9. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

FCC Rules

Test Requirement(s): § 2.1051 Measurements required: Spurious emissions at antenna terminals:

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

§ 24.238 Emission limitations for Broadband PCS equipment.

The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(c) Alternative out of band emission limit. Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

(d) Interference caused by out of band emissions. If any emission from a transmitter

operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

§ 27.53 Emission limits

(h) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 $\log_{10}$(P) dB.

Test Procedures: A modulated carrier generated by the signal generator carrier was connected to either the Uplink or Downlink RF port at a maximum level as determined by the spectrum analyzer was connected to either the Uplink or Downlink port depending on the circuitry being measured.

The spectrum was investigated from 9 kHz to the 26.5 GHz of the carrier.

Test Results: The EUT complies with the requirements of this section. There were no detectable Spurious emissions for this EUT

IC Rules

Test Requirement(s): RSS-131 6.4

Spurious emissions of zone enhancers and translators shall be suppressed as much as possible. Spurious emissions shall be attenuated below the rated power of the enhancer by at least:
43 + 10 Log10(Prated in watts), or 70 dB, whichever is less stringent.

Note: If the minimum standard is not met, check to see if the input signal generators have a high harmonic content.

Test Procedures: RSS-131 4.4

4.4.1 Multi-channel Enhancer

The spurious emissions of the equipment under test shall be measured using the two-tone method in section 4.3.1, with the two tones Po1 and Po2 set to the required levels.
Using a spectrum analyser with a resolution bandwidth set at 100 kHz, search for spurious emissions from 30 MHz to at least 5 times the highest RF passband frequency. The search may omit the band that contains the test tones and intermodulation products.

4.4.2 Single channel Enhancer

The enhancer shall be operated as described in section 4.3.2 during the search for spurious emissions.
Using a spectrum analyser with a resolution bandwidth set at 100 kHz, search for spurious emissions from 30 MHz to at least 5 times the highest RF passband frequency. The search may omit the band that contains the input signal.

[RDU 1900P/AWS-1 (MIMO)]

Band Edge

	Channel	Frequency (MHz)	Emission Level	
			(dBm)	(uW)
LTE 5 MHz	Low	1932.5	-36.08	0.246
	High	1992.5	-37.07	0.196
LTE 10 MHz	Low	1935.0	-34.85	0.328
	High	1990.0	-40.78	0.084

	Channel	Frequency (MHz)	Emission Level	
			(dBm)	(uW)
LTE 5 MHz	Low	2112.5	-33.95	0.403
	High	2152.5	-40.33	0.093
LTE 10 MHz	Low	2115.0	-34.49	0.356
	High	2150.0	-40.74	0.084

Spurious emissions

	Channel	Frequency (MHz)	Emission Level	
			(dBm)	(uW)
LTE 5 MHz	Low	1932.5	-21.58	6.944
	Middle	1962.5	-25.20	3.021
	High	1992.5	-22.90	5.130
LTE 10 MHz	Low	1935.0	-25.00	3.161
	Middle	1962.5	-24.99	3.169
	High	1990.0	-24.90	3.233

	Channel	Frequency (MHz)	Emission Level	
			(dBm)	(uW)
LTE 5 MHz	Low	2112.5	-25.09	3.101
	Middle	2132.5	-24.89	3.247
	High	2152.5	-23.92	4.053
LTE 10 MHz	Low	2115.0	-25.12	3.075
	Middle	2132.5	-25.16	3.050
	High	2150.0	-25.04	3.137

[RDU 1900P+AWS-1_R]

Band Edge

	Channel	Frequency (MHz)	Emission Level	
			(dBm)	(uW)
LTE 5 MHz	Low	1932.5	-34.94	0.321
	High	1992.5	-32.60	0.550
LTE 10 MHz	Low	2115.0	-41.82	0.066
	High	2150.0	-42.90	0.051

Spurious emissions

	Channel	Frequency (MHz)	Emission Level	
			(dBm)	(uW)
LTE 5 MHz	Low	1932.5	-28.67	1.358
	Middle	1962.5	-29.33	1.167
	High	1992.5	-28.17	1.524
LTE 10 MHz	Low	2115.0	-29.00	1.259
	Middle	2132.5	-29.67	1.079
	High	2150.0	-28.33	1.469

[Sum data]

Band Edge

	Channel	Frequency (MHz)	Emission Level	
			(dBm)	(uW)
LTE 5 MHz	Low	1932.5	-32.46	0.567
	High	1992.5	-31.27	0.746
LTE 10 MHz	Low	2115.0	-33.75	0.422
	High	2150.0	-38.70	0.135

Spurious emissions

	Channel	Frequency (MHz)	Emission Level	
			(dBm)	(uW)
LTE 5 MHz	Low	1932.5	-20.81	8.302
	Middle	1962.5	-23.78	4.188
	High	1992.5	-21.77	6.654
LTE 10 MHz	Low	2115.0	-23.63	4.334
	Middle	2132.5	-23.84	4.129
	High	2150.0	-23.37	4.606

Note : RDU 1900P+AWS-1_R data, reference to the Test Report No. : E126R-006.

Single channel Enhancer Plots of Spurious Emission

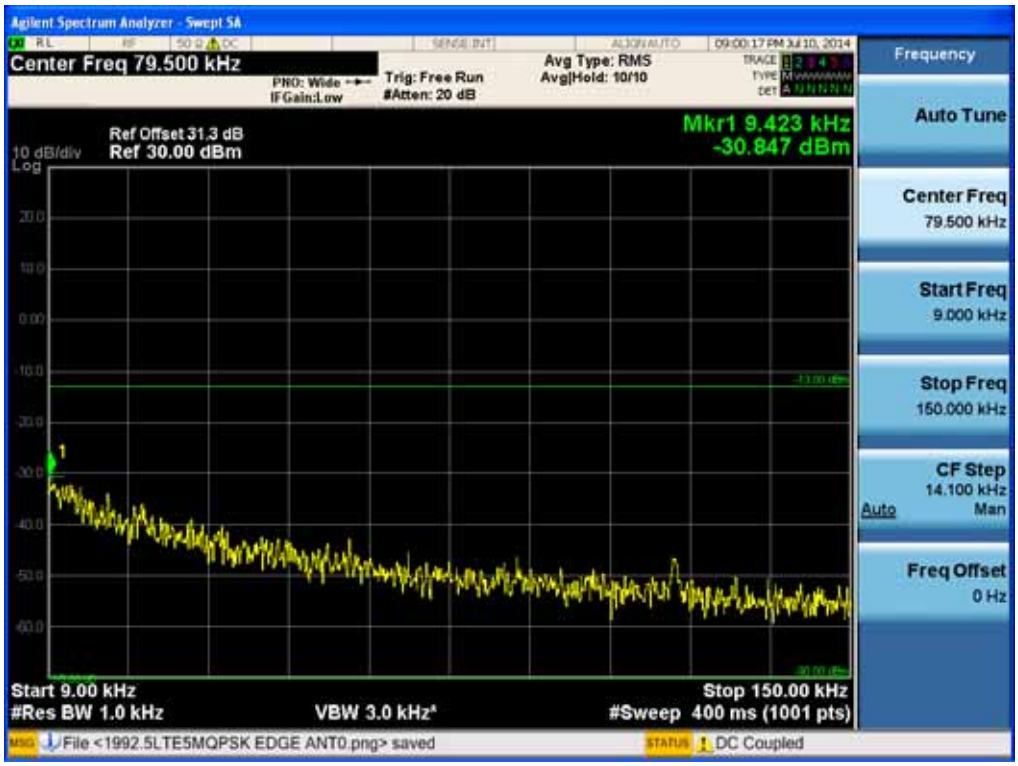
Conducted Spurious Emissions (9 kHz – 150 kHz)

[PCS Downlink]

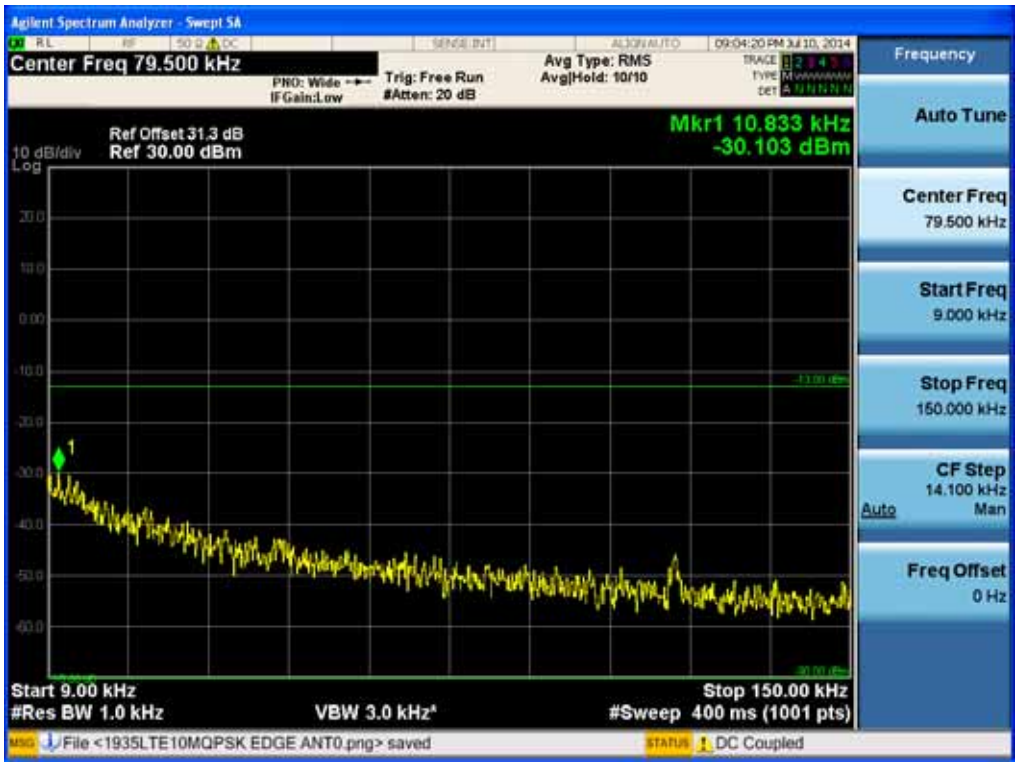
[LTE Downlink 5 MHz Low]

[LTE Downlink 5 MHz Middle]

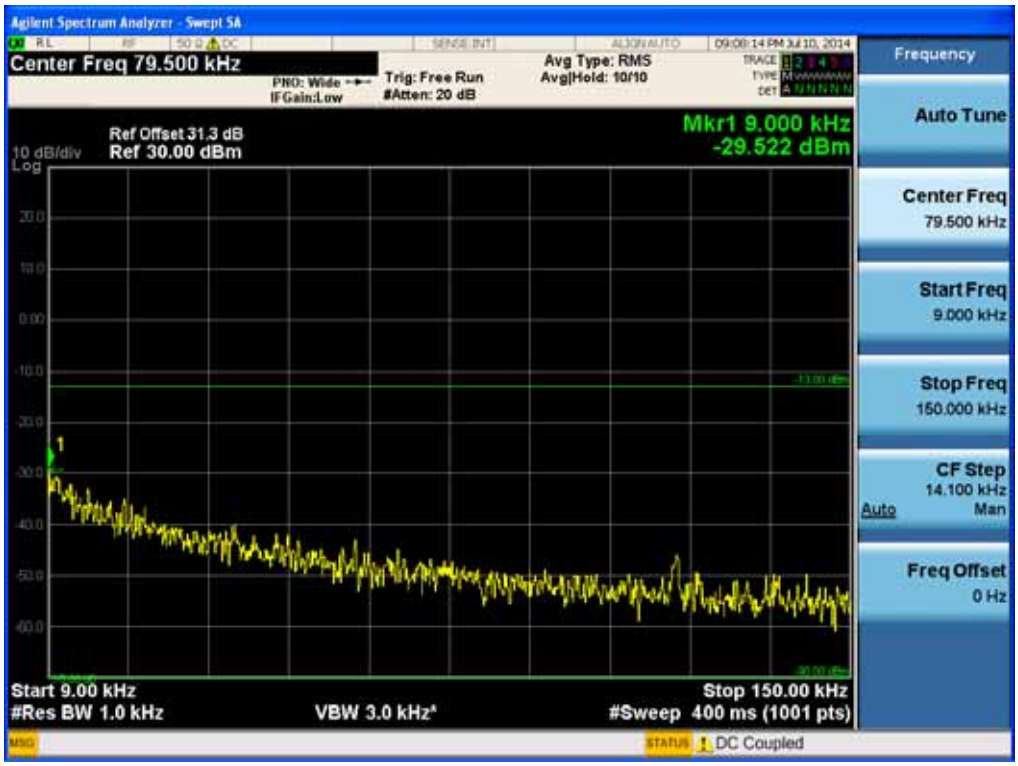
[LTE Downlink 5 MHz High]



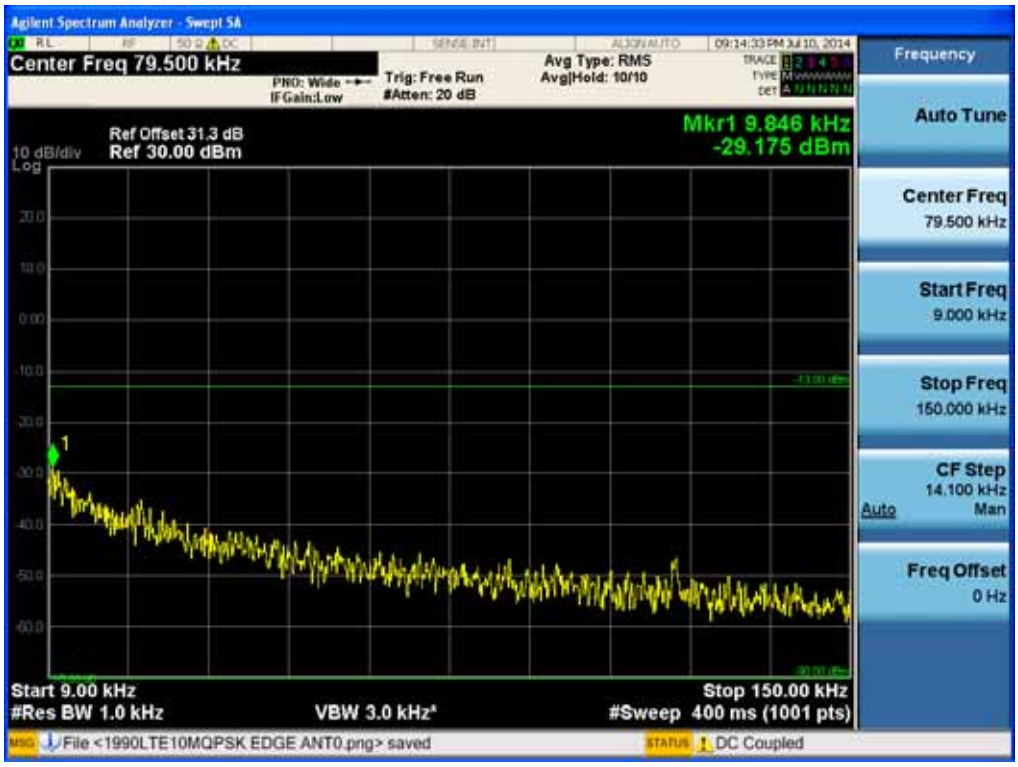
[LTE Downlink 10 MHz Low]



[LTE Downlink 10 MHz Middle]

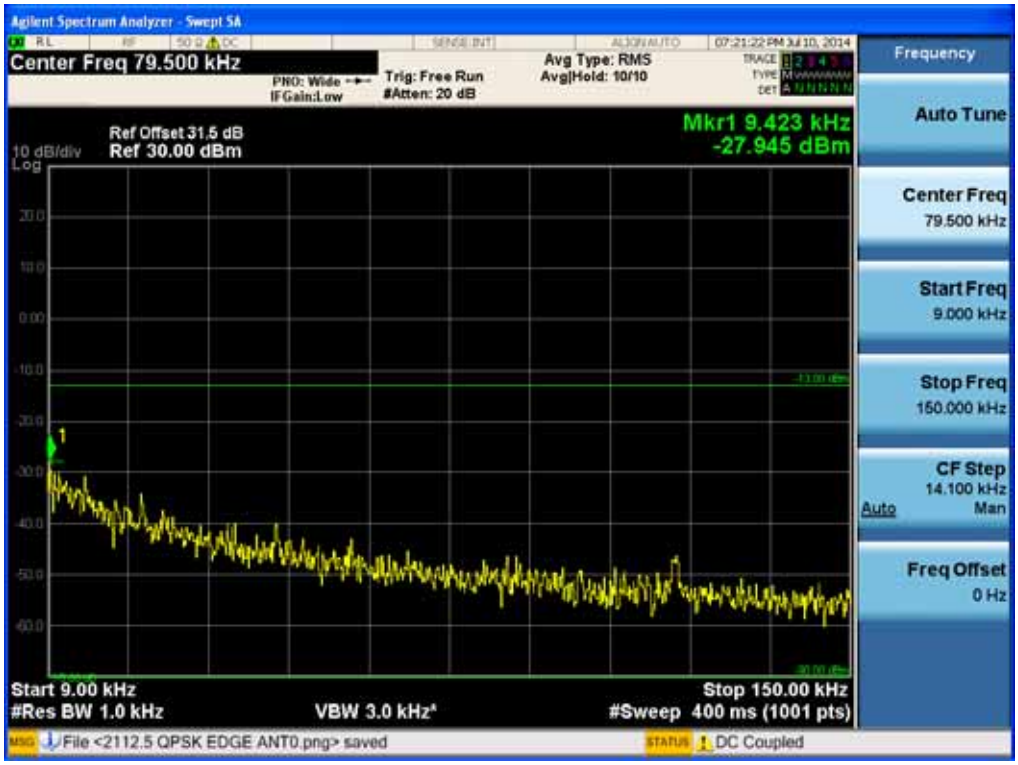


[LTE Downlink 10 MHz High]



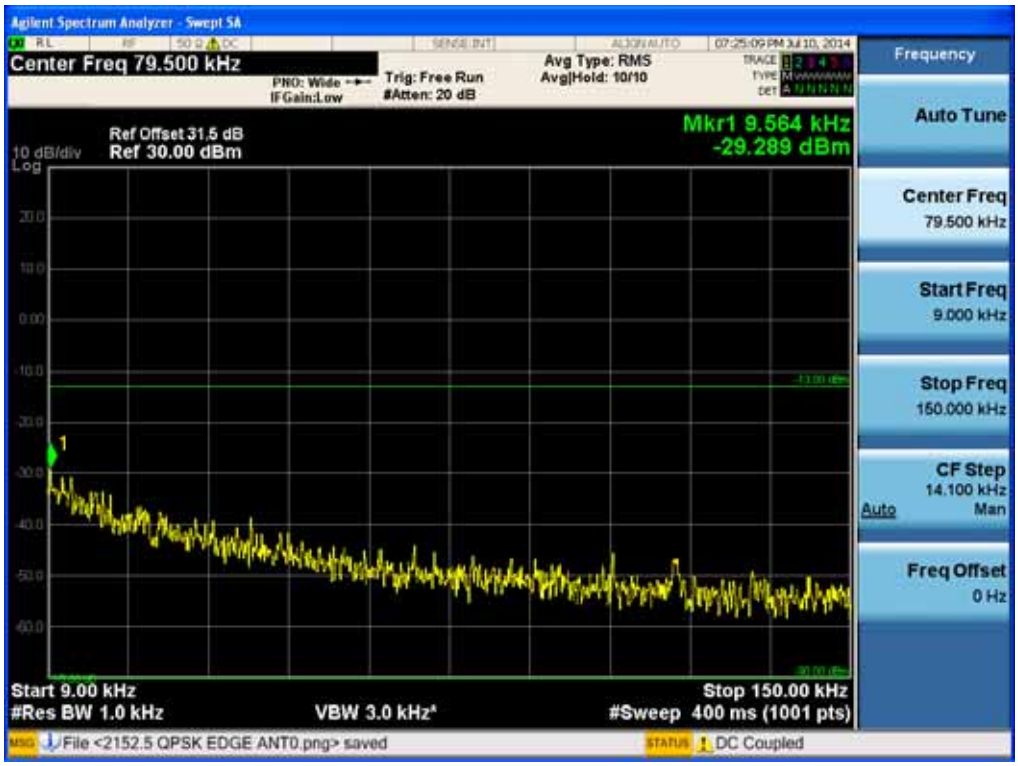
[AWS Downlink]

[LTE Downlink 5 MHz Low]

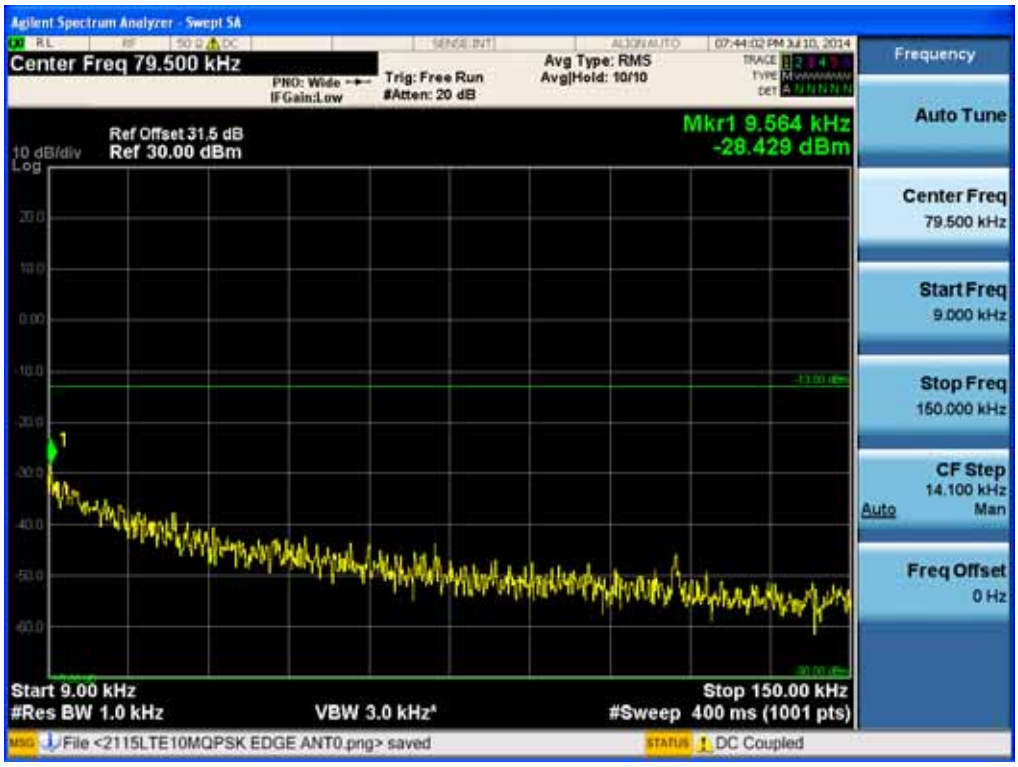


[LTE Downlink 5 MHz Middle]

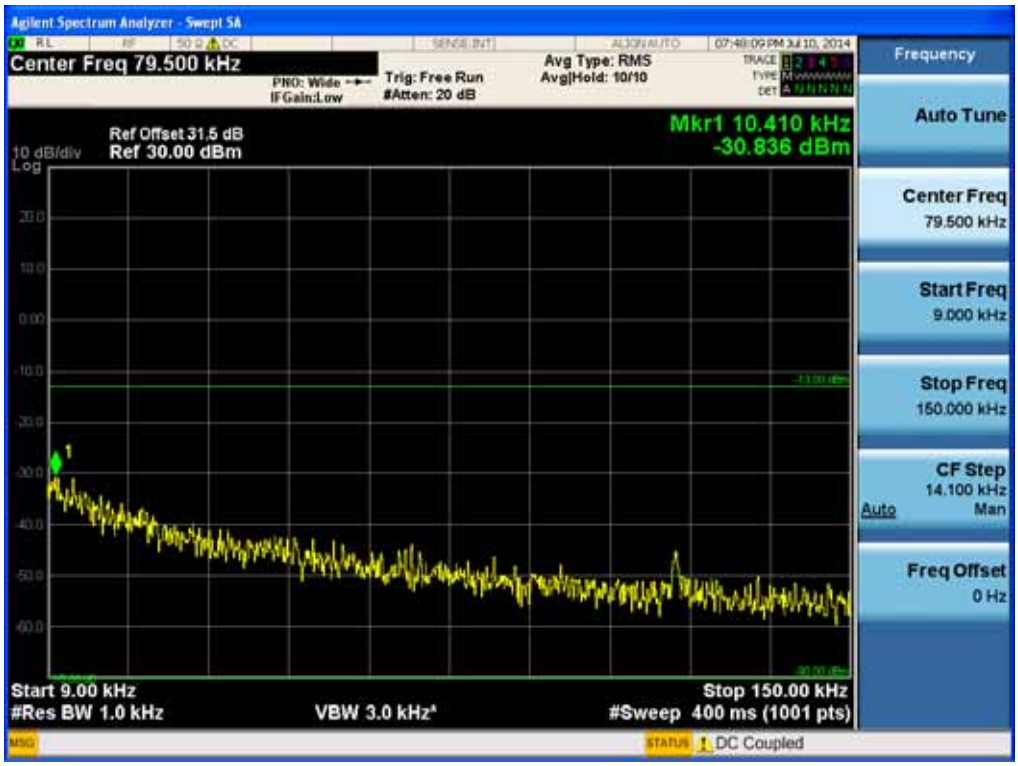
[LTE Downlink 5 MHz High]



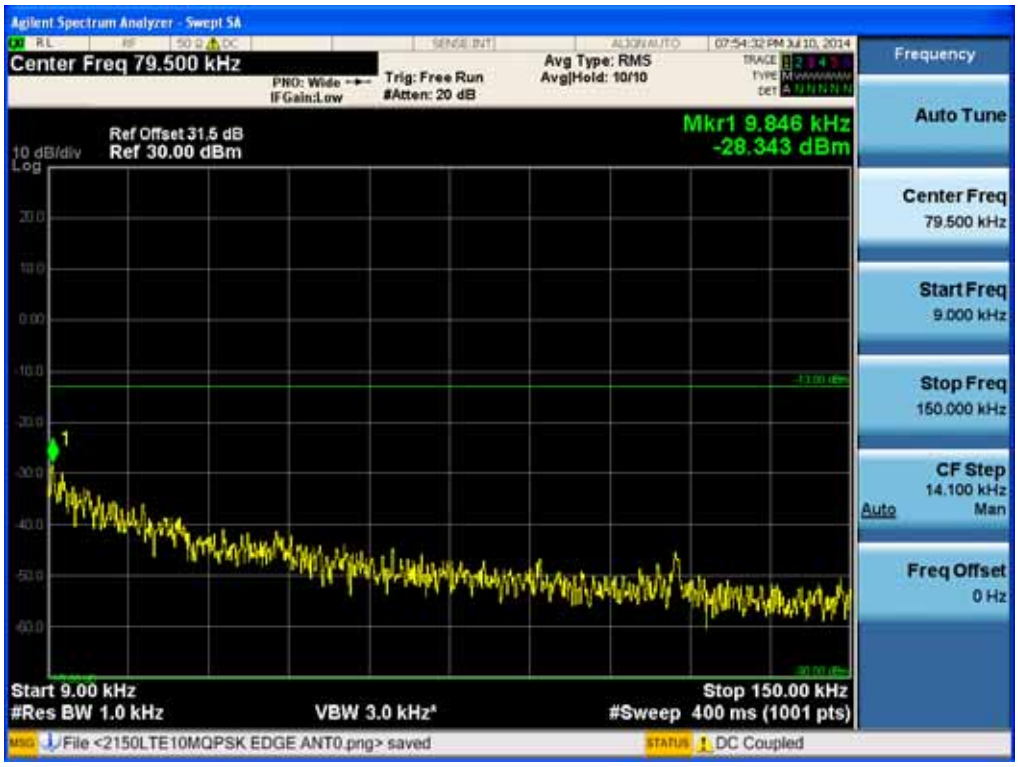
[LTE Downlink 10 MHz Low]



[LTE Downlink 10 MHz Middle]

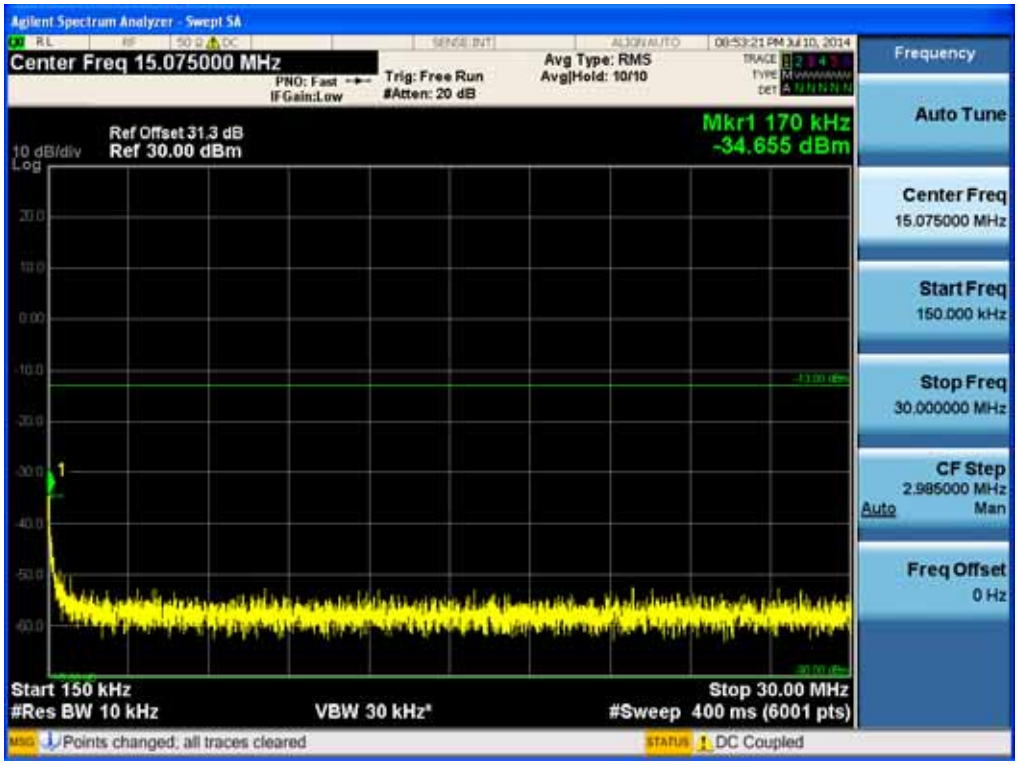


[LTE Downlink 10 MHz High]

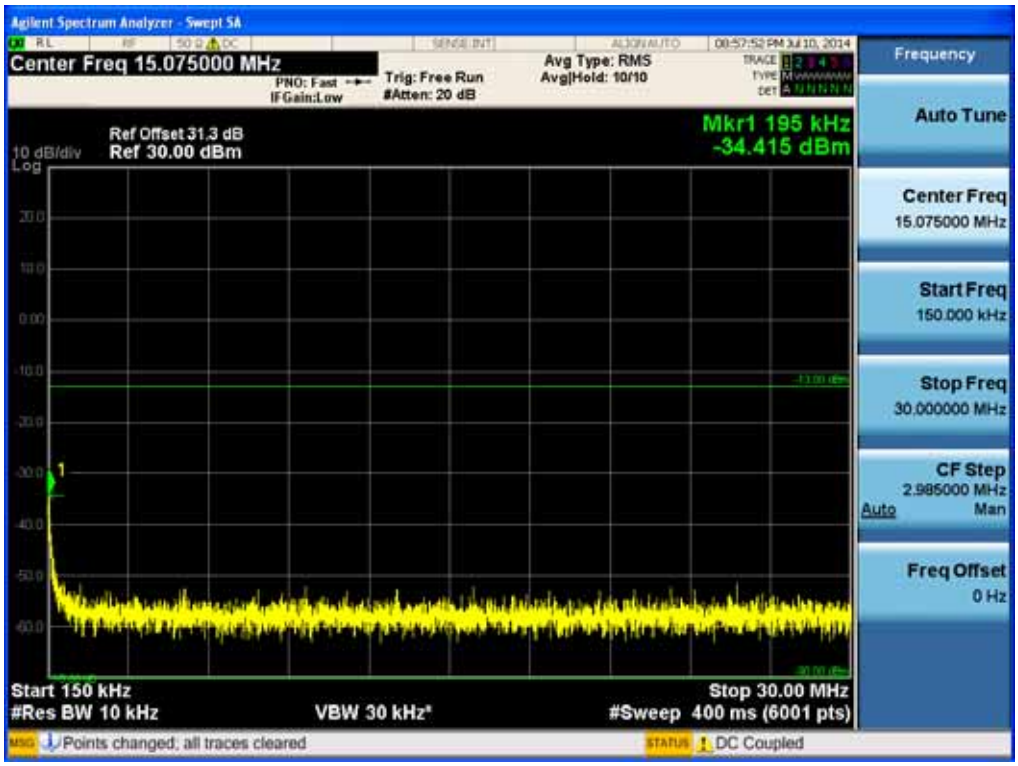


Conducted Spurious Emissions (150 kHz – 30 MHz)
[PCS Downlink]

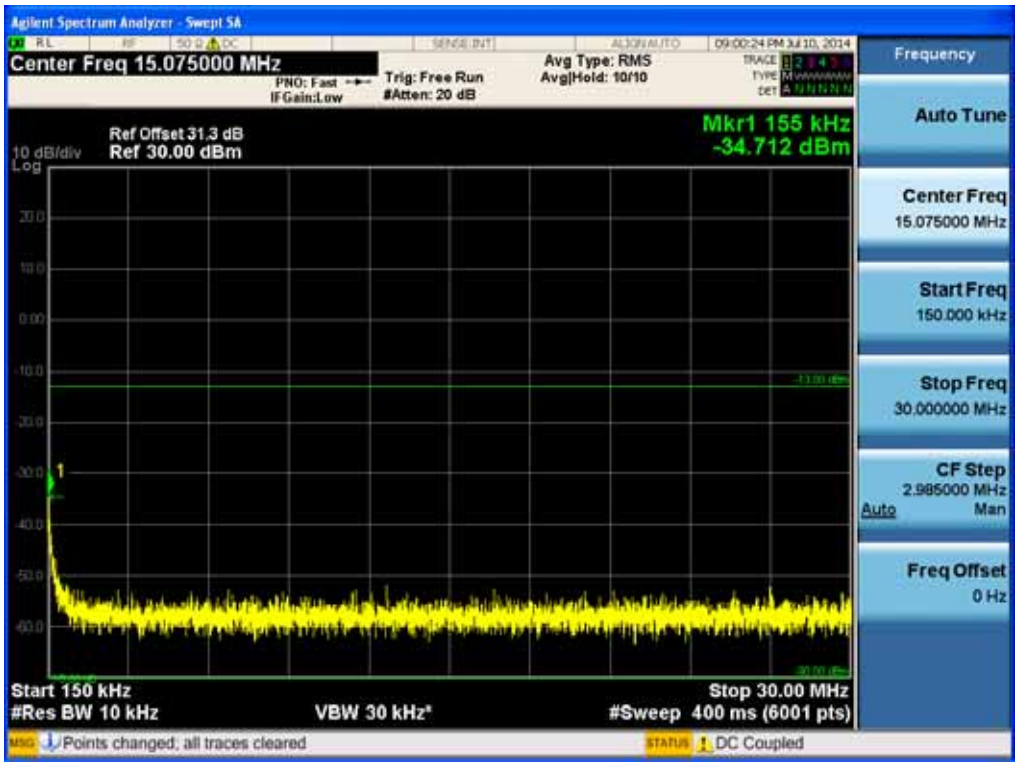
[LTE Downlink 5 MHz Low]



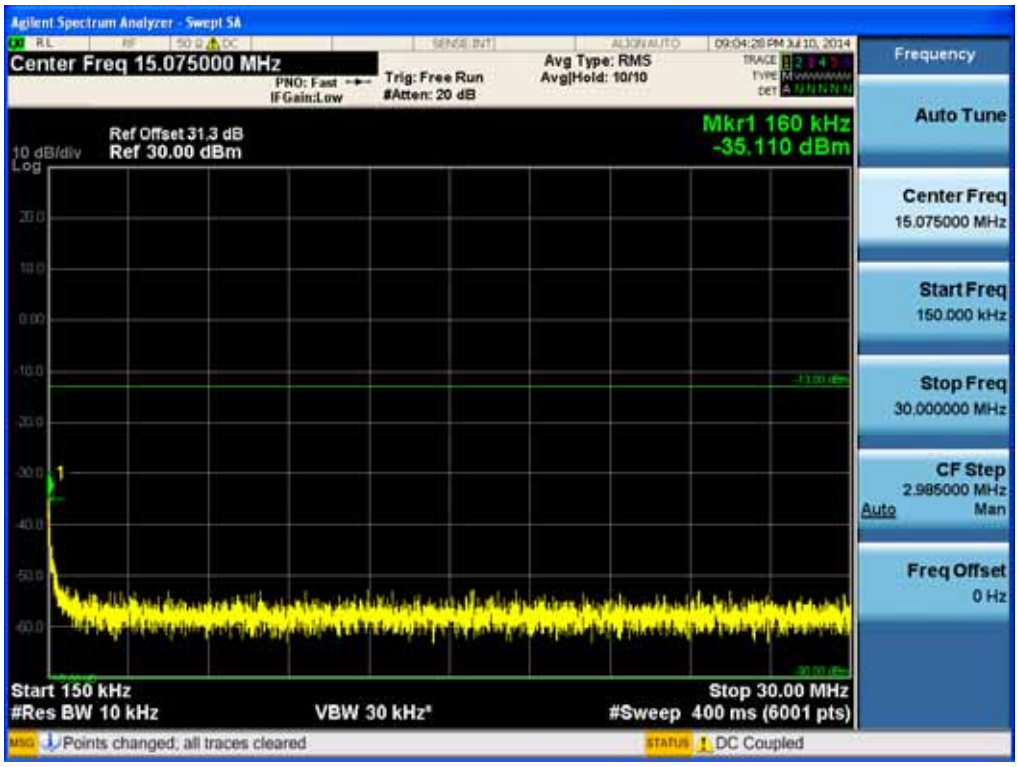
[LTE Downlink 5 MHz Middle]



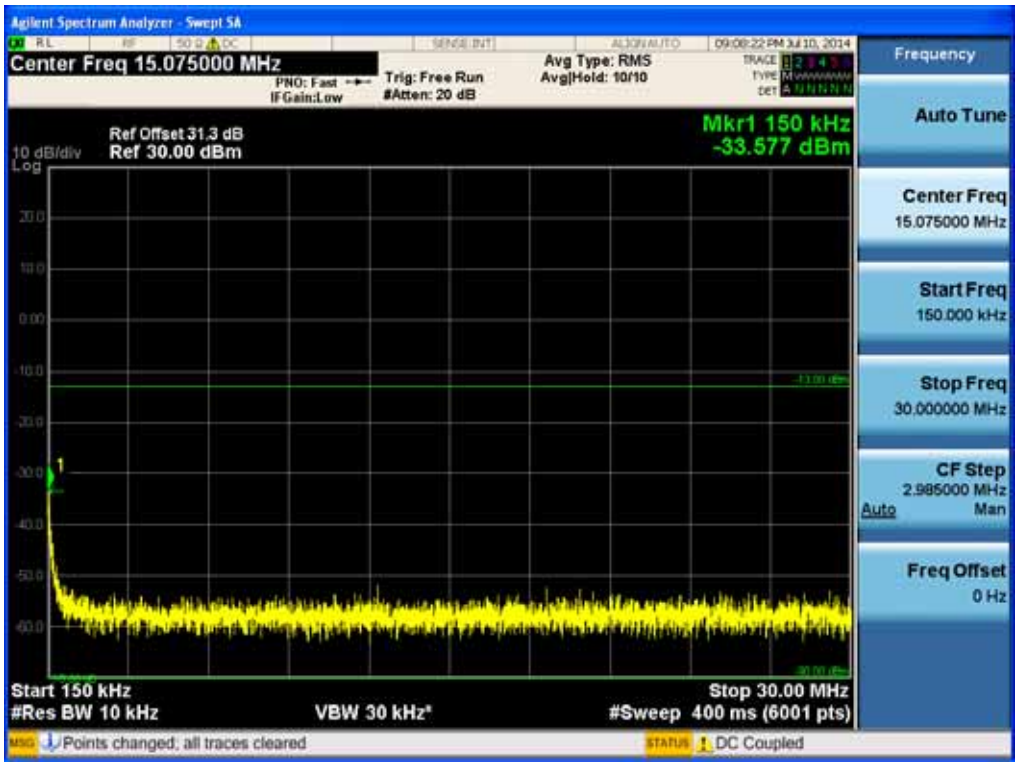
[LTE Downlink 5 MHz High]



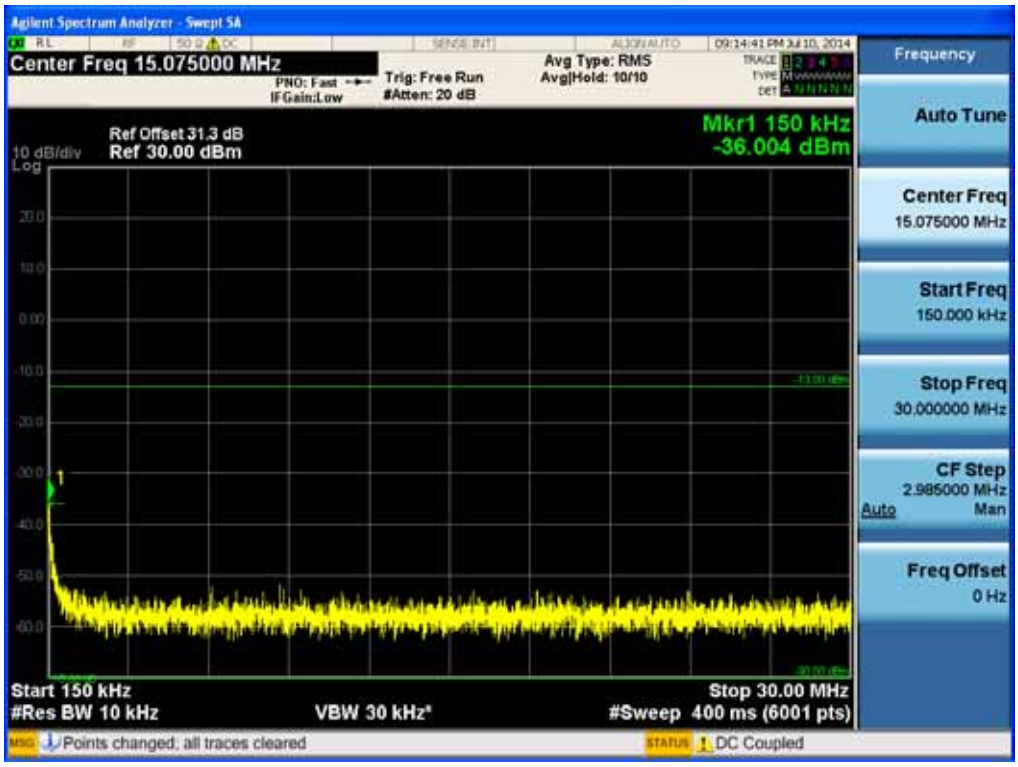
[LTE Downlink 10 MHz Low]



[LTE Downlink 10 MHz Middle]

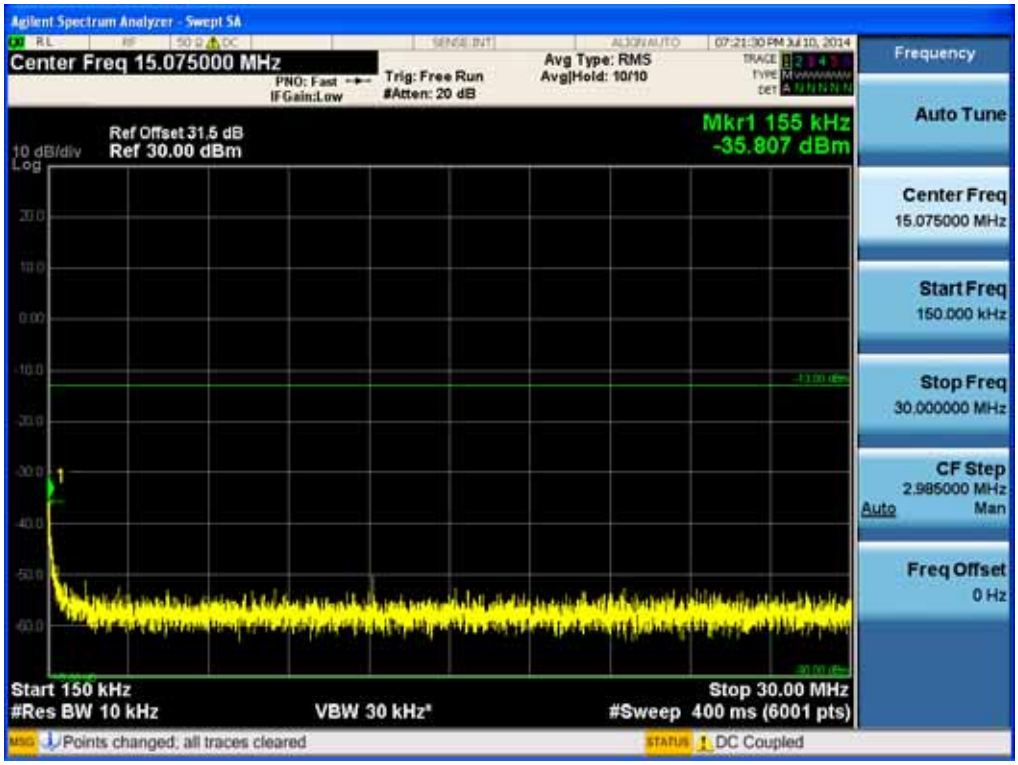


[LTE Downlink 10 MHz High]

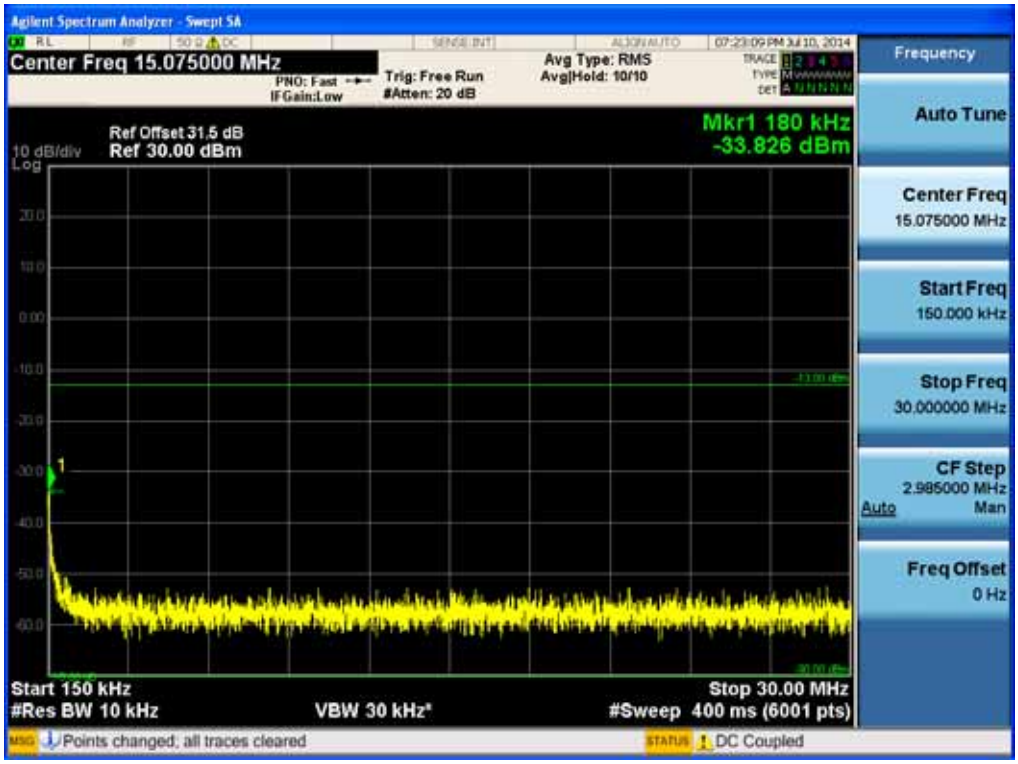


[AWS Downlink]

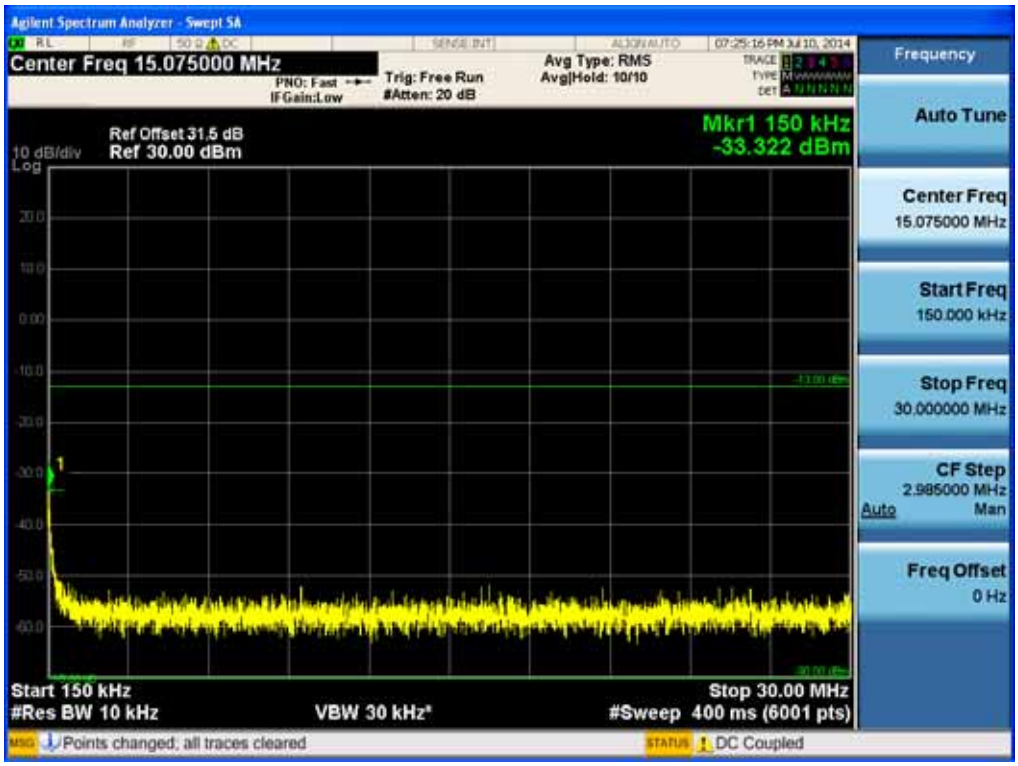
[LTE Downlink 5 MHz Low]



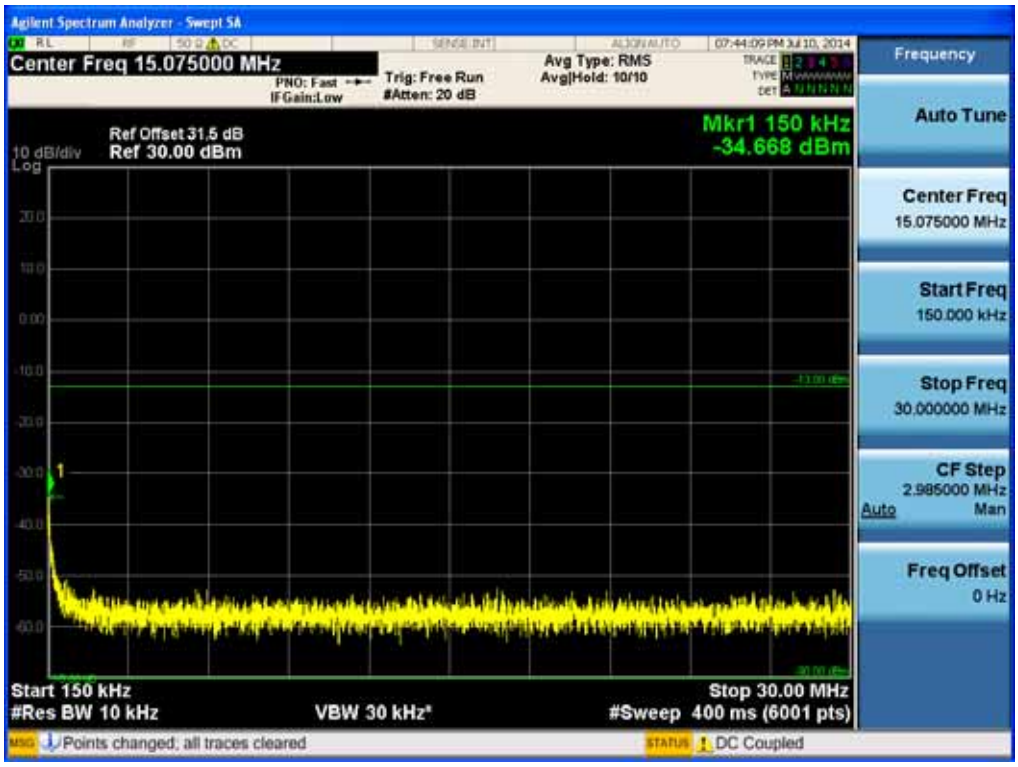
[LTE Downlink 5 MHz Middle]



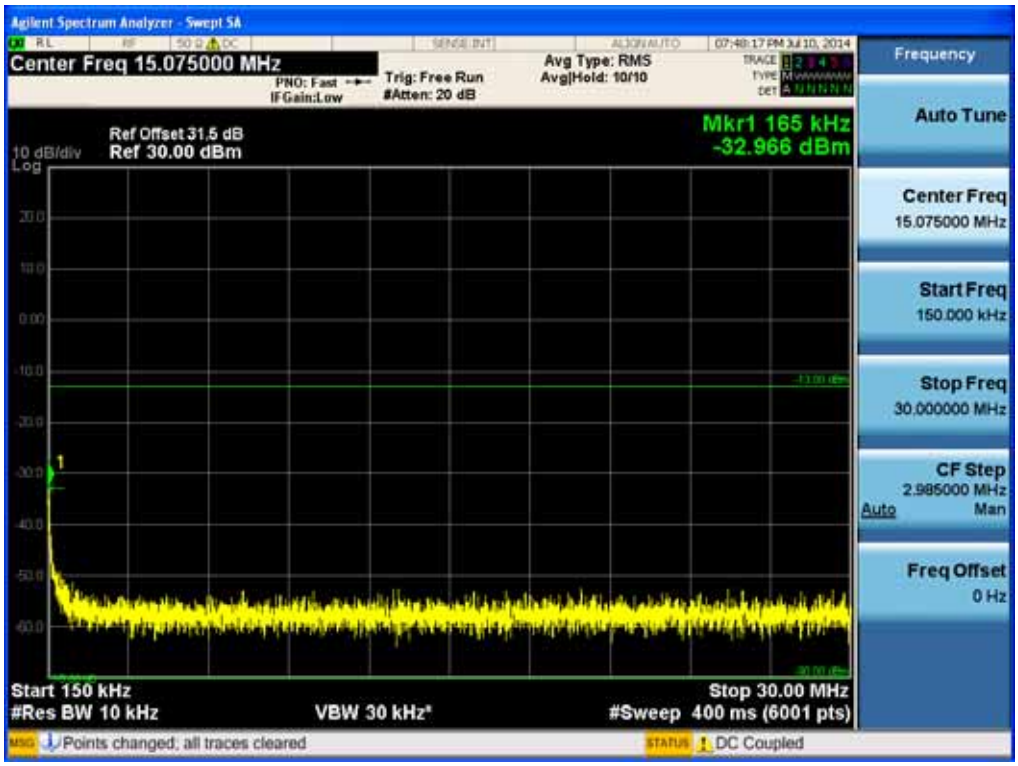
[LTE Downlink 5 MHz High]



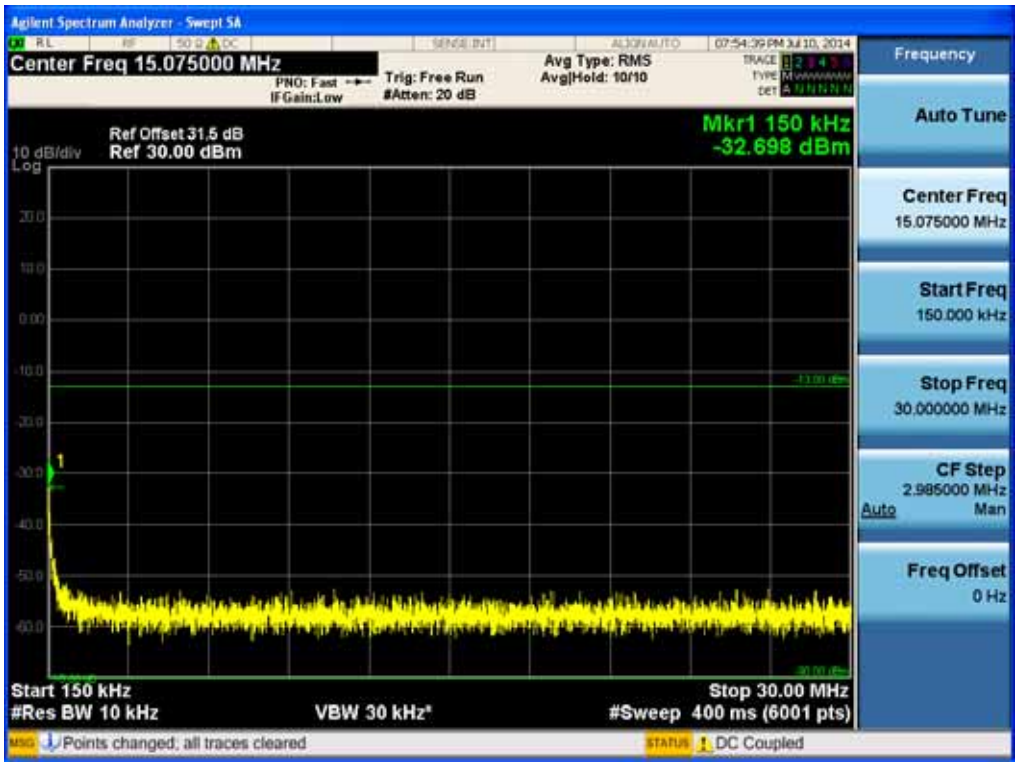
[LTE Downlink 10 MHz Low]



[LTE Downlink 10 MHz Middle]

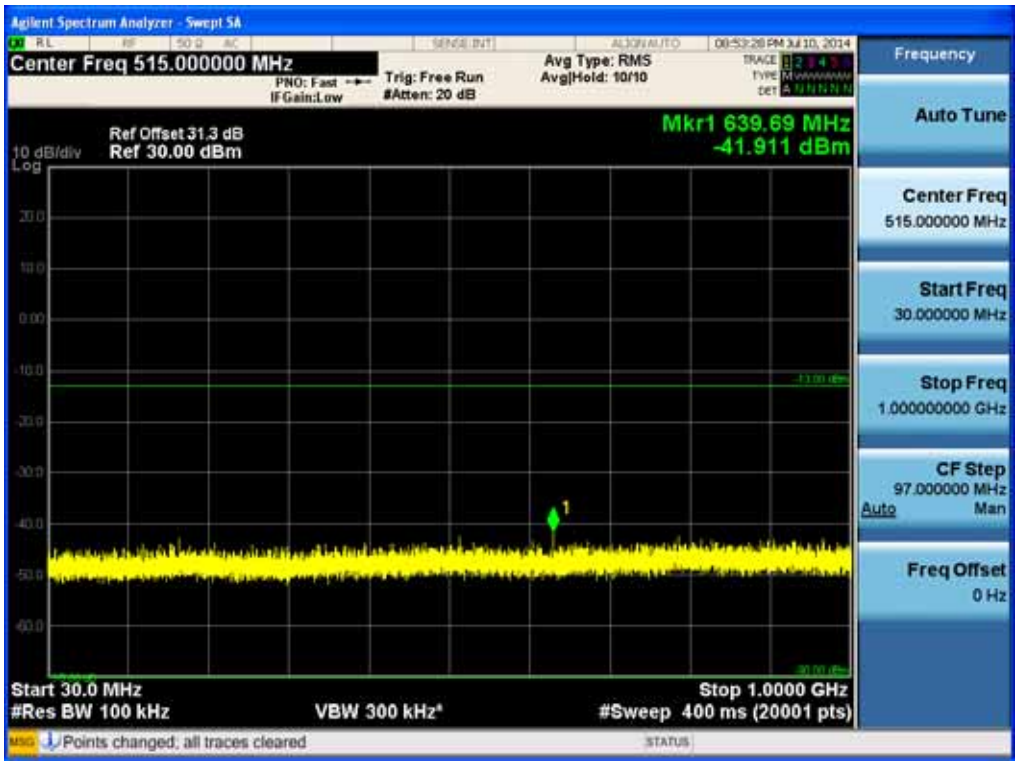


[LTE Downlink 10 MHz High]

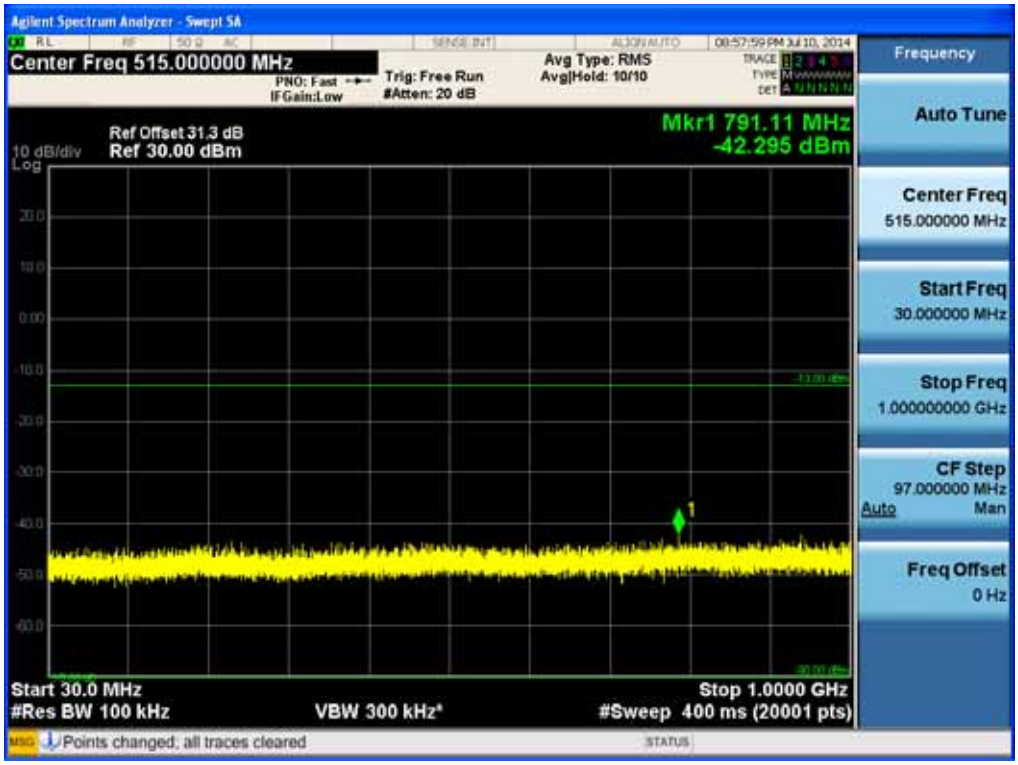


Conducted Spurious Emissions (30 MHz – 1 GHz)
[PCS Downlink]

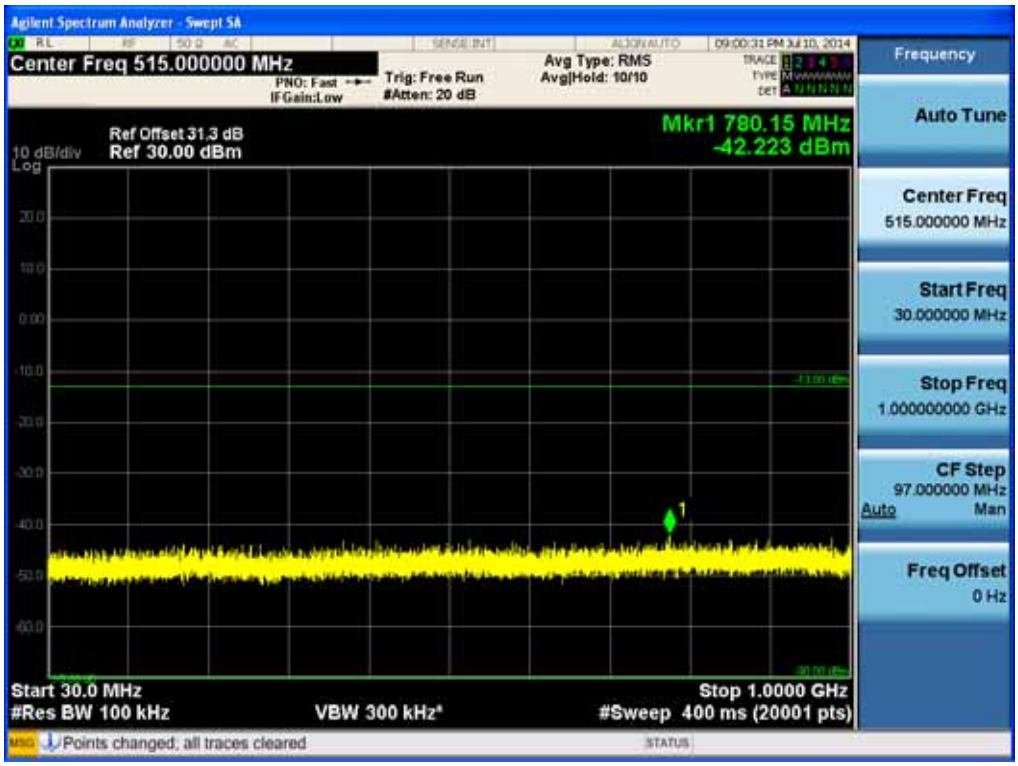
[LTE Downlink 5 MHz Low]



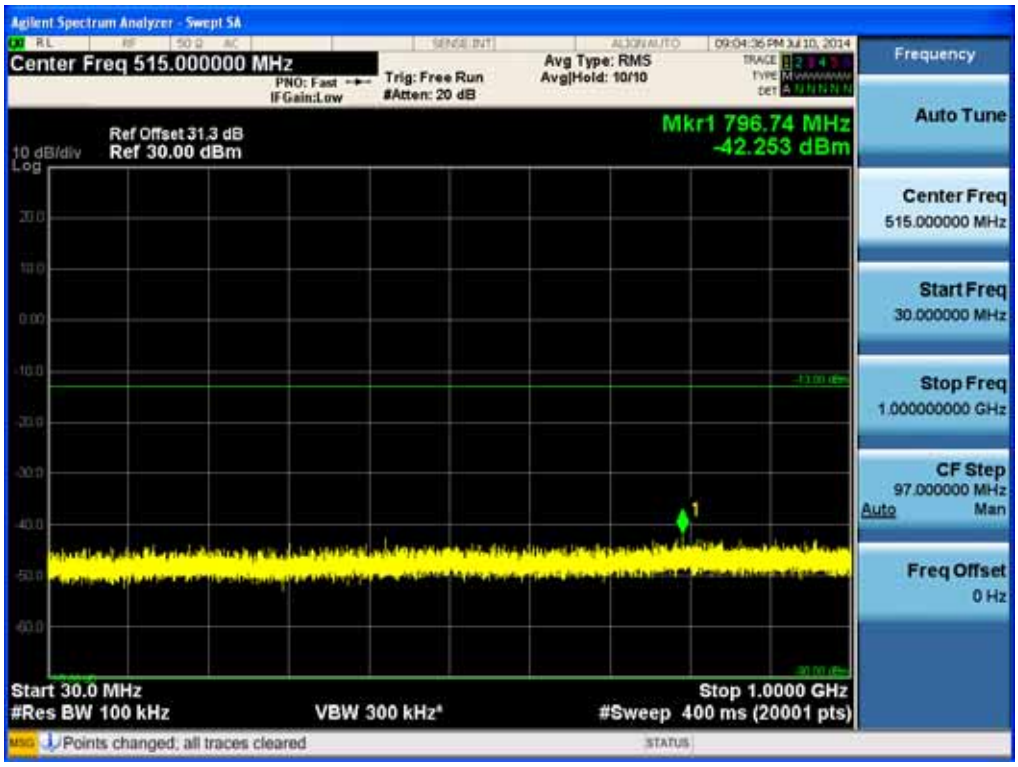
[LTE Downlink 5 MHz Middle]



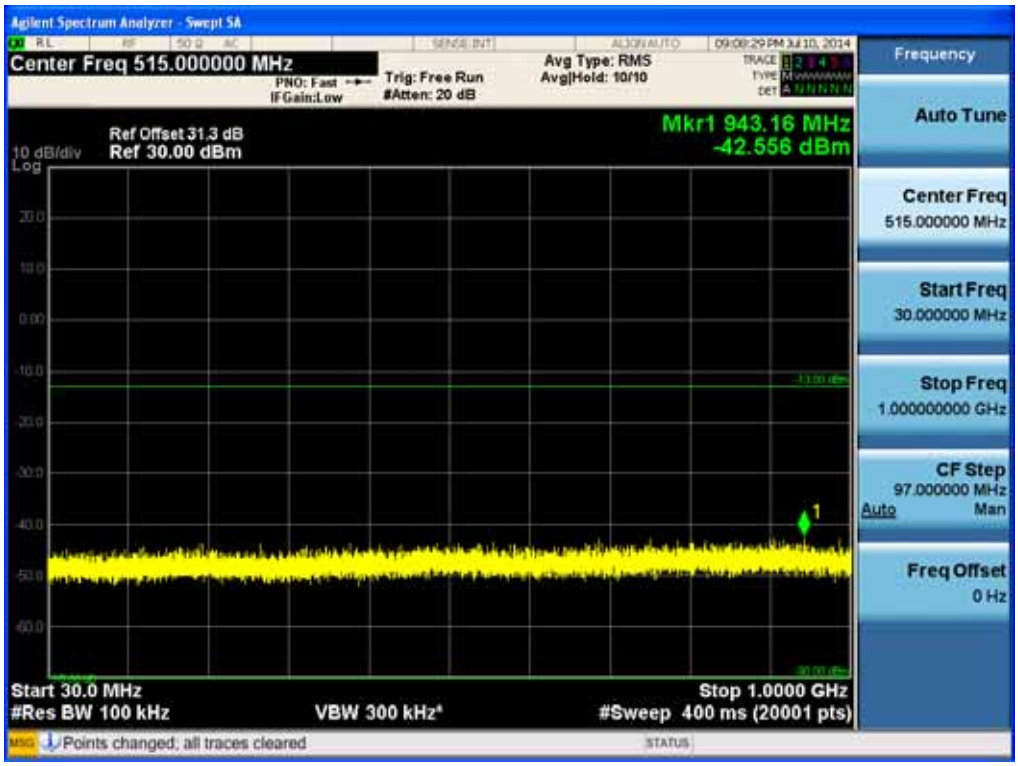
[LTE Downlink 5 MHz High]



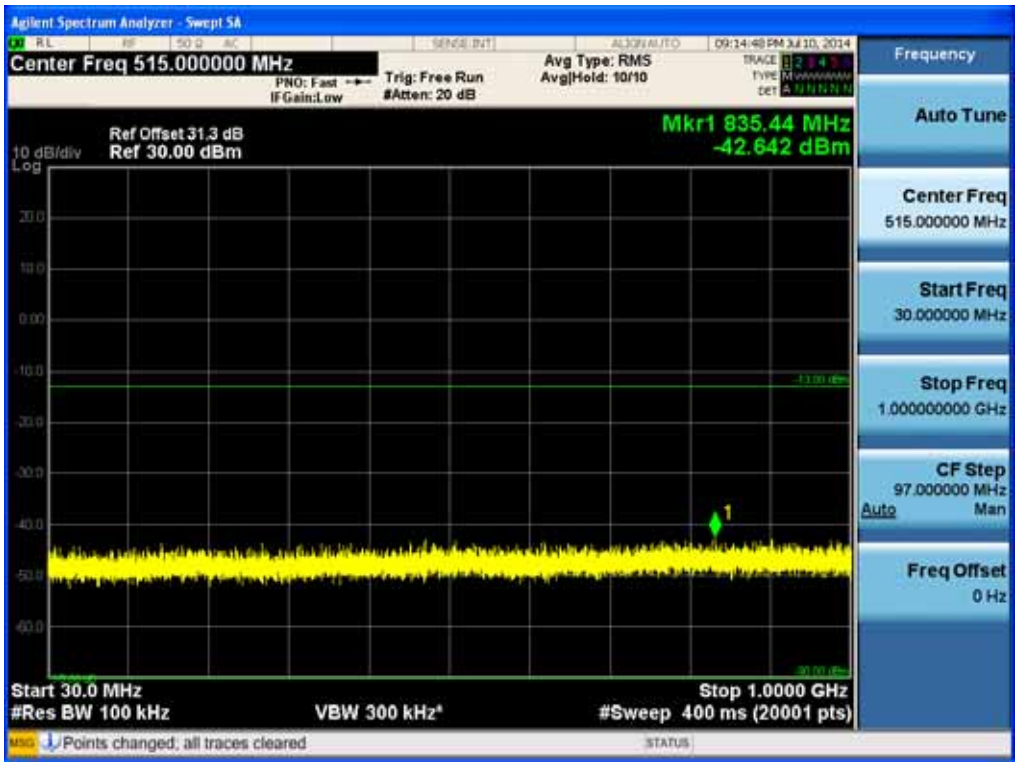
[LTE Downlink 10 MHz Low]



[LTE Downlink 10 MHz Middle]

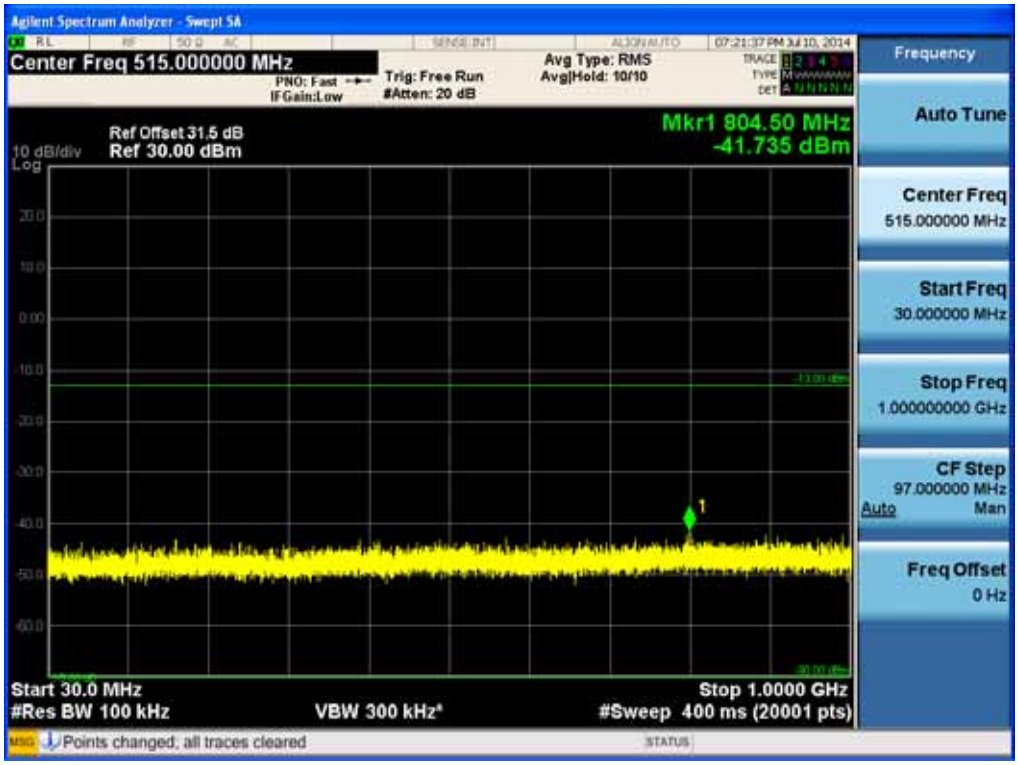


[LTE Downlink 10 MHz High]

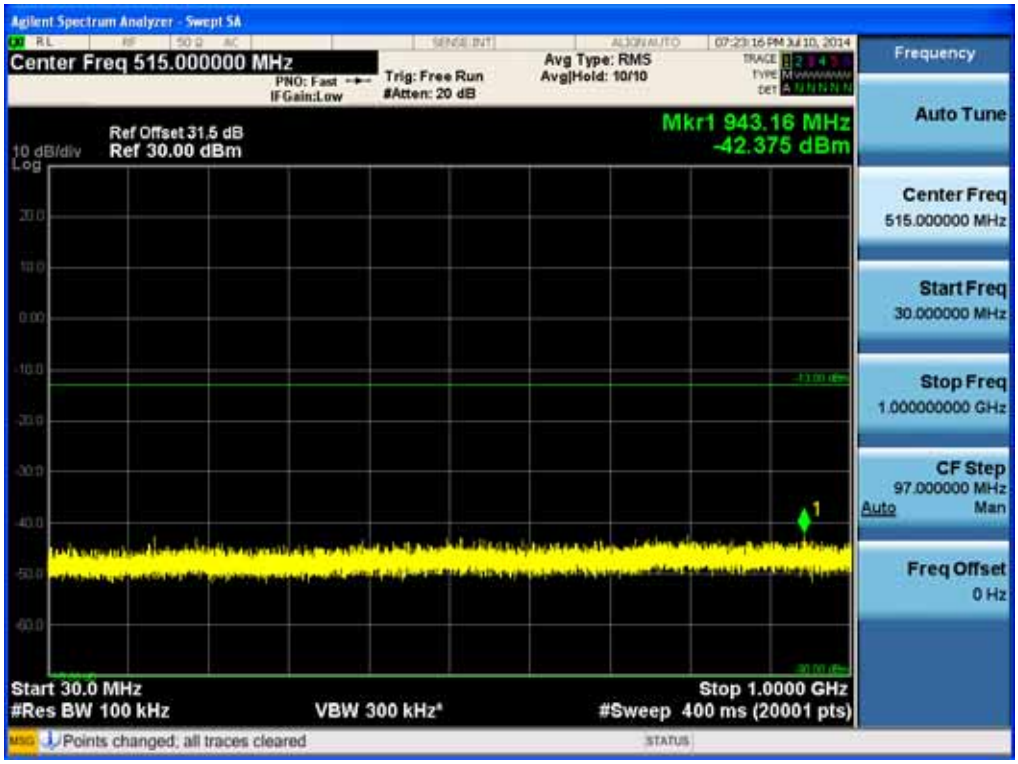


[AWS Downlink]

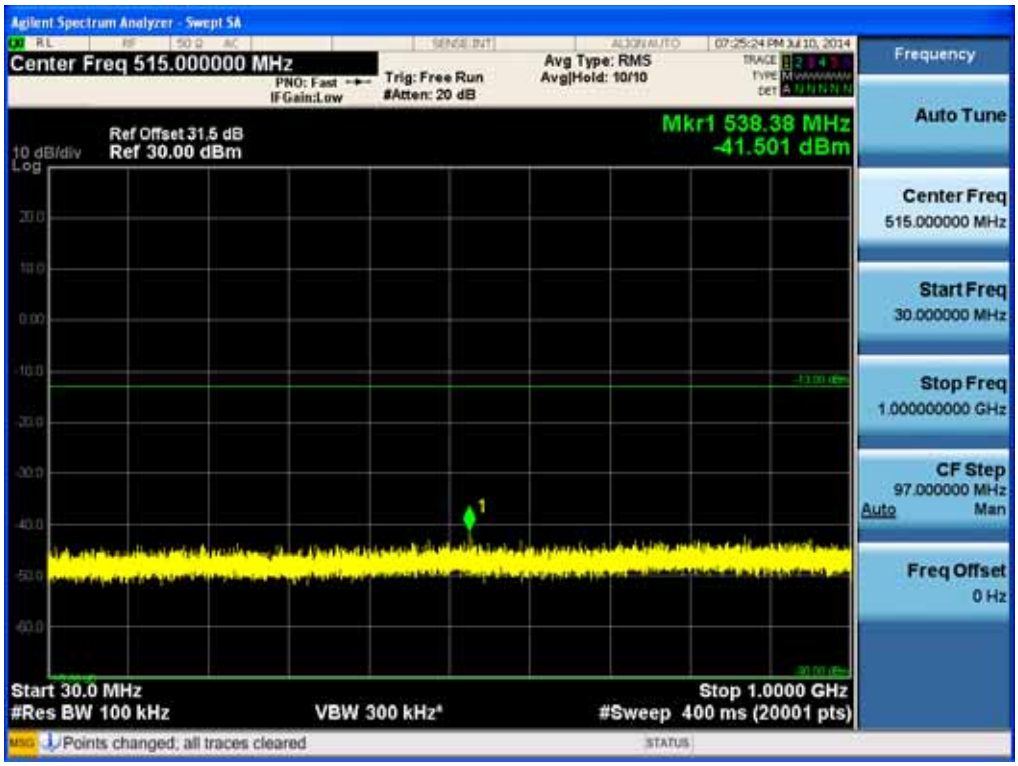
[LTE Downlink 5 MHz Low]



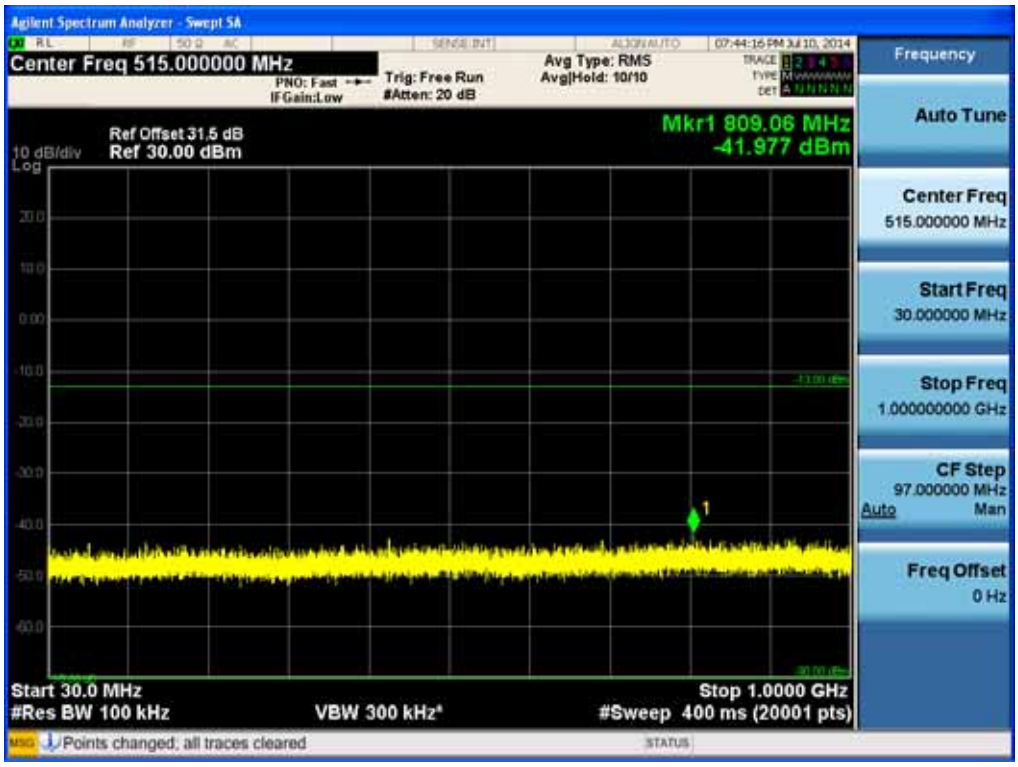
[LTE Downlink 5 MHz Middle]



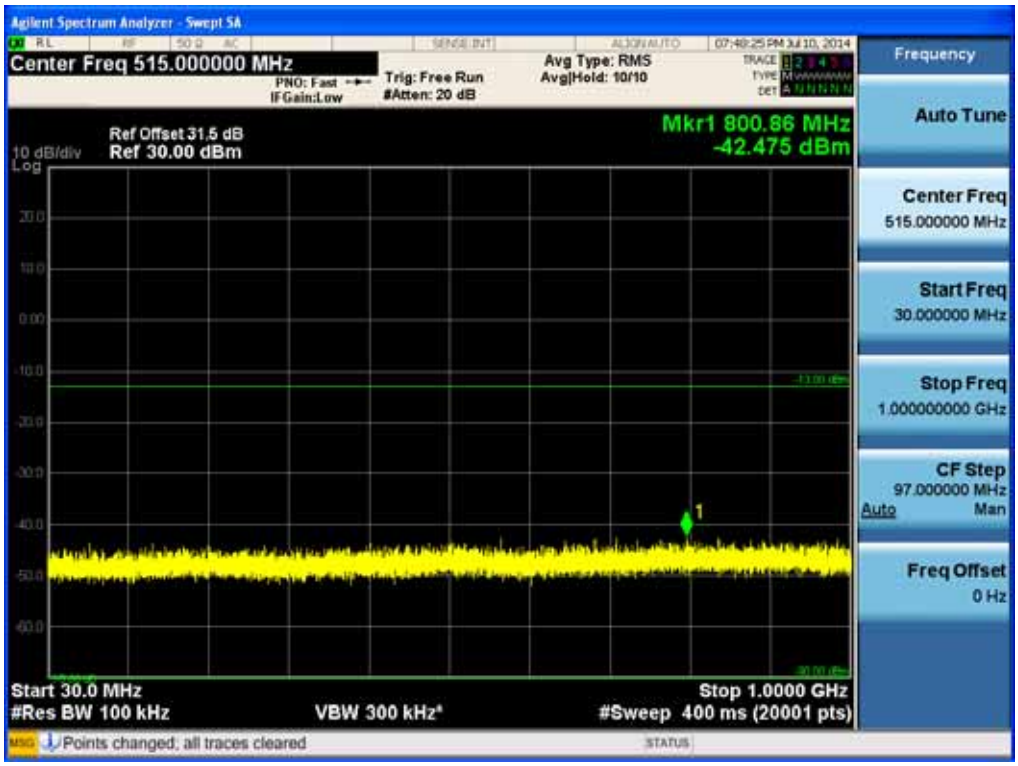
[LTE Downlink 5 MHz High]



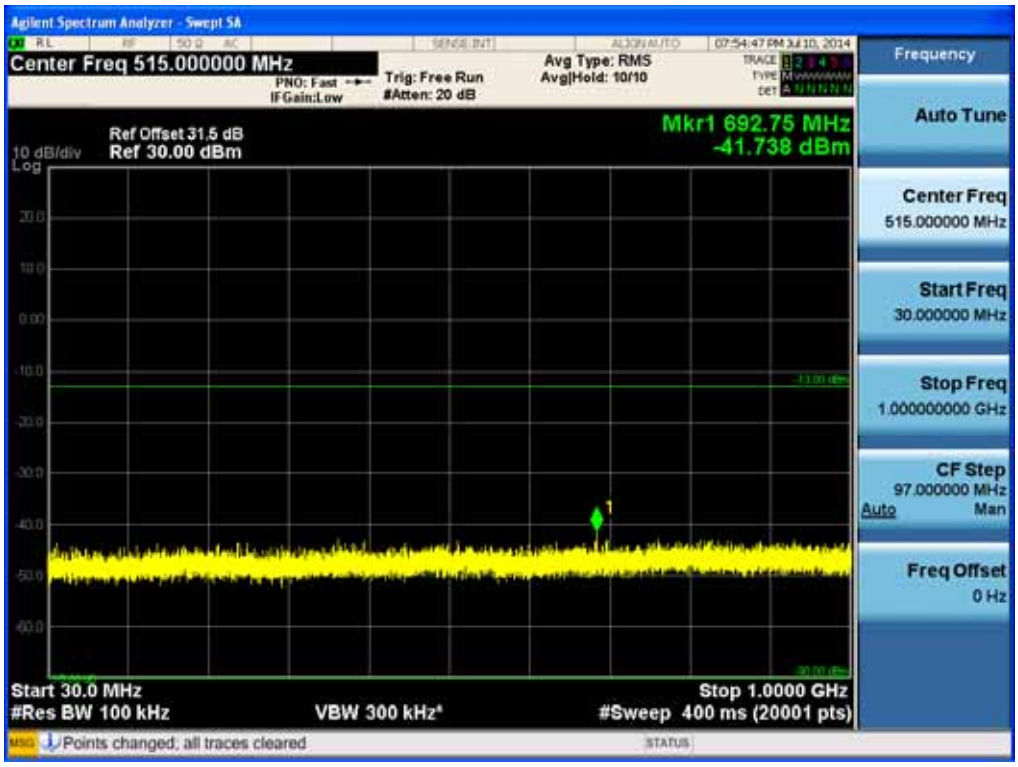
[LTE Downlink 10 MHz Low]



[LTE Downlink 10 MHz Middle]



[LTE Downlink 10 MHz High]



Conducted Spurious Emissions (1 GHz –26.5 GHz)
[PCS Downlink]

[LTE Downlink 5 MHz Low]

[LTE Downlink 5 MHz Middle]

[LTE Downlink 5 MHz High]

[LTE Downlink 10 MHz Low]

[LTE Downlink 10 MHz Middle]

[LTE Downlink 10 MHz High]

[AWS Downlink]

[LTE Downlink 5 MHz Low]

[LTE Downlink 5 MHz Middle]

[LTE Downlink 5 MHz High]

[LTE Downlink 10 MHz Low]

[LTE Downlink 10 MHz Middle]

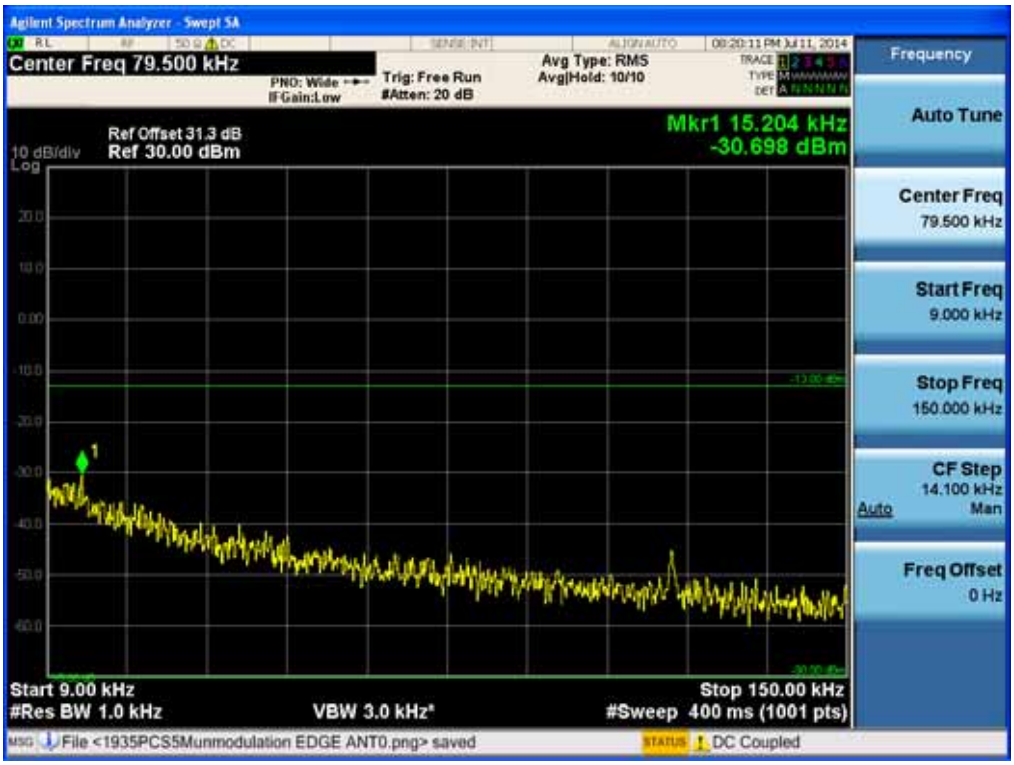
[LTE Downlink 10 MHz High]

Multi channel Enhancer Plots of Spurious Emission for IC

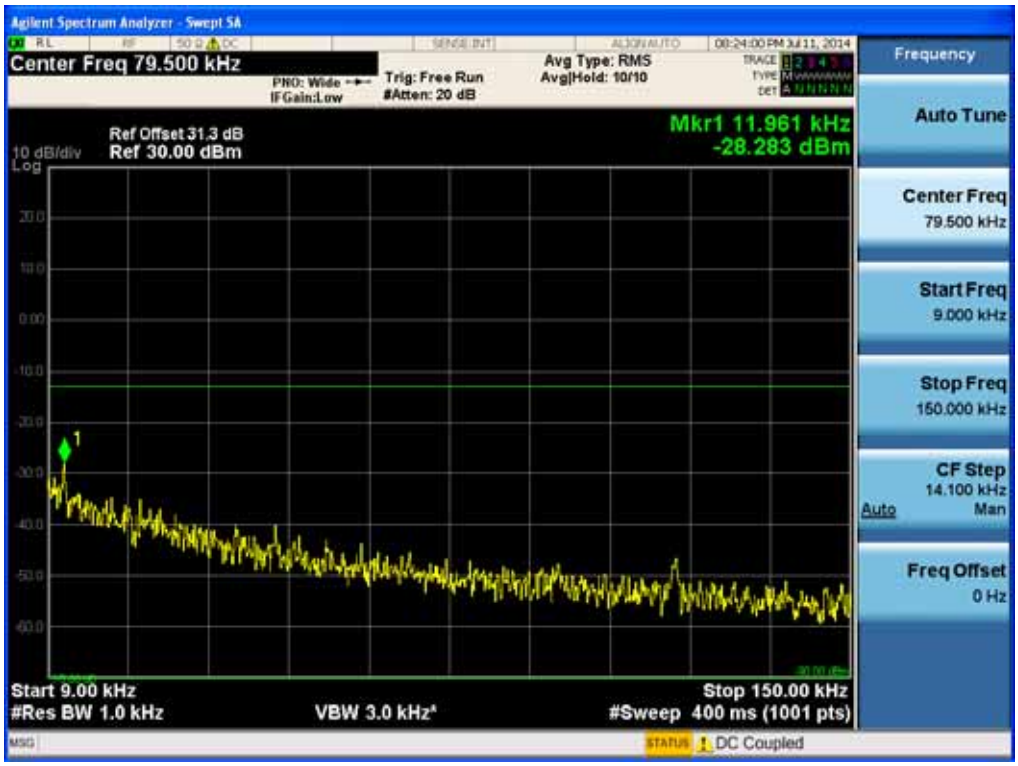
Conducted Spurious Emissions (9 kHz – 150 kHz)

[PCS Downlink]

[LTE Downlink Low]



[LTE Downlink Middle]



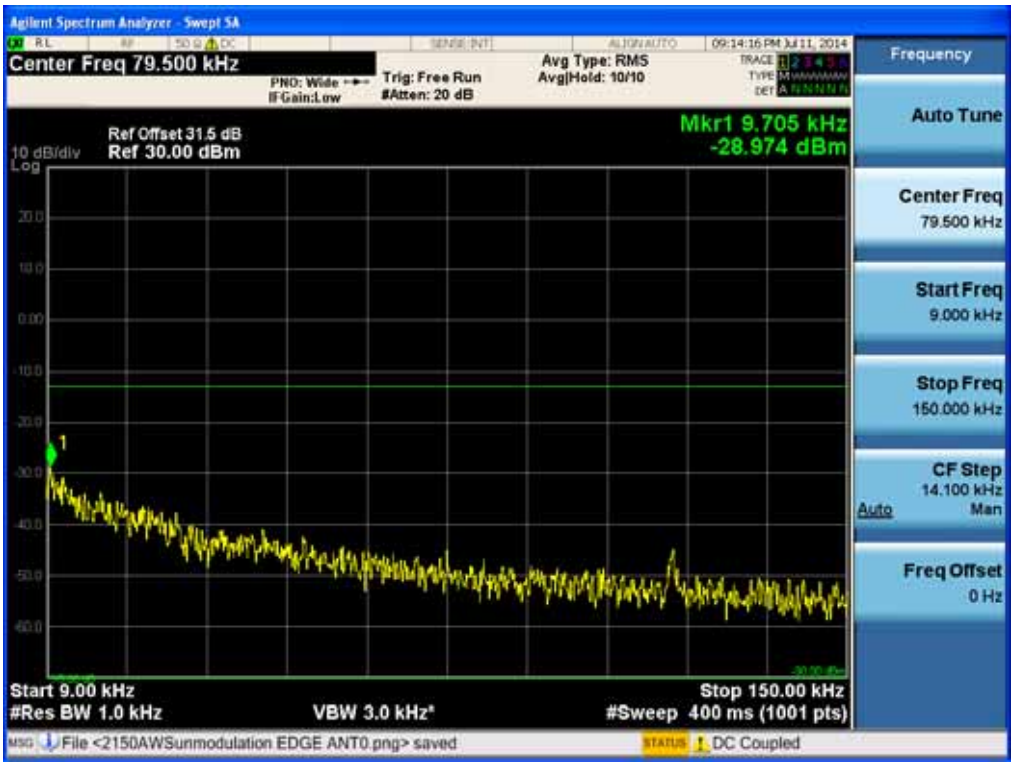
[LTE Downlink High]

[AWS Downlink]

[LTE Downlink Low]

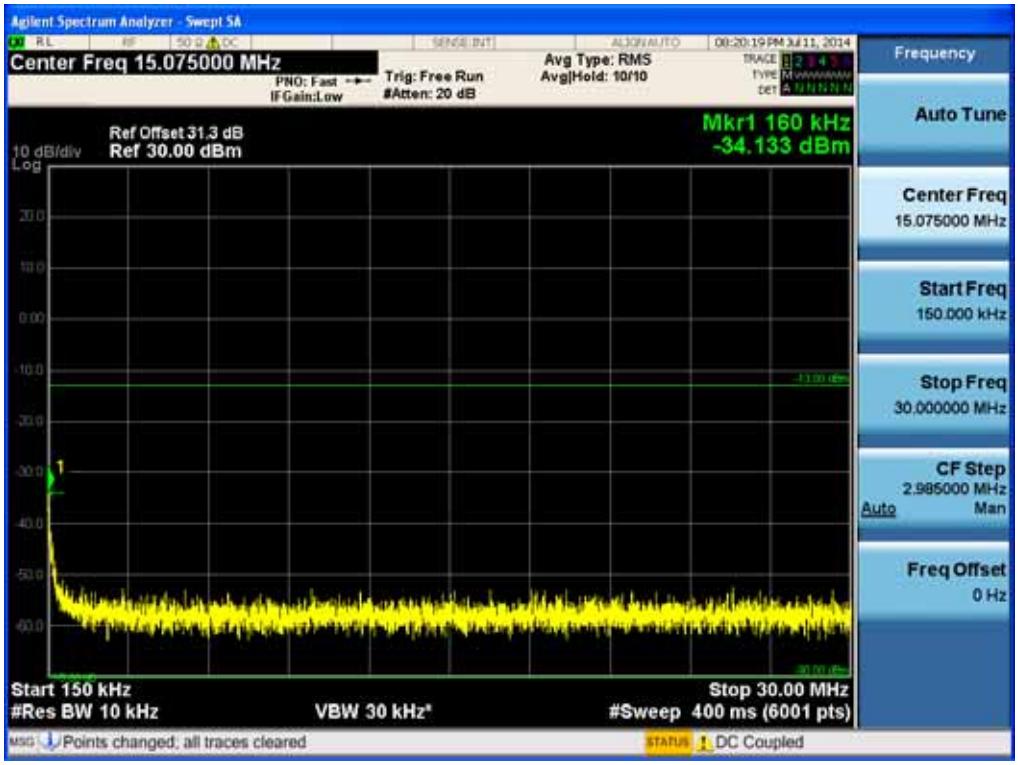
[LTE Downlink Middle]

[LTE Downlink High]

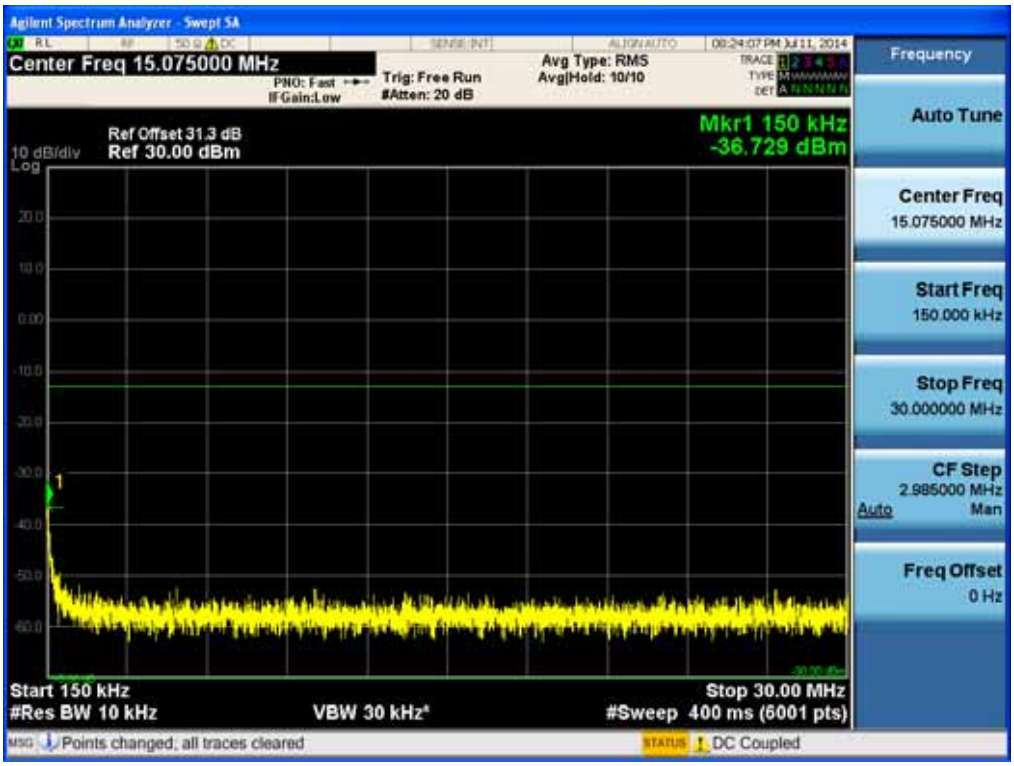


Conducted Spurious Emissions (150 kHz – 30 MHz)
[PCS Downlink]

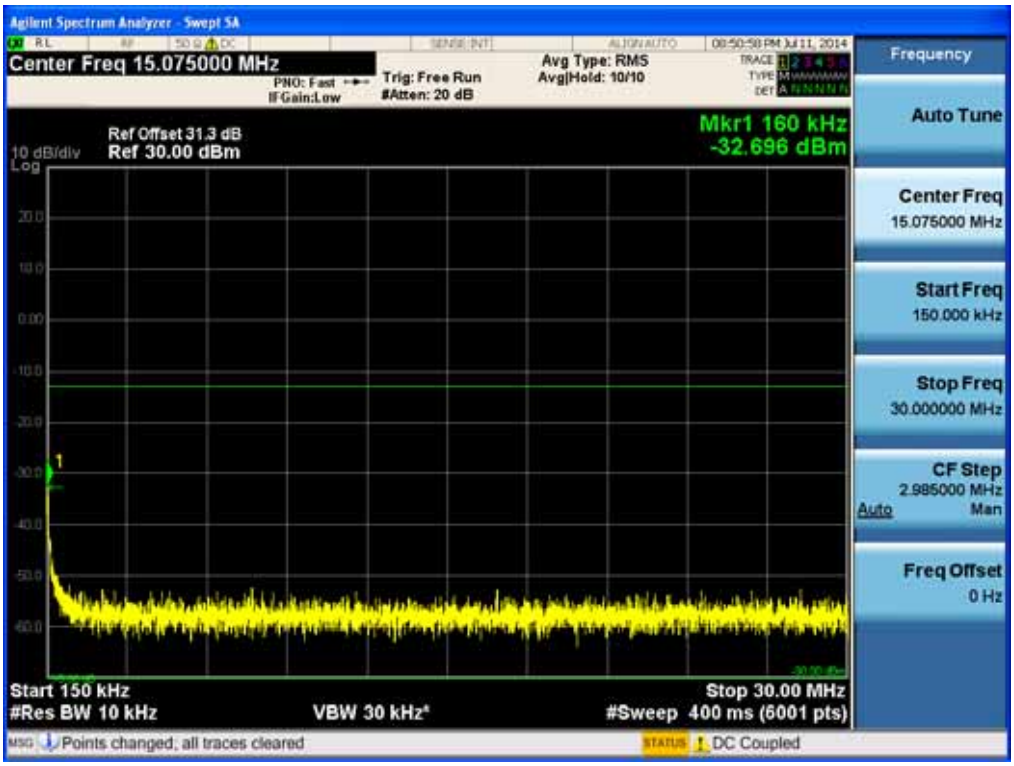
[LTE Downlink Low]



[LTE Downlink Middle]

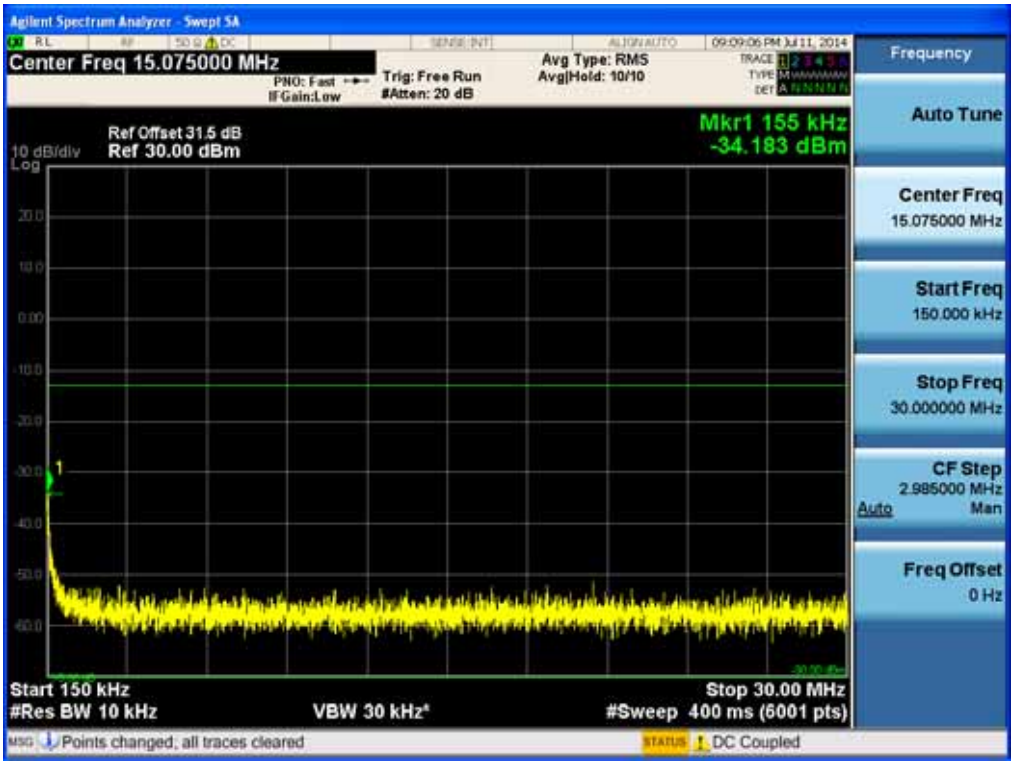


[LTE Downlink High]

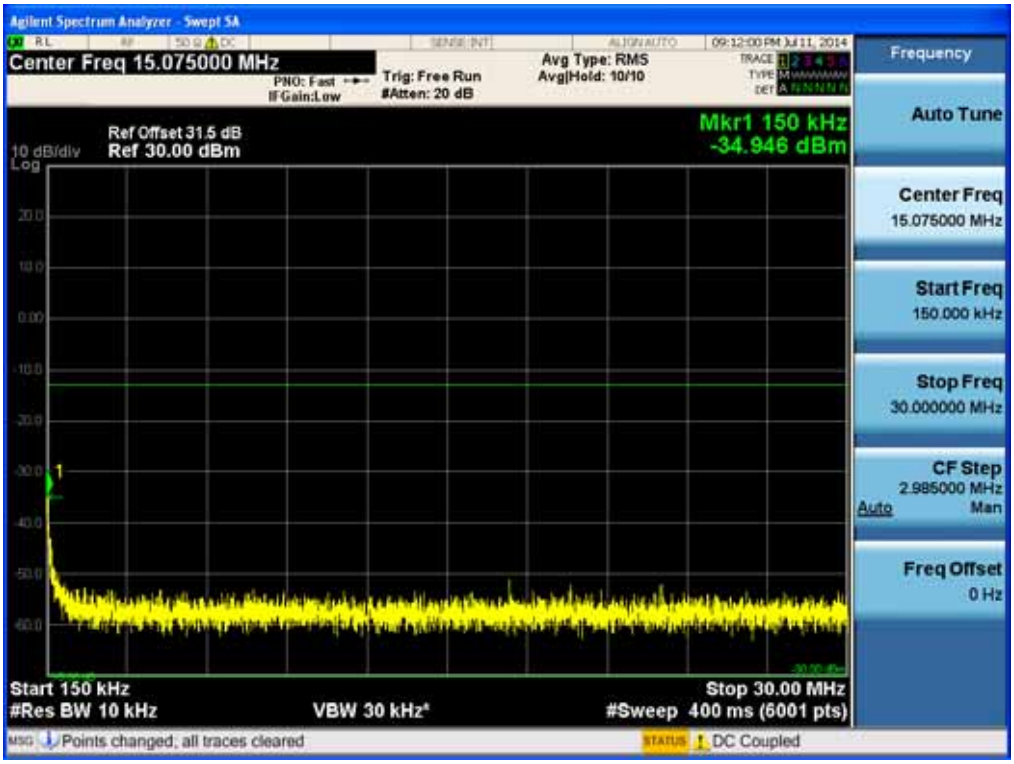


[AWS Downlink]

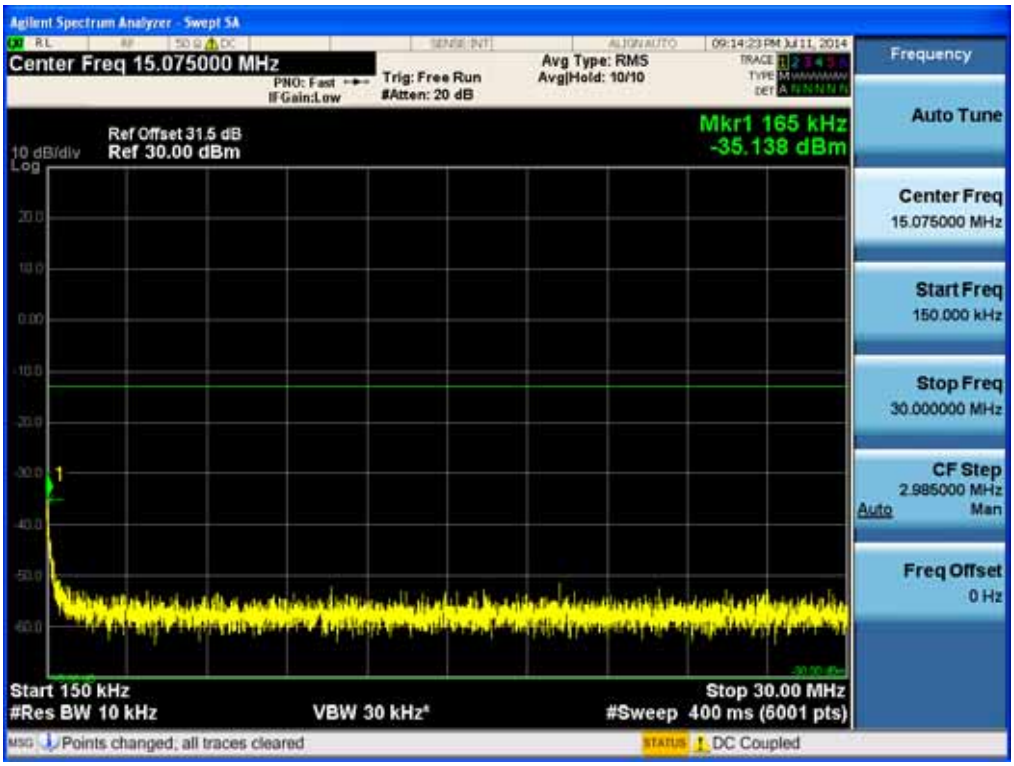
[LTE Downlink Low]



[LTE Downlink Middle]



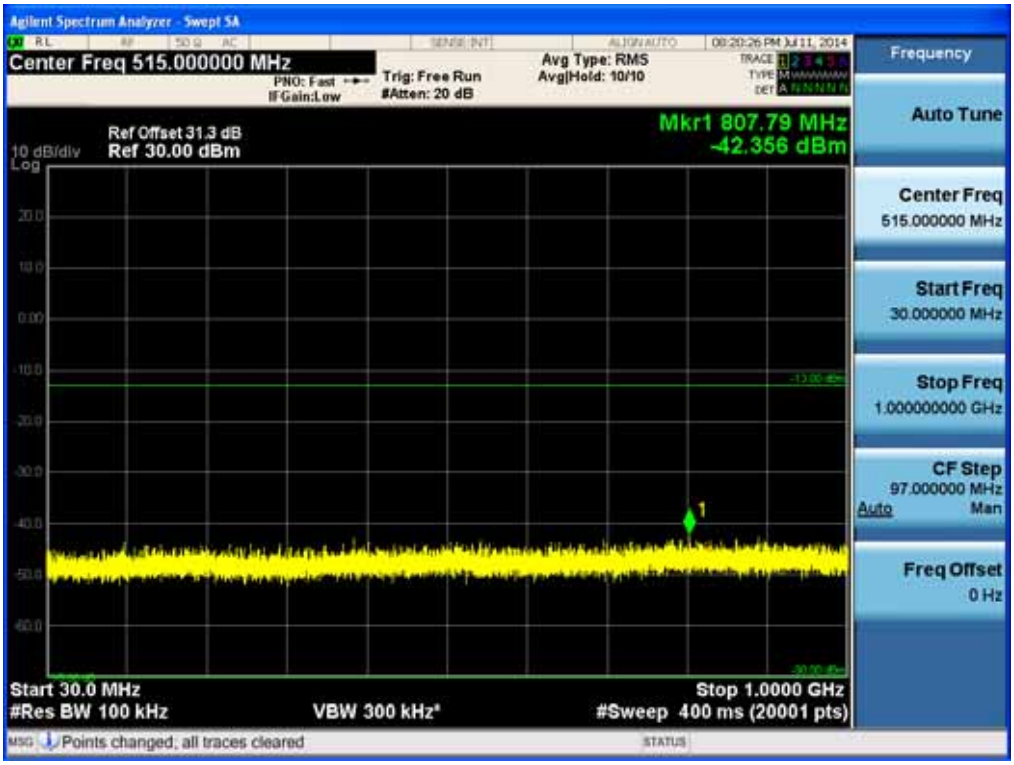
[LTE Downlink High]



Conducted Spurious Emissions (30 MHz – 1 GHz)

[PCS Downlink]

[LTE Downlink Low]



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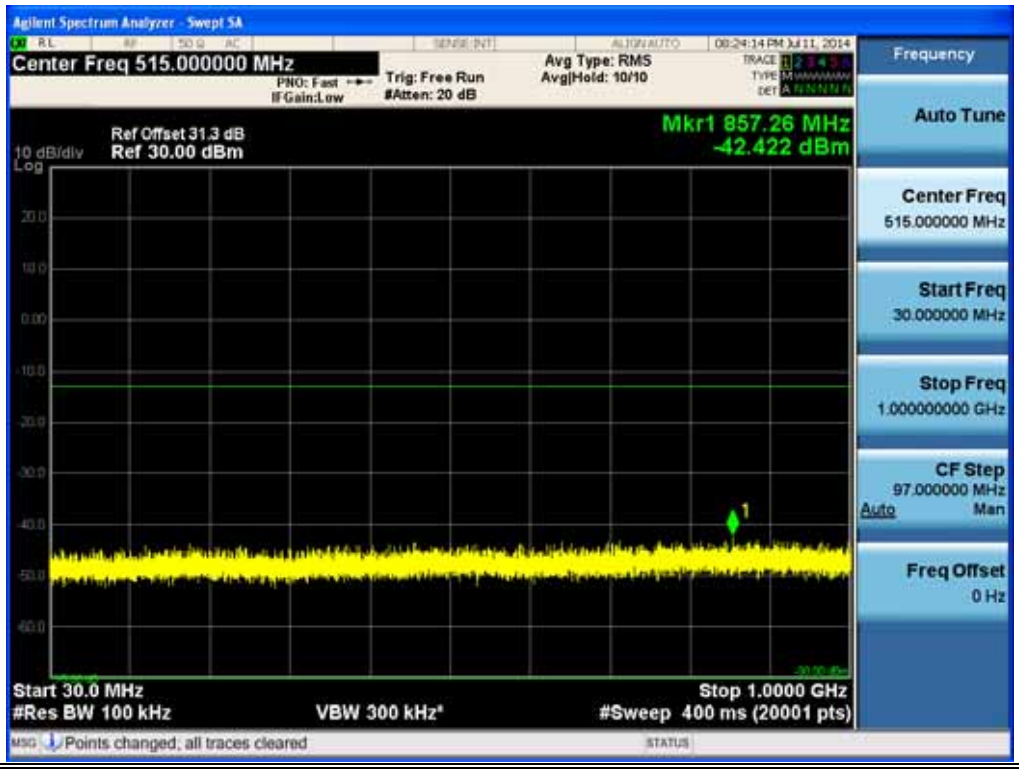
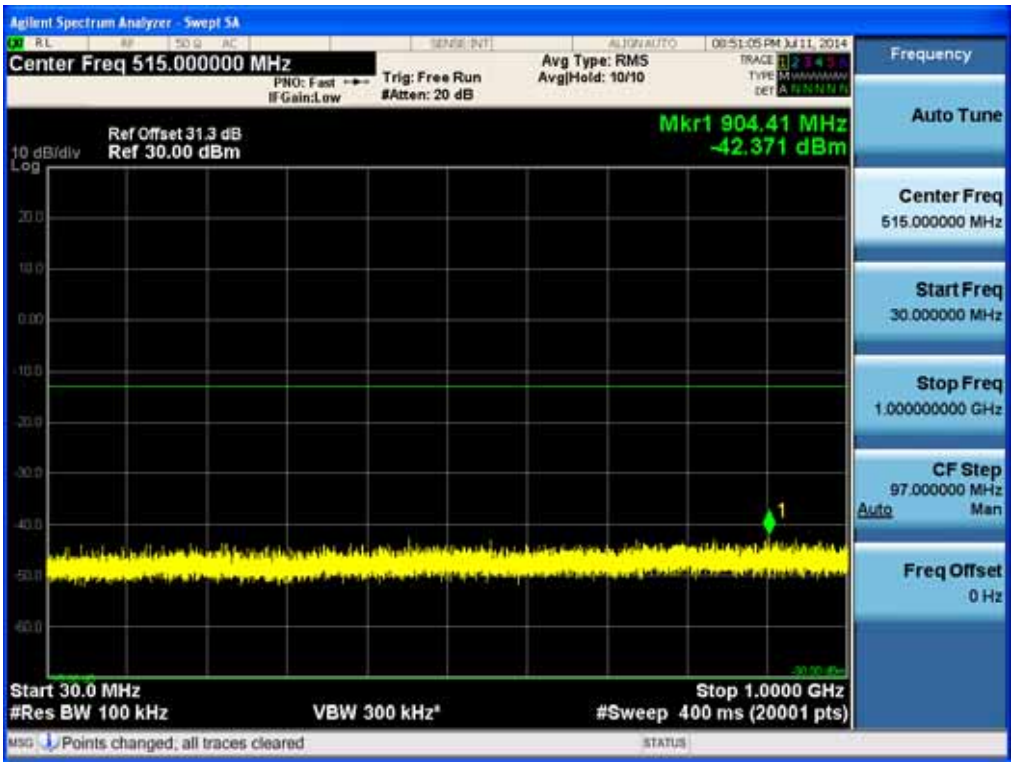
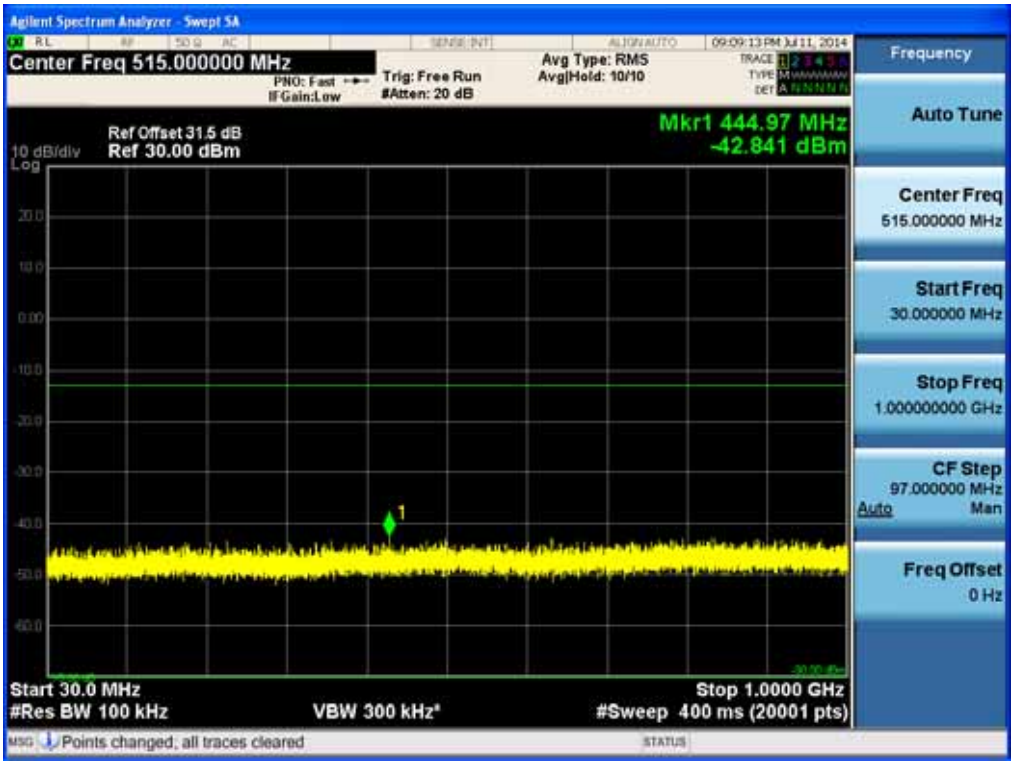


[LTE Downlink High]

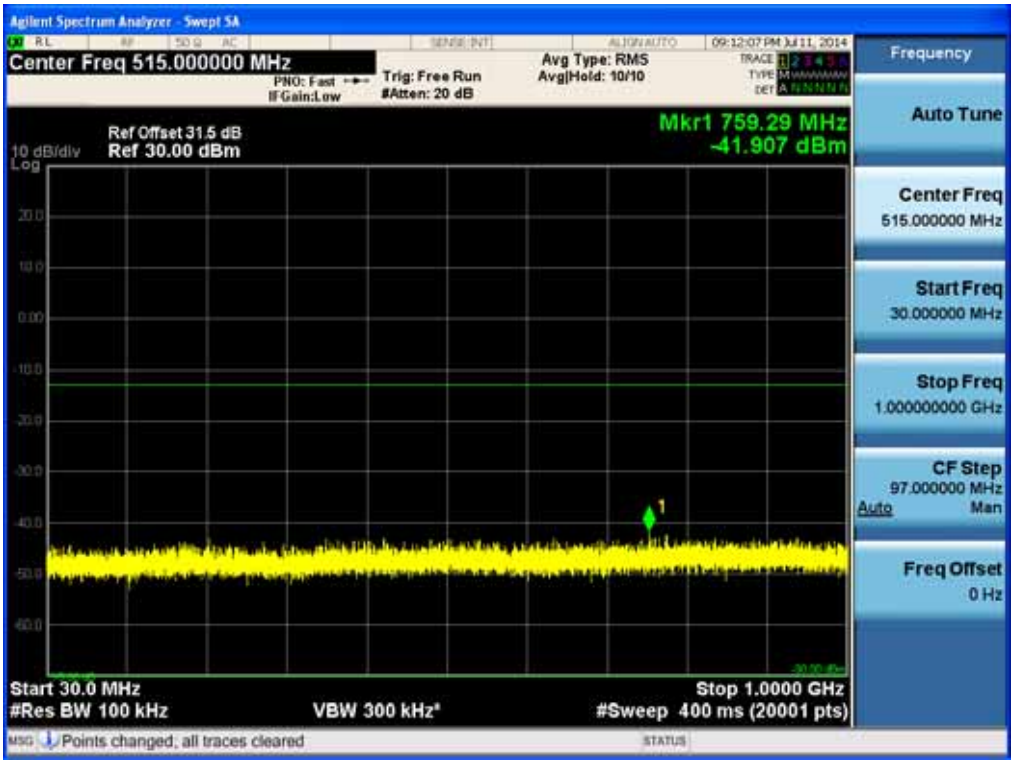


[AWS Downlink]

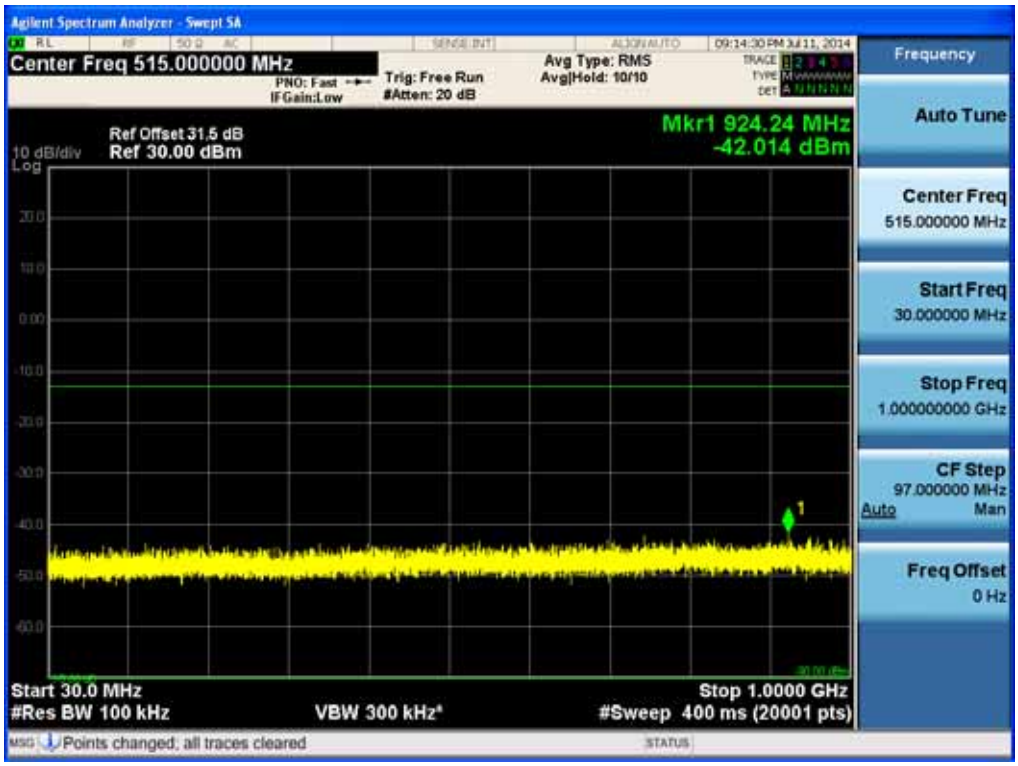
[LTE Downlink Low]



[LTE Downlink Middle]



[LTE Downlink High]



Conducted Spurious Emissions (1 GHz –26.5 GHz)
[PCS Downlink]

[LTE Downlink Low]

[LTE Downlink Middle]

[LTE Downlink High]

[AWS Downlink]

[LTE Downlink Low]

[LTE Downlink Middle]

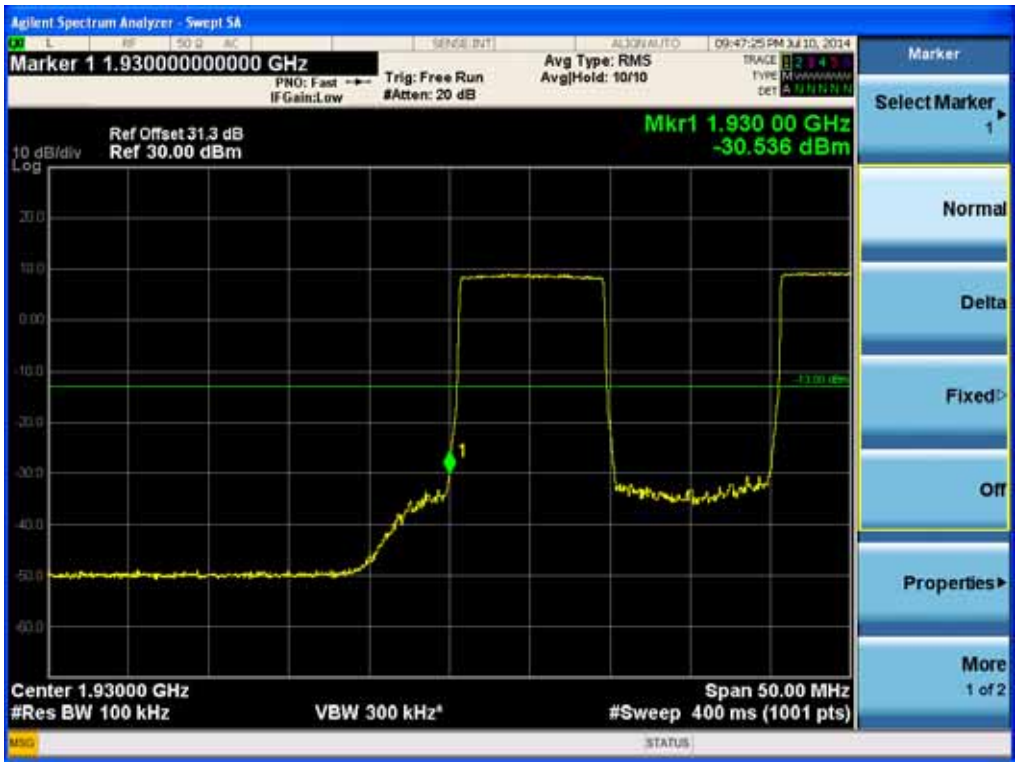
[LTE Downlink High]

Intermodulation Spurious Emissions for FCC
[PCS Downlink]

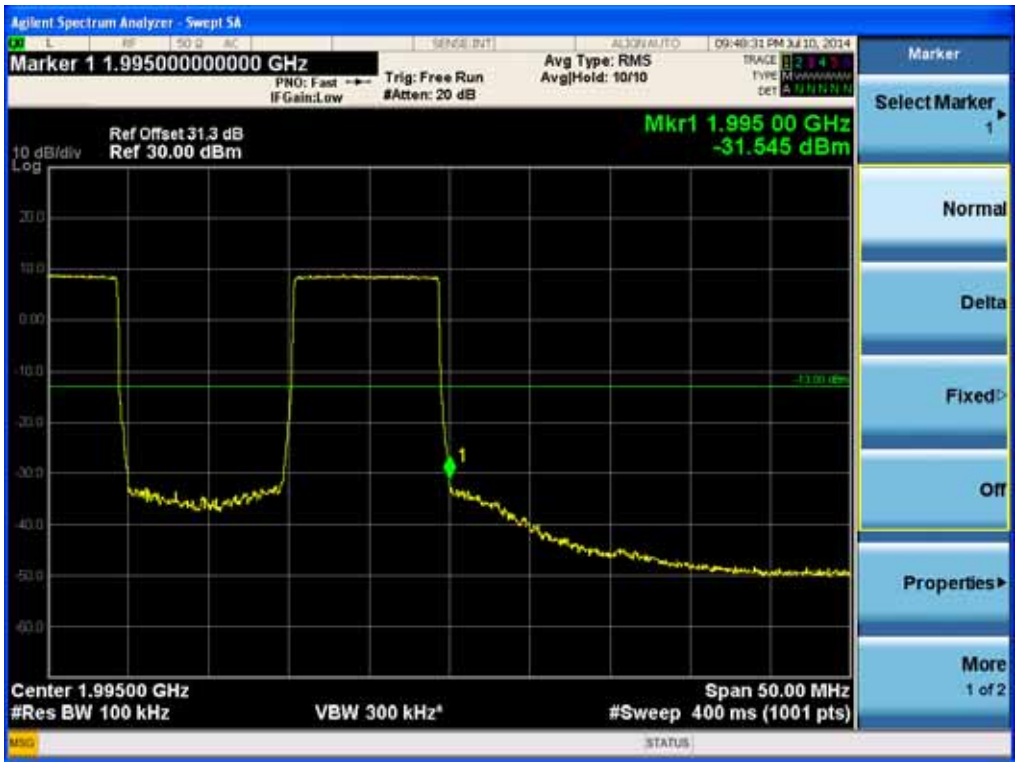
[LTE Downlink 5 MHz Low]

[LTE Downlink 5 MHz High]

[LTE Downlink 10 MHz Low]



[LTE Downlink 10 MHz High]



[AWS Downlink]

[LTE Downlink 5 MHz Low]

[LTE Downlink 5 MHz High]

[LTE Downlink 10 MHz Low]

[LTE Downlink 10 MHz High]

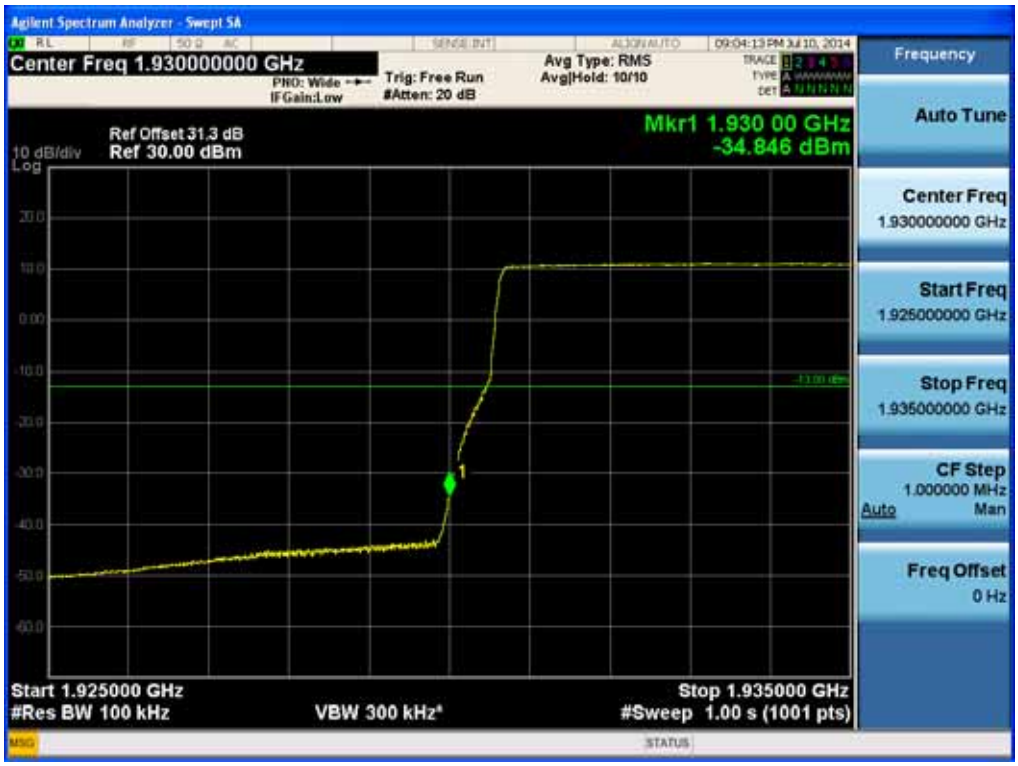
Single channel Enhancer Band Edge

[PCS Downlink]

[LTE Downlink 5 MHz Low]

[LTE Downlink 5 MHz High]

[LTE Downlink 10 MHz Low]



[LTE Downlink 10 MHz High]

[AWS Downlink]

[LTE Downlink 5 MHz Low]

[LTE Downlink 5 MHz High]

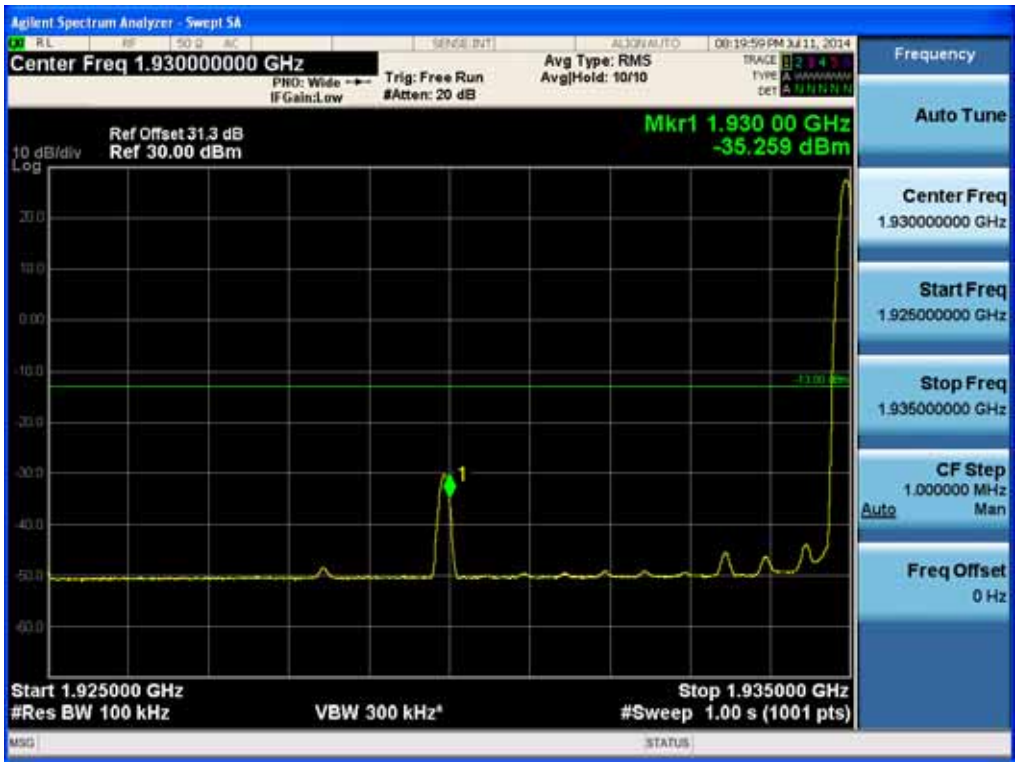
[LTE Downlink 10 MHz Low]

[LTE Downlink 10 MHz High]

Multi channel Enhancer Band Edge for IC

[PCS Downlink]

[LTE Downlink Low]



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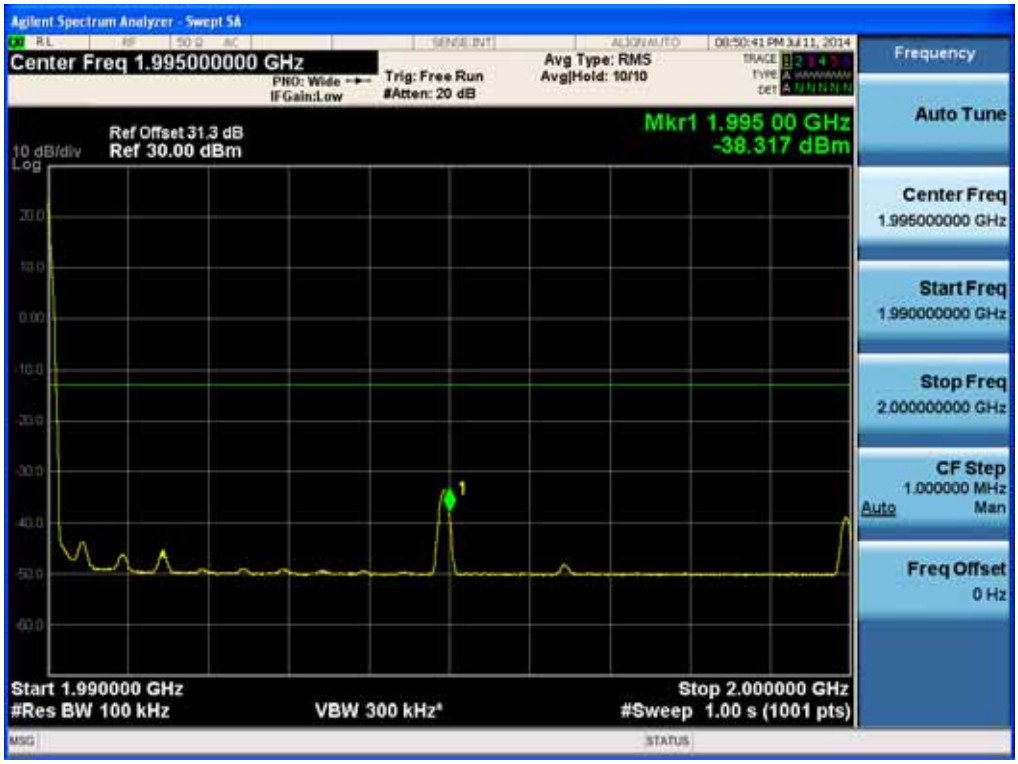
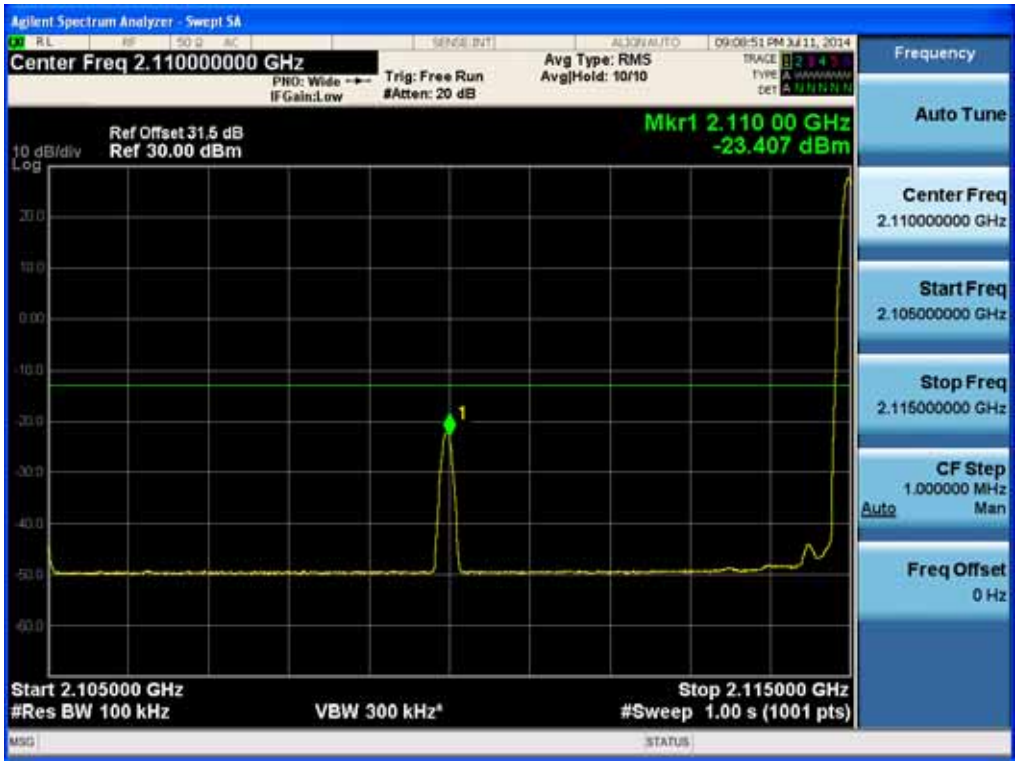
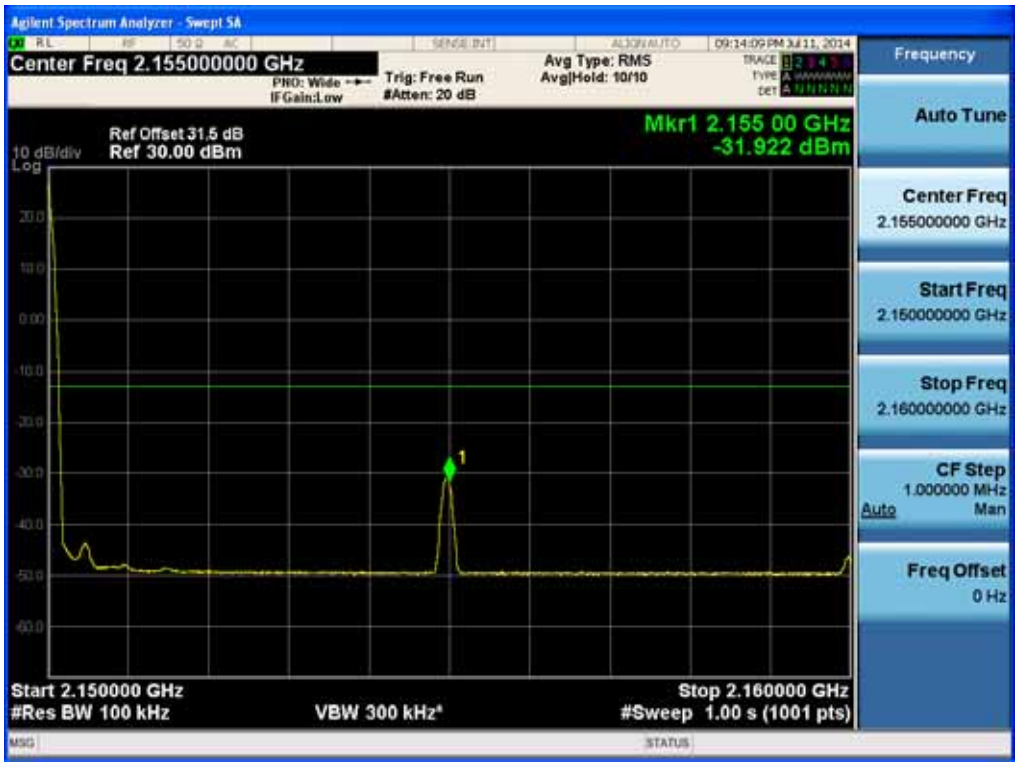


[AWS Downlink]

[LTE Downlink Low]



[LTE Downlink High]



10. RADIATED SPURIOUS EMISSIONS

Test Requirement(s): § 2.1053 Measurements required: Field strength of spurious radiation.

§ 2.1053 (a) Measurements shall be made to detect spurious emissions that may be Radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

§ 2.1053 (b): The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to The transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

Test Procedures: As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* were made in accordance with the procedures of ANSI/TIA-603-C-2004 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber. The EUT was set at a distance of 3m from the receiving antenna. The EUT's RF ports were terminated to 50ohm load. The EUT was set to transmit at the low, mid and high channels of

the transmitter frequency range at its maximum power level. The EUT was rotated about 360 and the receiving antenna scanned from 1-3m in order to capture the maximum emission. A calibrated antenna source was positioned in place of the EUT and the previously recorded signal was duplicated. The maximum EIRP of the emission was calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps were carried. out with the receiving antenna in both vertical and horizontal polarization. Harmonic emissions up to the 10th or 40GHz, whichever was the lesser, were investigated.

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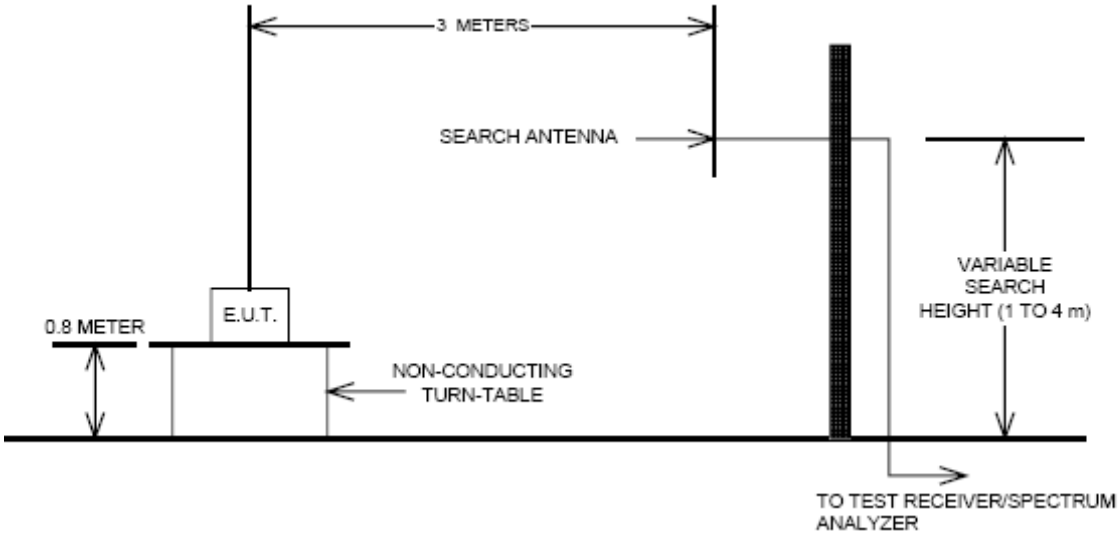
Radiated Spurious Emissions Test Setup



Test Result:

PCS

[Downlink]

Voltage supplied to EUT	Tx Freq.(MHz)	Freq.(MHz)	Substitute Level [dBm]	Ant. Gain (dBi)	C.L	Pol.	EIRP (dBm)	Margin (dB)
120 Vac	1932.5	3865	-45.67	12.62	7.89	H	-41.47	28.47
	1962.5	3925	-46.32	12.67	7.97	H	-42.22	29.22
	1992.5	3985	-46.94	12.72	8.69	H	-42.94	29.94

PCS

[Downlink]

Voltage supplied to EUT	Tx Freq.(MHz)	Freq.(MHz)	Substitute Level [dBm]	Ant. Gain (dBi)	C.L	Pol.	EIRP (dBm)	Margin (dB)
-48 Vdc	1932.5	3865	-44.92	12.62	7.89	H	-40.72	27.72
	1962.5	3925	-45.84	12.67	7.97	H	-41.74	28.74
	1992.5	3985	-46.27	12.72	8.69	H	-42.27	29.27

AWS

[Downlink]

Voltage supplied to EUT	Tx Freq.(MHz)	Freq.(MHz)	Substitute Level [dBm]	Ant. Gain (dBi)	C.L	Pol.	EIRP (dBm)	Margin (dB)
120 Vac	2112.5	4225	-45.92	12.73	8.72	H	-41.90	28.90
	2132.5	4265	-46.46	12.74	8.71	H	-42.44	29.44
	2152.5	4305	-46.93	12.74	8.71	H	-42.90	29.90

AWS

[Downlink]

Voltage supplied to EUT	Tx Freq.(MHz)	Freq.(MHz)	Substitute Level [dBm]	Ant. Gain (dBi)	C.L	Pol.	EIRP (dBm)	Margin (dB)
-48 Vdc	2112.5	4225	-45.35	12.73	8.72	H	-41.33	28.33
	2132.5	4265	-46.10	12.74	8.71	H	-42.08	29.08
	2152.5	4305	-46.52	12.74	8.71	H	-42.49	29.49

* Note

RDU 1900P+AWS-1_R data, reference to the Test Report No. : E126R-006.

The RDU 1900P+AWS-1_R results margin of more than 40 dB.

Therefore, it does not provide a result of the sum.

11. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

FCC Rules

Test Requirement(s): §2.1055(a)(1), § 24.235, § 27.54

Test Procedures:

As required by 47 CFR 2.1055, *Frequency Stability measurements* were made at the RF output terminals using a Spectrum Analyzer.

The EUT was placed in the Environmental Chamber.

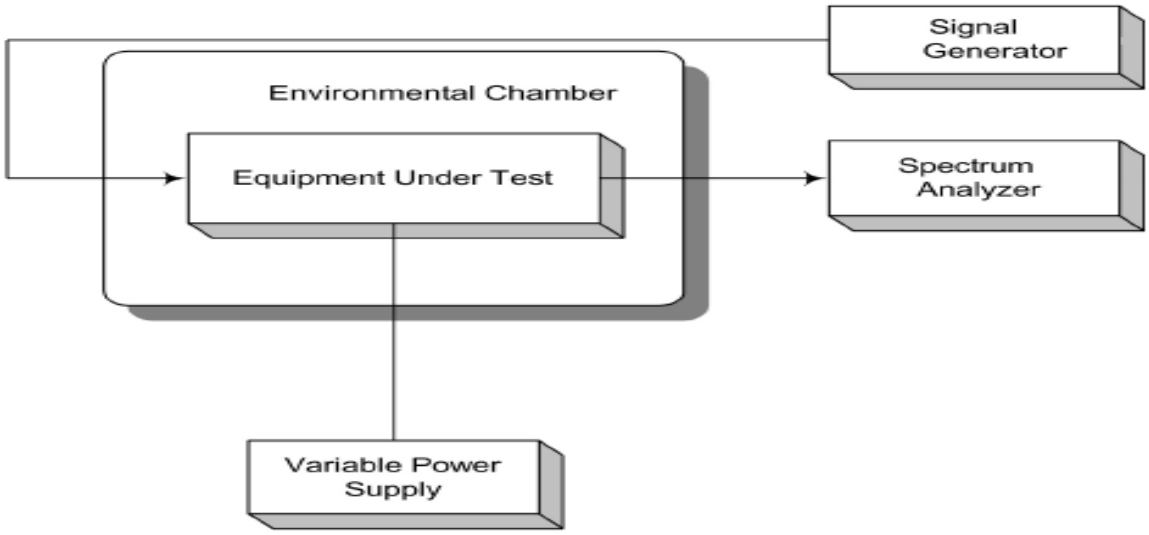
A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations.

The frequency drift was investigated for every 10 °C increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -30 to 50 °C.

Voltage supplied to EUT is 120 Vac & -48 Vdc, reference temperature was done at 20°C.

The voltage was varied by ± 15 % of nominal

Test Setup:



Test Results:

The E.U.T was found in compliance for Frequency Stability and Voltage Test

IC Rules

Test Requirement(s): RSS-131 6.5

A band translator is essentially a repeater station and should introduce as little frequency error as possible. The frequency stability should therefore meet the objectives of the overall land mobile or cellular service for which it serves. Better frequency stability than the minimum standard cited below will therefore be required in some cases.

The frequency stability shall be within 1.5 parts per million (0.00015%).

Test Procedures: RSS-131 4.5

In addition, the local oscillator frequency stability of the band translator shall be reported.

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

The following temperature and supply voltage ranges apply:

(a) at 10 degree intervals of temperatures between -30 °C and +50 °C, and at the manufacturer's rated-supply voltage; and

(b) at +20 °C temperature and 15% supply voltage variations.

Frequency Stability and Voltage Test Results

Reference: 120 Vac at 20°C **Freq.** = 1962.5 MHz

Voltage (%)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	1962499971. 9	-28.1	0.0	0.0000
	-30	1962499972. 3	-27.7	0.4	0.0002
	-20	1962499972. 2	-27.8	0.3	0.0002
	-10	1962499972. 1	-27.9	0.2	0.0001
	0	1962499972. 1	-27.9	0.2	0.0001
	+10	1962499972. 0	-28.0	0.1	0.0001
	+30	1962499971. 7	-28.3	-0.2	-0.0001
	+40	1962499971. 7	-28.3	-0.2	-0.0001
	+50	1962499971. 6	-28.4	-0.3	-0.0002
115%	+20	1962499971. 8	-28.2	-0.1	-0.0001
85%	+20	1962499971. 9	-28.1	0.0	0.0000

Reference: -48 Vdc at 20°C **Freq.** = 1962.5 MHz

Voltage (%)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	1962499975. 2	-24.8	0.0	0.0000
	-30	1962499974. 1	-25.9	-1.1	-0.0006
	-20	1962499974. 5	-25.5	-0.7	-0.0004
	-10	1962499974. 7	-25.3	-0.5	-0.0003
	0	1962499974. 9	-25.1	-0.3	-0.0002
	+10	1962499975. 1	-24.9	-0.1	-0.0001
	+30	1962499975. 2	-24.8	0.0	0.0000
	+40	1962499975. 2	-24.8	0.0	0.0000
	+50	1962499975. 3	-24.7	0.1	0.0001
115%	+20	1962499975. 1	-24.9	-0.1	-0.0001
85%	+20	1962499975. 2	-24.8	0.0	0.0000

Reference: 120 Vac at 20°C **Freq.** = 2132.5 MHz

Voltage (%)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	2132499986. 3	-13.7	0.0	0.0000
	-30	2132499986. 6	-13.4	0.3	0.0001
	-20	2132499986. 6	-13.4	0.3	0.0001
	-10	2132499986. 4	-13.6	0.1	0.0000
	0	2132499986. 4	-13.6	0.1	0.0000
	+10	2132499986. 3	-13.7	0.0	0.0000
	+30	2132499986. 3	-13.7	0.0	0.0000
	+40	2132499986. 3	-13.7	0.0	0.0000
	+50	2132499986. 2	-13.8	-0.1	0.0000
115%	+20	2132499986. 3	-13.7	0.0	0.0000
85%	+20	2132499986. 3	-13.7	0.0	0.0000

Reference: -48 Vdc at 20°C **Freq.** = 2132.5 MHz

Voltage (%)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	2132499987. 8	-12.2	0.0	0.0000
	-30	2132499987. 2	-12.8	-0.6	-0.0003
	-20	2132499987. 3	-12.7	-0.5	-0.0002
	-10	2132499987. 4	-12.6	-0.4	-0.0002
	0	2132499987. 6	-12.4	-0.2	-0.0001
	+10	2132499987. 7	-12.3	-0.1	0.0000
	+30	2132499987. 8	-12.2	0.0	0.0000
	+40	2132499987. 8	-12.2	0.0	0.0000
	+50	2132499987. 9	-12.1	0.1	0.0000
115%	+20	2132499987. 8	-12.2	0.0	0.0000
85%	+20	2132499987. 8	-12.2	0.0	0.0000