FCC PART 90

TEST AND MEASUREMENT REPORT

For

Teltronic S.A.U.

Poligono Malpica, Calle F Oeste, Parcela 12,

50016 Zaragoza, Spain

FCC ID: WT7PTMDT500760B
Model: MDT-500 763-870 MHz

Report Type: Original Report	**Product Type:** Land-Mobile and Fixed Radio Transmitter and Receiver

Prepared By: Lionel Lara

Report Number: R1212274-90

Report Date: 2013-03-20

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1212274-90	Original Report	2013-03-20

1. General Information

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Teltronic S.A.U.* and their product, FCC ID: WT7PTMDT500760B, model: MDT-500 763-870 MHz, which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a land-mobile and fixed radio transmitter and receiver with GPS receiver.

Specifications	
Frequency Band	C4FM: 769-775 MHz / 799-805 MHz D-LMR: 769-775 MHz / 799-805 MHz / 806-824 MHz / 851-869 MHz TETRA: 809-824 MHz / 854-869 MHz FM: 806-824 MHz / 851-869 MHz
Modulation Type	C4FM FM D-LMR: π/4-DQPSK, TDMA 4 slots TETRA: π/4-DQPSK, TDMA 4 slots
Emission Designator	C4FM: 8K10F1E, 8K10F1D, 8K10F1W FM: 14K0F3E, 16K0F3E D-LMR: 20K0D7W, 20K0D7E, 20K0D7D, 20K0Q7W, 20K0Q7E, 20K0Q7D TETRA: 22K0D7W, 22K0D7E, 22K0D7D, 22K0Q7W, 22K0Q7E, 22K0Q7D
RF Output Power	TETRA, D-LMR, C4FM, FM: 1 Watt (High Power) TETRA, D-LMR: 0.03 Watt (Low Power) C4FM, FM: 0.3 Watt (Low Power)
Channel Spacing	C4FM: 12.5 kHz FM: 20 KHz, 25 KHz D-LMR, TETRA: 25 KHz
Necessary /authorized Bandwidth	C4FM: 8.1 KHz (Necessary BW) / 11.25 KHz (Authorized BW) FM: 14 KHz (Necessary BW) / 20 KHz (Authorized BW) 16 KHz (Necessary BW) / 20 KHz (Authorized BW) D-LMR: 20 KHz TETRA: 22 KHz
Power Supply	13.2 DC volt supply input

RF Channel Spacing for D-LMR and TETRA: 25 kHz (Spectrum Efficiency 6.25 kHz)
Note: TDMA access scheme with 4 physical channels per carrier. The channel bandwidth is 25 kHz. As a result, the equipment meets the narrowbanding spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth. Modulation is π/4-DQPSK with 18 Ksym/sec. This modulation is based on transmitting two bits per symbol, so the data rate for each physical channel is 9000 bits per second (higher than narrowbanding standard of 4800 bps per 6.25 kHz of channel bandwidth).

1.2 Mechanical Description

The EUT measures approximately 21cm (L) x 16cm (W) x 5cm (H) and weighs 1675.5 g.

The test data gathered are from production sample. Serial number: 00018A031178900 provided by Teltronic S.A.U.

1.3 Objective

This type approval report is prepared on behalf of *Teltronic S.A.U.* in accordance with Part 90 and Rule & Order 12-114 of the Federal Communication Commissions rules.

The objective was to determine the RF output power, Occupied Bandwidth, Transmitter Spurious Emissions, Emission Mask and Frequency Stability 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:TIA603-C and ANSI 63.4-2003, American National Standard for Method of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

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 and Accreditation

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 C63.4-2003, 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-C.

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 tDriver USA F Approval Test 1.0.8.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Internal Configuration

Manufacturers	Descriptions	Models	Serial Numbers
Teltronic S.A.U.	Main Board	F077001	10849481
Teltronic S.A.U.	Interconnections Board	F077002	10880911
Teltronic S.A.U.	Host Board	F072001	10793507
Teltronic S.A.U.	GPS Board	F054203	10731687
Teltronic S.A.U.	Bridge Board	-	-

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Dell	Laptop	PP05L	7T390 A02

2.6 Local Support Equipment Power Supply and Line Filters

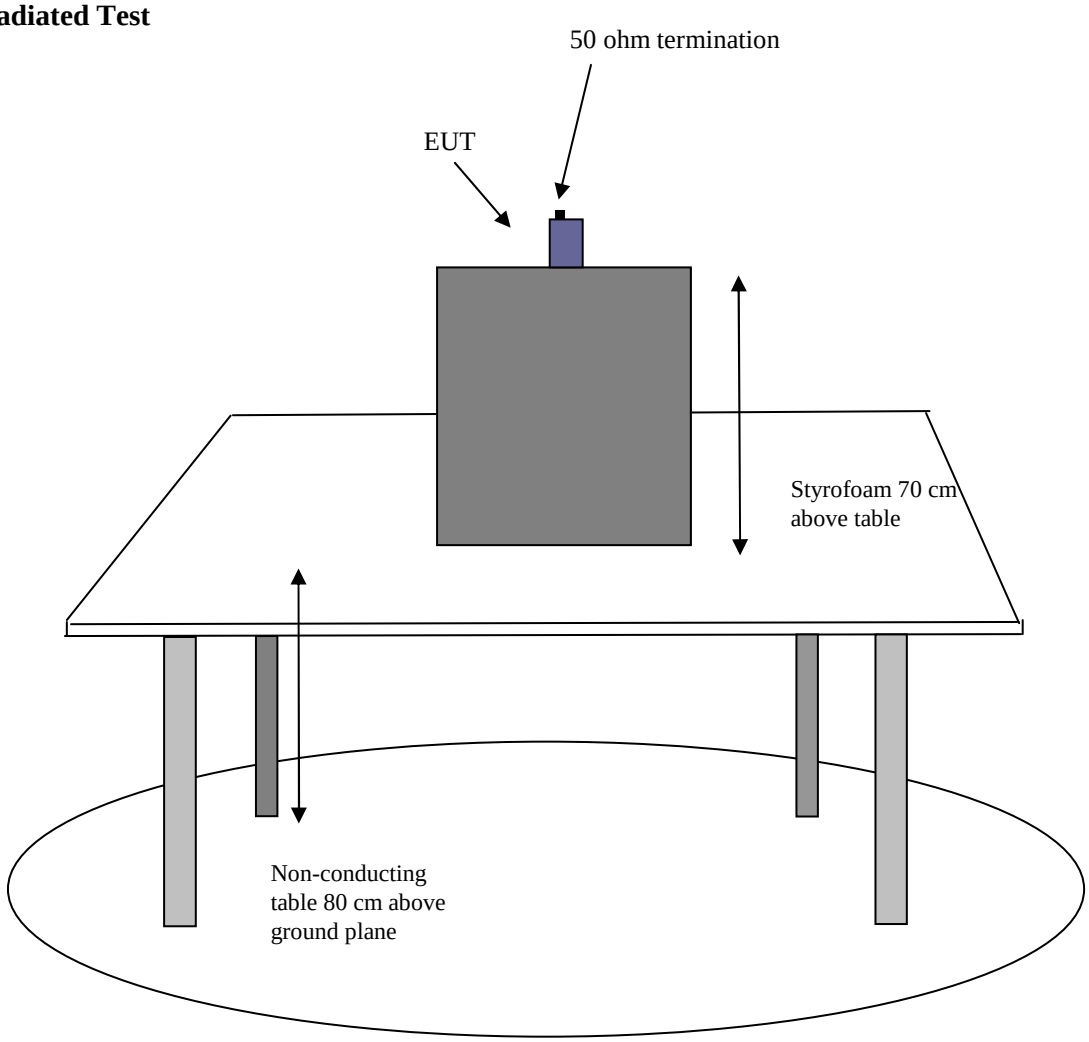
Manufacturer	Description	Model	Serial Number
BK Precision	DC Power Supply	1621A	D185052265
Minebea Matsushita Motor Corporation	DC Fan	3610KL- 0 4 W-B50	11742

2.7 External I/O Cabling List and Details

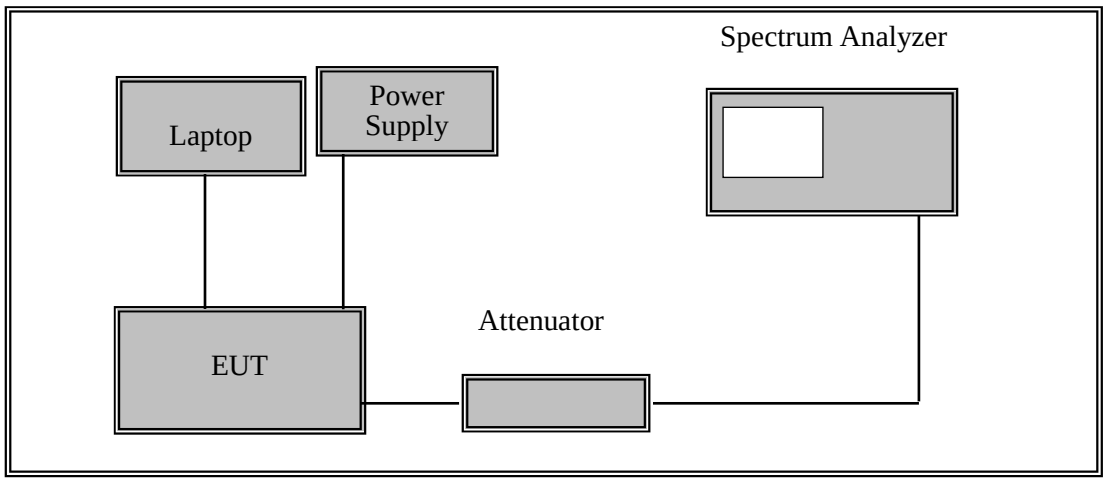
Cable Description	Length (m)	From	To
Serial cable	>1.0	Laptop Serial port	EUT Serial Port
Power Supply Cable	>1.0	Power Supply	EUT
RF cable	>1.0	EUT Output	PSA

2.8 Test Setup Block Diagram

Radiated Test



Conducted Test



3 Summary of Test Results

FCC Rules	Description of Tests	Results
FCC §1.1310, §2.1091	RF Exposure	Compliant
FCC §2.1046, §90.205	RF Output Power	Compliant
FCC §2.1047, §90.207	Modulation Characteristics, Audio Frequency Response and Audio Filter Response	Compliant[1]
FCC §2.1049, §90.209, §90.210	Occupied Bandwidth and Emission Mask	Compliant
FCC§2.1051,§90.210 §90.221	Spurious Emissions at Antenna Terminals	Compliant
FCC §2.1055, §90.213, §90.539	Frequency Stability	Compliant
FCC §2.1053, §90.210, §90.221, §90.543 (f)	Field Strength of Spurious Radiation 1559-1610 MHz Radiated Emissions (GNSS)	Compliant
FCC §90.214	Transient Frequency Behavior	N/A
FCC §2.1049, §90.221, §90.543	Adjacent Channel Power	Compliant

N/A: Not applicable.
Note 1: This test was completed by Teltronic S.A.U with test report:
Modulation Characteristics: D370000 RG95ed0100 Laboratory Measurements Reference Guide

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 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

Prediction 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

Modulation: D-LMR
Frequency: 769-775 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	29.89
Maximum peak output power at antenna input terminal (mW):	974.990
Prediction distance (cm):	35
Prediction frequency (MHz):	774.9
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	0.501
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.583

Modulation: D-LMR
Frequency: 799-805 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	29.84
Maximum peak output power at antenna input terminal (mW):	963.829
Prediction distance (cm):	35
Prediction frequency (MHz):	804.9
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	0.495
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.683

Modulation: D-LMR
Frequency: 806-824 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	29.83
Maximum peak output power at antenna input terminal (mW):	961.612
Prediction distance (cm):	35
Prediction frequency (MHz):	815
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	0.494
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.717

Modulation: D-LMR
Frequency: 851-869 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	29.62
Maximum peak output power at antenna input terminal (mW):	916.220
Prediction distance (cm):	35
Prediction frequency (MHz):	868.9
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	0.471
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.896

Modulation: TETRA
Frequency: 809-824 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	29.73
Maximum peak output power at antenna input terminal (mW):	939.723
Prediction distance (cm):	35
Prediction frequency (MHz):	809.1
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	0.483
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.697

Modulation: TETRA
Frequency: 854-869 MHz

Duty Cycle (TDMA 4 slots)	25%
Maximum peak output power at antenna input terminal (dBm):	29.9
Maximum peak output power at antenna input terminal (mW):	977.237
Prediction distance (cm):	35
Prediction frequency (MHz):	860
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.623
Power density of prediction frequency at 35 cm (mW/cm^2):	0.502
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.867

Modulation: C4FM
Frequency: 769-775 MHz

Duty Cycle	100%
Maximum peak output power at antenna input terminal (dBm):	30.8
Maximum peak output power at antenna input terminal (mW):	1202.264
Prediction distance (cm):	35
Prediction frequency (MHz):	772
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	2.47
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.573

Modulation: C4FM
Frequency: 799-805 MHz

Duty Cycle	100%
Maximum peak output power at antenna input terminal (dBm):	30.94
Maximum peak output power at antenna input terminal (mW):	1241.652
Prediction distance (cm):	35
Prediction frequency (MHz):	802
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.623
Power density of prediction frequency at 35 cm (mW/cm^2):	2.551
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.673

Modulation: FM (channel spacing 20 KHz)
Frequency: 806-824 MHz

Duty Cycle	100%
Maximum peak output power at antenna input terminal (dBm):	30.37
Maximum peak output power at antenna input terminal (mW):	1088.930
Prediction distance (cm):	35
Prediction frequency (MHz):	806.1
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	2.237
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.687

Modulation: FM (channel spacing 20 KHz)
Frequency: 851-869 MHz

Duty Cycle	100%
Maximum peak output power at antenna input terminal (dBm):	30.43
Maximum peak output power at antenna input terminal (mW):	1104.079
Prediction distance (cm):	35
Prediction frequency (MHz):	851.1
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	2.268
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.837

Modulation: FM (channel spacing 25 KHz)
Frequency: 806-824 MHz

Duty Cycle	100%
Maximum peak output power at antenna input terminal (dBm):	30.36
Maximum peak output power at antenna input terminal (mW):	1086.426
Prediction distance (cm):	35
Prediction frequency (MHz):	806.1
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	2.232
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.687

Modulation: FM (channel spacing 25 KHz)
Frequency: 851-869 MHz

Duty Cycle	100%
Maximum peak output power at antenna input terminal (dBm):	30.45
Maximum peak output power at antenna input terminal (mW):	1109.175
Prediction distance (cm):	35
Prediction frequency (MHz):	868.9
Maximum Antenna Gain, typical (dBi):	15
Maximum Antenna Gain (numeric):	31.62
Power density of prediction frequency at 35 cm (mW/cm^2):	2.279
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	2.896

Conclusion

The device complies with the MPE requirements by providing a safe separation distance of at least 35 cm between the antenna with maximum 15 dBi gain, including any radiating structure, and any persons when normally operated.

5 FCC §2.1046 & §90.205– RF Output Power

5.1 Applicable Standard

According to FCC §2.1046, and §90.205. The transmitting power of base transmitters must not exceed the limits given in paragraphs (a), (b) and (c) of §90.635.

(a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

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 Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 Year

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:	20.6 °C
Relative Humidity:	52 %
ATM Pressure:	101.3 kPa

The testing was performed by Lionel Lara on 2013-02-07 at the RF site.

5.5 Test Results

763-806 MHz

Test Mode: 25kHz Channel Spacing, D-LMR

FCC Band	Frequency (MHz)	High Output Power (dBm)	High Output Power (Watt)	Low Output Power (dBm)	Low Output Power (Watt)
769-775 MHz	769.1	29.78	0.95	14.32	0.027
	772	29.19	0.83	14.25	0.027
	774.9	29.89	0.97	14.49	0.028
799-805 MHz	799.1	29.17	0.83	14.75	0.030
	802	29.28	0.85	15.07	0.032
	804.9	29.84	0.96	14.39	0.027

Note: Manufacturer's rated power is 0.03-1 Watts

Test Mode: 12.5 kHz Channel Spacing, C4FM

FCC Band	Frequency (MHz)	High Output Power (dBm)	High Output Power (Watt)	Low Output Power (dBm)	Low Output Power (Watt)
769-775 MHz	769.1	29.27	0.85	25.04	0.32
	772	30.8	1.20	24.23	0.26
	774.9	29.09	0.81	25.01	0.32
799-805 MHz	799.1	29.4	0.87	25.24	0.33
	802	30.94	1.24	25.51	0.36
	804.9	30.73	1.18	24.46	0.28

Note: Manufacturer's rated power is 0.3-1 Watts

806-870 MHz

Test Mode: 25kHz Channel Spacing, TETRA

FCC Band	Frequency (MHz)	High Output Power (dBm)	High Output Power (Watt)	Low Output Power (dBm)	Low Output Power (Watt)
809-824 MHz	809.1	29.73	0.94	14.73	0.030
	815	29.34	0.86	14.86	0.031
	823.9	29.52	0.90	14.73	0.030
854-869 MHz	854.1	29.88	0.97	14.8	0.030
	860	29.9	0.98	14.54	0.028
	868.9	29.55	0.90	15.16	0.033

Note: Manufacturer's rated power is 0.03-1 Watts

Test Mode: 25kHz Channel Spacing, D-LMR

FCC Band	Frequency (MHz)	High Output Power (dBm)	High Output Power (Watt)	Low Output Power (dBm)	Low Output Power (Watt)
806-824 MHz	806.1	29.51	0.89	14.59	0.029
	815	29.83	0.96	14.58	0.029
	823.9	29.26	0.84	14.09	0.026
851-869 MHz	851.1	29.56	0.90	14.34	0.027
	860	29.51	0.89	14.68	0.029
	868.9	29.62	0.92	14.75	0.030

Note: Manufacturer's rated power is 0.03-1 Watts

Test Mode: 20kHz Channel Spacing, FM

FCC Band	Frequency (MHz)	High Output Power (dBm)	High Output Power (Watt)	Low Output Power (dBm)	Low Output Power (Watt)
806-824 MHz	806.1	30.37	1.09	25.04	0.32
	815	29.36	0.86	25.04	0.32
	823.9	29.34	0.86	25	0.32
851-869 MHz	851.1	30.43	1.10	25.09	0.32
	860	29.48	0.89	25.12	0.33
	868.9	29.47	0.89	25.11	0.32

Note: Manufacturer's rated power is 0.3-1 Watts

Test Mode: 25kHz Channel Spacing, FM

FCC Band	Frequency (MHz)	High Output Power (dBm)	High Output Power (Watt)	Low Output Power (dBm)	Low Output Power (Watt)
806-824 MHz	806.1	30.36	1.09	25.01	0.32
	815	29.33	0.86	25.1	0.32
	823.9	29.36	0.86	24.1	0.26
851-869 MHz	851.1	29.5	0.89	24.19	0.26
	860	29.53	0.90	24.15	0.26
	868.9	30.45	1.11	24.18	0.26

Note: Manufacturer's rated power is 0.3-1 Watts

6 FCC §2.1047 & §90.207 – Modulation Characteristic

6.1 Applicable Standard

FCC §2.1047 & §90.207:

(a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. For equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
(b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

6.2 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
AGILENT	RF Generator	E4438C	MY45093571	12/03/2012	2 years
ROHDE&SCHWARZ	Radiocommunication Service Monitor	CMS54	846393/018	18/02/2012	2 years
XANTREX	Power Supply	XFR 100-28	E00132443	18/02/2012	3 years

6.3 Test Environmental Conditions

Temperature:	25.1ºC
Relative Humidity:	37.2%
ATM Pressure:	102.6 kPa

The testing was performed by Denny Soto on 2012-11-07 at Teltronic S.A.U.

6.4 Test Results

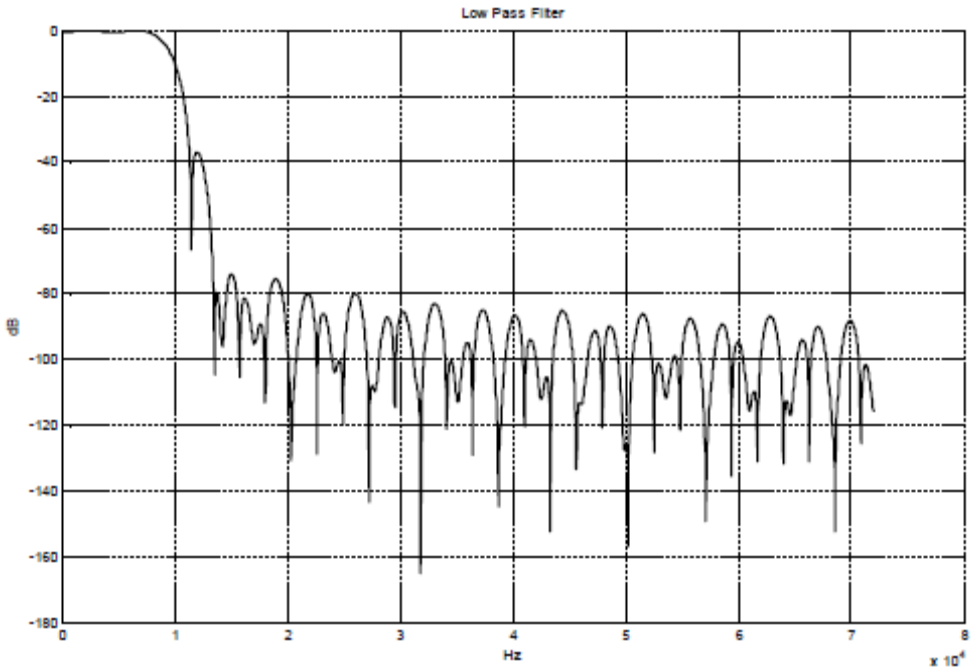
TETRA and D-LMR Transmitter Low Pass Filter

Type of Emission:
D-LMR: 20K0Q7E, 20K0Q7D, 20K0Q7W, 20K0D7E, 20K0D7D, 20K0D7W
TETRA: 22K0Q7E, 22K0Q7D, 22K0Q7W, 22K0D7E, 22K0D7D, 22K0D7W
The modulation used is π/4-shifted Differential Quaternary Phase Shift Keying (π/4-DQPSK), with a modulation rate of 18k symbol/sec. (36k bit/sec).

A root-raised-cosine filter (RRC) is used as transmitting and receiving filter in this digital communication system to perform matched filtering.
The combined response of two such filters is that of the raised-cosine filter.
The raised-cosine filter is a filter frequently used for pulse-shaping in digital modulation known for its ability to minimize intersymbol interference (ISI).

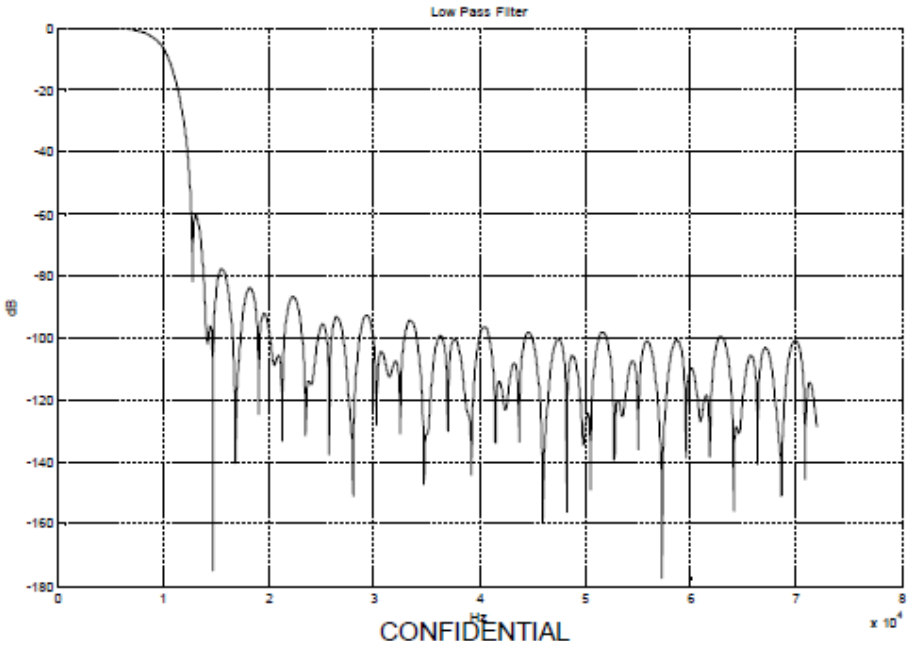
The access scheme is TDMA with 4 physical channels per carrier.

The following graph is the transfer function of the aforementioned filter for D-LMR modulation.



Note: Plot was provided by the manufacturer.

The following graph is the transfer function of the aforementioned filter for TETRA modulation.



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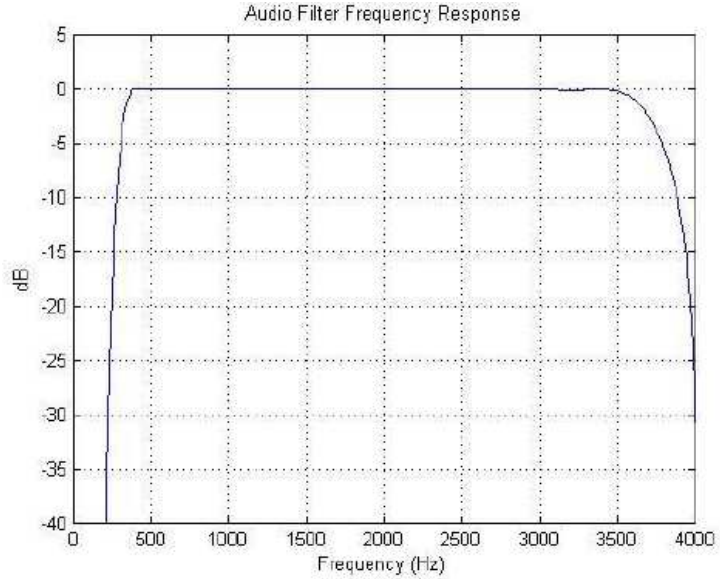
Note: Plot was provided by the manufacturer.

Audio Low Pass Filter

The modulation is limited by data characteristics and its filters.

In the previous section, the phase and quadrature branches (I and Q) are filtered with a root-raised-cosine filter (RRC) with a symbol rate of 18k symbol/sec. After that, the signal is pi/4 DQPSK modulated (see the plot in the previous section) for D-LMR and TETRA modulations.

The signal processing is carried out using a digital filter implemented in the OMAP processor. The next picture shows its frequency response, which is valid for all modulations

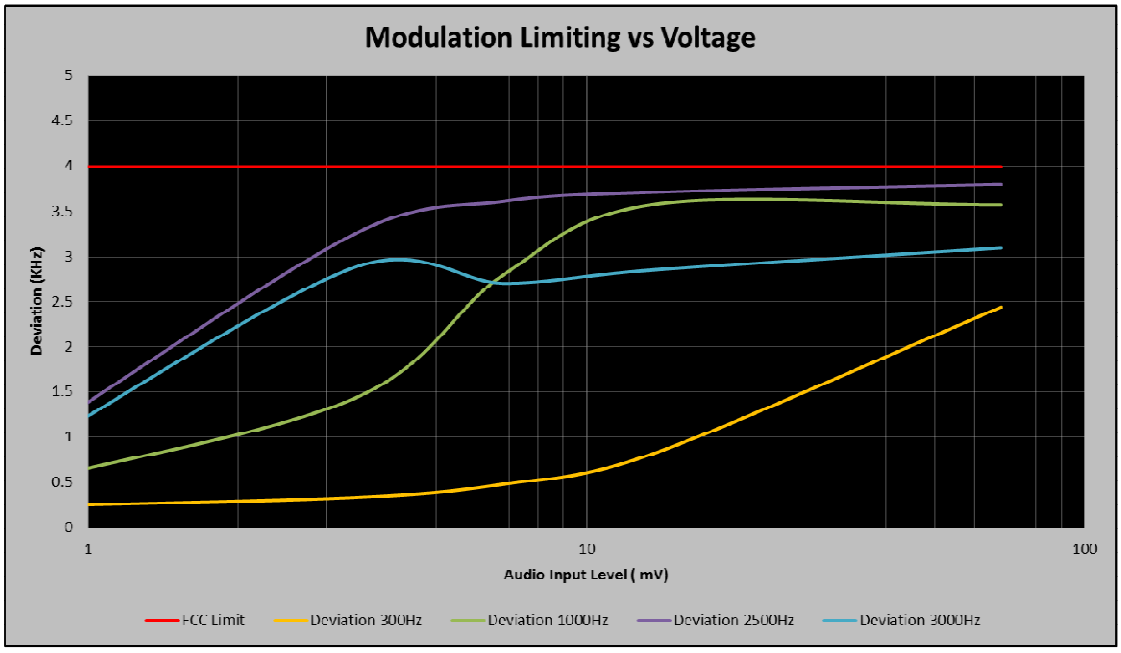


Note: Plot was provided by the manufacturer.

FM Modulation Limiting vs. Voltage

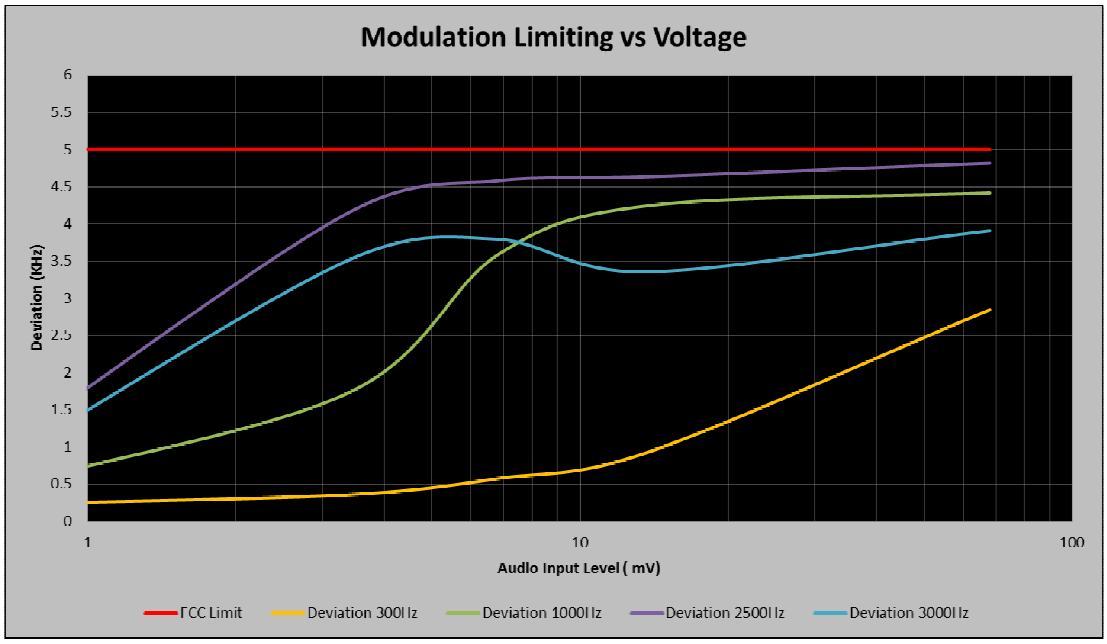
806-824 MHz, FM (20 kHz)

Middle Channel



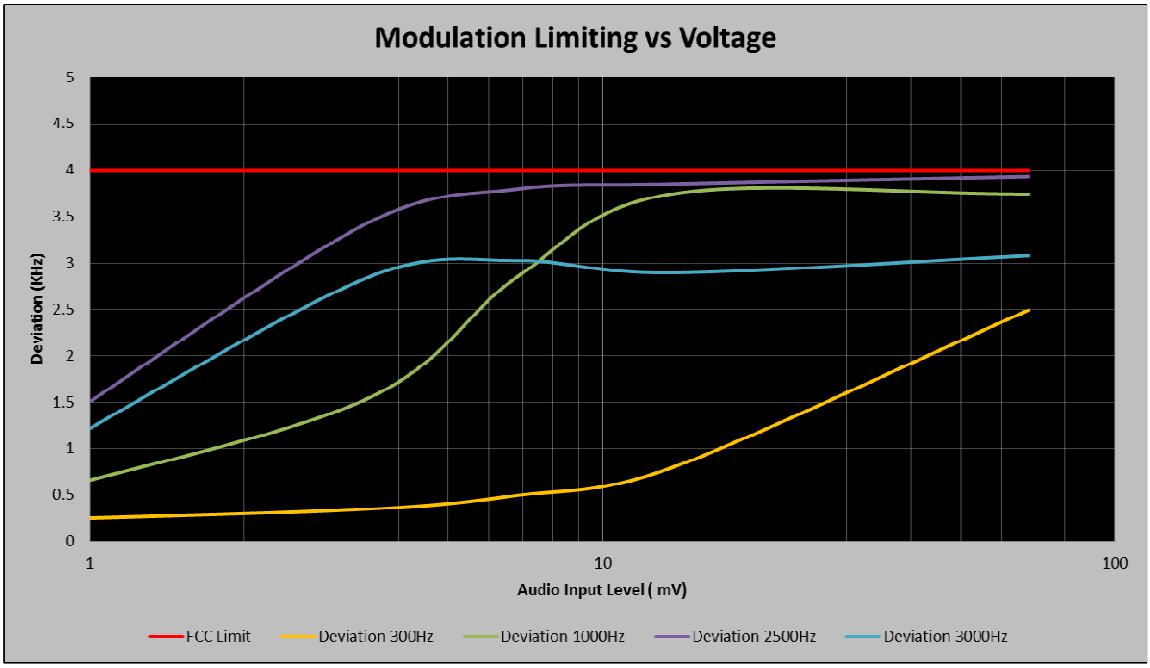
806-824 MHz, FM (25 kHz)

Middle Channel



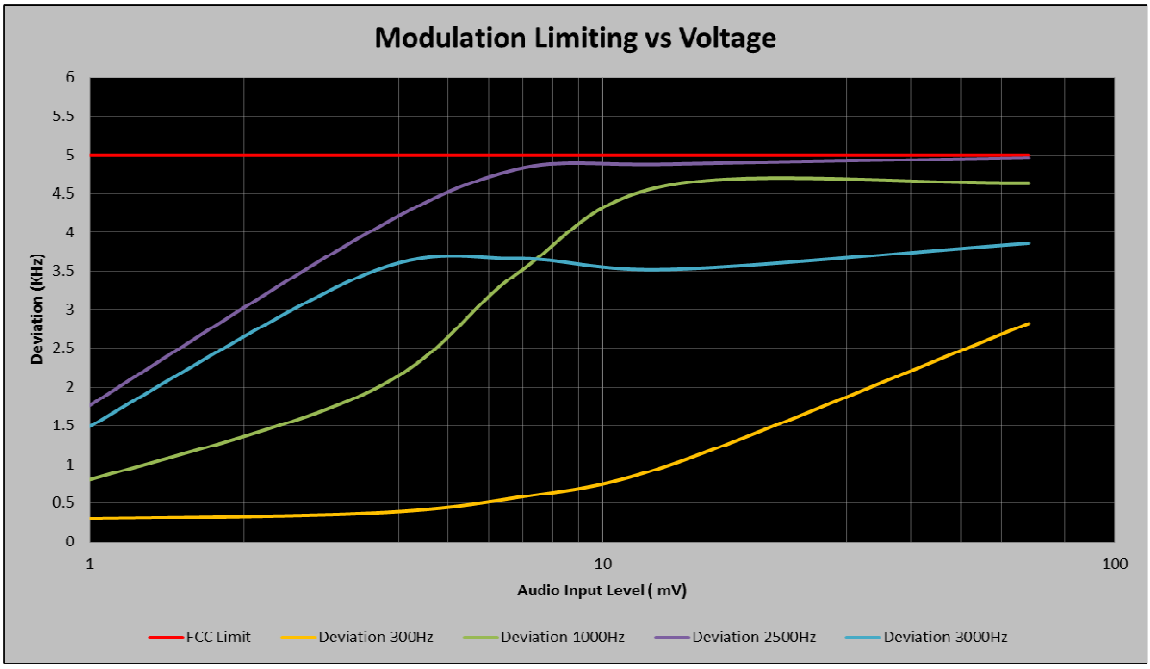
851-869 MHz, FM (20 kHz)

Middle Channel



851-869 MHz, FM (25 kHz)

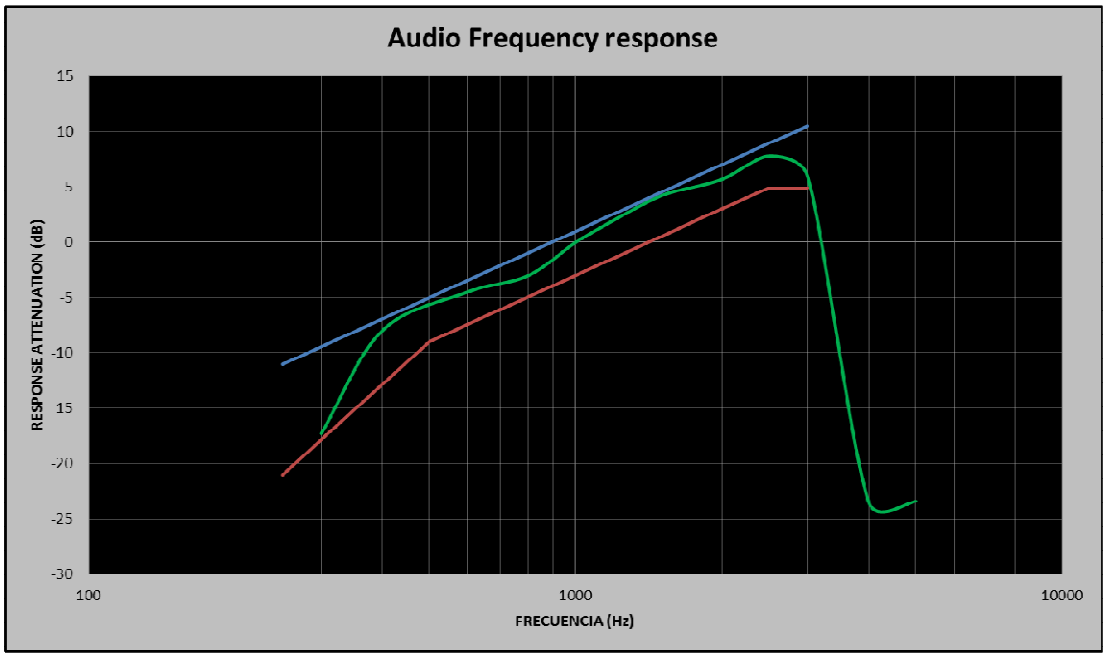
Middle Channel



FM Audio Frequency Response

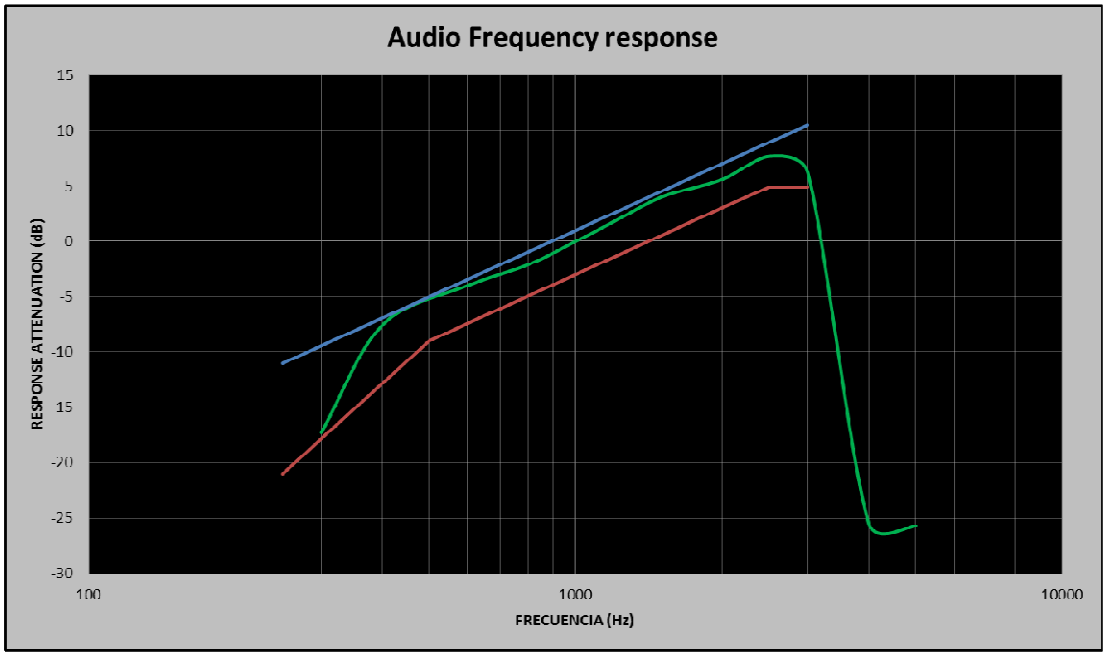
806-824 MHz, FM (20 kHz)

Middle Channel



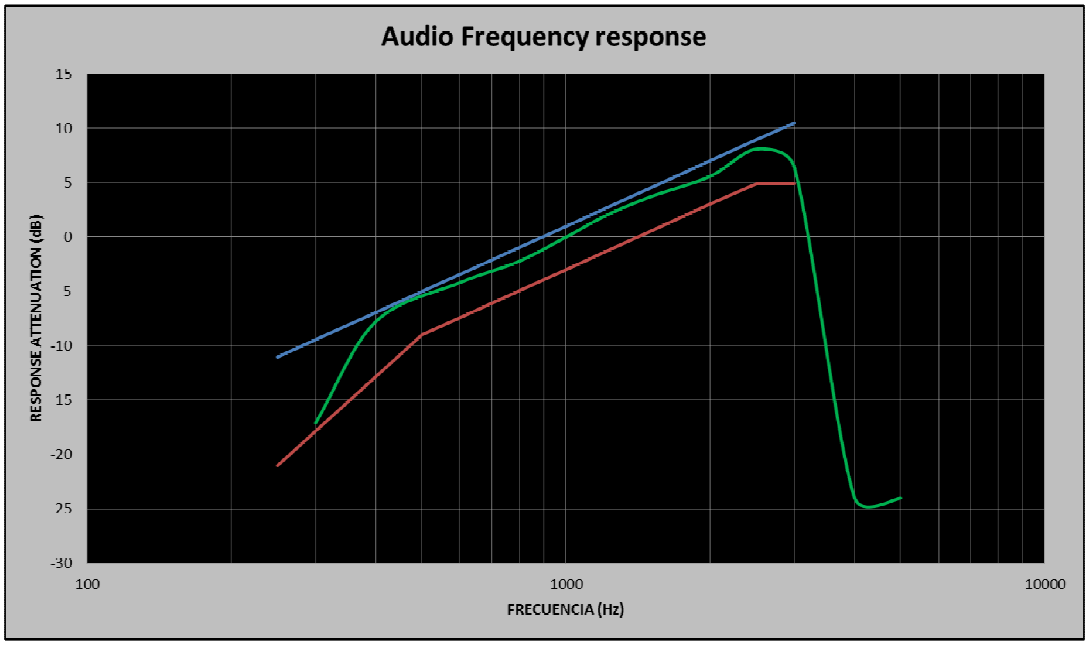
806-824 MHz, FM (25 kHz)

Middle Channel



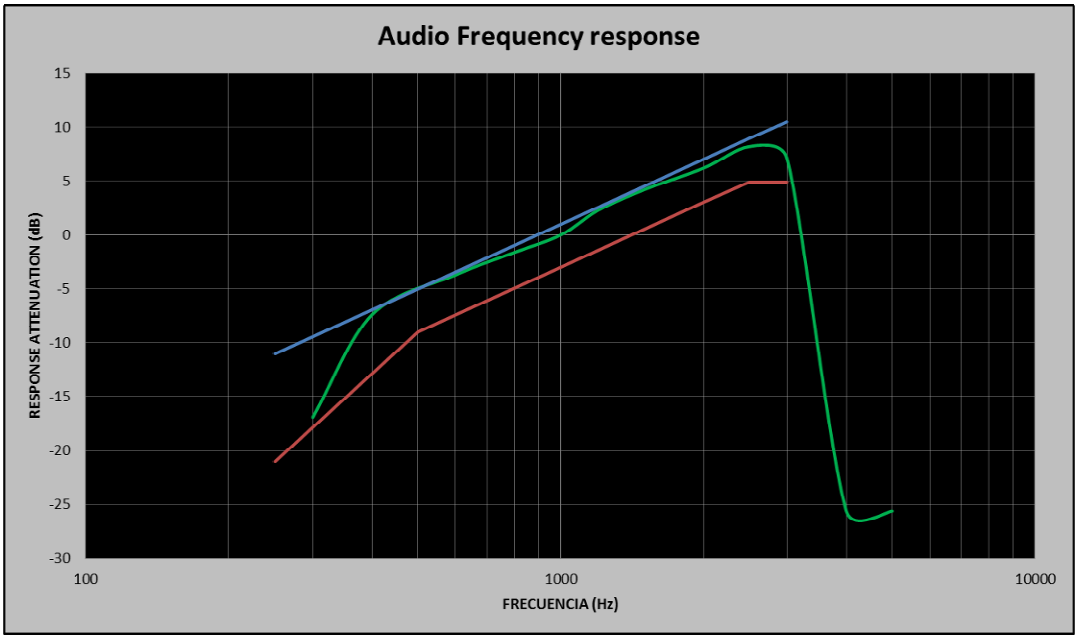
851-869 MHz, FM (20 kHz)

Middle Channel



851-869 MHz, FM (25 kHz)

Middle Channel



7 FCC §2.1049, §90.209 & §90.210 – Occupied Bandwidth & Emission Mask

7.1 Applicable Standard

According to FCC §90.210:

Frequency band (MHz)	Mask for equipment with Audio low pass filter	Mask for equipment without audio low pass filter
Below 25 [1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174 [2]	B, D, or E	C, D, or E
150 Paging-only	B	C
220-222	F	F
421-512 [2]	B, D, or E	C, D, or E
450 Paging-only	B	G
806-809/851-854	B	H
809-824/854-869 [3]	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M.
5850-5925 [4]		
All other bands	B	C

1 Equipment using single sideband J3E emission must the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.

2 Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth Must meet the requirements of Emission Mask E.

3 Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691.

4 DSRCS Roadside Units equipment in the 5850-5925 MHz band is governed under subpart M of this part.

5 Equipment may alternatively meet the Adjacent Channel Power limits of § 90.221, where applicable.

Emission Mask B:

For transmitters that are 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 assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

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

Emission Mask EA:

(a) Out-of-band emission requirement shall apply only to the ‘‘outer’’ channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee’s frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log10(f/6.1) decibels or 50 + 10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee’s frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

7.2 Test Procedure

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

Occupied Bandwidth:

- … C4FM: The resolution bandwidth of the spectrum analyzer was set at 100 Hz and the spectrum was recorded in the frequency band ±20 KHz from the carrier frequency
- … FM: The resolution bandwidth of the spectrum analyzer was set at 200 Hz and the spectrum was recorded in the frequency band ±30 KHz from the carrier frequency.
- … D-LMR, TETRA: The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the frequency band ±30 KHz from the carrier frequency.

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 Year

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:	18.9-20.6 °C
Relative Humidity:	52-53 %
ATM Pressure:	101.1-101.3 kPa

The testing was performed by Lionel Lara on 2013-02-07 and 2013-02-16 in the RF Site.

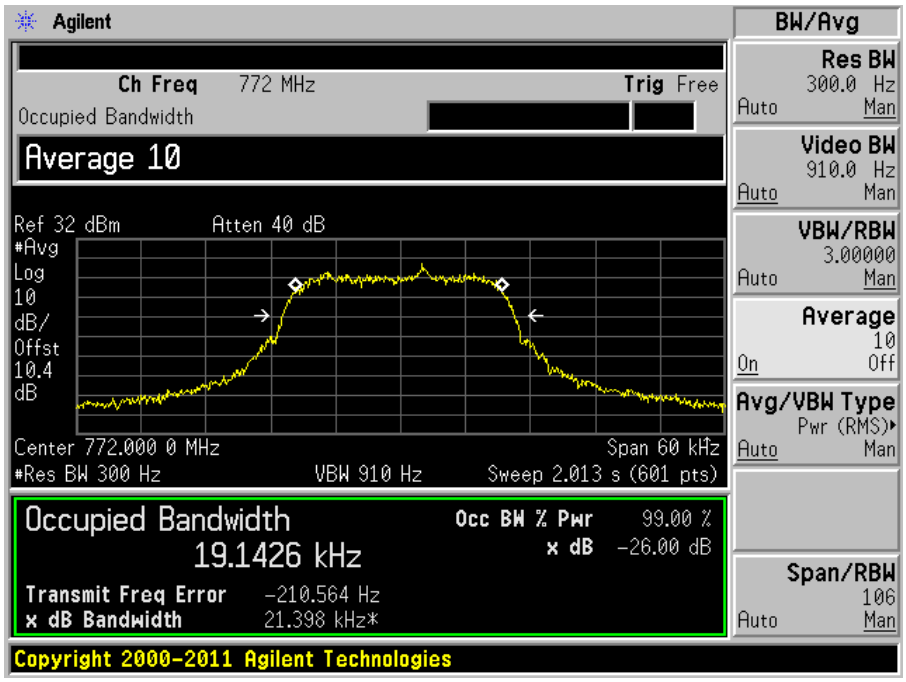
7.5 Test Results

Please refer to the following plots.

Occupied Bandwidth (High Power)

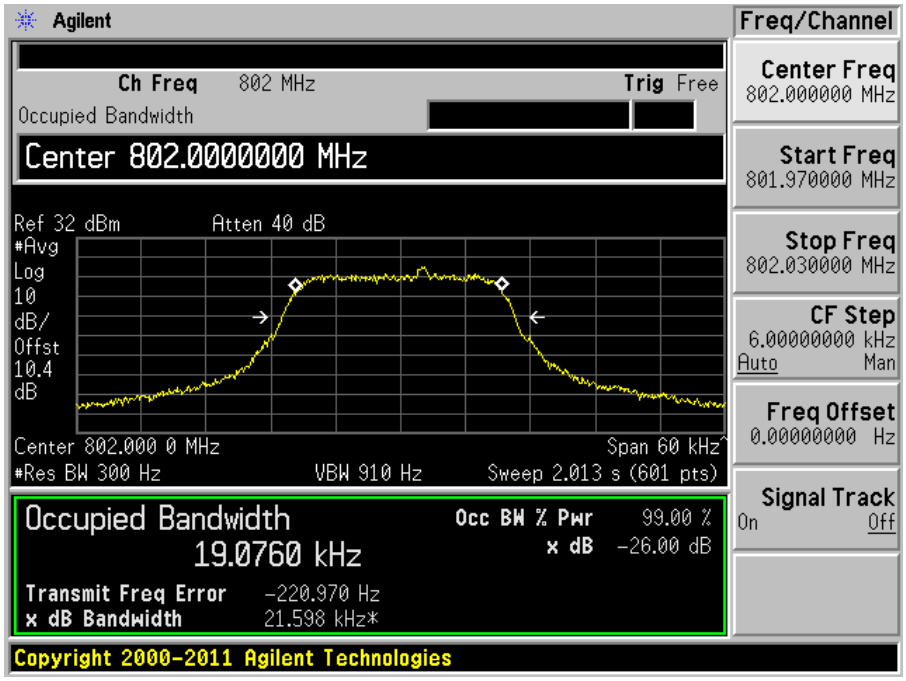
769-775 MHz, D-LMR

Middle Channel – 772 MHz



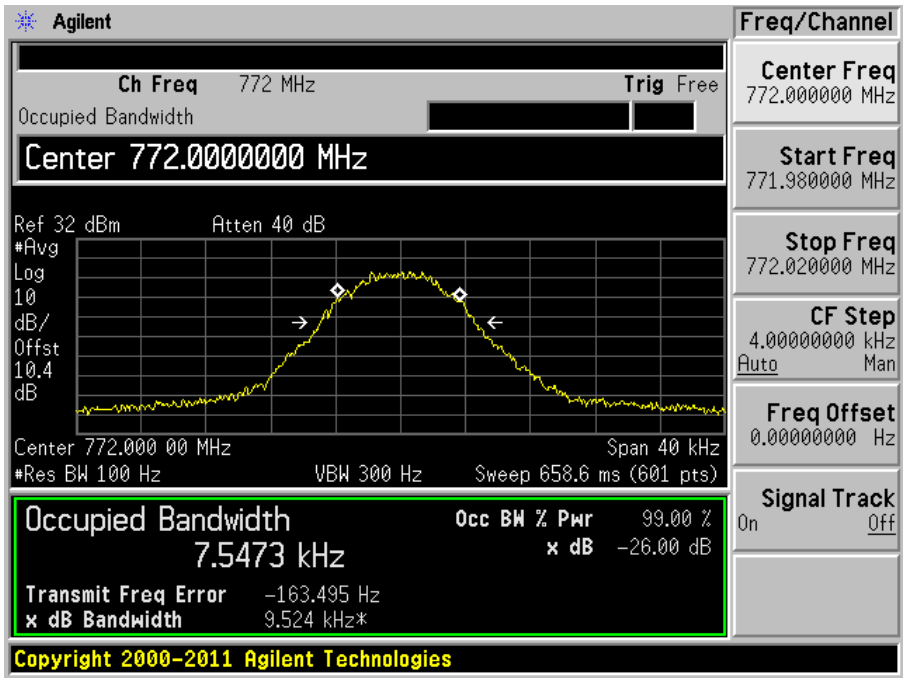
799-805 MHz, D-LMR

Middle Channel – 802 MHz



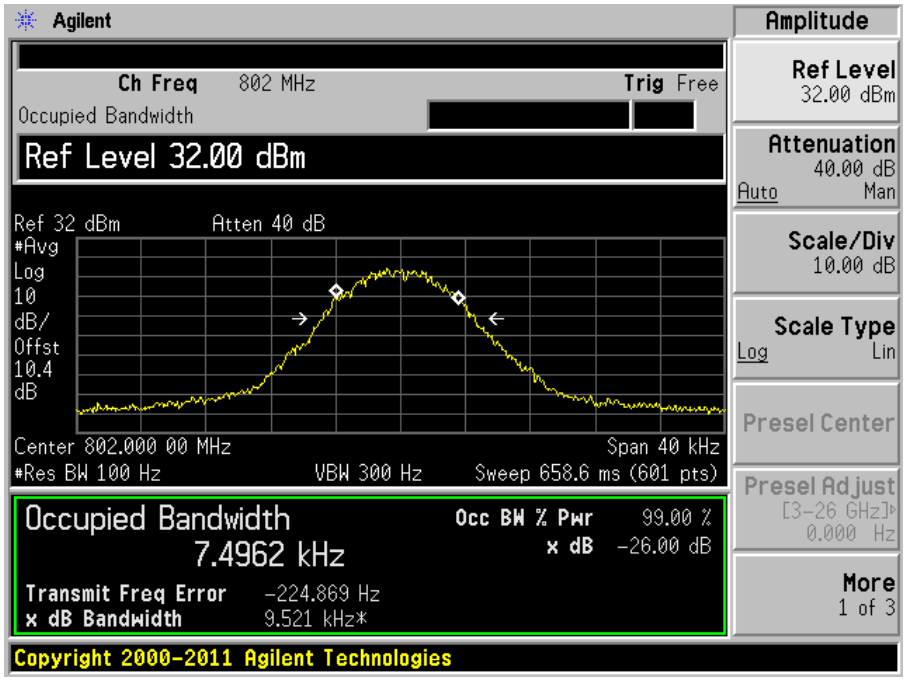
769-775 MHz, C4FM

Middle Channel – 772 MHz



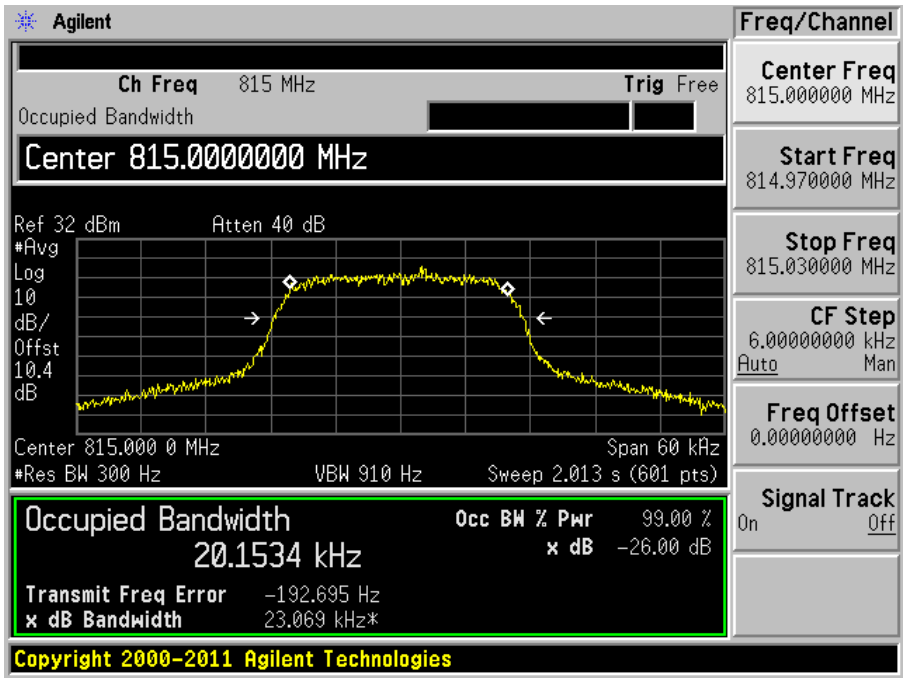
799-805 MHz, C4FM

Middle Channel – 802 MHz



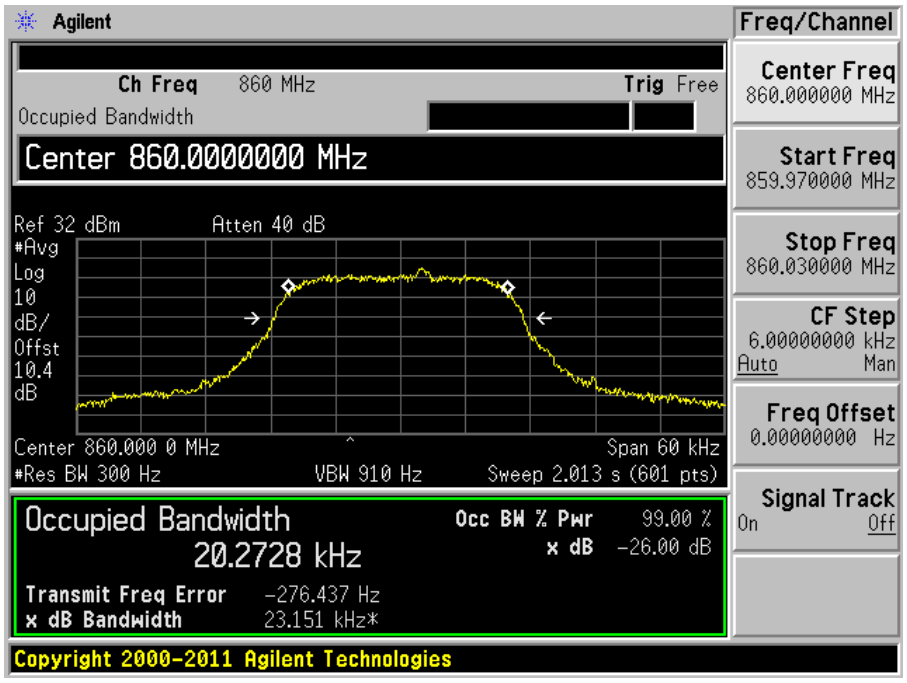
809-824 MHz, TETRA

Middle Channel – 815 MHz



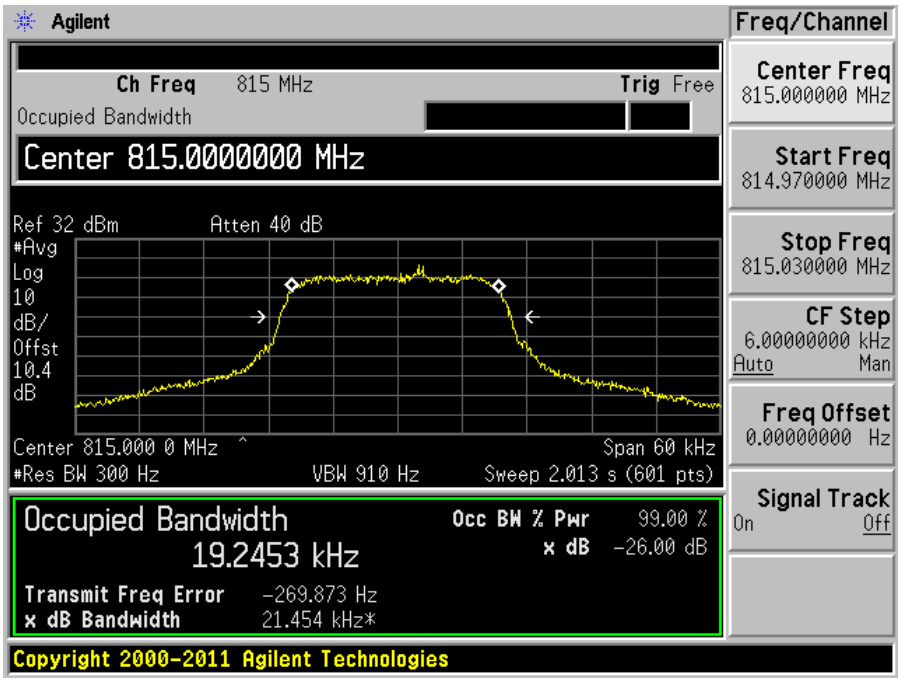
854-869 MHz, TETRA

Middle Channel – 860 MHz



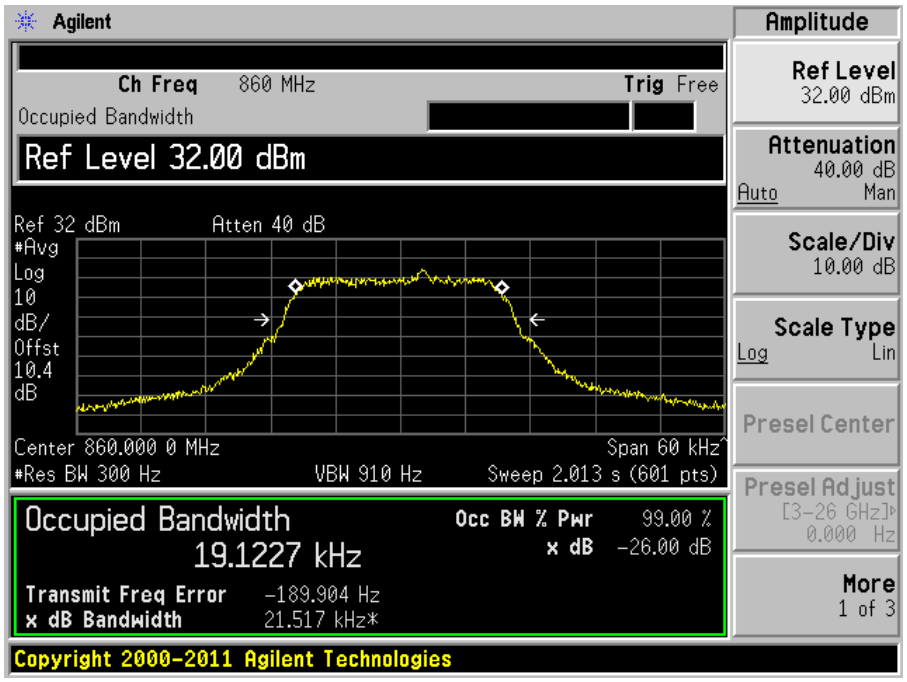
806-824 MHz, D-LMR

Middle Channel – 815 MHz



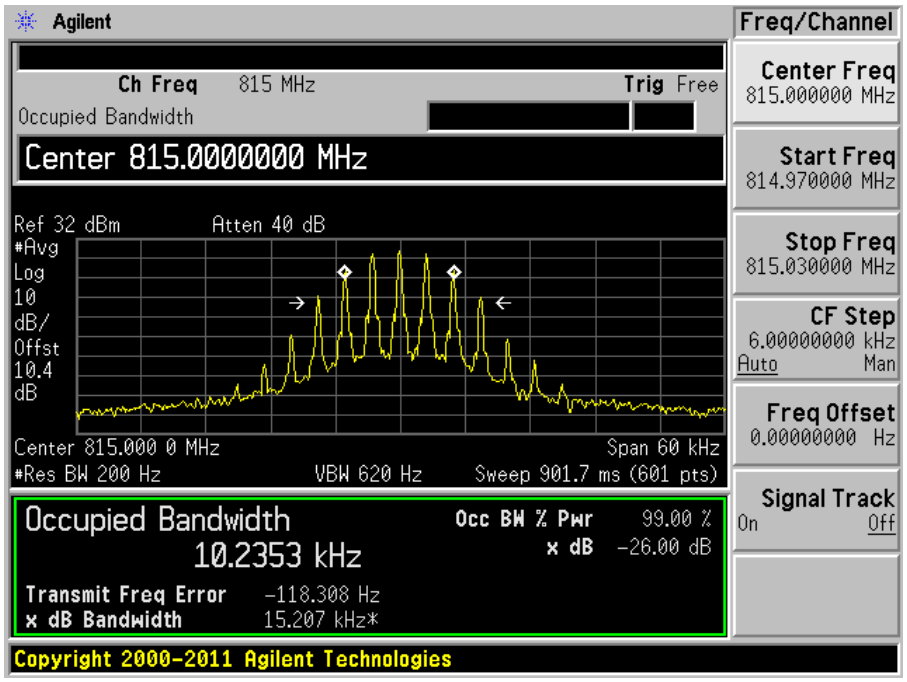
851-869 MHz, D-LMR

Middle Channel – 860 MHz



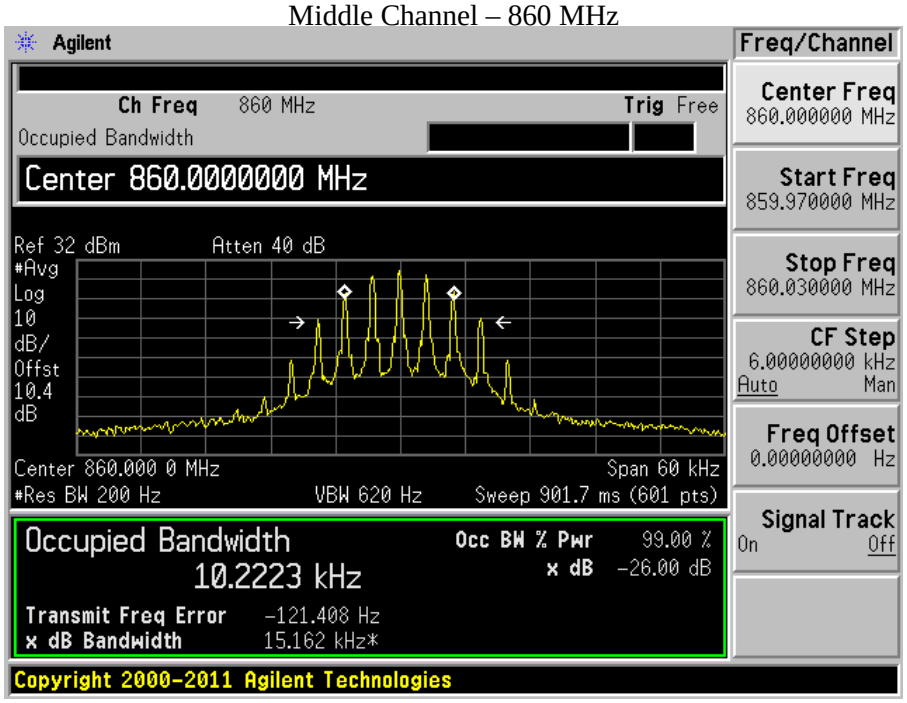
806-824 MHz, FM (20 kHz CS)

Middle Channel – 815 MHz



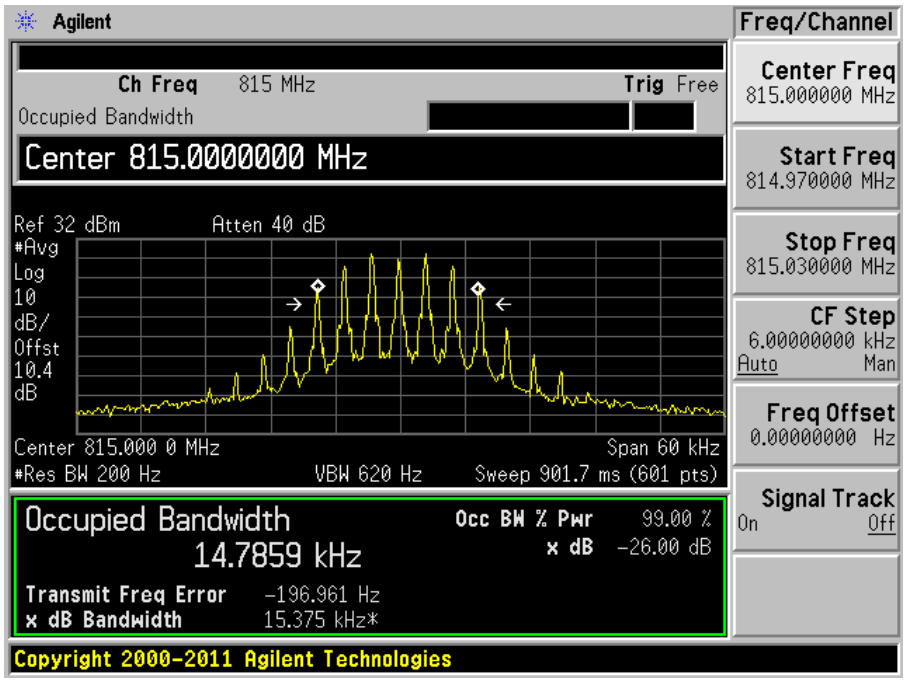
851-869 MHz, FM (20 kHz CS)

Middle Channel – 860 MHz



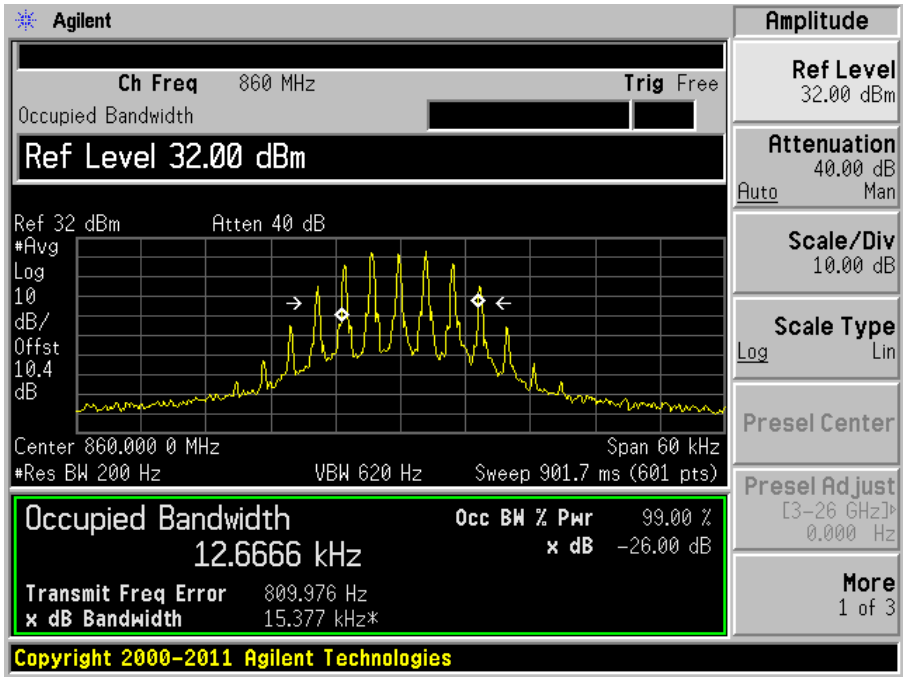
806-824 MHz, FM (25 KHz CS)

Middle Channel – 815 MHz



851-869 MHz, FM (25 kHz CS)

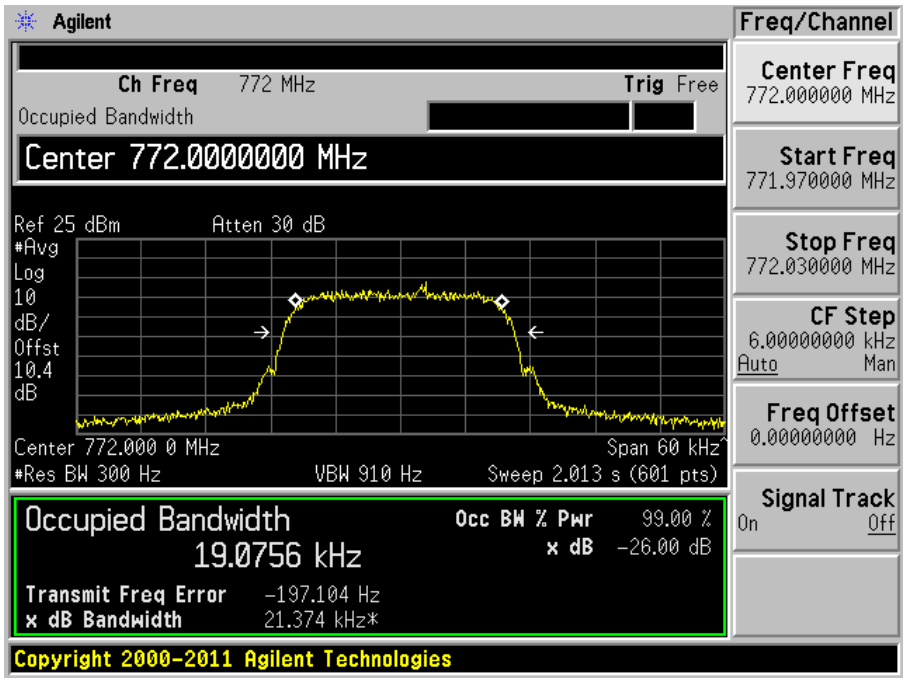
Middle Channel – 860 MHz



Occupied Bandwidth (Low Power)

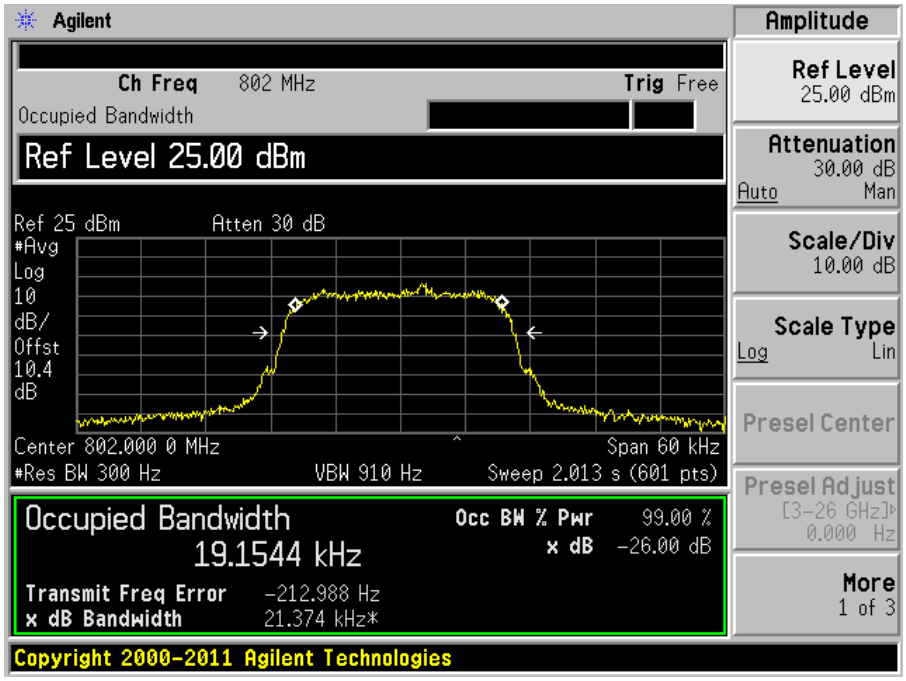
769-775 MHz, D-LMR

Middle Channel – 772 MHz



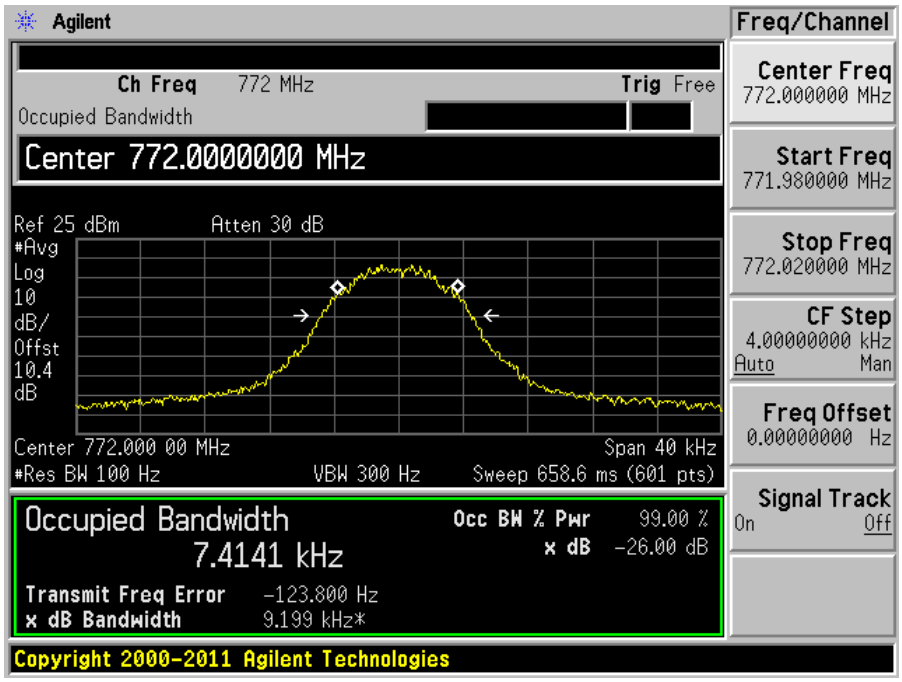
799-805 MHz, D-LMR

Middle Channel – 802 MHz



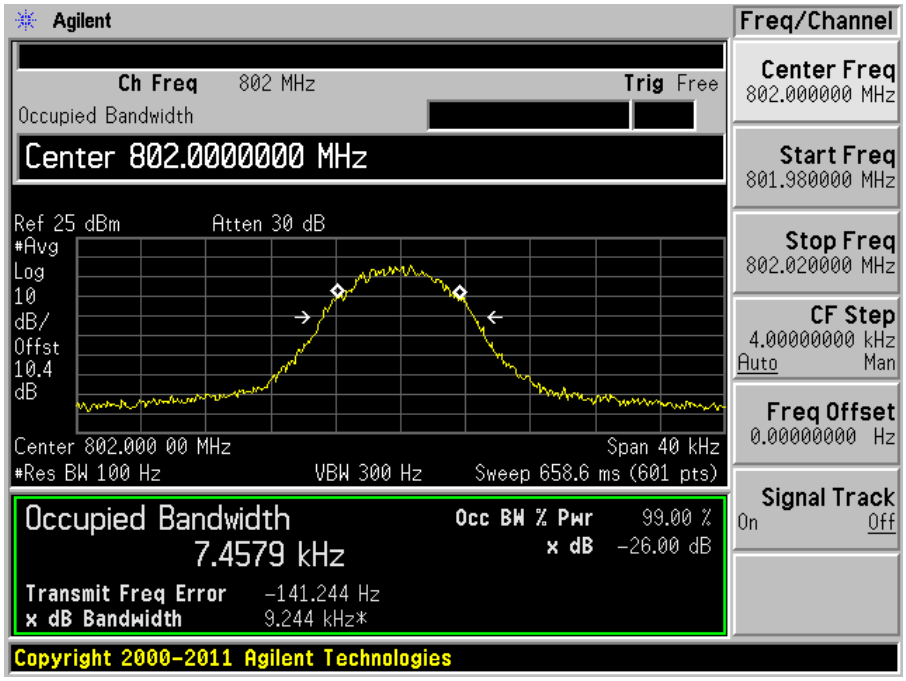
769-775 MHz, C4FM

Middle Channel – 772 MHz



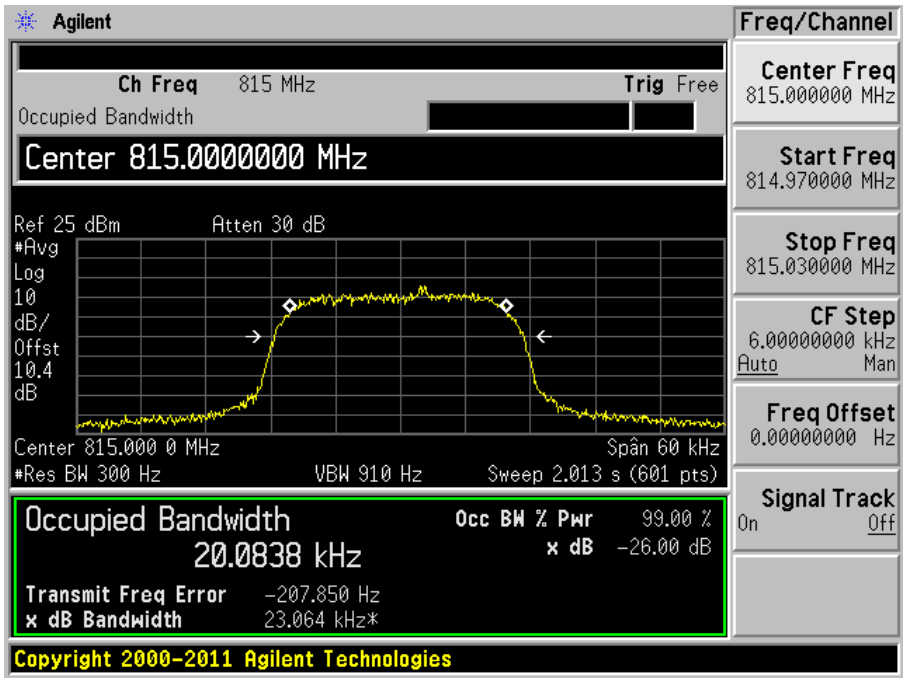
799-805 MHz, C4FM

Middle Channel – 802 MHz



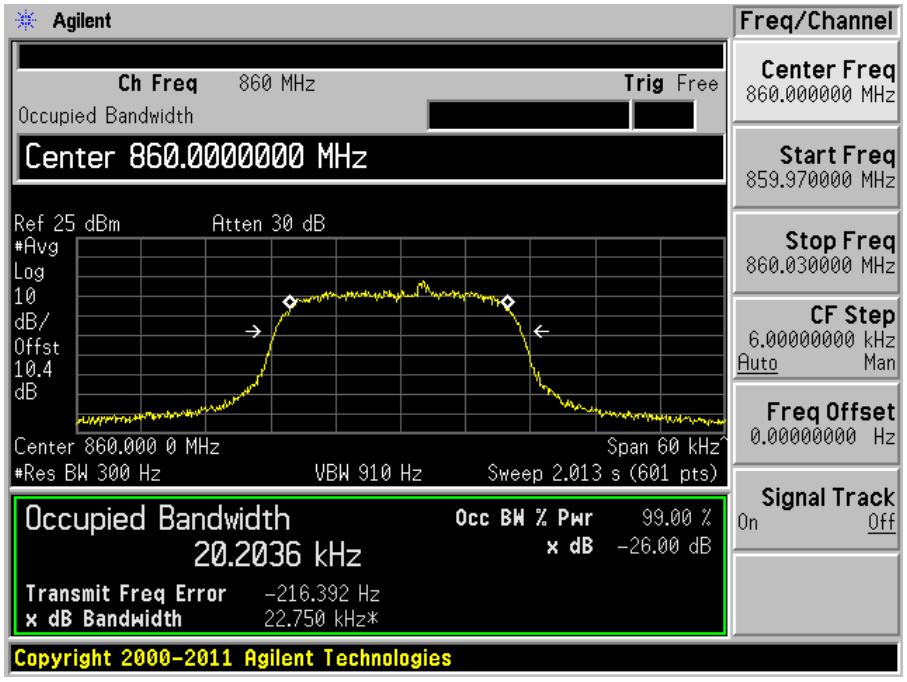
809-824 MHz, TETRA

Middle Channel – 815 MHz



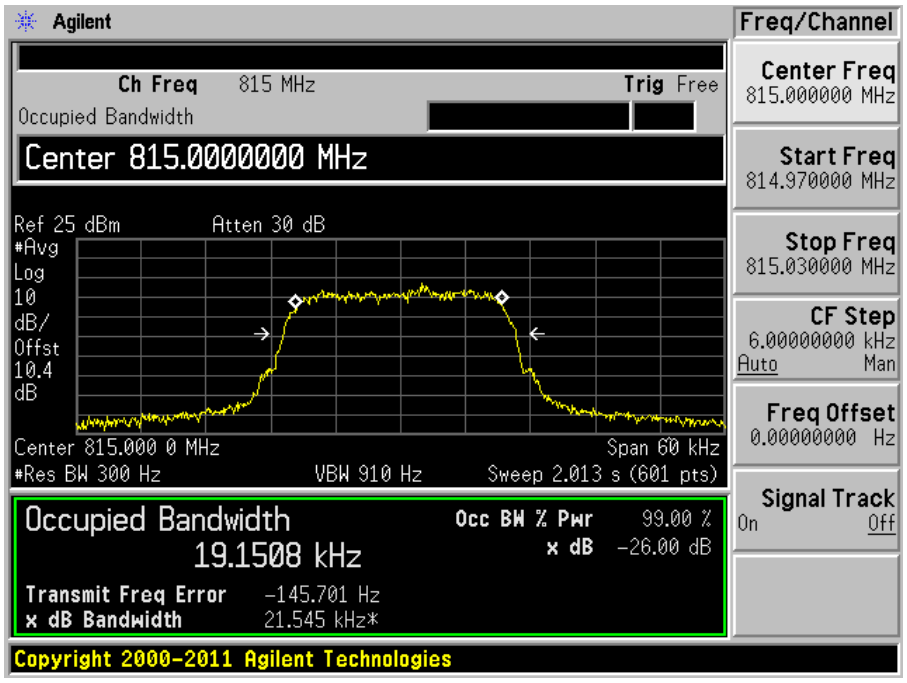
854-869 MHz, TETRA

Middle Channel – 860 MHz



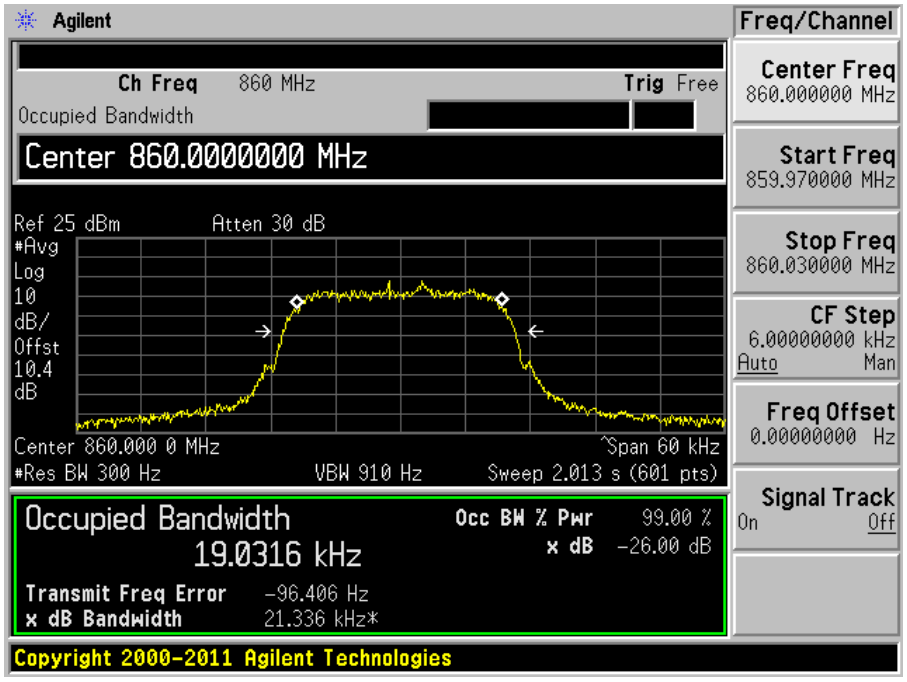
806-824 MHz, D-LMR

Middle Channel – 815 MHz



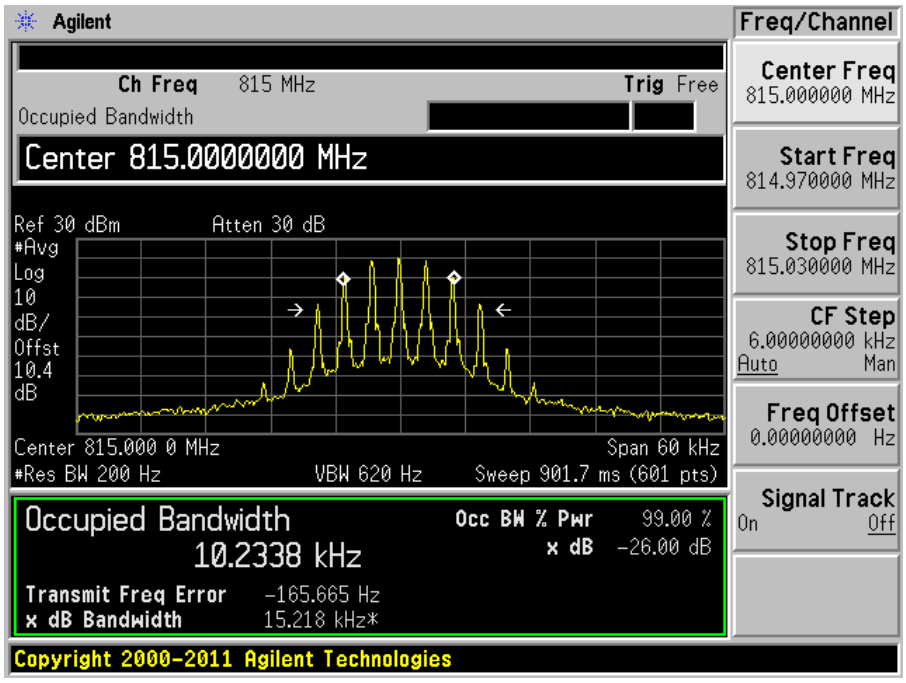
851-869 MHz, D-LMR

Middle Channel – 860 MHz



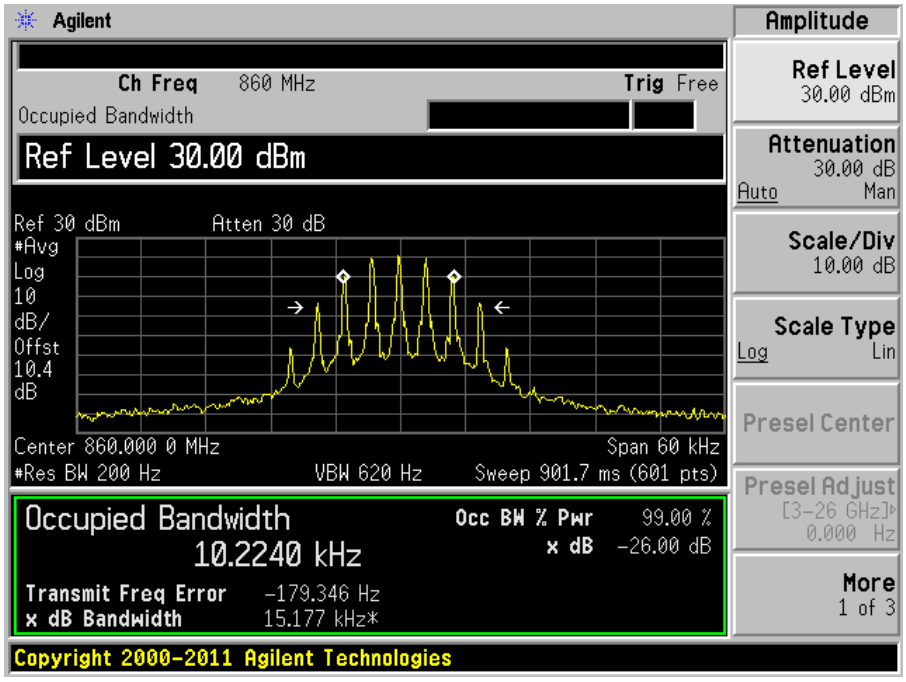
806-824 MHz, FM (20 kHz CS)

Middle Channel – 815 MHz



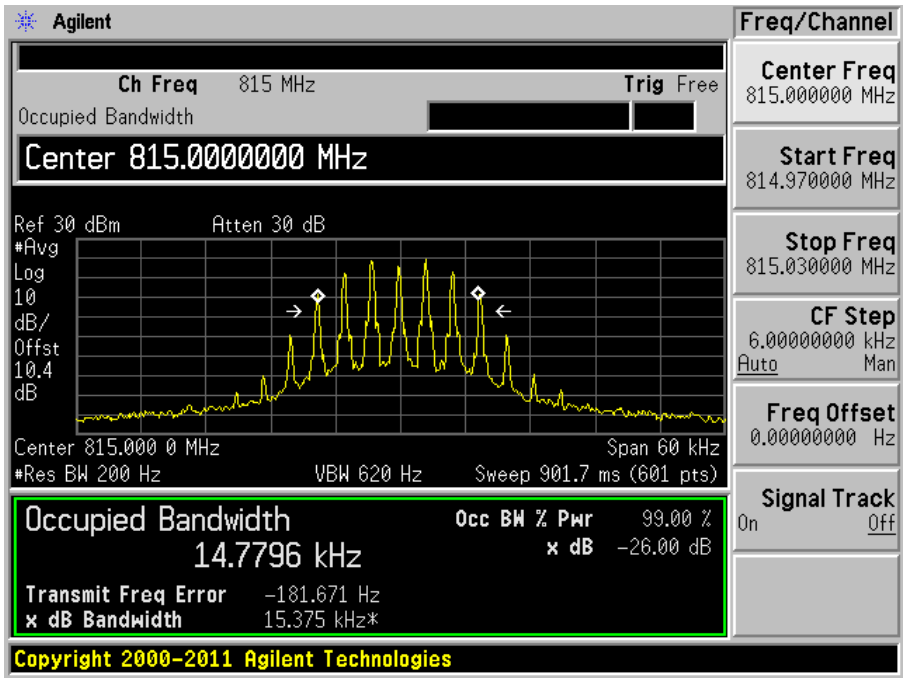
851-869 MHz, FM (20 kHz CS)

Middle Channel – 860 MHz



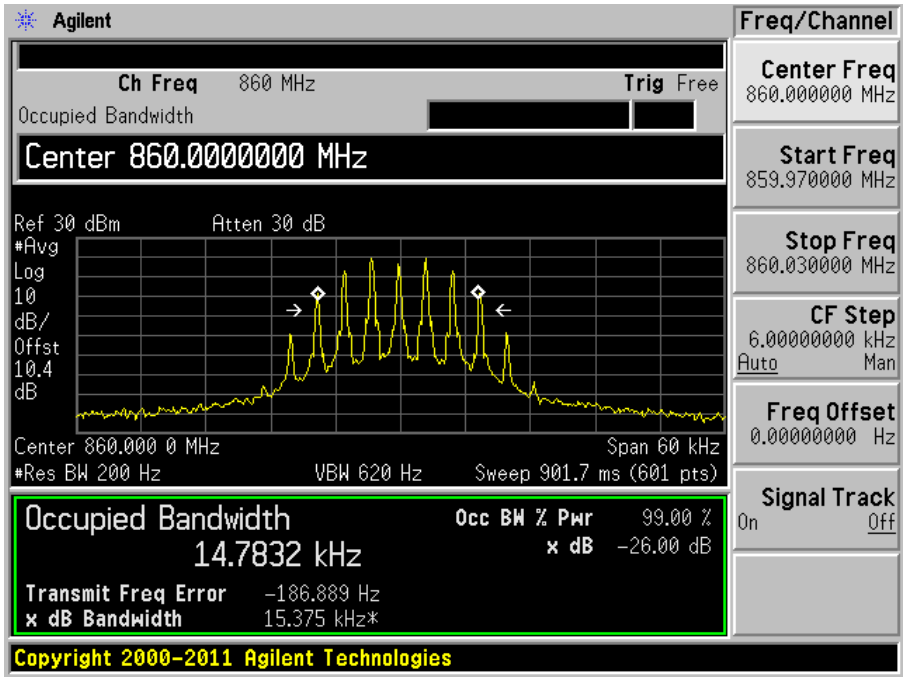
806-824 MHz, FM (25 KHz CS)

Middle Channel – 815 MHz



851-869 MHz, FM (25 kHz CS)

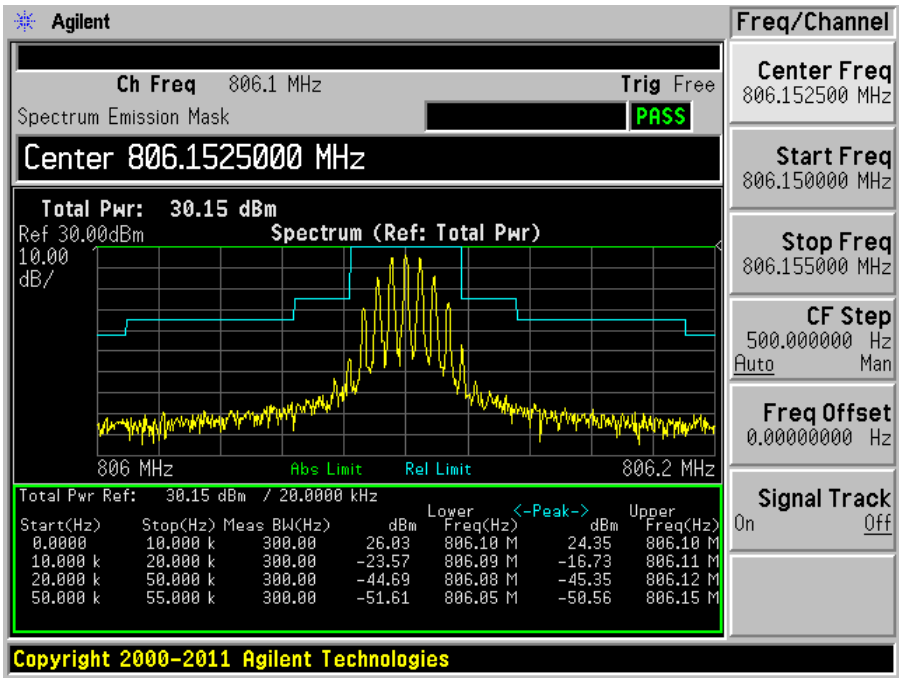
Middle Channel – 860 MHz



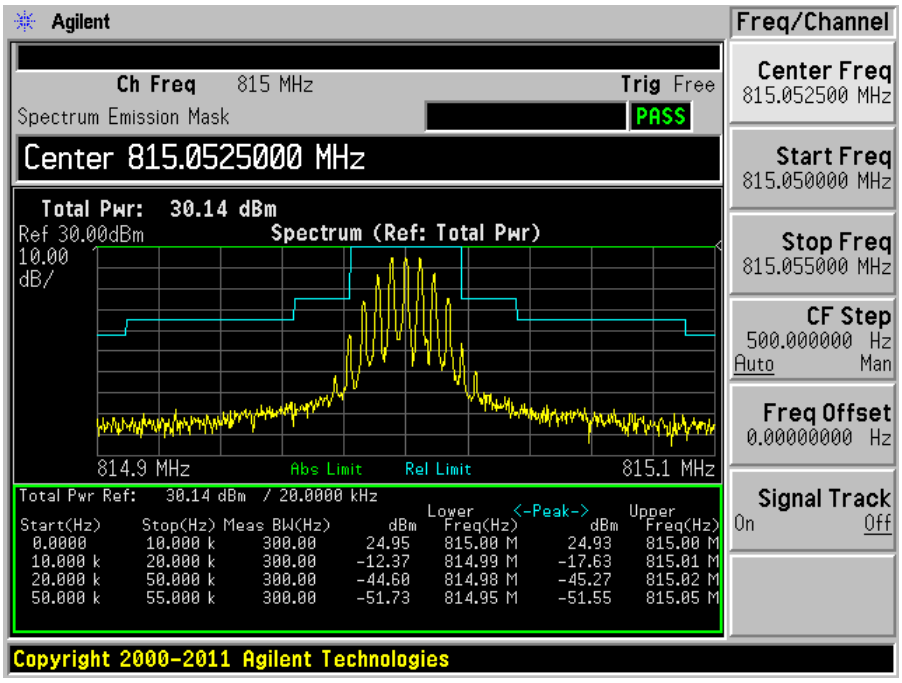
Emission Mask B (High Power)

806-824 MHz, FM (20 kHz CS)

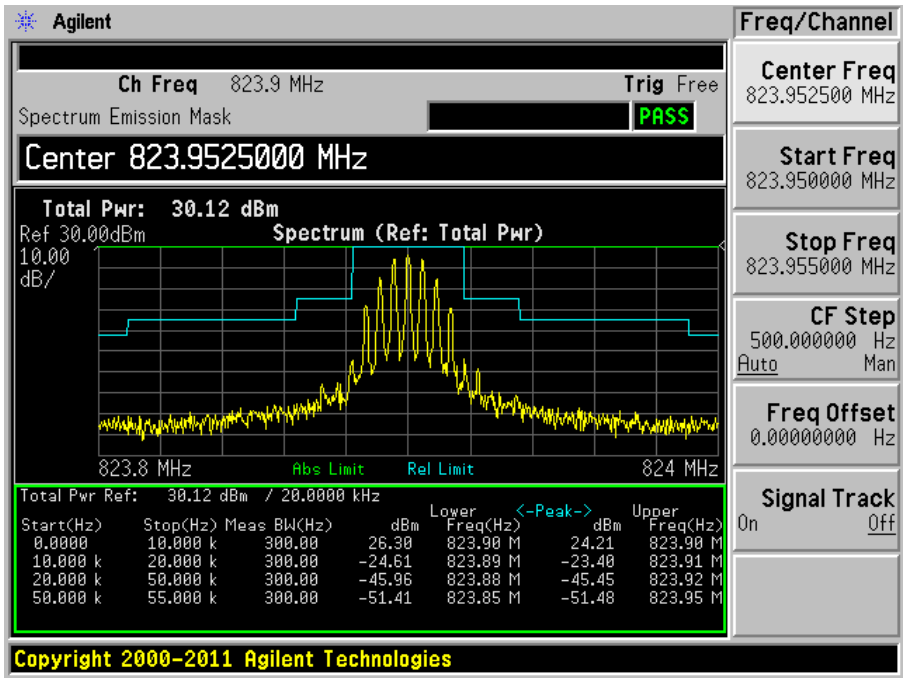
Low Channel – 806.1 MHz



Middle Channel – 815 MHz

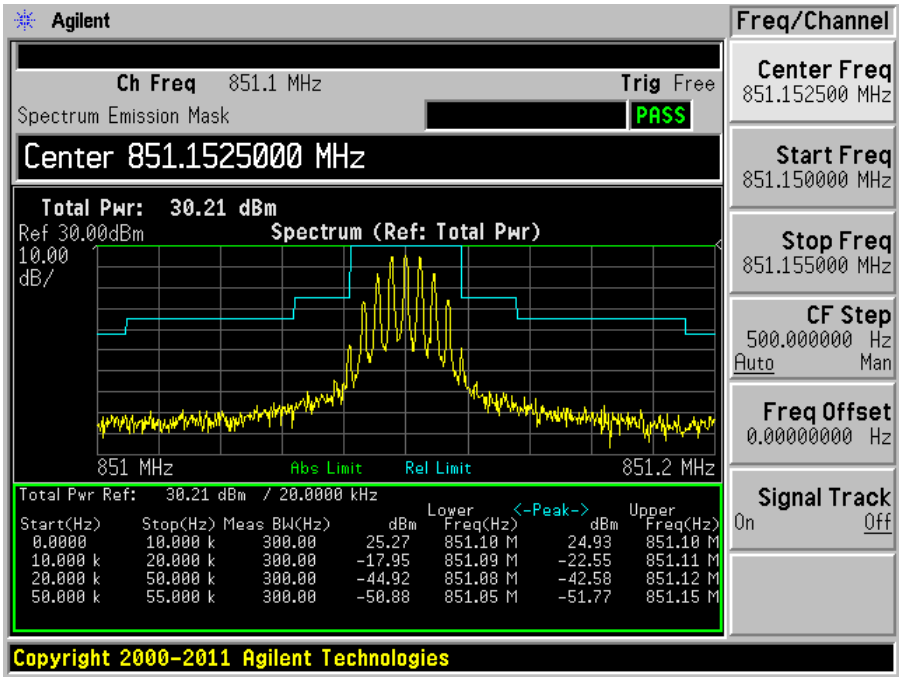


High Channel – 823.9 MHz

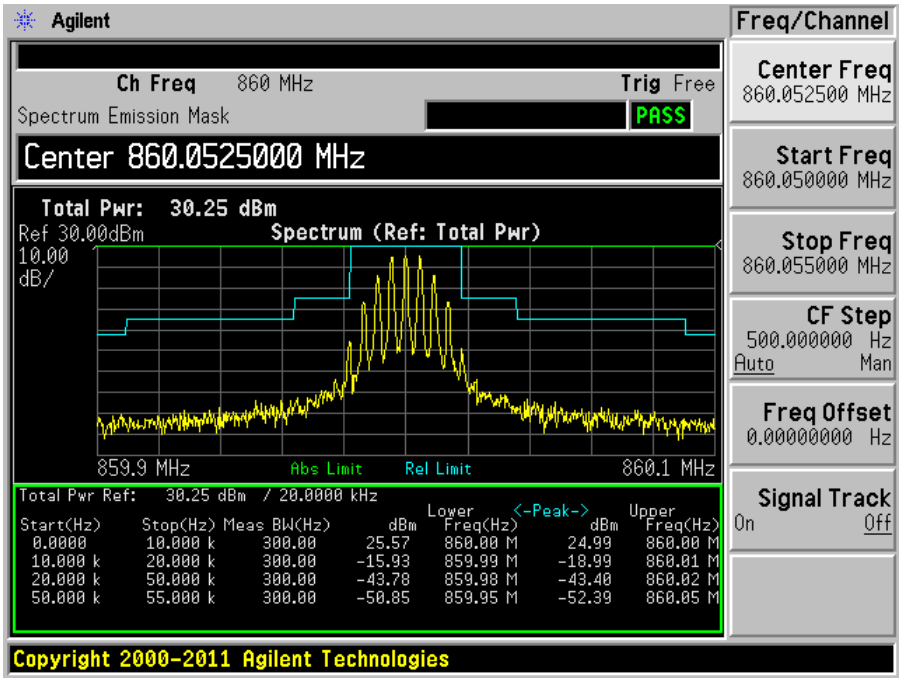


851-869 MHz, FM (20 kHz CS)

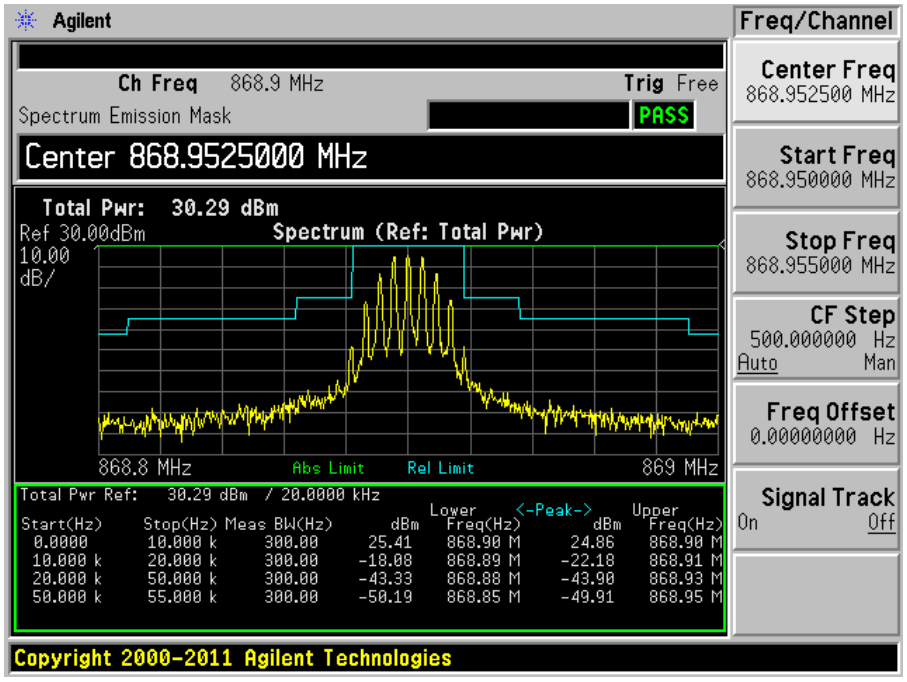
Low Channel – 851.1 MHz



Middle Channel – 860 MHz

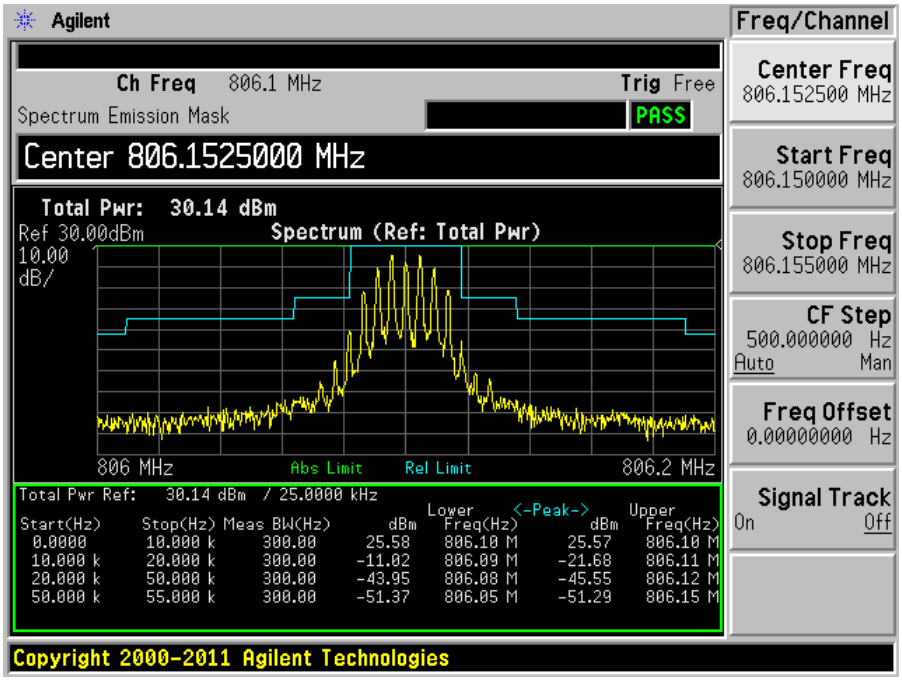


High Channel – 868.9 MHz

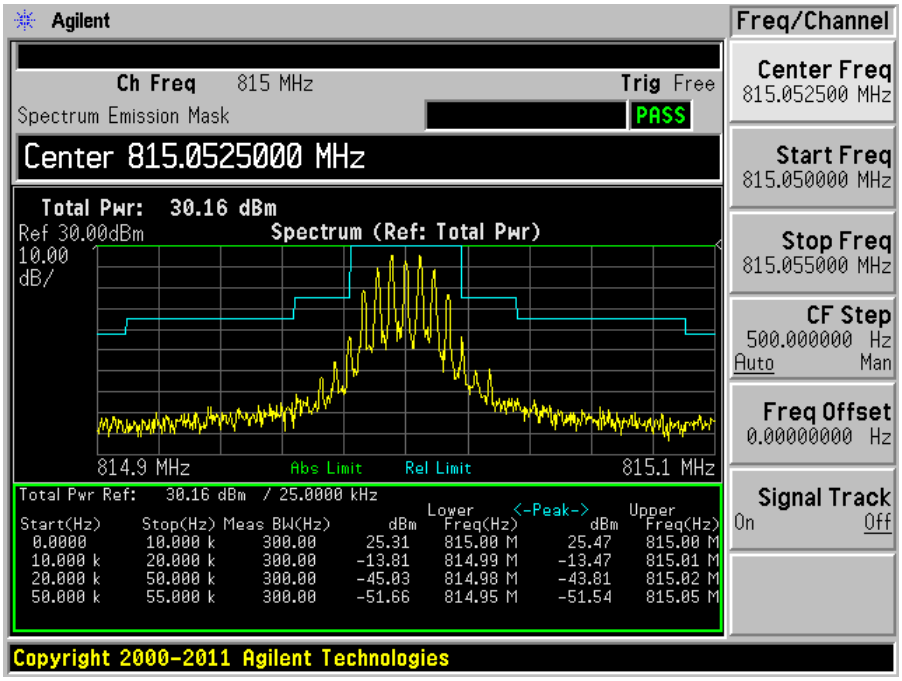


806-824 MHz, FM (25 kHz CS)

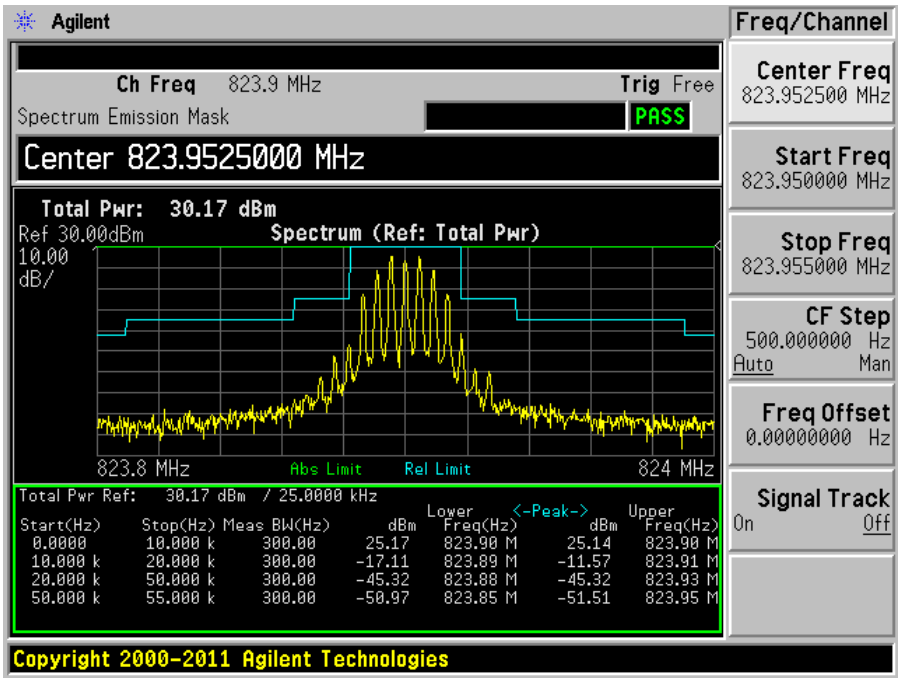
Low Channel – 806.1 MHz



Middle Channel – 815 MHz

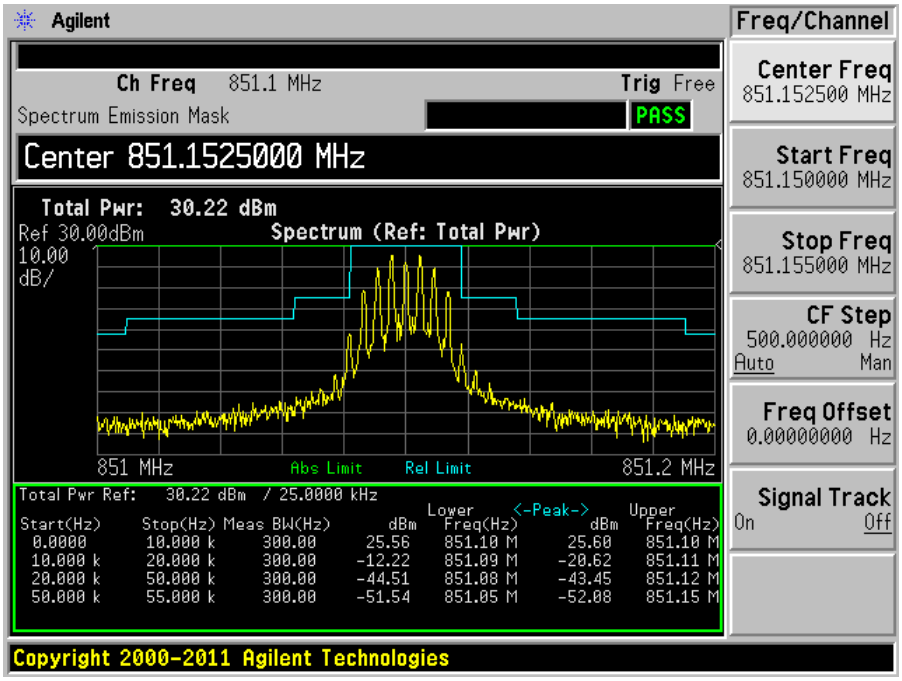


High Channel – 823.9 MHz

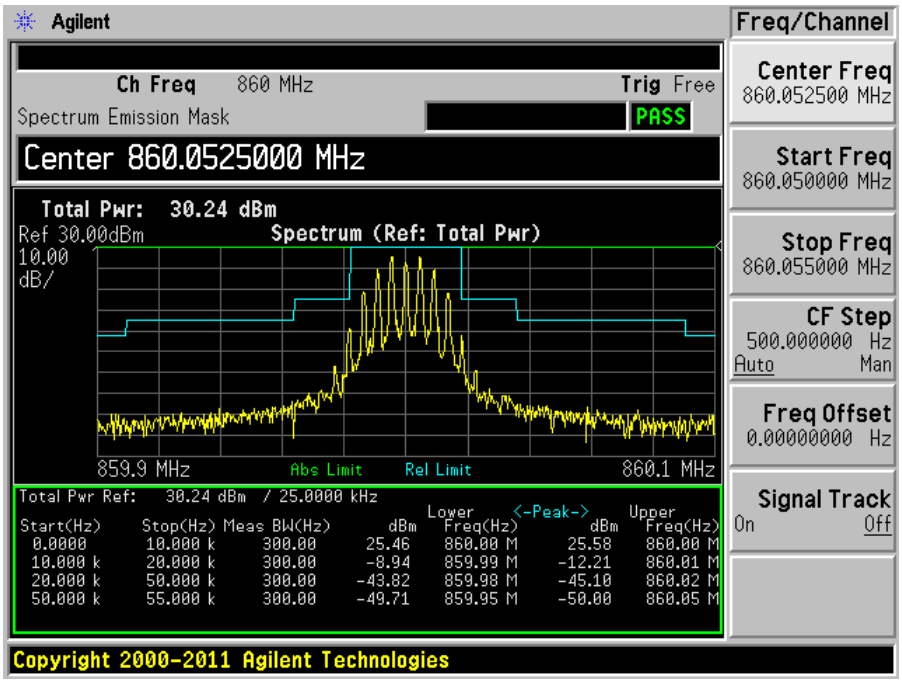


851-869 MHz, FM (25 kHz CS)

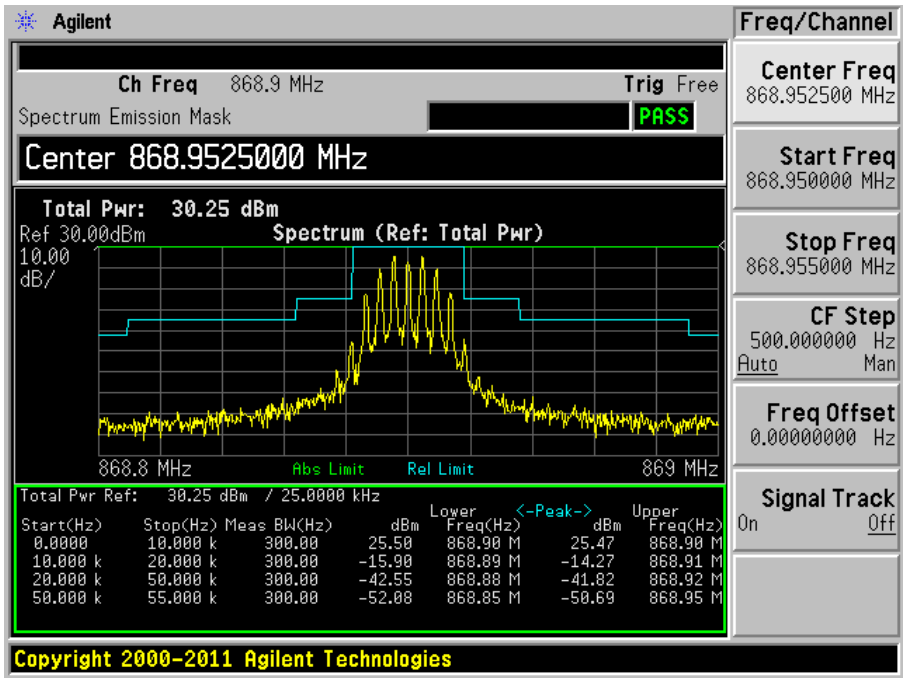
Low Channel – 851.1 MHz



Middle Channel – 860 MHz

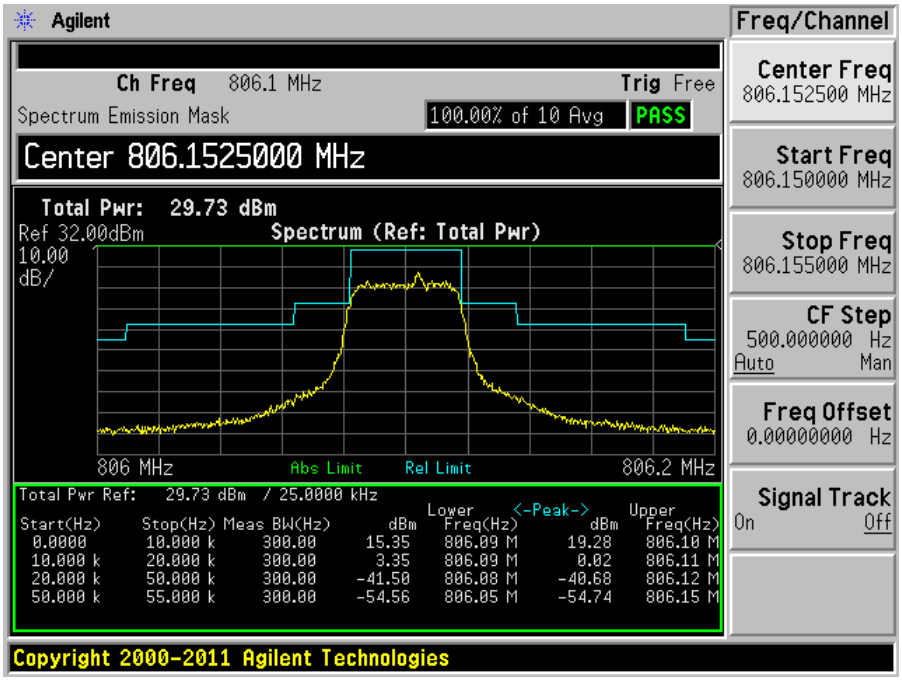


High Channel – 868.9 MHz

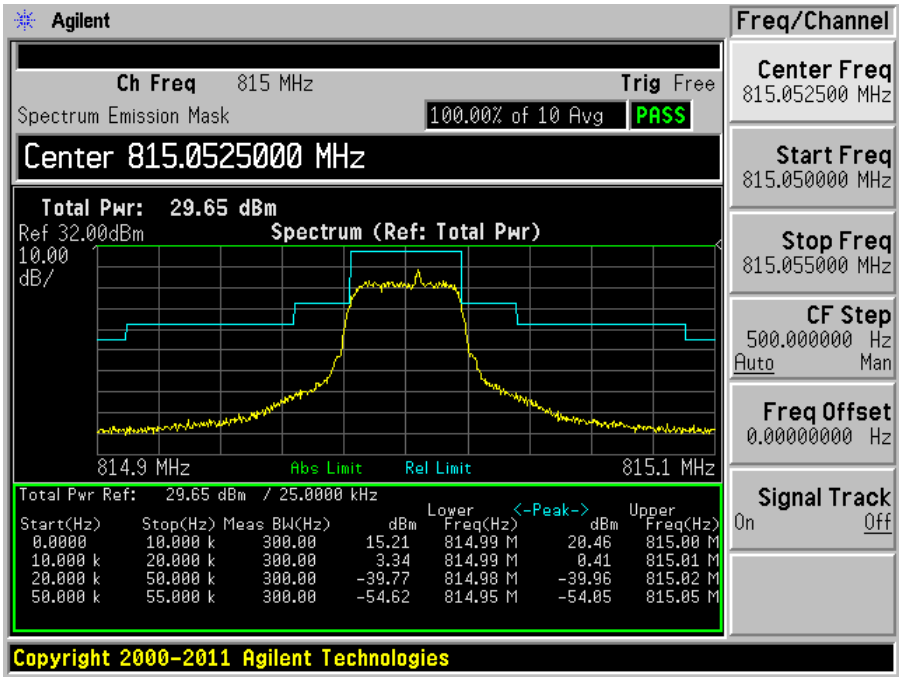


806-824 MHz, D-LMR

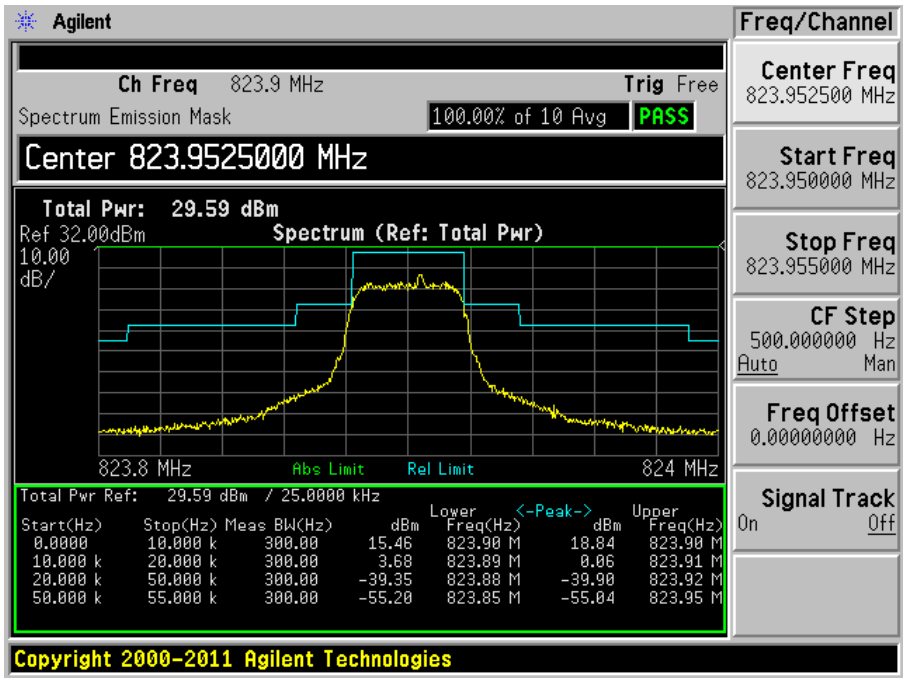
Low Channel – 806.1 MHz



Middle Channel – 815 MHz

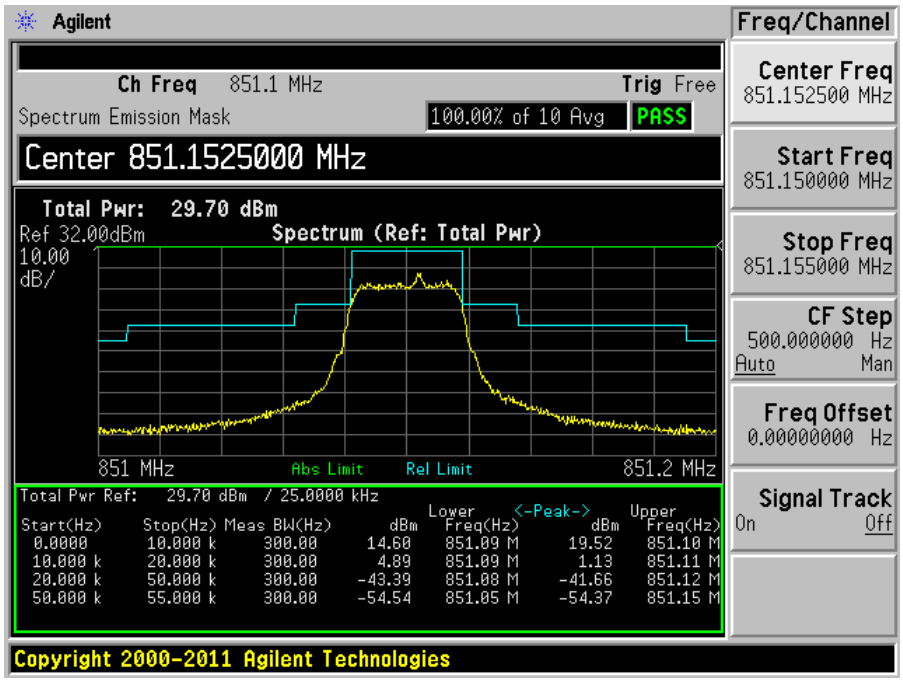


High Channel – 823.9 MHz

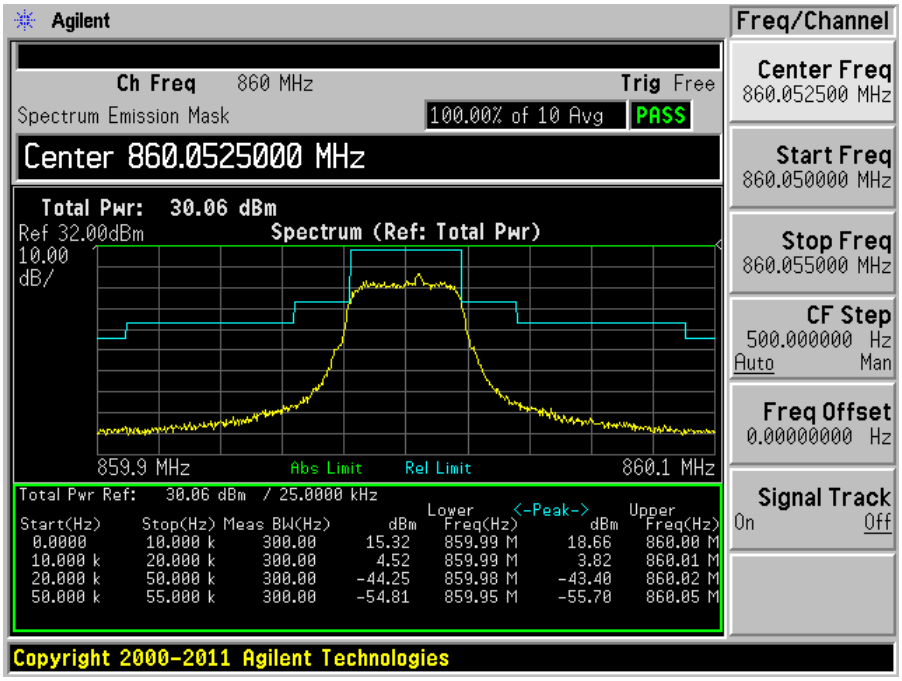


851-869 MHz, D-LMR

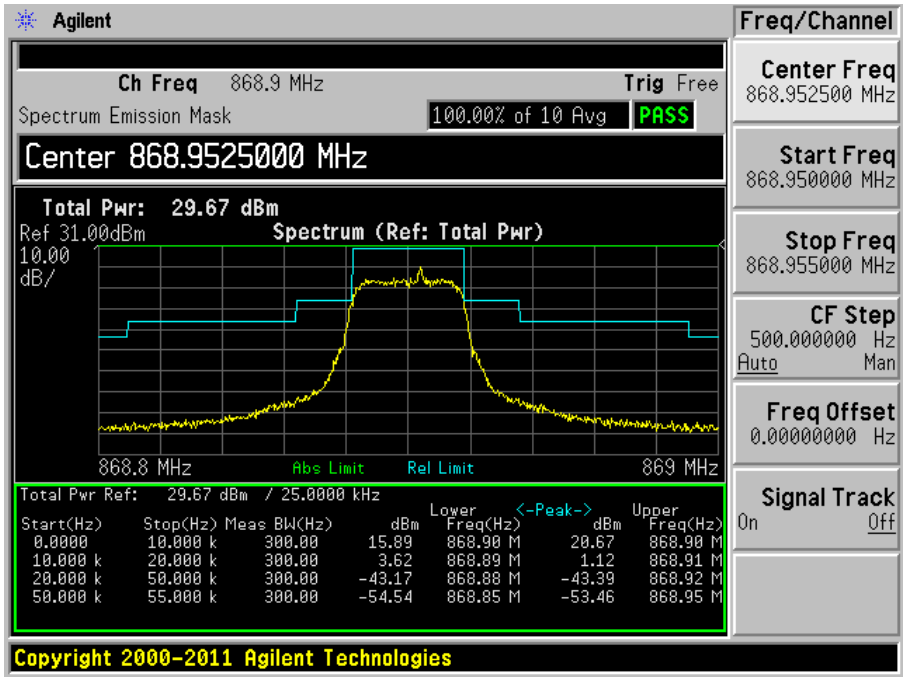
Low Channel – 851.1 MHz



Middle Channel – 860 MHz



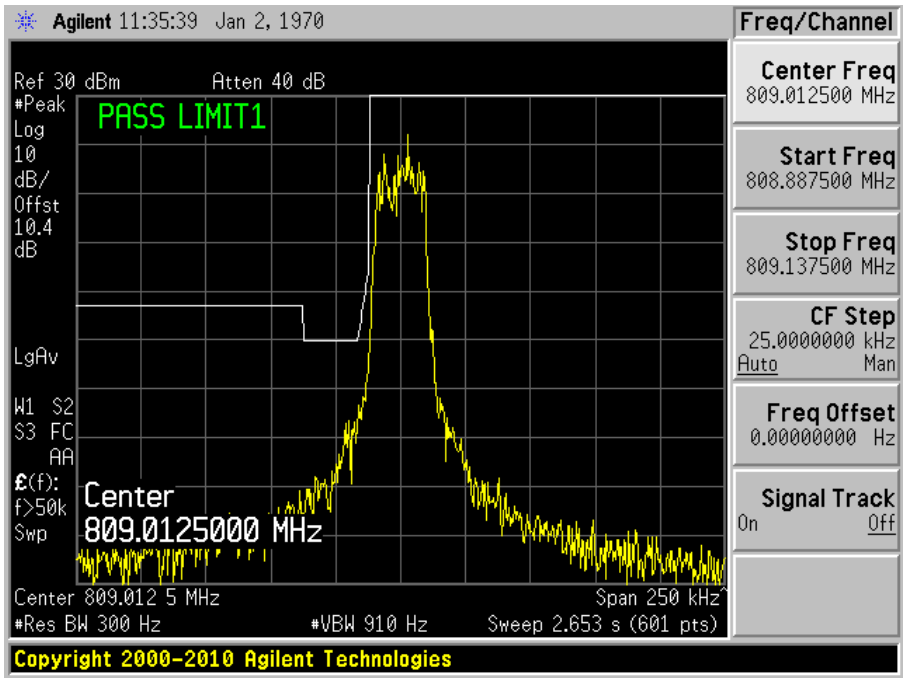
High Channel – 868.9 MHz



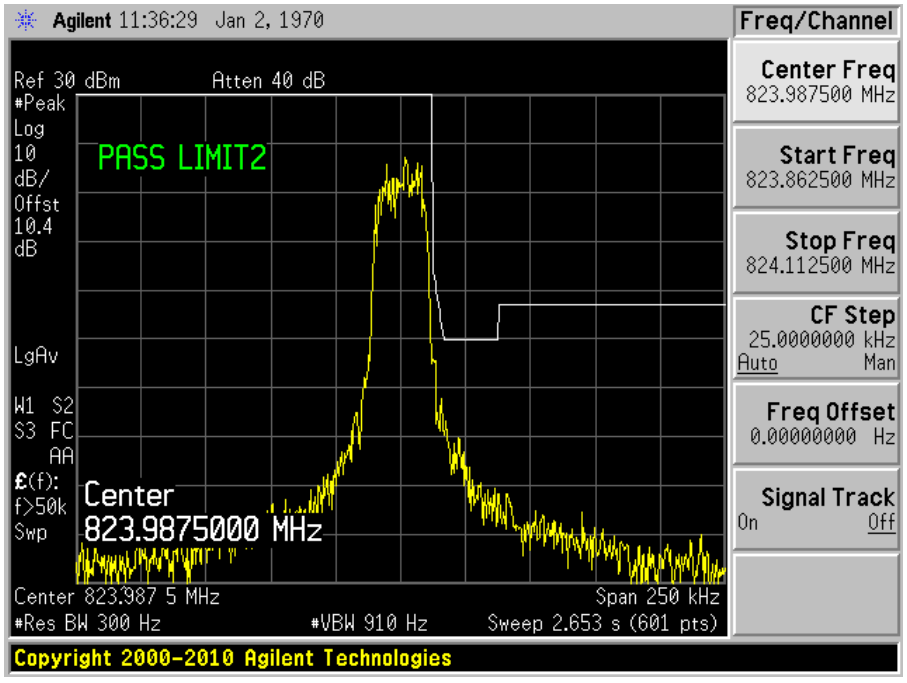
EA Mask (High Power)

809-824 MHz, D-LMR

Low Channel – 809.0125 MHz

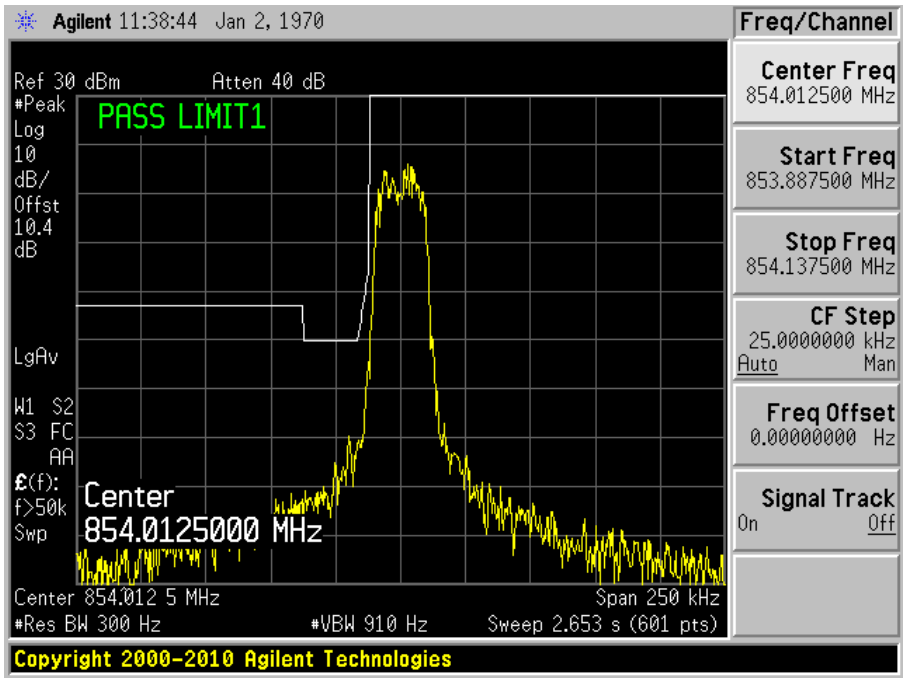


High Channel – 823.9875 MHz

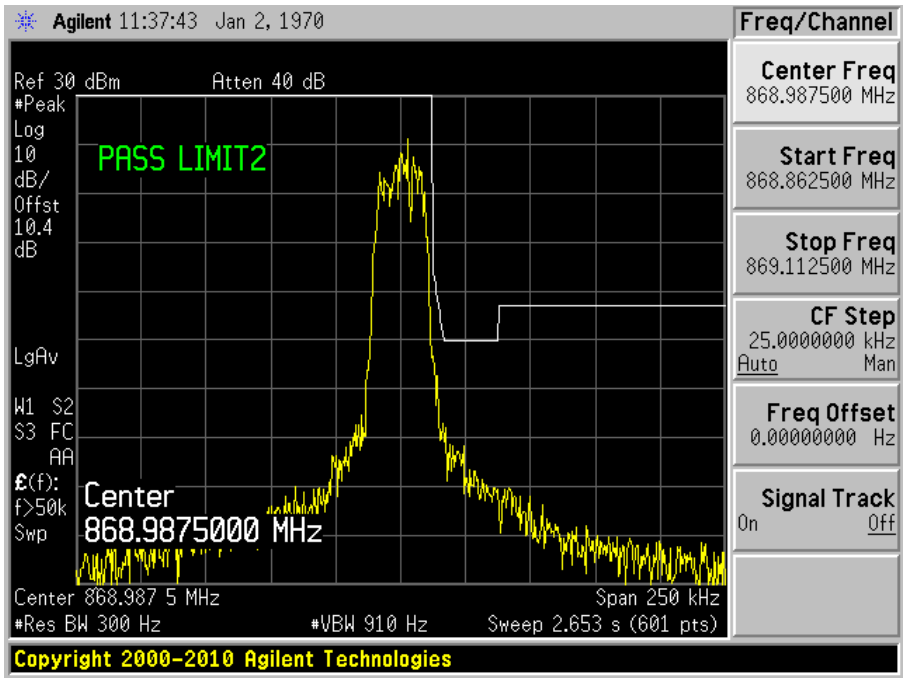


854-869 MHz, D-LMR

Low Channel – 854.0125 MHz

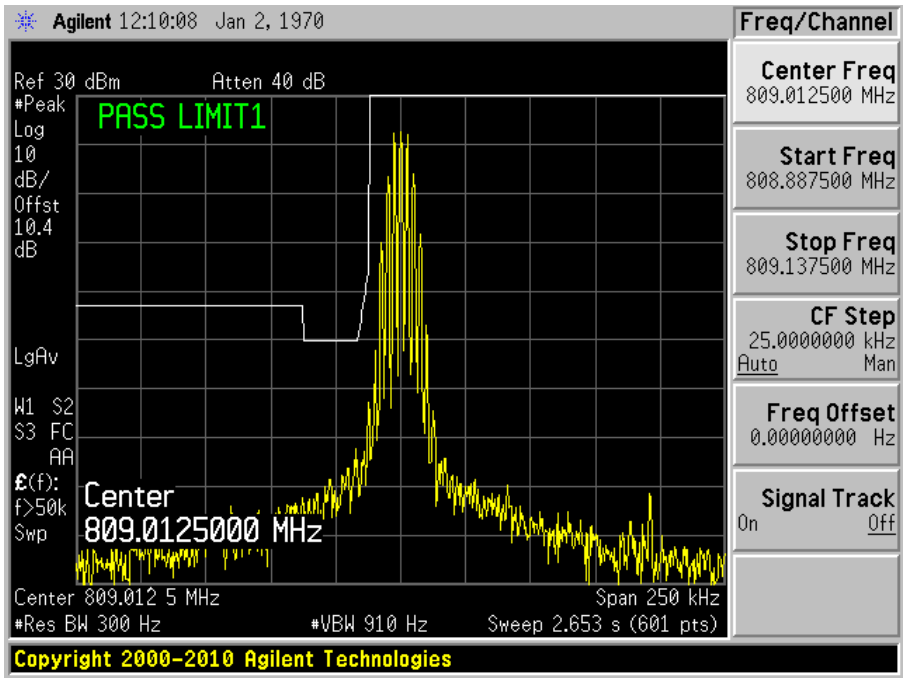


High Channel – 868.9875 MHz

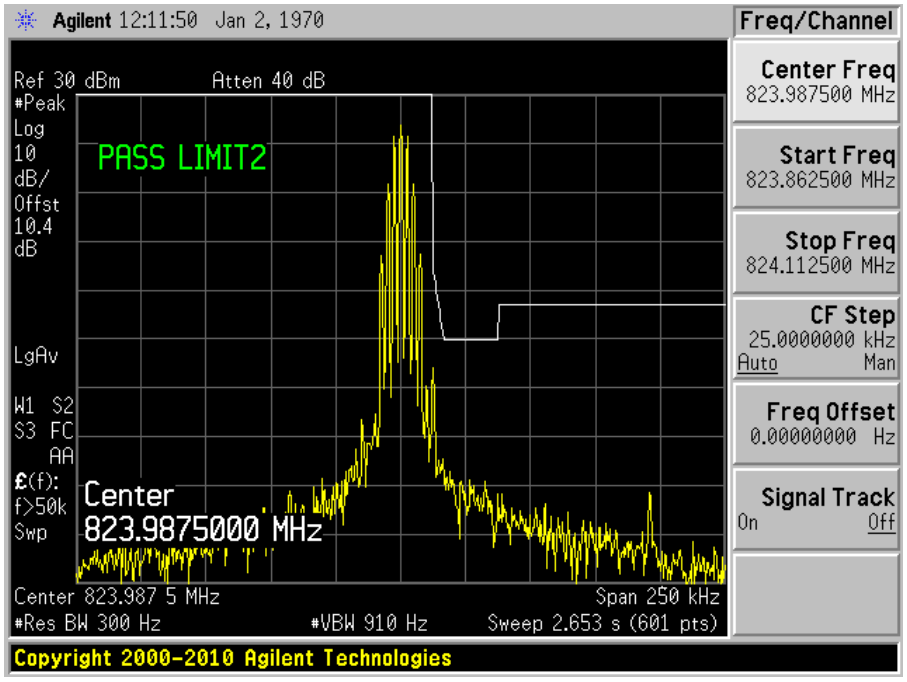


809-824 MHz, FM (20 kHz CS)

Low Channel – 809.0125 MHz

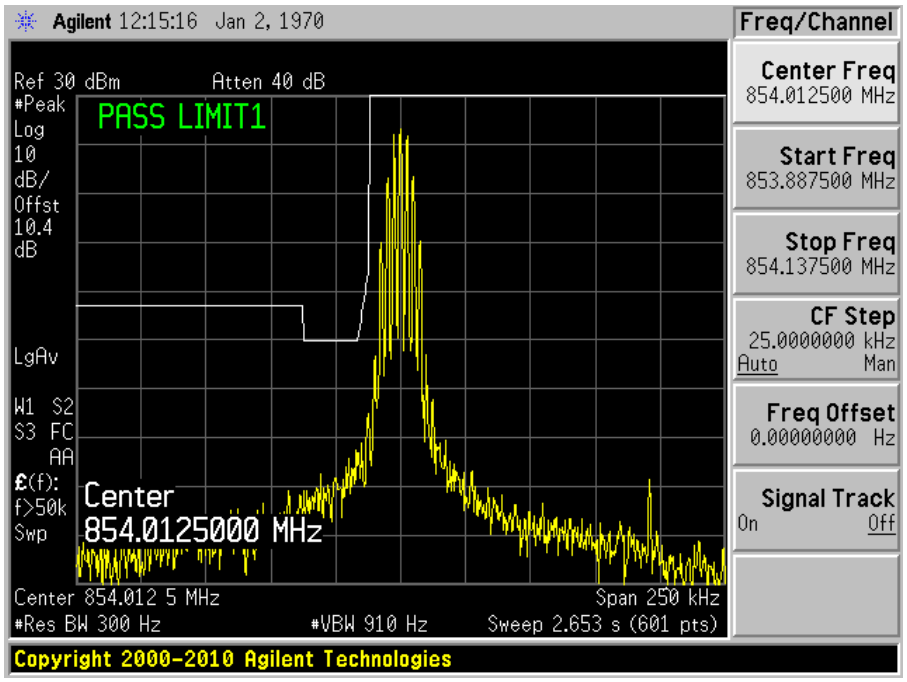


High Channel – 823.9875 MHz

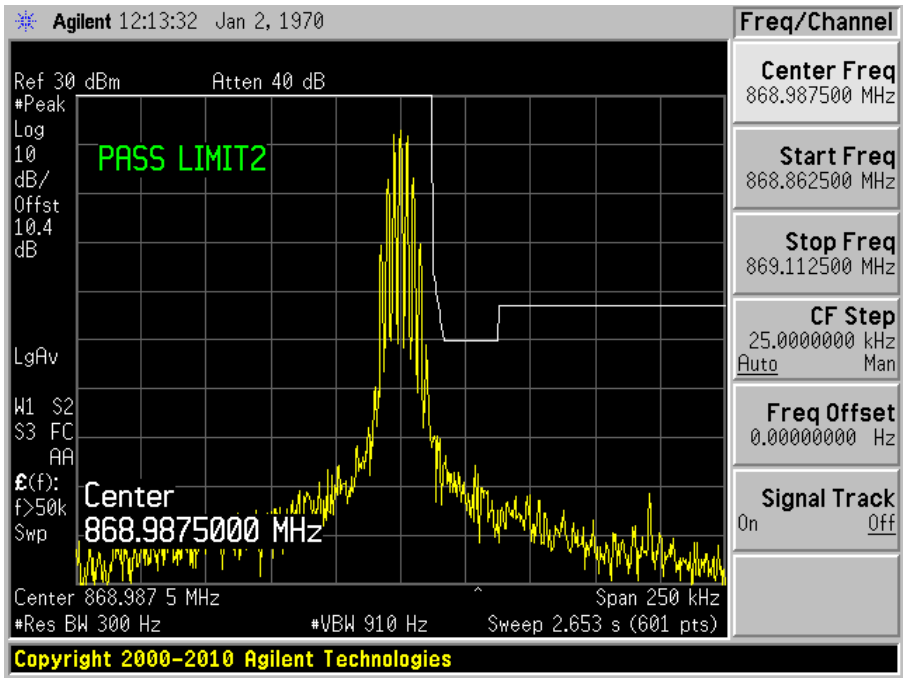


854-869 MHz, FM (20 kHz CS)

Low Channel – 854.0125 MHz

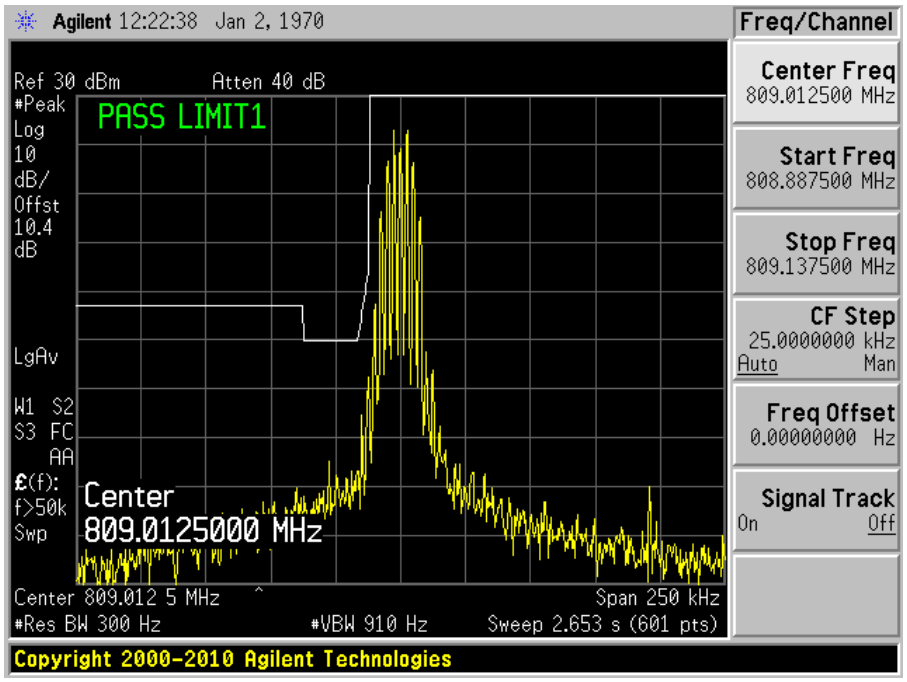


High Channel – 868.9875 MHz

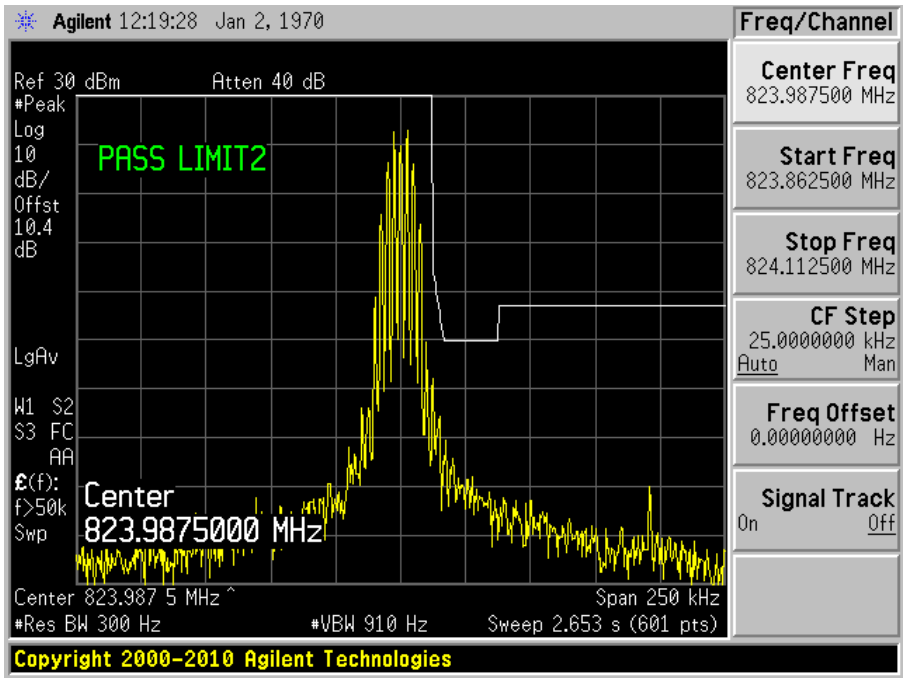


809-824 MHz, FM (25 kHz CS)

Low Channel – 809.0125 MHz

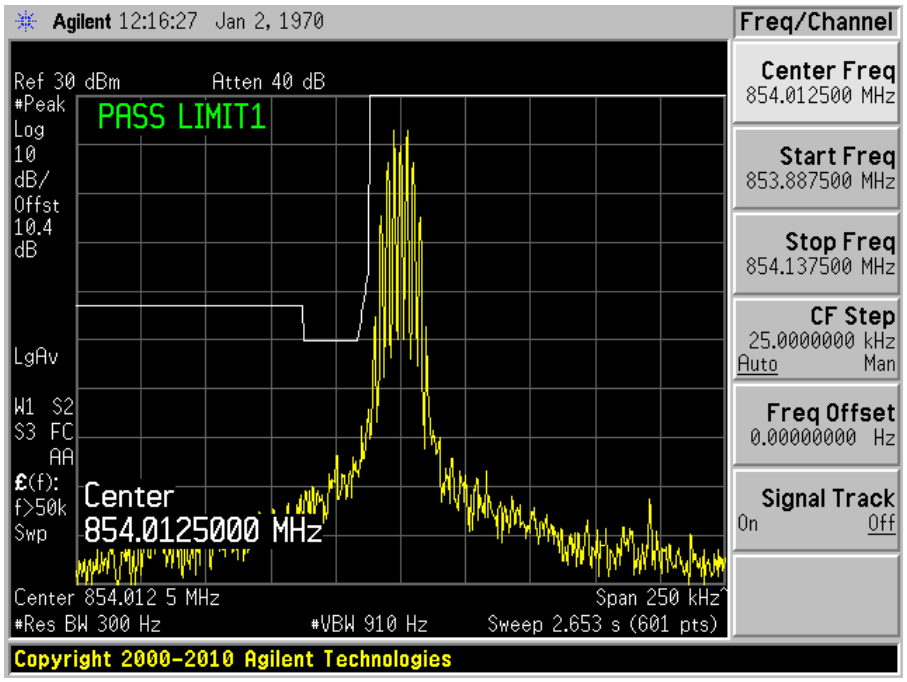


High Channel – 823.9875 MHz

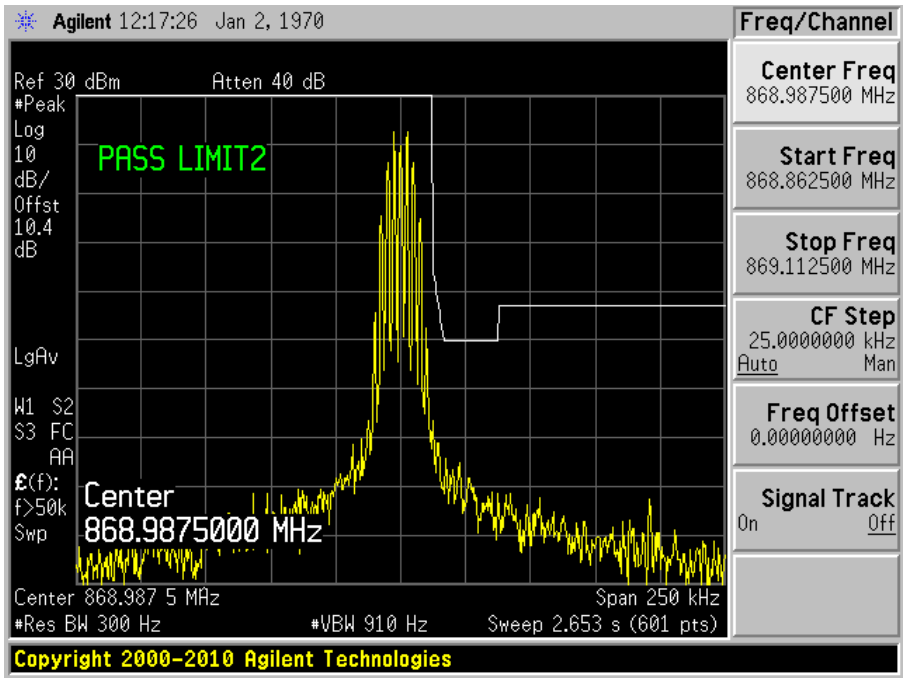


854-869 MHz, FM (25 kHz CS)

Low Channel – 854.0125 MHz



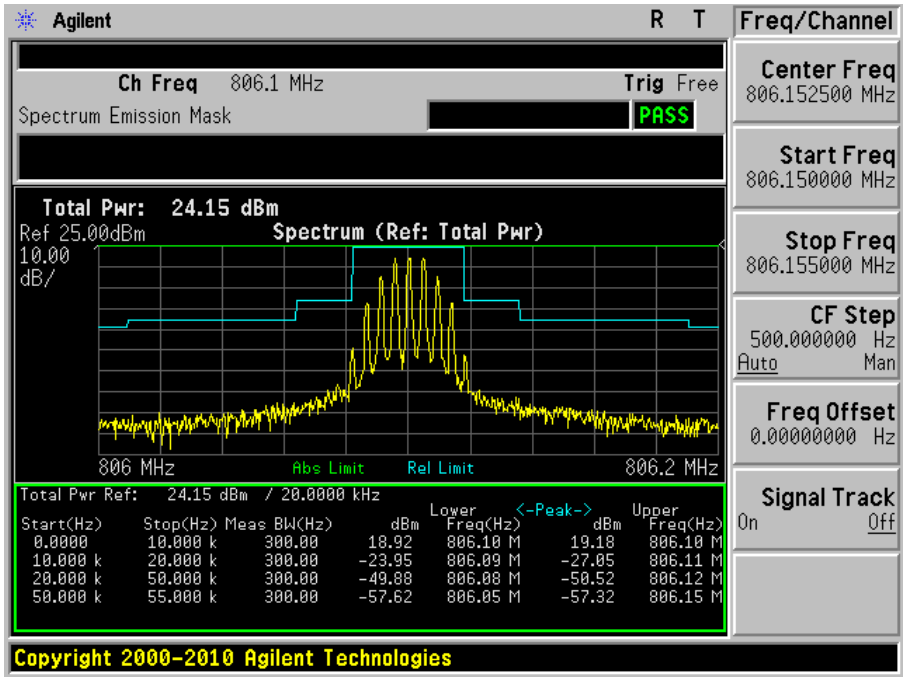
High Channel – 868.9875 MHz



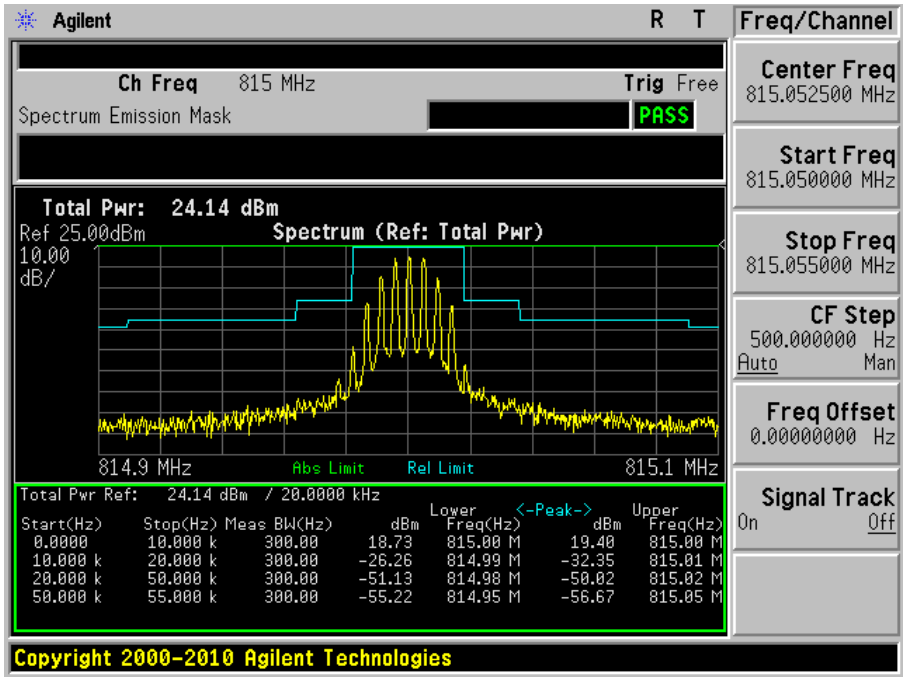
Emission Mask B (Low Power)

806-824 MHz, FM (20 kHz CS)

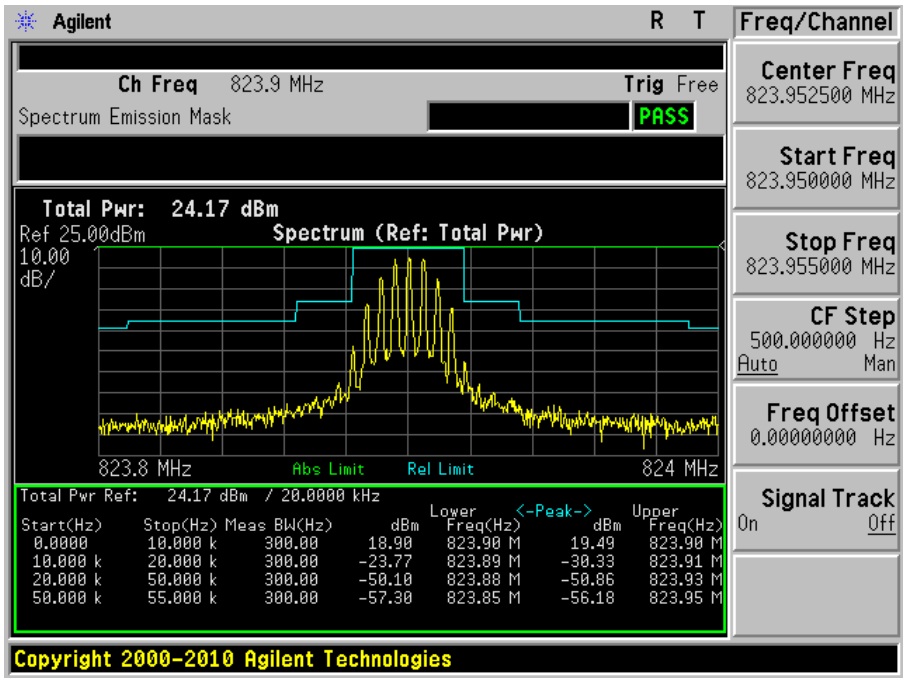
Low Channel – 806.1 MHz



Middle Channel – 815 MHz

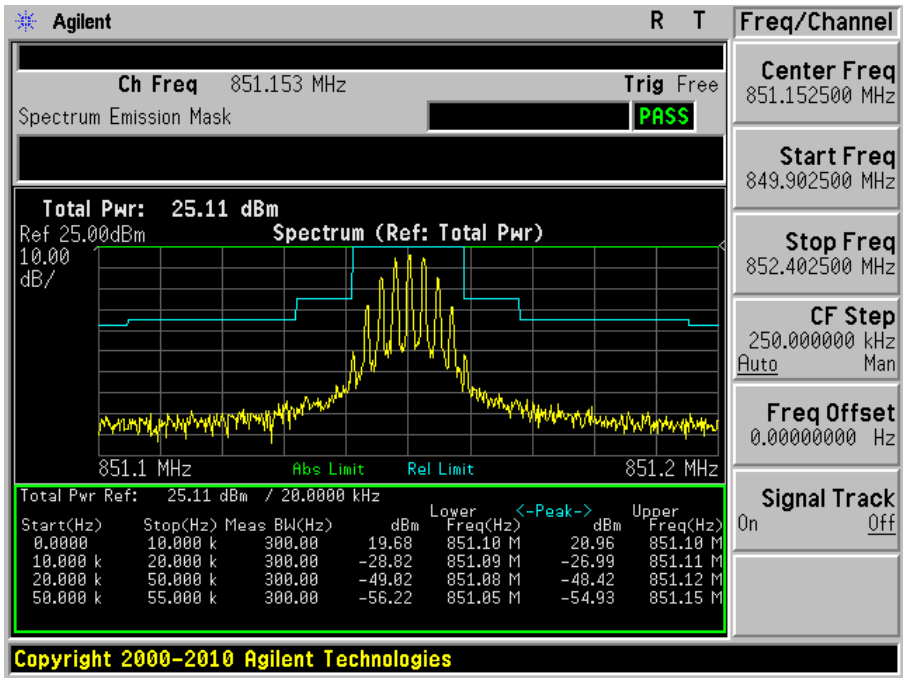


High Channel – 823.9 MHz

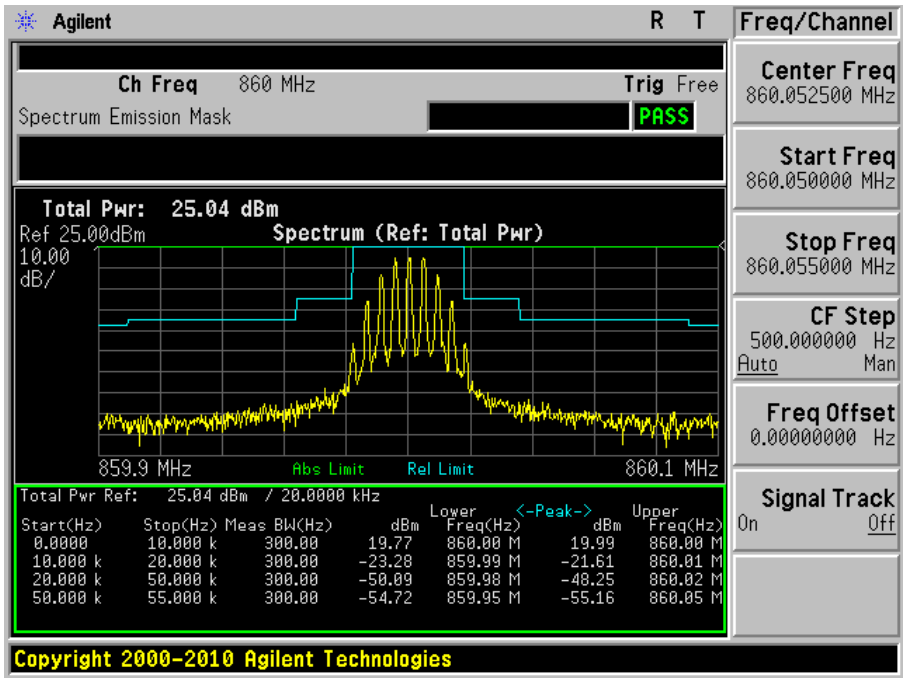


851-869 MHz, FM (20 kHz CS)

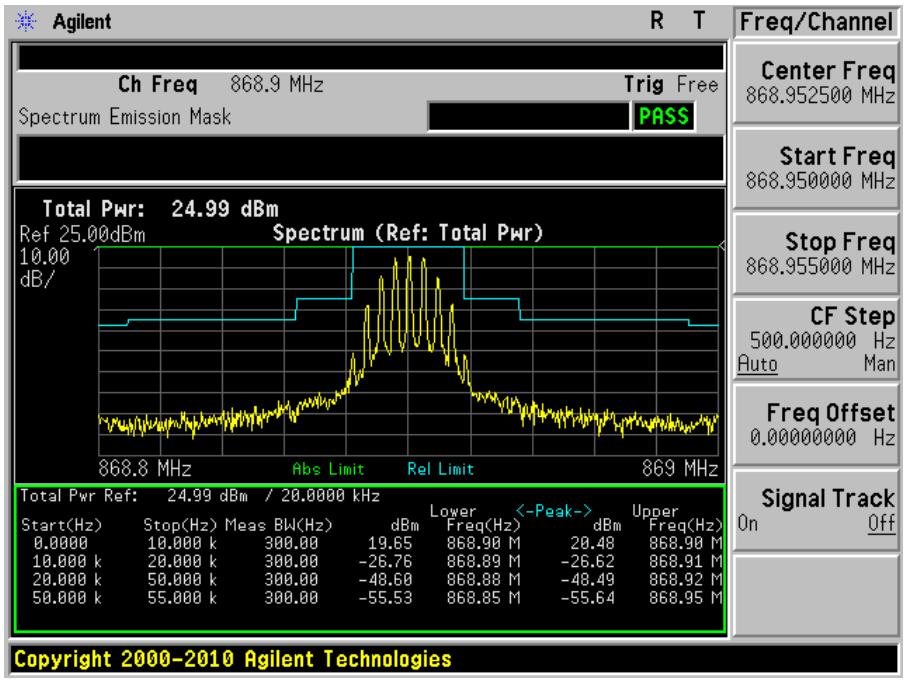
Low Channel – 851.1 MHz



Middle Channel – 860 MHz

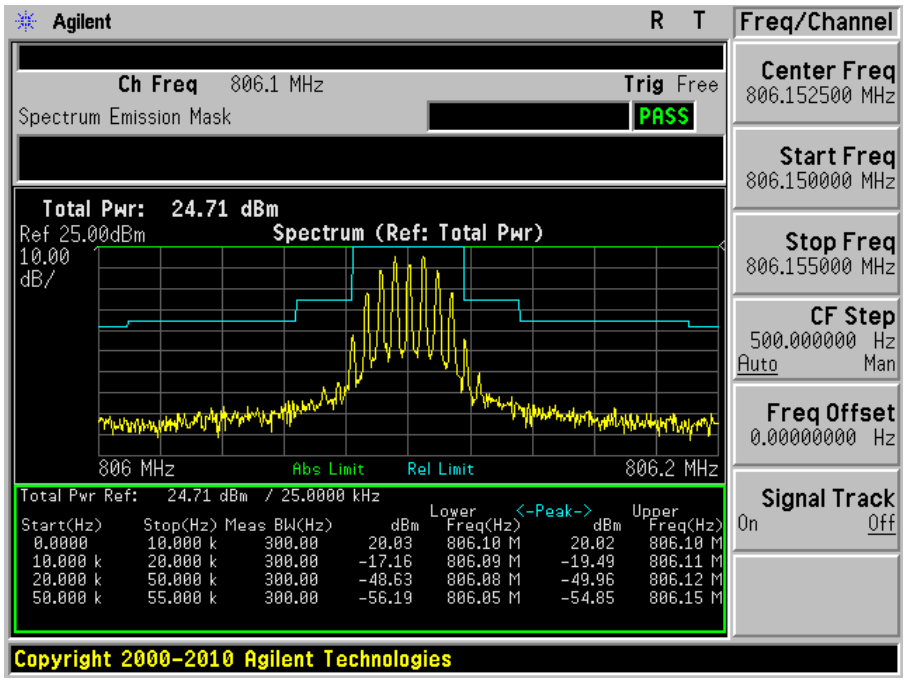


High Channel – 868.9 MHz

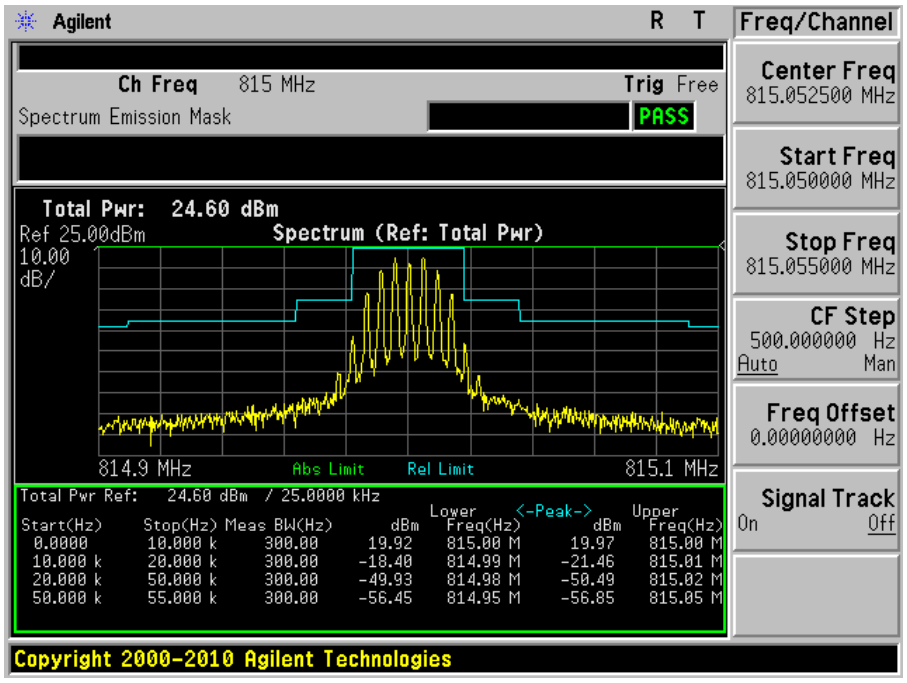


806-824 MHz, FM (25 kHz CS)

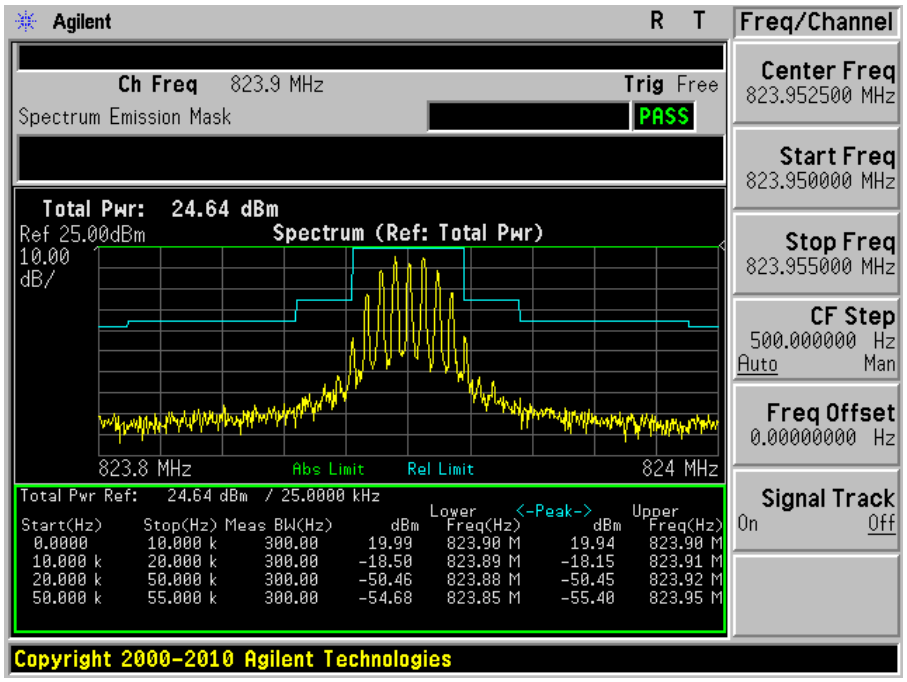
Low Channel – 806.1 MHz



Middle Channel – 815 MHz

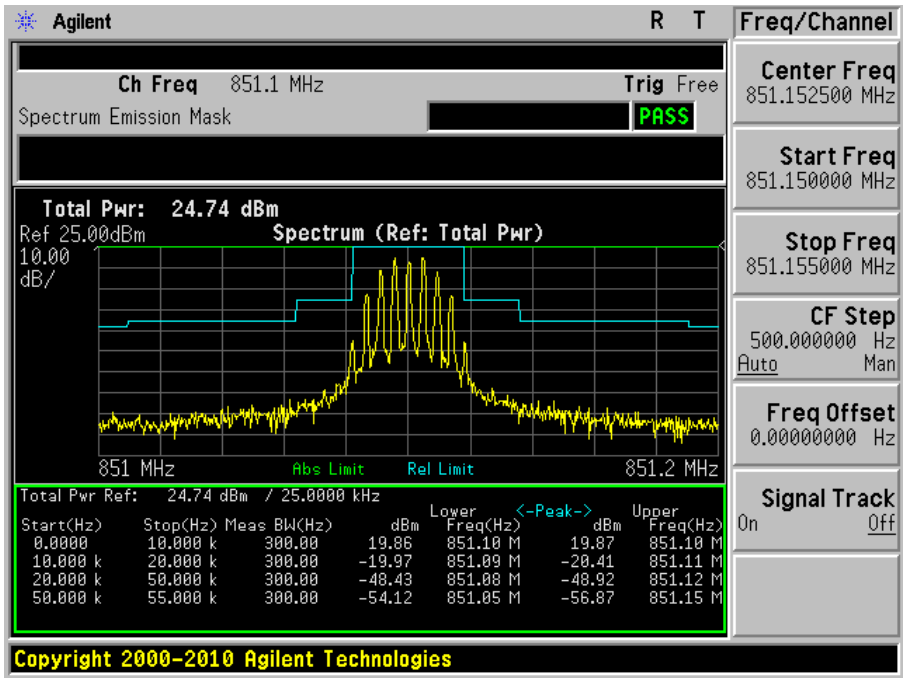


High Channel – 823.9 MHz

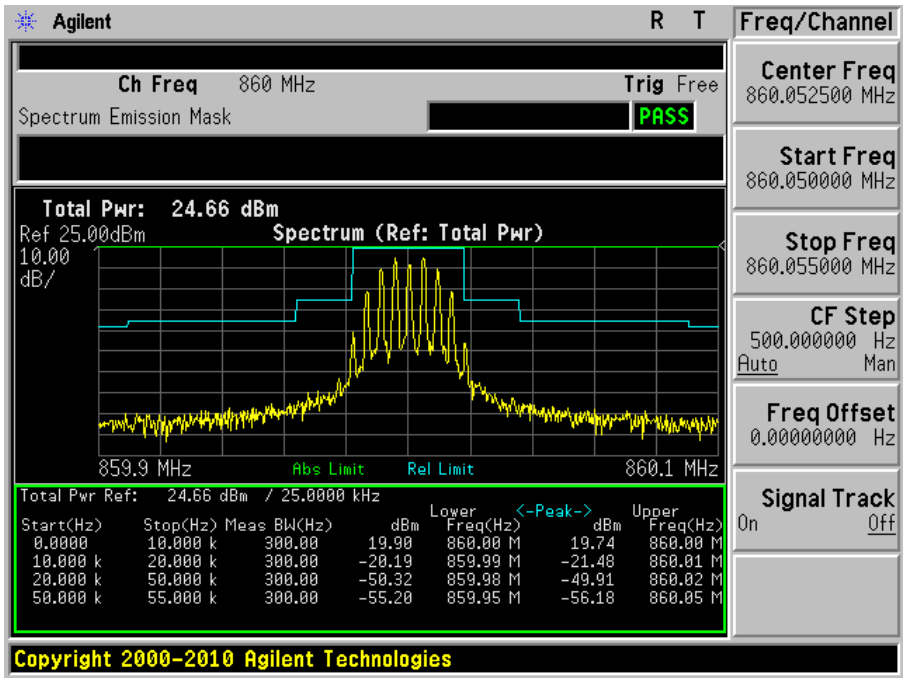


851-869 MHz, FM (25 kHz CS)

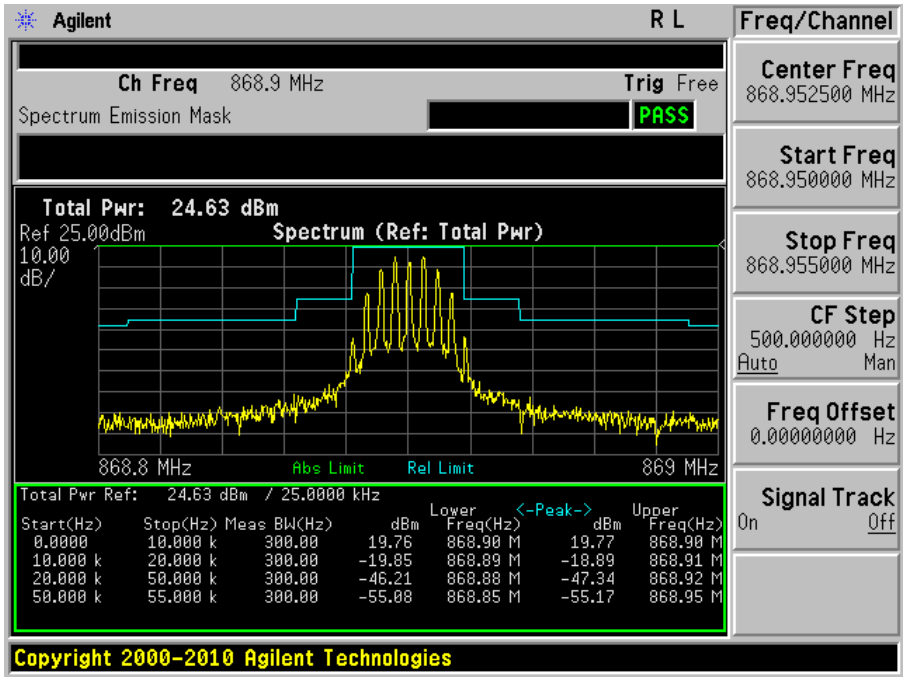
Low Channel – 851.1 MHz



Middle Channel – 860 MHz

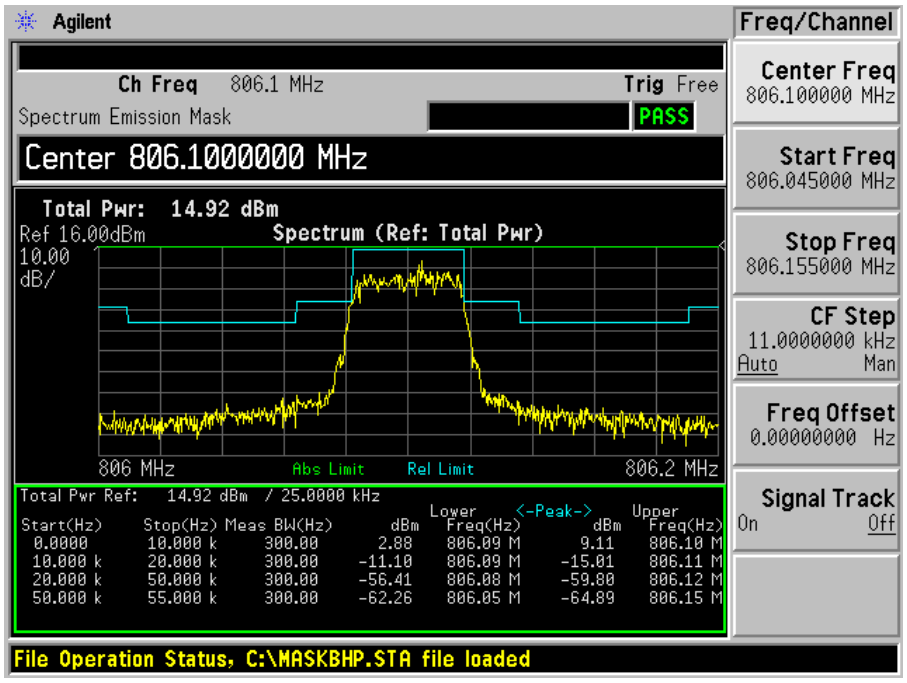


High Channel – 868.9 MHz

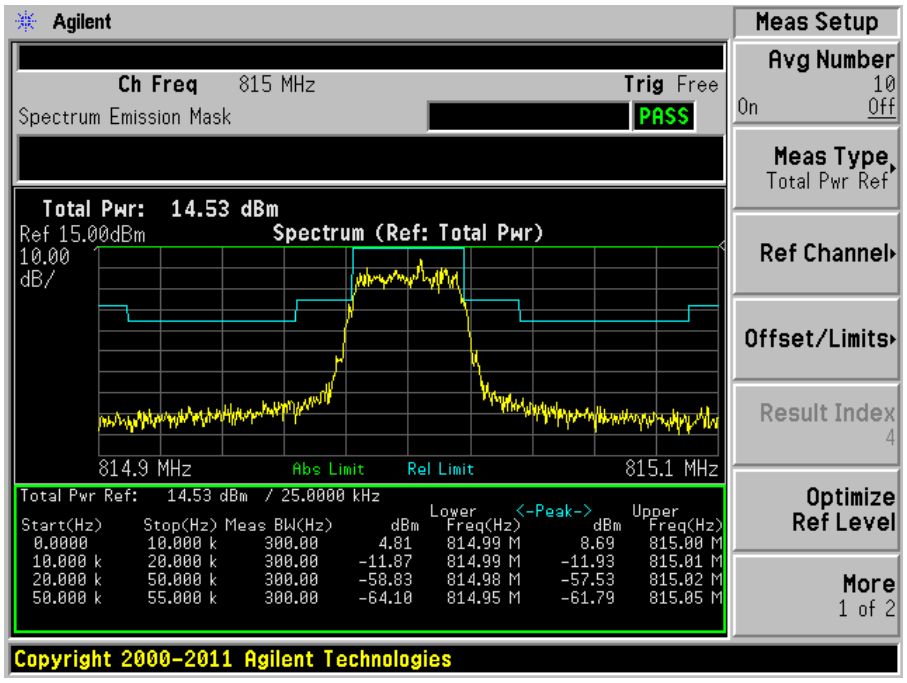


806-824 MHz, D-LMR

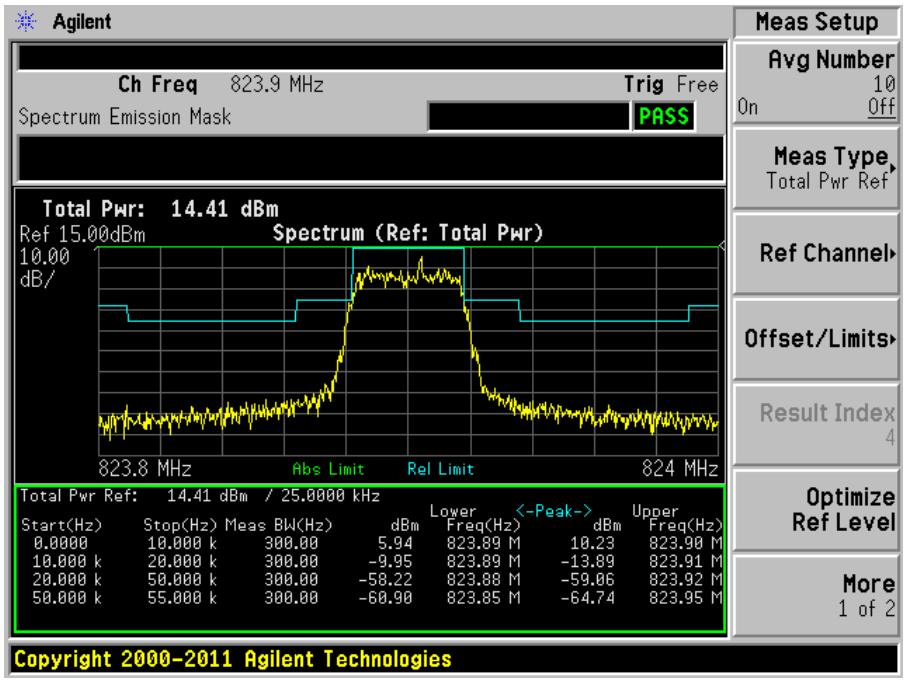
Low Channel – 806.1 MHz



Middle Channel – 815 MHz

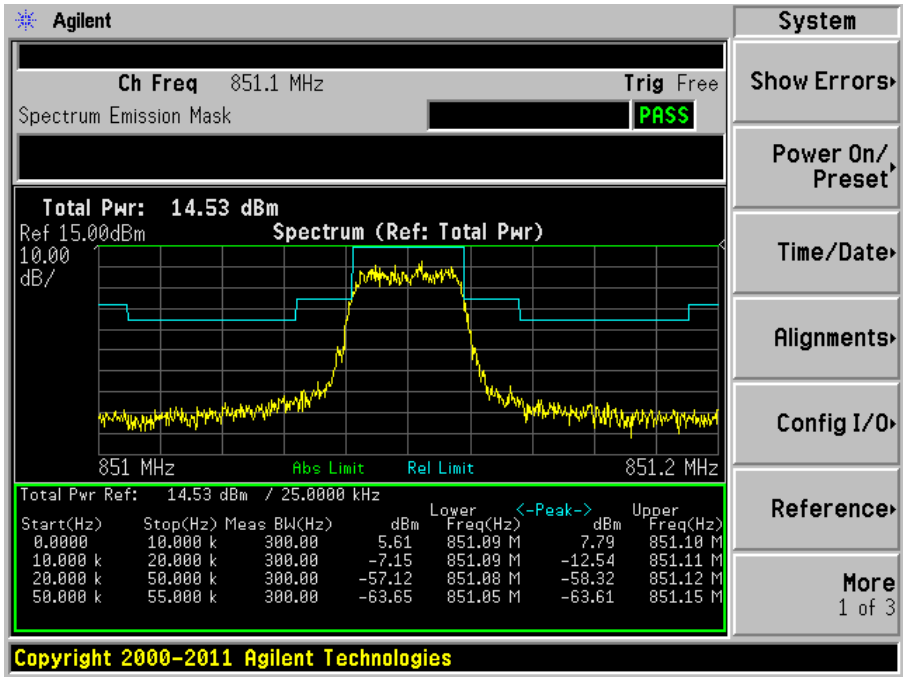


High Channel – 823.9 MHz

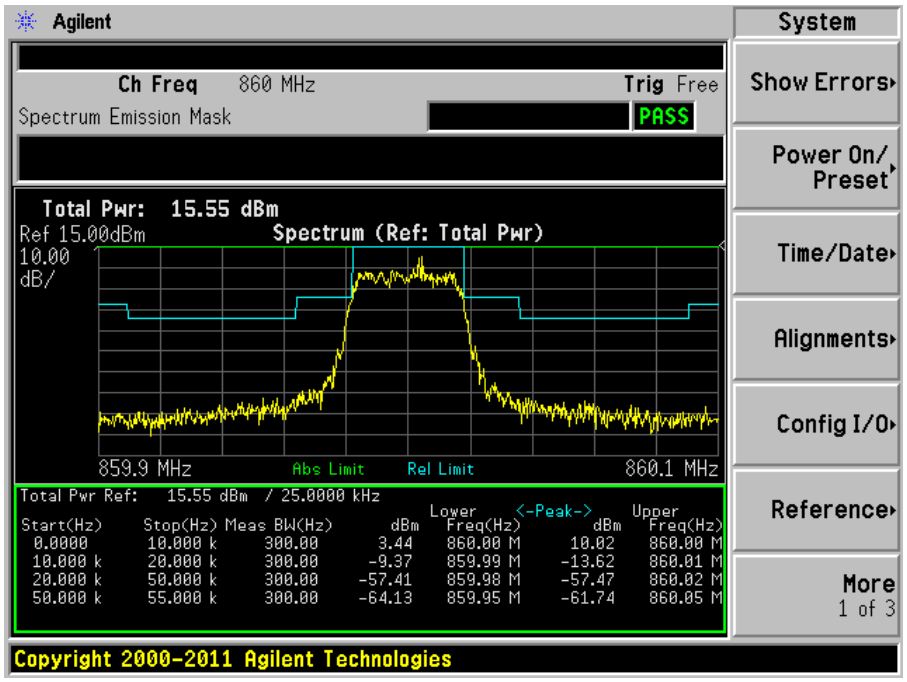


851-869 MHz, D-LMR

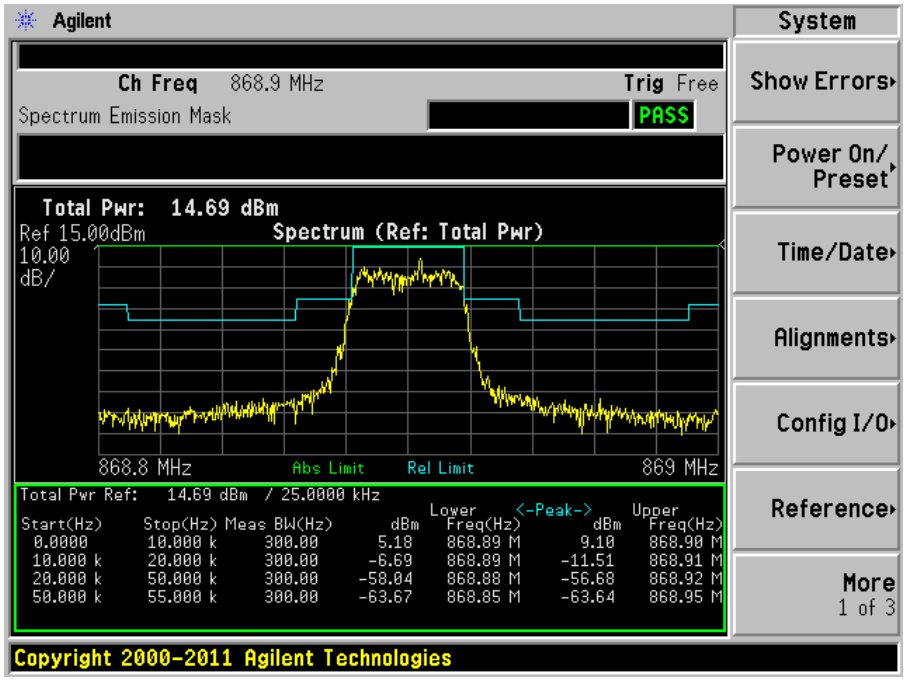
Low Channel – 851.1 MHz



Middle Channel – 860 MHz



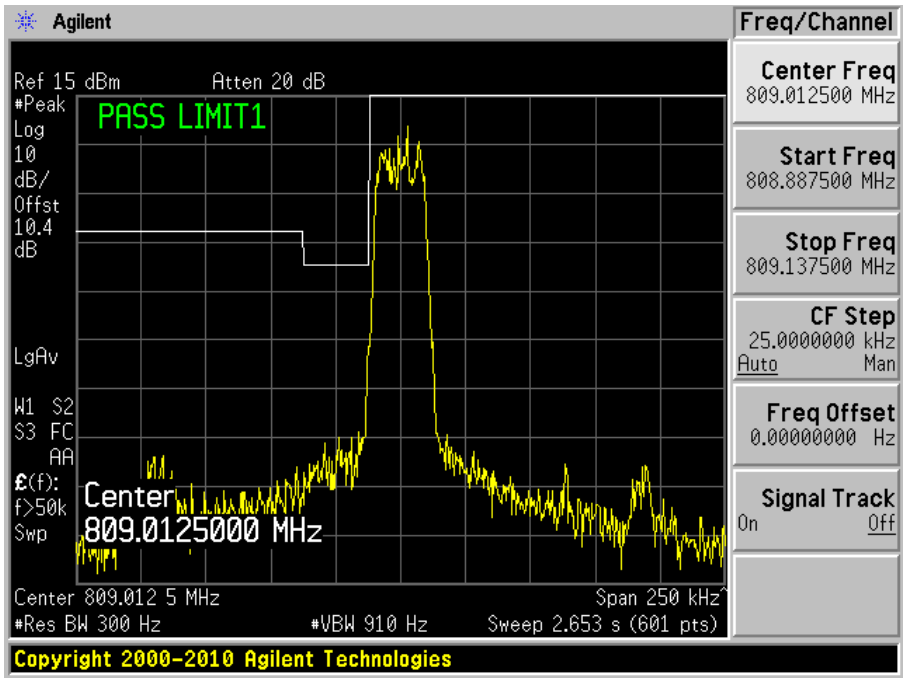
High Channel – 868.9 MHz



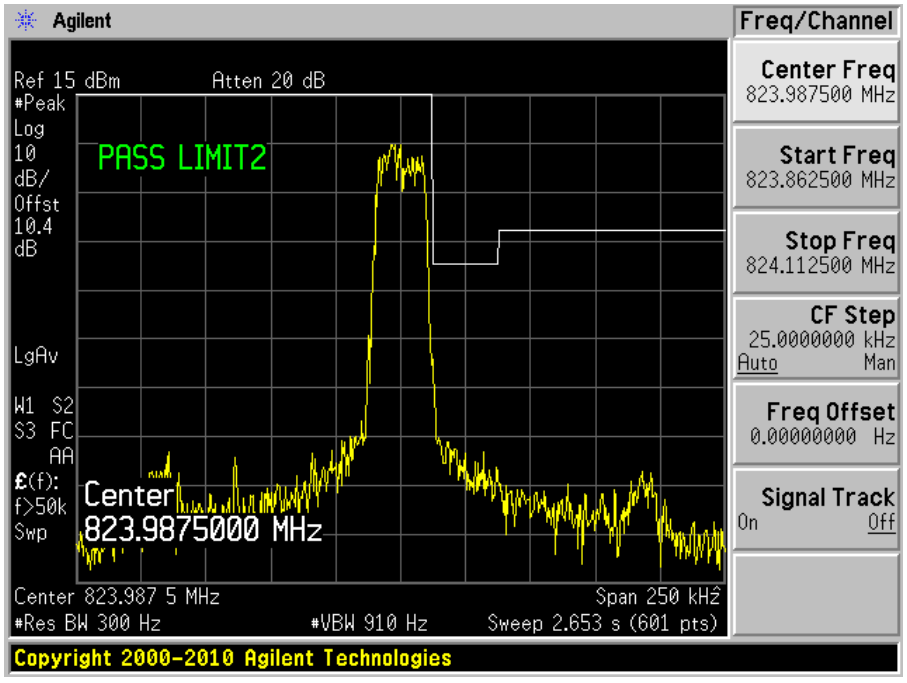
EA Mask (Low Power)

809-824 MHz, D-LMR

Low Channel – 809.0125 MHz

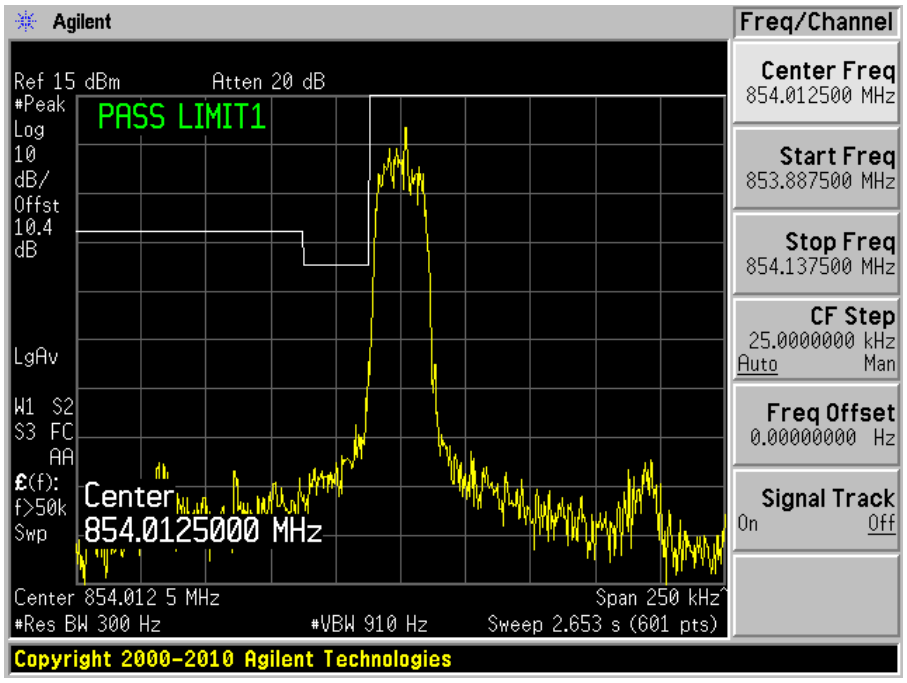


High Channel – 823.9875 MHz

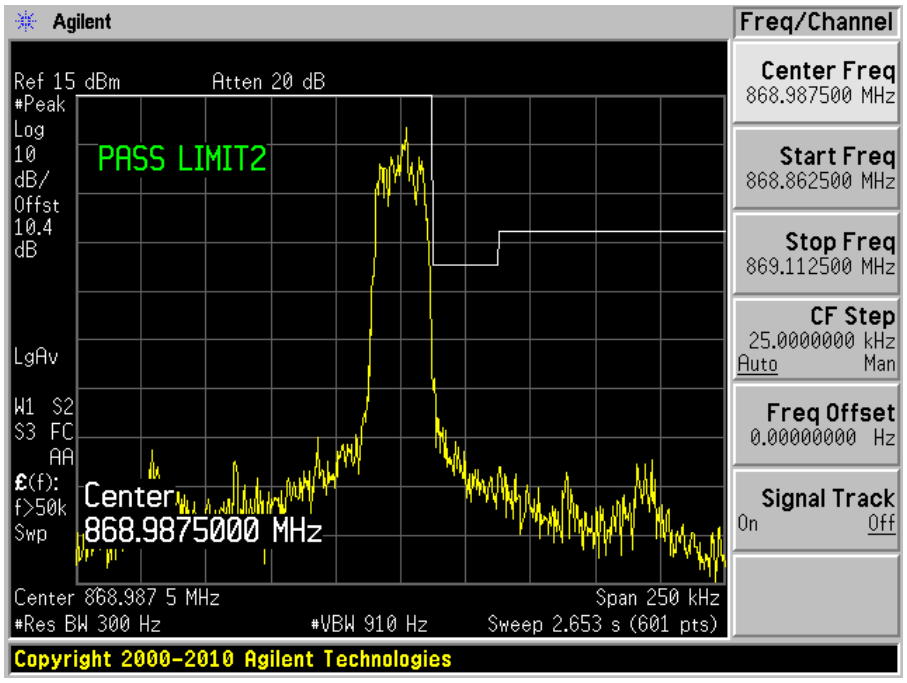


854-869 MHz, D-LMR

Low Channel – 854.0125 MHz

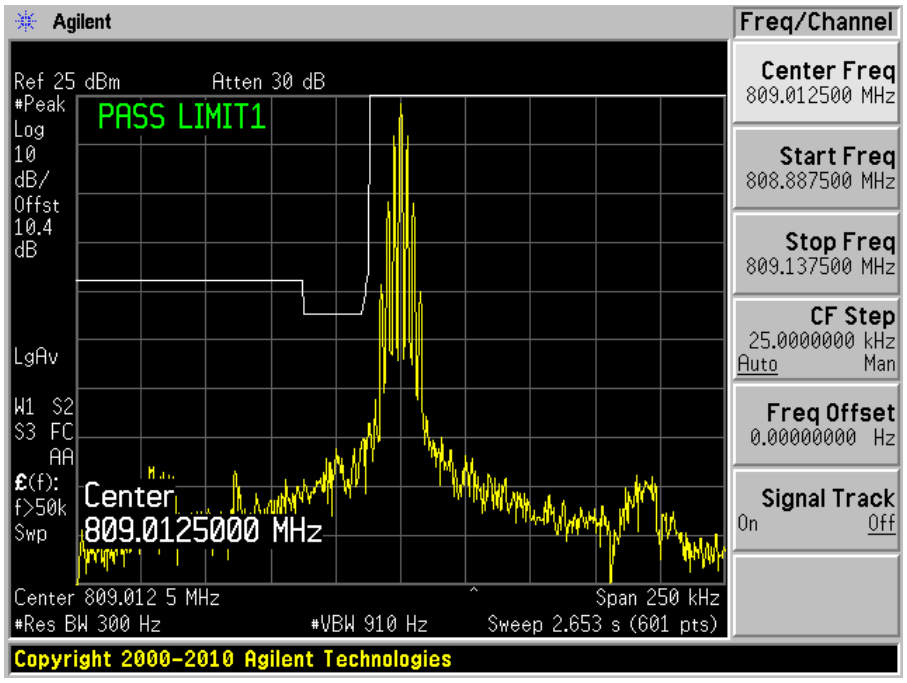


High Channel – 868.9875 MHz

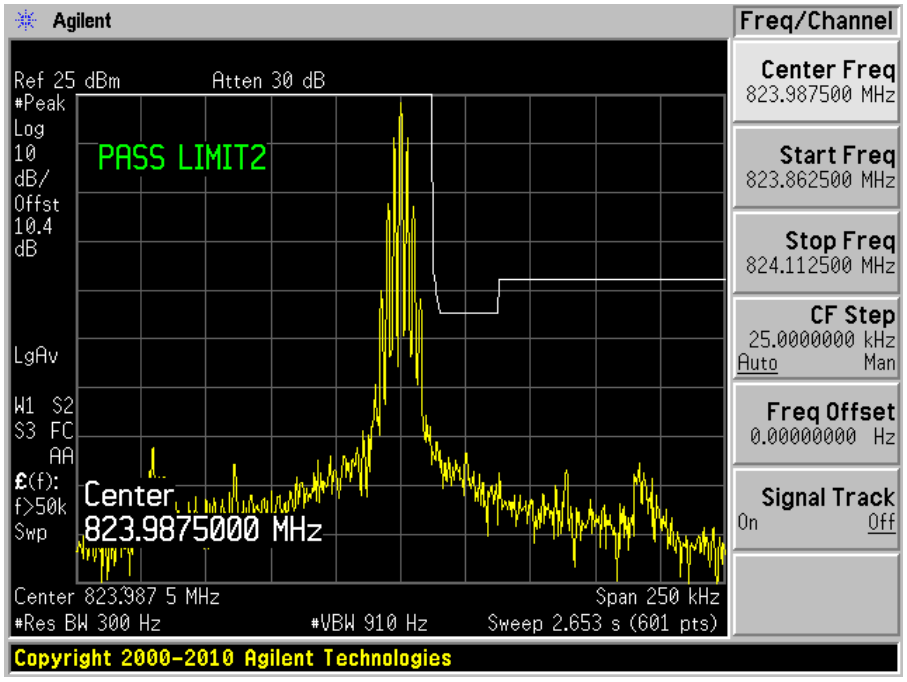


809-824 MHz, FM (20 kHz CS)

Low Channel – 809.0125 MHz

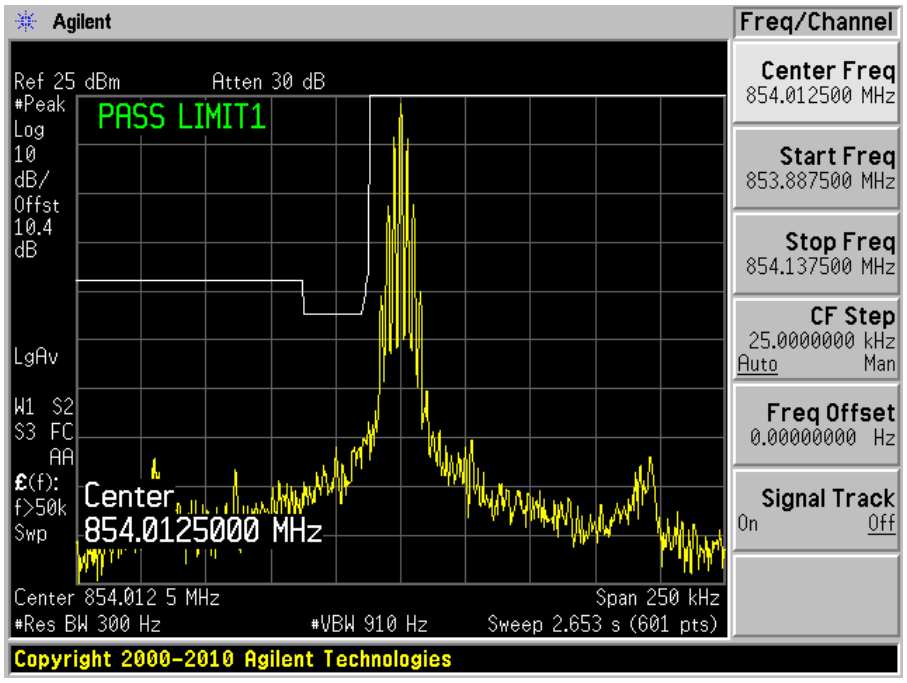


High Channel – 823.9875 MHz

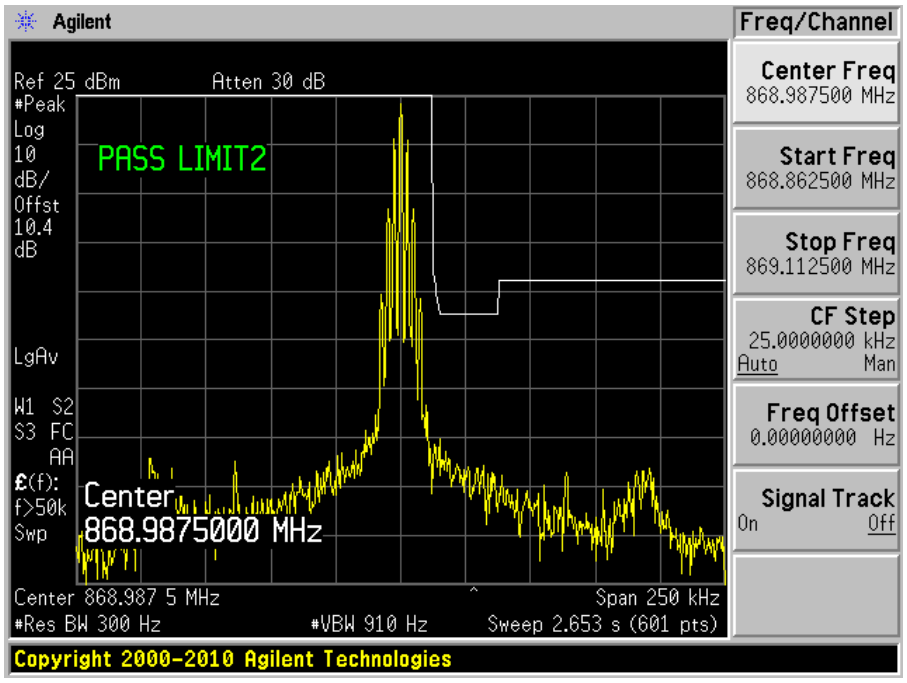


854-869 MHz, FM (20 kHz CS)

Low Channel – 854.0125 MHz

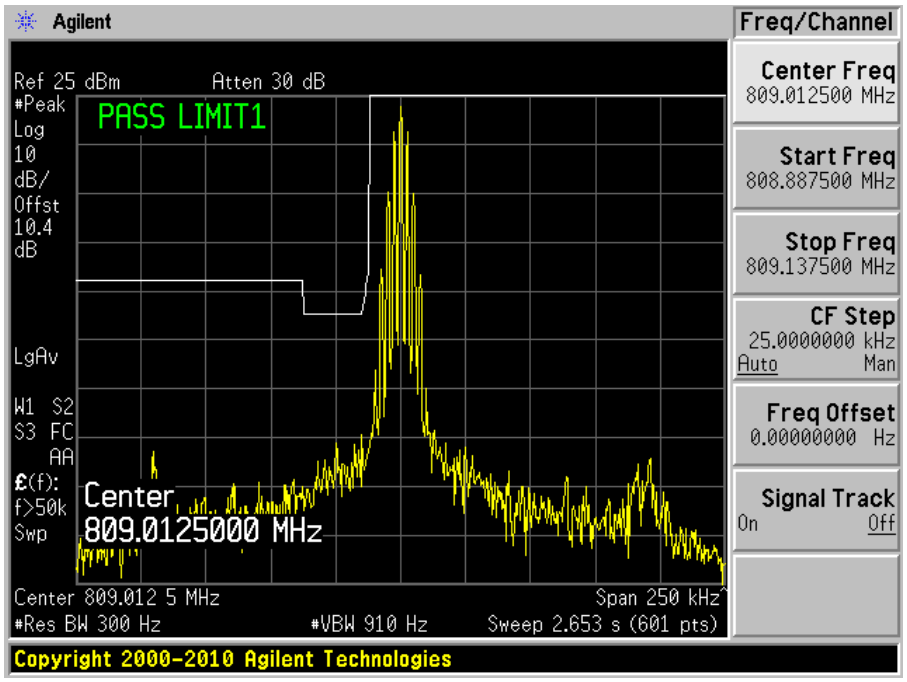


High Channel – 868.9875 MHz

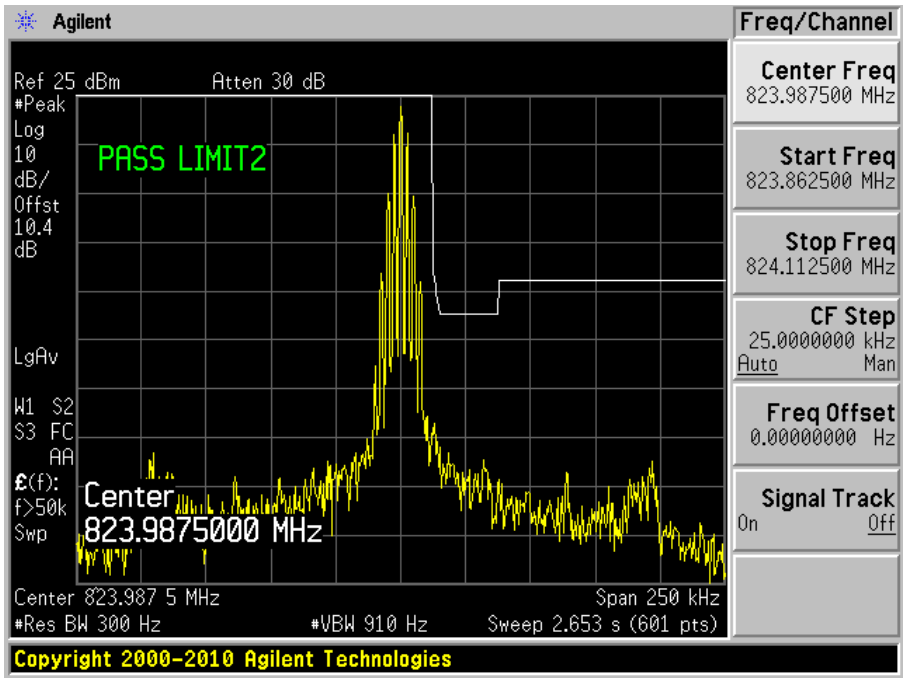


809-824 MHz, FM (25 kHz CS)

Low Channel – 809.0125 MHz

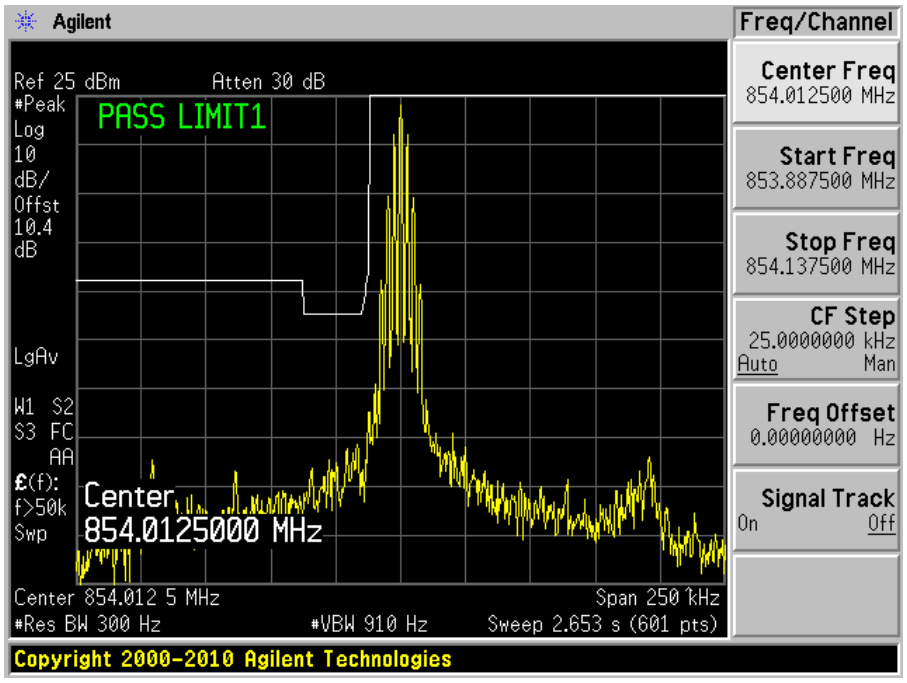


High Channel – 823.9875 MHz

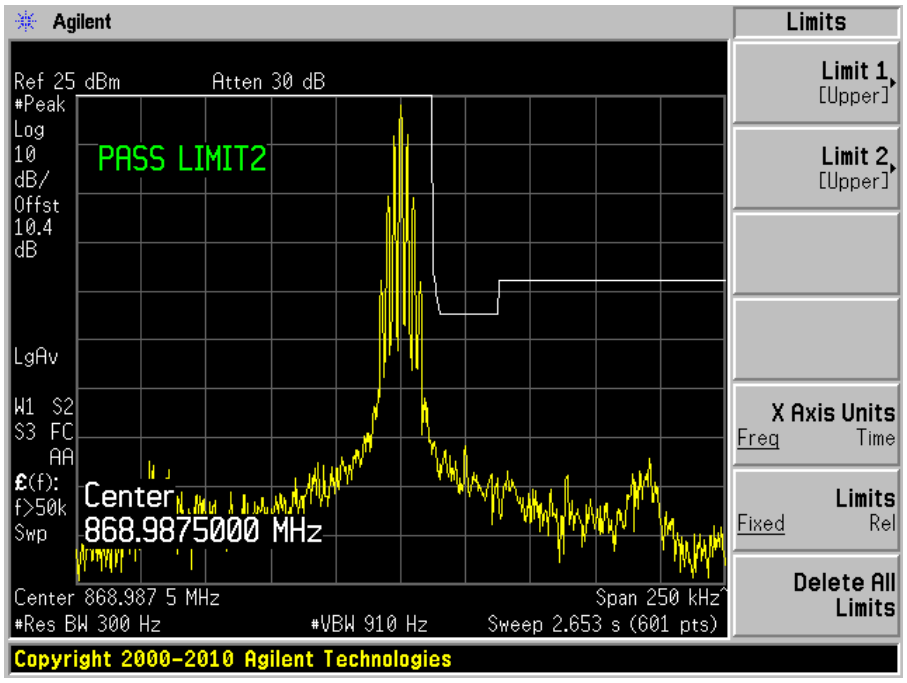


854-869 MHz, FM (25 kHz CS)

Low Channel – 854.0125 MHz



High Channel – 868.9875 MHz



8 FCC §2.1051, §90.210 & §90.221 - Spurious Emissions at Antenna Terminals

8.1 Applicable Standard

TETRA (809-824 MHz / 854-869 MHz):
According to FCC §90.221: (d) On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least 43 + 10 log (Pwatts) dB.

D-LMR & FM (Mask B, 806-824 MHz / 851-869 MHz):
According to FCC §90.210 (b) (3): On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (Pwatts) dB.

D-LMR & C4FM (769-775 MHz / 799-805 MHz):
According to FCC §90.543 (c): *Out-of-band emission limit*. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10 log (Pwatts) dB measured in a 100 KHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

8.2 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 for frequencies below 1 GHz and at 1 MHz for frequencies above 1 GHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic

8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 Year

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:	18.9 °C
Relative Humidity:	53 %
ATM Pressure:	101.1 kPa

The testing was performed by Lionel Lara on 2013-02-16 in the RF Site.

8.5 Test Results

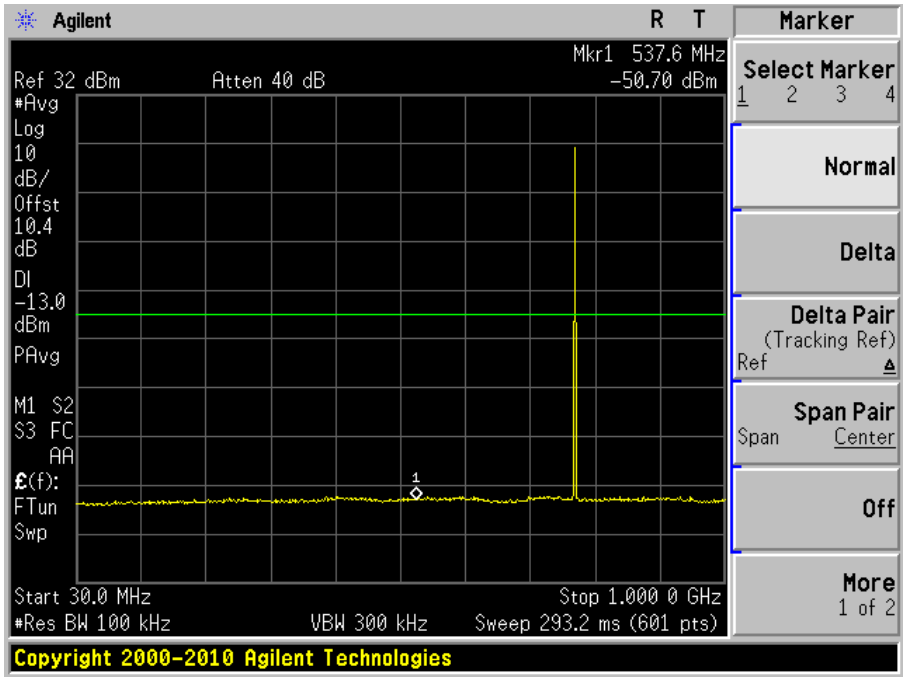
Please refer to the following plots.

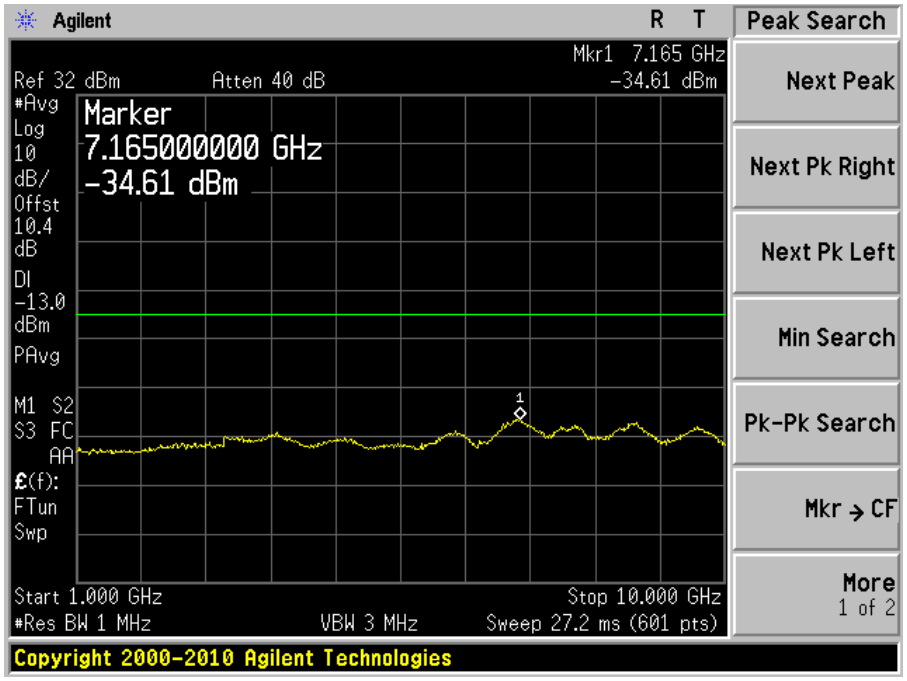
Note: Only the worst modulation was chosen between TETRA and D-LMR in each frequency band. Once the worst modulation was determined, then the worst channel was chosen for each modulation between TETRA/D-LMR, C4FM and FM in each frequency band.

High Power

769-775 MHz, D-LMR

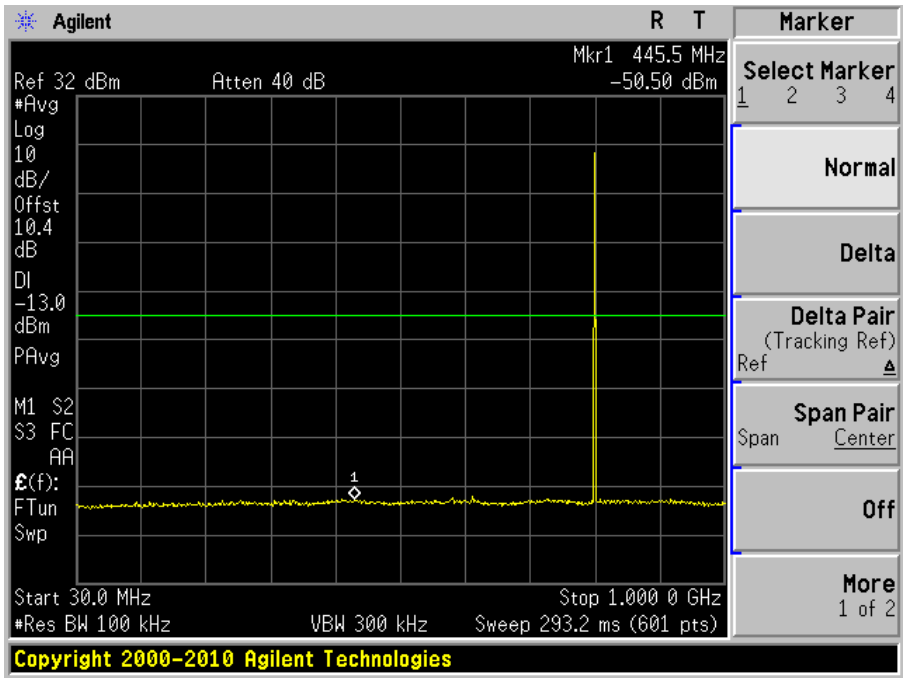
High Channel – 774.9 MHz

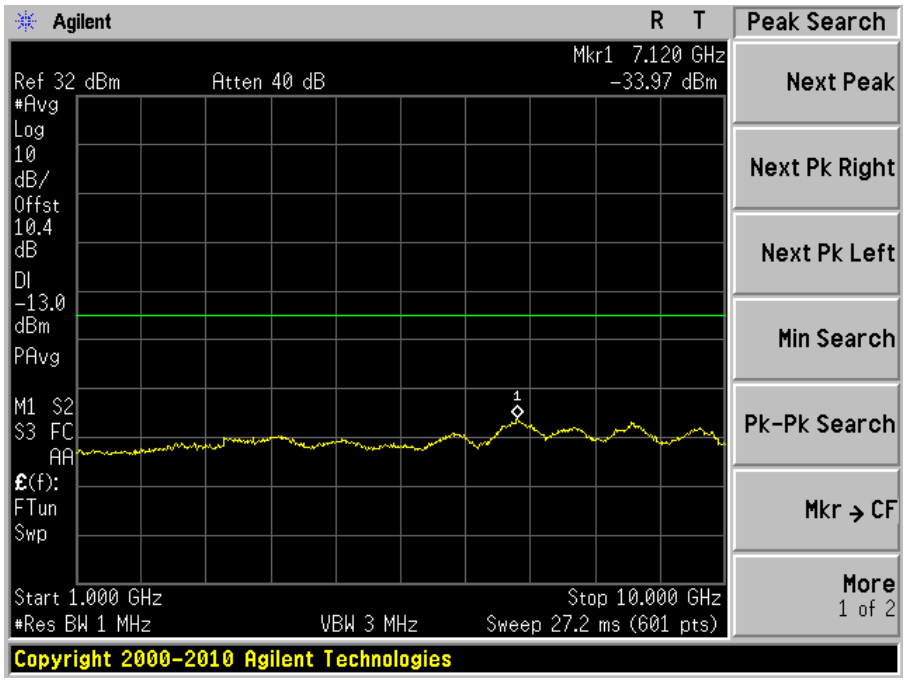




799-805 MHz, D-LMR

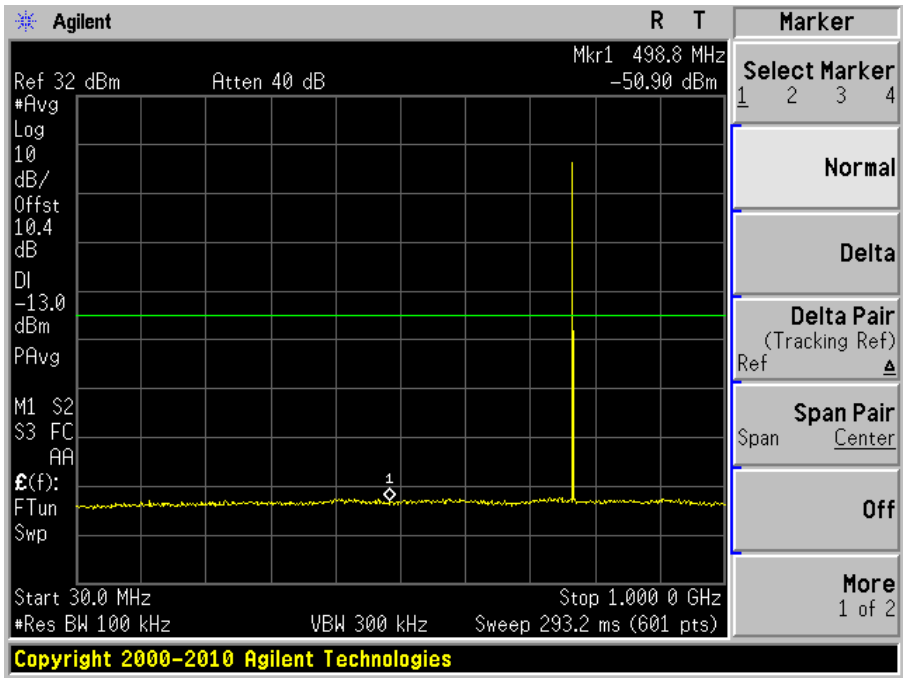
High Channel – 804.9 MHz

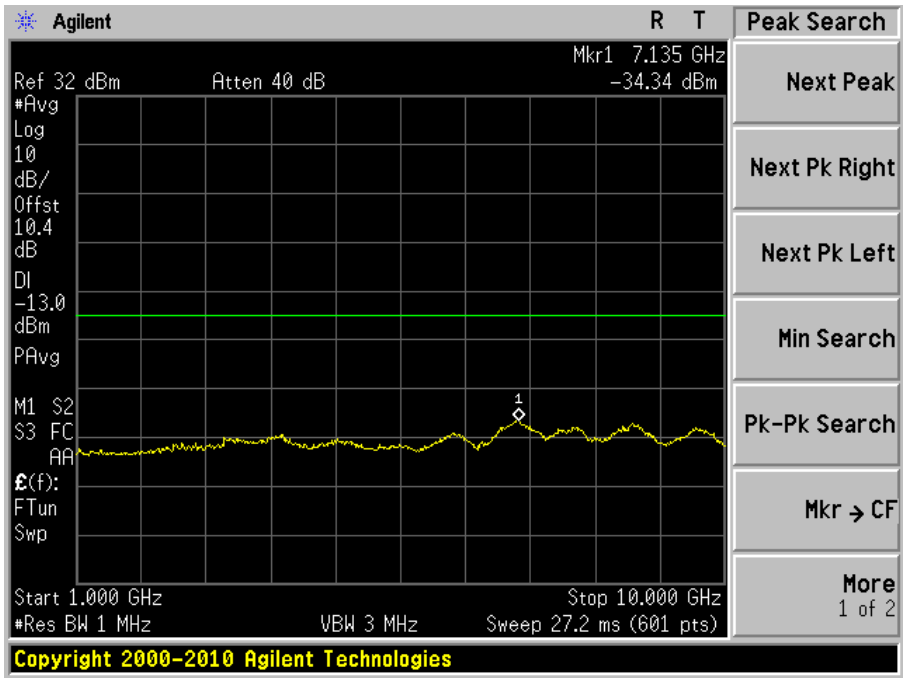




769-775 MHz, C4FM

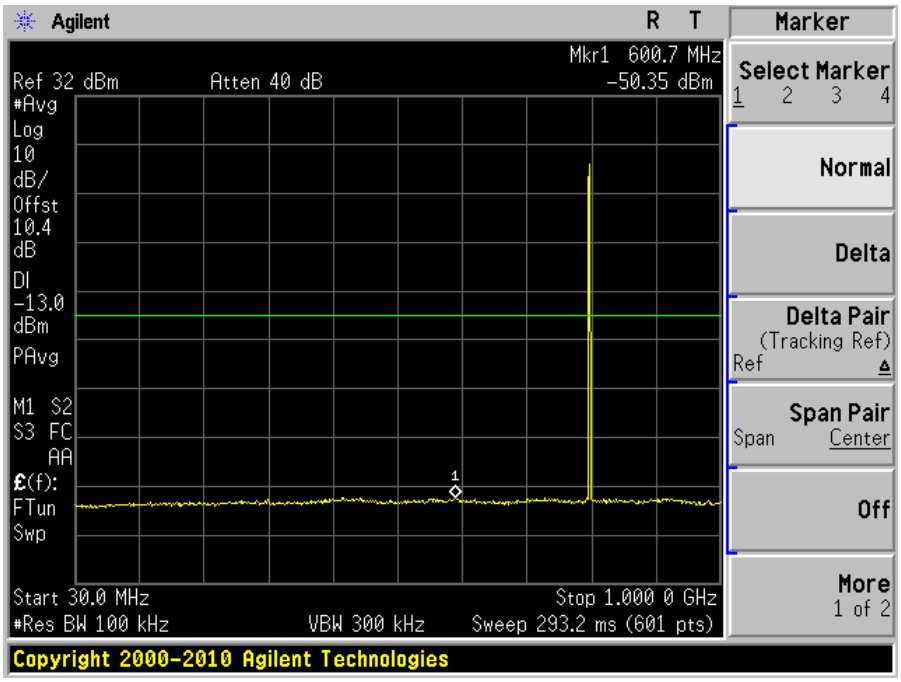
Middle Channel – 772 MHz

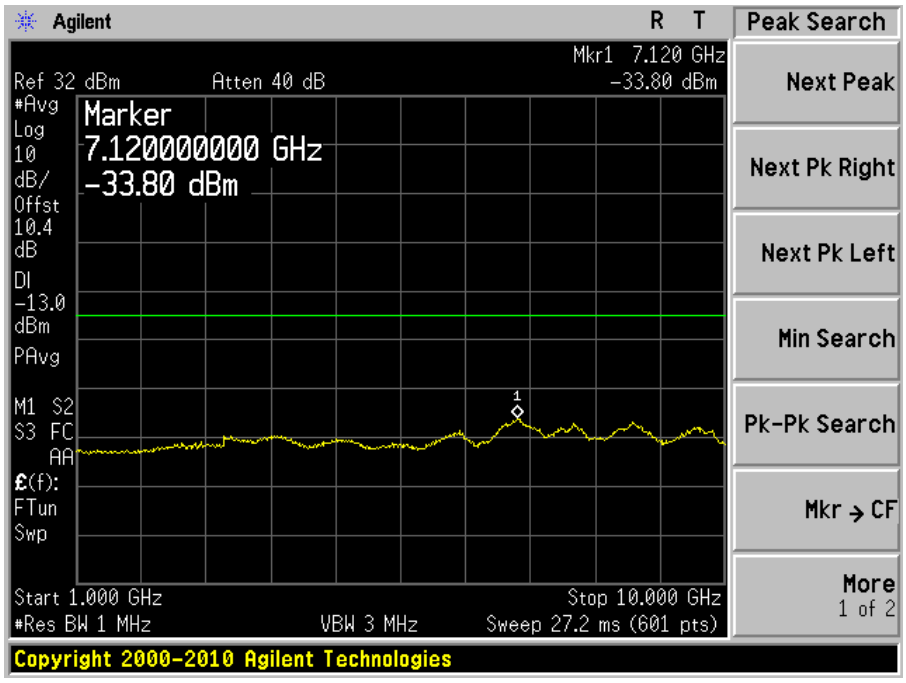




799-805 MHz, C4FM

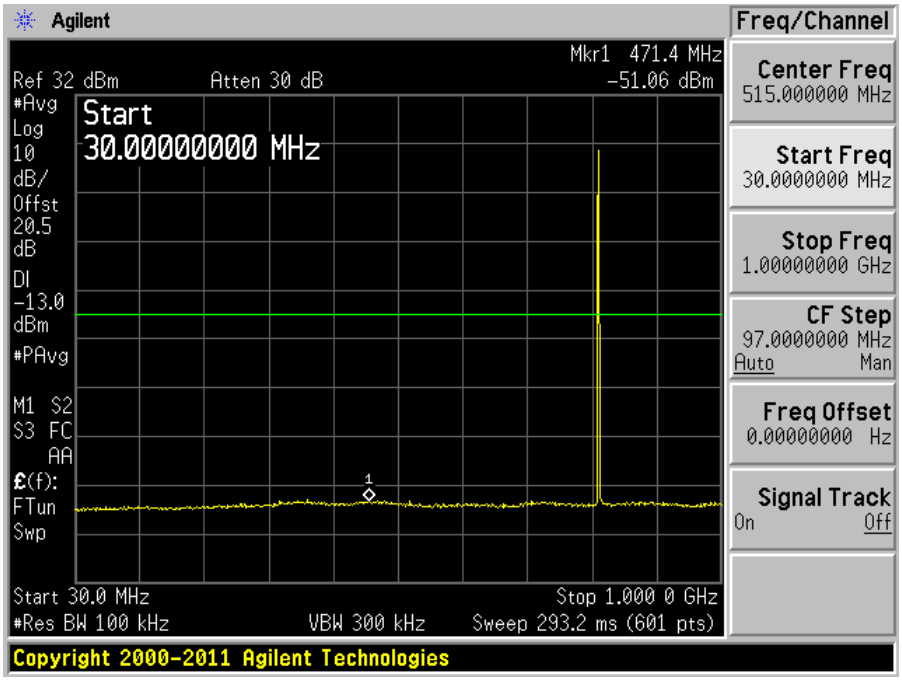
Middle Channel – 802 MHz

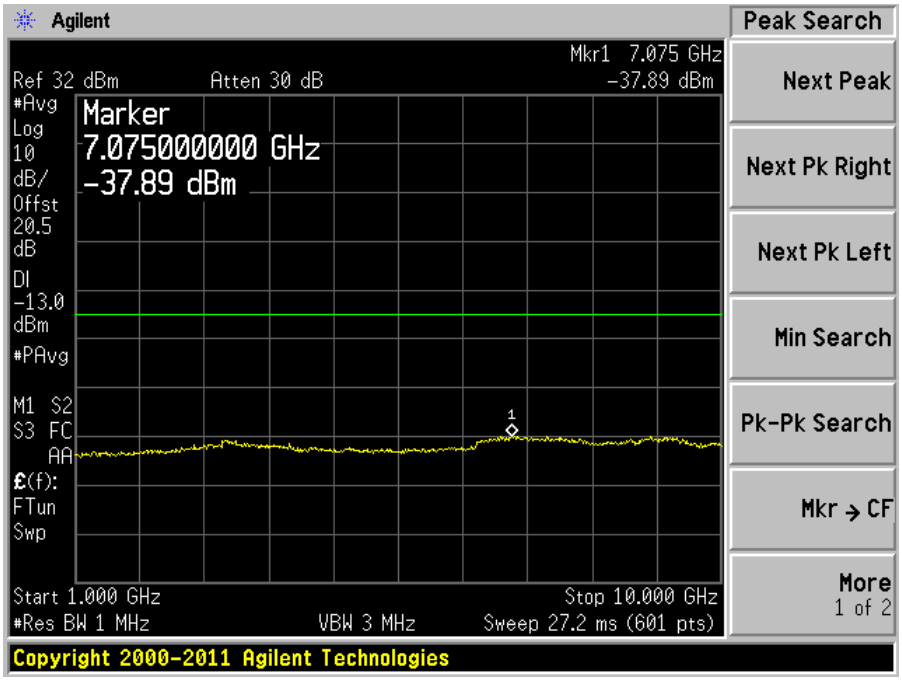




806-824 MHz, D-LMR

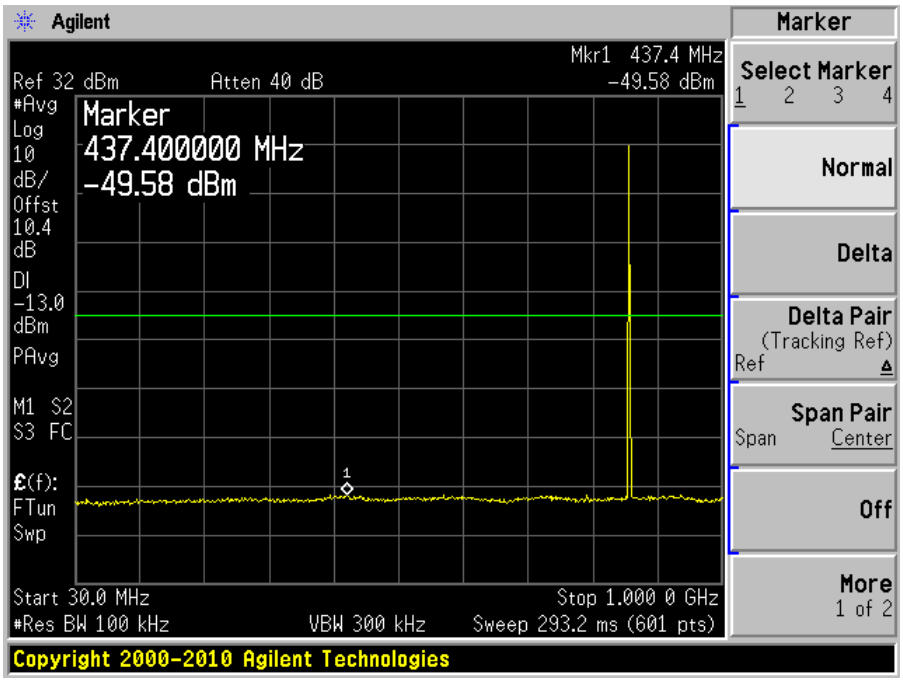
Middle Channel – 815 MHz

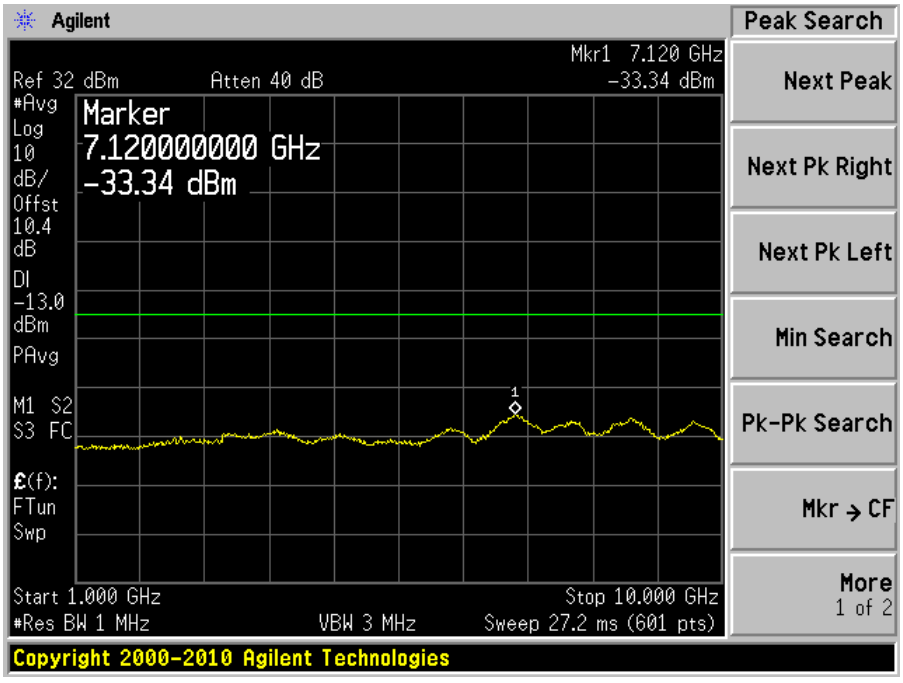




854-869 MHz, TETRA

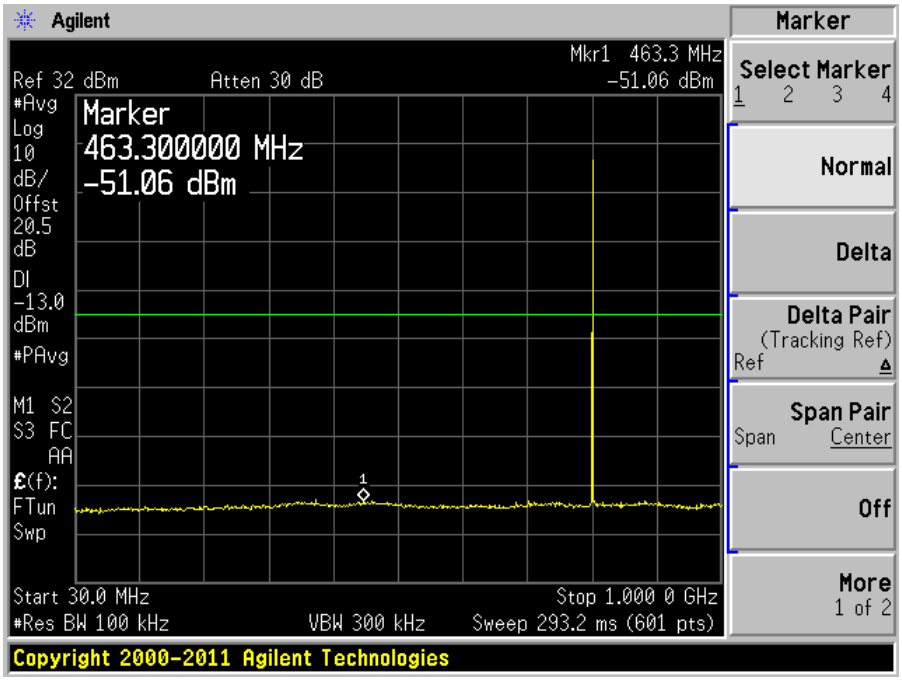
Middle Channel – 860 MHz

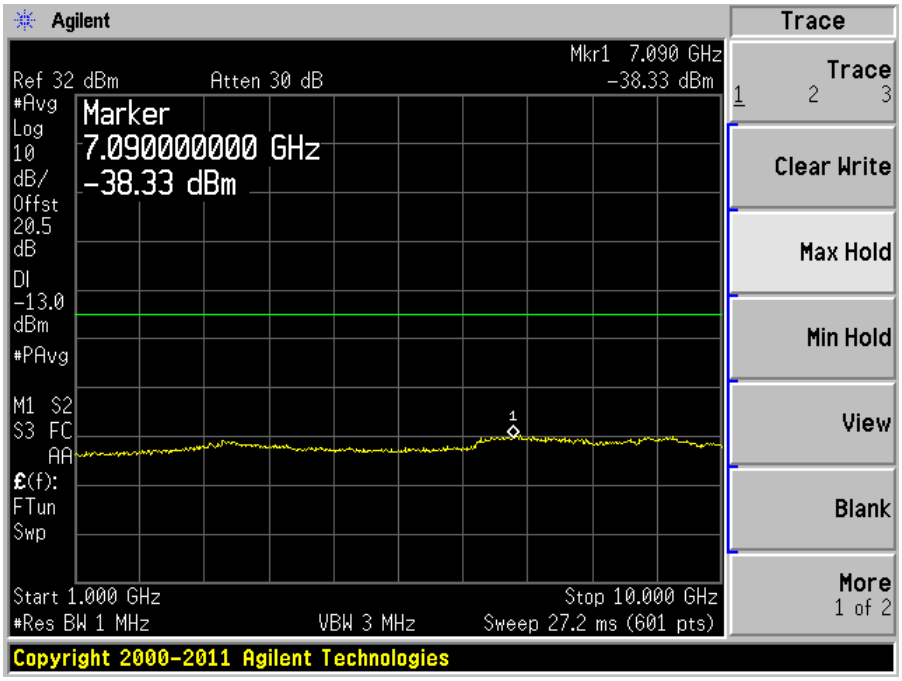




806-824 MHz, FM (20 kHz CS)

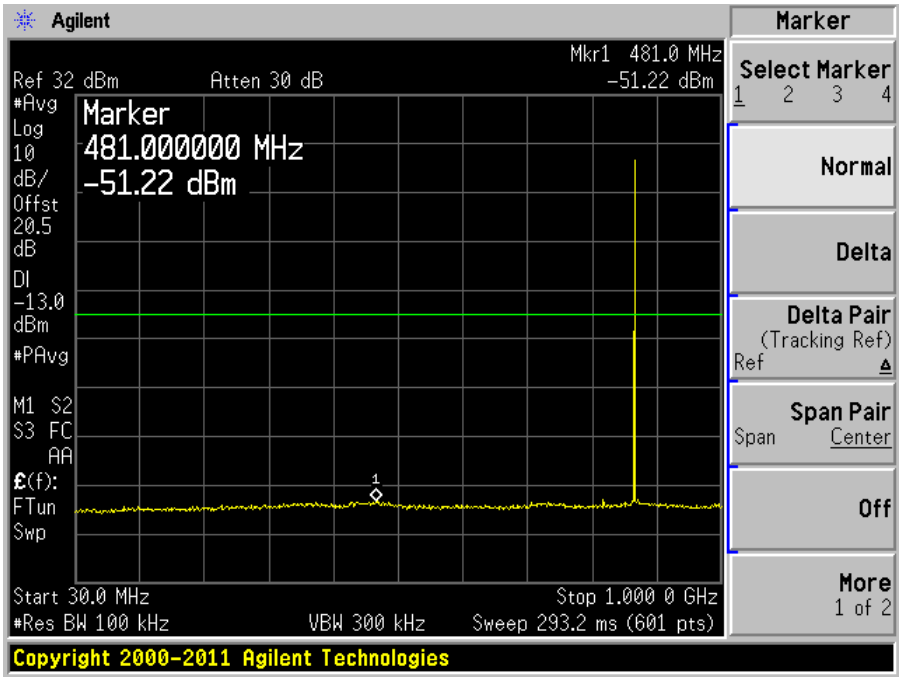
Low Channel – 806.1 MHz

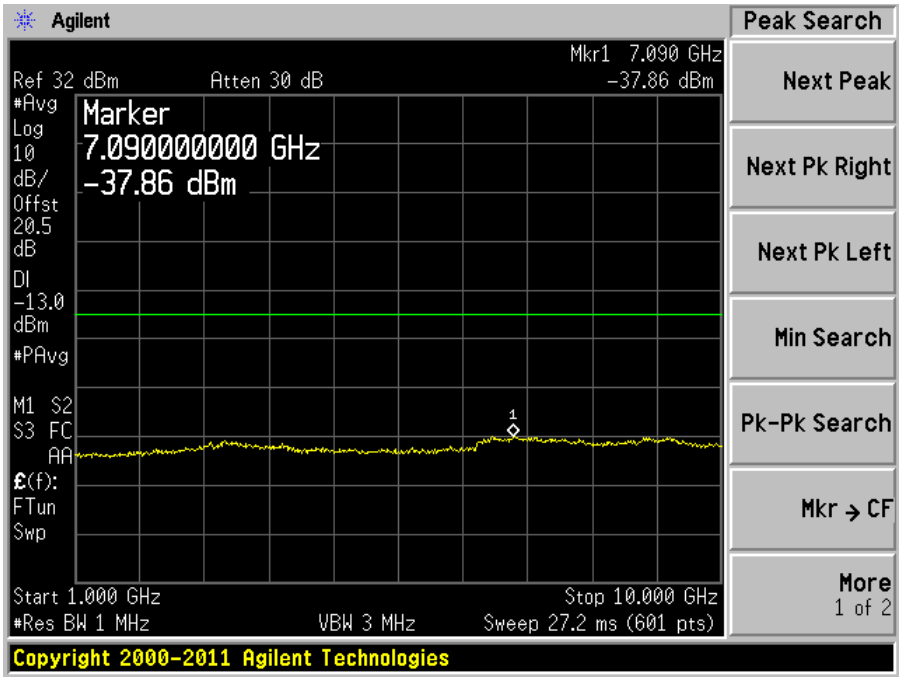




851-869 MHz, FM (25 kHz CS)

High Channel – 868.9 MHz





9 FCC §2.1055 (d), §90.213 &§90.539 - Frequency Stability

9.1 Applicable Standard

According to FCC §90.213: (a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	[1,2,3] 100	100	200
25-50	20	20	50
72-76	5		50
150-174	[5,11] 5	[6] 5	[4,6] 50
216-220	1.0		1.0
220-222 [12]	0.1	1.5	1.5
421-512	[7,11,14] 2.5	[8] 5	[8] 5
806-809	[14] 1.0	1.5	1.5
809-824	[14] 1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	[14] 0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928 [13]	2.5	2.5	2.5
929-930	1.5		
935-940	0.1	1.5	1.5
1427-1435	[9] 300	300	300
Above 2450 [10]			

14 Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

According to FCC §90.539 (c): The frequency stability of mobile, portable, and control transmitters operating in the narrowband segment must be 400 parts per billion or better when AFC is locked to the base station. When AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2 channel aggregate), and 2.5 ppm for 25 kHz (4 channel aggregate).

9.2 Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to the Spectrum Analyzer via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Spectrum Analyzer.

Frequency Stability vs. Voltage: An external variable DC power supply Source. The voltage was set to 115% and 85% of the nominal value. The output frequency was recorded for each voltage.

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 Year
Tenney	Temperature Chamber	TUJR	27445-06	2012-07-09	1 Year

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:	18.9 ºC
Relative Humidity:	53 %
ATM Pressure:	101.1 kPa

The testing was performed by Lionel Lara on 2013-02-16 in the RF Site.

9.5 Test Results

769-775 MHz

Test Environment		Channel Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
Supply Voltage (Vdc)	Temperature (°C)					
Frequency vs. Temperature						
13.2	-30	772	772.000117	117	0.15155	±1.5
	-20	772	772.000117	117	0.15155	±1.5
	-10	772	772.000117	117	0.15155	±1.5
	0	772	772.000117	117	0.15155	±1.5
	10	772	772.000100	100	0.12953	±1.5
	20	772	772.000100	100	0.12953	±1.5
	30	772	772.000100	100	0.12953	±1.5
	40	772	771.999900	-100	-0.129534	±1.5
	50	772	771.999900	-100	-0.129534	±1.5
Frequency vs. Voltage						
15.18	20	772	771.999967	-33	-0.042746	±1.5
11.22	20	772	772.000083	83	0.10751	±1.5

799-805 MHz

Test Environment		Channel Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
Supply Voltage (Vdc)	Temperature (°C)					
Frequency vs. Temperature						
13.2	-30	802	802.000100	100	0.12469	±1.5
	-20	802	802.000117	117	0.14589	±1.5
	-10	802	802.000100	100	0.12469	±1.5
	0	802	802.000133	133	0.16584	±1.5
	10	802	802.000067	67	0.08354	±1.5
	20	802	801.999950	-50	-0.062344	±1.5
	30	802	801.999950	-50	-0.062344	±1.5
	40	802	801.999950	-50	-0.062344	±1.5
	50	802	801.999917	-83	-0.103491	±1.5
Frequency vs. Voltage						
15.18	20	802	801.999950	-50	-0.062344	±1.5
11.22	20	802	801.999967	-33	-0.041147	±1.5

806-824 MHz

Test Environment		Channel Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
Supply Voltage (Vdc)	Temperature (°C)					
Frequency vs. Temperature						
13.2	-30	815	815.000100	100	0.1227	±1.5
	-20	815	815.000100	100	0.1227	±1.5
	-10	815	815.000100	100	0.1227	±1.5
	0	815	815.000100	100	0.1227	±1.5
	10	815	814.999933	-67	-0.082209	±1.5
	20	815	814.999933	-67	-0.082209	±1.5
	30	815	814.999933	-67	-0.082209	±1.5
	40	815	814.999933	-67	-0.082209	±1.5
	50	815	814.999950	-50	-0.06135	±1.5
Frequency vs. Voltage						
15.18	20	815	814.999983	-17	-0.020859	±1.5
11.22	20	815	814.999967	-33	-0.040491	±1.5

851-869 MHz

Test Environment		Channel Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
Supply Voltage (Vdc)	Temperature (°C)					
Frequency vs. Temperature						
13.2	-30	860	860.000117	117	0.13605	±1.5
	-20	860	860.000117	117	0.13605	±1.5
	-10	860	860.000100	100	0.11628	±1.5
	0	860	860.000083	83	0.09651	±1.5
	10	860	860.000033	33	0.03837	±1.5
	20	860	859.999917	-83	-0.096512	±1.5
	30	860	859.999950	-50	-0.05814	±1.5
	40	860	859.999967	-33	-0.038372	±1.5
	50	860	859.999983	-17	-0.019767	±1.5
Frequency vs. Voltage						
15.18	20	860	859.999900	-100	-0.116279	±1.5
11.22	20	860	859.999900	-100	-0.116279	±1.5

10 FCC §2.1053, §90.221, §90.210 & §90.543 – Field Strength of Spurious Radiation

10.1 Applicable Standard

TETRA (809-824 MHz / 854-869 MHz):
According to FCC §90.221 (d): On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least 43 + 10 log (Pwatts) dB.

D-LMR & FM (Mask B, 806-824 MHz / 851-869 MHz):
According to FCC §90.210 (b) (3): On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (Pwatts) dB.

D-LMR & C4FM (769-775 MHz / 799-805 MHz):
According to FCC §90.543 (c): *Out-of-band emission limit*. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10 log (Pwatts) dB measured in a 100 KHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

According to FCC §90.543 (f):
For operations in the 763-775 MHz and 793-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

10.2 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

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 Year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	-
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2012-08-15	1 Year
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 Year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2012-06-09	1 Year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1 Year
Eaton	Horn antenna	96001	Mar-07	2012-10-17	1 Year
Rohde & Schwarz	Signal Generator	SMIQ03	849192/0085 / DE23746	2012-04-23	2 Years

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:	19 °C
Relative Humidity:	42 %
ATM Pressure:	101.4 kPa

The testing was performed by Lionel Lara on 2013-02-22 in 5 meter chamber 3.

10.5 Test Results

According to the data hereinafter, the EUT complied with the FCC Pt 90 standard's radiated emissions limits, and had a worst case margin of:

Worst Margin: **-3.74 dB** at **1609.8 MHz** in the **Horizontal** polarization.

Please see following table for detailed results.

Note: Only the worst modulation was chosen between TETRA and D-LMR in each frequency band. Once the worst modulation was determined, then the worst channel was chosen for each modulation between TETRA/D-LMR, C4FM and FM in each frequency band.

769-775 MHz, D-LMR, High Power

High Channel – 774.9 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)		
1549.8	44.96	163	146	H	1549.8	-53.95	7.87	1.34	-47.42	-13	-34.42
1549.8	43.22	129	156	V	1549.8	-55.69	7.87	1.34	-49.16	-13	-36.16

799-805 MHz, DLMR, High Power

High Channel – 804.9 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)		
1609.8	47.72	166	132	H	1609.8	-50.9	8.5	1.34	-43.74	-40	-3.74
1609.8	45.26	130	144	V	1609.8	-53.36	8.5	1.34	-46.2	-40	-6.2

For emissions in the band 1559-1610 MHz the limit becomes -40 dBm according to §90.543 (f)

769-775 MHz, C4FM, High Power

Middle Channel – 772 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)		
1544	42.69	164	141	H	1544	-56.22	7.87	1.34	-49.69	-13	-36.69
1544	42.25	130	153	V	1544	-56.66	7.87	1.34	-50.13	-13	-37.13

799-805 MHz, C4FM, High Power

Middle Channel – 802 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)		
1604	47.7	166	137	H	1604	-50.92	8.5	1.34	-43.76	-40	-3.76
1604	45.65	129	148	V	1604	-52.97	8.5	1.34	-45.81	-40	-5.81

For emissions in the band 1559-1610 MHz the limit becomes -40 dBm according to §90.543 (f)

806-824 MHz, D-LMR, High Power

Middle Channel – 815 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)		
1630	48.58	171	135	H	1630	-49.92	8.5	1.34	-42.76	-13	-29.76
1630	45.21	142	141	V	1630	-53.29	8.5	1.34	-46.13	-13	-33.13

854-869 MHz, TETRA, High Power

Middle Channel – 860 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)		
1720	51.35	170	104	H	1720	-46.69	8.49	1.34	-39.54	-13	-26.54
1720	49.03	132	150	V	1720	-49.01	8.49	1.34	-41.86	-13	-28.86

806-824 MHz, FM (20 kHz CS), High Power

Low Channel – 806.1 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)		
1612.2	46.8	171	138	H	1612.2	-51.82	8.5	1.34	-44.66	-13	-31.66
1612.2	45.22	132	142	V	1612.2	-53.4	8.5	1.34	-46.24	-13	-33.24

851-869 MHz, FM (25 kHz CS), High Power

High Channel – 868.9 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)		
1737.8	49.44	173	175	H	1737.8	-48.6	8.49	1.34	-41.45	-13	-28.45
1737.8	48.29	132	151	V	1737.8	-49.75	8.49	1.34	-42.6	-13	-29.6

11 FCC §2.1049 §90.221 & §90.543 – Adjacent Channel Power

11.1 Applicable Standard

According to FCC §90.221: (a) For the frequency bands indicated below, operations using equipment designed to operate with a 25 kHz channel bandwidth may be authorized up to a 22 kHz bandwidth if the equipment meets the adjacent channel power (ACP) limits below. The table specifies a value for the ACP as a function of the displacement from the channel center frequency and a measurement bandwidth of 18 kHz.

(c)(1) Maximum adjacent power levels for frequencies in the 809-824/854-869 MHz band:

Frequency offset	Maximum ACP (dBc) for devices less than 15 watts	Maximum ACP (dBc) for devices 15 watts and above
25 kHz	−55 dBc	−55 dBc
50 kHz	−65 dBc	−65 dBc
75 kHz	−65 dBc	−70 dBc

(2) In any case, no requirement in excess of −36 dBm shall apply.

(d) On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least 43 + 10 log (Pwatts) dB.

According to FCC §90.543: Transmitters designed to operate in 769-775 MHz and 799-805 MHz frequency bands must meet the emission limitations in paragraphs (a) through (d) of this section. Transmitters operating in 763-768 MHz and 793-798 MHz bands must meet the emission limitations in (e) of this section.

(a) The adjacent channel power (ACP) requirements for transmitters designed for various channel sizes are shown in the following tables. Mobile station requirements apply to handheld, car mounted and control station units. The tables specify a value for the ACP as a function of the displacement from the channel center frequency and measurement bandwidth. In the following tables, “(s)” indicates a swept measurement may be used.

12.5 kHz Mobile Transmitter ACP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACP relative (dBc)
9.375	6.25	−40
15.625	6.25	−60
21.875	6.25	−60
37.50	25.00	−60
62.50	25.00	−65
87.50	25.00	−65
150.00	100	−65
250.00	100	−65
350.00	100	−65
>400 to 12 MHz	30 (s)	−75
12 MHz to paired receive band	30 (s)	−75
In the paired receive band	30 (s)	−100

25 kHz Mobile Transmitter ACP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACP relative (dBc)
15.625	6.25	−40
21.875	6.25	−60
37.50	25	−60
62.50	25	−65
87.50	25	−65
150.00	100	−65
250.00	100	−65
350.00	100	−65
>400 kHz to 12 MHz	30 (s)	−75
12 MHz to paired receive band	30 (s)	−75
In the paired receive band	30 (s)	−100

11.2 Test Procedure

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

11.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16

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

11.4 Test Environmental Conditions

Temperature:	19.4ºC
Relative Humidity:	50%
ATM Pressure:	101.2 kPa

The testing was performed by Lionel Lara on 2013-02-21 at the RF site.

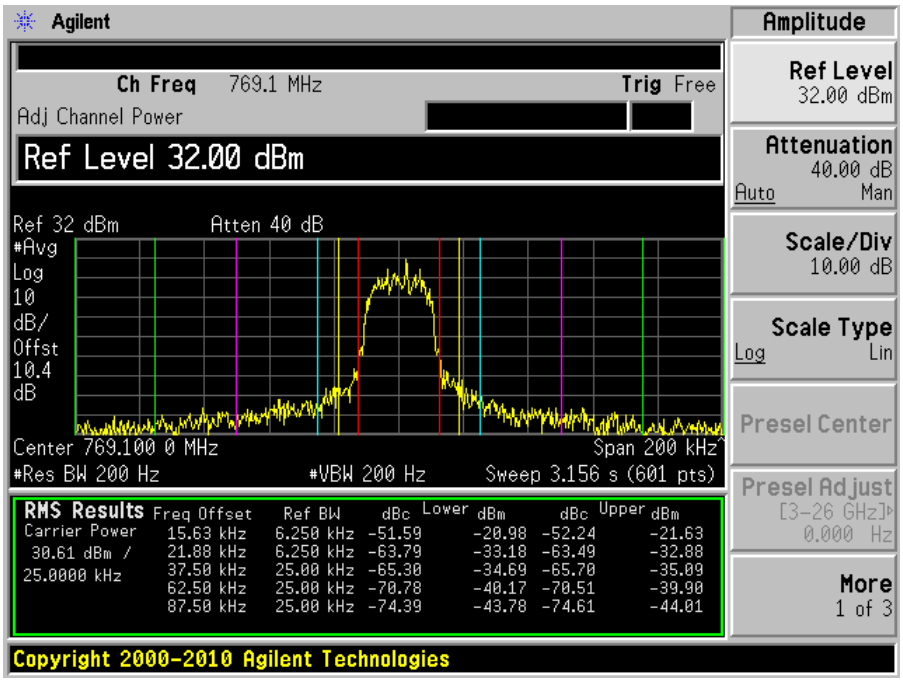
11.5 Test Results

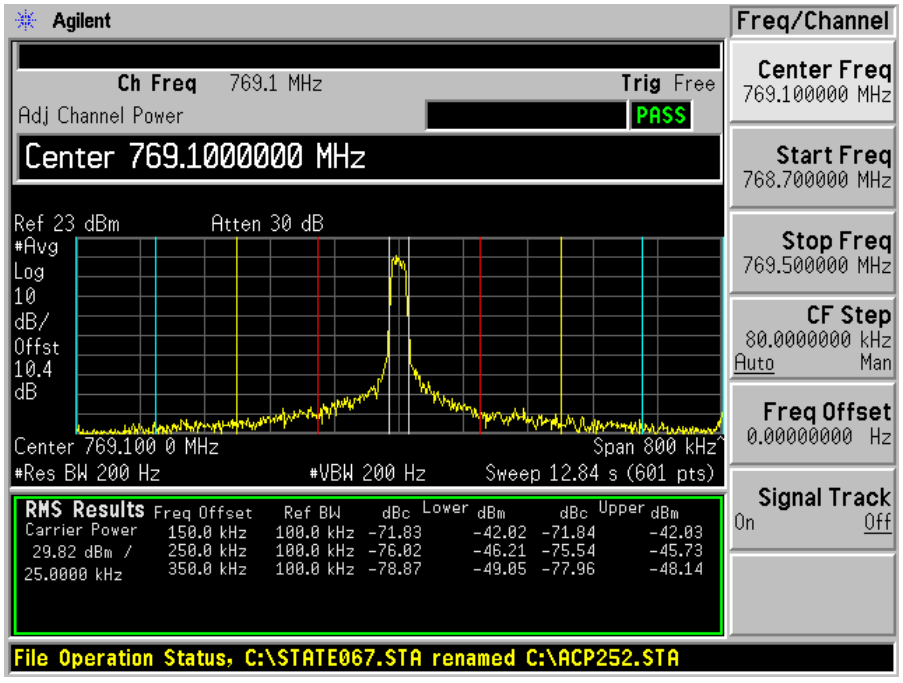
Please refer to the following plots.

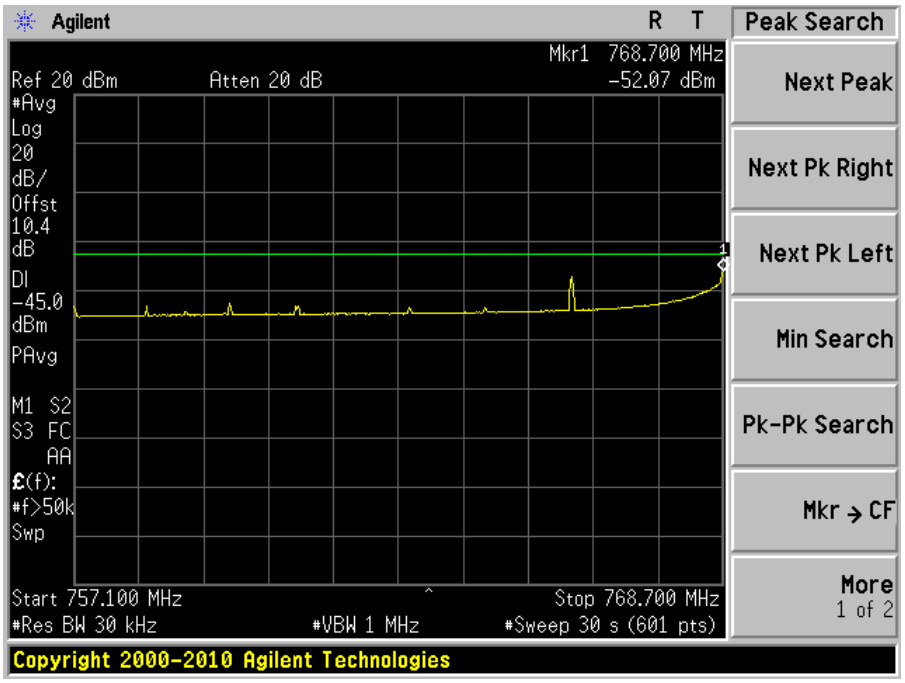
ACP (High Power)

769-775 MHz, D-LMR

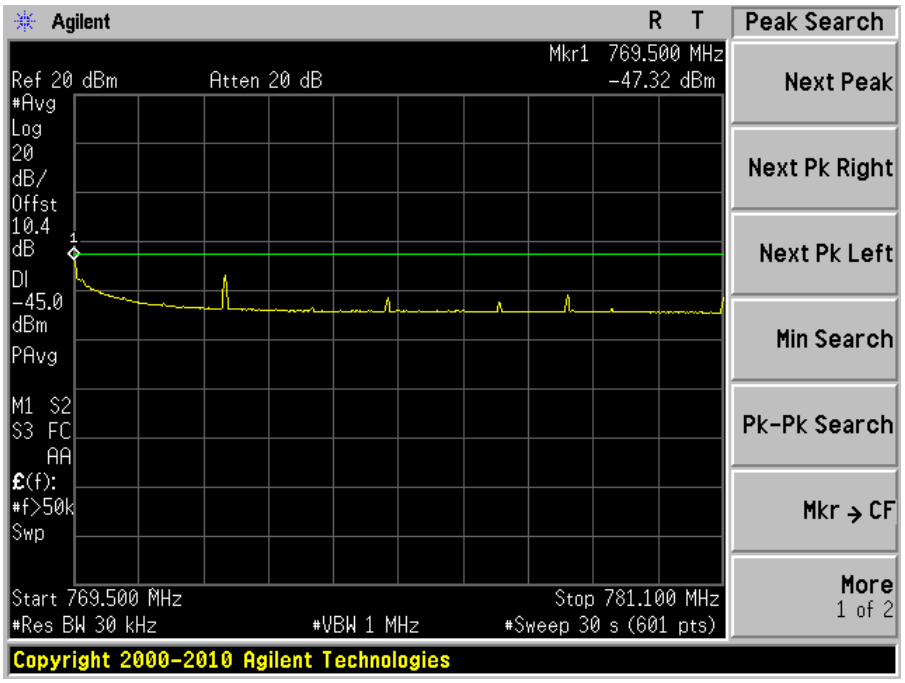
Low Channel – 769.1 MHz



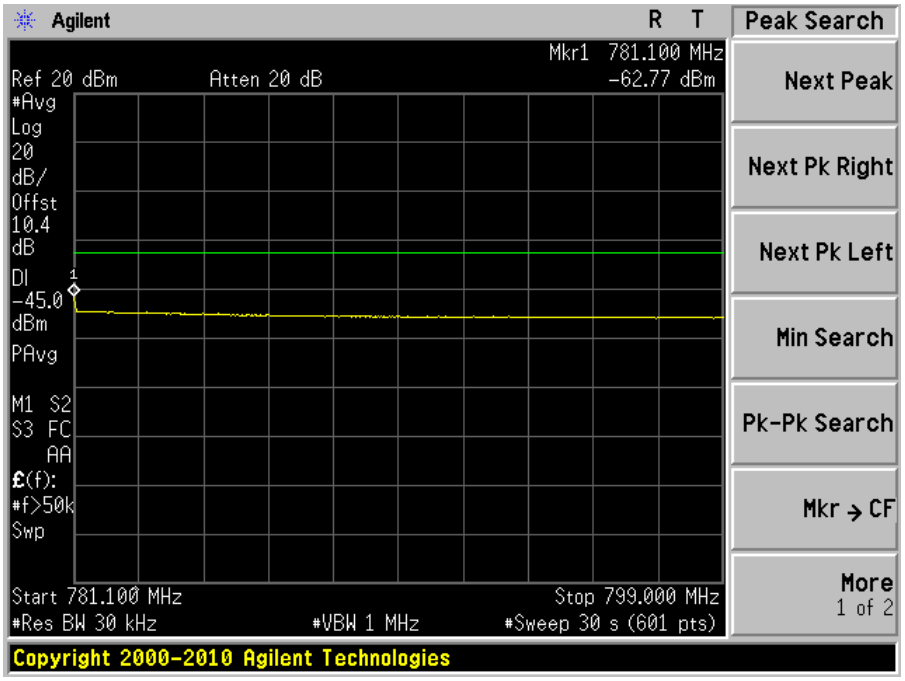




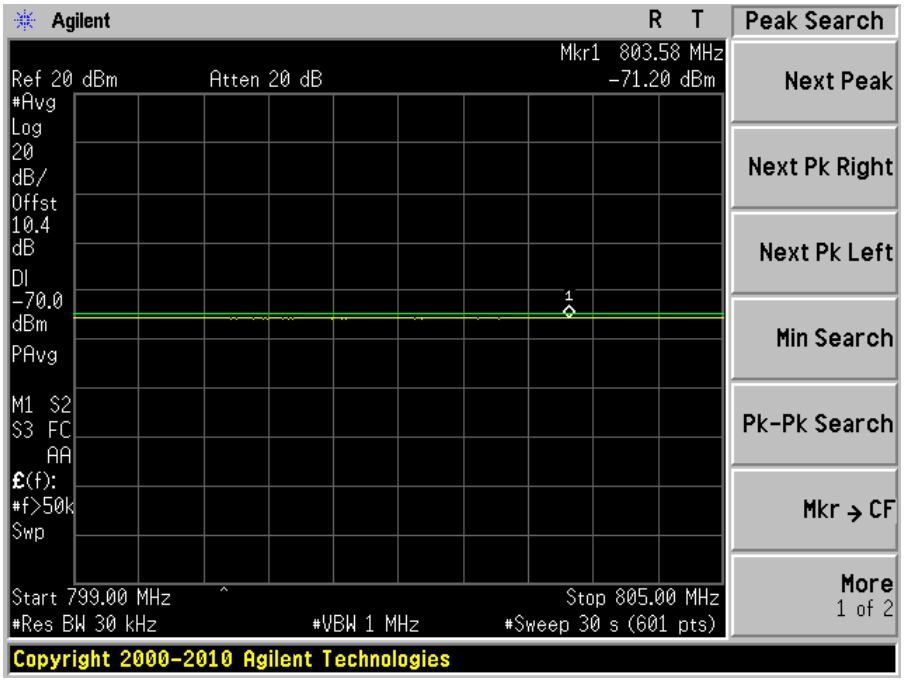
-12MHz to -400kHz



+400kHz to +12MHz

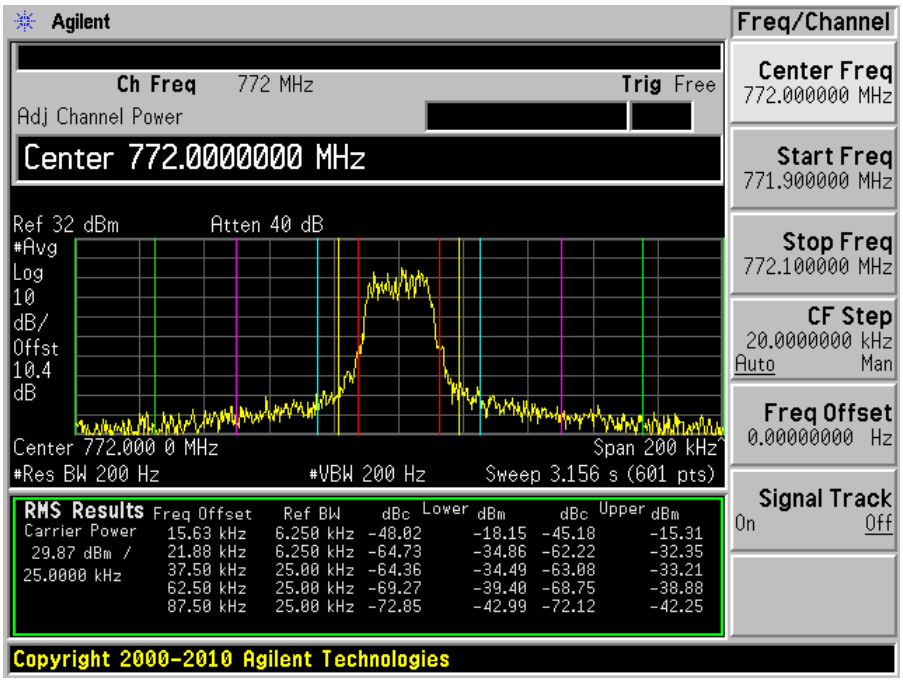


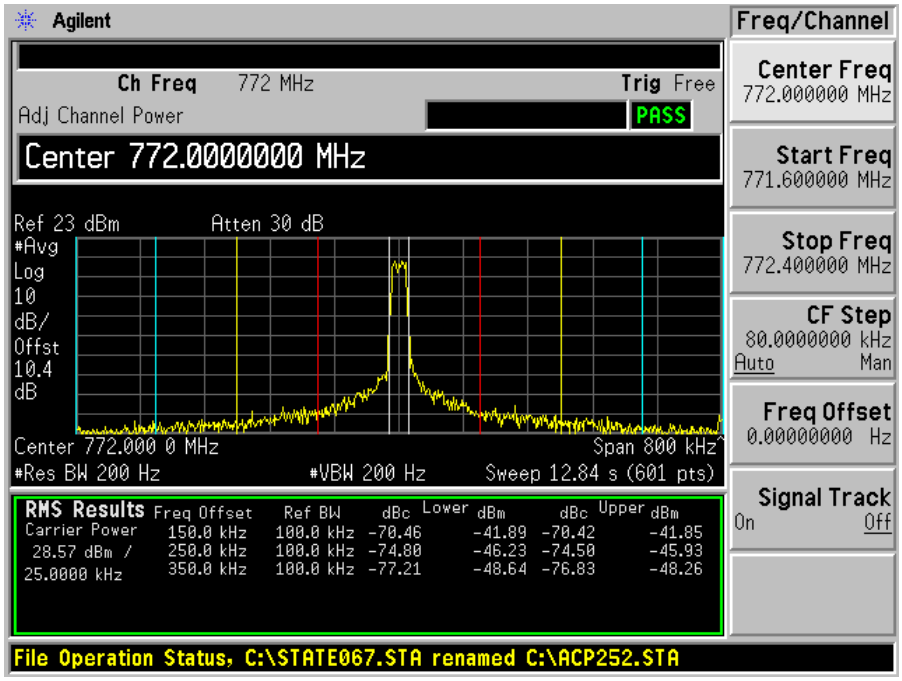
+12MHz to receive band

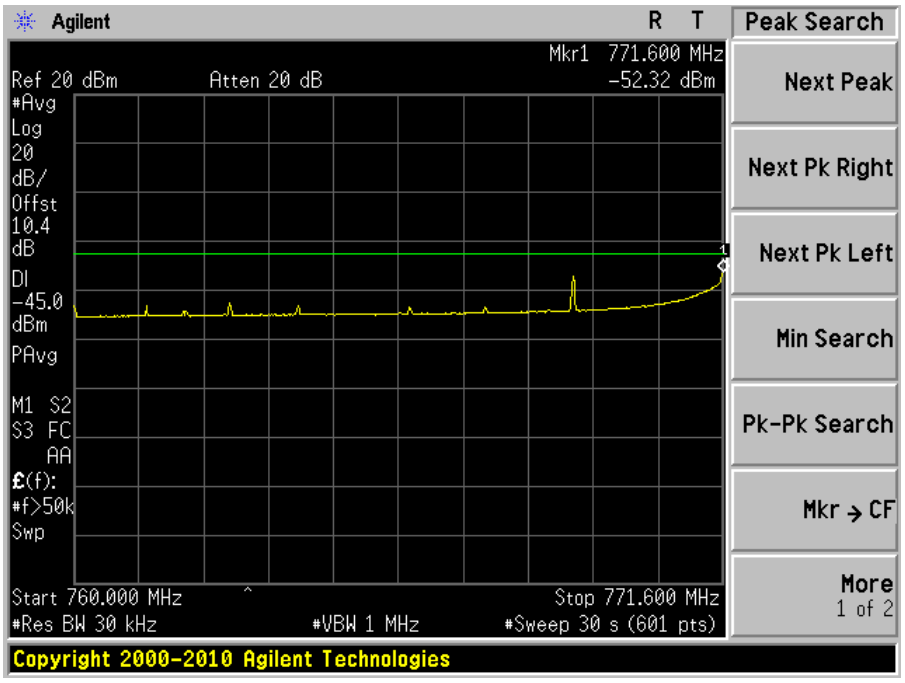


In receive band

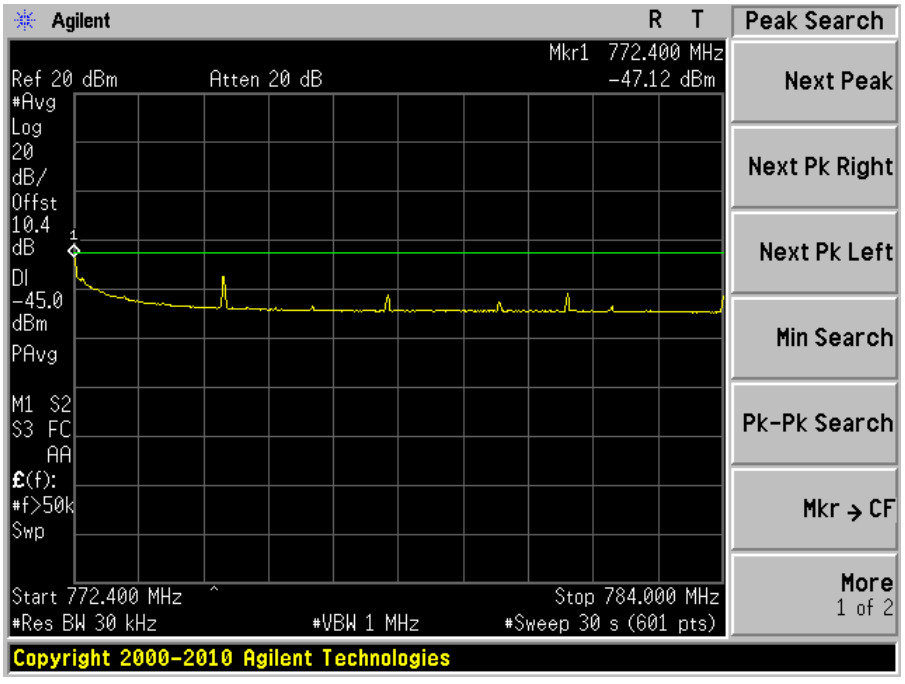
Middle Channel – 772 MHz



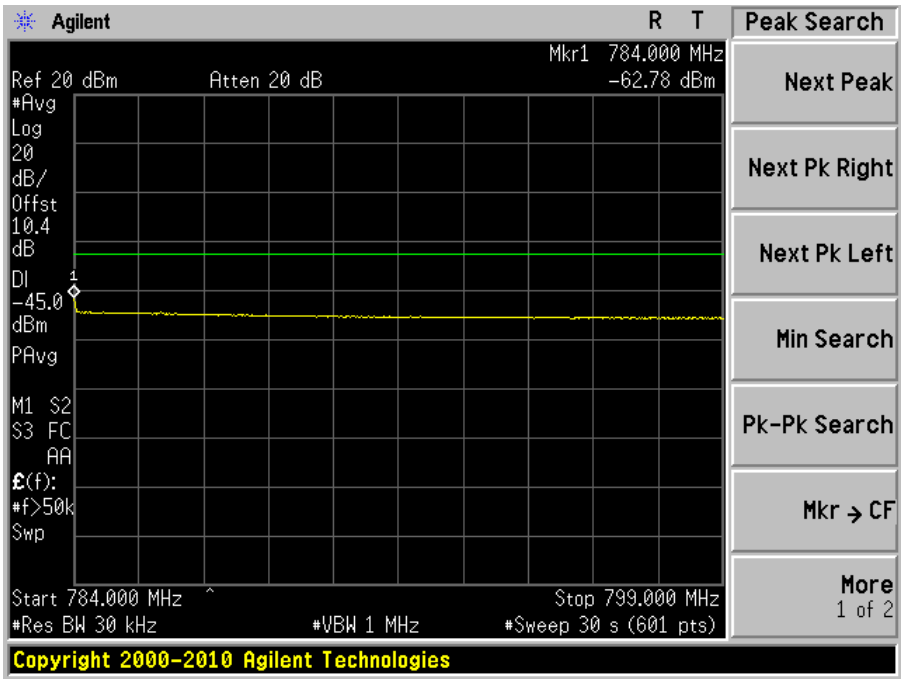




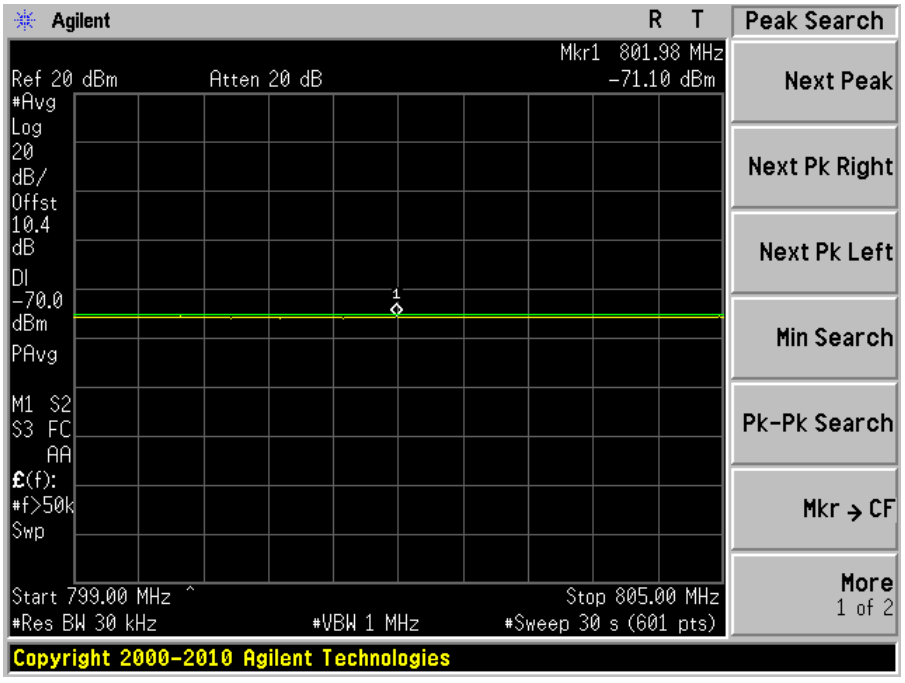
-12MHz to -400kHz



+400kHz to +12MHz

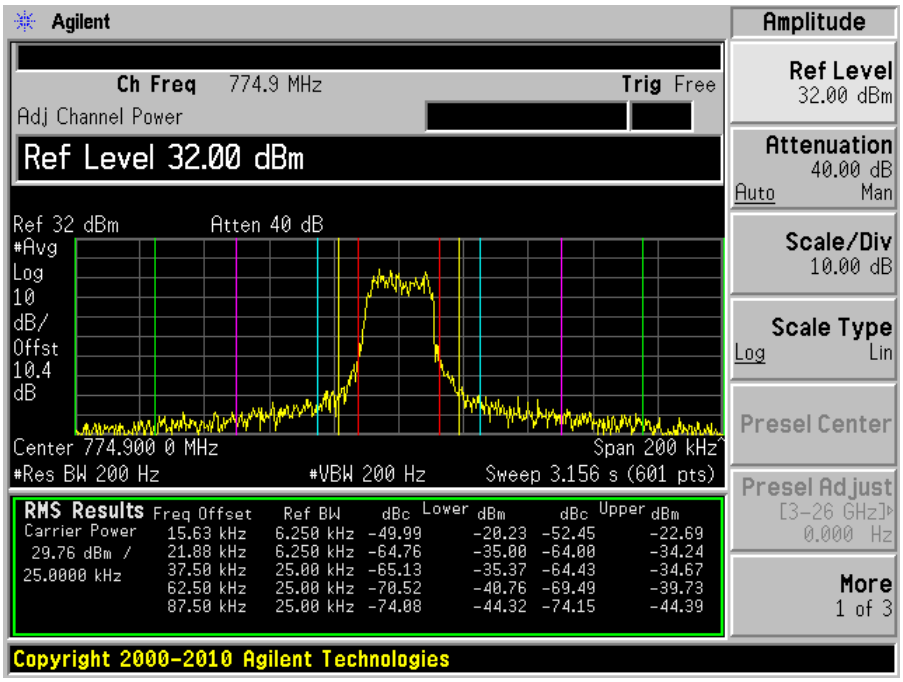


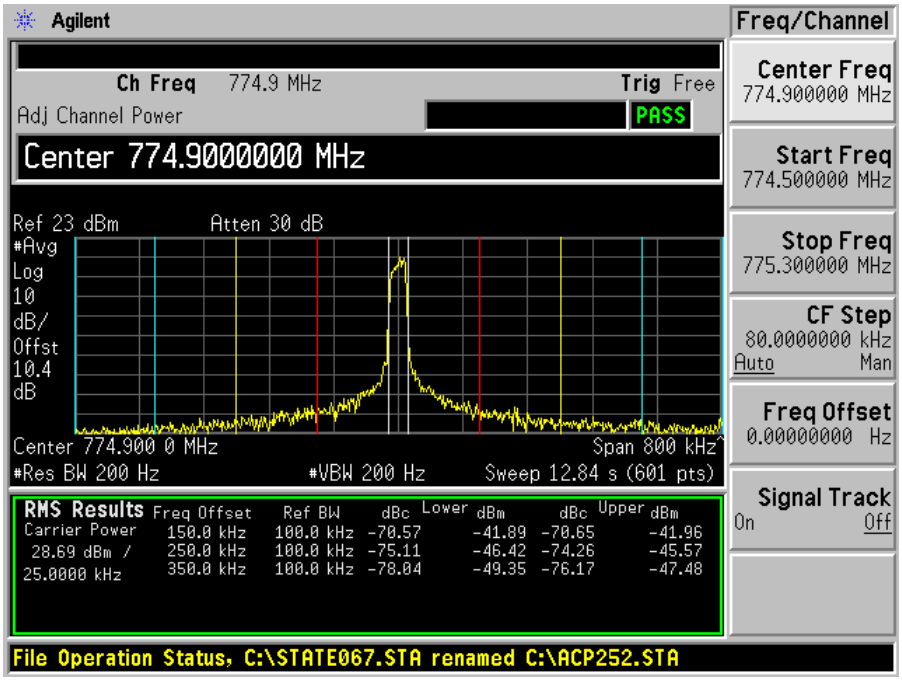
+12MHz to receive band

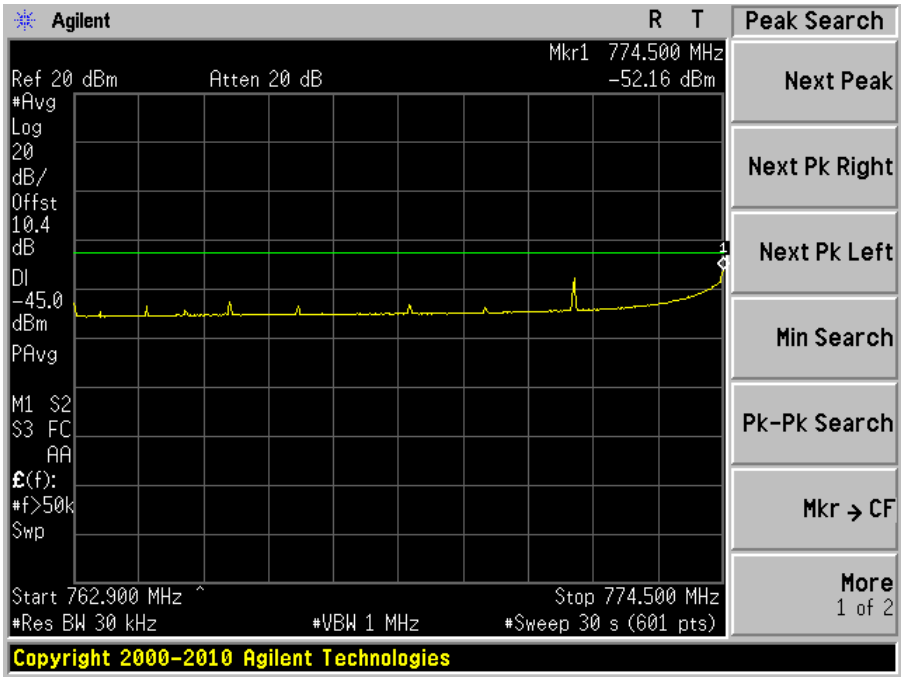


In receive band

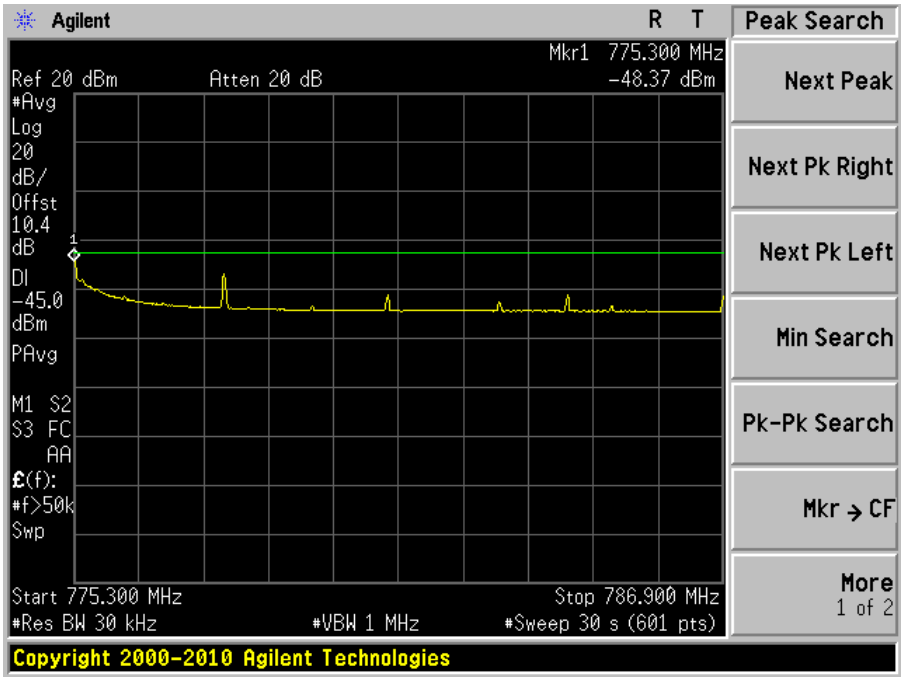
High Channel – 774.9 MHz



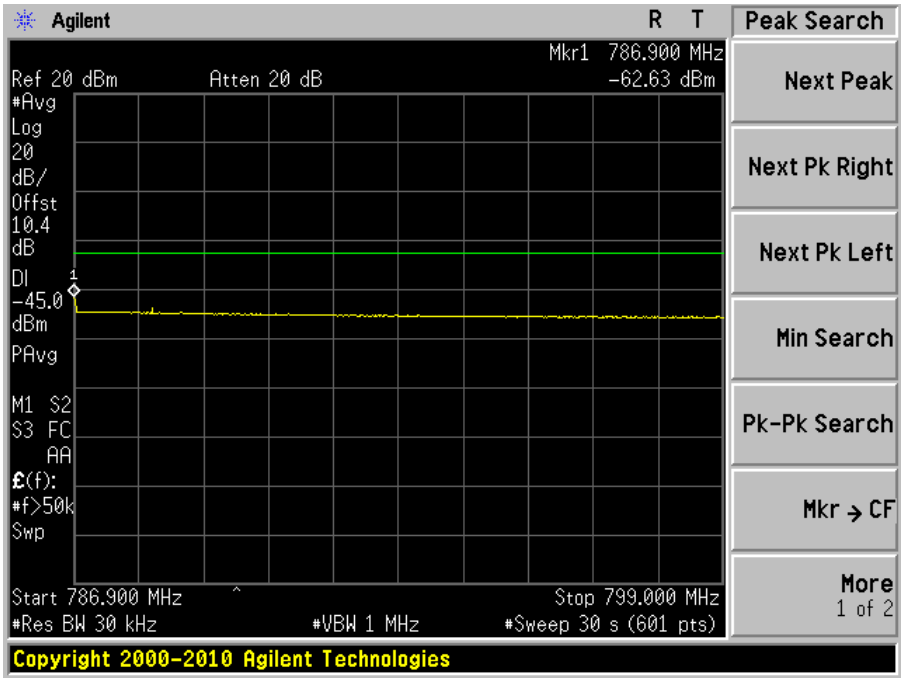




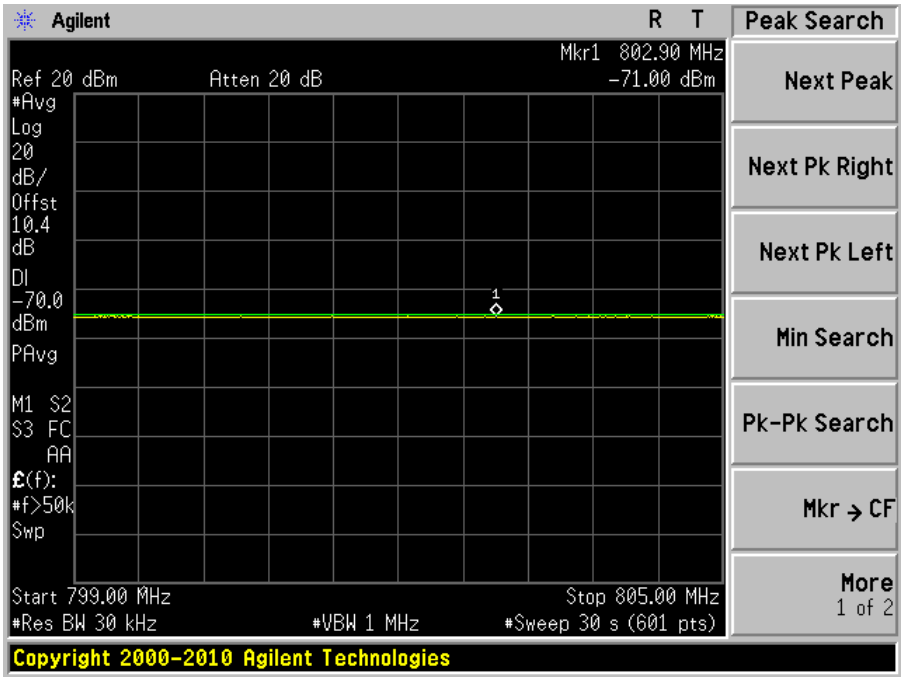
-12MHz to -400kHz



+400kHz to +12MHz



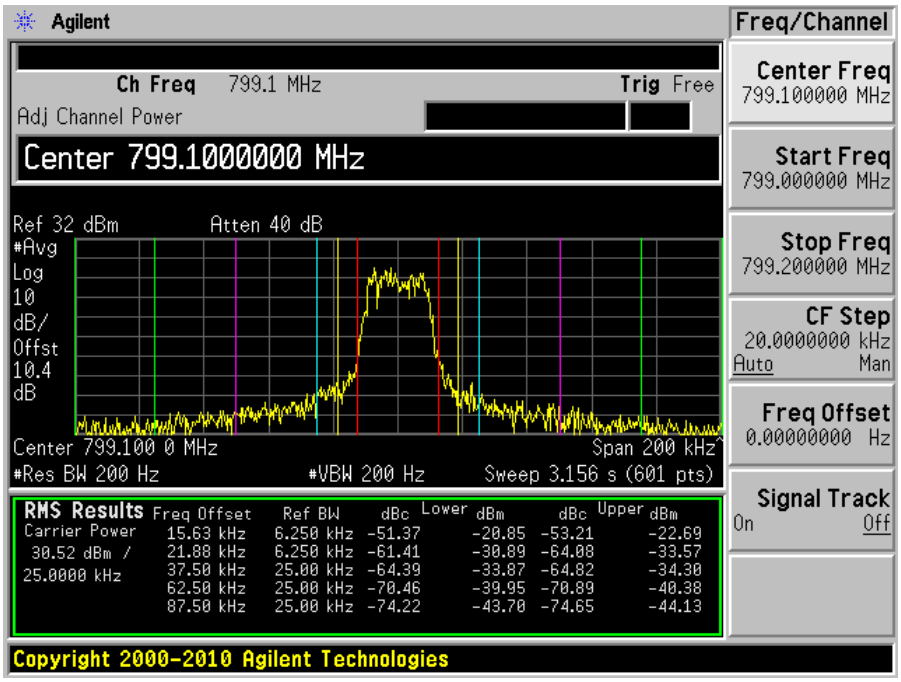
+12MHz to receive band

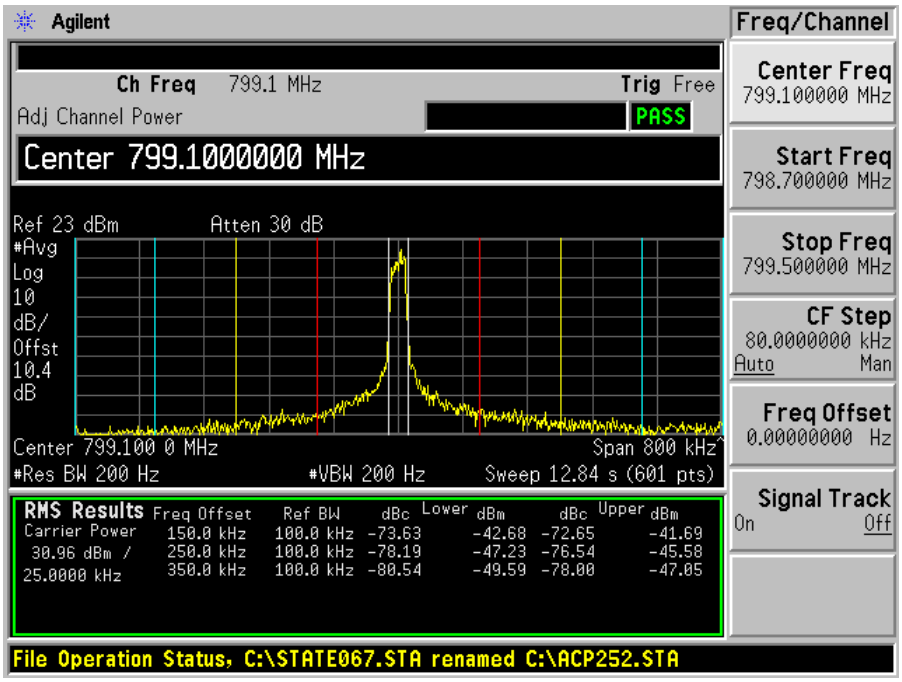


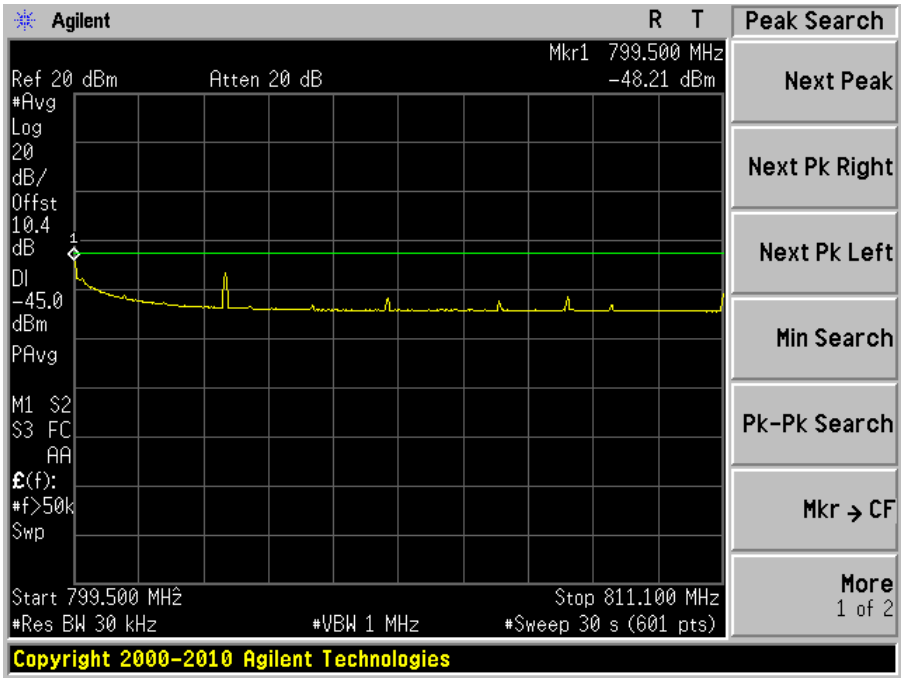
In receive band

799-805 MHz, D-LMR

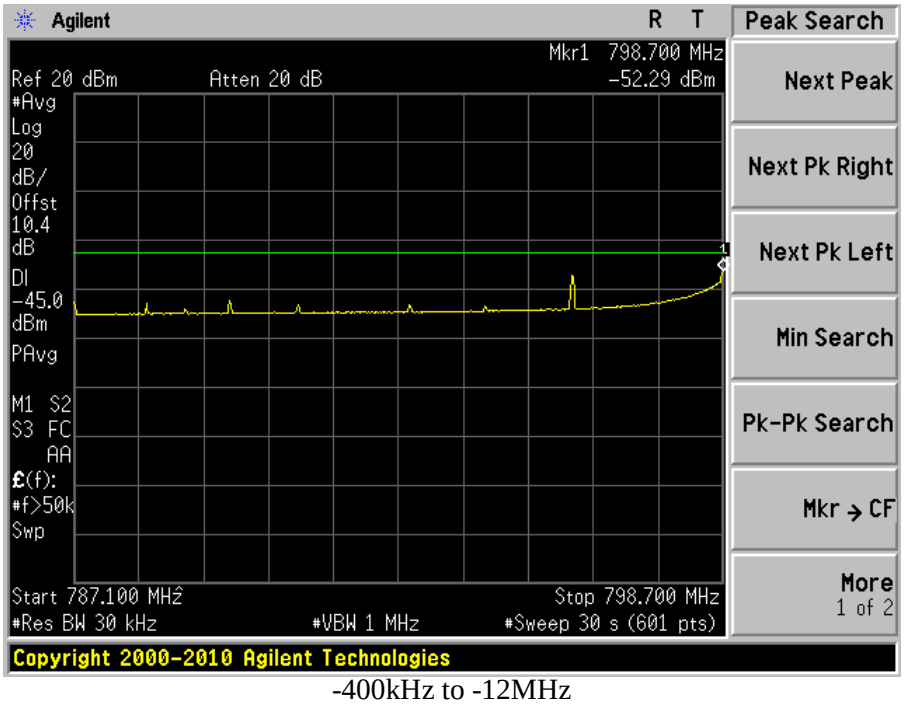
Low Channel – 799.1 MHz



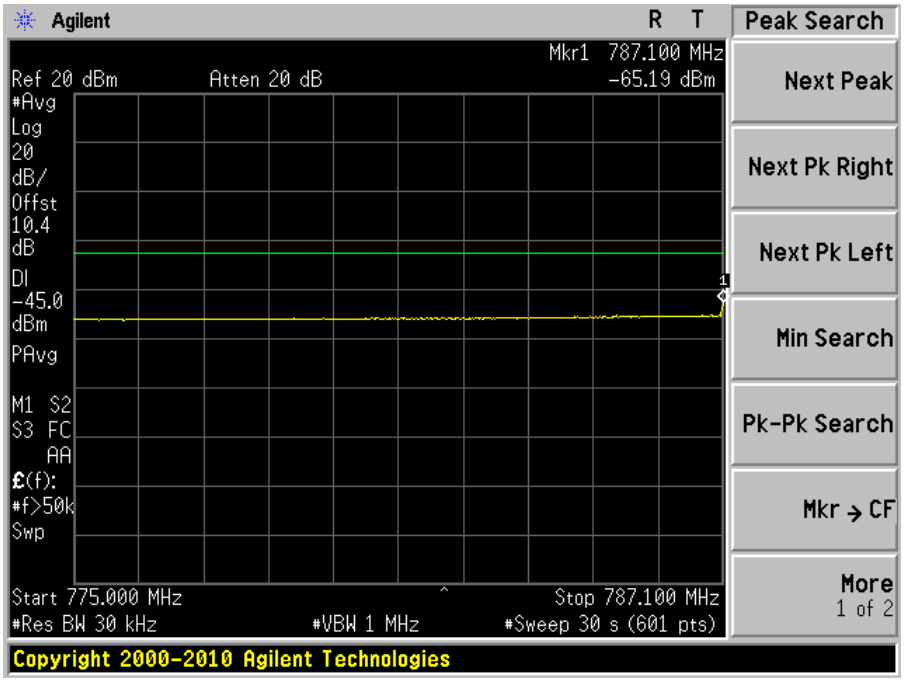




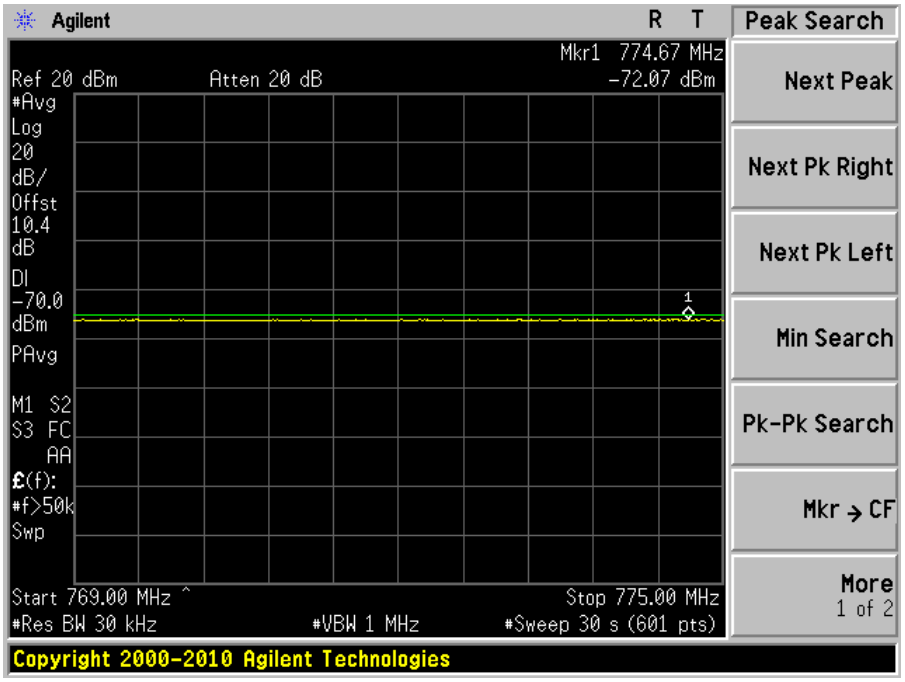
+12MHz to +400kHz



-400kHz to -12MHz

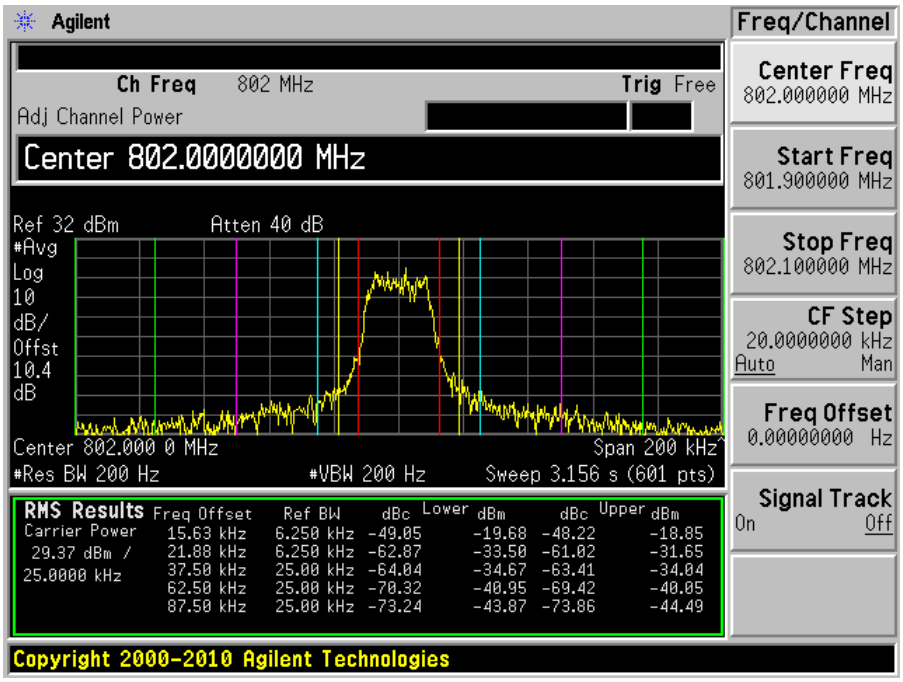


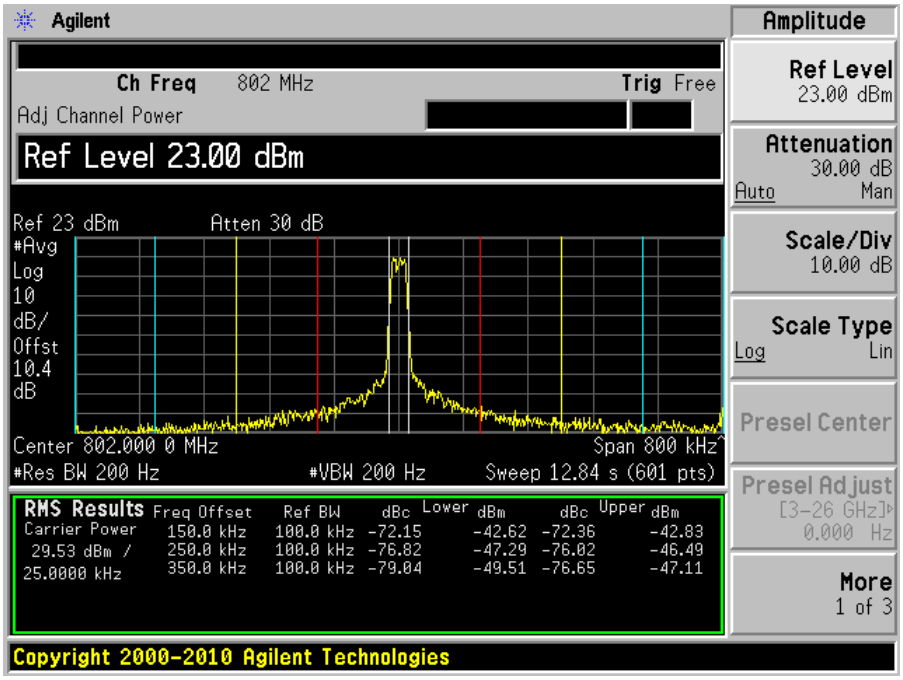
-12MHz to receive band

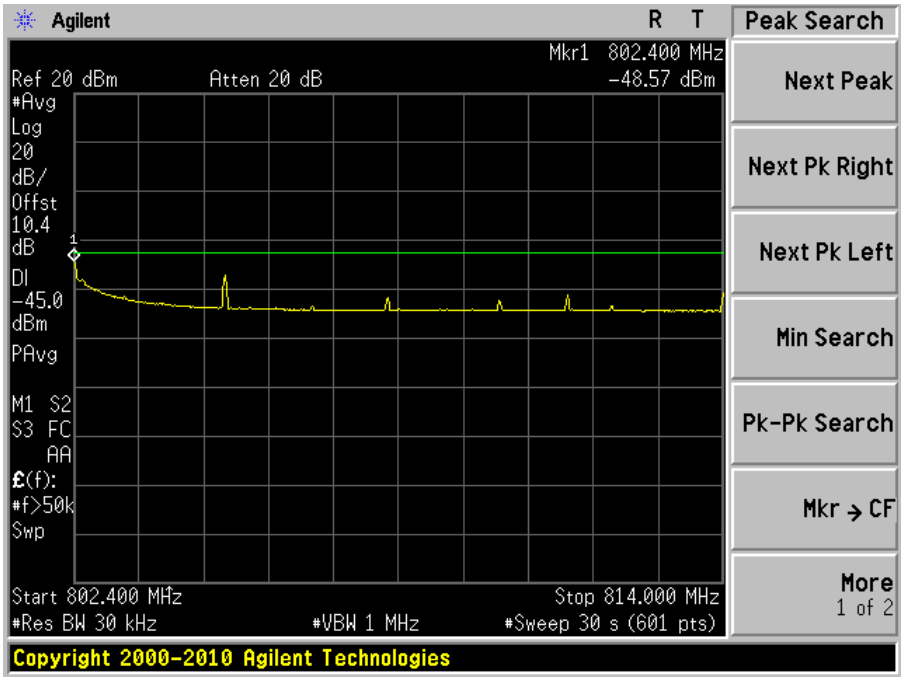


In receive band

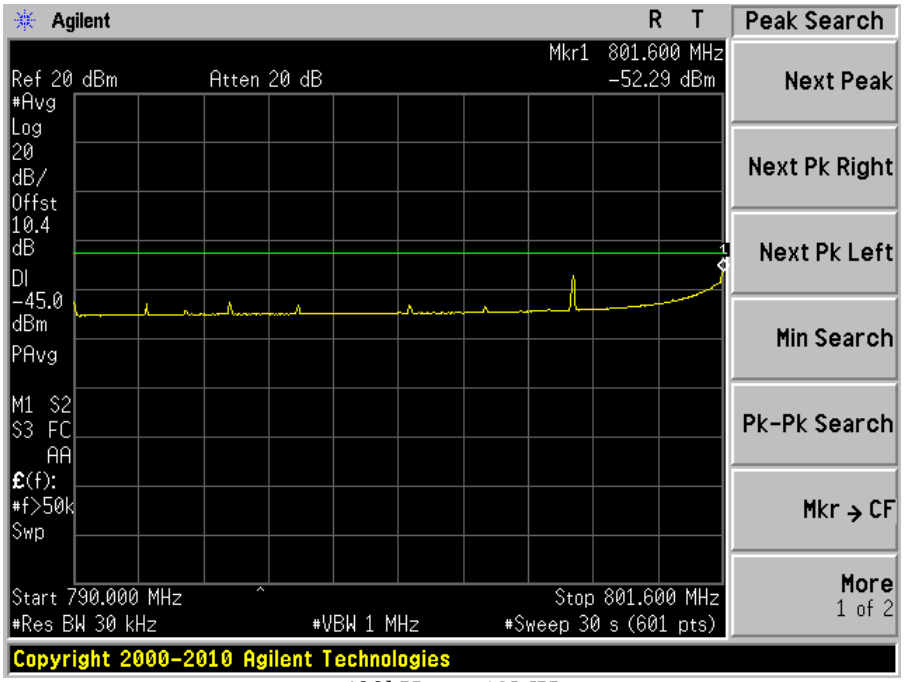
Middle Channel – 802 MHz



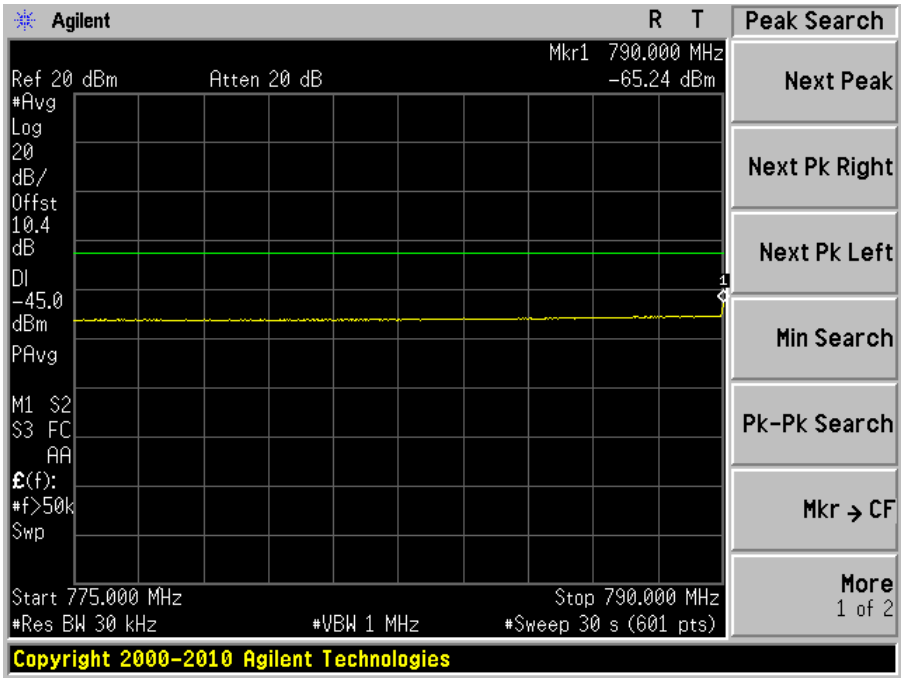




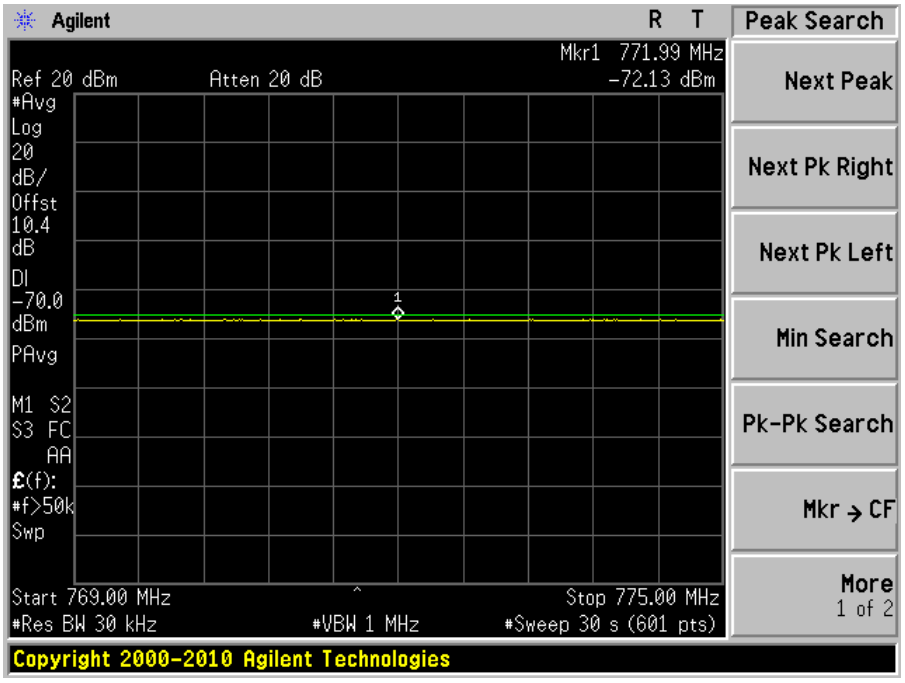
+12MHz to +400kHz



-400kHz to -12MHz

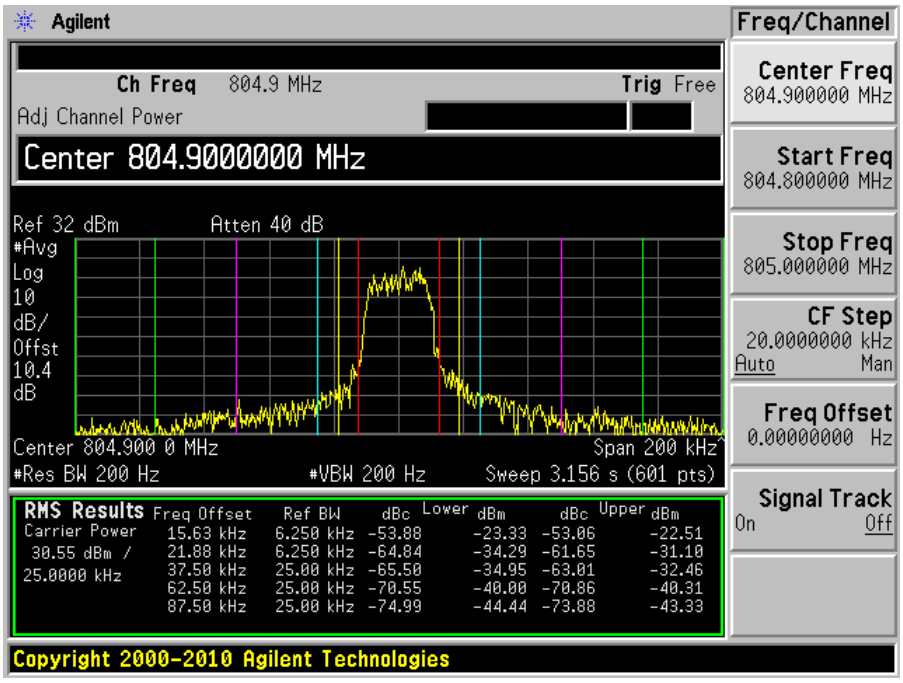


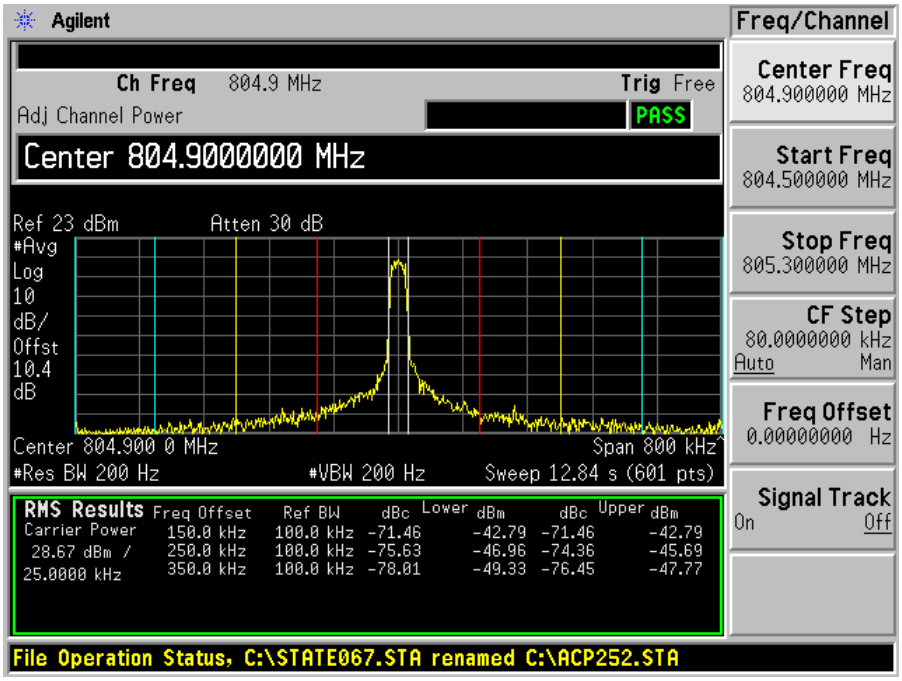
-12MHz to receive band

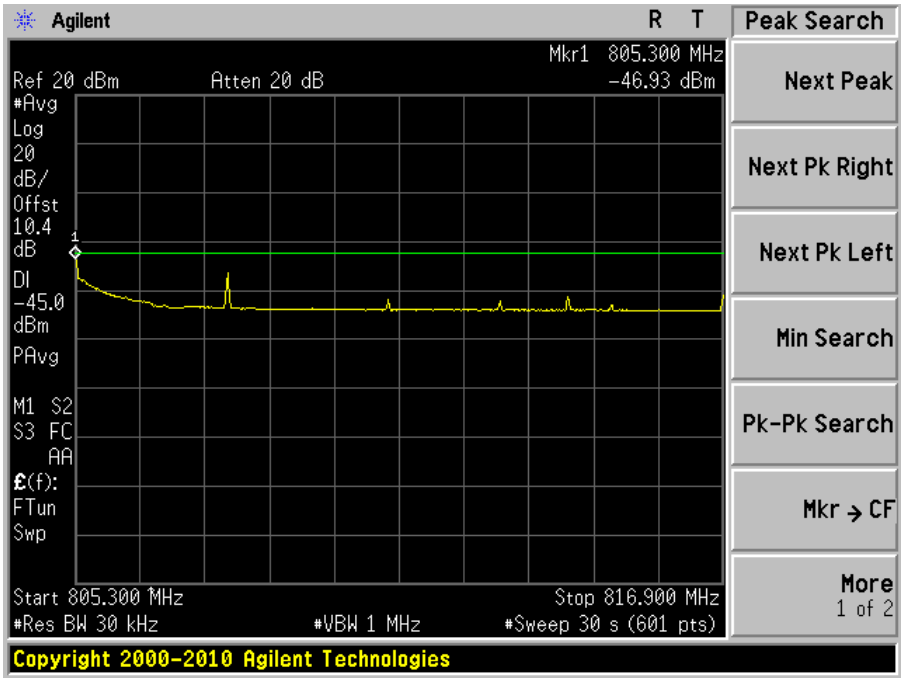


In receive band

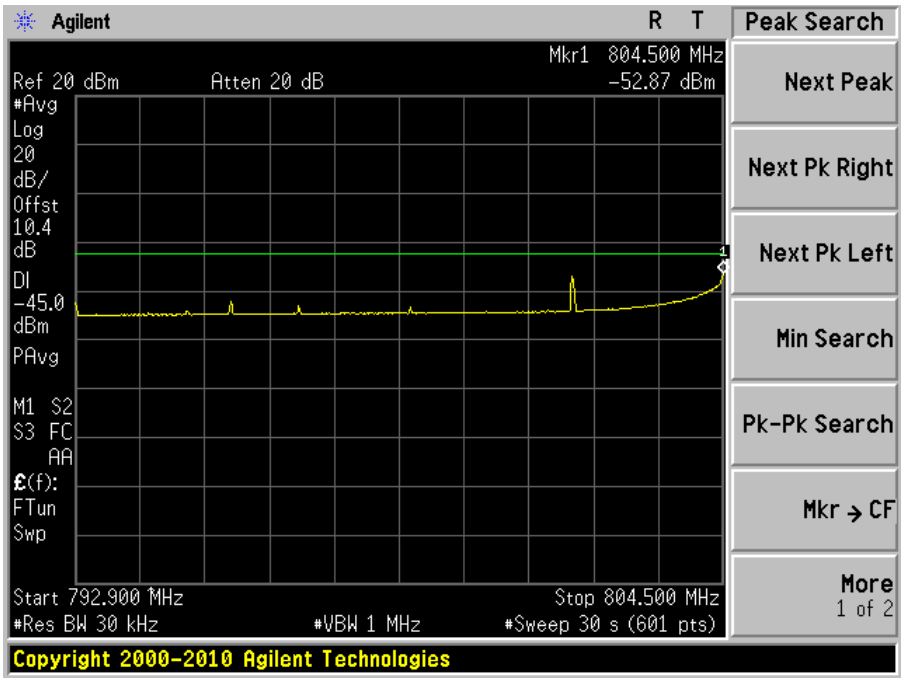
High Channel – 804.9 MHz



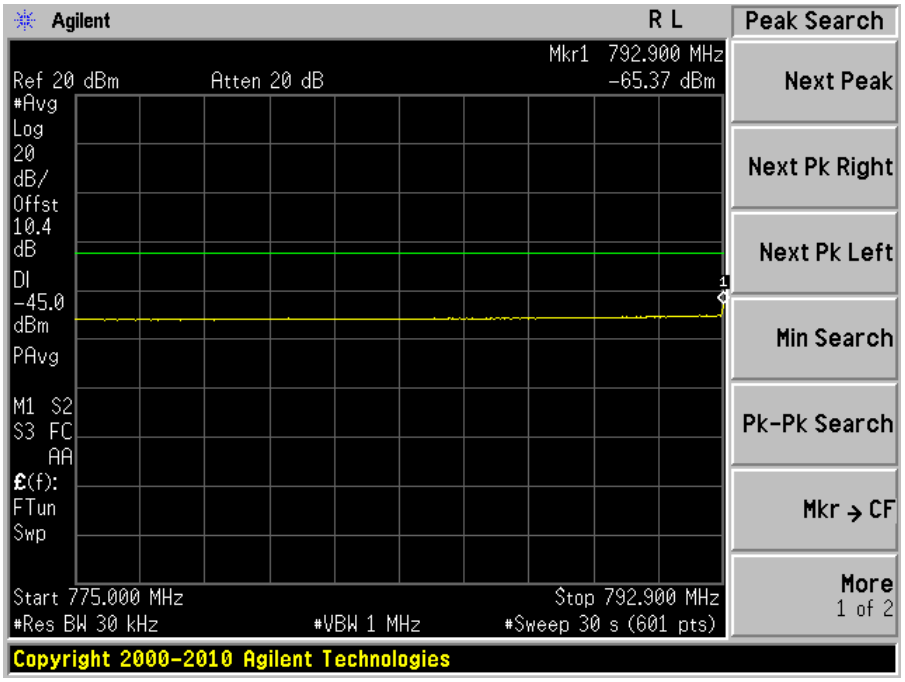




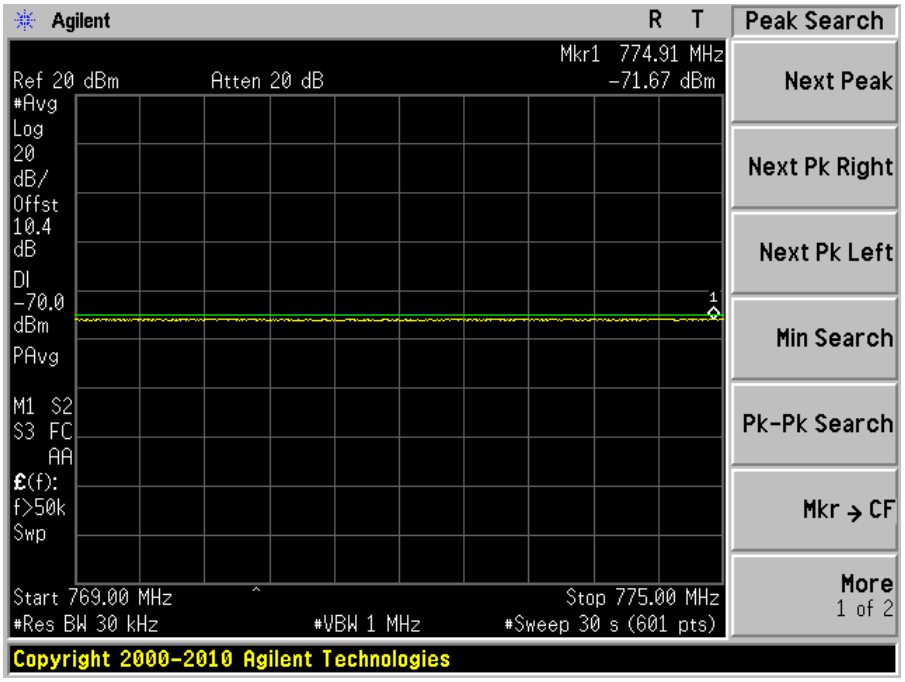
+12MHz to +400kHz



-400kHz to -12MHz



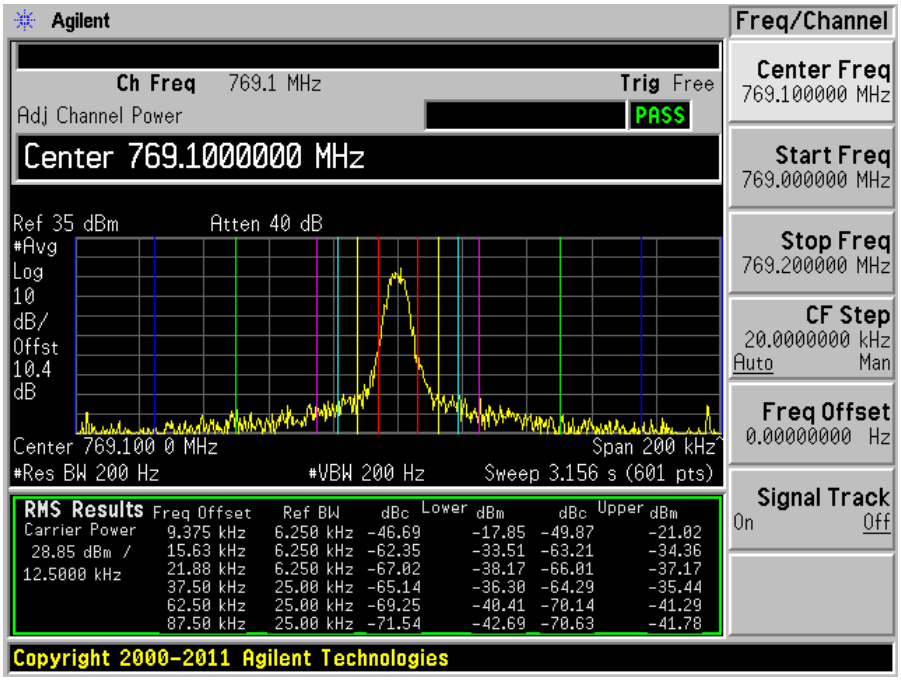
-12MHz to receive band

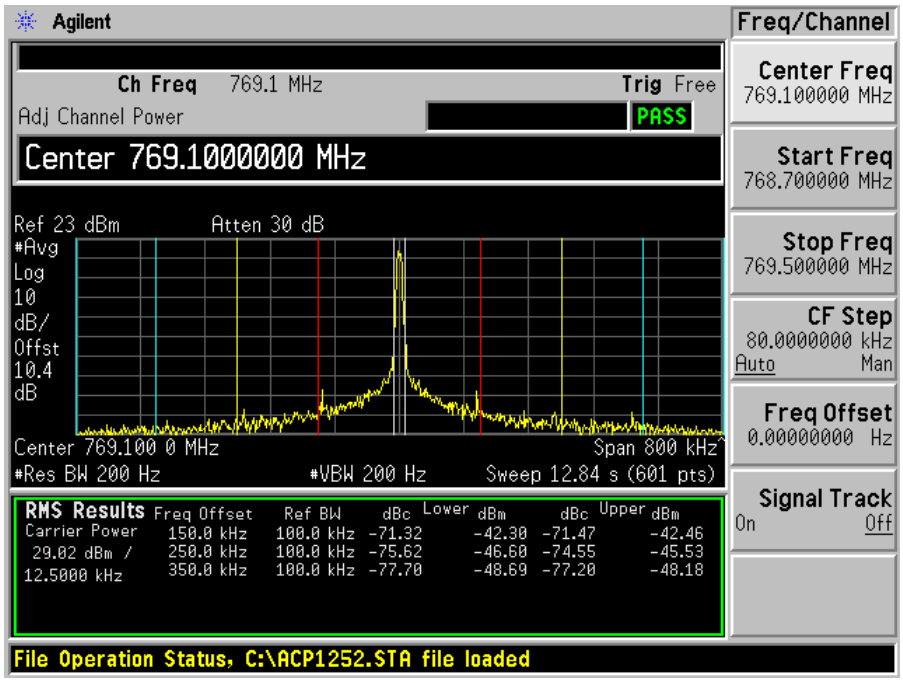


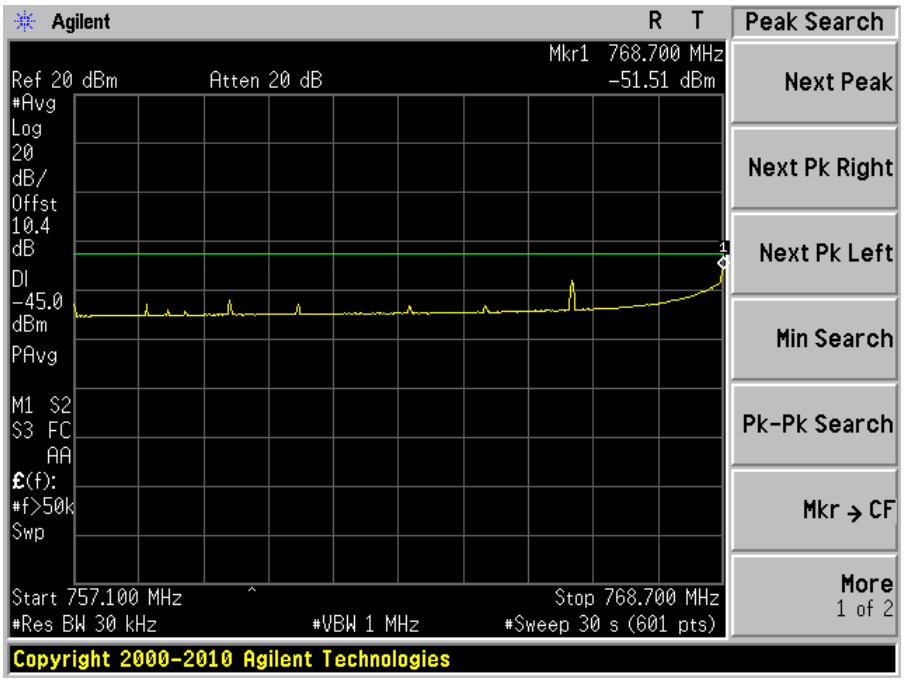
In receive band

769-775 MHz, C4FM

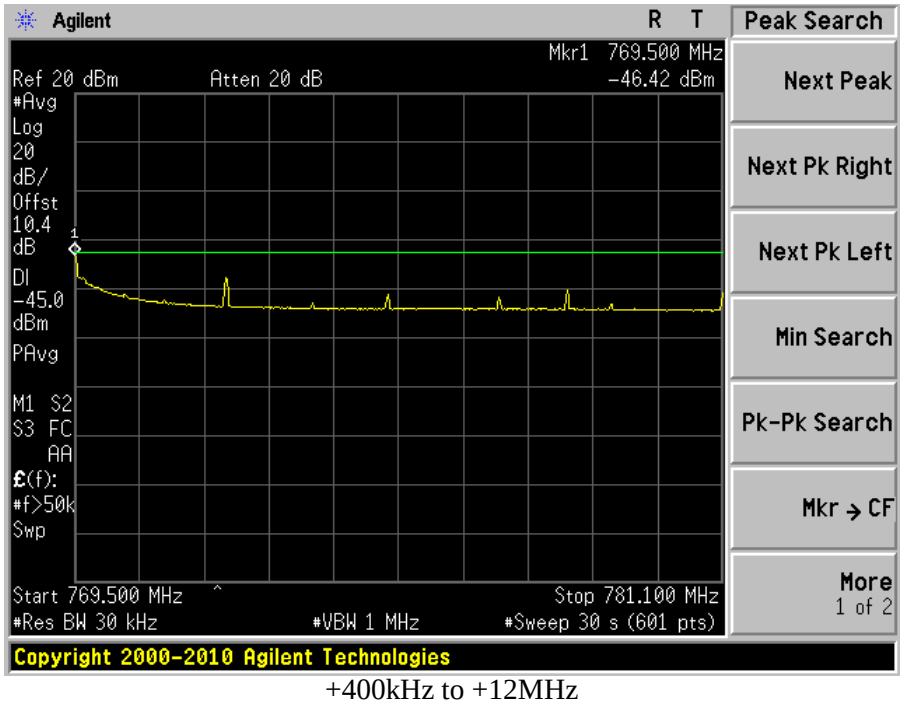
Low Channel – 769.1 MHz



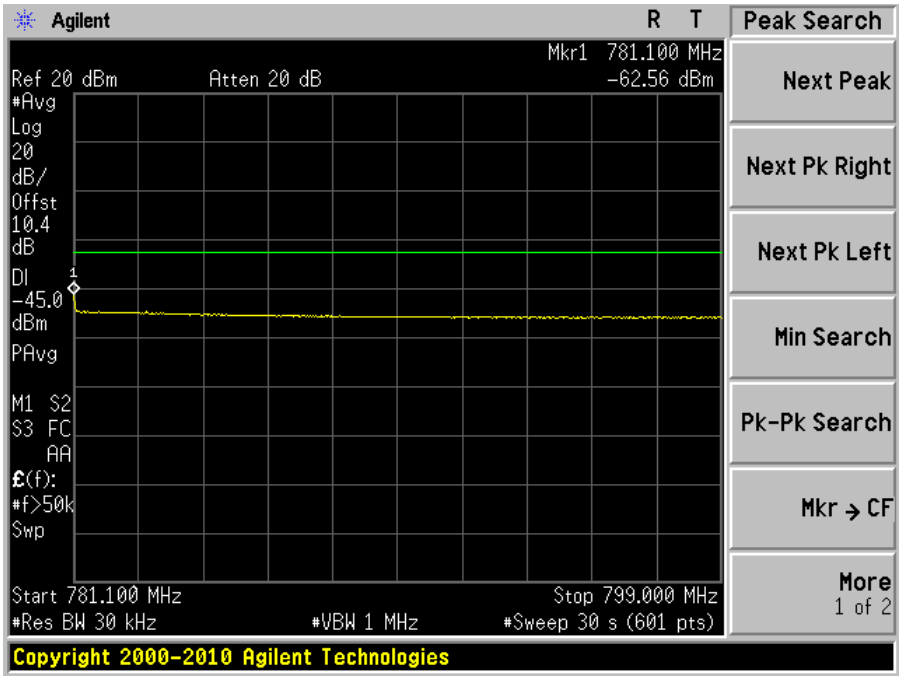




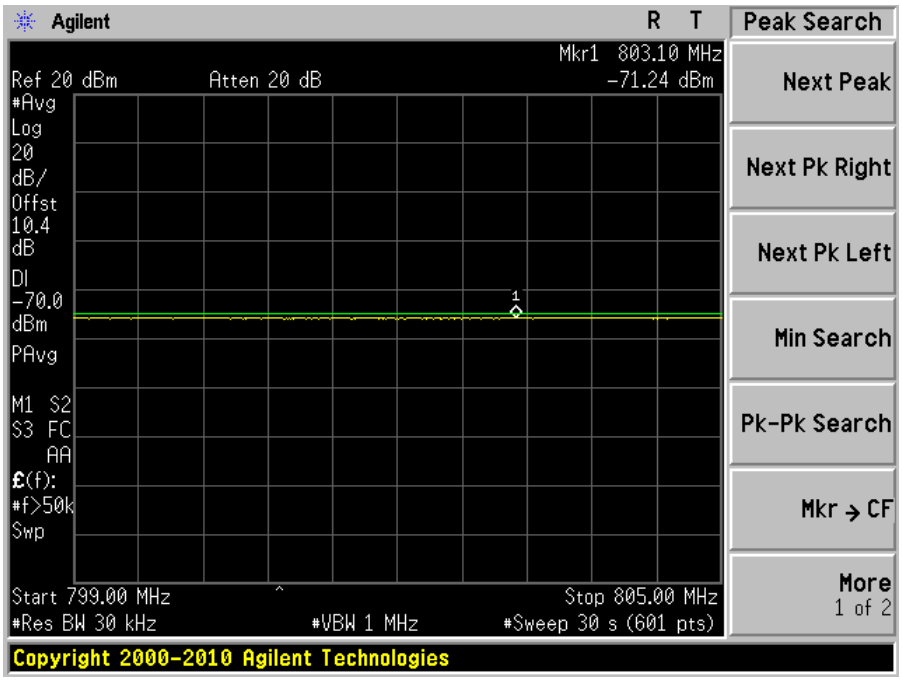
-12MHz to -400kHz



+400kHz to +12MHz

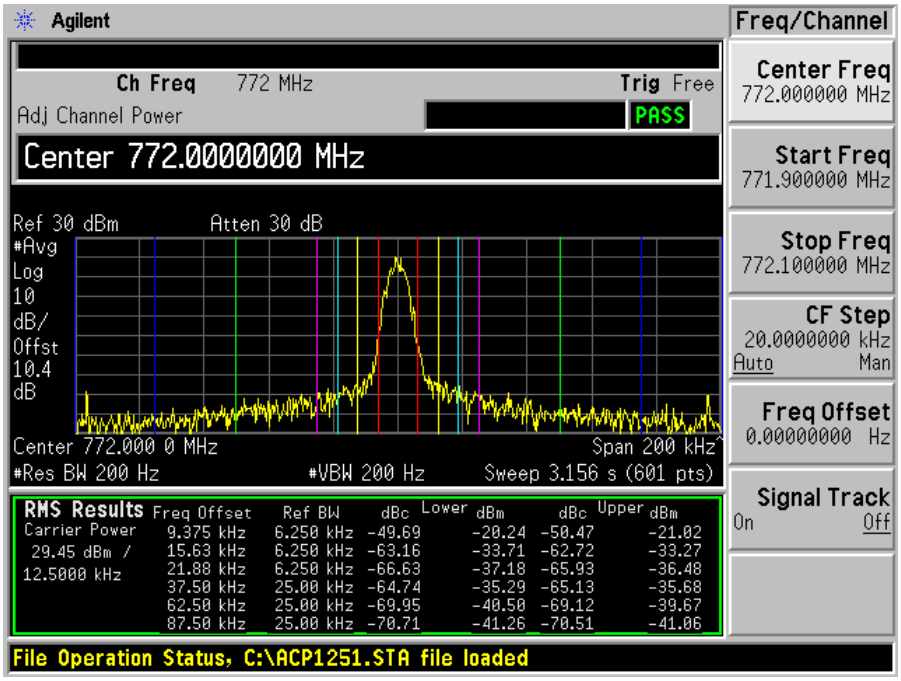


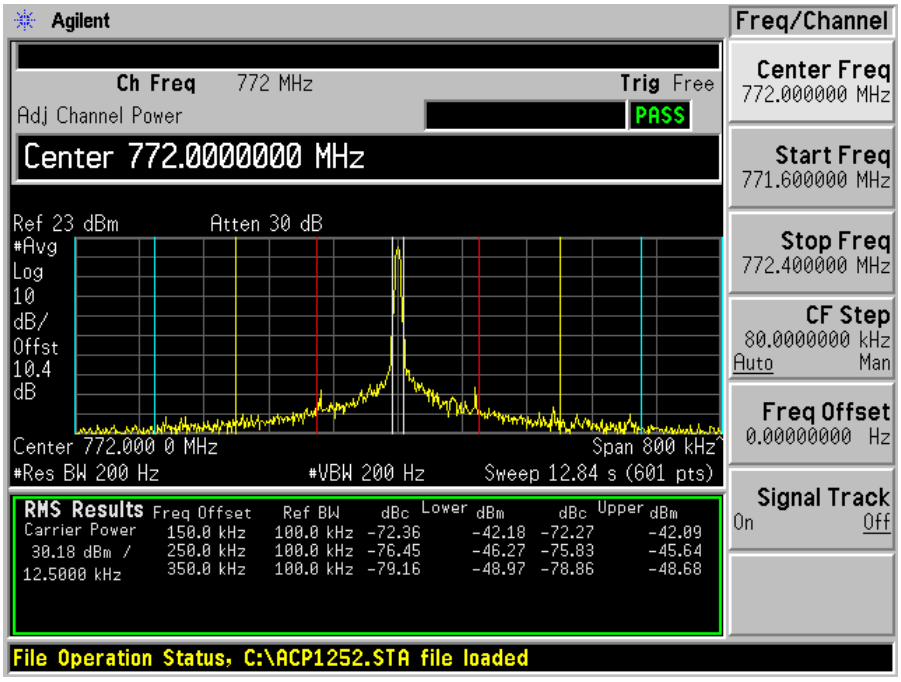
+12MHz to receive band

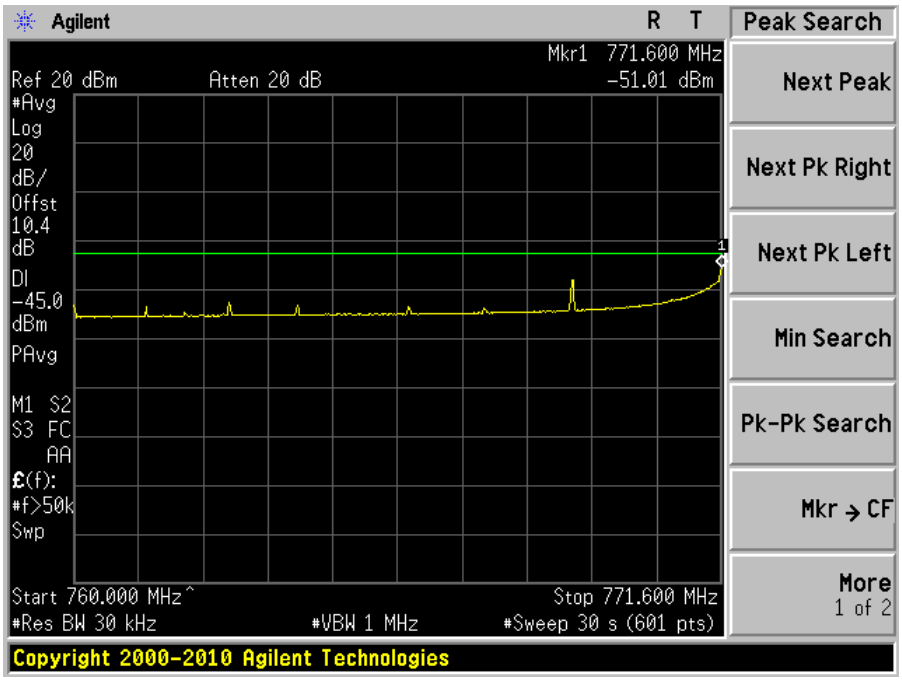


In receive band

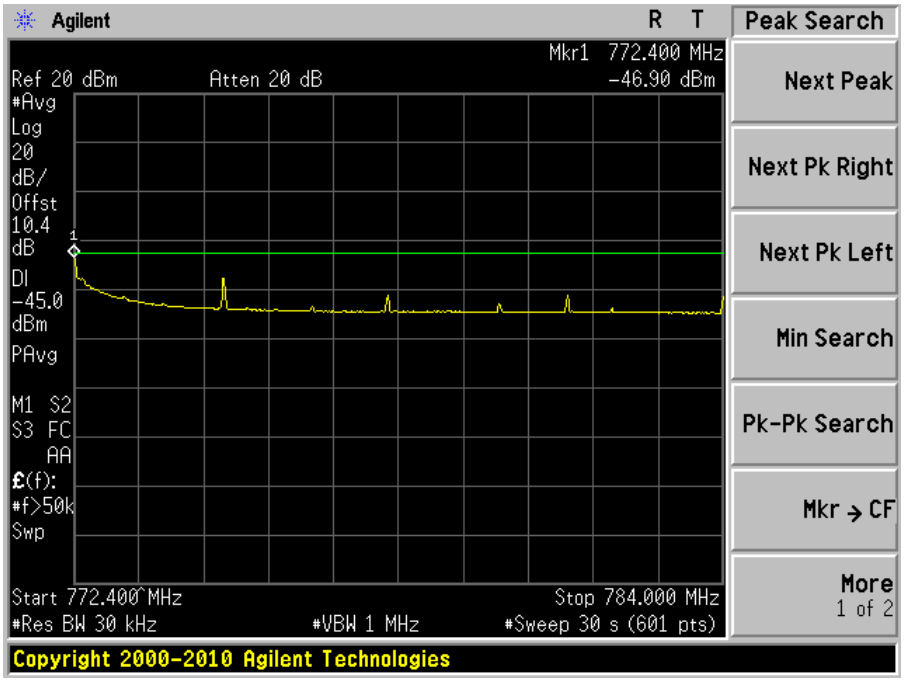
Middle Channel – 772 MHz



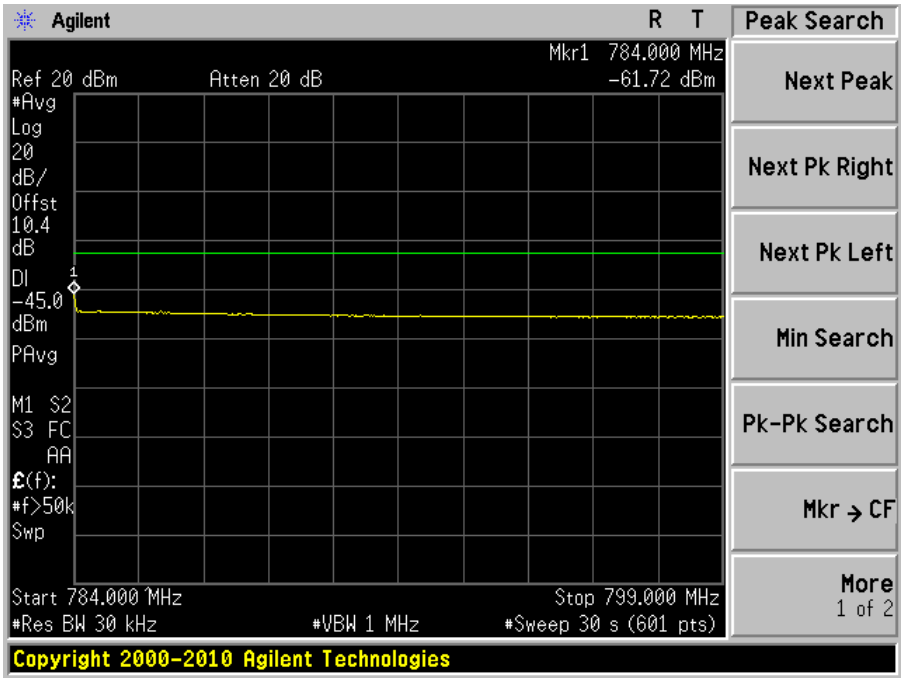




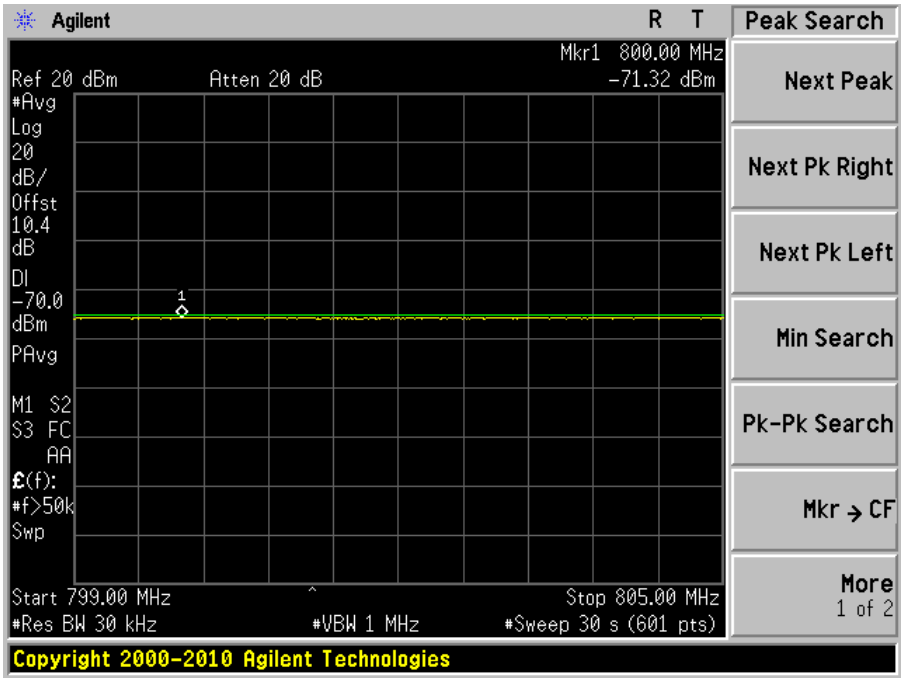
-12MHz to -400kHz



+400kHz to +12MHz

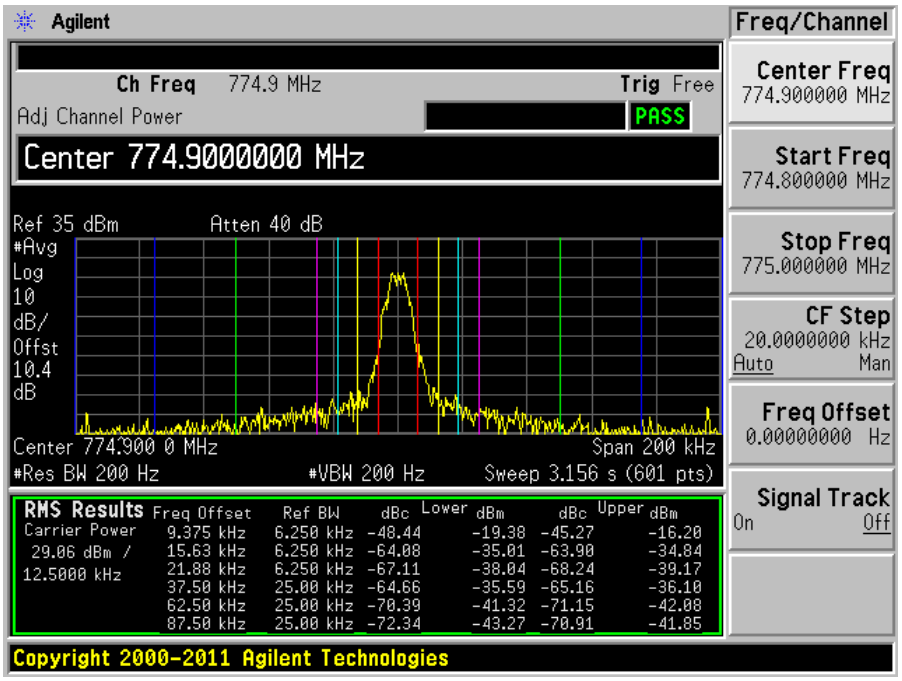


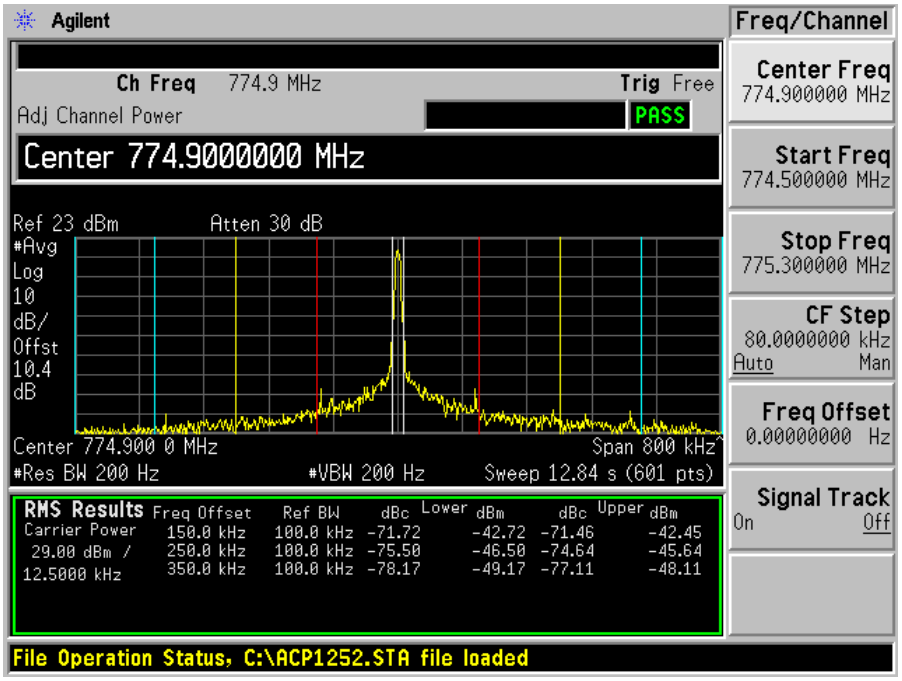
+12MHz to receive band

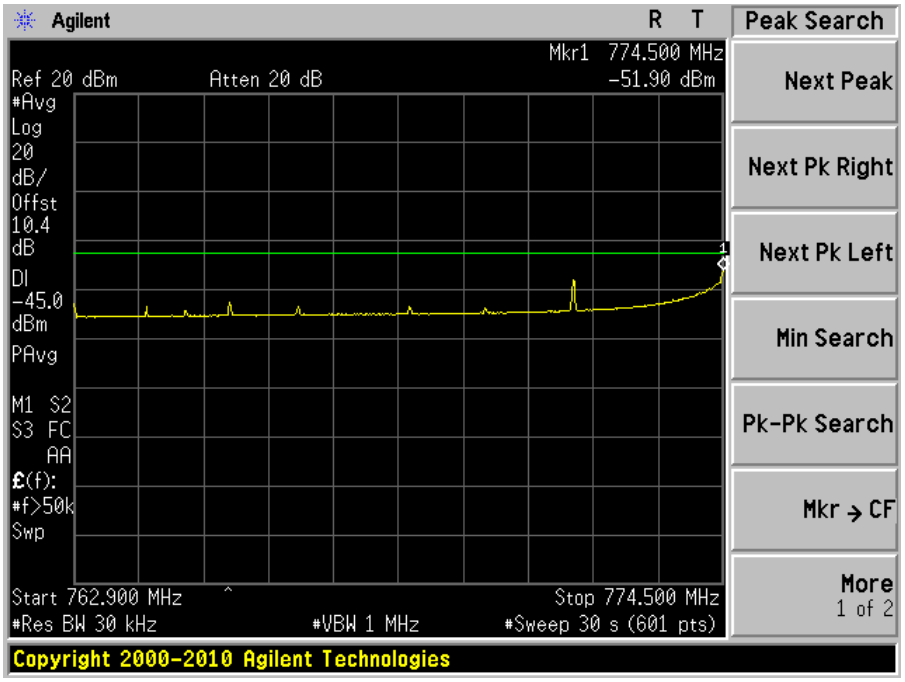


In receive band

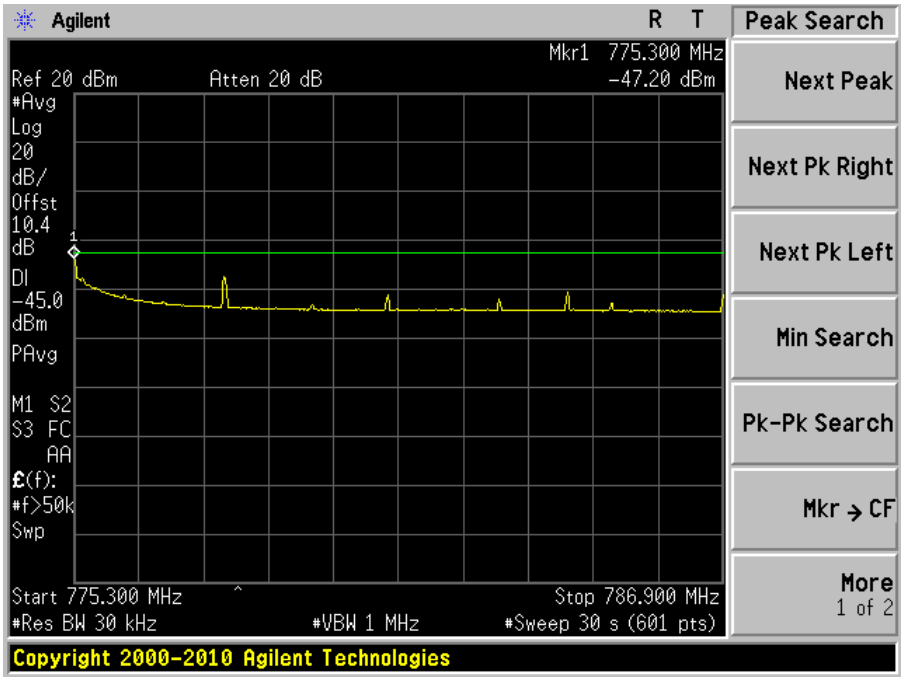
High Channel – 774.9 MHz



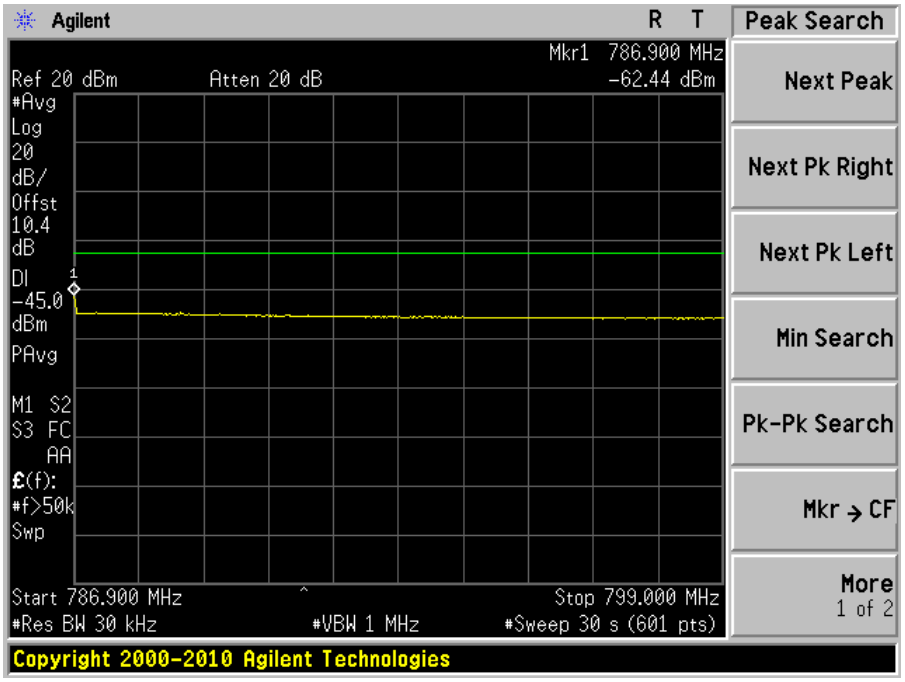




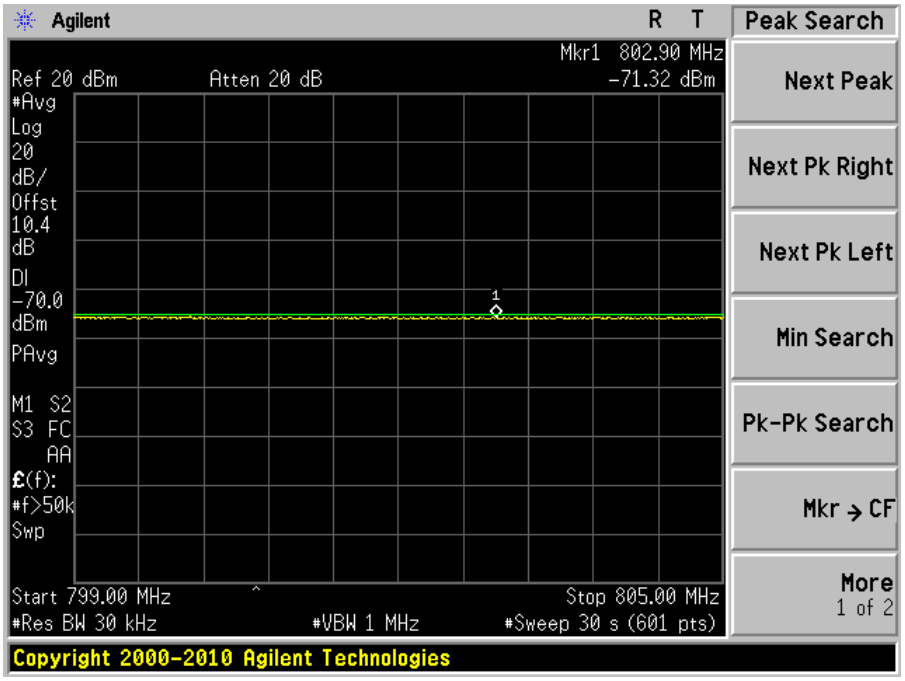
-12MHz to -400kHz



+400kHz to +12MHz



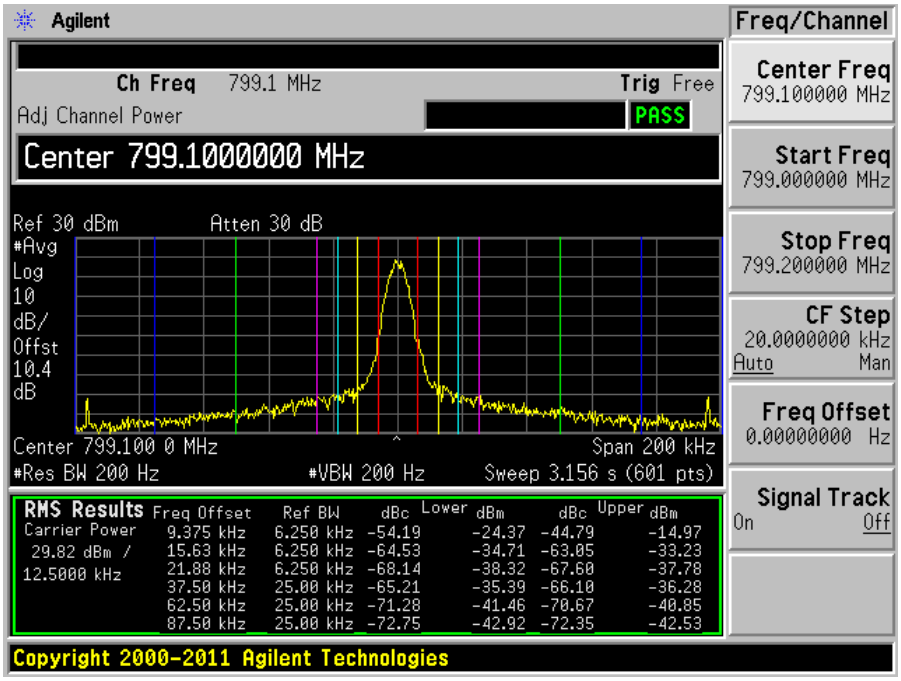
+12MHz to receive band

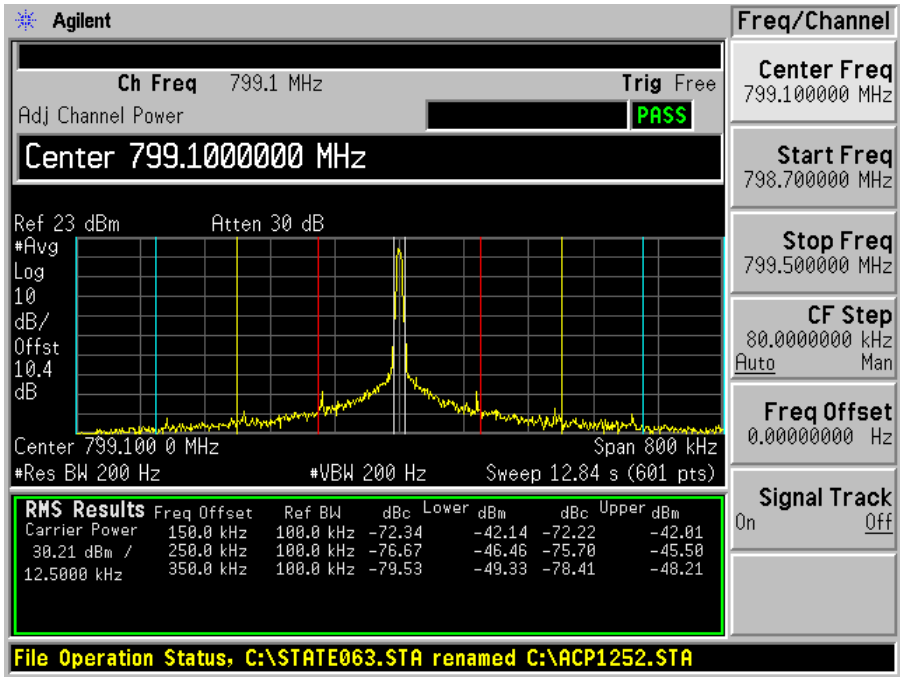


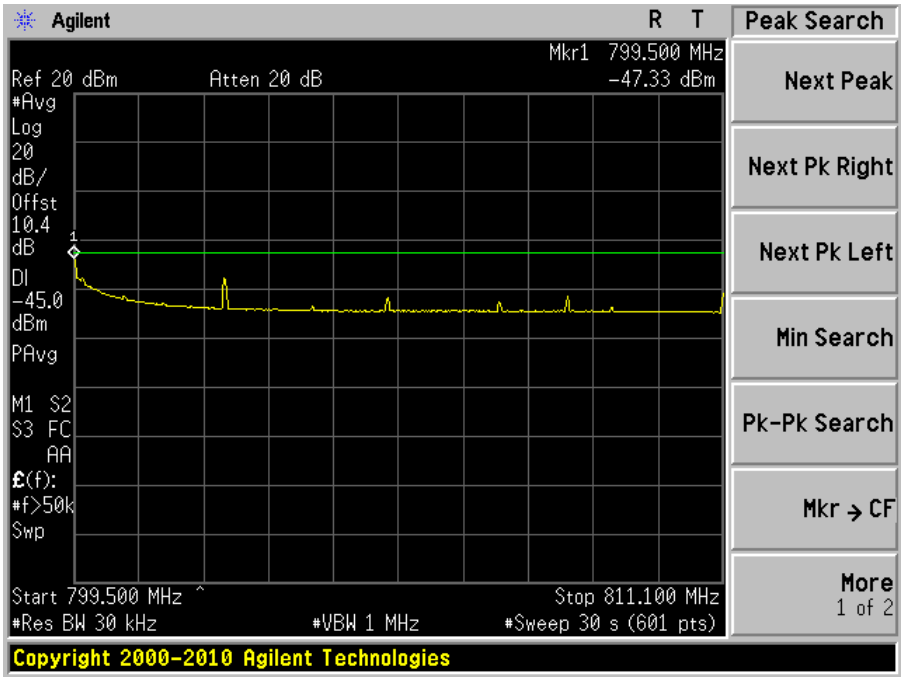
In receive band

799-805 MHz, C4FM

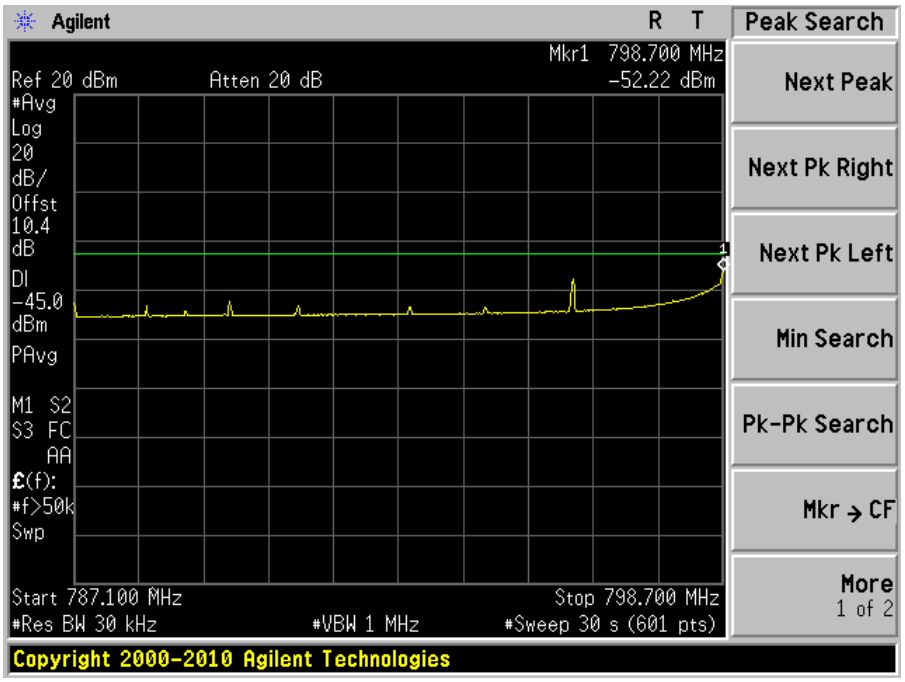
Low Channel – 799.1 MHz



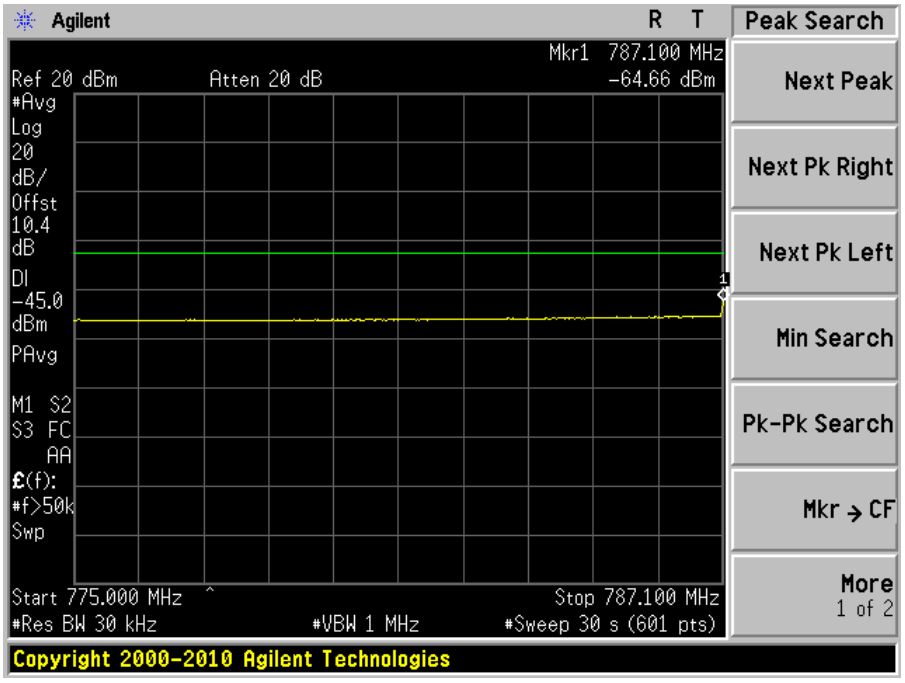




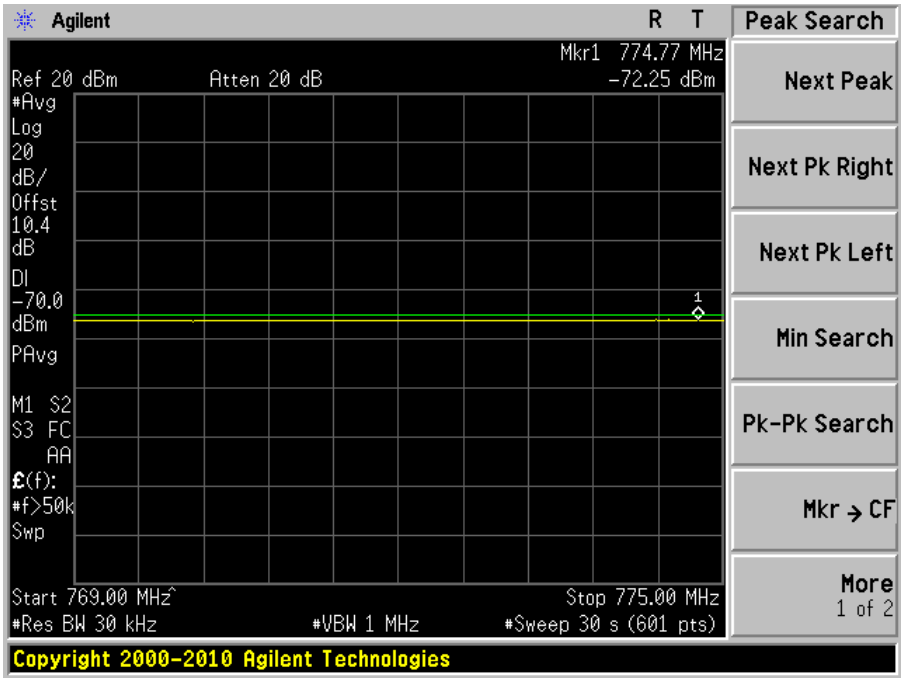
+12MHz to +400kHz



-400kHz to -12MHz

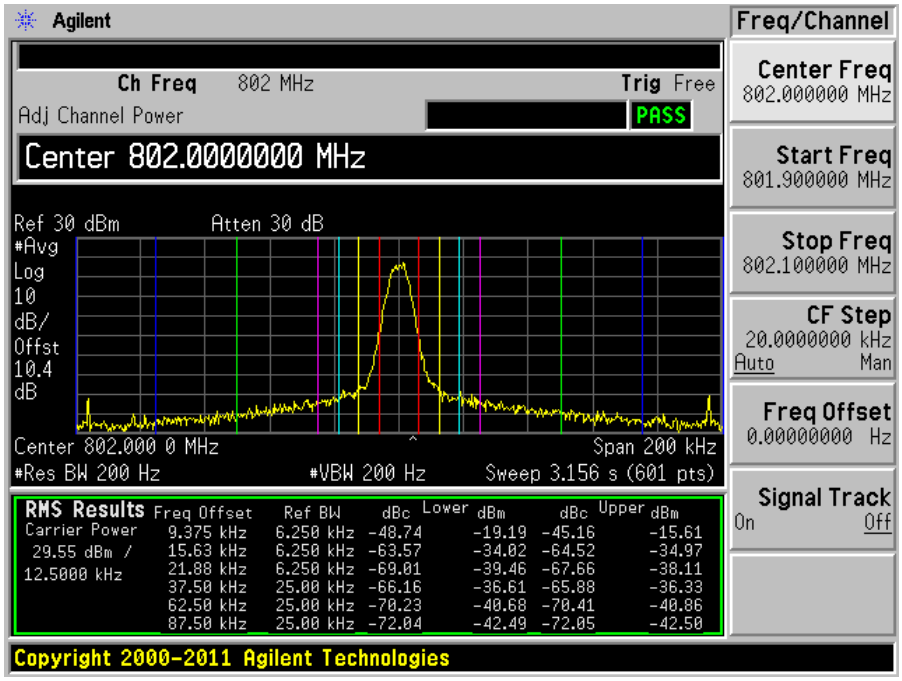


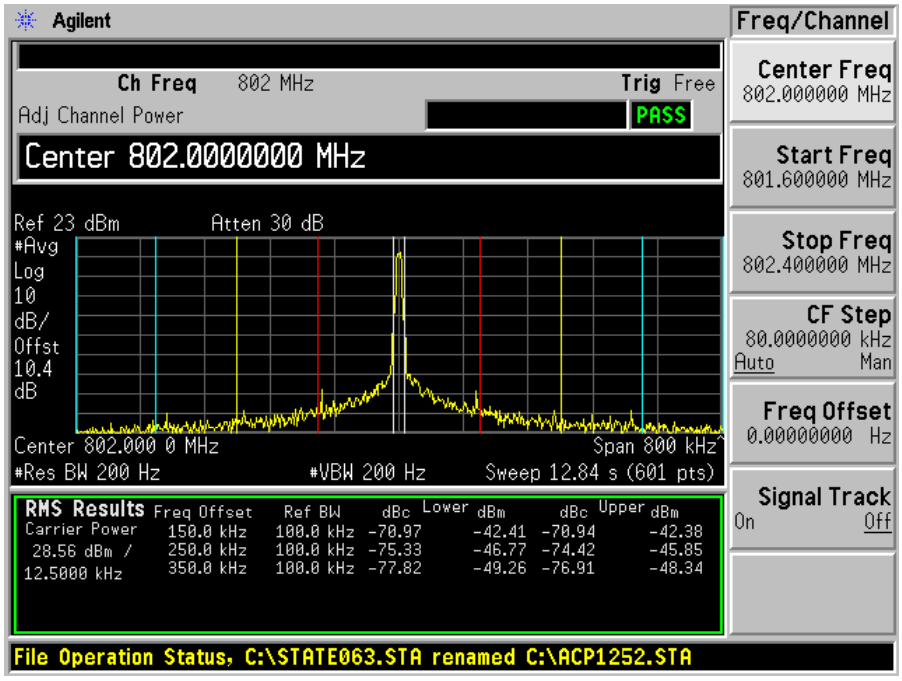
-12MHz to receive band

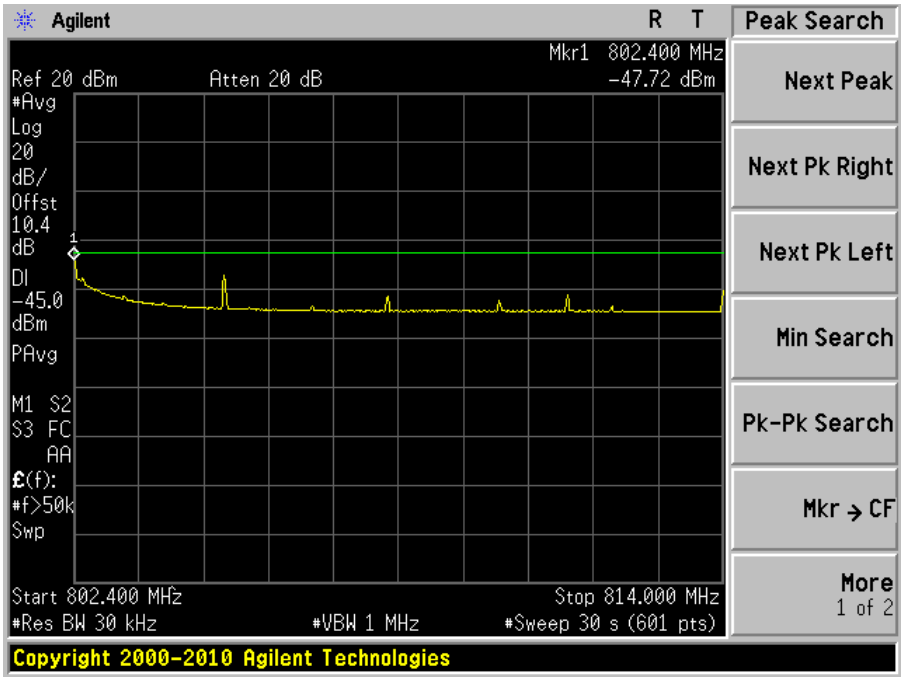


In receive band

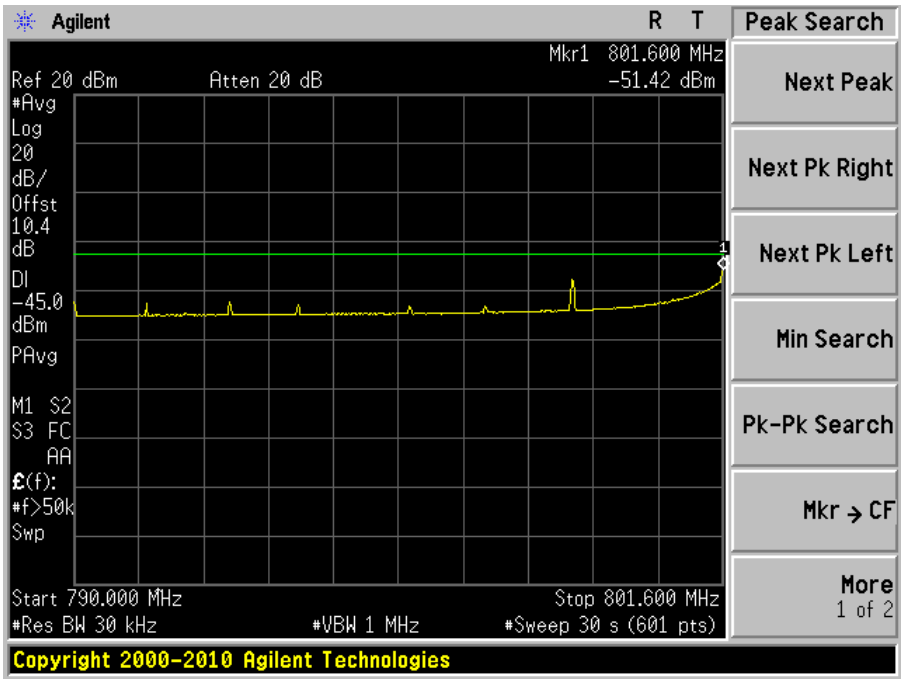
Middle Channel – 802 MHz



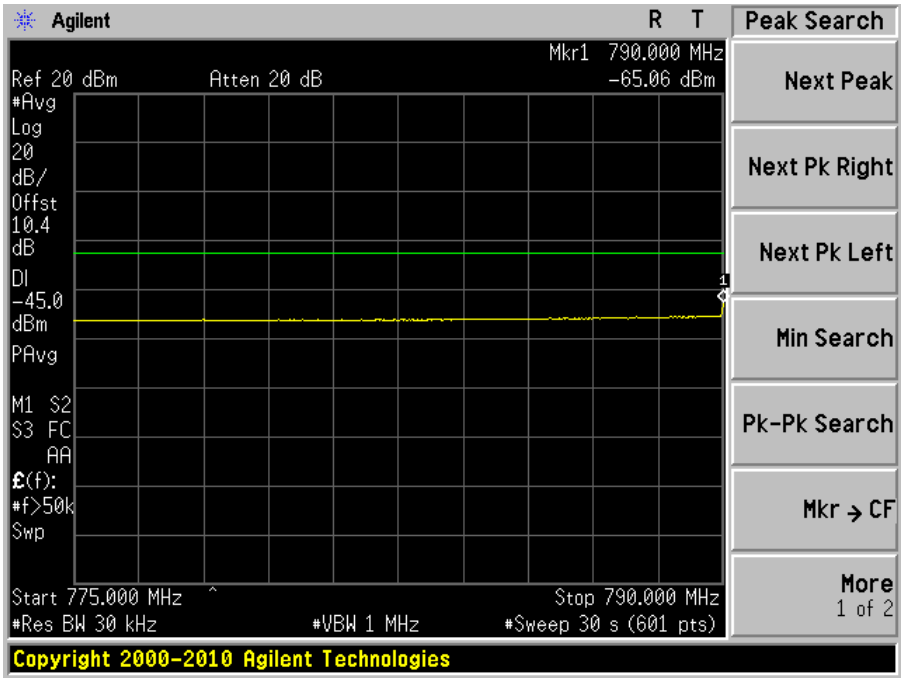




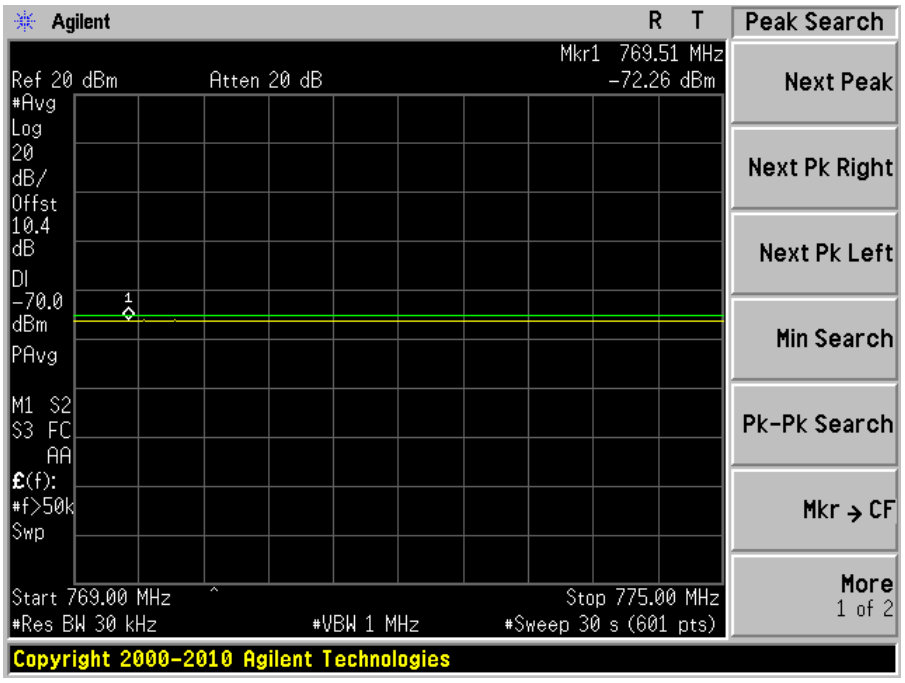
+12MHz to +400kHz



-400kHz to -12MHz

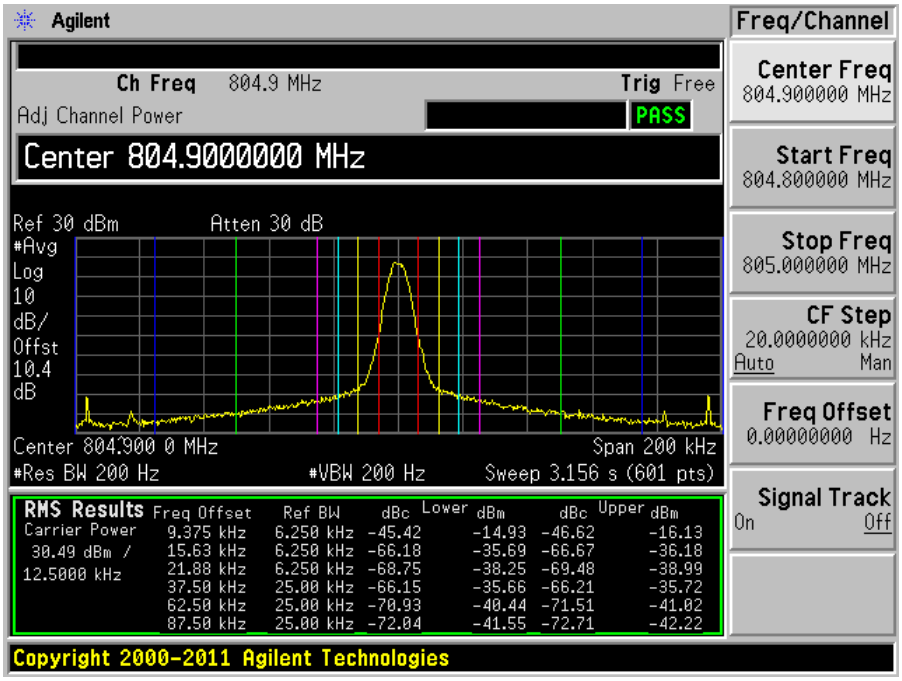


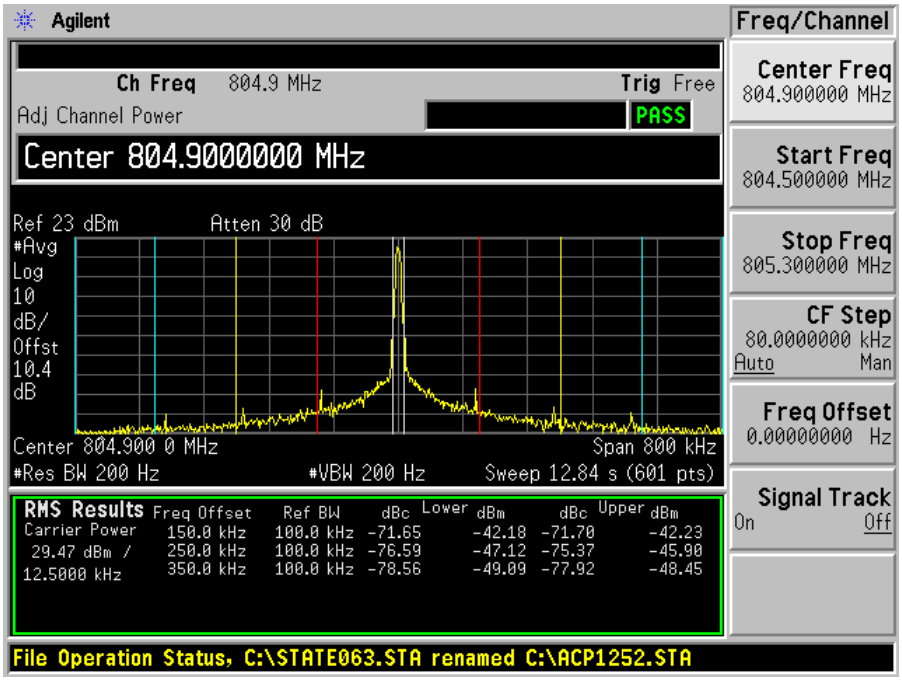
-12MHz to receive band

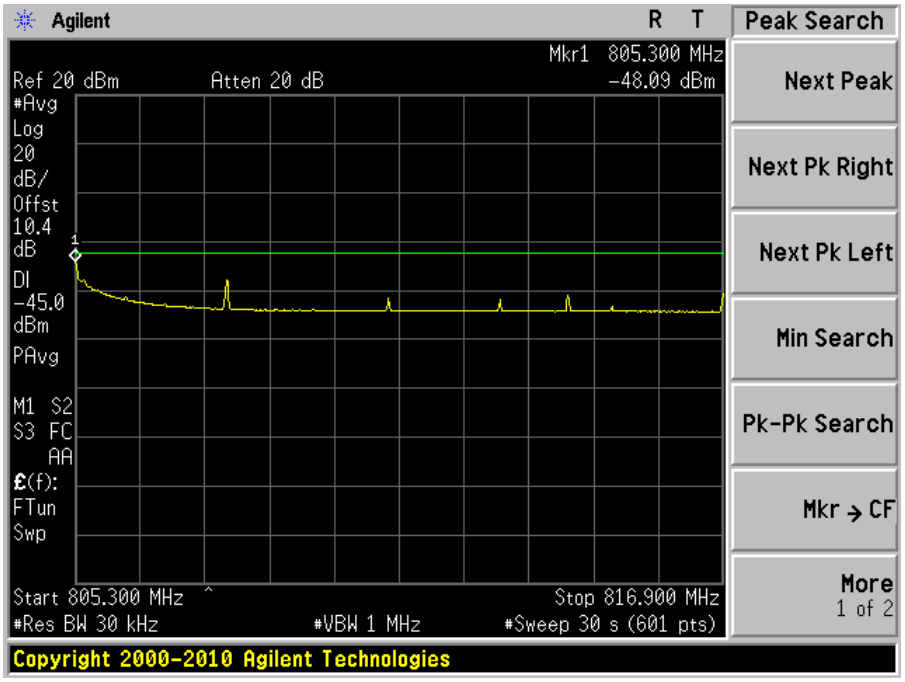


In receive band

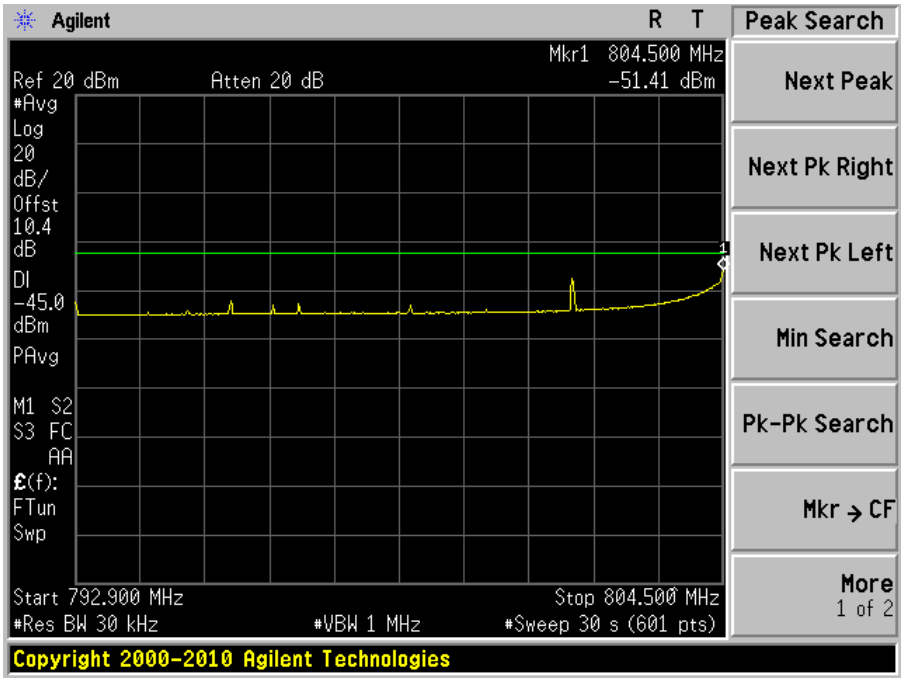
High Channel – 804.9 MHz



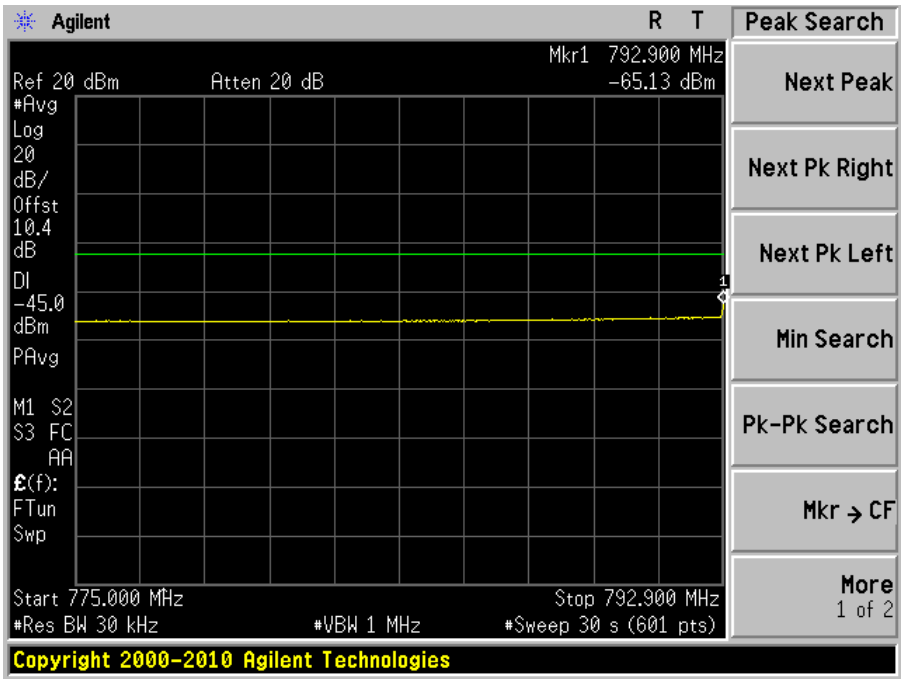




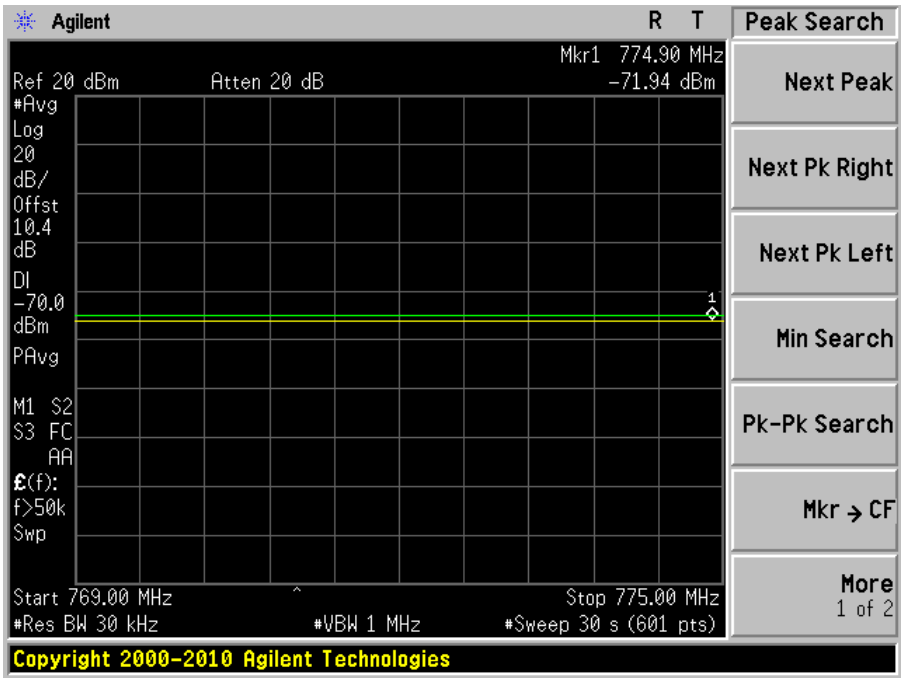
+12MHz to +400kHz



-400kHz to -12MHz



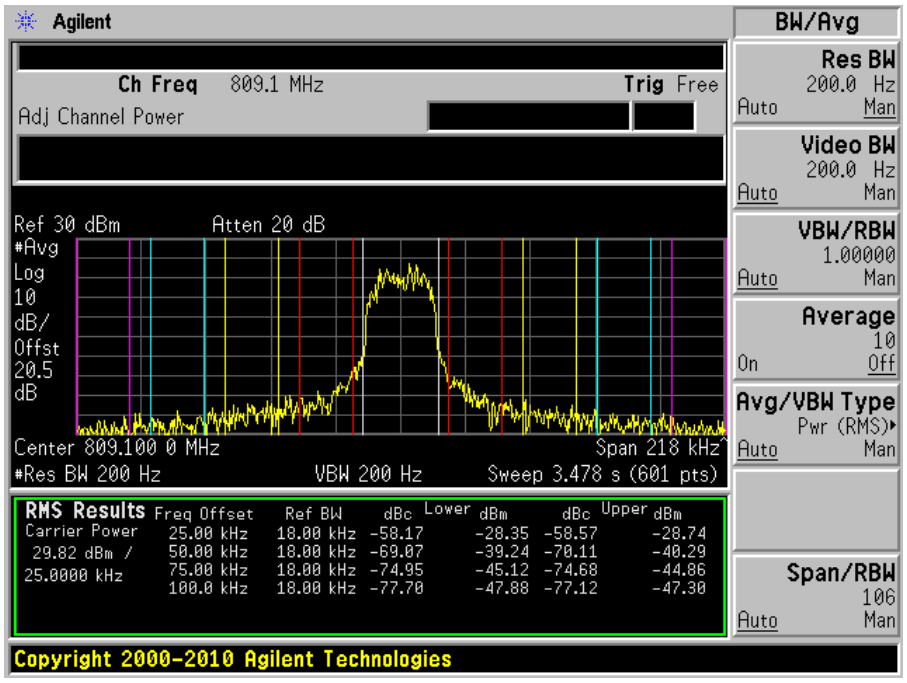
-12MHz to receive band



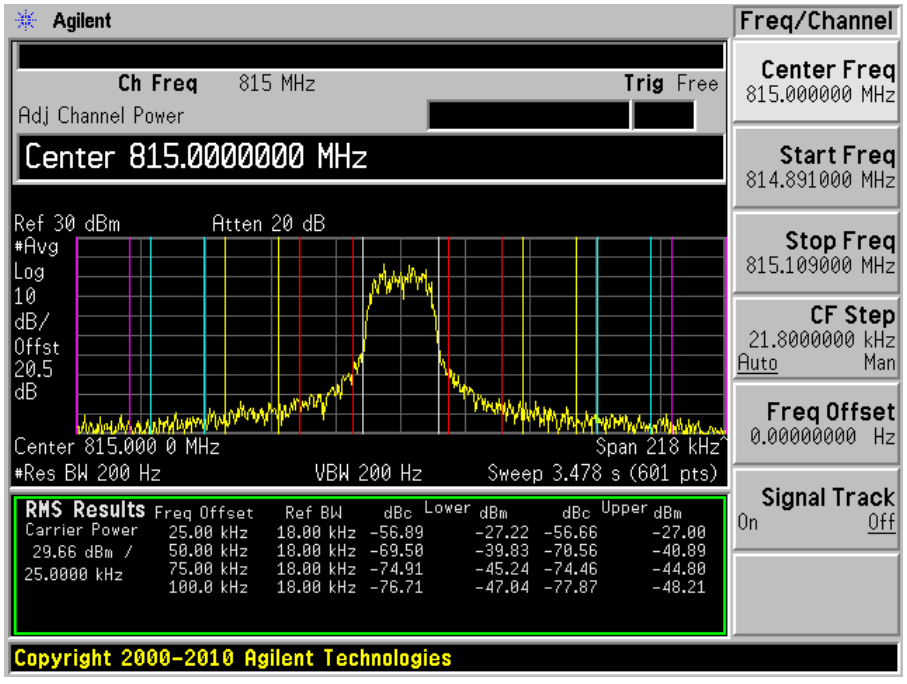
In receive band

809-824 MHz, TETRA

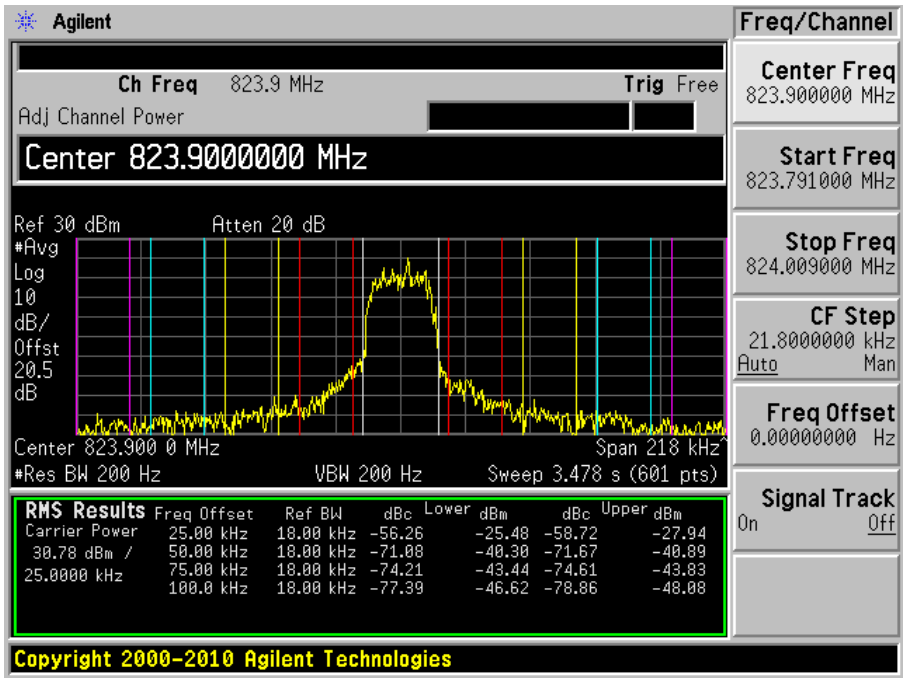
Low Channel – 809.1 MHz



Middle Channel – 815 MHz

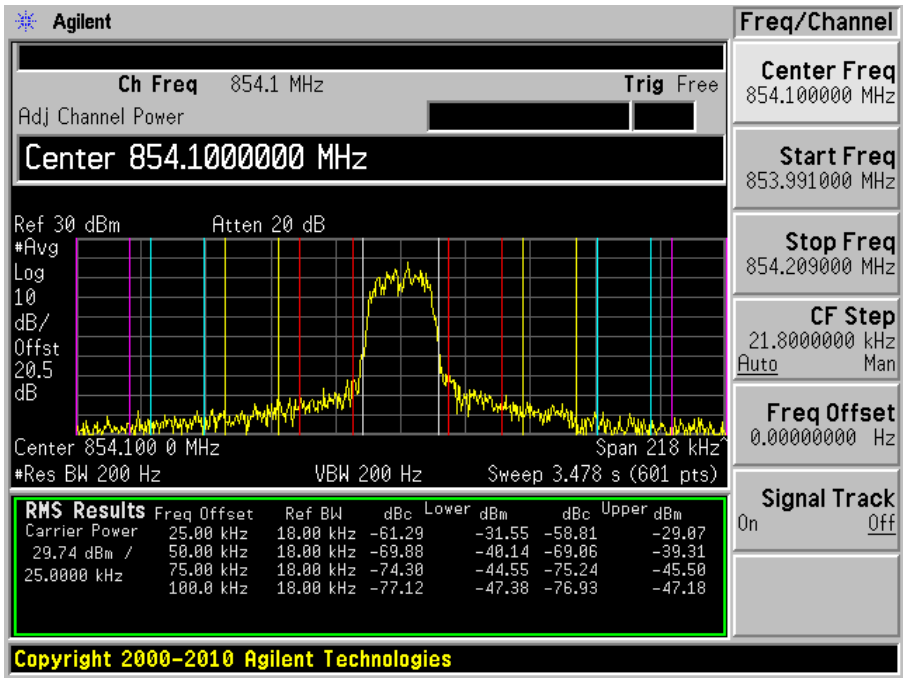


High Channel – 823.9 MHz

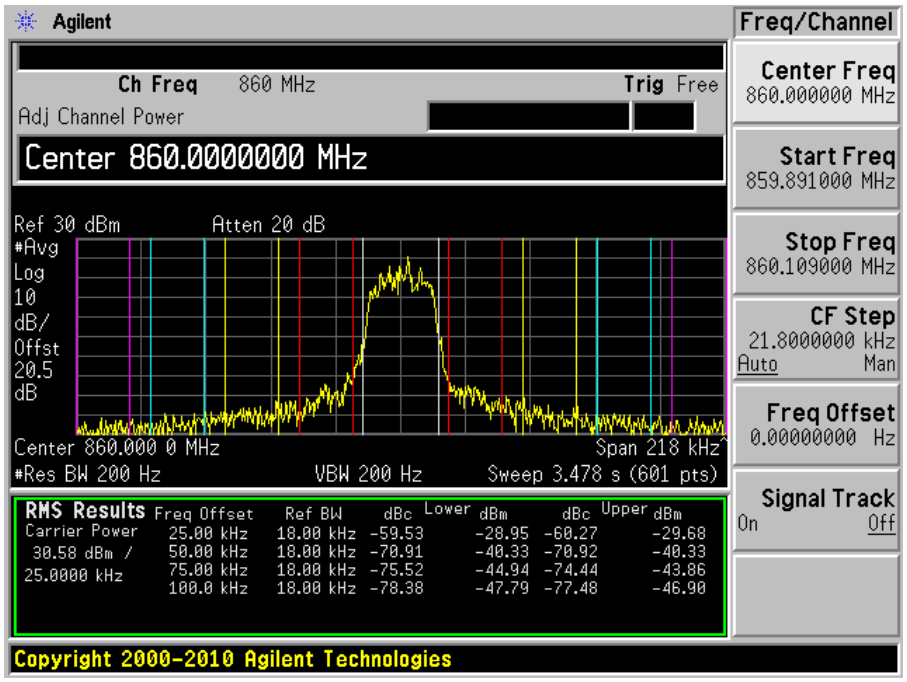


854-869 MHz, TETRA

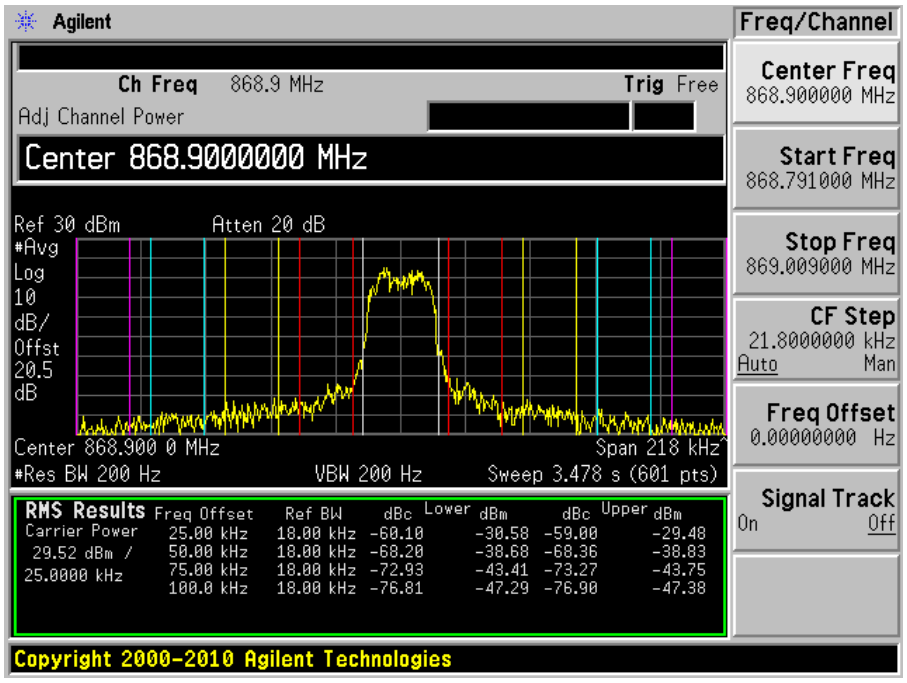
Low Channel – 854.1 MHz



Middle Channel – 860 MHz



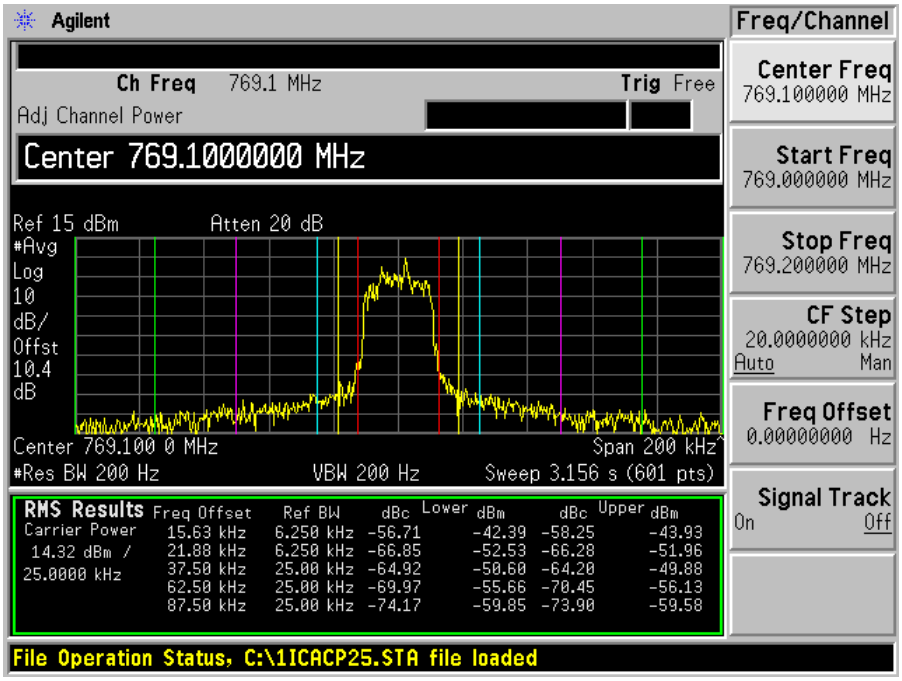
High Channel – 868.9 MHz

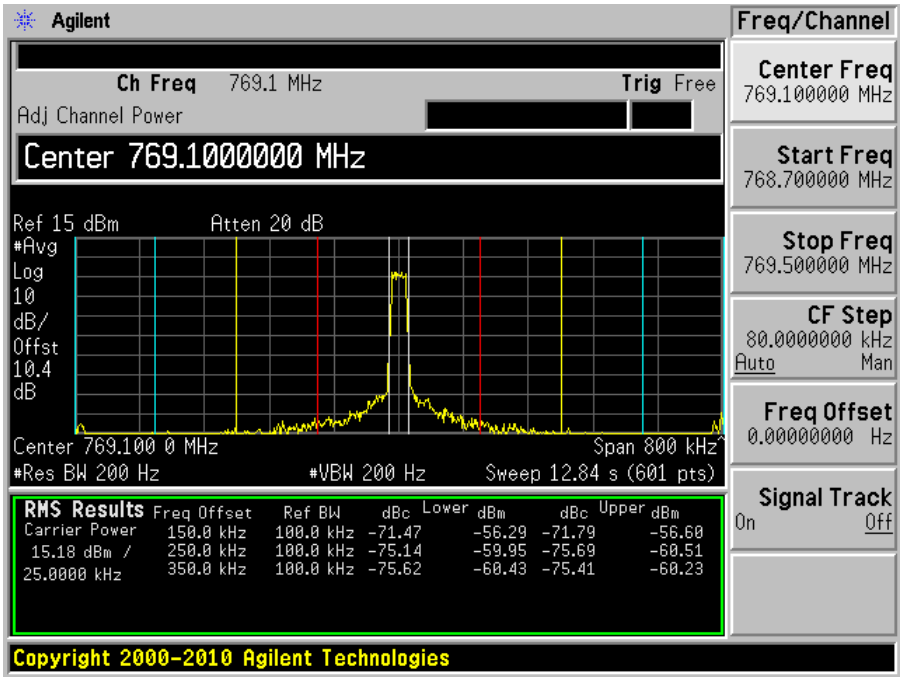


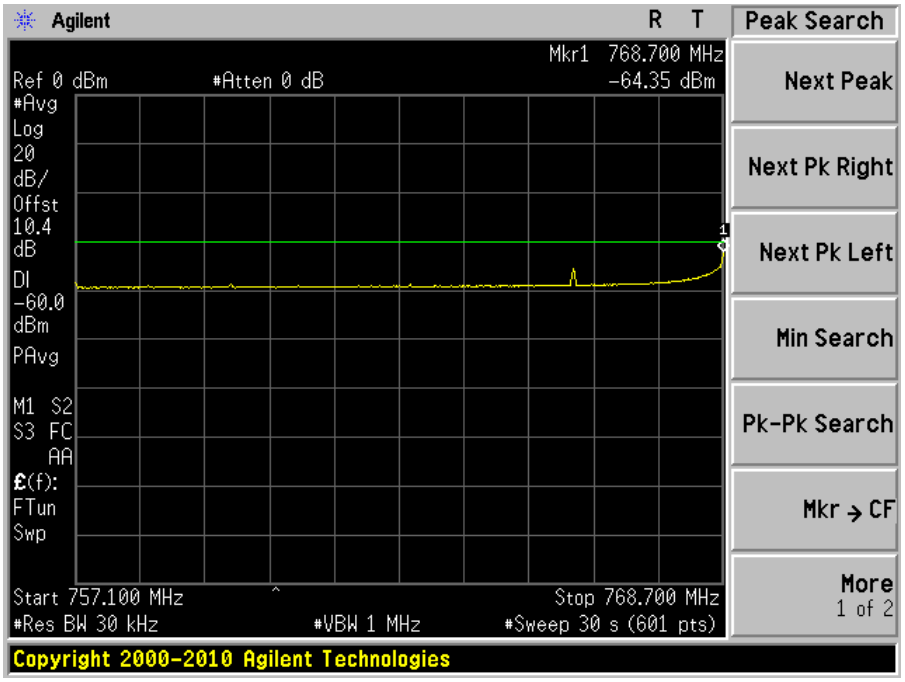
ACP (Low Power)

769-775 MHz, D-LMR

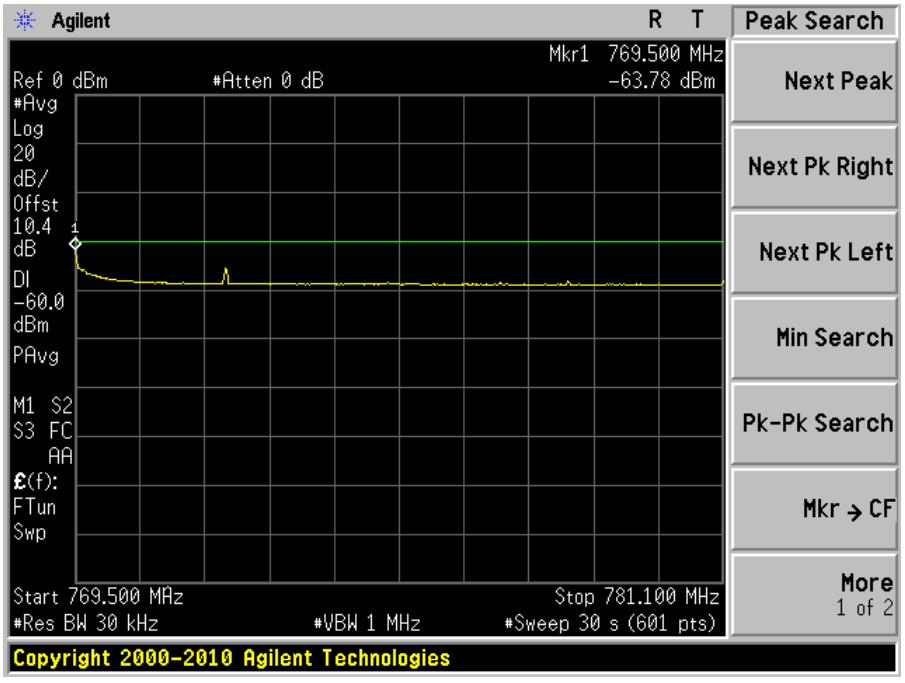
Low Channel – 769.1 MHz



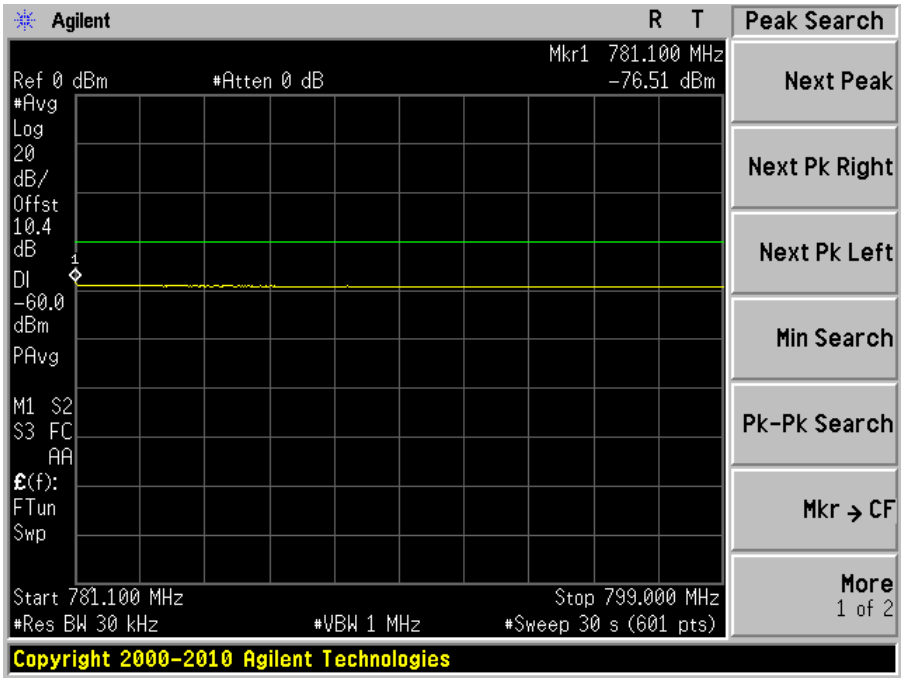




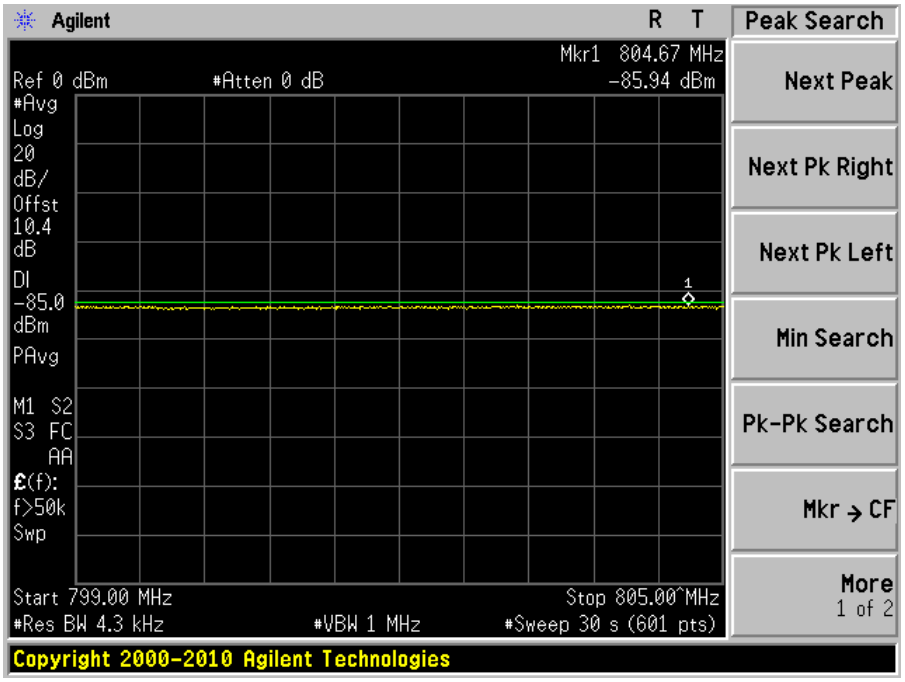
-12MHz to -400kHz



+400kHz to +12MHz



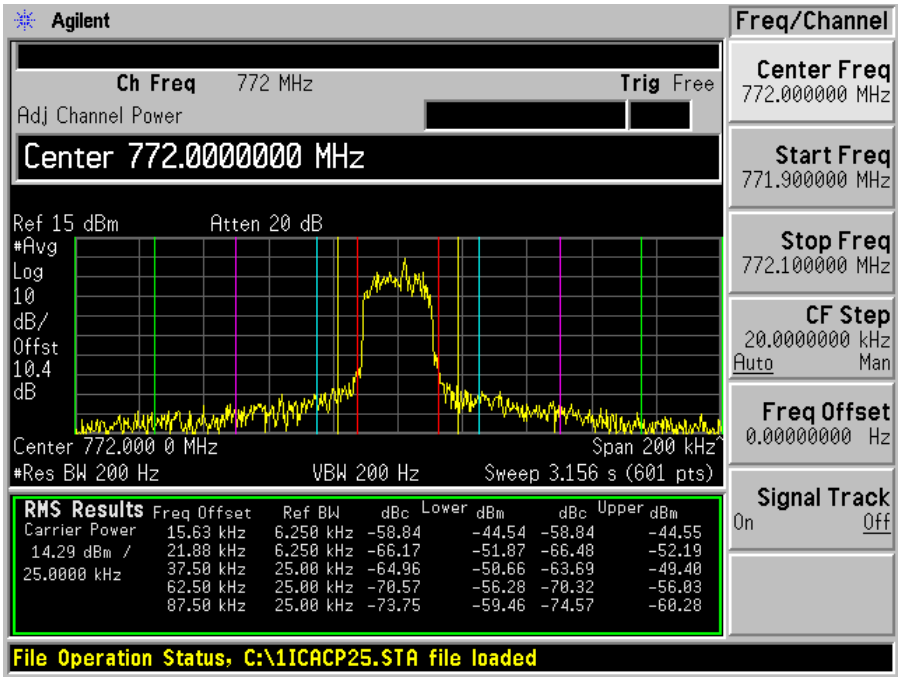
+12MHz to receive band

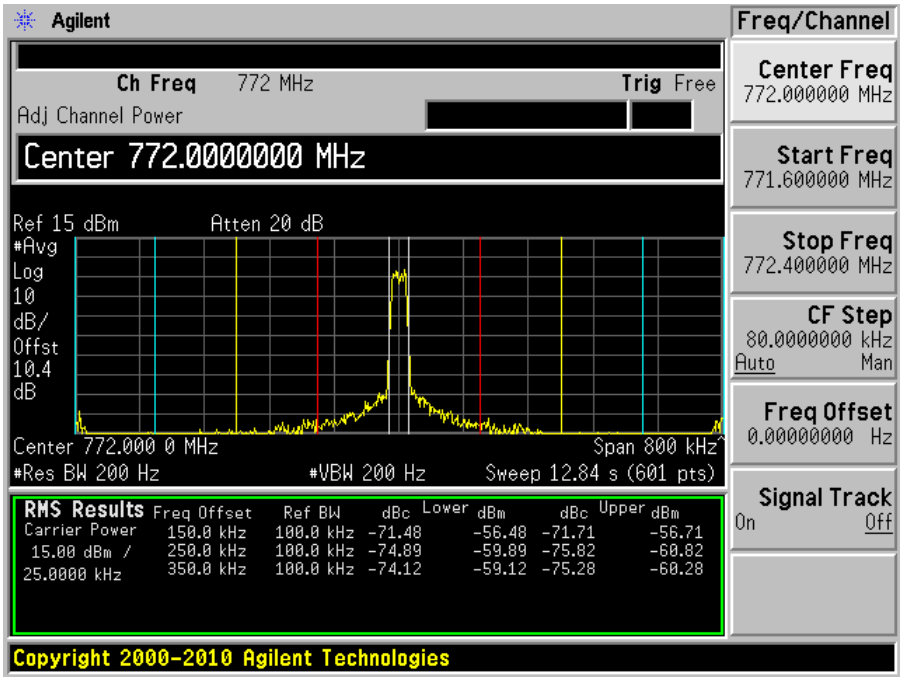


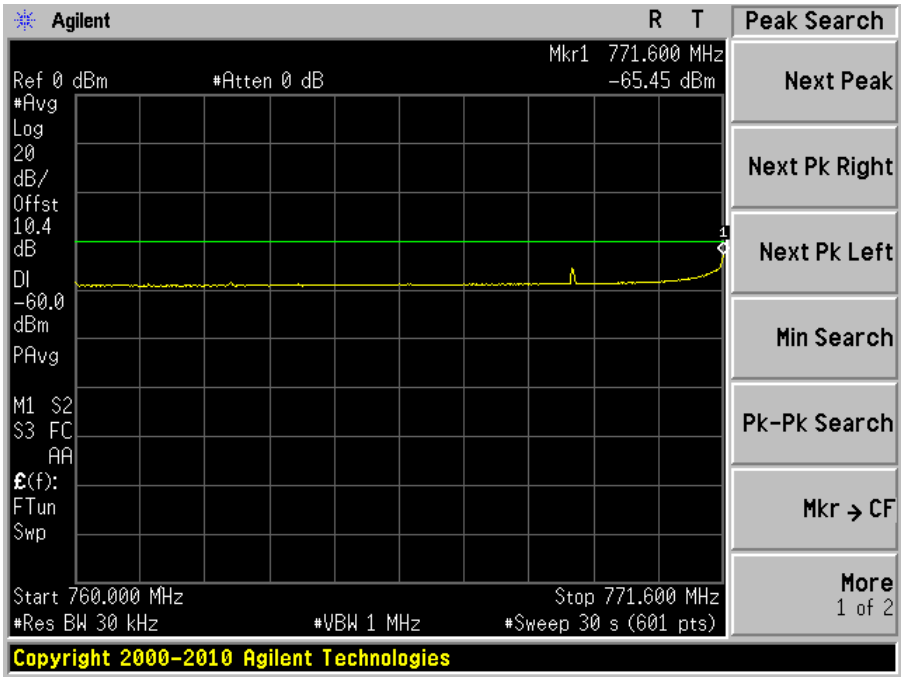
In receive band

Note: The noise floor is above the limit at 30 kHz, therefore the RBW was reduced to 4.3 kHz to show that no emissions are present.

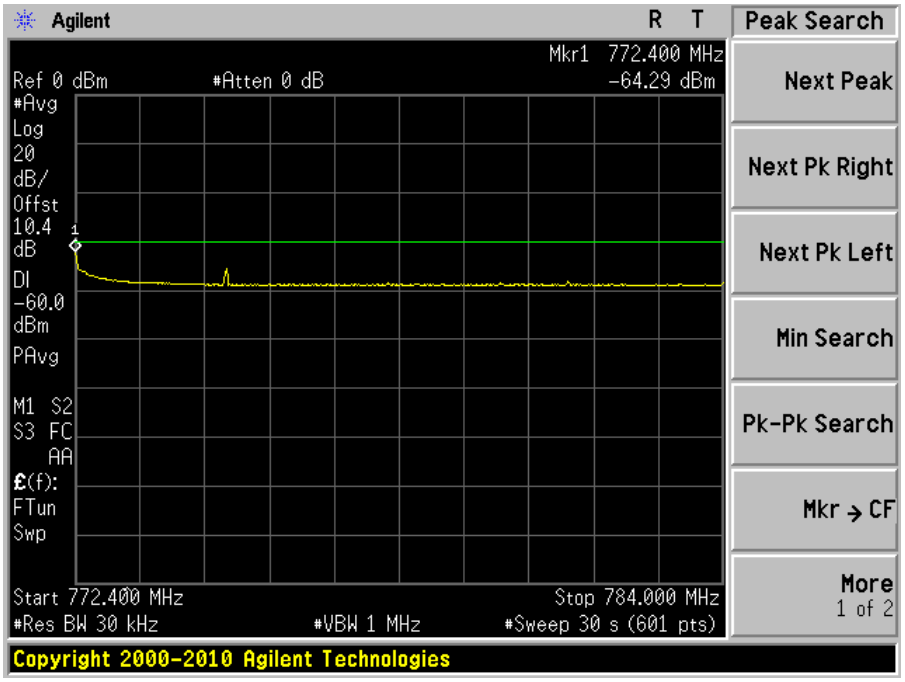
Middle Channel – 772 MHz



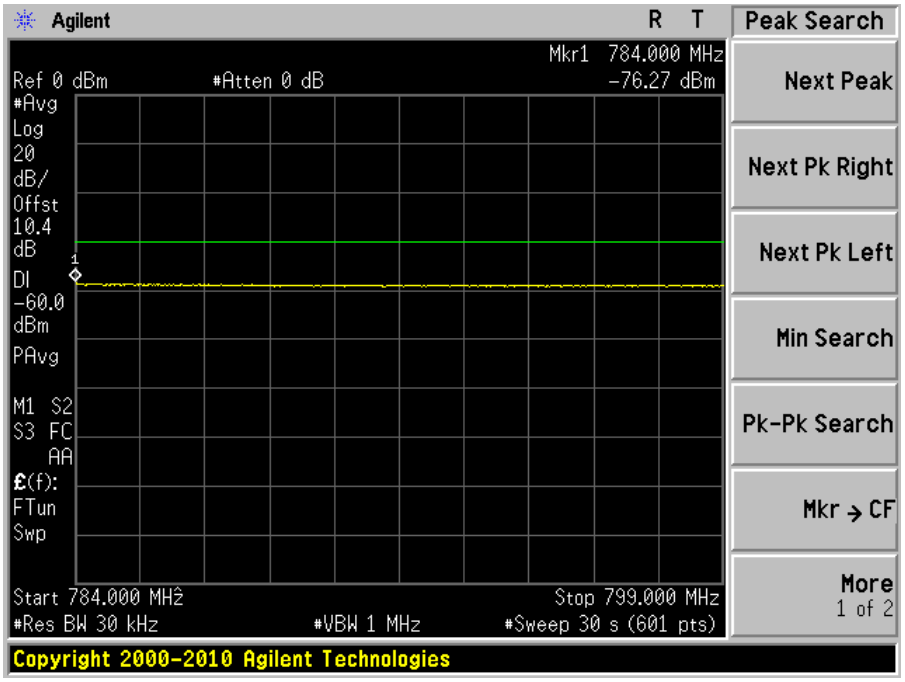




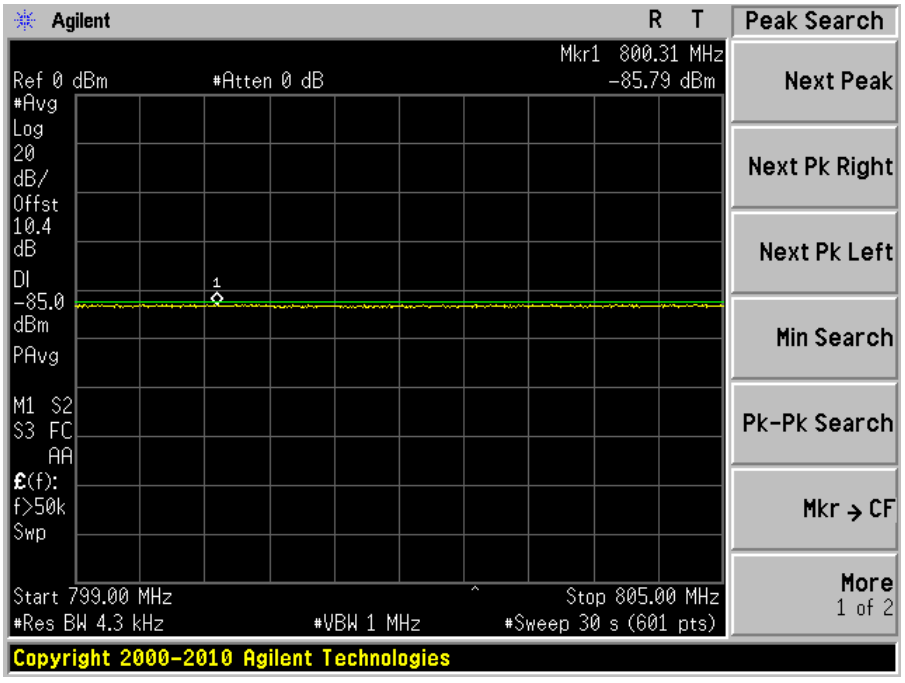
-12MHz to -400kHz



+400kHz to +12MHz



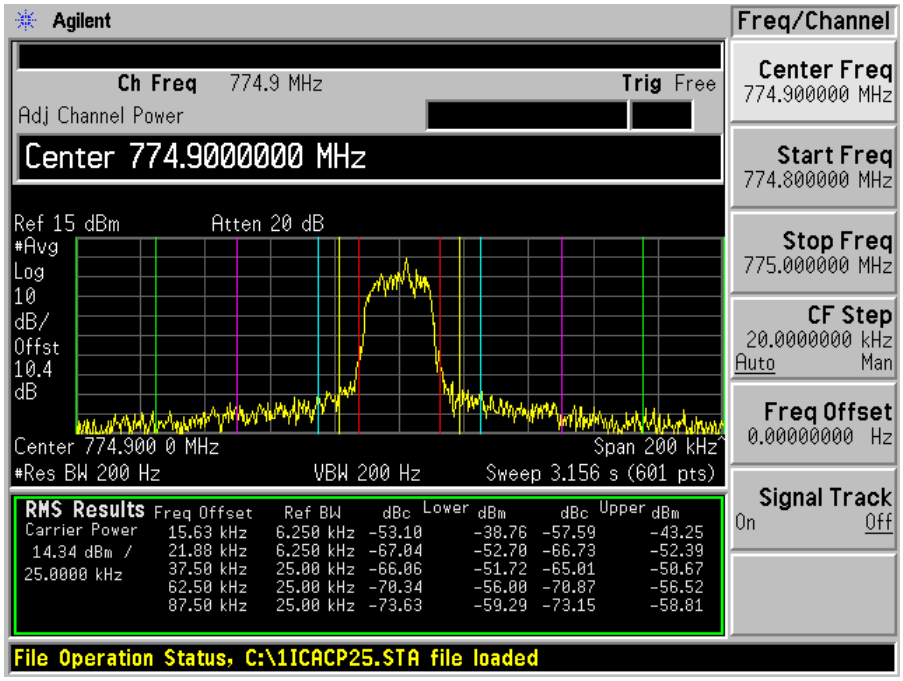
+12MHz to receive band

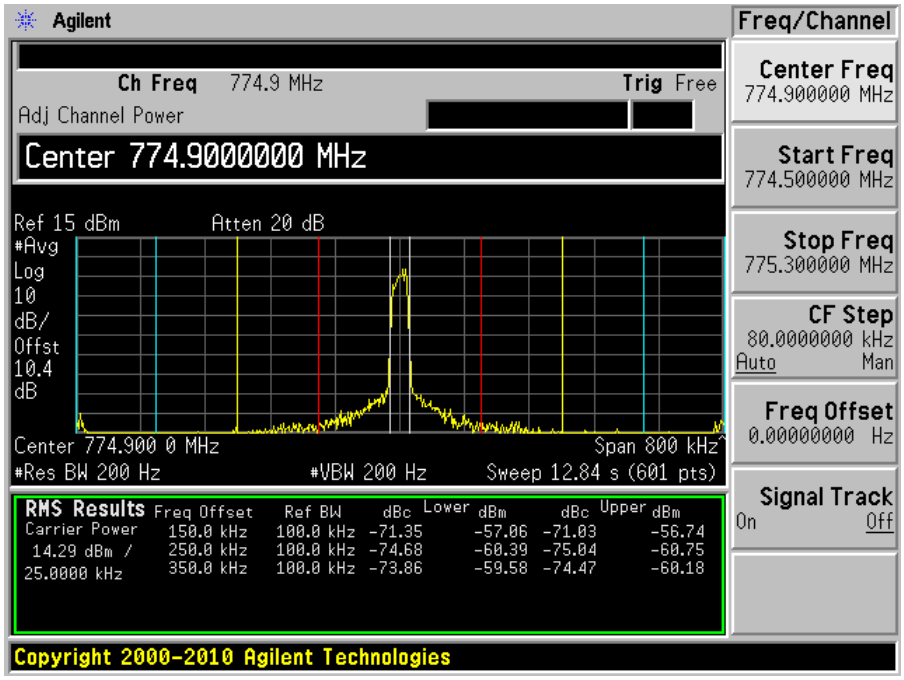


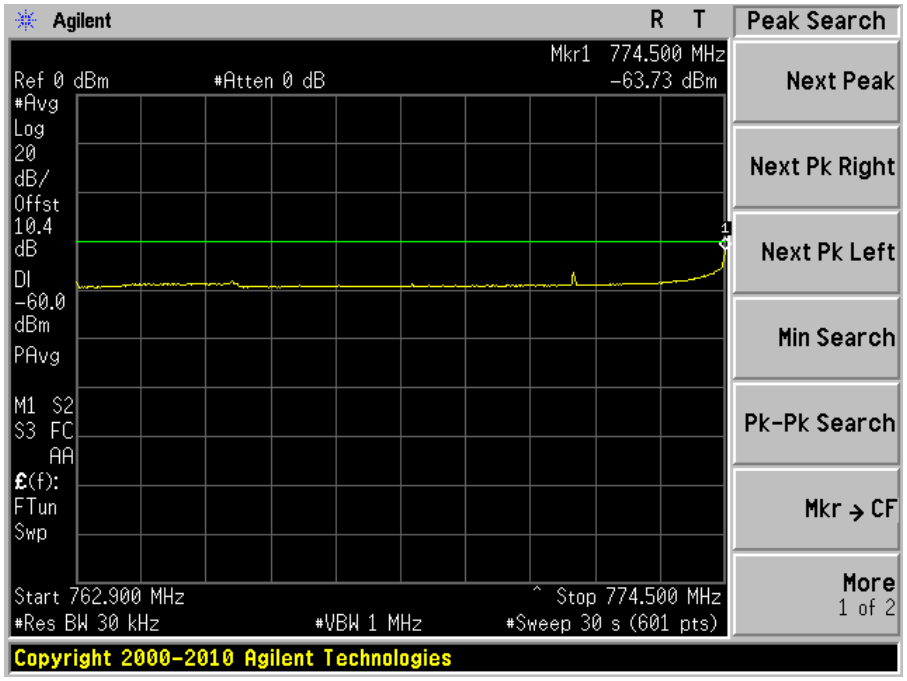
In receive band

Note: The noise floor is above the limit at 30kHz, therefore the RBW was reduced to 4.3kHz to show that no emissions are present.

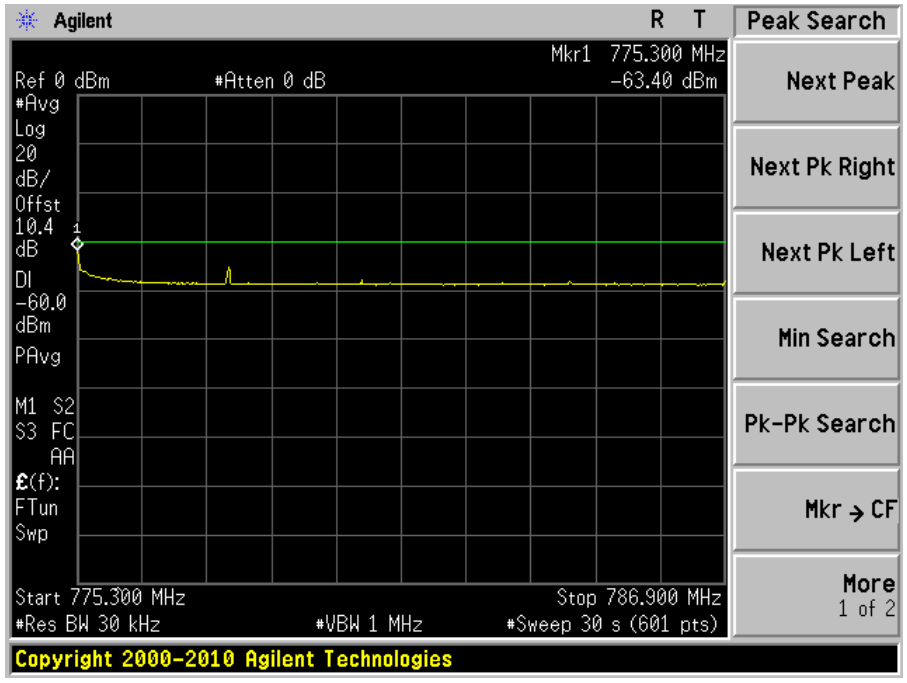
High Channel – 774.9 MHz



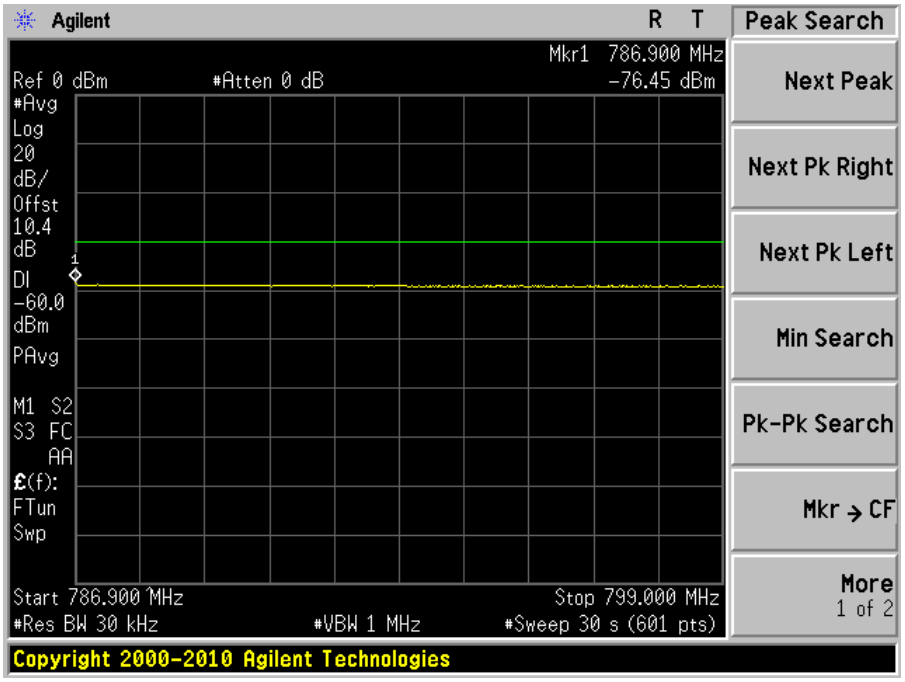




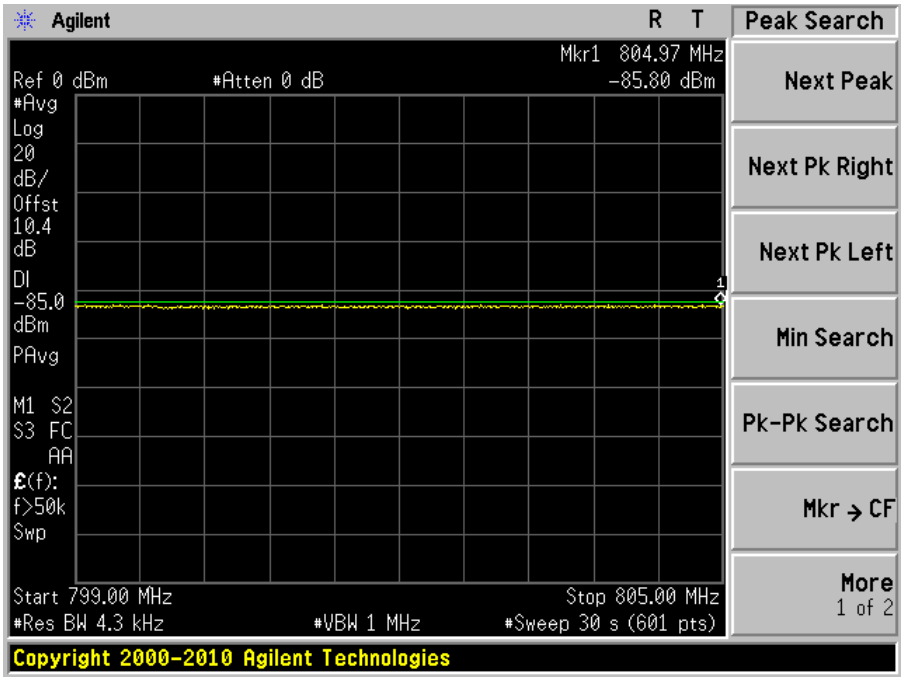
-12MHz to -400kHz



+400kHz to +12MHz



+12MHz to receive band

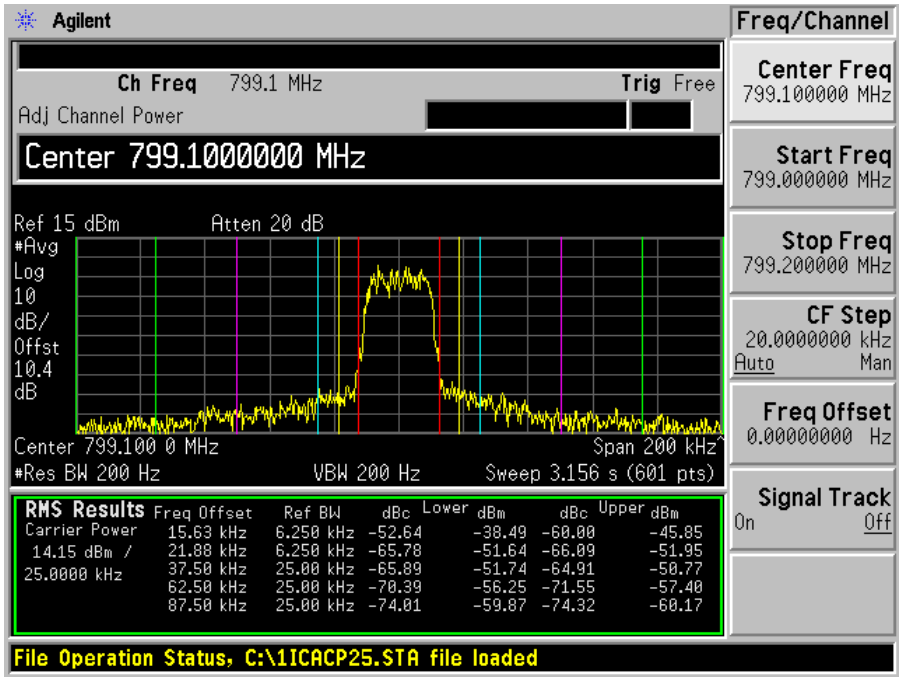


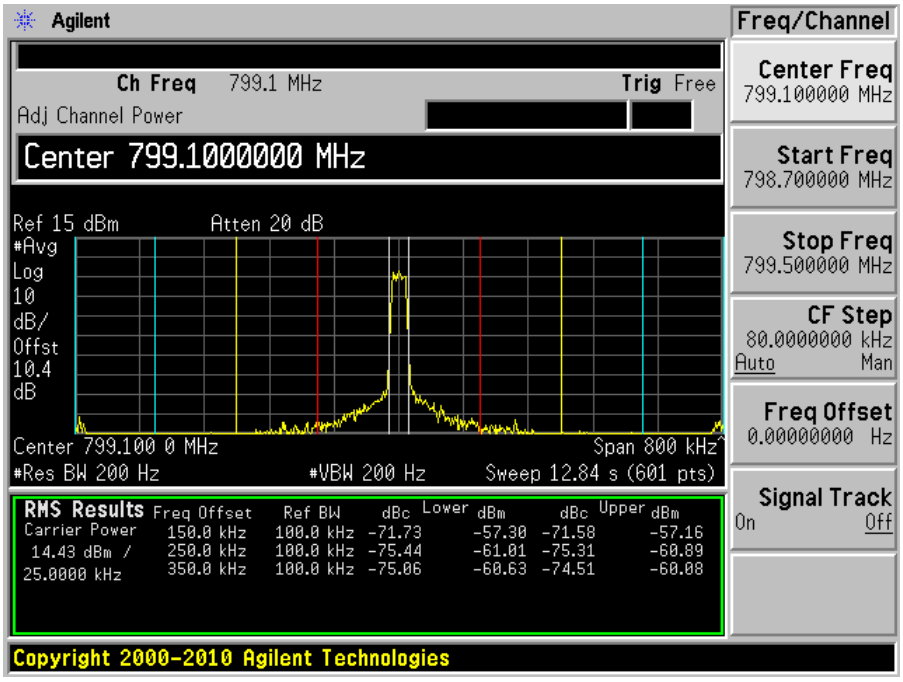
In receive band

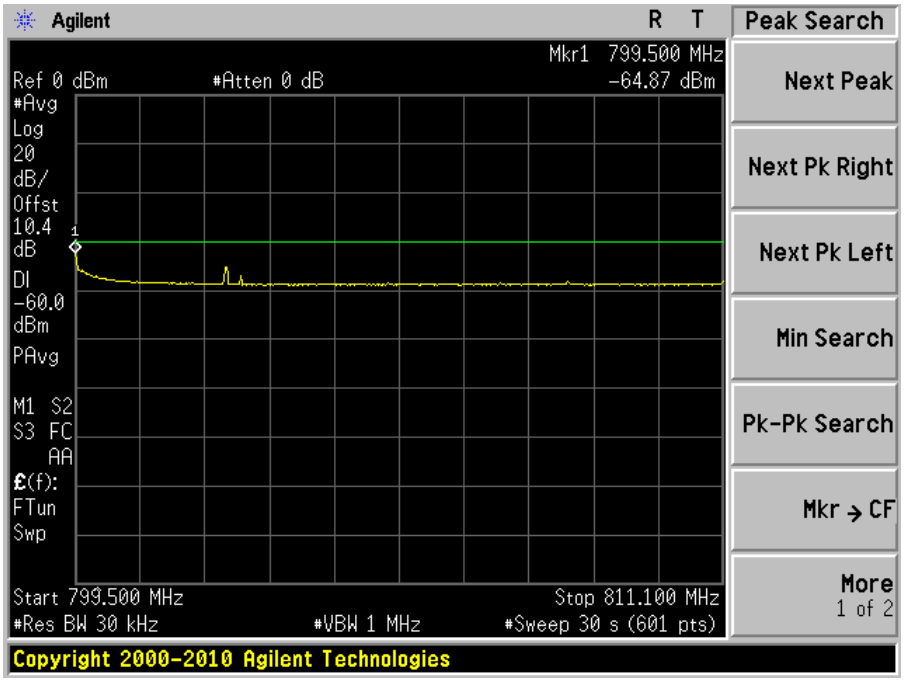
Note: The noise floor is above the limit at 30kHz, therefore the RBW was reduced to 4.3kHz to show that no emissions are present.

799-805 MHz, D-LMR

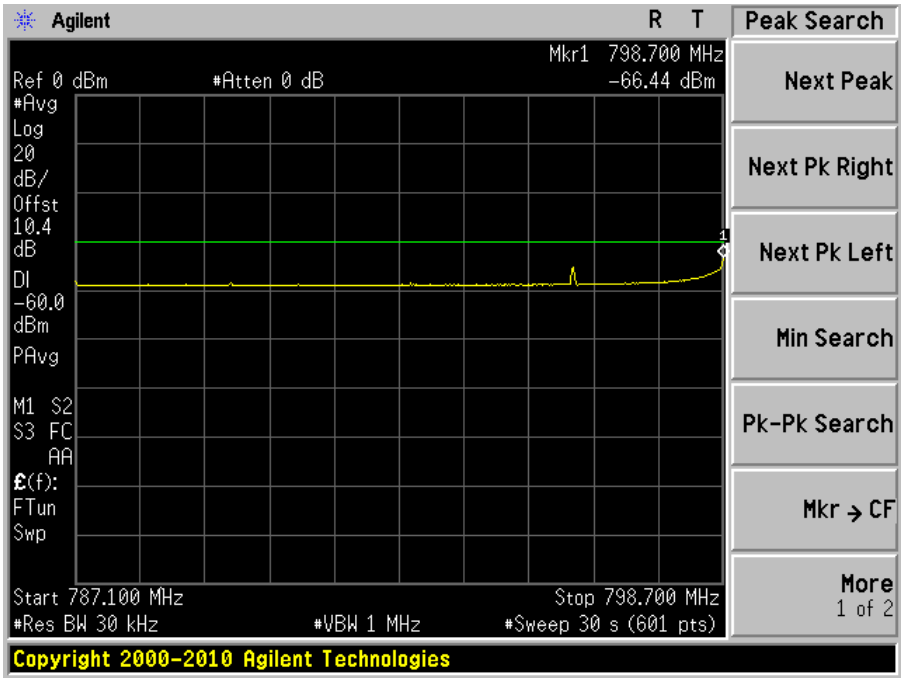
Low Channel – 799.1 MHz



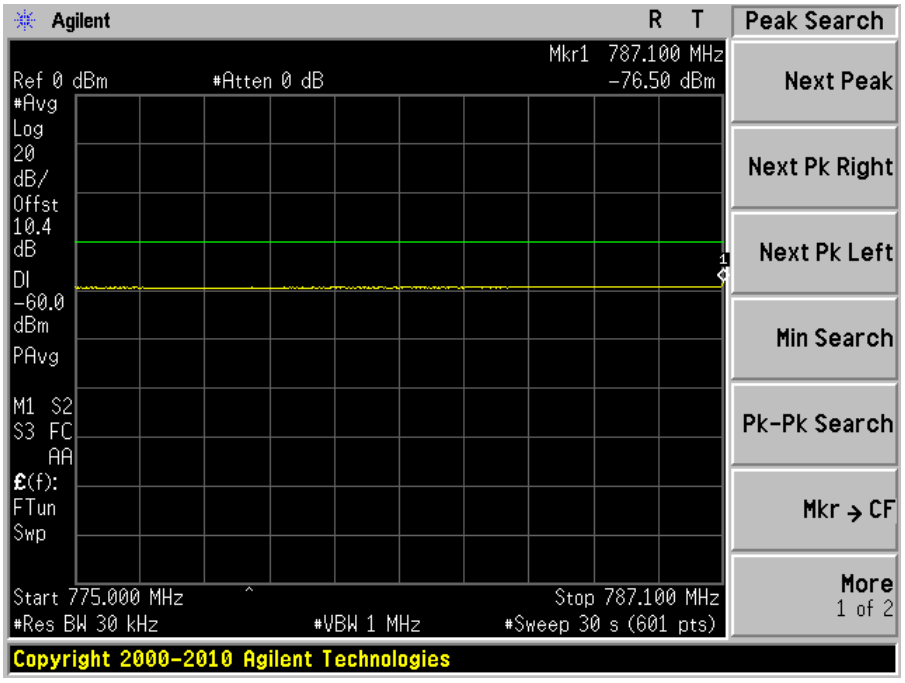




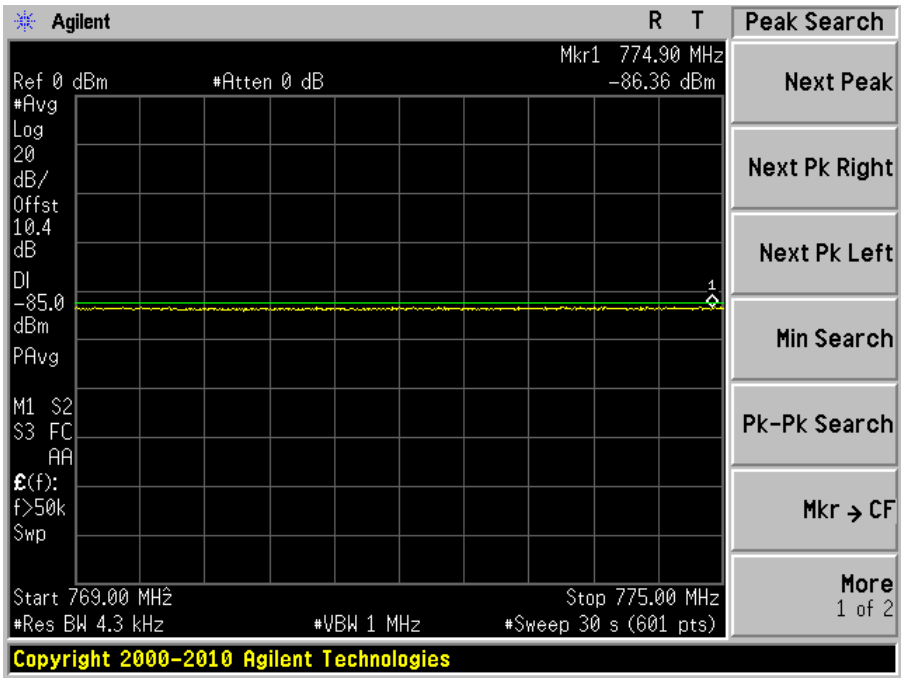
+12MHz to +400kHz



-400kHz to -12MHz



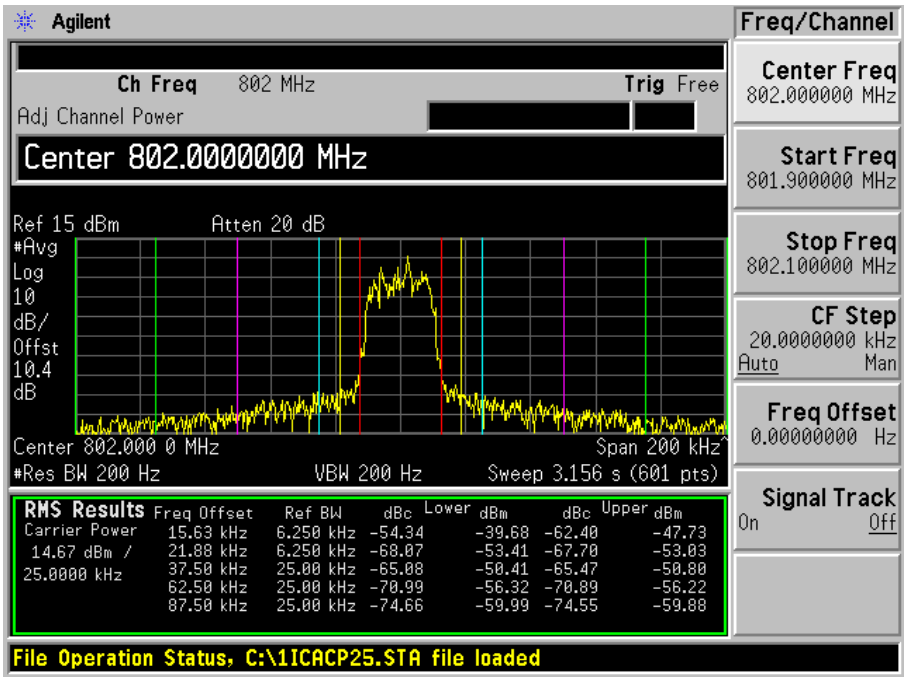
-12MHz to receive band

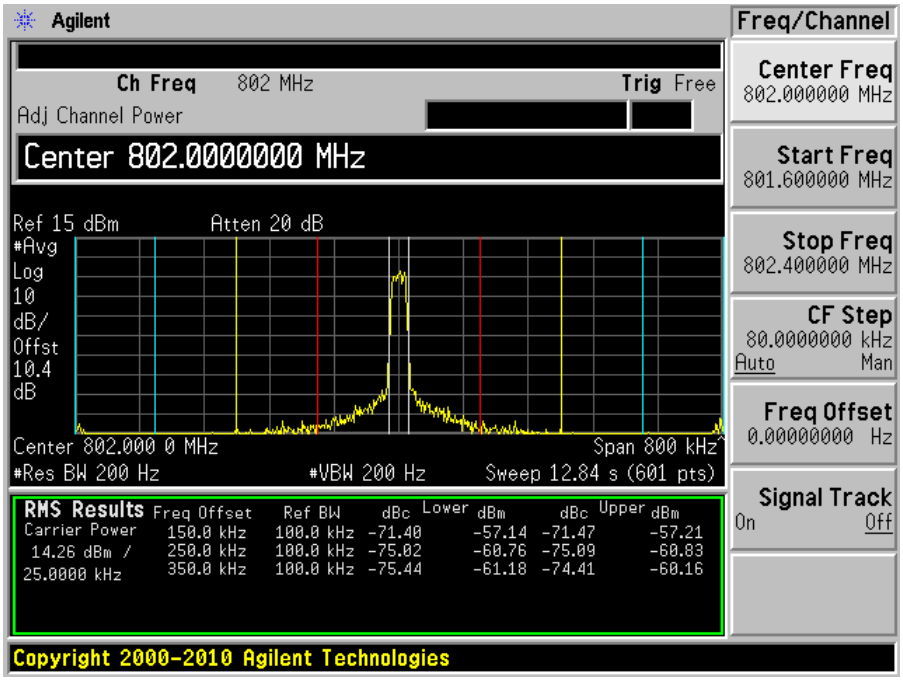


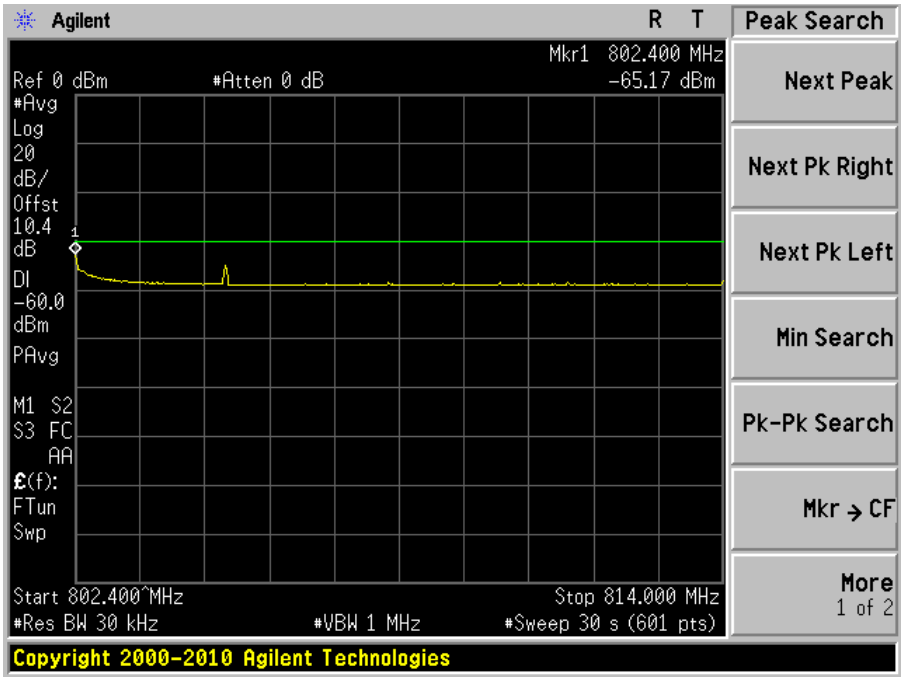
In receive band

Note: The noise floor is above the limit at 30kHz, therefore the RBW was reduced to 4.3kHz to show that no emissions are present.

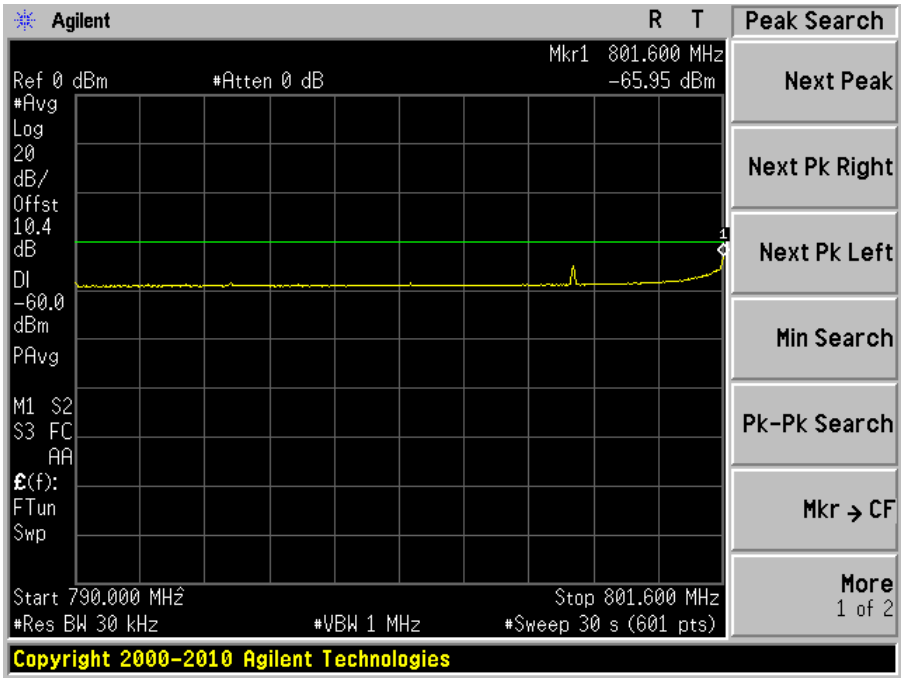
Middle Channel – 802 MHz



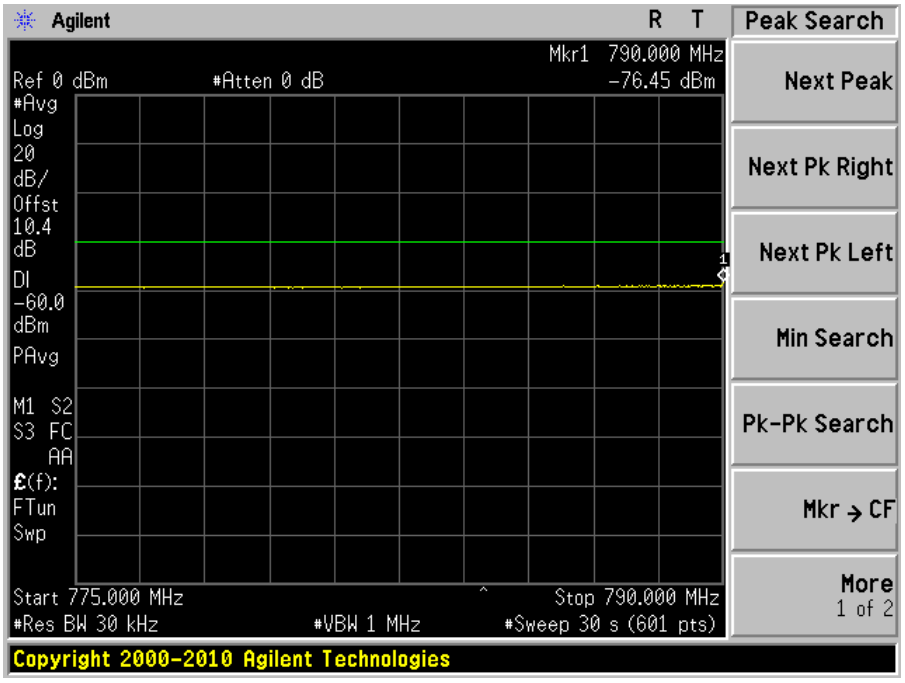




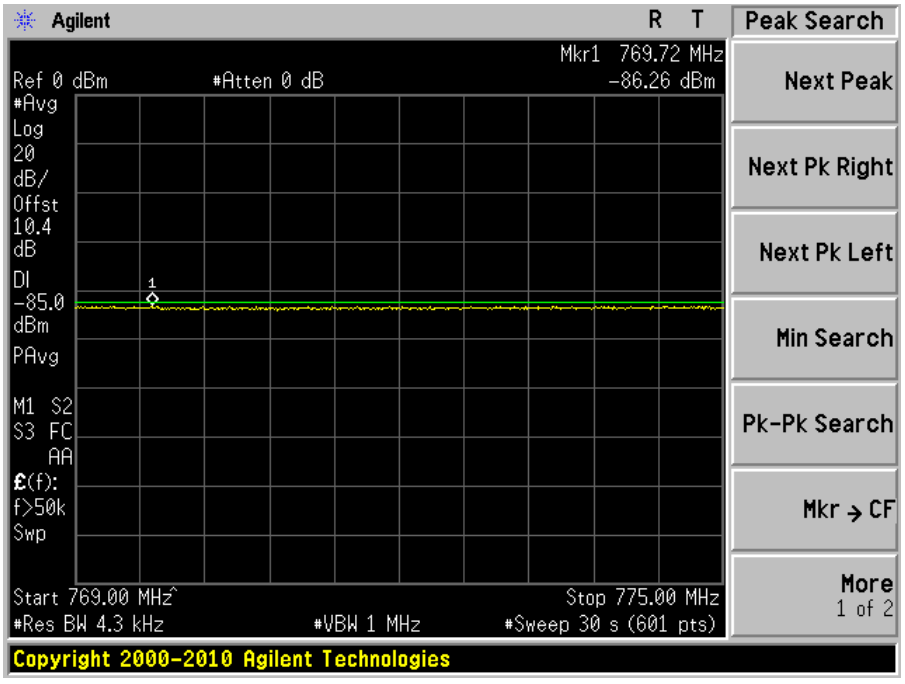
+12MHz to +400kHz



-400kHz to -12MHz



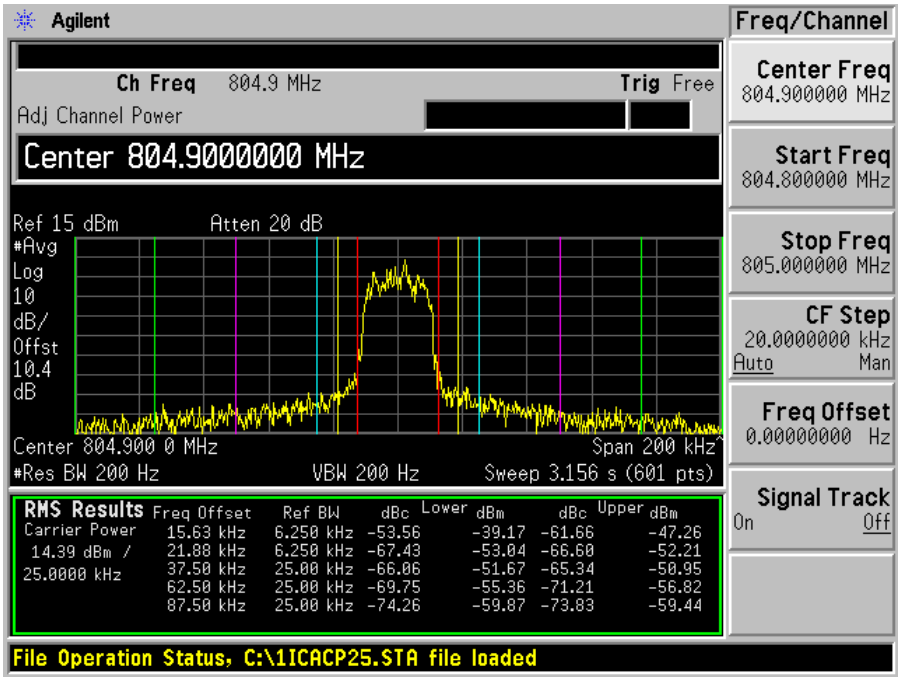
-12MHz to receive band

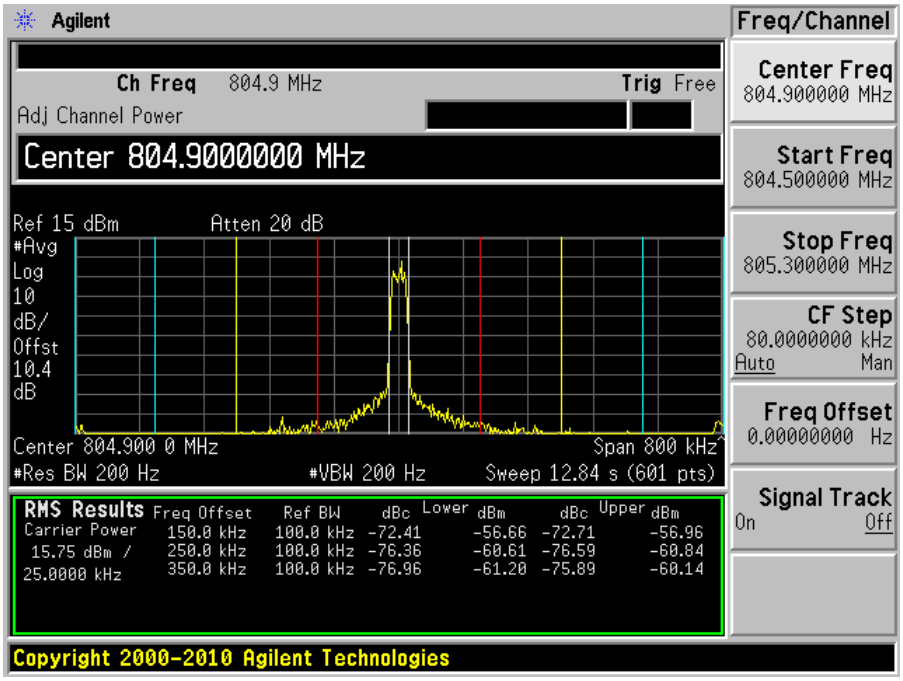


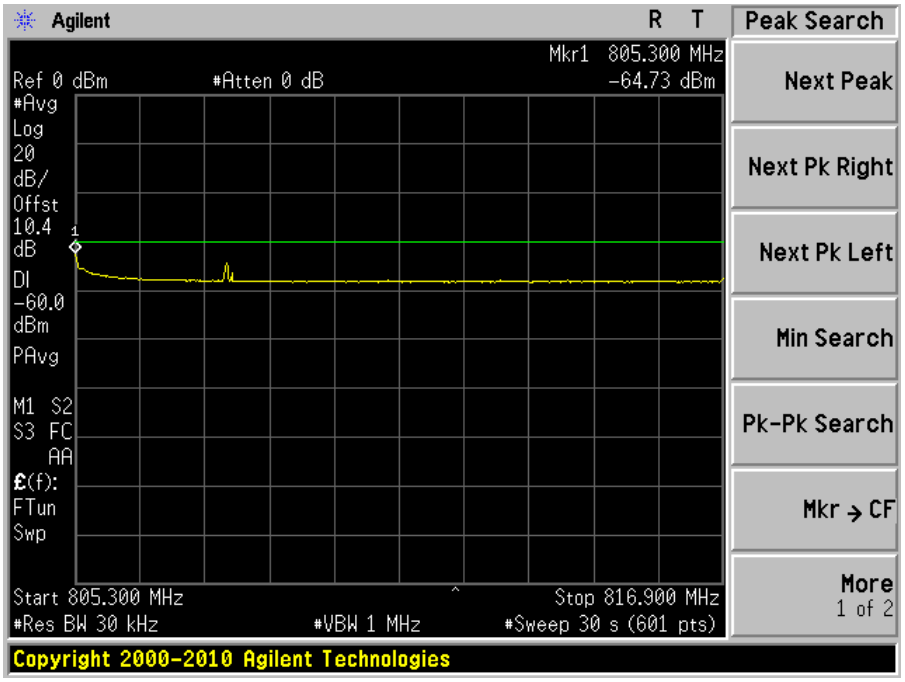
In receive band

Note: The noise floor is above the limit at 30kHz, therefore the RBW was reduced to 4.3kHz to show that no emissions are present.

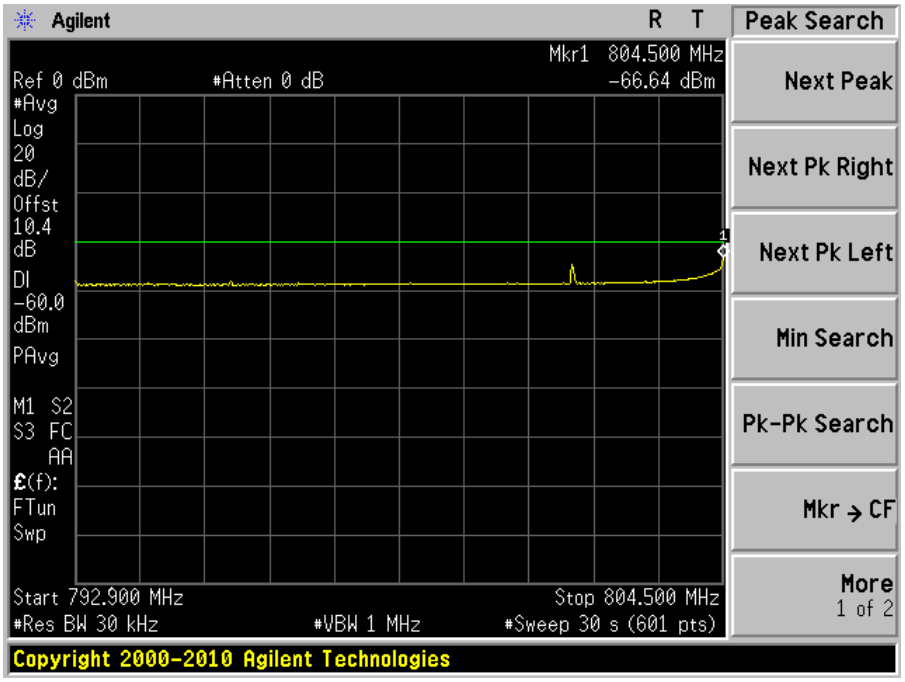
High Channel – 804.9 MHz



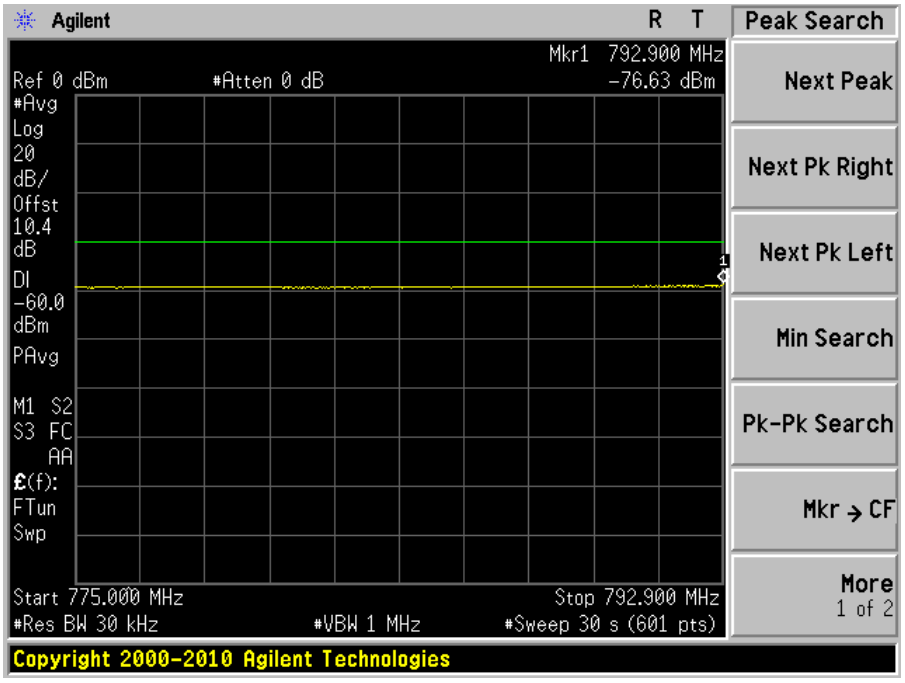




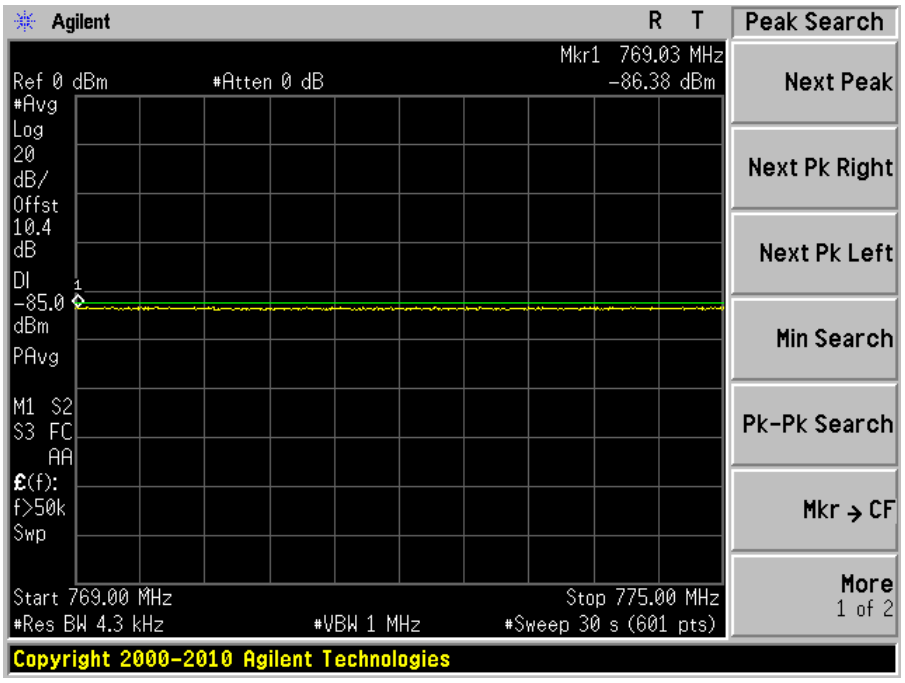
+12MHz to +400kHz



-400kHz to -12MHz



-12MHz to receive band

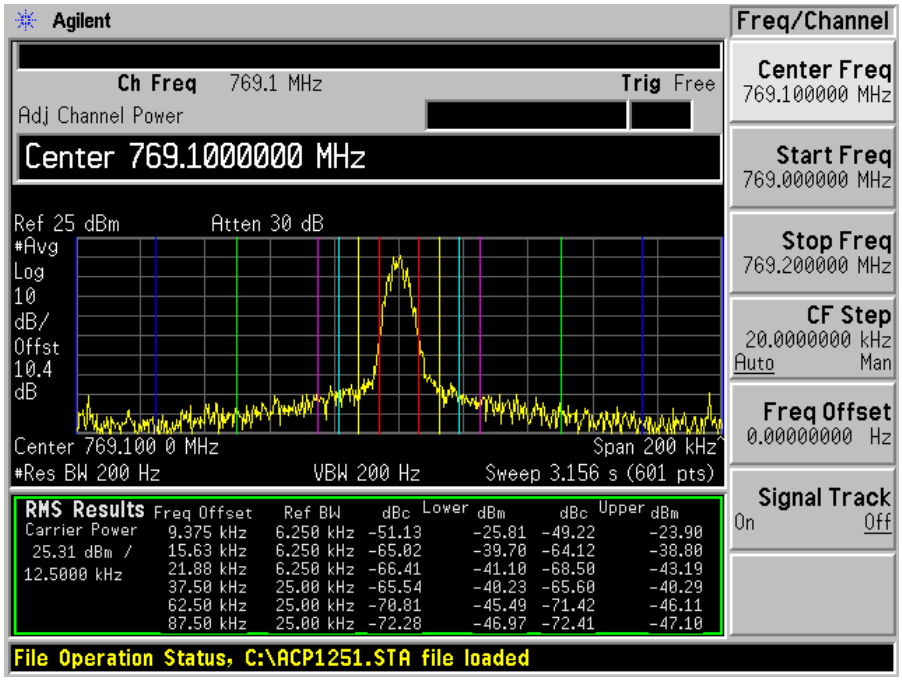


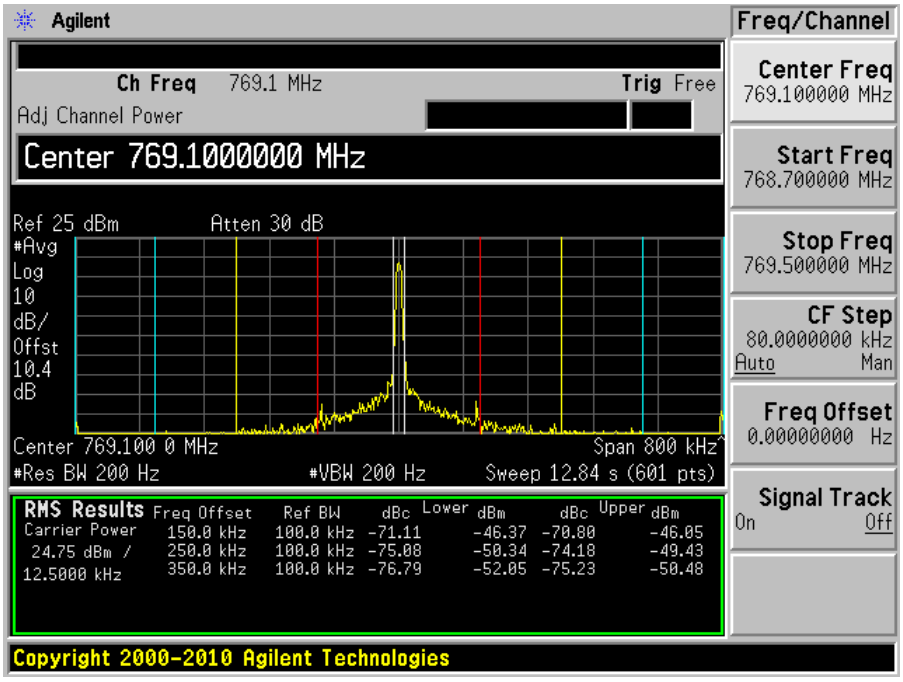
In receive band

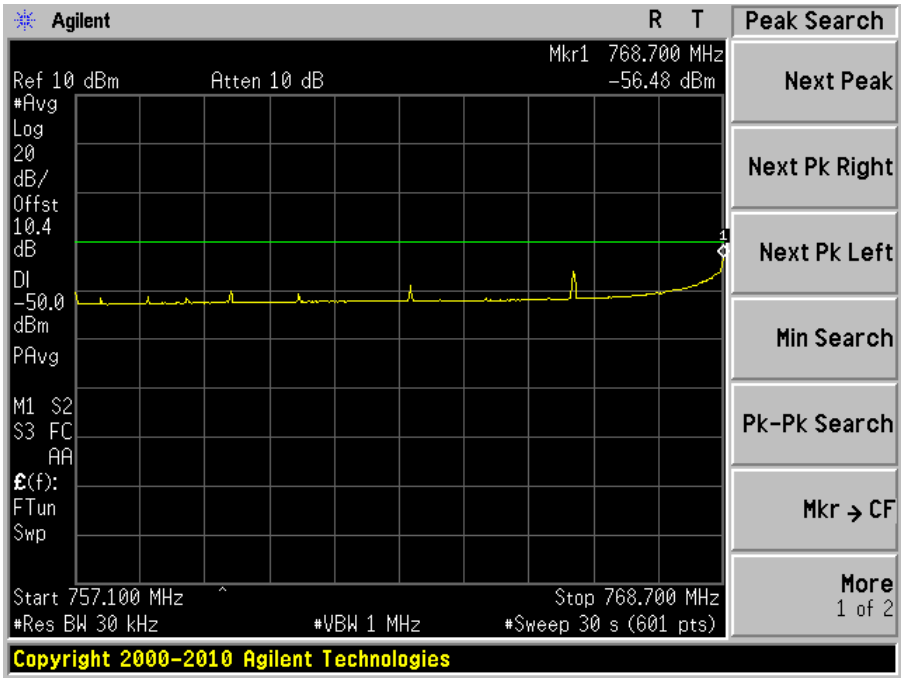
Note: The noise floor is above the limit at 30kHz, therefore the RBW was reduced to 4.3kHz to show that no emissions are present.

769-775 MHz, C4FM

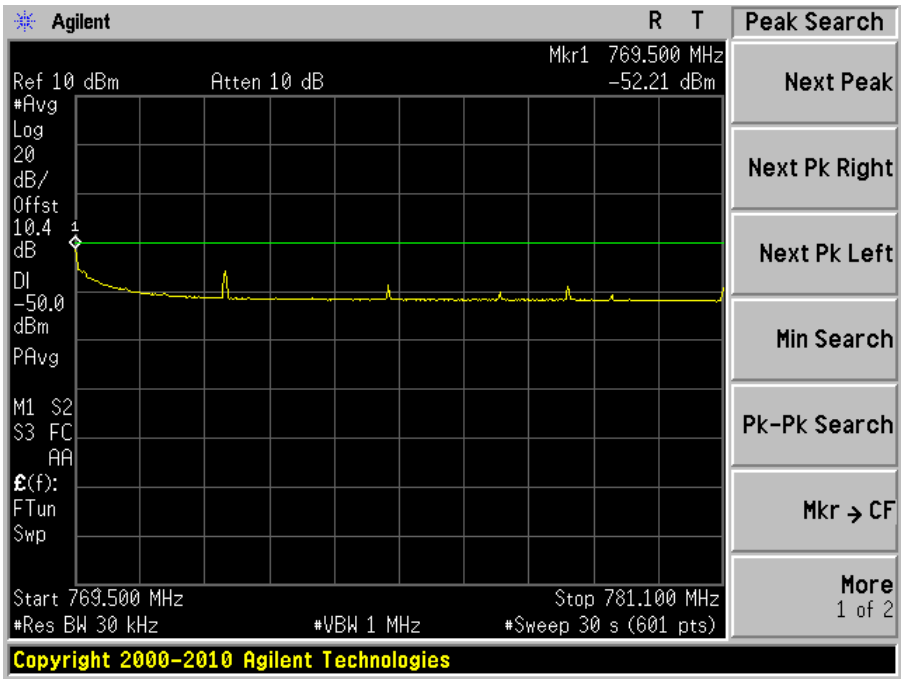
Low Channel – 769.1 MHz



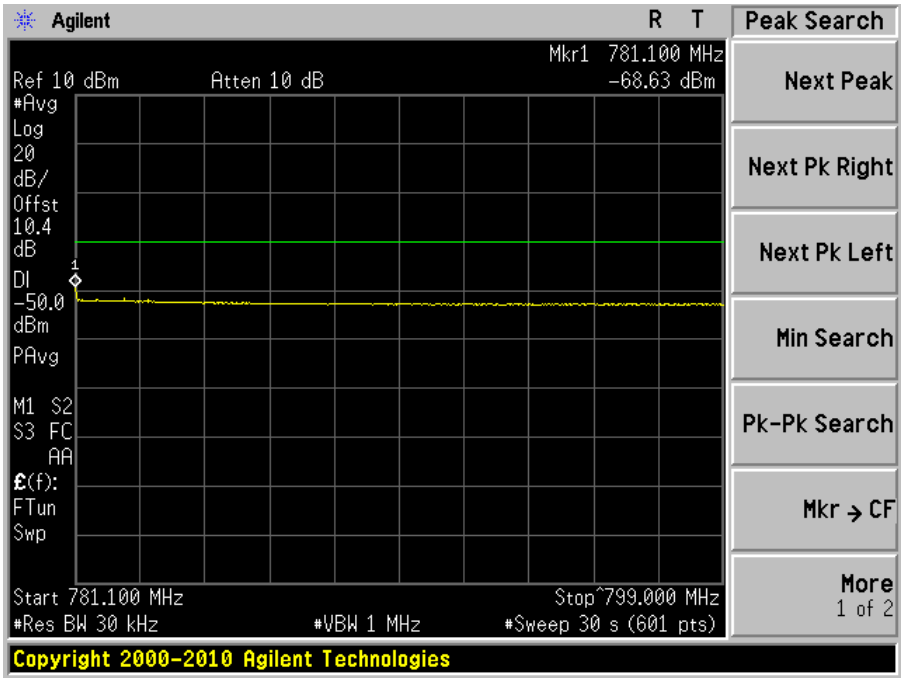




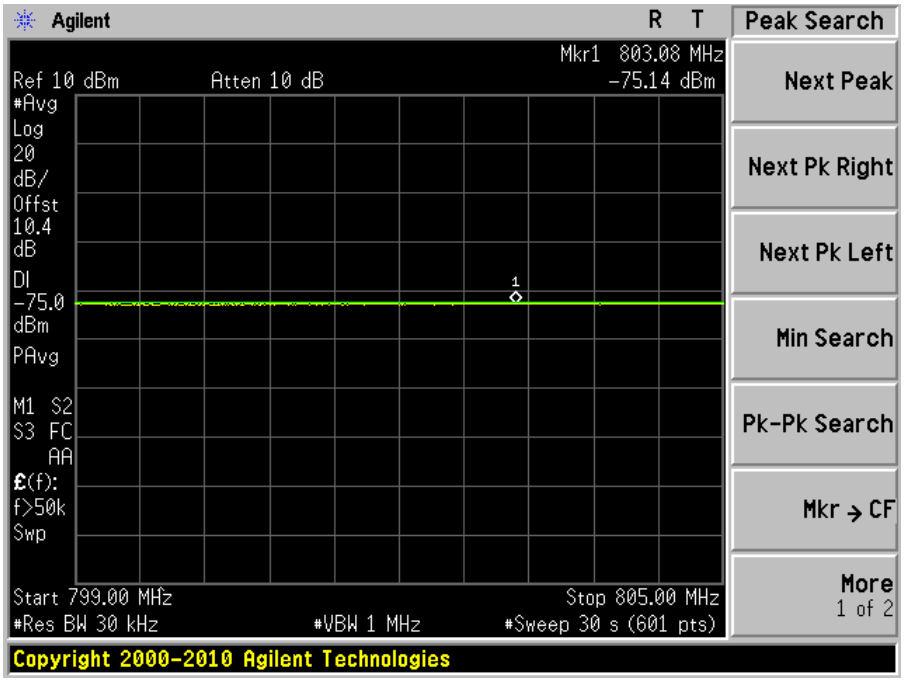
-12MHz to -400kHz



+400kHz to +12MHz

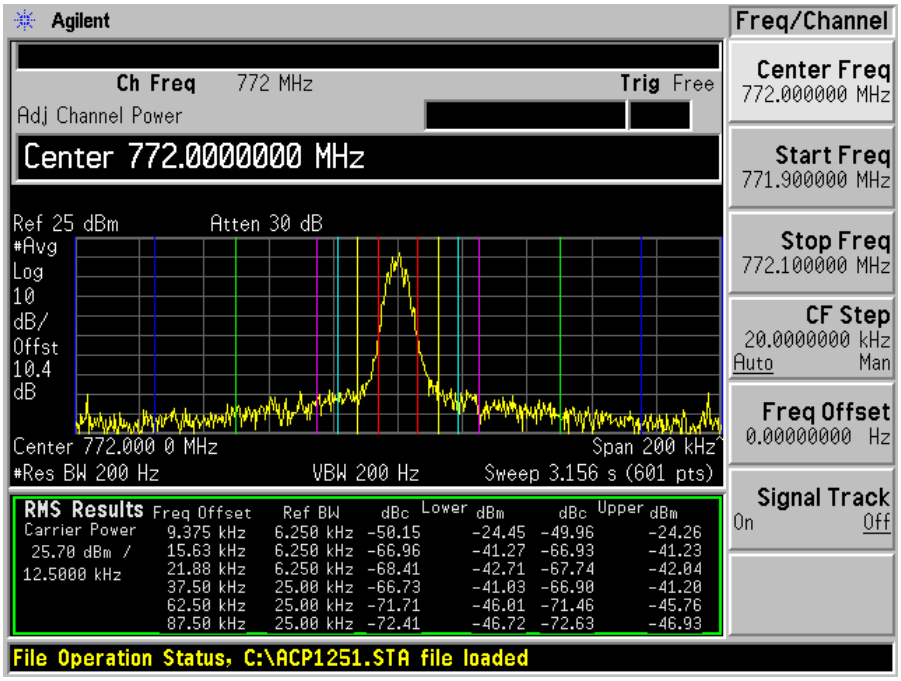


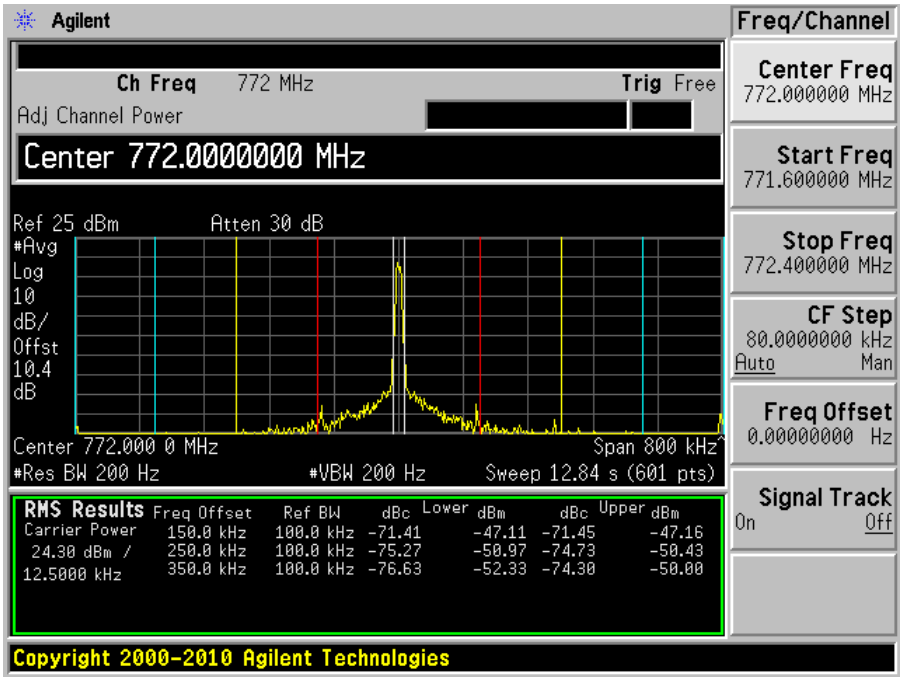
+12MHz to receive band

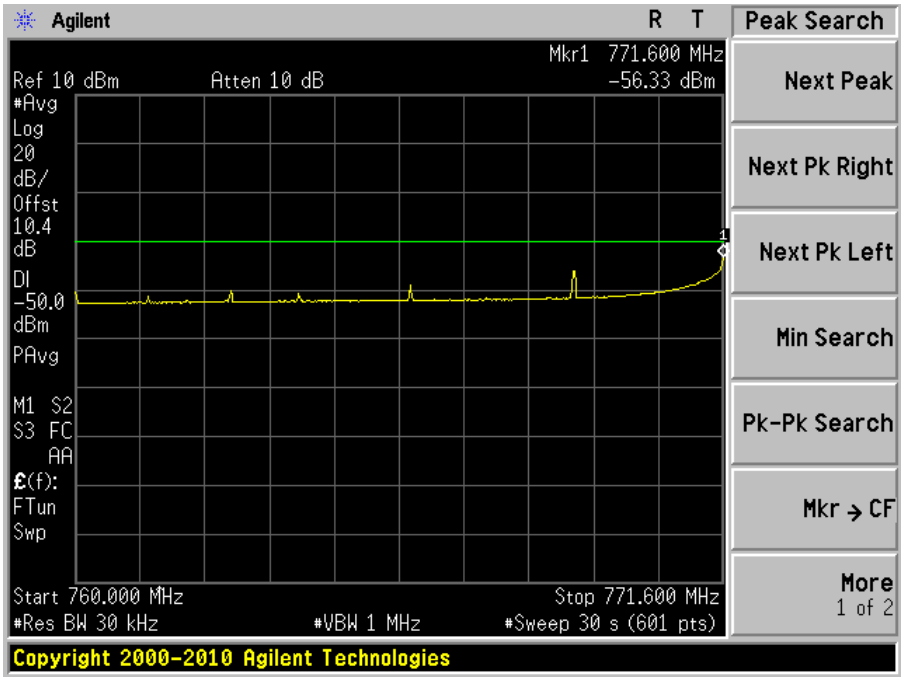


In receive band

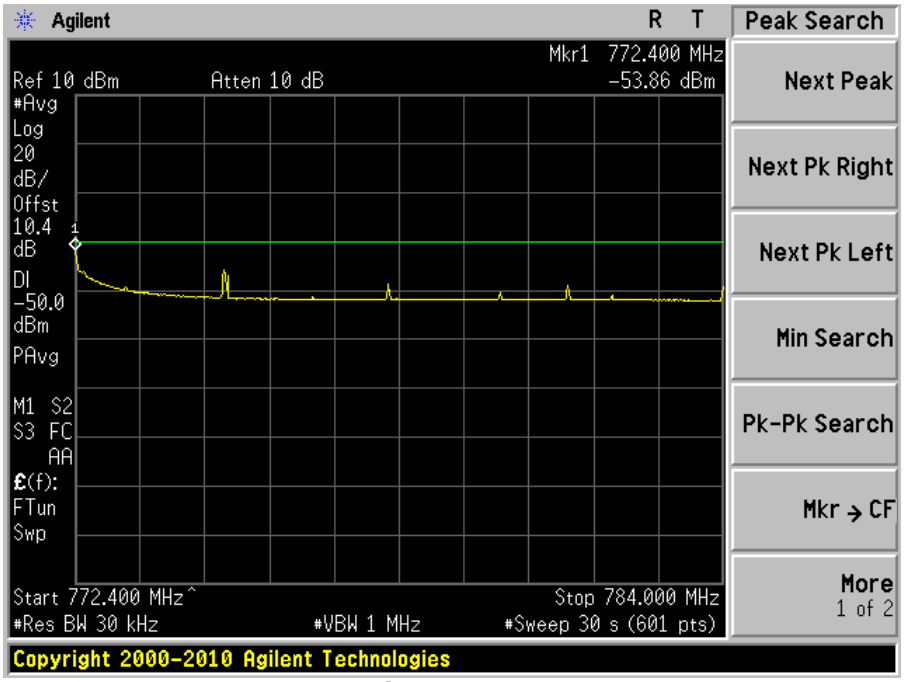
Middle Channel – 772 MHz



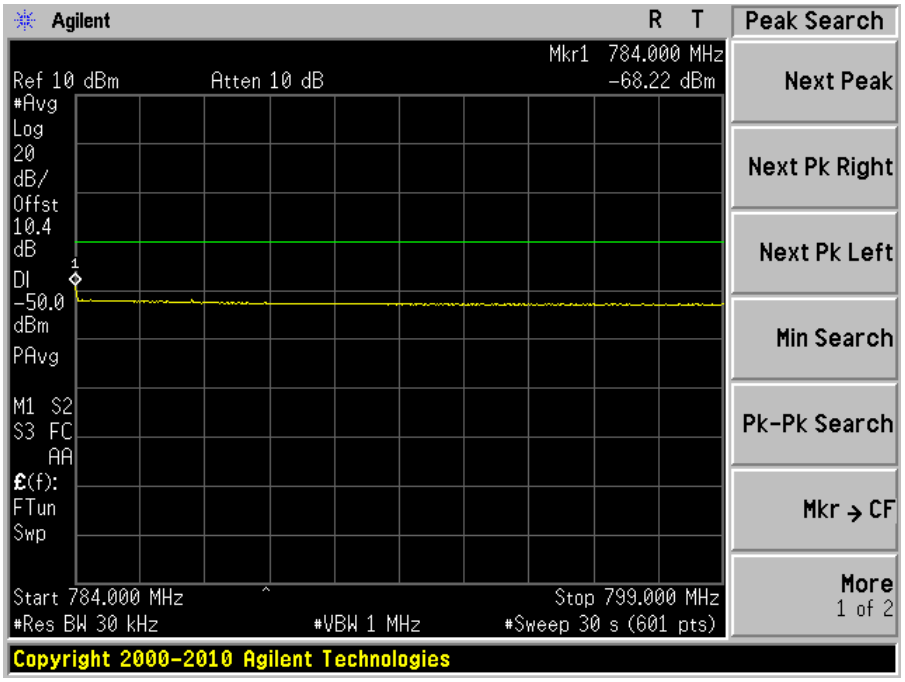




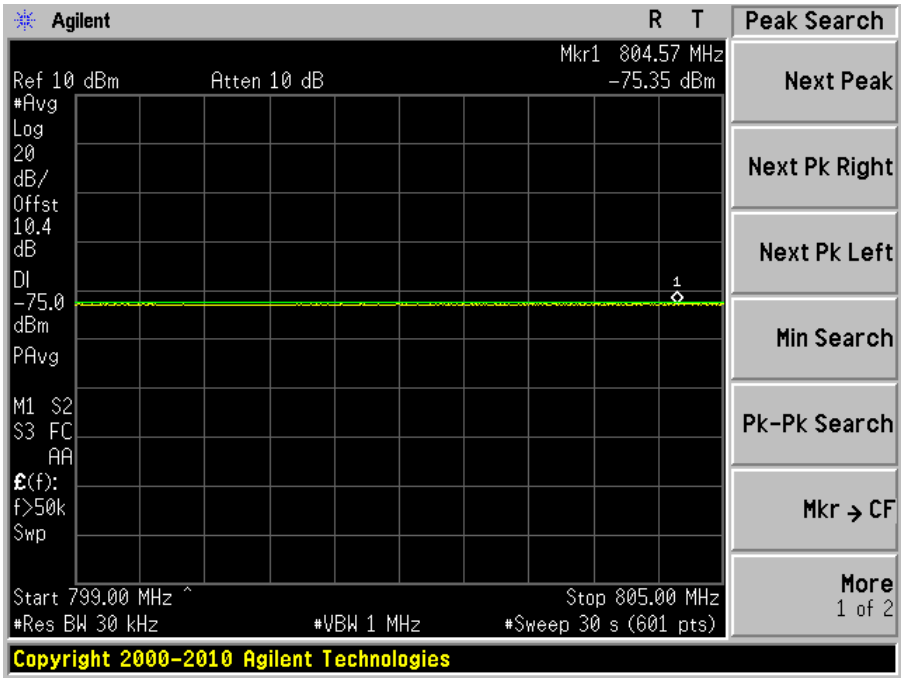
-12MHz to -400kHz



+400kHz to +12MHz

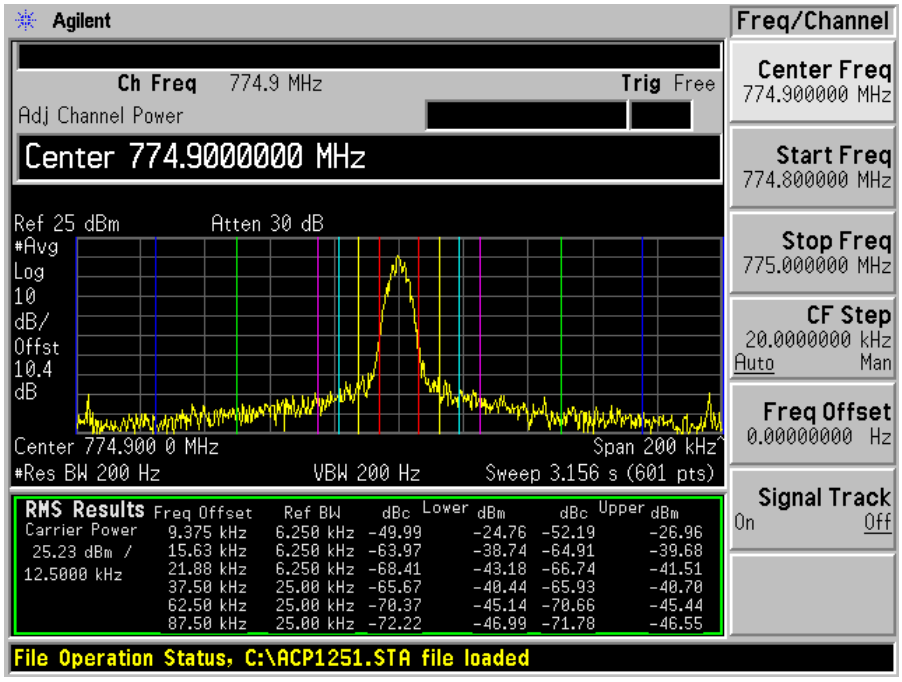


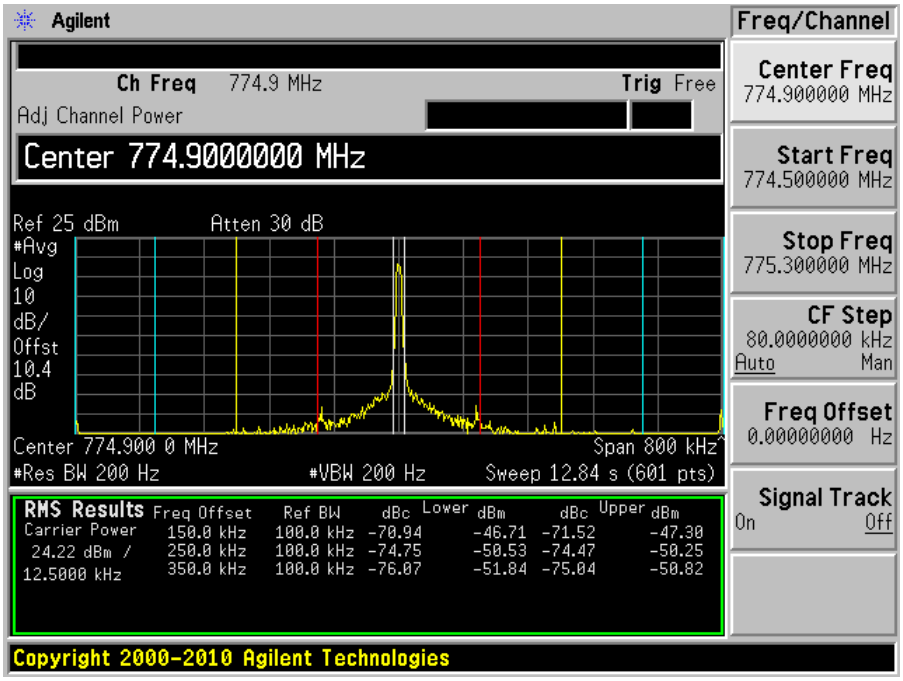
+12MHz to receive band

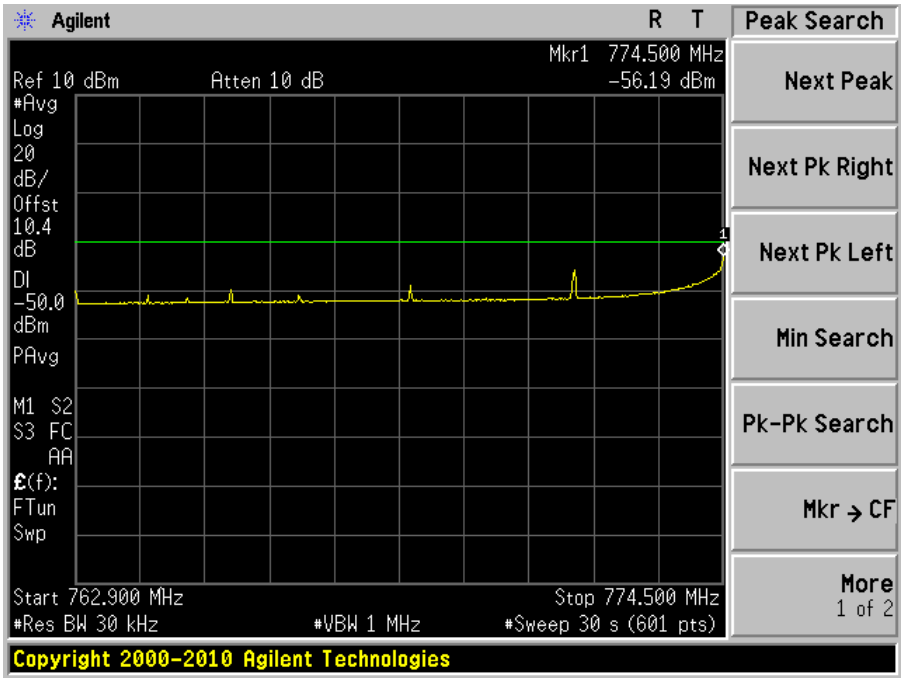


In receive band

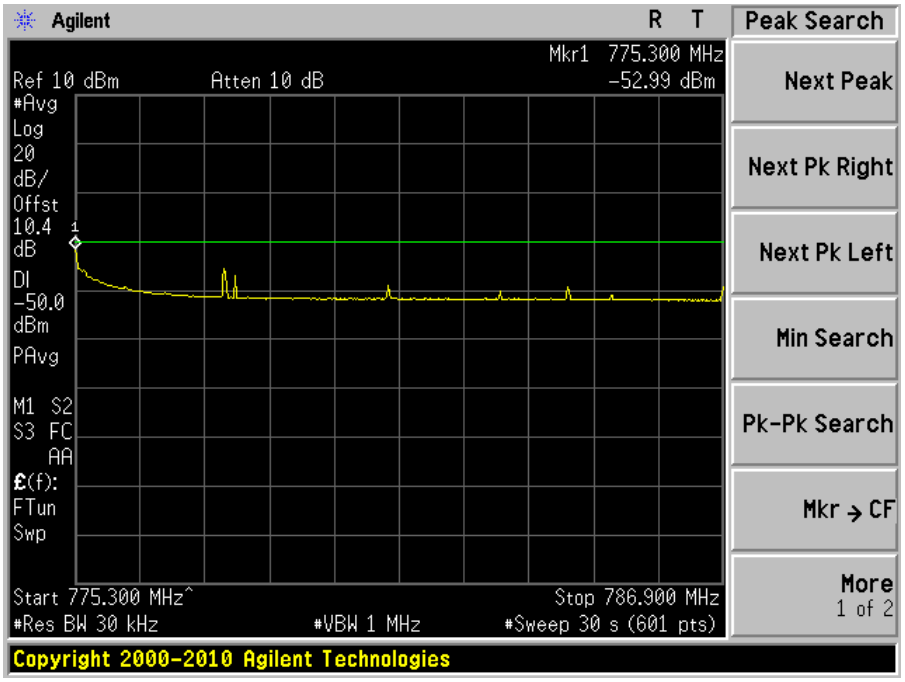
High Channel – 774.9 MHz



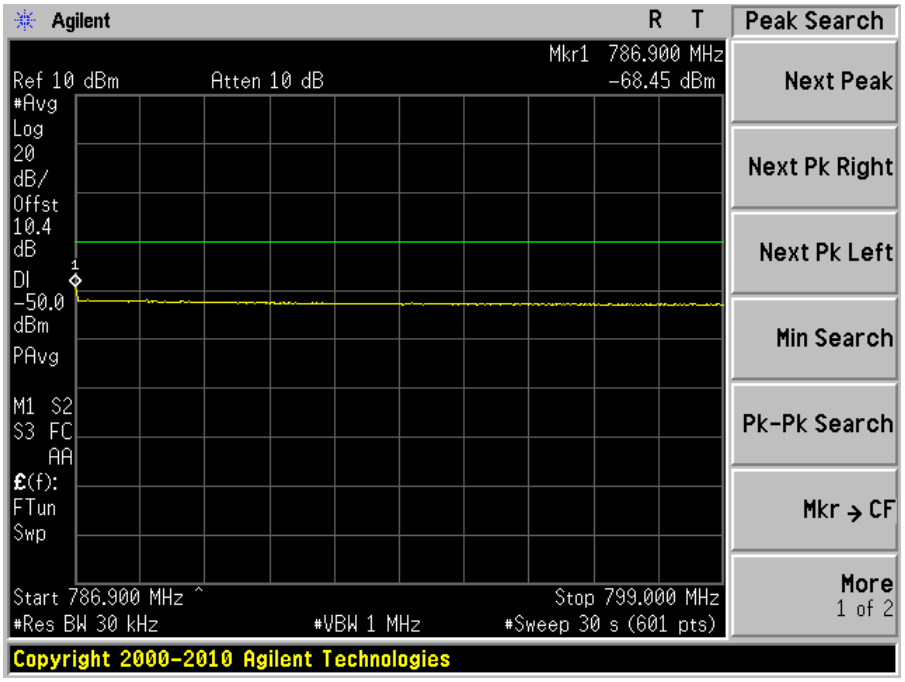




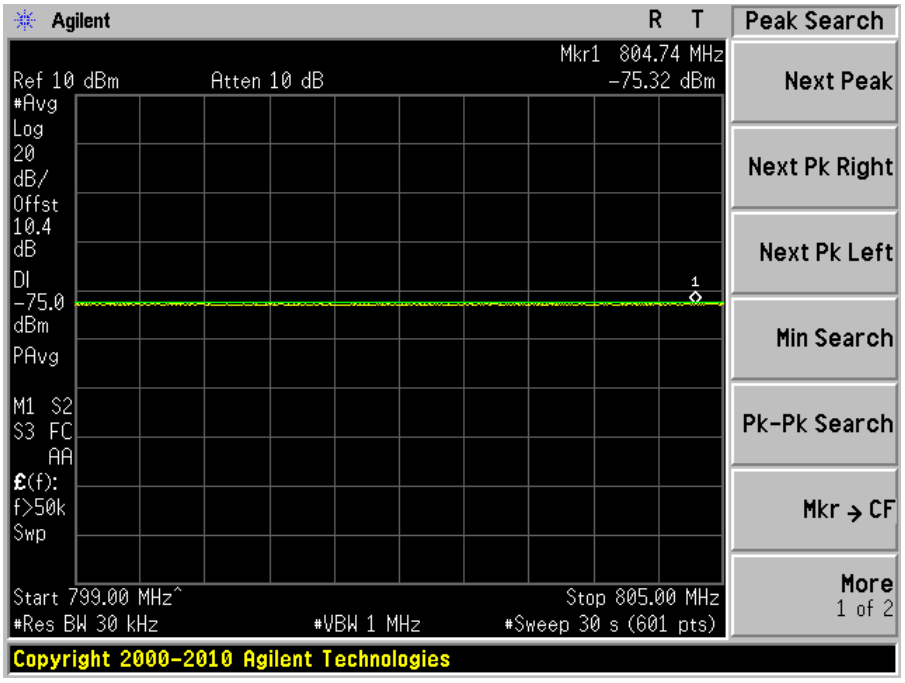
-12MHz to -400kHz



+400kHz to +12MHz



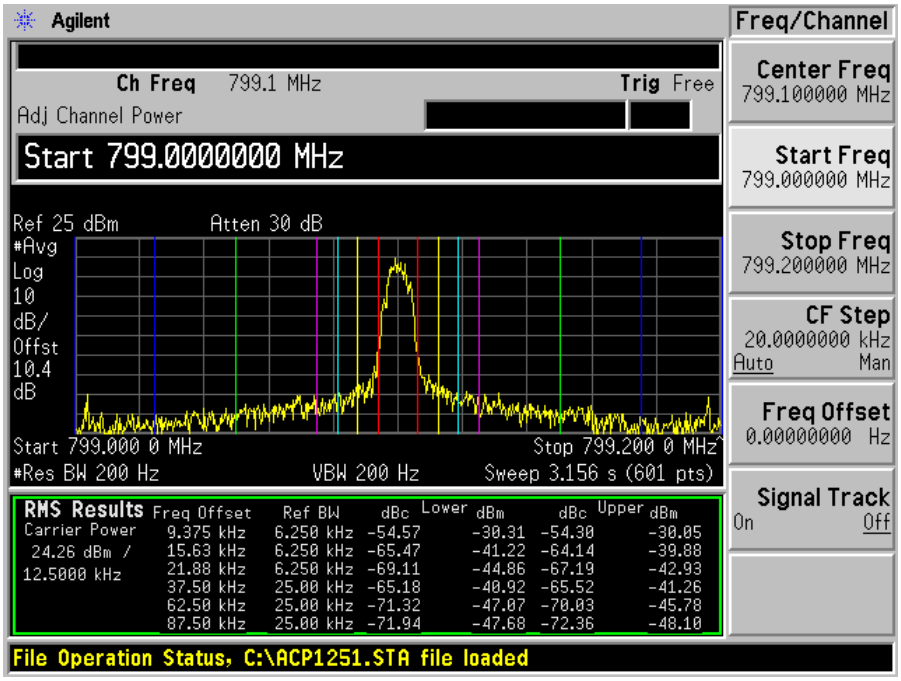
+12MHz to receive band

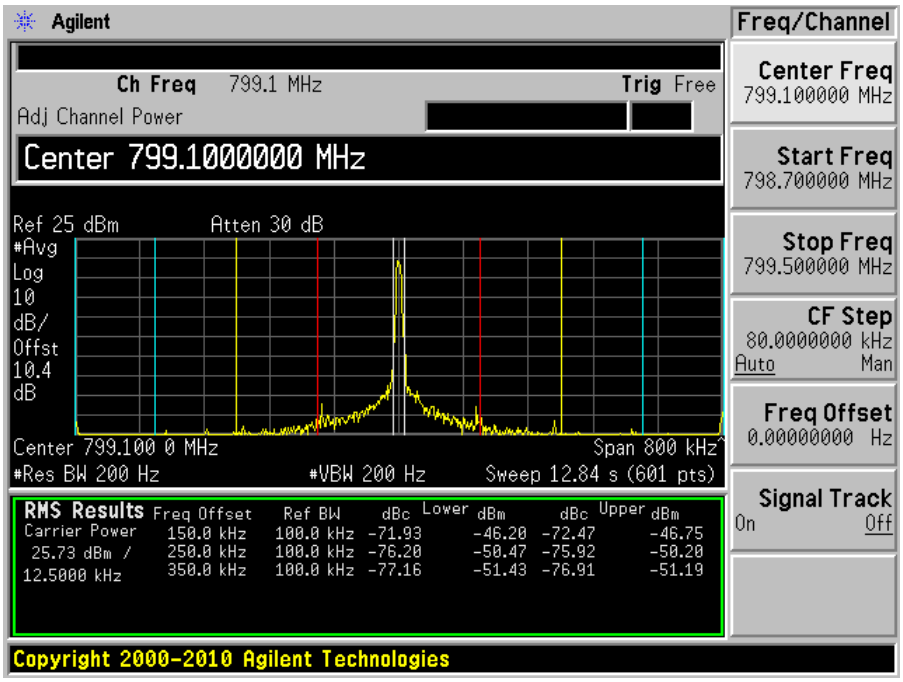


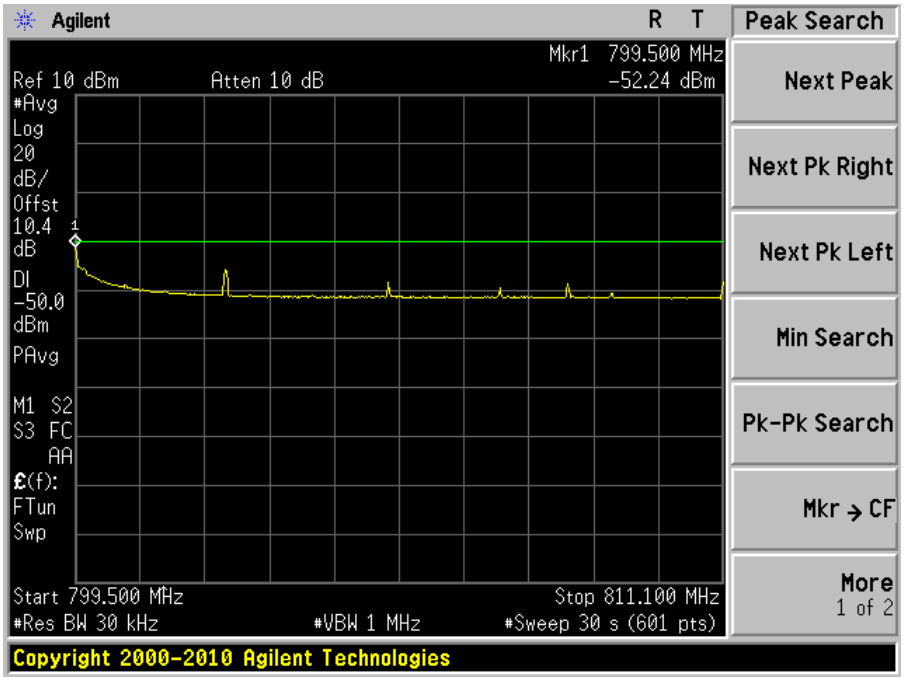
In receive band

799-805 MHz, C4FM

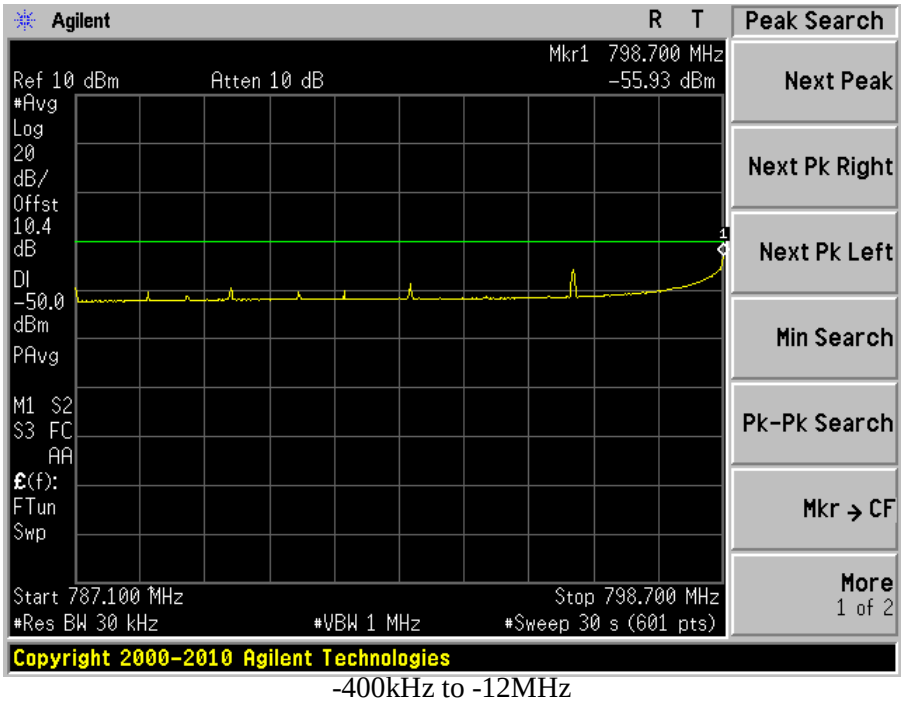
Low Channel – 799.1 MHz



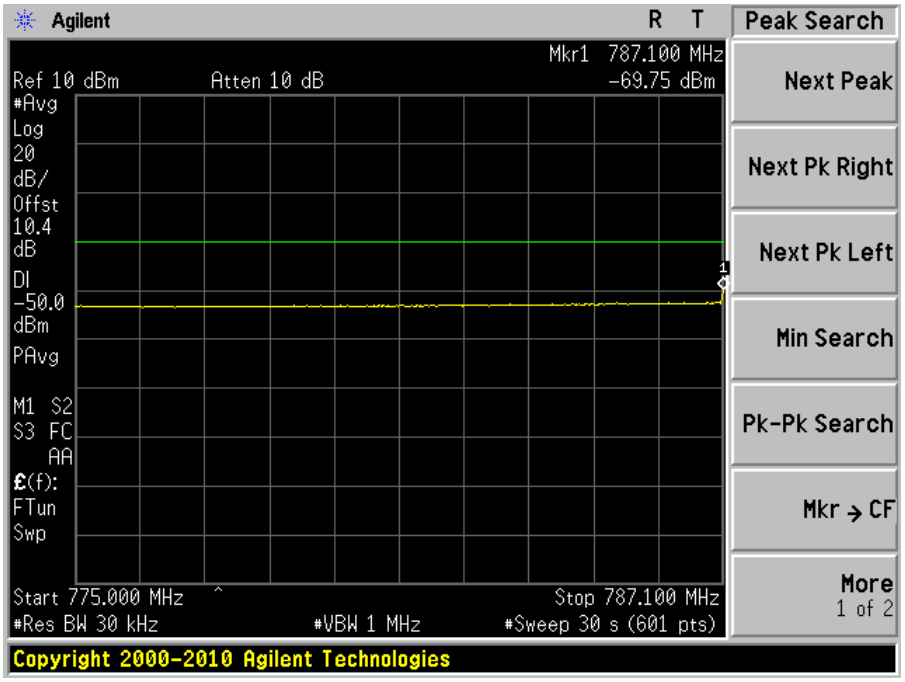




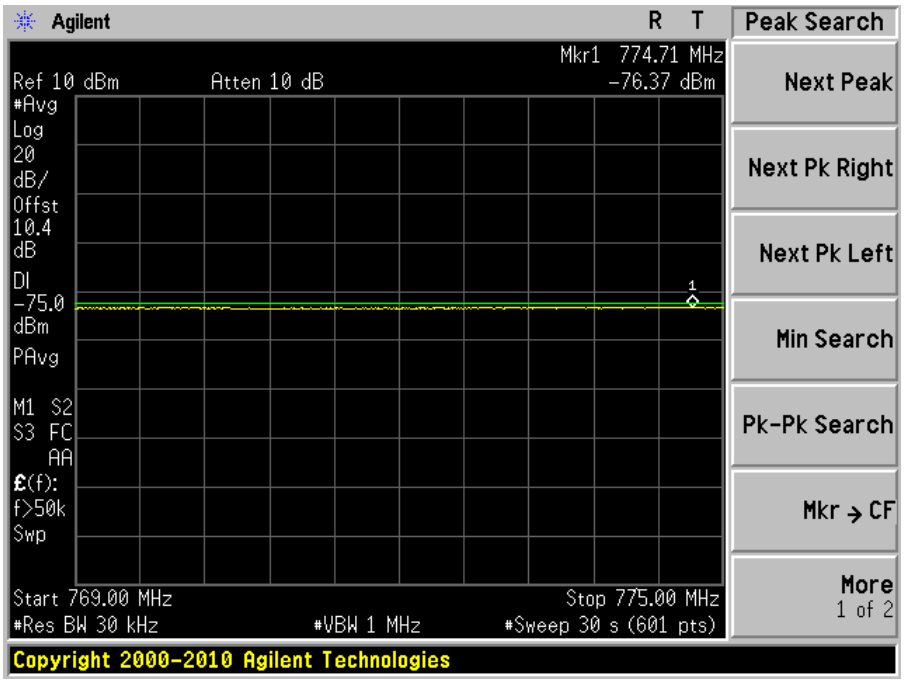
+12MHz to +400kHz



-400kHz to -12MHz

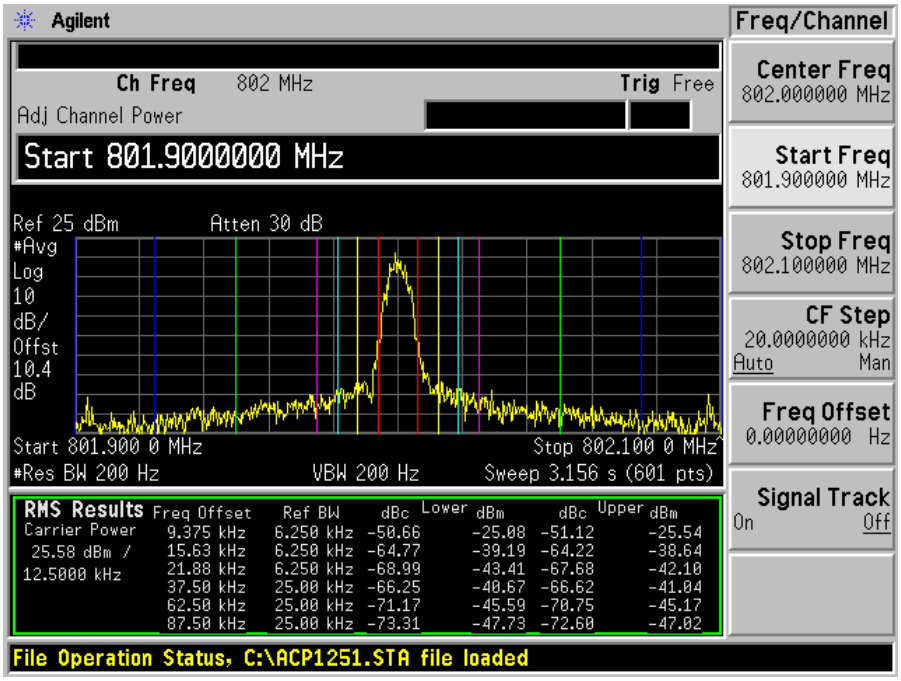


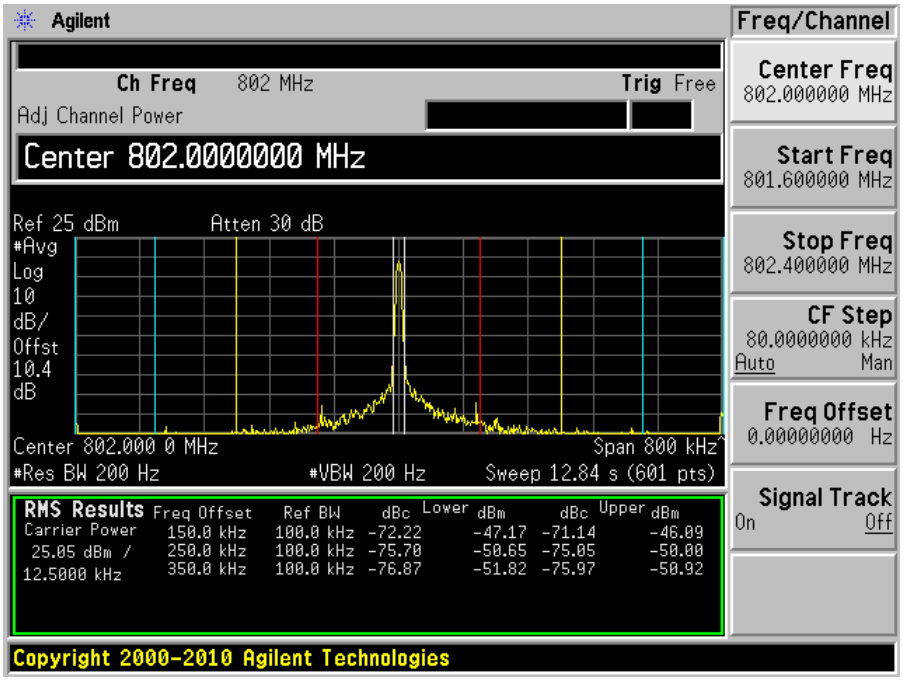
-12MHz to receive band

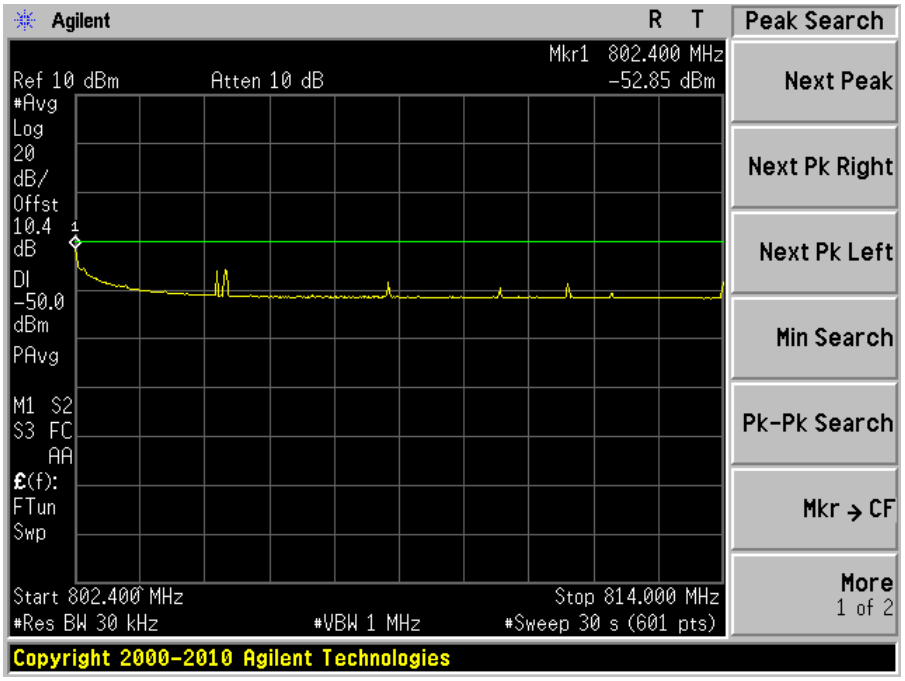


In receive band

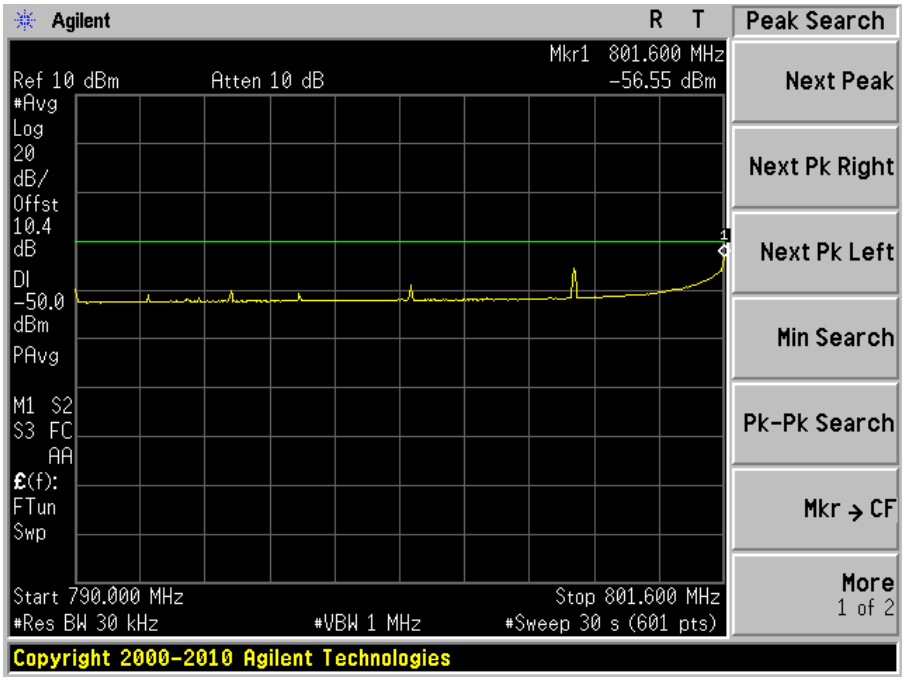
Middle Channel – 802 MHz



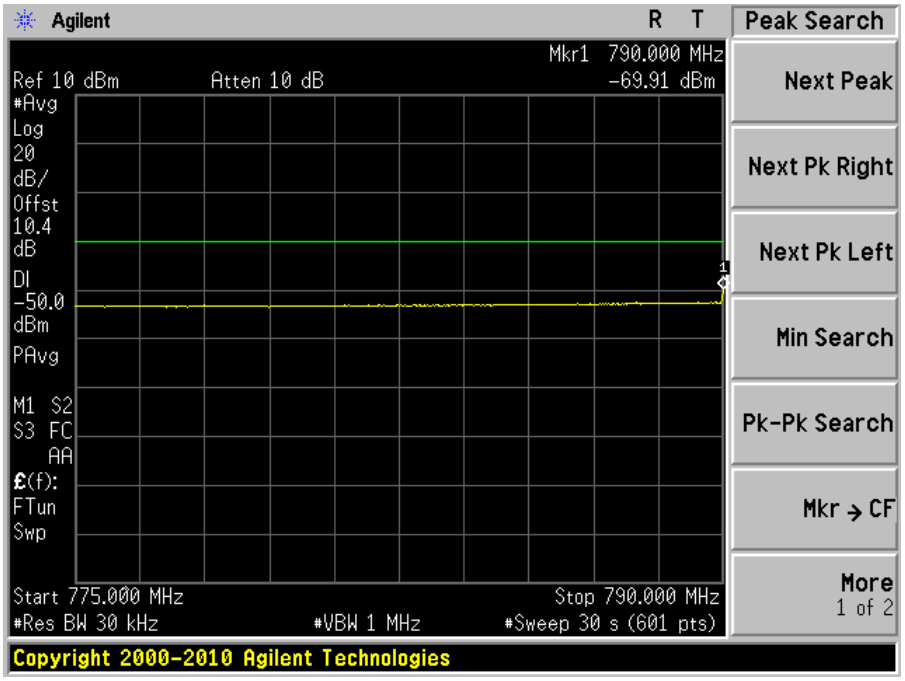




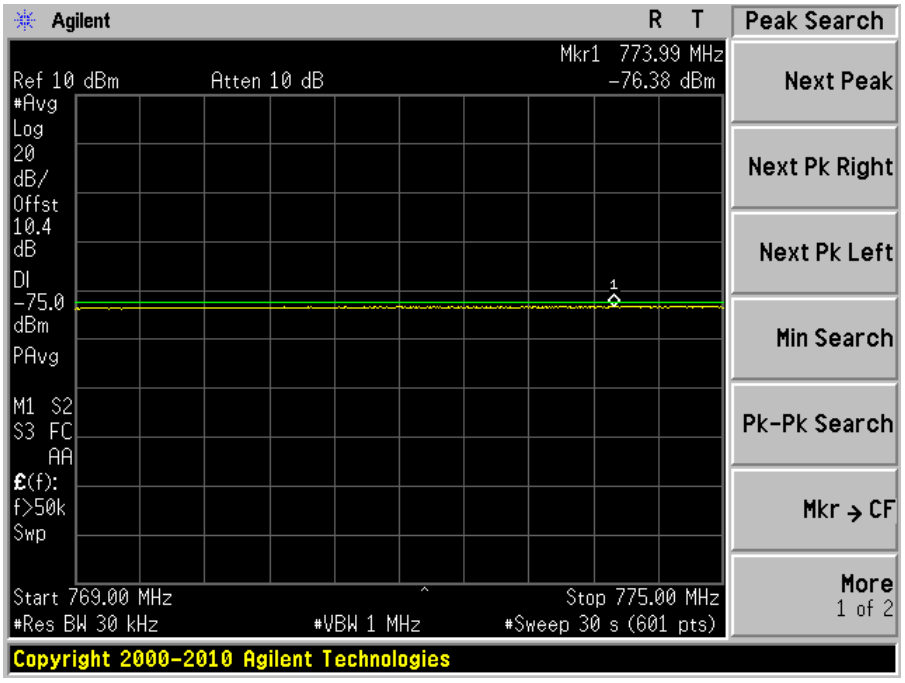
+12MHz to +400kHz



-400kHz to -12MHz

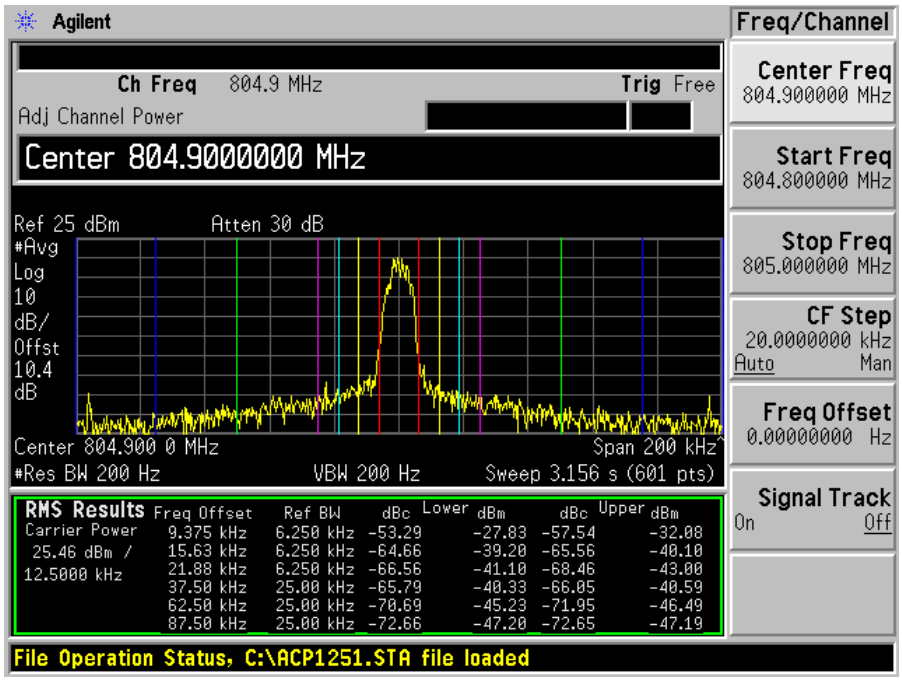


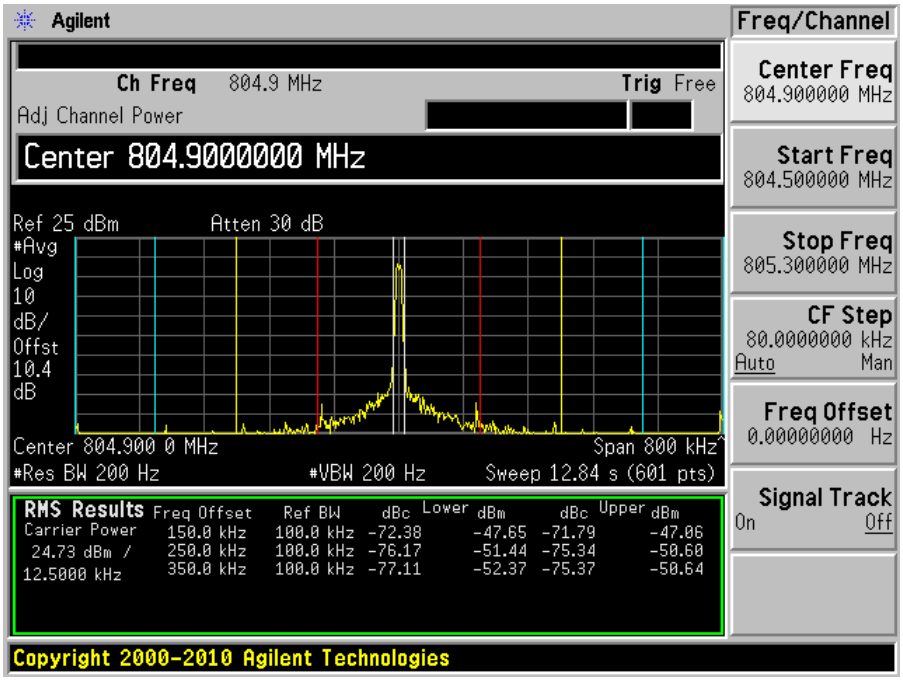
-12MHz to receive band

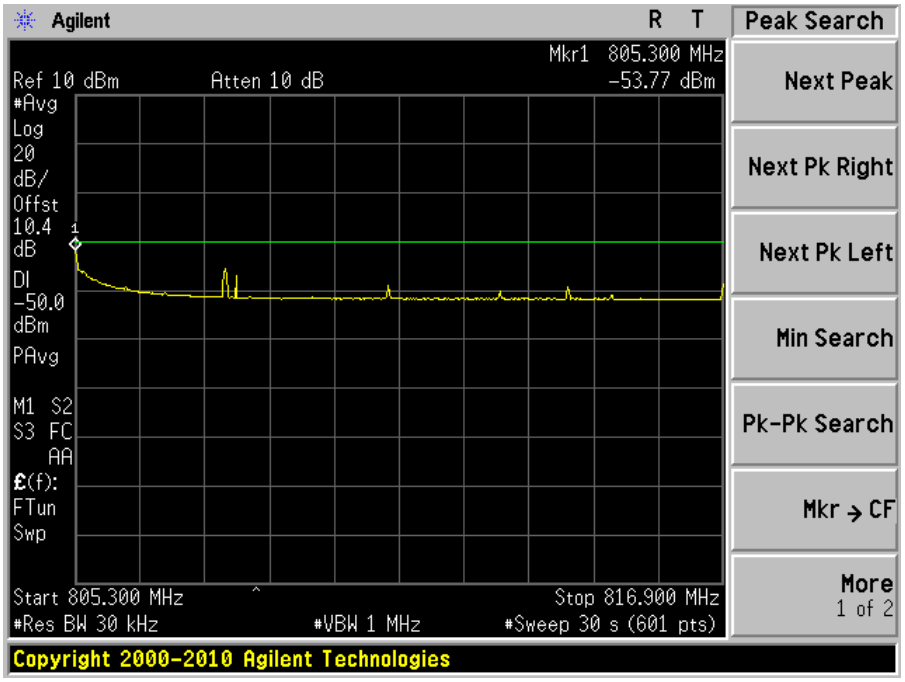


In receive band

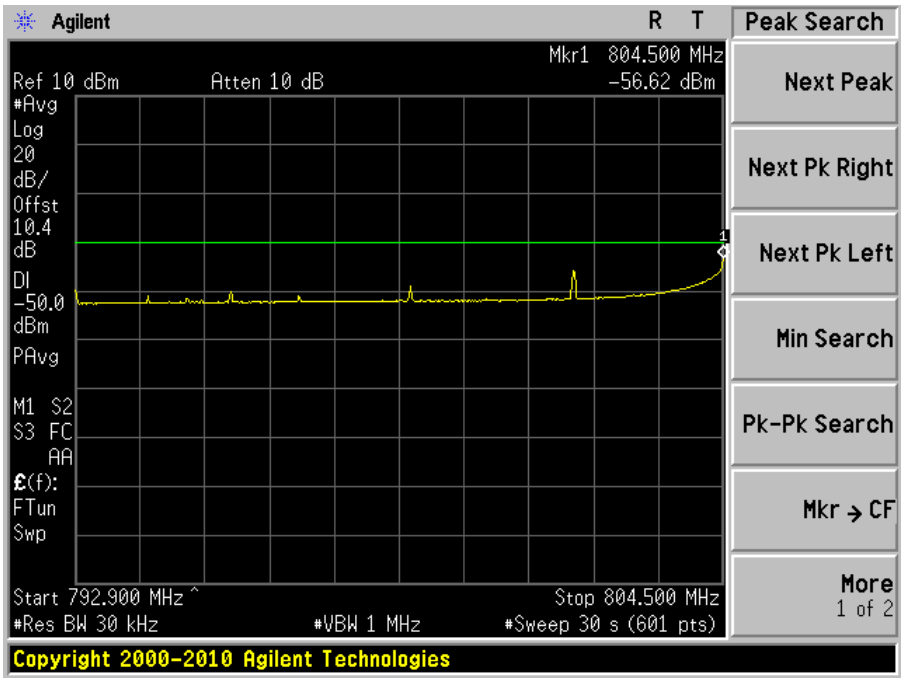
High Channel – 804.9 MHz



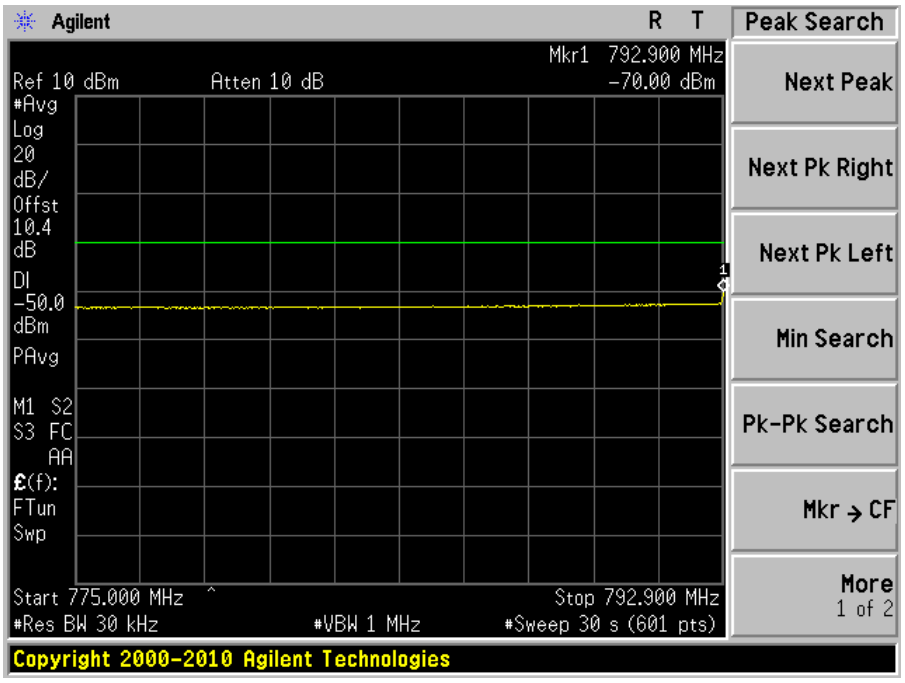




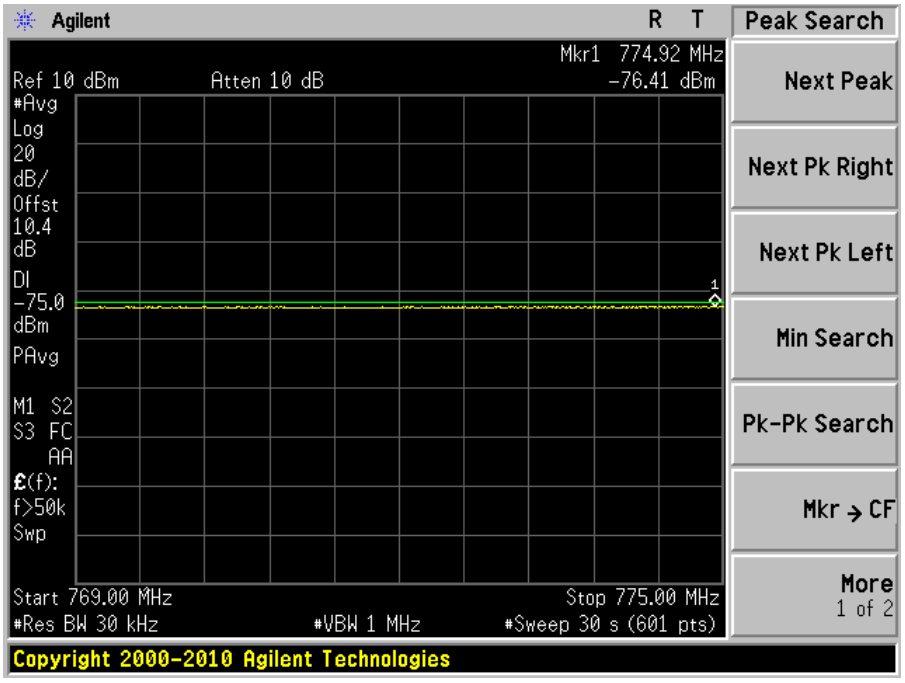
+12MHz to +400kHz



-400kHz to -12MHz



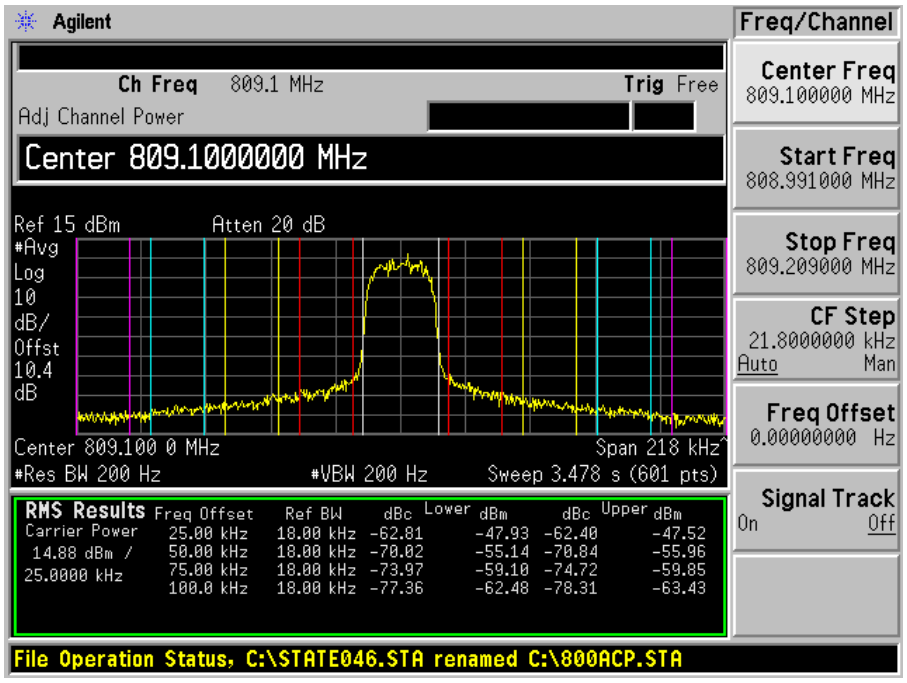
-12MHz to receive band



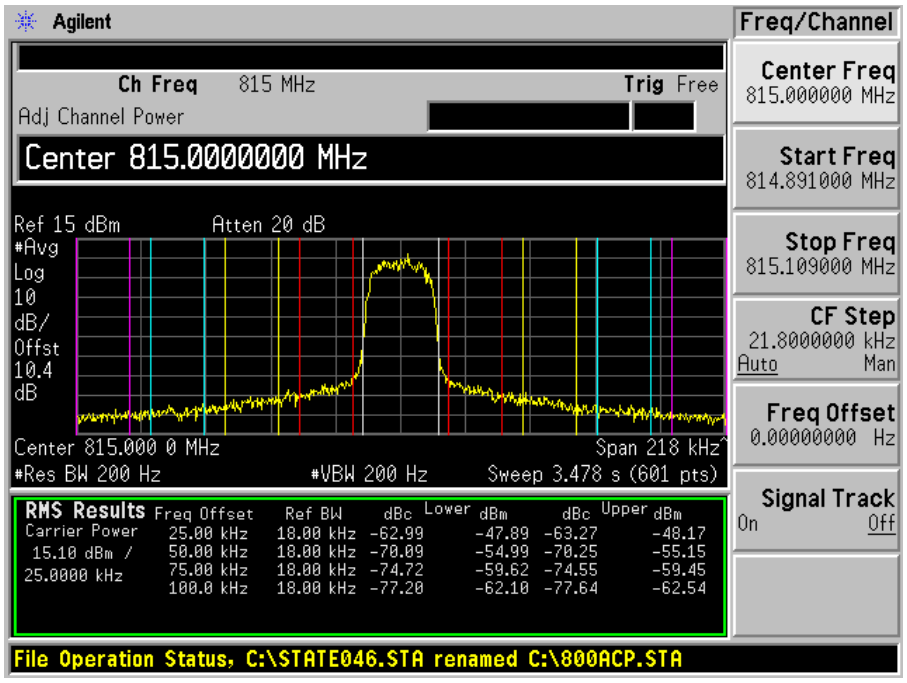
In receive band

809-824 MHz, TETRA

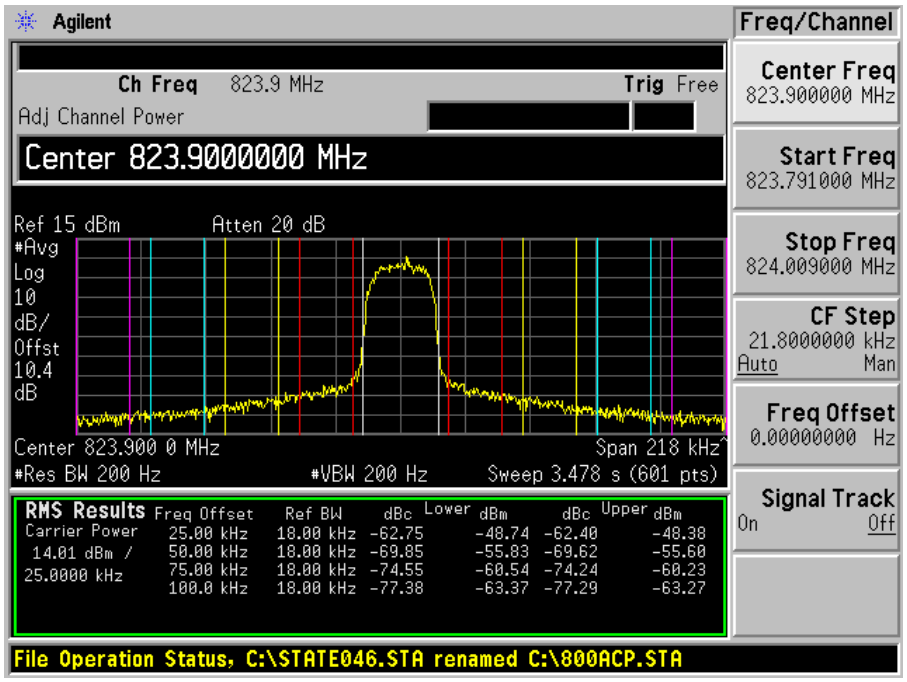
Low Channel – 809.1 MHz



Middle Channel – 815 MHz

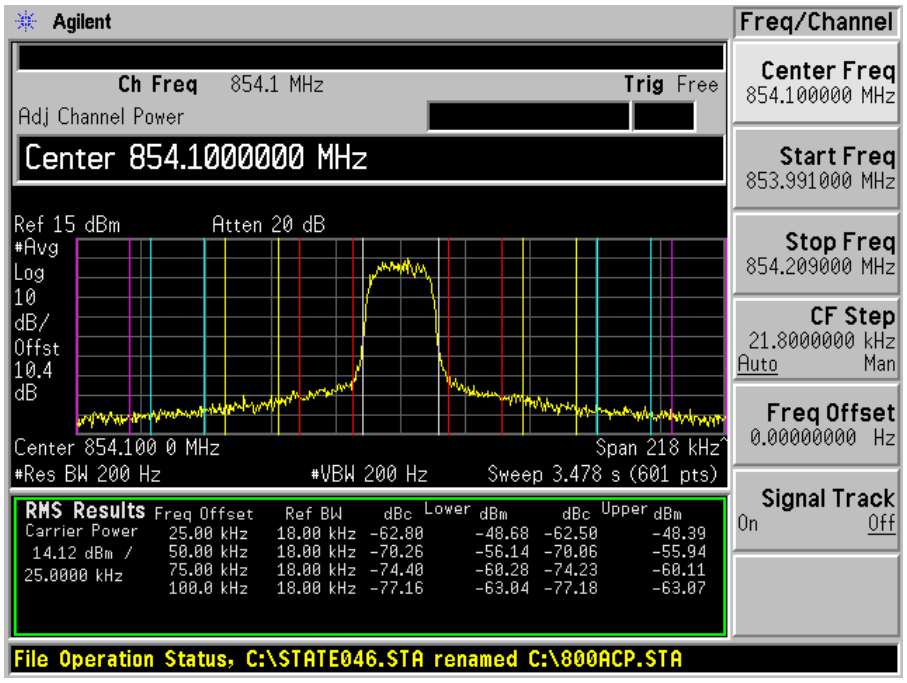


High Channel – 823.9 MHz

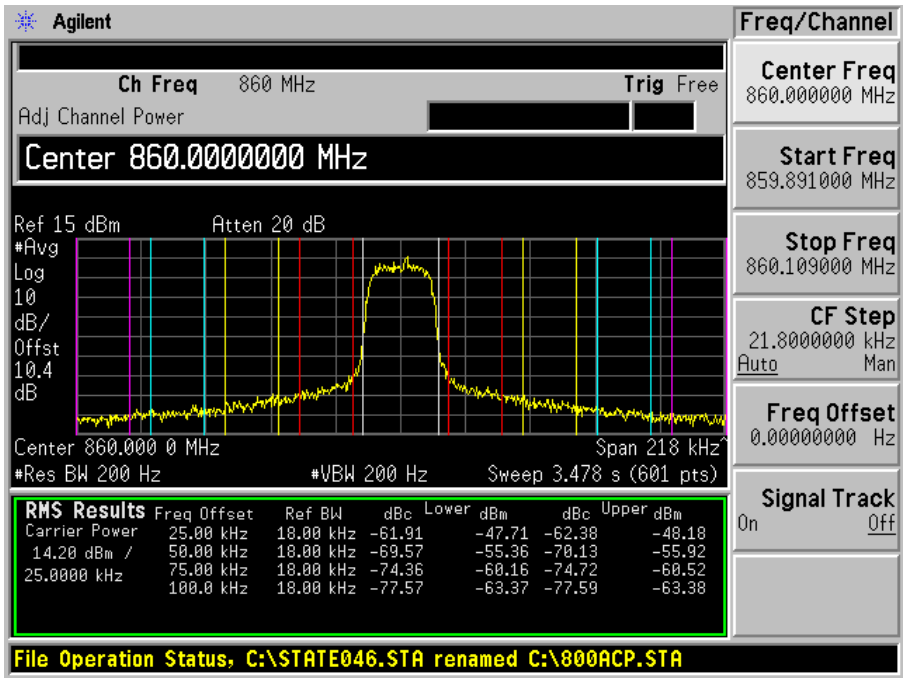


854-869 MHz, TETRA

Low Channel – 854.1 MHz



Middle Channel – 860 MHz



High Channel – 868.9 MHz