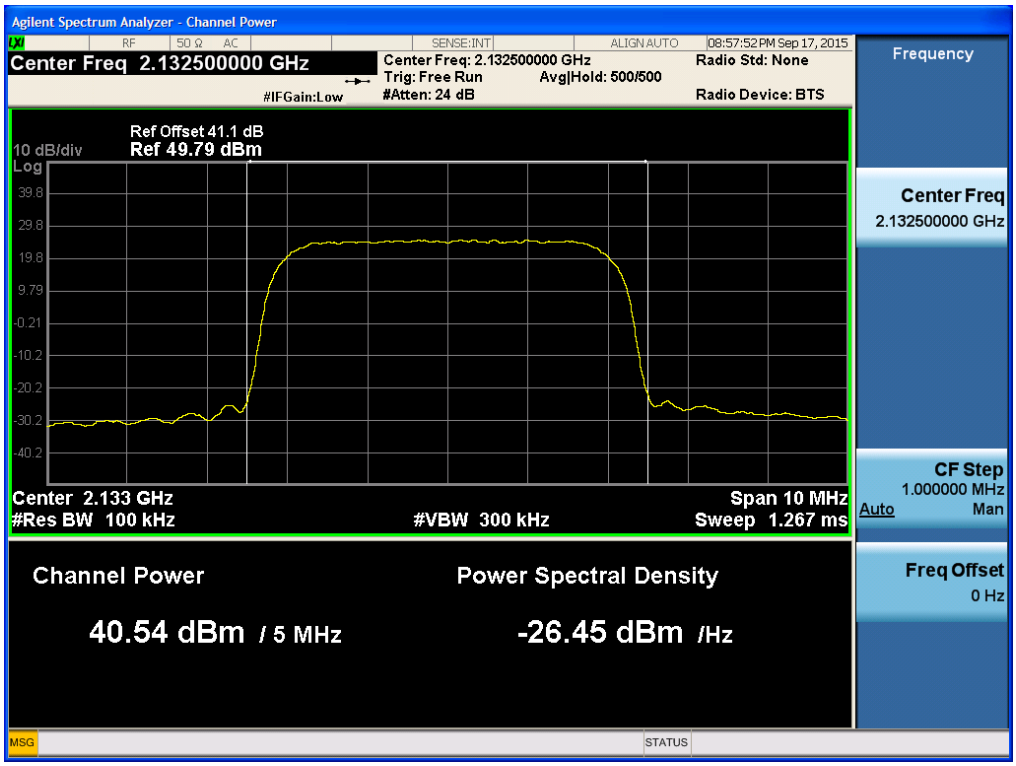
[AGC threshold Downlink LTE 10 MHz High]



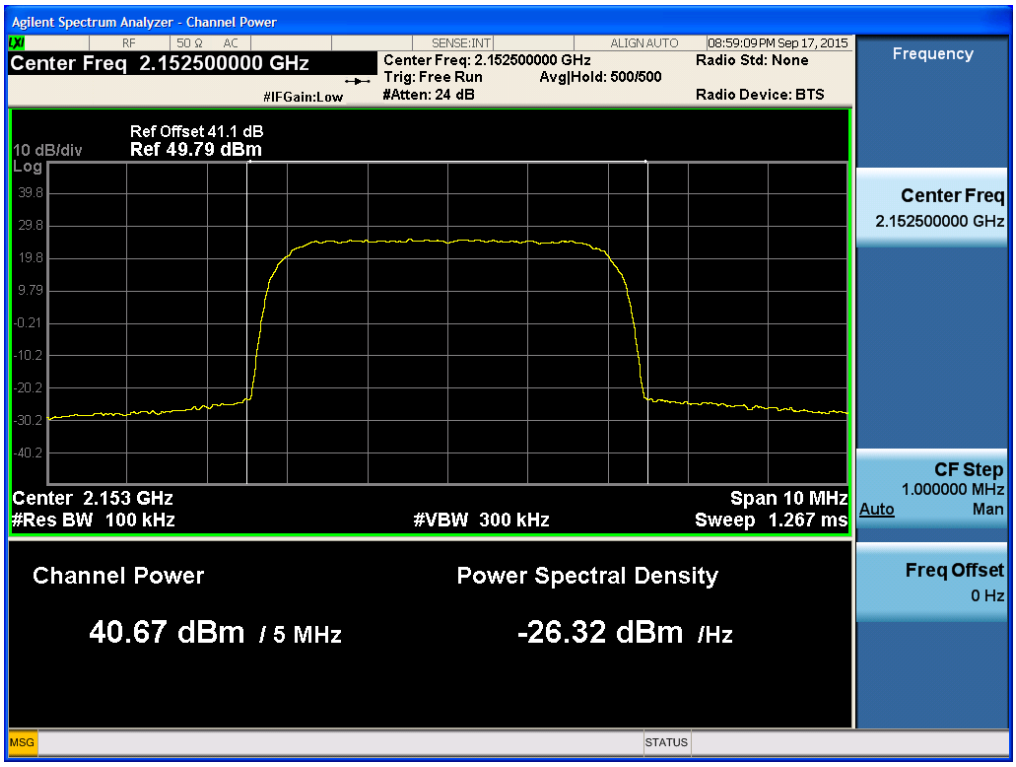
[AGC threshold Downlink WCDMA Low]



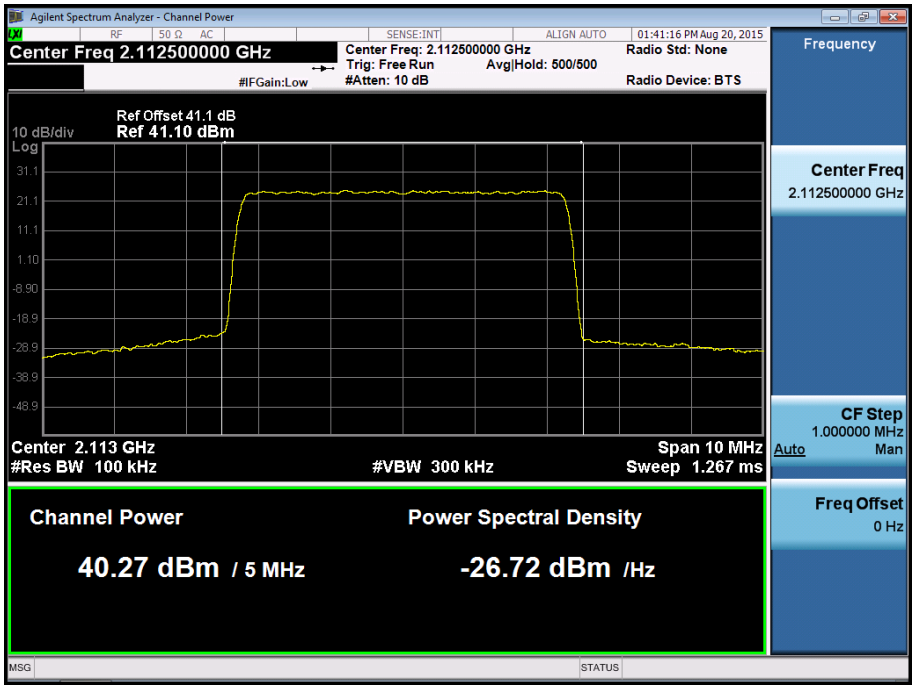
[AGC threshold Downlink WCDMA Middle]



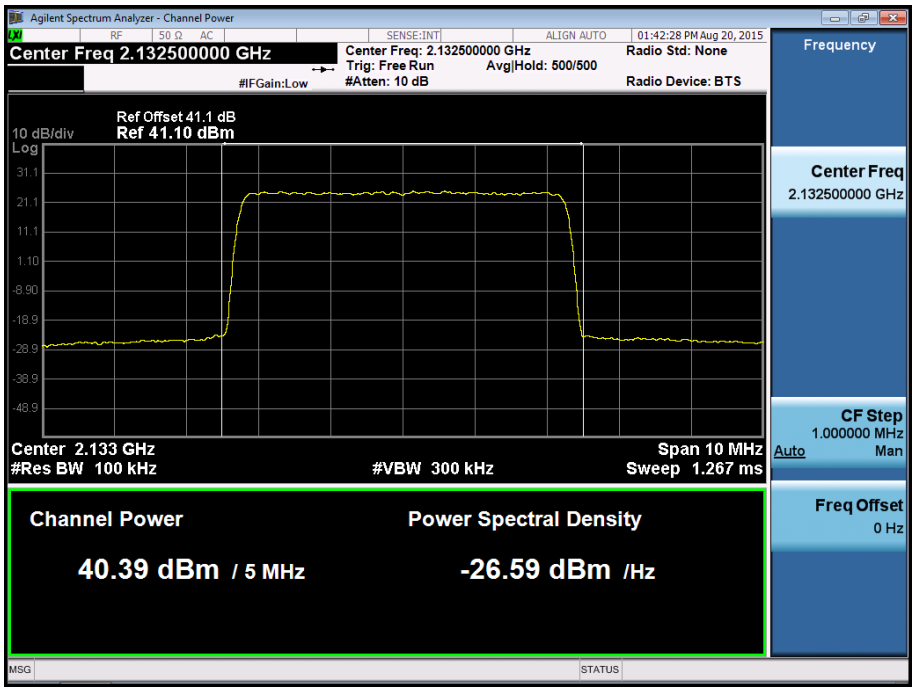
[AGC threshold Downlink WCDMA High]



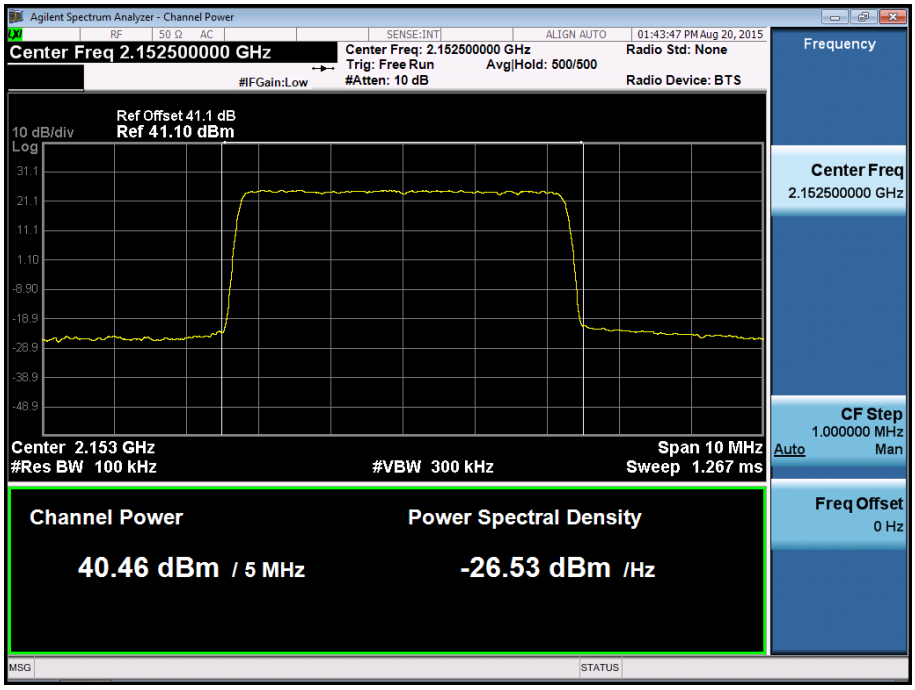
[+3dB above the AGC threshold Downlink LTE 5 MHz Low]



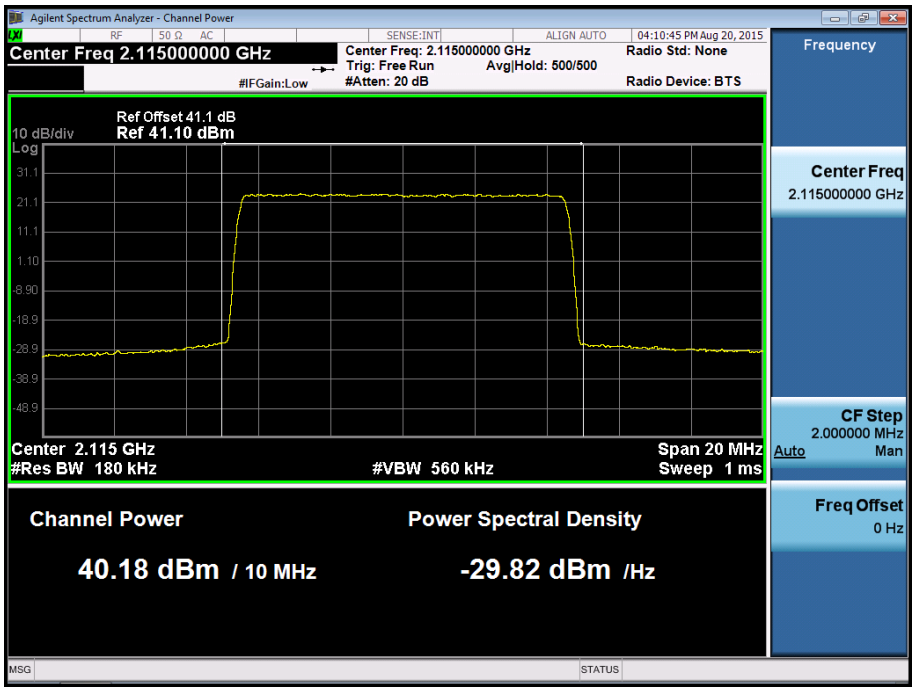
[+3dB above the AGC threshold Downlink LTE 5 MHz Middle]



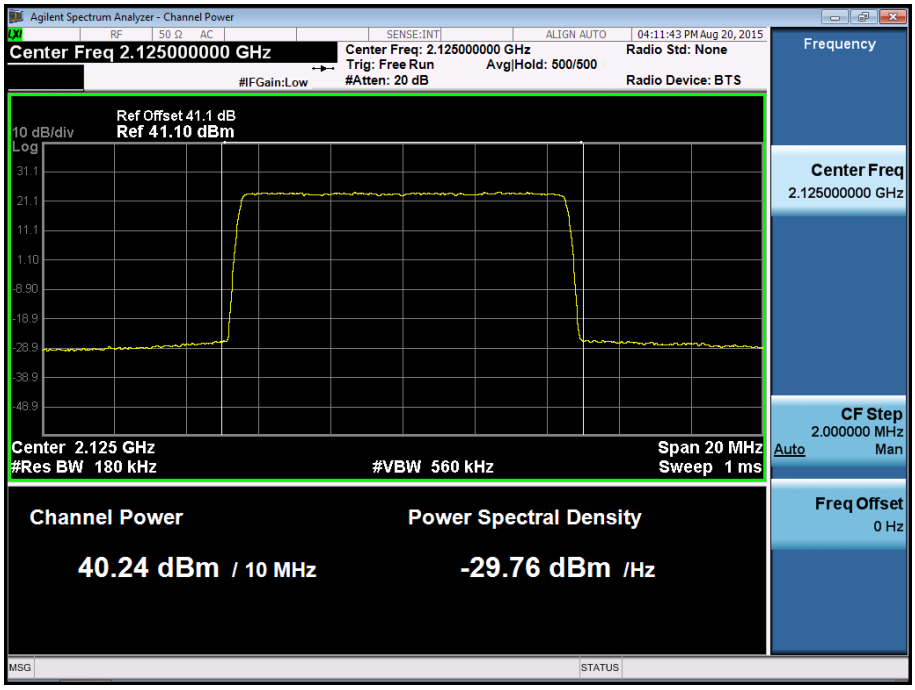
[+3dB above the AGC threshold Downlink LTE 5 MHz High]



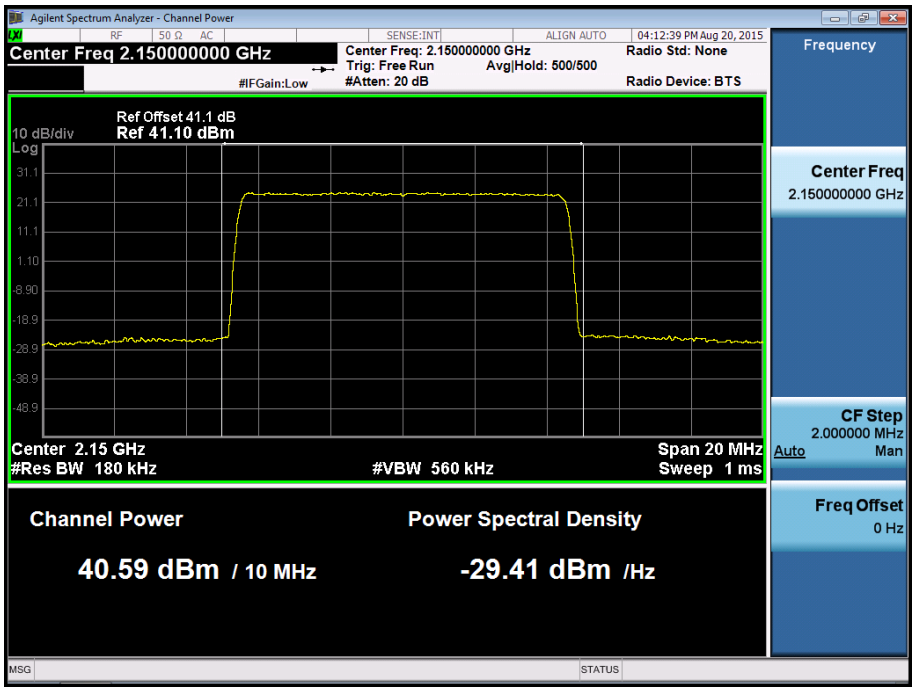
[+3dB above the AGC threshold Downlink LTE 10 MHz Low]



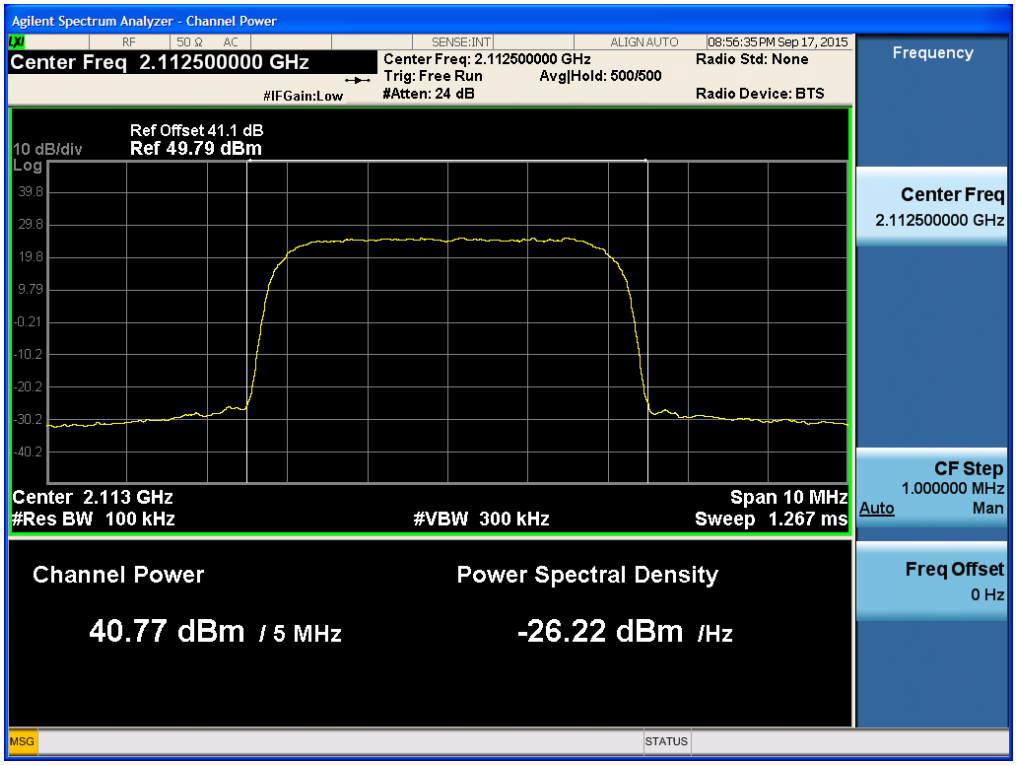
[+3dB above the AGC threshold Downlink LTE 10 MHz Middle]



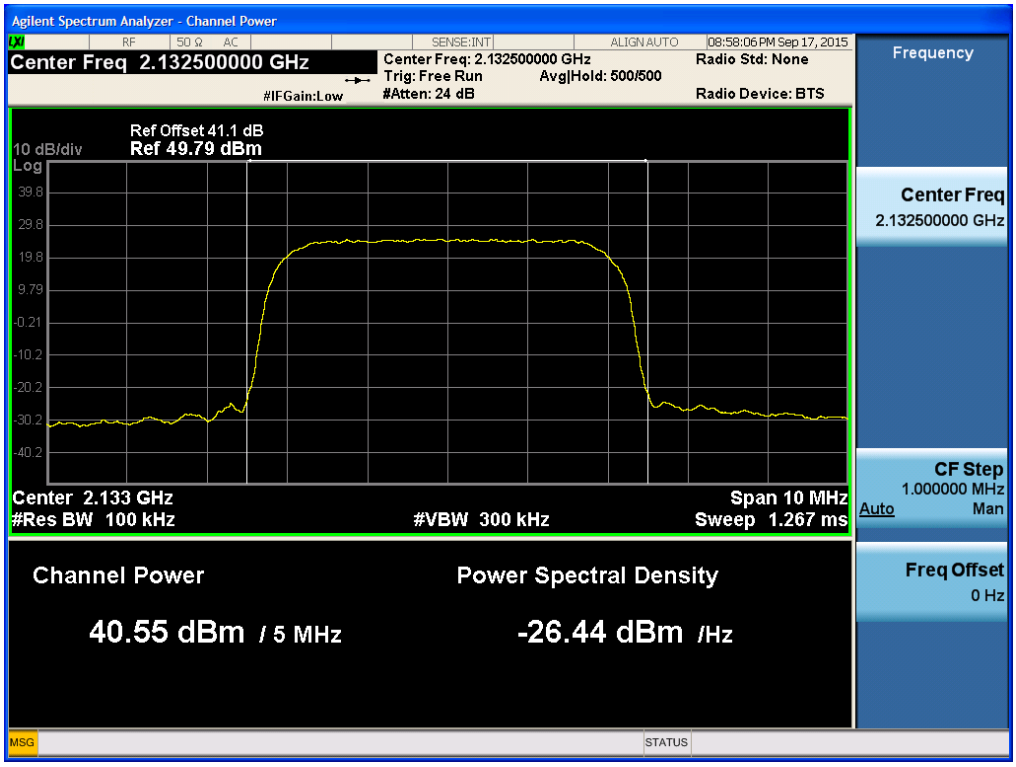
[+3dB above the AGC threshold Downlink LTE 10 MHz High]



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



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



[+3dB above the AGC threshold Downlink WCDMAHigh]

7. OCCUPIED BANDWIDTH

Test Requirement(s): § 2.1049 Measurements required: Occupied bandwidth:

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049 (a) through (i) as applicable.

Test Procedures:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 v01 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 OBW.

f) The nominal resolution bandwidth (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.

NOTE—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) Use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.

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

m) Compare the spectral plot of the input signal (determined from step l) to the output signal

(determined from step k) 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.

n) Repeat for all frequency bands authorized for use by the EUT.

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

AWS Band

Input Signal	Input Level (dBm)	Maximum Amp Gain
LTE 5 MHz	DL: -30 dBm	DL : 70 dB
LTE 10 MHz		
WCDMA		

[Downlink Output]

	Channel	Frequency (MHz)	OBW (MHz)
AGC threshold LTE 5 MHz	Low	2112.50	4.4563
	Middle	2132.50	4.4484
	High	2152.50	4.4577
AGC threshold LTE 10 MHz	Low	2115.00	8.9477
	Middle	2125.00	8.9663
	High	2150.00	8.9549
AGC threshold WCDMA	Low	2112.50	4.165
	Middle	2132.50	4.151
	High	2152.50	4.154

[Downlink Input]

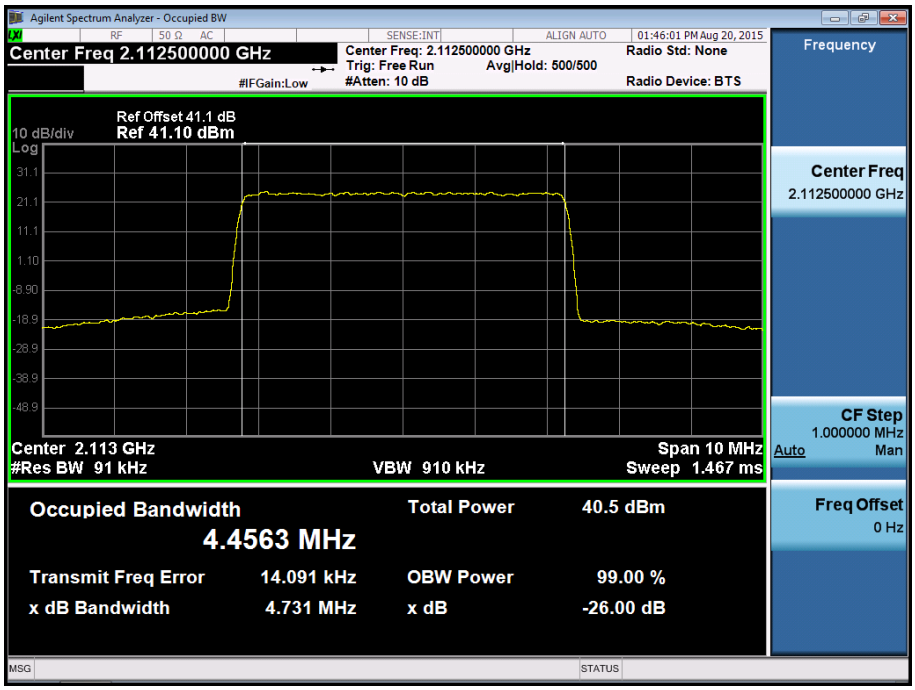
	Channel	Frequency (MHz)	OBW (MHz)
AGC threshold LTE 5 MHz	Low	2112.50	4.4974
	Middle	2132.50	4.4986
	High	2152.50	4.4968
AGC threshold LTE 10 MHz	Low	2115.00	8.9935
	Middle	2125.00	8.9870
	High	2150.00	8.9904
AGC threshold WCDMA	Low	2112.50	4.179
	Middle	2132.50	4.178
	High	2152.50	4.178

[Downlink Output]

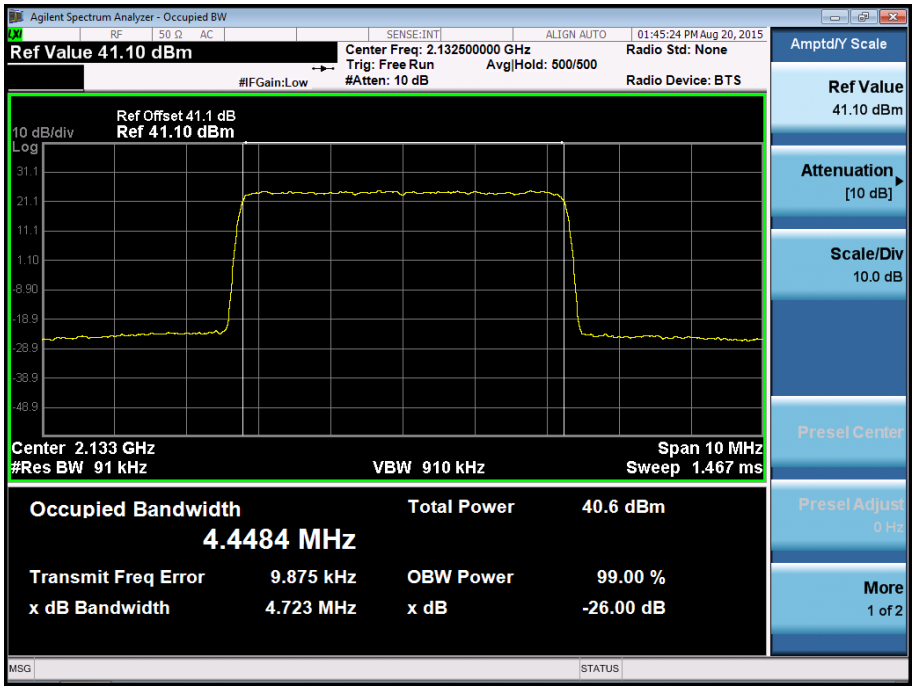
	Channel	Frequency (MHz)	OBW (MHz)
+3dB above the AGC threshold LTE 5 MHz	Low	2112.50	4.4577
	Middle	2132.50	4.4525
	High	2152.50	4.4548
+3dB above the AGC threshold LTE 10 MHz	Low	2115.00	8.9527
	Middle	2125.00	8.9525
	High	2150.00	8.9452
+3dB above the AGC threshold WCDMA	Low	2112.50	4.164
	Middle	2132.50	4.146
	High	2152.50	4.152

Plots of Occupied Bandwidth

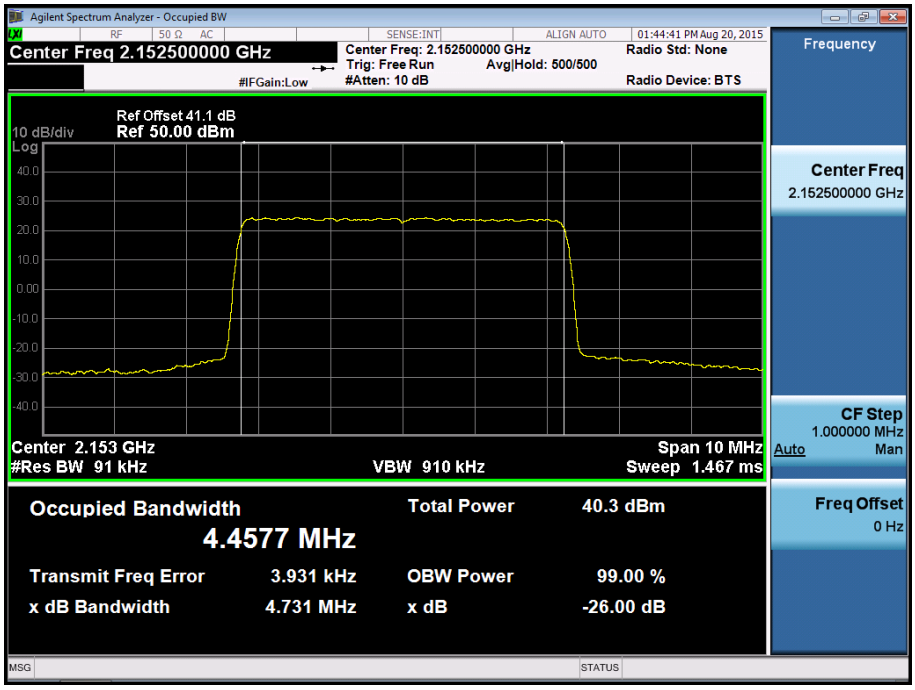
[AGC threshold Downlink Output LTE 5 MHz Low]



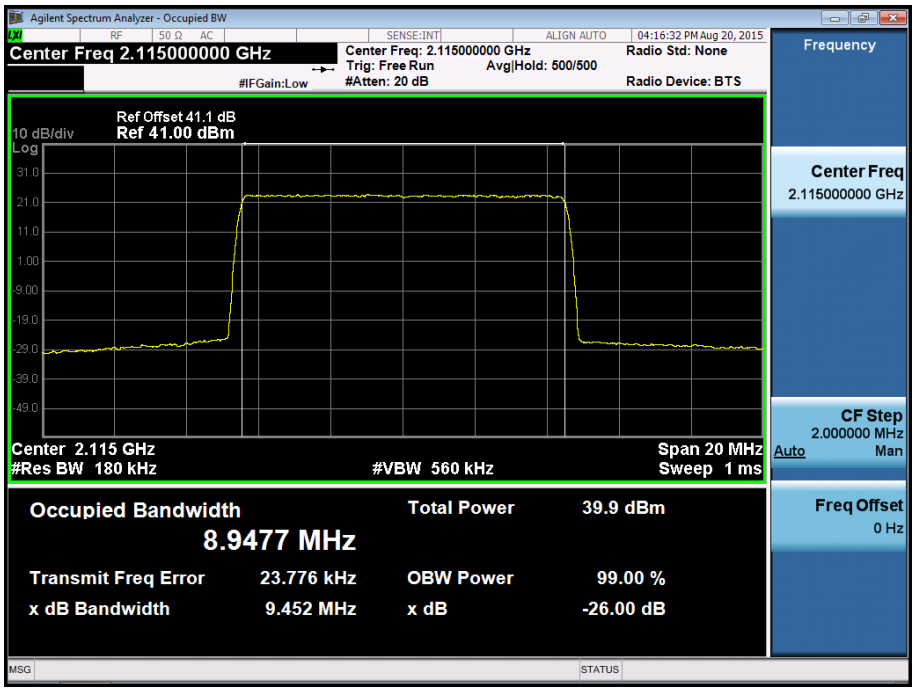
[AGC threshold Downlink Output LTE 5 MHz Middle]



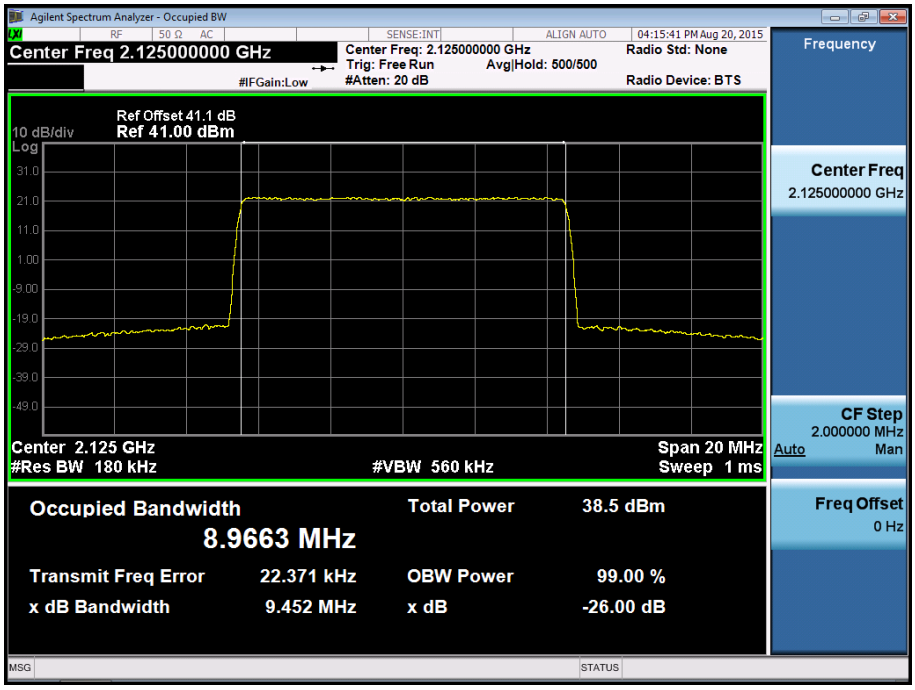
[AGC threshold Downlink Output LTE 5 MHz High]



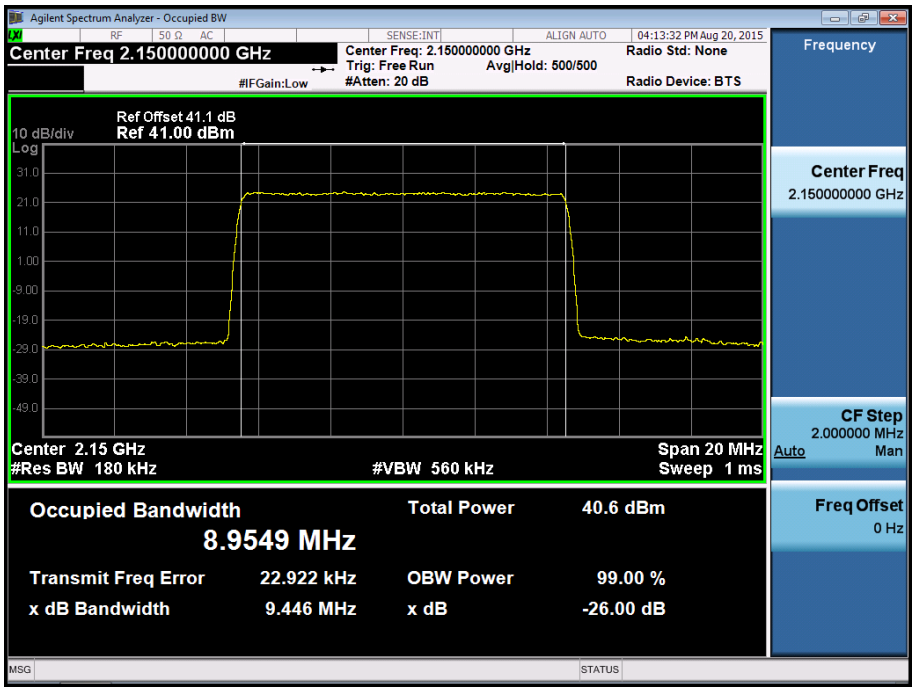
[AGC threshold Downlink Output LTE 10 MHz Low]



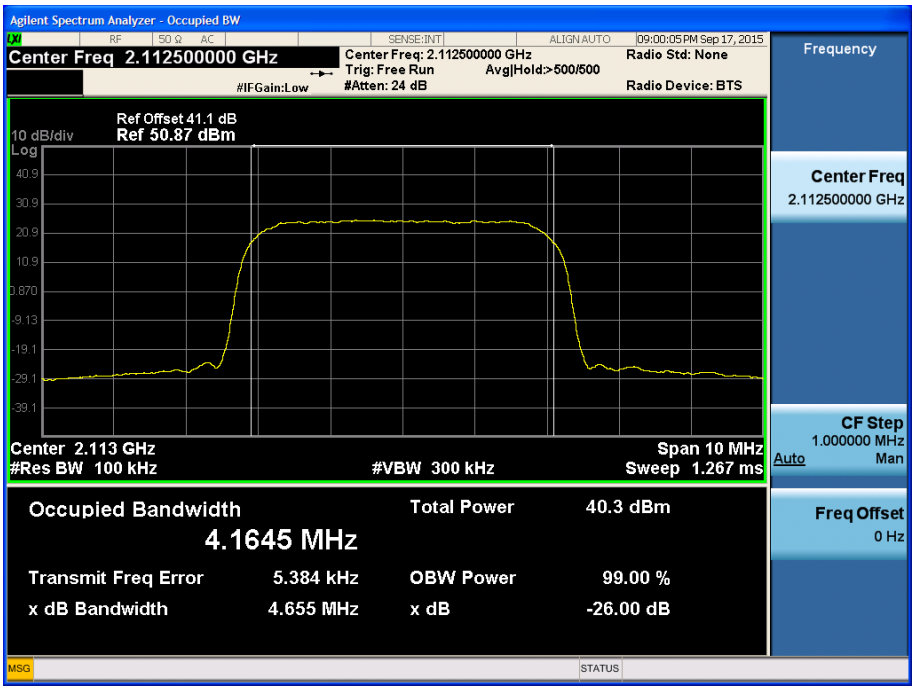
[AGC threshold Downlink Output LTE 10 MHz Middle]



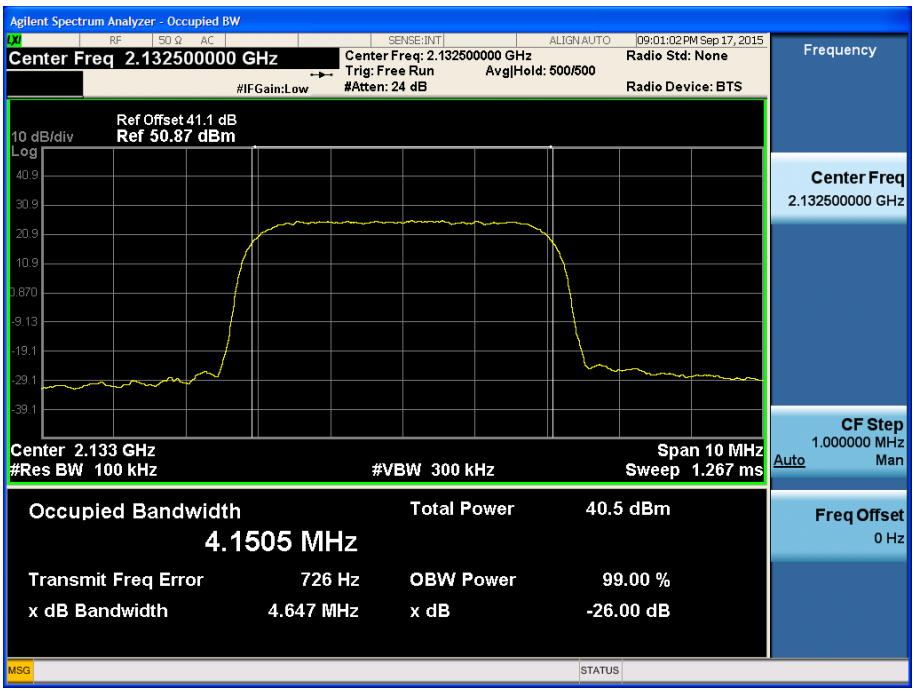
[AGC threshold Downlink Output LTE 10 MHz High]



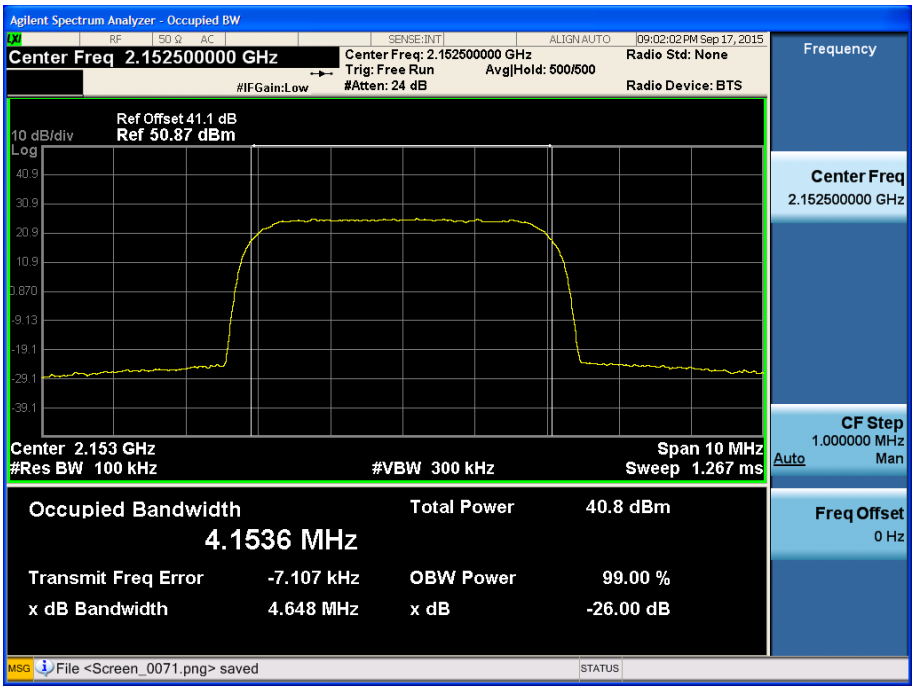
[AGC threshold Downlink Output WCDMA Low]



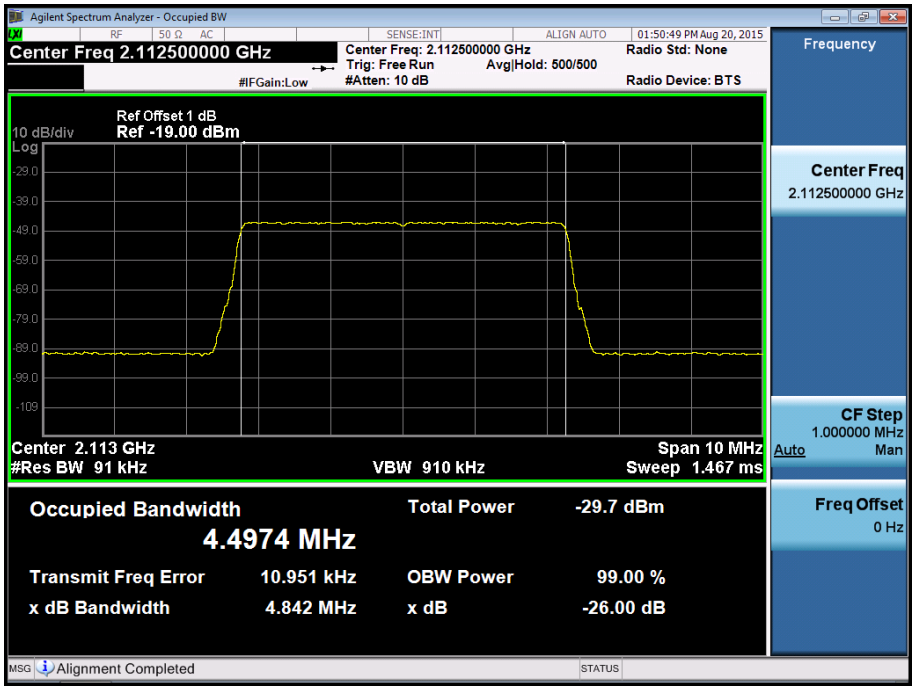
[AGC threshold Downlink Output WCDMA Middle]



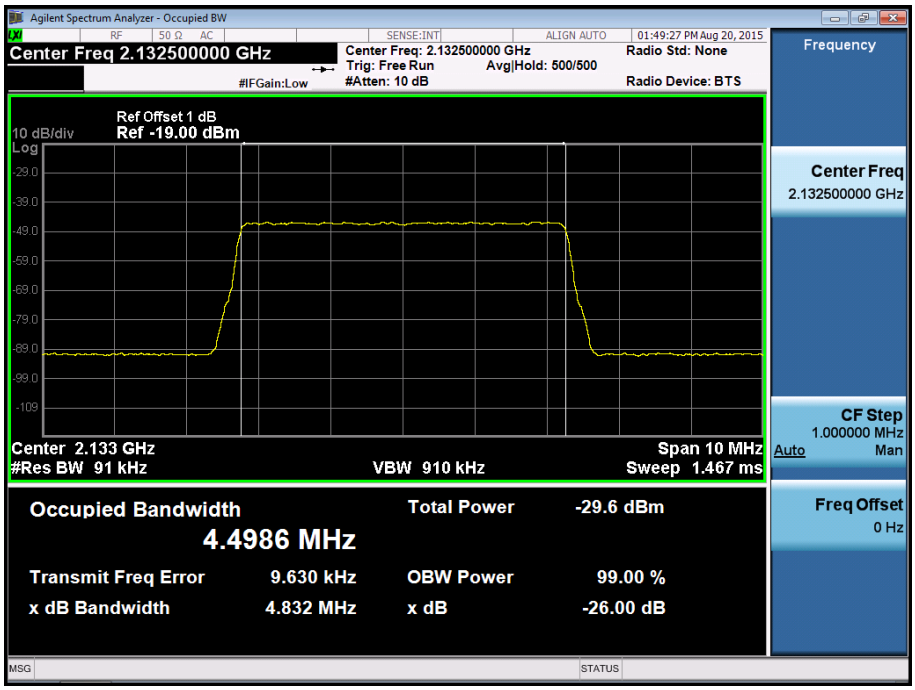
[AGC threshold Downlink Output WCDMA High]



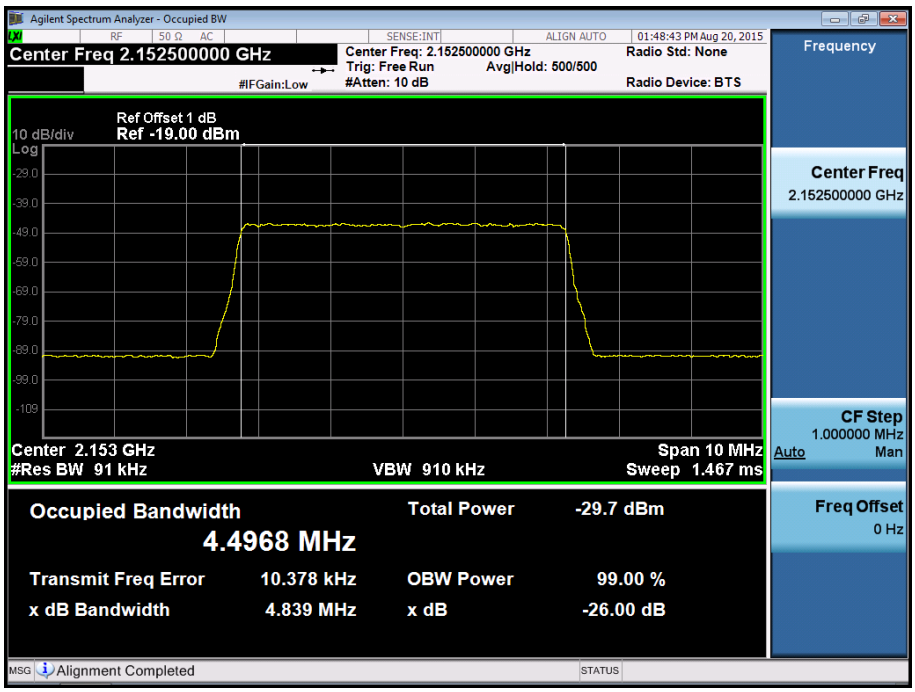
[AGC threshold Downlink Input LTE 5 MHz Low]



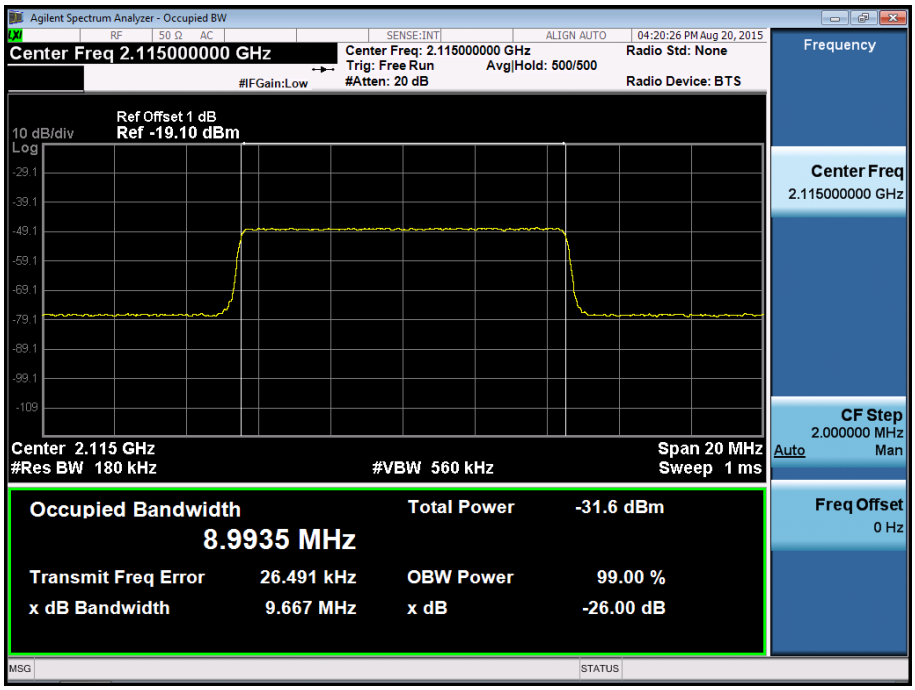
[AGC threshold Downlink Input LTE 5 MHz Middle]



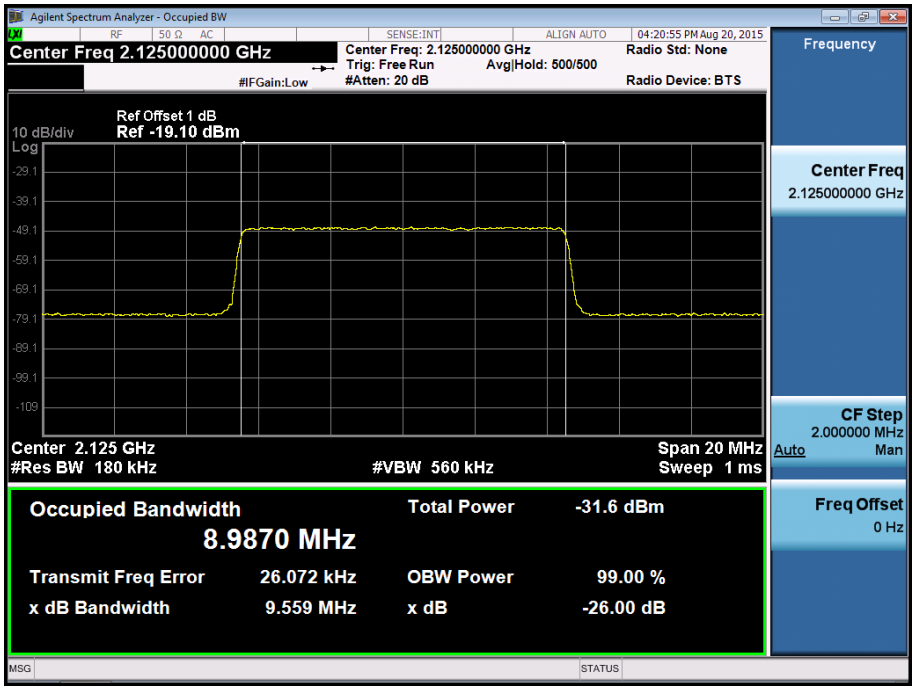
[AGC threshold Downlink Input LTE 5 MHz High]



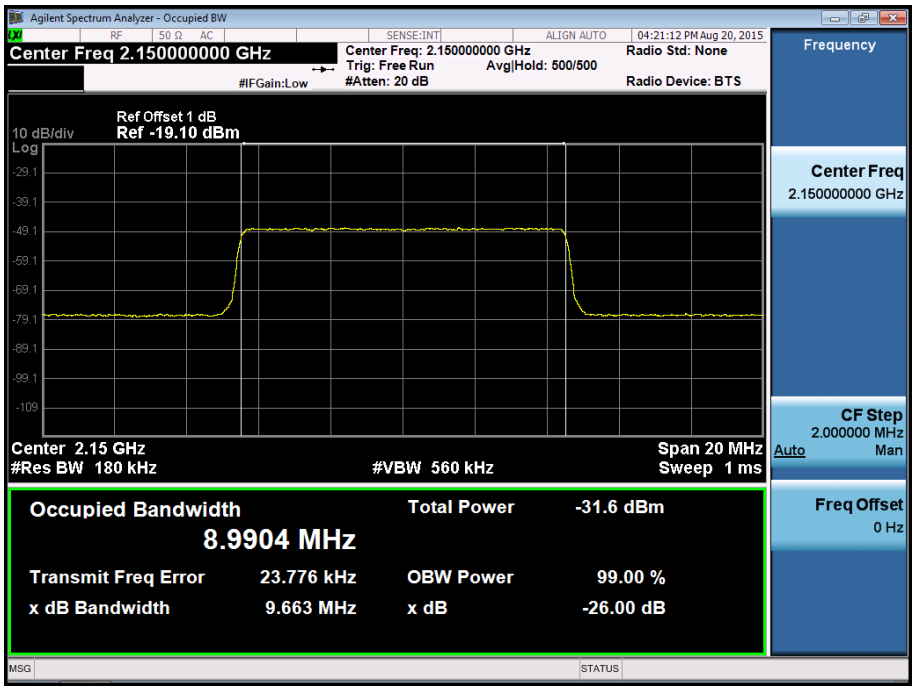
[AGC threshold Downlink Input LTE 10 MHz Low]



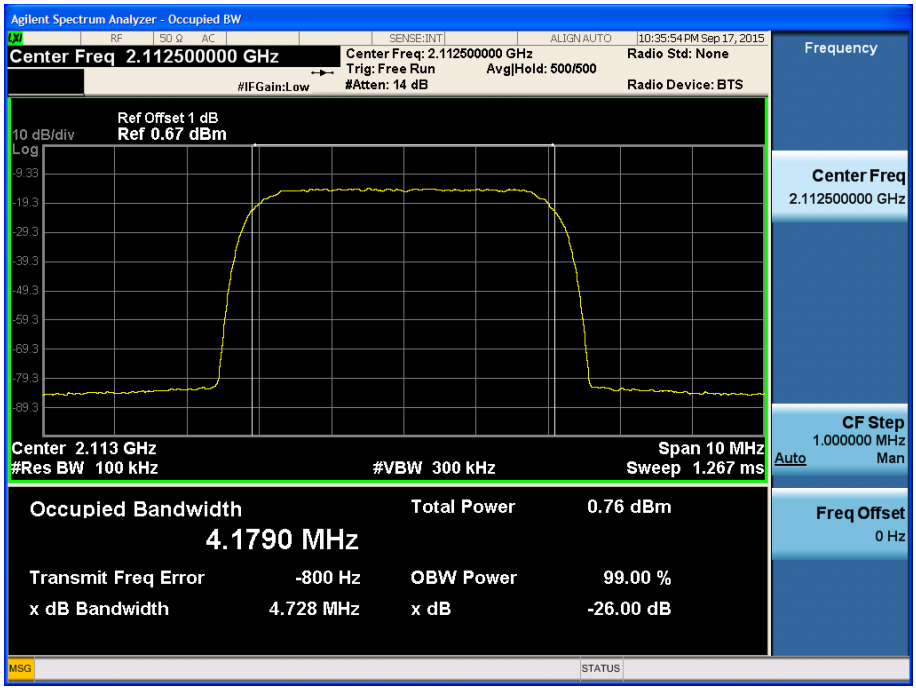
[AGC threshold Downlink Input LTE 10 MHz Middle]



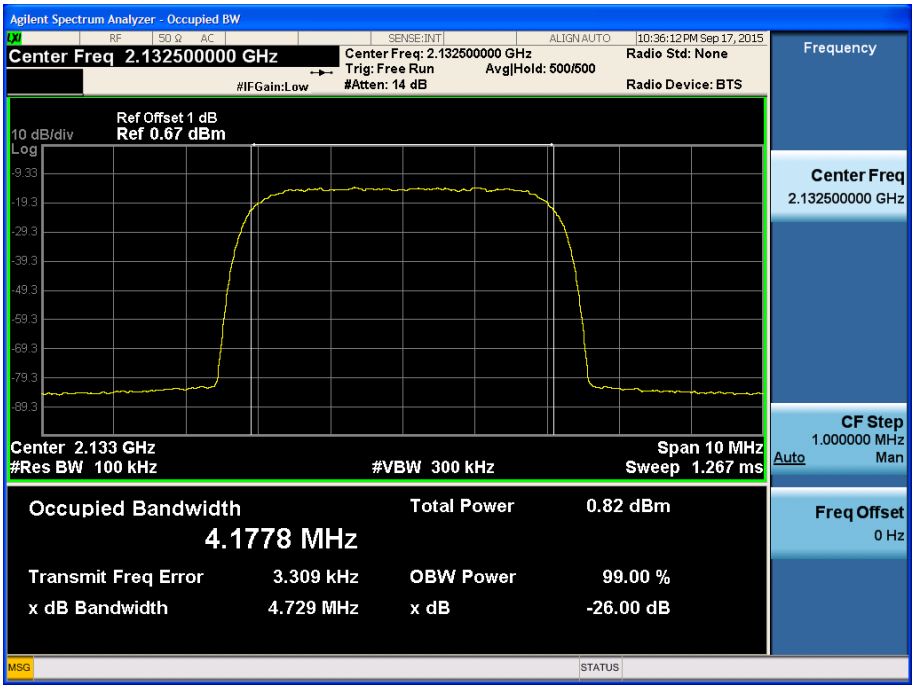
[AGC threshold Downlink Input LTE 10 MHz High]



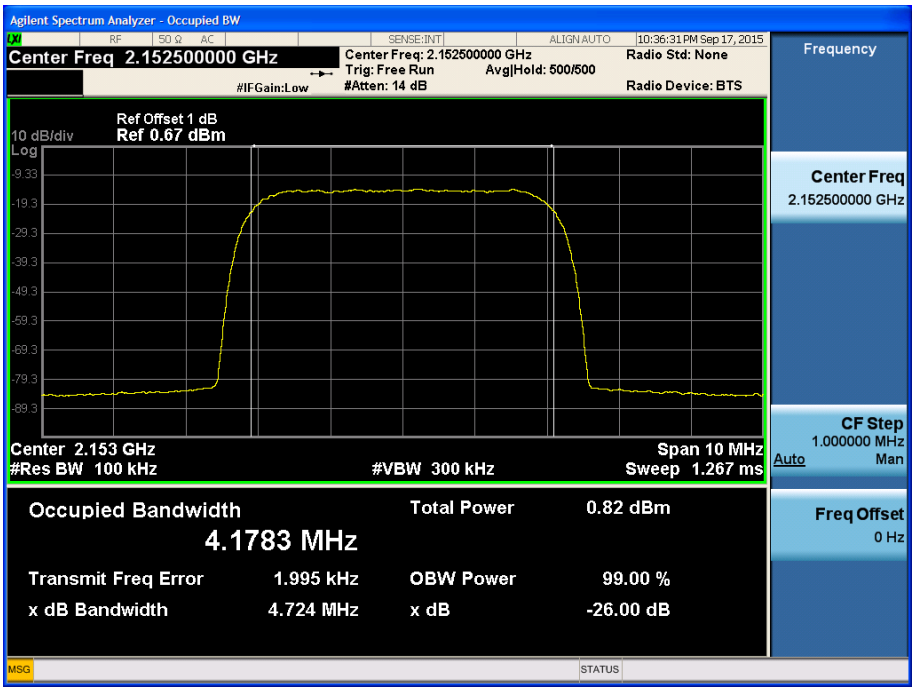
[AGC threshold Downlink Input WCDMA Low]



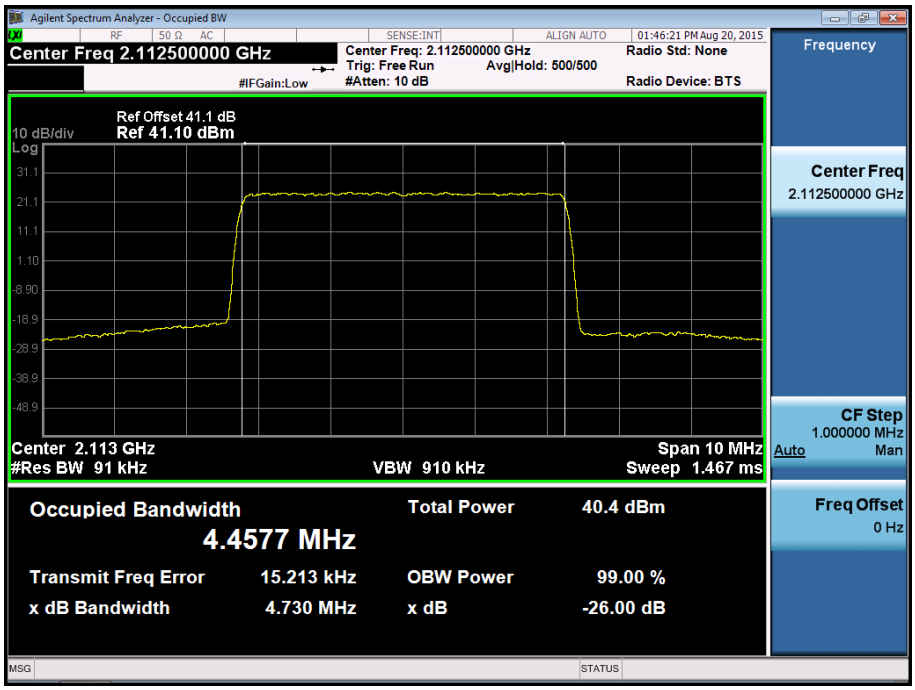
[AGC threshold Downlink Input WCDMA Middle]



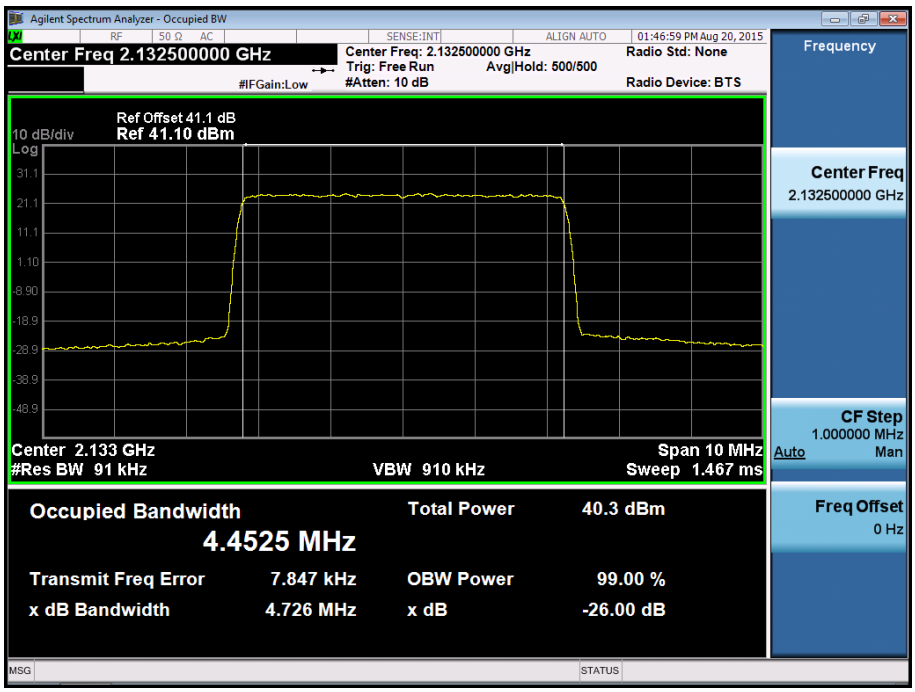
[AGC threshold Downlink Input WCDMA High]



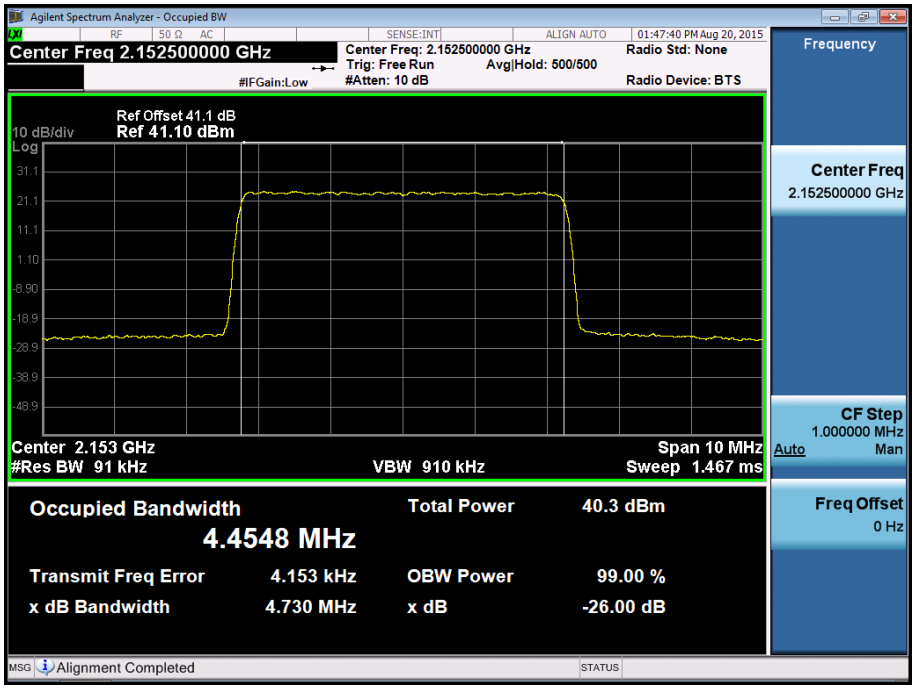
[+3dB above the AGC threshold Downlink Output LTE 5 MHz Low]



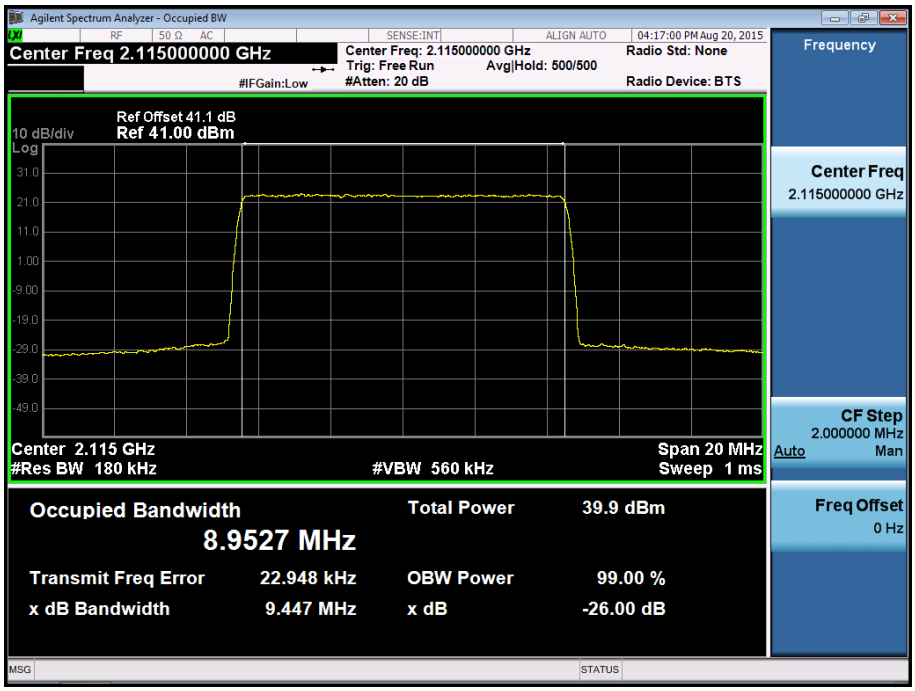
[+3dB above the AGC threshold Downlink Output LTE 5 MHz Middle]



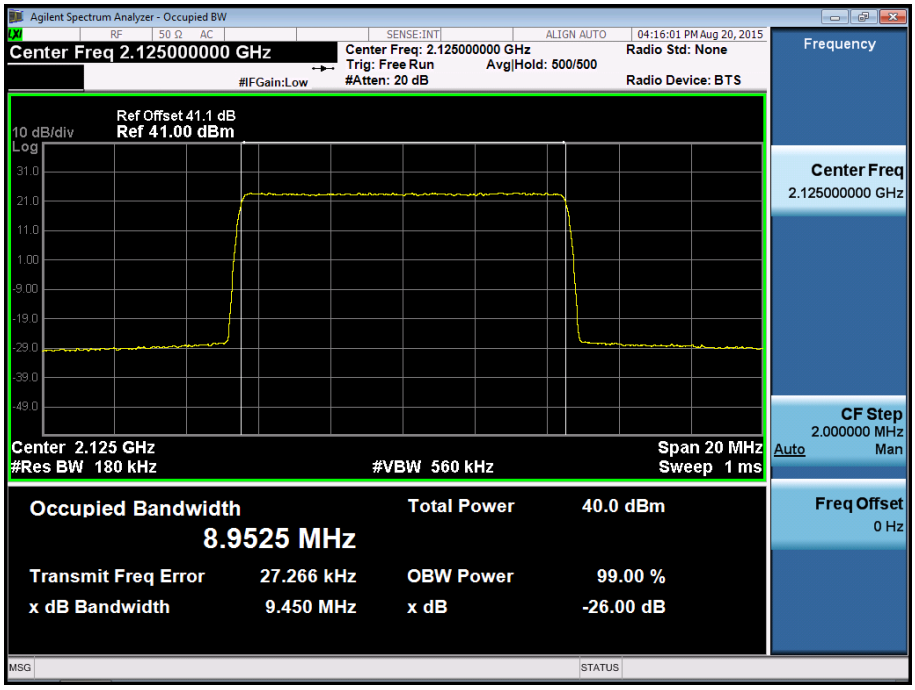
[+3dB above the AGC threshold Downlink Output LTE 5 MHz High]



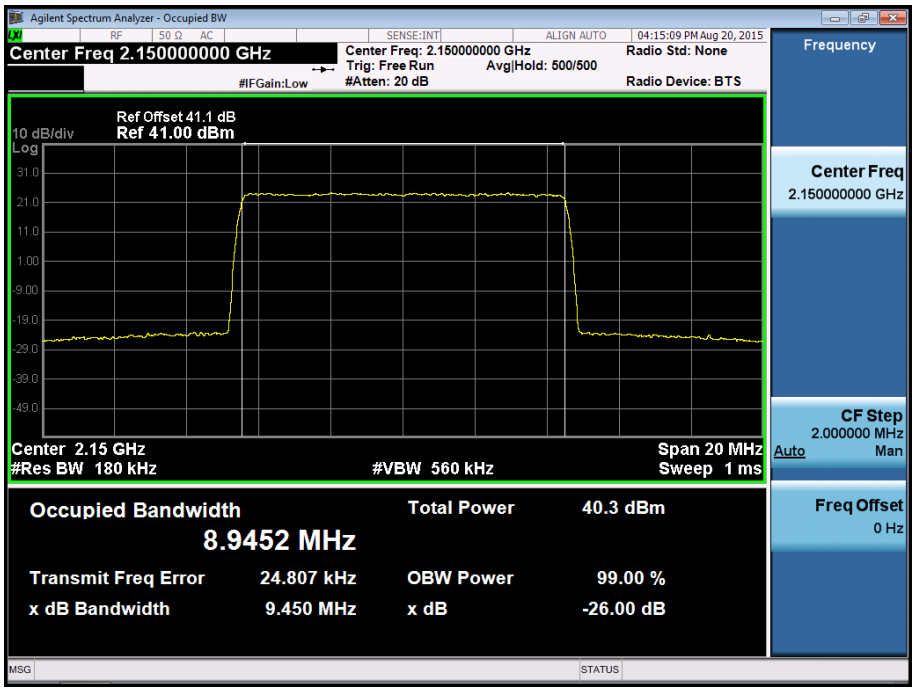
[+3dB above the AGC threshold Downlink Output LTE 10 MHz Low]



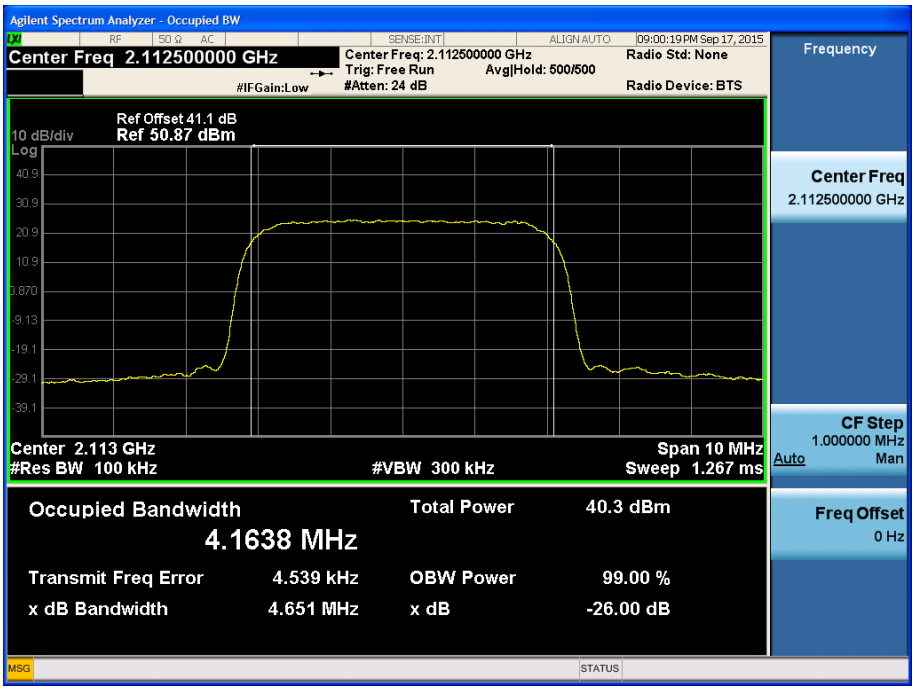
[+3dB above the AGC threshold Downlink Output LTE 10 MHz Middle]



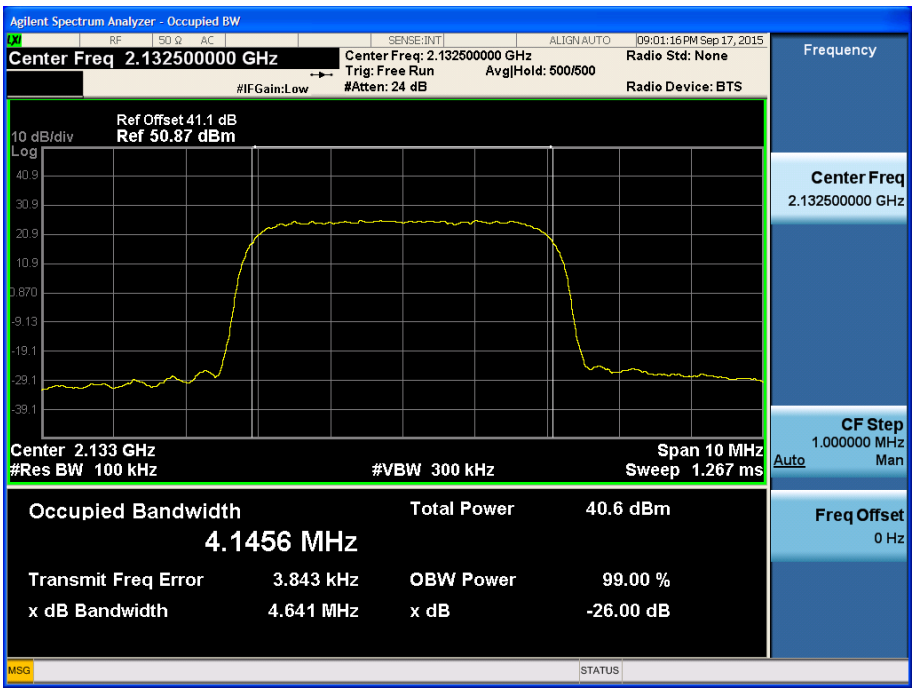
[+3dB above the AGC threshold Downlink Output LTE 10 MHz High]



[+3dB above the AGC threshold Downlink Output WCDMA Low]



[+3dB above the AGC threshold Downlink Output WCDMA Middle]



[+3dB above the AGC threshold Downlink Output WCDMA High]