

FCC REPORT

Certification

Applicant Name:

FRTEK CO., LTD.

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

Address:

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

Report No.: HCT-R-1510-F014

HCT FRN: 0005866421

FCC ID: 2AFEGFRWL46ROU19

APPLICANT: FRTEK CO., LTD.

FCC Model(s): FRWL46ROU19

EUT Type: MODAS(Multi-Operator DAS)

Frequency Ranges: 1 930 MHz – 1 995 MHz

Conducted Output Power: 40 W (46 dBm)

Date of Test: September 14, 2015 ~ October 13, 2015

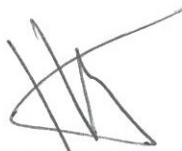
FCC Rule Part(s): CFR 47, Part 24

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 24 of the FCC Rules under normal use and maintenance.



Report prepared by
: Yong Hyun Lee

Test engineer of RF Team



Approved by
: Sang Jun Lee

Manager of RF Team

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1510-F014	October 15, 2015	- 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
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FCC ID:	2AFEGFRWL46ROU19
EUT Type:	MODAS(Multi-Operator DAS)
FCC Model(s):	FRWL46ROU19
Frequency Ranges:	1 930 MHz – 1 995 MHz
Conducted Output Power:	40 W (46 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
FCC Rule Part(s):	CFR Title 47 Part 24
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-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 24.

Description	Reference	Results
RF Output Power	§2.1046; §24.232	Compliant
Occupied Bandwidth	§2.1049	Compliant
Out of Band Rejection	KDB 935210 D02 v03	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	Compliant

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	$f \leq 1$ GHz	± 4.80 dB
	$f > 1$ GHz	± 6.07 dB
Frequency Stability	-	$\pm 1.22 \times 10^{-6}$

4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

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

5. TEST EQUIPMENT

Manufacturer	Model / Equipment	Cal Interval	Calibration Date	Serial No.
Agilent	E4438C /Signal Generator	Annual	09/02/2015	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
WEINSCHTEL	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.

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

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

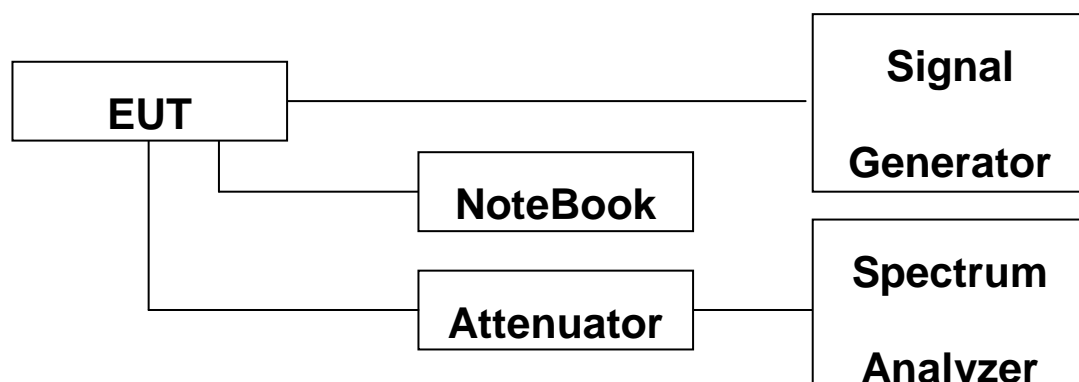
Test Procedures:

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:

PCS Band

Input Signal	Input Level (dBm)	Maximum Amp Gain
LTE 5 MHz	DL: -30 dBm	DL : 76 dB
LTE 10 MHz		
WCDMA		

[Downlink]

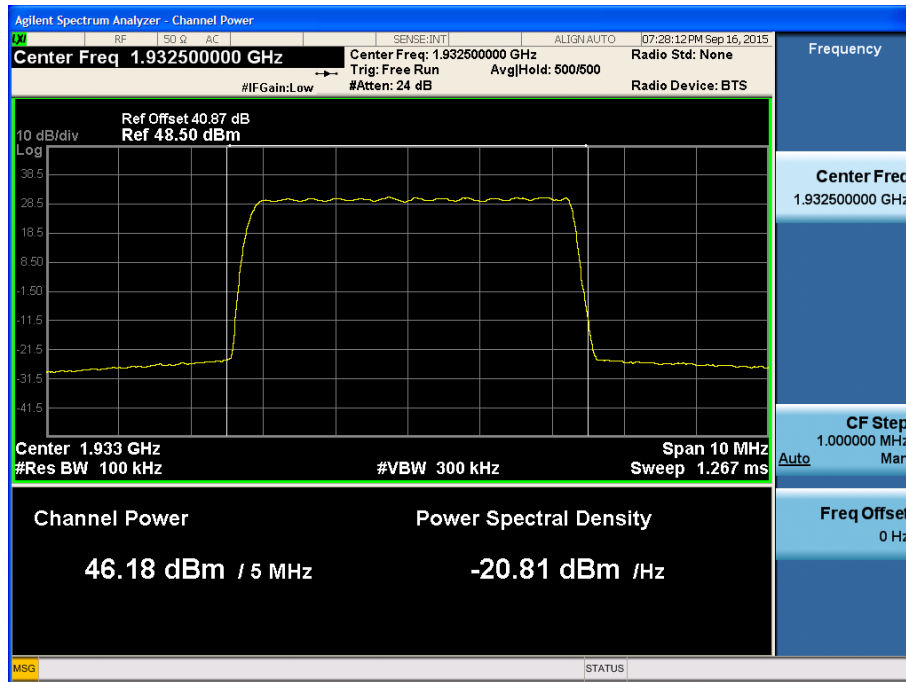
	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
AGC threshold LTE 5 MHz	Low	1932.50	46.18	41.495
	Middle	1962.50	46.81	47.973
	High	1992.50	46.40	43.652
AGC threshold LTE 10 MHz	Low	1935.00	46.41	43.752
	Middle	1960.00	46.76	47.424
	High	1985.00	46.53	44.978
AGC threshold WCDMA	Low	1932.50	46.60	45.709
	Middle	1962.50	46.68	46.559
	High	1992.50	46.30	42.658

[Downlink]

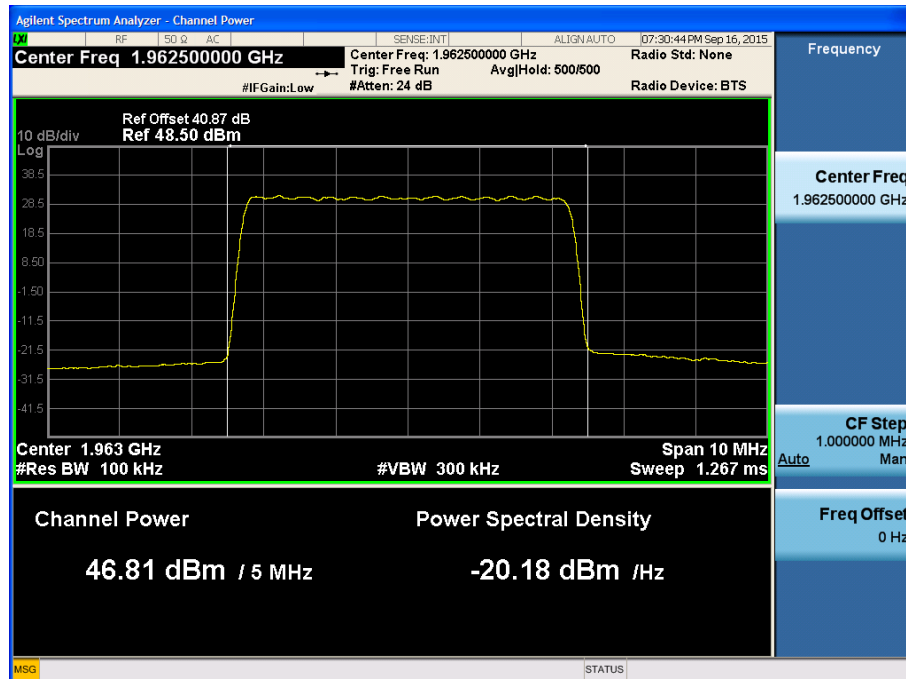
	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
+3dB above the AGC threshold LTE 5 MHz	Low	1932.50	46.10	40.738
	Middle	1962.50	46.95	49.545
	High	1992.50	46.28	42.462
+3dB above the AGC threshold LTE 10 MHz	Low	1935.00	46.14	41.115
	Middle	1960.00	46.82	48.084
	High	1985.00	46.49	44.566
+3dB above the AGC threshold WCDMA	Low	1932.50	46.62	45.920
	Middle	1962.50	46.72	46.989
	High	1992.50	46.27	42.364

Plots of RF Output Power

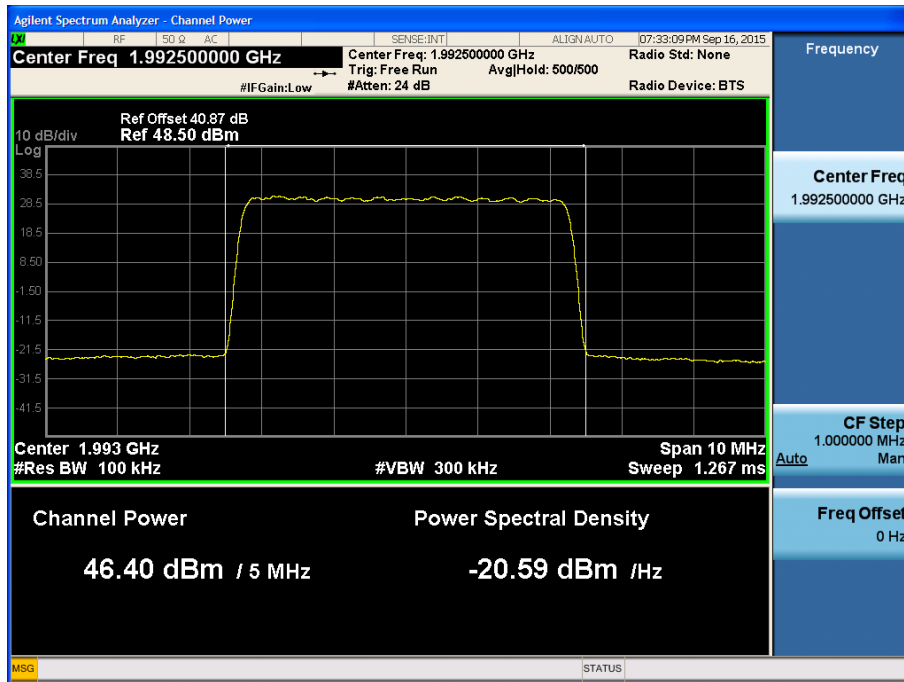
[AGC threshold Downlink LTE 5 MHz Low]



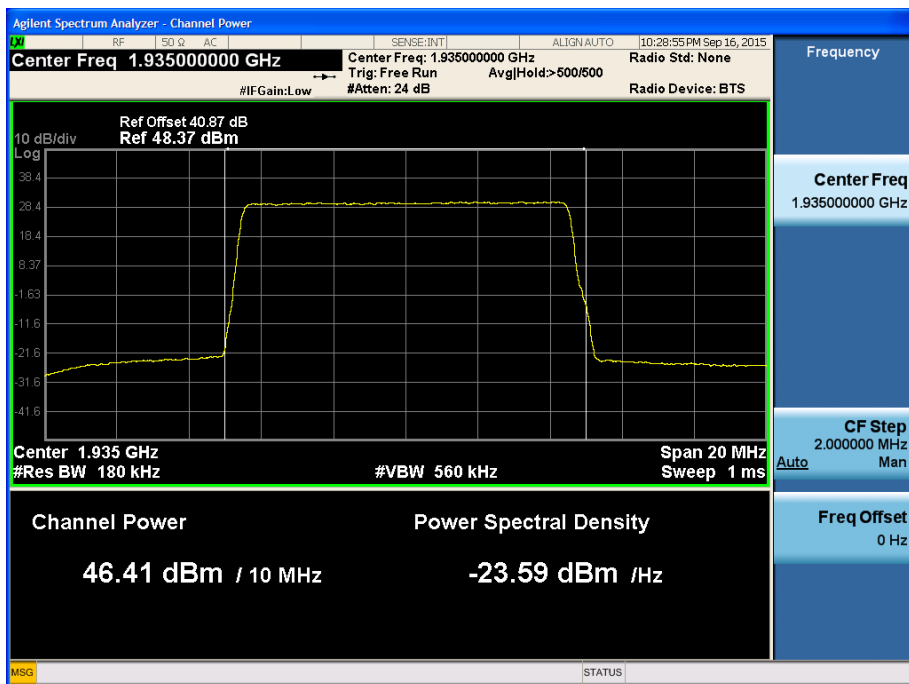
[AGC threshold Downlink LTE 5 MHz Middle]



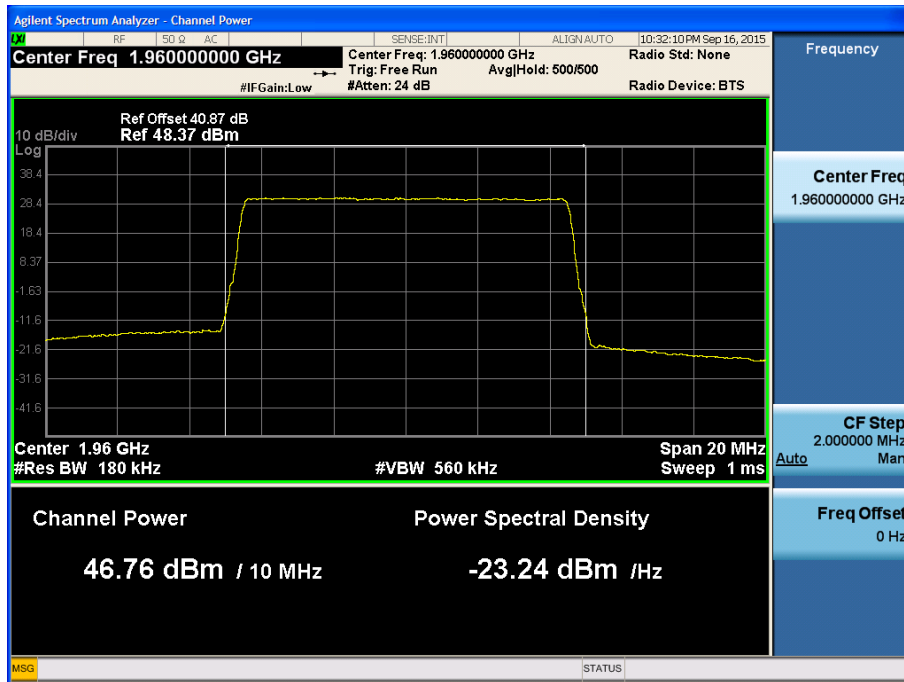
[AGC threshold Downlink LTE 5 MHz High]



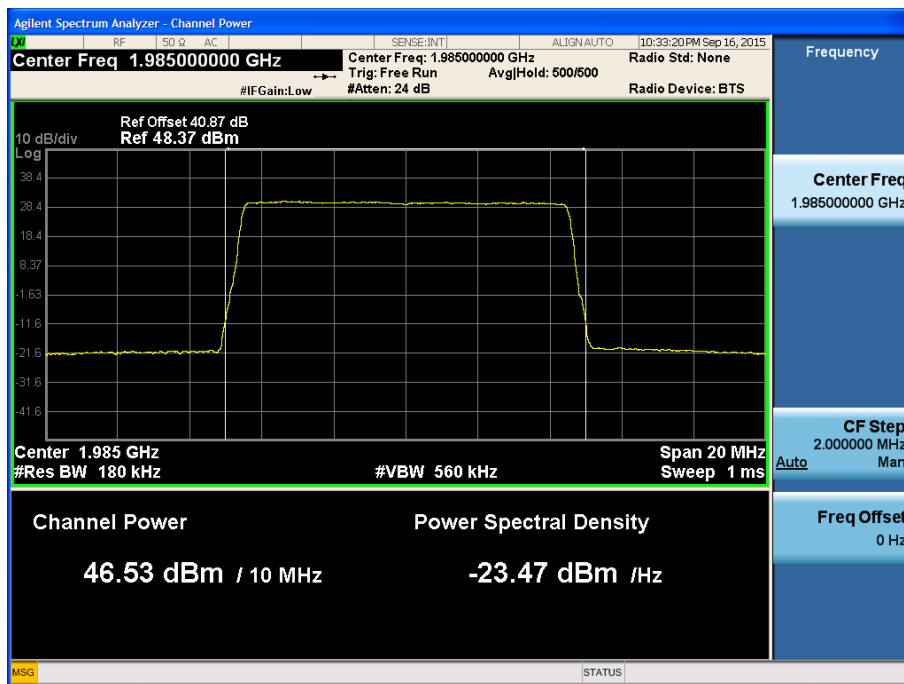
[AGC threshold Downlink LTE 10 MHz Low]



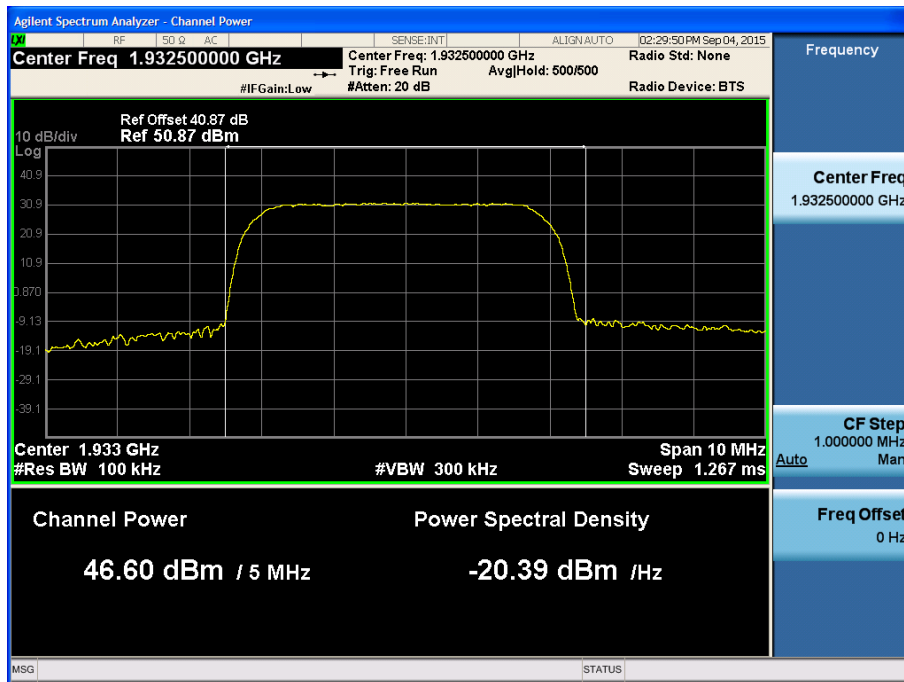
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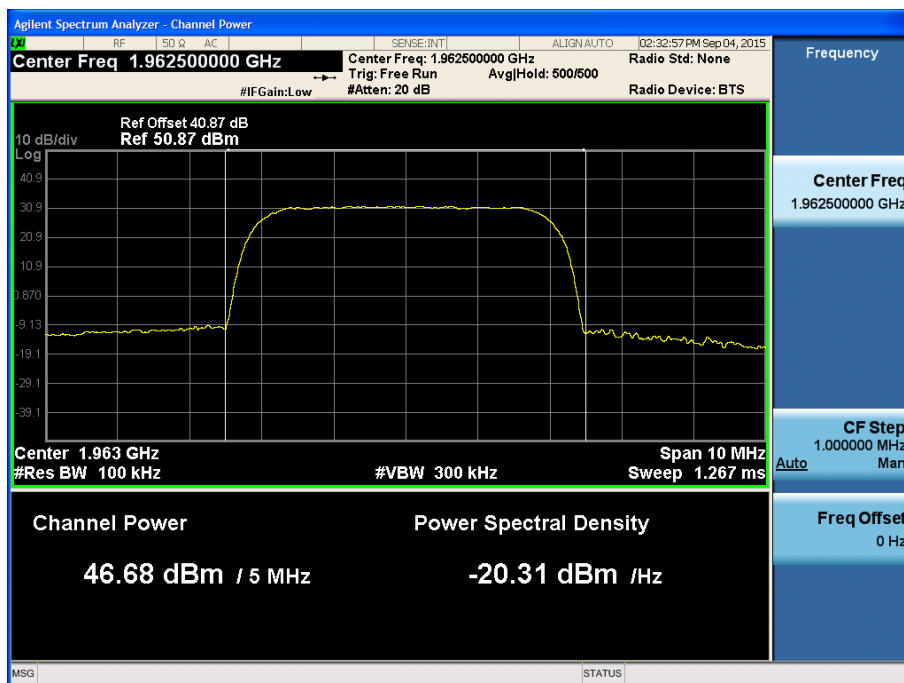
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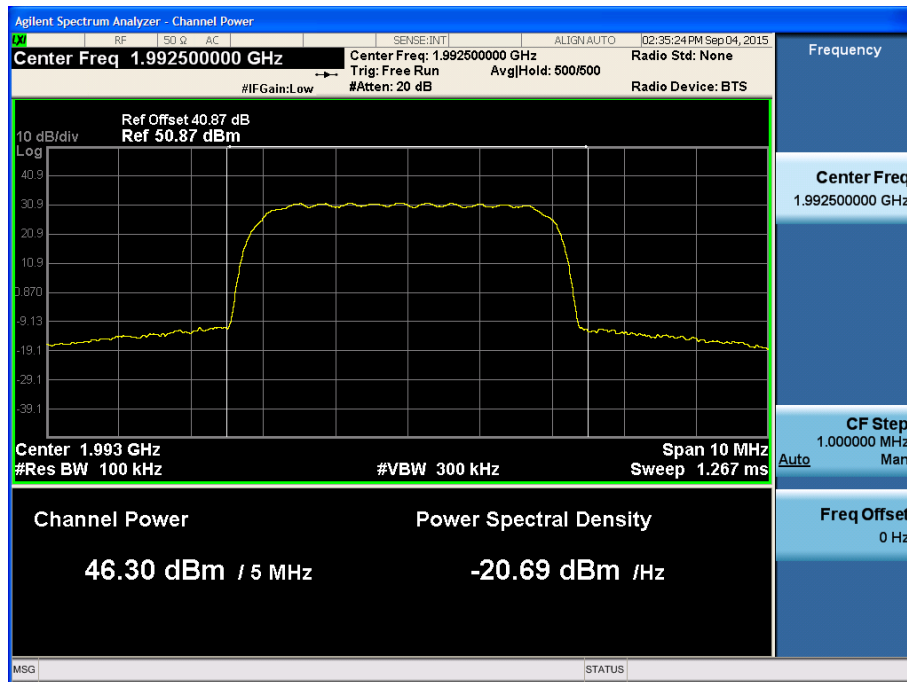
[AGC threshold Downlink WCDMA Low]



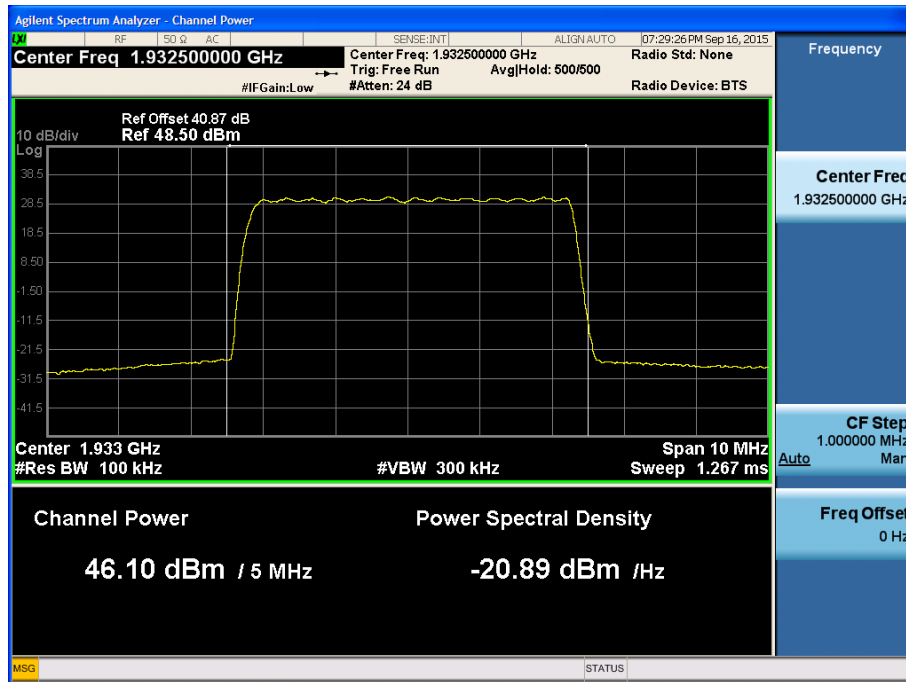
[AGC threshold Downlink WCDMA Middle]



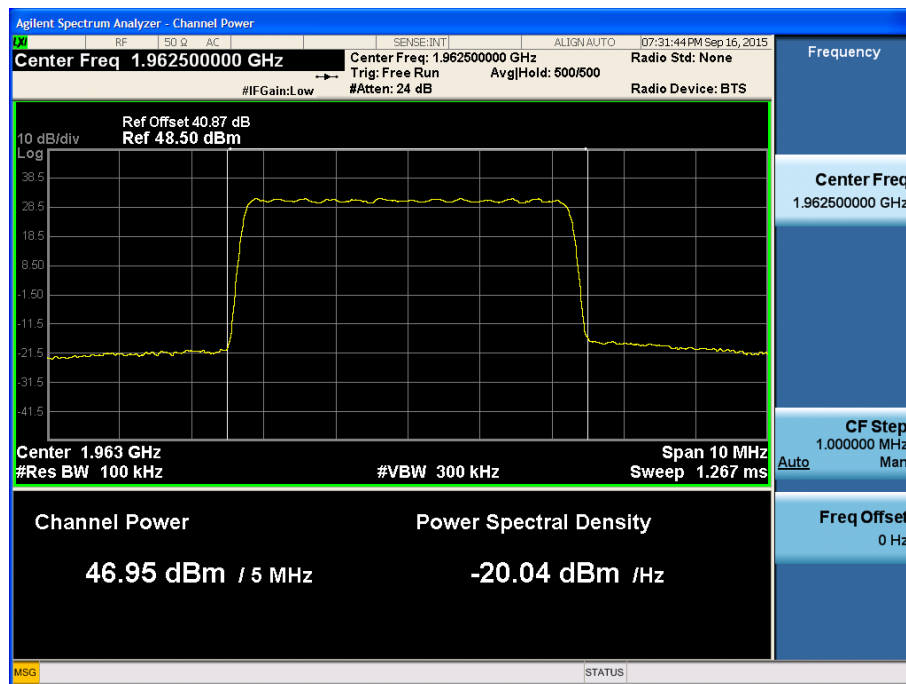
[AGC threshold Downlink WCDMA High]



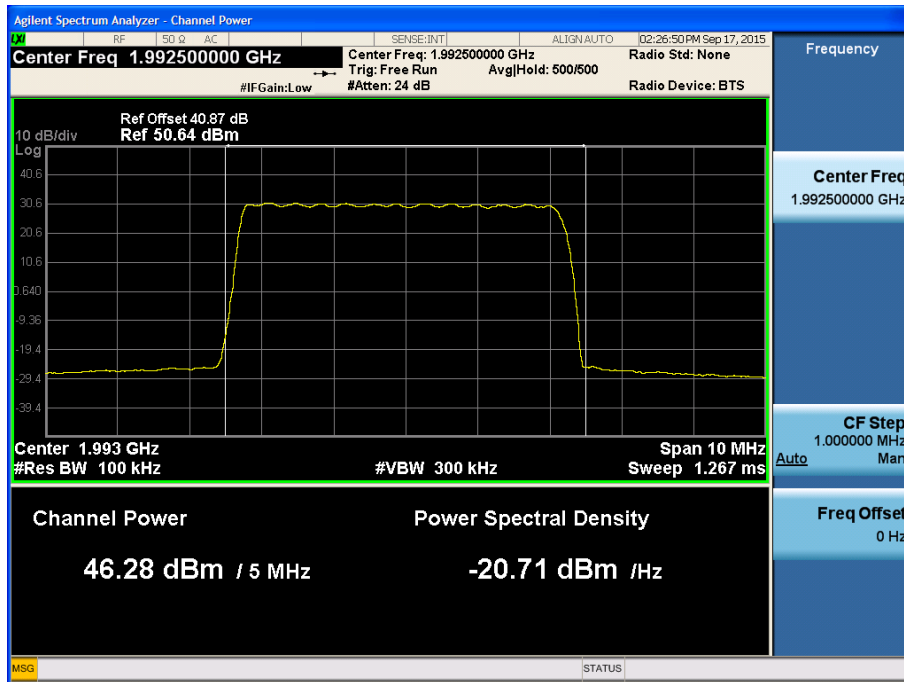
[+3dB above the AGC threshold Downlink LTE 5 MHz Low]



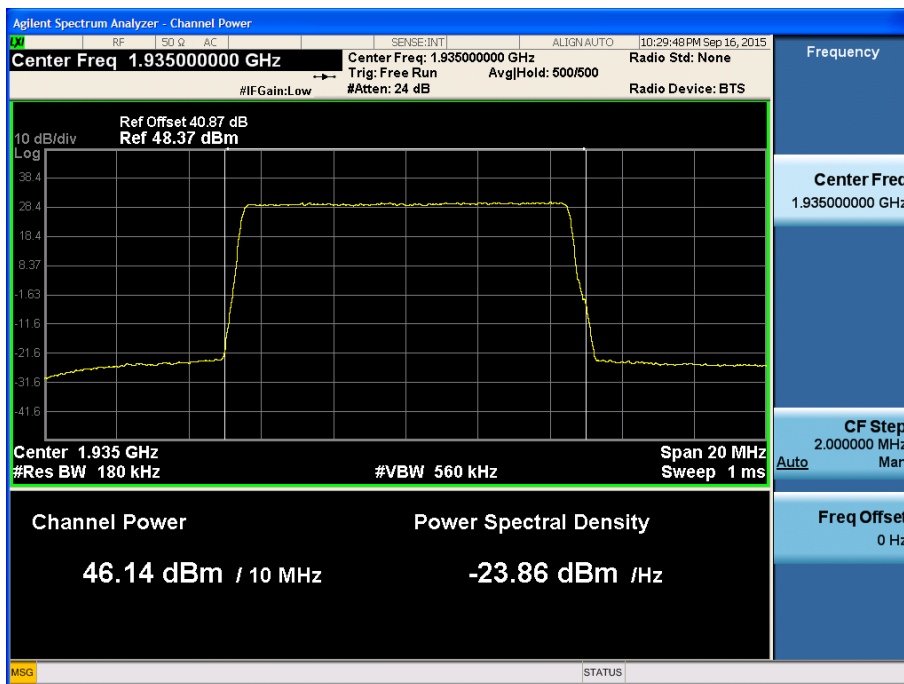
[+3dB above the AGC threshold Downlink LTE 5 MHz Middle]



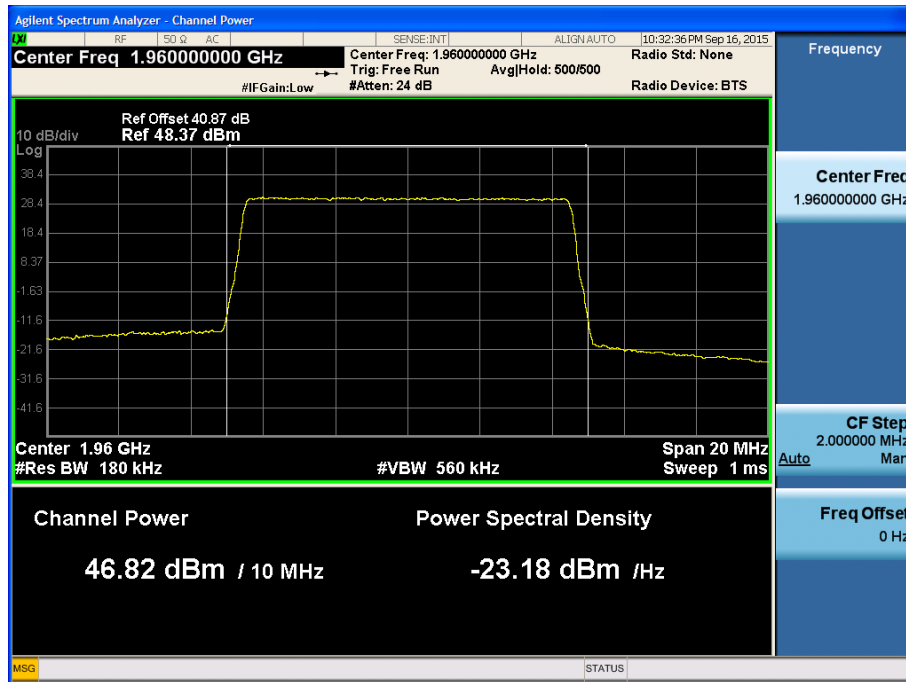
[+3dB above the AGC threshold Downlink LTE 5 MHz High]



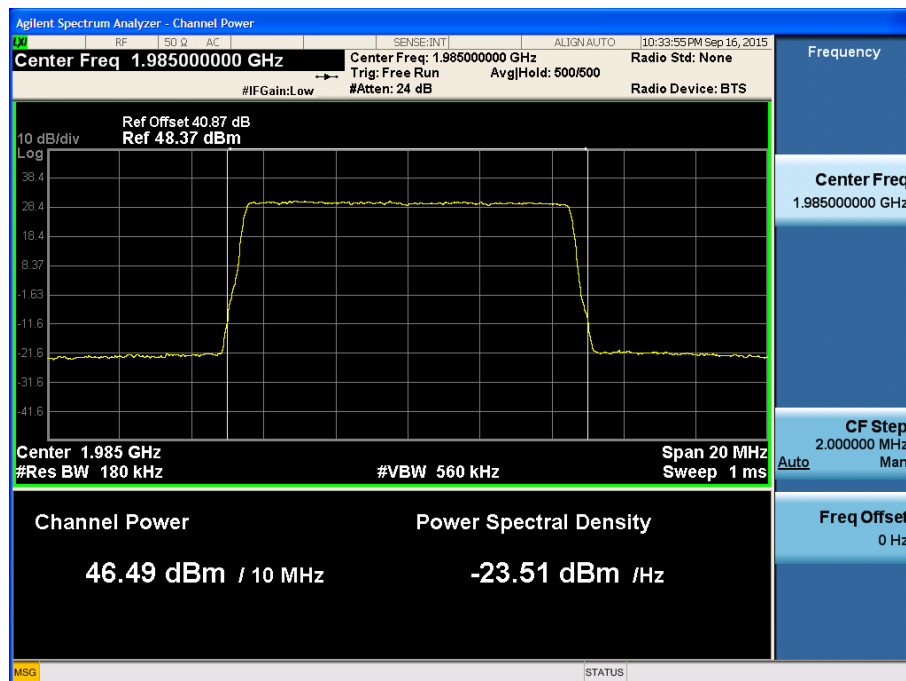
[+3dB above the AGC threshold Downlink LTE 10 MHz Low]



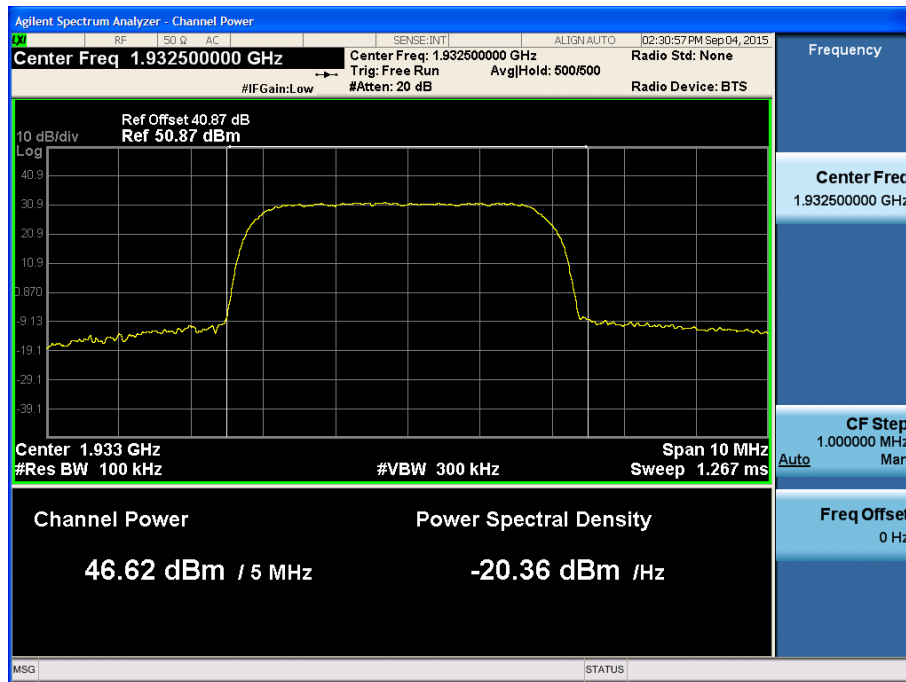
[+3dB above the AGC threshold Downlink LTE 10 MHz Middle]



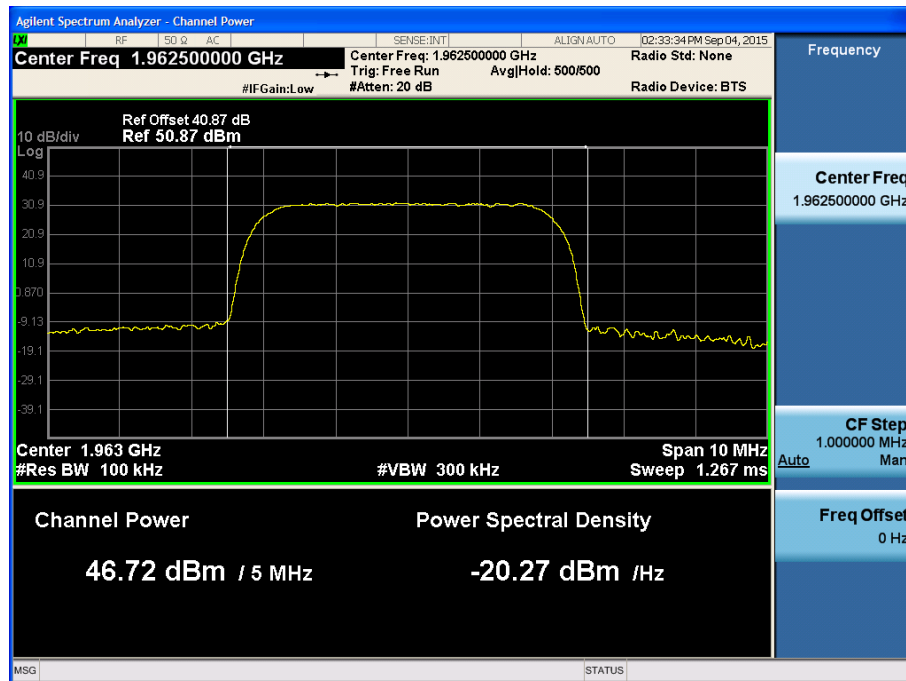
[+3dB above the AGC threshold Downlink LTE 10 MHz High]



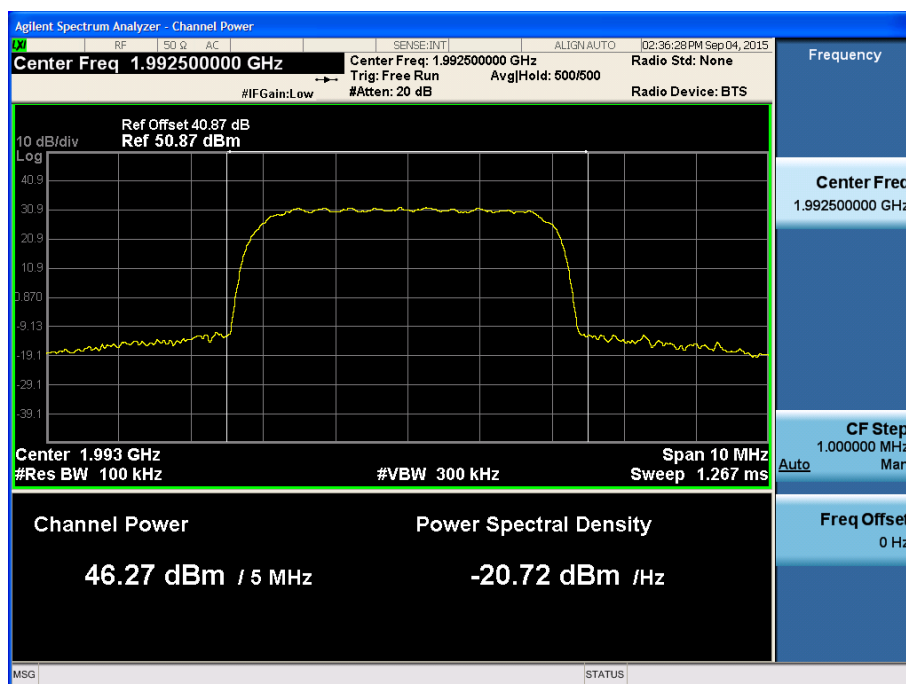
[+3dB above the AGC threshold Downlink WCDMA Low]



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



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



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 $\geq 3 \times \text{RBW}$.
 - 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 $[10 \log (\text{OBW} / \text{RBW})]$ 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.

PCS Band

Input Signal	Input Level (dBm)	Maximum Amp Gain
LTE 5 MHz	DL: -30 dBm	DL : 76 dB
LTE 10 MHz		
WCDMA		

[Downlink Output]

	Channel	Frequency (MHz)	OBW (MHz)
AGC threshold LTE 5 MHz	Low	1932.50	4.400
	Middle	1962.50	4.452
	High	1992.50	4.445
AGC threshold LTE 10 MHz	Low	1935.00	8.968
	Middle	1960.00	8.972
	High	1985.00	8.966
AGC threshold WCDMA	Low	1932.50	4.154
	Middle	1962.50	4.172
	High	1992.50	4.133

[Downlink Input]

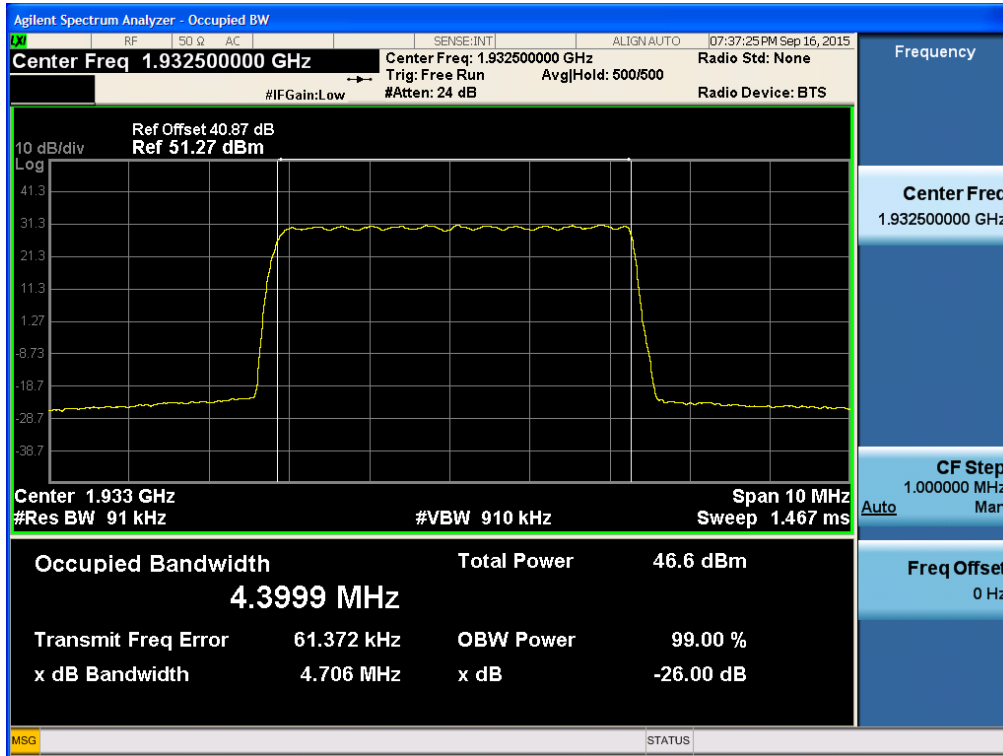
	Channel	Frequency (MHz)	OBW (MHz)
AGC threshold LTE 5 MHz	Low	1932.50	4.559
	Middle	1962.50	4.555
	High	1992.50	4.554
AGC threshold LTE 10 MHz	Low	1935.00	8.976
	Middle	1960.00	8.969
	High	1985.00	8.972
AGC threshold WCDMA	Low	1932.50	4.184
	Middle	1962.50	4.179
	High	1992.50	4.181

[Downlink Output]

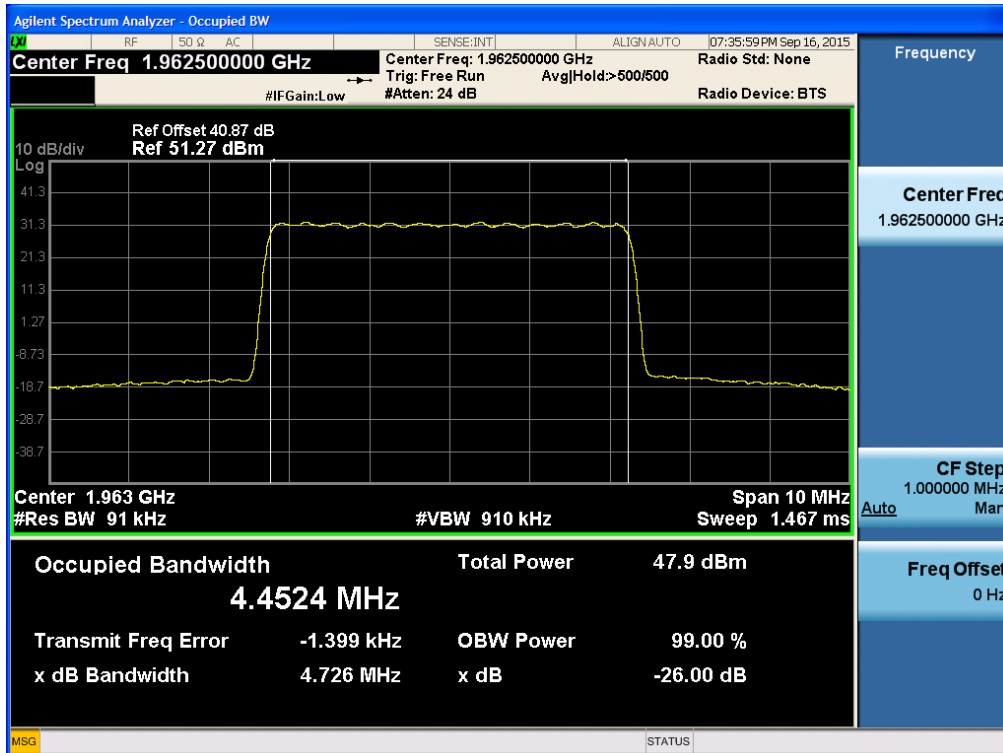
	Channel	Frequency (MHz)	OBW (MHz)
+3dB above the AGC threshold LTE 5 MHz	Low	1932.50	4.401
	Middle	1962.50	4.448
	High	1992.50	4.439
+3dB above the AGC threshold LTE 10 MHz	Low	1935.00	8.965
	Middle	1960.00	8.971
	High	1985.00	8.964
+3dB above the AGC threshold WCDMA	Low	1932.50	4.144
	Middle	1962.50	4.170
	High	1992.50	4.129

Plots of Occupied Bandwidth

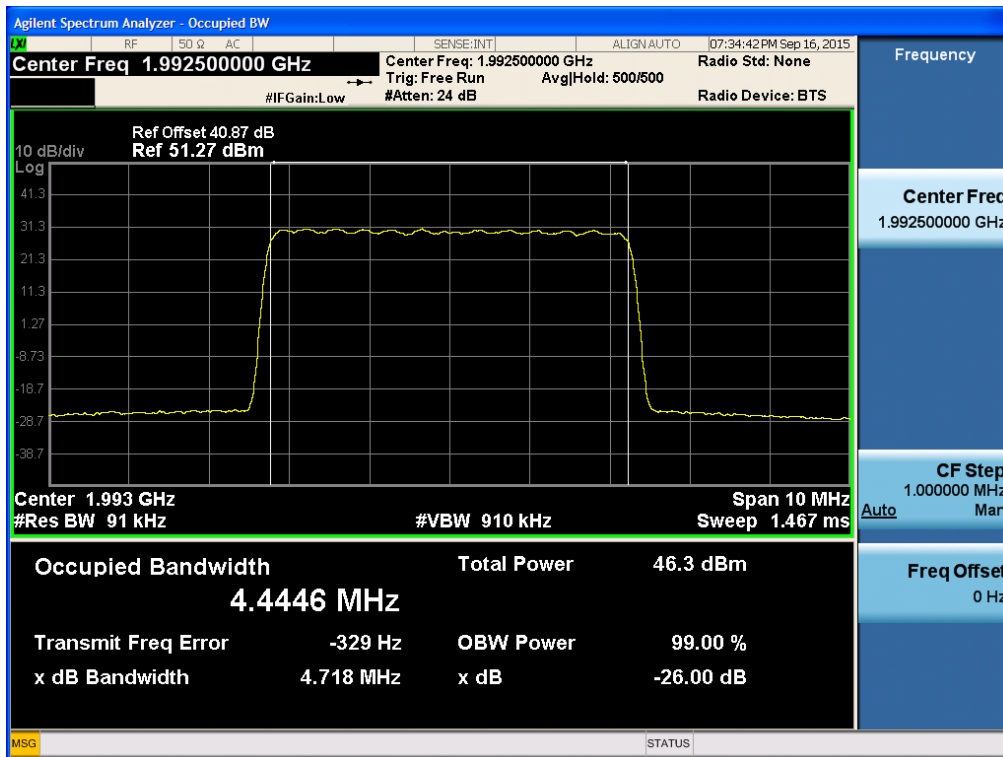
[AGC threshold Downlink Output LTE 5 MHz Low]



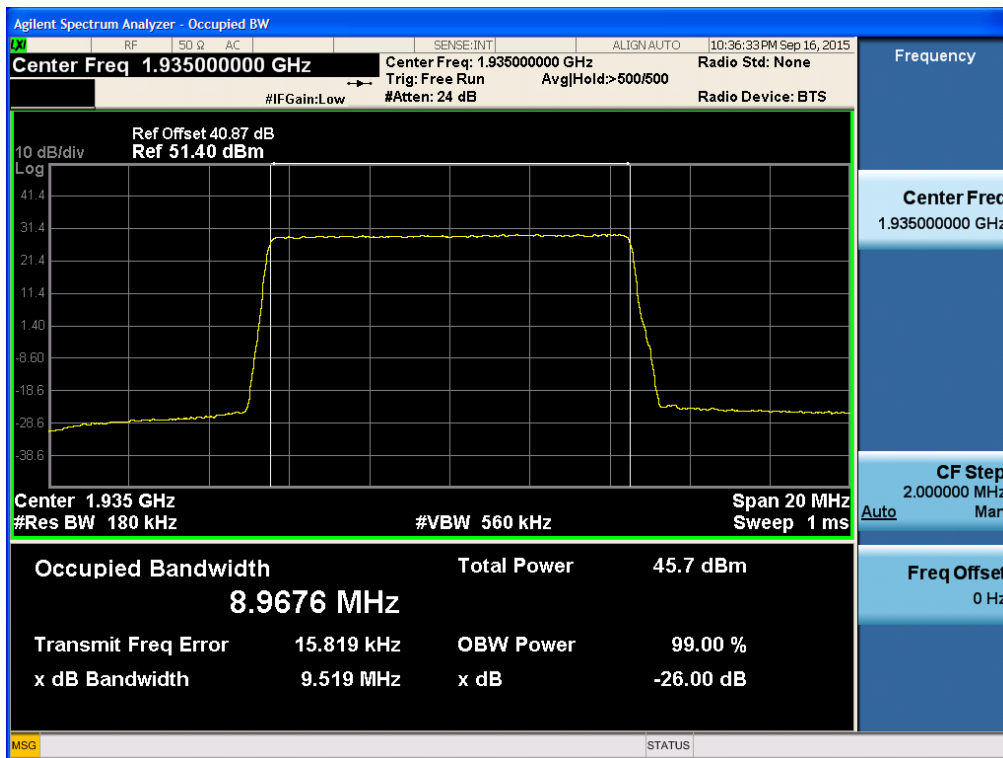
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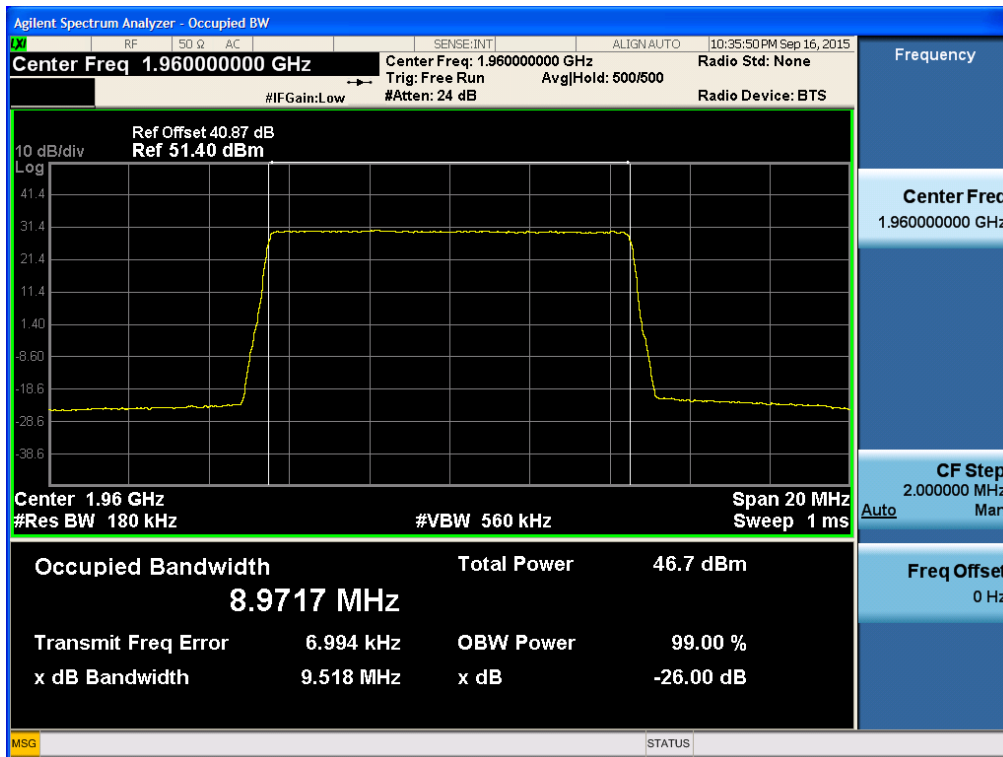
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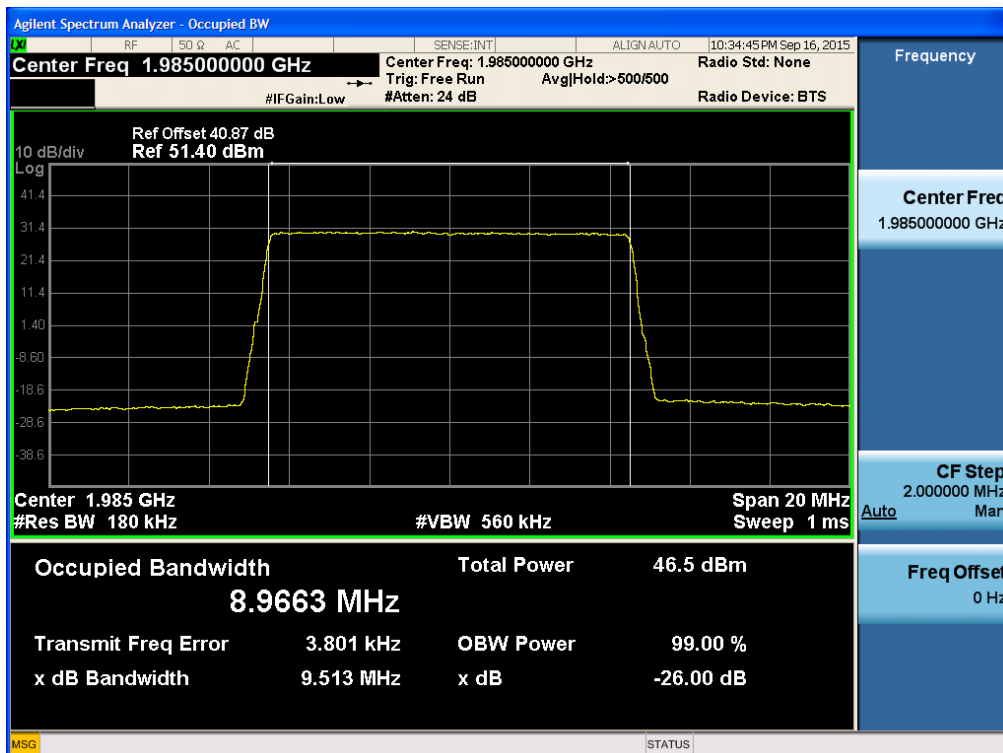
[AGC threshold Downlink Output LTE 10 MHz Low]



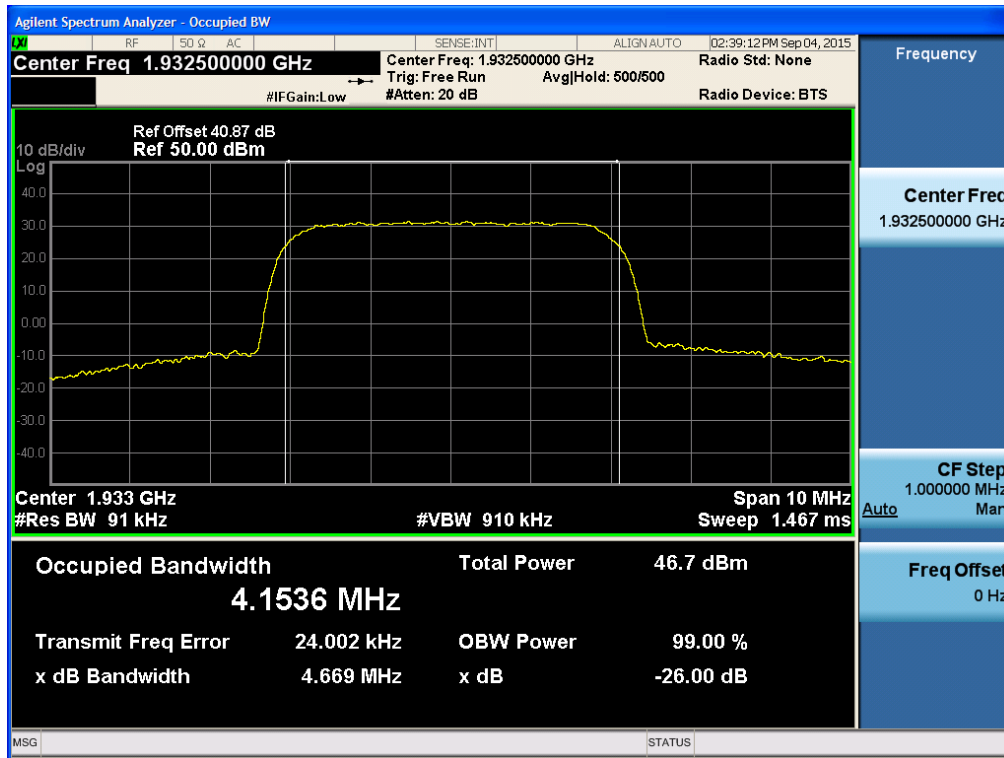
[AGC threshold Downlink Output LTE 10 MHz Middle]



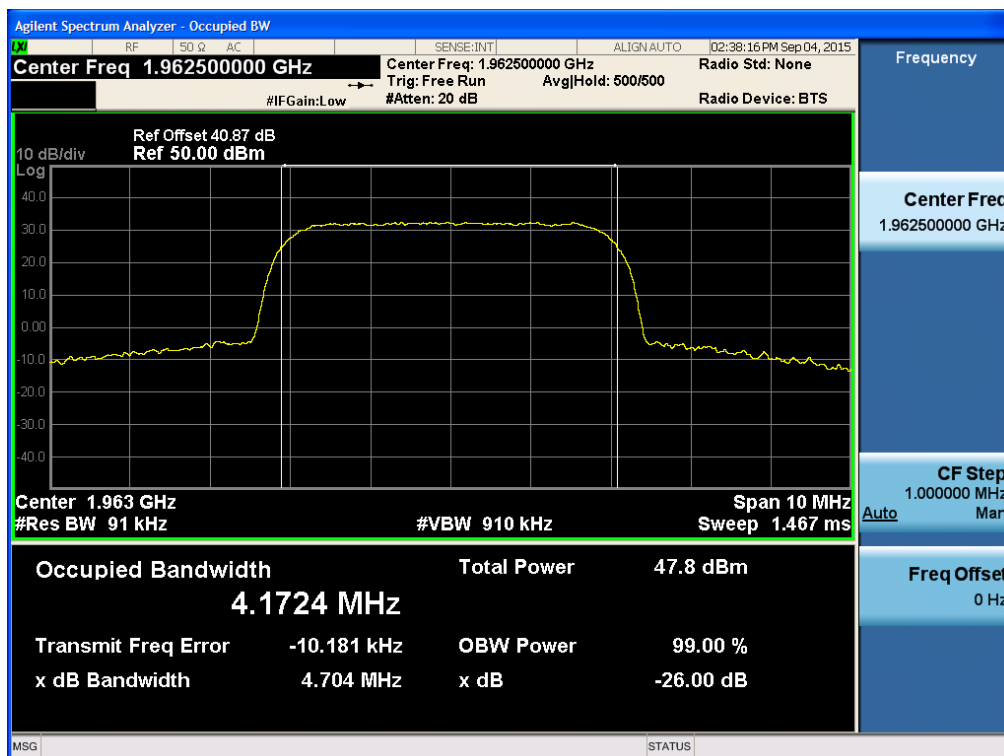
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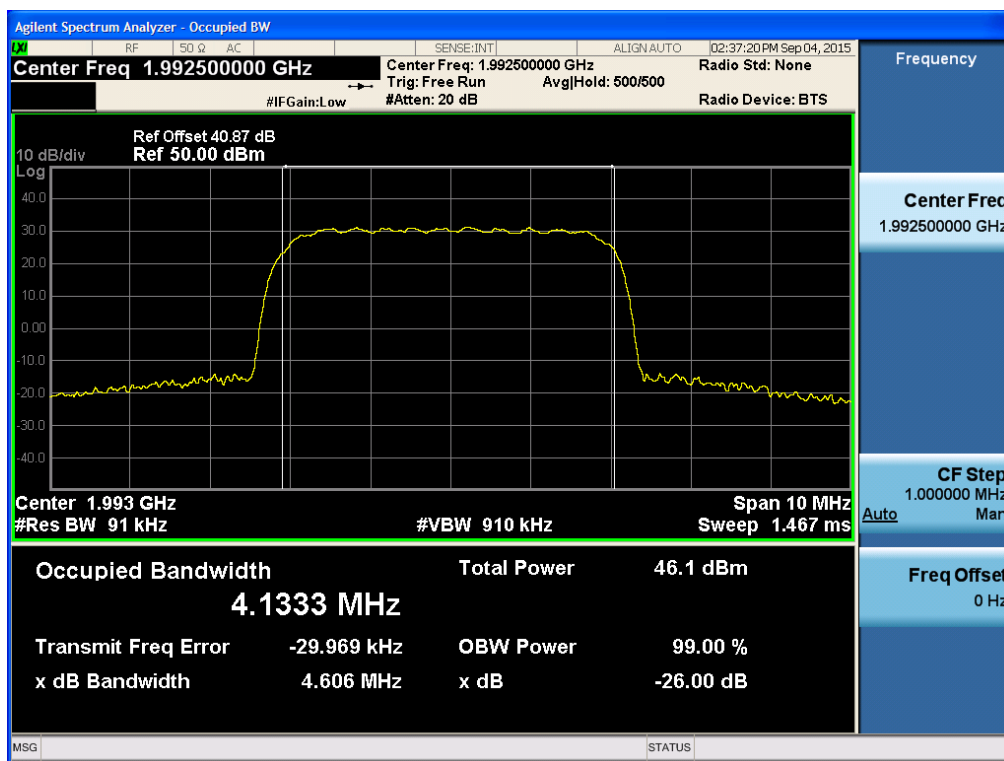
[AGC threshold Downlink Output WCDMA Low]



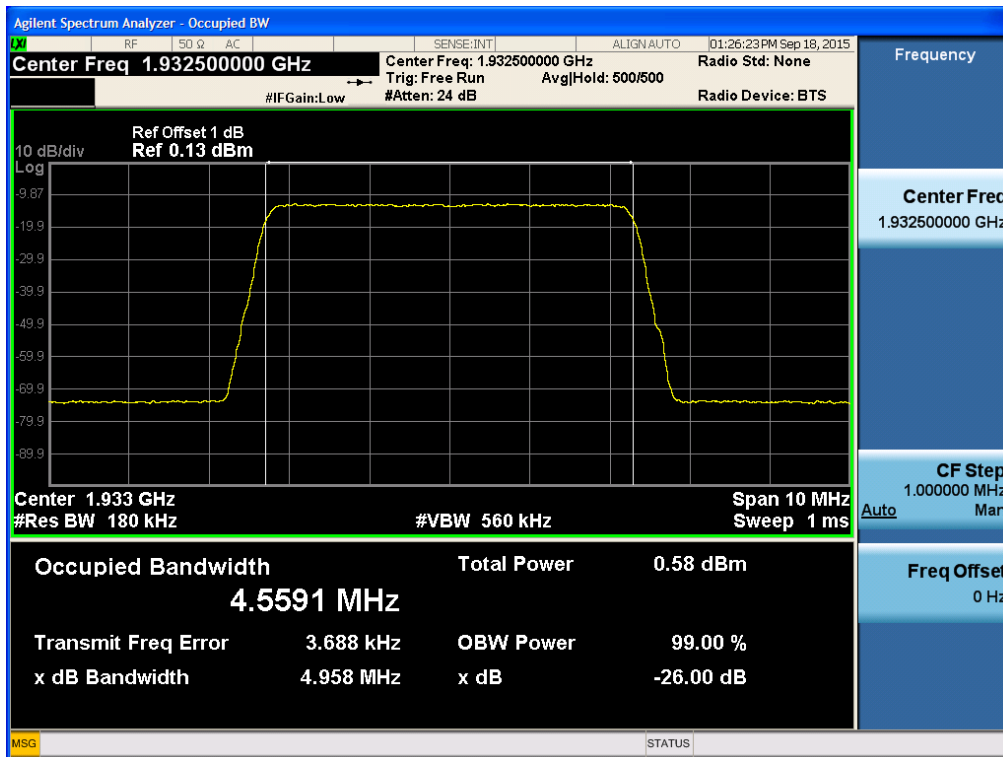
[AGC threshold Downlink Output WCDMA Middle]



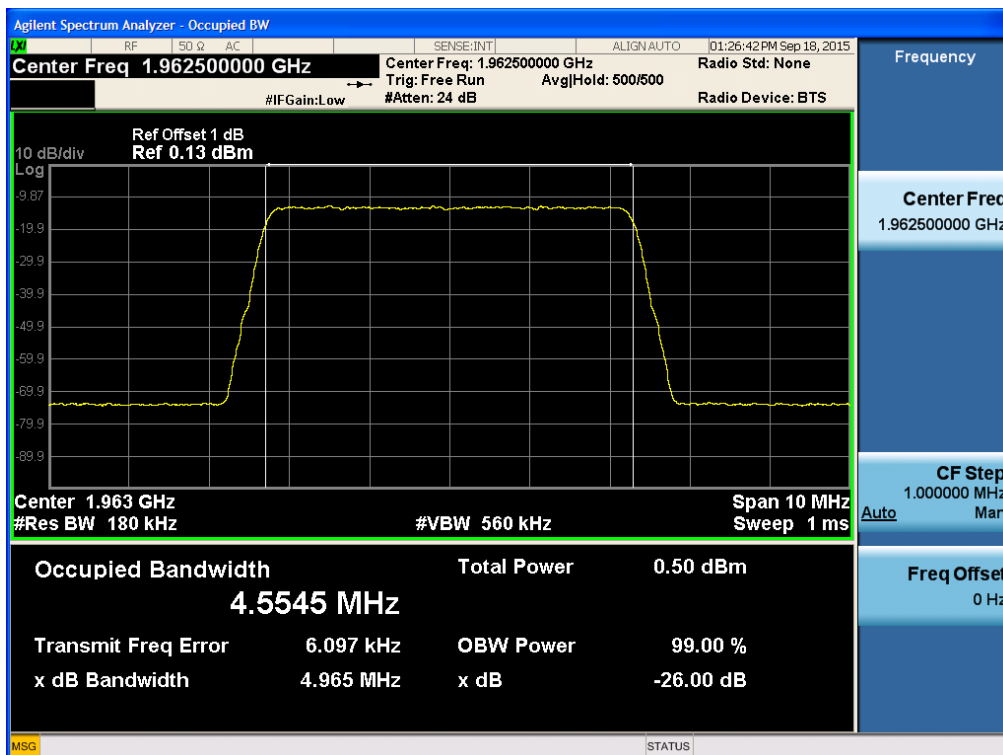
[AGC threshold Downlink Output WCDMA High]



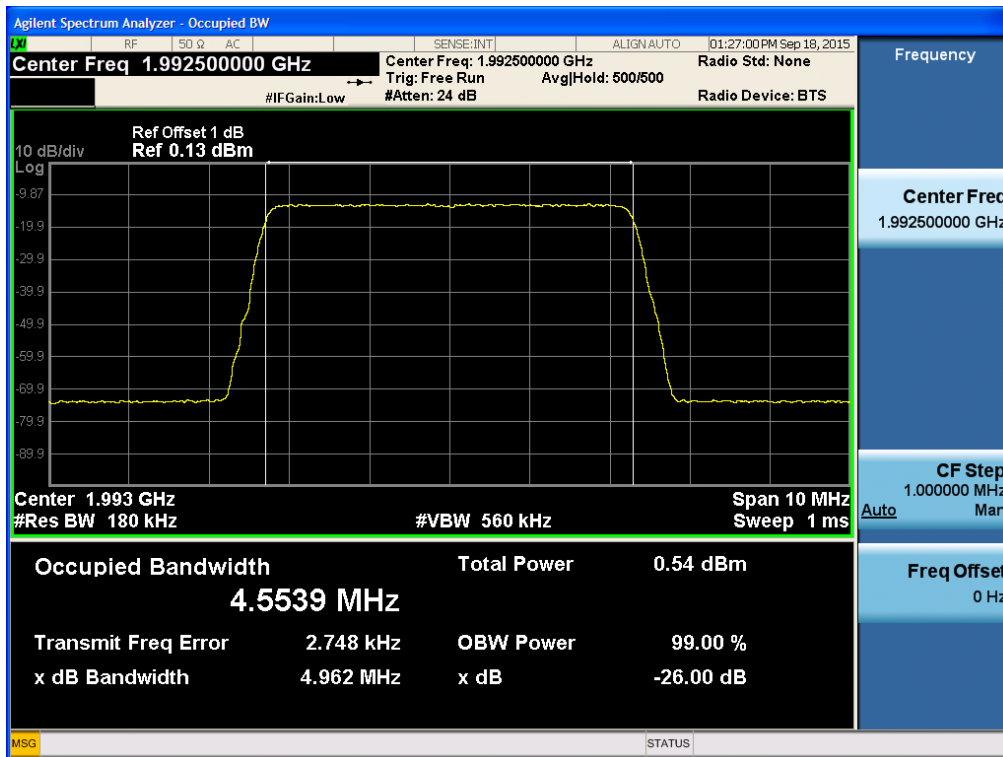
[AGC threshold Downlink Input LTE 5 MHz Low]



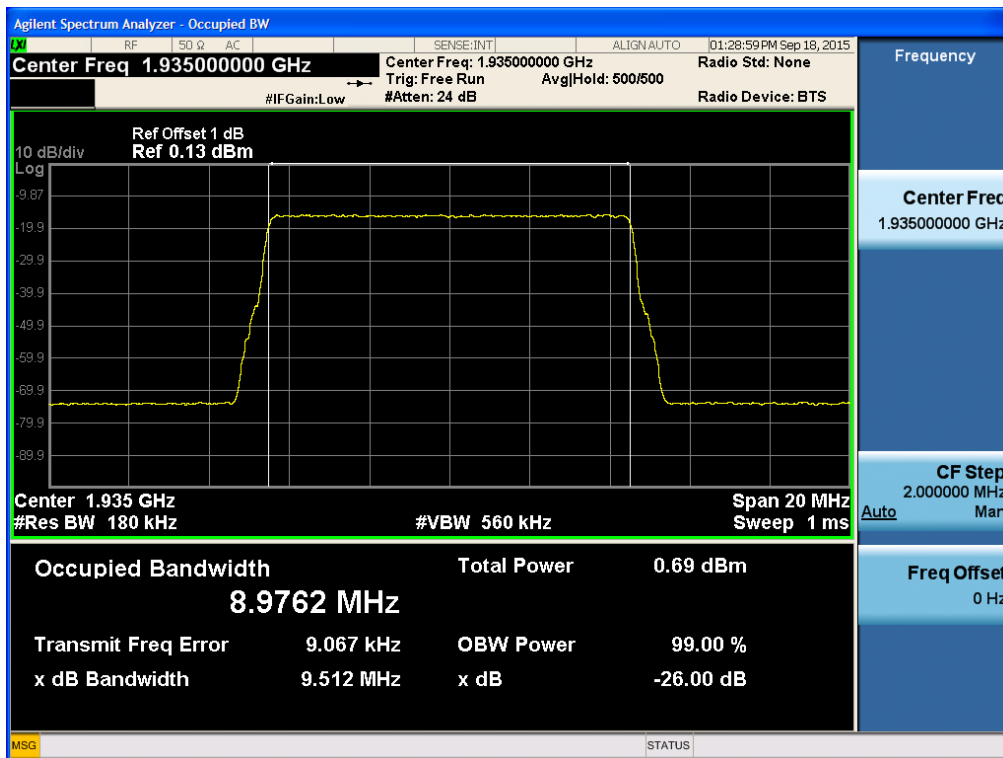
[AGC threshold Downlink Input LTE 5 MHz Middle]



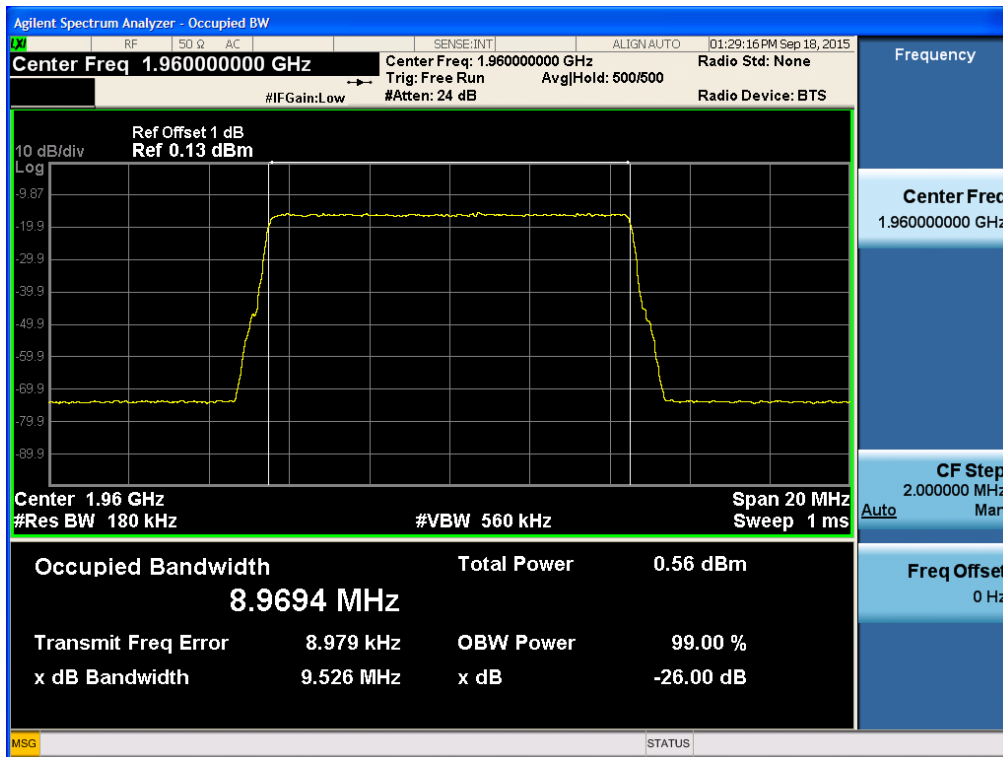
[AGC threshold Downlink Input LTE 5 MHz High]



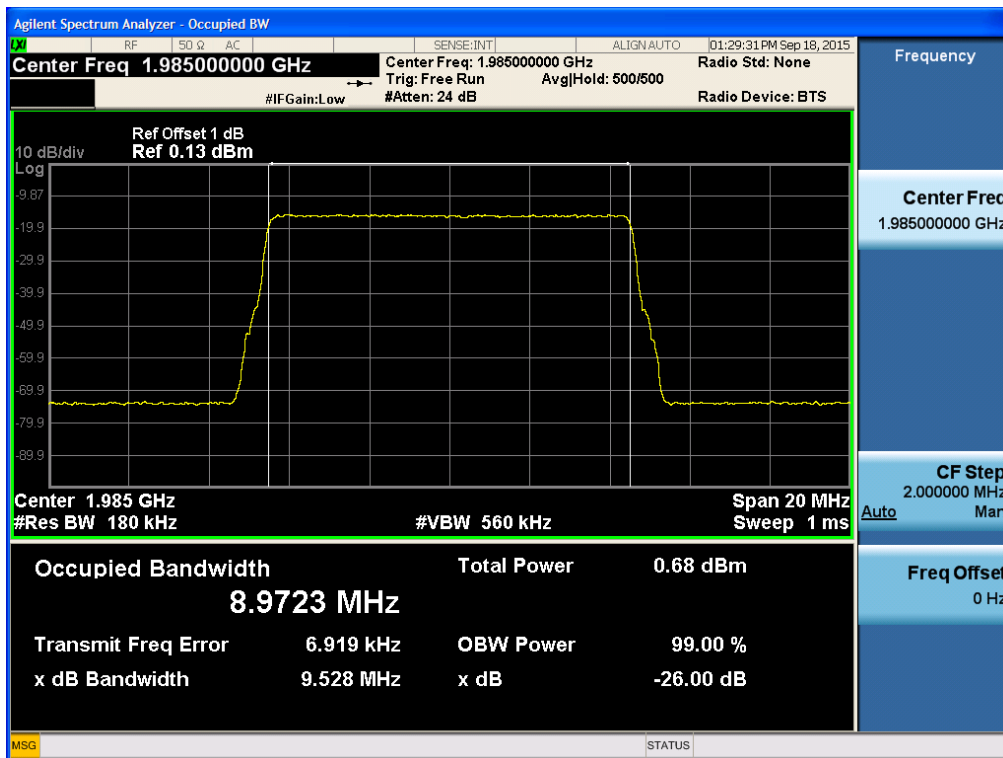
[AGC threshold Downlink Input LTE 10 MHz Low]



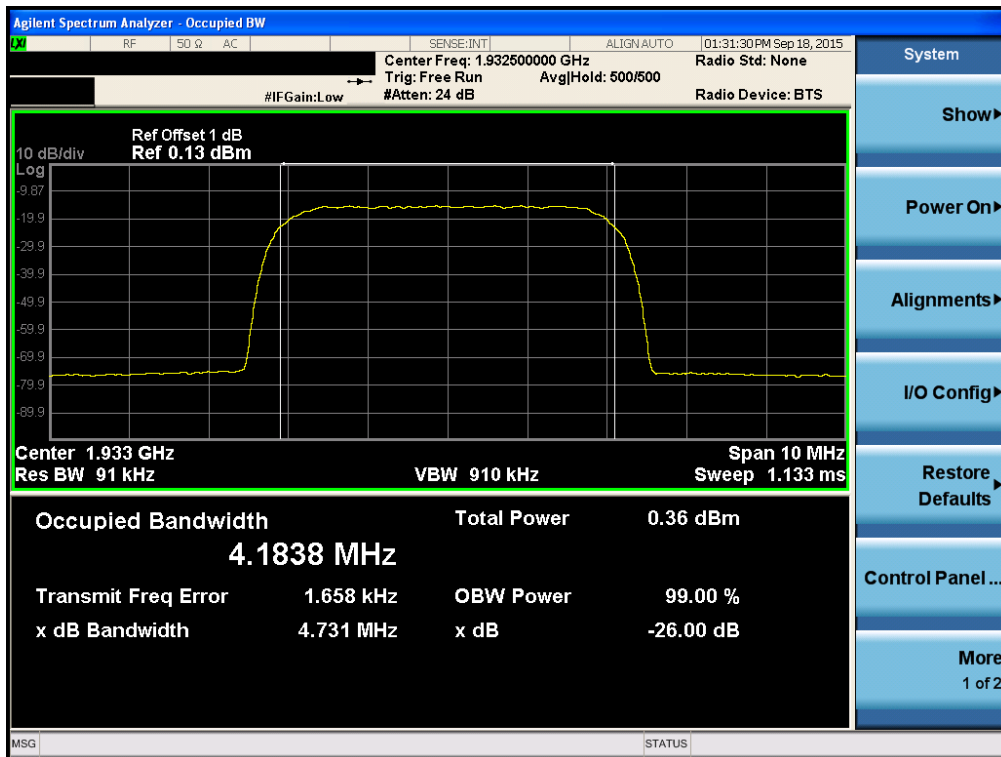
[AGC threshold Downlink Input LTE 10 MHz Middle]



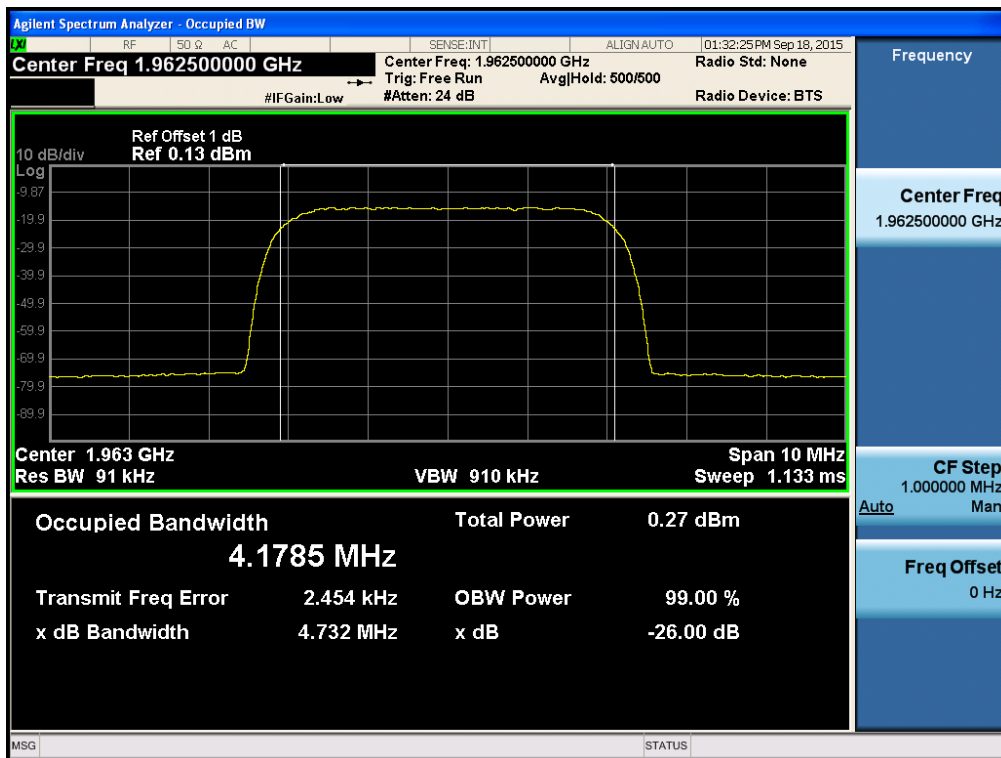
[AGC threshold Downlink Input LTE 10 MHz High]



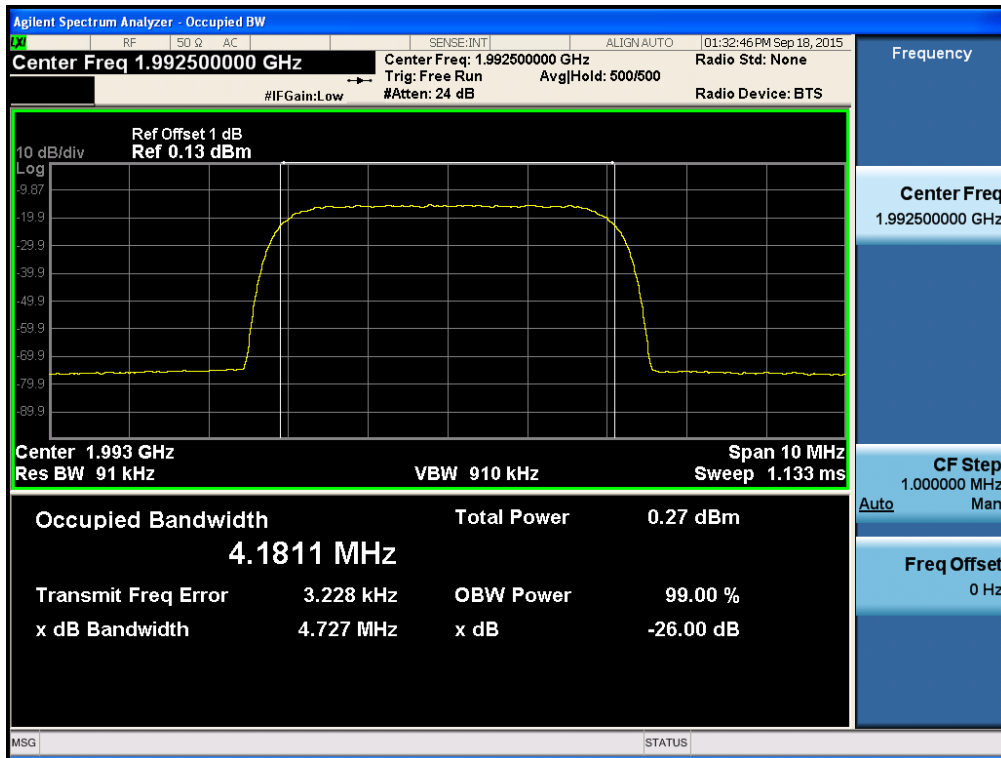
[AGC threshold Downlink Input WCDMA Low]



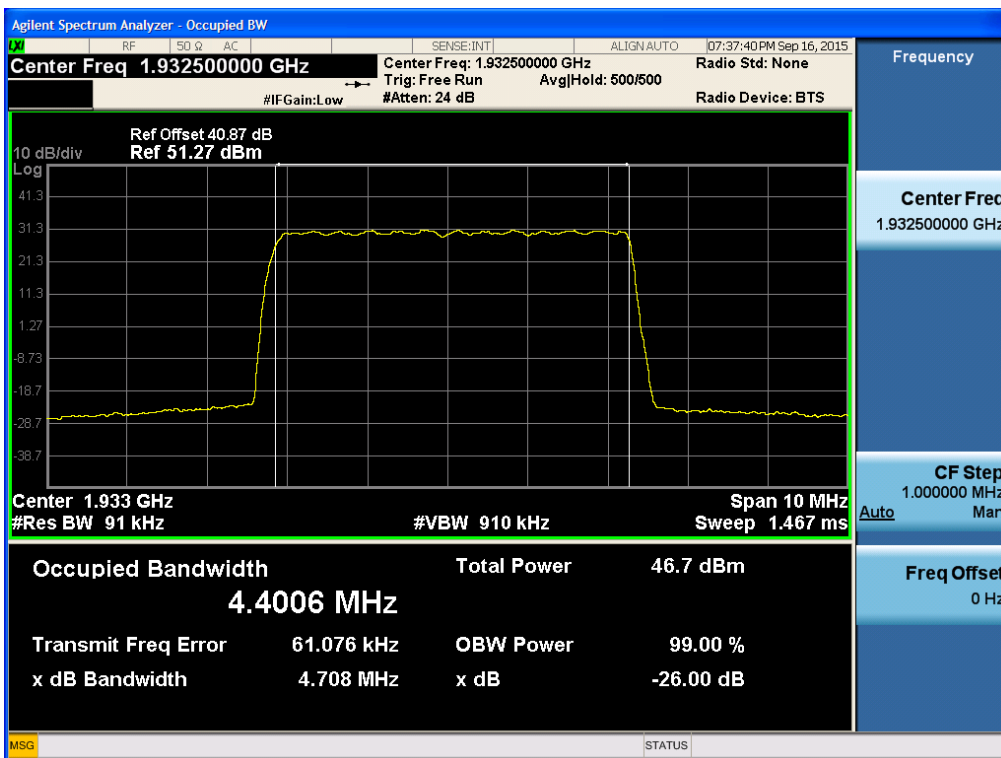
[AGC threshold Downlink Input WCDMA Middle]



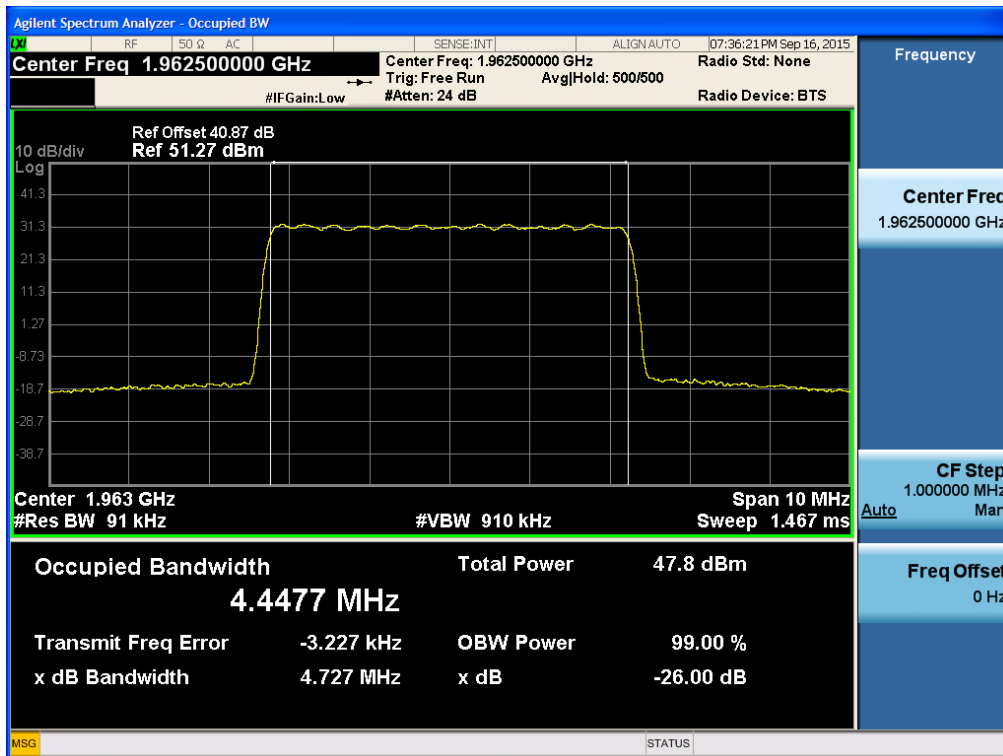
[AGC threshold Downlink Input WCDMA High]



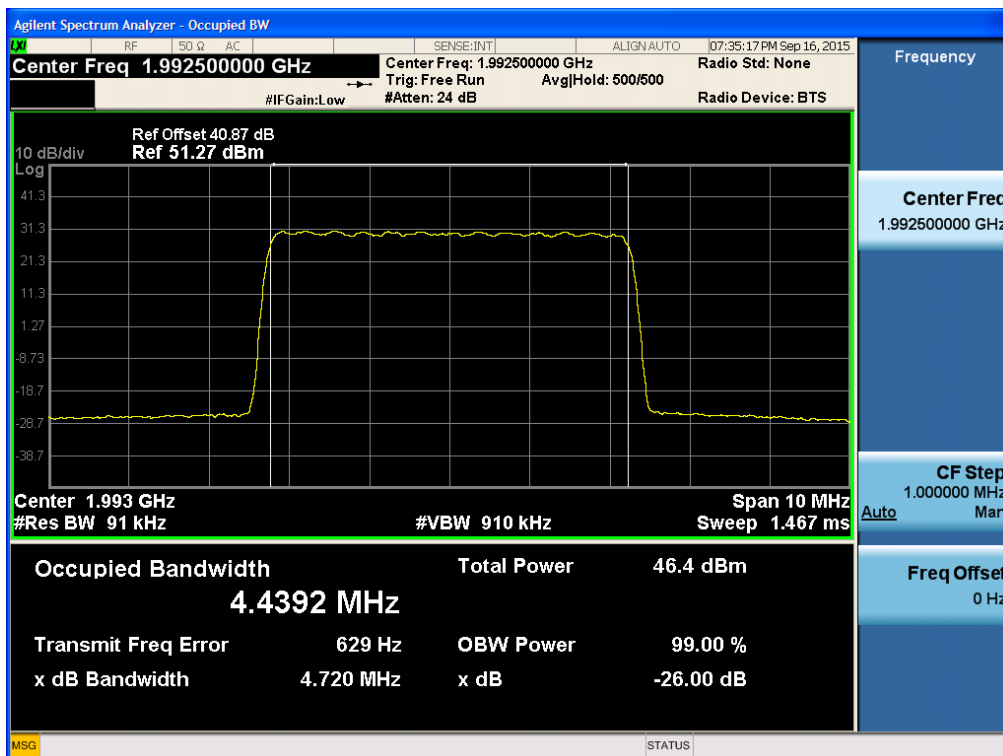
[+3dB above the AGC threshold Downlink Output LTE 5 MHz Low]



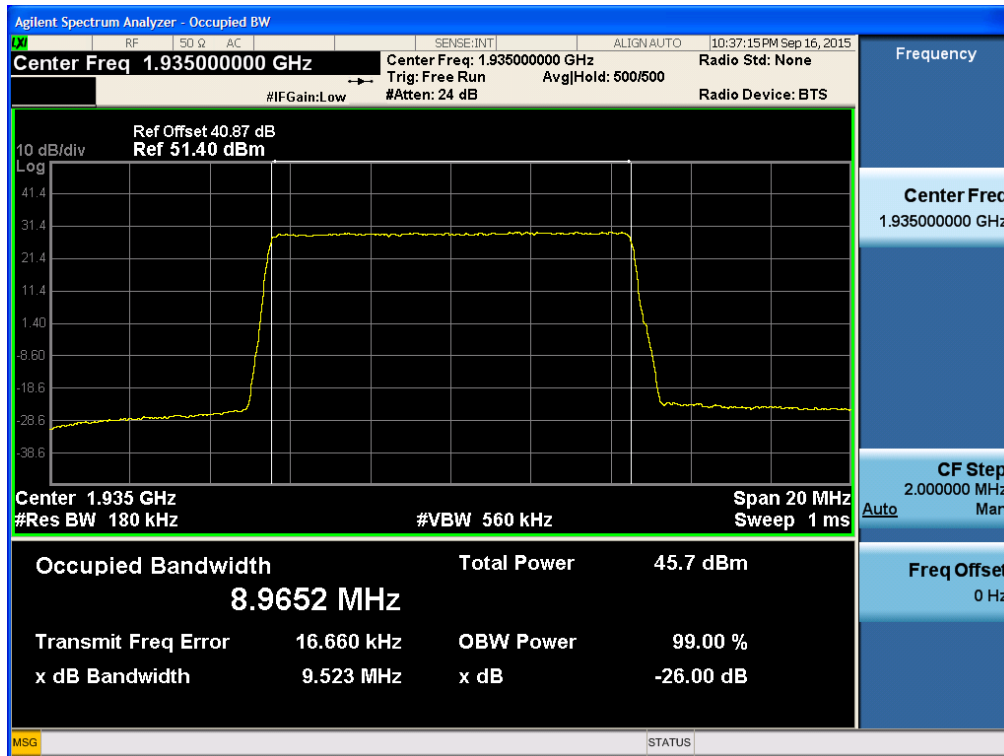
[+3dB above the AGC threshold Downlink Output LTE 5 MHz Middle]



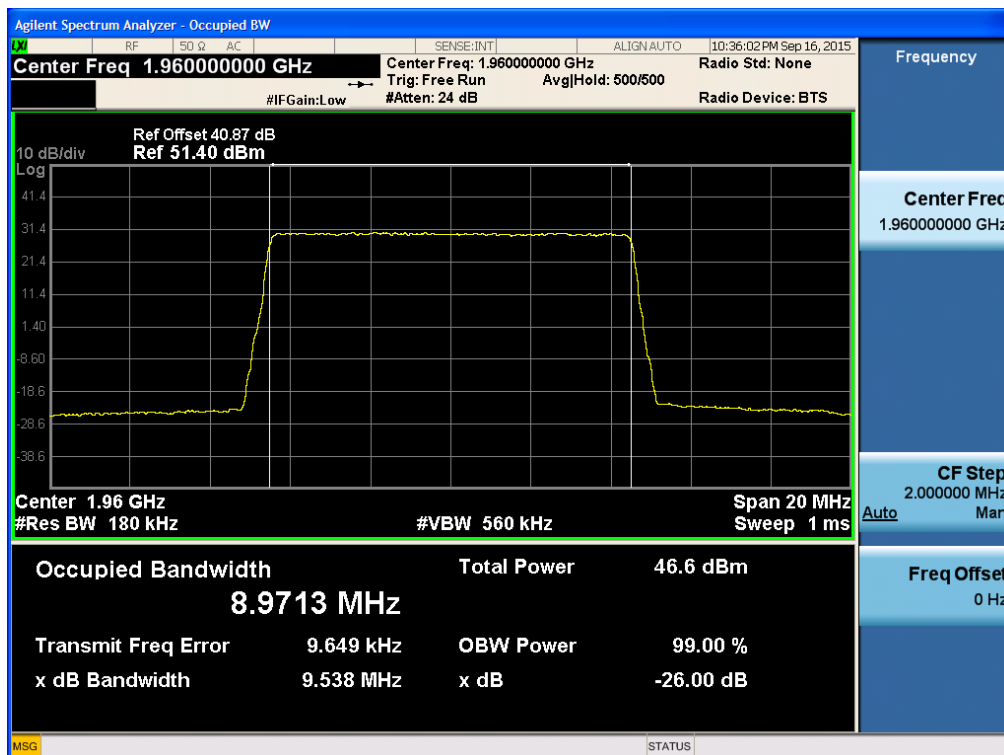
[+3dB above the AGC threshold Downlink Output LTE 5 MHz High]



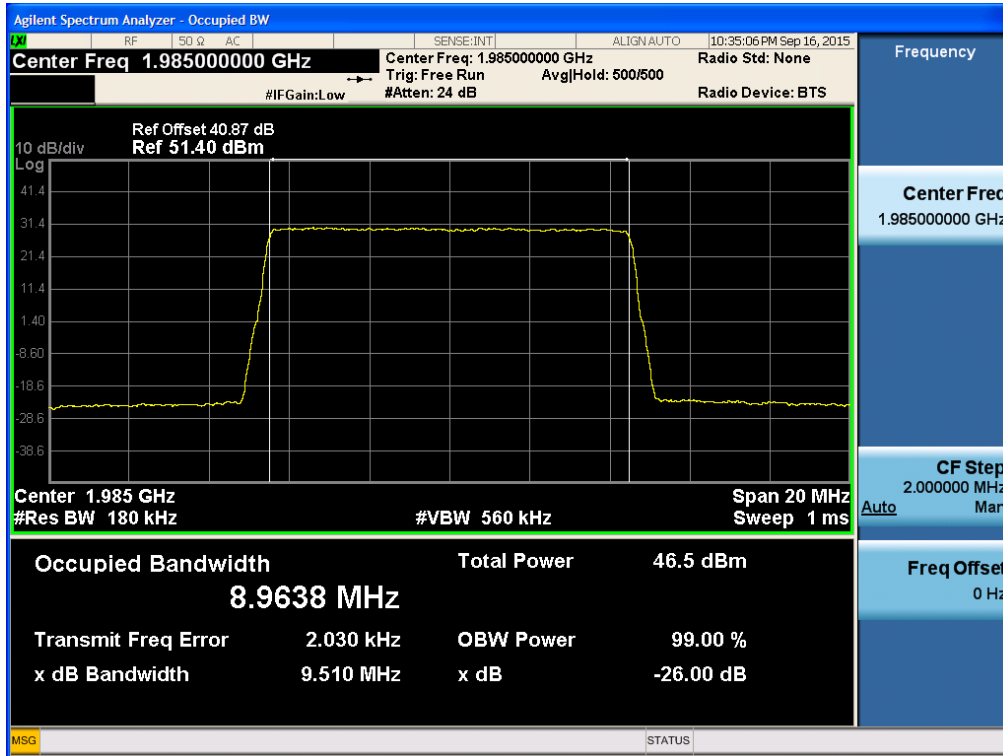
[+3dB above the AGC threshold Downlink Output LTE 10 MHz Low]



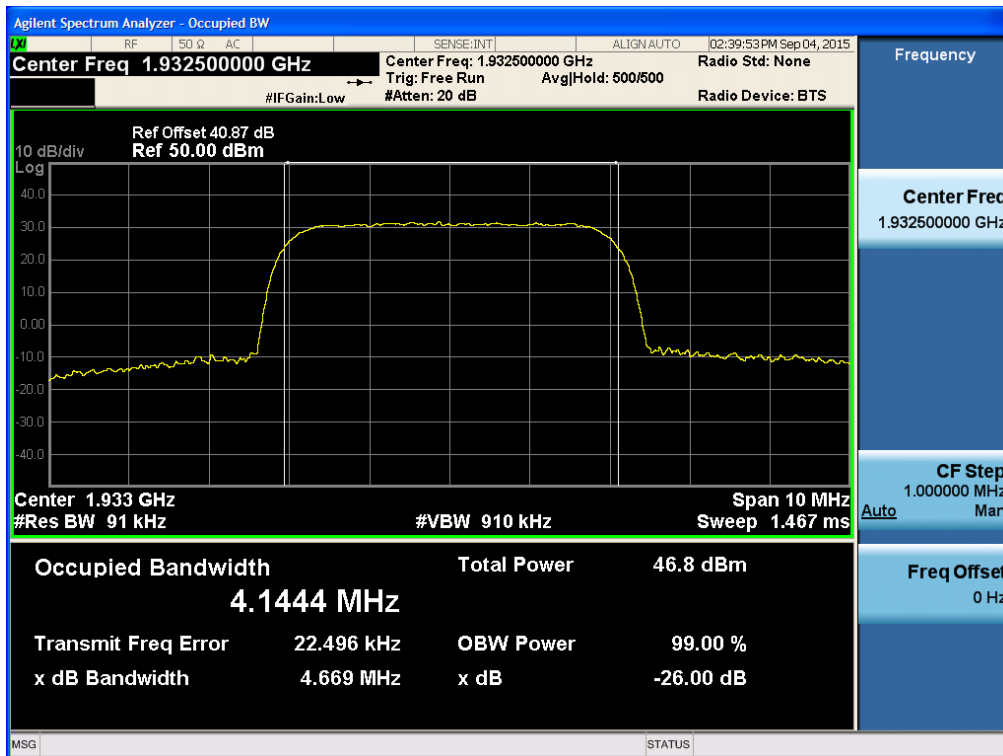
[+3dB above the AGC threshold Downlink Output LTE 10 MHz Middle]



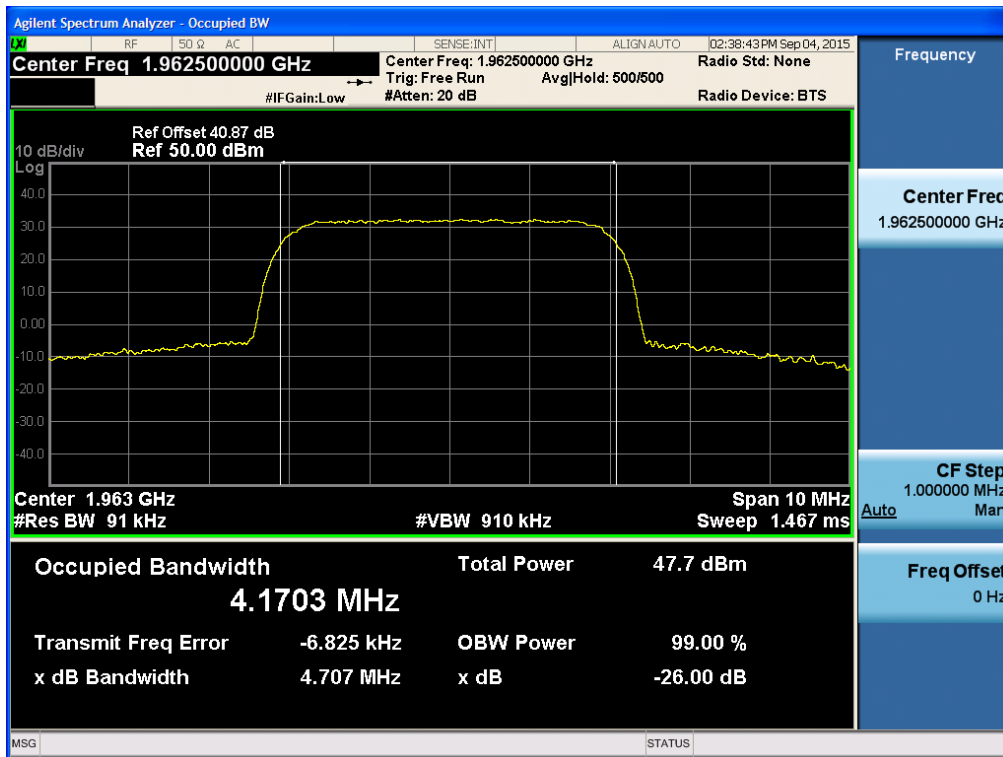
[+3dB above the AGC threshold Downlink Output LTE 10 MHz High]



[+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]

