

FCC / ISED REPORT

Certification

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|--|---|
| Applicant Name: SOLiD, Inc. | Date of Issue: June 13, 2017 |
| Address: 10, 9th Floor, SOLiD Space, Pangyo-yeok-ro 220, Bundang-gu, Seongnam-si, Gyeonggi-do, 463- 400, South Korea | Location: HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA |
| | Report No.: HCT-R-1706-F041 |
| | HCT FRN: 0005866421 |
| | ISED Registration No.: 5944A-5 |

| | |
|-------------------|------------------------|
| FCC ID: | W6UNH1900P-40 |
| IC: | 9354A-NH1900P40 |
| APPLICANT: | SOLiD, Inc. |

| | |
|--------------------------------|--|
| FCC/ IC Model(s): | N20-HRDU_1900P_40 |
| EUT Type: | ALLIANCE_N20 |
| Frequency Ranges: | 1 930 MHz ~1 995 MHz (Downlink) |
| Conducted Output Power: | 40 W (46 dBm) |
| Date of Test: | April 19, 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, May 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 this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of 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

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Version

| TEST REPORT NO. | DATE | DESCRIPTION |
|-----------------|---------------|-------------------------|
| HCT-R-1706-F041 | June 13, 2017 | - First Approval Report |
| | | |
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Table of Contents

| | |
|---|------------|
| 1. CLIENT INFORMATION..... | 4 |
| 2. FACILITIES AND ACCREDITATIONS..... | 5 |
| 2.1. FACILITIES | 5 |
| 2.2. EQUIPMENT | 5 |
| 3. TEST SPECIFICATIONS..... | 6 |
| 3.1. STANDARDS | 6 |
| 3.2. MODE OF OPERATION DURING THE TEST..... | 6 |
| 3.3. MAXIMUM MEASUREMENTUNCERTAINTY | 7 |
| 4. STANDARDS ENVIRONMENTAL TEST CONDITIONS | 7 |
| 5. TEST EQUIPMENT | 8 |
| 6. RF OUTPUT POWER..... | 9 |
| 7. OCCUPIED BANDWIDTH | 31 |
| 8. INPUT VERSUS OUTPUT SPECTRUM..... | 62 |
| 9. OUT OF BAND REJECTION & MEAN OUTPUT POWER AND ZONE ENHANCER GAIN..... | 64 |
| 10. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL | 67 |
| 11. RADIATED SPURIOUS EMISSIONS..... | 142 |
| 12. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS..... | 147 |

1. CLIENT INFORMATION

The EUT has been tested by request of

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

FCC ID: W6UNH1900P-40
IC: 9354A-NH1900P40
EUT Type: ALLIANCE_N20
FCC/ IC Model(s): N20-HRDU_1900P_40
Power Supply: AC 110 / 220 V
DC -48 V
Frequency Ranges: 1 930 MHz ~1 995 MHz (Downlink)
Conducted Output Power: 40 W (46 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 47 Part 2, Part 24
IC Rules Part(s): RSS-Gen (Issue 4, November 2014),
RSS-131 (Issue 3, May 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 MEASUREMENT UNCERTAINTY

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

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

| Description | Condition | Uncertainty |
|--|-------------------------------|---------------------------------|
| Conducted RF Output Power | - | ± 0.72 dB |
| Occupied Bandwidth | OBW ≤ 20 MHz | ± 52 kHz |
| 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 | $f \leq 1$ GHz $f > 1$ GHz | ± 4.80 dB ± 6.07 dB |
| Frequency Stability | - | $\pm 1.22 \times 10^{-6}$ |

4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

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

5. TEST EQUIPMENT

| Manufacturer | Model / Equipment | Cal Interval | Calibration Date | Serial No. |
|------------------------|--|--------------|------------------|----------------|
| Agilent | 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 | 04/19/2017 | 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 | 01/23/2017 | 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.

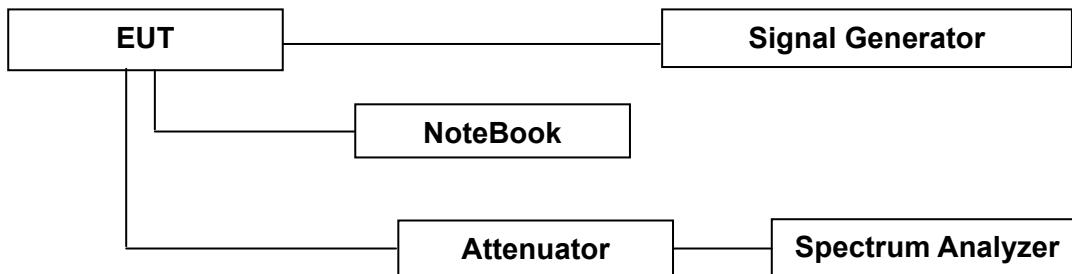
Test Procedures:

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 | -15 dBm | 61 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 | 45.94 | 39.264 |
| | Middle | 1962.50 | 45.96 | 39.446 |
| | High | 1992.50 | 45.94 | 39.264 |
| 1900 PCS Band _ LTE 5 MHz +3dBm above the AGC threshold | Low | 1992.50 | 46.02 | 39.994 |
| | Middle | 1992.50 | 46.57 | 45.394 |
| | High | 1992.50 | 45.83 | 38.282 |
| 1900 PCS Band _ LTE 10 MHz AGC threshold | Low | 1935.00 | 45.90 | 38.905 |
| | Middle | 1962.50 | 46.38 | 43.451 |
| | High | 1990.00 | 46.05 | 40.272 |
| 1900 PCS Band _ LTE 10 MHz +3dBm above the AGC threshold | Low | 1935.00 | 45.93 | 39.174 |
| | Middle | 1962.50 | 46.36 | 43.251 |
| | High | 1990.00 | 45.87 | 38.637 |
| 1900 PCS Band _ WCDMA AGC threshold | Low | 1932.50 | 46.38 | 43.451 |
| | Middle | 1962.50 | 45.98 | 39.628 |
| | High | 1992.50 | 46.42 | 43.853 |
| 1900 PCS Band _ WCDMA +3dBm above the AGC threshold | Low | 1932.50 | 45.83 | 38.282 |
| | Middle | 1962.50 | 46.00 | 39.811 |
| | High | 1992.50 | 46.34 | 43.053 |

| | Channel | Frequency (MHz) | Output Power | |
|---|---------|--------------------|--------------|--------|
| | | | (dBm) | (W) |
| 1900 PCS Band _ CDMA AGC threshold | Low | 1931.25 | 46.16 | 41.305 |
| | Middle | 1962.50 | 45.94 | 39.264 |
| | High | 1993.75 | 46.05 | 40.272 |
| 1900 PCS Band _ CDMA +3dBm above the AGC threshold | Low | 1931.25 | 46.00 | 39.811 |
| | Middle | 1962.50 | 45.92 | 39.084 |
| | High | 1993.75 | 45.84 | 38.371 |
| 1900 PCS Band _ GSM AGC threshold | Low | 1930.40 | 46.17 | 41.400 |
| | Middle | 1962.50 | 46.25 | 42.170 |
| | High | 1994.60 | 46.03 | 40.087 |
| 1900 PCS Band _ GSM +3dBm above the AGC threshold | Low | 1930.40 | 45.91 | 38.994 |
| | Middle | 1962.50 | 46.09 | 40.631 |
| | High | 1994.60 | 46.16 | 41.305 |

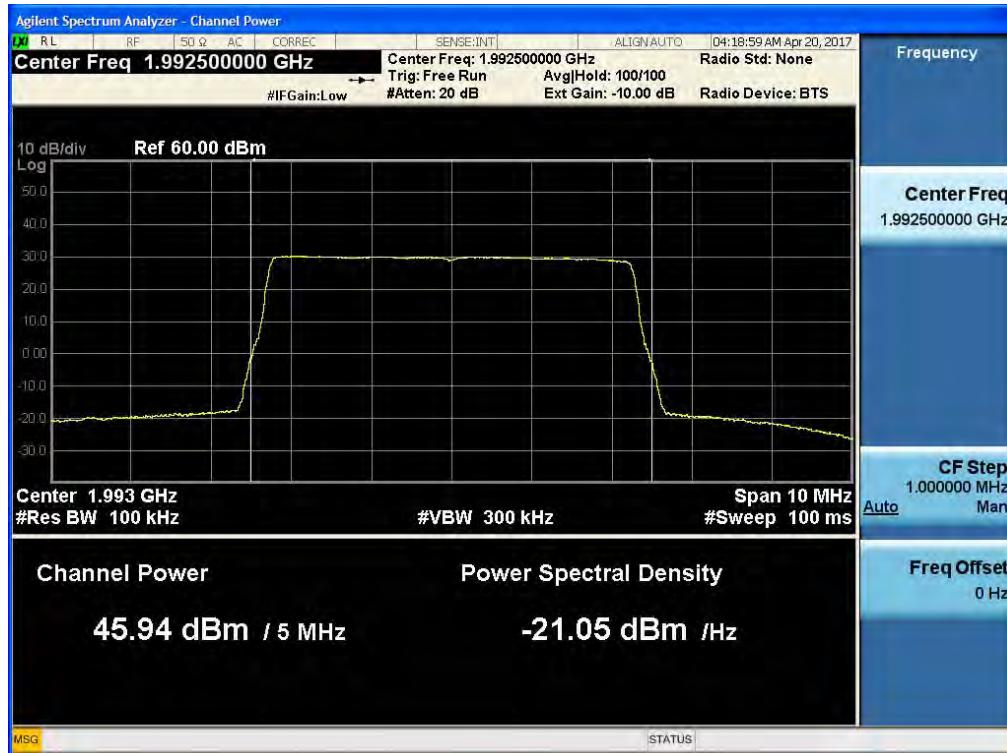
Plots of RF Output Power for 1900 PCS Band LTE 5 MHz [AGC threshold Downlink Low]



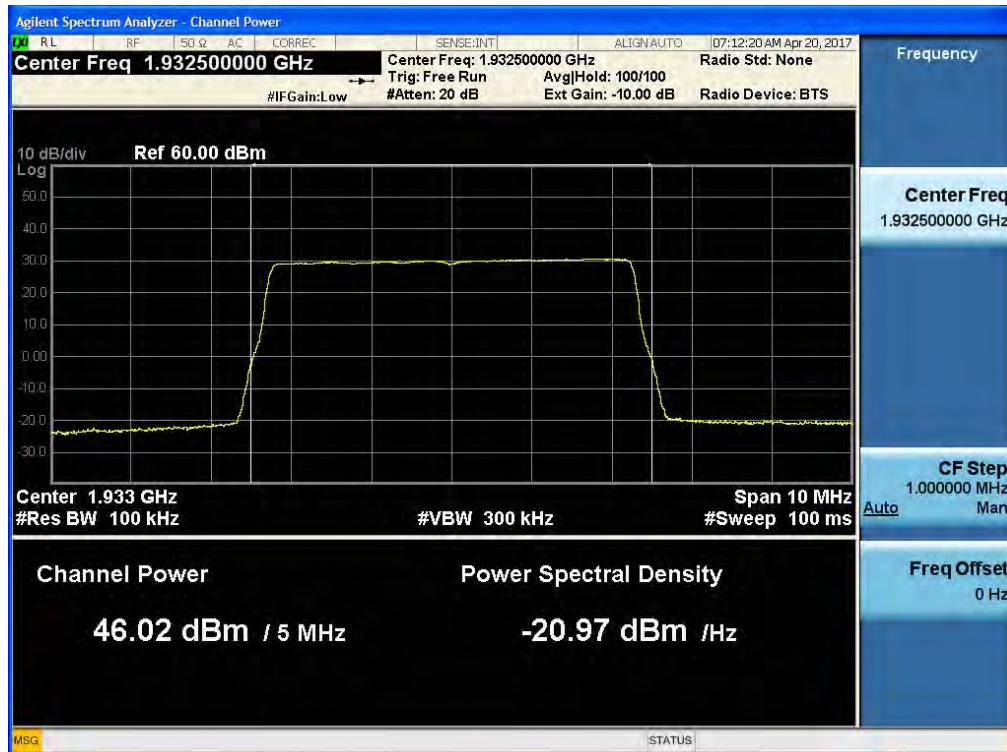
[AGC threshold Downlink Middle]



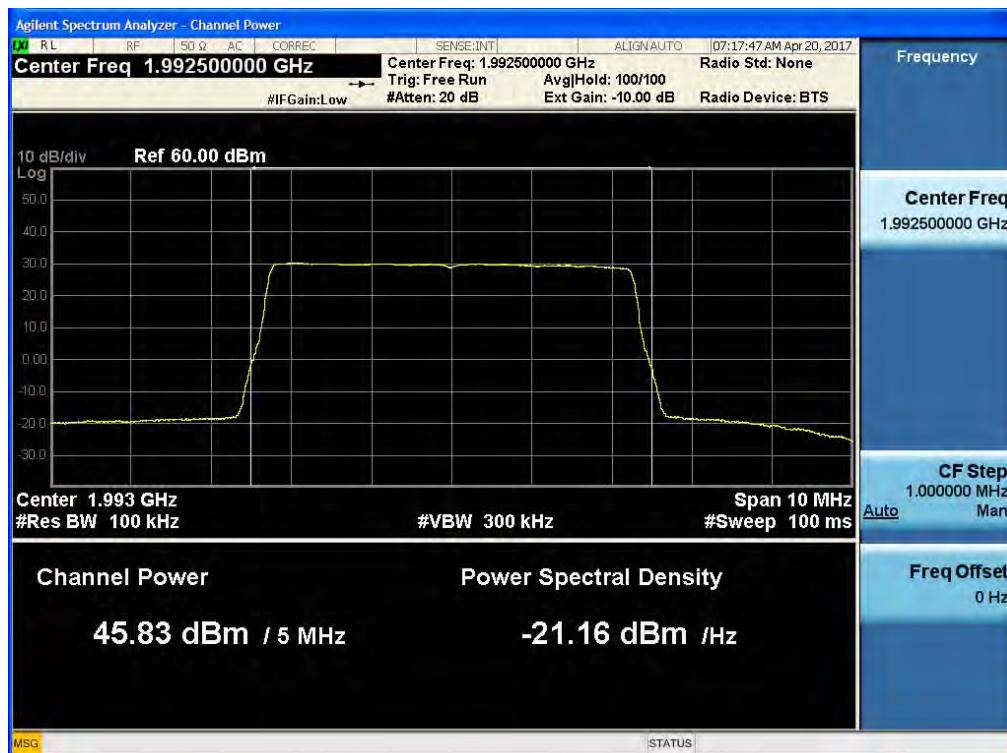
[AGC threshold Downlink High]



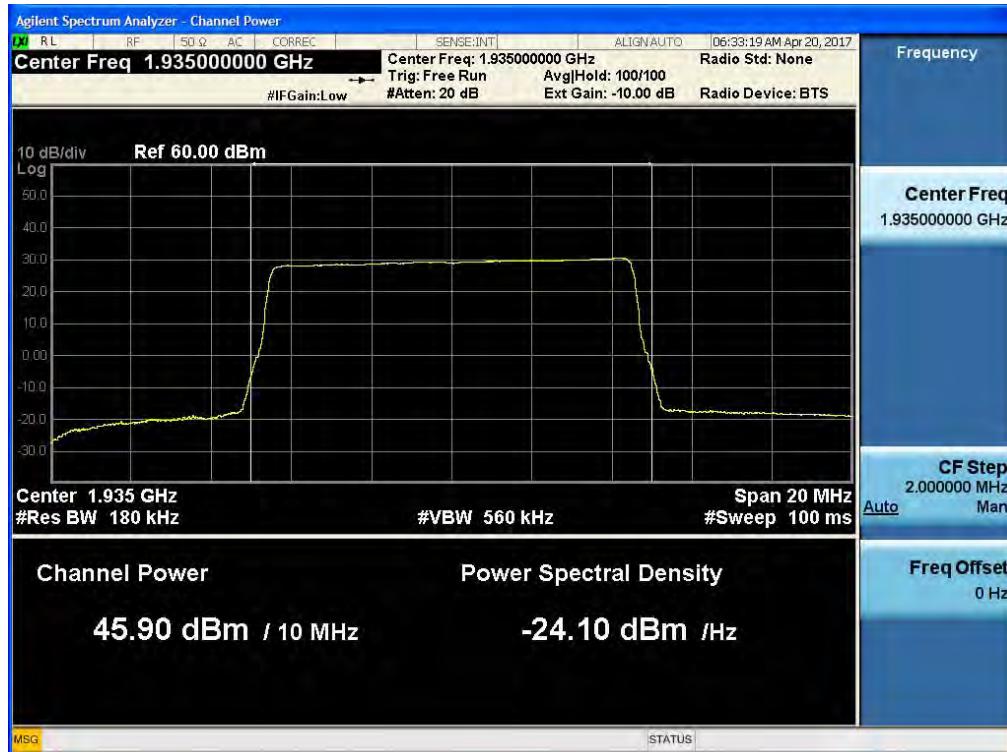
[+3dBm above AGC threshold Downlink Low]



[+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]

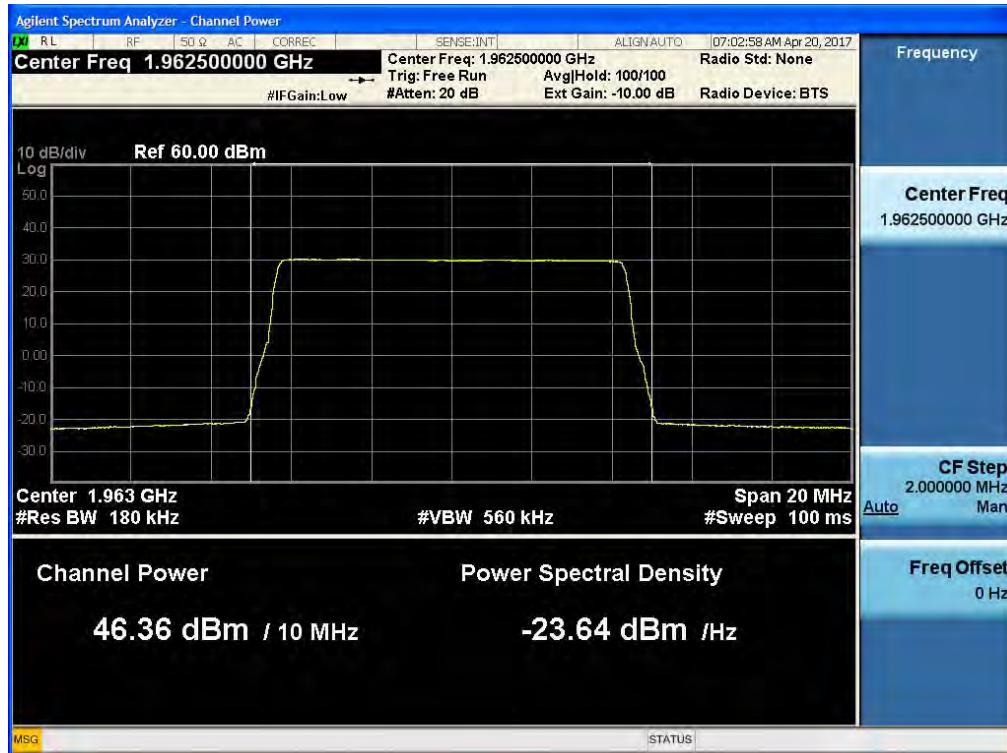


[AGC threshold Downlink High]



[+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 WCDMA

[AGC threshold Downlink Low]



[AGC threshold Downlink Middle]

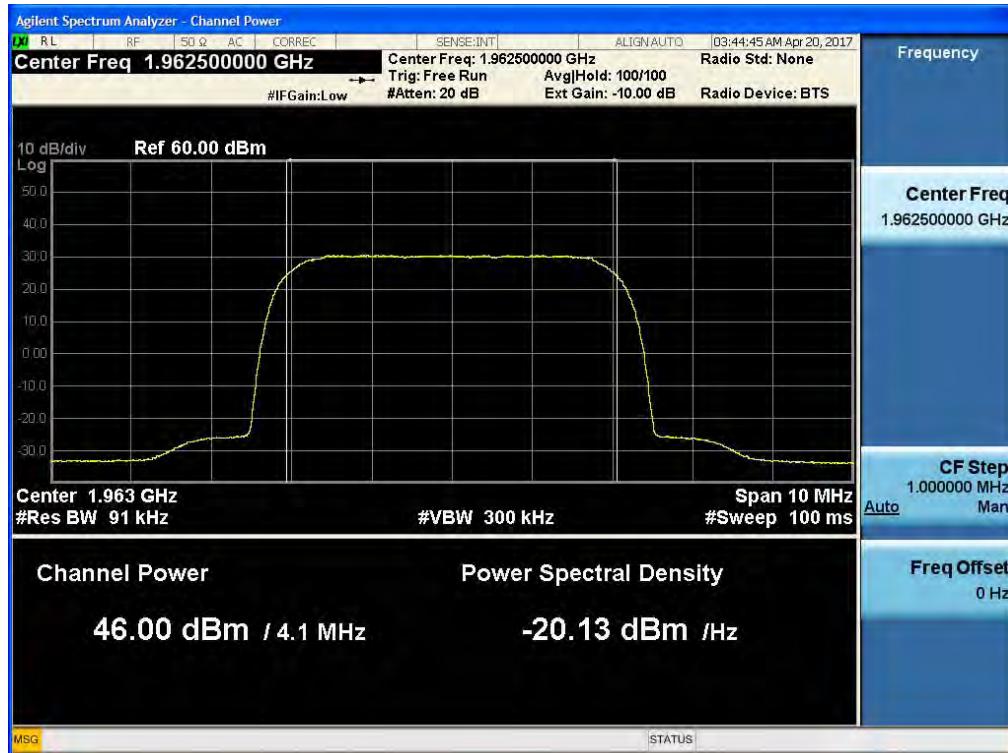


[AGC threshold Downlink High]



[+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]

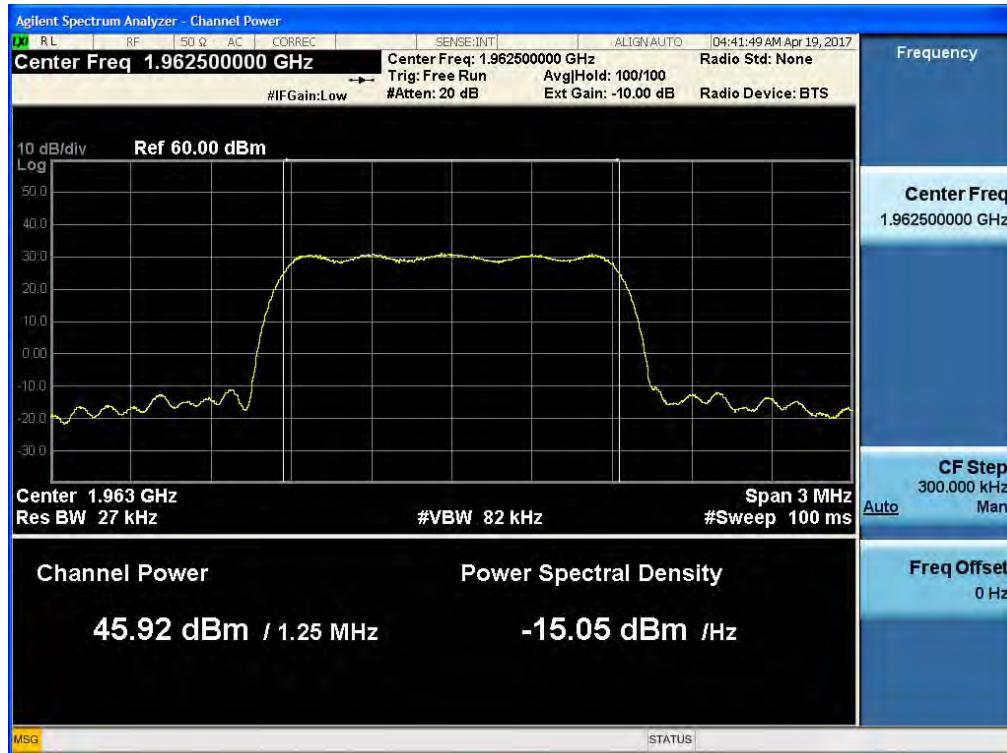


[AGC threshold Downlink High]



[+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 $\geq 3 \times$ RBW.
- g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than $[10 \log (\text{OBW} / \text{RBW})]$ below the reference level.
NOTE—Steps f) and g) may require iteration to enable adjustments within the specified tolerances.
- h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below

the reference level.

- i) Set spectrum analyzer detection function to positive peak.
- j) Set the trace mode to max hold.
- k) Use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.
- l) Repeat steps e) to k) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).
- m) Compare the spectral plot of the input signal (determined from step l) to the output signal (determined from step k) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.
- n) Repeat for all frequency bands authorized for use by the EUT.
- 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) |
|---|---------|--------------------|-----------|
| LTE 5 MHz AGC threshold | Low | 1932.50 | 4.5113 |
| | Middle | 1962.50 | 4.5159 |
| | High | 1992.50 | 4.5061 |
| LTE 5 MHz +3dBm above the AGC threshold | Low | 1992.50 | 4.5128 |
| | Middle | 1992.50 | 4.5126 |
| | High | 1992.50 | 4.5054 |
| LTE 10 MHz AGC threshold | Low | 1935.00 | 8.9905 |
| | Middle | 1962.50 | 9.0003 |
| | High | 1990.00 | 8.6384 |
| LTE 10 MHz +3dBm above the AGC threshold | Low | 1935.00 | 8.6474 |
| | Middle | 1962.50 | 8.6399 |
| | High | 1990.00 | 8.6432 |

| | Channel | Frequency (MHz) | OBW (MHz) |
|--|---------|--------------------|-----------|
| WCDMA AGC threshold | Low | 1932.50 | 4.1813 |
| | Middle | 1962.50 | 4.1790 |
| | High | 1992.50 | 4.1694 |
| WCDMA +3dBm above the AGC threshold | Low | 1932.50 | 4.1774 |
| | Middle | 1962.50 | 4.1828 |
| | High | 1992.50 | 4.1726 |
| CDMA AGC threshold | Low | 1931.25 | 1.2717 |
| | Middle | 1962.50 | 1.2711 |
| | High | 1993.75 | 1.2699 |
| CDMA +3dBm above the AGC threshold | Low | 1931.25 | 1.2768 |
| | Middle | 1962.50 | 1.2733 |
| | High | 1993.75 | 1.2754 |

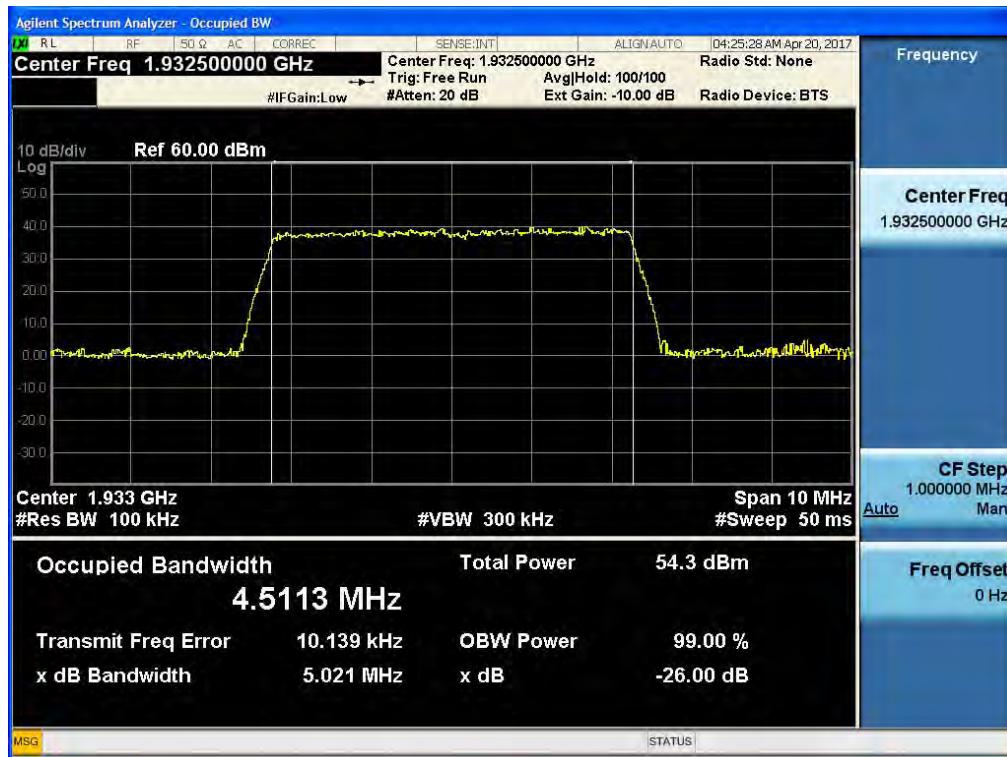
| | Channel | Frequency (MHz) | OBW (kHz) |
|--|---------|--------------------|-----------|
| GSM AGC threshold | Low | 1930.40 | 246.52 |
| | Middle | 1962.50 | 246.35 |
| | High | 1994.60 | 244.32 |
| GSM +3dBm above the AGC threshold | Low | 1930.40 | 246.62 |
| | Middle | 1962.50 | 234.34 |
| | High | 1994.60 | 246.11 |

[Downlink Input_1900 PCS BAND]

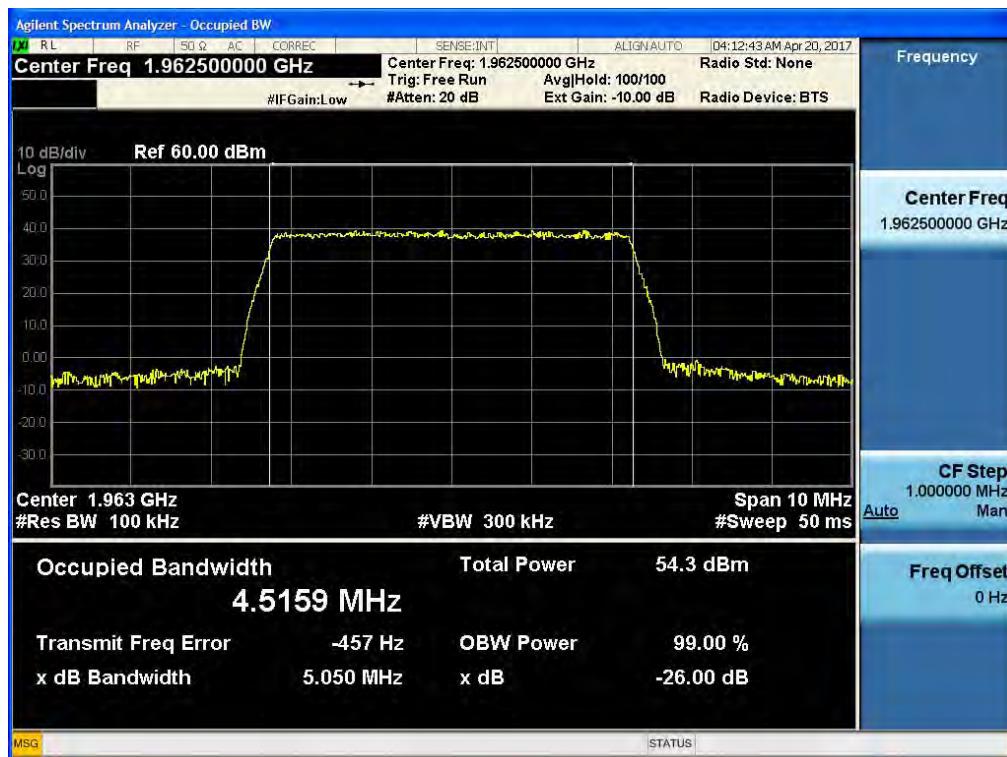
| | Channel | Frequency (MHz) | OBW (MHz) |
|--|----------------|----------------------------|------------------|
| 1900 PCS Band_ LTE 5 MHz AGC threshold | Low | 1932.50 | 4.5140 |
| | Middle | 1962.50 | 4.5115 |
| | High | 1992.50 | 4.5112 |
| 1900 PCS Band_ LTE 10 MHz AGC threshold | Low | 1935.00 | 9.0008 |
| | Middle | 1962.50 | 9.0018 |
| | High | 1990.00 | 8.9986 |
| 1900 PCS Band_ WCDMA AGC threshold | Low | 1932.50 | 4.1781 |
| | Middle | 1962.50 | 4.1805 |
| | High | 1992.50 | 4.1785 |
| 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 | 1930.40 | 243.91 |
| | Middle | 1962.50 | 244.77 |
| | High | 1994.60 | 245.17 |

Plots of Occupied Bandwidth_1900 PCS BAND LTE 5 MHz

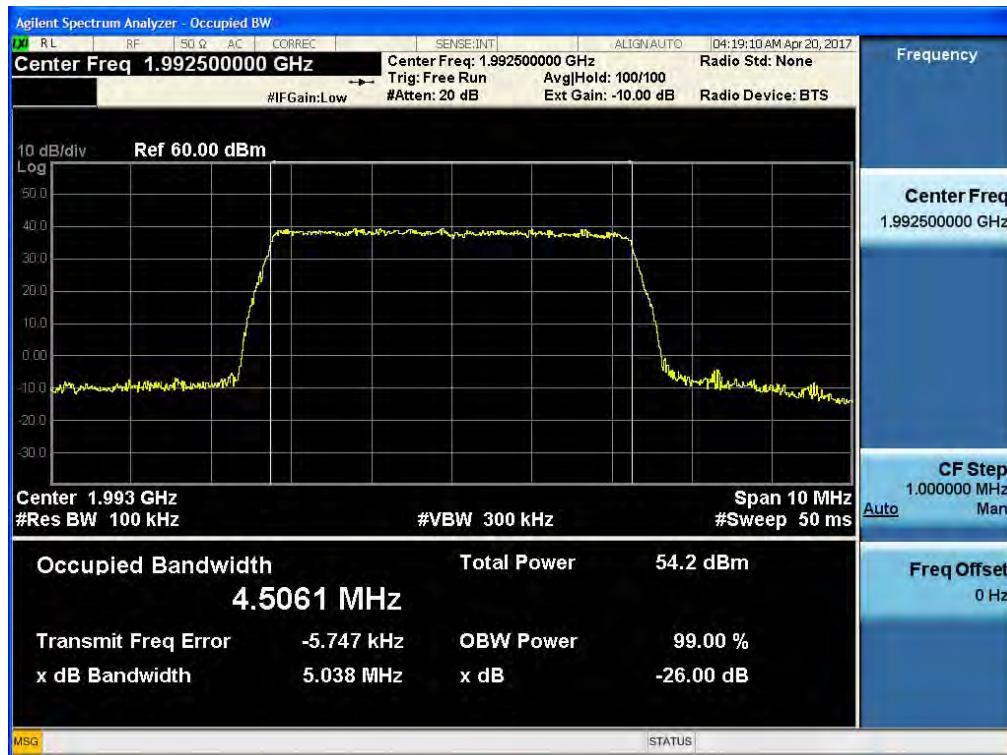
[AGC threshold Output Downlink Low]



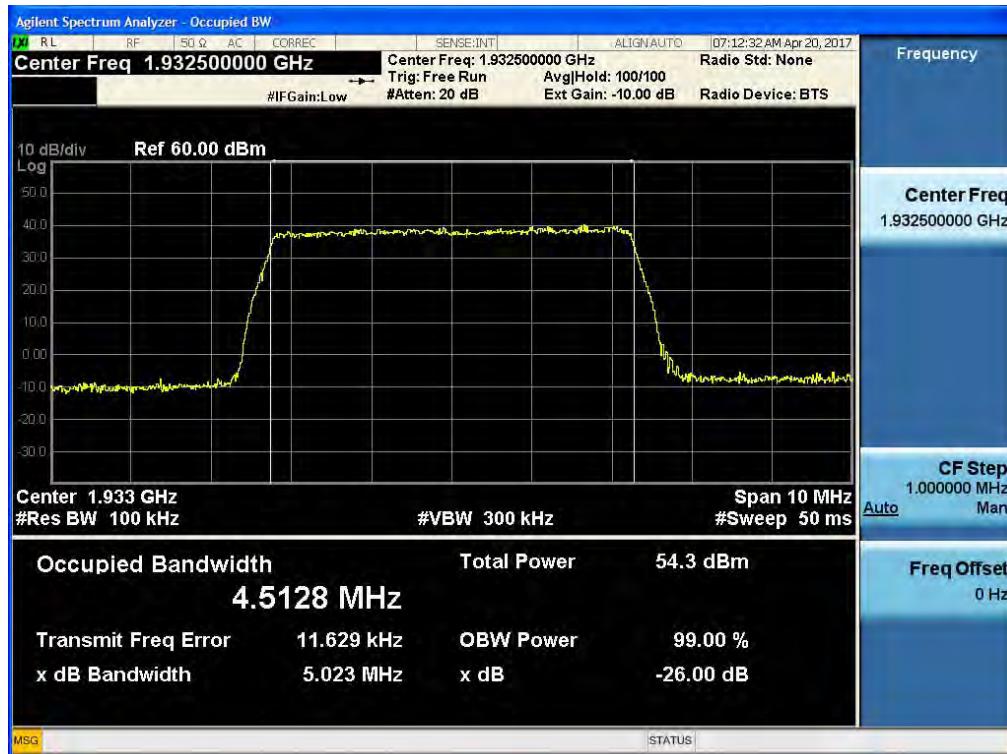
[AGC threshold Output Downlink Middle]

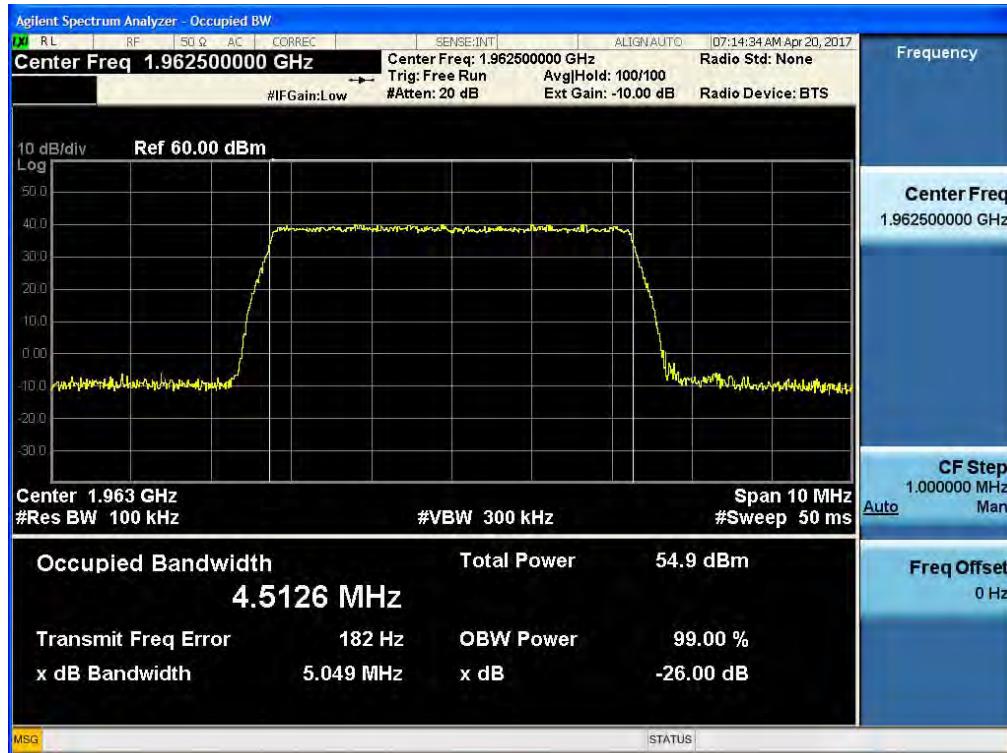
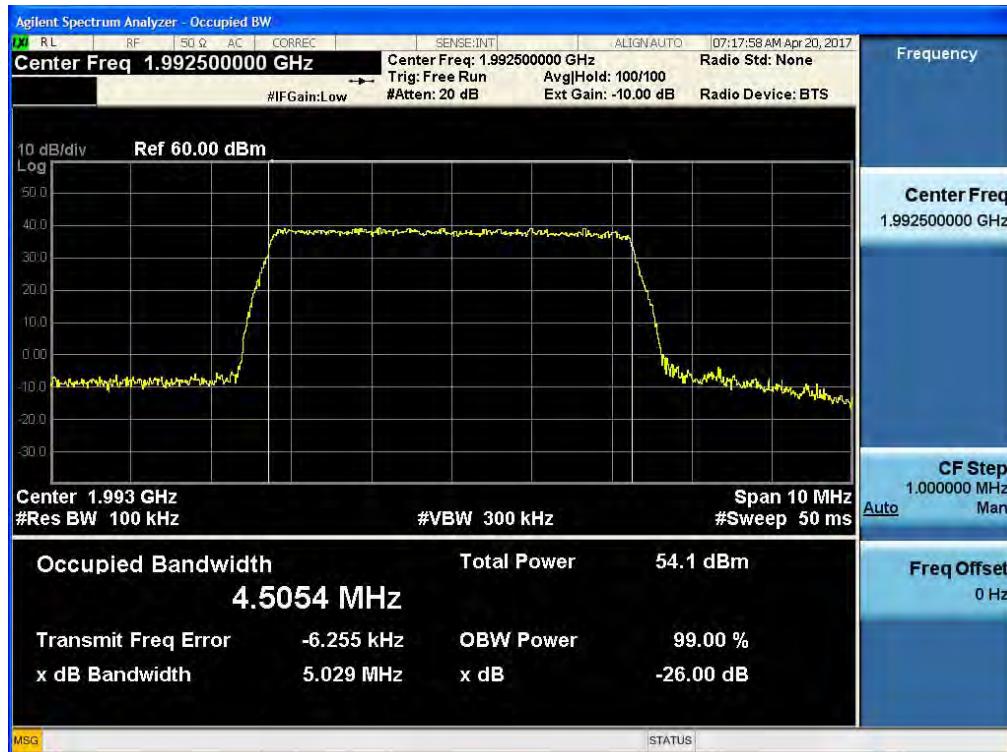


[AGC threshold Output Downlink High]



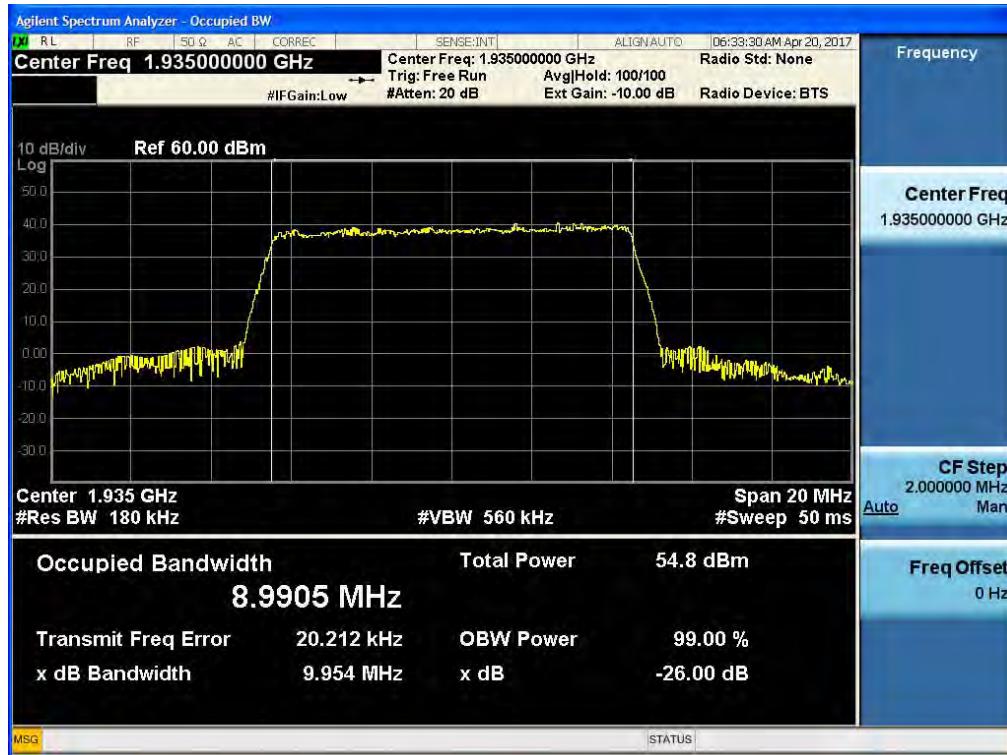
[+3dBmabove AGC threshold Output Downlink Low]



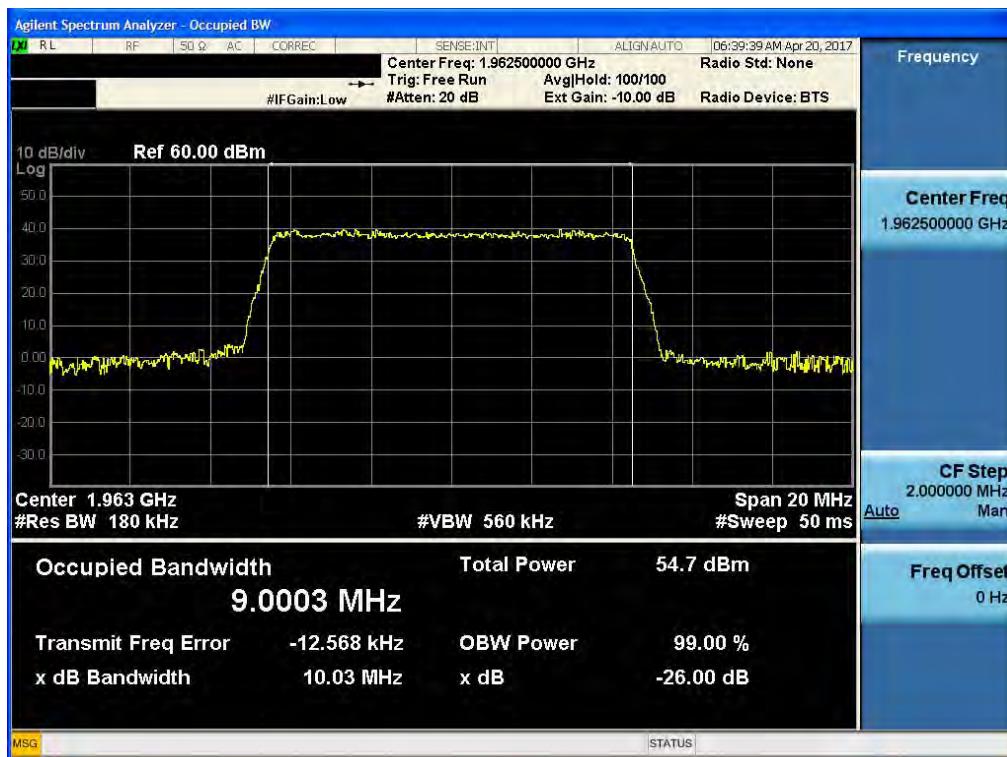
[+3dBm above AGC threshold Output Downlink Middle]

[+3dBm above AGC threshold Output Downlink High]


Plots of Occupied Bandwidth_ 1900 PCS BAND LTE 10 MHz

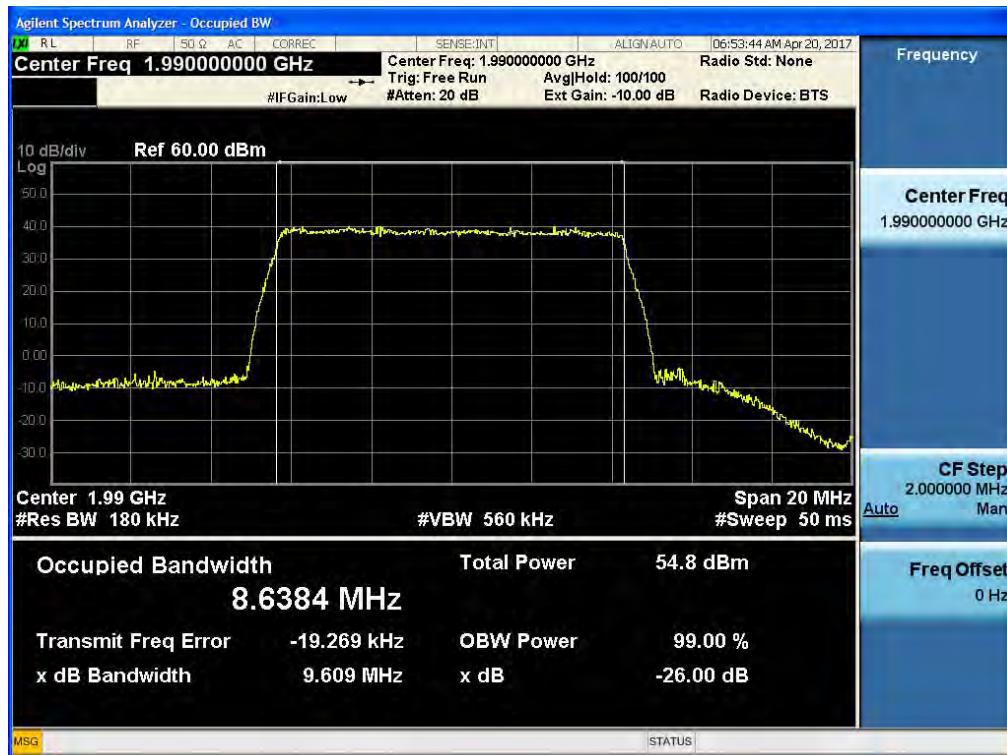
[AGC threshold Output Downlink Low]



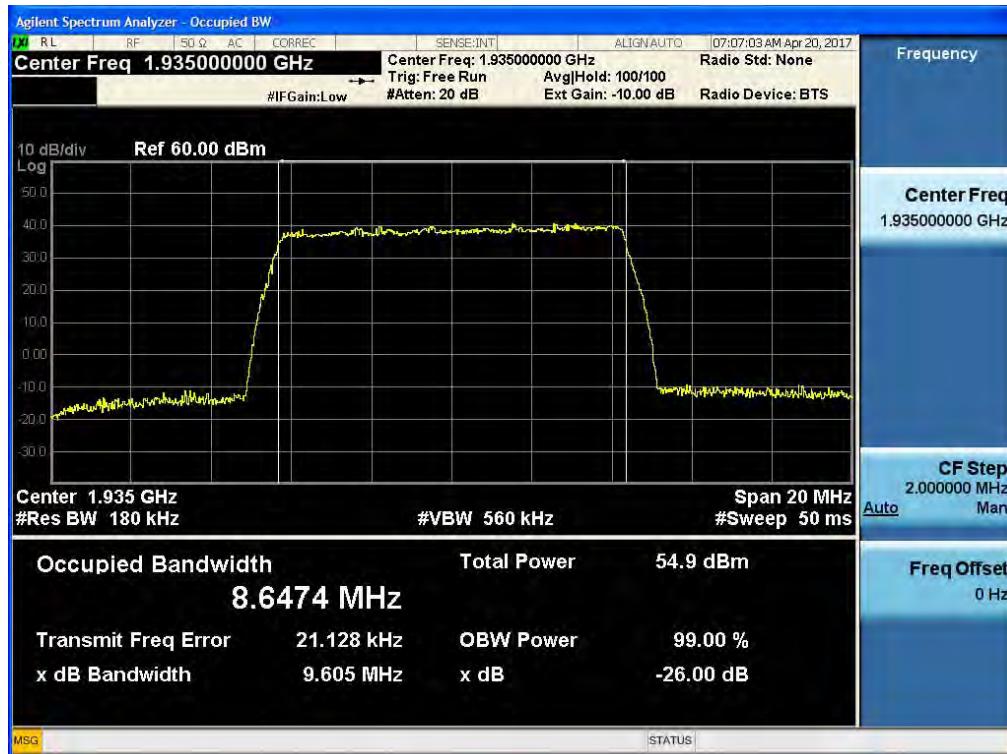
[AGC threshold Output Downlink Middle]

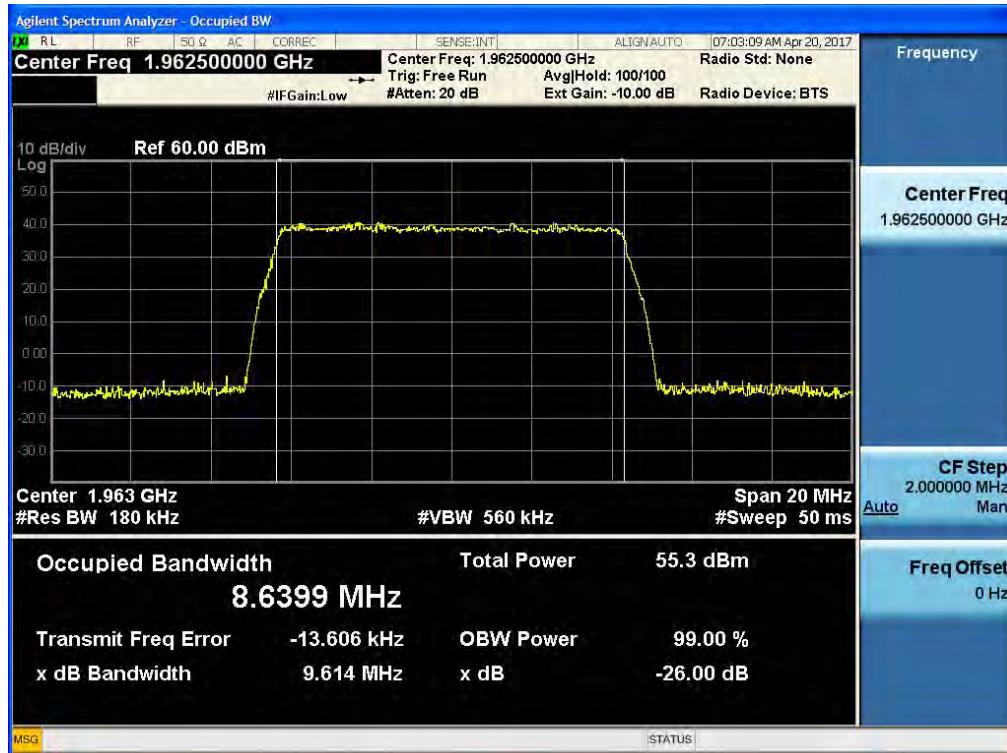
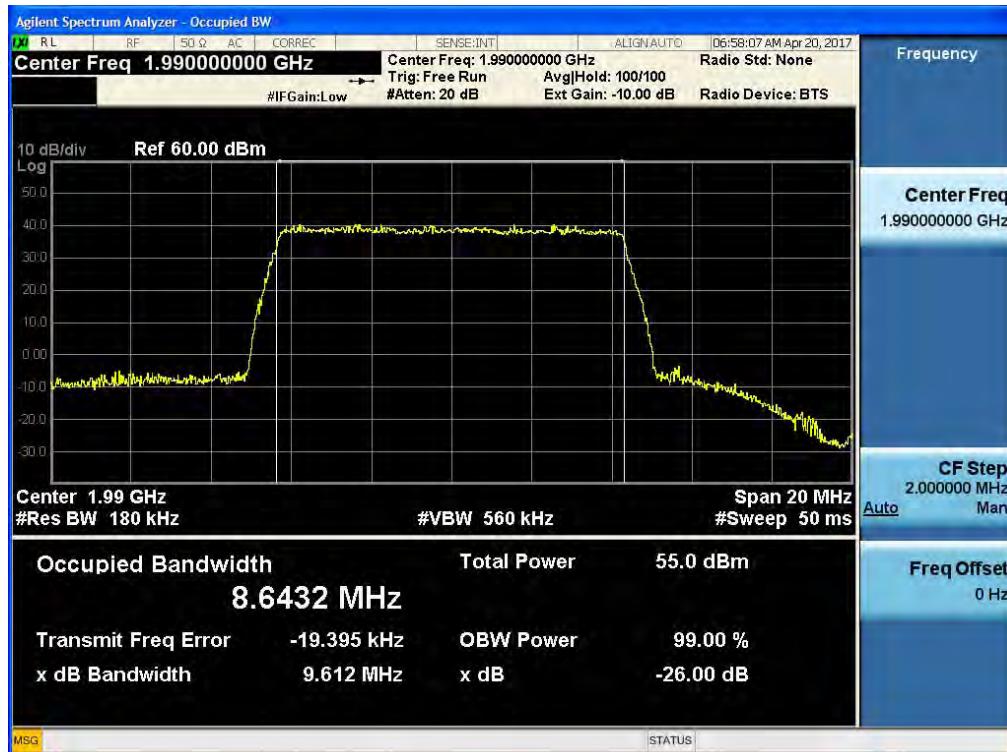


[AGC threshold Output Downlink High]



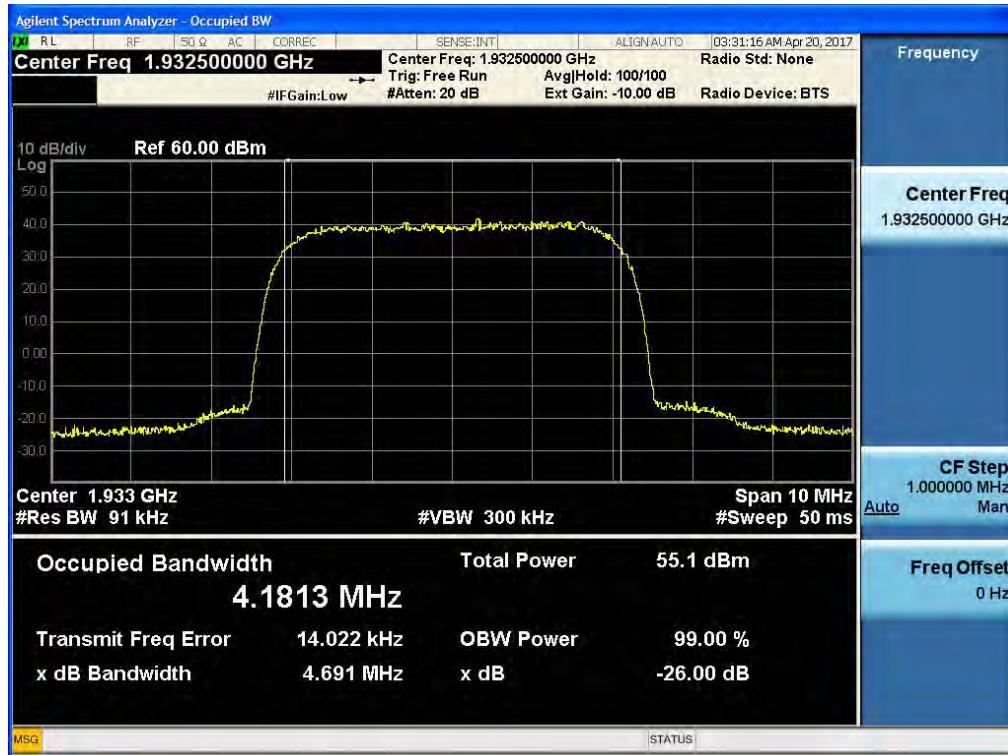
[+3dBmabove AGC threshold Output Downlink Low]



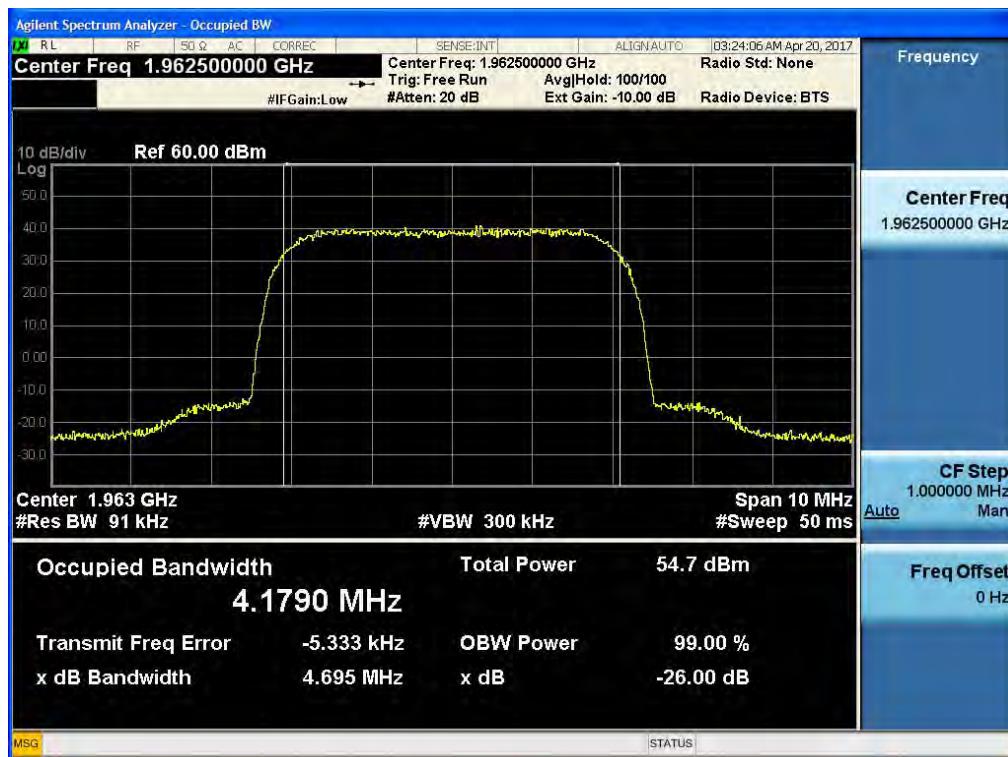
[+3dBm above AGC threshold Output Downlink Middle]

[+3dBm above AGC threshold Output Downlink High]


Plots of Occupied Bandwidth_ 1900 PCS BAND WCDMA

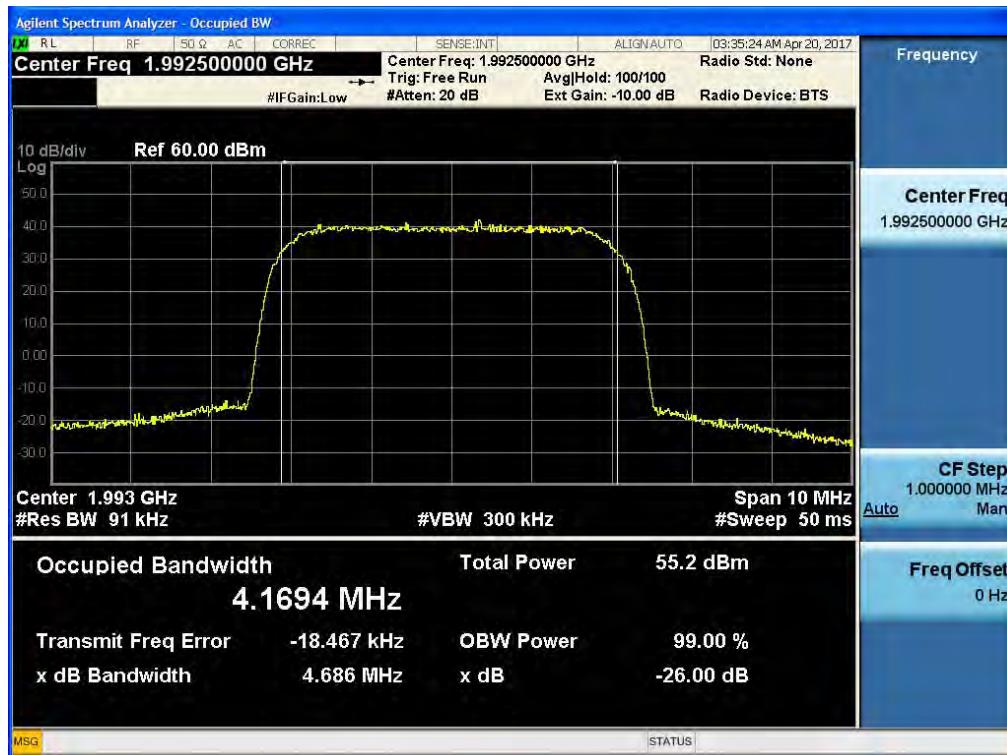
[AGC threshold Output Downlink Low]



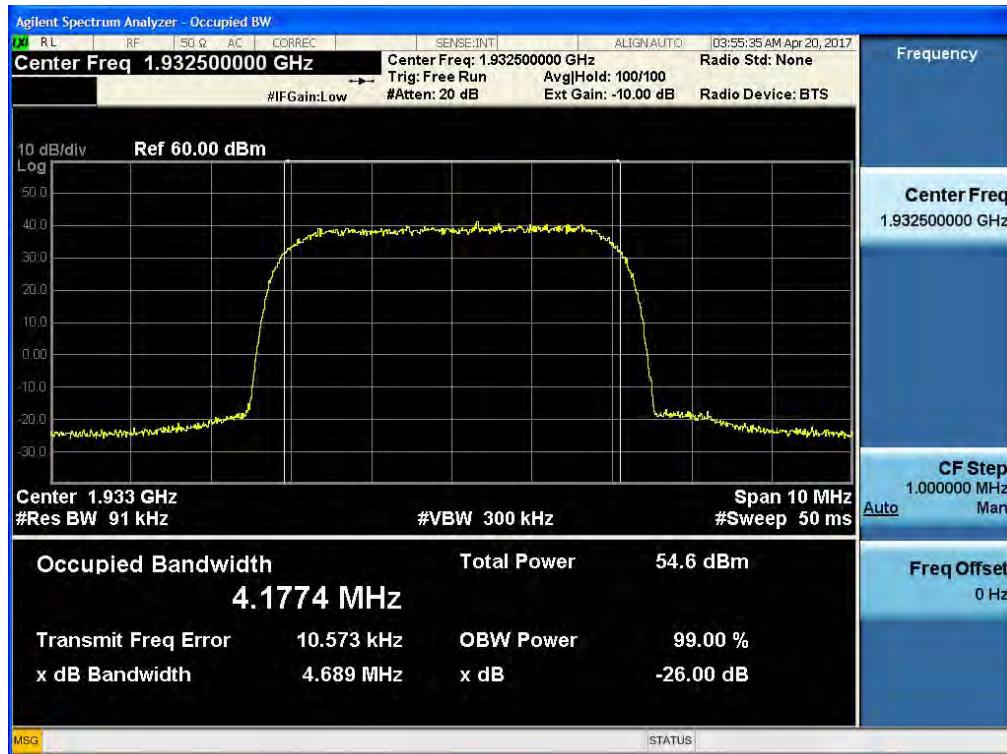
[AGC threshold Output Downlink Middle]

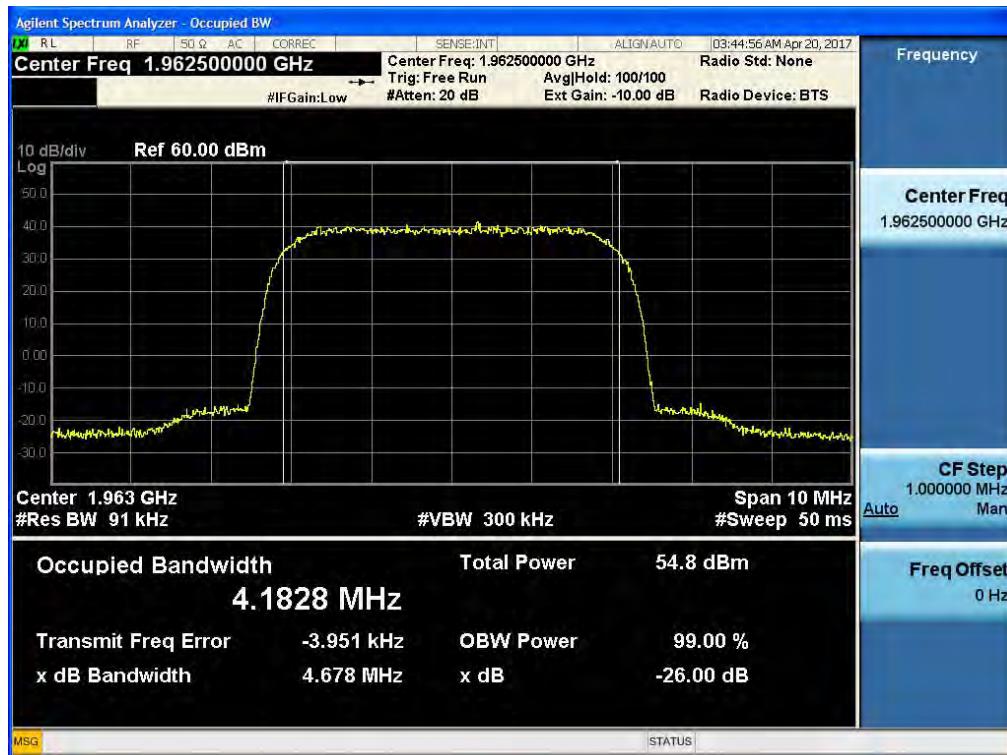
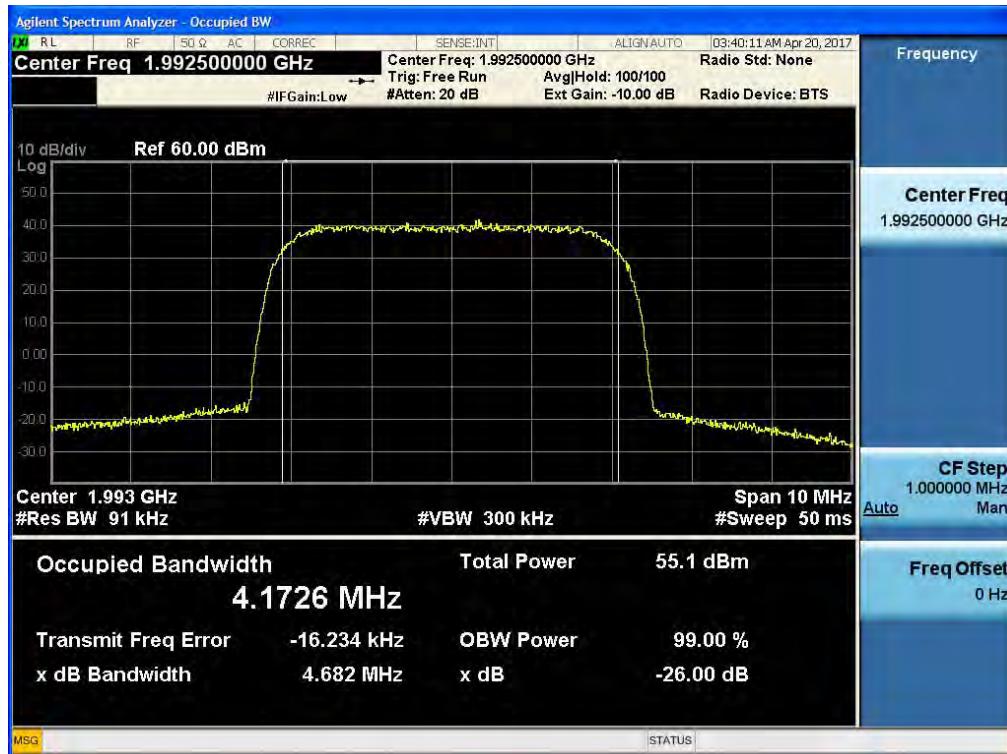


[AGC threshold Output Downlink High]



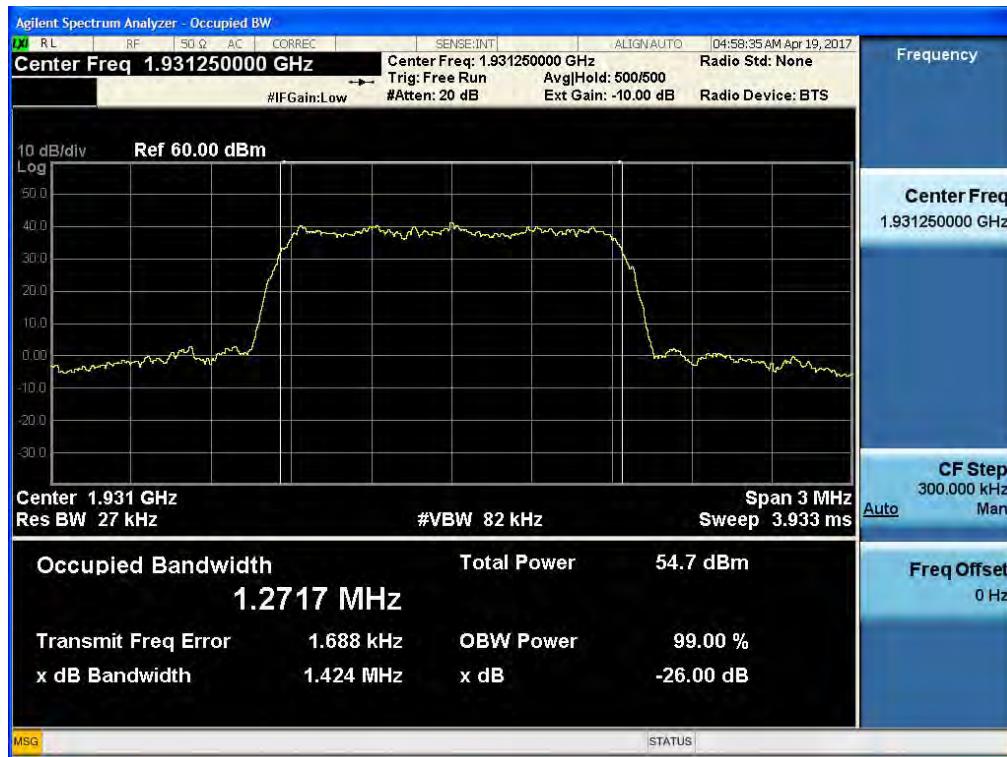
[+3dBm above AGC threshold Output Downlink Low]



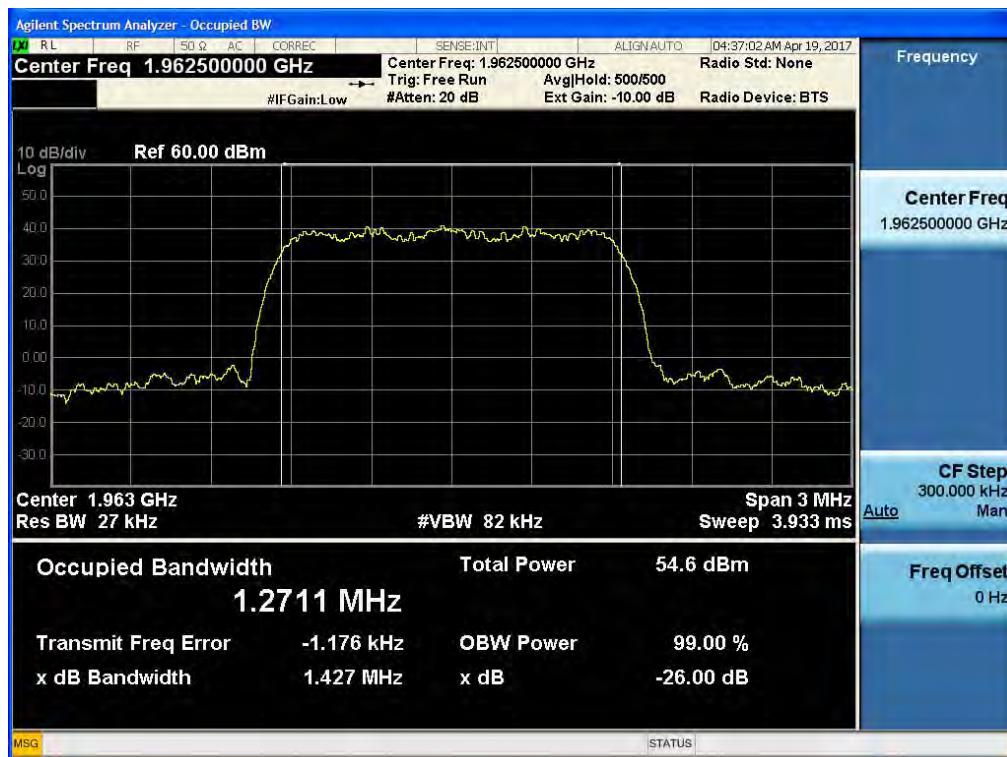
[+3dBm above AGC threshold Output Downlink Middle]

[+3dBm above AGC threshold Output Downlink High]


Plots of Occupied Bandwidth_1900 PCS BAND CDMA

[AGC threshold Output Downlink Low]



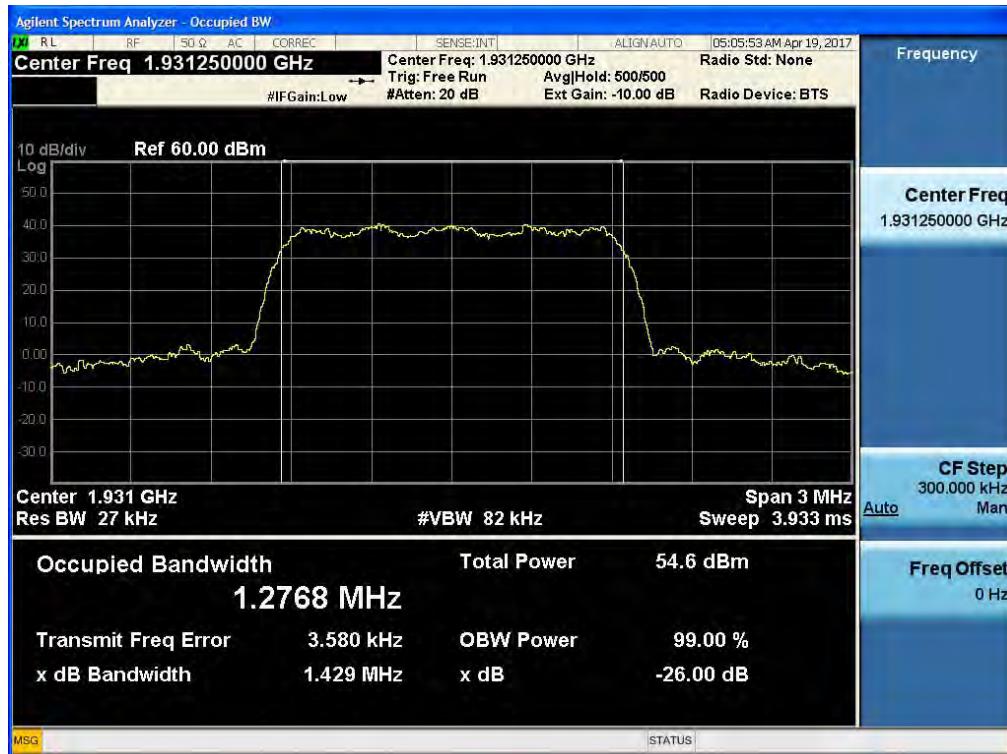
[AGC threshold Output Downlink Middle]

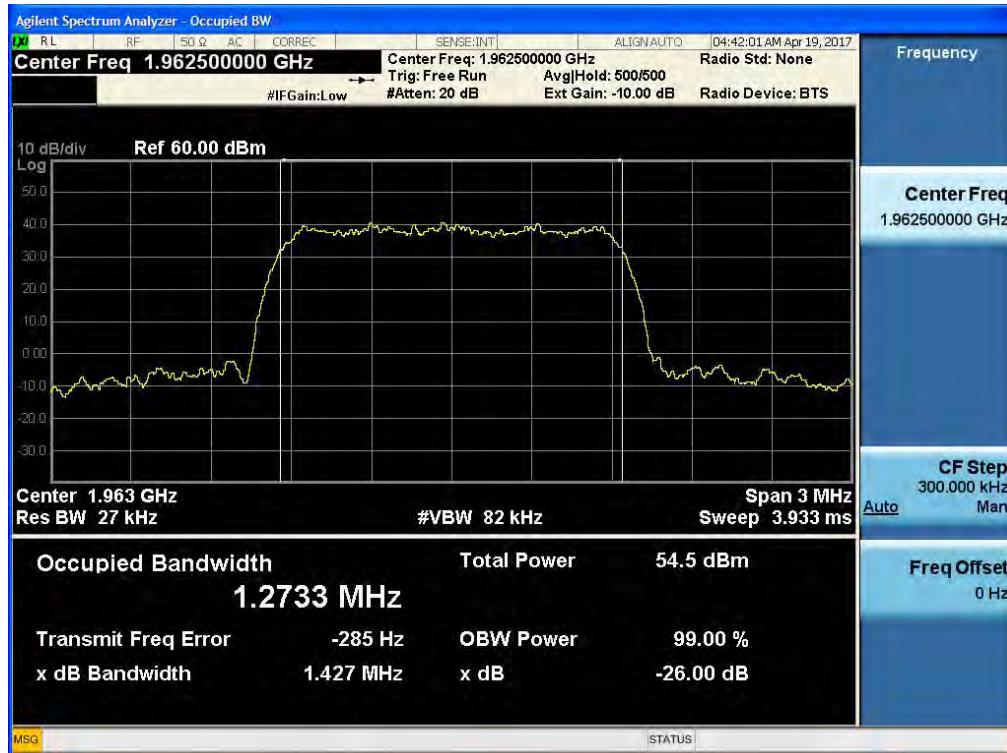
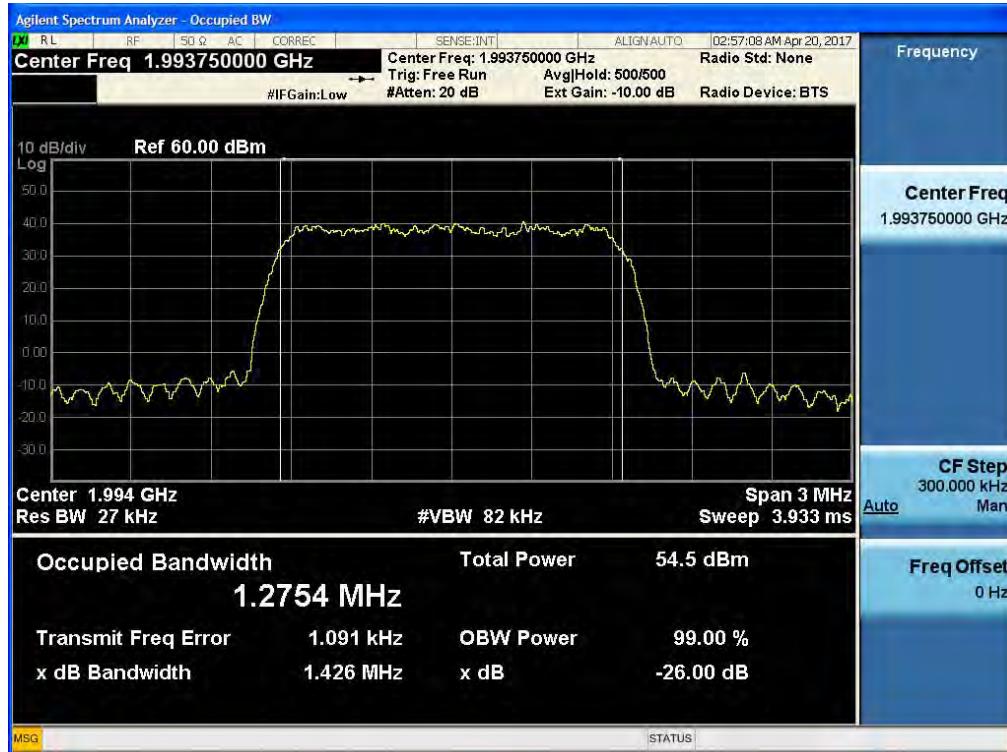


[AGC threshold Output Downlink High]



[+3dBmabove AGC threshold Output Downlink Low]



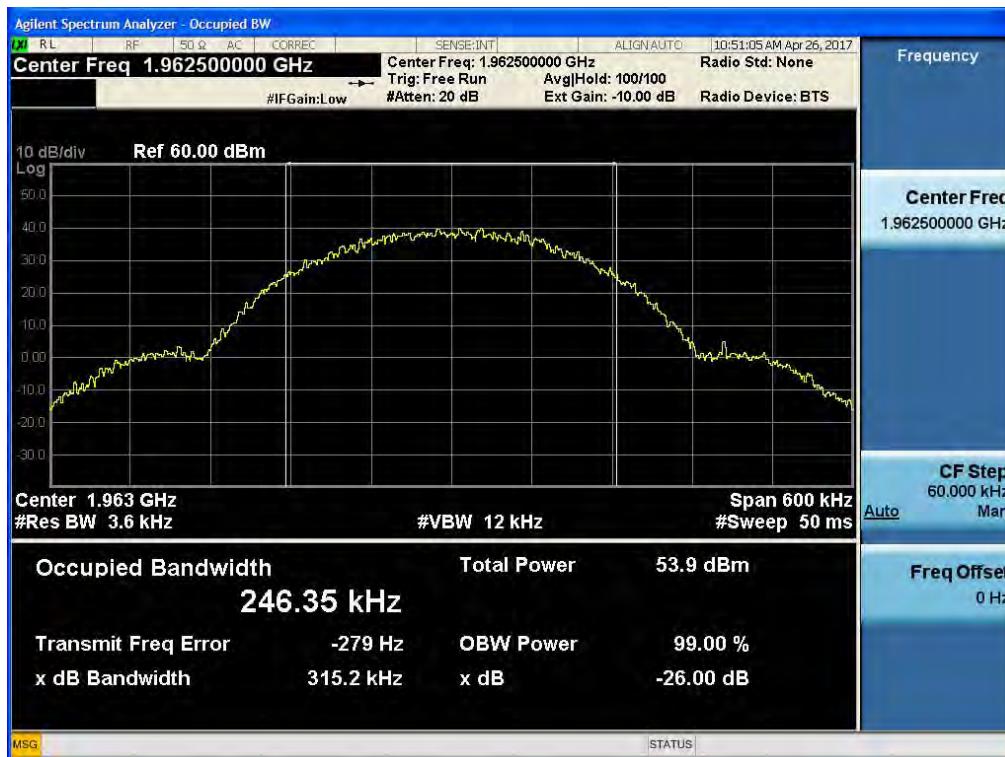
[+3dBm above AGC threshold Output Downlink Middle]

[+3dBm above AGC threshold Output Downlink High]


Plots of Occupied Bandwidth_1900 PCS BAND GSM

[AGC threshold Output Downlink Low]



[AGC threshold Output Downlink Middle]

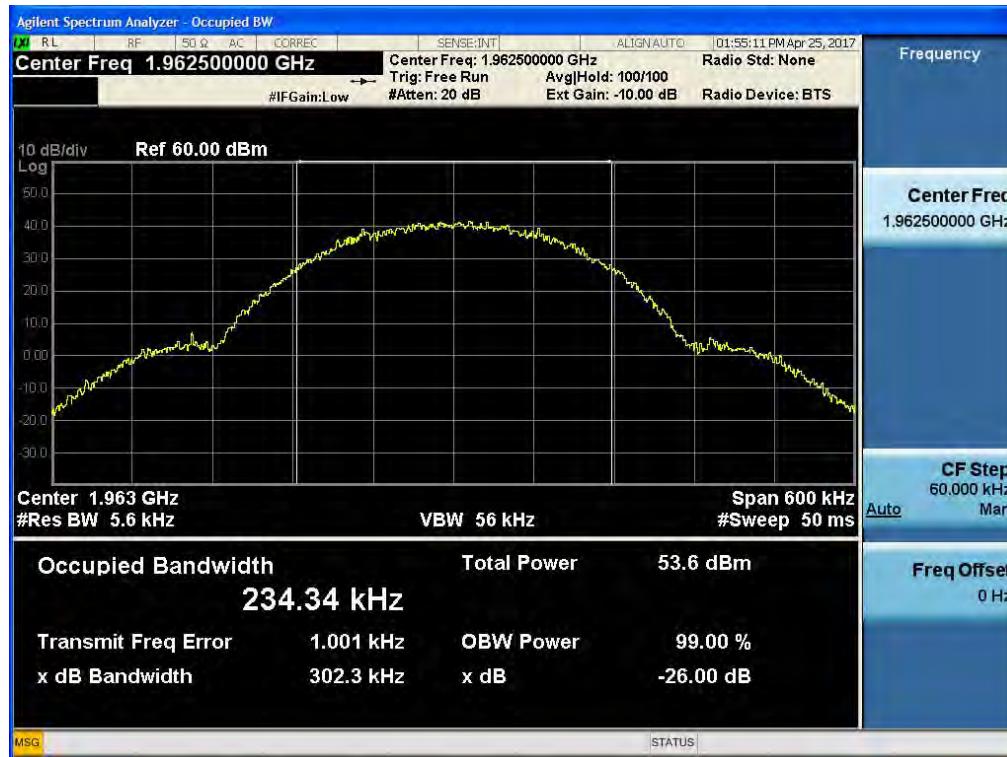


[AGC threshold Output Downlink High]



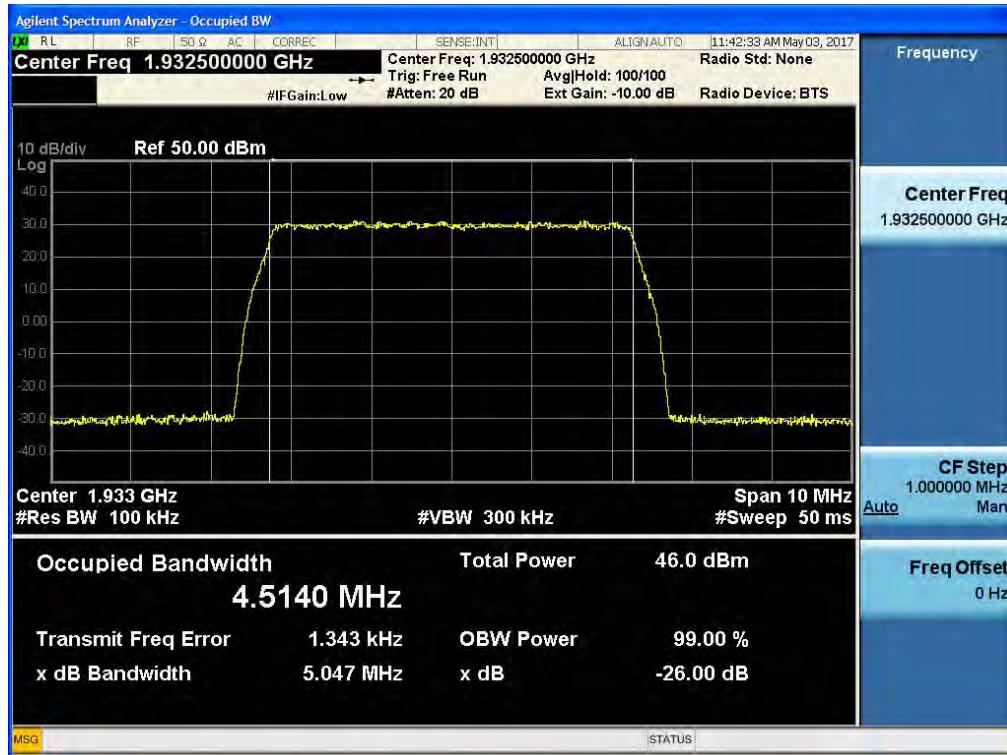
[+3dBm above AGC threshold Output Downlink Low]



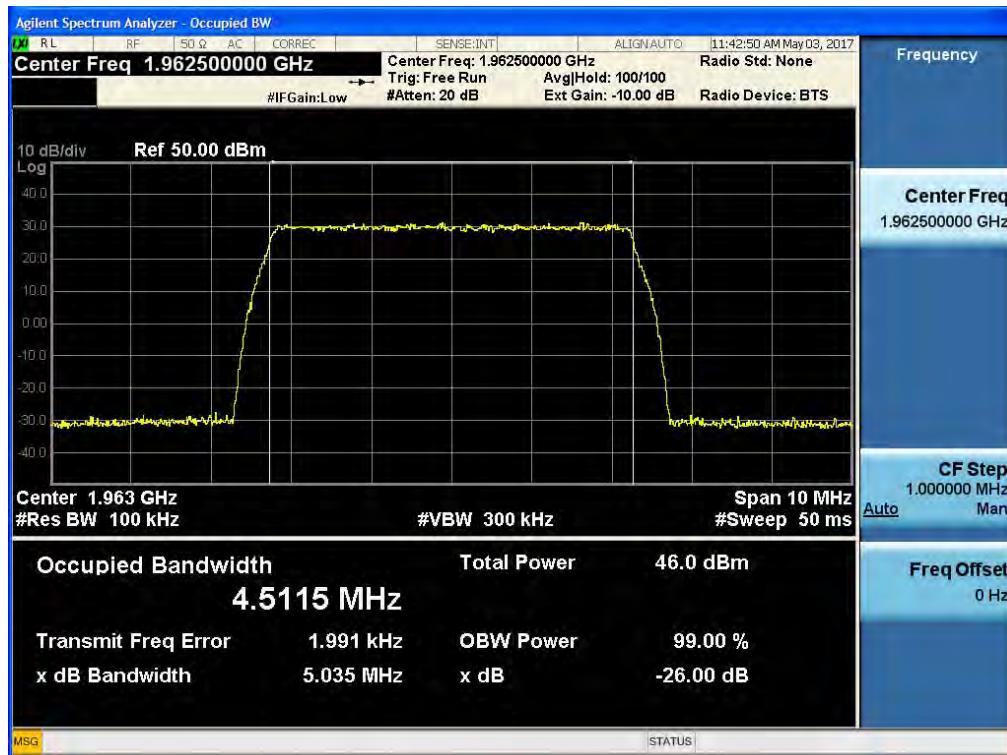
[+3dBm above AGC threshold Output Downlink Middle]

[+3dBm above AGC threshold Output Downlink High]


Plots of Occupied Bandwidth_1900 PCS BAND LTE 5 MHz

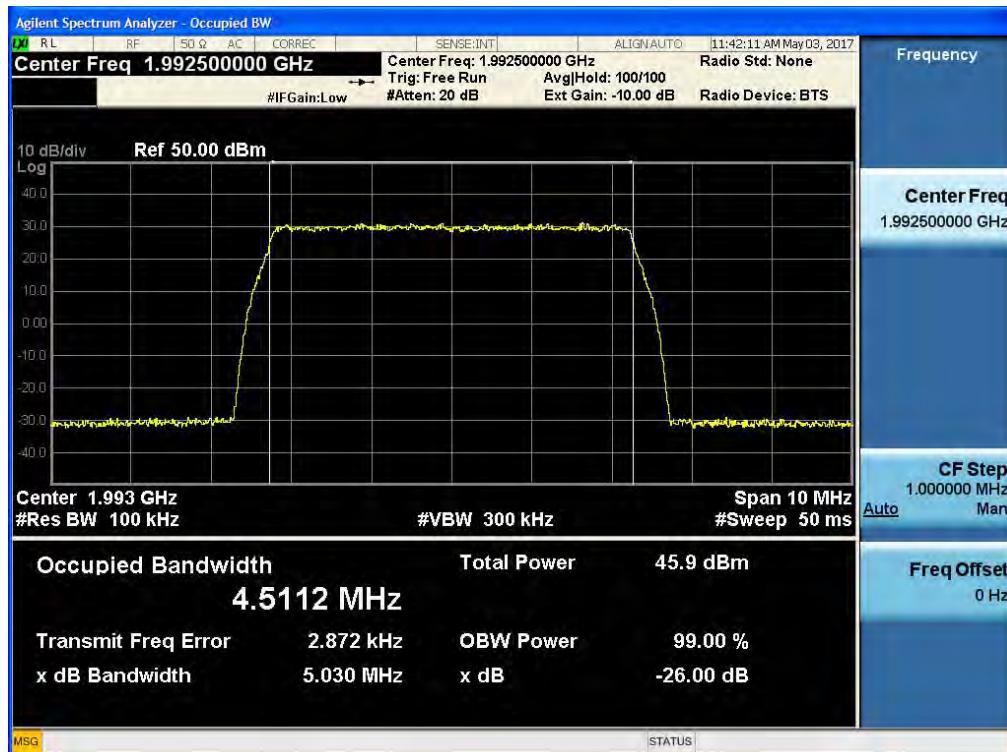
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

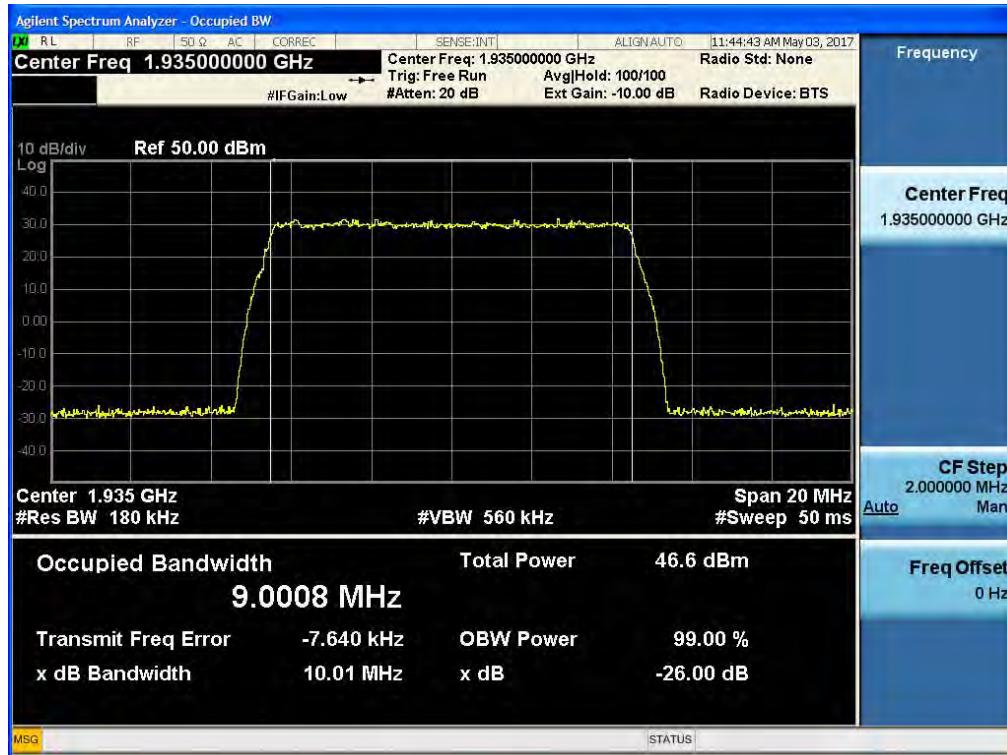


[AGC threshold Input Downlink High]

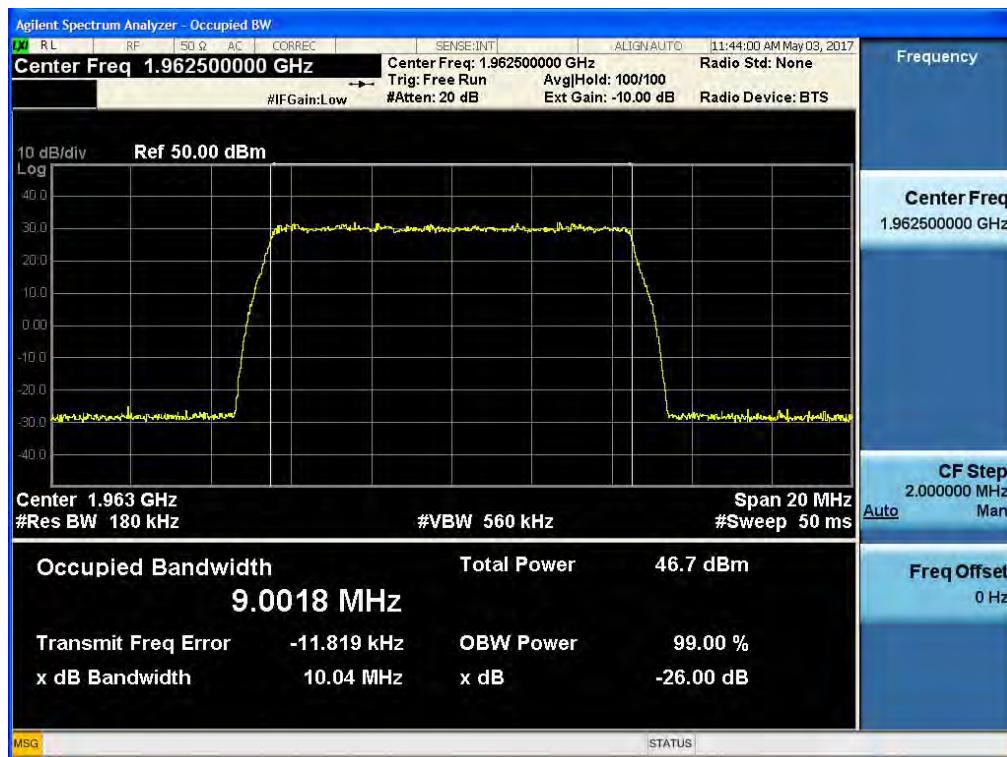


Plots of Occupied Bandwidth_1900 PCS BAND LTE 10 MHz

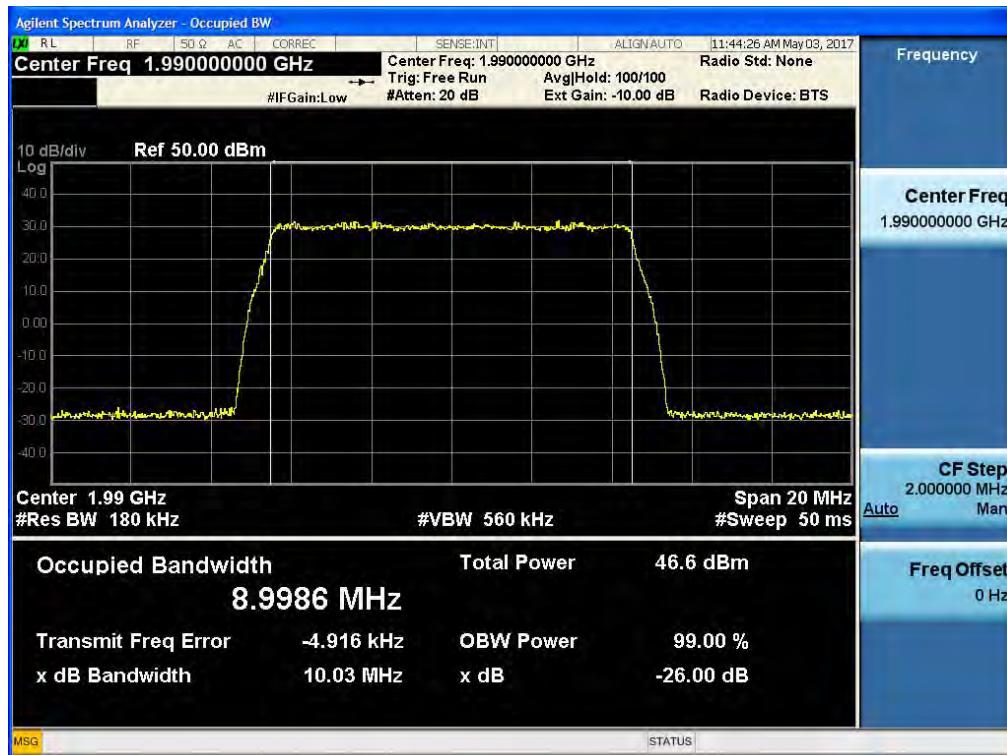
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

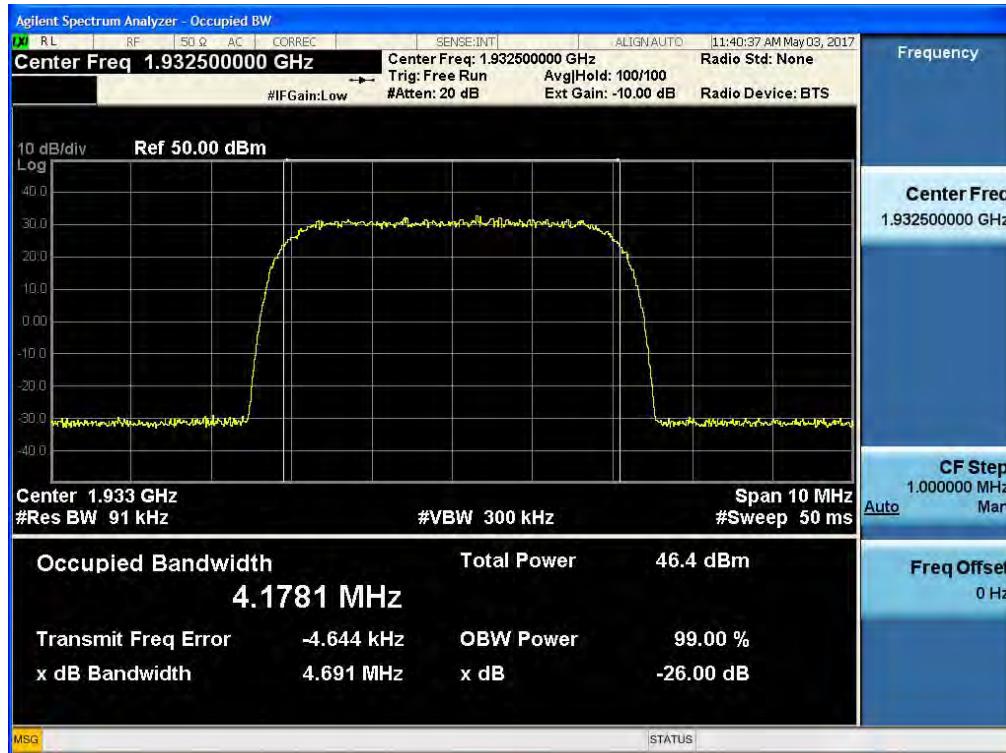


[AGC threshold Input Downlink High]

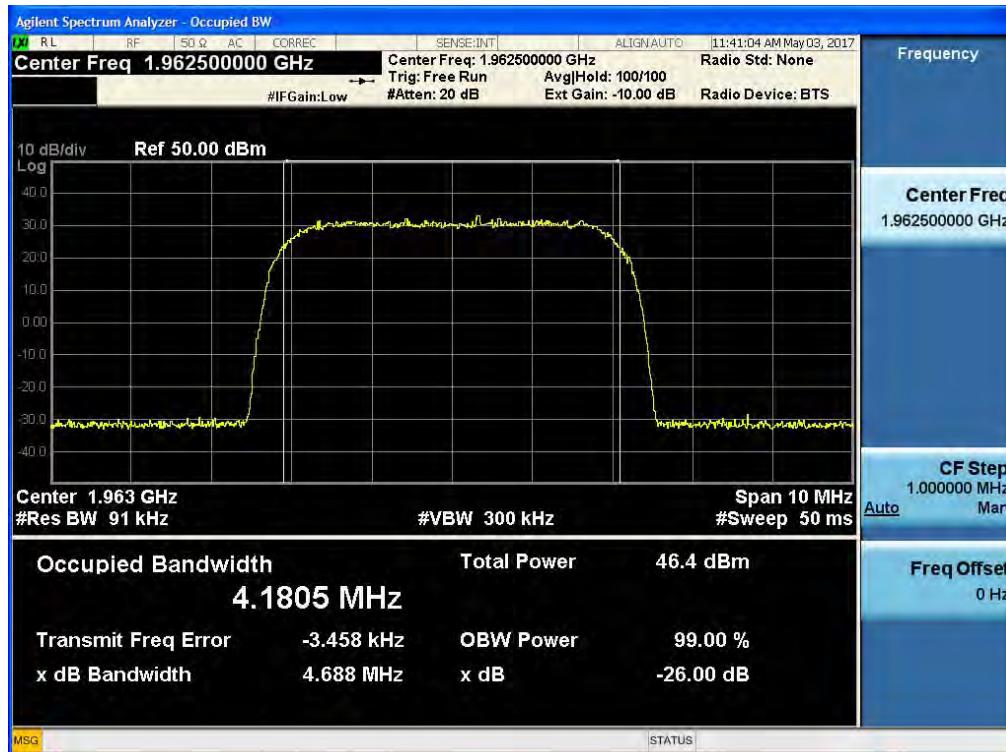


Plots of Occupied Bandwidth_1900 PCS BAND WCDMA

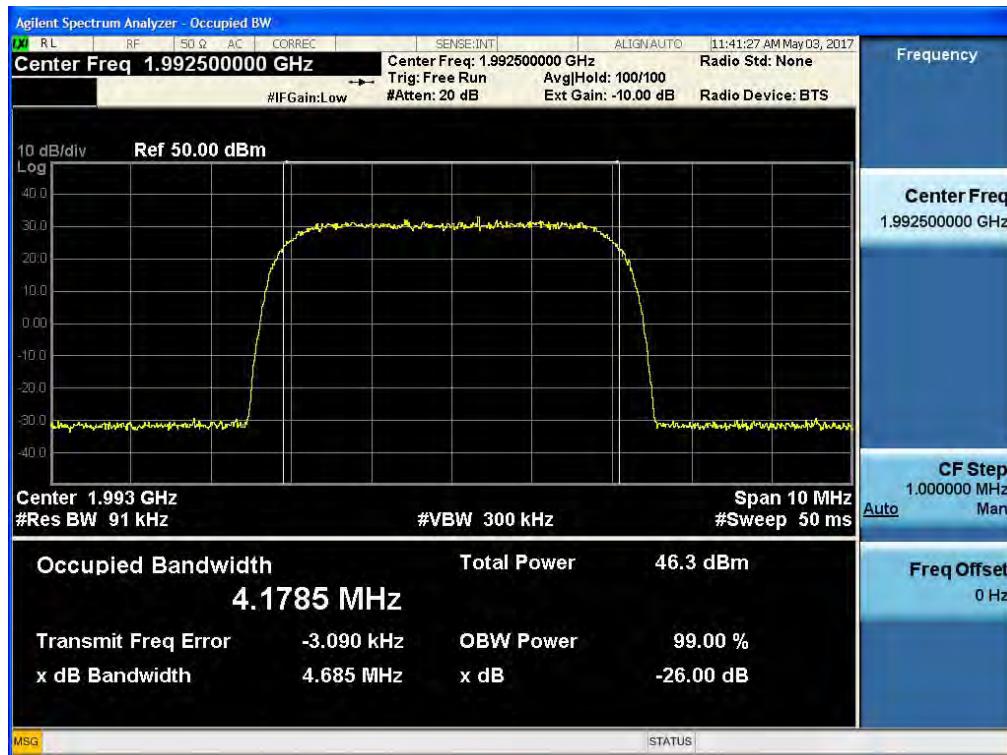
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]

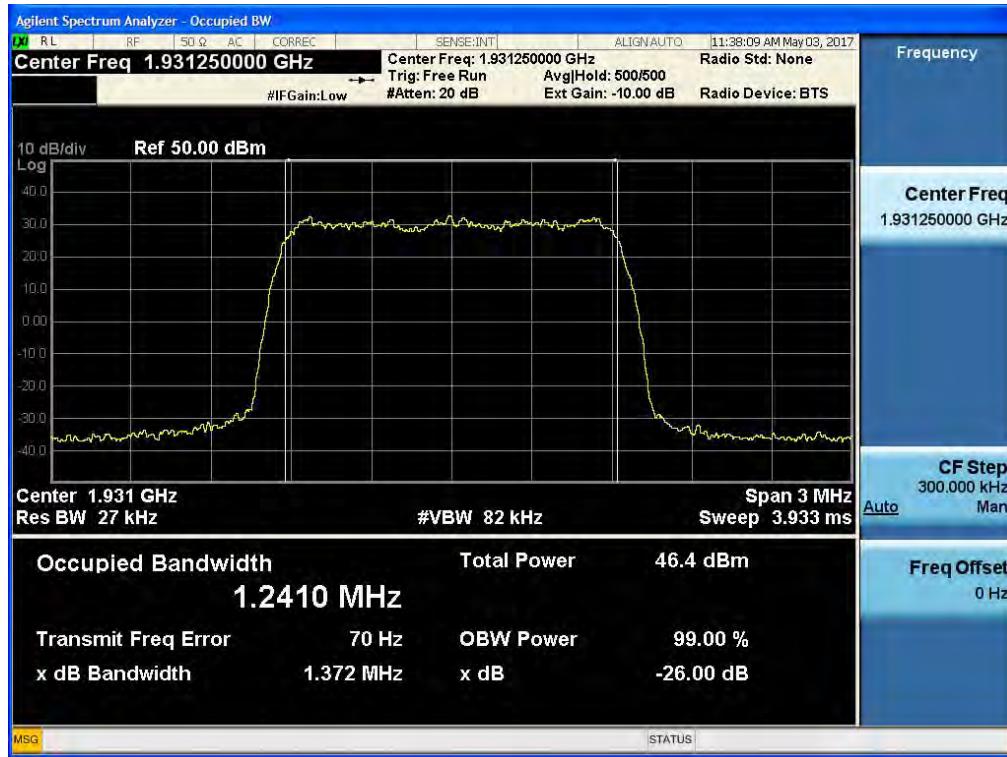


[AGC threshold Input Downlink High]

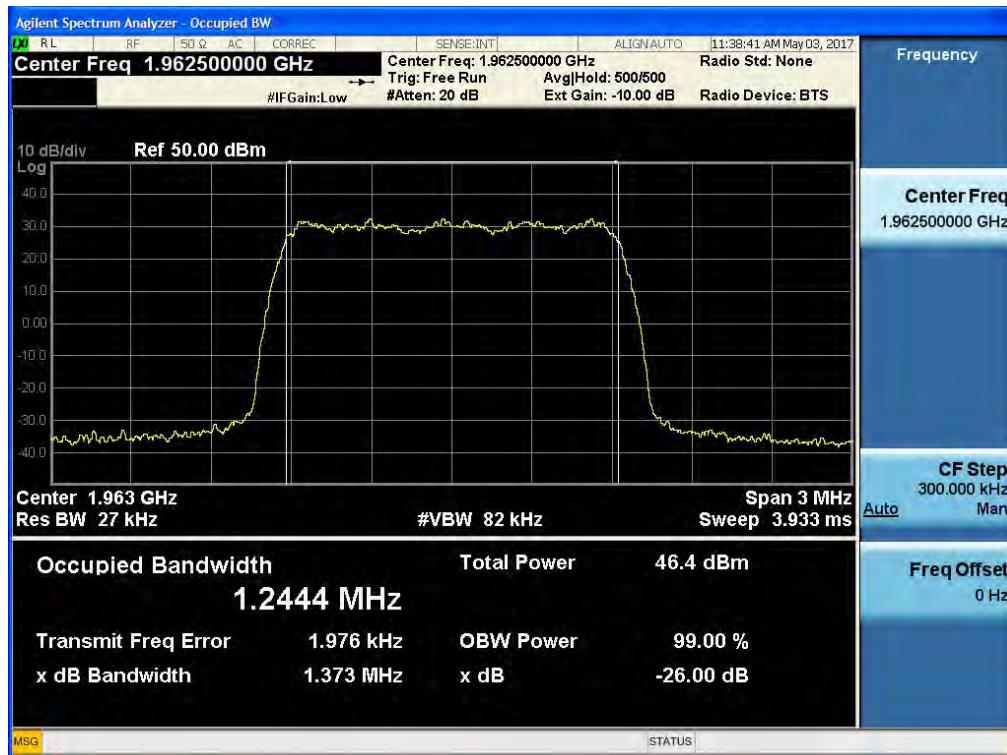


Plots of Occupied Bandwidth_1900 PCS BAND CDMA

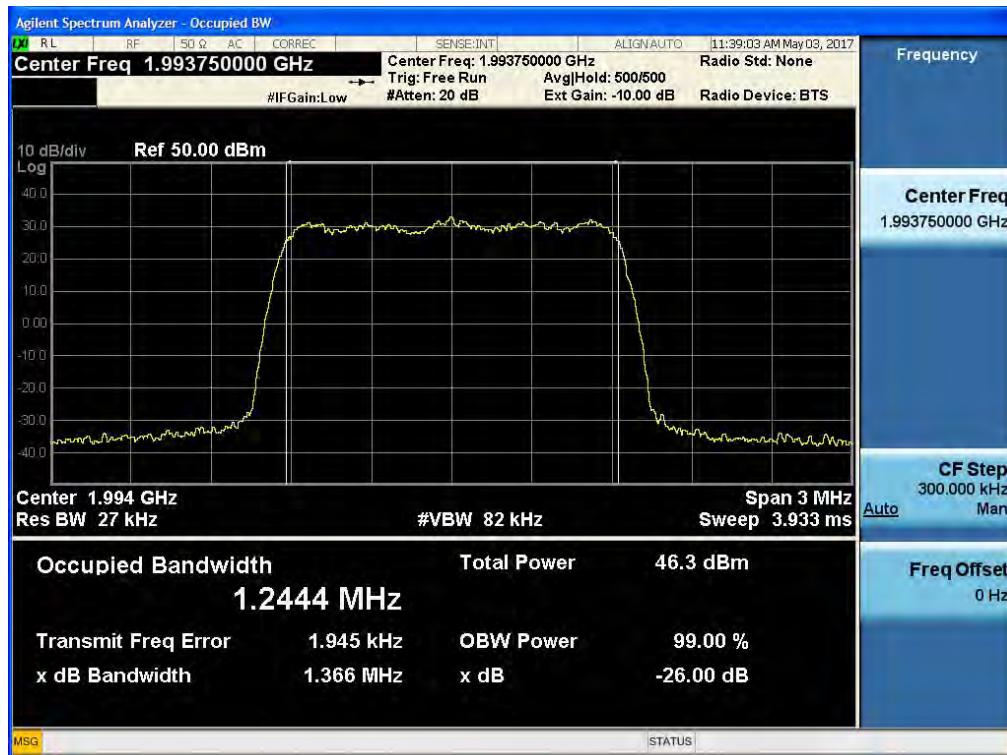
[AGC threshold Input Downlink Low]



[AGC threshold Input Downlink Middle]



[AGC threshold Input Downlink High]



Plots of Occupied Bandwidth_1900 PCS BAND GSM

[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 | 5.021 |
| | Middle | 1962.50 | 5.050 |
| | High | 1992.50 | 5.038 |
| 1900 PCS Band_ LTE 10 MHz AGC threshold | Low | 1935.00 | 9.954 |
| | Middle | 1962.50 | 10.03 |
| | High | 1990.00 | 9.609 |
| 1900 PCS Band_ WCDMA AGC threshold | Low | 1932.50 | 4.691 |
| | Middle | 1962.50 | 4.695 |
| | High | 1992.50 | 4.686 |
| 1900 PCS Band_ CDMA AGC threshold | Low | 1931.25 | 1.424 |
| | Middle | 1962.50 | 1.427 |
| | High | 1993.75 | 1.421 |
| 1900 PCS Band_ GSM AGC threshold | Low | 1930.20 | 312.4 |
| | Middle | 1962.50 | 315.2 |
| | High | 1994.80 | 314.4 |

* 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 D02 v03r02

Out of Band Rejection – Test for rejection of out of band signals. 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 = $\pm 250\%$ 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 $\geq 3 \times \text{RBW}$.

- 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 f_0 .
- 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.

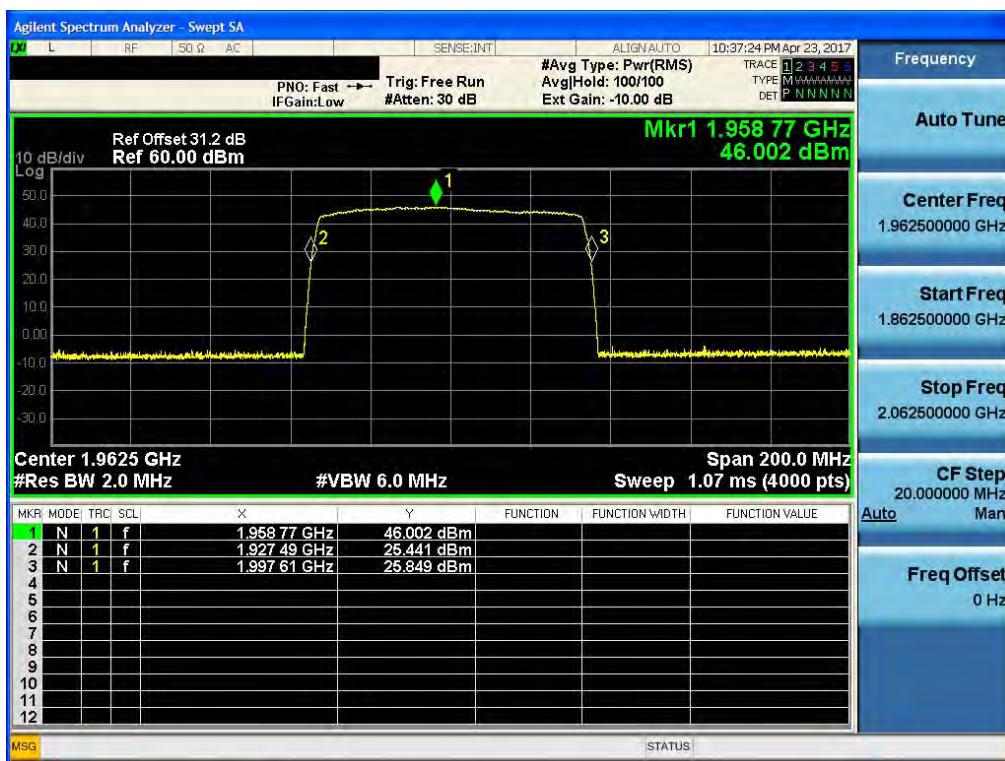
- a) Connect a signal generator to the input of the EUT.
- b) Configure a swept CW signal with the following parameters:
- c) Frequency range = $\pm 250\%$ of the manufacturer's pass band.
- d) The CW amplitude will be 3 dB below the AGC threshold (see 4.2) and but not activate the AGC threshold throughout 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 $3 \times \text{RBW}$.
- 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 f_0 , 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 (dBm) Input Signal : Sinusoidal | Maximum Amp Gain |
|---------------|--|------------------|
| 1900 PCS Band | -15 dBm | 61 dB |

[Downlink_1900 PCS BAND]

| | 20 dB point frequency | Output power (dBm) | Gain (dB) |
|---------------|-----------------------------------|--------------------|-----------|
| 1900 PCS Band | 1927.490 MHz ~ 1997.610 MHz | 46.002 | 61.002 |

Plots of Passband Gain and Bandwidth & Out of Band Rejection
[1900 PCS BAND]


10. 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.

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 $43 + 10 \log_{10}p(\text{watts})$.
- 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 $43 + 10 \log_{10}p(\text{watts})$. 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 = $3 \times$ 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 $\geq 3 \times$ 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 $\geq (2 \times \text{span}/\text{RBW})$, 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 (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 $\geq (2 \times \text{span}/\text{RBW})$, 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]

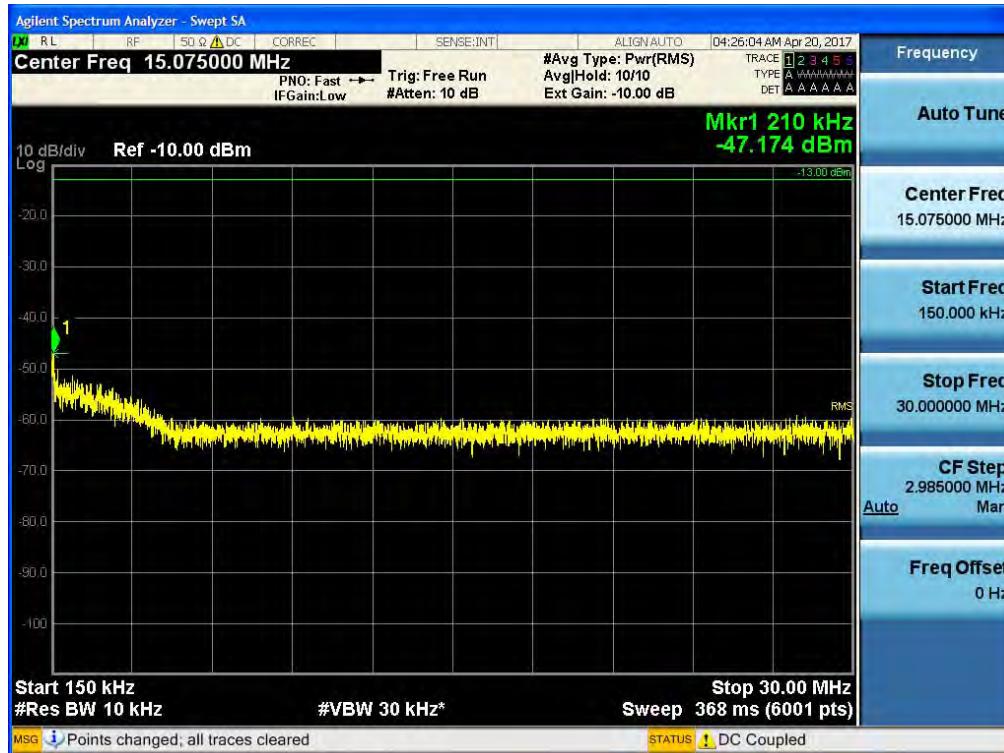


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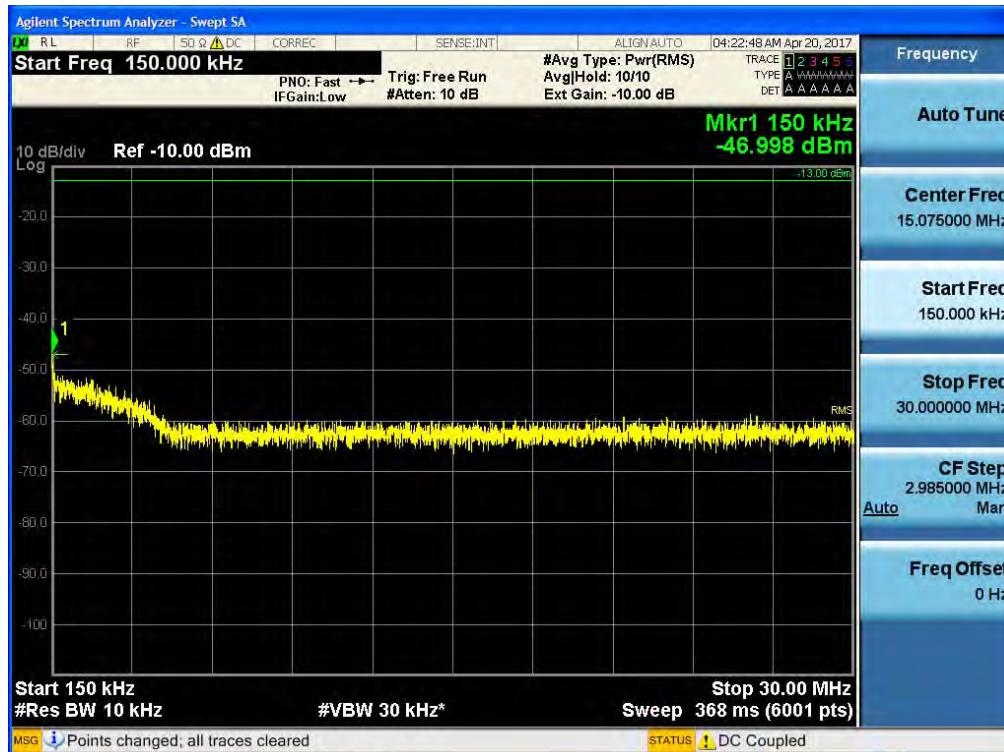


Conducted Spurious Emissions (150 kHz – 30 MHz)

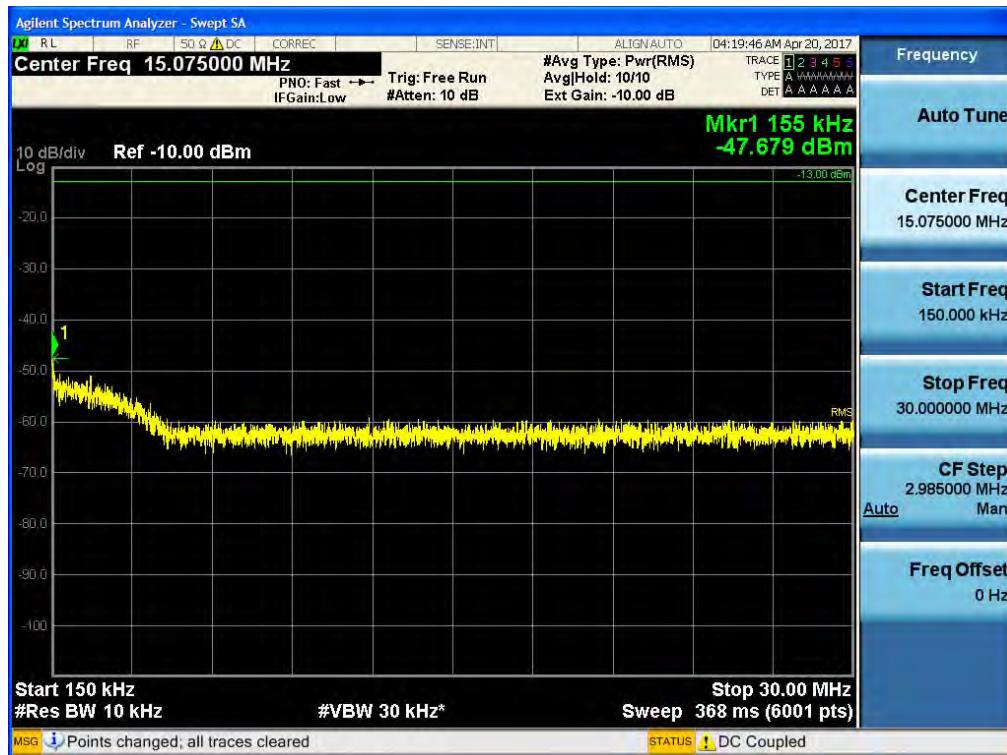
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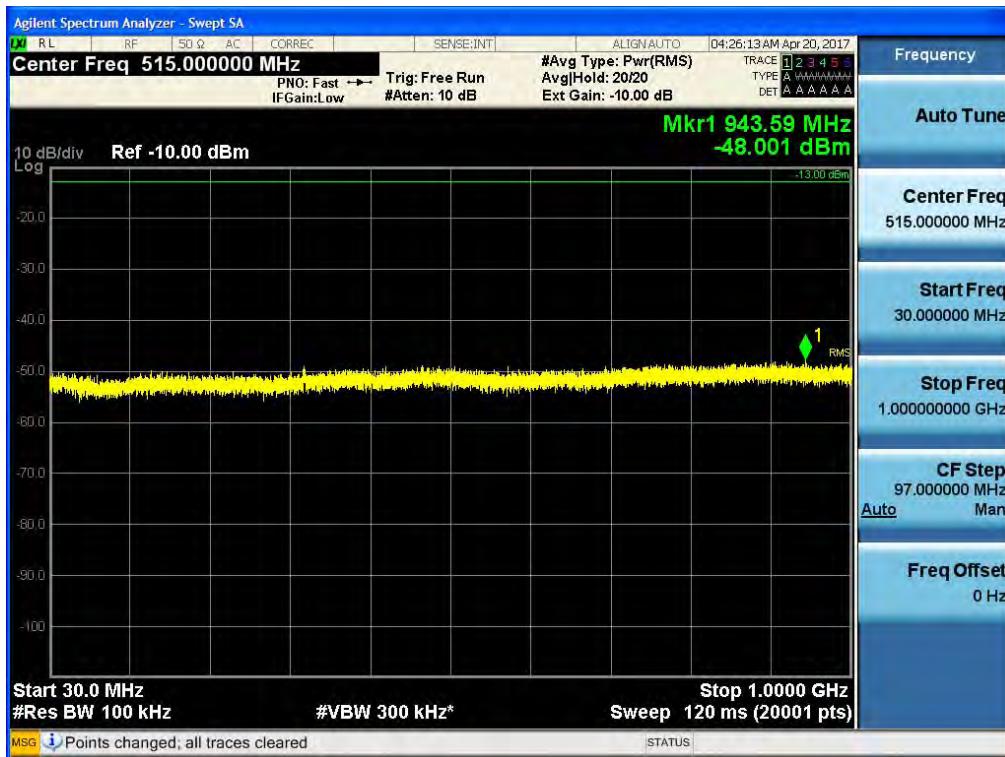


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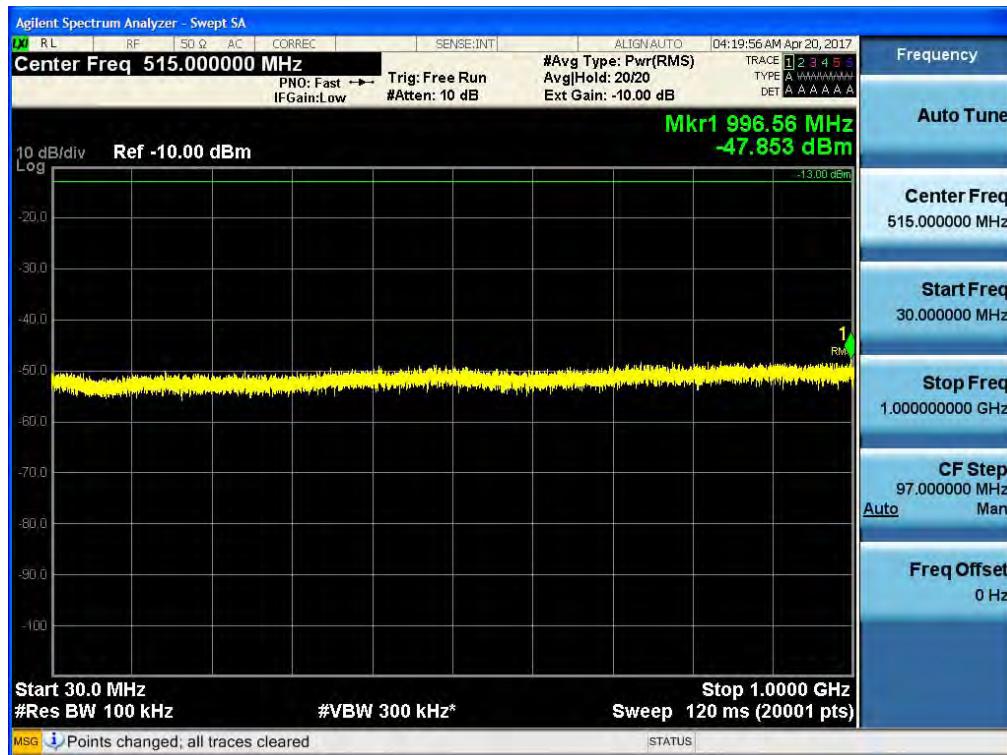
Conducted Spurious Emissions (30 MHz – 1 GHz)

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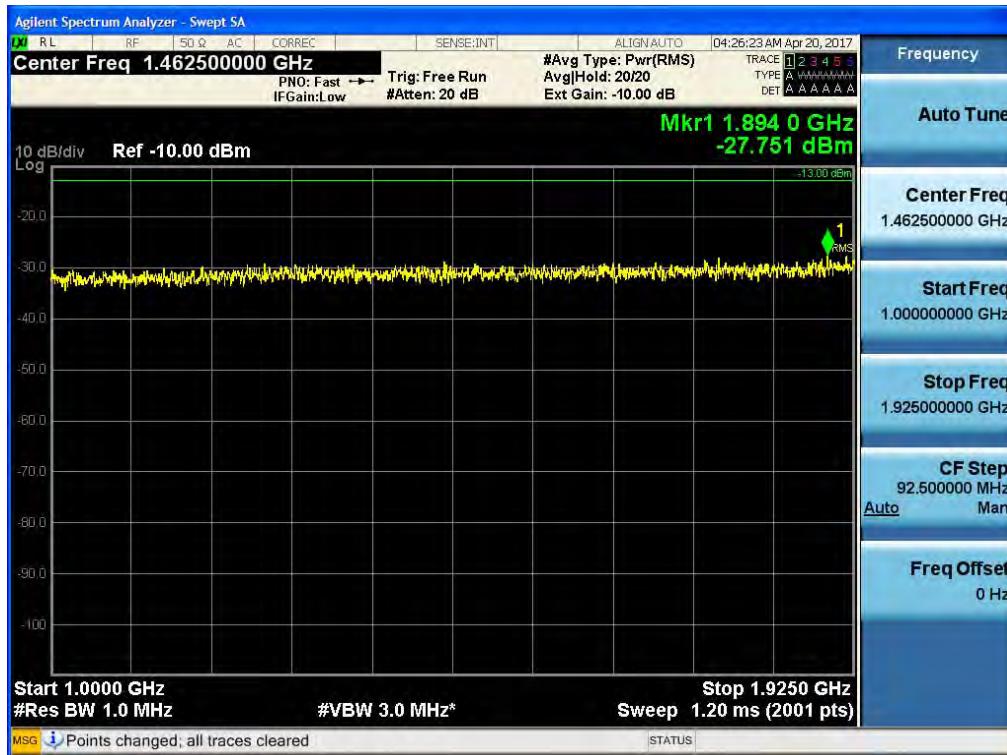
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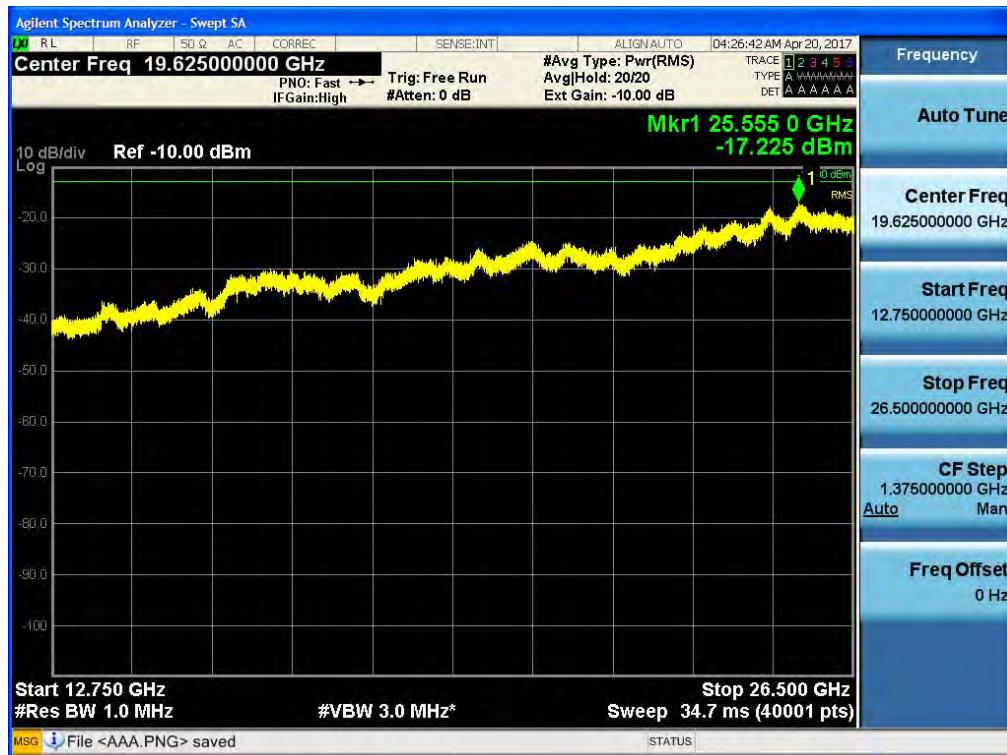
Conducted Spurious Emissions (1 GHz – 26.5 GHz)

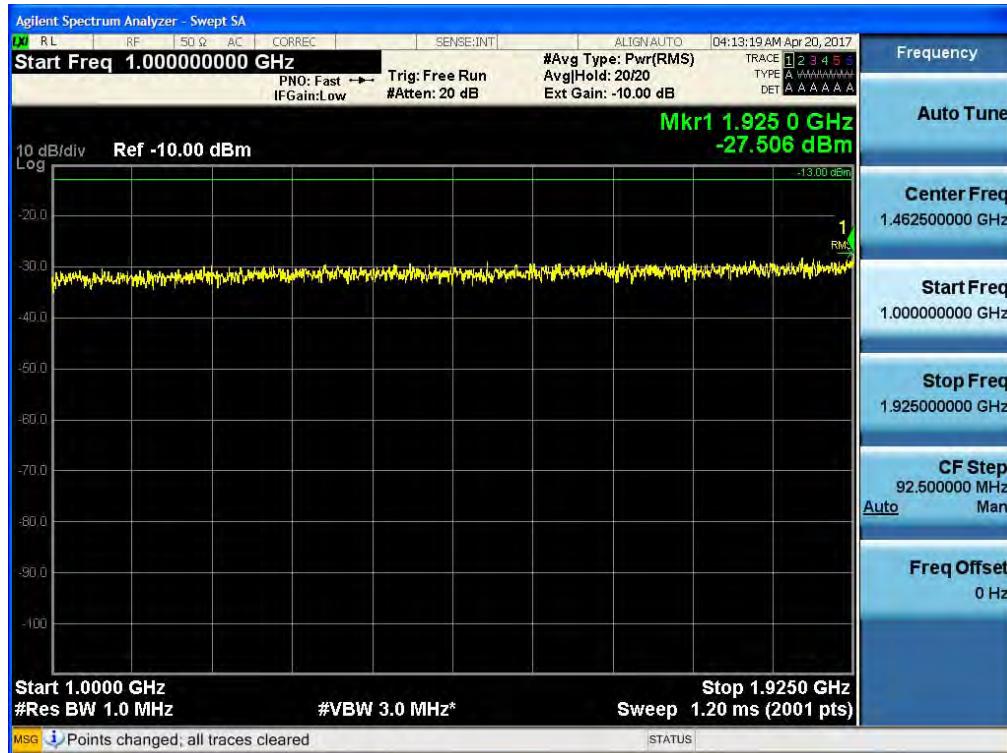
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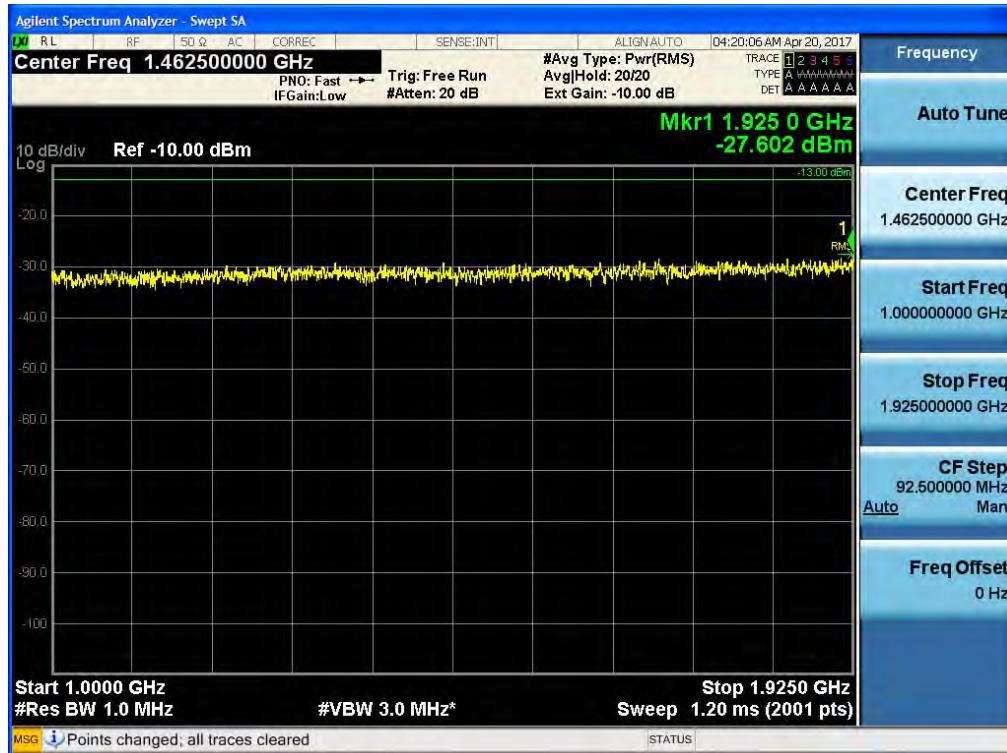


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