

7. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

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.

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 30 MHz 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.

Plots of Spurious Emission

Conducted Spurious Emissions (30 MHz – 1 GHz)

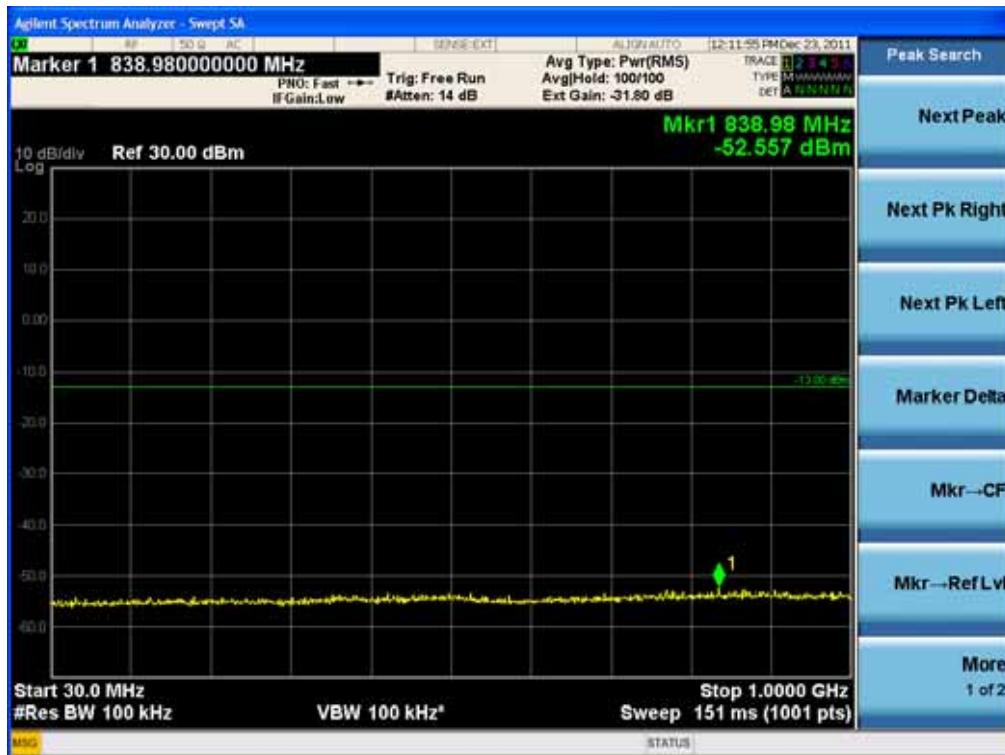
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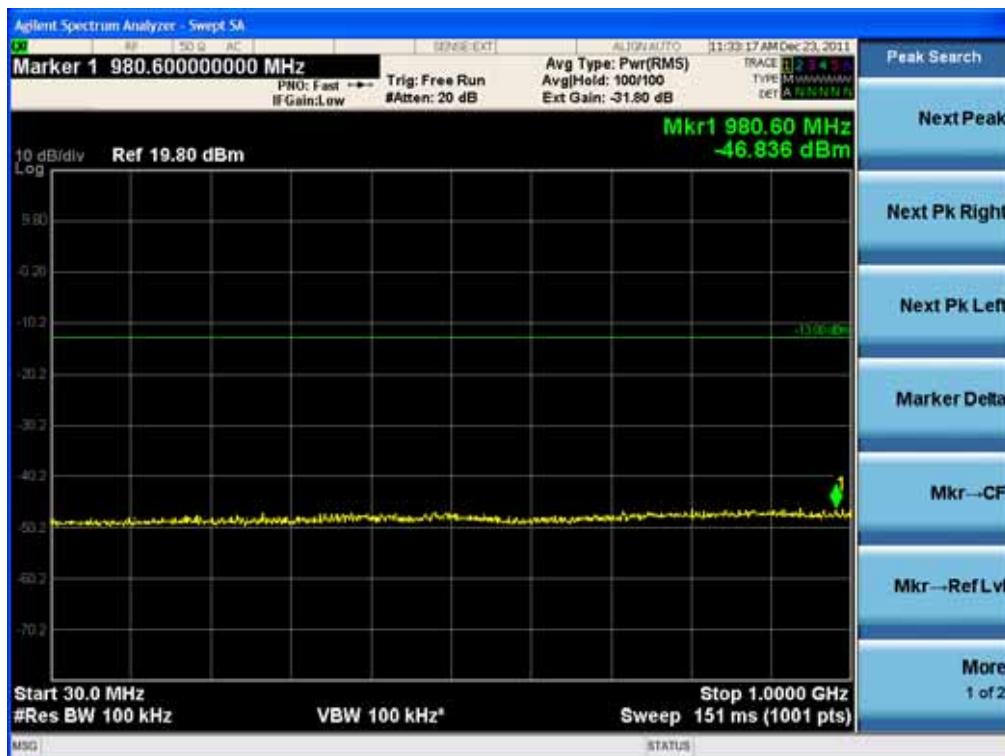
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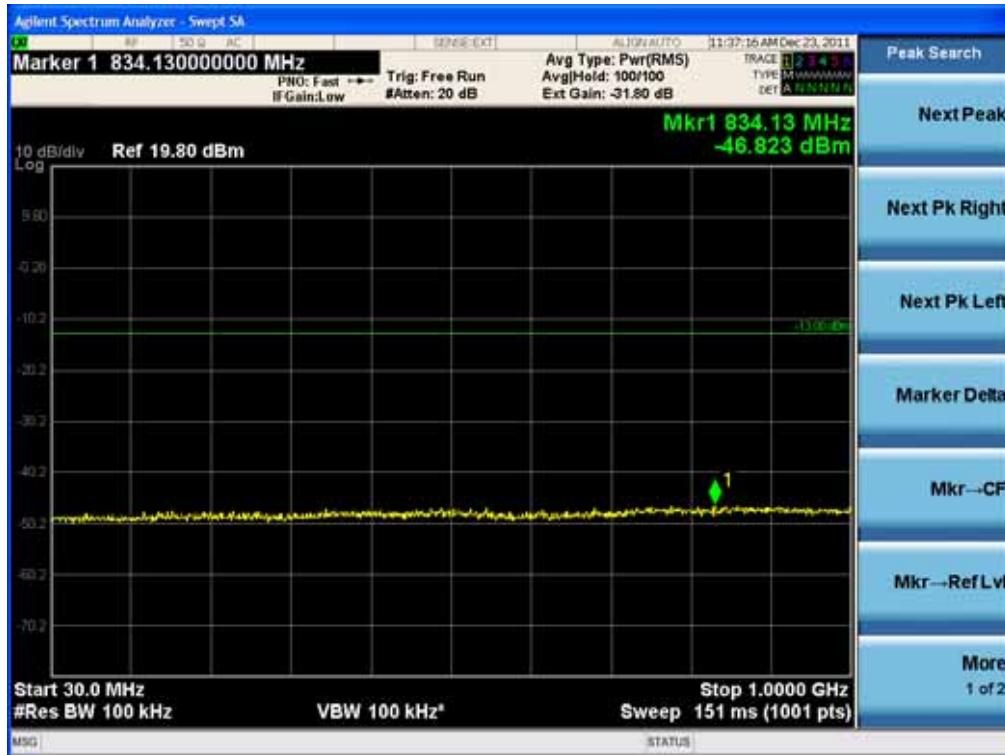
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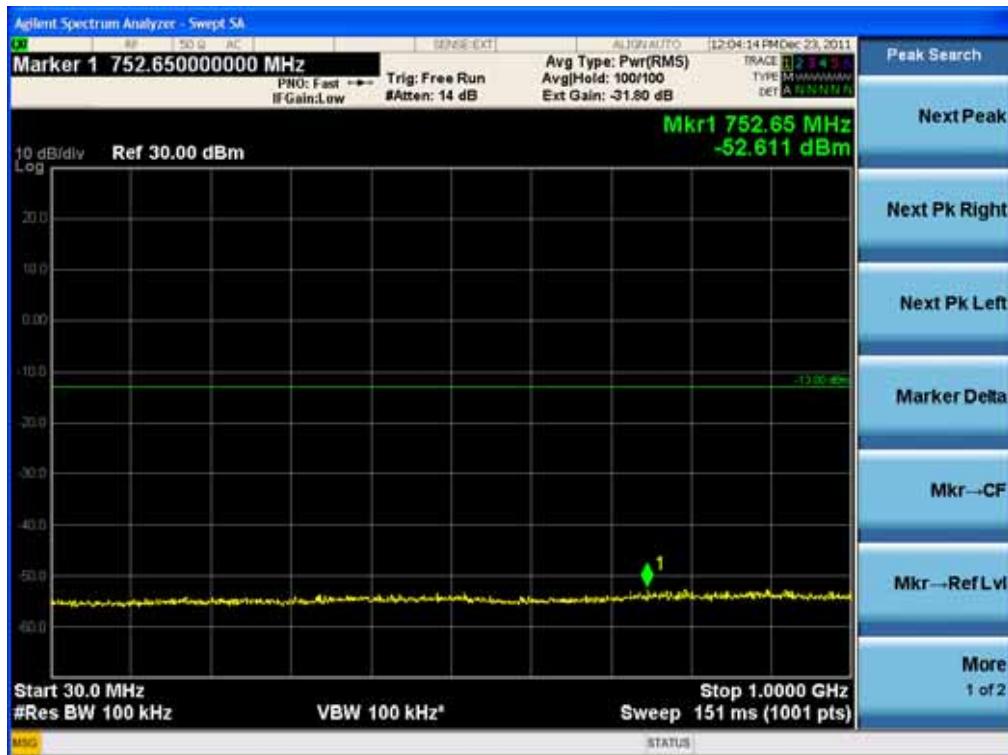
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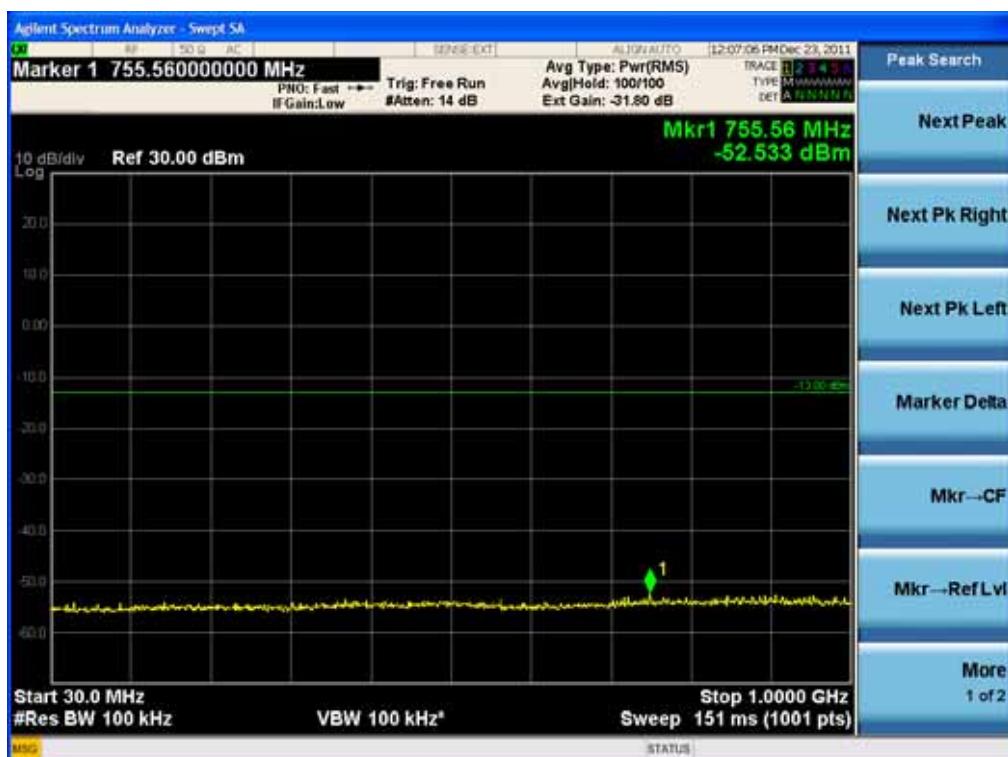
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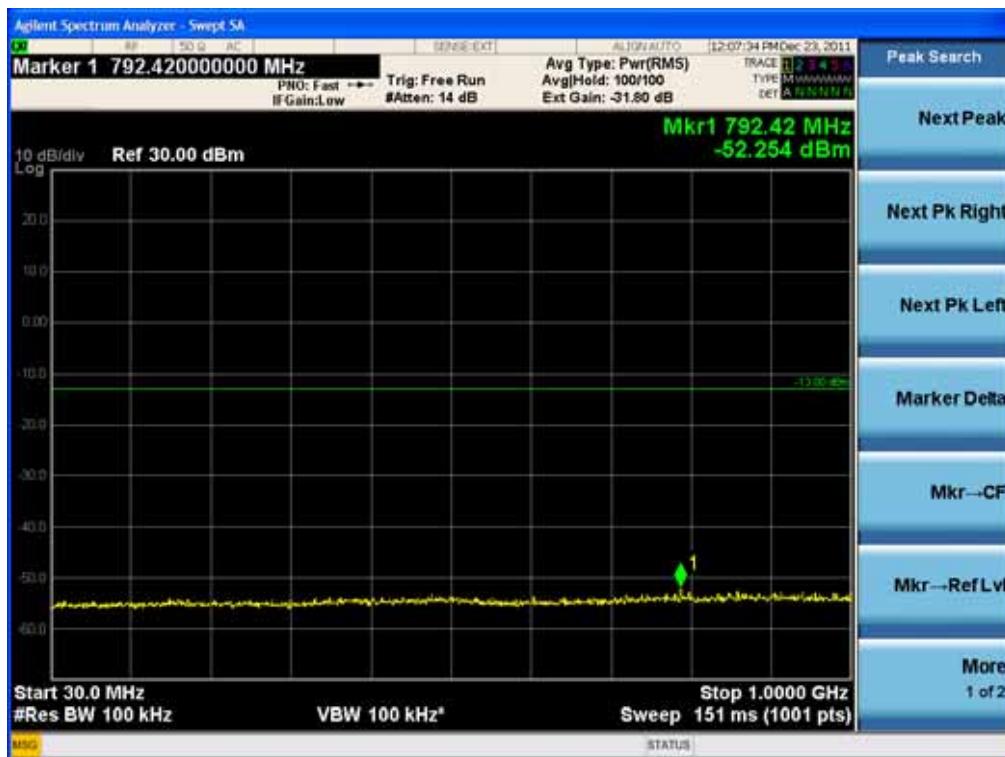
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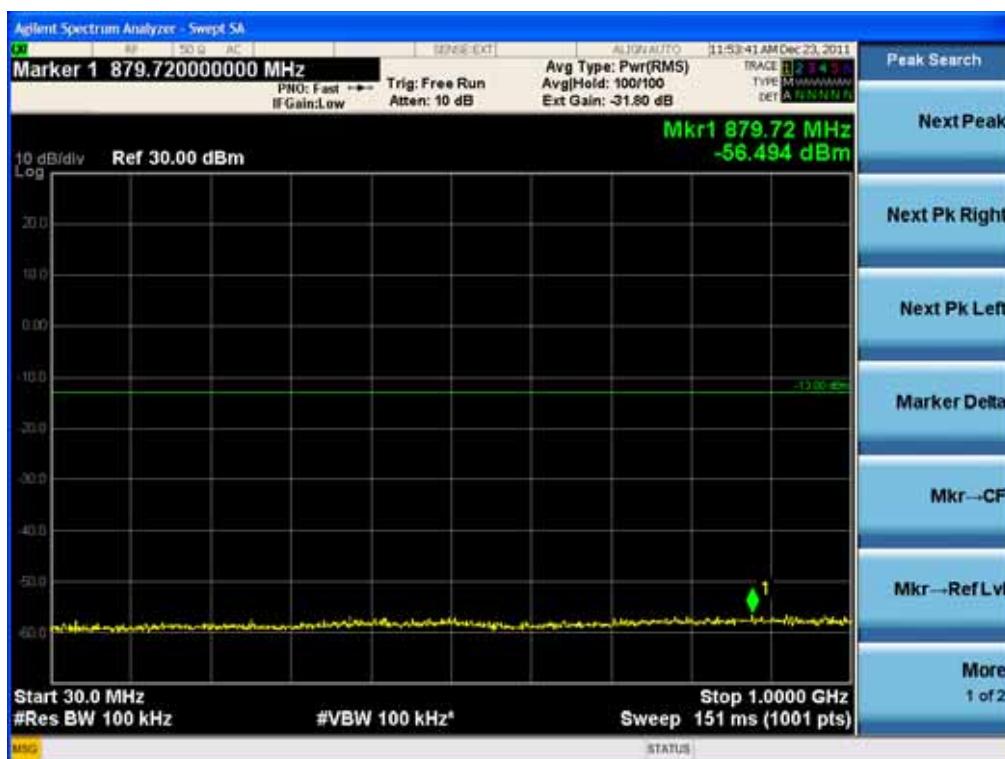
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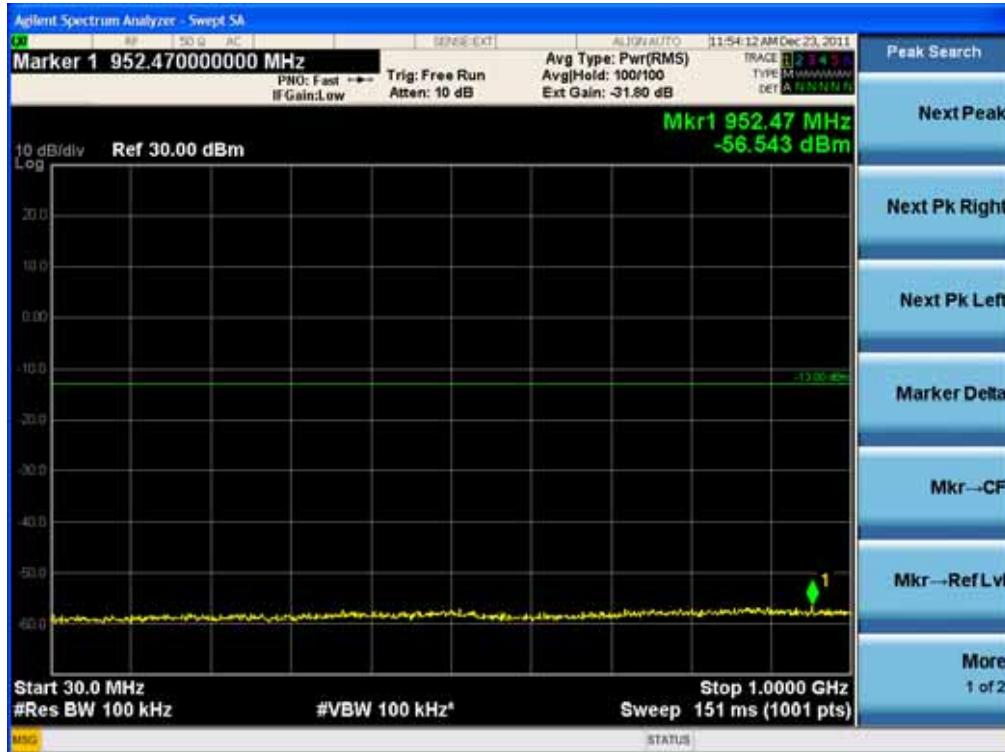
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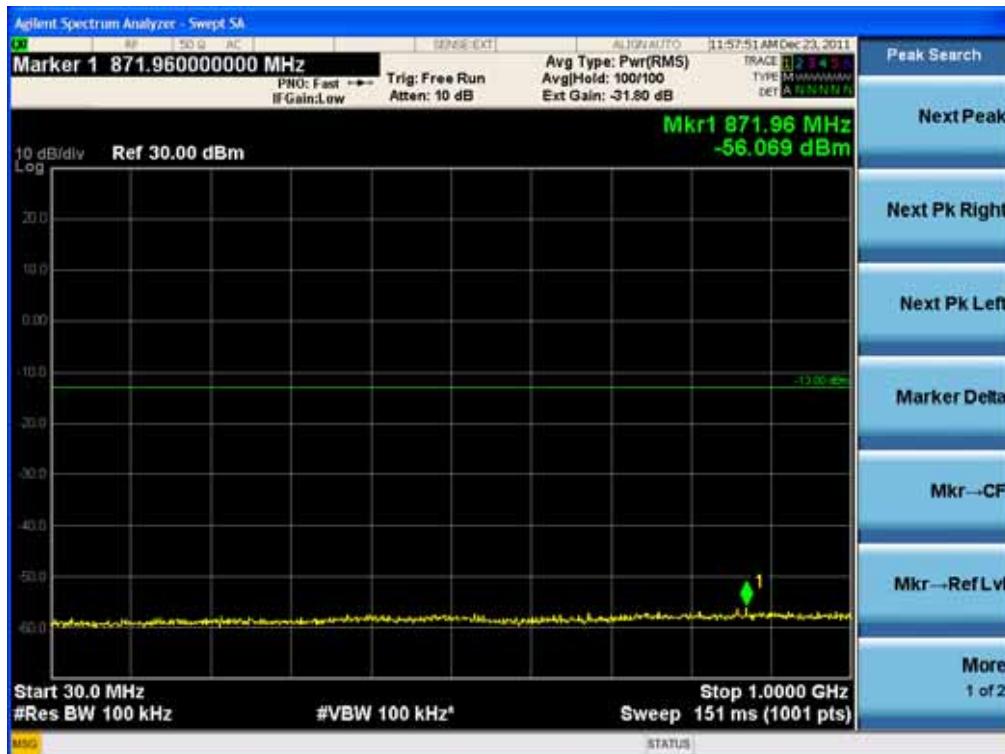
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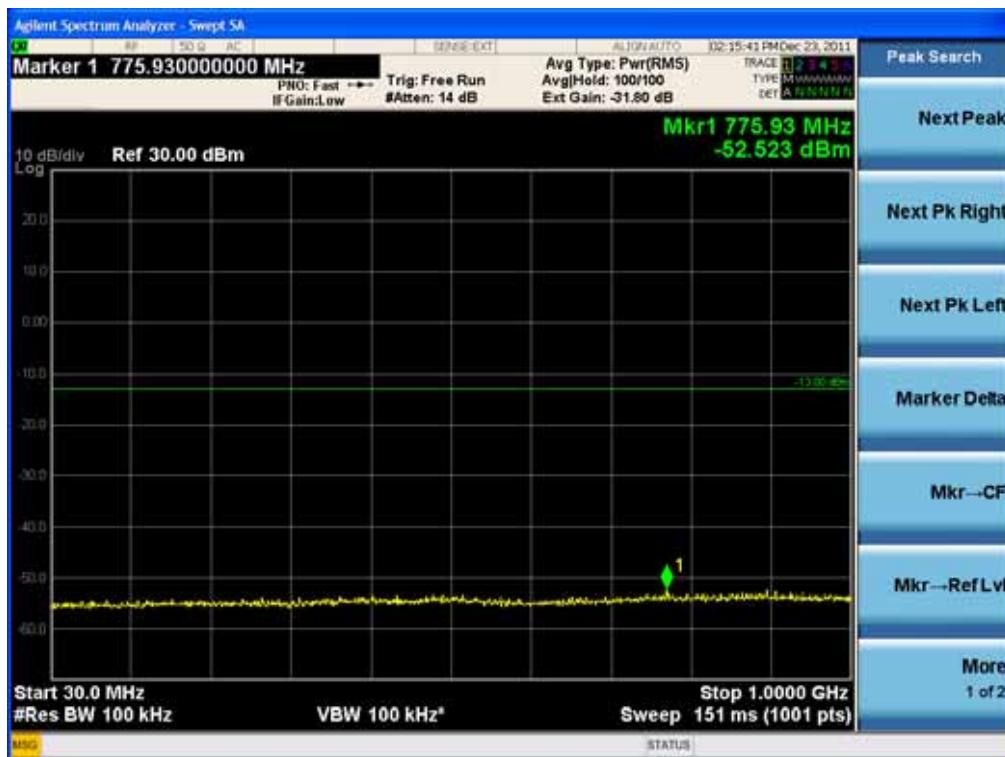
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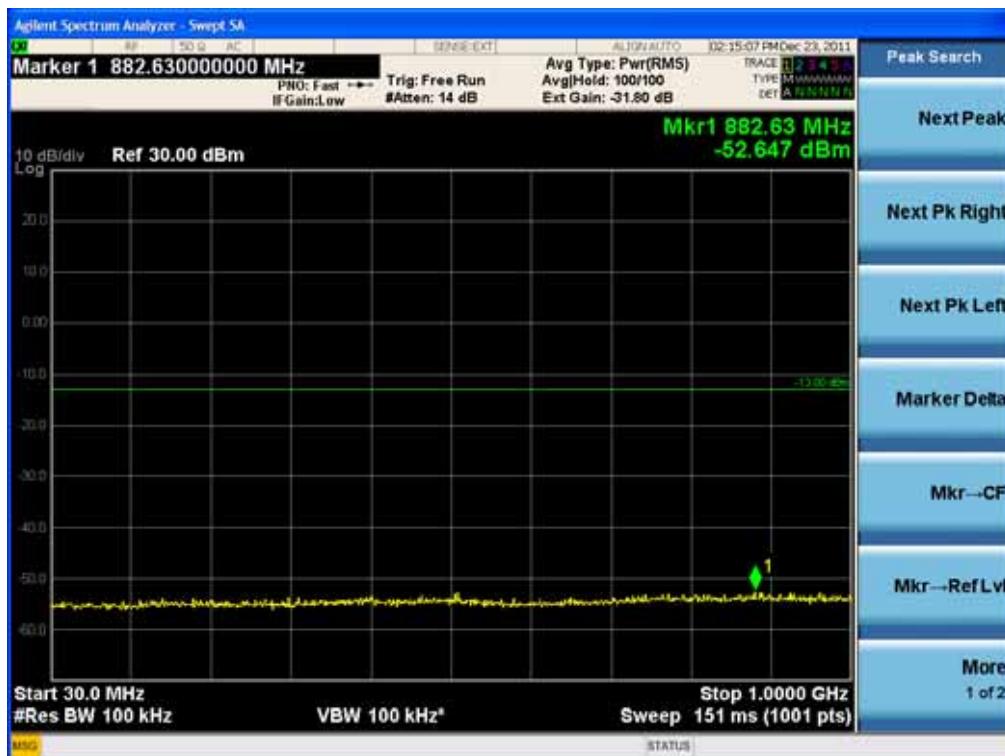
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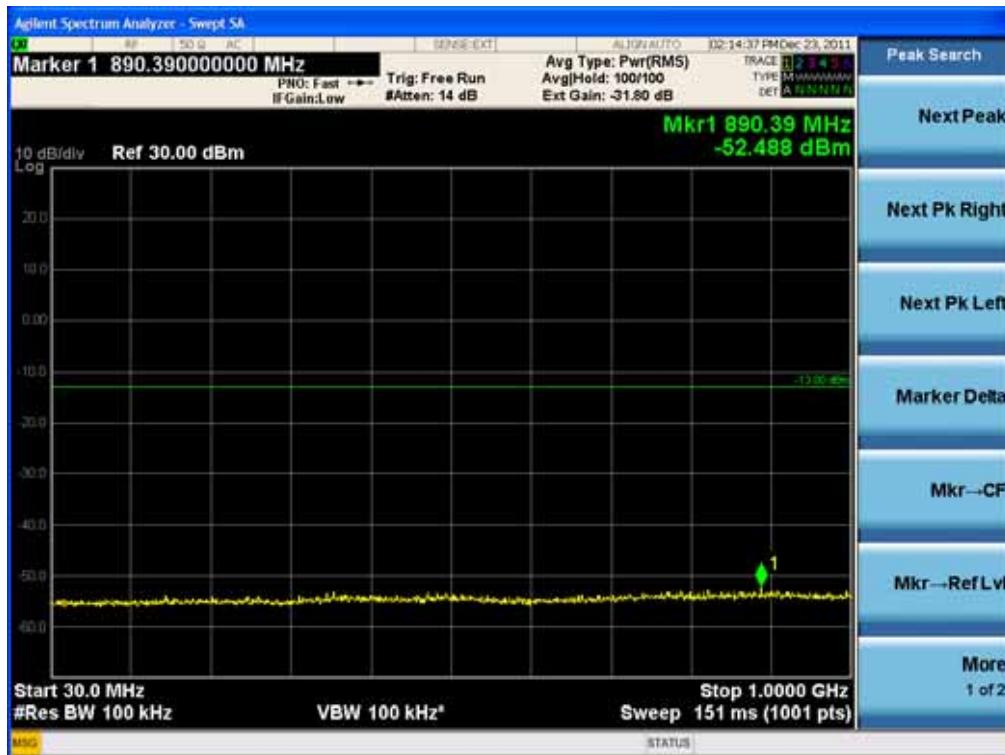
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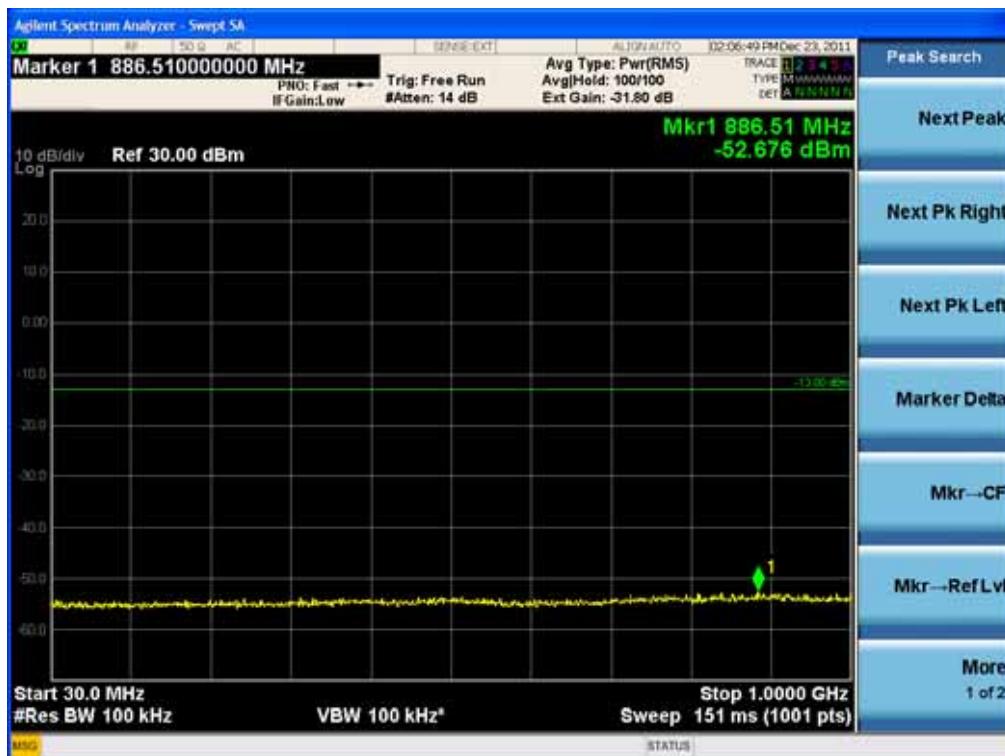
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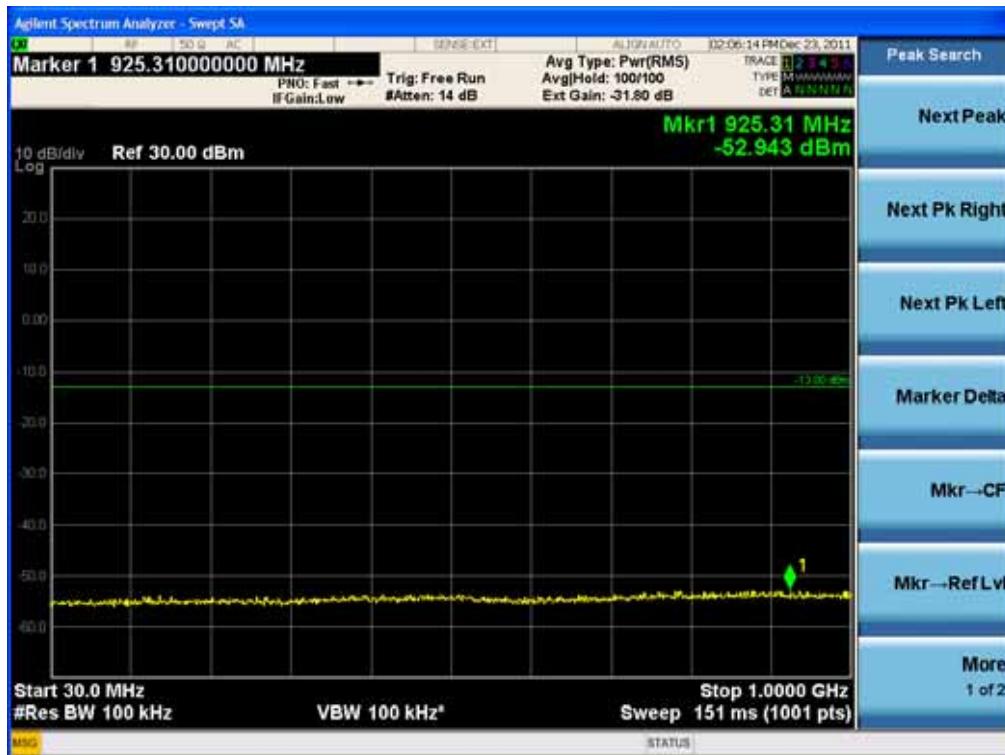
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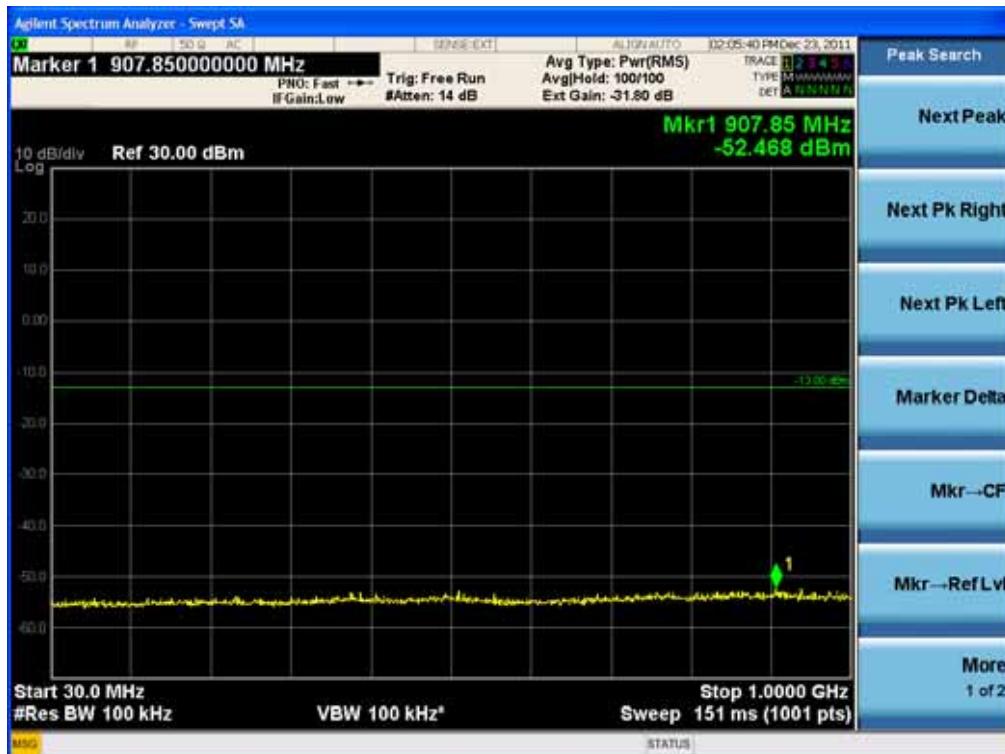
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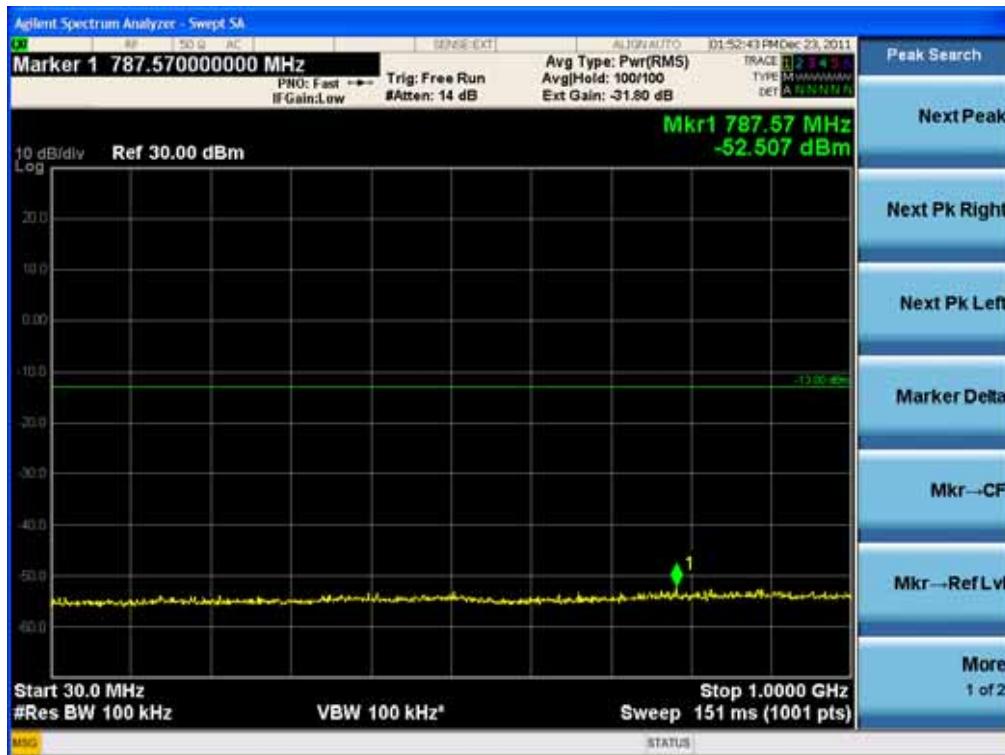
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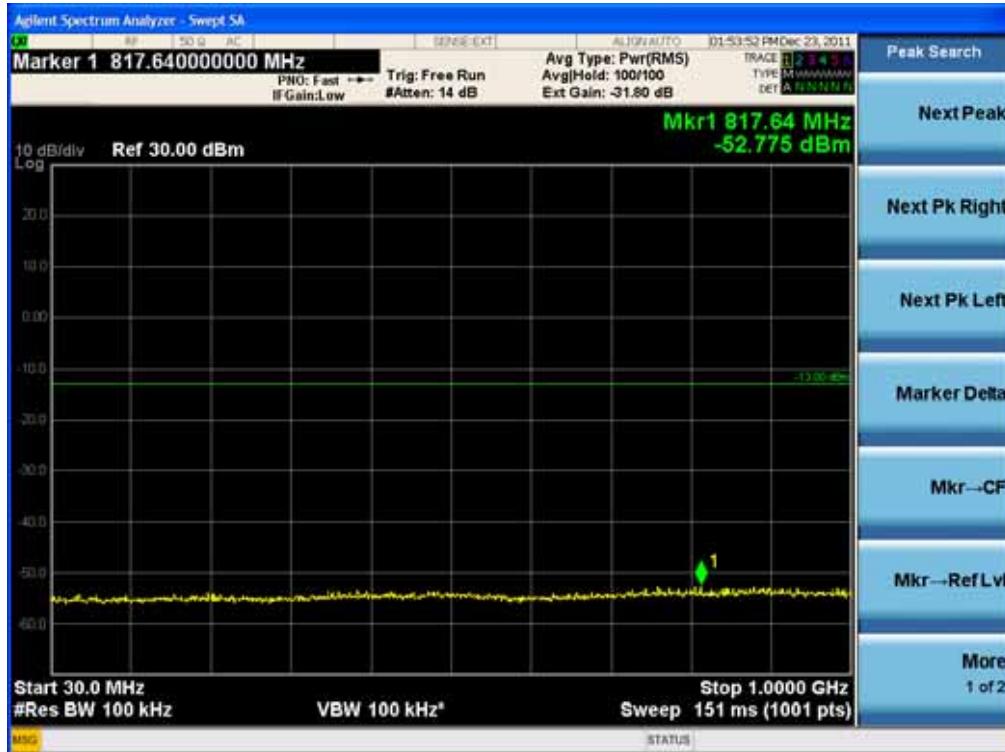
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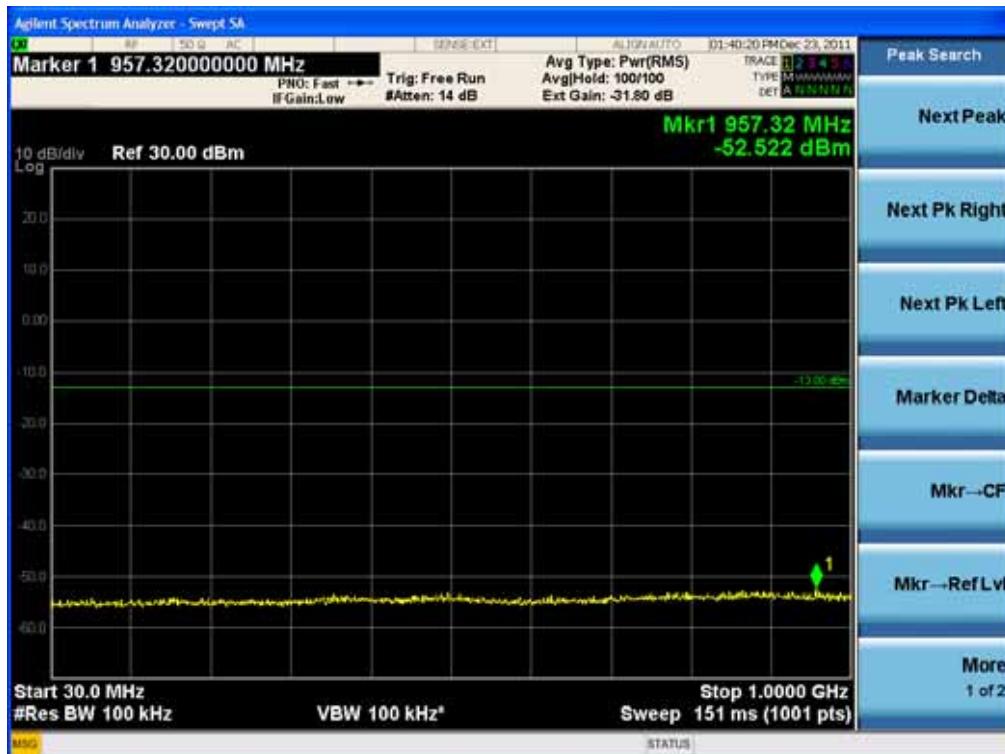
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Conducted Spurious Emissions (1 GHz –26.5 GHz)

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[CDMA Downlink Middle]



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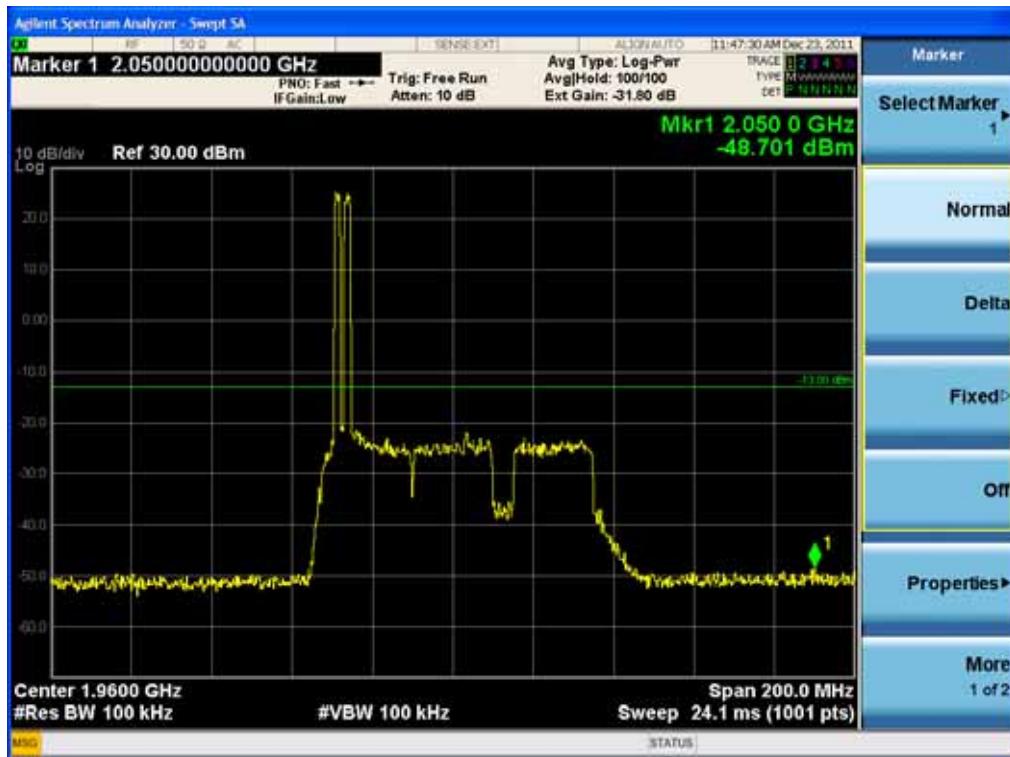


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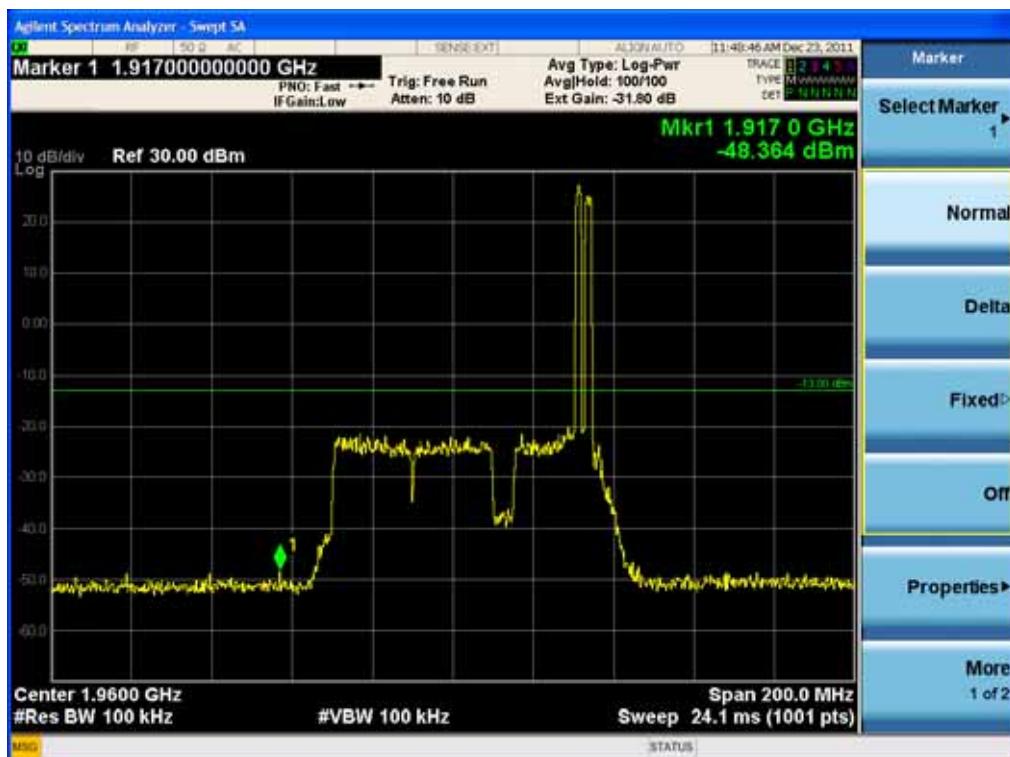


Intermodulation Spurious Emissions

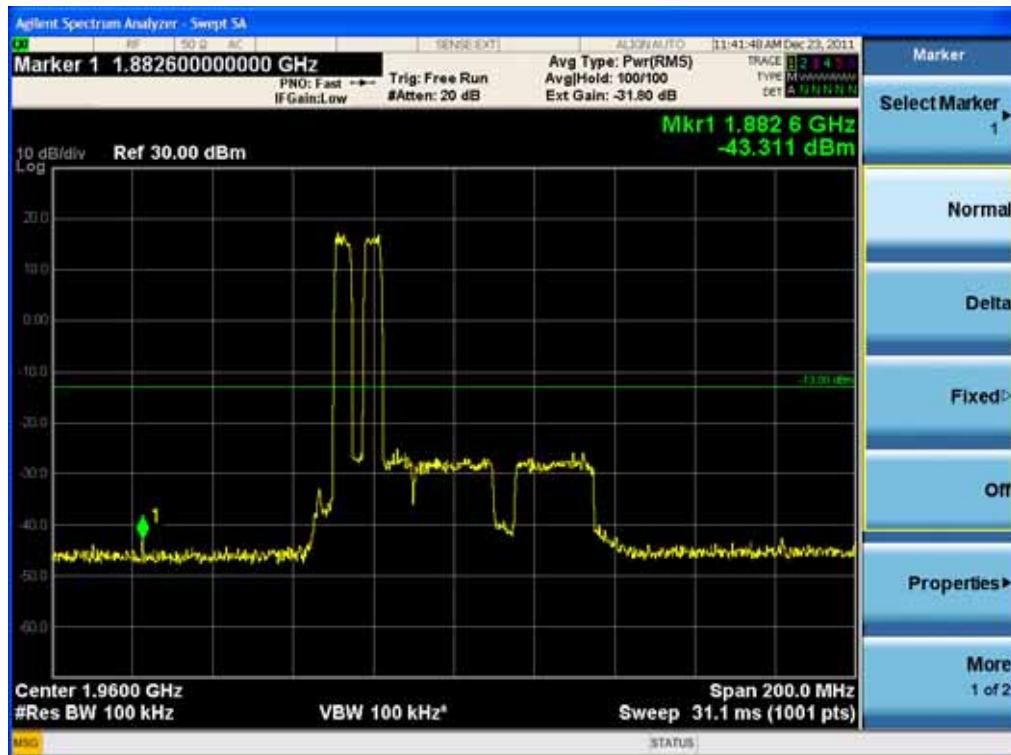
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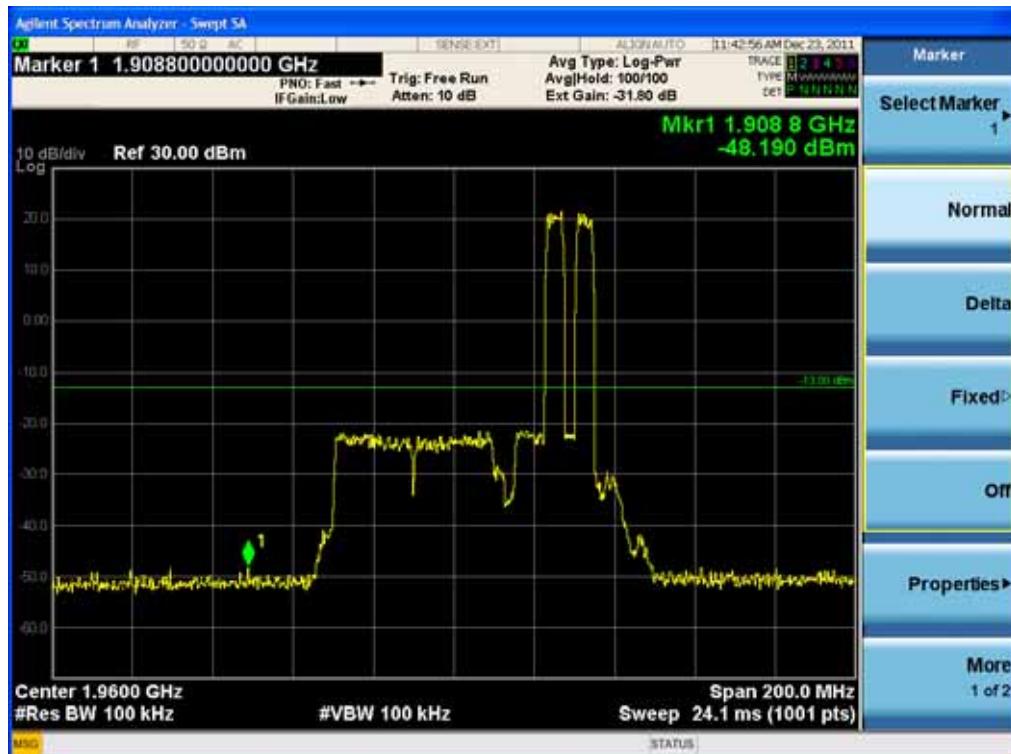
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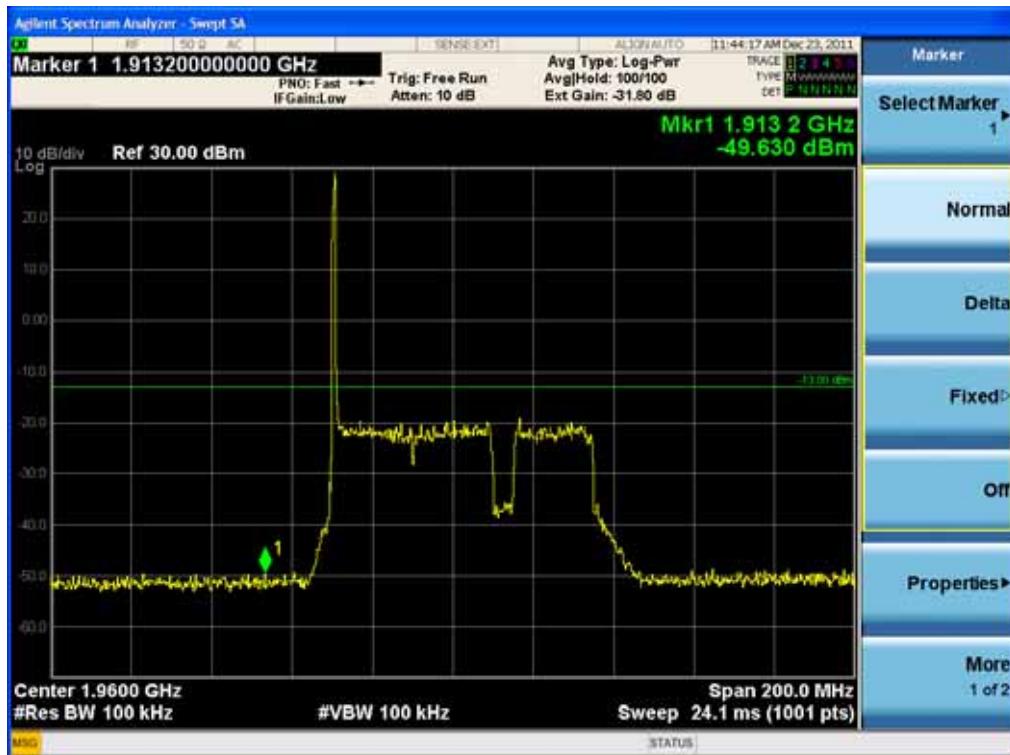
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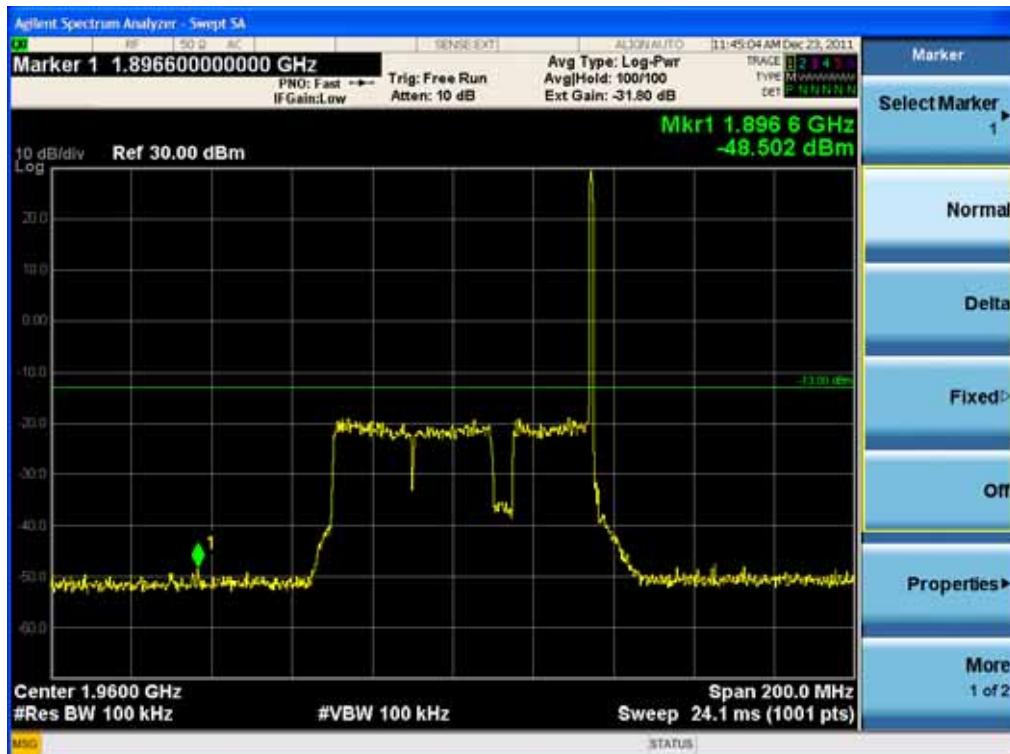
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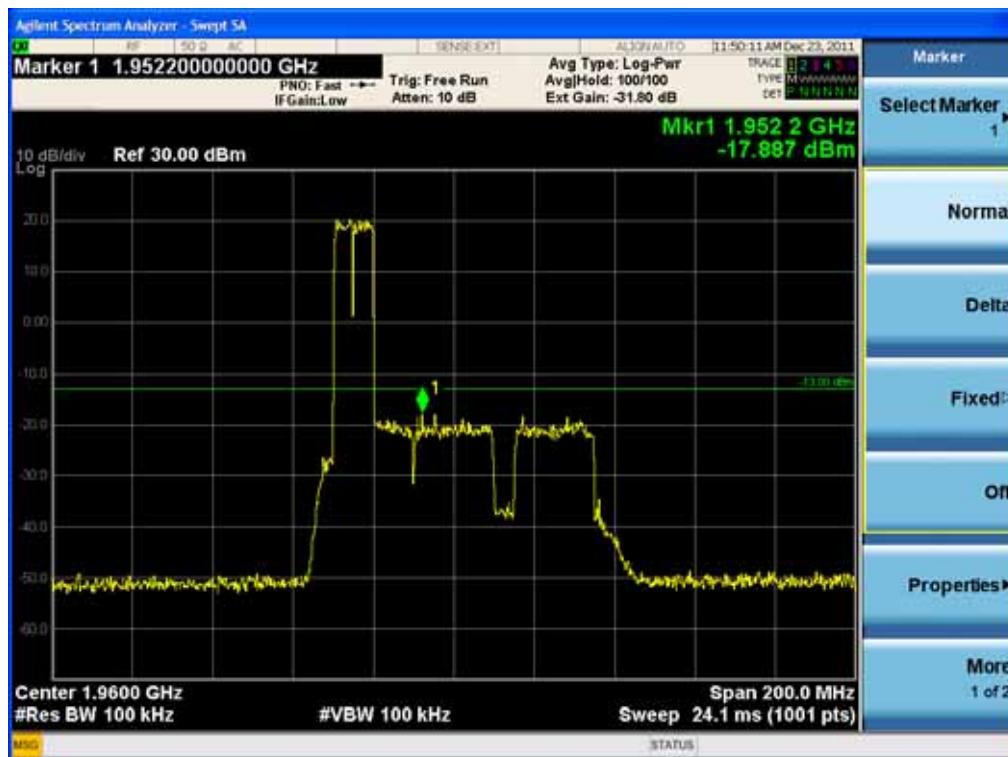
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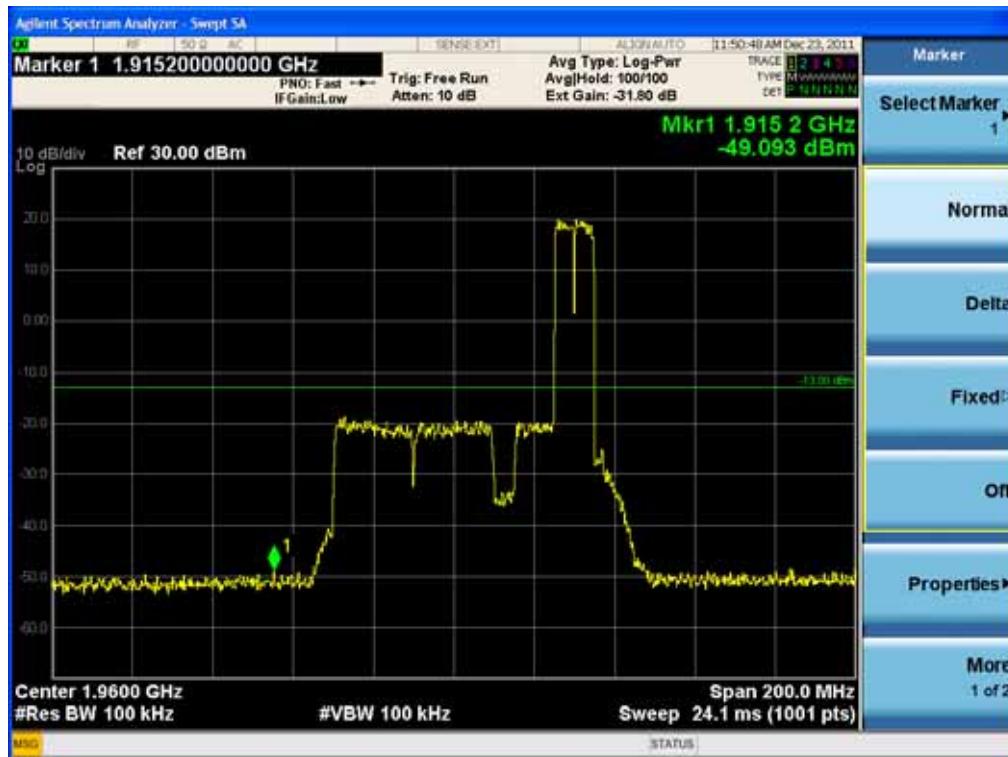
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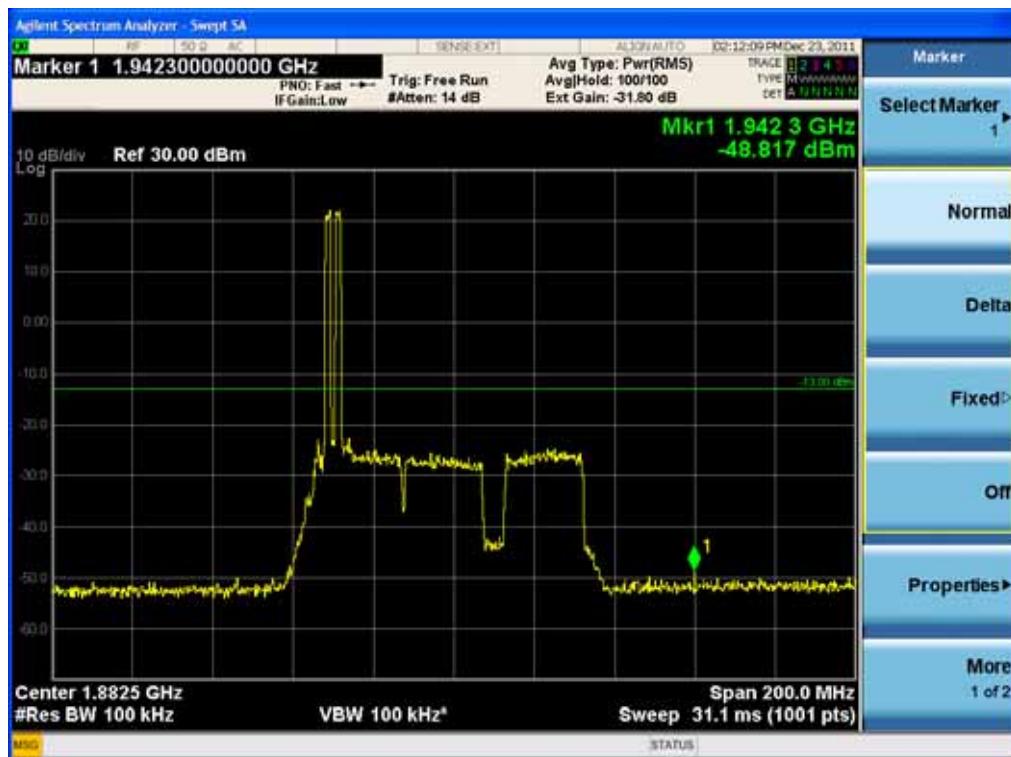
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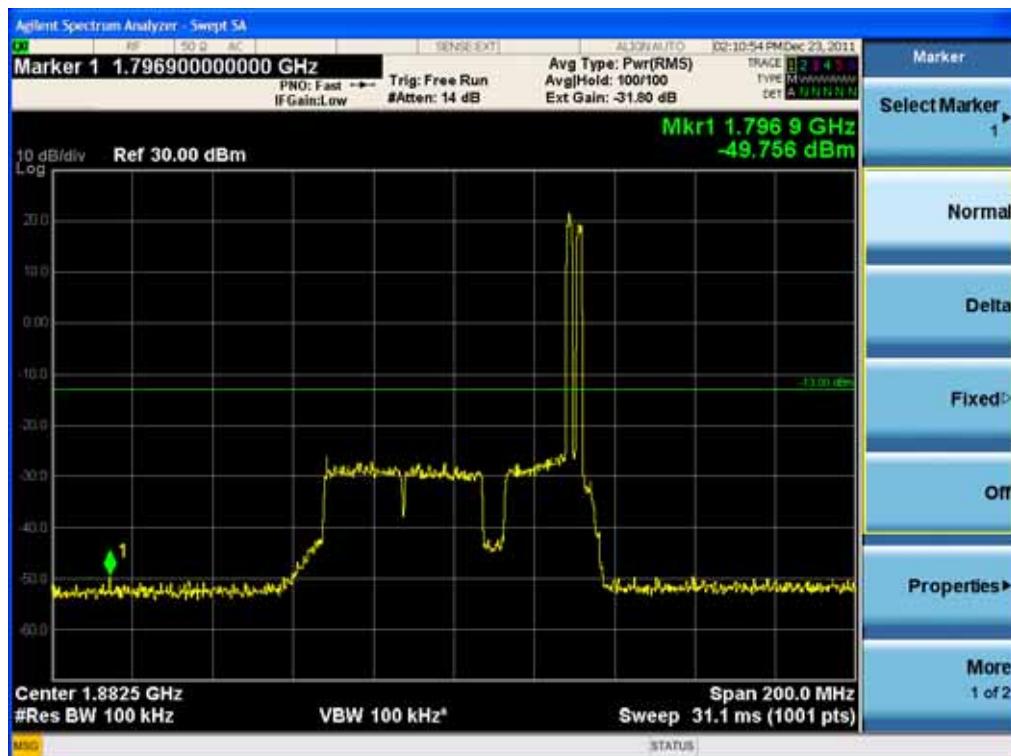
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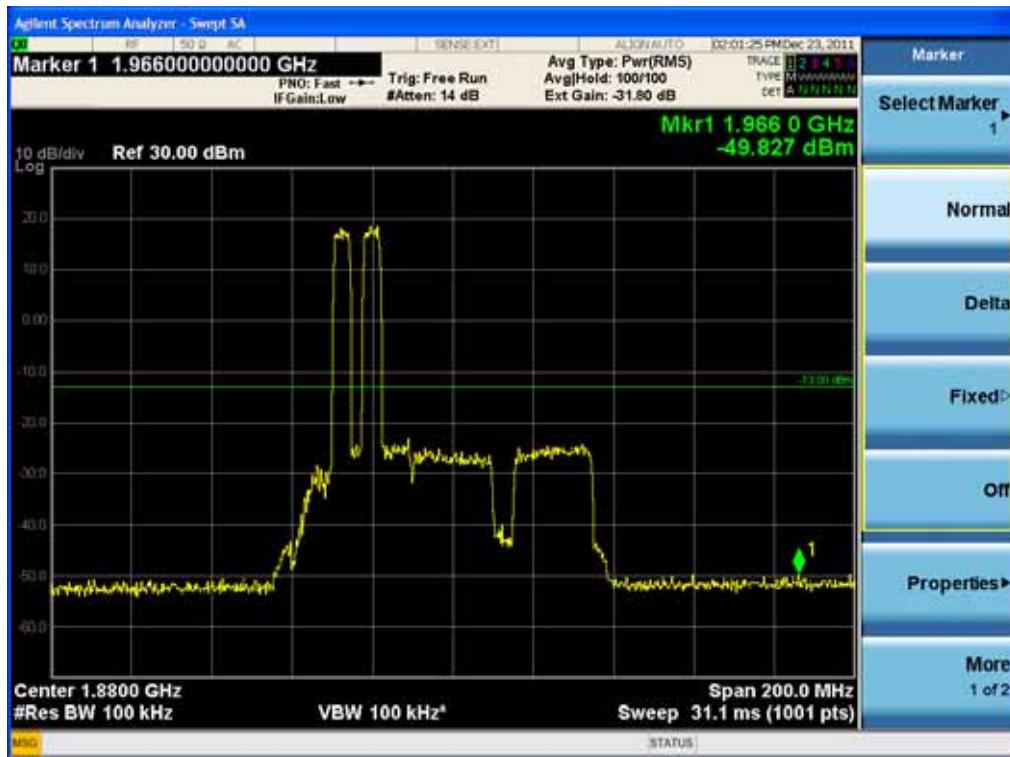
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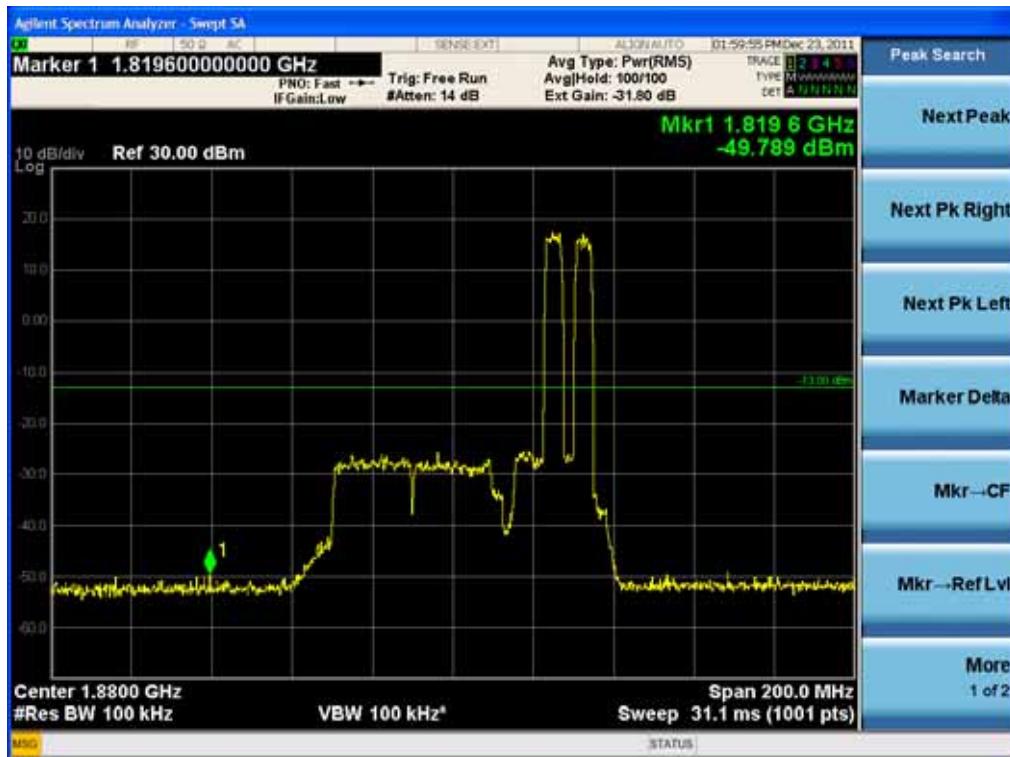
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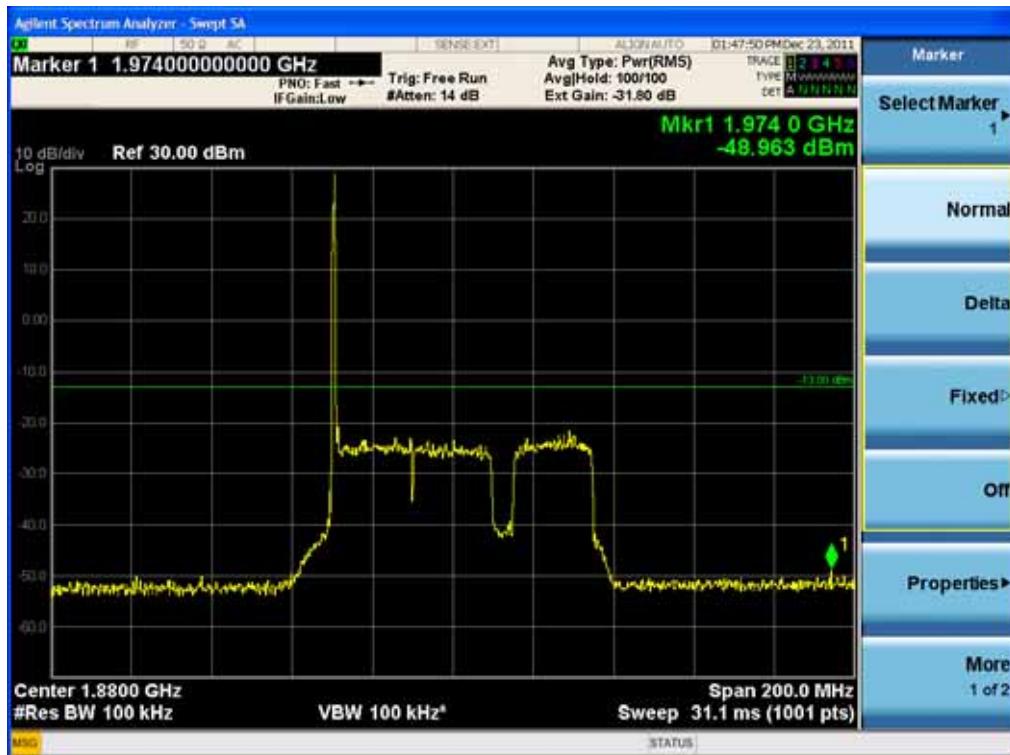
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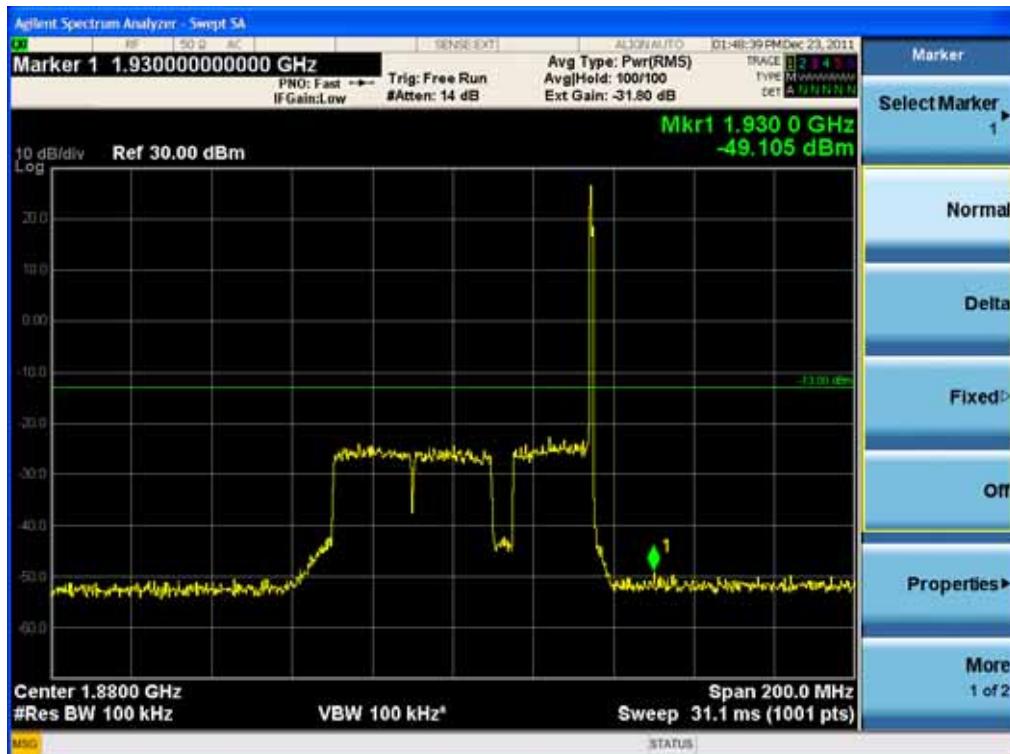
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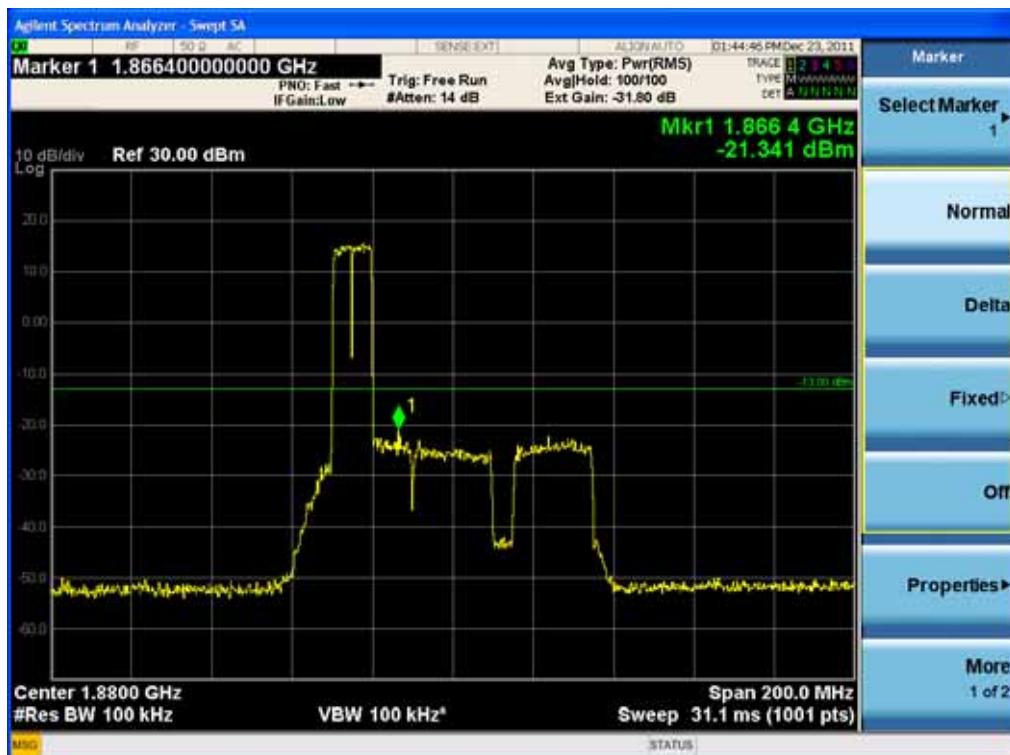
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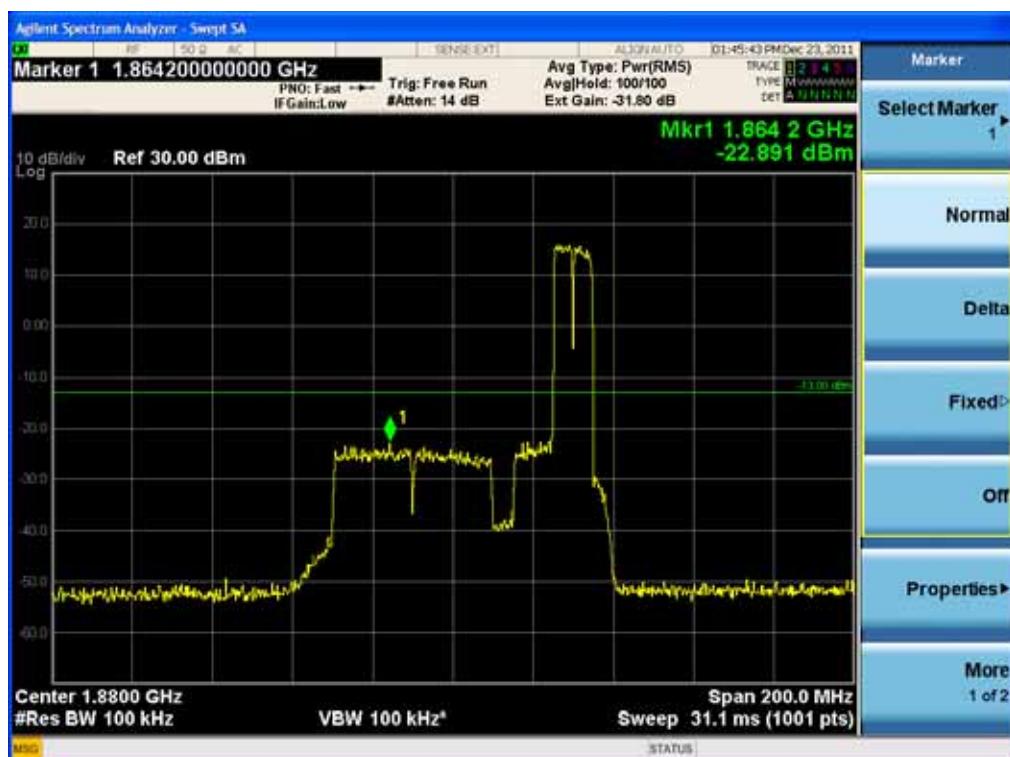
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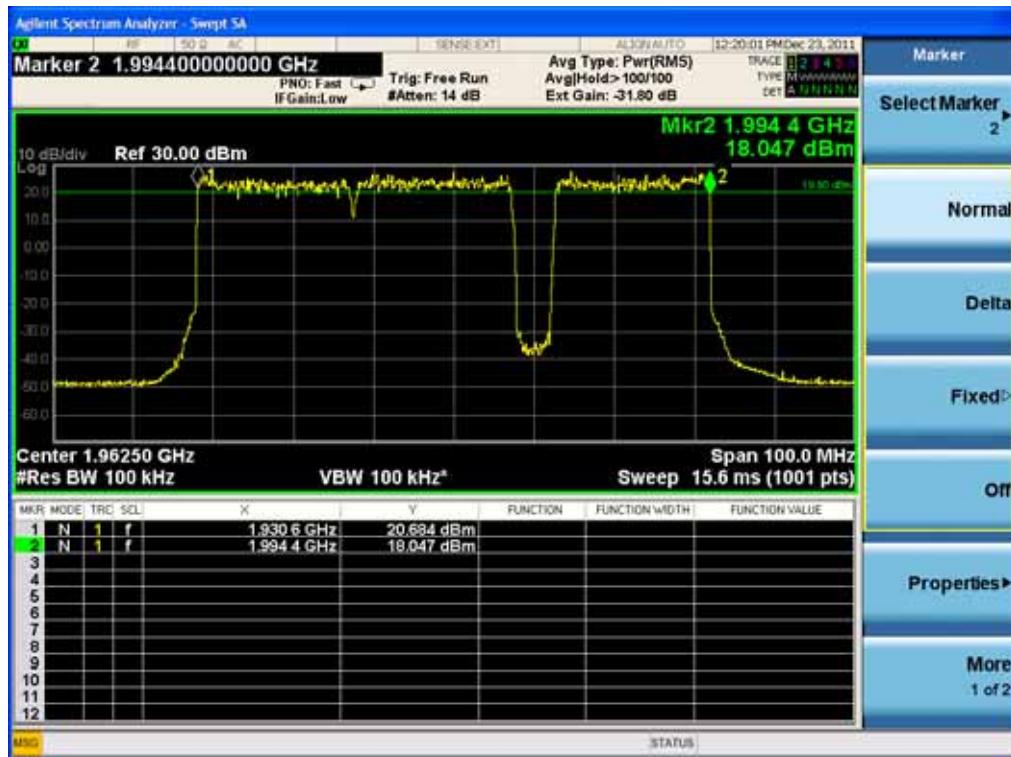


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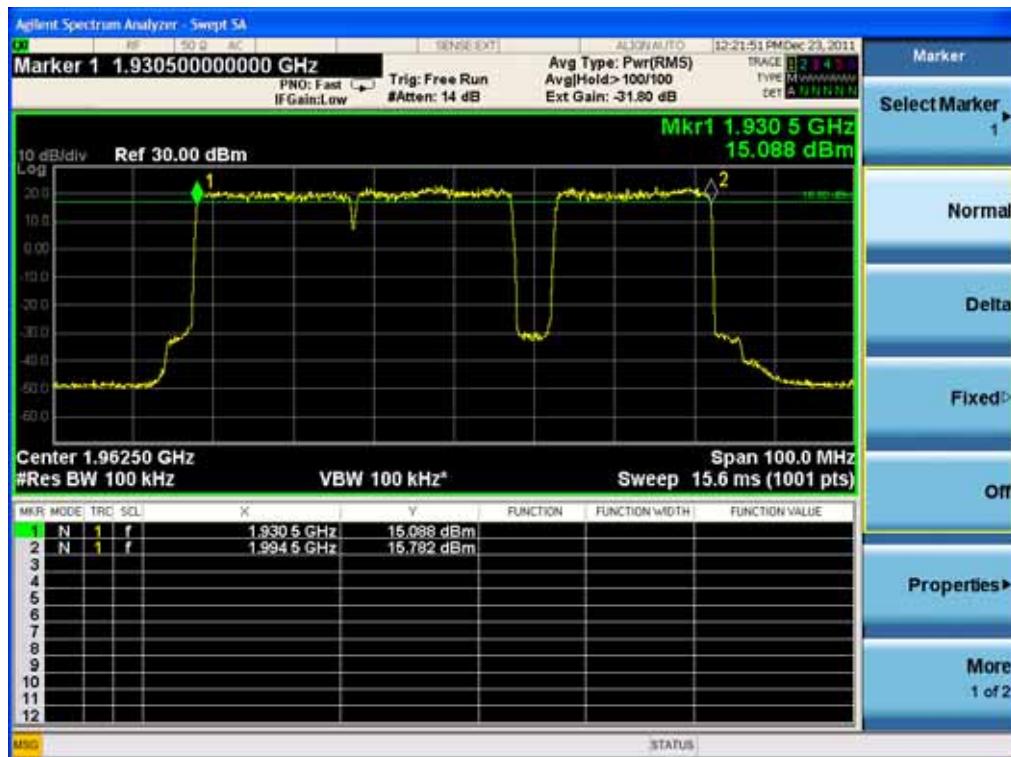


Passband Gain

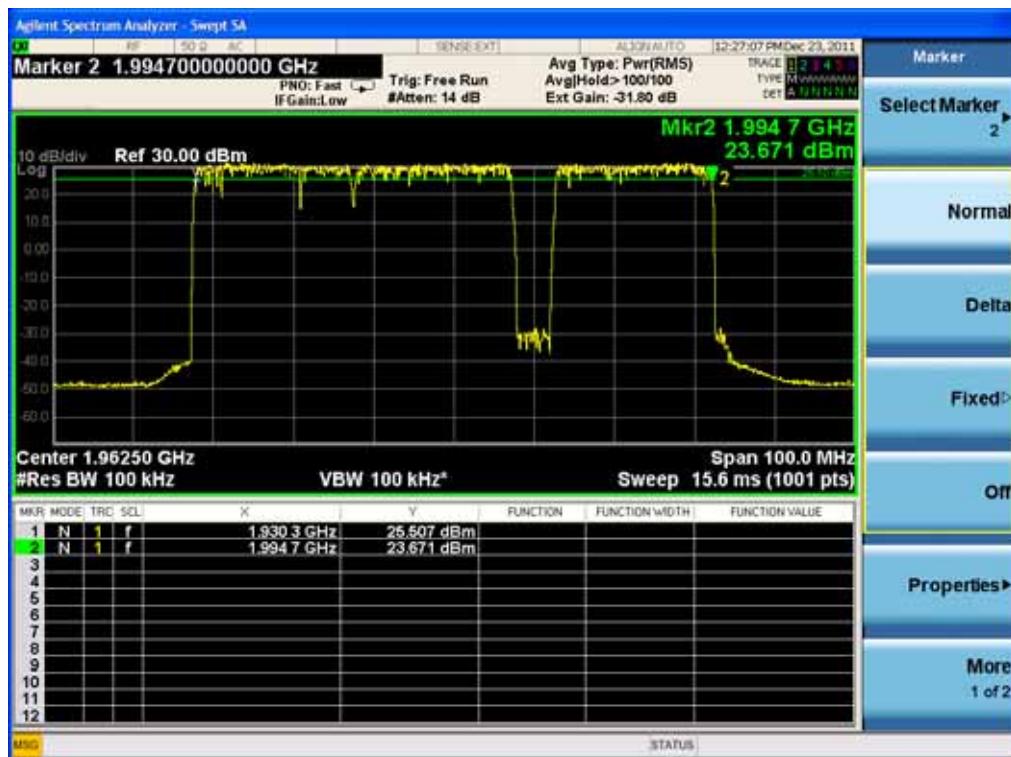
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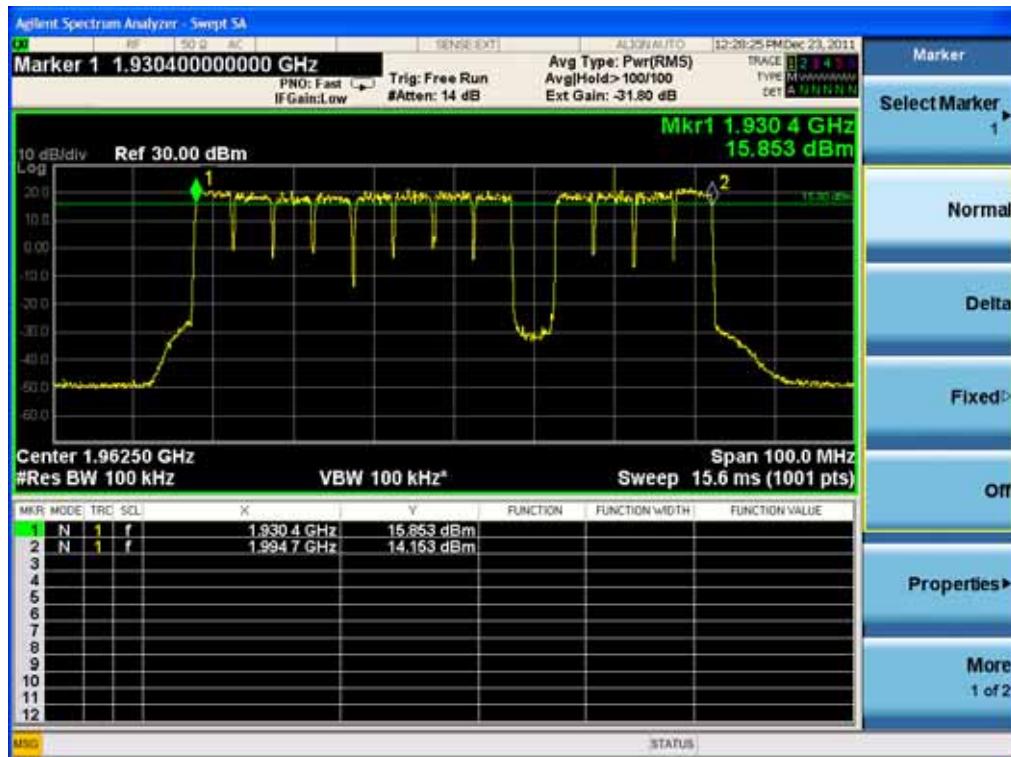
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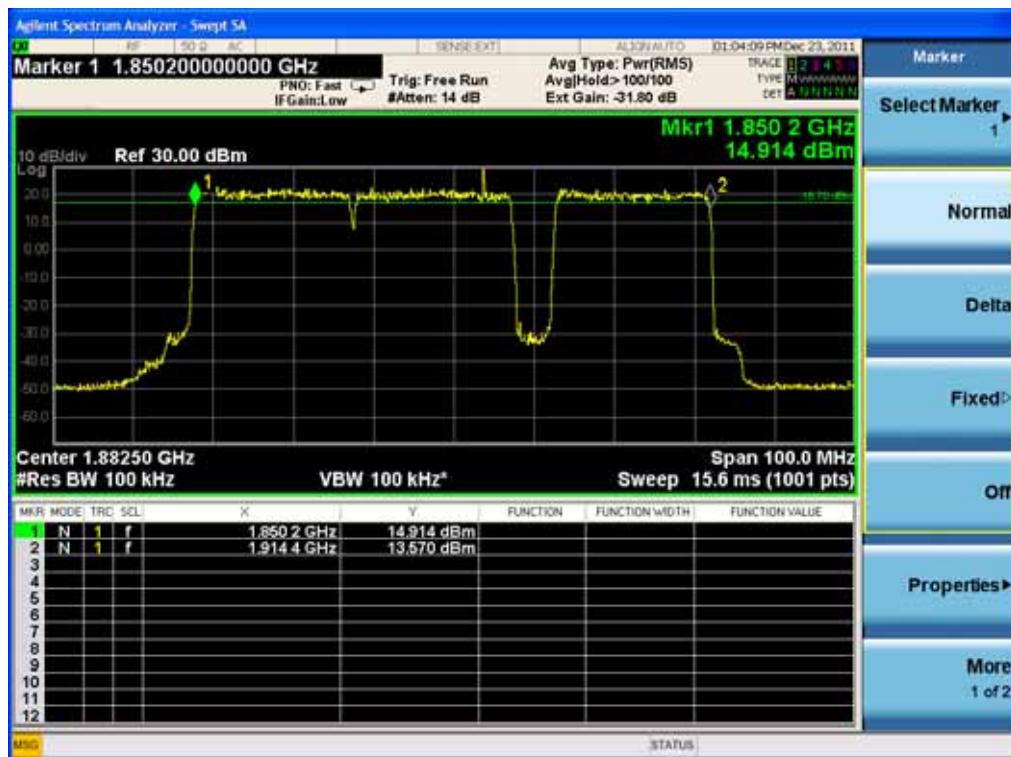
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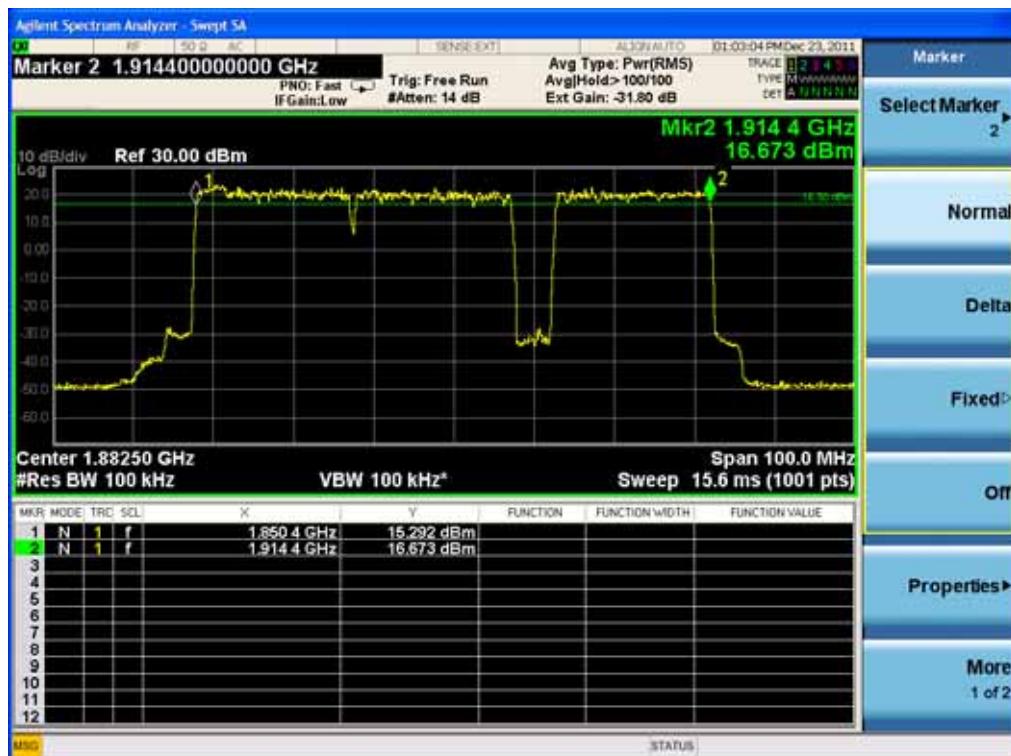
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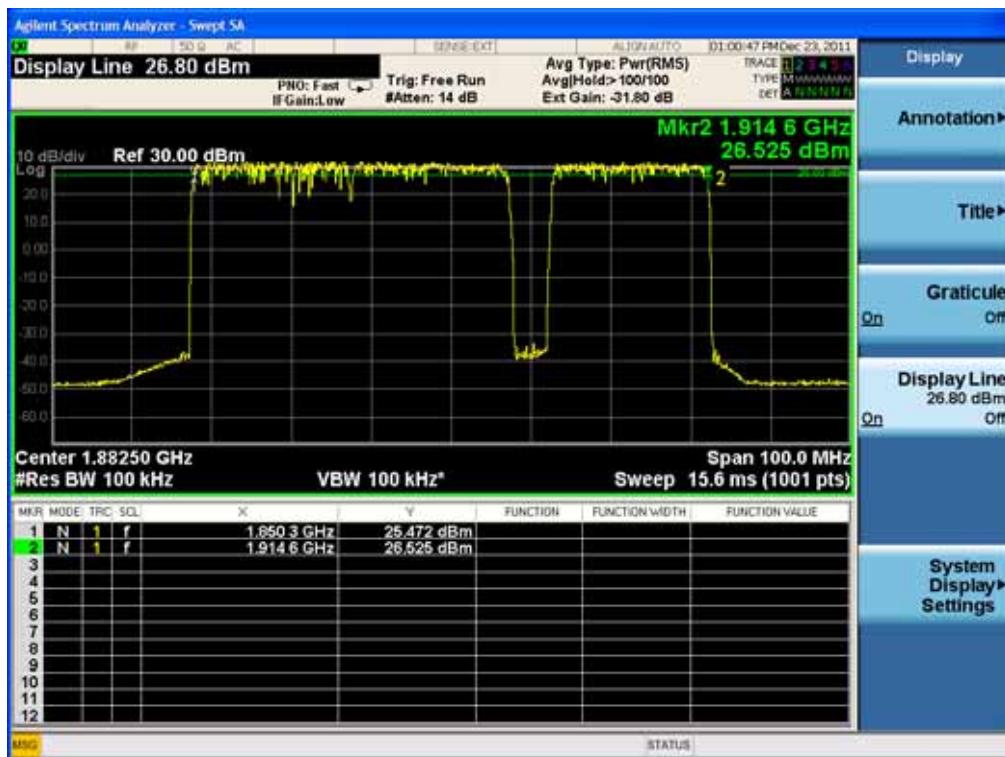
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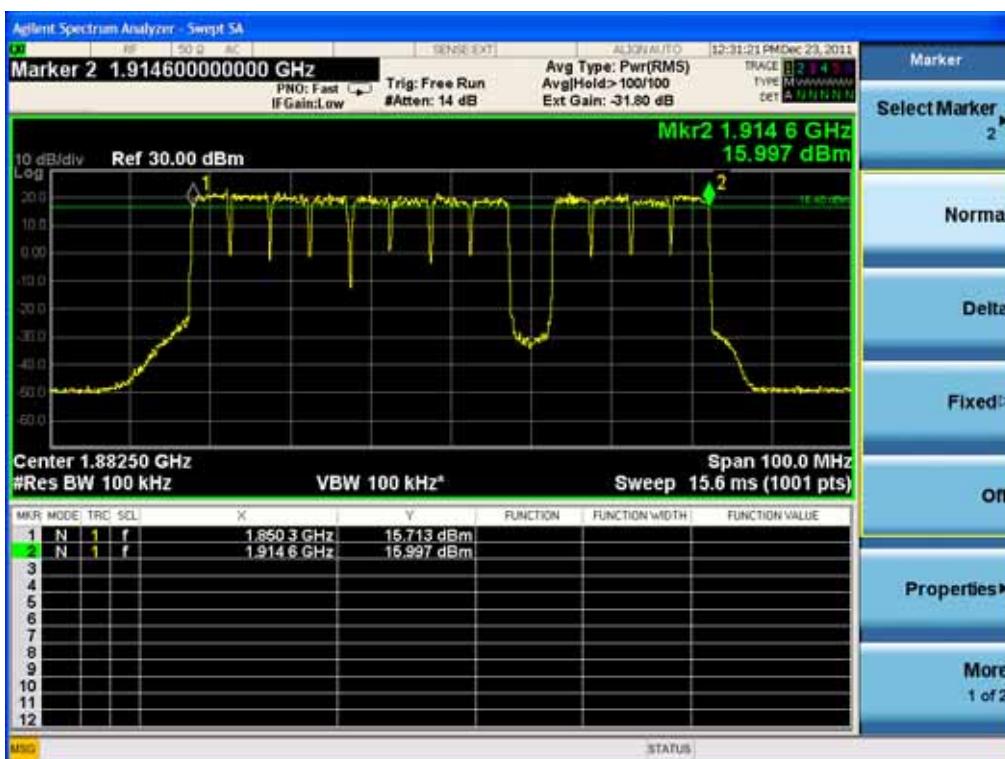
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[LTE Uplink Middle]



Band Edge

[CDMA Downlink Low]



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[CDMA Uplink Low]



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[GSM Uplink Low]



[GSM Uplink High]



[LTE Uplink Low]



[LTE Uplink High]



8. FIELD STRENGTH OF SPURIOUS RADIATION

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:

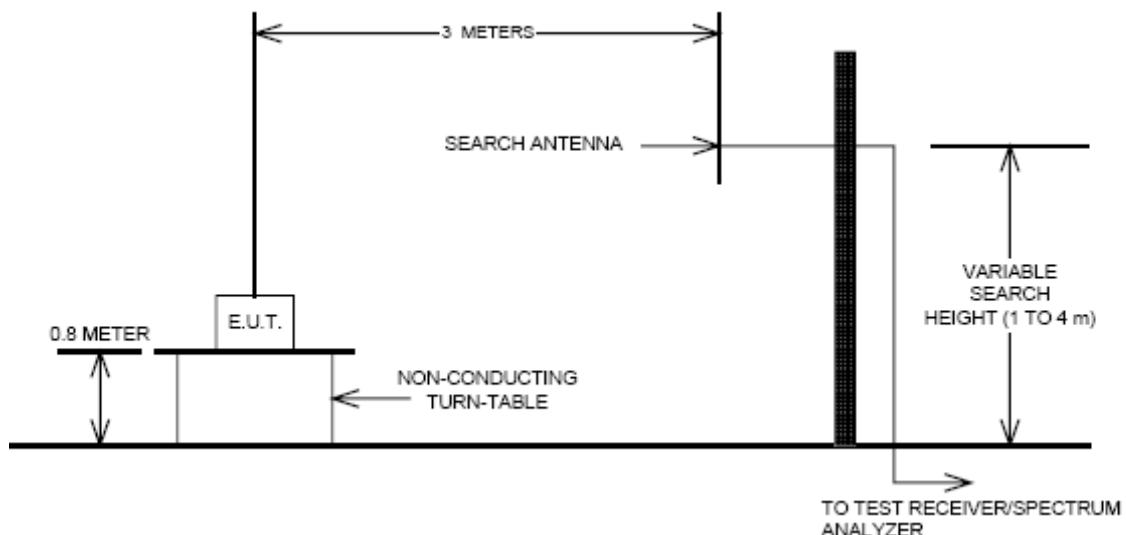
As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* were made in accordance with the procedures of TIA/EIA-603-A-2001 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards". Radiated emission measurements were performed inside a 3 meter semi-anechoic 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.

Radiated Spurious Emissions Test Setup



Test Result:

[Downlink]

Mode	Frequency	Freq.(MHz)	<u>Substitute</u> <u>Level</u> [dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
CDMA	1962.5	3925.00	-52.30	10.38	7.99	V	-49.91	-36.91
		5887.50	-51.90	10.74	10.38	V	-51.54	-38.54
WCDMA	1960	3920.00	-52.60	10.37	8.00	V	-50.23	-37.23
		5880.00	-52.90	10.73	10.37	V	-52.54	-39.54
GSM	1960	3920.00	-52.00	10.37	8.00	V	-49.63	-36.63
		5880.00	-50.70	10.73	10.37	V	-50.34	-37.34
LTE	1960	3920.00	-51.80	10.37	8.00	V	-49.43	-36.43
		5880.00	-51.10	10.73	10.37	V	-50.74	-37.74

[Uplink]

Mode	Frequency	Freq.(MHz)	<u>Substitute</u> <u>Level</u> [dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
CDMA	1882.5	3765.00	-49.80	10.33	8.04	V	-47.51	-34.51
		5647.50	-49.20	10.61	10.04	V	-48.63	-35.63
WCDMA	1880	3760.00	-49.60	10.33	7.97	V	-47.24	-34.24
		5640.00	-48.80	10.60	10.00	V	-48.20	-35.20
GSM	1880	3760.00	-49.50	10.33	7.97	V	-47.14	-34.14
		5640.00	-49.10	10.60	10.00	V	-48.50	-35.50
LTE	1880	3760.00	-50.00	10.33	7.97	V	-47.64	-34.64
		5640.00	-49.40	10.60	10.00	V	-48.80	-35.80

9. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

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

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.

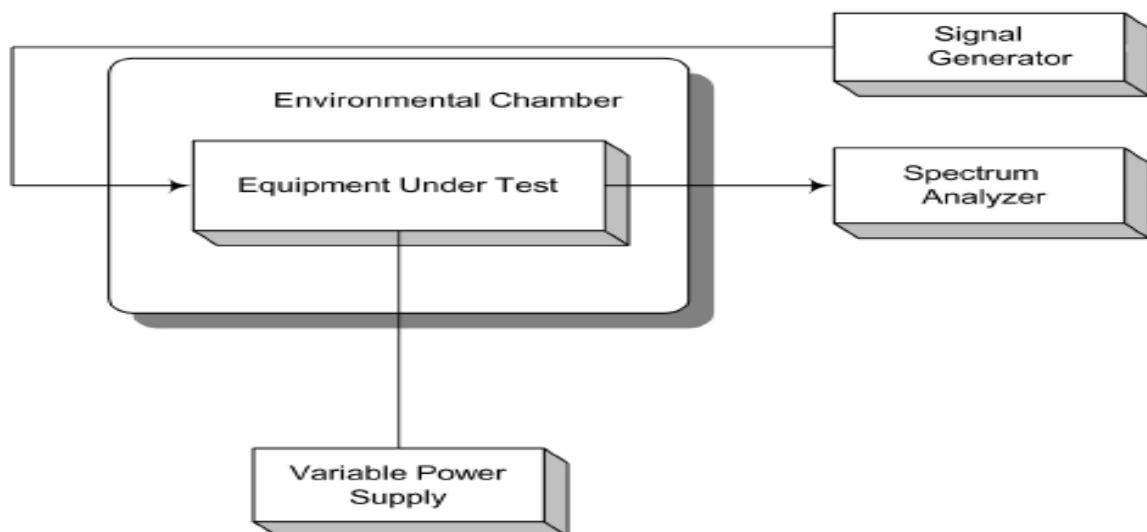
A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations.

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 110 Vac reference temperature was done at 20°C.

The voltage was varied by $\pm 15\%$ of nominal

Test Setup:



Test Results:

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

Frequency Stability and Voltage Test Results

Reference: 110 Vac at 20°C **Freq.** = 1960.0 MHz

Voltage (%)	Temp. ()	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	1959 999 998	-2.5	0.0	0.0000
	-30	1959 999 996	-3.9	-1.4	-0.0007
	-20	1959 999 998	-2.4	0.1	0.0001
	-10	1959 999 997	-2.8	-0.3	-0.0002
	0	1959 999 997	-2.7	-0.2	-0.0001
	+10	1959 999 998	-2.5	0.0	0.0000
	+30	1959 999 998	-2.0	0.5	0.0003
	+40	1959 999 998	-1.8	0.7	0.0004
	+50	1959 999 998	-1.7	0.8	0.0004
	115%	1959 999 998	-2.4	0.1	0.0001
85%	+20	1959 999 998	-2.3	0.2	0.0001

[Downlink]

Reference: 110 Vac at 20°C **Freq.** = 1880.0 MHz

Voltage (%)	Temp. ()	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	1879 999 996	-4.4	0.0	0.0000
	-30	1879 999 996	-4.5	-0.1	-0.0001
	-20	1879 999 996	-4.3	0.1	0.0001
	-10	1879 999 995	-4.6	-0.2	-0.0001
	0	1879 999 995	-5.1	-0.7	-0.0004
	+10	1879 999 995	-4.7	-0.3	-0.0002
	+30	1879 999 996	-4.1	0.3	0.0002
	+40	1879 999 996	-4.2	0.2	0.0001
	+50	1879 999 996	-3.6	0.8	0.0004
	115%	1879 999 996	-4.5	-0.1	-0.0001
85%	+20	1879 999 996	-4.1	0.3	0.0002

[Uplink]

10. RECEIVER SPURIOUS EMISSIONS

Test Requirement(s): RSS-GEN 4.10

The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port.

If the receiver is super-regenerative, stabilize it by coupling to it an unmodulated carrier on the receiver frequency (antenna conducted measurement) or by transmitting an unmodulated carrier on the receiver frequency from an antenna in the proximity of the receiver (radiated measurement). Taking care not to overload the receiver, vary the amplitude and frequency of the stabilizing signal to obtain the highest level of the spurious emissions from the receiver.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

For emissions below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector with the same measurement bandwidth as that for CISPR quasi-peak measurements. Above 1 GHz, measurements shall be performed using an average detector and a resolution bandwidth of 300 kHz to 1 MHz.

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:

$43 + 10 \log_{10}(P_{\text{rated}} \text{ in watts})$, 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:

The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port.

If the receiver is super-regenerative, stabilize it by coupling to it an unmodulated carrier on the receiver frequency (antenna conducted measurement) or by transmitting an unmodulated carrier on the receiver frequency from an antenna in the proximity of the receiver (radiated measurement). Taking care not to overload the receiver, vary the amplitude and frequency of the stabilizing signal to obtain the highest level of the spurious emissions from the receiver.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

For emissions below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector with the same measurement bandwidth as that for CISPR quasi-peak measurements. Above 1 GHz, measurements shall be performed using an average detector and a resolution bandwidth of 300 kHz to 1 MHz.

Spurious Frequency (MHz)	Field Strength (microvolts/m) at 3 metres
30-88	100
88-216	150
216-960	200
960-1610	500
Above 1610	1000

30 MHz ~ 1 GHz

Frequency MHz	Reading dBuV	Ant. Factor dB/m	Cable Loss dB	ANT POL (H/V)	Total dBuV/m	Limit dBuV/m	Margin dB
224	16.9	10.2	1.6	V	28.7	46.0	17.3
812	9.8	21.5	3.2	H	34.5		11.5

Above 1 GHz

Frequency MHz	Reading dBuV	Ant. Factor dB/m	Cable Loss dB	ANT POL (H/V)	Total dBuV/m	Limit dBuV/m	Margin dB
No Peaks Found							

11. RF EXPOSURE STATEMENT

1. LIMITS

According to §1.1310 and §2.1091 RF exposure is calculated.

(B) Limits for General Population/Uncontrolled Exposures

Frequency range (MHz)	Electric field Strength (V/m)	Magnetic field Strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
0.3 - 1.34.....	614	1.63	*(100)	30
1.34 - 30.....	824/f	2.19/f	*(180/ f ²)	30
30 - 300.....	27.5	0.073	0.2	30
300 - 1500.....	f/1500	30
1500 - 100.000.....	1.0	30

F = frequency in MHz

* = Plane-wave equivalent power density

2. MAXIMUM PERMISSIBLE EXPOSURE Prediction

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

S = Power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

2-1 Limit (DownLink)

Max Peak output Power at antenna input terminal	30.00	dBm
Max Peak output Power at antenna input terminal	1000.0	mW
Prediction distance	60.00000	cm
Prediction frequency	1960.0000	MHz
Antenna Gain(typical)	12.00000	dBi
Antenna Gain(numeric)	15.84893	-
Power density at prediction frequency (S)	0.350338	mW/cm ²
MPE limit for uncontrolled exposure at prediction frequency	1.00000	mW/cm ²

2-2 Limit (UpLink)

Max Peak output Power at antenna input terminal	30.08000	dBm
Max Peak output Power at antenna input terminal	1018.59	mW
Prediction distance	60.00000	cm
Prediction frequency	1850.20000	MHz
Antenna Gain(typical)	12.00000	dBi
Antenna Gain(numeric)	15.84893	-
Power density at prediction frequency (S)	0.356852	mW/cm ²
MPE limit for uncontrolled exposure at prediction frequency	1.00000	mW/cm ²

3. RESULTS

The power density level at 60 cm is 0.350338 mW/cm², which is below the uncontrolled exposure limit of 1.0 mW/cm² at Down Link Band

The power density level at 60 cm is 0.356852 mW/cm², which is below the uncontrolled exposure limit of 1.0 mW/cm² at Up Link Band

Simultaneous MPE at 60 cm is $(0.350338/1.0) + (0.356852/1) = 0.7071 < 1$

Warning: In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, it must also have a minimum distance of 60 cm from the body during normal operation.