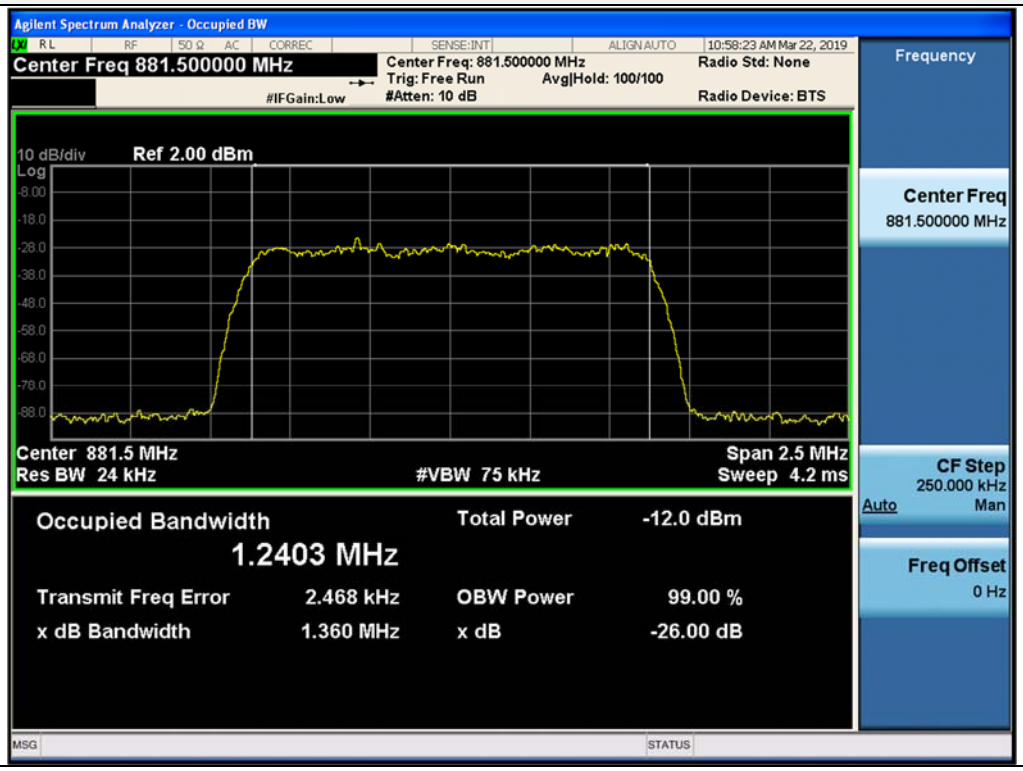
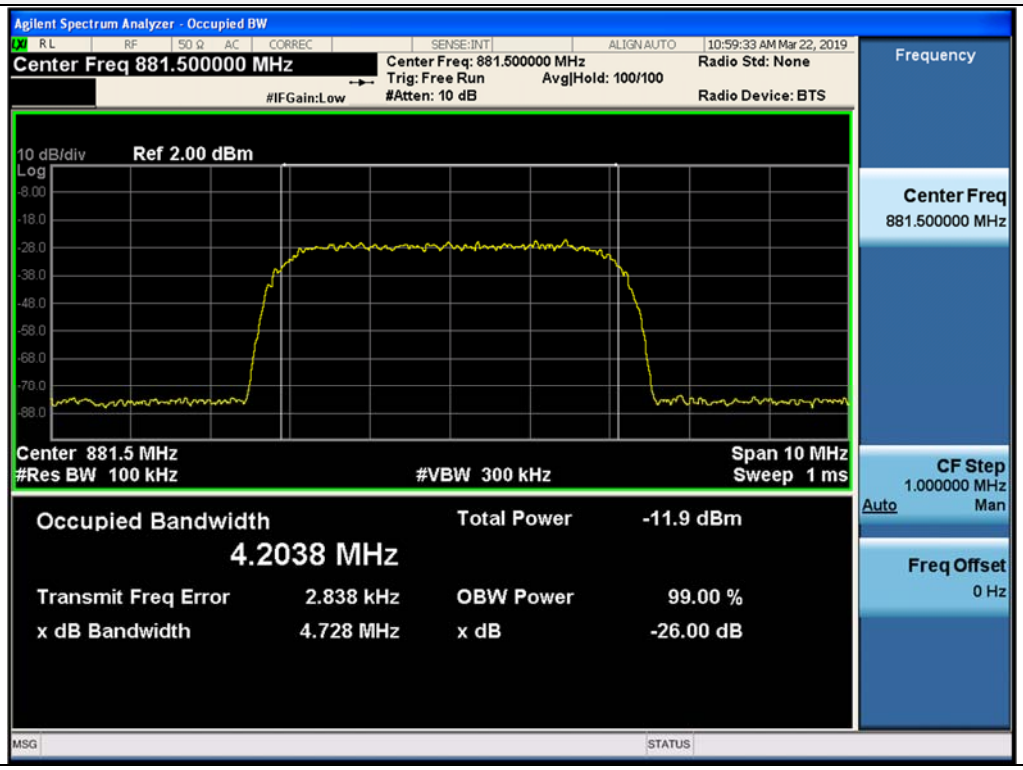
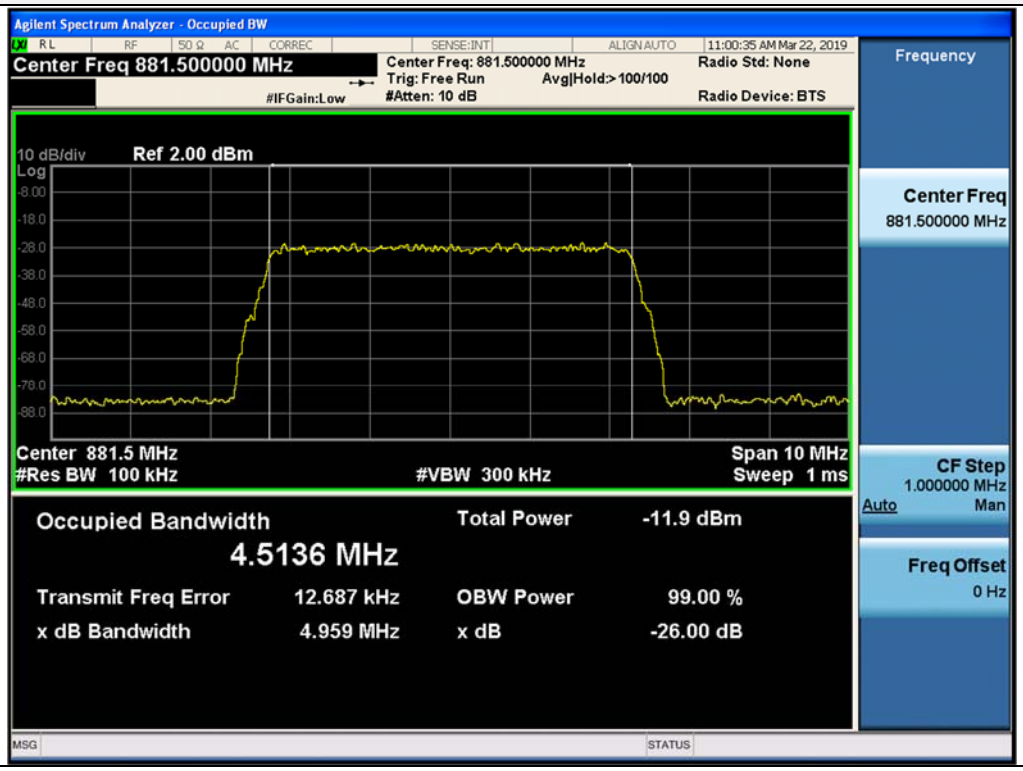
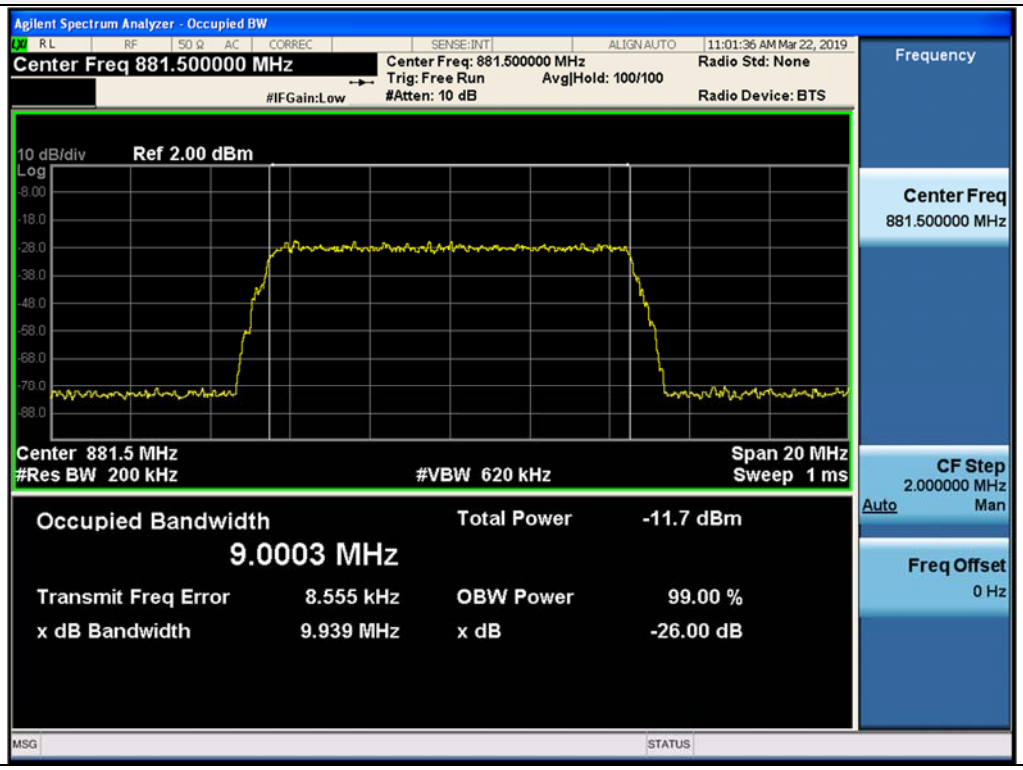
Input / Cellular / Downlink / CDMA


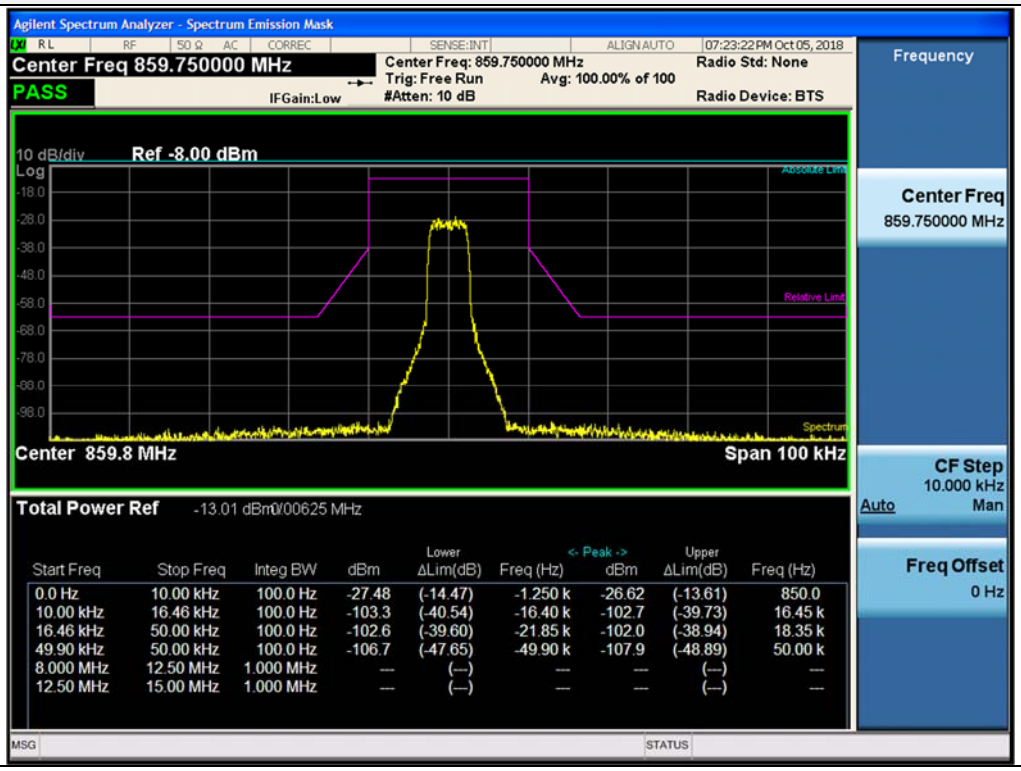
Input / Cellular / Downlink / WCDMA


Input / Cellular / Downlink / LTE 5 MHz


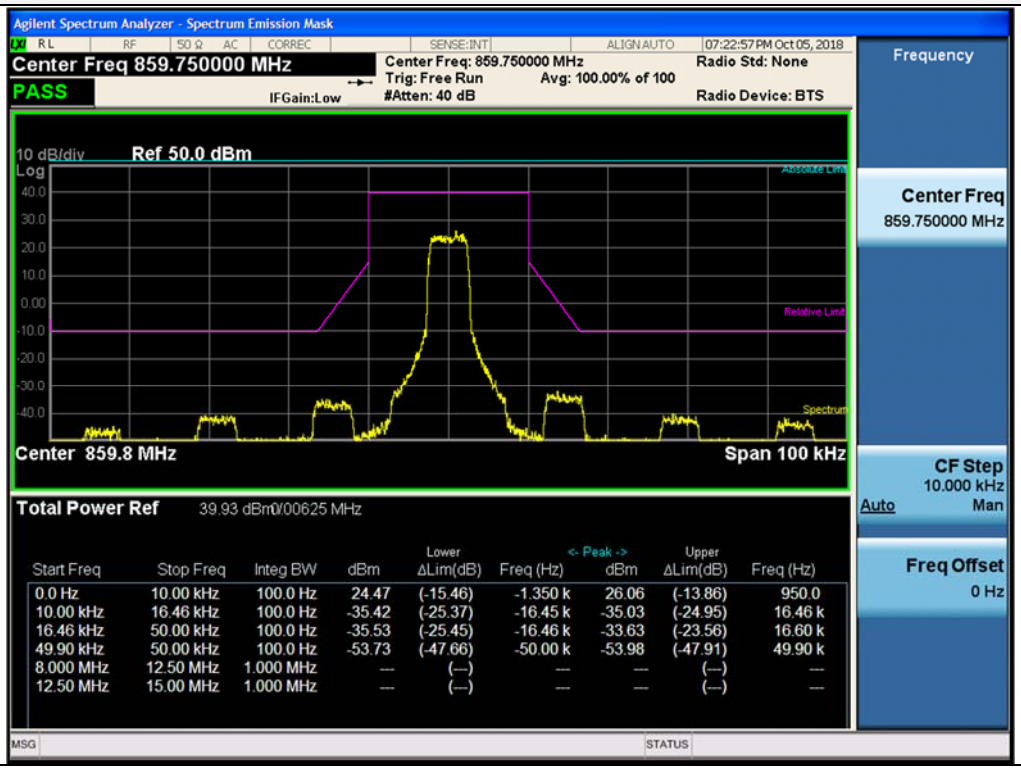
Input / Cellular / Downlink / LTE 10 MHz


Plot data of Emission Masks_PS; B/ILT; SMR Band

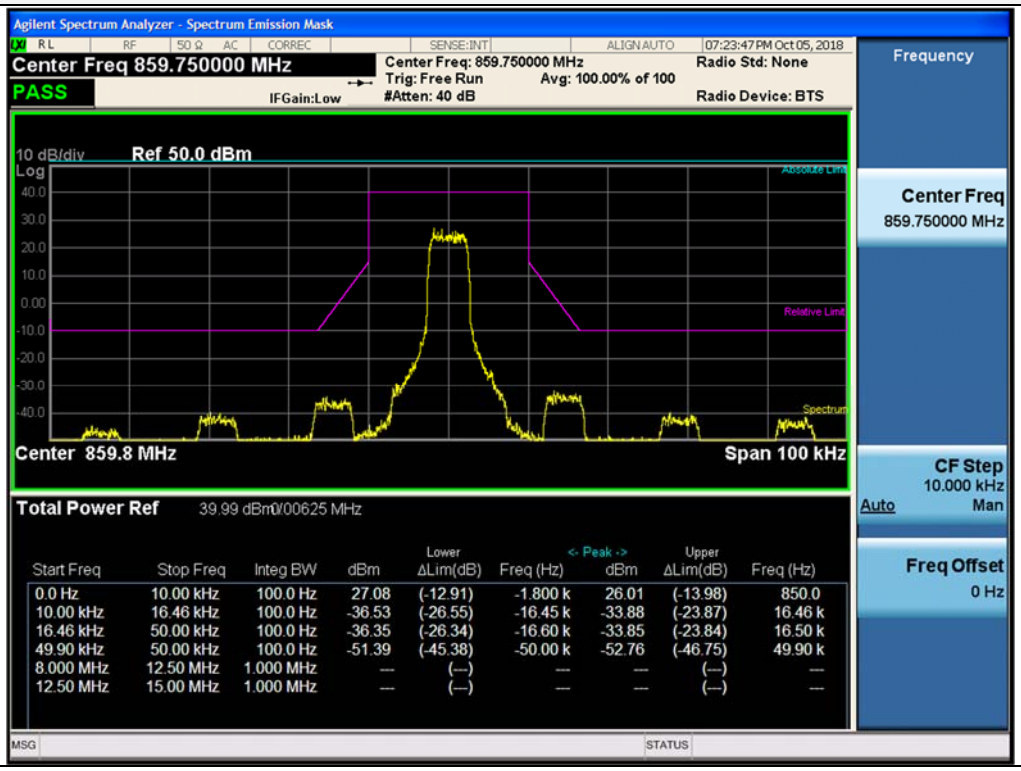
Input / PS; B/ILT SMR / Downlink / P25 Phase 2 / Mask G



Output / PS; B/ILT SMR / Downlink / P25 Phase 2 / Mask G



3 dB above the AGC threshold Output / PS; B/ILT SMR / Downlink / P25 Phase 2 / Mask G



Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	10.00 kHz	100.0 Hz	27.08	(-12.91)	-1.800 k	26.01	(-13.98)	850.0
10.00 kHz	16.46 kHz	100.0 Hz	-36.53	(-26.55)	-16.45 k	-33.88	(-23.87)	16.46 k
16.46 kHz	50.00 kHz	100.0 Hz	-36.35	(-26.34)	-16.60 k	-33.85	(-23.84)	16.50 k
49.90 kHz	50.00 kHz	100.0 Hz	-51.39	(-45.38)	-50.00 k	-52.76	(-46.75)	49.90 k
8.000 MHz	12.50 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

Tabular data of Output Occupied Bandwidth_PCS Band

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
PCS	Downlink	GSM	1962.50	245.08	313.8
		Signal	Center Frequency (MHz)	99 % OBW (MHz)	26 dB OBW (MHz)
		CDMA	1962.50	1.2667	1.409
		WCDMA	1962.50	4.1715	4.677
		LTE 5 MHz	1962.50	4.5129	5.045
		LTE 10 MHz	1962.50	8.9862	10.01
		LTE 20 MHz	1962.50	18.027	20.03

Tabular data of 3 dB above the AGC threshold Output Occupied Bandwidth_PCS Band

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
PCS	Downlink	GSM	1962.50	244.44	304.2
		Signal	Center Frequency (MHz)	99 % OBW (MHz)	26 dB OBW (MHz)
		CDMA	1962.50	1.2693	1.412
		WCDMA	1962.50	4.1751	4.680
		LTE 5 MHz	1962.50	4.5109	5.037
		LTE 10 MHz	1962.50	9.0040	10.01
		LTE 20 MHz	1962.50	18.014	20.08

Tabular data of Input Occupied Bandwidth_PCS Band

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (kHz)
PCS	Downlink	GSM	1962.50	244.09	309.8
		Signal	Center Frequency (MHz)	99 % OBW (MHz)	26 dB OBW (MHz)
		CDMA	1962.50	1.2663	1.402
		WCDMA	1962.50	4.1844	4.688
		LTE 5 MHz	1962.50	4.5109	5.045
		LTE 10 MHz	1962.50	8.9905	10.02
		LTE 20 MHz	1962.50	18.022	20.06

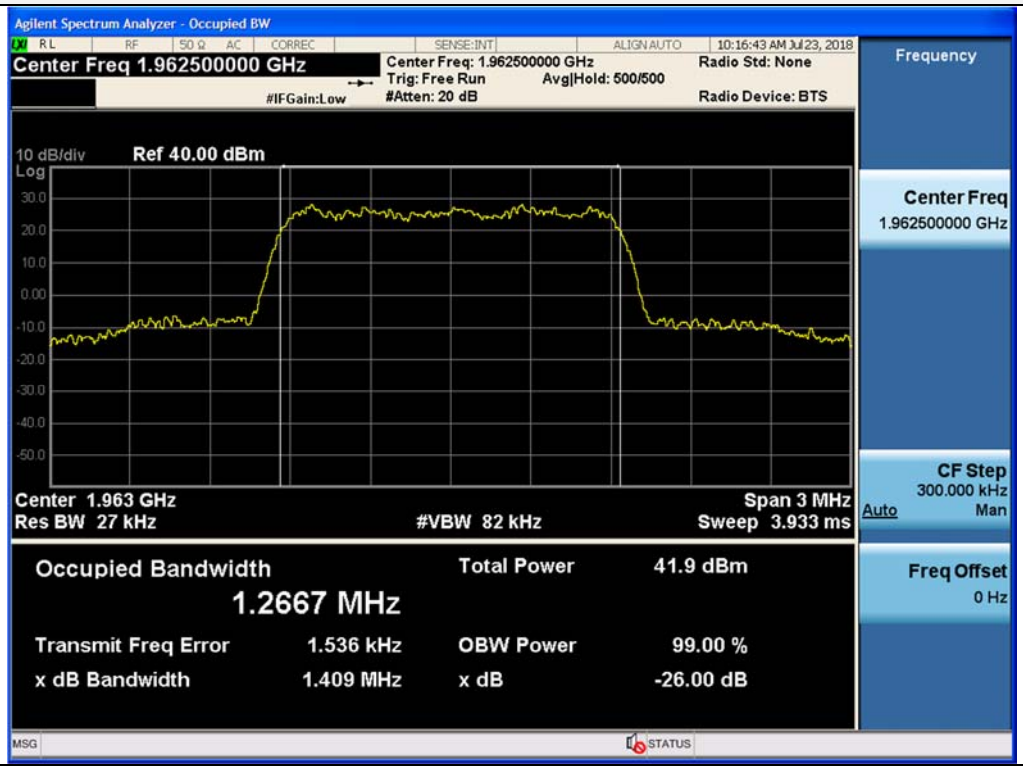
Measured Occupied Bandwidth Comparison_PCS Band

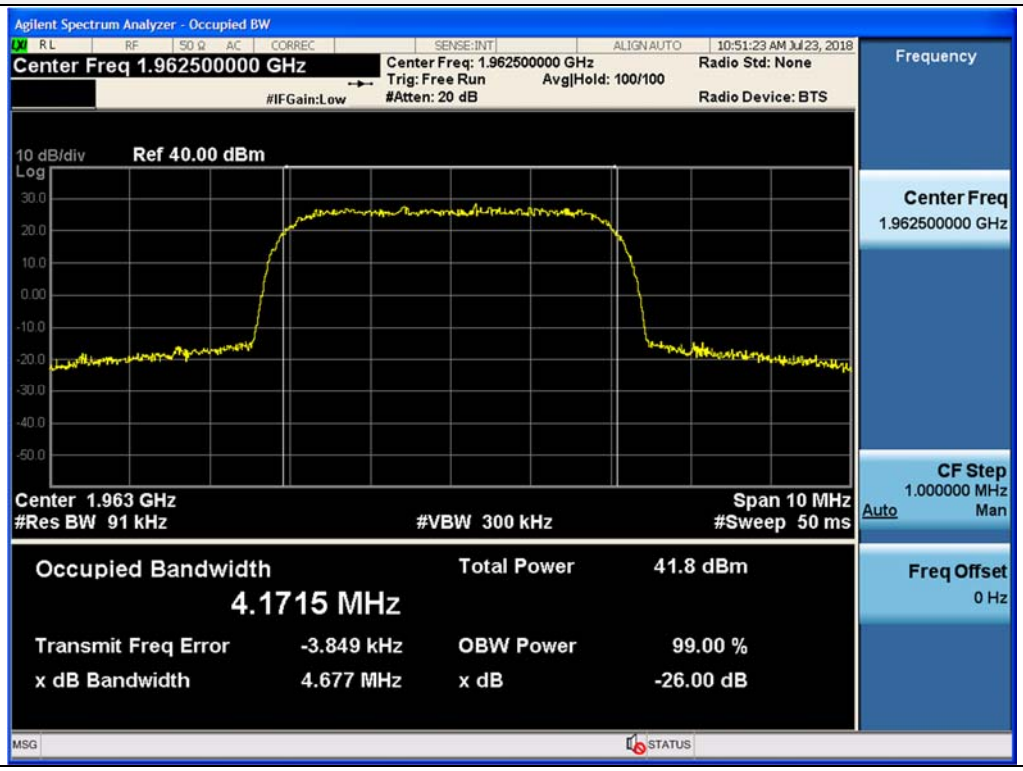
Test Band	Link	Signal	Variant of Input and output Occupied Bandwidth (%)	Variant of Input and 3 dB above the AGC threshold output Occupied Bandwidth (%)
PCS	Downlink	GSM	1.291	-1.808
		CDMA	0.499	0.713
		WCDMA	-0.235	-0.171
		LTE 5 MHz	0.000	-0.159
		LTE 10 MHz	-0.100	-0.100
		LTE 20 MHz	-0.150	0.100

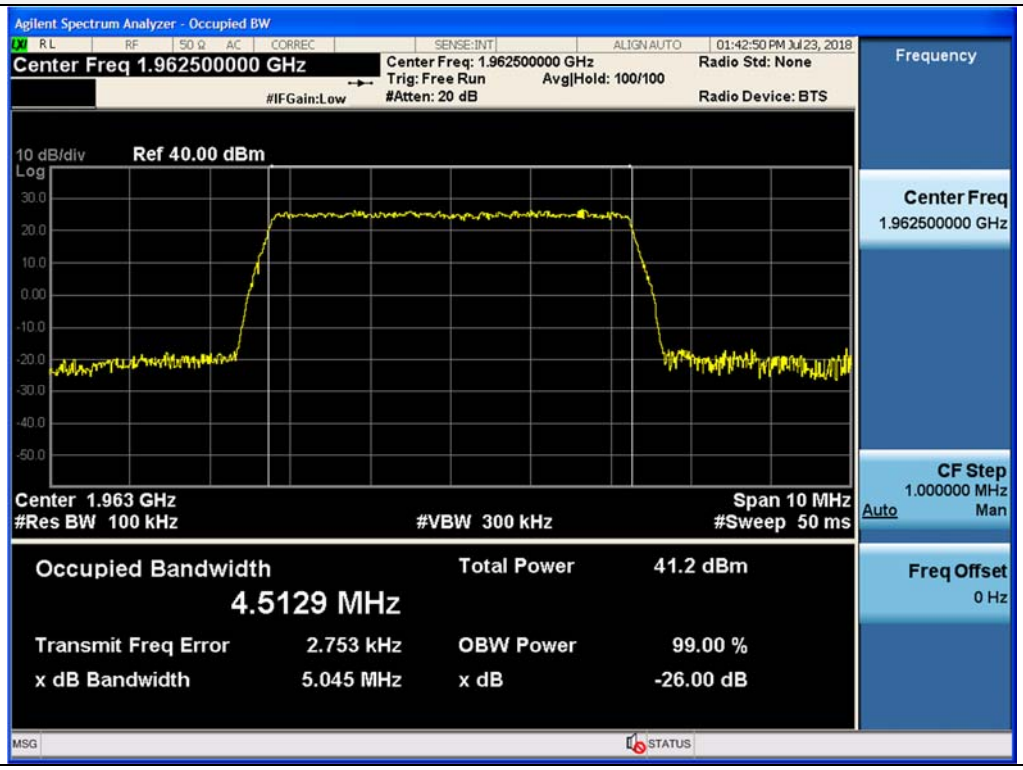
** Change in input-output OBW is less than ±5 %.*

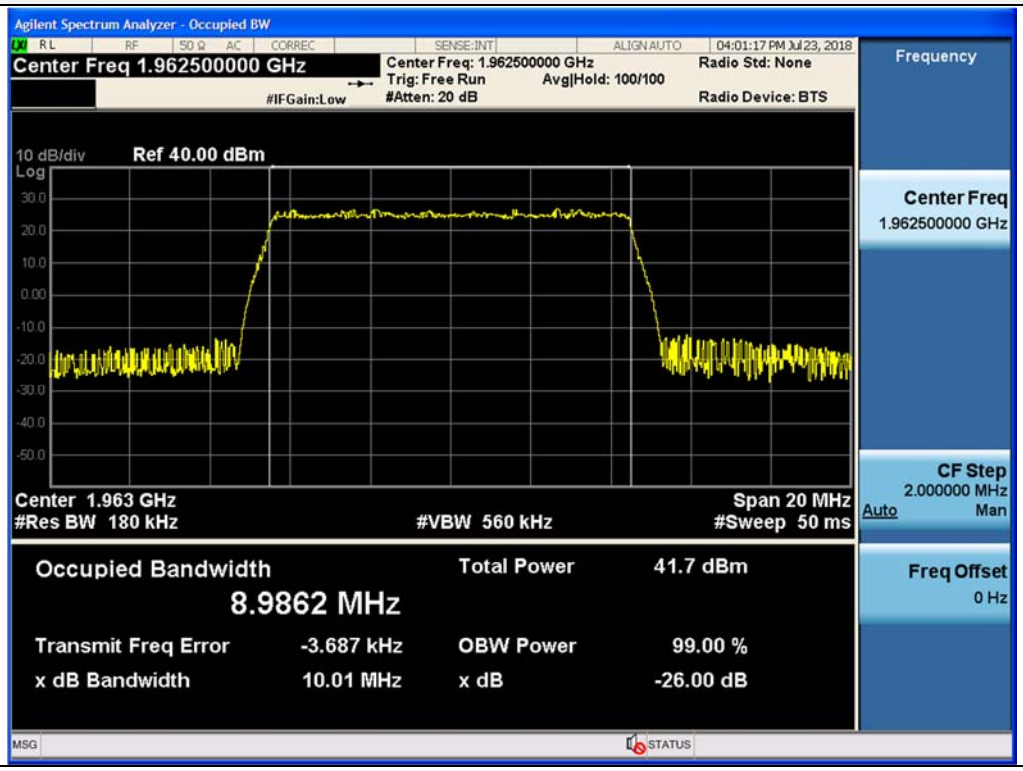
Plot data of Occupied Bandwidth_PCS Band

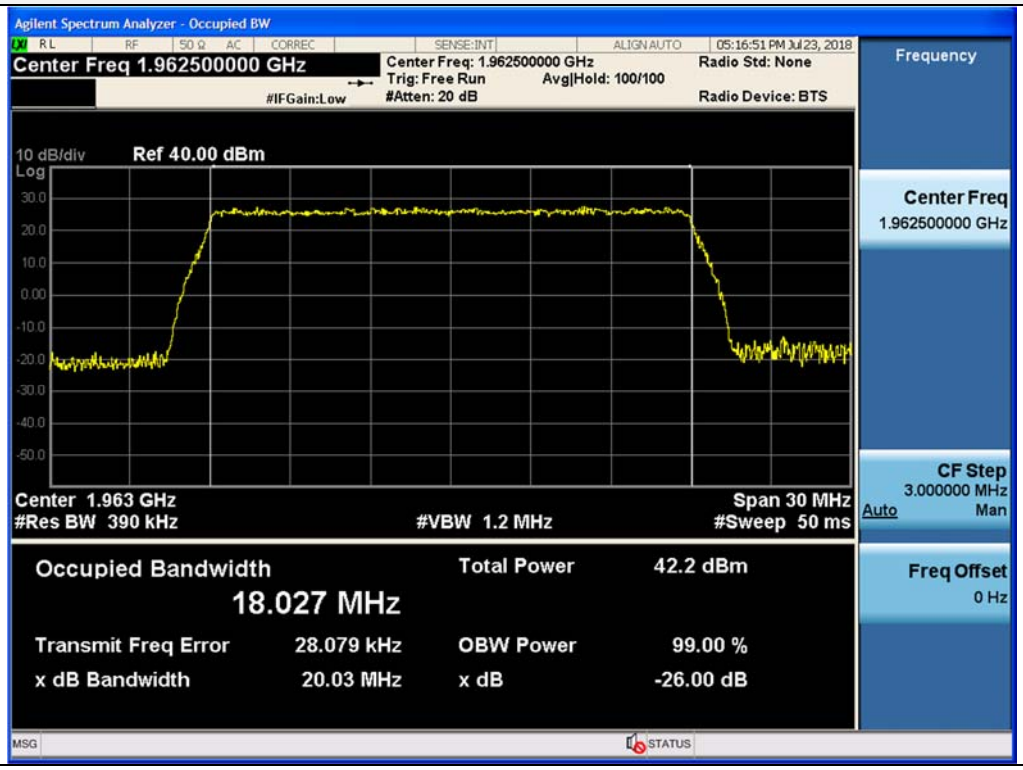
Output / PCS / Downlink / GSM


Output / PCS / Downlink / CDMA


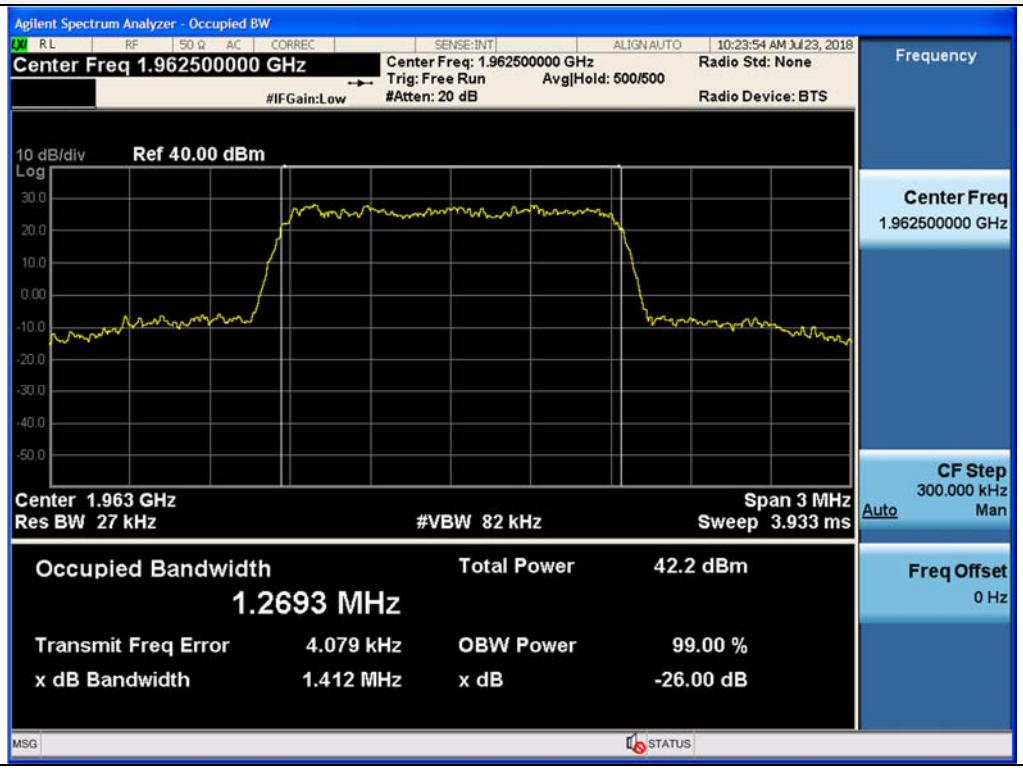
Output / PCS / Downlink / WCDMA


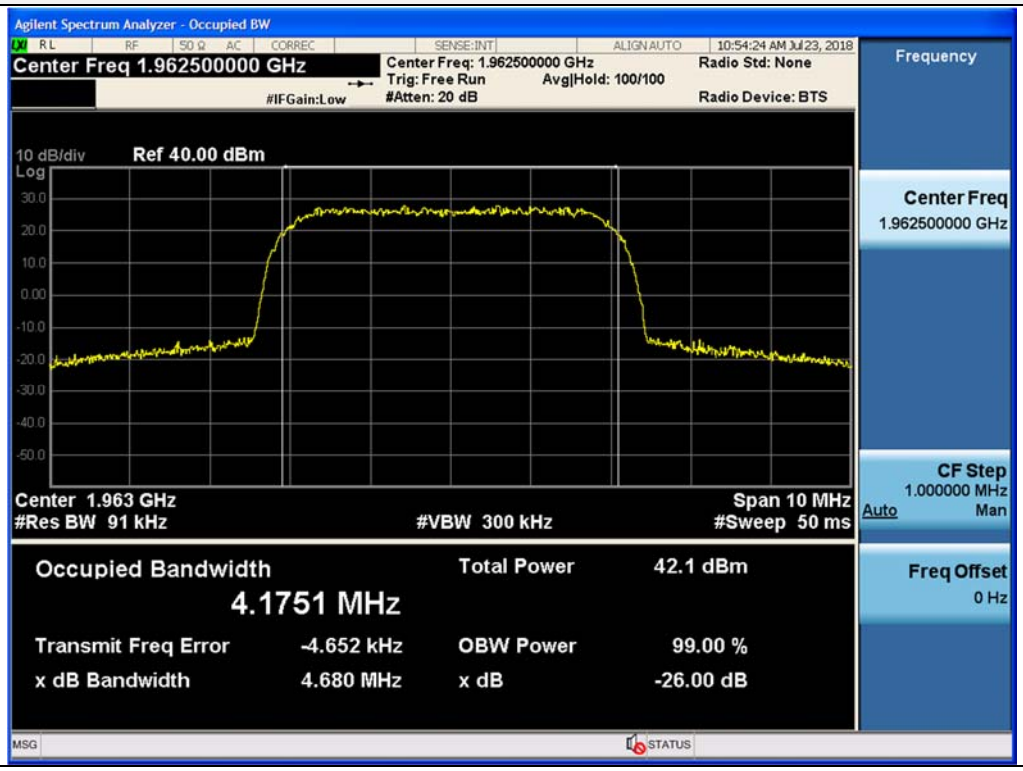
Output / PCS / Downlink / LTE 5 MHz


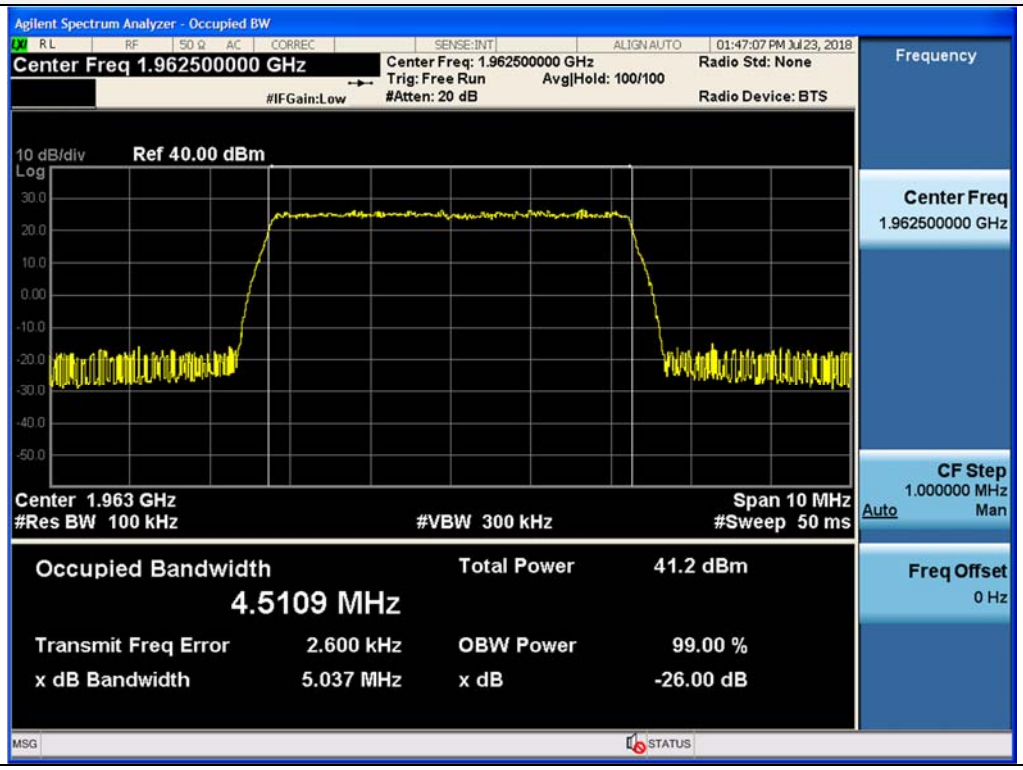
Output / PCS / Downlink / LTE 10 MHz


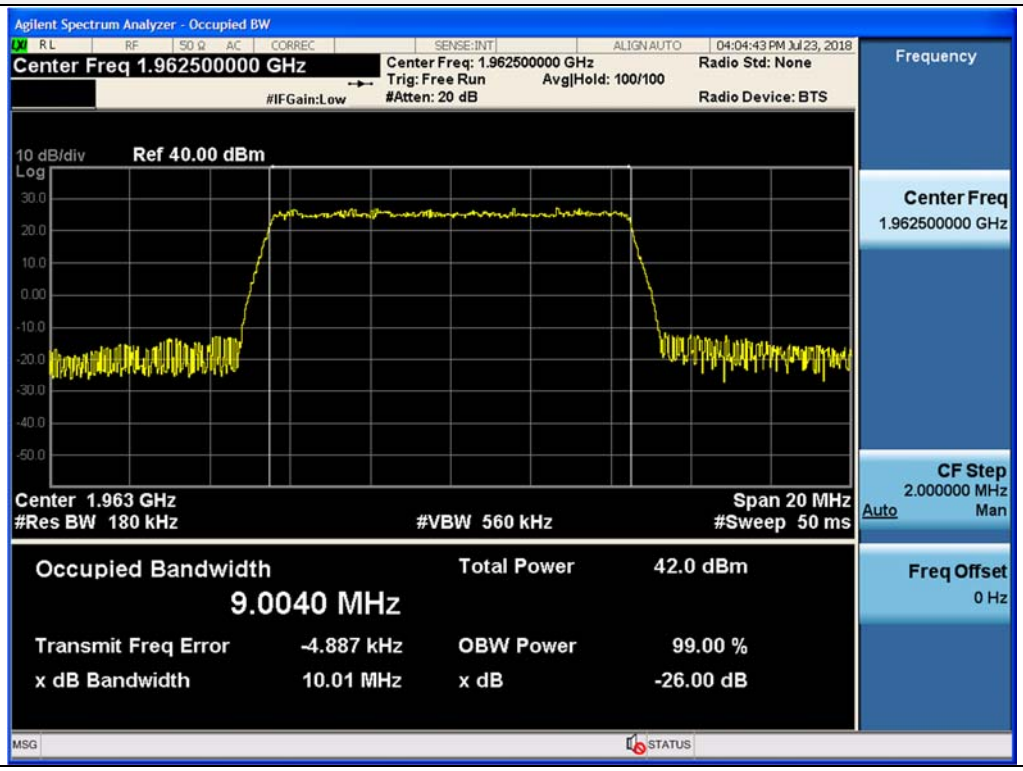
Output / PCS / Downlink / LTE 20 MHz


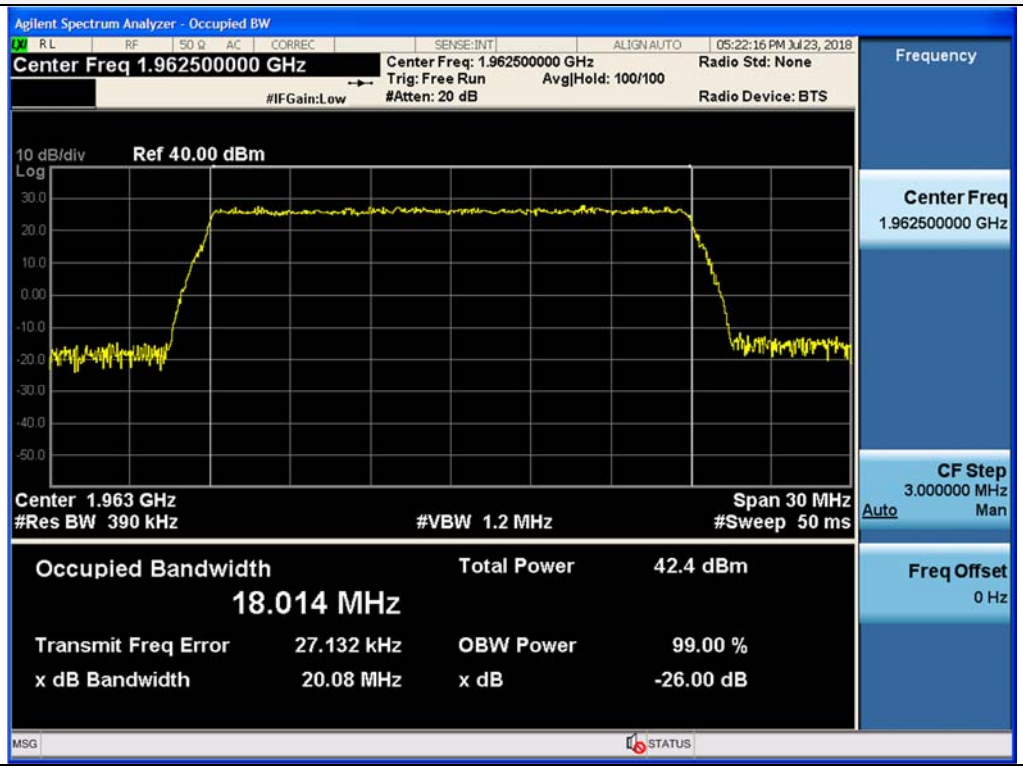
3 dB above the AGC threshold output / PCS / Downlink / GSM


3 dB above the AGC threshold output / PCS / Downlink / CDMA


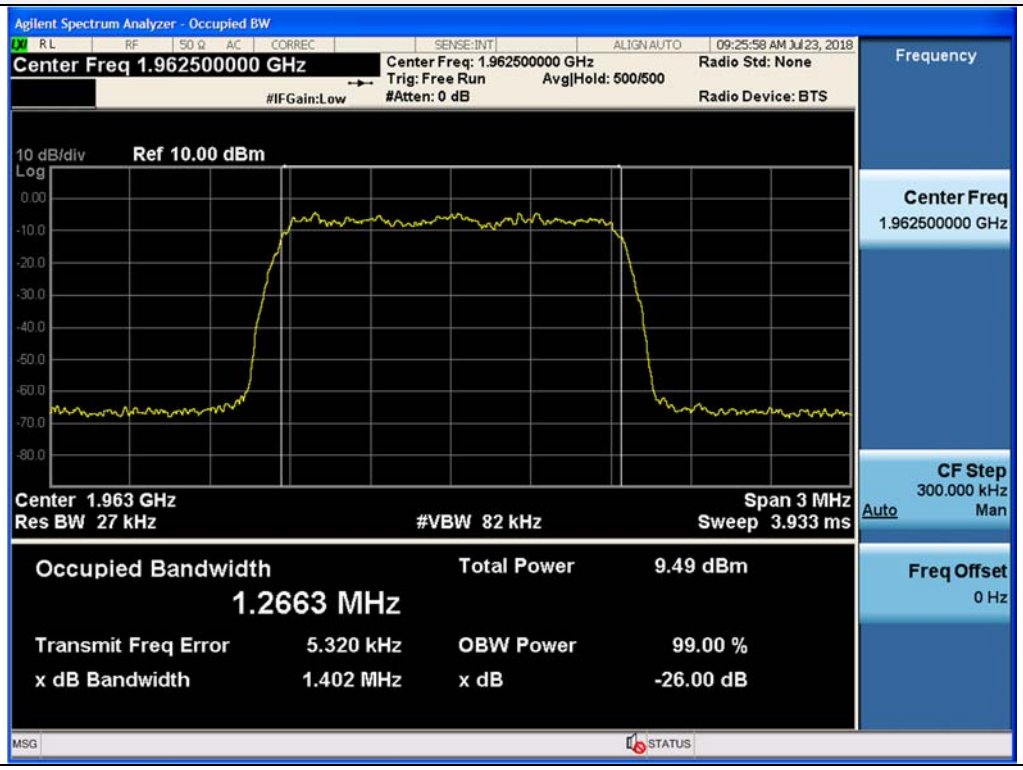
3 dB above the AGC threshold output / PCS / Downlink / WCDMA


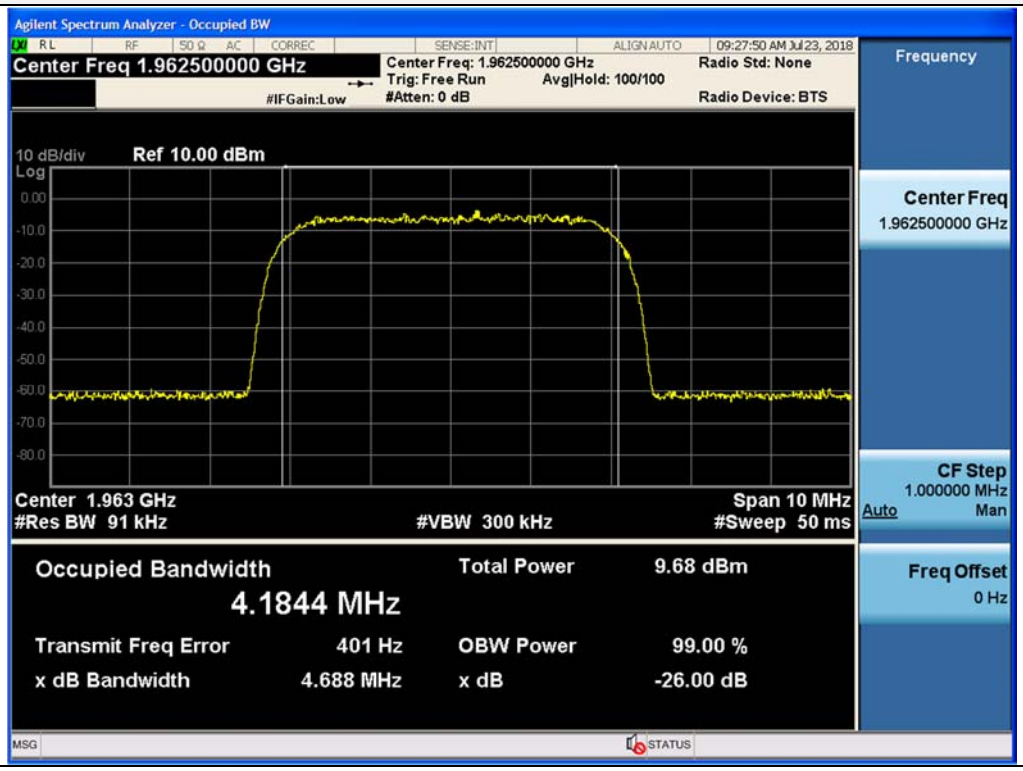
3 dB above the AGC threshold output / PCS / Downlink / LTE 5 MHz


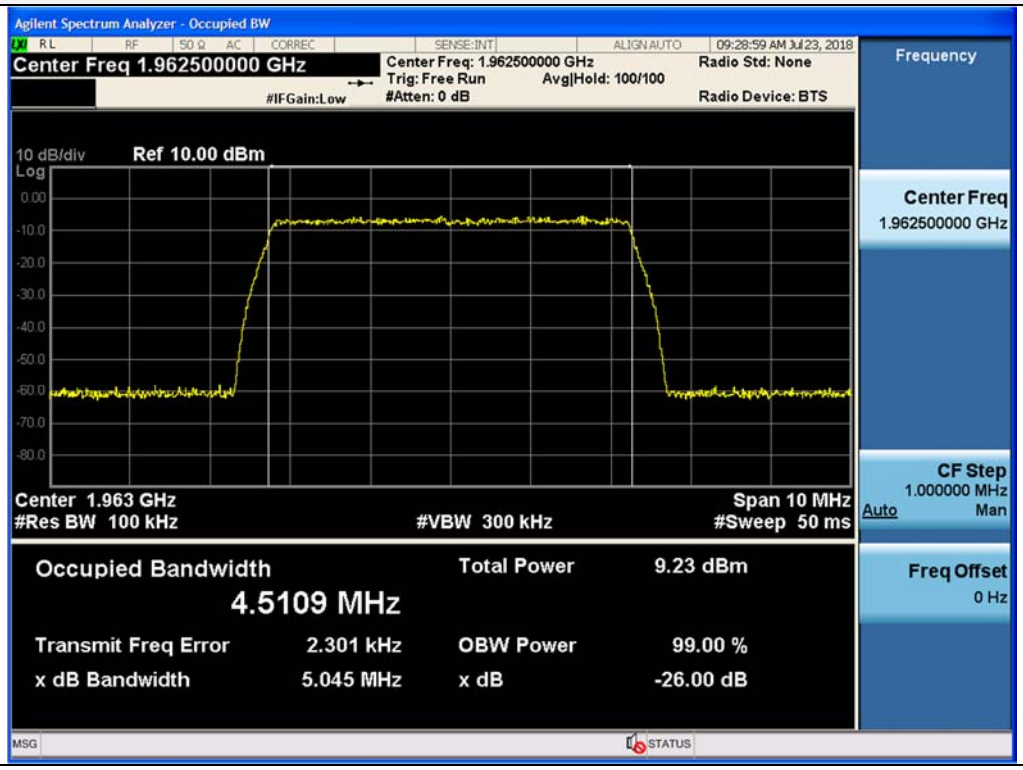
3 dB above the AGC threshold output / PCS / Downlink / LTE 10 MHz


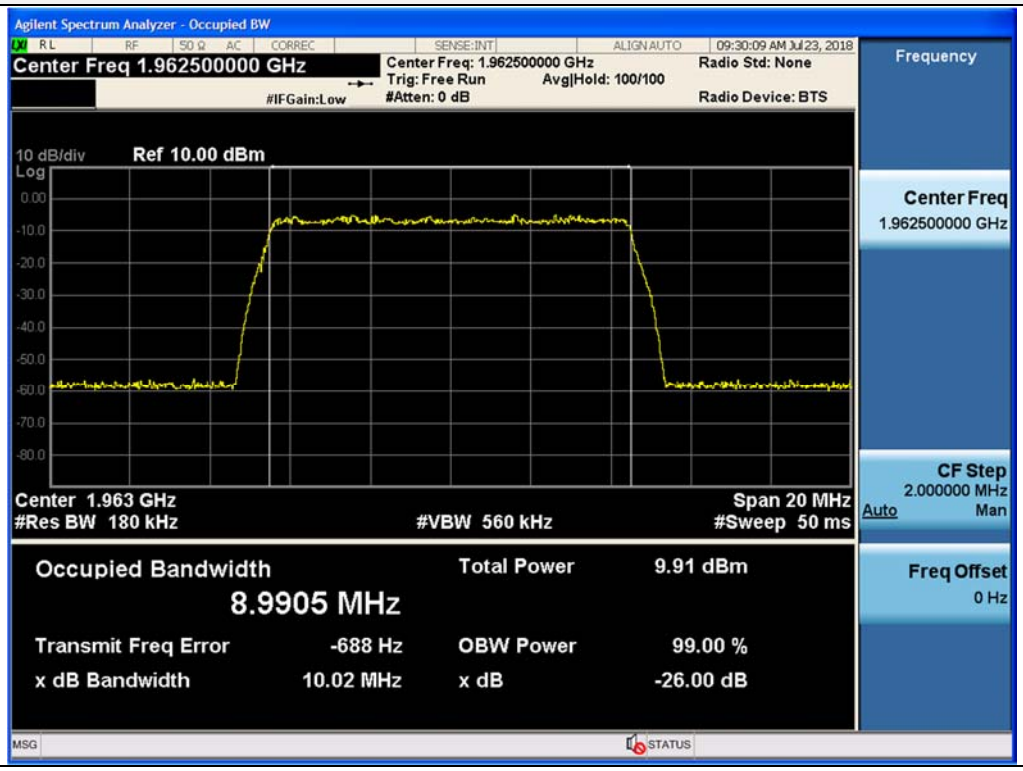
3 dB above the AGC threshold output / PCS / Downlink / LTE 20 MHz


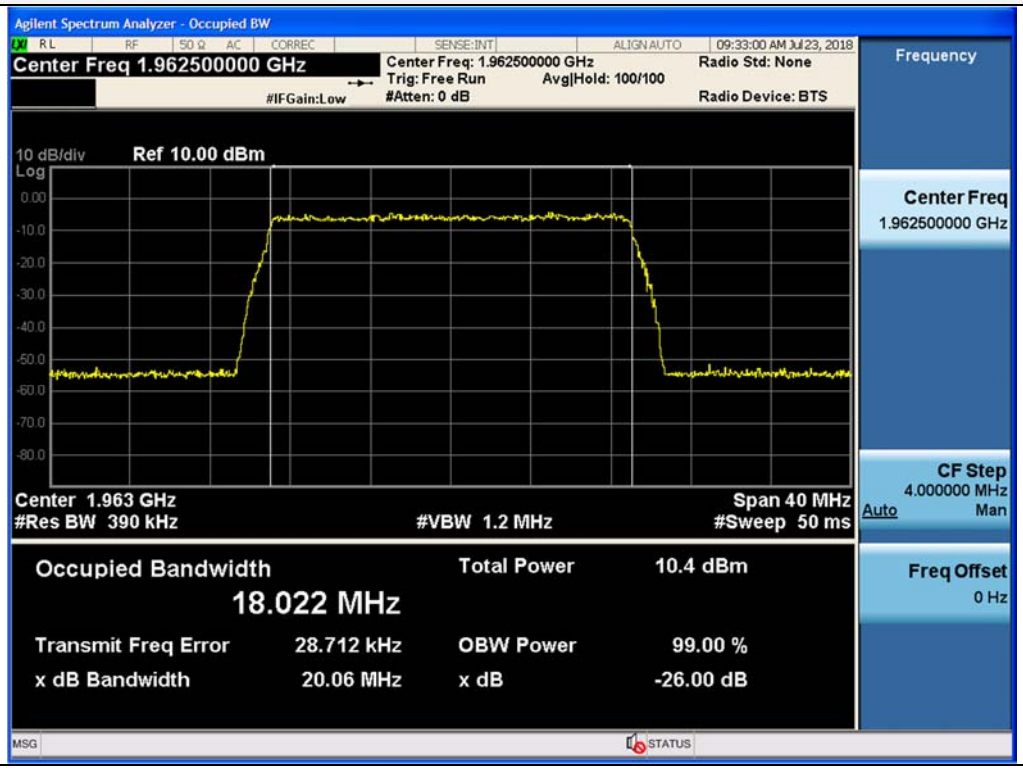
Input / PCS / Downlink / GSM


Input / PCS / Downlink / CDMA


Input / PCS / Downlink / WCDMA


Input / PCS / Downlink / LTE 5 MHz


Input / PCS / Downlink / LTE 10 MHz


Input / PCS / Downlink / LTE 20 MHz


Tabular data of Output Occupied Bandwidth_AWS Band

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (MHz)
AWS	Downlink	CDMA	2145.00	1.2423	1.367
		WCDMA	2145.00	4.1599	4.689
		LTE 5 MHz	2145.00	4.5155	5.039
		LTE 10 MHz	2145.00	9.0016	10.01
		LTE 20 MHz	2145.00	18.039	20.06

Tabular data of 3 dB above the AGC threshold Output Occupied Bandwidth_AWS Band

Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (MHz)
AWS	Downlink	CDMA	2145.00	1.2464	1.373
		WCDMA	2145.00	4.1717	4.683
		LTE 5 MHz	2145.00	4.5151	5.045
		LTE 10 MHz	2145.00	9.0062	10.03
		LTE 20 MHz	2145.00	18.030	20.10

Tabular data of Input Occupied Bandwidth_AWS Band

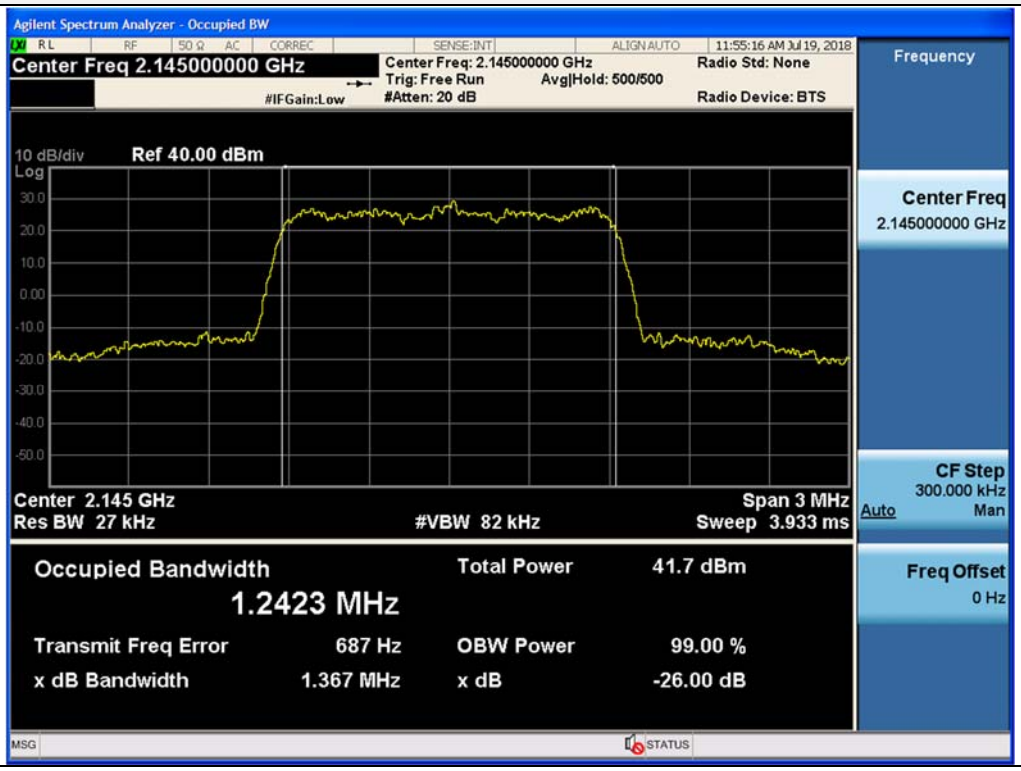
Test Band	Link	Signal	Center Frequency (MHz)	99 % OBW (kHz)	26 dB OBW (MHz)
AWS	Downlink	CDMA	2145.00	1.2435	1.365
		WCDMA	2145.00	4.1663	4.676
		LTE 5 MHz	2145.00	4.5086	5.028
		LTE 10 MHz	2145.00	8.9911	10.02
		LTE 20 MHz	2145.00	18.025	20.08

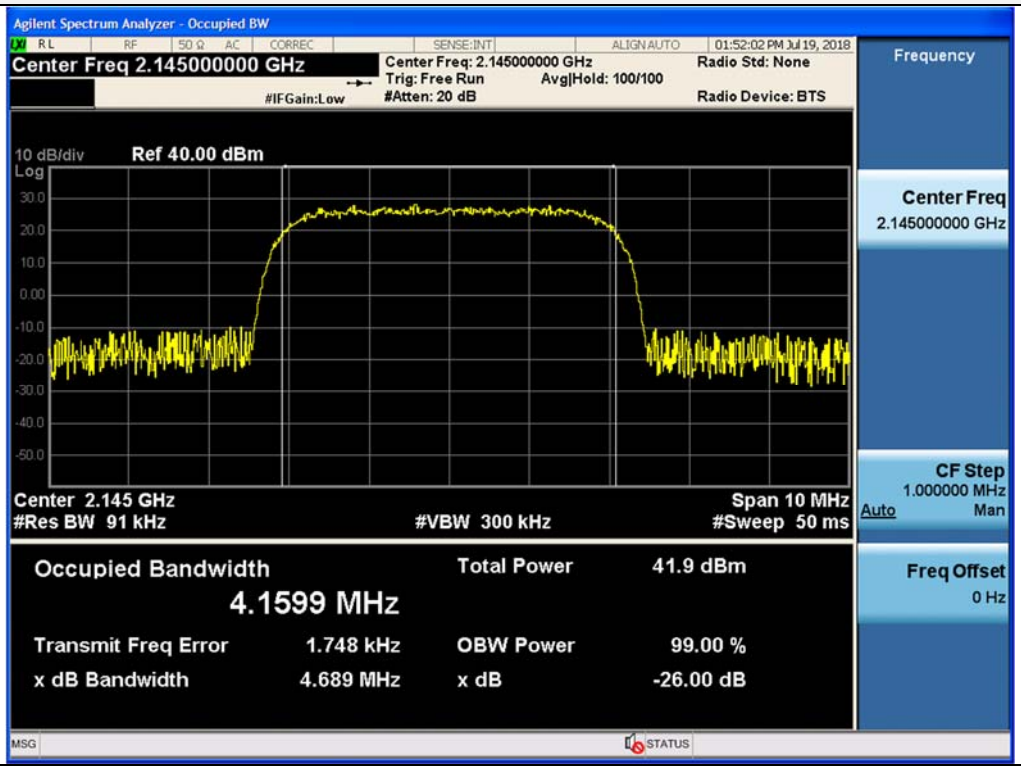
Measured Occupied Bandwidth Comparison_AWS Band

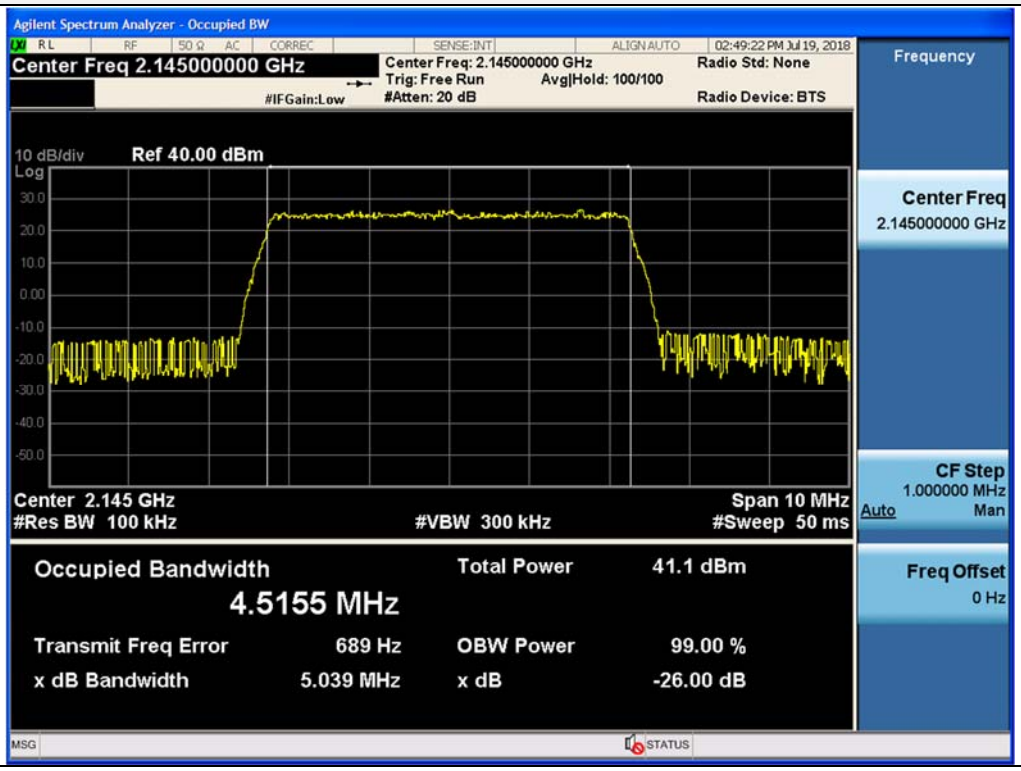
Test Band	Link	Signal	Variant of Input and output Occupied Bandwidth (%)	Variant of Input and 3 dB above the AGC threshold output Occupied Bandwidth (%)
AWS	Downlink	CDMA	0.147	0.586
		WCDMA	0.278	0.150
		LTE 5 MHz	0.219	0.338
		LTE 10 MHz	-0.100	0.100
		LTE 20 MHz	-0.100	0.100

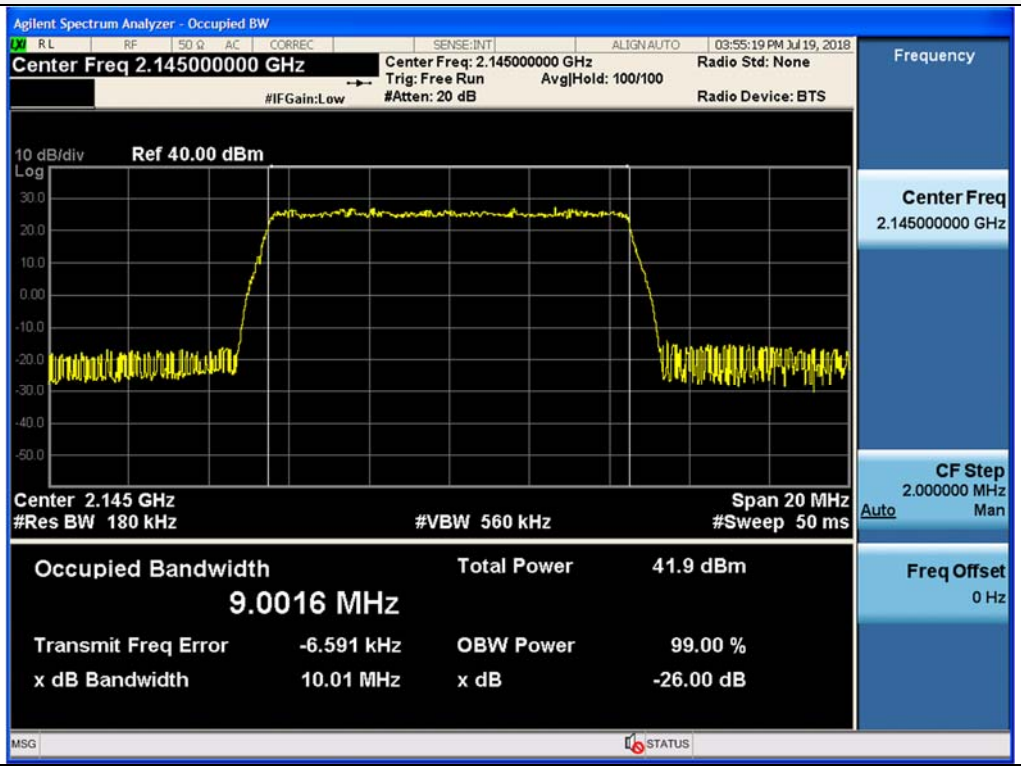
** Change in input-output OBW is less than ±5 %.*

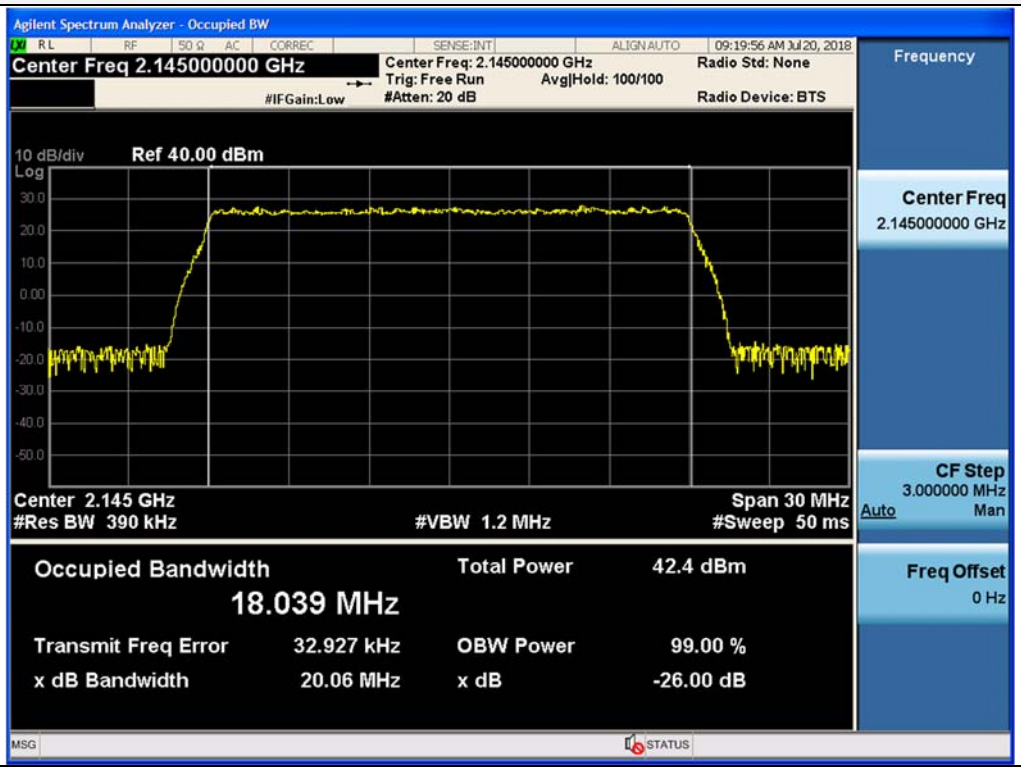
Plot data of Occupied Bandwidth_AWS Band

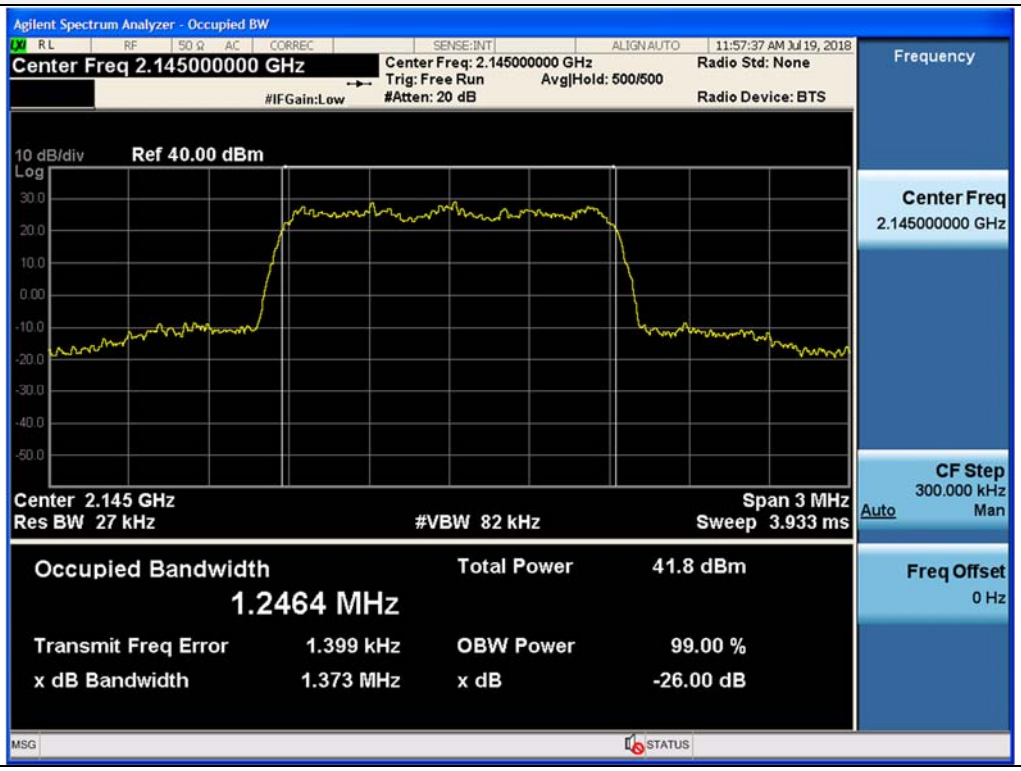
Output / AWS / Downlink / CDMA


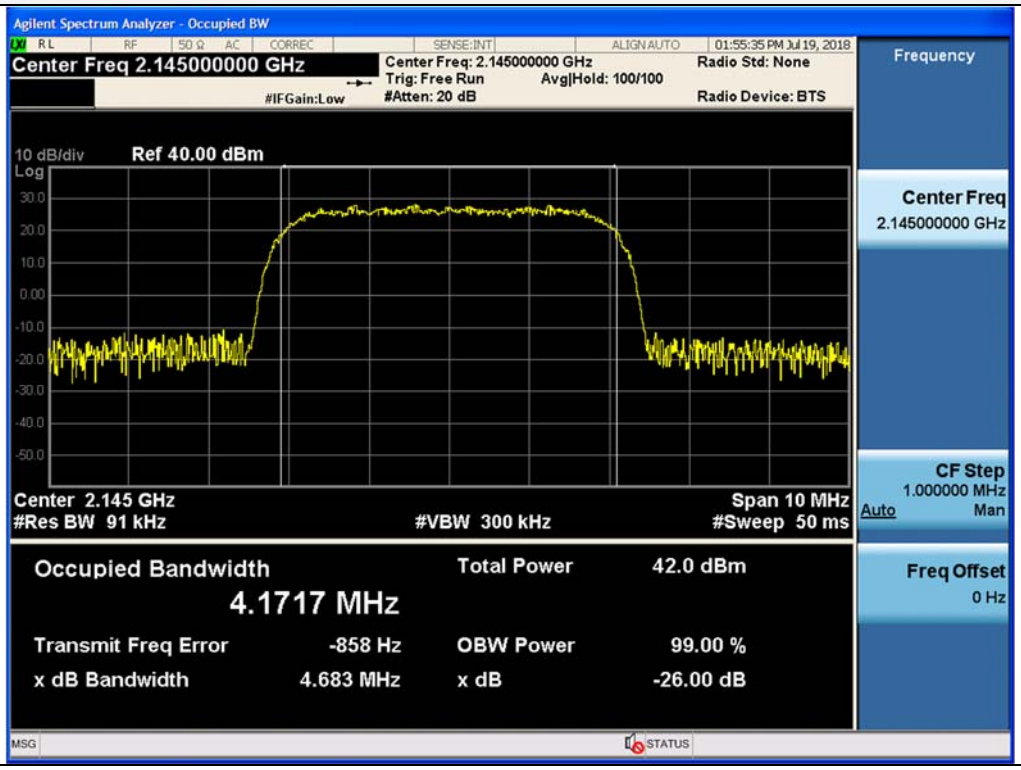
Output / AWS / Downlink / WCDMA


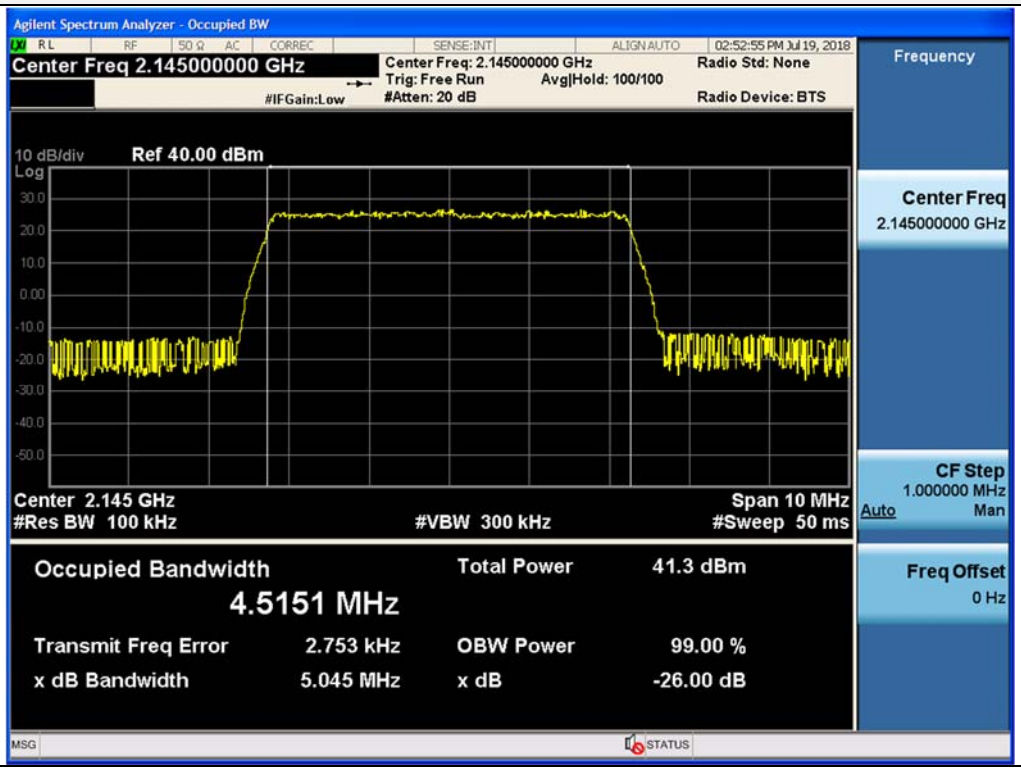
Output / AWS / Downlink / LTE 5 MHz


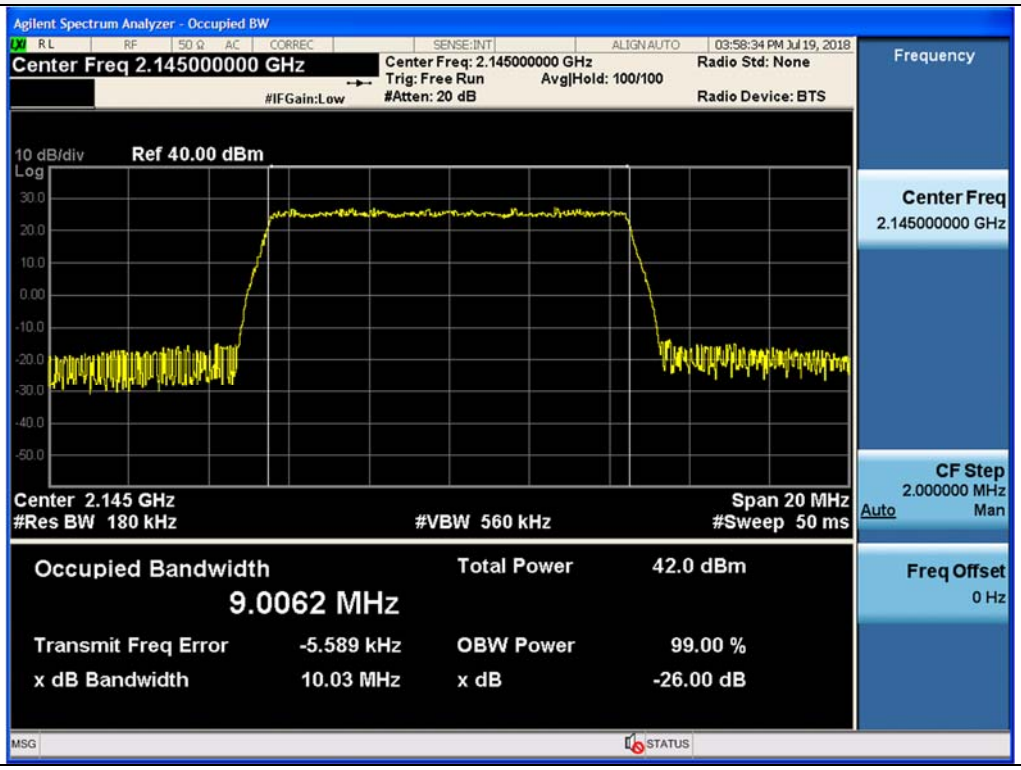
Output / AWS / Downlink / LTE 10 MHz


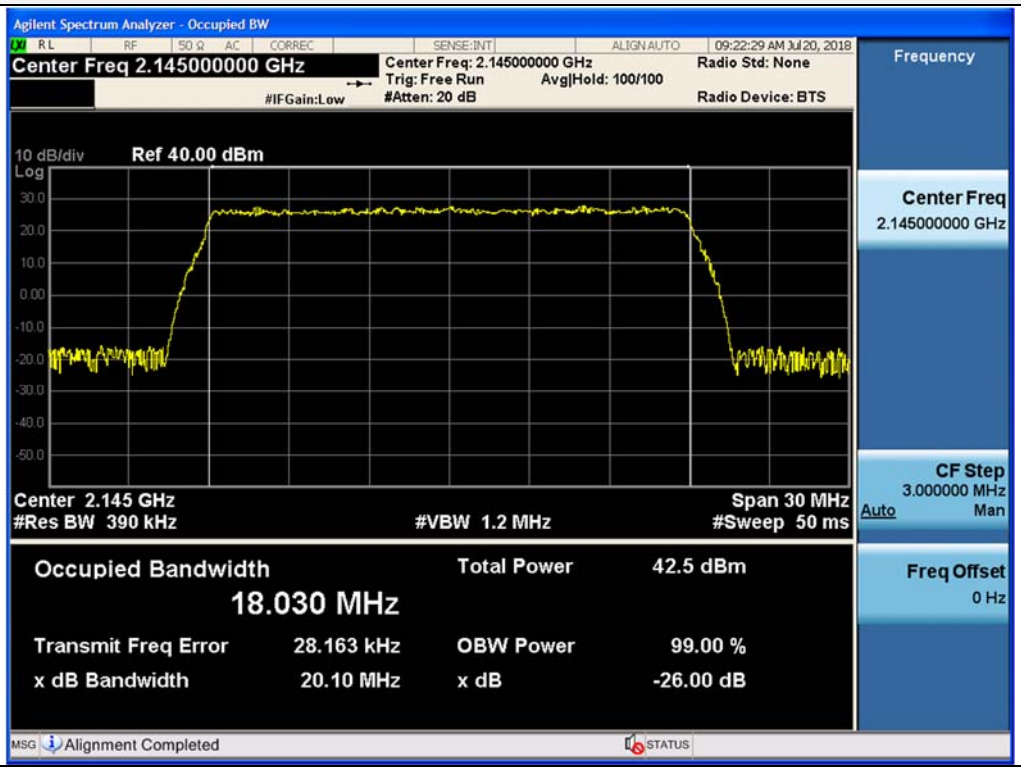
Output / AWS / Downlink / LTE 20 MHz


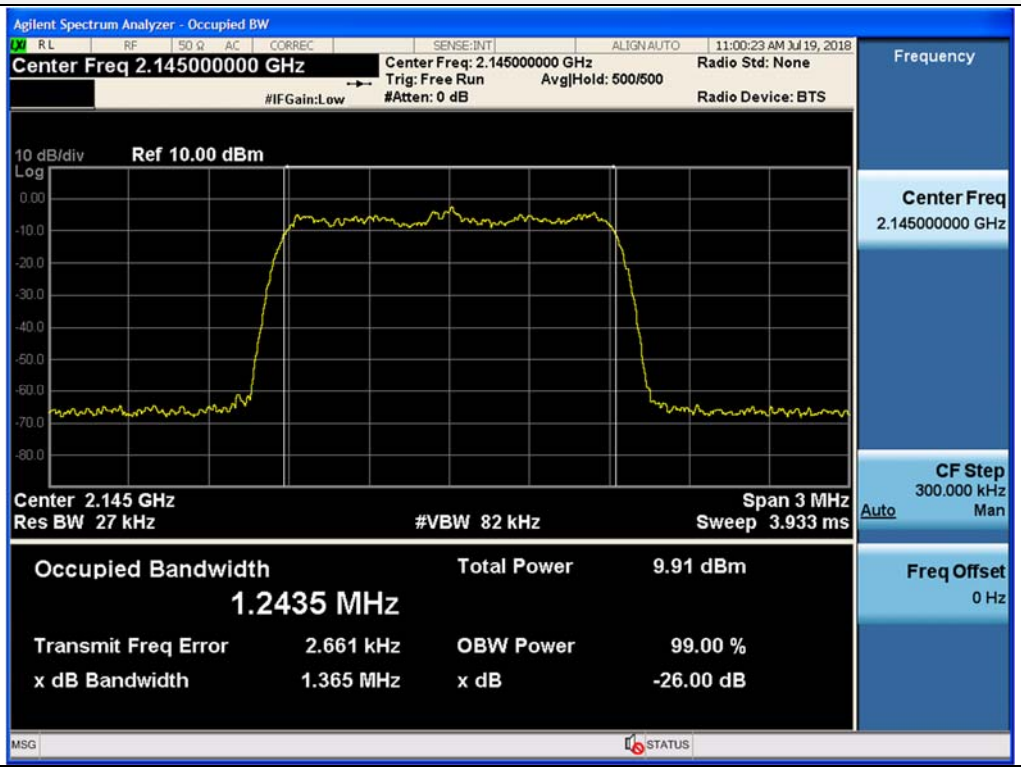
3 dB above the AGC threshold output / AWS / Downlink / CDMA


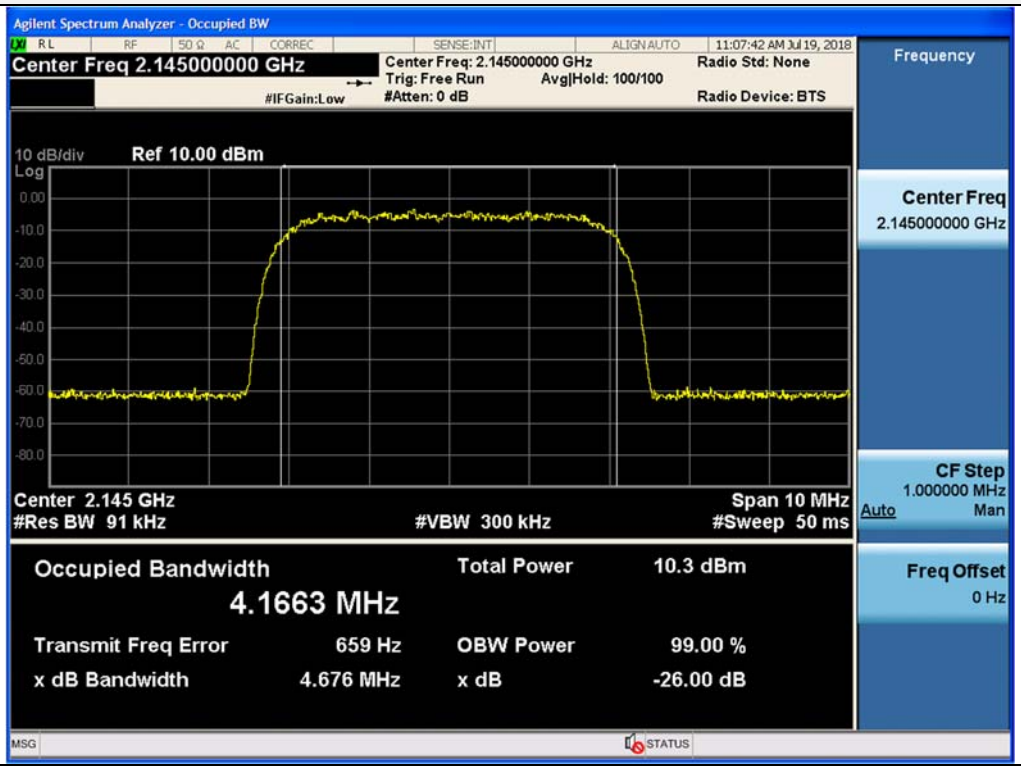
3 dB above the AGC threshold output / AWS / Downlink / WCDMA


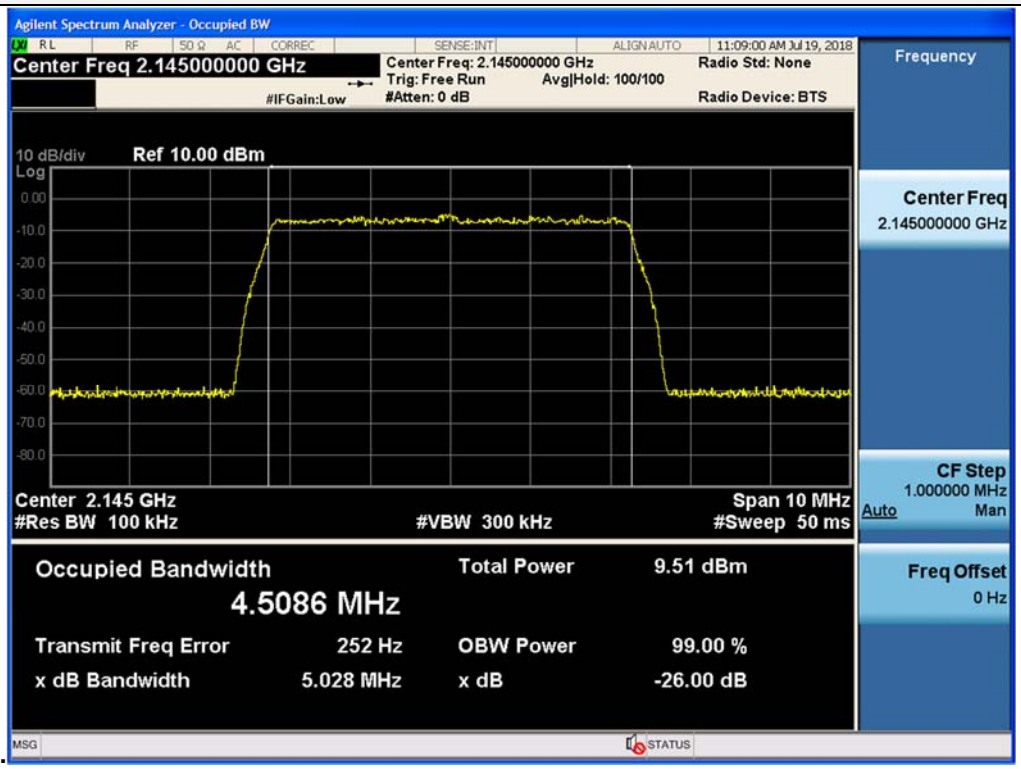
3 dB above the AGC threshold output / AWS / Downlink / LTE 5 MHz


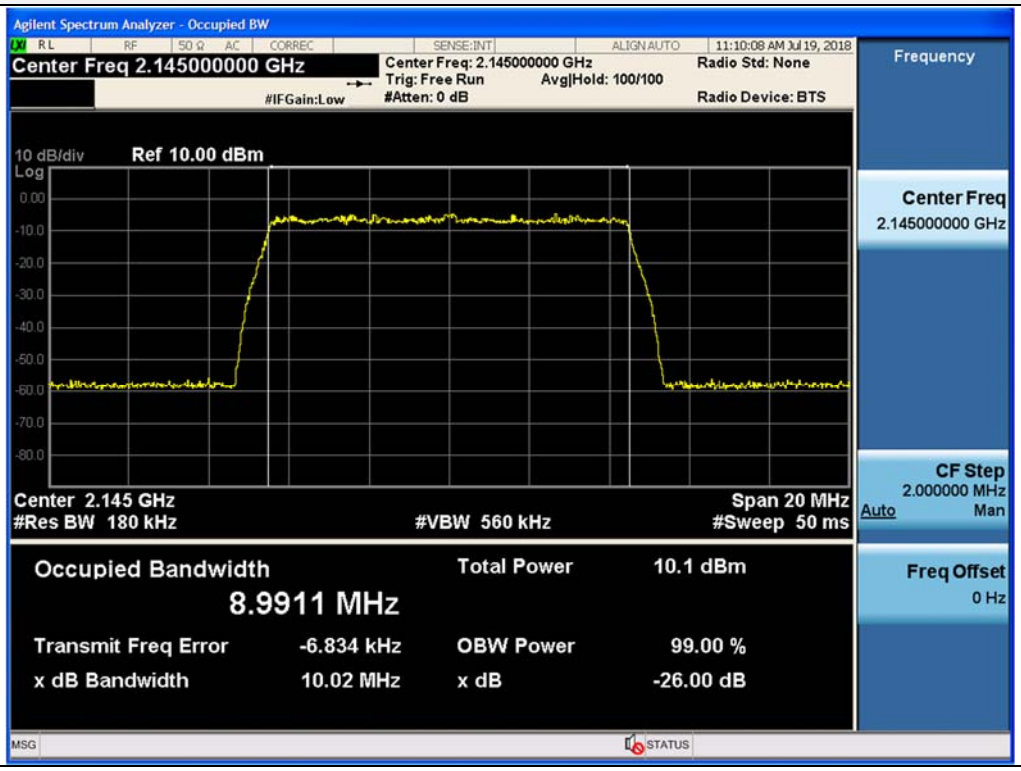
3 dB above the AGC threshold output / AWS / Downlink / LTE 10 MHz


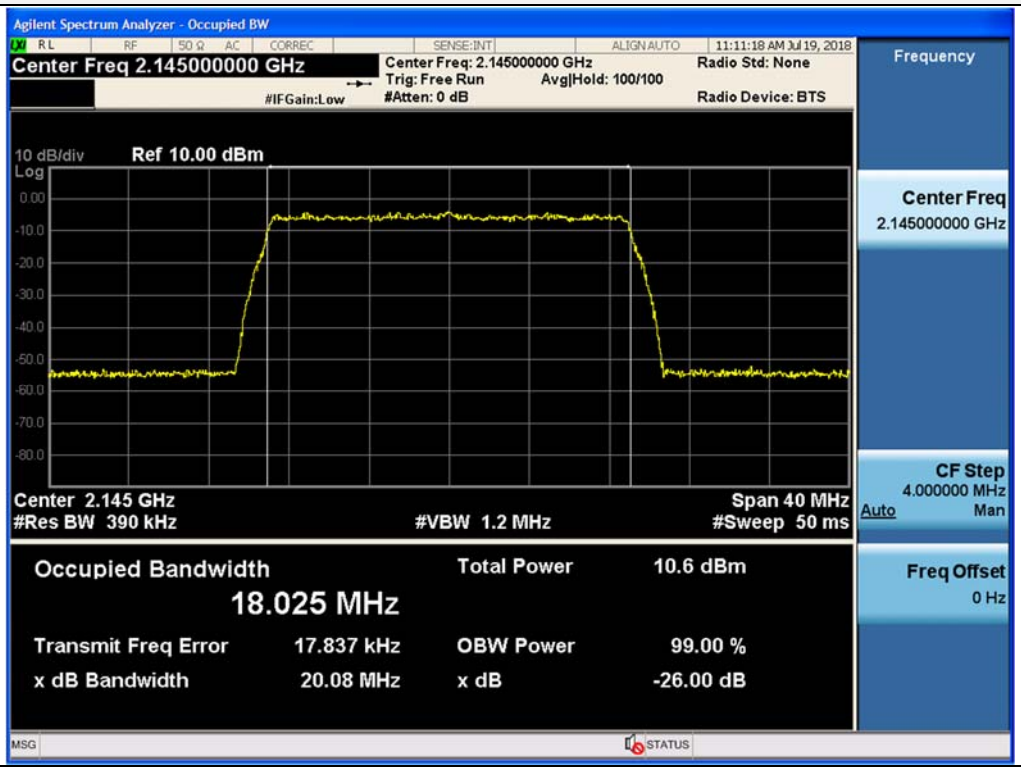
3 dB above the AGC threshold output / AWS / Downlink / LTE 20 MHz


Input / AWS / Downlink / CDMA


Input / AWS / Downlink / WCDMA


Input / AWS / Downlink / LTE 5 MHz


Input / AWS / Downlink / LTE 10 MHz


Input / AWS / Downlink / LTE 20 MHz


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.

(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:

(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:

(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.

§ 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.

Measurements were in accordance with the test methods section 4.5 of KDB 935210 D05 v01r02.

4.5.2 Measuring input and output power levels for determining amplifier/booster gain

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

b) Configure to generate the CW 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 a 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 4.5.3 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) Omit

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

4.5.3 Power measurement Method 1: using a spectrum or signal analyzer

a) Set the span to at least 1 MHz.

b) Set the RBW 100 kHz.

c) Set the VBW to ≥ 3 × RBW.

d) Set the detector to PEAK with the trace to MAX HOLD.

e) Place a marker on the peak of the signal a record the value.

f) Repeat without EUT in place.

g) Calculate gain with the following formula: Gain (dB) = output (dBm) − input (dBm).

4.5.5 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_700 MHz Band

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
700 LTE	Downlink	LTE 5 MHz	753.50	-20.05	33.15	53.20
		LTE 10 MHz	751.00	-20.08	32.99	53.07
FirstNet	Downlink	LTE 5 MHz	760.50	-20.03	32.89	52.92
			765.50	-20.11	32.81	52.92
		LTE 10 MHz	763.00	-20.01	32.96	52.97

Tabular data of Input / 3 dB above AGC threshold Output Power and Gain_700 MHz Band

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
700 LTE	Downlink	LTE 5 MHz	753.50	-20.05	33.17	53.22
		LTE 10 MHz	751.00	-20.08	33.21	53.29
FirstNet	Downlink	LTE 5 MHz	760.50	-20.03	32.90	52.93
			765.50	-20.11	32.79	52.90
		LTE 10 MHz	763.00	-20.01	32.88	52.89

Tabular data of PAPR_700 MHz Band

Test Band	Link	Signal	f_0 Frequency (MHz)	0.1 % PAPR (dB)
700 LTE	Downlink	LTE 5 MHz	742.00	8.30
		LTE 10 MHz	741.00	8.33
FirstNet	Downlink	LTE 5 MHz	763.00	8.25
		LTE 10 MHz	763.00	8.22

Tabular data of Input / Output Power and Gain_800 MHz Band

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
PS; B/ILT; SMR	Downlink	P25 Phase 2	861.42	-20.07	33.70	53.77
ESMR	Downlink	CDMA	867.36	-20.12	32.72	52.84
		LTE 5 MHz	866.50	-20.05	33.30	53.35
Cellular	Downlink	CDMA	871.01	-20.15	32.64	52.79
		WCDMA	871.50	-20.08	32.95	53.03
		LTE 5 MHz	871.50	-20.01	32.80	52.81
		LTE 10 MHz	874.00	-20.09	32.76	52.85

Tabular data of Input / 3 dB above AGC threshold Output Power and Gain_800 MHz Band

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	+3 dB Output Power (dBm)	Gain (dB)
ESMR	Downlink	CDMA	867.36	-20.12	32.80	52.92
		LTE 5 MHz	866.50	-20.05	33.35	53.40
Cellular	Downlink	CDMA	871.01	-20.15	32.82	52.97
		WCDMA	871.50	-20.08	32.97	53.05
		LTE 5 MHz	871.50	-20.01	32.79	52.80
		LTE 10 MHz	874.00	-20.09	32.76	52.85

Tabular data of PAPR_800 MHz Band

Test Band	Link	Signal	f_0 Frequency (MHz)	0.1 % PAPR (dB)
Cellular	Downlink	CDMA	871.01	7.74
		WCDMA	871.50	4.72
		LTE 5 MHz	871.50	8.33
		LTE 10 MHz	874.00	8.37

Tabular data of Input / Output Power and Gain_PCS Band

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
PCS	Downlink	GSM	1962.50	-20.03	32.94	52.97
		CDMA	1962.50	-20.14	33.20	53.34
		WCDMA	1962.50	-20.10	33.05	53.15
		LTE 5 MHz	1992.50	-20.07	33.16	53.23
		LTE 10 MHz	1962.50	-20.05	32.82	52.87
		LTE 20 MHz	1985.00	-20.09	33.12	53.21

Tabular data of Input / 3 dB above AGC threshold Output Power and Gain_PCS Band

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
PCS	Downlink	GSM	1962.50	-20.03	33.14	53.17
		CDMA	1962.50	-20.14	33.29	53.43
		WCDMA	1962.50	-20.10	33.34	53.44
		LTE 5 MHz	1992.50	-20.07	32.96	53.03
		LTE 10 MHz	1962.50	-20.05	33.05	53.10
		LTE 20 MHz	1985.00	-20.09	33.27	53.36

Tabular data of PAPR_PCS Band

Test Band	Link	Signal	f_0 Frequency (MHz)	0.1 % PAPR (dB)
PCS	Downlink	GSM	1962.50	8.42
		CDMA	1962.50	8.36
		WCDMA	1962.50	8.44
		LTE 5 MHz	1962.50	4.80
		LTE 10 MHz	1962.50	8.16
		LTE 20 MHz	1962.50	0.33

*Note: We have done CDMA and 1xEVDO / GSM and EDGE modulation test in technology. Test results are only attached worst cases.

Tabular data of Input / Output Power and Gain_AWS Band

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
AWS	Downlink	CDMA	2178.75	-20.05	33.24	53.29
		WCDMA	2112.50	-20.04	32.86	52.90
		LTE 5 MHz	2145.00	-20.06	32.91	52.97
		LTE 10 MHz	2175.00	-20.05	33.14	53.19
		LTE 20 MHz	2145.00	-20.11	33.01	53.12

Tabular data of Input / 3 dB above AGC threshold Output Power and Gain_ AWS Band

Test Band	Link	Signal	f_0 Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
AWS	Downlink	CDMA	2178.75	-20.05	33.22	53.27
		WCDMA	2112.50	-20.04	32.90	52.94
		LTE 5 MHz	2145.00	-20.06	32.99	53.05
		LTE 10 MHz	2175.00	-20.05	33.10	53.15
		LTE 20 MHz	2145.00	-20.11	33.07	53.18

Tabular data of PAPR_ AWS Band

Test Band	Link	Signal	f_0 Frequency (MHz)	0.1 % PAPR (dB)
AWS	Downlink	CDMA	2145.00	8.43
		WCDMA	2145.00	8.34
		LTE 5 MHz	2145.00	8.49
		LTE 10 MHz	2145.00	8.67
		LTE 20 MHz	2145.00	8.34

5.5. NOISE FIGURE

Test Requirements:

§ 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.

(2) The noise figure of a signal booster must not exceed 9 dB in either direction.

Test Procedures:

Measurements were in accordance with Agilent Application Note 57-1, 'The Direct Noise Measurement Method".

The output power of the device is measured with an input termination at a temperature of approximately 290K. If the gain of the device and noise bandwidth of the measurement system is known, the noise factor can be determined.

$$F_{sys} = \frac{N_o}{kT_oBG}$$

F_{sys} = System Noise Factor

N_0 = Output Noise Power

k = Boltzmann's Constant

T_0 = Standard Noise Temperature (290K)

B = Noise Bandwidth

G = Gain

'kT_0B' calculation result for 1 MHz noise bandwidth is -114 dBm/MHz.

'Gain' *v*alue can be obtained from the test performed previously.

For measure the 'output noise power', perform the following procedure.

a) Remove a signal generator from the input port of EUT then terminate it.

b) Turn off the AGC function in EUT.

c) Connect a spectrum analyzer to output port of EUT.

e) Set the RBW 1 MHz. and set the VBW to ≥ 3 × RBW.

f) Measure the maximum output noise power for EUT pass band.

After the measurement, calculate the noise figure according to the following formular.

Noise Figure = Noise Output Power - kT0B - Gain

Test Results:

Test Band	Link	Measured Value (dBm)	Calculated Factor (-kT0B-Gain, dB)	Noise Figure (dB)
PS; B/ILT SMR	Downlink	-52.189	60.23	8.041

* For reason of filter setting, noise figure is measured at all frequencies of 857.5 ~ 894 MHz band.

5.6. 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.

(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;

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(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.