



FCC PART 90

TEST AND MEASUREMENT REPORT

For

G-Wave, Inc.

38 Leuning Street,
South Hackensack, NJ 07606, USA

FCC ID: Q8KPS725W90

Report Type: Original Report	Product Type: Bi-Directional Amplifier
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Report Number: <u>R1104262-90</u>	
Report Date: <u>2011-06-29</u>	
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* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk “*” (Rev.2)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1104262-90	Original Report	2011-05-24
1	R1104262-90	Updated output power section	2011-06-29

1 GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of G-wave, Inc., and their product, FCC ID: Q8KPS725W90, model: BDA-PS7-2/25W-90-AB, which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a bi-directional amplifier (BDA System).

General Specifications:

- Operating Frequency: Downlink: 763-775 MHz
Uplink: 793-805 MHz
- Power Source: Input: 120V/60Hz

1.2 Mechanical Description of EUT

The EUT dimension is approximately 365mm (L) x 380mm (W) x 200mm (H) and weighs approximately 13.83 kg.

The test data gathered are from typical production sample, serial number: 11041001, provided by the Manufacturer.

1.3 Objective

This type approval report is prepared on behalf of *G-Wave, Inc.*, in accordance with Part 2 Subpart J, and Part 90 of the Federal Communication Commissions rules.

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

1.4 Related Submittal(s)/Grant(s)

No Related Submittals

1.5 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 90 Private Land Mobile Radio Services

Applicable Standards: TIA-603-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.

1.6 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.

1.7 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 in accordance to ANSI C63.4-2003 Standards.

2.2 EUT Exercise Software

Signal was sent through EUT using a signal generator.

2.3 Equipment Modifications

No modification was made to the EUT

2.4 Special Equipment

No special equipment was used during testing

2.5 Local Support Equipment

Manufacturers	Descriptions	Models	Serial Numbers
Rohde & Schwarz	Signal Generator	SMIQ03	849192/0085

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
G-Wave Microwave	Diplexer	PS700	11041001
G-Wave Microwave	Diplexer	PS700	11041002
G-Wave Microwave	Down Link Filter	PS700	11041002
G-Wave Microwave	UP Link Filter	PS700	11041001
G-Wave Microwave	Low Noise Amplifier	MA7XX/2.3/45OK-A1	11041001
G-Wave Microwave	Low Noise Amplifier	MA7XX/2.3/45OK-A1	11041002
COSEL	Live Heat Sinks	LEP240F	-

2.7 External I/O Cabling List and Details

Cable Descriptions	Length (m)	From	To
-	-	-	-

3 SUMMARY OF TEST RESULTS

FCC Rules	Description of Tests	Results
§2.1046; §90.541; §90.542	RF Output Power	Compliant
§2.1051; §90.543; §90.210	Band Edge	Compliant
§2.1049; §90.210	99% and 26 dB Occupied Bandwidth	Compliant
§2.1051; §90.543; §90.210	Emission Limitation	Compliant
§2.1051; §90.543; §90.210	Spurious Emissions at Antenna Terminals	Compliant
§2.1053; §90.543; §90.210	Field Strength of Spurious Radiation	Compliant
§2.1051; §90.543; §90.210	Inter-modulation Characteristics	Compliant
§1.1307; §2.1091	RF Exposure Information (MPE)	Compliant
§2.1047; §90.535	Modulation Characteristics	N/A
§2.1055; §90.539	Frequency Stability	N/A

N/A: This EUT is amplifier and does not contain modulation circuitry or frequency generation.

4 FCC §2.1046, §90.541 & §90.542 – RF OUTPUT POWER

4.1 Applicable Standards

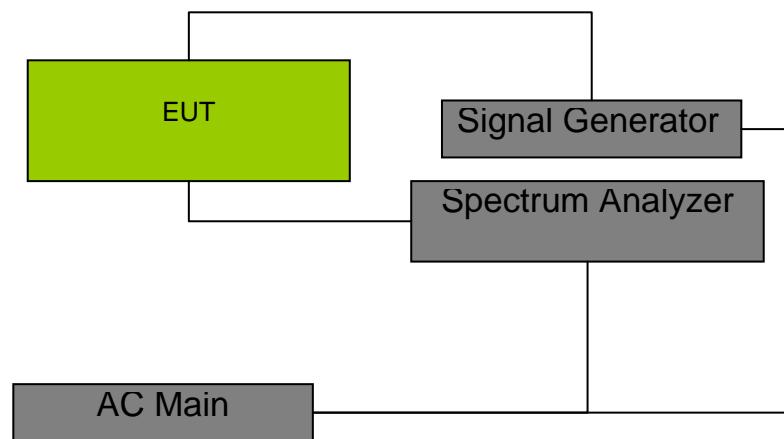
FCC §2.1046, §90.541 and §90.542.

4.2 Test Procedure

Conducted:

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

4.3 Test Setup Block Diagram



4.4 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	PSA Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31

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

4.5 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

The testing was performed by Kevin Li on 2011-04-28 in RF Site.

4.6 Test Results

Input power for downlink: -21 dBm, Input power for uplink: -34 dBm

	Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Downlink	Low	763	35.33	3.411
	Middle	769	37.00	5.011
	High	775	36.36	4.325
Uplink	Low	793	26.78	0.476
	Middle	799	27.57	0.571
	High	805	26.33	0.430

Note: All power results are base on the conducted measurement; according to manufactures antenna information:

1. For Downlink will be 0 dBi antenna, so the ERP will be $37.0 \text{ dBm} + 0 \text{ dBi} - 2.15 \text{ dB} = 34.85 \text{ dBm} = 3.055 \text{ Watt}$ which meets FCC 5 Watt ERP limit.
2. For Uplink will be 10 dBi antenna, so the ERP will be $27.57 \text{ dBm} + 10 \text{ dBi} - 2.15 \text{ dB} = 35.42 \text{ dBm} = 3.483 \text{ Watt}$ which meet FCC 5 Watt ERP limit.

5 FCC §2.1047 & §90.535 - MODULATION CHARACTERISTIC

5.1 Applicable Standard

According to FCC §2.1047(d) and Part §90.535, the EUT is an amplifier and there is no modulating/or limiting circuit, therefore modulation characteristic is not presented.

5.2 Test Result

N/A

6 FCC §2.1049 & §90.210 – OCCUPIED BANDWIDTH

6.1 Applicable Standard

Requirements: FCC §2.1049, §90.210.

6.2 Test Procedure

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

According to the FCC 2-11-04/EAB/RF, Input and output signals were compared to verify that there was no any degradation to the signal due to amplification and conversion from the repeater using an RBW of 300 Hz or 1% of the emission bandwidth. Then the 20 dB & 99% bandwidth was recorded.

6.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31

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

6.4 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

The testing was performed by Kevin Li on 2011-04-28 in RF Site.

6.5 Test Results

Downlink Frequency: 769 MHz

Channel Spacing (kHz)	Modulation	Input Signal 99% Emission Bandwidth (kHz)	Output Signal 99% Emission Bandwidth (kHz)
12.5	FM with 2.5 kHz Sin wave signal	10.36	10.30
25	FM with 5 kHz Sin wave signal	15.72	15.71
6.25	FM with an External 9600 b/s random data source	4.37	4.56
12.5	FM with an External 9600 b/s random data source	8.54	8.73
25	FM with an External 9600 b/s random data source	12.20	12.22

Uplink Frequency: 799 MHz

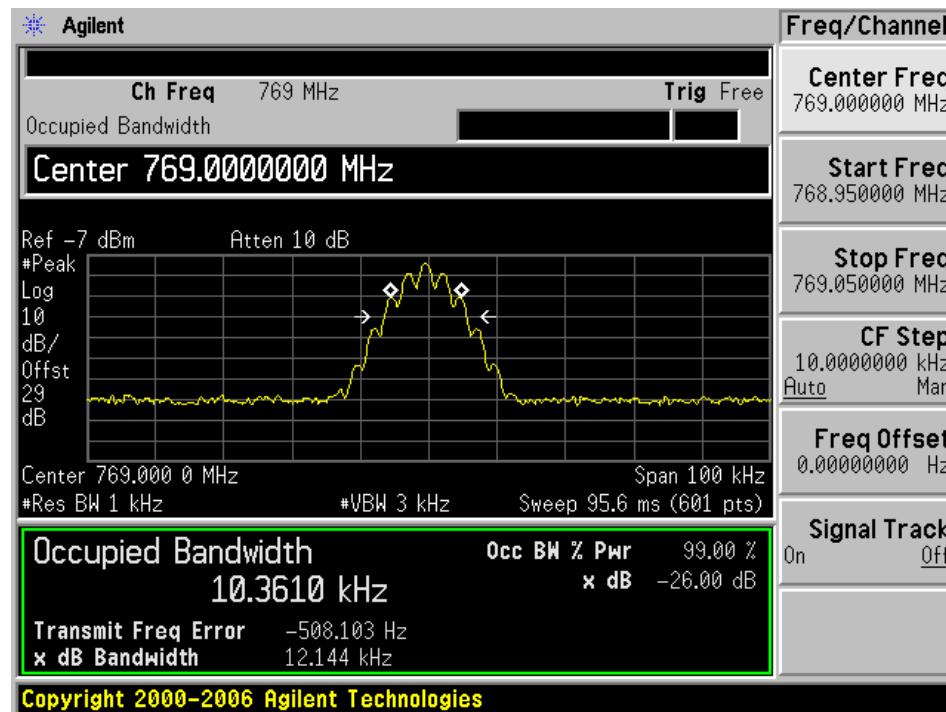
Channel Spacing (kHz)	Modulation	Input Signal 99% Emission Bandwidth (kHz)	Output Signal 99% Emission Bandwidth (kHz)
12.5	FM with 2.5 kHz Sin wave signal	10.36	10.30
25	FM with 5 kHz Sin wave signal	15.72	15.84
6.25	FM with an External 9600 b/s random data source	3.83	4.12
12.5	FM with an External 9600 b/s random data source	8.51	8.16
25	FM with an External 9600 b/s random data source	12.35	12.18

Please refer to the following plots:

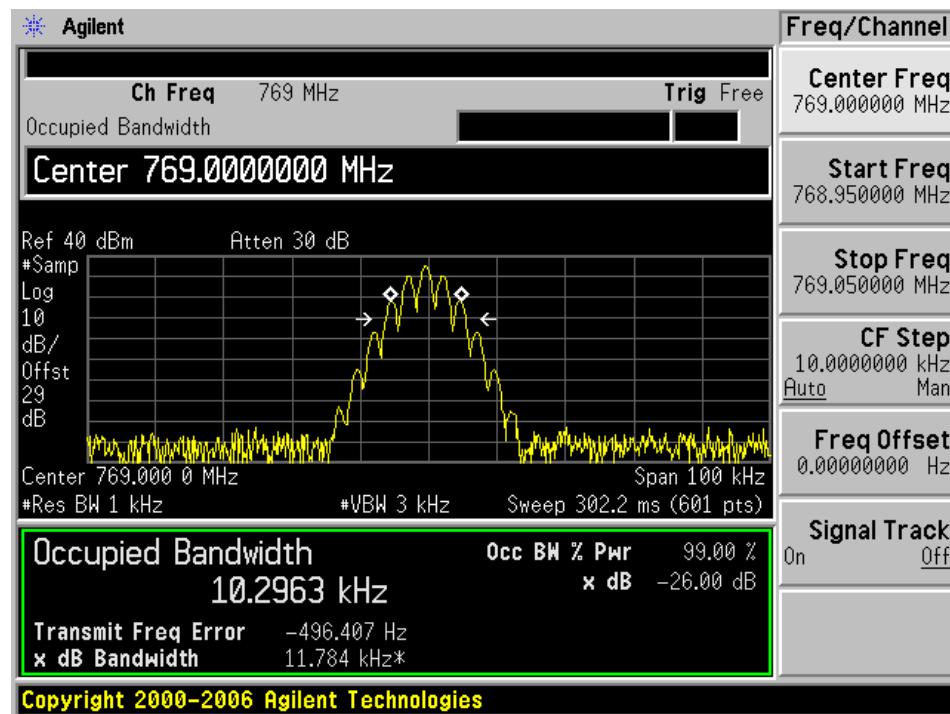
Downlink, Middle Channel: 769 MHz

12.5 kHz channel Spacing with FM modulation with 2.5 kHz Sin Wave signal

Input

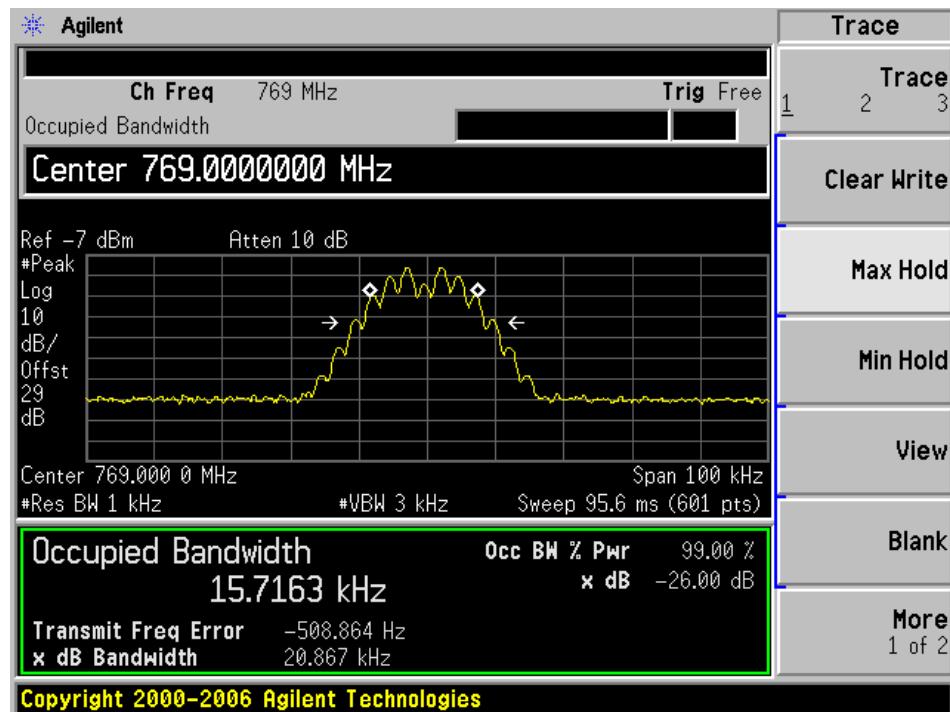


Output

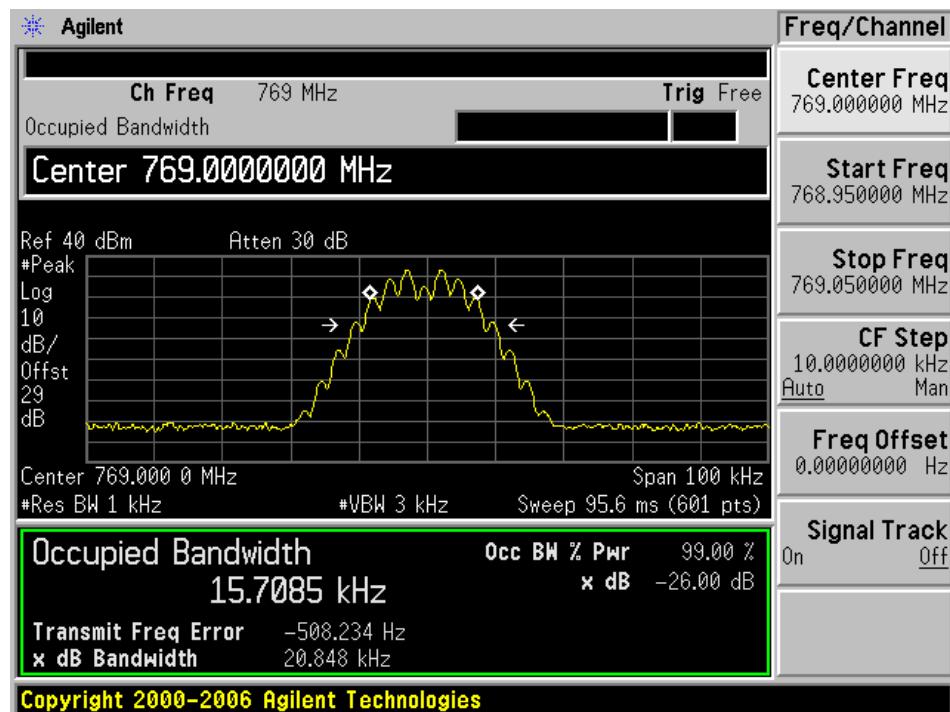


25 kHz channel Spacing with FM modulation with 5 kHz Sin Wave signal

Input

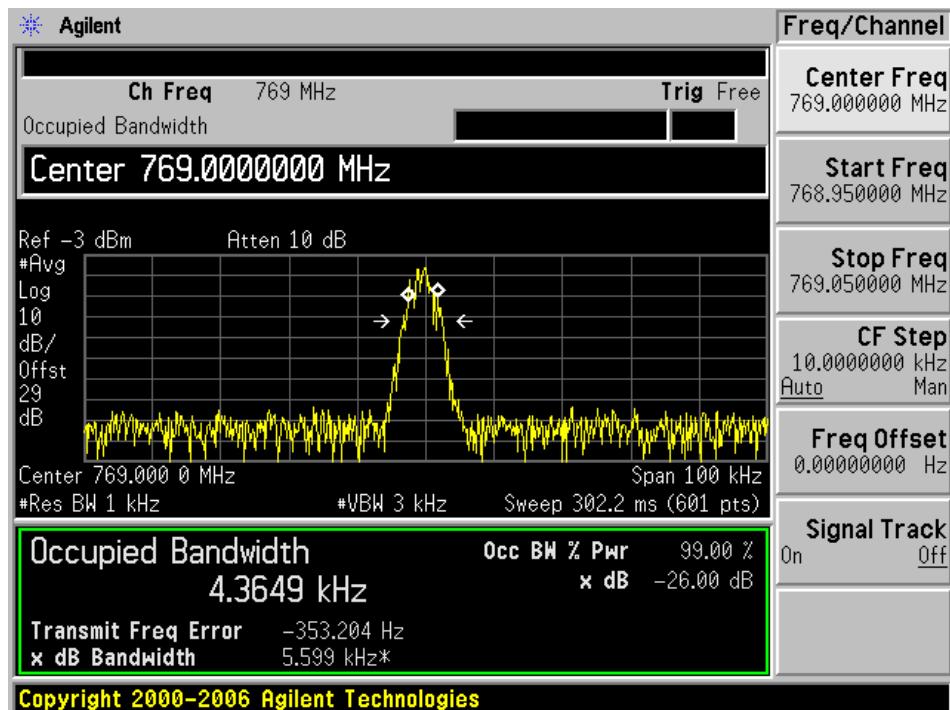


Output

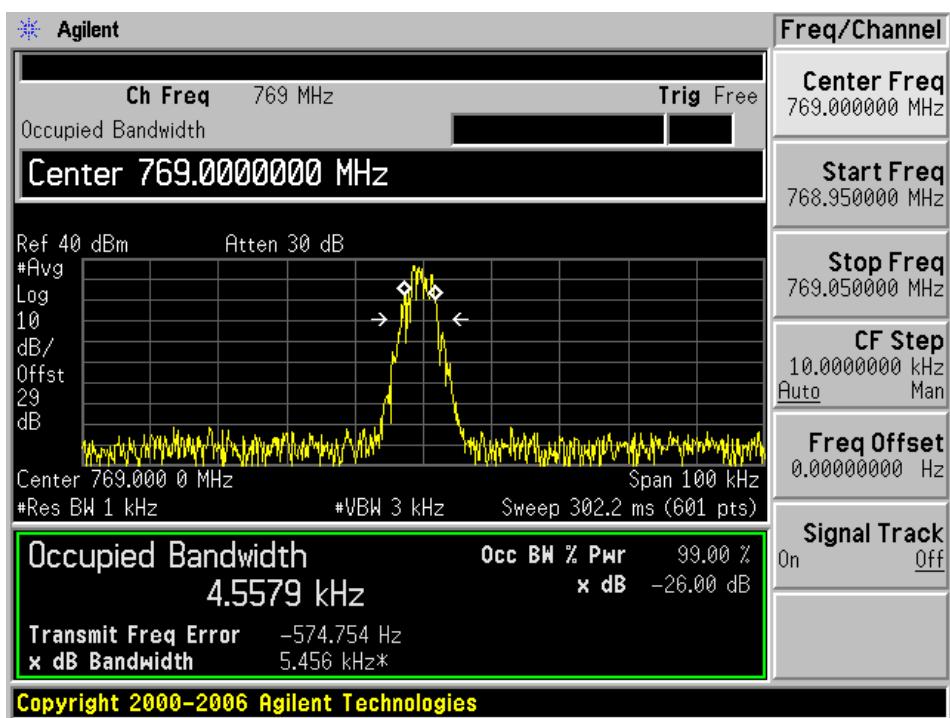


6.25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

Input

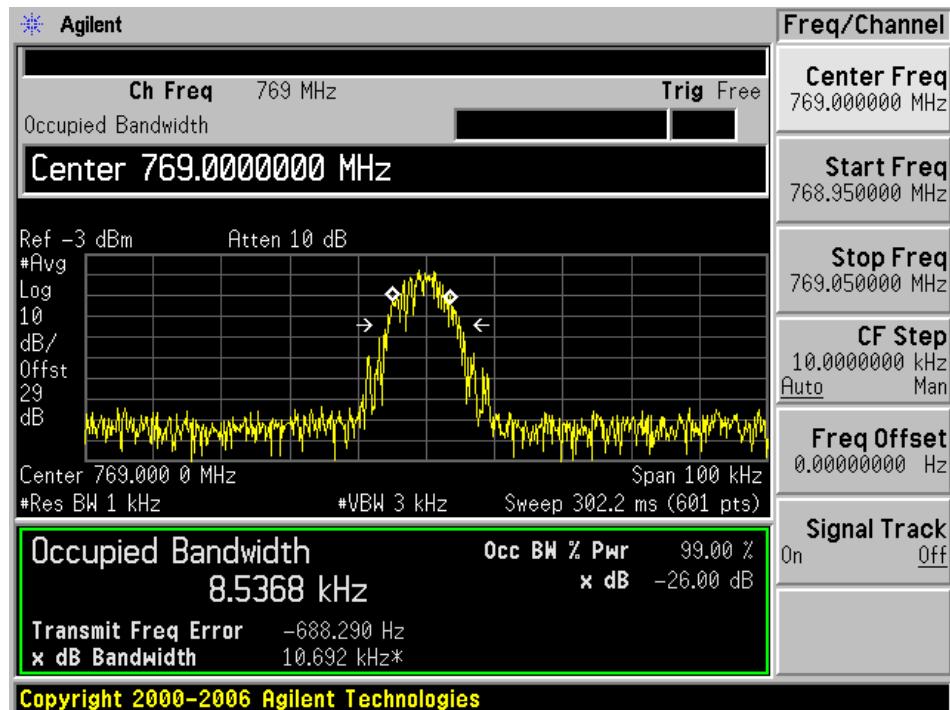


Output

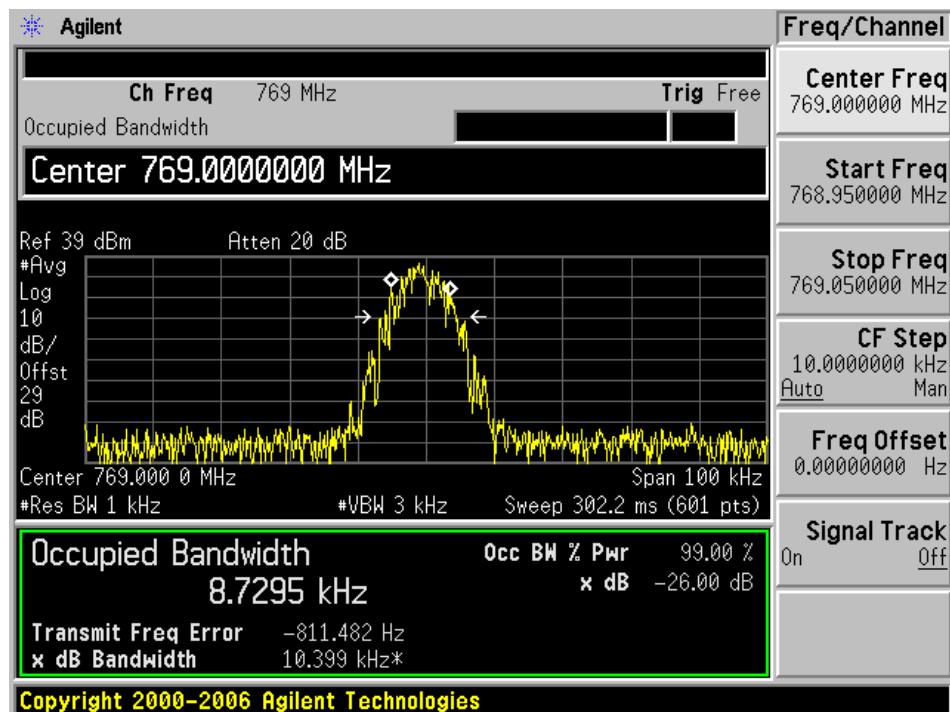


12.5 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

Input

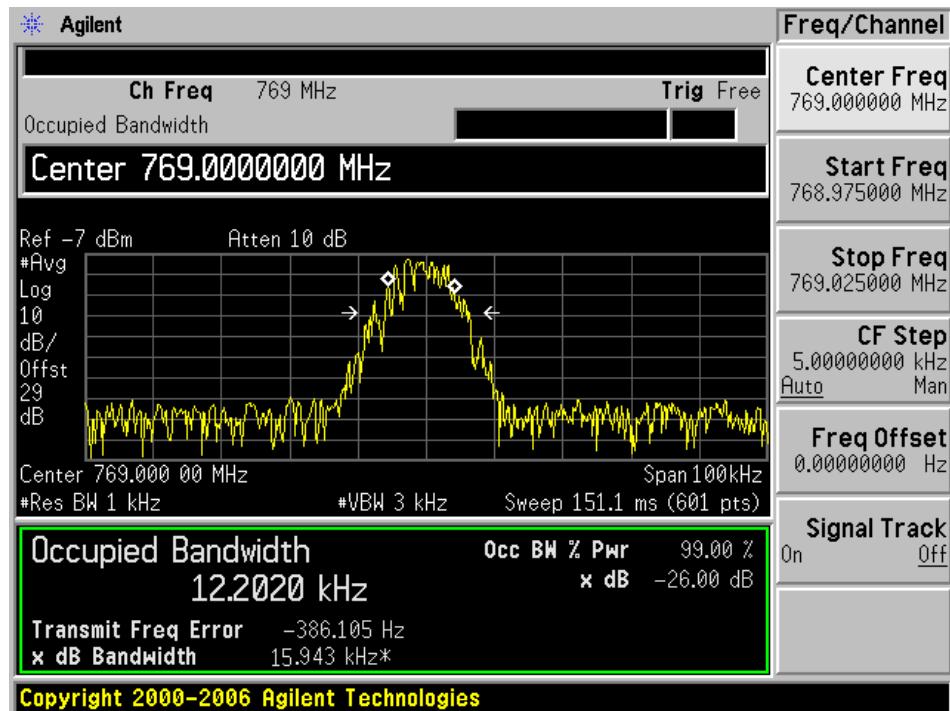


Output

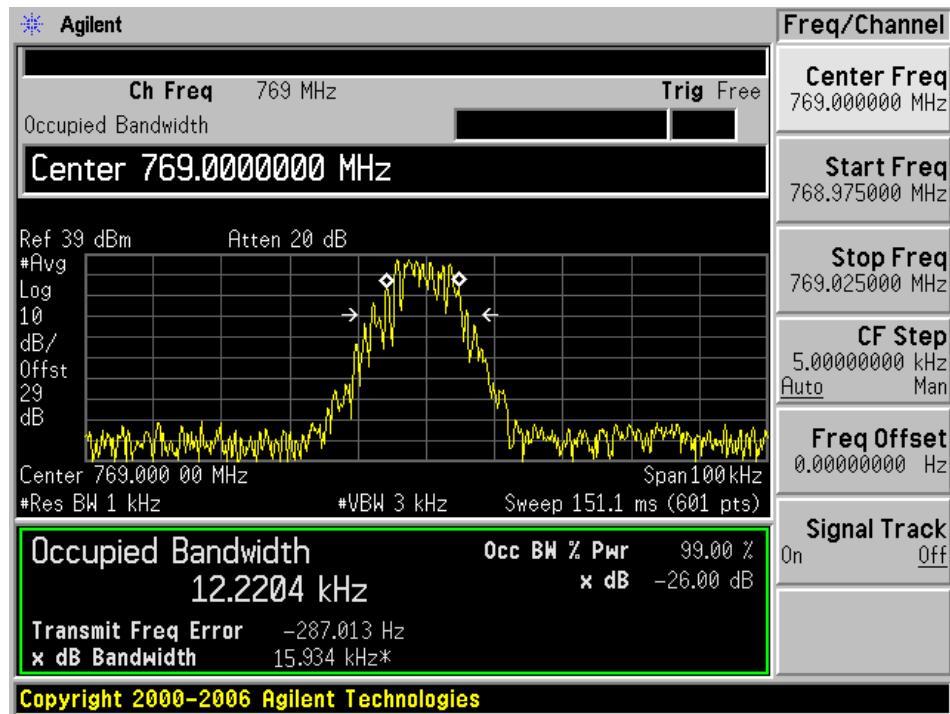


25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

Input



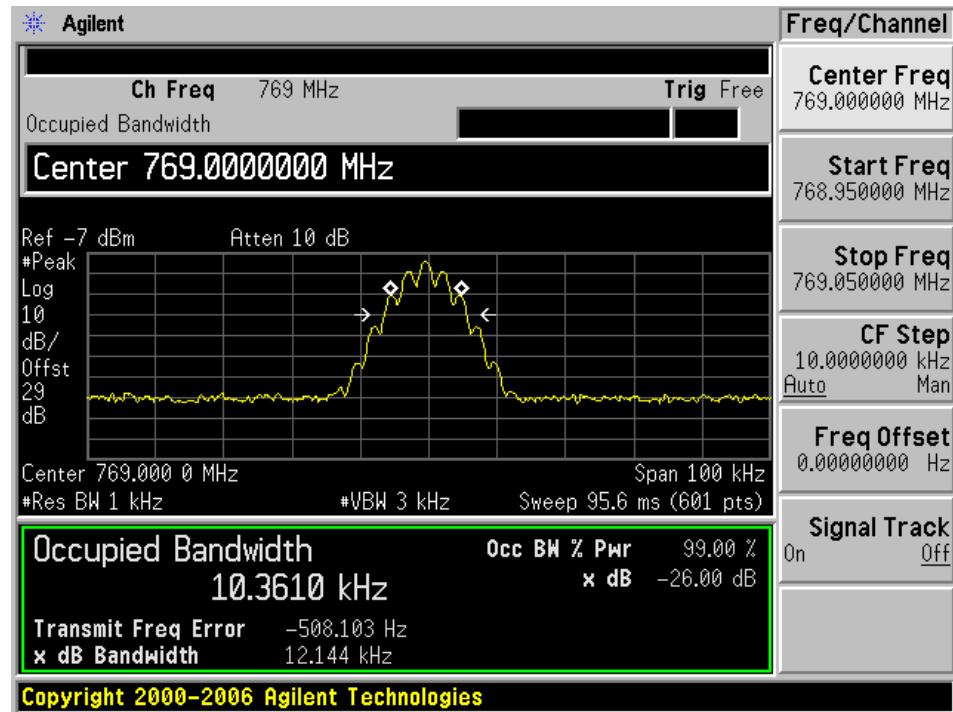
Output



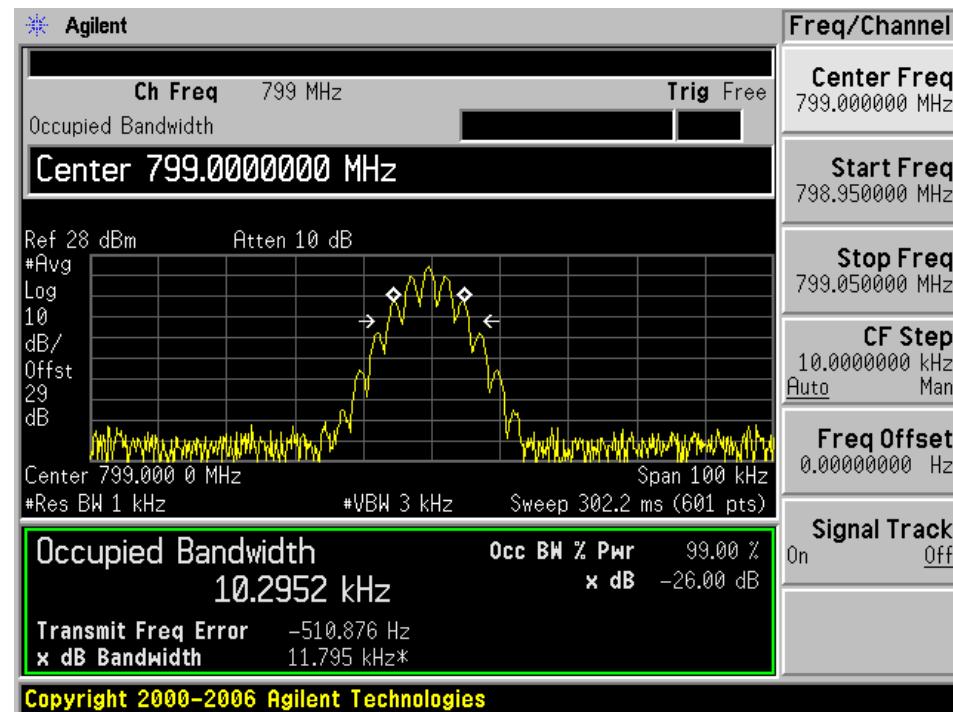
Uplink, Middle Channel: 799 MHz

12.5 kHz channel Spacing with FM modulation with 2.5 kHz Sin Wave signal

Input

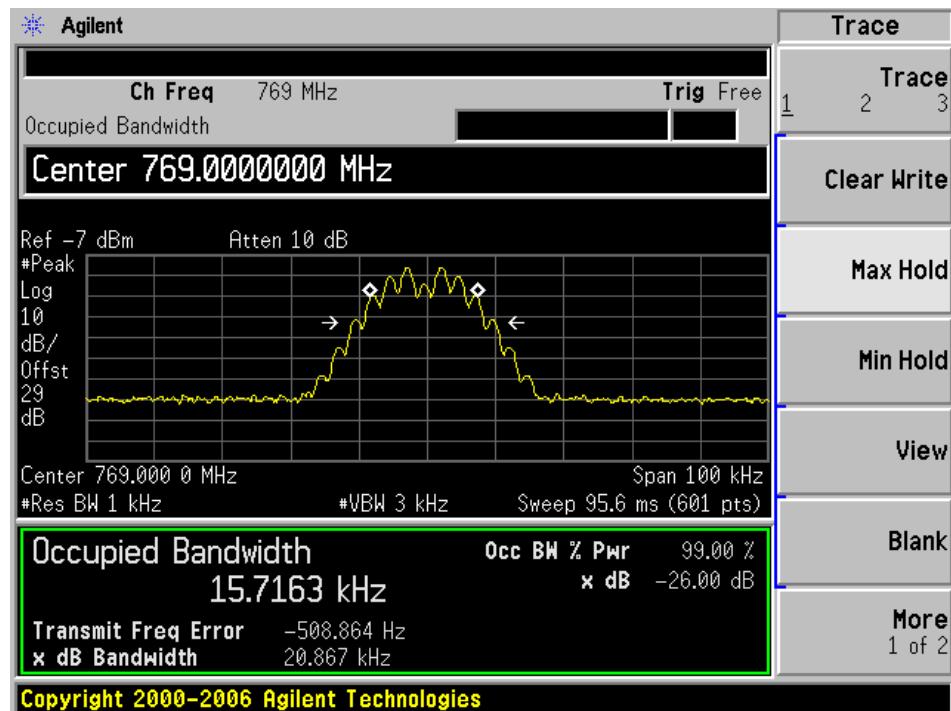


Output

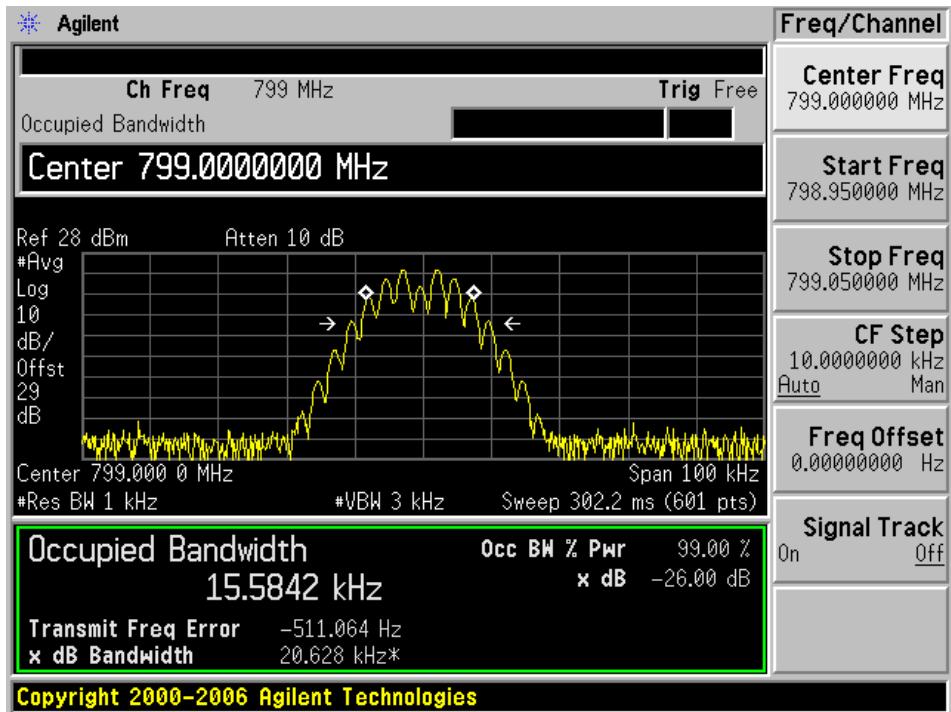


25 kHz channel Spacing with FM modulation with 5 kHz Sin Wave signal

Input

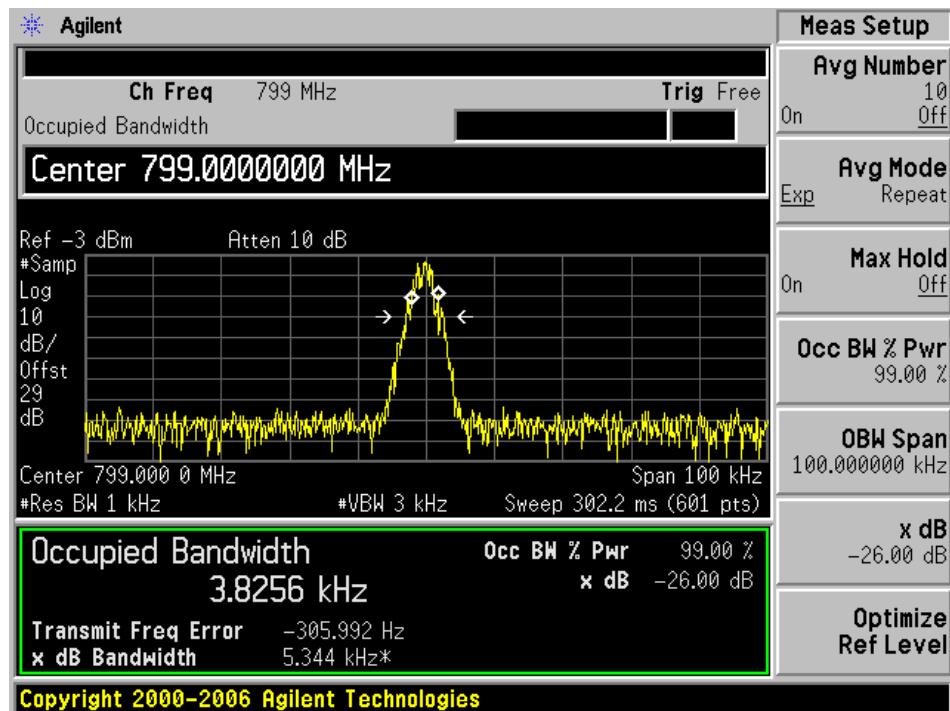


Output

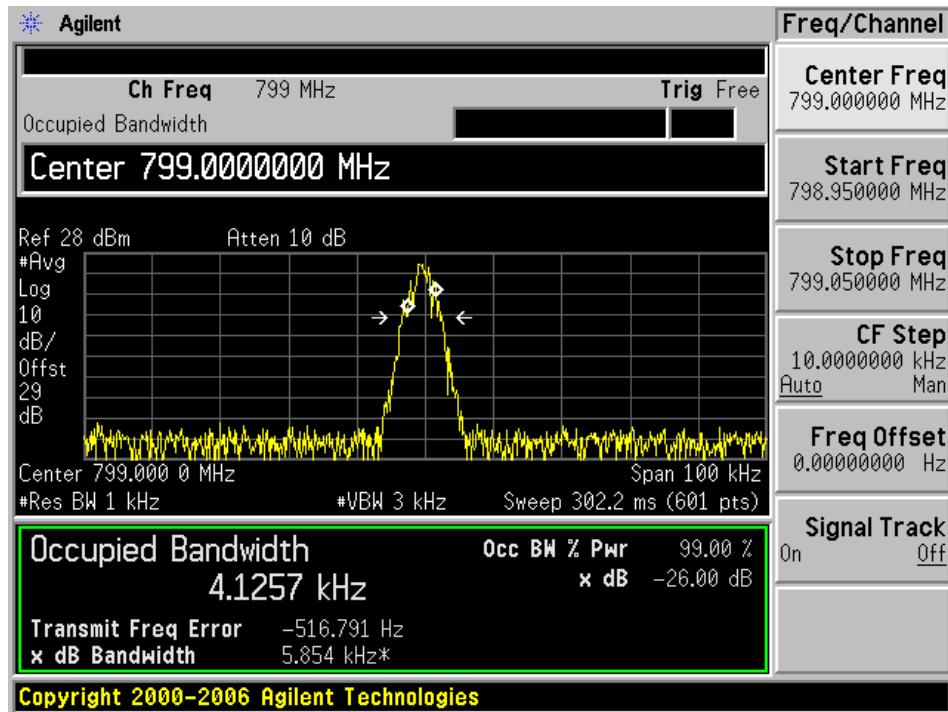


6.25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

Input

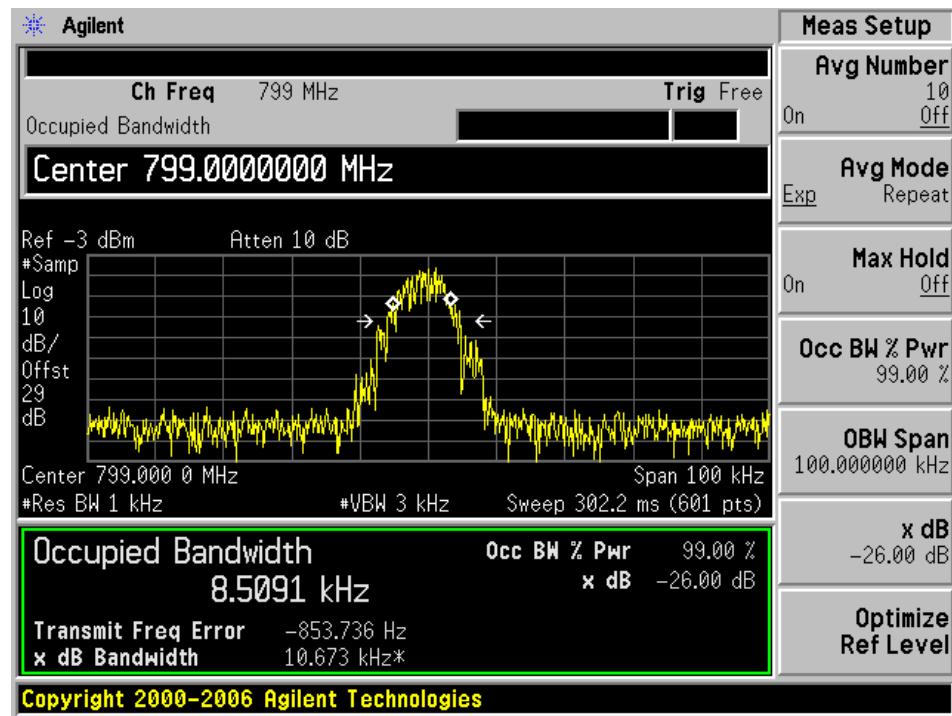


Output

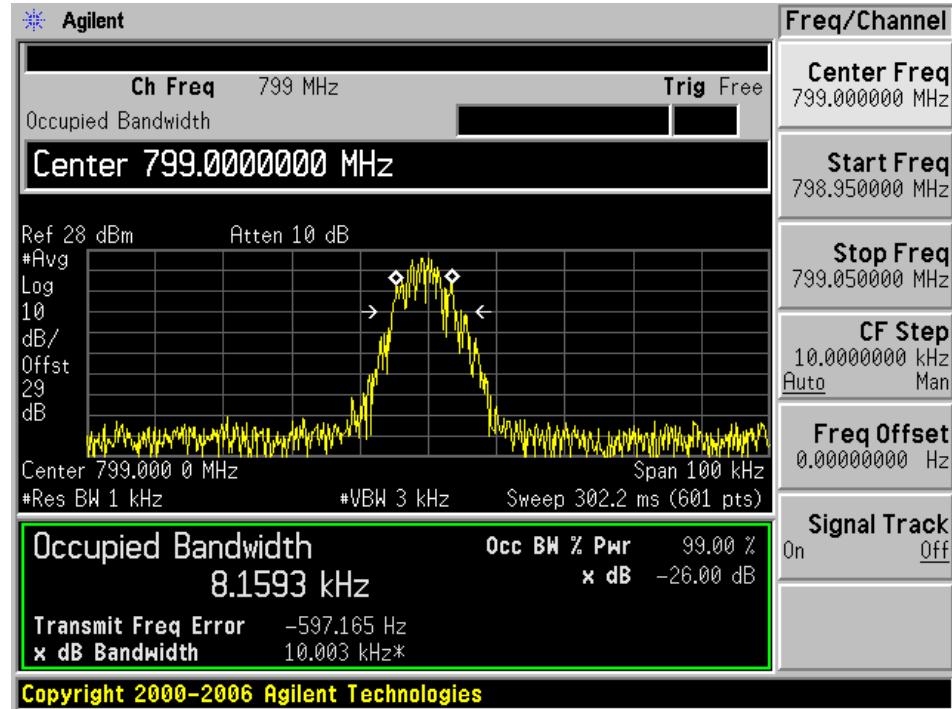


12.5 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

Input

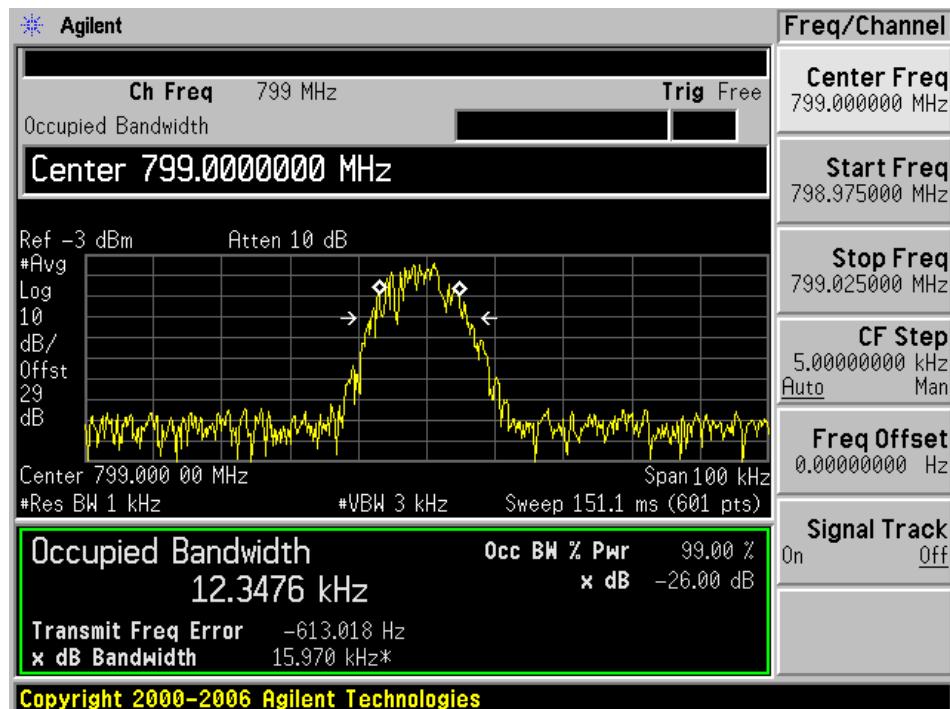


Output

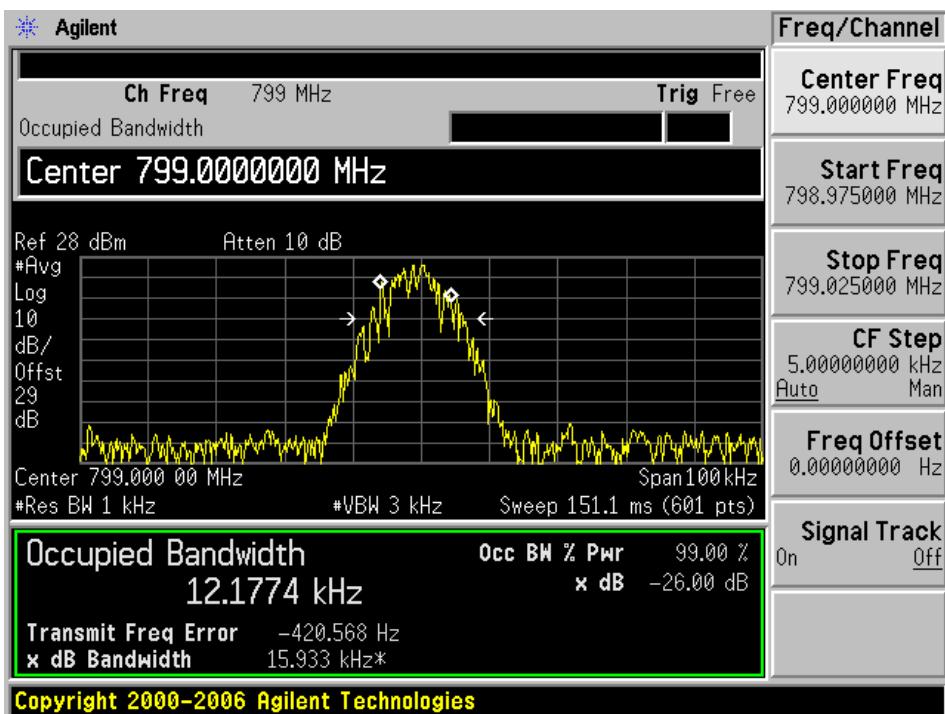


25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

Input



Output



7 FCC §2.1051, §90.543 & §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

7.1 Applicable Standard

Requirements: FCC §2.1051, §90.543 and §90.210.

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency.

7.2 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.

7.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31

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

7.4 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

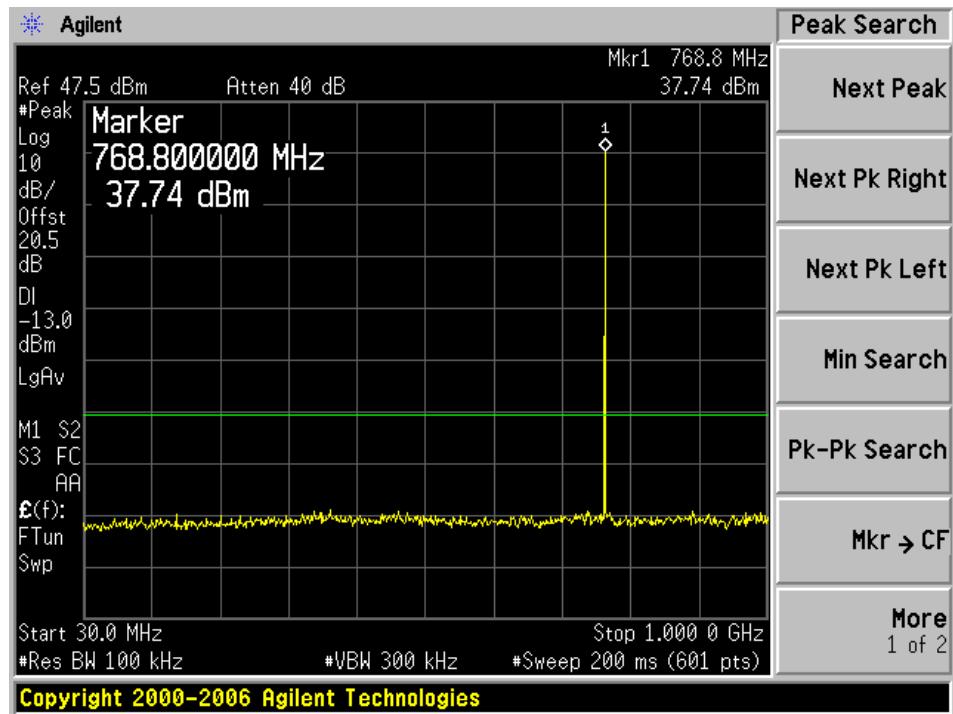
The testing was performed by Kevin Li on 2011-04-28 in RF Site.

7.5 Test Results

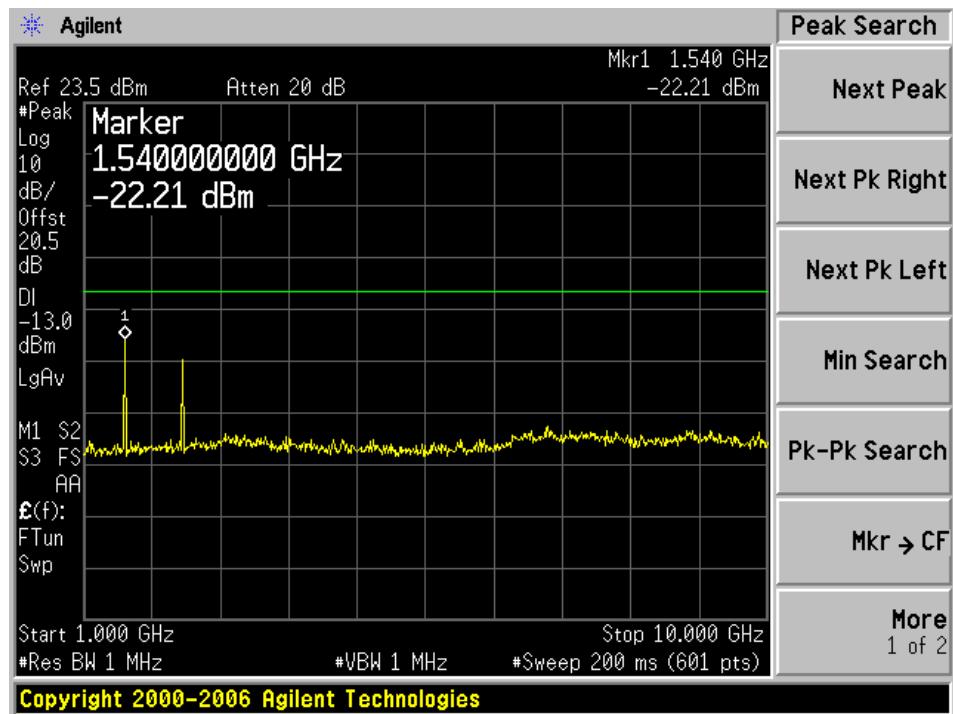
Please refer to the plot hereinafter.

Downlink, Middle Channel (769 MHz)

30MHz ~ 1GHz

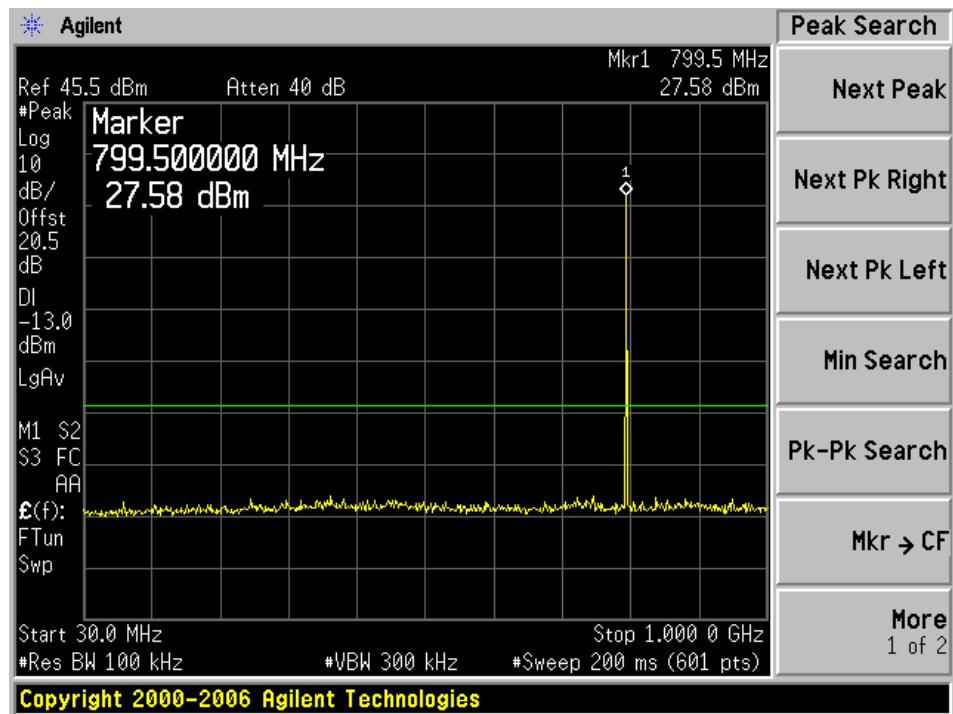


1GHz~10GHz

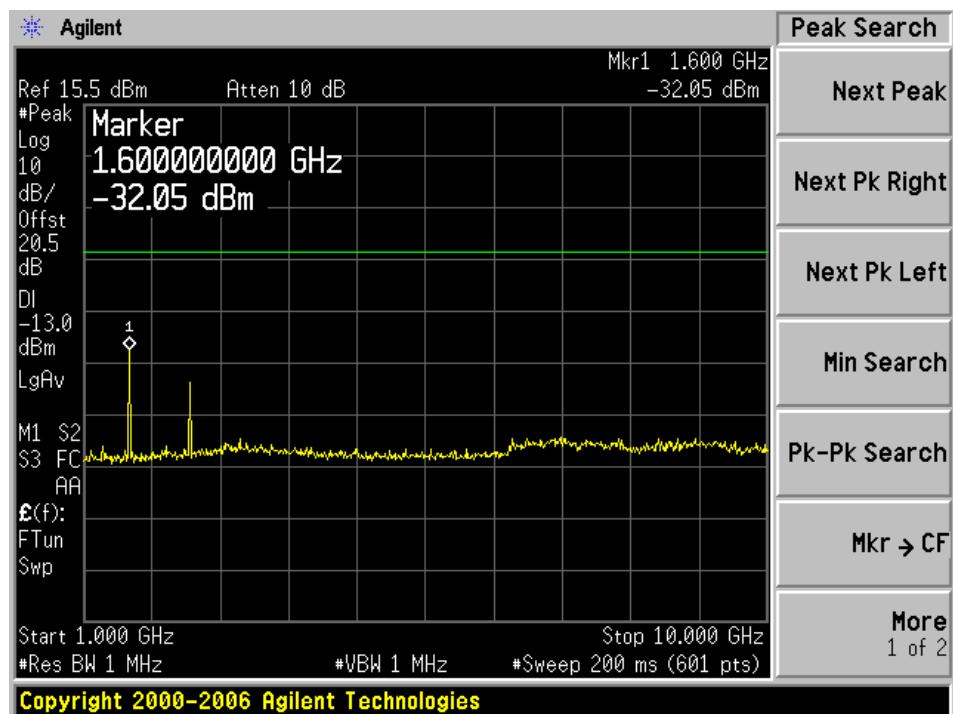


Uplink, Middle Channel (799 MHz)

30MHz ~ 1GHz



1GHz~10GHz



8 FCC §2.1047 & §90.543 – INTERMODULATION CHARACTERISTICS

8.1 Applicable Standard

Requirements: FCC §2.1047, §90.543 and §90.210.

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency.

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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.

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

8.4 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

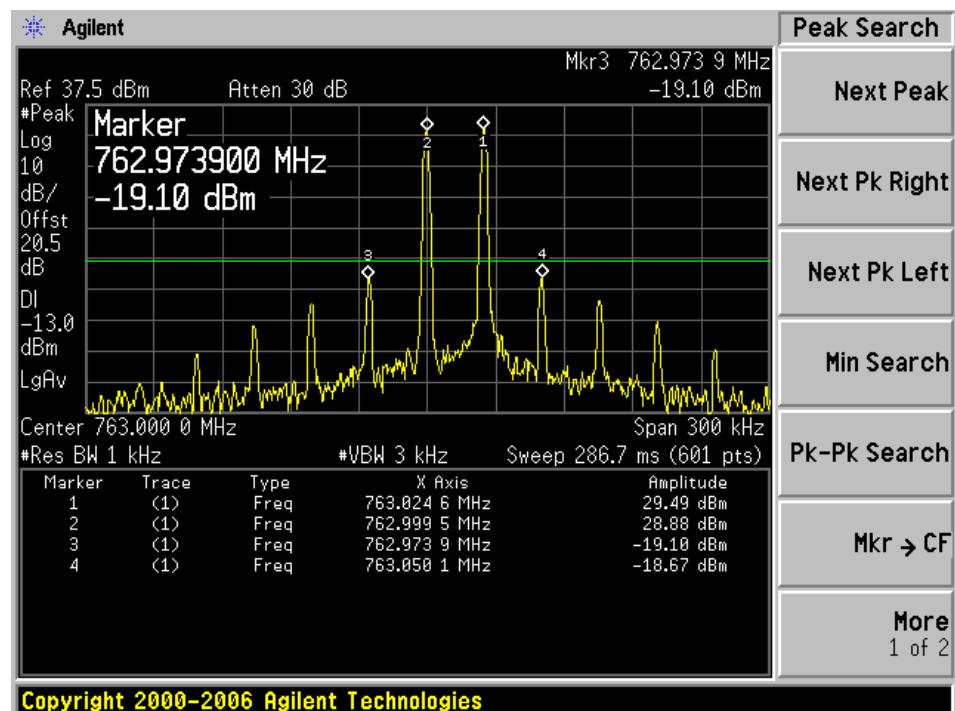
The testing was performed by Kevin Li on 2011-04-28 in RF Site.

8.5 Test Results

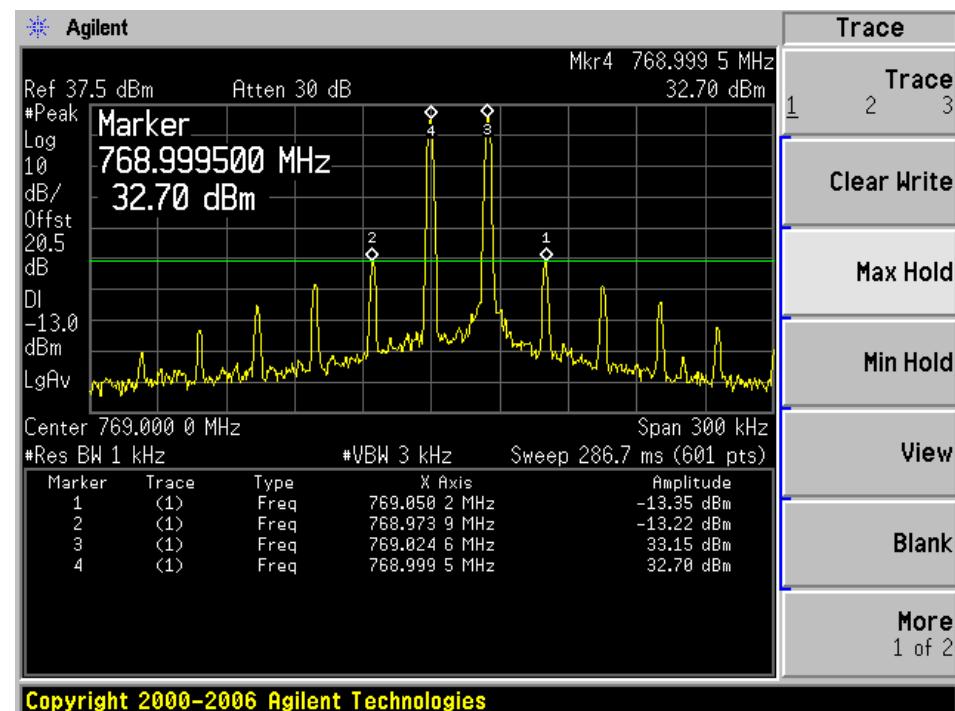
Please refer to the plots hereinafter.

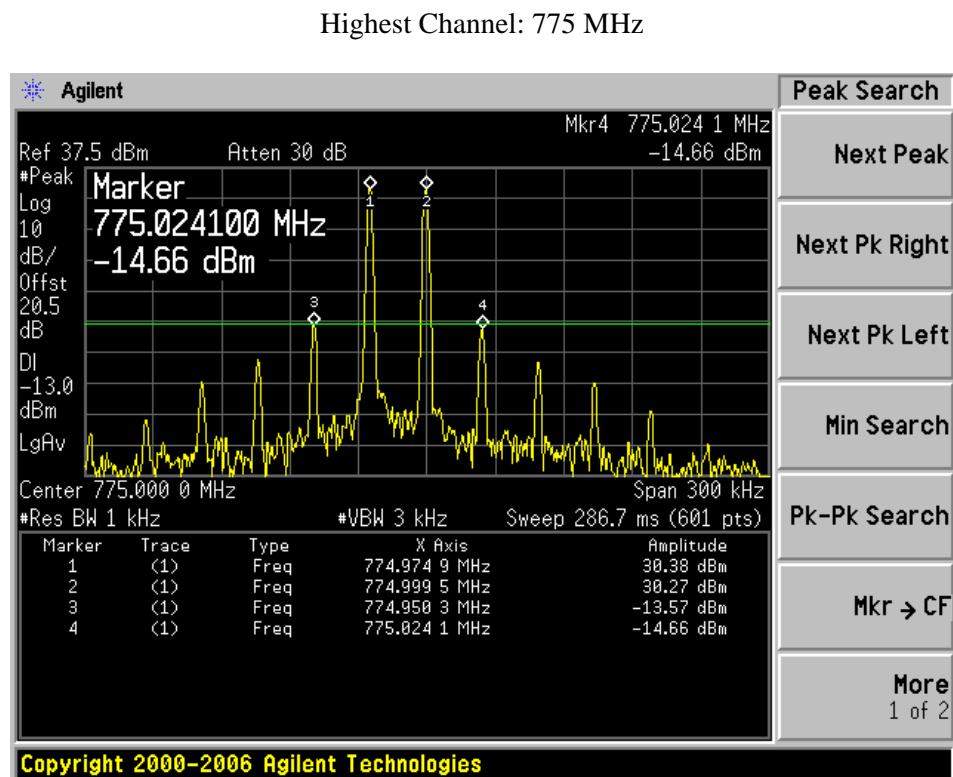
Downlink

Lowest Channel: 763 MHz

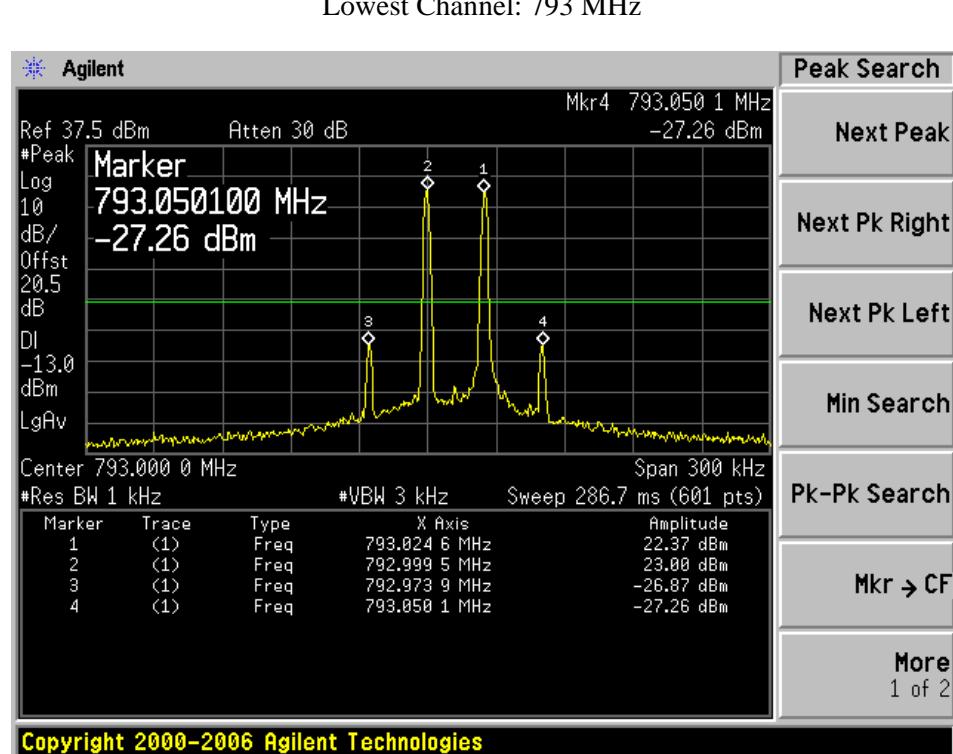


Middle Channel: 769 MHz

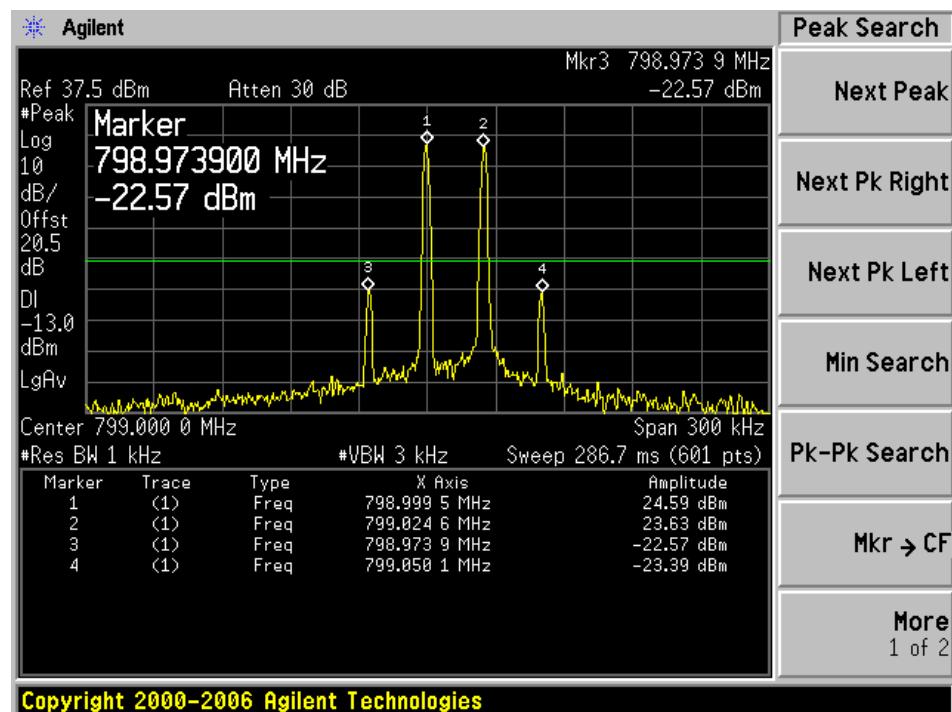




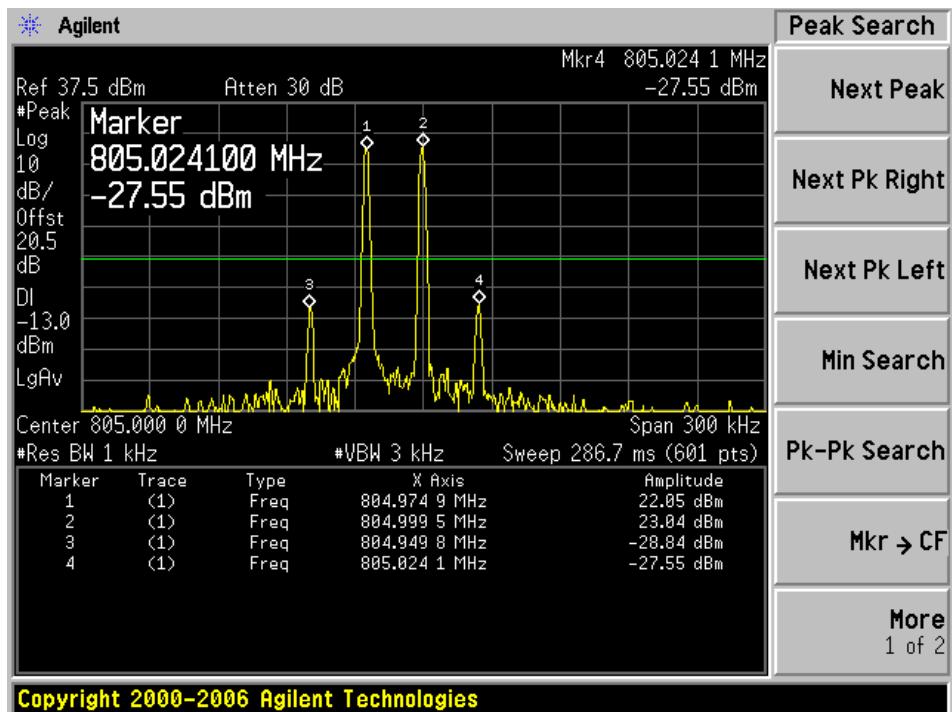
Uplink



Middle Channel: 799 MHz



Highest Channel: 805 MHz



9 FCC §2.1053, §90.210 & §90.543 - SPURIOUS RADIATED EMISSIONS

9.1 Applicable Standard

Requirements: FCC §2.1053, §90.210 and §90.543.

9.2 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 = $10 \log (\text{TX Power in Watts}/0.001)$ – the absolute level
Spurious attenuation limit in dB = $43 + 10 \log_{10} (\text{power out in Watts})$

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-24
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2010-06-16
Hewlett Packard	Pre amplifier	8447D	2944A06639	2010-06-18
A.R.A Inc	Horn antenna	DRG-1181A	1132	2010-11-29
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2010-05-12

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

9.4 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

The testing was performed by Kevin Li 2011-04-28 in 5 meter Chamber 3.

9.5 Test Results

Downlink - Middle Channel 769 MHz

Indicated		Turntable Azimuth (degree)	Test Antenna		Substituted				Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (m)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Cord. (dB)	Cable Loss (dB)		
-	-	-	-	-	-	-	-	-	-	-

Note: All the Restricted Band Frequencies are more than 20 dB below the margin

Uplink - Middle Channel 799 MHz

Indicated		Turntable Azimuth (degree)	Test Antenna		Substituted				Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (m)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Cord. (dB)	Cable Loss (dB)		
-	-	-	-	-	-	-	-	-	-	-

Note: All the Restricted Band Frequencies are more than 20 dB below the margin

10 FCC §90.210 & §90.543 – BAND EDGE

10.1 Applicable Standard

Requirements: FCC §90.543, and §90.210.

10.2 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 the band edge emissions.

10.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09
Rhode & Schwarz	Signal Generator	SMIQ 03	849192/0085	2011-03-31

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

10.4 Test Environmental Conditions

Temperature:	22-24°C
Relative Humidity:	50-55 %
ATM Pressure:	101-102kPa

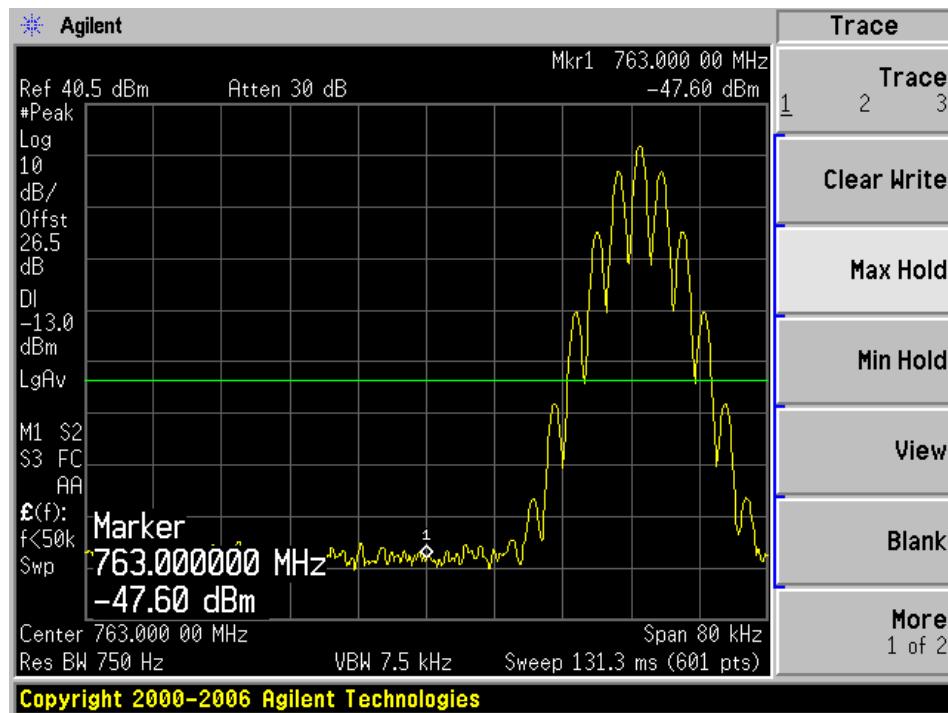
The testing was performed by Kevin Li on 2011-04-28 in RF Site.

10.5 Test Results

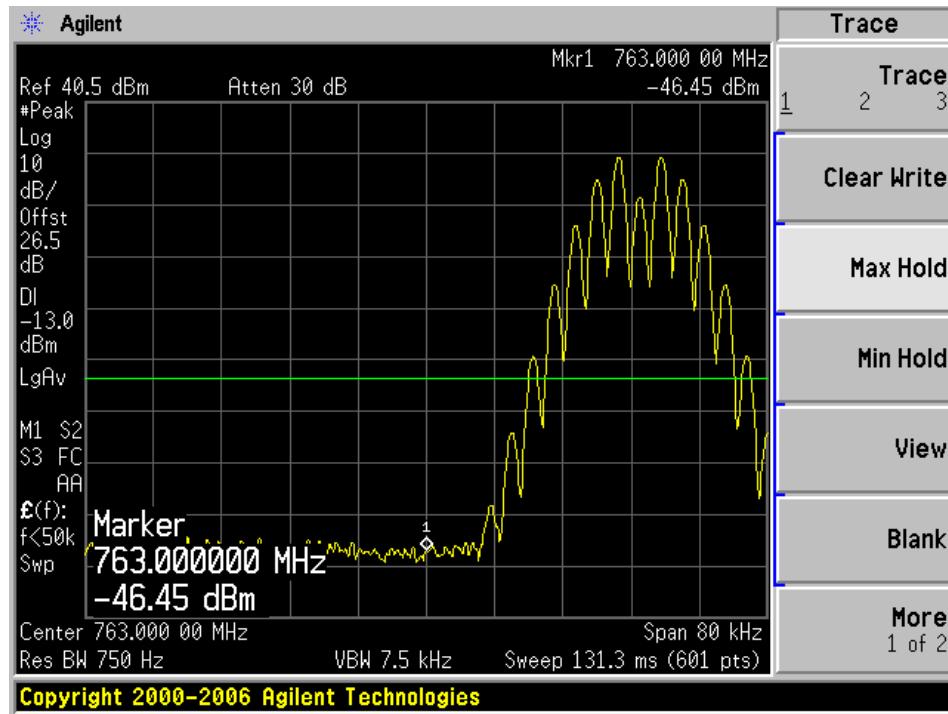
Please refer to the plots hereinafter.

Downlink, Low Channel: 763 MHz

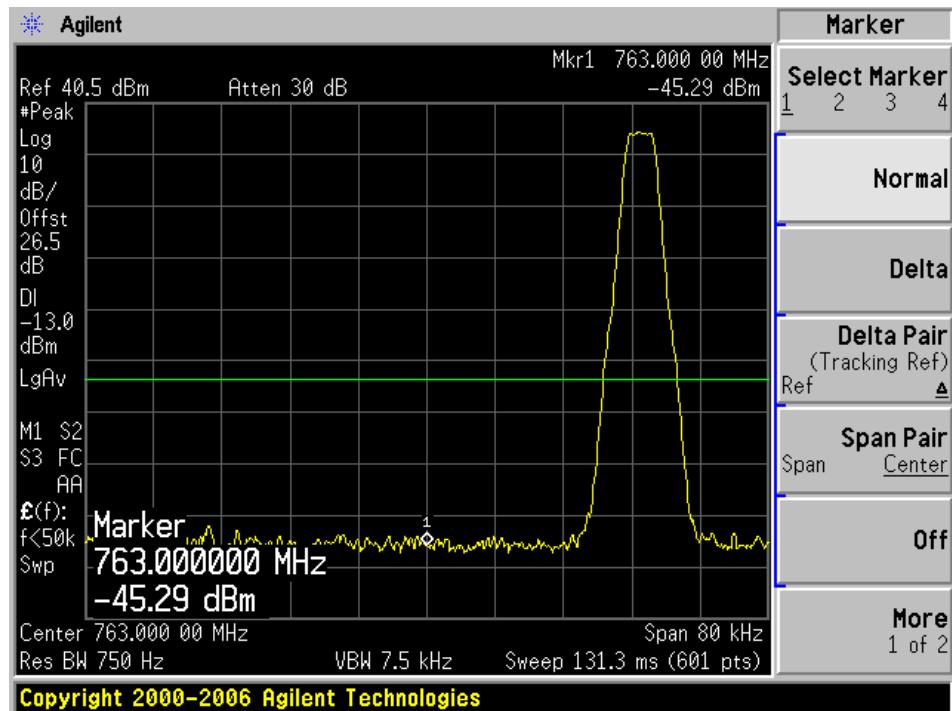
12.5 kHz channel Spacing with FM modulation with 2.5 kHz Sin Wave signal



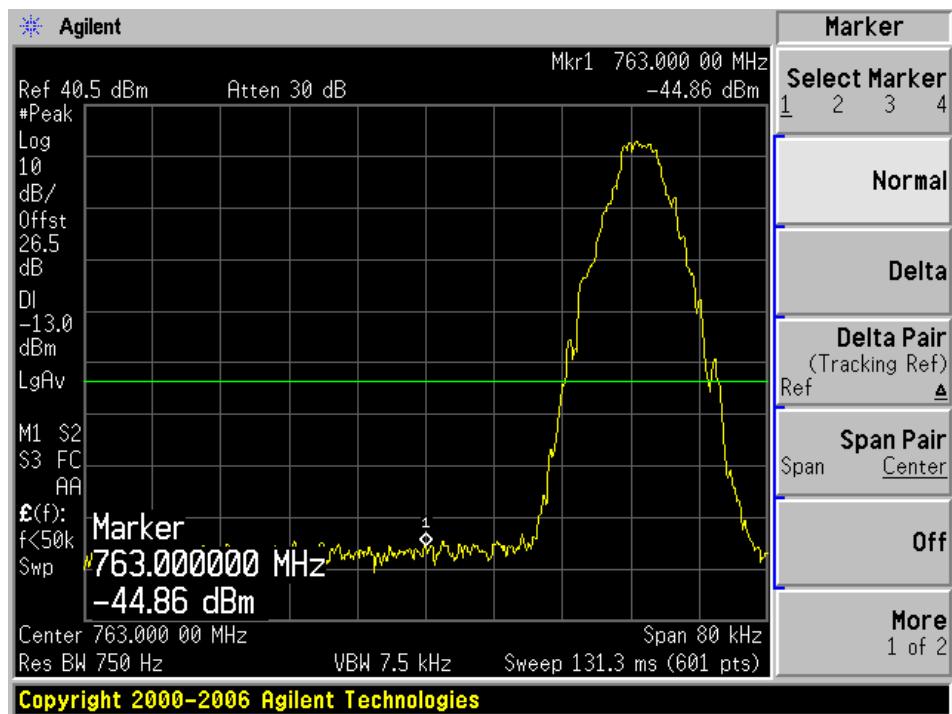
25 kHz channel Spacing with FM modulation with 5 kHz Sin Wave signal



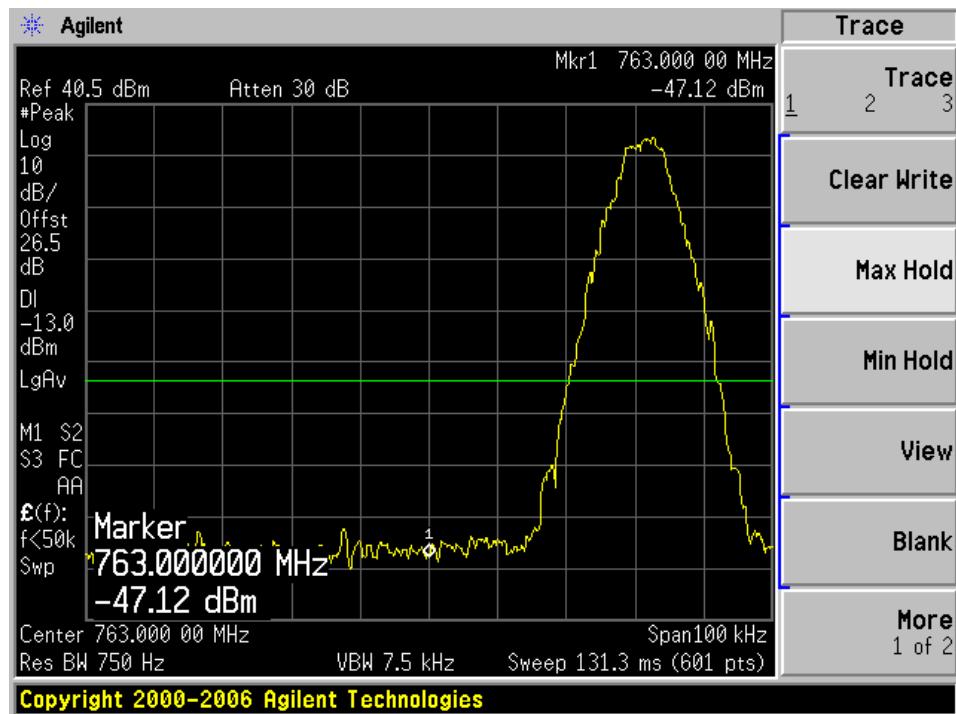
6.25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source



12.5 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

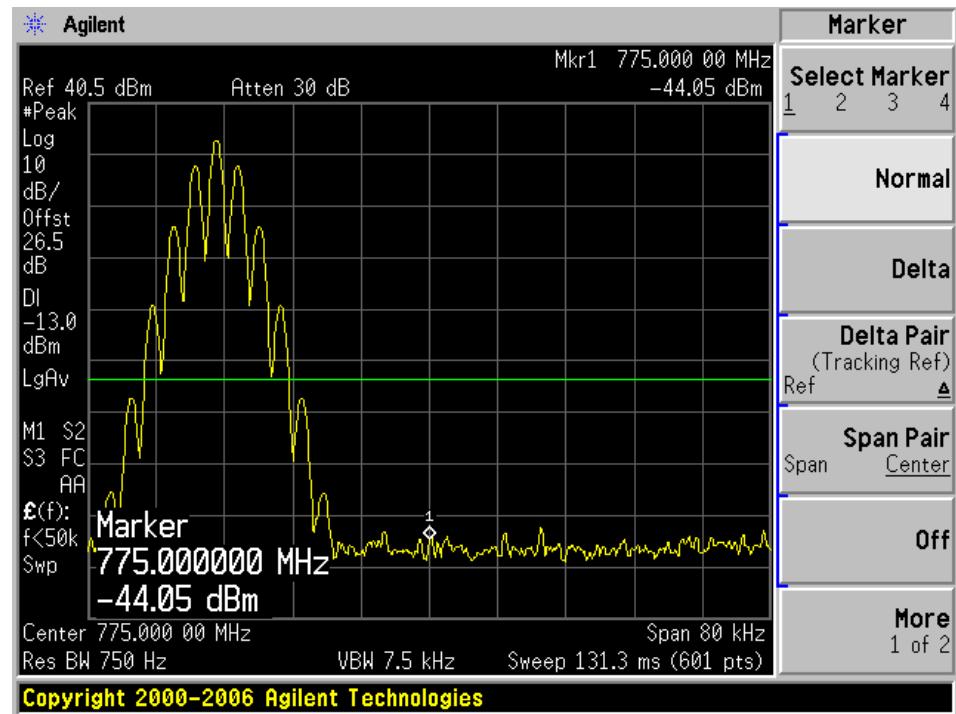


25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

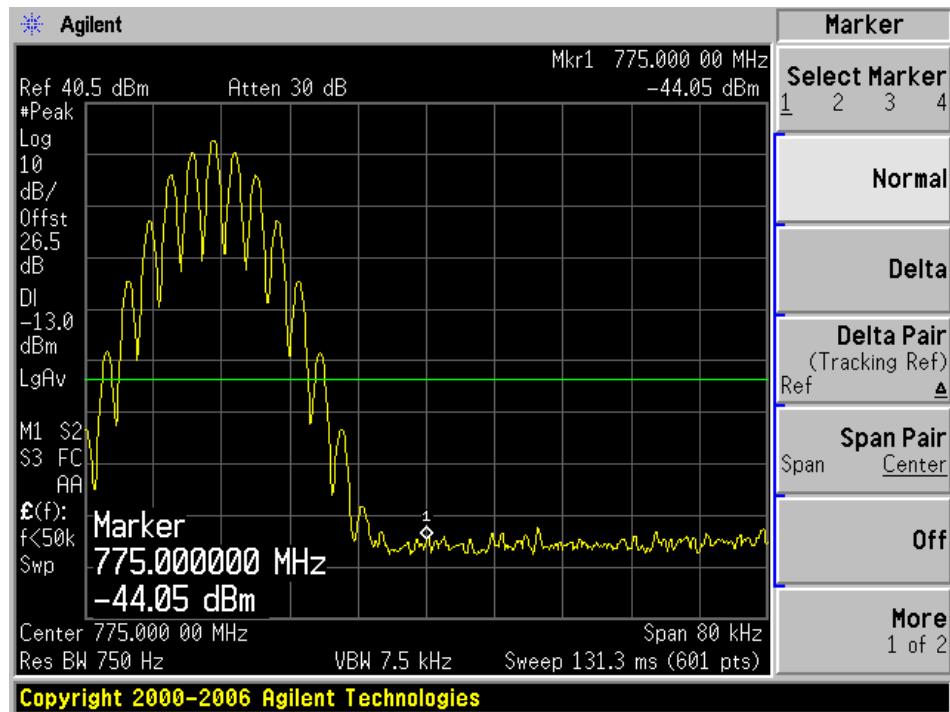


Downlink, High Channel: 775 MHz

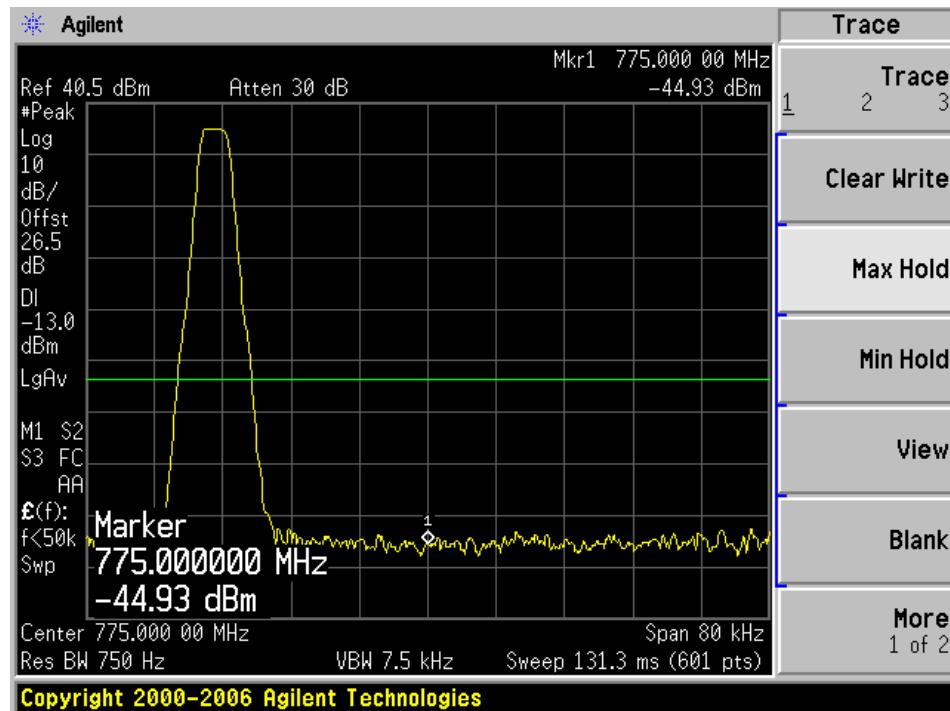
12.5 kHz channel Spacing with FM modulation with 2.5 kHz Sin Wave signal



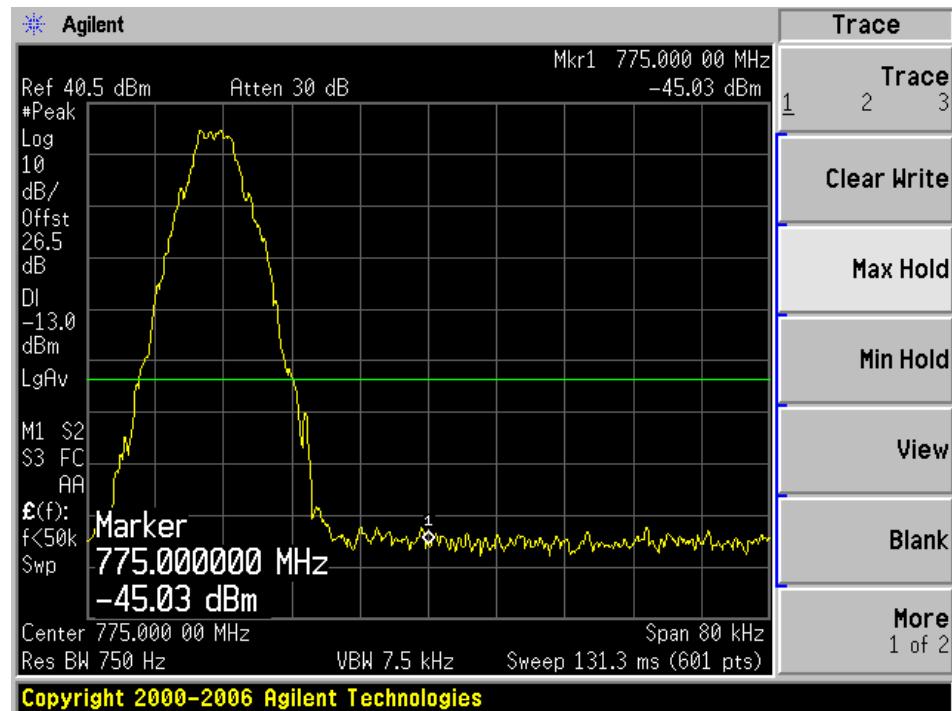
25 kHz channel Spacing with FM modulation with 5 kHz Sin Wave signal



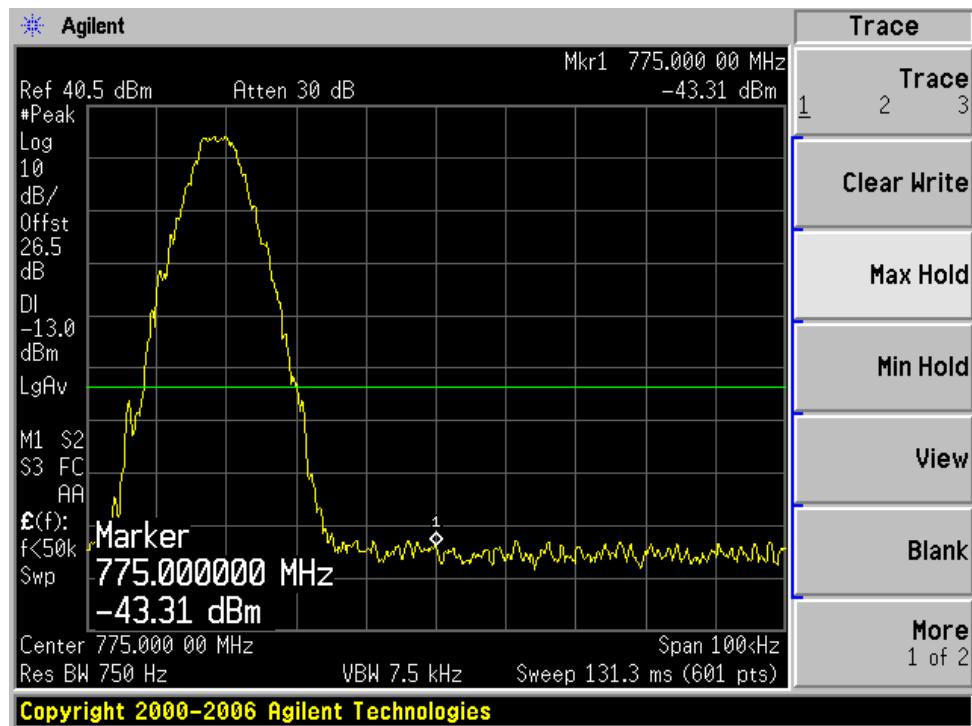
6.25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source



12.5 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

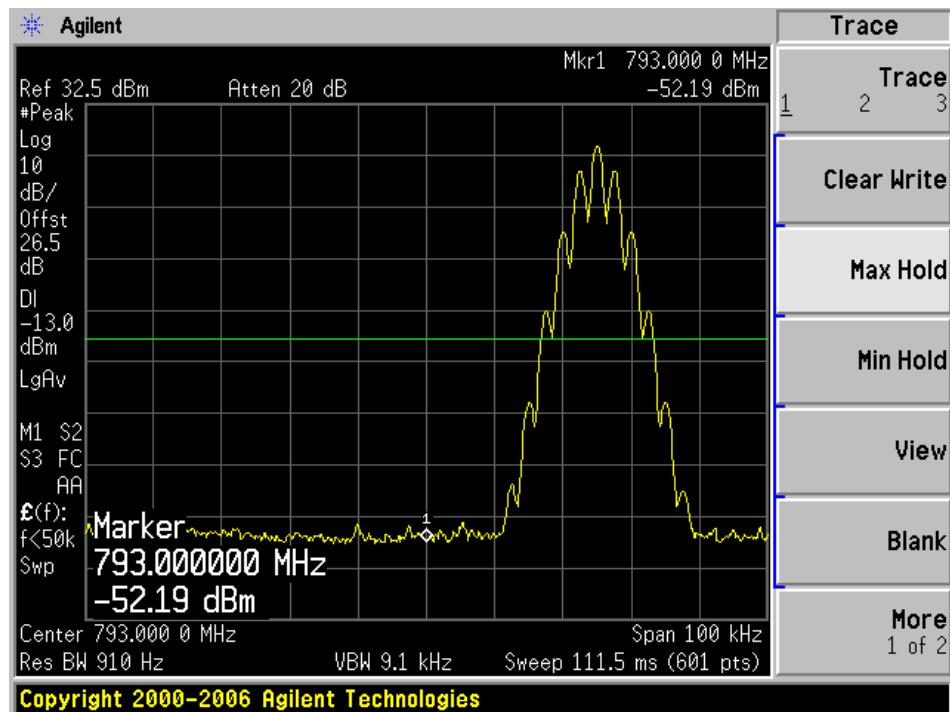


25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

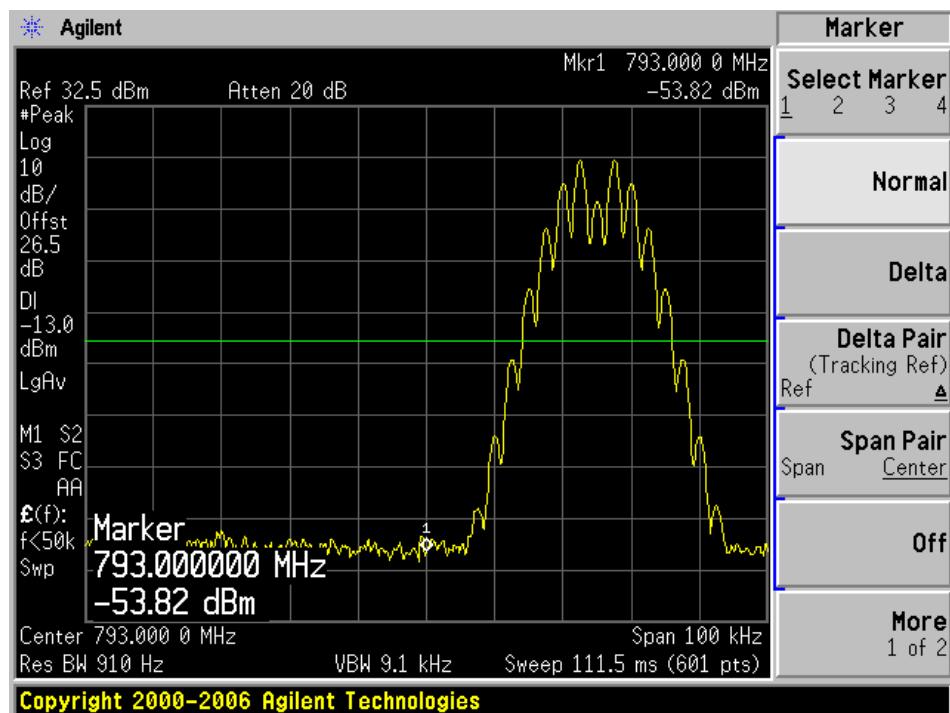


Uplink, Low Channel: 793 MHz

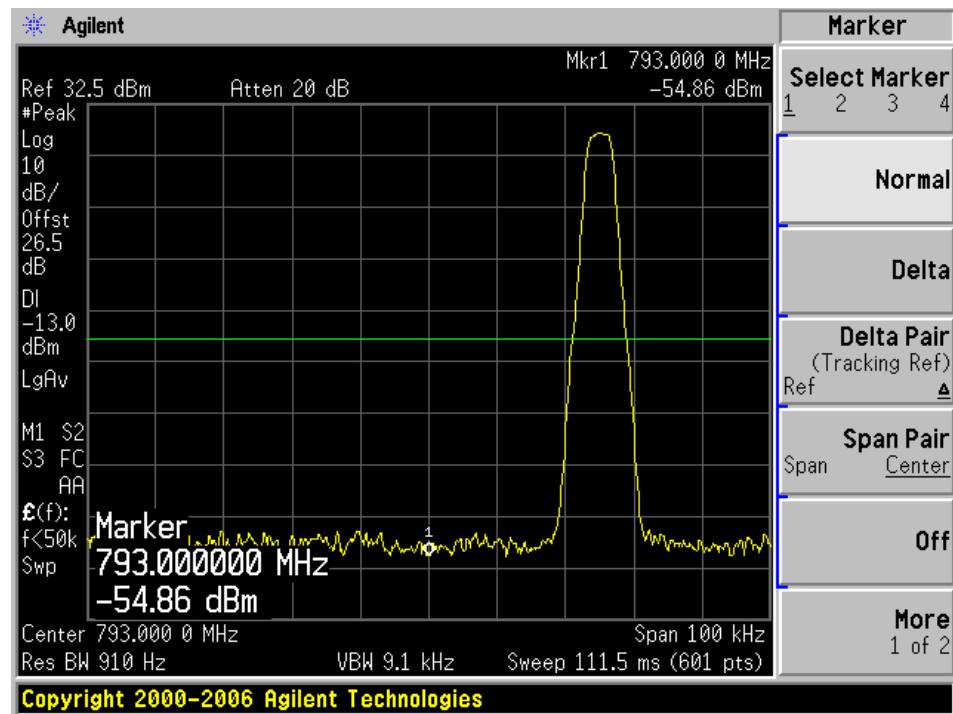
12.5 kHz channel Spacing with FM modulation with 2.5 kHz Sin Wave signal



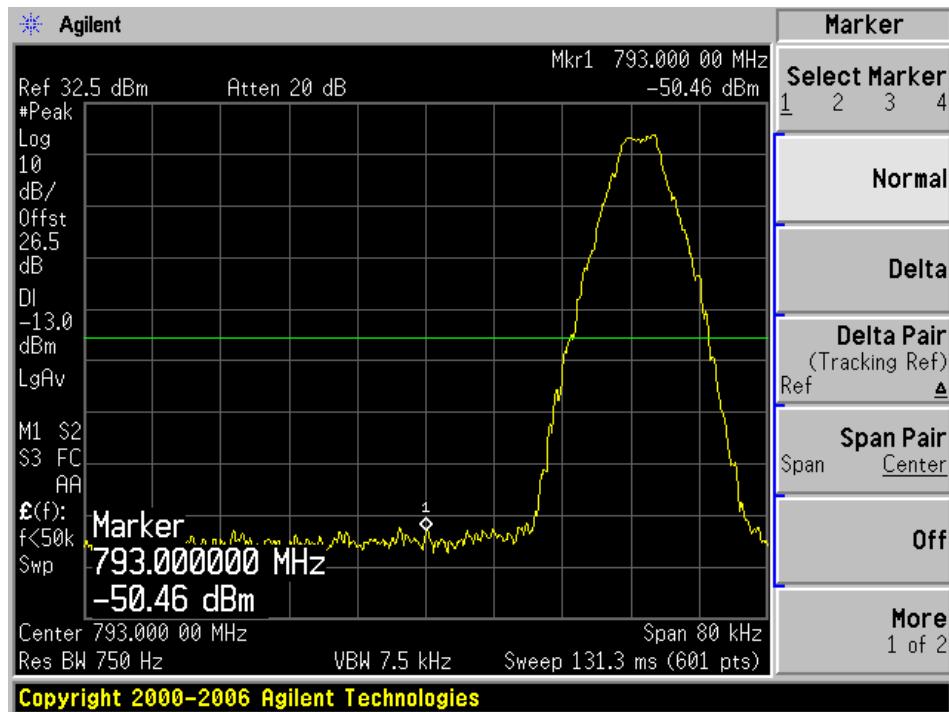
25 kHz channel Spacing with FM modulation with 5 kHz Sin Wave signal



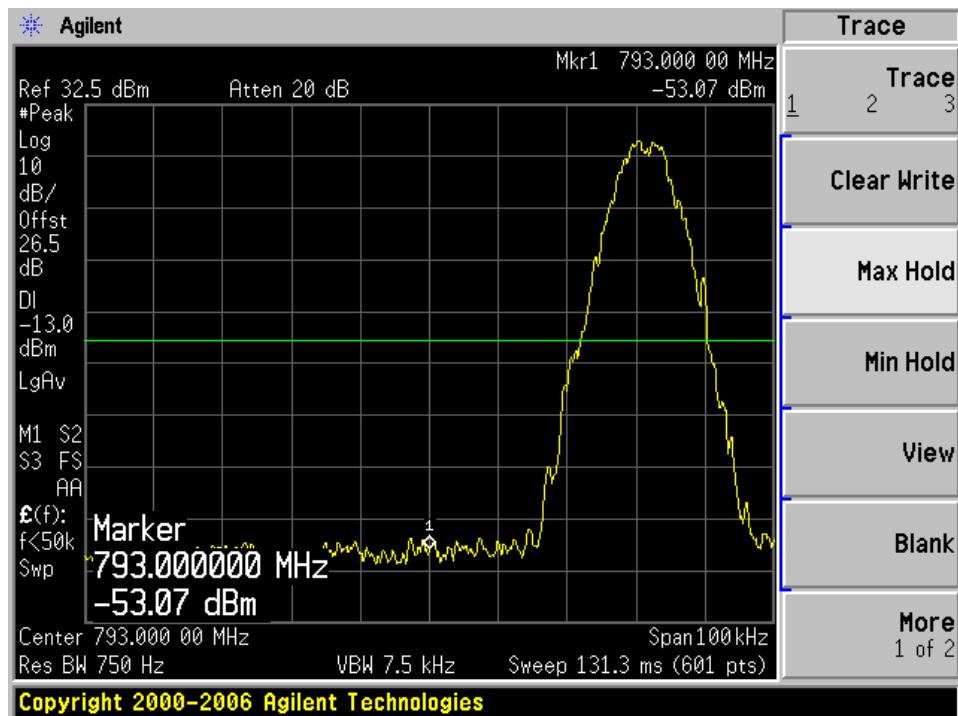
6.25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source



12.5 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

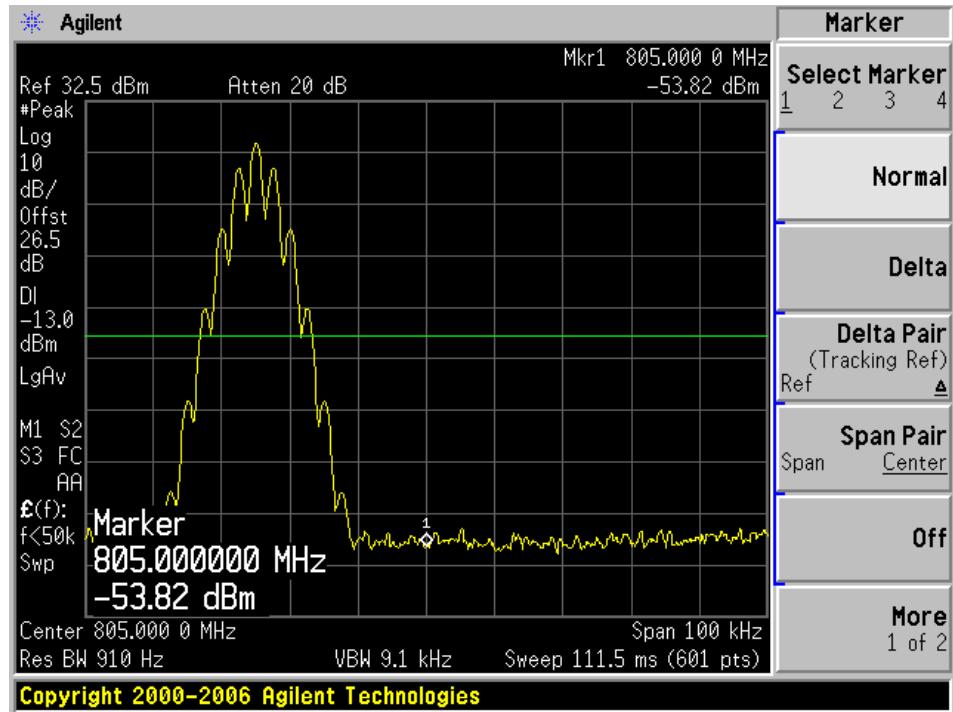


25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source

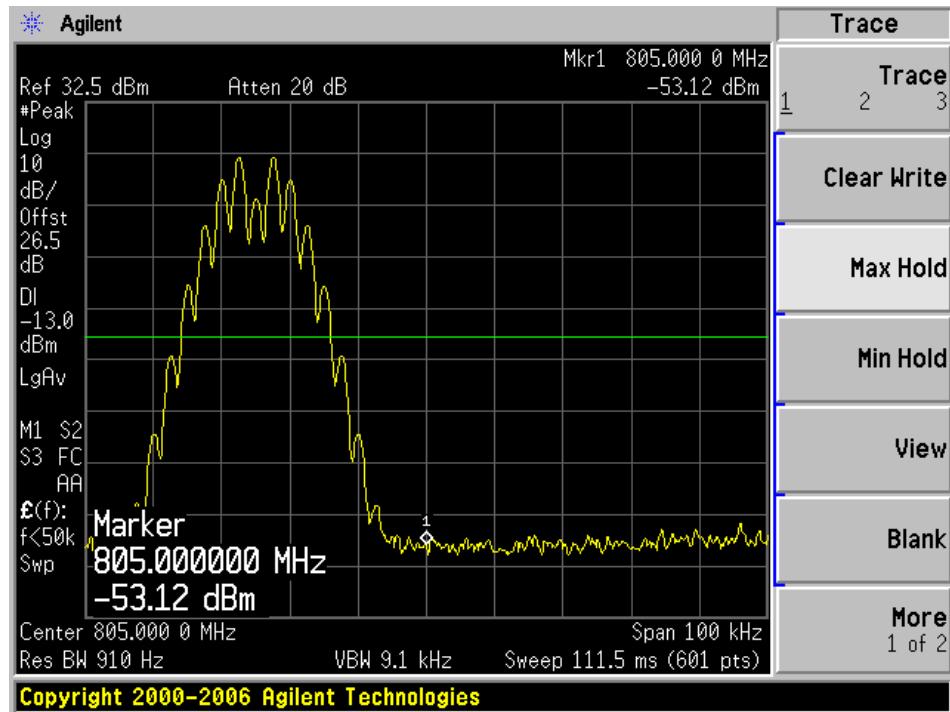


Uplink, High Channel: 805 MHz

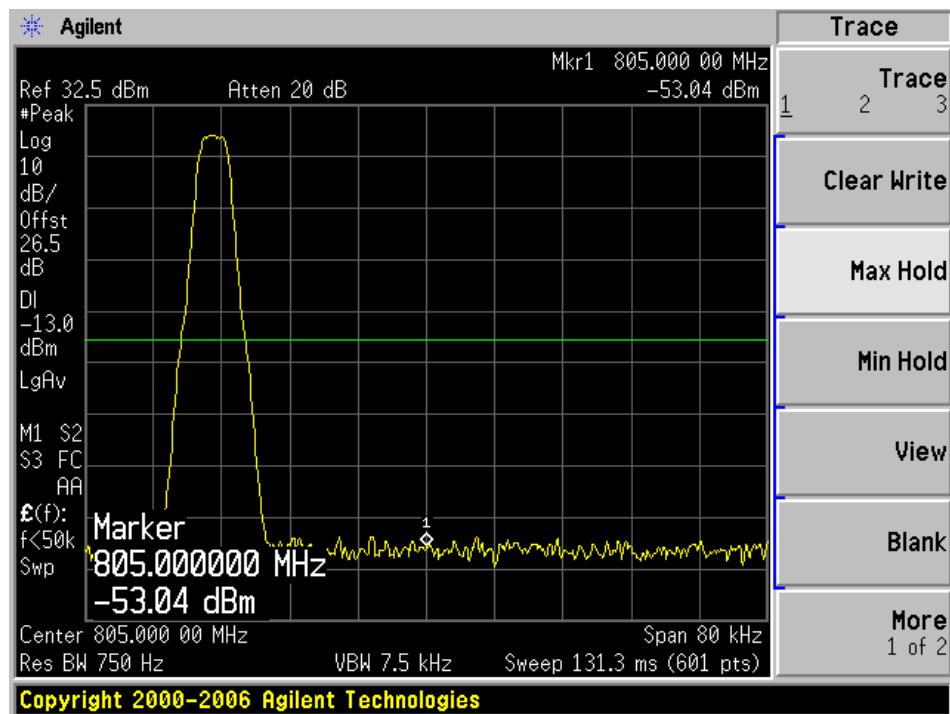
12.5 kHz channel Spacing with FM modulation with 2.5 kHz Sin Wave signal



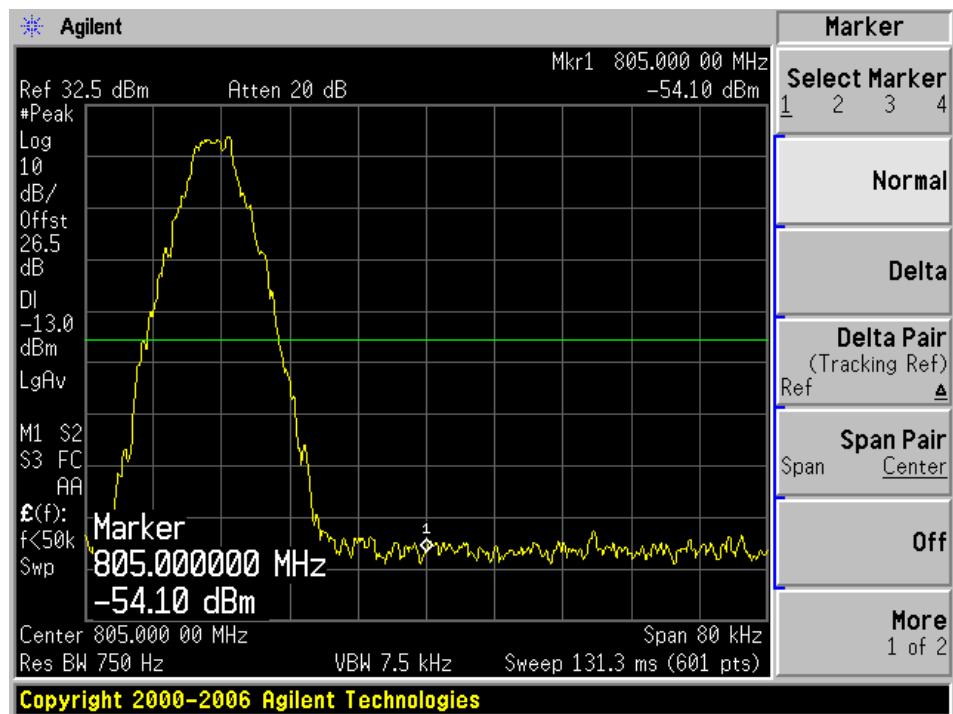
25 kHz channel Spacing with FM modulation with 5 kHz Sin Wave signal



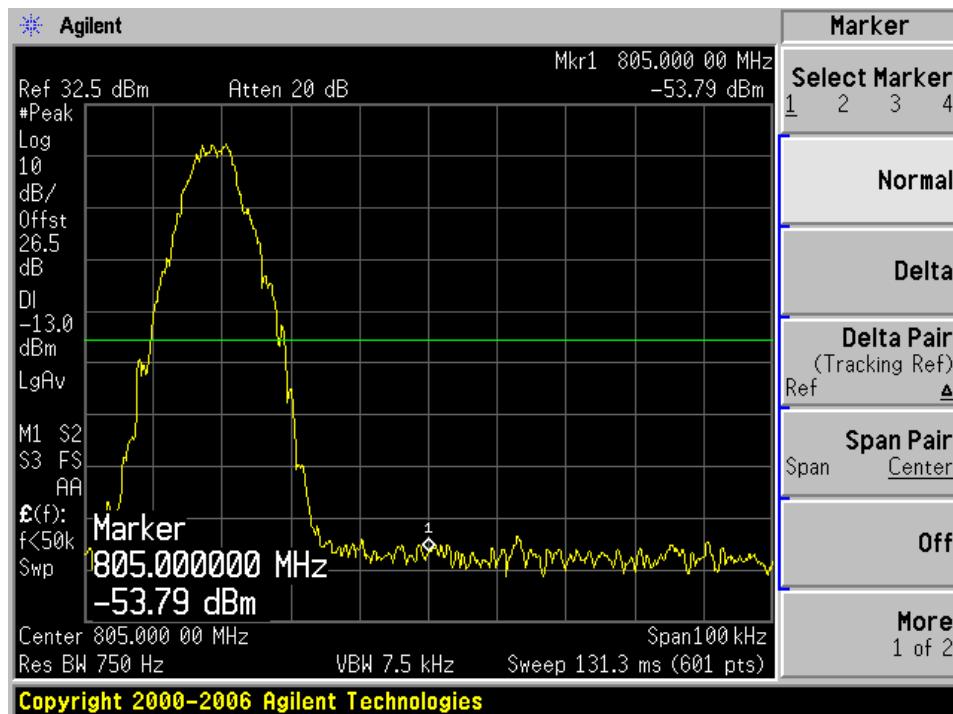
6.25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source



12.5 kHz channel Spacing with FM modulation with an external 9600 b/s random data source



25 kHz channel Spacing with FM modulation with an external 9600 b/s random data source



11 FCC §1.1307(b)(1) & §2.1091 - RF EXPOSURE INFORMATION

11.1 Applicable Standard

According to FCC §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

Note: f = frequency in MHz, * = Plane-wave equivalent power density

11.2 MPE Prediction

Predication of MPE limit at a given distance, equation from 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

Downlink:

Maximum peak output power at antenna input terminal (dBm):	37
Maximum peak output power at antenna input terminal (mW):	5011.87
Prediction distance (cm):	35
Prediction frequency (MHz):	773
Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1.0
Power density at predication frequency and distance (mW/cm ²):	0.325
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	0.515

Uplink:

Maximum peak output power at antenna input terminal (dBm):	27.57
Maximum peak output power at antenna input terminal (mW):	571.48
Prediction distance (cm):	35
Prediction frequency (MHz):	805
Antenna Gain, typical (dBi):	10.0
Maximum Antenna Gain (numeric):	10
Power density at predication frequency and distance (mW/cm ²):	0.371
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	0.54

Note: The Manufacturer's rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced by 3.5 dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. This power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device.

11.3 Test Results

The device meets MPE limit at 35 cm distance for the uncontrolled exposure environment.