(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.

§ 90.210 Emission limits: The rules in this section govern the spectral characteristics of emissions in the Radiotelephone Service. 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) or 80 dB whichever is the lesser attenuation.

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 OEM A spectrum analyzer was connected to either the Uplink or Downlink port depending on the circuitry being measured. The spectrum analyzer was set to 1MHz RBW and 3MHz VBW. The spectrum was investigated from 30MHz to the 10th harmonic of the carrier.

The inter-modulation requirements were performed in a similar manner as described above. The spectrum analyzer was set to 100kHz RBW and 300kHz VBW. Two modulated carriers were injected into the EUT. One carrier was set at the band edge of either the Uplink or Downlink band and the other at carrier set at 6MHz deviation from the first carrier. The in band spurious emissions were investigated.

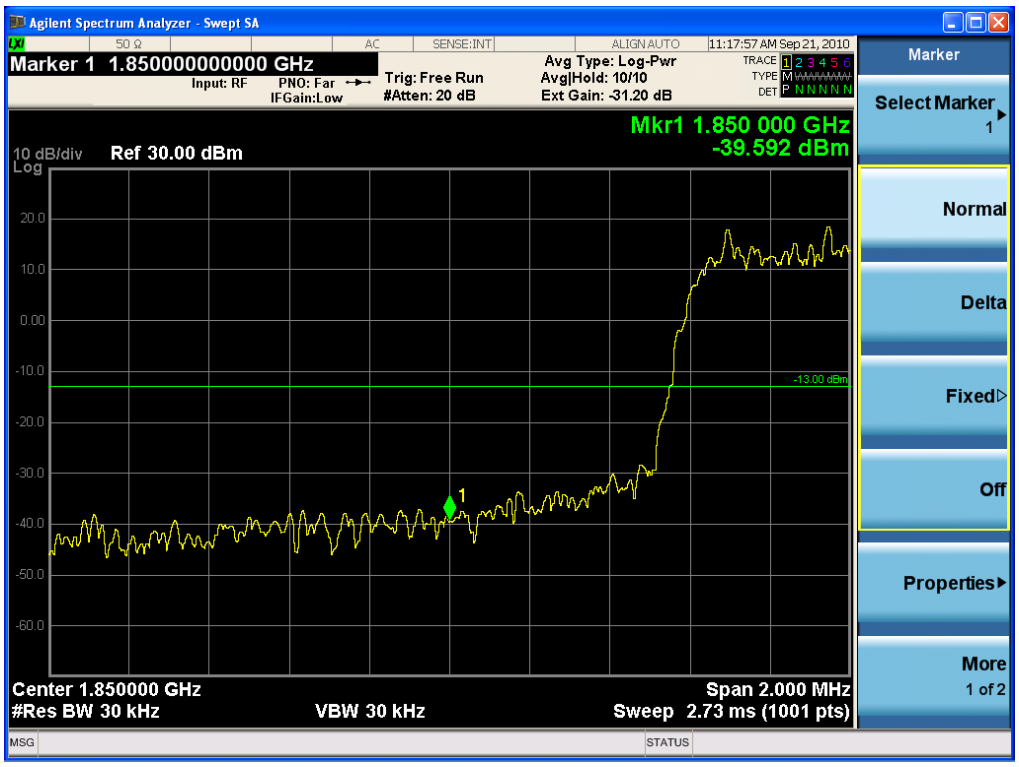
Test Results: The EUT complies with the requirements of this section. There were no detectable spurious emissions for this EUT.

NOTE: The EUT is a band selective repeater. The test was performed using all selective bands and there was not much difference between them. The test result is reported using the widest bands.

Plots of BAND EDGE

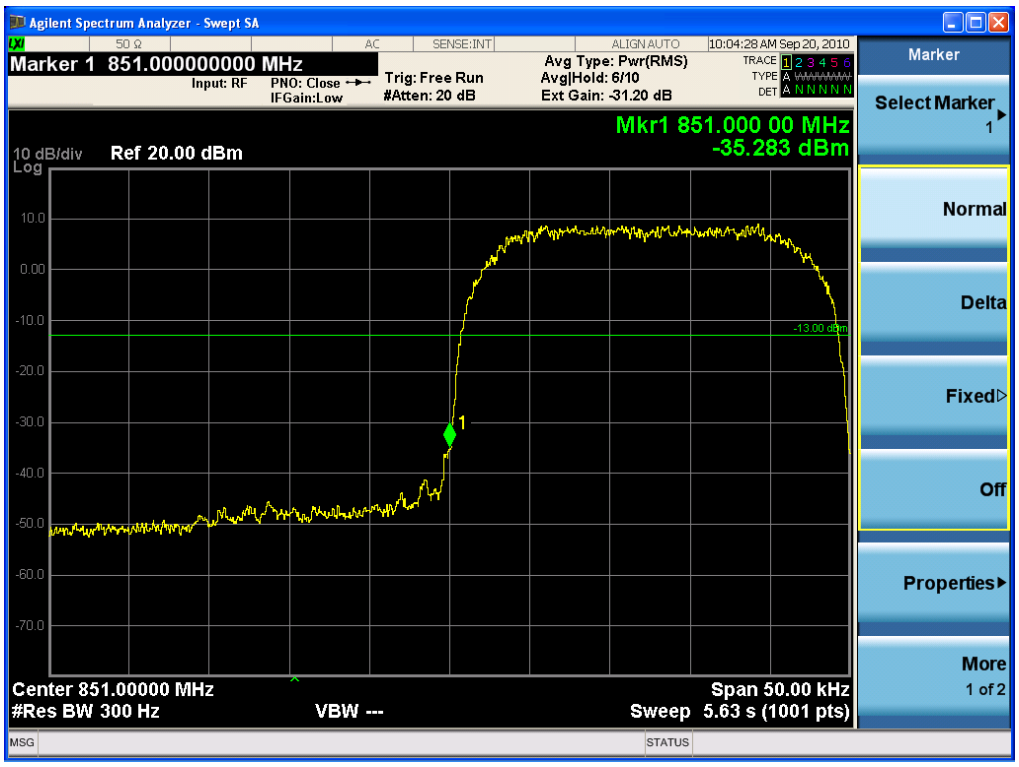
(PCS1900 Downlink Low CH)

(PCS1900 Downlink High CH)

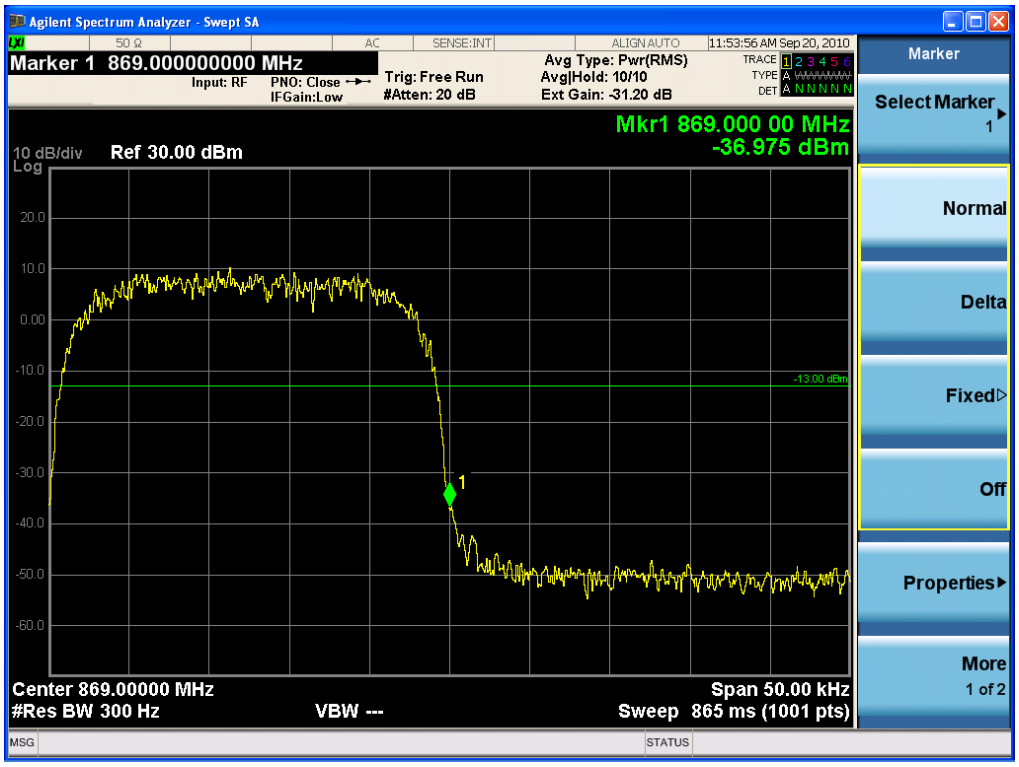


(PCS1900 Uplink Low CH)

(PCS1900 Uplink High CH)

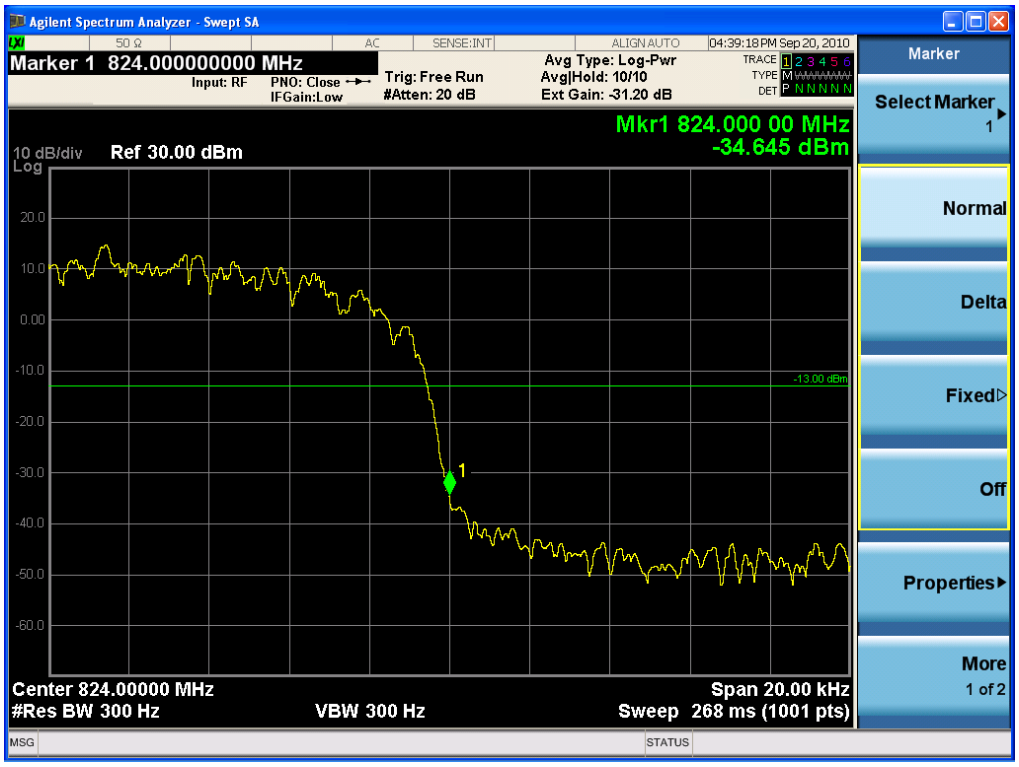


(iDEN800 Downlink Low CH)-18 MHz



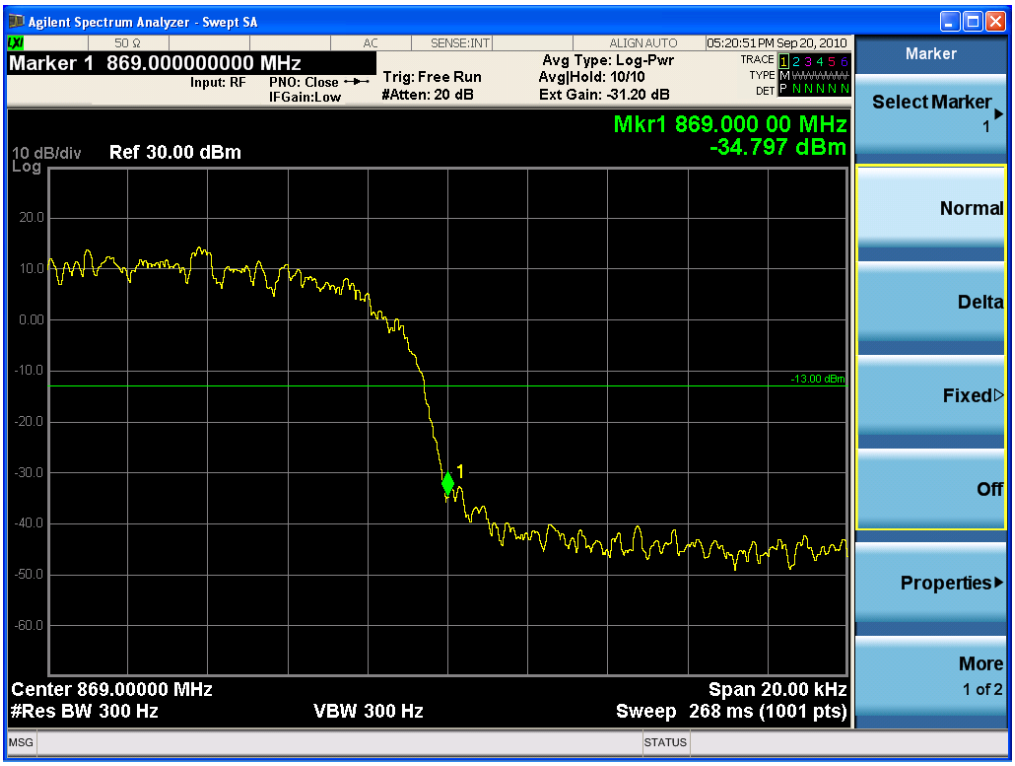
(iDEN800 Downlink High CH) -18 MHz

(iDEN800 Uplink Low CH) -18 MHz



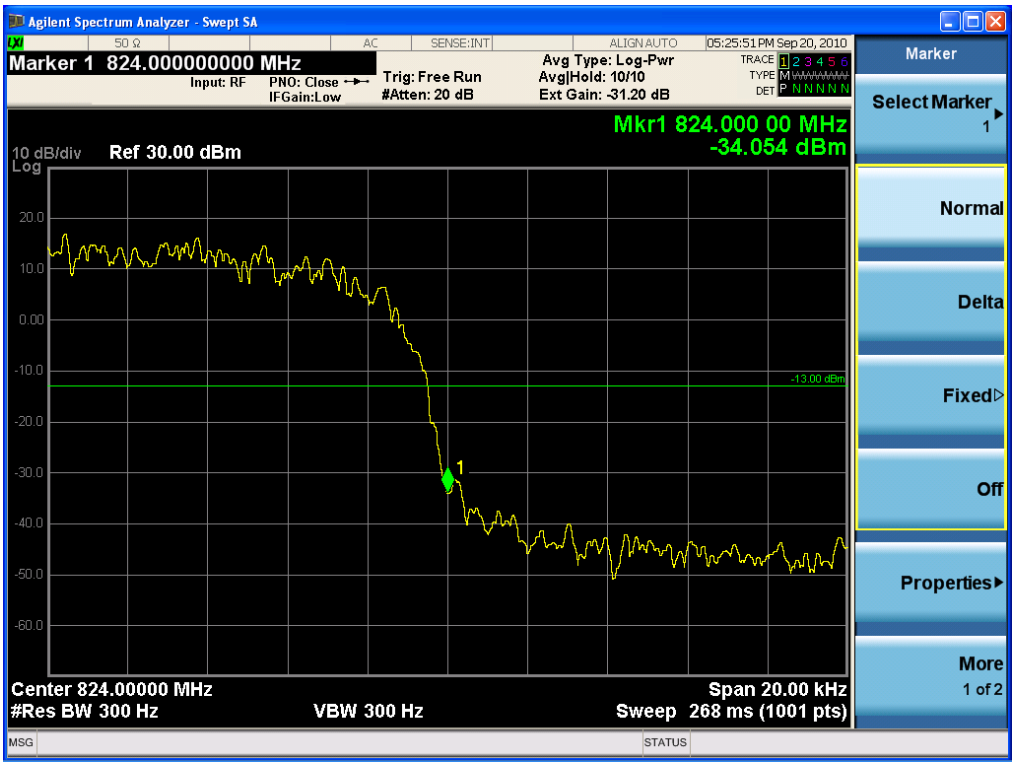
(iDEN800 Uplink High CH) -18 MHz

(iDEN800 Downlink Low CH) -7 MHz



(iDEN800 Downlink High CH) -7 MHz

(iDEN800 Uplink Low CH) -7 MHz



(iDEN800 Uplink High CH) -7 MHz

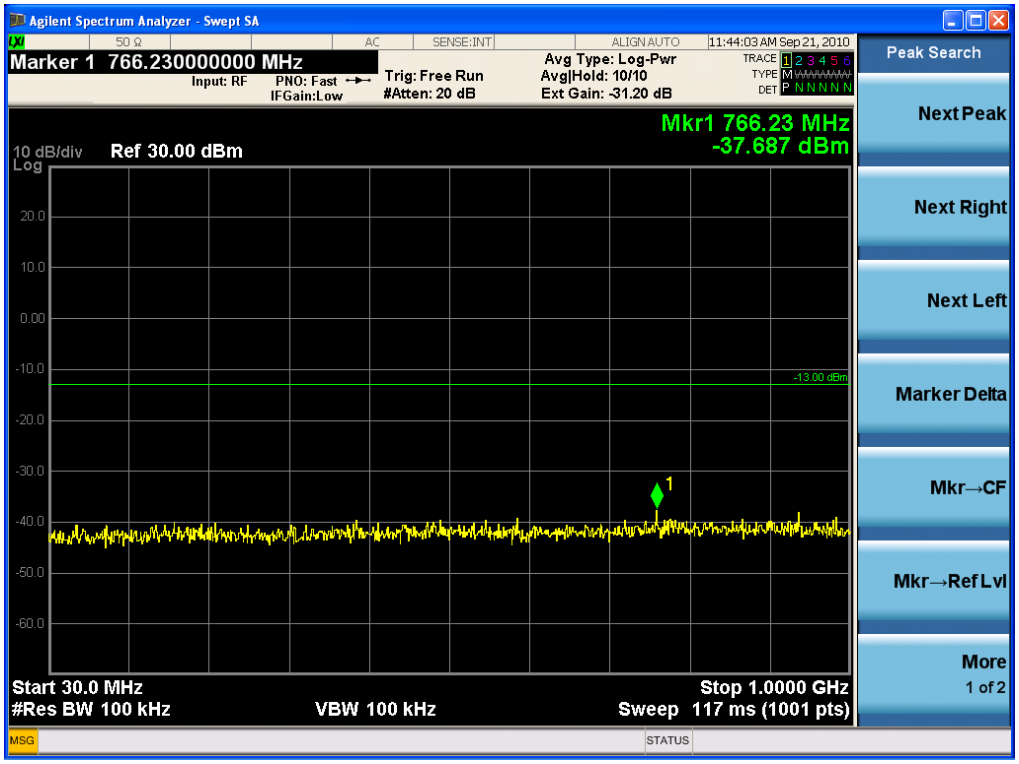
(iDEN900 Downlink Low CH)

(iDEN900 Downlink High CH)

(iDEN900 Uplink Low CH)

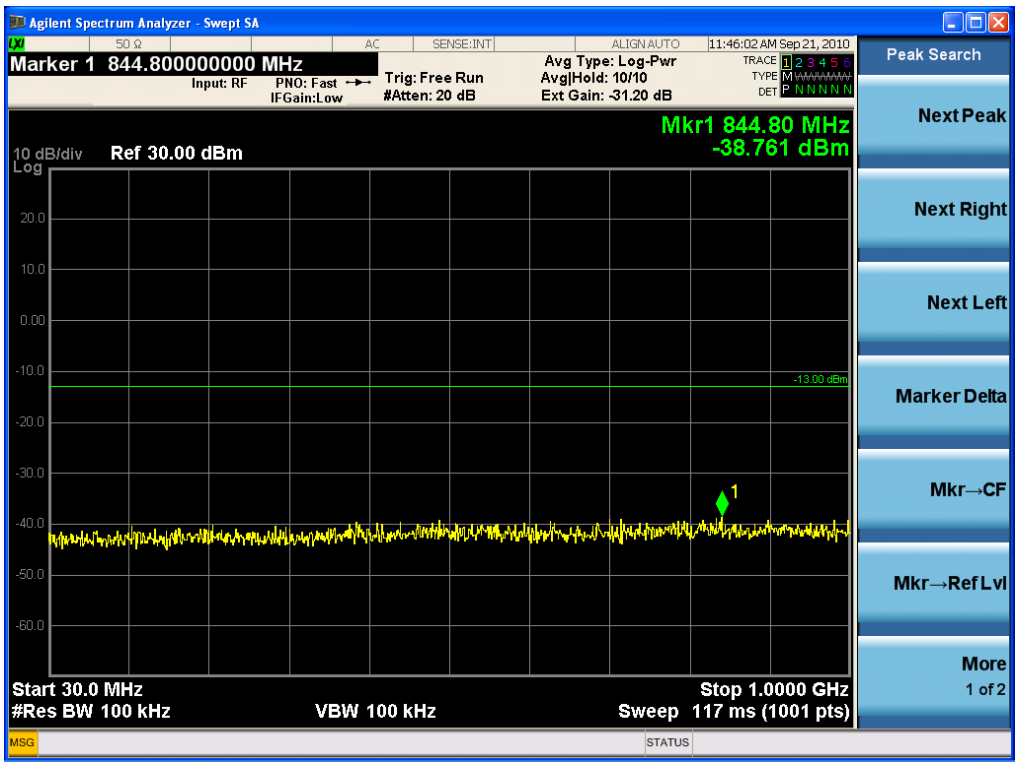
(iDEN900 Uplink High CH)

Plots of Spurious Emission, PCS1900



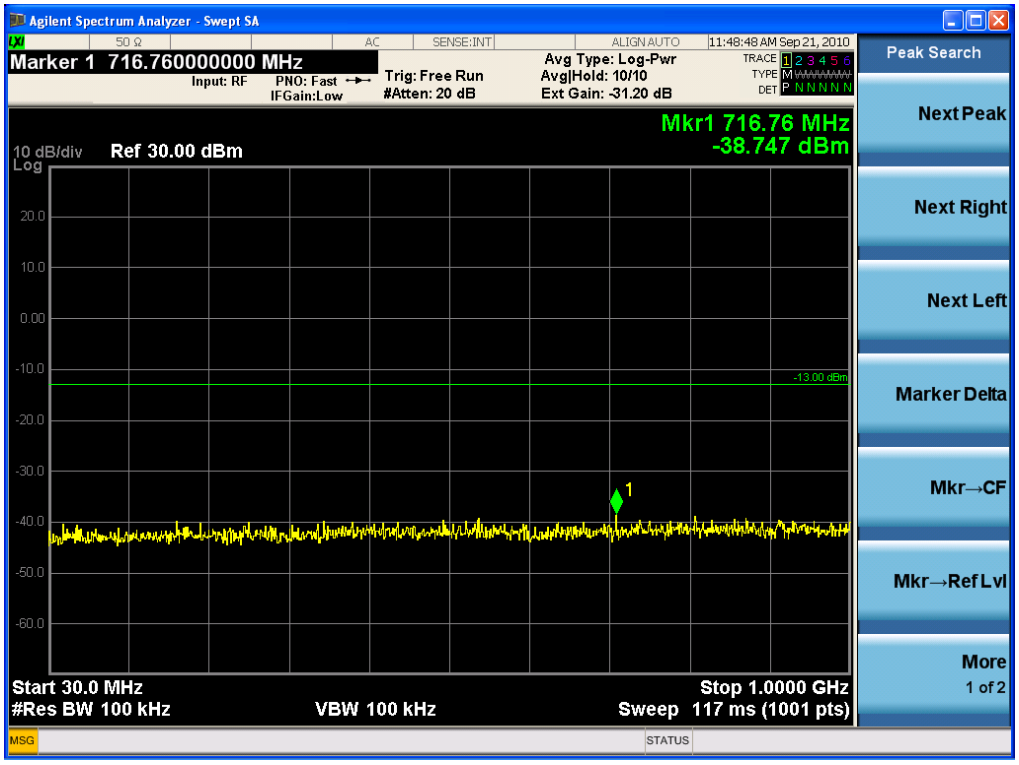
Conducted Spurious Emissions Downlink Low CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink Low CH (1 GHz – 26.5 GHz)



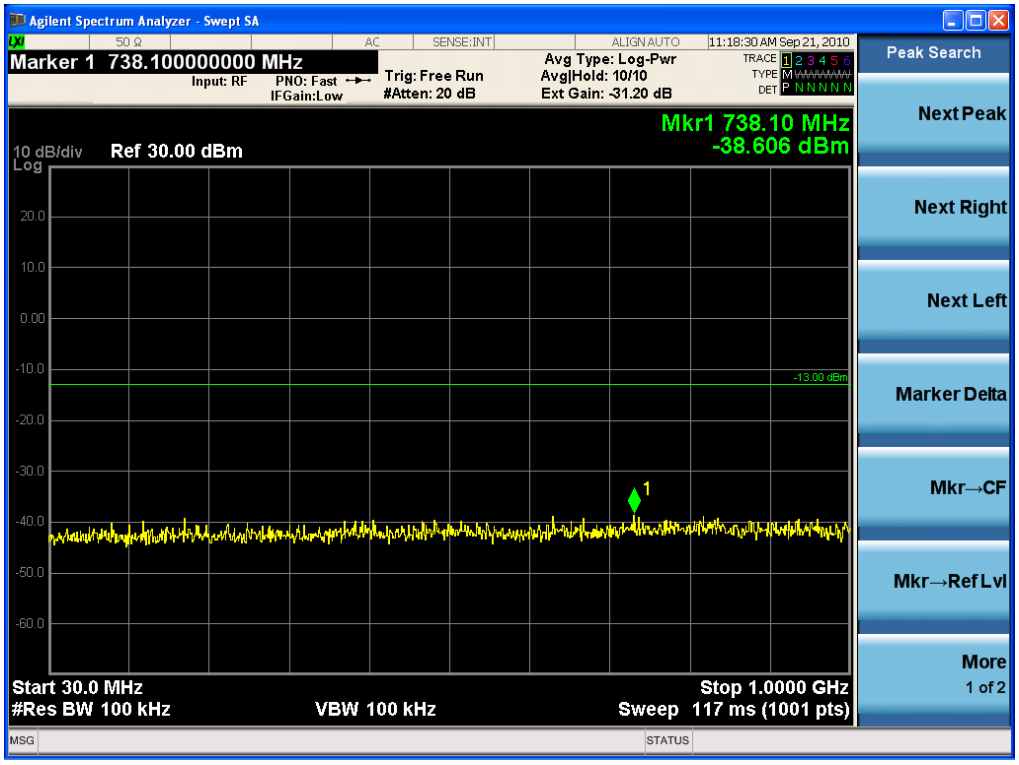
Conducted Spurious Emissions Downlink Mid CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink Mid CH (1 GHz – 26.5 GHz)



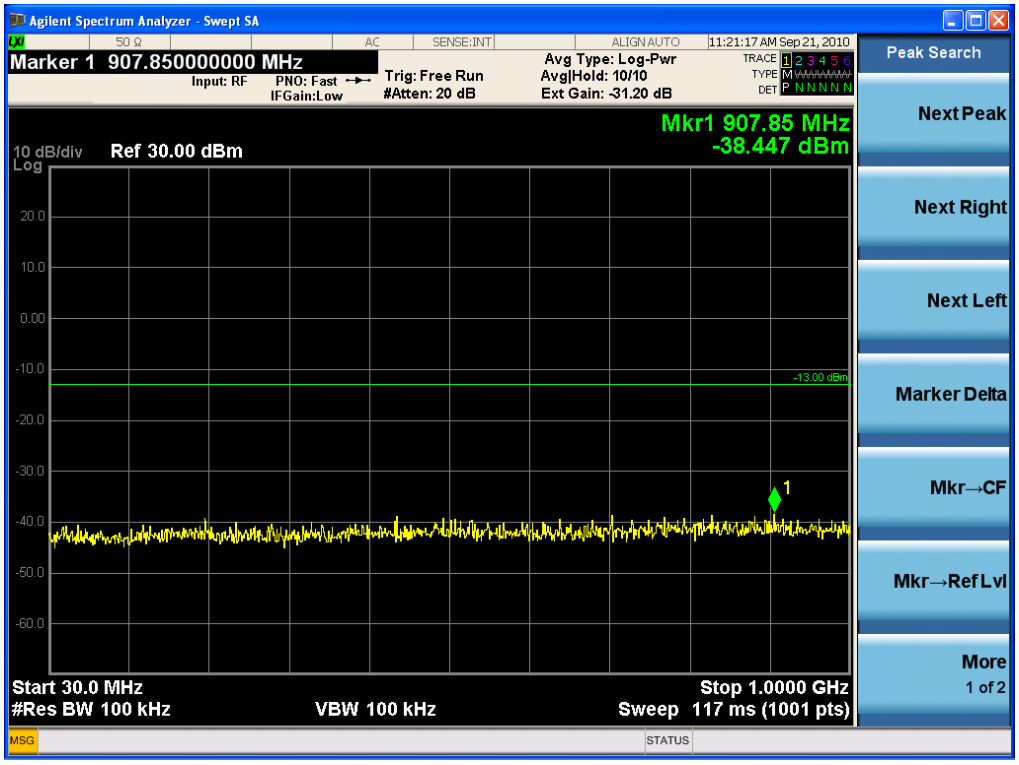
Conducted Spurious Emissions Downlink High CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink High CH (1 GHz – 26.5 GHz)



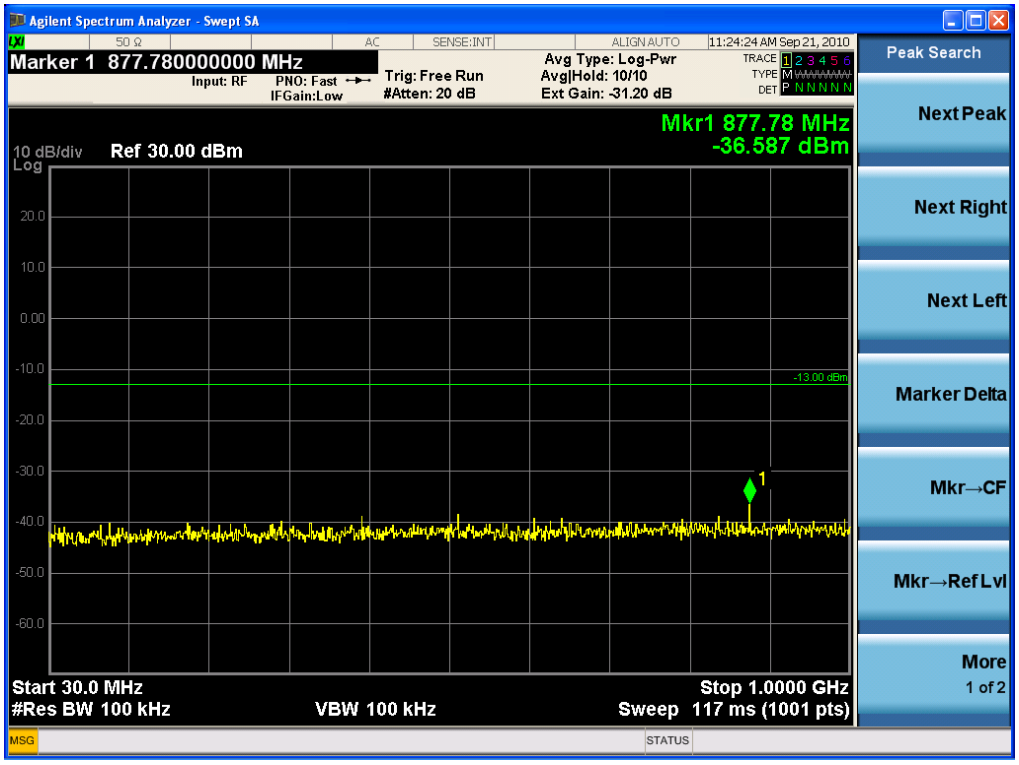
Conducted Spurious Emissions Uplink Low CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Uplink Low CH (1 GHz – 26.5 GHz)



Conducted Spurious Emissions Uplink Mid CH (30 MHz – 1 GHz)

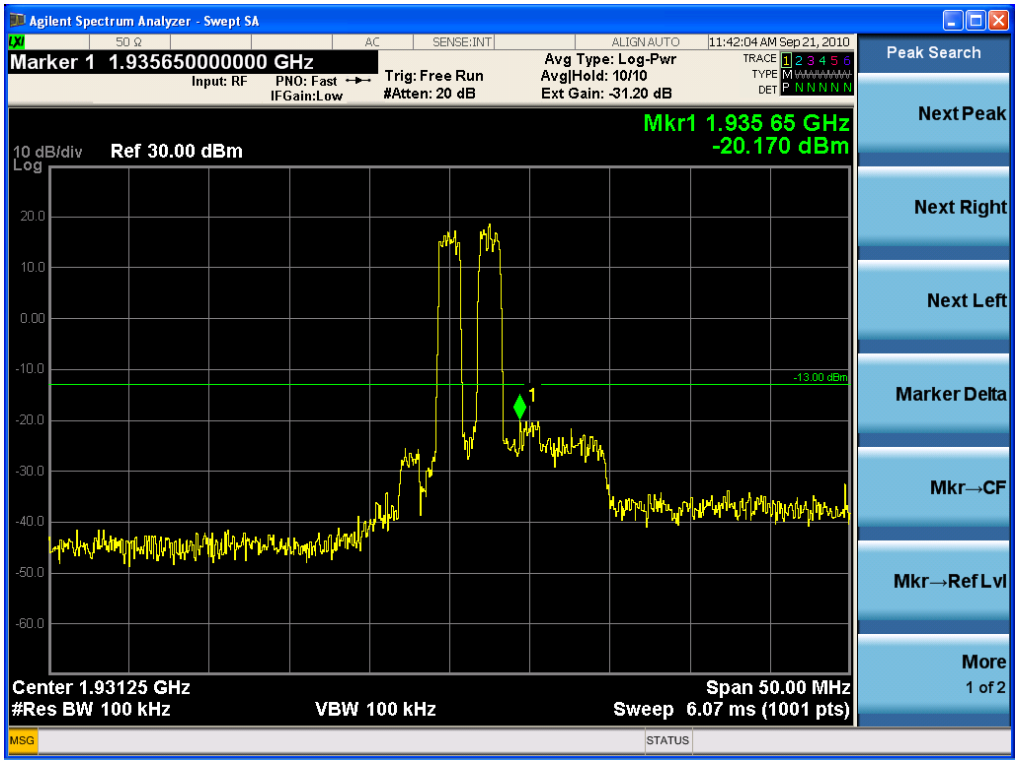
Conducted Spurious Emissions Uplink Mid CH (1 GHz – 26.5 GHz)



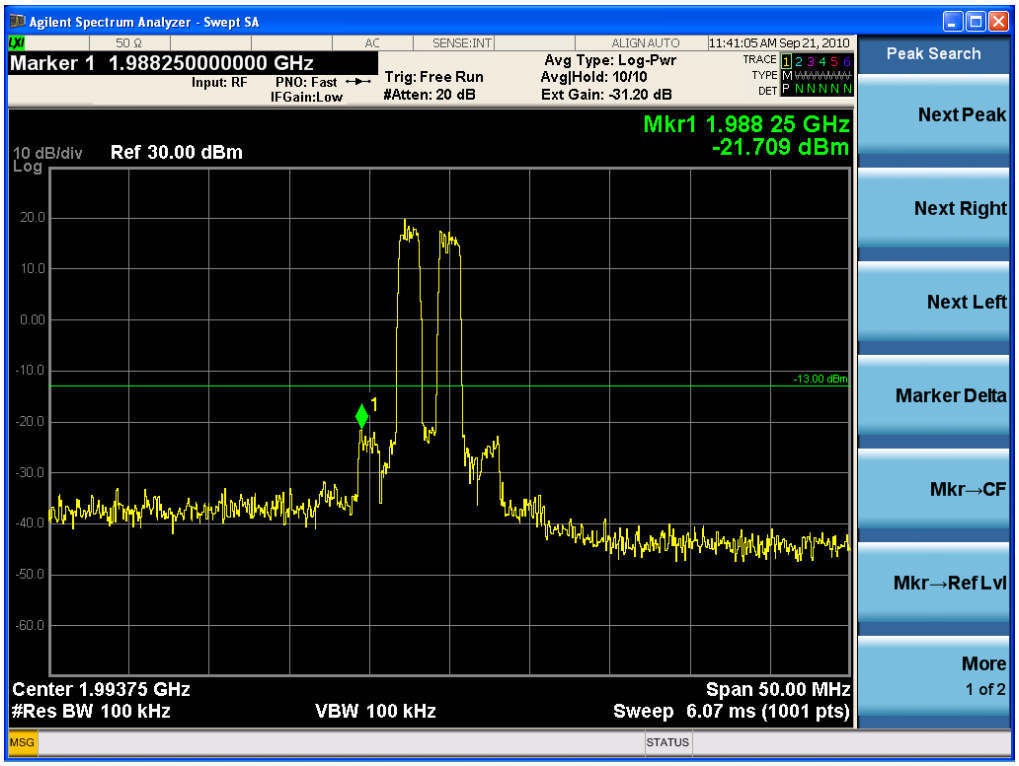
Conducted Spurious Emissions Uplink High CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Uplink High CH (1 GHz – 26.5 GHz)

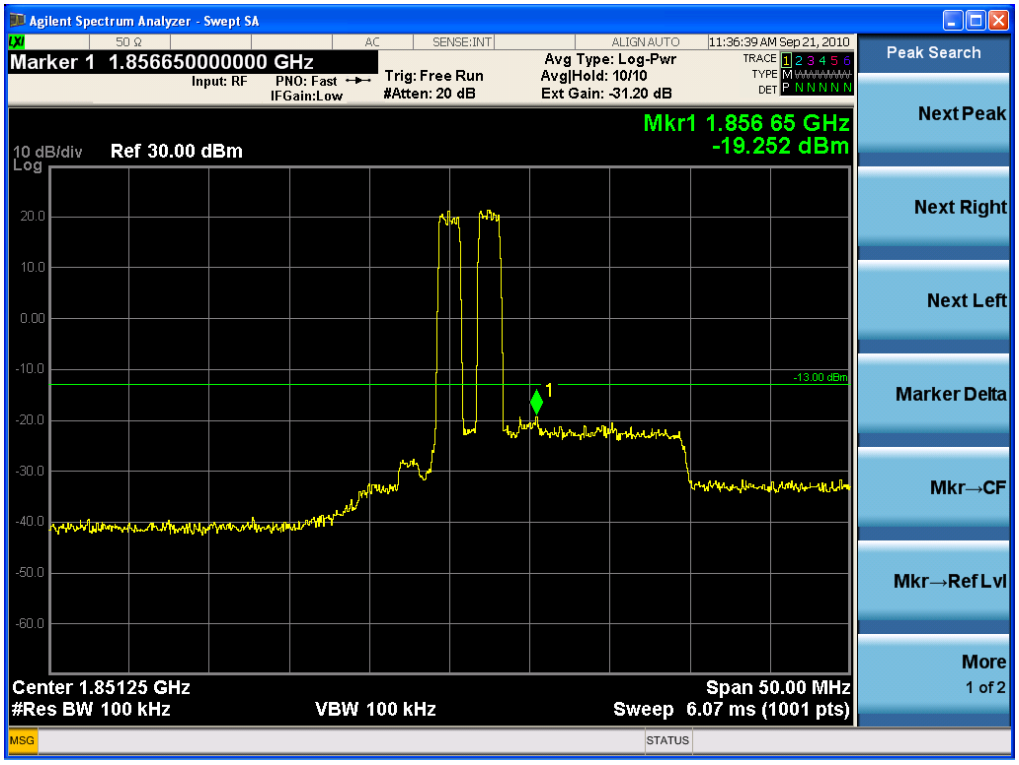
Plots of Two Tone Intermodulation, PCS1900



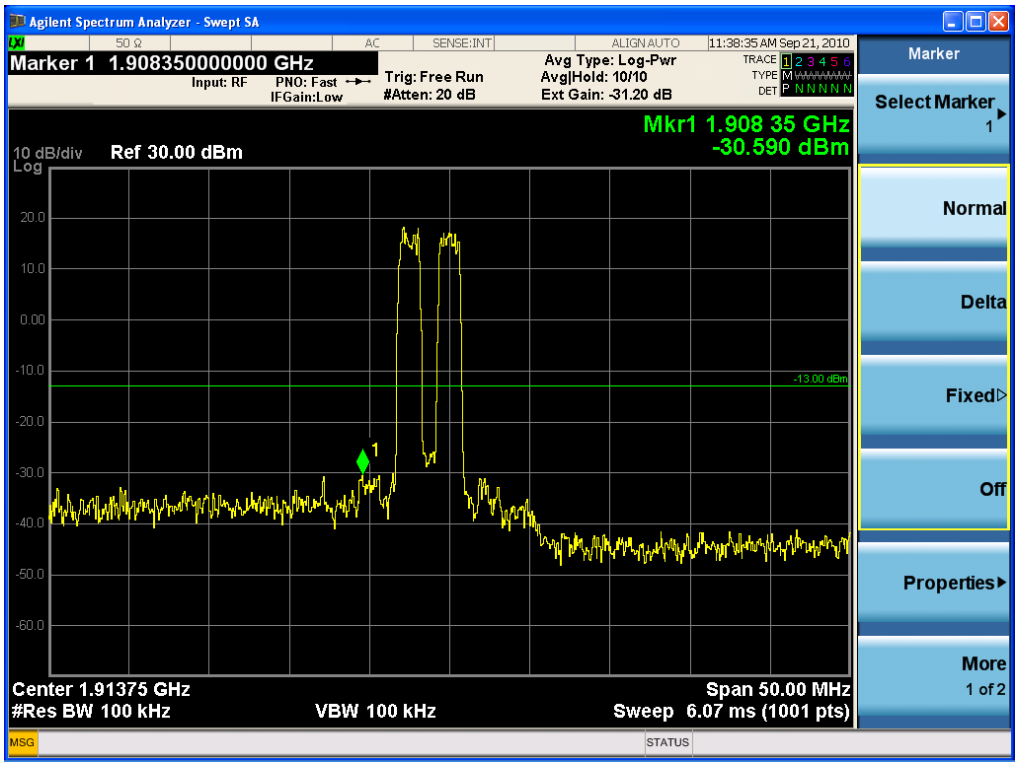
Two Tone Downlink Low End Intermodulation



Two Tone Downlink Hi End Intermodulation

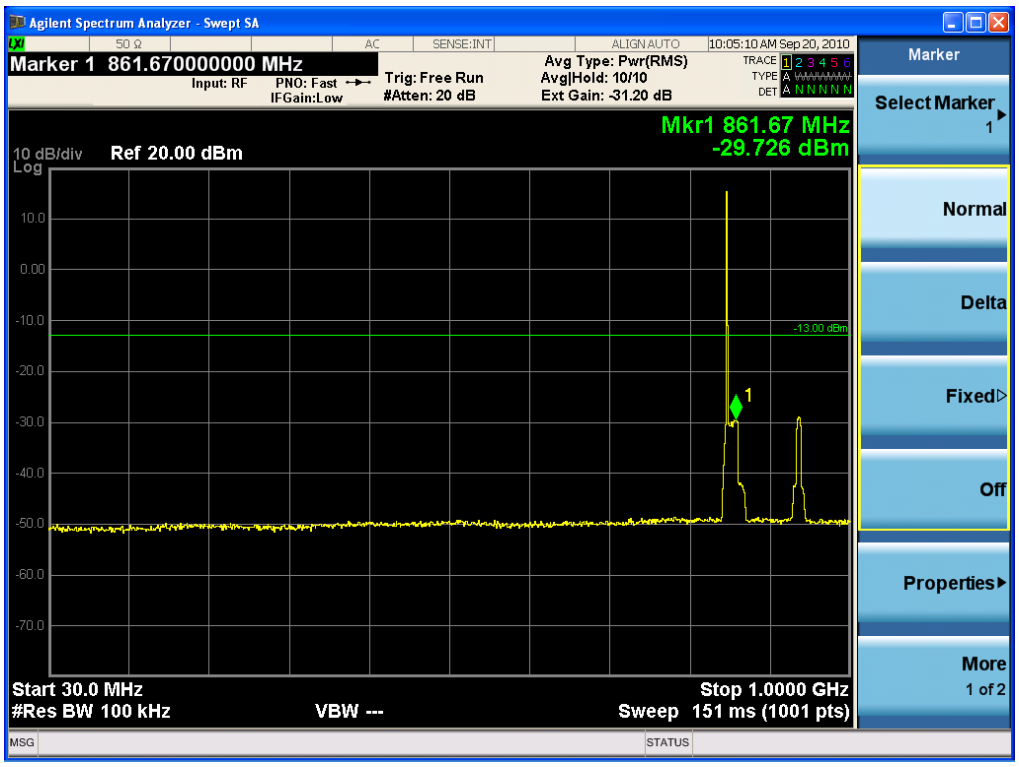


Two Tone Uplink Low End Intermodulation



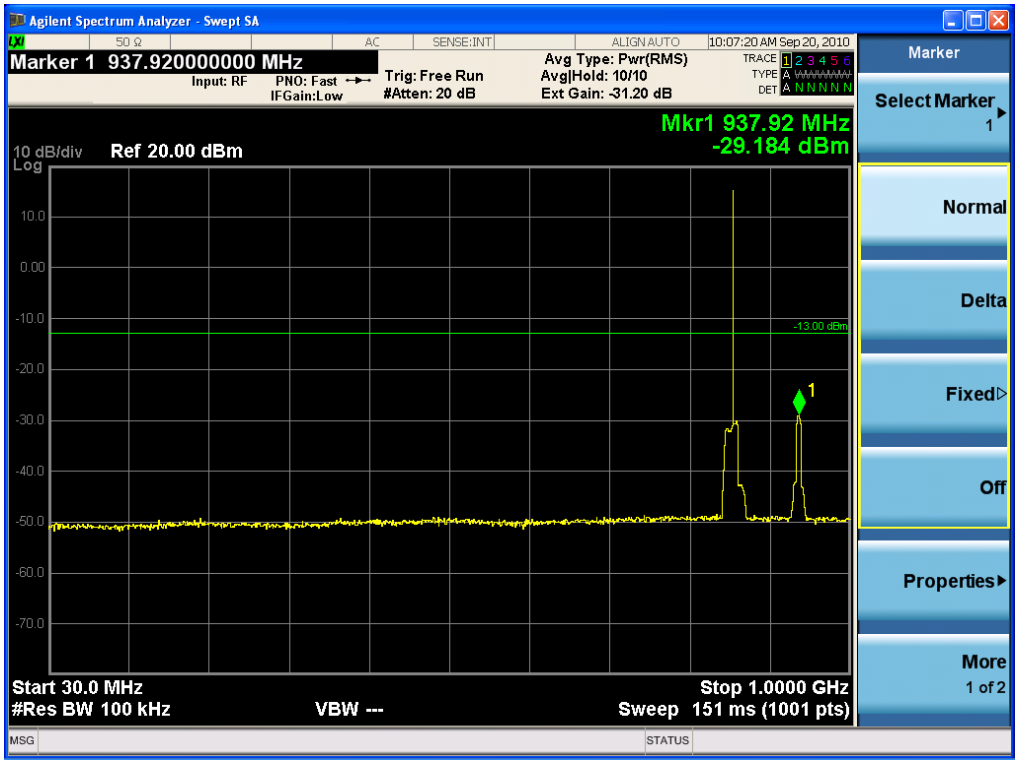
Two Tone Uplink Hi End Intermodulation

Plots of Spurious Emission, iDEN800-18 MHz



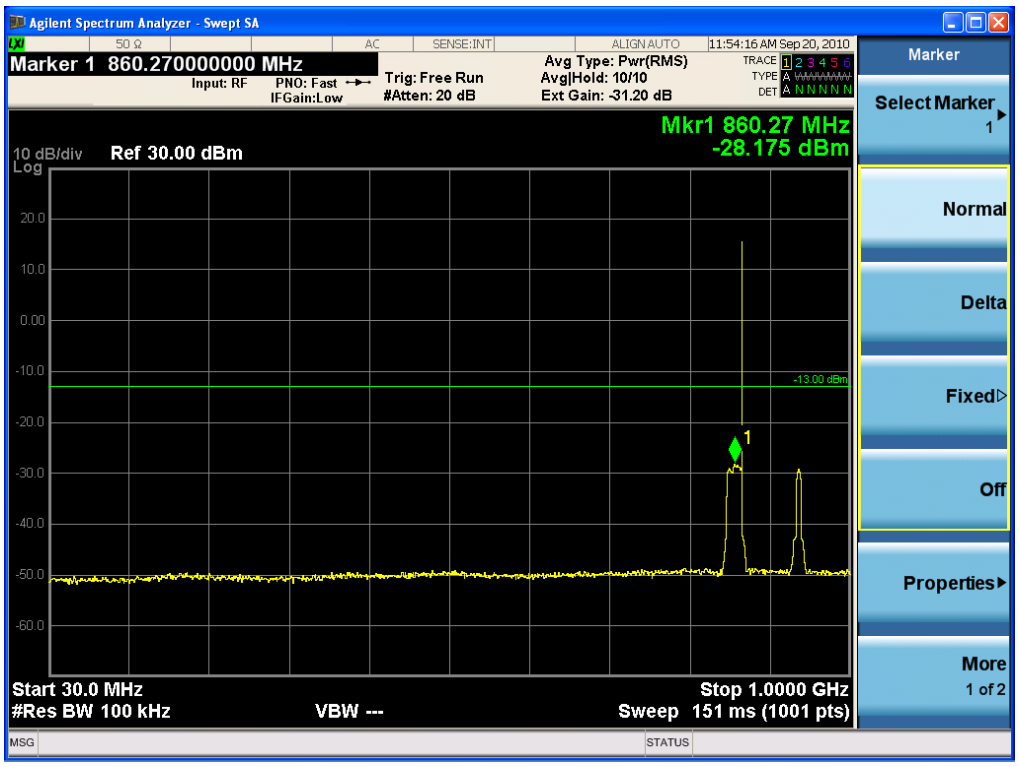
Conducted Spurious Emissions Downlink Low CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink Low CH (1 GHz – 26.5 GHz)



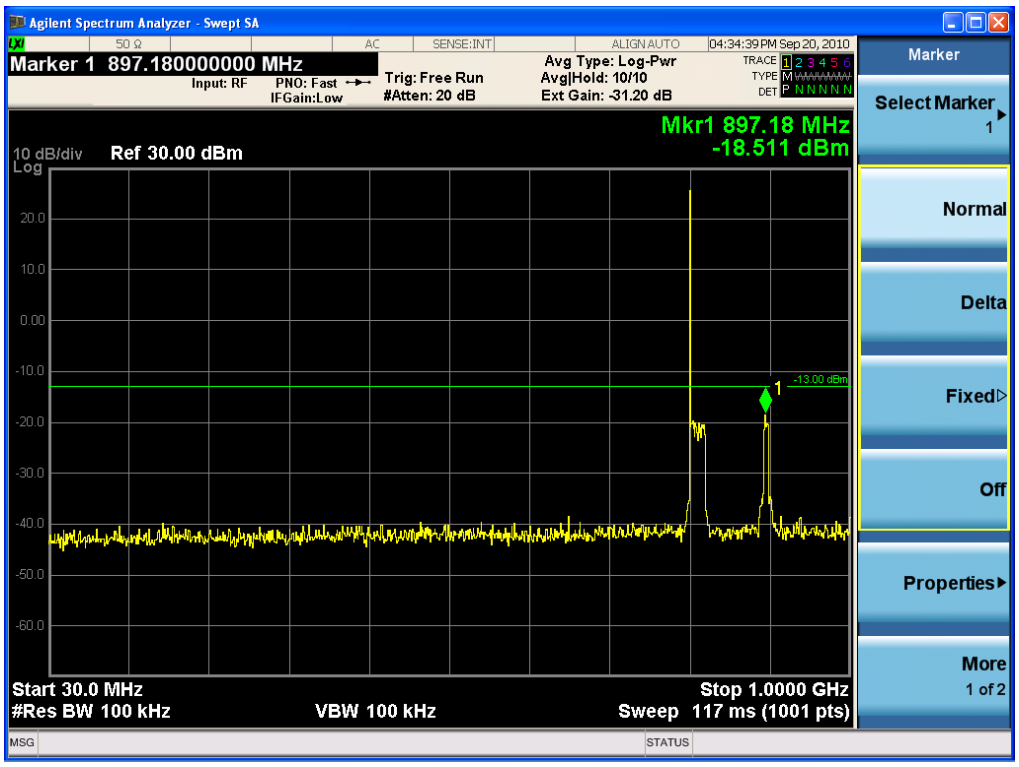
Conducted Spurious Emissions Downlink Mid CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink Mid CH (1 GHz – 26.5 GHz)



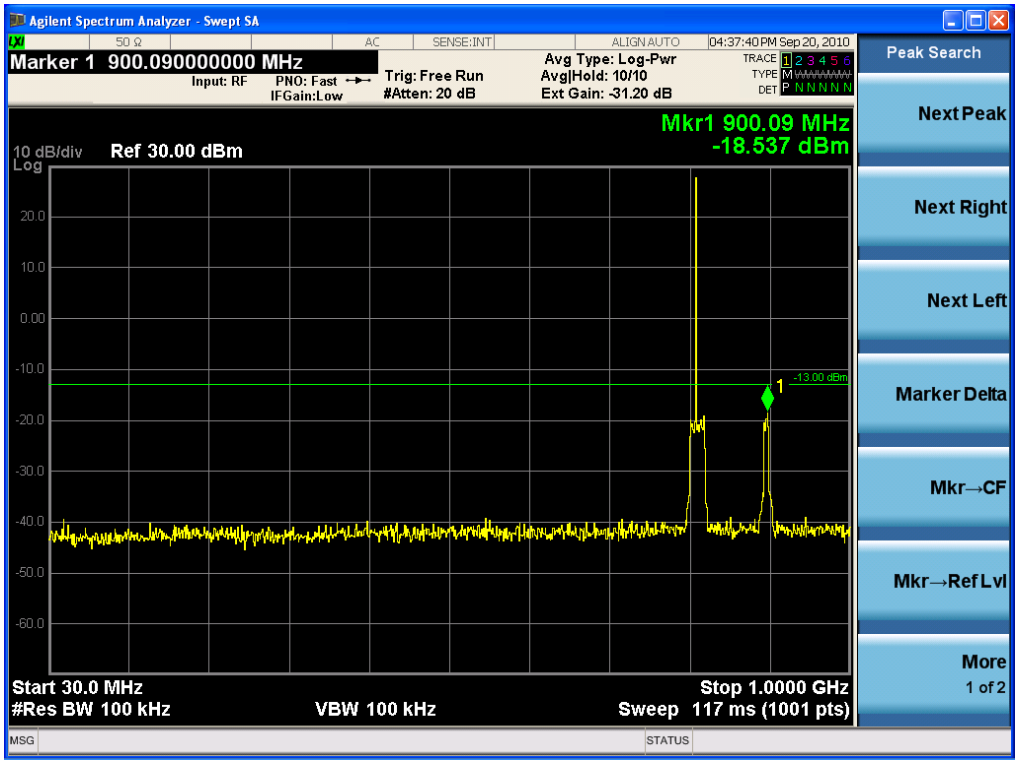
Conducted Spurious Emissions Downlink High CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink High CH (1 GHz – 26.5 GHz)



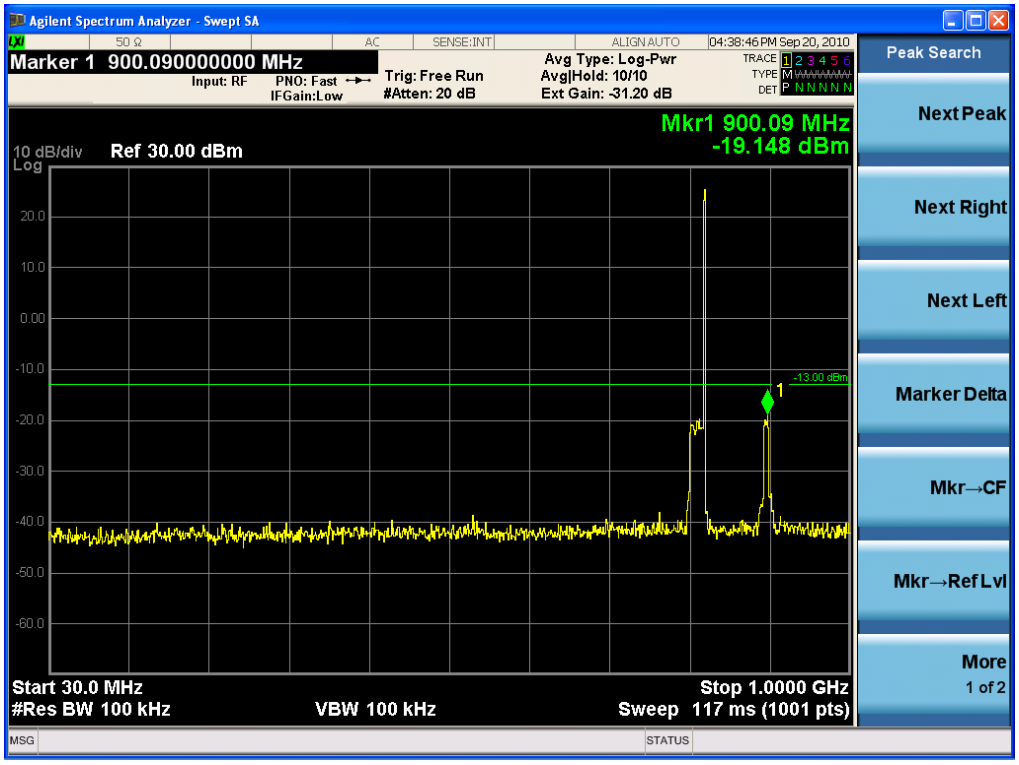
Conducted Spurious Emissions Uplink Low CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Uplink Low CH (1 GHz – 26.5 GHz)



Conducted Spurious Emissions Uplink Mid CH (30 MHz – 1 GHz)

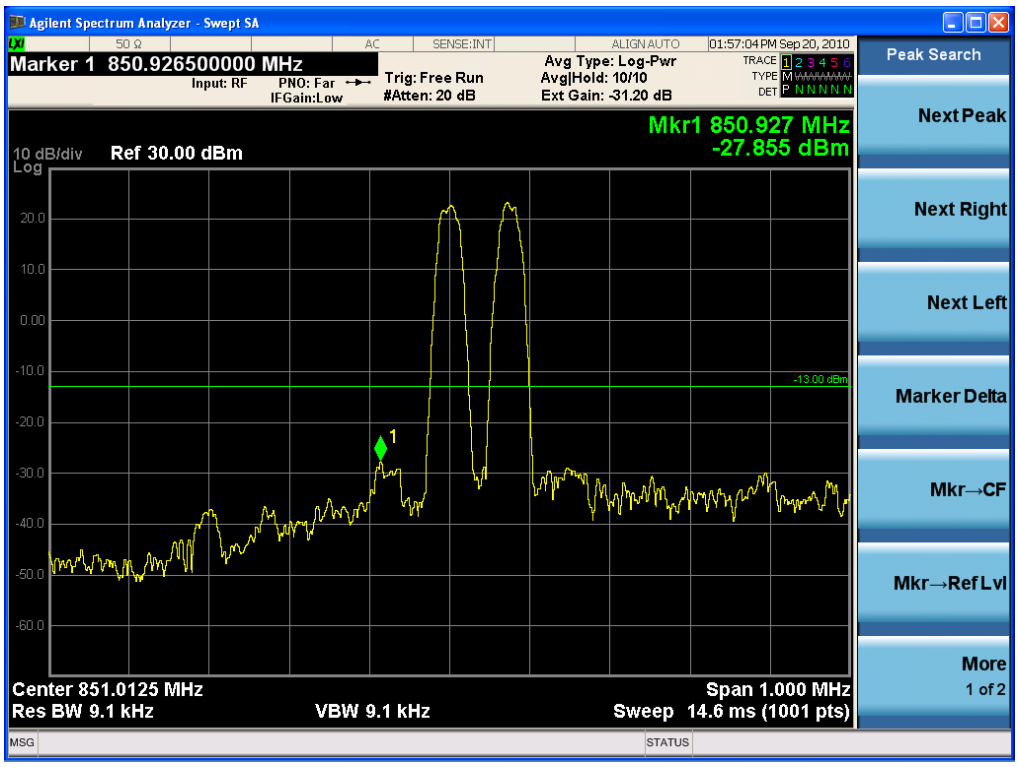
Conducted Spurious Emissions Uplink Mid CH (1 GHz – 26.5 GHz)



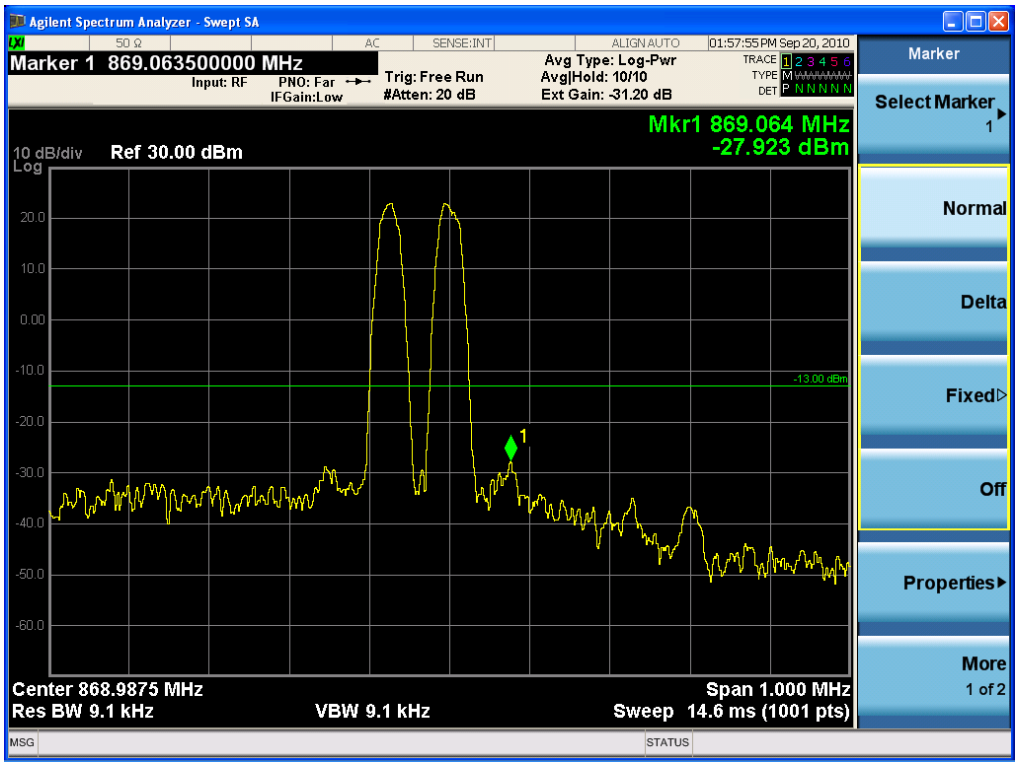
Conducted Spurious Emissions Uplink High CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Uplink High CH (1 GHz – 26.5 GHz)

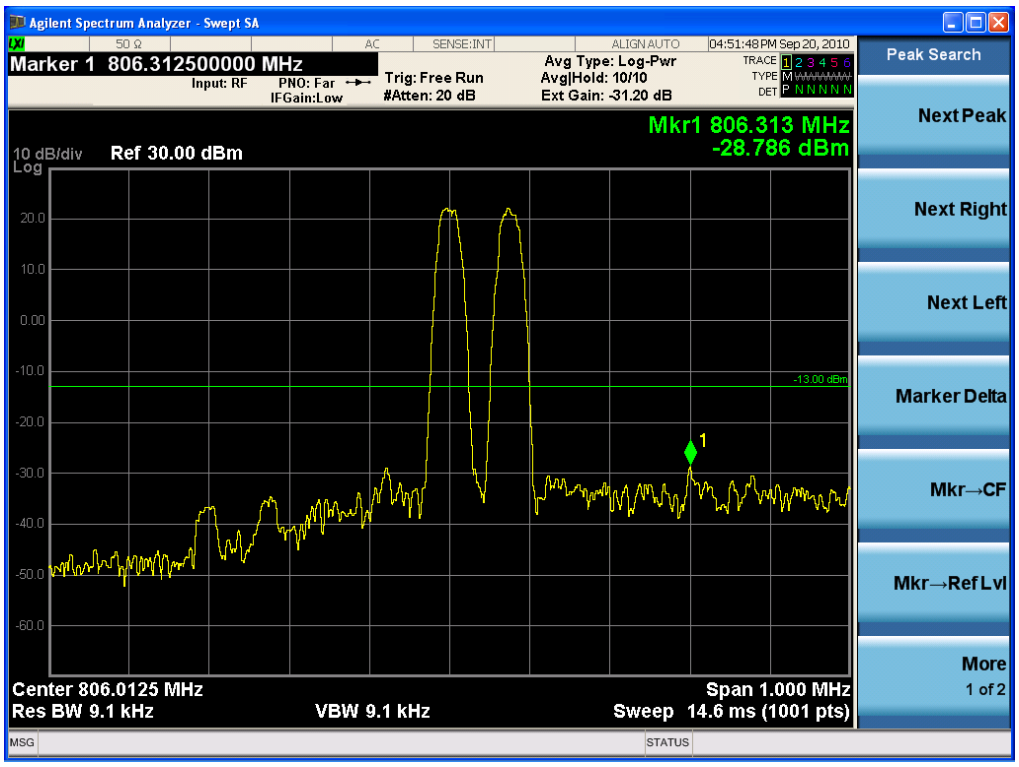
Plots of Two Tone Intermodulation, iDEN 800-18 MHz



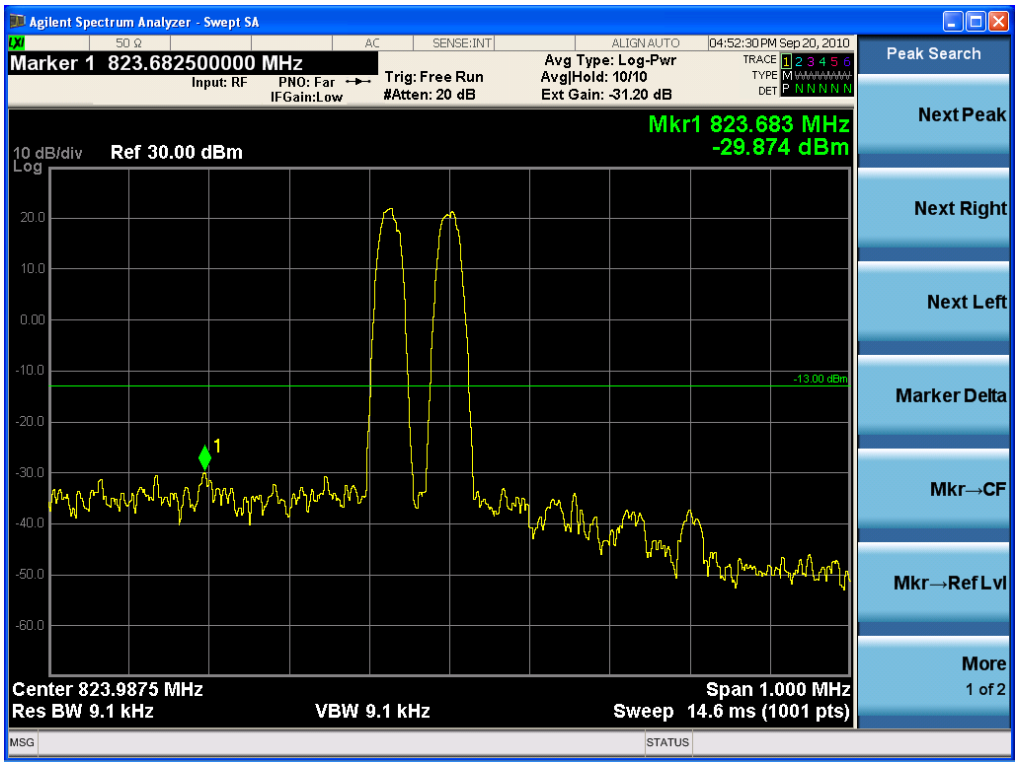
Two Tone Downlink Low End Intermodulation



Two Tone Downlink Hi End Intermodulation

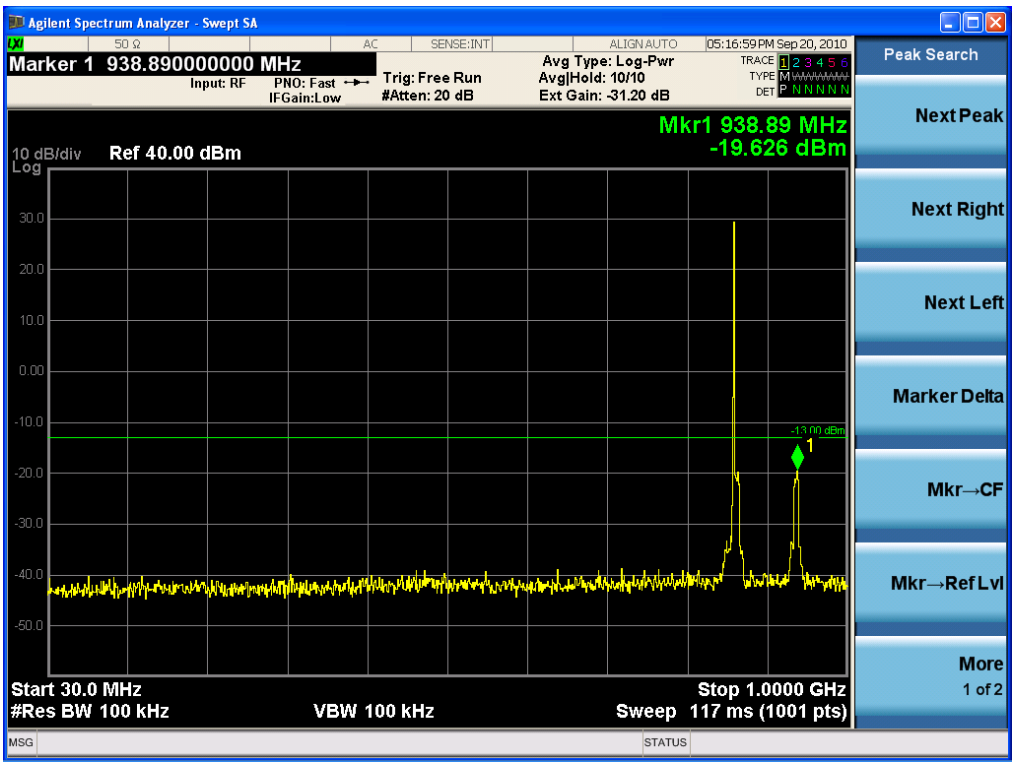


Two Tone Uplink Low End Intermodulation



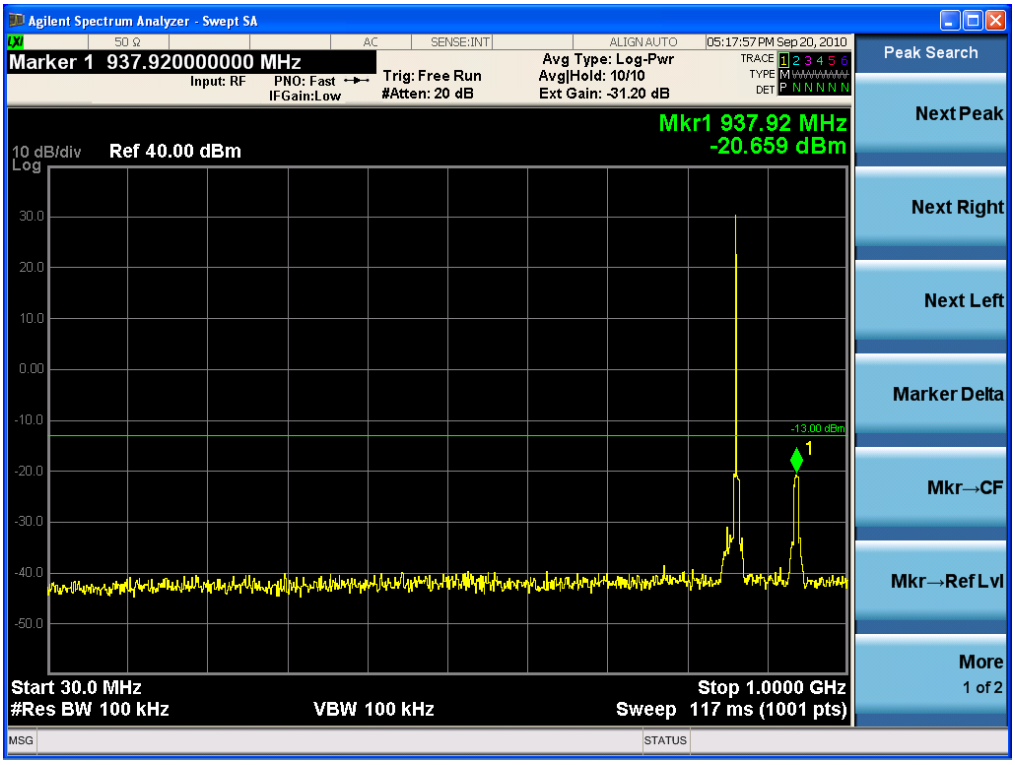
Two Tone Uplink Hi End Intermodulation

Plots of Spurious Emission, iDEN800-7 MHz



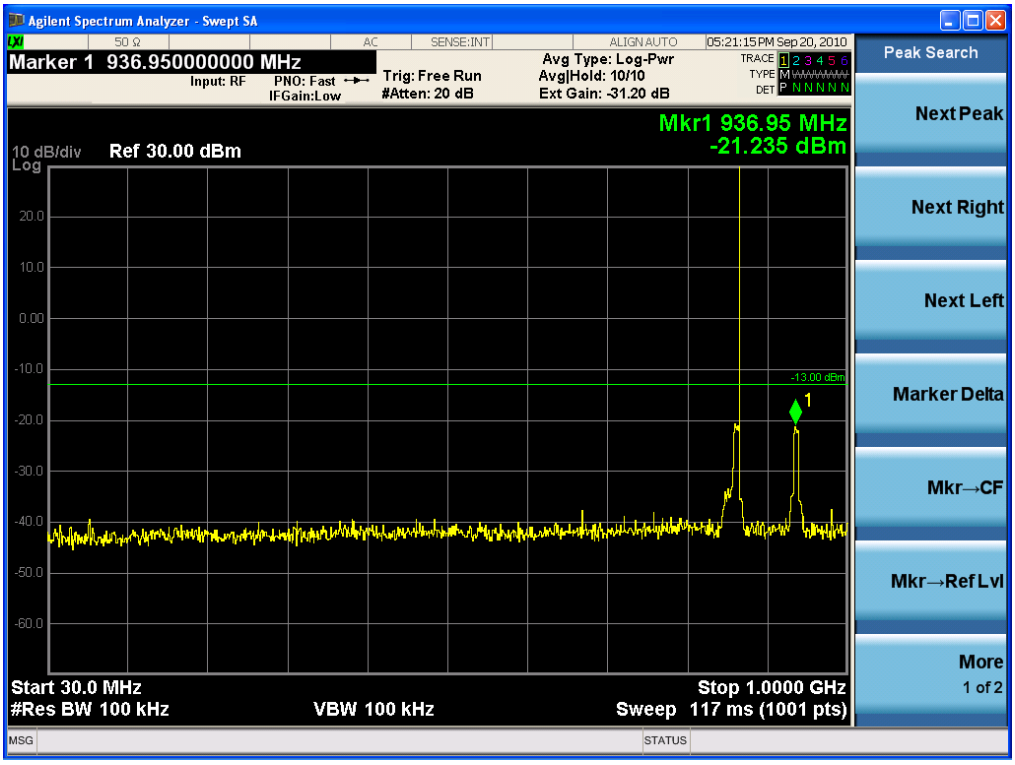
Conducted Spurious Emissions Downlink Low CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink Low CH (1 GHz – 26.5 GHz)



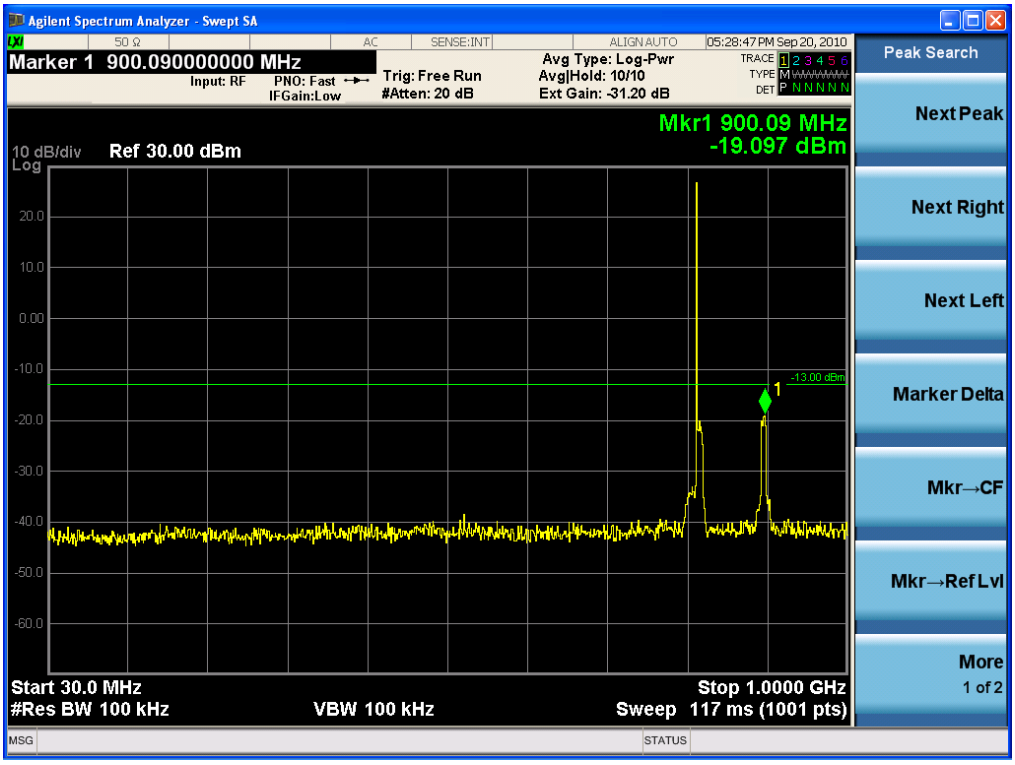
Conducted Spurious Emissions Downlink Mid CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink Mid CH (1 GHz – 26.5 GHz)



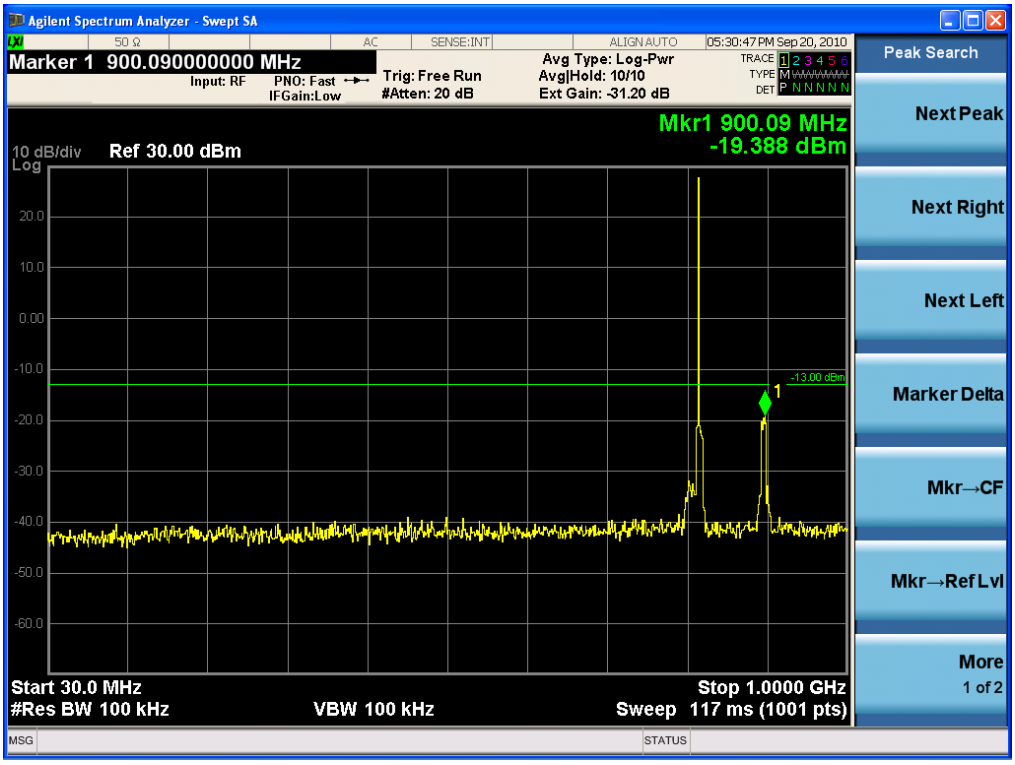
Conducted Spurious Emissions Downlink High CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink High CH (1 GHz – 26.5 GHz)

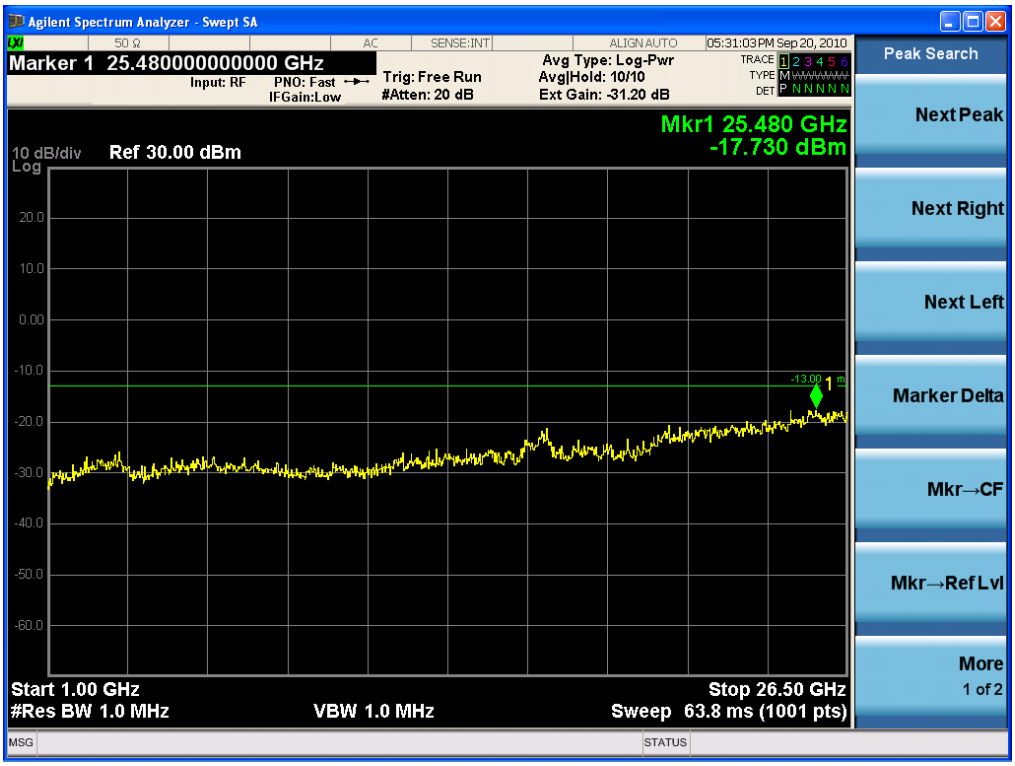


Conducted Spurious Emissions Uplink Low CH (30 MHz – 1 GHz)

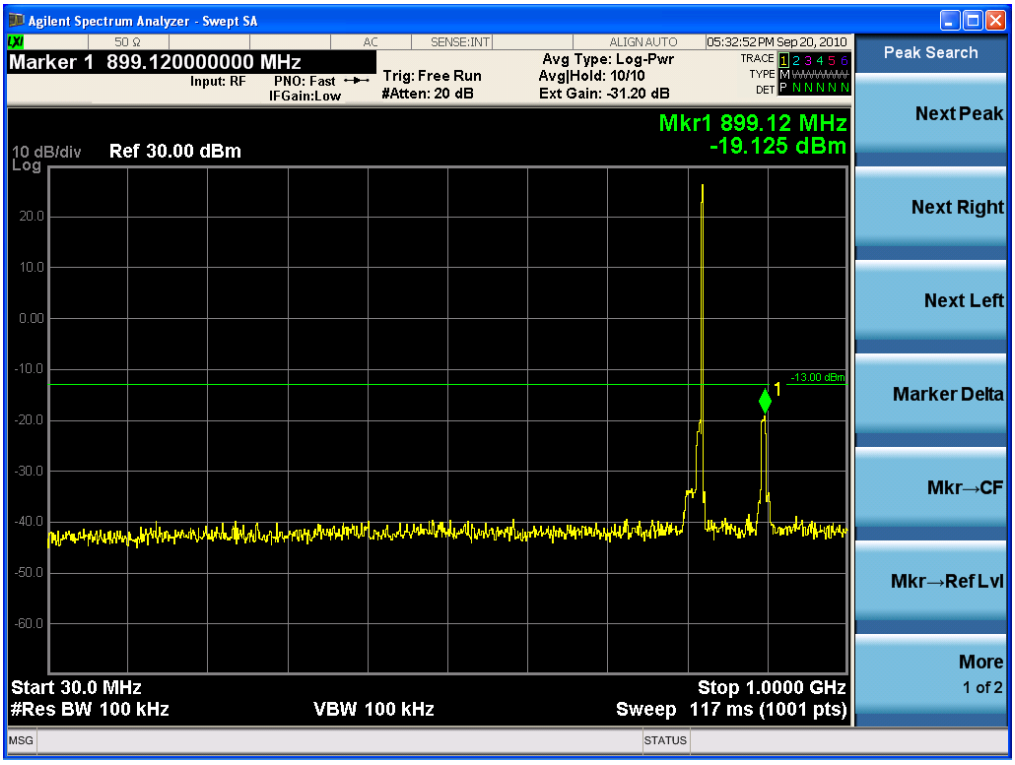
Conducted Spurious Emissions Uplink Low CH (1 GHz – 26.5 GHz)



Conducted Spurious Emissions Uplink Mid CH (30 MHz – 1 GHz)



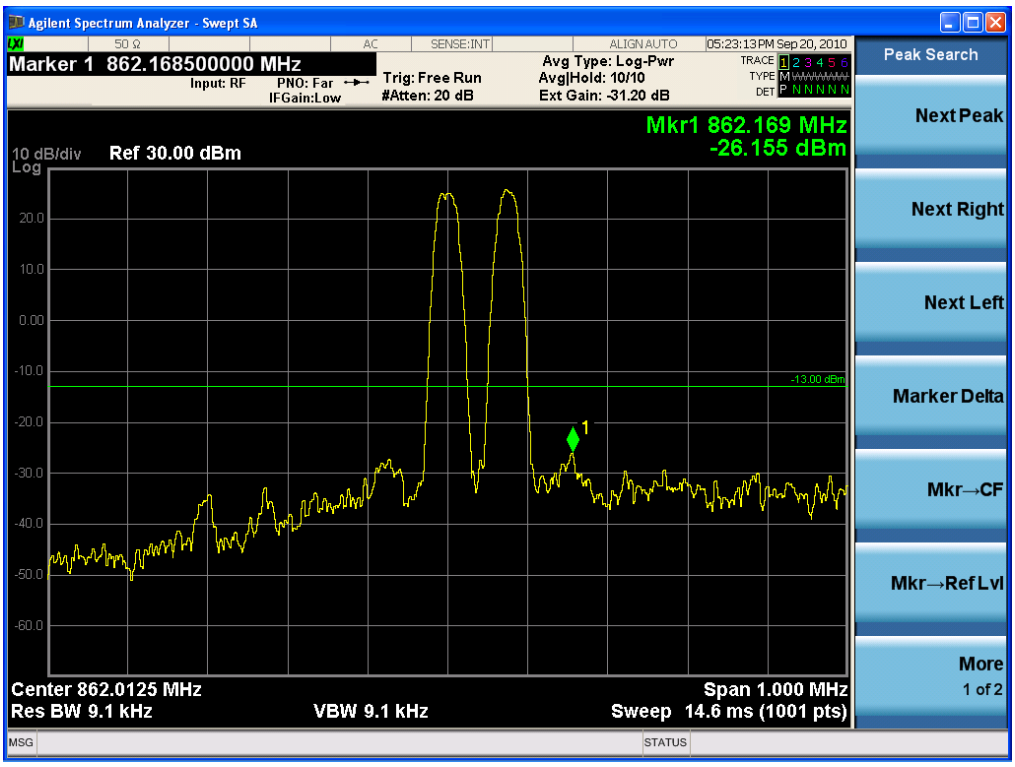
Conducted Spurious Emissions Uplink Mid CH (1 GHz – 26.5 GHz)



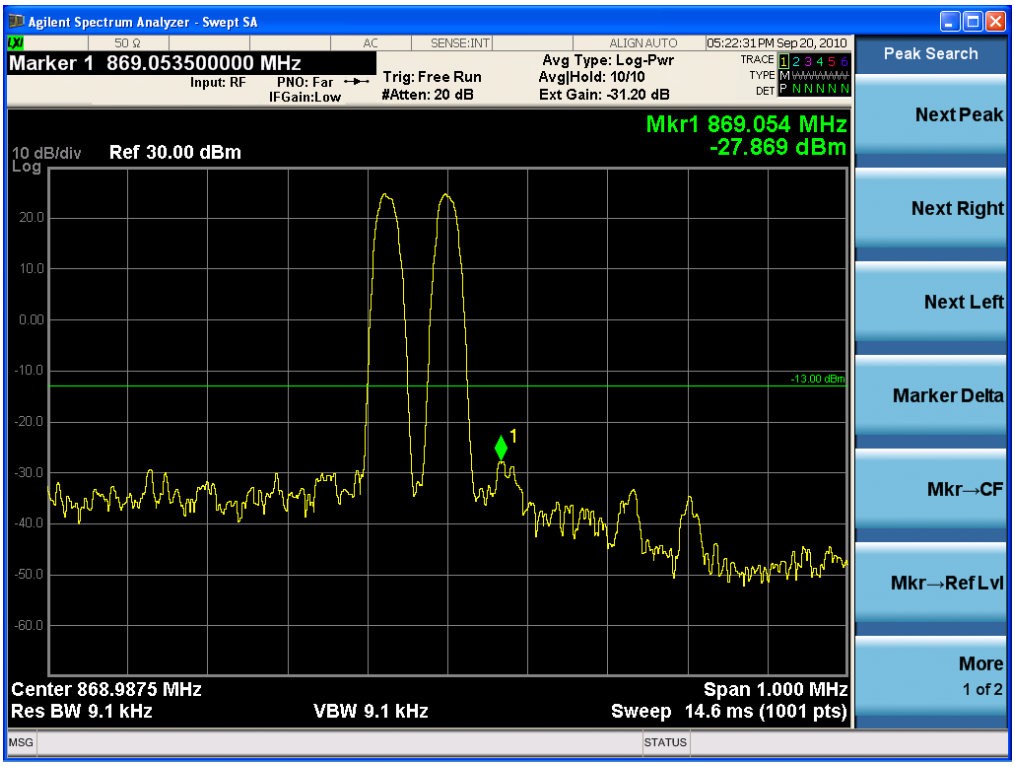
Conducted Spurious Emissions Uplink High CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Uplink High CH (1 GHz – 26.5 GHz)

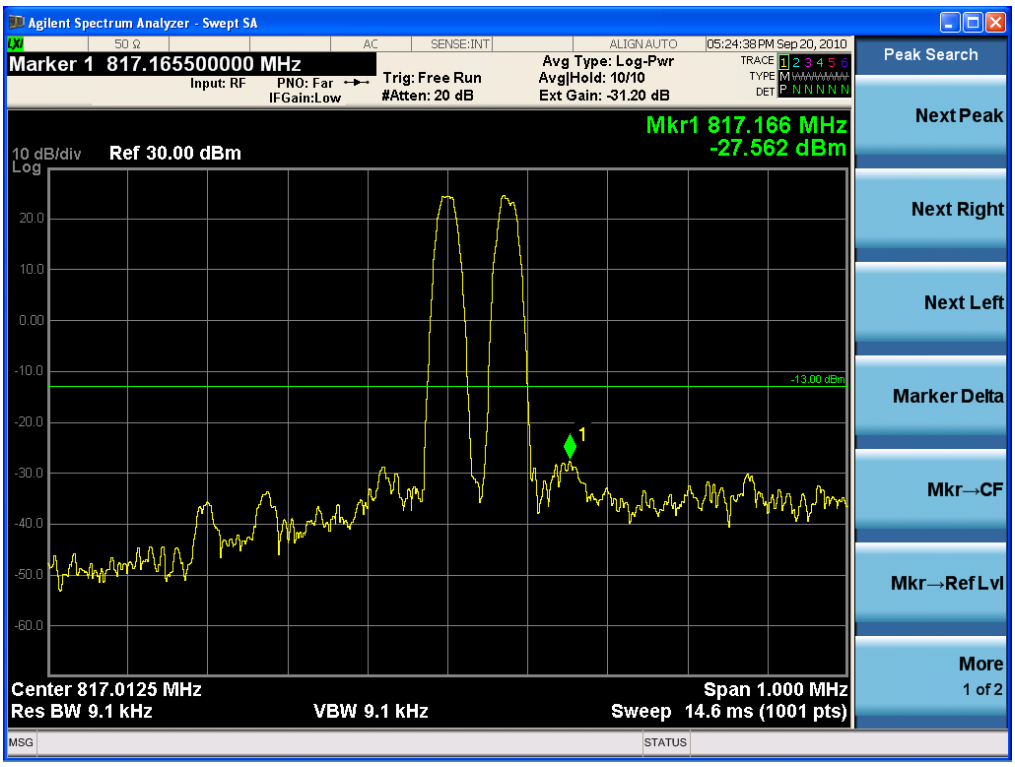
Plots of Two Tone Intermodulation, iDEN 800-7 MHz



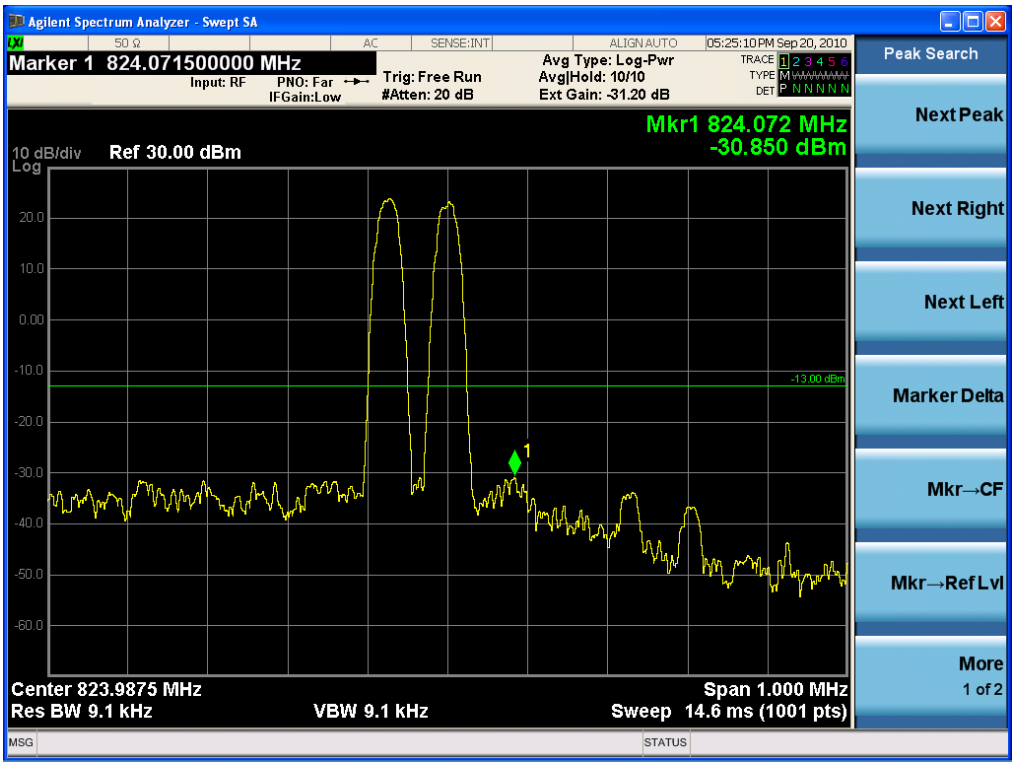
Two Tone Downlink Low End Intermodulation



Two Tone Downlink Hi End Intermodulation

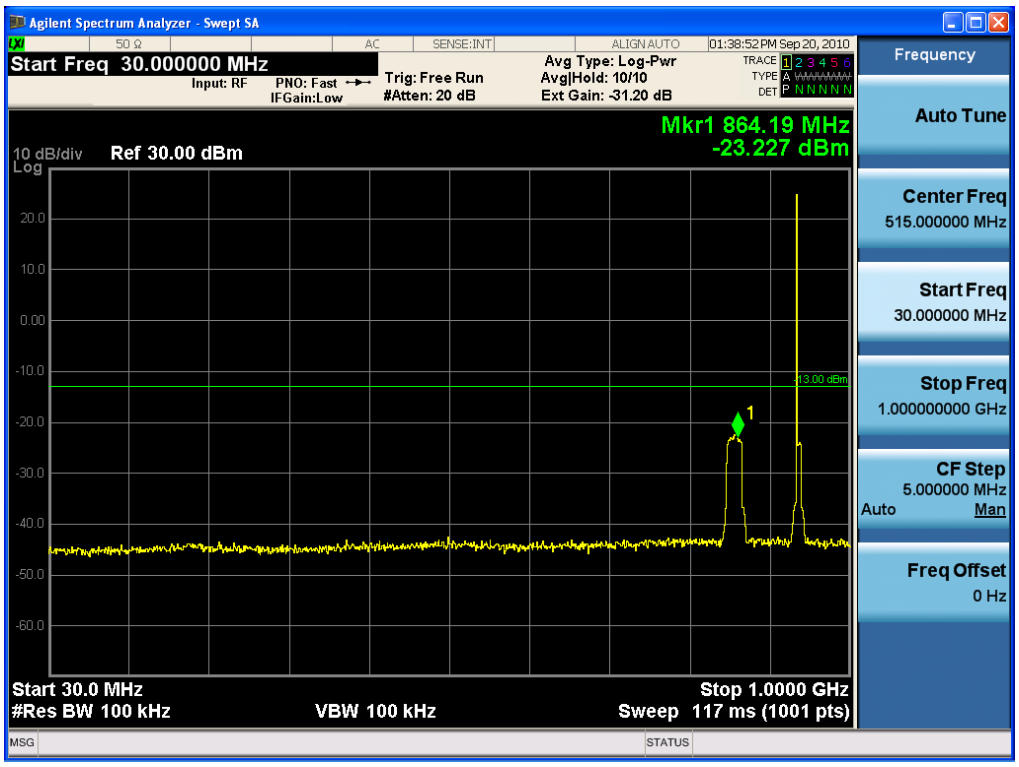


Two Tone Uplink Low End Intermodulation



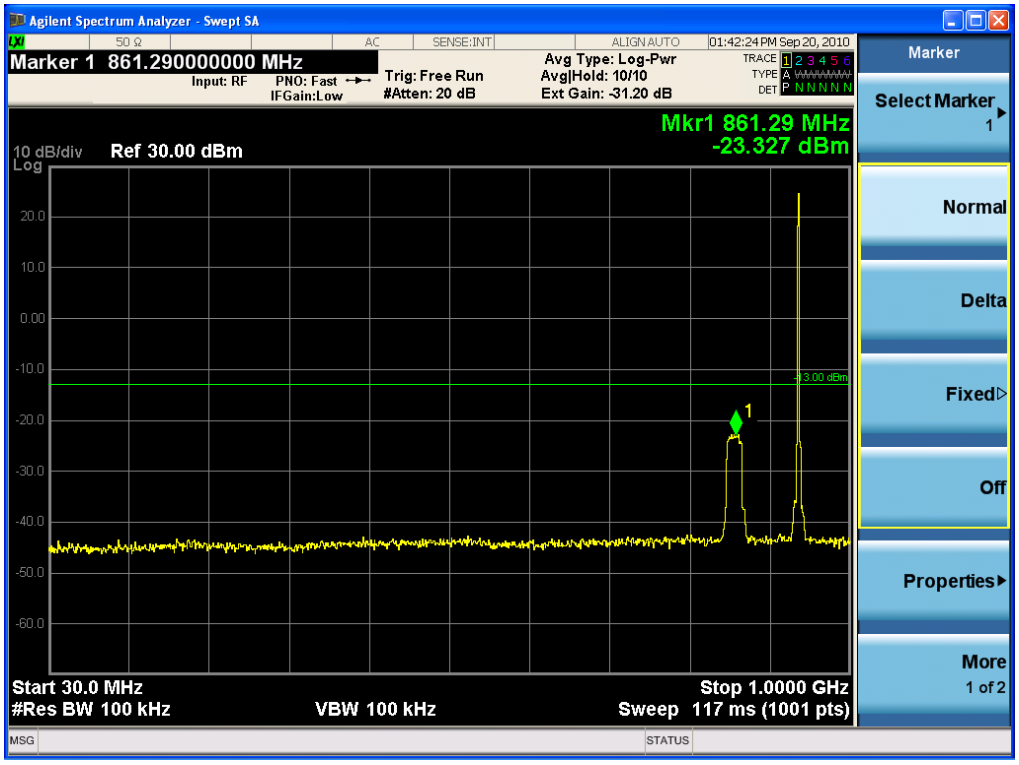
Two Tone Uplink Hi End Intermodulation

Plots of Spurious Emission, iDEN900



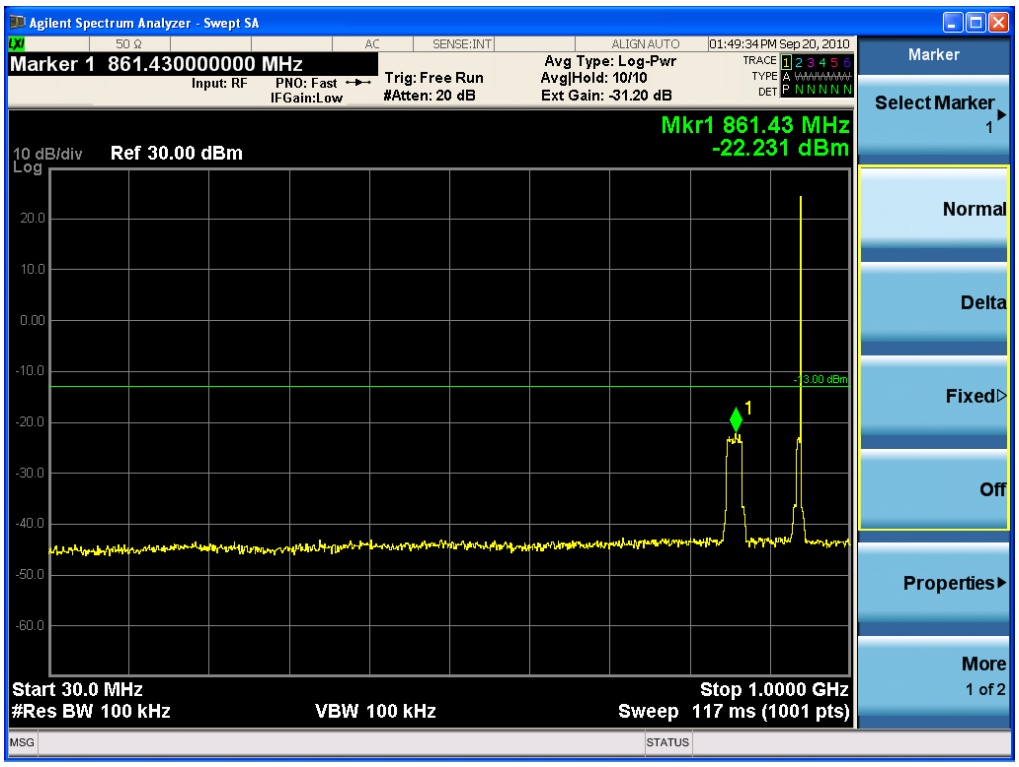
Conducted Spurious Emissions Downlink Low CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink Low CH (1 GHz – 26.5 GHz)



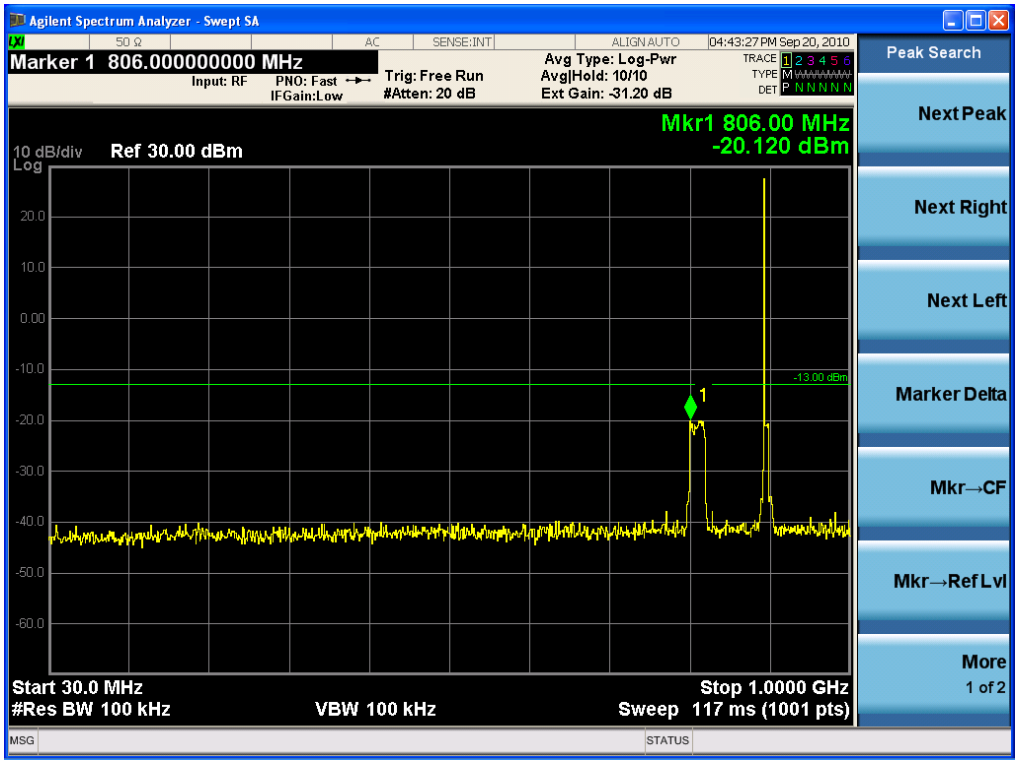
Conducted Spurious Emissions Downlink Mid CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink Mid CH (1 GHz – 26.5 GHz)



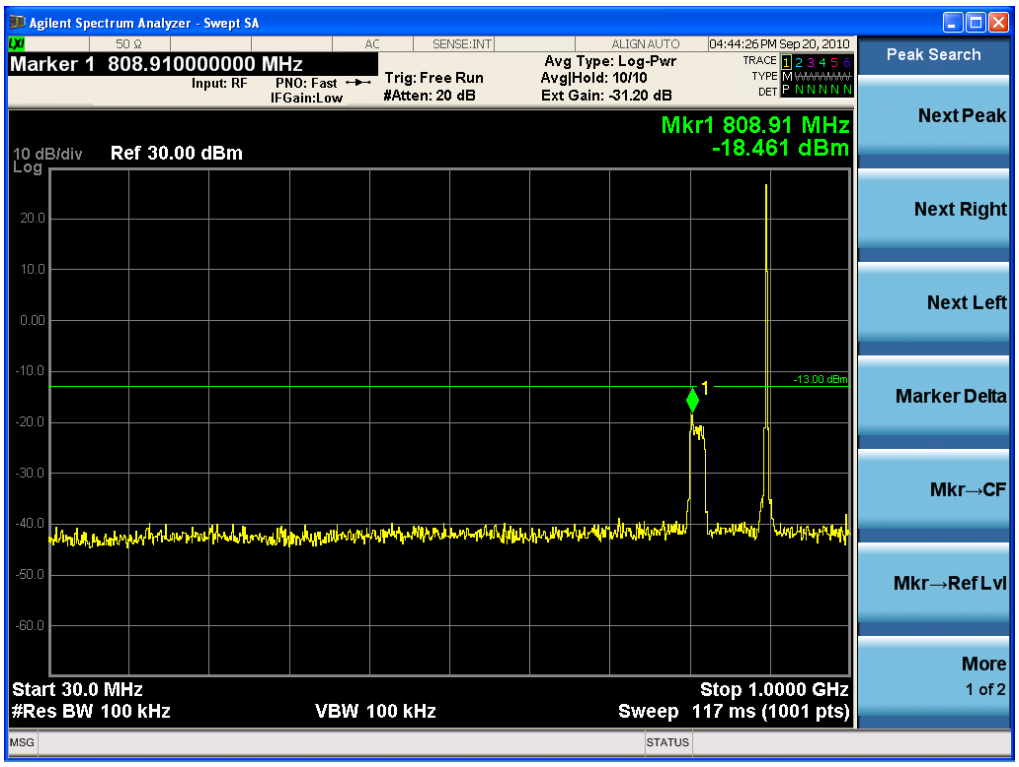
Conducted Spurious Emissions Downlink High CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Downlink High CH (1 GHz – 26.5 GHz)



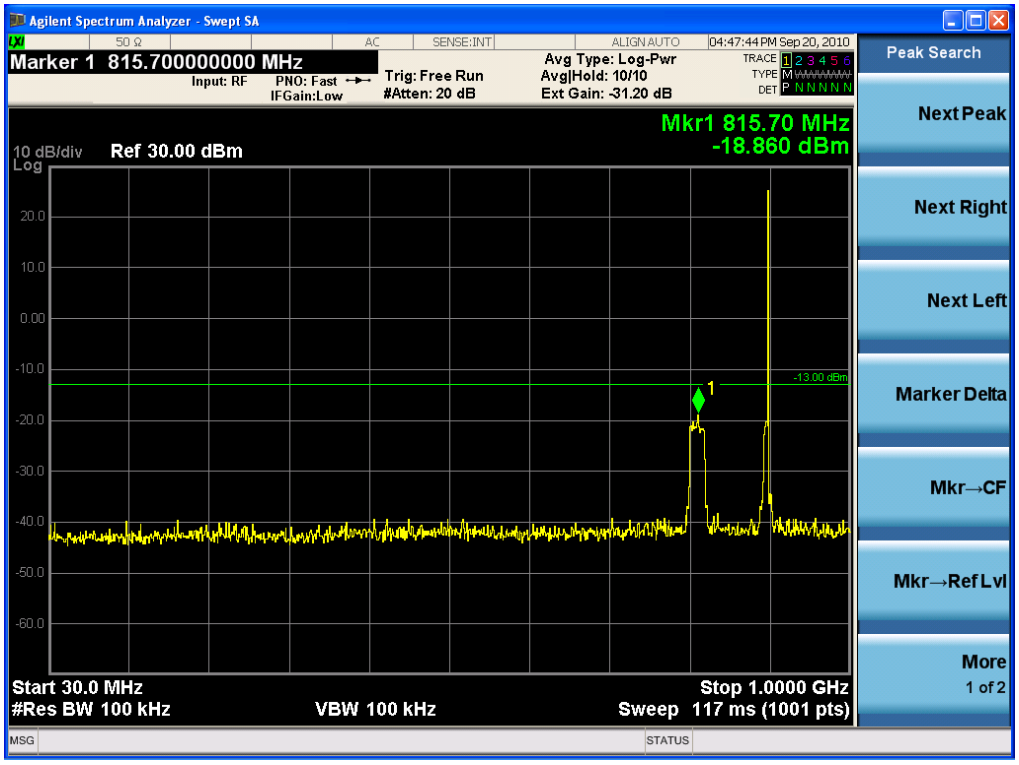
Conducted Spurious Emissions Uplink Low CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Uplink Low CH (1 GHz – 26.5 GHz)



Conducted Spurious Emissions Uplink Mid CH (30 MHz – 1 GHz)

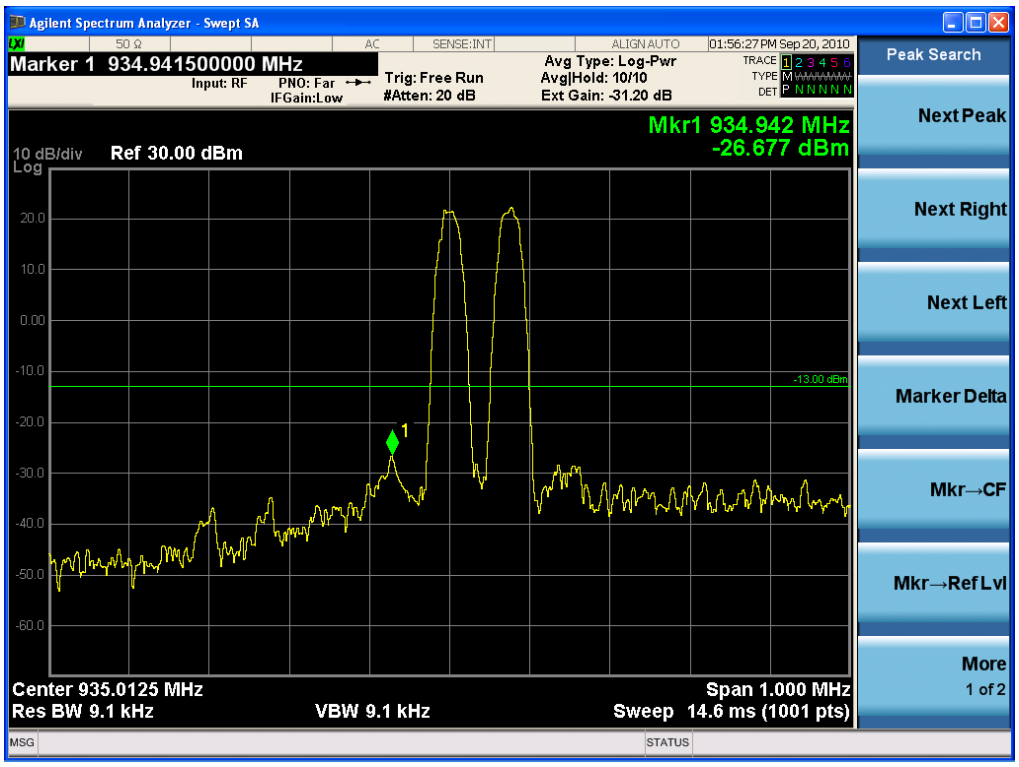
Conducted Spurious Emissions Uplink Mid CH (1 GHz – 26.5 GHz)



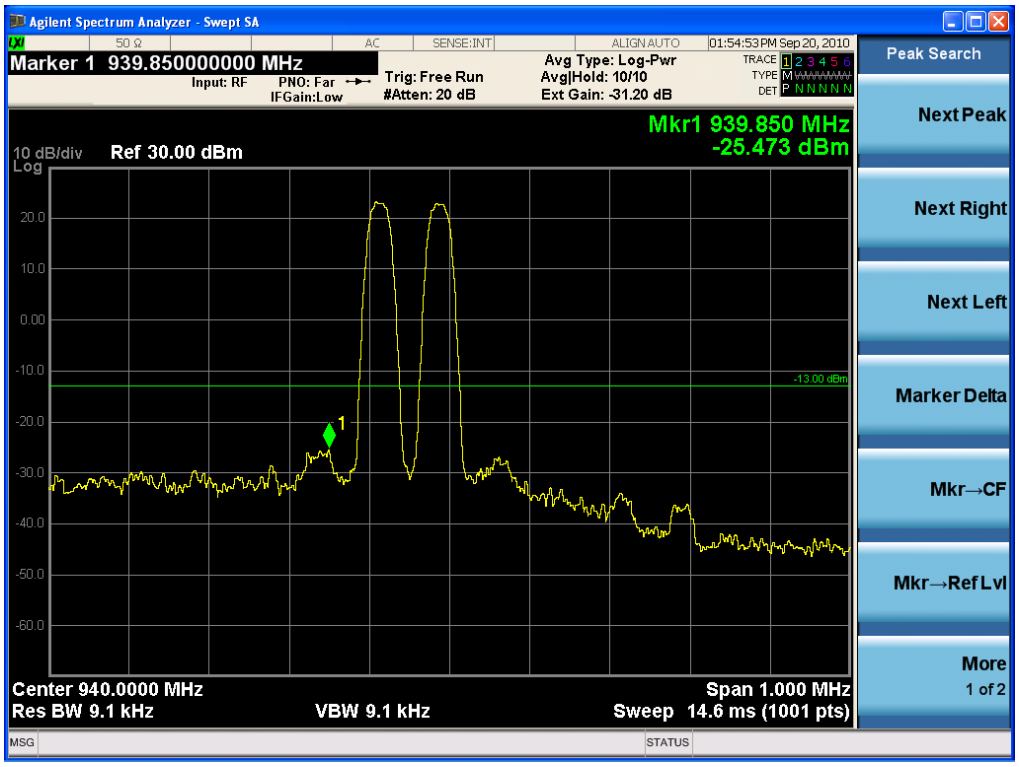
Conducted Spurious Emissions Uplink High CH (30 MHz – 1 GHz)

Conducted Spurious Emissions Uplink High CH (1 GHz – 26.5 GHz)

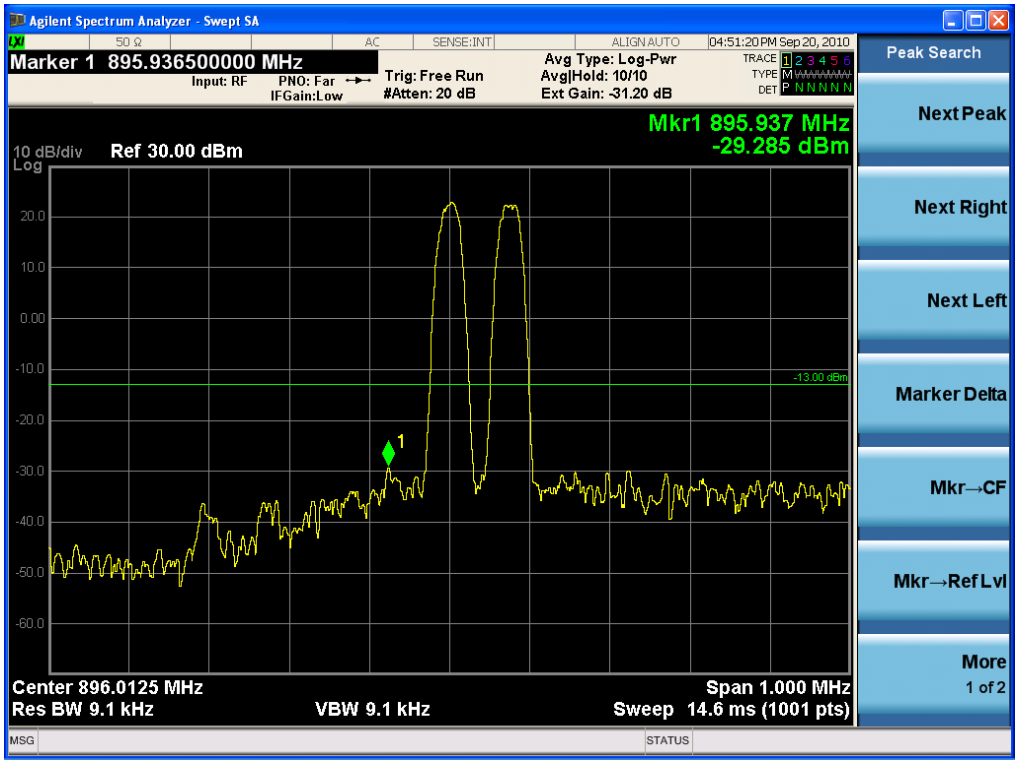
Plots of Two Tone Intermodulation, iDEN 900



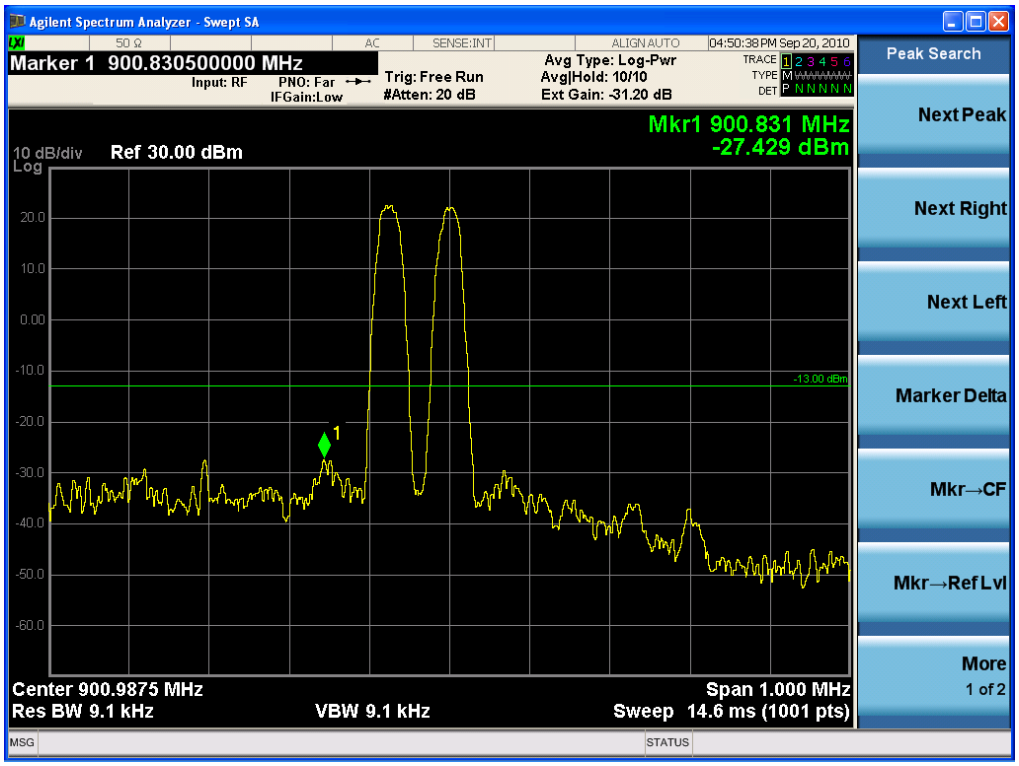
Two Tone Downlink Low End Intermodulation



Two Tone Downlink Hi End Intermodulation



Two Tone Uplink Low End Intermodulation



Two Tone Uplink Hi End Intermodulation

9. 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.

§ 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.

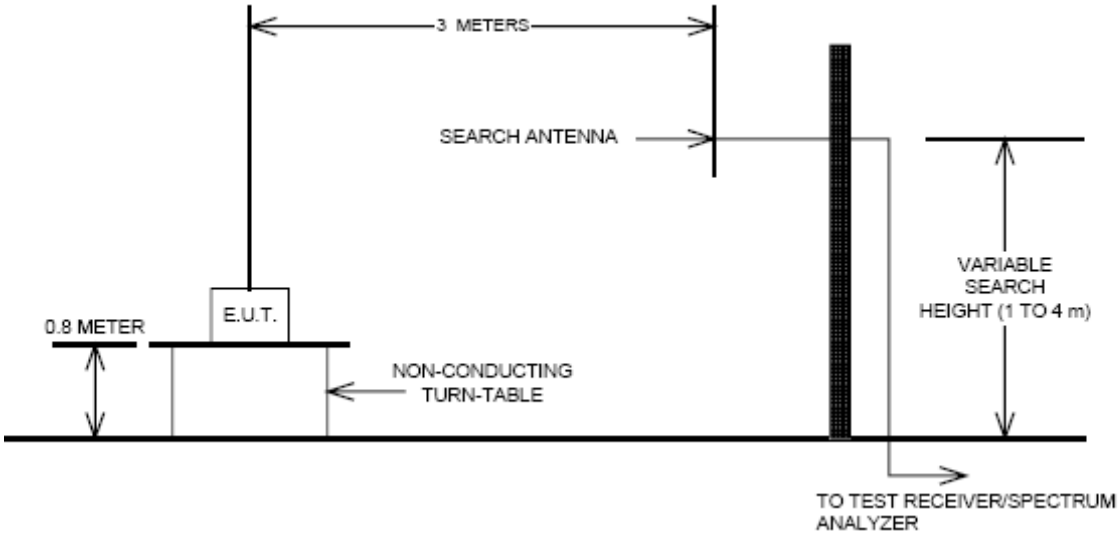
§ 24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P).

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 10 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 1-4m 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.

Test Results: There were no emissions detected above the noise floor which was at least 20 dB below the limit.

Radiated Spurious Emissions Test Setup



[iDEN 800]

Mode	Frequency	Freq.(MHz)	Substitute Level [dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
DOWN-LINK	858.6125	1717.225	-50.5	7.4868	2.40	H	-45.4132	-32.4132
		2575.8375	-48.0	8.2643	4.67	H	-44.4057	-31.4057
UPLINK	813.6125	1627.225	-51.0	7.0593	2.35	H	-46.2907	-33.2907
		2440.8375	-49.0	8.1163	4.29	H	-45.1737	-32.1737

[iDEN 900]

Mode	Frequency	Freq.(MHz)	Substitute Level [dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
DOWN-LINK	937.5	1875.0	-50.0	7.9025	2.52	H	-44.6175	-31.6175
		2812.5	-48.5	8.6525	3.12	H	-42.9675	-29.9675
UPLINK	898.5	1797.0	-51.0	7.8657	2.49	H	-45.6243	-32.6243
		2695.5	-48.5	8.4606	3.39	H	-43.4294	-30.4294

[PCS 1800]

Mode	Frequency	Freq.(MHz)	Substitute Level [dBm]	Ant. Gain (dBd)	C.L	Pol.	ERP (dBm)	Margin (dB)
DOWN-LINK	1962.5	3925.0	-46.5	10.369	3.39	H	-39.521	-26.521
		5887.5	-44.0	10.7303	4.45	H	-37.7197	-24.7197
UPLINK	1882.5	3765.0	-47.0	10.313	3.41	H	-40.097	-27.097
		5647.5	-45.5	10.7303	4.36	H	-39.1297	-26.1297

10. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

Test Requirement(s):

§2.1055(a)(1) §90.213

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 ℃ increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -30 to 50 ℃.

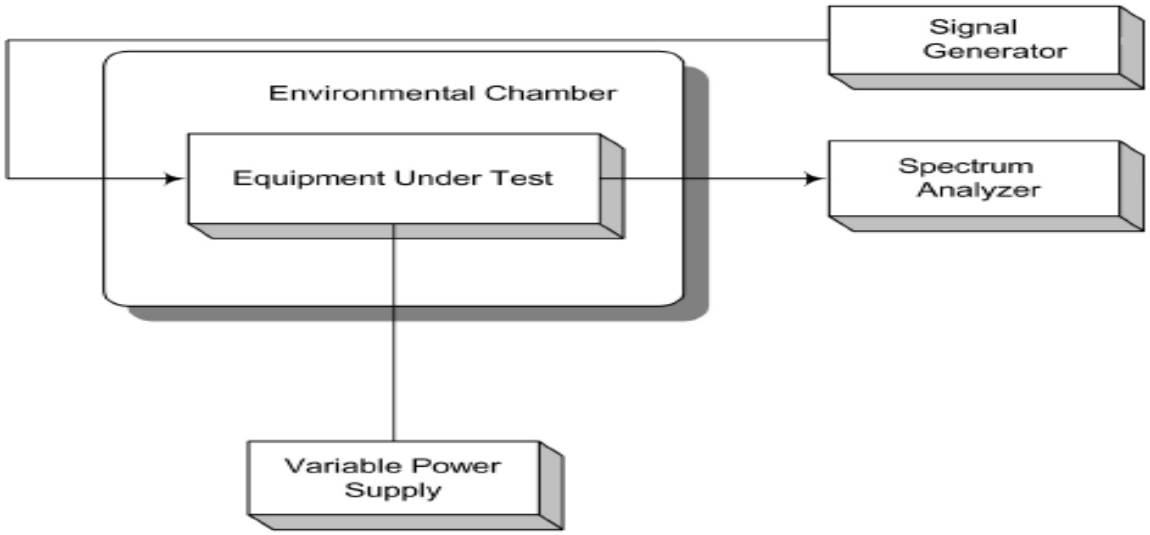
Voltage supplied to EUT is 120 Vac reference temperature was done at 20℃. The voltage was varied by ± 15 % of nominal

Test Results:

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

NOTE: The EUT is a band selective repeater. The test was performed using all selective bands and there was not much difference between them. The test result is reported using the widest bands.

Test Setup:



Frequency Stability and Voltage Test Results

Reference: 120 Vac at 20°C **Freq.** = 1882.500045 MHz

Temperature (Celsius)	Measured Freq (MHz)	Drift ppm
50	1882.500059	0.000017
40	1882.500051	0.000010
30	1882.500042	0.000005
20	Reference	
10	1882.500037	- 0.000007
0	1882.500020	- 0.000023
-10	1882.500016	- 0.000028
-20	1882.500003	- 0.000040
-30	1882.499997	- 0.000045

Reference: 120 Vac at 20°C **Freq.** = 1882.500045 MHz

Voltage(dc) +/-15% Ref	Measured Freq (MHz)	Drift (Hz)
102	1882.500012	0.000035
138	1882.500049	0.000004

Uplink Mid CH CDMA

Reference: 120 Vac at 20°C **Freq.** = 1962.499983 MHz

Temperature (Celsius)	Measured Freq (MHz)	Drift Ppm
50	1962.499977	- 0.000007
40	1962.499965	- 0.000019
30	1962.499960	- 0.000024
20	Reference	
10	1962.499987	0.000005
0	1962.499991	0.000009
-10	1962.499998	0.000016
-20	1962.500007	0.000025
-30	1962.500011	0.000029

Reference: 120 Vac at 20°C Freq. = 1962.499983 **MHz**

Voltage(dc) +/-15% Ref	Measured Freq (MHz)	Drift (Hz)
102	1962.499977	- 0.000017
138	1962.499997	- 0.000007

Downlink Mid CH CDMA

Reference: 120 Vac at 20°C **Freq.** = 813.612463 MHz

Temperature (Celsius)	Measured Freq (MHz)	Drift ppm
50	813.612479	0.000017
40	813.612470	0.000010
30	813.612468	0.000006
20	Reference	
10	813.612460	- 0.000004
0	813.612457	- 0.000008
-10	813.612451	- 0.000013
-20	813.612448	- 0.000017
-30	813.612443	- 0.000023

Reference: 120 Vac at 20°C **Freq.** = 813.612463 MHz

Voltage(dc) +/-15% Ref	Measured Freq (MHz)	Drift (Hz)
102	813.612458	- 0.000006
138	813.612470	- 0.000008

Uplink Mid CH, iDEN 800

Reference: 120 Vac at 20°C **Freq.** = 858.612488 MHz

Temperature (Celsius)	Measured Freq (MHz)	Drift ppm
50	858.612495	0.000009
40	858.612490	0.000005
30	858.612487	- 0.000002
20	Reference	
10	858.612478	- 0.000011
0	858.612467	- 0.000023
-10	858.612462	- 0.000027
-20	858.612460	- 0.000029
-30	858.612453	- 0.000037

Reference: 120 Vac at 20°C **Freq.** = 858.612488 MHz

Voltage(dc) +/-15% Ref	Measured Freq (MHz)	Drift (Hz)
102	858.612475	- 0.000014
138	858.612497	0.000011

Downlink Mid CH, iDEN 800

Reference: 120 Vac at 20°C **Freq.** = 898.500006 MHz

Temperature (Celsius)	Measured Freq (MHz)	Drift Ppm
50	898.499988	0.000019
40	898.499984	0.000024
30	898.499991	0.000016
20	Reference	
10	898.499999	0.000008
0	898.499997	0.0000011
-10	898.499982	0.000025
-20	898.499977	0.000030
-30	898.499979	0.000029

Reference: 120Vac at 20°C **Freq.** = 898.500006 MHz

Voltage(dc) +/-15% Ref	Measured Freq (MHz)	Drift (Hz)
102	898.499985	0.022
138	898.499995	0.012

Uplink Mid CH, iDEN 900

Reference: 120 Vac at 20°C **Freq.** = 937.499987 MHz

Temperature (Celsius)	Measured Freq (MHz)	Drift Ppm
50	937.499981	0.000005
40	937.499995	-0.000009
30	937.499983	0.000005
20	Reference	
10	937.500003	-0.000017
0	937.499997	-0.000011
-10	937.499983	0.000007
-20	937.499989	-0.000004
-30	937.499992	-0.000006

Reference: 120Vac at 20°C **Freq.** = 937.499987 MHz

Voltage(dc) +/-15% Ref	Measured Freq (MHz)	Drift (Hz)
102	937.499982	0.000004
138	937.499997	-0.000012

Downlink Mid CH, iDEN 900

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. iDen Downlink

Max Peak output Power at antenna input terminal	24.980	dBm
Max Peak output Power at antenna input terminal	314.775	mW
Prediction distance	30.000	cm
Prediction frequency	864.613	MHz
Antenna Gain(typical)	12.000	dBi
Antenna Gain(numeric)	15.849	-
Power density at prediction frequency(S)	0.441	mW/cm^2
MPE limit for uncontrolled exposure at prediction frequency	0.576	mW/cm^2

2-2. PCS Downlink

Max Peak output Power at antenna input terminal	23.98000	dBm
Max Peak output Power at antenna input terminal	250.03454	mW
Prediction distance	30.00000	cm
Prediction frequency	1993.75000	MHz
Antenna Gain(typical)	12.00000	dBi
Antenna Gain(numeric)	15.84893	-
Power density at prediction frequency (S)	0.35039	mW/cm^2
MPE limit for uncontrolled exposure at prediction frequency	1.00000	mW/cm^2

2-3. iDen Uplink

Max Peak output Power at antenna input terminal	25.080	dBm
Max Peak output Power at antenna input terminal	322.107	mW
Prediction distance	30.000	cm
Prediction frequency	819.613	MHz
Antenna Gain(typical)	12.000	dBi
Antenna Gain(numeric)	15.849	-
Power density at prediction frequency(S)	0.451	mW/cm^2
MPE limit for uncontrolled exposure at prediction frequency	0.546	mW/cm^2

2-4. PCS Uplink

Max Peak output Power at antenna input terminal	23.95000	dBm
Max Peak output Power at antenna input terminal	248.31331	mW
Prediction distance	30.00000	cm
Prediction frequency	1851.25000	MHz
Antenna Gain(typical)	12.00000	dBi
Antenna Gain(numeric)	15.84893	-
Power density at prediction frequency (S)	0.34797	mW/cm^2
MPE limit for uncontrolled exposure at prediction frequency	1.00000	mW/cm^2

3. RESULTS

The power density level at 30 cm is 0.451 mW/cm²(iDen UpLink), 0.441 mW/cm²(iDen DownLink), 0.34797 mW/cm²(PCS UpLink), 0.35039 mW/cm²(PCS DownLink), which is below the uncontrolled exposure limit for Cellular & PCS band.

Warning: In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, it must also have a minimum distance of 30 cm from the body during normal operation.