HCT CO.,LTD.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
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FCC /ISED REPORT

Certification

Applicant Name:
SOLiD, Inc.

Address:
10, 9th Floor, SOLiD Space, Pangyoyeok-ro 220, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-400, South Korea

Date of Issue:
May 19, 2017
Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
Report No.: HCT-R-1705-F010
HCT FRN: 0005866421
ISED Registration No.: 5944A-5

FCC ID:	**W6UHM1900PM**
IC:	**9354A-HM1900PM**
APPLICANT:	**SOLiD, Inc.**

FCC/ IC Model:	MRDU_1900P_M
EUT Type:	ALLIANCE_5W
Frequency Ranges:	1 930 MHz ~1 995 MHz (Downlink)
Conducted Output Power:	5 W (37 dBm)
Date of Test:	May 03, 2017 ~ May 18, 2017
FCC Rule Part(s):	CFR 47 Part 2, Part 24
IC Rules(s):	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 3, January 2017) RSS-133 (Issue 6, January 2013)

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from thisequipment 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 the FCC / IC Rules under normal use and maintenance.

Report prepared by : Kyung Soo Kang
Engineer of Telecommunication testing center

Approved by : Jong Seok Lee
Manager of Telecommunication testing center

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1705-F010	May 19, 2017	- First Approval Report

Table of Contents

1. CLIENT INFORMATION

The EUT has been tested by request of

Company	SOLiD, Inc. 10, 9th Floor, SOLiD Space, Pangyoyeok-ro 220, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-400, South Korea

FCC ID:	W6UHM1900PM
IC:	9354A-HM1900PM
EUT Type:	ALLIANCE_5W
FCC/ IC Model:	MRDU_1900P_M
Power Supply:	AC 110 / 220 V DC -48 V
Frequency Ranges:	1 930 MHz ~1 995 MHz (Downlink)
Conducted Output Power:	5 W (37 dBm)
Antenna Gain(s):	Manufacturer does not provide an antenna.
Measurement standard(s):	ANSI/TIA-603-D-2010, KDB 971168 D01 v02r02, KDB 935210 D05 v01r01, RSS-Gen, RSS-131, RSS-133
FCC Rule Part(s):	CFR Title 47 - Part 2, Part 24
IC Rules Part(s):	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 3, January 2017), RSS-133 (Issue 6, January 2013)
Place of Tests:	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) 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, RSS-Gen, RSS-131, RSS-133.

Description	Reference (FCC)	Reference (IC)	Results
Conducted RF Output Power	§2.1046, §24.232	RSS-133, Section 6.4	Compliant
Occupied Bandwidth	§2.1049	RSS-GEN, Section 6.6	Compliant
Input-versus-output Spectrum	-	RSS-131 Section 5.2.2	Compliant
Out of Band Rejection & Mean Output Power and Zone Enhancer Gain	KDB 935210 D05 v01r01	RSS-131, Section 5.2.1 RSS-131 Section 5.2.3	Compliant
Spurious Emissions at Antenna Terminals	§2.1051, §24.238	RSS-133, Section 6.5	Compliant
Radiated Spurious Emissions	§2.1053, §24.238	RSS-Gen, Section 7.1.2 RSS-133, Section 6.6	Compliant
Frequency Stability	§2.1055, §27.235	RSS-131, Section 5.2.4 RSS-133, Section 6.3	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.

* Note: This EUT is supported power supply both of AC and DC. Test results are only attached worst cases.

3.3. MAXIMUM MEASUREMENTUNCERTAINTY

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
Input-versus-output Spectrum		
Out of Band Rejection & Mean Output Power and Zone Enhancer Gain	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Transmitter unwanted emissions	-	± 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	N5182A /Signal Generator	03/29/2017	Annual	MY50141649
Agilent	N5182A /Signal Generator	01/23/2017	Annual	MY47070406
Agilent	N9020A / Spectrum Analyzer	07/04/2016	Annual	MY49100925
Weinschel	67-30-33 / Fixed Attenuator	02/09/2017	Annual	CC7264
Weinschel	2-10 / 10 dB Attenuator	02/22/2017	Annual	BR0554
Agilent	11636A / Power Divider	08/12/2016	Annual	09109
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/05/2017	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	04/06/2017	Biennial	760
Schwarzbeck	BBHA 9120D / Horn Antenna	12/11/2015	Biennial	9120D-1191
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	09/03/2015	Biennial	BBHA9170541
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	WHKX10-2700-3000-18000-40SS / High Pass Filter	08/11/2016	Annual	4
CERNEX	CBLU1183540 / Power Amplifier	01/25/2017	Annual	24614
CERNEX	CBL06185030 / Power Amplifier	01/25/2017	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.

Table 1—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth of 1 MHz or Less

HAAT in meters	Maximum EIRP watts
≤300	1640

≤500	1070
≤1000	490
≤1500	270
≤2000	160

Table 2—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth Greater Than 1 MHz

HAAT in meters	Maximum EIRP watts/MHz
≤300	1640
≤500	1070
≤1000	490
≤1500	270
≤2000	160

(b)(1) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth of 1 MHz or less are limited to 3280 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(2) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth greater than 1 MHz are limited to 3280 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; *see* Tables 3 and 4 of this section.

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

(5) Operation under this paragraph (b) at power limits greater than permitted under paragraph (a) of this section must be coordinated in advance with all broadband PCS licensees authorized to operate on adjacent frequency blocks within 120 kilometers (75 miles) of the base station and is limited to base stations located more than 120 kilometers (75 miles) from the Canadian border and more than 75 kilometers (45 miles) from the Mexican border.

Table 3—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth of 1 MHz or Less

HAAT in meters	Maximum EIRP watts
≤300	3280
≤500	2140

≤1000	980
≤1500	540
≤2000	320

Table 4—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth Greater Than 1 MHz

HAAT in meters	Maximum EIRP watts/MHz
≤300	3280
≤500	2140
≤1000	980
≤1500	540
≤2000	320

(c) Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

(d) Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(e) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, *etc.*, so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

Note to §24.232: Height above average terrain (HAAT) is to be calculated using the method set forth in §24.53 of this part.

IC Rules

Test Requirements:

6. Transmitter and Receiver Standard Specifications

6.4 Transmitter Output Power and Equivalent Isotropically Radiated Power

The equivalent isotropically radiated power (e.i.r.p.) for transmitters shall not exceed the limits given in SRSP-510. Moreover, base station transmitters operating in the band 1930-1995 MHz shall not have output power exceeding 100 watts.

In addition, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

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 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.

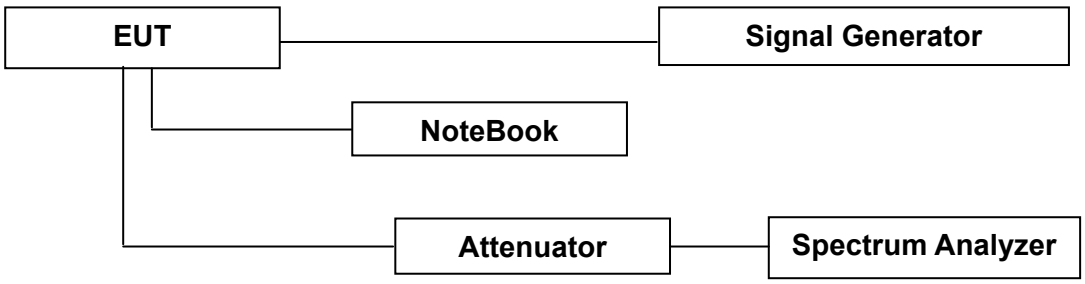
h) Repeat the procedure with the narrowband test signal.

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 D01 v02r02.



Block Diagram 1. RF Power Output Test Setup

Test Results:

Input Signal	Input Level	Maximum Amp Gain
1900 PCS	-14 dBm	51 dB

*Note: Due to EUT's ALC function (Auto Level Control), even if input signal is increased, The same output power is transmit.

[Downlink]

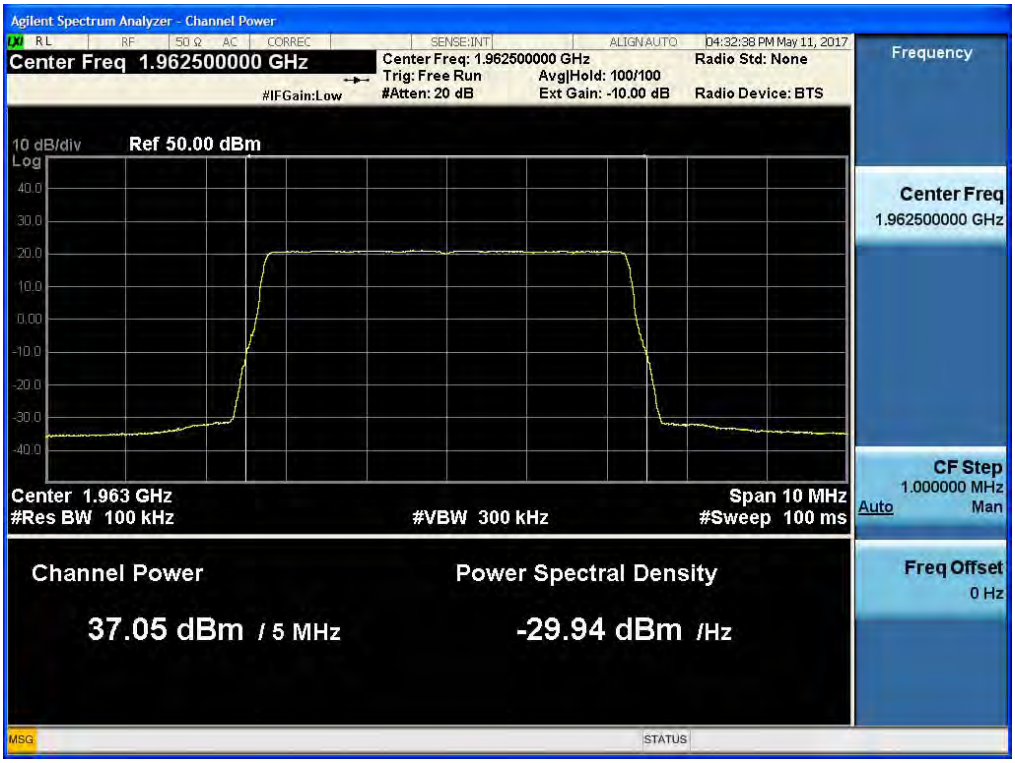
	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
1900 PCS Band _ LTE 5 MHz AGC threshold	Low	1932.50	37.02	5.035
	Middle	1962.50	37.05	5.070
	High	1992.50	37.04	5.058
1900 PCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	1932.50	37.11	5.140
	Middle	1962.50	37.09	5.117
	High	1992.50	36.95	4.955
1900 PCS Band _ LTE 10 MHz AGC threshold	Low	1935.00	37.06	5.082
	Middle	1962.50	37.04	5.058
	High	1990.00	37.07	5.093
1900 PCS Band _ LTE 10 MHz +3dBm above the AGC threshold	Low	1935.00	36.99	5.000
	Middle	1962.50	37.07	5.093
	High	1990.00	36.97	4.977
1900 PCS Band _ LTE 20 MHz AGC threshold	Low	1940.00	37.00	5.012
	Middle	1962.50	37.07	5.093
	High	1985.00	36.88	4.875
1900 PCS Band _ LTE 20 MHz +3dBm above the AGC threshold	Low	1940.00	37.03	5.047
	Middle	1962.50	37.06	5.082
	High	1985.00	37.05	5.070

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
1900 PCS Band _ WCDMA AGC threshold	Low	1932.50	37.14	5.176
	Middle	1962.50	37.05	5.070
	High	1992.50	36.99	5.000
1900 PCS Band _ WCDMA +3dBm above the AGC threshold	Low	1932.50	37.09	5.117
	Middle	1962.50	37.10	5.129
	High	1992.50	36.93	4.932
1900 PCS Band _ CDMA AGC threshold	Low	1931.25	37.03	5.047
	Middle	1962.50	37.00	5.012
	High	1993.75	37.02	5.035
1900 PCS Band _ CDMA +3dBm above the AGC threshold	Low	1931.25	36.98	4.989
	Middle	1962.50	37.00	5.012
	High	1993.75	37.07	5.093
1900 PCS Band _ GSM AGC threshold	Low	1930.20	37.08	5.105
	Middle	1962.50	37.08	5.105
	High	1994.80	37.02	5.035
1900 PCS Band _ GSM +3dBm above the AGC threshold	Low	1930.20	37.10	5.129
	Middle	1962.50	37.22	5.272
	High	1994.80	37.12	5.152

Plots of RF Output Power for 1900 PCS Band LTE 5 MHz

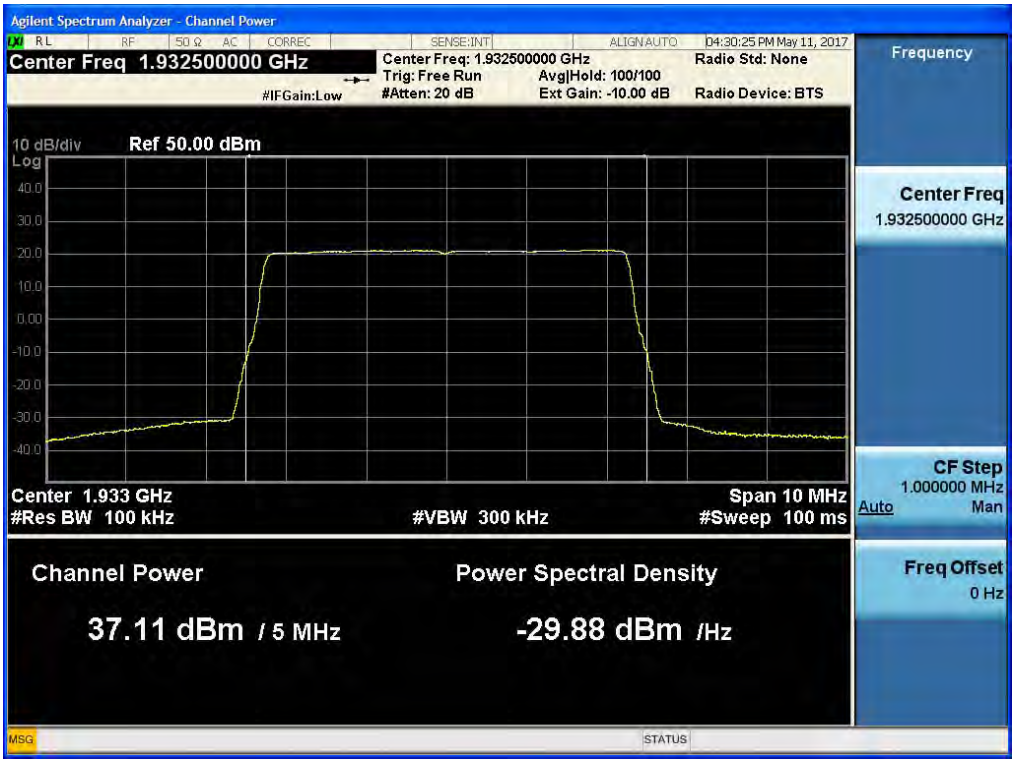
[AGC threshold Downlink Low]

[AGC threshold Downlink Middle]

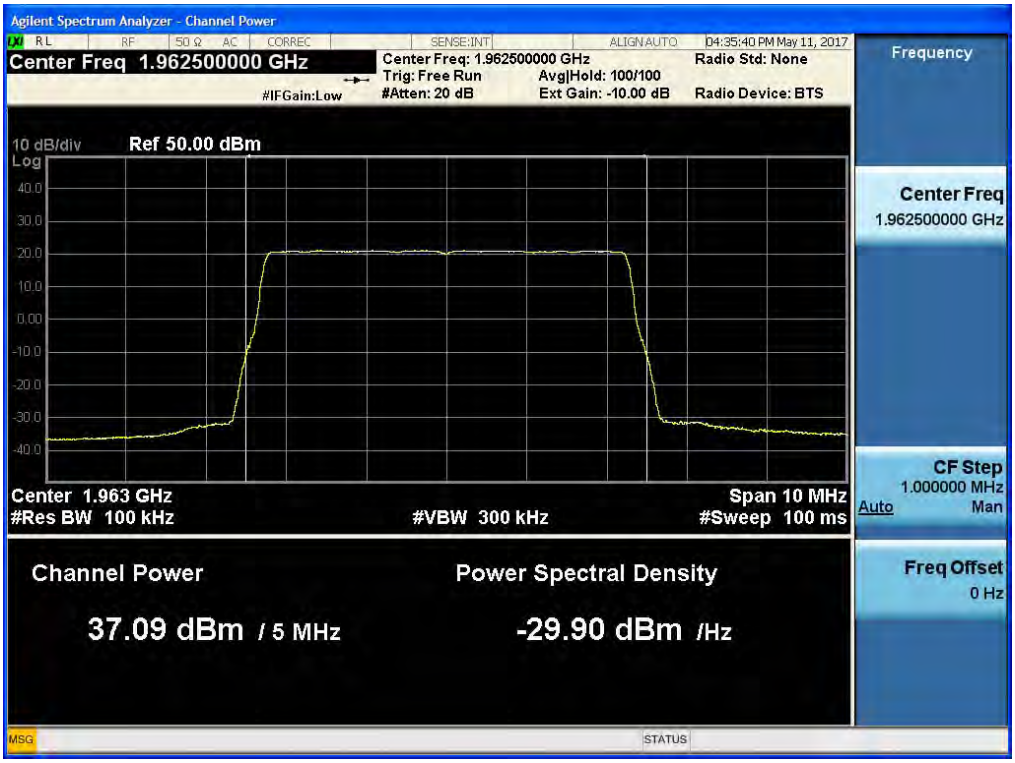


[AGC threshold Downlink High]

[+3dBm above AGC threshold Downlink Low]



[+3dBm above AGC threshold Downlink Middle]



[+3dBm above AGC threshold Downlink High]

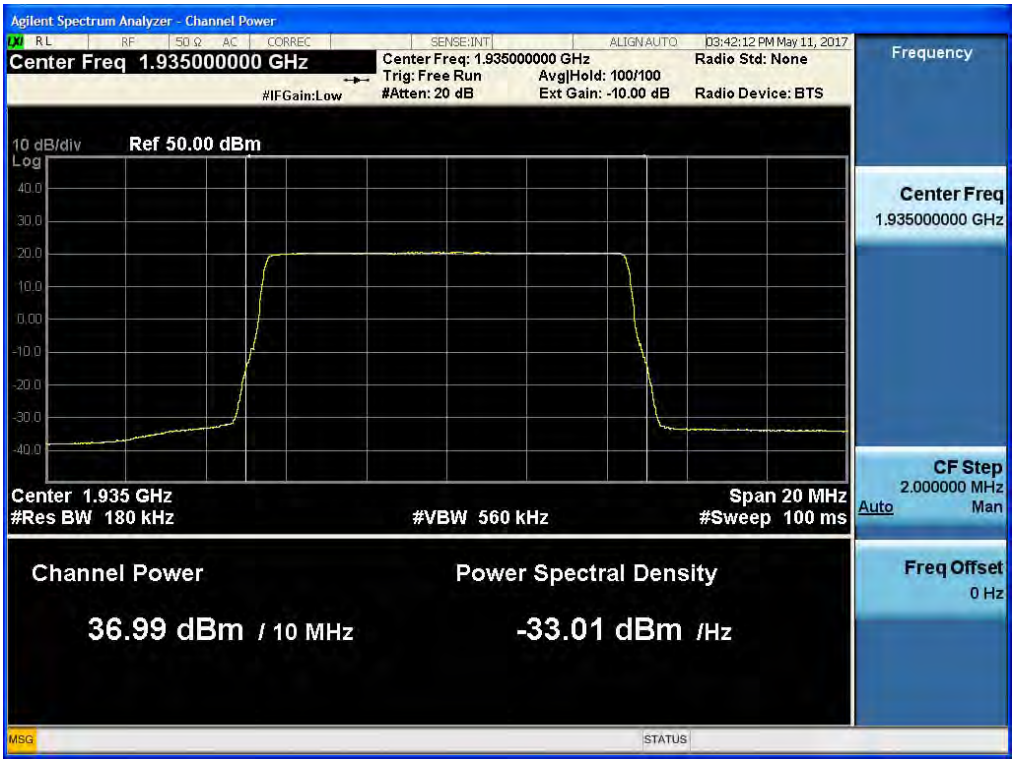
Plots of RF Output Power for 1900 PCS Band LTE 10 MHz

[AGC threshold Downlink Low]

[AGC threshold Downlink Middle]

[AGC threshold Downlink High]

[+3dBm above AGC threshold Downlink Low]



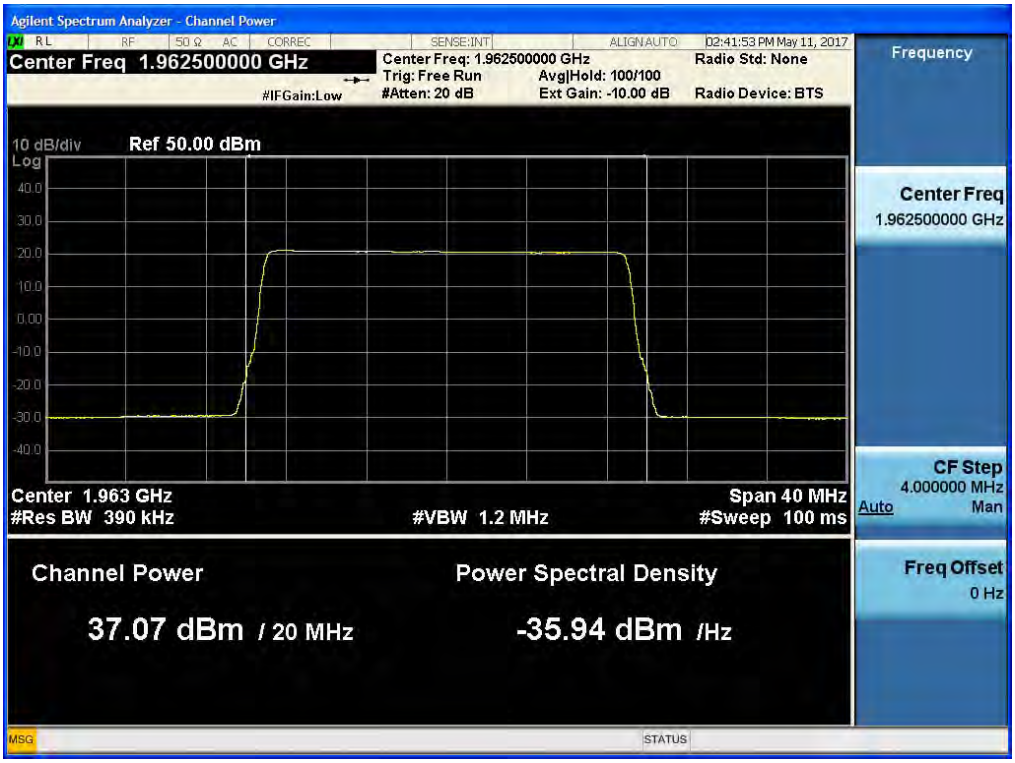
[+3dBm above AGC threshold Downlink Middle]

[+3dBm above AGC threshold Downlink High]

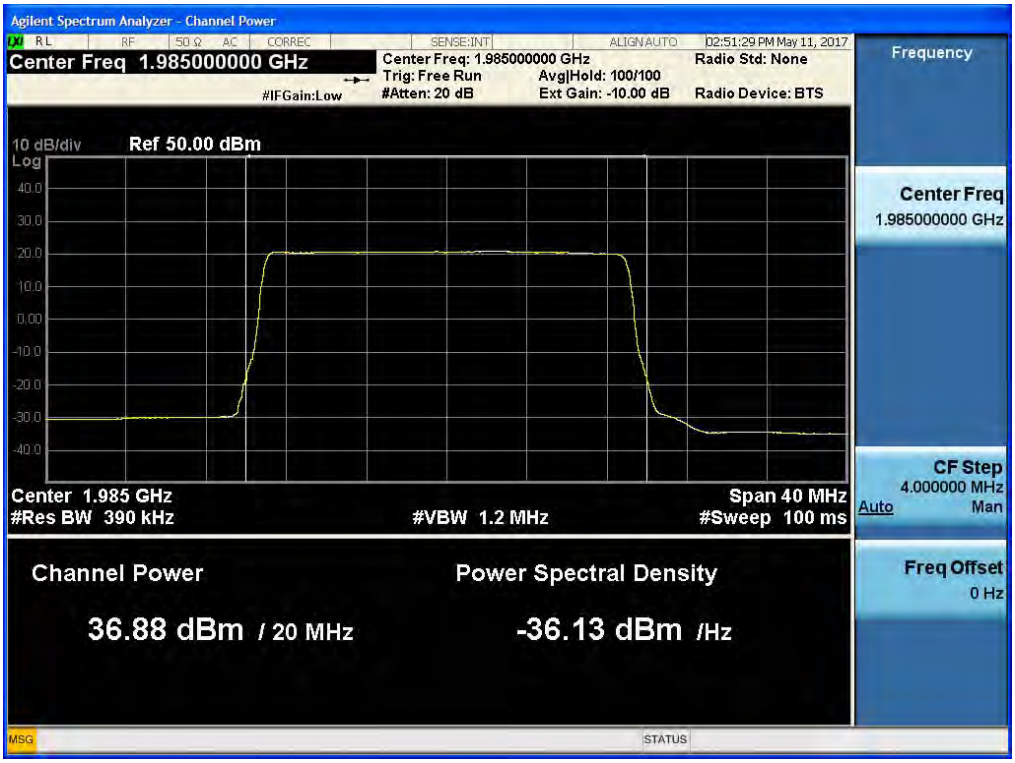
Plots of RF Output Power for 1900 PCS Band LTE 20 MHz

[AGC threshold Downlink Low]

[AGC threshold Downlink Middle]

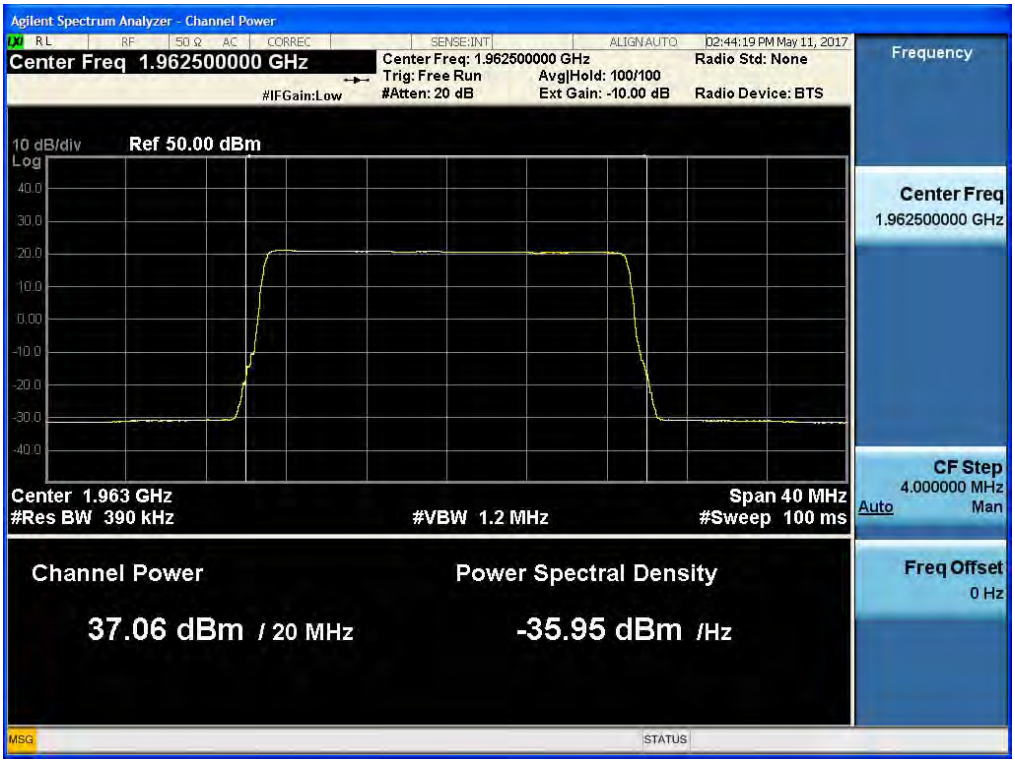


[AGC threshold Downlink High]

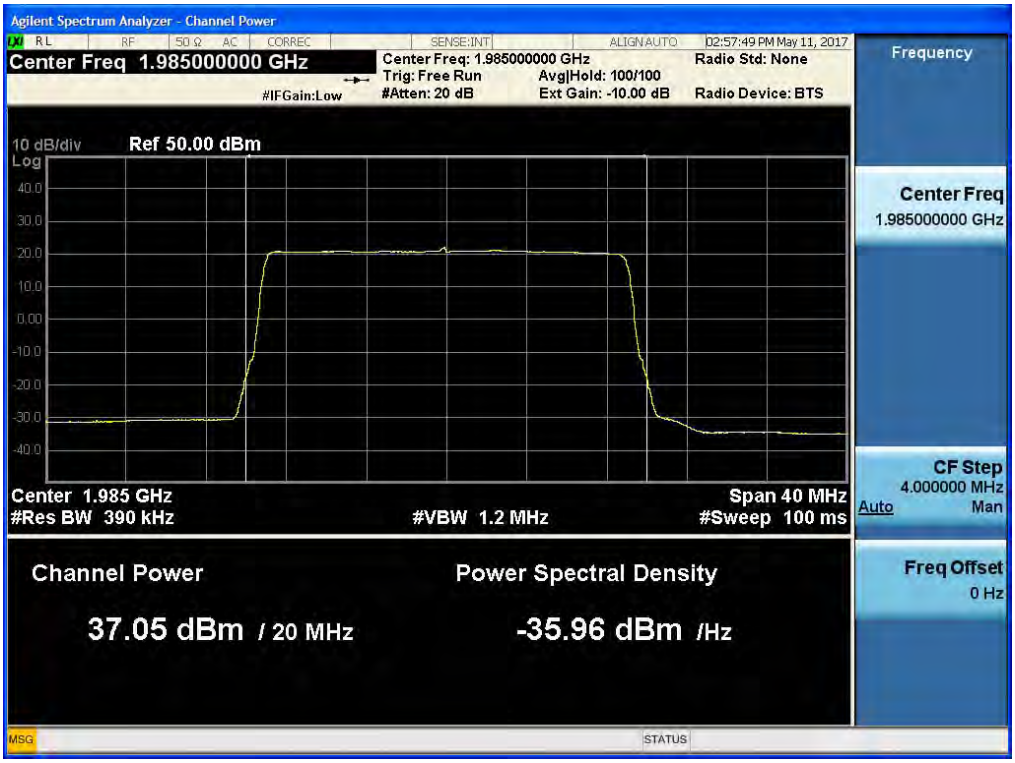


[+3dBm above AGC threshold Downlink Low]

[+3dBm above AGC threshold Downlink Middle]



[+3dBm above AGC threshold Downlink High]



Plots of RF Output Power for 1900 PCS Band WCDMA

[AGC threshold Downlink Low]

[AGC threshold Downlink Middle]

[AGC threshold Downlink High]

[+3dBm above AGC threshold Downlink Low]

[+3dBm above AGC threshold Downlink Middle]

[+3dBm above AGC threshold Downlink High]

Plots of RF Output Power for 1900 PCS Band CDMA

[AGC threshold Downlink Low]

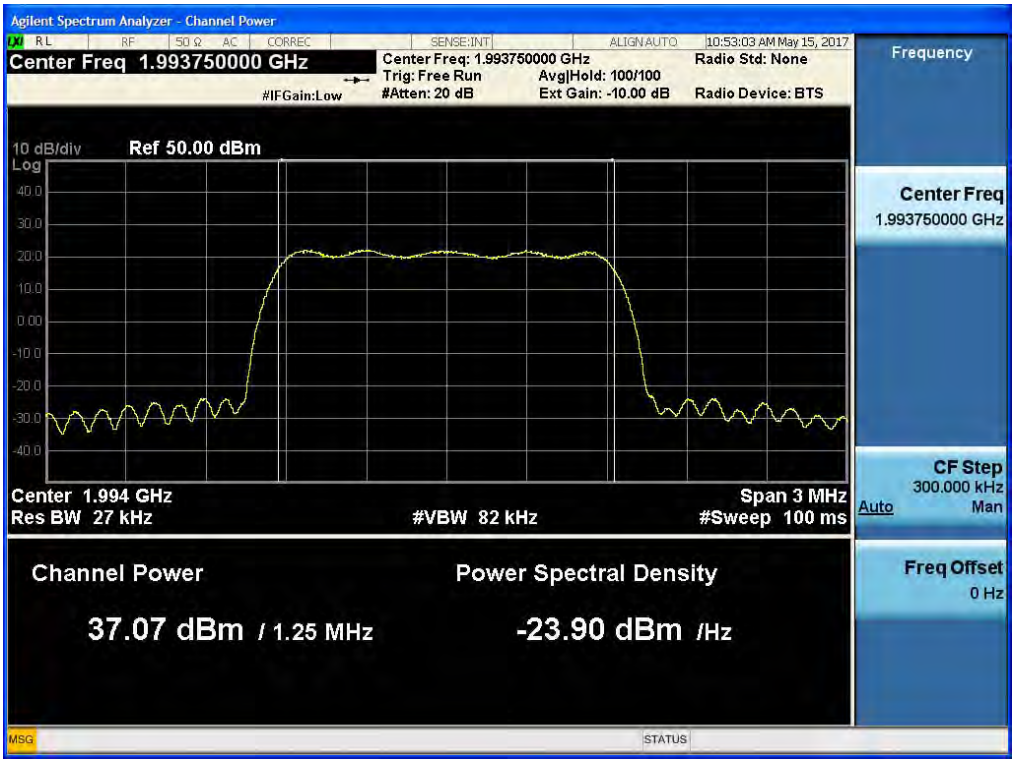
[AGC threshold Downlink Middle]

[AGC threshold Downlink High]

[+3dBm above AGC threshold Downlink Low]

[+3dBm above AGC threshold Downlink Middle]

[+3dBm above AGC threshold Downlink High]



Plots of RF Output Power for 1900 PCS Band GSM

[AGC threshold Downlink Low]

[AGC threshold Downlink Middle]

[AGC threshold Downlink High]

[+3dBm above AGC threshold Downlink Low]

[+3dBm above AGC threshold Downlink Middle]

[+3dBm above AGC threshold Downlink 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.

IC Rules

Test Requirements:

RSS-Gen

6 Technical Requirements

6.6 Occupied Bandwidth

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99 % emission bandwidth, as calculated or measured.

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 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.
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.

RSS-GEN

6 Technical Requirements

6.6 Occupied Bandwidth

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3×RBW.

Note: Video averaging is not permitted.
A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.
The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.
The difference between the two recorded frequencies is the 99% occupied bandwidth.

Test Results:

[Downlink Output]

	Channel	Frequency (MHz)	OBW (MHz)
1900 PCS Band_ LTE 5 MHz AGC threshold	Low	1932.50	4.5093
	Middle	1962.50	4.5144
	High	1992.50	4.4701
1900 PCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	1932.50	4.5082
	Middle	1962.50	4.5073
	High	1992.50	4.4709
1900 PCS Band_ LTE 10 MHz AGC threshold	Low	1935.00	8.9855
	Middle	1962.50	9.0017
	High	1990.00	8.9856
1900 PCS Band_ LTE 10 MHz +3dBm above the AGC threshold	Low	1935.00	8.9800
	Middle	1962.50	9.0015
	High	1990.00	8.9909

	Channel	Frequency (MHz)	OBW (MHz)
1900 PCS Band_ LTE 20 MHz AGC threshold	Low	1940.00	18.016
	Middle	1962.50	18.016
	High	1985.00	17.965
1900 PCS Band_ LTE 20 MHz +3dBm above the AGC threshold	Low	1940.00	18.011
	Middle	1962.50	18.014
	High	1985.00	17.989
1900 PCS Band_ WCDMA AGC threshold	Low	1932.50	4.1689
	Middle	1962.50	4.1797
	High	1992.50	4.1769
1900 PCS Band_ WCDMA +3dBm above the AGC threshold	Low	1932.50	4.1744
	Middle	1962.50	4.1755
	High	1992.50	4.1743

	Channel	Frequency (MHz)	OBW (MHz)
1900 PCS Band_ CDMA AGC threshold	Low	1931.25	1.2744
	Middle	1962.50	1.2770
	High	1993.75	1.2752
1900 PCS Band_ CDMA +3dBm above the AGC threshold	Low	1931.25	1.2734
	Middle	1962.50	1.2735
	High	1993.75	1.2756
	Channel	**Frequency (MHz)**	**OBW (kHz)**
1900 PCS Band_ GSM AGC threshold	Low	1930.20	244.00
	Middle	1962.50	243.47
	High	1994.80	242.14
1900 PCS Band_ GSM +3dBm above the AGC threshold	Low	1930.20	242.94
	Middle	1962.50	243.82
	High	1994.80	244.06

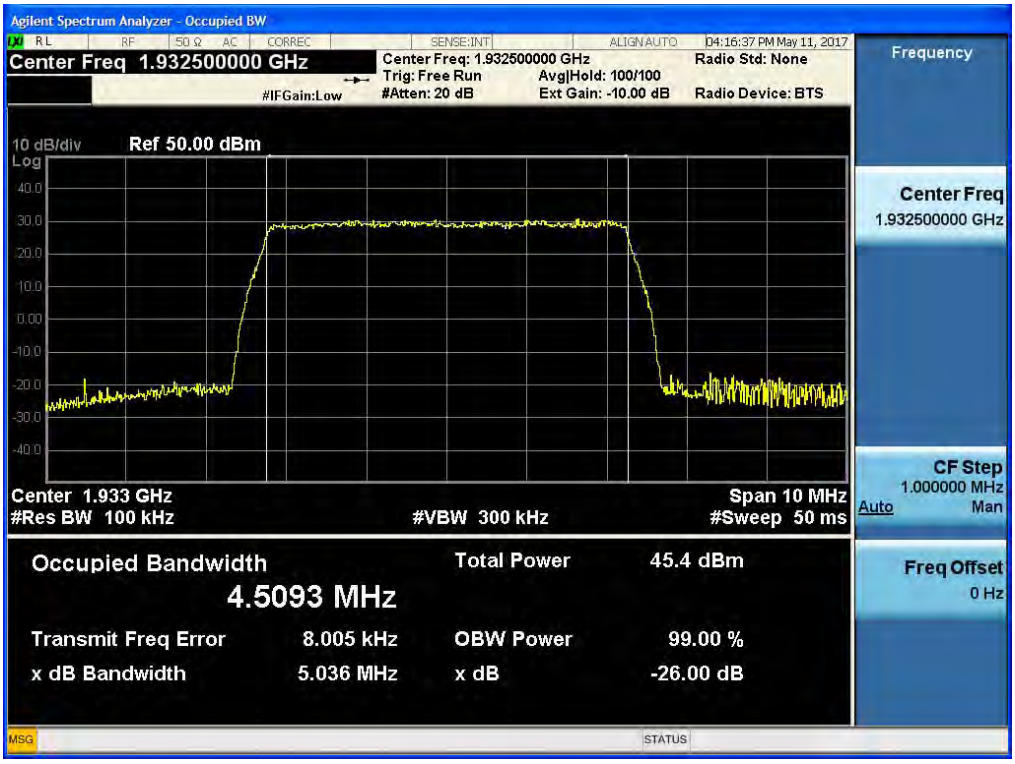
[Downlink Input]

	Channel	Frequency (MHz)	OBW (MHz)
1900 PCS Band_ LTE 5 MHz AGC threshold	Low	1932.50	4.5140
	Middle	1962.50	4.5115
	High	1992.50	4.5112
1900 PCS Band_ LTE 10 MHz AGC threshold	Low	1935.00	9.0008
	Middle	1962.50	9.0018
	High	1990.00	8.9986
1900 PCS Band_ LTE 20 MHz AGC threshold	Low	1940.00	18.007
	Middle	1962.50	18.010
	High	1985.00	18.028
1900 PCS Band_ WCDMA AGC threshold	Low	1932.50	4.1781
	Middle	1962.50	4.1805
	High	1992.50	4.1785

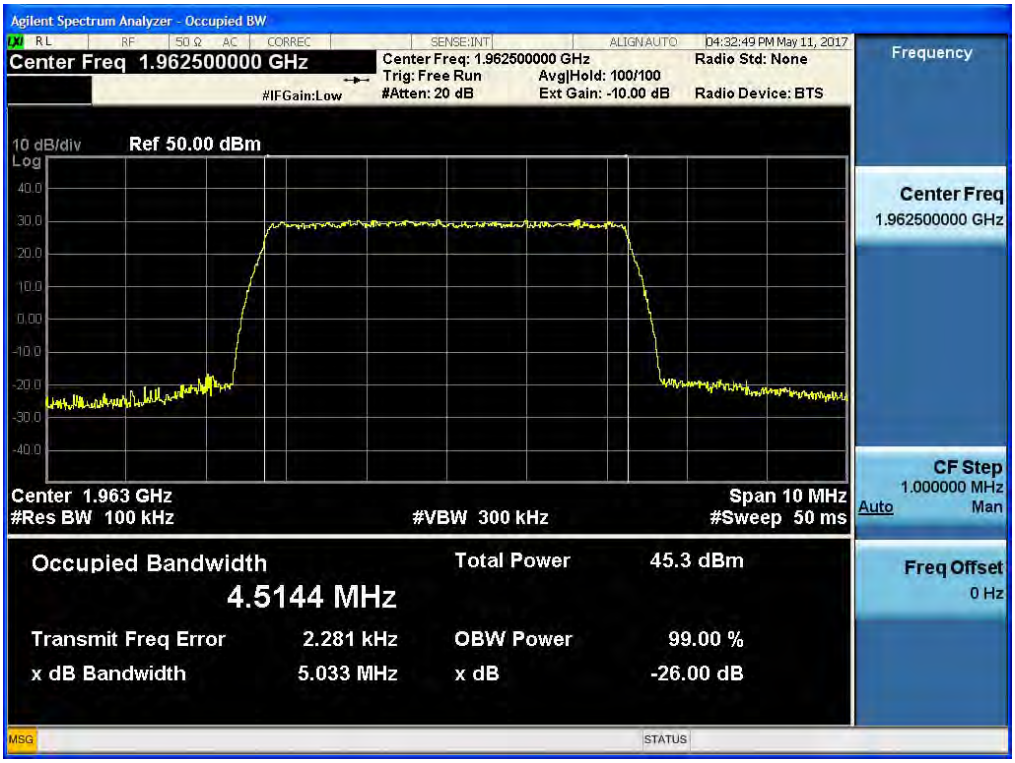
	Channel	Frequency (MHz)	OBW (MHz)
1900 PCS Band_ CDMA AGC threshold	Low	1931.25	1.2410
	Middle	1962.50	1.2444
	High	1993.75	1.2444
	Channel	**Frequency (MHz)**	**OBW (kHz)**
1900 PCS Band_ GSM AGC threshold	Low	1930.20	244.96
	Middle	1962.50	244.77
	High	1994.80	245.41

Plots of Occupied Bandwidth_1900 PCS BAND LTE 5 MHz

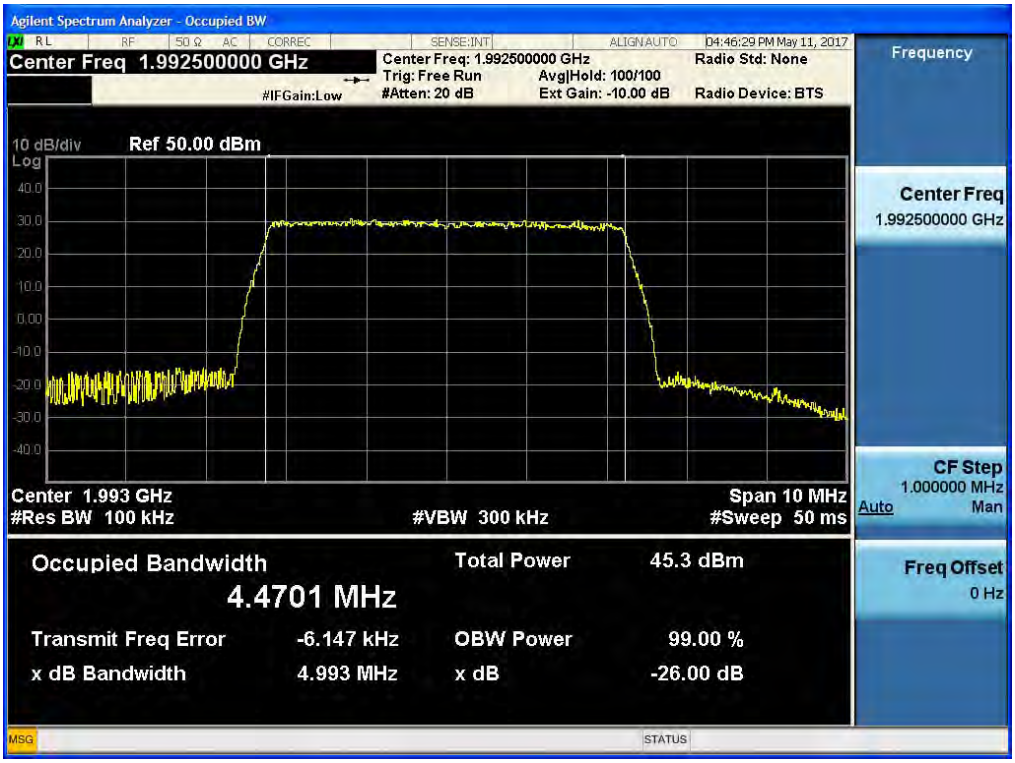
[AGC threshold Output Downlink Low]



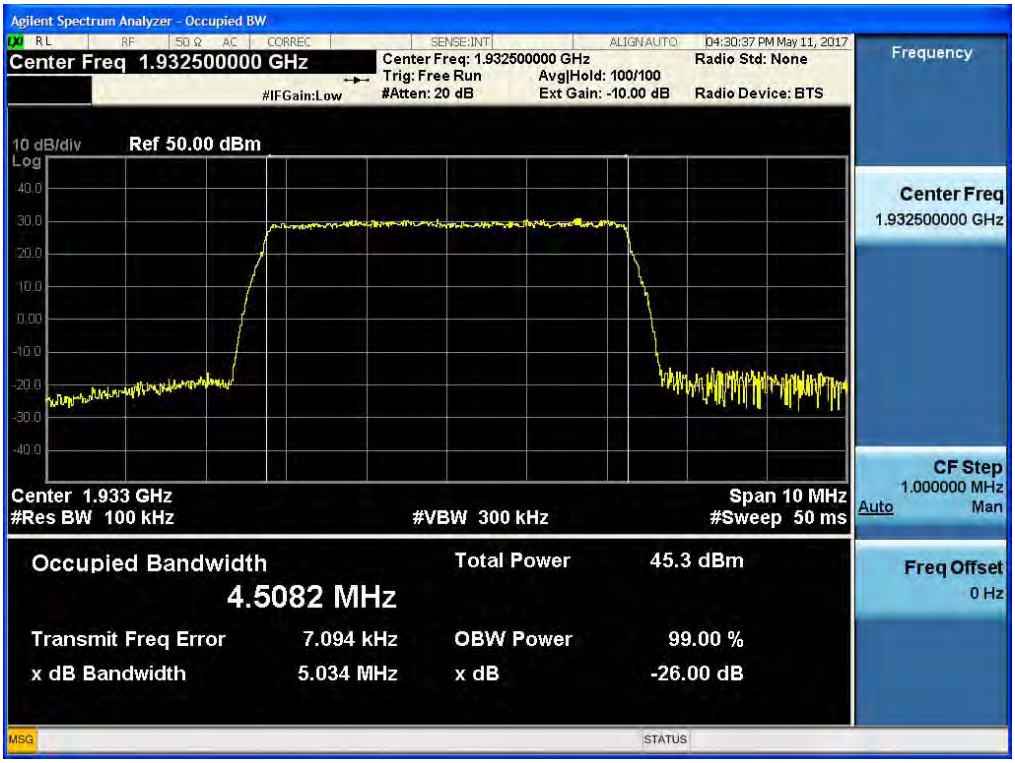
[AGC threshold Output Downlink Middle]



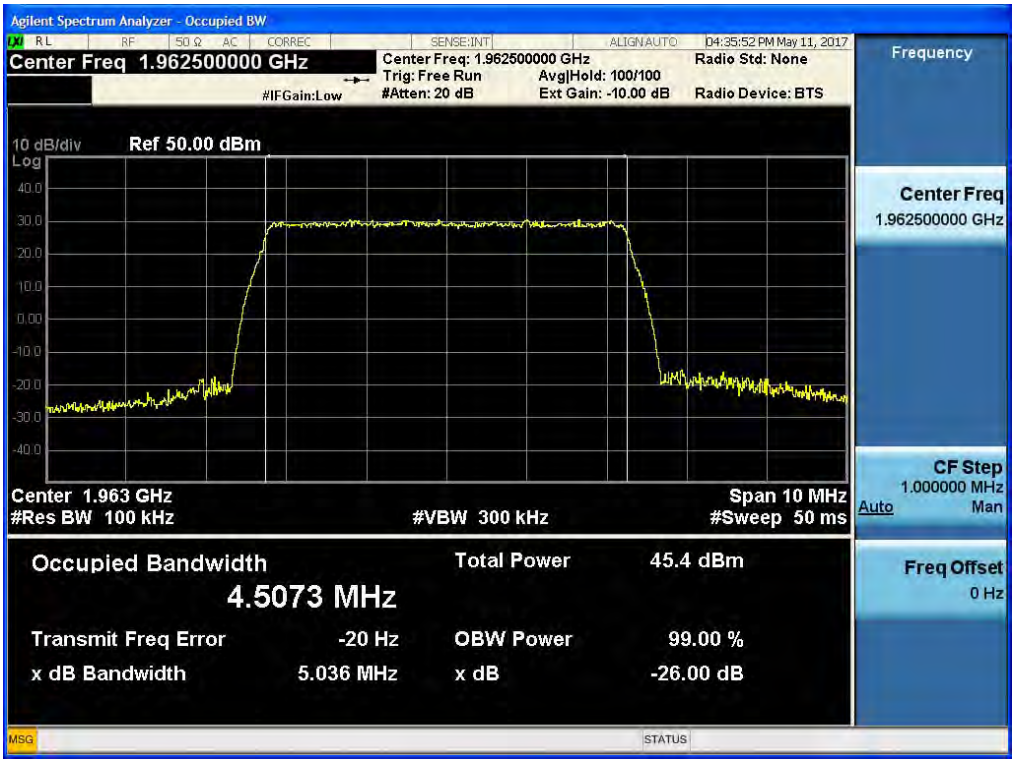
[AGC threshold Output Downlink High]



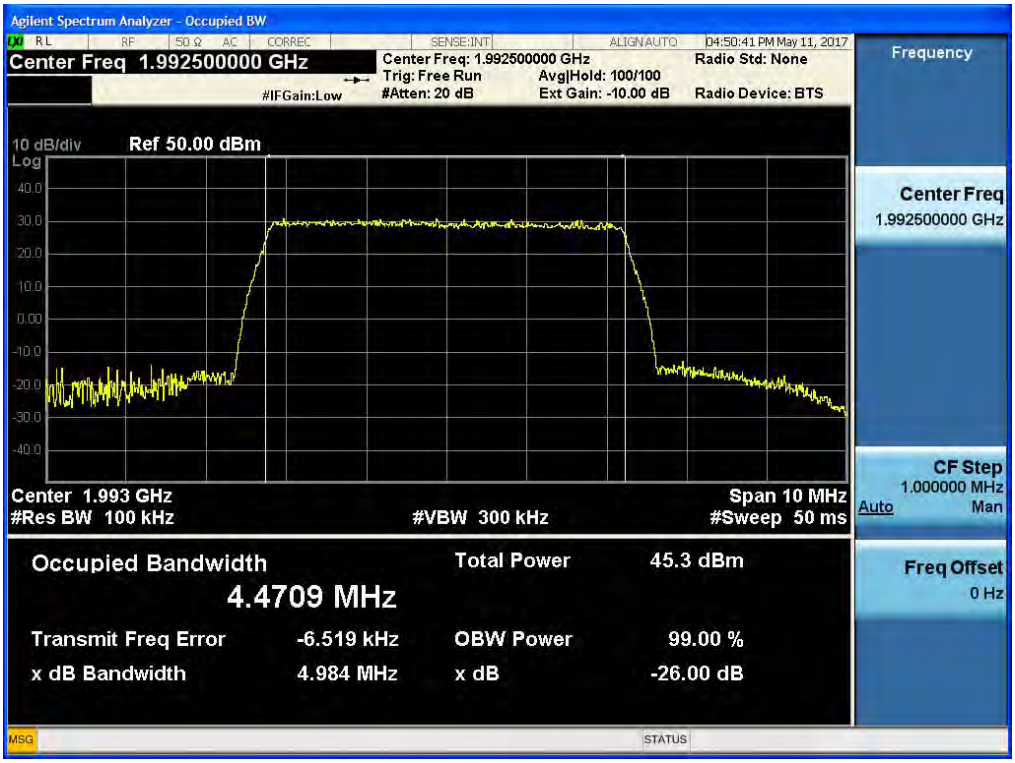
[+3dBmabove AGC threshold Output Downlink Low]



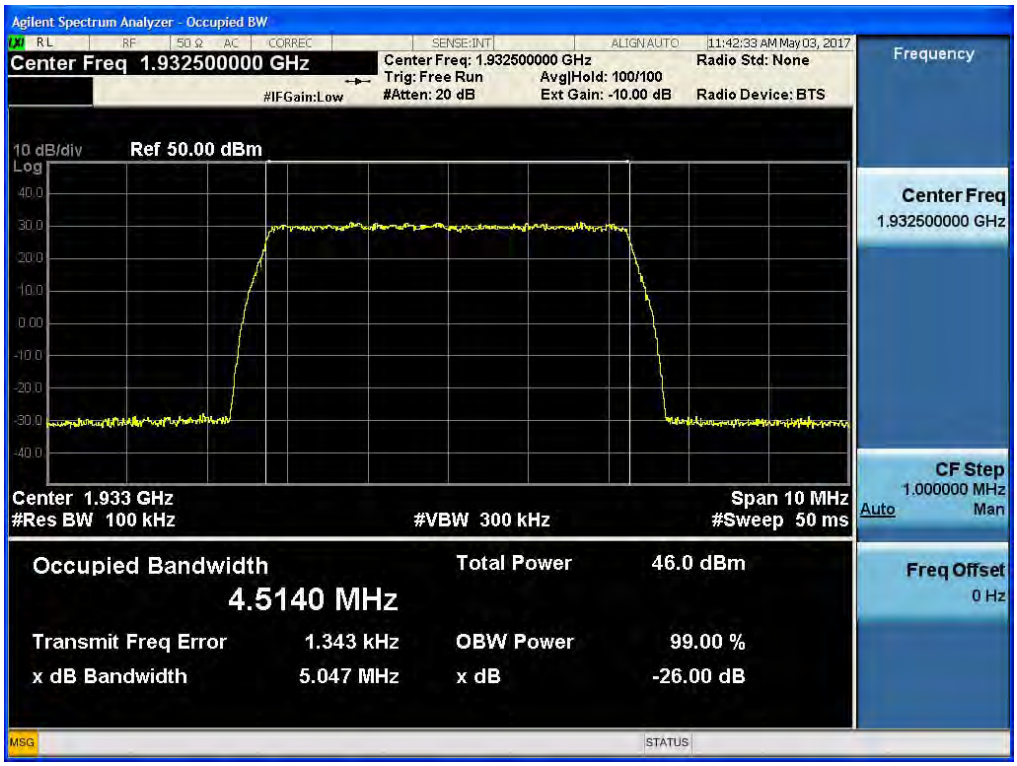
[+3dBm above AGC threshold Output Downlink Middle]



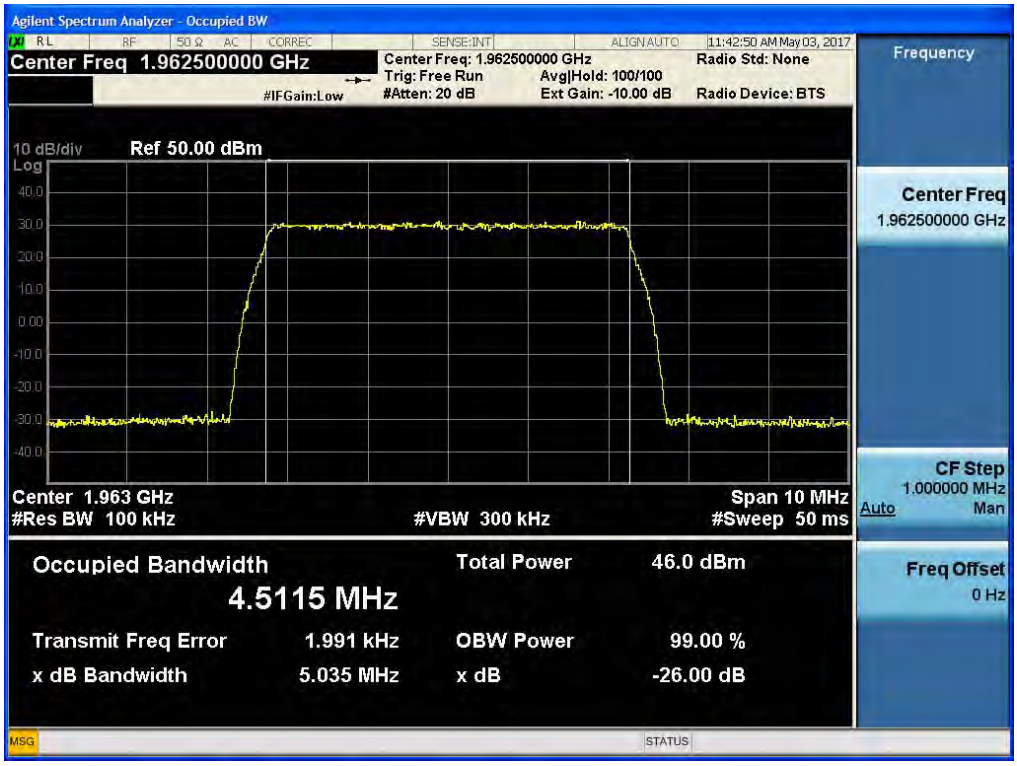
[+3dBm above AGC threshold Output Downlink High]



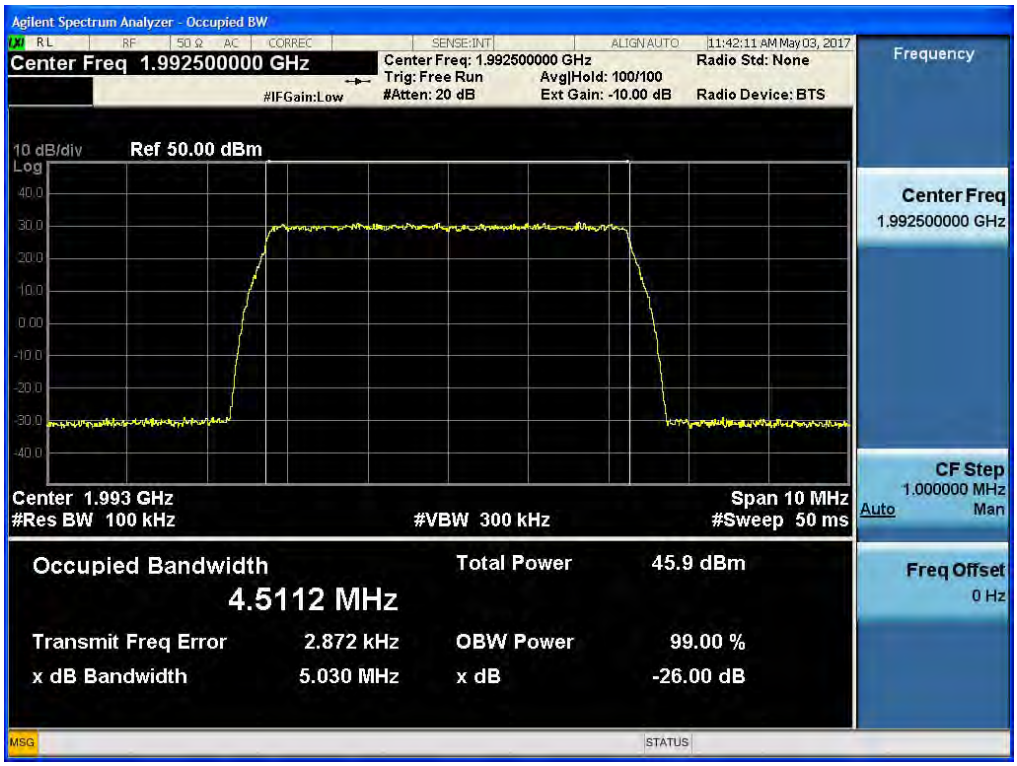
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

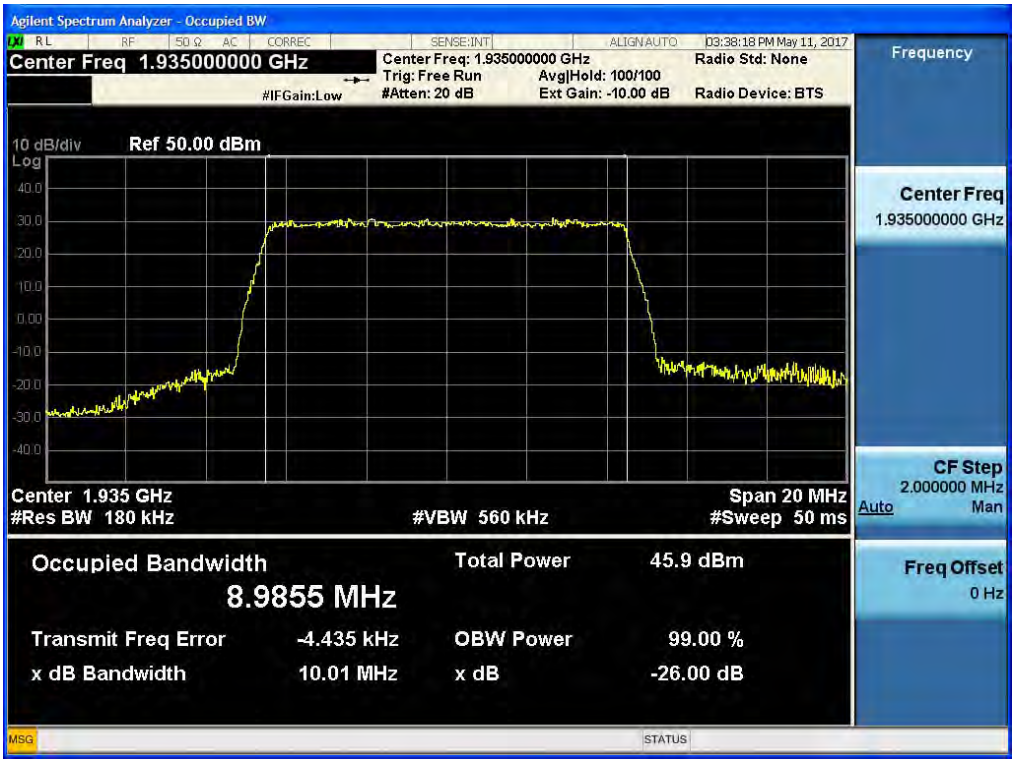


[AGC threshold Input Downlink High]

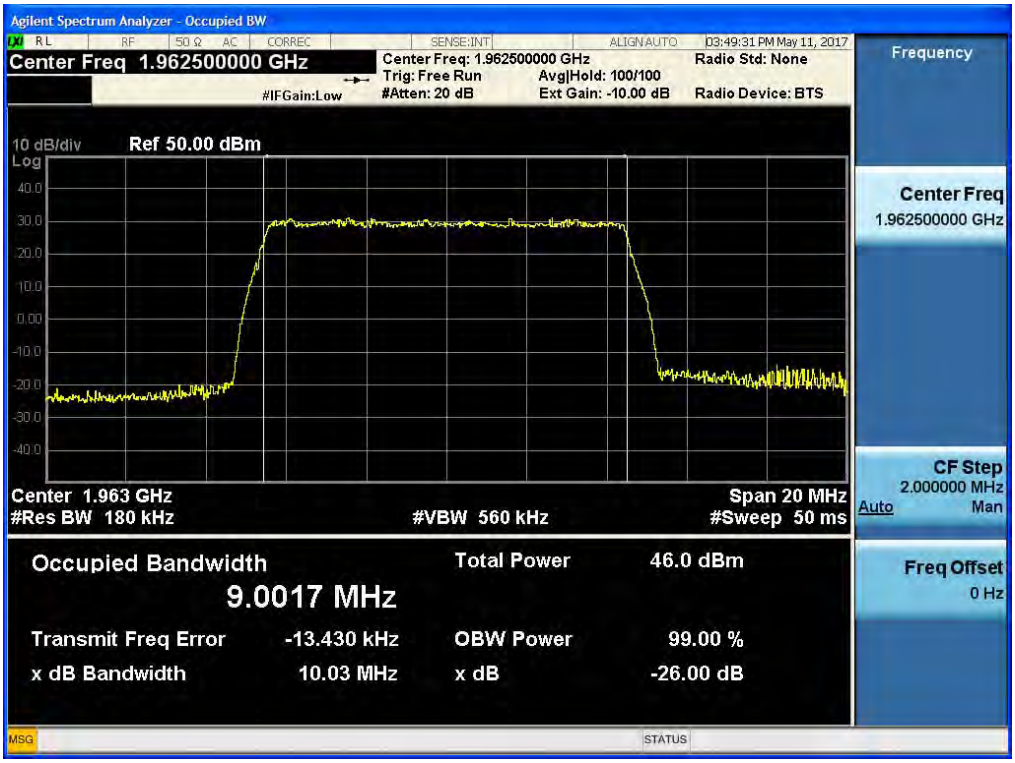


Plots of Occupied Bandwidth_ 1900 PCS BAND LTE 10 MHz

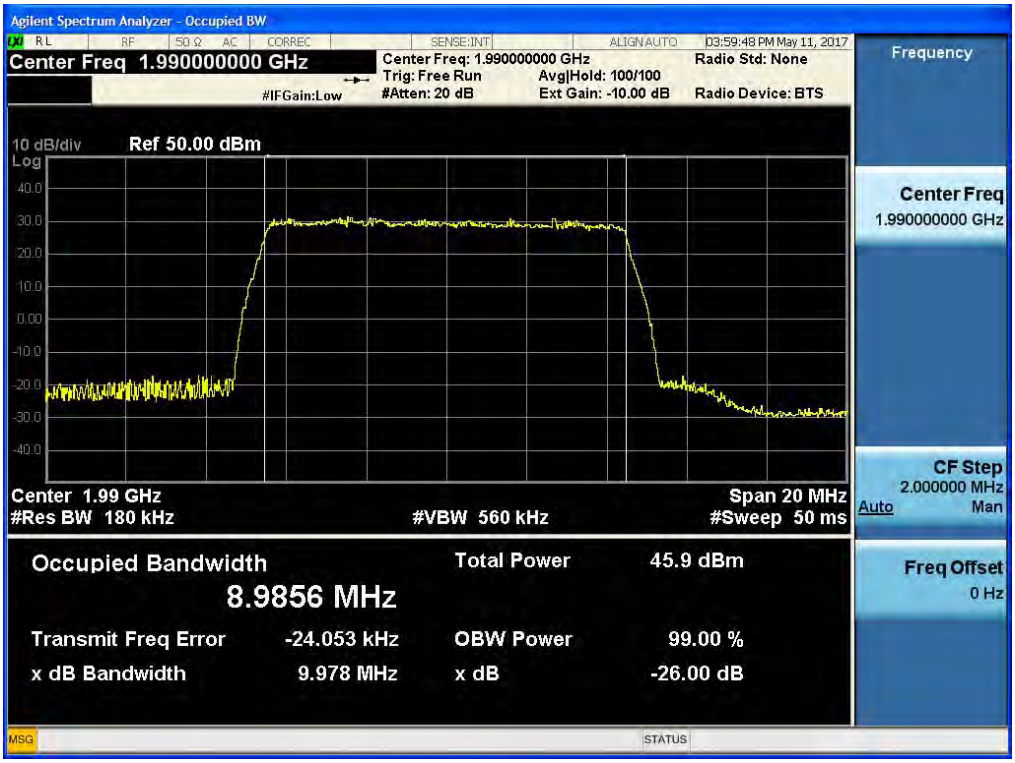
[AGC threshold Output Downlink Low]



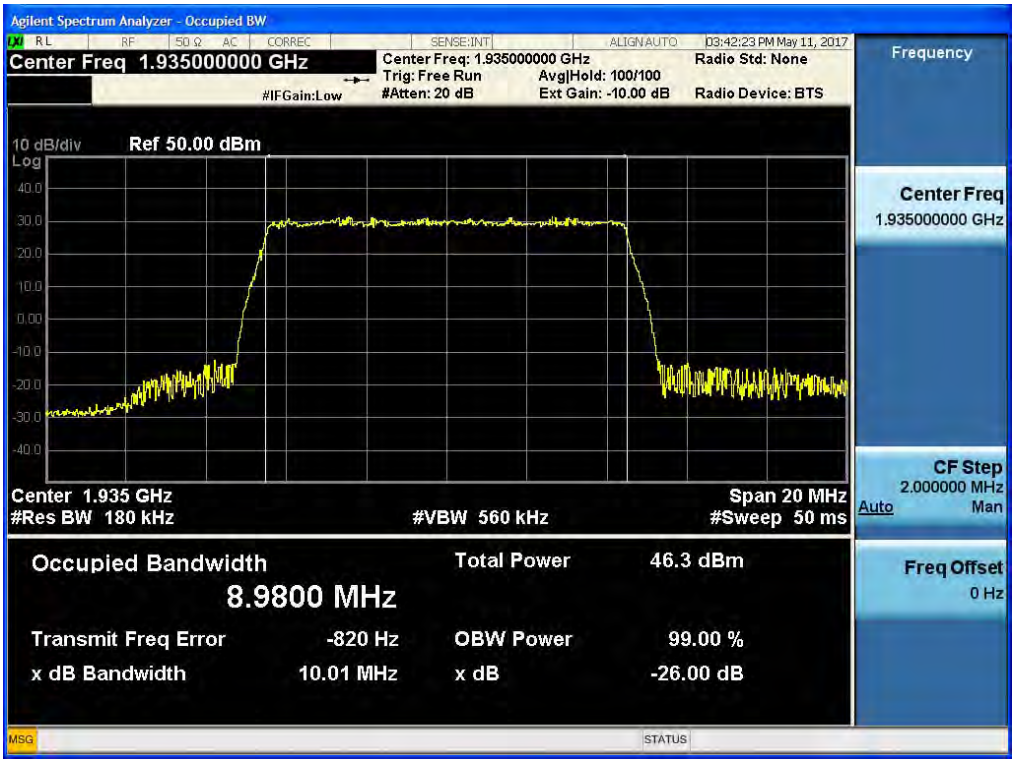
[AGC threshold Output Downlink Middle]



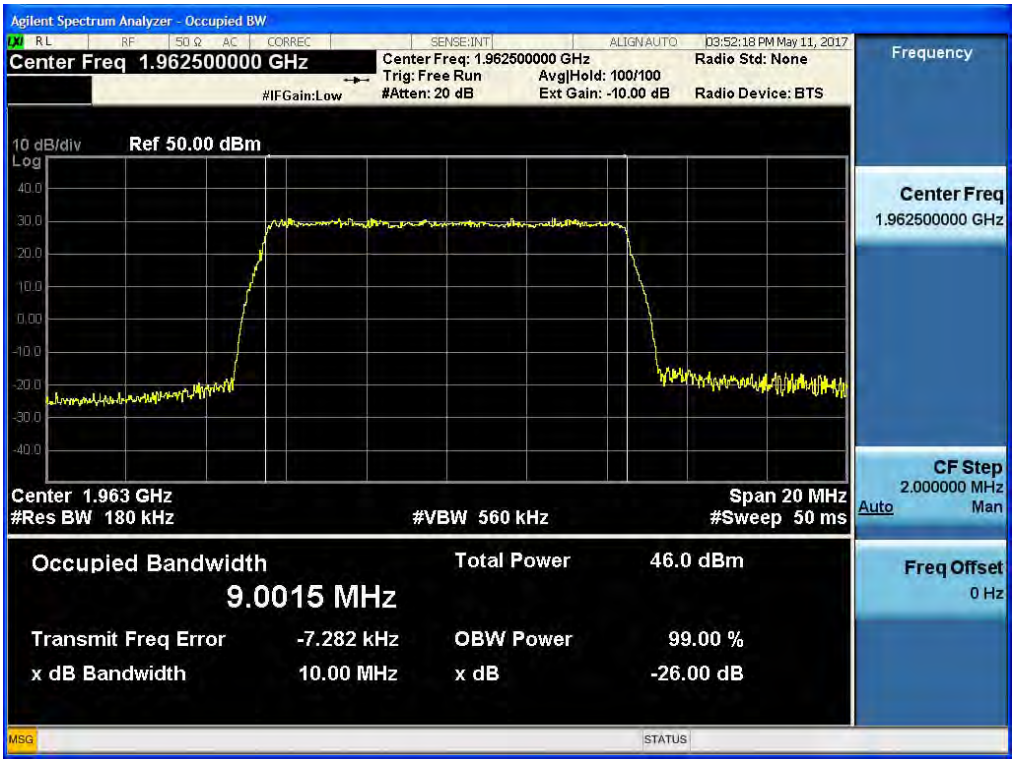
[AGC threshold Output Downlink High]



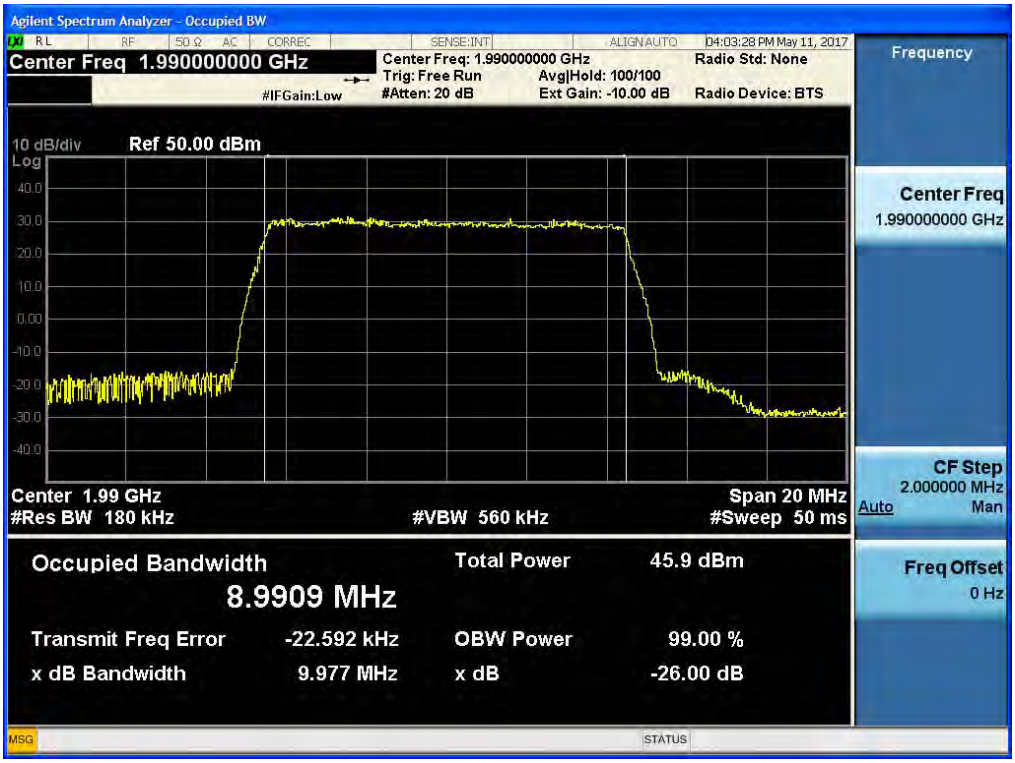
[+3dBmabove AGC threshold Output Downlink Low]



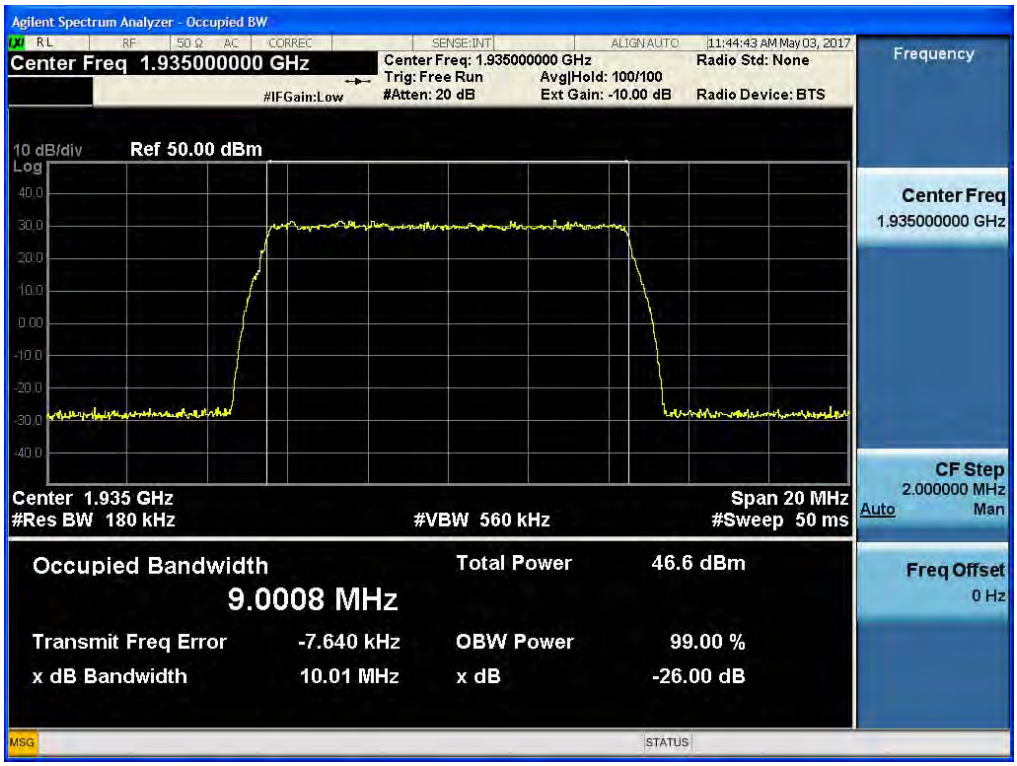
[+3dBm above AGC threshold Output Downlink Middle]



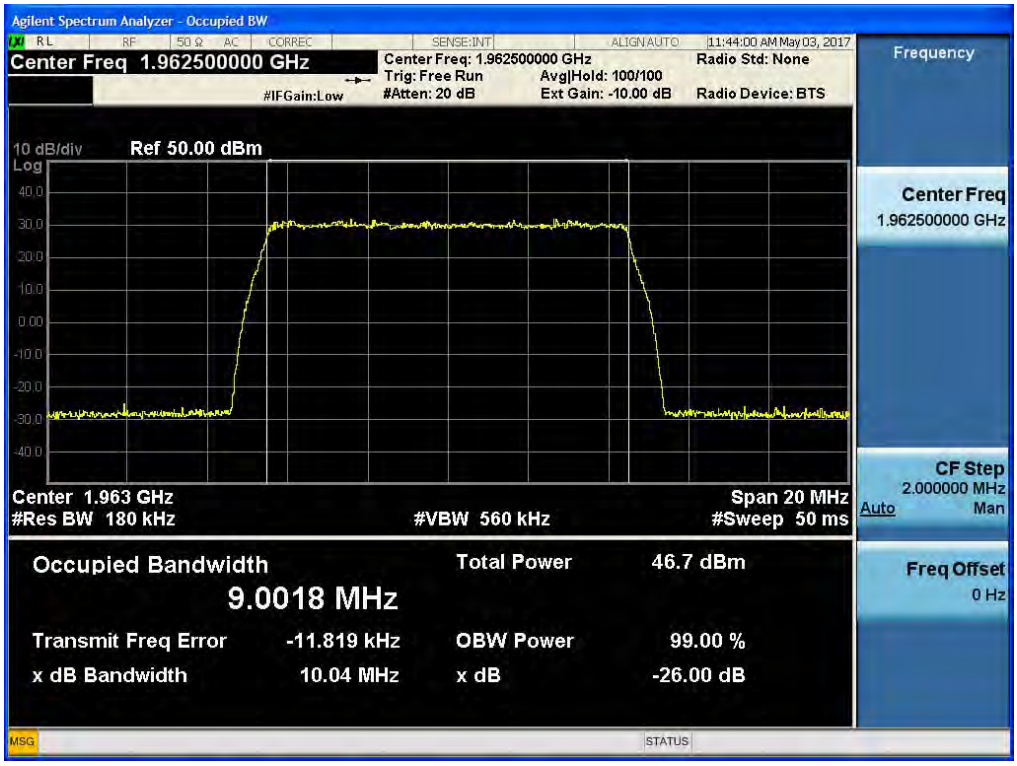
[+3dBm above AGC threshold Output Downlink High]



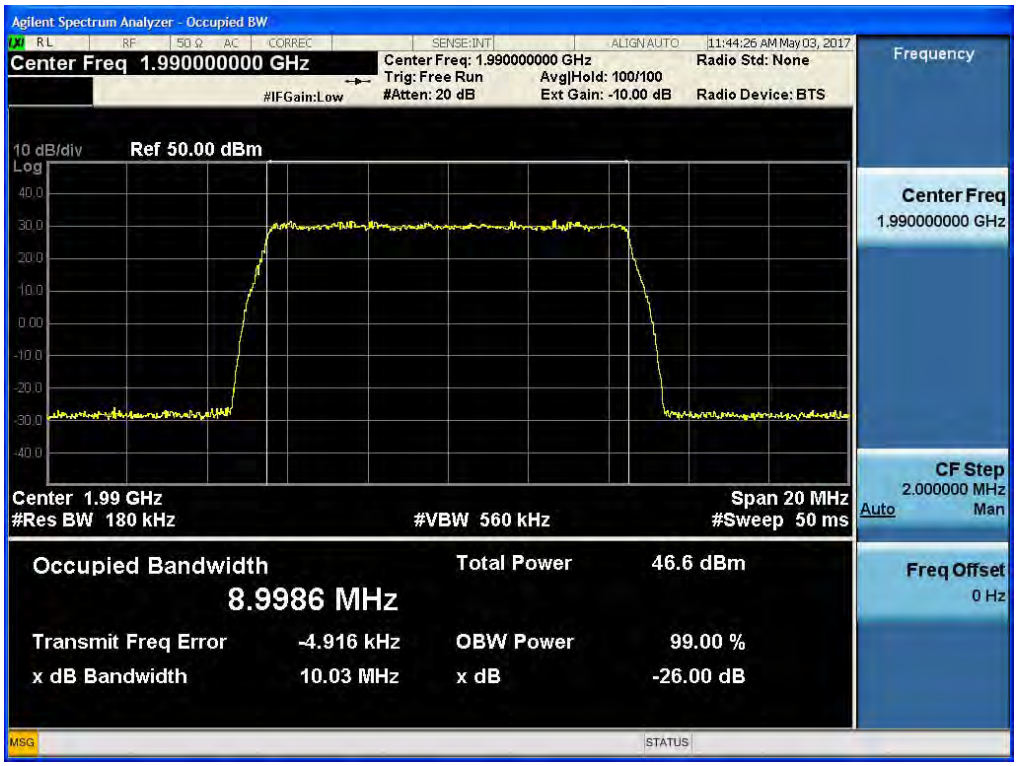
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

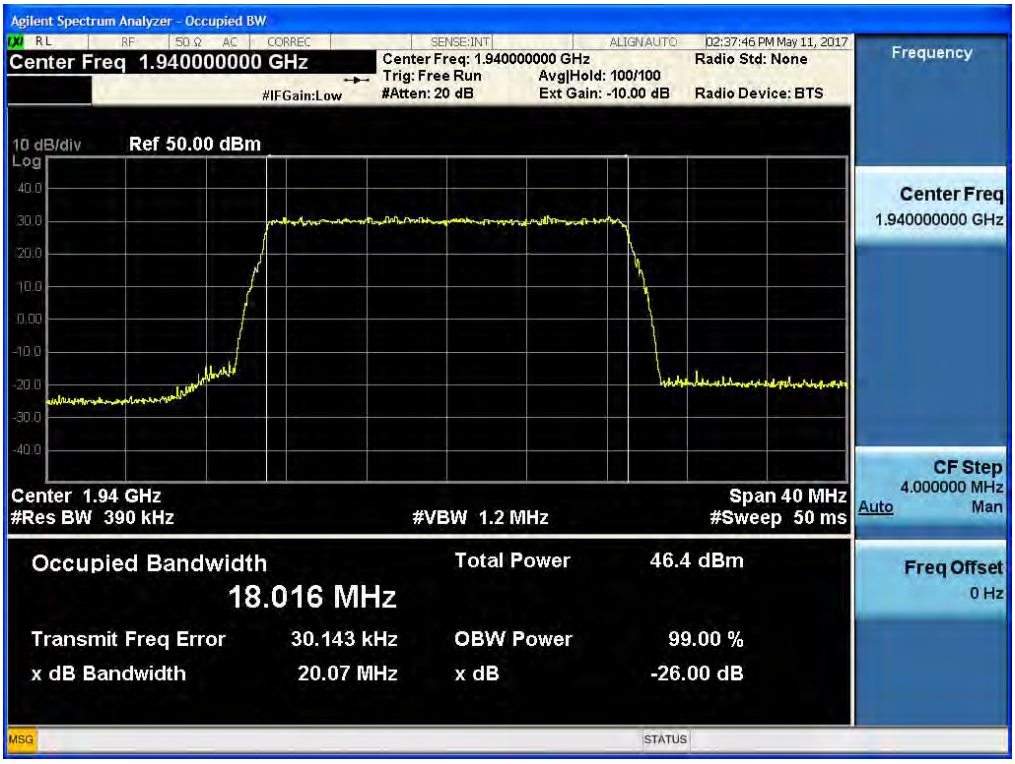


[AGC threshold Input Downlink High]

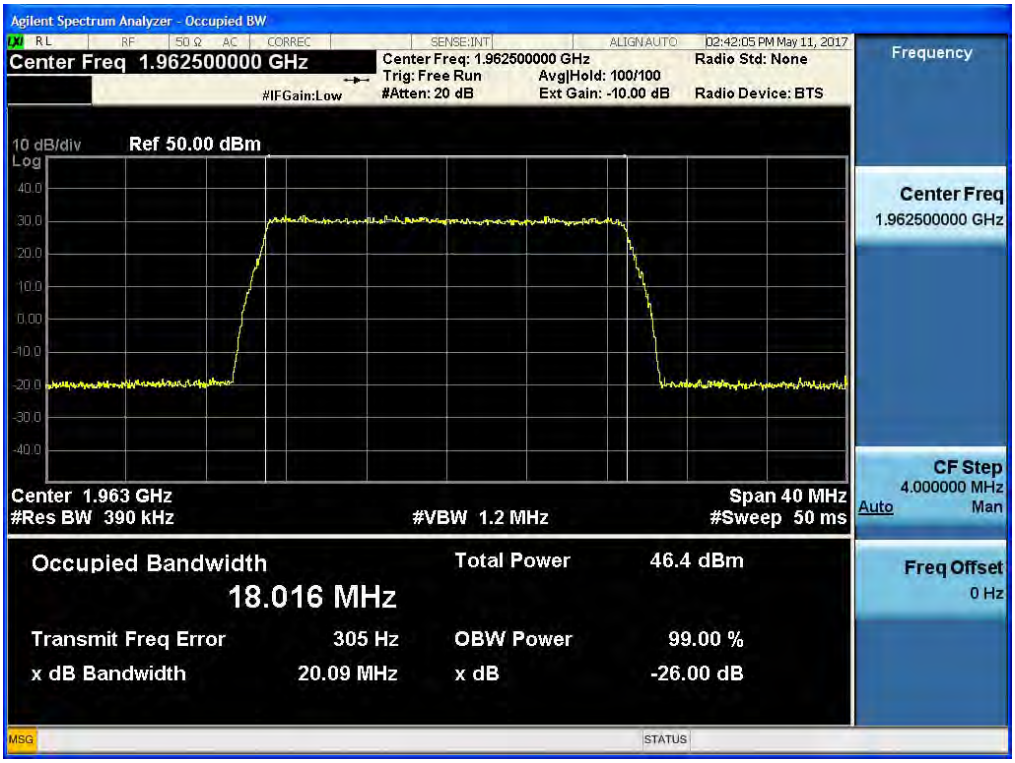


Plots of Occupied Bandwidth_ 1900 PCS BAND LTE 20 MHz

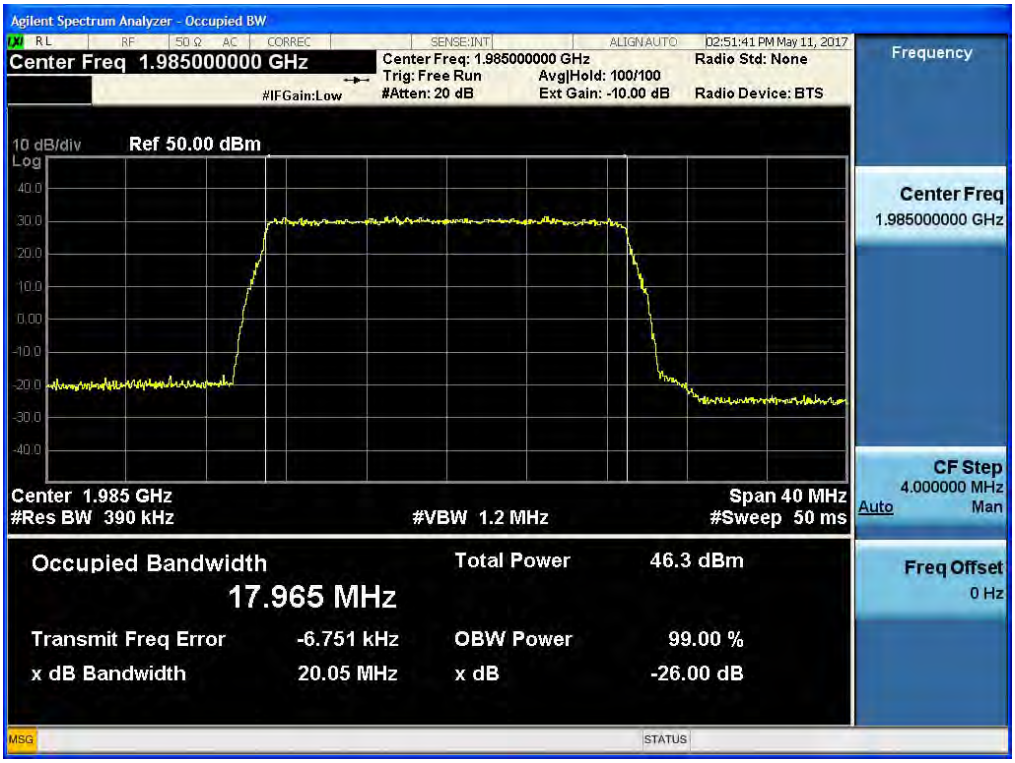
[AGC threshold Output Downlink Low]



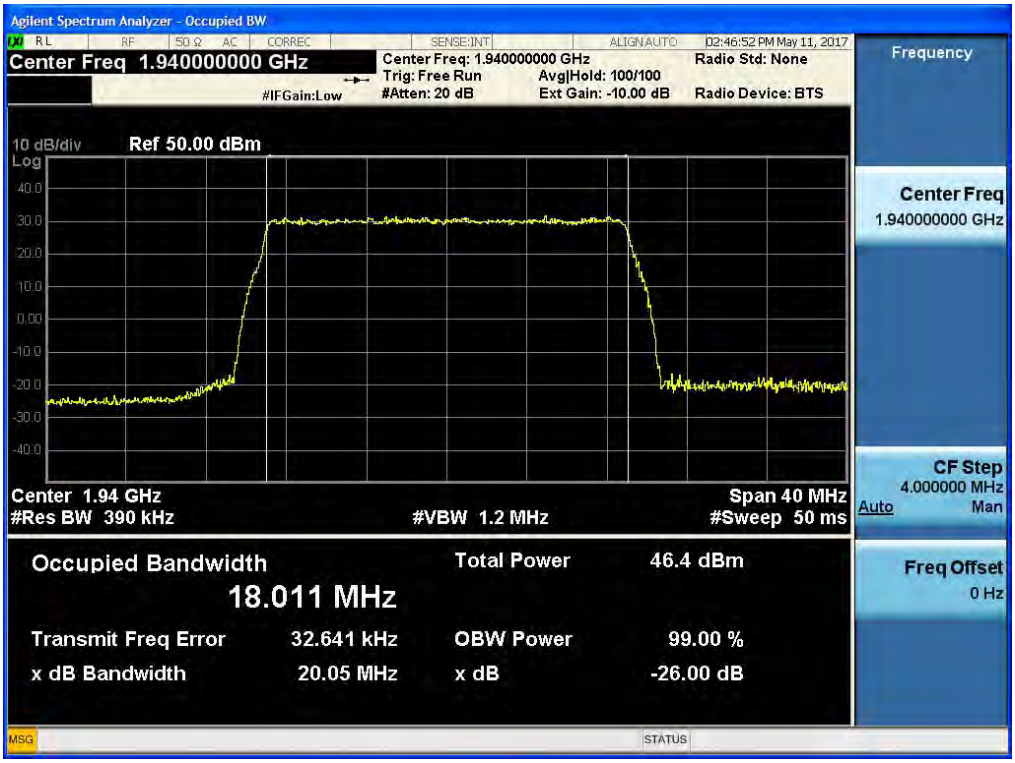
[AGC threshold Output Downlink Middle]



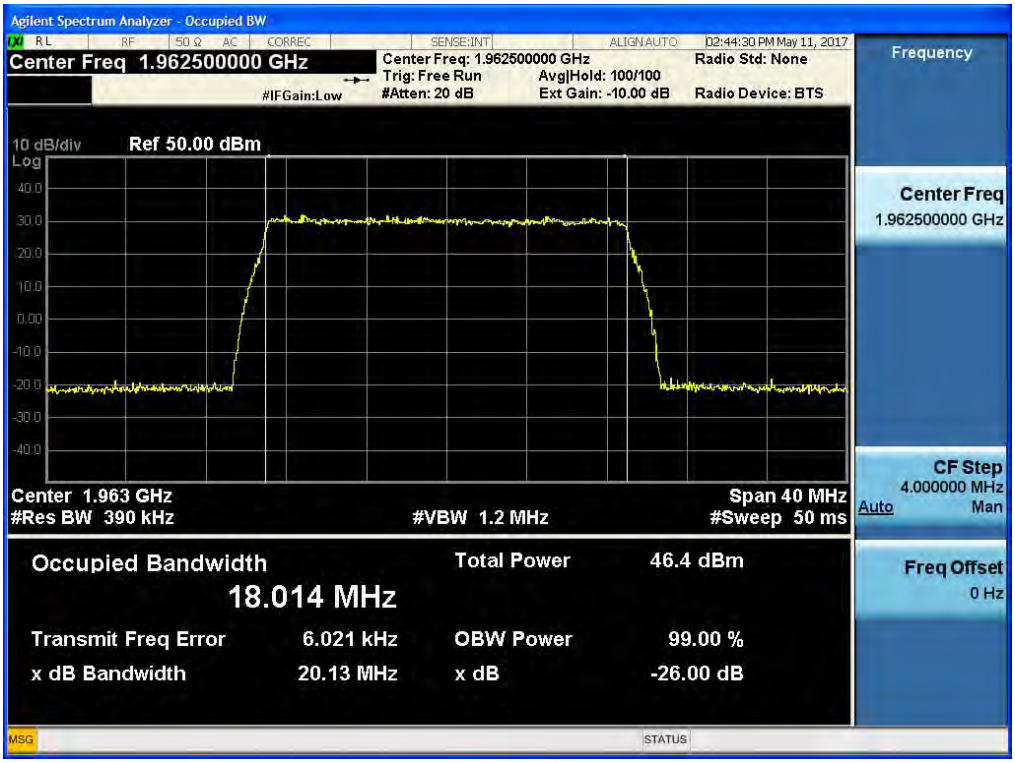
[AGC threshold Output Downlink High]



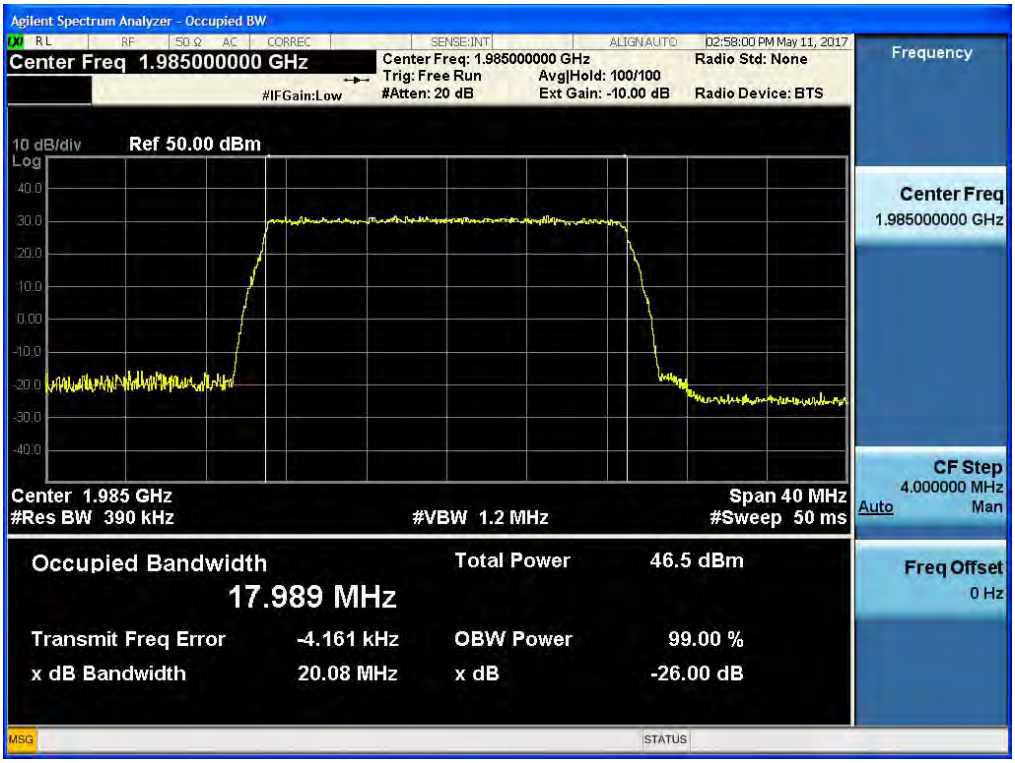
[+3dBmabove AGC threshold Output Downlink Low]



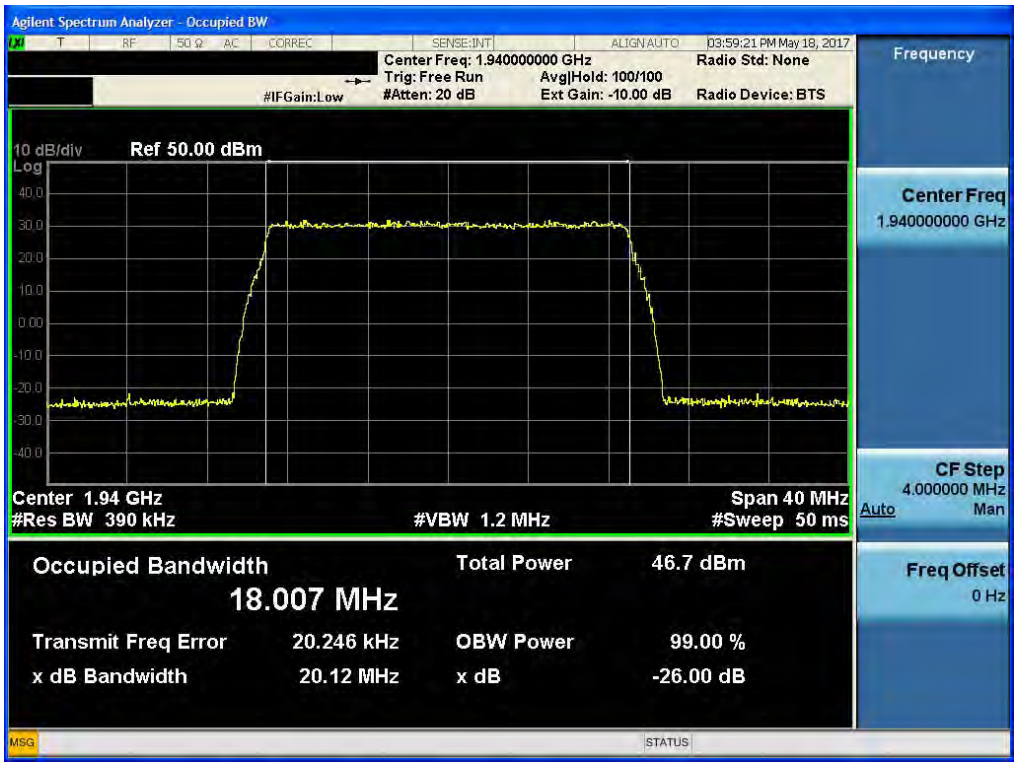
[+3dBm above AGC threshold Output Downlink Middle]



[+3dBm above AGC threshold Output Downlink High]

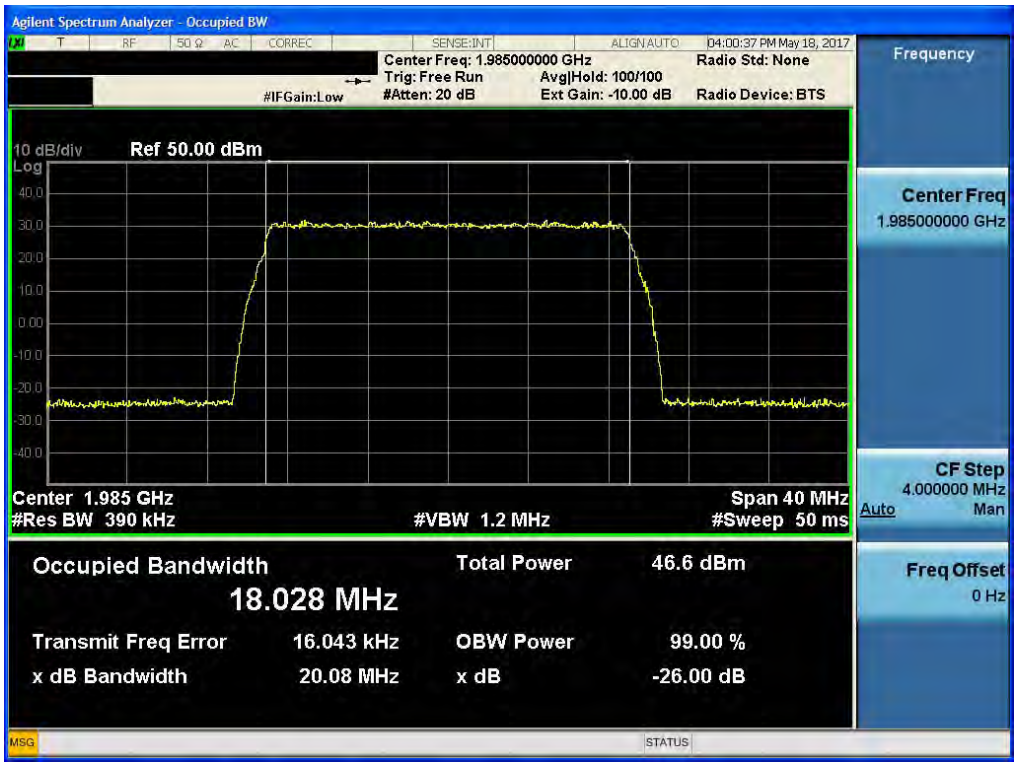


[AGC threshold Input Downlink Low]



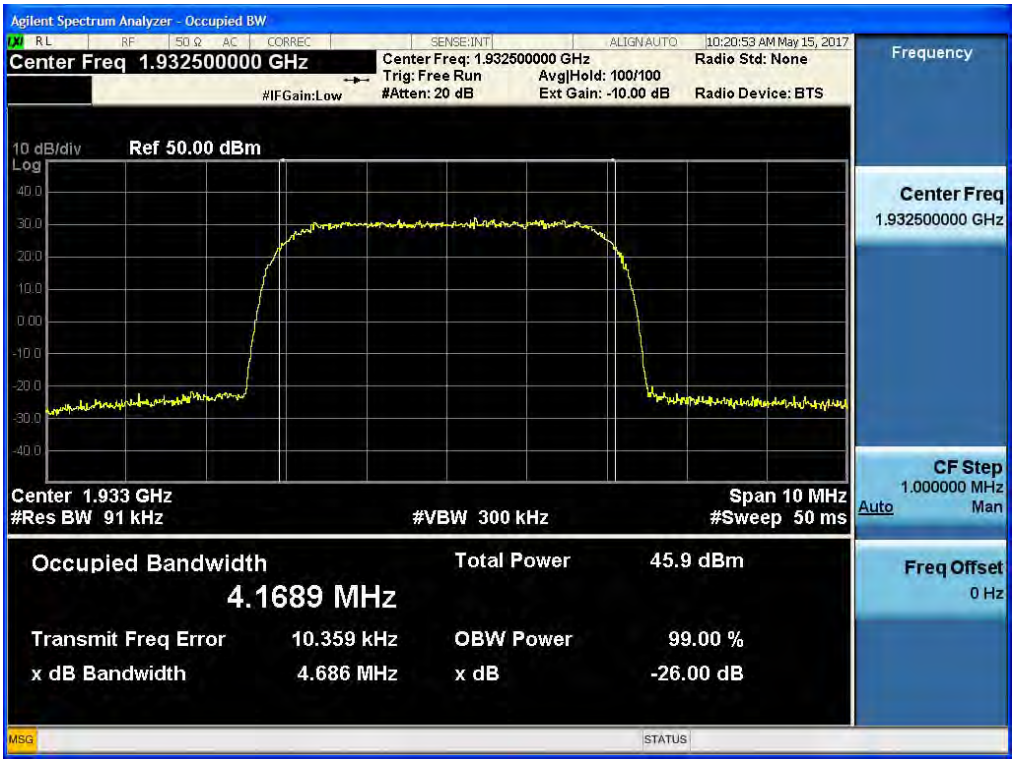
[AGC threshold Input Downlink Middle]

[AGC threshold Input Downlink High]

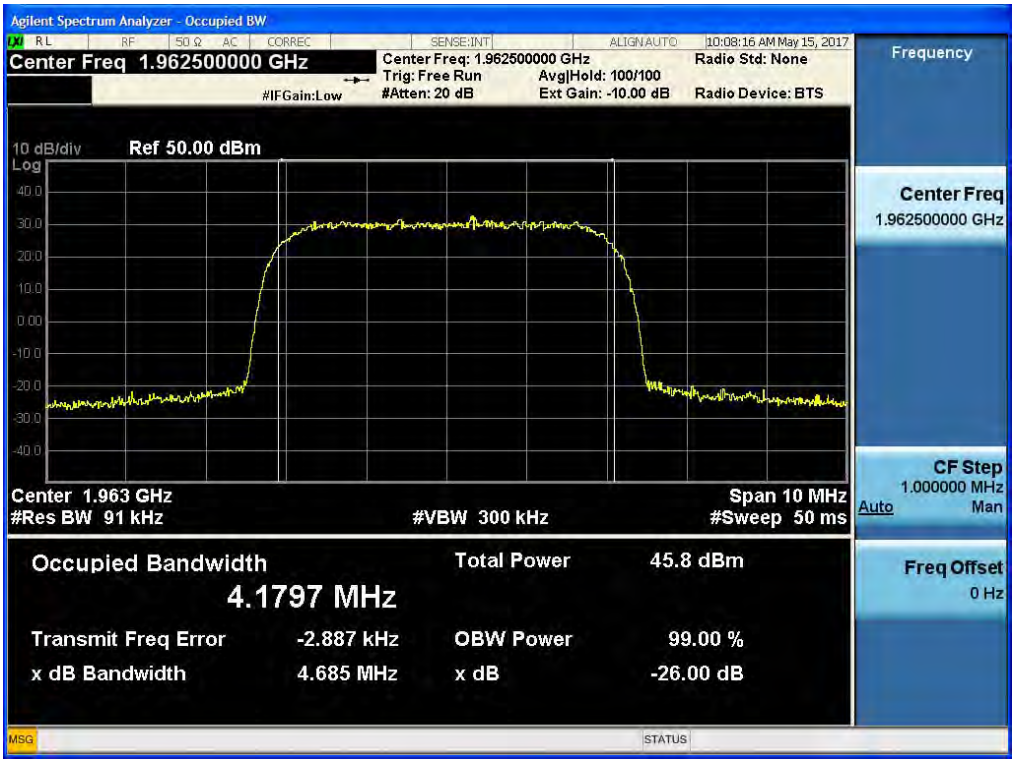


Plots of Occupied Bandwidth_ 1900 PCS BAND WCDMA

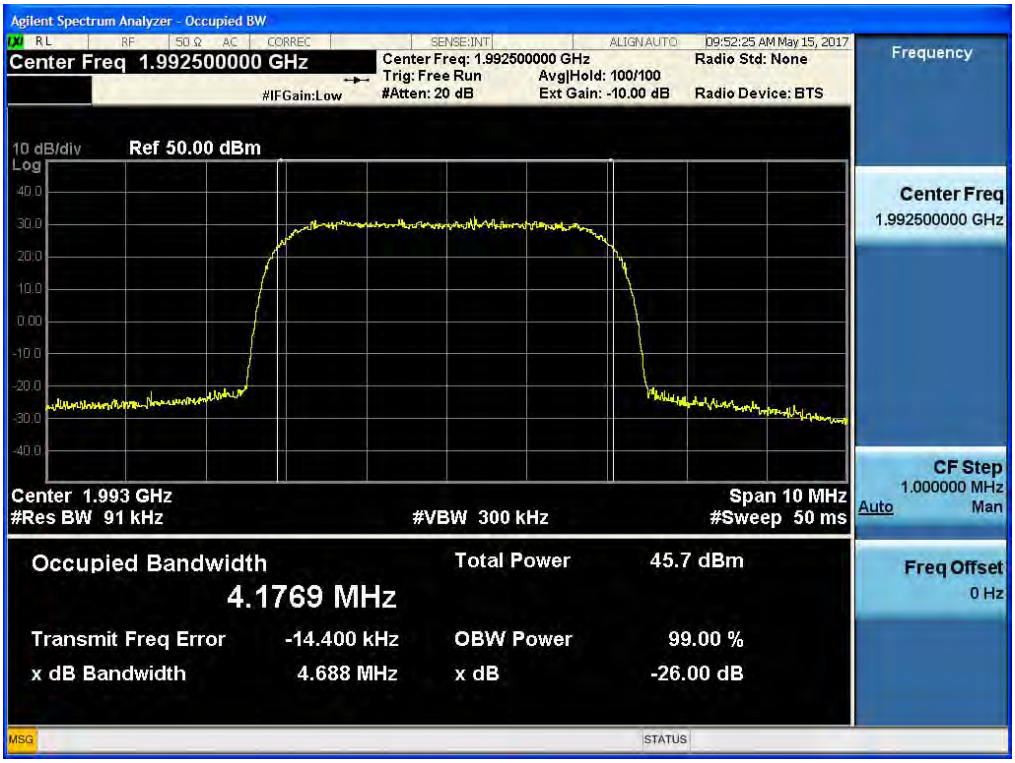
[AGC threshold Output Downlink Low]



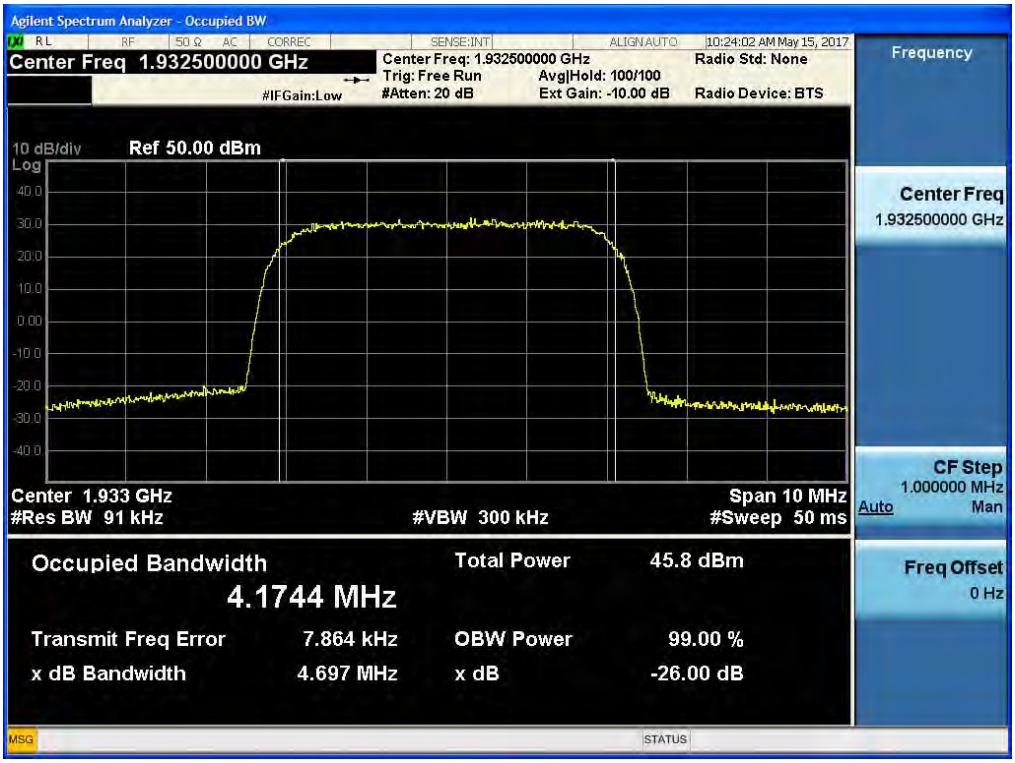
[AGC threshold Output Downlink Middle]



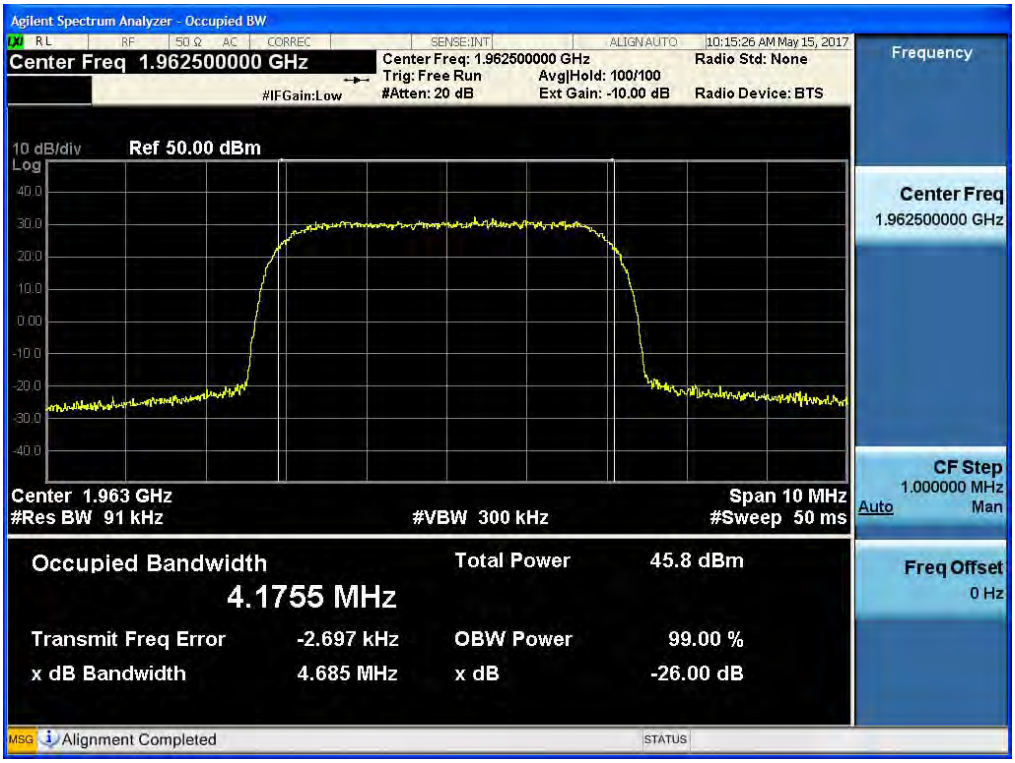
[AGC threshold Output Downlink High]



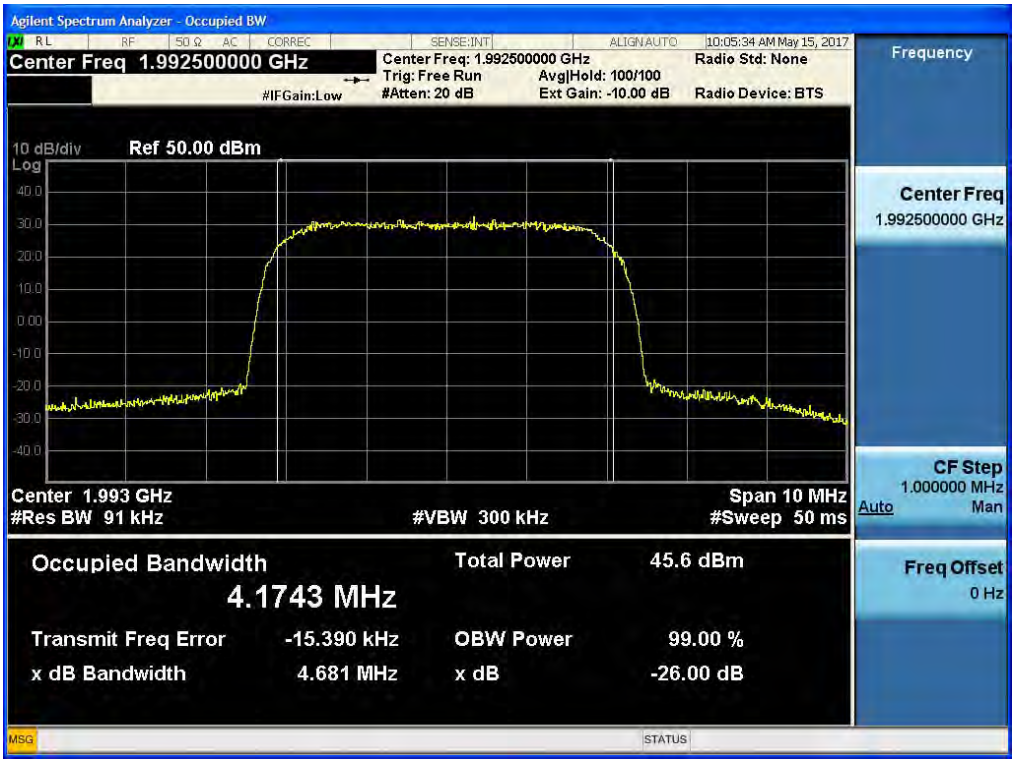
[+3dBmabove AGC threshold Output Downlink Low]



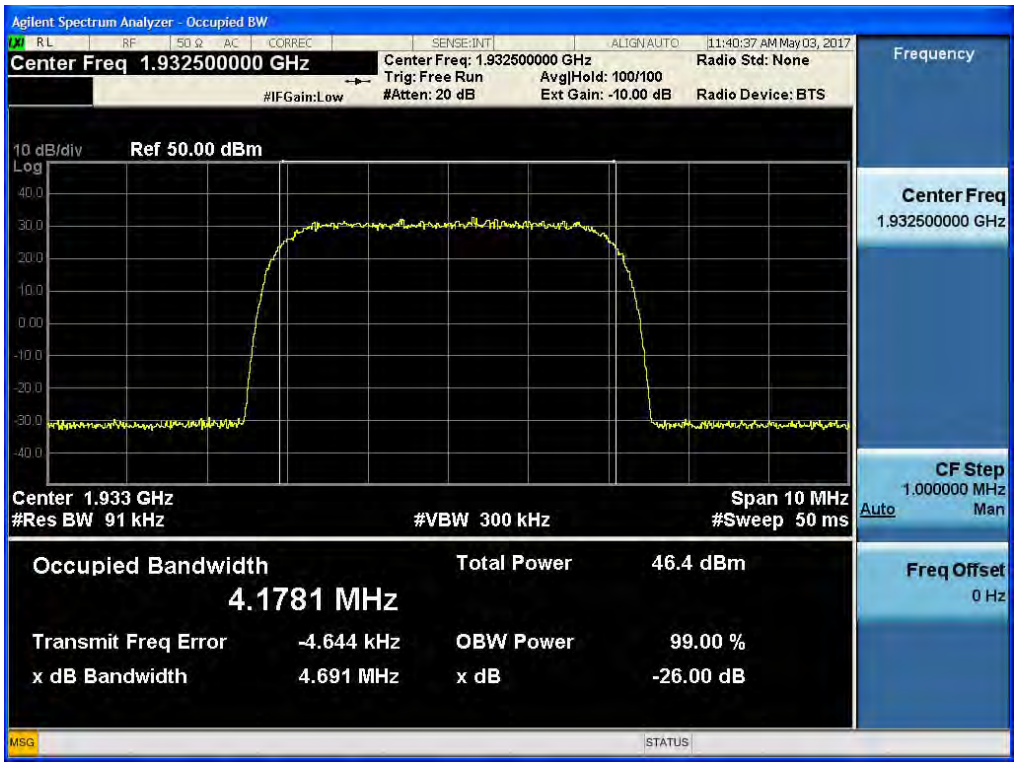
[+3dBm above AGC threshold Output Downlink Middle]



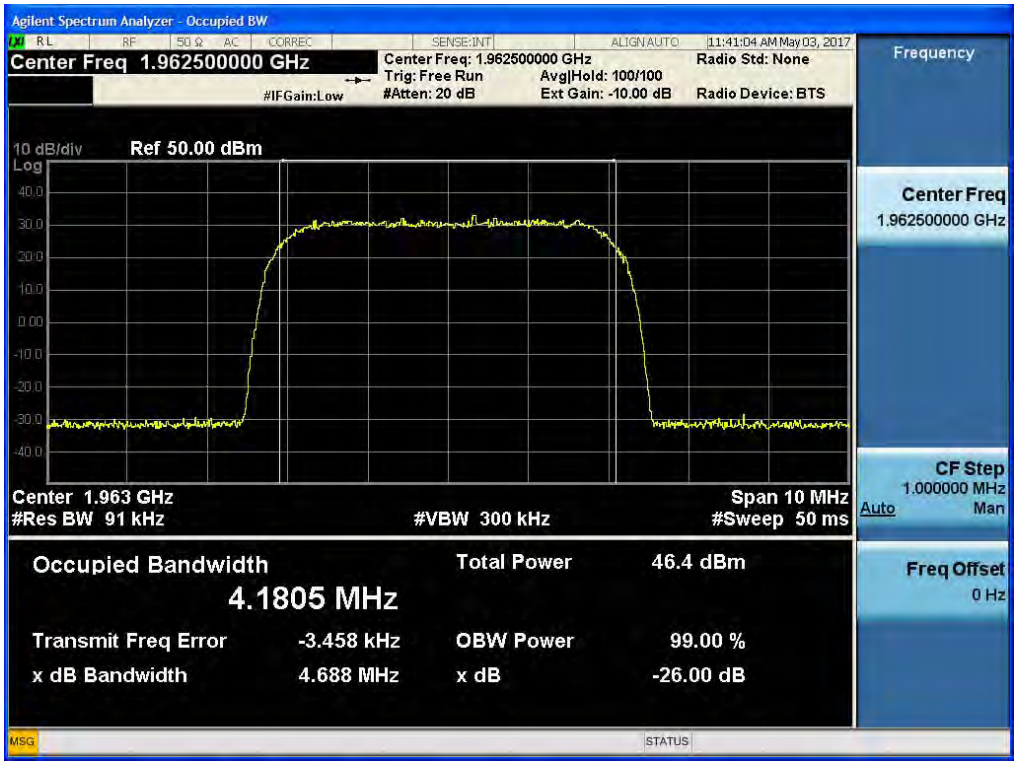
[+3dBm above AGC threshold Output Downlink High]



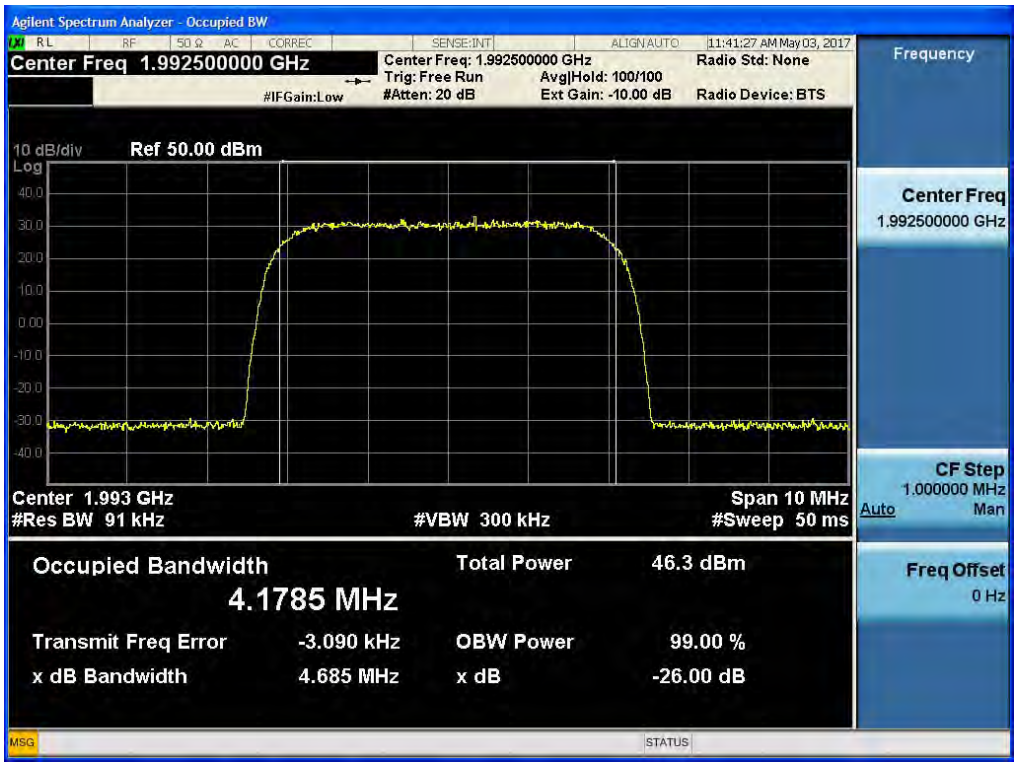
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

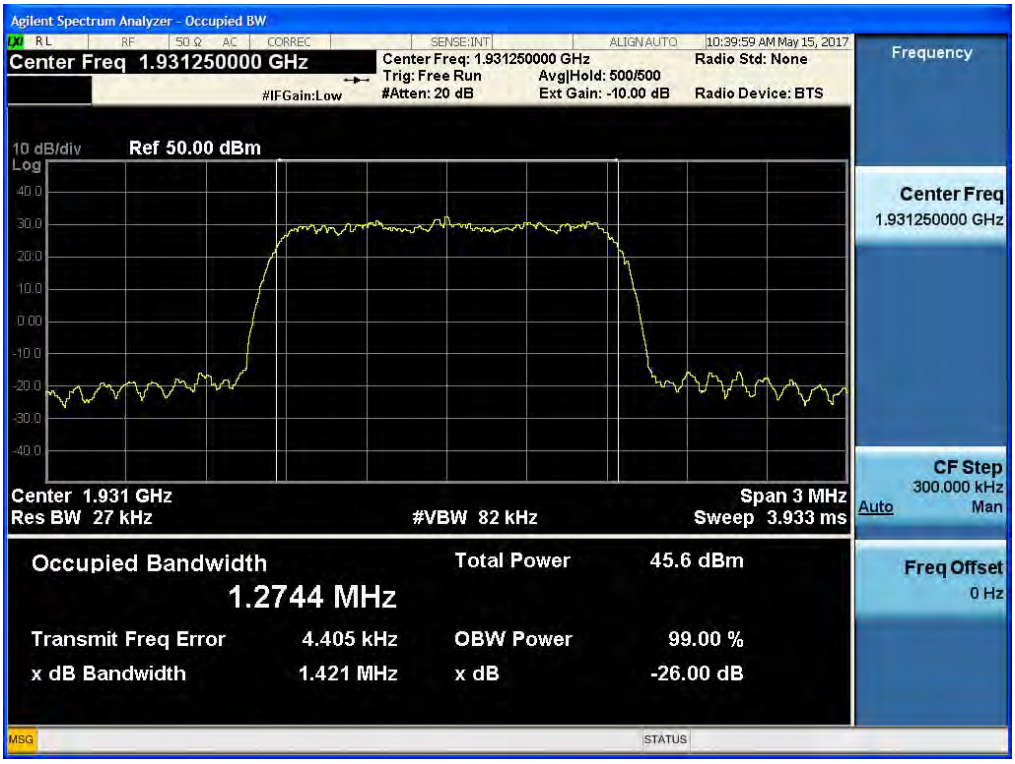


[AGC threshold Input Downlink High]

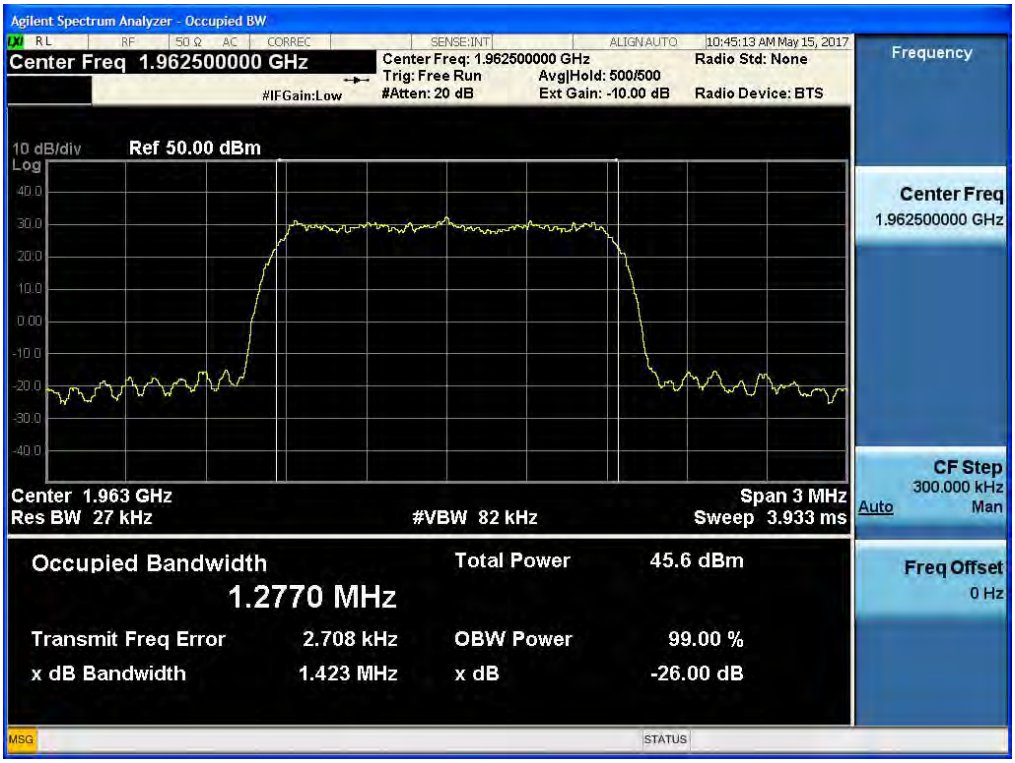


Plots of Occupied Bandwidth_1900 PCS BAND CDMA

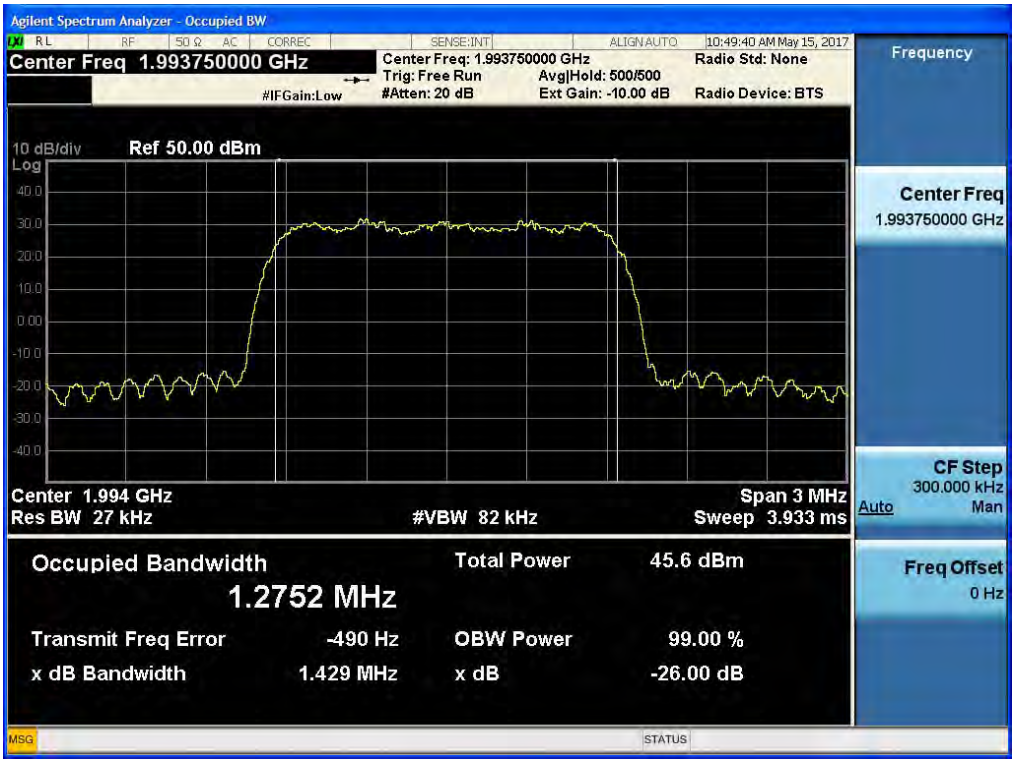
[AGC threshold Output Downlink Low]



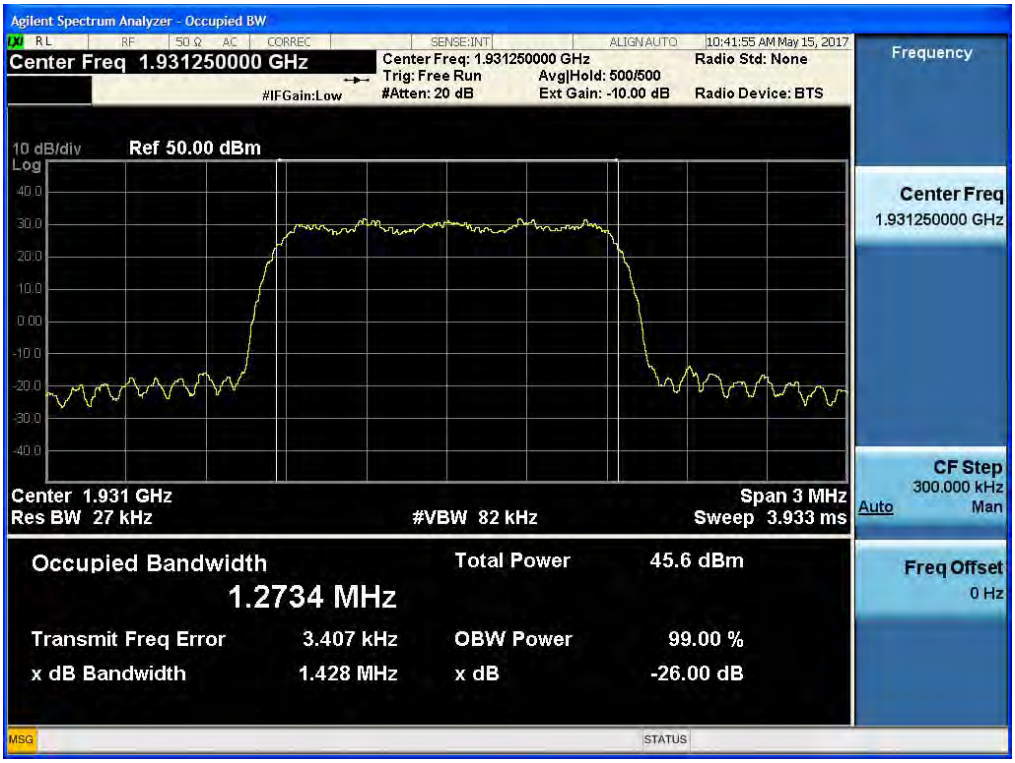
[AGC threshold Output Downlink Middle]



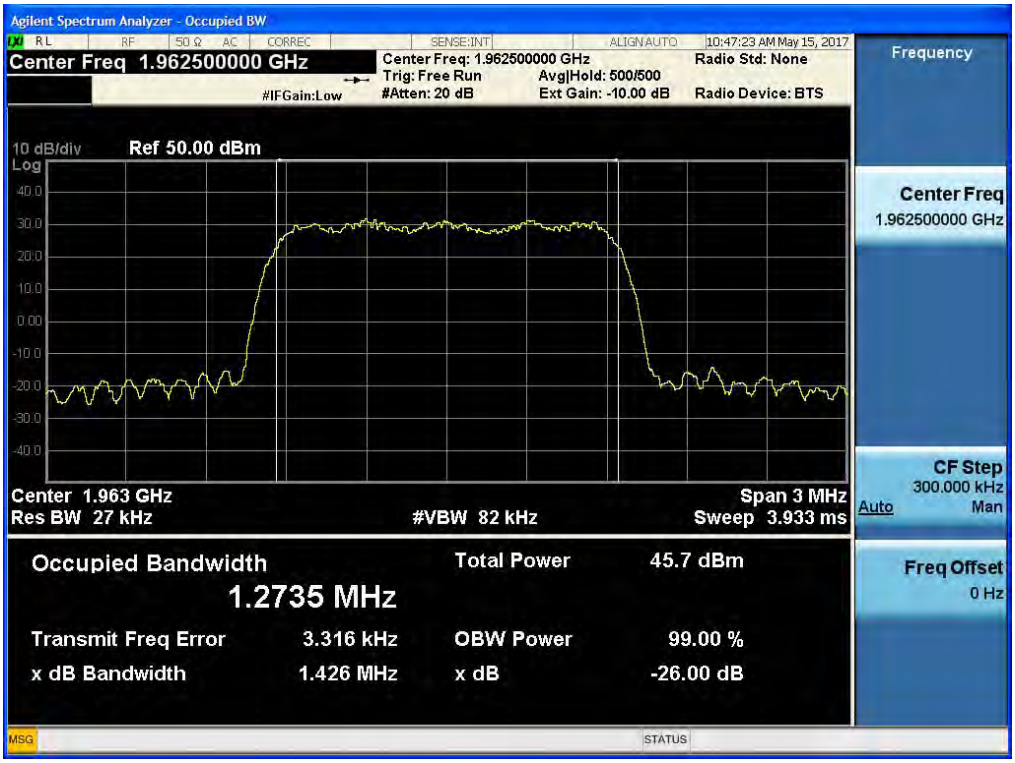
[AGC threshold Output Downlink High]



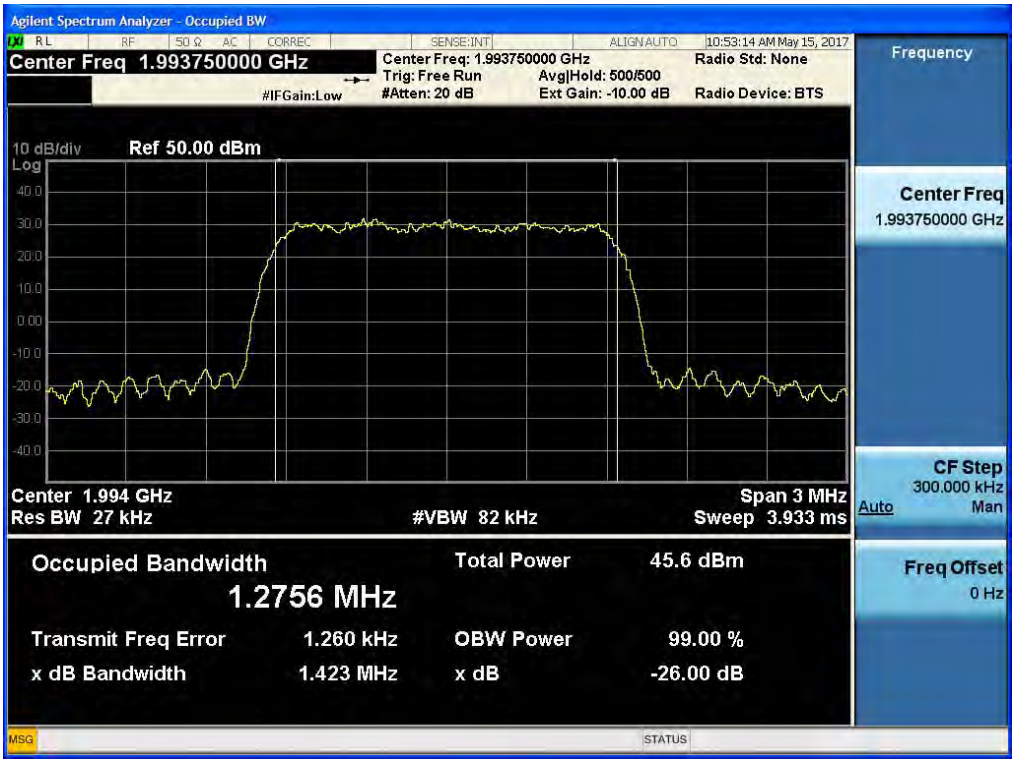
[+3dBmabove AGC threshold Output Downlink Low]



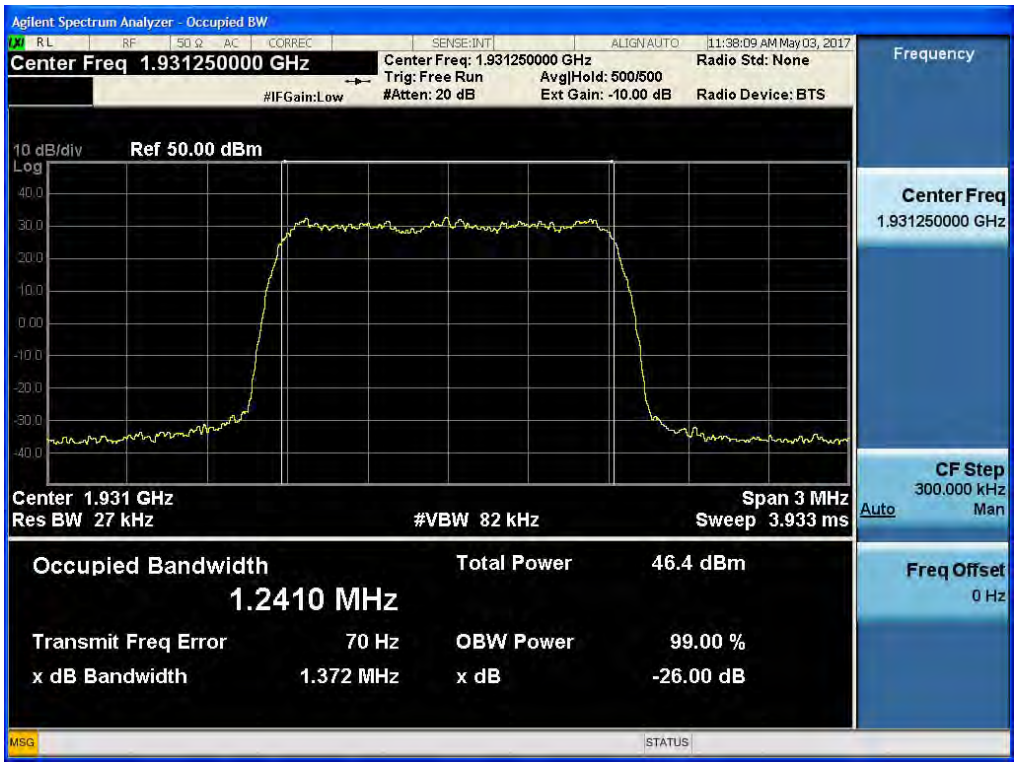
[+3dBm above AGC threshold Output Downlink Middle]



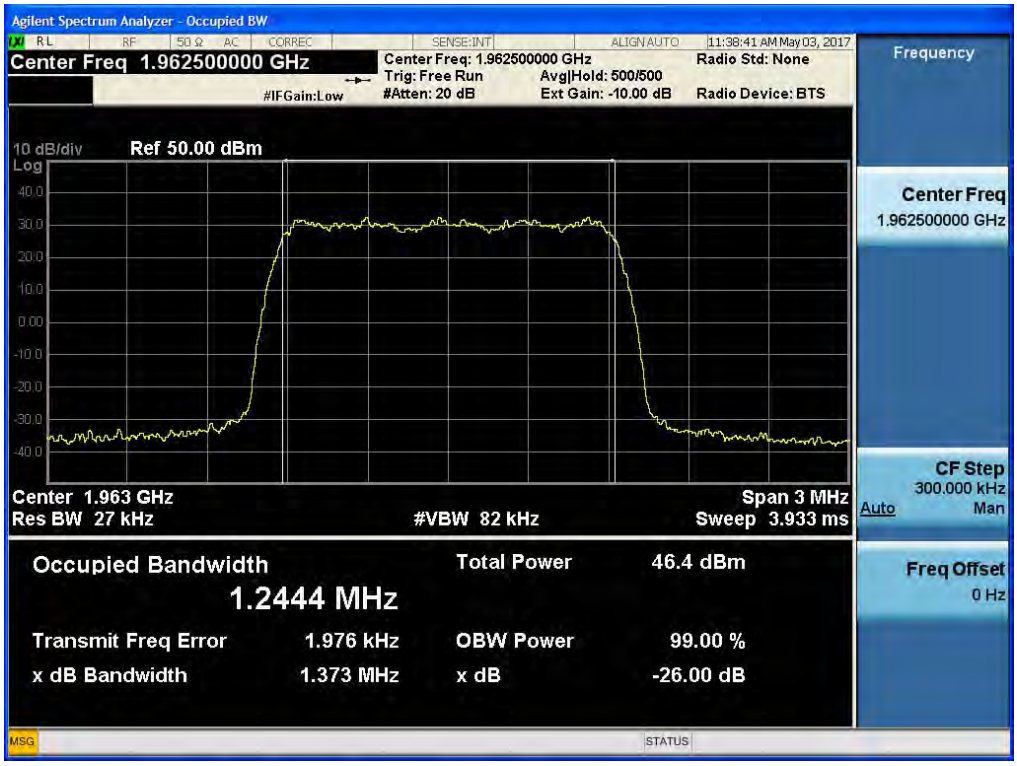
[+3dBm above AGC threshold Output Downlink High]



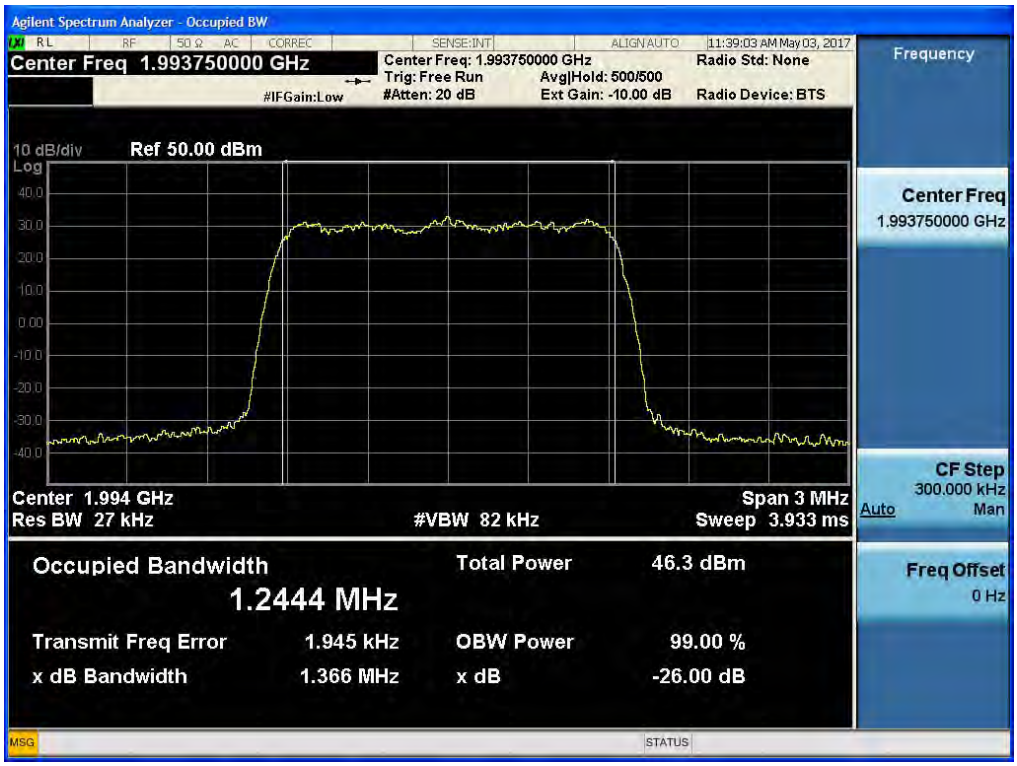
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

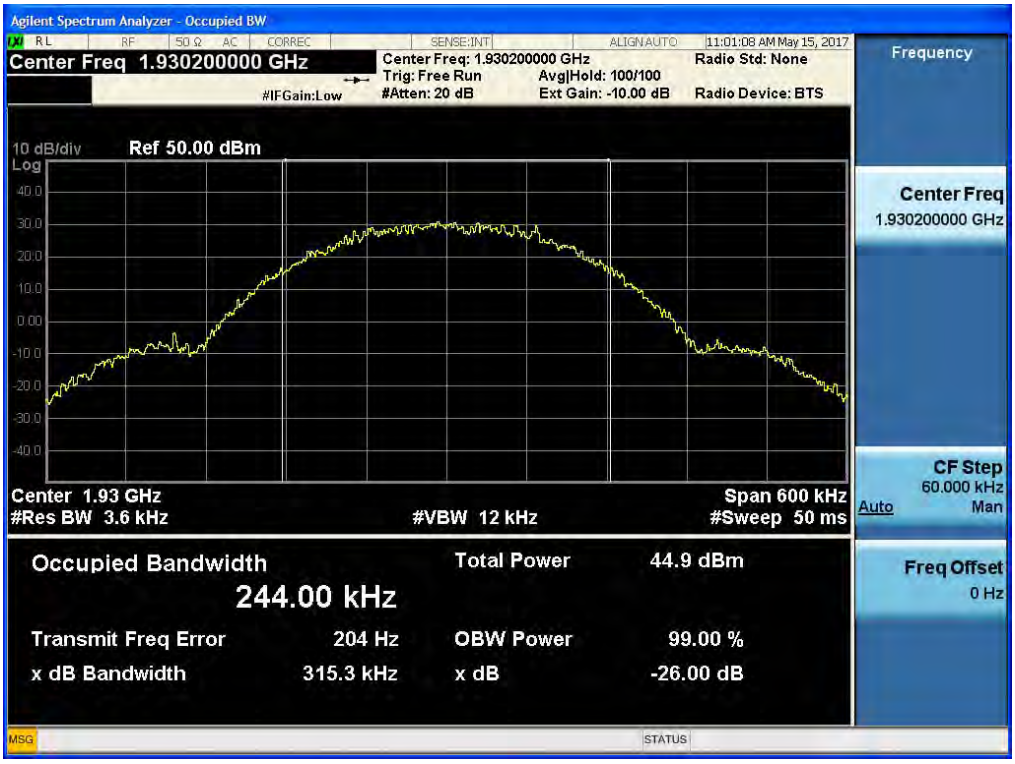


[AGC threshold Input Downlink High]



Plots of Occupied Bandwidth_ 1900 PCS BAND GSM

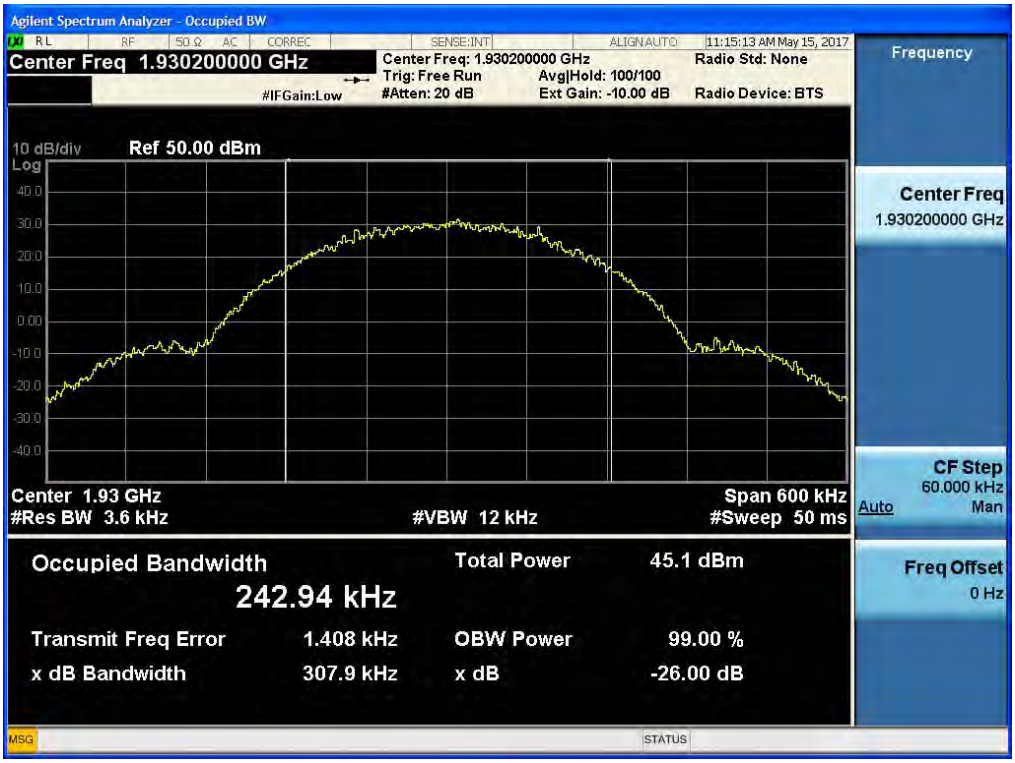
[AGC threshold Output Downlink Low]



[AGC threshold Output Downlink Middle]

[AGC threshold Output Downlink High]

[+3dBmabove AGC threshold Output Downlink Low]



[+3dBm above AGC threshold Output Downlink Middle]

[+3dBm above AGC threshold Output Downlink High]

[AGC threshold Input Downlink Low]

[AGC threshold Input Downlink Middle]

[AGC threshold Input Downlink High]

8. INPUT VERSUS OUTPUT SPECTRUM

IC Rules

Test Requirements:

RSS-131

5. Equipment standard specifications for zone enhancers working with equipment certified in RSSs listed in section 1 except RSS-119

5.2 Industrial Zone Enhancers

5.2.2 Input-versus-output spectrum

The spectral growth of the 26 dB bandwidth of the output signal shall be less than 5% of the input signal spectrum.

Test Procedures:

RSS-GEN

6 Technical Requirements

6.6 Occupied Bandwidth

The emission bandwidth (X dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated X dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3 x the resolution bandwidth.

Note : We tested using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 26 dB.

Test Results:

[Downlink Output]

	Channel	Frequency (MHz)	26 dB BW (MHz)
1900 PCS Band_ LTE 5 MHz AGC threshold	Low	1932.50	5.036
	Middle	1962.50	5.033
	High	1992.50	4.993
1900 PCS Band_ LTE 10 MHz AGC threshold	Low	1935.00	10.01
	Middle	1962.50	10.03
	High	1990.00	9.978
1900 PCS Band_ LTE 20 MHz AGC threshold	Low	1940.00	20.07
	Middle	1962.50	20.09
	High	1985.00	20.05
1900 PCS Band_ WCDMA AGC threshold	Low	1932.50	4.686
	Middle	1962.50	4.685
	High	1992.50	4.688
1900 PCS Band_ CDMA AGC threshold	Low	1931.25	1.421
	Middle	1962.50	1.423
	High	1993.75	1.429
1900 PCS Band_ GSM AGC threshold	Low	1930.20	315.3
	Middle	1962.50	314.4
	High	1994.80	310.3

*** Plots of results are the same as Section 7.**

9. OUT OF BAND REJECTION & MEAN OUTPUT POWER AND ZONE ENHANCER GAIN

FCC Rules

Test Requirement(s):

KDB 935210 D05 v01r01

Out of Band Rejection – Testing for rejection of out of band signals. Alternatively, filter freq. response plots are acceptable.

IC Rules

Test Requirements:

RSS-131

5. Equipment standard specifications for zone enhancers working with equipment certified in RSSs listed in section 1 except RSS-119

5.2 Industrial Zone Enhancers

5.2.1 Out-of-band rejection

The gain-versus-frequency response and the 20 dB bandwidth of the zone enhancer shall be reported. The zone enhancer shall reject amplification of other signals outside the passband of the zone enhancer.

5.2.3 Mean output power and zone enhancer gain

The zone enhancer gain shall not exceed the nominal gain by more than 1.0 dB. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point.

Test Procedures:

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

3.3 EUT 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 from the center of the passband.

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 = approx. 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 of the spectrum analyzer to be 1 % to 5 % of the passband and

the video bandwidth 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. Capture the frequency response of the EUT.

4.3 PLMRS device out-of-band rejection

Adjust the internal gain control of the equipment under test 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:

c) Frequency range = ± 250 % of the manufacturer's pass band.

d) The CW amplitude will be 3 dB below the AGC threshold (see 4.2) and but not activate the AGC threshold throughout the test.

e) Dwell time = approx. 10 ms.

f) Frequency step = 50 kHz.

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

h) Set the resolution bandwidth of the spectrum analyzer between 1 % and 5 % of the manufacturer's pass band with the video bandwidth set to 3 × RBW.

i) Set the detector to Peak and the trace to Max-Hold.

j) 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 gain has fallen by 20 dB).

k) Capture the frequency response plot and for inclusion in the test report.

Test Results:

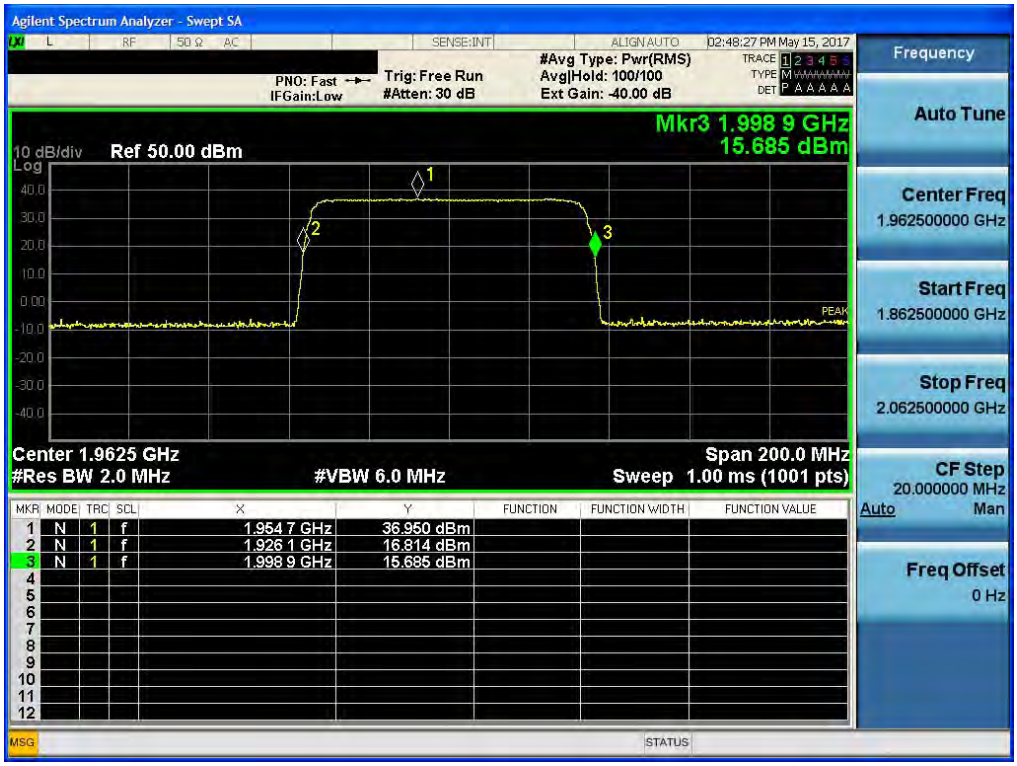
Input Signal	Input Level Input Signal : Sinusoidal	Maximum Amp Gain
1900 PCS Band	-14 dBm	51 dB

[Downlink]

	20 dB point frequency	Output power (dBm)	Gain (dB)
1900 PCS Band	1926.100 MHz ~ 1998.900 MHz	36.950	51.950

Plots of Out of Band Rejection & Mean Output Power and Zone Enhancer Gain

[1900 PCS BAND]



10. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

FCC Rules

Test Requirements:

§ 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.

IC Rules

Test Requirements:

RSS-133

6. Transmitter and Receiver Standard Specifications

6.5 Transmitter Unwanted Emissions

6.5.1 Out-of-Block Emissions

Equipment shall comply with the limits in (i) and (ii) below.

i. In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p(watts).

ii. After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p(watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

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

Refer to the applicable rule part(s) for specified limits on unwanted (out-of-band/out-of-block and spurious) emissions.

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/out-of-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 may 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 (e.g., 4.1 MHz

OBW).

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, 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.

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 (i.e., 4.1 MHz OBW AWGN).

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).
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.
p) Repeat steps i) to o) with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.
q) Repeat steps b) to p) with the narrowband test signal.
r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

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 for 1900 PCS BAND LTE 5 MHz

Conducted Spurious Emissions (9 kHz – 150 kHz)

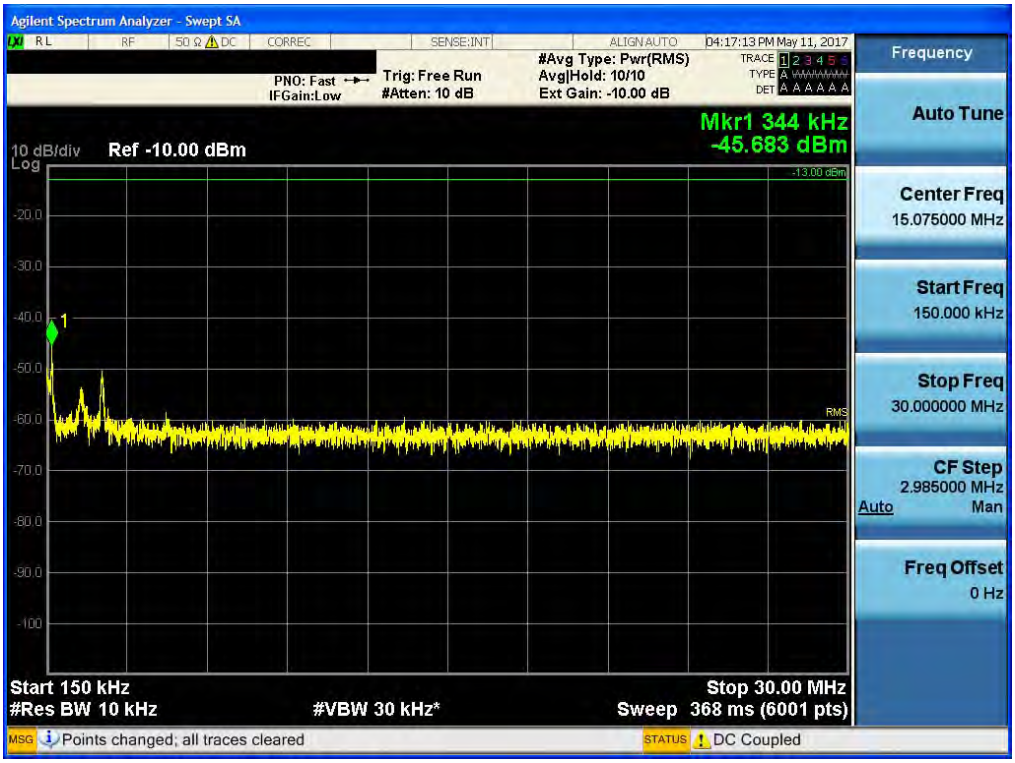
[Downlink Low]

[Downlink Middle]

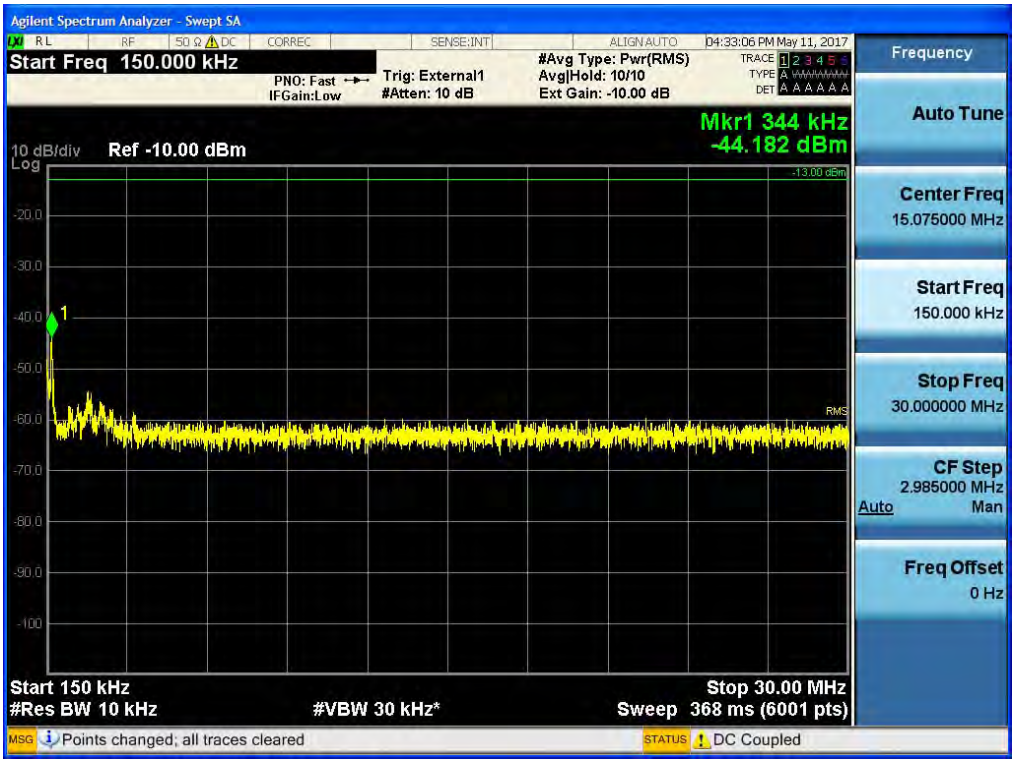
[Downlink High]

Conducted Spurious Emissions (150 kHz – 30 MHz)

[Downlink Low]



[Downlink Middle]



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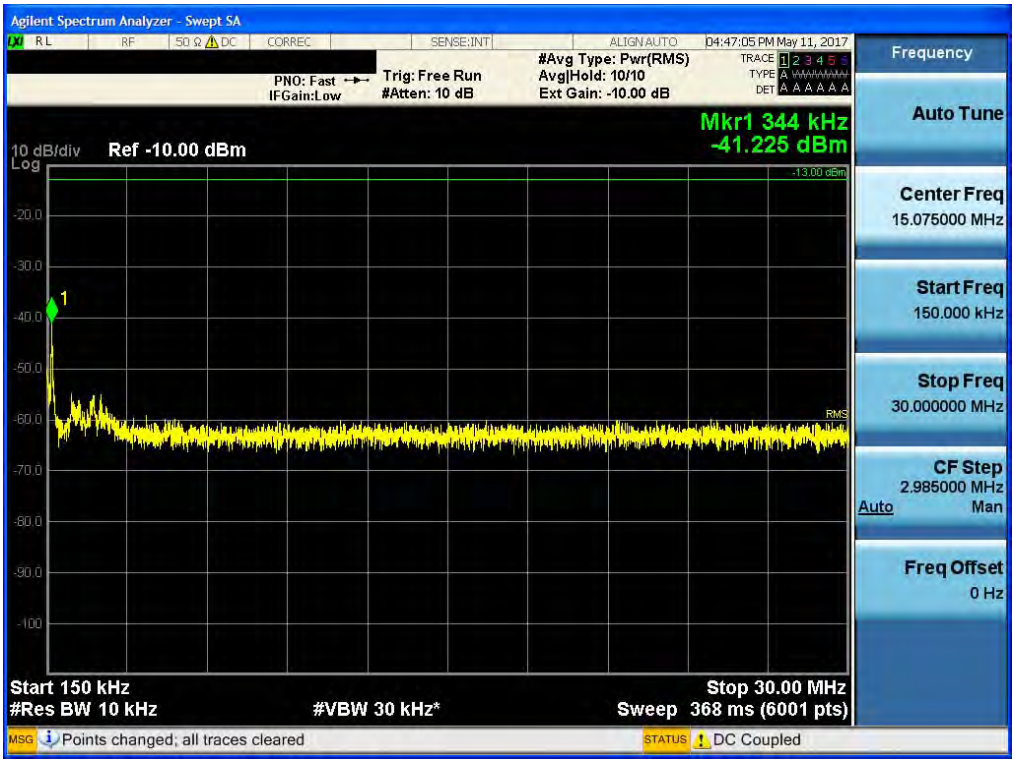
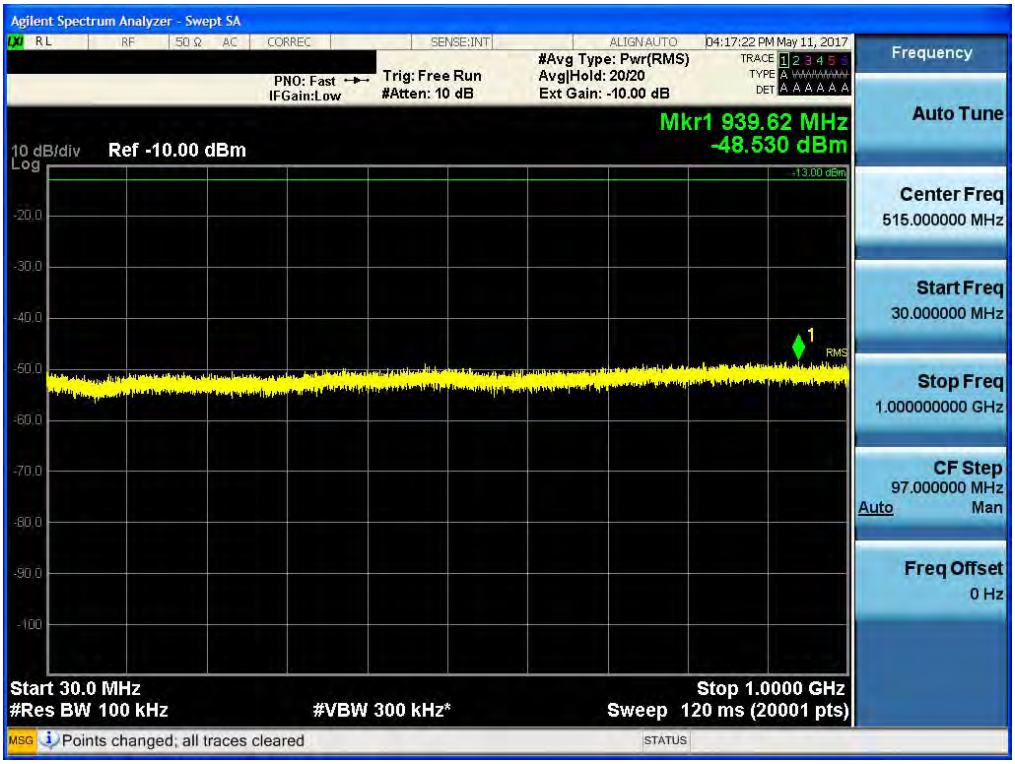


Conducted Spurious Emissions (30 MHz – 1 GHz)

[Downlink Low]



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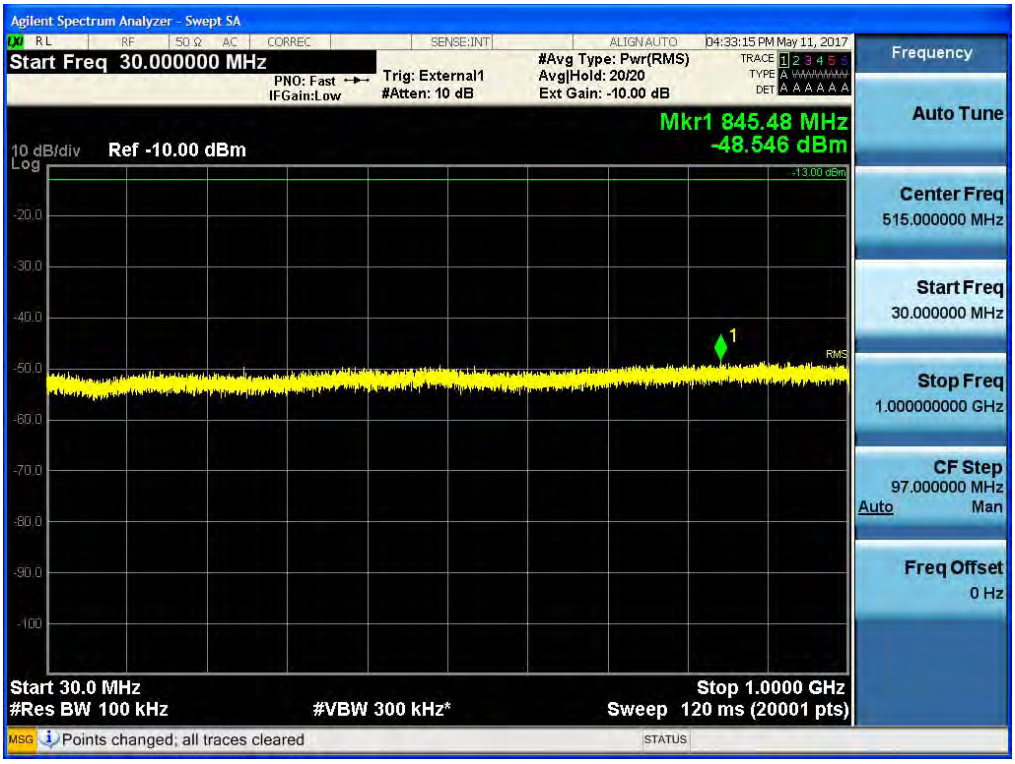

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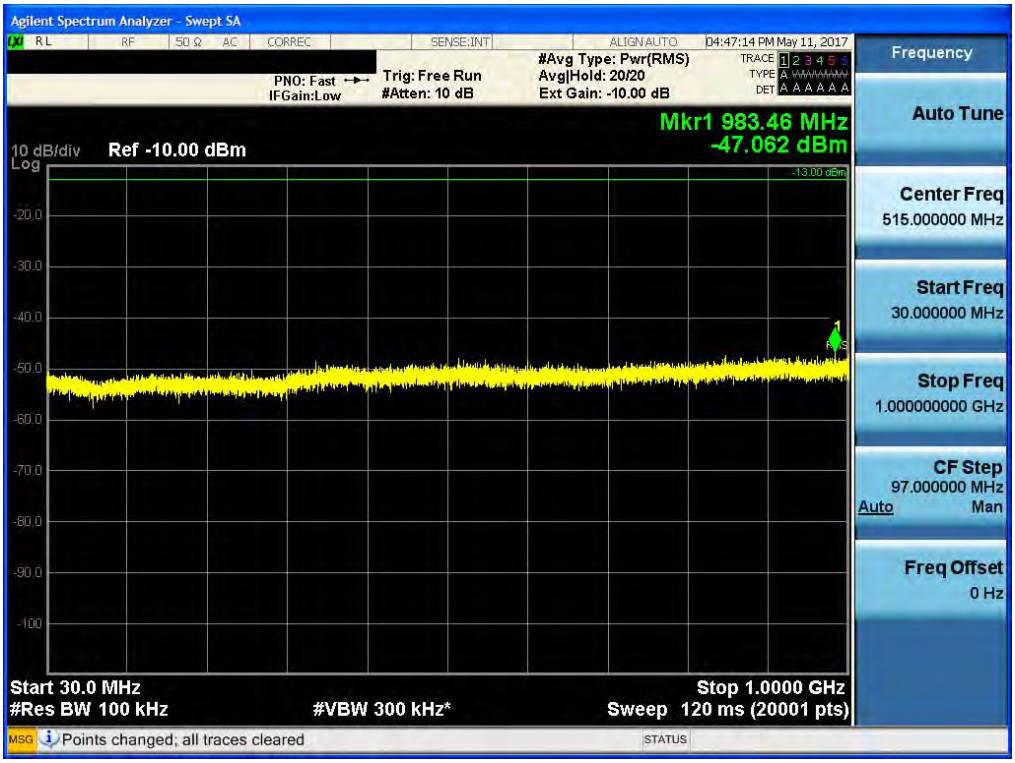
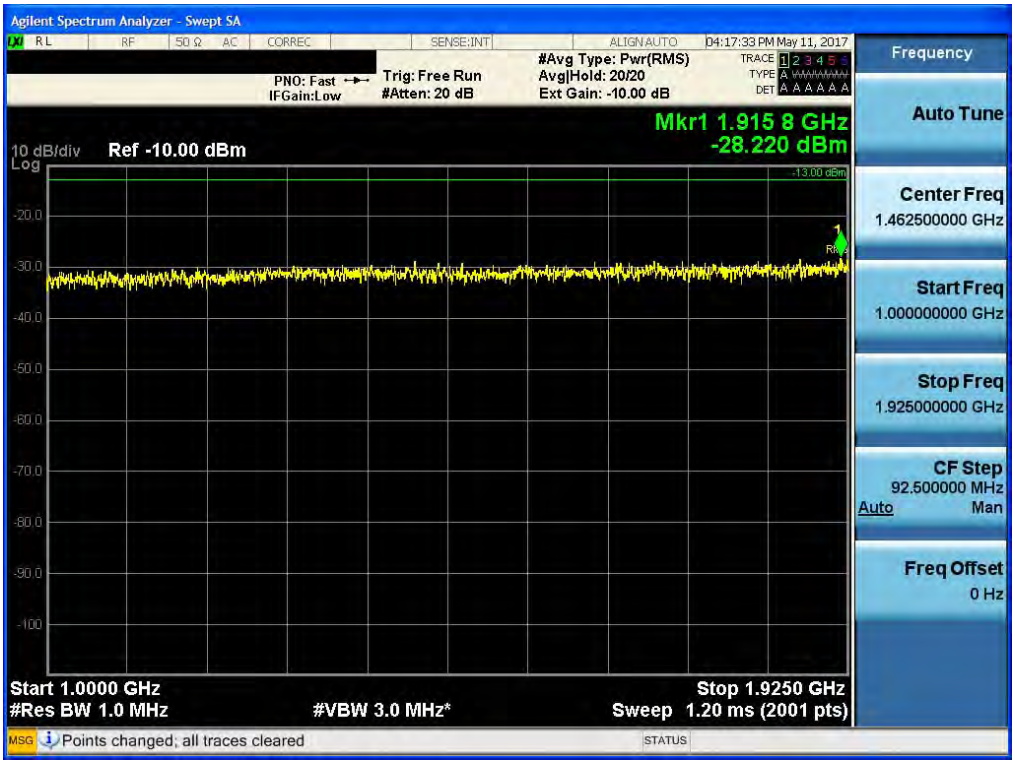


Conducted Spurious Emissions (1 GHz – 26.5 GHz)

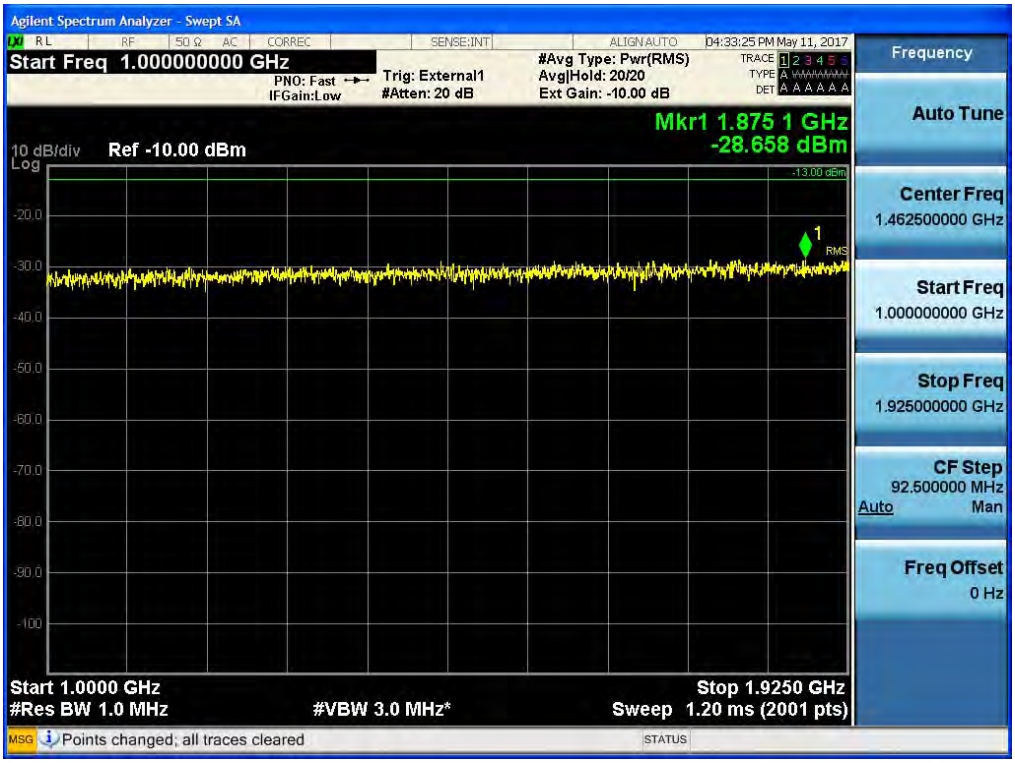
[Downlink Low]-1



[Downlink Low]-2

[Downlink Low]-3

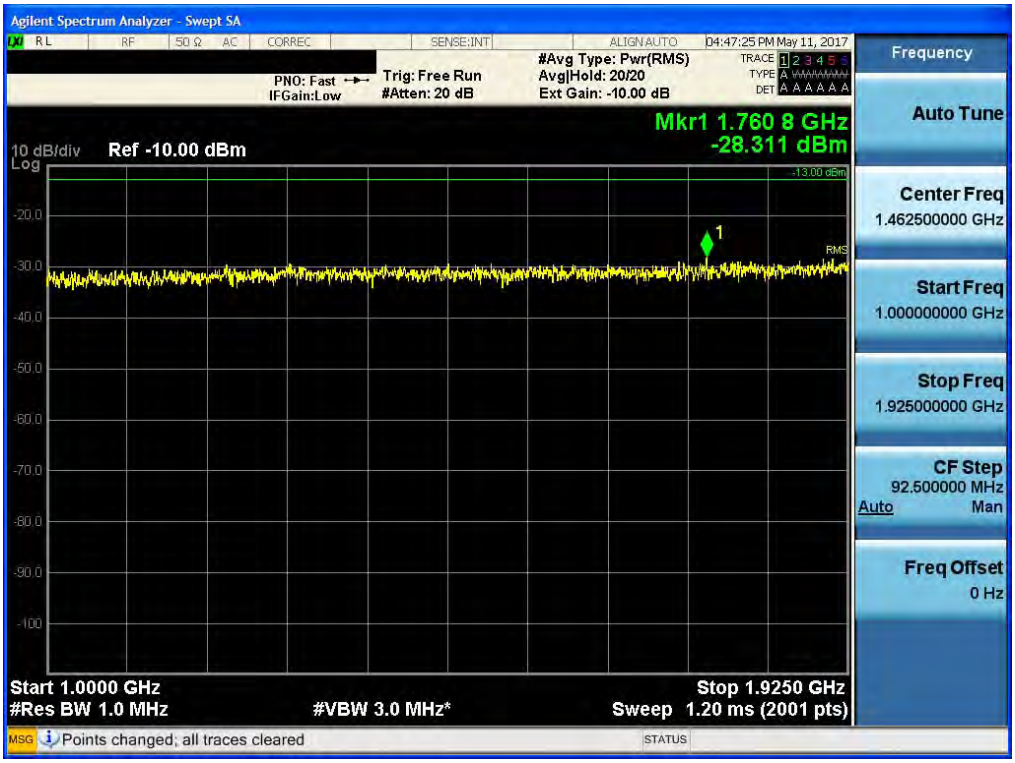
[Downlink Middle]-1



[Downlink Middle]-2

[Downlink Middle]-3

[Downlink High]-1



[Downlink High]-2

[Downlink High]-3