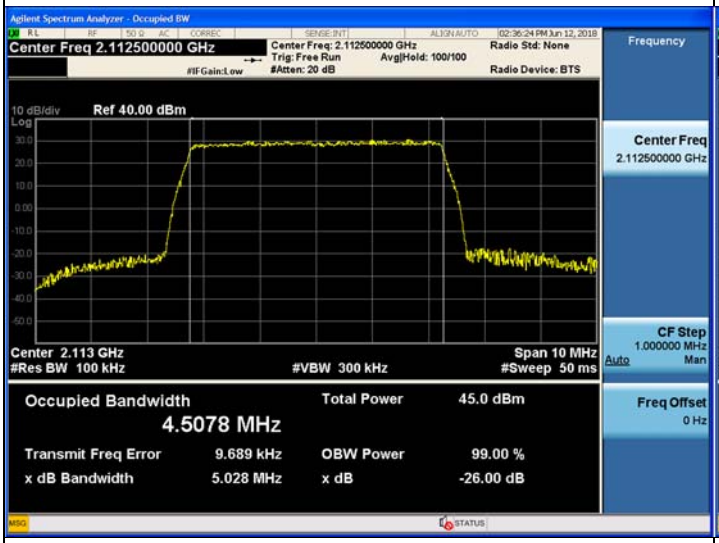
[Downlink Input_AWS 2100 Band]

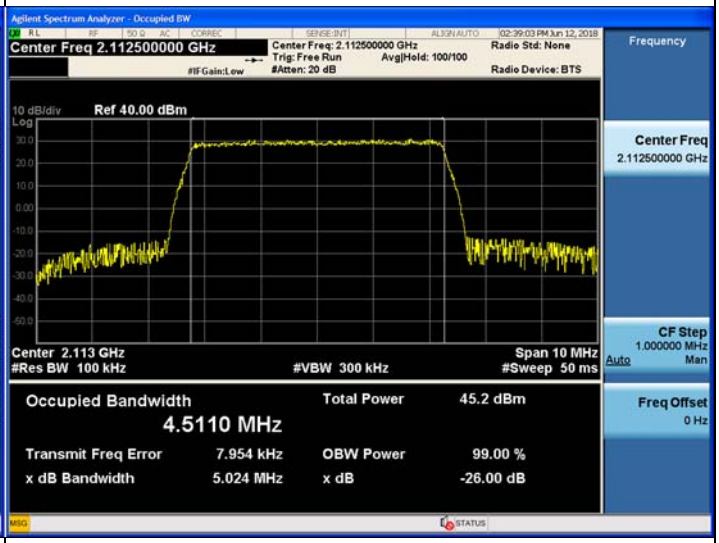
AWS 2100 Band	Channel	Frequency (MHz)	OBW (MHz)
LTE 5 MHz AGC threshold	Low	2112.50	4.5117
	Middle	2145.00	4.5104
	High	2177.50	4.5144
LTE 10 MHz AGC threshold	Low	2115.00	9.0072
	Middle	2145.00	8.9956
	High	2175.00	8.9940
LTE 20 MHz AGC threshold	Low	2115.00	18.021
	Middle	2145.00	18.012
	High	2175.00	17.994
WCDMA AGC threshold	Low	2112.50	4.1735
	Middle	2145.00	4.1746
	High	2177.50	4.1846
CDMA AGC threshold	Low	2111.25	1.2593
	Middle	2145.00	1.2660
	High	2178.75	1.2622

Plots of Output Occupied Bandwidth for AWS 2100 Band LTE 5 MHz

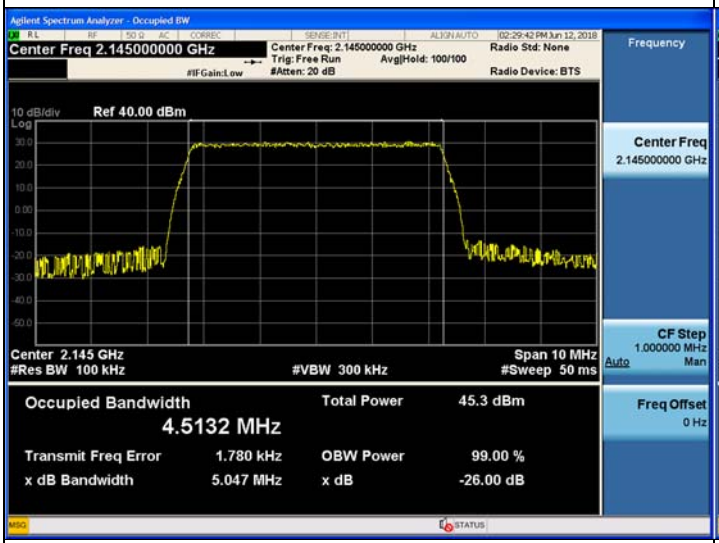
Low Channel AGC threshold



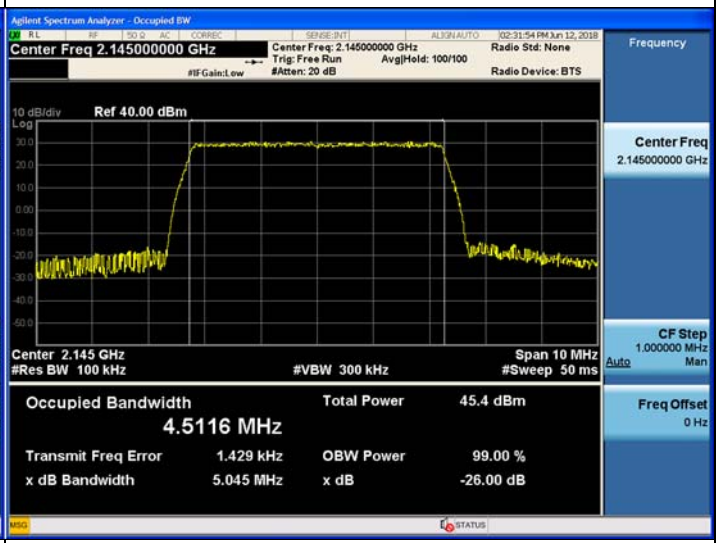
Low Channel +3 dB AGC threshold



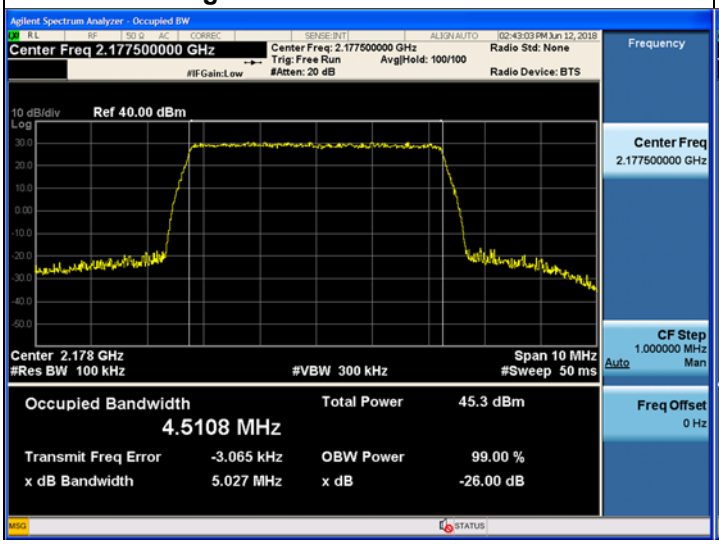
Middle Channel AGC threshold



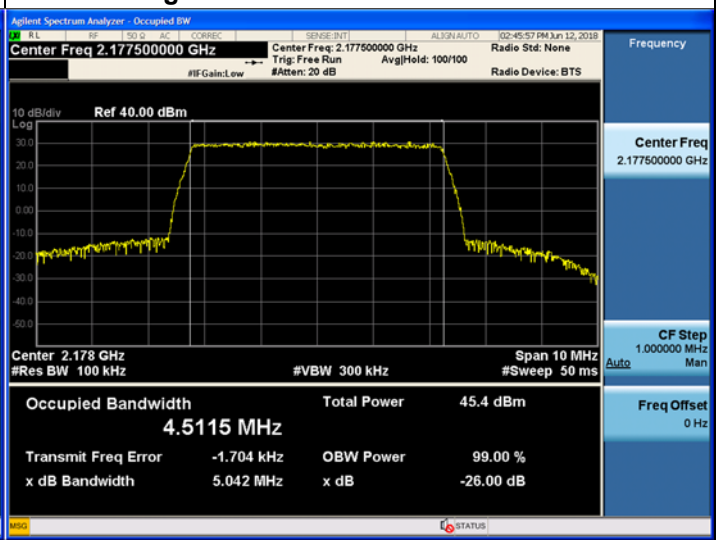
Middle Channel +3 dB AGC threshold



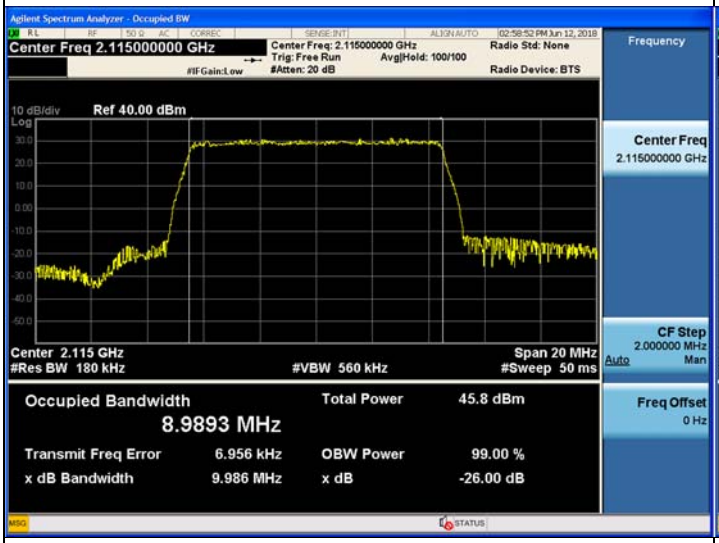
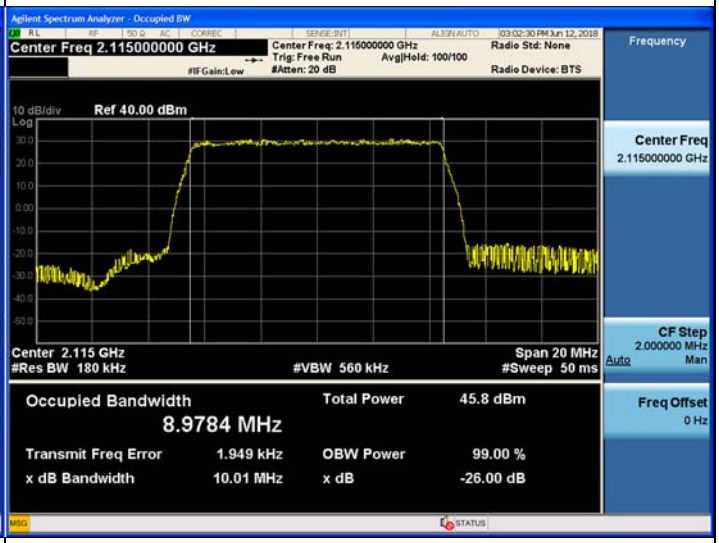
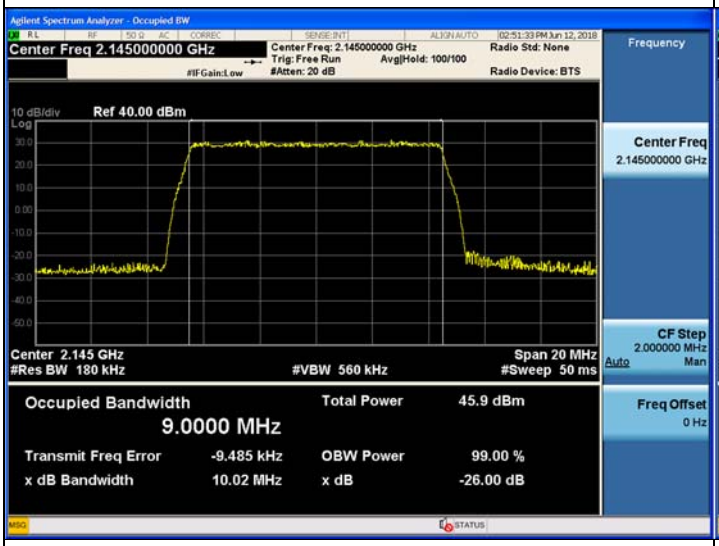
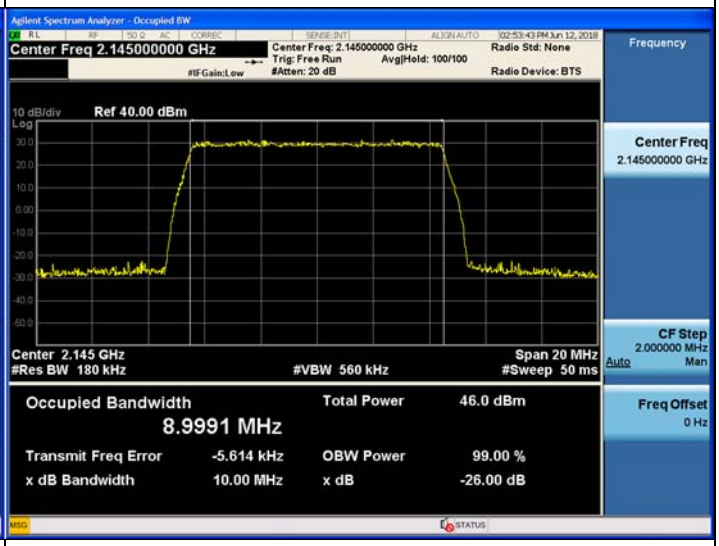
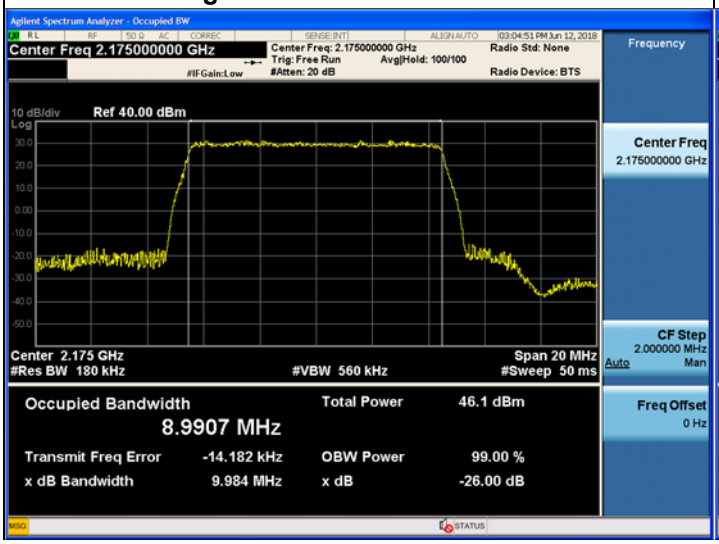
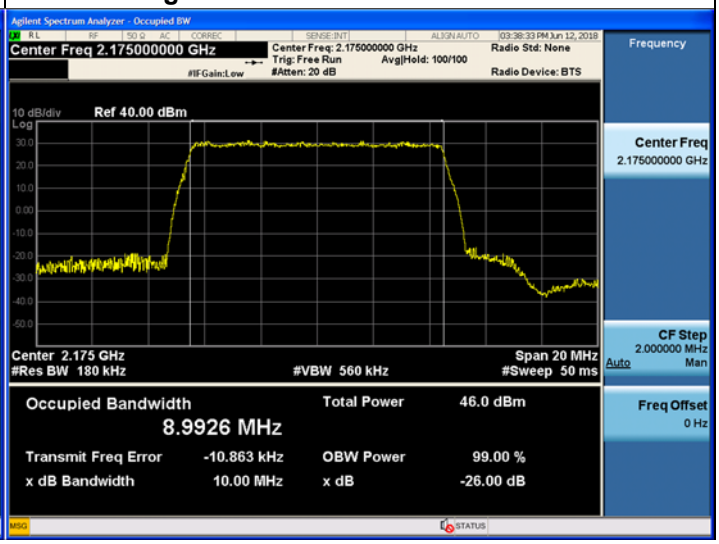
High Channel AGC threshold



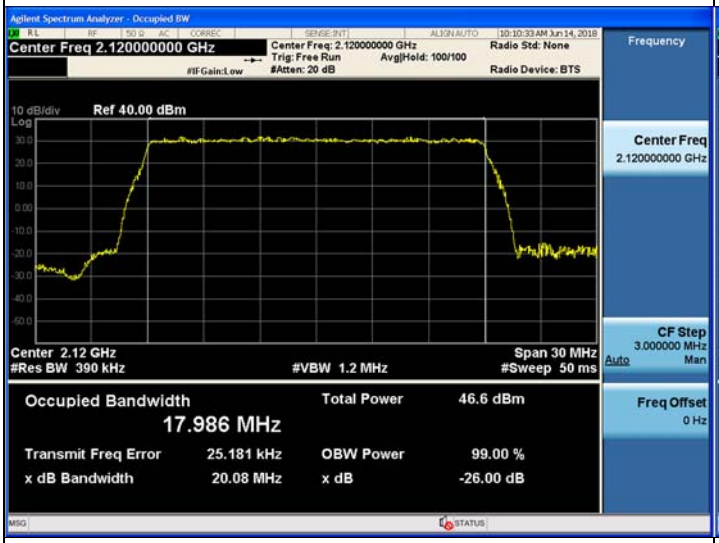
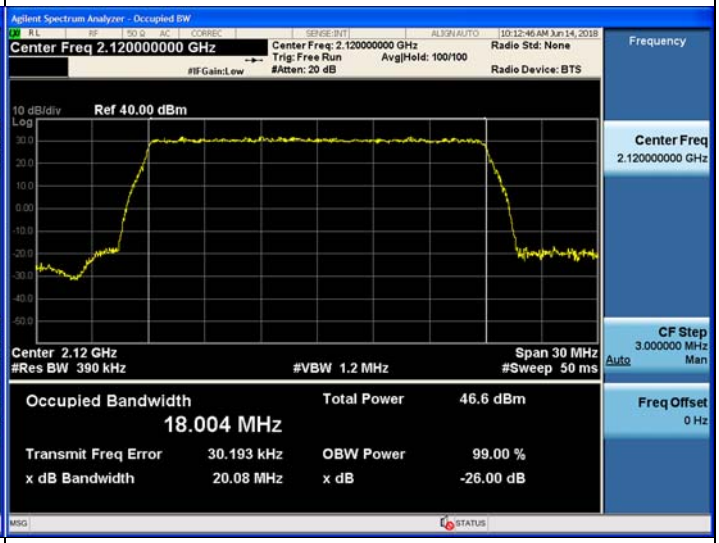
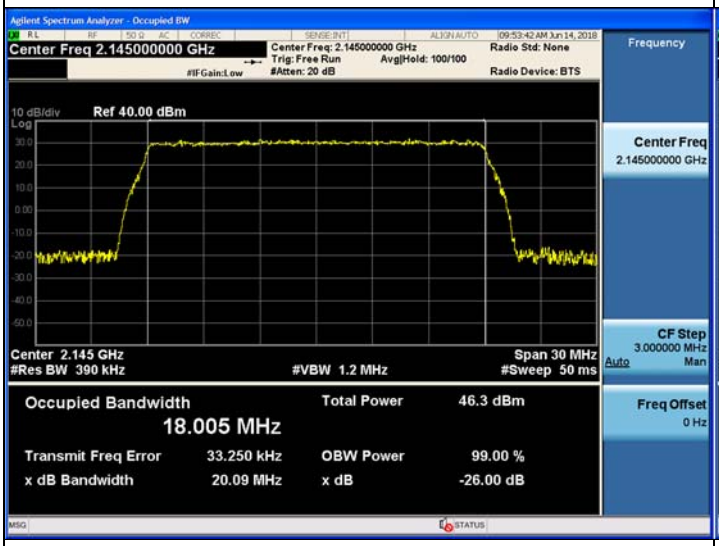
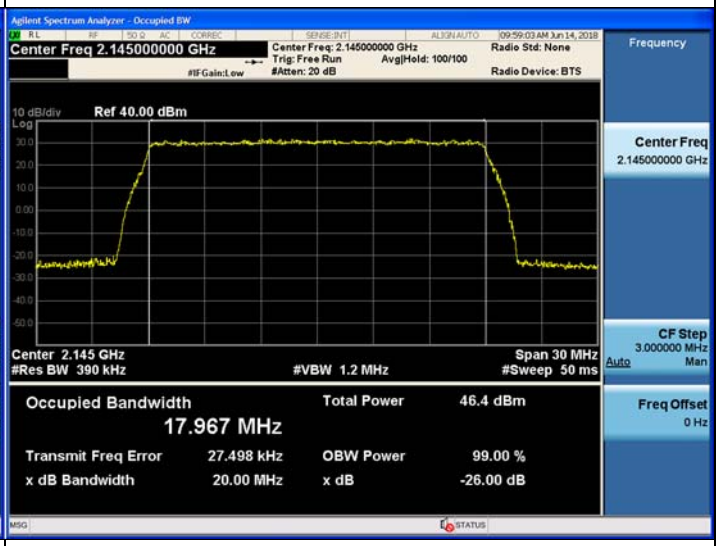
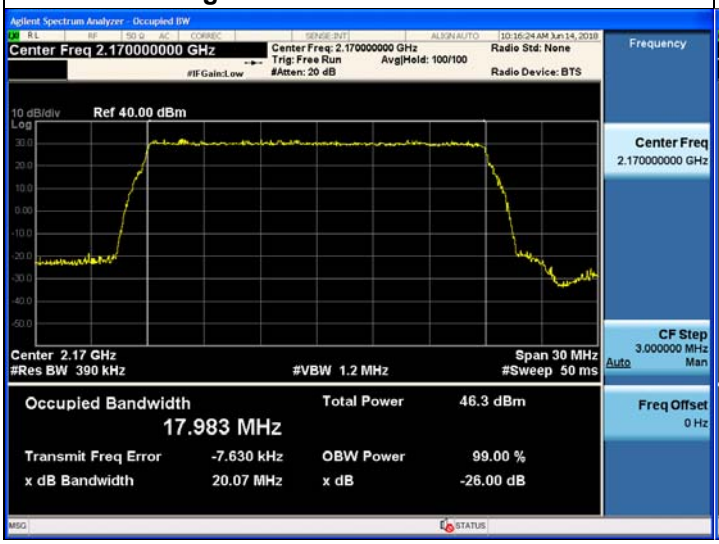
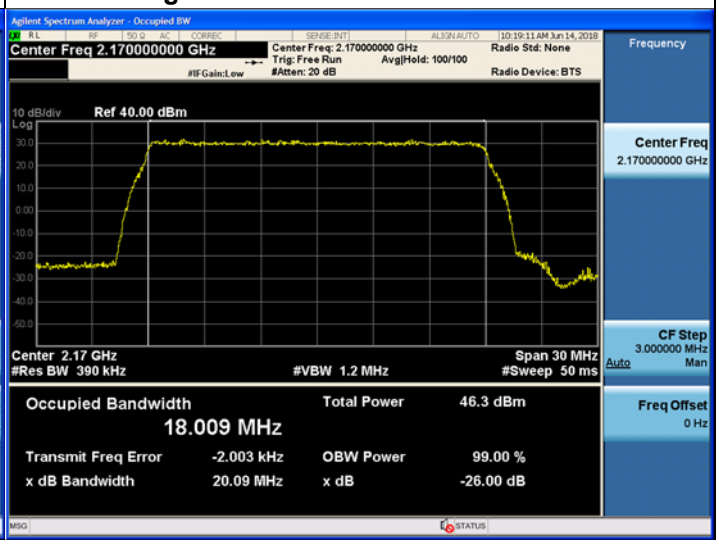
High Channel +3 dB AGC threshold



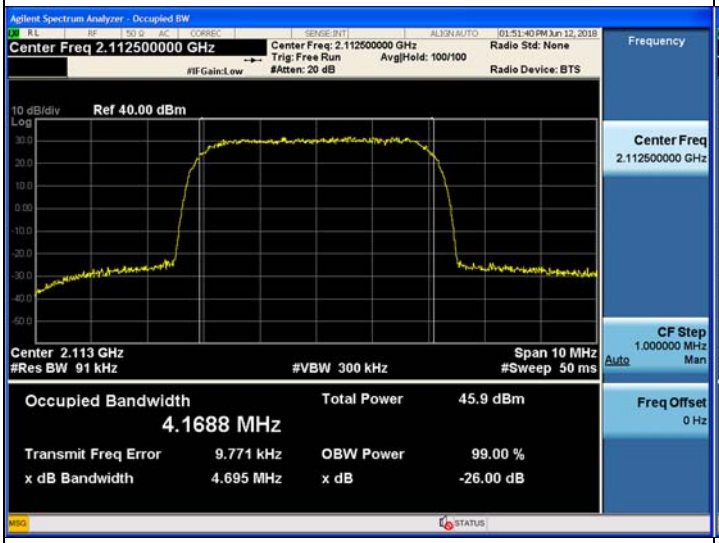
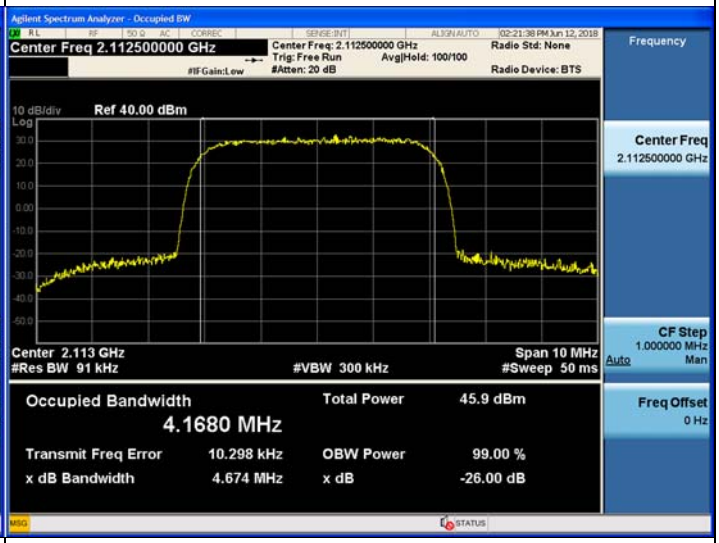
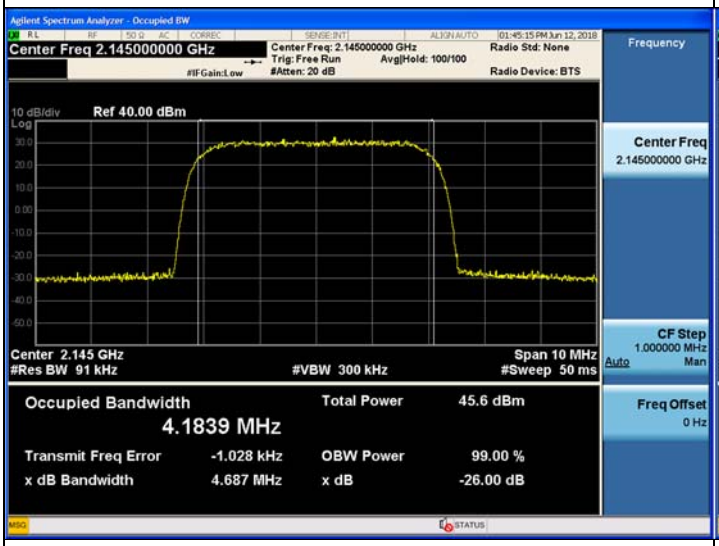
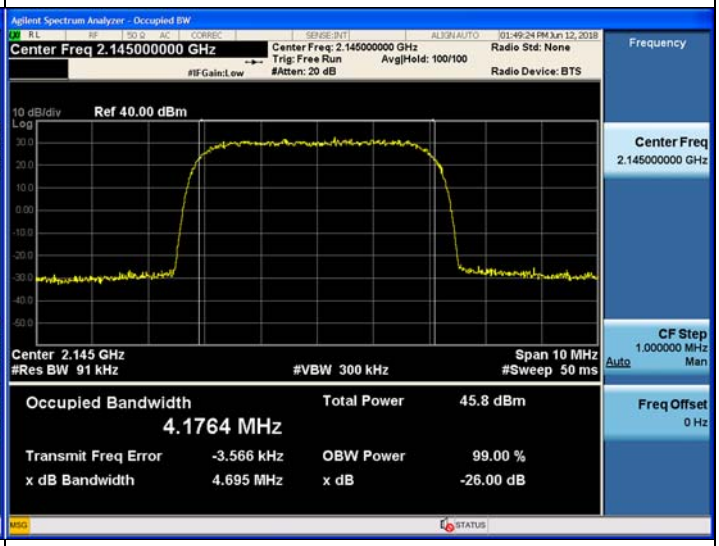
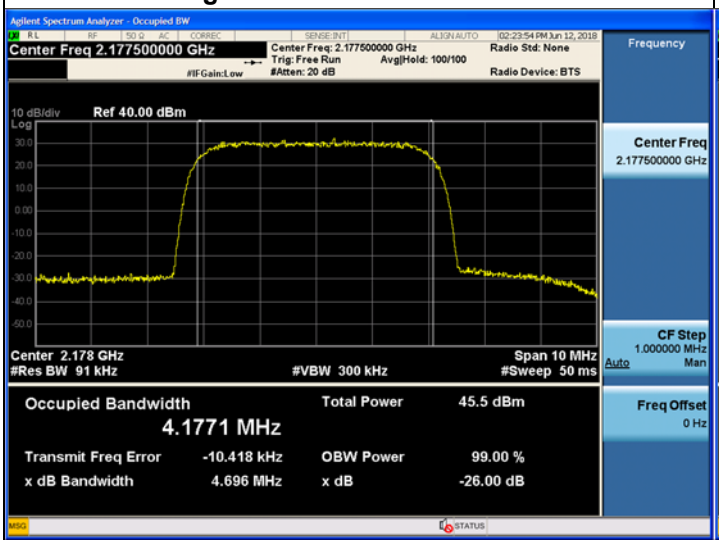
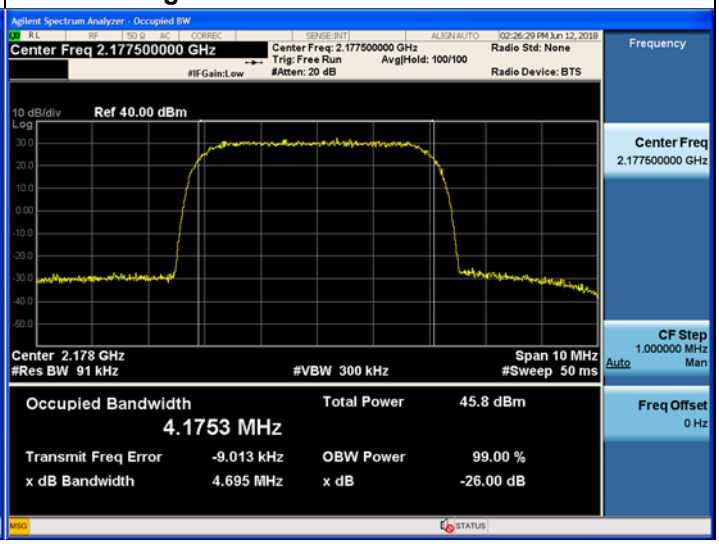
Plots of Output Occupied Bandwidth for AWS 2100 Band LTE 10 MHz

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

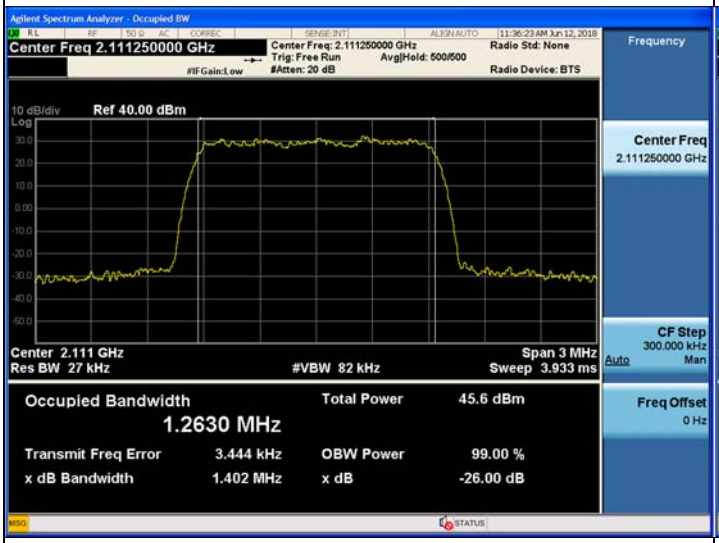
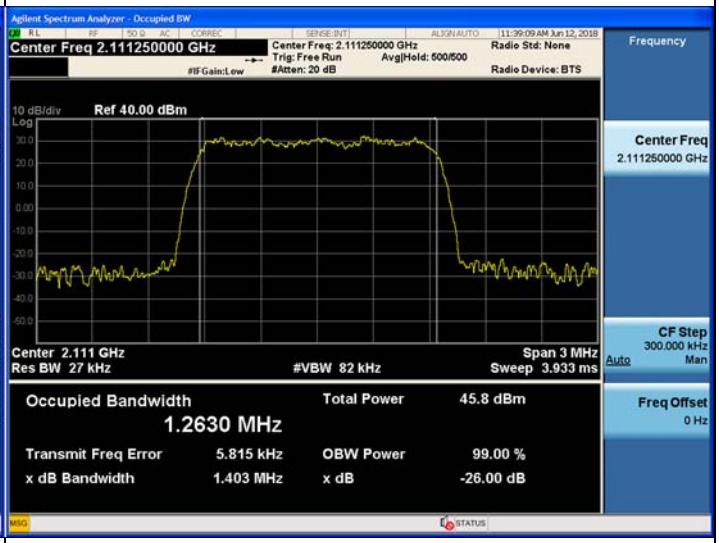
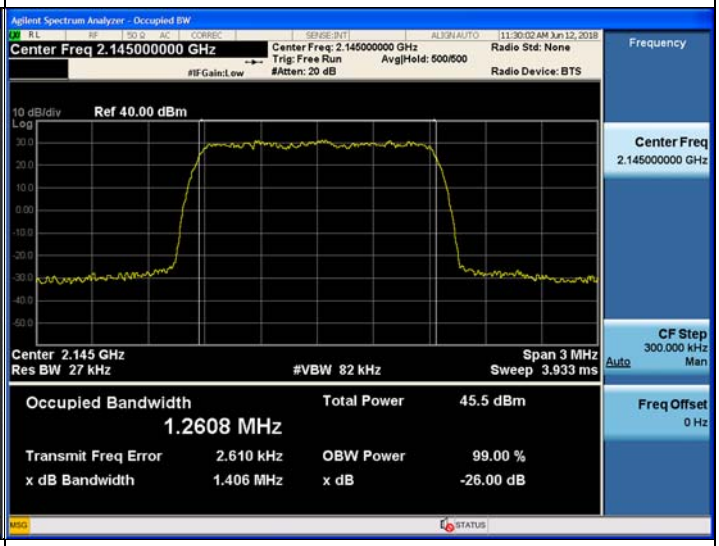
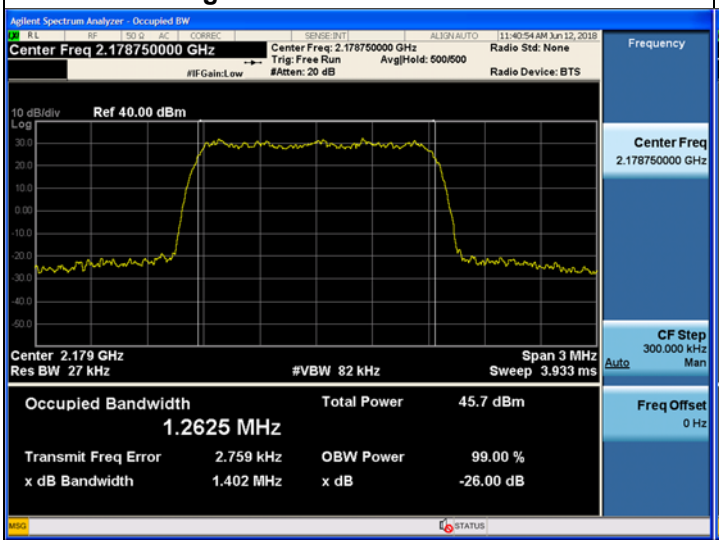
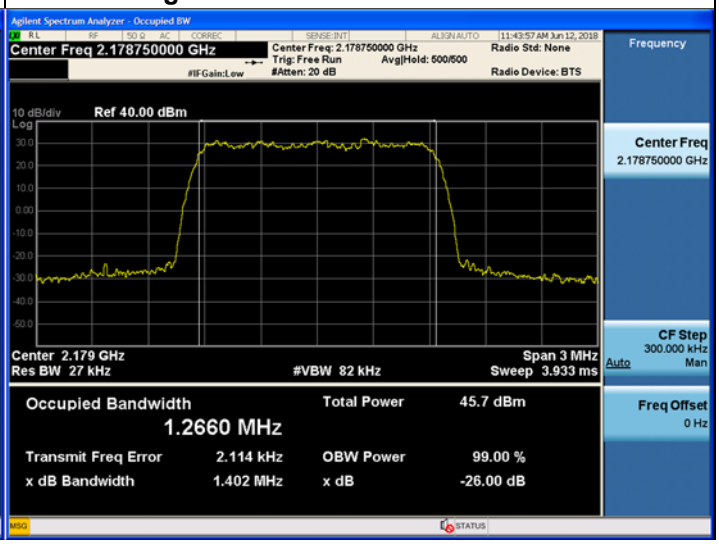
Plots of Output Occupied Bandwidth for AWS 2100 Band LTE 20 MHz

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

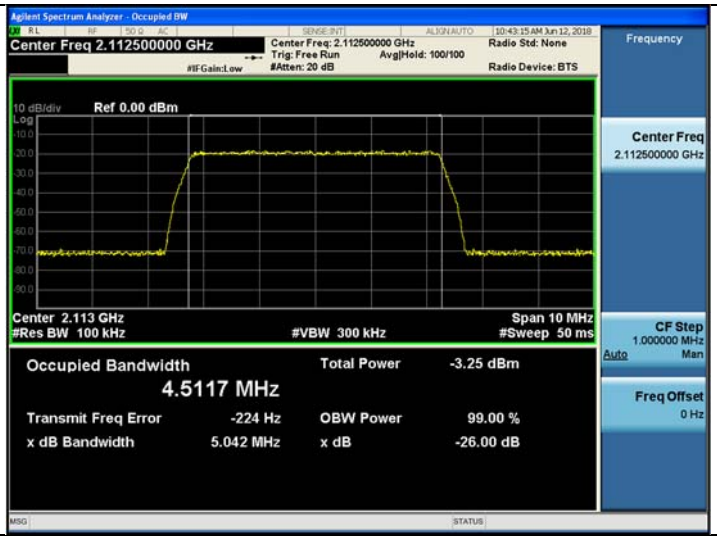
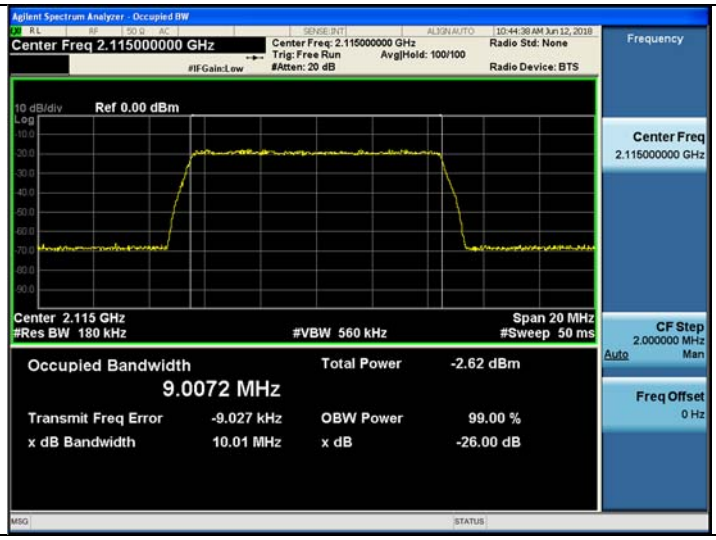
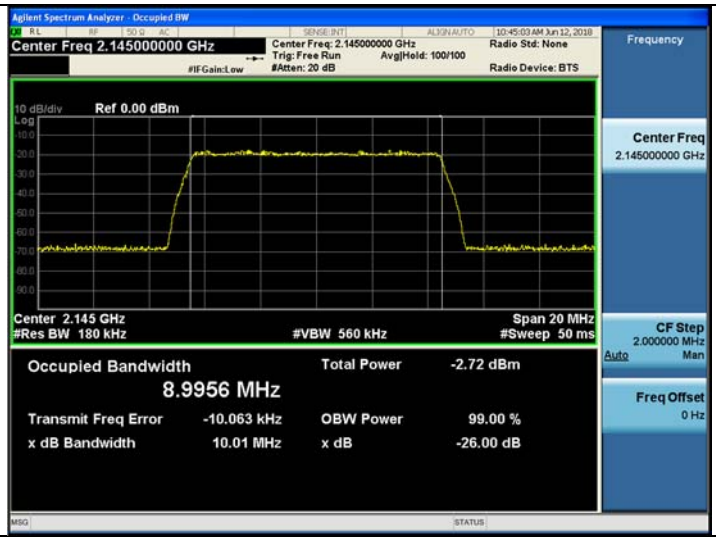
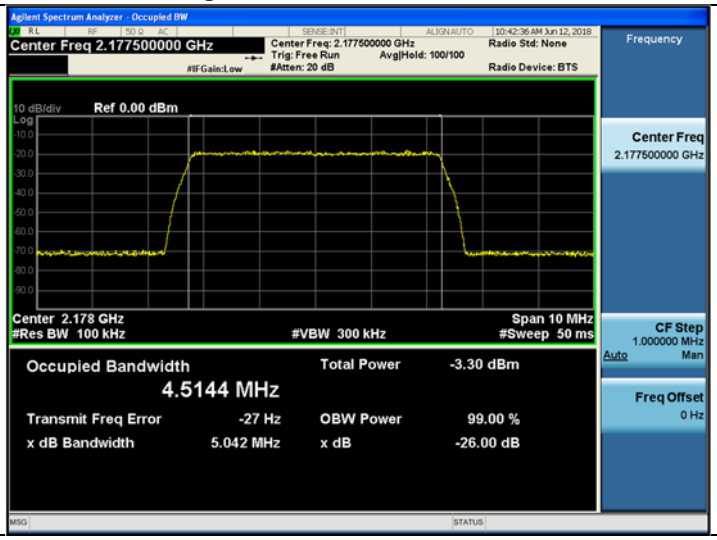
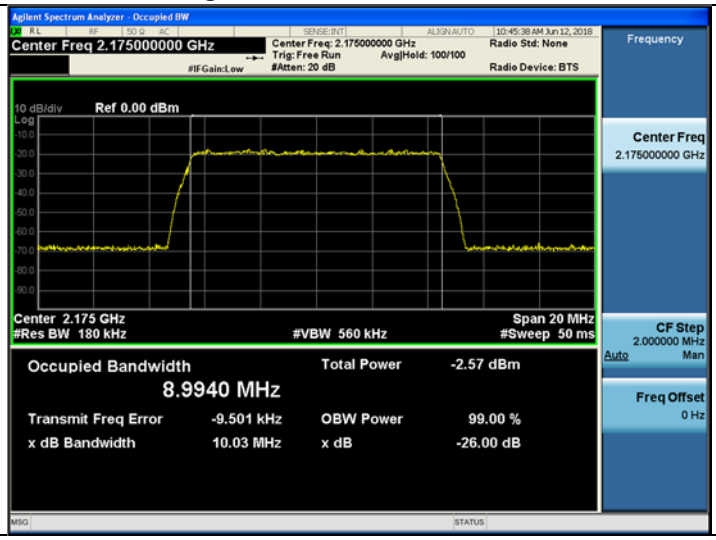
Plots of Output Occupied Bandwidth for AWS 2100 Band WCDMA

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

Plots of Output Occupied Bandwidth for AWS 2100 Band CDMA

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

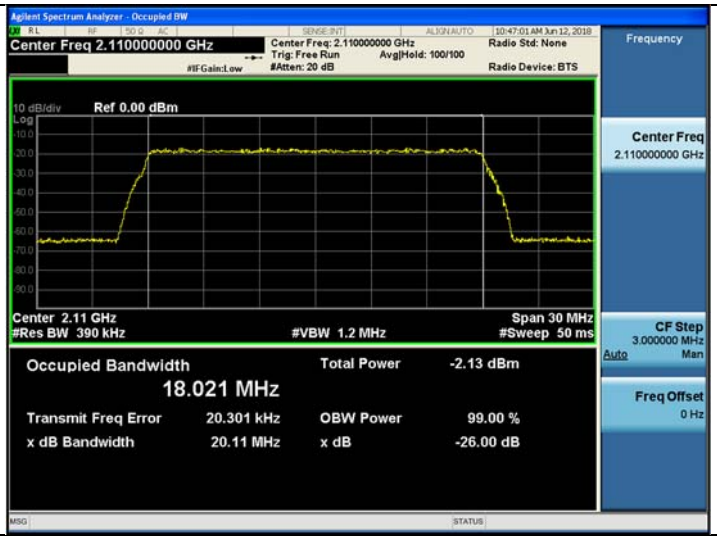
Plots of Input Occupied Bandwidth for AWS 2100 LTE Band

LTE 5 MHz	LTE 10 MHz
Low Channel AGC threshold	Low Channel AGC threshold
	
Middle Channel AGC threshold	Middle Channel AGC threshold
	
High Channel AGC threshold	High Channel AGC threshold
	

Plots of Input Occupied Bandwidth for AWS 2100 LTE Band

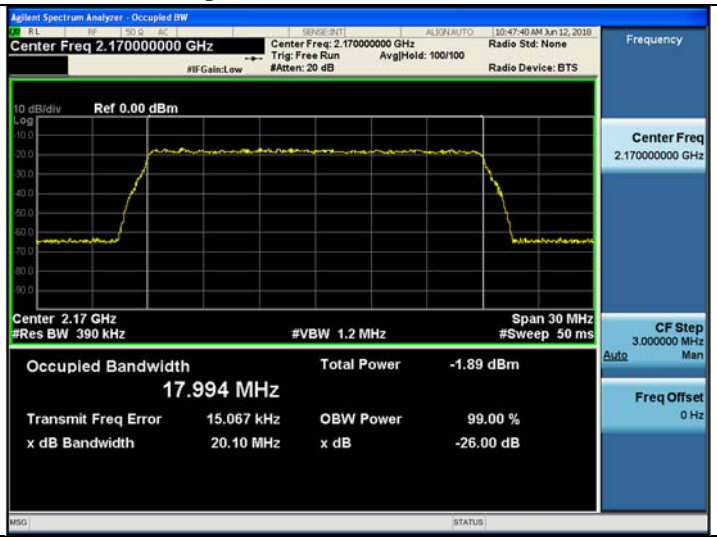
LTE 20 MHz

Low Channel AGC threshold

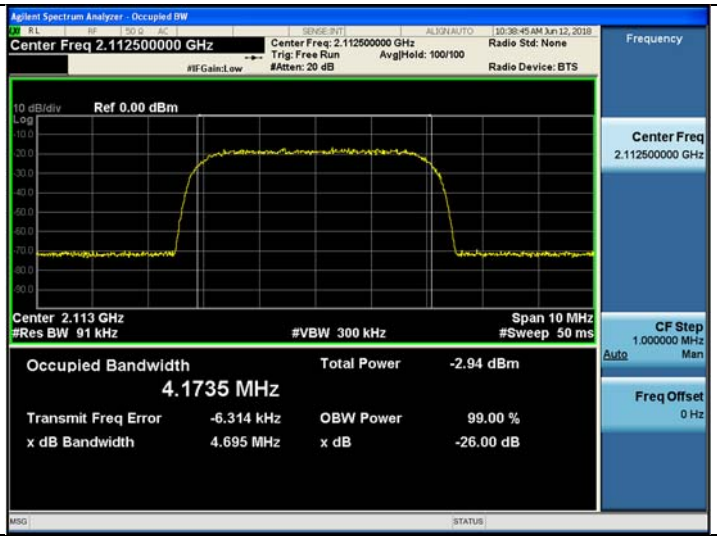
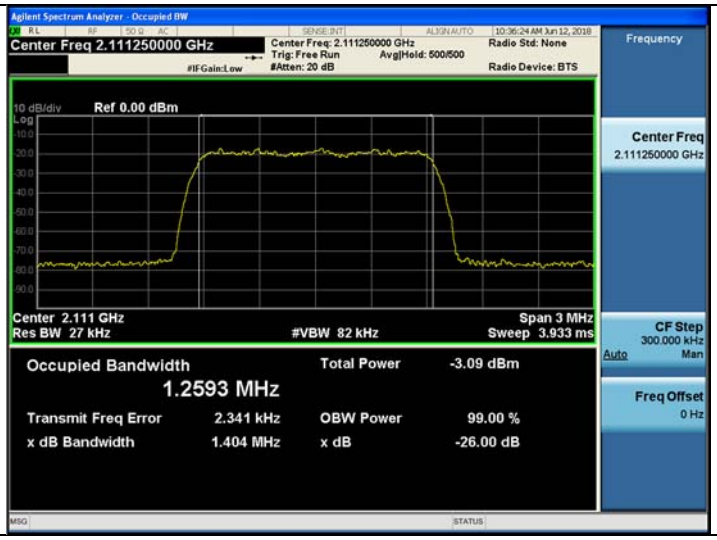
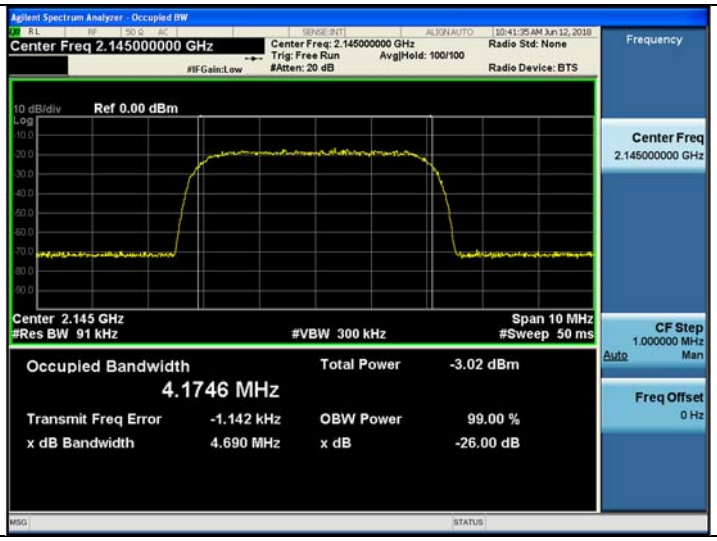
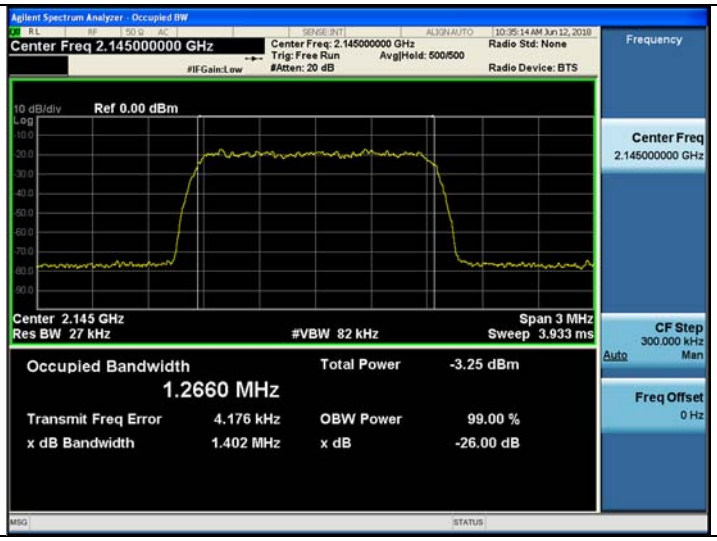
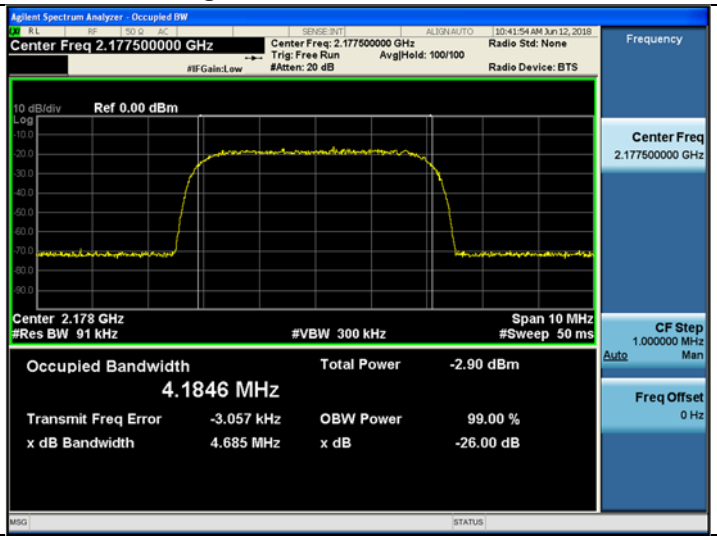
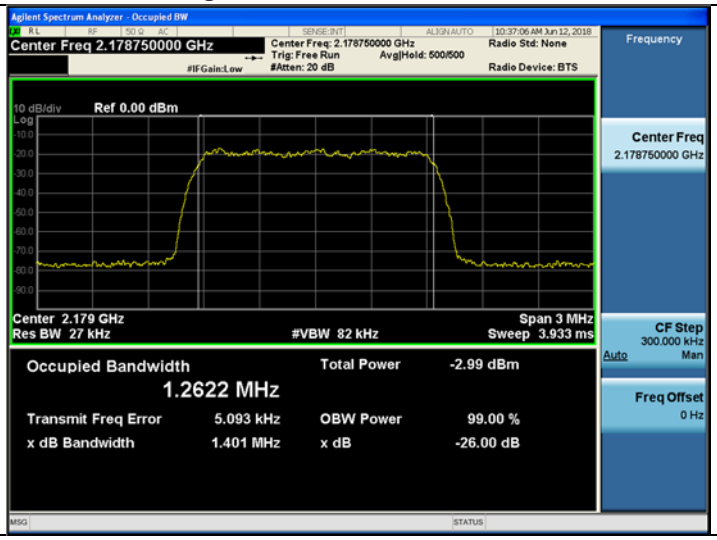


Middle Channel AGC threshold

High Channel AGC threshold



Plots of Input Occupied Bandwidth for AWS 2100 Band

WCDMA	CDMA
Low Channel AGC threshold	**Low Channel AGC threshold**
	
Middle Channel AGC threshold	**Middle Channel AGC threshold**
	
High Channel AGC threshold	**High Channel AGC threshold**
	

7. INPUT VERSUS OUTPUT SPECTRUM

ISED Rules

Test Requirements:

RSS-131

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

5.2 Industrial Zone Enhancers

5.2.2 Input-versus-output spectrum

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

Test Procedures:

RSS-GEN

6 General administrative and technical requirements

6.7 Occupied bandwidth (or 99% emission bandwidth) and x dB bandwidth

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

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

Test Results:

[Downlink Output_AWS 2100 Band]

AWS 2100 Band	Channel	Frequency (MHz)	26 dB BW (MHz)	Growth (%)
LTE 5 MHz AGC threshold	Low	2112.50	5.028	-0.28
	Middle	2145.00	5.047	-0.06
	High	2177.50	5.027	-0.30
LTE 5 MHz +3dBm above the AGC threshold	Low	2112.50	5.024	-0.36
	Middle	2145.00	5.045	-0.10
	High	2177.50	5.042	0.00
LTE 10 MHz AGC threshold	Low	2115.00	9.986	-0.24
	Middle	2145.00	10.02	0.10
	High	2175.00	9.984	-0.46
LTE 10 MHz +3dBm above the AGC threshold	Low	2115.00	10.01	0.00
	Middle	2145.00	10.00	-0.10
	High	2175.00	10.00	-0.30
LTE 20 MHz AGC threshold	Low	2120.00	20.08	-0.15
	Middle	2145.00	20.09	0.00
	High	2170.00	20.07	-0.15
LTE 20 MHz +3dBm above the AGC threshold	Low	2120.00	20.08	-0.15
	Middle	2145.00	20.00	-0.45
	High	2170.00	20.09	-0.05
WCDMA AGC threshold	Low	2112.50	4.695	0.00
	Middle	2145.00	4.687	-0.06
	High	2177.50	4.696	0.23
WCDMA +3dBm above the AGC threshold	Low	2112.50	4.674	-0.45
	Middle	2145.00	4.695	0.11
	High	2177.50	4.695	0.21
CDMA AGC threshold	Low	2111.25	1.402	-0.14
	Middle	2145.00	1.408	0.43
	High	2178.75	1.402	0.07
CDMA +3dBm above the AGC threshold	Low	2111.25	1.403	-0.07
	Middle	2145.00	1.406	0.29
	High	2178.75	1.402	0.07

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

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

FCC Rules

Test Requirements:

KDB 935210 D05 v01r02

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

ISED Rules

Test Requirements:

RSS-131

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

5.2 Industrial Zone Enhancers

5.2.1 Out-of-band rejection

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

5.2.3 Mean output power and zone enhancer gain

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

Test Procedures:

Measurements were in accordance with the test methods section 3.3, 4.3 of KDB 935210 D05 v01r02.

3.3 EUT out-of-band rejection

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

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

1) Frequency range = ± 250 % of the passband from the center of the passband.

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

3) Dwell time = approx. 10 ms.

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

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

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

e) Set the resolution bandwidth of the spectrum analyzer to be 1 % to 5 % of the passband and

the video bandwidth shall be set to ≥ 3 × RBW.

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

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

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

4.3 PLMRS device out-of-band rejection

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

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

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

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

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

e) Dwell time = approx. 10 ms.

f) Frequency step = 50 kHz.

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

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

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

j) After the trace is completely filled, place a marker at the peak amplitude, which is designated as f0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the gain has fallen by 20 dB).

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

Test Results:

Input Signal	Input Level Input Signal : Sinusoidal	Maximum Amp Gain
AWS 2100 Band	-20 dBm	57 dB

[Downlink]

Band	20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
AWS 2100	2 102.300 MHz ~ 2 188.225 MHz	37.240	57.240

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

9. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

FCC Rules

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals:

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

§ 27.53 Emission limits

(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.

ISED Rules

Test Requirements:

RSS-139

6. Transmitter Standard Specifications

6.6 Transmitter Unwanted Emissions

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

ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.

Test Procedures:

Measurements were in accordance with the test methods section 3.6 and 4.7 of KDB 935210 D05 v01r02.

3.6.1 General

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

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

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

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

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

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

3.6.2 Out-of-band/out-of-block emissions conducted measurements

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

If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.

b) Set the signal generator to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW).

c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168, but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168.

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the EBW or 100 kHz or 1 MHz)

g) Set the VBW = 3 × RBW.

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

i) Set the Sweep time = auto-couple.

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

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

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

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

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

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

p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.

q) Repeat steps k) to n).

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

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

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

3.6.3 Spurious emissions conducted measurements

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

b) Set the signal generator to produce the broadband test signal as previously described (i.e., 4.1 MHz OBW AWGN).

c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.

d) Set the EUT input power to a level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).

g) Set the VBW ≥ 3 × RBW.

h) Set the Sweep time = auto-couple.

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

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

j) Select the power averaging (rms) detector function.

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

l) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test

report.

m) Reset the spectrum analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to 10 times the highest frequency of the fundamental emission (see § 2.1057). The number of measurement points in each sweep must be ≥ (2 × span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

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

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

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

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

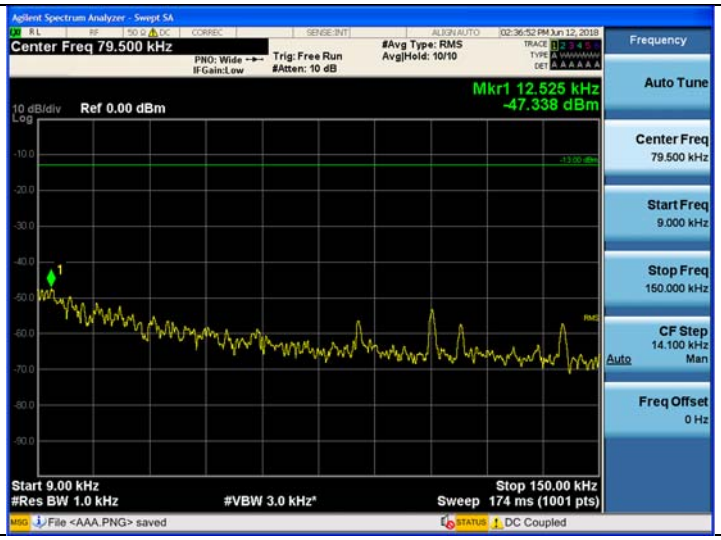
r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

Notes: In 9 KHz-150 KHz and 150 KHz-30 MHz bands, RBW was reduced to 1% and 10% of the reference bandwidth for measuring unwanted emission level(typically, 100KHz if the authorized frequency band is below 1GHz) and power was integrated.(1% = +20 dB, 10% = +10 dB)

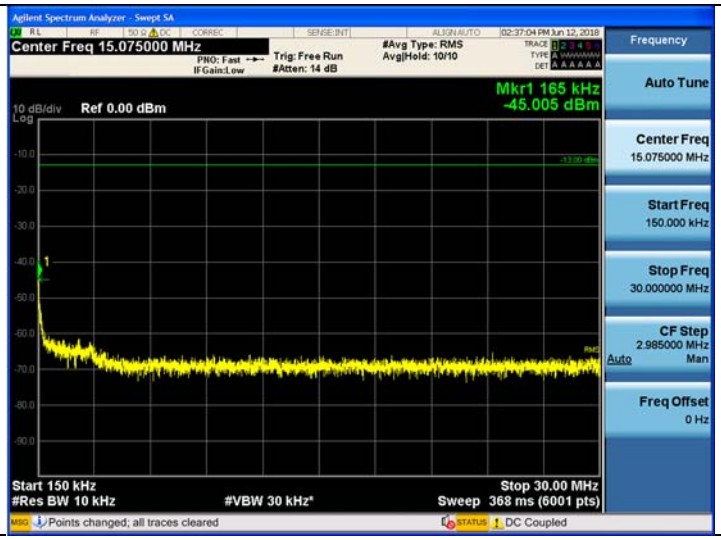
Plots of Unwanted Conducted Emissions for AWS 2100 Band LTE 5 MHz

Low Channel

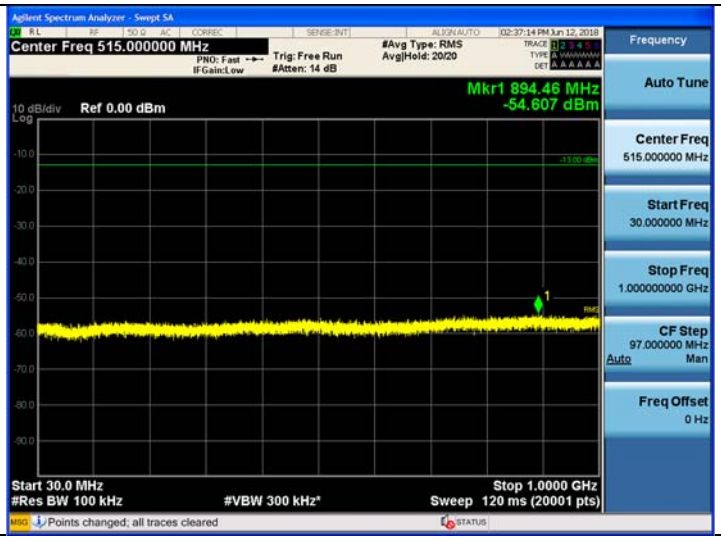
9 kHz ~ 150 kHz



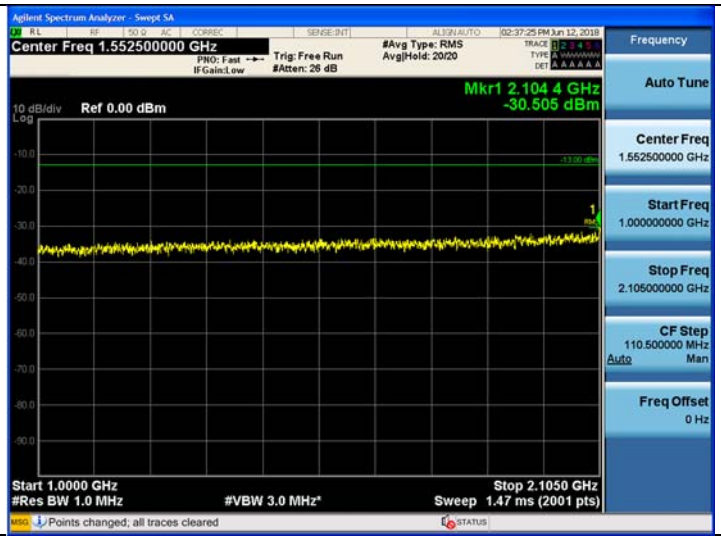
150 kHz ~ 30 MHz



30 MHz – 1 GHz

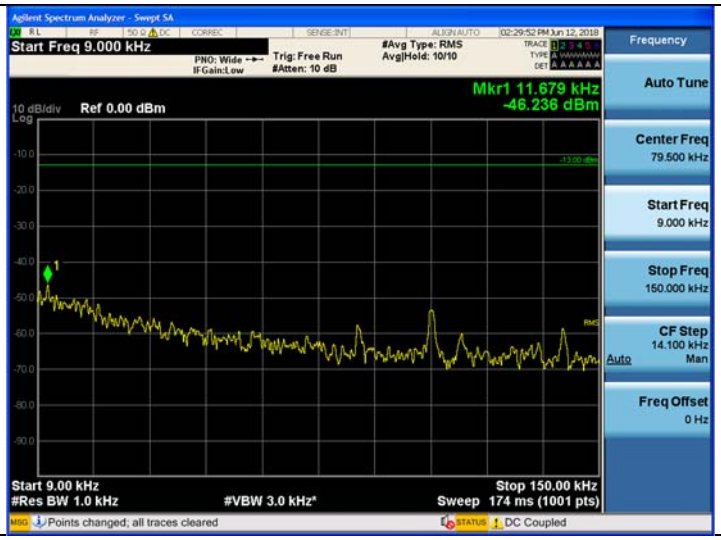
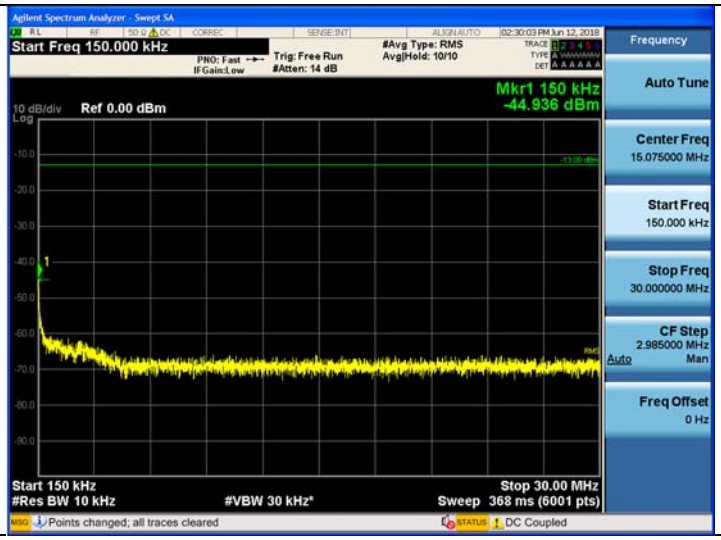
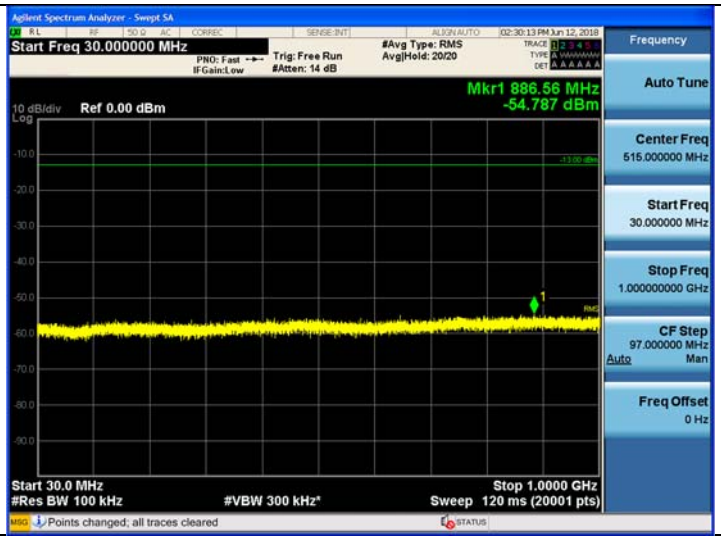
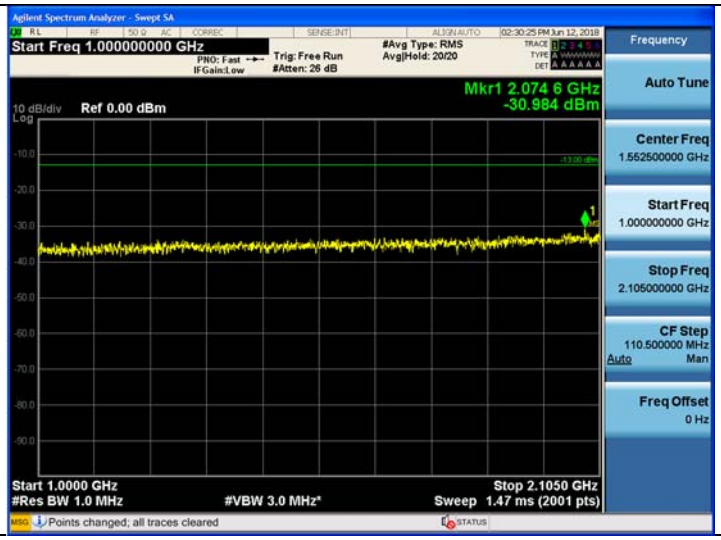


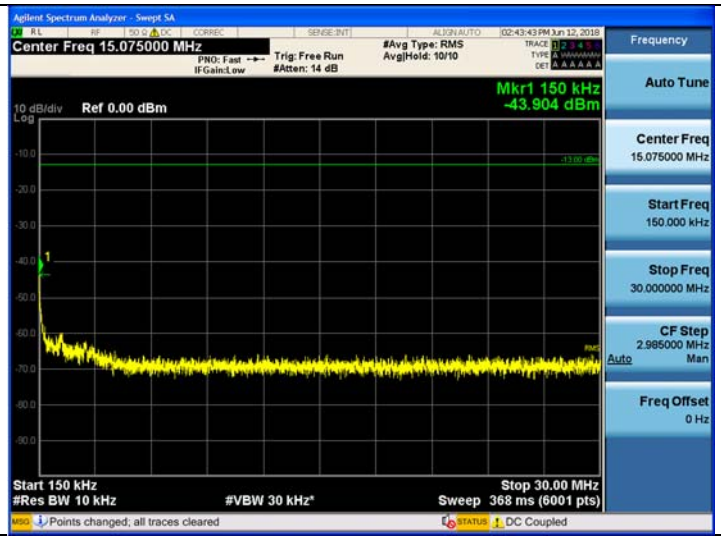
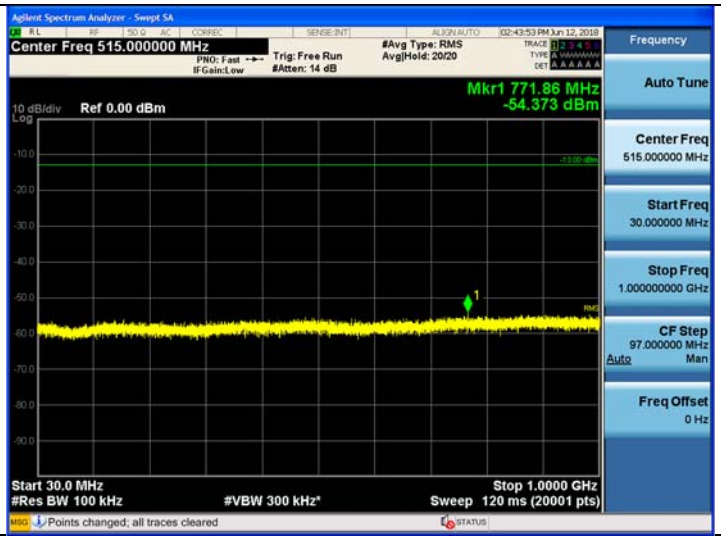
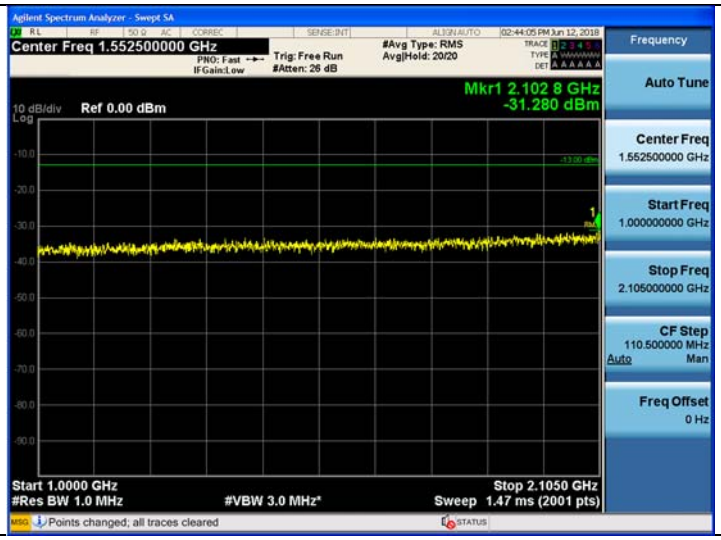
1 GHz – 2.105 GHz



2.185 GHz – 12.75 GHz

12.75 GHz – 26.5 GHz

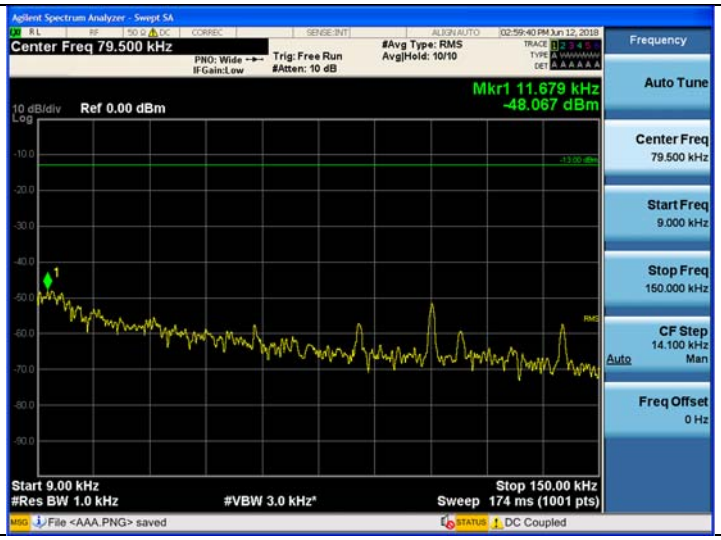
Middle Channel	
9 kHz ~ 150 kHz	**150 kHz ~ 30 MHz**
	
30 MHz – 1 GHz	**1 GHz – 2.105 GHz**
	
2.185 GHz – 12.75 GHz	**12.75 GHz – 26.5 GHz**
	

High Channel	
9 kHz ~ 150 kHz	**150 kHz ~ 30 MHz**
	
30 MHz – 1 GHz	**1 GHz – 2.105 GHz**
	
2.185 GHz – 12.75 GHz	**12.75 GHz – 26.5 GHz**
	

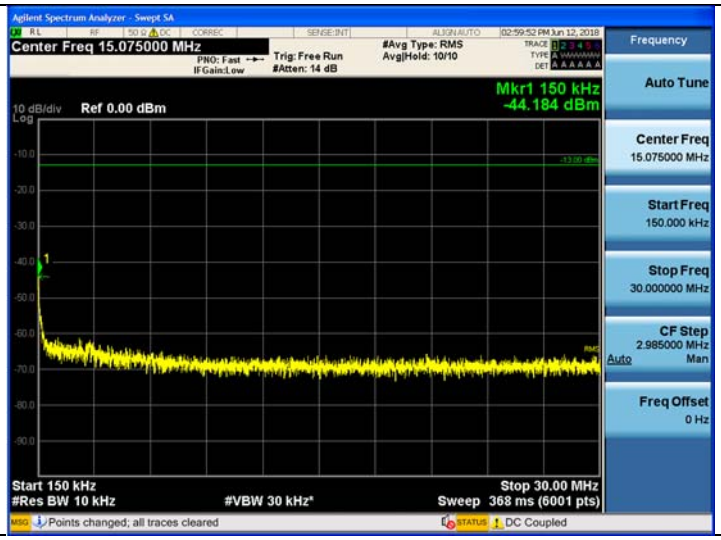
Plots of Unwanted Conducted Emissions for AWS 2100 Band LTE 10 MHz

Low Channel

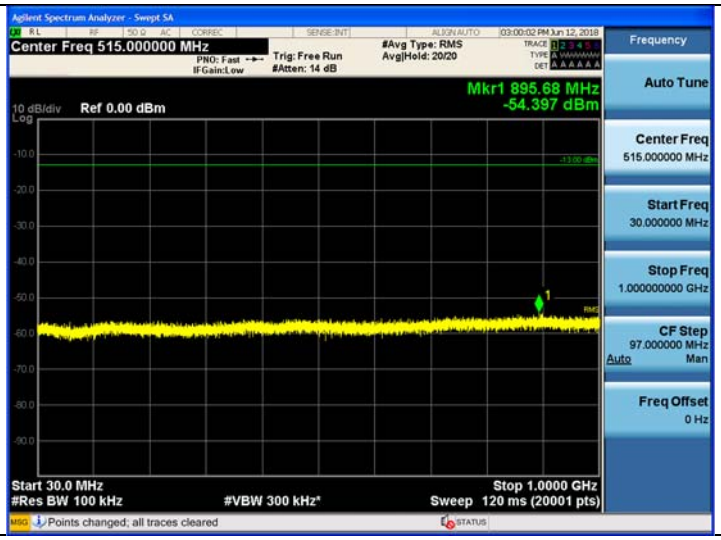
9 kHz ~ 150 kHz



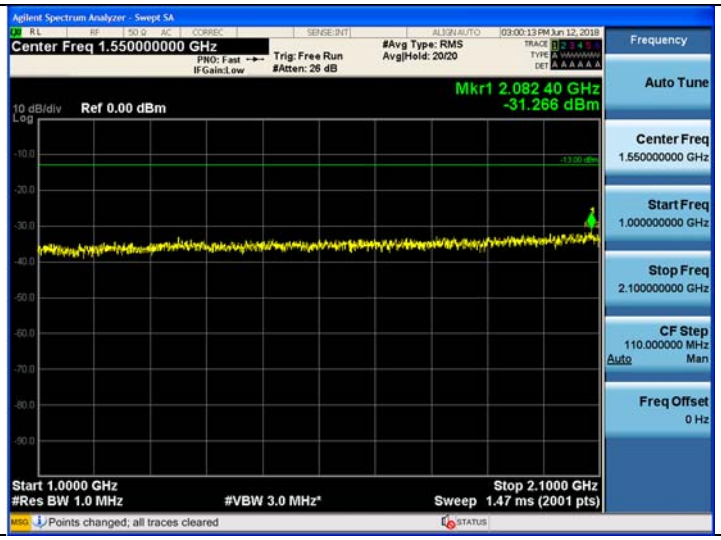
150 kHz ~ 30 MHz



30 MHz – 1 GHz

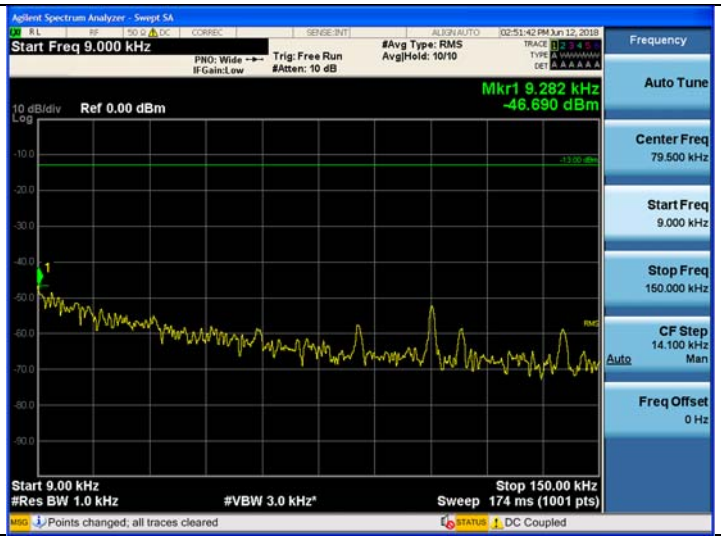
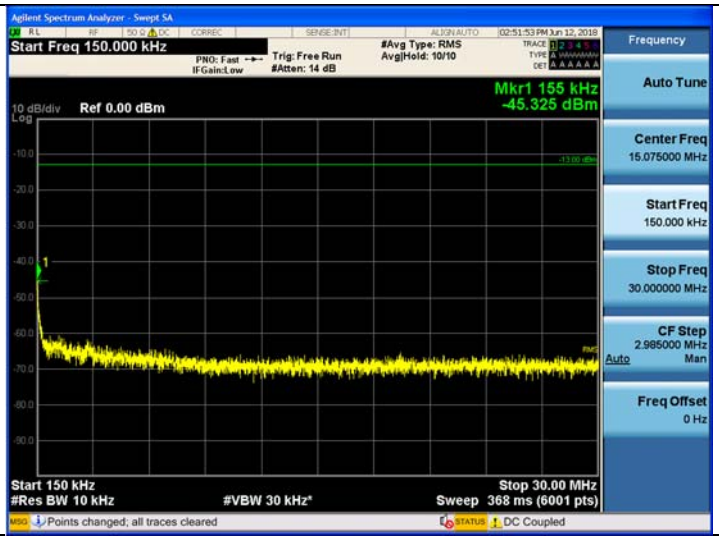
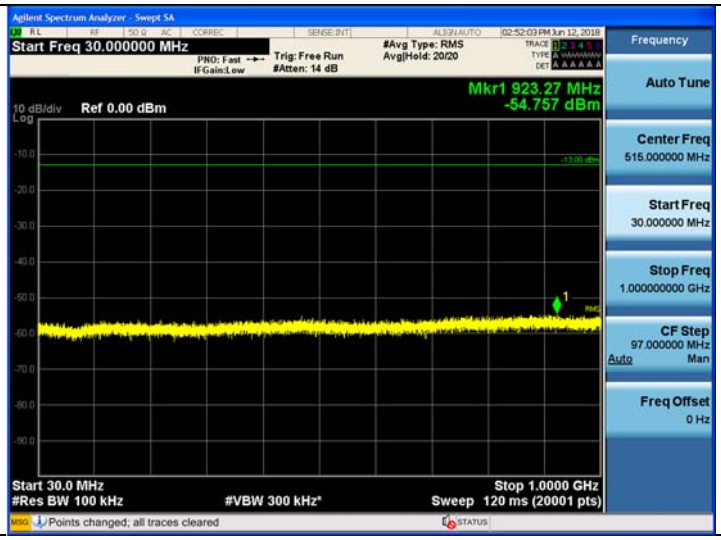
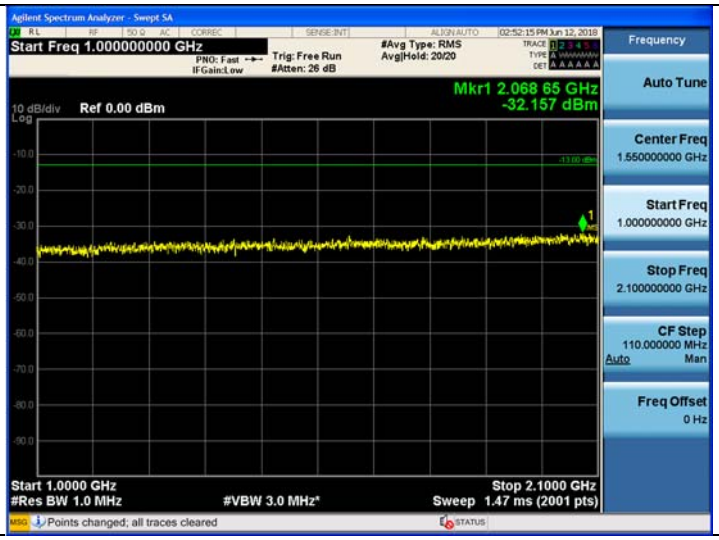


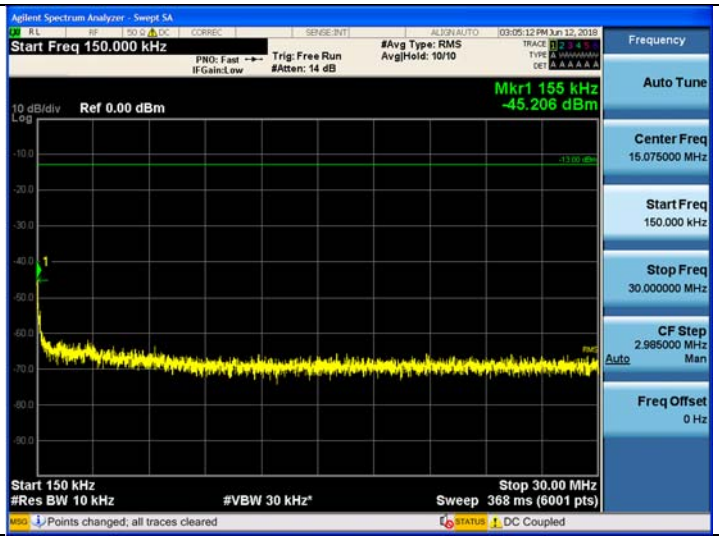
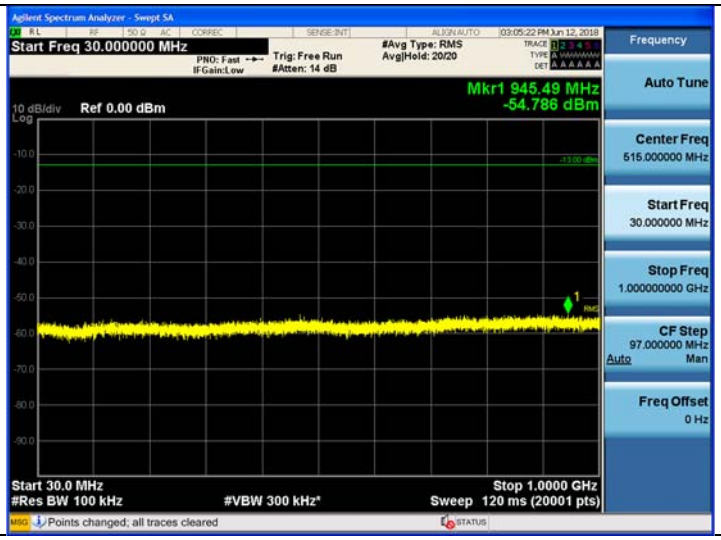
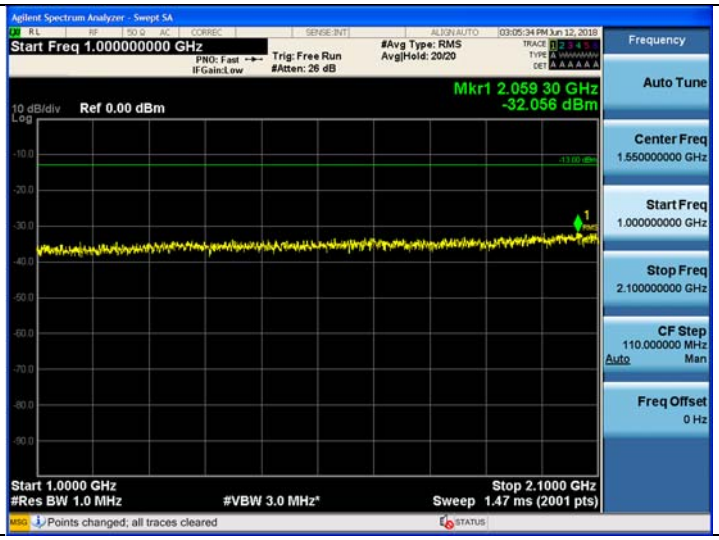
1 GHz – 2.100 GHz



2.19 GHz – 12.75 GHz

12.75 GHz – 26.5 GHz

Middle Channel	
9 kHz ~ 150 kHz	**150 kHz ~ 30 MHz**
	
30 MHz – 1 GHz	**1 GHz – 2.100 GHz**
	
2.19 GHz – 12.75 GHz	**12.75 GHz – 26.5 GHz**
	

High Channel	
9 kHz ~ 150 kHz	**150 kHz ~ 30 MHz**
	
30 MHz – 1 GHz	**1 GHz – 2.100 GHz**
	
2.19 GHz – 12.75 GHz	**12.75 GHz – 26.5 GHz**