FCC PART 90

TEST AND MEASUREMENT REPORT

For

Canam Technology, Inc.

5318 East 2nd St., #700,

Long Beach, CA 90803, USA

FCC ID: TCJ-M4DBDA8

Report Type: Original Report	**Product Type:** MARK-IV Digital Narrowband (Class-A) Signal Booster

Prepared By:	Simon Ma, Test Engineer
Report Number:	R1503032-90 Rev F
Report Date:	2015-06-03
Reviewed By:	Bo Li, RF Lead

Bay Area Compliance Laboratories Corp.
1274 Anvilwood Avenue,
Sunnyvale, CA 94089, USA
Tel: (408) 732-9162
Fax: (408) 732 9164

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1503032-90	Original Report	2015-03-30
1	R1503032-90 Rev A	Revised section 2.4	2015-03-30
2	R1503032-90 Rev B	Revised section 2.4	2015-03-31
3	R1503032-90 Rev C	Revised Report	2015-05-07
4	R1503032-90 Rev D	Revised Report- Upated section 1.1. 4.2, 5.5, 6.5, 7.5, 8.5, 9.5 & 10.10	2015-05-22
5	R1503032-90 Rev E	Updated section 1.1	2015-06-02
6	R1503032-90 Rev F	Updated Report	2015-06-03

1. General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Canam Technology,Inc.* and their product, FCC ID: TCJ-M4DBDA8, model: M4DBDA8, which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a bi-directional amplifier.

Specifications	
Frequency Band	Downlink: 851-862 MHz Uplink: 806-817 MHz
Modulation Type	FM Data, FM Voice, C4FM, CQPSK
Emission Designator	F1E, F3E, F1D, G1E
RF Output Power	5 Watts (ERP)
Channel Spacing	25 kHz
Necessary/authorized Bandwidth	25 kHz
Power Source	120 VAC

1.2 Mechanical Description

The EUT measures approximately 48.9cm (L) x 48.2cm (W) x 17.7cm (H) and weighs 27000 g.

The test data gathered are from production sample. Serial number: 924 provided by the manufacturer.

1.3 Objective

This type approval report is prepared on behalf of *Canam Technology, Inc.* in accordance with Part 90 of the Federal Communication Commissions rules.

The objective was to determine the RF output power; Occupied Bandwidth, Spurious Emissions, Band Edge and Emission Mask are in compliance with the FCC rules.

1.4 Related Submittal(s)/Grant(s)

None.

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 individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards: KDB 935210 D02 v02r01

All emissions measurement was performed by Bay Area Compliance Laboratories 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 CISPR16-4-2:2003, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65: 1996** by **A2LA** to certify:
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

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 site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have 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 test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

2 System Test Configuration

2.1 Justification

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

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

2.2 EUT Exercise Software

The software used was a web based GUI.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Internal Configuration

Manufacturer	Descriptions	Models	Serial Numbers
Canam Technology	Power Amplifer UL	CT-HPA8U10	N/A
Canam Technology	Power Amplifer DL	CT-HPA8D10	N/A
Canam Technology	Uplink Analog Interface Module	M4D-AIC-8UL	N/A
Canam Technology	Downlink Analog Interface Module	M4D-AIC-8DL	N/A
Canam Technology	DSP Module	M4D-DSP	N/A
Canam Technology	ECM Control Board	M4D-ECM	N/A
Canam Technology	ECM Break-out	ECM-BO	N/A

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Dell	Laptop	PP11L	H5914 A03

2.6 Local Support Equipment Power Supply and Line Filters

N/A

2.7 External I/O Cabling List and Details

Cable Description	Length (m)	From	To
Cross over Cable	> 1.0	EUT	Laptop
RF Cable	1.0	EUT	Signal Generator
RF Cable	1.0	EUT	PSA

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1046, §90.219(e)	RF Output Power	Compliant
§2.1051, §90.219(e)	Intermodulation	Compliant
§2.1049, §90.219(e)	Occupied Bandwidth & Emission Mask	Compliant
§2.1051, §90.219(e)	Spurious Emissions at Antenna Terminals	Compliant
§2.1053, §90.219(e)	Field Strength of Spurious Radiation	Compliant
§90.219(e)	Noise Figure	Compliant
§90.219	Out of Band Rejection	Compliant

4 FCC §2.1091 - RF Exposure Information

4.1 Applicable Standards

FCC §2.1091, (a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).

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

Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-1.34	614	1.63	*(100)	6
1.34-30	1842/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6

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

4.2 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):	36.94
Maximum peak output power at antenna input terminal (mW):	4943.11
Prediction distance (cm):	100
Prediction frequency (MHz):	856.5
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1
Power density of prediction frequency at 100 cm (mW/cm^2):	0.04
MPE limit for controlled exposure at prediction frequency (mW/cm^2):	2.86

Uplink:

Maximum peak output power at antenna input terminal (dBm):	36.78
Maximum peak output power at antenna input terminal (mW):	4764.3
Prediction distance (cm):	100
Prediction frequency (MHz):	806.0125
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1
Power density of prediction frequency at 100 cm (mW/cm^2):	0.04
MPE limit for controlled exposure at prediction frequency (mW/cm^2):	2.69

4.3 Conclusion

The device complies with the MPE requirements by providing a safe separation distance of at least 100 cm between the antenna with maximum 0 dBi gain, including any radiating structure, and any persons when normally operated.

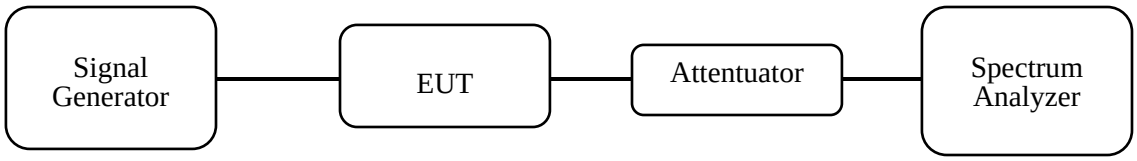
5 FCC §2.1046 & §90.219(e) – RF Output Power

5.1 Applicable Standard

According to FCC §90.219(e), the output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

5.2 Test Procedure

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



5.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Due Date
Agilent	Spectrum Analyzer	E4446A	MY48250238	2015-09-03
Agilent	Generator, Signal	E4438C	MY45091309	2015-07-15

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

5.4 Test Environmental Conditions

Temperature:	22.2 °C
Relative Humidity:	33 %
ATM Pressure:	101.6 kPa

The testing was performed by Simon Ma on 2015-03-09 in the RF Site.

5.5 Test Results

Mode		ALC on/off	Channel	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
FM Data	851-862 MHz Downlink	ON	Low	851.0125	-70	36.4	-2.15	34.25	37	-2.75
			Middle	856.5000	-70	36.64	-2.15	34.49	37	-2.51
			High	861.9875	-70	35.78	-2.15	33.63	37	-3.37
		OFF	Low	851.0125	-66	36.88	-2.15	34.73	37	-2.27
			Middle	856.5000	-69	36.55	-2.15	34.4	37	-2.6
			High	861.9875	-64	36.13	-2.15	33.98	37	-3.02
	806-817 MHz Uplink	ON	Low	806.0125	-70	35.91	-2.15	33.76	37	-3.24
			Middle	811.5000	-70	36.69	-2.15	34.54	37	-2.46
			High	816.9875	-70	36.71	-2.15	34.56	37	-2.44
		OFF	Low	806.0125	-63	36.13	-2.15	33.98	37	-3.02
			Middle	811.5000	-66	36.41	-2.15	34.26	37	-2.74
			High	816.9875	-61	35.86	-2.15	33.71	37	-3.29

Mode		ALC on/off	Channel	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
FM Voice	851-862 MHz Downlink	ON	Low	851.0125	-70	36.99	-2.15	34.84	37	-2.16
			Middle	856.5000	-70	36.77	-2.15	34.62	37	-2.38
			High	861.9875	-70	36.22	-2.15	34.07	37	-2.93
		OFF	Low	851.0125	-60	36.71	-2.15	34.56	37	-2.44
			Middle	856.5000	-62	36.37	-2.15	34.22	37	-2.78
			High	861.9875	-60	36.6	-2.15	34.45	37	-2.55
	806-817 MHz Uplink	ON	Low	806.0125	-70	36.78	-2.15	34.63	37	-2.37
			Middle	811.5000	-70	36.01	-2.15	33.86	37	-3.14
			High	816.9875	-70	36.75	-2.15	34.6	37	-2.4
		OFF	Low	806.0125	-56	36.43	-2.15	34.28	37	-2.72
			Middle	811.5000	-62	36.48	-2.15	34.33	37	-2.67
			High	816.9875	-60	35.79	-2.15	33.64	37	-3.36

Mode		ALC on/off	Channel	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
C4FM	851-862 MHz Downlink	ON	Low	851.0125	-70	36.84	-2.15	34.69	37	-2.31
			Middle	856.5000	-70	36.71	-2.15	34.56	37	-2.44
			High	861.9875	-70	36.63	-2.15	34.48	37	-2.52
		OFF	Low	851.0125	-66	36.47	-2.15	34.32	37	-2.68
			Middle	856.5000	-69	36.94	-2.15	34.79	37	-2.21
			High	861.9875	-64	36.87	-2.15	34.72	37	-2.28
	806-817 MHz Uplink	ON	Low	806.0125	-70	35.76	-2.15	33.61	37	-3.39
			Middle	811.5000	-70	35.48	-2.15	33.33	37	-3.67
			High	816.9875	-70	35.37	-2.15	33.22	37	-3.78
		OFF	Low	806.0125	-63	35.73	-2.15	33.58	37	-3.42
			Middle	811.5000	-66	35.96	-2.15	33.81	37	-3.19
			High	816.9875	-61	35.72	-2.15	33.57	37	-3.43

Mode		ALC on/off	Channel	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
CQPSK	851-862 MHz Downlink	ON	Low	851.0125	-70	36.09	-2.15	33.94	37	-3.06
			Middle	856.5000	-70	36.58	-2.15	34.43	37	-2.57
			High	861.9875	-70	36.21	-2.15	34.06	37	-2.94
		OFF	Low	851.0125	-66	36.58	-2.15	34.43	37	-2.57
			Middle	856.5000	-69	36.53	-2.15	34.38	37	-2.62
			High	861.9875	-64	36.77	-2.15	34.62	37	-2.38
	806-817 MHz Uplink	ON	Low	806.0125	-70	33.95	-2.15	31.8	37	-5.2
			Middle	811.5000	-70	35.76	-2.15	33.61	37	-3.39
			High	816.9875	-70	34.96	-2.15	32.81	37	-4.19
		OFF	Low	806.0125	-63	36.08	-2.15	33.93	37	-3.07
			Middle	811.5000	-66	36.45	-2.15	34.3	37	-2.7
			High	816.9875	-61	34.99	-2.15	32.84	37	-4.16

Note: Manufacturer's rated power is 5 Watts (37 dBm), 0 dBi antenna gain was used while testing.

EIRP = Measured Conducted Output Power (dBm) + Antenna Gain (dBi)
ERP = EIRP – 2.15 (dB)
dBi = dBd + 2.15

6 FCC §2.1049 & §90.219(e) – Occupied Bandwidth & Emission Mask

6.1 Applicable Standard

According to FCC §90.219 (e): a signal booster must be designed such that all signals that it retransmits meet the following requirement: there is no change in the occupied bandwidth of the retransmitted signals.

According to KDB 935210 D02 v02r01Section V, for 800 MHz NPSPAC Public Safety Band operations, the equipment conforms to Emission Mask H [§90.210(h)] when operating on the NPSPAC public safety channels.

Applicable Emission Masks

Frequency Band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
806-809/851-854	B	H
809-817/854-862	B	G

§90.210 (g) Emission Mask G. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but no more than 250 percent of the authorized bandwidth: At least 116 log (fd/6.1) dB, or 50 + 10 log (P) dB, or 70 dB, whichever is the lesser attenuation;

(2) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

§90.210 (h) Emission Mask H. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of 4 kHz or less: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 4 kHz, but no more than 8.5 kHz: At least 107 log (fd/4) dB;

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 8.5 kHz, but no more than 15 kHz: At least 40.5 log (fd/1.16) dB;

(4) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 15 kHz, but no more than 25 kHz: At least 116 log (fd/6.1) dB;

(5) On any frequency removed from the center of the authorized bandwidth by more than 25 kHz: At least 43 + log (P) dB.

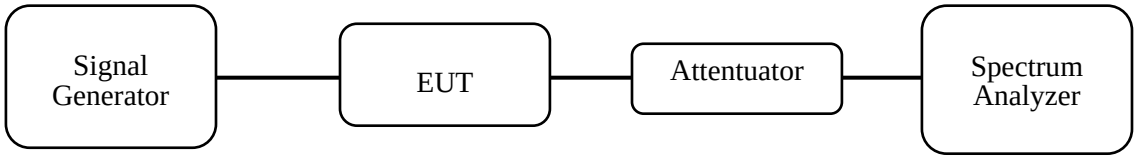
6.2 Test Procedure

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

The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the frequency band ±50 kHz from the carrier frequency.

EUT does not equipt with audio low pass filter. Low channel frequencies of uplink and downlink fall into 806-809/851-854 range, thus emission mask H applied;

Middle channel and high channel frequencies of uplink and downlink fall into 809-817/854-862 range, thus emission mask G applied.



6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Due Date
Agilent	Spectrum Analyzer	E4446A	MY48250238	2015-09-03
Agilent	Generator, Signal	E4438C	MY45091309	2015-07-15

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

6.4 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	32 %
ATM Pressure:	101.3 kPa

The testing was performed by Simon Ma on 2015-03-10 in the RF Site.

6.5 Test Results

Please refer to the following tables and plots.

Mode		ALC on/off	Channel	Frequency (MHz)	Output OBW (kHz)	Input OBW (kHz)
FM Data	851-862 MHz Downlink	ON	Low	851.0125	6.096	5.936
			Middle	856.5000	6.232	6.599
			High	861.9875	6.262	6.613
		OFF	Low	851.0125	5.852	5.936
			Middle	856.5000	6.253	6.599
			High	861.9875	6.258	6.613
	806-817 MHz Uplink	ON	Low	806.0125	5.854	5.979
			Middle	811.5000	6.185	6.558
			High	816.9875	6.369	6.594
		OFF	Low	806.0125	5.854	5.979
			Middle	811.5000	6.280	6.558
			High	816.9875	6.303	6.594

Mode		ALC on/off	Channel	Frequency (MHz)	Output OBW (kHz)	Input OBW (kHz)
FM Voice	851-862 MHz Downlink	ON	Low	851.0125	4.043	4.161
			Middle	856.5000	4.112	4.476
			High	861.9875	4.120	4.450
		OFF	Low	851.0125	4.08	4.161
			Middle	856.5000	4.121	4.476
			High	861.9875	4.124	4.450
	806-817 MHz Uplink	ON	Low	806.0125	4.043	4.173
			Middle	811.5000	4.094	4.410
			High	816.9875	4.153	4.483
		OFF	Low	806.0125	4.173	4.173
			Middle	811.5000	4.126	4.410
			High	816.9875	4.142	4.483

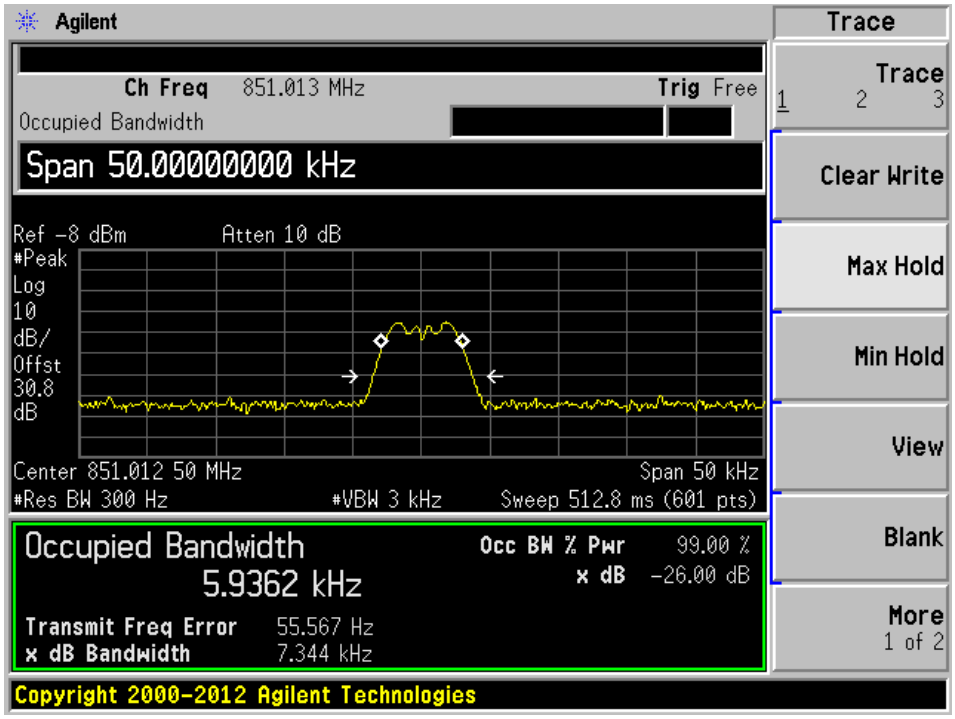
Mode		ALC on/off	Channel	Frequency (MHz)	Output OBW (kHz)	Input OBW (kHz)
C4FM	851-862 MHz Downlink	ON	Low	851.0125	8.349	8.747
			Middle	856.5000	8.081	8.656
			High	861.9875	8.328	8.776
		OFF	Low	851.0125	7.991	8.747
			Middle	856.5000	8.105	8.656
			High	861.9875	8.319	8.776
	806-817 MHz Uplink	ON	Low	806.0125	8.139	8.444
			Middle	811.5000	8.015	8.583
			High	816.9875	8.495	8.509
		OFF	Low	806.0125	8.317	8.444
			Middle	811.5000	8.295	8.583
			High	816.9875	8.340	8.509

Mode		ALC on/off	Channel	Frequency (MHz)	Output OBW (kHz)	Input OBW (kHz)
CQPSK	851-862 MHz Downlink	ON	Low	851.0125	4.778	5.052
			Middle	856.5000	5.109	5.102
			High	861.9875	5.020	5.147
		OFF	Low	851.0125	4.960	5.052
			Middle	856.5000	5.073	5.102
			High	861.9875	5.070	5.147
	806-817 MHz Uplink	ON	Low	806.0125	4.999	5.101
			Middle	811.5000	5.051	5.052
			High	816.9875	5.063	5.052
		OFF	Low	806.0125	4.992	5.101
			Middle	811.5000	5.051	5.052
			High	816.9875	5.022	5.052

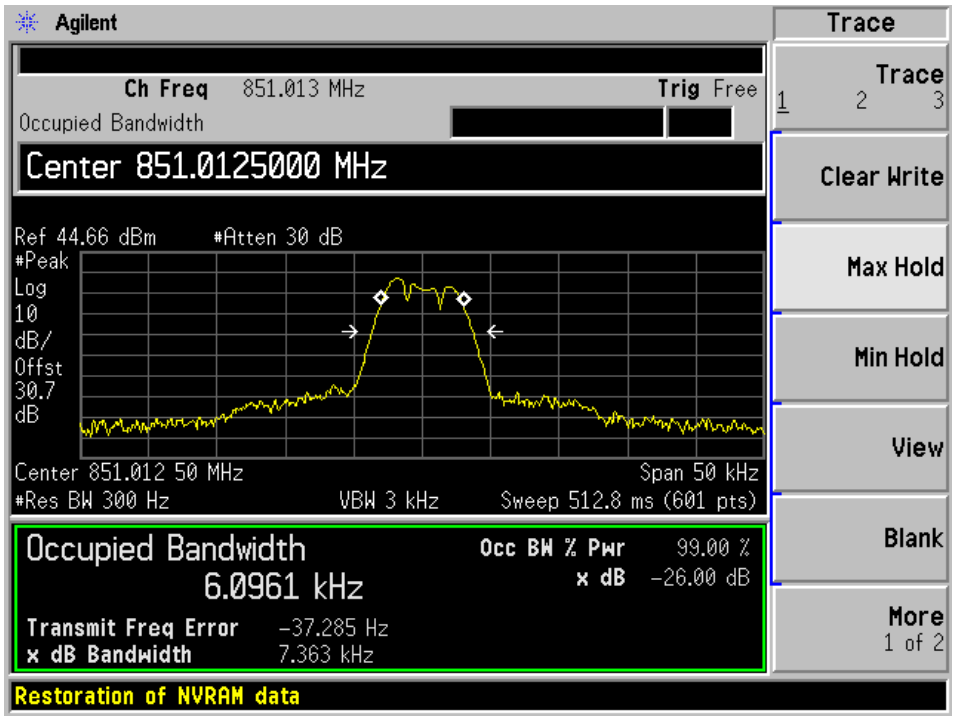
Occupied Bandwidth (ALC on)

Downlink: 851-862 MHz

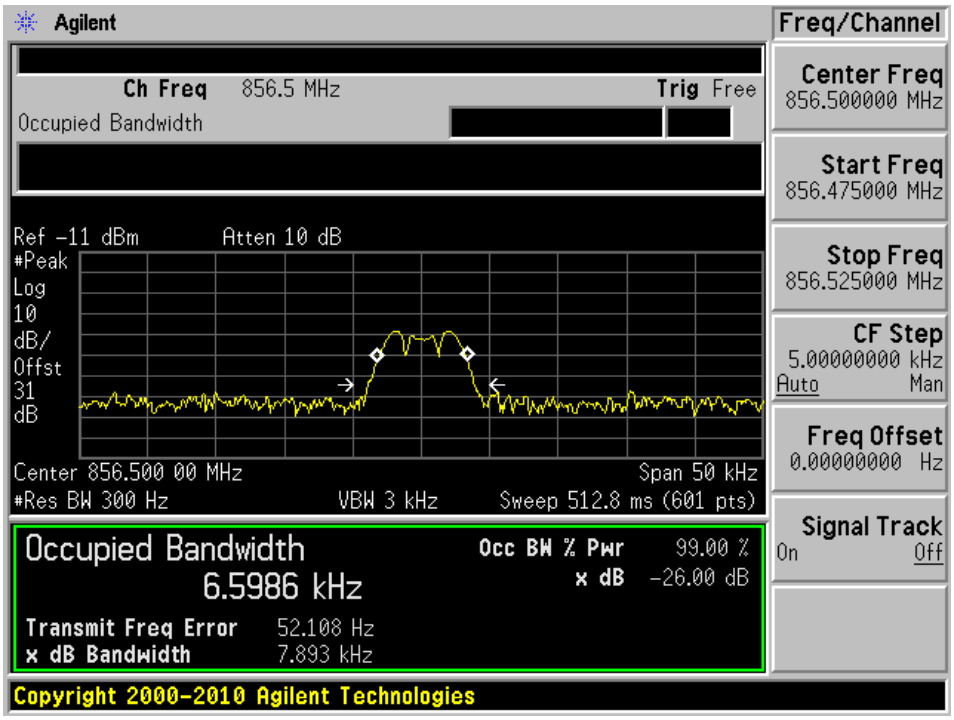
FM Data, Input, Low Channel – 851.0125 MHz



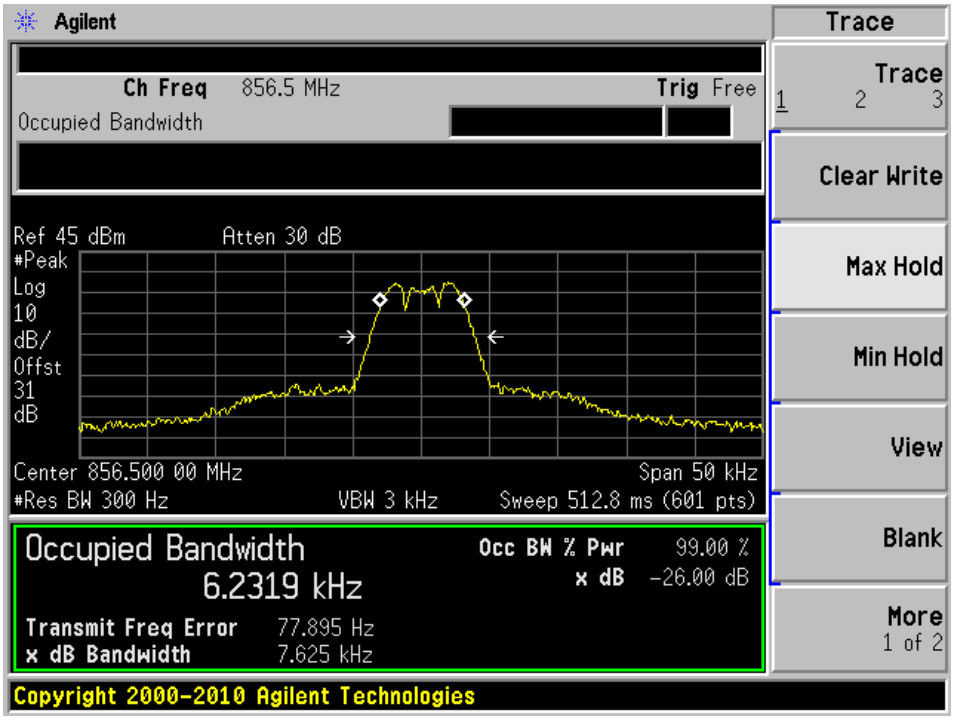
FM Data, Output, Low Channel – 851.0125 MHz



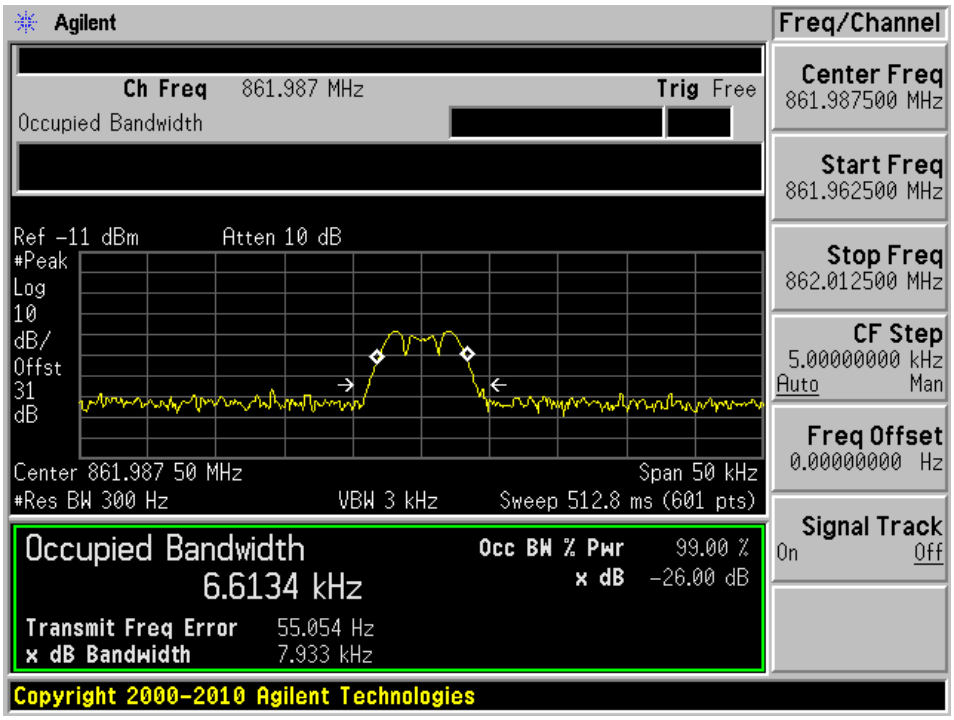
FM Data, Input, Middle Channel – 856.5 MHz



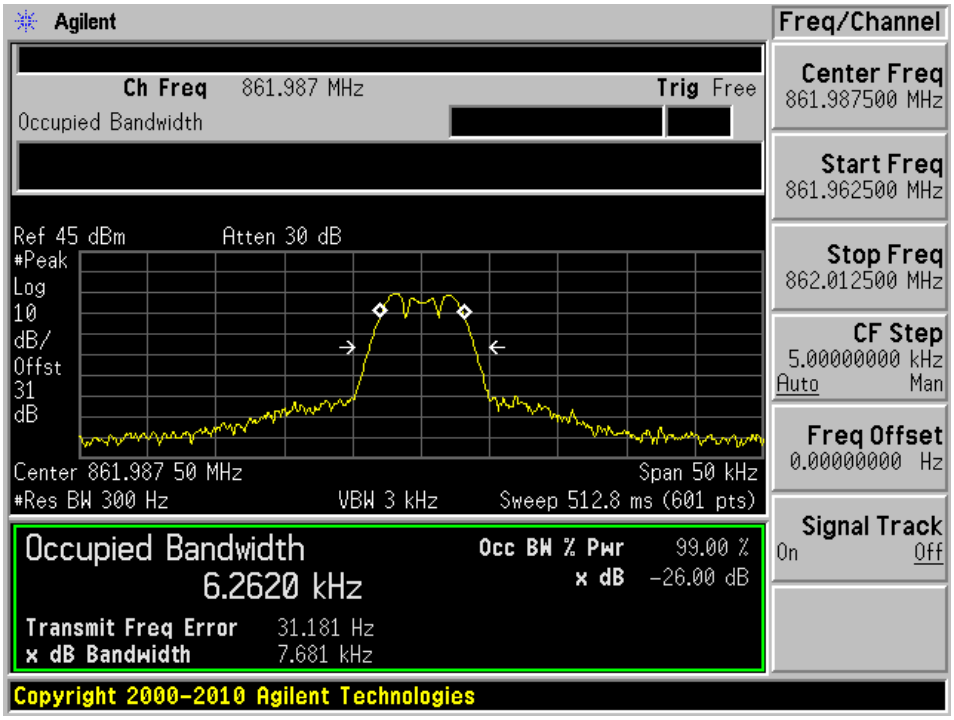
FM Data, Output, Middle Channel – 856.5 MHz



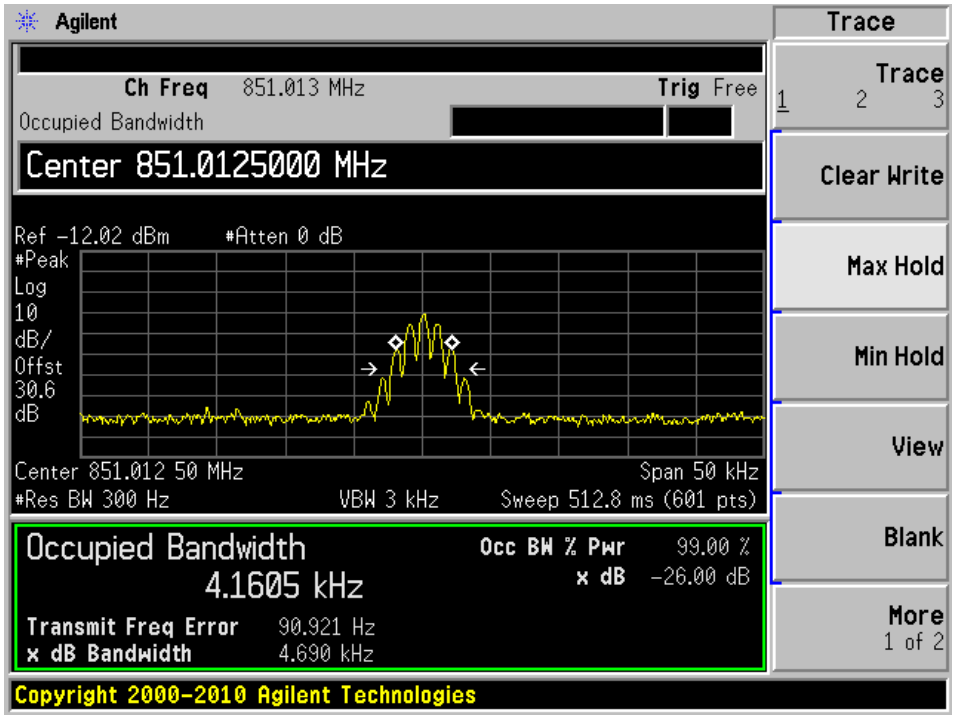
FM Data, Input, High Channel – 861.9875 MHz



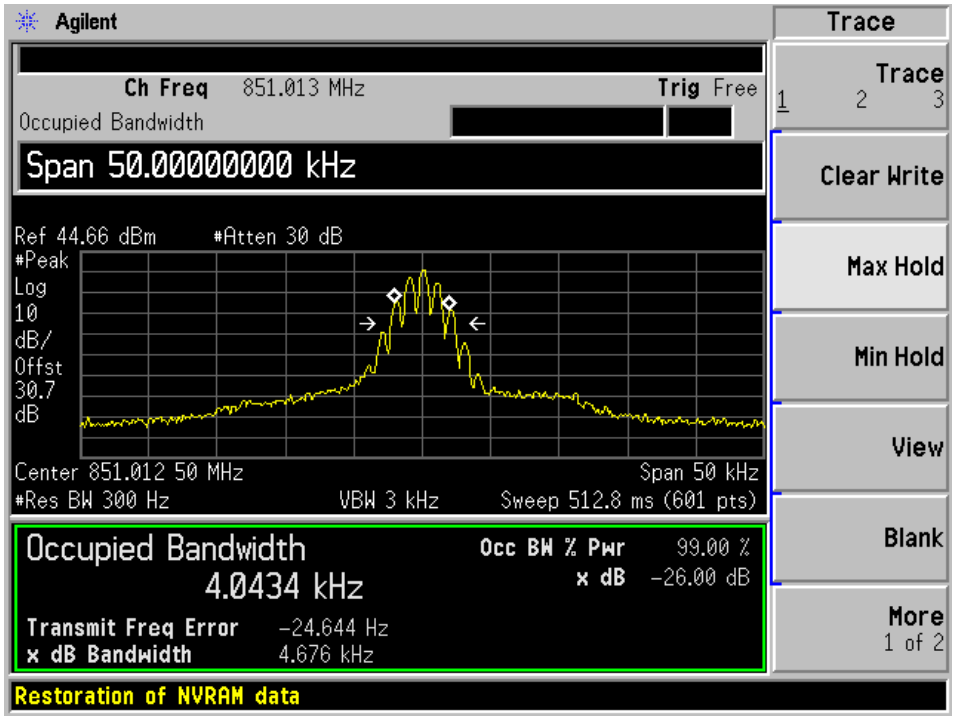
FM Data, Output, High Channel – 861.9875 MHz



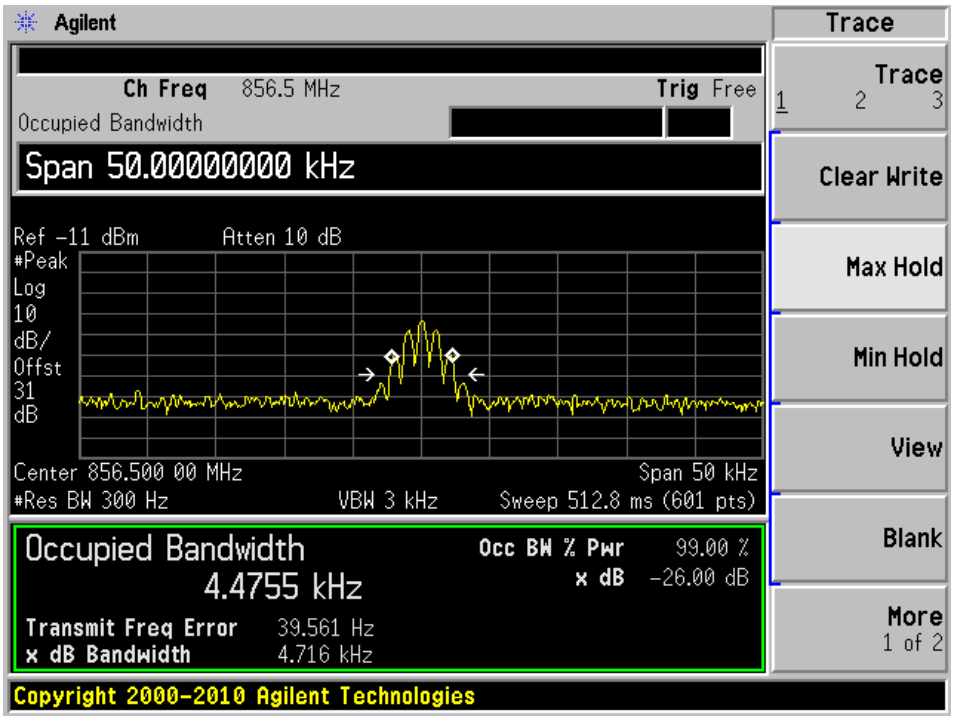
FM Voice, Input, Low Channel – 851.0125 MHz



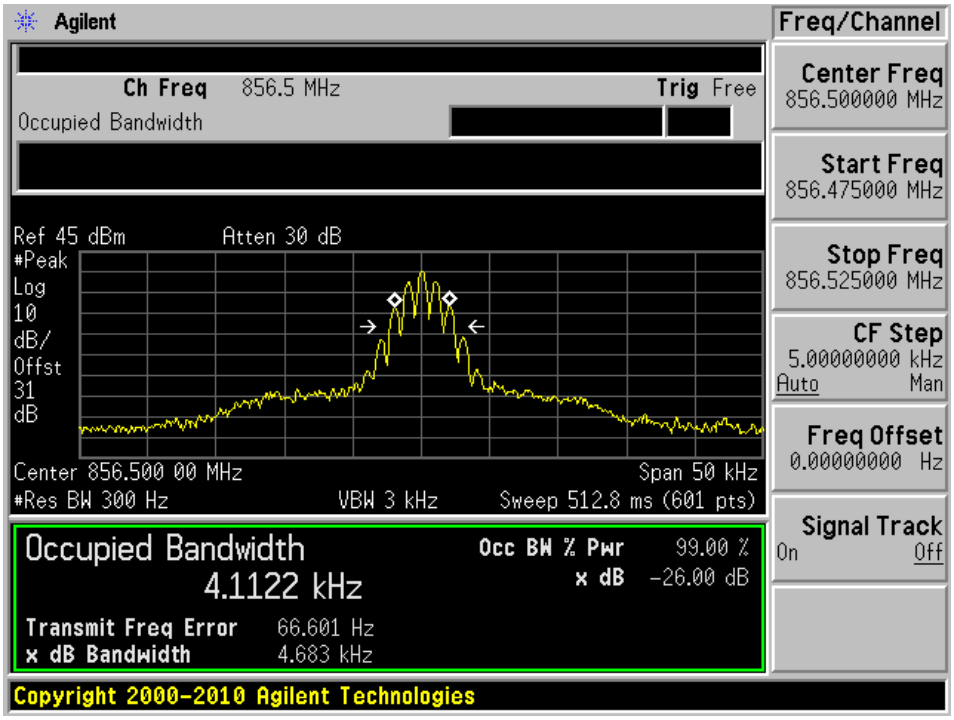
FM Voice, Output, Low Channel – 851.0125 MHz



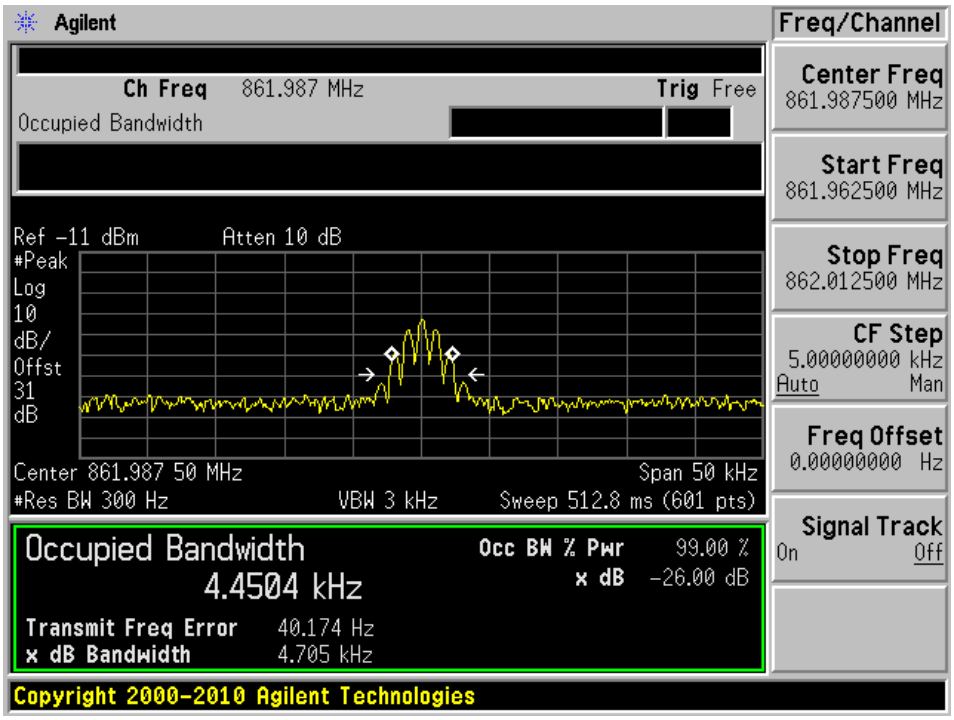
FM Voice, Input, Middle Channel – 856.5 MHz



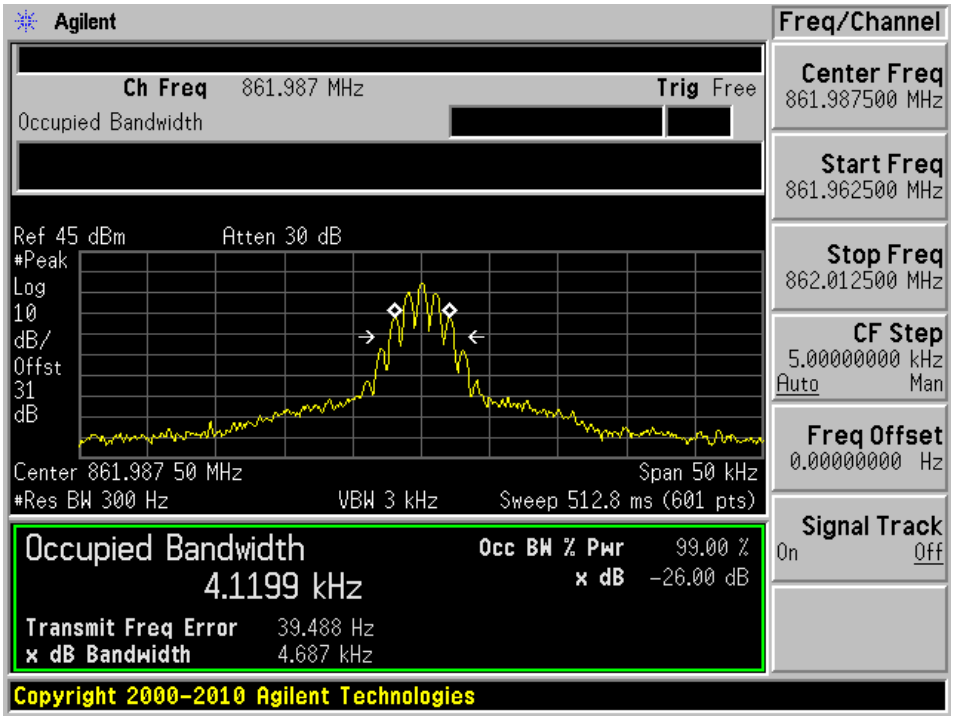
FM Voice, Output, Middle Channel – 856.5 MHz



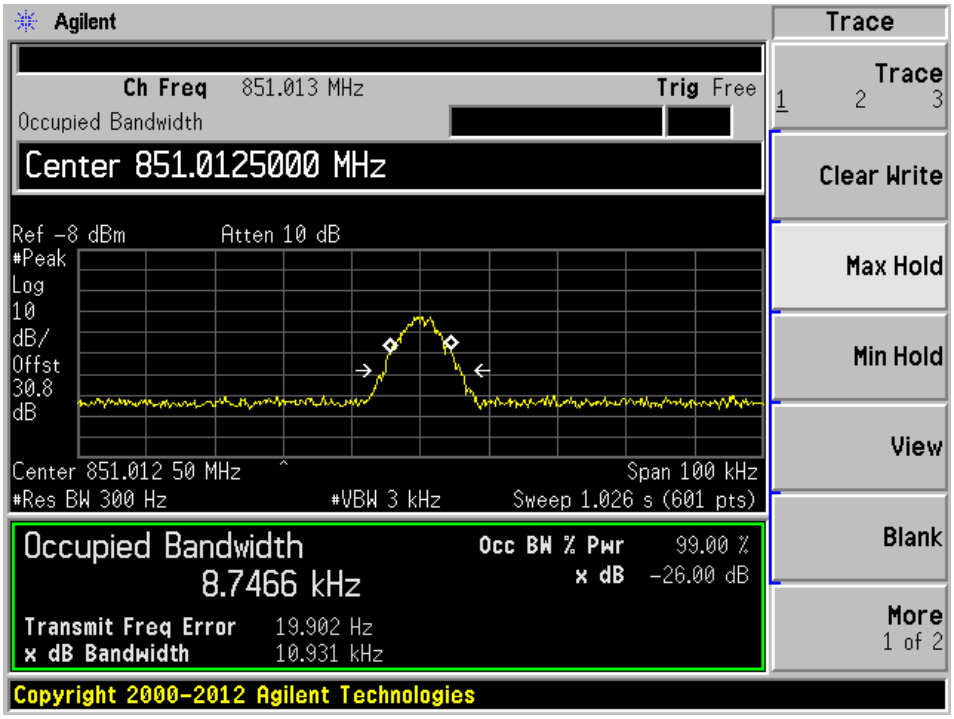
FM Voice, Input, High Channel – 861.9875 MHz



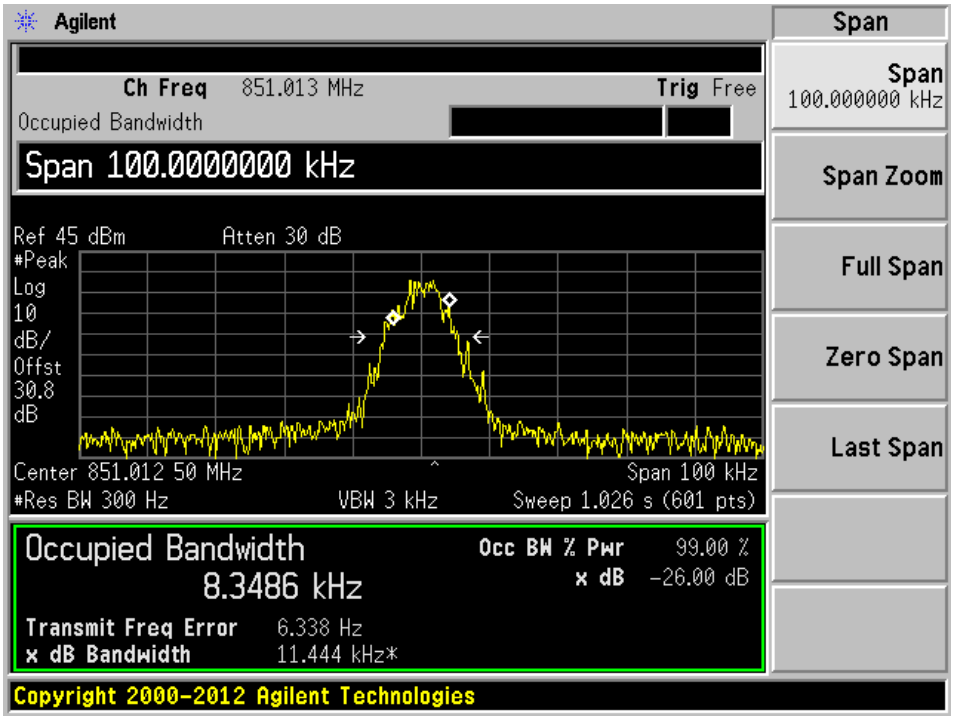
FM Voice, Output, High Channel – 861.9875 MHz



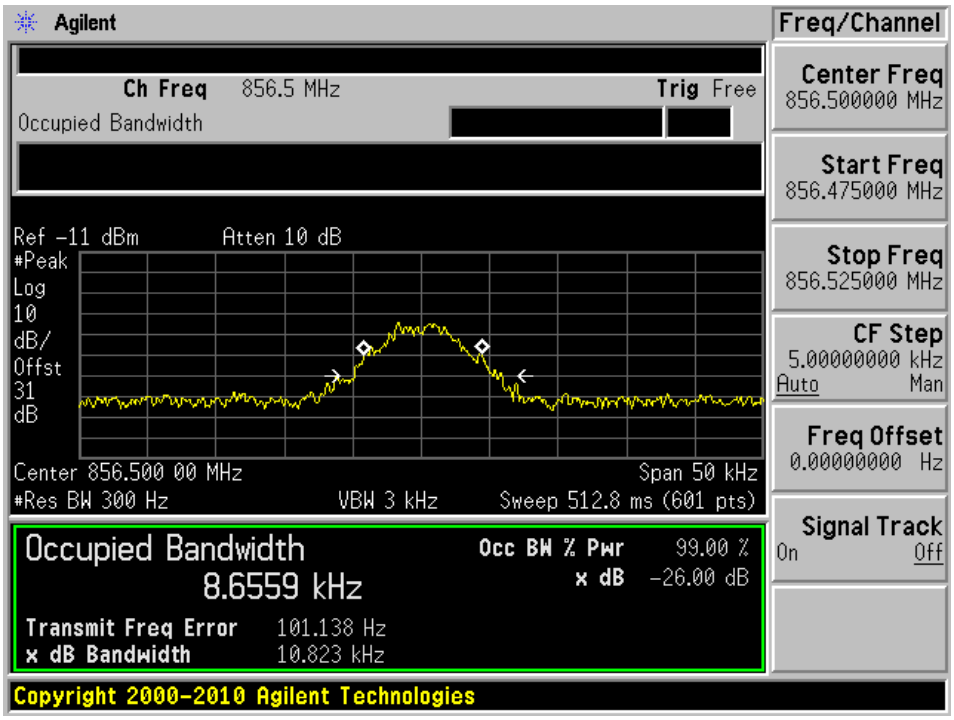
C4FM, Input, Low Channel – 851.0125 MHz



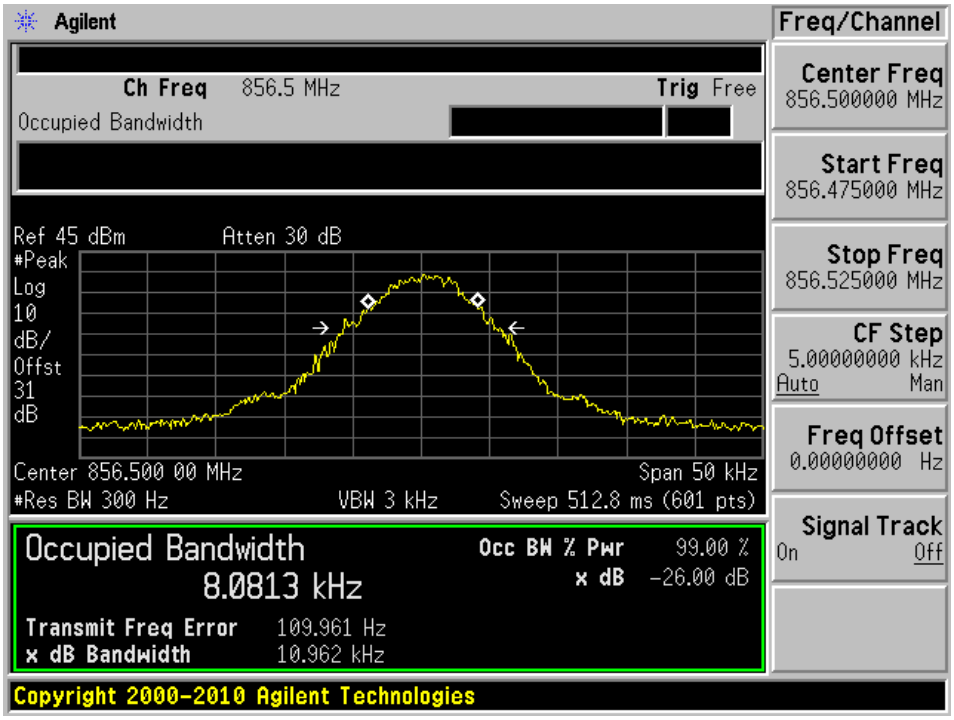
C4FM, Output, Low Channel – 851.0125 MHz



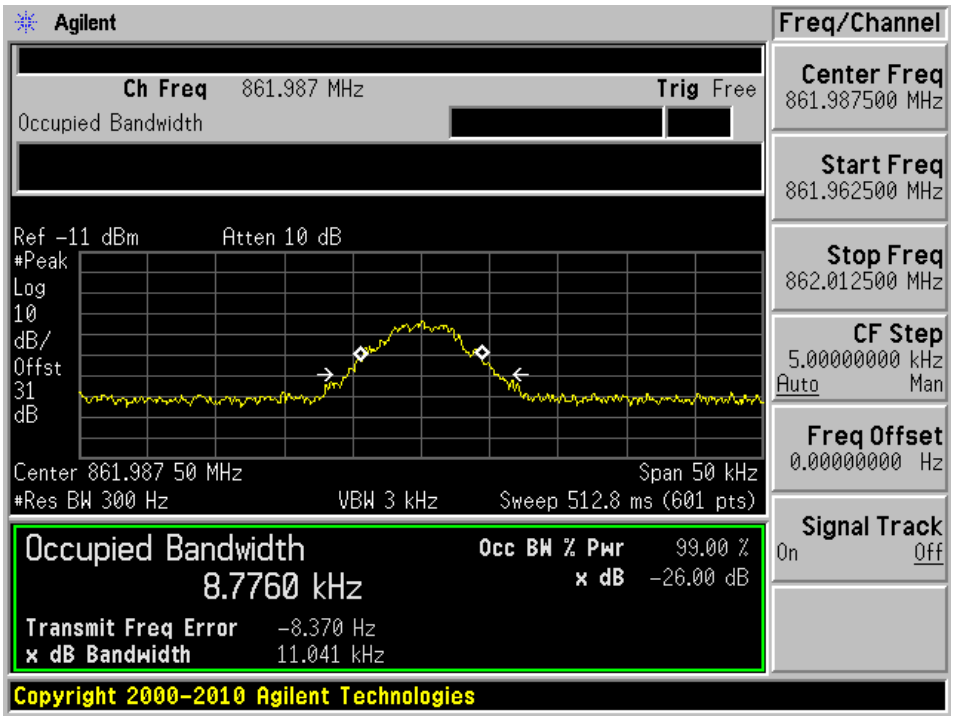
C4FM, Input, Middle Channel – 856.5 MHz



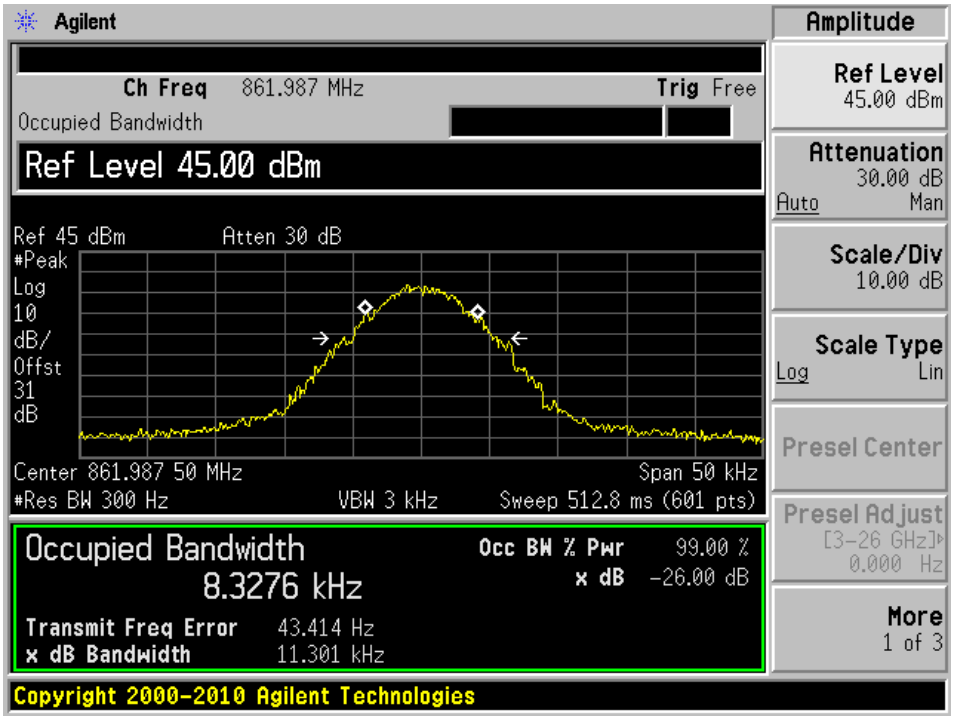
C4FM, Output, Middle Channel – 856.5 MHz



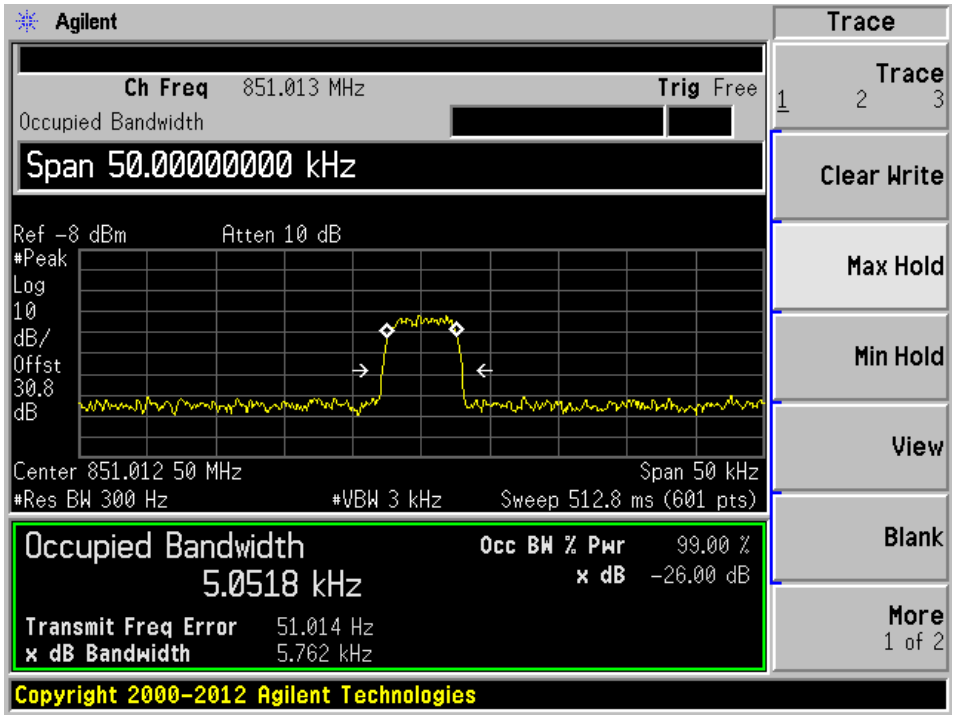
C4FM, Input, High Channel – 861.9875 MHz



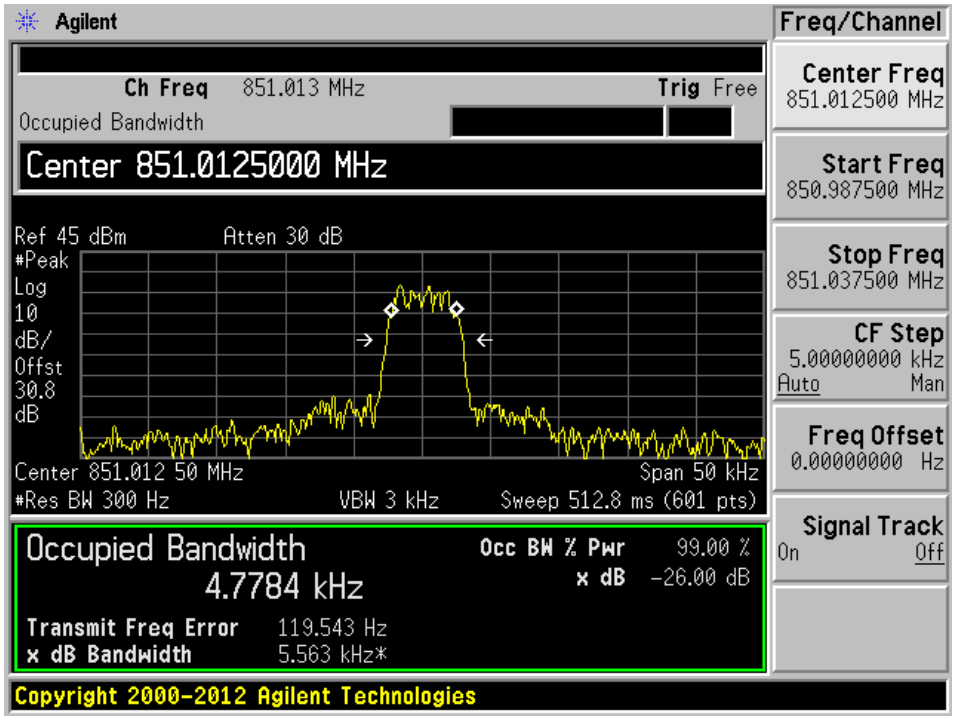
C4FM, Output, High Channel – 861.9875 MHz



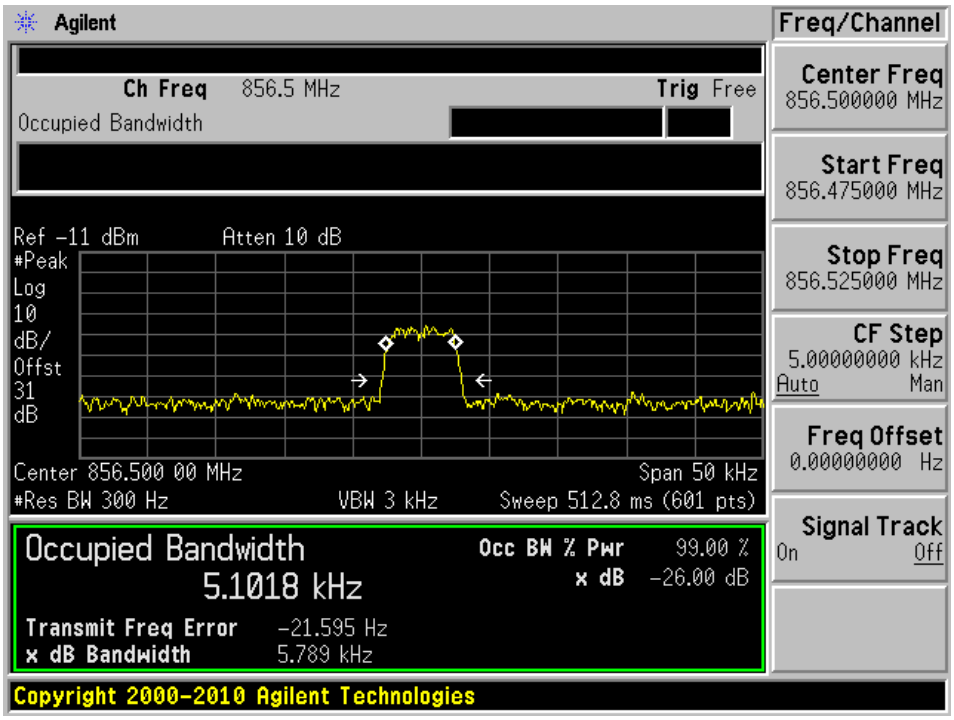
CQPSK, Input, Low Channel – 851.0125 MHz



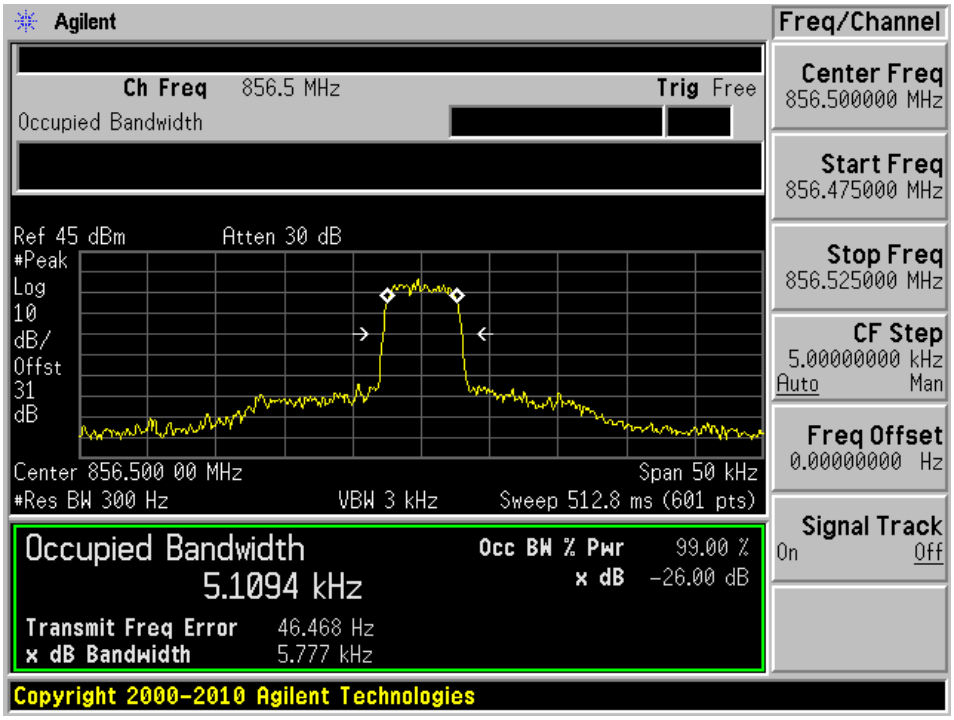
CQPSK, Output, Low Channel – 851.0125 MHz



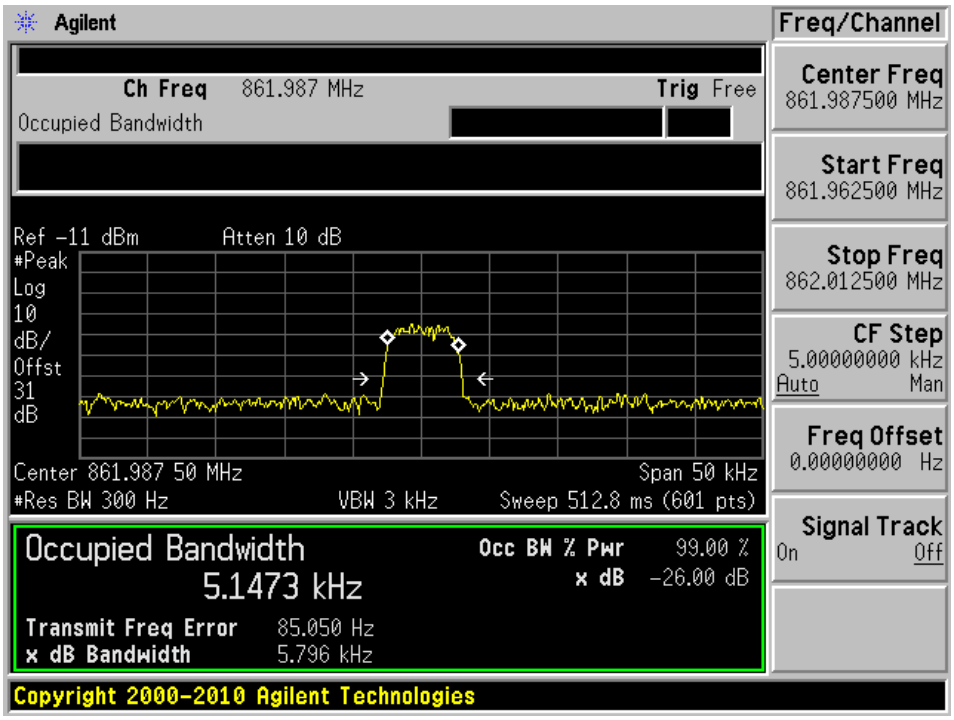
CQPSK, Input, Middle Channel – 856.5 MHz



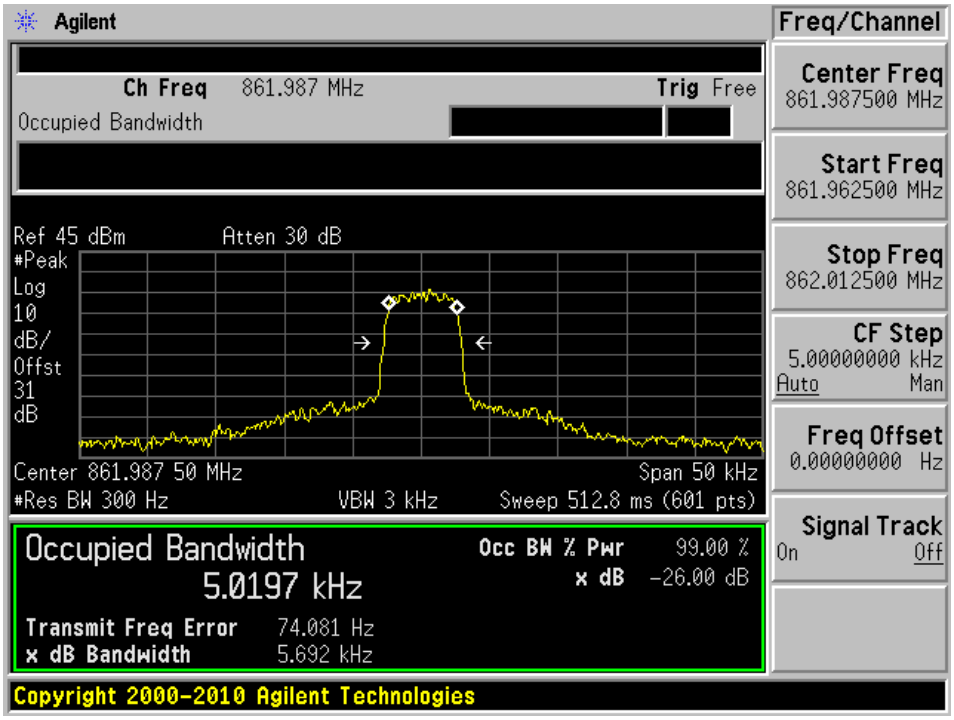
CQPSK, Output, Middle Channel – 856.5 MHz



CQPSK, Input, High Channel – 861.9875 MHz

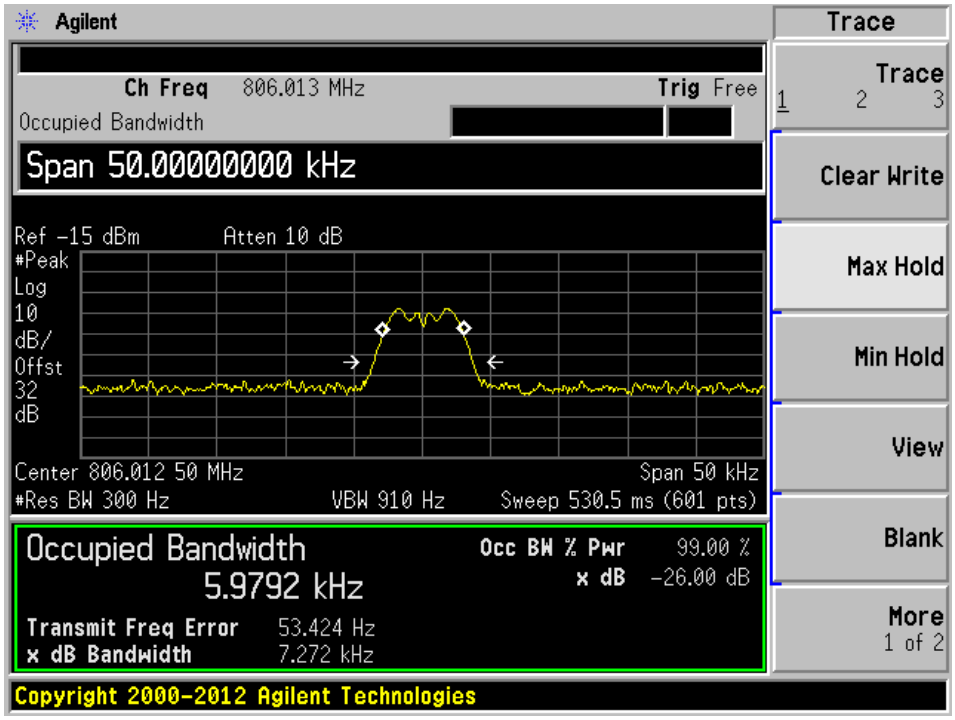


CQPSK, Output, High Channel – 861.9875 MHz

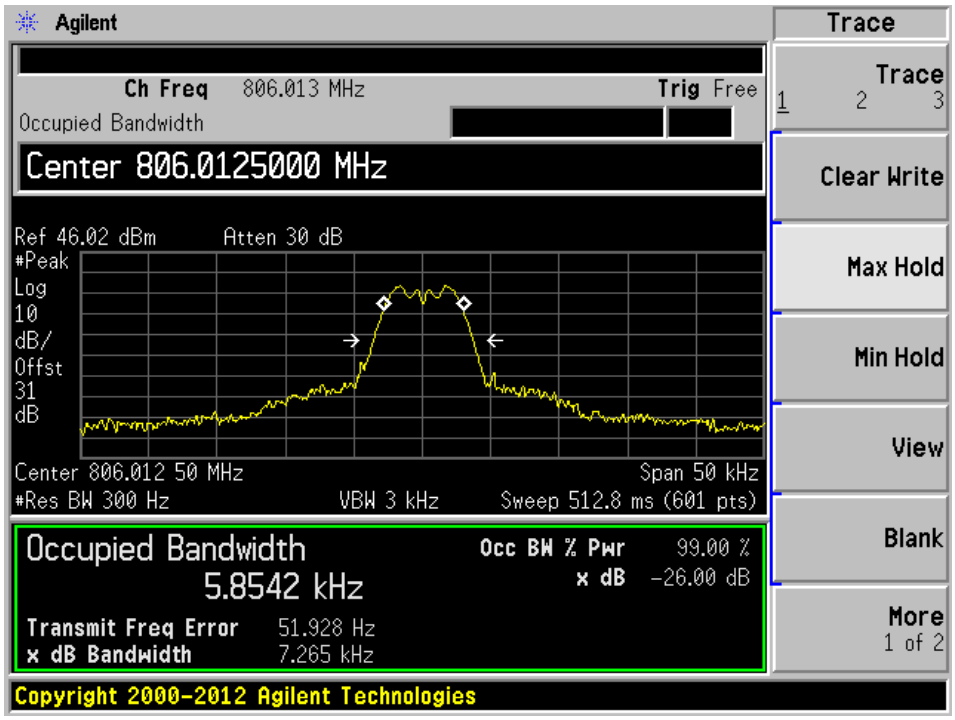


Uplink: 806-817 MHz

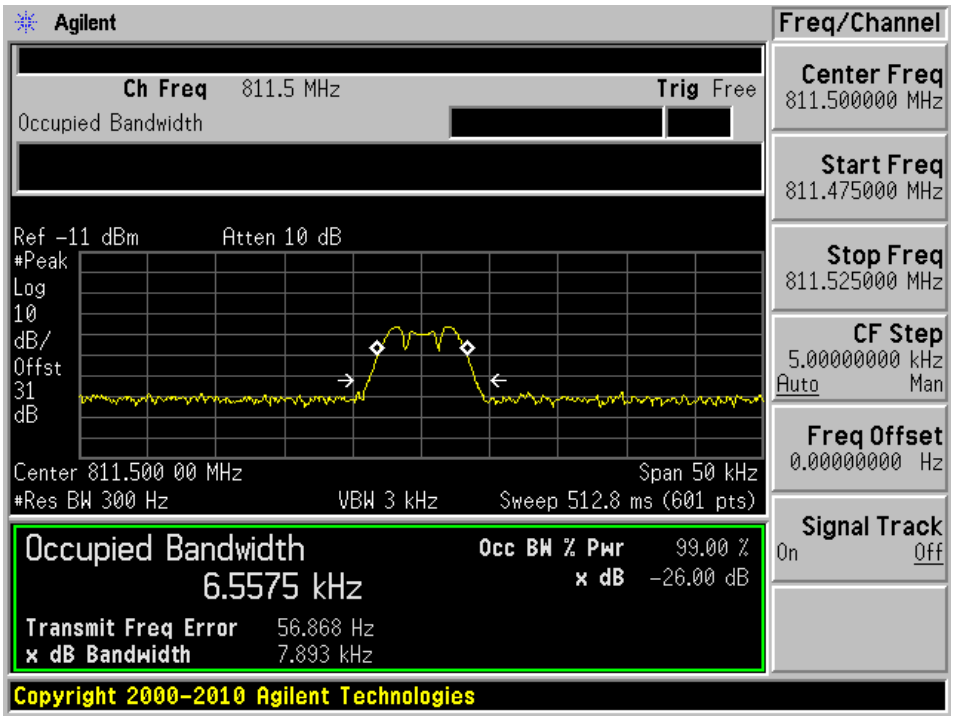
FM Data, Input, Low Channel – 806.0125 MHz



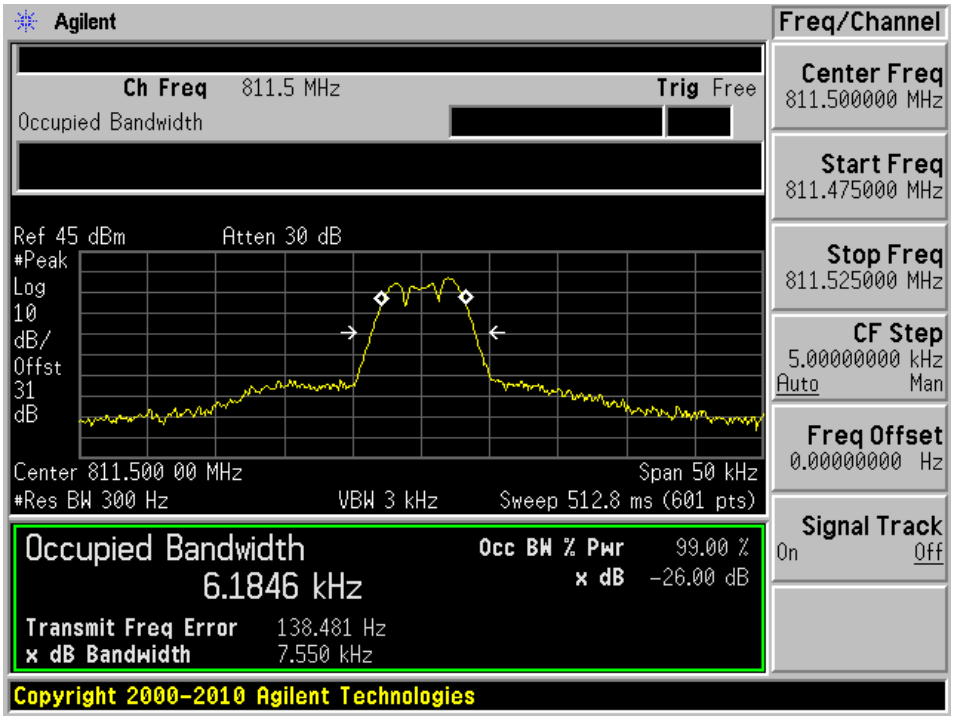
FM Data, Output, Low Channel – 806.0125 MHz



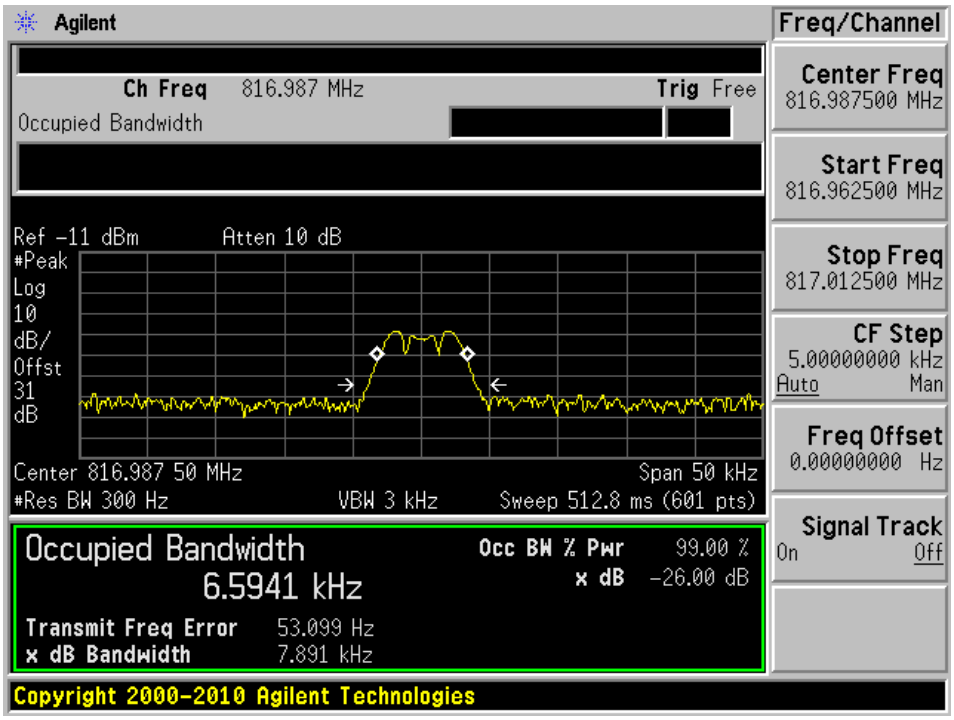
FM Data, Input, Middle Channel – 811.5 MHz



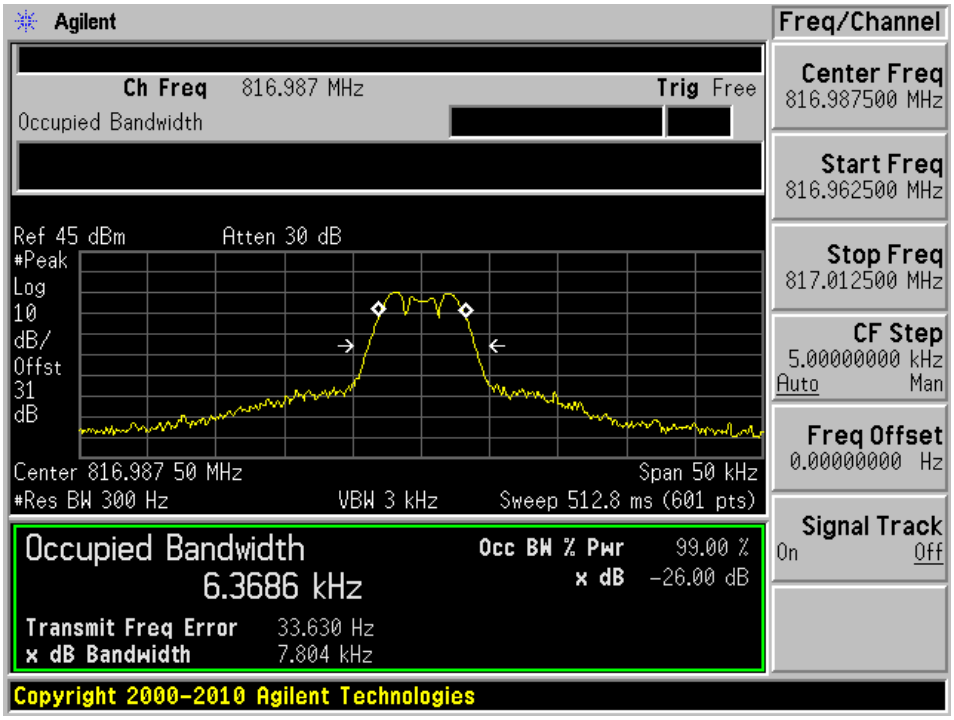
FM Data, Output, Middle Channel – 811.5 MHz



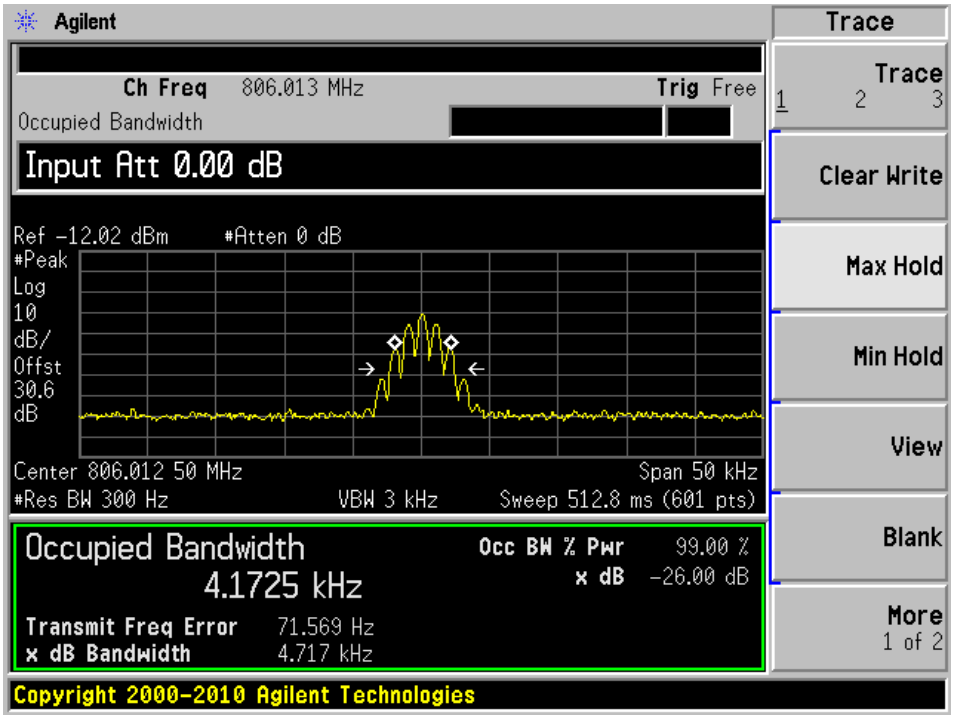
FM Data, Input, High Channel – 816.9875 MHz



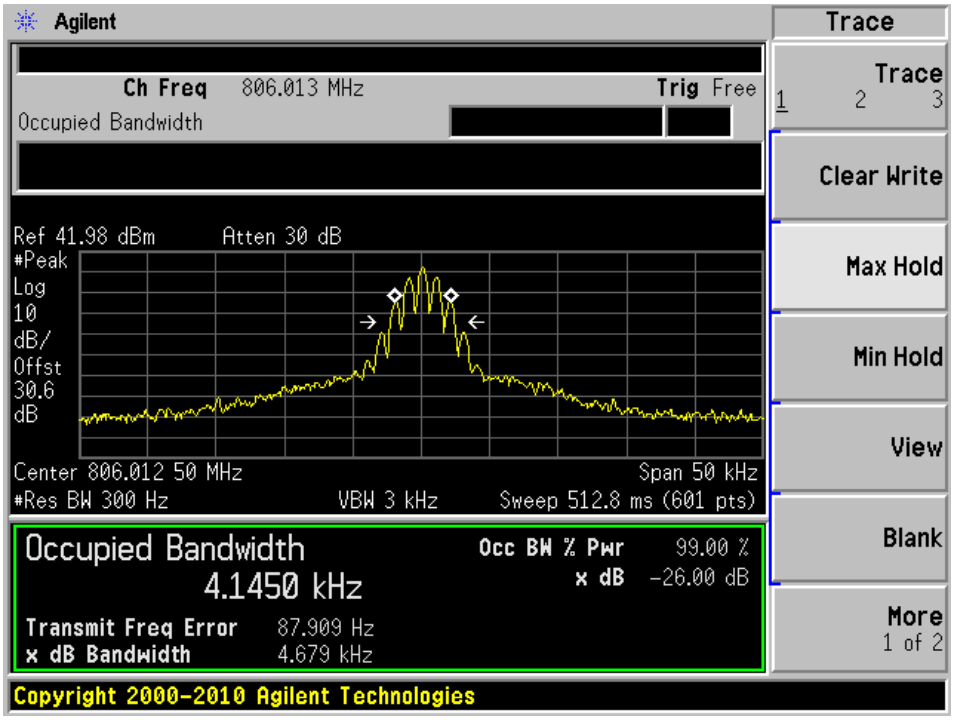
FM Data, Output, High Channel – 816.9875 MHz



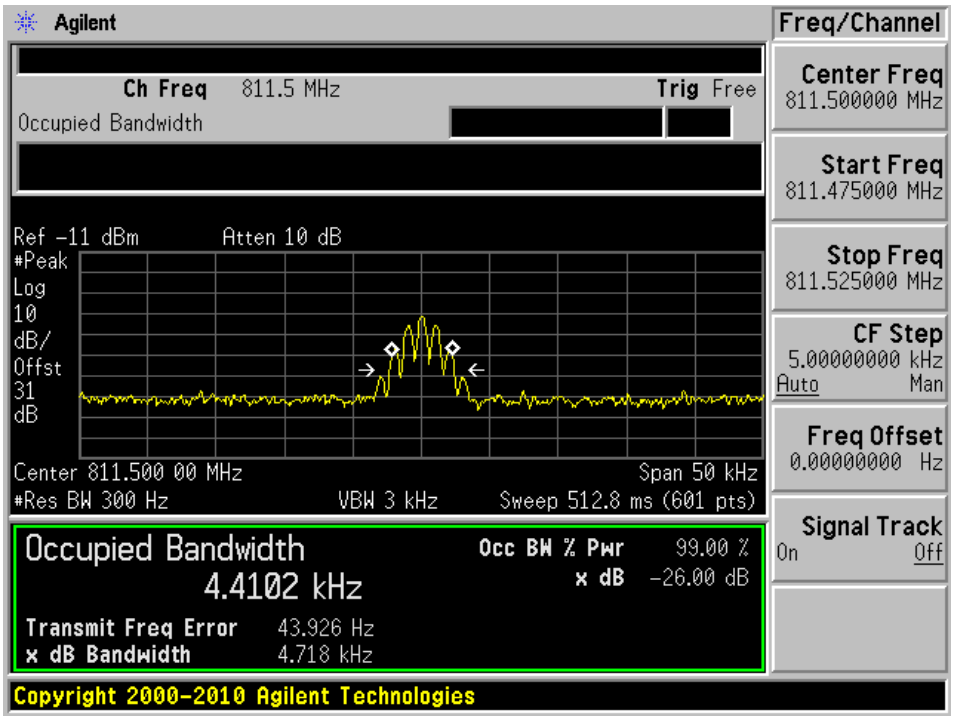
FM Voice, Input, Low Channel – 806.0125 MHz



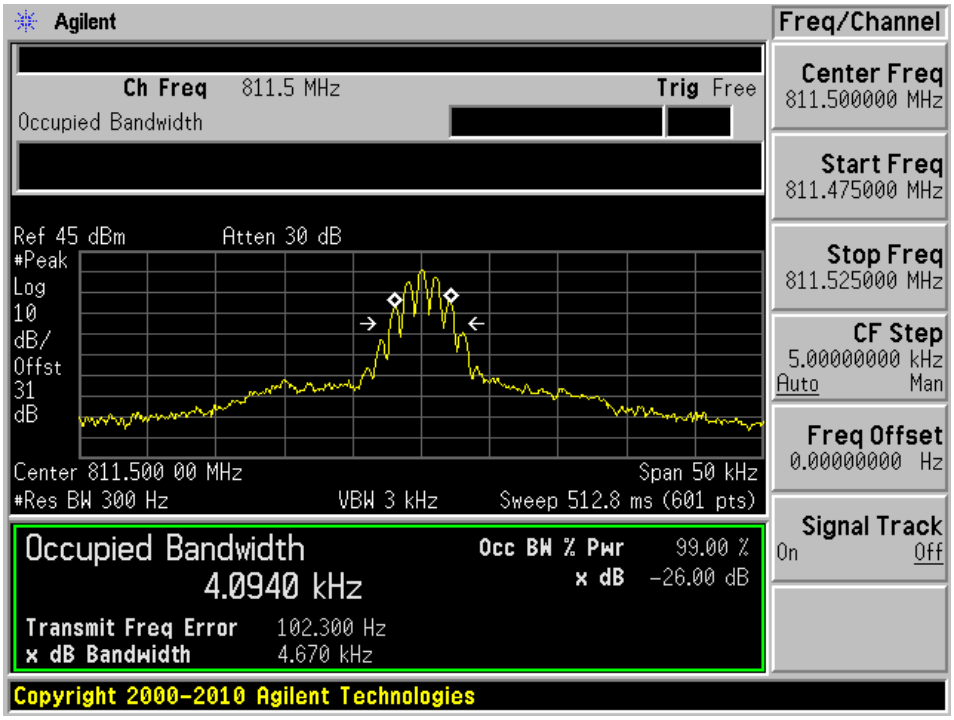
FM Voice, Output, Low Channel – 806.0125 MHz



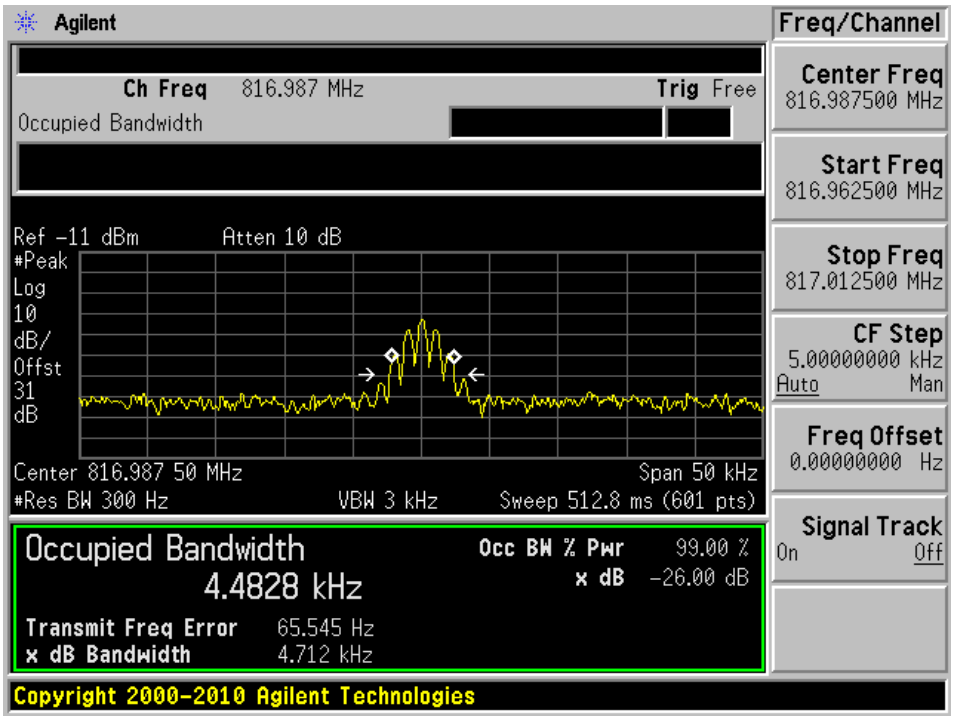
FM Voice, Input, Middle Channel – 811.5 MHz



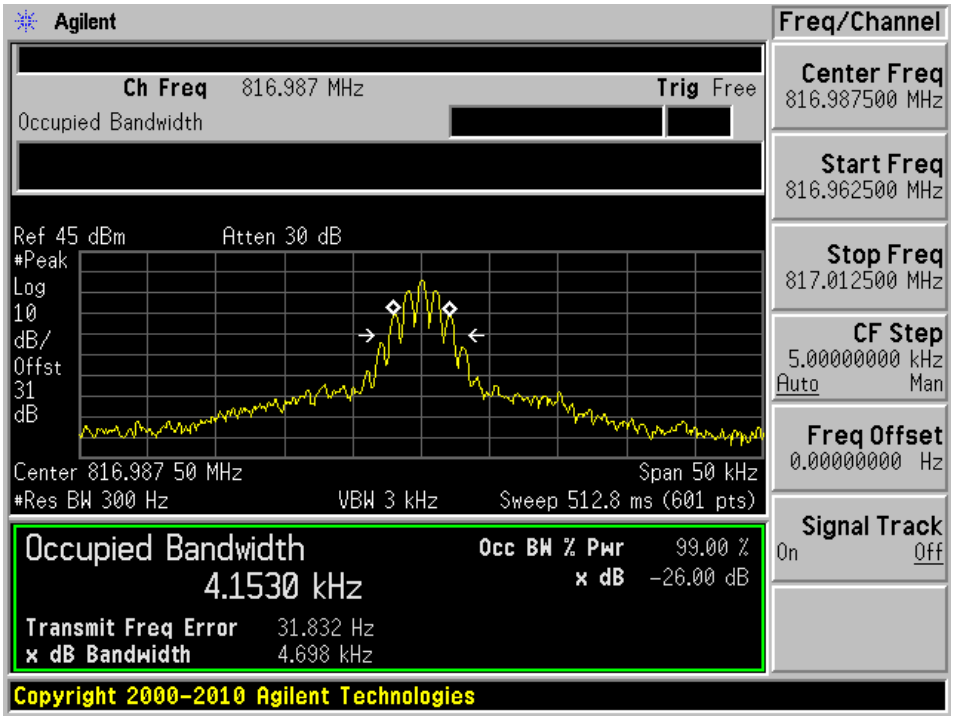
FM Voice, Output, Middle Channel – 811.5 MHz



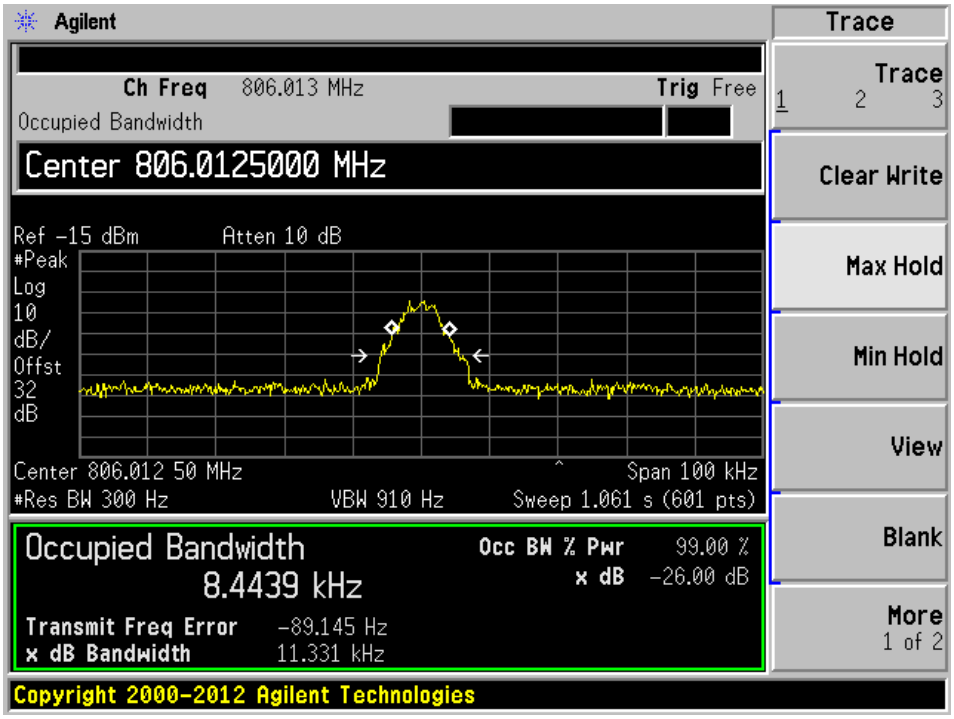
FM Voice, Input, High Channel – 816.9875 MHz



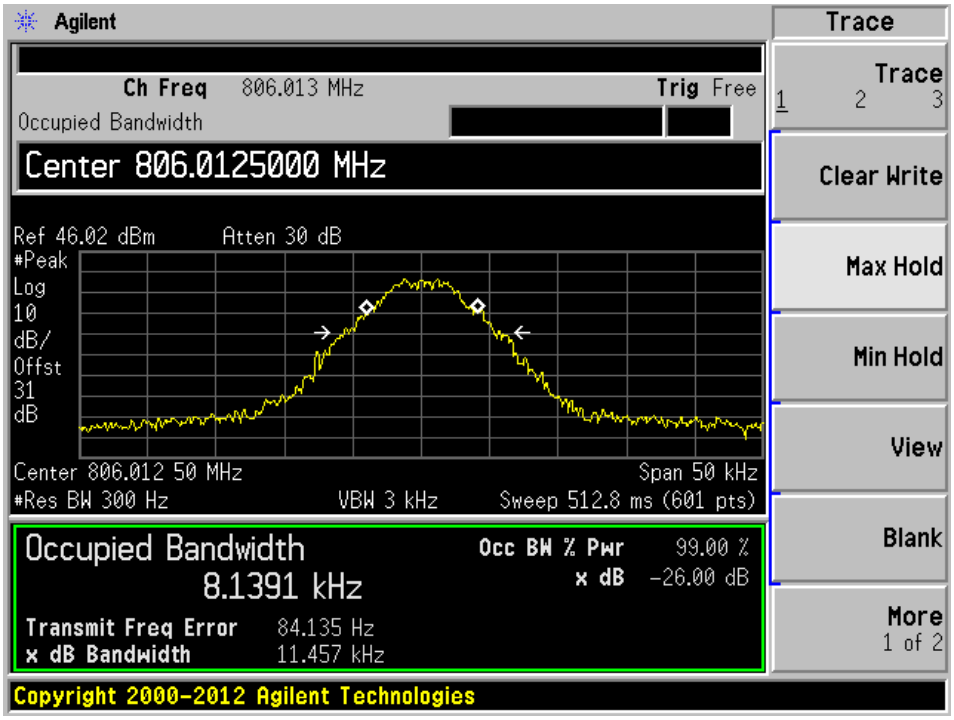
FM Voice, Output, High Channel – 816.9875 MHz



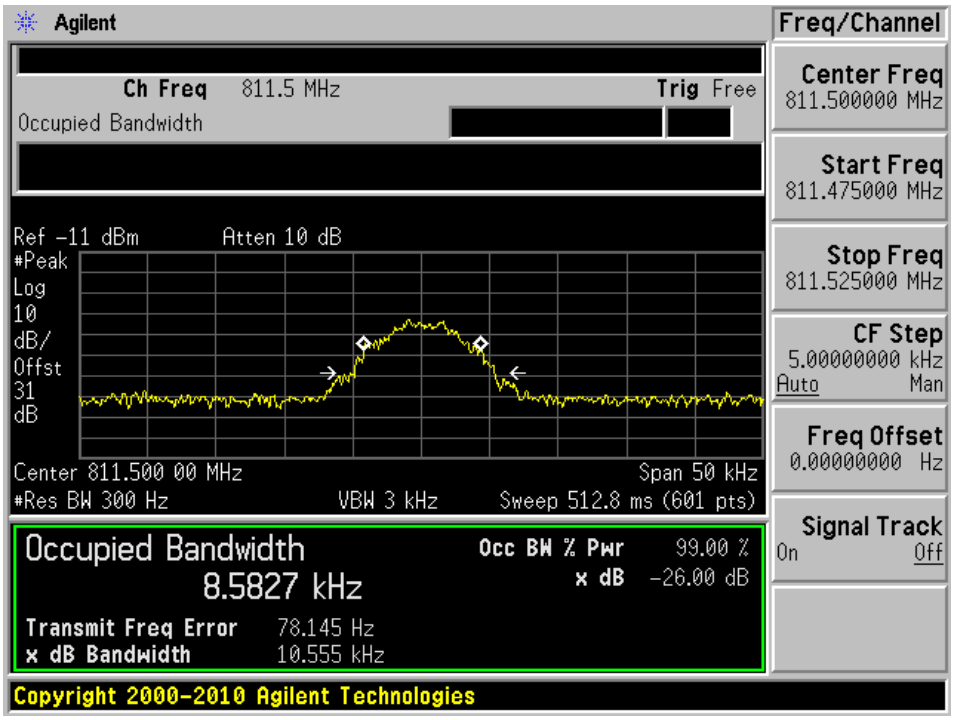
C4FM, Input, Low Channel – 806.0125 MHz



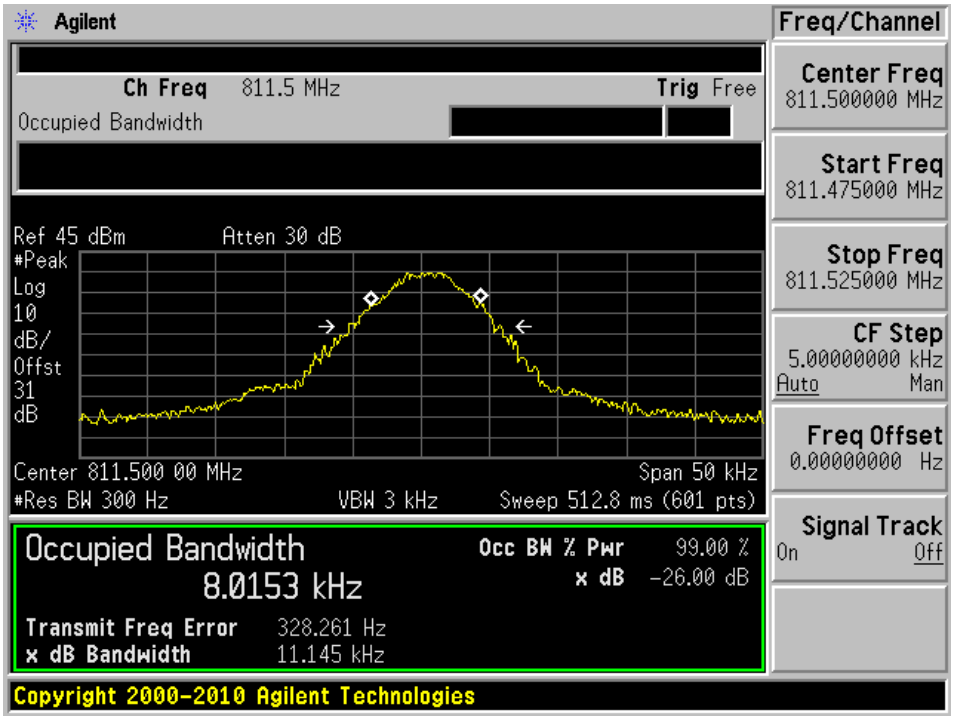
C4FM, Output, Low Channel – 806.0125 MHz



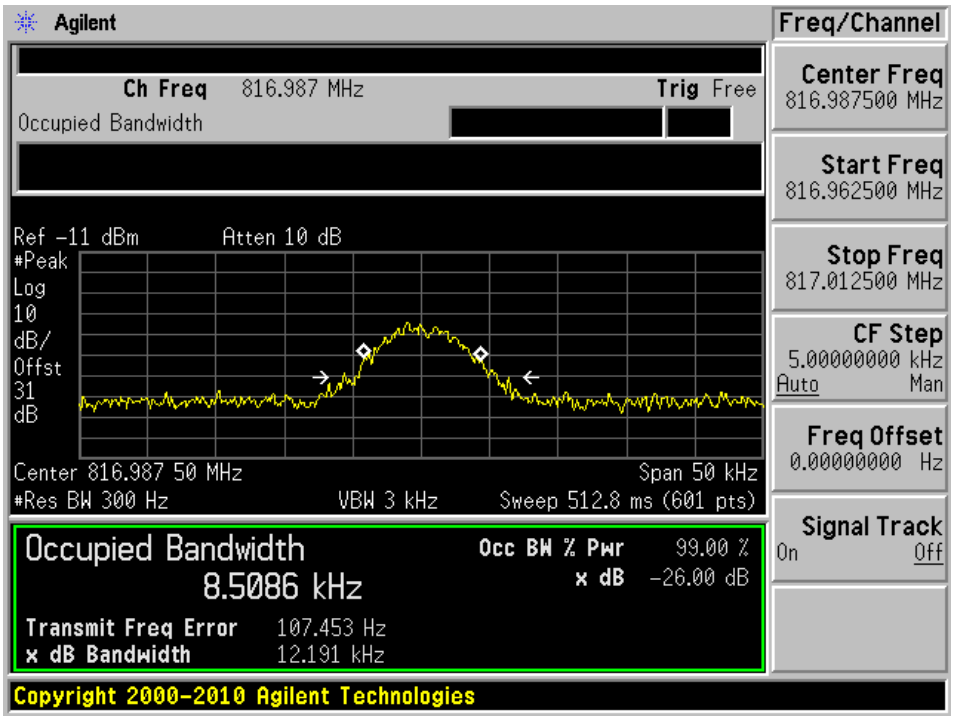
C4FM, Input, Middle Channel – 811.5 MHz



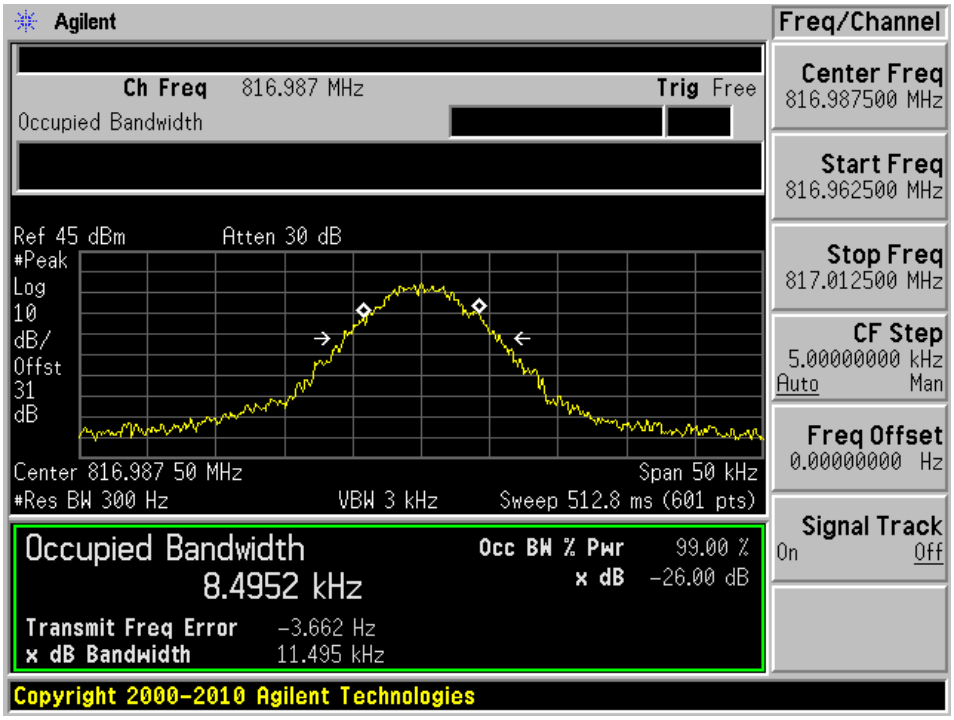
C4FM, Output, Middle Channel – 811.5 MHz



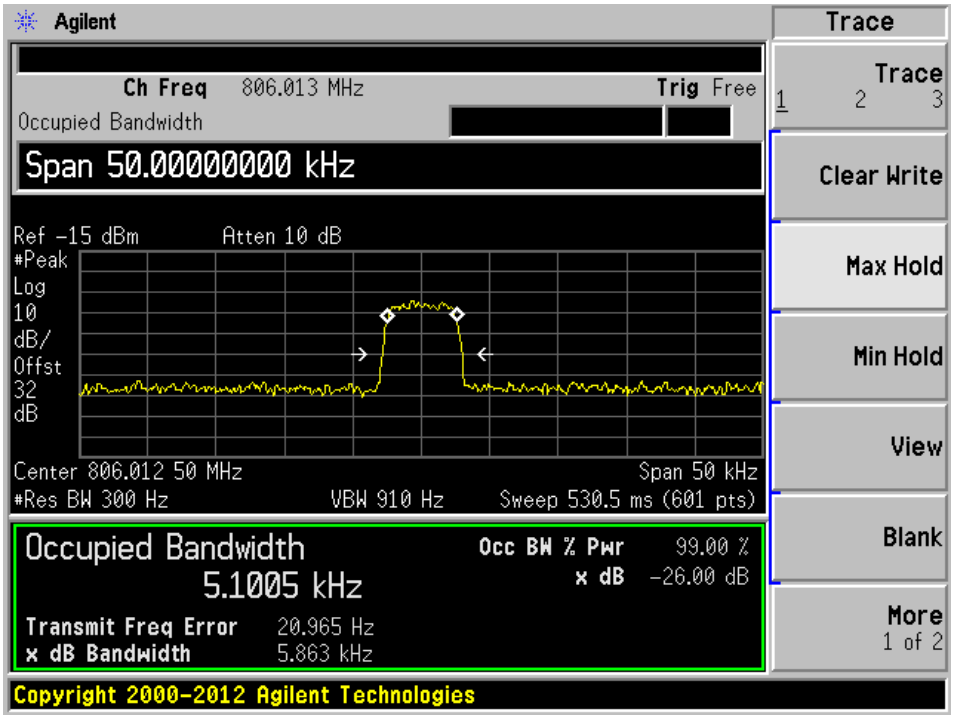
C4FM, Input, High Channel – 816.9875 MHz



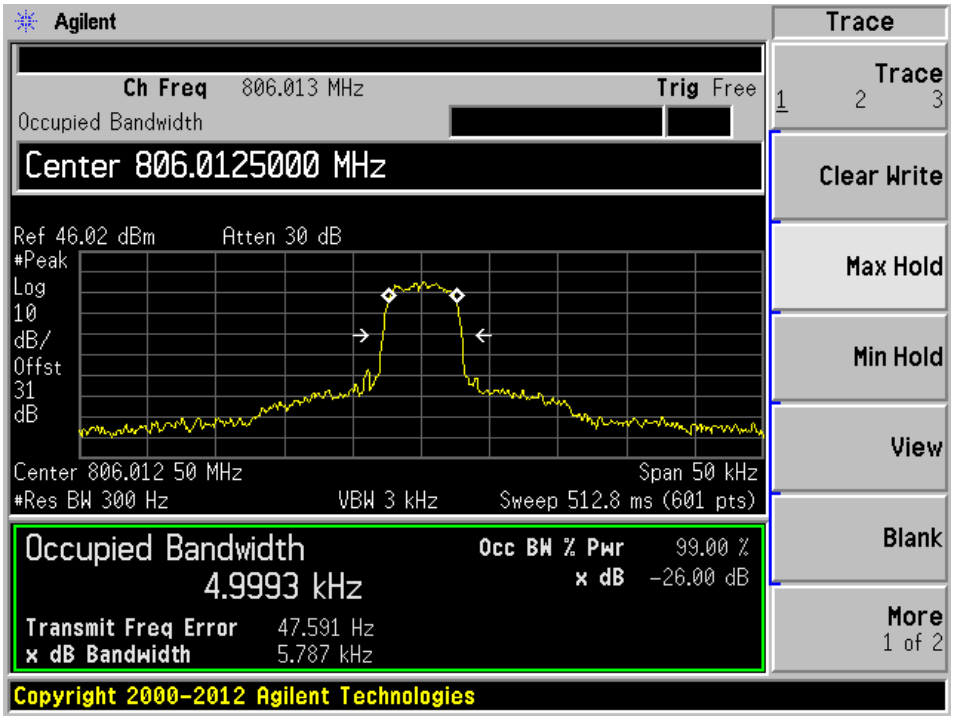
C4FM, Output, High Channel – 816.9875 MHz



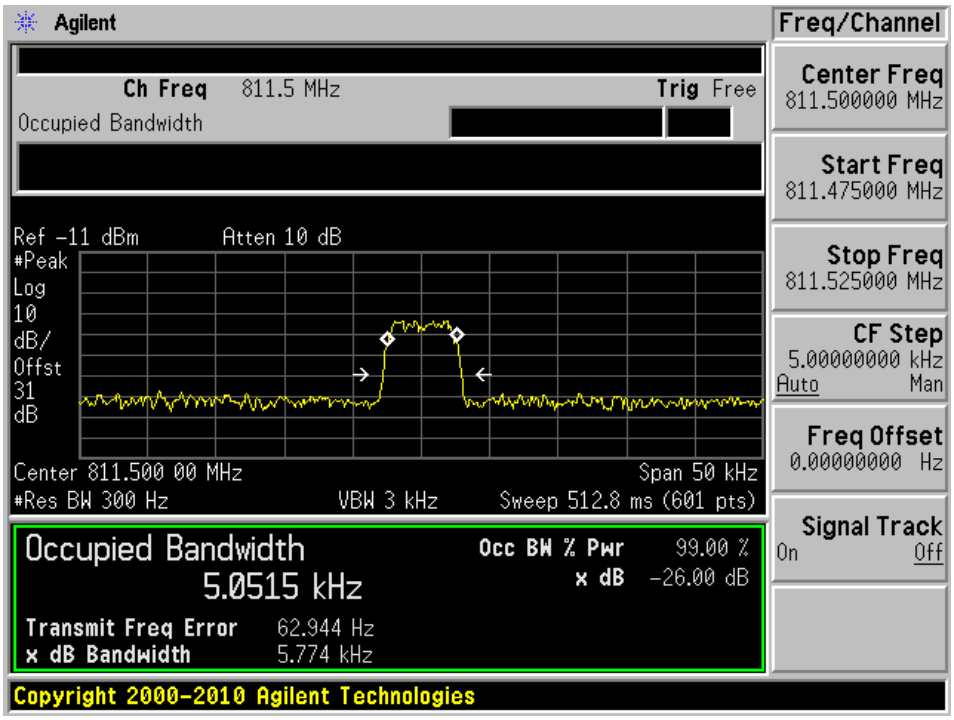
CQPSK, Input, Low Channel – 806.0125 MHz



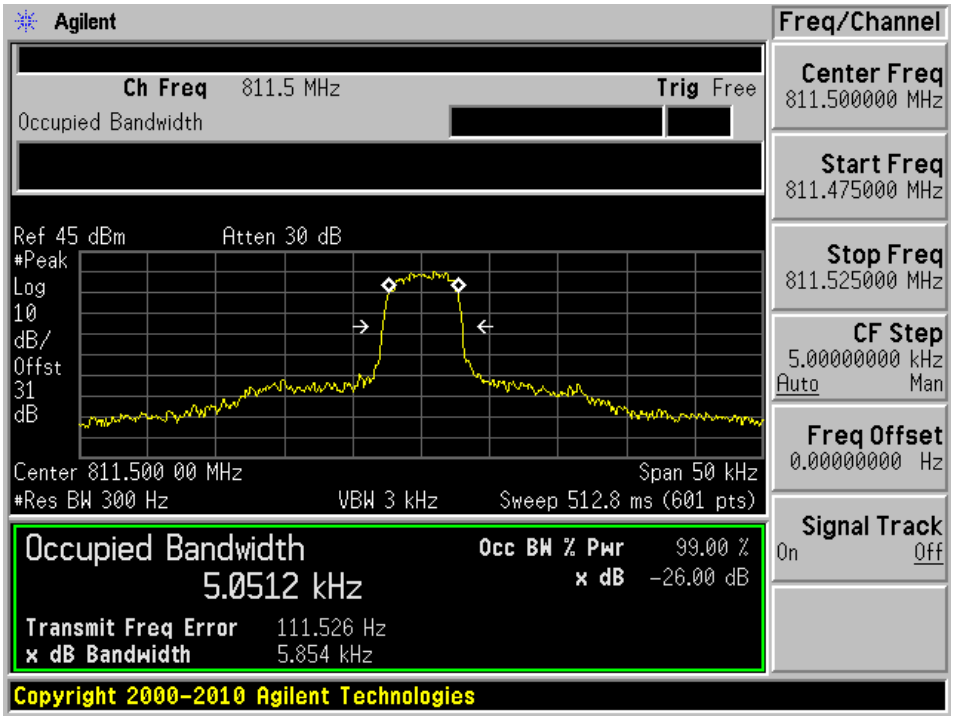
CQPSK, Output, Low Channel – 806.0125 MHz



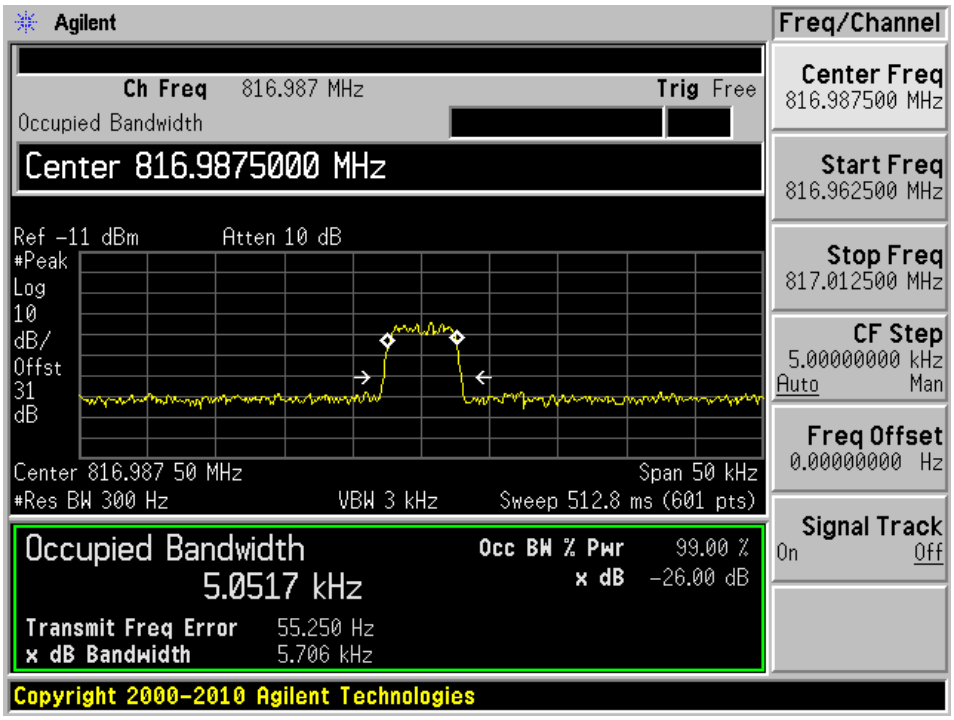
CQPSK, Input, Middle Channel – 811.5 MHz



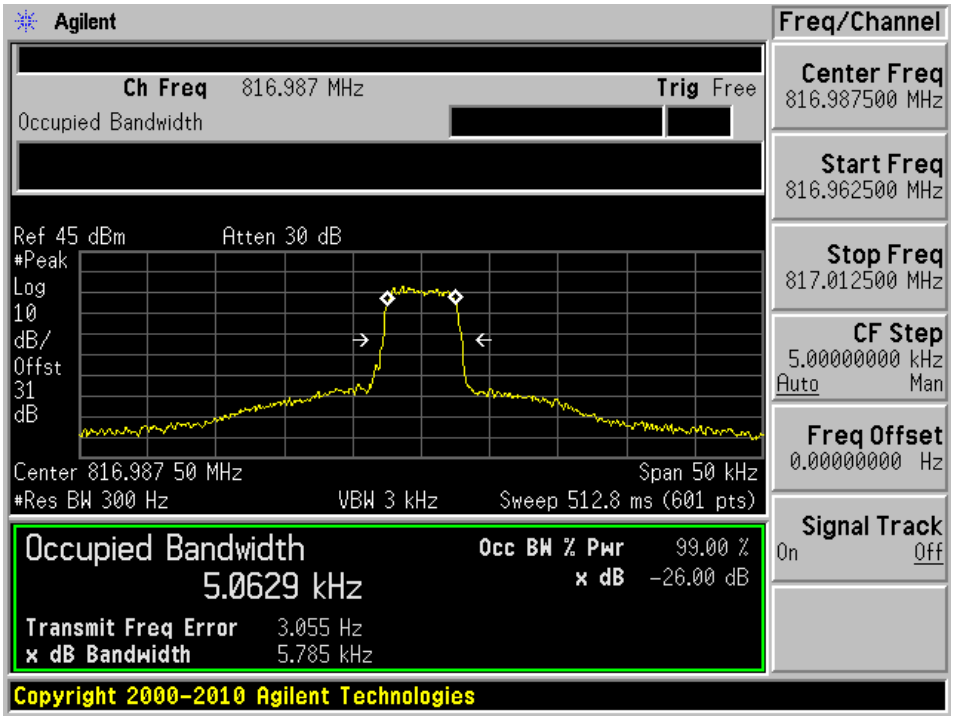
CQPSK, Output, Middle Channel – 811.5 MHz



CQPSK, Input, High Channel – 816.9875 MHz



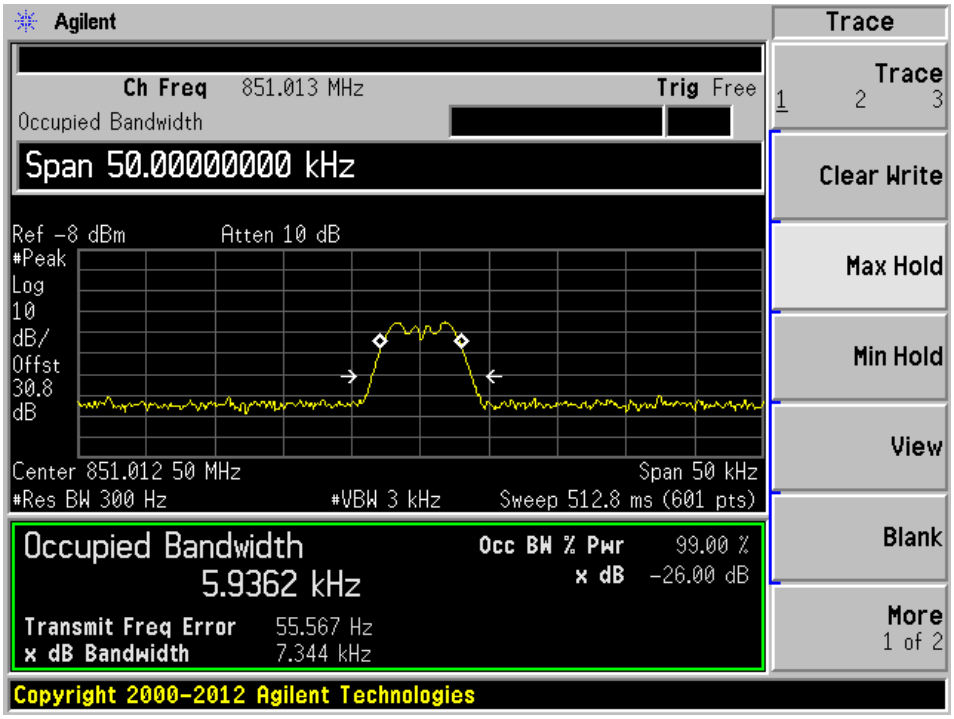
CQPSK, Output, High Channel – 816.9875 MHz



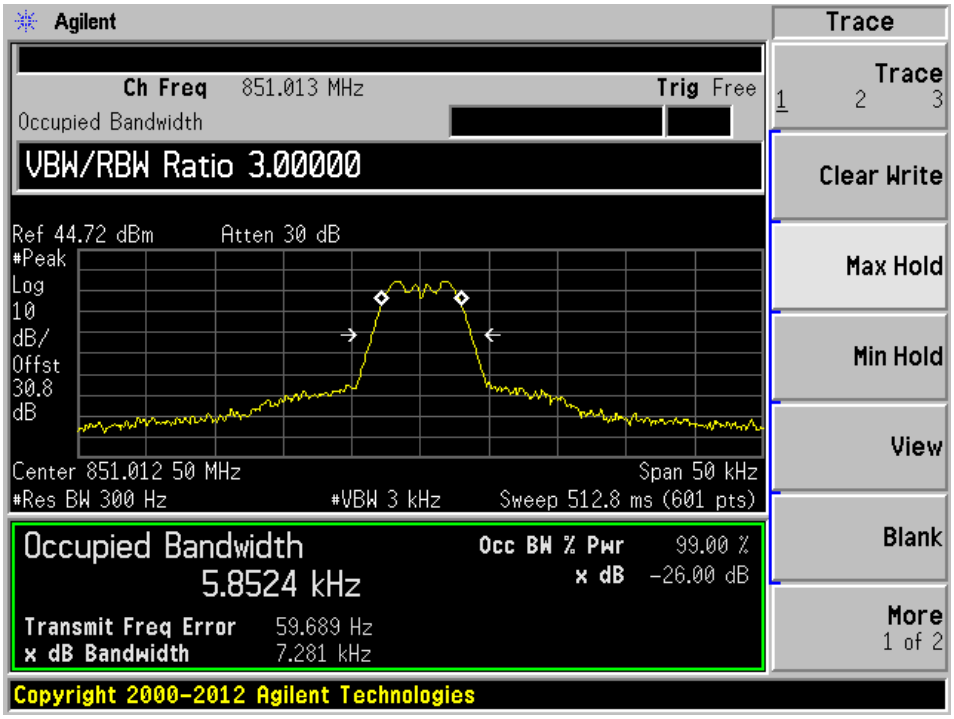
Occupied Bandwidth (ALC off)

Downlink: 851-862 MHz

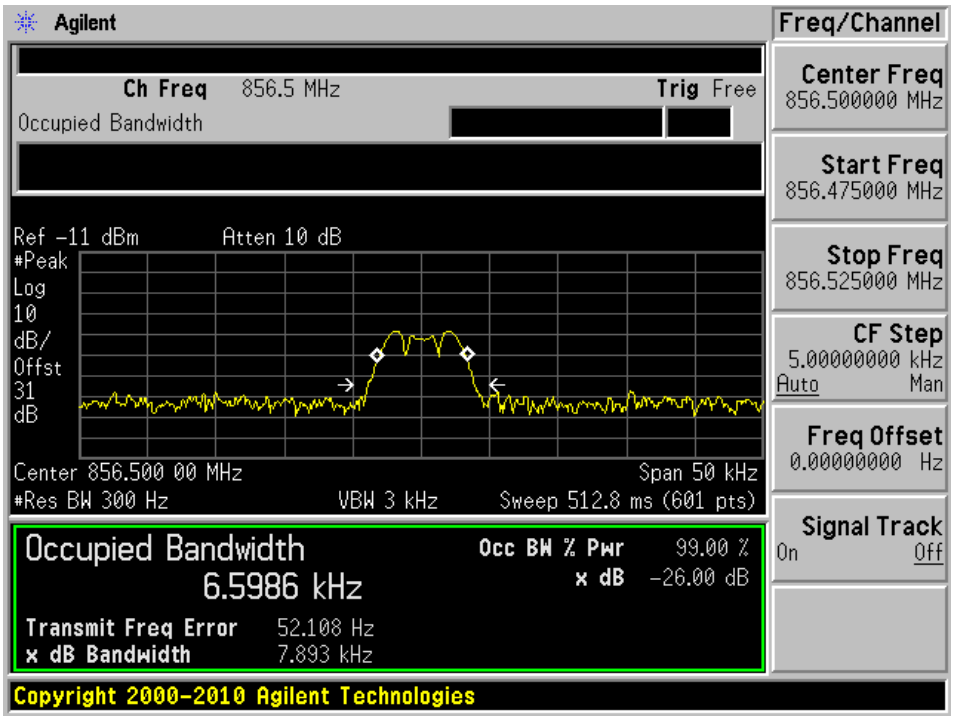
FM Data, Input, Low Channel – 851.0125 MHz



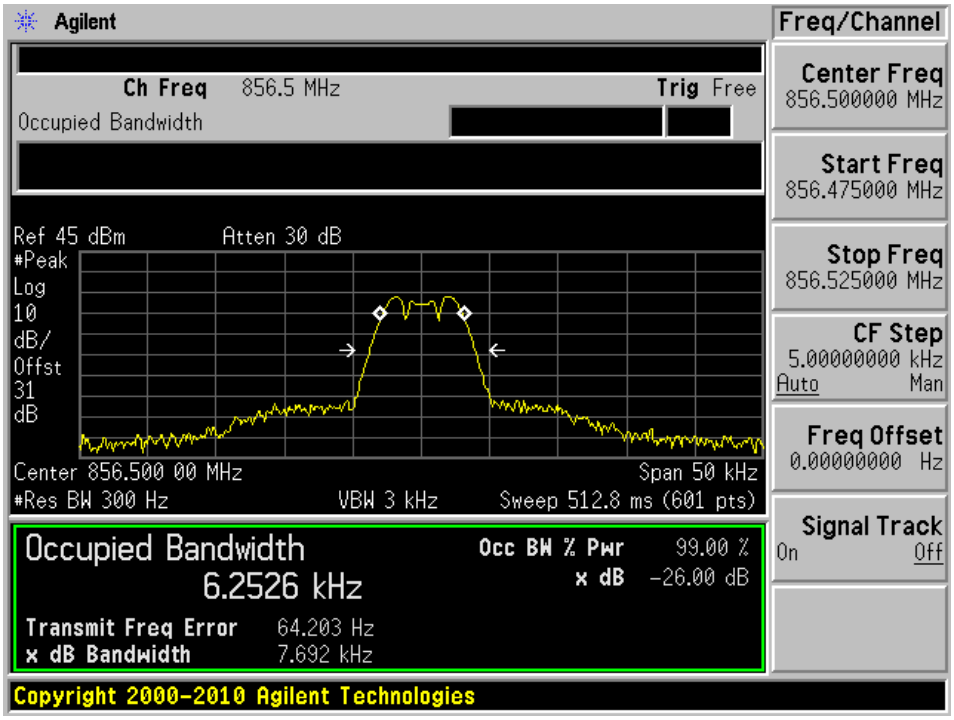
FM Data, Output, Low Channel – 851.0125 MHz



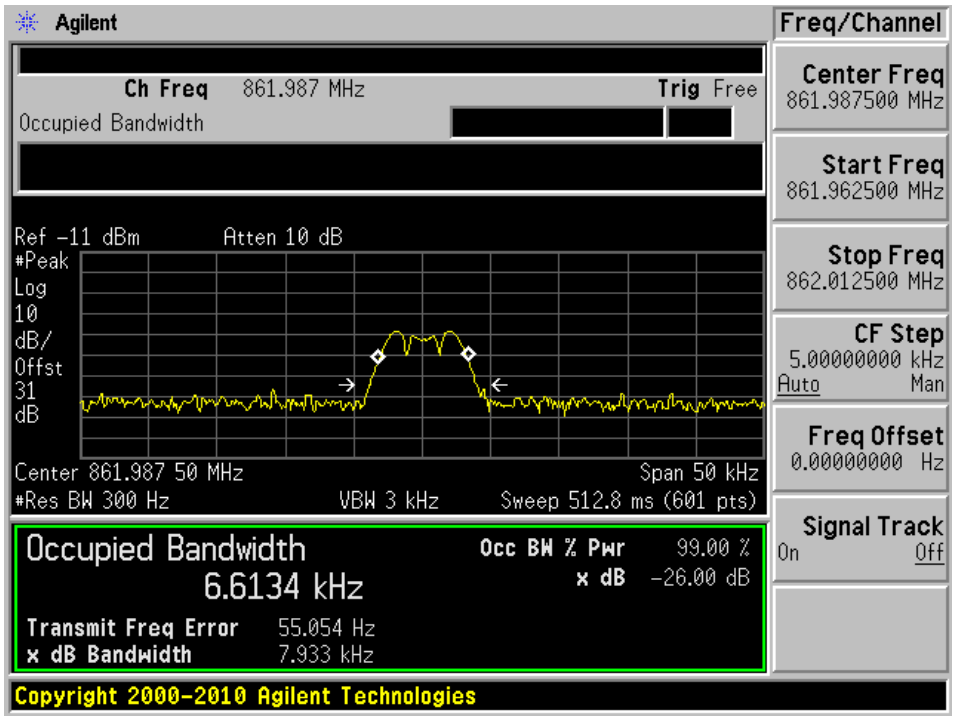
FM Data, Input, Middle Channel – 856.5 MHz



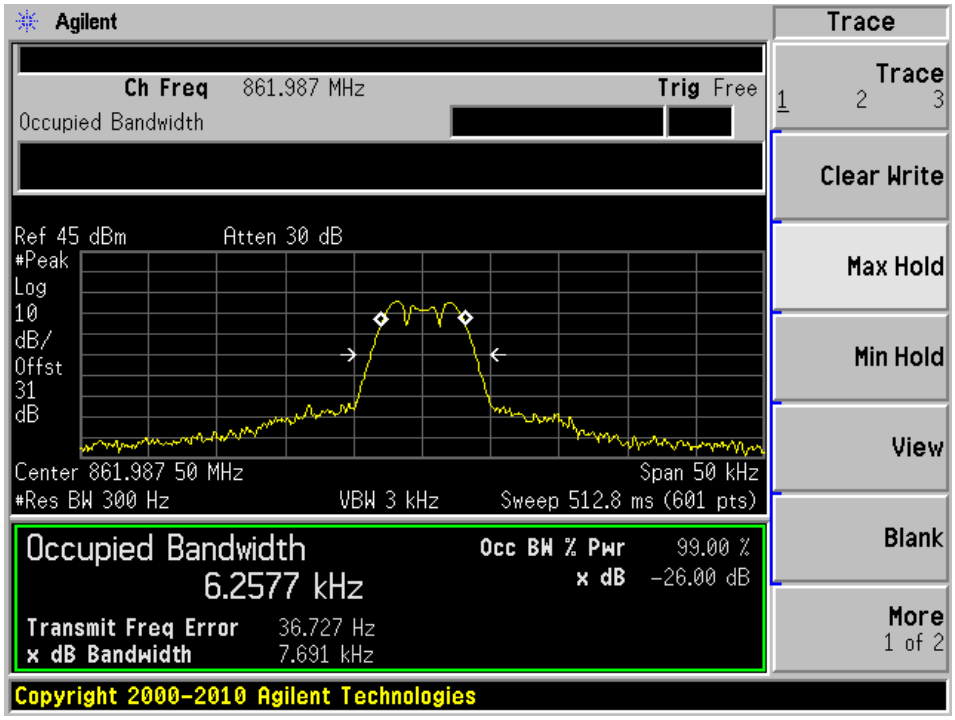
FM Data, Output, Middle Channel – 856.5 MHz



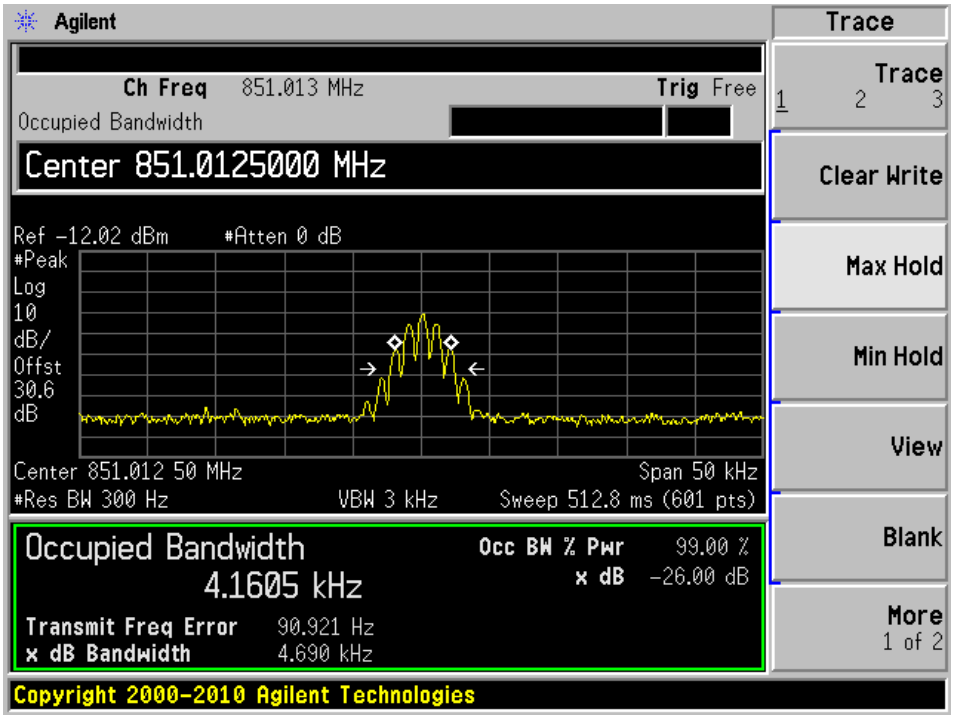
FM Data, Input, High Channel – 861.9875 MHz



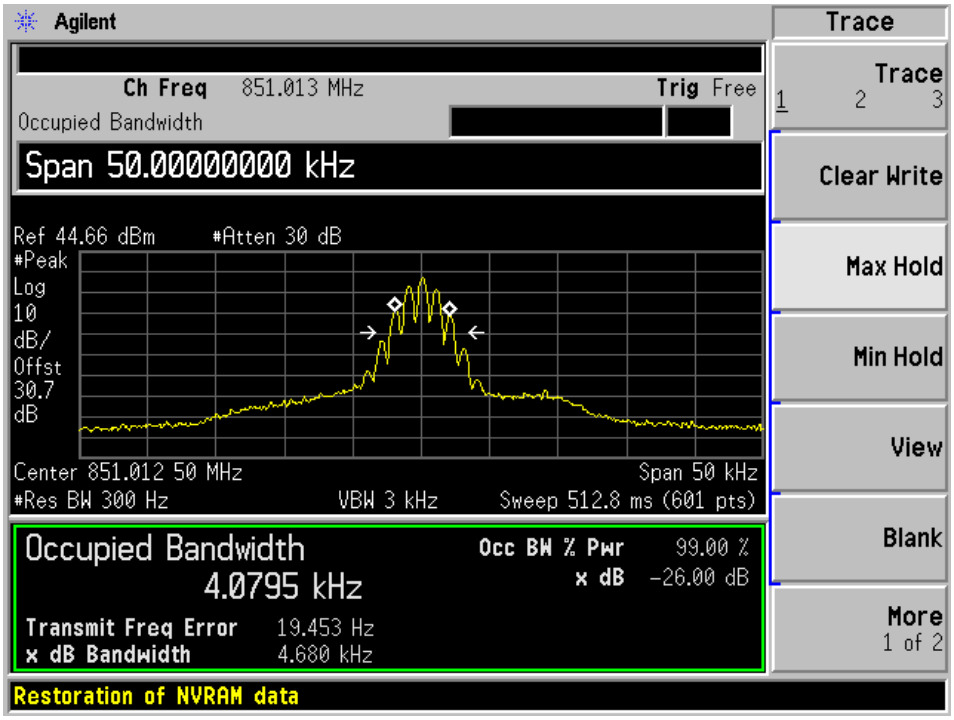
FM Data, Output, High Channel – 861.9875 MHz



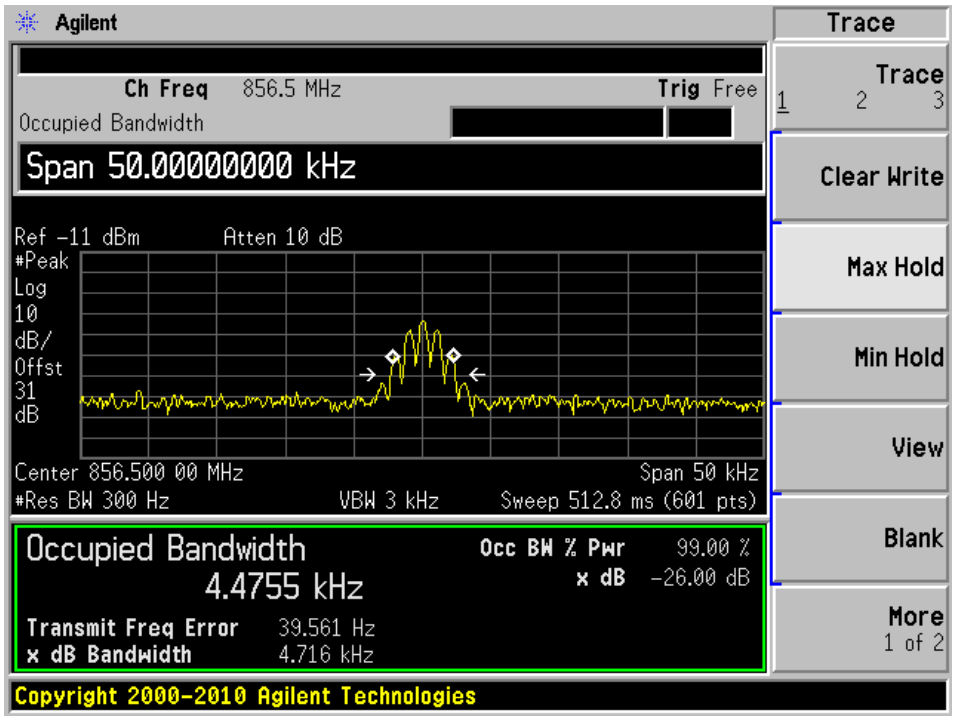
FM Voice, Input, Low Channel – 851.0125 MHz



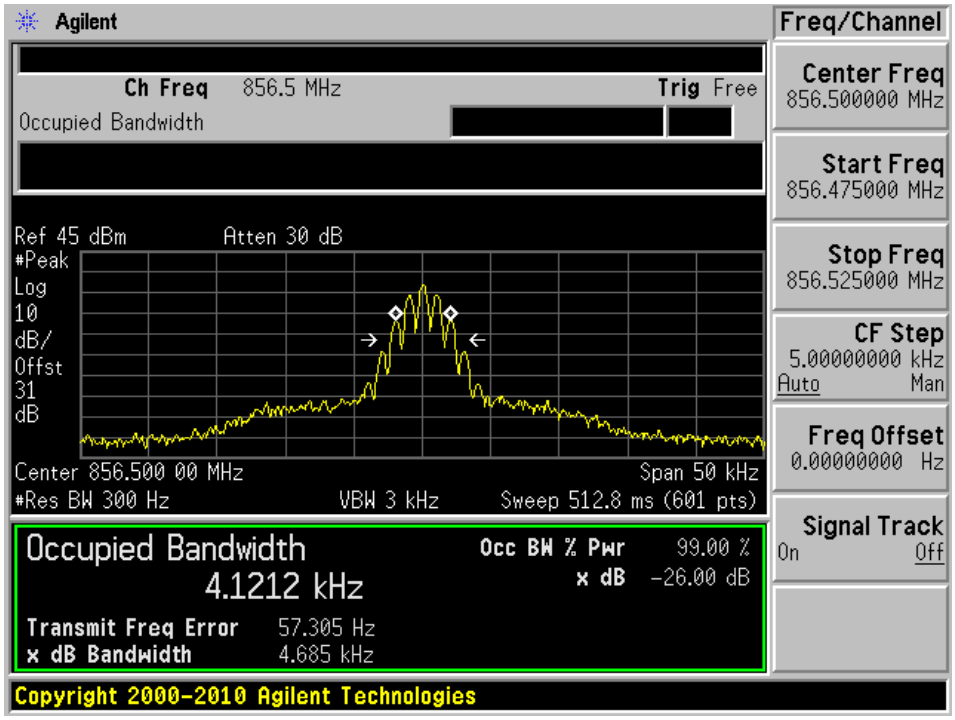
FM Voice, Output, Low Channel – 851.0125 MHz



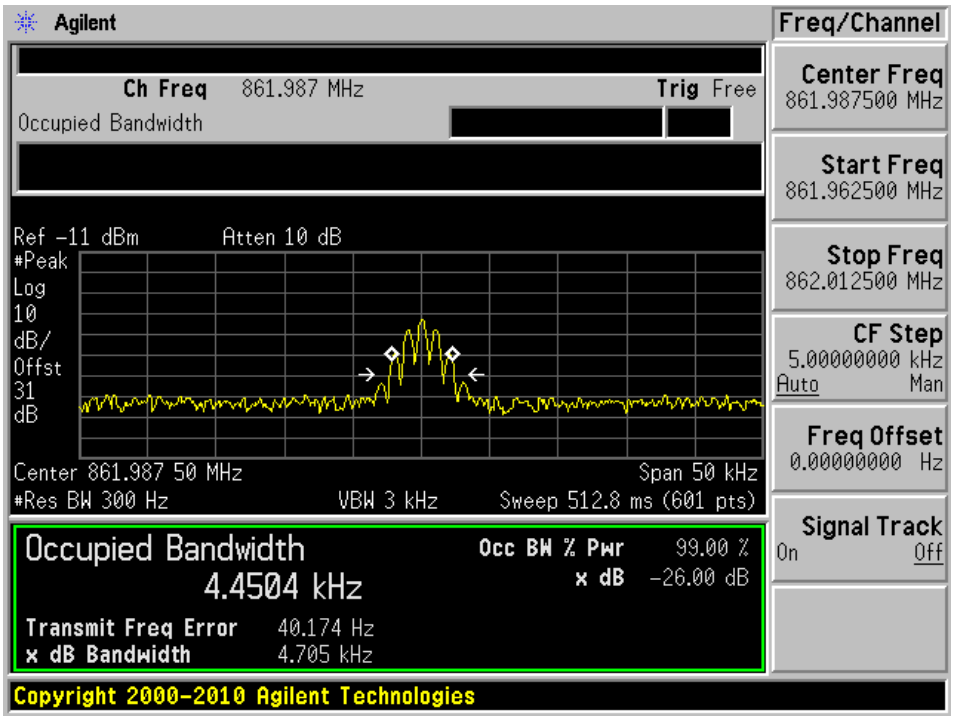
FM Voice, Input, Middle Channel – 856.5 MHz



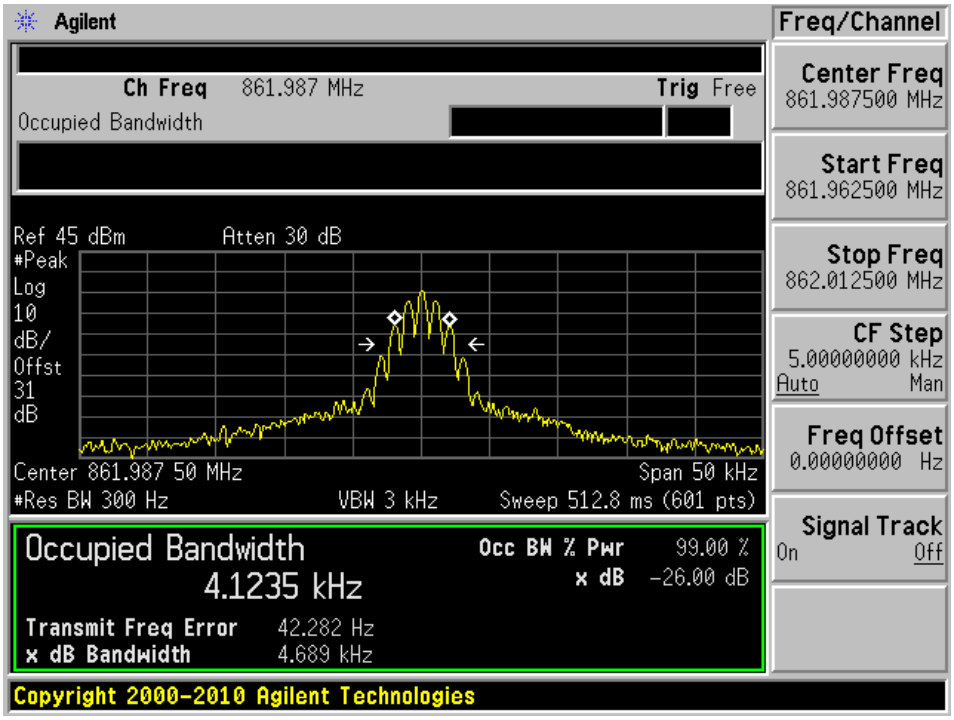
FM Voice, Output, Middle Channel – 856.5 MHz



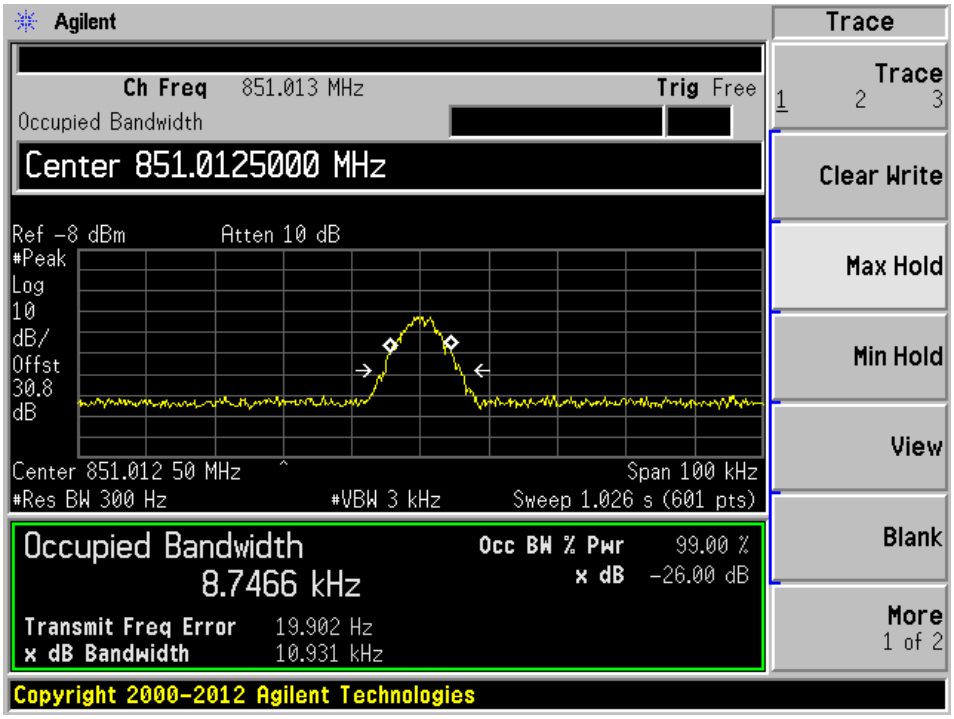
FM Voice, Input, High Channel – 861.9875 MHz



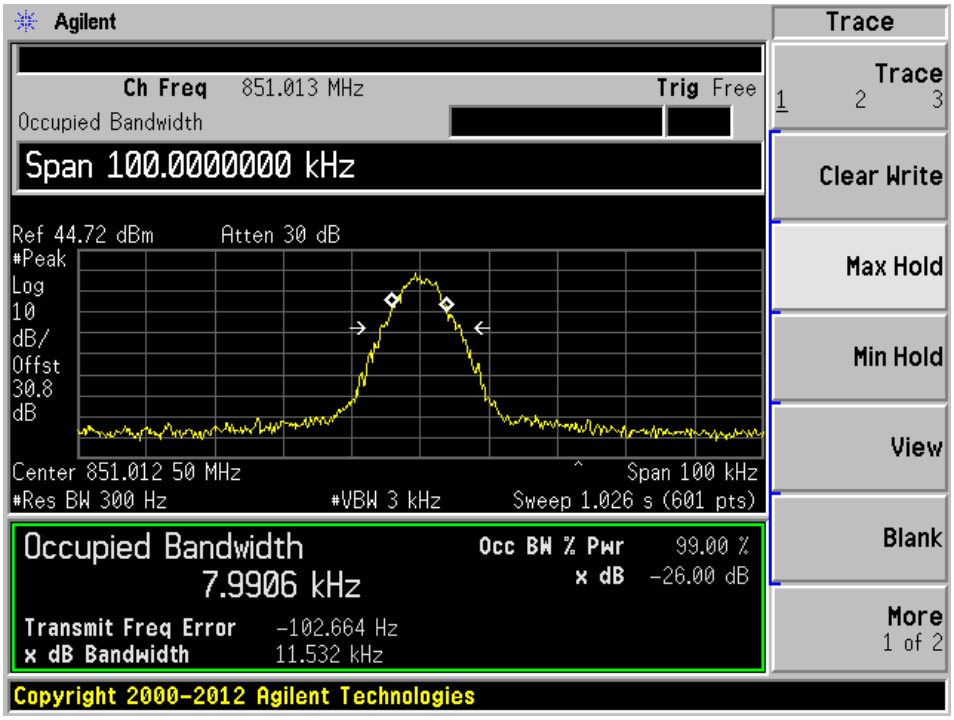
FM Voice, Output, High Channel – 861.9875 MHz



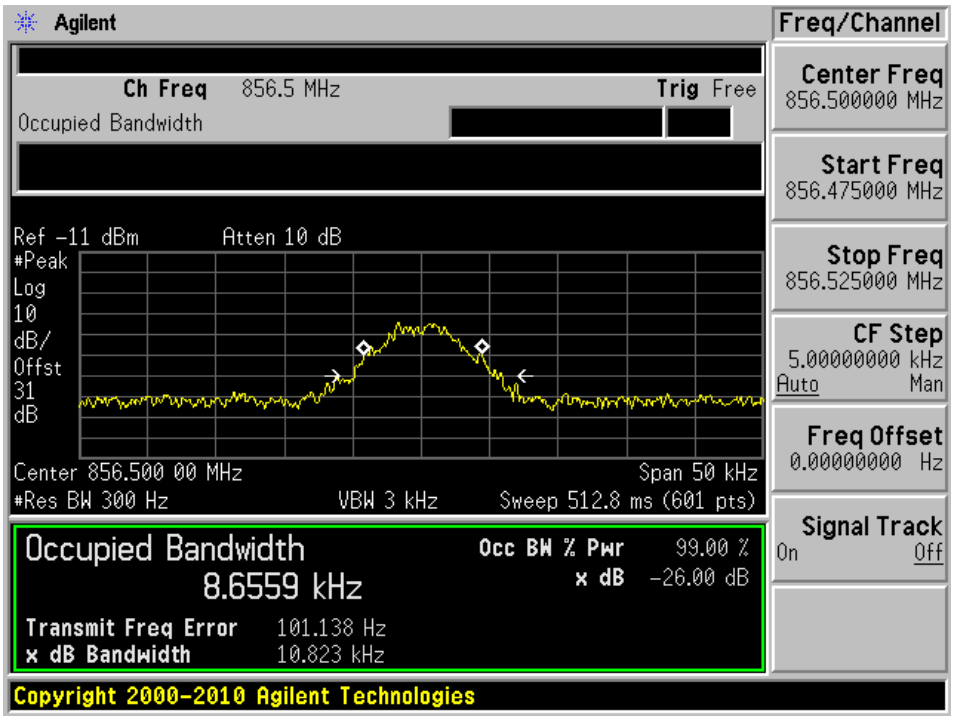
C4FM, Input, Low Channel – 851.0125 MHz



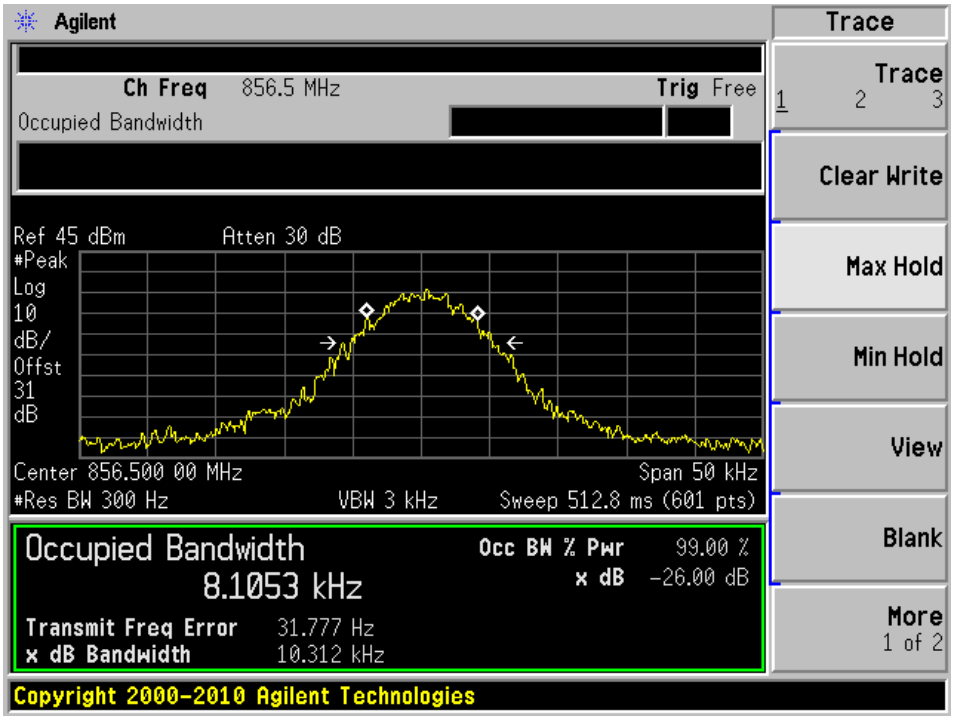
C4FM, Output, Low Channel – 851.0125 MHz



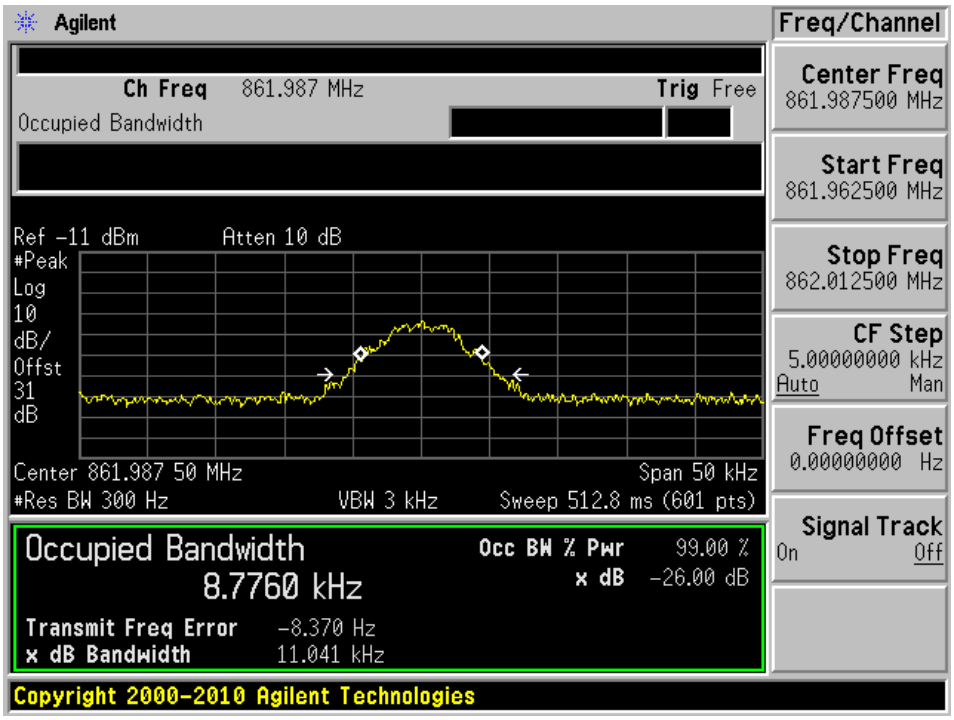
C4FM, Input, Middle Channel – 856.5 MHz



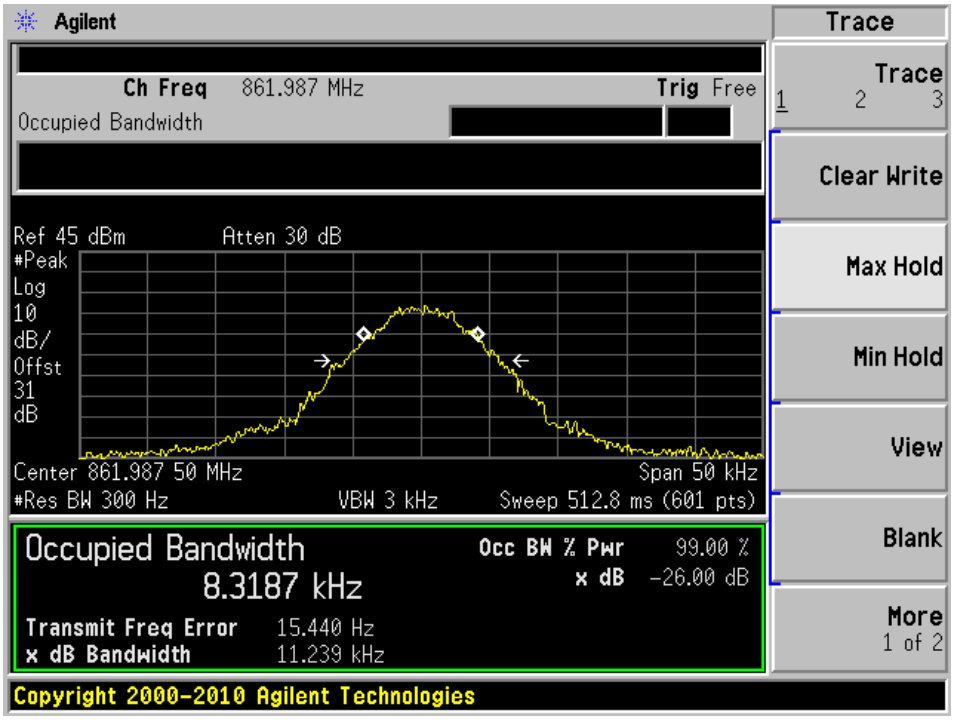
C4FM, Output, Middle Channel – 856.5 MHz



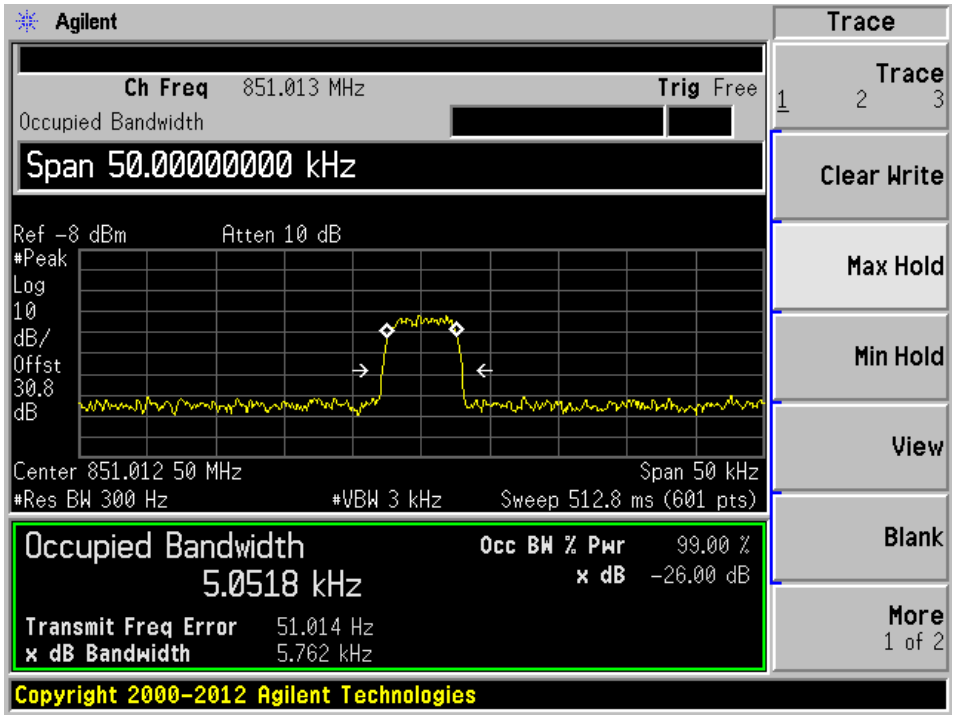
C4FM, Input, High Channel – 861.9875 MHz



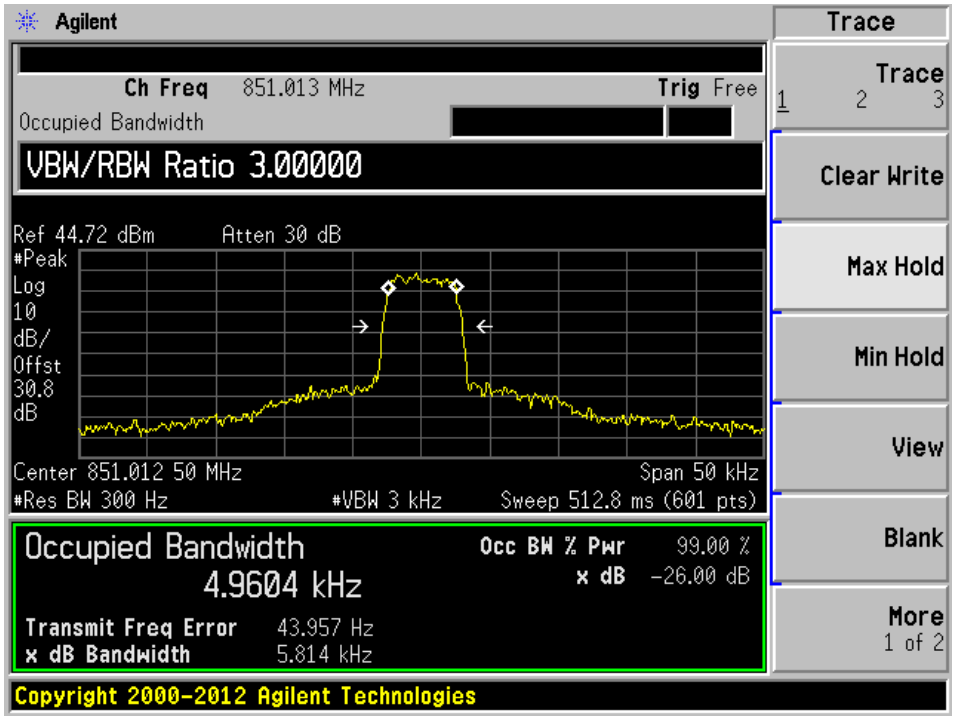
C4FM, Output, High Channel – 861.9875 MHz



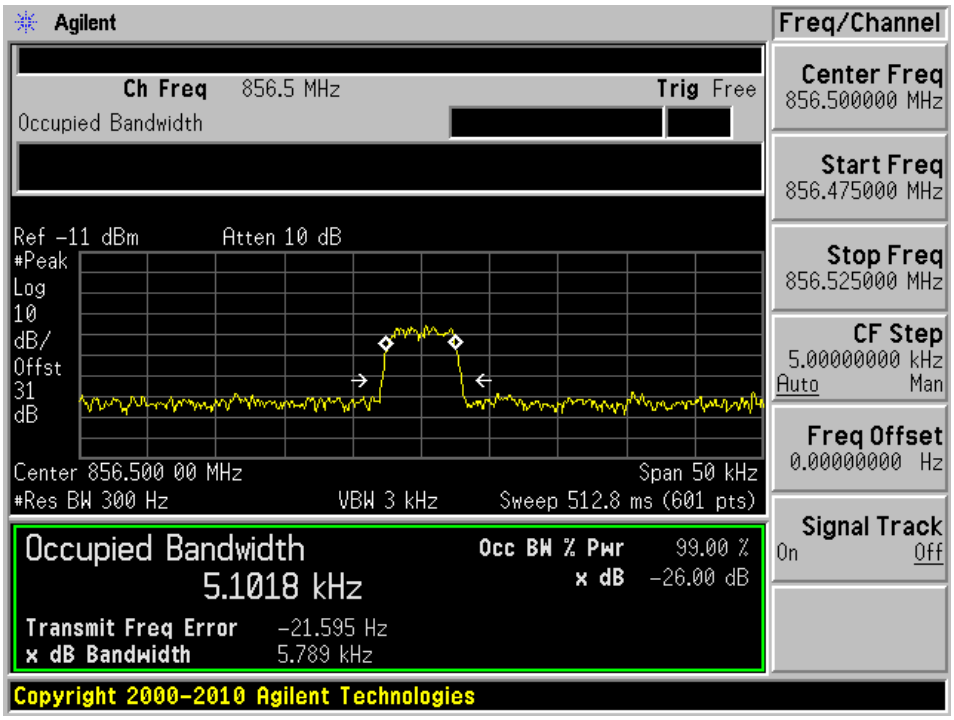
CQPSK, Input, Low Channel – 851.0125 MHz



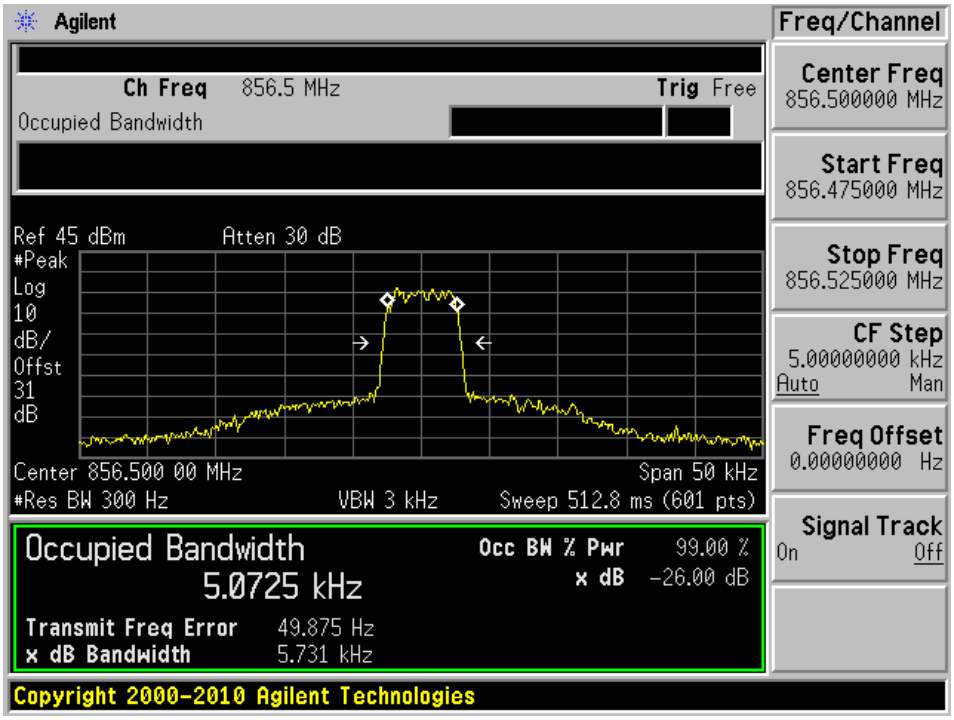
CQPSK, Output, Low Channel – 851.0125 MHz



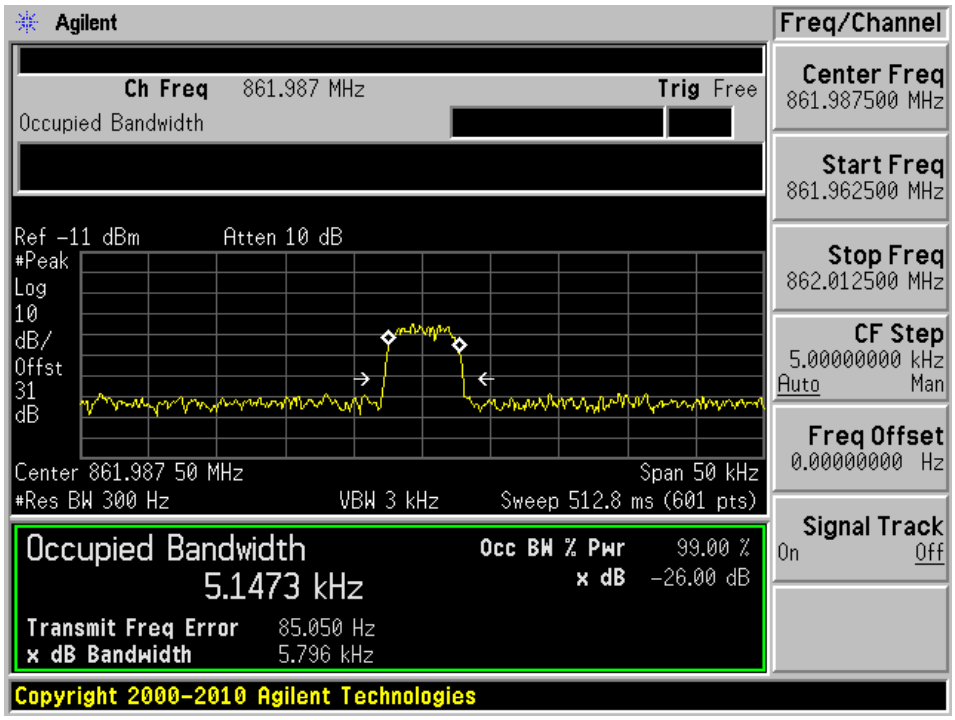
CQPSK, Input, Middle Channel – 856.5 MHz



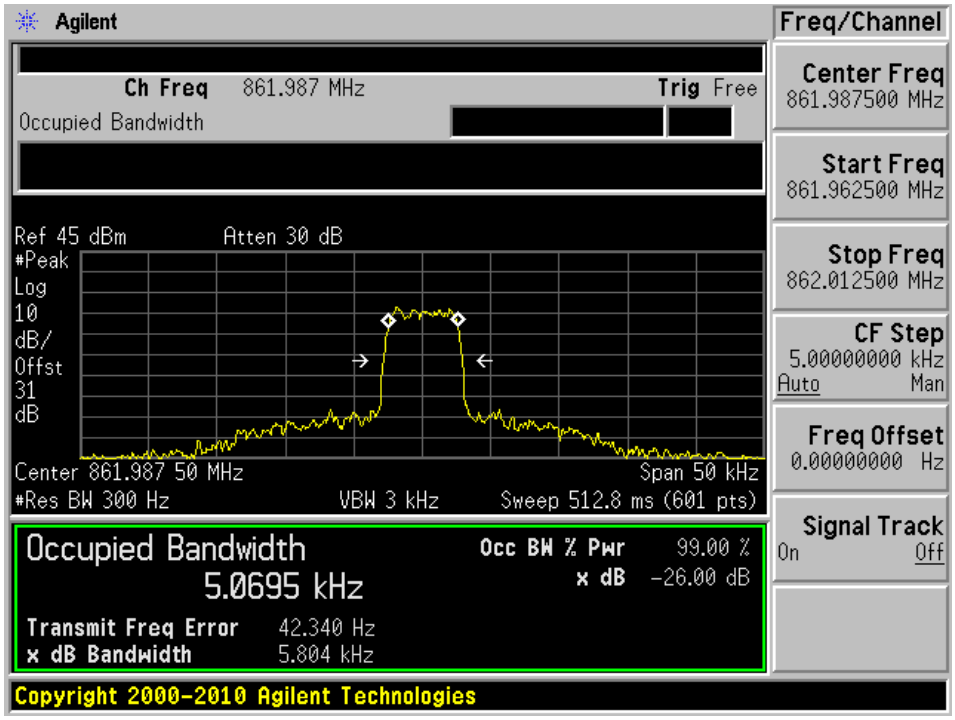
CQPSK, Output, Middle Channel – 856.5 MHz



CQPSK, Input, High Channel – 861.9875 MHz

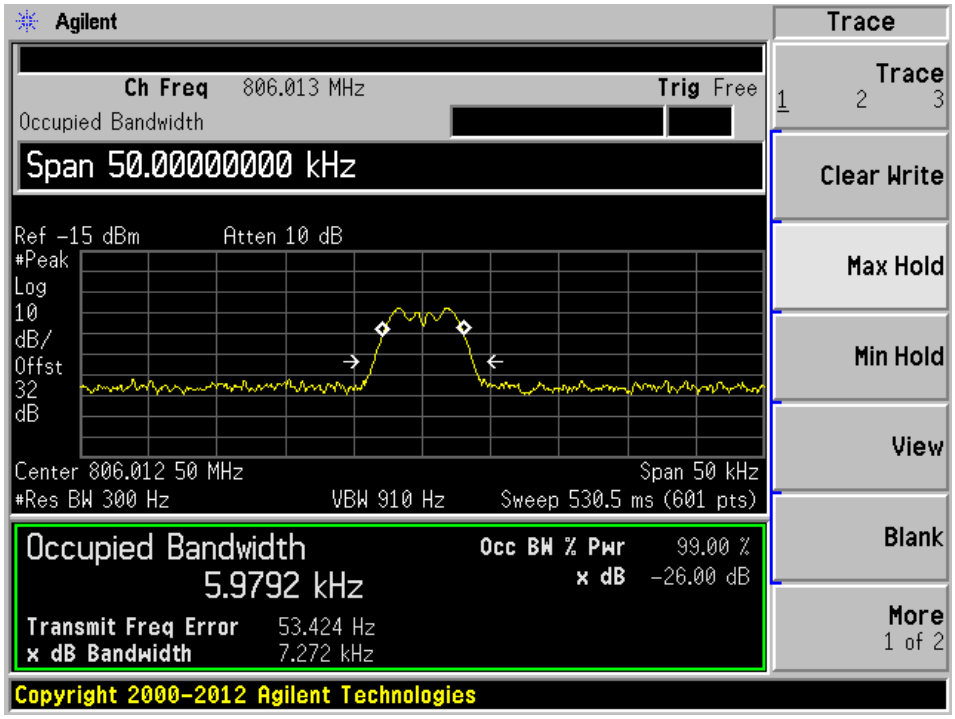


CQPSK, Output, High Channel – 861.9875 MHz

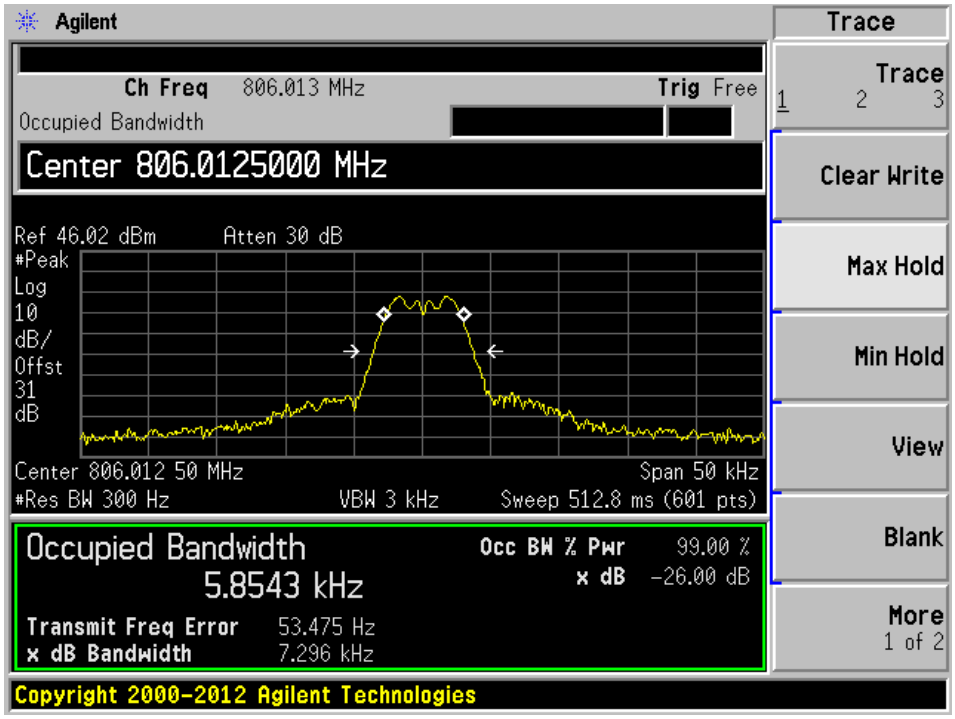


Uplink: 806-817 MHz

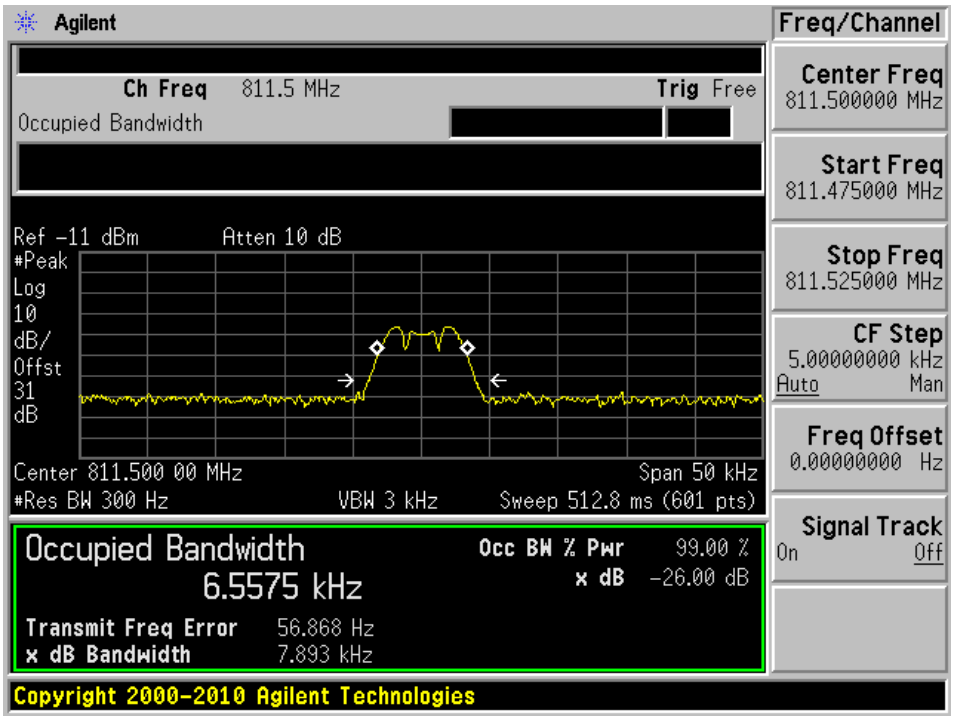
FM Data, Input, Low Channel – 806.0125 MHz



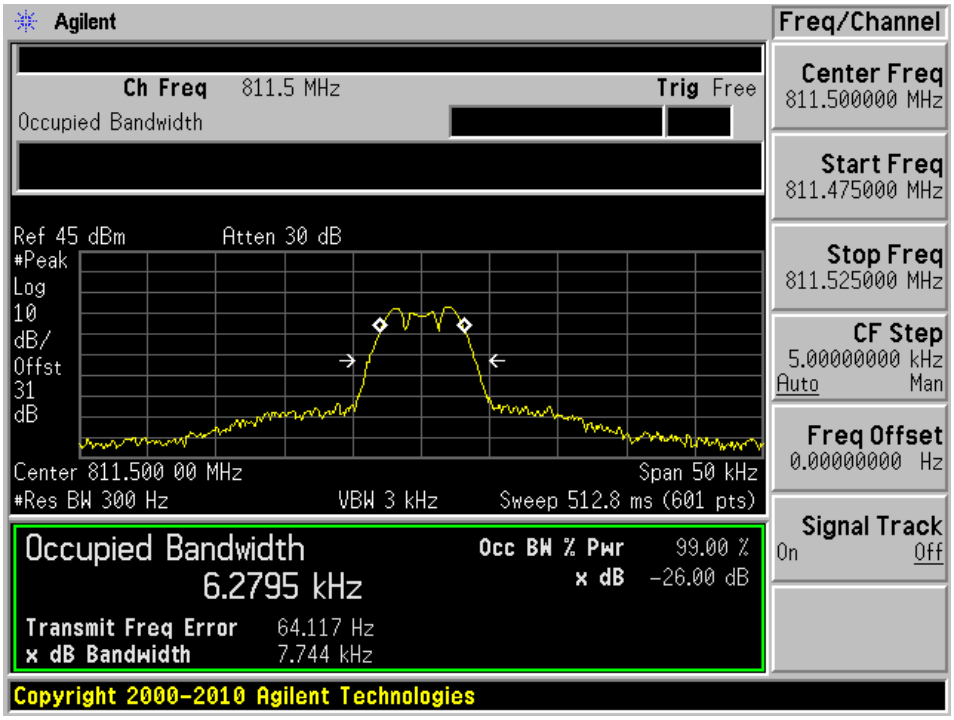
FM Data, Output, Low Channel – 806.0125 MHz



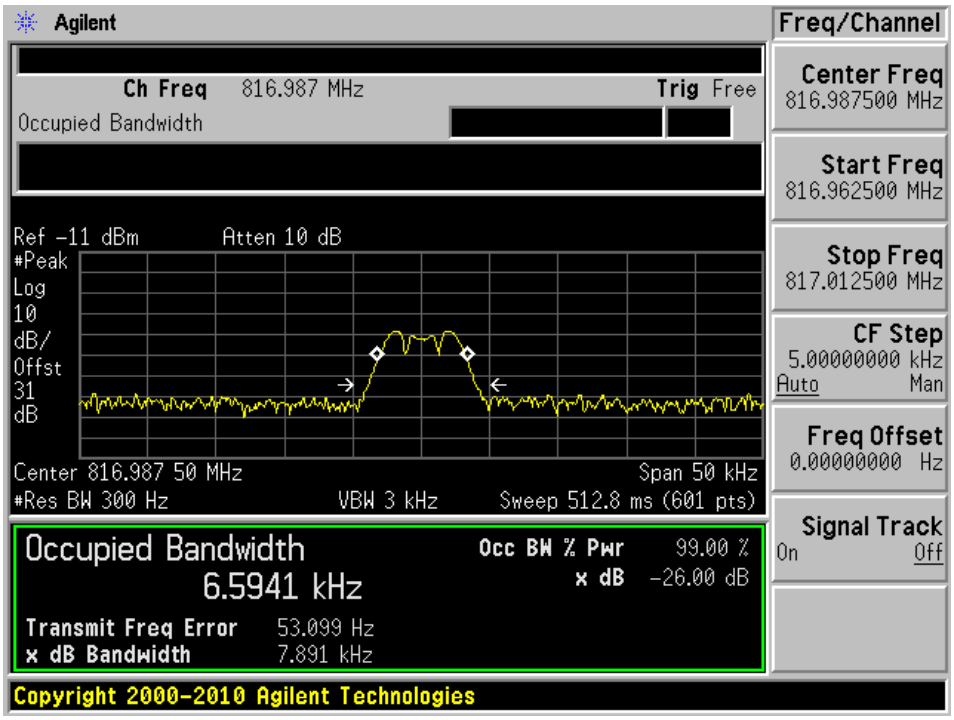
FM Data, Input, Middle Channel – 811.5 MHz



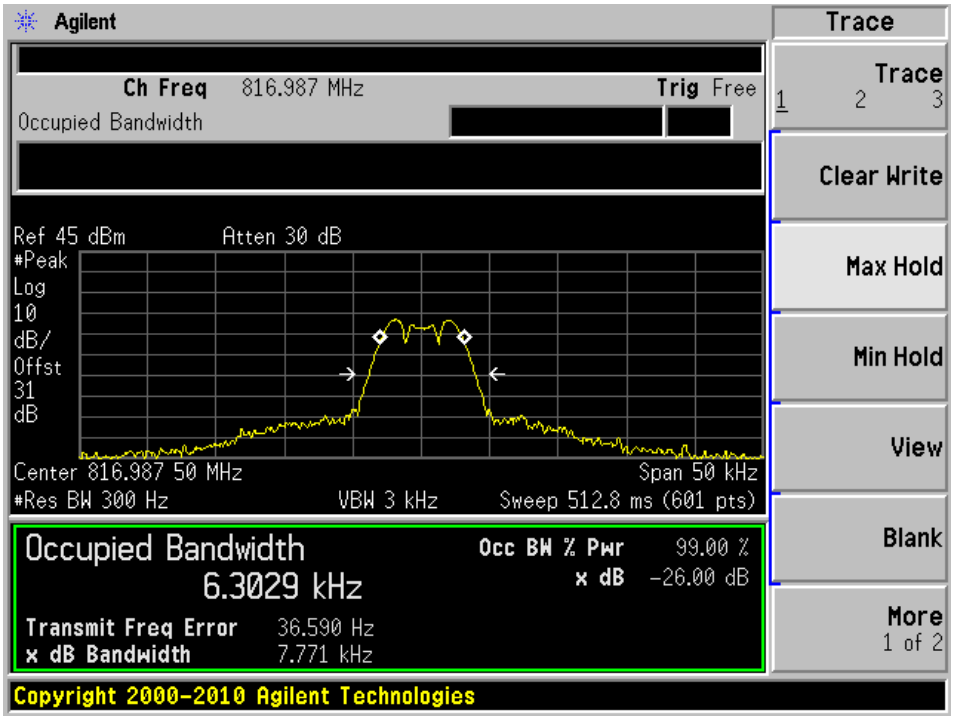
FM Data, Output, Middle Channel – 811.5 MHz



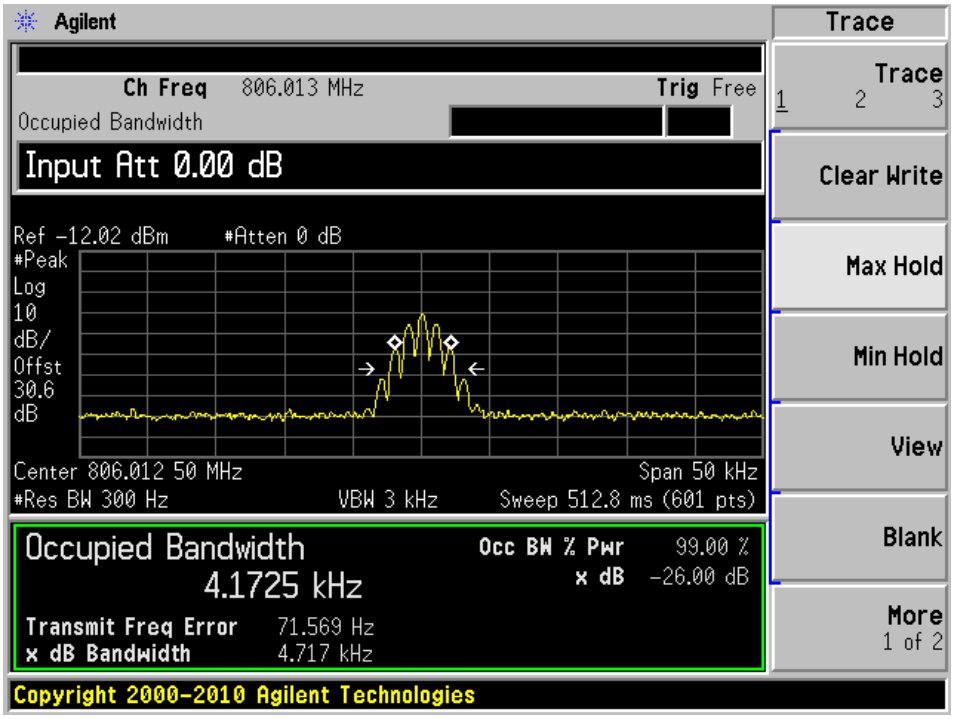
FM Data, Input, High Channel – 816.9875 MHz



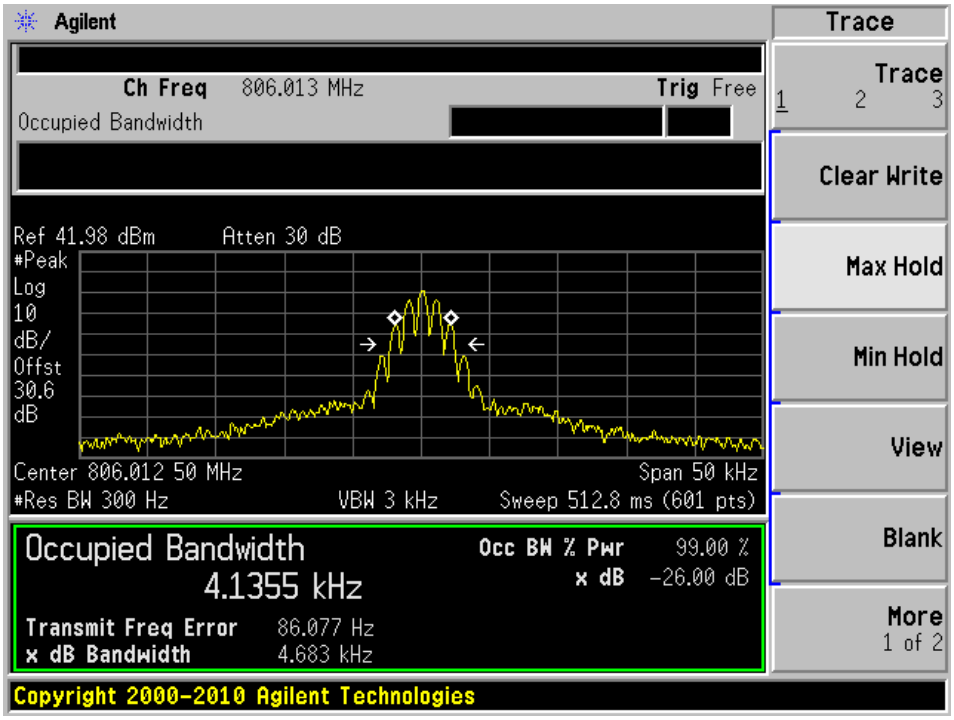
FM Data, Output, High Channel – 816.9875 MHz



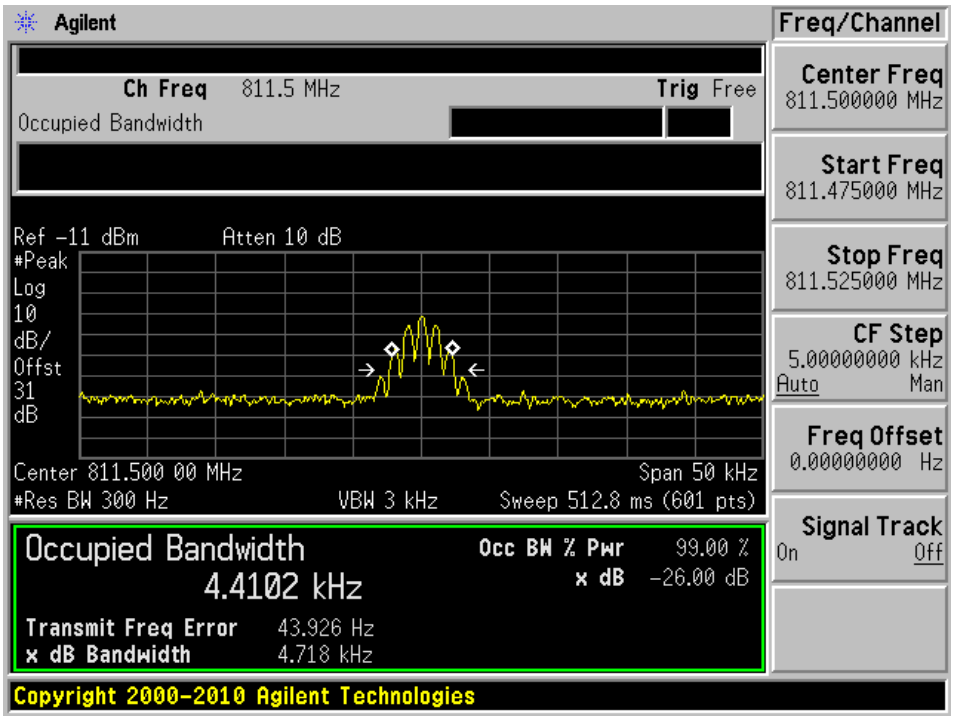
FM Voice, Input, Low Channel – 806.0125 MHz



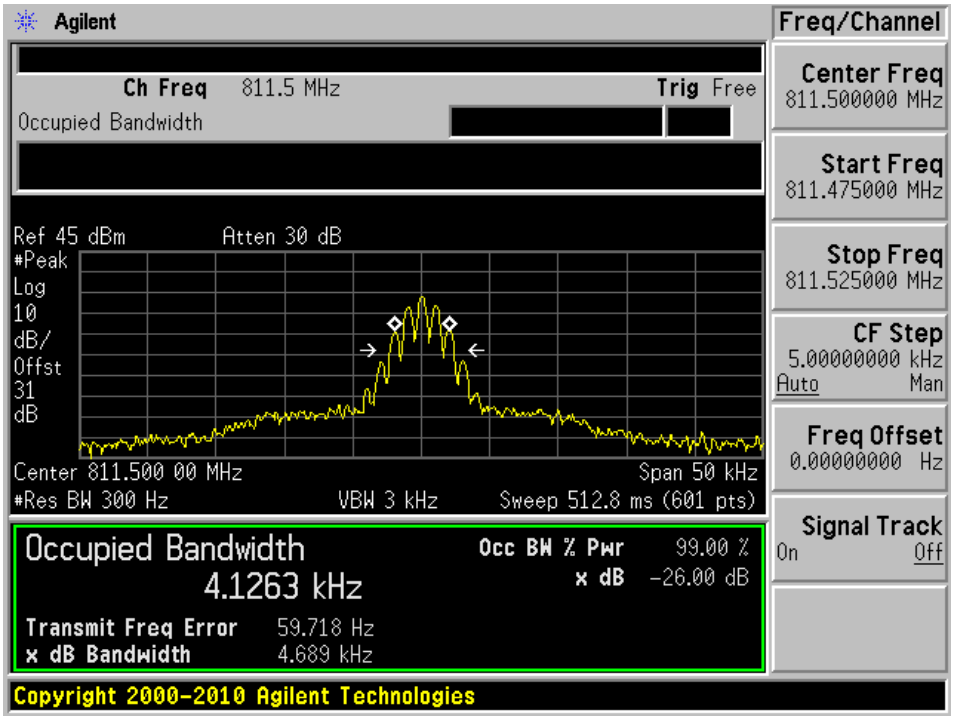
FM Voice, Output, Low Channel – 806.0125 MHz



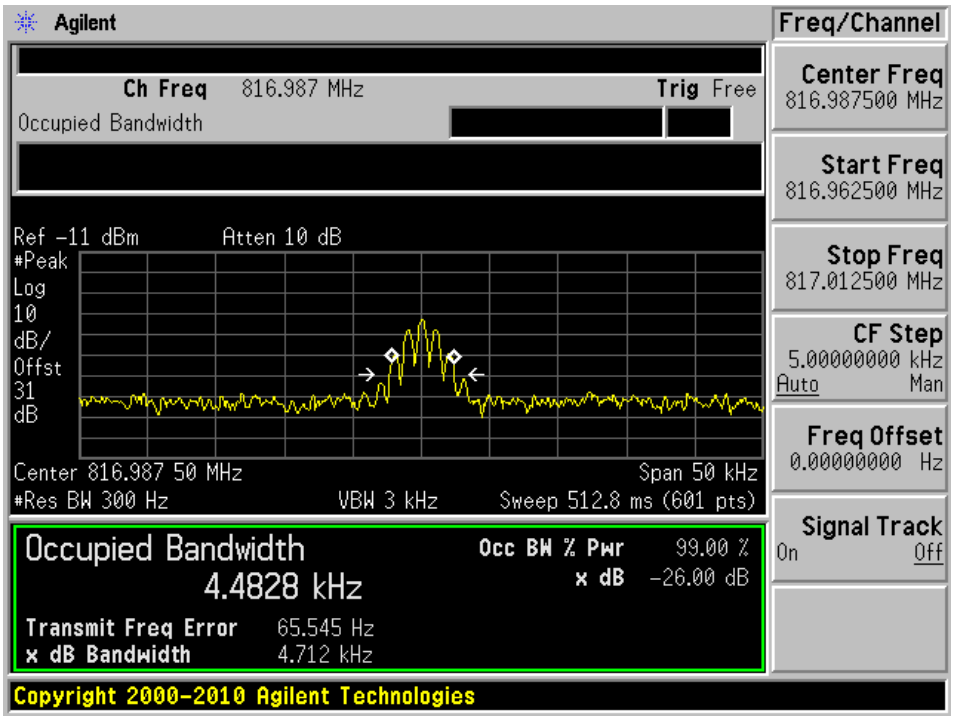
FM Voice, Input, Middle Channel – 811.5 MHz



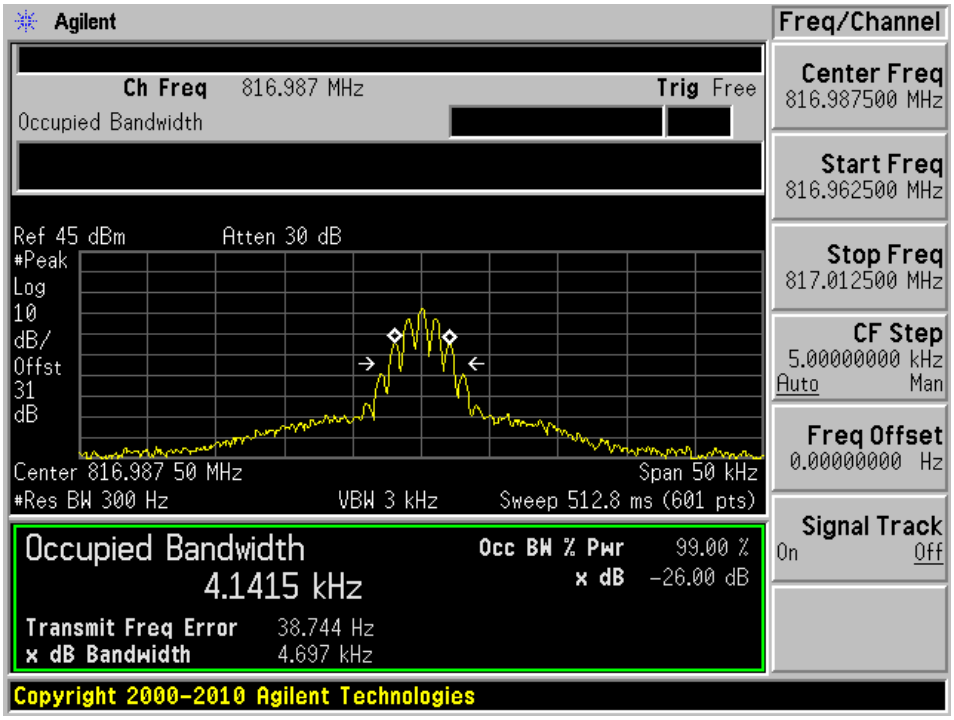
FM Voice, Output, Middle Channel – 811.5 MHz



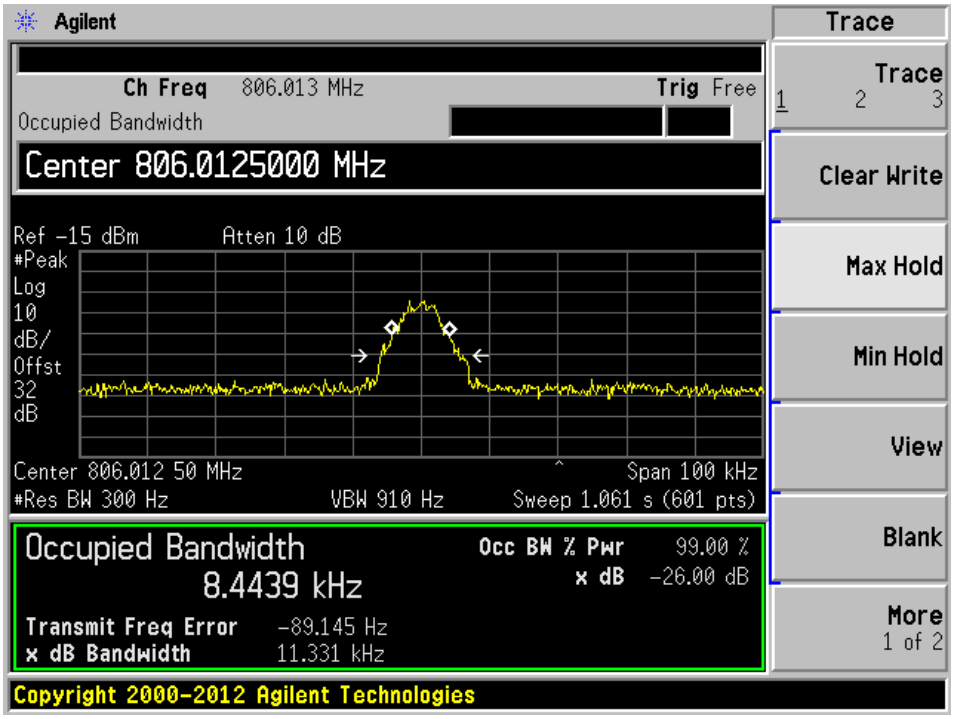
FM Voice, Input, High Channel – 816.9875 MHz



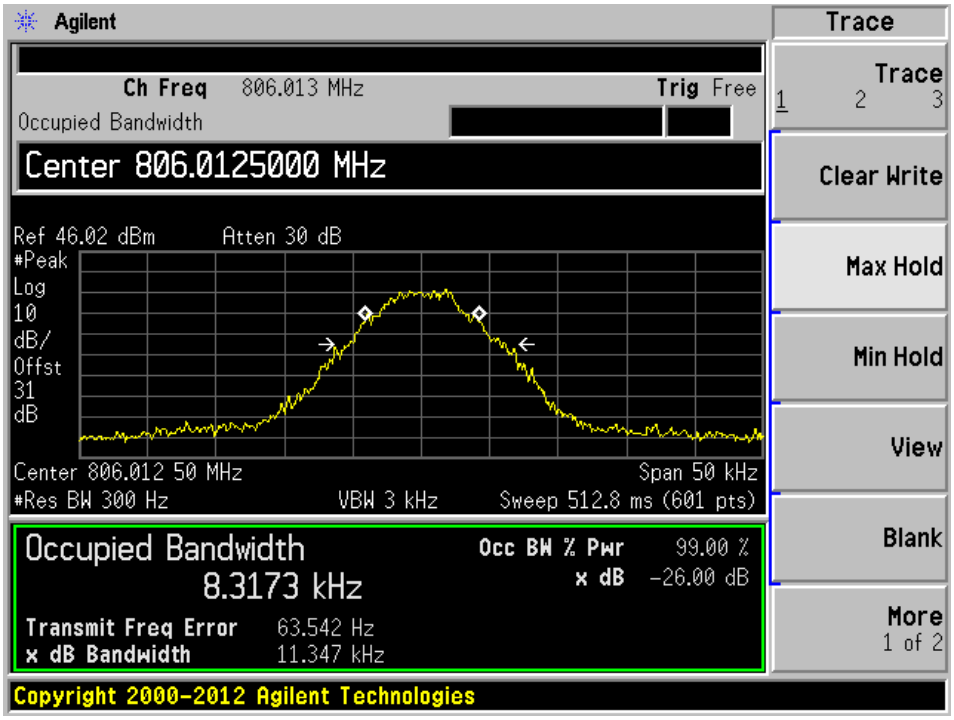
FM Voice, Output, High Channel – 816.9875 MHz



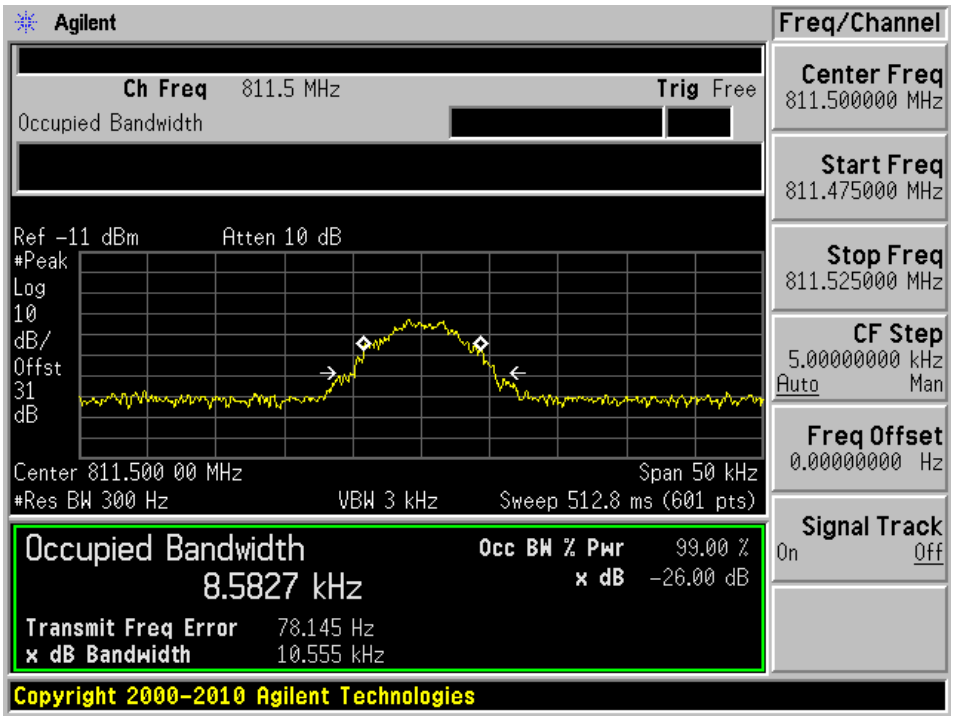
C4FM, Input, Low Channel – 806.0125 MHz



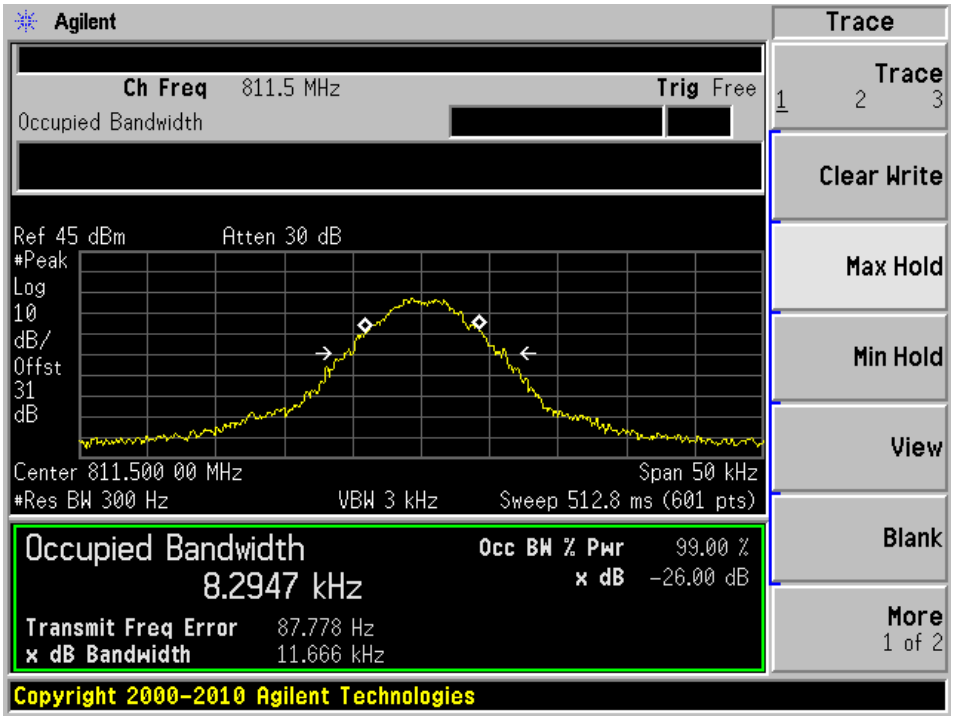
C4FM, Output, Low Channel – 806.0125 MHz



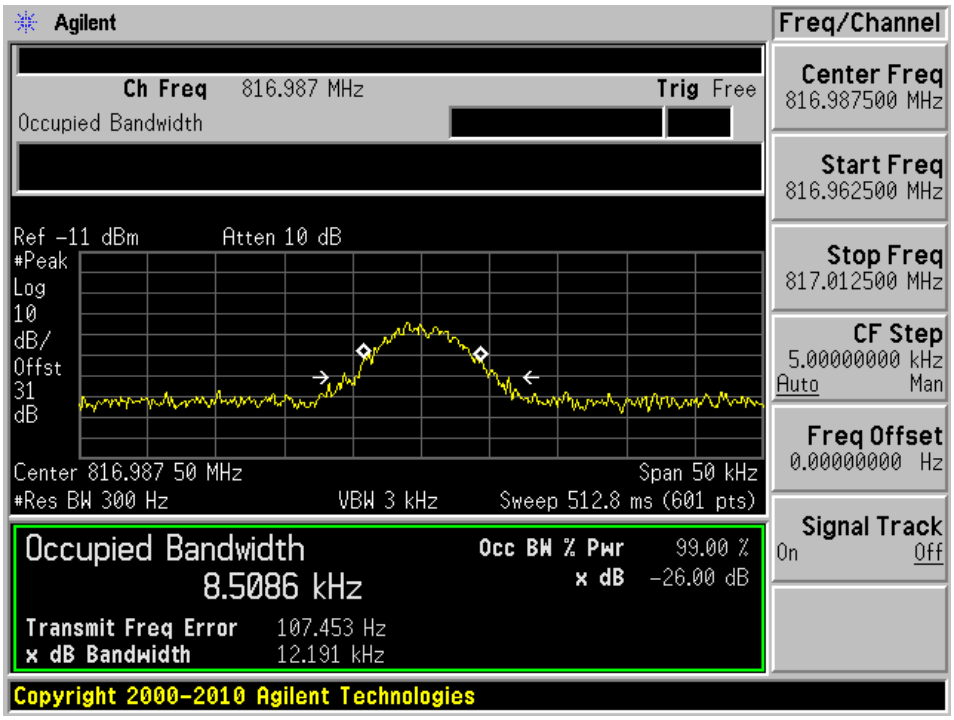
C4FM, Input, Middle Channel – 811.5 MHz



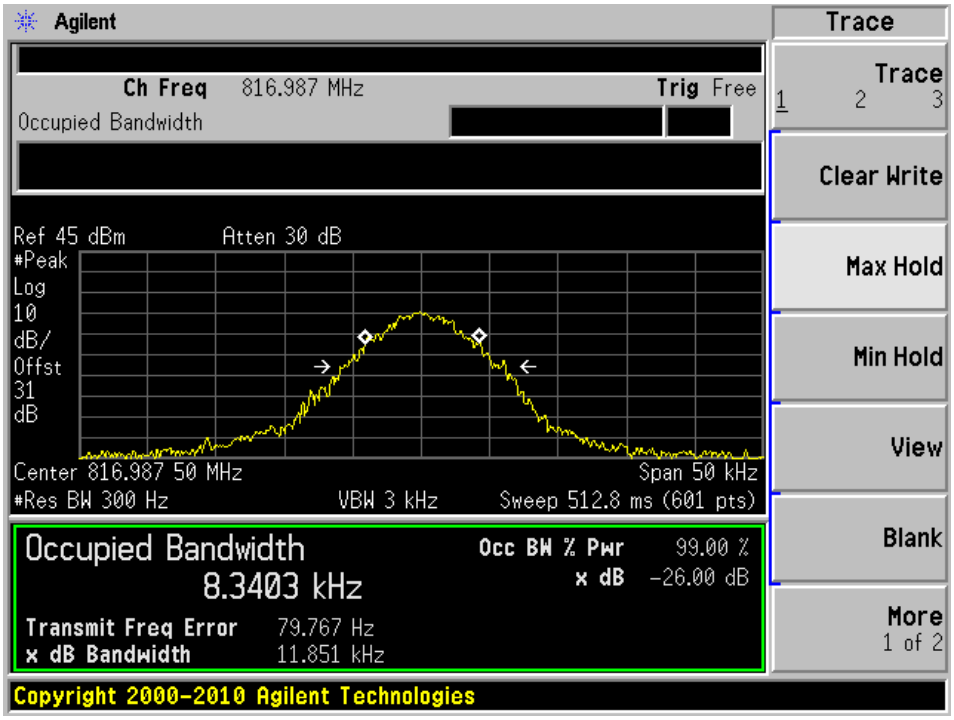
C4FM, Output, Middle Channel – 811.5 MHz



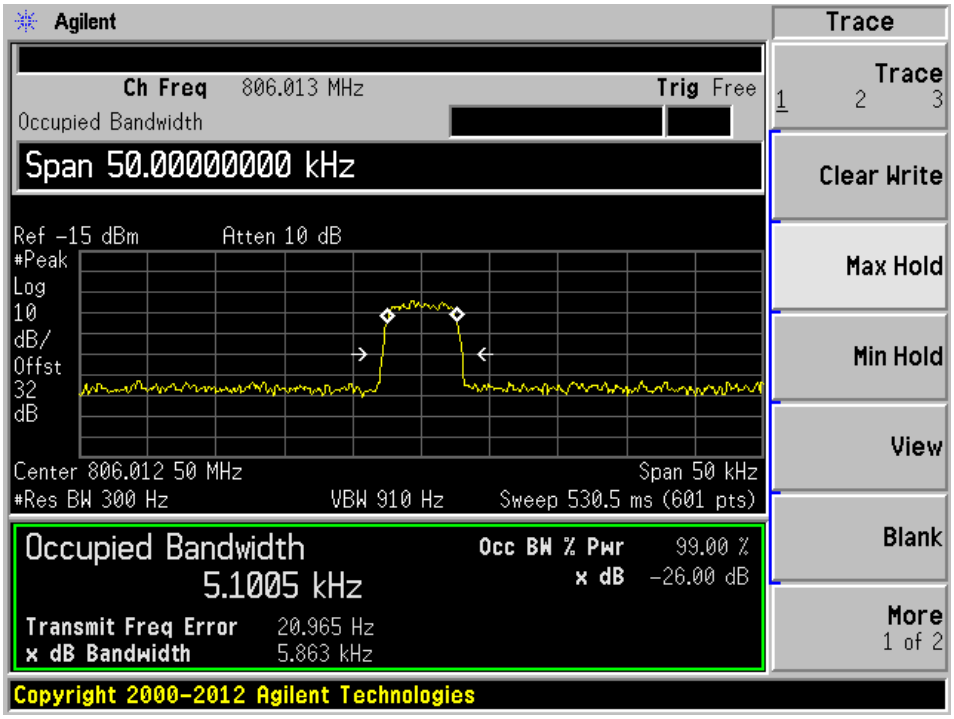
C4FM, Input, High Channel – 816.9875 MHz



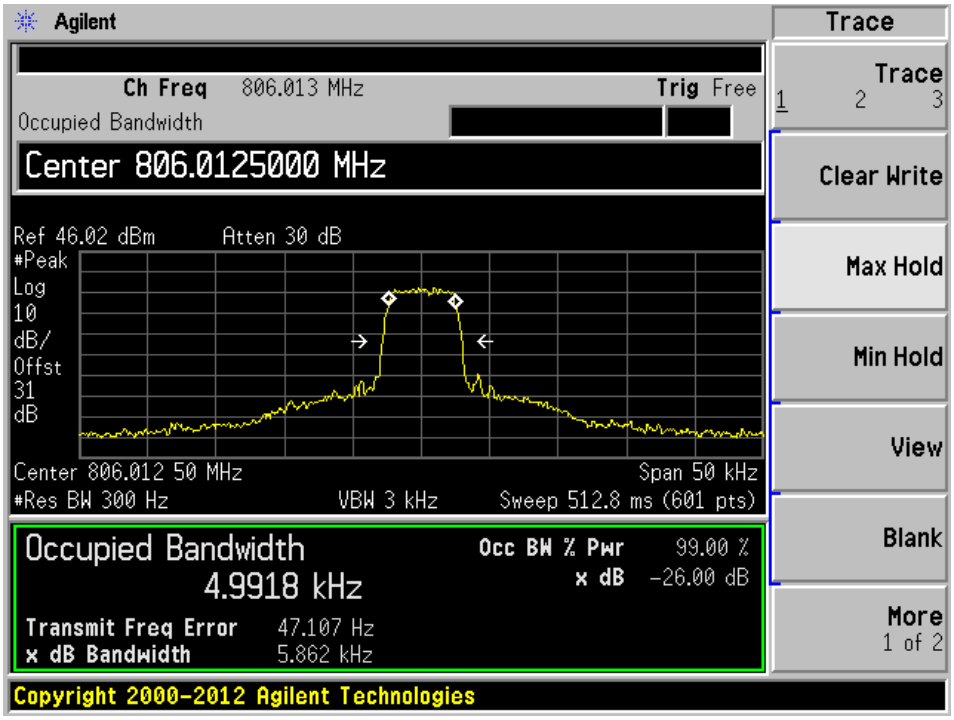
C4FM, Output, High Channel – 816.9875 MHz



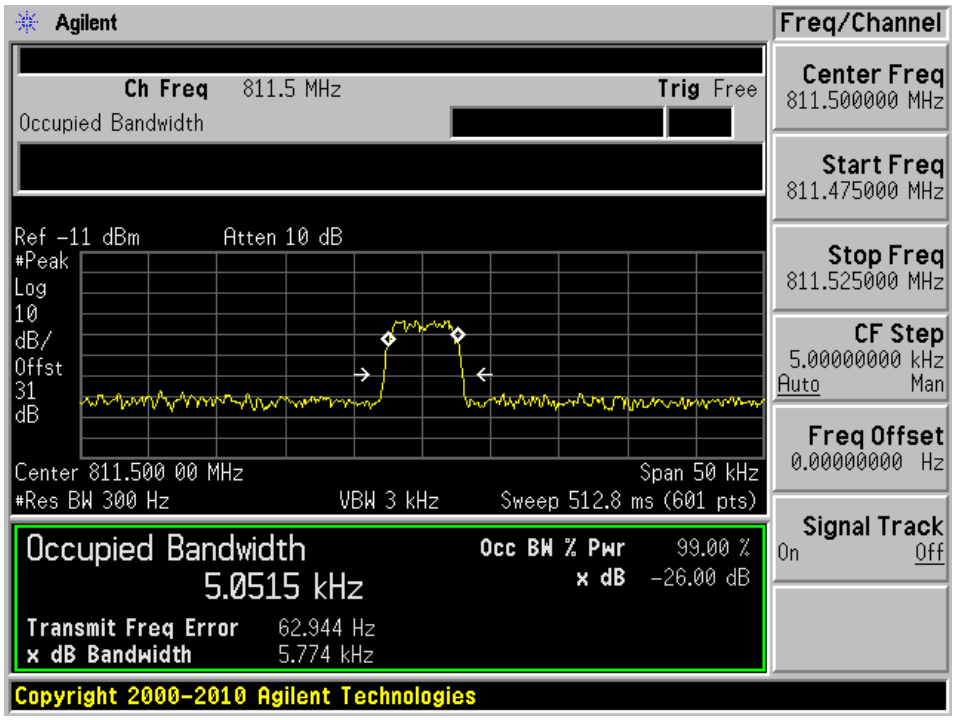
CQPSK, Input, Low Channel – 806.0125 MHz



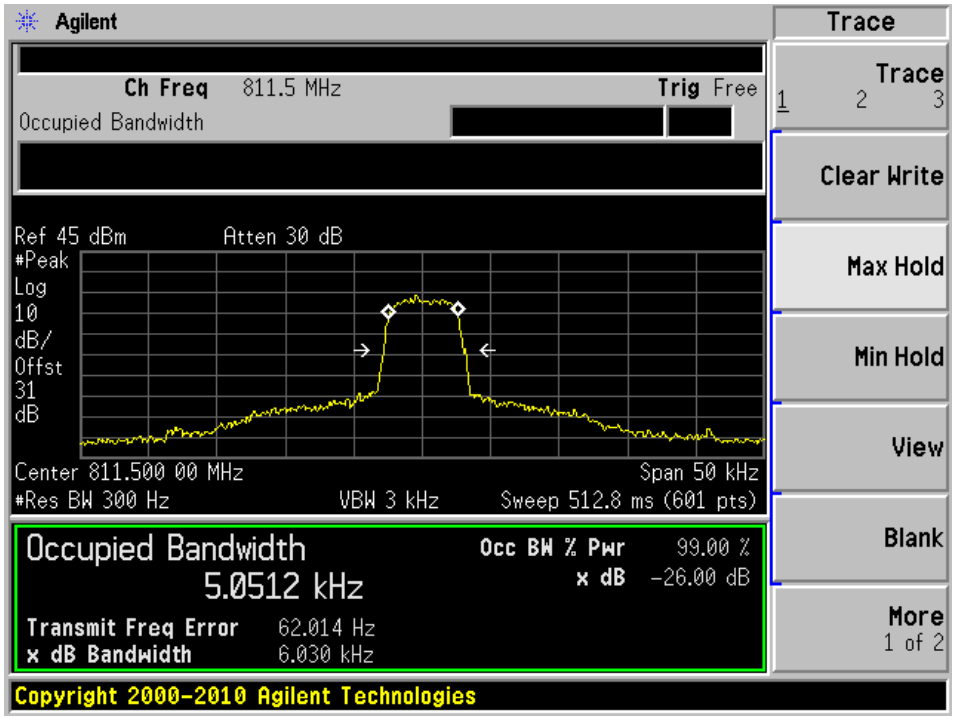
CQPSK, Output, Low Channel – 806.0125 MHz



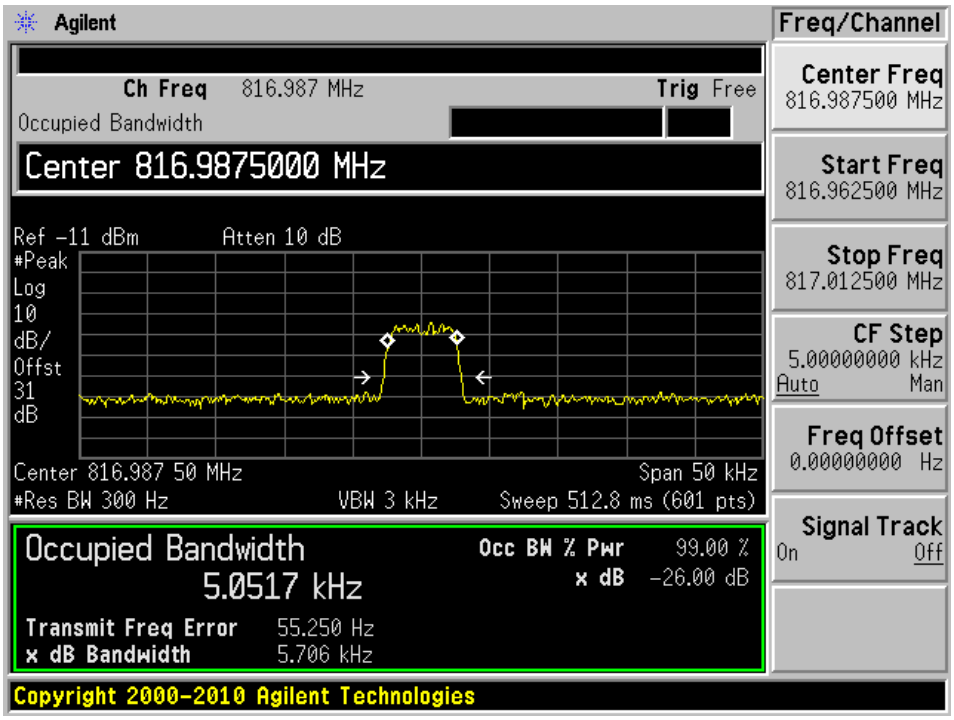
CQPSK, Input, Middle Channel – 811.5 MHz



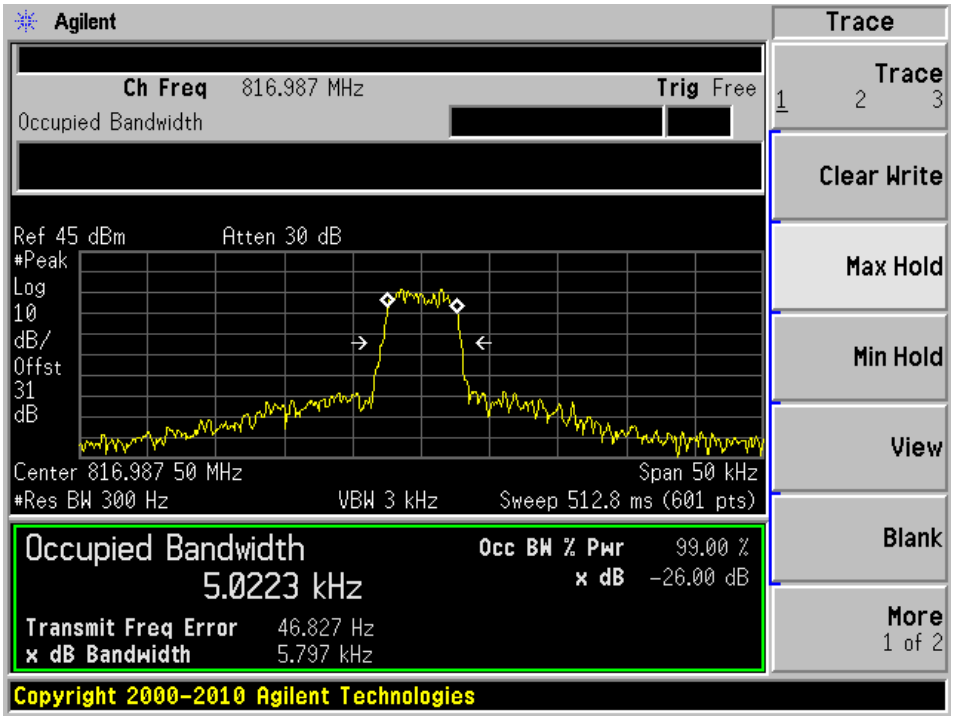
CQPSK, Output, Middle Channel – 811.5 MHz



CQPSK, Input, High Channel – 816.9875 MHz



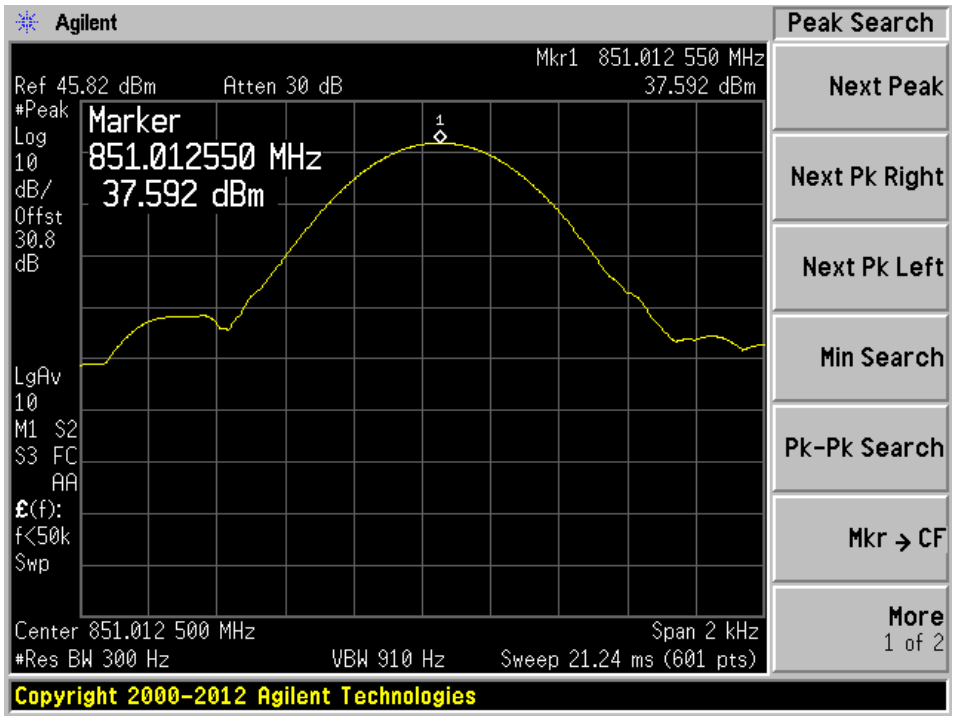
CQPSK, Output, High Channel – 816.9875 MHz



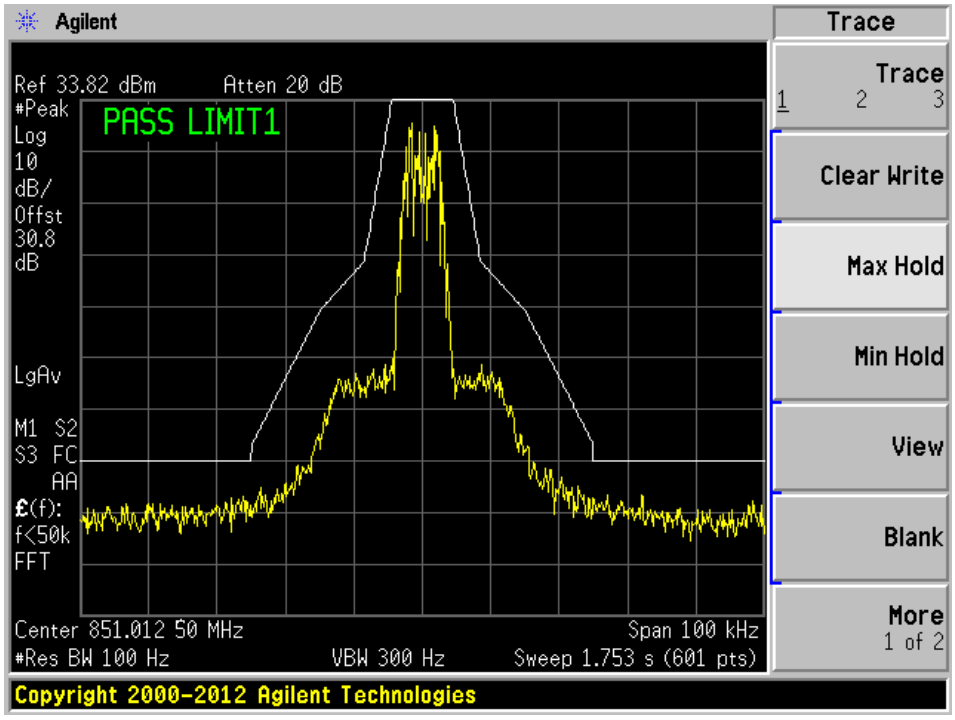
Emission Mask (ALC on)

Downlink: 851-862 MHz

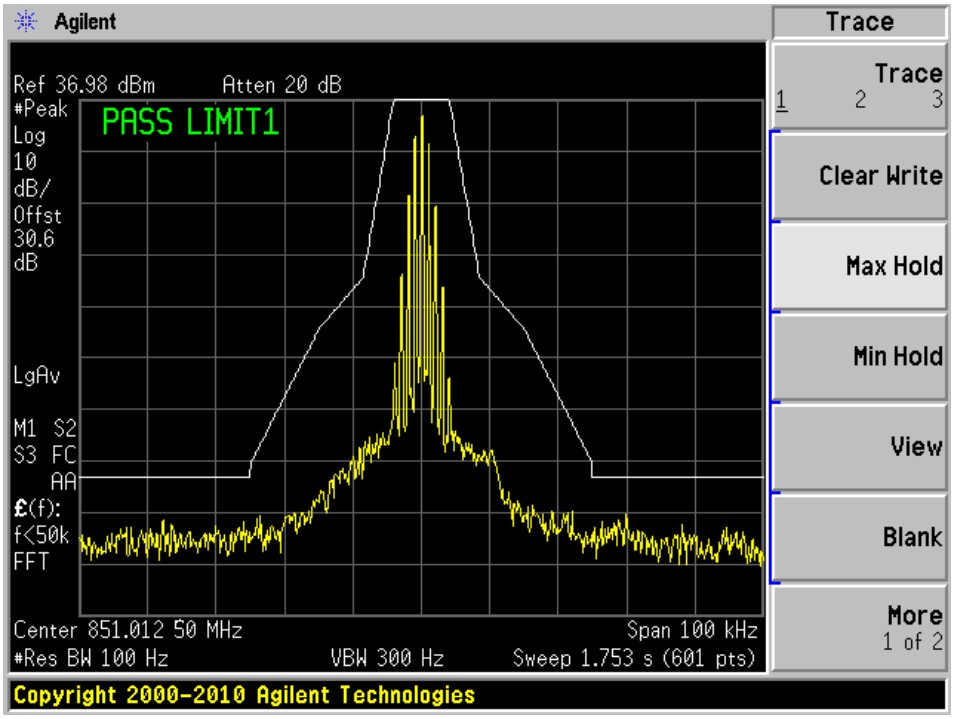
CW, Low Channel – 851.0125 MHz



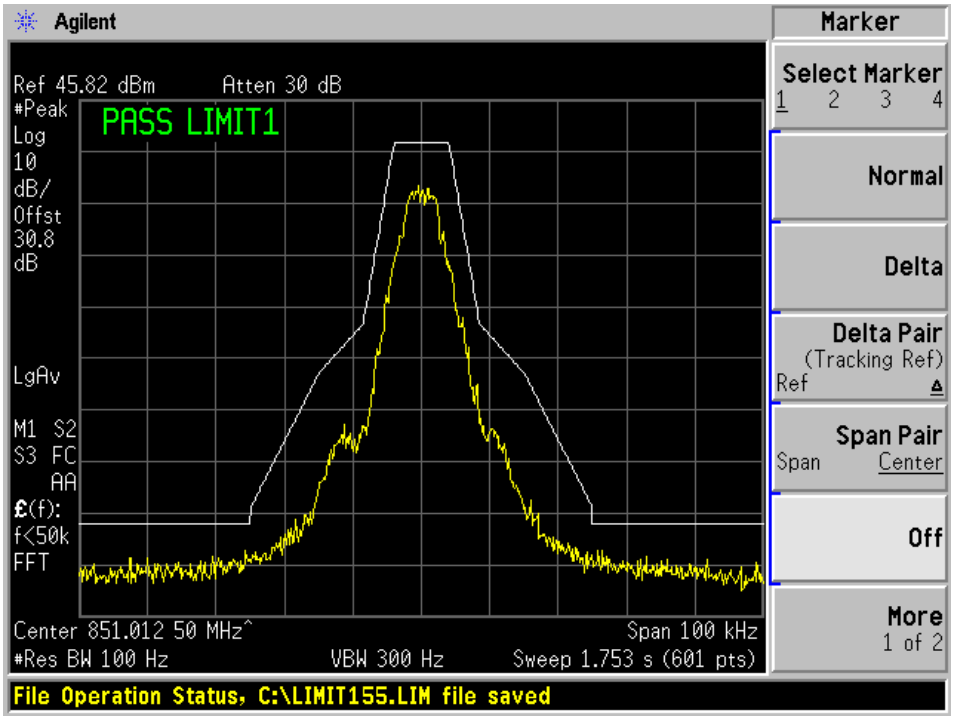
FM Data, Low Channel – 851.0125 MHz



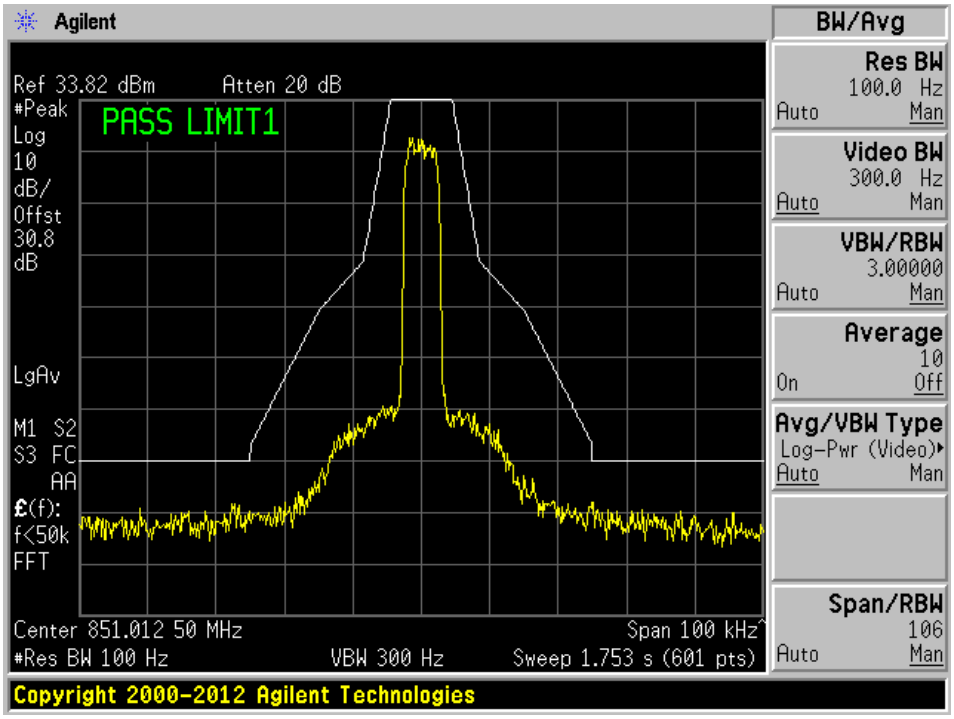
FM Voice, Low Channel – 851.0125 MHz



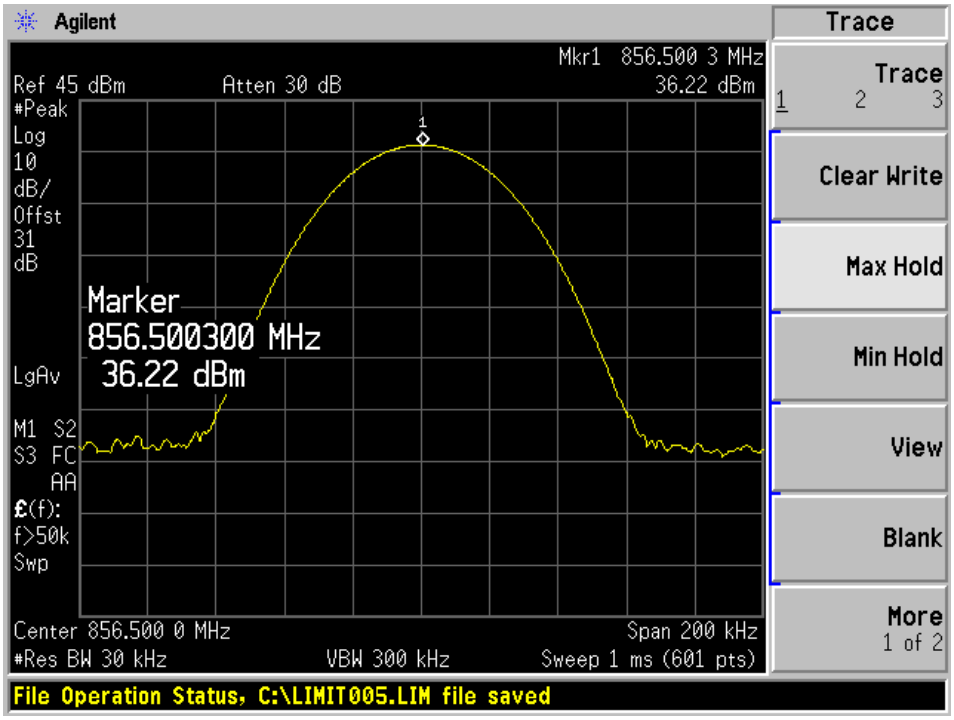
C4FM, Low Channel – 851.0125 MHz



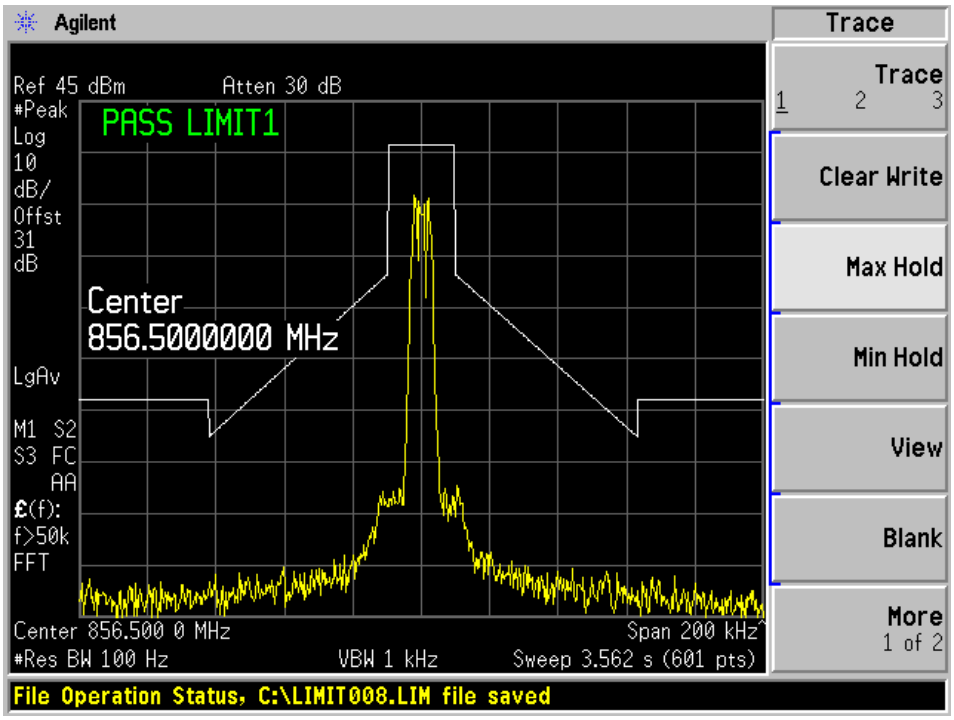
CQPSK, Low Channel – 851.0125 MHz



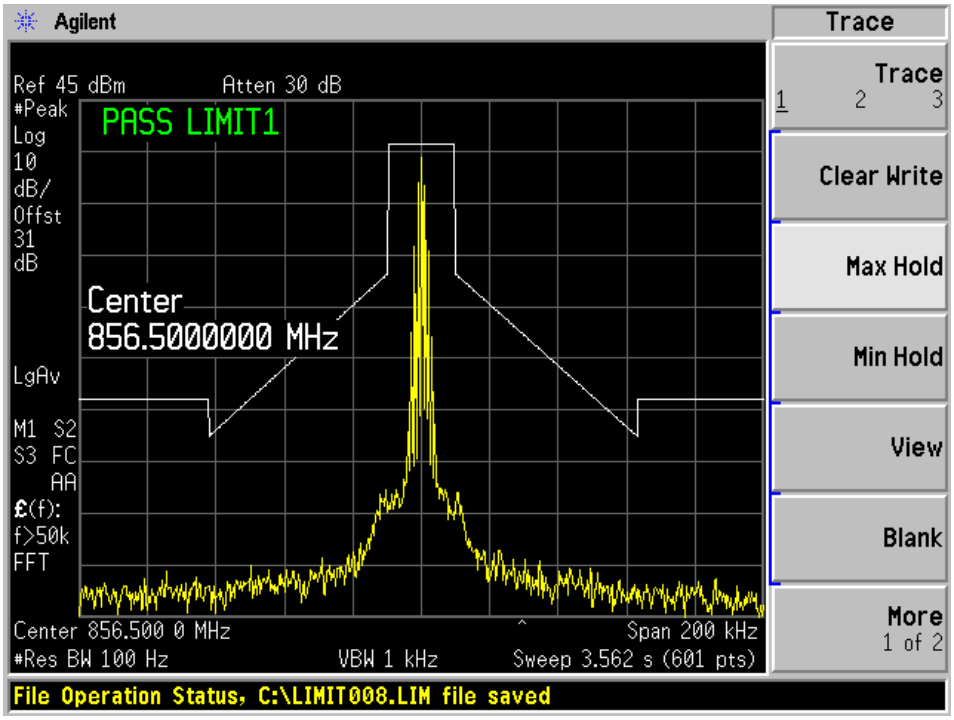
CW, Middle Channel – 856.5 MHz



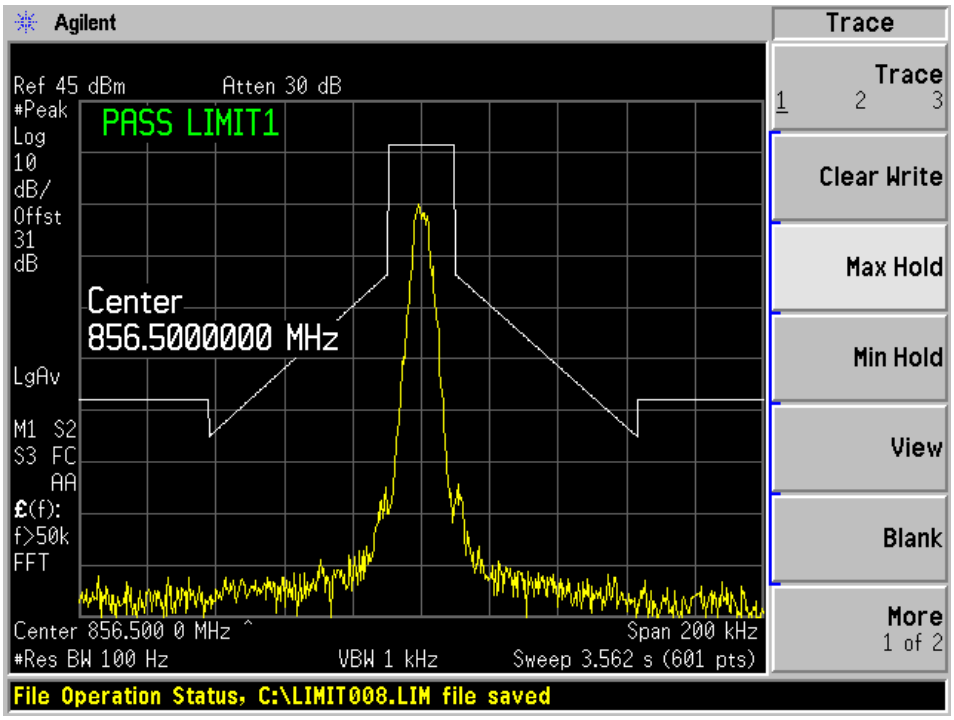
FM Data, Middle Channel – 856.5 MHz



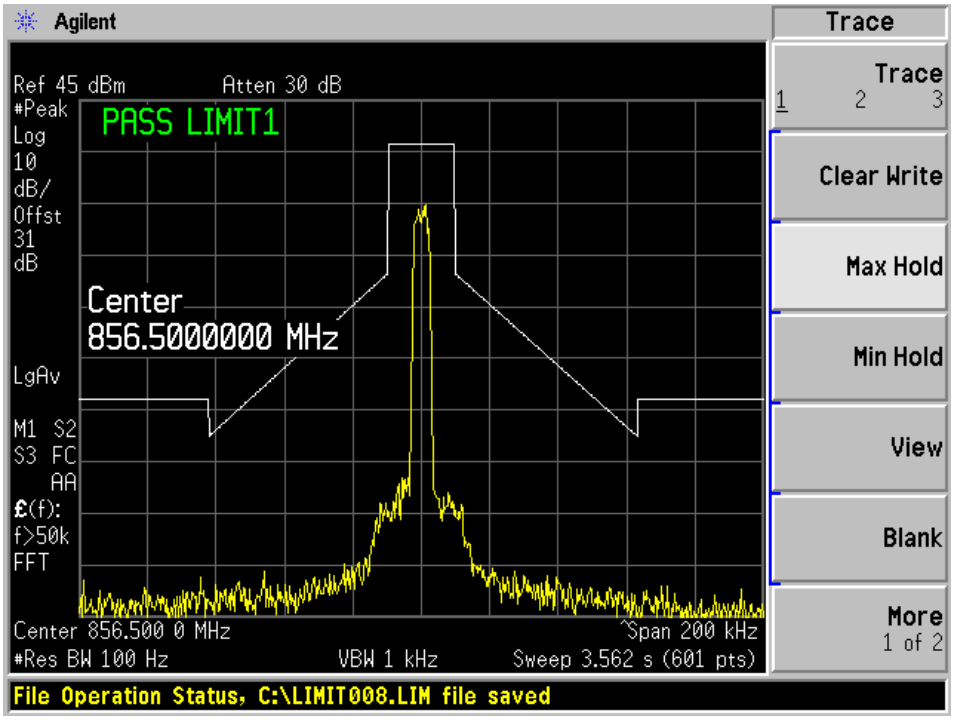
FM Voice, Middle Channel – 856.5 MHz



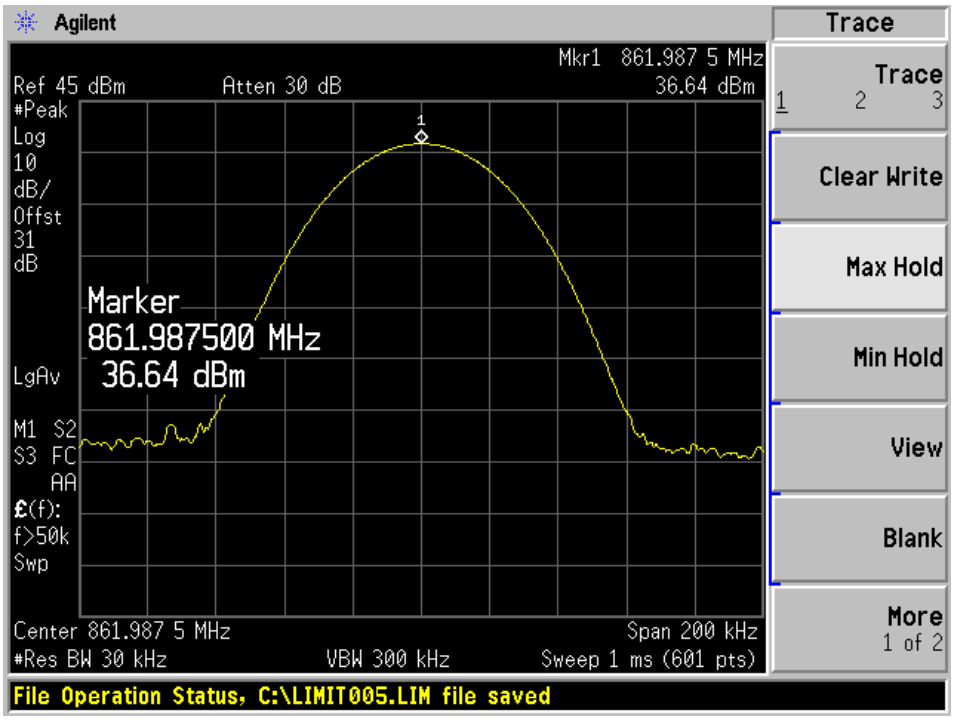
C4FM, Middle Channel – 856.5 MHz



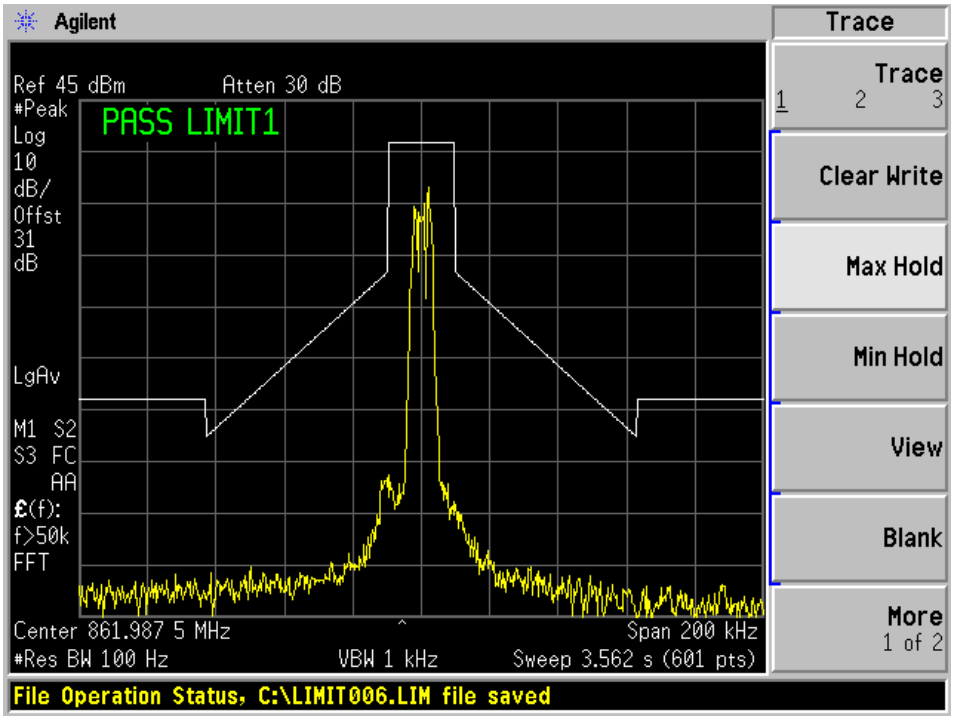
CQPSK, Middle Channel – 856.5 MHz



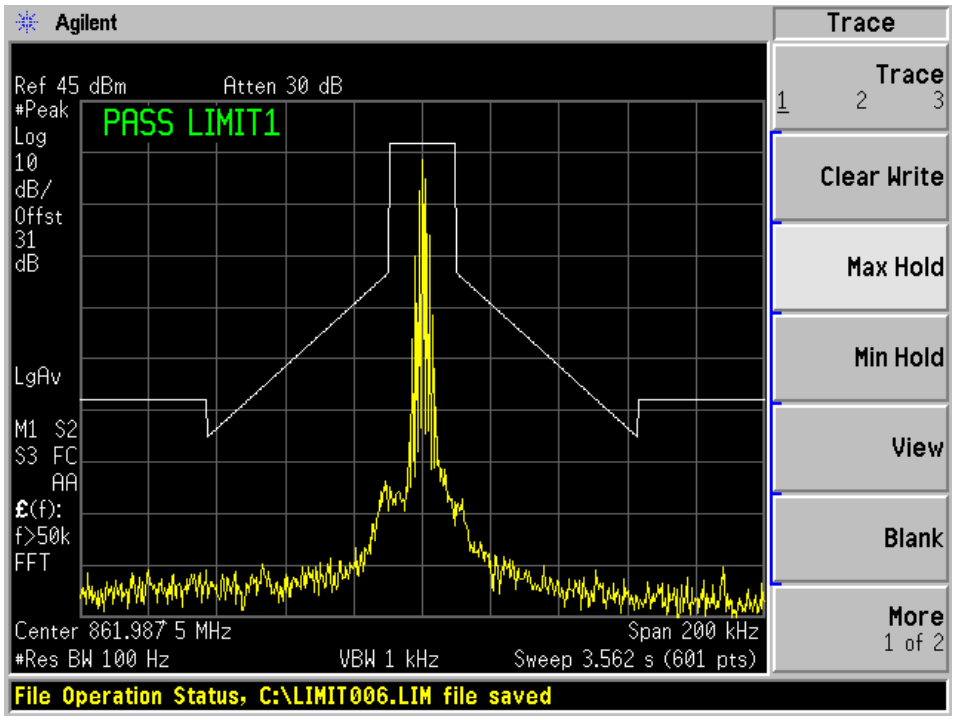
CW, High Channel – 861.9875 MHz



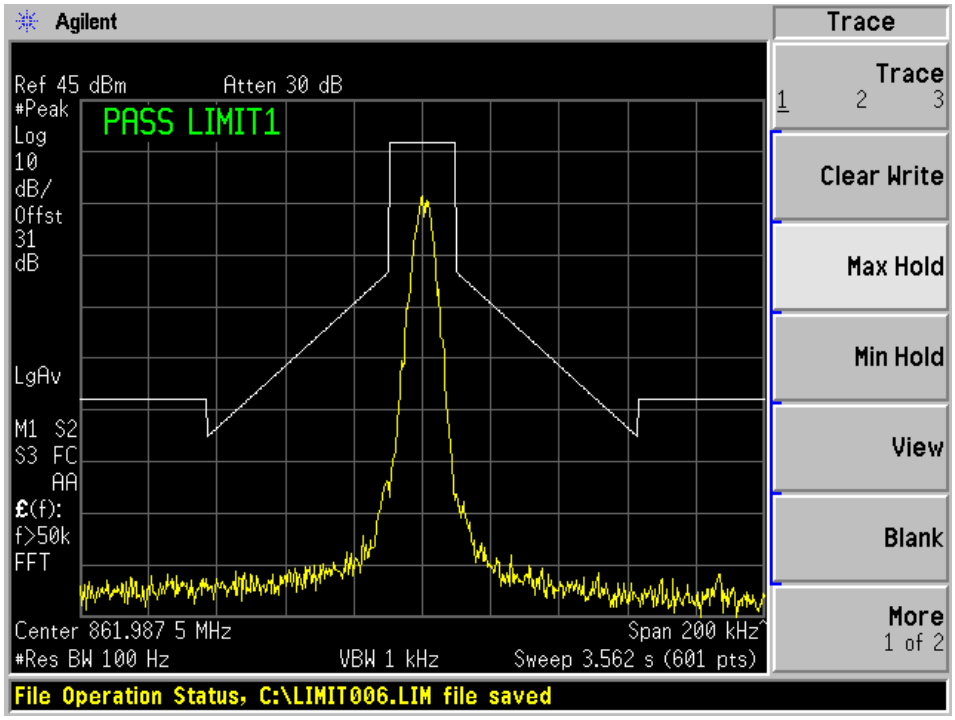
FM Data, High Channel – 861.9875 MHz



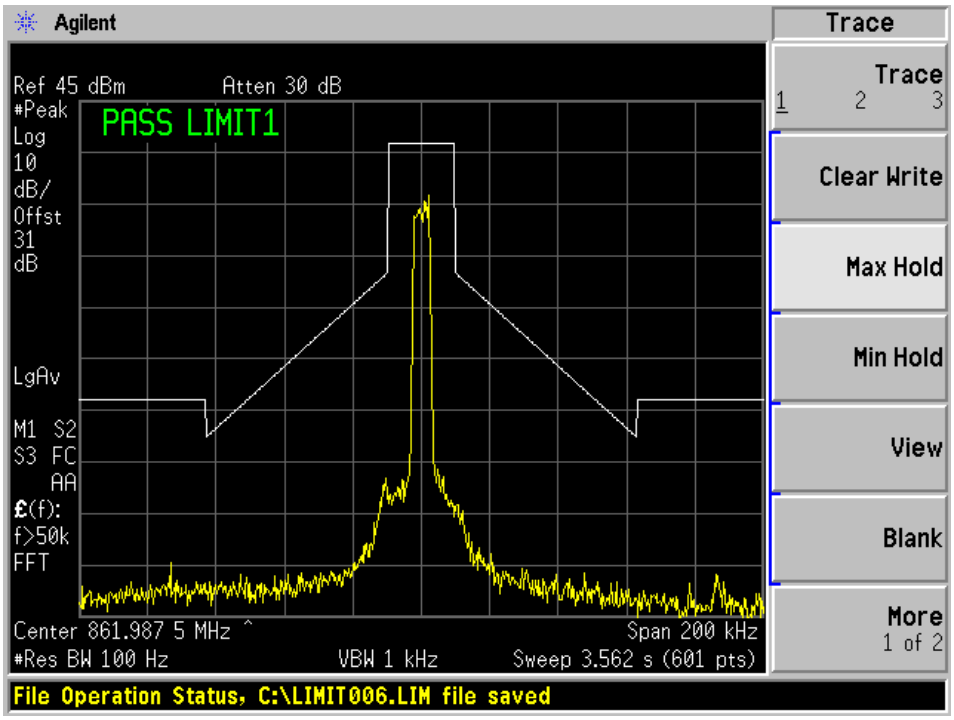
FM Voice, High Channel – 861.9875 MHz



C4FM, High Channel – 861.9875 MHz

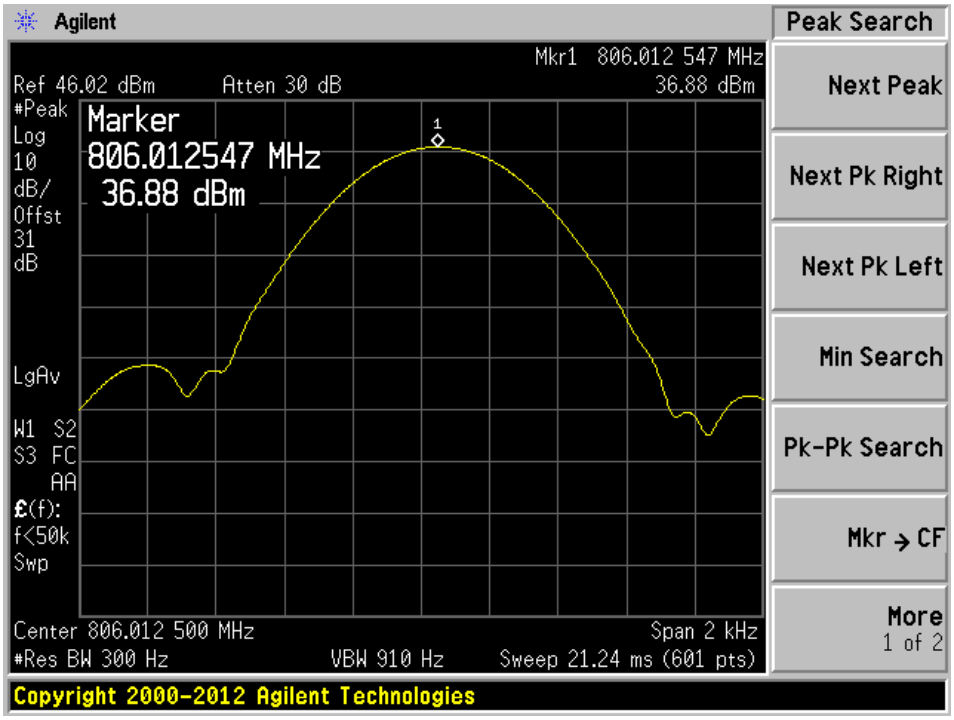


CQPSK, High Channel – 861.9875 MHz

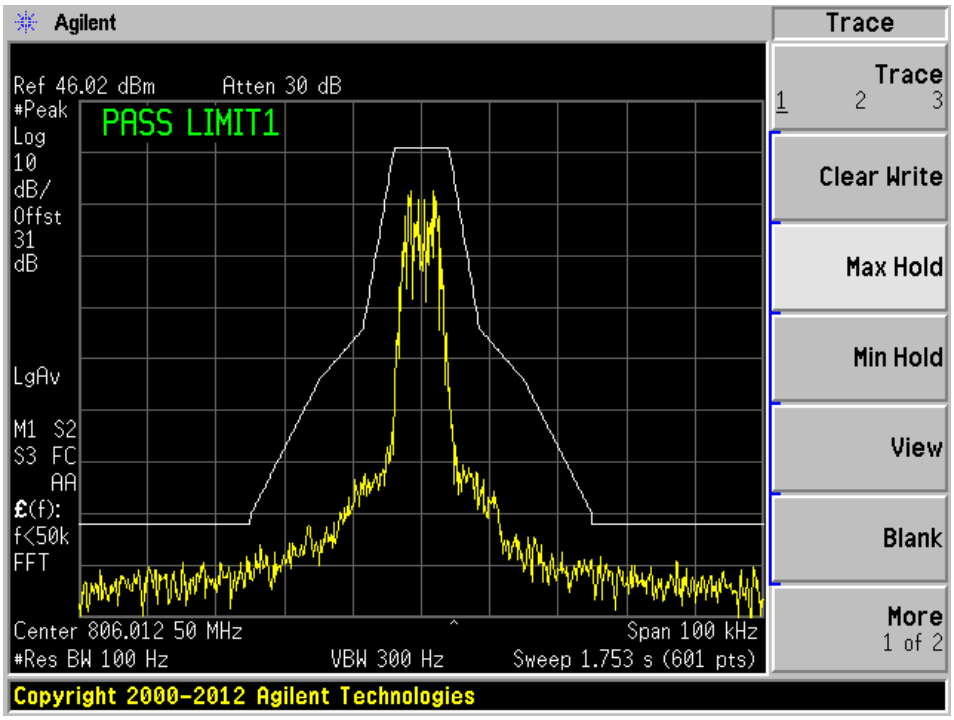


Uplink: 806-817 MHz

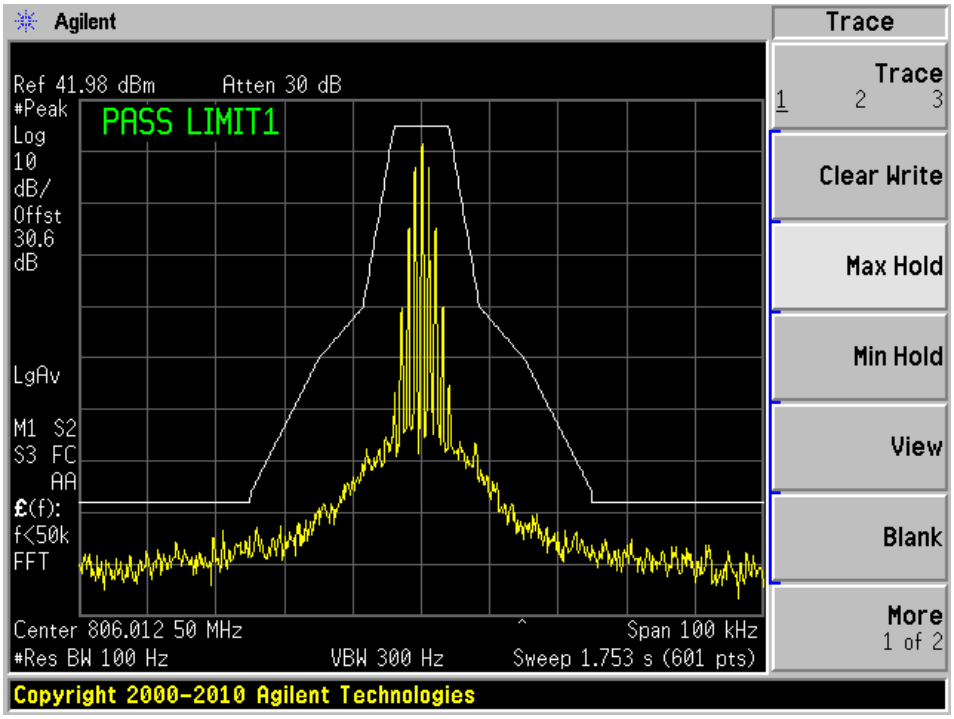
CW, Low Channel – 806.0125 MHz



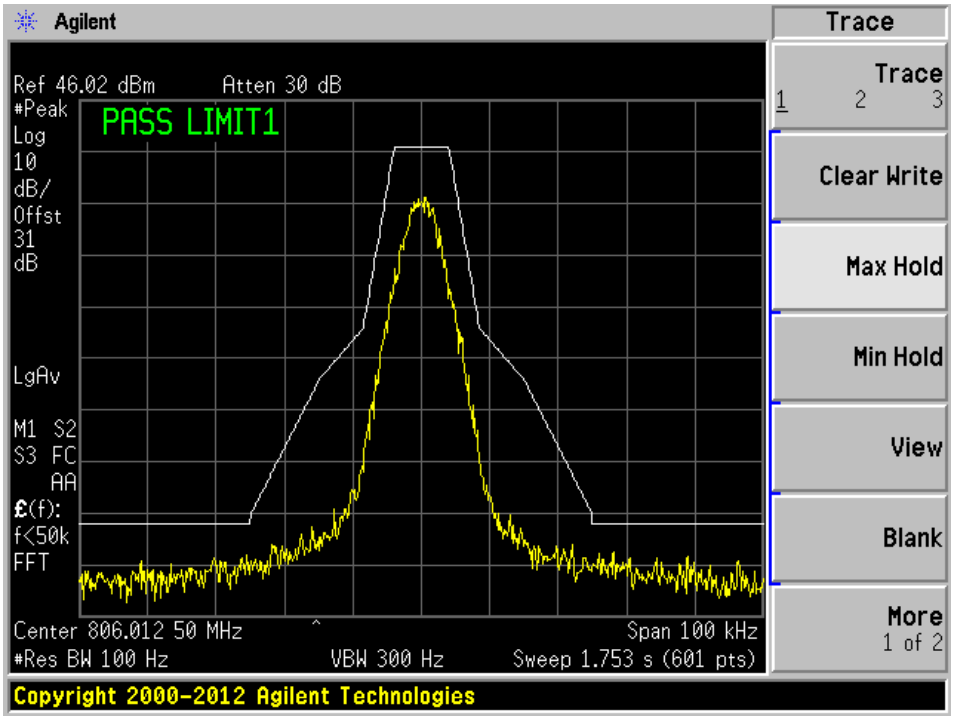
FM Data, Low Channel – 806.0125 MHz



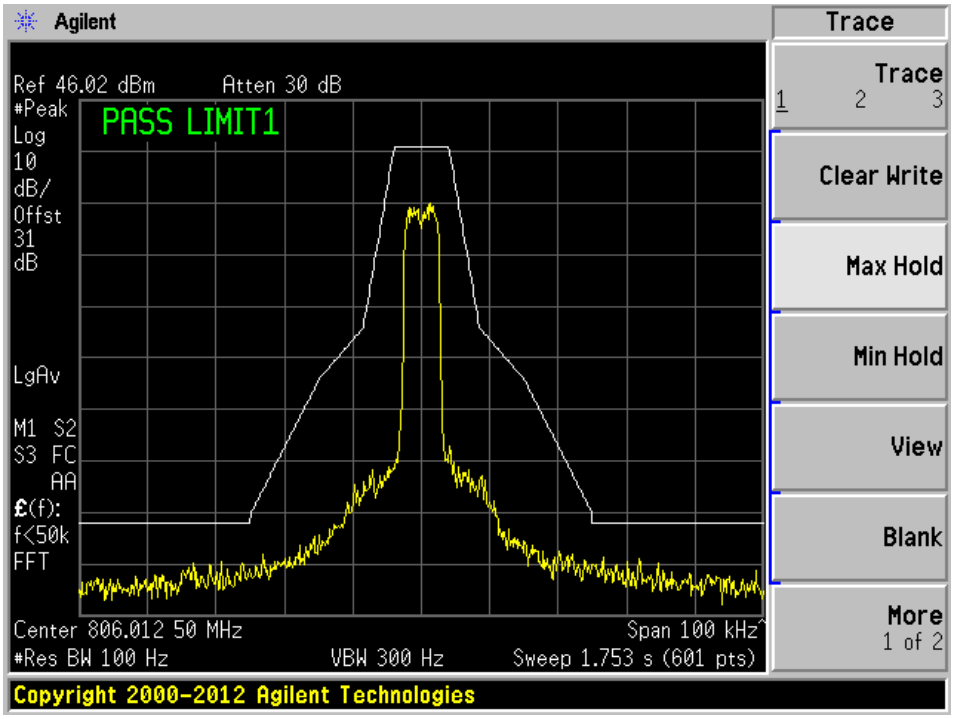
FM Voice, Low Channel – 806.0125 MHz



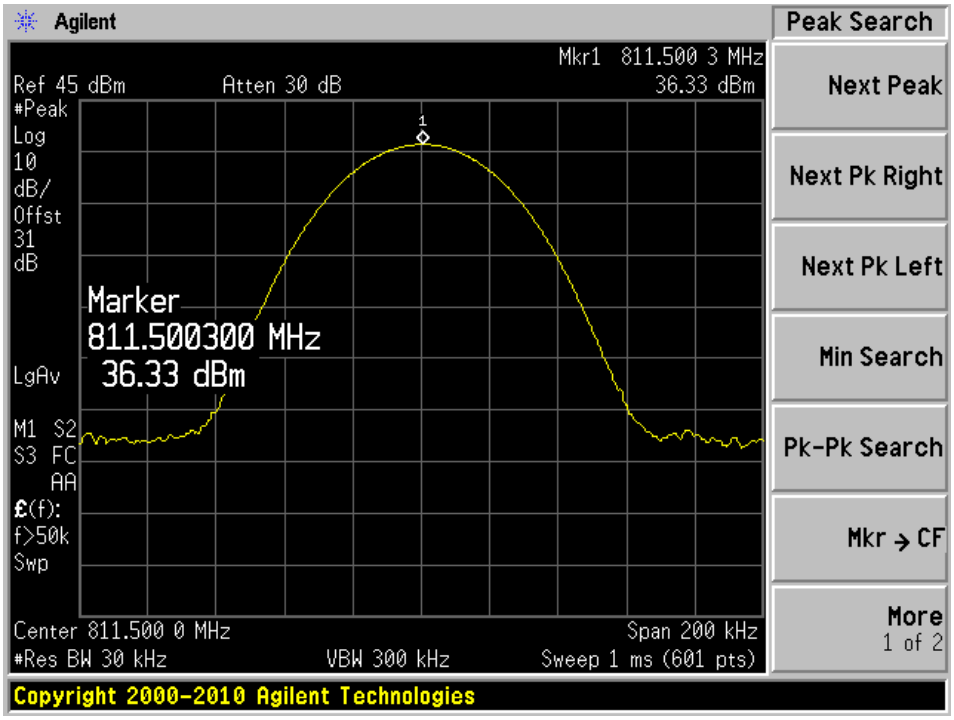
C4FM, Low Channel – 806.0125 MHz



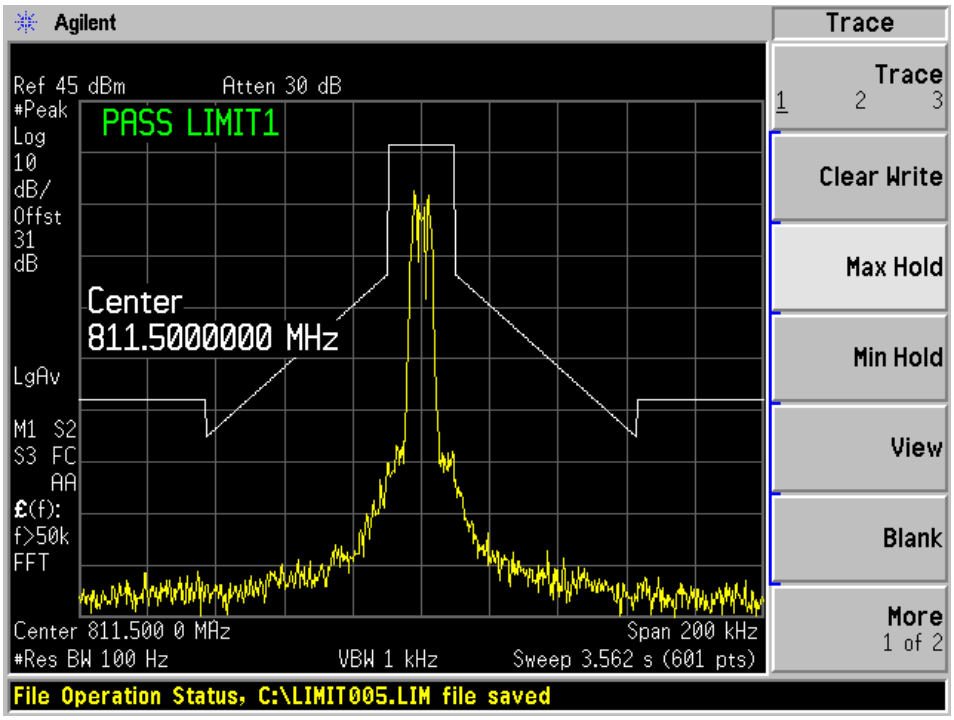
CQPSK, Low Channel – 806.0125 MHz



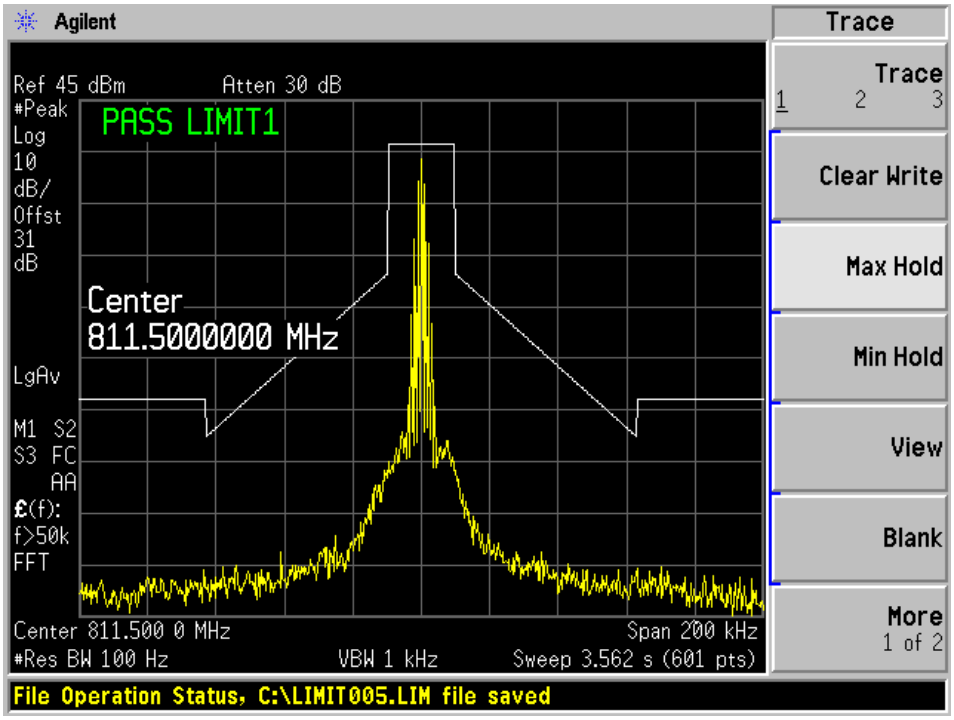
CW, Middle Channel – 811.5 MHz



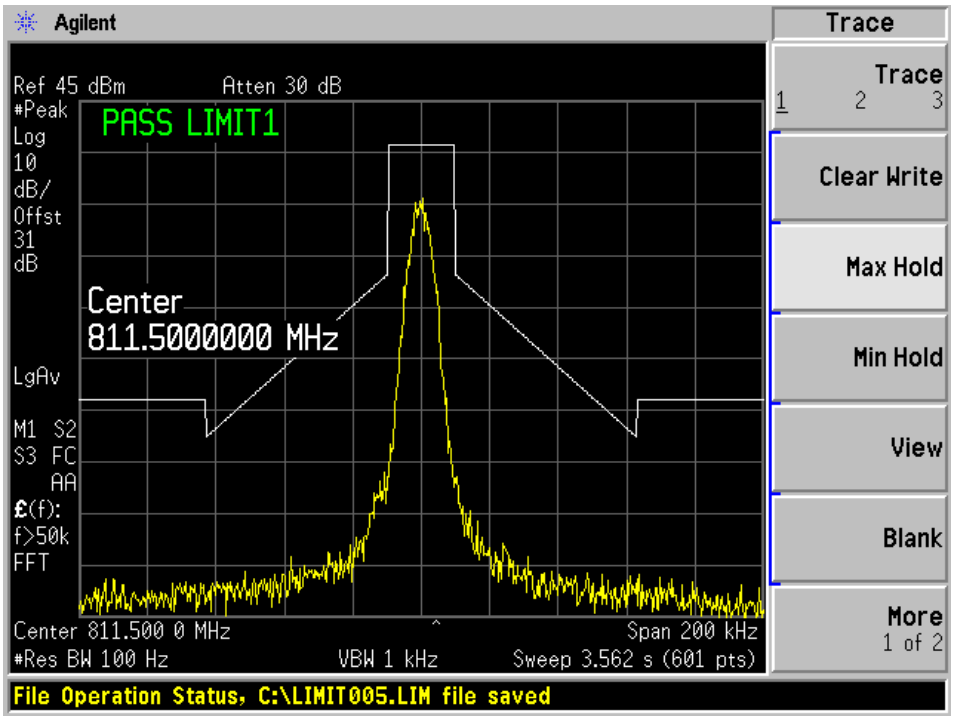
FM Data, Middle Channel – 811.5 MHz



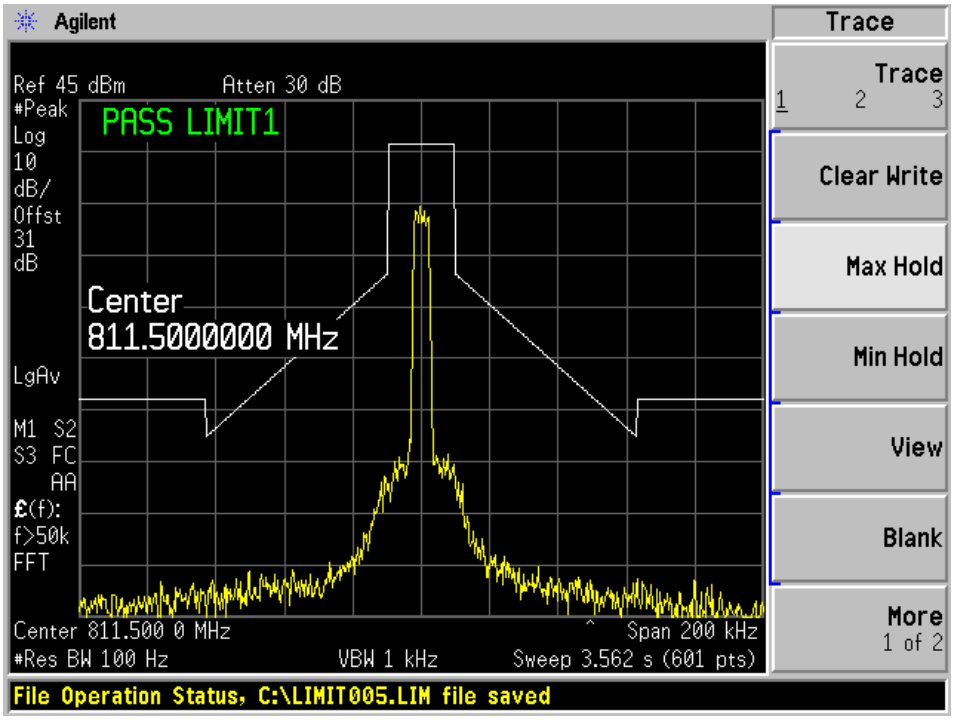
FM Voice, Middle Channel – 811.5 MHz



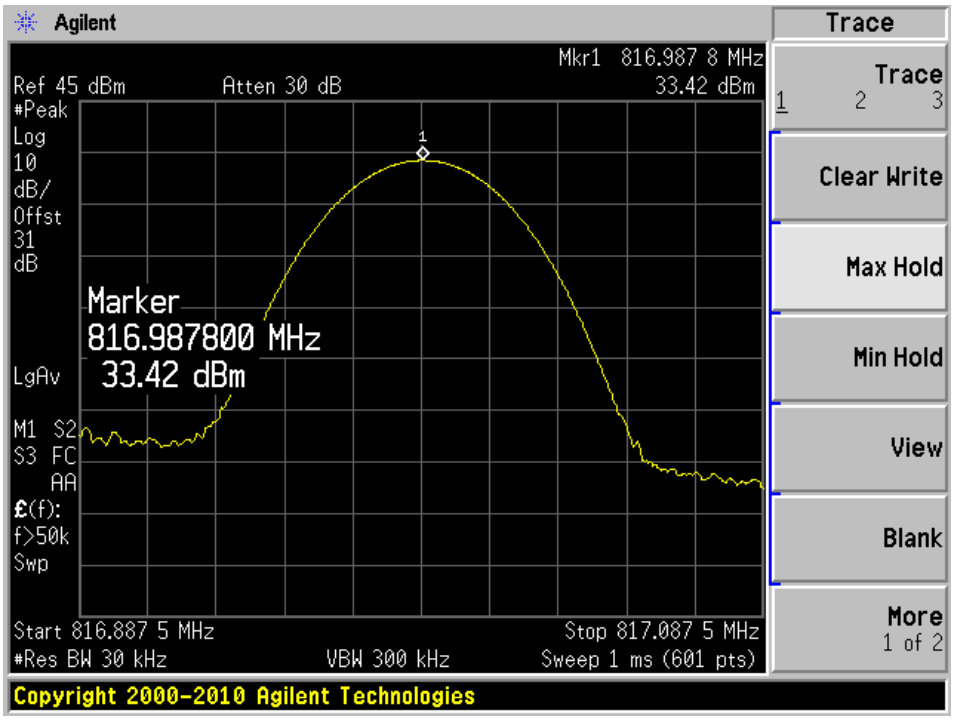
C4FM, Middle Channel – 811.5 MHz



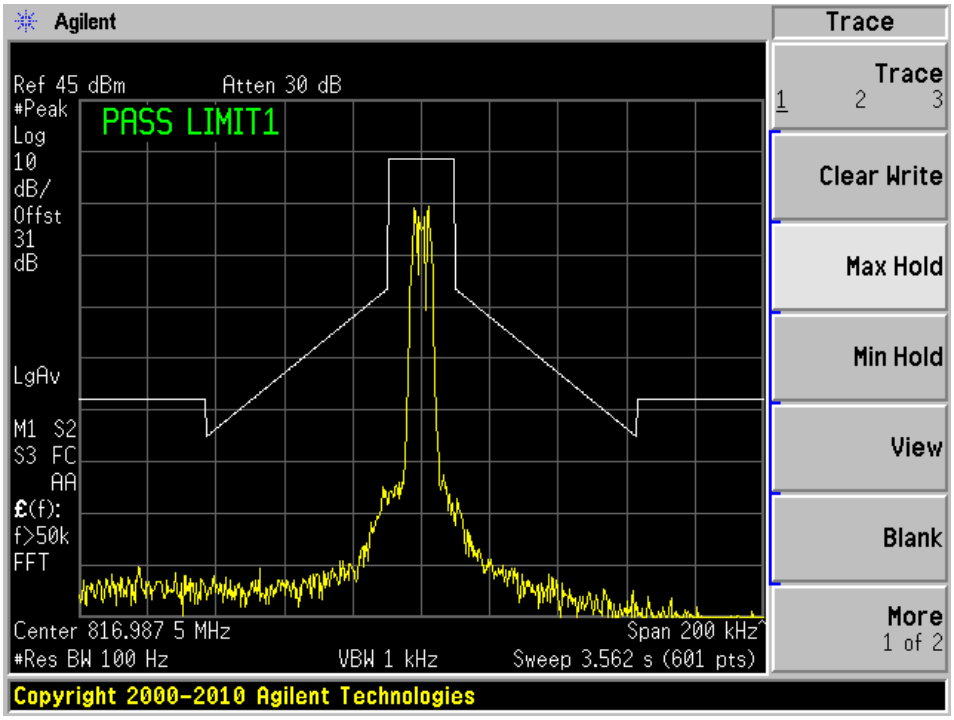
CQPSK, Middle Channel – 811.5 MHz



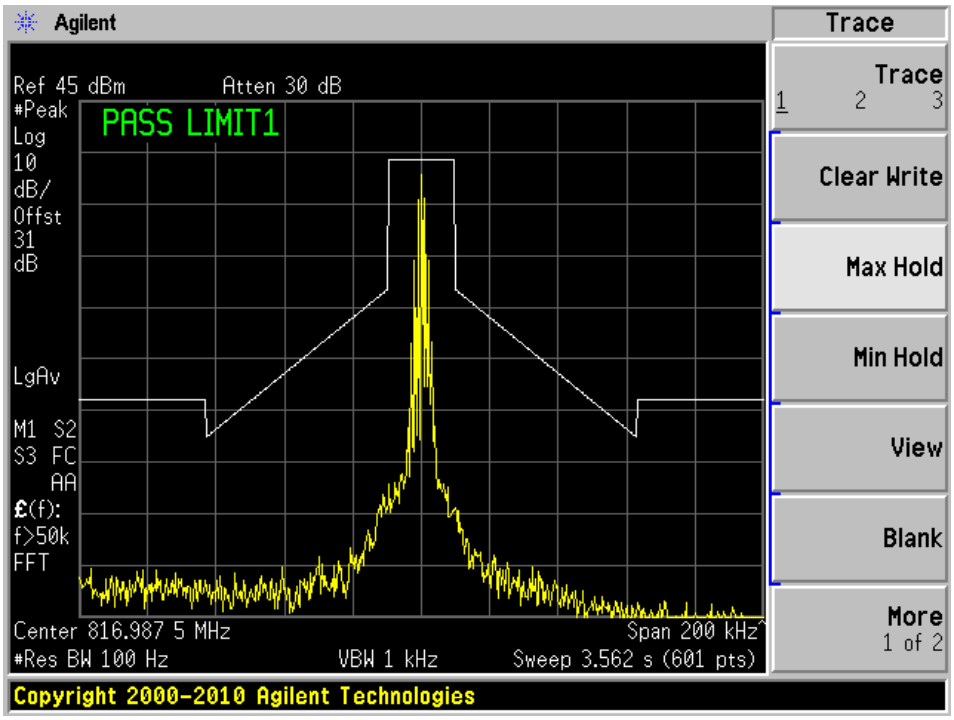
CW, High Channel – 816.9875 MHz



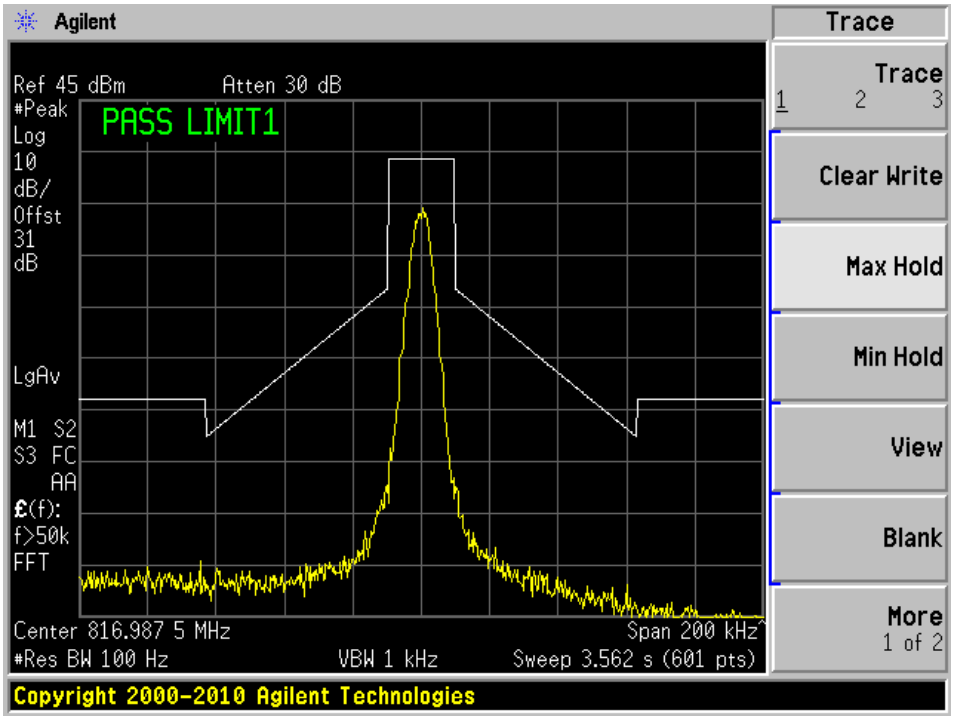
FM Data, High Channel – 816.9875 MHz



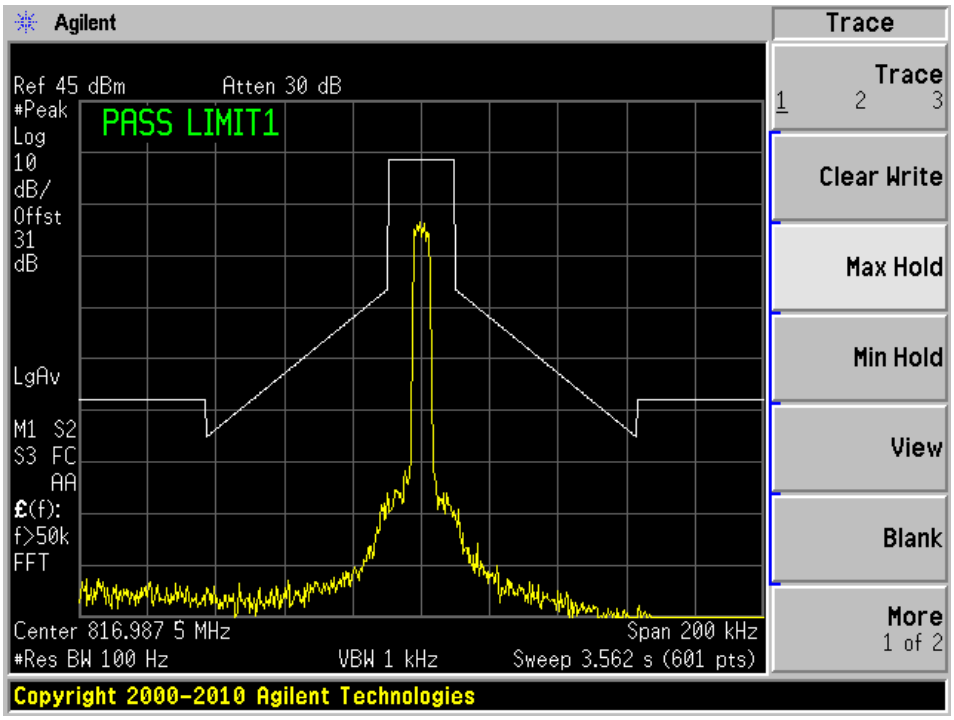
FM Voice, High Channel – 816.9875 MHz



C4FM, High Channel – 816.9875 MHz



CQPSK, High Channel – 816.9875 MHz



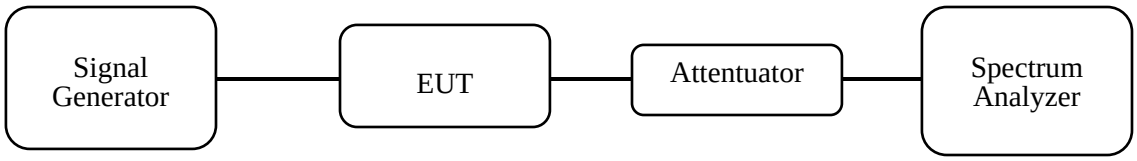
7 FCC §2.1051 & §90.219(e) - Spurious Emissions at Antenna Terminals

7.1 Applicable Standard

According to FCC §90.219 (e), spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.

7.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer 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

Manufacturer	Description	Model	Serial Number	Calibration Due Date
Agilent	Spectrum Analyzer	E4446A	MY48250238	2015-09-03
Agilent	Generator, Signal	E4438C	MY45091309	2015-07-15

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

7.4 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	32 %
ATM Pressure:	101.3 kPa

The testing was performed by Simon Ma on 2015-03-10 in the RF Site.

7.5 Test Results

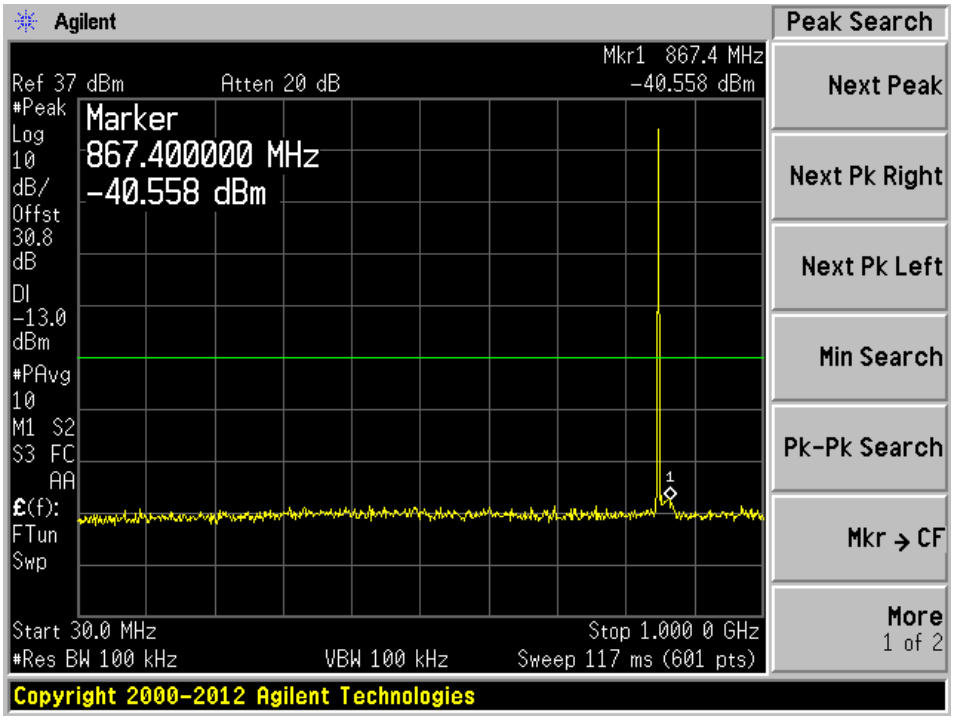
Please refer to the following plots.

Spurious Emissions (ALC on)

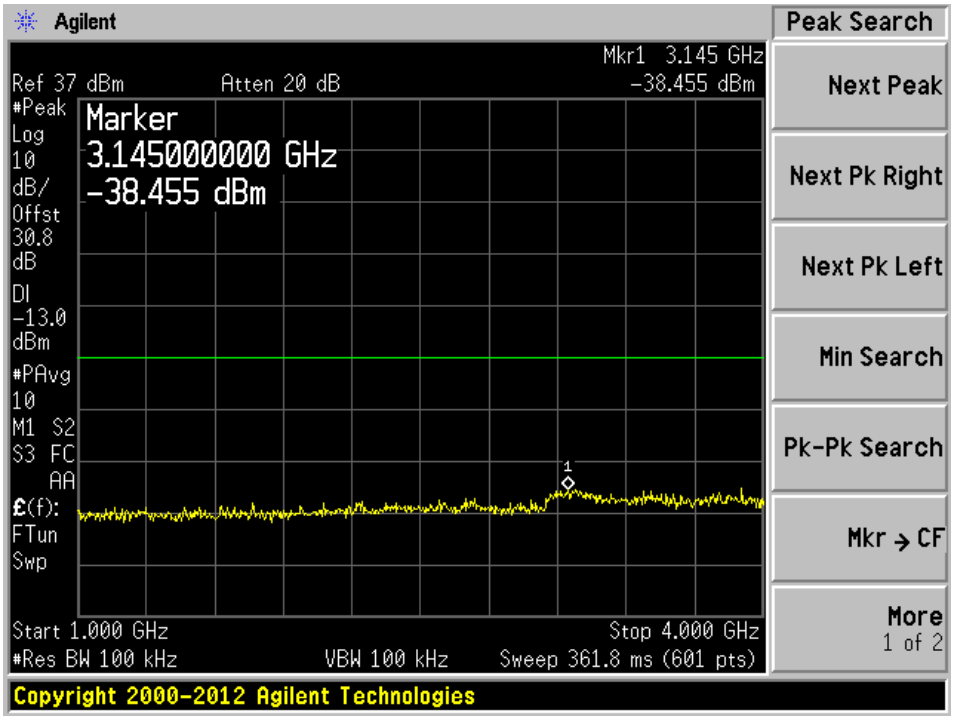
Downlink: 851-862 MHz

FM Data, Low Channel – 851.0125 MHz

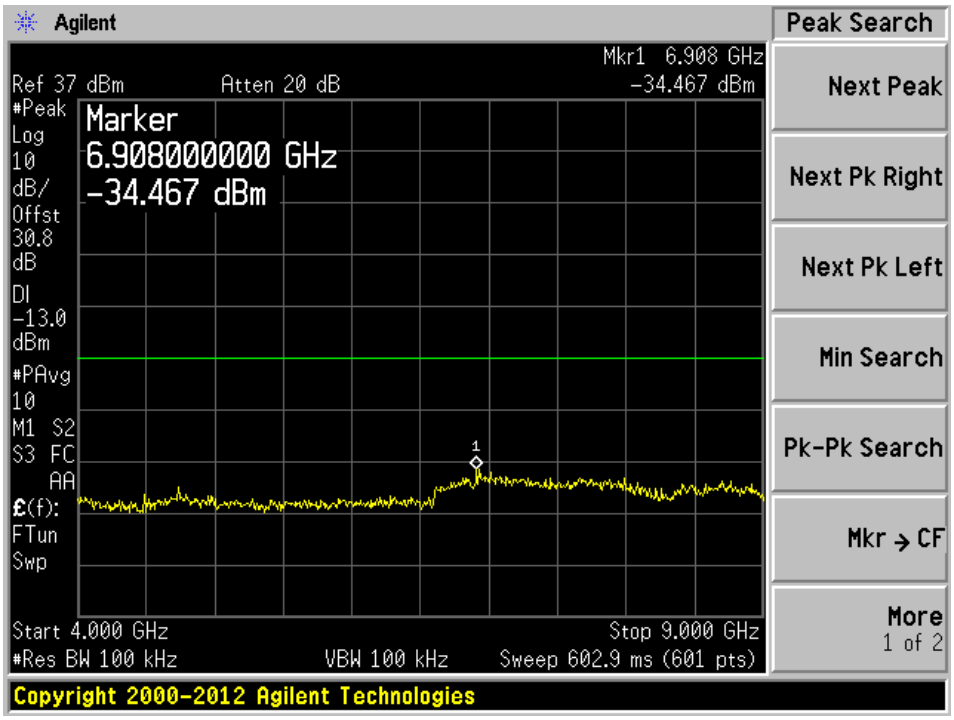
30 MHz – 1 GHz



1 GHz – 4 GHz

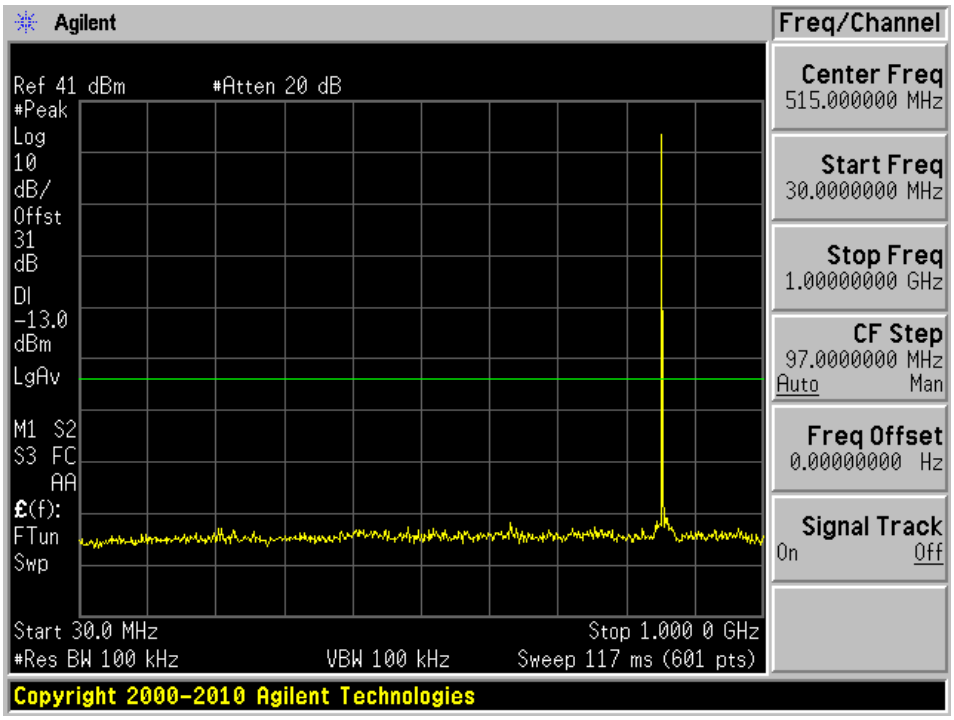


4 GHz – 9 GHz

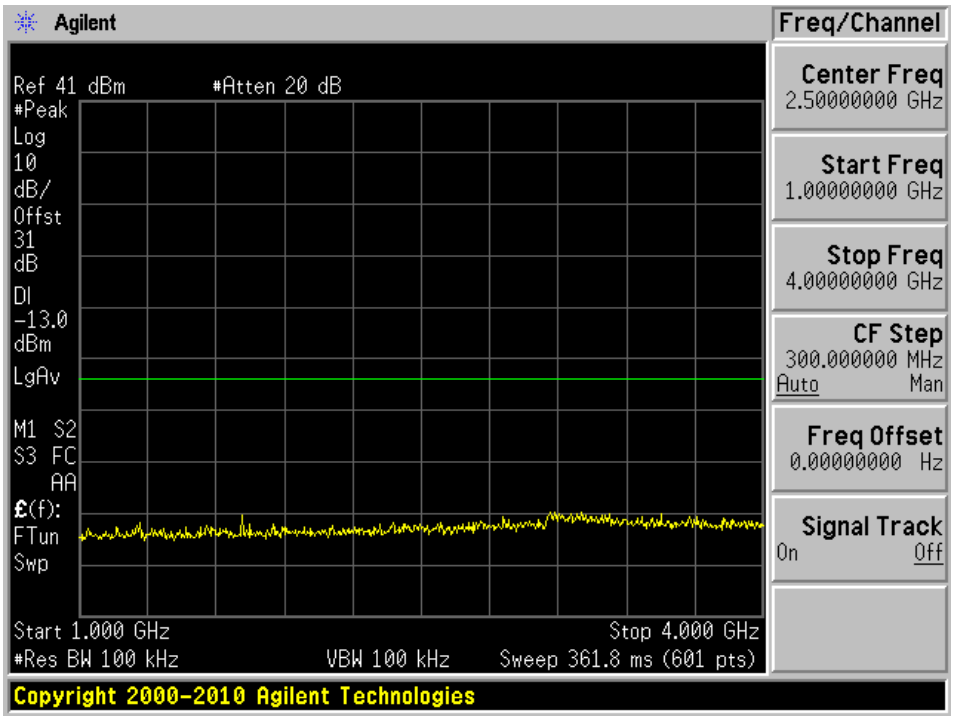


FM Data, Middle Channel – 856.5 MHz

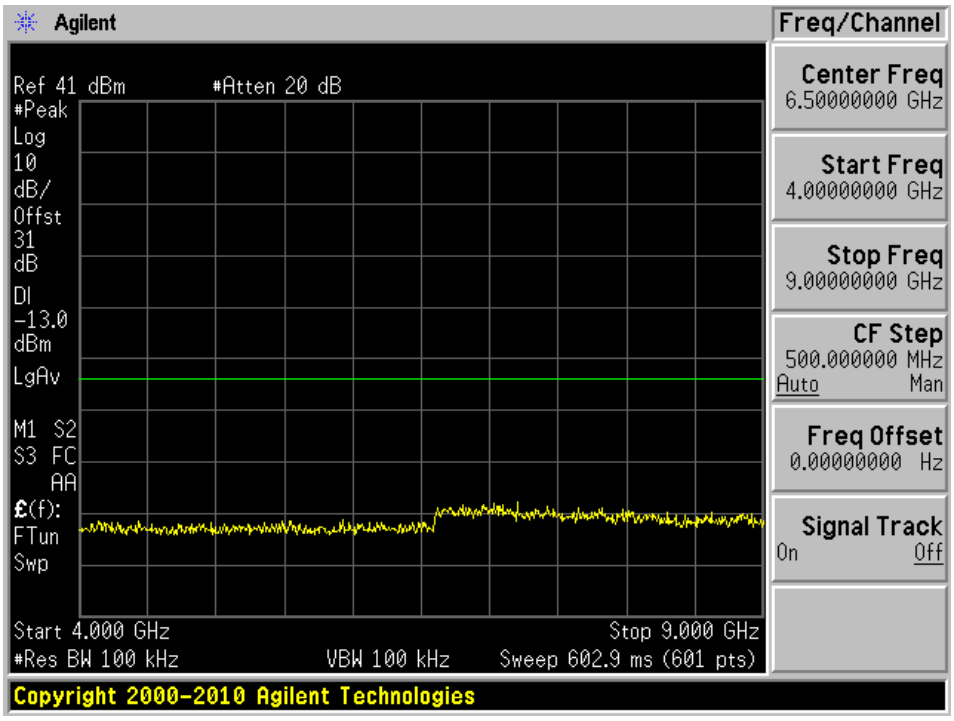
30 MHz – 1 GHz



1 GHz – 4 GHz

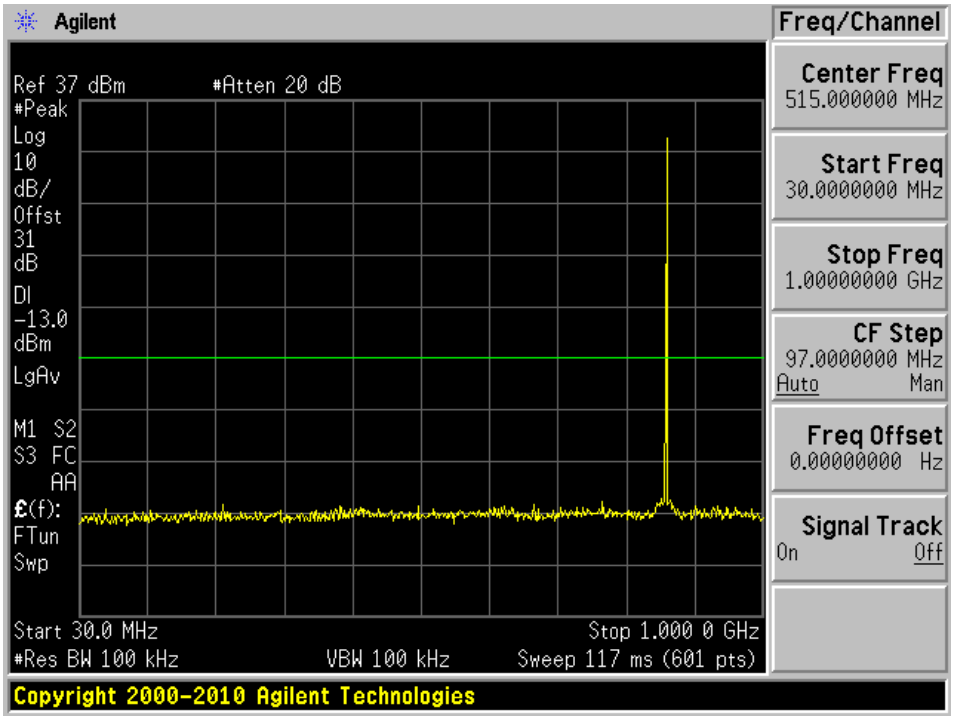


4 GHz – 9 GHz

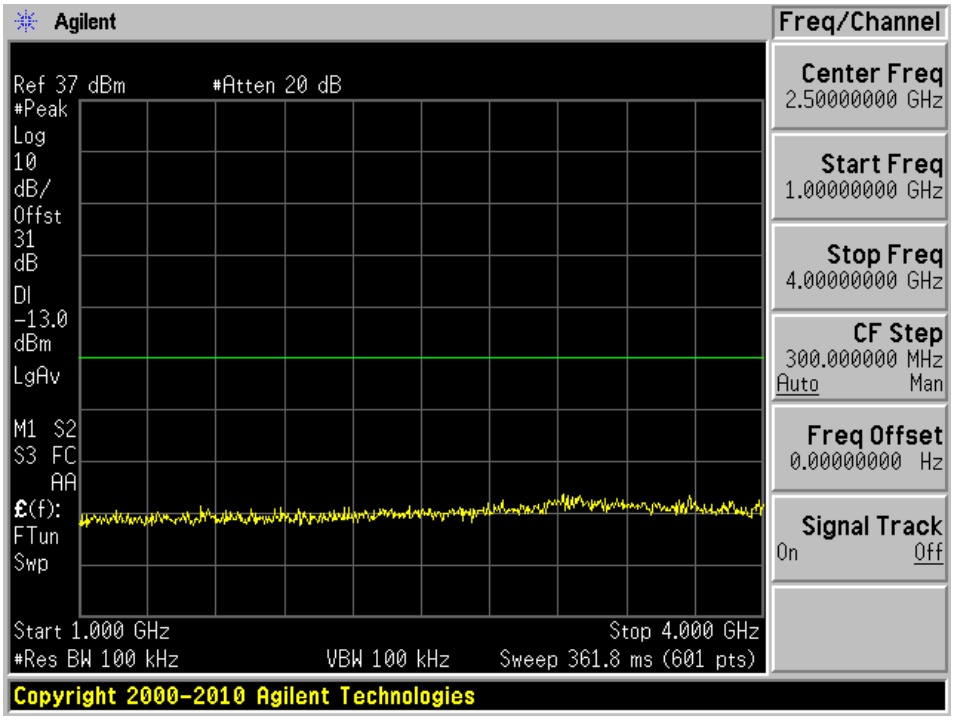


FM Data, High Channel – 861.9875 MHz

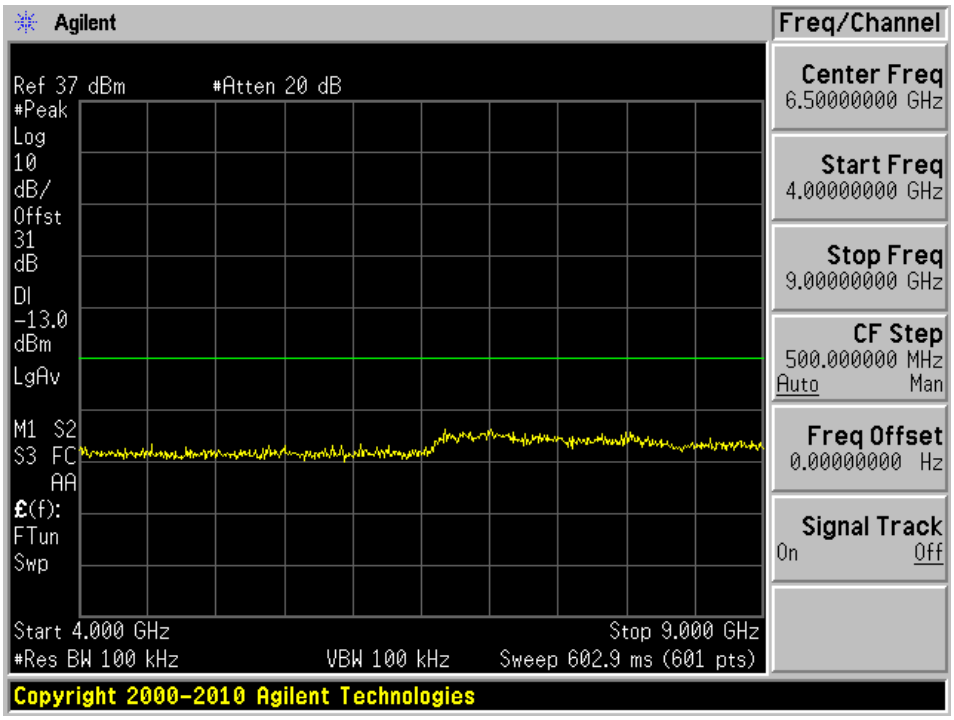
30 MHz – 1 GHz



1 GHz – 4 GHz

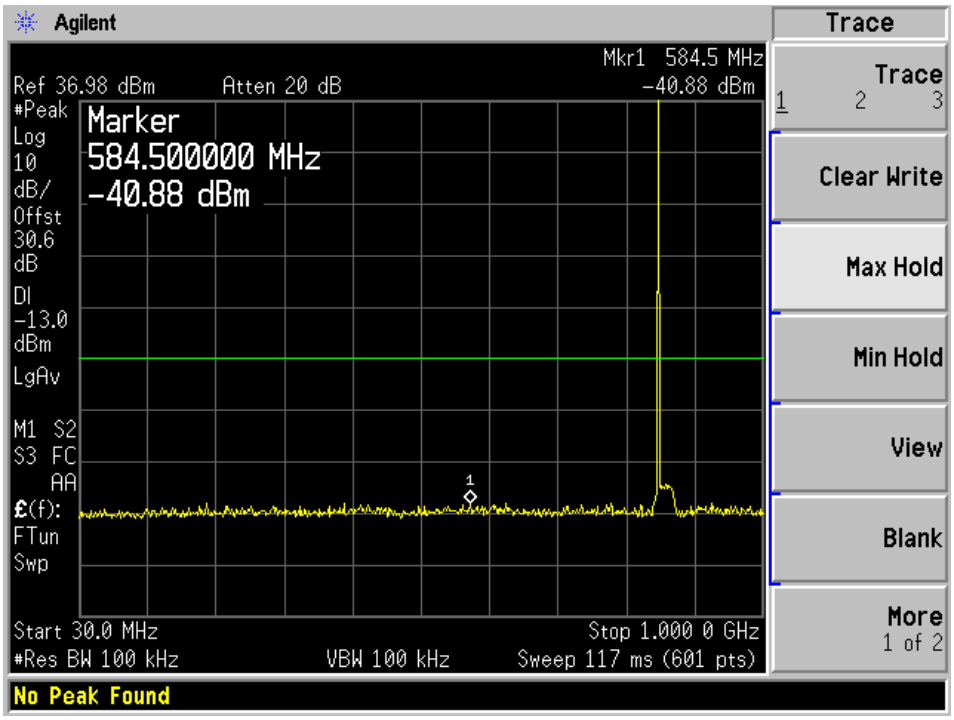


4 GHz – 9 GHz

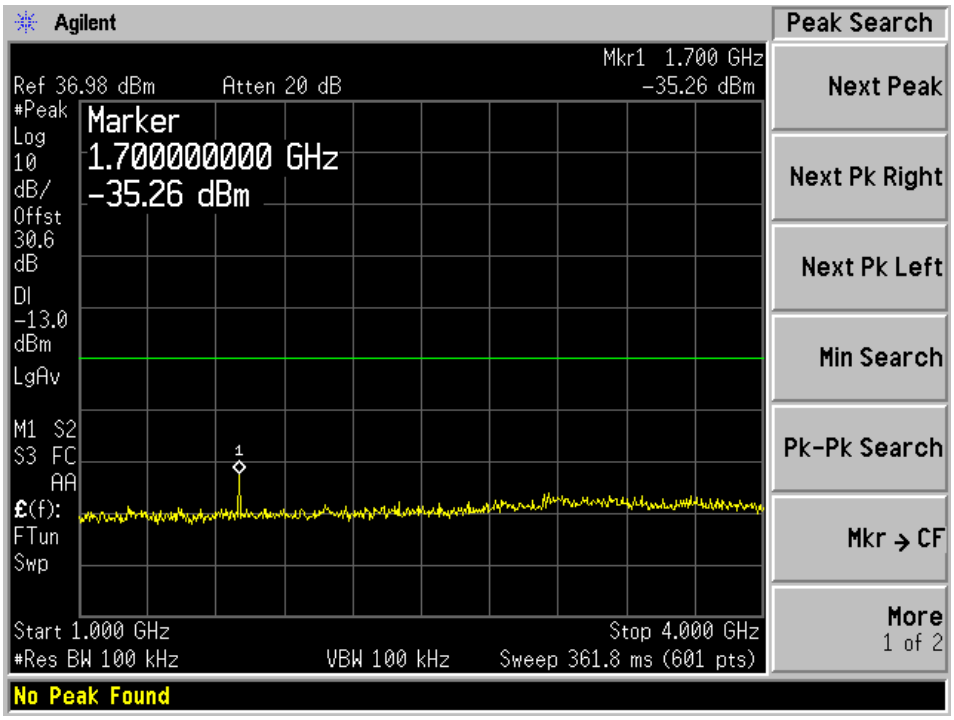


FM Voice, Low Channel – 851.0125 MHz

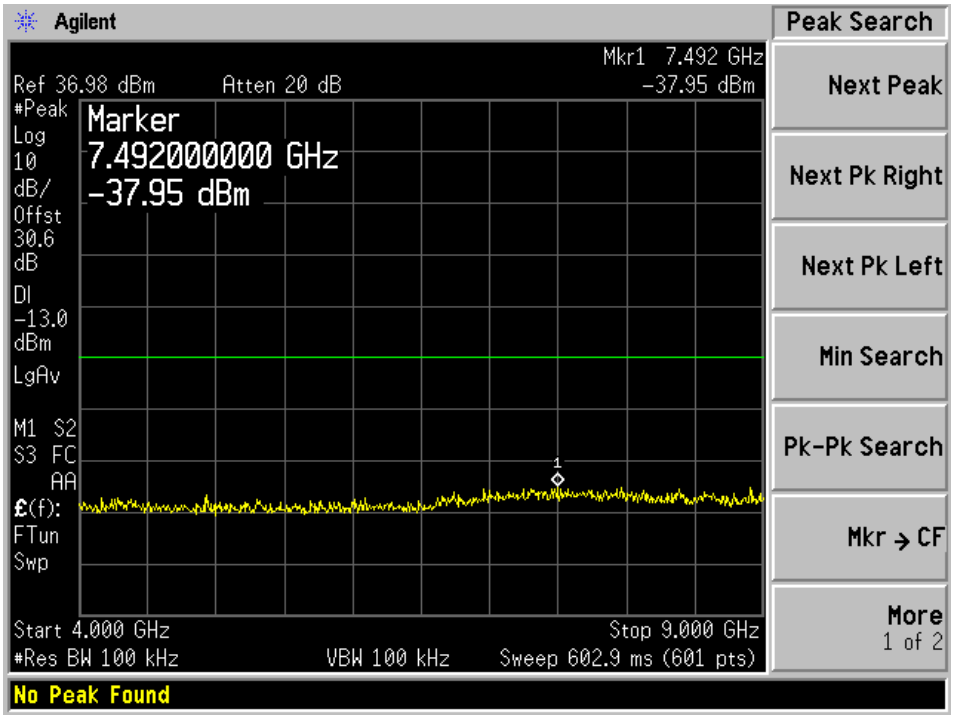
30 MHz – 1 GHz



1 GHz – 4 GHz

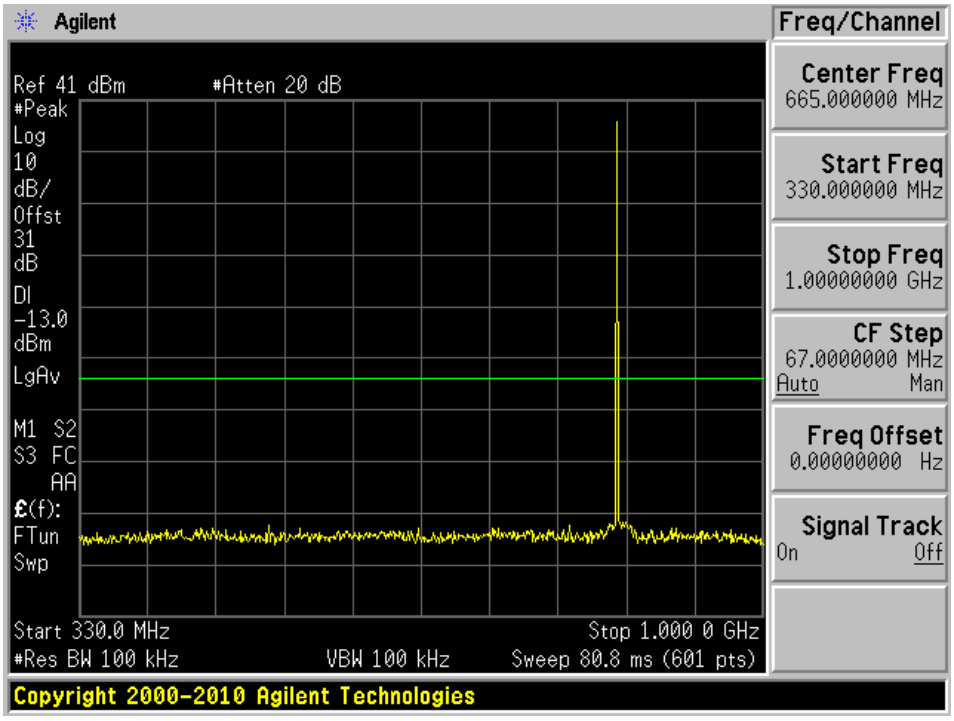


4 GHz – 9 GHz

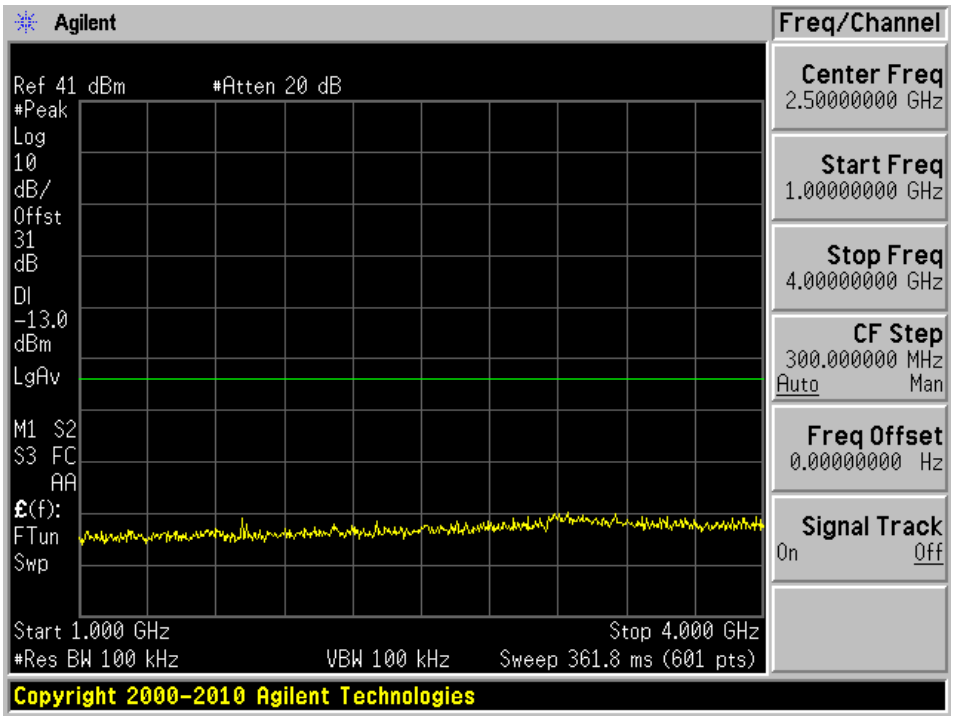


FM Voice, Middle Channel – 856.5 MHz

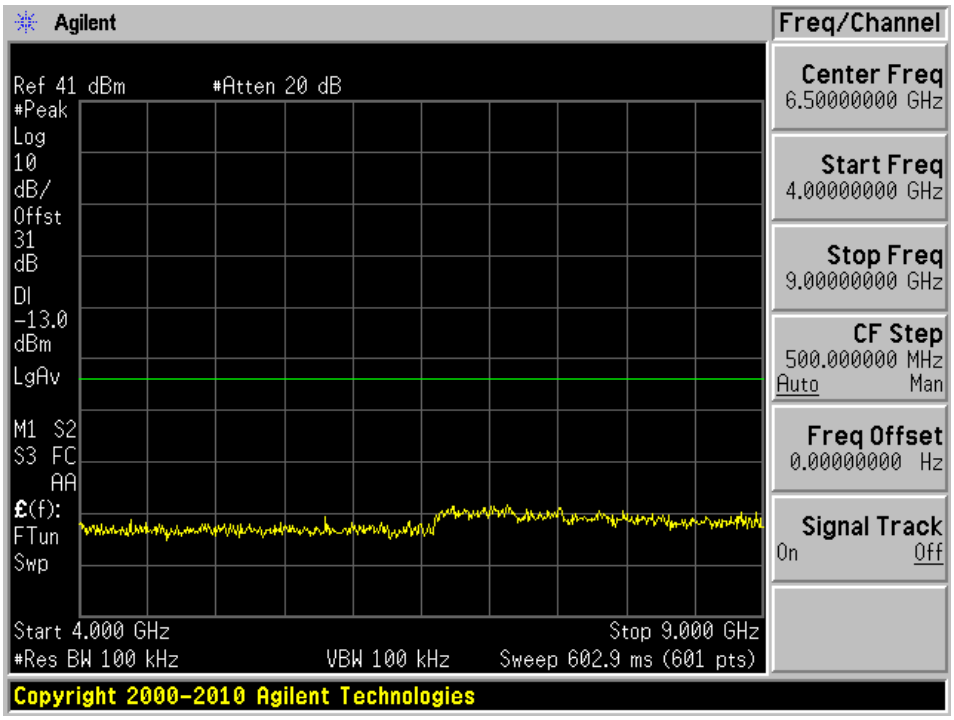
30 MHz – 1 GHz



1 GHz – 4 GHz

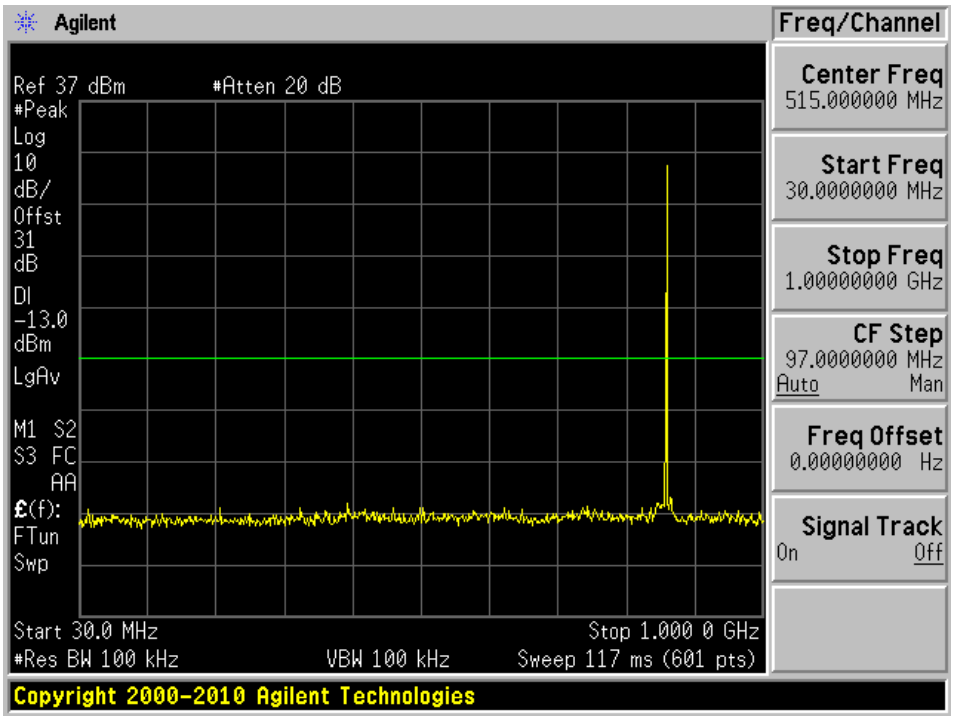


4 GHz – 9 GHz

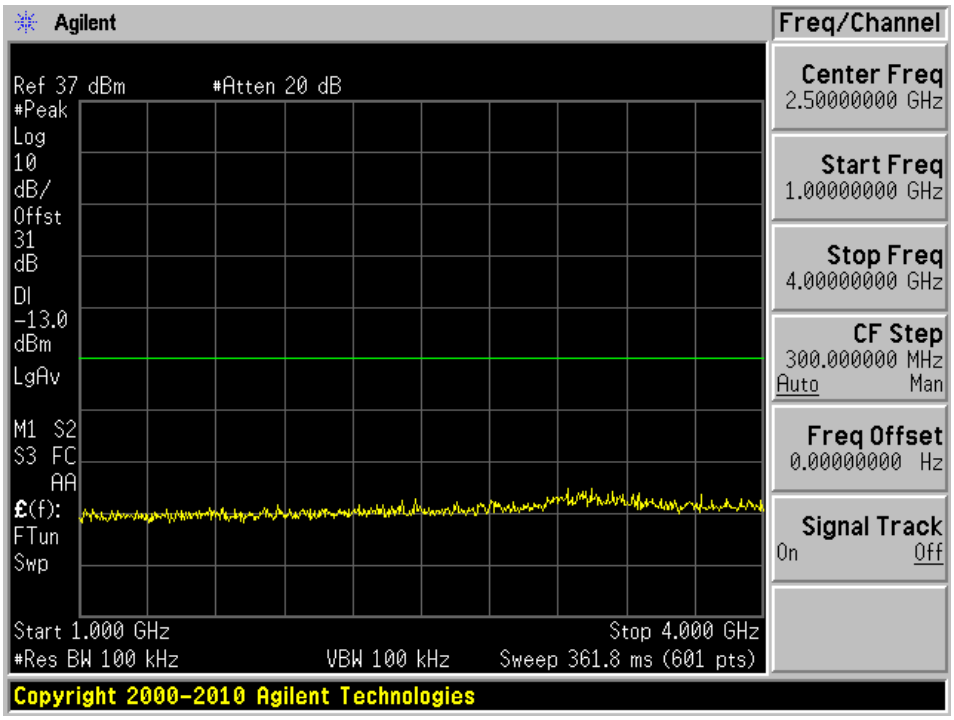


FM Voice, High Channel – 861.9875 MHz

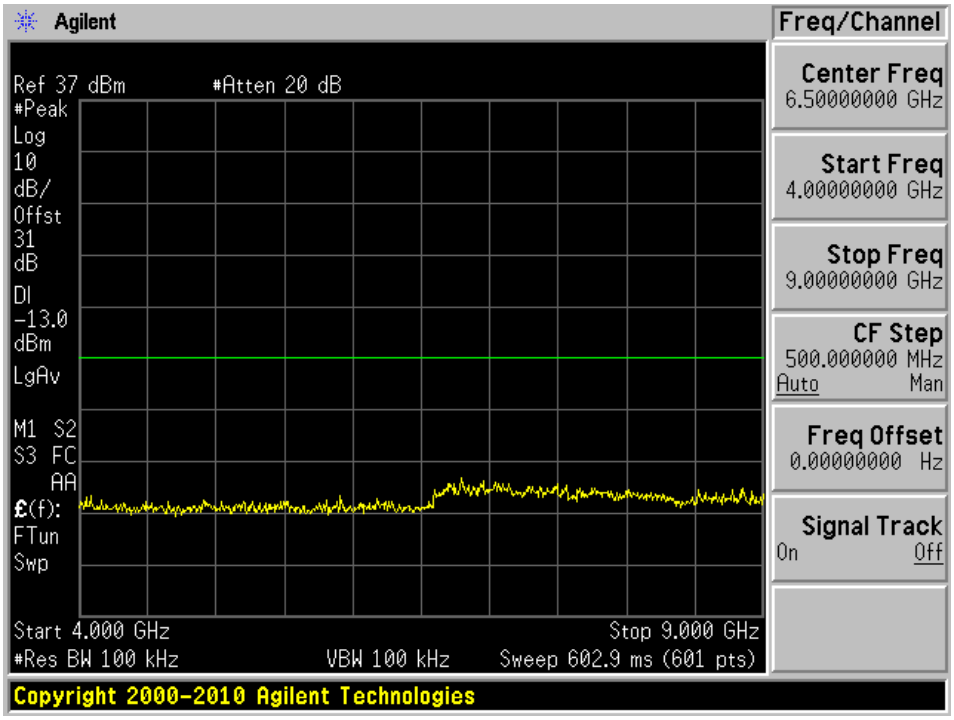
30 MHz – 1 GHz



1 GHz – 4 GHz

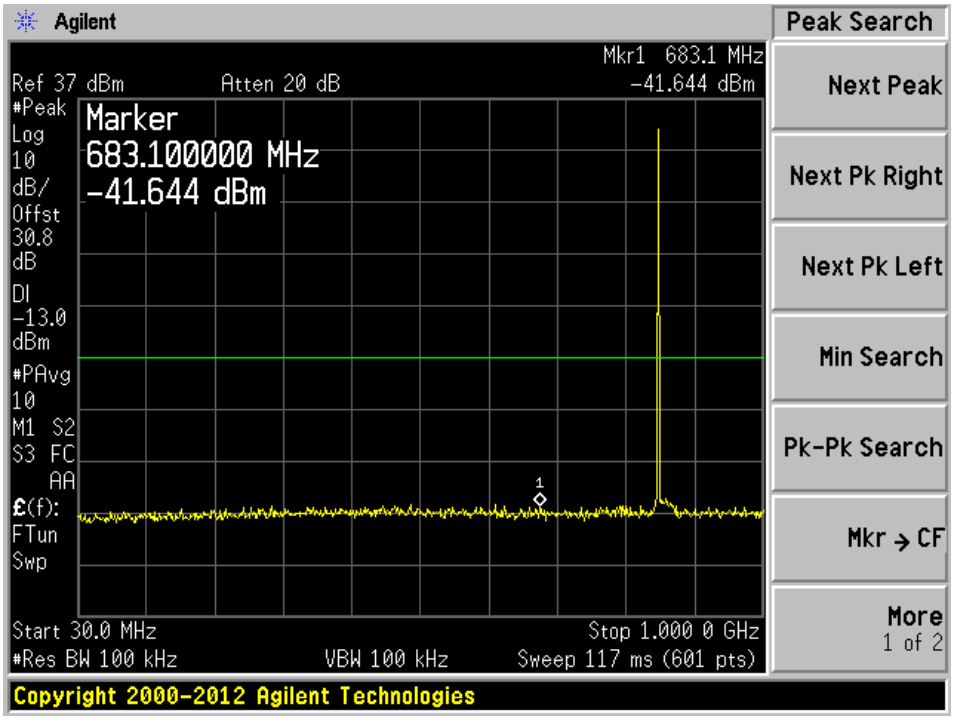


4 GHz – 9 GHz

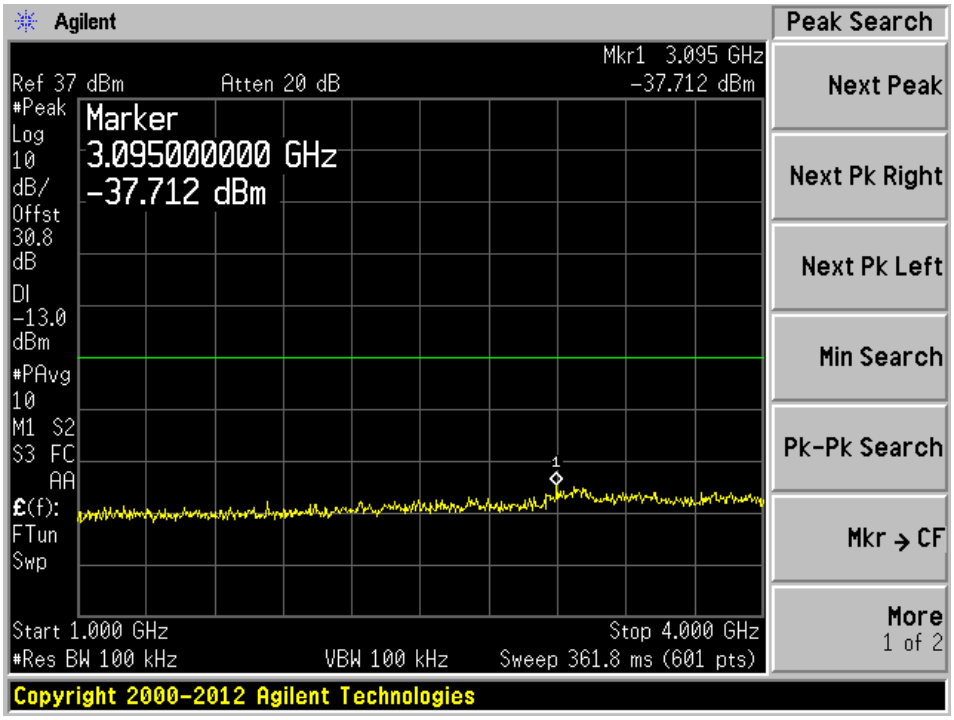


C4FM, Low Channel – 851.0125 MHz

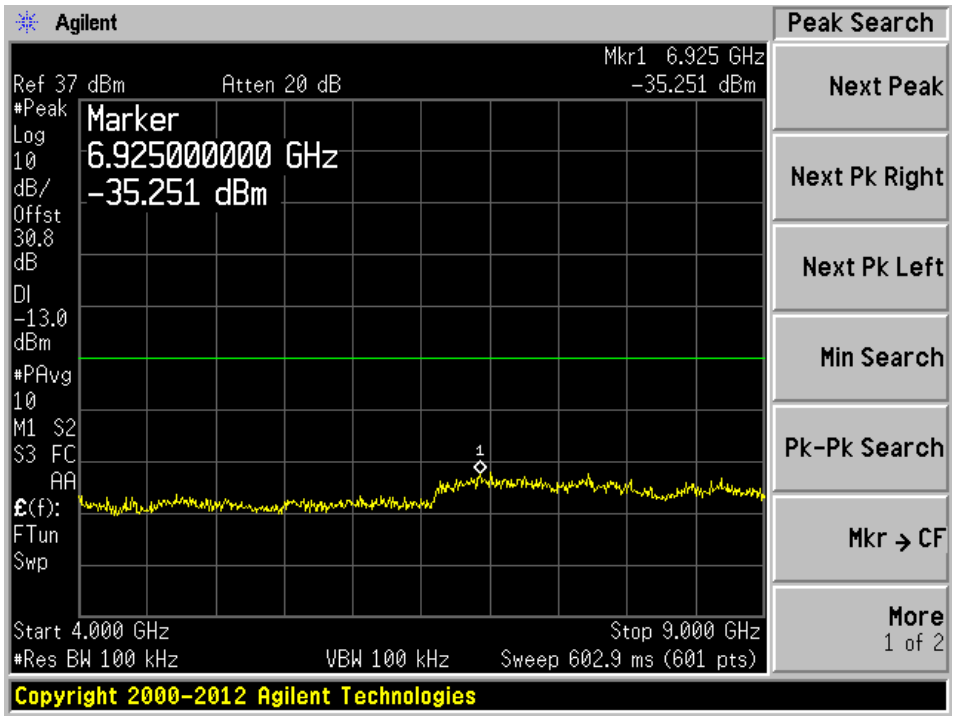
30 MHz – 1 GHz



1 GHz – 4 GHz

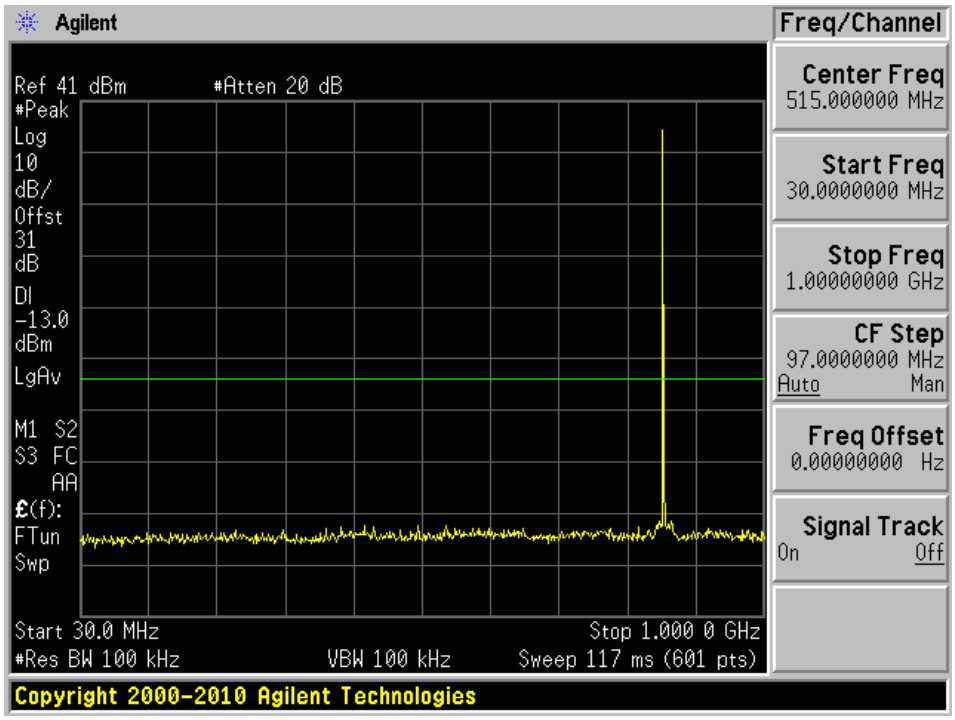


4 GHz – 9 GHz

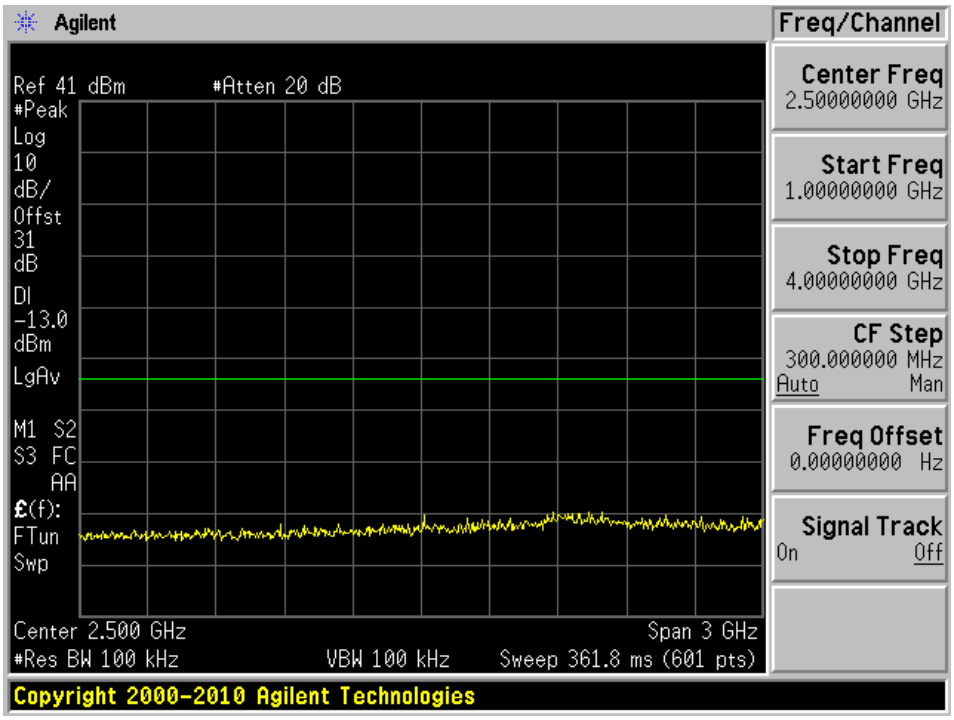


C4FM, Middle Channel – 856.5 MHz

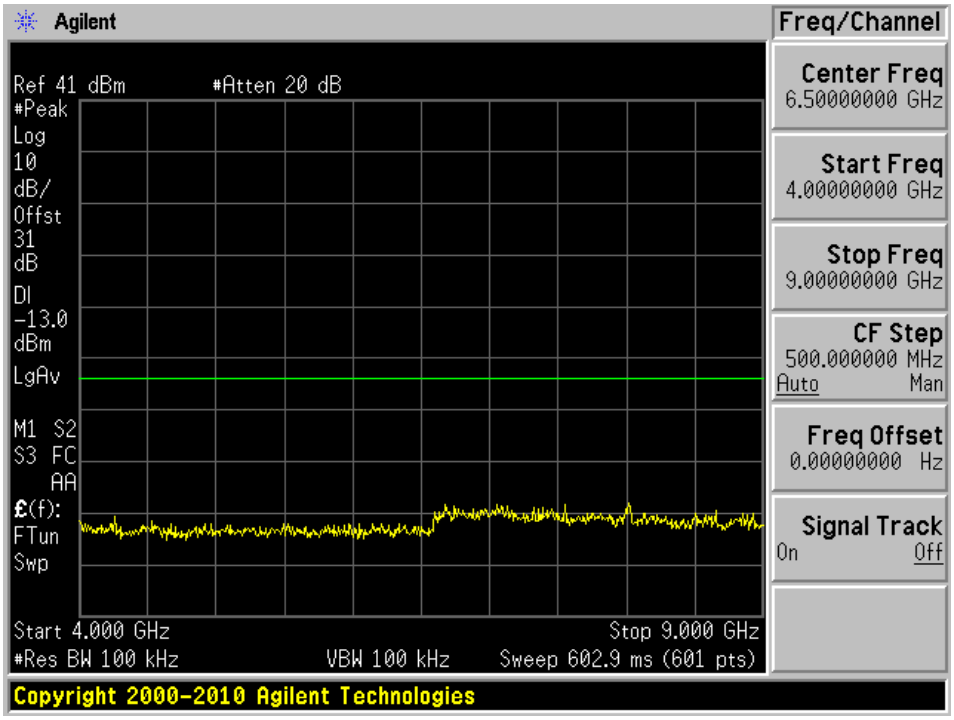
30 MHz – 1 GHz



1 GHz – 4 GHz

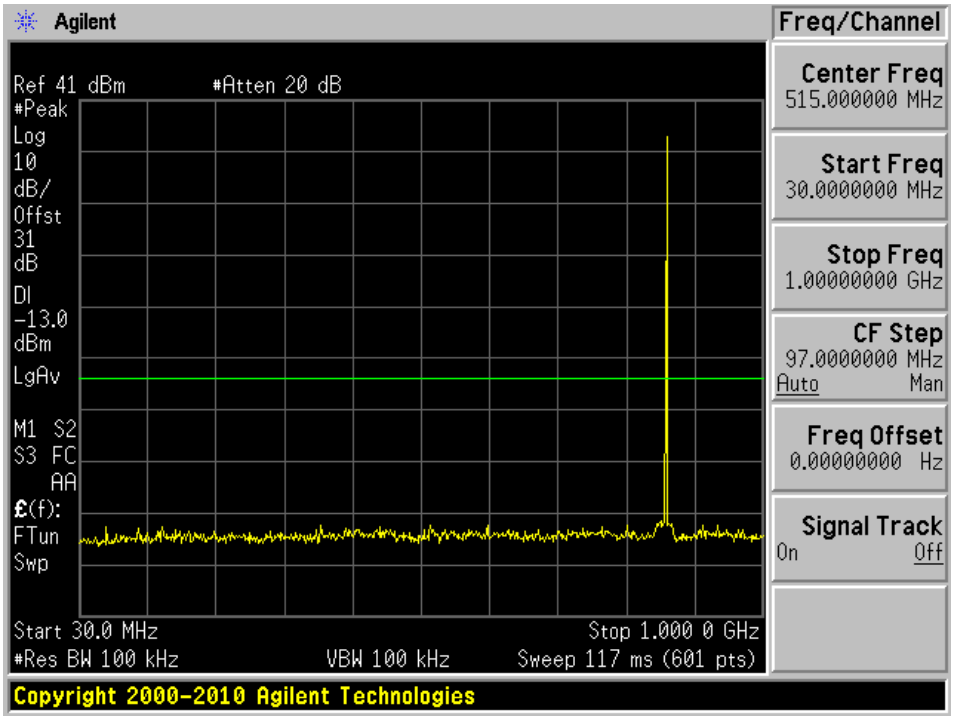


4 GHz – 9 GHz

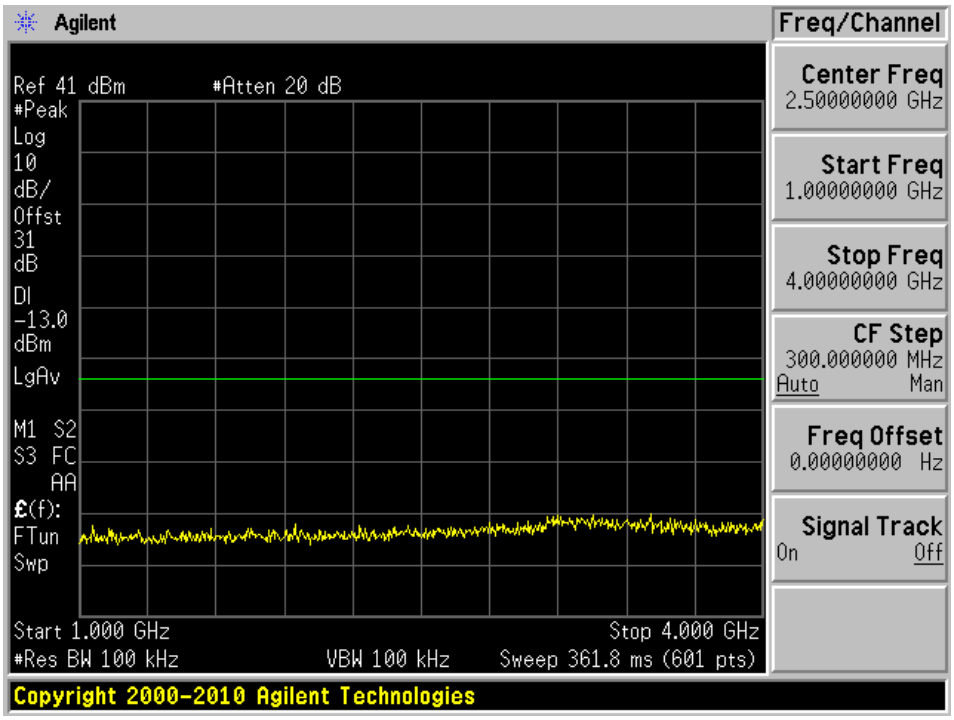


C4FM, High Channel – 861.9875 MHz

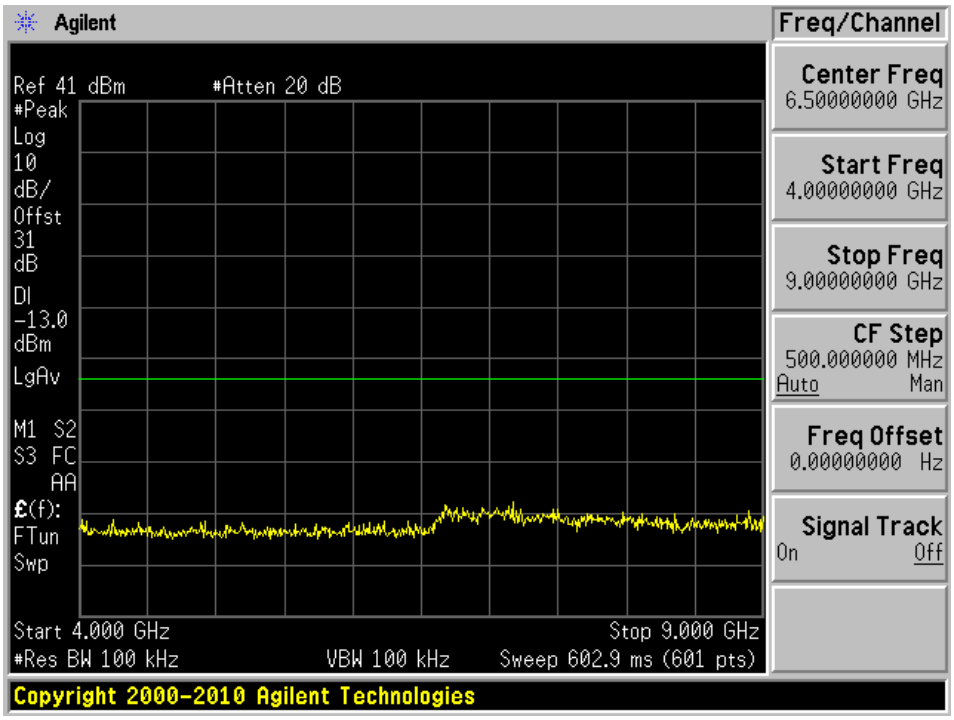
30 MHz – 1 GHz



1 GHz – 4 GHz

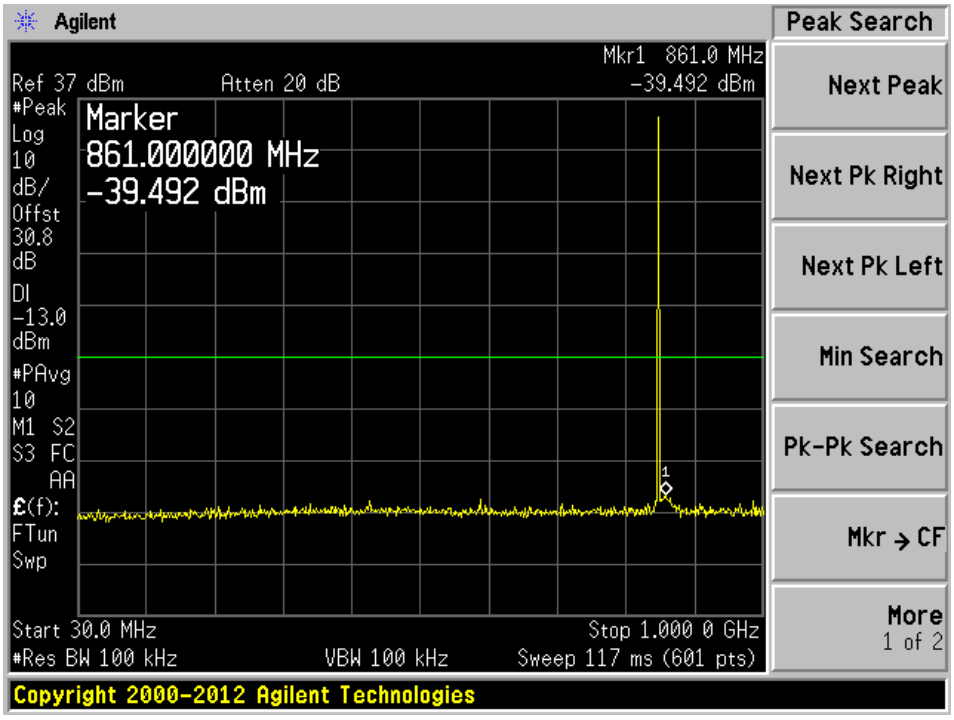


4 GHz – 9 GHz

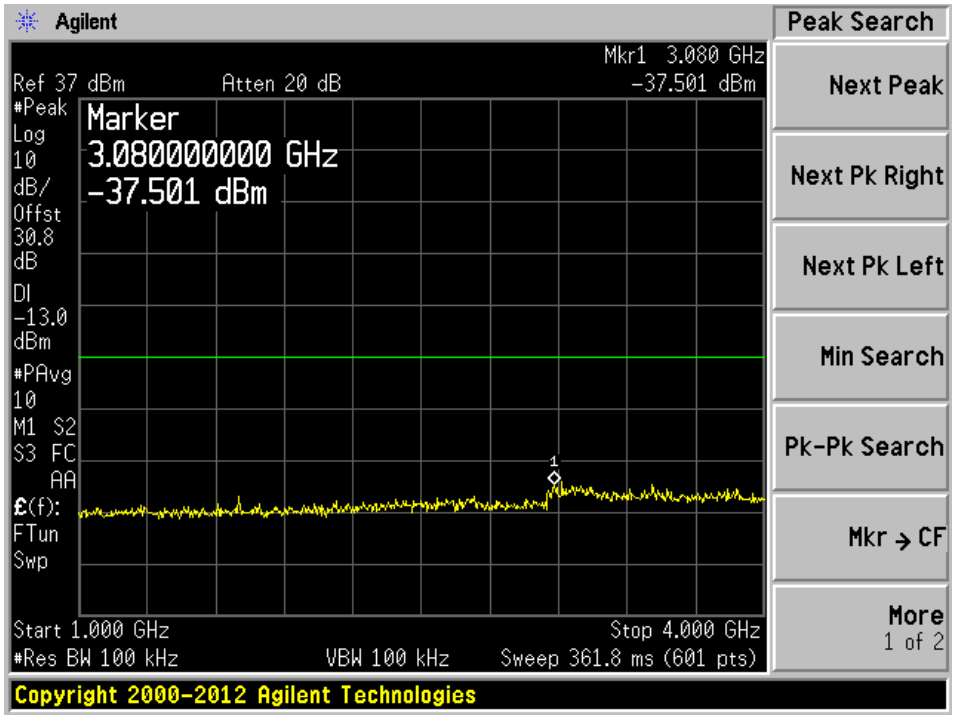


CQPSK, Low Channel – 851.0125 MHz

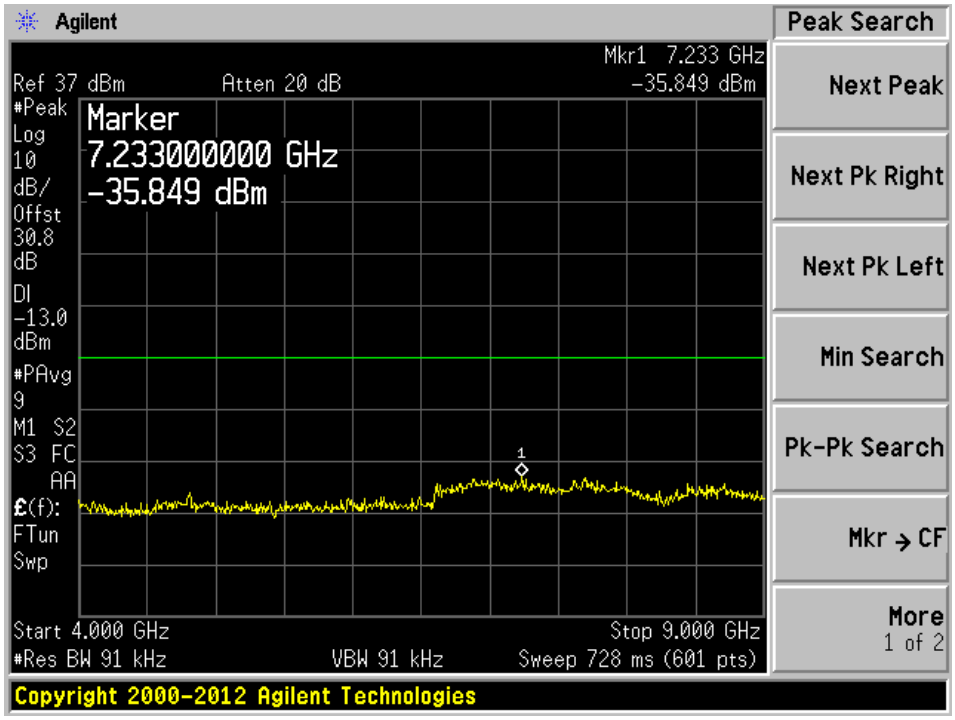
30 MHz – 1 GHz



1 GHz – 4 GHz

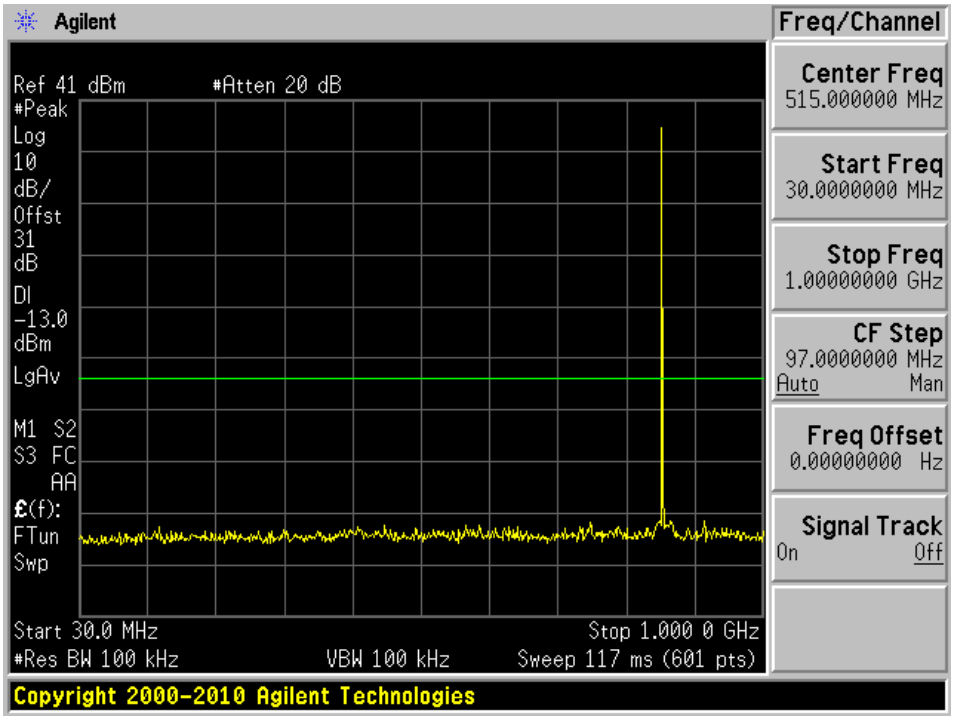


4 GHz – 9 GHz

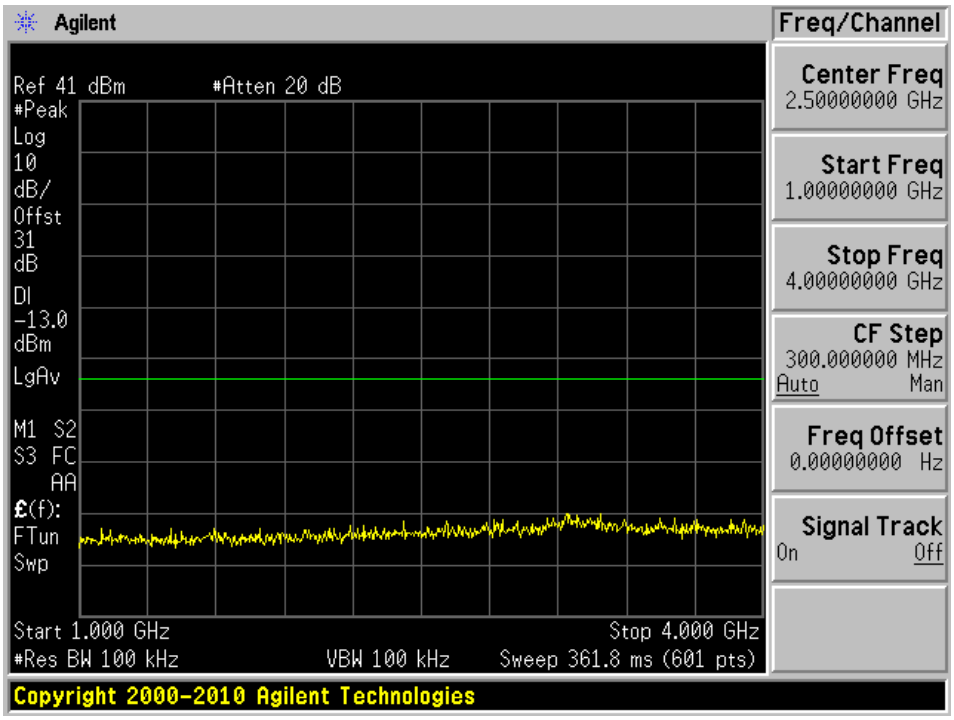


CQPSK, Middle Channel – 856.5 MHz

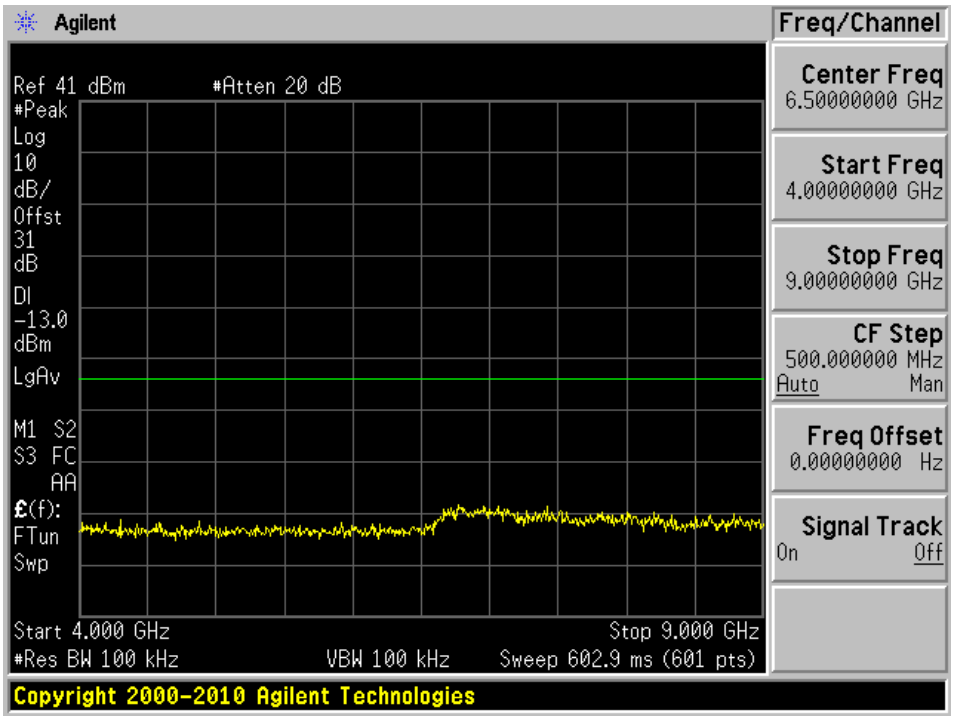
30 MHz – 1 GHz



1 GHz – 4 GHz

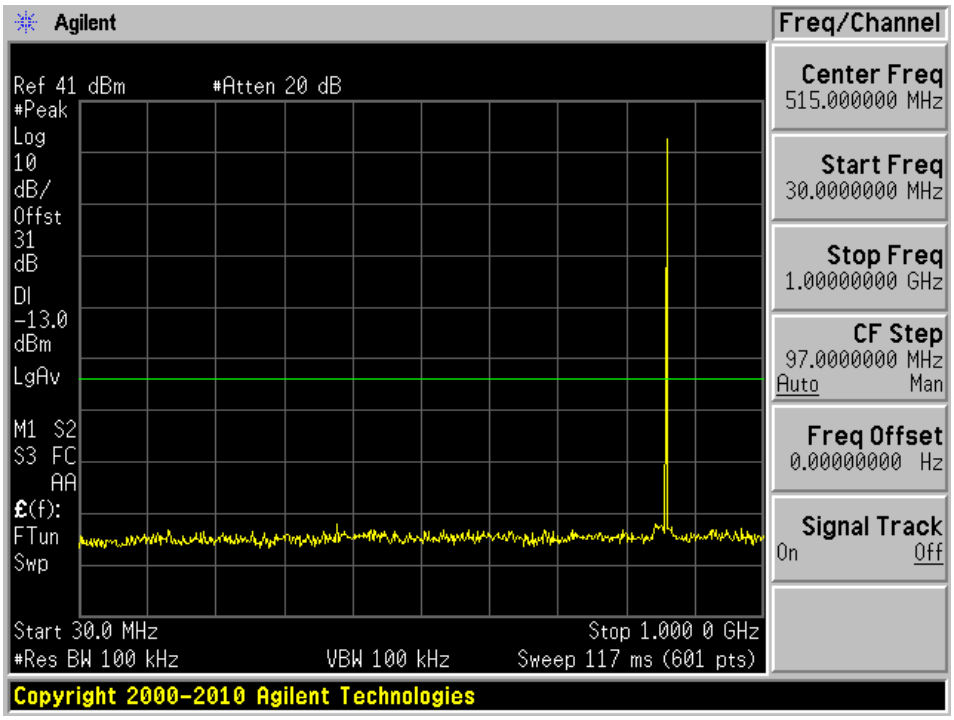


4 GHz – 9 GHz

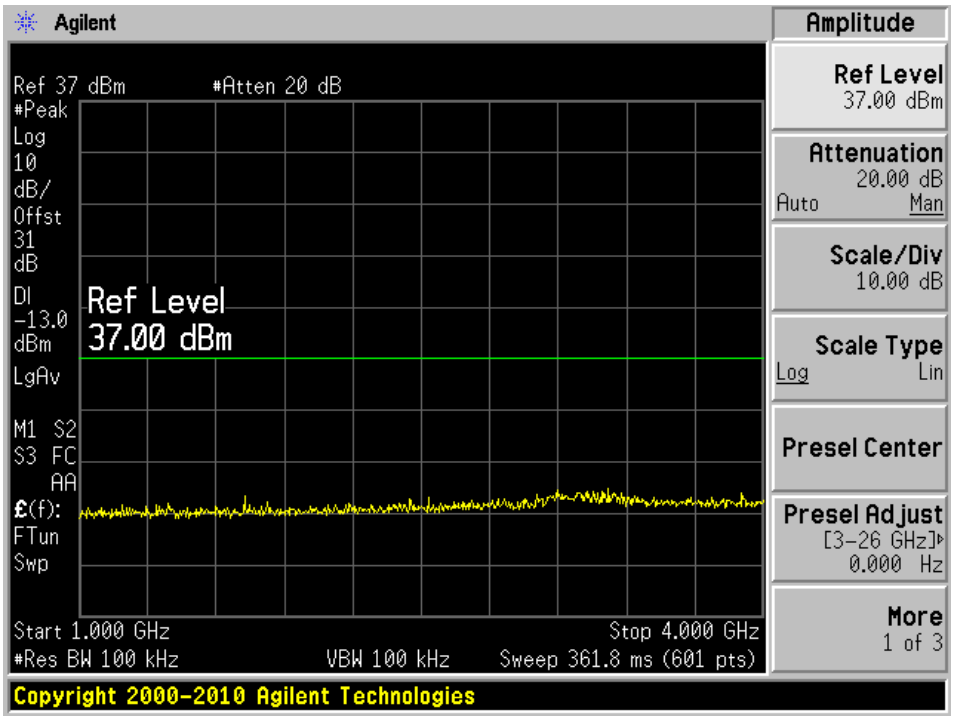


CQPSK, High Channel – 861.9875 MHz

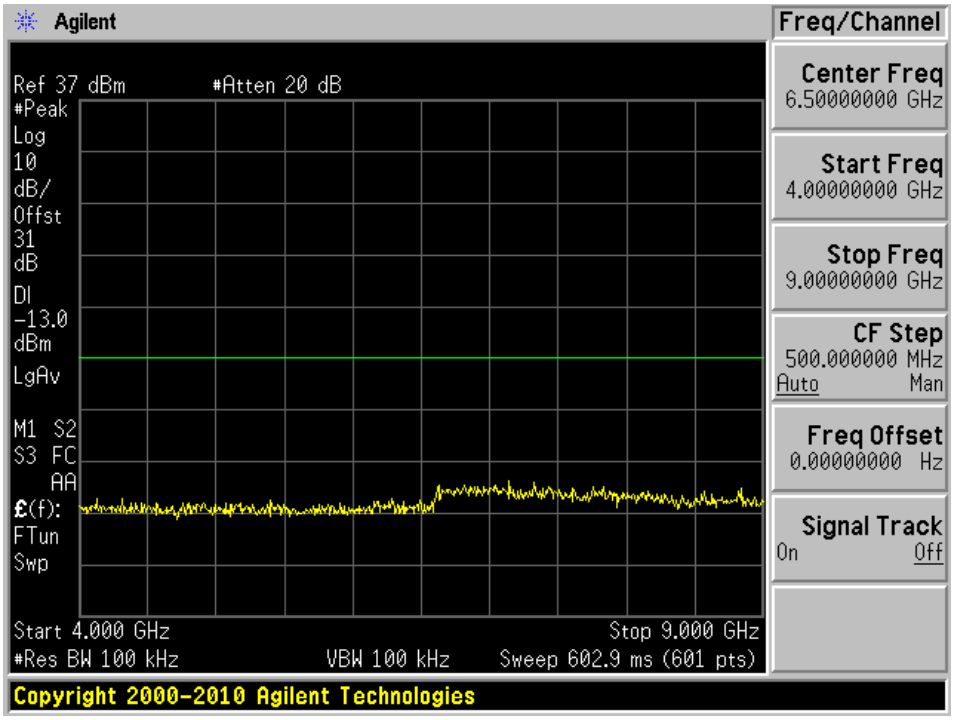
30 MHz – 1 GHz



1 GHz – 4 GHz



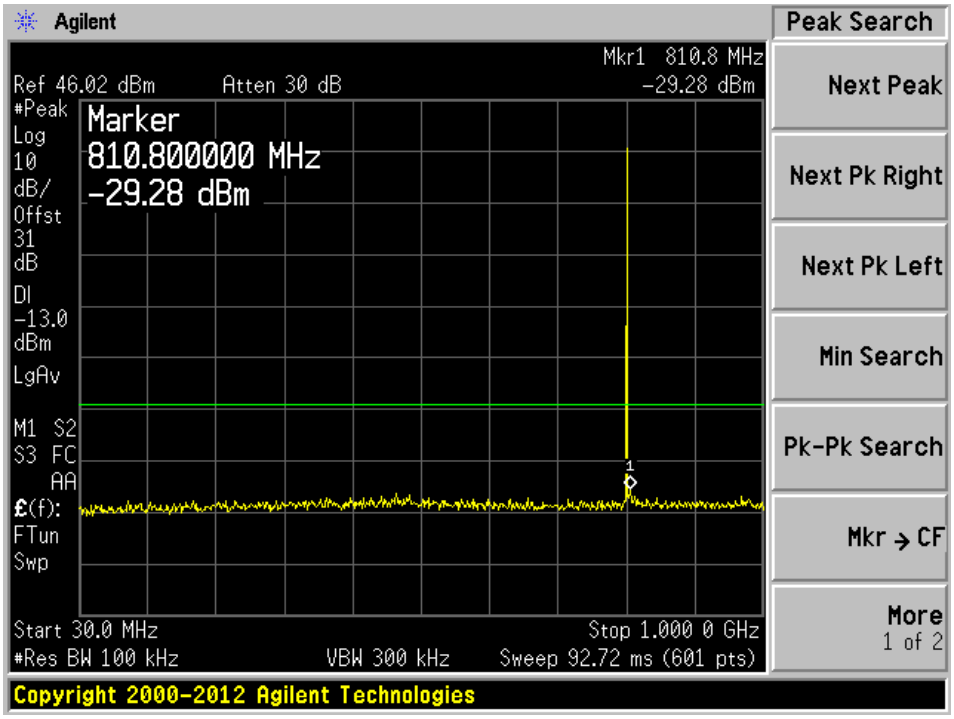
4 GHz – 9 GHz



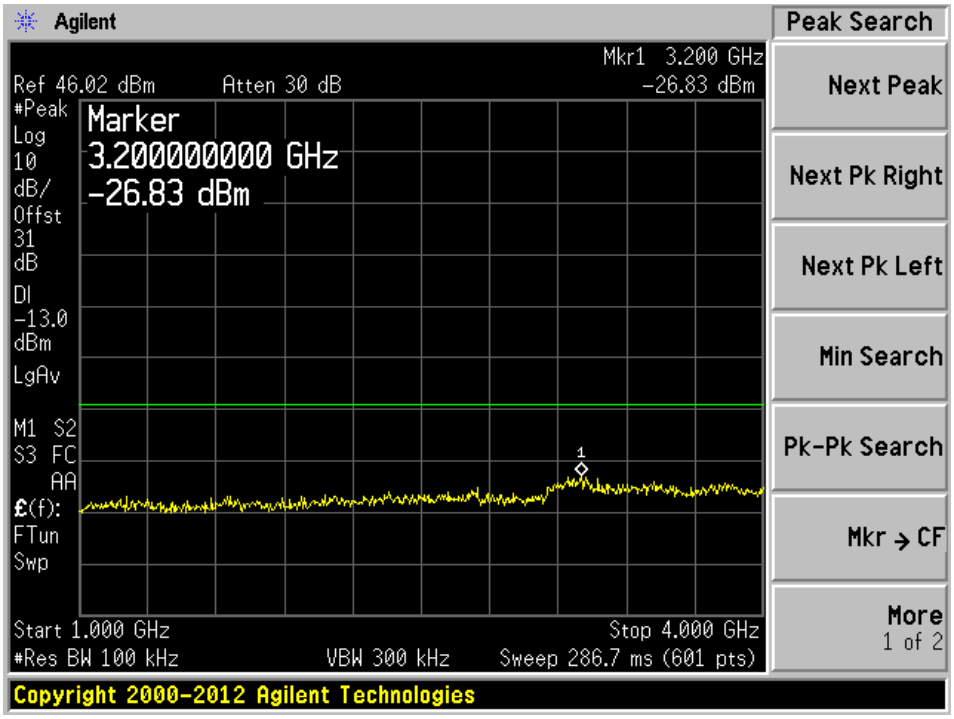
Uplink: 806-817 MHz

FM Data, Low Channel – 806.0125 MHz

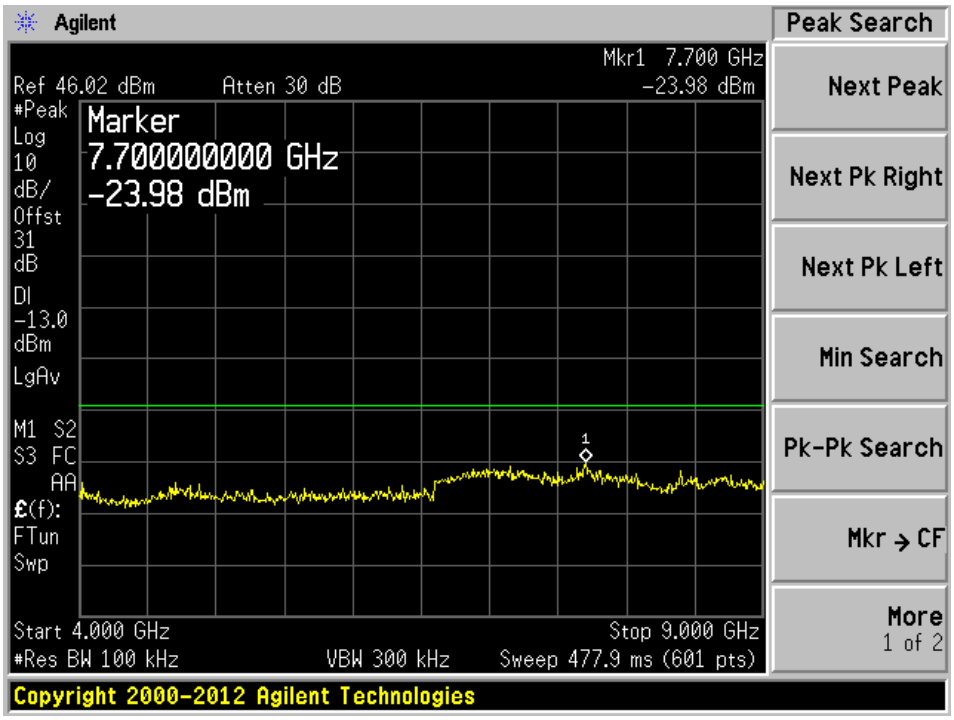
30 MHz – 1 GHz



1 GHz – 4 GHz

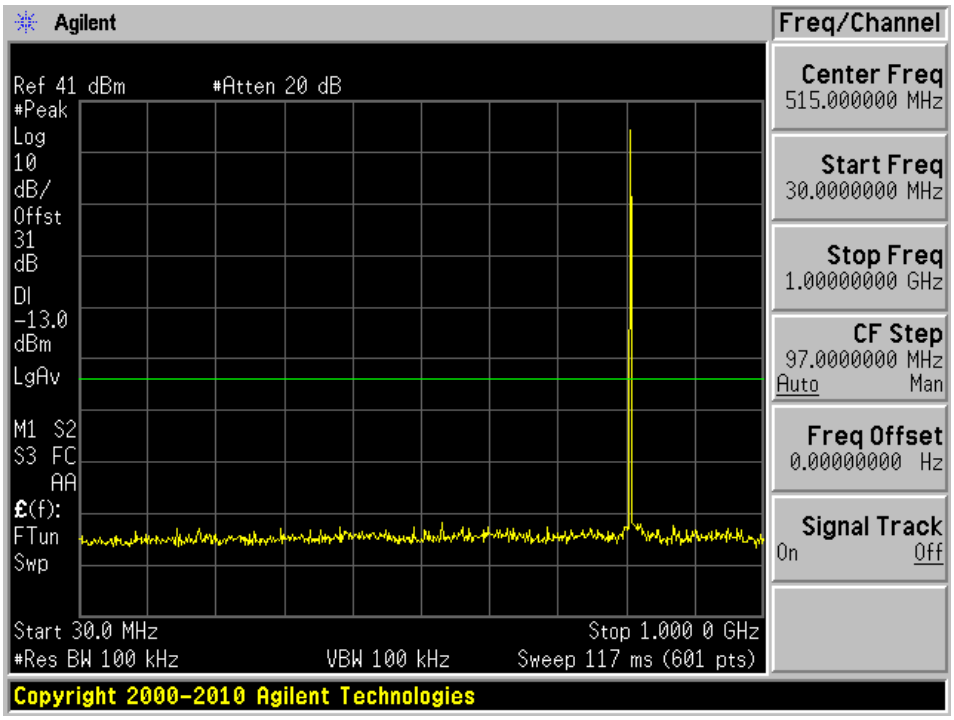


4 GHz – 9 GHz

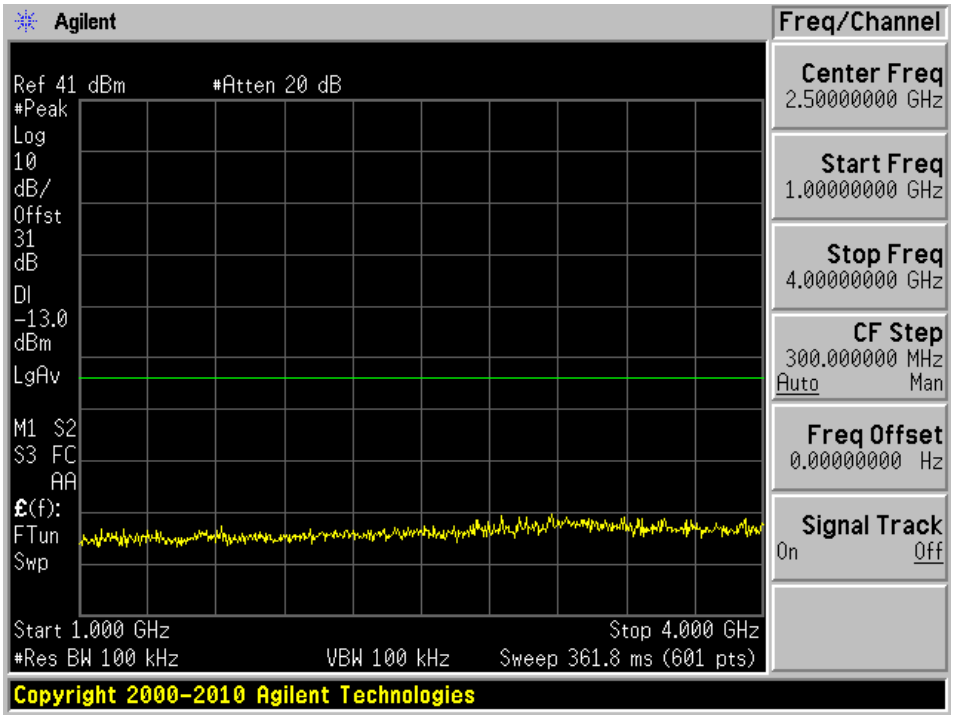


FM Data, Middle Channel – 811.5 MHz

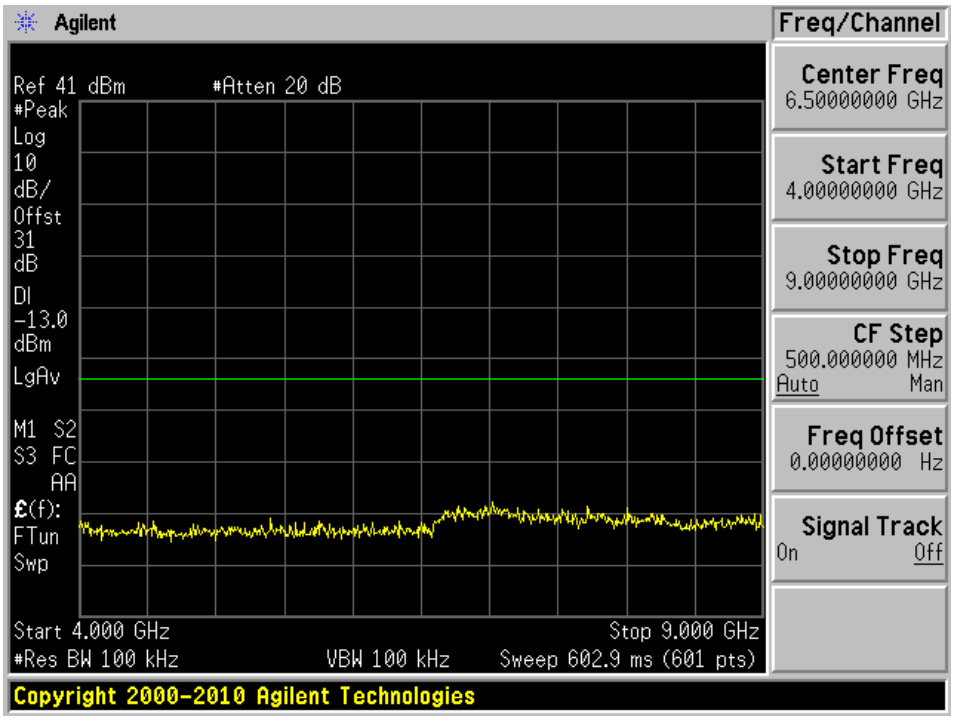
30 MHz – 1 GHz



1 GHz – 4 GHz

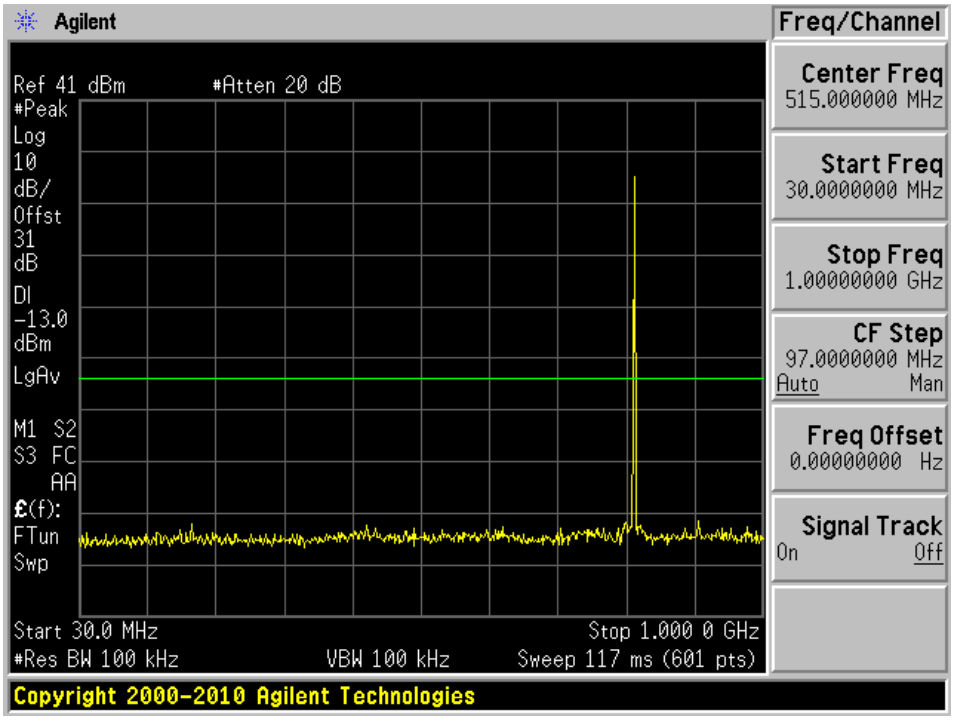


4 GHz – 9 GHz

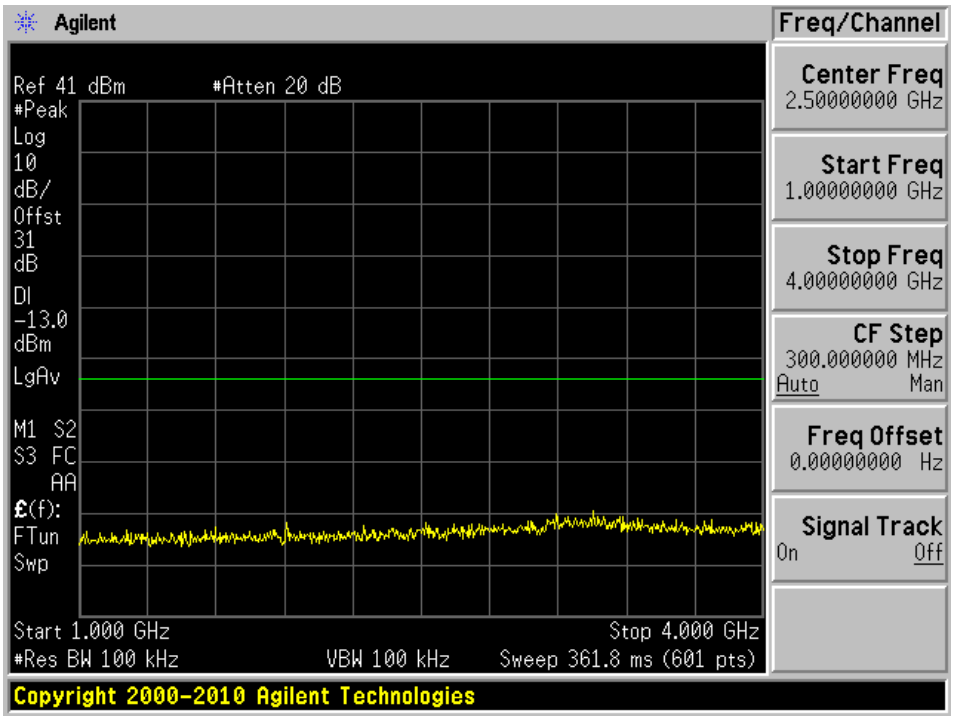


FM Data, High Channel – 816.9875 MHz

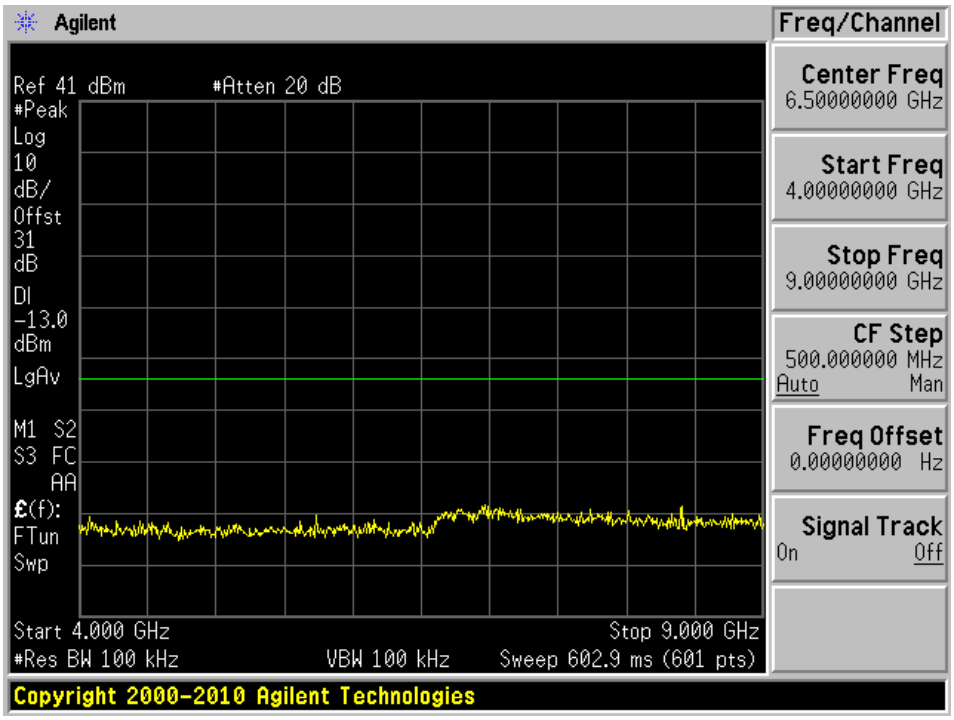
30 MHz – 1 GHz



1 GHz – 4 GHz

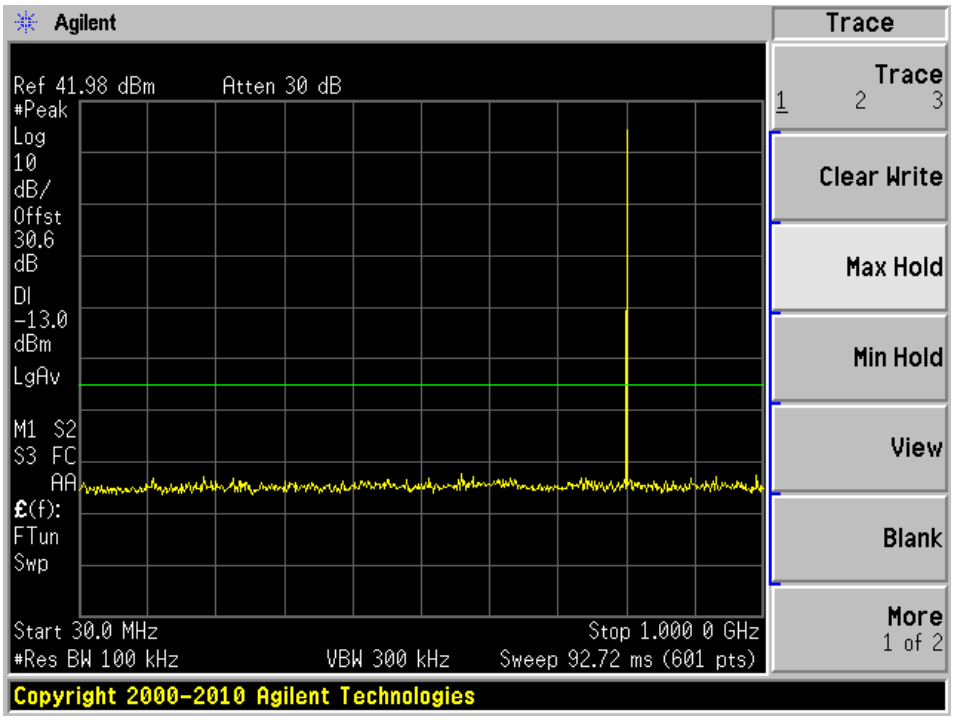


4 GHz – 9 GHz

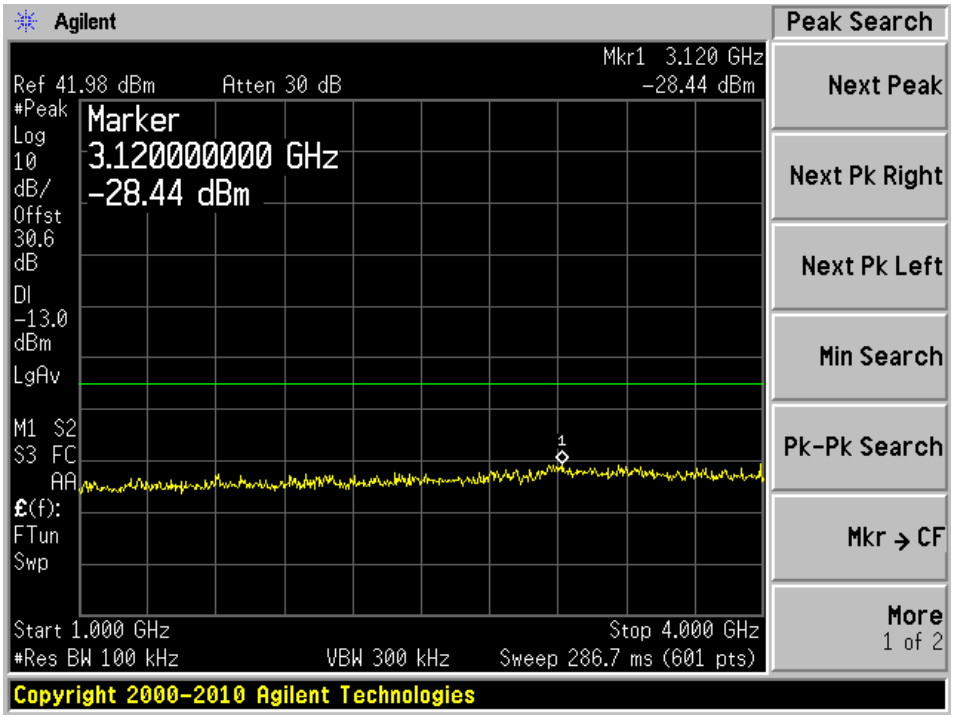


FM Voice, Low Channel – 806.0125 MHz

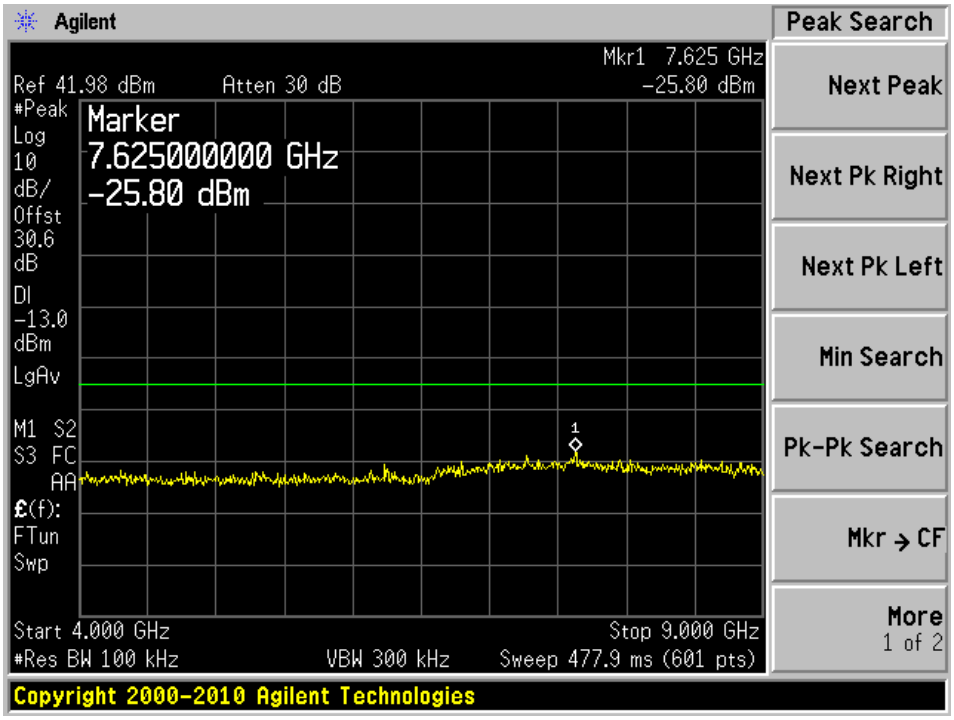
30 MHz – 1 GHz



1 GHz – 4 GHz

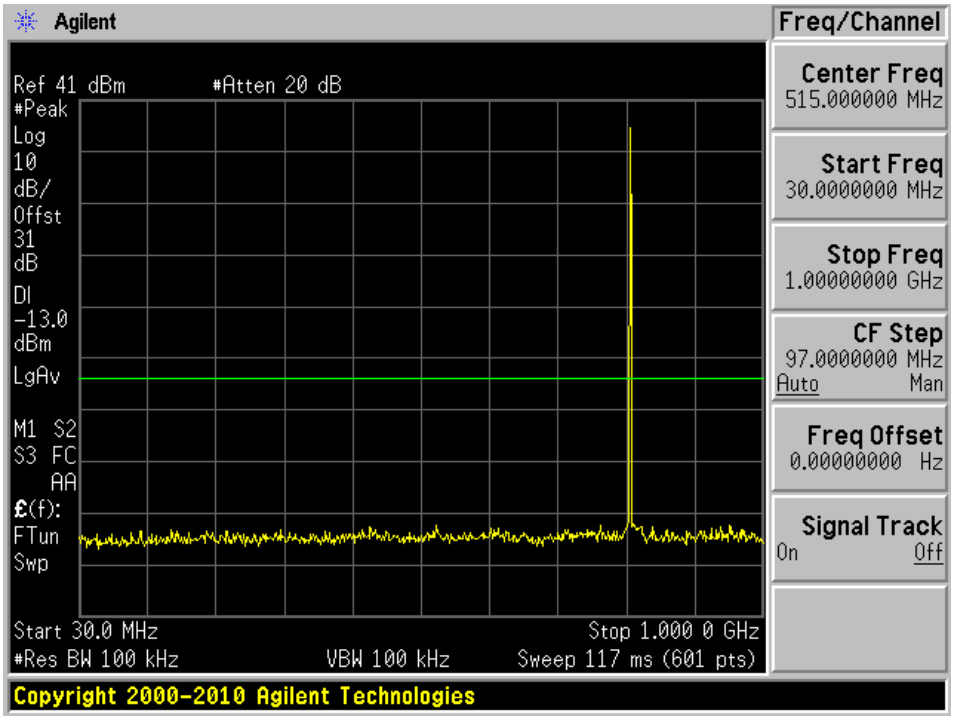


4 GHz – 9 GHz

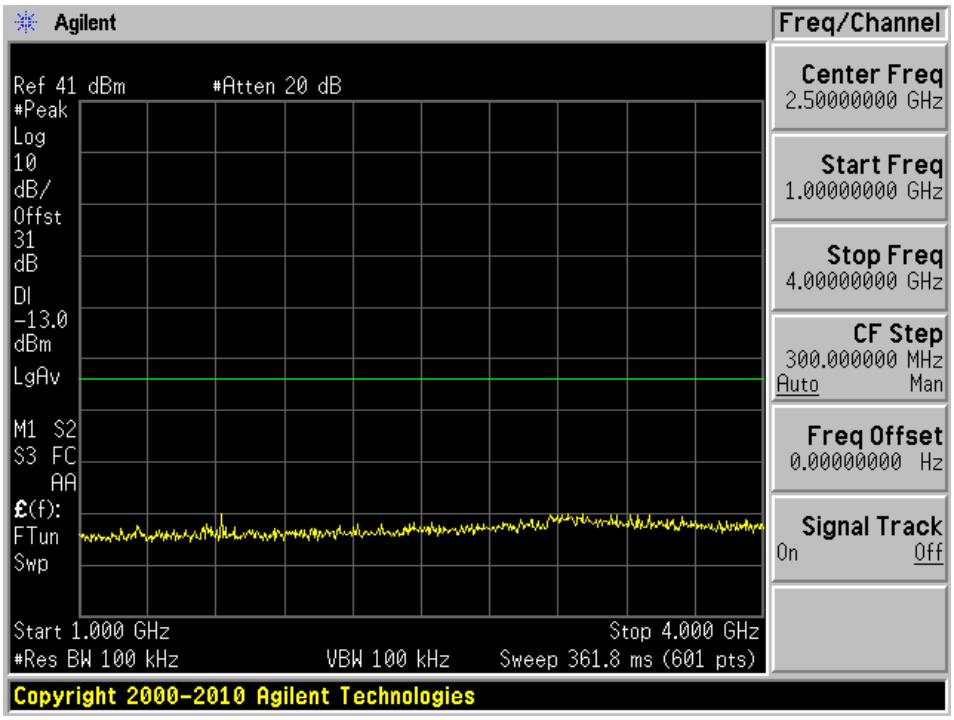


FM Voice, Middle Channel – 811.5 MHz

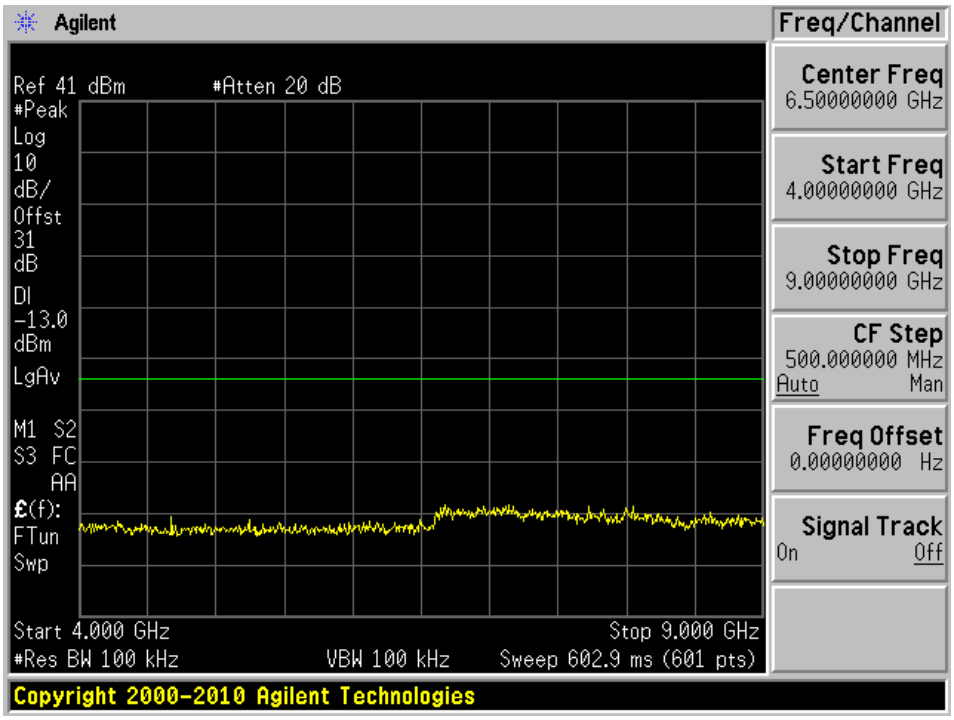
30 MHz – 1 GHz



1 GHz – 4 GHz

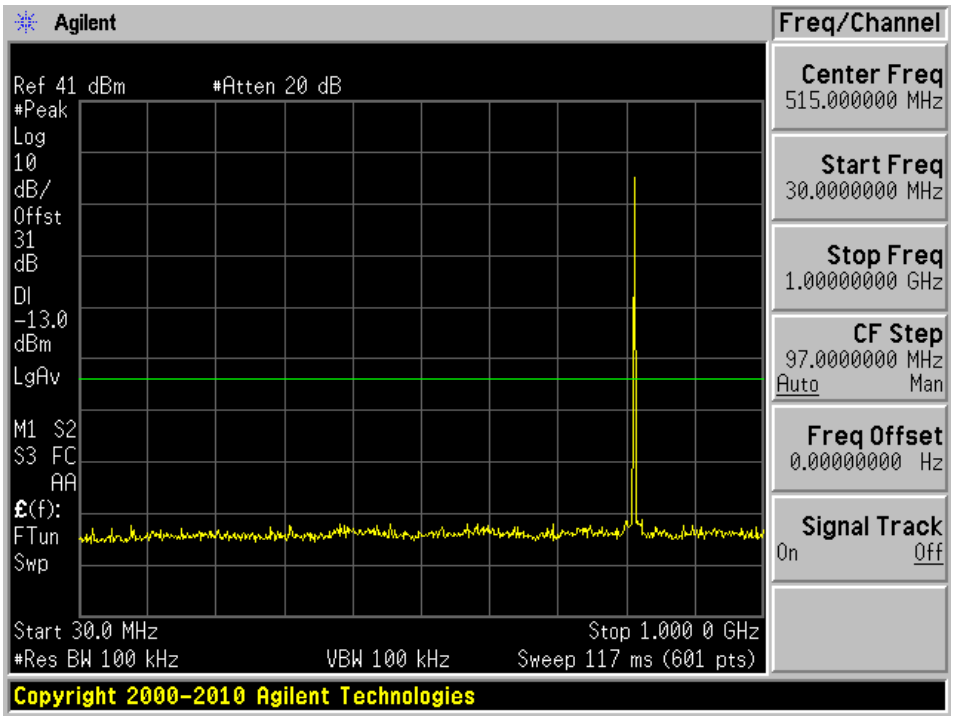


4 GHz – 9 GHz

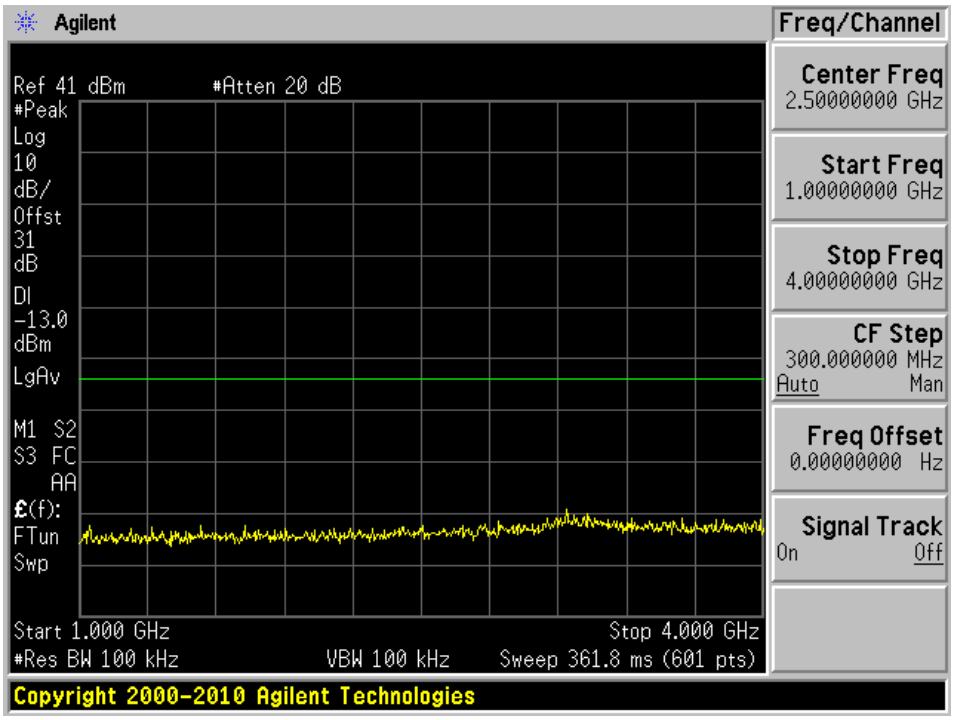


FM Voice, High Channel – 816.9875 MHz

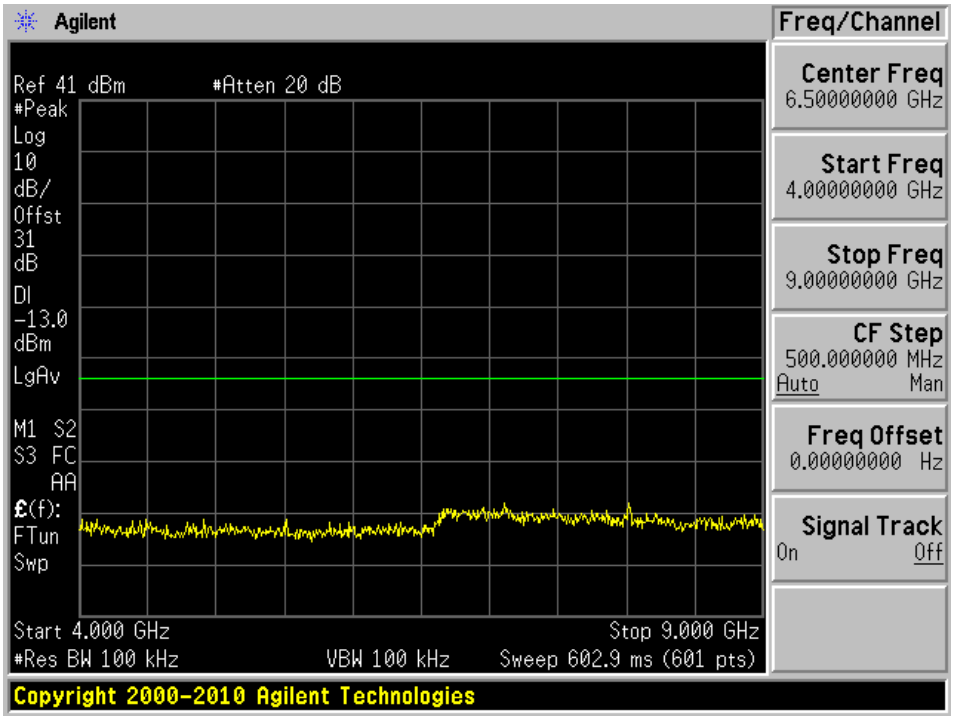
30 MHz – 1 GHz



1 GHz – 4 GHz

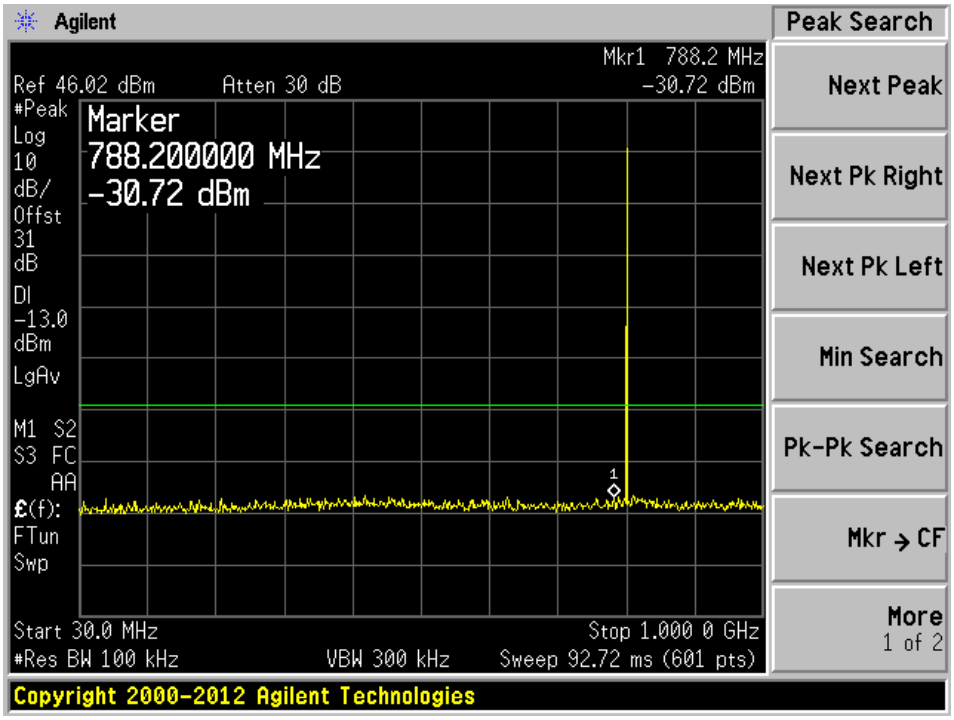


4 GHz – 9 GHz

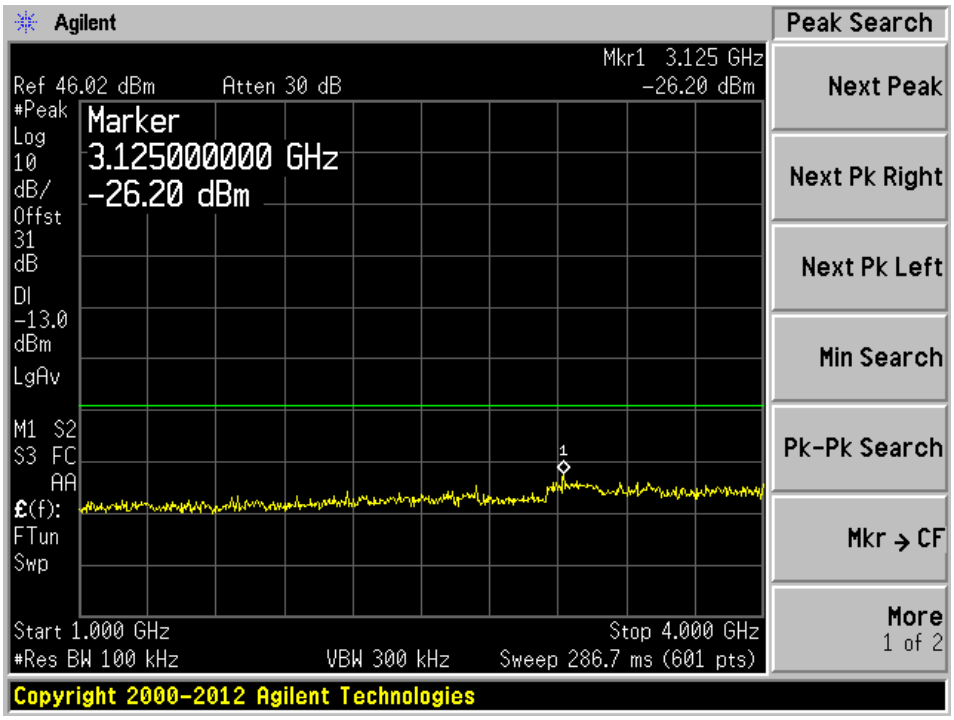


C4FM, Low Channel – 806.0125 MHz

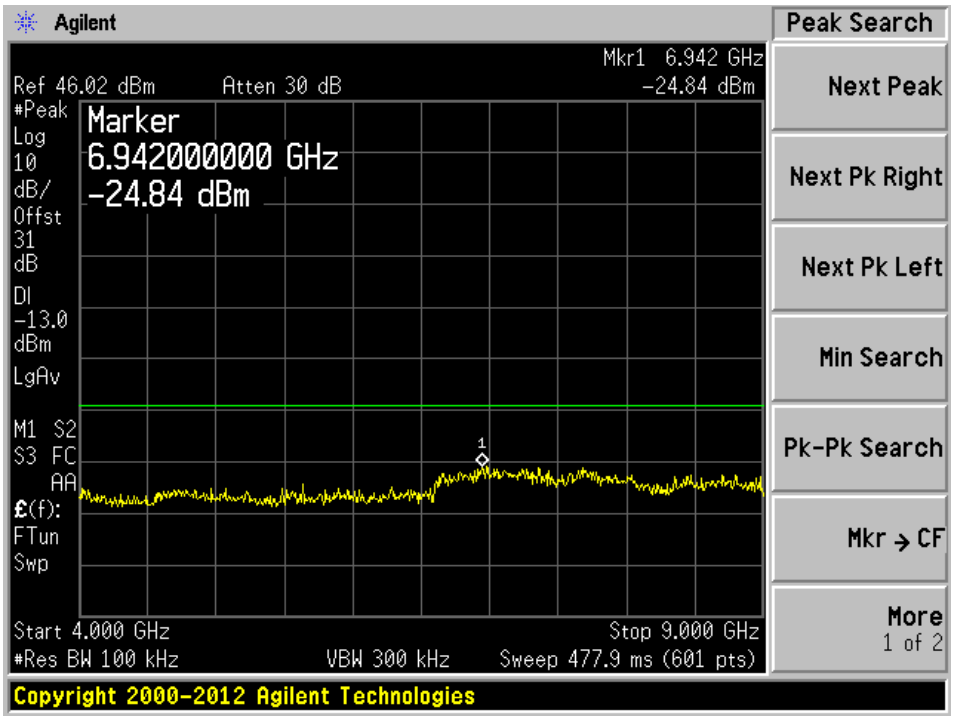
30 MHz – 1 GHz



1 GHz – 4 GHz

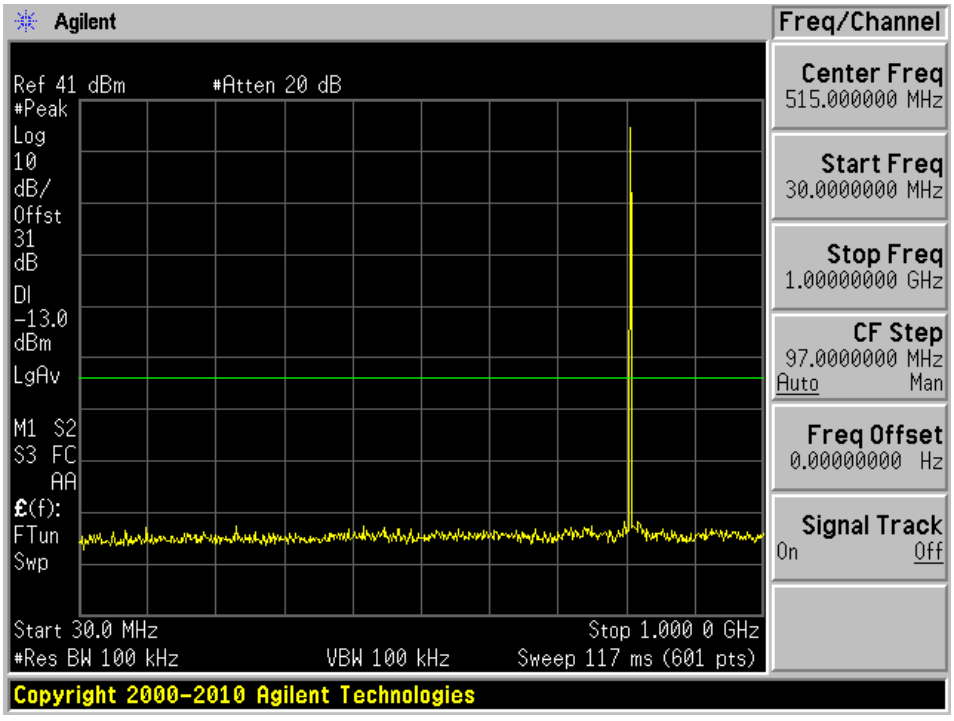


4 GHz – 9 GHz

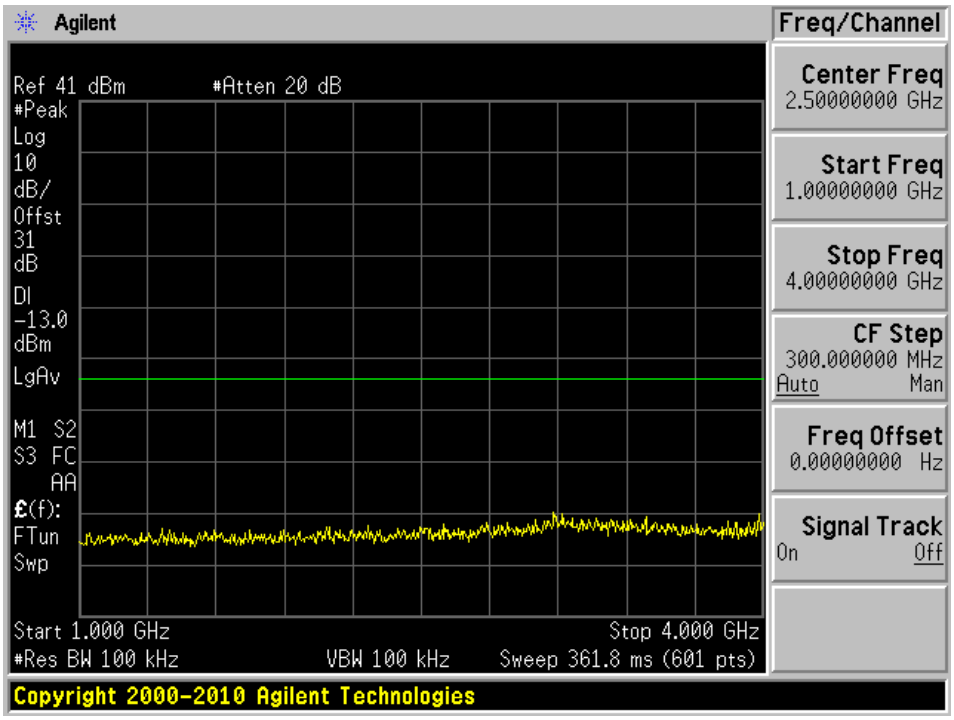


C4FM, Middle Channel – 811.5 MHz

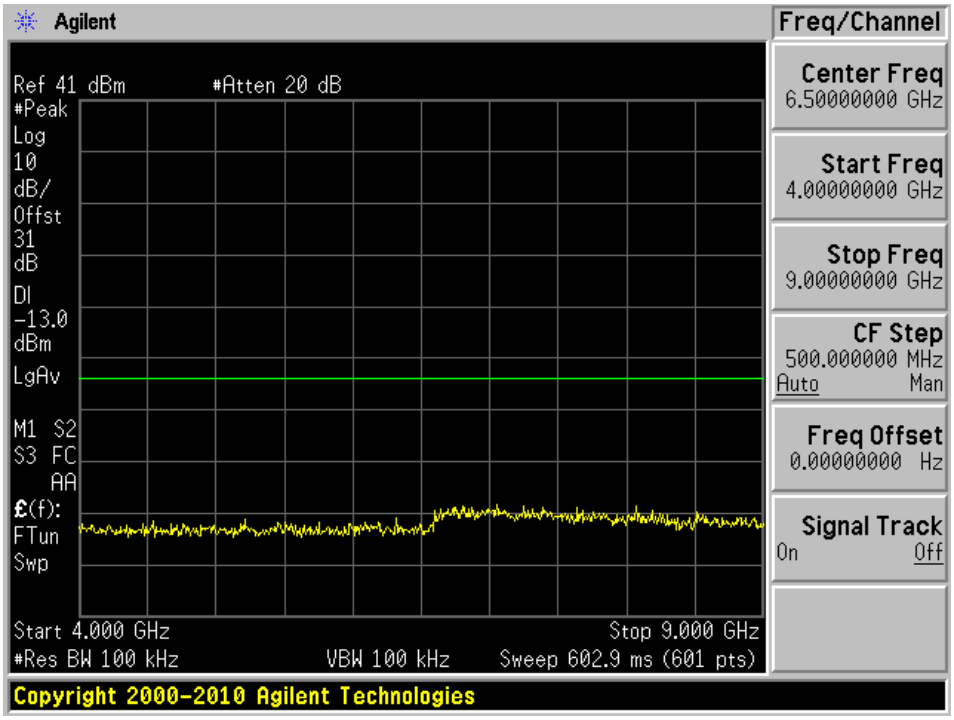
30 MHz – 1 GHz



1 GHz – 4 GHz

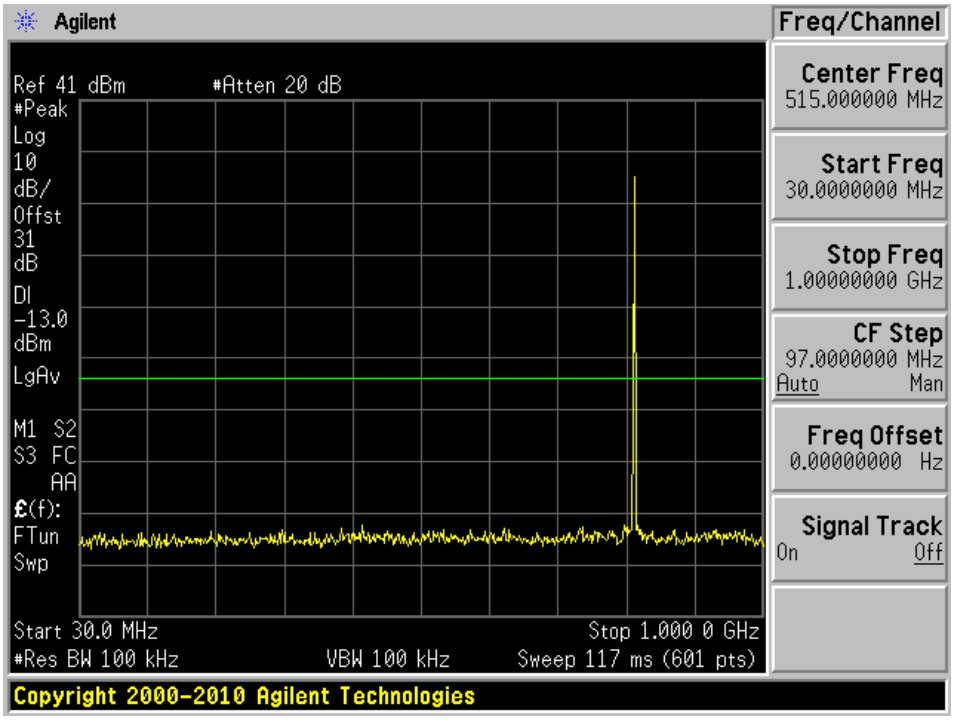


4 GHz – 9 GHz

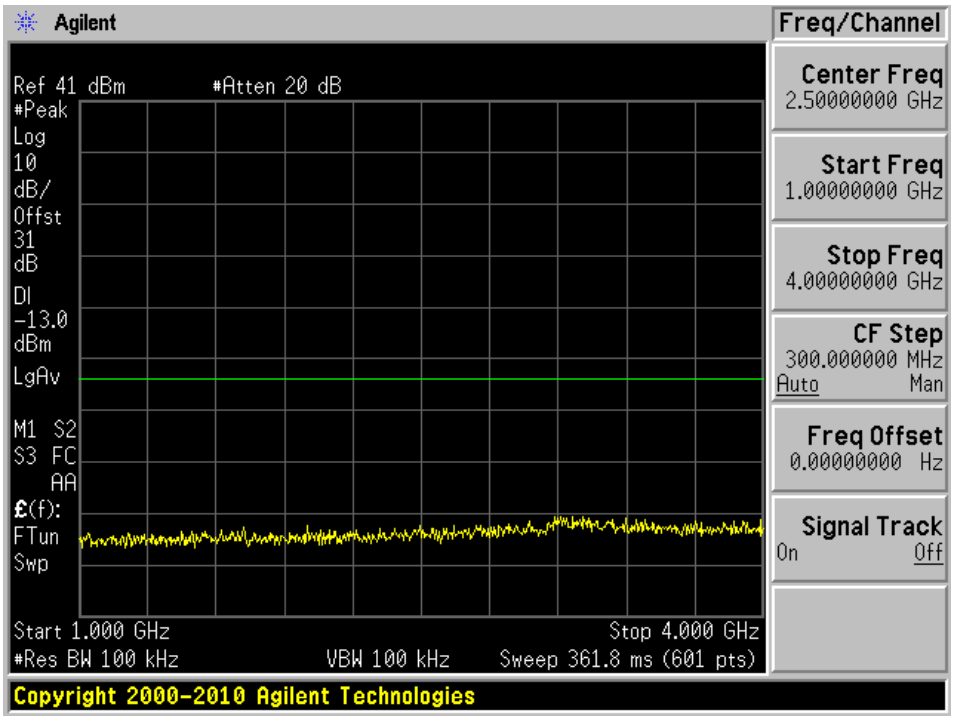


C4FM, High Channel – 816.9875 MHz

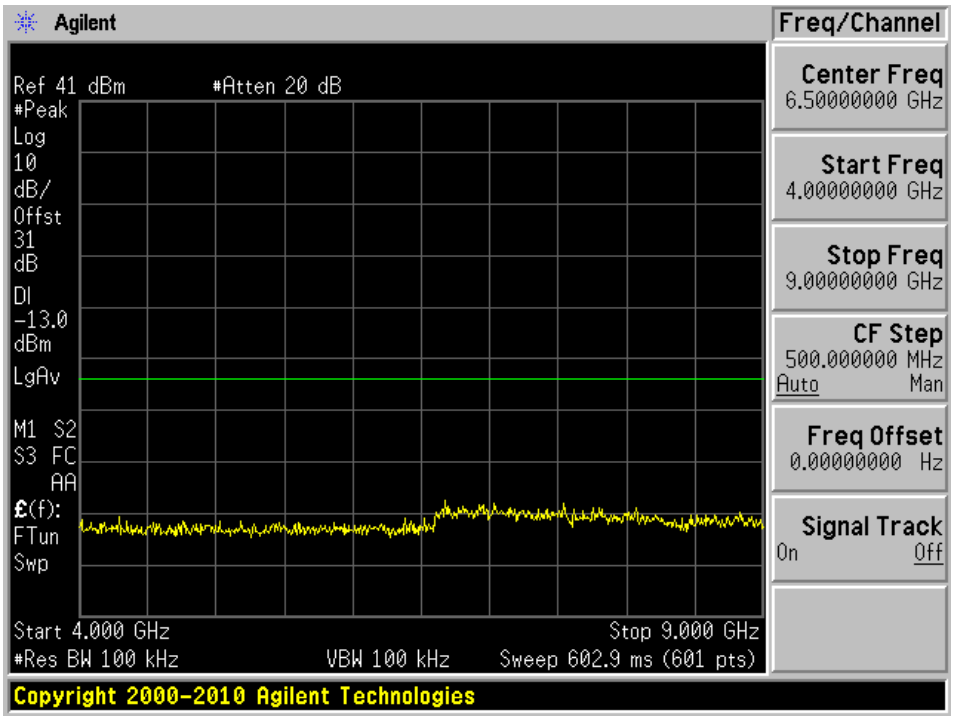
30 MHz – 1 GHz



1 GHz – 4 GHz

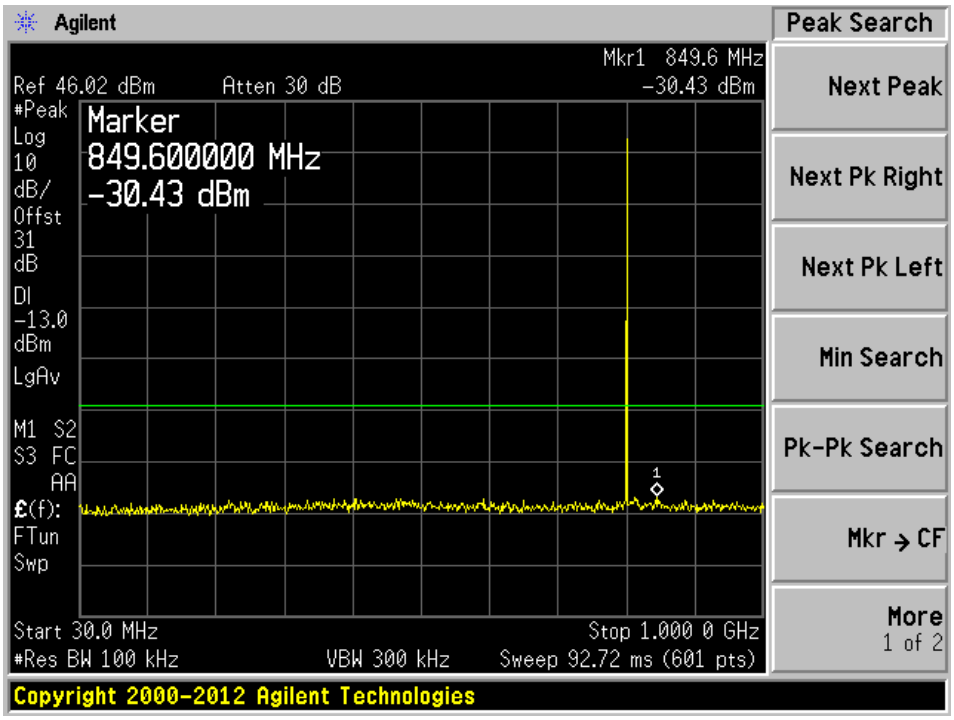


4 GHz – 9 GHz

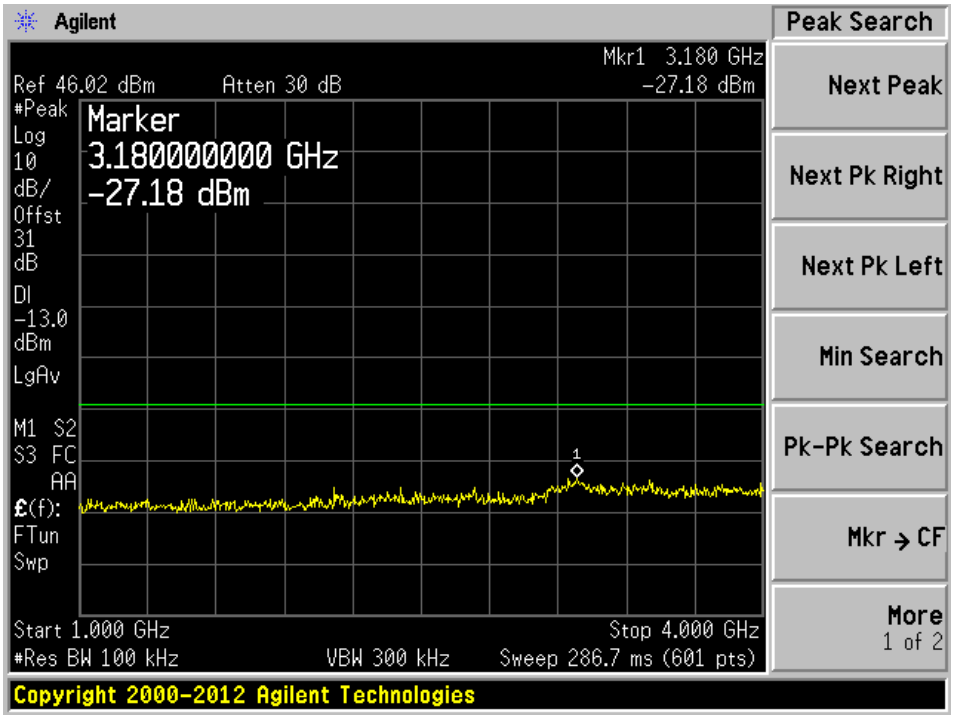


CQPSK, Low Channel – 806.0125 MHz

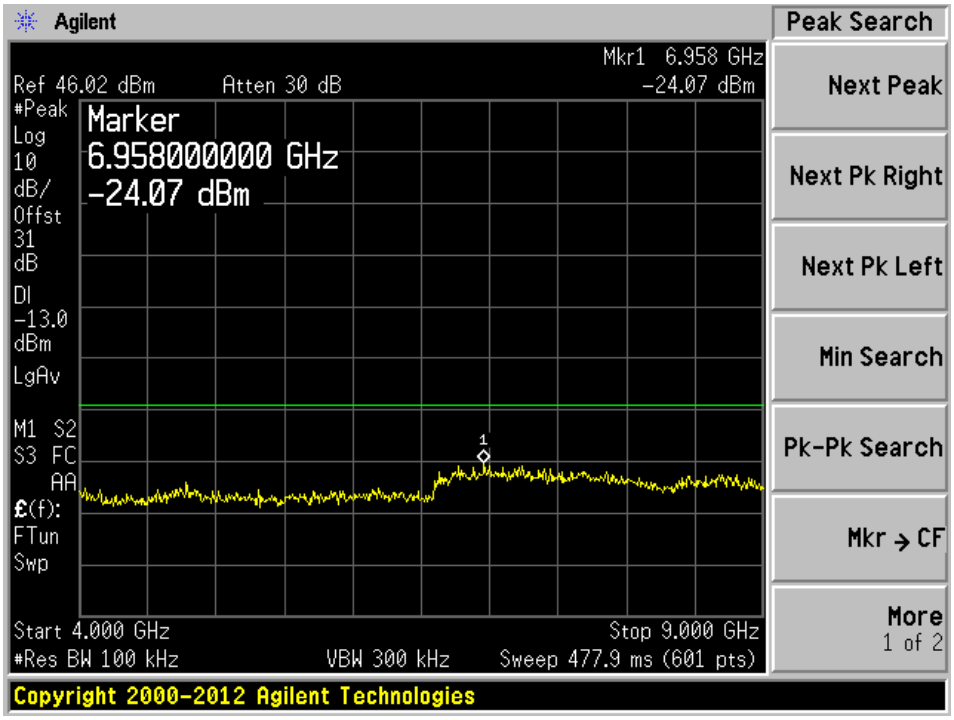
30 MHz – 1 GHz



1 GHz – 4 GHz

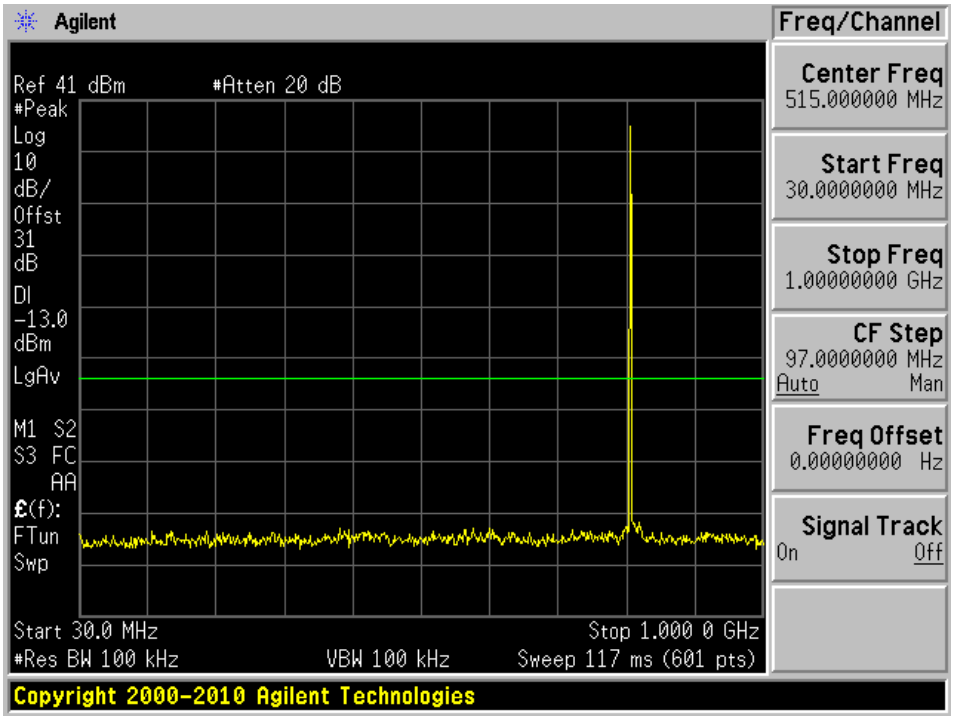


4 GHz – 9 GHz

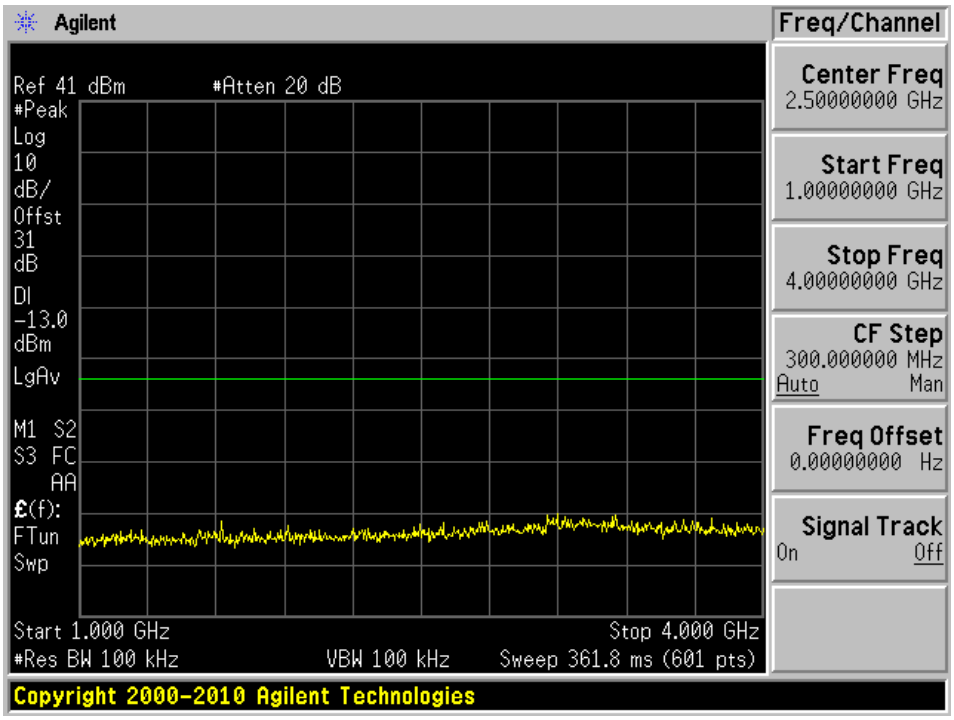


CQPSK, Middle Channel – 811.5 MHz

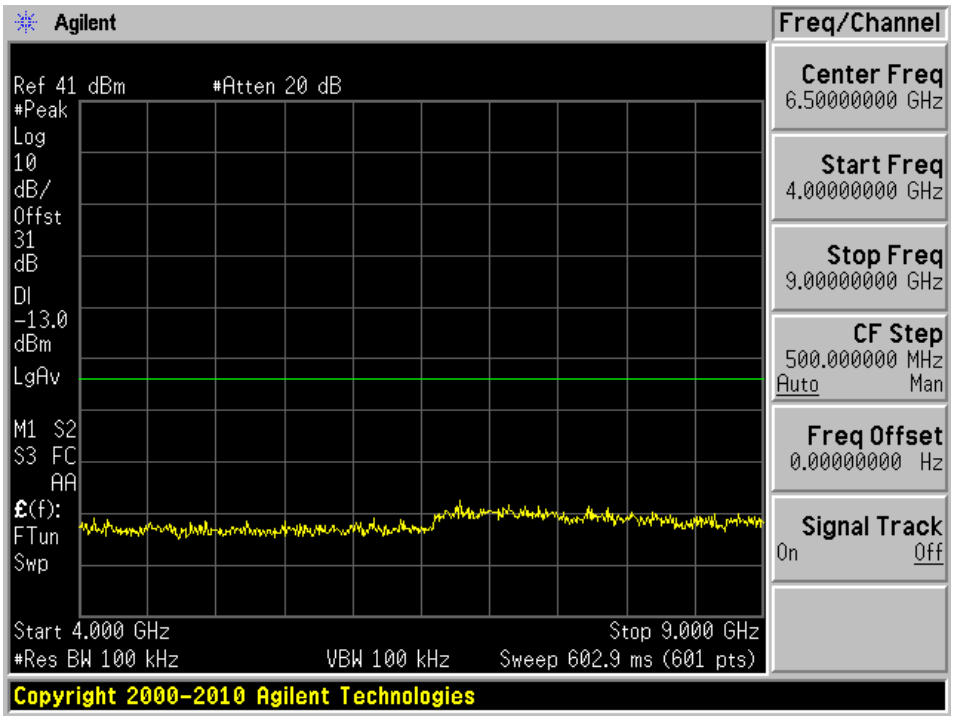
30 MHz – 1 GHz



1 GHz – 4 GHz

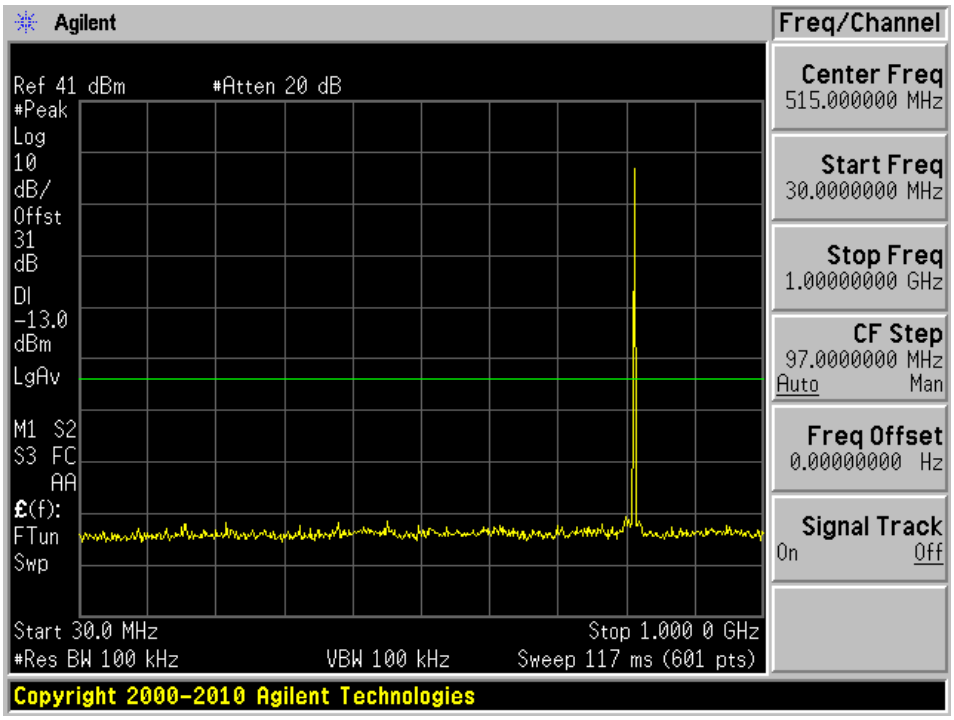


4 GHz – 9 GHz

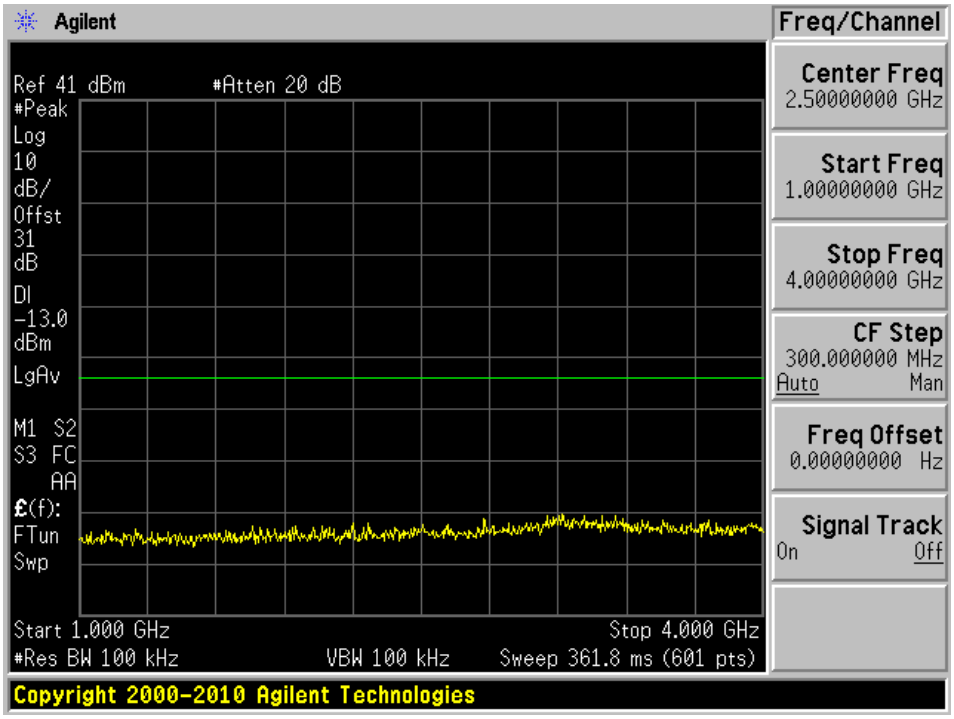


CQPSK, High Channel – 816.9875 MHz

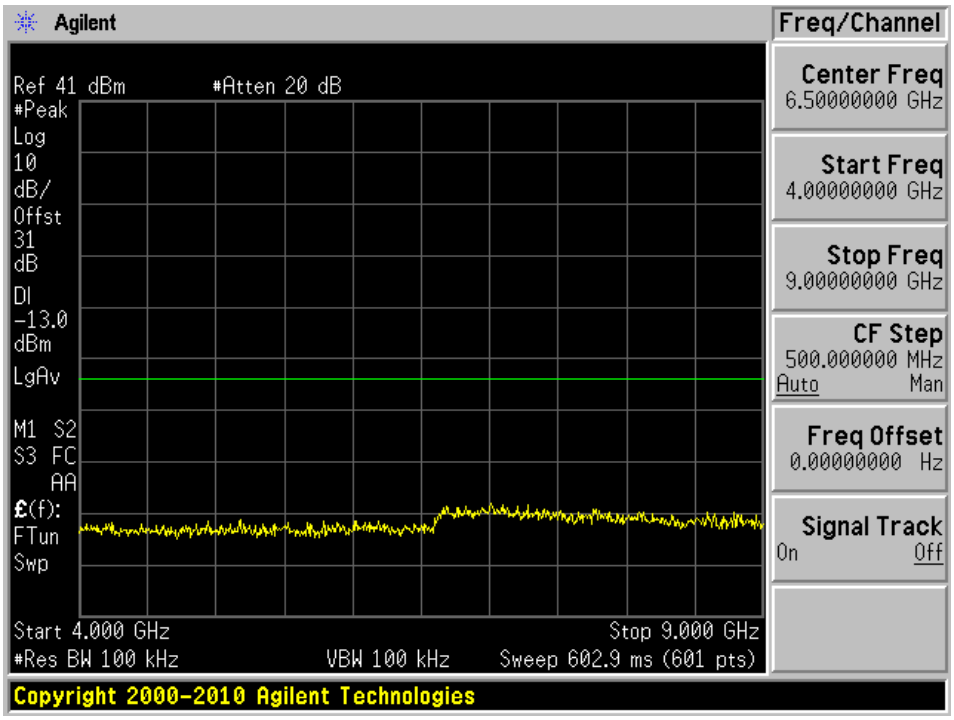
30 MHz – 1 GHz



1 GHz – 4 GHz



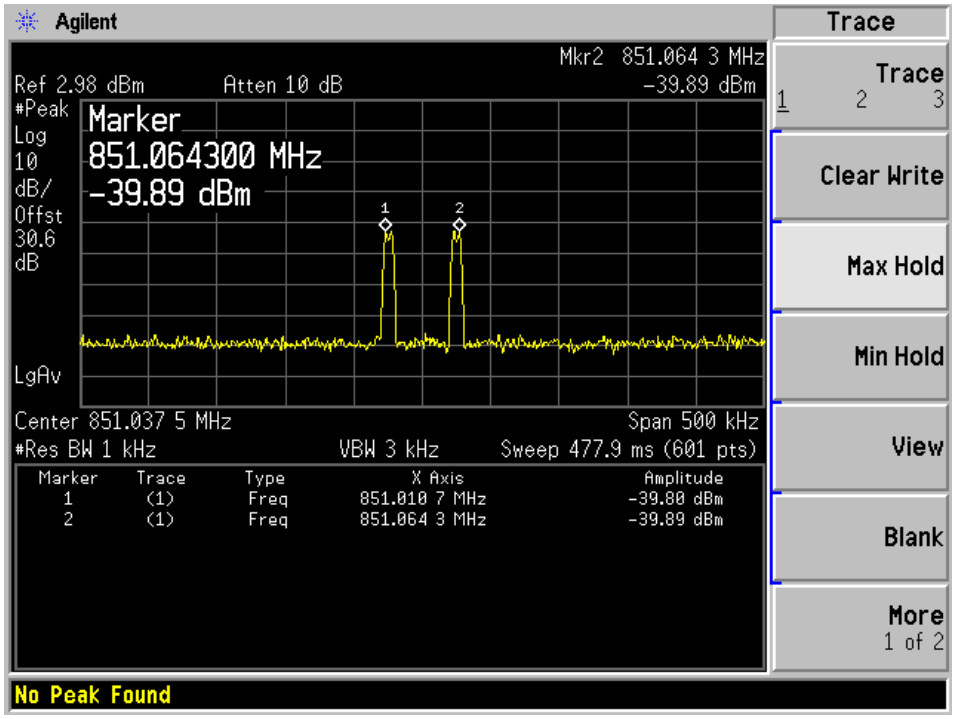
4 GHz – 9 GHz



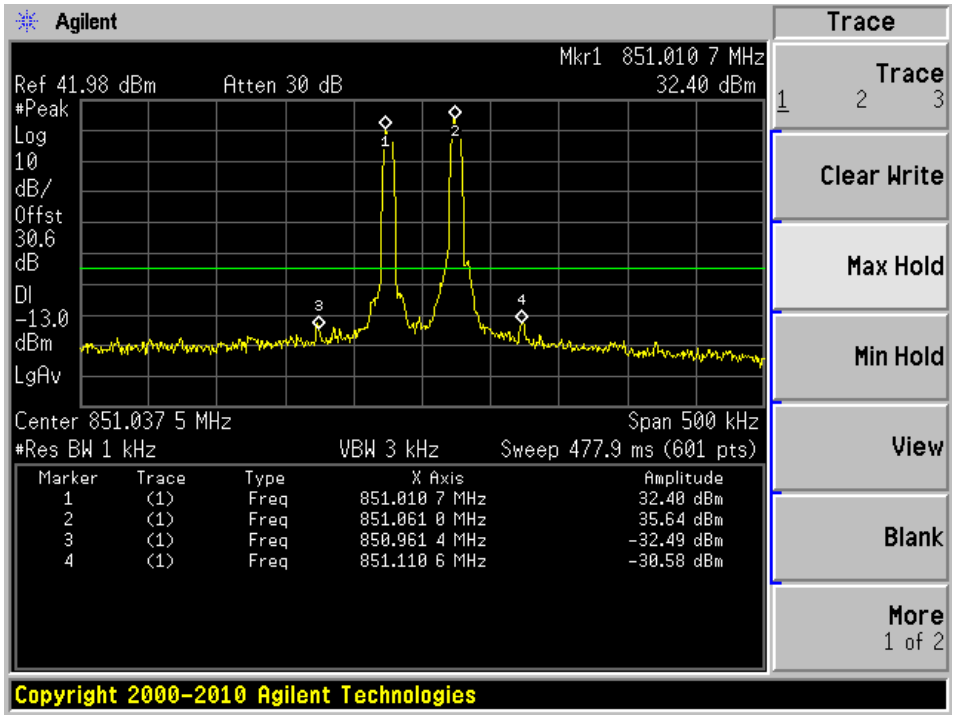
Intermodulation (ALC on)

Downlink: 851-862 MHz

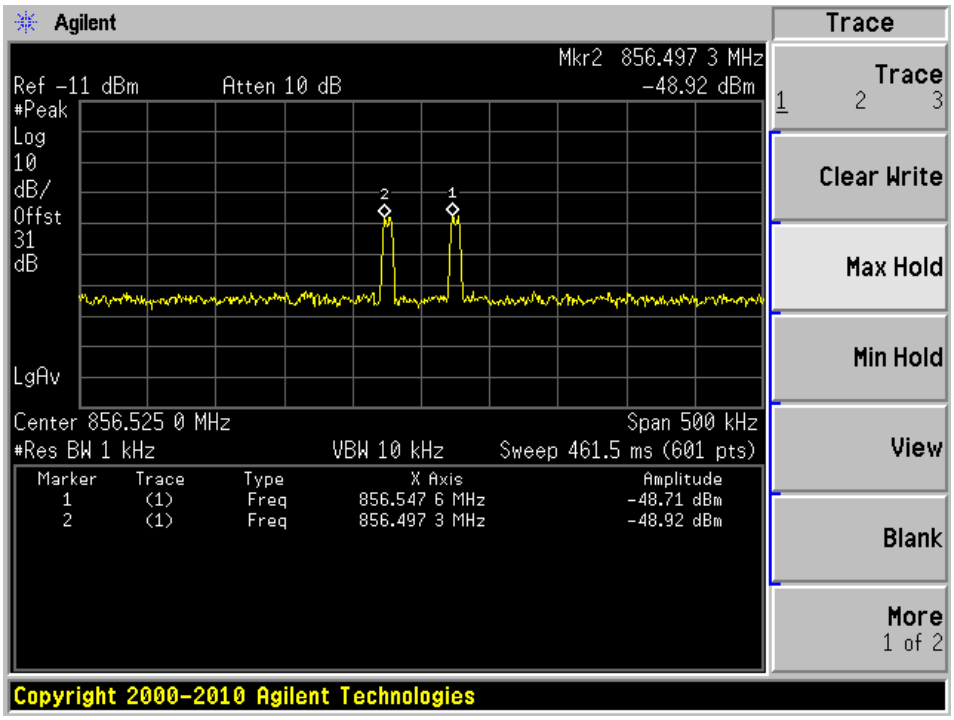
FM Data, Input, Low Channel



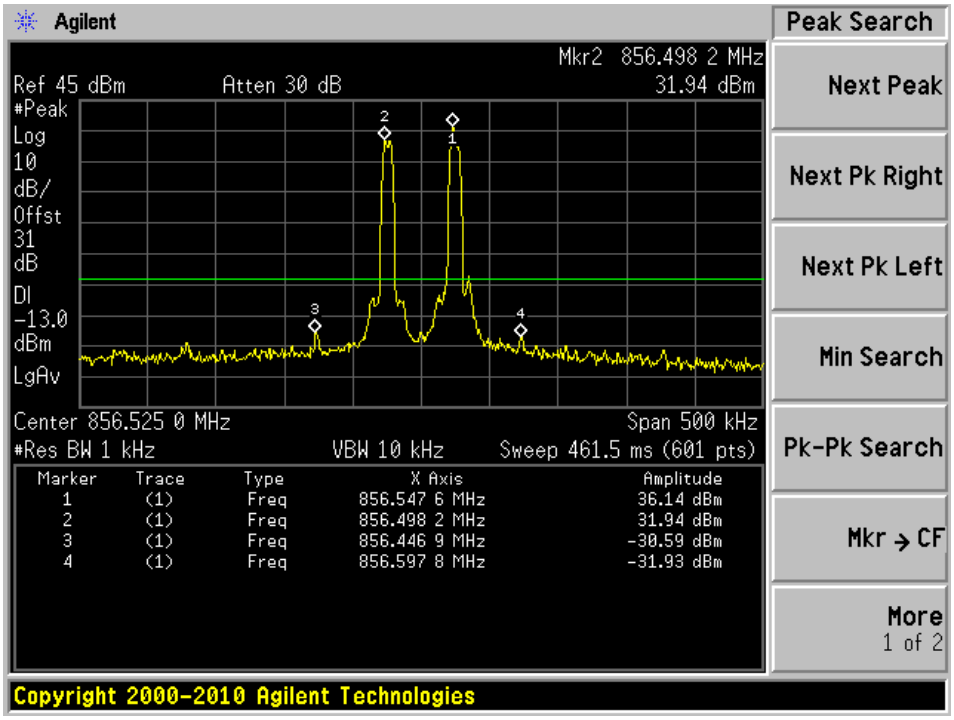
FM Data, Output, Low Channel



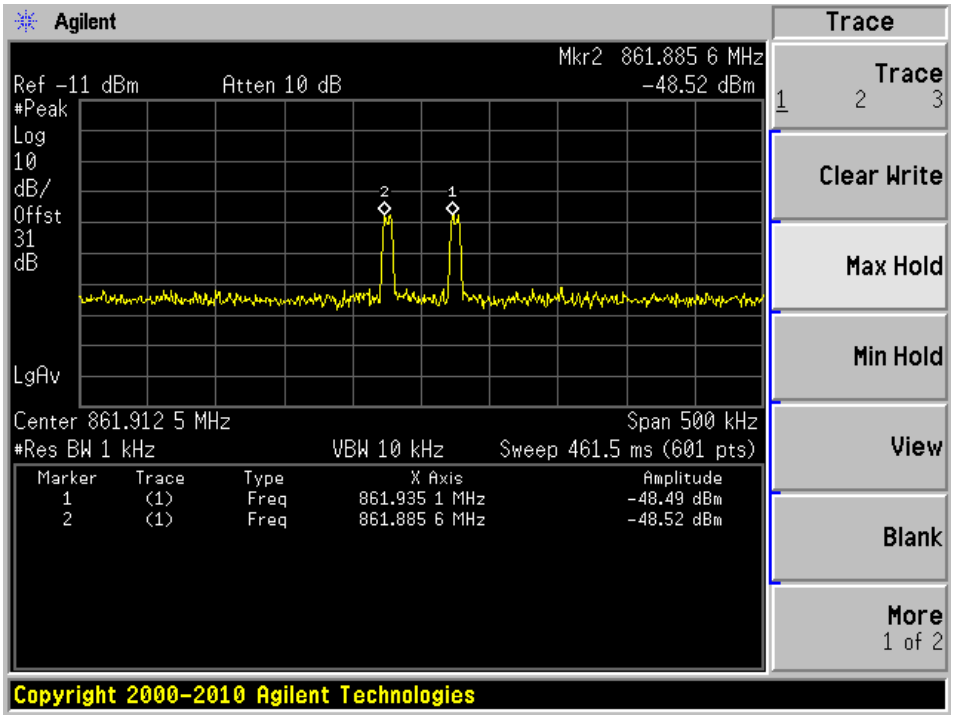
FM Data, Input, Middle Channel



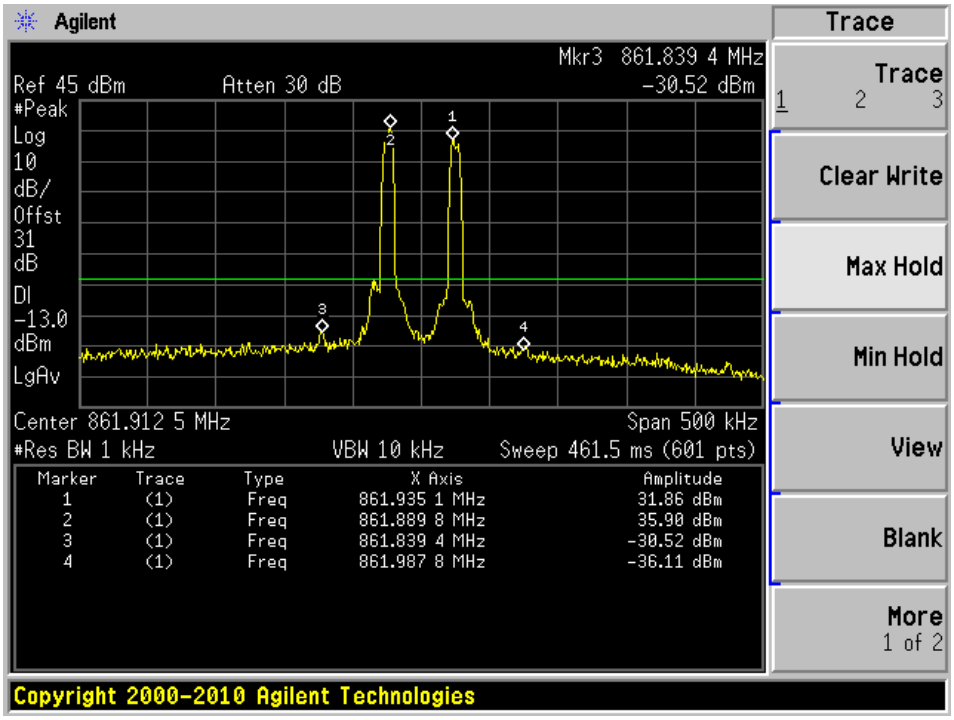
FM Data, Output, Middle Channel



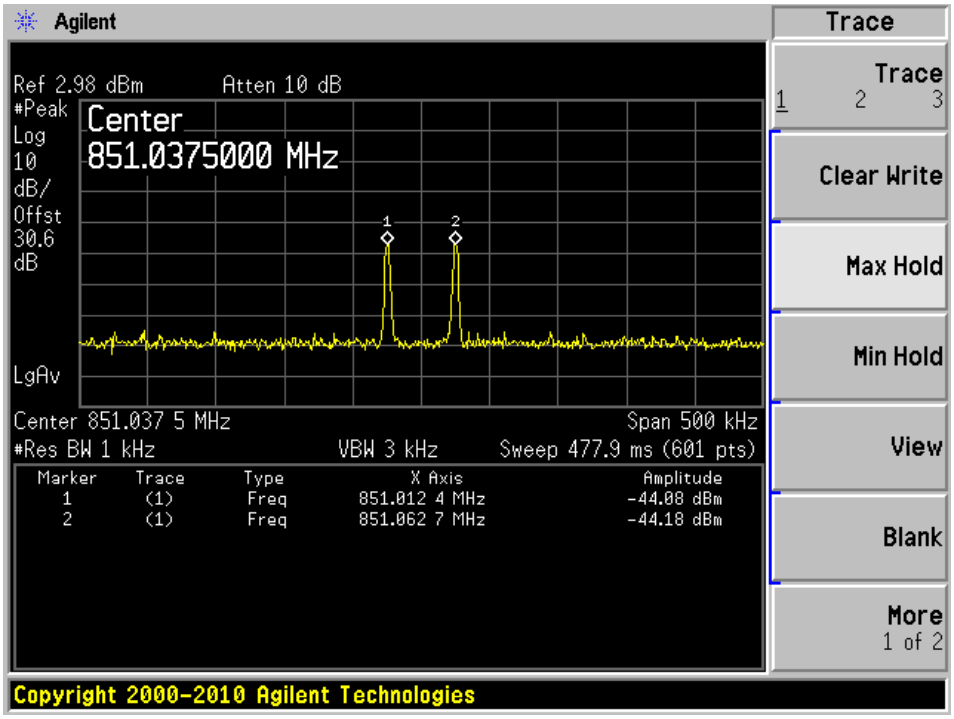
FM Data, Input, High Channel



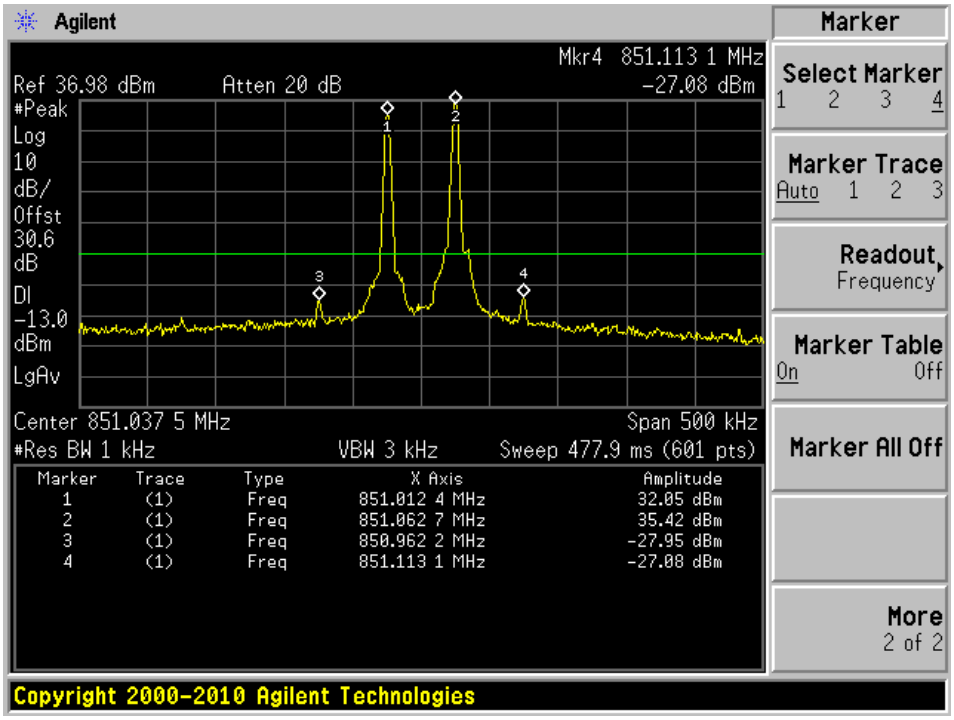
FM Data, Output, High Channel



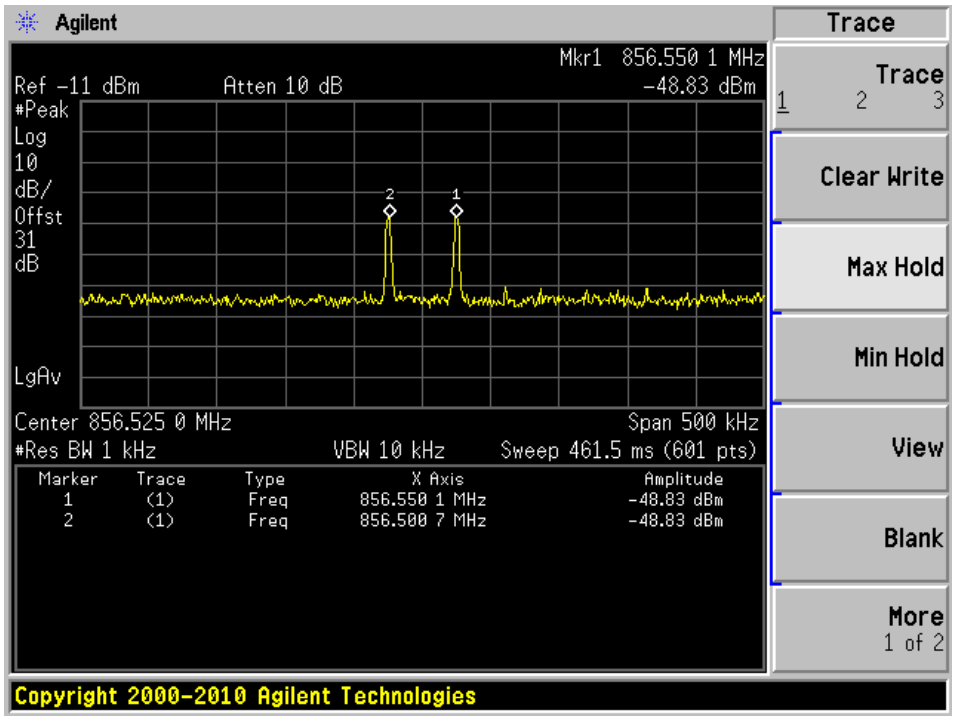
FM Voice, Input, Low Channel



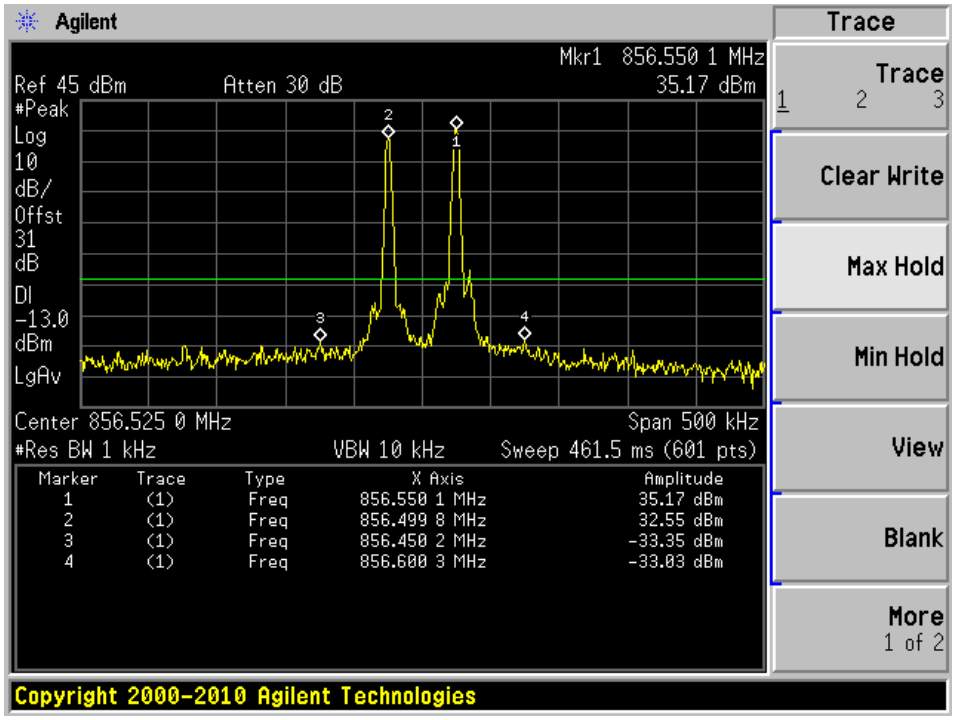
FM Voice, Output, Low Channel



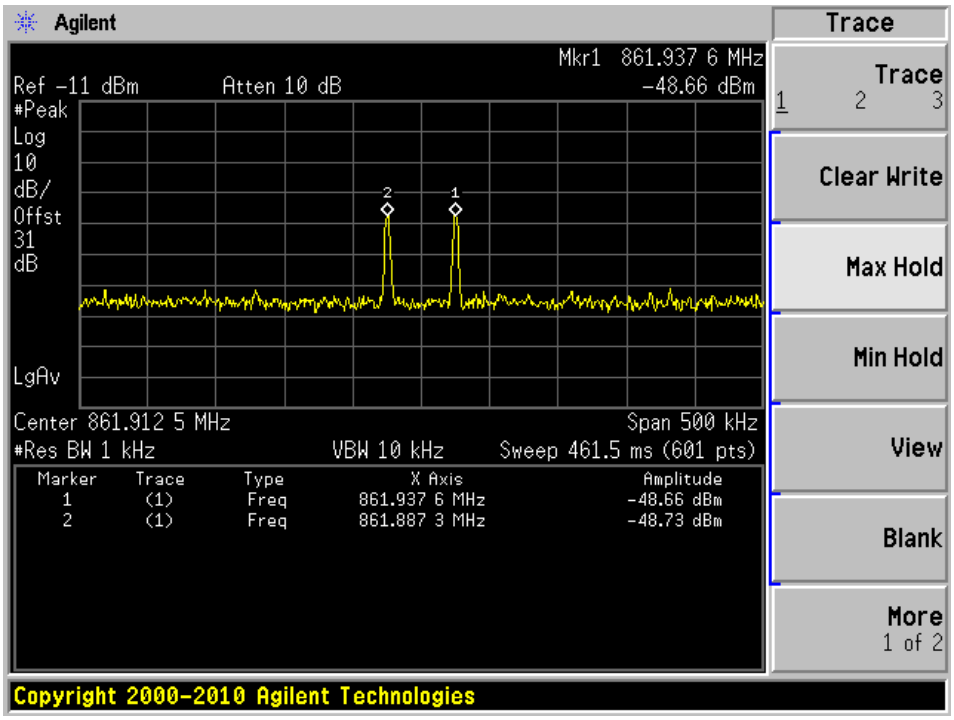
FM Voice, Input, Middle Channel



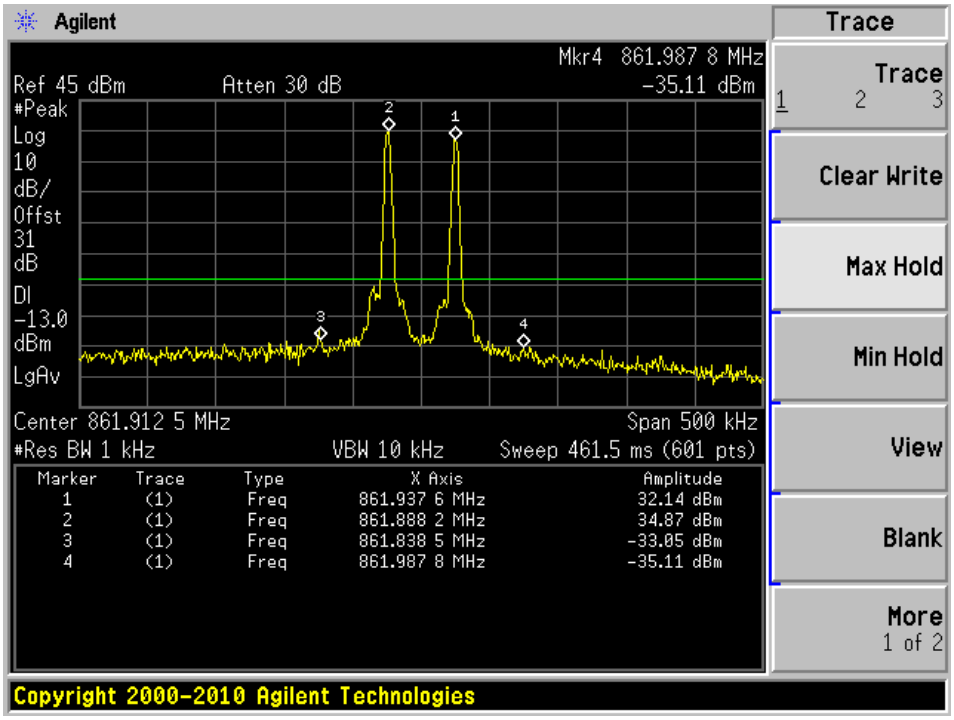
FM Voice, Output, Middle Channel



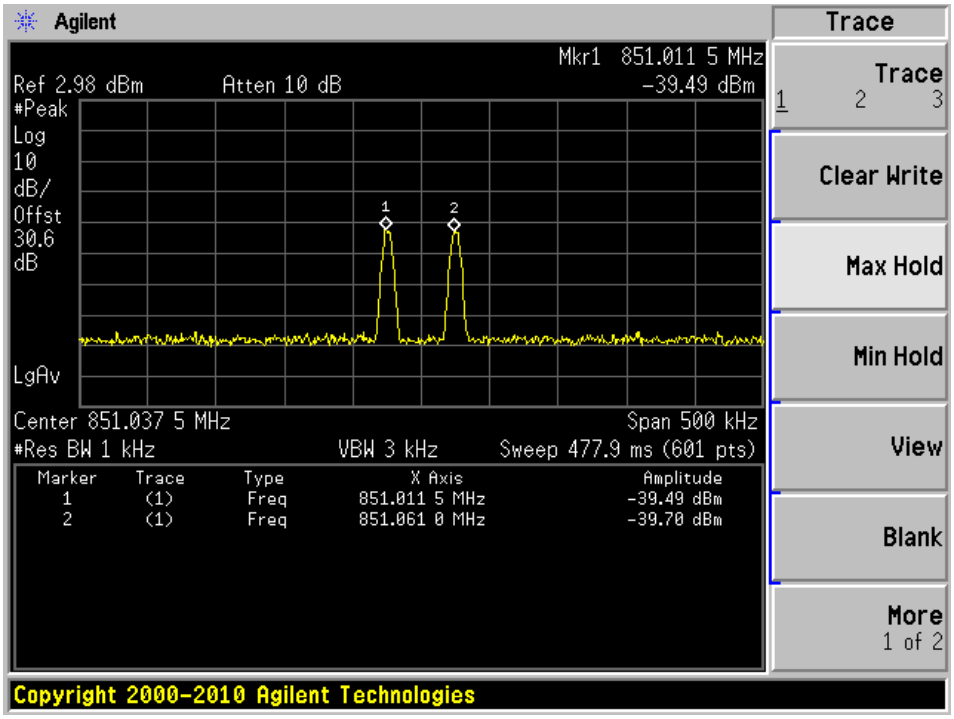
FM Voice, Input, High Channel



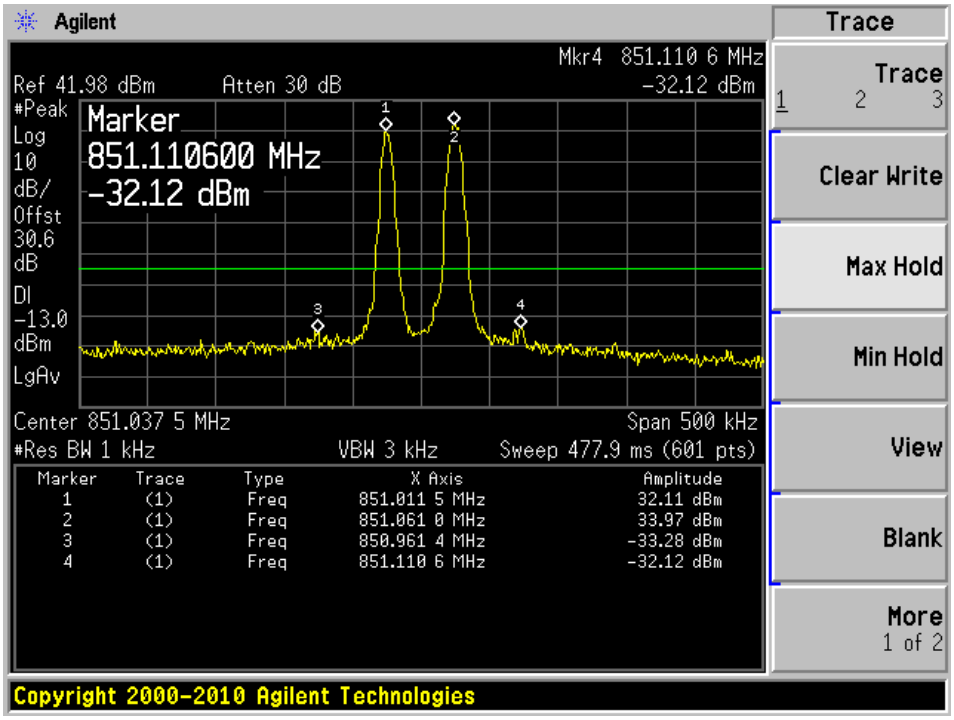
FM Voice, Output, High Channel



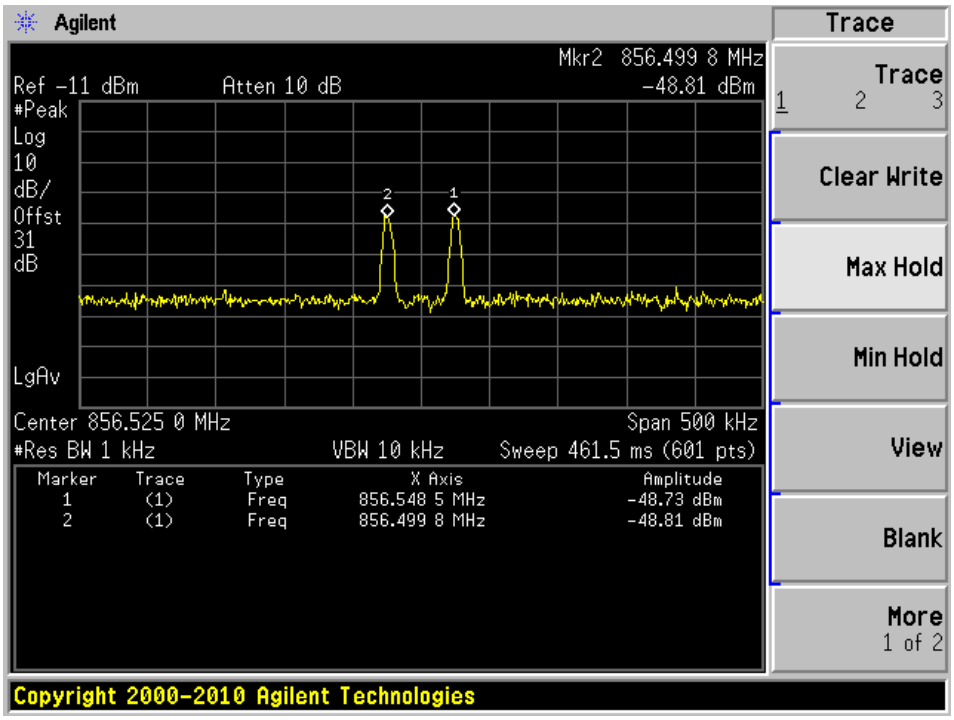
C4FM, Input, Low Channel



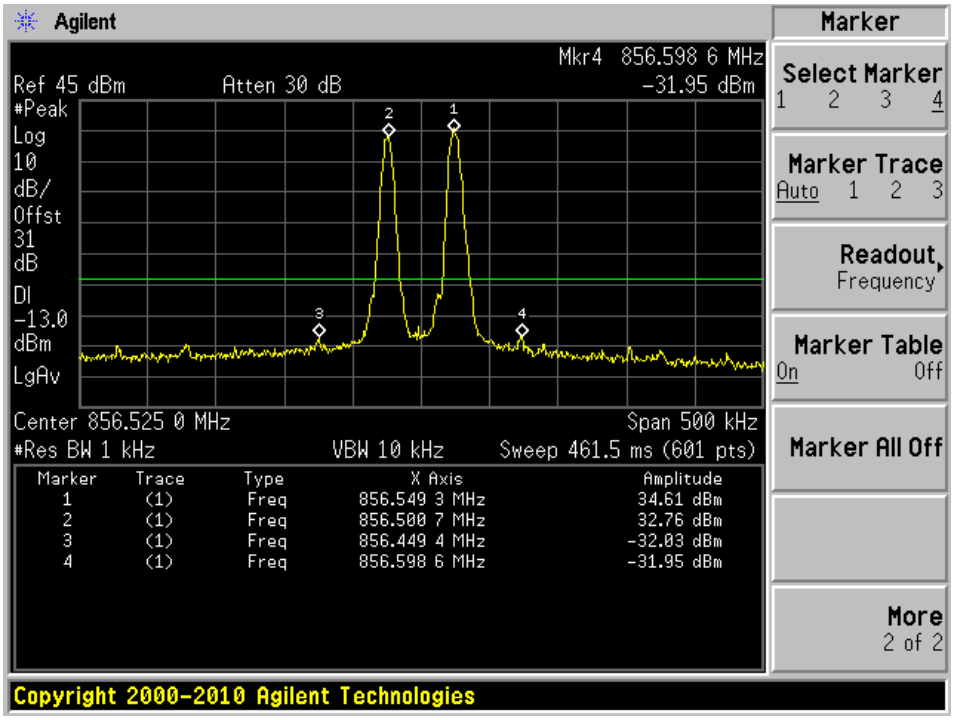
C4FM, Output, Low Channel



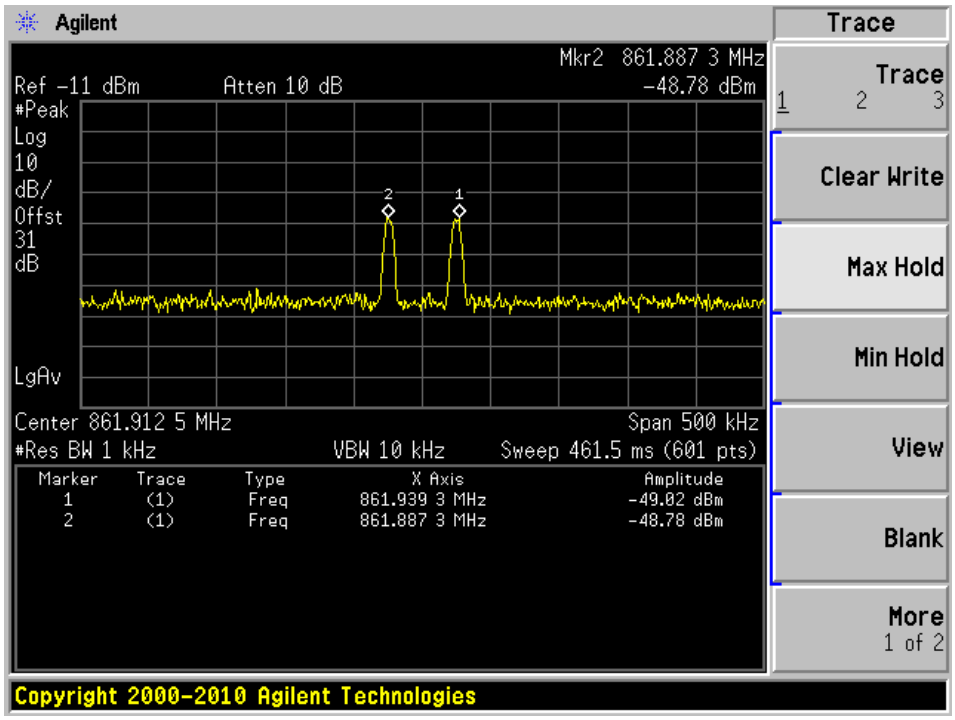
C4FM, Input, Middle Channel



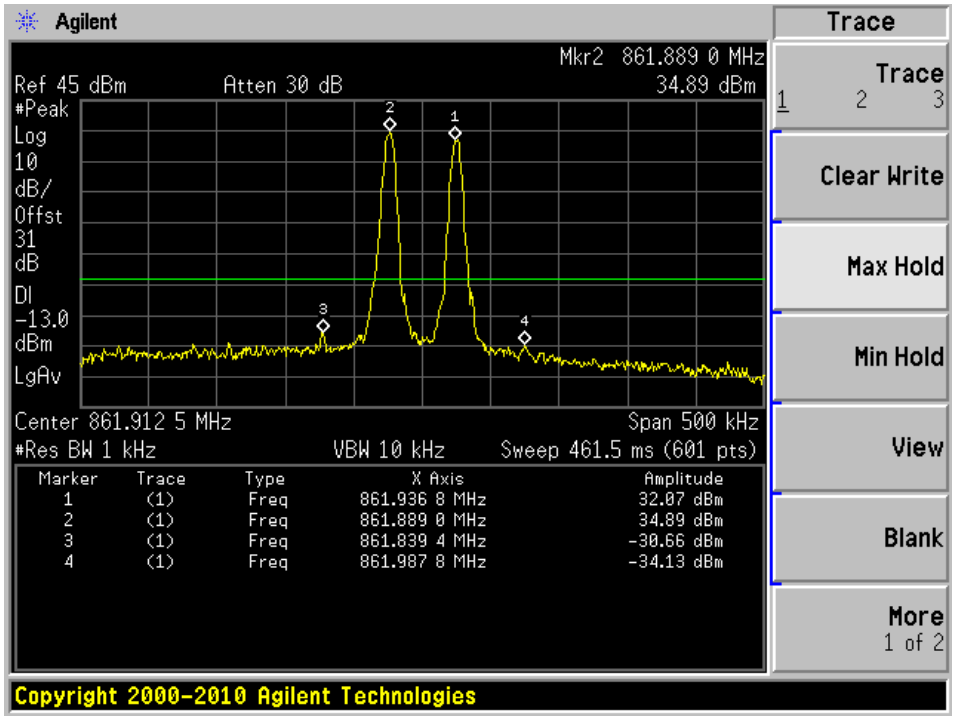
C4FM, Output, Middle Channel



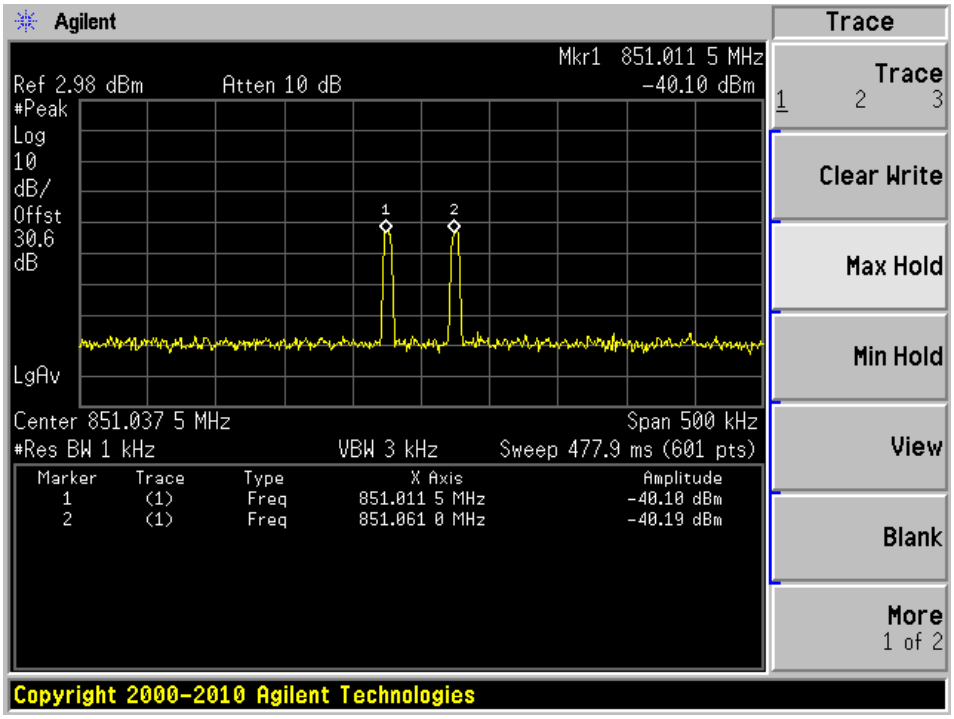
C4FM, Input, High Channel



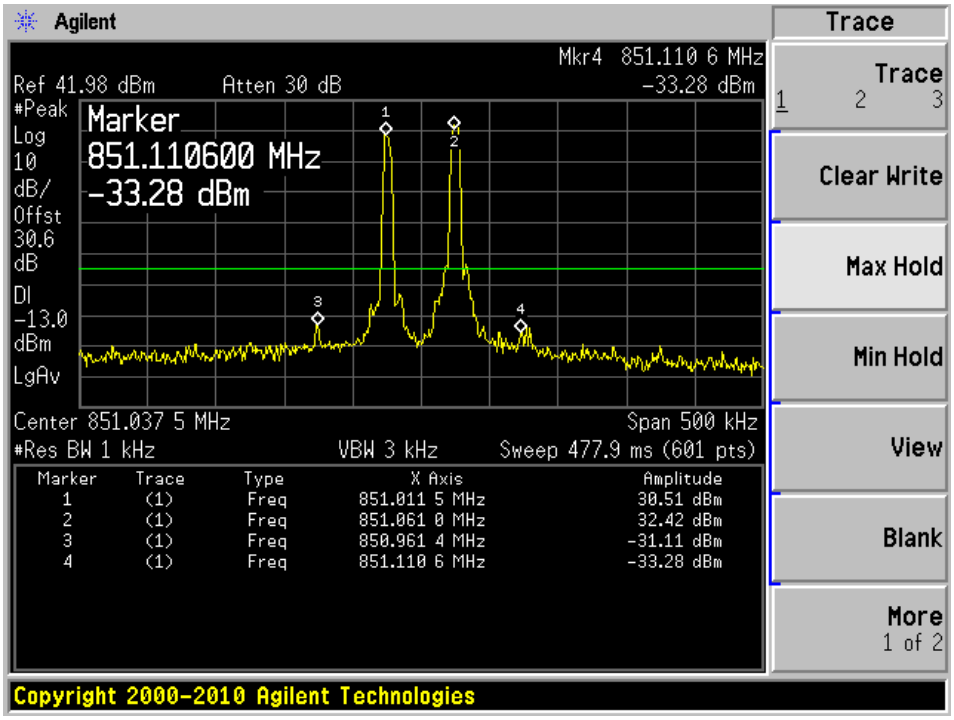
C4FM, Output, High Channel



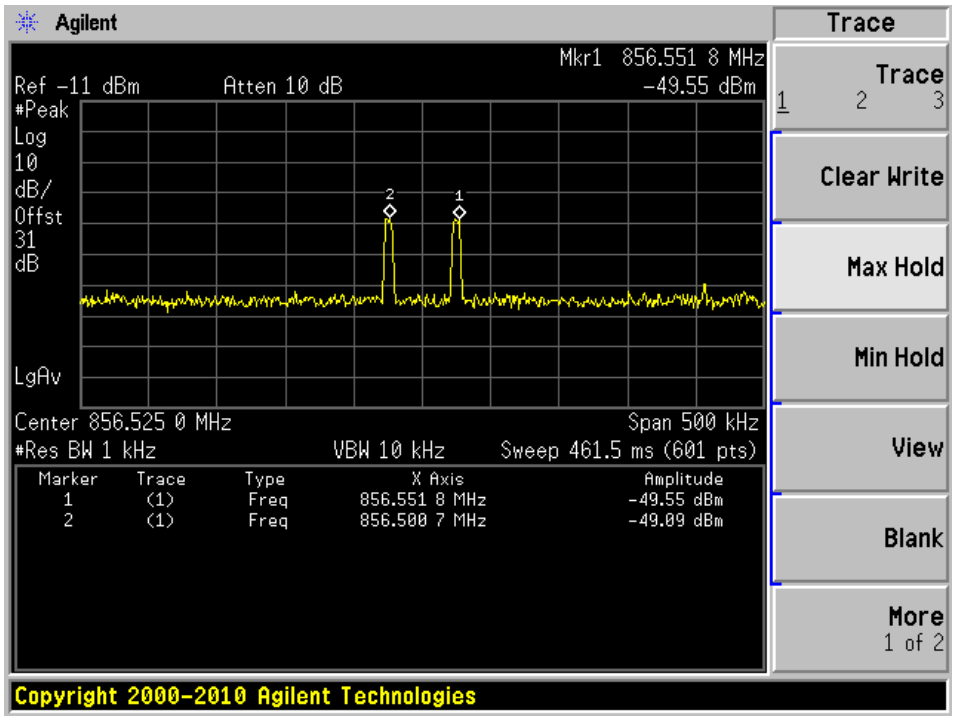
CQPSK, Input, Low Channel



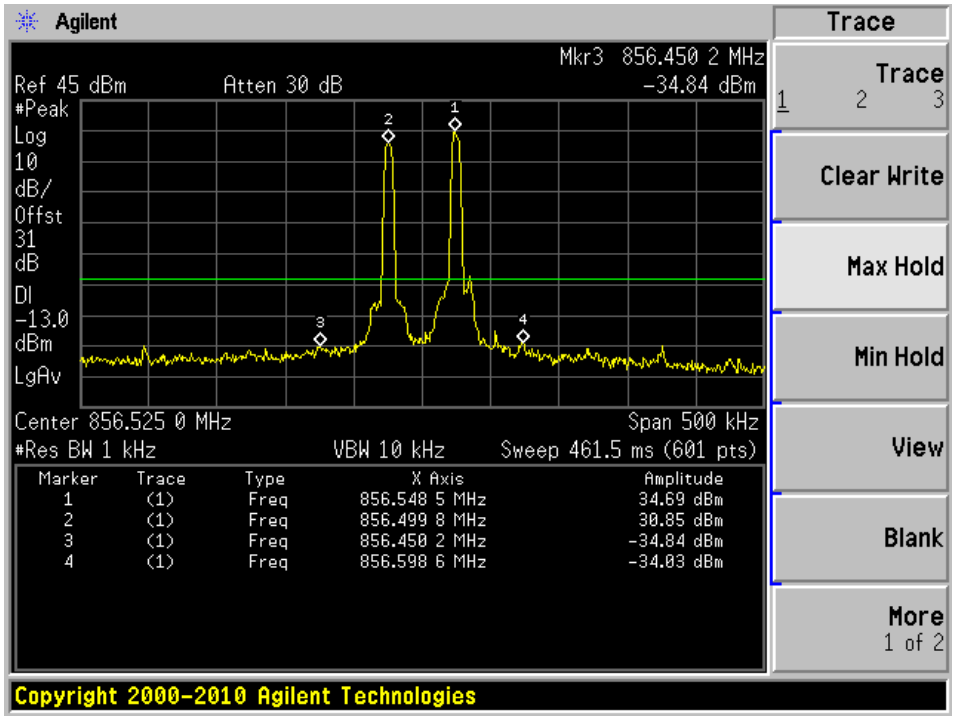
CQPSK, Output, Low Channel



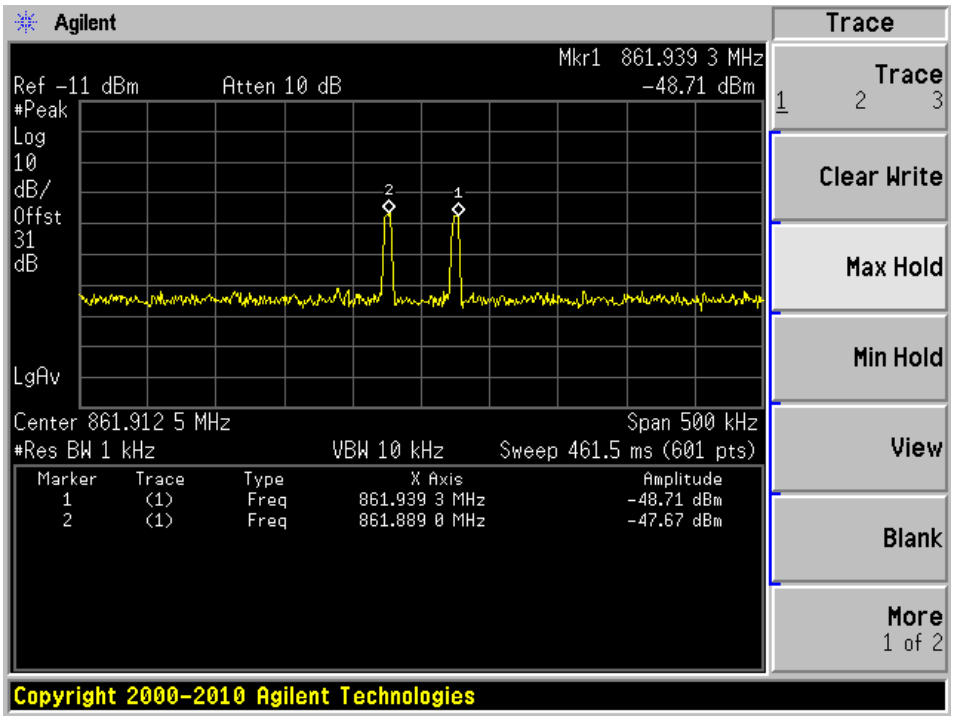
CQPSK, Input, Middle Channel



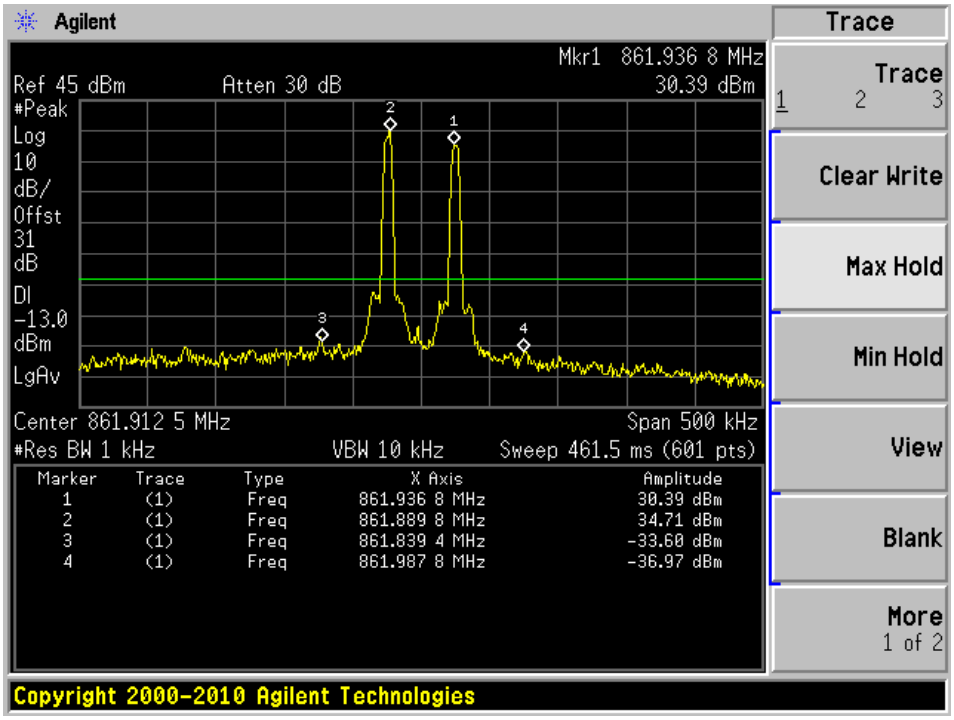
CQPSK, Output, Middle Channel



CQPSK, Input, High Channel

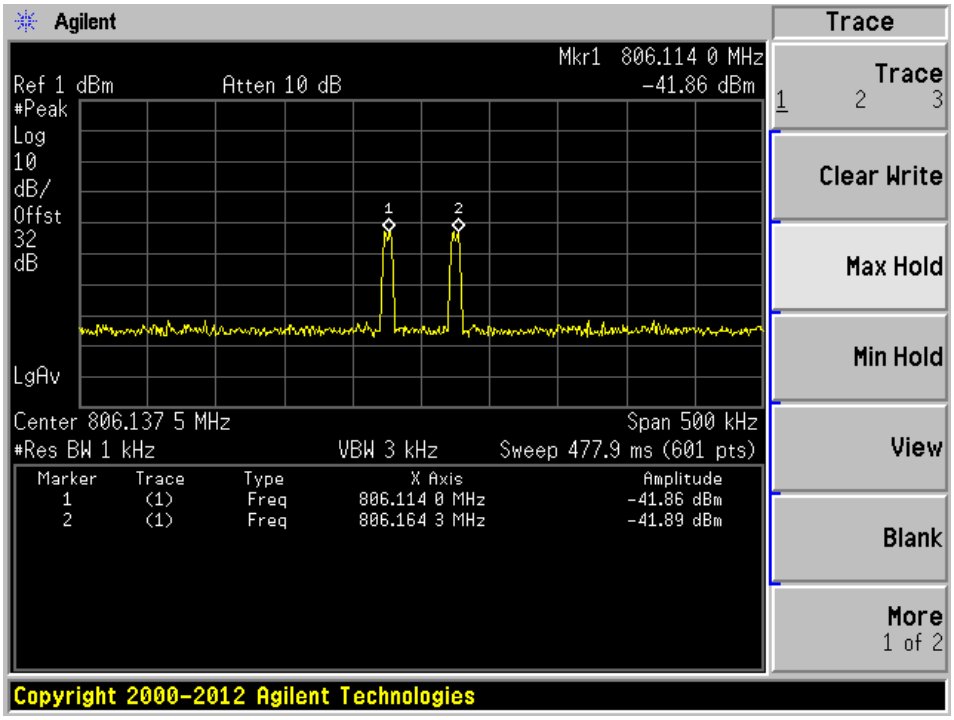


CQPSK, Output, High Channel

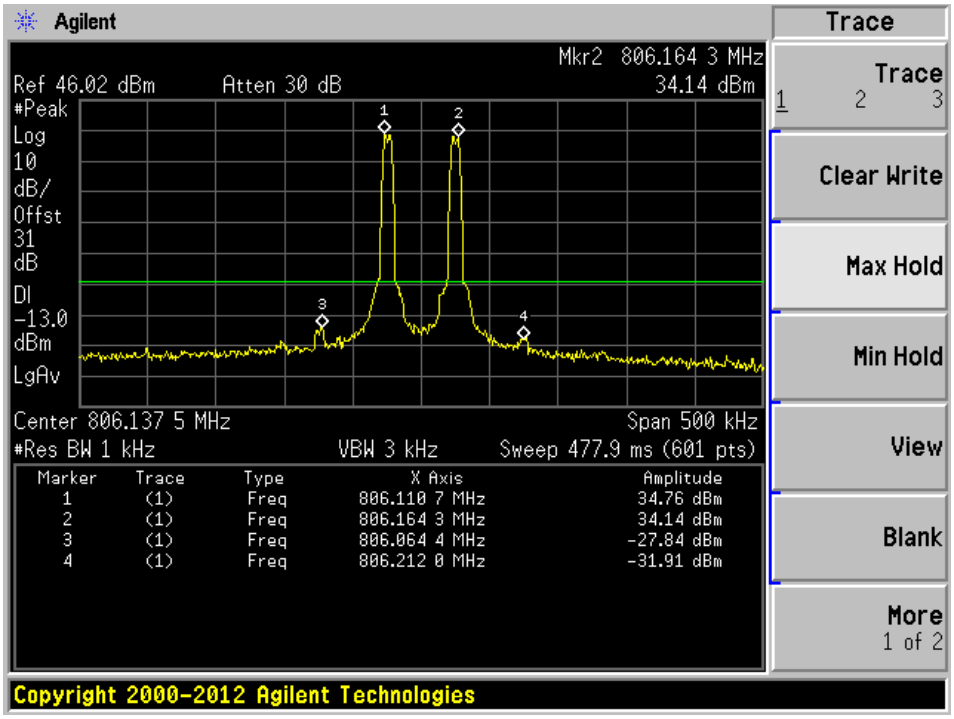


Uplink: 806-817 MHz

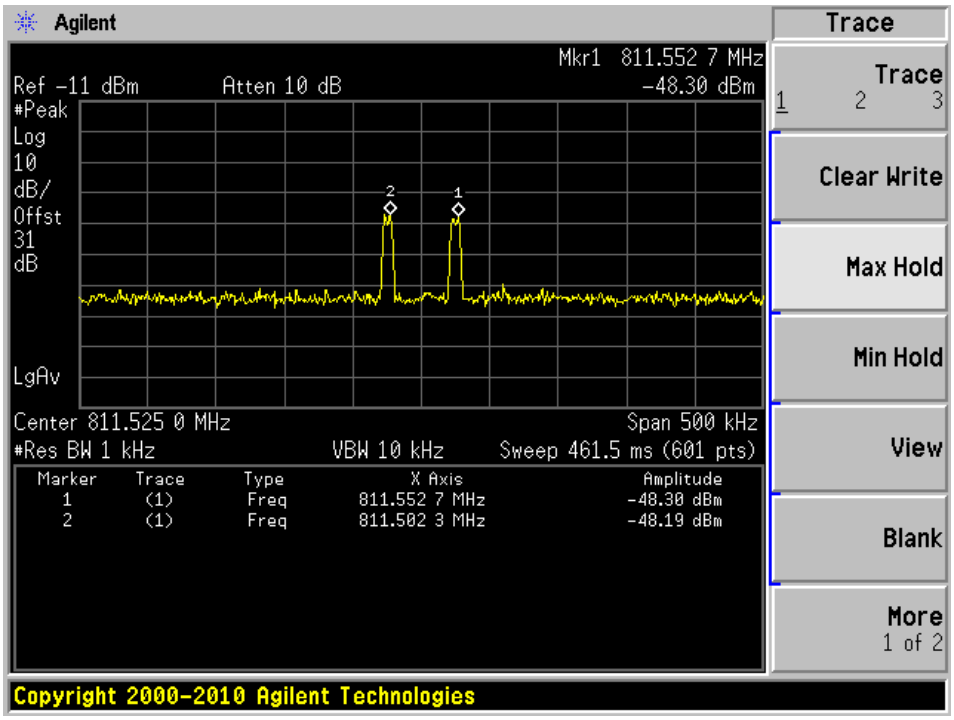
FM Data, Input, Low Channel



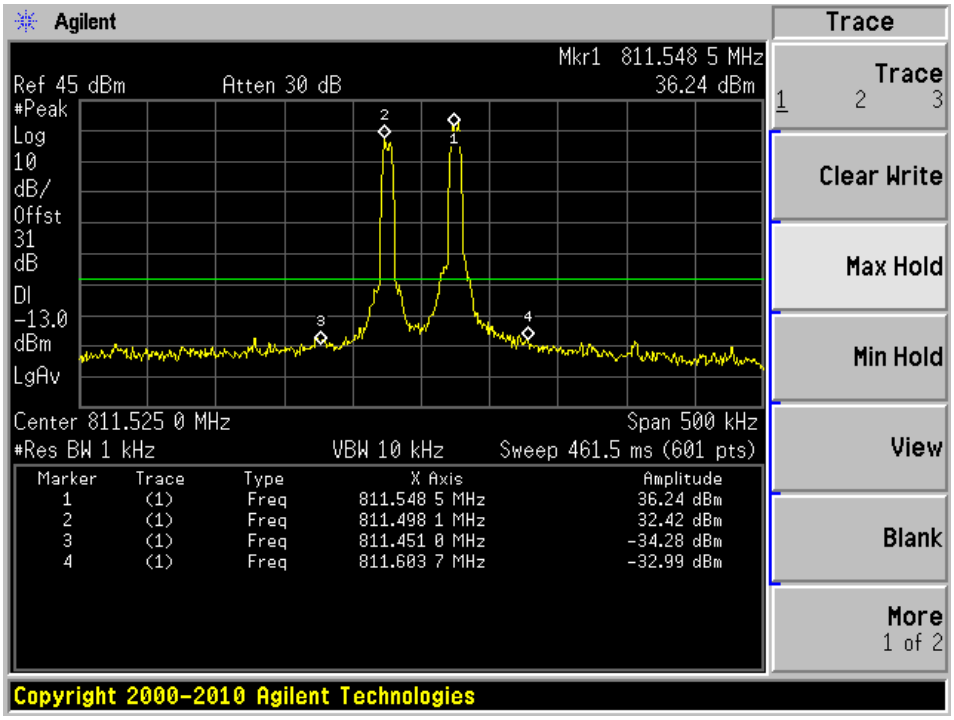
FM Data, Output, Low Channel



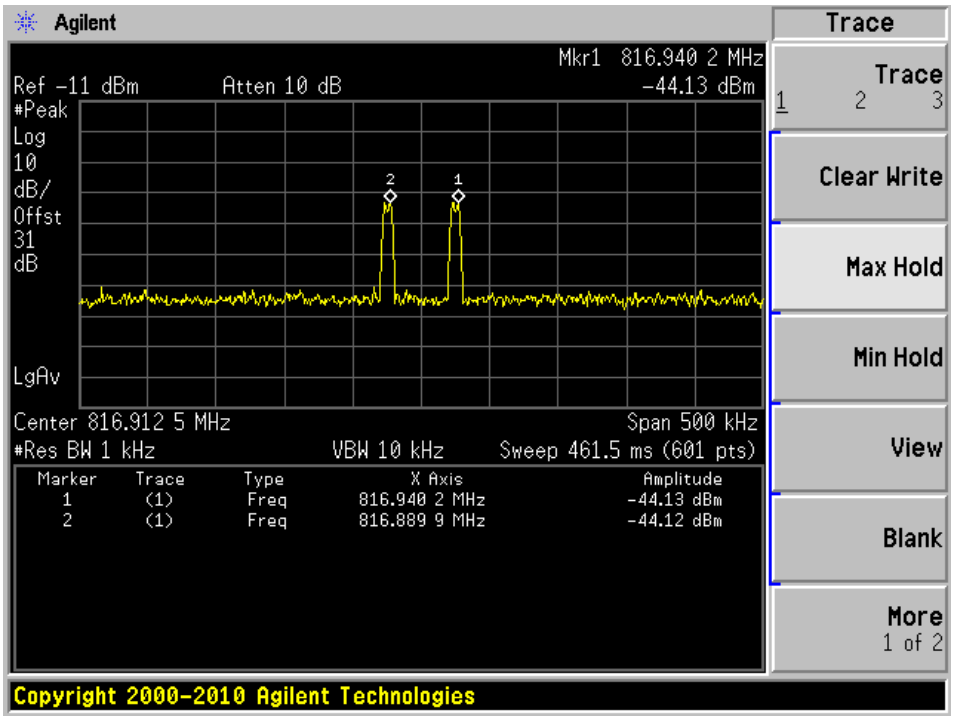
FM Data, Input, Middle Channel



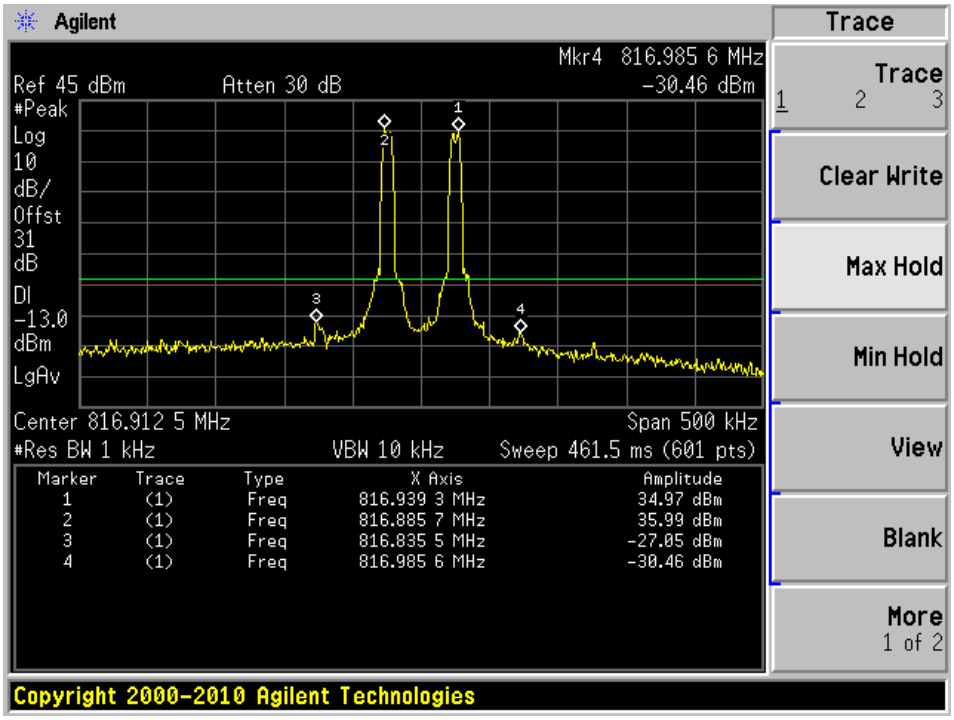
FM Data, Output, Middle Channel



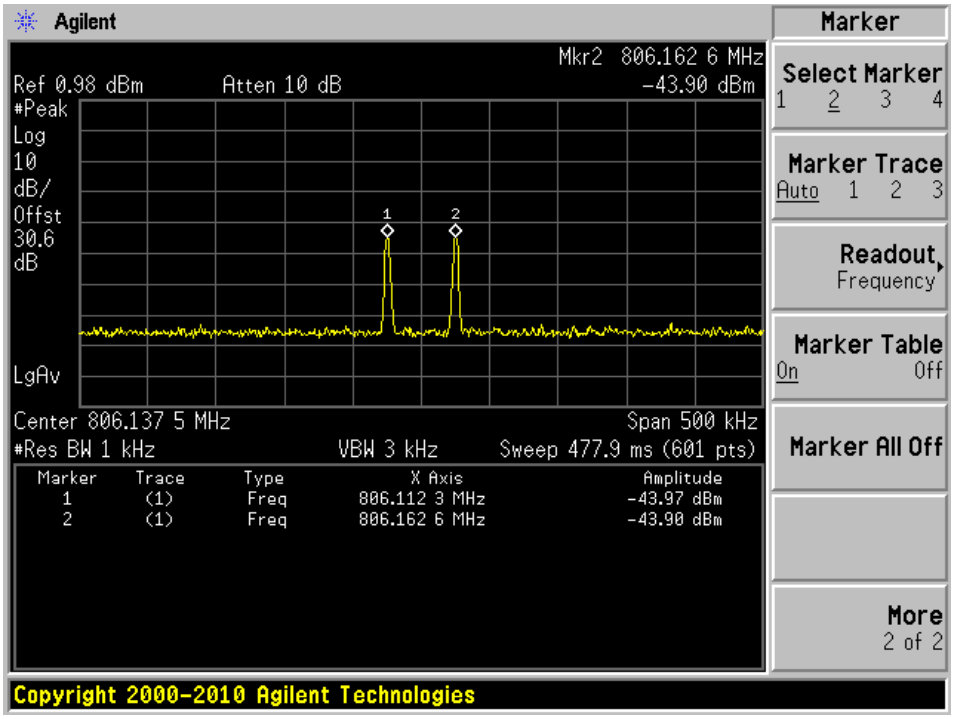
FM Data, Input, High Channel



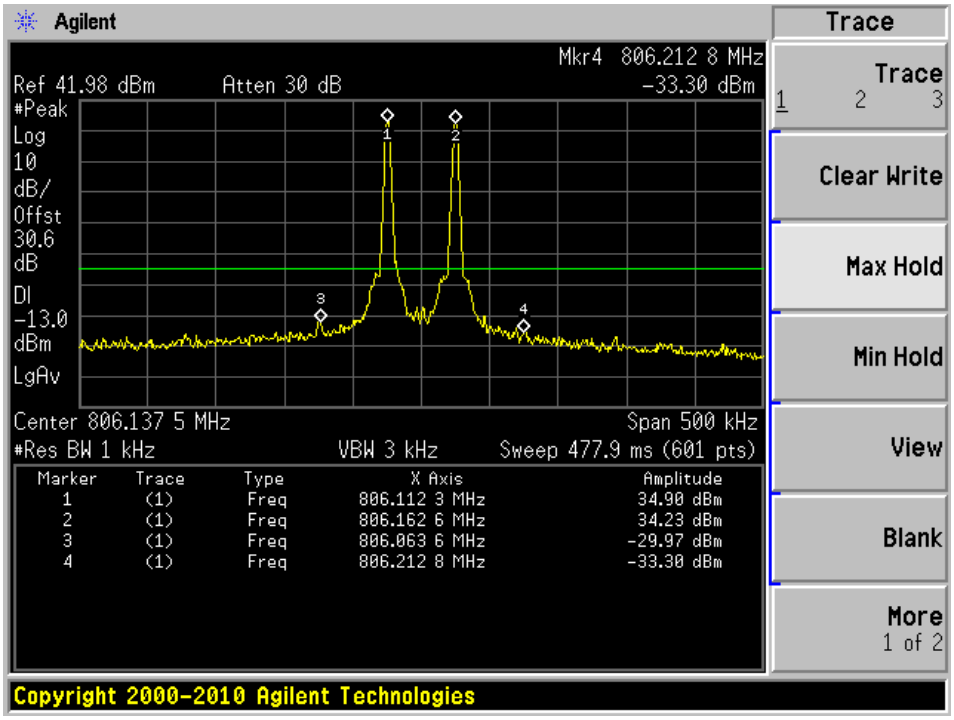
FM Data, Output, High Channel



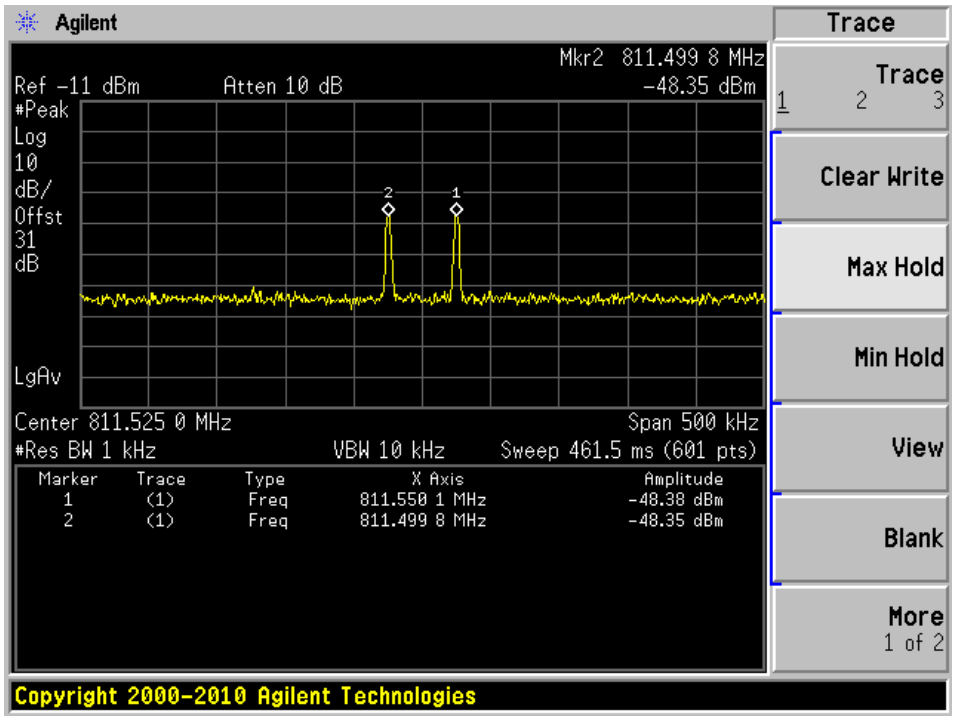
FM Voice, Input, Low Channel



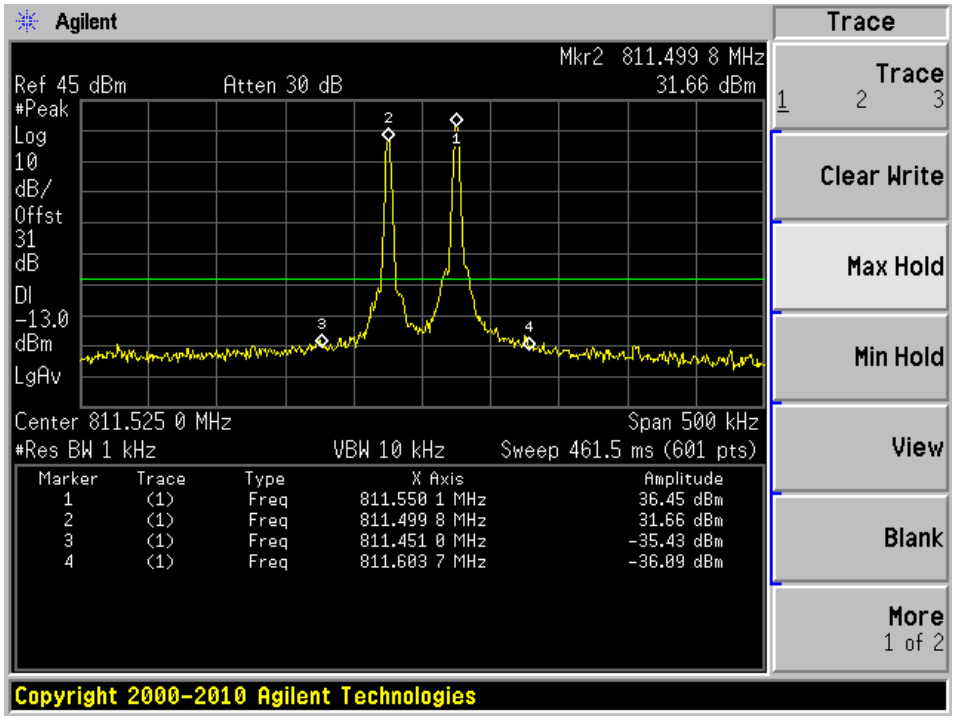
FM Voice, Output, Low Channel



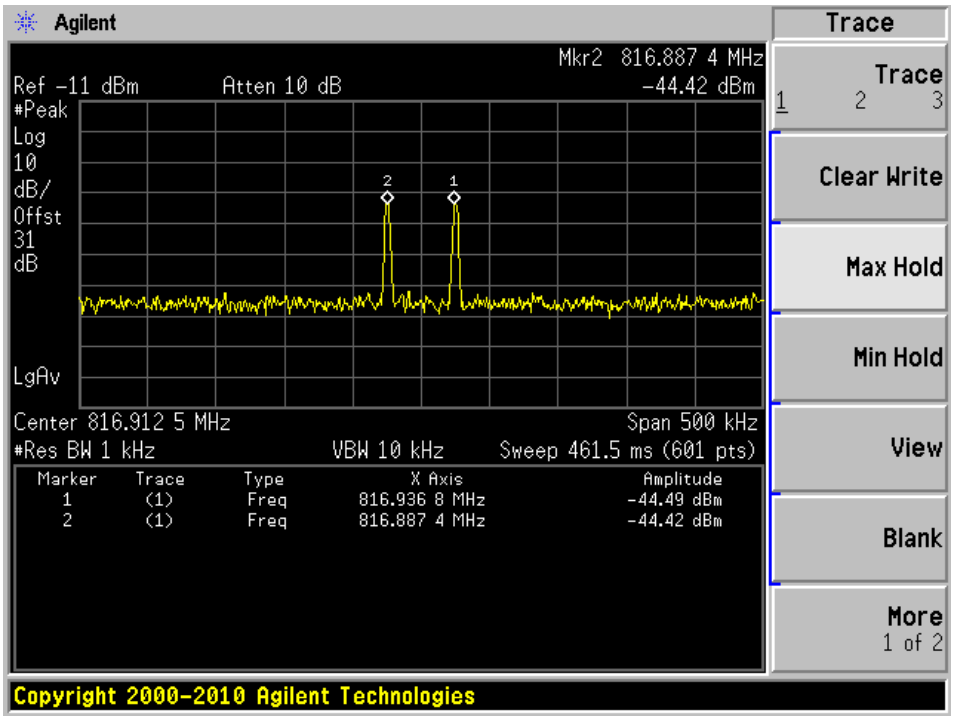
FM Voice, Input, Middle Channel



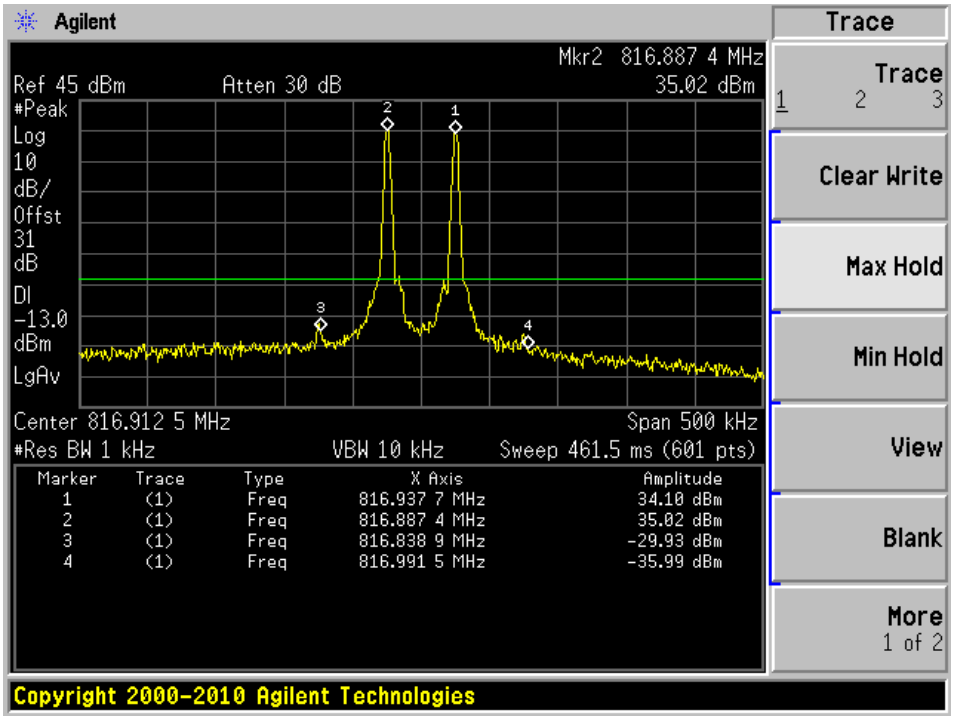
FM Voice, Output, Middle Channel



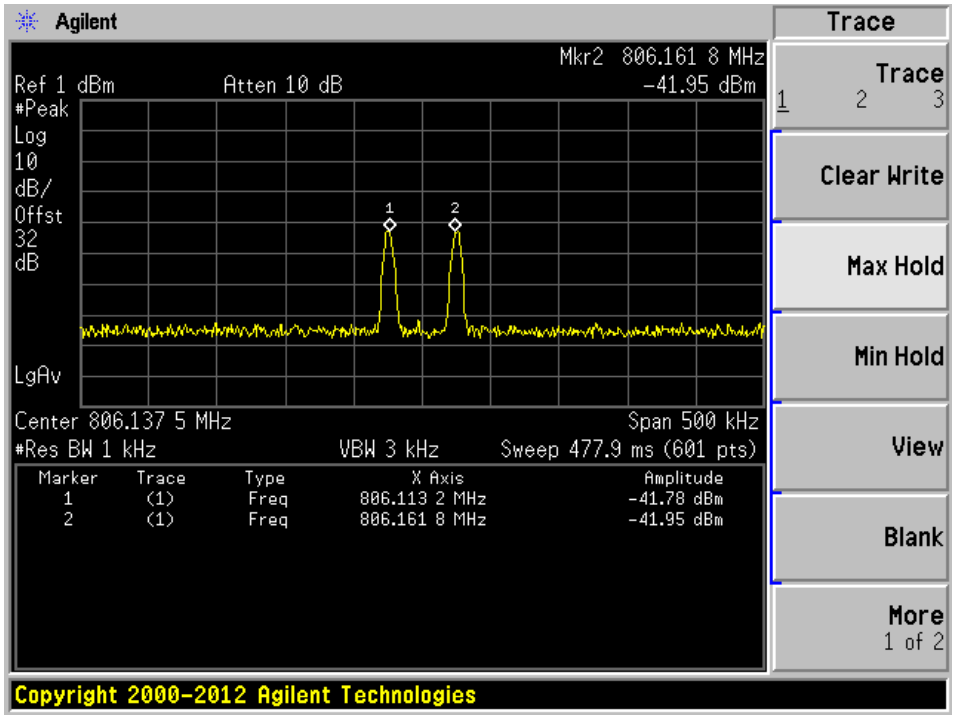
FM Voice, Input, High Channel



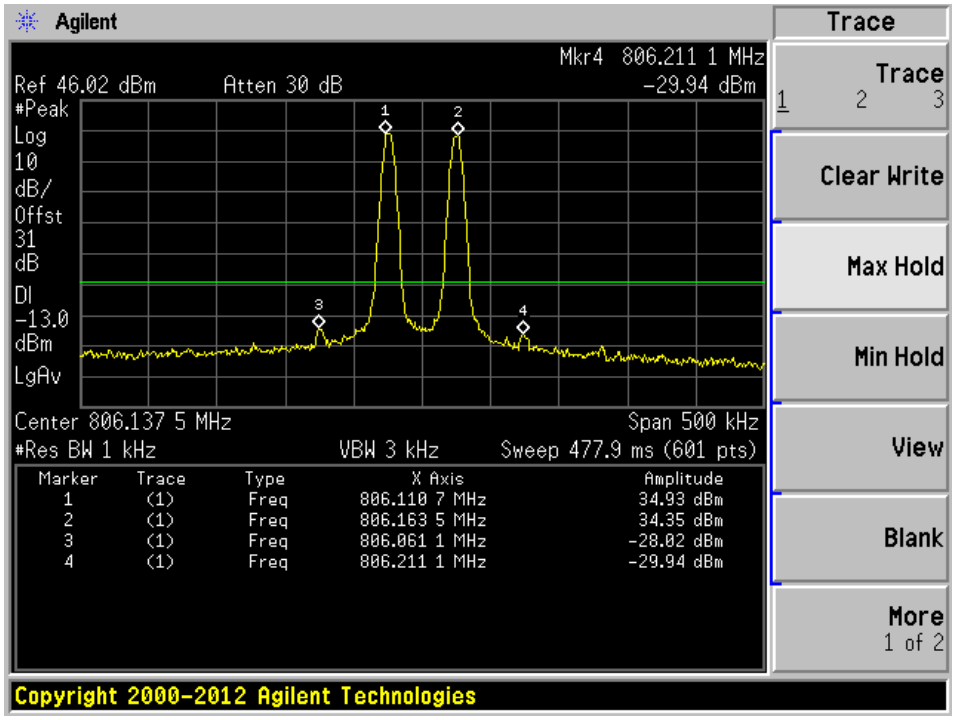
FM Voice, Output, High Channel



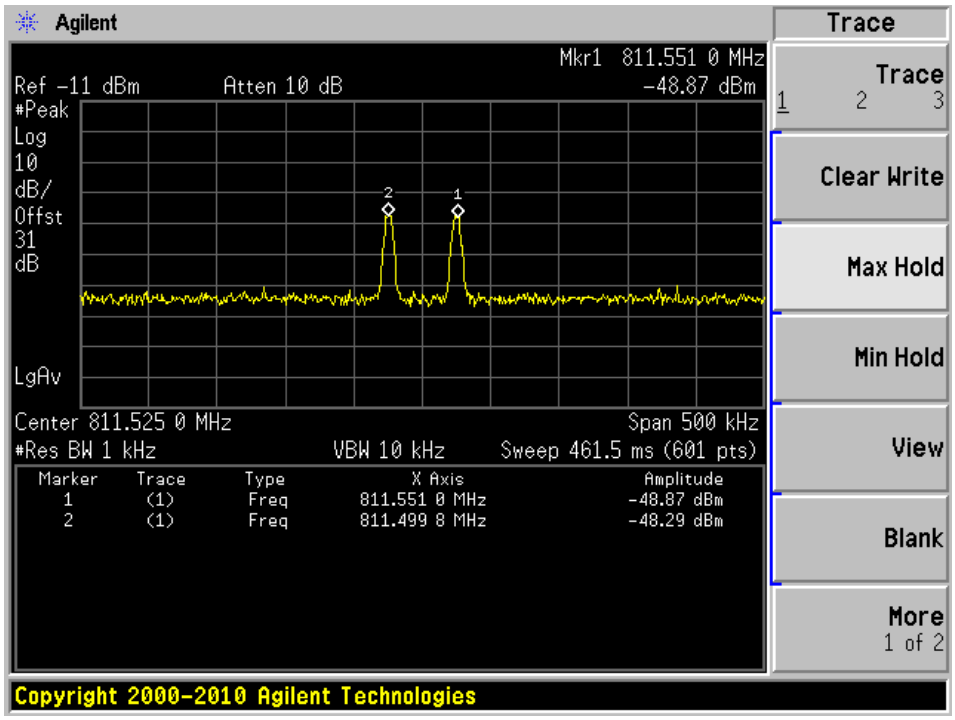
C4FM, Input, Low Channel



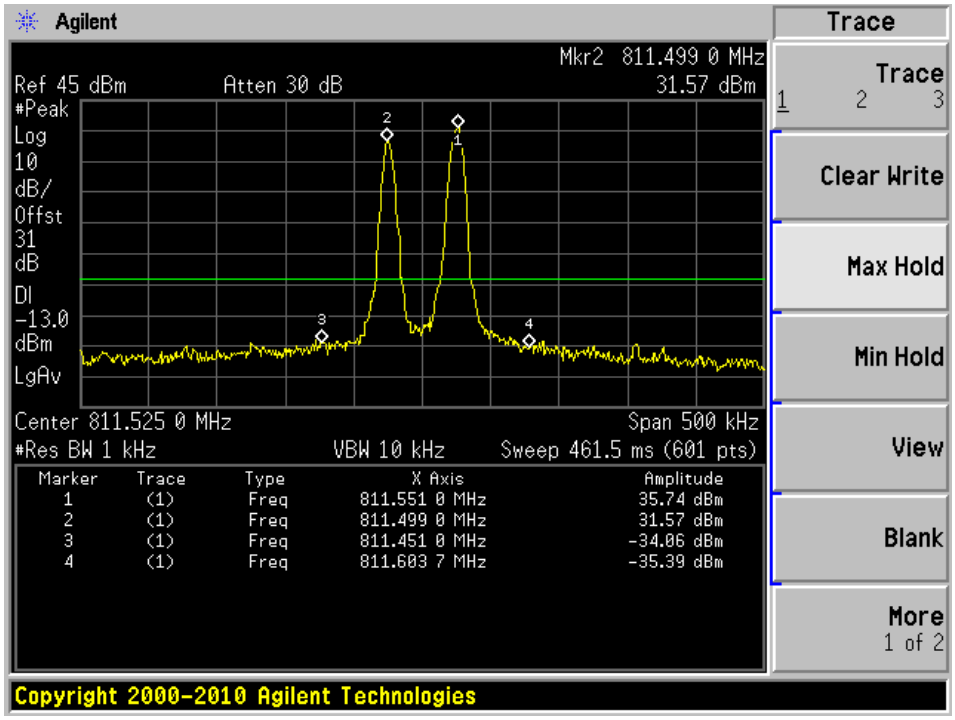
C4FM, Output, Low Channel



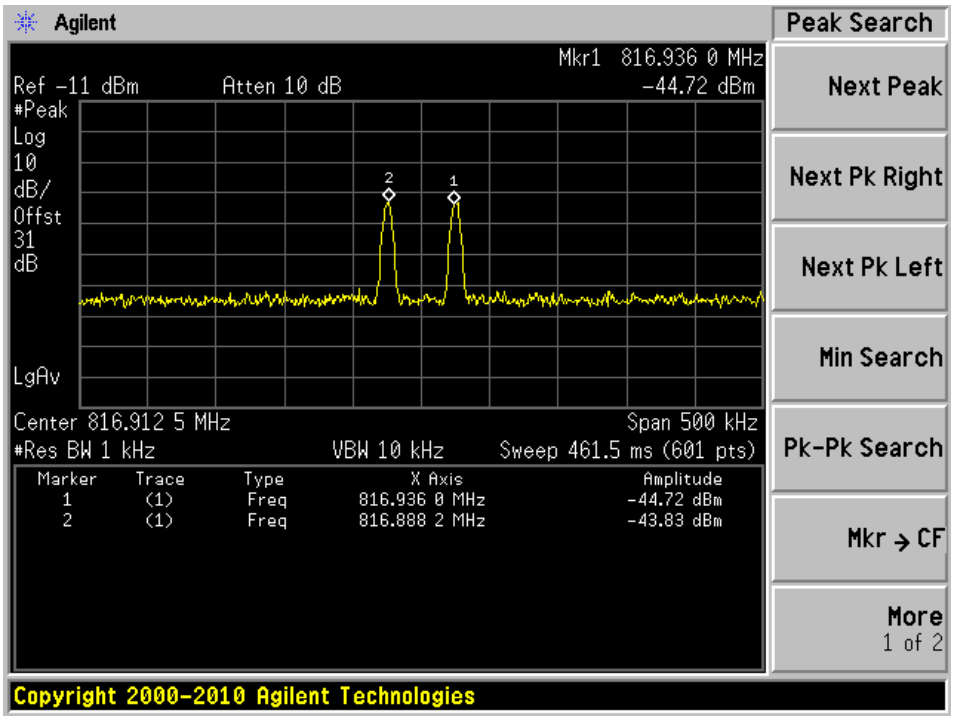
C4FM, Input, Middle Channel



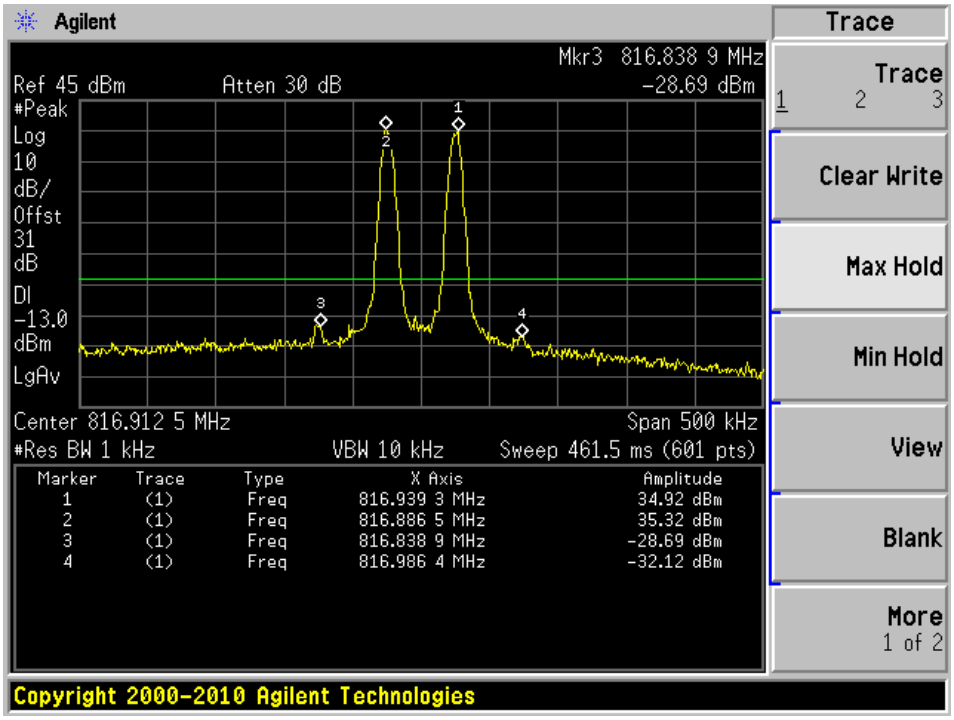
C4FM, Output, Middle Channel



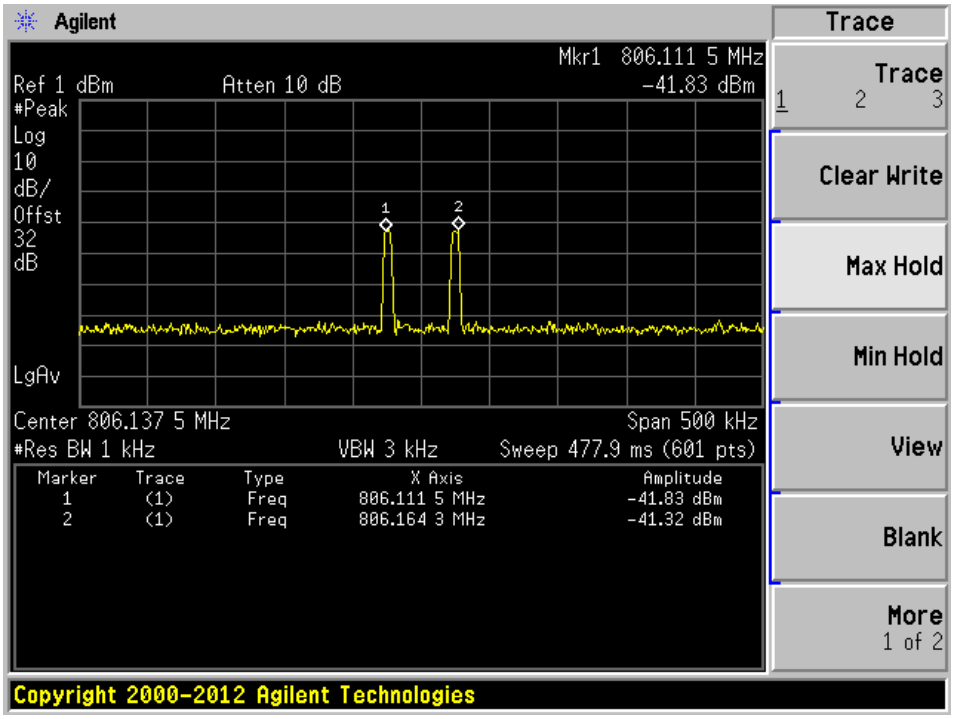
C4FM, Input, High Channel



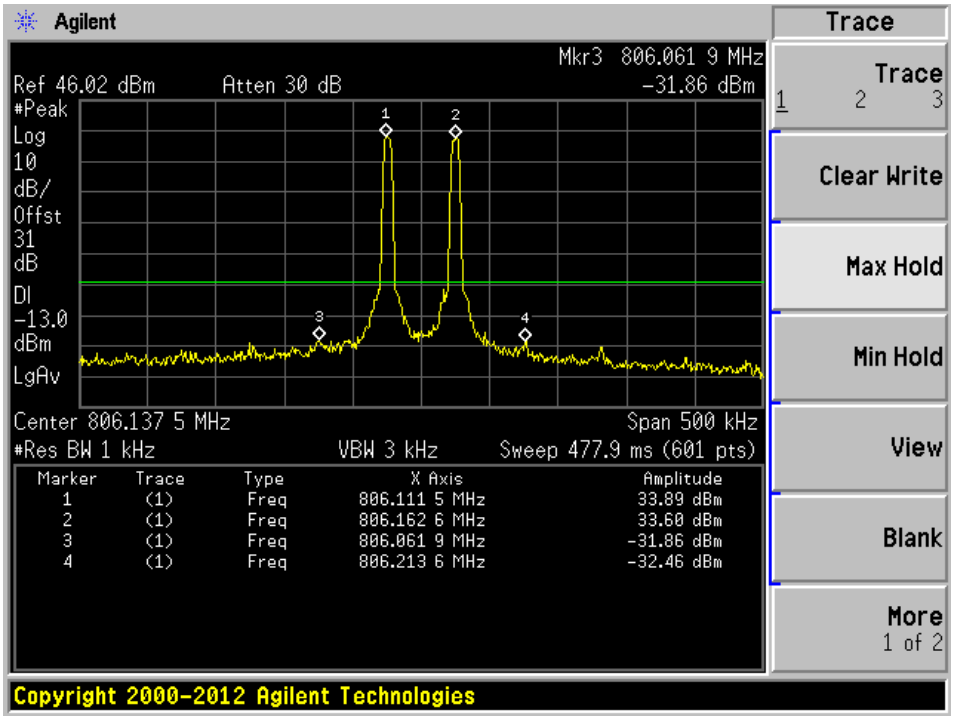
C4FM, Output, High Channel



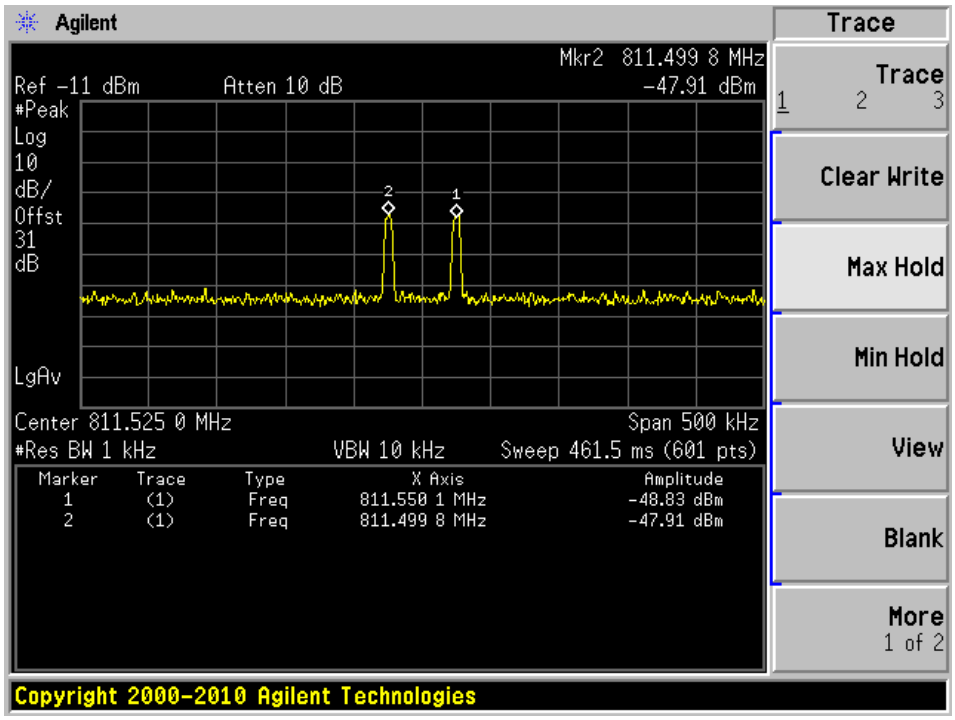
CQPSK, Input, Low Channel



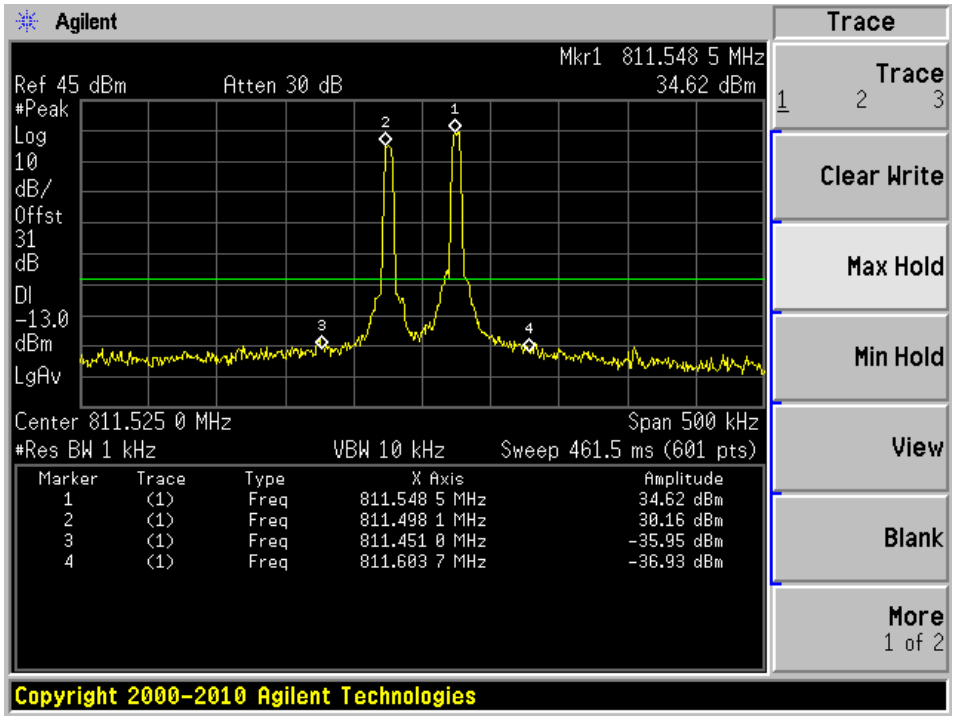
CQPSK, Output, Low Channel



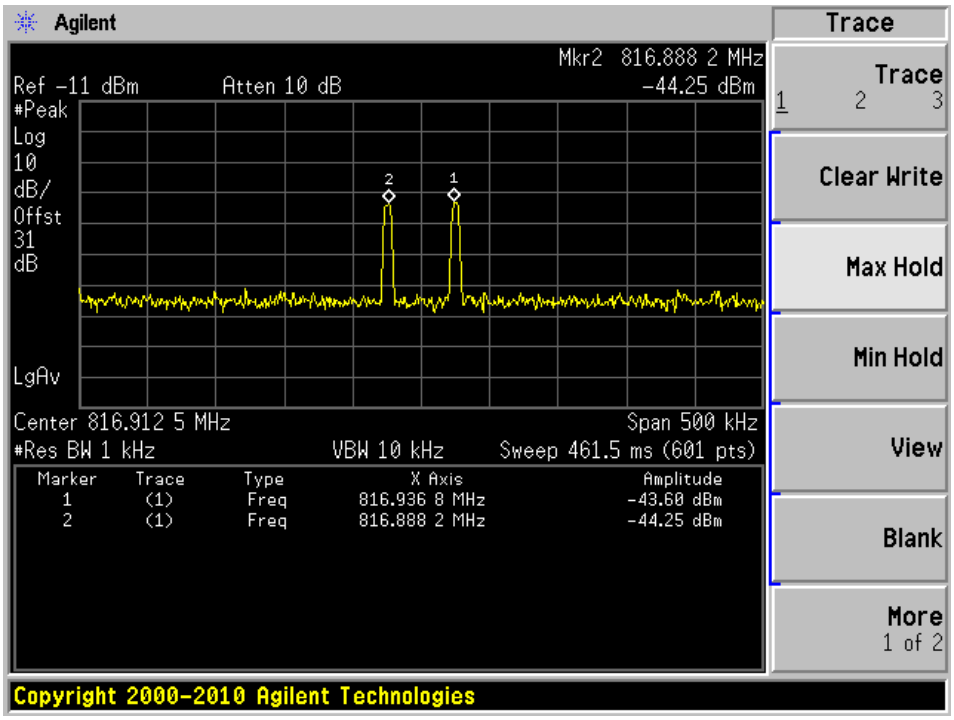
CQPSK, Input, Middle Channel



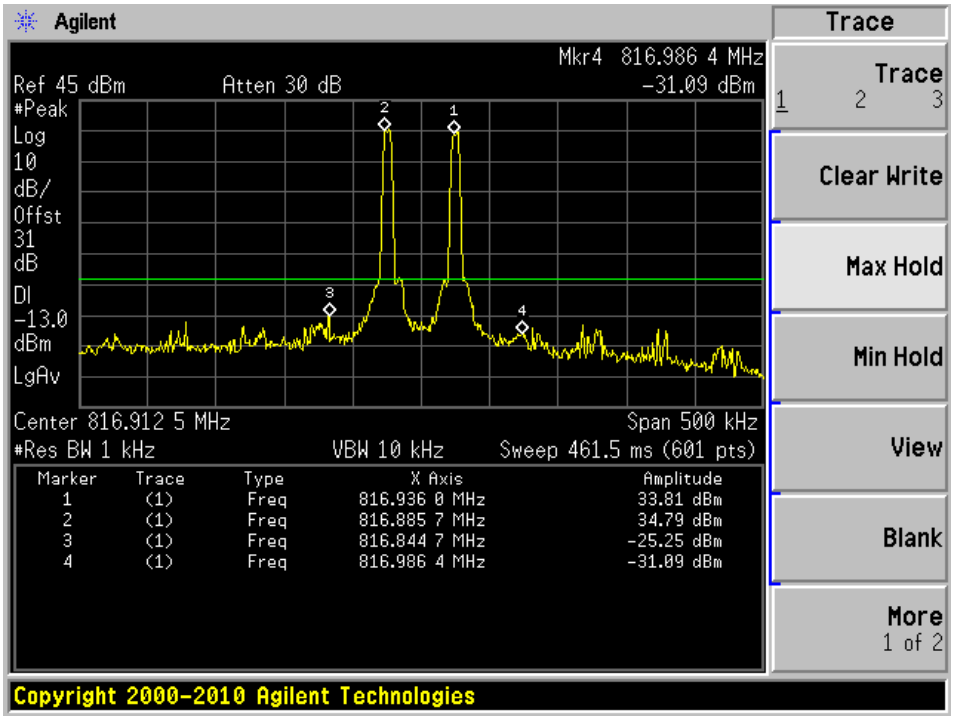
CQPSK, Output, Middle Channel



CQPSK, Input, High Channel



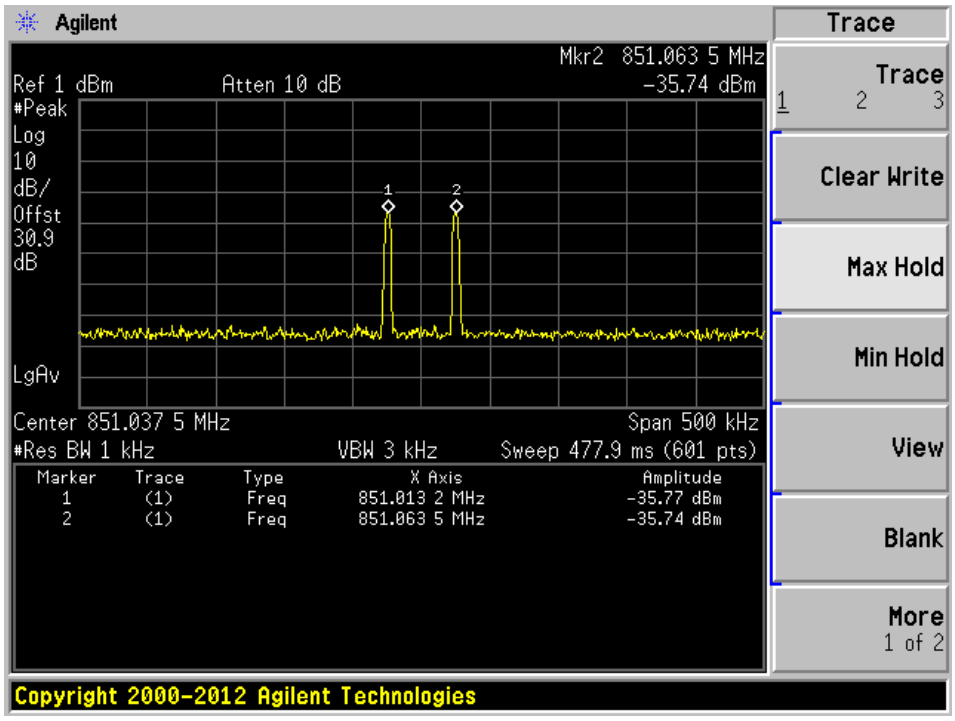
CQPSK, Output, High Channel



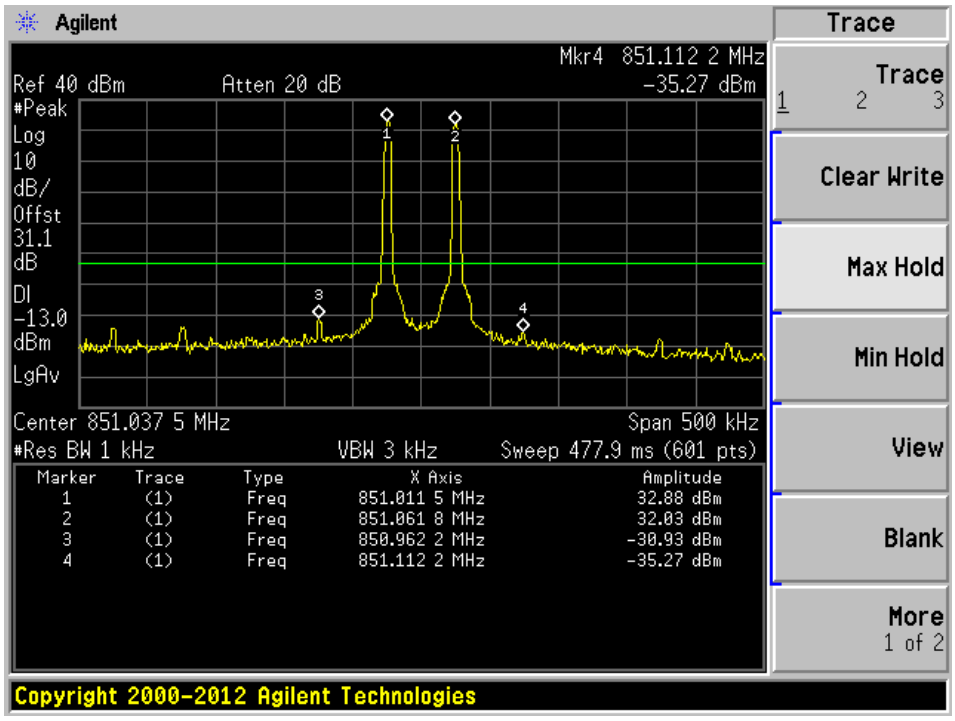
Intermodulation (ALC off)

Downlink: 851-862 MHz

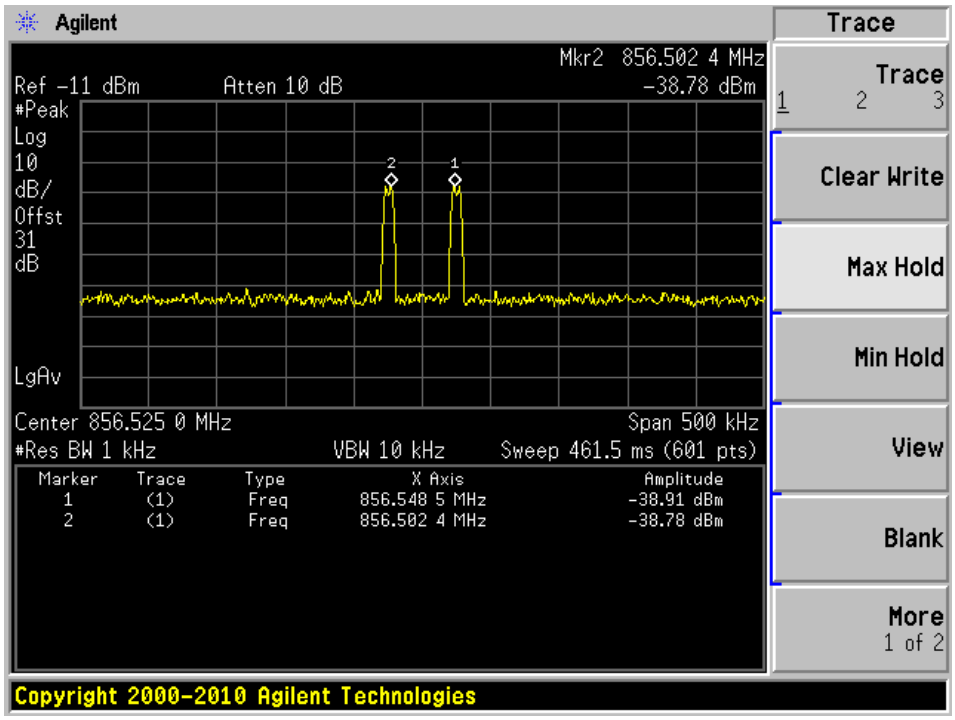
FM Data, Input, Low Channel



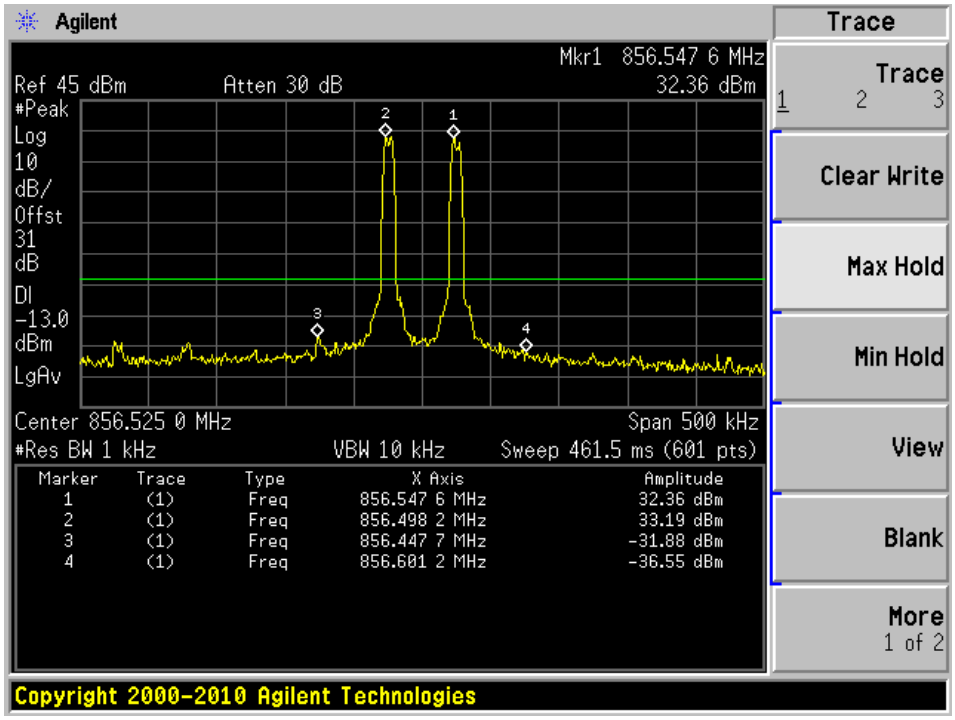
FM Data, Output, Low Channel



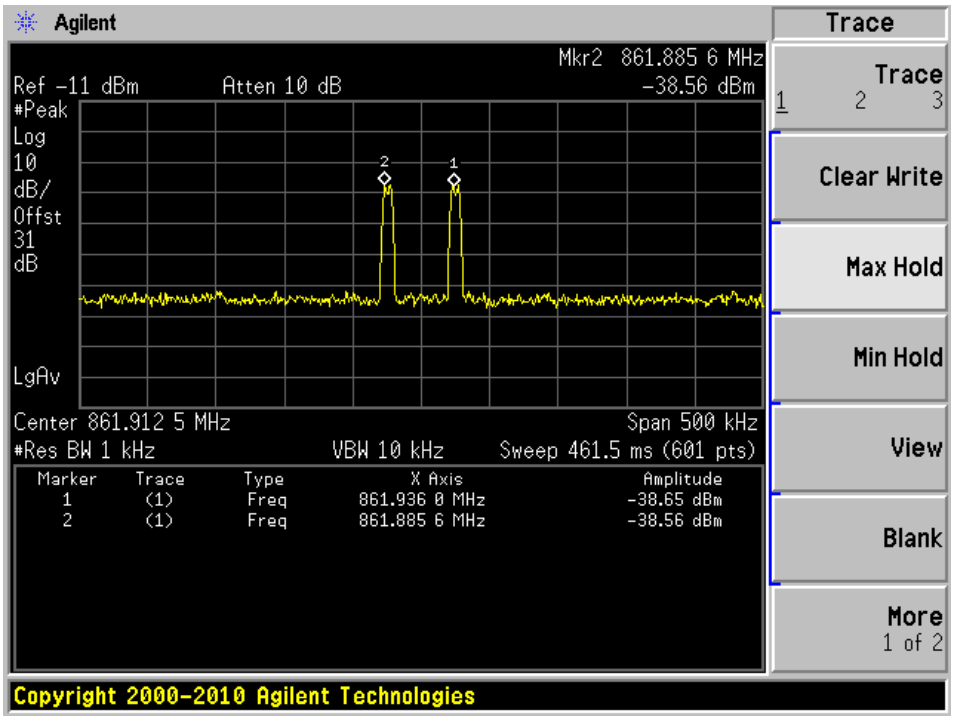
FM Data, Input, Middle Channel



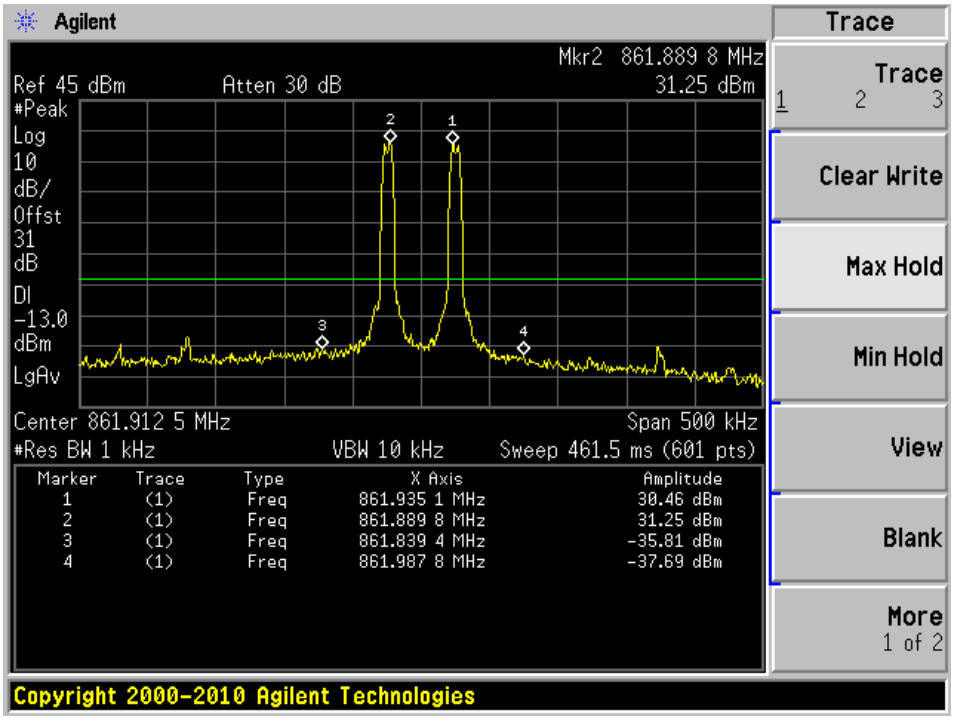
FM Data, Output, Middle Channel



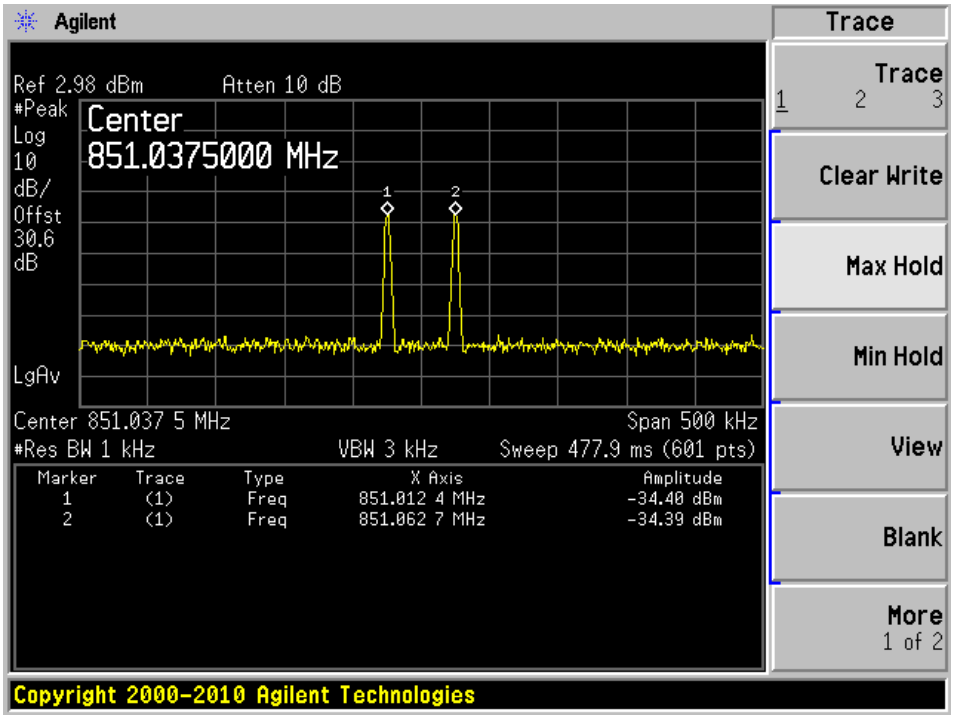
FM Data, Input, High Channel



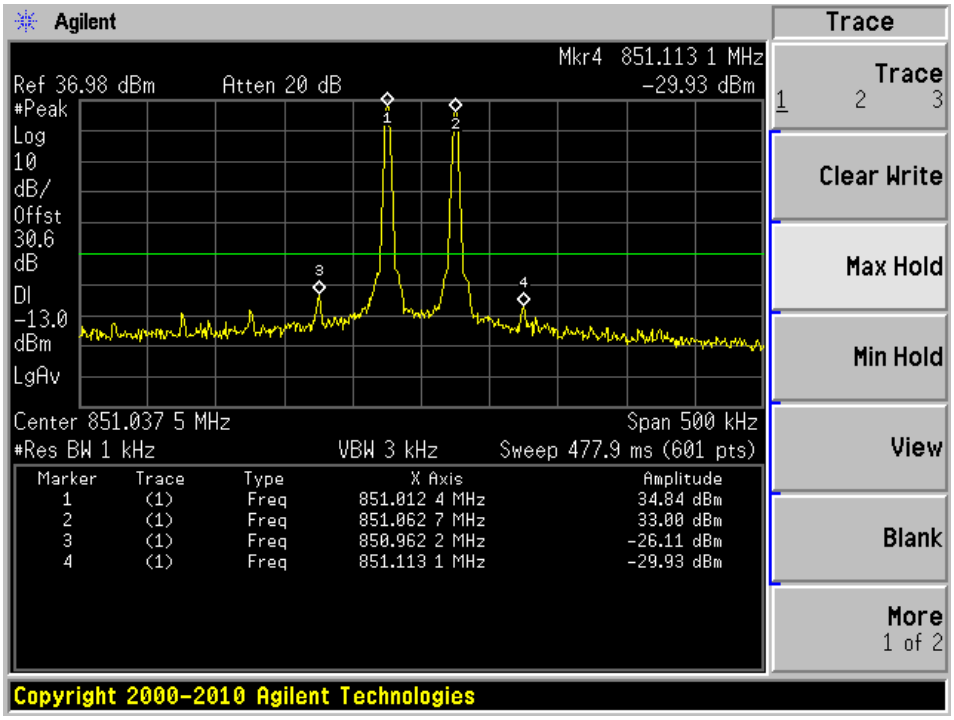
FM Data, Output, High Channel



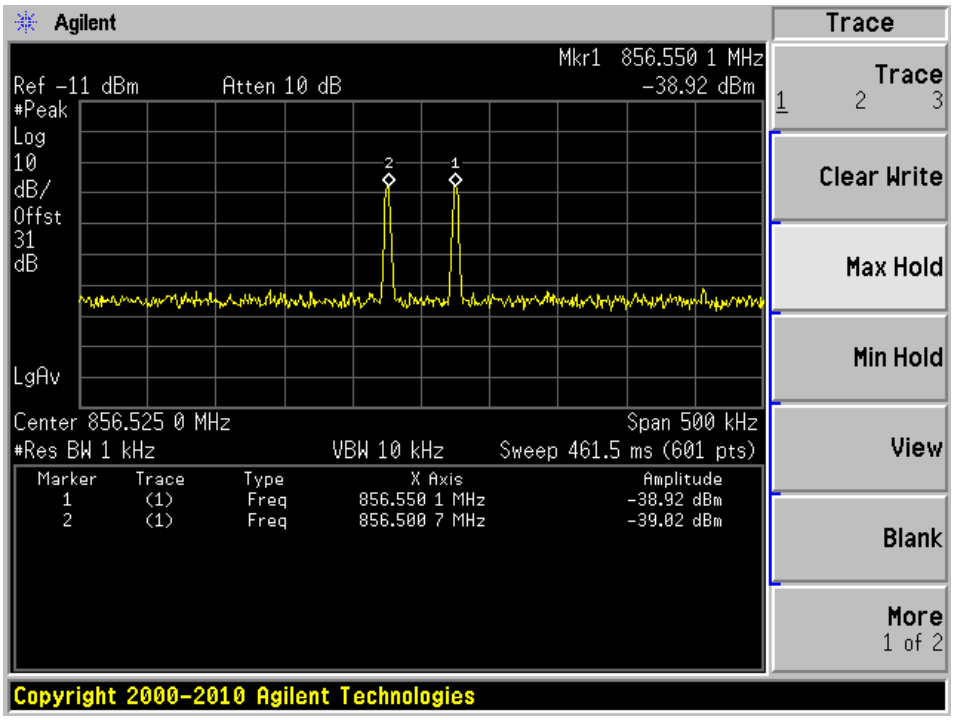
FM Voice, Input, Low Channel



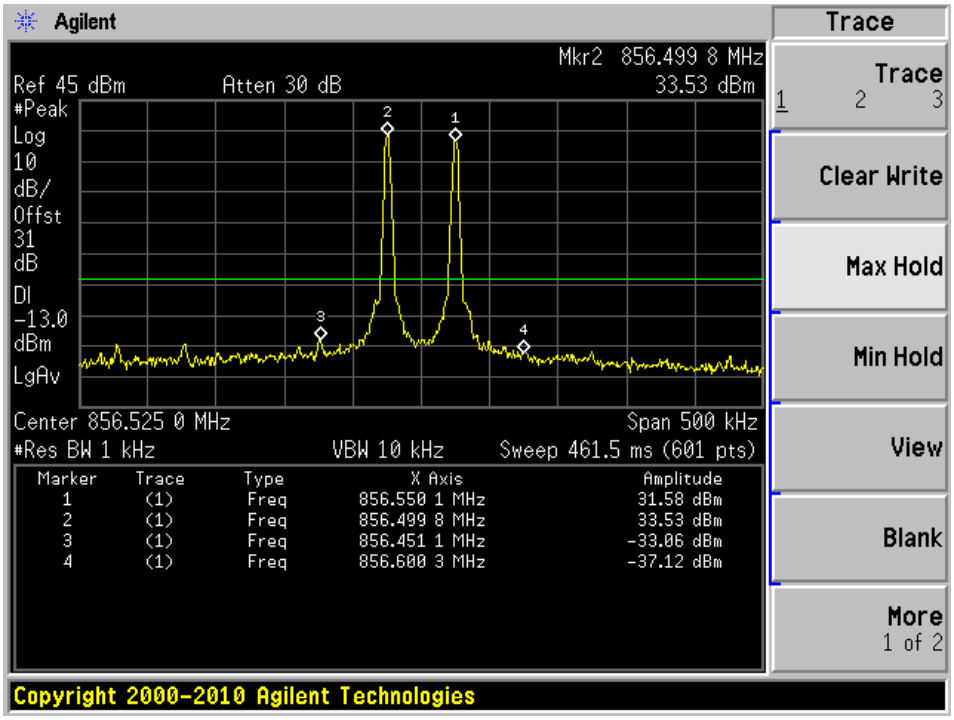
FM Voice, Output, Low Channel



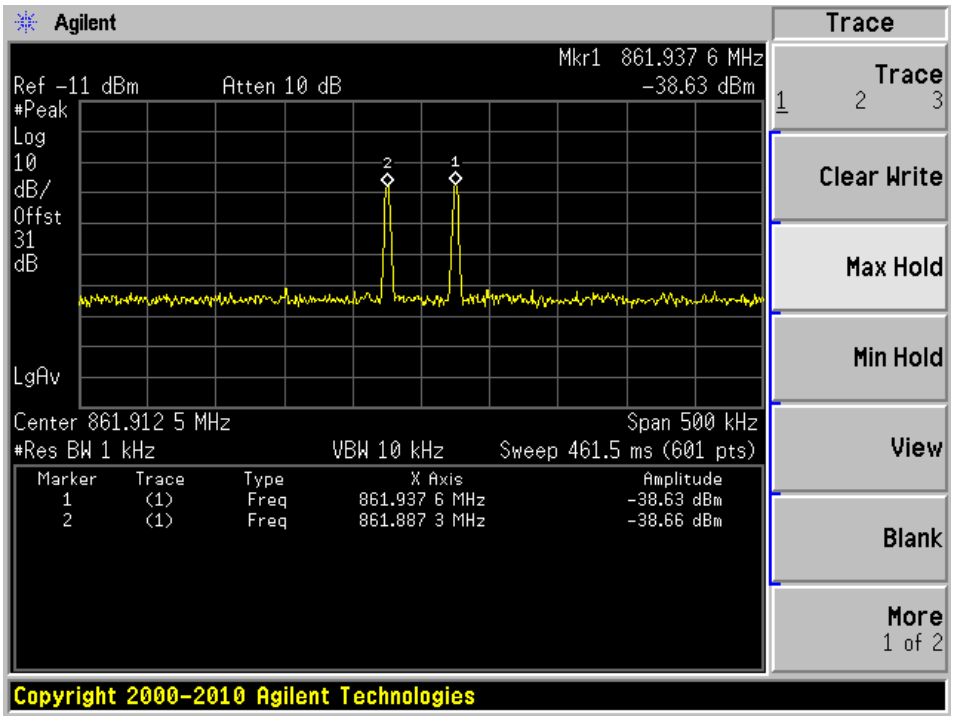
FM Voice, Input, Middle Channel



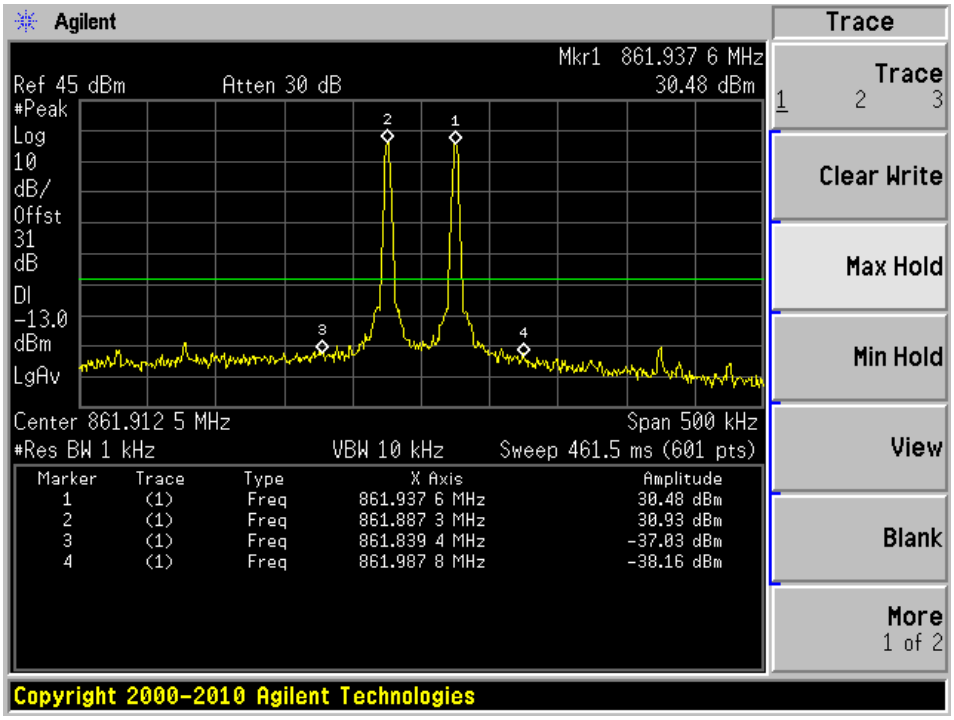
FM Voice, Output, Middle Channel



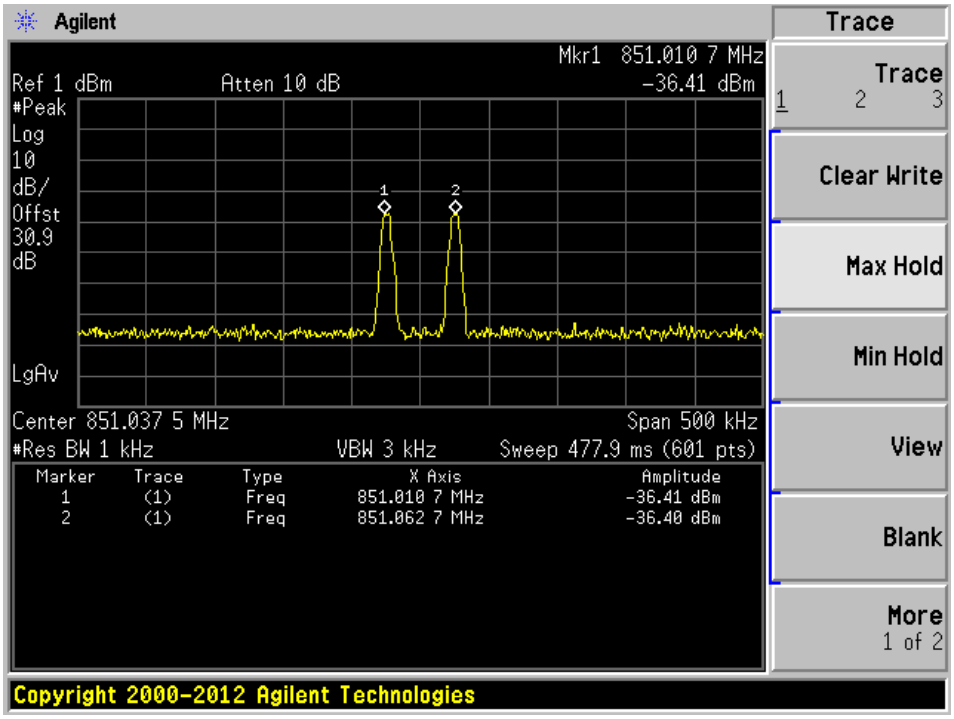
FM Voice, Input, High Channel



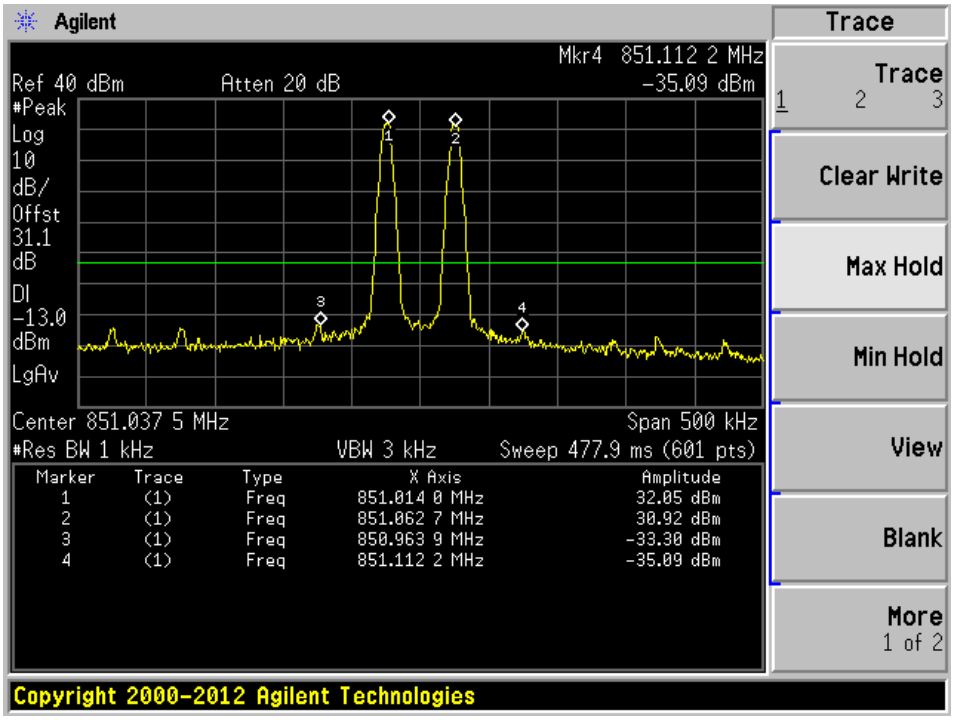
FM Voice, Output, High Channel



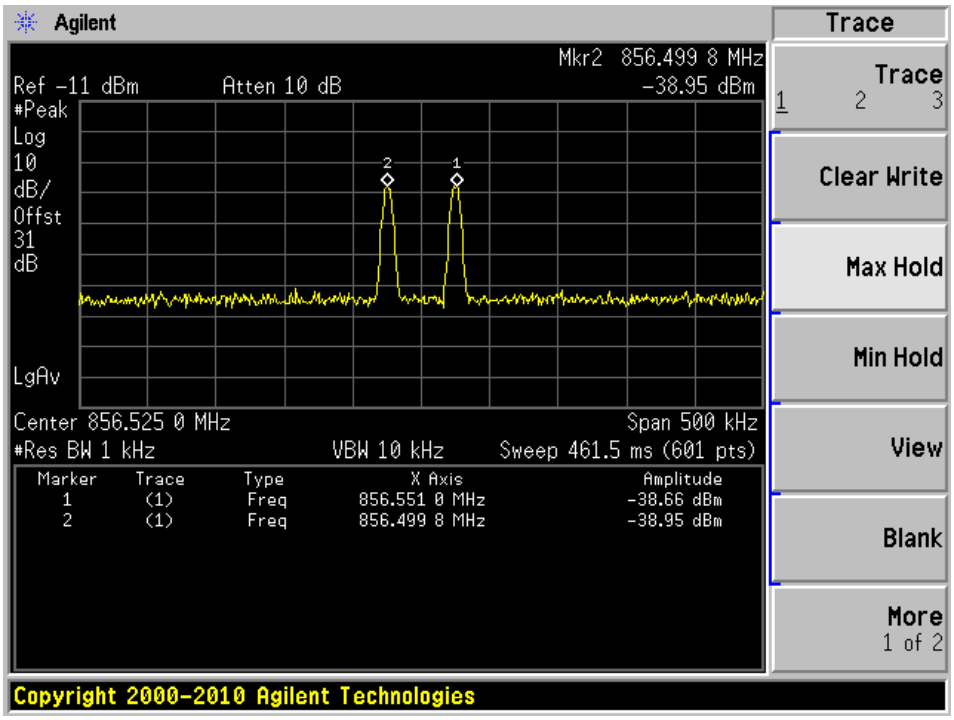
C4FM, Input, Low Channel



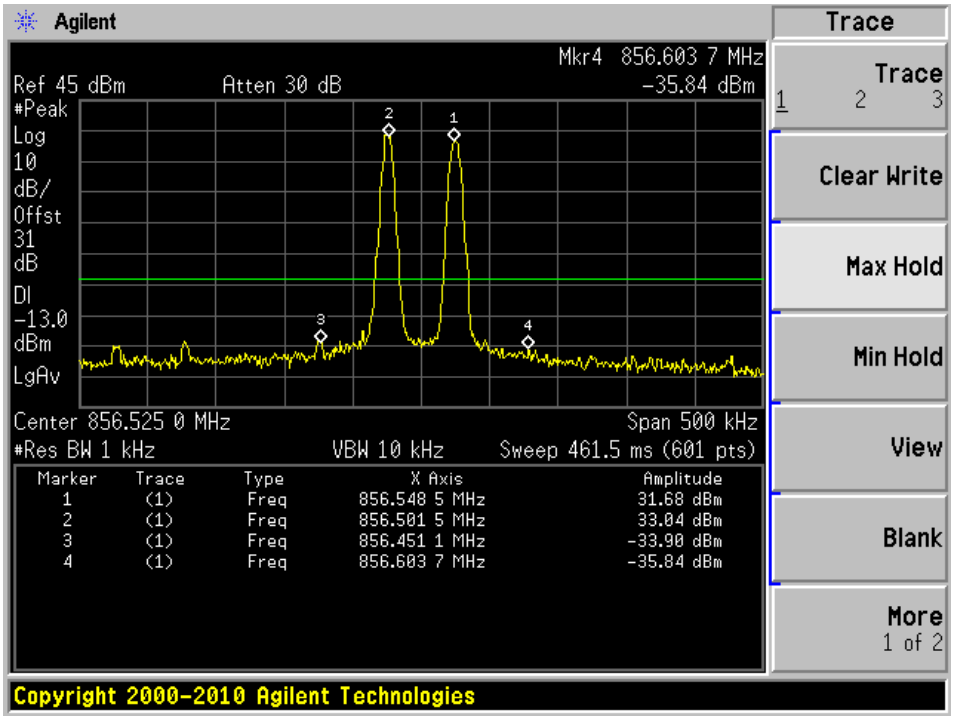
C4FM, Output, Low Channel



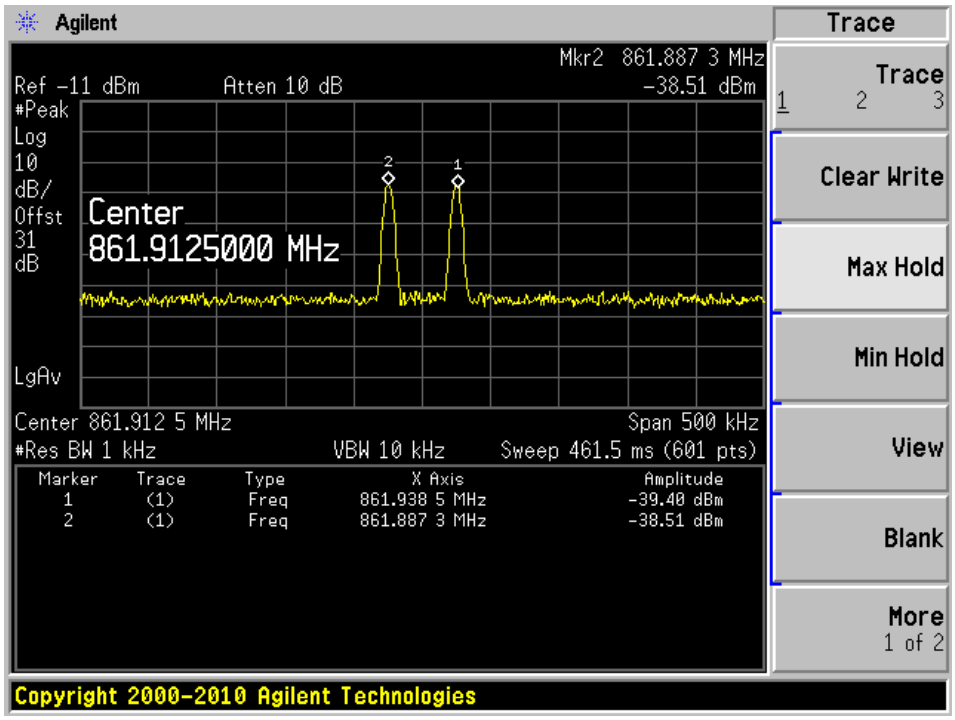
C4FM, Input, Middle Channel



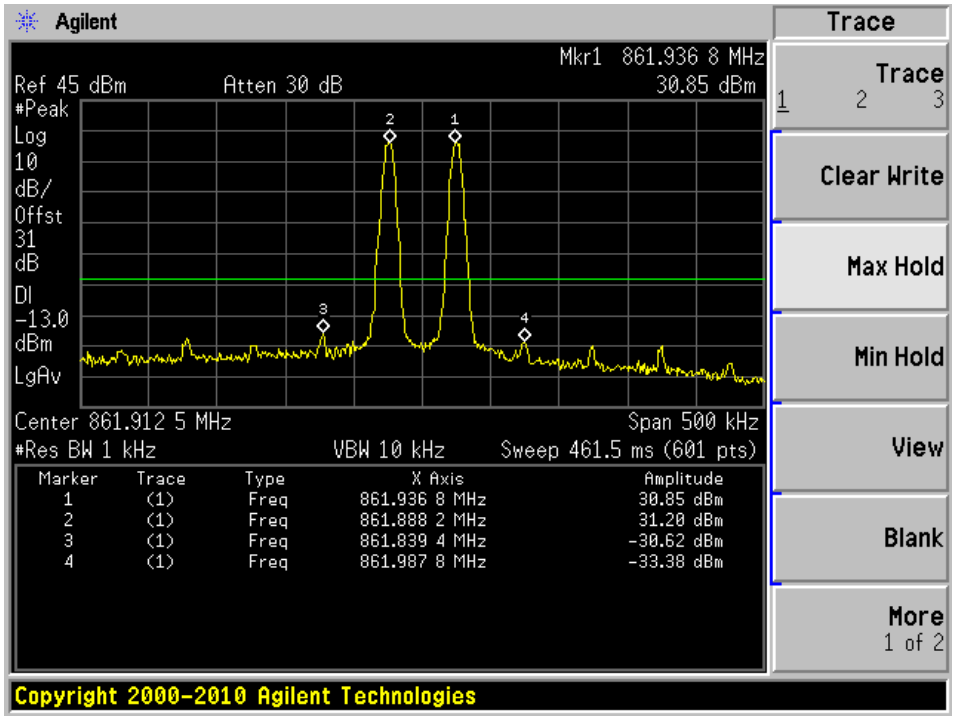
C4FM, Output, Middle Channel



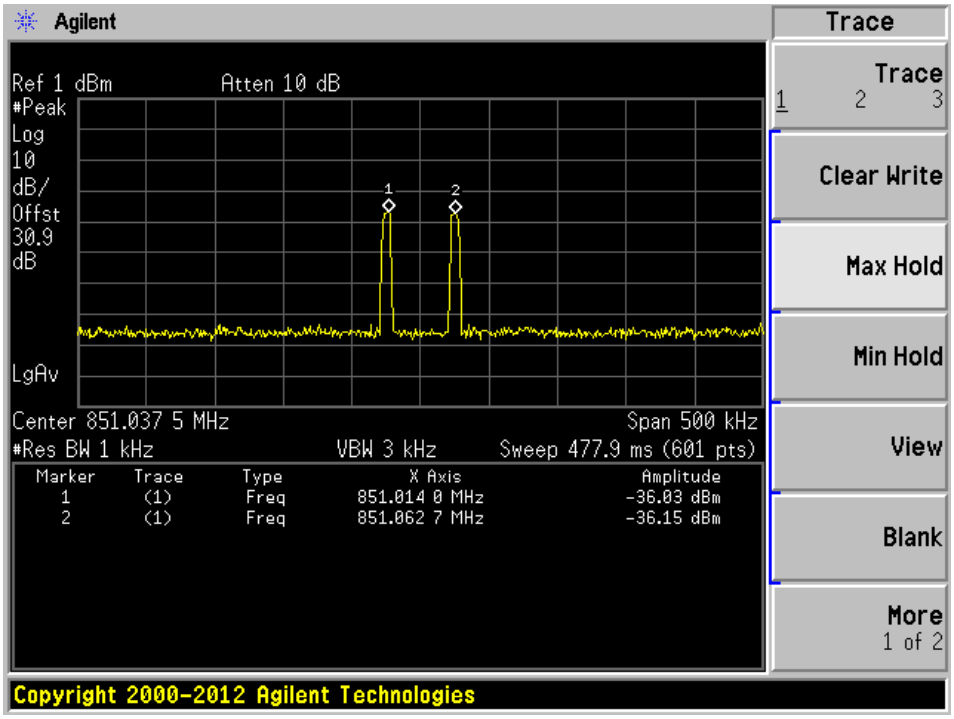
C4FM, Input, High Channel



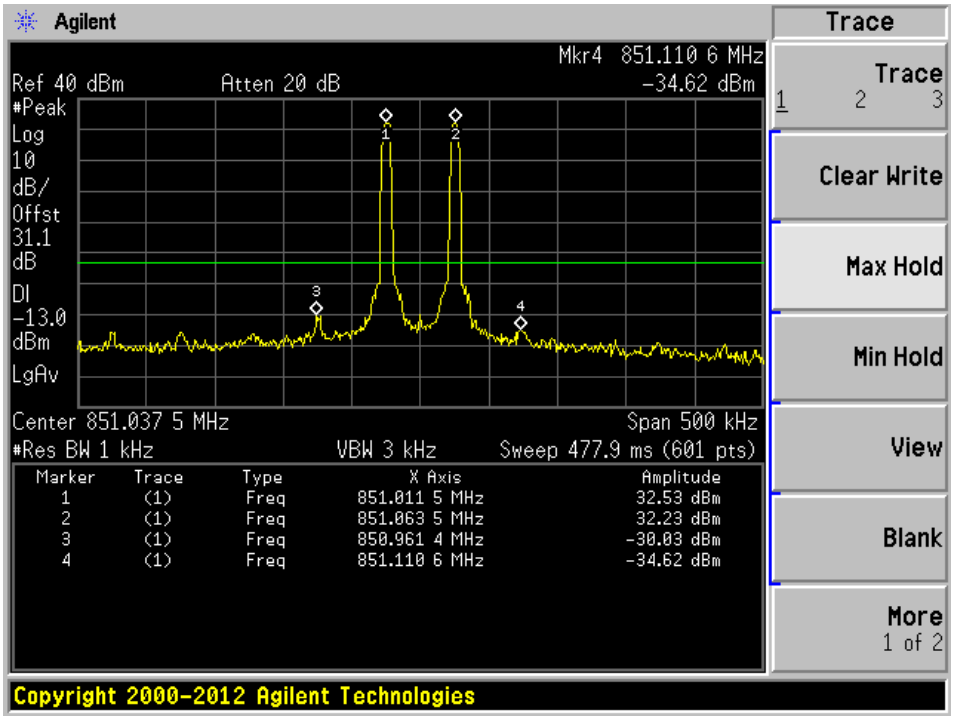
C4FM, Output, High Channel



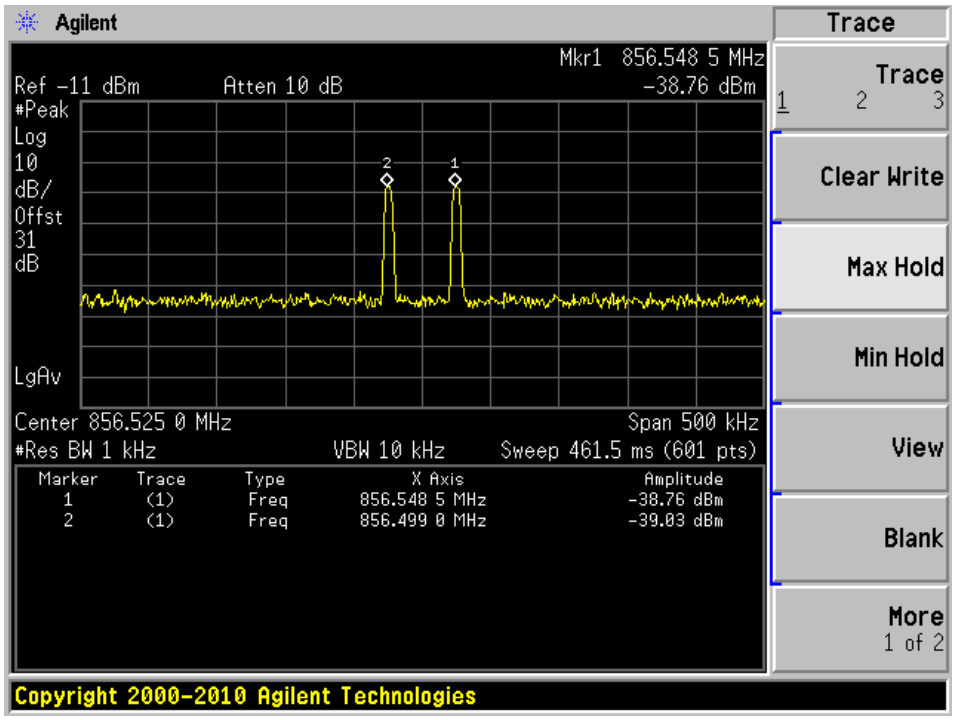
CQPSK, Input, Low Channel



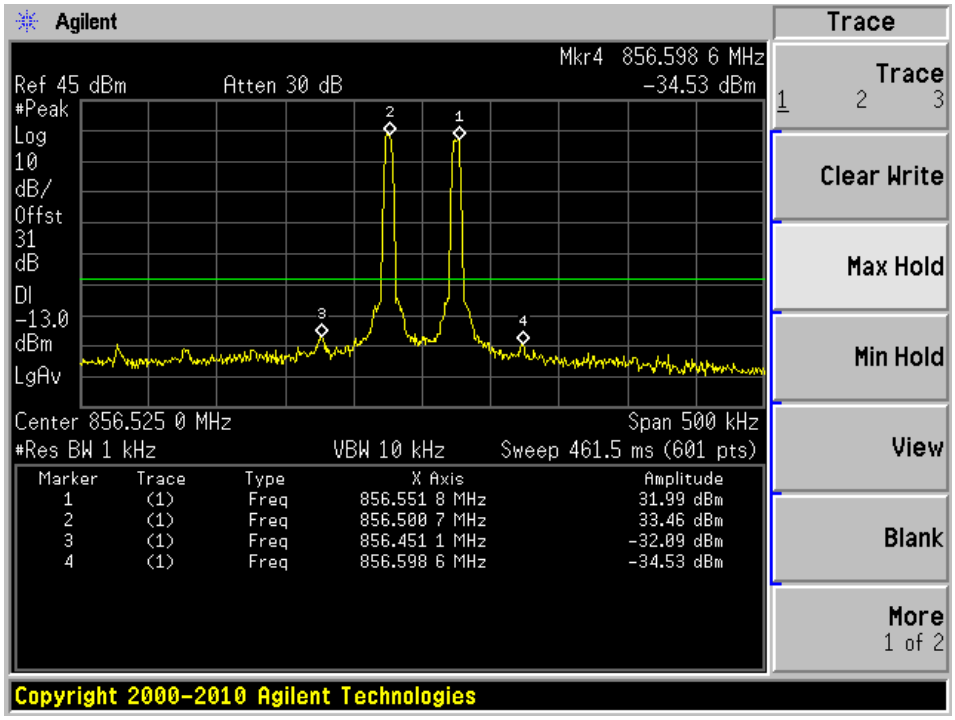
CQPSK, Output, Low Channel



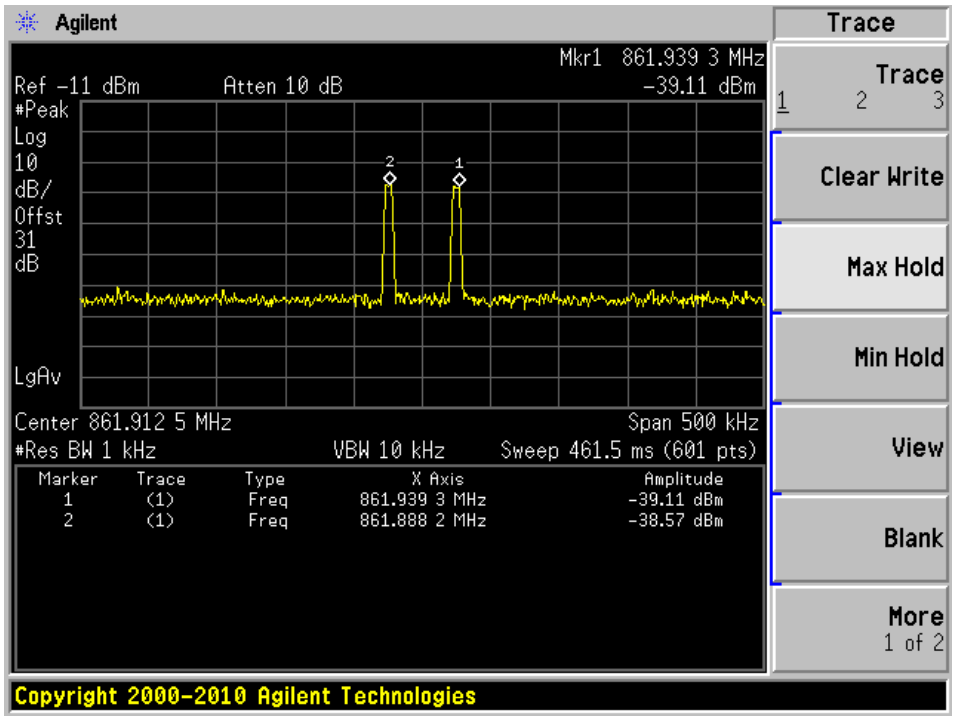
CQPSK, Input, Middle Channel



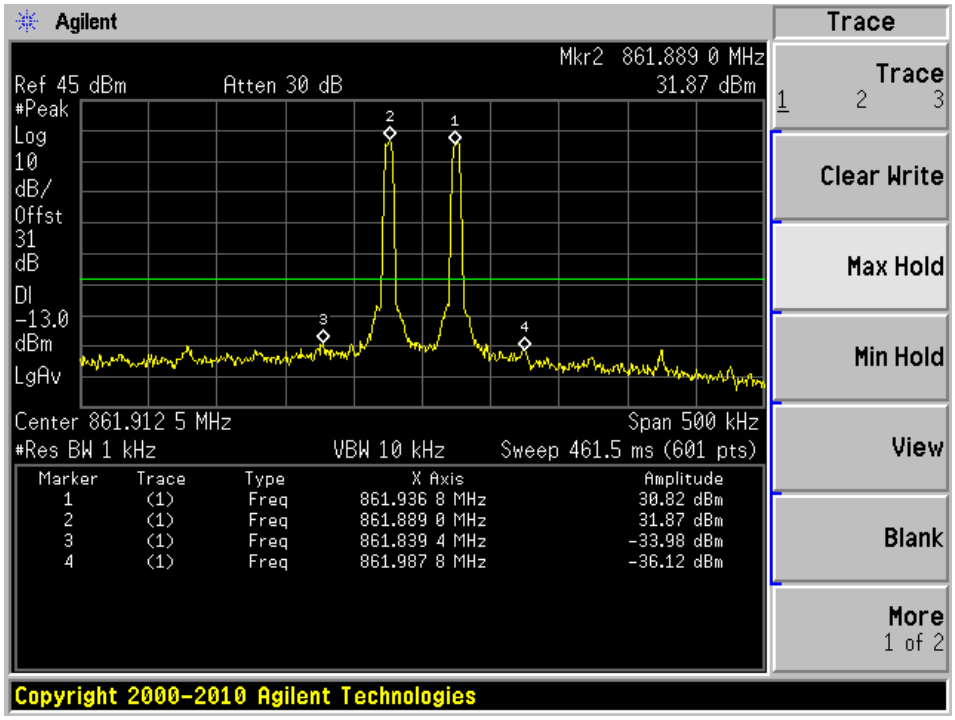
CQPSK, Output, Middle Channel



CQPSK, Input, High Channel

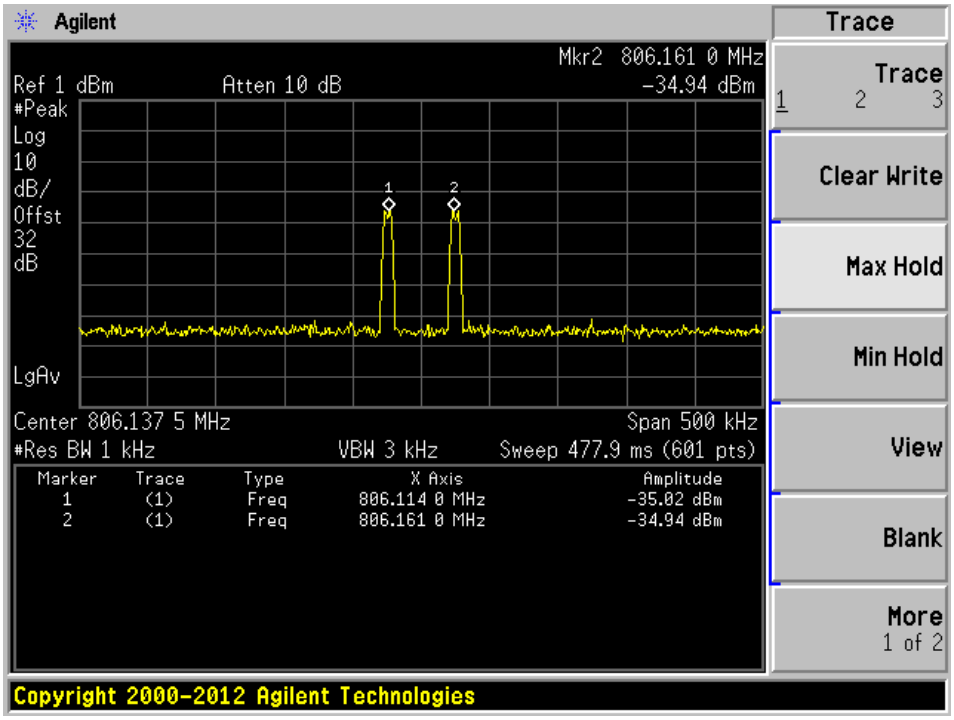


CQPSK, Output, High Channel

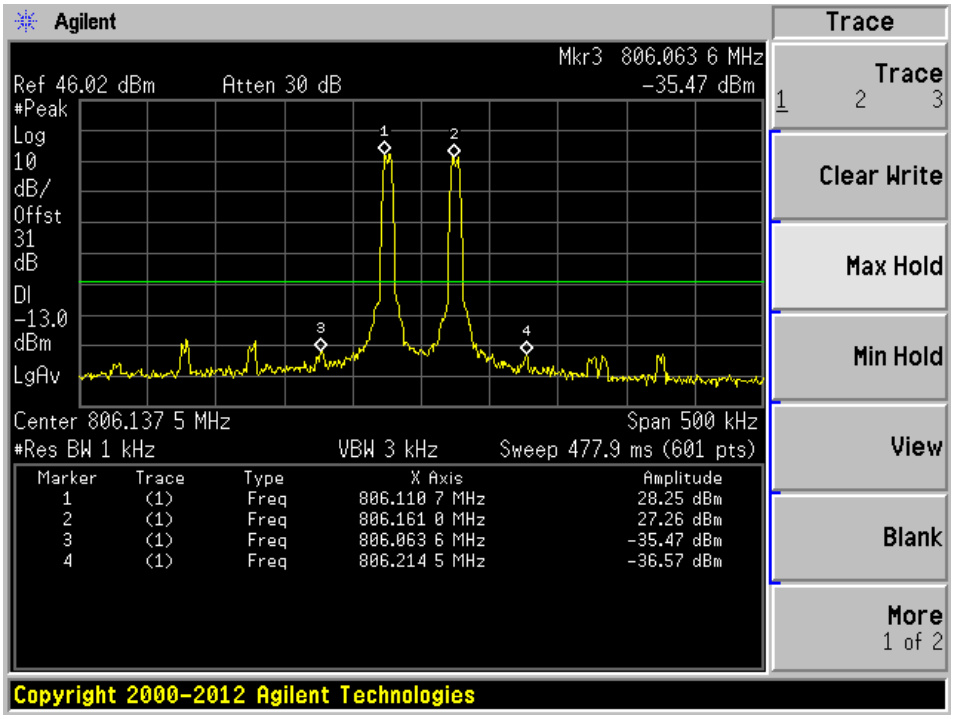


Uplink: 806-817 MHz

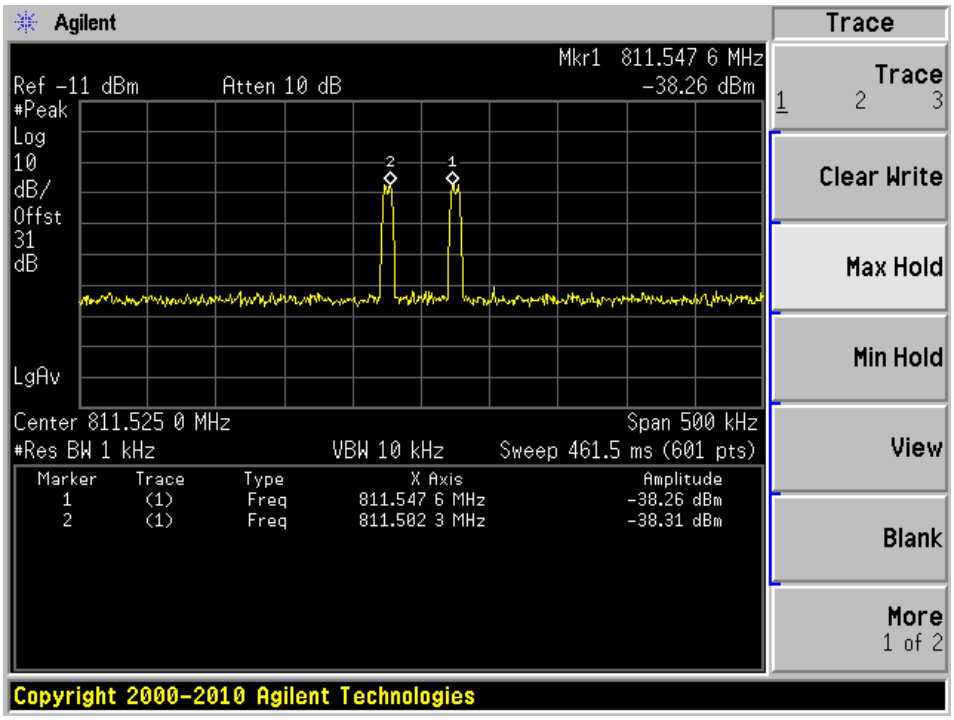
FM Data, Input, Low Channel



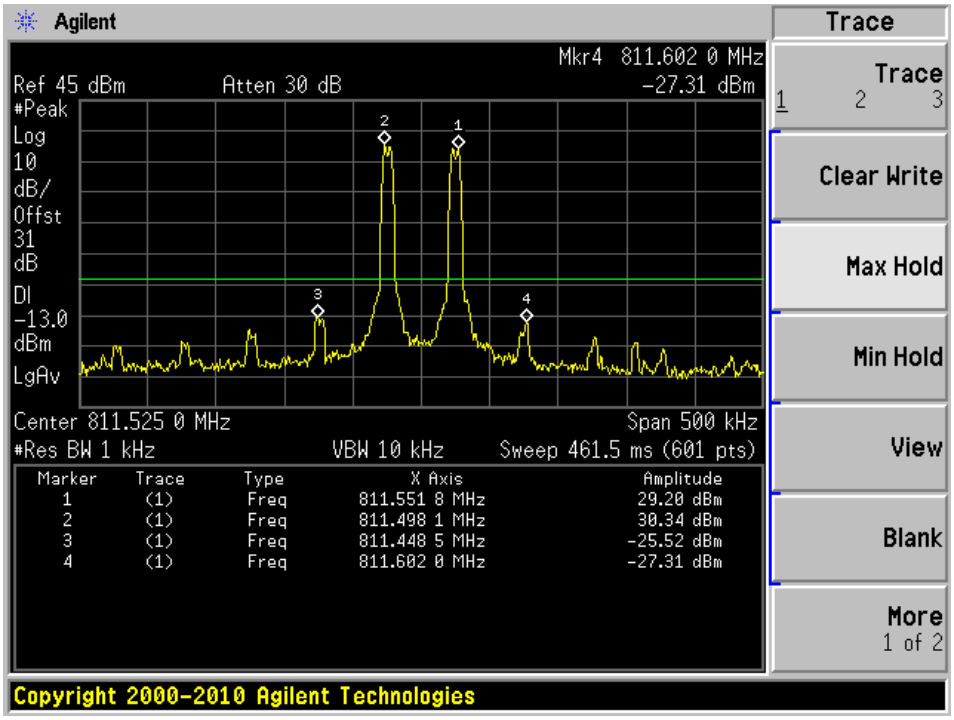
FM Data, Output, Low Channel



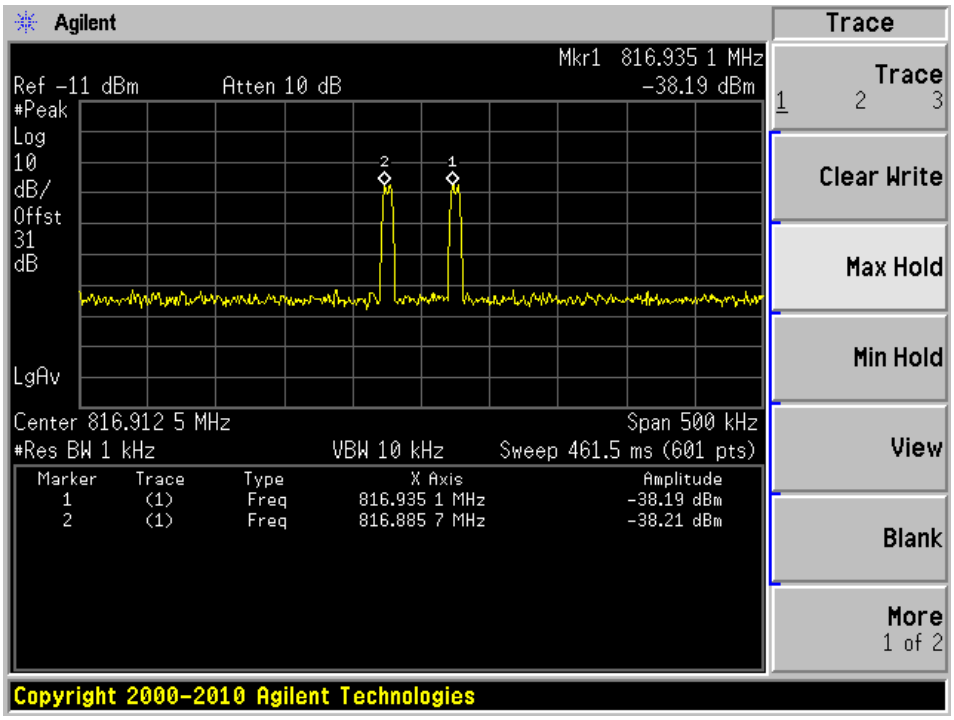
FM Data, Input, Middle Channel



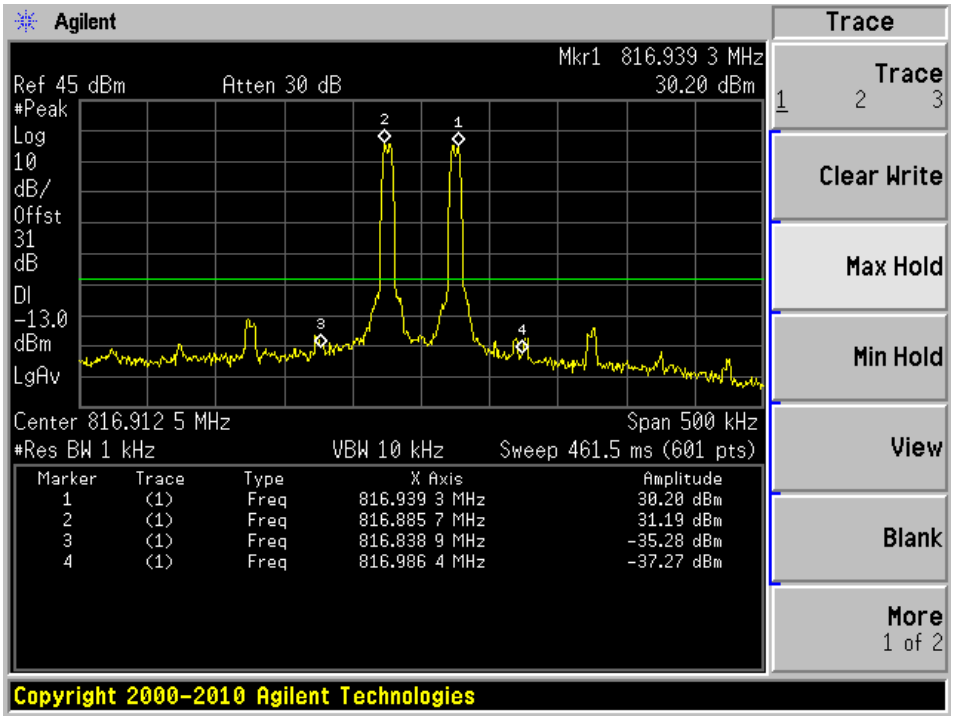
FM Data, Output, Middle Channel



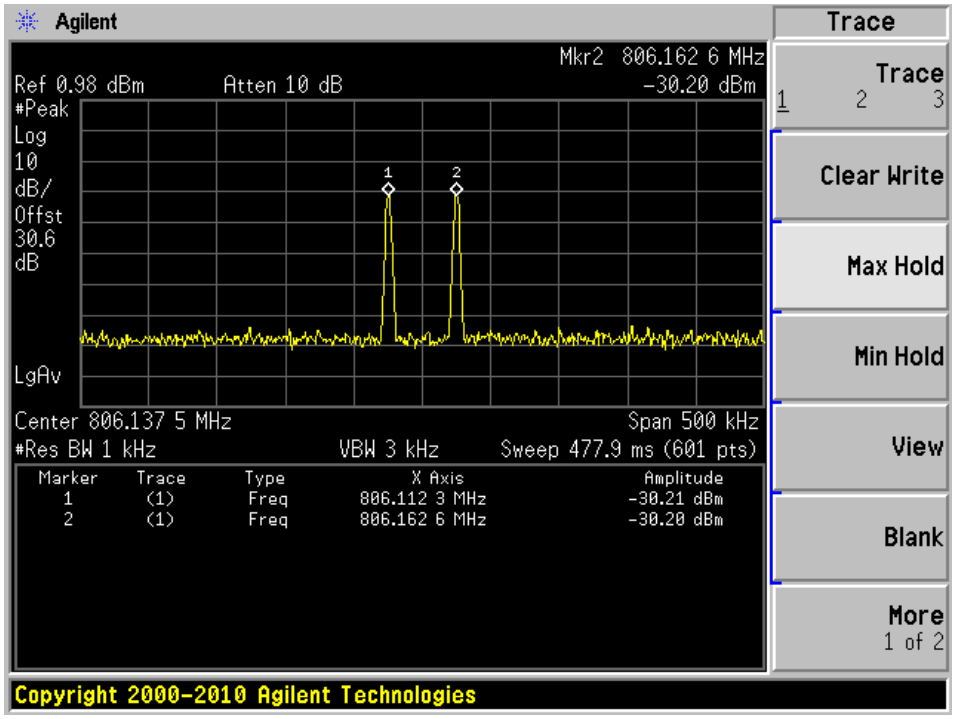
FM Data, Input, High Channel



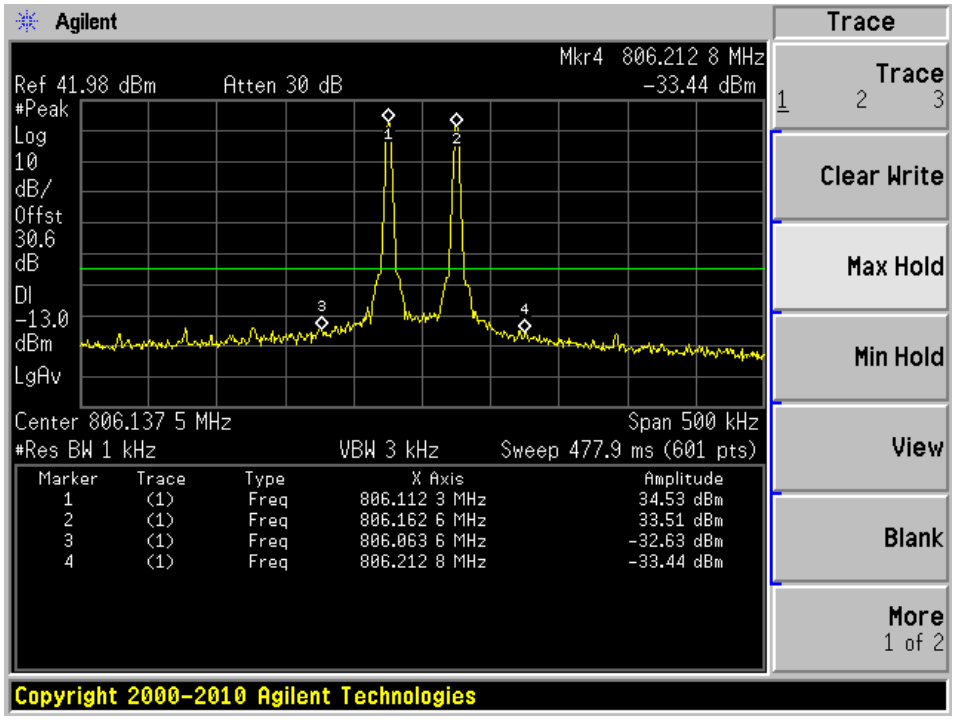
FM Data, Output, High Channel



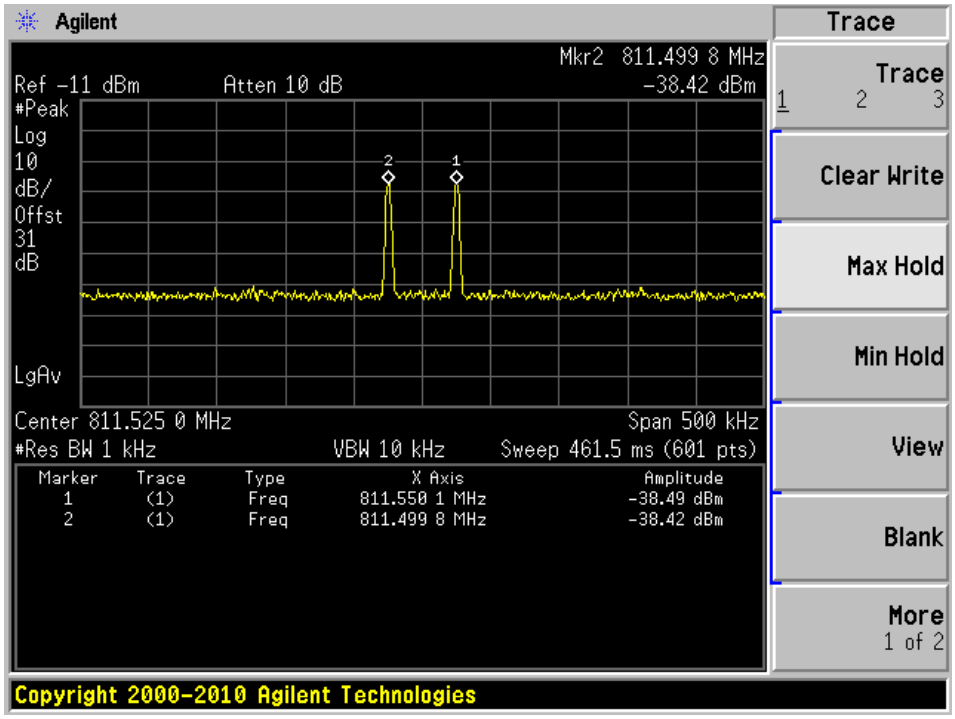
FM Voice, Input, Low Channel



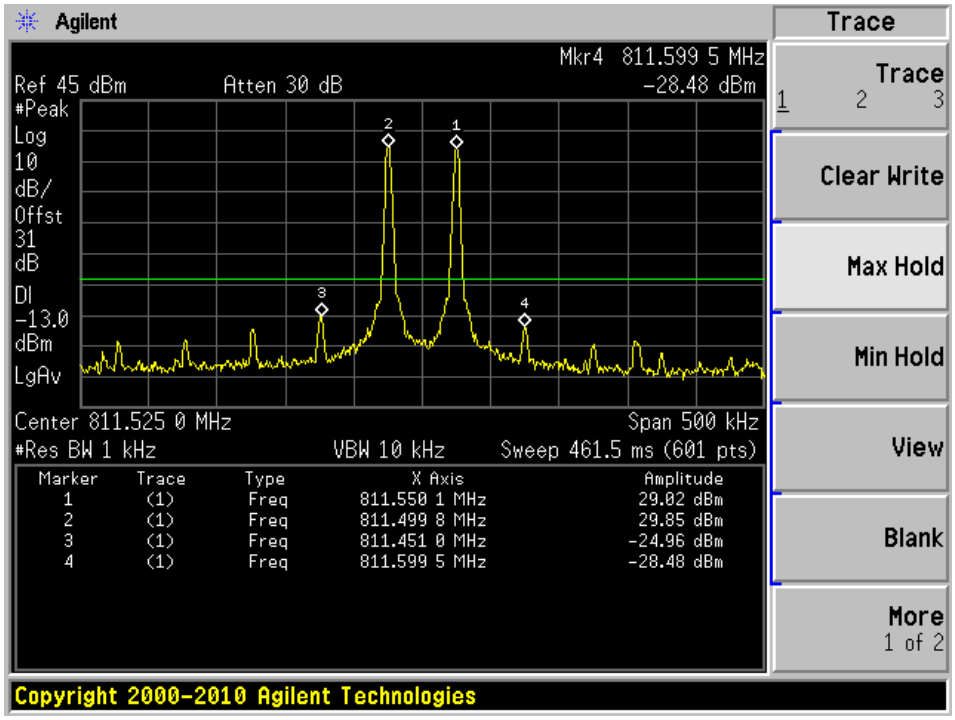
FM Voice, Output, Low Channel



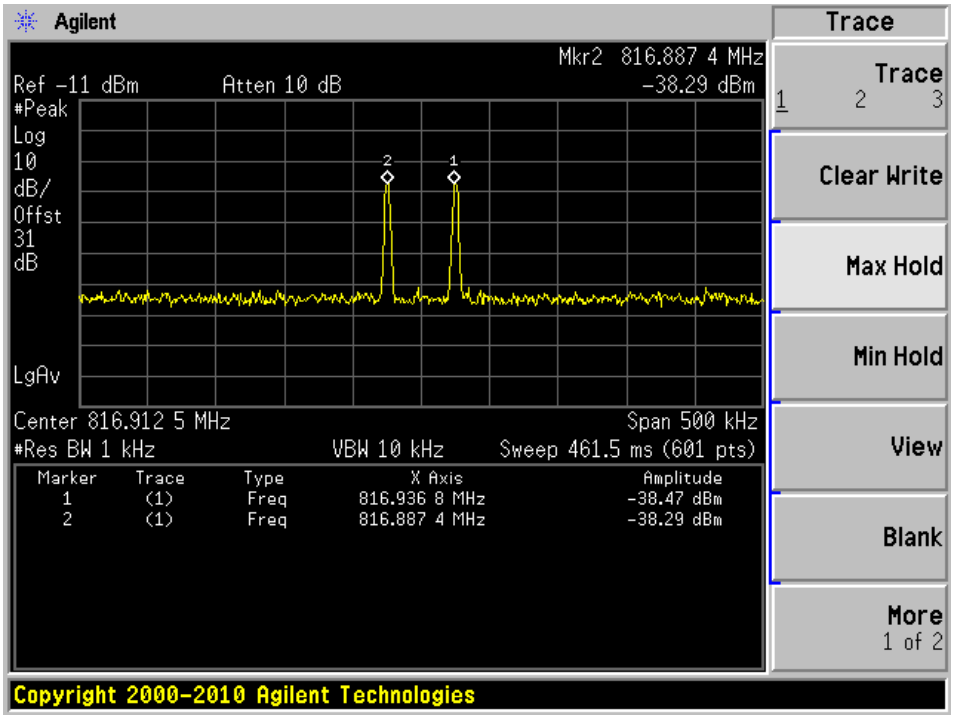
FM Voice, Input, Middle Channel



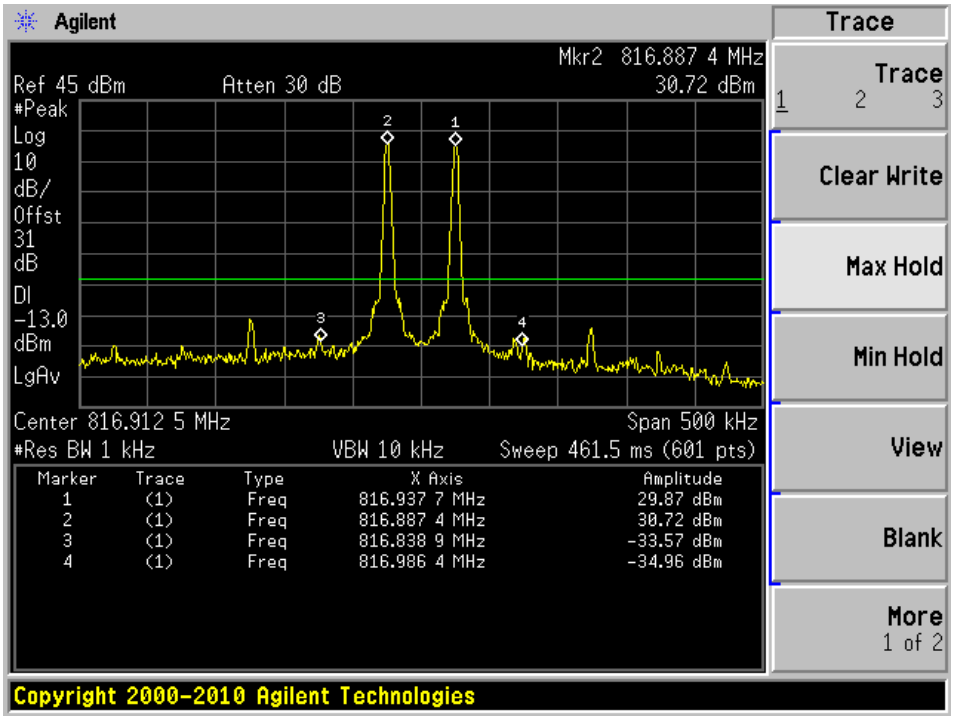
FM Voice, Output, Middle Channel



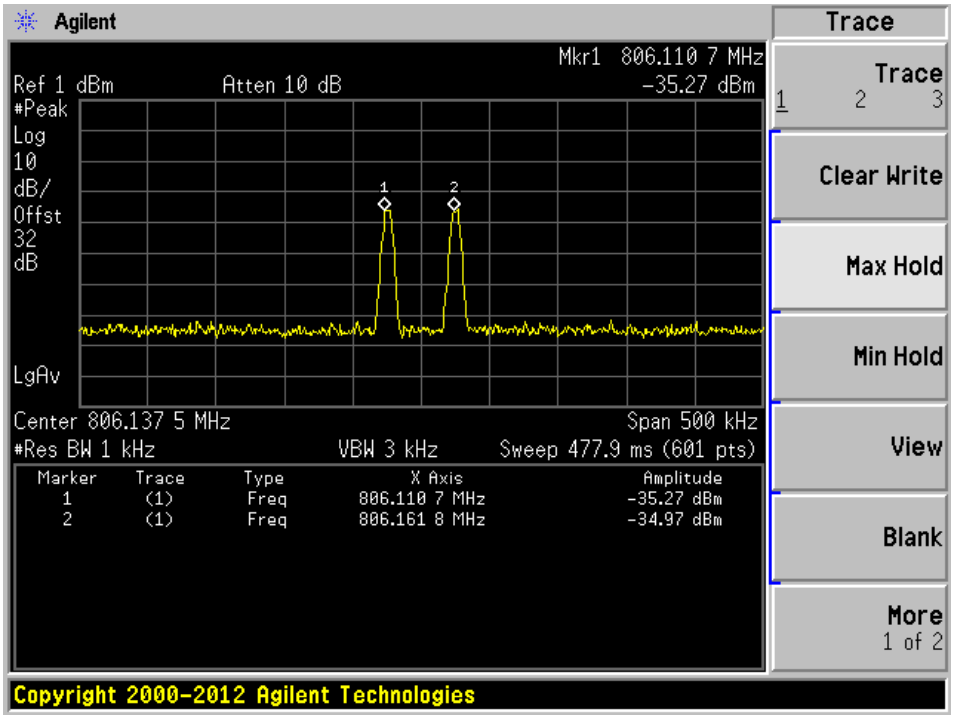
FM Voice, Input, High Channel



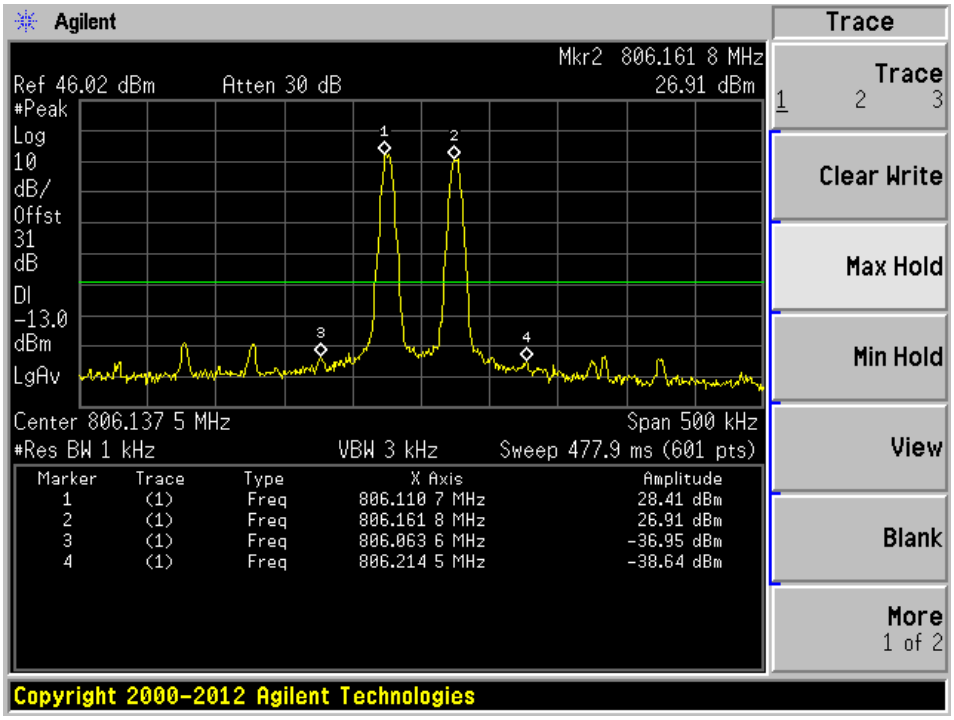
FM Voice, Output, High Channel



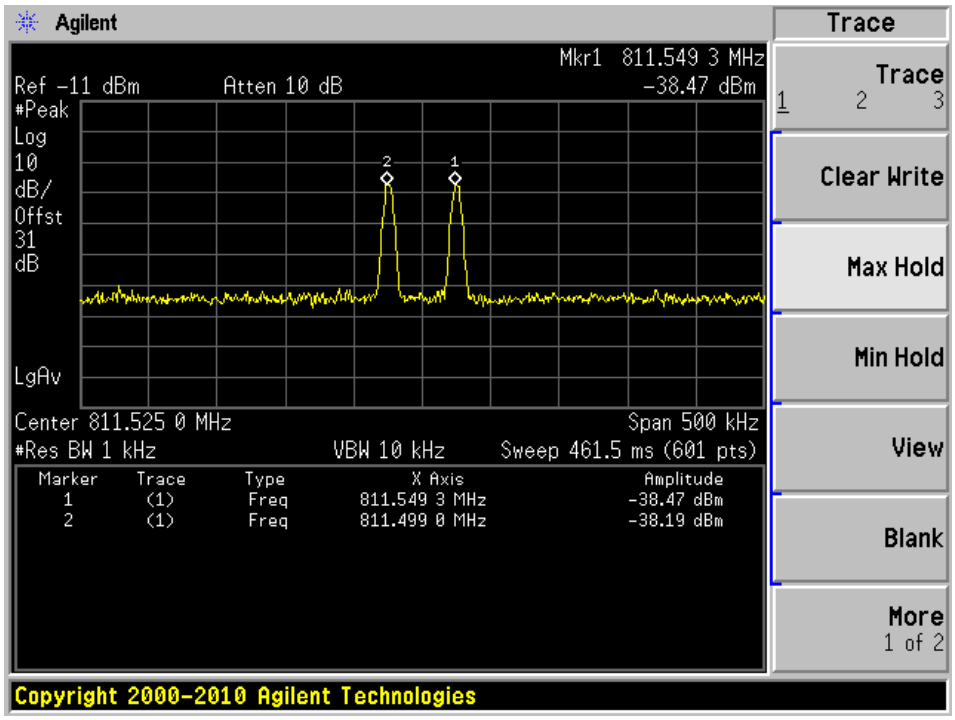
C4FM, Input, Low Channel



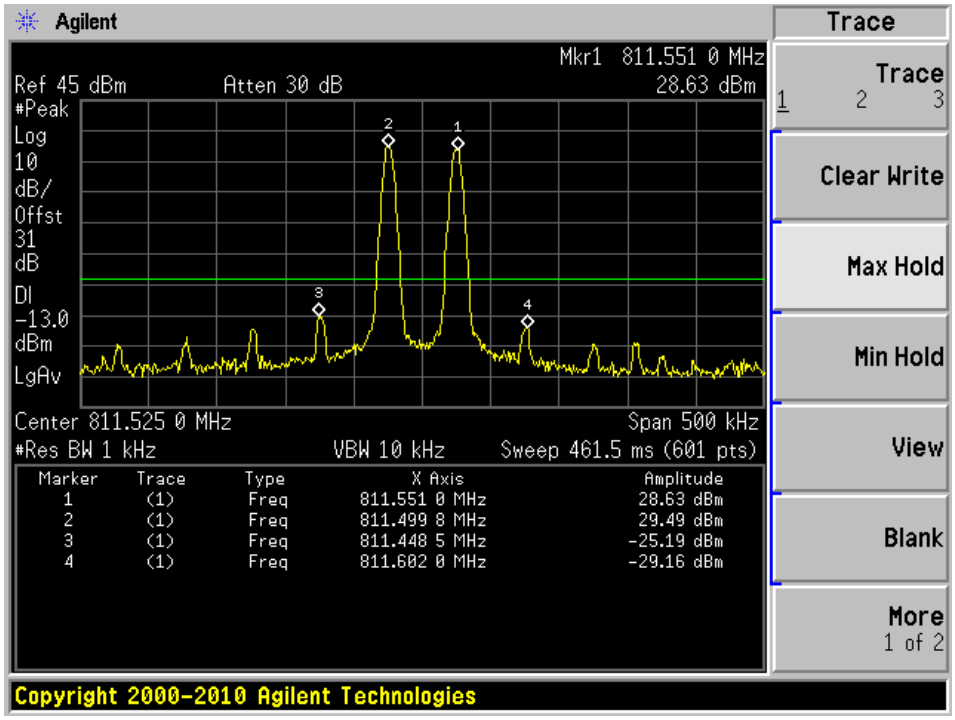
C4FM, Output, Low Channel



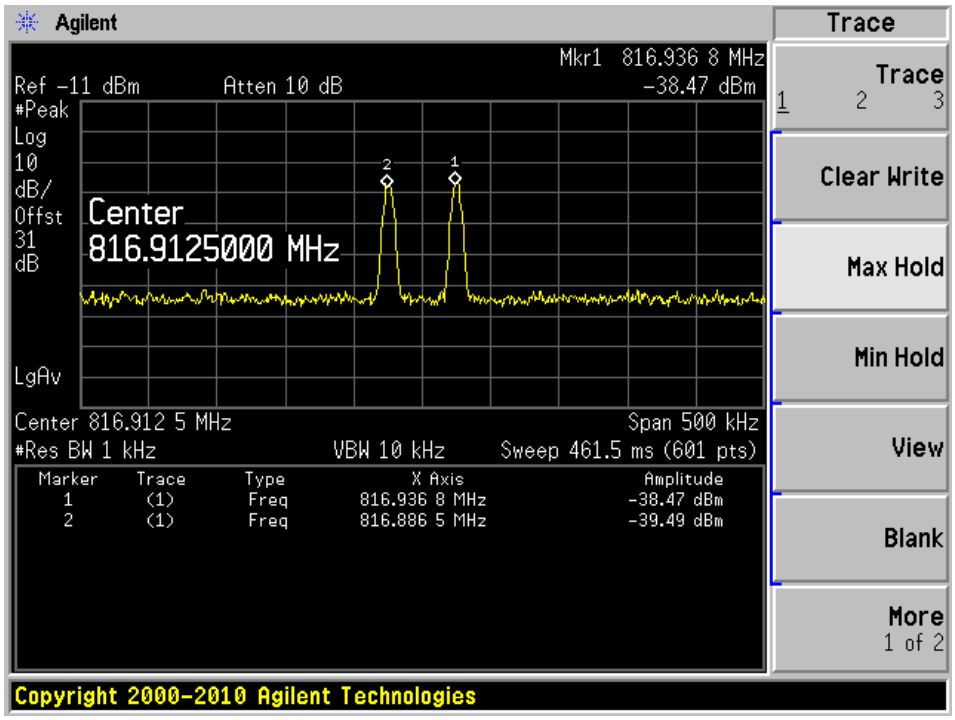
C4FM, Input, Middle Channel



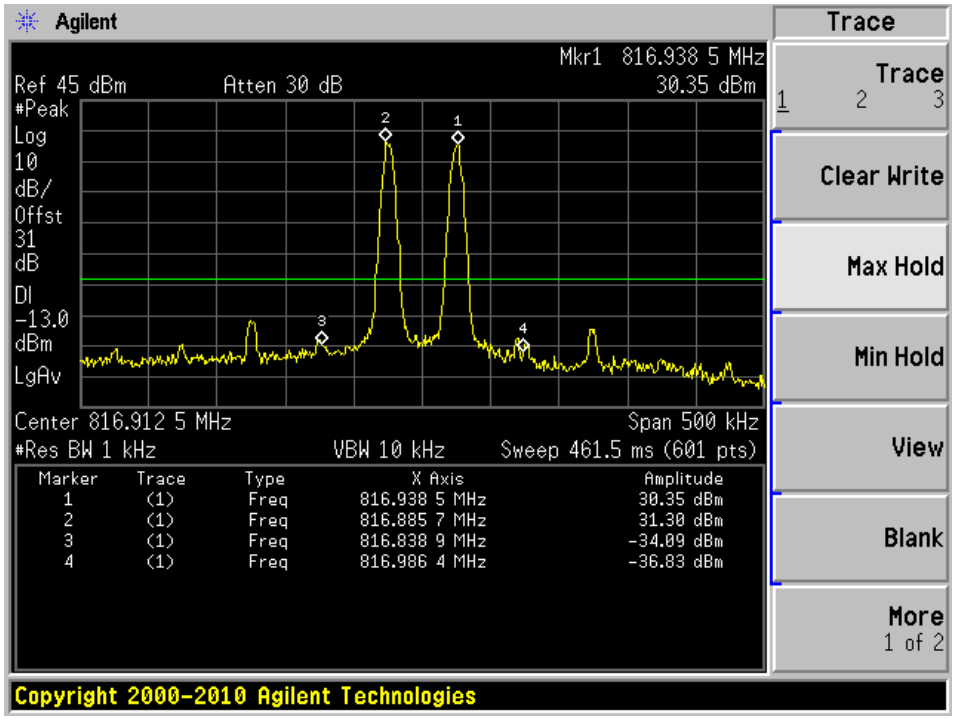
C4FM, Output, Middle Channel



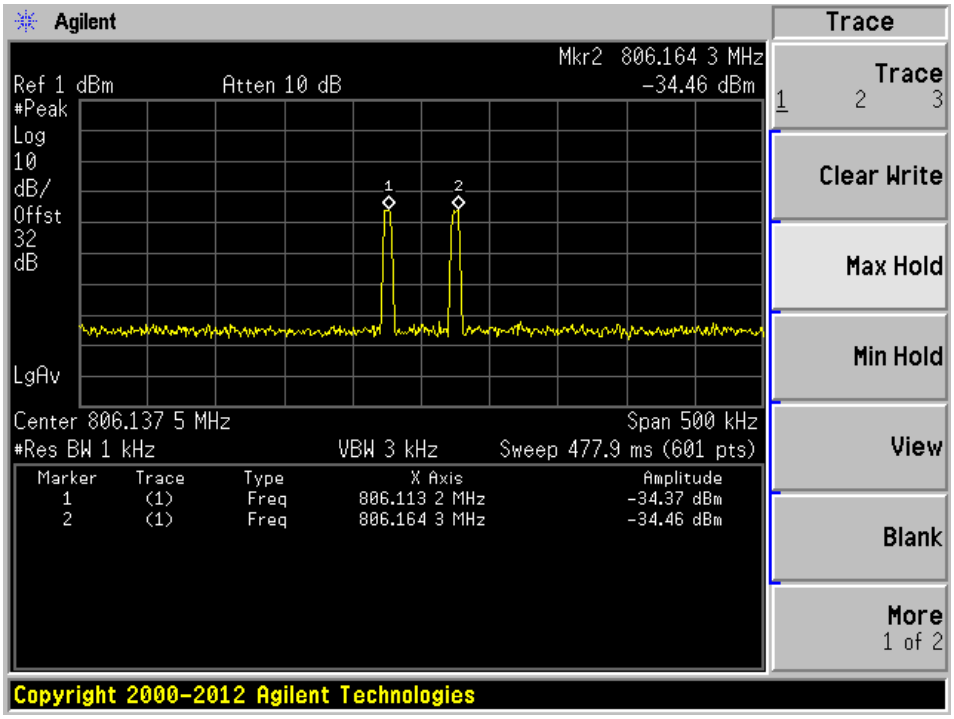
C4FM, Input, High Channel



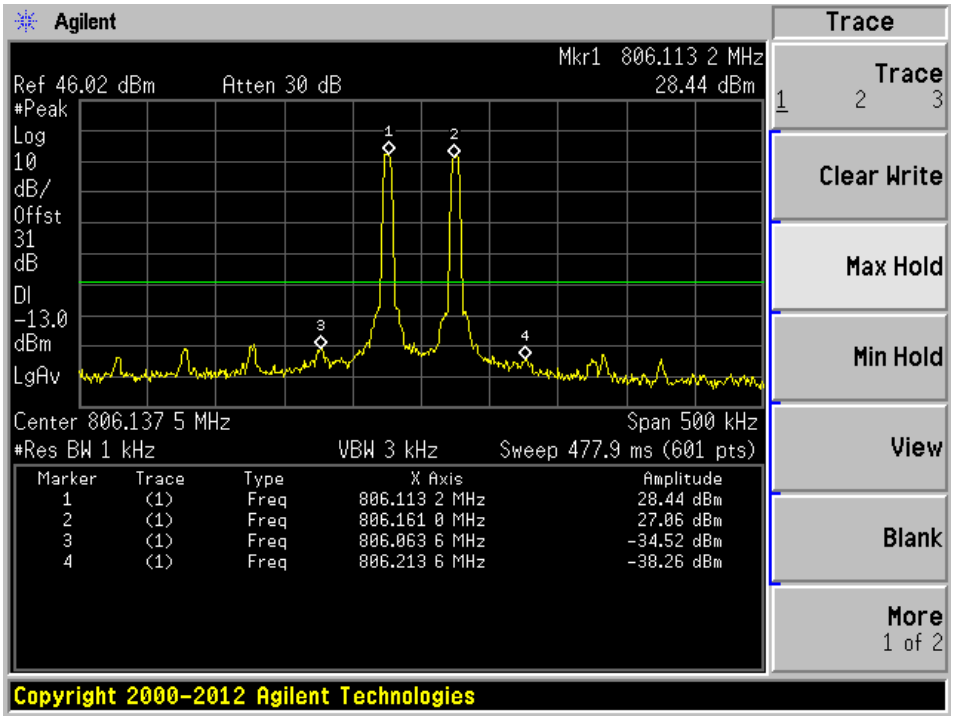
C4FM, Output, High Channel



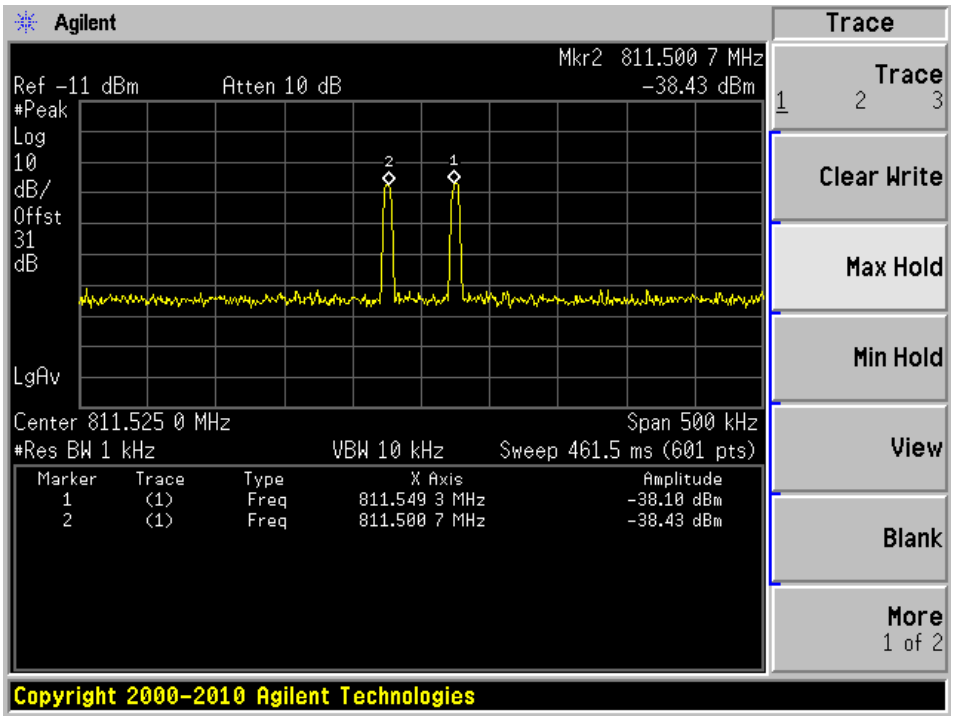
CQPSK, Input, Low Channel



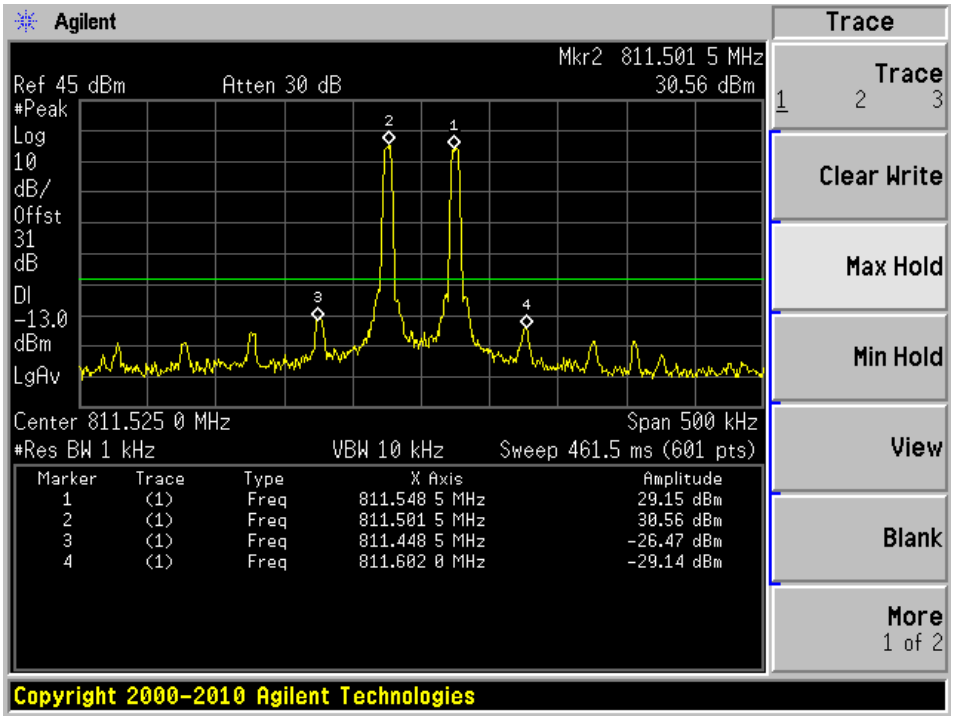
CQPSK, Output, Low Channel



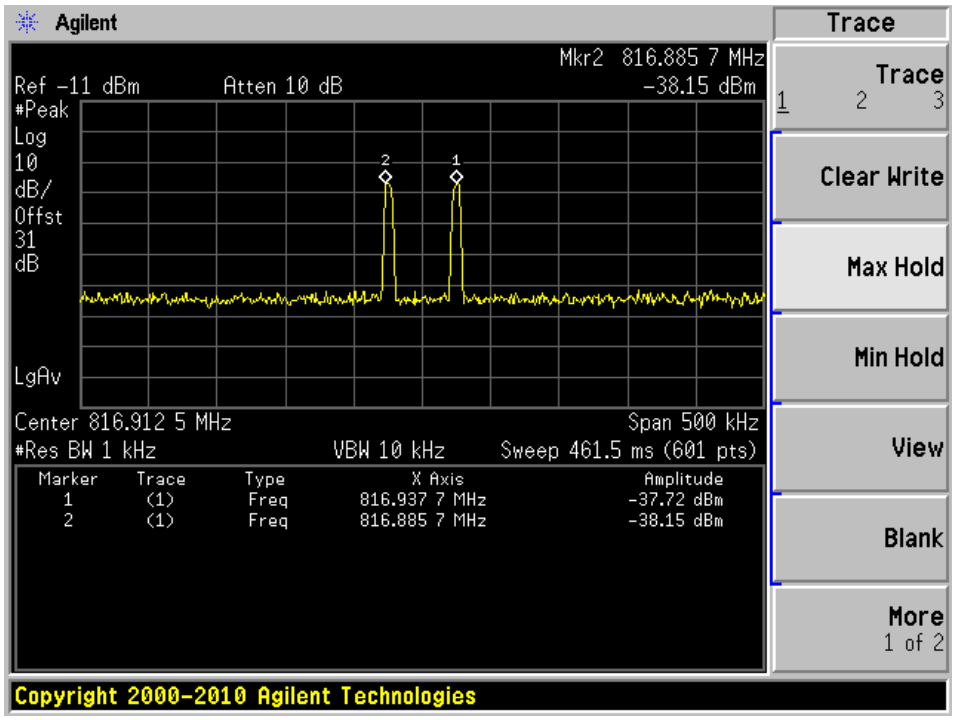
CQPSK, Input, Middle Channel



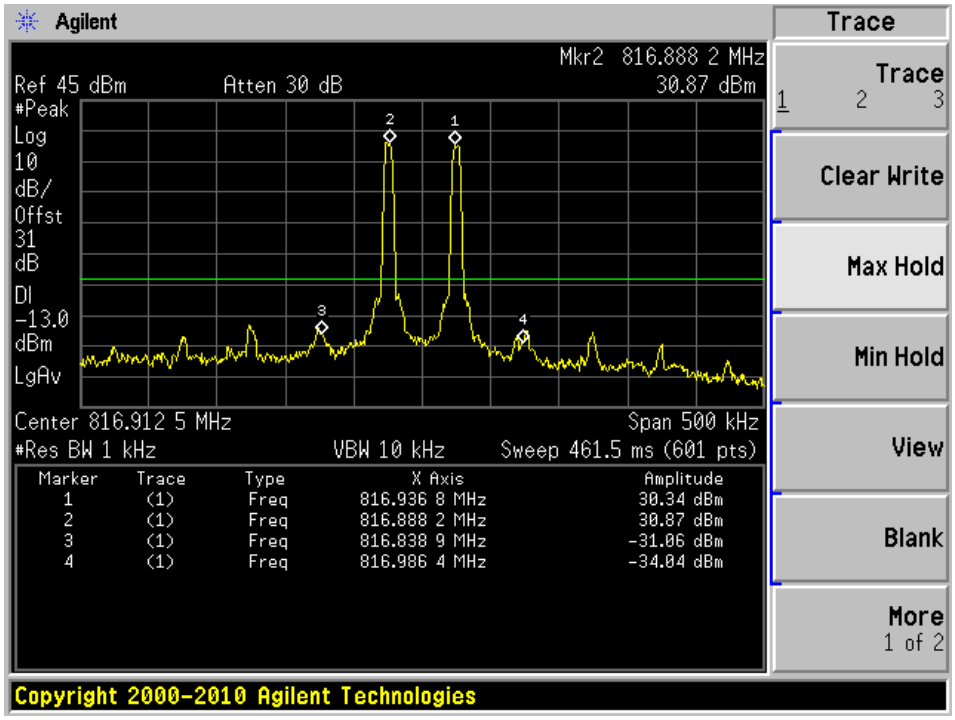
CQPSK, Output, Middle Channel



CQPSK, Input, High Channel



CQPSK, Output, High Channel



8 FCC §2.1053 & §90.219(e) – Field Strength of Spurious Radiation

8.1 Applicable Standard

According to FCC §90.219 (e), spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.

8.2 Test Procedure

The transmitter was placed on Styrofoam on the turntable, and it was normal transmitting with 50ohm termination 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 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 (TXpwr in Watts/0.001) – the absolute level

8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Due Date
Eaton	Antenna, Horn	96001	2617	2015-11-18
EMCO	Antenna, Horn	3115	9511-4627	2016-01-15
HP	Pre- Amp	8447D	2944A06639	2015-09-06
HP/ Agilant	Pre Amplifier	8449B OPT HO2	3008A0113	2016-03-11
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-09-17
APREL	Anttenna dipole	ALS-D-1800-S-2	200-00664	2016-10-27
Agilent	Spectrum Analyzer	E4446A	MY48250238	2015-09-03
Agilent	Generator, Signal	E4438C	MY45091309	2015-07-15

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

8.4 Test Environmental Conditions

Temperature:	26 °C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

The testing was performed by Todd Moy 2015-03-13 in 5 meter chamber 2.

8.5 Test Results

Worst Margin: **-20.52 dB** at **482.017 MHz** in the **Vertical** polarization.

Please see following table for detailed results.

Downlink: 851-862 MHz

CW, Low Channel – 851.0125 MHz

Indicated		Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
319.4	30.9	339	100	H	319.4	-55.04	0	0.06	-55.1	-13	-42.1
319.4	39.86	307	100	V	319.4	-44.94	0	0.06	-45	-13	-32
2123	49.43	0	100	H	2123	-41.93	8.902	0.99	-34.018	-13	-21.018
2123	49.68	0	100	V	2123	-41.43	8.762	0.99	-33.658	-13	-20.658

Note: All other emissions at noise floor level.

CW, Middle Channel – 856.5 MHz

Indicated		Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
480	52.05	344	158	H	480	-33.89	0	0.5	-34.39	-13	-21.39
479	45.58	348	151	V	479	-39.22	0	0.5	-39.72	-13	-26.72
1613.483	58.48	264	152	V	1613.483	-56.7	8.63	0.22	-48.29	-13	-35.29
1616.617	56.9	288	153	H	1616.617	-58.33	8.618	0.22	-49.932	-13	-36.932

Note: All other emissions at noise floor level.

CW, High Channel – 861.9875 MHz

Indicated		Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
448.02	50.65	217	155	V	448.02	-34.15	0	0.5	-34.65	-13	-21.65
482	51.49	319	159	H	482	-34.45	0	0.5	-34.95	-13	-21.95
1662.35	61.31	343	153	V	1662.35	-53.81	8.948	0.22	-45.082	-13	-32.082
1144.433	53.23	317	153	H	1144.433	-59.3	6.477	0.3	-53.123	-13	-40.123

Note: All other emissions at noise floor level.

Uplink: 806-817 MHz

CW, Low Channel – 806.0125 MHz

Indicated		Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
319.4	36.16	222	100	H	319.4	-49.78	0	0.06	-49.84	-13	-36.84
319.4	41.07	256	100	V	319.4	-43.73	0	0.06	-43.79	-13	-30.79
2123	47.96	0	100	H	2123	-43.4	8.902	0.99	-35.488	-13	-22.488
2123	47.48	0	100	V	2123	-43.63	8.762	0.99	-35.858	-13	-22.858

Note: All other emissions at noise floor level.

CW, Middle Channel – 811.5 MHz

Indicated		Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
480.017	51.3	332	154	H	480.017	-34.64	0	0.5	-35.14	-13	-22.14
480	50.31	86	154	V	480	-34.49	0	0.5	-34.99	-13	-21.99
1590.667	57.93	34	154	V	1590.667	-56.88	8.63	0.22	-48.47	-13	-35.47
1590.383	55.67	287	154	H	1590.383	-59.52	8.618	0.22	-51.122	-13	-38.122

Note: All other emissions at noise floor level.

CW, High Channel – 816.9875 MHz

Indicated		Azimuth Degrees	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Freq. (MHz)	Amp. (dBuV)		Height (cm)	Polar (H/V)	Freq. (MHz)	Level (dBm)	Antenna Cord. (dBi)	Cable Loss (dB)	Absolute Level (dBm)		
480.008	50.54	93	153	H	480.008	-35.4	0	0.5	-35.9	-13	-22.9
482.017	51.78	102	153	V	482.017	-33.02	0	0.5	-33.52	-13	-20.52
1617.75	62.3	93	151	H	1617.75	-52.9	8.618	0.22	-44.502	-13	-31.502
1598.45	63.71	329	154	V	1598.45	-51.3	8.63	0.22	-42.89	-13	-29.89

Note: All other emissions at noise floor level.

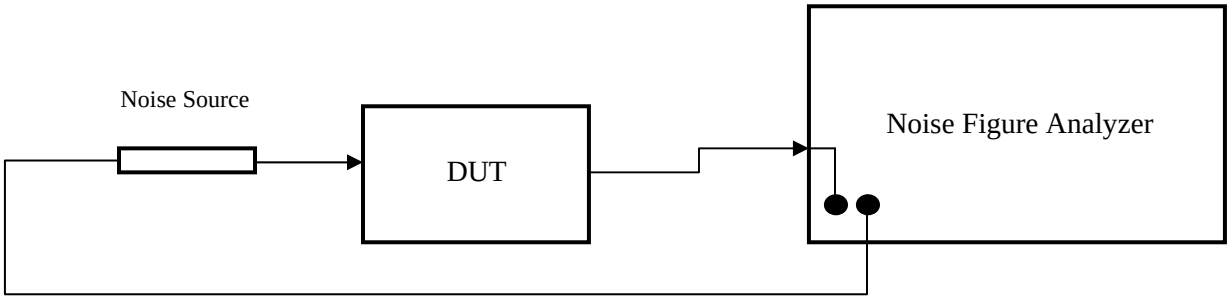
9 FCC §90.219 – Noise Figure

9.1 Applicable Standard

According to FCC §90.219 (e), the noise figure of a signal booster must not exceed 9 dB in either direction.

9.2 Test Procedure

Connect the EUT and Noise Source to the Noise Figure Analyzer as the measurement set-up diagram shown below,



Set the Noise Figure Analyzer to measured frequency and record the reading.

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Due Date
Agilent	Smart Noise Source	AT/N4002A	US41130571	04-30-2016
Agilent	Noise Figure Analyzer	AT/N8973A	GB41111016	04-30-2016

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

9.4 Test Environmental Conditions

Temperature:	24 °C
Relative Humidity:	31 %
ATM Pressure:	101 kPa

The testing was performed by Simon Ma on 2015-05-06 in the RF Site.

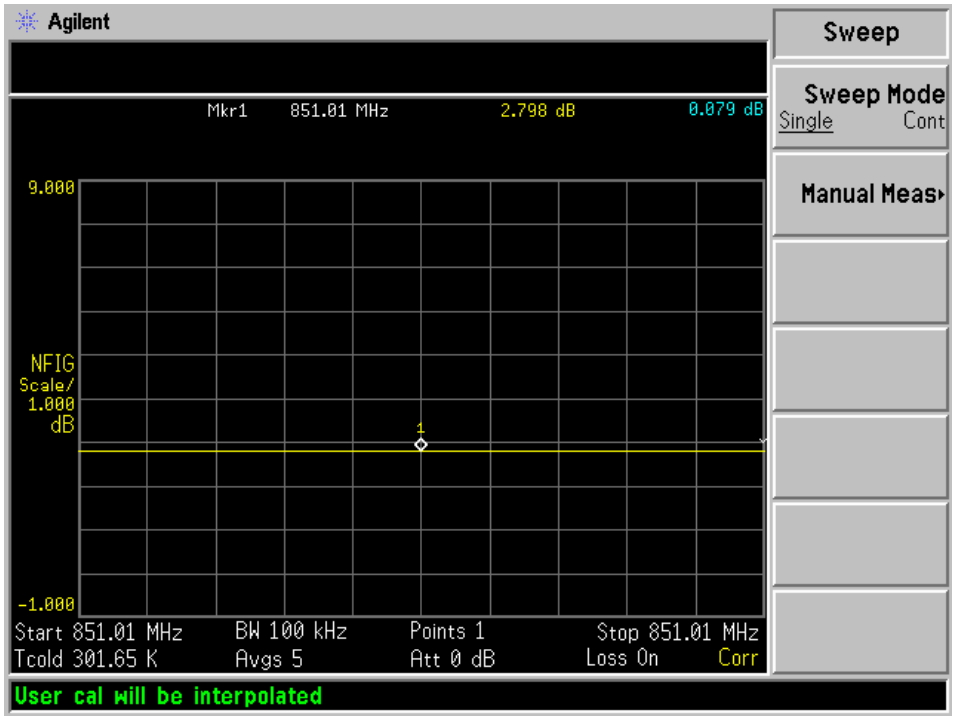
9.5 Test Results

Frequency Band	Frequency	Noise Figure (dB)	Limit (dB)
Downlink	851.0125 MHz	2.798	9
	860 MHz	3.133	9
Uplink	806.0125 MHz	2.775	9
	815 MHz	2.013	9

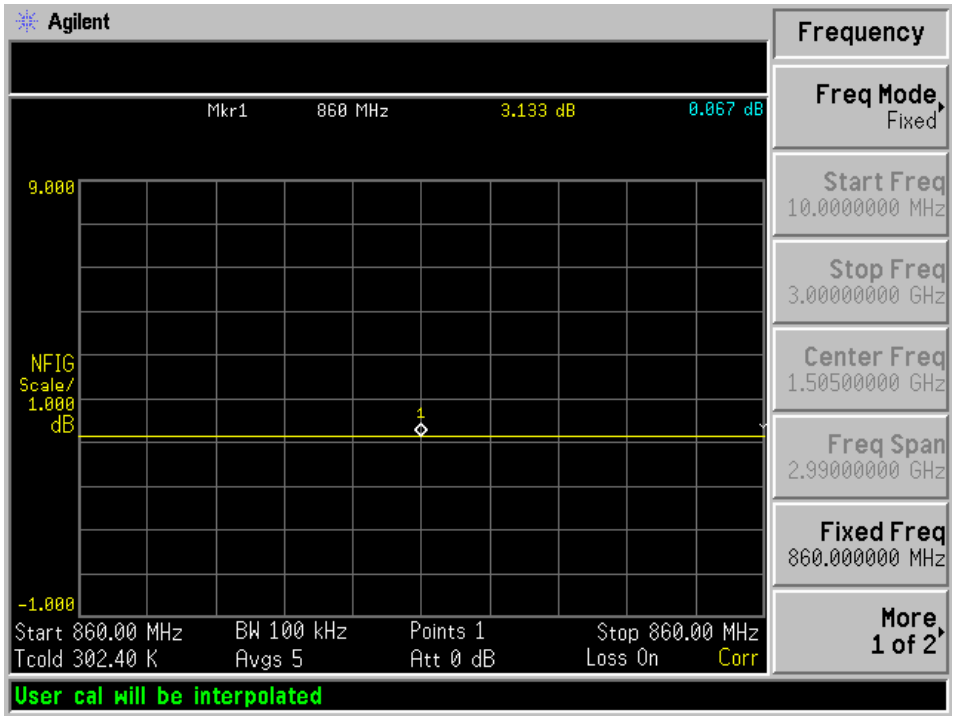
Please refer to the following plots,

Downlink, 851-862 MHz

851.0125 MHz

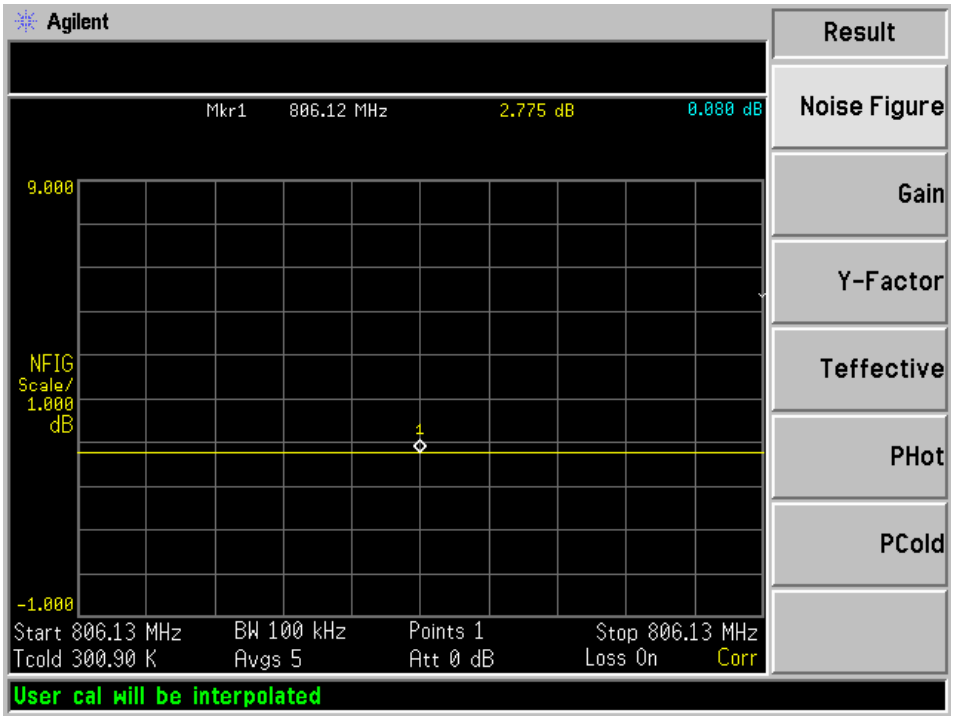


860 MHz

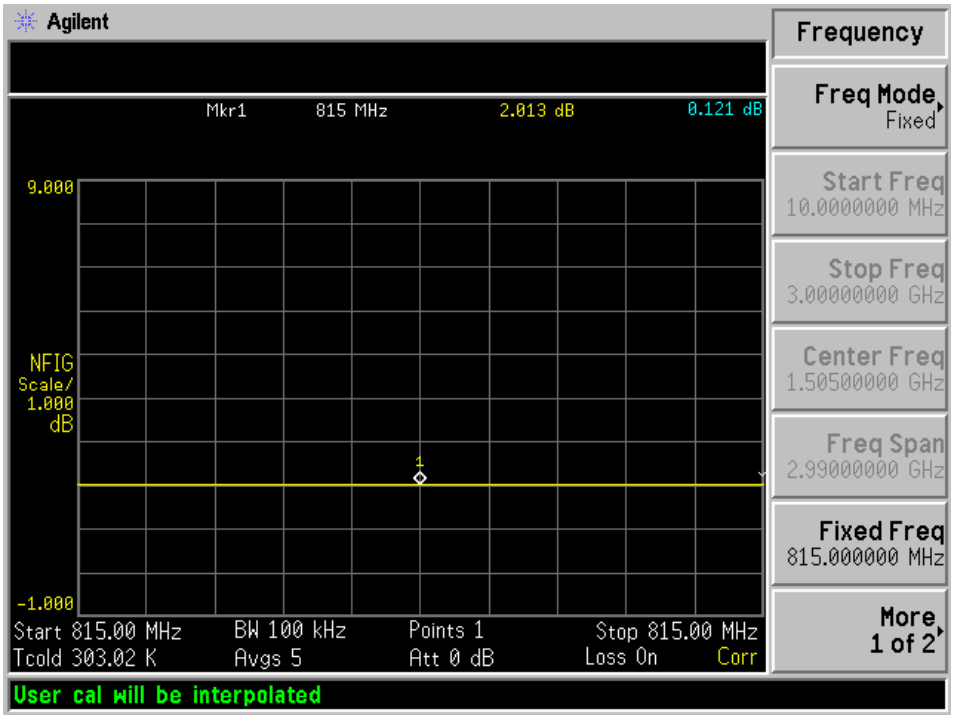


Uplink, 806-817 MHz

806.0125 MHz



815 MHz



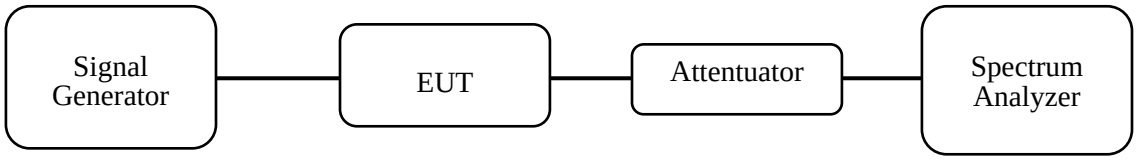
10 FCC §90.219 – Out of Band Rejection

10.1 Applicable Standard

According to FCC KDB 935210 D02 v02r01, appendix D section3, test for rejection of out of band signals. Filter frequency response plots are acceptable.

10.2 Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The span of the spectrum analyzer was set to be wide enough in order to capture the spectrum of entire operating band.



10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Due Date
Agilent	Spectrum Analyzer	E4446A	MY48250238	2015-09-03
Agilent	Generator, Signal	E4438C	MY45091309	2015-07-15

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

10.4 Test Environmental Conditions

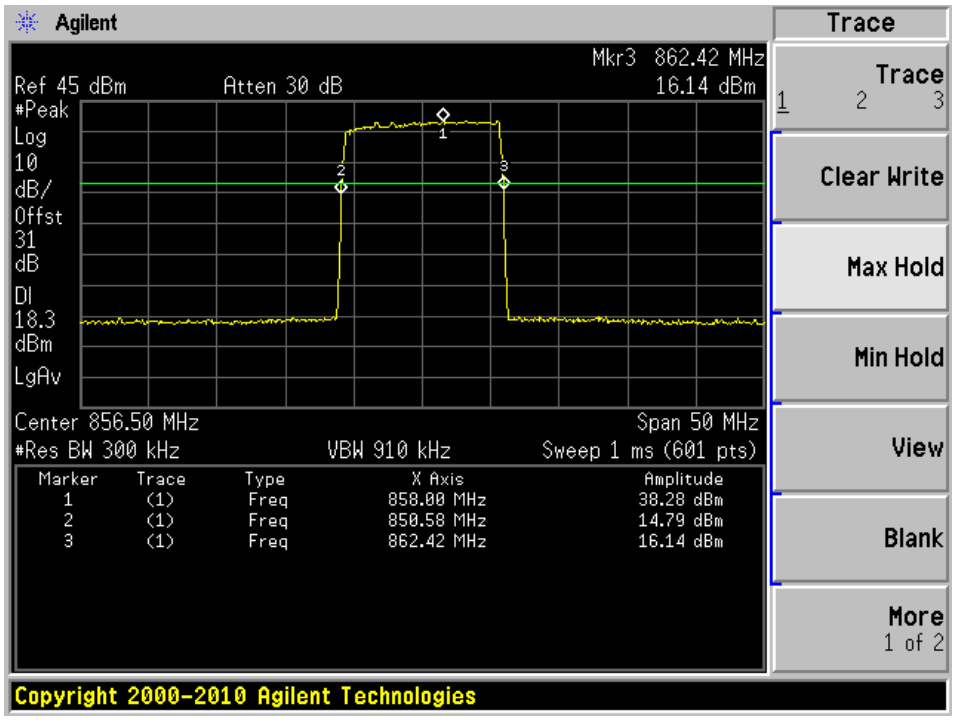
Temperature:	23 °C
Relative Humidity:	32 %
ATM Pressure:	101.3 kPa

The testing was performed by Simon Ma on 2015-03-10 in the RF Site.

10.5 Test Results

Please refer to the following plots,

Downlink: 851-862 MHz



Uplink: 806-817 MHz