

FCC PART 24E

MEASUREMENT AND TEST REPORT

For

Boston Amplifier, Inc.

2110 Artesia Blvd Suite B-202
Redondo Beach, CA, 90278, USA

FCC ID: T5C-1900603-BDA
Model: BDA-1900-603

Report Type: Original Report	Product Type: Bi-Directional Amplifier
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Report Number: R0807162-24	
Report Date: 2008-09-10	
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* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk “*”

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R0807164-24	Original Report	2008-09-10

1 GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

The Boston Amplifier, Inc. product, model: BDA-1900-603 and FCC ID: T5C-1900603-BDA or the "EUT" as referred to in this report, is a Bi-Directional amplifier that employs GSM and Code Division Multiple Access (CDMA) modulation to transmit at PCS service (1900 MHz).

1.2 Mechanical Description

The EUT Approximate measurement is: 174mm (L) x 103 mm (W) x 47 mm (H). It is of metallic construction.

** The test data gathered are from typical production sample, serial number: 72085, provided by the manufacturer.*

1.3 EUT Photo



Please see additional photos in Exhibit C

1.4 Objective

This type approval report is prepared on behalf of Boston Amplifier, Inc. in accordance with Part 2, Subpart J, Part 24 Subpart E, of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC rules for RF output power, modulation characteristic, occupied bandwidth, spurious emissions at antenna terminal, field strength of spurious radiation, frequency stability, band edge, and conducted and radiated margin.

1.5 Related Submittal(s)/Grant(s)

No Related Submittals

1.6 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

Part 24 Subpart E - Public Mobile Services

Applicable Standards: TIA EIA 98-C, TIA/EIA603-C, ANSI C63.4-2003.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.7 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values ranging from +2.0 dB for Conducted Emissions tests and +4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

Detailed instrumentation measurement uncertainties can be found in BACL Corp. report QAP-018.

1.8 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at <http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm>

2 SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT was configured for testing according to TIA/EIA-603-C.

The final qualification test was performed with the EUT operating at normal mode.

2.2 EUT Exercise Software

NA, signal was sent through EUT using a signal generator, device was set to normal operating mode.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number
BOSTON Amplifier, Inc.	AC/DC Switch Adapter	BDA-13	3037251

2.5 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Midwest Microwave	10dB attenuator pad	ATT-0263-10-000-02	N/A

2.6 Interface Ports and Cabling

Cable Description	Length (m)	From	To
RF cable	0.2	Signal Generator	Input/ EUT
RF cable	0.2	Output/ EUT	Spectrum analyzer

3 SUMMARY OF TEST RESULTS

FCC Rules	Description of Tests	Results
§ 2.1047	Modulation Characteristics	N/A
§ 2.1053	Field Strength of Spurious Radiation	Compliant
§2.1091	RF Exposure	Compliant
§ 2.1046, § 24.232	RF Output Power	Compliant
§ 2.1049 § 24.238 (b)	Occupied Bandwidth	Compliant
§ 2.1051, § 24.238 (a)	Spurious Emissions at Antenna Terminals	Compliant
§ 24.238 (a)	Band Edge	Compliant
§ 2.1055	Frequency Stability	N/A

4 §2.1047 - MODULATION CHARACTERISTIC

4.1 Applicable Standard

According to FCC § 2.1047(d) and part 24E, there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

4.2 Test Result

N/A

5 §1.1307(b) (1) & §2.1091 - RF EXPOSURE

5.1 Applicable Standard

According to §1.1310 and §2.1091 (Mobile Devices) RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
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

5.2 MPE Prediction

Predication of MPE limit at a given distance

EQUATION FROM PAGE 18 OF OET BULLETIN 65, EDITION 97-01

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

Where: 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

CDMA Mode

Uplink:

Maximum peak output power at antenna input terminal (dBm): 18.35

Maximum peak output power at antenna input terminal (mW): 68.39

Prediction distance (cm): 80

Prediction frequency (MHz): 1880

Antenna Gain, typical (dBi): 12

Maximum Antenna Gain (numeric): 15.85

Power density at predication frequency and distance (mW/cm²): 0.0135

MPE limit for uncontrolled exposure at predication frequency (mW/cm²): 1.000

Downlink:

Maximum peak output power at antenna input terminal (dBm):	4.12
Maximum peak output power at antenna input terminal (mW):	2.58
Prediction distance (cm):	80
Prediction frequency (MHz):	1960
Antenna Gain, typical (dBi):	9
Maximum Antenna Gain (numeric):	7.943
Power density at predication frequency and distance (mW/cm ²):	0.0005
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	1.000

GSM Mode**Uplink:**

Maximum peak output power at antenna input terminal (dBm):	20.17
Maximum peak output power at antenna input terminal (mW):	103.99
Prediction distance (cm):	80
Prediction frequency (MHz):	1880
Antenna Gain, typical (dBi):	12
Maximum Antenna Gain (numeric):	15.85
Power density at predication frequency and distance (mW/cm ²):	0.0205
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	1.000

Downlink:

Maximum peak output power at antenna input terminal (dBm):	4.06
Maximum peak output power at antenna input terminal (mW):	2.55
Prediction distance (cm):	80
Prediction frequency (MHz):	1960
Antenna Gain, typical (dBi):	12
Maximum Antenna Gain (numeric):	15.85
Power density at predication frequency and distance (mW/cm ²):	0.0005
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	1.000

5.3 Test Result

The device is compliant with the requirement MPE limit for uncontrolled exposure at predication frequency 1.0 mW/cm². The maximum power density at the distance of 80 cm was 0.0205 mW/cm². Thus, the requirement of at least 80 cm required by the manufacturer is in compliance with the MPE requirement.

6 §2.1053, §24.232 - SPURIOUS RADIATED EMISSIONS

6.1 Applicable Standard

Requirements: CFR 47, § 2.1053, § 24.232.

6.2 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = $10 \lg(\text{TXpwr in Watts}/0.001)$ – the absolute level

Spurious attenuation limit in dB = $43 + 10 \log_{10}(\text{power out in Watts})$

6.3 Environmental Conditions

Temperature:	23 °C
Relative Humidity:	44 %
ATM Pressure:	101.1kPa

** The testing was performed by Victor Zhang on 2008-08-22*

6.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Mini-Circuits	Pre amplifier	ZKL-2	7786100643	2008-01-02
HP	Pre amplifier	8449B	3147A00400	2007-11-05
Sunol Sciences Corp	Combination Antenna	JB1 Antenna	A103105-3	2008-04-01
A. H. Systems	Antenna, Horn, DRG	SAS-200/571	261	2008-07-14
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-05-07
A.R.A.	Antenna, Horn	DRG-118/A	1132	2008-08-07

* **Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

6.5 Summary of Test Results

Worst case reading as follows:

6.5.1 CDMA

Mode: Downlink			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Input Frequency
-14.44	3920	Vertical	1960 MHz

Mode: Uplink			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Input Frequency
-10.88	3760	Vertical	1880 MHz

6.5.2 GSM

Mode: Downlink			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Input Frequency
-19.17	3920	Vertical	1960 MHz

Mode: Uplink			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Input Frequency
-13.28	5640	Vertical	1880 MHz

6.6 Test Data

6.6.1 CDMA

Downlink

Input frequency = 1960 MHz

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (m)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)		
3920	59.85	243	1.00	V	3920	-36.65	10.6	1.39	-27.44	-13	-14.44
3920	49.24	220	1.05	H	3920	-47.34	10.6	1.39	-38.13	-13	-25.13
5880	41.22	245	1.03	V	5880	-51.20	10.4	1.84	-42.64	-13	-29.64
5880	36.97	200	1.00	H	5880	-55.26	10.4	1.84	-46.70	-13	-33.70

Uplink

Input frequency = 1880 MHz

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (m)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)		
3760	62.58	216	1.69	V	3760	-33.09	10.6	1.39	-23.88	-13	-10.88
5640	59.55	201	1.45	V	5640	-33.73	10.4	1.84	-25.17	-13	-12.17
5640	58.85	156	1.88	H	5640	-34.43	10.4	1.84	-25.87	-13	-12.87
3760	56.91	143	1.00	H	3760	-38.88	10.6	1.39	-29.59	-13	-16.59

6.6.2 GSM

Downlink

Input frequency = 1960 MHz

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (m)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)		
3920	55.12	265	1.00	v	3920	-41.38	10.6	1.39	-32.17	-13	-19.17
3920	47.36	219	1.98	h	3920	-49.22	10.6	1.39	-40.01	-13	-27.01
5880	41.25	248	1.00	v	5880	-51.17	10.4	1.84	-42.61	-13	-29.61
5880	36.89	198	1.00	h	5880	-55.34	10.4	1.84	-46.78	-13	-33.78

Uplink

Input frequency = 1880 MHz

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (m)	Polarity (H/V)	Freq. (MHz)	Level (dBm)	Antenna Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)		
5640	58.44	262	1.15	v	5640	-34.84	10.4	1.84	-26.28	-13	-13.28
3760	59.49	214	1.04	v	3760	-36.18	10.6	1.39	-26.97	-13	-13.97
5640	55.12	157	1.87	h	5640	-38.16	10.4	1.84	-29.6	-13	-16.6
3760	54.66	144	1	h	3760	-41.05	10.6	1.39	-31.84	-13	-18.84

7 §2.1046, §24.232 – RF OUTPUT POWER

7.1 Applicable Standard

According to FCC §2.1046 and §24.232, output power is limited to 7 watts.

7.2 Test Procedure

Conducted:

The RF output of the transmitter was connected to the signal generator and the spectrum analyzer through sufficient attenuation.

7.3 Environmental Conditions

Temperature:	21 °C
Relative Humidity:	50 %
ATM Pressure:	101.7kPa

* The testing was performed by Victor Zhang on 2008-08-11.

7.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-05-07

* **Statement of Traceability:** BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

7.5 Test Results

Mode		Channel	Frequency (MHz)	Output Power (dBm)	Antenna Gain (dBi)	Output Power (E.I.R.P) (dBm)	Limit (E.I.R.P) (dBm)
CDMA	Uplink	Middle	1880	18.35	12	30.35	33
	Downlink	Middle	1960	4.12	12	16.12	33
GSM	Uplink	Middle	1880	20.17	12	32.17	33
	Downlink	Middle	1960	4.06	12	16.06	33

8 §2.1049, §24.238 (b) – OCCUPIED BANDWIDTH

8.1 Applicable Standard

Requirements: CFR 47, Section 2.1049, Section 22.238 (b).

8.2 Test Procedure

The RF output of the transmitter was connected to the simulator and the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 30 kHz (Cellular /PCS) and the 26 dB & 99% bandwidth was recorded.

8.3 Environmental Conditions

Temperature:	22 °C
Relative Humidity:	51 %
ATM Pressure:	101.7kPa

The testing was performed by Victor Zhang on 2008-08-12.

8.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-05-07

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

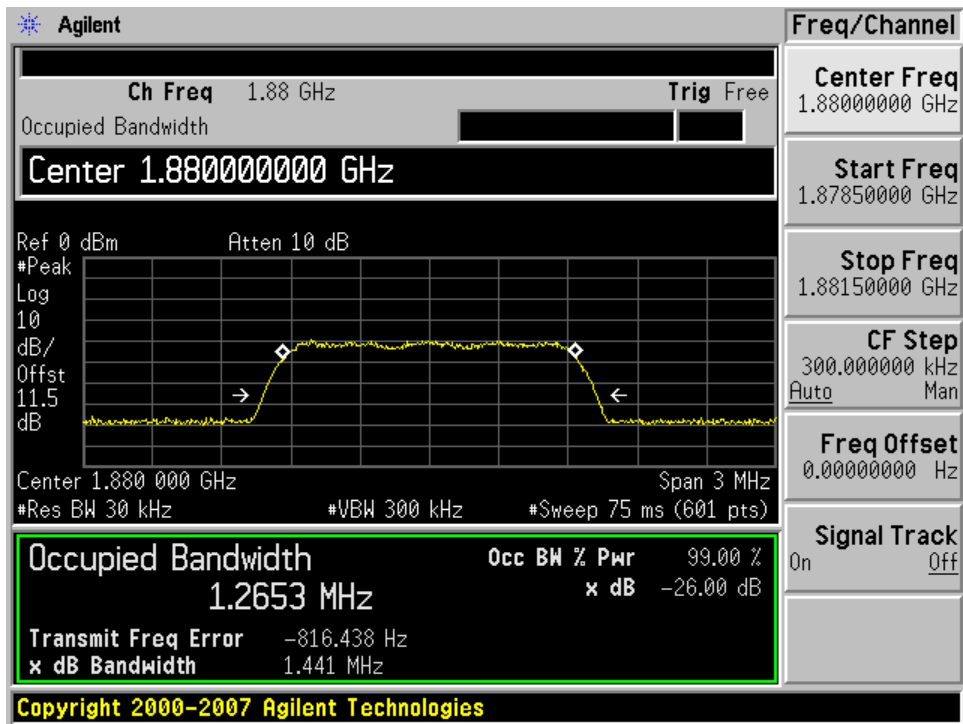
8.5 Summary of Test Results

Mode		Channel	Frequency (MHz)	Emission Bandwidth (kHz)
CDMA	Uplink	Middle	1880	1275.9
	Downlink	Middle	1960	1269.6
GSM	Uplink	Middle	1880	245.0965
	Downlink	Middle	1960	244.9180

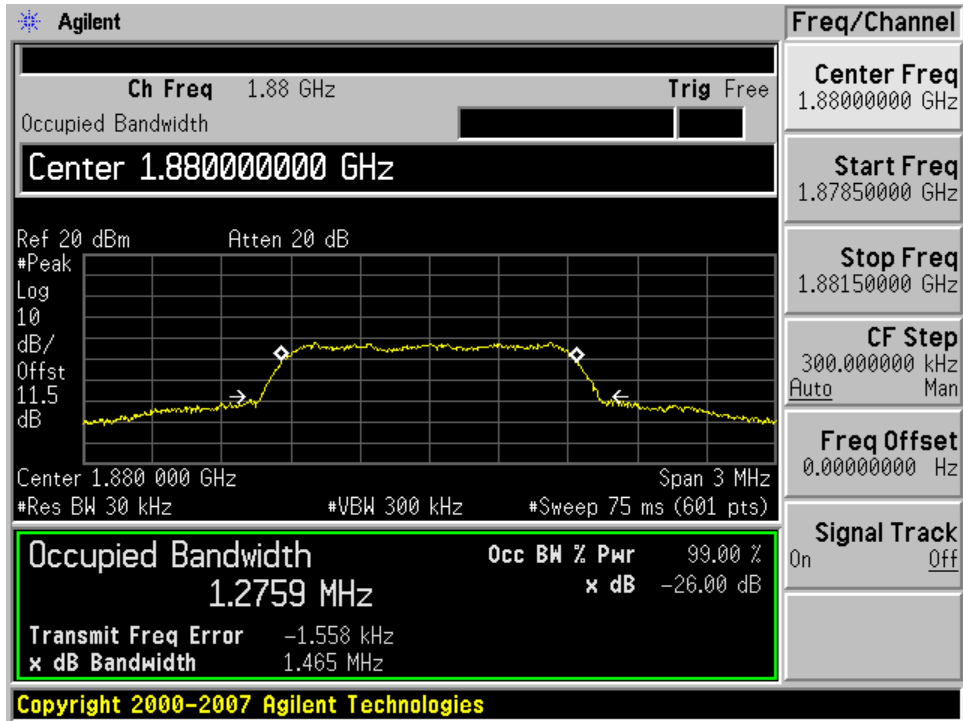
8.6 Test data

8.6.1 CDMA Uplink

Input

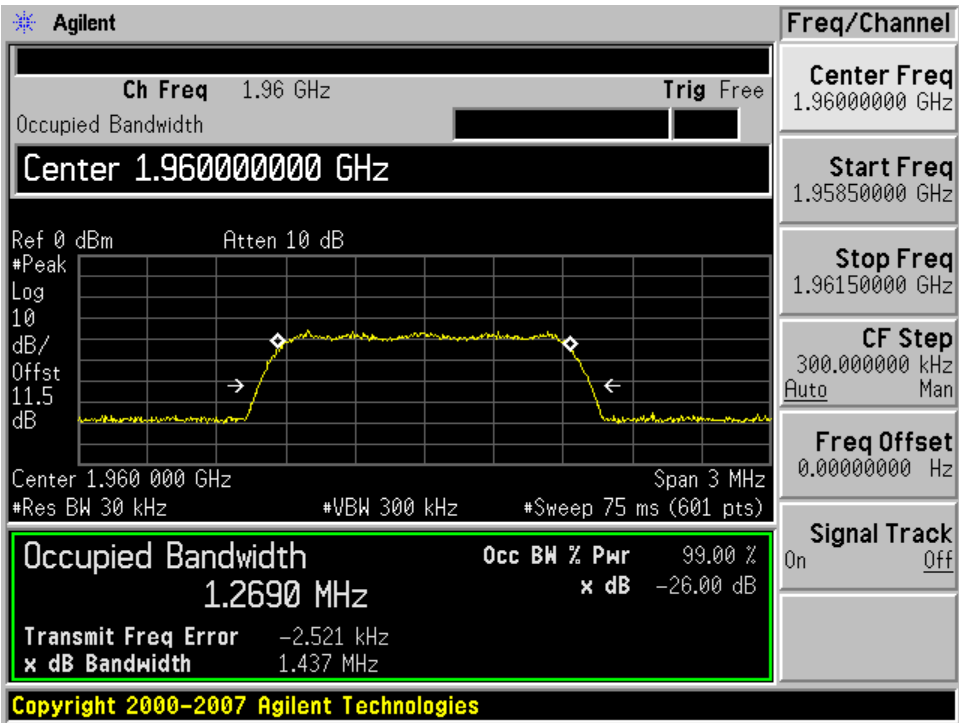


Output

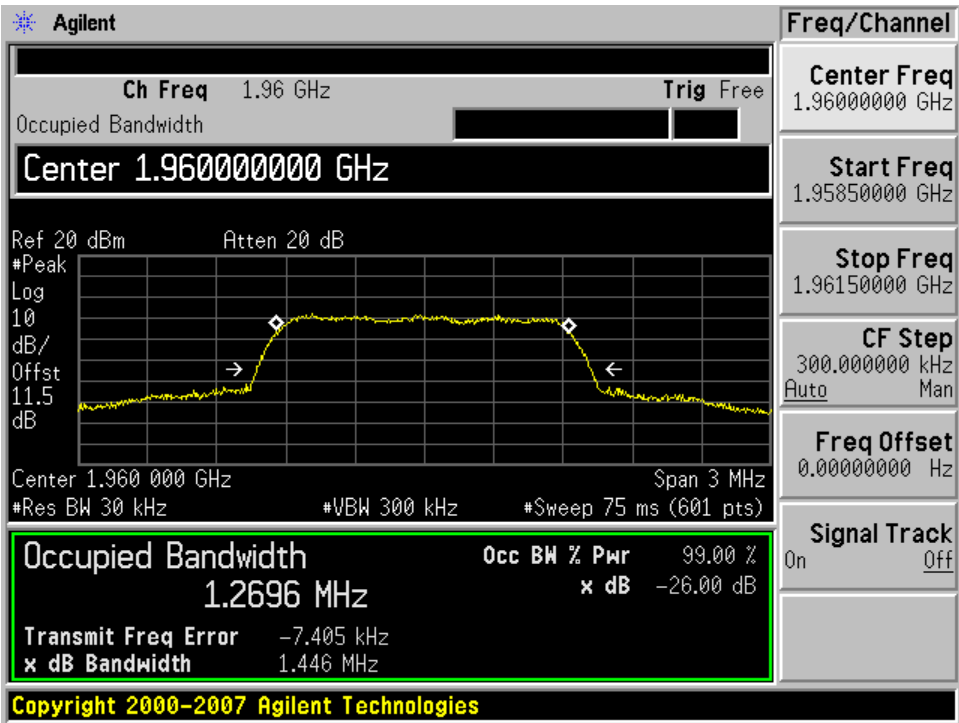


8.6.2 CDMA Downlink

Input

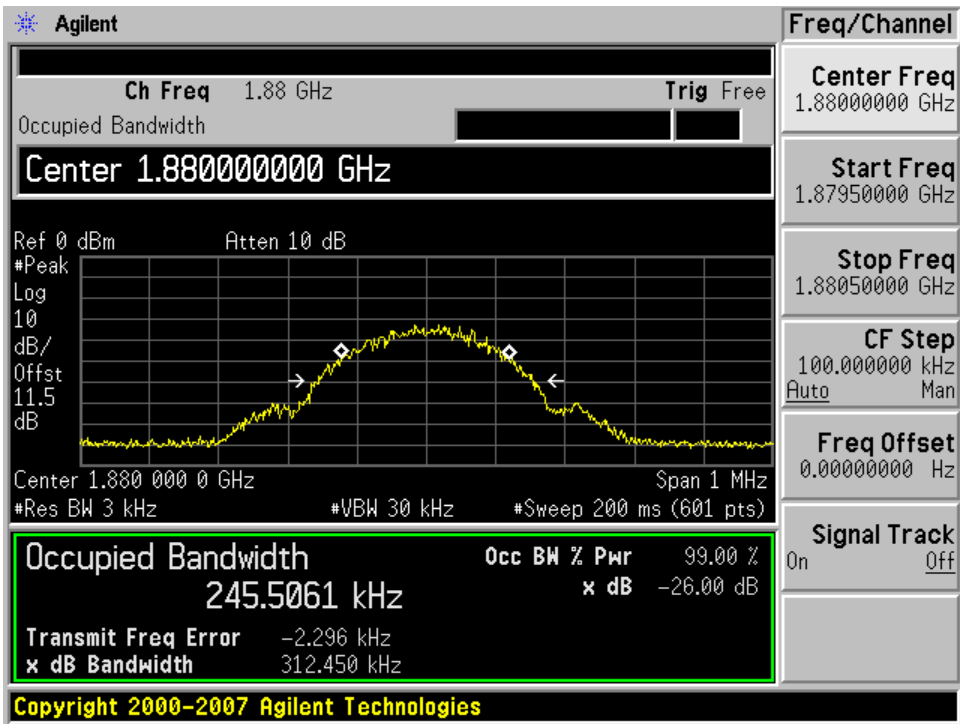


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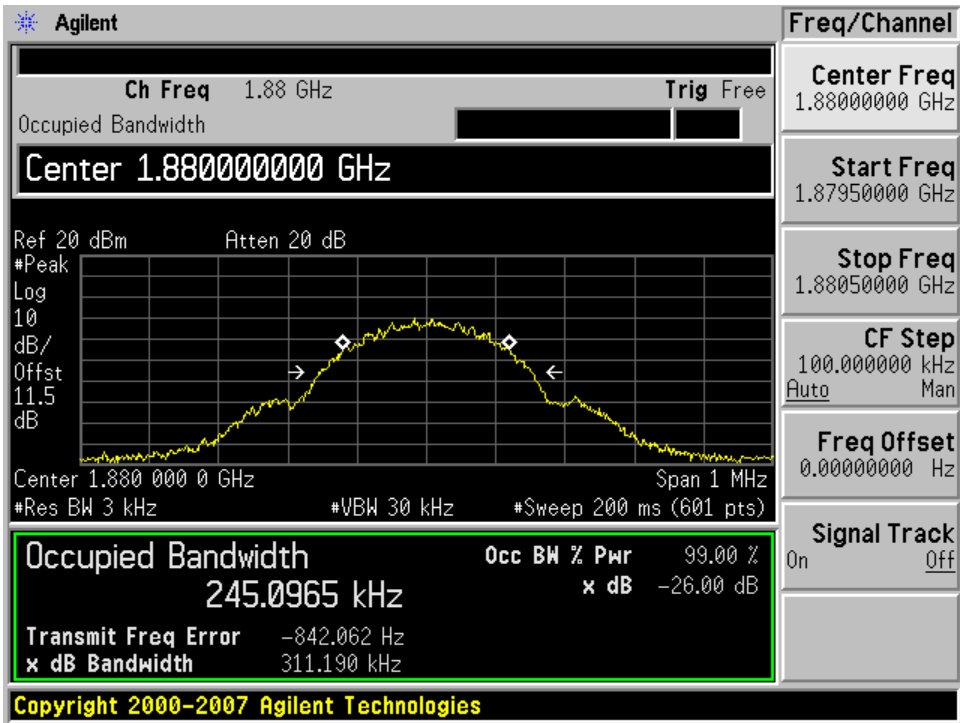


8.6.3 GSM Uplink

Input

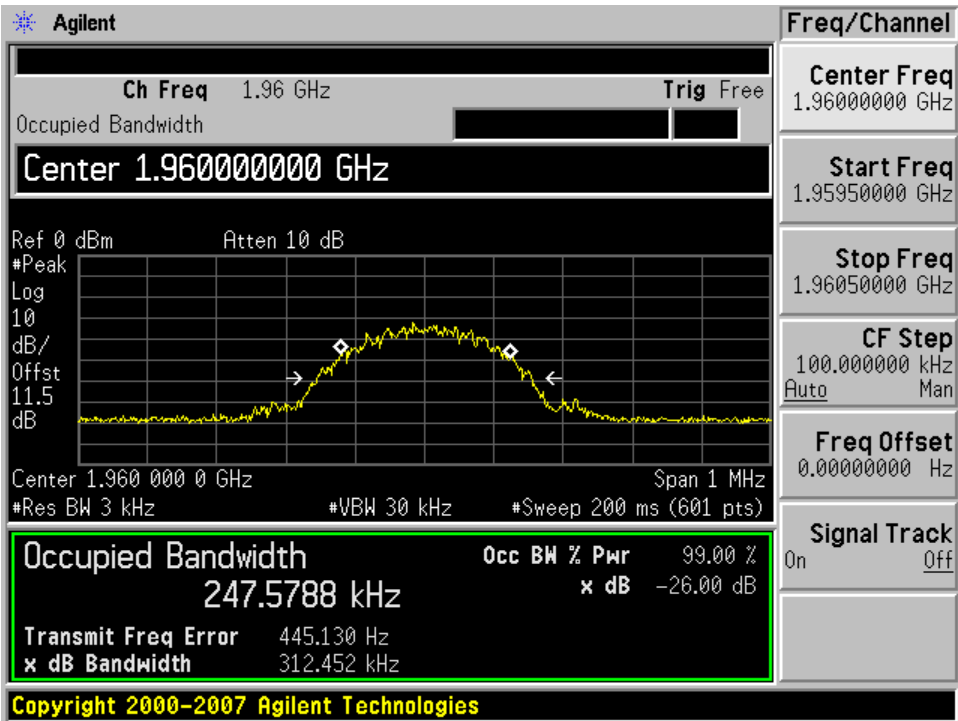


Output

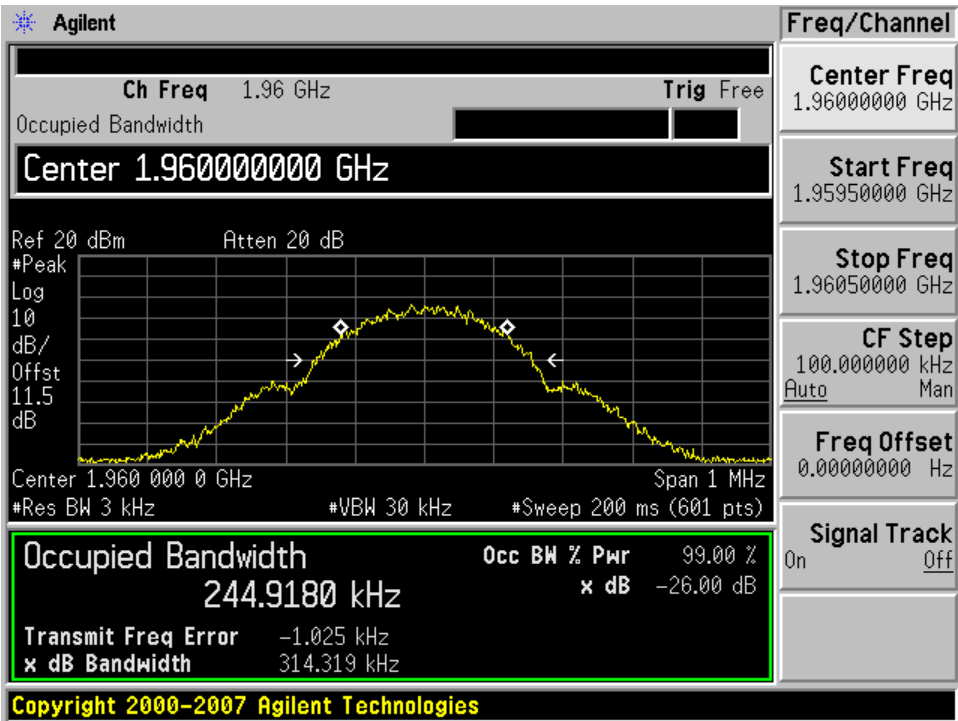


8.6.4 GSM Downlink

Input



Output



9 §2.1051, §24.238 (a) - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

9.1 Applicable Standard

Requirements: CFR 47, § 2.1051. § 24.238 (a).

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency as specified in § 2.1057.

9.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

9.3 Environmental Conditions

Temperature:	22 °C
Relative Humidity:	51 %
ATM Pressure:	101.7kPa

* The testing was performed by Victor Zhang on 2008-08-12.

9.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Analyzer, Spectrum	E4446A	US44300386	2008-05-27

* **Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

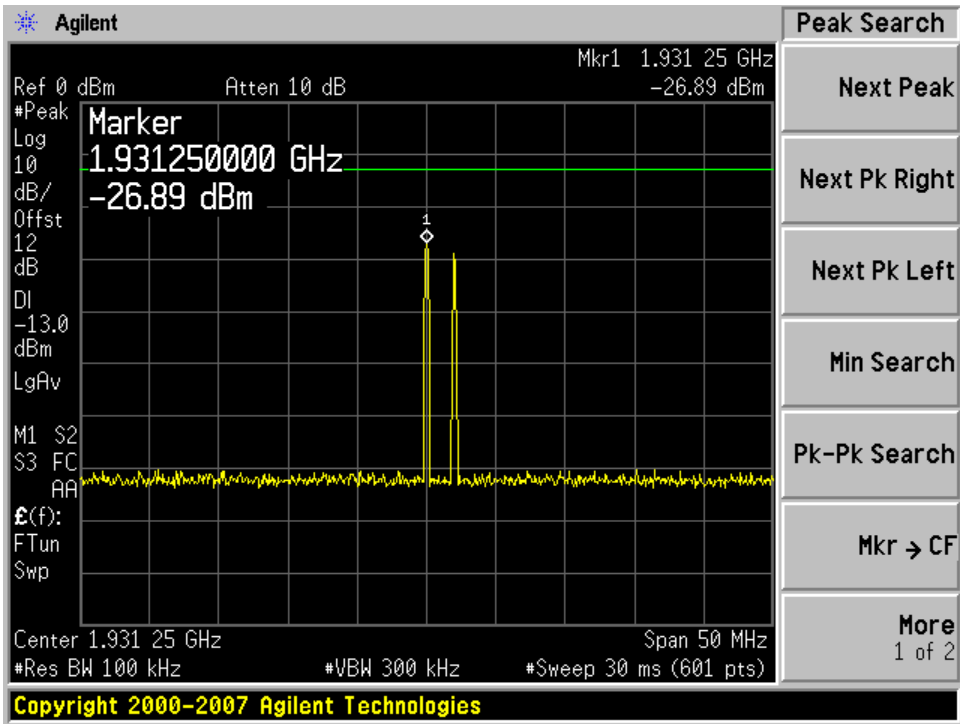
9.5 Test Results

Please refer to the hereinafter plots.

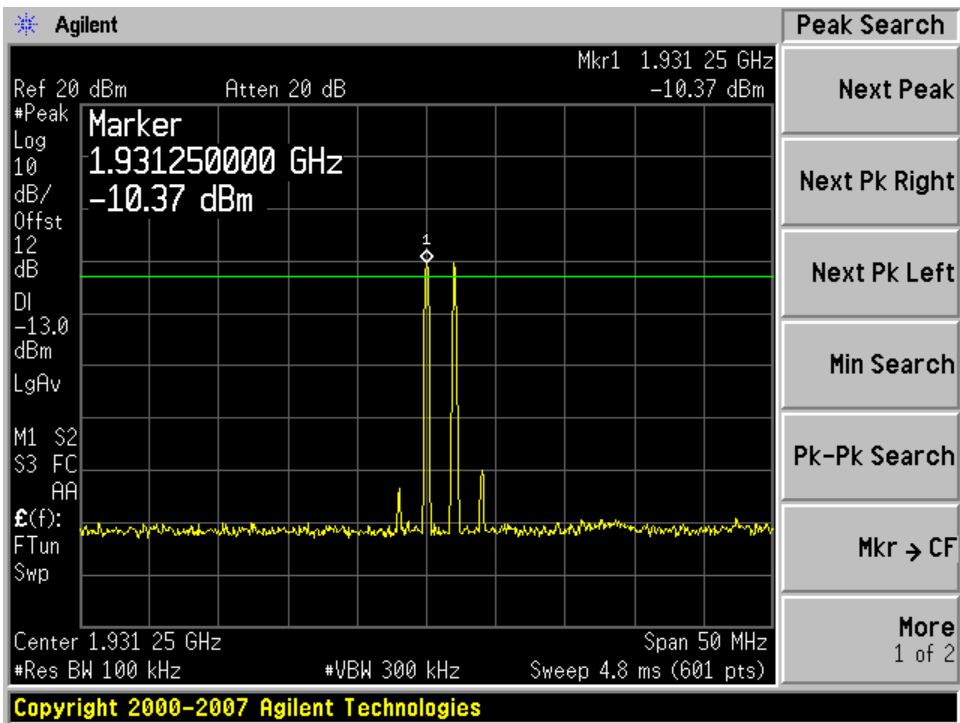
CDMA Downlink: Low Channel

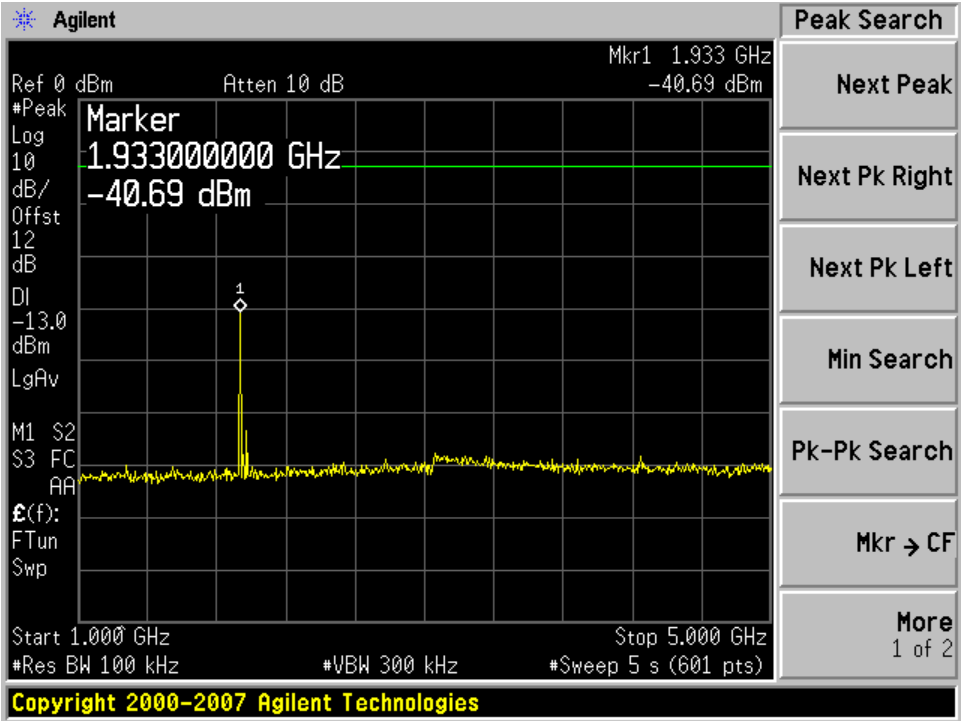
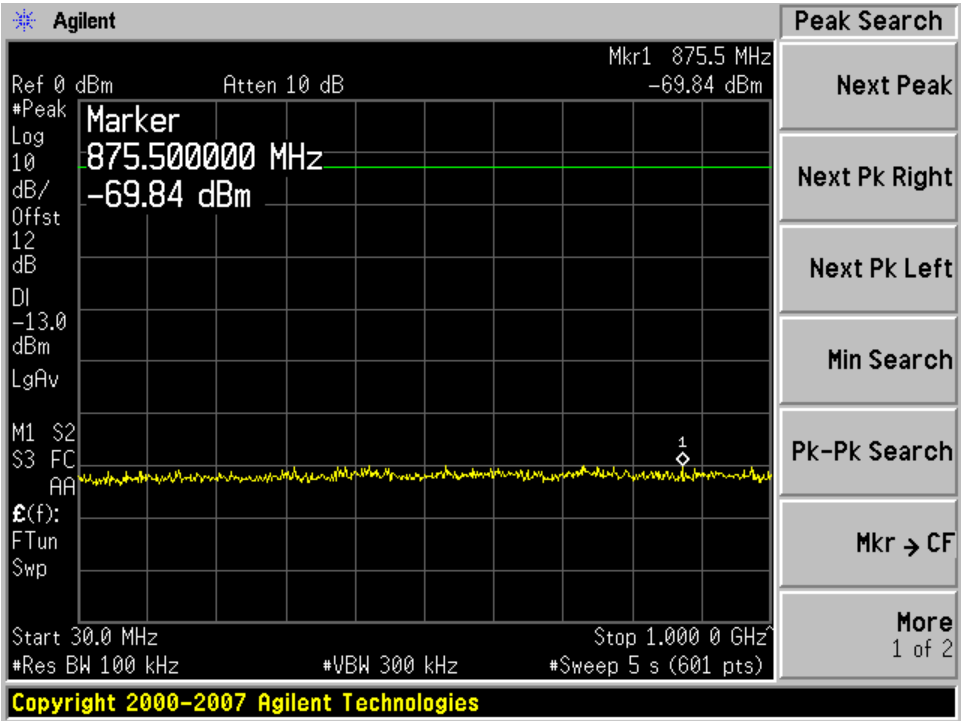
Intemodulation Testing

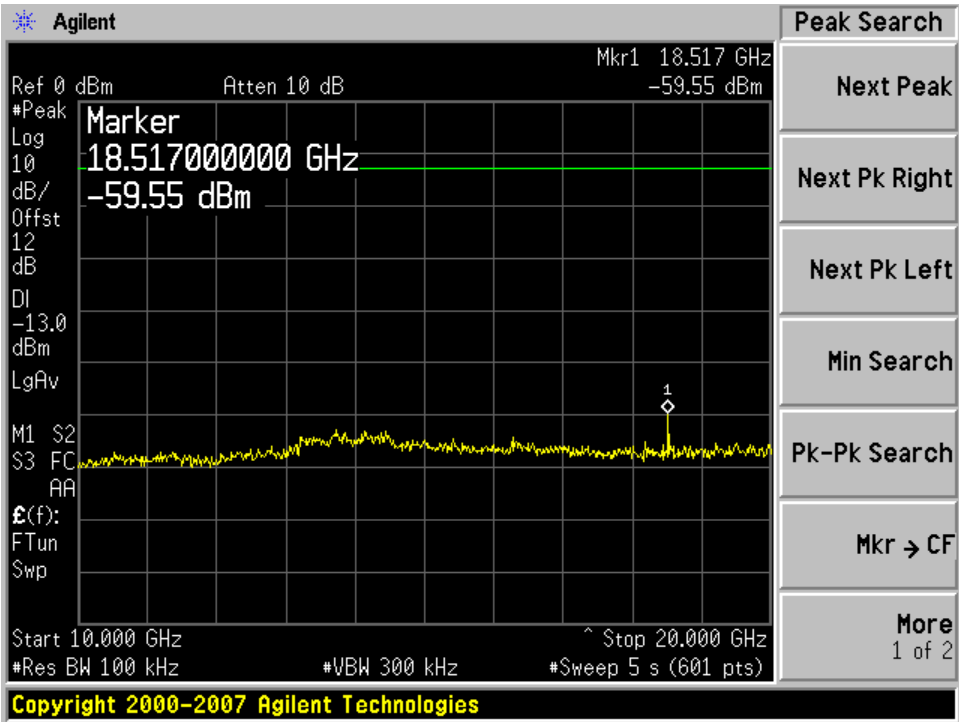
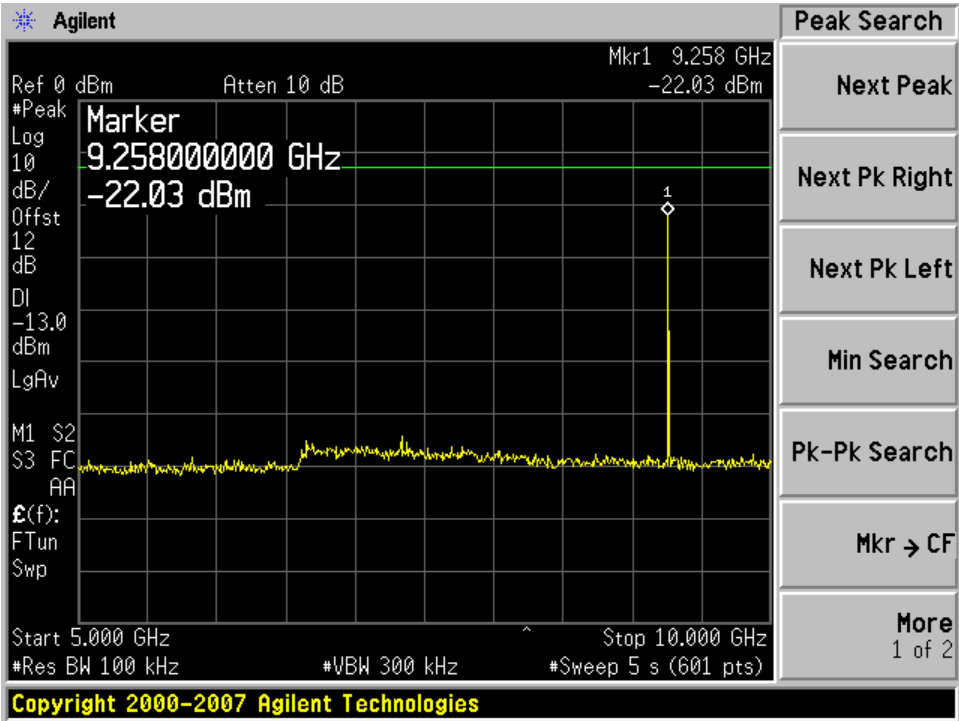
Input



Output



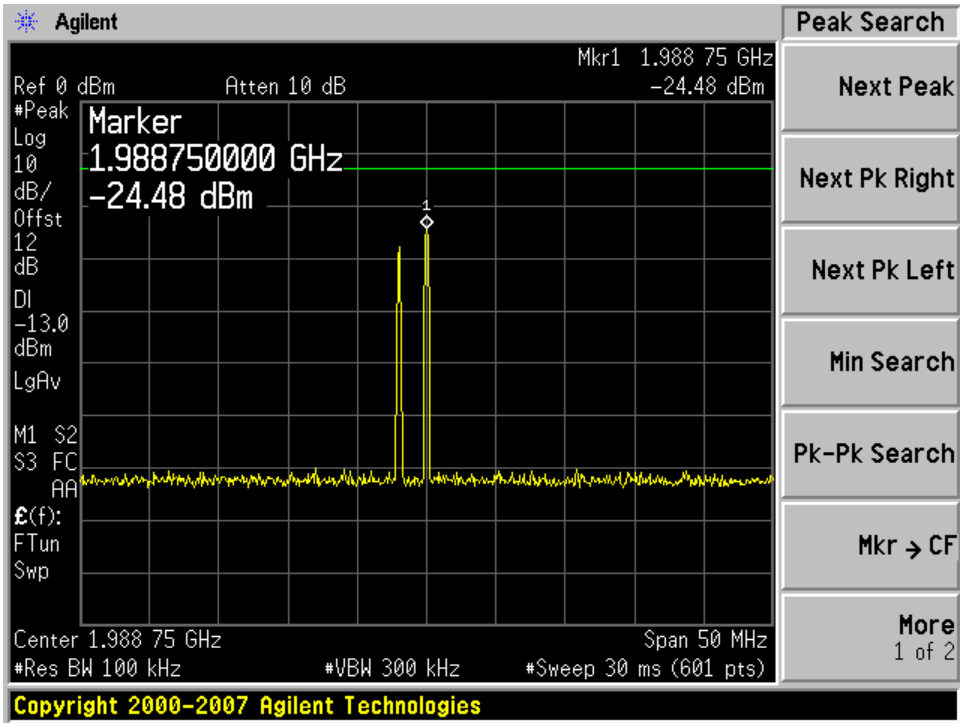




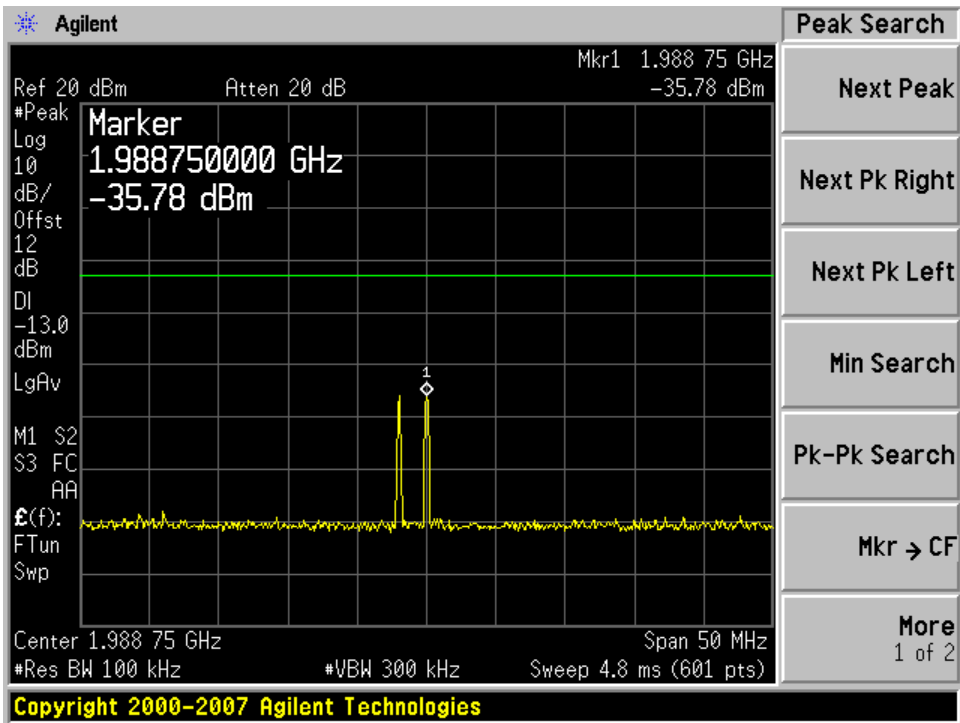
CDMA Downlink: High Channel

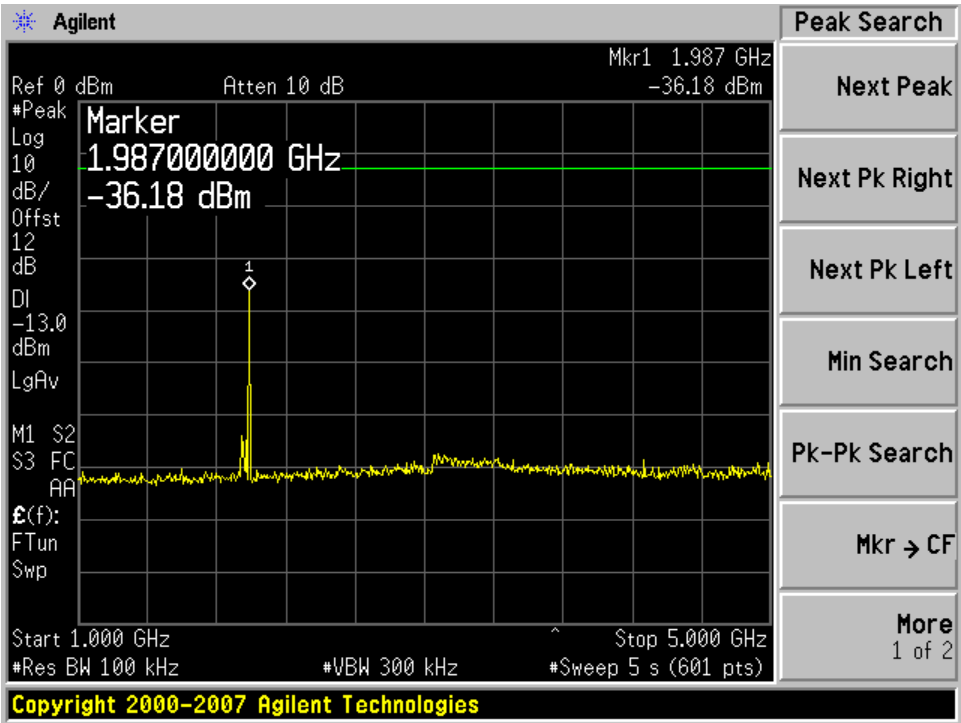
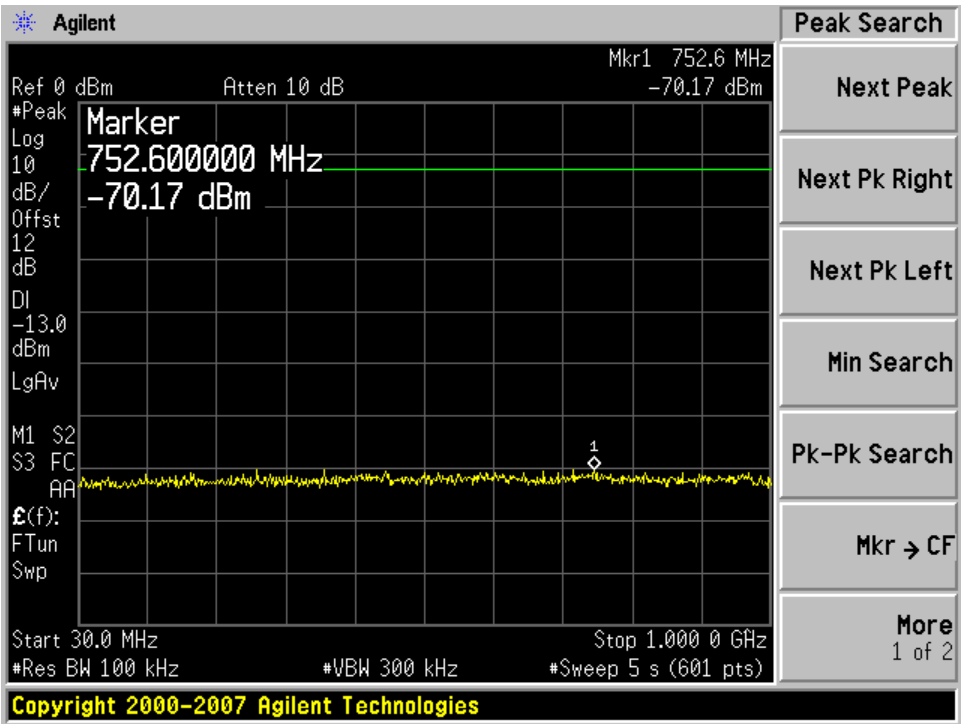
Intemodulation Testing

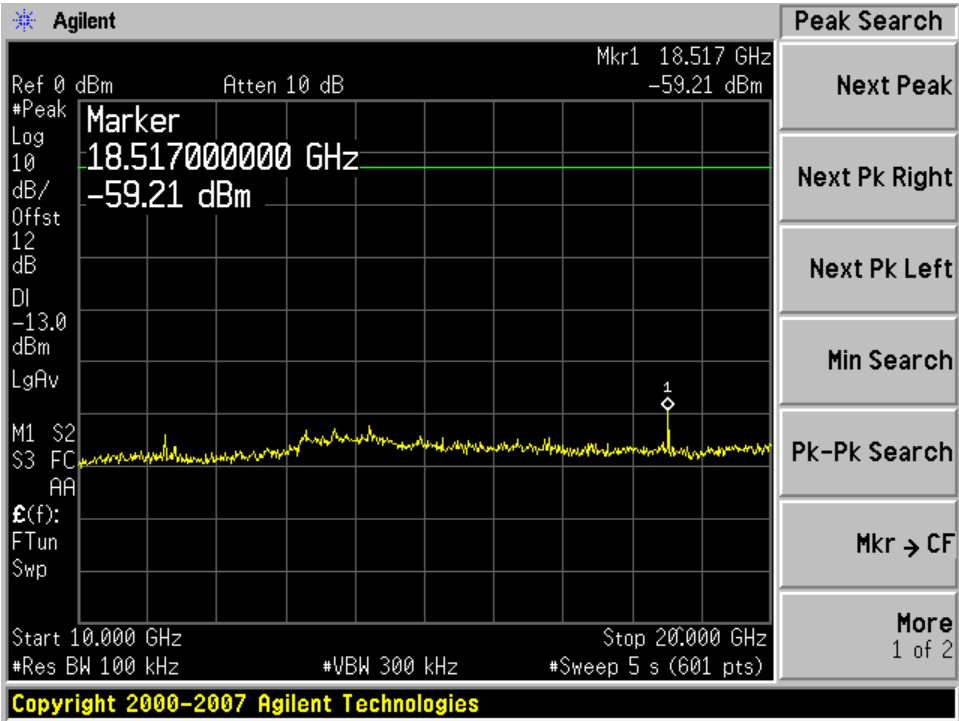
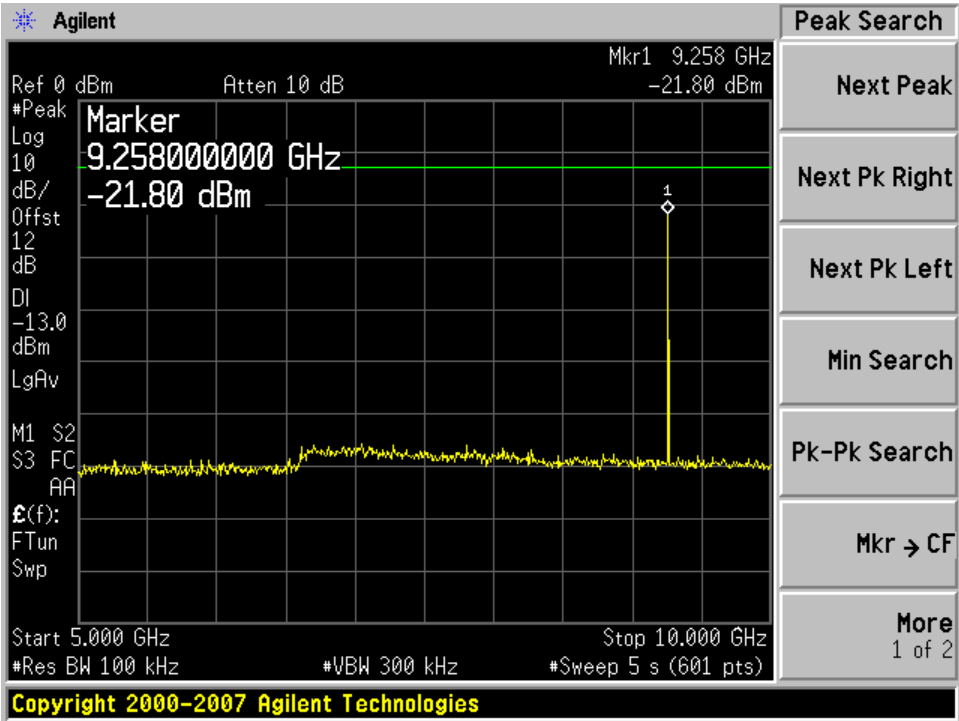
Input



Output



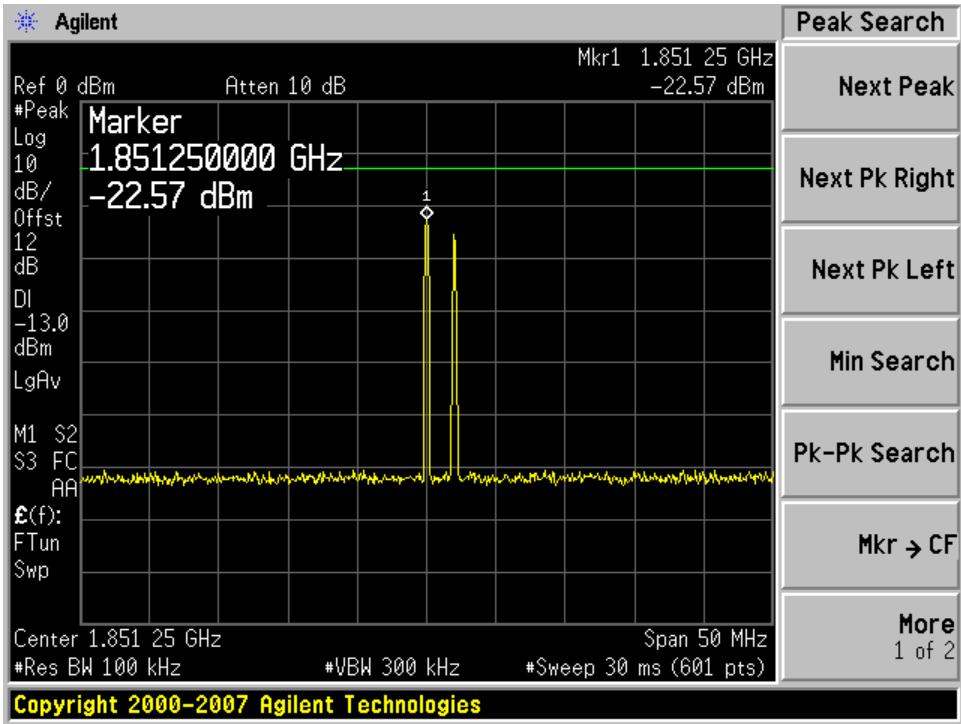




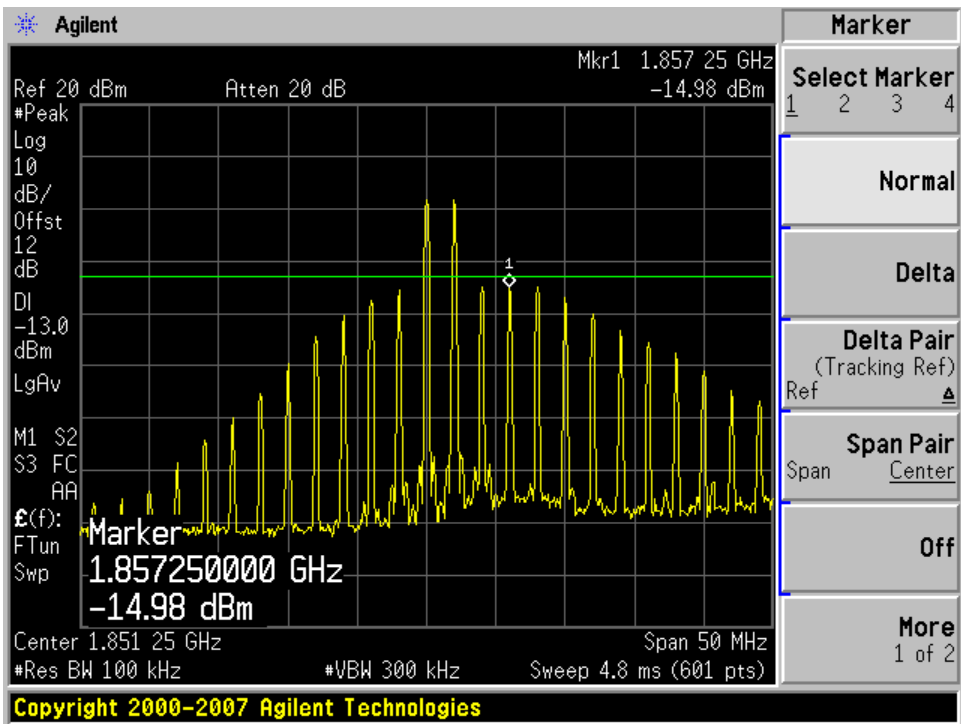
CDMA Uplink: Low Channel

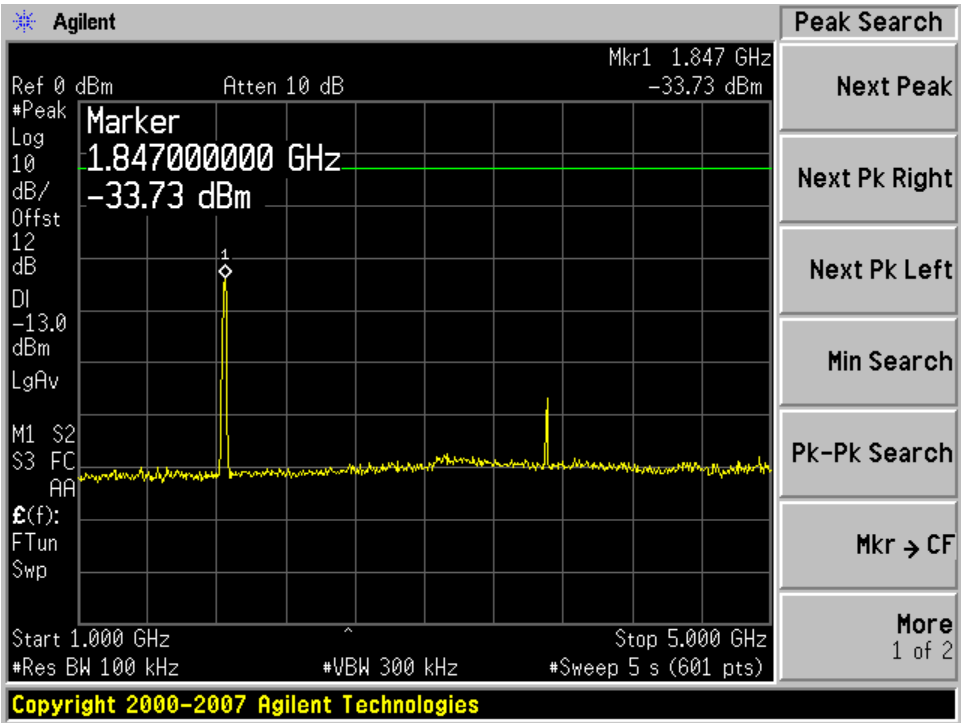
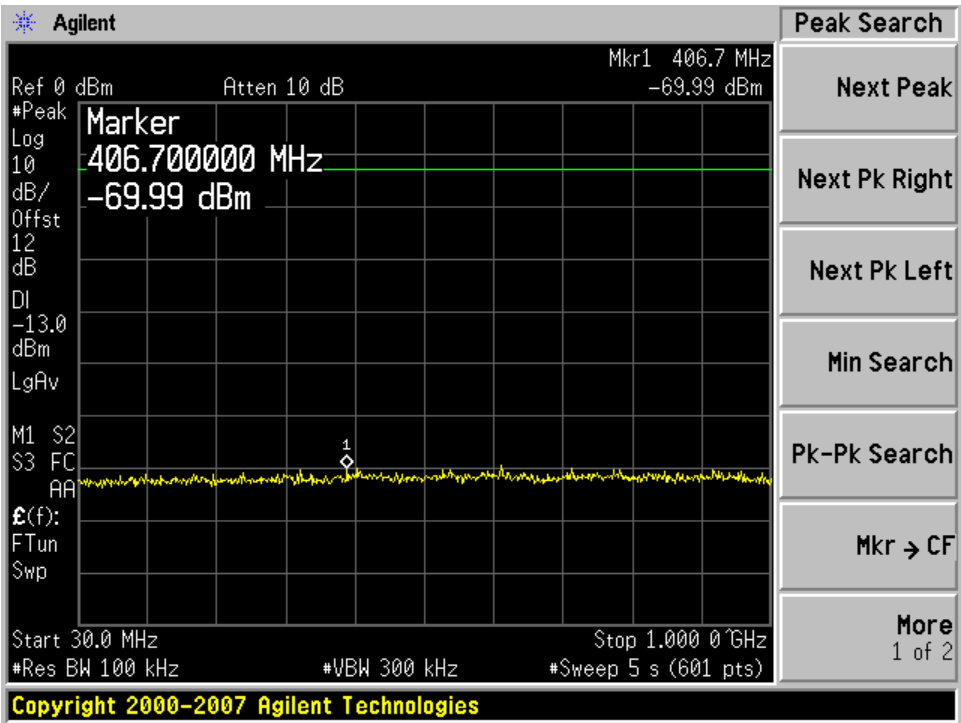
Intemodulation Testing

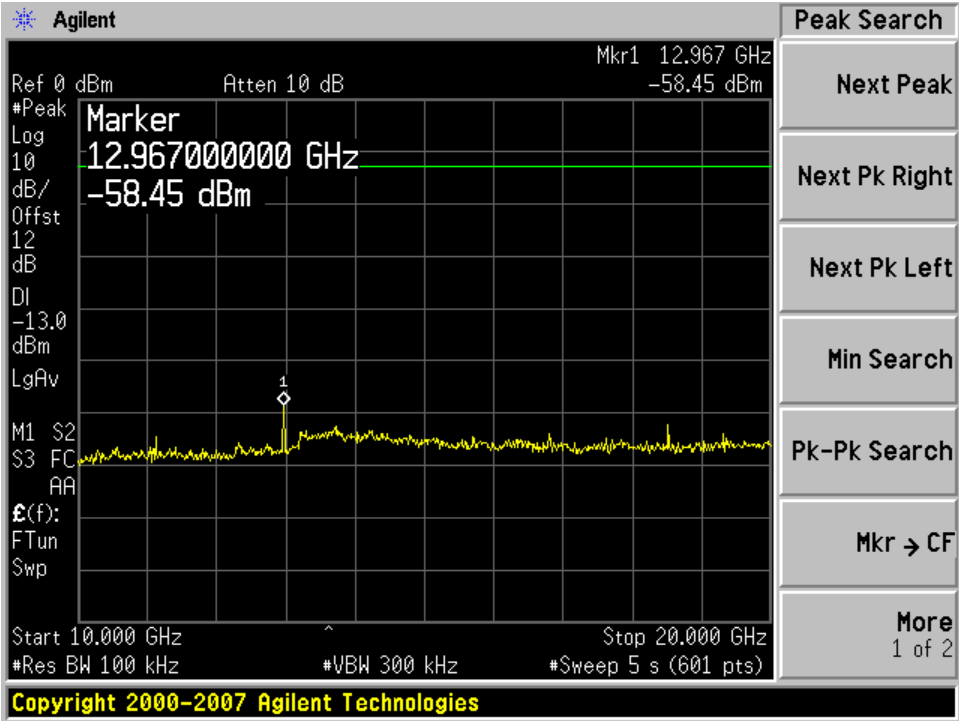
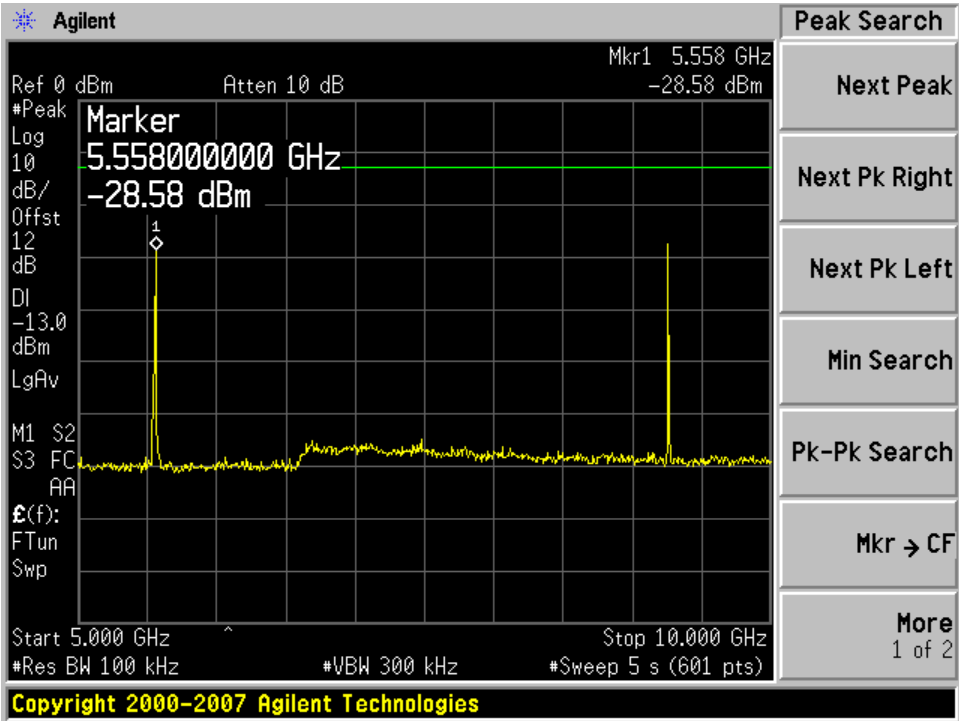
Input



Output



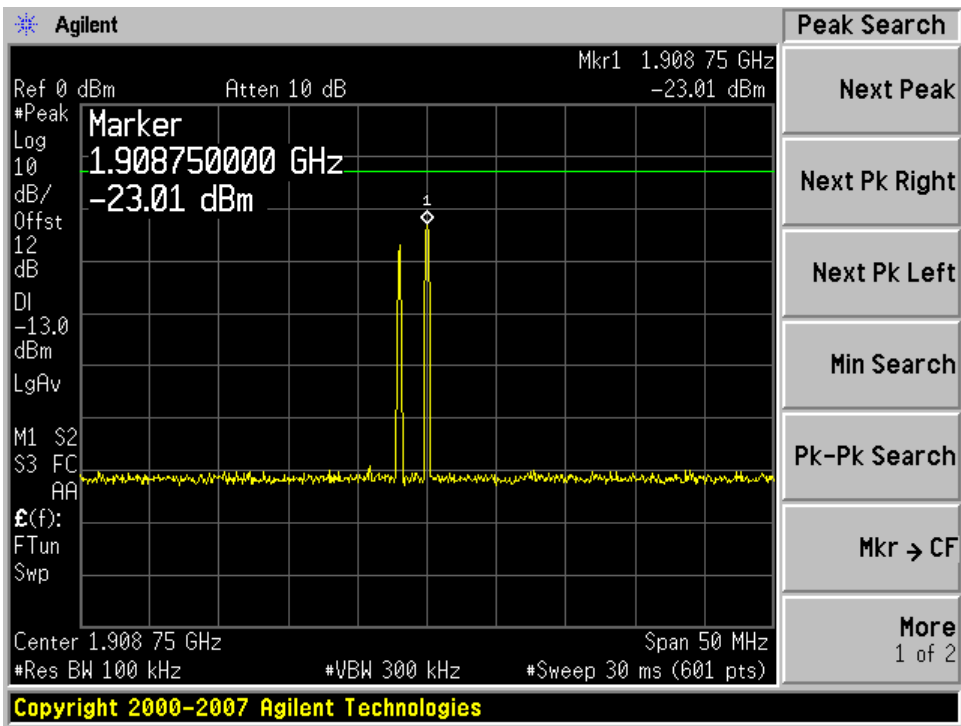




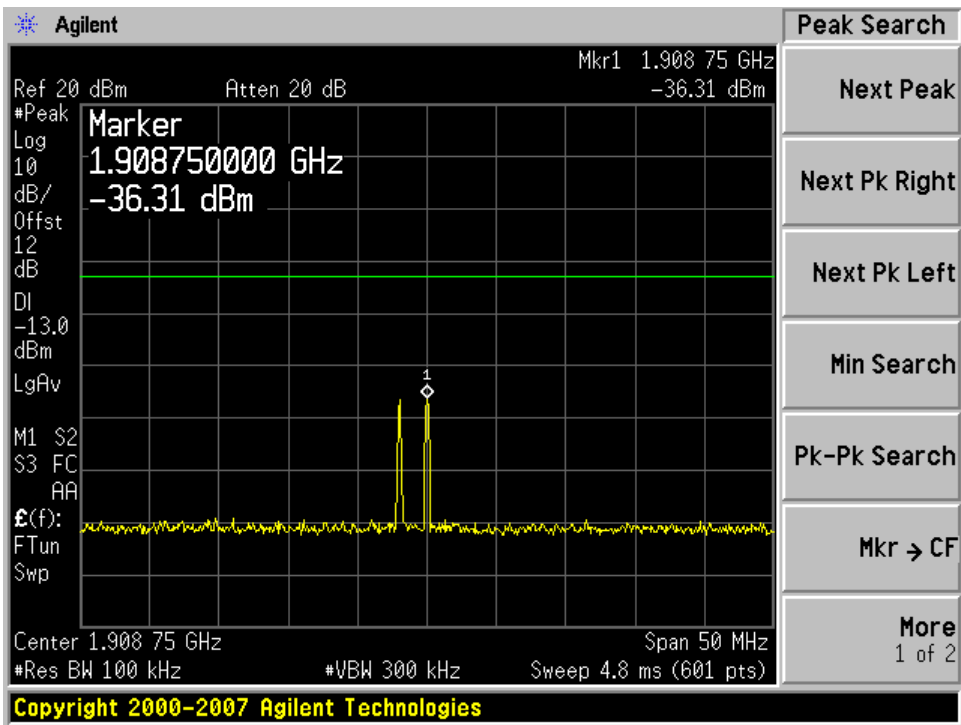
CDMA Uplink: High Channel

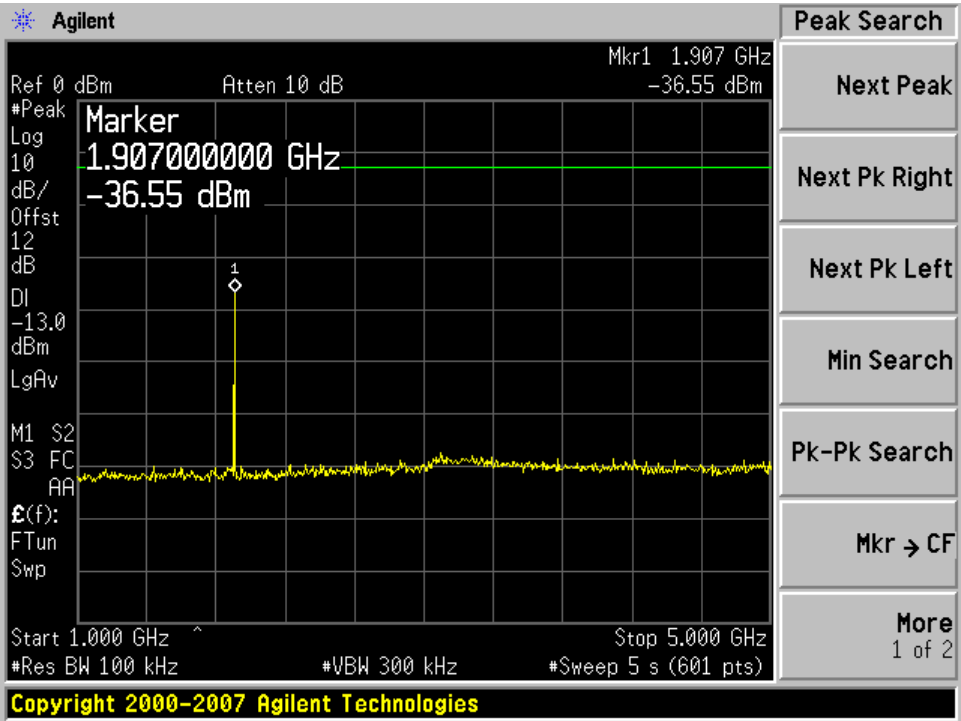
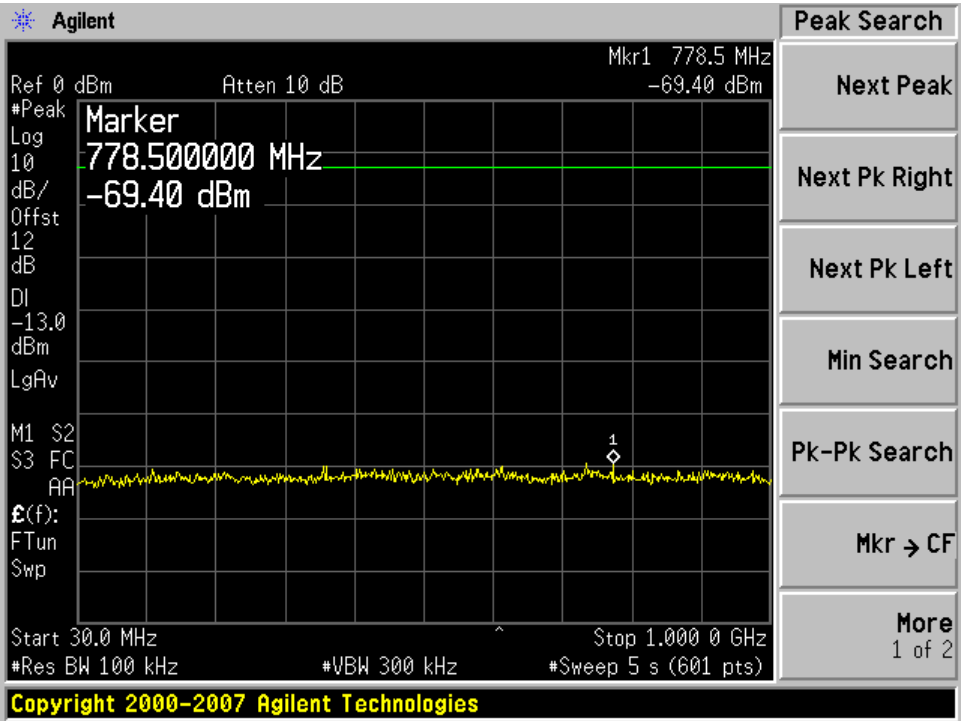
Intemodulation Testing

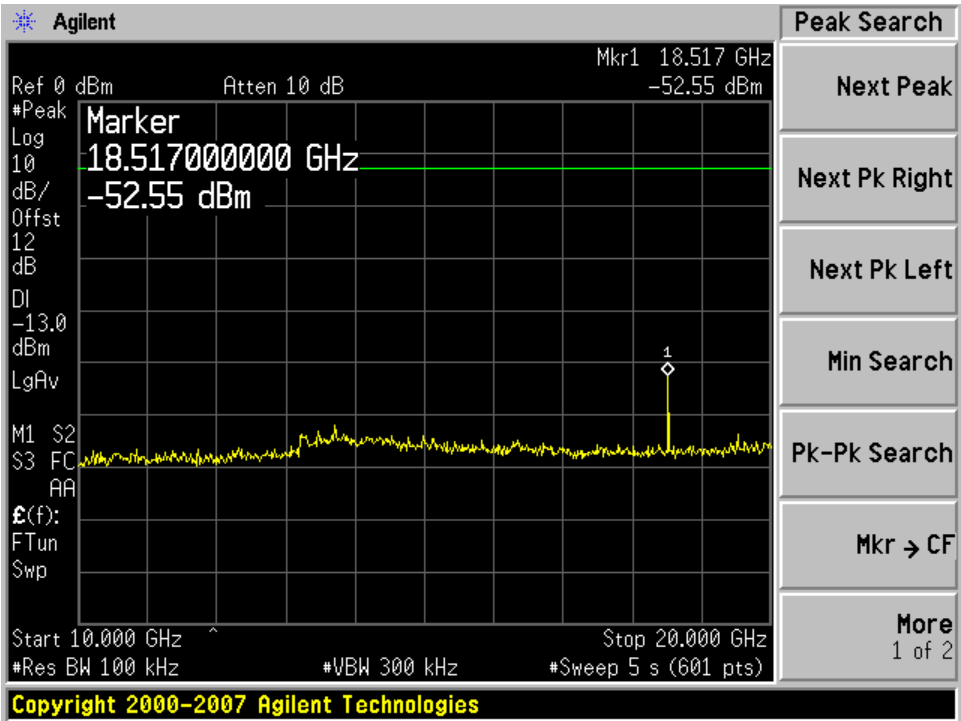
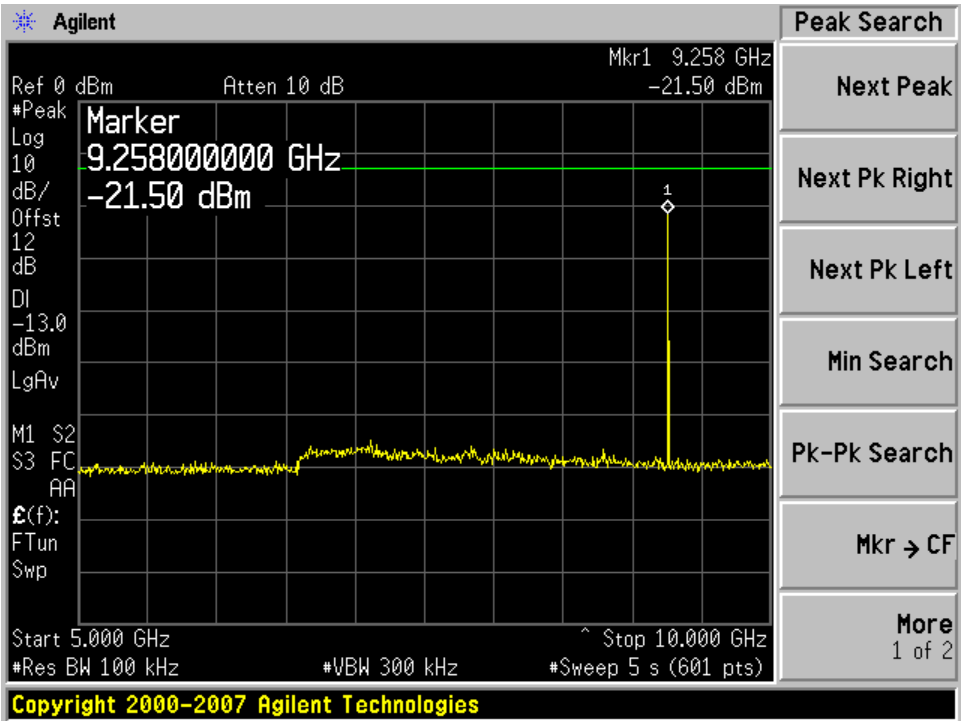
Input



Output



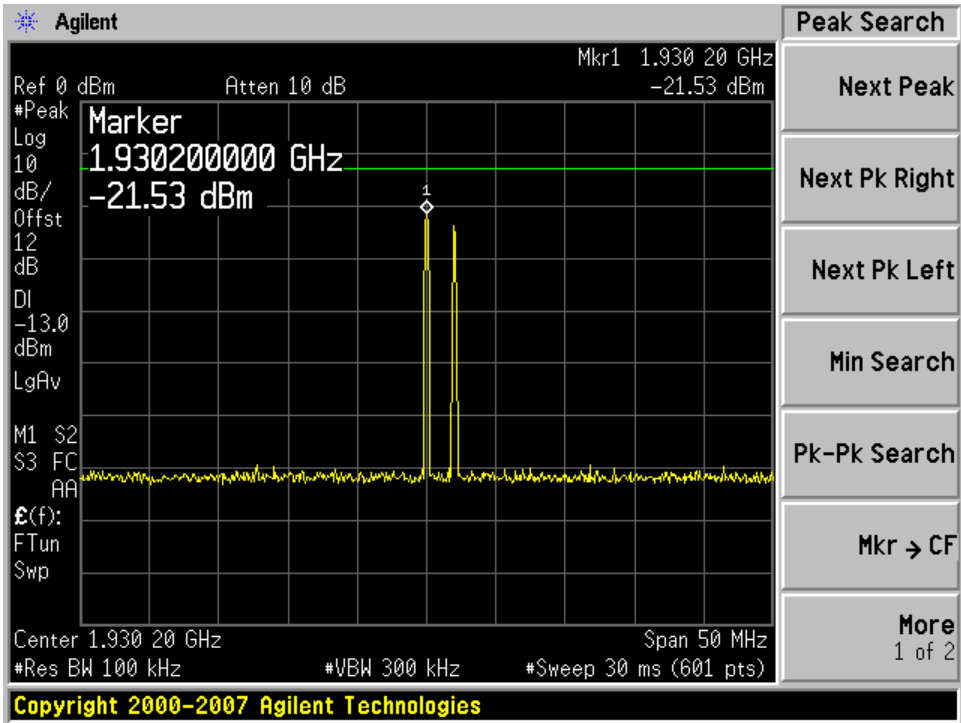




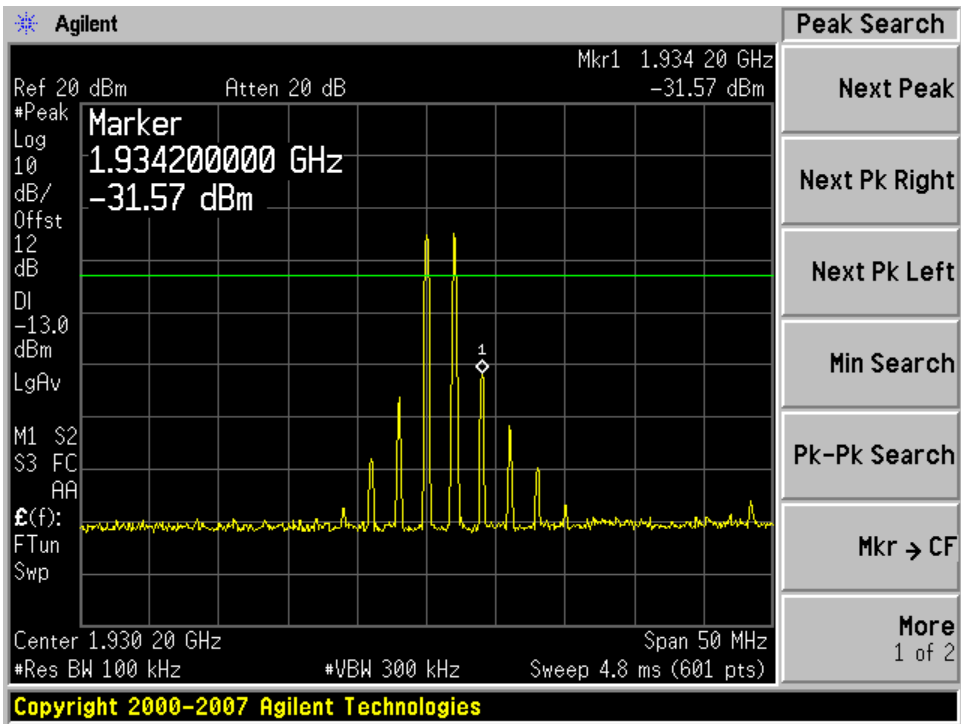
GSM Downlink: Low Channel

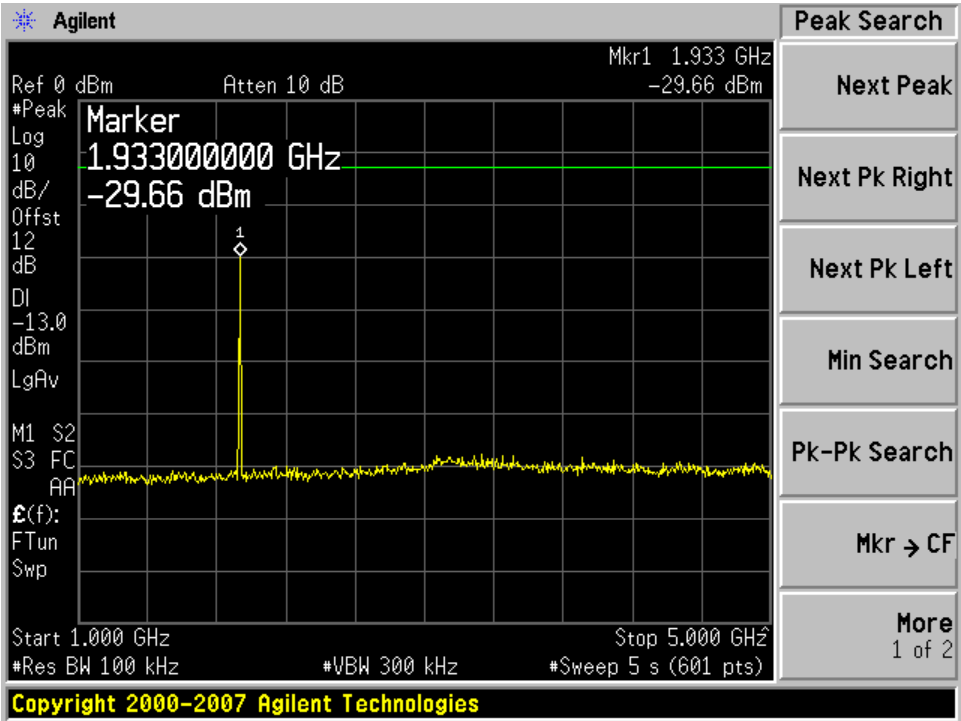
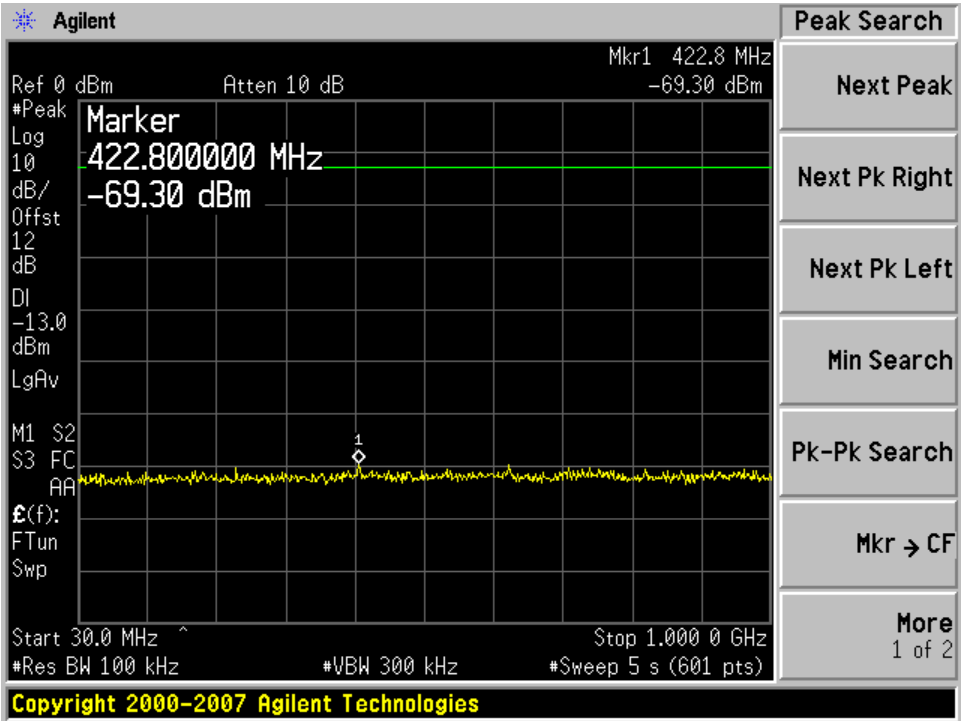
Intermodulation Testing

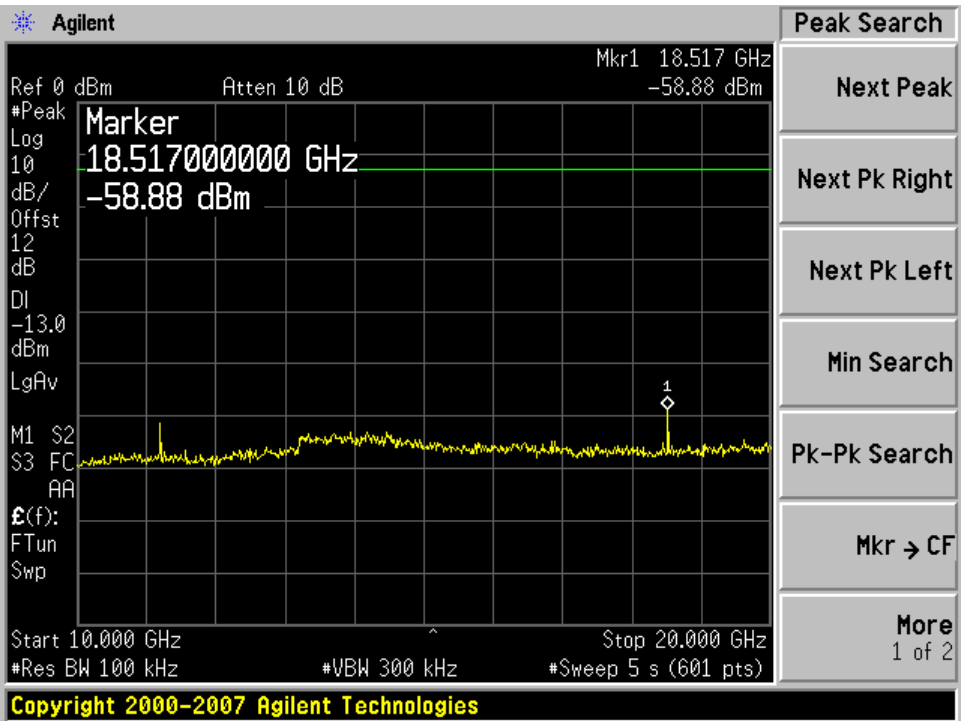
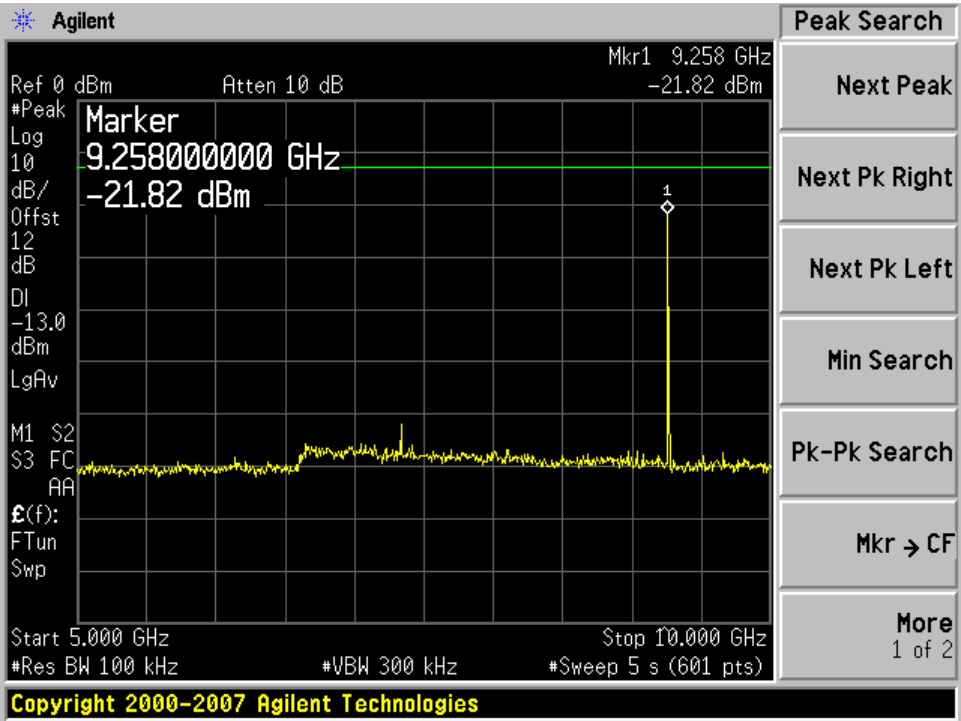
Input



Output



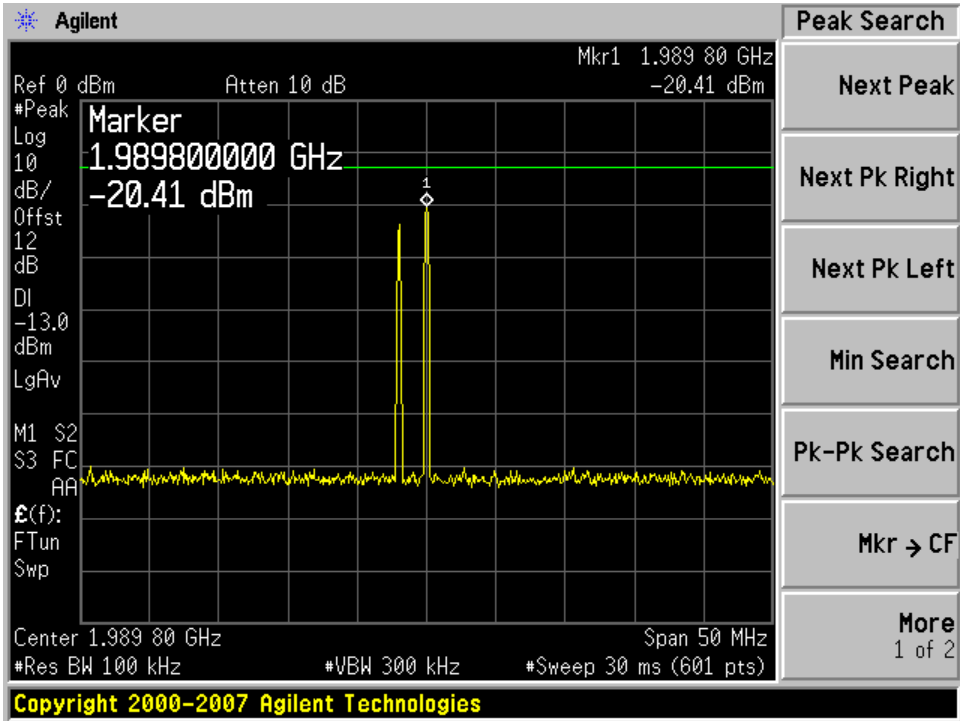




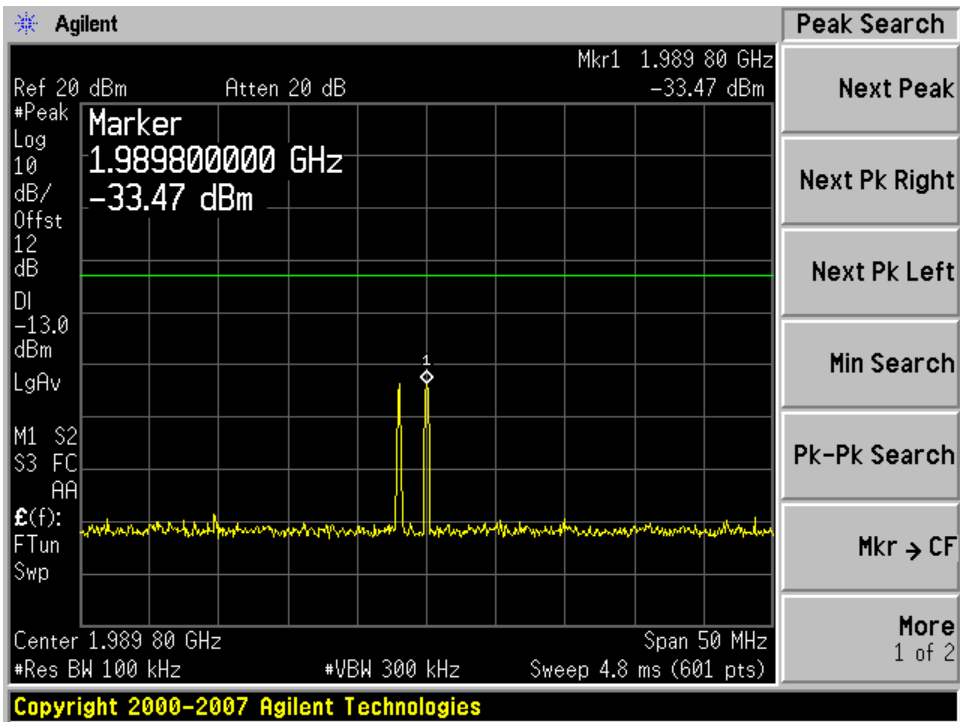
GSM Downlink: High Channel

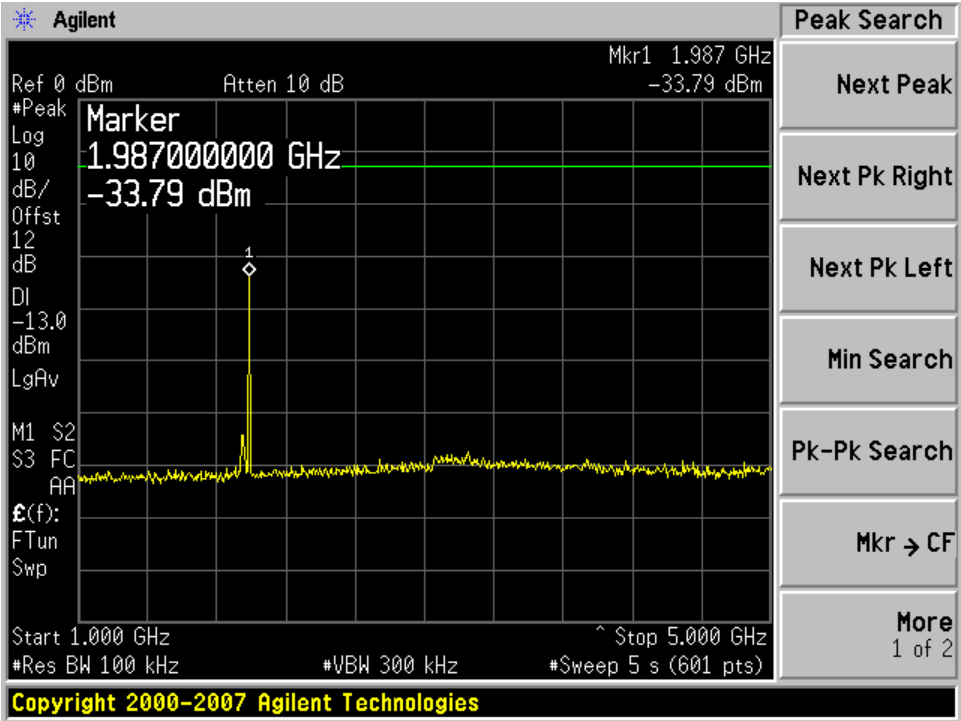
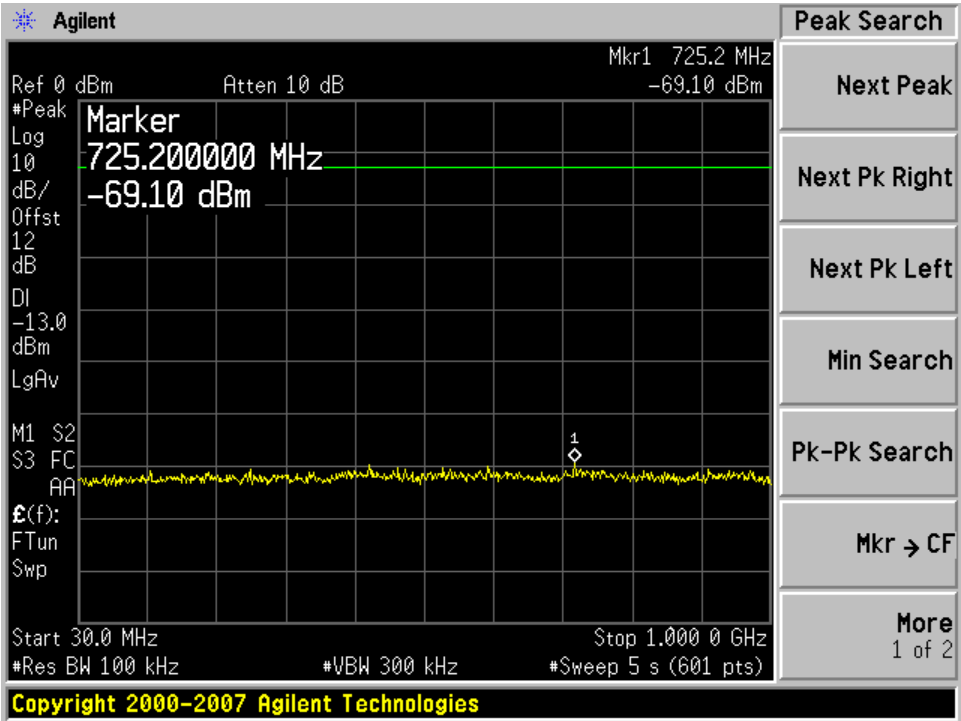
Intemodulation Testing

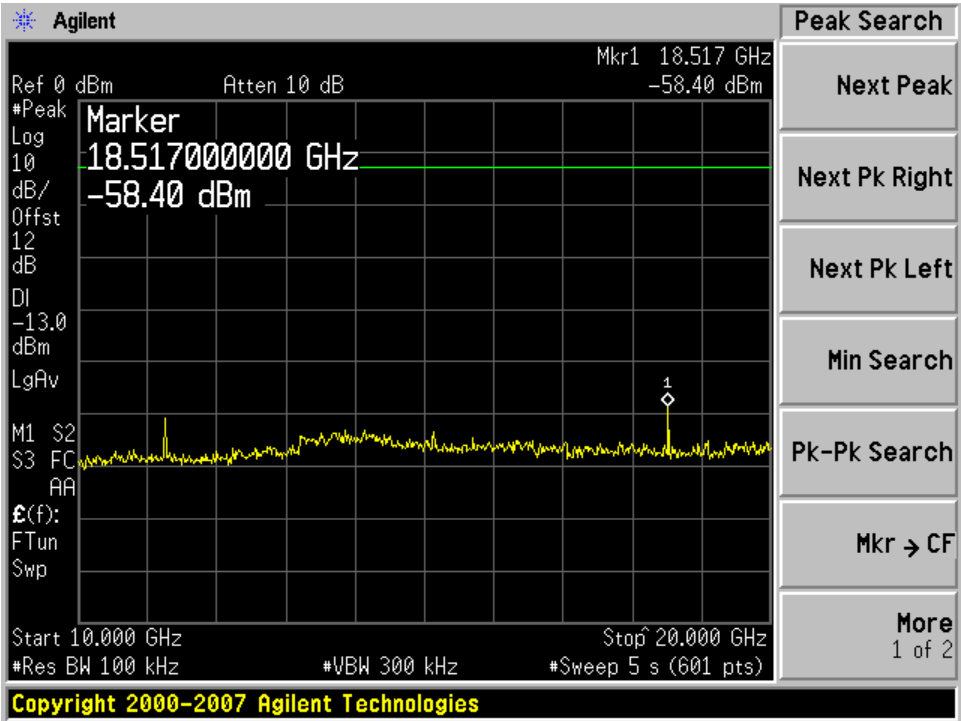
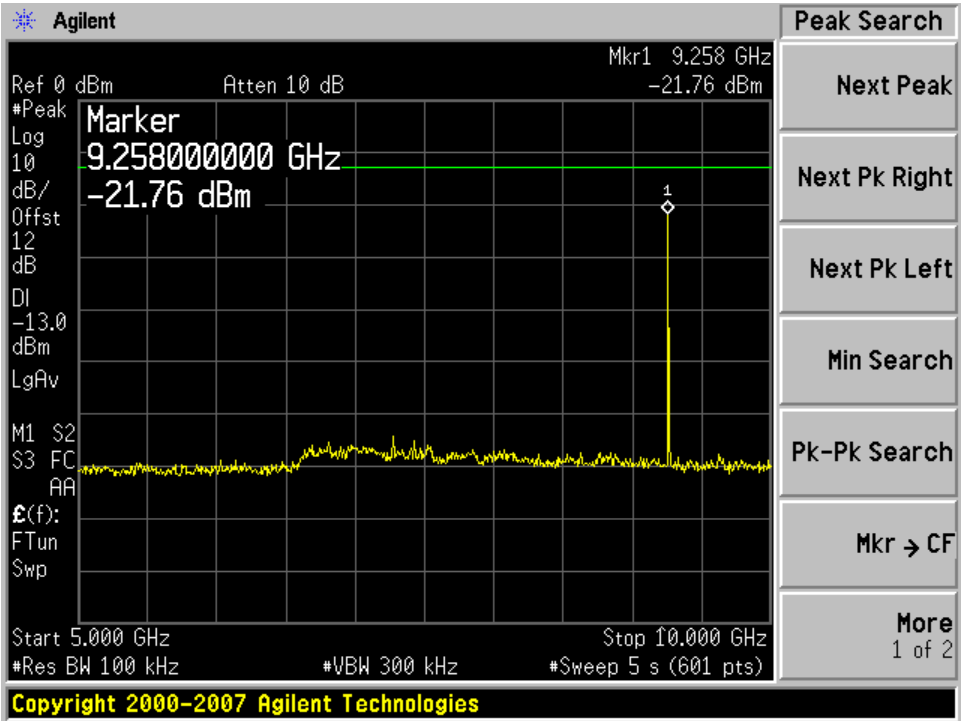
Input



Output

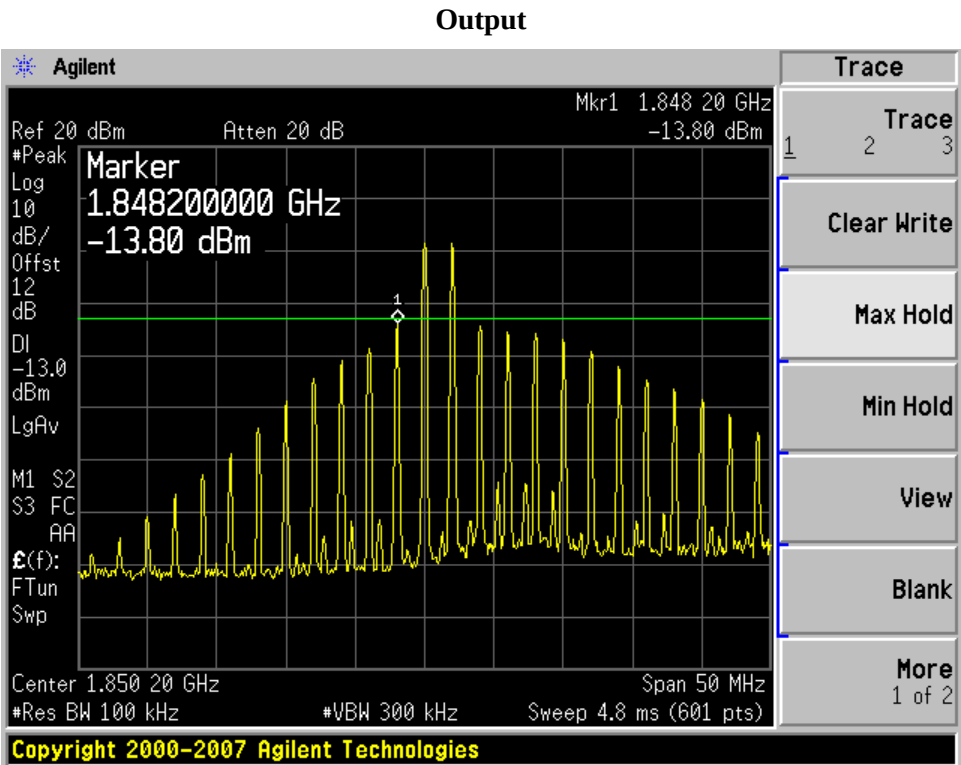
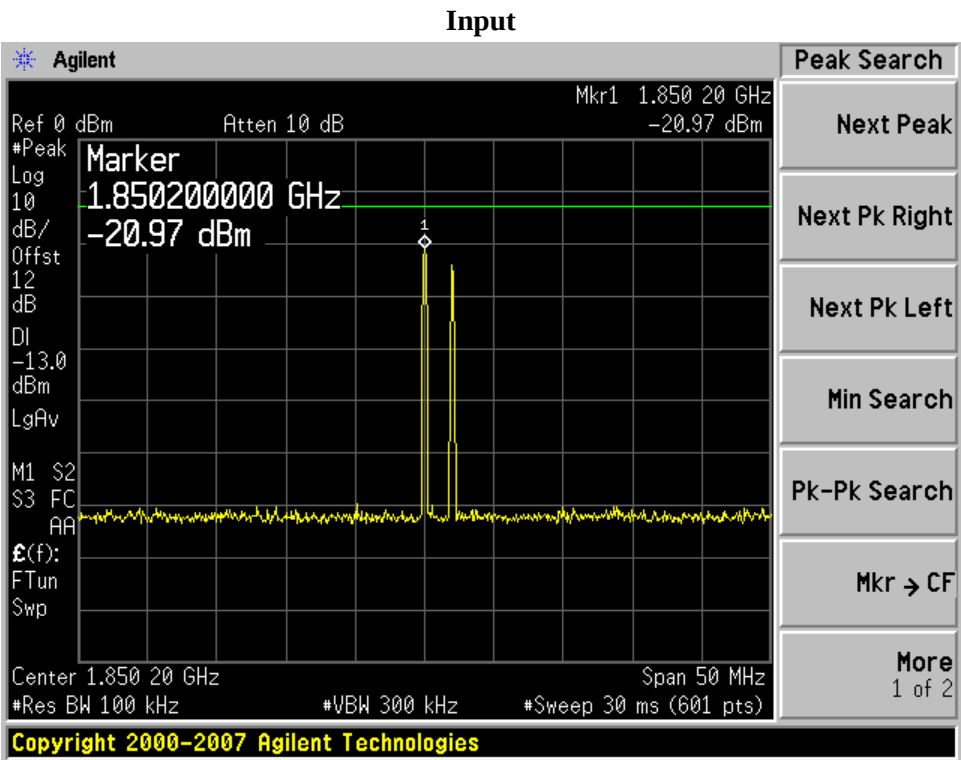


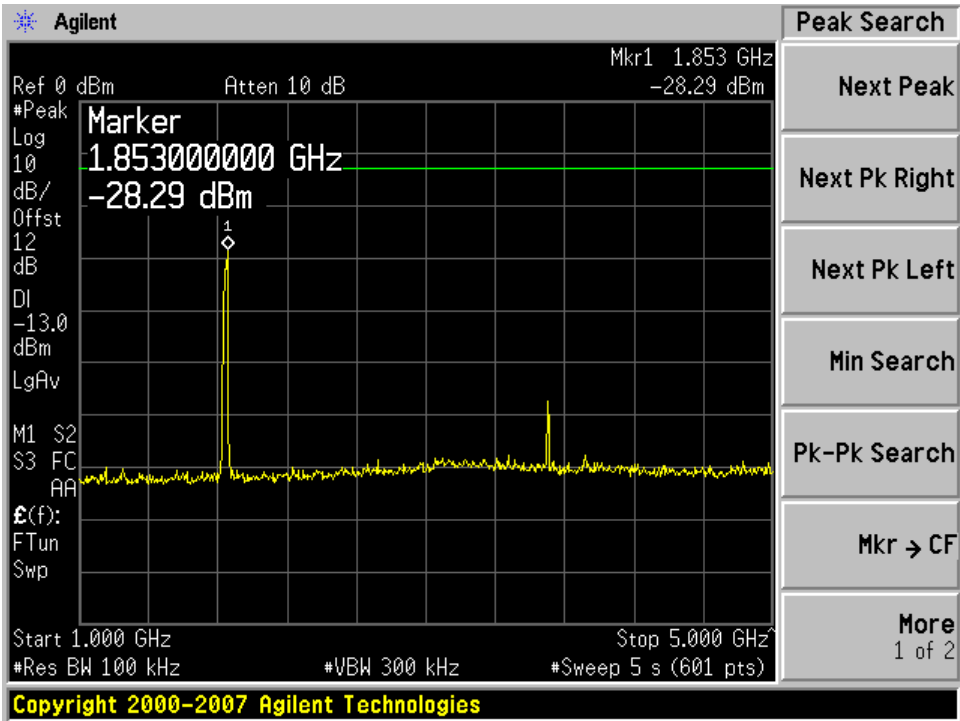
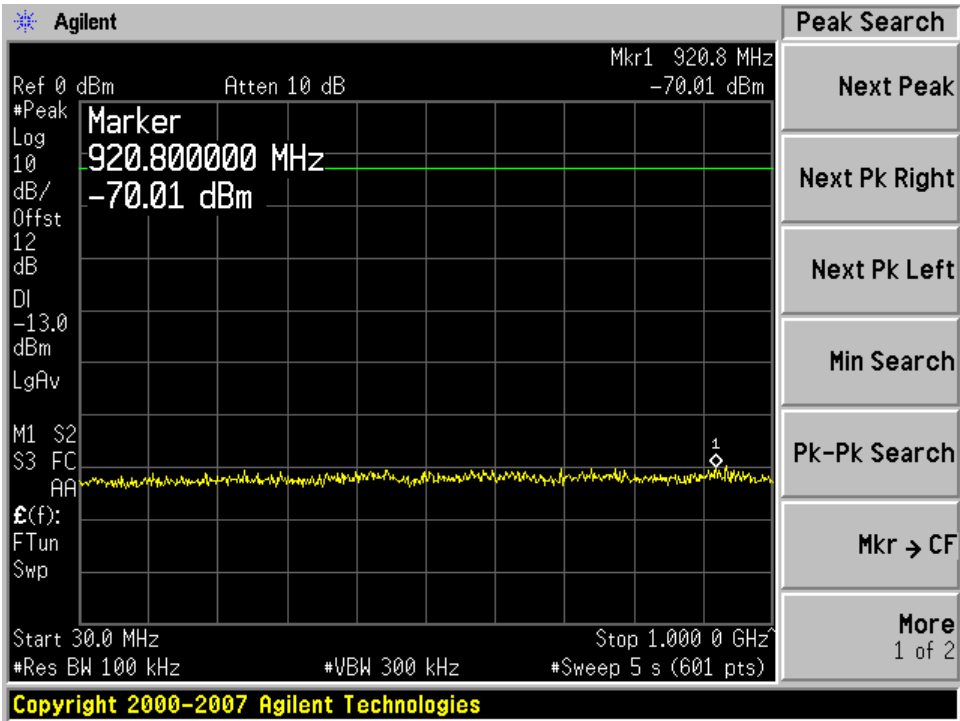


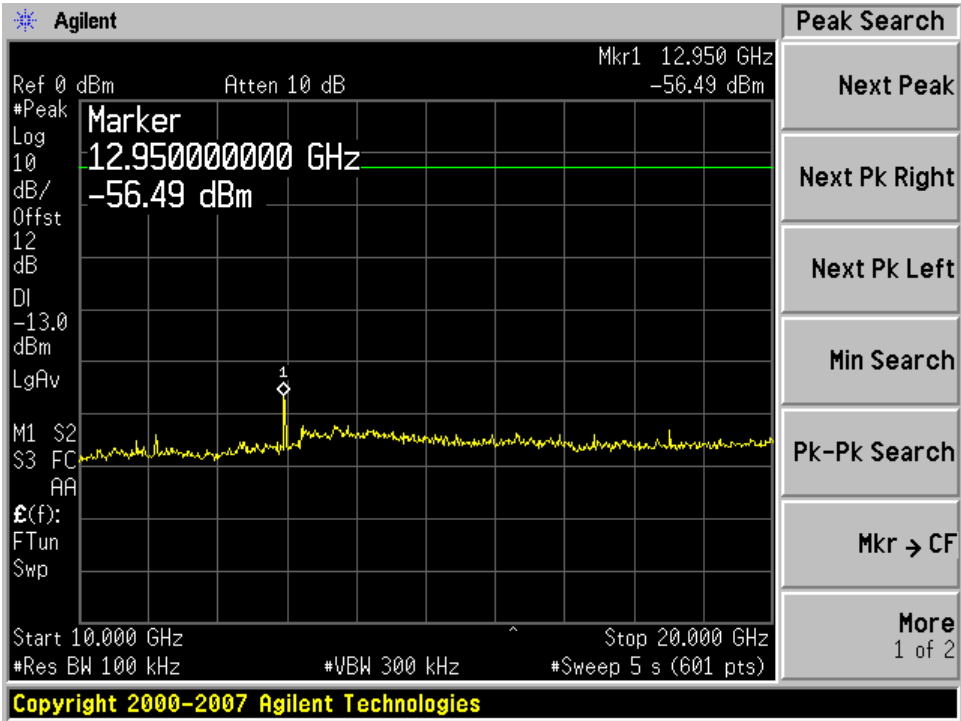
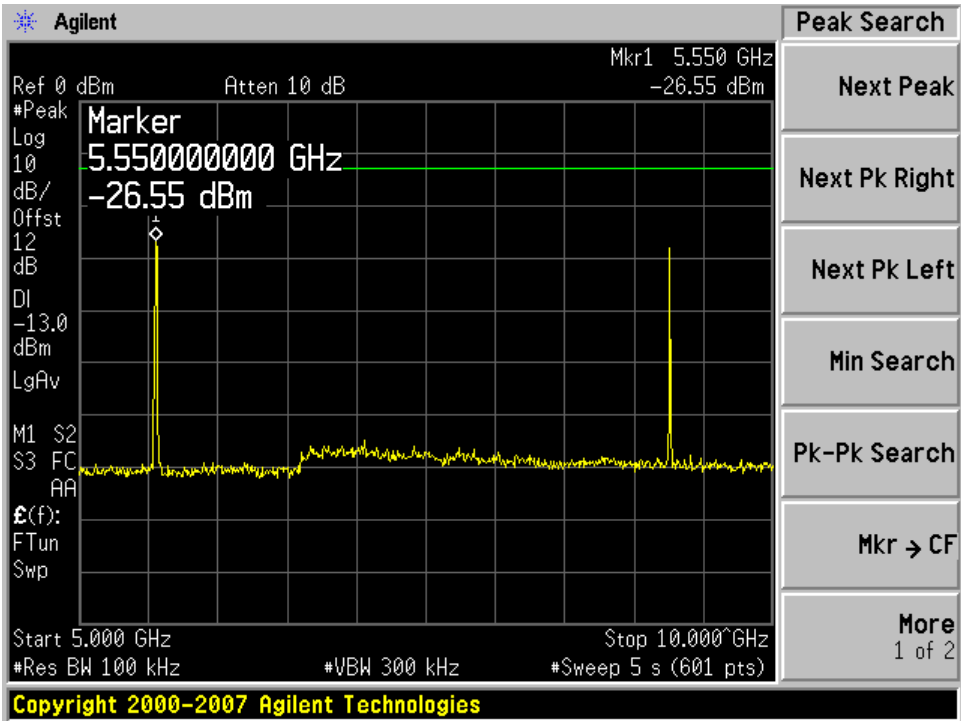


GSM Uplink: Low Channel

Intemodulation Testing



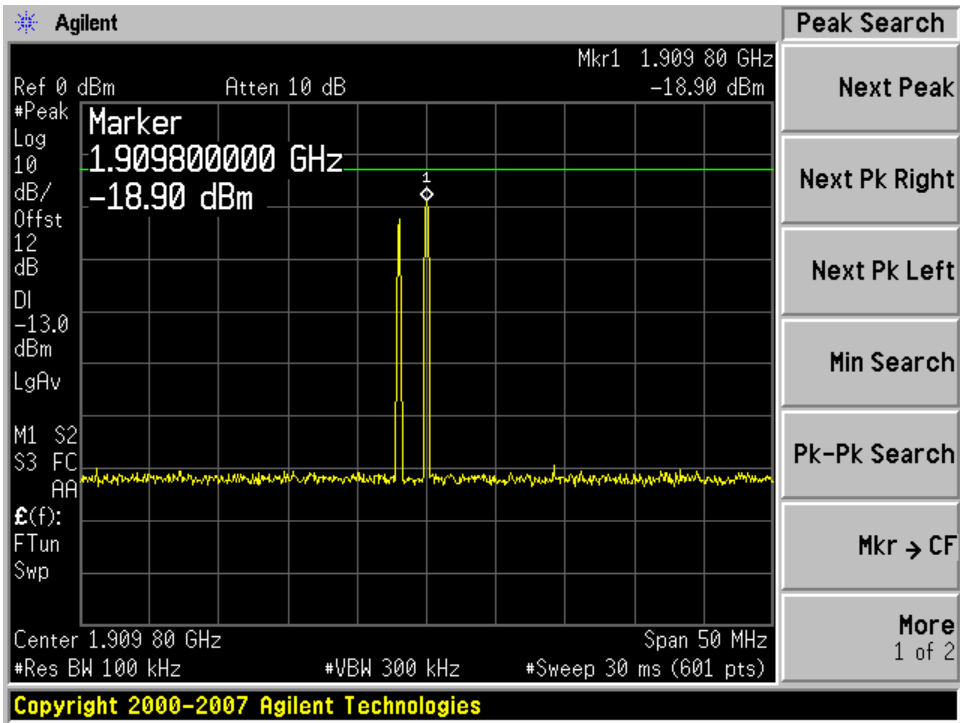




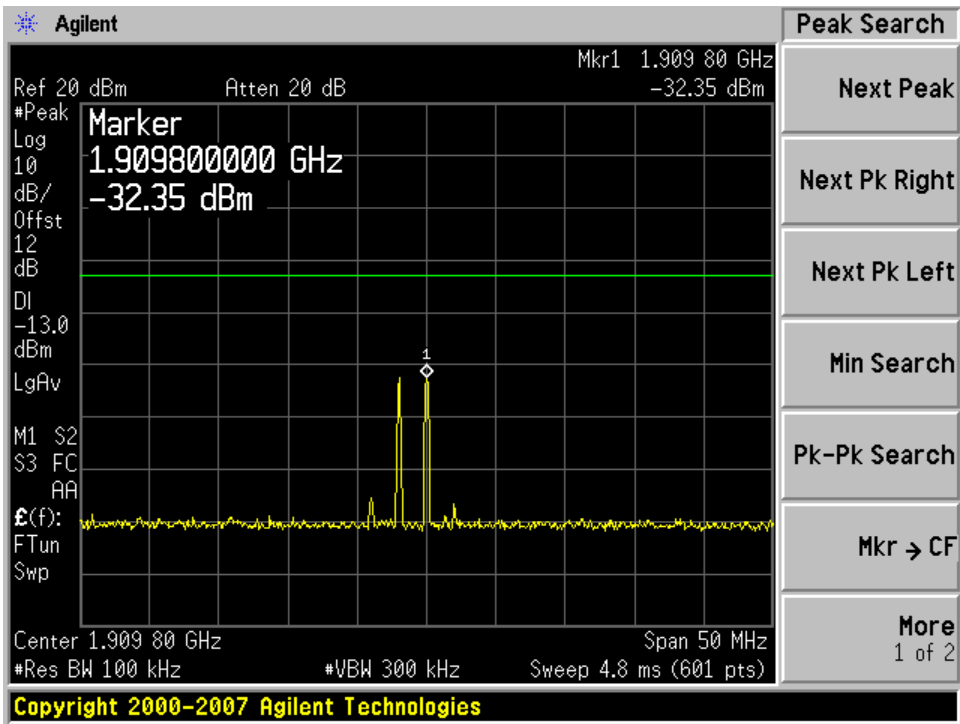
GSM Uplink: High Channel

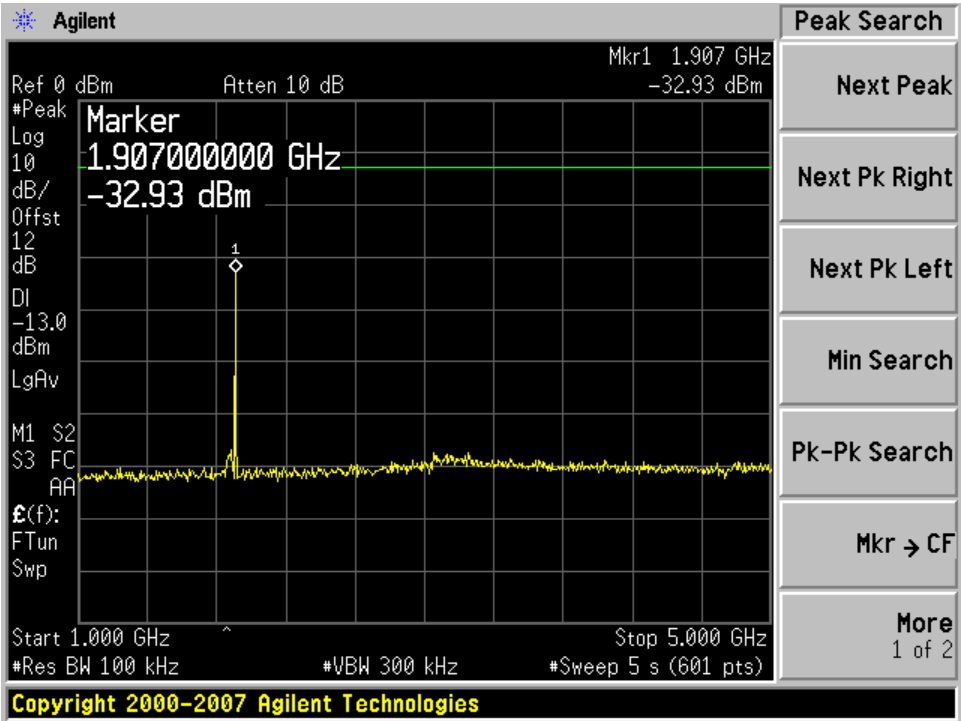
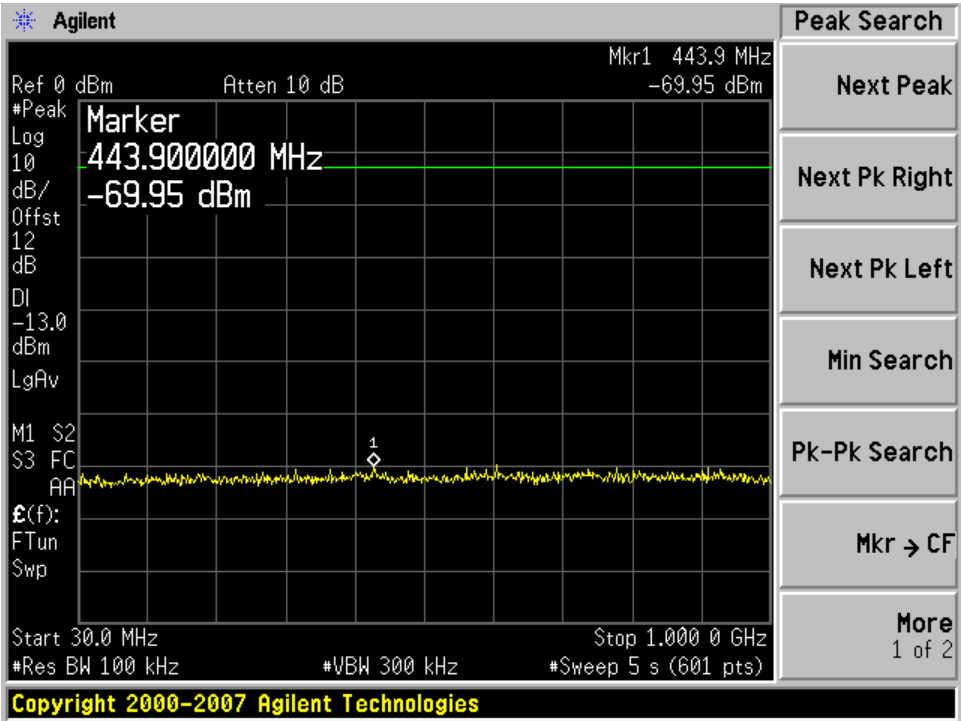
Intemodulation Testing

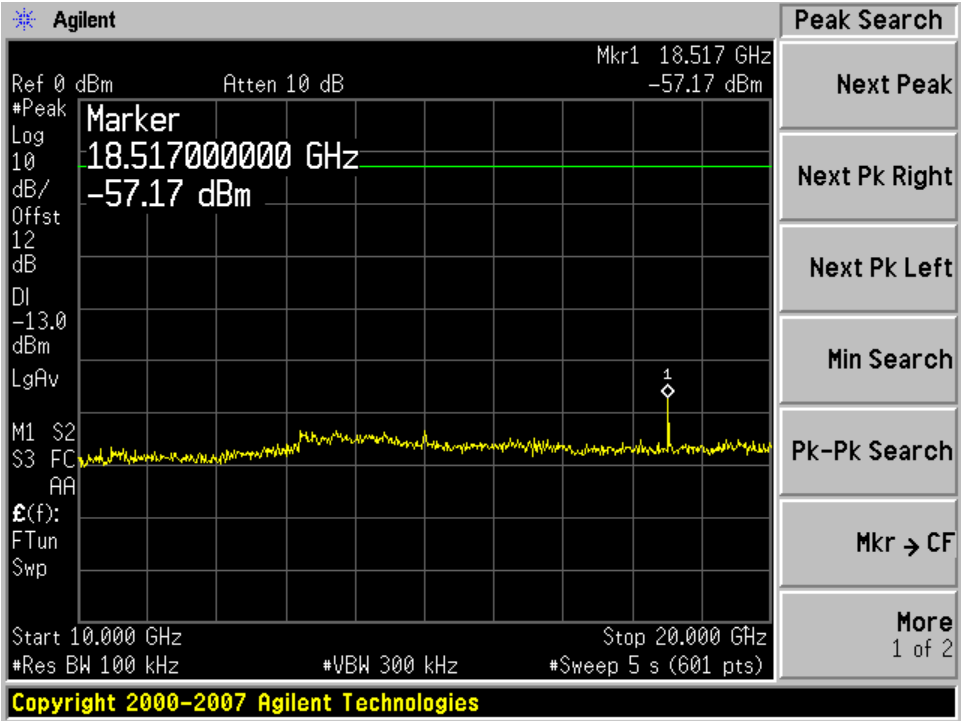
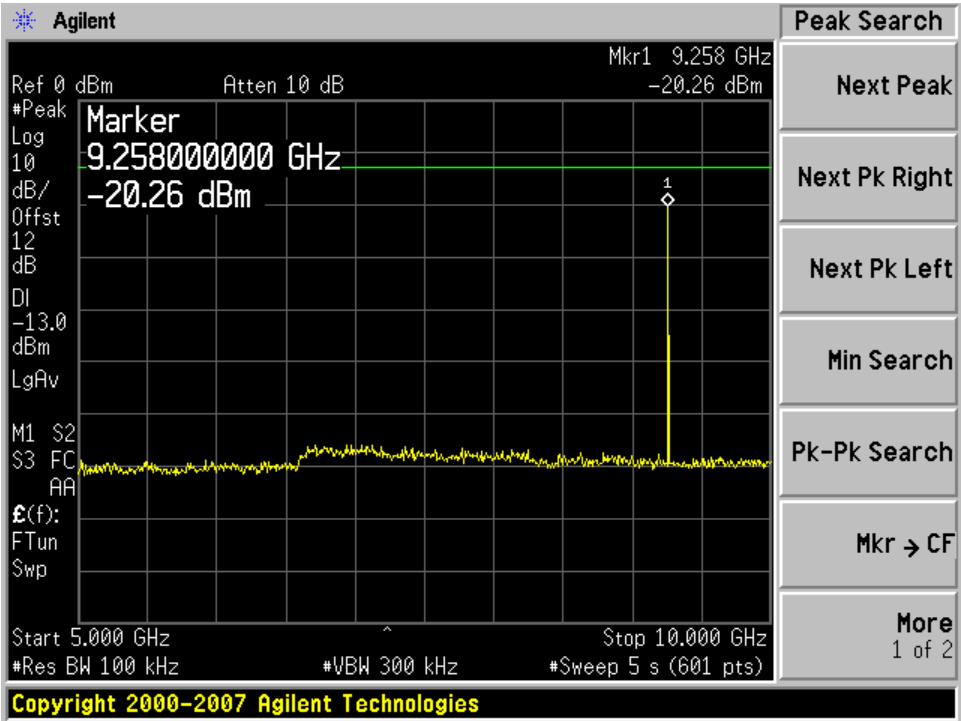
Input



Output







10 §24.238 (a) – BAND EDGE

10.1 Applicable Standard

According to § 24.238 (a), the power of any emissions 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.

10.2 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The center of the spectrum analyzer was set to block edge frequency, RBW set to 10 kHz.

10.3 Environmental Conditions

Temperature:	23 °C
Relative Humidity:	45 %
ATM Pressure:	101.1kPa

* The testing was performed by Victor Zhang on 2008-08-22.

10.4 Test Equipment List and Details

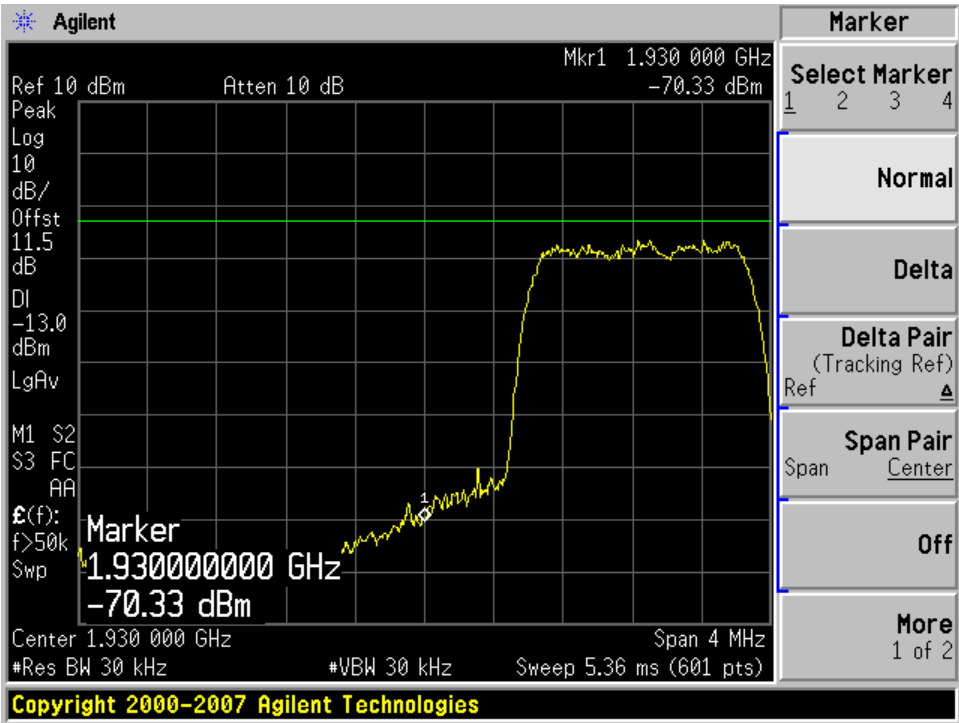
Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-05-07

* **Statement of Traceability:** BACL Corp. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

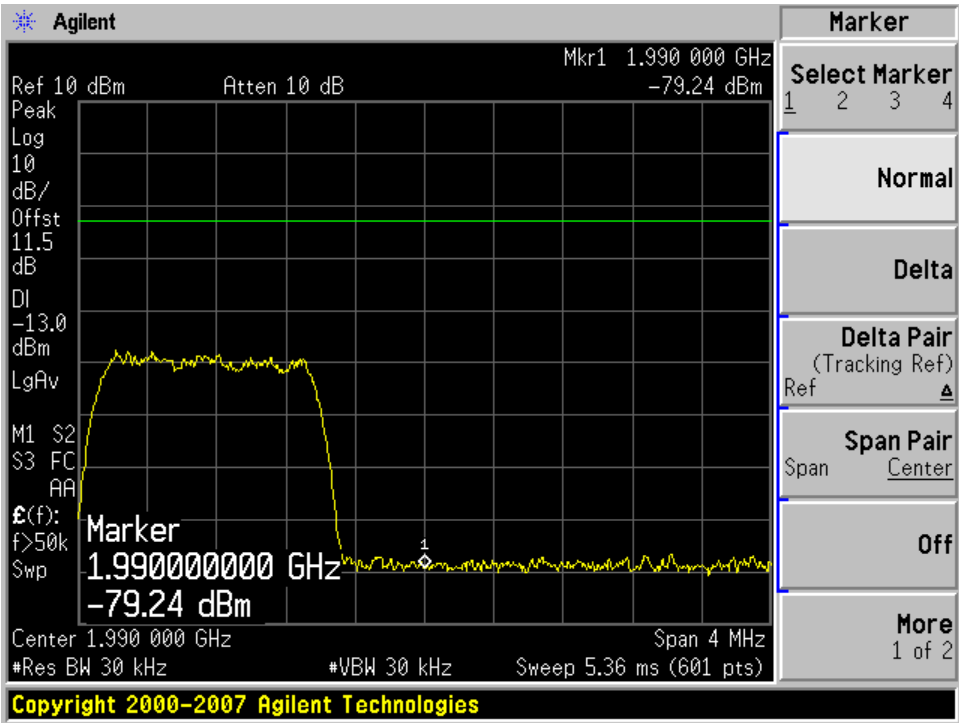
10.5 Test Results

Please refer to the following plots.

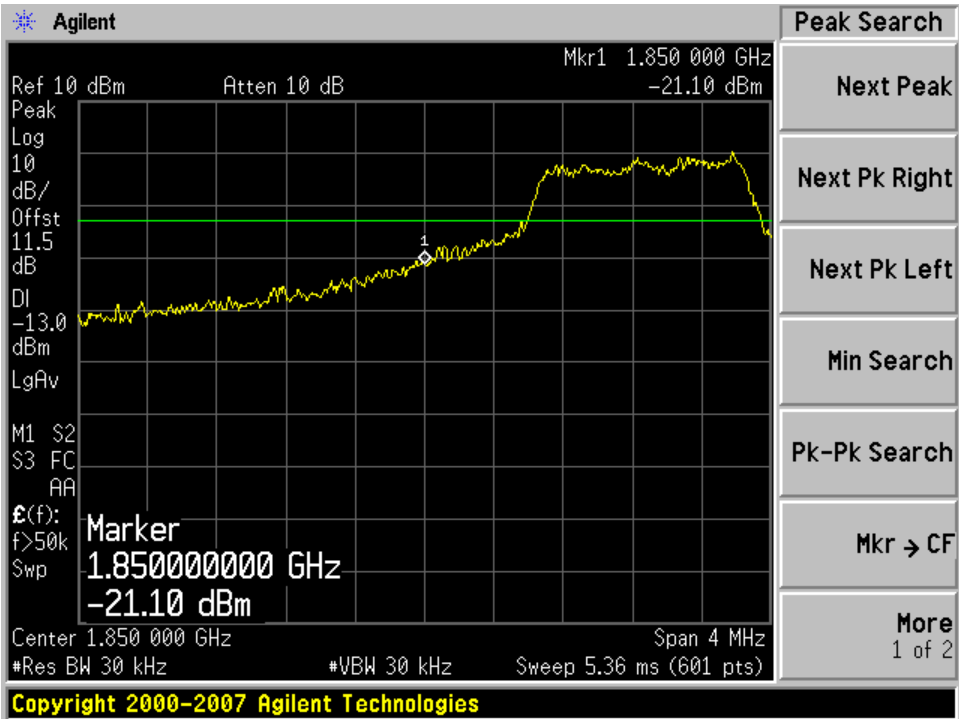
CDMA Downlink: Lowest Channel



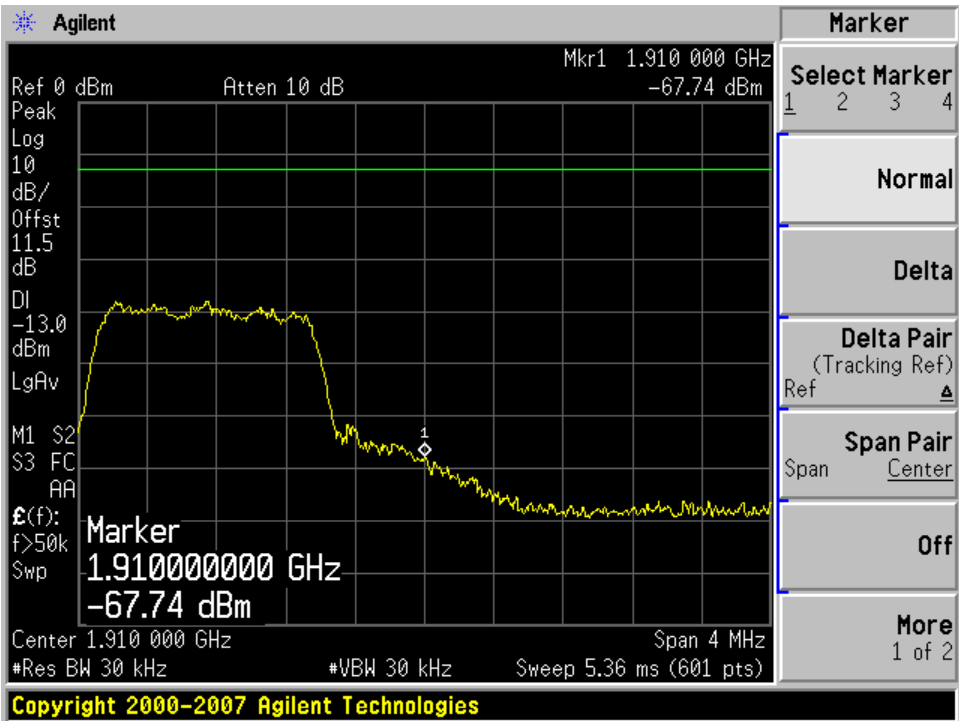
CDMA Downlink: Highest Channel



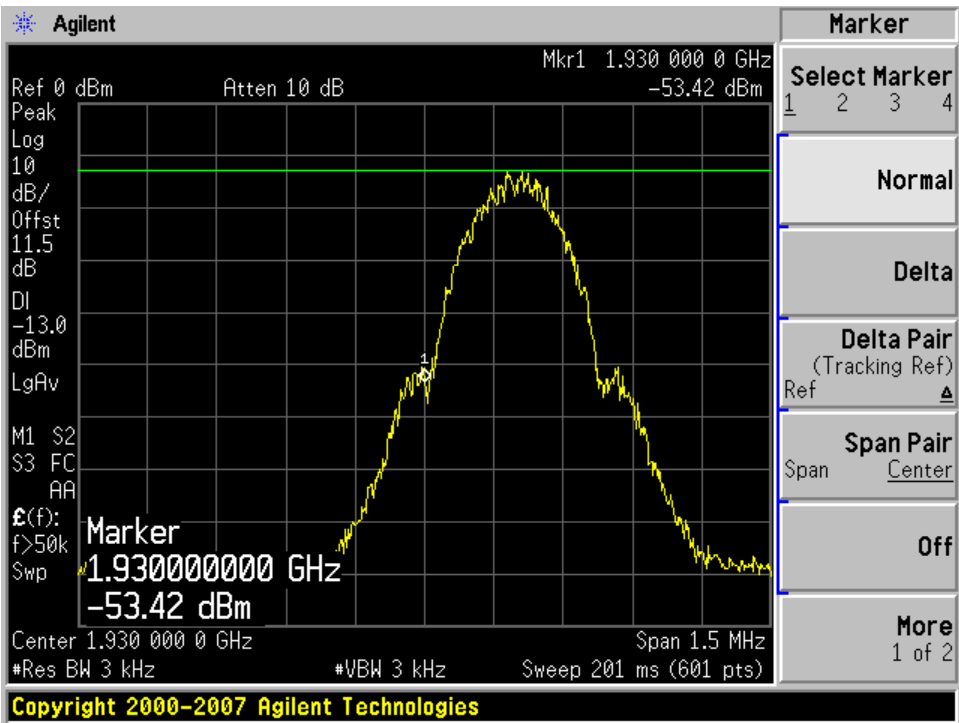
CDMA Uplink: Lowest Channel



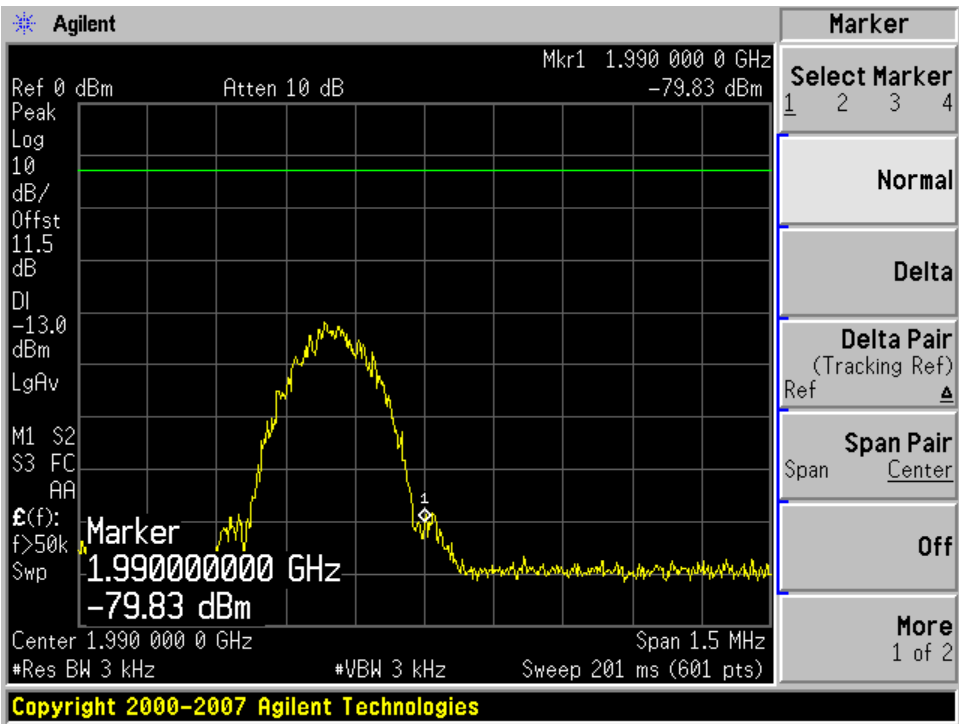
CDMA Uplink: Highest Channel



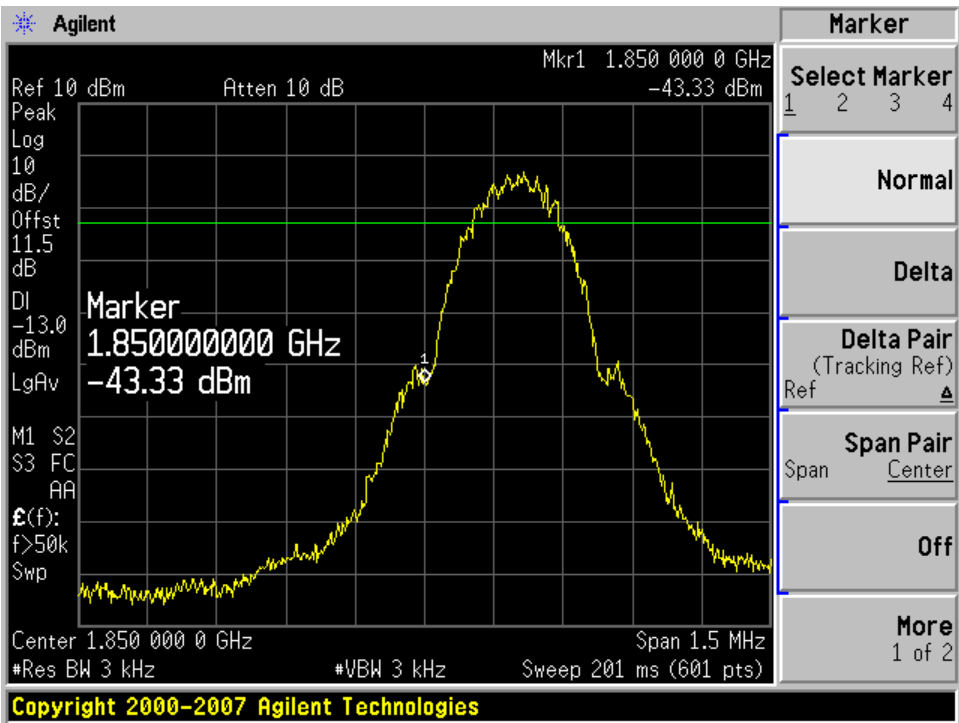
GSM Downlink: Lowest Channel



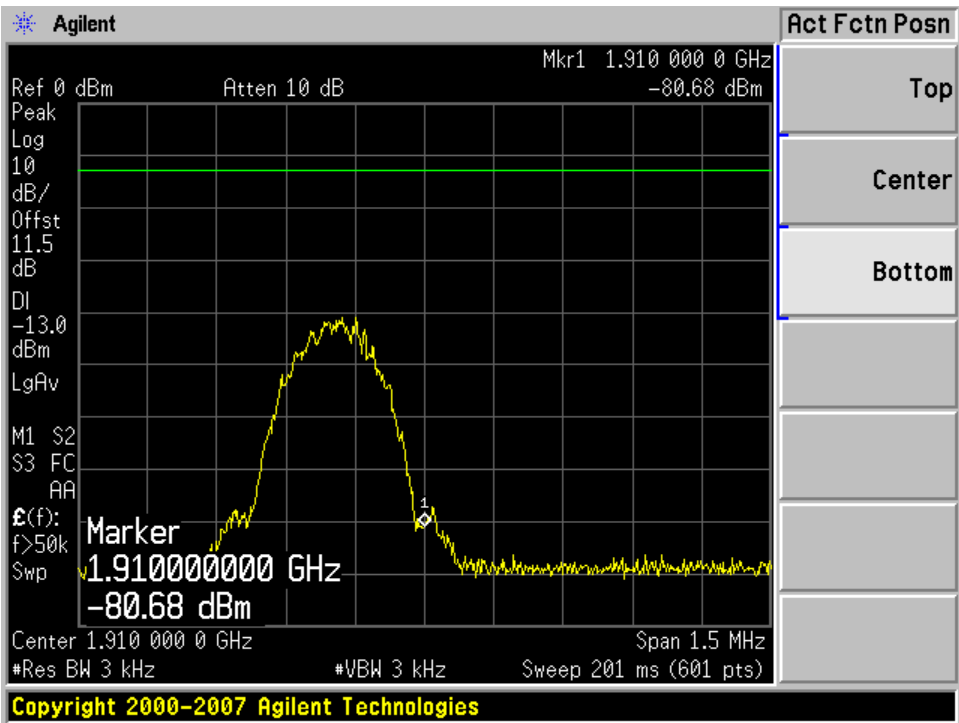
GSM Downlink: Highest Channel



GSM Uplink: Lowest Channel



GSM Uplink: Highest Channel



11 §2.1055 – Frequency Stability

This EUT is an amplifier, not a transmitter. There is no oscillator circuit in the EUT, therefore there is no frequency stability measurement required.

11.1 Test Result

N/A