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FCC /ISED REPORT

Class Ⅱ Permissive Change

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:
September 19, 2016

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

Report No.: HCT-R-1608-F014-1
HCT FRN: 0005866421
IC Recognition No.: 5944A-5

FCC ID:	**W6UHM1900P**
IC:	**9354A-HM1900P**
APPLICANT:	**SOLiD, Inc**

FCC/ IC Model(s):	MRDU-1900PCS
EUT Type:	RDU(Remote Drive Unit)
Frequency Ranges:	1 850 MHz ~1 915 MHz (Uplink) / 1 930 MHz ~1 995 MHz (Downlink)
Conducted Output Power:	5.012 W (37 dBm)
Date of Test:	July 6, 2016 ~ August 10, 2016
FCC Rule Part(s):	CFR 47 Part 24
IC Rules :	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 2, July 2003)

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
Test Engineer of RF Team

Approved by
: Jong Seok Lee
Manager of RF Team

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1608-F014	August 10, 2016	- First Approval Report
HCT-R-1608-F014-1	September 19, 2016	-.Revised the IC ID

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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:	W6UHM1900P
IC:	9354A-HM1900P
EUT Type:	RDU(Remote Drive Unit)
FCC/ IC Model(s):	MRDU-1900PCS
Frequency Ranges:	1 850 MHz ~1 915 MHz (Uplink) / 1 930 MHz ~1 995 MHz (Downlink)
Conducted Output Power:	5.012 W (37 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 v03r02, KDB 935210 D05 v01r01, RSS-GEN, RSS-131
FCC Rule Part(s):	CFR 47 Part 24
IC Rules Part(s):	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 2, July 2003)
Place of Tests:	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 :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 24, RSS-GEN, RSS-131.

Description	Reference (FCC)	Reference (IC)	Results
Conducted RF Output Power	§2.1046, §24.232	RSS-131, Section 4.3 RSS-131, Section 6.2 SRSP-510	Compliant
Occupied Bandwidth	§2.1049	RSS-GEN, Section 6.6	Compliant
Passband Gain and Bandwidth & Out of Band Rejection	KDB 935210 D02 v03r02	RSS-131, Section 4.2 RSS-131, Section 6.1	Compliant
Spurious Emissions at Antenna Terminals	§2.1051, §24.238	RSS-131, Section 4.4 RSS-131, Section 6.3 RSS-131, Section 6.4 SRSP-510	Compliant
Radiated Spurious Emissions	§2.1053, §24.238	-	Compliant
Frequency Stability	§2.1055, §24.235	RSS-131, Section 4.5 RSS-131, Section 6.5	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 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
Passband Gain and Bandwidth & Out of Band Rejection	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Spurious Emissions at Antenna Terminals	-	± 1.08 dB
Radiated Spurious Emissions	f ≤ 1 GHz f > 1 GHz	± 4.80 dB ± 6.07 dB
Frequency Stability	-	± 1.22 x 10^{-6}

4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

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

5. TEST EQUIPMENT

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	E4438C /Signal Generator	09/02/2015	Annual	MY42082646
Agilent	N5182A /Signal Generator	03/29/2016	Annual	MY50141649
Agilent	N5182A /Signal Generator	05/13/2016	Annual	MY47070230
Agilent	N9030A / Signal Analyzer	11/24/2015	Annual	MY49431210
Weinschel	67-30-33 / Fixed Attenuator	10/29/2015	Annual	BR5347
Weinschel	1506A / Power Divider	02/15/2016	Annual	MD793
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/06/2016	Annual	1003030-1
AMETEK	XFR 60-20 / DC Power Supply	02/27/2016	Annual	1045A01016
NANGYEUL CO., LTD.	NY-THR18750 / Temperature and Humidity Chamber	10/27/2015	Annual	NY-2009012201A
Innco system	MA4000-EP / Antenna Position Tower	N/A	N/A	N/A
Innco system	CT0800 / Turn Table	N/A	N/A	N/A
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
ETS	2090 / Controller(Turn table)	N/A	N/A	1646
Rohde&Schwarz	Loop Antenna	02/23/2016	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/15/2015	Biennial	255
Schwarzbeck	BBHA 9120D / Horn Antenna	08/26/2014	Biennial	9120D-1300
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	09/03/2015	Biennial	BBHA9170541
Rohde & Schwarz	FSP / Spectrum Analyzer	10/05/2015	Annual	836650/016
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/23/2015	Annual	101068-SZ
Wainwright Instruments	WHK1.2/15G-10EF / Highpass Filter	04/11/2016	Annual	4
Wainwright Instruments	WHK3.0/18G-10EF / Highpass Filter	06/24/2016	Annual	8
CERNEX	CBLU1183540 / Power Amplifier	02/01/2016	Annual	24614
CERNEX	CBL06185030 / Power Amplifier	02/01/2016	Annual	24615
CERNEX	CBL18265035 / Power Amplifier	07/11/2016	Annual	22966

6. RF OUTPUT POWER

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output:

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8).The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radio telephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§ 24.232 Power and antenna height limits.

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

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

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

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

Test Procedures:

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

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

b) Configure to generate the AWGN (broadband) test signal.

c) The frequency of the signal generator shall be set to the frequency f0 as determined from 3.3.

d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.

e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.

f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.

g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.

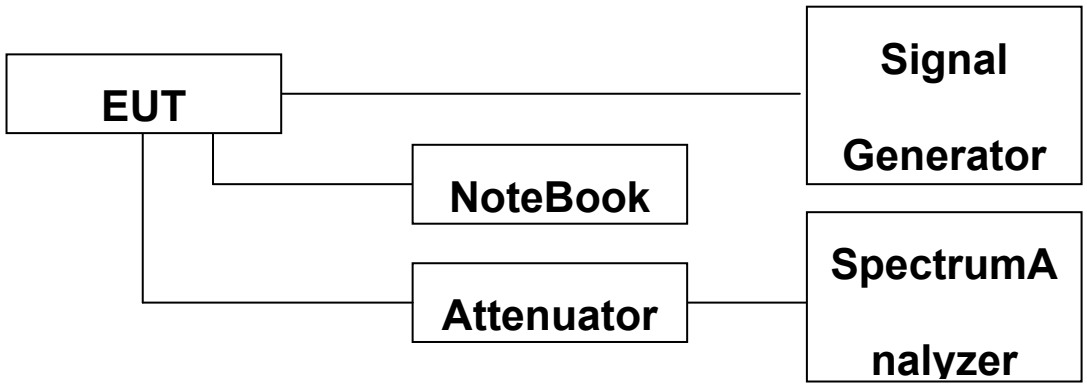
h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.

i) Repeat steps e) to h) with the narrowband test signal.

j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.

Power measurement Method :

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



Block Diagram 1. RF Power Output Test Setup

IC Rules

Test Requirements:

SRSP-510

5. Technical Criteria

5.1 Radiated Power and Antenna Height Limits

5.1.1 Base Stations

For base stations with channel bandwidth equal to or less than 1 MHz, the maximum equivalent isotropically radiated power (e.i.r.p.) is limited to 3280 watts with an antenna height above average terrain (HAAT) up to 300 metres. Base stations operating in urban areas are limited to a maximum allowable e.i.r.p. of 1640 watts. Base station antenna heights above average terrain may exceed 300 metres with a corresponding reduction in e.i.r.p. according to the following table:

HAAT[5] (in metres)	Maximum e.i.r.p. (watts)
≤ 300	3280 or 1640[6]
≤ 500	1070
≤1000	490
≤1500	270
≤2000	160

For base stations with a channel bandwidth greater than 1 MHz, the maximum e.i.r.p. is limited to 3280 watts/MHz e.i.r.p. (i.e., no more than 3280 watts e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 metres. Fixed or base stations operating in urban areas are limited to a maximum allowable e.i.r.p. of 1640 watts/MHz e.i.r.p. Base station antenna heights above average terrain may exceed 300 metres with a corresponding reduction ine.i.r.p. according to the following table:

HAAT[5] (in metres)	Maximum e.i.r.p. (watts per MHz)
≤ 300	3280 or 1640[6]
≤ 500	1070
≤1000	490
≤1500	270
≤2000	160

Base stations transmitting in the lower sub-band shall comply with the power limits set forth in section 5.1.2, i.e. the same as mobile stations.

The service area boundary limit specified in section 6 applies.

RSS-131

6. Equipment Standard Specification

6.2 Output Power

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

Additional Power Back-off Condition for Multiple Carrier Operations:

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

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

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

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

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

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

Test Procedures:

RSS-131

4. Measurement Methods

4.3.1 Multi-channel Enhancer

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

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

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

Set the two generator frequencies f_1 and f_2 such that they and their third-order intermodulation product frequencies, $f_3 = 2f_1-f_2$ and $f_4 = 2f_2 - f_1$, are all within the passband of the DUT.

Raise the input level to the DUT while observing the output tone levels, P_{o1} and P_{o2}, and the intermodulation product levels, P_{o3} and P_{o4}.

For enhancers rated 500 watts or less: Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, P_{o3} or P_{o4}, equals -43 dBW.

For enhancers rated over 500 watts: Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, P_{o3} or P_{o4}, is 67 dB below the level of either output tone level, P_{o1} or P_{o2}.

Record all signal levels and their frequencies. Calculate the mean output power (P_{mean}) under this testing condition using $P_{mean} = P_{o1} + 3$ dB.

4.3.2 Single Channel Enhancer

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

Test Results:

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

Single channel Enhancer

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

[Downlink]

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
1900 PCS Band _ LTE 5 MHz AGC threshold	Low	1932.50	37.17	5.213
	Middle	1962.50	37.70	5.885
	High	1992.50	37.50	5.621
1900 PCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	1992.50	37.64	5.808
	Middle	1992.50	37.01	5.027
	High	1992.50	37.35	5.435
1900 PCS Band _ LTE 10 MHz AGC threshold	Low	1935.00	37.19	5.241
	Middle	1962.50	37.34	5.414
	High	1990.00	37.19	5.231
1900 PCS Band _ LTE 10 MHz +3dBm above the AGC threshold	Low	1935.00	37.07	5.089
	Middle	1962.50	37.79	6.012
	High	1990.00	37.72	5.920
1900 PCS Band _ LTE 20 MHz AGC threshold	Low	1940.00	37.32	5.400
	Middle	1962.50	37.53	5.667
	High	1985.00	37.10	5.134
1900 PCS Band _ LTE 20 MHz +3dBm above the AGC threshold	Low	1940.00	37.35	5.432
	Middle	1962.50	37.72	5.922
	High	1985.00	37.50	5.627

	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
1900 PCS Band _ CDMA AGC threshold	Low	1931.25	37.28	5.348
	Middle	1962.50	37.56	5.704
	High	1993.75	37.26	5.323
1900 PCS Band _ CDMA +3dBm above the AGC threshold	Low	1931.25	37.86	6.108
	Middle	1962.50	37.35	5.435
	High	1993.75	37.63	5.801
1900 PCS Band _ WCDMA AGC threshold	Low	1932.50	37.47	5.589
	Middle	1962.50	37.61	5.771
	High	1992.50	37.42	5.523
1900 PCS Band _ WCDMA +3dBm above the AGC threshold	Low	1932.50	37.14	5.179
	Middle	1962.50	37.52	5.653
	High	1992.50	37.81	6.045

Multi-channel Enhancer for IC

* 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	
			Po1(dBm)	Pmean(dBm)
1900 PCS Band	Low	1930.40	34.096	37.096
	Middle	1962.50	34.039	37.039
	High	1994.60	34.051	37.051

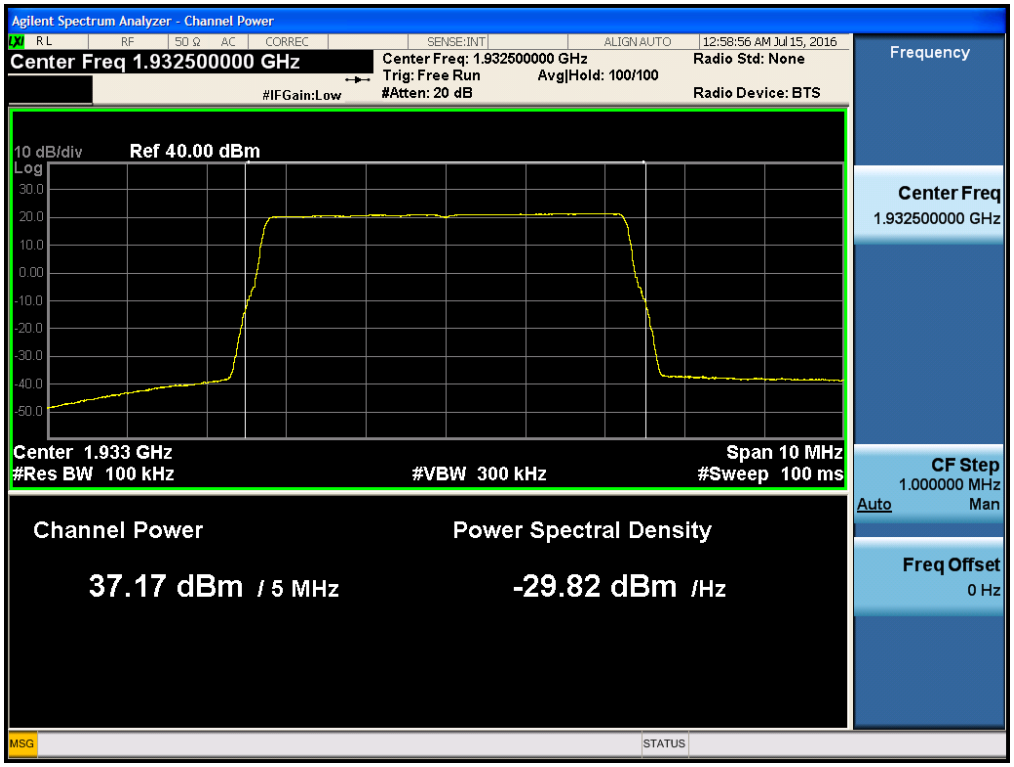
Additional Power Back-off Condition for Multiple Carrier Operations for IC

[Downlink]

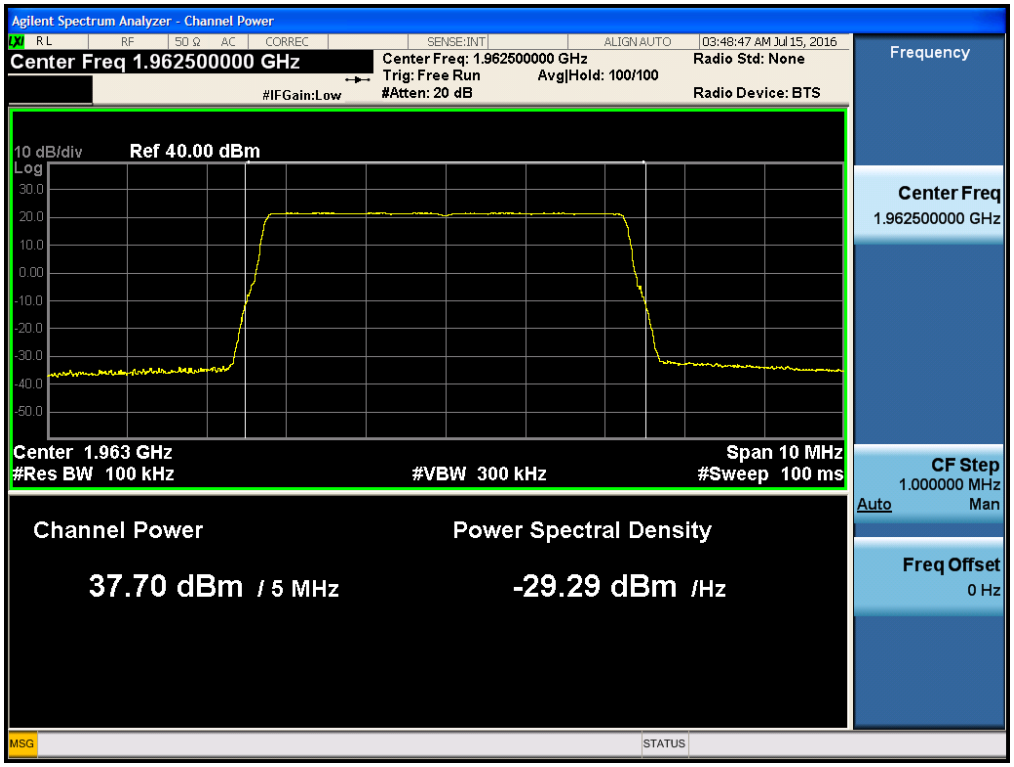
	1 Carrier (dBm)	3 Carrier (dBm)	Power Back-off (dB)
1900 PCS Band	37.70	32.70	5.00

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

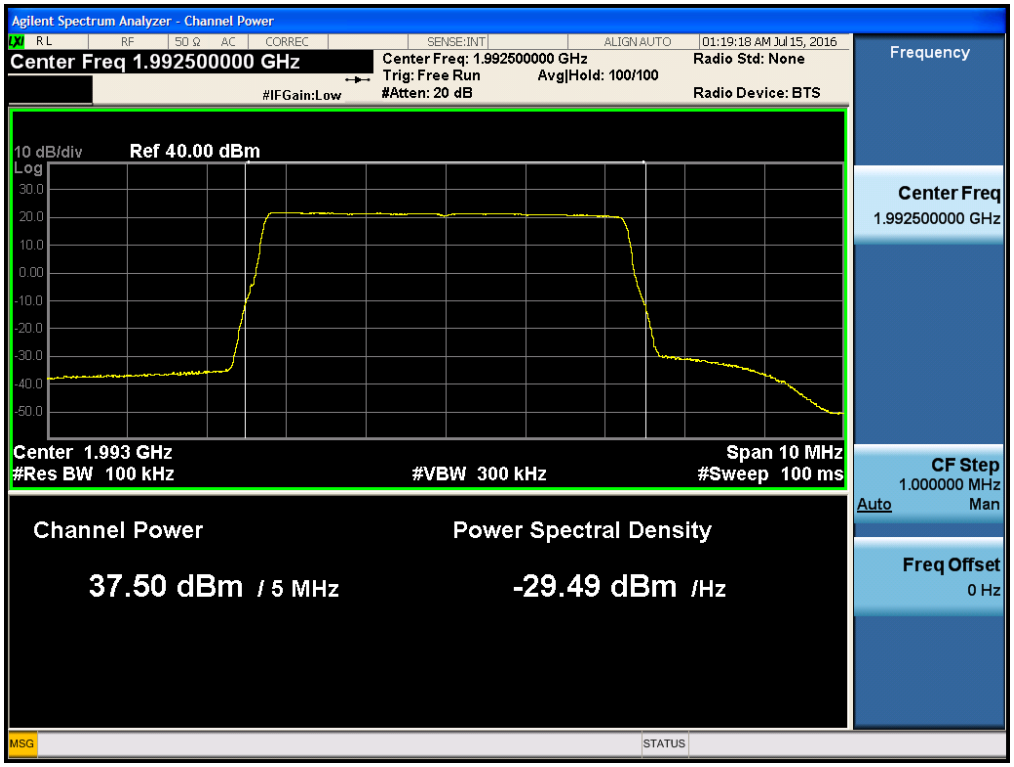
[AGC threshold Downlink Low]



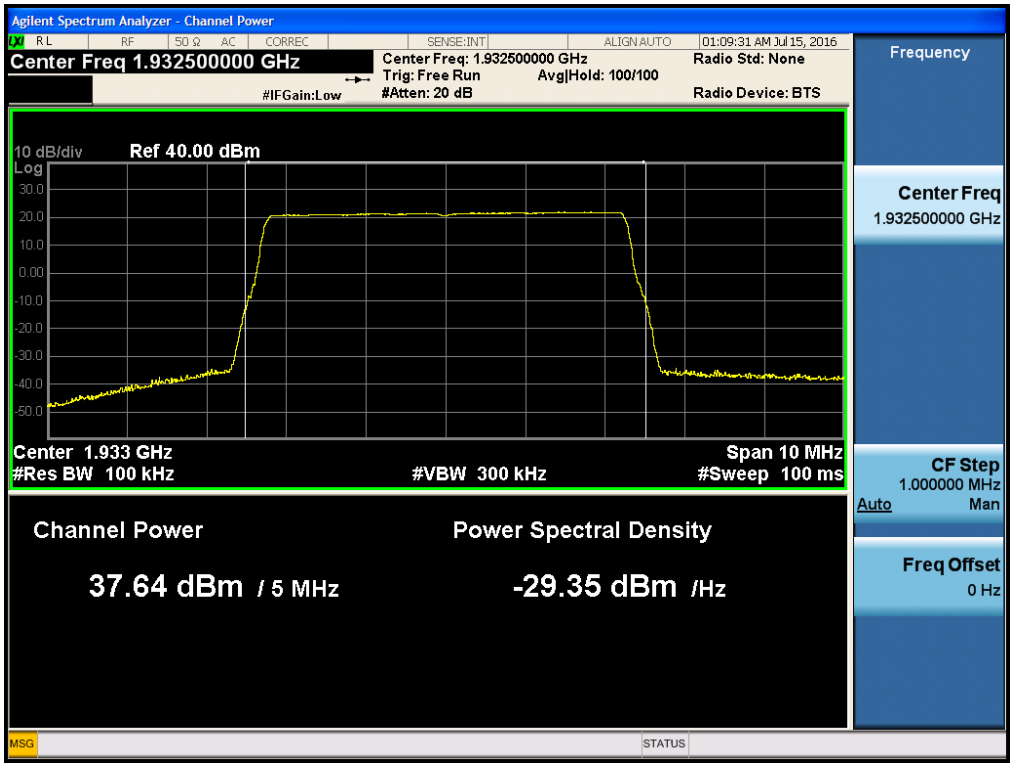
[AGC threshold Downlink Middle]



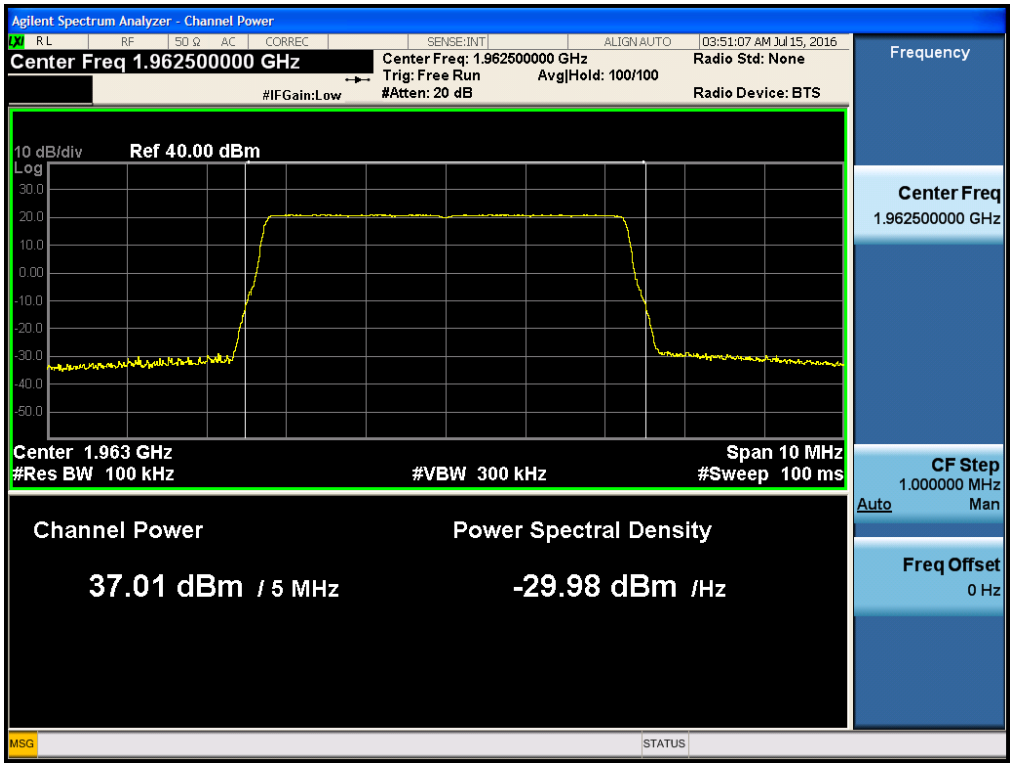
[AGC threshold Downlink High]



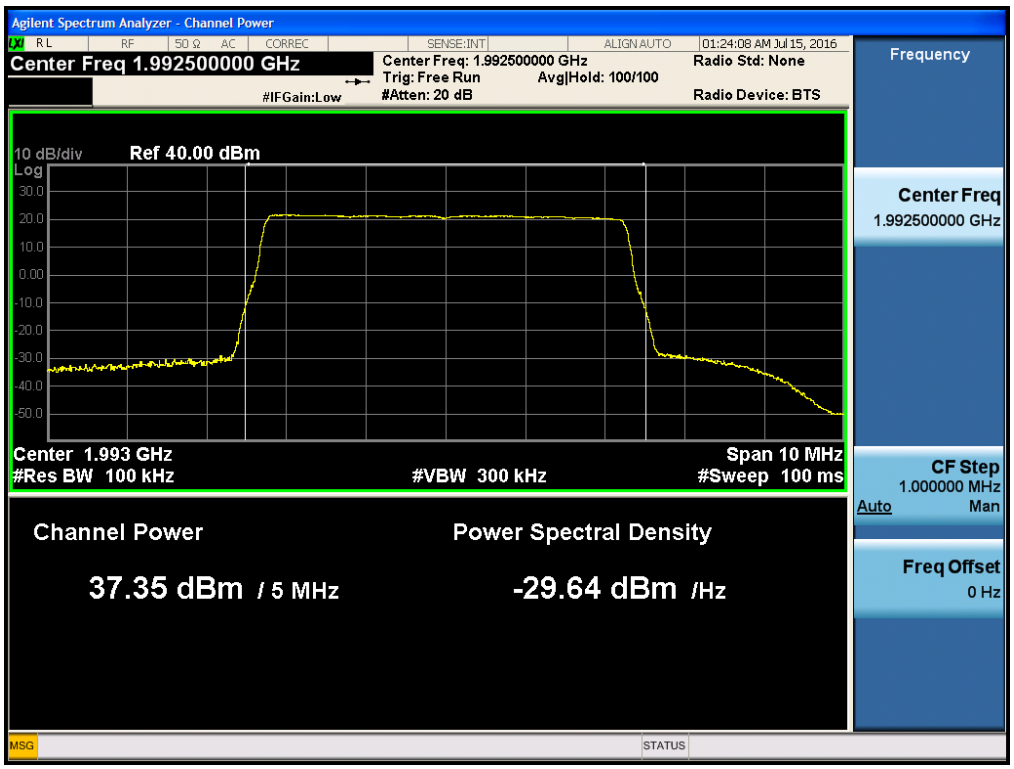
[+3dBm above AGC threshold Downlink Low]



[+3dBm above AGC threshold Downlink Middle]

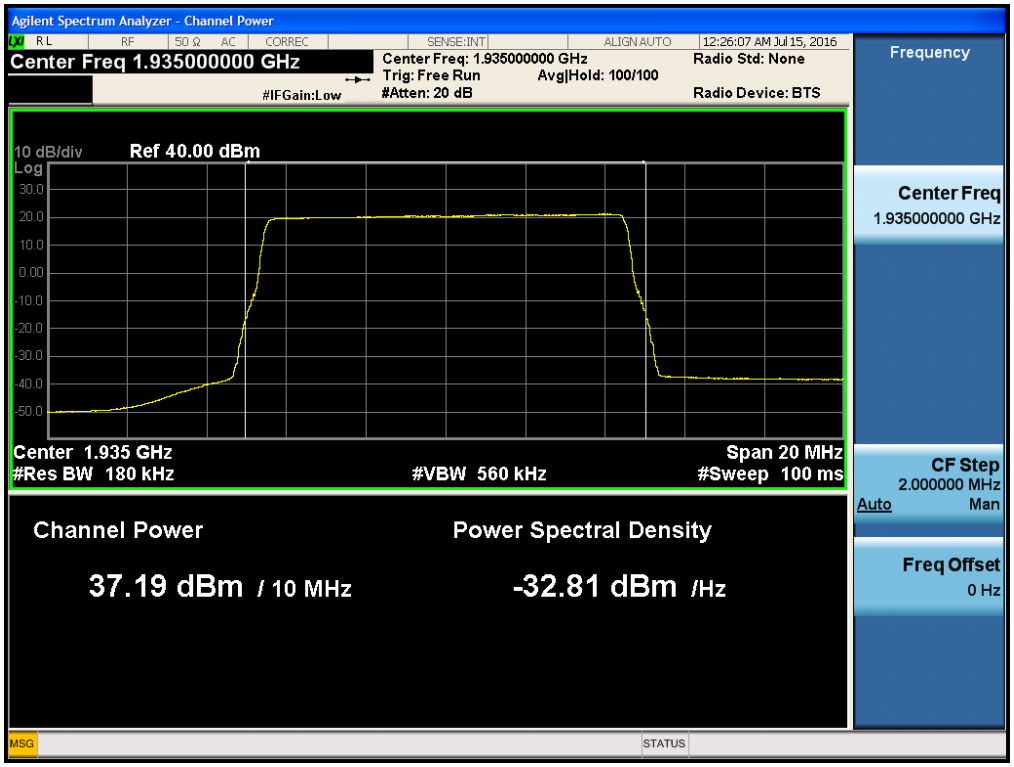


[+3dBm above AGC threshold Downlink High]

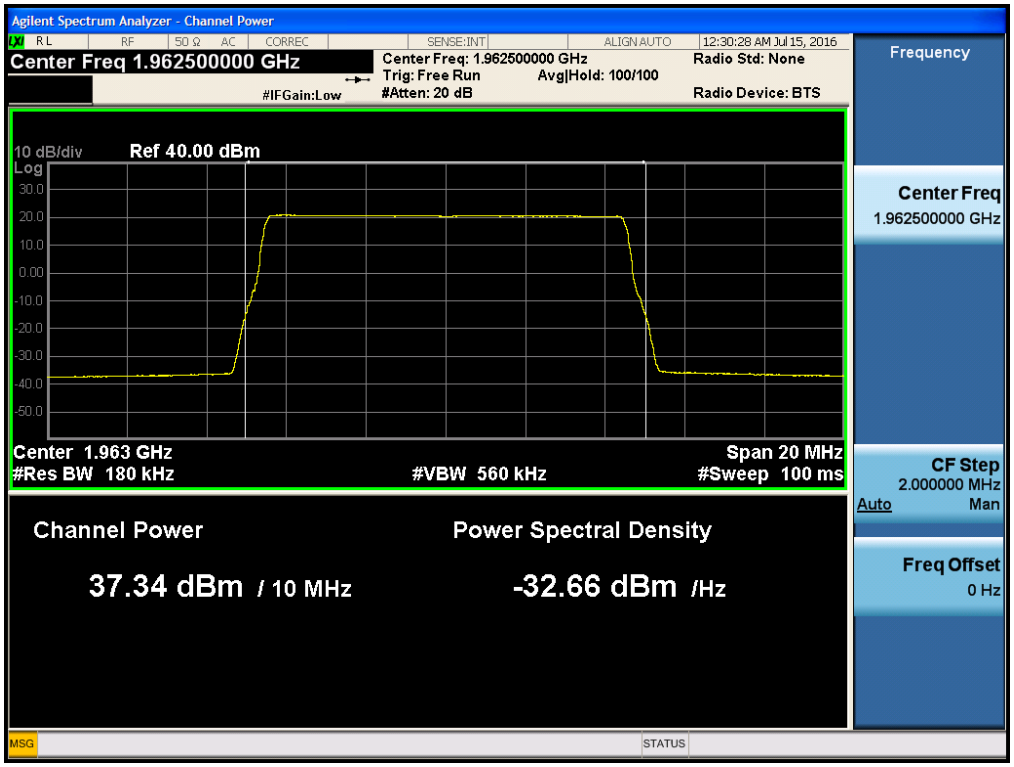


Plots of RF Output Power for 1900 PCS Band LTE 10 MHz

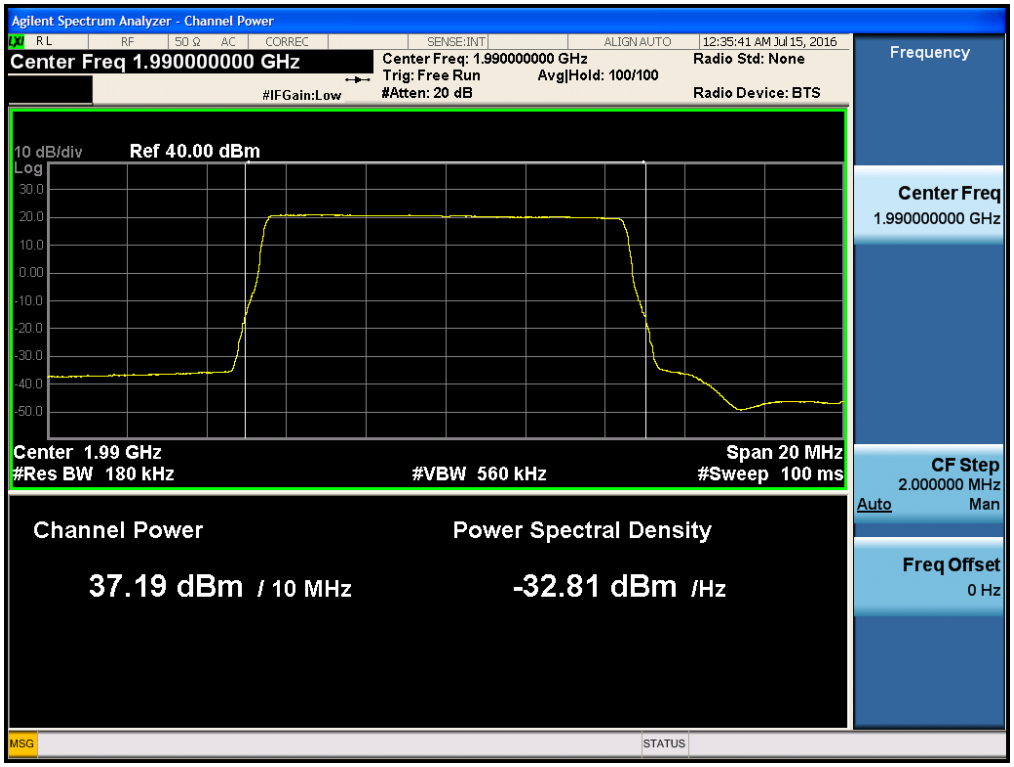
[AGC threshold Downlink Low]



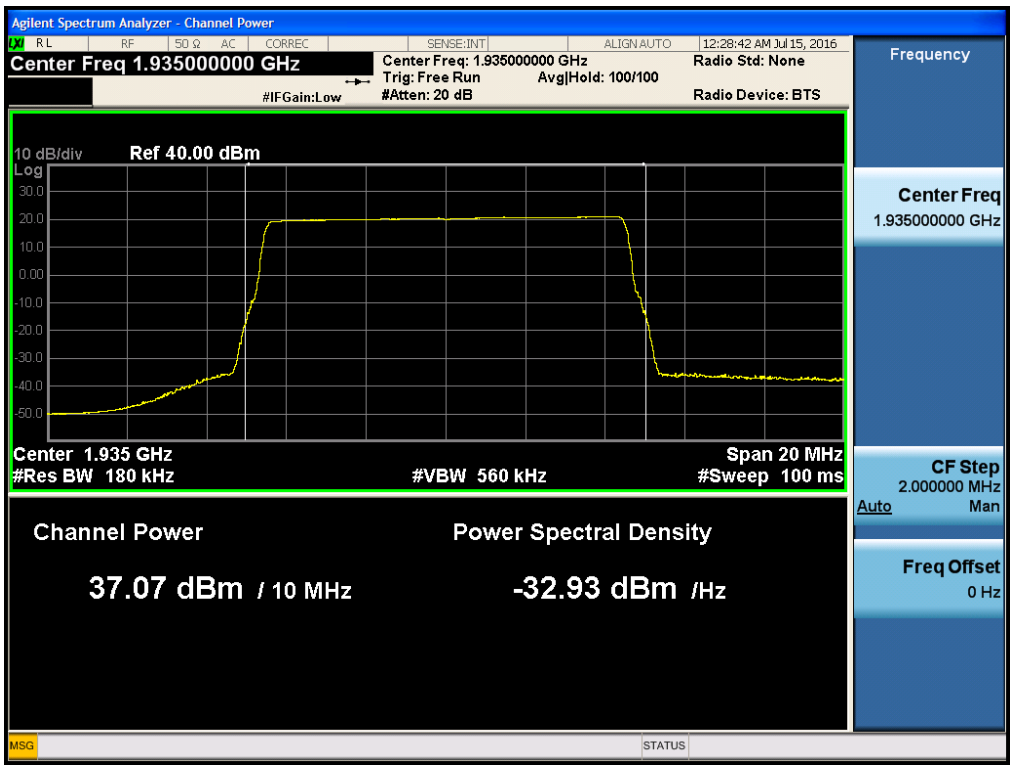
[AGC threshold Downlink Middle]



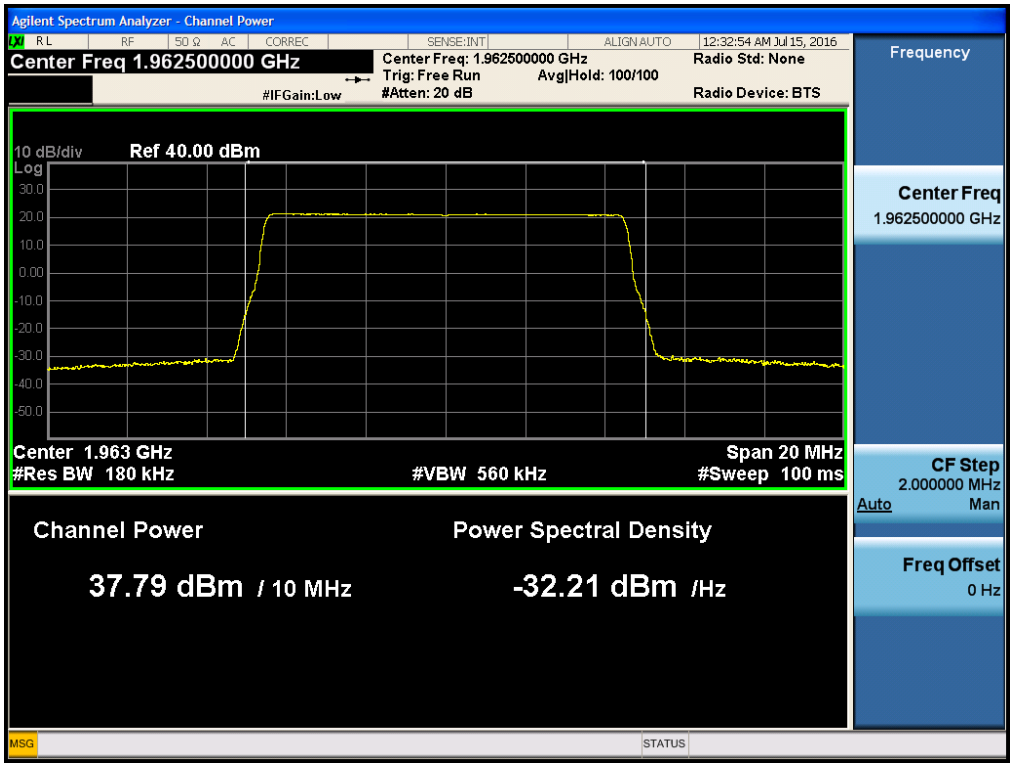
[AGC threshold Downlink High]



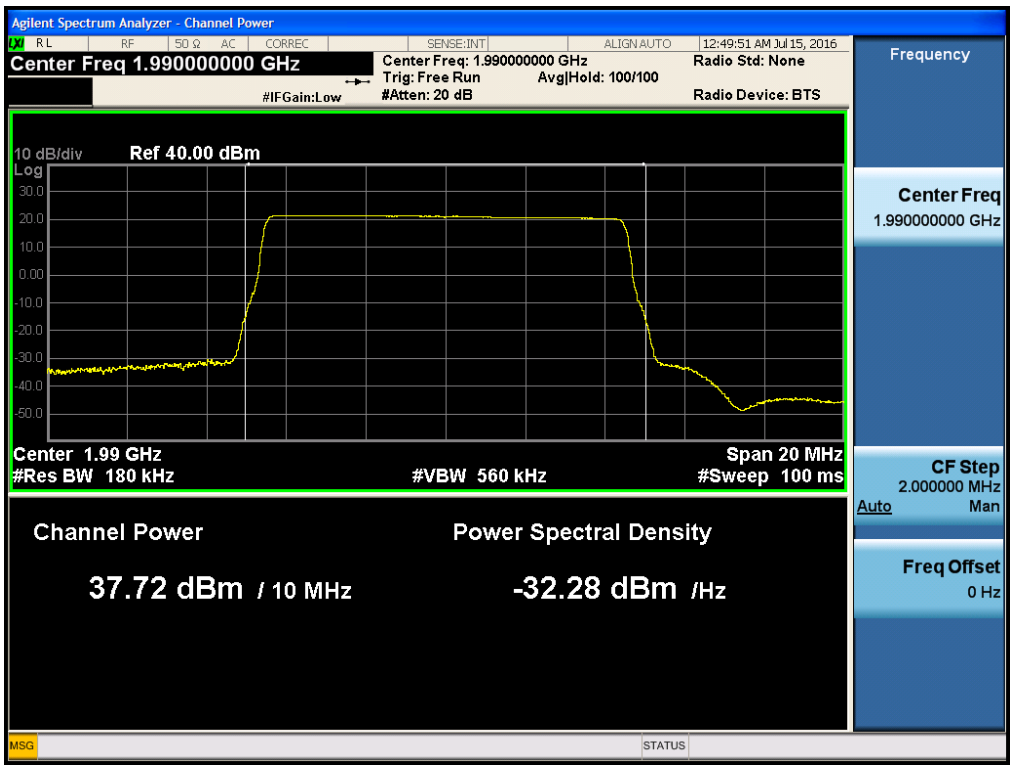
[+3dBm above AGC threshold Downlink Low]



[+3dBm above AGC threshold Downlink Middle]

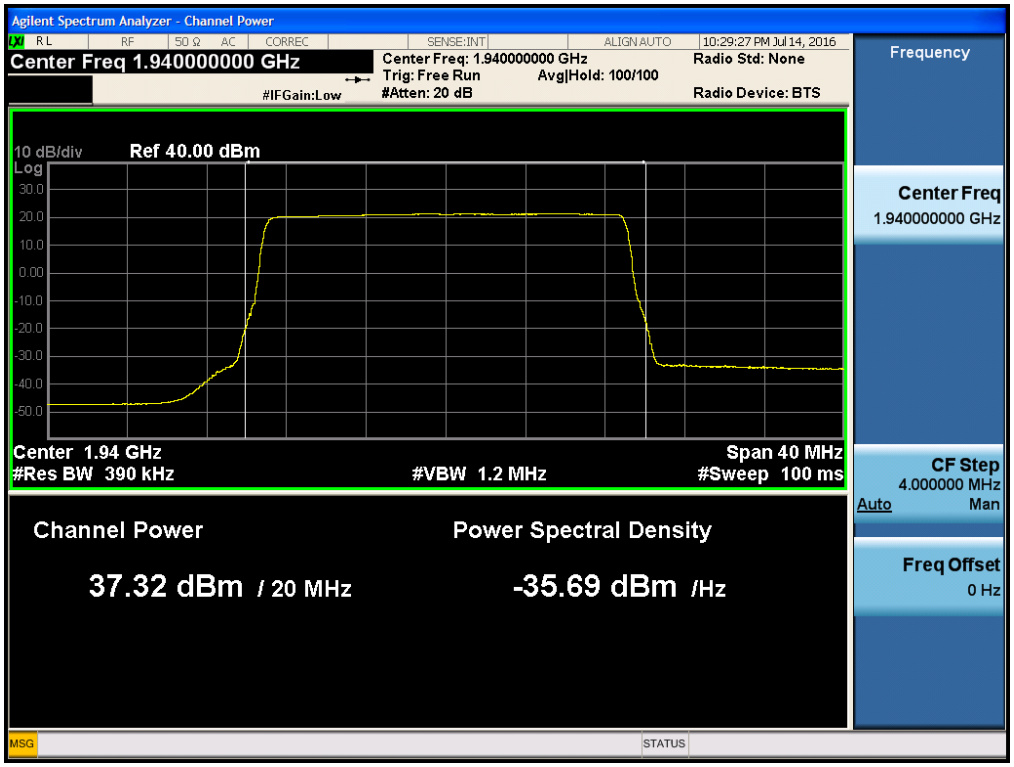


[+3dBm above AGC threshold Downlink High]

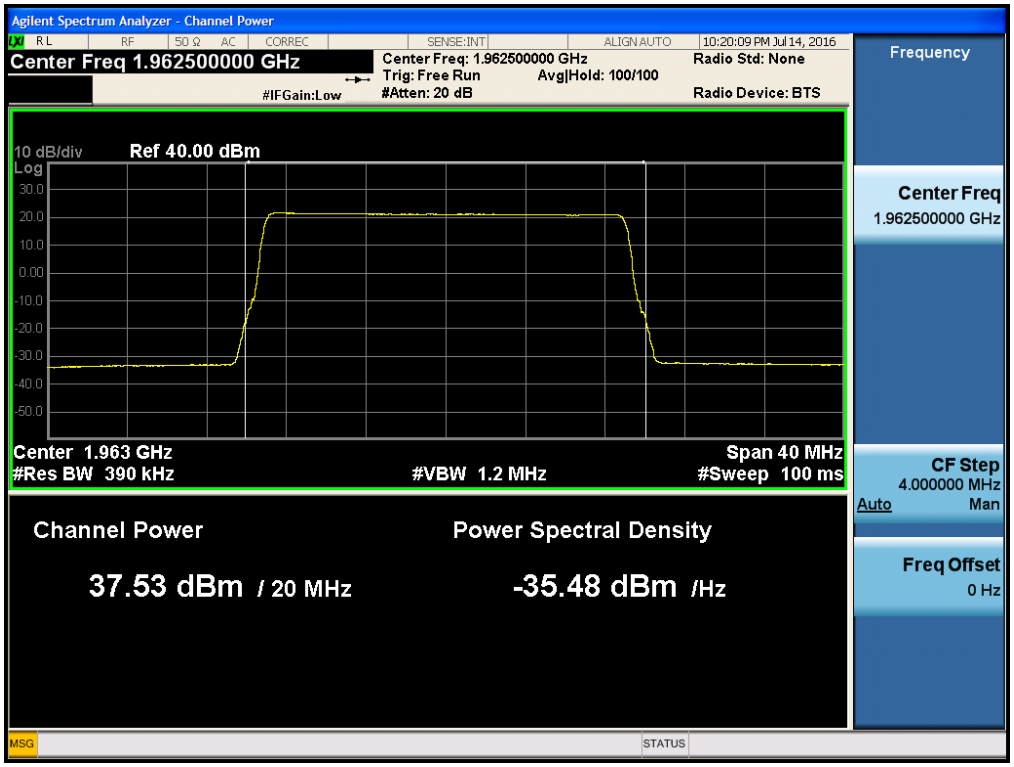


Plots of RF Output Power for 1900 PCS Band LTE 20 MHz

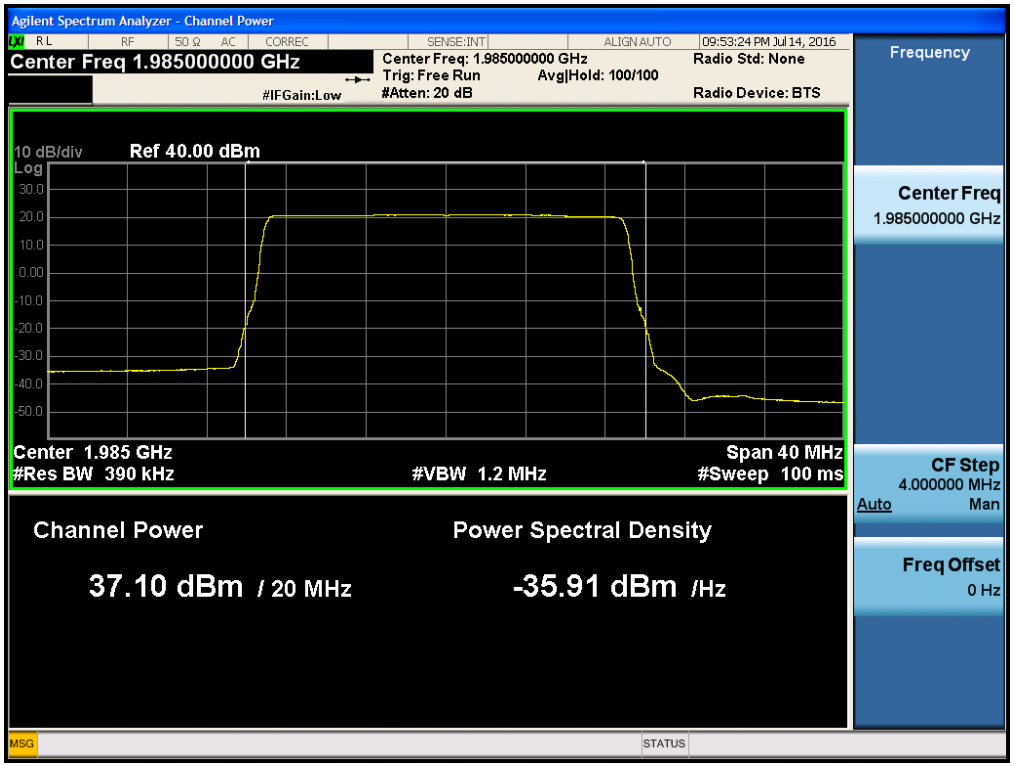
[AGC threshold Downlink Low]



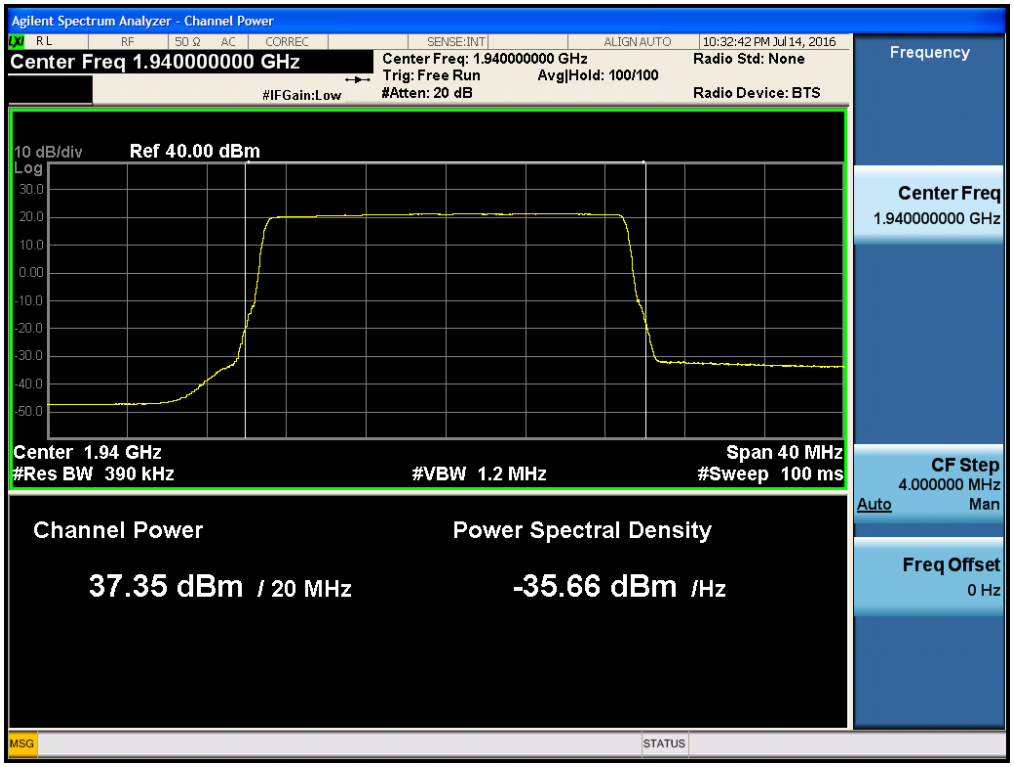
[AGC threshold Downlink Middle]



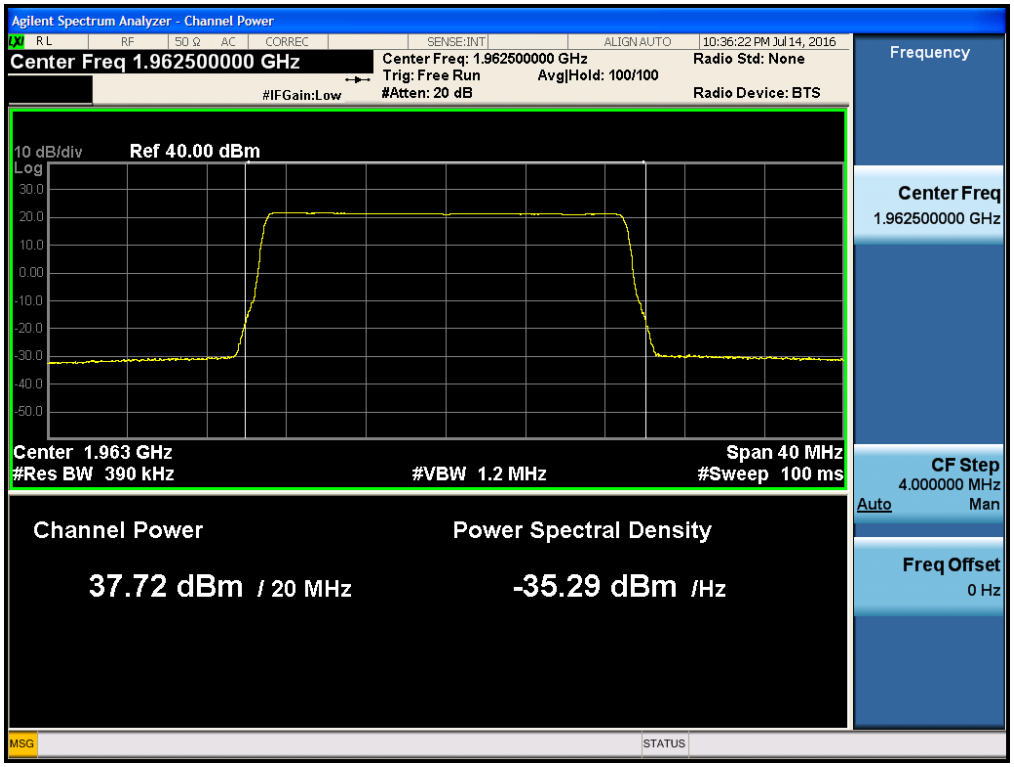
[AGC threshold Downlink High]



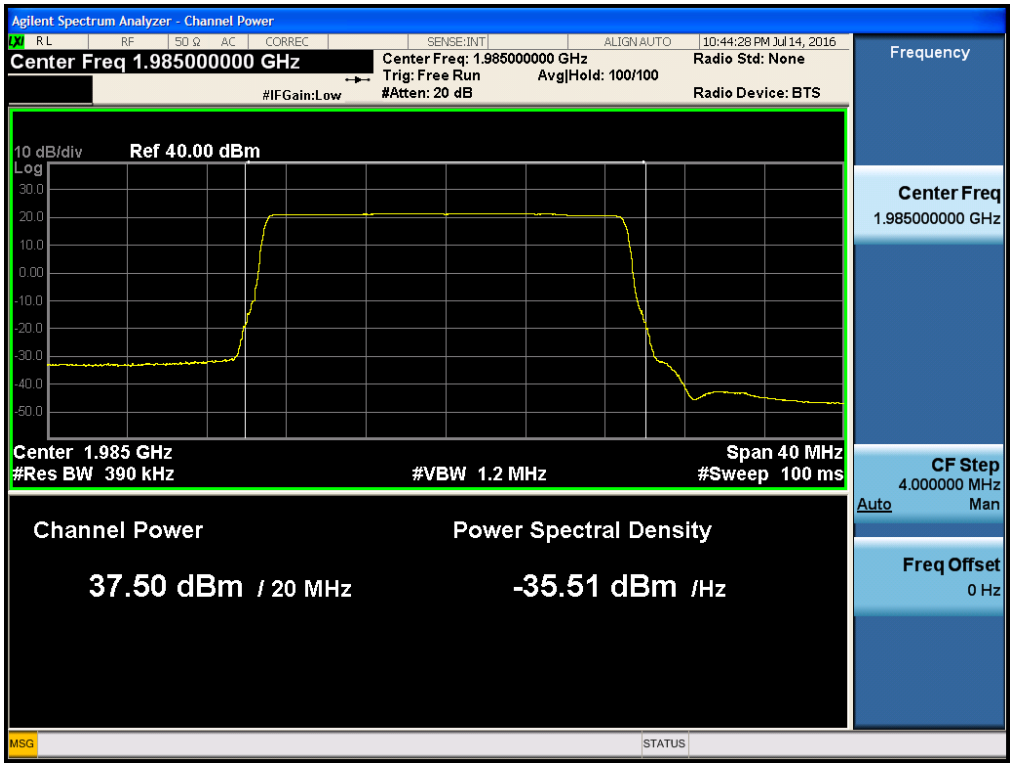
[+3dBm above AGC threshold Downlink Low]



[+3dBm above AGC threshold Downlink Middle]

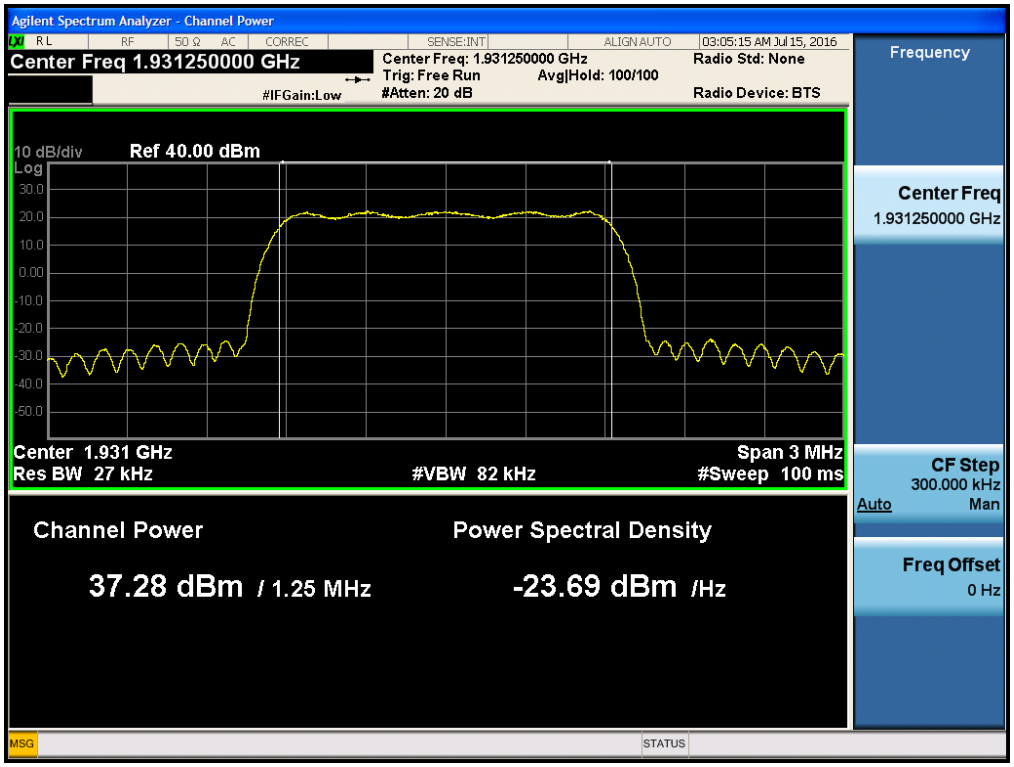


[+3dBm above AGC threshold Downlink High]

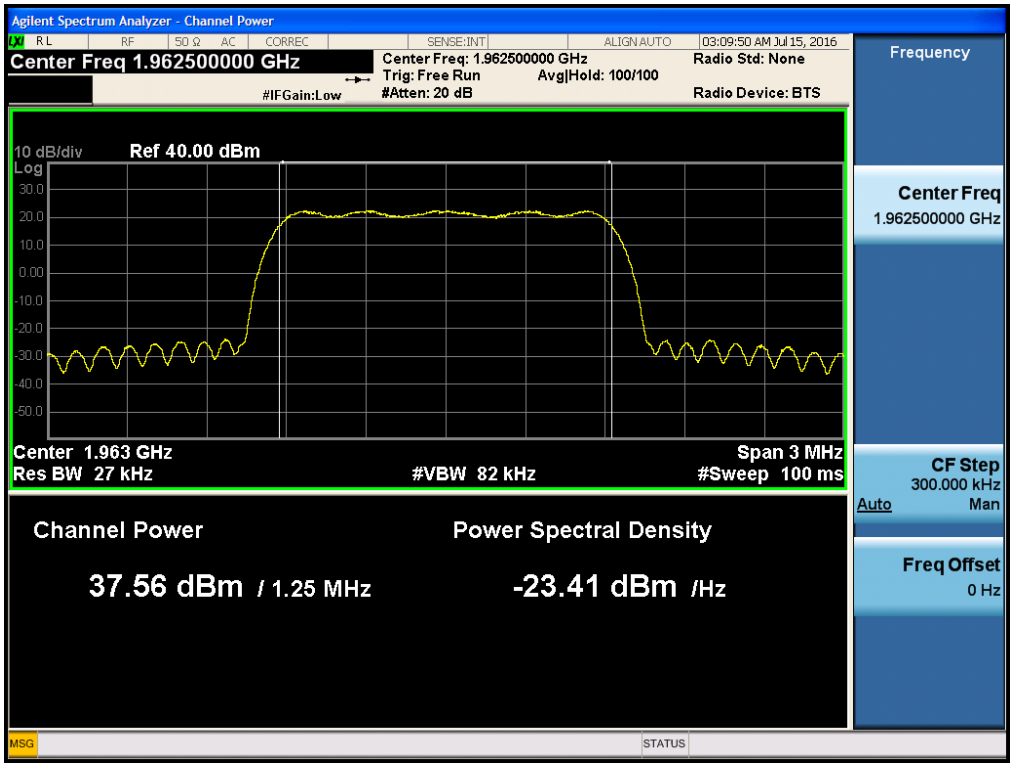


Plots of RF Output Power for 1900 PCS Band CDMA

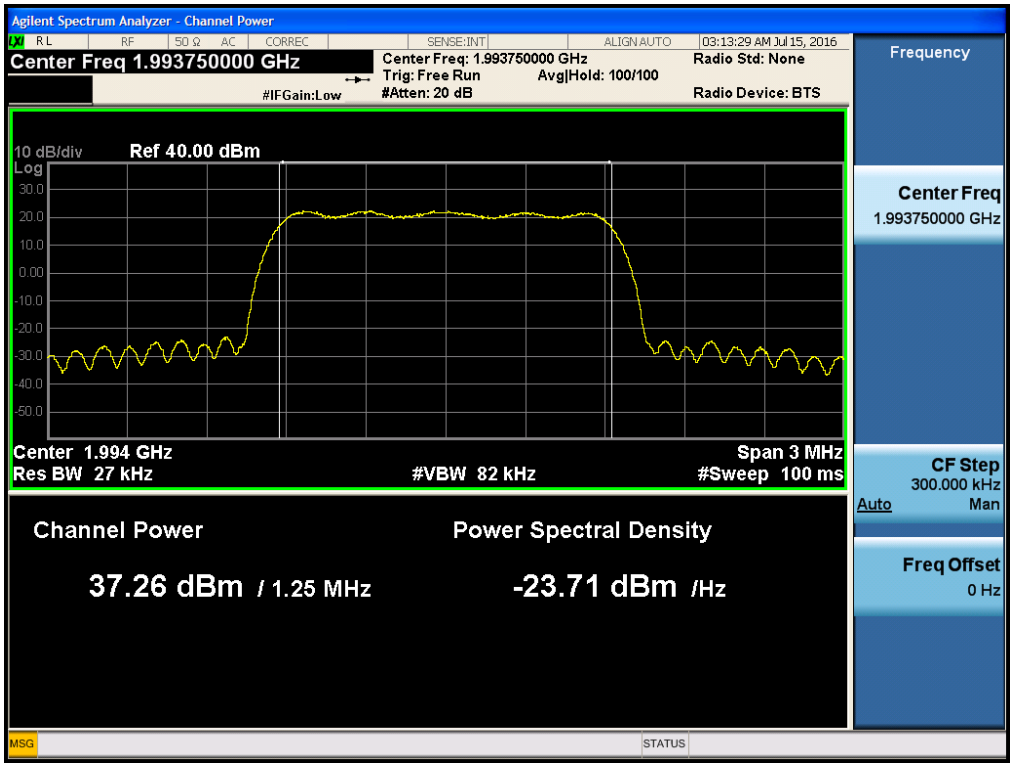
[AGC threshold Downlink Low]



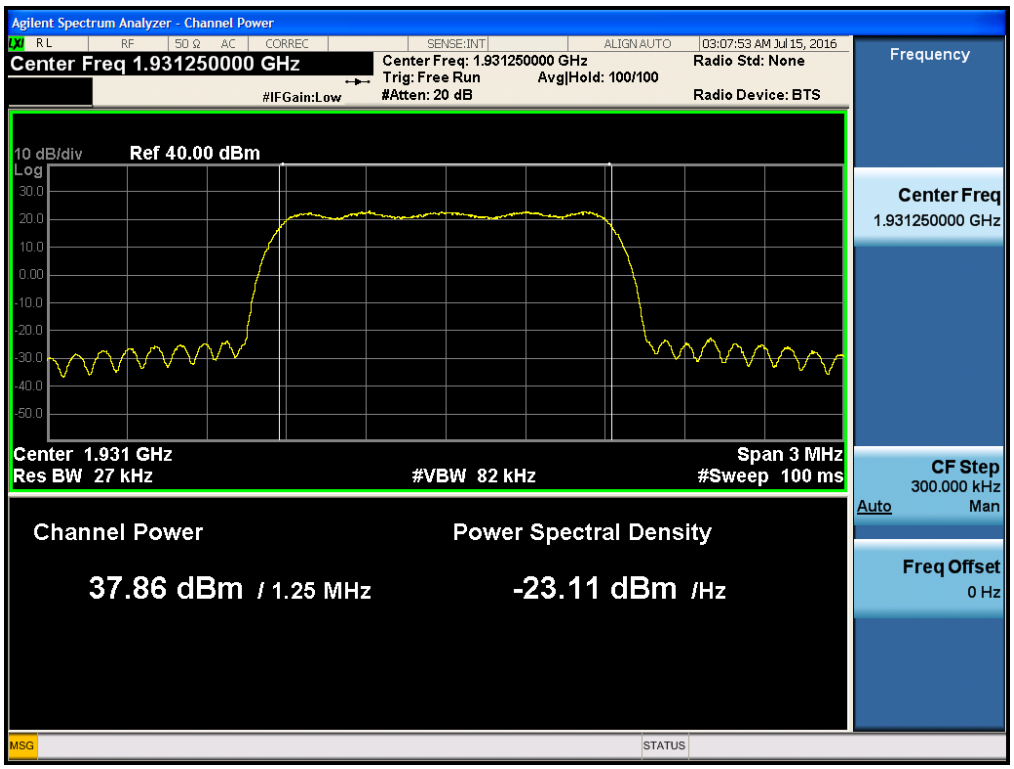
[AGC threshold Downlink Middle]



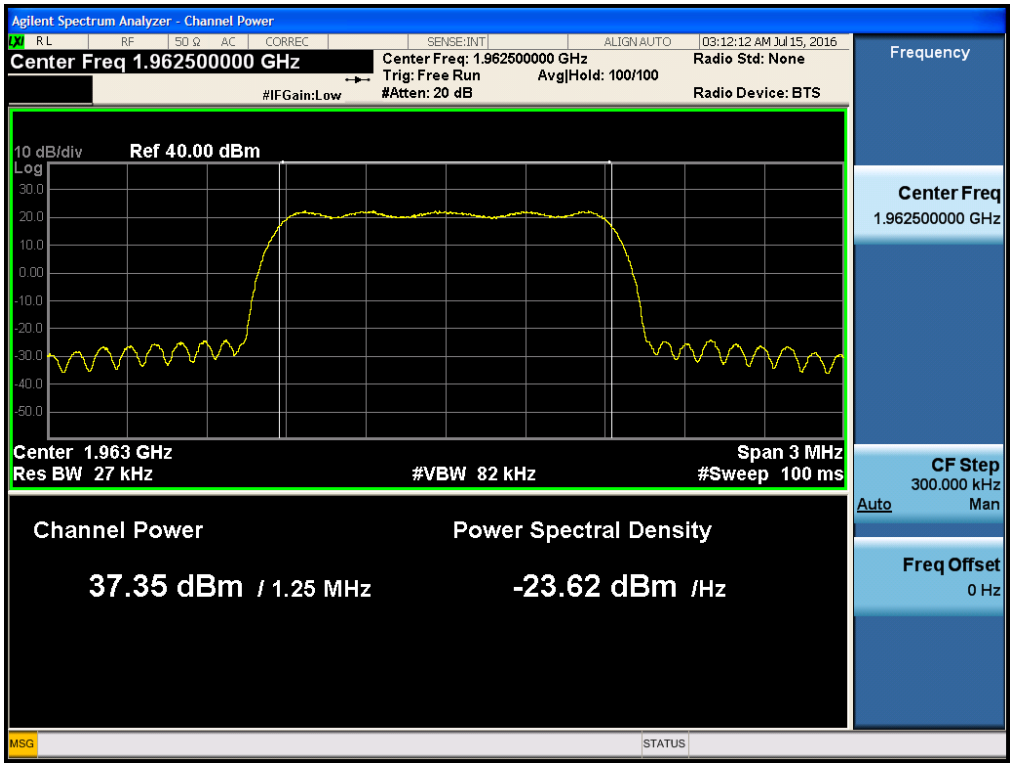
[AGC threshold Downlink High]



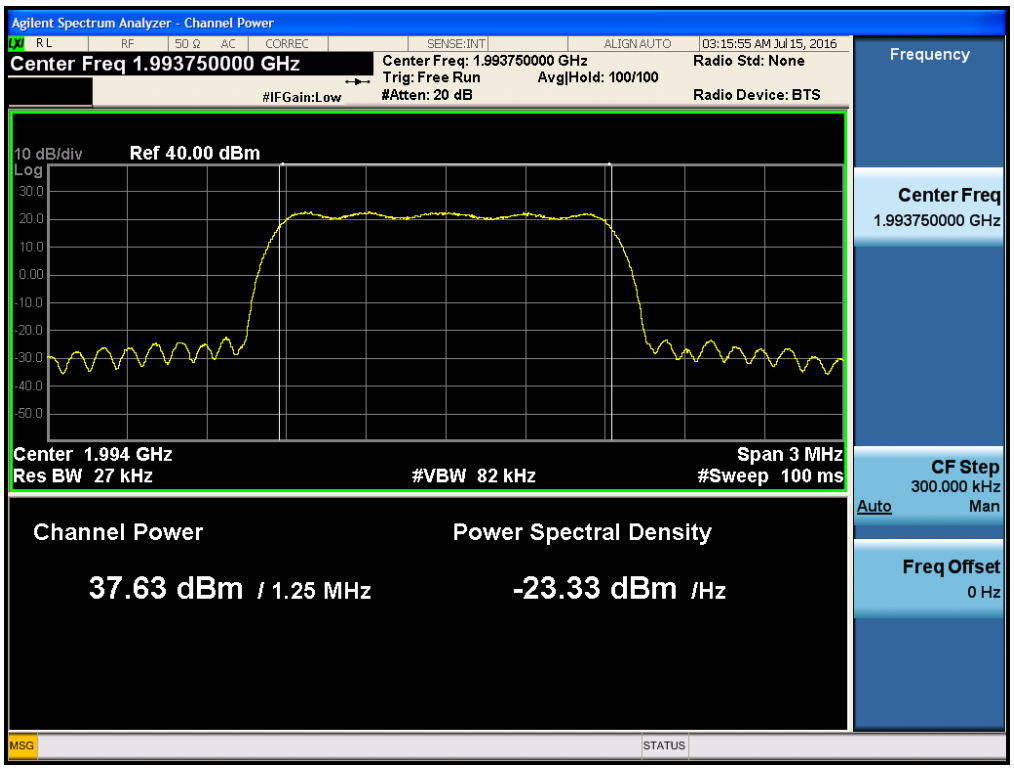
[+3dBm above AGC threshold Downlink Low]



[+3dBm above AGC threshold Downlink Middle]

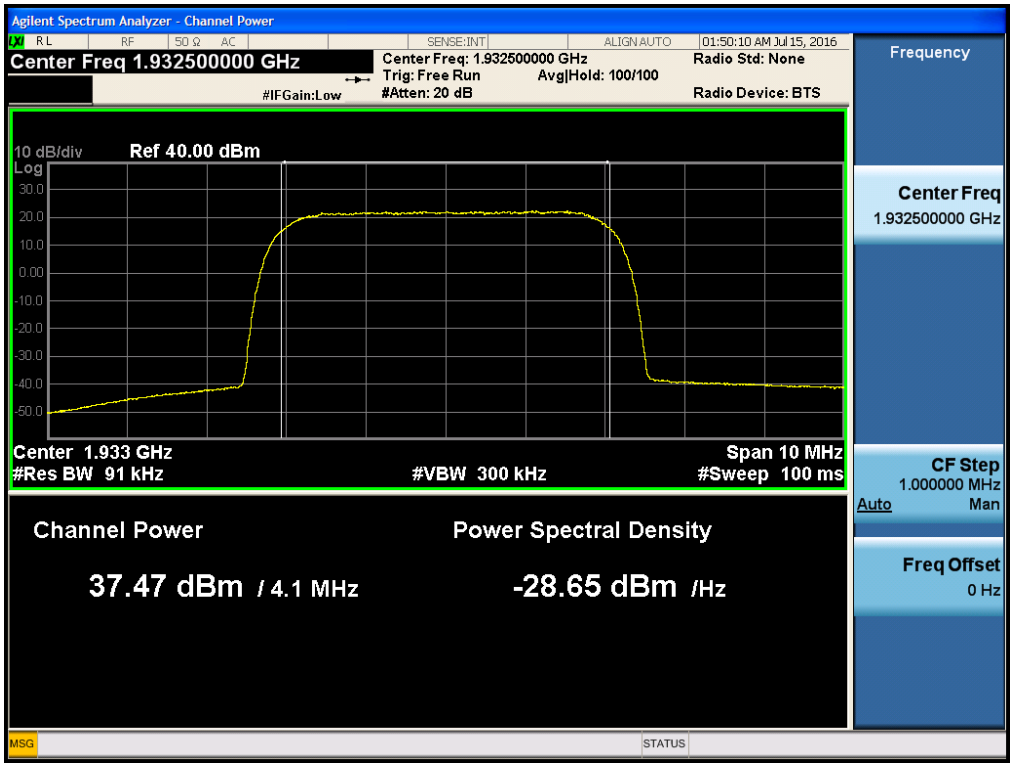


[+3dBm above AGC threshold Downlink High]

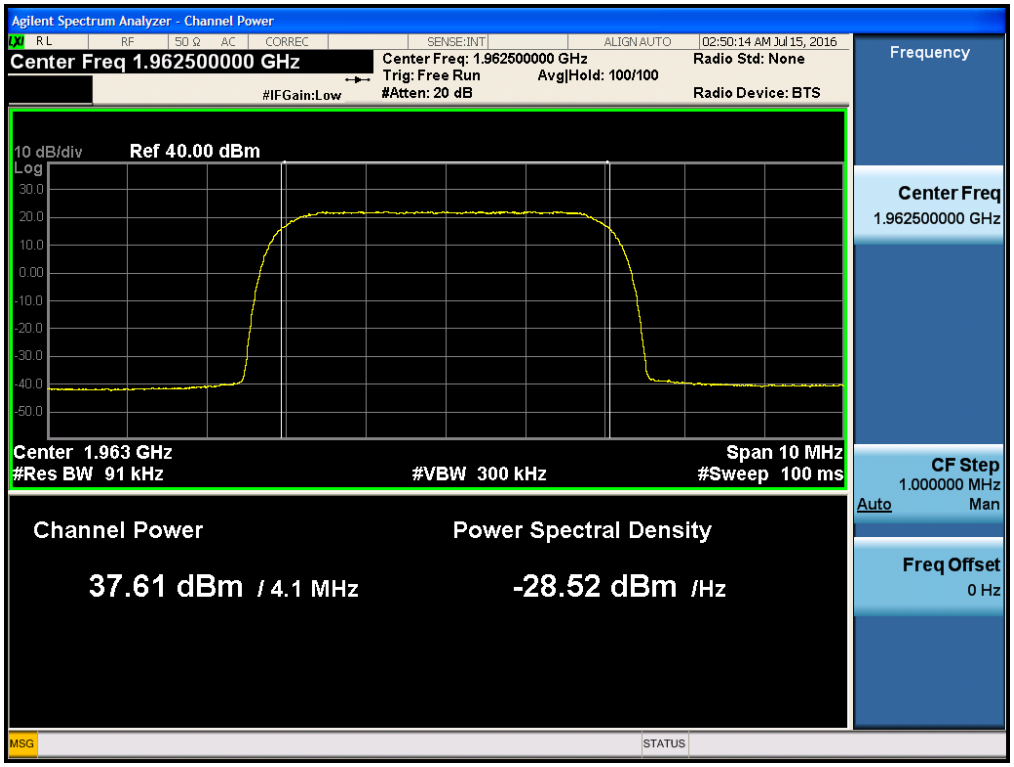


Plots of RF Output Power for 1900 PCS Band WCDMA

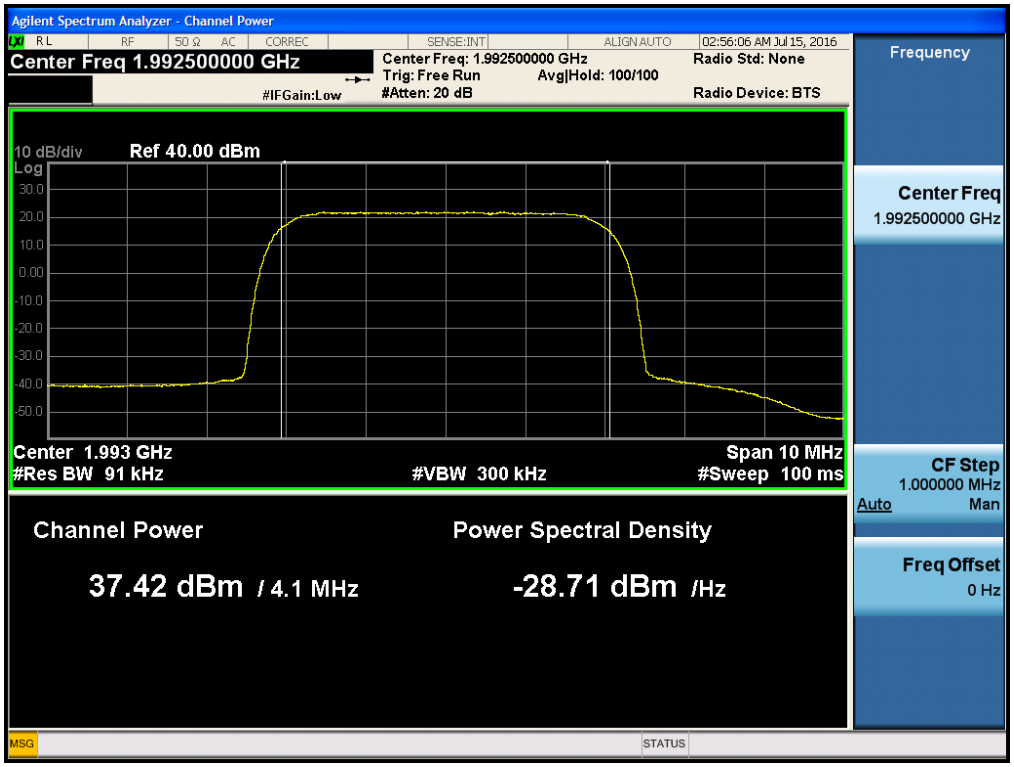
[AGC threshold Downlink Low]



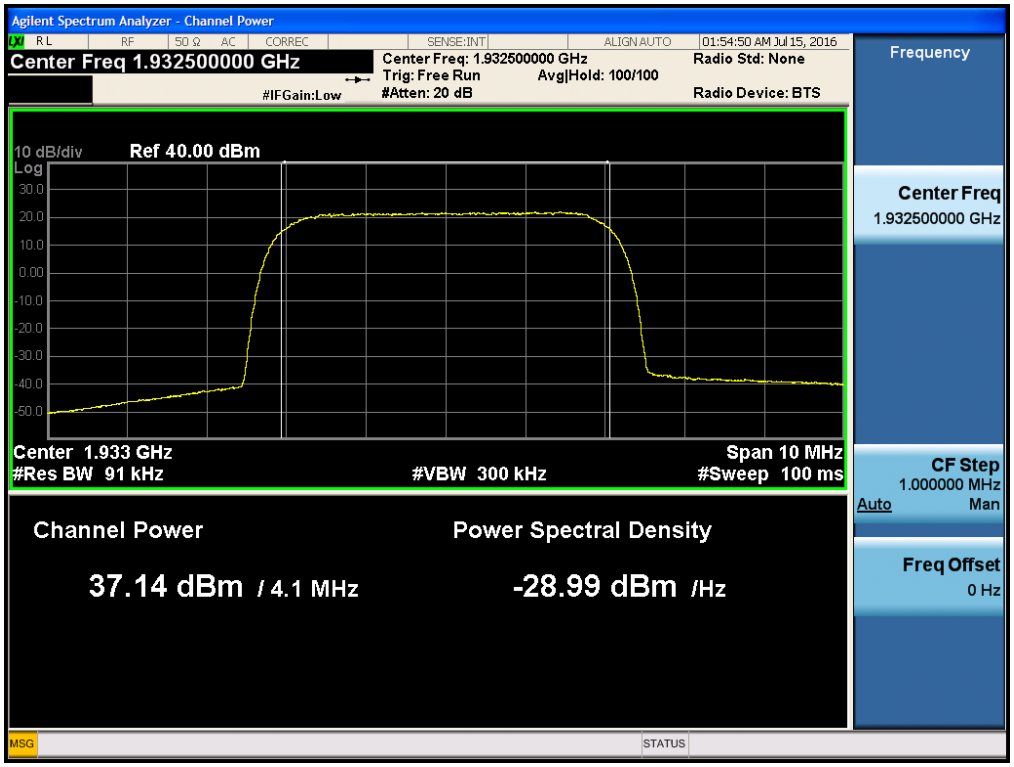
[AGC threshold Downlink Middle]



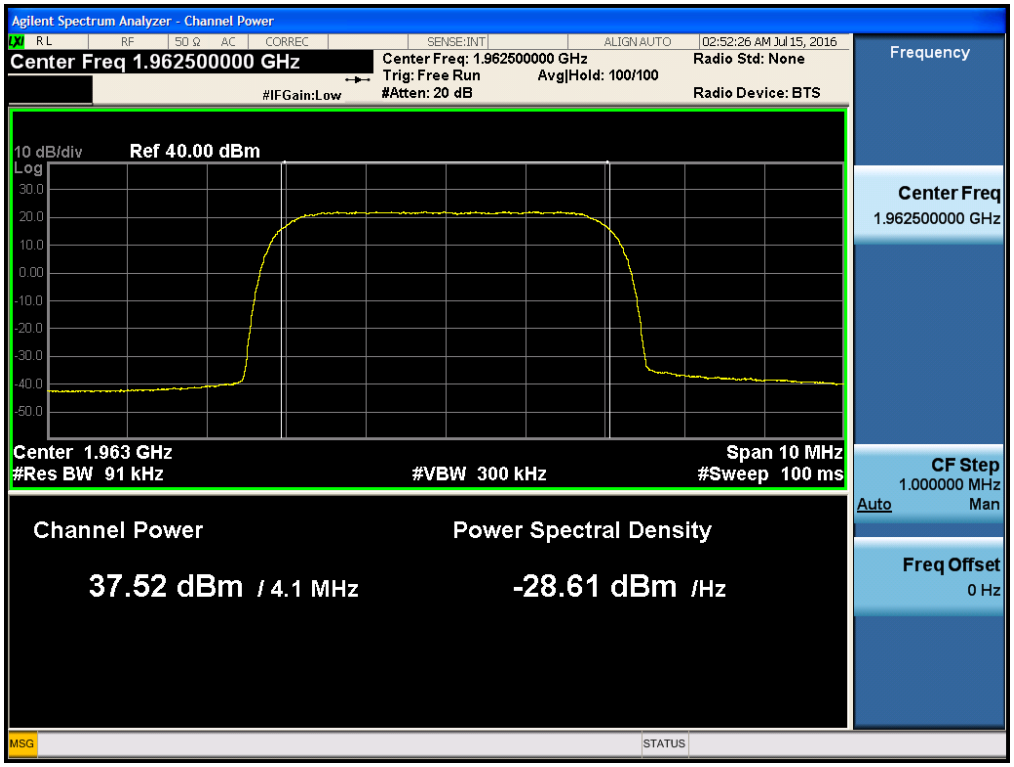
[AGC threshold Downlink High]



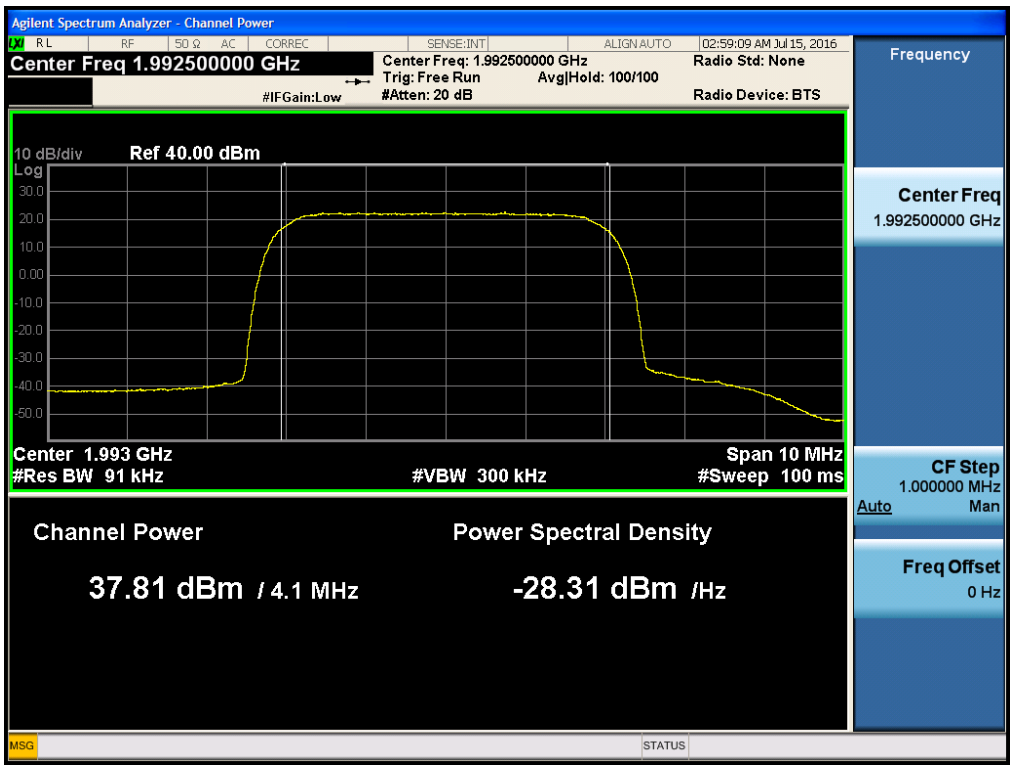
[+3dBm above AGC threshold Downlink Low]



[+3dBm above AGC threshold Downlink Middle]

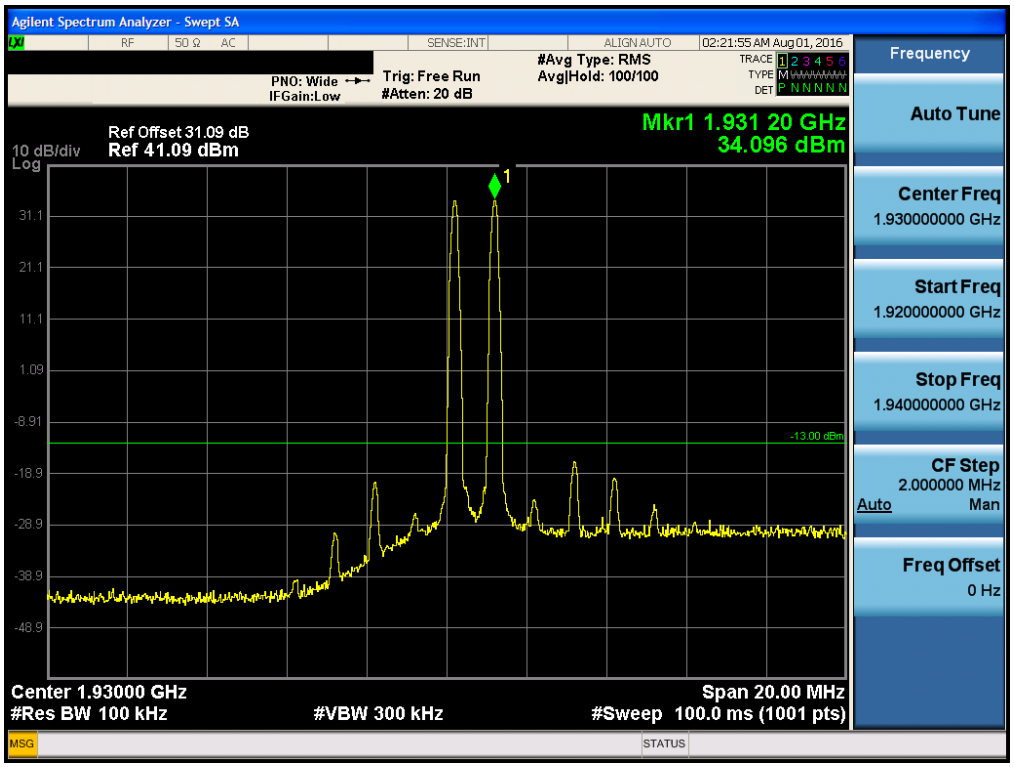


[+3dBm above AGC threshold Downlink High]

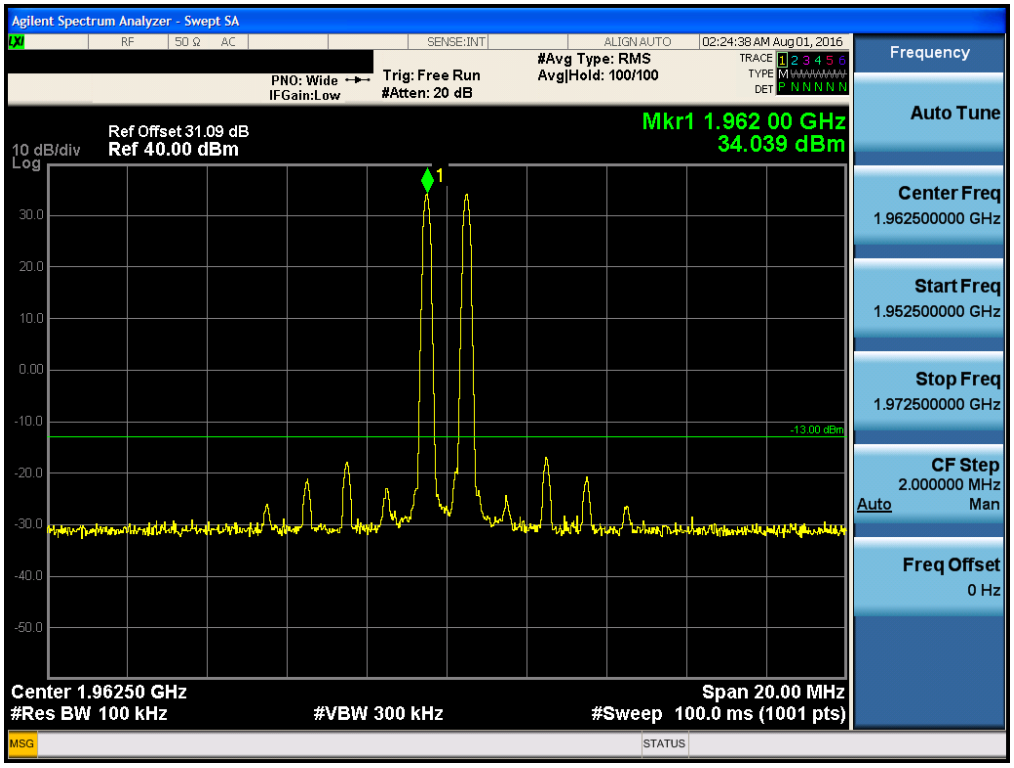


Multi-channel Enhancer for IC_ 1900 PCS BAND

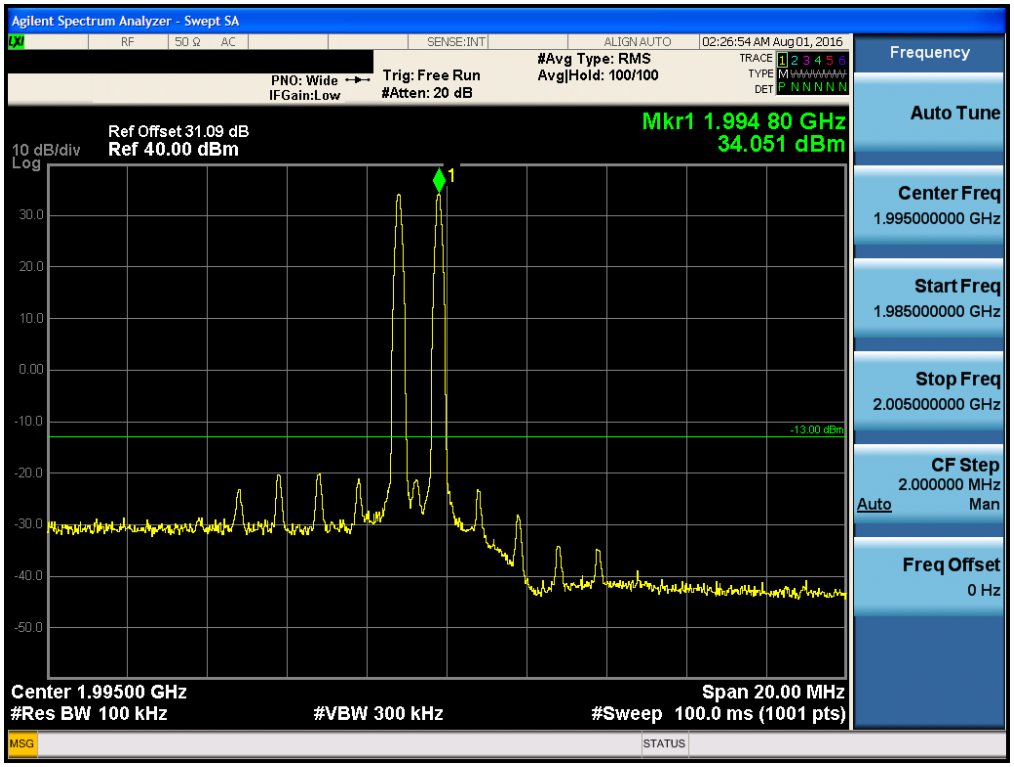
[Downlink Low]



[Downlink Middle]

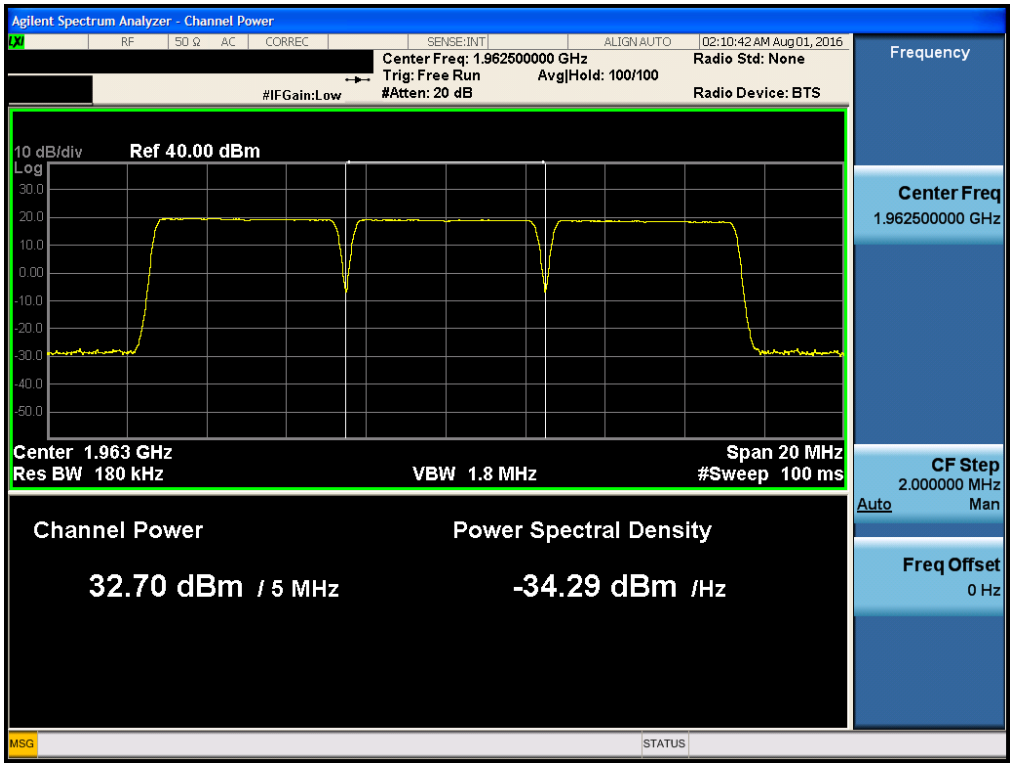


[Downlink High]



*** Power Back-off for IC_ 1900 PCS BAND**

[Downlink 3 Carrier Middle]



7. OCCUPIED BANDWIDTH

FCC Rules

Test Requirement(s):

§ 2.1049 Measurements required: Occupied bandwidth:

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

Test Procedures:

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

Test is 99% OBW measured and used.

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

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

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

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

e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between 2 times to 5 times the 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 pass band and roll off 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.

IC Rules

Test Requirements:

RSS-GEN

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:

RSS-GEN

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:

The EUT complies with the requirements of this section.

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

[Downlink Output_1900 PCS BAND]

	Channel	Frequency (MHz)	OBW (MHz)
1900 PCS Band_ LTE 5 MHz AGC threshold	Low	1932.50	4.5118
	Middle	1962.50	4.5150
	High	1992.50	4.5063
1900 PCS Band_ LTE 5 MHz +3dBm above the AGC threshold	Low	1992.50	4.5089
	Middle	1992.50	4.5126
	High	1992.50	4.5080
1900 PCS Band_ LTE 10 MHz AGC threshold	Low	1935.00	8.9825
	Middle	1962.50	8.9985
	High	1990.00	8.9909
1900 PCS Band_ LTE 10 MHz +3dBm above the AGC threshold	Low	1935.00	8.9939
	Middle	1962.50	8.9977
	High	1990.00	8.9926

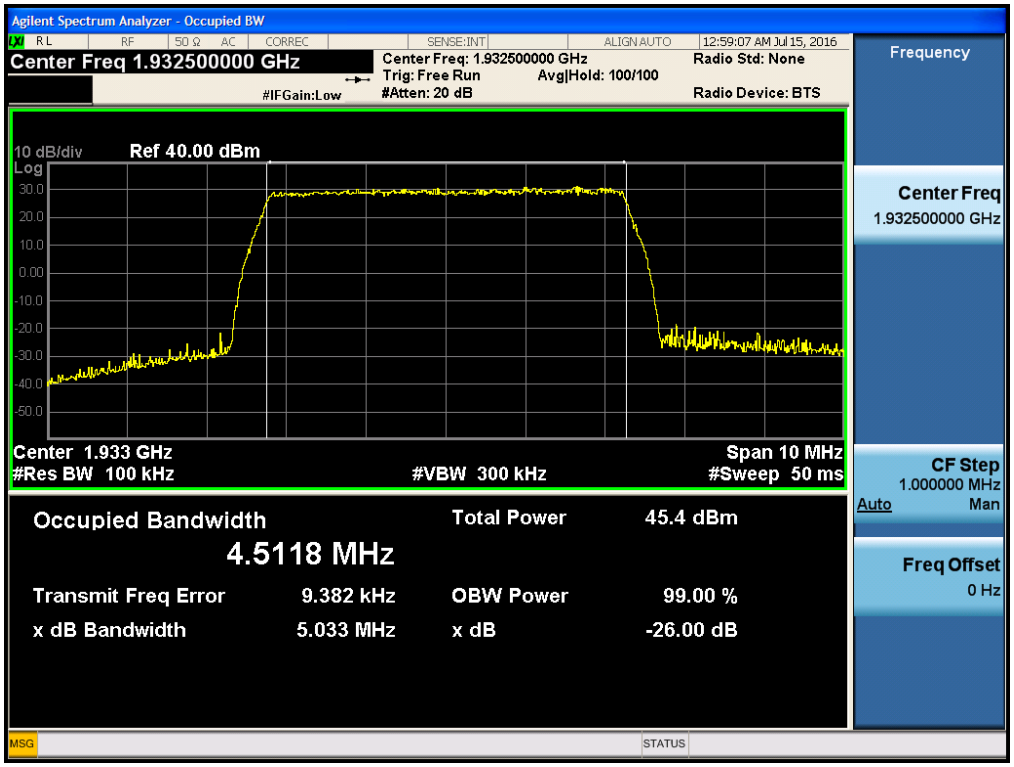
	Channel	Frequency (MHz)	OBW (MHz)
1900 PCS Band_ LTE 20 MHz AGC threshold	Low	1940.00	17.992
	Middle	1962.50	18.025
	High	1985.00	17.975
1900 PCS Band_ LTE 20 MHz +3dBm above the AGC threshold	Low	1940.00	17.979
	Middle	1962.50	18.041
	High	1985.00	17.981
1900 PCS Band_ CDMA AGC threshold	Low	1931.25	1.2763
	Middle	1962.50	1.2726
	High	1993.75	1.2752
1900 PCS Band_ CDMA +3dBm above the AGC threshold	Low	1931.25	1.2747
	Middle	1962.50	1.2756
	High	1993.75	1.2719
1900 PCS Band_ WCDMA AGC threshold	Low	1932.50	4.1811
	Middle	1962.50	4.1772
	High	1992.50	4.1737
1900 PCS Band_ WCDMA +3dBm above the AGC threshold	Low	1932.50	4.1709
	Middle	1962.50	4.1799
	High	1992.50	4.1712

[Downlink Input_1900 PCS BAND]

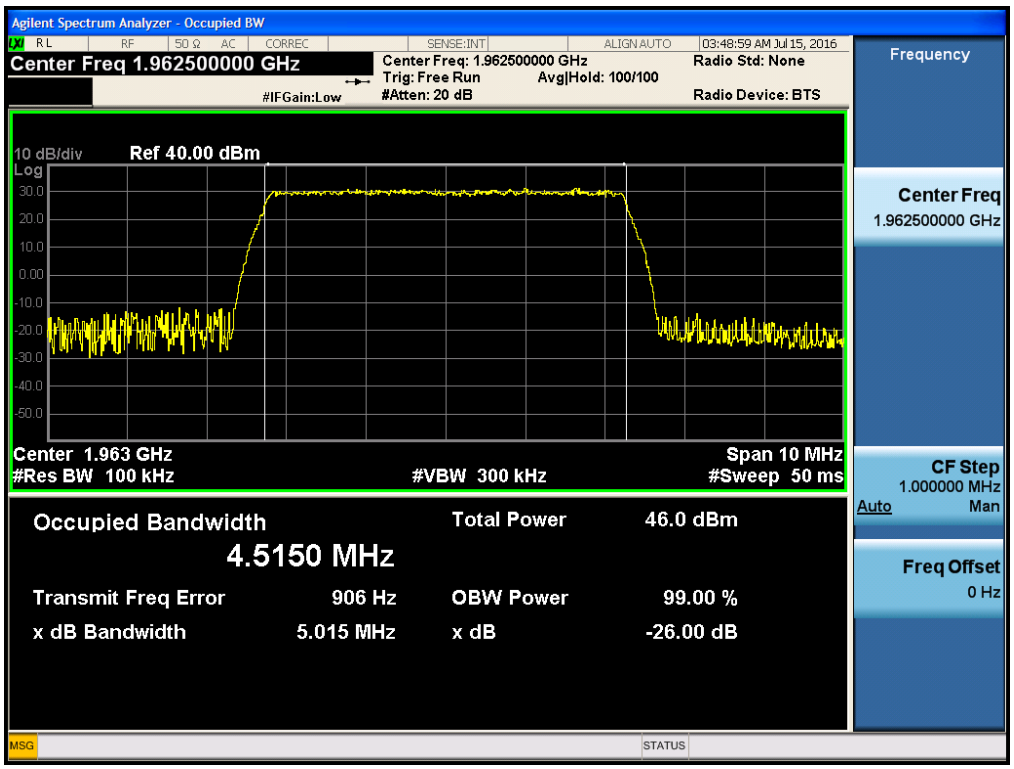
	Channel	Frequency (MHz)	OBW (MHz)
1900 PCS Band_ LTE 5 MHz AGC threshold	Low	1932.50	4.5101
	Middle	1962.50	4.5117
	High	1992.50	4.5129
1900 PCS Band_ LTE 10 MHz AGC threshold	Low	1935.00	8.9937
	Middle	1962.50	8.9978
	High	1990.00	9.0037
1900 PCS Band_ LTE 20 MHz AGC threshold	Low	1940.00	18.025
	Middle	1962.50	18.000
	High	1985.00	18.003
1900 PCS Band_ CDMA AGC threshold	Low	1931.25	1.2720
	Middle	1962.50	1.2723
	High	1993.75	1.2756
1900 PCS Band_ WCDMA AGC threshold	Low	1932.50	4.1793
	Middle	1962.50	4.1841
	High	1992.50	4.1844

Plots of Occupied Bandwidth_1900 PCS BAND LTE 5 MHz

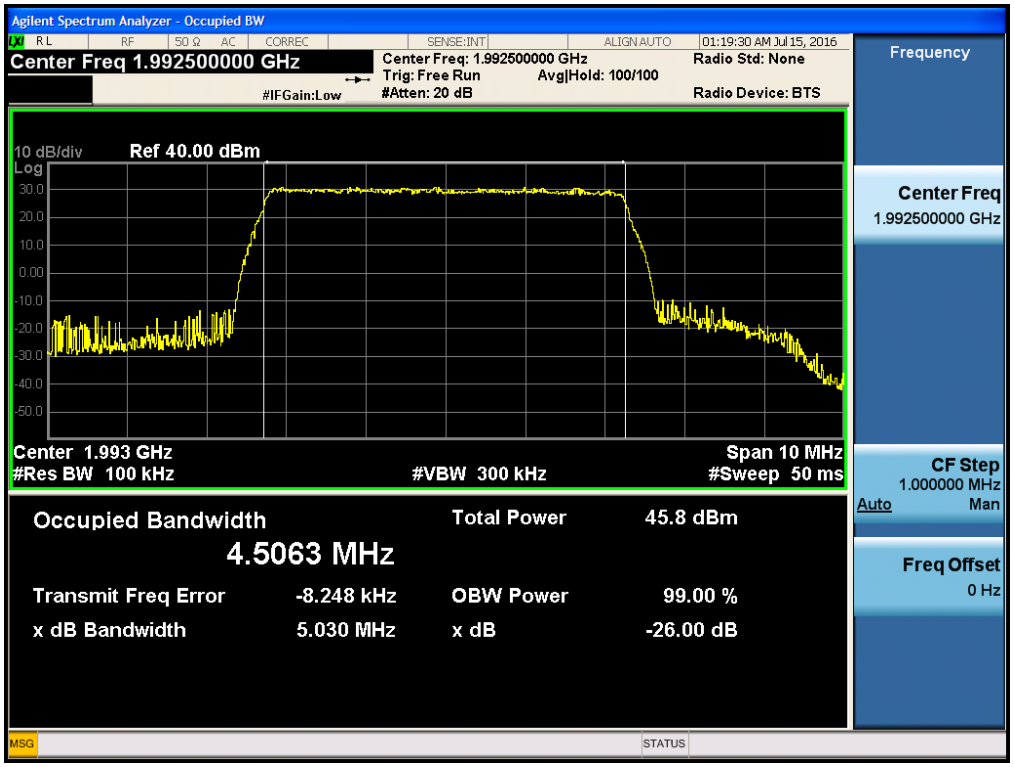
[AGC threshold Output Downlink Low]



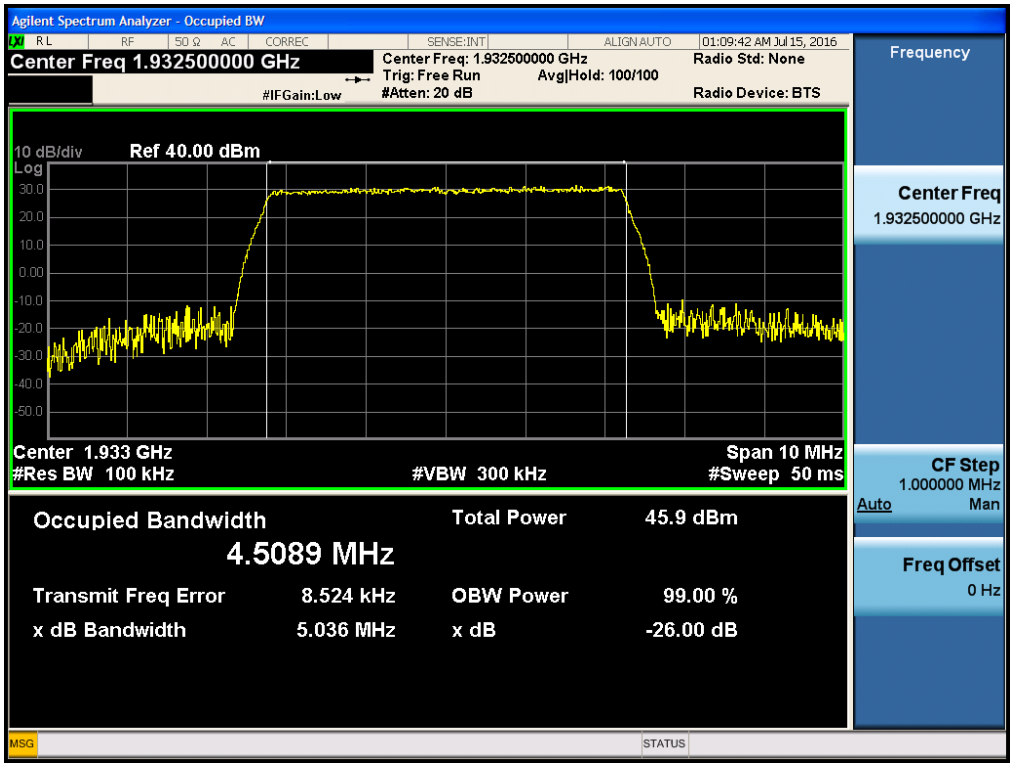
[AGC threshold Output Downlink Middle]



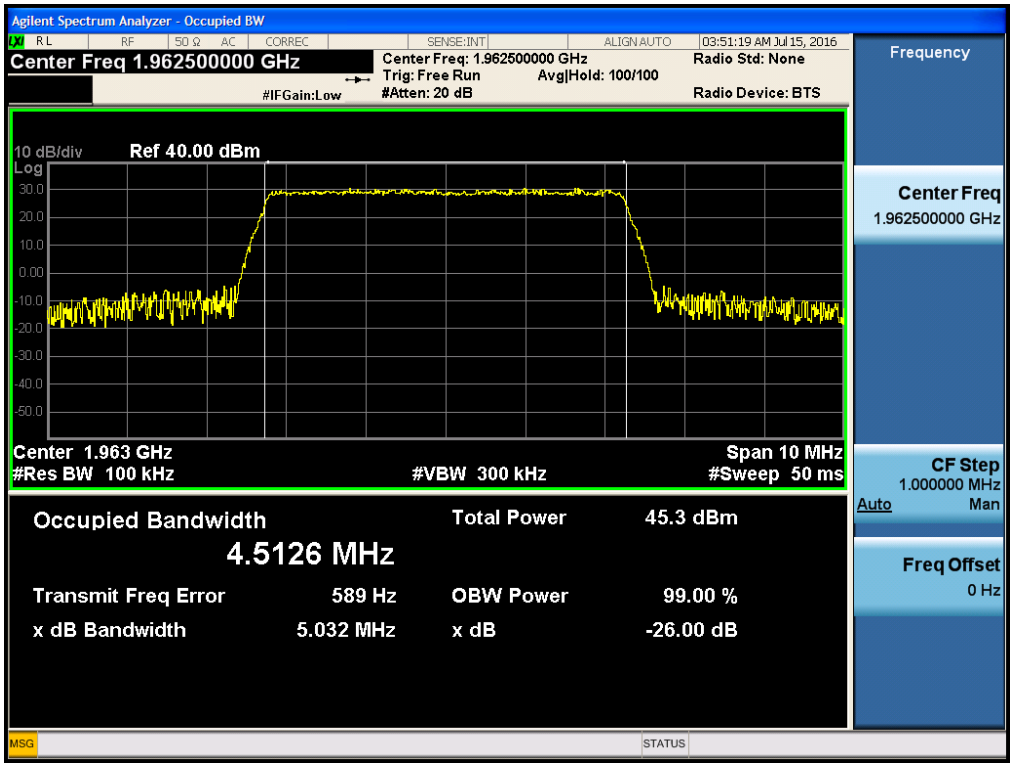
[AGC threshold Output Downlink High]



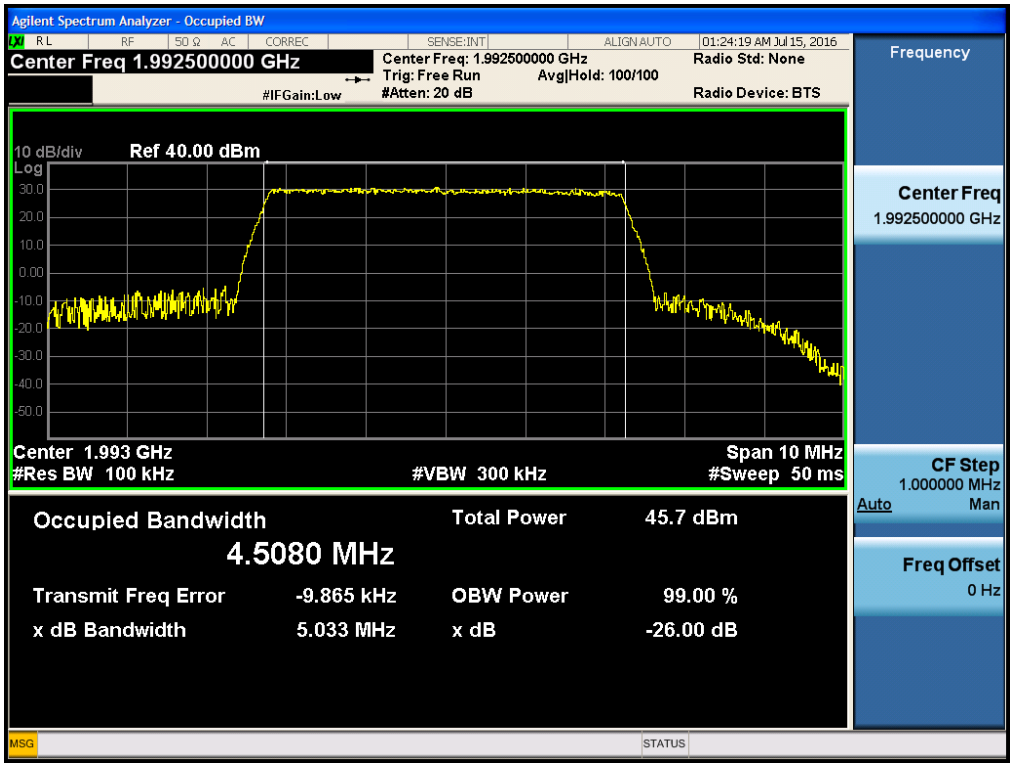
[+3dBmabove AGC threshold Output Downlink Low]



[+3dBm above AGC threshold Output Downlink Middle]

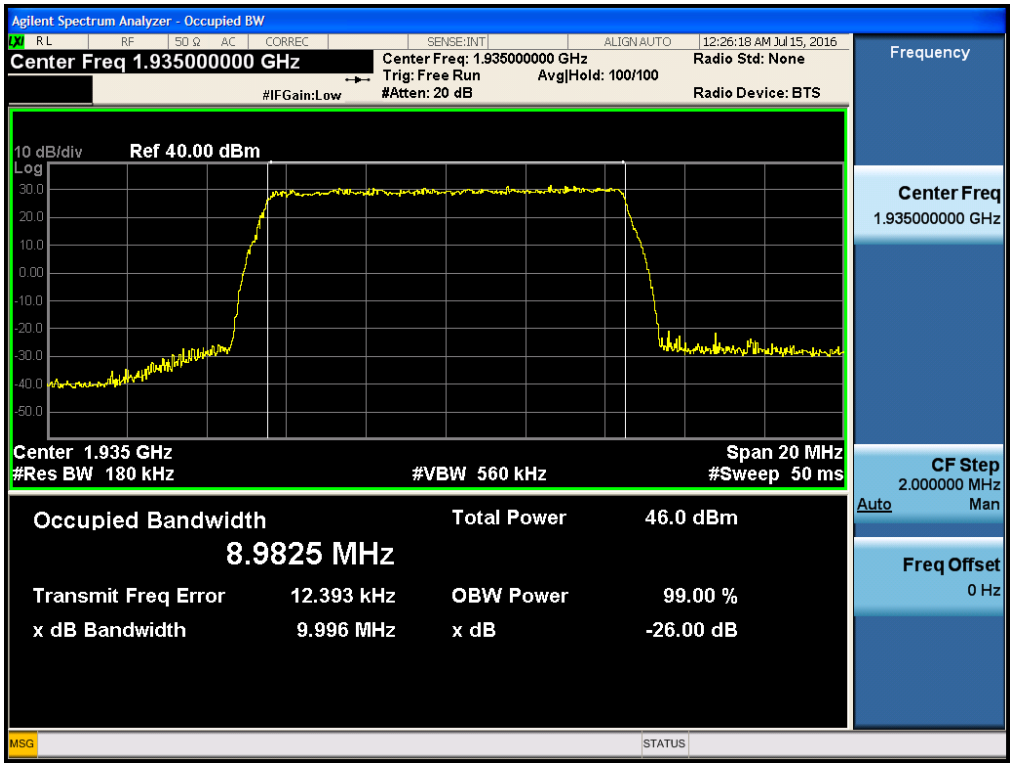


[+3dBm above AGC threshold Output Downlink High]

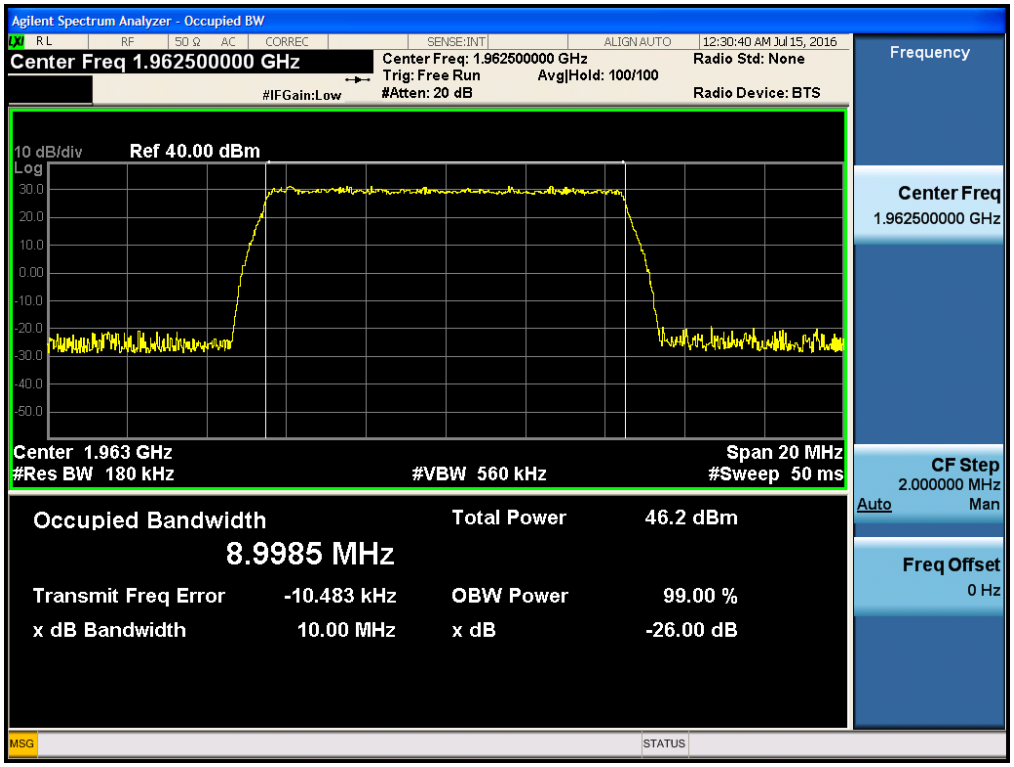


Plots of Occupied Bandwidth_ 1900 PCS BAND LTE 10 MHz

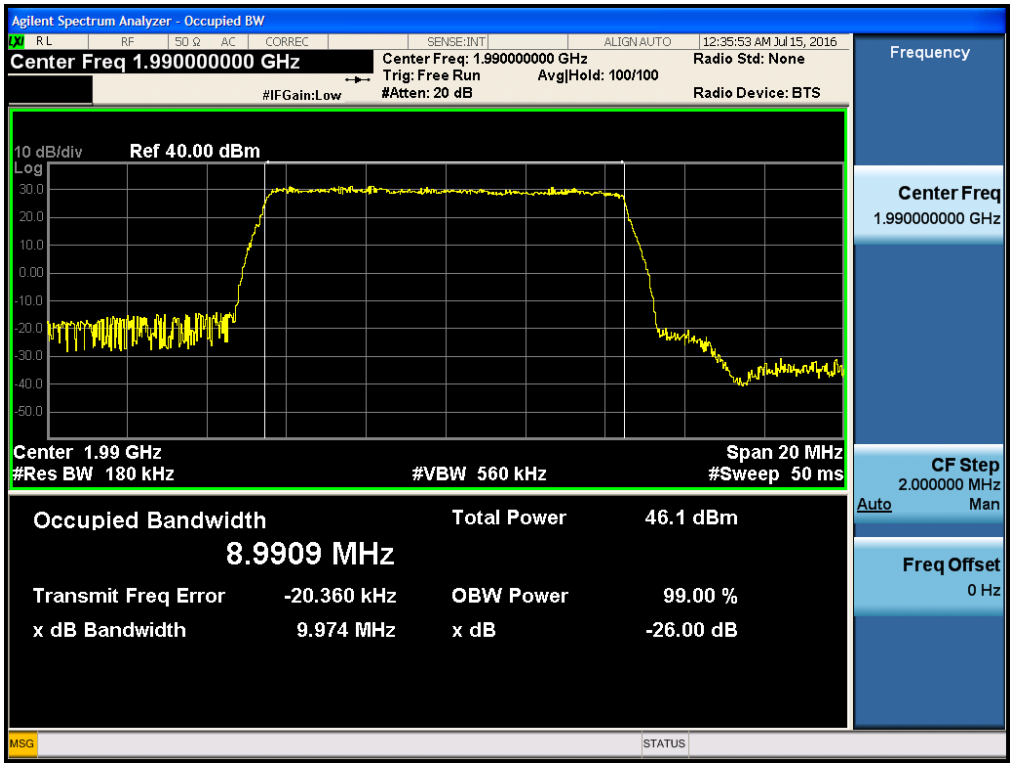
[AGC threshold Output Downlink Low]



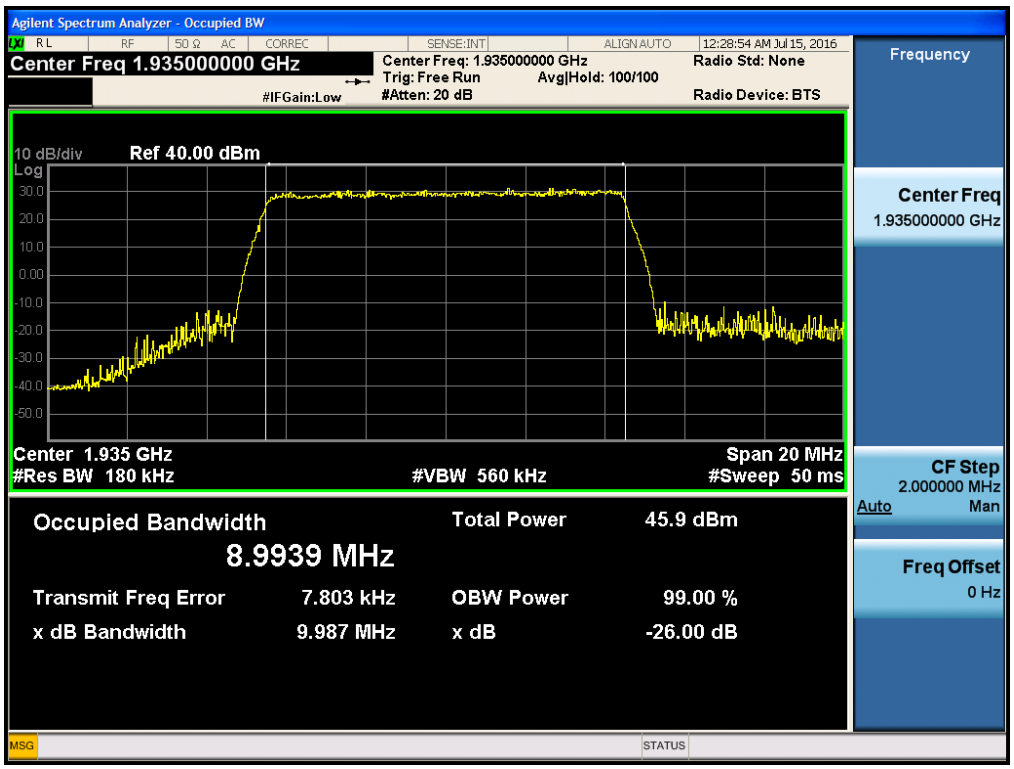
[AGC threshold Output Downlink Middle]



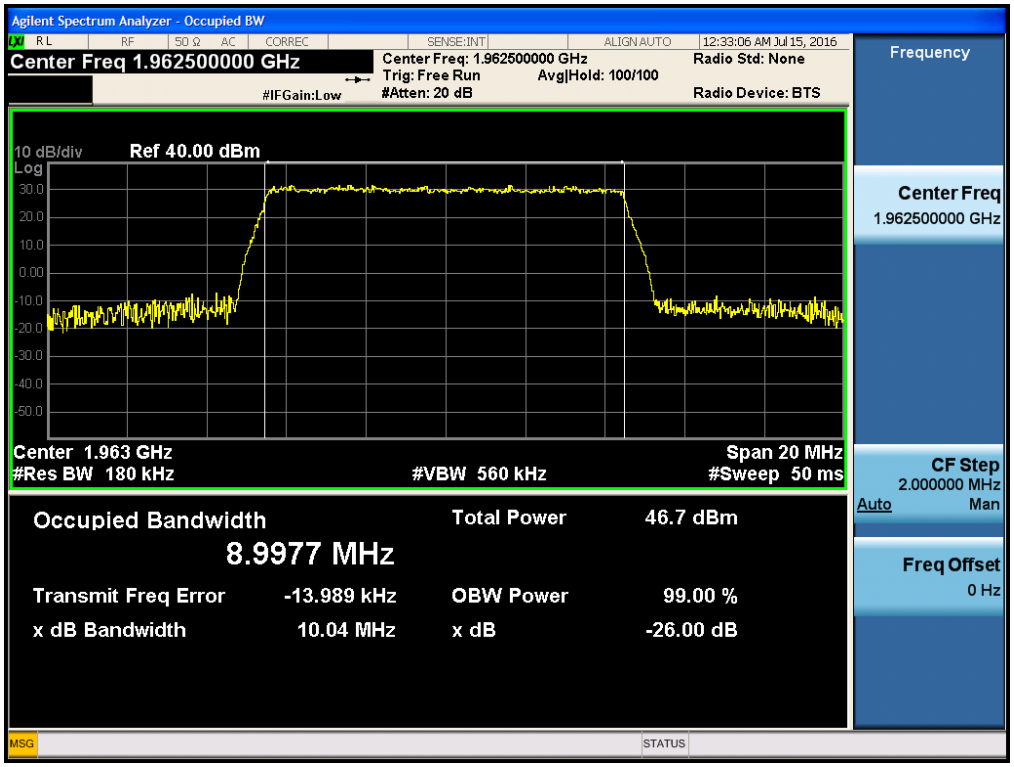
[AGC threshold Output Downlink High]



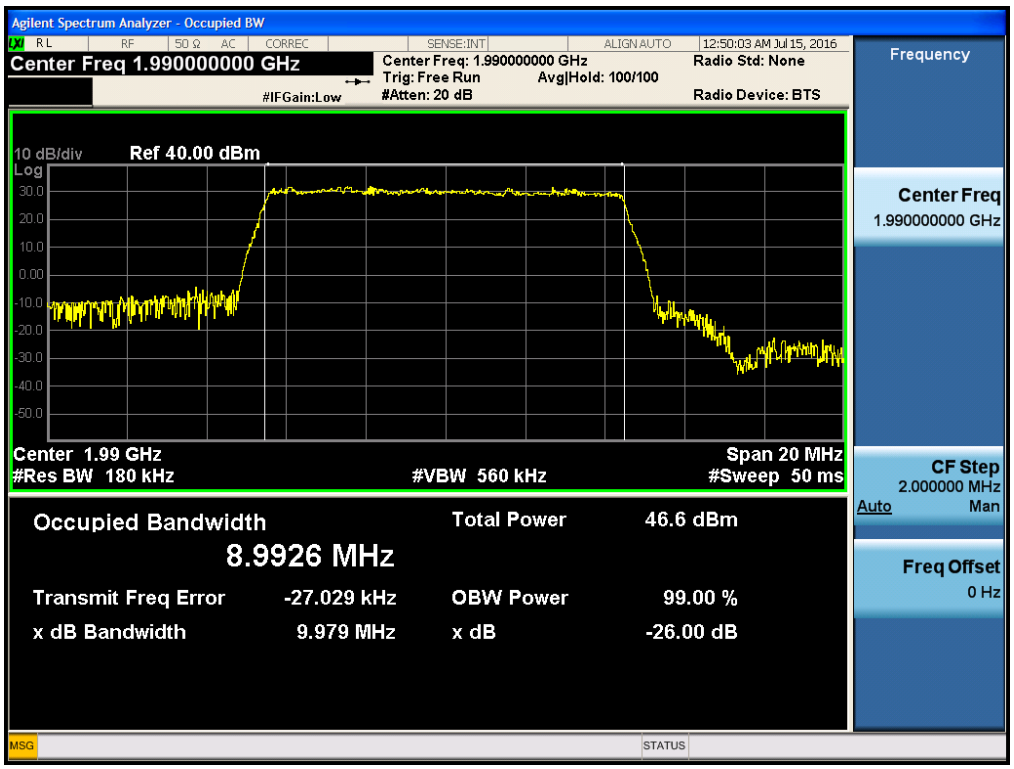
[+3dBmabove AGC threshold Output Downlink Low]



[+3dBm above AGC threshold Output Downlink Middle]

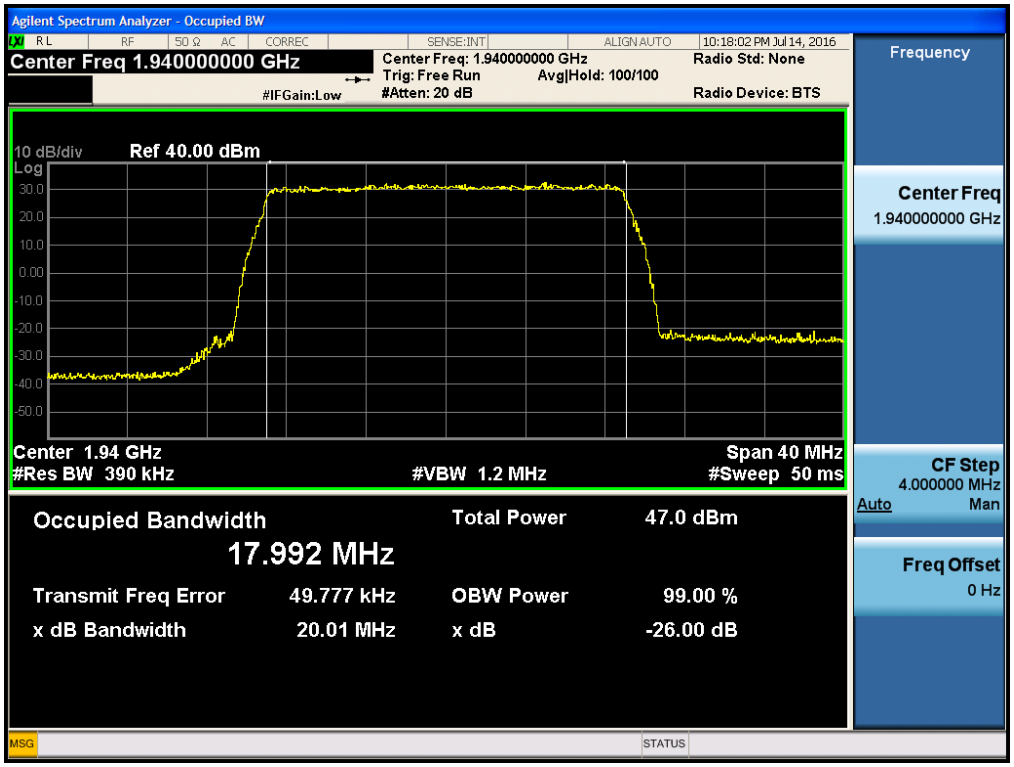


[+3dBm above AGC threshold Output Downlink High]

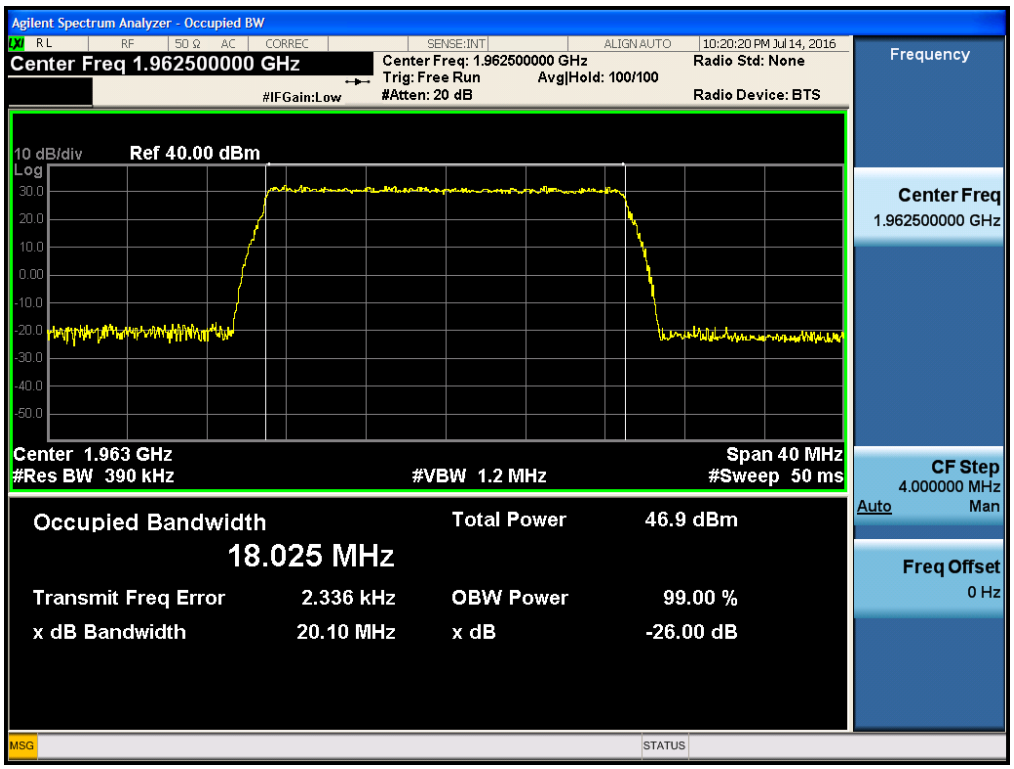


Plots of Occupied Bandwidth_ 1900 PCS BAND LTE 20 MHz

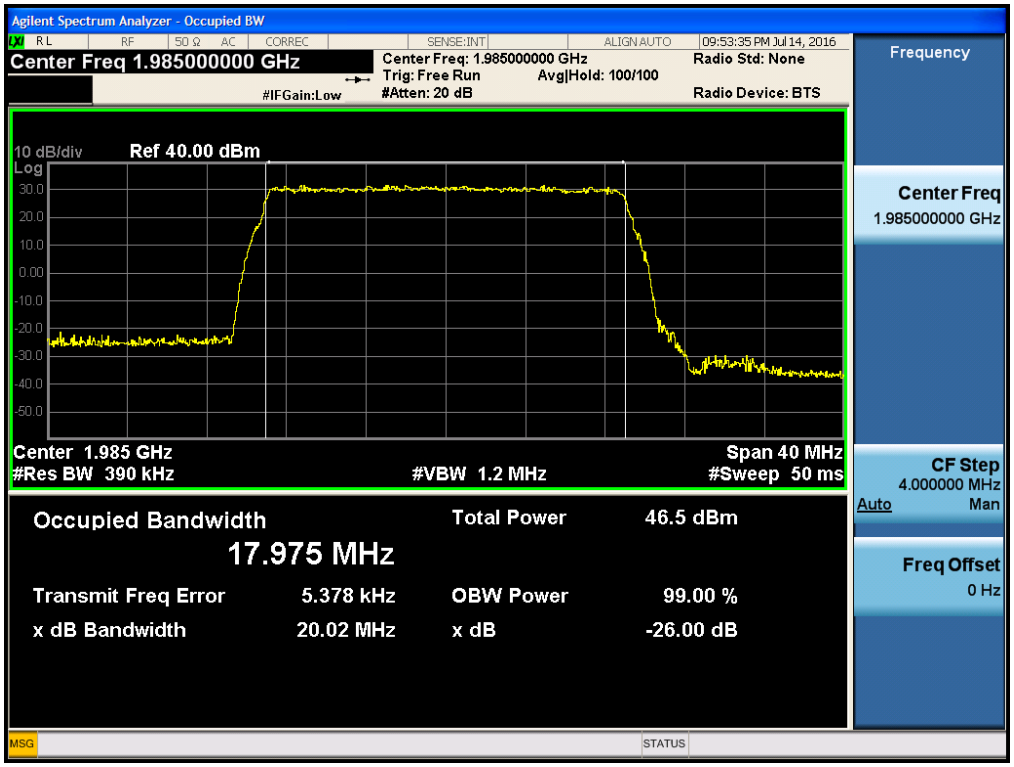
[AGC threshold Output Downlink Low]



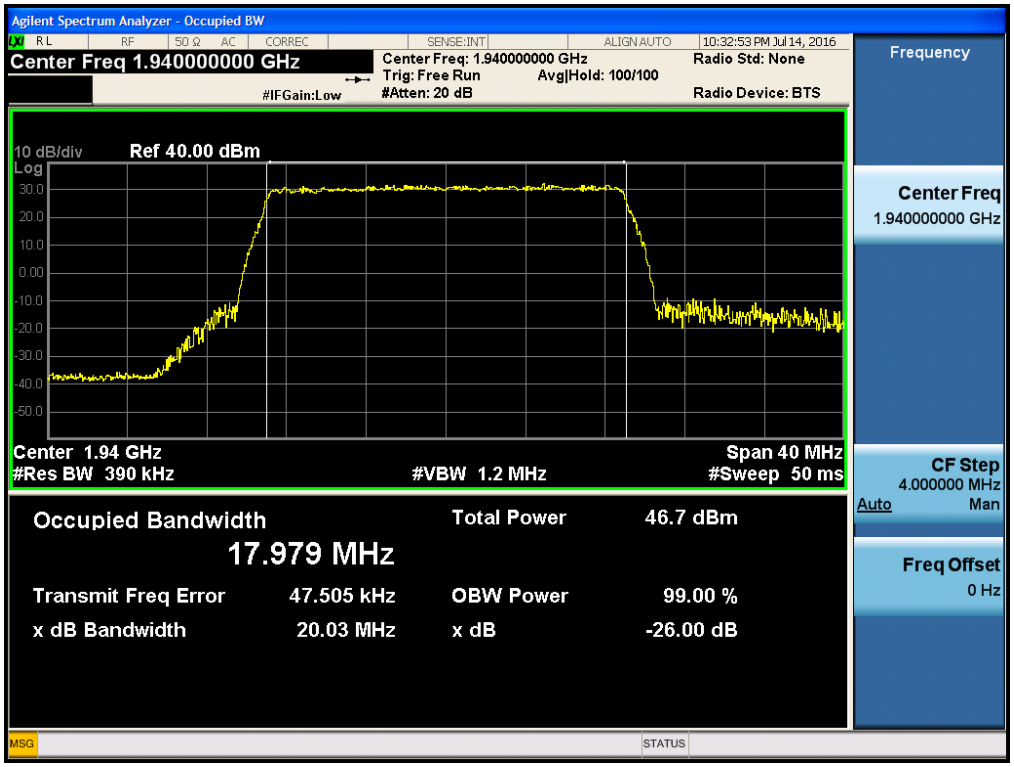
[AGC threshold Output Downlink Middle]



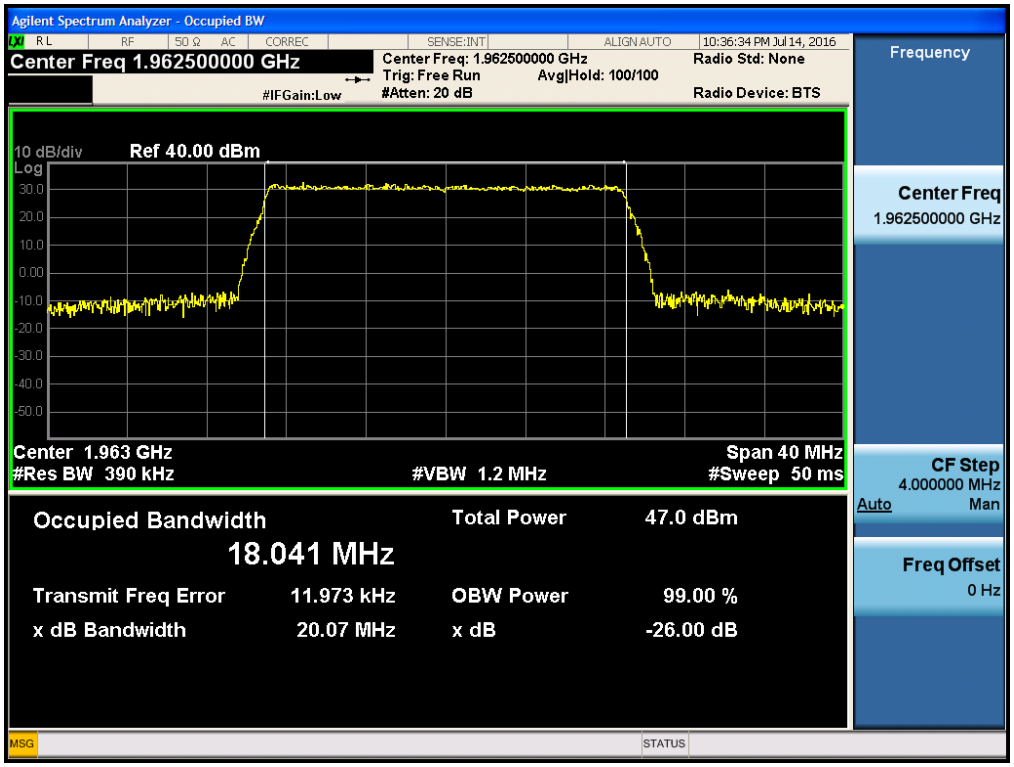
[AGC threshold Output Downlink High]



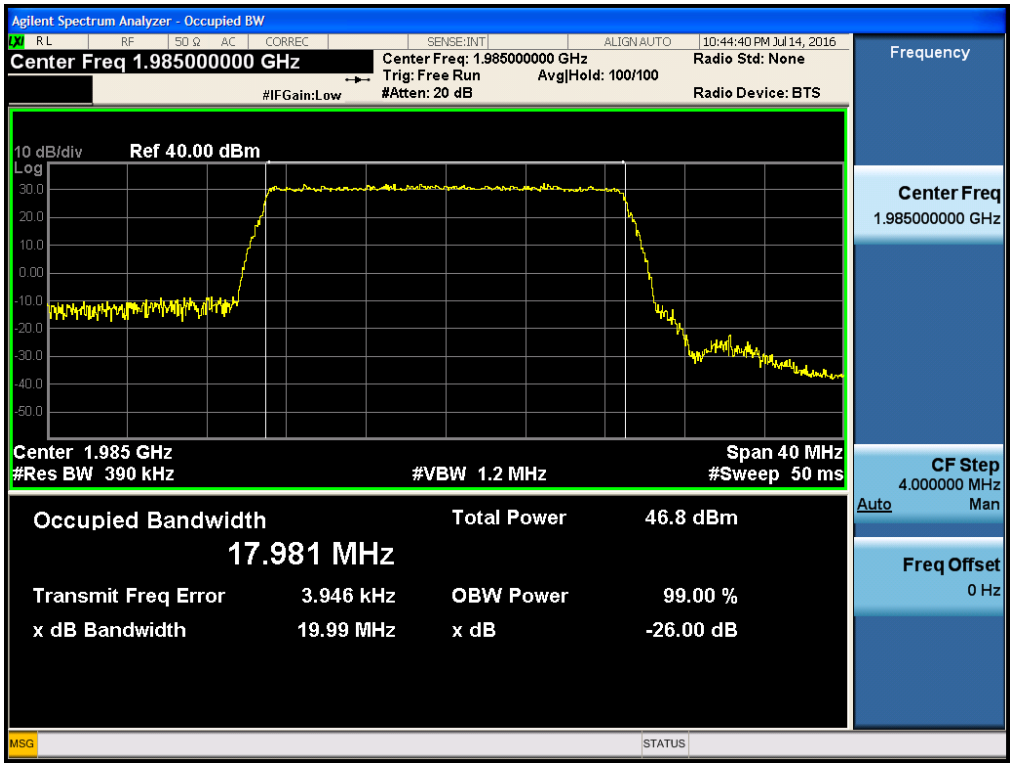
[+3dBmabove AGC threshold Output Downlink Low]



[+3dBm above AGC threshold Output Downlink Middle]

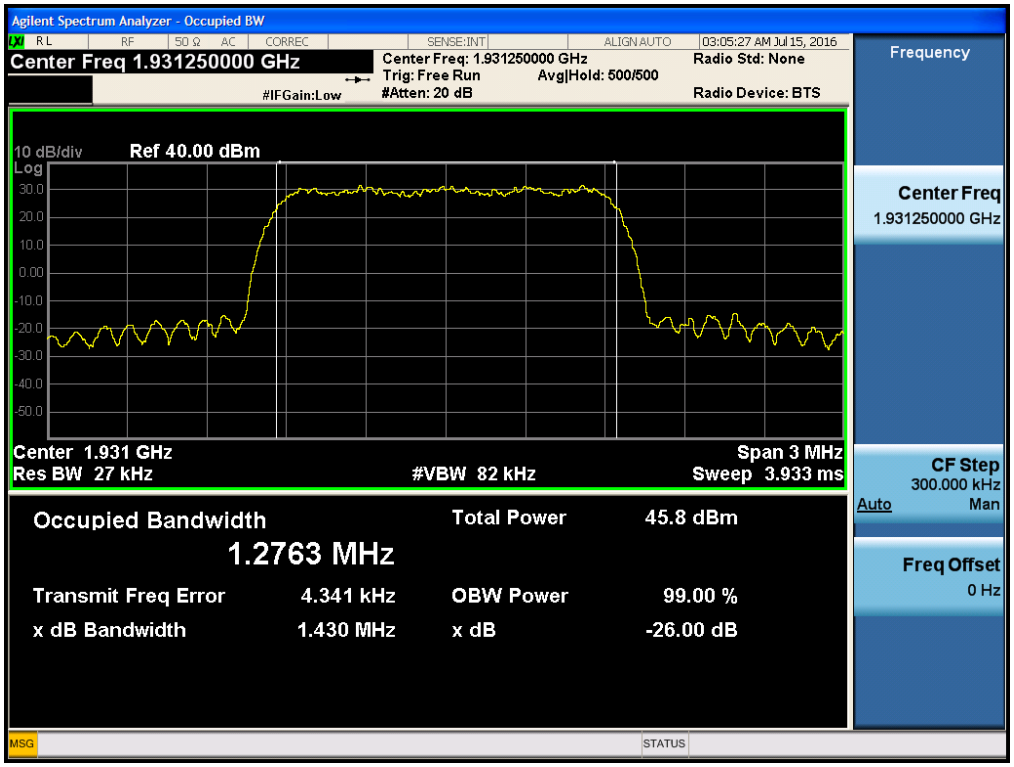


[+3dBm above AGC threshold Output Downlink High]

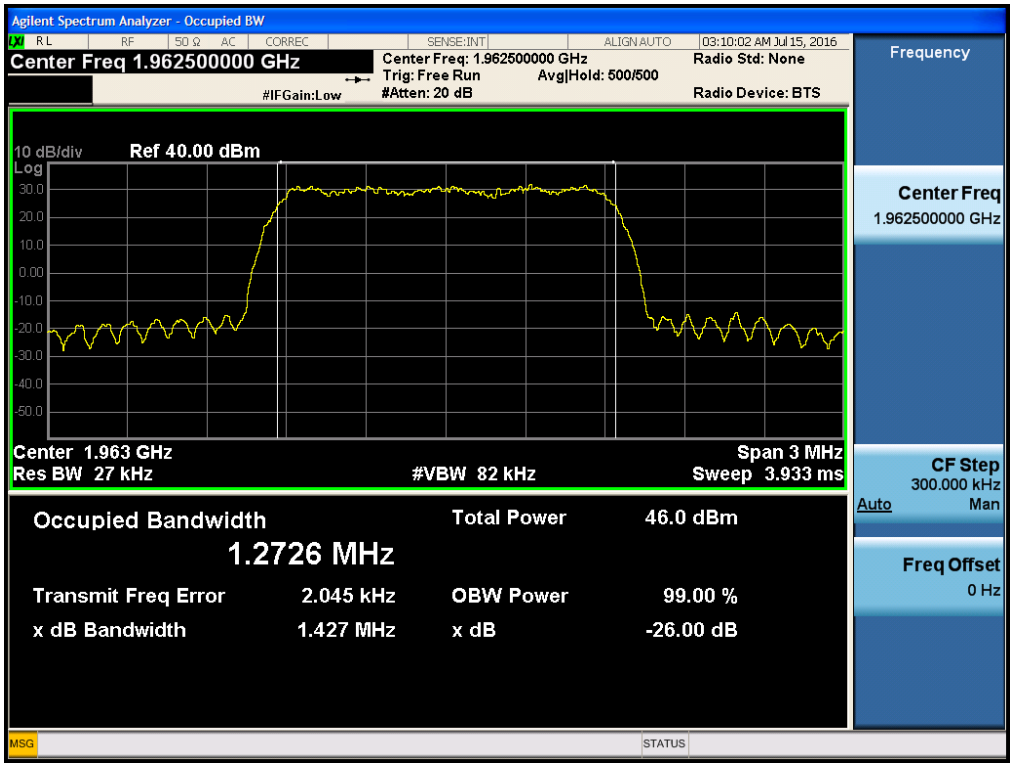


Plots of Occupied Bandwidth_ 1900 PCS BAND CDMA

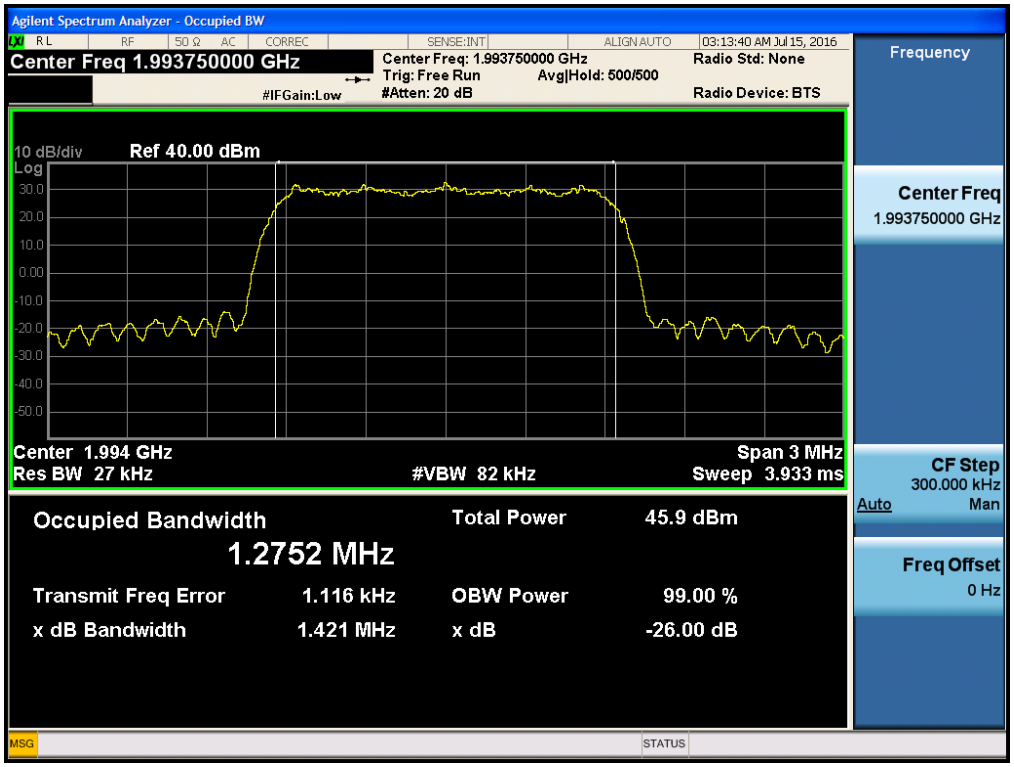
[AGC threshold Output Downlink Low]



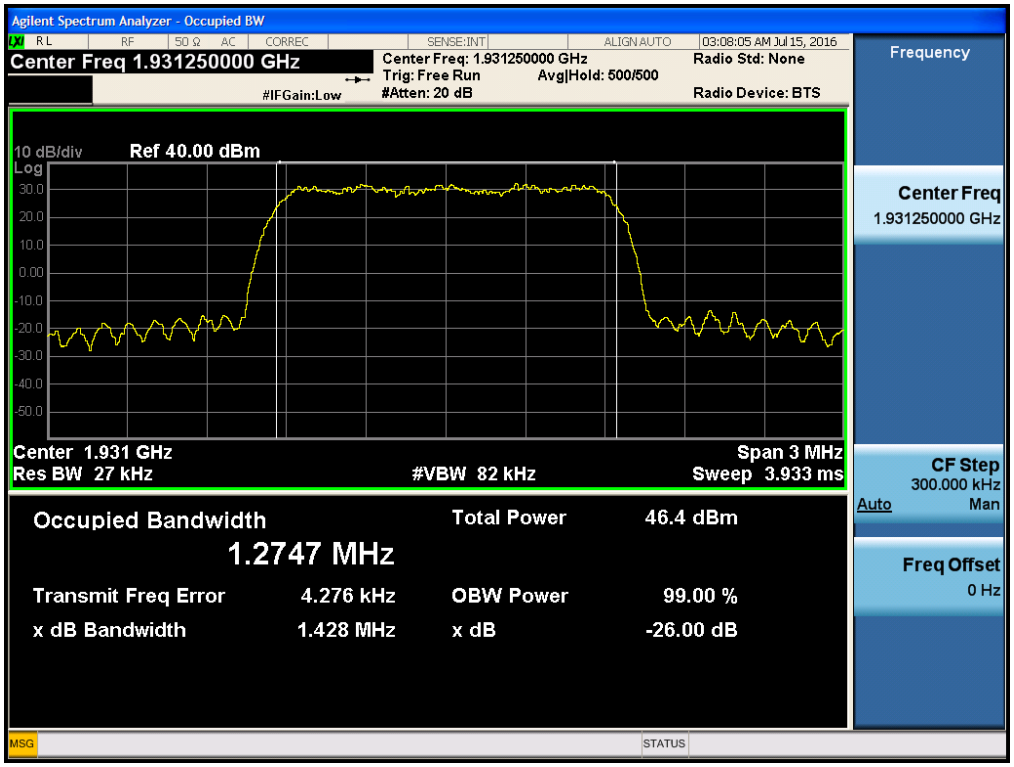
[AGC threshold Output Downlink Middle]



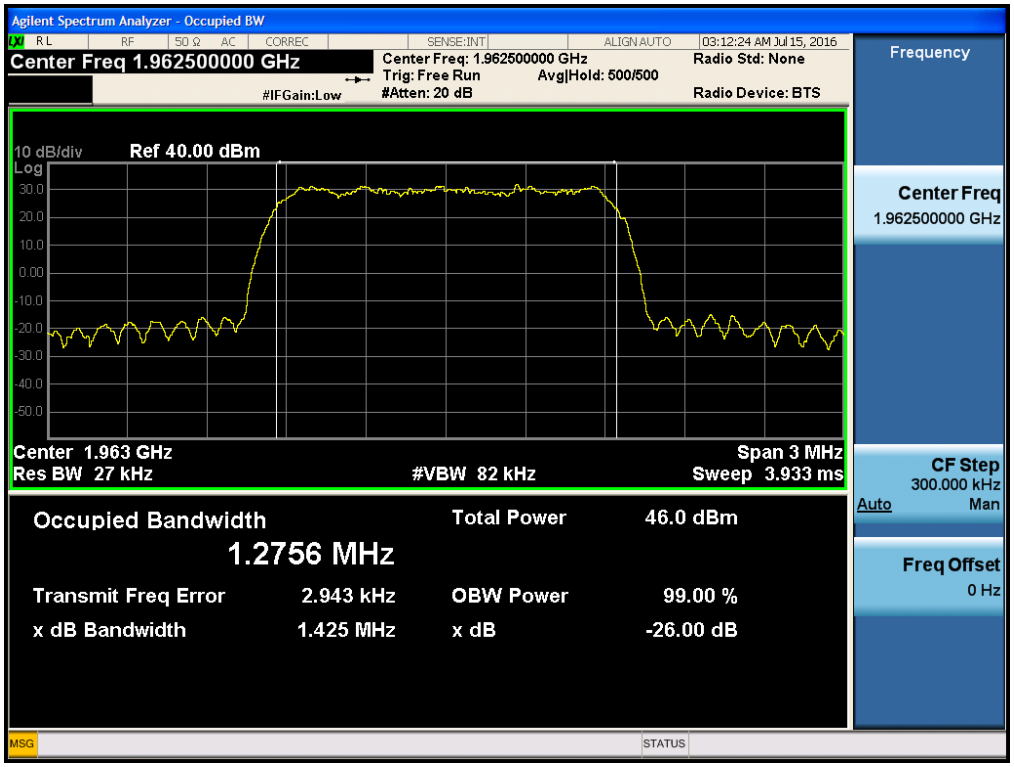
[AGC threshold Output Downlink High]



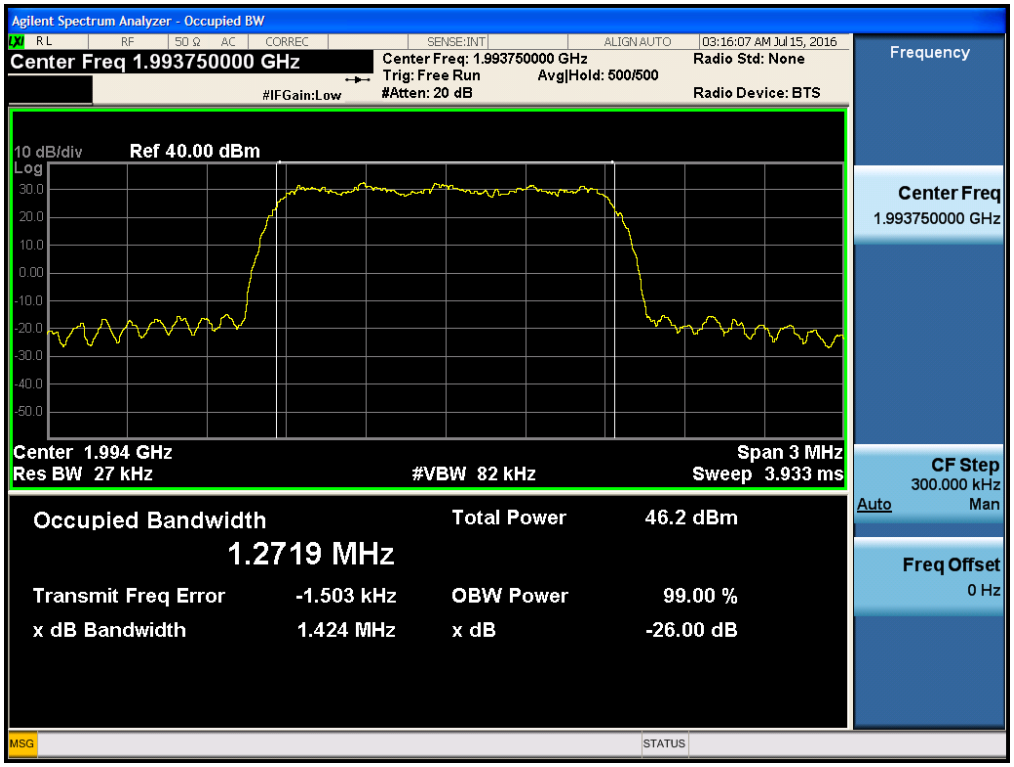
[+3dBmabove AGC threshold Output Downlink Low]



[+3dBm above AGC threshold Output Downlink Middle]

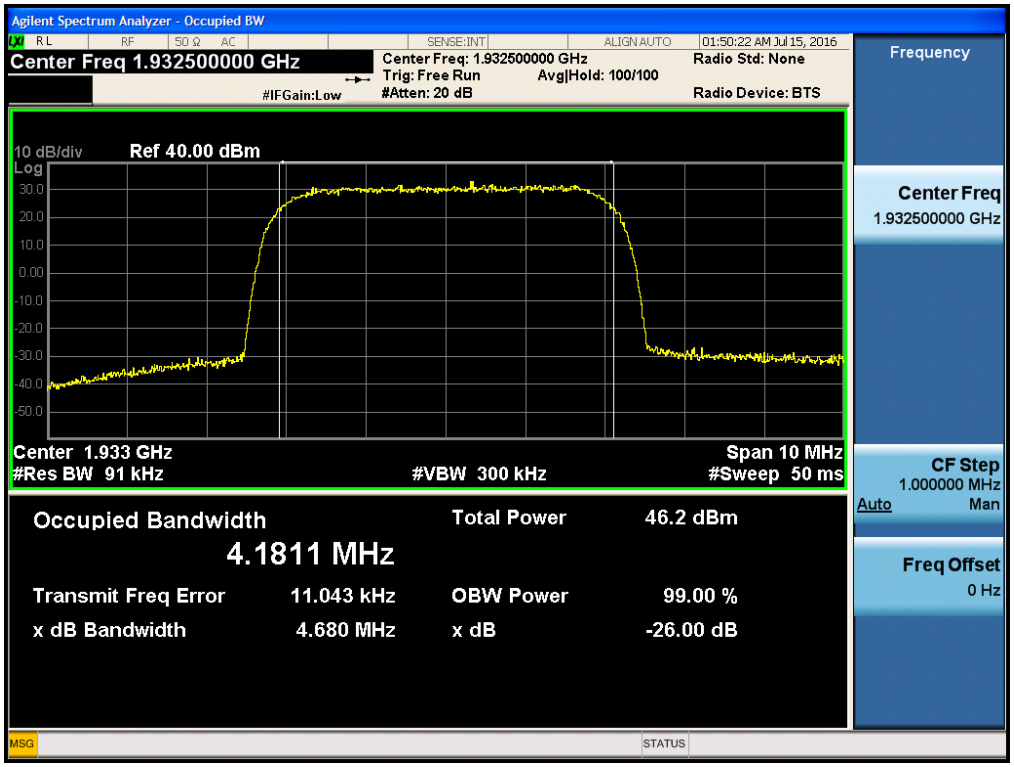


[+3dBm above AGC threshold Output Downlink High]

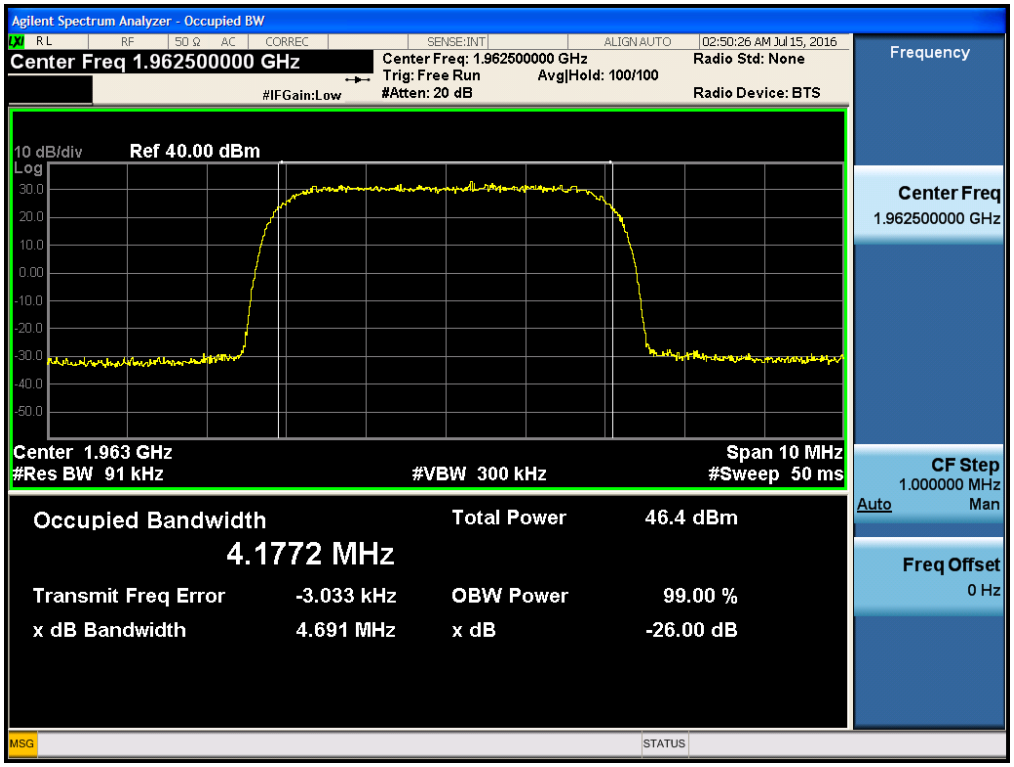


Plots of Occupied Bandwidth_1900 PCS BAND WCDMA

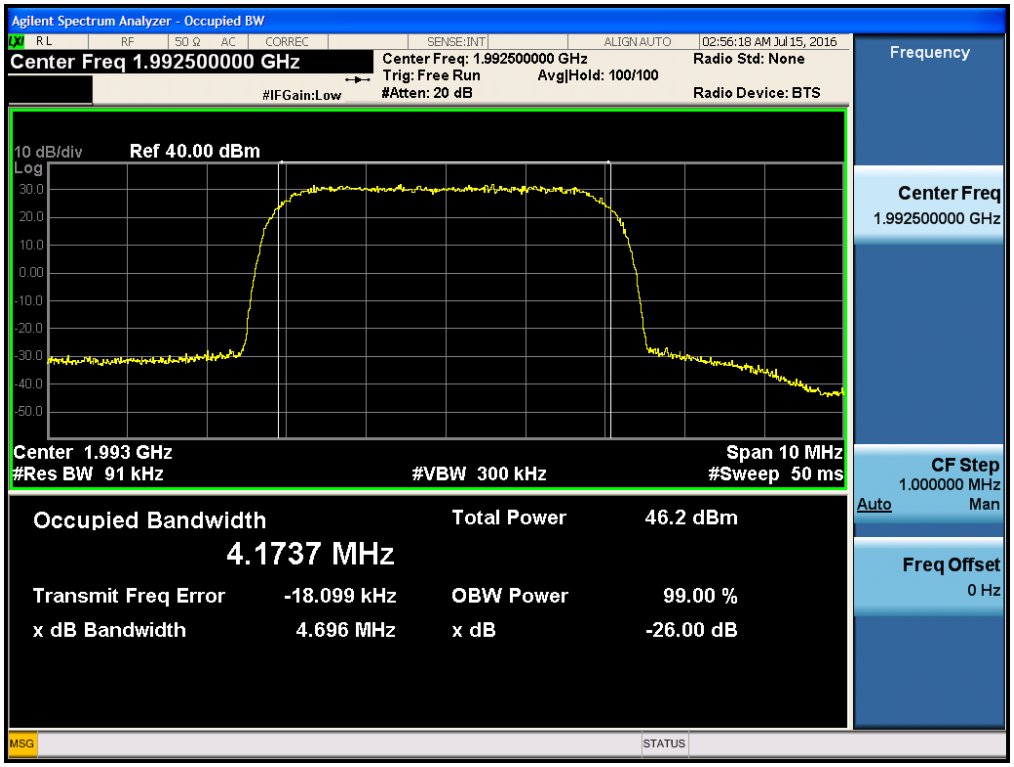
[AGC threshold Output Downlink Low]



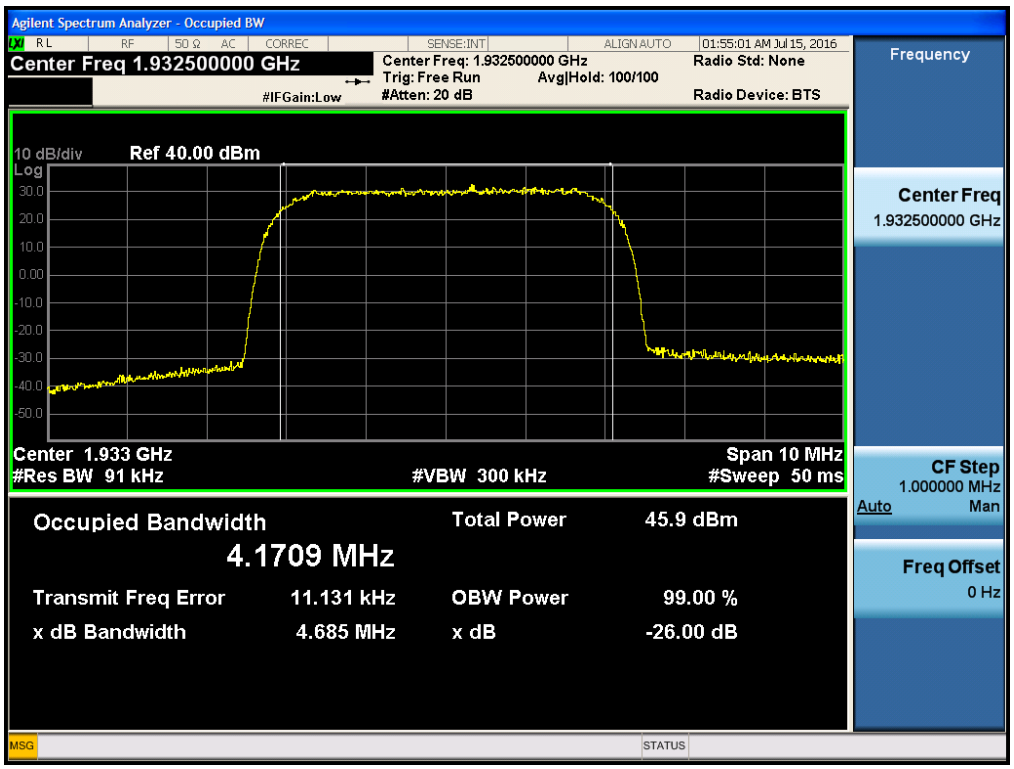
[AGC threshold Output Downlink Middle]



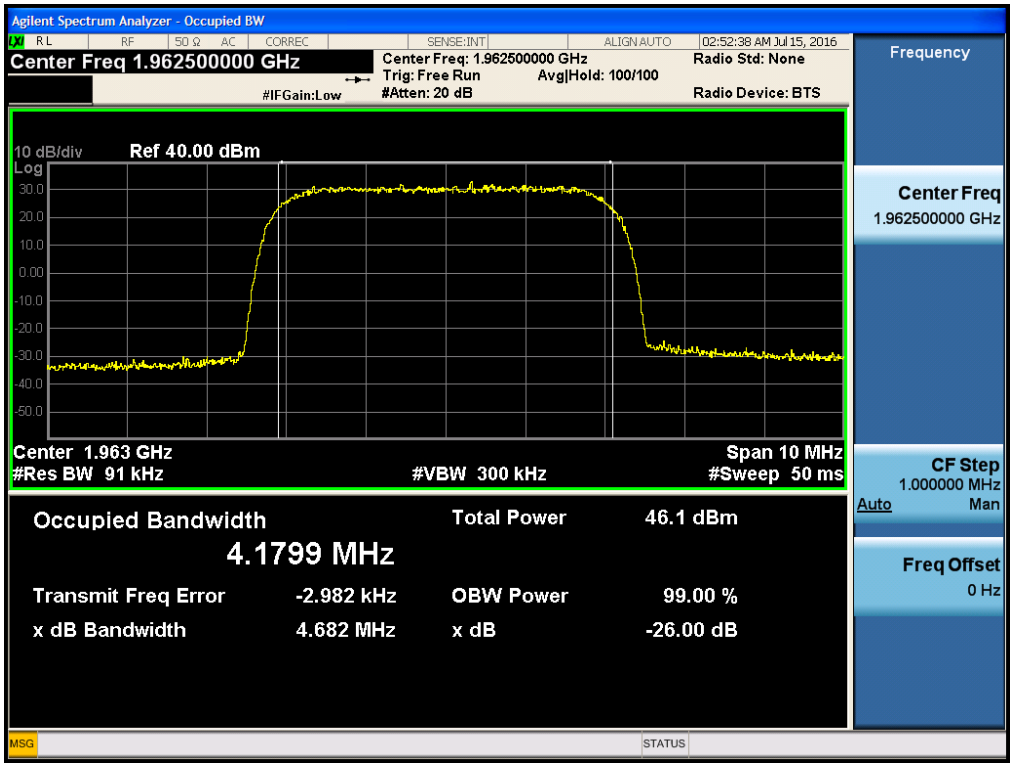
[AGC threshold Output Downlink High]



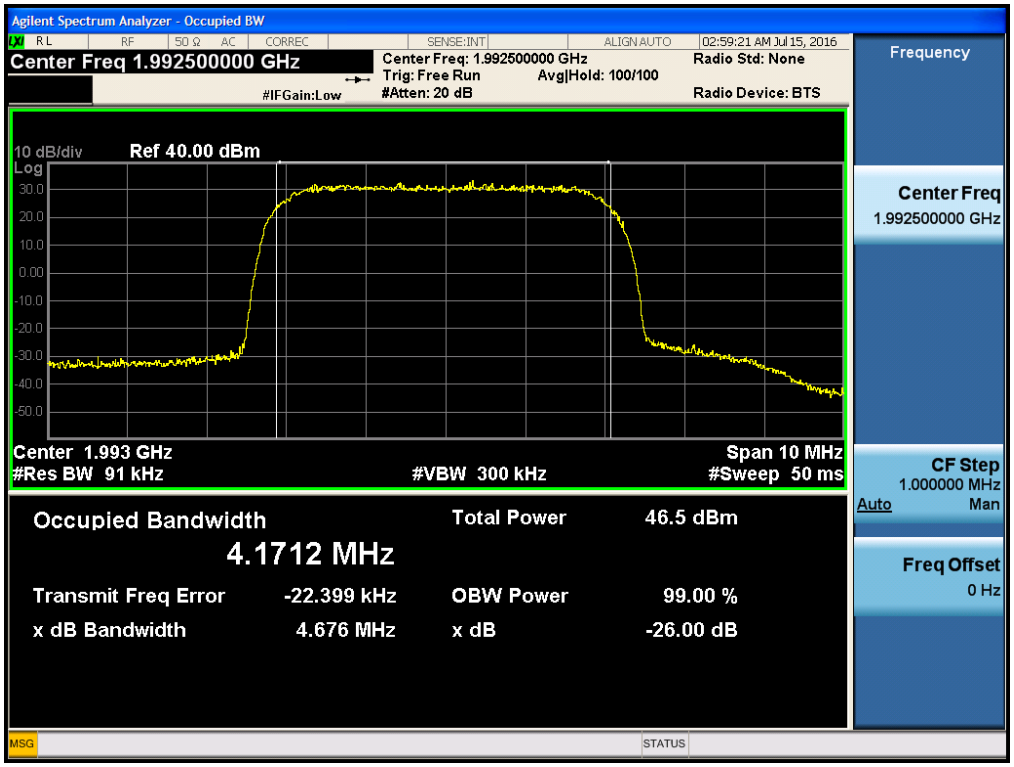
[+3dBmabove AGC threshold Output Downlink Low]



[+3dBm above AGC threshold Output Downlink Middle]

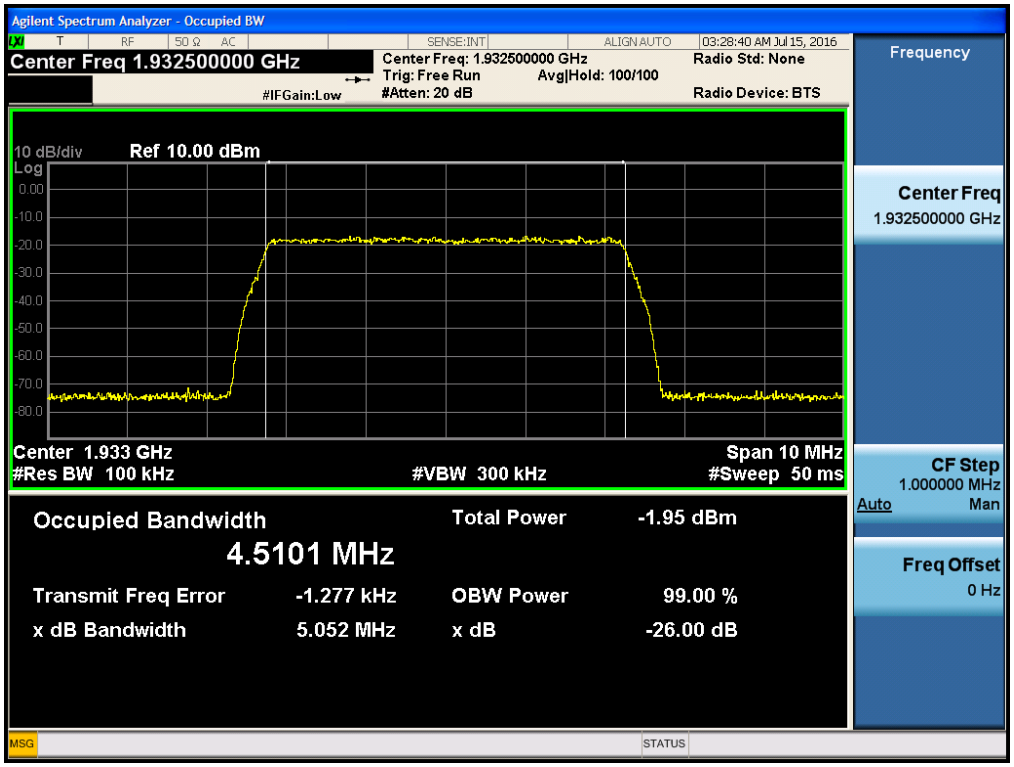


[+3dBm above AGC threshold Output Downlink High]

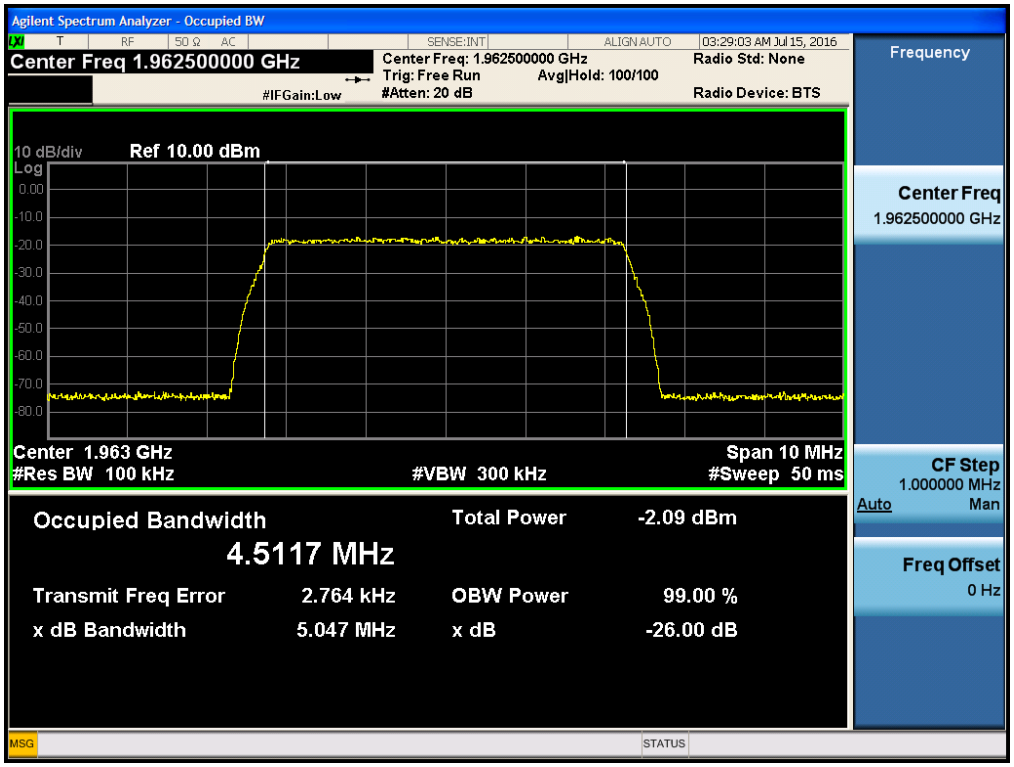


Plots of Occupied Bandwidth_1900 PCS BAND LTE 5 MHz

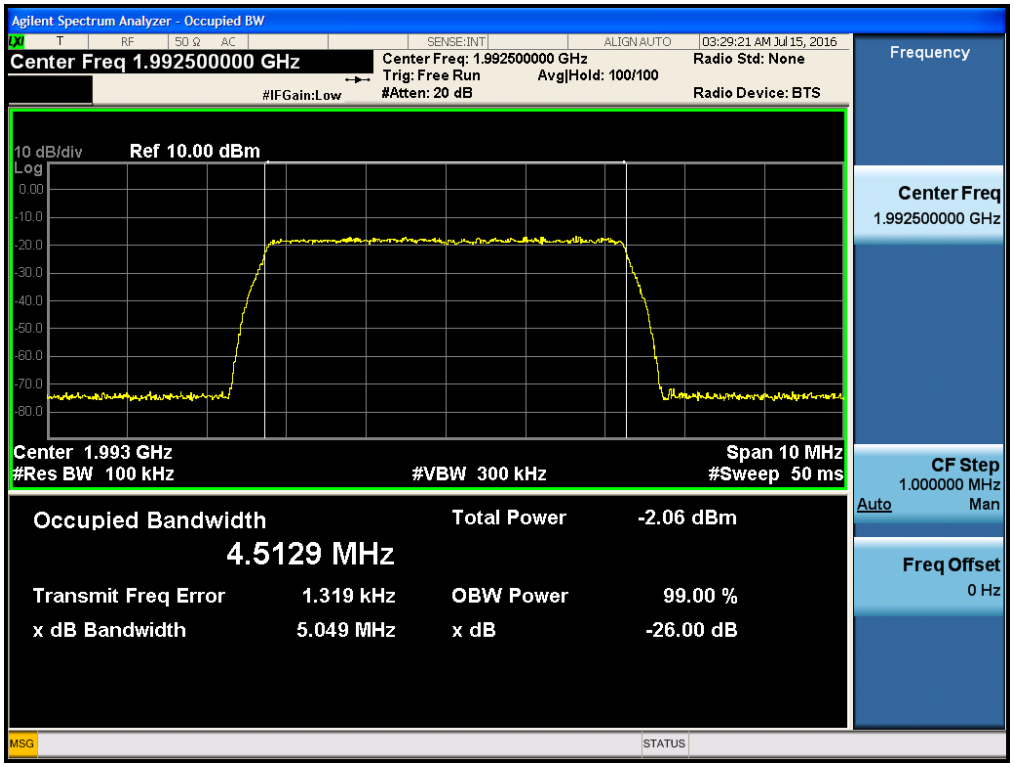
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

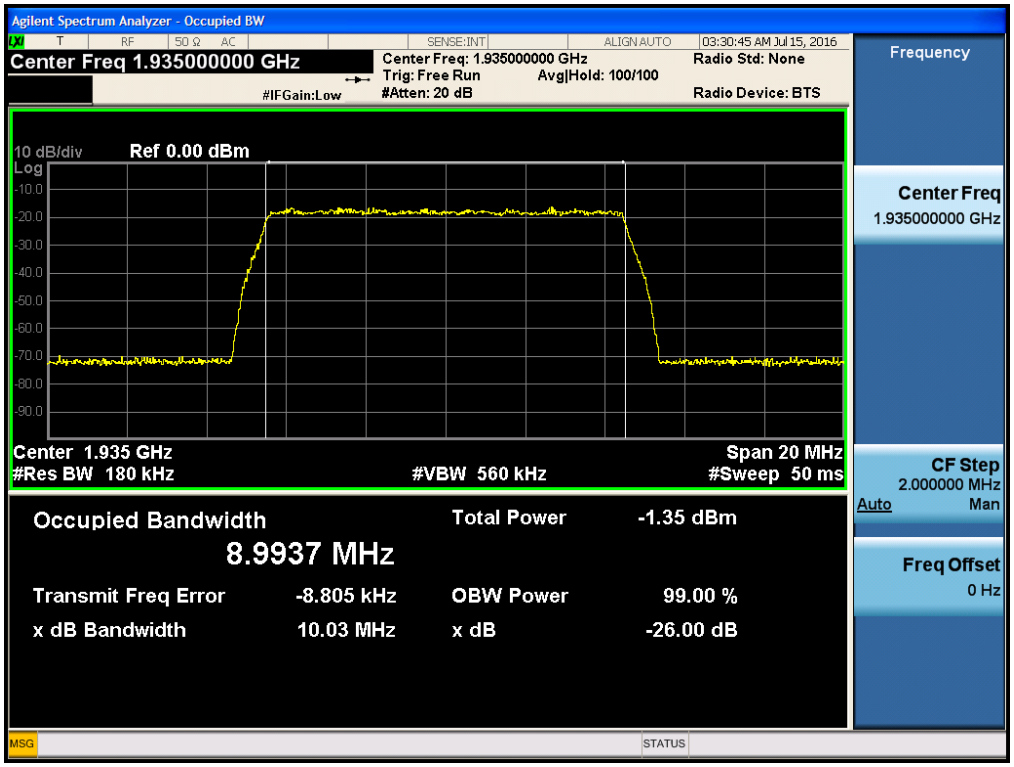


[AGC threshold Input Downlink High]

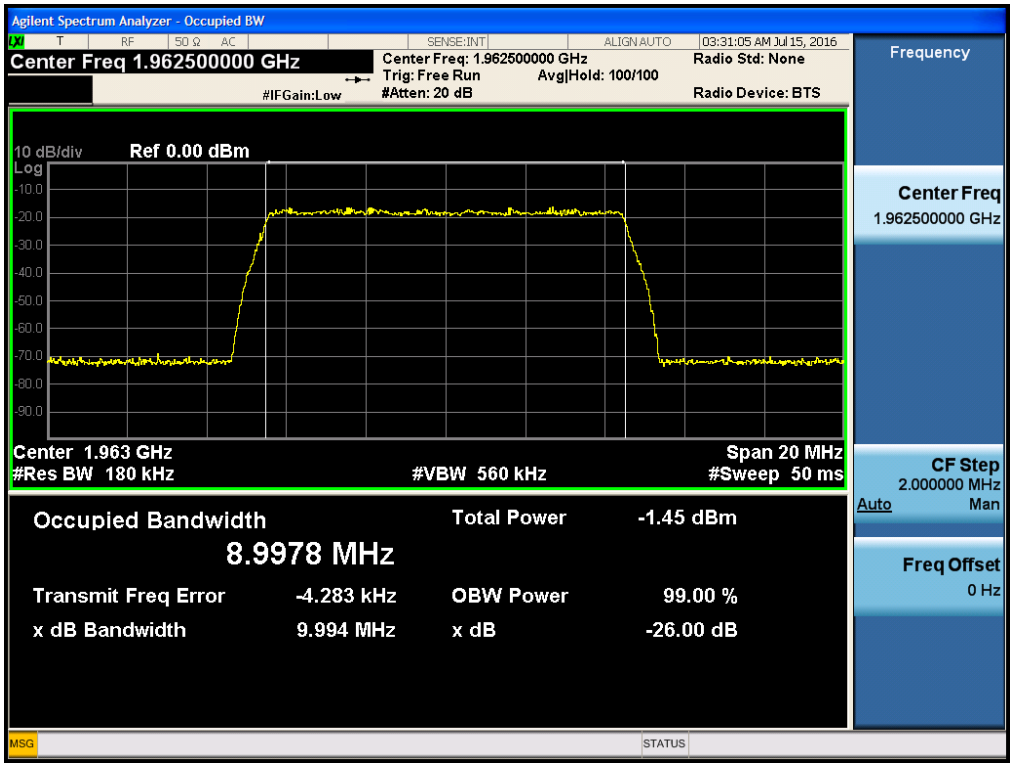


Plots of Occupied Bandwidth_1900 PCS BAND LTE 10 MHz

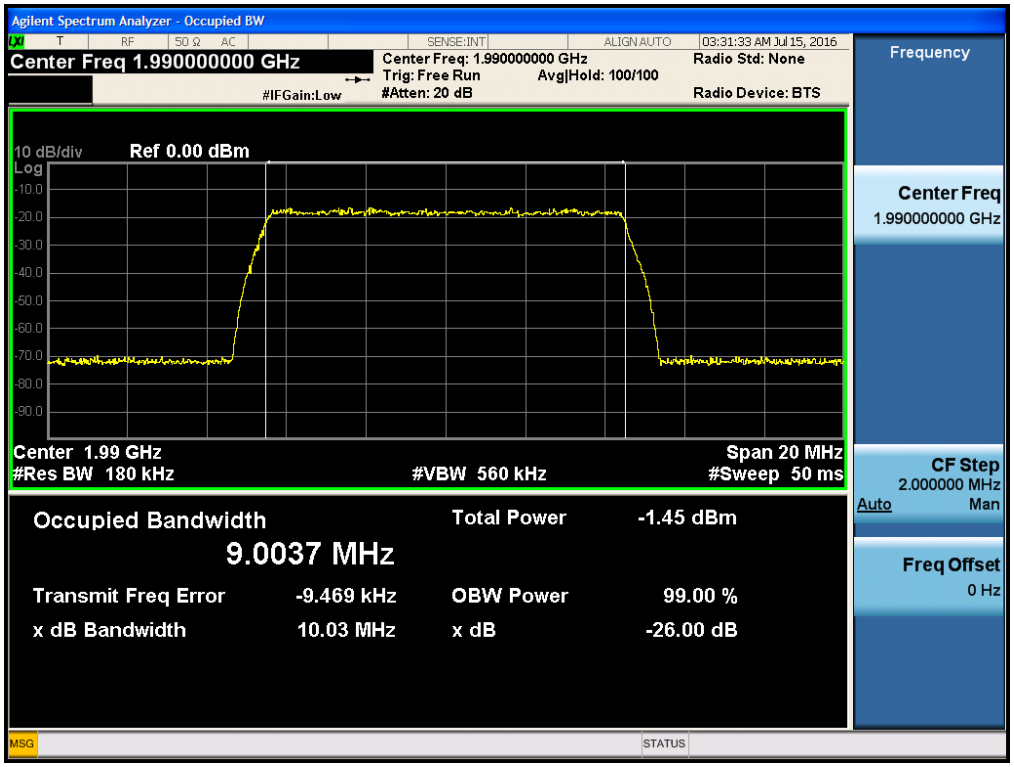
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

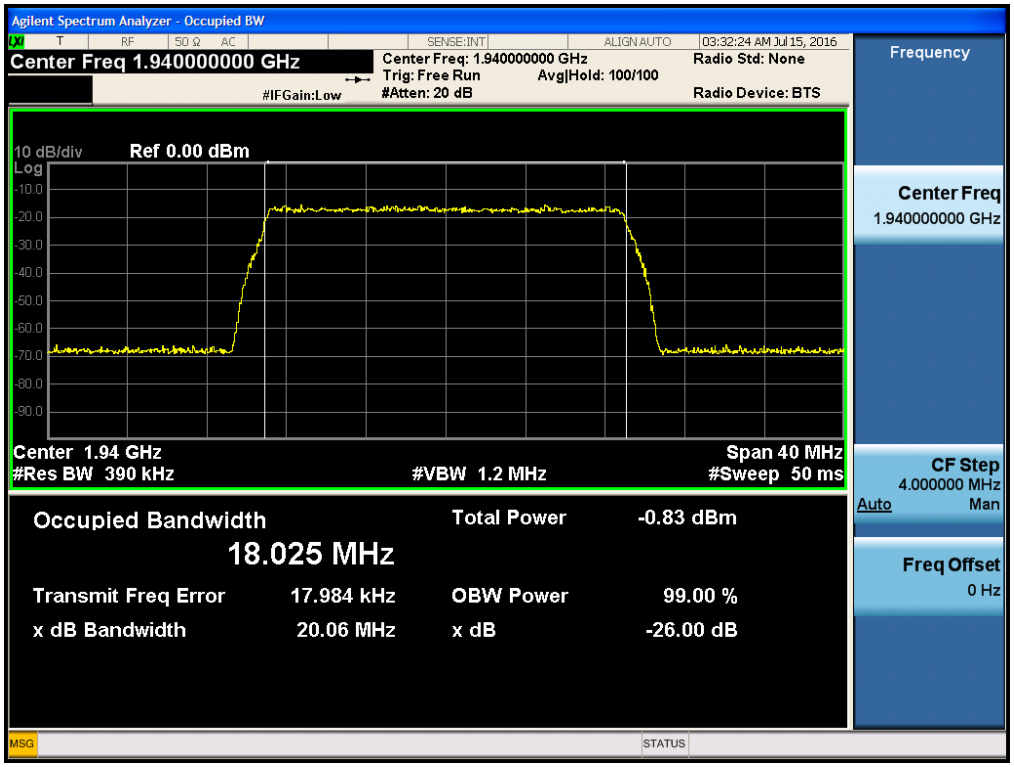


[AGC threshold Input Downlink High]

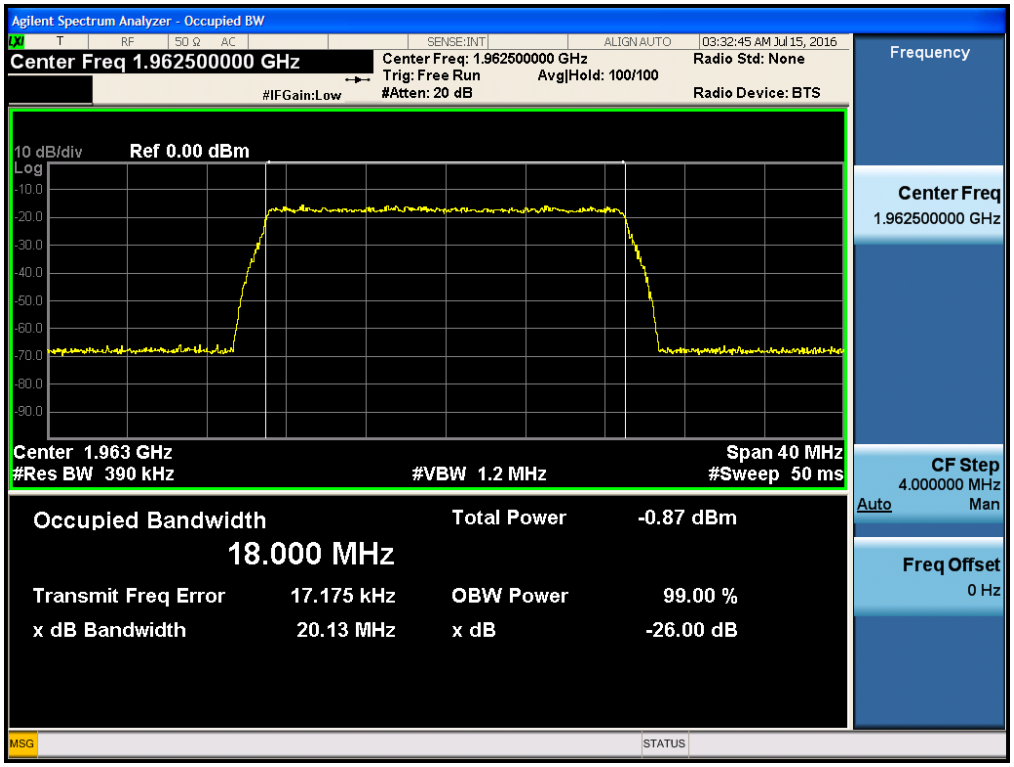


Plots of Occupied Bandwidth_1900 PCS BAND LTE 20MHz

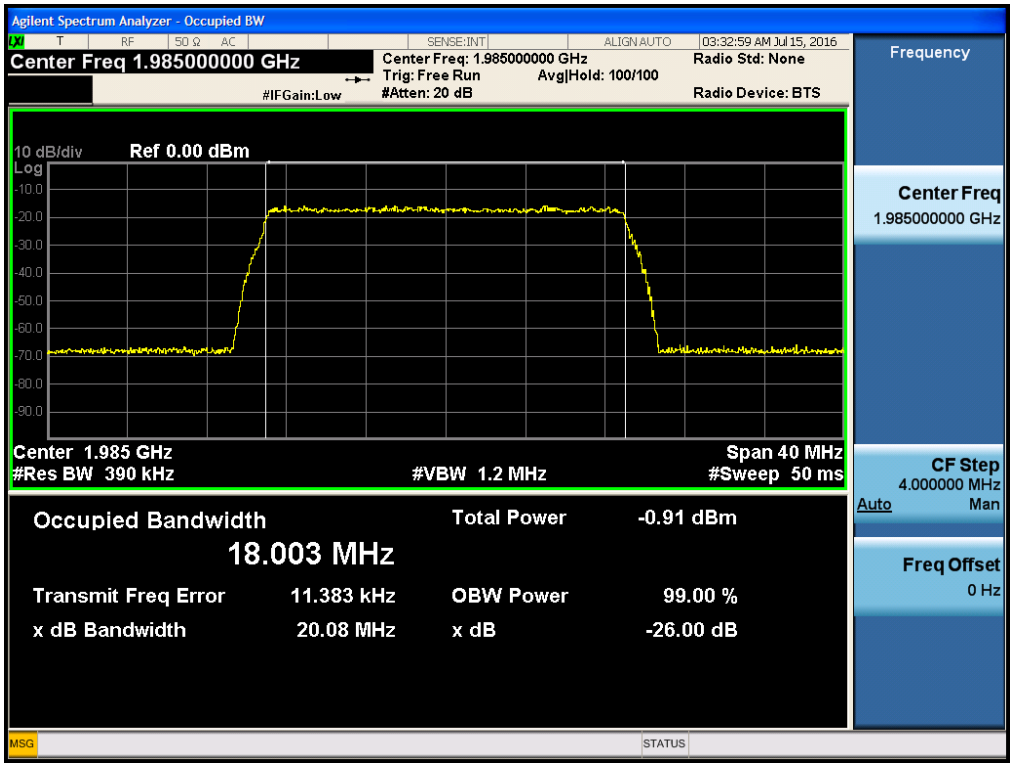
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

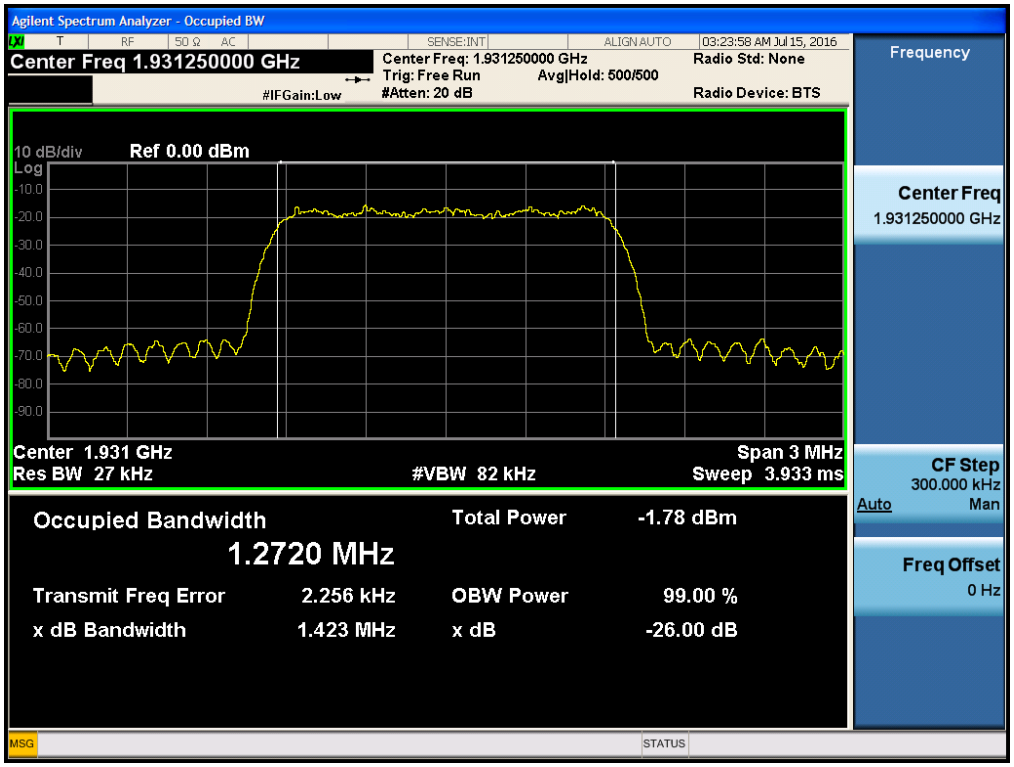


[AGC threshold Input Downlink High]

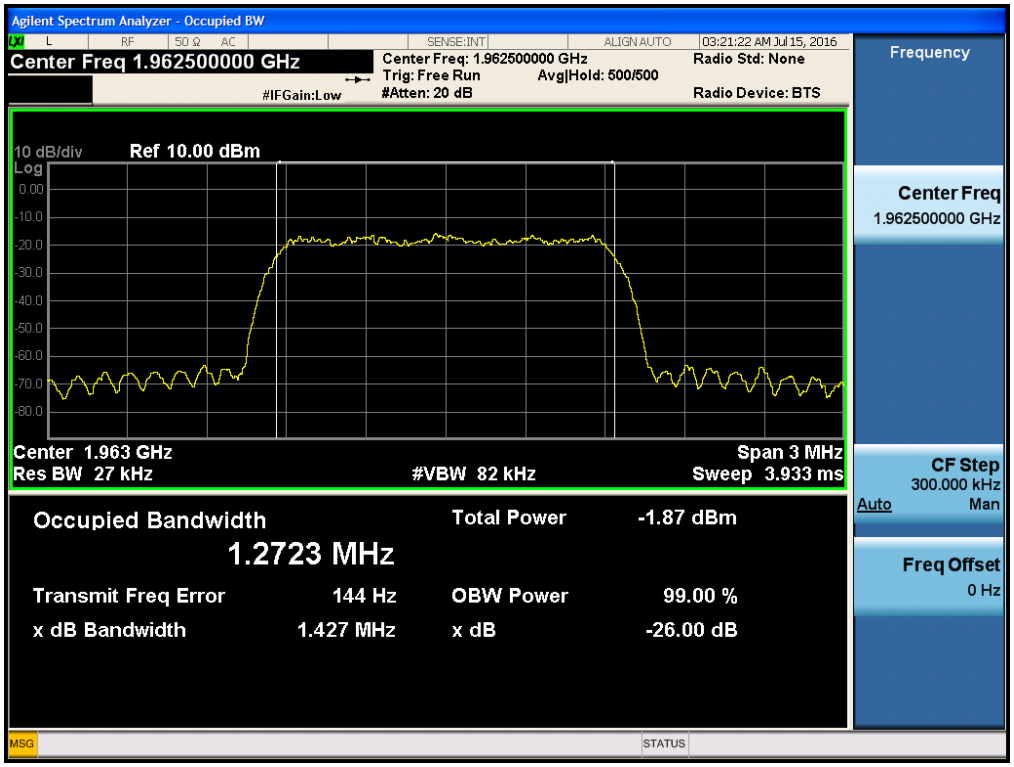


Plots of Occupied Bandwidth_1900 PCS BAND CDMA

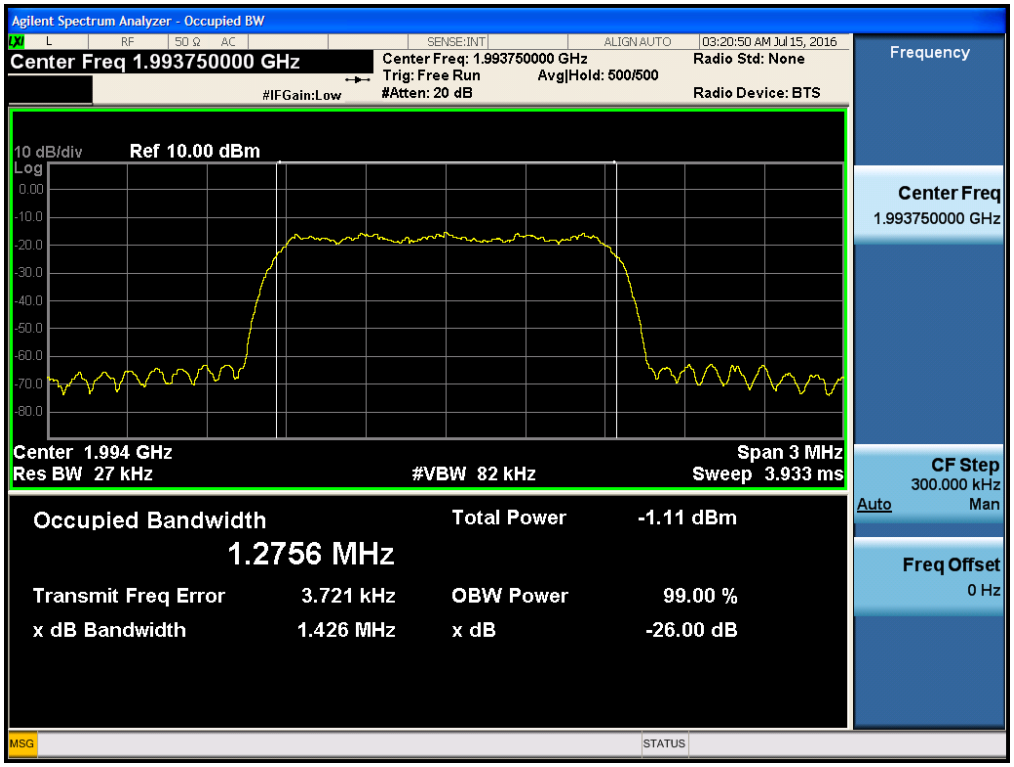
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

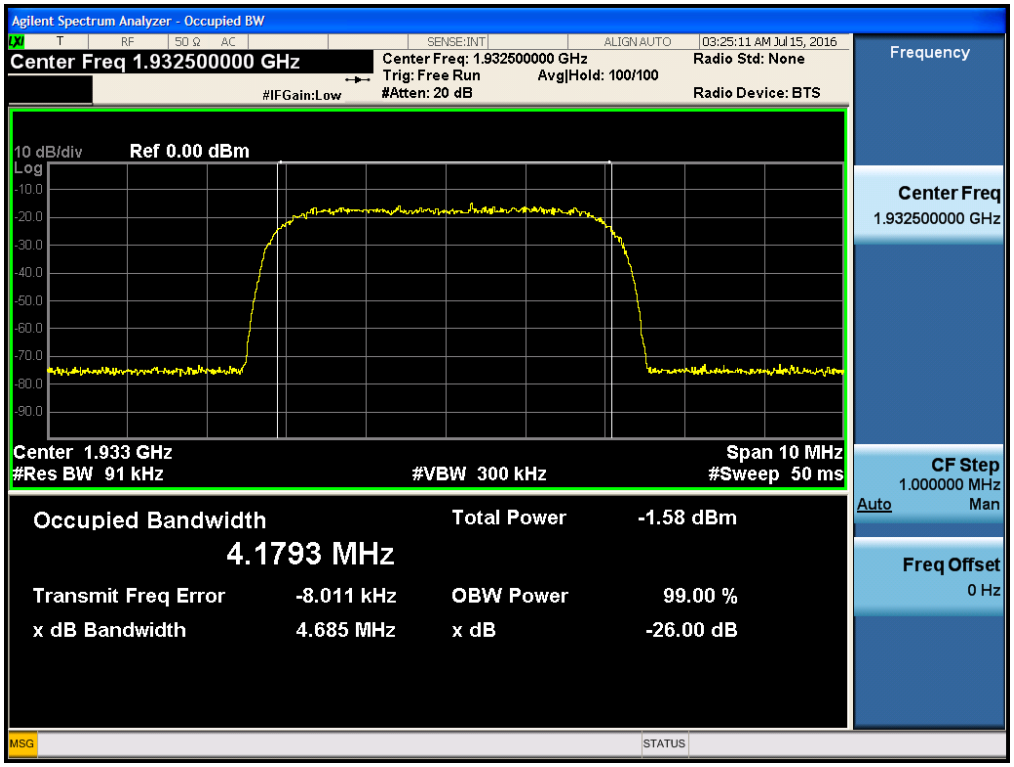


[AGC threshold Input Downlink High]

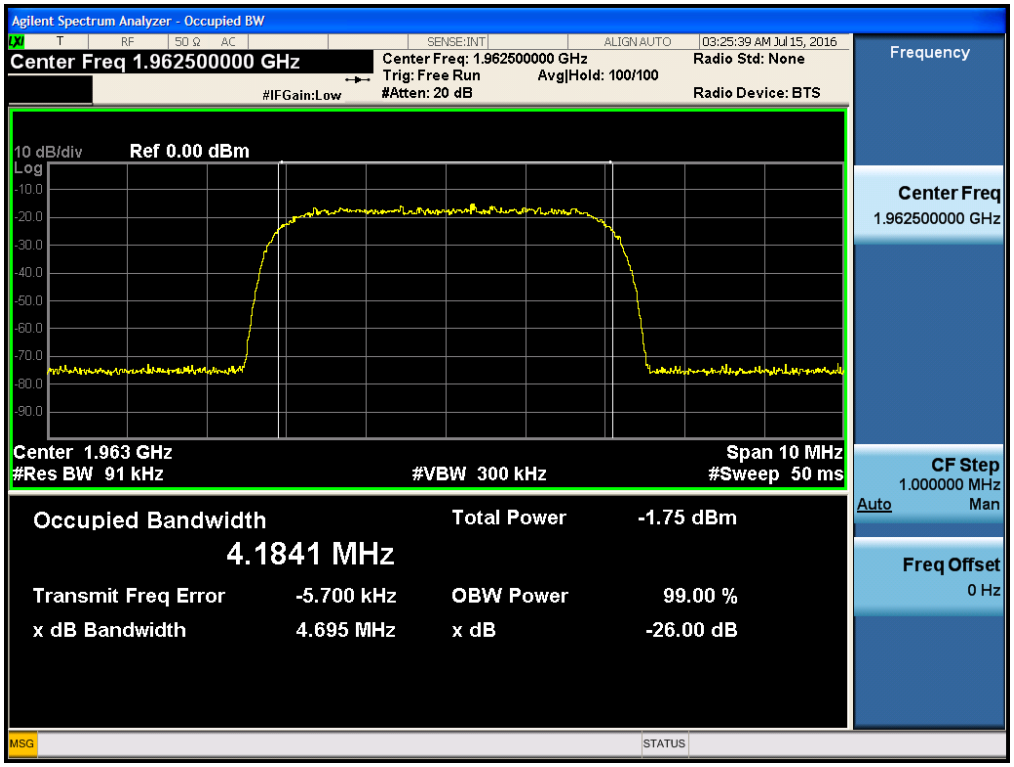


Plots of Occupied Bandwidth_1900 PCS BAND WCDMA

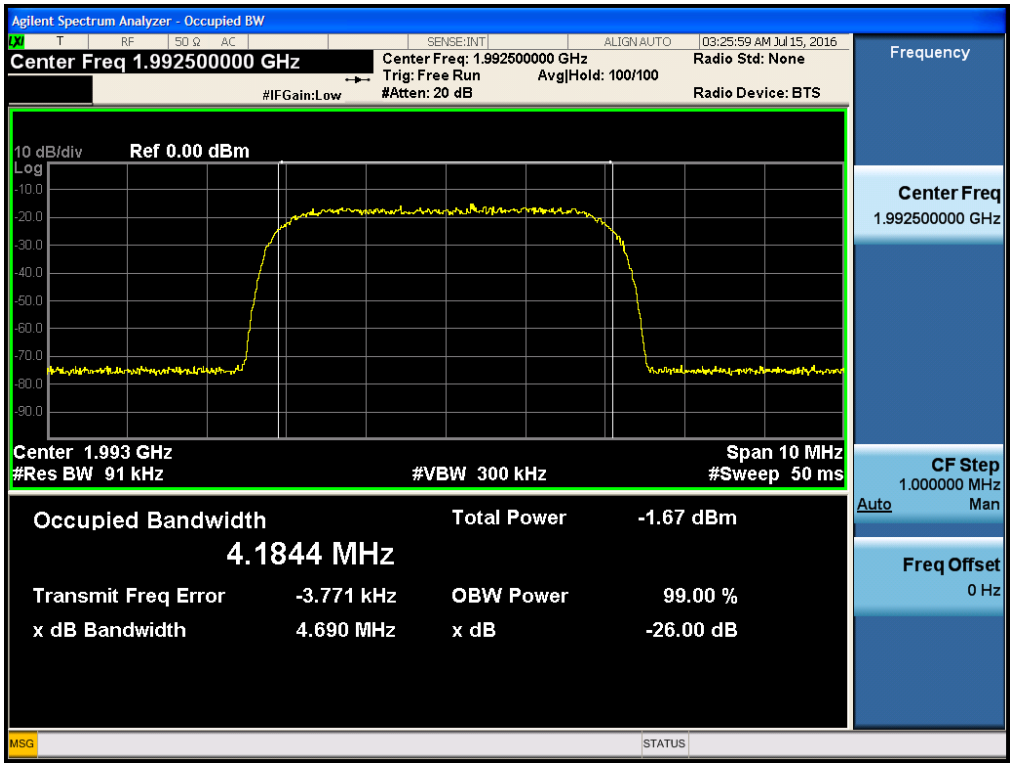
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]



[AGC threshold Input Downlink High]



8. PASSBAND GAIN AND BANDWIDTH & OUT OF BAND REJECTION

FCC Rules

Test Requirement(s):

KDB 935210 D02 v03r02

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

Test Procedures:

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

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

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

1) Frequency range = ± 250 % of the passband, for each applicable CMRS band (see also KDB Publication 935210 D02 [R7] and KDB Publication 634817 [R5] about selection of frequencies for testing and for grant listings).

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

3) Dwell time = approximately 10 ms.

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

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

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

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

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

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

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

i) Capture the frequency response of the EUT.

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

IC Rules

Test Requirements:

RSS-131

6.1 Amplifier Gain and Bandwidth

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

Test Procedures:

RSS-131

4.2 Passband Gain and Bandwidth

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

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

Test Results:

The EUT complies with the requirements of this section.

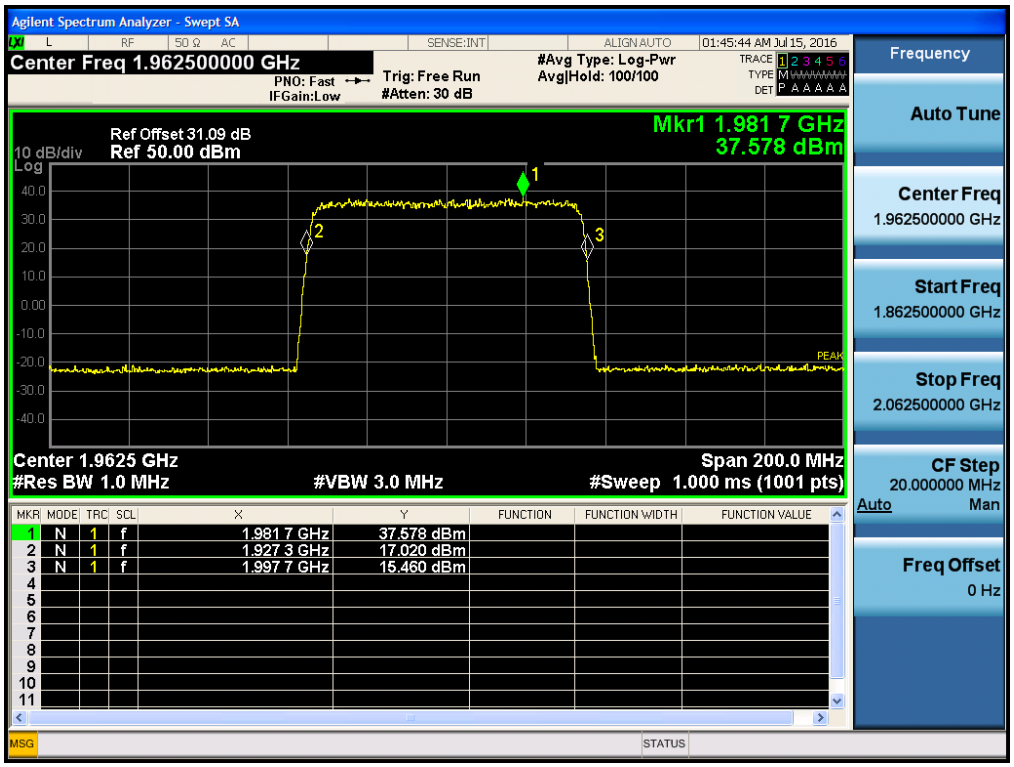
Input Signal	Input Level (dBm) Input Signal : Sinusoidal	Maximum Amp Gain
1900 PCS Band	-14 dBm	51 dB

[Downlink_1900 PCS BAND]

	20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
1900 PCS Band	1927.300 MHz ~ 1997.700 MHz	37.578	51.578

Plots of Passband Gain and Bandwidth & Out of Band Rejection

[1900 PCS BAND]



9. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

FCC Rules

Test Requirement(s):

§ 2.1051 Measurements required: Spurious emissions at antenna terminals:

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 24.238 Emission limitations for Broadband PCS equipment.

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

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) *Measurement procedure.* Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

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

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

Test Procedures:

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

3.6.1. General

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle and high channels or frequencies within each authorized frequency band of operation.

Out-of-band/block emissions (including intermodulation products) shall be measured under each of the following two stimulus conditions:

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

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

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

3.6.2. EUT out-of-band/block emissions conducted measurement

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

NOTE—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 the two-tone 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 of interest.

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 emission bandwidth, 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 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 (i.e., 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 the procedure with the composite input power level set to 3 dB above the AGC threshold.
o) Reset the input signals frequencies to the lower edge of the frequency block or band under examination.
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. EUT spurious emissions conducted measurement
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 (e.g., 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 analyzer start frequency to the lowest radio frequency 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.
NOTE—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.
j) Select the power averaging (rms) detector function.

k) Trace average at least 10 traces in power averaging (i.e., 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 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 analyzer stop frequency to 10 times the highest frequency of the fundamental emission (see §2.1057). Note that 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 (i.e., 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 and provide tabular data, if required.
p) Repeat the procedure with the input test signals tuned to a middle band/block frequency/channel and then a high band/block frequency/channel.
q) Repeat entire procedure with the narrowband test signal.
r) Repeat for all authorized frequency bands/blocks used by the EUT.

IC Rules

Test Requirement(s):

RSS-131

6.3 Non-Linearity

Transmitter signals amplified by a non-linear device (enhancer or translator) will alter the occupied bandwidth of the transmitted signals; therefore, the extent of non-linearity shall be tested.

6.3.1 Multi-channel Enhancer

For a multi-channel enhancer, any intermodulation product level must be attenuated, relative to P, by at least:

$43 + 10 \text{ Log}_{10}P$, or 70 dB, whichever is less stringent,

where P is the total RF output power of the test tones in watts.

6.3.2 Single Channel Enhancer

For a single channel amplifier, the 99% emission bandwidth shall be measured under the conditions described in section 4.3.2 and the spectrum analyser plots submitted in the test report. Set the resolution bandwidth of the spectrum analyser from 1% to 3% of the 99% emission bandwidth and set the video bandwidth to 3 times the resolution bandwidth. Record both the amplifier input and output signals.

All emissions in the amplifier's output signal that falls outside a licensed frequency block or allocated bandwidth for the technology under test must be attenuated, relative to P, by at least:

$43 + 10 \text{ Log}_{10}P$, or 70 dB, whichever is less stringent

where P is the manufacturer's rated output power in watts.

6.4 Spurious Emissions

Spurious emissions of zone enhancers and translators shall be suppressed as much as possible. Spurious emissions shall be attenuated below the rated power of the enhancer by at least:

$43 + 10 \text{ Log}_{10}(P_{rated}$ in watts), or 70 dB, whichever is less stringent.

Note: If the minimum standard is not met, check to see if the input signal generators have a high harmonic content.

Test Procedures:

RSS-131

4.4 Spurious Emission

4.4.1 Multi-channel Enhancer

The spurious emissions of the equipment under test shall be measured using the two-tone method in section 4.3.1, with the two tones P_{o1} and P_{o2} set to the required levels.

Using a spectrum analyser with a resolution bandwidth set at 100 kHz, search for spurious emissions from 30 MHz to at least 5 times the highest RF passband frequency. The search may omit the band that contains the test tones and intermodulation products.

4.4.2 Single channel Enhancer

The enhancer shall be operated as described in section 4.3.2 during the search for spurious emissions.

Using a spectrum analyser with a resolution bandwidth set at 100 kHz, search for spurious emissions from 30 MHz to at least 5 times the highest RF passband frequency. The search may omit the band that contains the input signal.

Test Results:

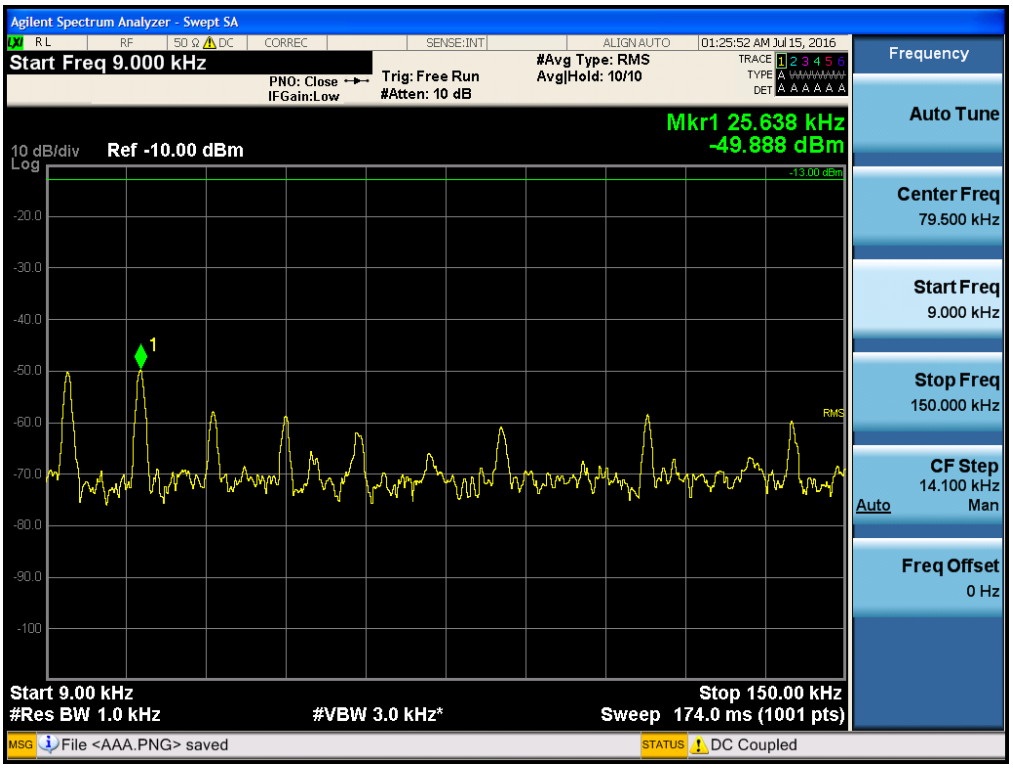
The EUT complies with the requirements of this section. There were no Detectable Spurious emissions for this EUT.

*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)

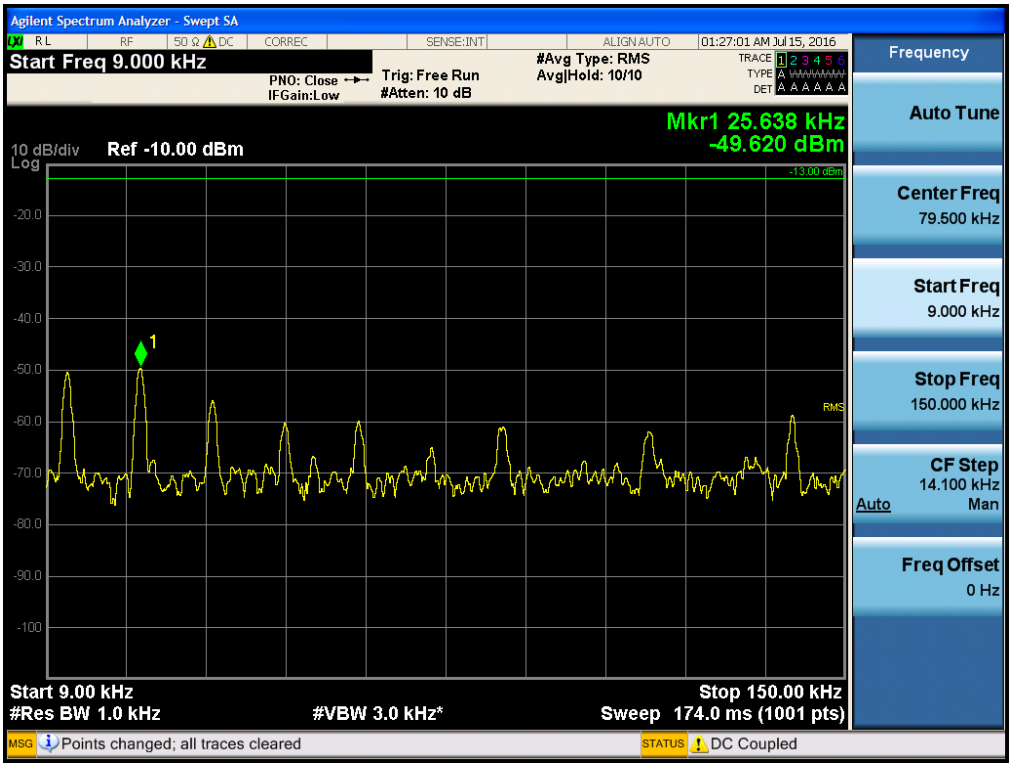
Single channel Enhancer Plots of Spurious Emission for 1900 PCS BAND LTE 5 MHz

Conducted Spurious Emissions (9 kHz – 150 kHz)

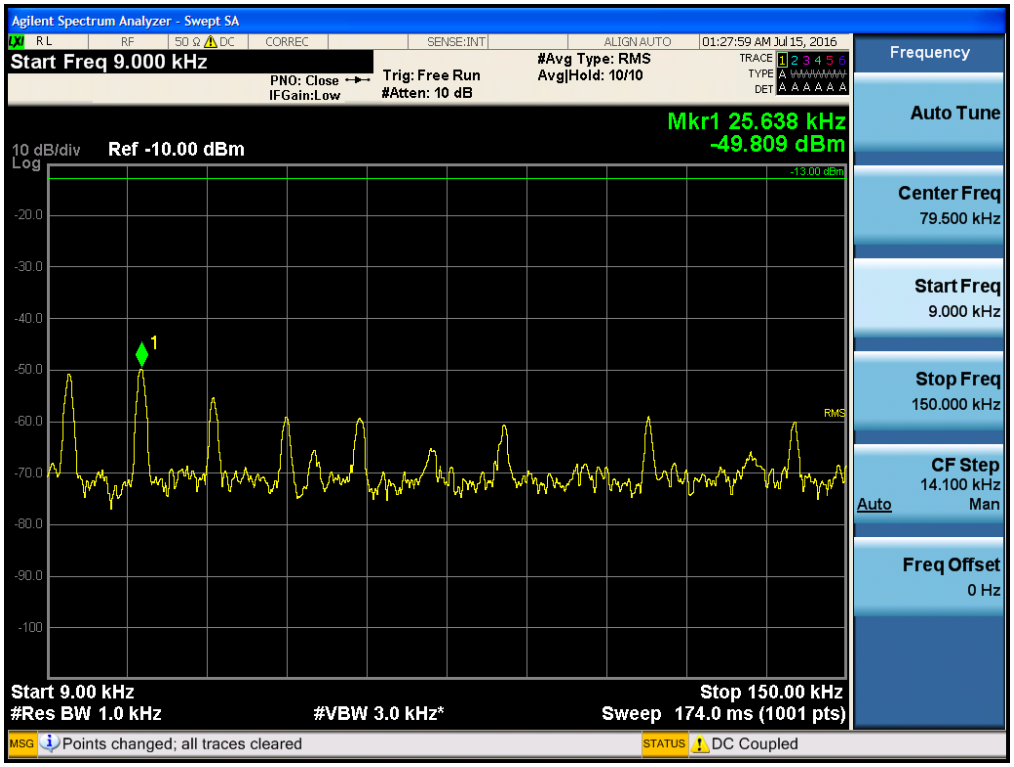
[Downlink Low]



[Downlink Middle]

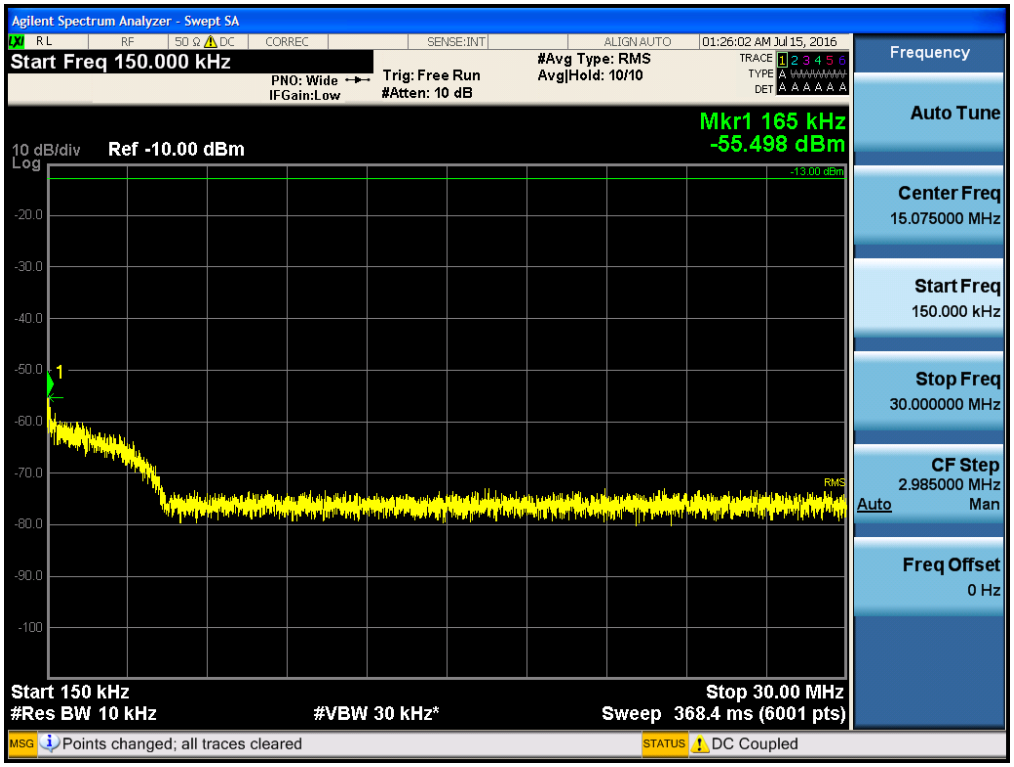


[Downlink High]



Conducted Spurious Emissions (150 kHz – 30 MHz)

[Downlink Low]



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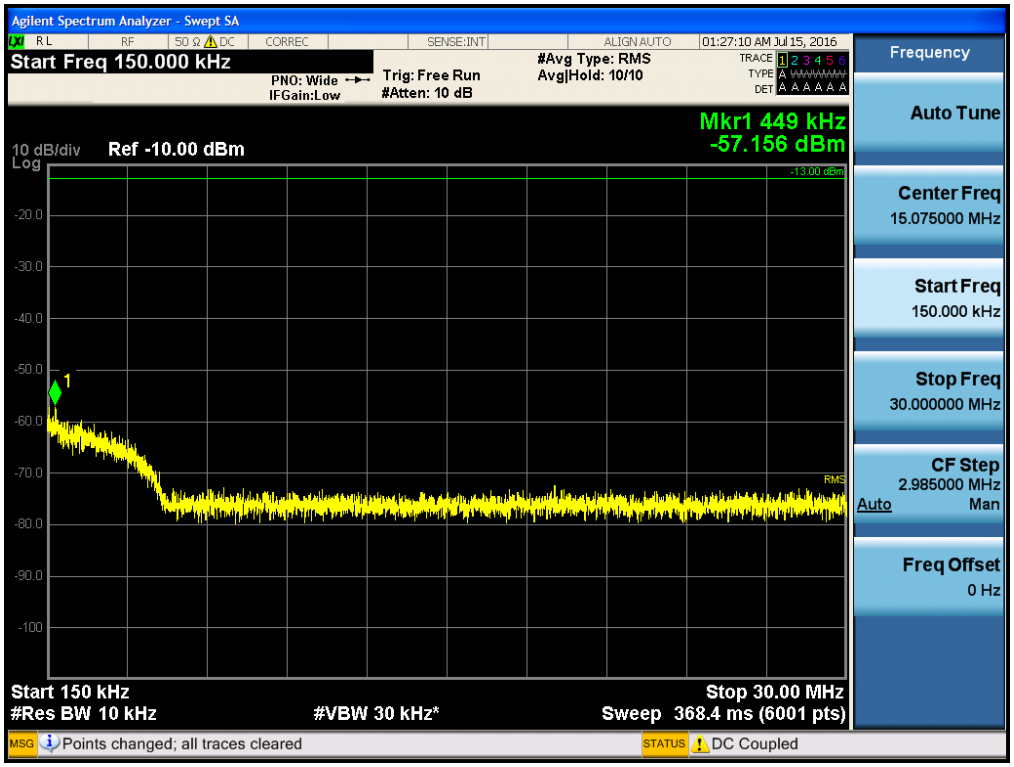
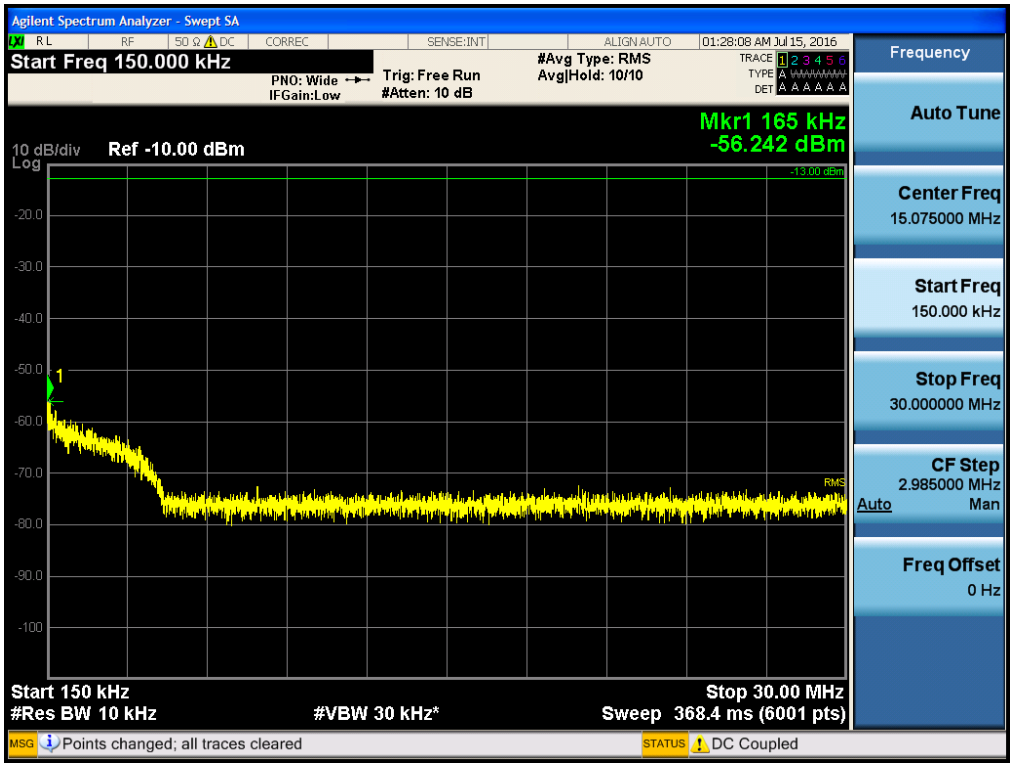
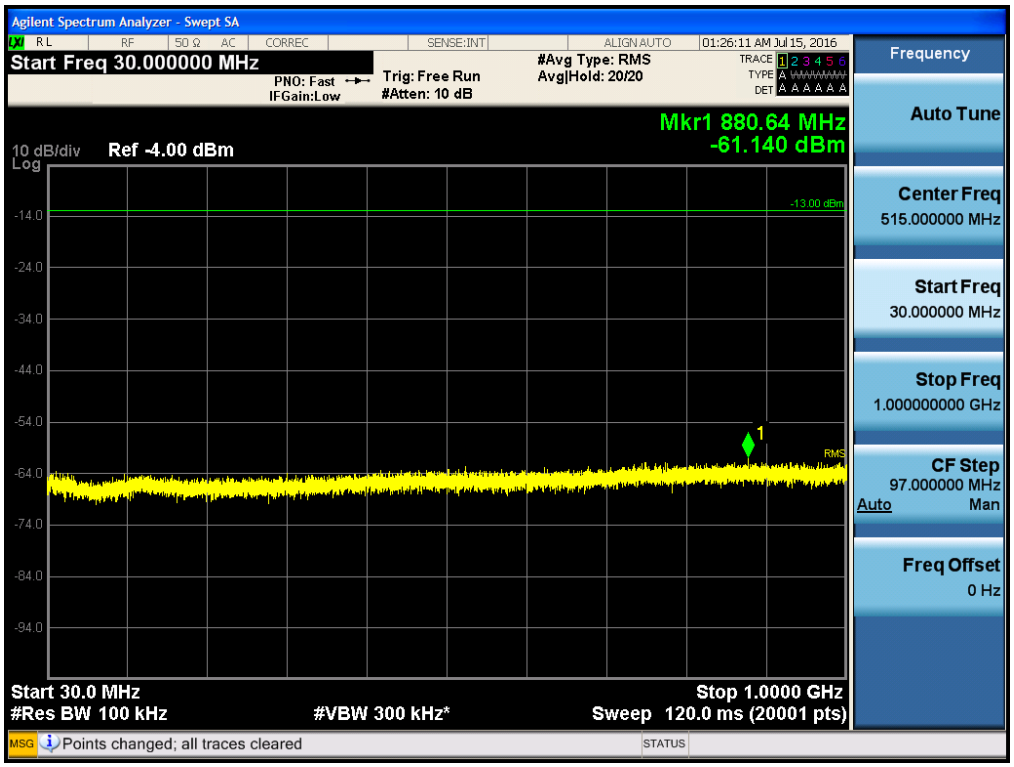


[Downlink High]



Conducted Spurious Emissions (30 MHz – 1 GHz)

[Downlink Low]



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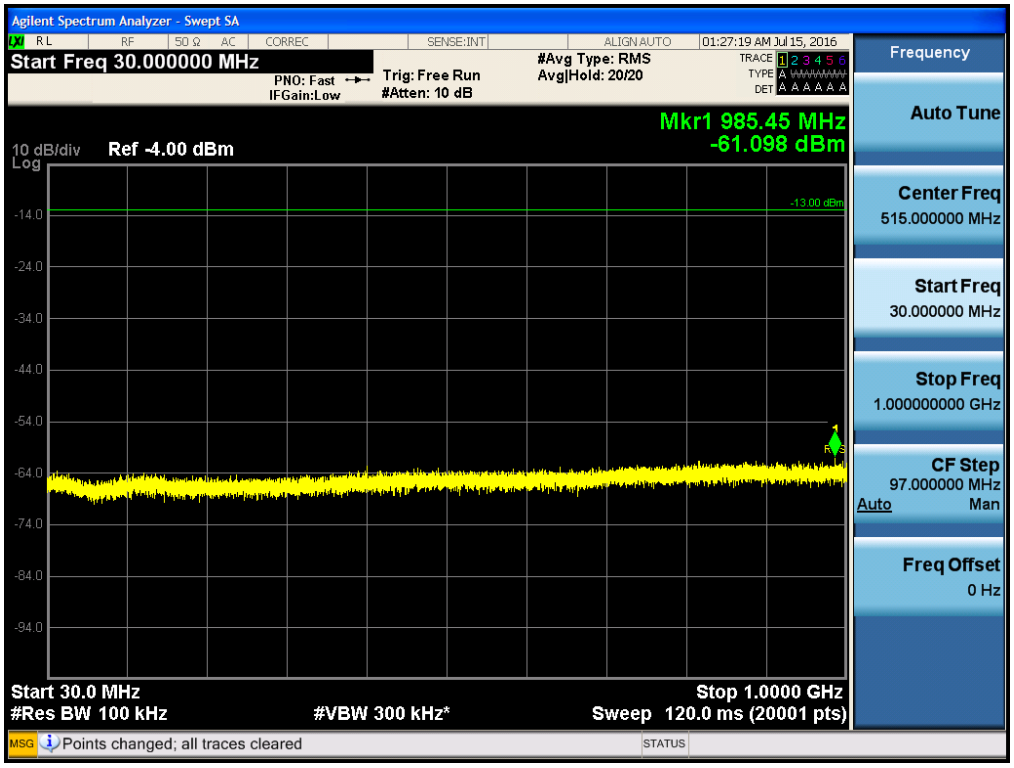

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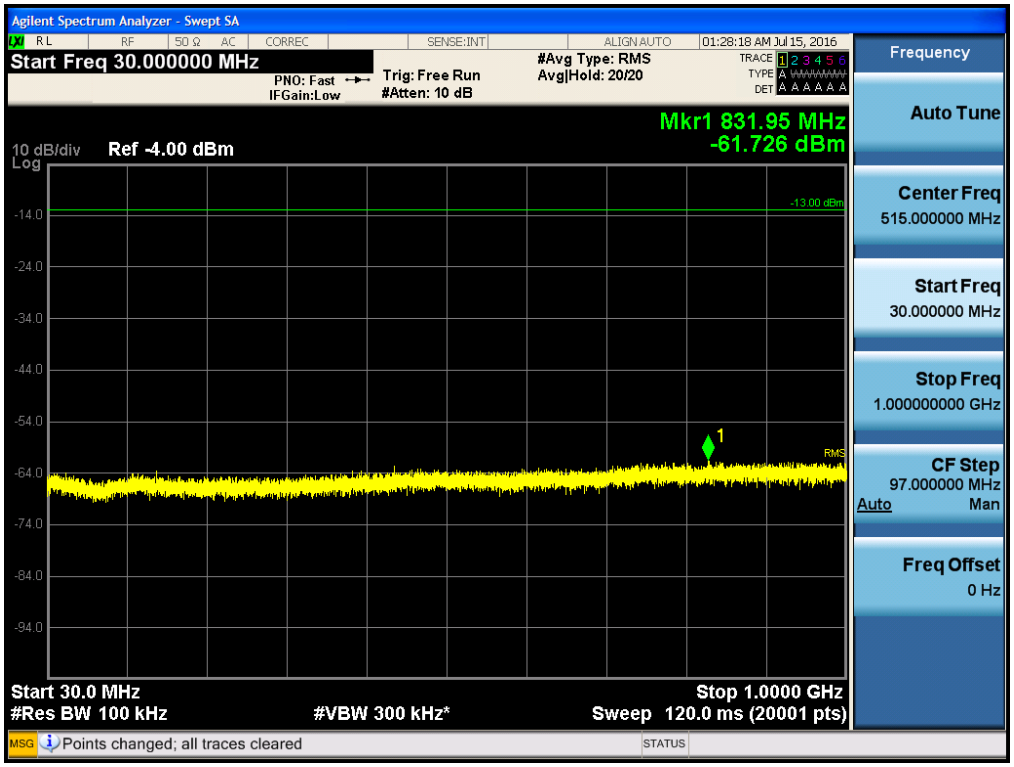
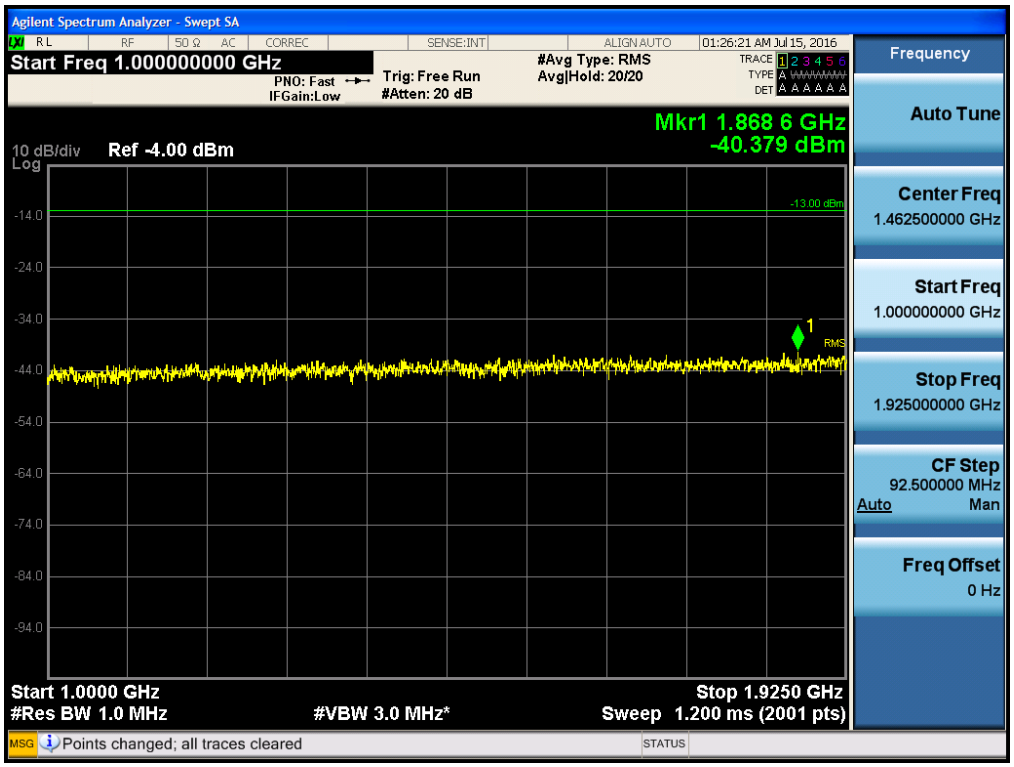


Conducted Spurious Emissions (1 GHz – 26.5 GHz)

[Downlink Low]-1



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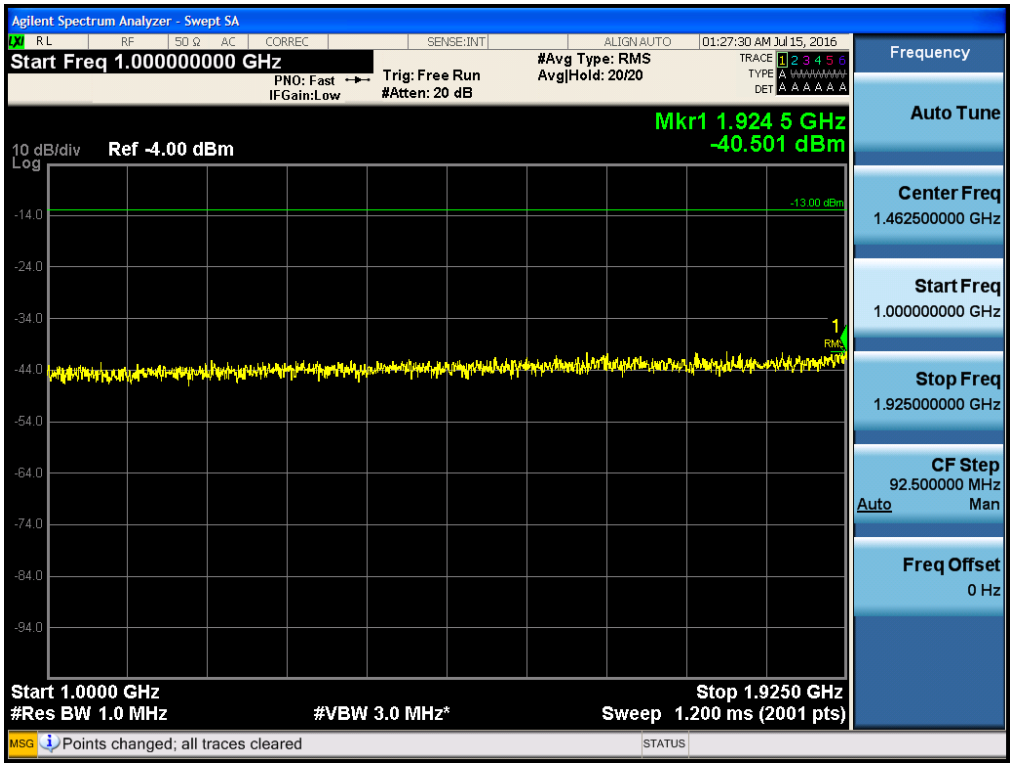

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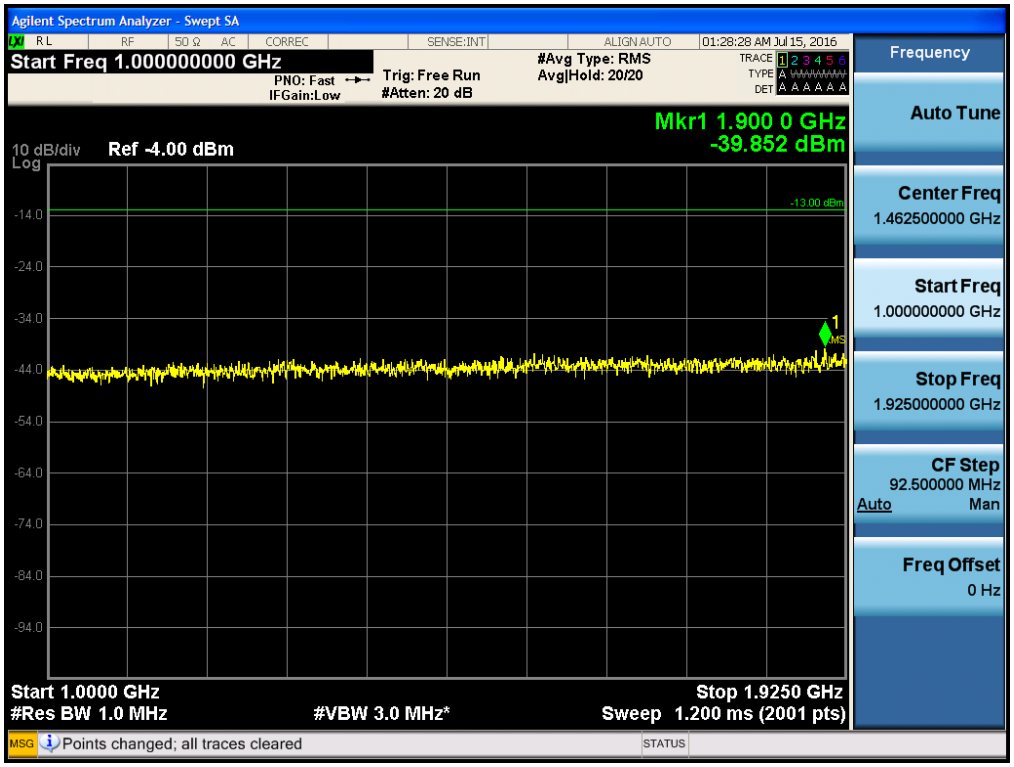

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