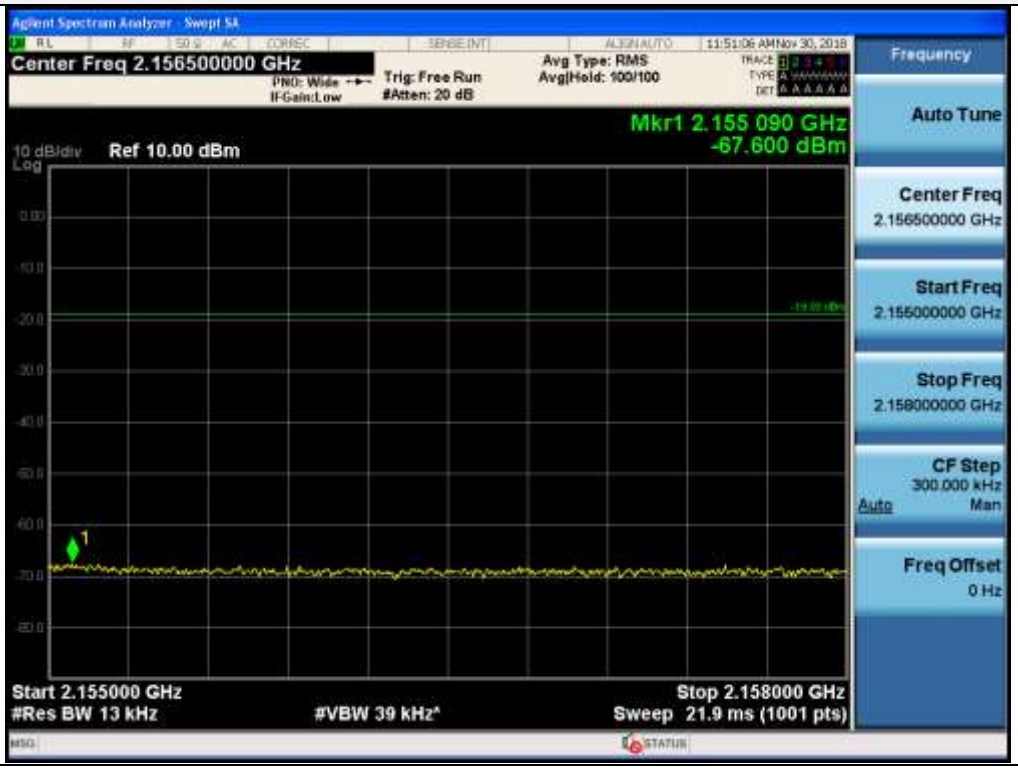
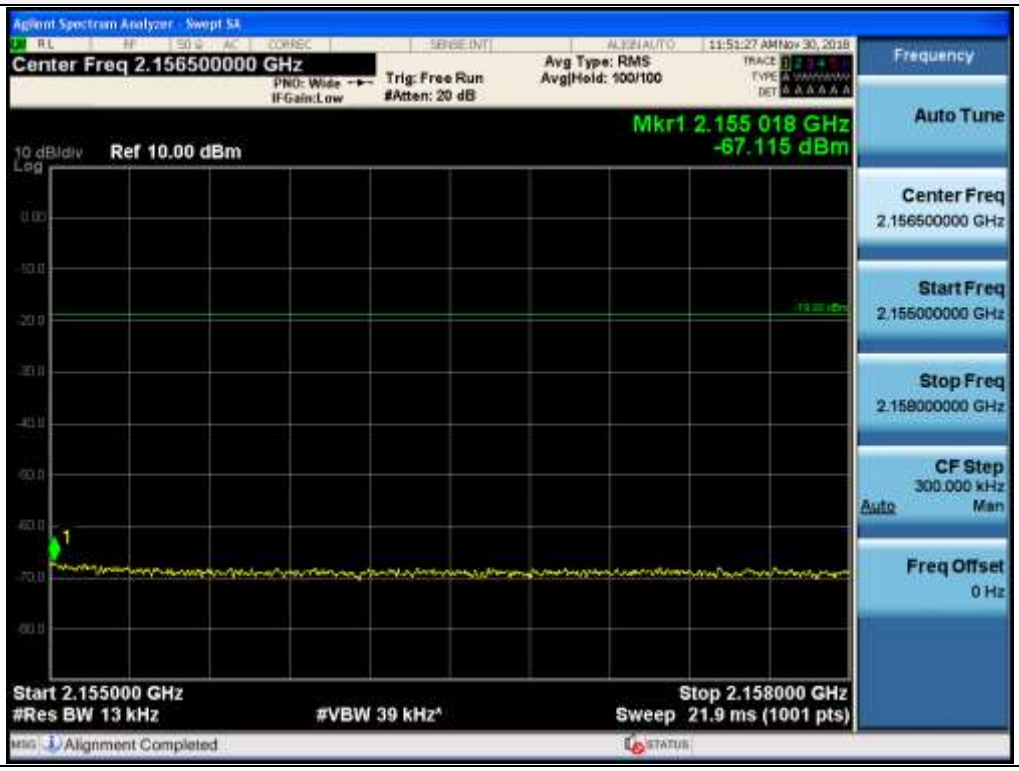
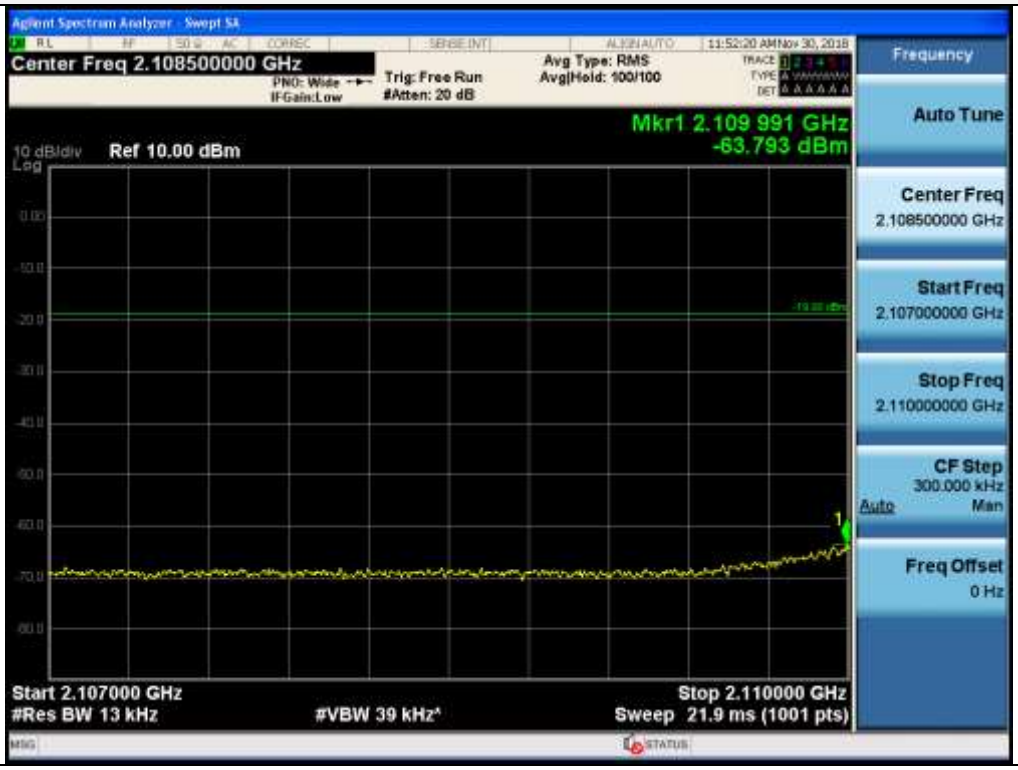
Out-of-Band Emissions / AWS-1 / Downlink / CDMA / Upper Edge / AGC threshold



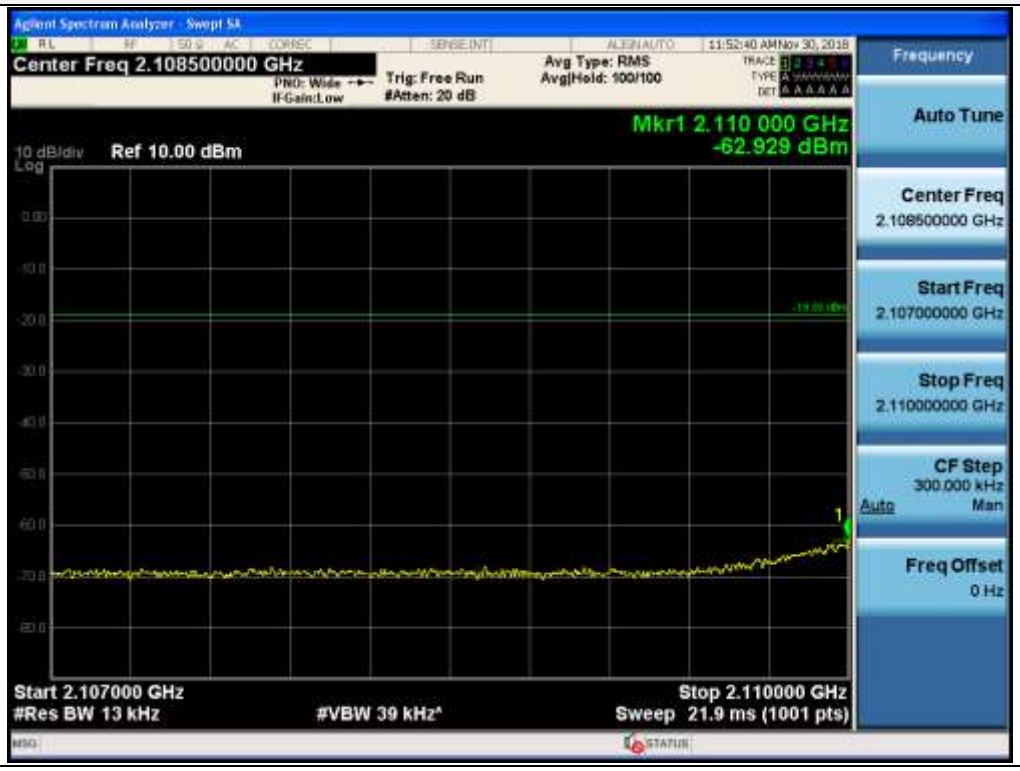
Out-of-Band Emissions / AWS-1 / Downlink / CDMA / Upper Edge / AGC threshold +10 dB



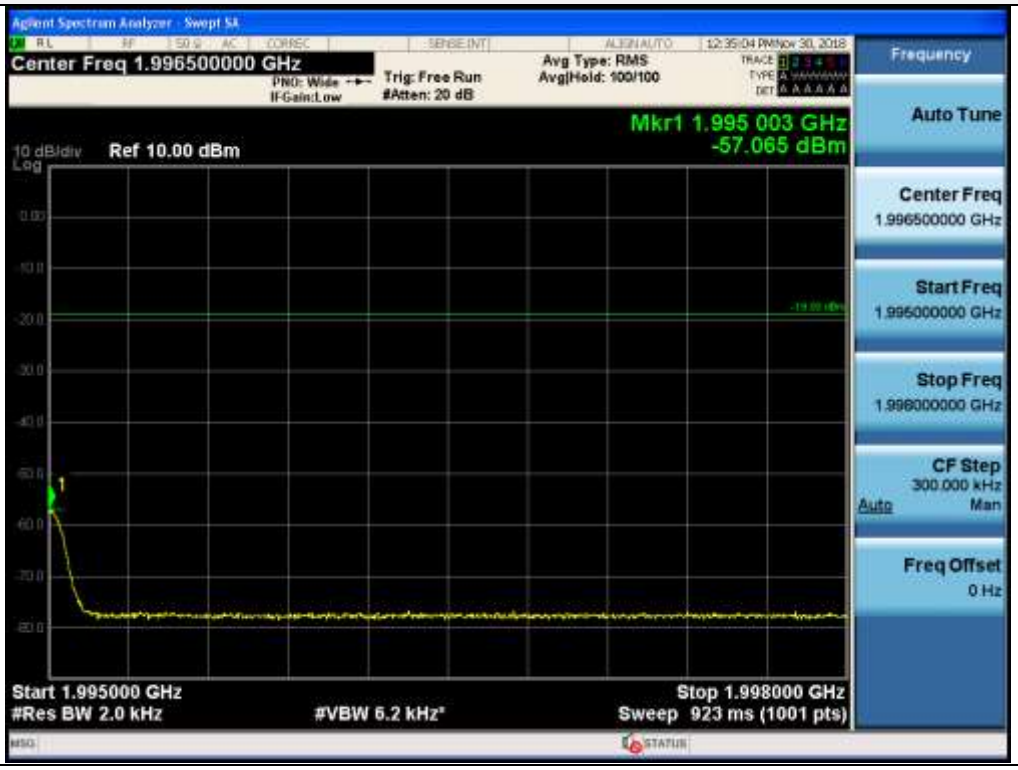
Out-of-Band Emissions / AWS-1 / Downlink / CDMA / Lower Edge / AGC threshold



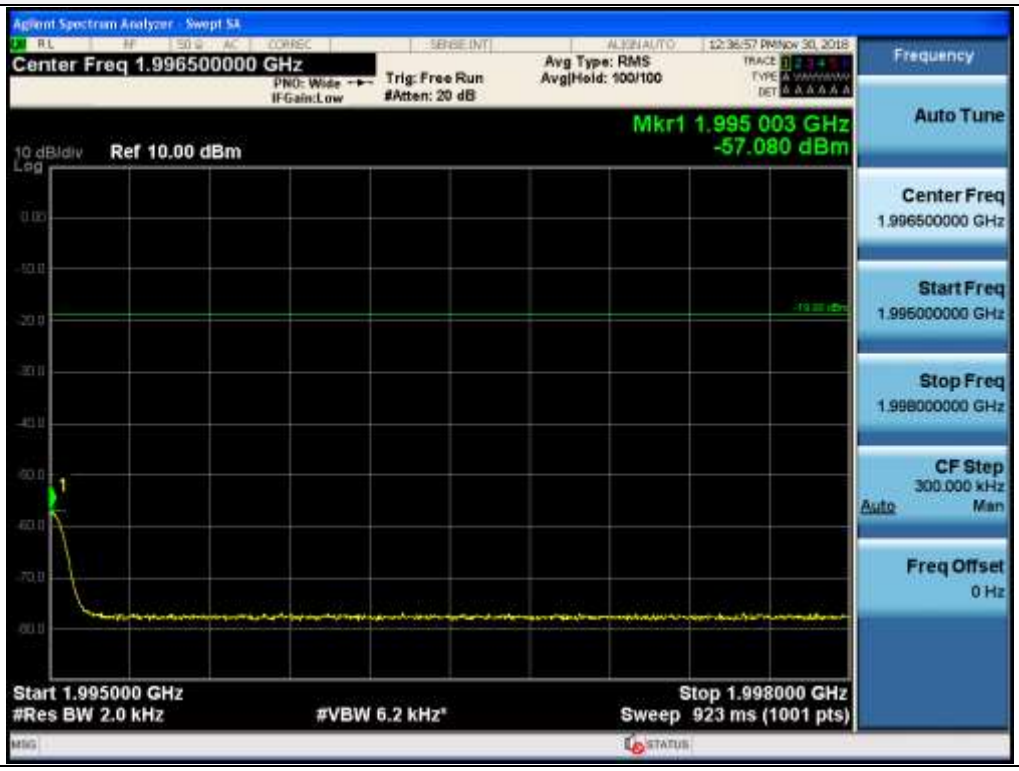
Out-of-Band Emissions / AWS-1 / Downlink / CDMA / Lower Edge / AGC threshold +10 dB



Out-of-Band Emissions / Broadband PCS / Downlink / GSM / Upper Edge / AGC threshold

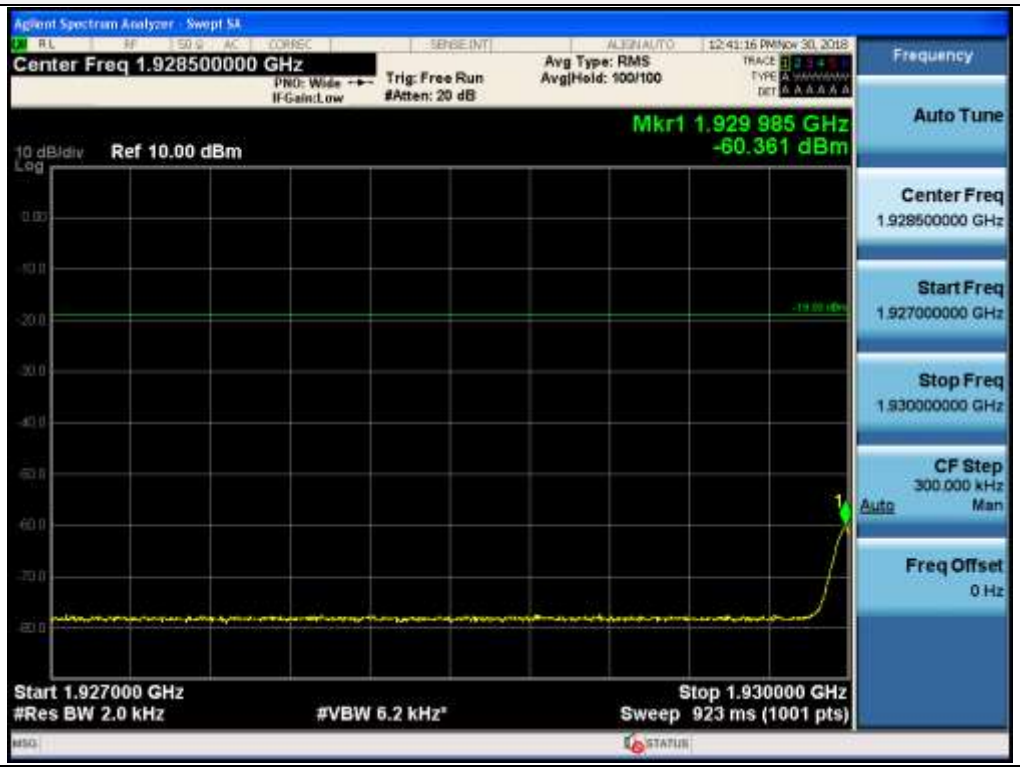


Out-of-Band Emissions / Broadband PCS / Downlink / GSM / Upper Edge / AGC threshold +10 dB



Out-of-Band Emissions / Broadband PCS / Downlink / GSM / Lower Edge / AGC threshold

Out-of-Band Emissions / Broadband PCS / Downlink / GSM / Lower Edge / AGC threshold +10 dB



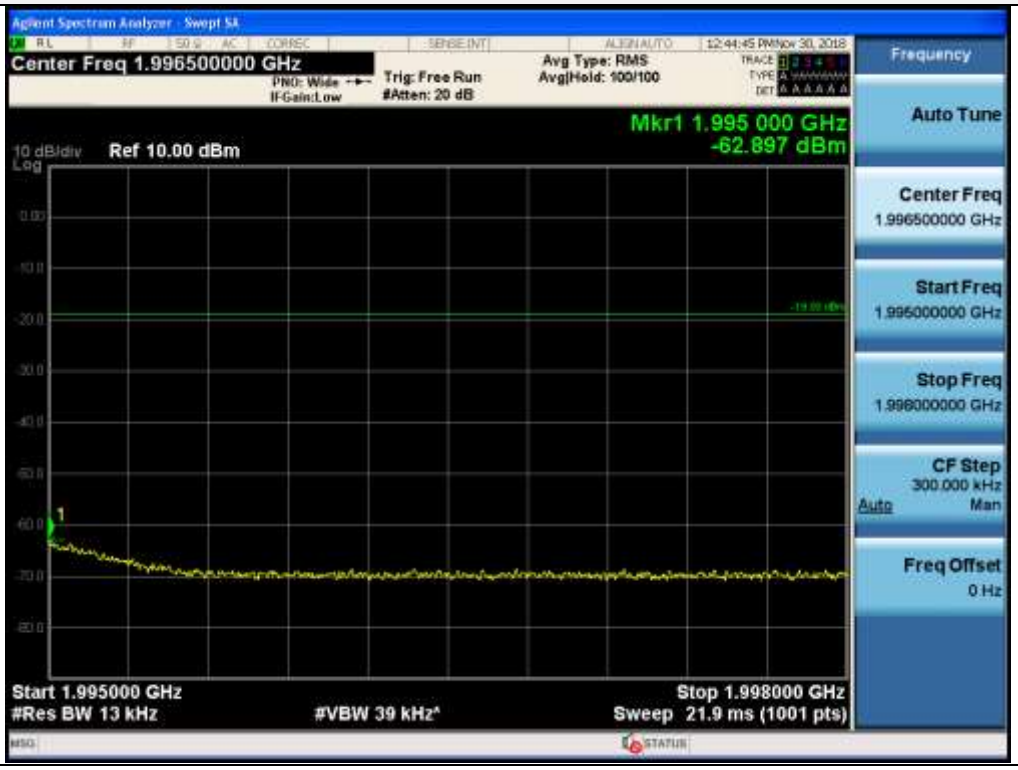
Out-of-Band Emissions / Broadband PCS / Downlink / LTE 5 MHz / Upper Edge / AGC threshold

Out-of-Band Emissions / Broadband PCS / Downlink / LTE 5 MHz / Upper Edge / AGC threshold +10 dB

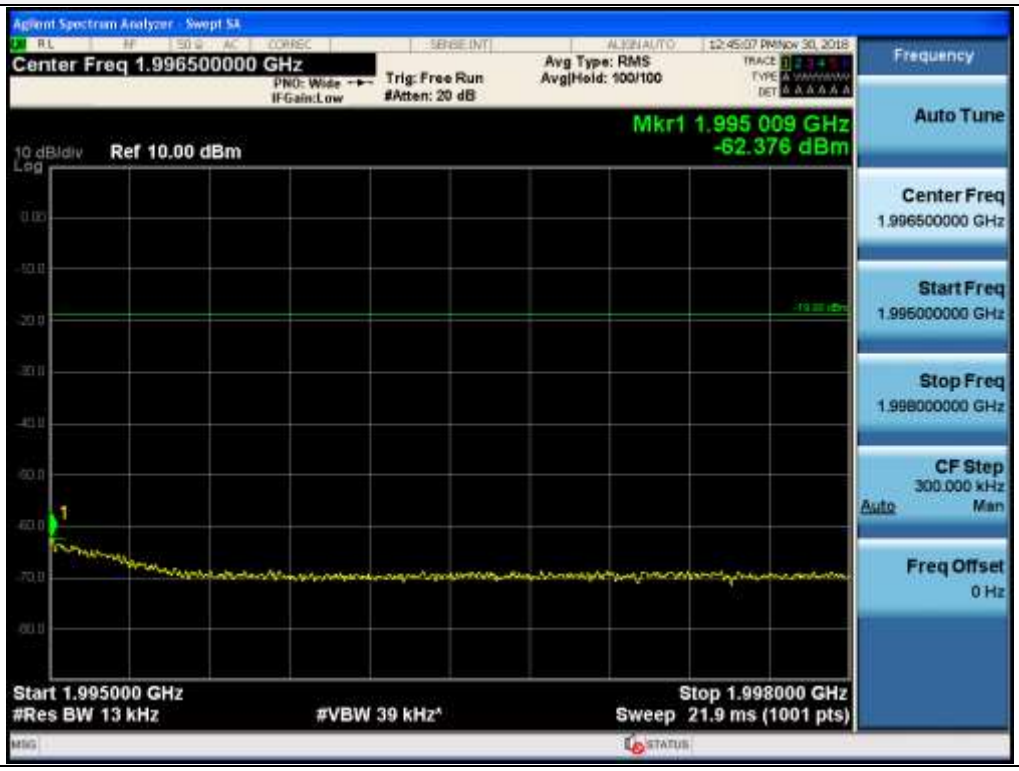
Out-of-Band Emissions / Broadband PCS / Downlink / LTE 5 MHz / Lower Edge / AGC threshold

Out-of-Band Emissions / Broadband PCS / Downlink / LTE 5 MHz / Lower Edge / AGC threshold +10 dB

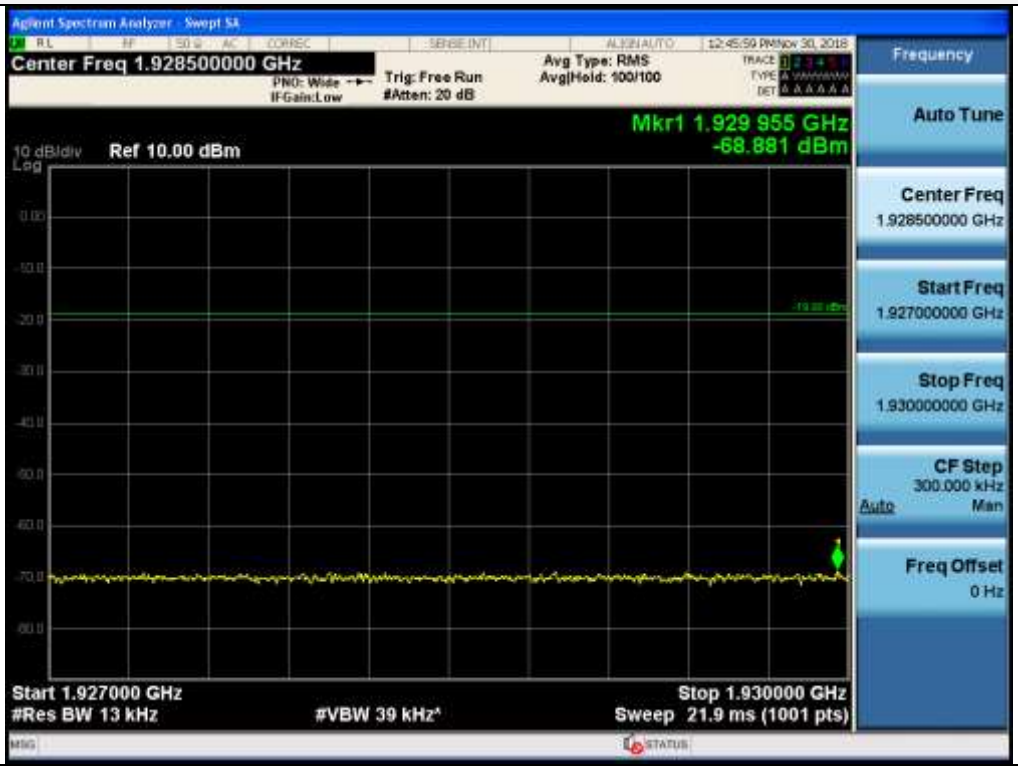
Out-of-Band Emissions / Broadband PCS / Downlink / CDMA / Upper Edge / AGC threshold



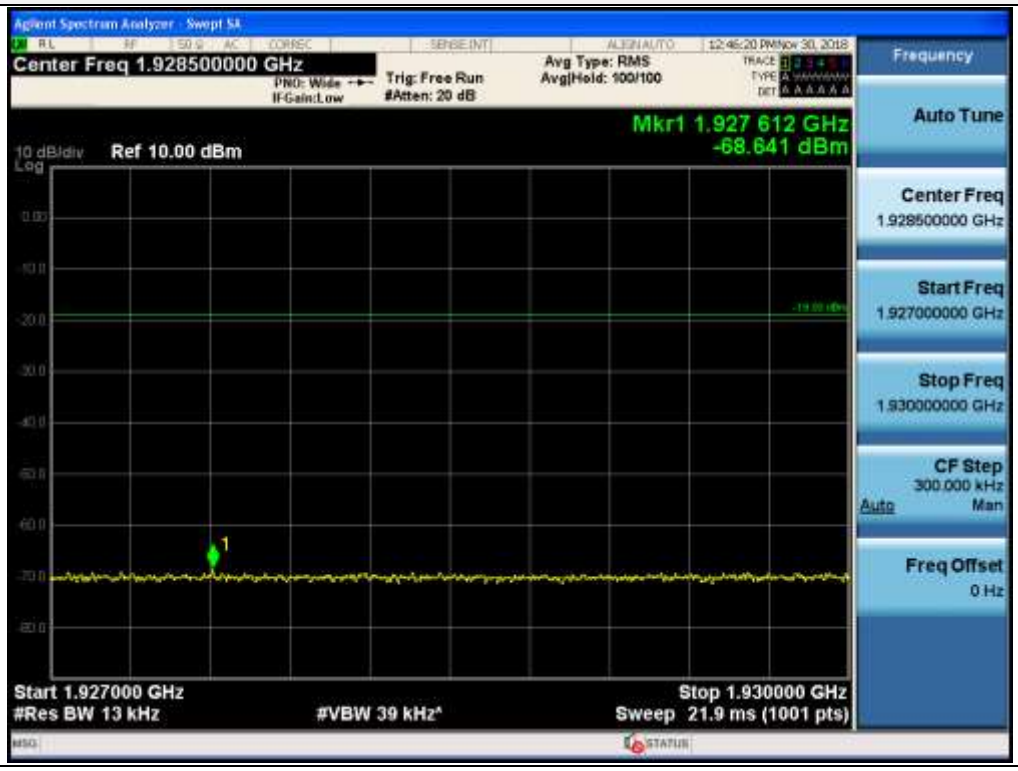
Out-of-Band Emissions / Broadband PCS / Downlink / CDMA / Upper Edge / AGC threshold +10 dB



Out-of-Band Emissions / Broadband PCS / Downlink / CDMA / Lower Edge / AGC threshold



Out-of-Band Emissions / Broadband PCS / Downlink / CDMA / Lower Edge / AGC threshold +10 dB



5.6. CONDUCTED 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.

§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.

§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;

(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 log10 (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.

Test Procedures:

Measurements were in accordance with the test methods section 7.6 of KDB 935210 D03 v04r02.

a) Begin with the uplink output (donor) port connected to the spectrum analyzer.

b) Configure the signal generator for AWGN with a 99% OBW of 4.1 MHz, with a center frequency corresponding to the center of the CMRS band under test.

c) Set the signal generator amplitude to the level determined in the power measurement procedure in maximum power measurement test.

d) Turn on the signal generator RF output and measure the spurious emission power levels with an appropriate measuring instrument as follows.

1) Set RBW = measurement bandwidth specified in the applicable rule section for the operational frequency band under consideration. Note that many of the individual rule sections permit the use of a narrower RBW [typically ≥ 1% of the emission bandwidth (EBW)] to enhance measurement accuracy, but the result must then be integrated over the specified measurement bandwidth.

2) Set VBW = 3 x RBW.

3) Select the power averaging (rms) detector.

4) Sweep time = auto-couple.

5) Set the analyzer start frequency to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part. Note that the number of measurement points in each sweep must be ≥ (2 x span/RBW), which may require that the measurement range defined by the preceding start and stop frequencies be subdivided, depending on the available number of measurement points of the spectrum analyzer. Trace average at least 10 traces in power averaging (i.e., rms) mode.

6) 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.

7) Reset the analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the analyzer stop frequency to 10 times the highest frequency of

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

8) 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.

e) Repeat b) through d) for each supported frequency band of operation.

Note1. Except band of upper 700 MHz, '43 + 10 Log (Power) = -13 dBm' limit is applied for all spurious test. For upper 700 MHz band, in 763-775 MHz and 793-805 MHz '65 + 10 log (Power) = -35 dBm (6.25 kHz RBW)' limit is applied. Additionally in 1559-1610 MHz shall be limited to −70 dBW/MHz (-40 dBm, 1 MHz RBW) and −80 dBW (-50 dBm, 700 Hz RBW) EIRP.

Note2. Coupling In 9 kHz-150 kHz and 150 kHz-30 MHz bands, RBW was reduced to 1 kHz and 10 kHz and correction factor was applied according to section 5.7.2 of ANSI C63.26-2015.

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

Note3. RBW and Band Separation is according to note 1 of out-of-band emissions test in this report

Test Results:

Tabulated Result of Uplink Conducted Spurious Emissions

Band	Range (MHz)	Frequency (MHz)	Limit (dBm)	Spurious Emission (dBm)
Lower 700 MHz	0.009 ~ 0.15	0.010 551	-13	-39.788
	0.15 ~ 30	0.150		-51.125
	30 ~ 703.9	703.80		-48.381
	716.1 ~ 2 000	716.49		-52.909
	2 000 ~ 4 000	2 700.80		-63.250
	4 000 ~ 6 000	5 661.30		-61.954
	6 000 ~ 8 000	7 574.95		-62.154
Upper 700 MHz	0.009 ~ 0.15	0.009 564		-38.291
	0.15 ~ 30	0.160		-50.090
	30 ~ 775.9	775.86		-52.921
	787.1 ~ 2 000	787.10		-49.773
	2 000 ~ 4 000	2 646.80		-63.105
	4 000 ~ 6 000	5 892.80		-62.166
	6 000 ~ 8 000	7 383.35		-62.400
	763 ~ 775	774.299 2	-35	-67.352
	793 ~ 805	793.057 6		-76.211
	1 559 ~ 1 610 (1 MHz)	1 564.049	-40	-58.447
	1 559 ~ 1 573 (700 Hz)	1 561.821 00	-50	-88.675
	1 573 ~ 1 587 (700 Hz)	1 580.821 45		-89.146
	1 587 ~ 1 601 (700 Hz)	1 595.761 90		-88.726
	1 601 ~ 1 610 (700 Hz)	1 601.673 2		-88.634

Band	Range (MHz)	Frequency (MHz)	Limit (dBm)	Spurious Emission (dBm)
Cellular	0.009 ~ 0.15	0.009 282	-13	-38.903
	0.15 ~ 30	0.150		-49.947
	30 ~ 823	755.71		-56.020
	850 ~ 1 000	889.950		-57.197
	1 000 ~ 10 000	9 444.25		-39.701
AWS-1	0.009 ~ 0.15	0.012 102		-29.210
	0.15 ~ 30	0.150		-39.042
	30 ~ 1 709	1 707.74		-45.628
	1 756 ~ 10 000	9 493.4		-40.838
	10 000 ~ 26 500	25 714.2		-37.821
Broadband PCS	0.009 ~ 0.15	0.009 000		-28.353
	0.15 ~ 30	0.180		-41.273
	30 ~ 1 849	1 782.06		-45.649
	1 916 ~ 10 000	7 421.6		-41.277
	10 000 ~ 26 500	26 273.1		-37.973

Tabulated Result of Downlink Conducted Spurious Emissions

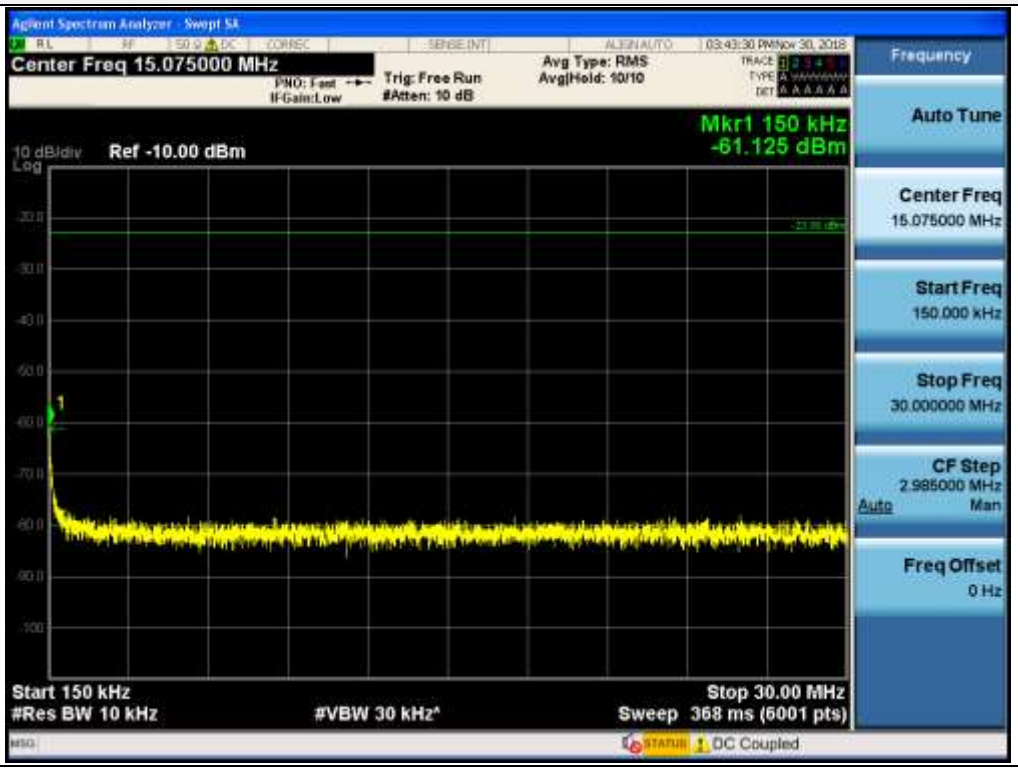
Band	Range (MHz)	Frequency (MHz)	Limit (dBm)	Spurious Emission (dBm)
Lower 700 MHz	0.009 ~ 0.15	0.009 564	-13	-38.024
	0.15 ~ 30	0.150		-51.117
	30 ~ 733.9	717.85		-55.941
	746.1 ~ 2 000	1 936.59		-56.766
	2 000 ~ 4 000	2 785.90		-63.641
	4 000 ~ 6 000	5 830.30		-61.373
	6 000 ~ 8 000	6 782.80		-62.568
Upper 700 MHz	0.009 ~ 0.15	0.010 833		-38.910
	0.15 ~ 30	0.150		-49.776
	30 ~ 745.9	706.13		-56.568
	757.1 ~ 2 000	1 918.05		-56.703
	2 000 ~ 4 000	2 790.75		-63.726
	4 000 ~ 6 000	5 735.85		-62.072
	6 000 ~ 8 000	6 278.95		-62.113
	763 ~ 775	764.869 6	-35	-79.861
	793 ~ 805	799.787 2		-79.614
	1 559 ~ 1 610 (1 MHz)	1 599.953	-40	-58.858
	1 559 ~ 1 573 (700 Hz)	1 559.912 10	-50	-89.517
	1 573 ~ 1 587 (700 Hz)	1 581.441 65		-89.037
	1 587 ~ 1 601 (700 Hz)	1 597.937 85		-89.360
	1 601 ~ 1 610 (700 Hz)	1 608.769 1		-89.427

Band	Range (MHz)	Frequency (MHz)	Limit (dBm)	Spurious Emission (dBm)
Cellular	0.009 ~ 0.15	0.009 141	-13	-38.687
	0.15 ~ 30	0.155		-50.571
	30 ~ 868	802.59		-55.781
	895 ~ 1 000	994.172 5		-56.926
	1 000 ~ 10 000	7 417.00		-41.319
AWS-1	0.009 ~ 0.15	0.009 141		-28.206
	0.15 ~ 30	0.155		-40.607
	30 ~ 2 109	1 170.44		-45.298
	2 156 ~ 10 000	6 099.6		-41.401
	10 000 ~ 26 500	25 818.1		-38.232
Broadband PCS	0.009 ~ 0.15	0.009 423		-28.010
	0.15 ~ 30	0.150		-38.858
	30 ~ 1 929	1 516.06		-44.852
	1 996 ~ 10 000	8 284.7		-41.630
	10 000 ~ 26 500	26 234.8		-37.848

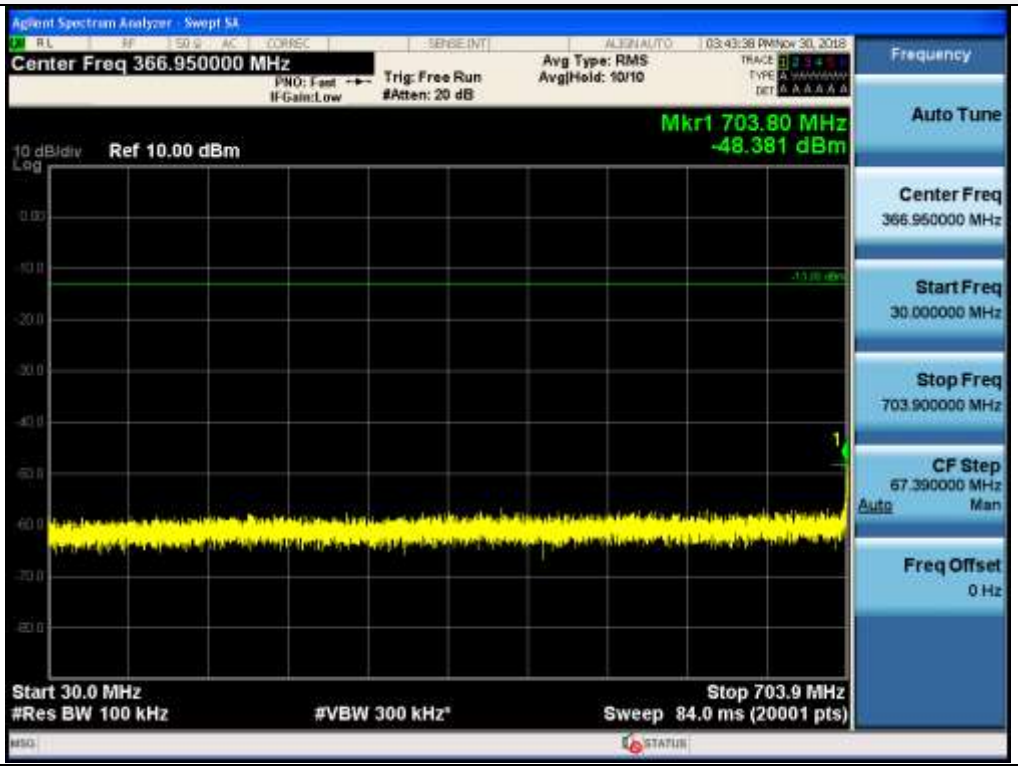
Plot data of Conducted Spurious Emissions

Conducted Spurious Emissions / Lower 700 MHz / Uplink / 9 kHz ~ 150 kHz

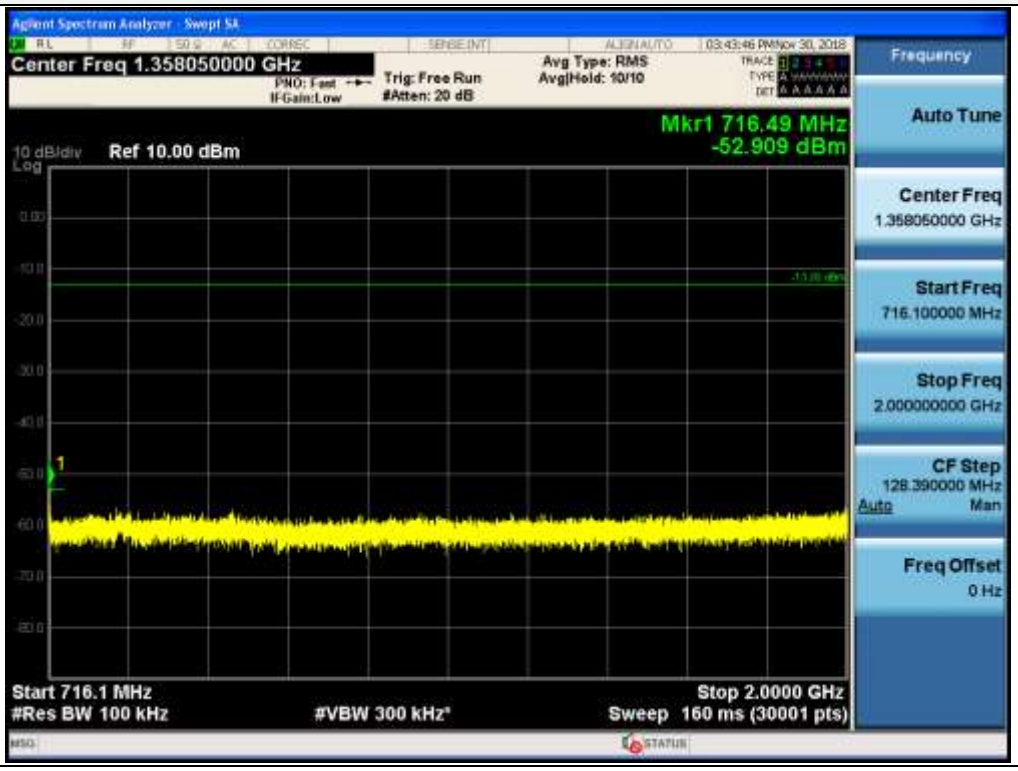
Conducted Spurious Emissions / Lower 700 MHz / Uplink / 150 kHz ~ 30 MHz



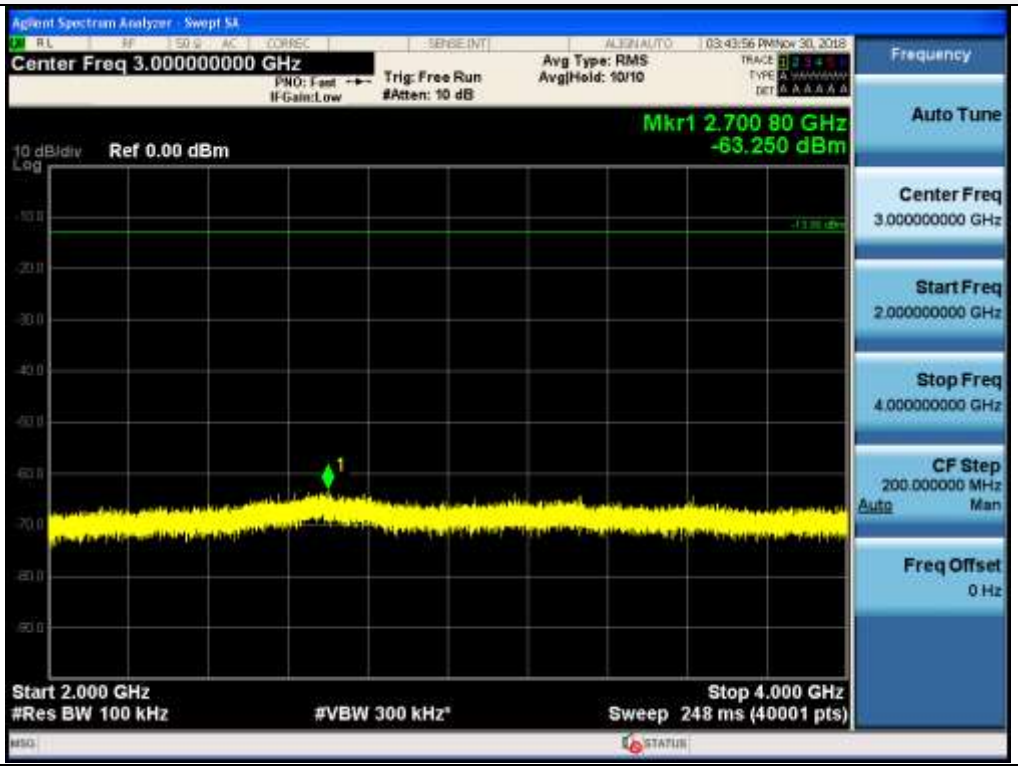
Conducted Spurious Emissions / Lower 700 MHz / Uplink / 30 MHz ~ 703.9 MHz



Conducted Spurious Emissions / Lower 700 MHz / Uplink / 716.1 MHz ~ 2 GHz

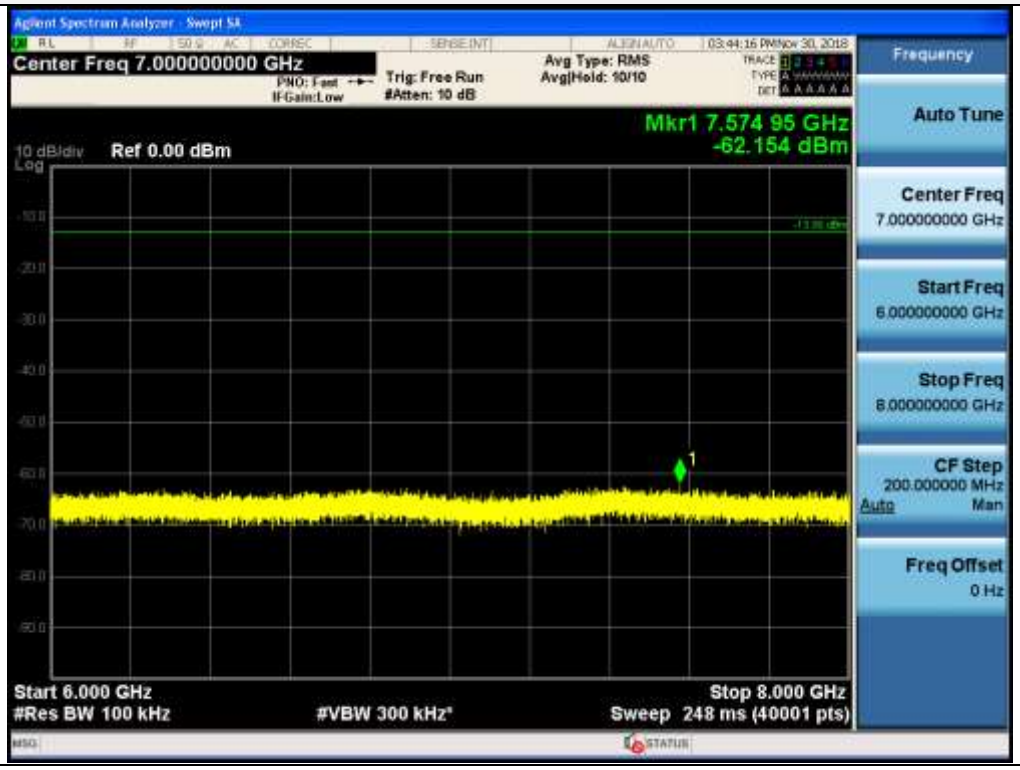


Conducted Spurious Emissions / Lower 700 MHz / Uplink / 2 GHz ~ 4 GHz



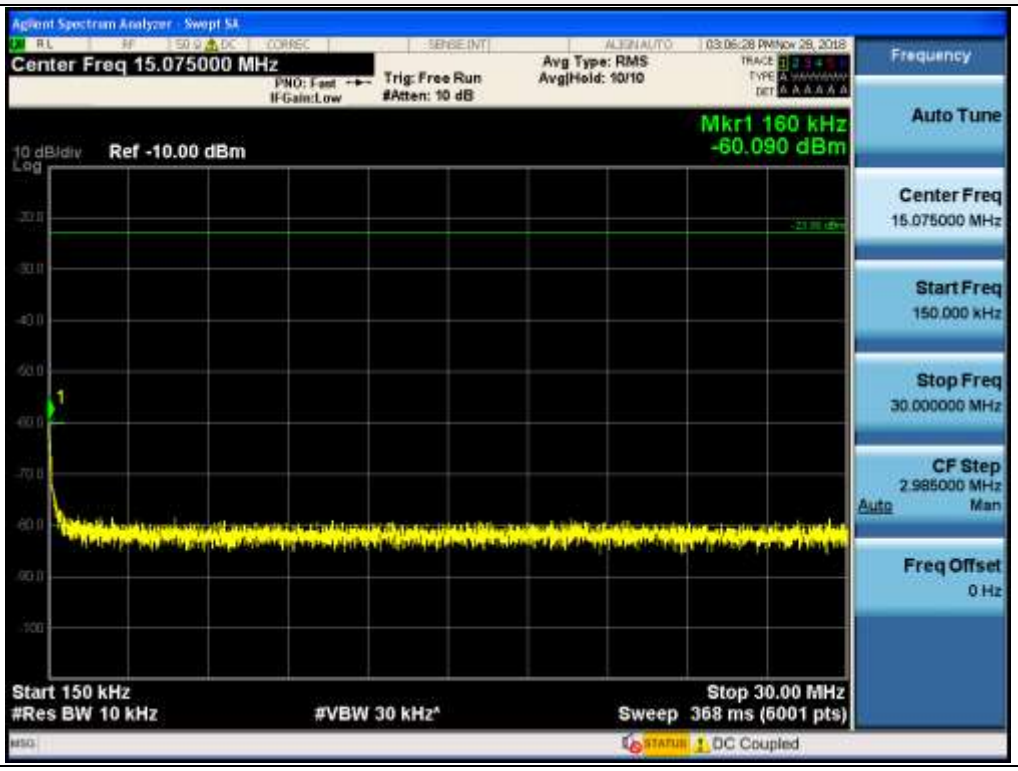
Conducted Spurious Emissions / Lower 700 MHz / Uplink / 4 GHz ~ 6 GHz

Conducted Spurious Emissions / Lower 700 MHz / Uplink / 6 GHz ~ 8 GHz

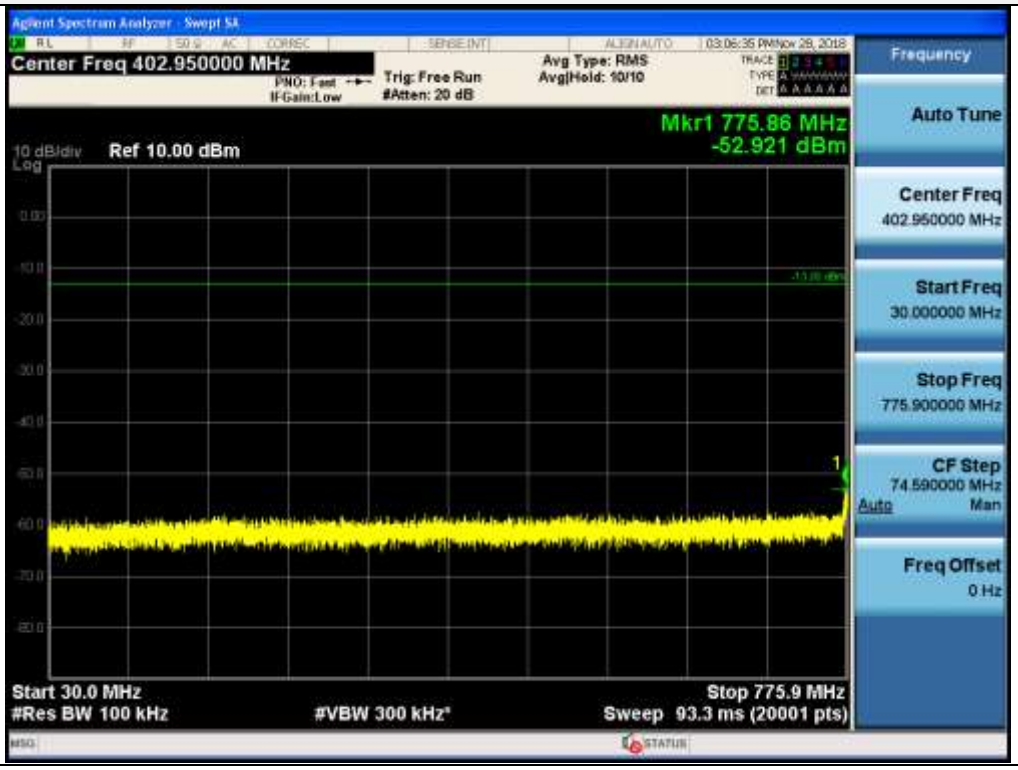


Conducted Spurious Emissions / Upper 700 MHz / Uplink / 9 kHz ~ 150 kHz

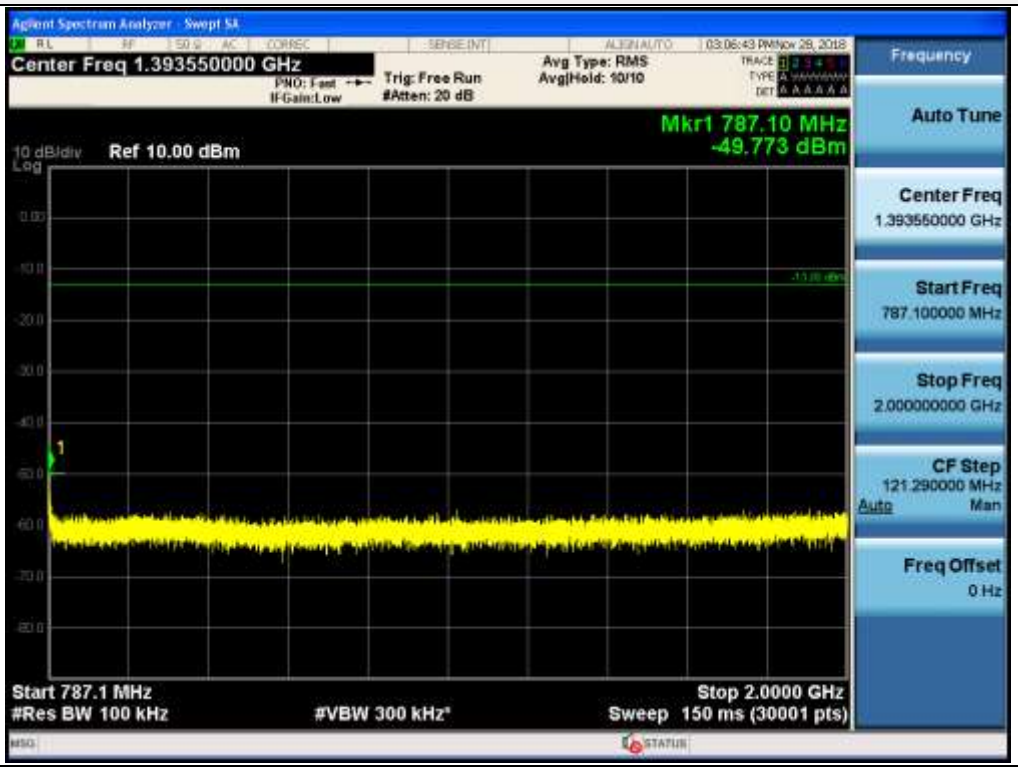
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 150 kHz ~ 30 MHz



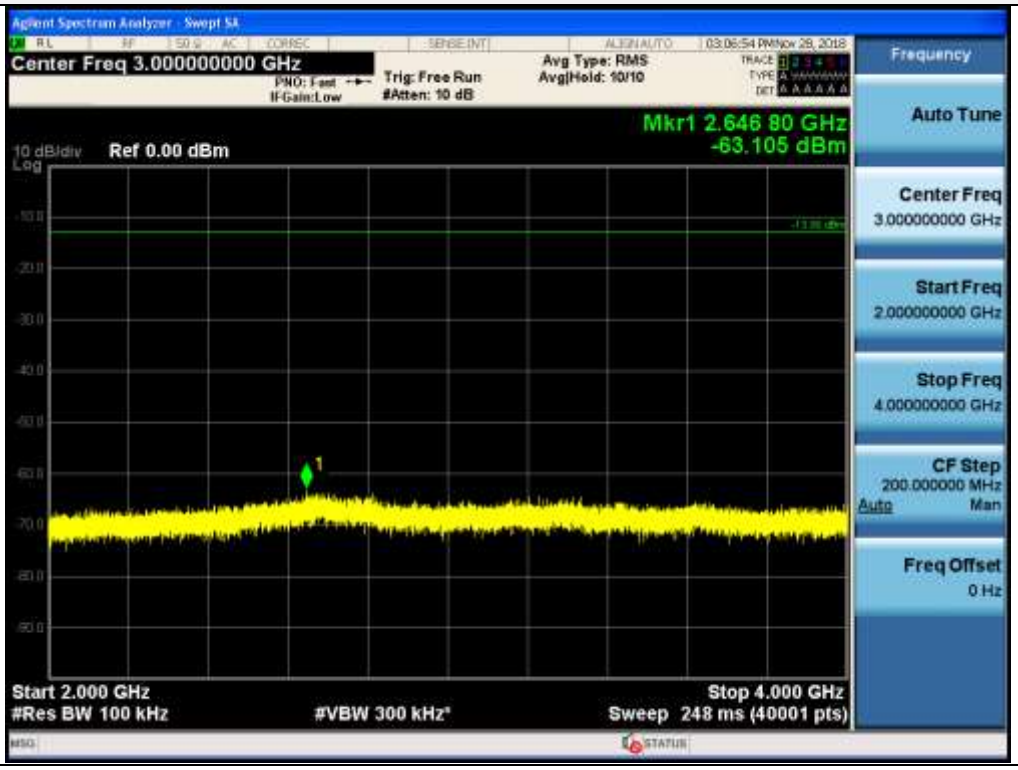
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 30 MHz ~ 775.9 MHz



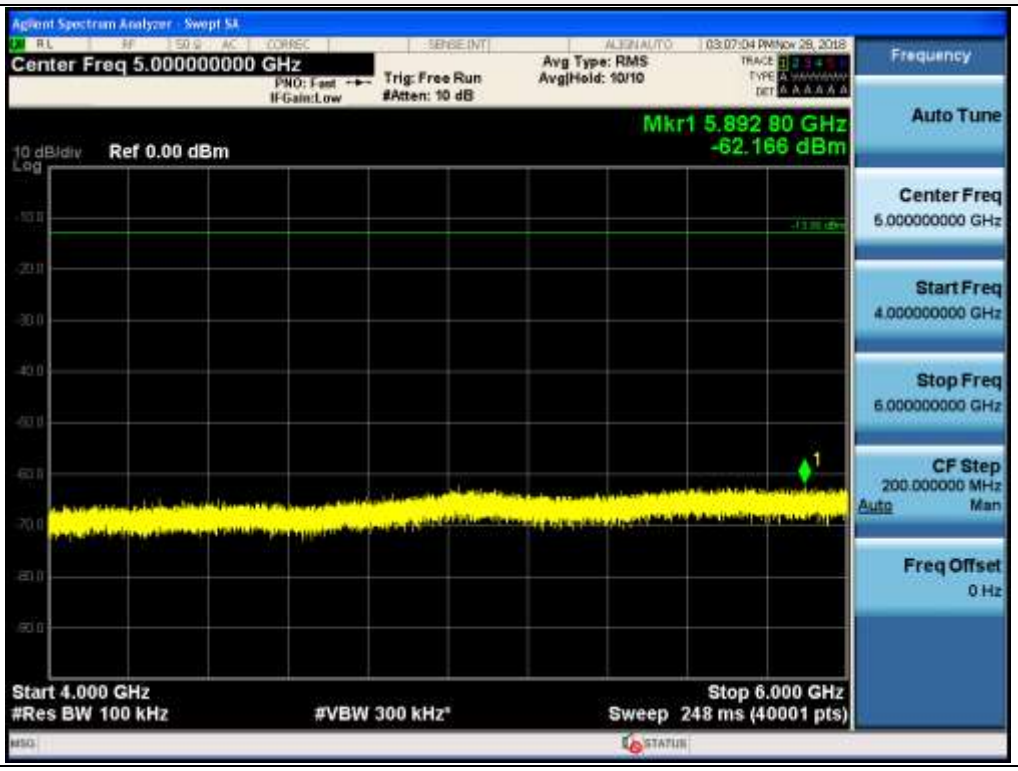
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 787.1 MHz ~ 2 GHz



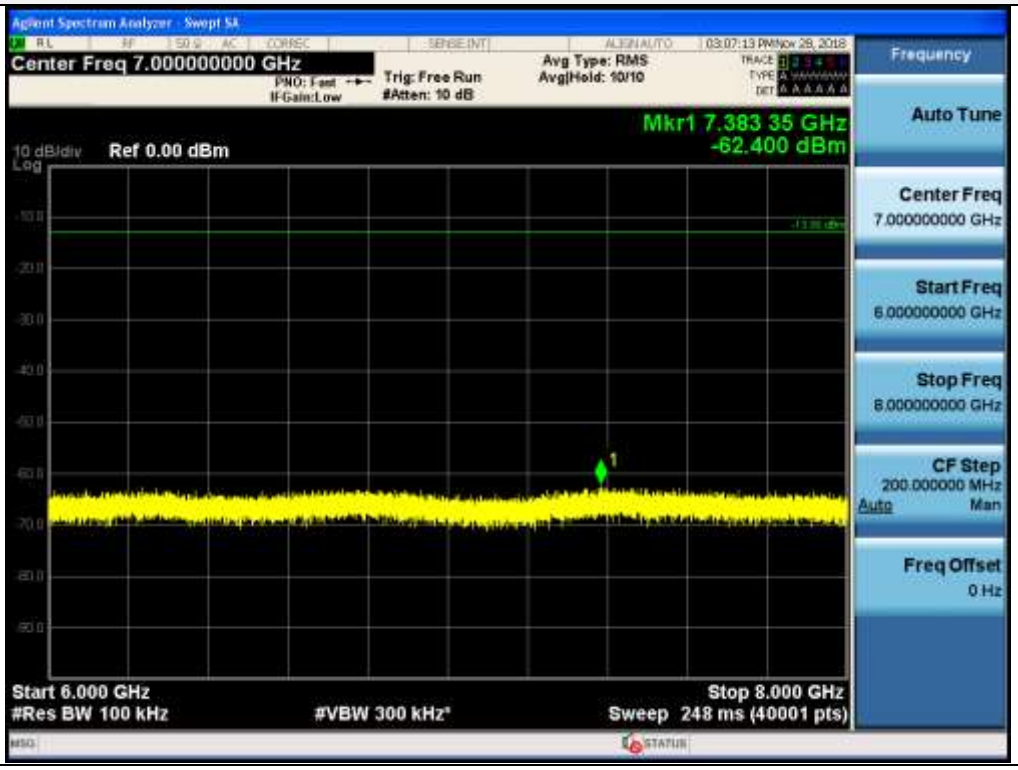
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 2 GHz ~ 4 GHz



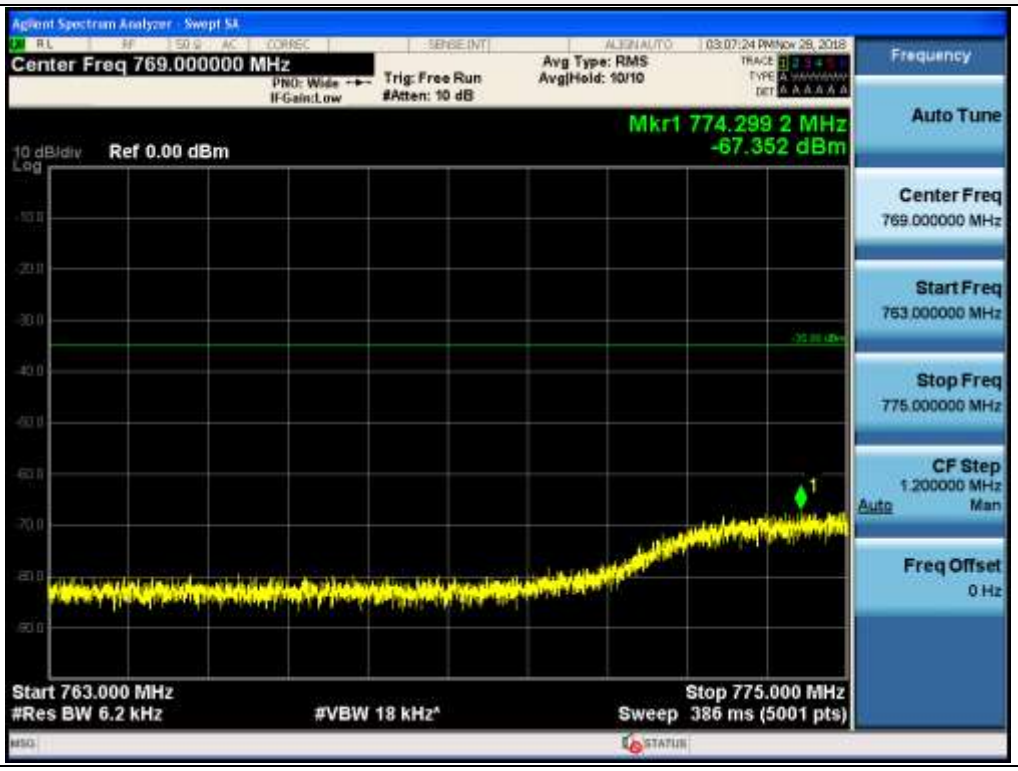
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 4 GHz ~ 6 GHz



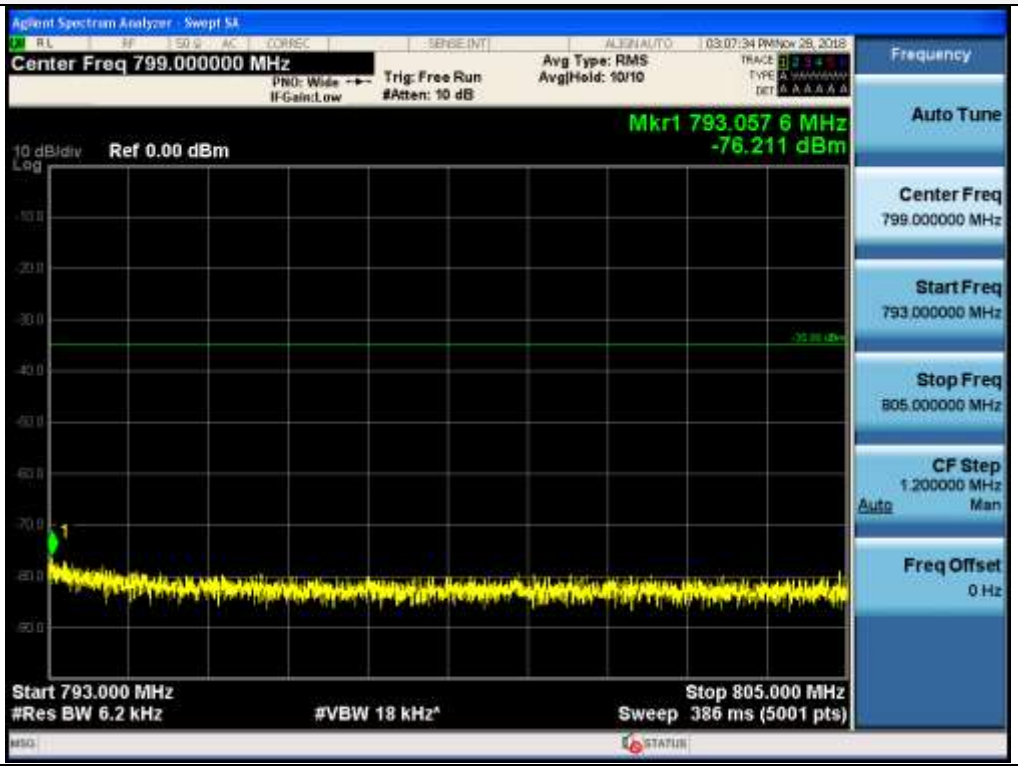
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 6 GHz ~ 8 GHz



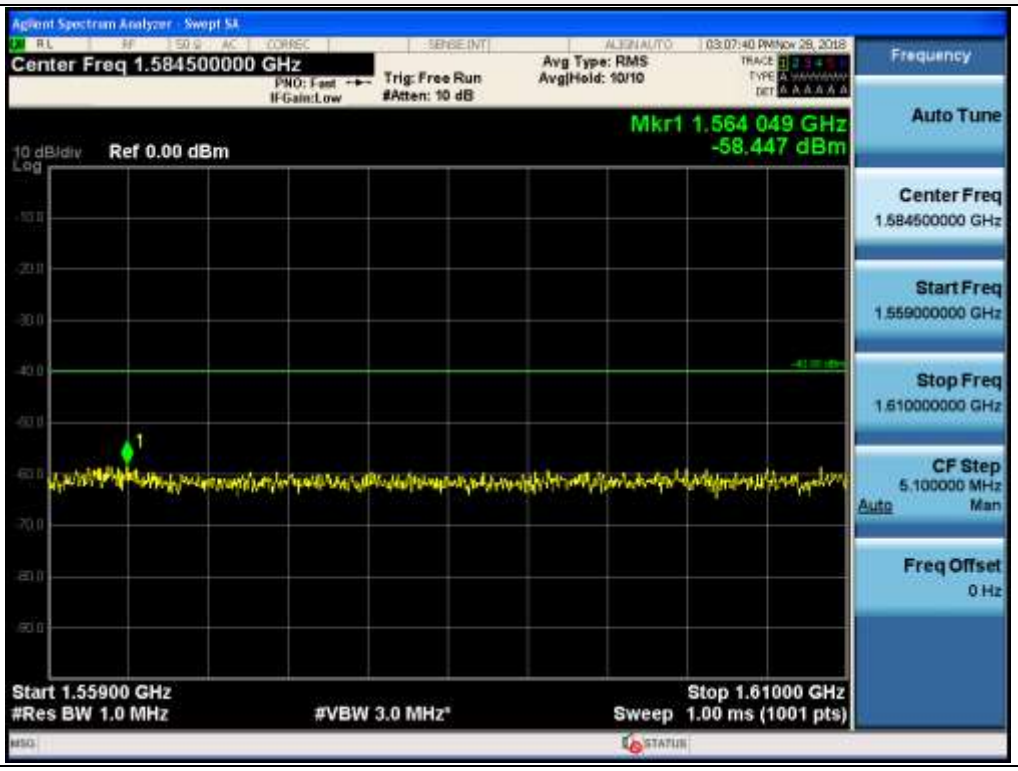
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 763 MHz ~ 775 MHz



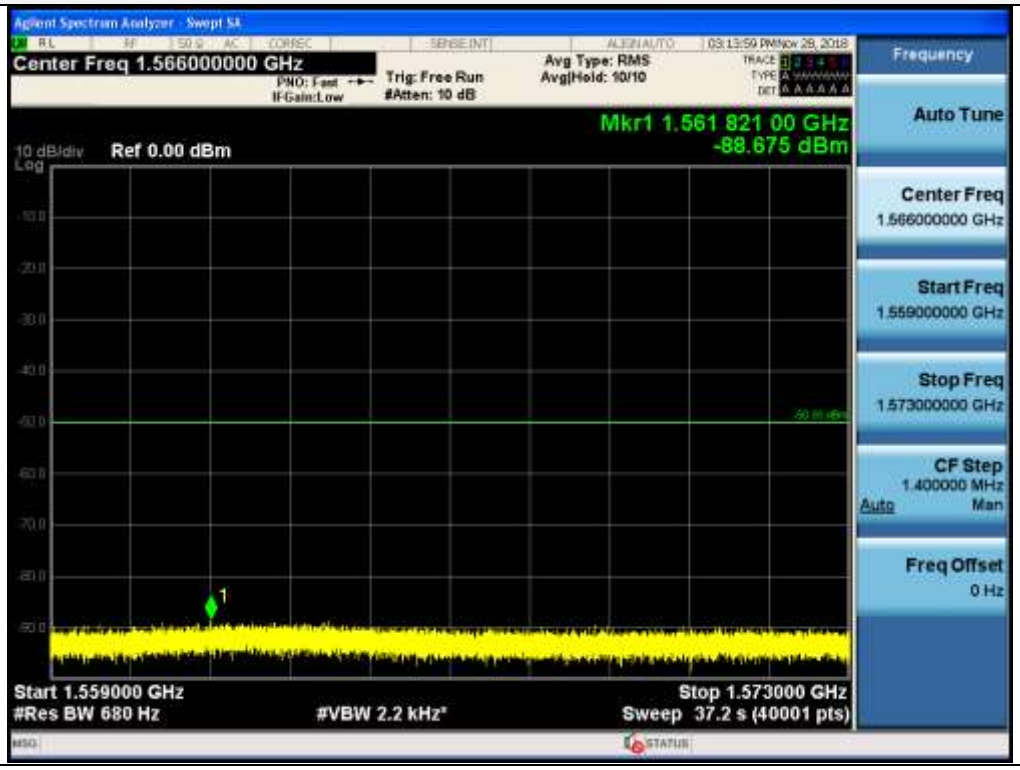
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 793 MHz ~ 805 MHz



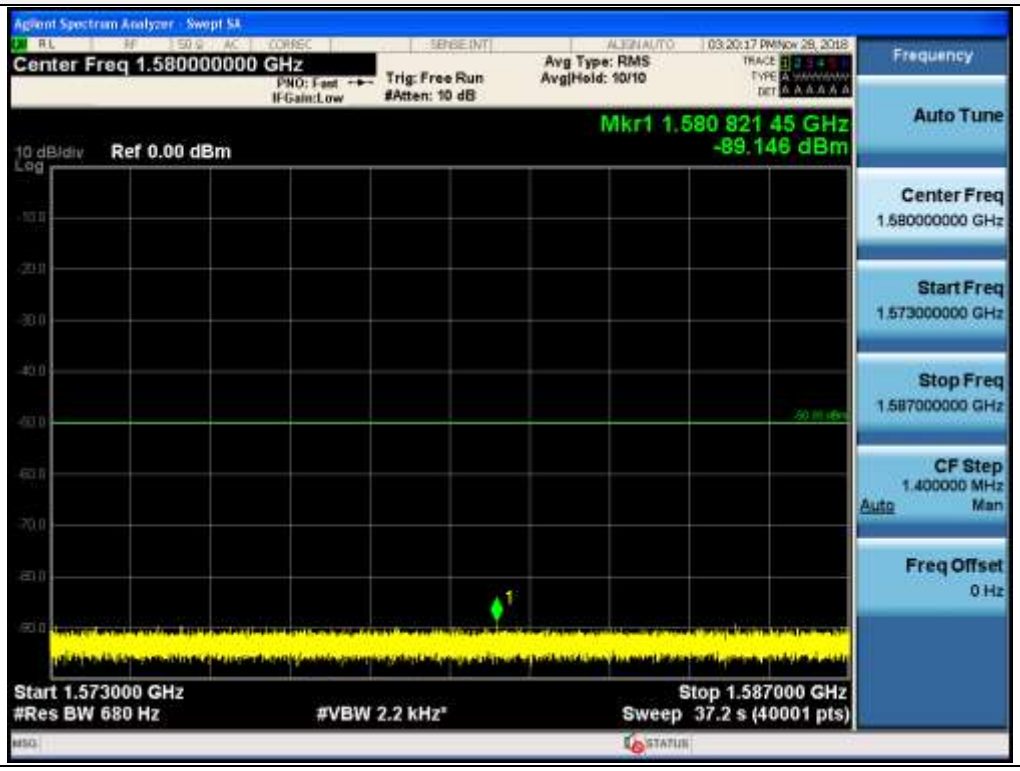
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 1.559 GHz ~ 1.610 GHz (1 MHz)



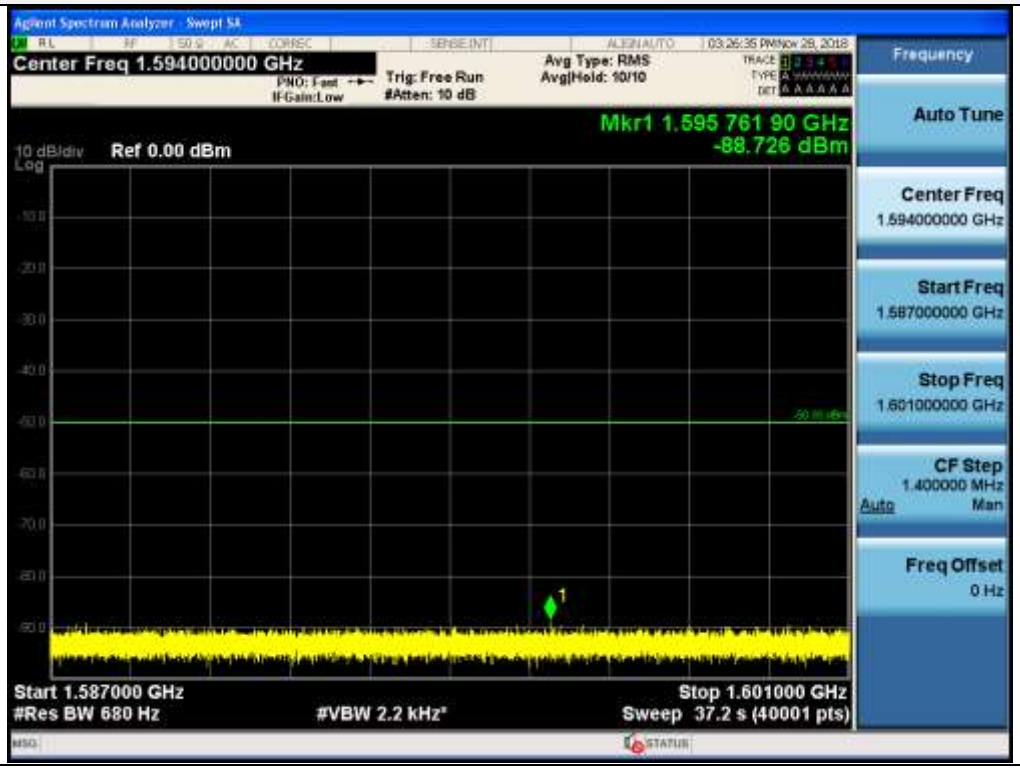
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 1.559 GHz ~ 1.573 GHz (700 Hz)



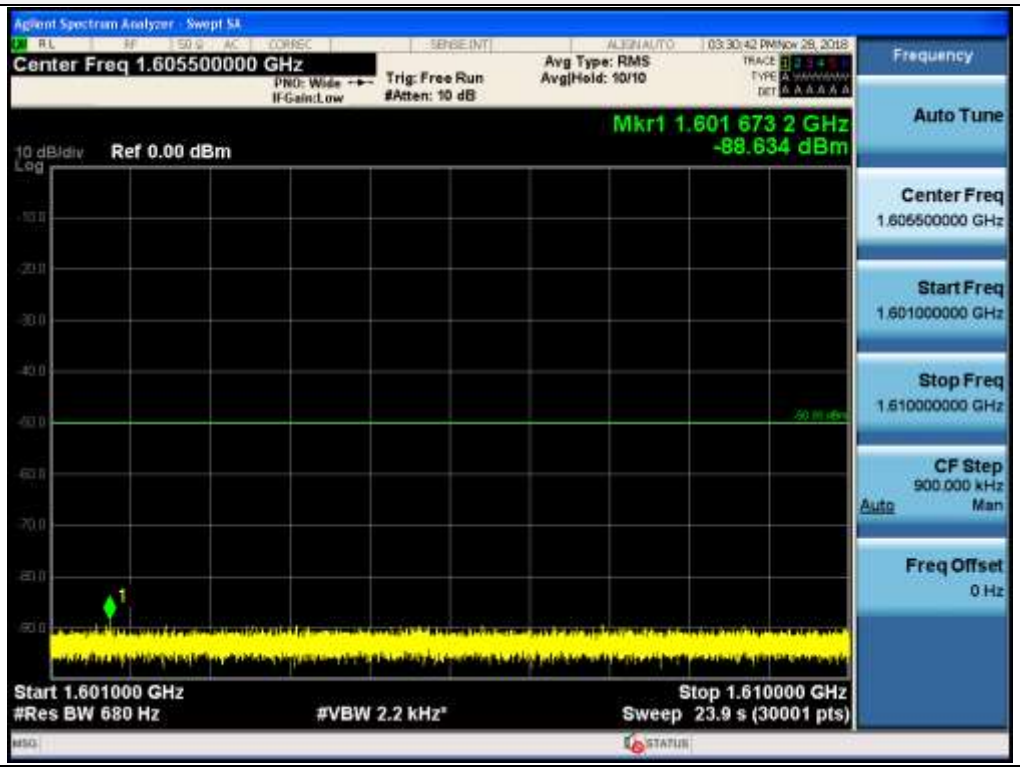
Conducted Spurious Emissions / Upper 700 MHz / Uplink / 1.573 GHz ~ 1.587 GHz (700 Hz)



Conducted Spurious Emissions / Upper 700 MHz / Uplink / 1.587 GHz ~ 1.601 GHz (700 Hz)

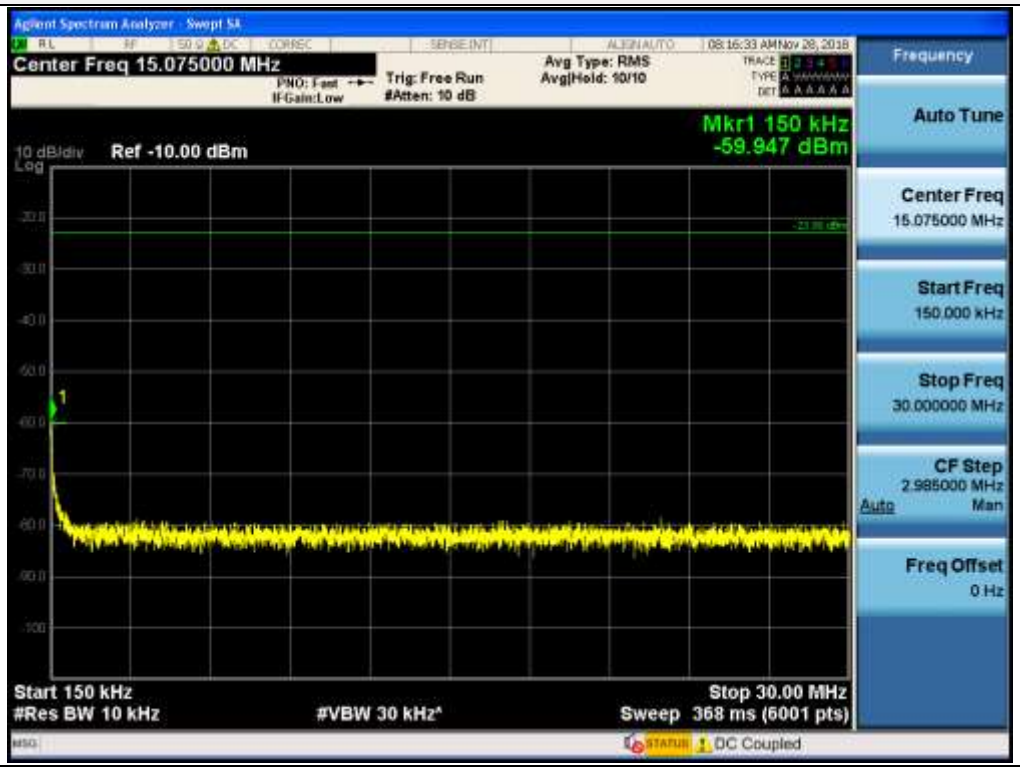


Conducted Spurious Emissions / Upper 700 MHz / Uplink / 1.601 GHz ~ 1.610 GHz (700 Hz)

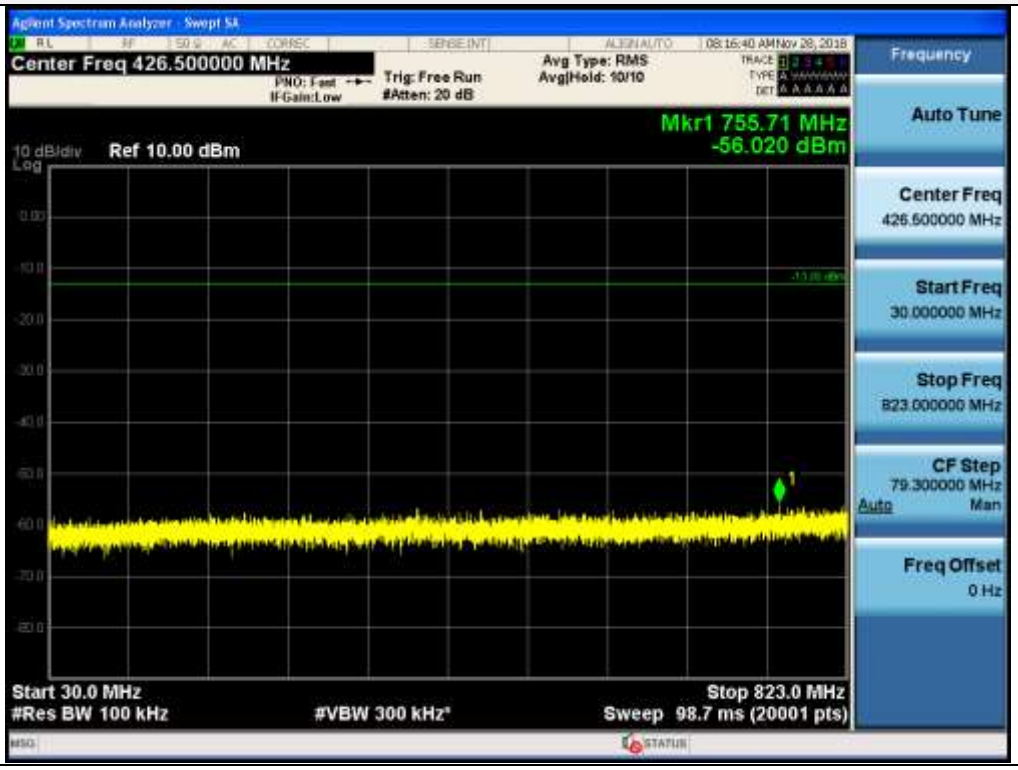


Conducted Spurious Emissions / Cellular / Uplink / 9 kHz ~ 150 kHz

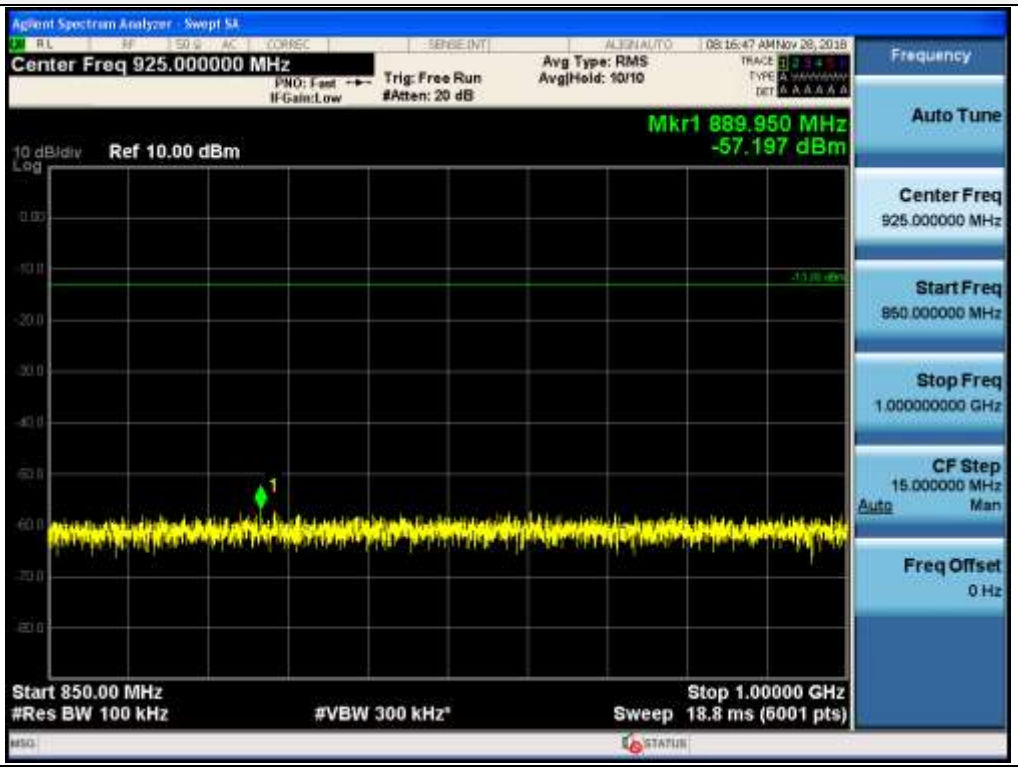
Conducted Spurious Emissions / Cellular / Uplink / 150 kHz ~ 30 MHz



Conducted Spurious Emissions / Cellular / Uplink / 30 MHz ~ 823 MHz



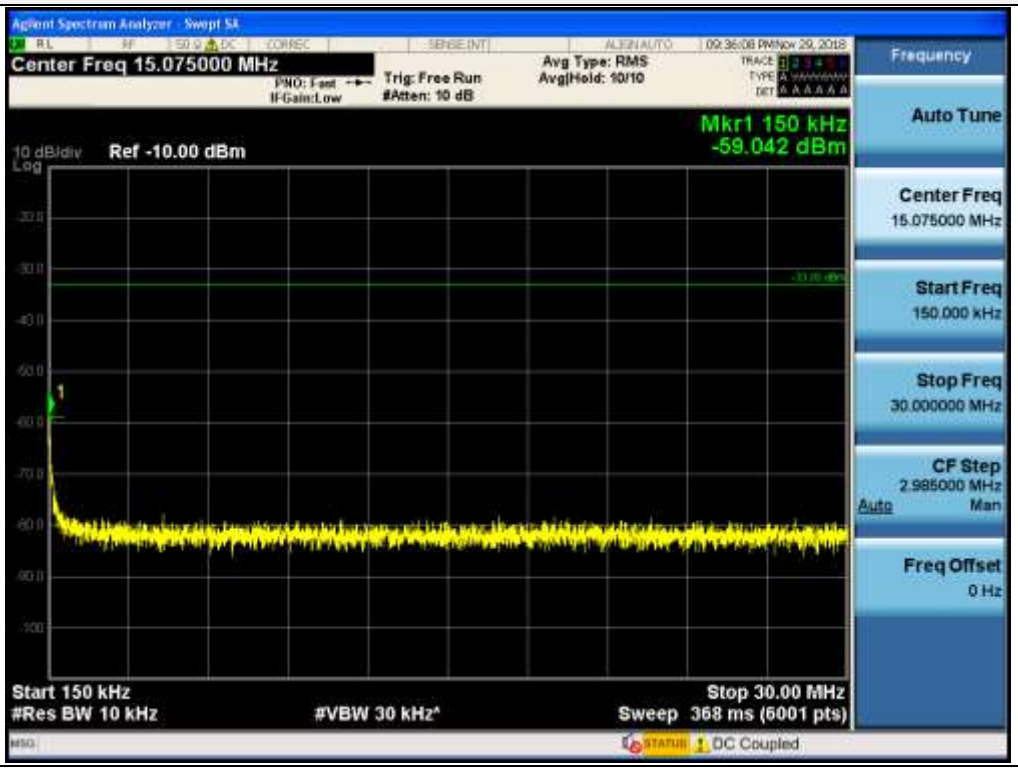
Conducted Spurious Emissions / Cellular / Uplink / 850 MHz ~ 1 GHz



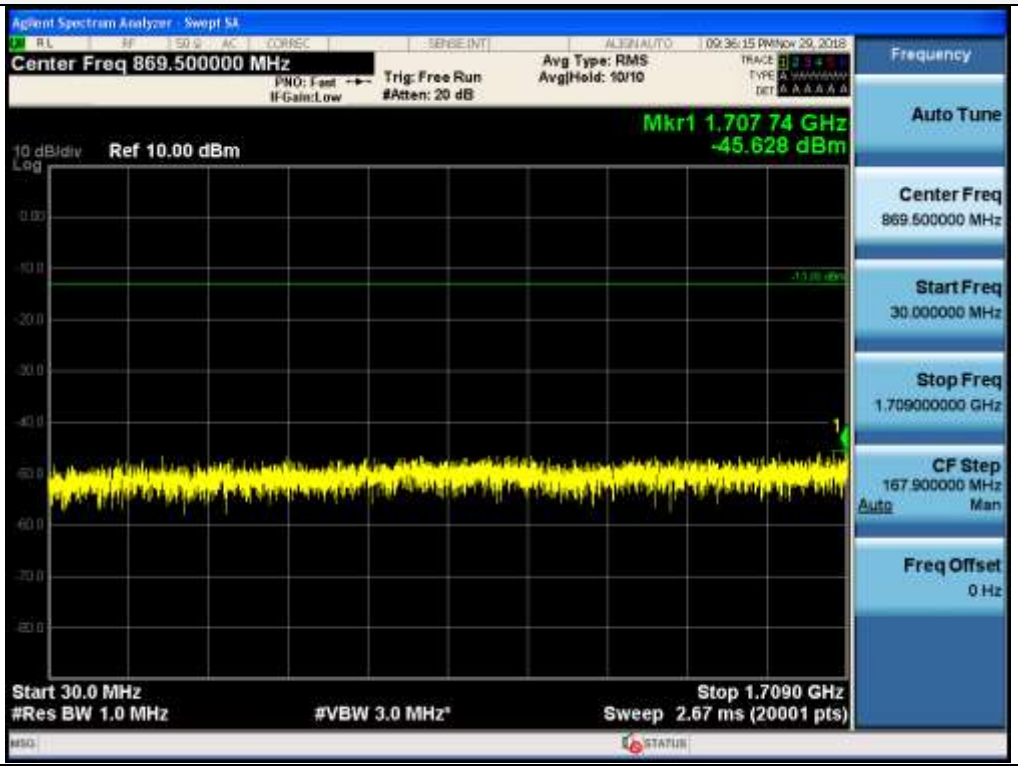
Conducted Spurious Emissions / Cellular / Uplink / 1 GHz ~ 10 GHz

Conducted Spurious Emissions / AWS-1 / Uplink / 9 kHz ~ 150 kHz

Conducted Spurious Emissions / AWS-1 / Uplink / 150 kHz ~ 30 MHz

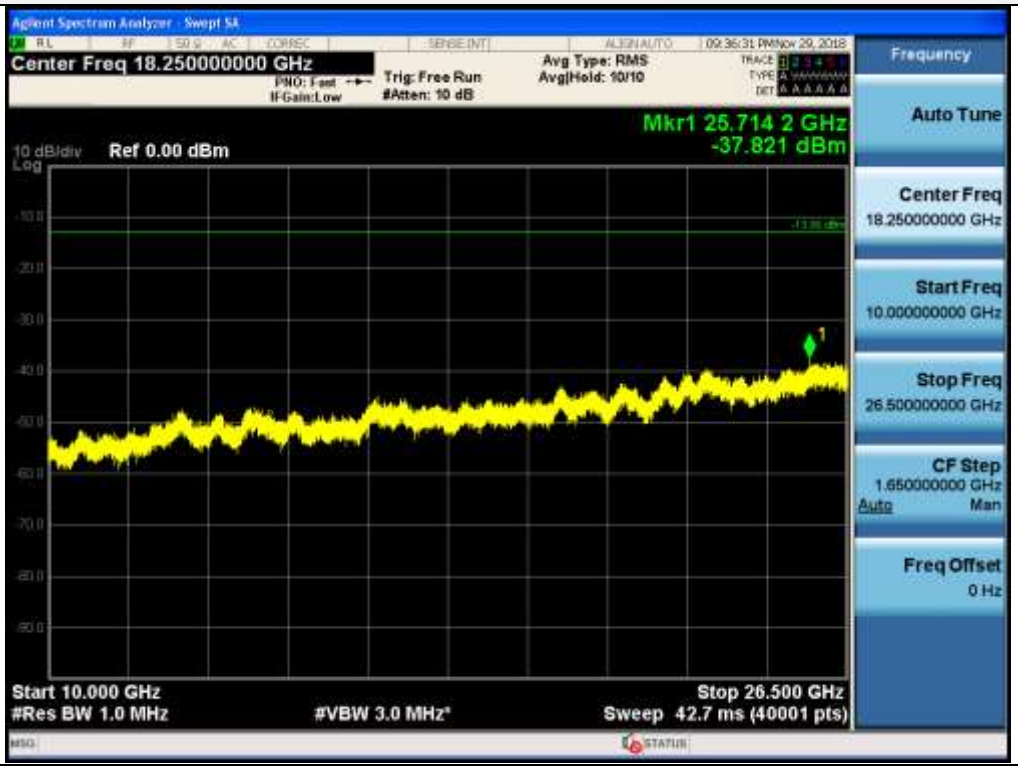


Conducted Spurious Emissions / AWS-1 / Uplink / 30 MHz ~ 1.709 GHz



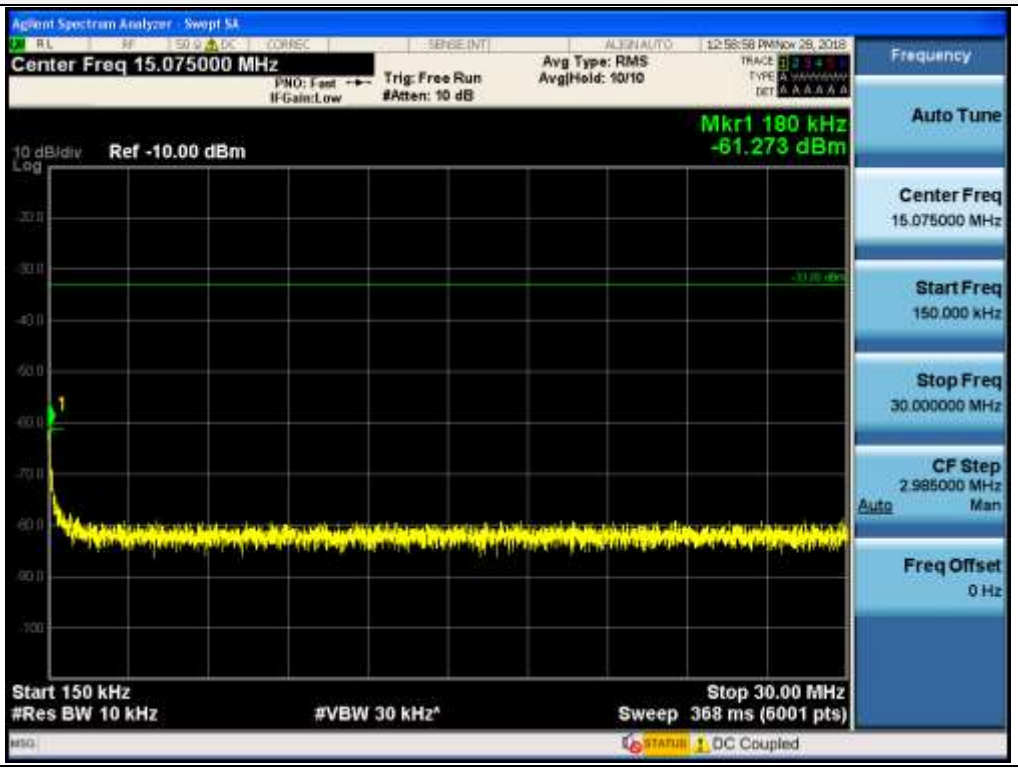
Conducted Spurious Emissions / AWS-1 / Uplink / 1.756 GHz ~ 10 GHz

Conducted Spurious Emissions / AWS-1 / Uplink / 10 GHz ~ 26.5 GHz

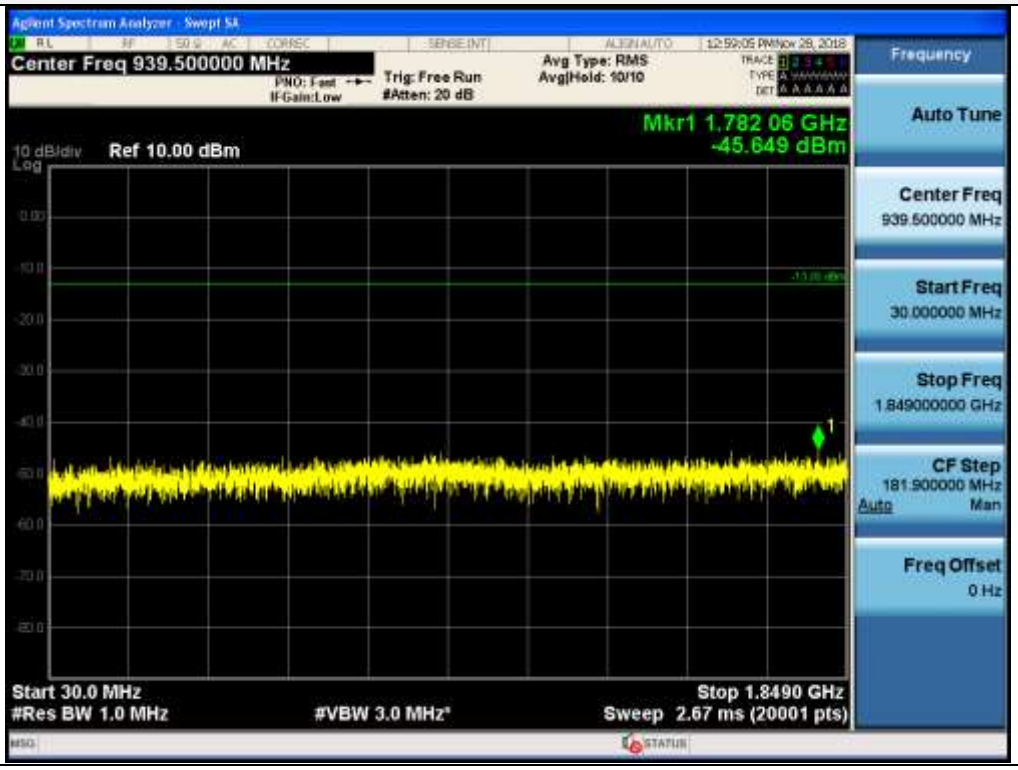


Conducted Spurious Emissions / Broadband PCS / Uplink / 9 kHz ~ 150 kHz

Conducted Spurious Emissions / Broadband PCS / Uplink / 150 kHz ~ 30 MHz

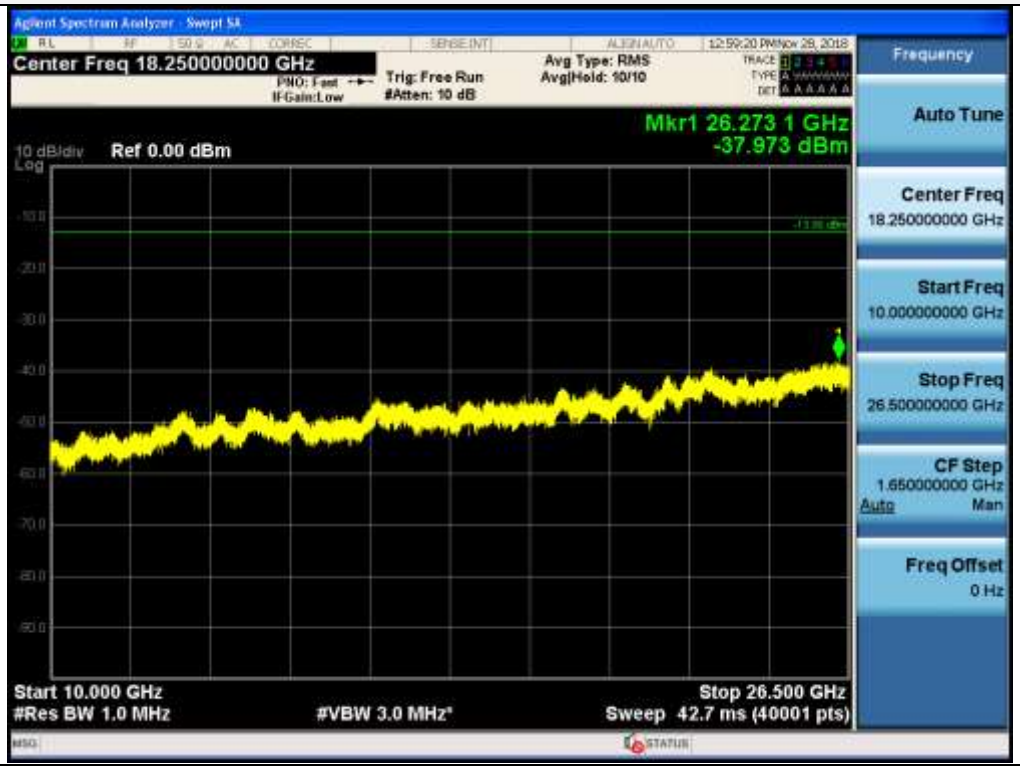


Conducted Spurious Emissions / Broadband PCS / Uplink / 30 MHz ~ 1.849 GHz



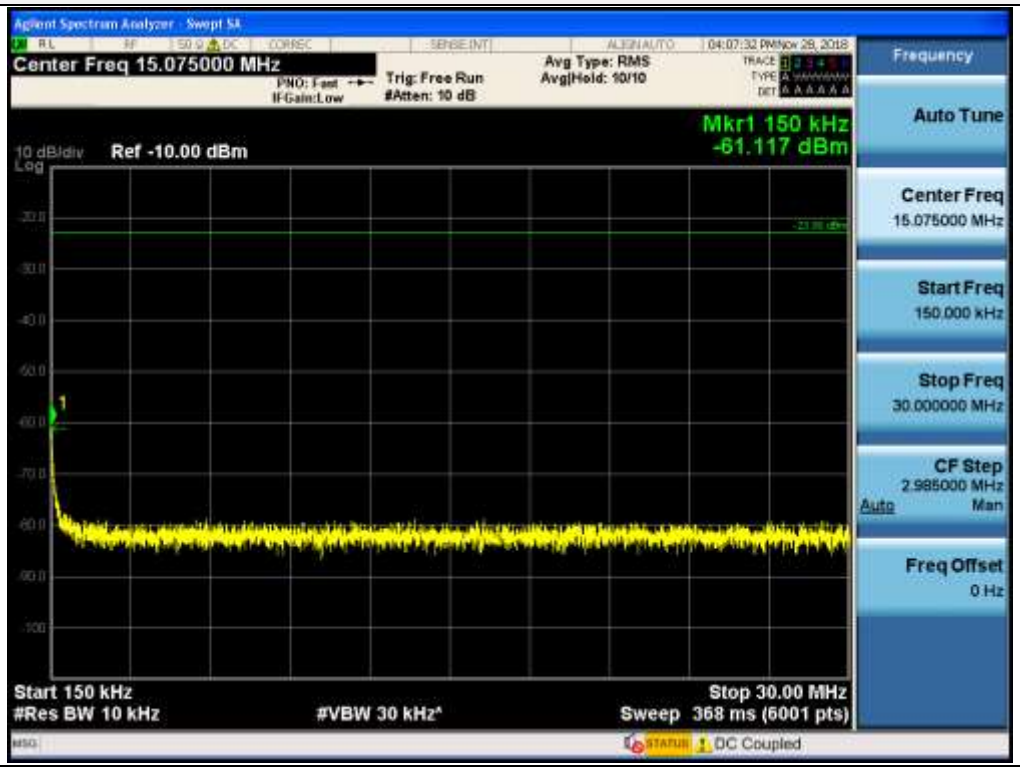
Conducted Spurious Emissions / Broadband PCS / Uplink / 1.916 GHz ~ 10 GHz

Conducted Spurious Emissions / Broadband PCS / Uplink / 10 GHz ~ 26.5 GHz

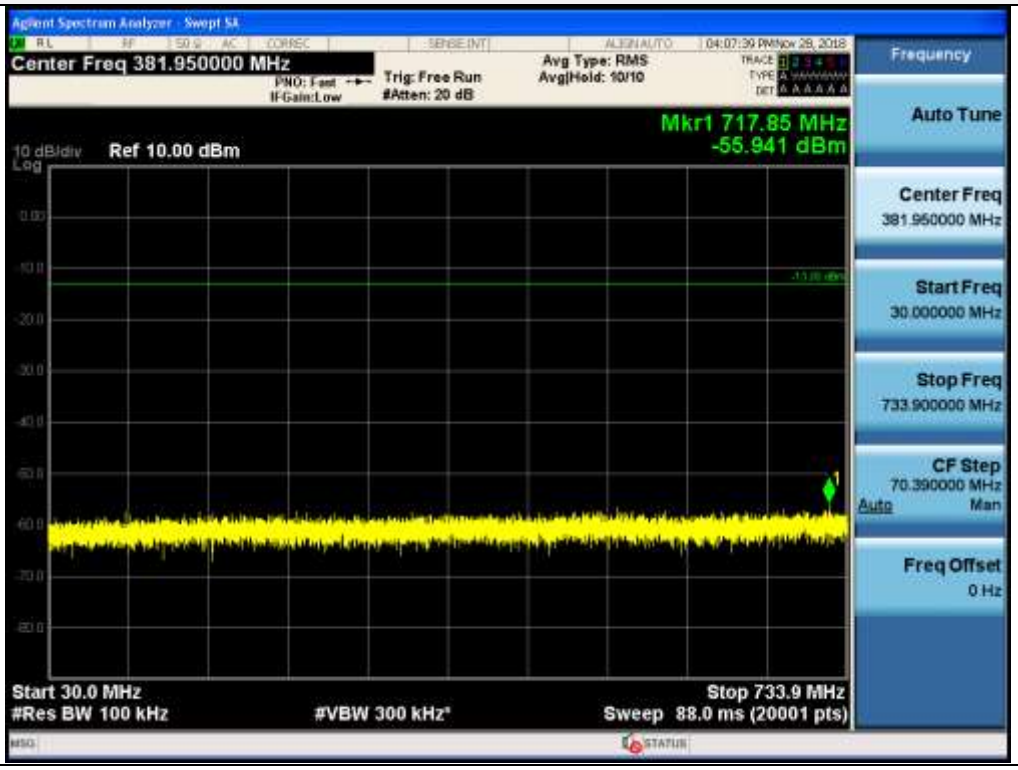


Conducted Spurious Emissions / Lower 700 MHz / Downlink / 9 kHz ~ 150 kHz

Conducted Spurious Emissions / Lower 700 MHz / Downlink / 150 kHz ~ 30 MHz

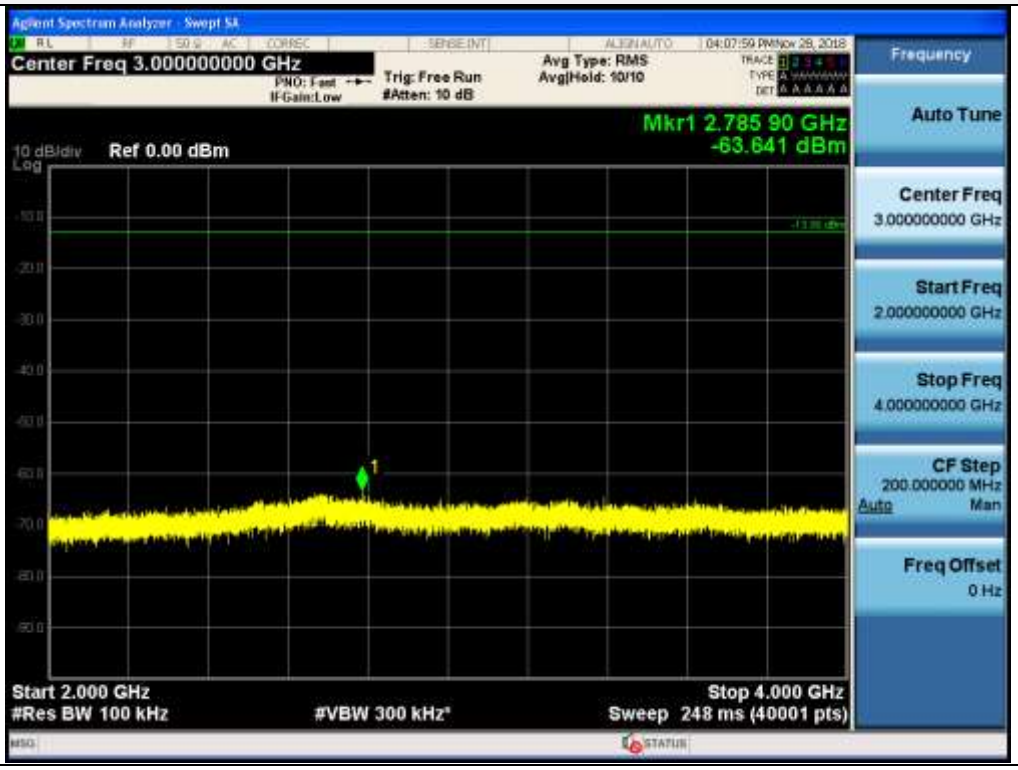


Conducted Spurious Emissions / Lower 700 MHz / Downlink / 30 MHz ~ 733.9 MHz



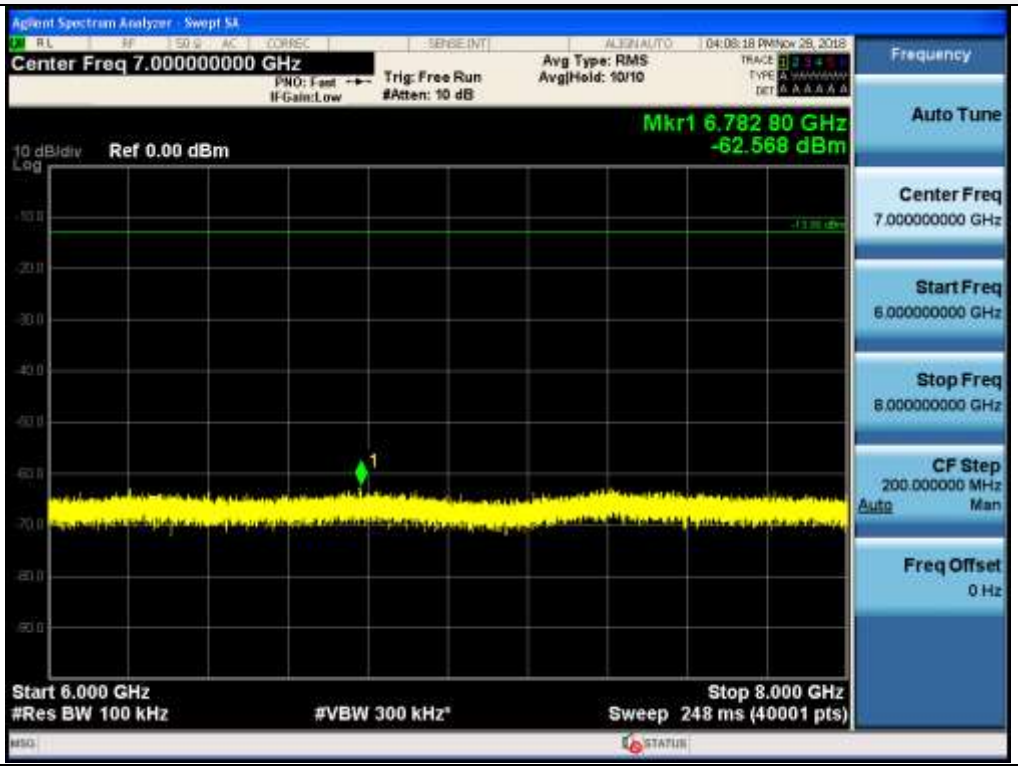
Conducted Spurious Emissions / Lower 700 MHz / Downlink / 746.1 MHz ~ 2 GHz

Conducted Spurious Emissions / Lower 700 MHz / Downlink / 2 GHz ~ 4 GHz



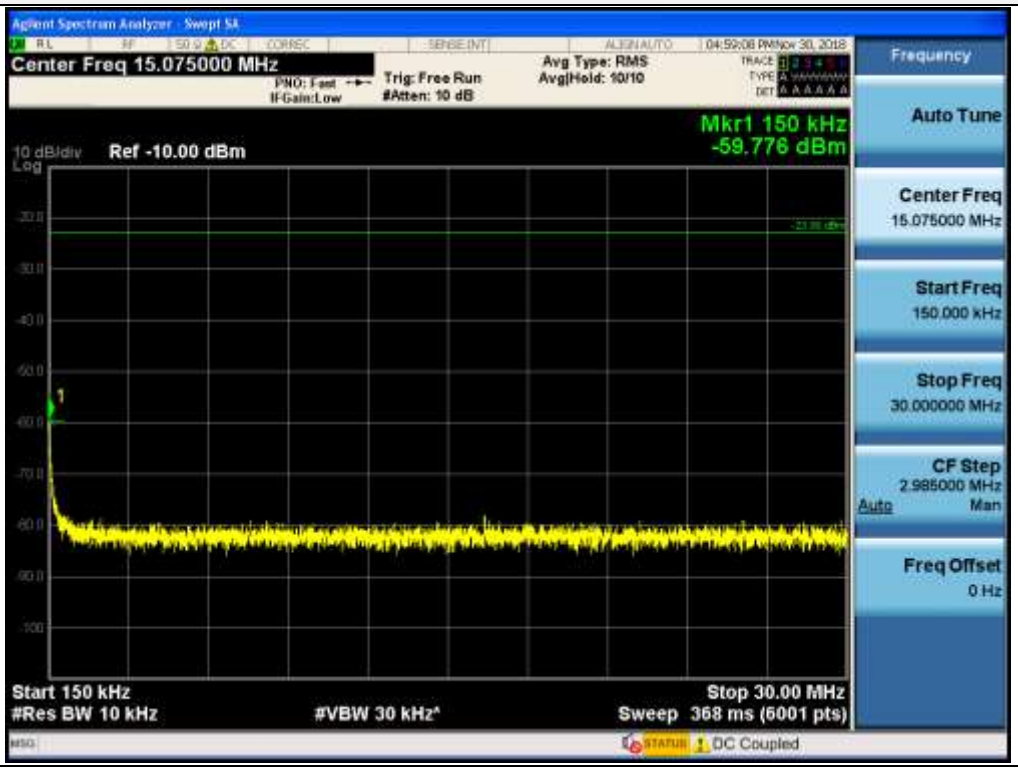
Conducted Spurious Emissions / Lower 700 MHz / Downlink / 4 GHz ~ 6 GHz

Conducted Spurious Emissions / Lower 700 MHz / Downlink / 6 GHz ~ 8 GHz



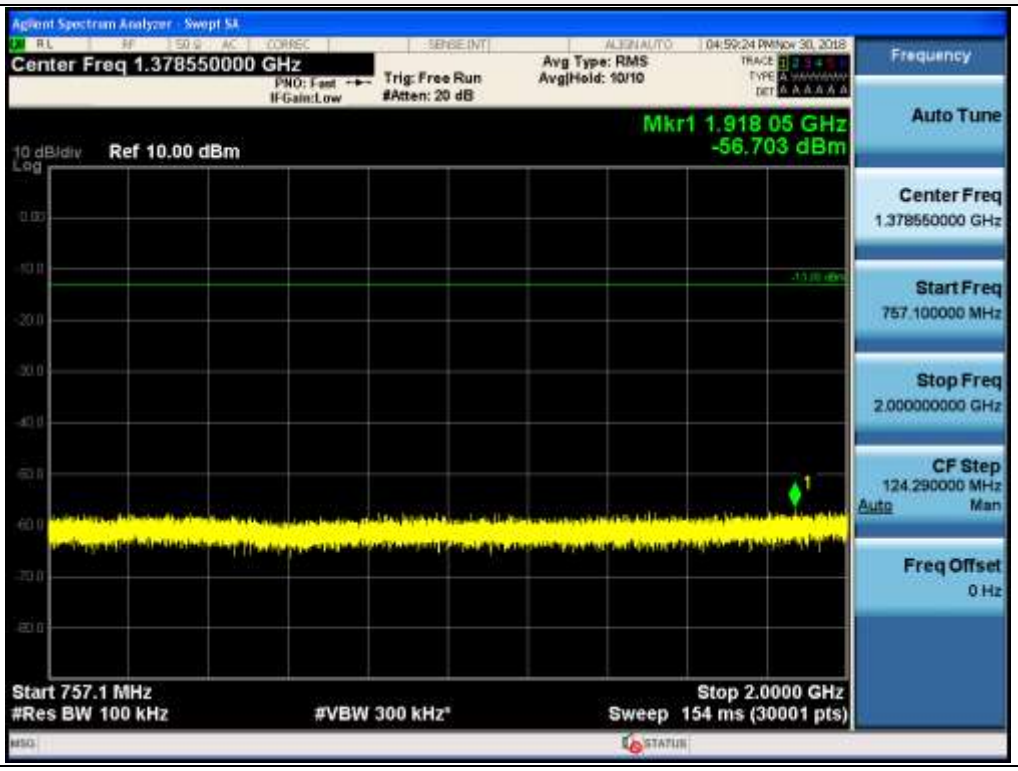
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 9 kHz ~ 150 kHz

Conducted Spurious Emissions / Upper 700 MHz / Downlink / 150 kHz ~ 30 MHz

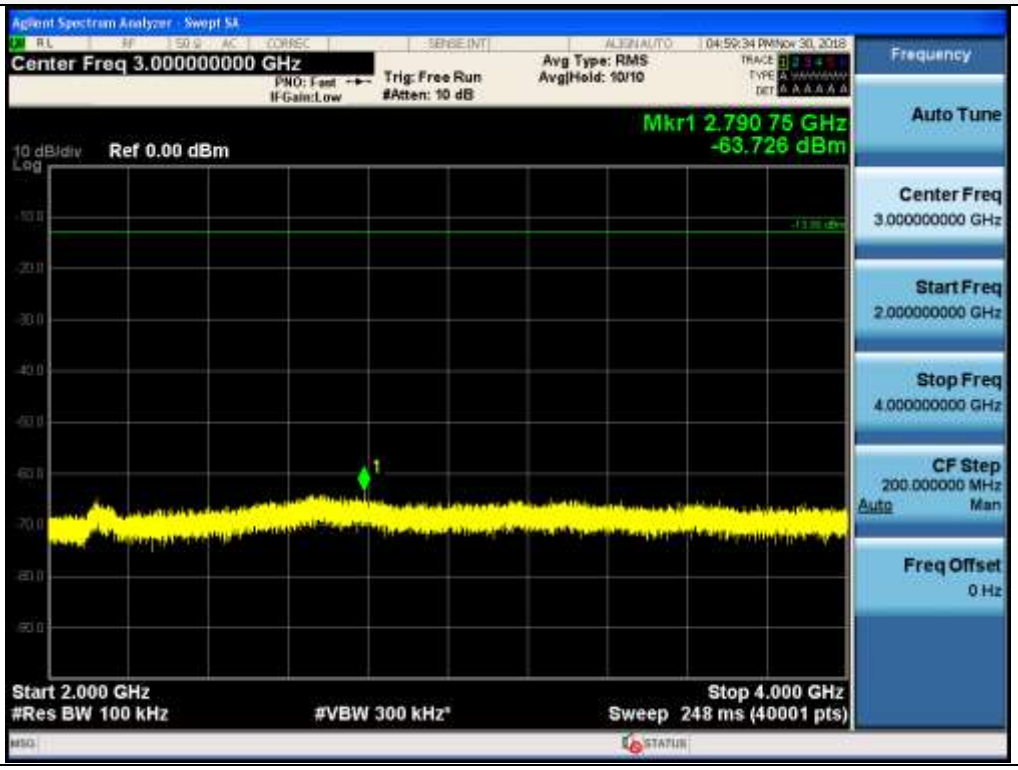


Conducted Spurious Emissions / Upper 700 MHz / Downlink / 30 MHz ~ 745.9 MHz

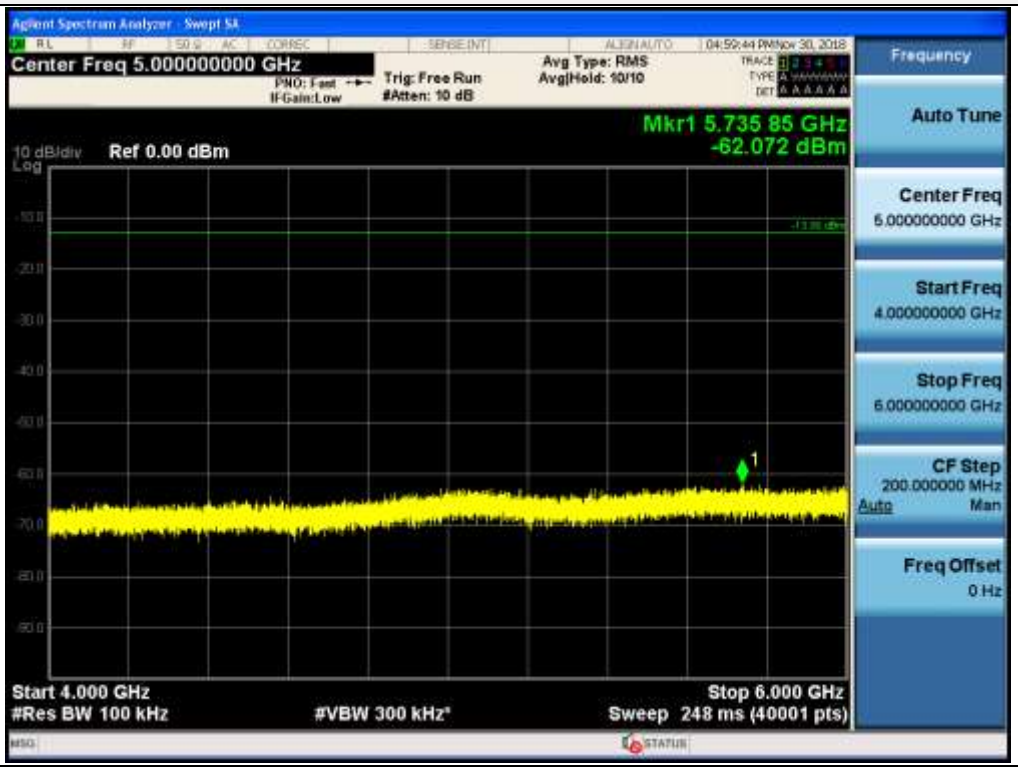
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 757.1 MHz ~ 2 GHz



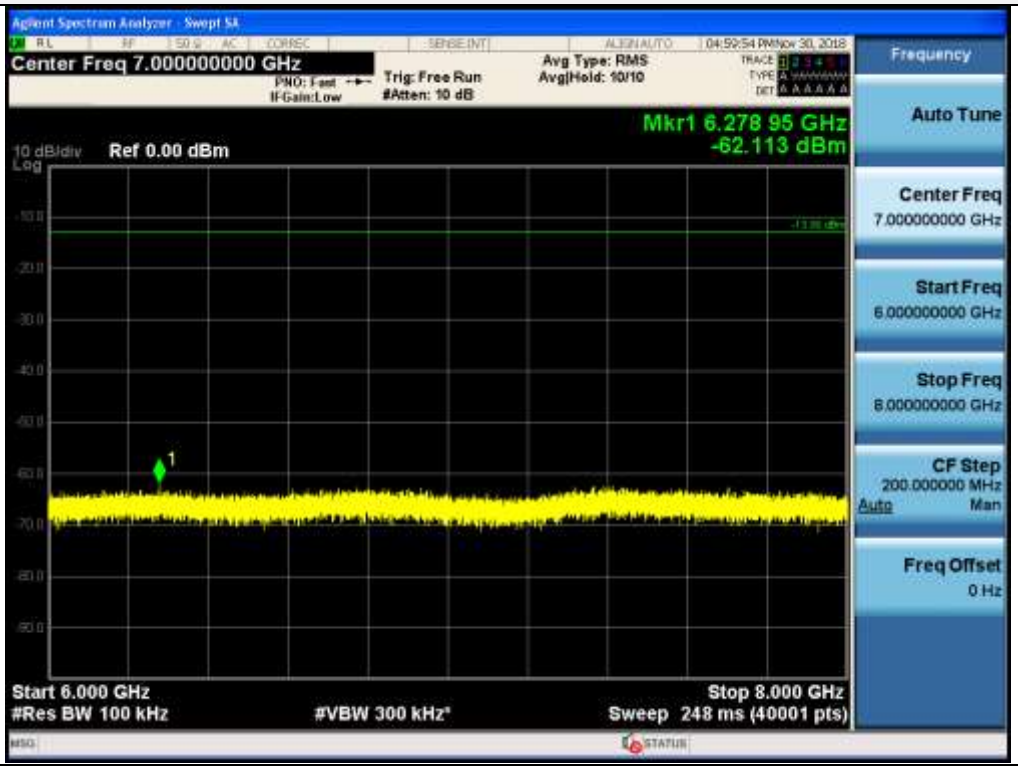
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 2 GHz ~ 4 GHz



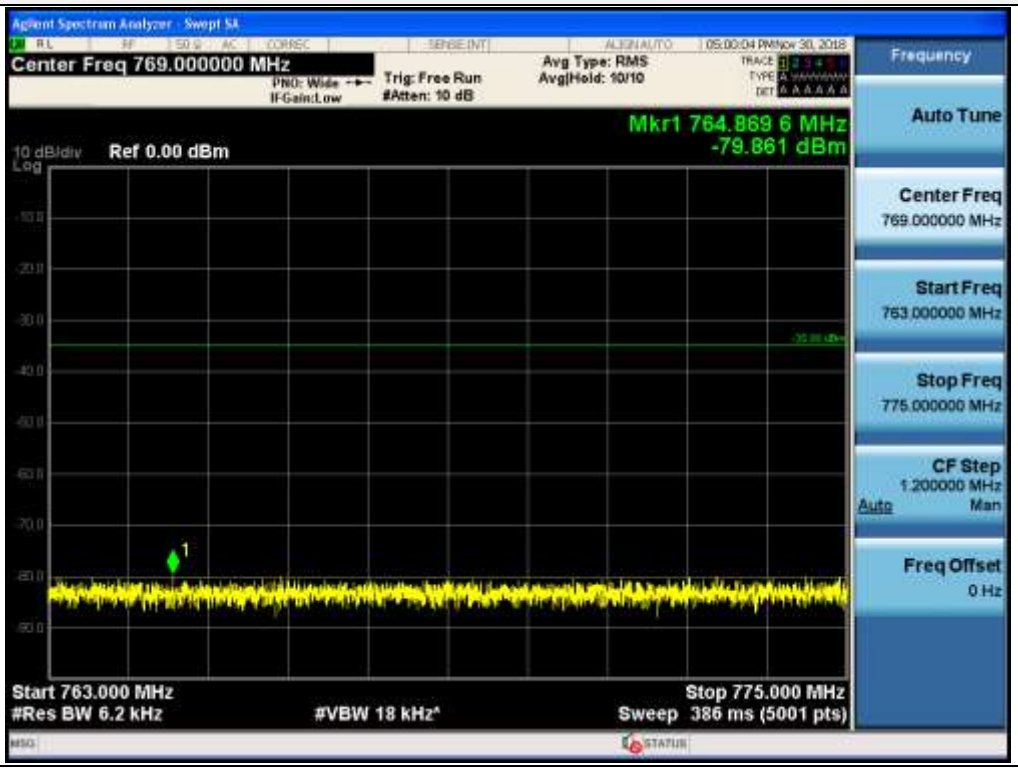
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 4 GHz ~ 6 GHz



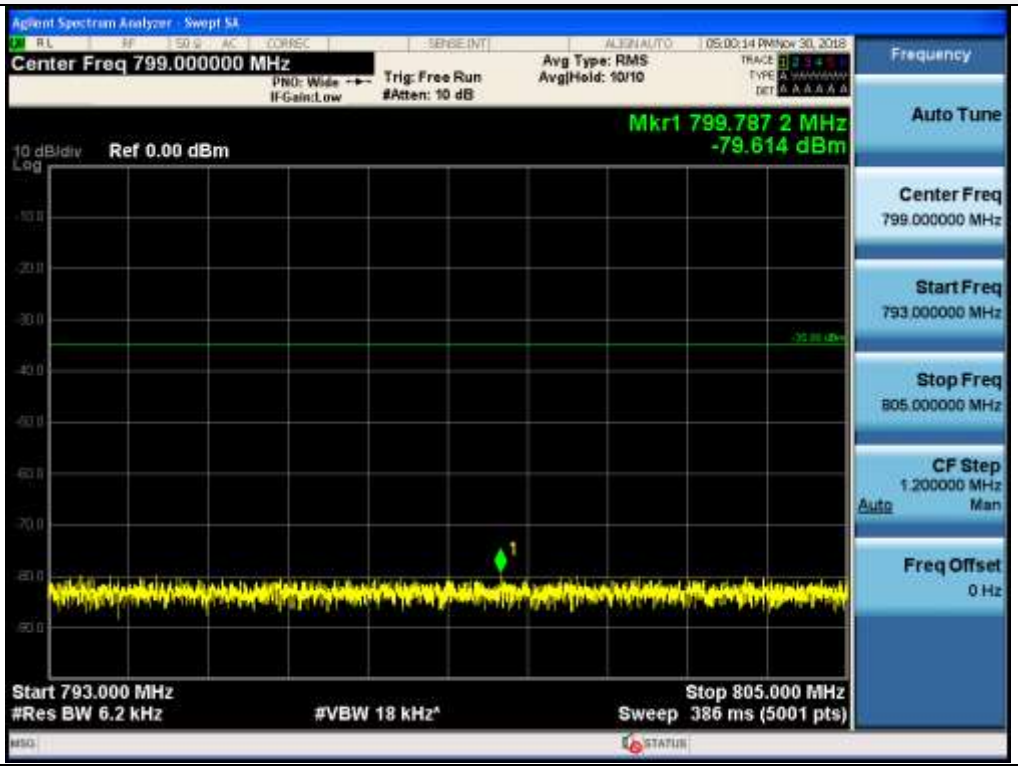
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 6 GHz ~ 8 GHz



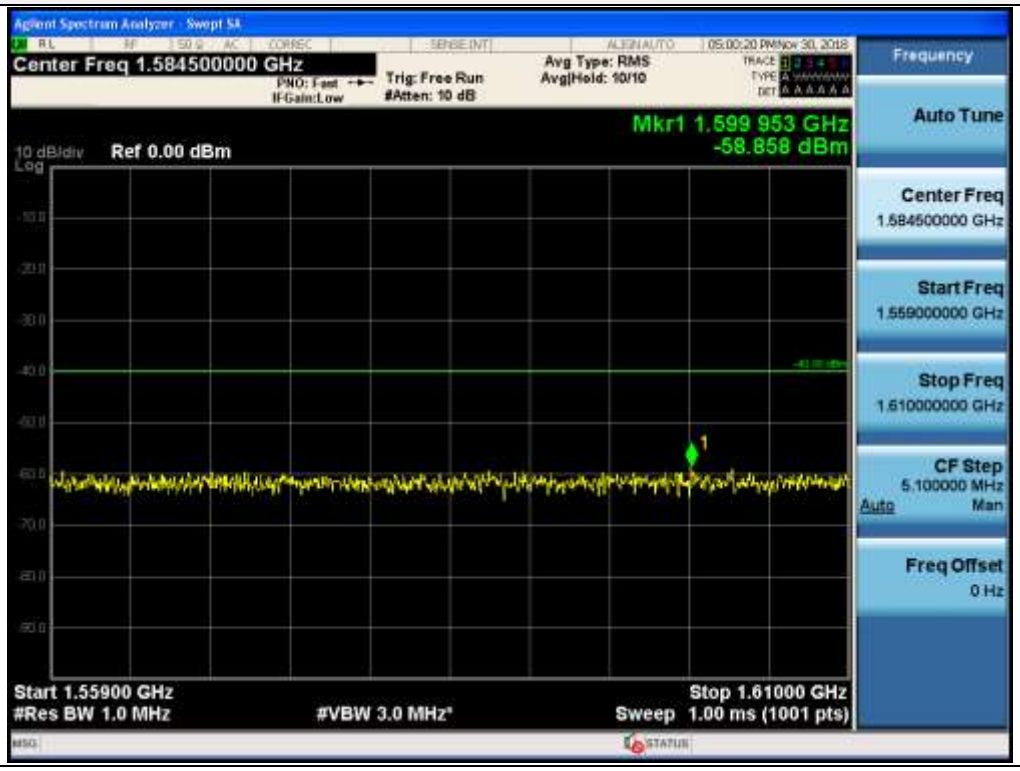
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 763 MHz ~ 775 MHz



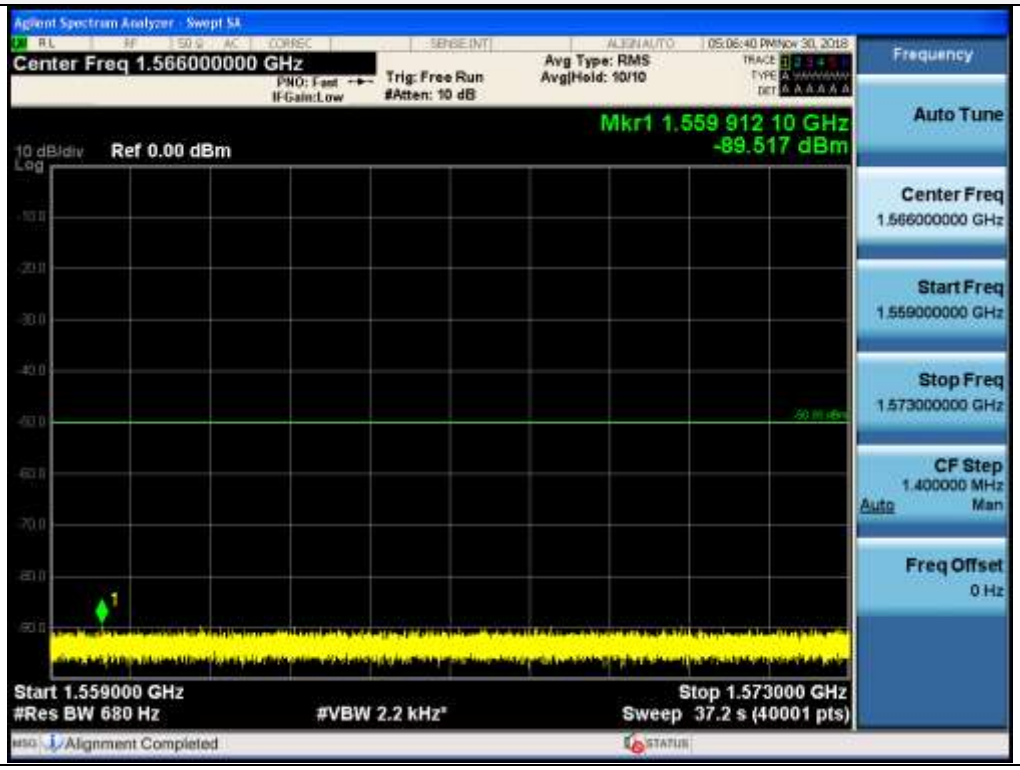
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 793 MHz ~ 805 MHz



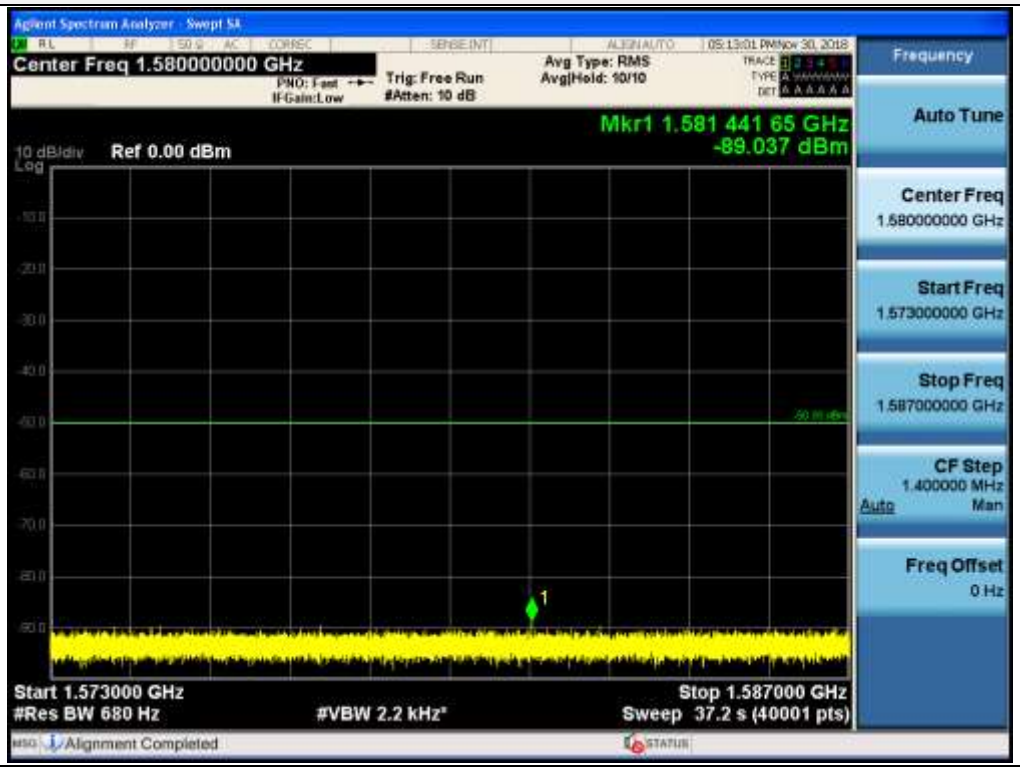
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 1.559 GHz ~ 1.610 GHz (1 MHz)



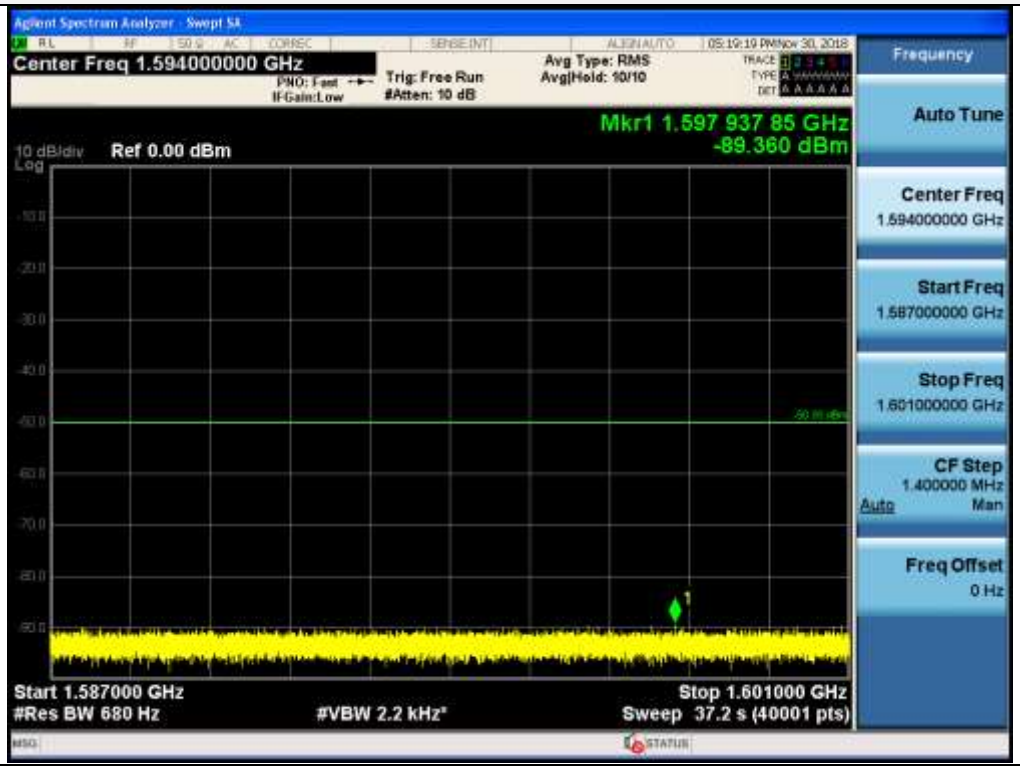
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 1.559 GHz ~ 1.573 GHz (700 Hz)



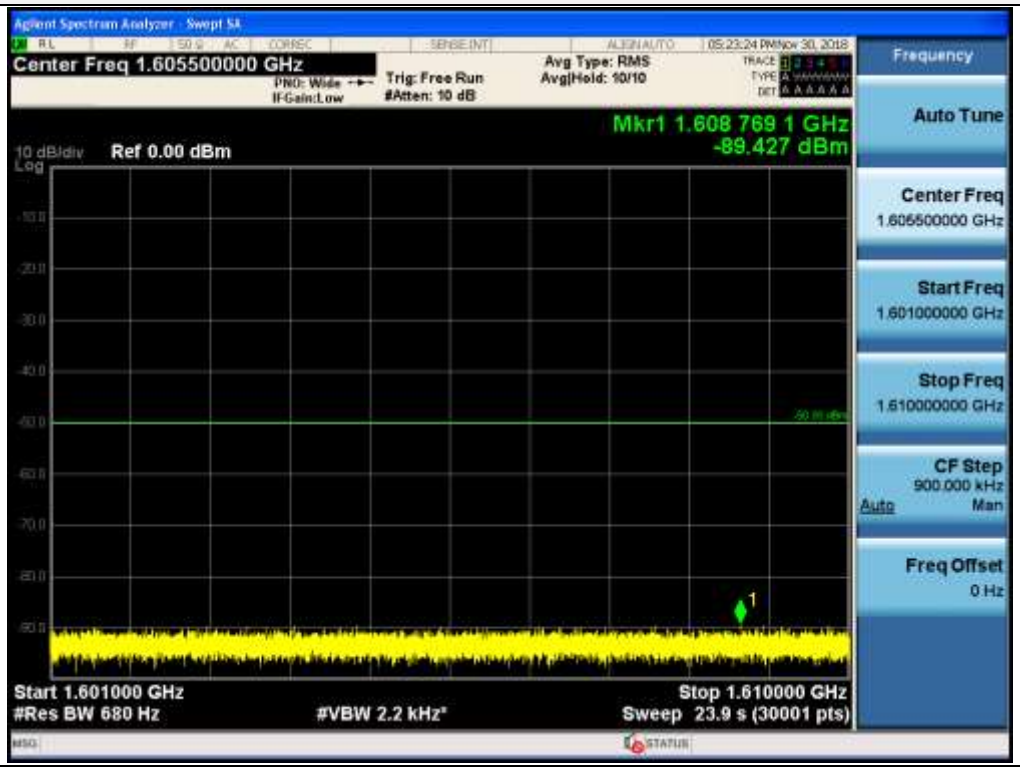
Conducted Spurious Emissions / Upper 700 MHz / Downlink / 1.573 GHz ~ 1.587 GHz (700 Hz)



Conducted Spurious Emissions / Upper 700 MHz / Downlink / 1.587 GHz ~ 1.601 GHz (700 Hz)

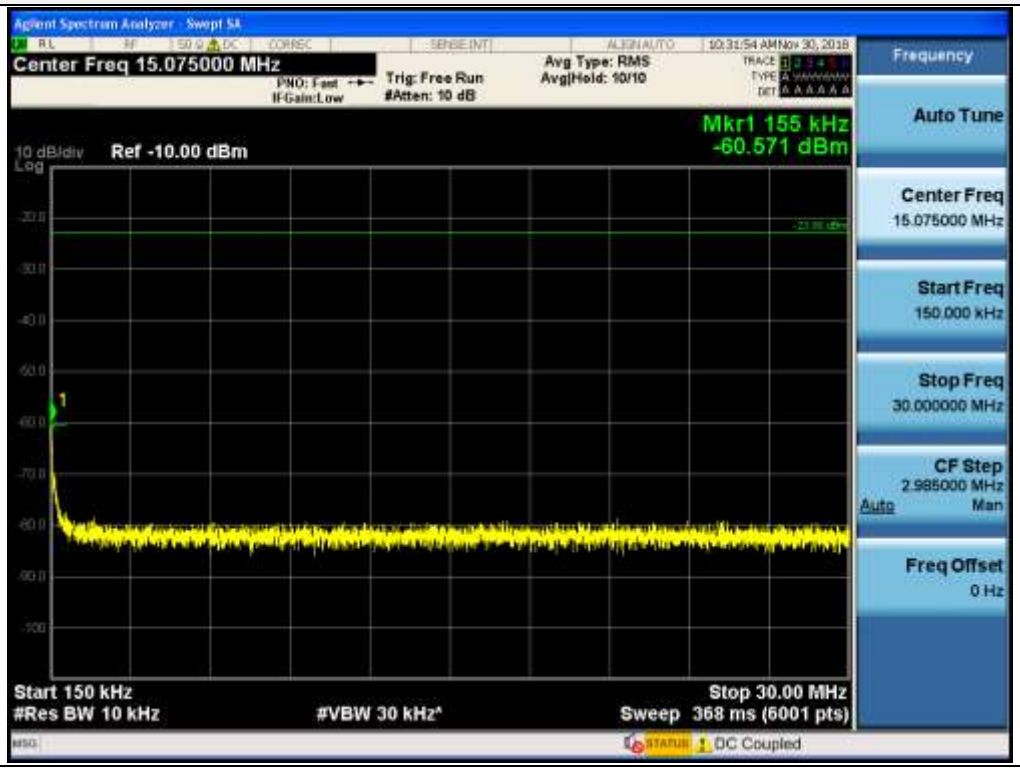


Conducted Spurious Emissions / Upper 700 MHz / Downlink / 1.601 GHz ~ 1.610 GHz (700 Hz)

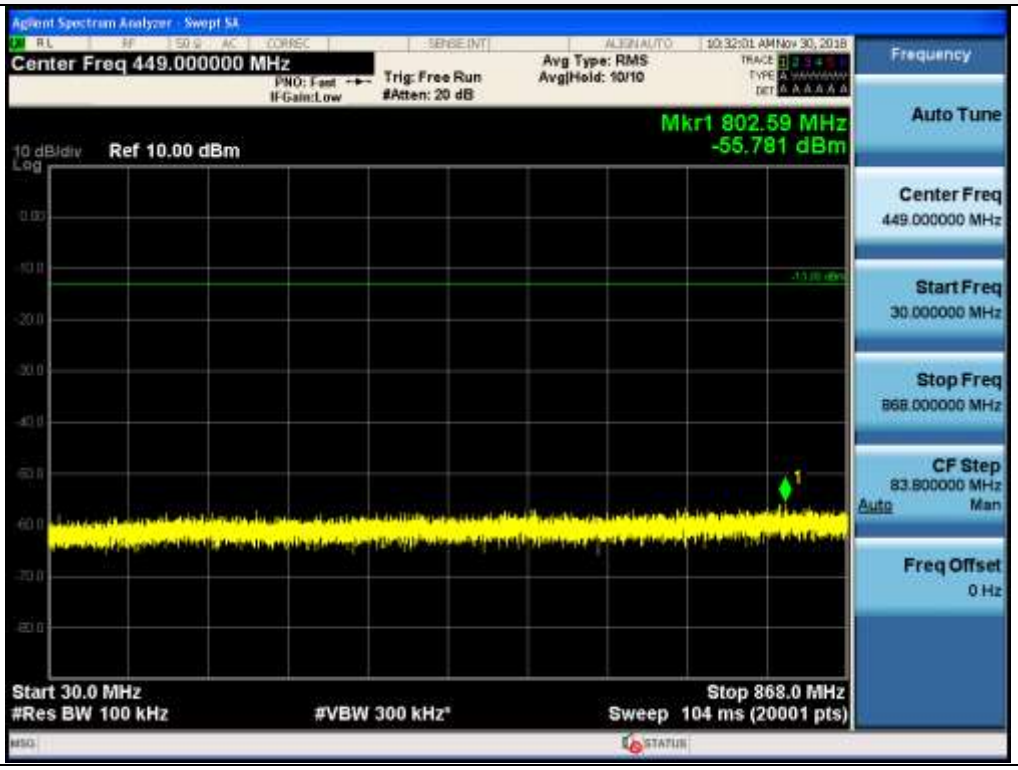


Conducted Spurious Emissions / Cellular / Downlink / 9 kHz ~ 150 kHz

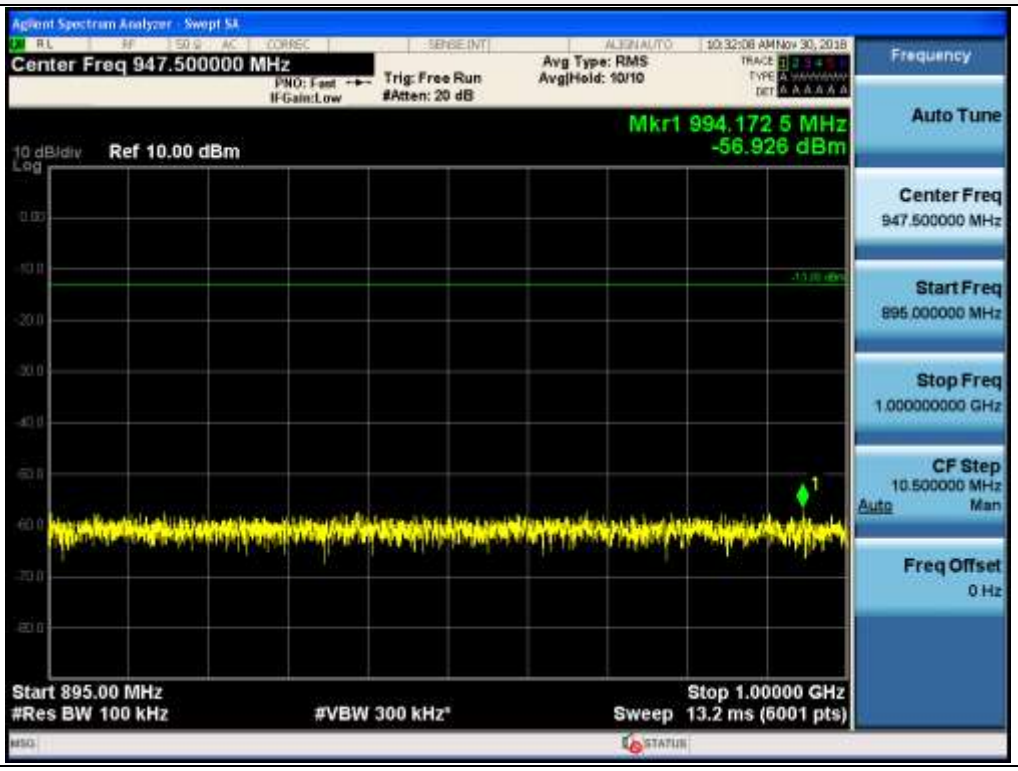
Conducted Spurious Emissions / Cellular / Downlink / 150 kHz ~ 30 MHz



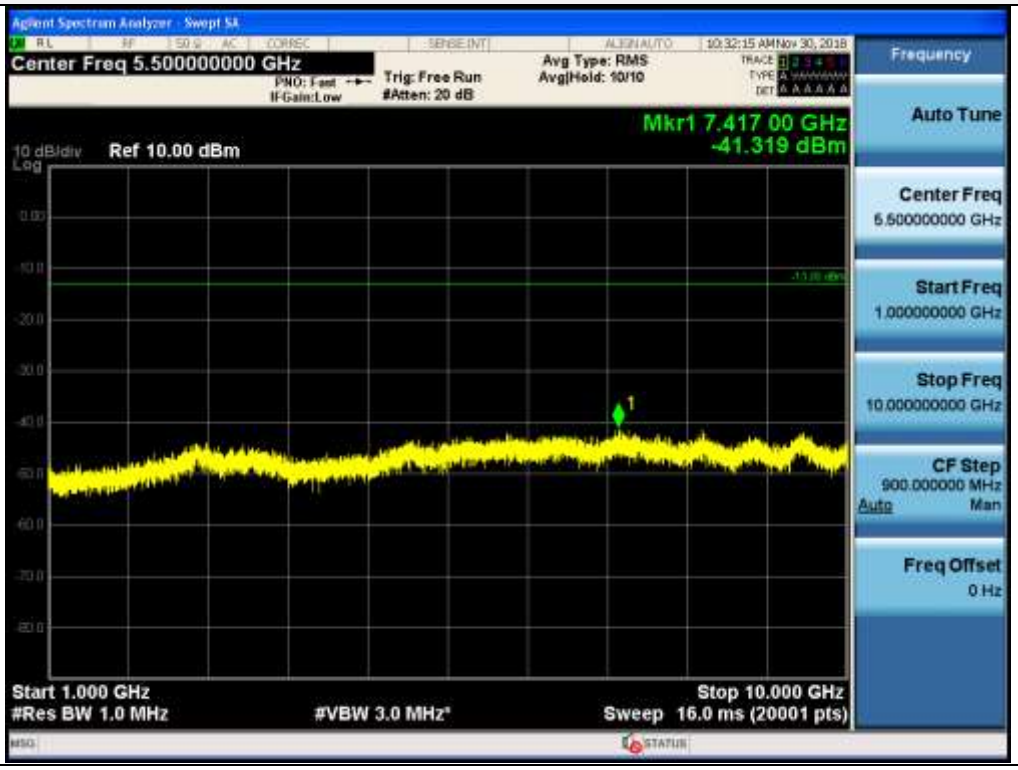
Conducted Spurious Emissions / Cellular / Downlink / 30 MHz ~ 868 MHz



Conducted Spurious Emissions / Cellular / Downlink / 895 MHz ~ 1 GHz

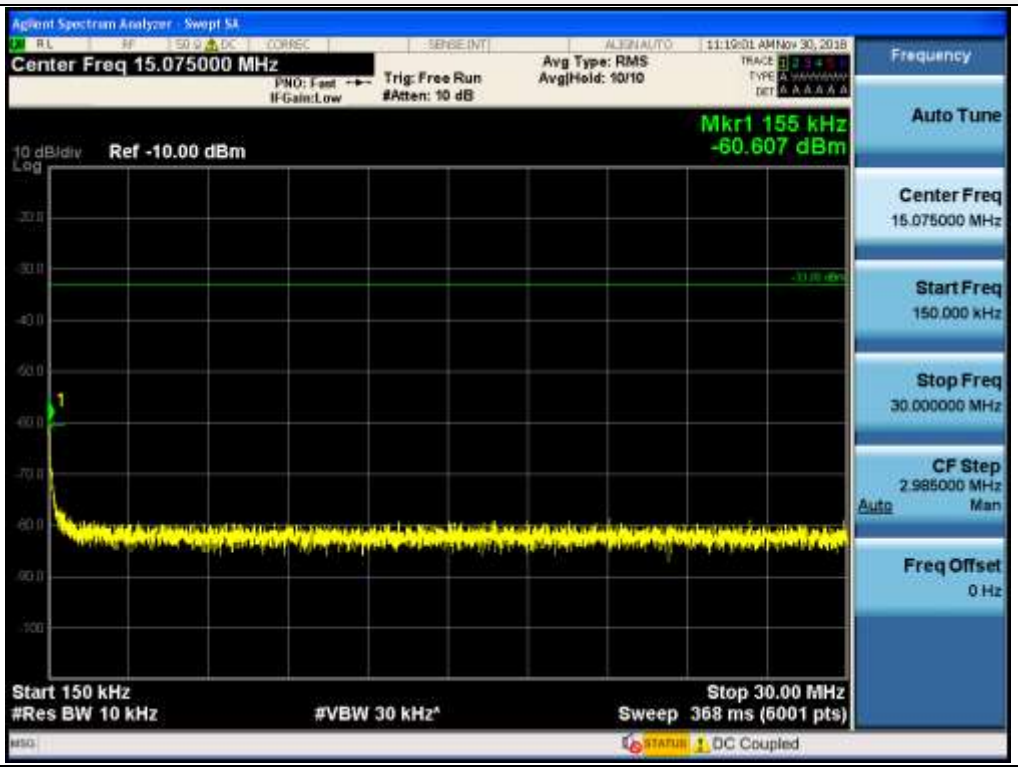


Conducted Spurious Emissions / Cellular / Downlink / 1 GHz ~ 10 GHz

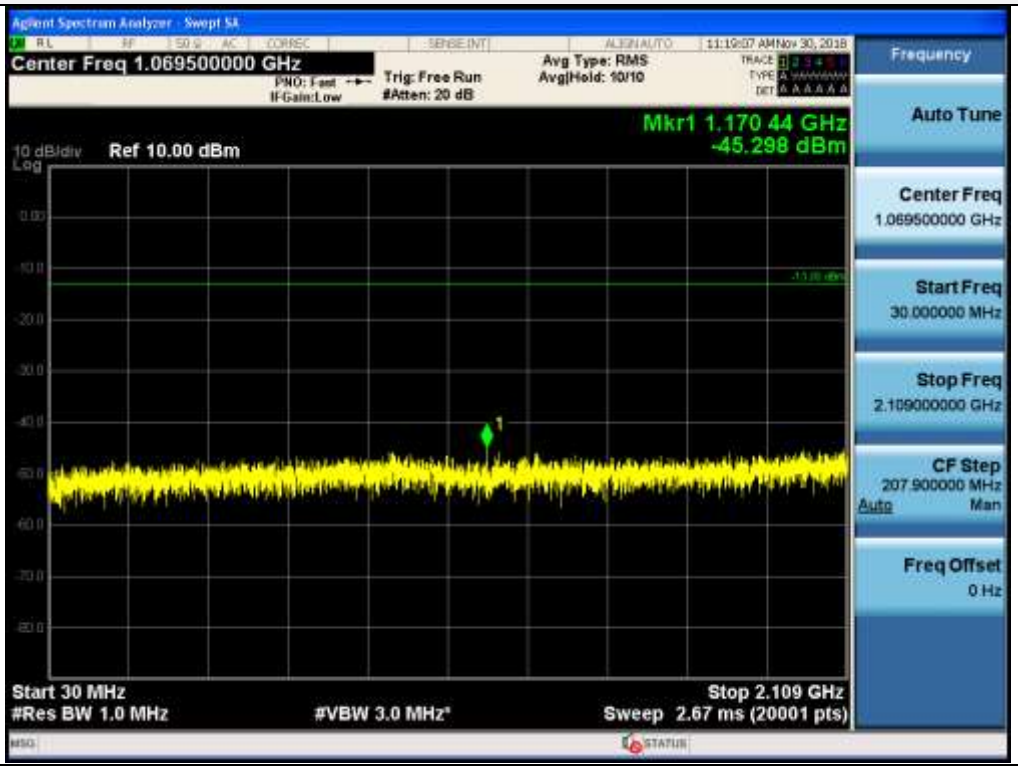


Conducted Spurious Emissions / AWS-1 / Downlink / 9 kHz ~ 150 kHz

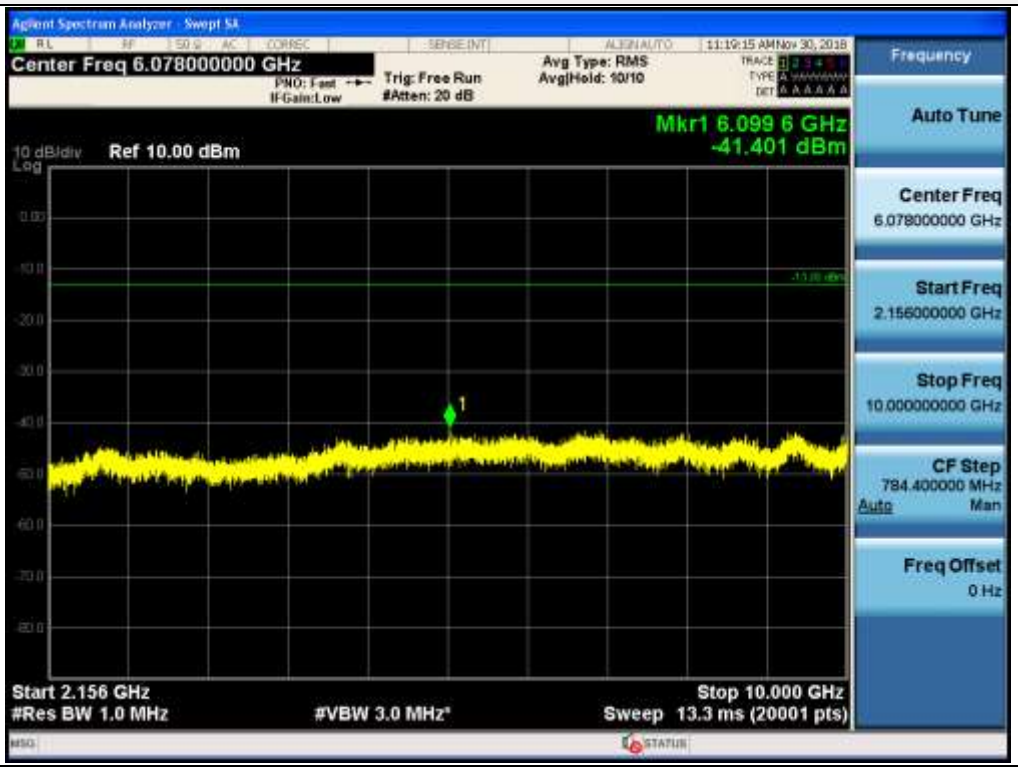
Conducted Spurious Emissions / AWS-1 / Downlink / 150 kHz ~ 30 MHz



Conducted Spurious Emissions / AWS-1 / Downlink / 30 MHz ~ 2.109 GHz



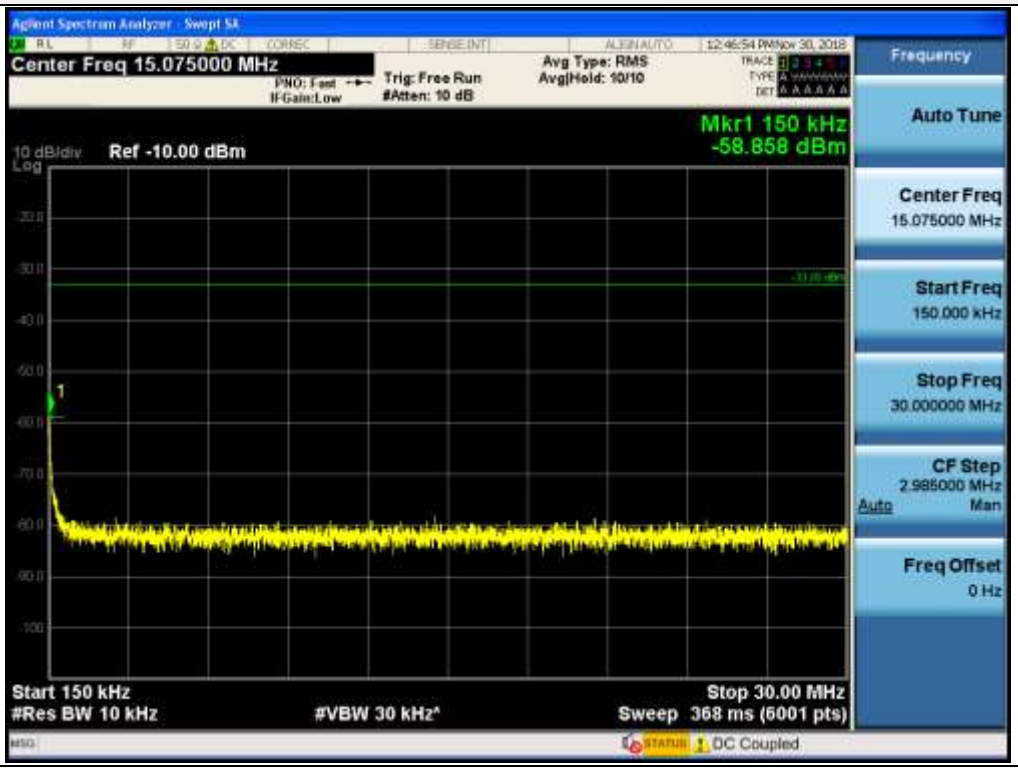
Conducted Spurious Emissions / AWS-1 / Downlink / 2.156 GHz ~ 10 GHz



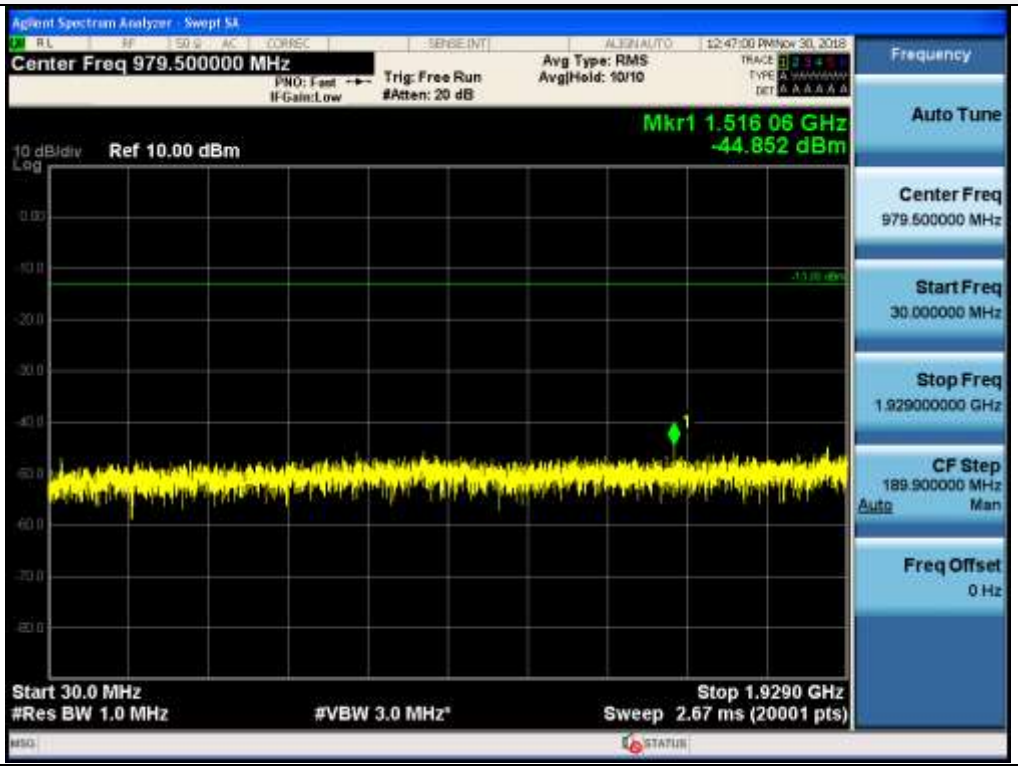
Conducted Spurious Emissions / AWS-1 / Downlink / 10 GHz ~ 26.5 GHz

Conducted Spurious Emissions / Broadband PCS / Downlink / 9 kHz ~ 150 kHz

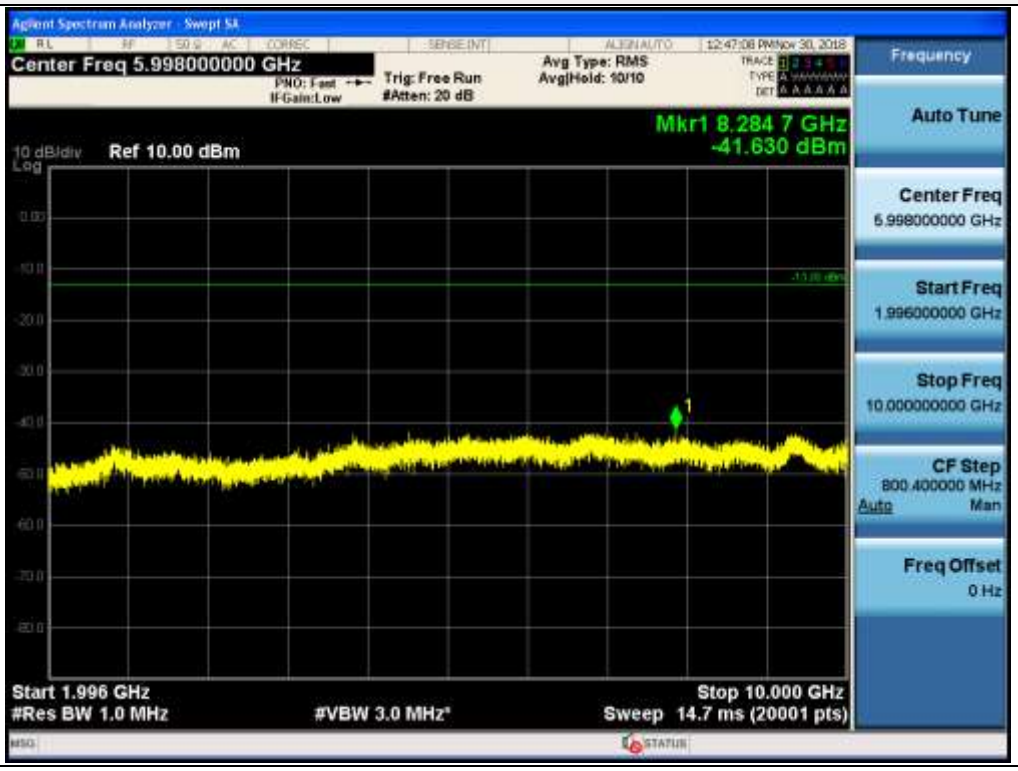
Conducted Spurious Emissions / Broadband PCS / Downlink / 150 kHz ~ 30 MHz



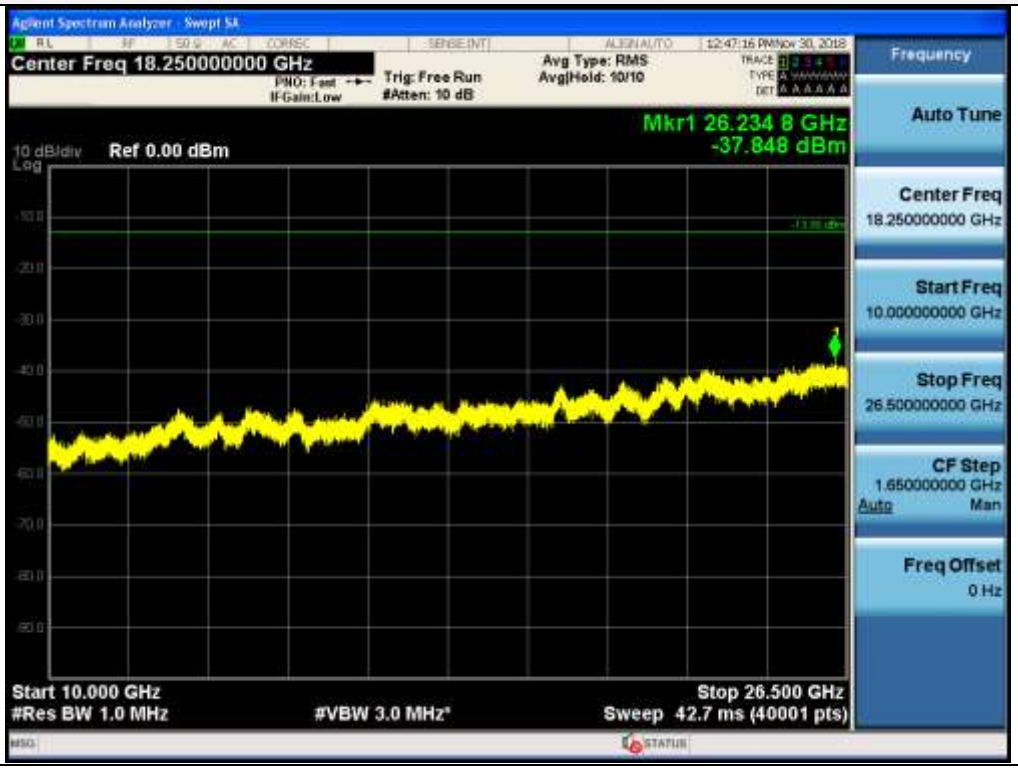
Conducted Spurious Emissions / Broadband PCS / Downlink / 30 MHz ~ 1.929 GHz



Conducted Spurious Emissions / Broadband PCS / Downlink / 1.996 GHz ~ 10 GHz



Conducted Spurious Emissions / Broadband PCS / Downlink / 10 GHz ~ 26.5 GHz



5.7. NOISE LIMITS

Test Requirements:

§20.21(e)(8)(i)(A) NOISE LIMITS.

(1) The transmitted noise power in dBm/MHz of consumer boosters at their uplink port shall not exceed −103 dBm/MHz—RSSI. RSSI (received signal strength indication expressed in negative dB units relative to 1 mW) is the downlink composite received signal power in dBm at the booster donor port for all base stations in the band of operation.

(2) The transmitted maximum noise power in dBm/MHz of consumer boosters at their uplink and downlink ports shall not exceed the following limits:

(ii) Mobile booster maximum noise power shall not exceed−59 dBm/MHz.

(iii) Compliance with Noise limits will use instrumentation calibrated in terms of RMS equivalent voltage, and with booster input ports terminated or without input signals applied within the band of measurement.

§20.21(e)(8)(i)(H) Transmit Power Off Mode (uplink and downlink noise power).

When the consumer booster cannot otherwise meet the noise and gain limits defined herein it must operate in "Transmit Power Off Mode." In this mode of operation, the uplink and downlink noise power shall not exceed −70 dBm/MHz and both uplink and downlink gain shall not exceed the lesser of 23 dB or MSCL.

Test Procedures:

Measurements were in accordance with the test methods section 7.7 of KDB 935210 D03 v04r02.

7.7.1 Maximum transmitter noise power level

a) Begin with the uplink output (donor) port connected to the spectrum analyzer.

b) Set the spectrum analyzer RBW to 1 MHz with the VBW ≥ 3 RBW.

c) Select the power averaging (rms) detector and trace average over at least 100 traces.

d) Set the center frequency of the spectrum analyzer to the center of the CMRS band under test with the span ≥ 2 the CMRS band.

e) Measure the maximum transmitter noise power level.

f) Save the spectrum analyzer plot as necessary for inclusion in the final test report.

g) Repeat b) to f) for all operational uplink and downlink bands.

h) Connect the EUT for uplink noise power measurement in the presence a downlink signal. Affirm the coupled path of the RF coupler is connected to the spectrum analyzer.

i) Configure the signal generator for AWGN operation with a 99% OBW of 4.1 MHz.

j) Set the spectrum analyzer RBW for 1 MHz, VBW ≥ 3 RBW, with a power averaging (rms) detector with at least 100 trace averages.

k) Set the center frequency of the spectrum analyzer to the center of the CMRS band under test, with the

span ≥ 2 the CMRS band. This shall include all spectrum blocks in the particular CMRS band under.

l) For uplink noise measurements, set the spectrum analyzer center frequency for the uplink band under test, and tune the signal generator to the center of the paired downlink band.

m) Measure the maximum transmitter noise power level while varying the downlink signal generator output level from −90 dBm to −20 dBm, as measured at the input port, in 1 dB steps inside the RSSI-dependent region, and in 10 dB steps outside the RSSI-dependent region. Report the six values closest to the limit, with at least two points within the RSSI-dependent region of the limit.

n) Repeat h) through m) for all operational uplink bands.

7.7.2 Variable uplink noise timing

a) Set the spectrum analyzer to the uplink frequency to be measured.

b) Set the span to 0 Hz, with a sweep time of 10 seconds.

c) Set the power level of signal generator to the lowest level of the RSSI-dependent noise.

d) Select MAX HOLD and increase the power level of signal generator by 10 dB for mobile boosters, and 20 dB for fixed boosters.

e) Confirm that the uplink noise decreases to the specified level within 1 second for mobile devices, and within 3 seconds for fixed devices.

f) Repeat a) to e) for all operational uplink bands.

g) Include plots and summary table in test report.

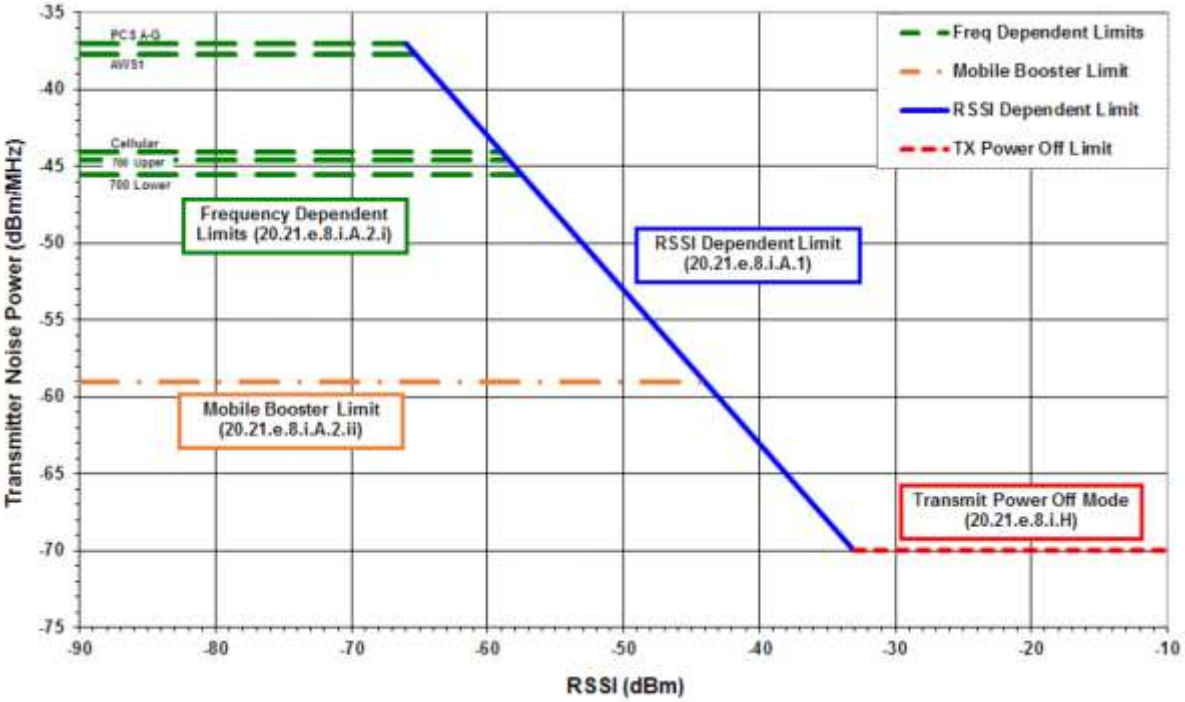
Note1. Test limit is according to mobile booster limit line of figure in Note3.

- Limit in -90 dBm to -50 dBm RSSI range: -59 dBm/MHz
- Limit in -43 dBm to -34 dBm RSSI range: −103 dBm/MHz—RSSI
- Limit in -30 dBm to -20 dBm RSSI range: -70 dBm/MHz
- Timing limit is according to mobile device 1 second limit in section 7.7.2 of KDB 935210 D03

Note2. Following switch coupled loss is corrected in signal generating.

Band	Uplink generating loss (dB)	Downlink generating loss (dB)
Lower 700 MHz	3.46	4.62
Upper 700 MHz	4.04	3.96
Cellular	4.53	4.78
AWS-1	4.97	5.13
Broadband PCS	8.17	5.16

Note3. Tests refer to following noise limit in appendix D of KDB 935210 D03 v04r02.



Test Result:

Tabulated Result of Uplink Maximum Transmitter Noise Power Level

Band	Frequency (MHz)	Limit (dBm/MHz)	Noise Level (dBm/MHz)
Lower 700 MHz	708.296	-59	-65.221
Upper 700 MHz	782.006		-63.333
Cellular	829.65		-62.193
AWS-1	1 722.06		-61.234
Broadband PCS	1 899.14		-60.246

Tabulated Result of Downlink Maximum Transmitter Noise Power Level

Band	Frequency (MHz)	Limit (dBm/MHz)	Noise Level (dBm/MHz)
Lower 700 MHz	742.808	-59	-59.310
Upper 700 MHz	742.062		-59.192
Cellular	873.65		-59.839
AWS-1	2 122.60		-59.817
Broadband PCS	1 962.63		-59.468

Tabulated Result of Variable Uplink Noise Power

Band	RSSI (dBm)	Frequency (MHz)	Limit (dBm/MHz)	Noise Level (dBm/MHz)
Lower 700 MHz	-37	707.888	-66.00	-70.229
	-36	708.200	-67.00	-70.490
	-35	708.032	-68.00	-70.935
	-34	707.504	-69.00	-70.887
	-30	707.288	-70.00	-71.464
	-20	707.888	-70.00	-71.588
Upper 700 MHz	-37	781.698	-66.00	-67.654
	-36	781.566	-67.00	-68.416
	-35	781.698	-68.00	-68.820
	-34	781.808	-69.00	-69.225
	-30	781.962	-70.00	-70.198
	-20	781.742	-70.00	-70.537
Cellular	-70	830.350	-59.00	-61.870
	-60	830.750	-59.00	-61.715
	-35	829.950	-68.00	-70.408
	-34	830.050	-69.00	-70.811
	-30	830.100	-70.00	-71.715
	-20	830.650	-70.00	-72.040
AWS-1	-90	1 720.620	-59.00	-59.900
	-38	1 720.620	-65.00	-65.929
	-37	1 720.440	-66.00	-66.652
	-36	1 720.710	-67.00	-67.632
	-35	1 720.350	-68.00	-68.249
	-34	1 721.430	-69.00	-69.107
Broadband PCS	-90	1 898.620	-59.00	-59.686
	-70	1 899.140	-59.00	-59.469
	-60	1 899.010	-59.00	-59.490
	-50	1 899.920	-59.00	-59.590
	-35	1 899.400	-68.00	-69.429
	-34	1 900.050	-69.00	-69.789

Tabulated Result of Variable Uplink Noise Timing

Band	Frequency (MHz)	Limit (ms)	Noise Timing (ms)
Lower 700 MHz	710.00	1 000	360
Upper 700 MHz	781.50		230
Cellular	836.50		190
AWS-1	1 732.50		430
Broadband PCS	1 882.50		250

Plot data of Maximum transmitter noise power level

Maximum noise level / Lower 700 MHz / Uplink

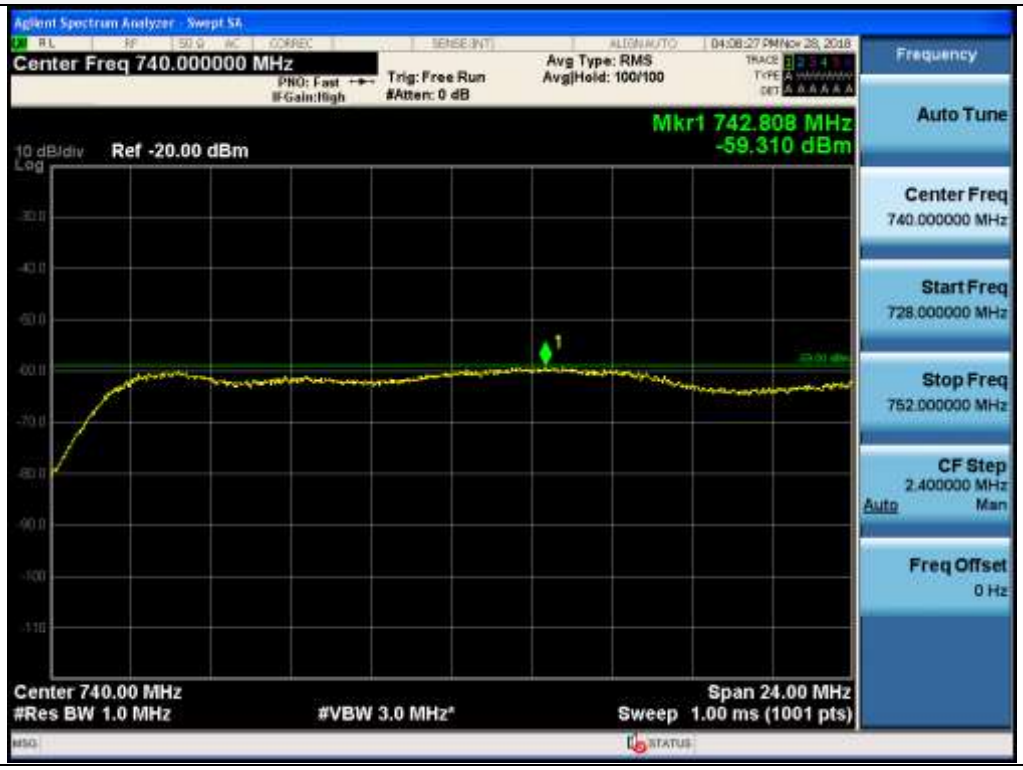
Maximum noise level / Upper 700 MHz / Uplink

Maximum noise level / Cellular / Uplink

Maximum noise level / AWS-1 / Uplink

Maximum noise level / Broadband PCS / Uplink


Maximum noise level / Lower 700 MHz / Downlink



Maximum noise level / Upper 700 MHz / Downlink

Maximum noise level / Cellular / Downlink

Maximum noise level / AWS-1 / Downlink

Maximum noise level / Broadband PCS / Downlink


Plot data of Variable Uplink Noise Timing

Uplink Noise Timing / Lower 700 MHz

Uplink Noise Timing / Upper 700 MHz

Uplink Noise Timing / Cellular

Uplink Noise Timing / AWS-1

Uplink Noise Timing / Broadband PCS


5.8. UPLINK INACTIVITY

Test Requirements:

§ 20.21(e)(8)(i)(A) NOISE LIMITS (Uplink).

When a consumer booster is not serving an active device connection after 5 minutes the uplink noise power shall not exceed −70 dBm/MHz.

Test Procedures:

Measurements were in accordance with the test methods section 7.8 of KDB 935210 D03 v04r02.

a) The uplink output (donor) port connected to the spectrum analyzer.

b) Select the power averaging (rms) detector.

c) Set the spectrum analyzer RBW for 1 MHz with the VBW ≥ 3 RBW.

d) Set the center frequency of the spectrum analyzer to the center of the uplink operational band.

e) Set the span for 0 Hz with a single sweep time for a minimum of 330 seconds.

f) Start to capture a new trace using MAX HOLD.

g) After approximately 15 seconds, turn on the EUT power.

h) After the full spectrum analyzer trace is complete, place a MARKER on the leading edge of the pulse, then use the DELTA MARKER METHOD to measure the time until the uplink becomes inactive.

i) Affirm that the noise level is below the uplink inactivity noise power limit, as specified by the rules.

j) Capture the plot for inclusion in the test report.

k) Measure noise using procedures in a) to f).

l) Repeat d) through k) for all operational uplink bands.

Note1. Test limit is applied both time (5 minutes) and level (-70 dBm/MHz) in § 20.21(e)(8)(i)(A)

Test Result:

Tabulated Result of Uplink Inactivity

Band	Frequency (MHz)	Time Limit (s)	Inactivity Timing (s)
Lower 700 MHz	710.000	300	58.40
Upper 700 MHz	781.500		58.50
Cellular	836.500		58.50
AWS-1	1 732.500		58.40
Broadband PCS	1 882.500		58.40

Tabulated Result of Uplink Inactivity Noise

Band	Frequency (MHz)	Noise Limit (dBm/MHz)	Noise Level (dBm/MHz)
Lower 700 MHz	698.192	-70	-91.298
Upper 700 MHz	785.746		-91.070
Cellular	826.45		-91.221
AWS-1	1 697.22		-90.302
Broadband PCS	1 865.08		-88.984

Plot data of Inactivity timing

Inactivity Timing / Lower 700 MHz

Inactivity Timing / Upper 700 MHz

Inactivity Timing / Cellular

Inactivity Timing / AWS-1

Inactivity Timing / Broadband PCS

Plot data of Inactivity Noise Level

Inactivity Noise Level / Lower 700 MHz

Inactivity Noise Level / Upper 700 MHz

Inactivity Noise Level / Cellular

Inactivity Noise Level / AWS-1

Inactivity Noise Level / Broadband PCS

5.9. VARIABLE BOOSTER GAIN

Test Requirements:

§20.21(e)(8)(i)(C)(1) BOOSTER GAIN LIMITS (Variable gain)

(1) The uplink gain in dB of a consumer booster referenced to its input and output ports shall not exceed −34 dB—RSSI + MSCL.

(i) Where RSSI is the downlink composite received signal power in dBm at the booster donor port for all base stations in the band of operation. RSSI is expressed in negative dB units relative to 1 mW.

(ii) Where MSCL (Mobile Station Coupling Loss) is the minimum coupling loss in dB between the wireless device and input port of the consumer booster. MSCL must be calculated or measured for each band of operation and provided in compliance test reports.

§20.21(e)(8)(i)(H) TRANSMIT POWER OFF MODE (Uplink gain).

When the consumer booster cannot otherwise meet the noise and gain limits defined herein it must operate in “Transmit Power Off Mode.” In this mode of operation, the uplink and downlink noise power shall not exceed −70 dBm/MHz and both uplink and downlink gain shall not exceed the lesser of 23 dB or MSCL.

Test Procedures:

Measurements were in accordance with the test methods section 7.9 of KDB 935210 D03 v04r02.

7.9.1 Variable gain

a) The uplink output (donor) port connected to signal generator #1. Affirm that the coupled path of the RF coupler is connected to the spectrum analyzer.

b) Configure downlink signal generator #1 for AWGN operation with a 99% OBW of 4.1 MHz, tuned to the center of the operational band.

c) Set the power level and frequency of signal generator #2 to a value that is 5 dB below the AGC level determined from 7.2. The signal type is AWGN with a 99% OBW of 4.1 MHz.

d) Set RBW = 100 kHz.

e) Set VBW ≥ 300 kHz.

f) Select the CHANNEL POWER measurement mode.

g) Select the power averaging (rms) detector.

h) Affirm that the number of measurement points per sweep ≥ (2 x span)/RBW.

i) Sweep time = auto couple.

j) Trace average at least 10 traces in power averaging (i.e., rms) mode.

k) Measure the maximum channel power and compute maximum gain when varying the signal generator #1 output to a level from −90 dBm to −20 dBm, as measured at the input port, in 1 dB steps inside the RSSI-dependent region, and 10 dB steps outside the RSSI-dependent region. Report the six values closest to the

limit, including at least two points from within the RSSI-dependent region of operation. Additionally, document that the EUT provides equivalent uplink and downlink gain, and when operating in shutoff mode that the uplink and downlink gain is within the transmit power off mode gain limits.

l) Repeat b) to k) for all operational uplink bands.

7.9.2 Variable uplink gain timing

a) Set the spectrum analyzer to the uplink frequency to be measured.

b) Set the span to 0 Hz with a sweep time of 10 seconds.

c) Set the power level of signal generator #1 to the lowest level of the RSSI-dependent gain.

d) Select MAX HOLD and increase the power level of signal generator #1 by 10 dB for mobile boosters and by 20 dB for fixed indoor boosters. Signal generator #2 remains same.

e) Confirm that the uplink gain decreases to the specified levels, within 1 second for mobile devices, and within 3 seconds for fixed devices.

f) Repeat a) to e) for all operational uplink bands.

Note1. Test limit is according to inside (Car) antenna limit line of figure in Note4.

- Limit in -90 dBm to (-84+MSCL) dBm RSSI range: 50 dB
- Limit in (-84+MSCL) dBm to -34 dBm RSSI range: -34 dB – RSSI + MSCL
- Limit in -30 dBm to -20 dBm RSSI range: 'MSCL' dB
- Timing limit is according to mobile device 1 second limit in section 7.9.2 of KDB 935210 D03

Note2. Minimum MSCL value in this test is calculated according to following formula and table.

$$L_p = 20 \times Log\ (Uplink\ Band\ the\ Lowest\ frequency) + 20 \times Log\ (Distance) - 27.5$$

$$MSCL = Lp - Antenna\ gain + Cable\ loss$$

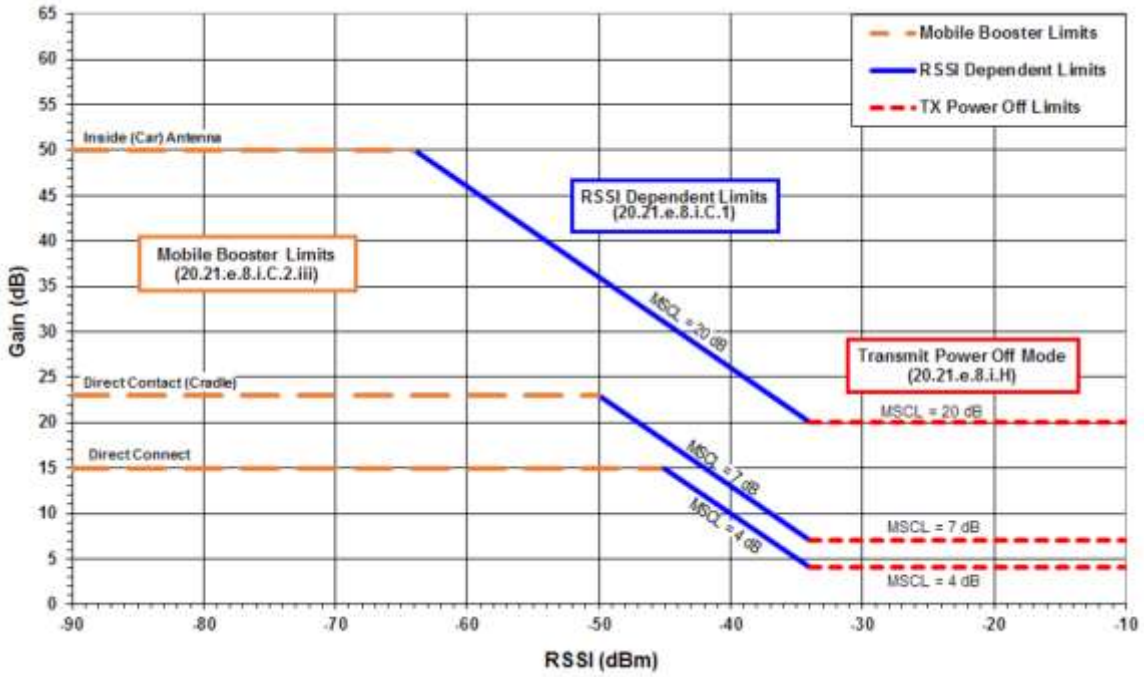
Frequency (MHz)	Server Ant. Gain (dBi)	Sever Cable Loss (dB)	Distance (ft)	Distance (m)	L_p	MSCL
704	-3.69	2.59	3	0.914	28.670	34.950
776	-1.89	2.59	3	0.914	29.516	33.996
824	-0.31	2.88	3	0.914	30.037	33.227
1 710	-3.67	4.67	3	0.914	36.379	44.719
1 850	-3.62	4.84	3	0.914	37.062	45.522

* Measured SDYC-4G Antenna gain is used.

* Distance is specified by manufacture and information is provided in the manual.

Note3. RSSI input is corrected by table in Noise limit test note 2 of this report.

Note4. Tests refer to following gain limit in appendix D of KDB 935210 D03 v04r02.



Test Result:

Tabulated Result of Variable Booster Gain

Band	MSCL	RSSI (dBm)	Input Power (dBm)	Output Power (dBm)	Limit (dB)	Variable Gain (dB)
Lower 700 MHz	34.950	-44	-29.50	12.75	45.00	42.25
		-40		8.70	41.00	38.20
		-39		7.68	40.00	37.18
		-38		6.63	39.00	36.13
		-37		5.72	38.00	35.22
		-36		4.66	37.00	34.16
Upper 700 MHz	33.996	-44	-27.50	15.20	44.00	42.70
		-43		14.32	43.00	41.82
		-42		13.07	42.00	40.57
		-39		10.26	39.00	37.76
		-38		9.19	38.00	36.69
		-37		8.28	37.00	35.78
Cellular	33.227	-46	-31.00	8.87	45.00	39.87
		-41		3.86	40.00	34.86
		-40		3.19	39.00	34.19
		-39		1.91	38.00	32.91
		-38		1.02	37.00	32.02
		-35		-2.11	34.00	28.89
AWS-1	44.719	-90	-29.50	14.21	50.00	43.71
		-80		14.30	50.00	43.80
		-70		14.26	50.00	43.76
		-60		14.23	50.00	43.73
		-36		6.39	47.00	35.89
		-34		4.45	45.00	33.95
Broadband PCS	45.522	-90	-30.50	12.85	50.00	43.35
		-70		12.83	50.00	43.33
		-60		12.71	50.00	43.21
		-50		12.80	50.00	43.30
		-37		3.71	49.00	34.21
		-35		1.74	47.00	32.24

Tabulated Result of Variable Gain Timing

Band	Frequency (MHz)	Limit (ms)	Gain Timing (ms)
Lower 700 MHz	710.00	1 000	120
Upper 700 MHz	781.50		420
Cellular	836.50		140
AWS-1	1 732.50		90
Broadband PCS	1 882.50		100

Plot data of Variable Gain Timing

Variable Gain Timing / Lower 700 MHz

Variable Gain Timing / Upper 700 MHz

Variable Gain Timing / Cellular

Variable Gain Timing / AWS-1

Variable Gain Timing / Broadband PCS

5.10. OCCUPIED BANDWIDTH

Test Requirements:

§ 2.1049 Measurements required: Occupied bandwidth.

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

Test Procedures:

Measurements were in accordance with the test methods section 7.10 of KDB 935210 D03 v04r02.

a) Connect the test equipment to firstly measure the characteristics of the test signals produced by the signal generator.

b) Set VBW ≥ 3 x RBW.

c) Set the center frequency of the spectrum analyzer to the center of the operational band. The span will be adjusted for each modulation type and OBW as necessary for accurately viewing the signals.

d) Set the signal generator for power level to match the values obtained from the tests of maximum output power measurement.

e) Set the signal generator modulation type for GSM with a PRBS pattern and allow the trace on the signal generator to stabilize adjusting the span as necessary.

f) Set the spectrum analyzer RBW for 1% to 5% of the EBW.

g) Capture the spectrum analyzer trace for inclusion in the test report.

h) Repeat c) to g) for CDMA and W-CDMA modulation, adjusting the span as necessary.

i) Repeat c) to h) for all uplink and downlink operational bands.

j) The uplink output (donor) port connected to the spectrum analyzer, and the server port connected to the signal generator.

k) Repeat c) to i) with this EUT uplink path test setup.

l) The downlink output (server) port connected to the spectrum analyzer, and the donor port connected to the signal generator.

m) Repeat c) to i) with this EUT downlink path test setup.

Test Result:

Tabulated Result of Uplink Occupied Bandwidth (-26 dB OBW)

Band	Signal	Frequency (MHz)	Input OBW (kHz)	Output OBW (kHz)	Comparison (%)
Lower 700 MHz	GSM	710.000	303.4	306.0	0.86
Upper 700 MHz		781.500	308.3	312.5	1.36
Cellular		836.500	305.2	313.1	2.59
AWS-1		1 732.500	313.3	305.4	-2.52
Broadband PCS		1 882.500	302.2	299.1	-1.03
Band	Signal	Frequency (MHz)	Input OBW (MHz)	Output OBW (MHz)	Comparison (%)
Lower 700 MHz	CDMA	710.000	1.360	1.358	-0.15
	WCDMA		4.727	4.667	-1.27
Upper 700 MHz	CDMA	781.500	1.369	1.368	-0.07
	WCDMA		4.709	4.662	-1.00
Cellular	CDMA	836.500	1.366	1.363	-0.22
	WCDMA		4.691	4.733	0.90
AWS-1	CDMA	1 732.500	1.370	1.357	-0.95
	WCDMA		4.687	4.688	0.02
Broadband PCS	CDMA	1 882.500	1.357	1.360	0.22
	WCDMA		4.715	4.707	-0.17

Tabulated Result of Downlink Occupied Bandwidth (-26 dB OBW)

Band	Signal	Frequency (MHz)	Input OBW (kHz)	Output OBW (kHz)	Comparison (%)
Lower 700 MHz	GSM	740.000	312.7	300.7	-3.84
Upper 700 MHz		751.500	306.6	306.3	-0.10
Cellular		881.500	300.2	312.1	3.96
AWS-1		2 132.500	305.6	313.7	2.65
Broadband PCS		1 962.500	314.4	309.1	-1.69
Band	Signal	Frequency (MHz)	Input OBW (MHz)	Output OBW (MHz)	Comparison (%)
Lower 700 MHz	CDMA	740.000	1.367	1.360	-0.51
	WCDMA		4.713	4.704	-0.19
Upper 700 MHz	CDMA	751.500	1.369	1.353	-1.17
	WCDMA		4.721	4.704	-0.36
Cellular	CDMA	881.500	1.351	1.362	0.81
	WCDMA		4.751	4.705	-0.97
AWS-1	CDMA	2 132.500	1.366	1.361	-0.37
	WCDMA		4.715	4.718	0.06
Broadband PCS	CDMA	1 962.500	1.360	1.365	0.37
	WCDMA		4.730	4.757	0.57

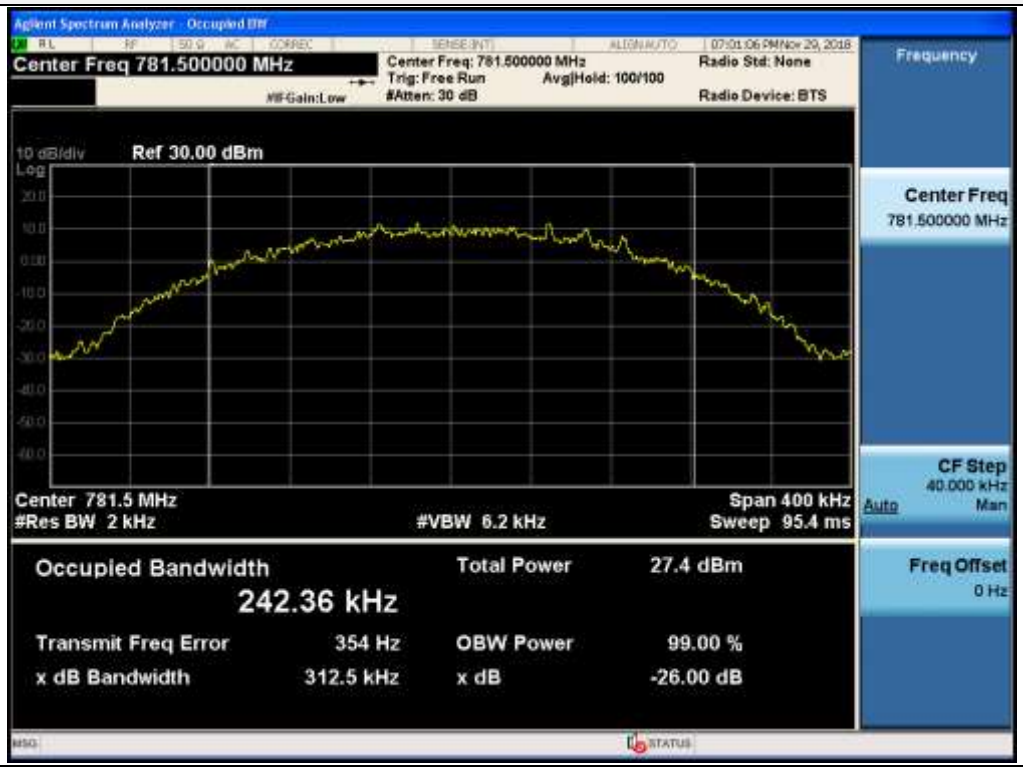
Plot data of Occupied Bandwidth

Occupied Bandwidth / Lower 700 MHz / Uplink / GSM / Input

Occupied Bandwidth / Lower 700 MHz / Uplink / GSM / Output

Occupied Bandwidth / Upper 700 MHz / Uplink / GSM / Input

Occupied Bandwidth / Upper 700 MHz / Uplink / GSM / Output



Occupied Bandwidth / Cellular / Uplink / GSM / Input

Occupied Bandwidth / Cellular / Uplink / GSM / Output

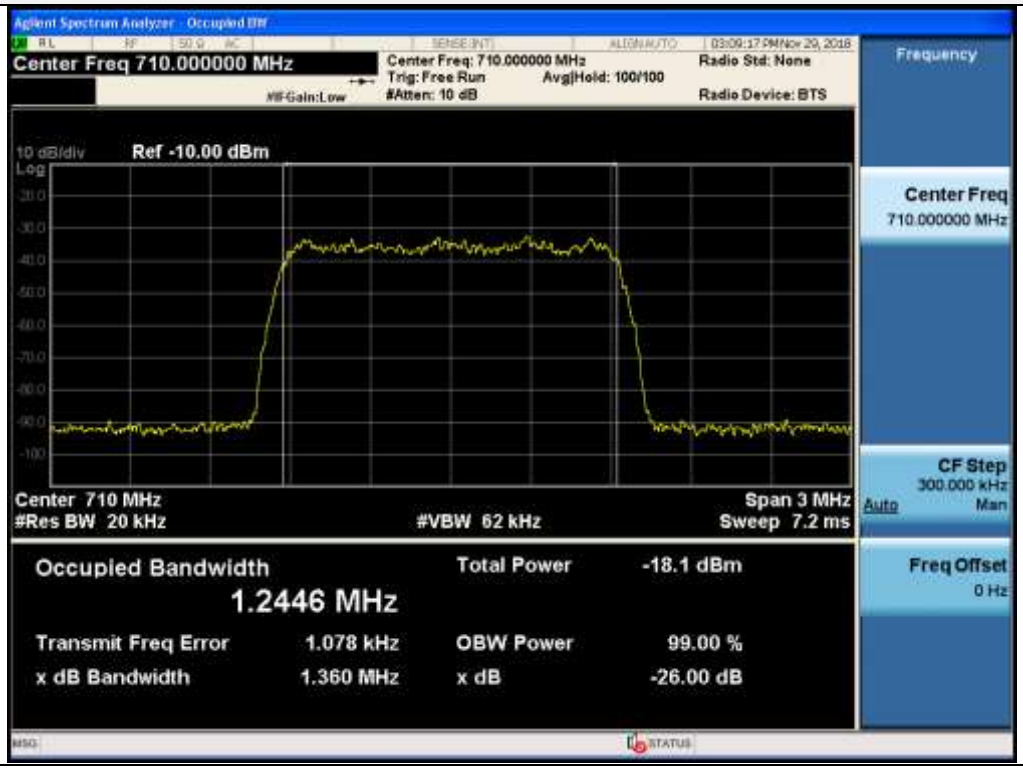
Occupied Bandwidth / AWS-1 / Uplink / GSM / Input

Occupied Bandwidth / AWS-1 / Uplink / GSM / Output

Occupied Bandwidth / Broadband PCS / Uplink / GSM / Input

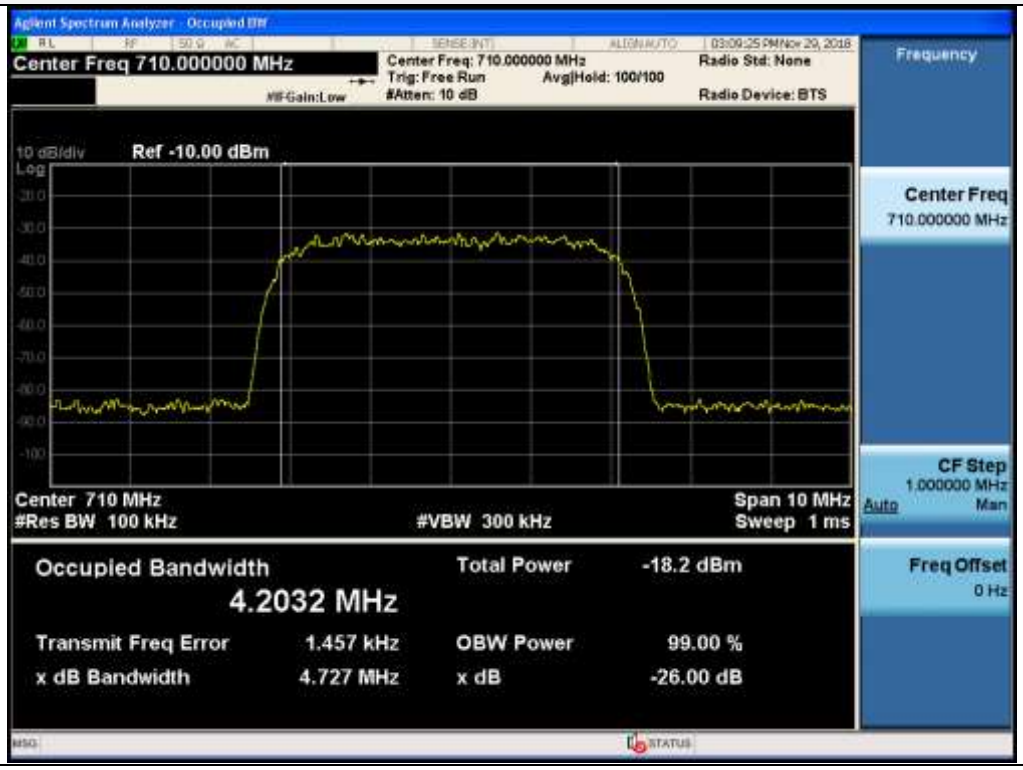
Occupied Bandwidth / Broadband PCS / Uplink / GSM / Output

Occupied Bandwidth / Lower 700 MHz / Uplink / CDMA/ Input



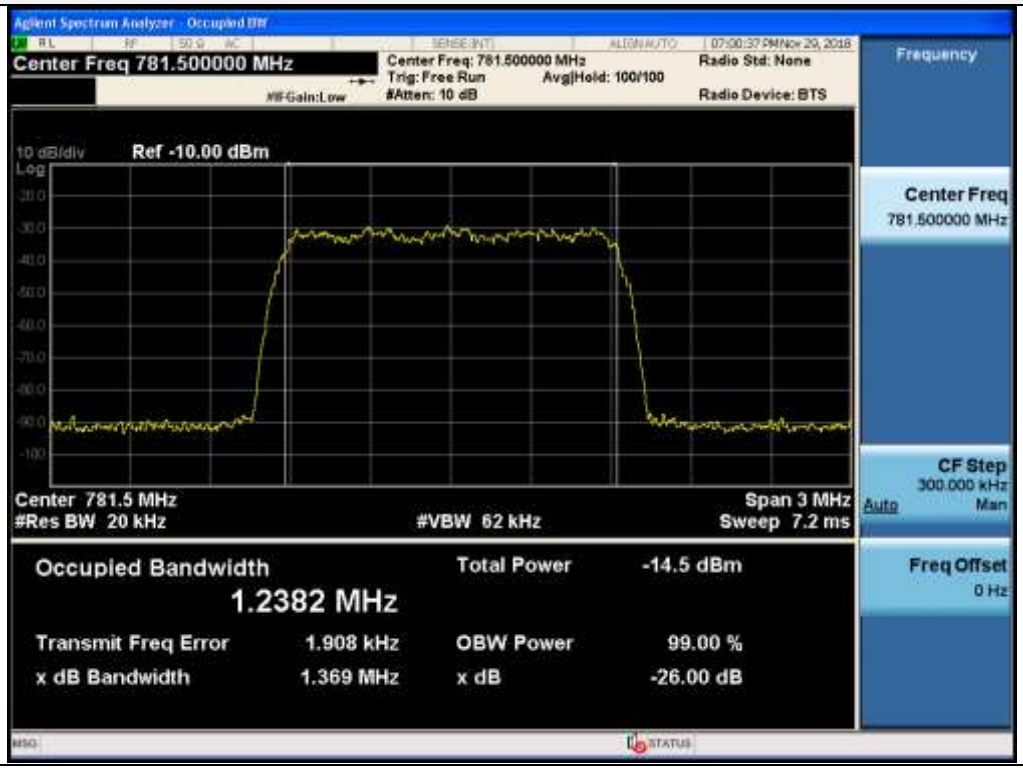
Occupied Bandwidth / Lower 700 MHz / Uplink / CDMA / Output

Occupied Bandwidth / Lower 700 MHz / Uplink / WCDMA/ Input

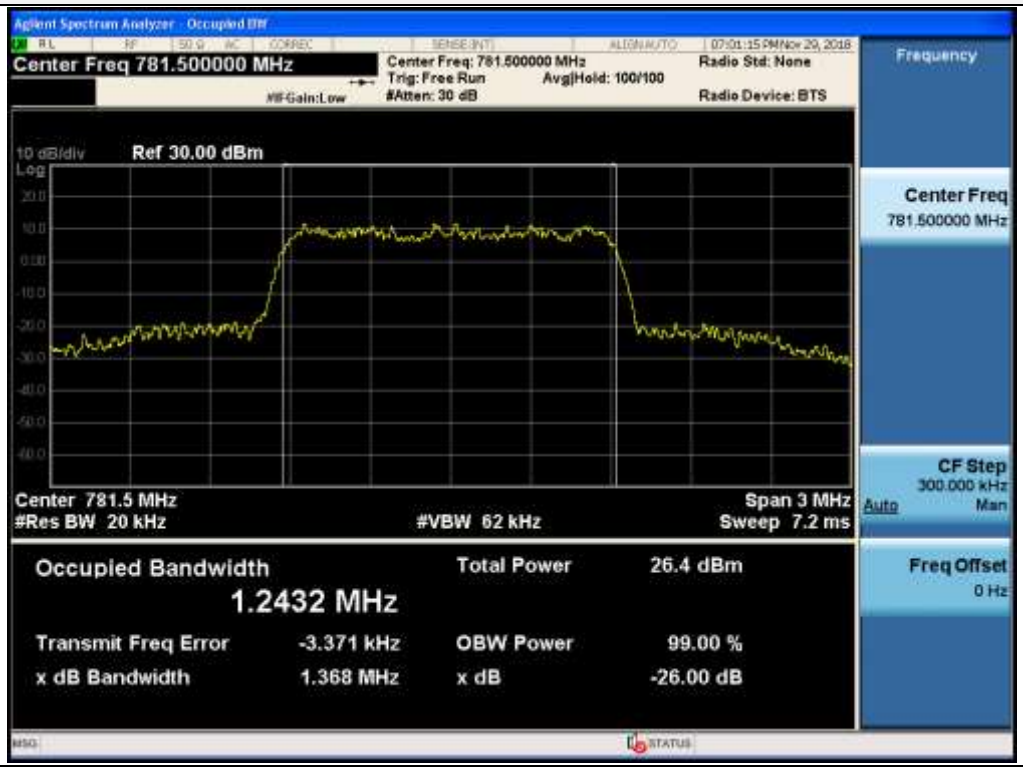


Occupied Bandwidth / Lower 700 MHz / Uplink / WCDMA / Output

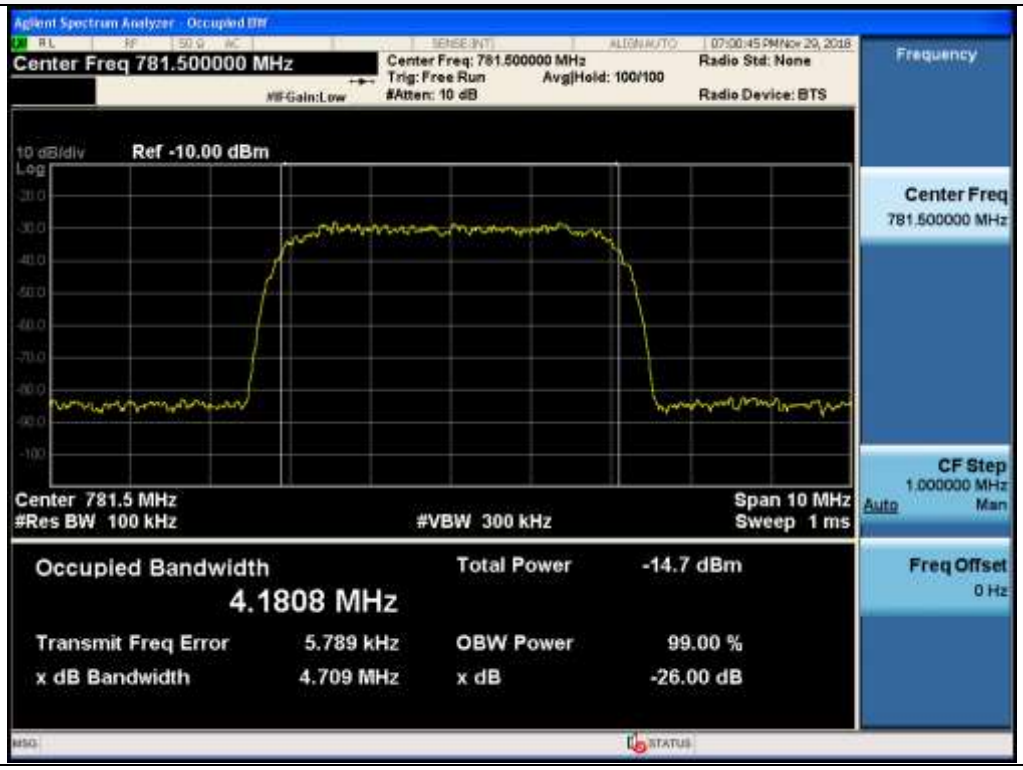
Occupied Bandwidth / Upper 700 MHz / Uplink / CDMA/ Input



Occupied Bandwidth / Upper 700 MHz / Uplink / CDMA / Output

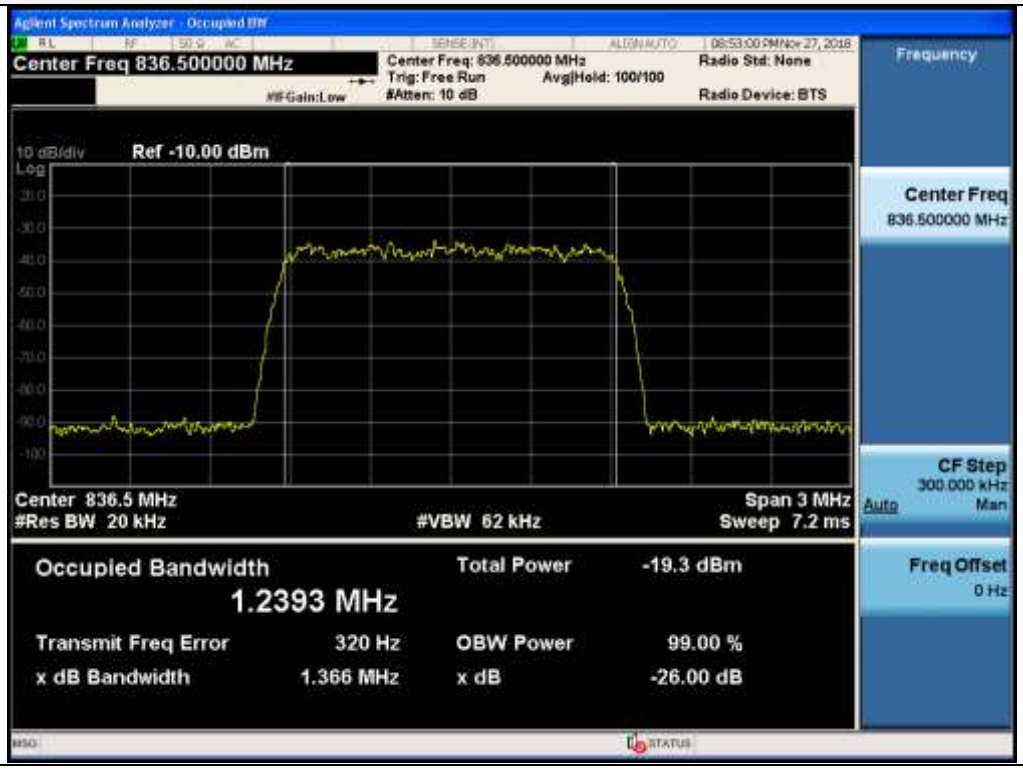


Occupied Bandwidth / Upper 700 MHz / Uplink / WCDMA/ Input

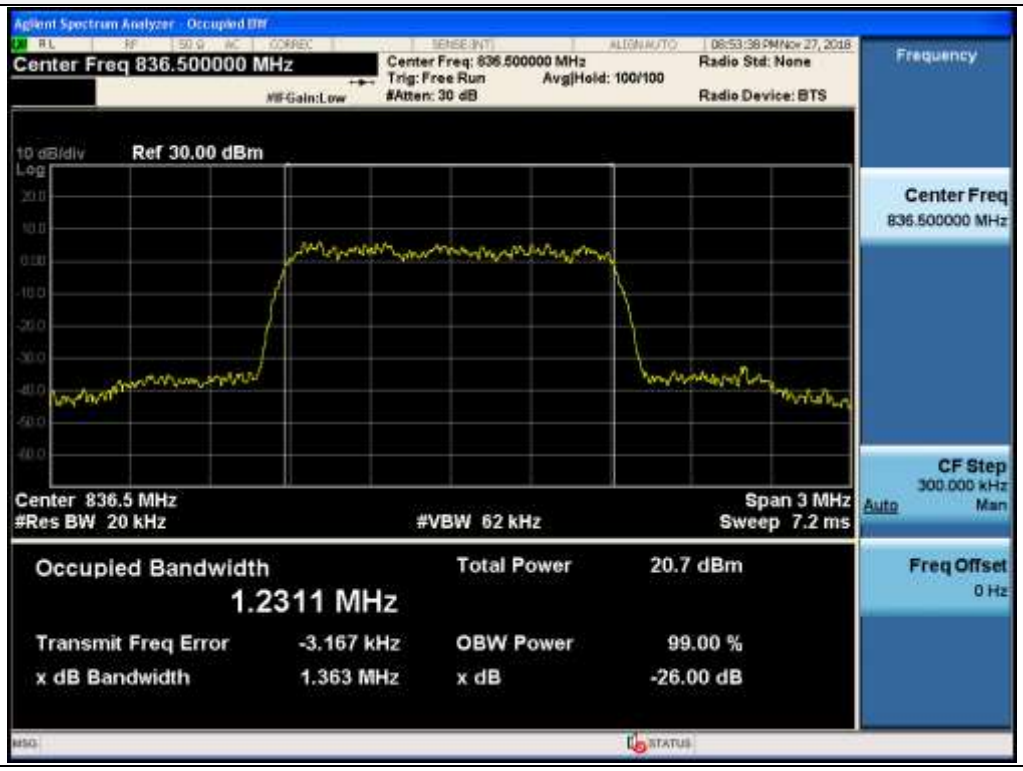


Occupied Bandwidth / Upper 700 MHz / Uplink / WCDMA / Output

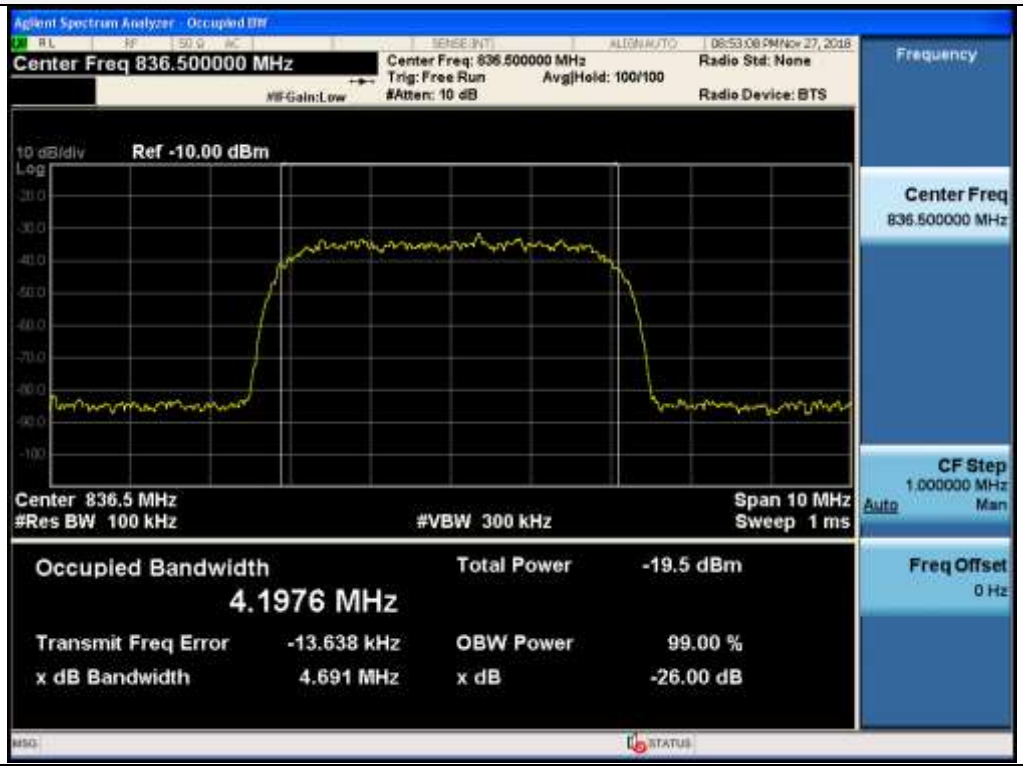
Occupied Bandwidth / Cellular / Uplink / CDMA/ Input



Occupied Bandwidth / Cellular / Uplink / CDMA / Output

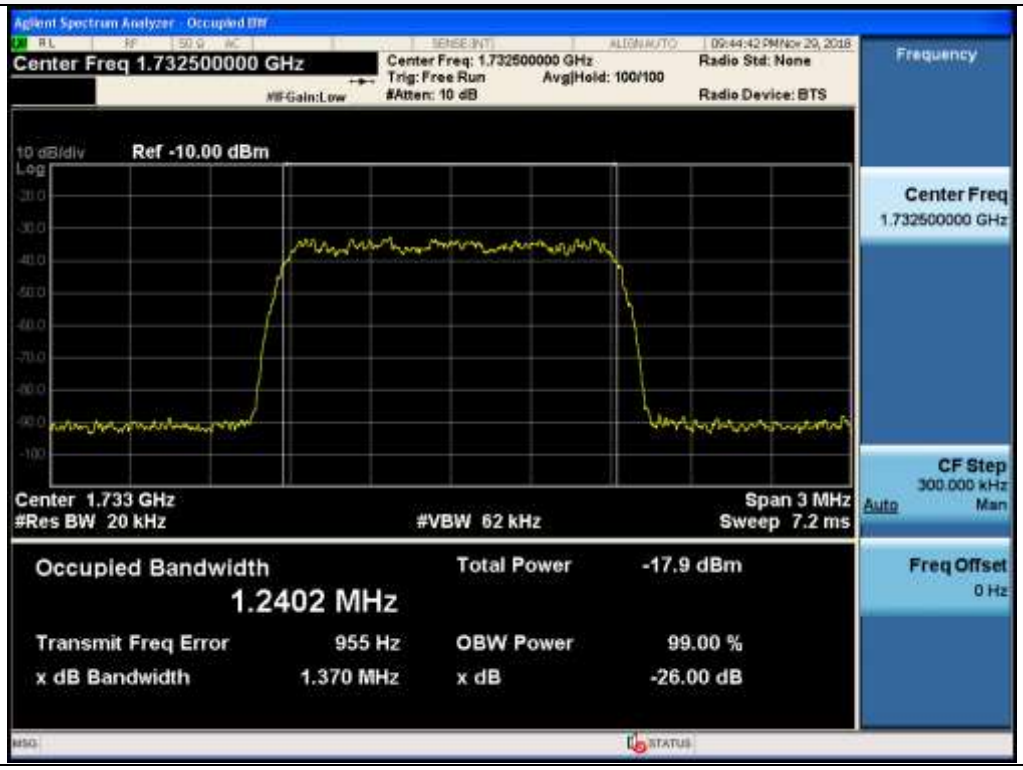


Occupied Bandwidth / Cellular / Uplink / WCDMA/ Input

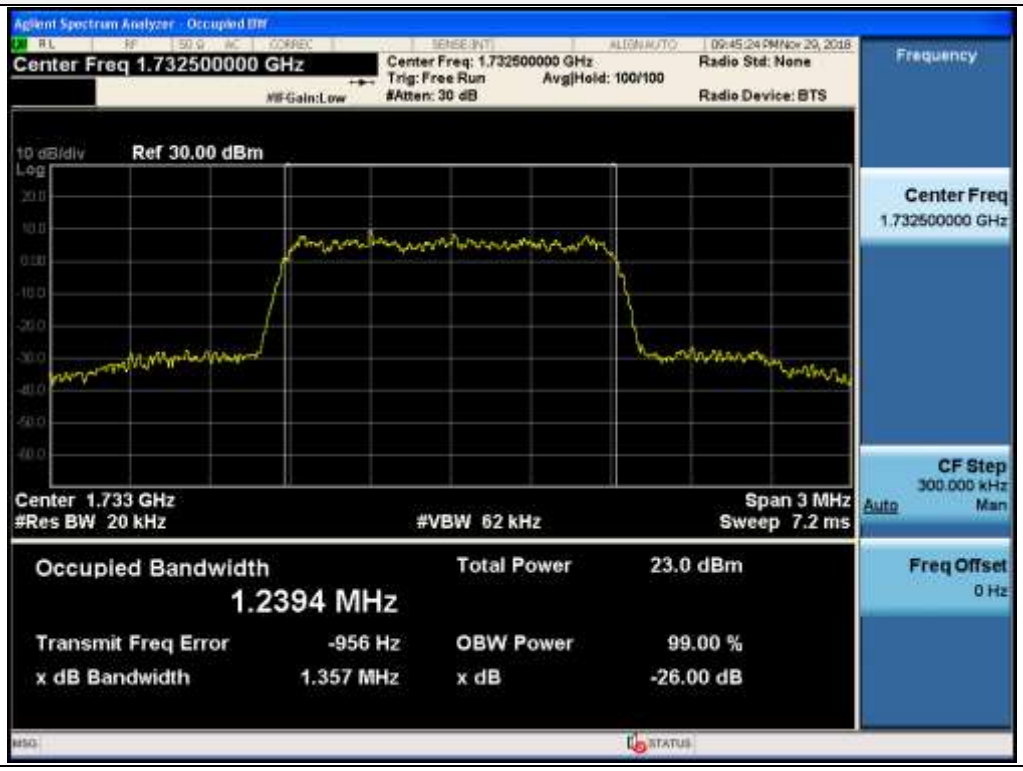


Occupied Bandwidth / Cellular / Uplink / WCDMA / Output

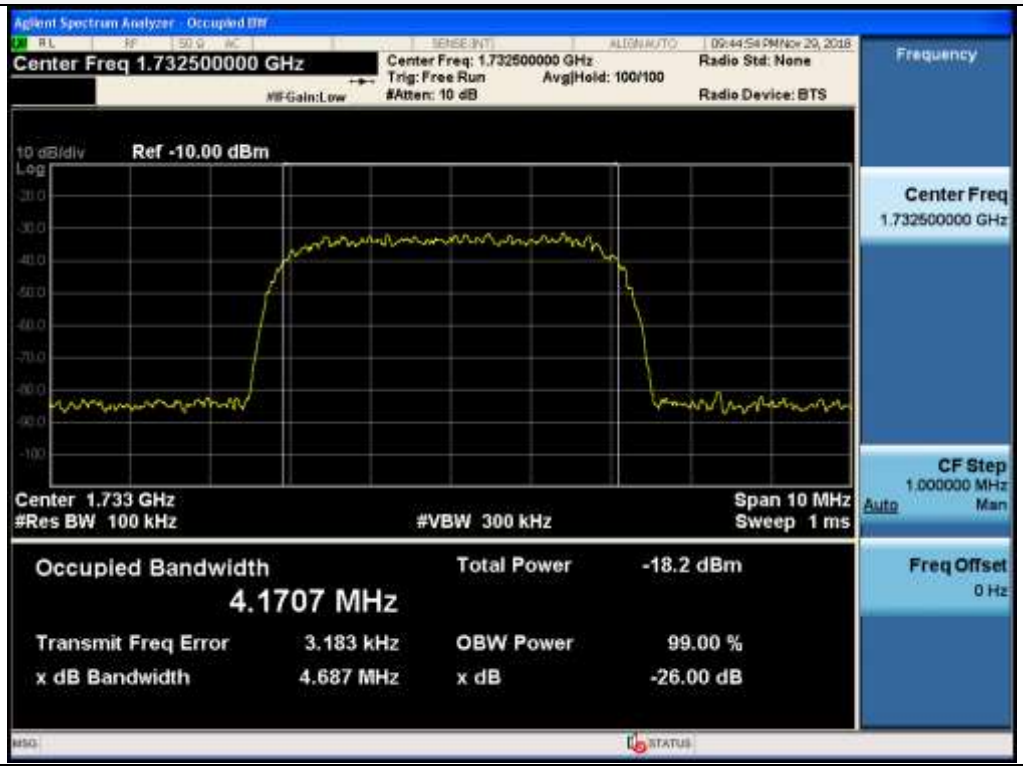
Occupied Bandwidth / AWS-1 / Uplink / CDMA/ Input



Occupied Bandwidth / AWS-1 / Uplink / CDMA / Output

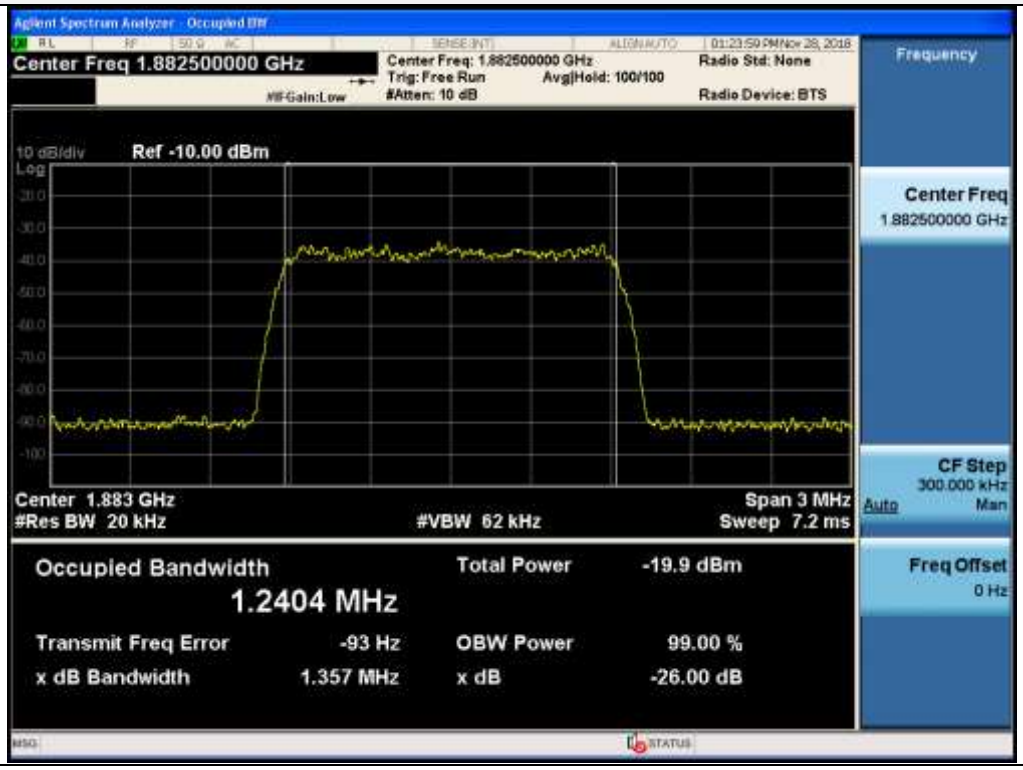


Occupied Bandwidth / AWS-1 / Uplink / WCDMA/ Input



Occupied Bandwidth / AWS-1 / Uplink / WCDMA / Output

Occupied Bandwidth / Broadband PCS / Uplink / CDMA/ Input



Occupied Bandwidth / Broadband PCS / Uplink / CDMA / Output