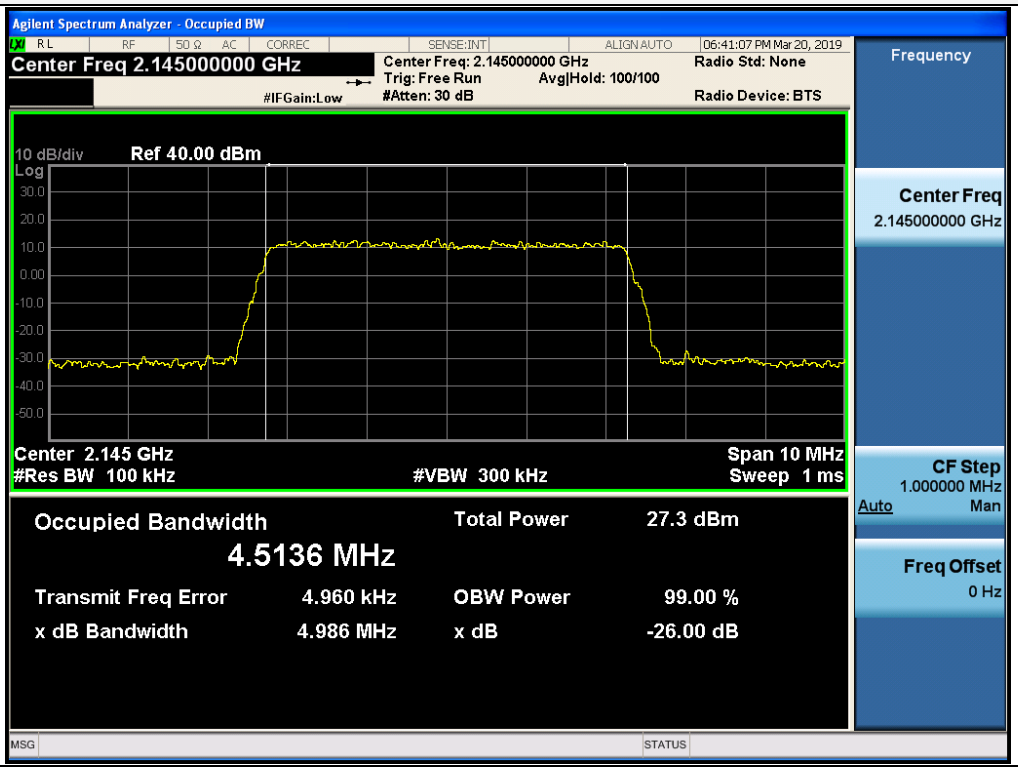
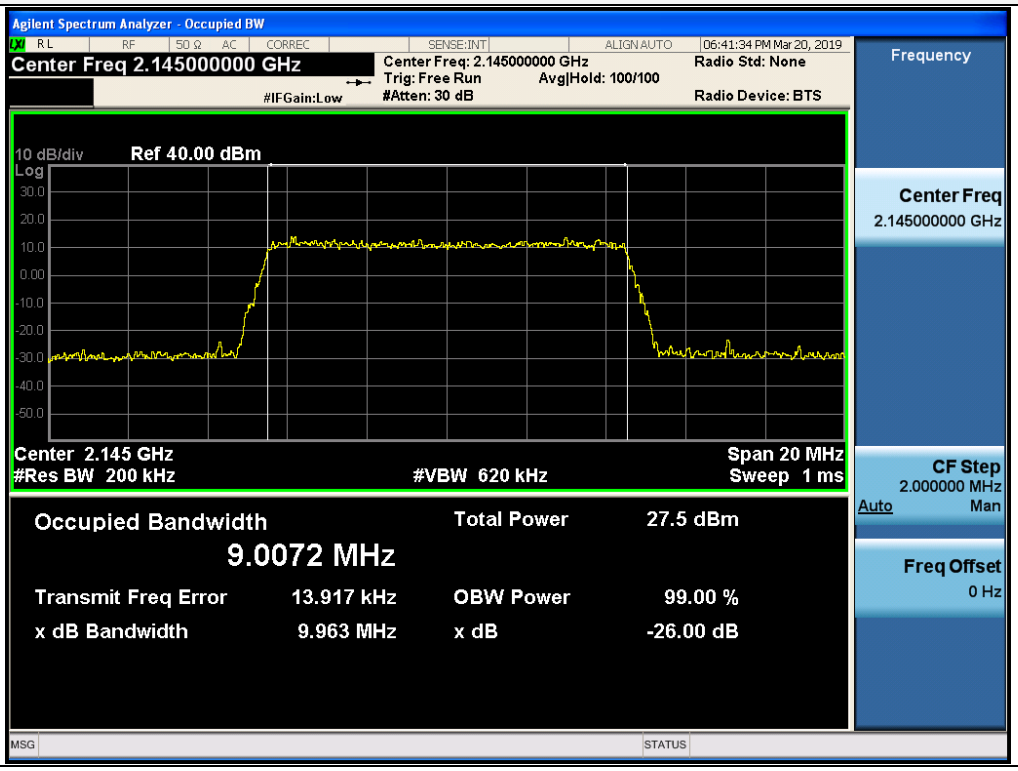
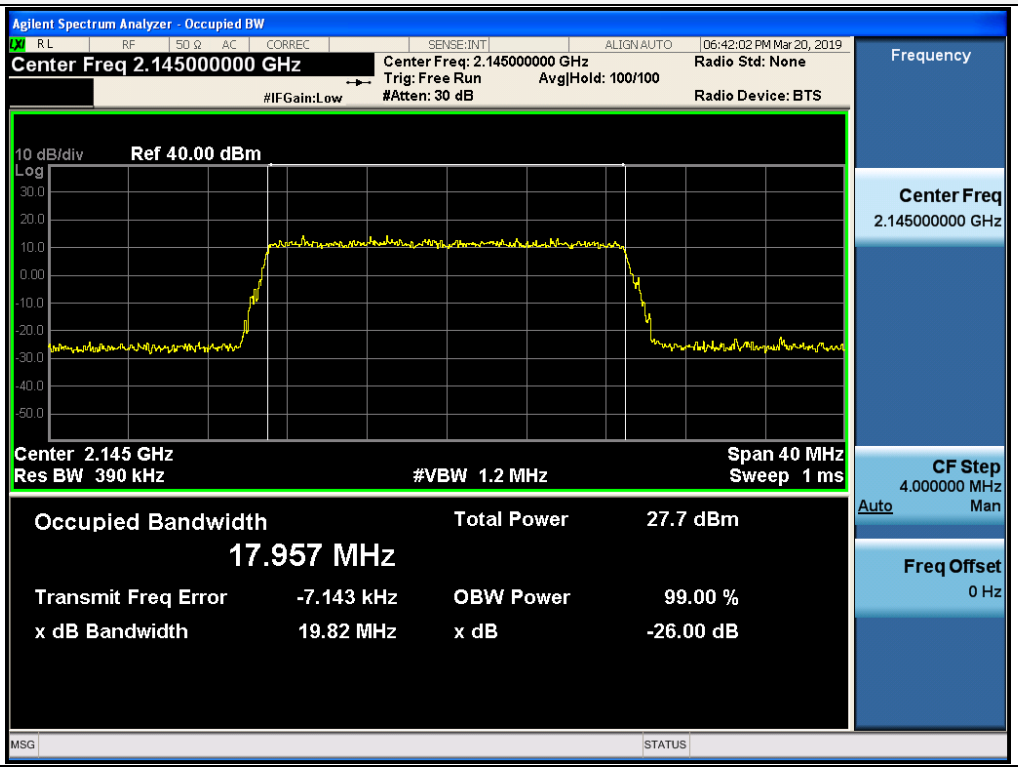
| 3 dB above the AGC threshold output / AWS1+3 / Downlink / LTE 5 MHz |
|---|
|  |

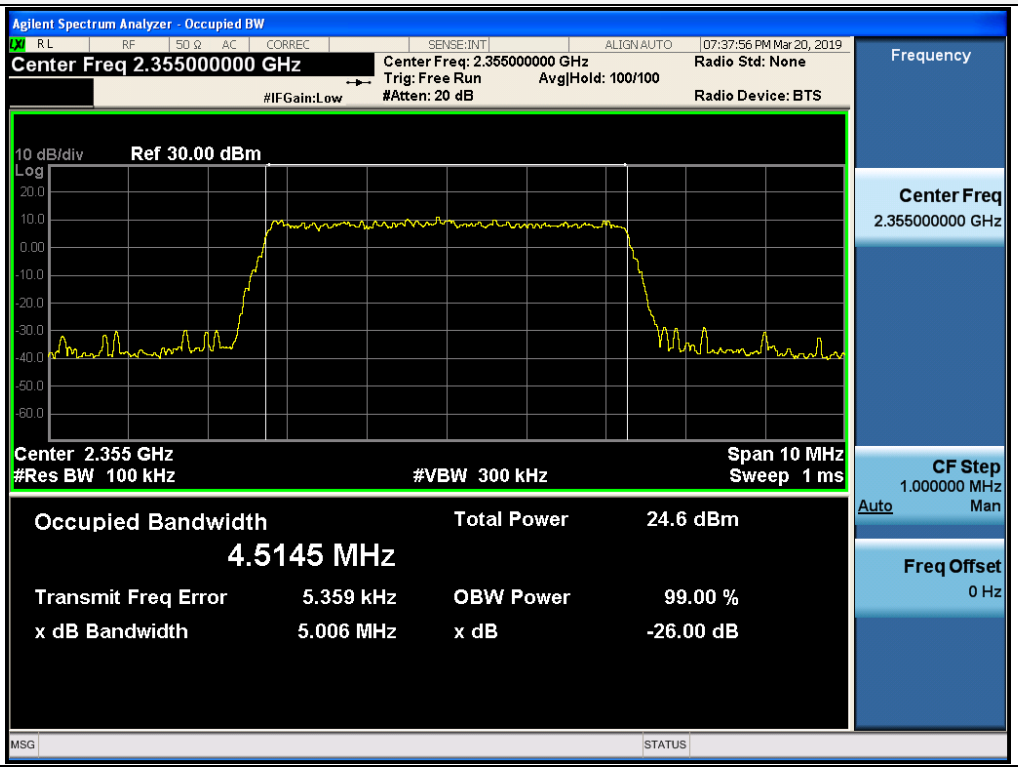


| 3 dB above the AGC threshold output / AWS1+3 / Downlink / LTE 10 MHz |
|---|
|  |

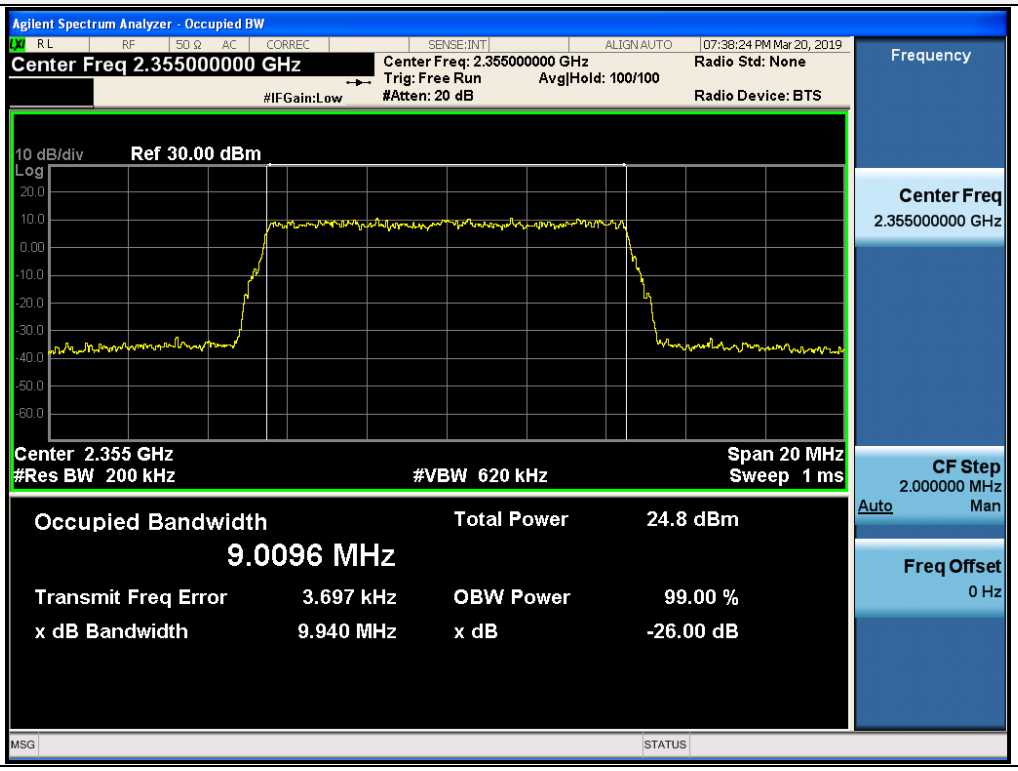
| 3 dB above the AGC threshold output / AWS1+3 / Downlink / LTE 20 MHz |
|---|



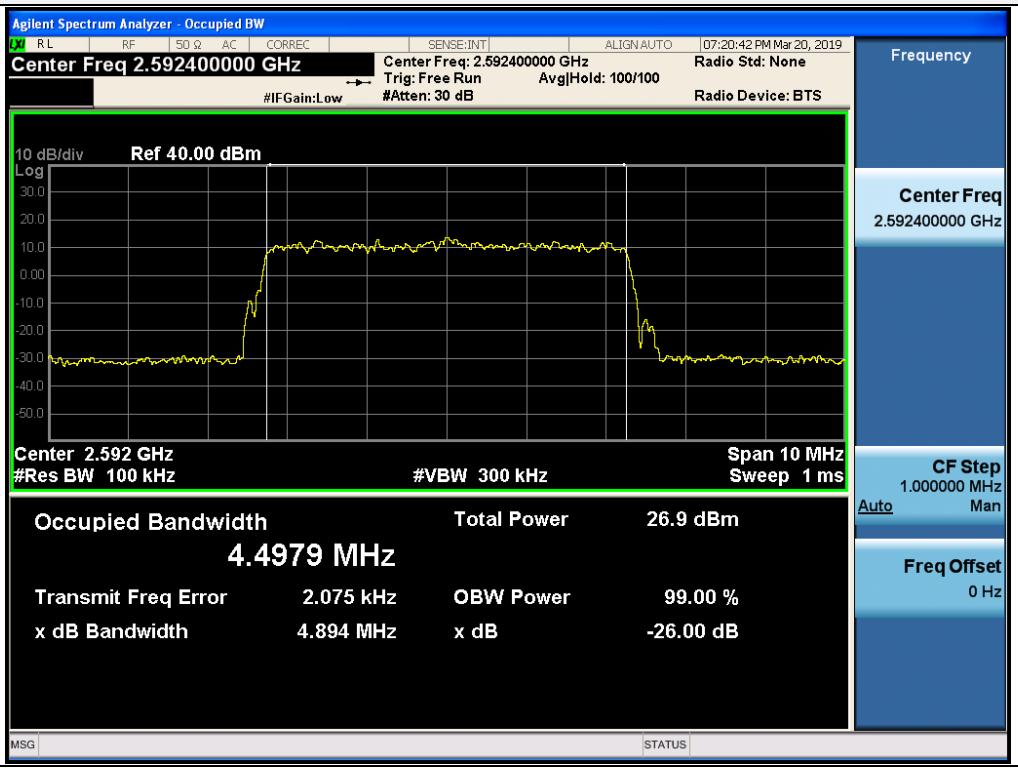

| 3 dB above the AGC threshold output / WCS / Downlink / LTE 5 MHz |
|---|



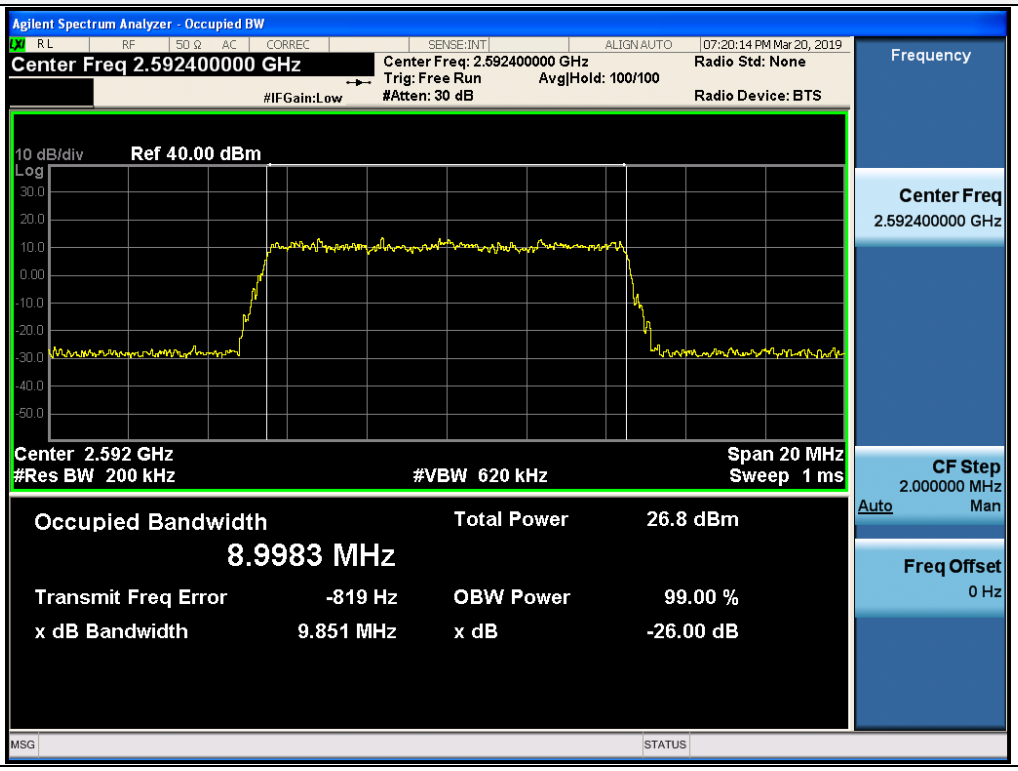
| 3 dB above the AGC threshold output / WCS / Downlink / LTE 10 MHz |
|---|



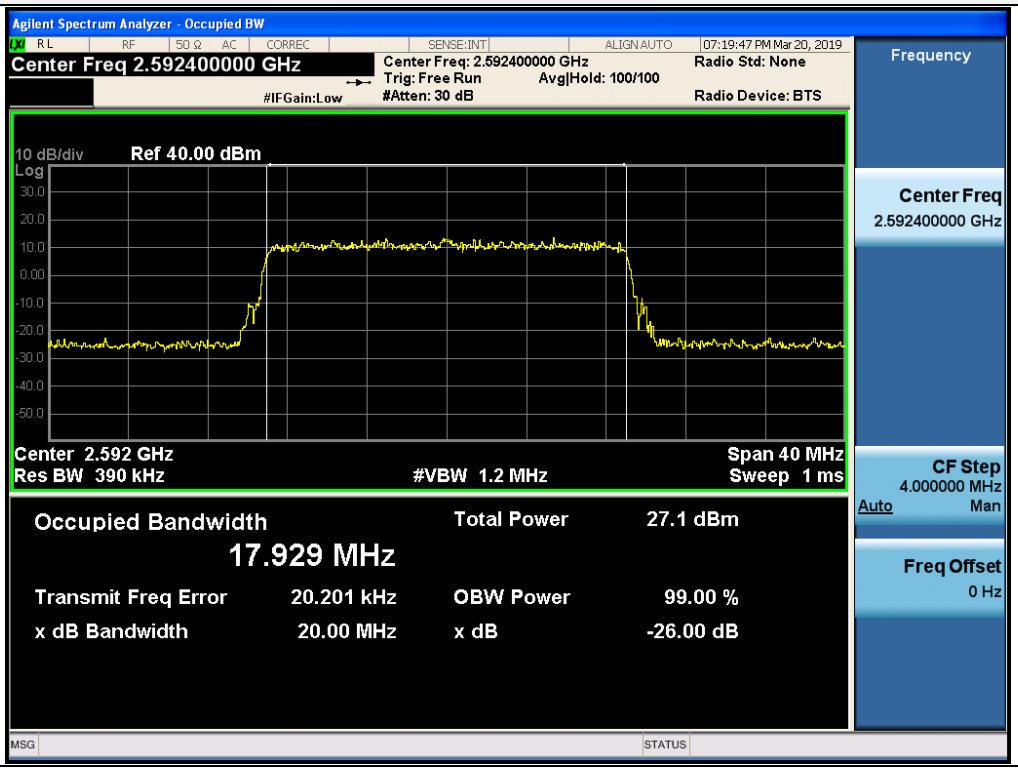

| 3 dB above the AGC threshold output / BRS/EBS / Downlink / LTE 5 MHz (TDD) |
|---|



| 3 dB above the AGC threshold output / BRS/EBS / Downlink / LTE 10 MHz (TDD) |
|---|




| 3 dB above the AGC threshold output / BRS/EBS / Downlink / LTE 20 MHz (TDD) |
|---|



## 5.4. INPUT/OUTPUT POWER AND AMPLIFIER/BOOSTER GAIN

**Test Requirement:**

**§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 radiotelephone transmitters the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and 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.

**§22.913 Effective radiated power limits.**

Licensees in the Cellular Radiotelephone Service are subject to the effective radiated power (ERP) limits and other requirements in this Section. See also §22.169.

(a) *Maximum ERP*. The ERP of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(1) Except as described in paragraphs (a)(2), (3), and (4) of this section, the ERP of base stations and repeaters must not exceed—

(i) 500 watts per emission; or

(ii) 400 watts/MHz (PSD) per sector.

(d) Power measurement. Measurement of the ERP of Cellular base transmitters and repeaters must be made using an average power measurement technique. The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB. Power measurements for base transmitters and repeaters must be made in accordance with either of the following:

(1) A Commission-approved average power technique (see FCC Laboratory's Knowledge Database); or

(2) For purposes of this section, peak transmit power must be measured over an 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.

**§ 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.

**§27.50 Power limits and duty cycle.**

(a) The following power limits and related requirements apply to stations transmitting in the 2305-2320 MHz band or the 2345-2360 MHz band.

(1) Base and fixed stations.

(i) For base and fixed stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band:

(A) The average equivalent isotropically radiated power (EIRP) must not exceed 2,000 watts within any 5 megahertz of authorized bandwidth and must not exceed 400 watts within any 1 megahertz of authorized bandwidth.

(B) The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

(ii) For base and fixed stations transmitting in the 2315-2320 MHz band or the 2345-2350 MHz band, the peak EIRP must not exceed 2,000 watts.

(b) The following power and antenna height limits apply to transmitters operating in the 746-758 MHz, 775-788 MHz and 805-806 MHz bands:

(1) Fixed and base stations transmitting a signal in the 757-758 and 775-776 MHz bands must not exceed an effective radiated power (ERP) of 1000 watts and an antenna height of 305 m height above average terrain (HAAT), except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

(4) Fixed and base stations transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section.

(5) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section.

(c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(3) Fixed and base stations transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section;

(4) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section;

(5) Licensees, except for licensees operating in the 600 MHz downlink band, seeking to operate a fixed or base station located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal at an ERP greater than 1000 watts must:

(i) Coordinate in advance with all licensees authorized to operate in the 698-758 MHz, 775-788, and 805-806 MHz bands within 120 kilometers (75 miles) of the base or fixed station;

(ii) coordinate in advance with all regional planning committees, as identified in §90.527 of this chapter, with jurisdiction within 120 kilometers (75 miles) of the base or fixed station.

(d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(1) The power of each fixed or base station transmitting in the 1995-2000 MHz, 2110-2155 MHz, 2155-2180 MHz or 2180-2200 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:

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

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

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

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

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

(3) A licensee operating a base or fixed station in the 2110-2155 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must coordinate such operations in advance

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

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

(5) Equipment employed must be authorized in accordance with the provisions of §24.51. 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 (d)(6) of this section. 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.

(6) 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.

(7) Fixed, mobile, and portable (hand-held) stations operating in the 2000-2020 MHz band are limited to 2 watts EIRP, except that the total power of any portion of an emission that falls within the 2000-2005 MHz band may not exceed 5 milliwatts. A licensee of AWS-4 authority may enter into private operator-to-operator agreements with all 1995-2000 MHz licensees to operate in 2000-2005 MHz at power levels above 5 milliwatts EIRP; except the total power of the AWS-4 mobile emissions may not exceed 2 watts EIRP.

(8) A licensee operating a base or fixed station in the 2180-2200 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all AWS licensees authorized to operate on adjacent frequency blocks in the 2180-2200 MHz band.

(9) Fixed, mobile and portable (hand-held) stations operating in the 1915-1920 MHz band are limited to 300 milliwatts EIRP.

(10) A licensee operating a base or fixed station in the 1995-2000 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all PCS G Block licensees authorized to operate on adjacent frequency blocks in the 1990-1995 MHz band within 120 kilometers of the base or fixed station operating in this band.

(h) The following power limits shall apply in the BRS and EBS:

(1) Main, booster and base stations.

(i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

(ii) If a main or booster station sectorizes or otherwise uses one or more transmitting antennas with a non-omnidirectional horizontal plane radiation pattern, the maximum EIRP in dBW in a given direction shall be determined by the following formula: EIRP = 33 dBW + 10 log(X/Y) dBW + 10 log(360/beamwidth) dBW, where X is the actual channel width in MHz, Y is either (i) 6 MHz if prior to transition or the station is in the MBS following transition or (ii) 5.5 MHz if the station is in the LBS and UBS following transition, and beamwidth is the total horizontal plane beamwidth of the individual transmitting antenna for the station or any sector measured at the half-power points.

**§ 90.219 Use of signal boosters.**

(e) Device Specifications. In addition to the general rules for equipment certification in §90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

(1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

**§ 90.542 Broadband transmitting power limits.**

(a) The following power limits apply to the 758-768/788-798 MHz band:

(1) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth of 1 MHz or less must not exceed an ERP of 1000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

(2) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 758-768 MHz band with an emission bandwidth of 1 MHz or less must not exceed an ERP of 2000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts ERP in accordance with Table 2 of this section.

(3) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP accordance with Table 3 of this section.

(4) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1

MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section.

(5) Licensees of fixed or base stations transmitting a signal in the 758-768 MHz band at an ERP greater than 1000 watts must comply with the provisions set forth in paragraph (b) of this section.

(6) Control stations and mobile stations transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 30 watts ERP.

(7) Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

(8) For transmissions in the 758-768 MHz and 788-798 MHz bands, licensees may employ equipment operating in compliance with either of the following measurement techniques:

(i) The maximum composite transmit power shall be measured over any interval of continuous transmission using instrumentation calibrated in terms of 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, etc., so as to obtain a true maximum composite measurement for the emission in question over the full bandwidth of the channel.

(ii) A Commission-approved average power technique.

Table 1 to §90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth of 1 MHz or Less

| Antenna height (AAT) in meters (feet) | Effective radiated power (ERP) (watts) |
|---|---|
| Above 1372 (4500) | 65 |
| Above 1220 (4000) To 1372 (4500) | 70 |
| Above 1067 (3500) To 1220 (4000) | 75 |
| Above 915 (3000) To 1067 (3500) | 100 |
| Above 763 (2500) To 915 (3000) | 140 |
| Above 610 (2000) To 763 (2500) | 200 |
| Above 458 (1500) To 610 (2000) | 350 |
| Above 305 (1000) To 458 (1500) | 600 |
| Up to 305 (1000) | 1000 |

Table 2 to §90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth of 1 MHz or Less

| Antenna height (AAT) in meters (feet) | Effective radiated power (ERP) (watts) |
|---|---|
| Above 1372 (4500) | 130 |
| Above 1220 (4000) To 1372 (4500) | 140 |
| Above 1067 (3500) To 1220 (4000) | 150 |
| Above 915 (3000) To 1067 (3500) | 200 |
| Above 763 (2500) To 915 (3000) | 280 |
| Above 610 (2000) To 763 (2500) | 400 |
| Above 458 (1500) To 610 (2000) | 700 |
| Above 305 (1000) To 458 (1500) | 1200 |
| Up to 305 (1000) | 2000 |

Table 3 to §90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth Greater Than 1 MHz

| Antenna height (AAT) in meters (feet) | Effective radiated power (ERP) per MHz (watts/MHz) |
|---|---|
| Above 1372 (4500) | 65 |
| Above 1220 (4000) To 1372 (4500) | 70 |
| Above 1067 (3500) To 1220 (4000) | 75 |
| Above 915 (3000) To 1067 (3500) | 100 |
| Above 763 (2500) To 915 (3000) | 140 |
| Above 610 (2000) To 763 (2500) | 200 |
| Above 458 (1500) To 610 (2000) | 350 |
| Above 305 (1000) To 458 (1500) | 600 |
| Up to 305 (1000) | 1000 |

Table 4 to §90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth Greater Than 1 MHz

| Antenna height (AAT) in meters (feet) | Effective radiated power (ERP) per MHz (watts/MHz) |
|---|---|
| Above 1372 (4500) | 130 |
| Above 1220 (4000) To 1372 (4500) | 140 |
| Above 1067 (3500) To 1220 (4000) | 150 |
| Above 915 (3000) To 1067 (3500) | 200 |

| | |
|---|---|
| Above 763 (2500) To 915 (3000) | 280 |
| Above 610 (2000) To 763 (2500) | 400 |
| Above 458 (1500) To 610 (2000) | 700 |
| Above 305 (1000) To 458 (1500) | 1200 |
| Up to 305 (1000) | 2000 |

(b) For base and fixed stations operating in the 758-768 MHz band in accordance with the provisions of paragraph (a)(5) of this section, the power flux density that would be produced by such stations through a combination of antenna height and vertical gain pattern must not exceed 3000 microwatts per square meter on the ground over the area extending to 1 km from the base of the antenna mounting structure.

**§90.635 Limitations on power and antenna height**

(a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

Table—Equivalent Power and Antenna Heights for Base Stations in the 851-869 MHz and 935-940 MHz Bands Which Have a Requirement for a 32 km (20 mi) Service Area Radius

| Antenna height (ATT) meters (feet) | Effective radiated power (watts) |
|---|---|
| Above 1,372 (4,500) | 65 |
| Above 1,220 (4,000) to 1,372 (4,500) | 70 |
| Above 1,067 (3,500) to 1,220 (4,000) | 75 |
| Above 915 (3,000) to 1,067 (3,500) | 100 |
| Above 763 (2,500) to 915 (3,000) | 140 |
| Above 610 (2,000) to 763 (2,500) | 200 |
| Above 458 (1,500) to 610 (2,000) | 350 |
| Above 305 (1,000) to 458 (1,500) | 600 |
| Up to 305 (1,000) | 1,000 |

**Test Procedures:**

Measurements were in accordance with the test methods section 3.5 of KDB 935210 D05 v01r02.

*Adjust the internal gain control of the EUT to the maximum gain for which the equipment certification is being sought. Any EUT attenuation settings shall be set to their minimum value.*

*Input power levels (uplink and downlink) should be set to maximum input ratings while confirming that the device is not capable of operating in saturation (non-linear mode) at the rated input levels, including during the performance of the input/output power measurements.*

3.5.2 Measuring the EUT mean input and output power

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

b) Configure to generate the test signal.

c) The frequency of the signal generator shall be set to the frequency $f_0$ as determined from out-of-band rejection test.

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, but not more than 0.5 dB below.

f) Measure and record the output power of the EUT; use ANSI C63.26-2015 subclause 5.2.4.4.1, 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.

3.5.5 Calculating amplifier, repeater, or industrial booster gain

After the input and output power levels have been measured as described in the preceding subclauses, the gain of the EUT can be determined from:

Gain (dB) = output power (dBm) − input power (dBm).

Report the gain for each authorized operating frequency band, and each test signal stimulus.

***Note1.*** *If $f_0$ that determined from out-of-band test is smaller or greater than difference of test signal's center frequency and operation band block, test is performed at the lowest or the highest frequency that test signals can be passed.*

**Test Results:**

**Tabular data of Input / Output Power and Gain**

| Test Band | Link | Signal | $f_0$ Frequency (MHz) | Input Power (dBm) | Output Power (dBm) | Gain (dB) |
|---|---|---|---|---|---|---|
| Lower 700 MHz | Downlink | LTE 5 MHz | 731.50 | 0.14 | 15.66 | 15.52 |
| | | LTE 10 MHz | 734.00 | 0.18 | 14.99 | 14.81 |
| Upper 700 MHz | Downlink | LTE 5 MHz | 755.50 | 0.09 | 14.56 | 14.47 |
| | | LTE 10 MHz | 753.00 | 0.16 | 14.90 | 14.74 |
| PS Broadband | Downlink | LTE 5 MHz | 760.50 | 0.11 | 15.35 | 15.24 |
| | | LTE 10 MHz | 763.00 | 0.18 | 15.27 | 15.09 |
| ESMR | Downlink | GSM | 867.75 | -0.48 | 15.50 | 15.98 |
| | | CDMA | 867.75 | -0.36 | 15.61 | 15.97 |
| | | WCDMA | 866.50 | -0.22 | 15.39 | 15.61 |
| Cellular | Downlink | GSM | 869.10 | -0.31 | 15.40 | 15.71 |
| | | CDMA | 869.63 | -0.27 | 15.30 | 15.57 |
| | | WCDMA | 871.50 | -0.20 | 15.47 | 15.67 |
| Broadband PCS | Downlink | GSM | 1994.19 | -0.22 | 20.22 | 20.44 |
| | | CDMA | 1994.19 | 0.24 | 20.94 | 20.70 |
| | | WCDMA | 1992.50 | 0.29 | 20.60 | 20.31 |
| | | LTE 5 MHz | 1992.50 | 0.25 | 20.50 | 20.25 |
| | | LTE 10 MHz | 1990.00 | 0.28 | 20.45 | 20.17 |
| | | LTE 20 MHz | 1985.00 | 0.25 | 20.08 | 19.83 |
| AWS1+3 | Downlink | LTE 5 MHz | 2140.28 | 0.13 | 20.10 | 19.97 |
| | | LTE 10 MHz | 2140.28 | 0.00 | 20.02 | 20.02 |
| | | LTE 20 MHz | 2140.28 | 0.18 | 20.01 | 19.83 |
| WCS | Downlink | LTE 5 MHz | 2357.50 | -0.19 | 17.41 | 17.60 |
| | | LTE 10 MHz | 2355.00 | -0.16 | 17.03 | 17.19 |
| BRS/EBS | Downlink | LTE 5 MHz (TDD) | 2519.73 | -0.19 | 19.62 | 19.81 |
| | | LTE 10 MHz (TDD) | 2519.73 | 0.26 | 20.30 | 20.04 |
| | | LTE 20 MHz (TDD) | 2519.73 | 0.14 | 20.12 | 19.98 |

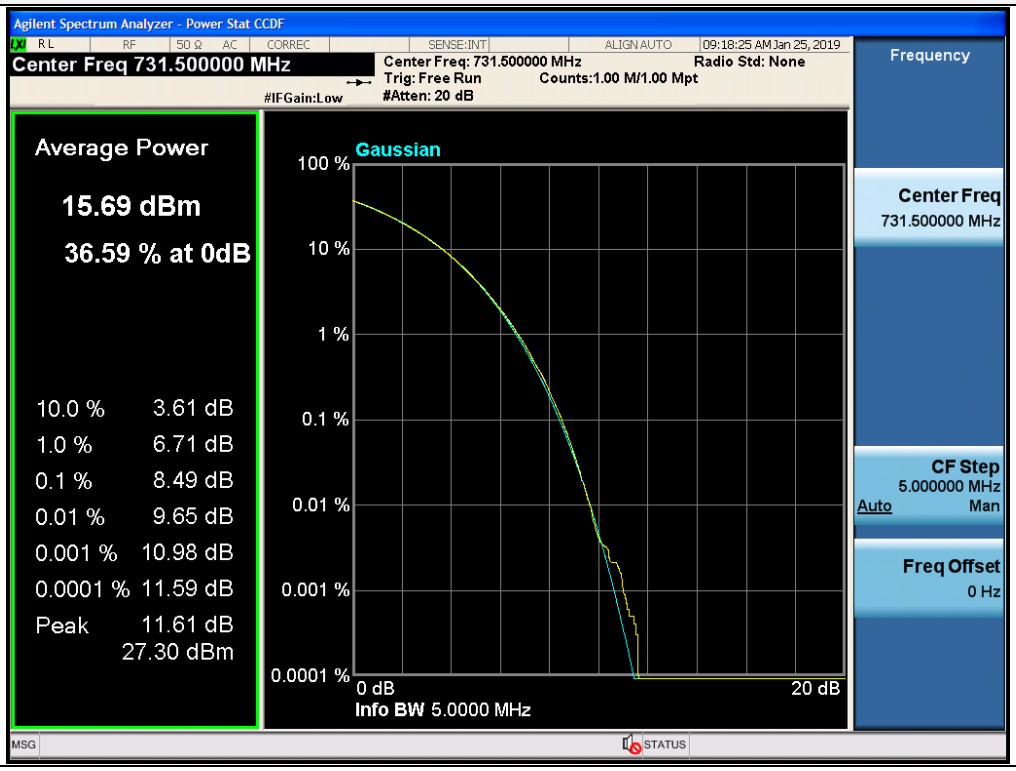
**Tabular data of Input / 3 dB above AGC threshold Output Power and Gain**

| Test Band | Link | Signal | $f_0$ Frequency (MHz) | Input Power (dBm) | +3 dB Output Power (dBm) | Gain (dB) |
|---|---|---|---|---|---|---|
| Lower 700 MHz | Downlink | LTE 5 MHz | 731.50 | 0.14 | 15.96 | 15.82 |
| | | LTE 10 MHz | 734.00 | 0.18 | 15.27 | 15.09 |
| Upper 700 MHz | Downlink | LTE 5 MHz | 755.50 | 0.09 | 14.97 | 14.88 |
| | | LTE 10 MHz | 753.00 | 0.16 | 15.13 | 14.97 |
| PS Broadband | Downlink | LTE 5 MHz | 760.50 | 0.11 | 15.55 | 15.44 |
| | | LTE 10 MHz | 763.00 | 0.18 | 15.53 | 15.35 |
| ESMR | Downlink | GSM | 867.75 | -0.48 | 15.57 | 16.05 |
| | | CDMA | 867.75 | -0.36 | 15.66 | 16.02 |
| | | WCDMA | 866.50 | -0.22 | 15.46 | 15.68 |
| Cellular | Downlink | GSM | 869.10 | -0.31 | 15.39 | 15.70 |
| | | CDMA | 869.63 | -0.27 | 15.42 | 15.69 |
| | | WCDMA | 871.50 | -0.20 | 15.42 | 15.62 |
| Broadband PCS | Downlink | GSM | 1994.19 | -0.22 | 20.17 | 20.39 |
| | | CDMA | 1994.19 | 0.24 | 20.83 | 20.59 |
| | | WCDMA | 1992.50 | 0.29 | 20.55 | 20.26 |
| | | LTE 5 MHz | 1992.50 | 0.25 | 20.47 | 20.22 |
| | | LTE 10 MHz | 1990.00 | 0.28 | 20.53 | 20.25 |
| | | LTE 20 MHz | 1985.00 | 0.25 | 20.11 | 19.86 |
| AWS1+3 | Downlink | LTE 5 MHz | 2140.28 | 0.13 | 20.15 | 20.02 |
| | | LTE 10 MHz | 2140.28 | 0.00 | 20.02 | 20.02 |
| | | LTE 20 MHz | 2140.28 | 0.18 | 20.12 | 19.94 |
| WCS | Downlink | LTE 5 MHz | 2357.50 | -0.19 | 17.59 | 17.78 |
| | | LTE 10 MHz | 2355.00 | -0.16 | 17.07 | 17.23 |
| BRS/EBS | Downlink | LTE 5 MHz (TDD) | 2519.73 | -0.19 | 19.73 | 19.92 |
| | | LTE 10 MHz (TDD) | 2519.73 | 0.26 | 20.33 | 20.07 |
| | | LTE 20 MHz (TDD) | 2519.73 | 0.14 | 20.25 | 20.11 |

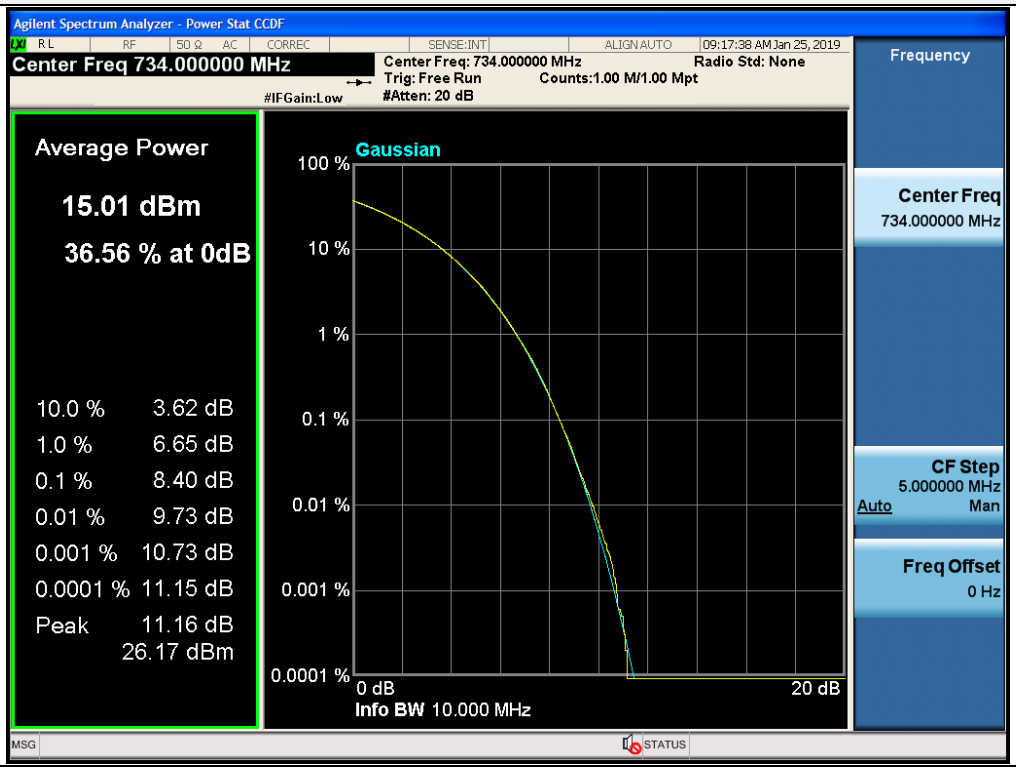
**Tabular data of PAPR**

| Test Band | Link | Signal | $f_0$ Frequency (MHz) | 0.1 % PAPR (dB) |
|---|---|---|---|---|
| Lower 700 MHz | Downlink | LTE 5 MHz | 731.50 | 8.49 |
| | | LTE 10 MHz | 734.00 | 8.40 |
| Upper 700 MHz | Downlink | LTE 5 MHz | 755.50 | 8.43 |
| | | LTE 10 MHz | 753.00 | 8.33 |
| PS Broadband | Downlink | LTE 5 MHz | 760.50 | 8.41 |
| | | LTE 10 MHz | 763.00 | 8.32 |
| ESMR | Downlink | GSM | 867.75 | 2.17 |
| | | CDMA | 867.75 | 7.93 |
| | | WCDMA | 866.50 | 4.46 |
| Cellular | Downlink | GSM | 869.10 | 2.18 |
| | | CDMA | 869.63 | 7.88 |
| | | WCDMA | 871.50 | 4.31 |
| Broadband PCS | Downlink | GSM | 1994.19 | 2.19 |
| | | CDMA | 1994.19 | 7.32 |
| | | WCDMA | 1992.50 | 4.58 |
| | | LTE 5 MHz | 1992.50 | 7.69 |
| | | LTE 10 MHz | 1990.00 | 7.66 |
| | | LTE 20 MHz | 1985.00 | 7.95 |
| AWS1+3 | Downlink | LTE 5 MHz | 2140.28 | 8.24 |
| | | LTE 10 MHz | 2140.28 | 7.95 |
| | | LTE 20 MHz | 2140.28 | 8.21 |
| WCS | Downlink | LTE 5 MHz | 2357.50 | 8.21 |
| | | LTE 10 MHz | 2355.00 | 8.27 |
| BRS/EBS | Downlink | LTE 5 MHz (TDD) | 2519.73 | 8.29 |
| | | LTE 10 MHz (TDD) | 2519.73 | 8.25 |
| | | LTE 20 MHz (TDD) | 2519.73 | 8.28 |

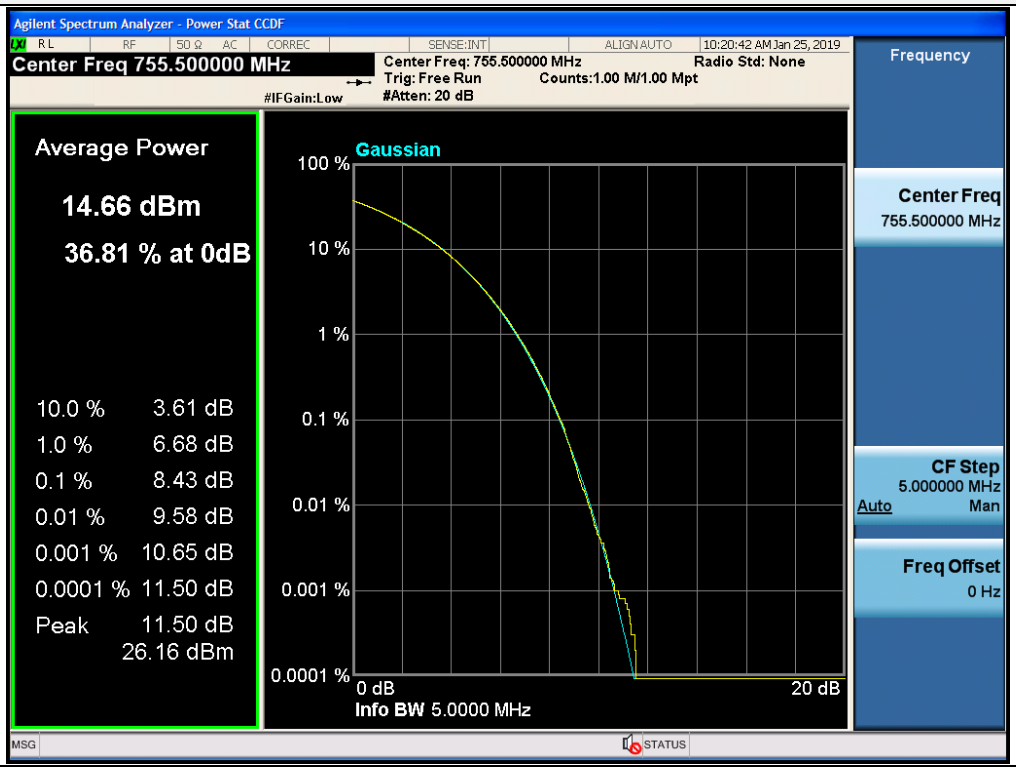
**Plot data of PAPR**

| PAPR / Lower 700 MHz / Downlink / LTE 5 MHz |
|---|
|  |

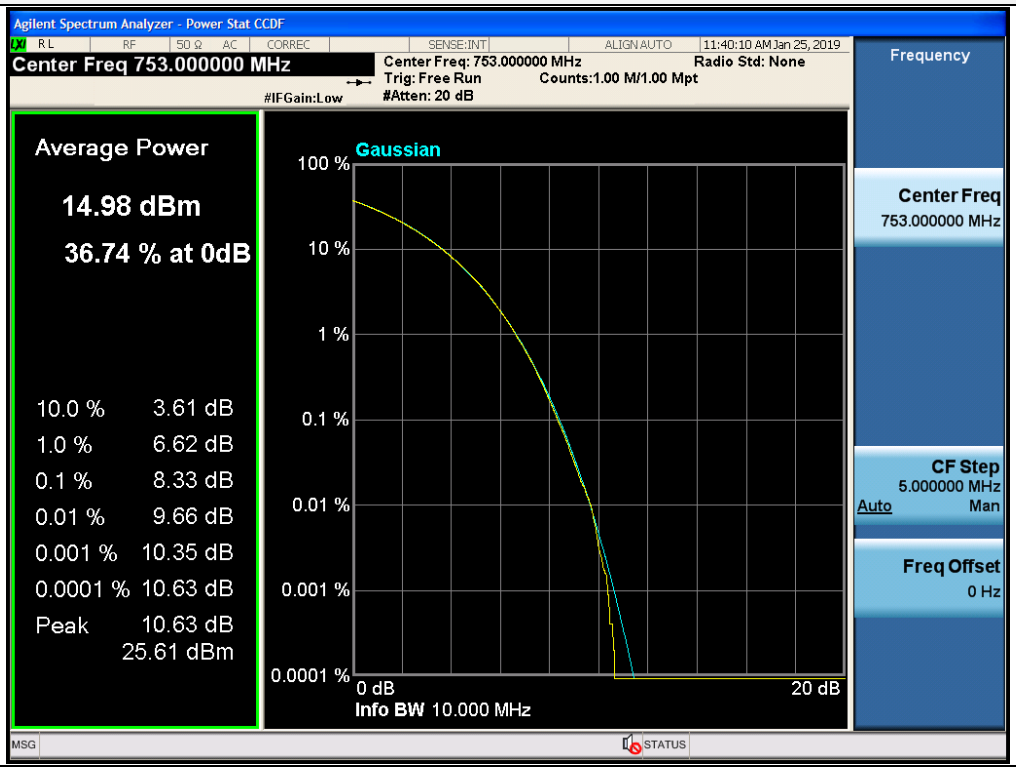


| PAPR / Lower 700 MHz / Downlink / LTE 10 MHz |
|---|
|  |

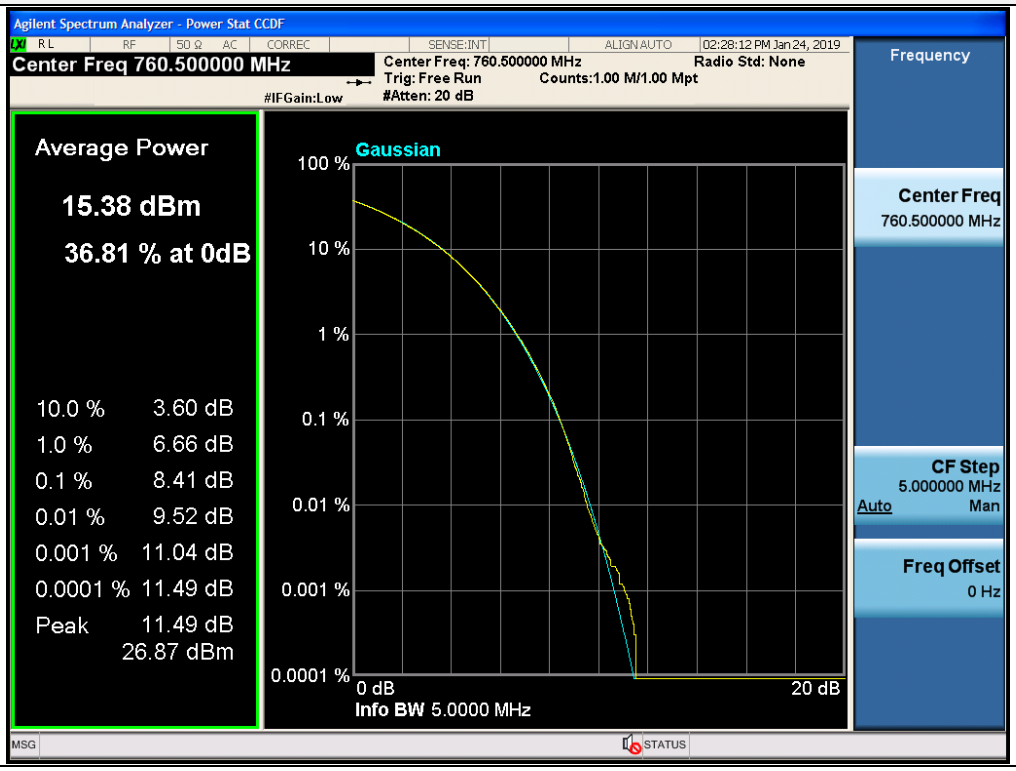
| PAPR / Upper 700 MHz / Downlink / LTE 5 MHz |
|---|



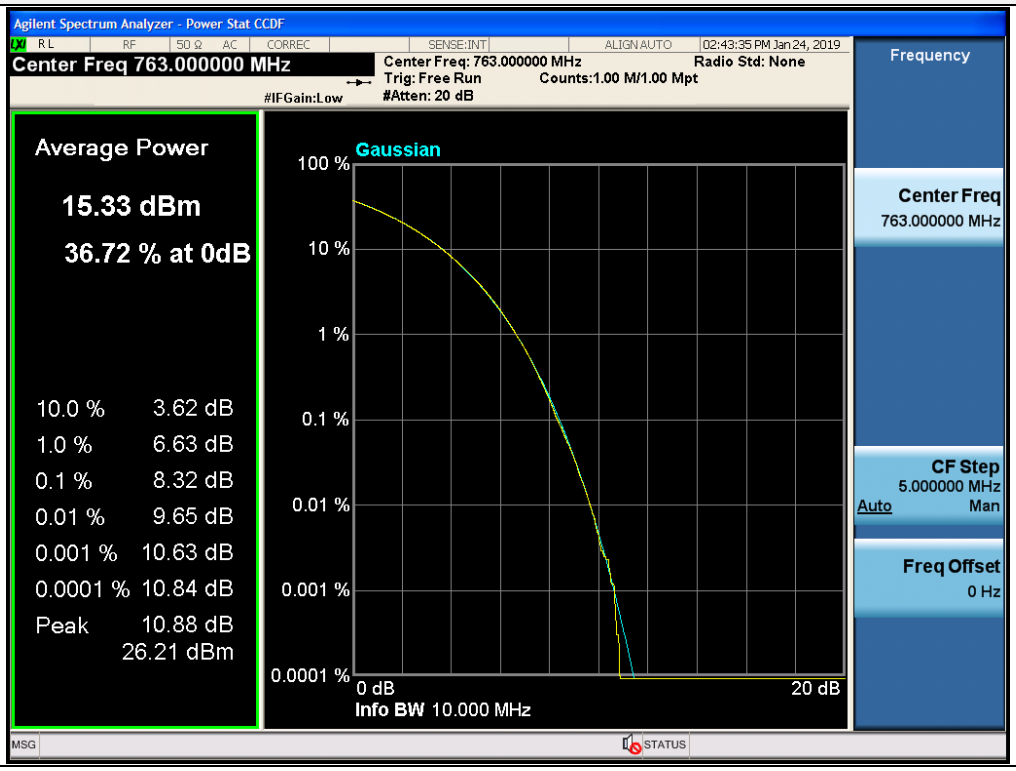

| PAPR / Upper 700 MHz / Downlink / LTE 10 MHz |
|---|



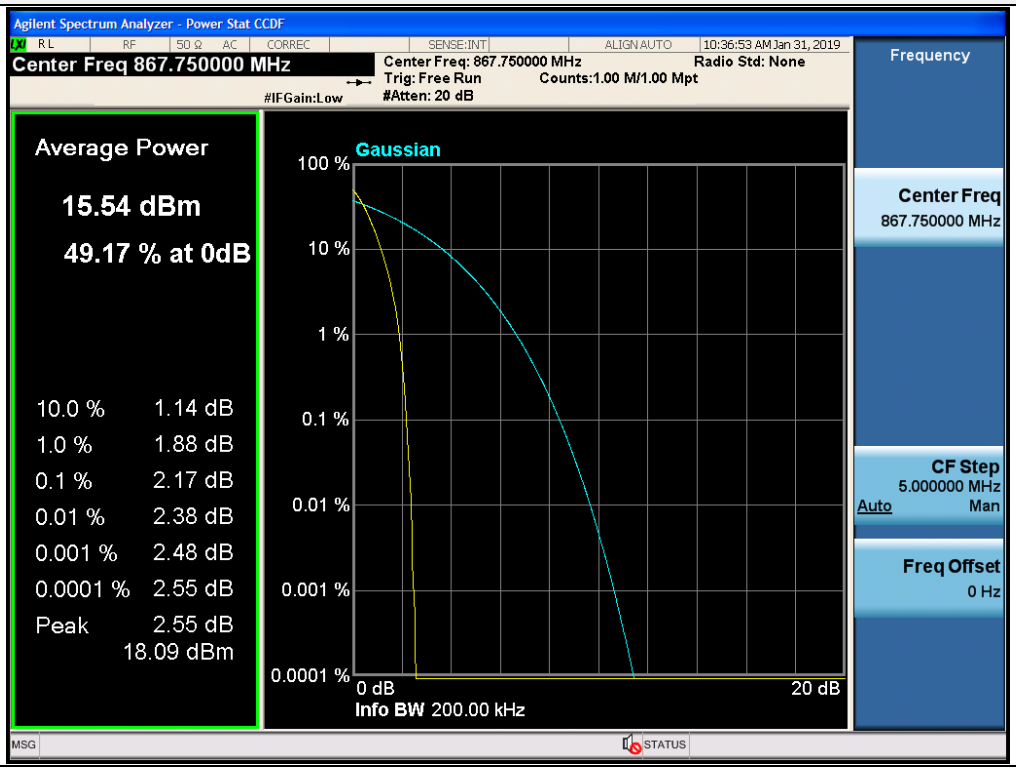
| PAPR / PS Broadband / Downlink / LTE 5 MHz |
|---|



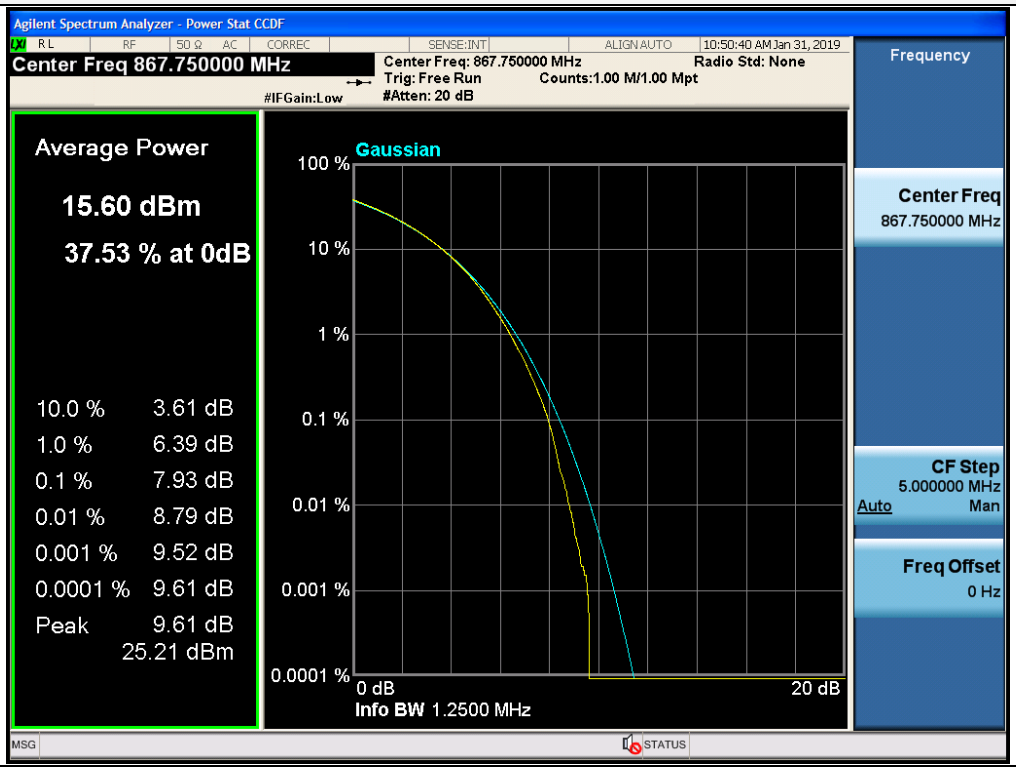

| PAPR / PS Broadband / Downlink / LTE 10 MHz |
|---|



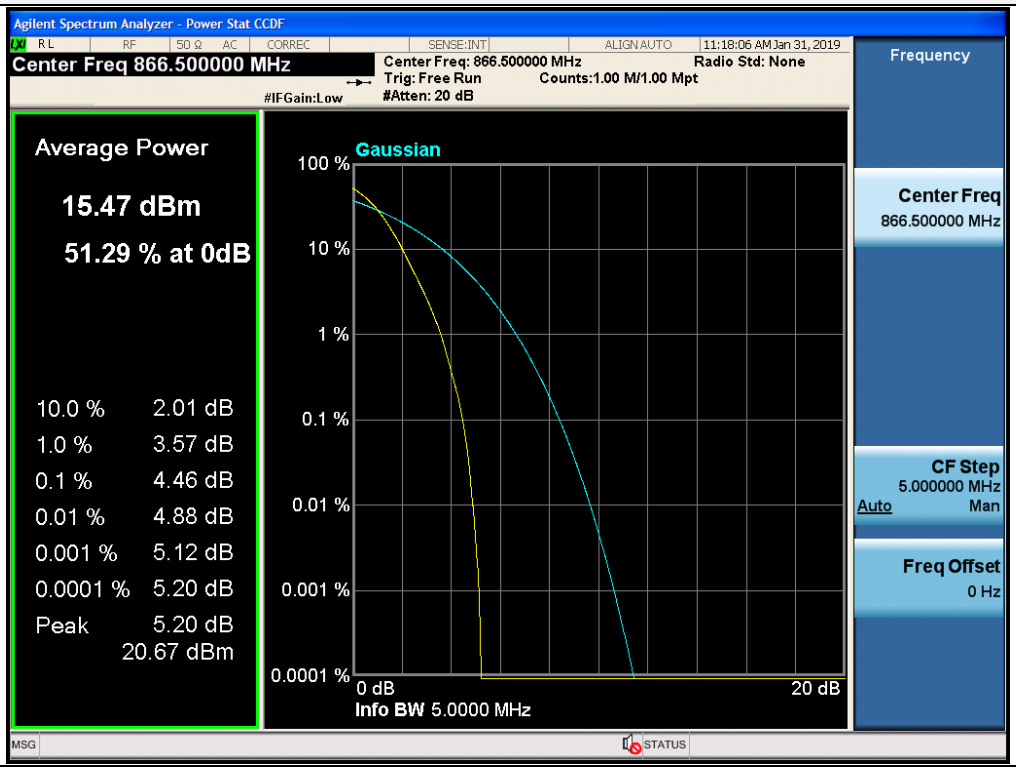
| PAPR / ESMR / Downlink / GSM |
|---|



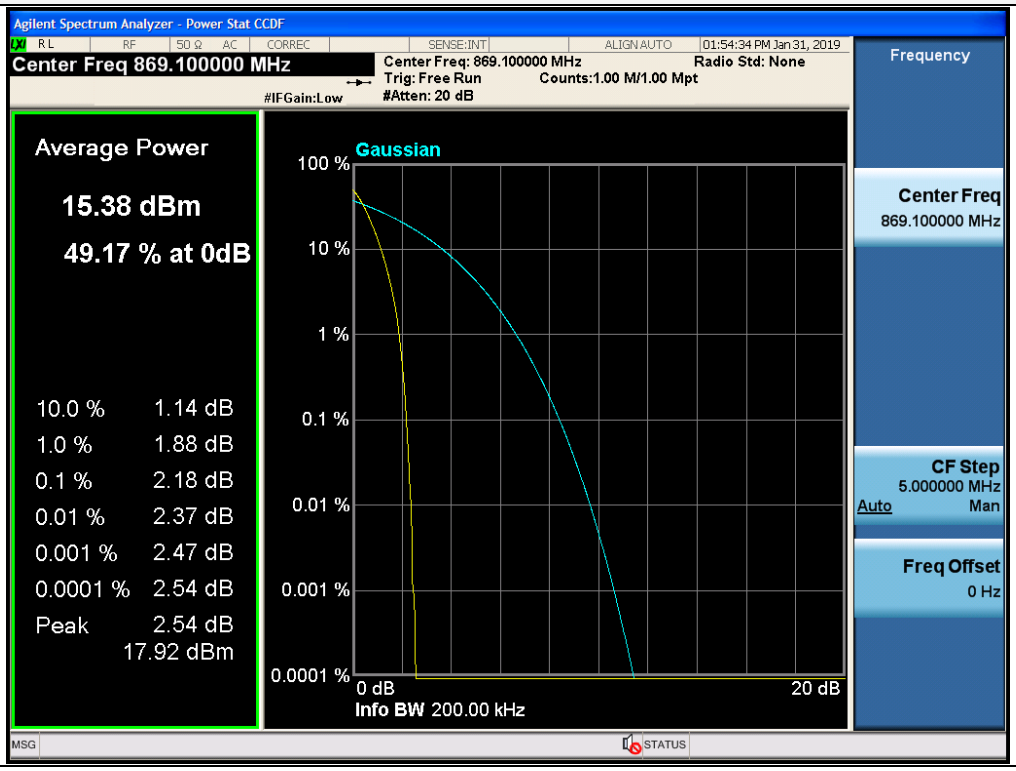

| PAPR / ESMR / Downlink / CDMA |
|---|



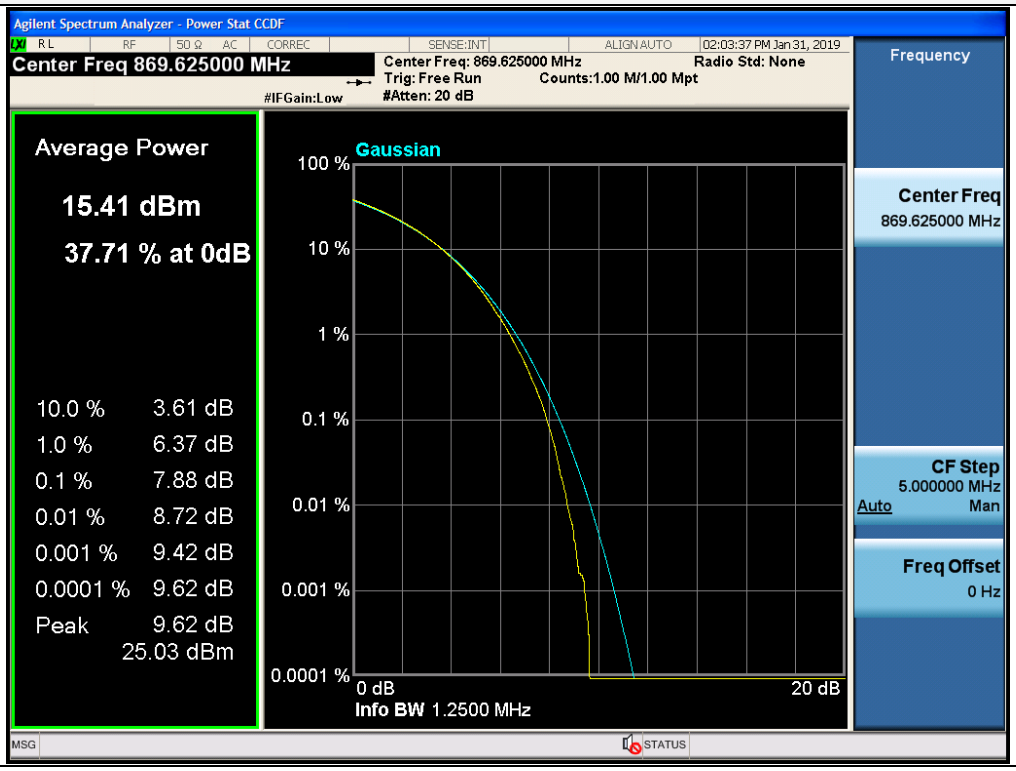
| PAPR / ESMR / Downlink / WCDMA |
|---|



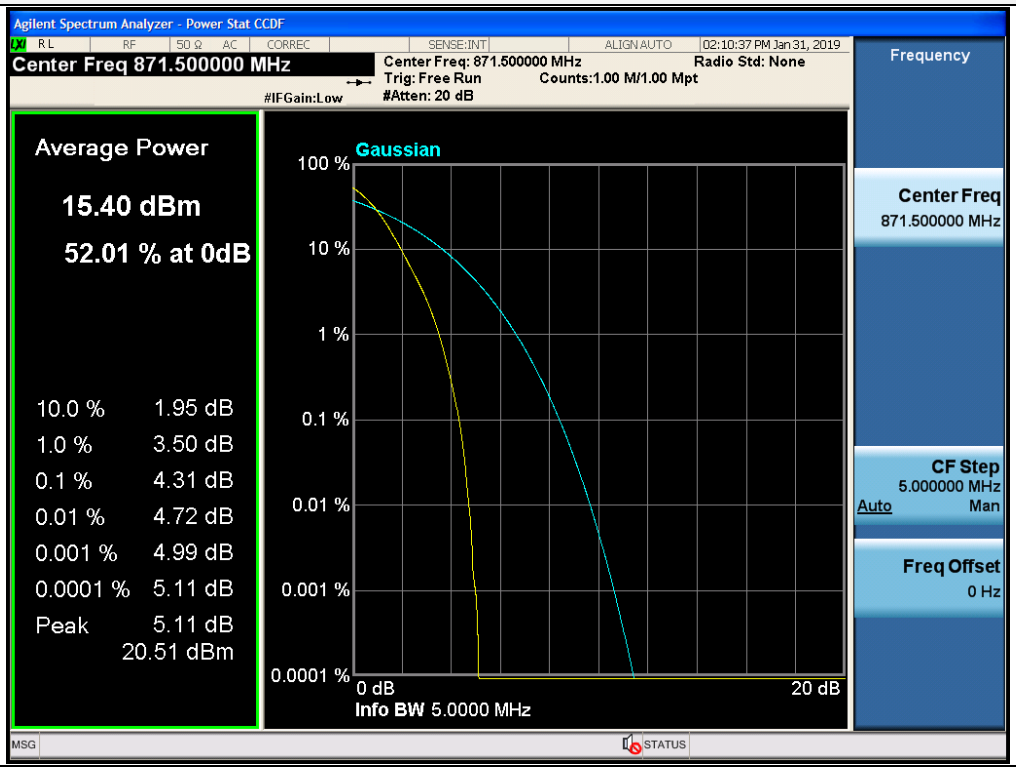

| PAPR / Cellular / Downlink / GSM |
|---|



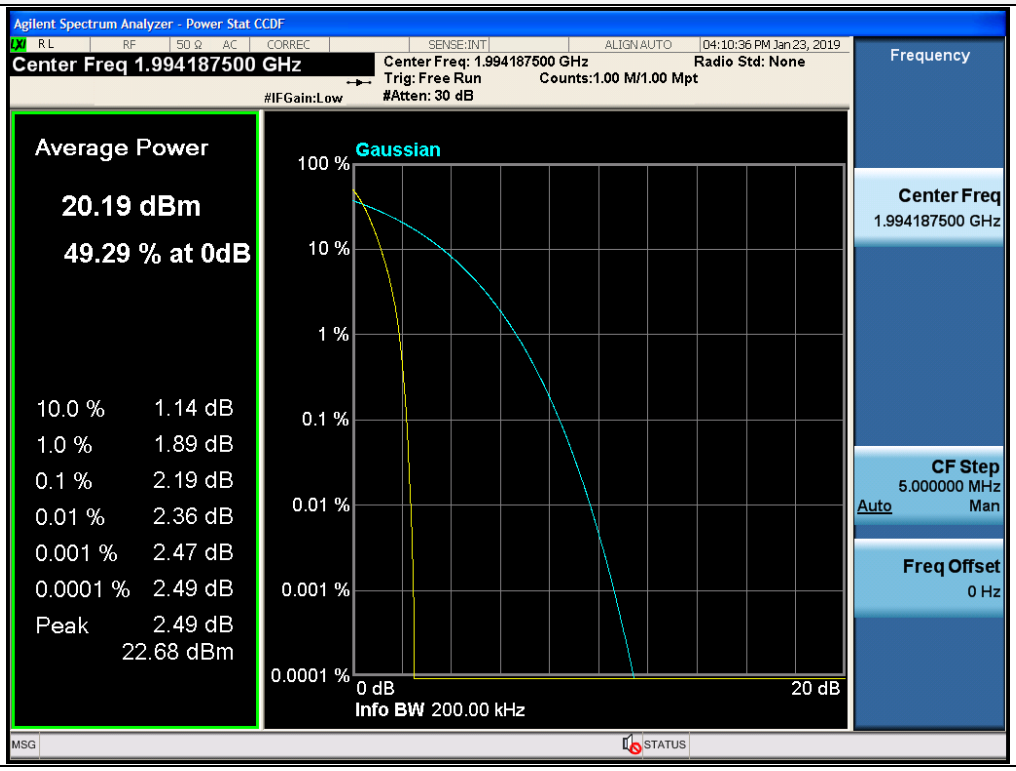
PAPR / Cellular / Downlink / CDMA



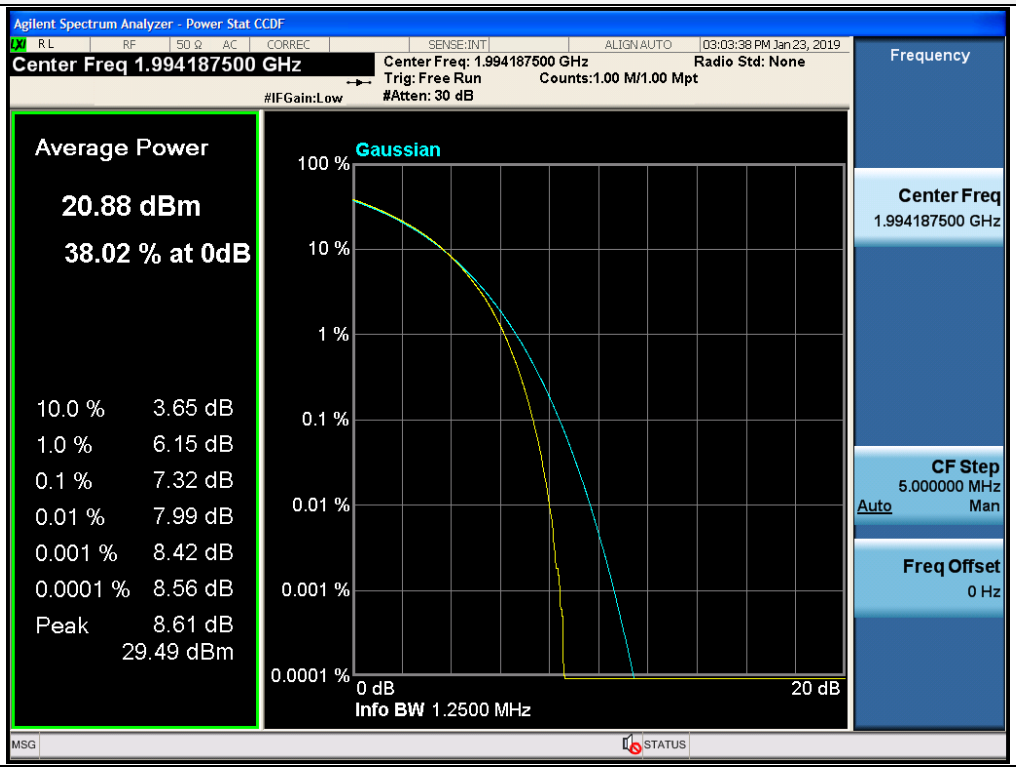

PAPR / Cellular / Downlink / LTE 5 MHz



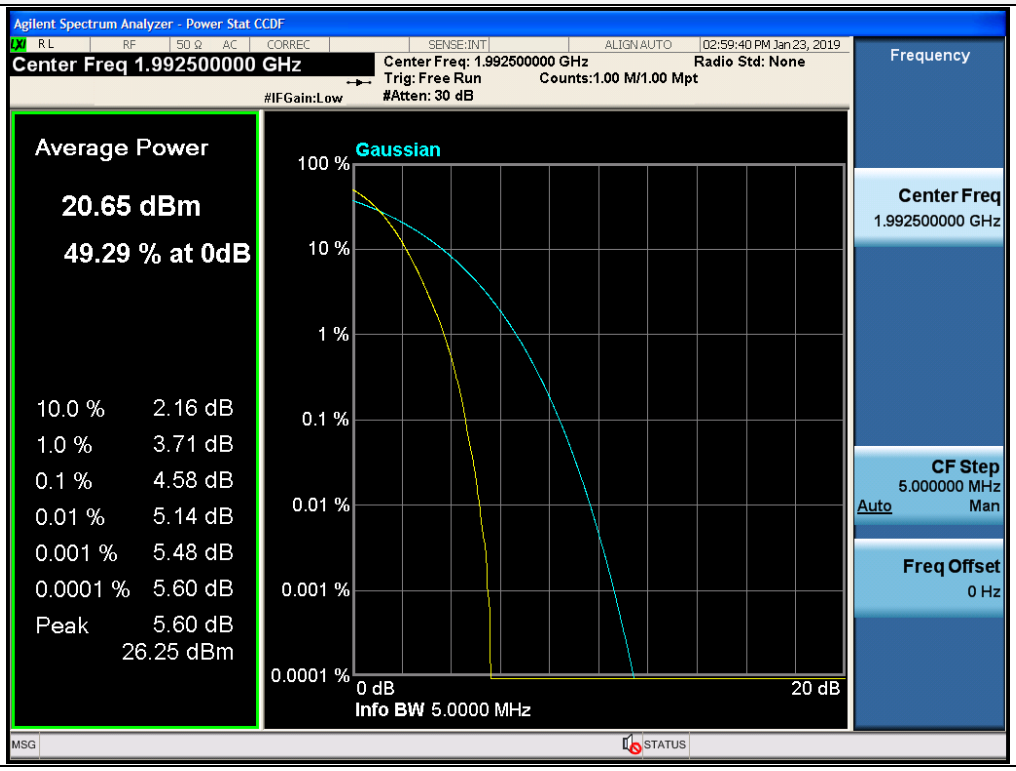
PAPR / Broadband PCS / Downlink / GSM



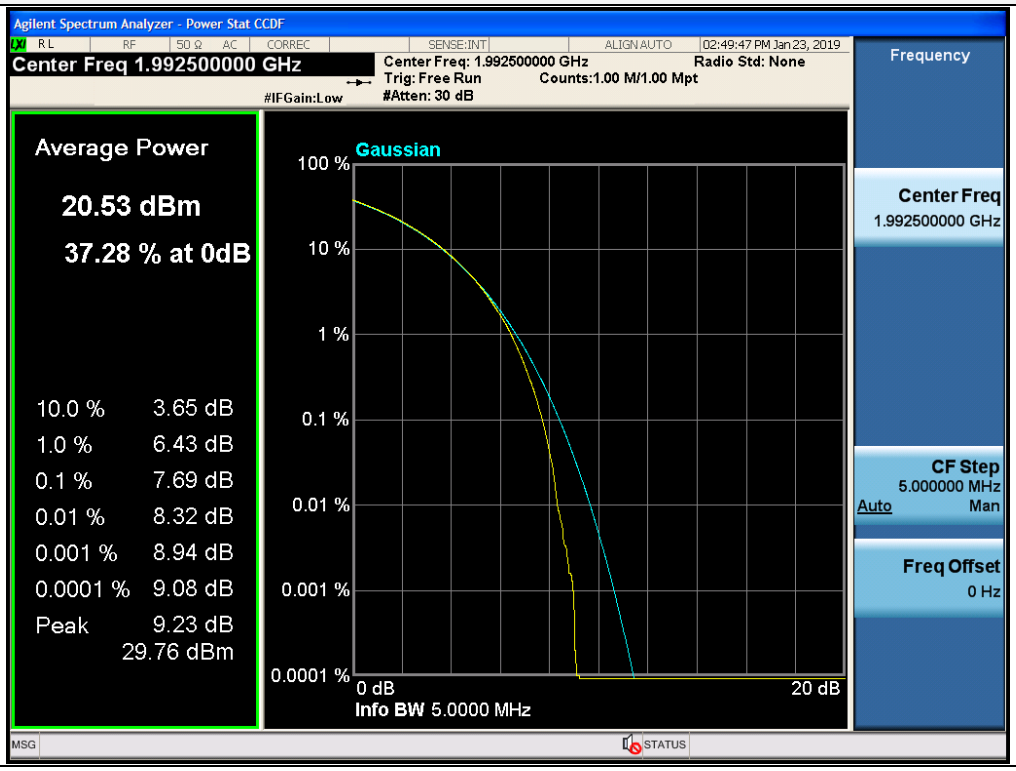

PAPR / Broadband PCS / Downlink / CDMA



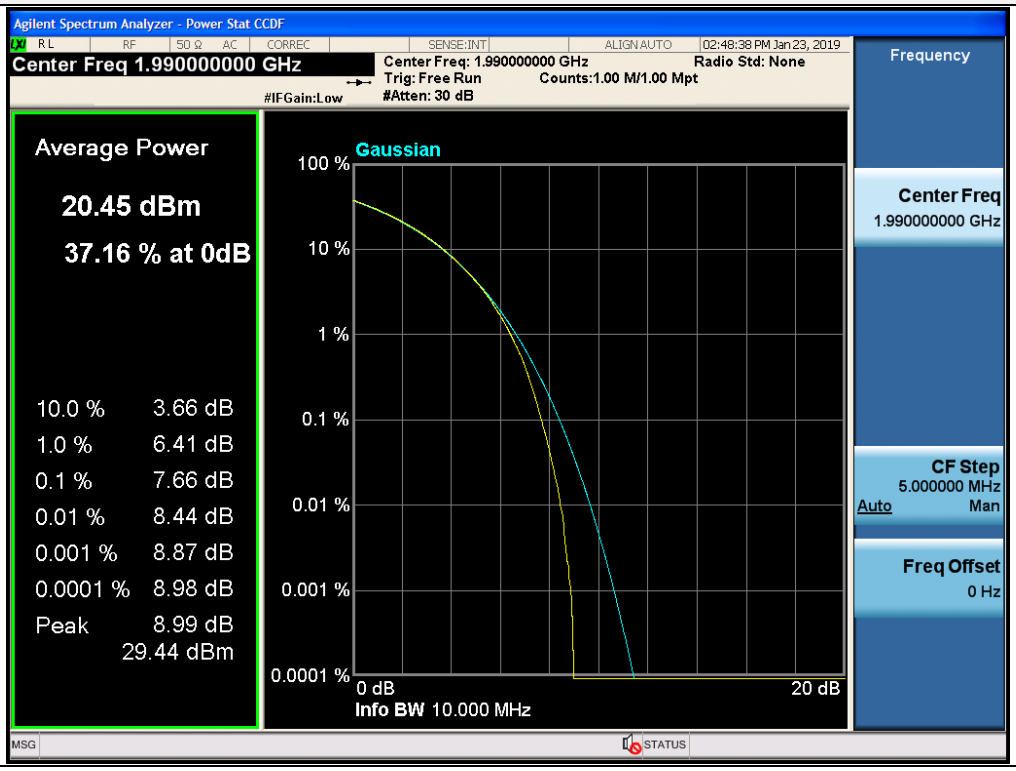
| PAPR / Broadband PCS / Downlink / WCDMA |
|---|



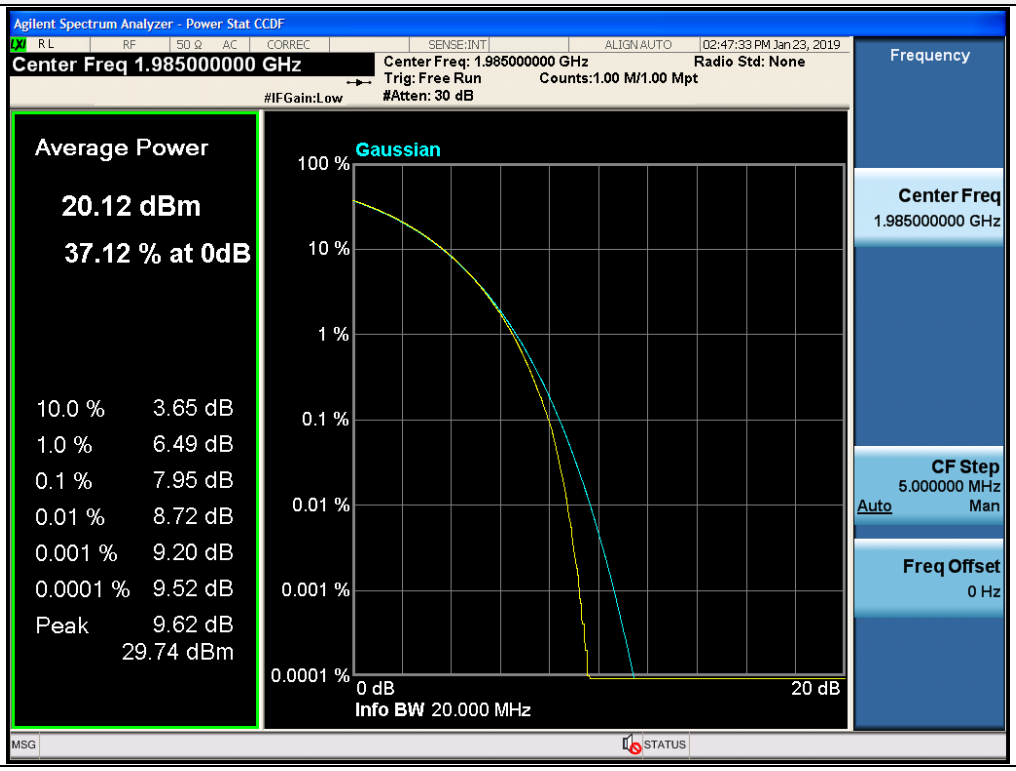

| PAPR / Broadband PCS / Downlink / LTE 5 MHz |
|---|

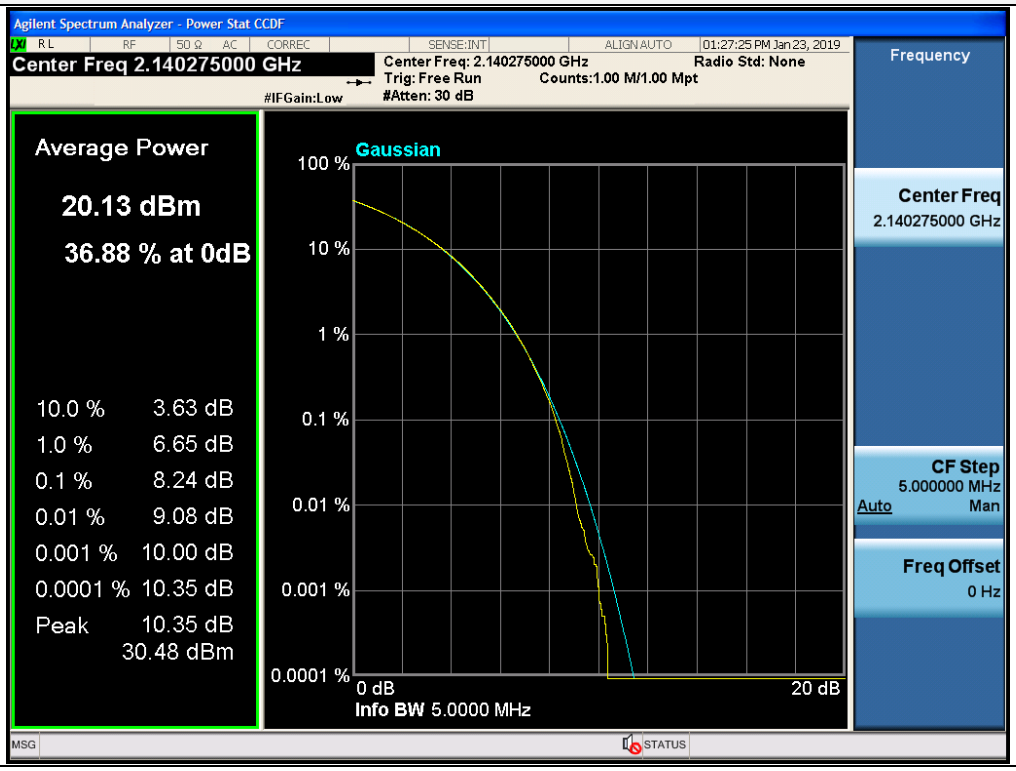


PAPR / Broadband PCS / Downlink / LTE 10 MHz

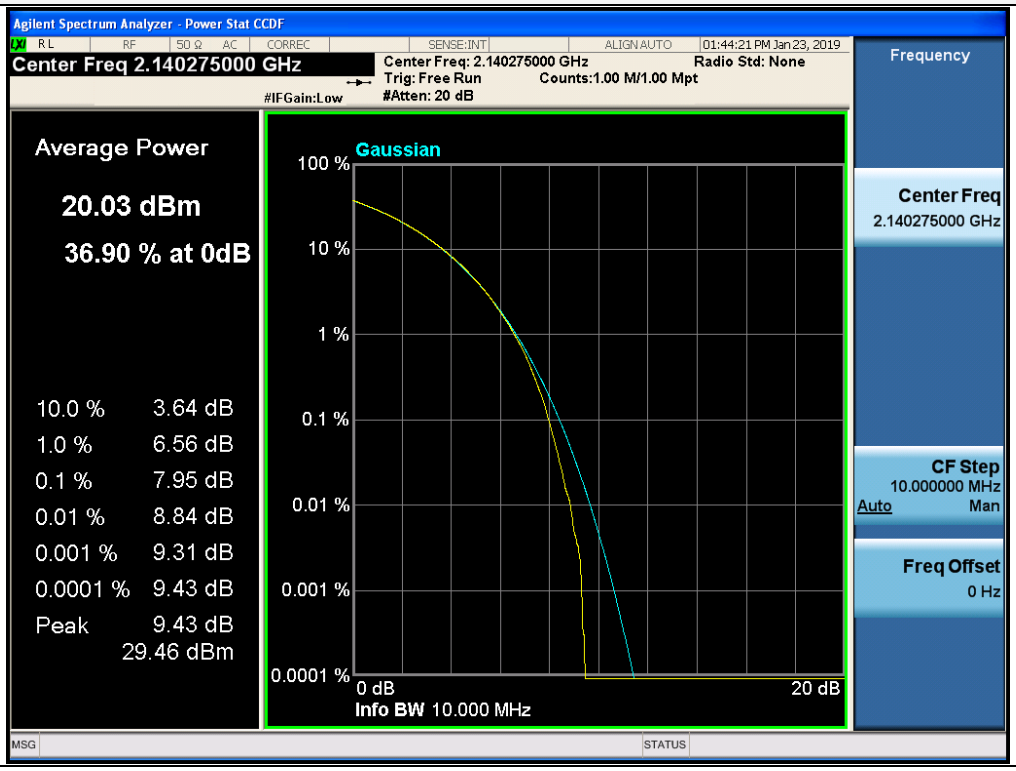



PAPR / Broadband PCS / Downlink / LTE 20 MHz

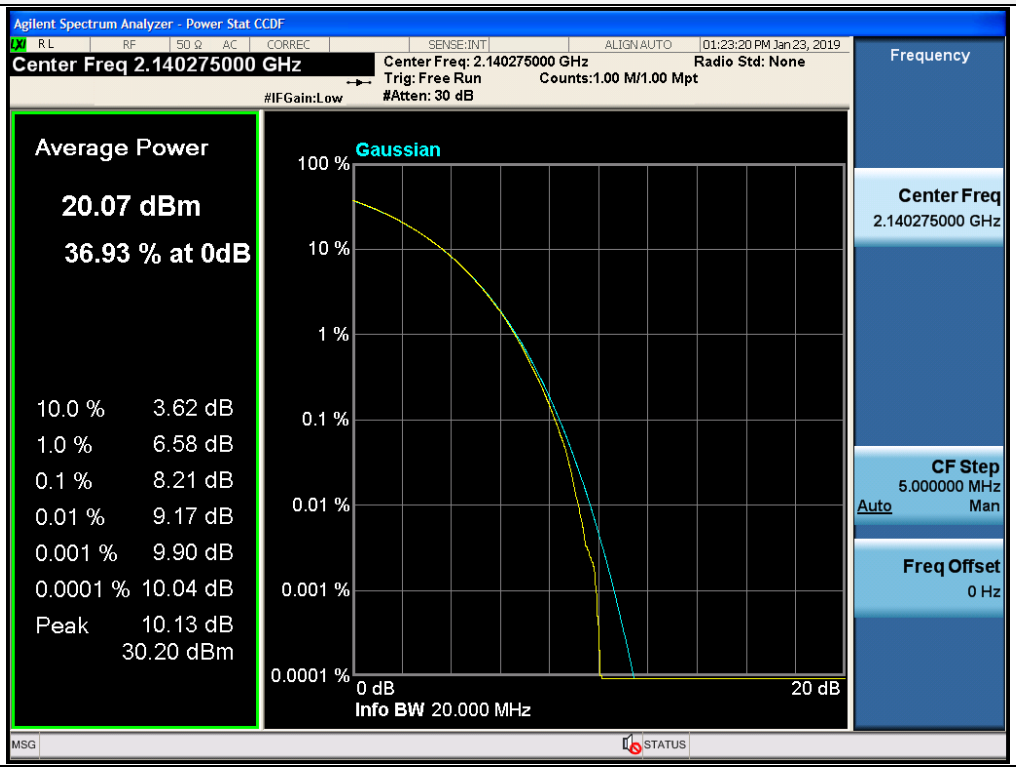


| PAPR / AWS1+3 / Downlink / LTE 5 MHz |
|---|
|  |

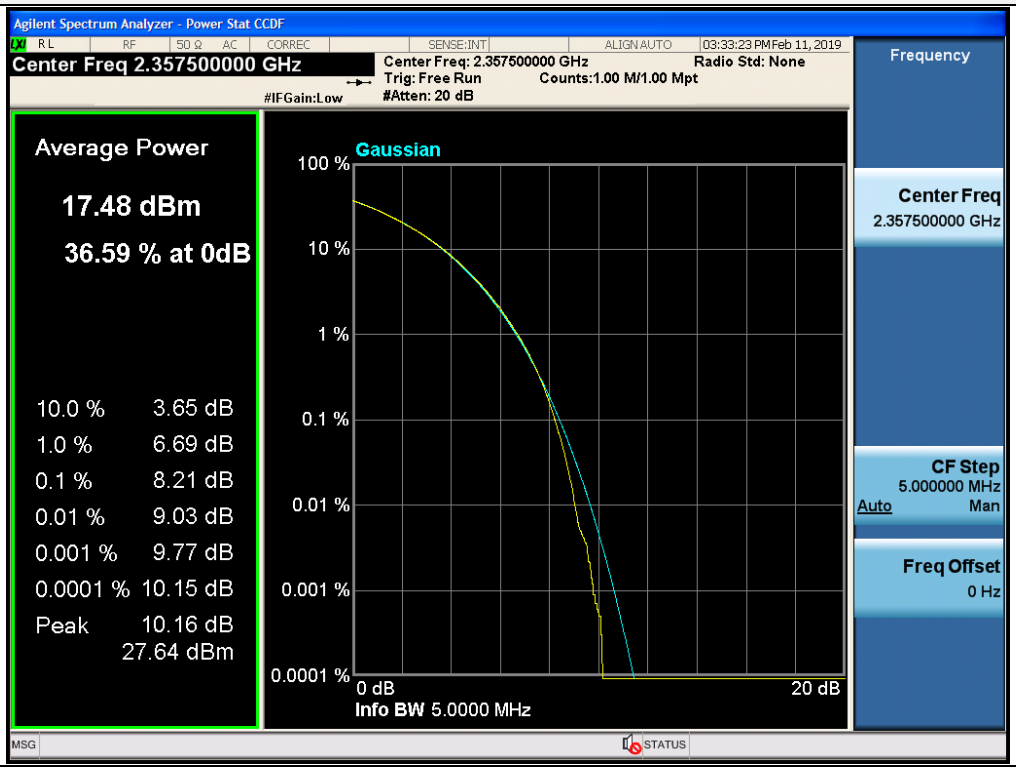


| PAPR / AWS1+3 / Downlink / LTE 10 MHz |
|---|
|  |

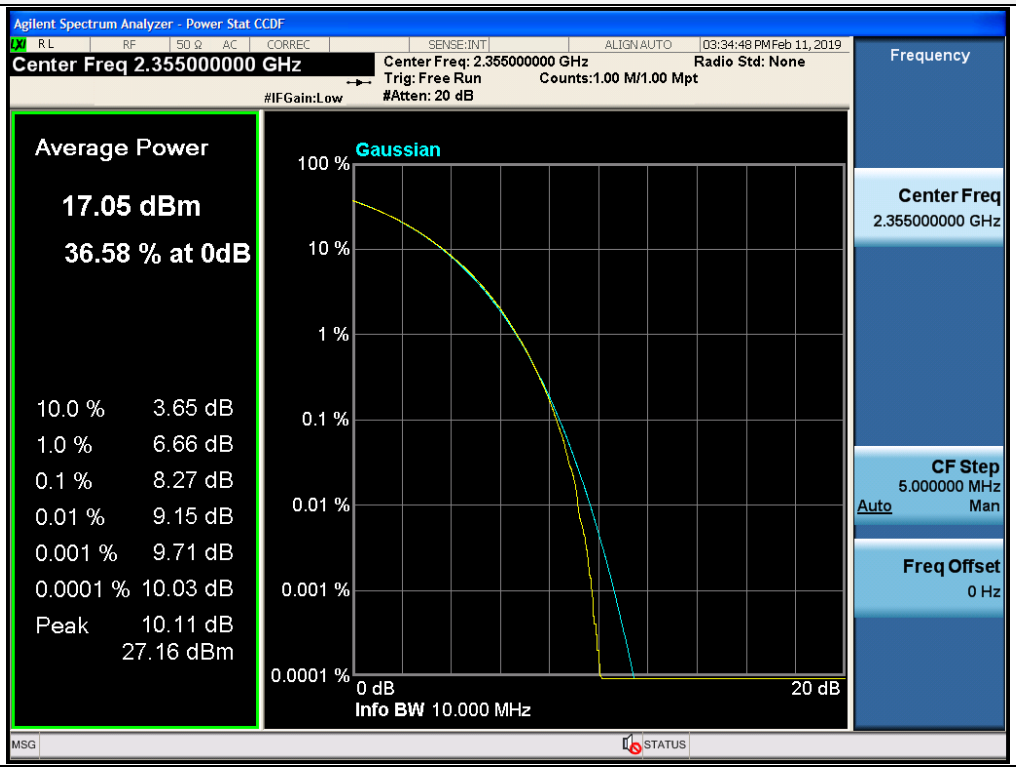
PAPR / AWS1+3 / Downlink / LTE 20 MHz



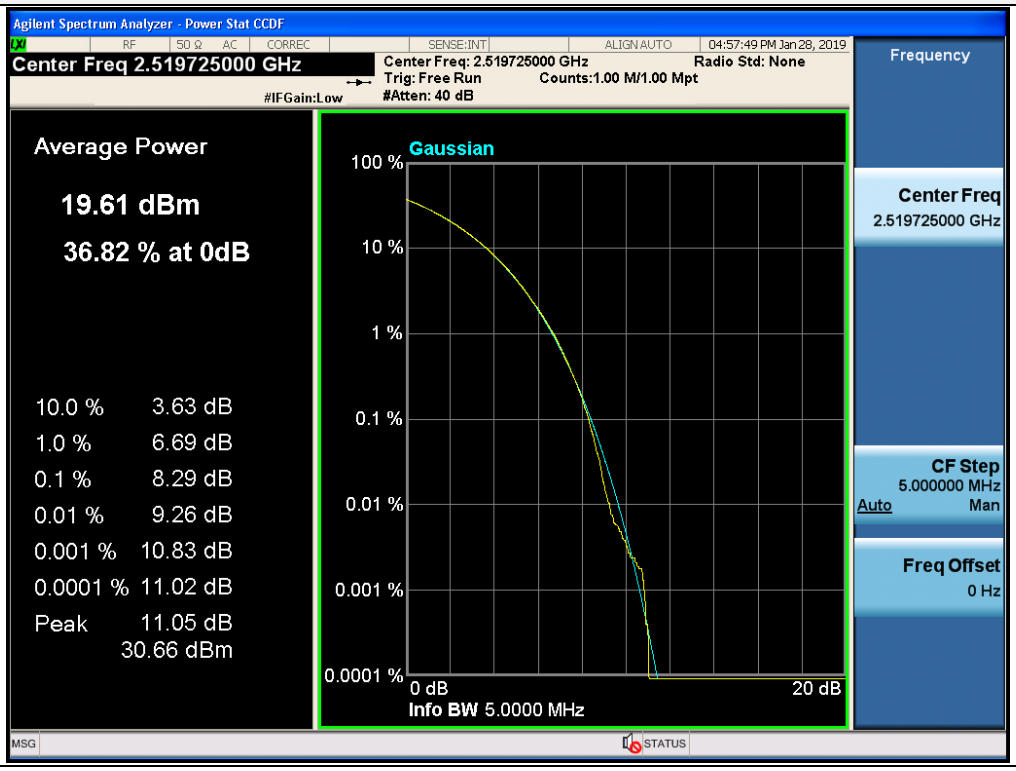

PAPR / WCS / Downlink / LTE 5 MHz

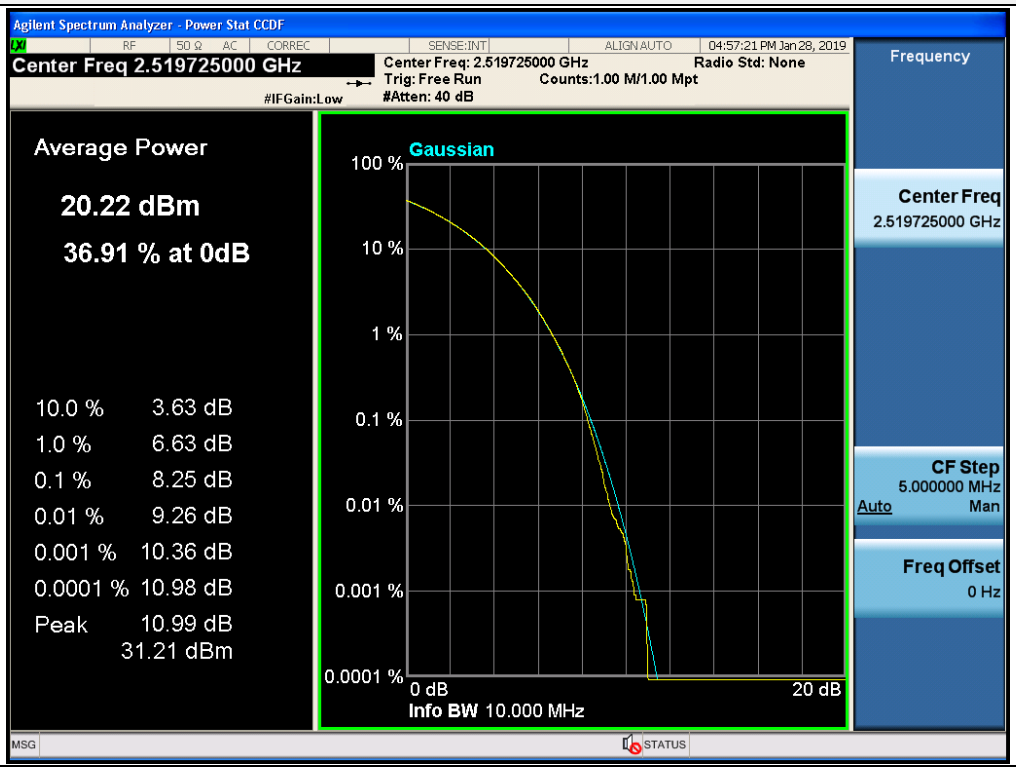


PAPR / WCS / Downlink / LTE 10 MHz

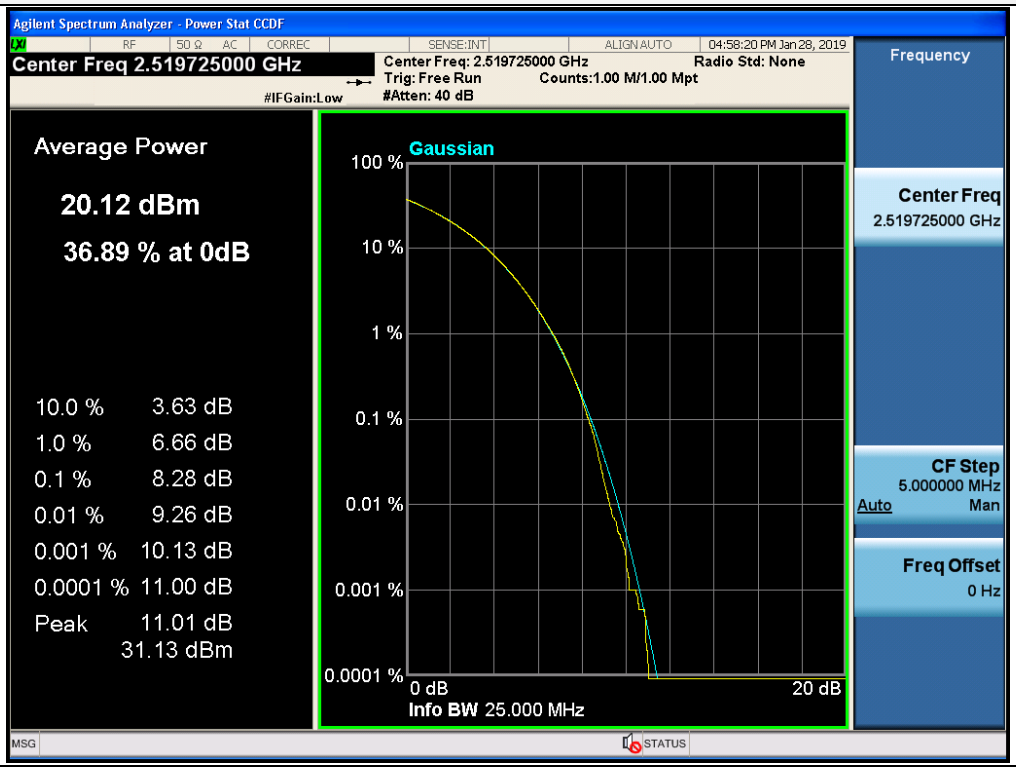



PAPR / BRS/EBS / Downlink / LTE 5 MHz(TDD)



| PAPR / BRS/EBS / Downlink / LTE 10 MHz(TDD) |
|---|
|  |



| PAPR / BRS / Downlink / LTE 20 MHz(TDD) |
|---|
|  |

## 5.5. OUT-OF-BAND/OUT-OF-BLOCK EMISSIONS AND SPURIOUS EMISSIONS

**Test Requirements:**

**§2.1051 Measurements required: Spurious emissions at antenna terminals.**

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

**§22.917 Emission limitations for cellular equipment.**

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone 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 reference bandwidth as follows:

(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. 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 that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz 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.

(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.

(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.

**§ 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.

**§27.53 Emission limits.**

(a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than 75 + 10 log (P) dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 70 + 10 log (P) dB on all frequencies between 2287.5 and 2300 MHz, 72 + 10 log (P) dB on all frequencies between 2285 and 2287.5 MHz, and 75 + 10 log (P) dB below 2285 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2362.5 MHz, 55 + 10 log (P) dB on all frequencies between 2362.5 and 2365 MHz, 70 + 10 log (P) dB on all frequencies between 2365 and 2367.5 MHz, 72 + 10 log (P) dB on all frequencies between 2367.5 and 2370 MHz, and 75 + 10 log (P) dB above 2370 MHz.

(5) *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 channel blocks at 2305, 2310, 2315, 2320, 2345, 2350, 2355, and 2360 MHz, a resolution bandwidth of at least 1 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). 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) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

(h) *AWS emission limits*

(1) *General protection levels.* Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155

MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 $\log_{10}$ (P) dB.

(2) *Additional protection levels.* Notwithstanding the foregoing paragraph (h)(1) of this section:

(i) Operations in the 2180-2200 MHz band are subject to the out-of-band emission requirements set forth in §27.1134 for the protection of federal government operations operating in the 2200-2290 MHz band.

(ii) For operations in the 2000-2020 MHz band, the power of any emissions below 2000 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 $\log_{10}$(P) dB.

(iii) For operations in the 1915-1920 MHz band, the power of any emission between 1930-1995 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 $\log_{10}$(P) dB.

(iv) For operations in the 1995-2000 MHz band, the power of any emission between 2005-2020 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 $\log_{10}$(P) dB.

(3) *Measurement procedure.*

(i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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.

(ii) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(iii) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

(4) *Private agreements.*

(i) For AWS operations in the 2000-2020 MHz and 2180-2200 MHz bands, to the extent a licensee establishes unified operations across the AWS blocks, that licensee may choose not to observe the emission limit specified in paragraph (h)(1), above, strictly between its adjacent block licenses in a geographic area, so long as it complies with other Commission rules and is not adversely affecting the operations of other parties by virtue of exceeding the emission limit.

(ii) For AWS operations in the 2000-2020 MHz band, a licensee may enter into private agreements with all licensees operating between 1995 and 2000 MHz to allow the 70 + 10 $\log_{10}$(P) dB limit to be exceeded within the 1995-2000 MHz band.

(iii) An AWS licensee who is a party to a private agreement described in this section (4) must maintain a copy of the agreement in its station files and disclose it, upon request, to prospective AWS assignees, transferees, or spectrum lessees and to the Commission.

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the

standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(2) For digital base stations, the attenuation shall be not less than 43 + 10 log (P) dB, unless a documented interference complaint is received from an adjacent channel licensee with an overlapping Geographic Service Area. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS No. 1 on the same terms and conditions as adjacent channel BRS or EBS licensees. Provided that a documented interference complaint cannot be mutually resolved between the parties prior to the applicable deadline, then the following additional attenuation requirements shall apply:

(i) If a pre-existing base station suffers harmful interference from emissions caused by a new or modified base station located 1.5 km or more away, within 24 hours of the receipt of a documented interference complaint the licensee of the new or modified base station must attenuate its emissions by at least 67 + 10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block and shall immediately notify the complaining licensee upon implementation of the additional attenuation. No later than 60 days after the implementation of such additional attenuation, the licensee of the complaining base station must attenuate its base station emissions by at least 67 + 10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the new or modified base station.

(ii) If a pre-existing base station suffers harmful interference from emissions caused by a new or modified base station located less than 1.5 km away, within 24 hours of receipt of a documented interference complaint the licensee of the new or modified base station must attenuate its emissions by at least 67 + 10 log (P)−20 log (Dkm/1.5) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the complaining licensee, or if both base stations are co-located, limit its undesired signal level at the pre-existing base station receiver(s) to no more than −107 dBm measured in a 5.5 megahertz bandwidth and shall immediately notify the complaining licensee upon such reduction in the undesired signal level. No later than 60 days after such reduction in the undesired signal level, the complaining licensee must attenuate its base station emissions by at least 67 + 10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the new or modified base station.

(iii) If a new or modified base station suffers harmful interference from emissions caused by a pre-existing base station located 1.5 km or more away, within 60 days of receipt of a documented interference complaint the licensee of each base station must attenuate its base station emissions by at least 67 + 10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the other licensee.

(iv) If a new or modified base station suffers harmful interference from emissions caused by a pre-existing base station located less than 1.5 km away, within 60 days of receipt of a documented interference complaint: (a) The licensee of the new or modified base station must attenuate its OOBE by at least 67 + 10 log (P)−20 log (Dkm/1.5) measured 3 megahertz above or below, from the channel

edge of its frequency block of the other licensee, or if the base stations are co-located, limit its undesired signal level at the other base station receiver(s) to no more than −107 dBm measured in a 5.5-megahertz bandwidth; and (b) the licensee causing the interference must attenuate its emissions by at least 67 + 10 log (P) dB measured at 3 megahertz, above or below, from the channel edge of its frequency block of the new or modified base station.

(v) For all fixed digital user stations, the attenuation factor shall be not less than 43 + 10 log (P) dB at the channel edge.

**§90.543 Emission limitations.**

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

**§90.691 Emission mask requirements for EA-based systems**

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10\text{Log}_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

**Test Procedures:**

Measurements were in accordance with the test methods section 3.6 of KDB 935210 D05 v01r02.

*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.

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, 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.

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.

g) Set the VBW = 3 × RBW.

h) Set the detector to power averaging (rms) detector.

i) Set the Sweep time = auto-couple.

j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.

k) Trace average at least 100 traces in power averaging (rms) mode.

l) Use the marker function to find the maximum power level.

m) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.

o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.

p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3

MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.

q) Repeat steps k) to n).

r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.

s) Repeat steps a) to r) with the narrowband test signal.

t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

3.6.3 Spurious emissions conducted measurements

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

b) Set the signal generator to produce the broadband test signal as previously described.

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, 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.

g) Set the VBW ≥ 3 × RBW.

h) Set the Sweep time = auto-couple.

i) Set the spectrum analyzer start frequency to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

The number of measurement points in each sweep must be ≥ (2 × span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

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. The number of measurement points in each sweep must be ≥ (2 × span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

n) Trace average at least 10 traces in power averaging (rms) mode.

o) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report;

also provide tabular data, if required.

p) Repeat steps i) to o) with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.

q) Repeat steps b) to p) with the narrowband test signal.

r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

***Note1.*** *In 9 kHz-150 kHz and 150 kHz-30 MHz bands, RBW was reduced to 1 kHz and 10 kHz and correction factor was applied according to section 5.7.2 of ANSI C63.26-2015*

| Band | 9 ~ 150 kHz Correction | 150 kHz ~ 30 MHz Correction |
|---|---|---|
| Below 1 GHz (Ref.RBW: 100 kHz) | 20 dB | 10 dB |
| Above 1 GHz (Ref.RBW: 1 MHz) | 30 dB | 20 dB |

***Note2.*** *Intermodulation tests in 700 MHz band are performed only for LTE 5 MHz signal, because the band cannot accommodate two LTE 10 MHz signals. And for the same reason, ESMR band tested GSM, CDMA signal. (Refer to Section 3.6.1 of KDB 935210 D05)*

***Note3.*** *The test condition of §90.691(a)(2) can be applied because the EUT provides filters above 37.5 kHz such as WCDMA and LTE. And its limit (43 + 10Log10(P)) is included in spurious emissions and band edge.*

***Note4.*** *Measurement bandwidth specified in the applicable rule section for the supported frequency band.*

| Band | RBW Requirements |
|---|---|
| Lower 700 MHz<br>Upper 700 MHz<br>PS Broadband | Reference 100 kHz or greater<br>30 kHz in the 100 kHz bands immediately block outside |
| ESMR<br>Cellular | Reference 100 kHz or greater (below 1 GHz)<br>Reference 1 MHz or greater (above 1 GHz)<br>1 % of fundamental emission bandwidth in the 1 MHz bands immediately block outside |
| Broadband PCS<br>AWS1+3<br>WCS<br>BRS/EBS | Reference 1 MHz or greater<br>1 % of fundamental emission bandwidth in the 1 MHz bands immediately block outside |

**Test Results:**

**Plot data of Out-of-band/out-of-block emissions**

Out-of-band (two adjacent test signals) / Lower 700 MHz / Downlink / LTE 5 MHz / Upper

Out-of-band (two adjacent test signals) / Lower 700 MHz / Downlink / LTE 5 MHz / Lower

Out-of-band (two adjacent test signals) / Upper 700 MHz / Downlink / LTE 5 MHz / Upper

Out-of-band (two adjacent test signals) / Upper 700 MHz / Downlink / LTE 5 MHz / Lower

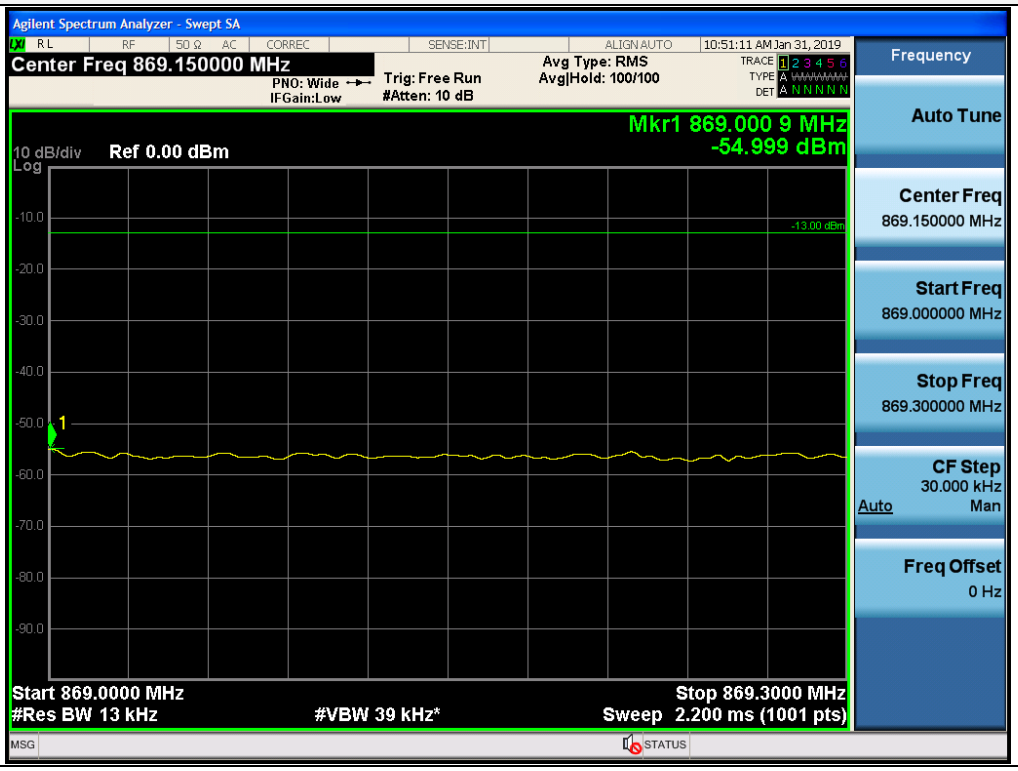
| Out-of-band (two adjacent test signals) / PS Broadband / Downlink / LTE 5 MHz / Upper |
|---|

| Out-of-band (two adjacent test signals) / PS Broadband / Downlink / LTE 5 MHz / Lower |
|---|

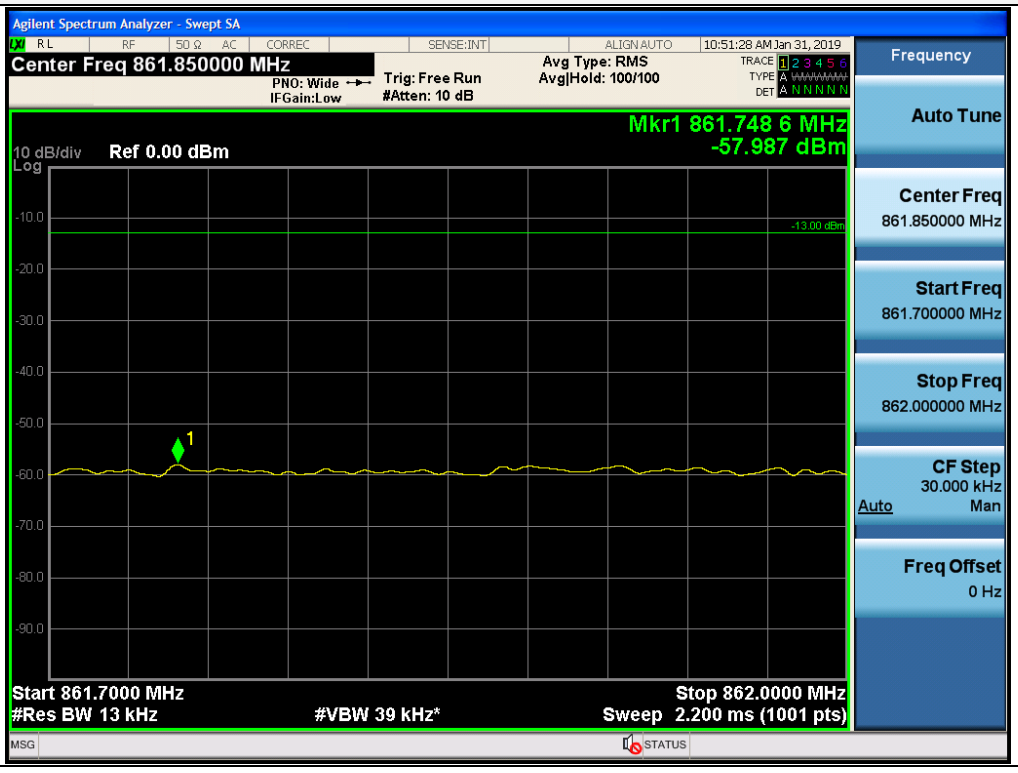
| Out-of-band (two adjacent test signals) / ESMR / Downlink / GSM / Upper |
|---|

| Out-of-band (two adjacent test signals) / ESMR / Downlink / GSM / Lower |
|---|

| Out-of-band (two adjacent test signals) / ESMR / Downlink / CDMA / Upper |
|---|



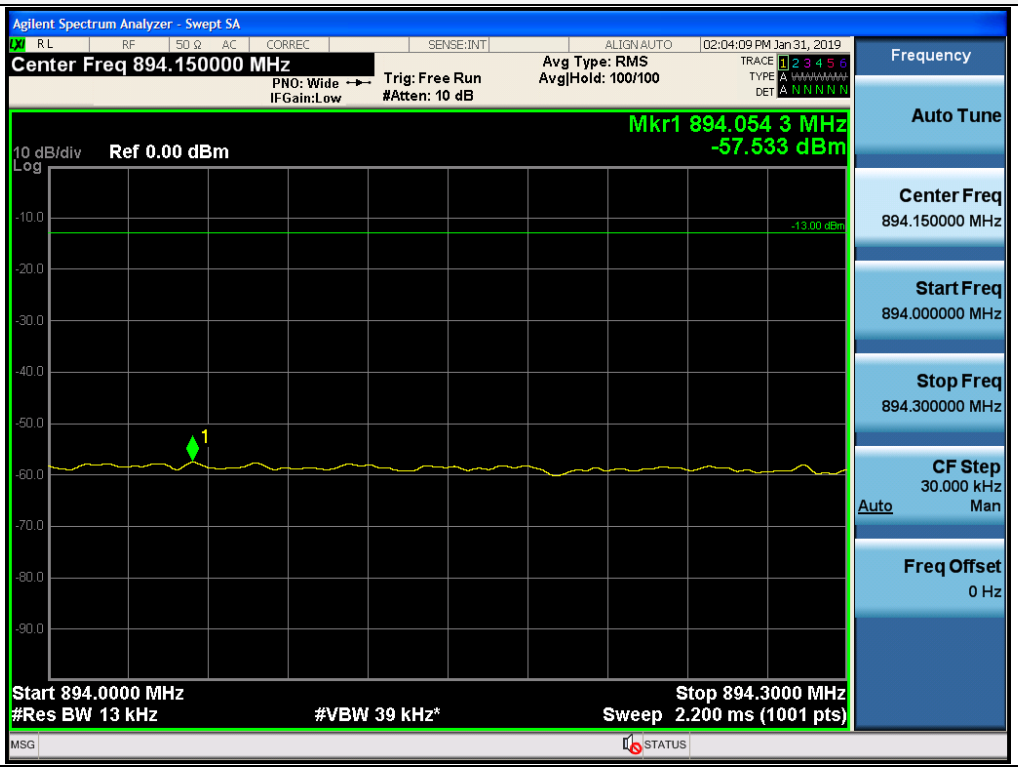

| Out-of-band (two adjacent test signals) / ESMR / Downlink / CDMA / Lower |
|---|



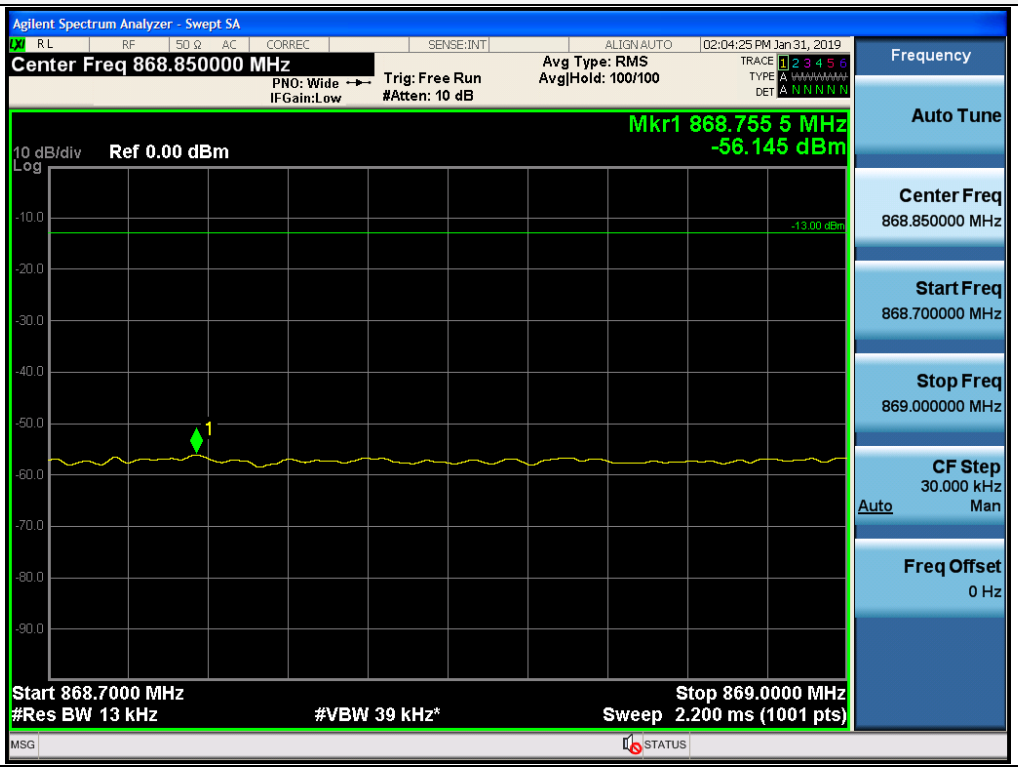
| Out-of-band (two adjacent test signals) / Cellular / Downlink / GSM / Upper |
|---|

| Out-of-band (two adjacent test signals) / Cellular / Downlink / GSM / Lower |
|---|

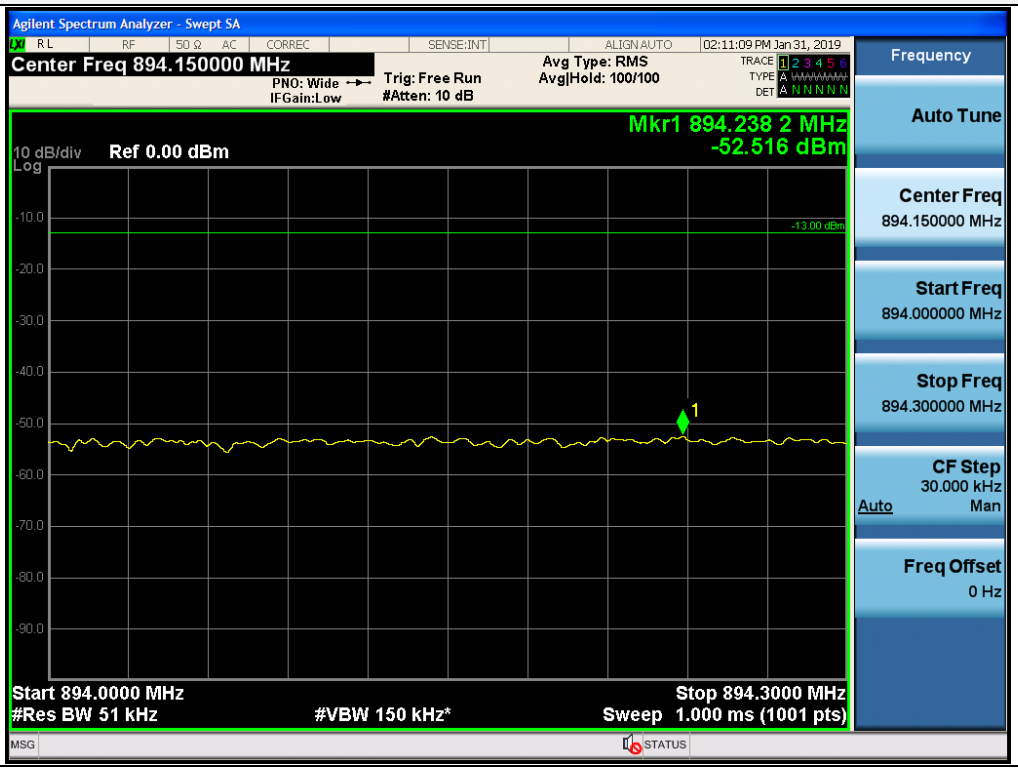
Out-of-band (two adjacent test signals) / Cellular / Downlink / CDMA / Upper




Out-of-band (two adjacent test signals) / Cellular / Downlink / CDMA / Lower



| Out-of-band (two adjacent test signals) / Cellular / Downlink / WCDMA / Upper |
|---|

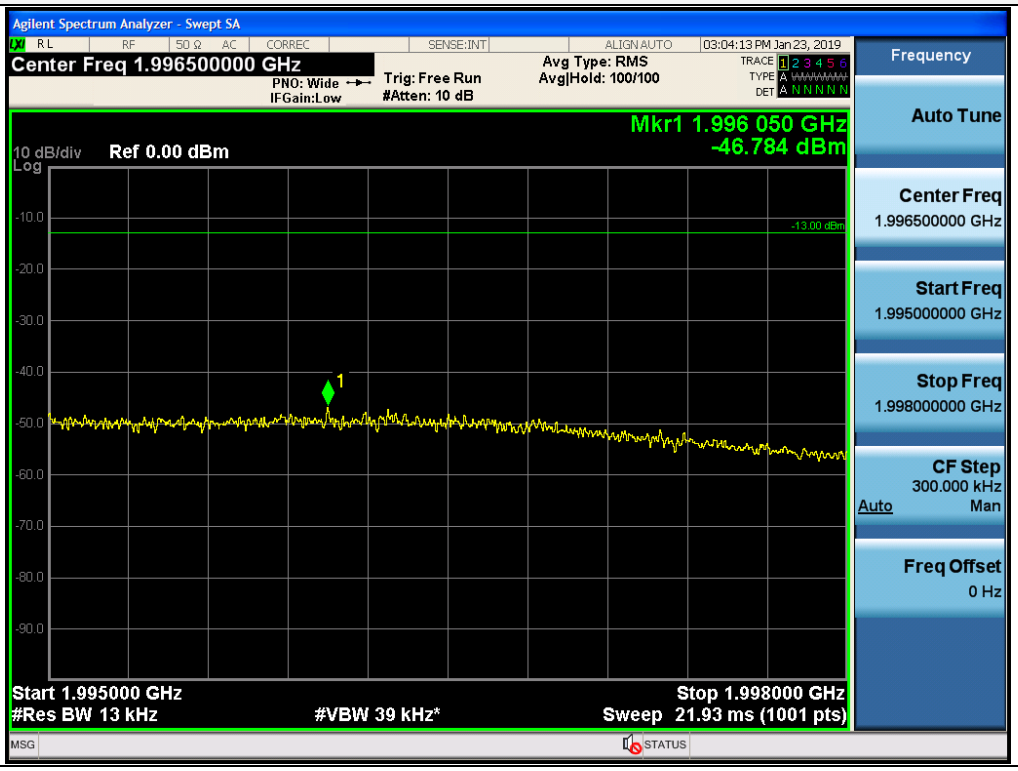



| Out-of-band (two adjacent test signals) / Cellular / Downlink / WCDMA / Lower |
|---|

Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / GSM / Upper

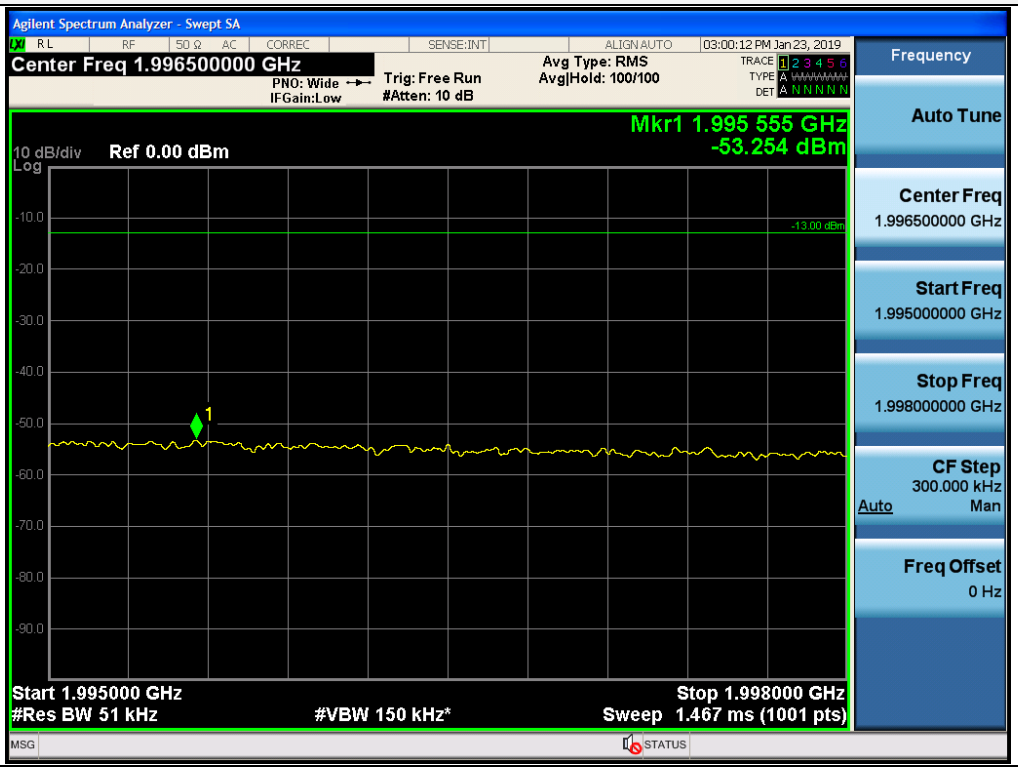
Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / GSM / Lower

| Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / CDMA / Upper |
|---|

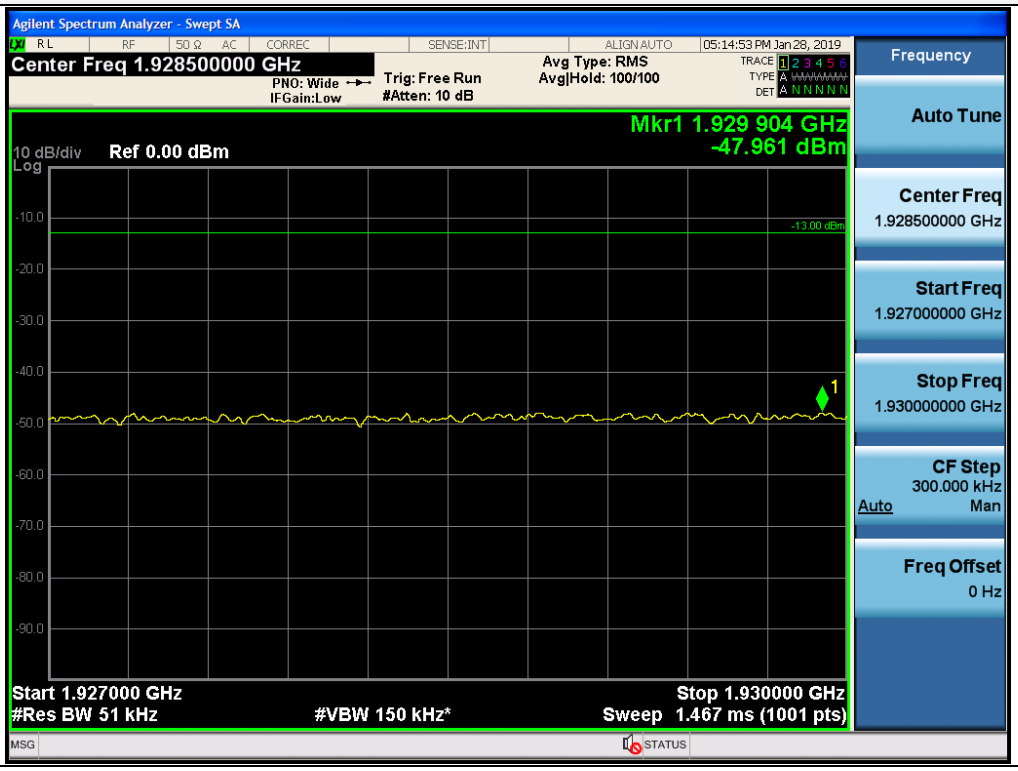



| Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / CDMA / Lower |
|---|

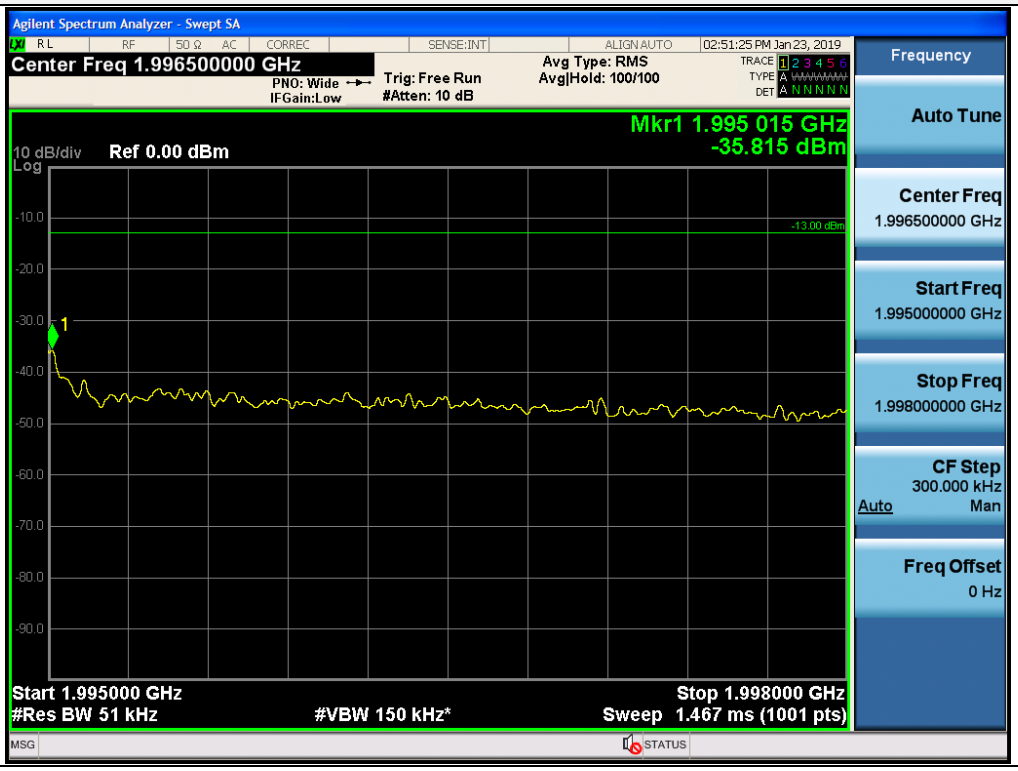
Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / WCDMA / Upper



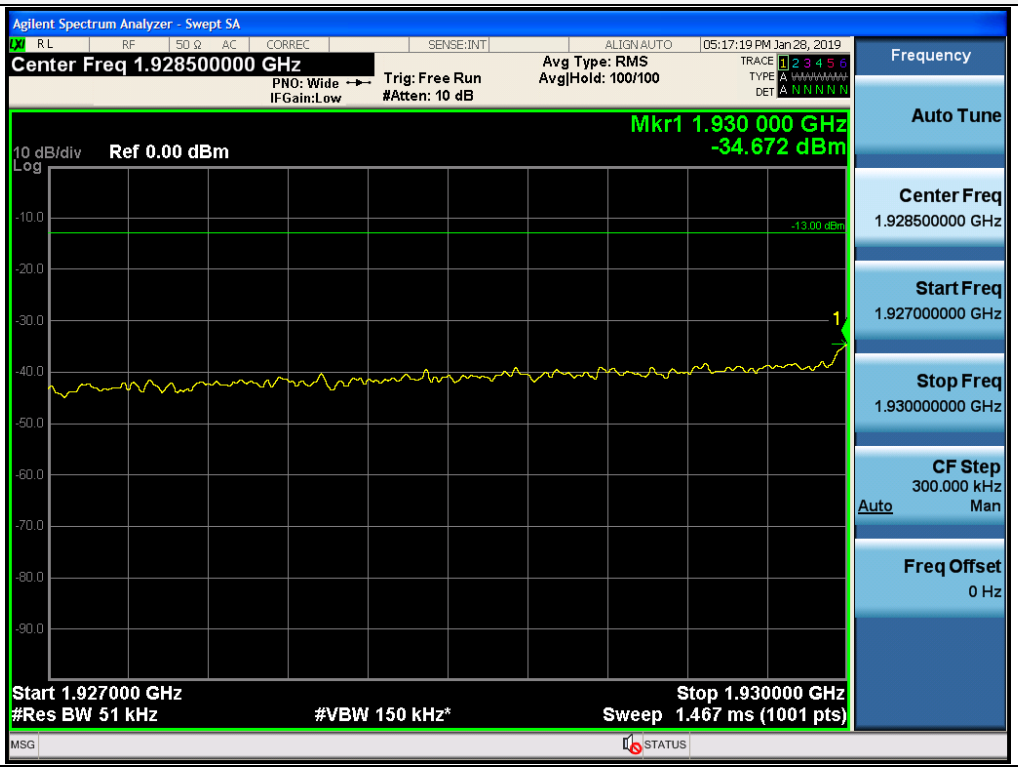

Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / WCDMA / Lower



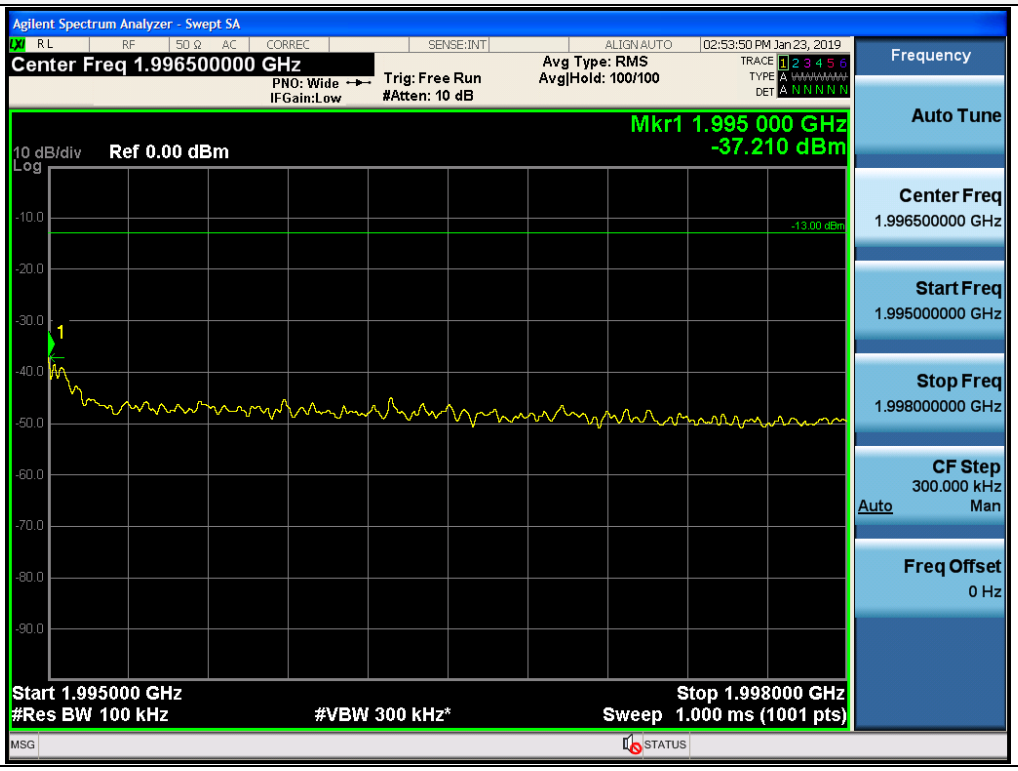
Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / LTE 5 MHz / Upper



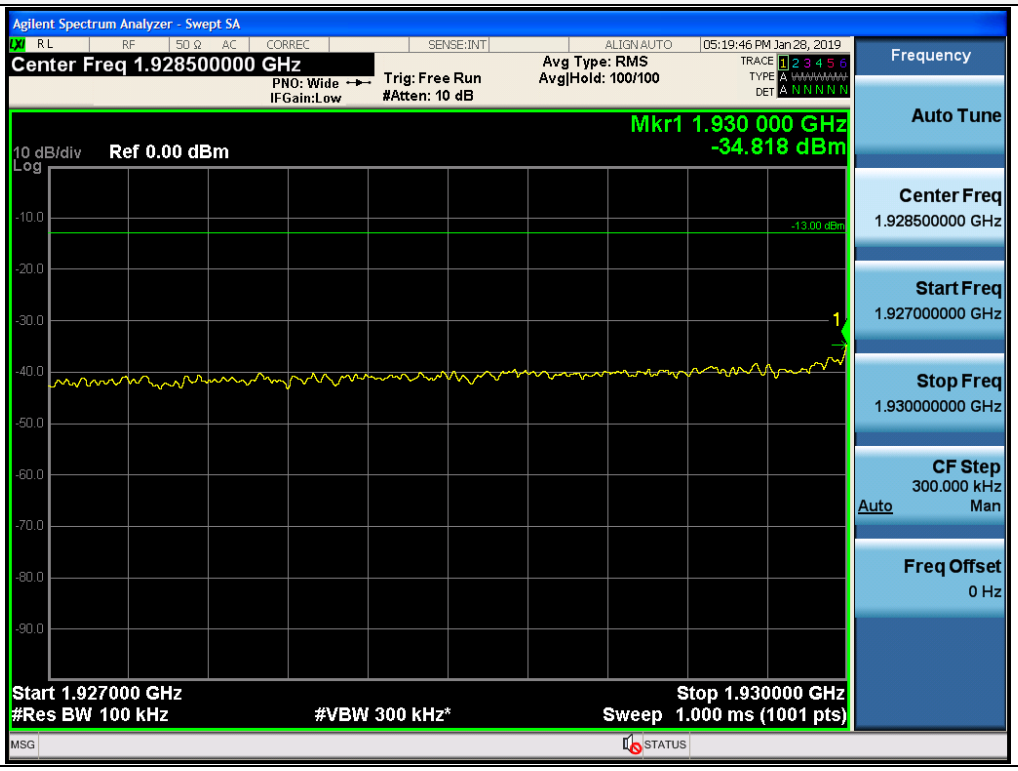

Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / LTE 5 MHz / Lower



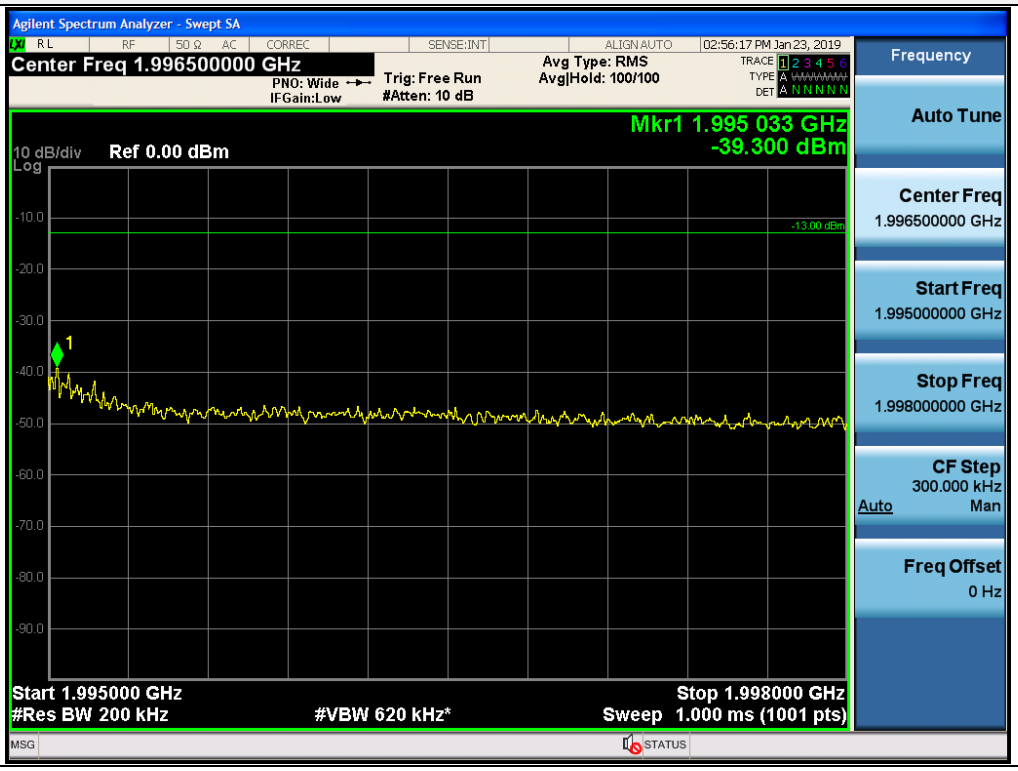
Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / LTE 10 MHz / Upper



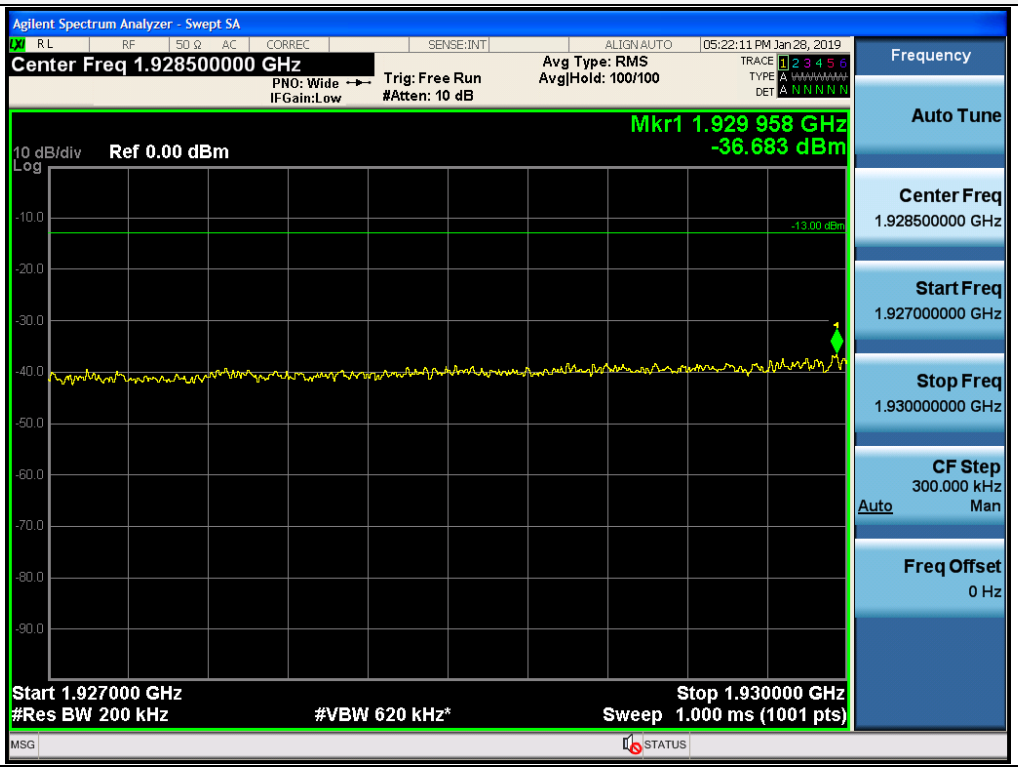

Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / LTE 10 MHz / Lower



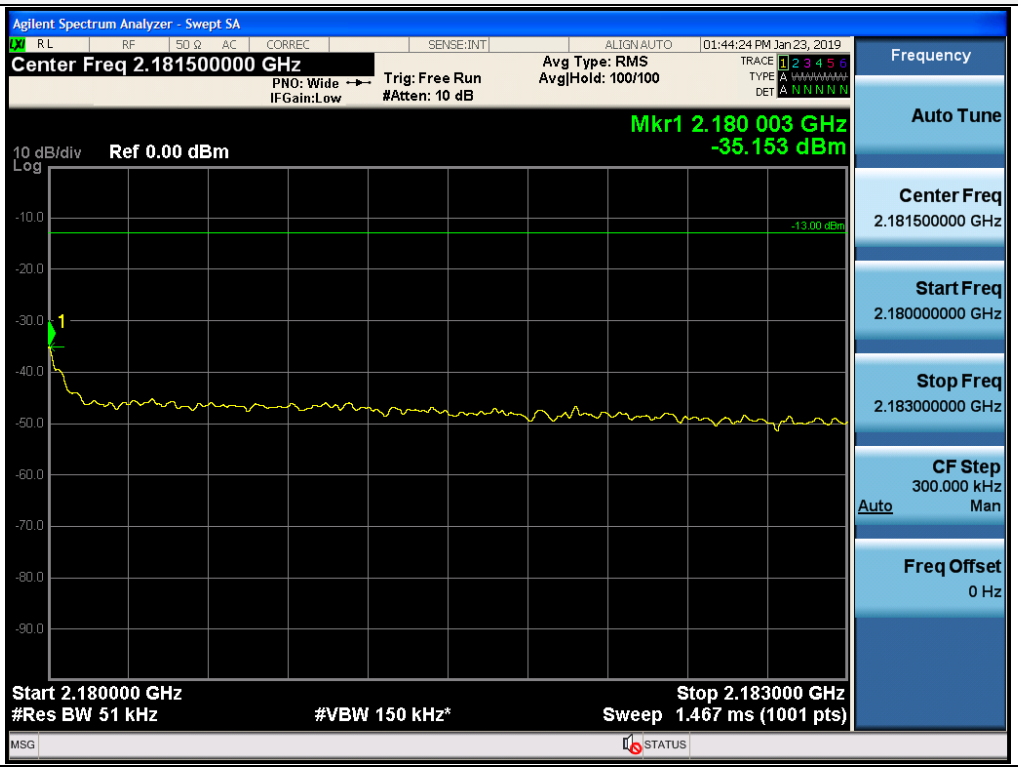
Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / LTE 20 MHz / Upper



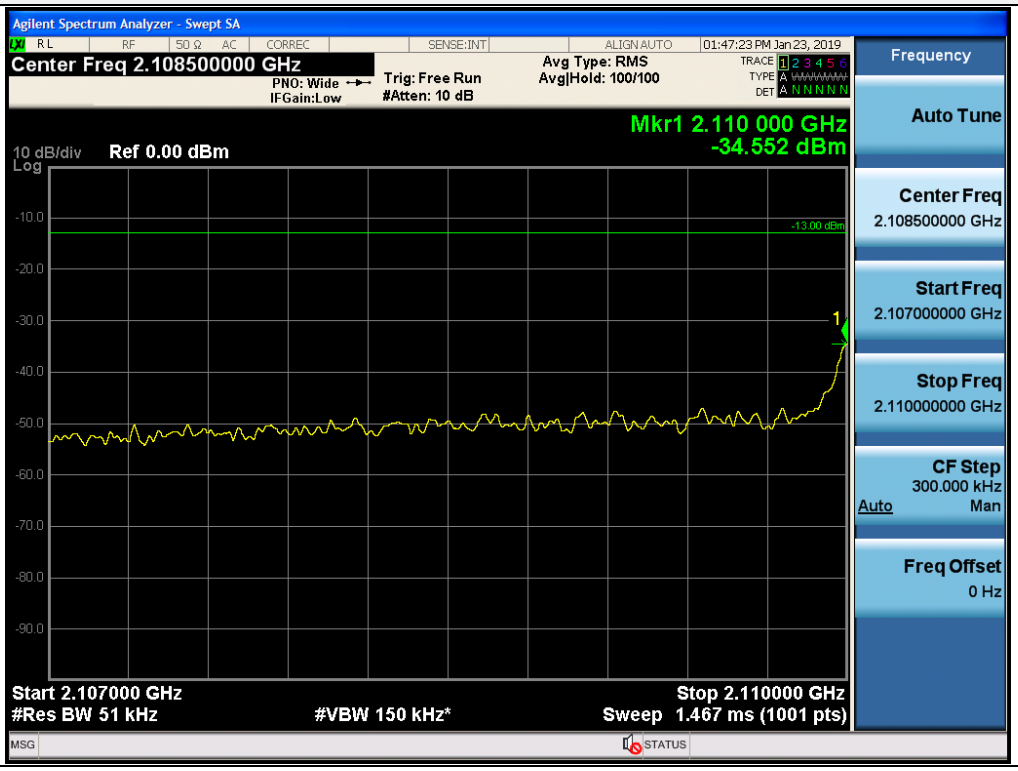

Out-of-band (two adjacent test signals) / Broadband PCS / Downlink / LTE 20 MHz / Lower



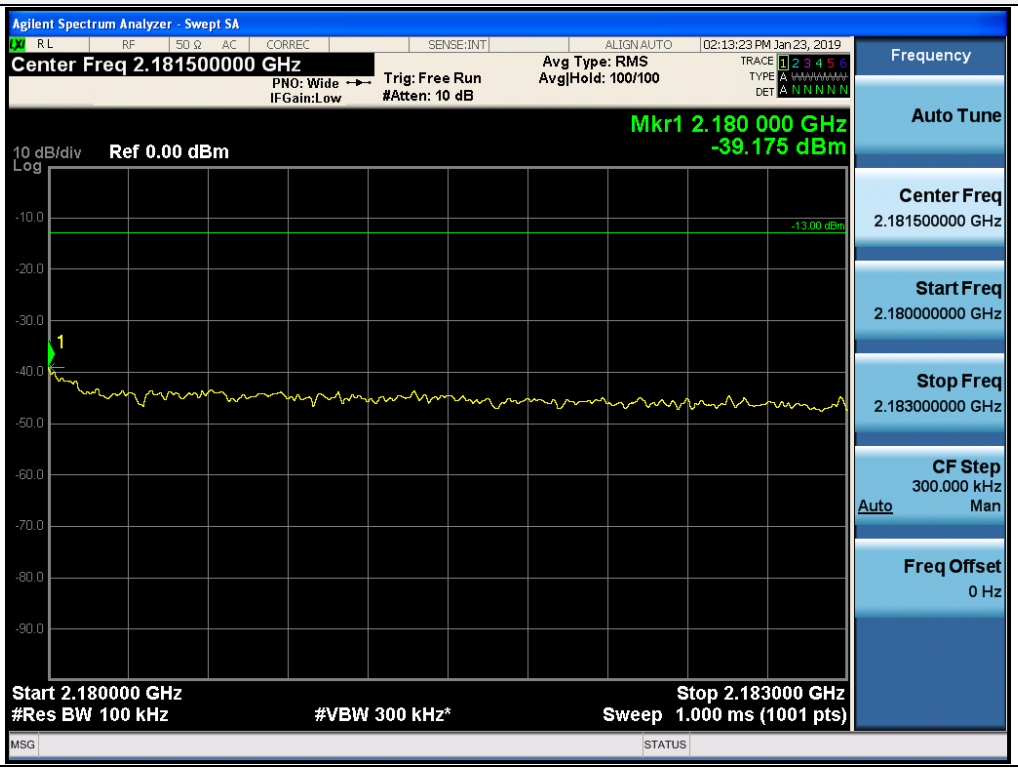
| Out-of-band (two adjacent test signals) / AWS1+3 / Downlink / LTE 5 MHz / Upper |
|---|



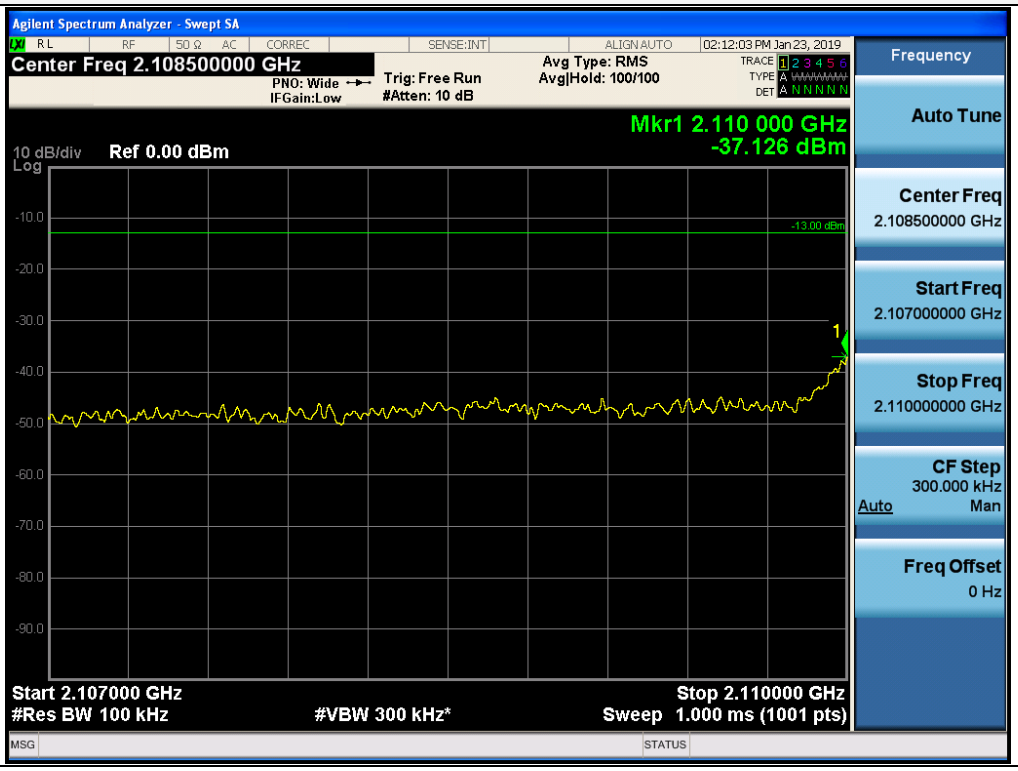

| Out-of-band (two adjacent test signals) / AWS1+3 / Downlink / LTE 5 MHz / Lower |
|---|



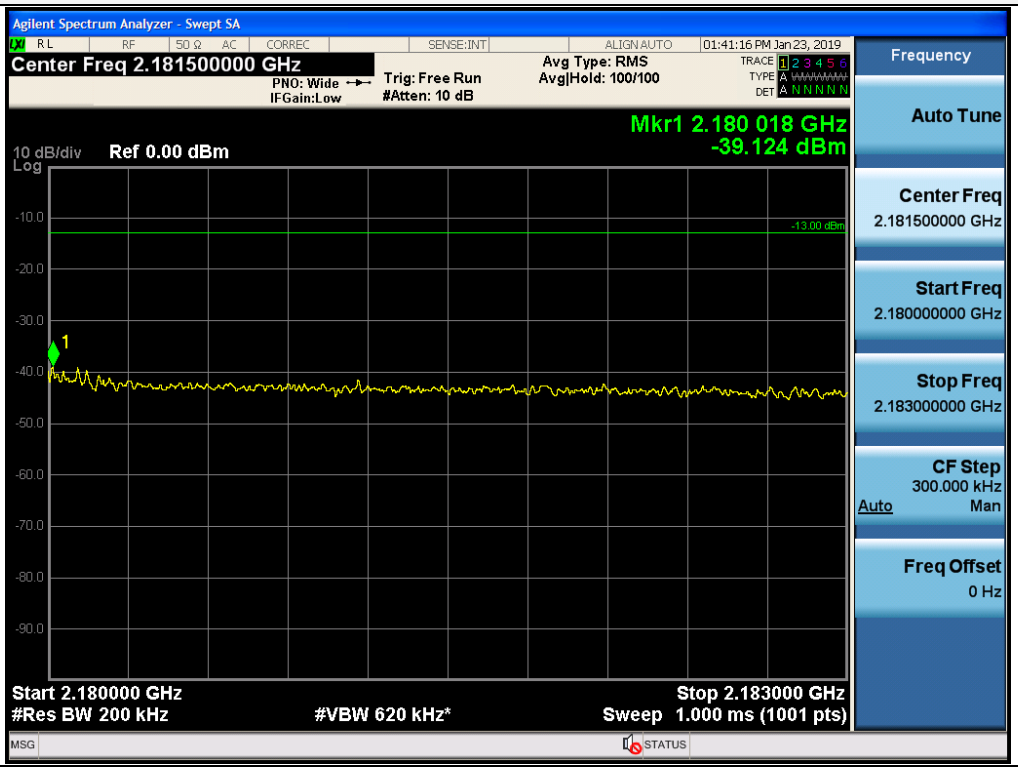
| Out-of-band (two adjacent test signals) / AWS1+3 / Downlink / LTE 10 MHz / Upper |
|---|



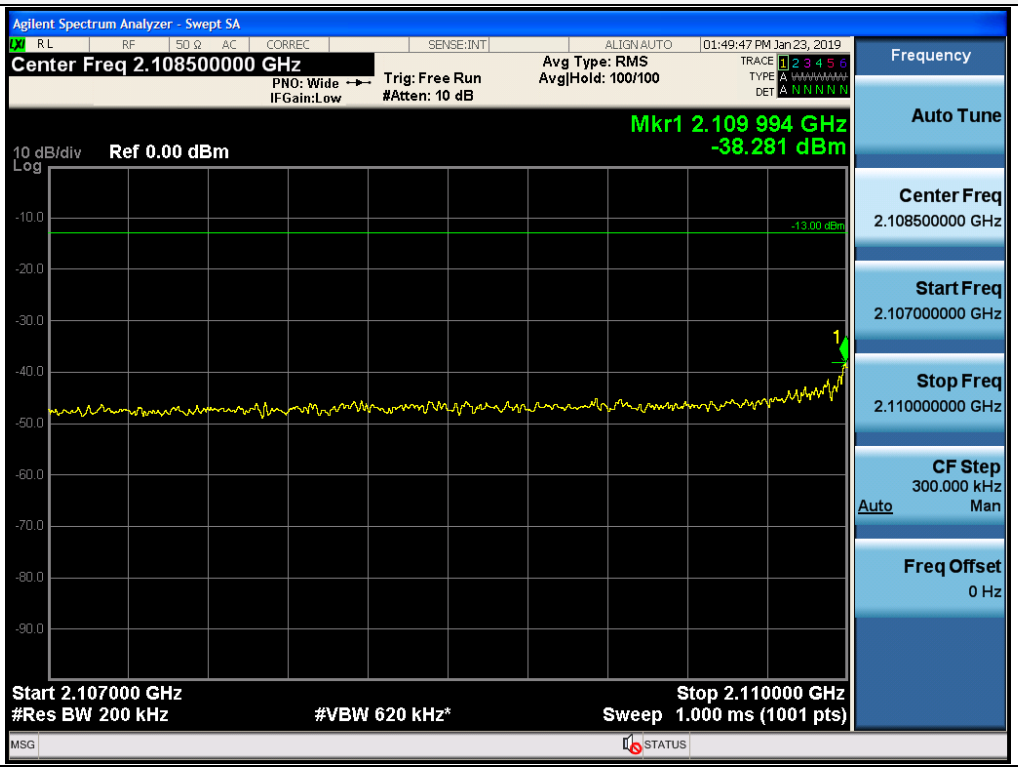

| Out-of-band (two adjacent test signals) / AWS1+3 / Downlink / LTE 10 MHz / Lower |
|---|



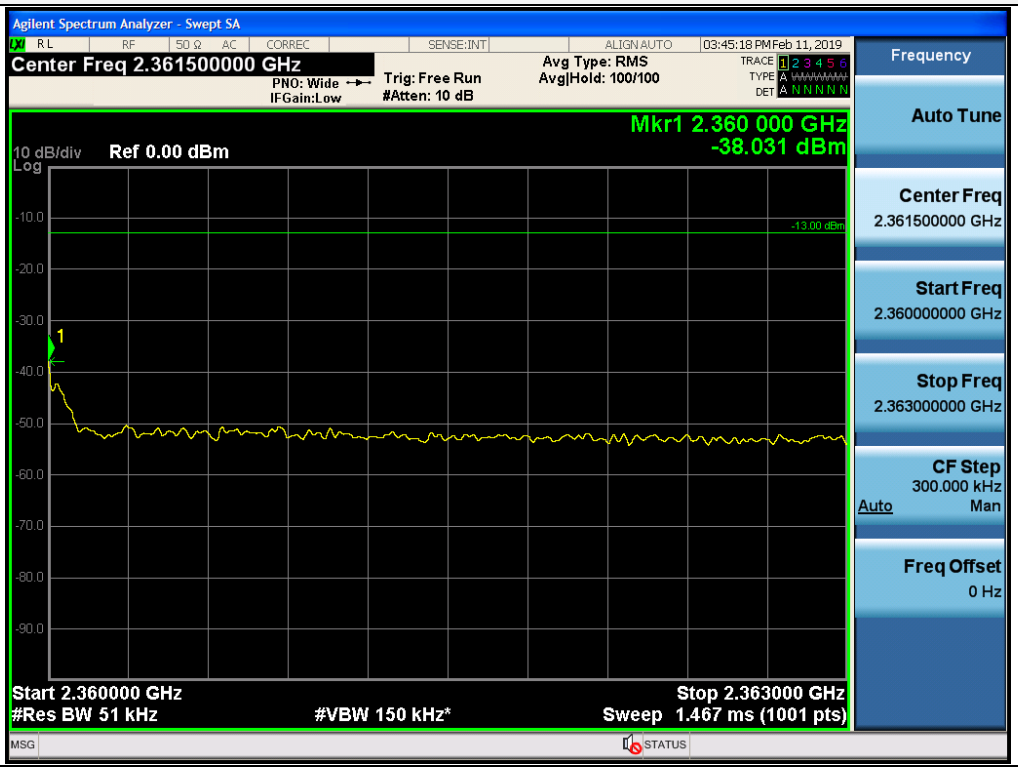
Out-of-band (two adjacent test signals) / AWS1+3 / Downlink / LTE 20 MHz / Upper



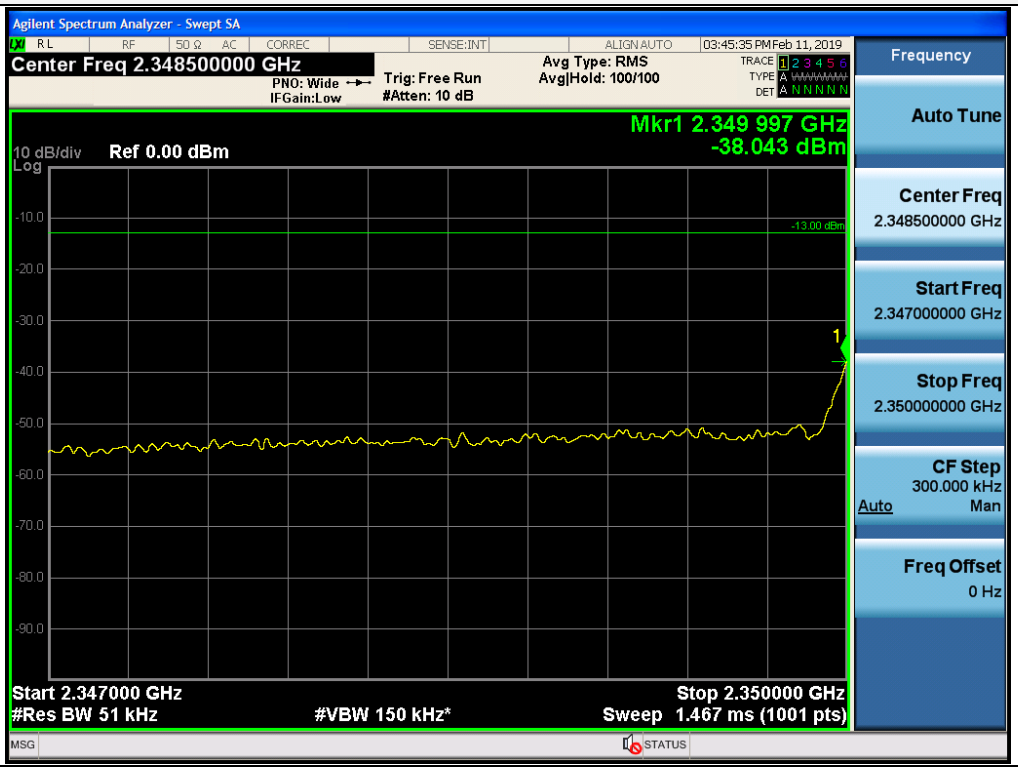

Out-of-band (two adjacent test signals) / AWS1+3 / Downlink / LTE 20 MHz / Lower



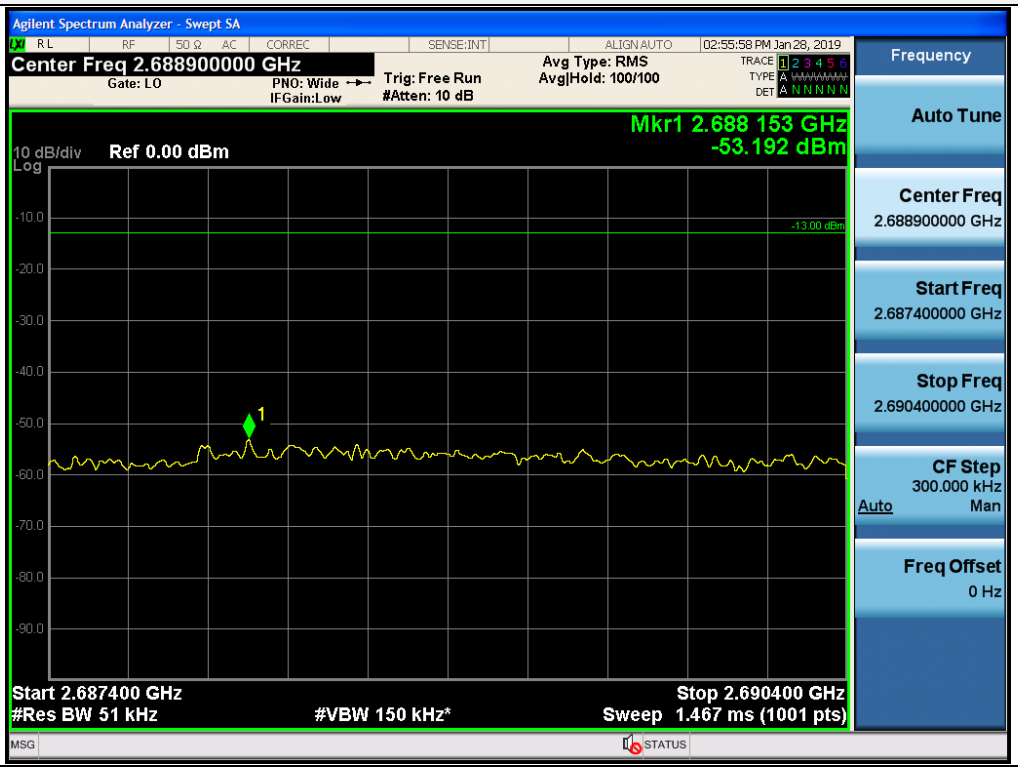
Out-of-band (two adjacent test signals) / WCS / Downlink / LTE 5 MHz / Upper



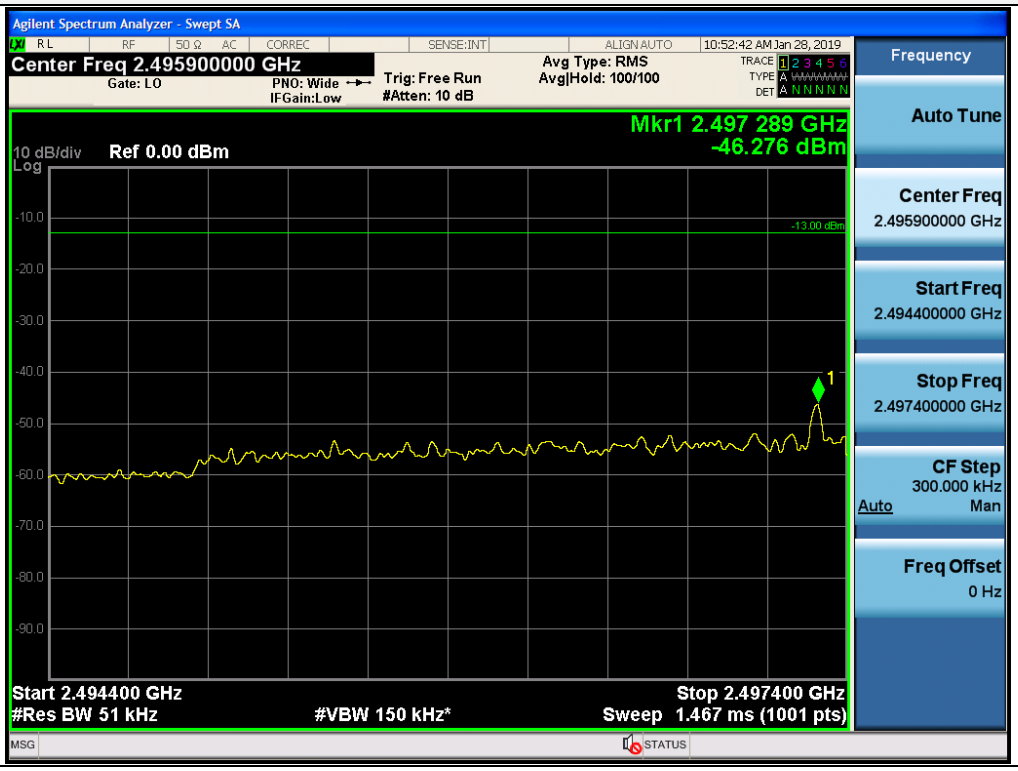

Out-of-band (two adjacent test signals) / WCS / Downlink / LTE 5 MHz / Lower



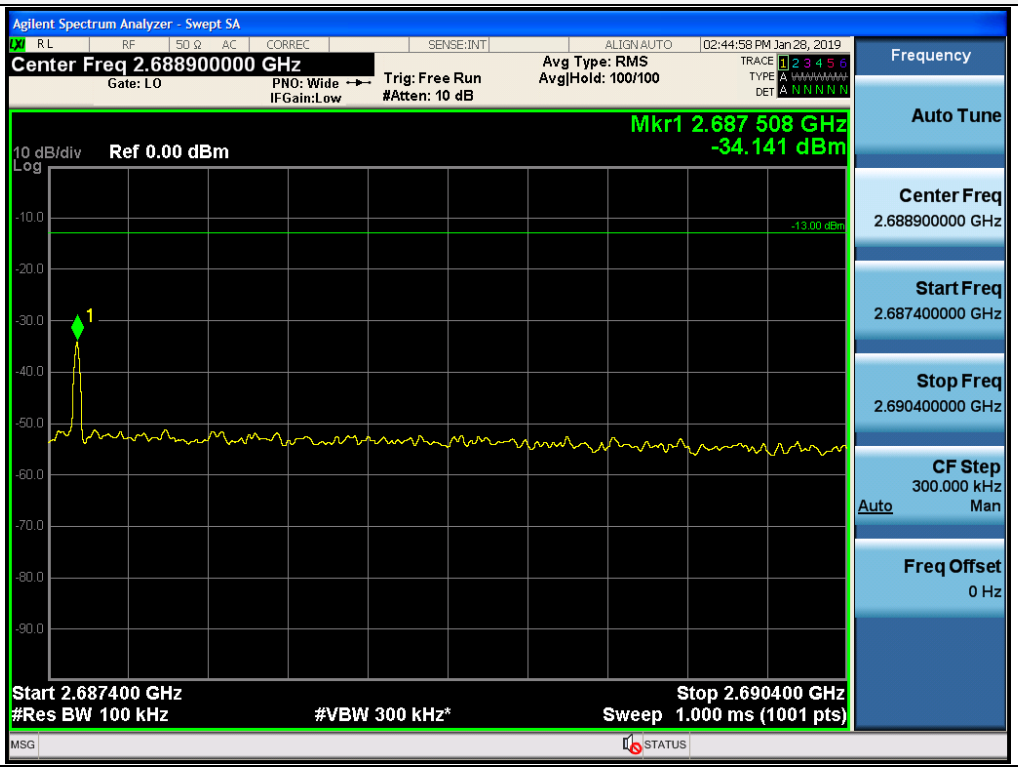
Out-of-band (two adjacent test signals) / BRS/EBS / Downlink / LTE 5 MHz (TDD) / Upper

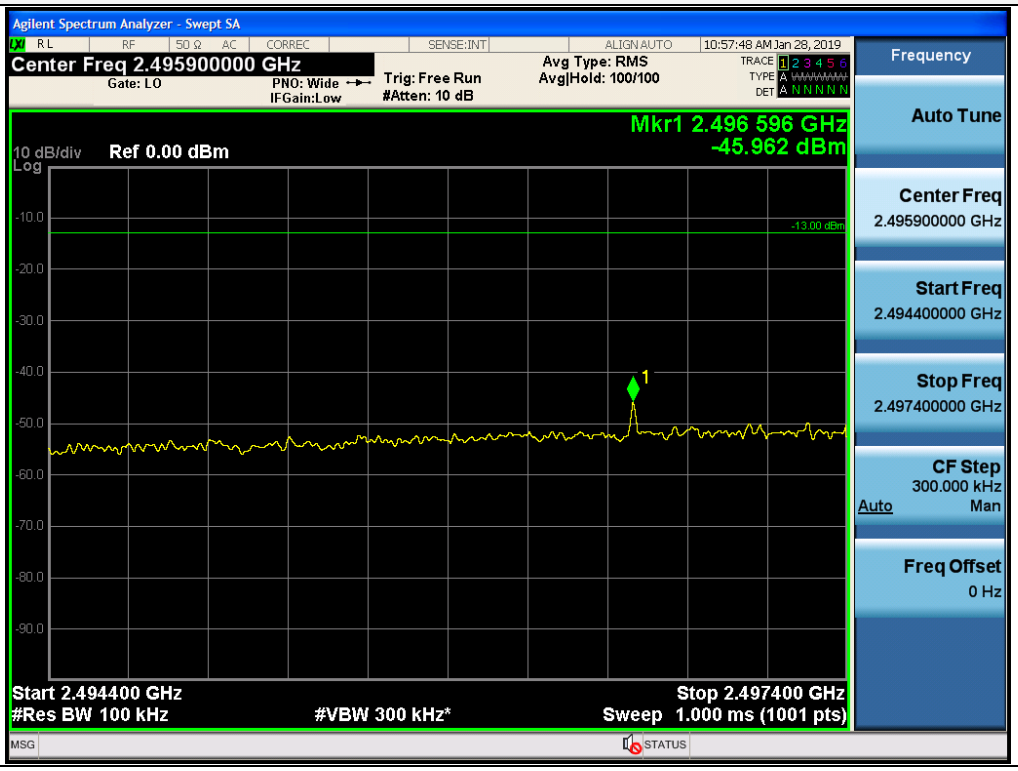



Out-of-band (two adjacent test signals) / BRS/EBS / Downlink / LTE 5 MHz (TDD) / Lower



Out-of-band (two adjacent test signals) / BRS/EBS / Downlink / LTE 10 MHz (TDD) / Upper




Out-of-band (two adjacent test signals) / BRS/EBS / Downlink / LTE 10 MHz (TDD) / Lower