Vyyo Inc.

FCC ID: PBJV3000-A
FCC Rule Part: 27
Section 27.5(b)1 Block A: 746–747 MHz – 150 kHz channel

General Overview

A description of the theory of operation and product configuration is found in an attachment to this application and report.

SPECIFICATIONS

Transmitter

TX operating frequency:	746-747 MHz
TX output power:	94.6 watts Peak/ 17.95 watts Average
Digital Modulation:	QPSK, 16AQM, and 64QAM Modulation is internally generated and limited
Power requirements:	120 VAC or 48 VDC
Antenna connector:	N- type
Frequency Tolerance	Remain in band: -30 to +50 C 85%-115% supply voltage at 20C

Block diagram and theory of operation is provided in a separate attachment.

Test Summary Results

Test Description	Plot or Table No.	Test Results
RF Power Output	Plots 1-12	Pass
Occupied Bandwidth	Plots 13-15	Pass
Spurious and Harmonic Emissions at Antenna Terminals (Includes ACP measurements)	Plots 16-45	Pass
Field Strength of Spurious and Harmonic Radiation	Table 1	Pass
Field Strength of Emissions in the 1559-1610 MHz Band	Table 2	Pass
Frequency Stability	Plots 46-50	Pass

FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Parts 1 and 2.

1.1307(b) in the **RF exposure information is provided in a separate attachment**

form of maximum permissible exposure (MPE) data.

2.1033(c)1 Applicant: Vyyo Inc.
4015 Miranda Avenue
Palo Alto, CA. 94304

2.1033(c)2 FCC ID: PBJV3000-A

2.1033(c)3 Installation instructions are found in separate document.

2.1033(c)4 Emission types and emission designators:

Emission Type	**Designator**
QPSK	130K0G1D
16QAM	130K0W1D
64QAM	130K0W1D

2.1033(c)5 Frequency range: 746-747 MHz

2.1033(c)6 Range of Operating Power

94.6 watts Peak/ 17.95 watts Average Maximum, variable in 1 dB steps

2.1033(c)7 Maximum Power Rating

94.6 watts Peak/ 17.95 watts Average

Maximum allowed per Section 27.50(b)1: 1 kW ERP

2.1033(c)8 Applied voltages and currents into the final transistor elements

Refer to schematics, separate submission accompanying this application

2.1033(c)9 Tune-up procedure

Refer to installation instructions.

2.1033(c)10 Circuit and Functional Block Diagram, Description of Circuitry

Product schematics are provided in separate attachments.
Circuit description and theory of operation are found in separate attachment.

2.1033(c)11 FCC ID Label

Refer to separate attachment.

2.1033(c)12 Product Photographs

Refer to separate attachment.

2.1033(c)13 Description of Modulation System

64QAM produced by internal DOCSIS cable modem

Test Equipment List

TEST EQUIPMENT LIST				
Name of Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Due Date**
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	3/29/06
RF Filter Section	HP	85420E	3705A00256	3/29/06
Antenna, Bilog 30MHz ~ 2Ghz	Sunol Sciences	JB1	A121003	3/3/06
Signal Generator 2 -40 GHz	R & S	SMP04	DE 34210	6/8/06
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	4/22/06
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	6717	4/22/06
Antenna, Horn 1 ~ 18 GHz	ETS	3117	29310	4/22/06
Peak Power Meter	Agilent	E4416A	GB41291160	2/9/06
Peak / Average Power Sensor	Agilent	E9327A	US40440755	2/10/06
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent	E4446A	US42070220	1/1/06
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	29800	6/10/06
High Power Attenuator	BIRD ELECTRONIC CORP	8343-200	970	N/A

2.1033(C)14 TEST DATA PER 2.1046 – 2.1057

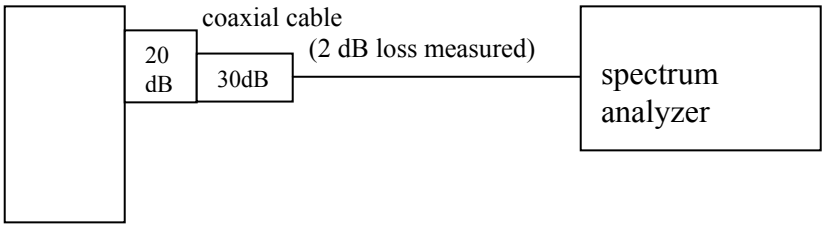
2.1046 RF Output Power Measurements
Requirement/Limit: 27.50(b)1

(b) The following power and antenna height limits apply to transmitters operating in the 746–764 MHz and 776–794 MHz bands:

(1) Fixed and base stations transmitting in the 746–764 MHz band and the 777–792 MHz band must not exceed an effective radiated power (ERP) of 1000 watts and an antenna height of 305 m height above average terrain (HAAT), except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section;

Test set-up:

Figure 1



Total offset: 20 dB + 30 dB + 2 dB = 52 dB

Test Procedures

The transmitter was set to produce the different modulations at the lowest and highest center frequencies at which all required Part 27 parameters are met:

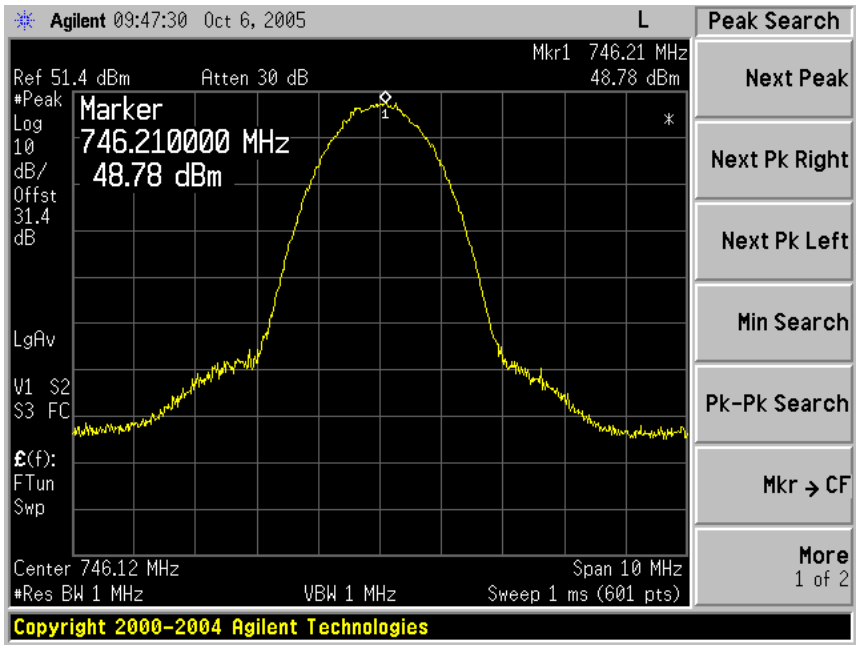
Modulation	Low Channel	High Channel
QPSK	746.1250	746.8625
16AQM	746.1375	746.8625
64QAM	746.1375	746.8500

The spectrum analyzer RBW=VBW > occupied bandwidth (130 kHz). Measurements were made for both PEAK and AVERAGE detector settings.

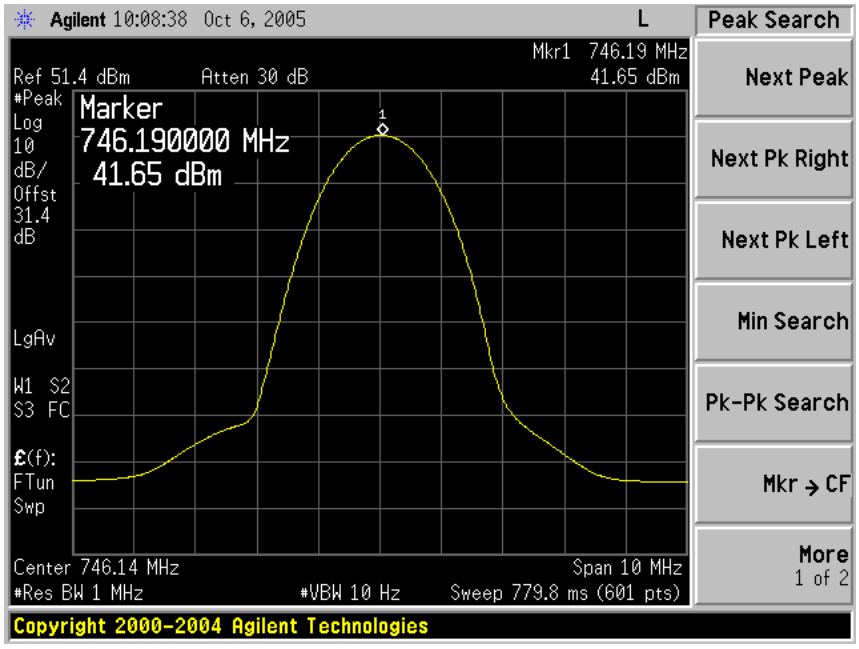
Test Results

Maximum results were 49.76 dBm/ 42.54 dBm (94.6 watts Peak/ 17.95 watts Average). Refer to spectrum analyzer plots below.

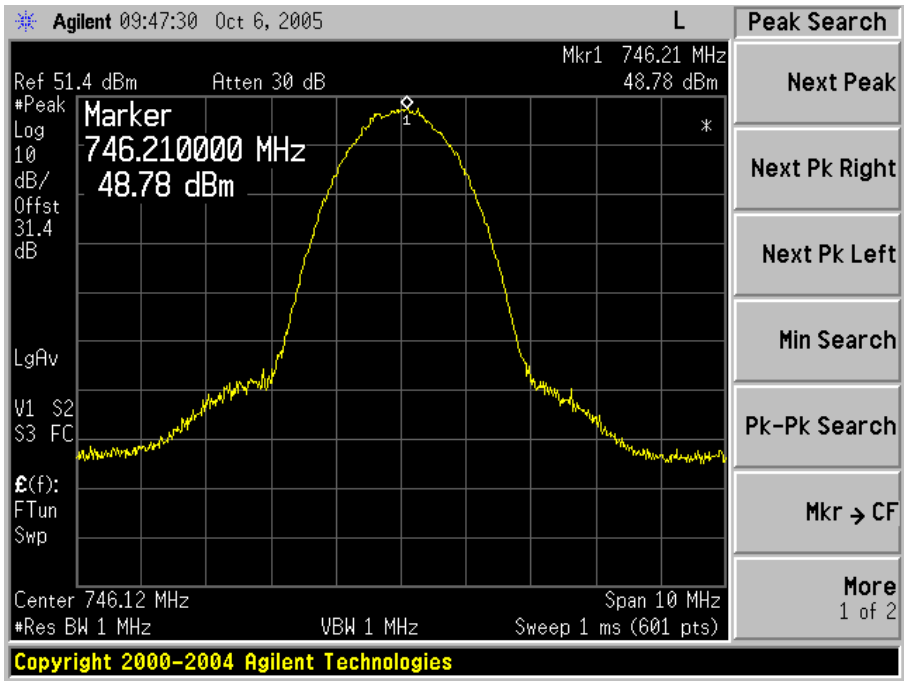
Plot #1 - QPSK PEAK Power Low Channel



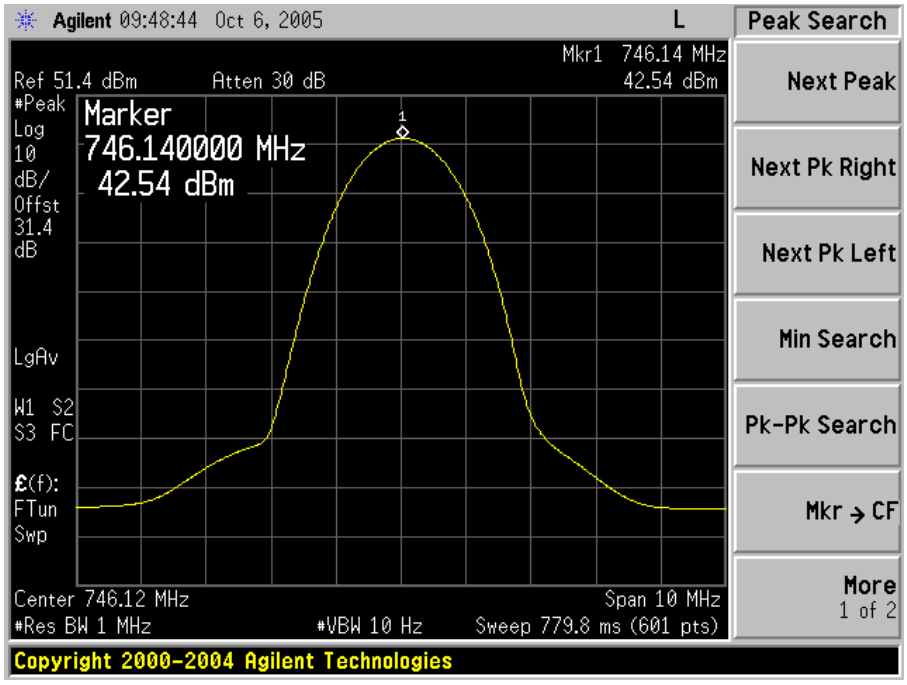
Plot#2 - QPSK AVERAGE Power Low Channel



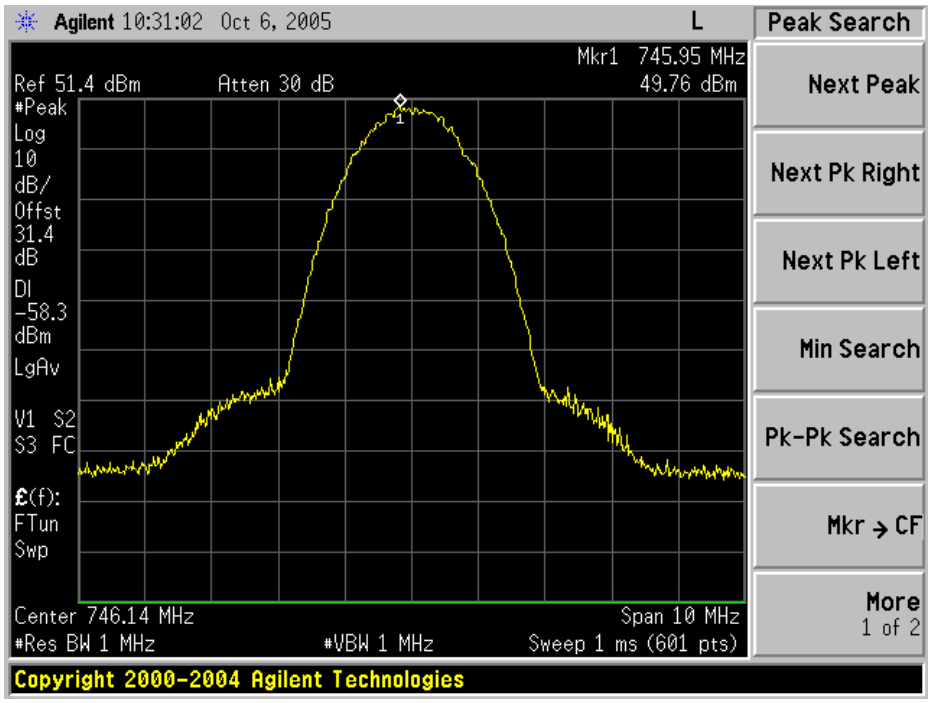
Plot#3 - QPSK PEAK Power High Channel



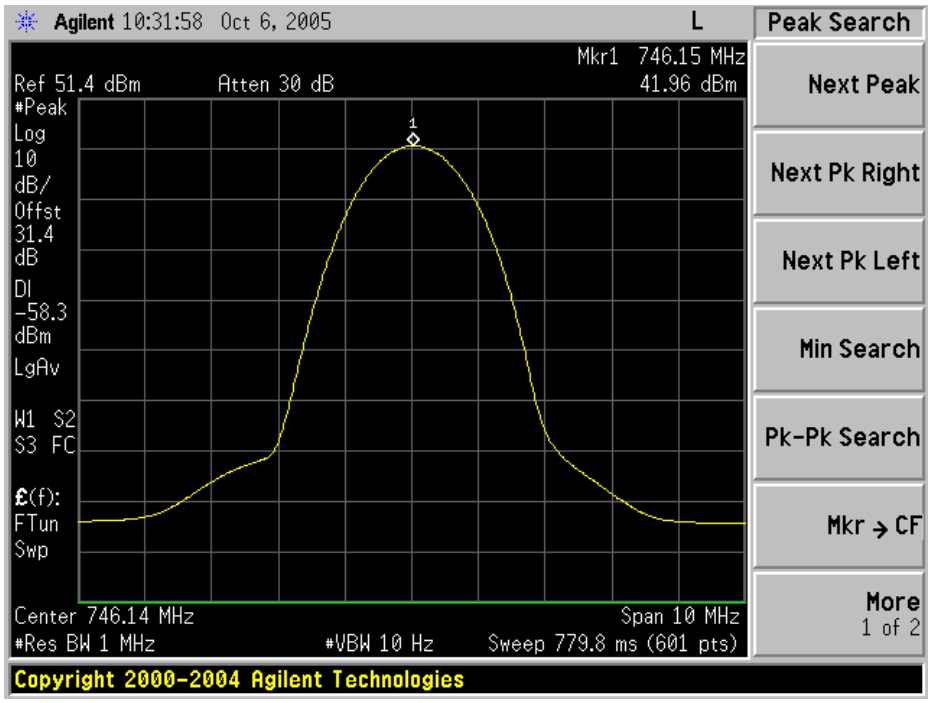
Plot#4 - QPSK AVERAGE Power High Channel



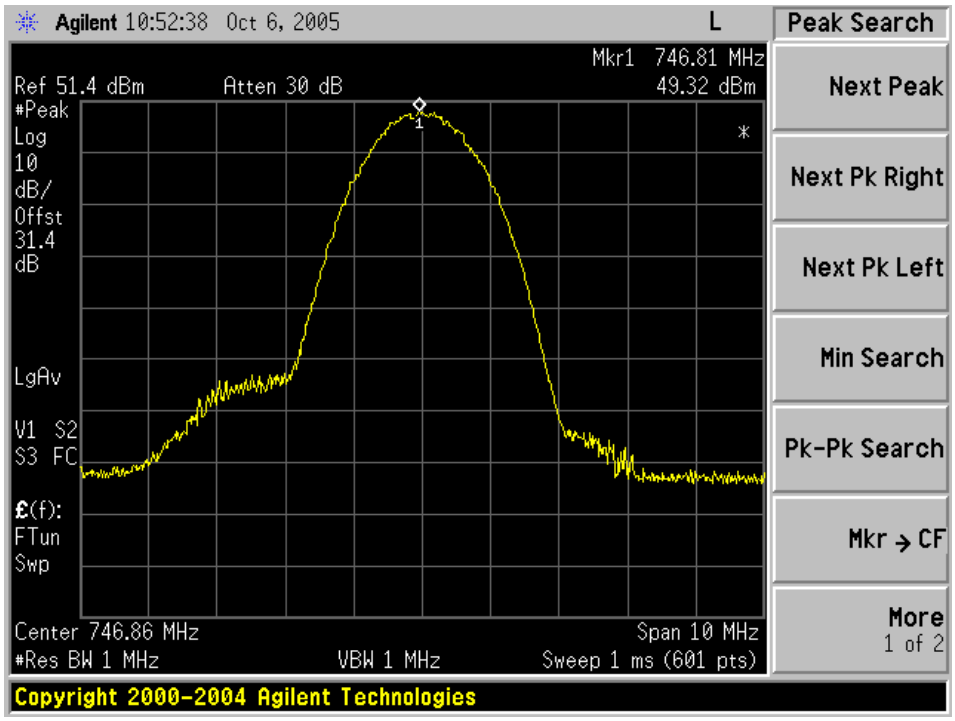
Plot # 5 - 16QAM PEAK Power Low Channel



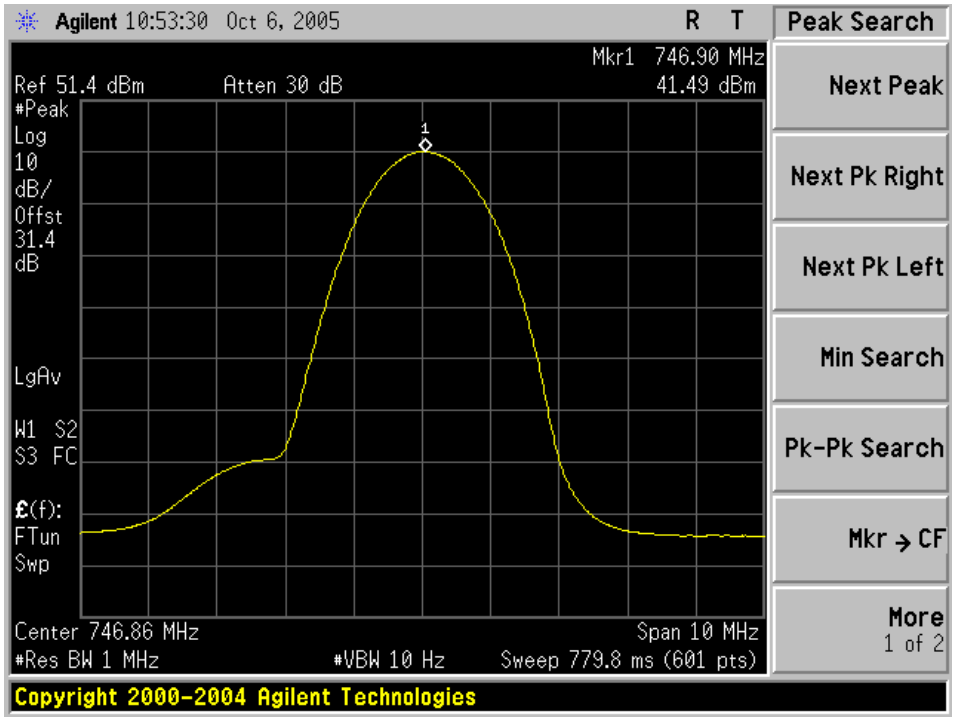
Plot # 6 - 16QAM AVERAGE Power Low Channel



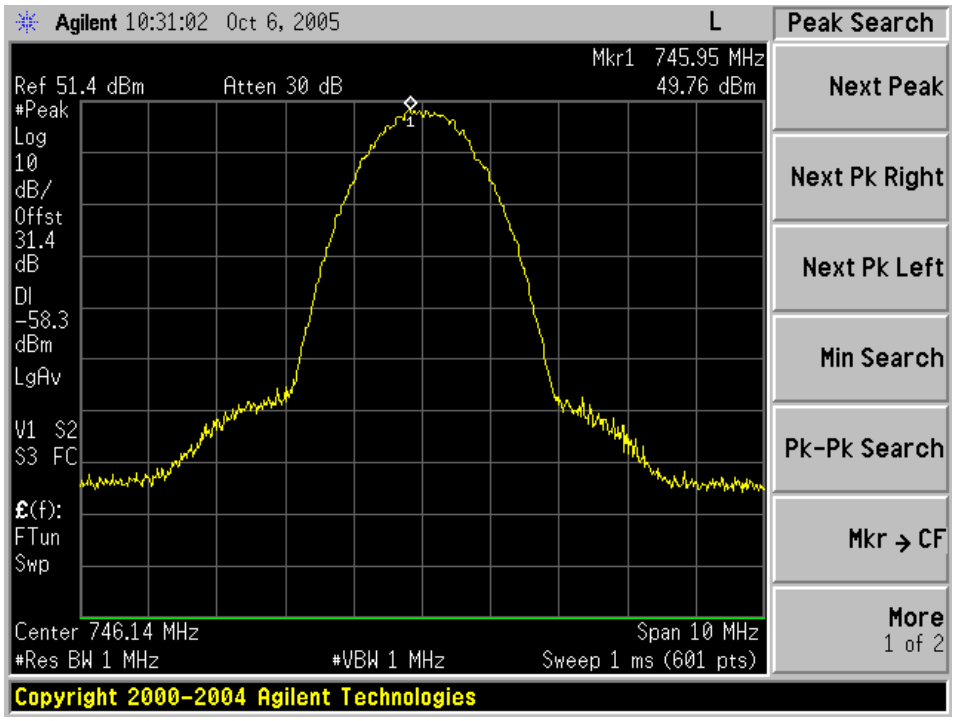
Plot # 7 - 16QAM PEAK Power HIGH Channel



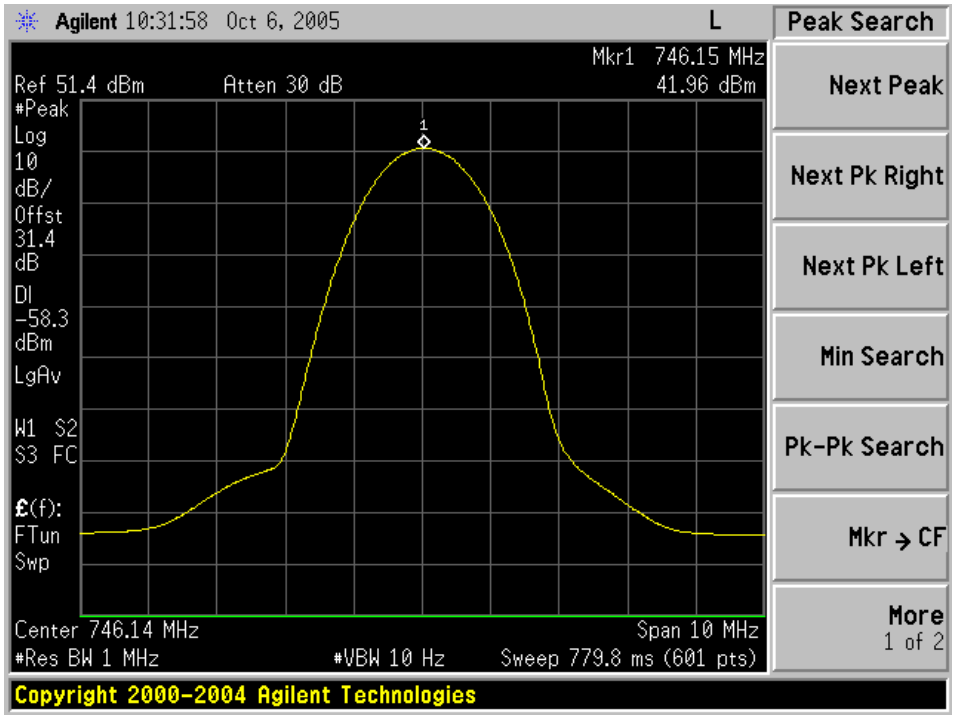
Plot # 8 - 16QAM AVERAGE Power High Channel



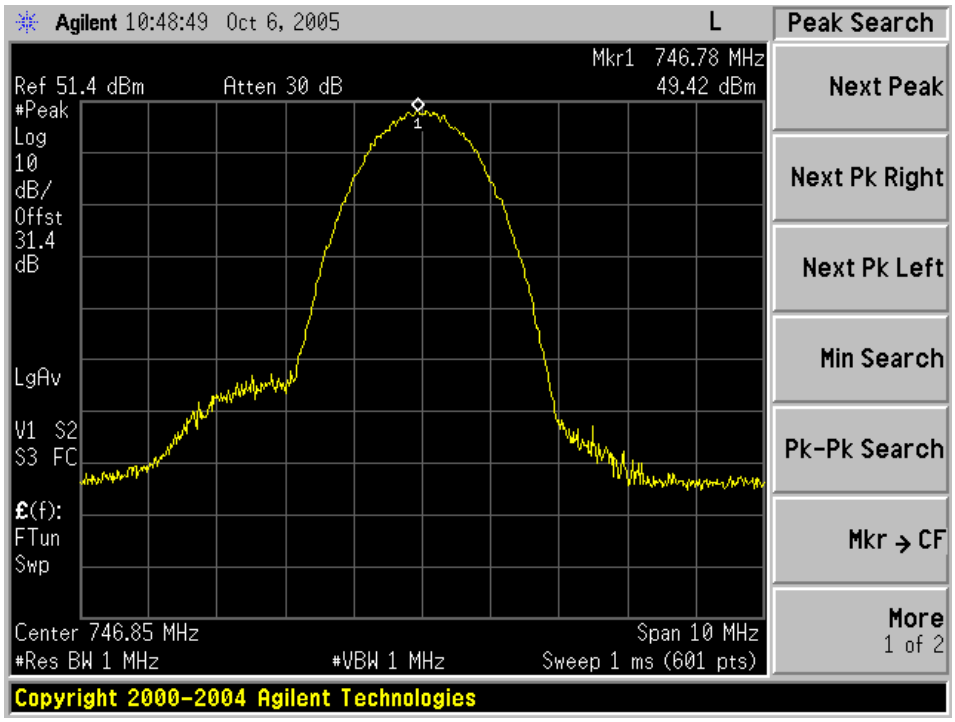
Plot # 9 - 64QAM PEAK Power Low Channel



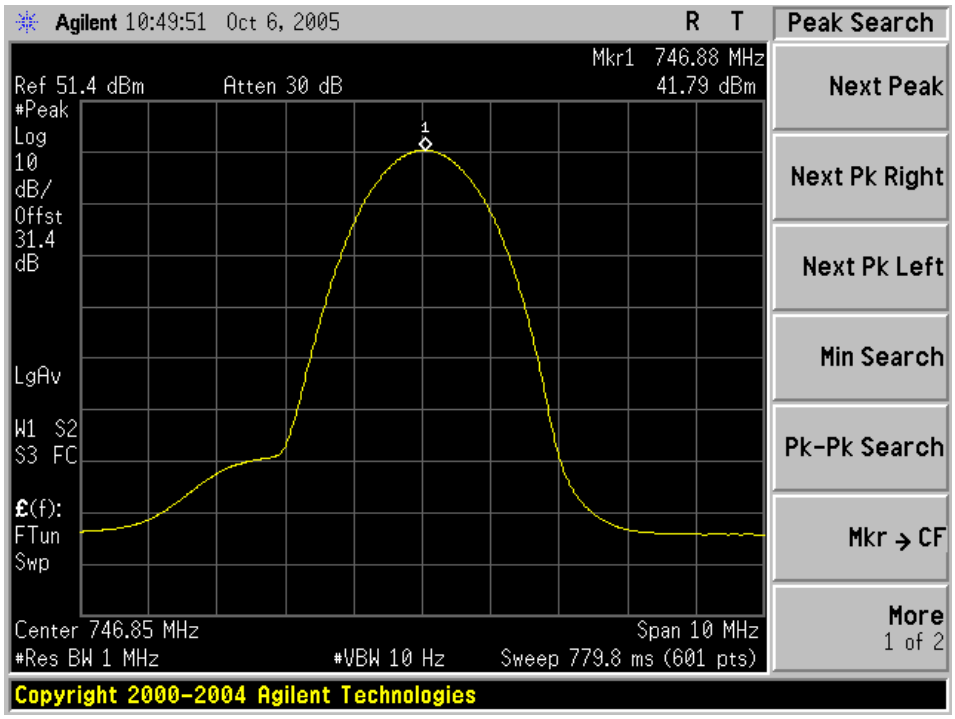
Plot # 10 - 64QAM AVERAGE Power Low Channel



Plot # 11 - 64QAM PEAK Power High Channel



Plot # 12 - 64QAM AVERAGE Power High Channel



Section 2.1049 Occupied Bandwidth
Requirement/Limit: 27.53(d)4

(4) *Authorized bandwidth.* Provided that the ACP requirements of this section are met, applicants may request any authorized bandwidth that does not exceed the channel size.

Test set-up: Refer to Figure 1, above

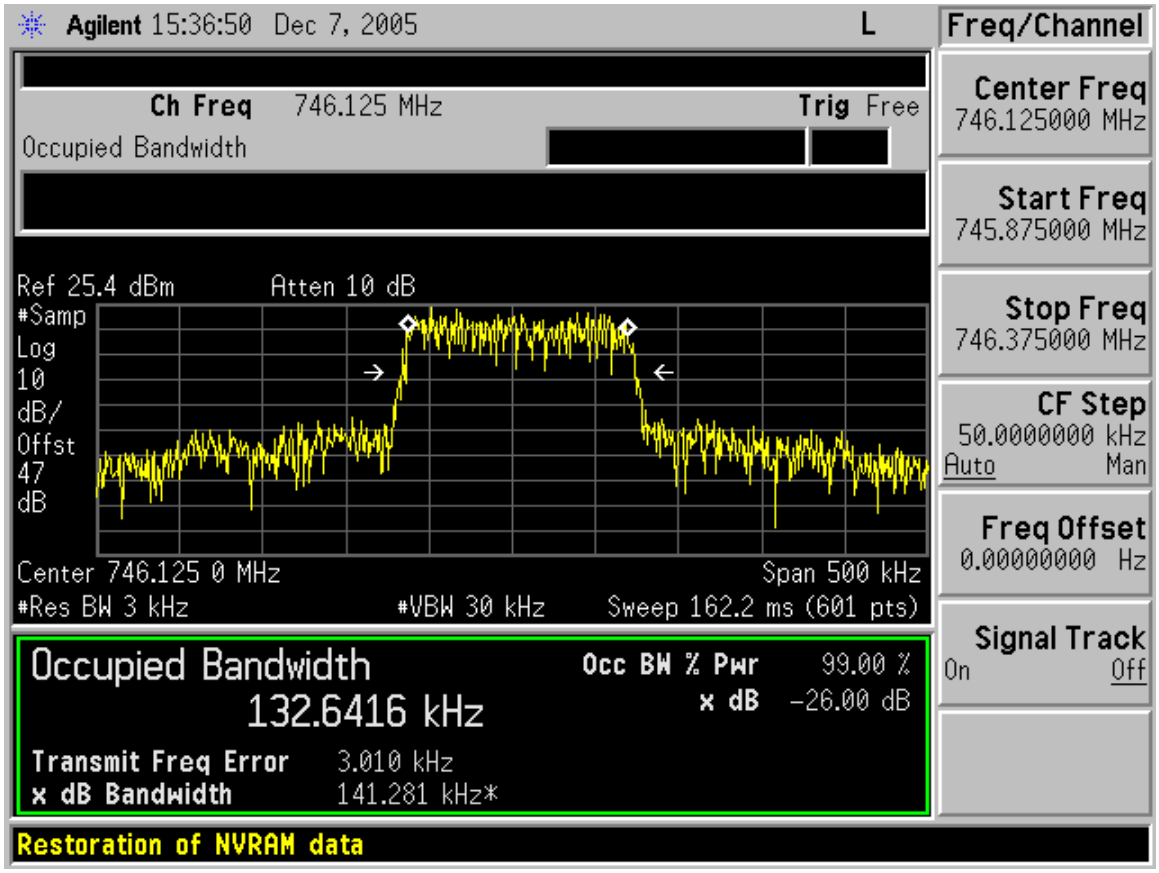
Test Procedures:

Using the spectrum analyzer Occupied Bandwidth measurement function, the 99% occupied bandwidth was measured for the EUT at LOW, MID, and HIGH channels with the EUT operating at full rated power.

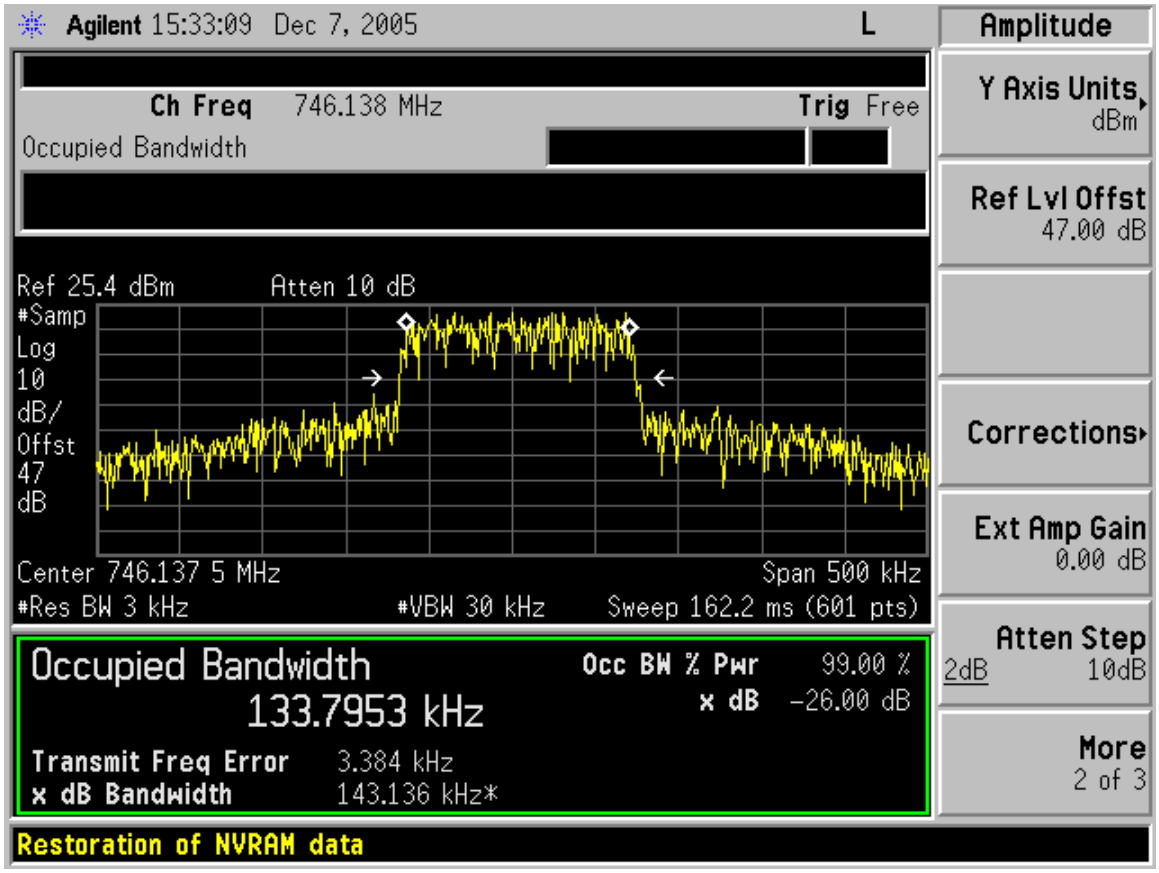
Test Results:

Refer to spectrum analyzer displays below.

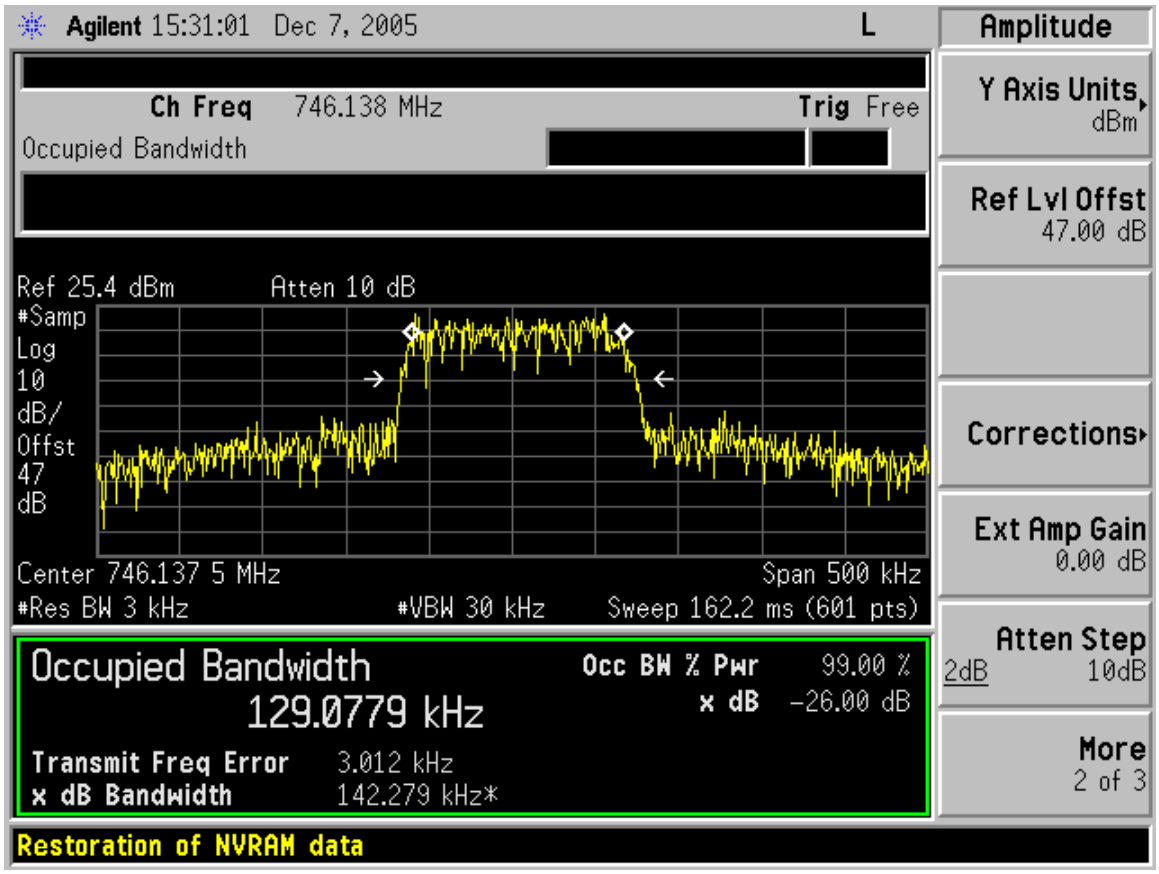
Plot # 13 - QPSK Occupied Bandwidth



Plot#14 – 16QAM Occupied Bandwidth



Plot#15 – 64QAM Occupied Bandwidth



Section 2.1051 ACP, Spurious and Harmonic Emissions at Antenna Terminals

Requirement/Limit: 27.53(d)

(d) For operations in the 746–747 MHz, 762–764 MHz, 776–777 MHz, and 792–794 MHz bands, transmitters must meet the following emission limitations:

(1) 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.

150 kHz Base Transmitter ACP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACP (dBc)
100	50	-40
200	50	-50
300	50	-55
400	50	-60
600-1000	30(s)	-65
1000 to receive band	30(s)	-75 (continues at -6dB/oct
In the receive band	30(s)	-100

(2) *ACP measurement procedure.* The following procedures are to be followed for making ACP transmitter measurements. For time division multiple access (TDMA) systems, the measurements are to be made under TDMA operation only during time slots when the transmitter is on. All measurements must be made at the input to the transmitter's antenna. Measurement bandwidth used below implies an instrument that measures the power in many narrow bandwidths (*e.g.,* 300 Hz) and integrates these powers across a larger band to determine power in the measurement bandwidth.

(i) *Setting reference level.* Using a spectrum analyzer capable of ACP measurements, set the measurement bandwidth to the channel size. For example, for a 6.25 kHz transmitter, set the measurement bandwidth to 6.25 kHz; for a 150 kHz transmitter, set the measurement bandwidth to 150 kHz. Set the frequency offset of the measurement bandwidth to zero and adjust the center frequency of the spectrum analyzer to give the power level in the measurement bandwidth. Record this power level in dBm as the "reference power level".

(ii) *Non-swept power measurement.* Using a spectrum analyzer capable of ACP measurements, set the measurement bandwidth as shown in the tables above. Measure the ACP in dBm. These measurements should be made at maximum power. Calculate the coupled power by subtracting the measurements made in this step from the reference power measured in the previous step. The absolute ACP values must be less than the values given in the table for each condition above.

(iii) *Swept power measurement.* Set a spectrum analyzer to 30 kHz resolution bandwidth, 1 MHz video bandwidth and sample mode detection. Sweep ± MHz from the carrier frequency. Set the reference level to the RMS value of the transmitter power and note the absolute power. The response at frequencies greater than 600 kHz must be less than the values in the tables above.

(3) *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 unmodulated carrier power (P) by at least 43 + 10 log (P) dB.

(e) For operations in the 746–764 MHz and 776–794 MHz bands, emissions 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.

Test set-up: Refer to Figure 1, above

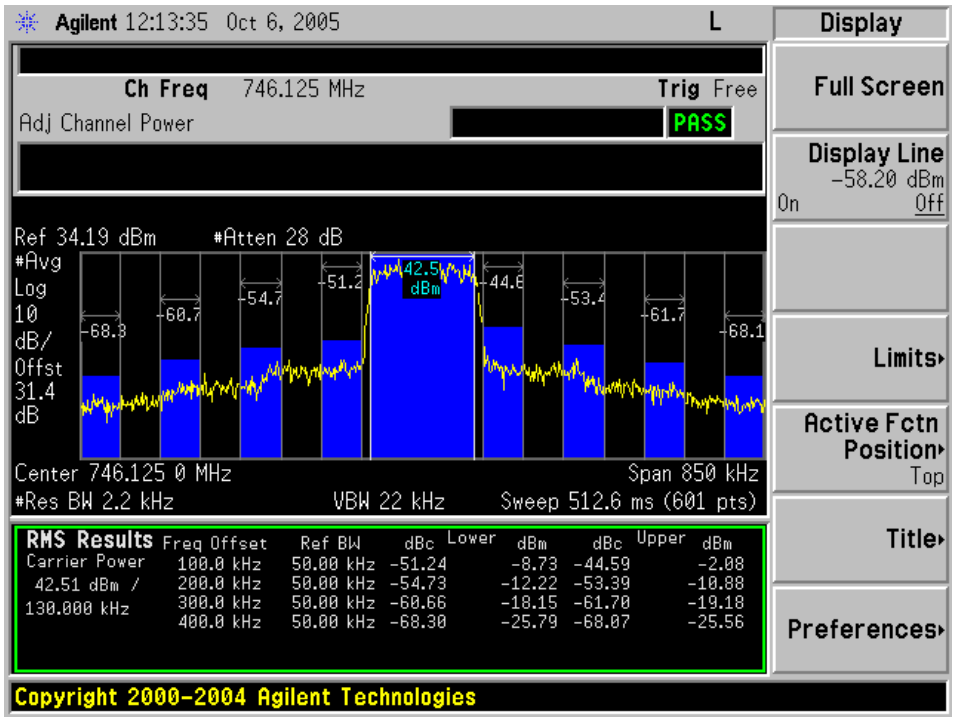
Test Procedures

1. For ACP measurements up to 400 kHz removed from center frequency, the built-in ACP function of the analyzer was used. The integration bandwidth was set to the 99% emission bandwidth (130 kHz).
2. For the other required measurements (swept measurements), the spectrum analyzer was swept across the required frequency range using the measurement bandwidths called out in the table. The display line was set to the level equivalent to the required number of dB below carrier (dBc).
3. Tests were performed for lowest and highest center frequencies for each of three modulations: QPSK, 16QAM, and 64QAM.

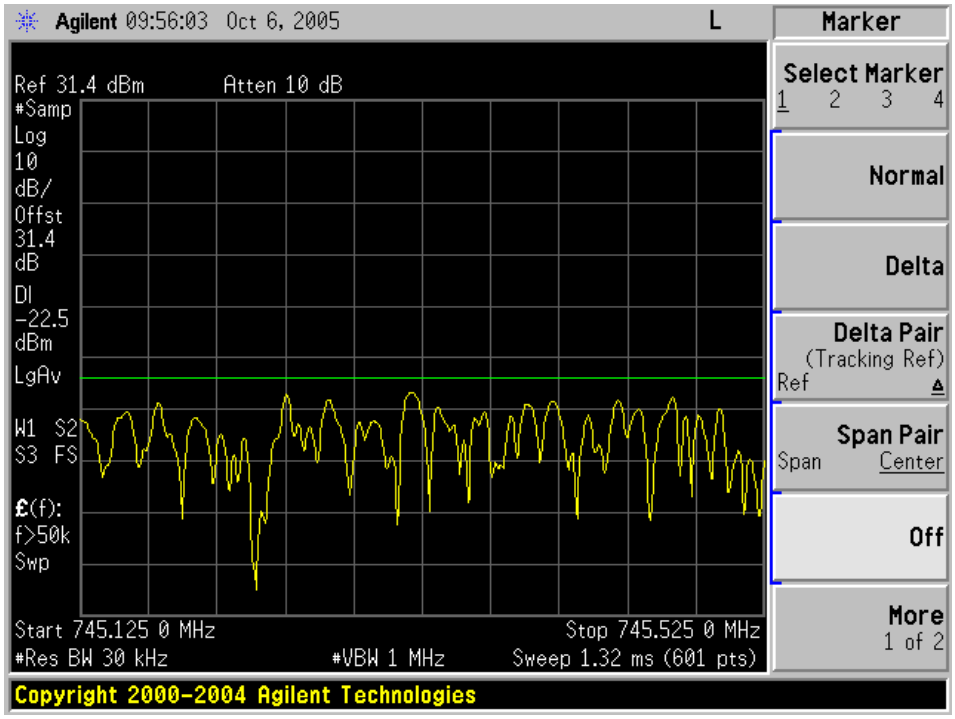
Test Results

PASS. Refer to spectrum analyzer plots below.

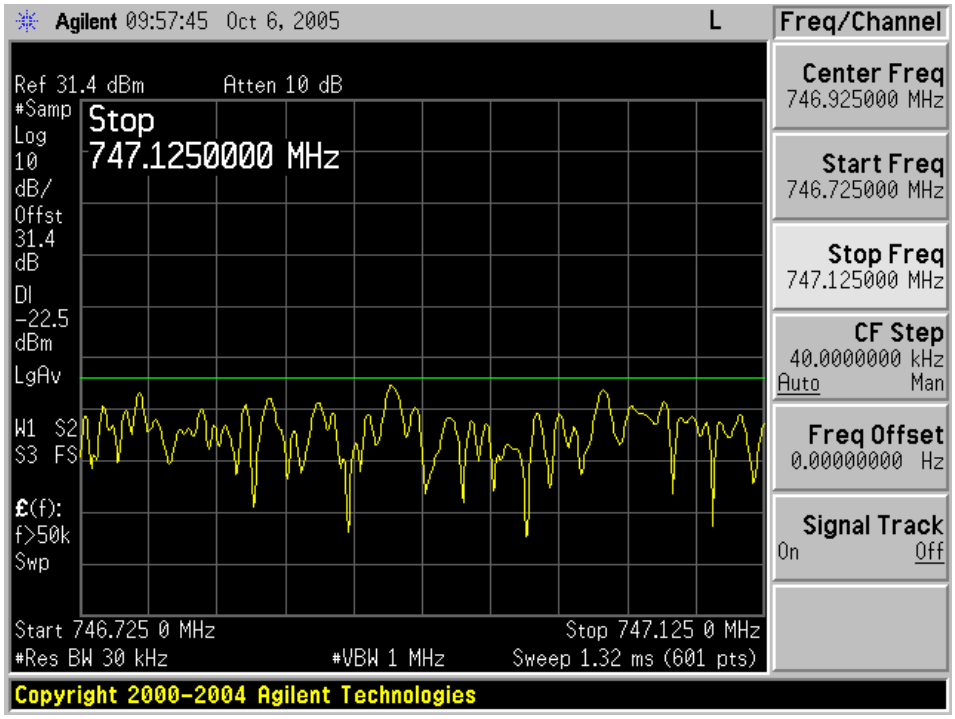
Plot#16 - ACP – QPSK LOW Channel



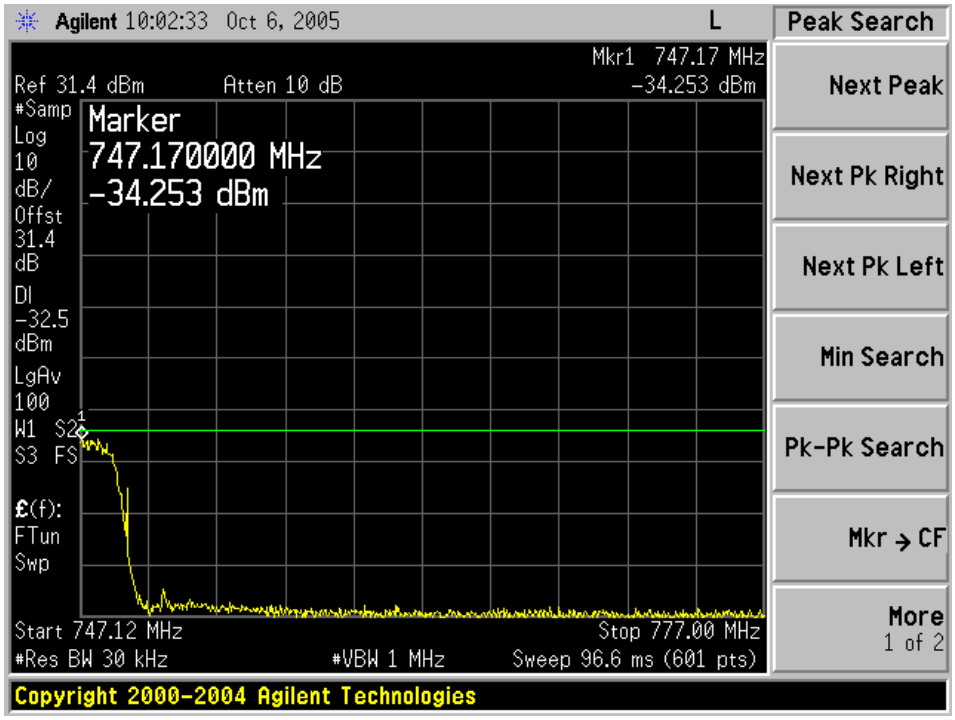
Plot#17 - ACP – QPSK LOW Channel
600-1000 kHz Below Center Frequency



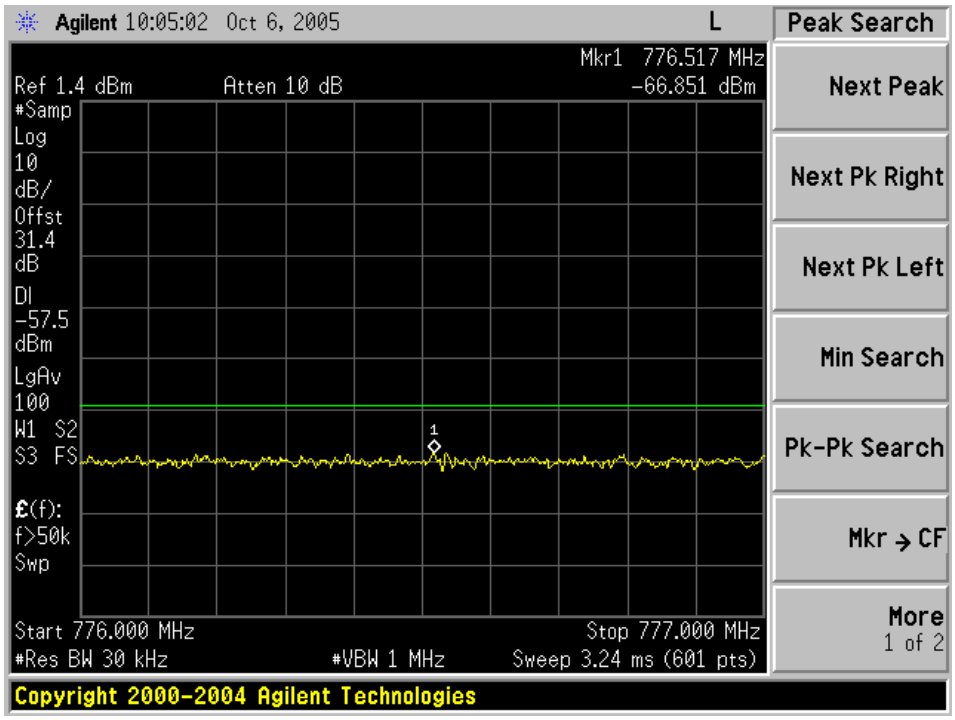
Plot#18 - ACP – QPSK LOW Channel
600-1000 kHz Above Center Frequency



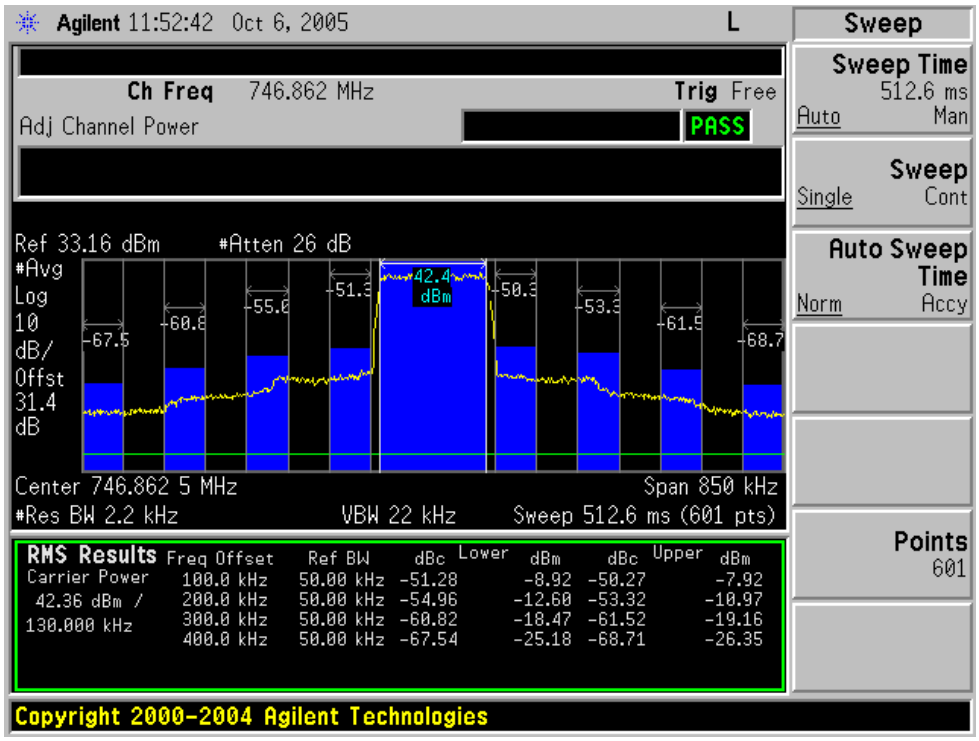
Plot#19 - ACP – QPSK LOW Channel
1000 kHz – RX Band


Agilent 10:02:33 Oct 6, 2005
L
Peak Search
Mkr1 747.17 MHz
Ref 31.4 dBm
Atten 10 dB
-34.253 dBm
Next Peak
#Samp
Log
10
dB/
Offst
31.4
dB
Marker
747.170000 MHz
-34.253 dBm
Next Pk Right
Dl
-32.5
dBm
Next Pk Left
LgAv
100
W1 S2
S3 FS
Min Search
Pk-Pk Search
£(f):
FTun
Swp
Mkr → CF
More
1 of 2
Start 747.12 MHz
Stop 777.00 MHz
#Res BW 30 kHz
#VBW 1 MHz
Sweep 96.6 ms (601 pts)
Copyright 2000-2004 Agilent Technologies

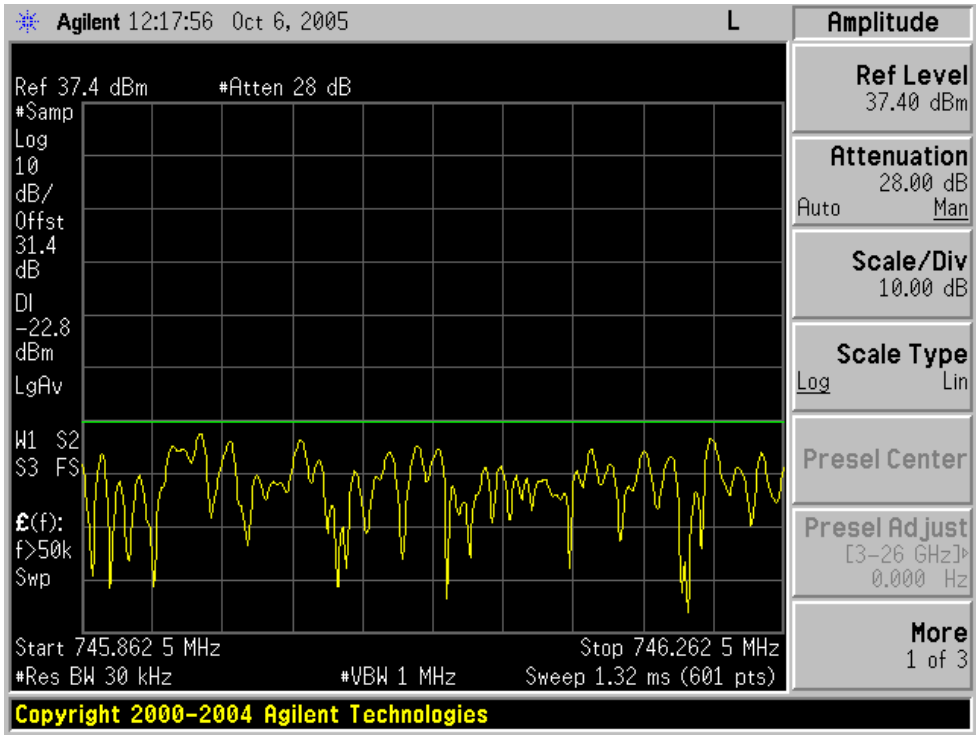
Plot#20 - ACP – QPSK LOW Channel
In the RX band



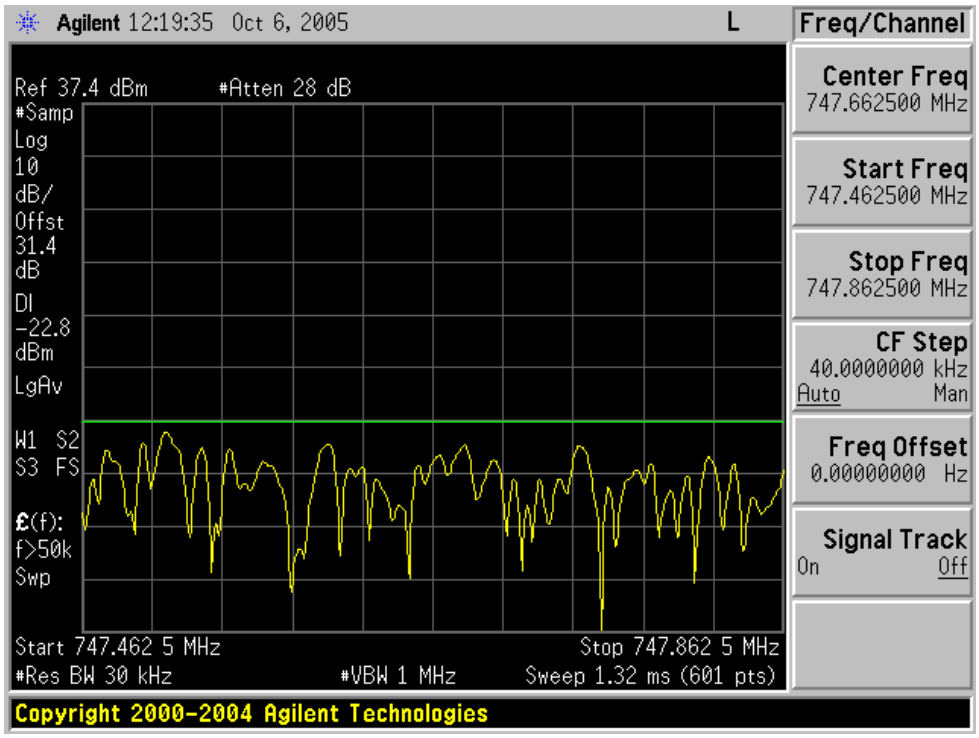
Plot#21 - ACP – QPSK HIGH Channel



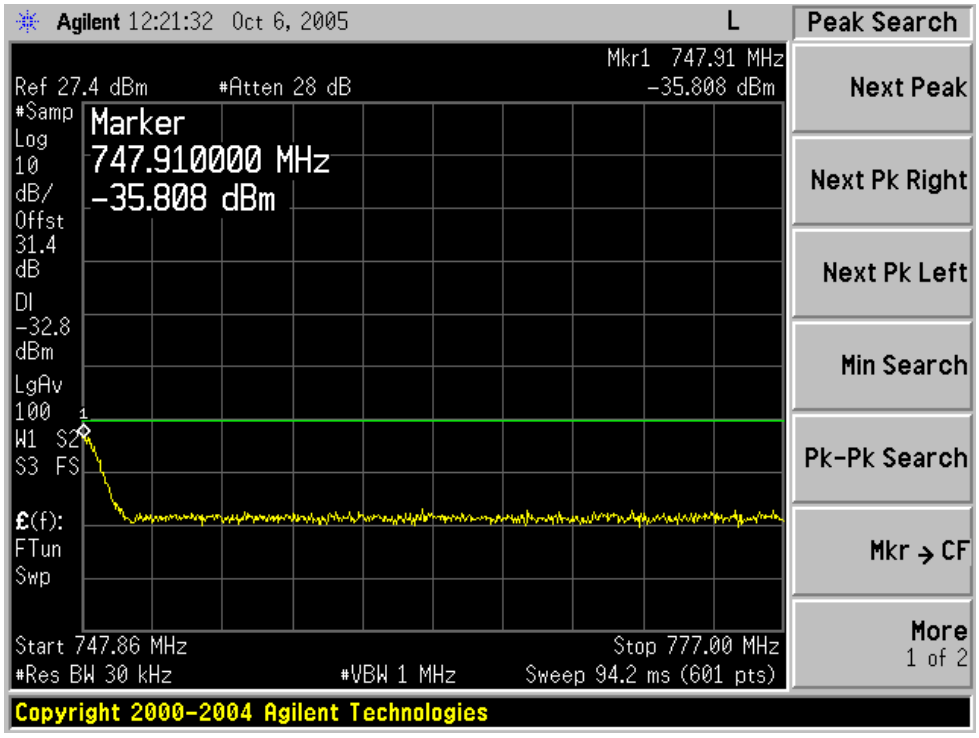
Plot#22 - ACP – QPSK HIGH Channel
600-1000 kHz Below Center Frequency



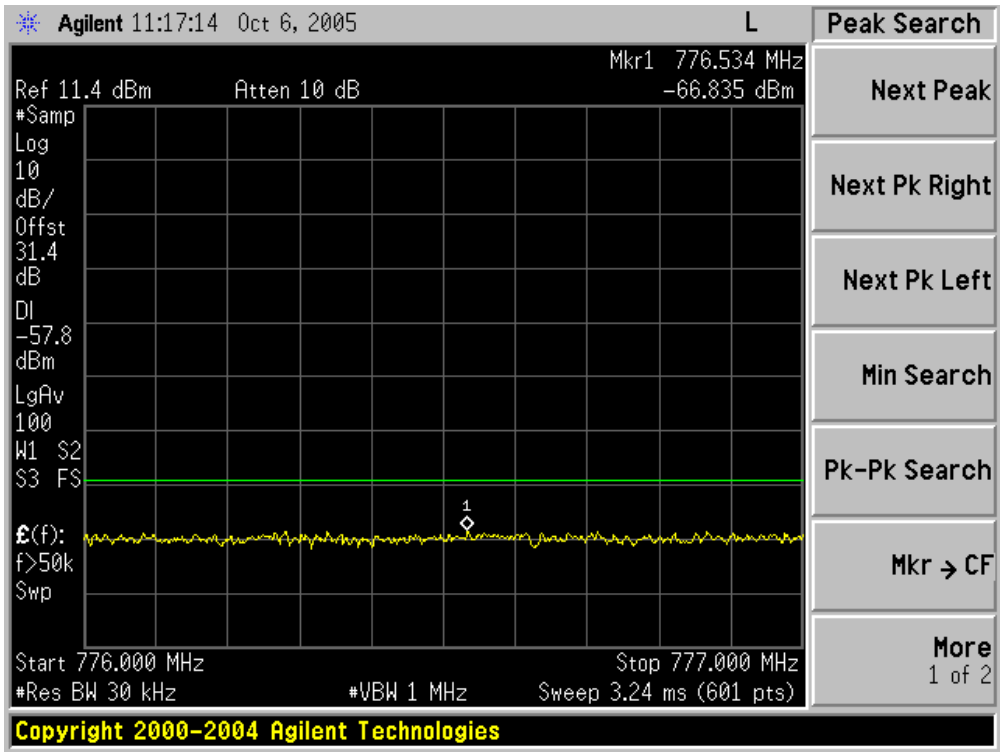
Plot#23 - ACP – QPSK HIGH Channel
600-1000 kHz Above Center Frequency



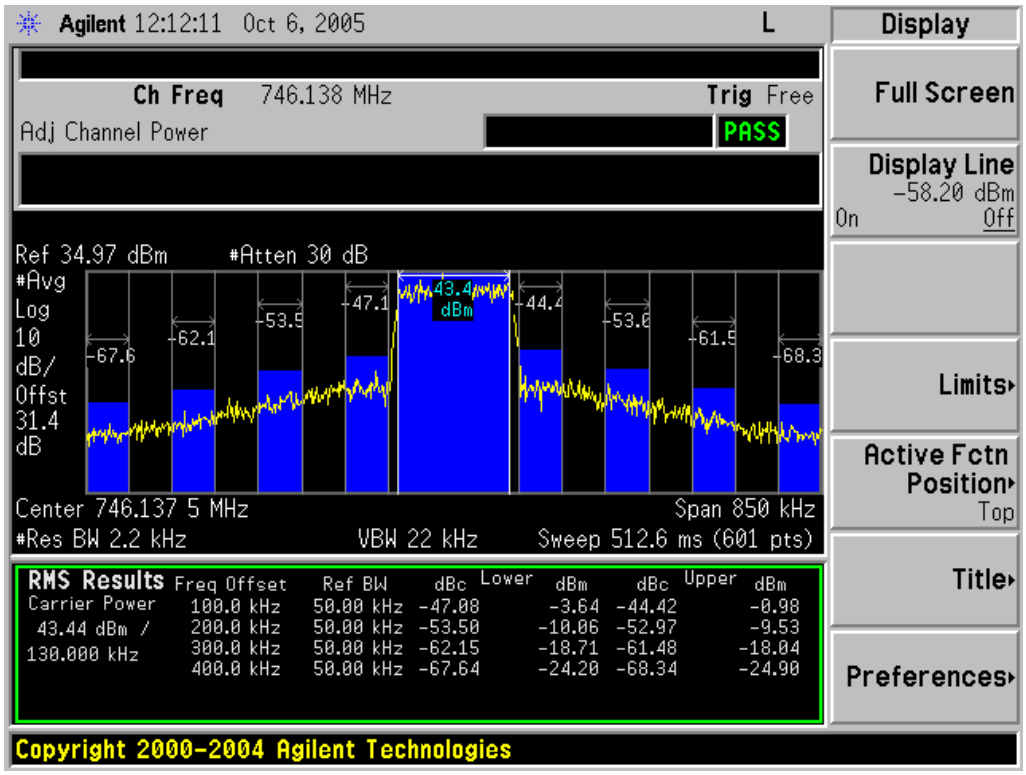
Plot#24 - ACP – QPSK HIGH Channel
1000 kHz – RX Band



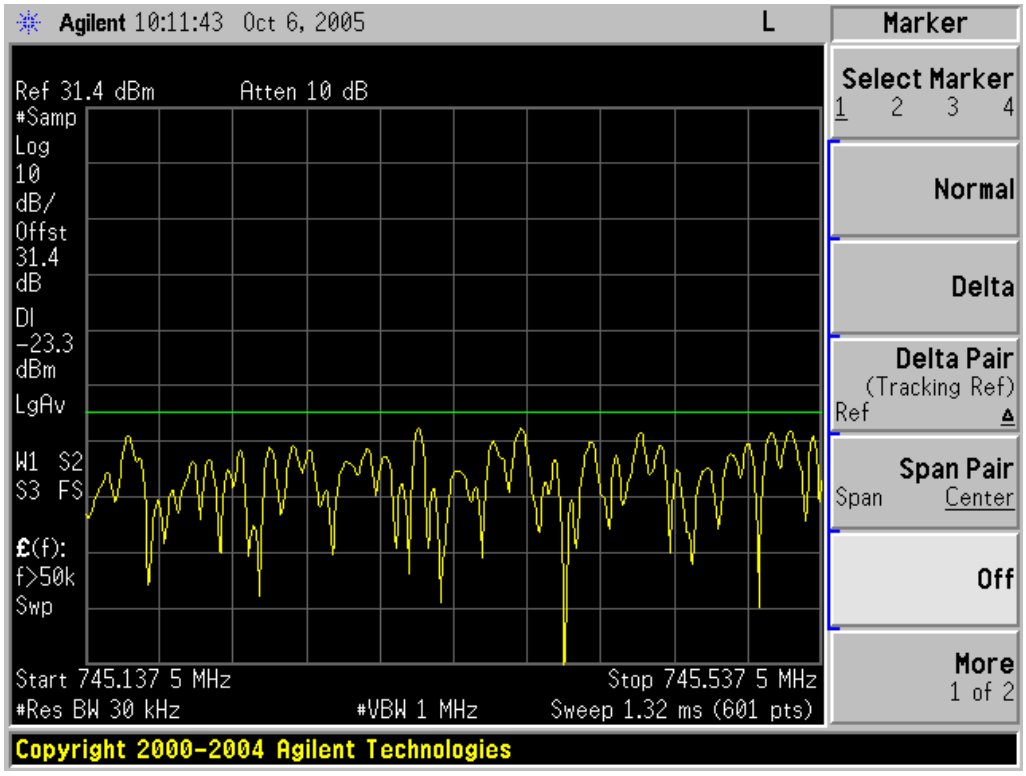
Plot#25 - ACP – QPSK HIGH Channel
In the RX Band



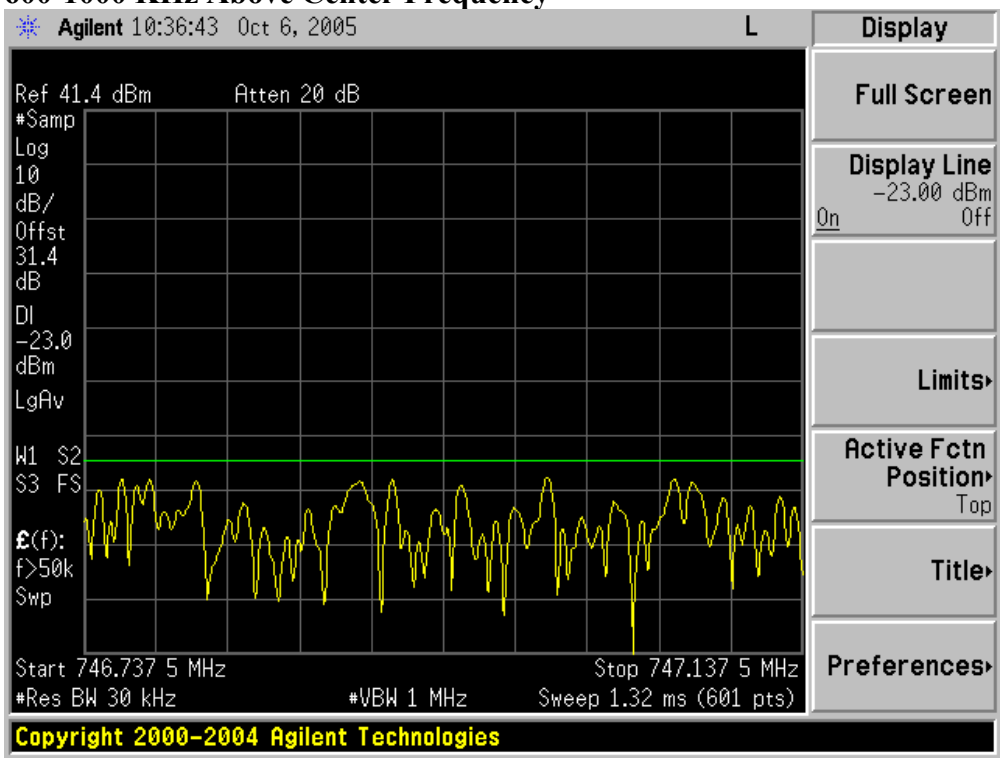
Plot#26 - ACP – 16QAM LOW Channel



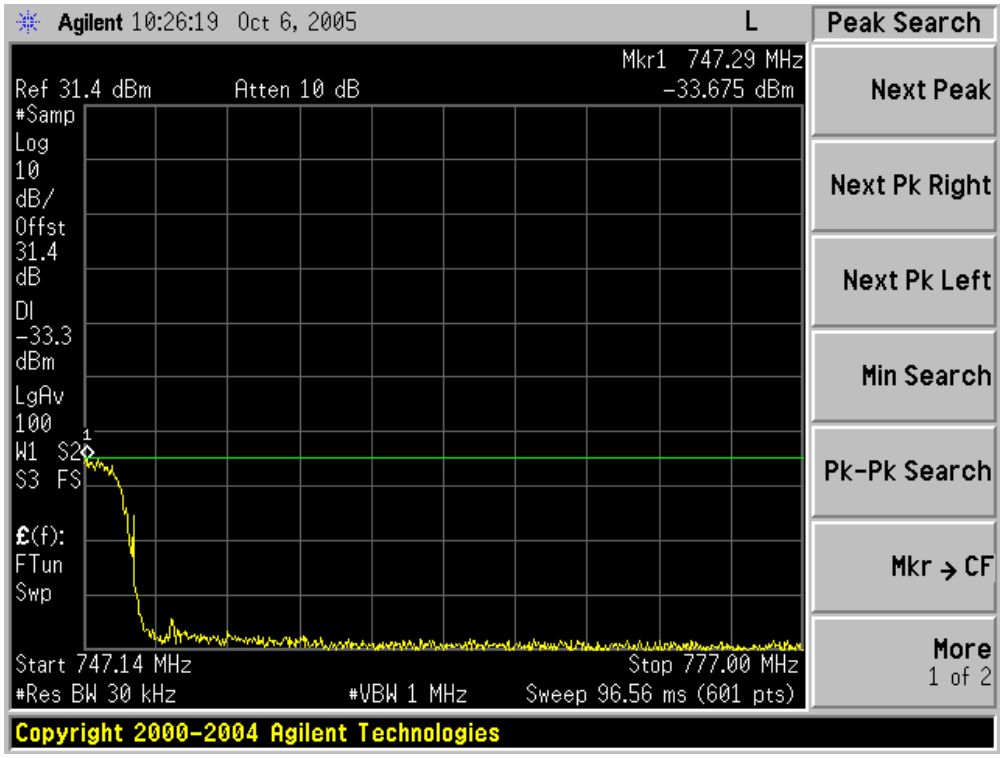
Plot#27 - ACP – 16QAM LOW Channel
600-1000 KHz Below Center Frequency


Agilent 10:11:43 Oct 6, 2005
L
Ref 31.4 dBm
Atten 10 dB
#Samp
Log
10
dB/
Offst
31.4
dB
Dl
-23.3
dBm
LgAv
W1 S2
S3 FS
£(f):
f>50k
Swp
Start 745.137 5 MHz
#Res BW 30 kHz
#VBW 1 MHz
Stop 745.537 5 MHz
Sweep 1.32 ms (601 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref
Span Pair
Span Center
Off
More
1 of 2
Copyright 2000-2004 Agilent Technologies

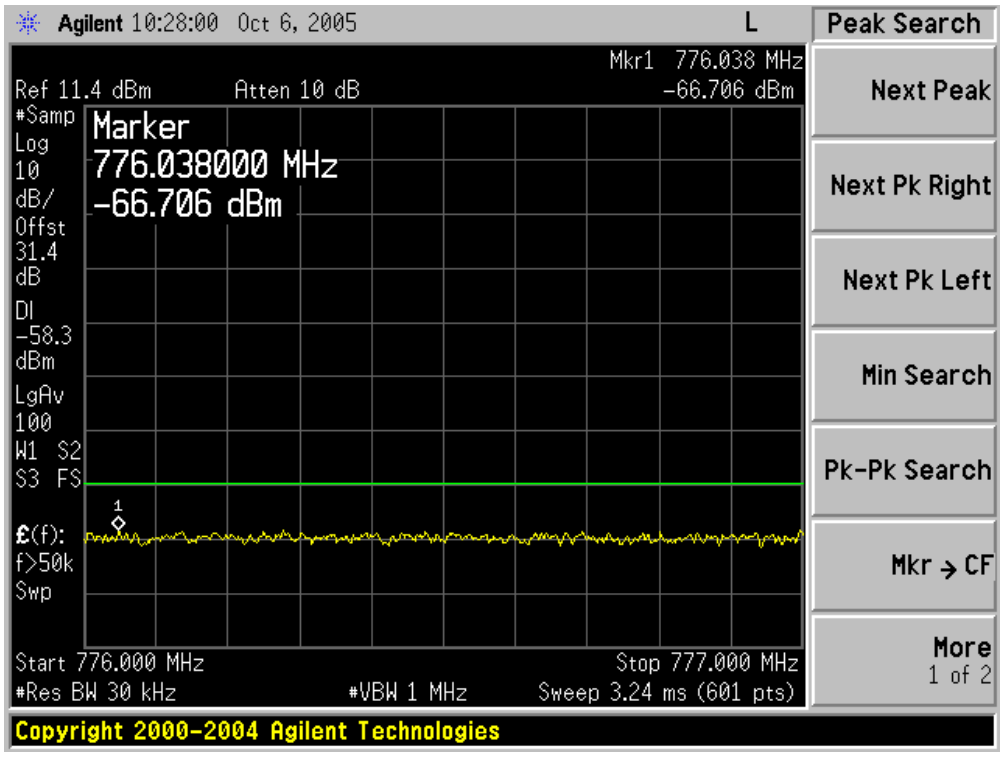
PLOT#28 - ACP – 16QAM LOW Channel
600-1000 KHz Above Center Frequency



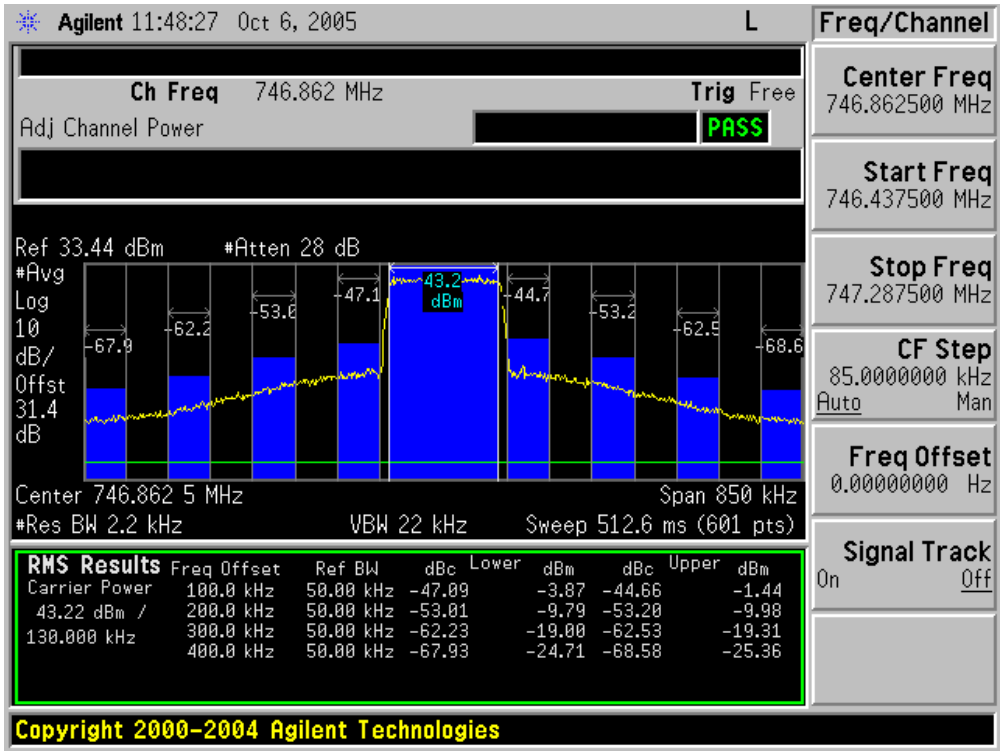
Plot#29 - ACP – 16QAM LOW Channel
1000kHz – RX Band



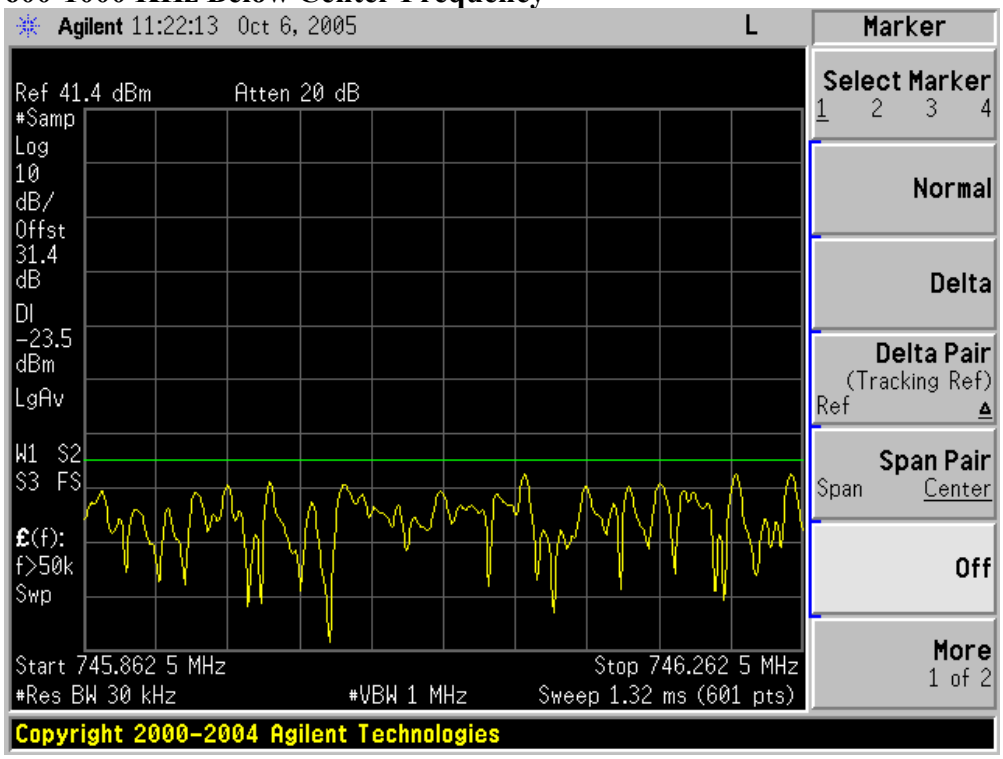
Plot#30 - ACP – 16QAM LOW Channel
In the RX Band



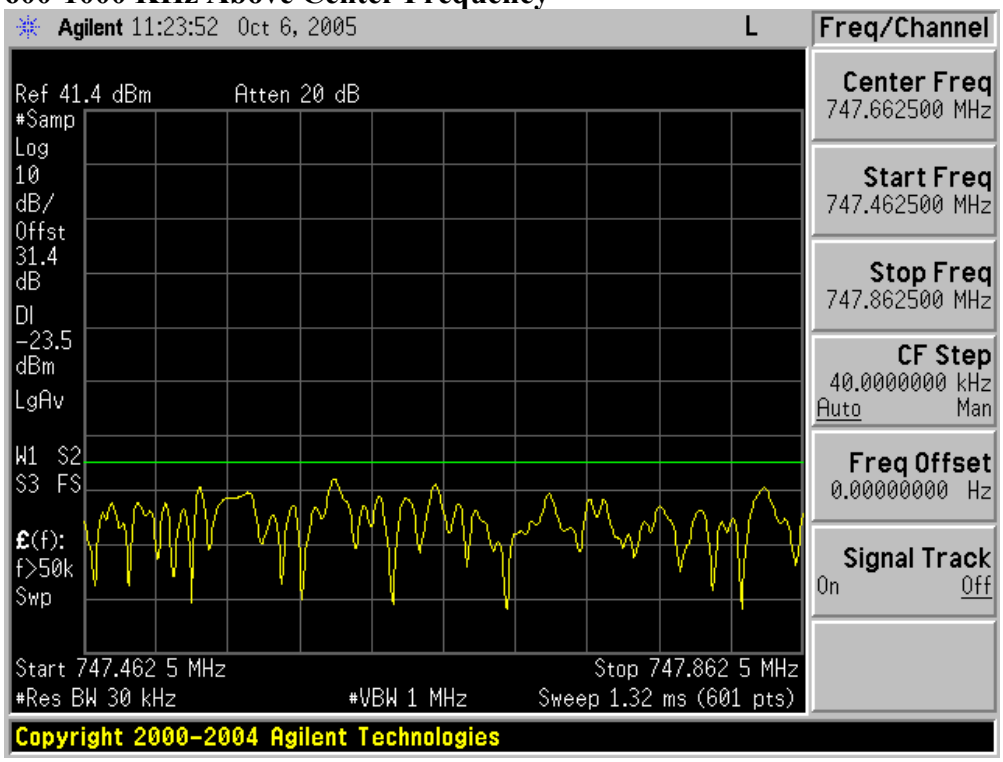
Plot#31 - ACP – 16QAM HIGH Channel



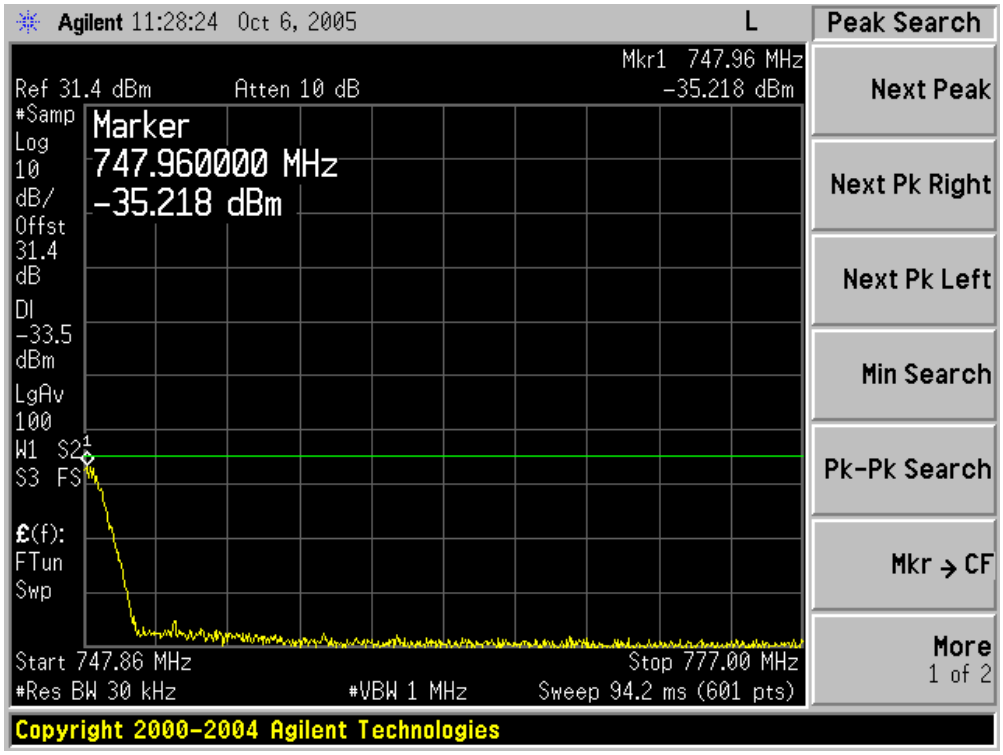
Plot#32 - ACP – 16QAM HIGH Channel
600-1000 KHz Below Center Frequency



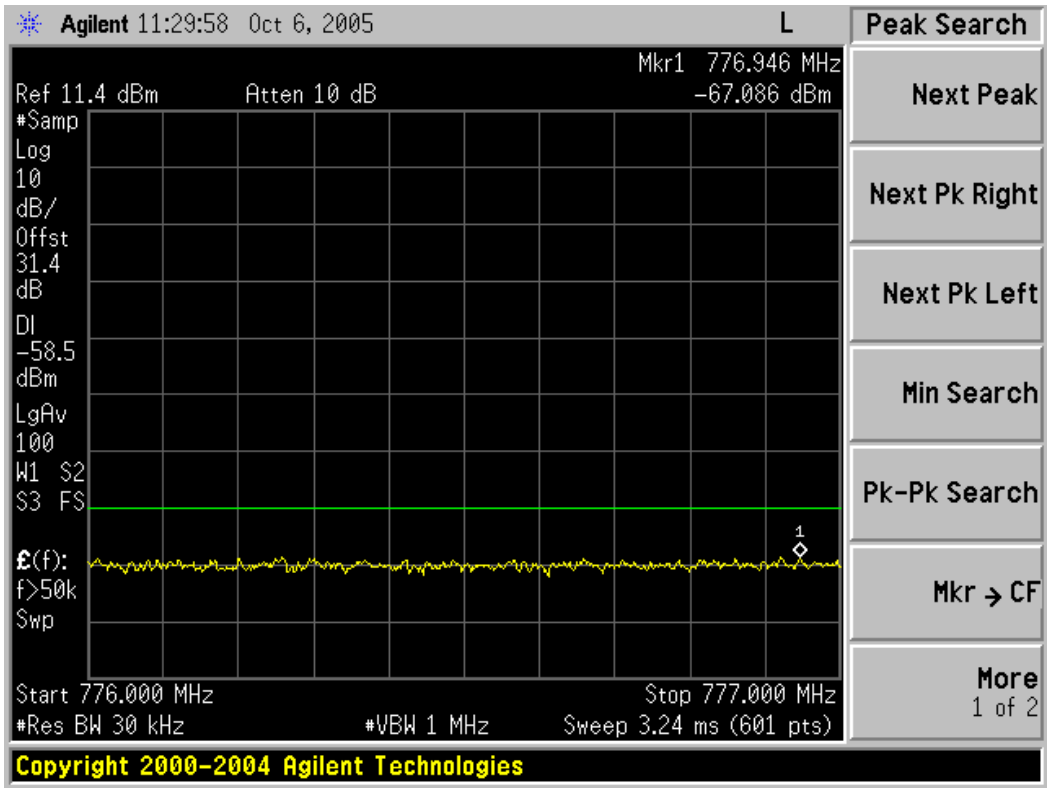
Plot#33 - ACP – 16QAM HIGH Channel
600-1000 KHz Above Center Frequency



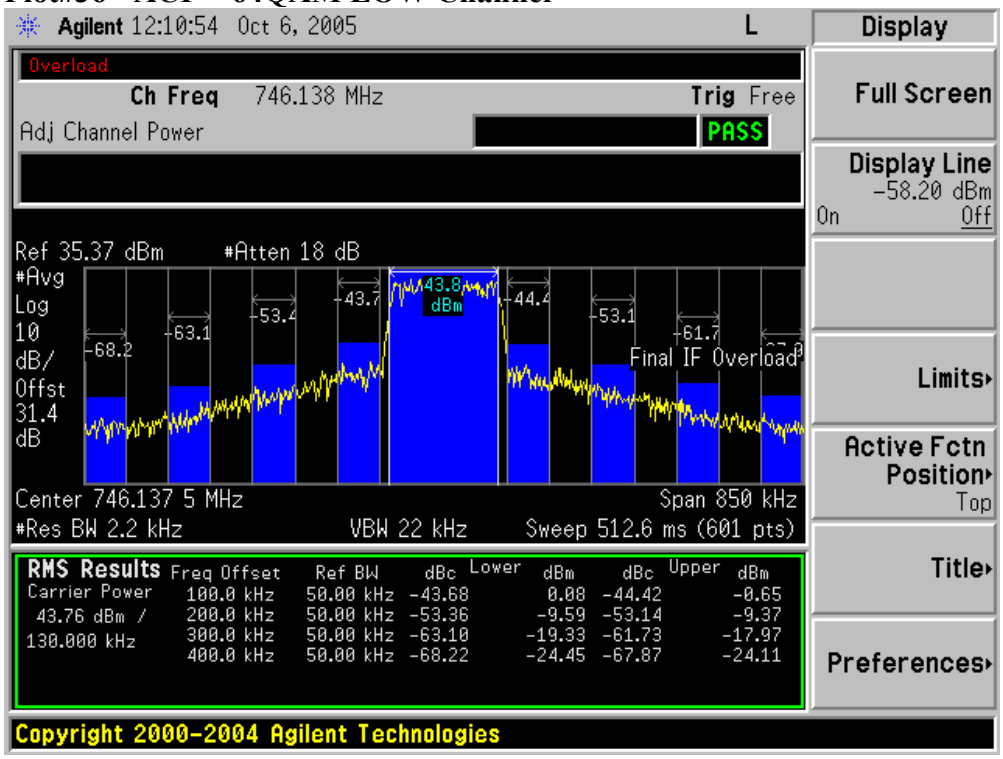
Plot#34 - ACP – 16QAM HIGH Channel
1000kHz – RX Band



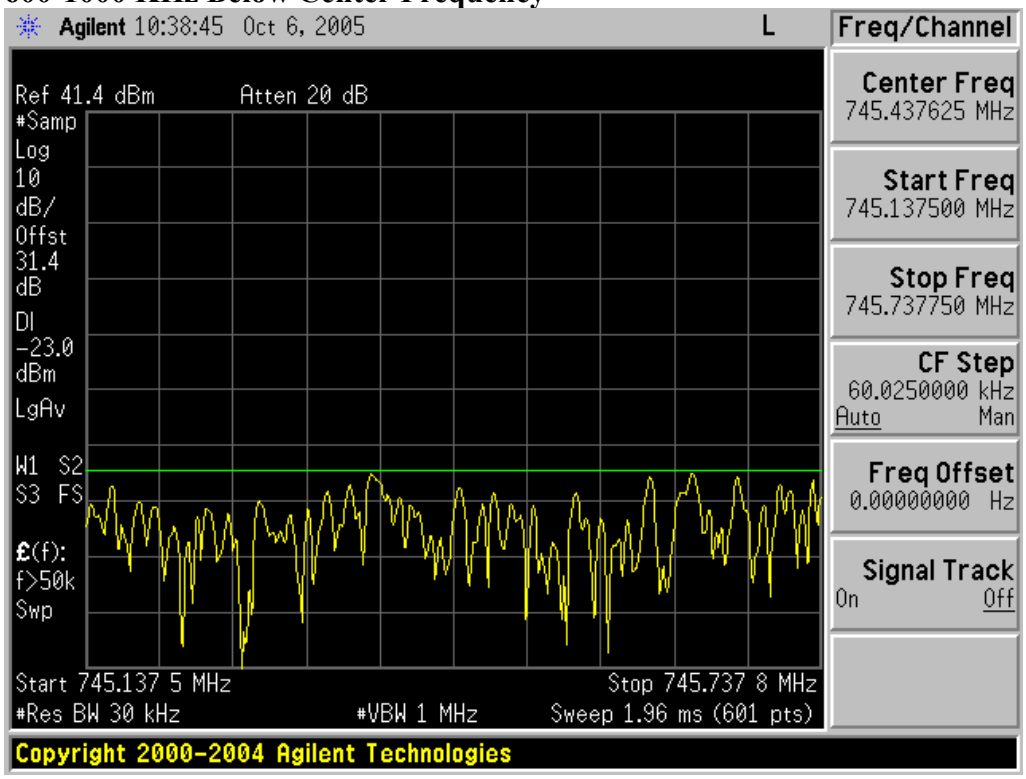
Plot#35 - ACP – 16QAM HIGH Channel
In the RX Band



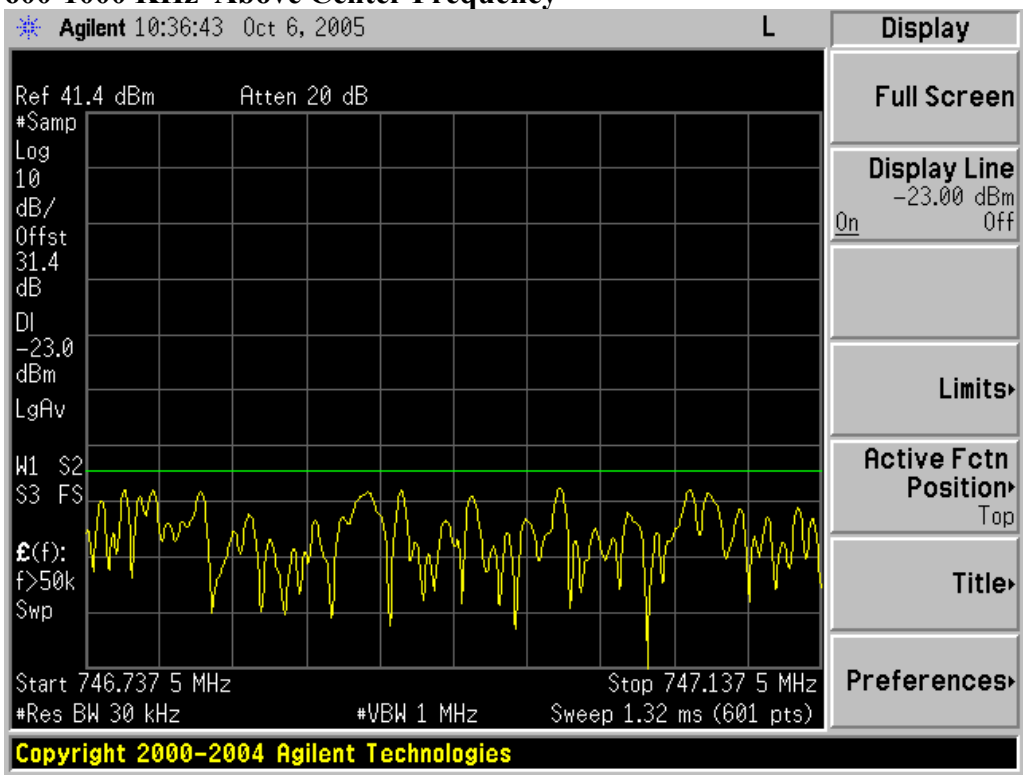
Plot#36 - ACP – 64QAM LOW Channel



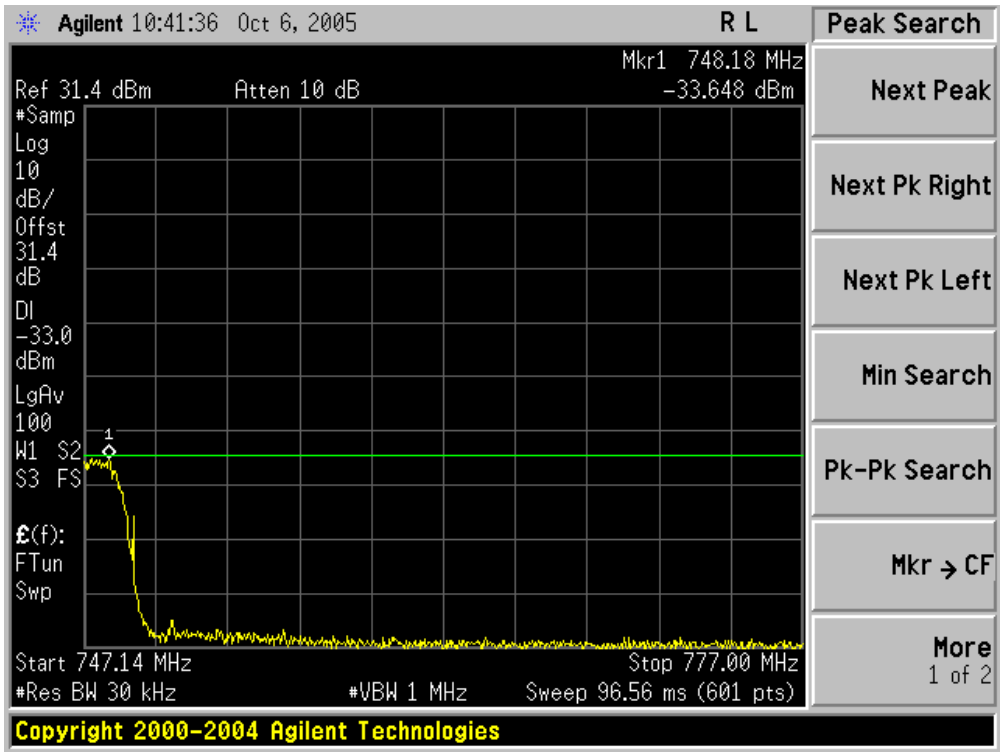
Plot#37 - ACP – 64QAM LOW Channel
600-1000 KHz Below Center Frequency



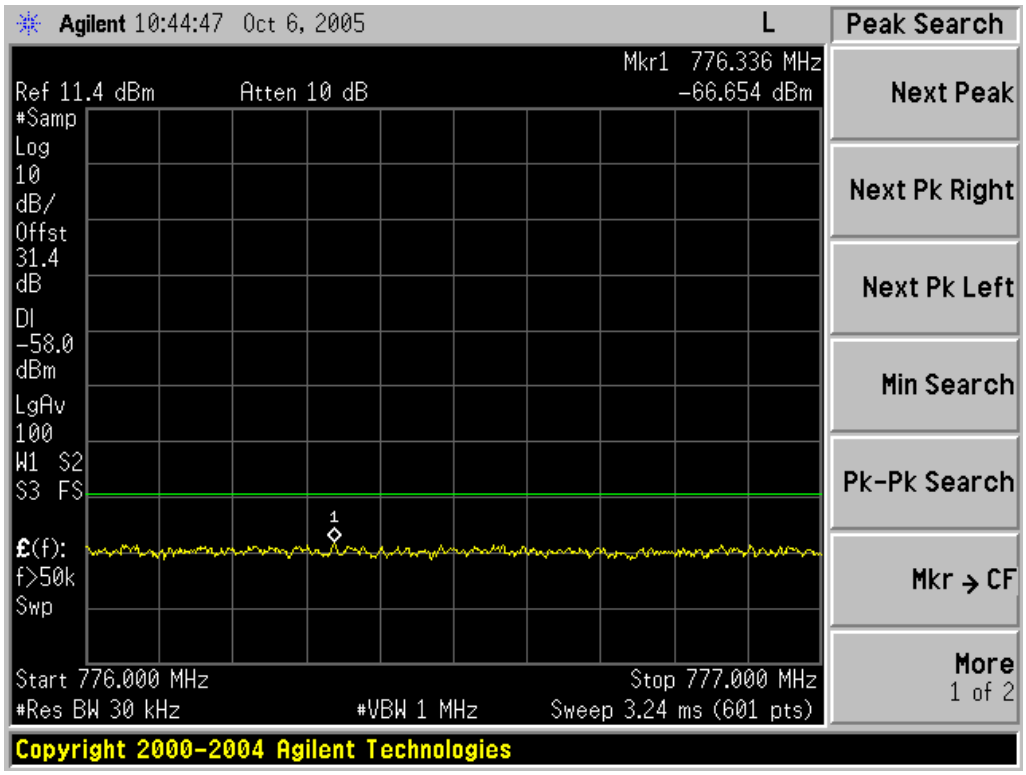
Plot#38 - ACP – 64QAM LOW Channel
600-1000 KHz Above Center Frequency



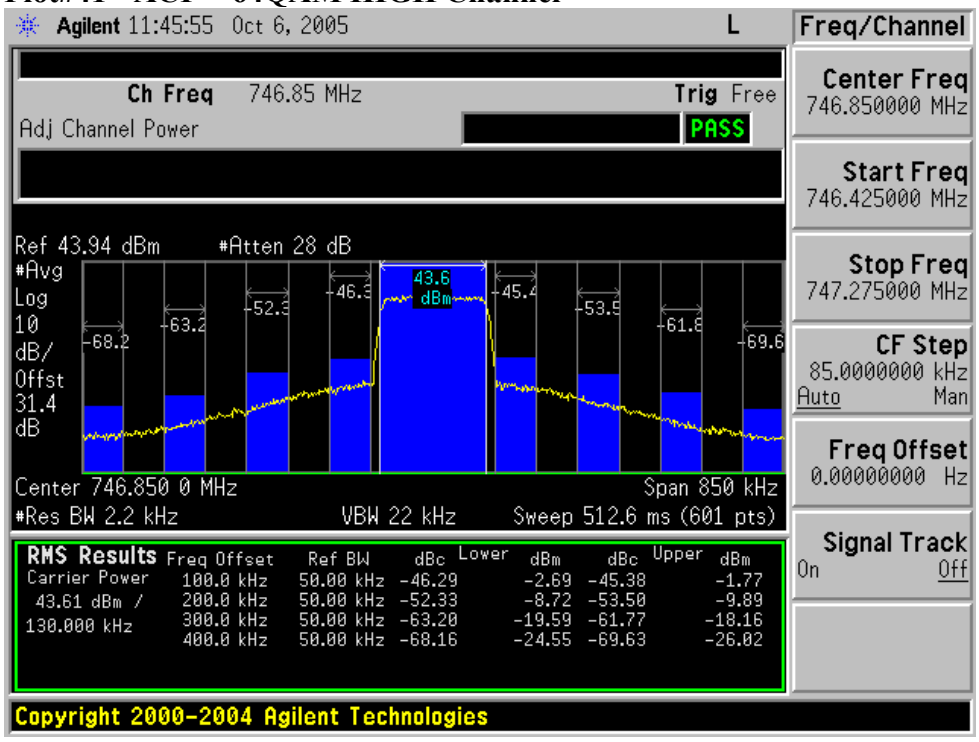
Plot#39 - ACP – 64QAM LOW Channel
1000kHz – RX Band



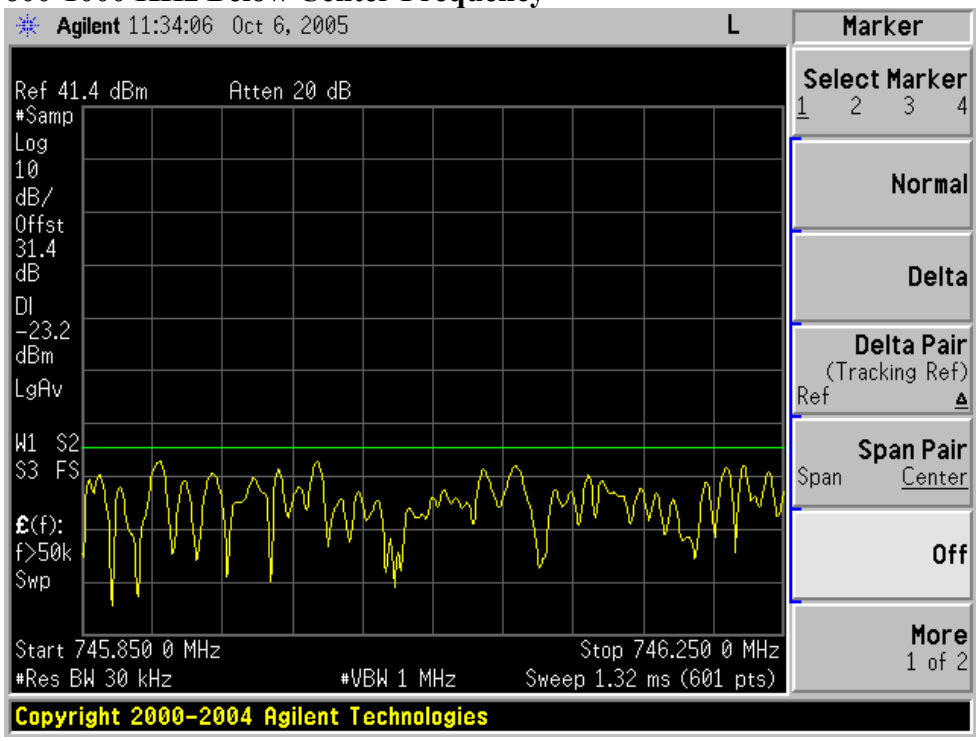
Plot#40 - ACP – 64QAM LOW Channel
In the RX Band



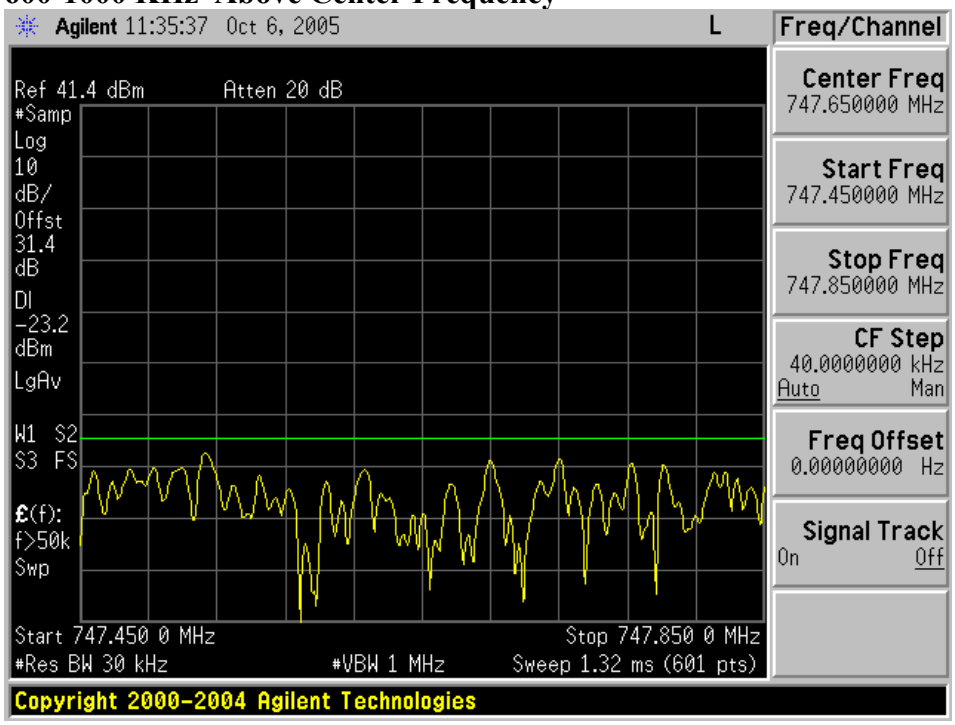
Plot#41 - ACP – 64QAM HIGH Channel



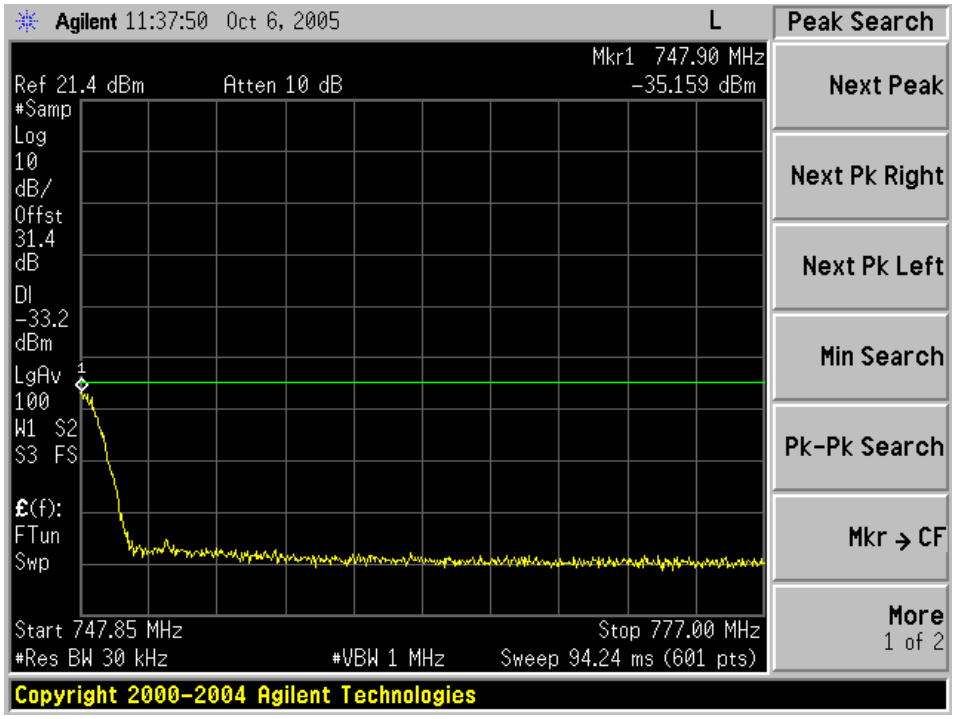
Plot#42 - ACP – 64QAM HIGH Channel
600-1000 KHz Below Center Frequency



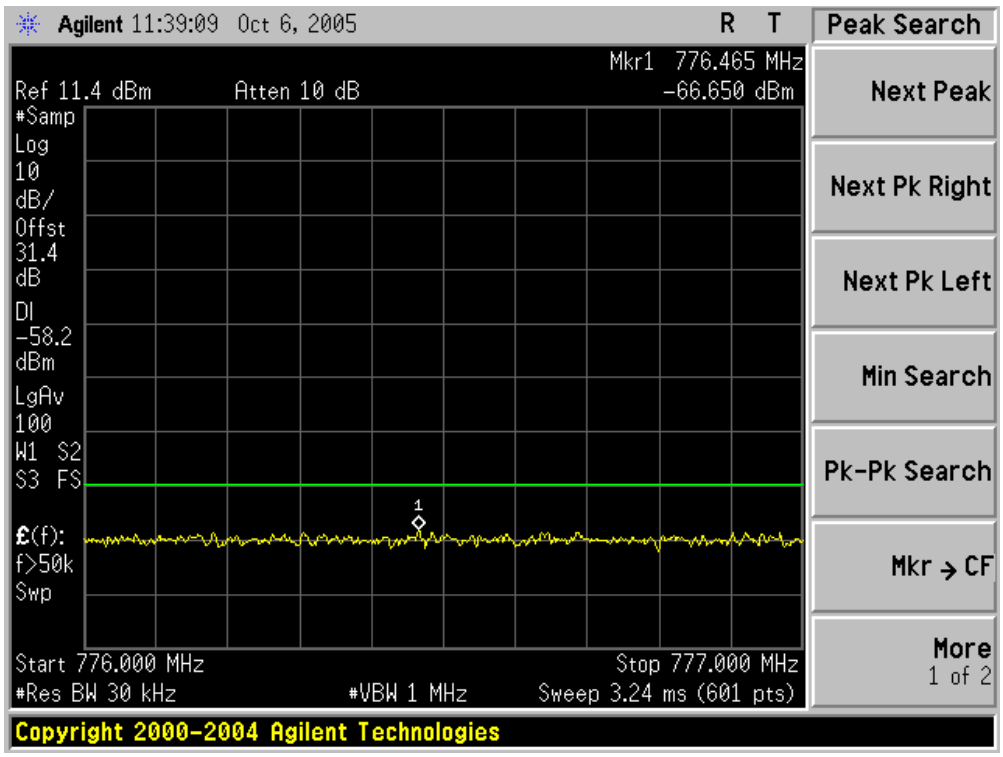
Plot#43 - ACP – 64QAM HIGH Channel
600-1000 KHz Above Center Frequency



Plot#44 - ACP – 64QAM HIGH Channel
1000kHz – RX Band



Plot#45 - ACP – 64QAM HIGH Channel In the RX Band

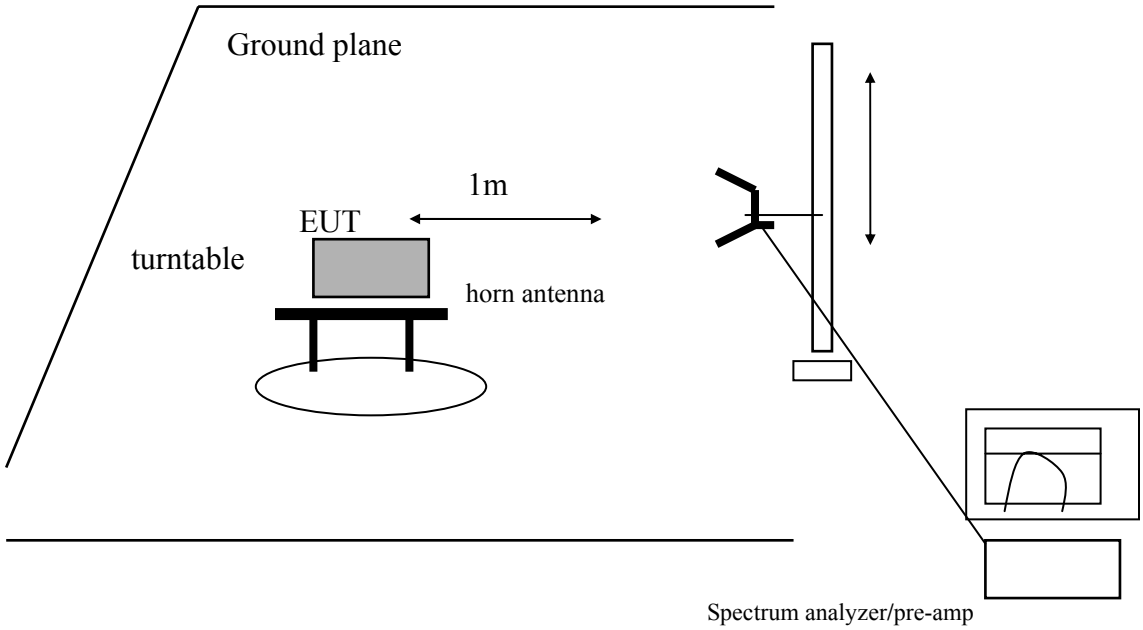


Section 2.1053 Field Strength of Spurious and Harmonic Radiation
Requirement: 27.53(d)3

(3) *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 unmodulated carrier power (P) by at least 43 + 10 log (P) dB.

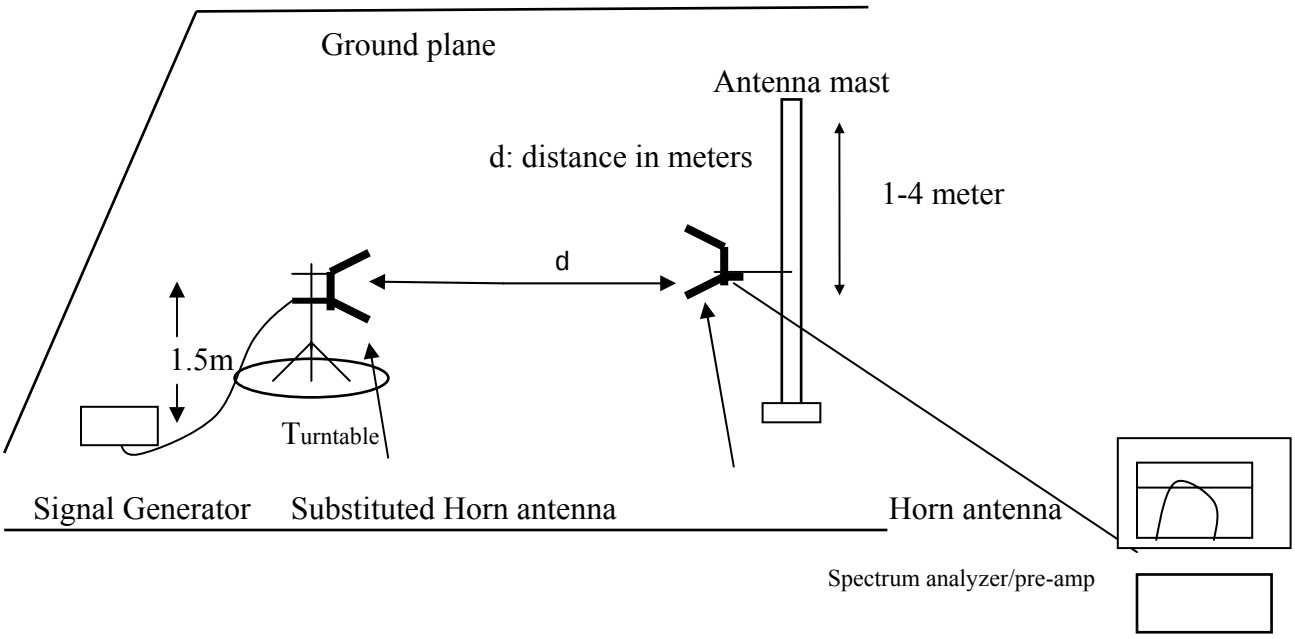
Test Set-Up : Spurious and harmonic emissions measurements

Figure 2a



Test Setup: Substitution antenna and signal generator

Figure 2b



Minimum Requirement

-13 dBm EIRP beyond 250% of authorized bandwidth

Test Method

The antenna output port of the EUT was terminated with a 50 ohm load. With the transmitter operating at full power, the EUT was rotated 360° and the search antenna was raised and lowered in both polarities, all in an attempt to maximize the levels of the received emission for each harmonic and spurious emission up to 10 fo.

The EUT was removed and was replaced by a substitution antenna connected via coax to a signal generator. The generator output was set to each emission frequency detected, the search antenna was raised and lowered, the turntable was rotated, until the maximum emission level was obtained. The signal generator output level was adjusted to match the radiated emission level from the EUT. After correcting for substitution antenna factor and generator cable loss, output power level is compared to the limit.

Test Results

Pass. All emissions detected were below –13 dBm EIRP. Refer to test data below.

Radiated Emissions above 1 GHz

10/04/05 **High Frequency Substitution Measurement**
Compliance Certification Services, Morgan Hill 5m Chamber Site

Test Engr:William Zhuang
Project #:05U3662-1
Company:Tom Cokenias / Vyyo
EUT Descrip.:Base Station
EUT M/N:
Test Target:FCC Part 27
Mode Oper:

Test Equipment:

EMCO Horn 1-18GHz: T73; S/N: 6717 @3m

Horn > 18GHz:

Limit: EIRP

Hi Frequency Cables: ☐ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☑ (12 ft)

Pre-amplifer 1-26GHz:

Pre-amplifer 2(:

f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Antenna port with dummy load									
1.494	50.5	V	-19.7	1.2	7.3	5.2	-13.6	-13.0	-0.6
1.494	43.3	H	-26.2	1.2	7.3	5.2	-20.1	-13.0	-7.1
2.240	46.4	V	-20.4	1.5	8.3	6.2	-13.6	-13.0	-0.6
2.240	43.9	H	-22.8	1.5	8.3	6.2	-16.0	-13.0	-3.0
2.987	49.9	H	-20.7	1.8	9.1	7.0	-13.4	-13.0	-0.4
2.987	35.6	H	-20.7	1.8	7.4	5.3	-15.1	-13.0	-2.1
2.987	45.2	H	-21.4	1.8	7.4	5.3	-15.8	-13.0	-2.8
3.734	35.7	V	-27.4	2.0	9.6	7.4	-19.9	-13.0	-6.9
3.734	38.7	H	-24.3	2.0	9.6	7.4	-16.7	-13.0	-3.7
4.480	31.0	H	-30.4	2.3	10.2	8.0	-22.5	-13.0	-9.5
4.480	28.8	V	-33.0	2.3	10.2	8.0	-25.1	-13.0	-12.1

Field Strength of Emissions in the 1559-1610 MHz band
Requirement: 27.53(e)

(e) For operations in the 746–764 MHz and 776–794 MHz bands, emissions 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.

Test Set-up

Refer to Figure 2a above.

Test Procedures

The EUT was set to produce maximum output power into a 7 dBi yagi antenna that could be used with the EUT

Test Results

One emission detected in the 1559 – 1610 MHz band. Refer to attached spreadsheet.

Emissions in 1559 – 1610 MHz band

10/04/05 **High Frequency Substitution Measurement**
Compliance Certification Services, Morgan Hill 5m Chamber Site

Test Engr: William Zhuang
Project #: 05U3662-1
Company: Tom Cokenias / Vyyo
EUT Descrip.: Base Station
EUT M/N:
Test Target: FCC Part 27
Mode Oper:

Test Equipment:

EMCO Horn 1-18GHz: T73; S/N: 6717 @3m
Horn > 18GHz:
Limit: EIRP
Hi Frequency Cables: (2 ft) ☑ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☐ (12 ft) ☑
Pre-amplifer 1-26GHz: T63 Miteq 646456
Pre-amplifer 26-4:

f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	EIRP (dBm)	Limit (dBm)	Margin (dB)
Antenna connected									
1.584	49.6	V	-61.9	1.0	3.6	1.4	-59.3	-50.0	-9.3
1.584	47.7	H	-62.0	1.6	3.6	1.5	-60.0	-50.0	-10.0

No other emissions detected 1559 - 1610 MHz band.

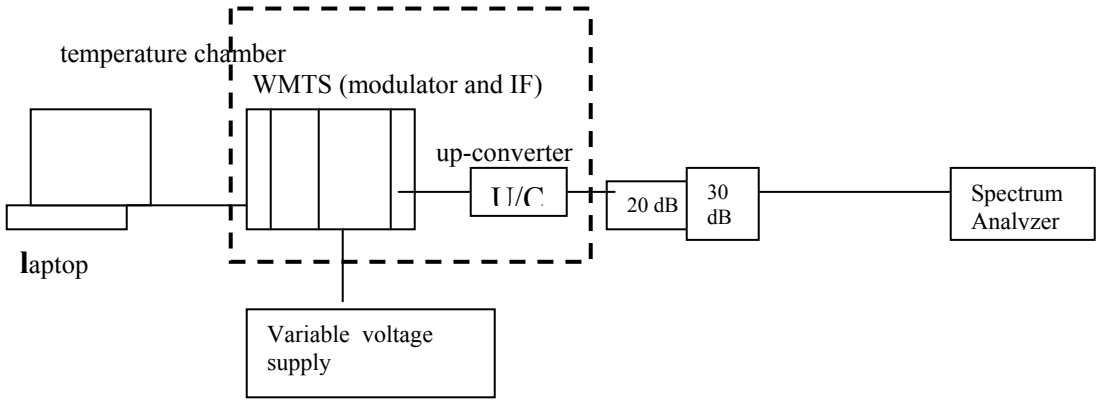
2.1055 Frequency Stability

Requirement/Limit: Section 27.54

27.54. The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Test Setup

Figure 3



Test Procedures

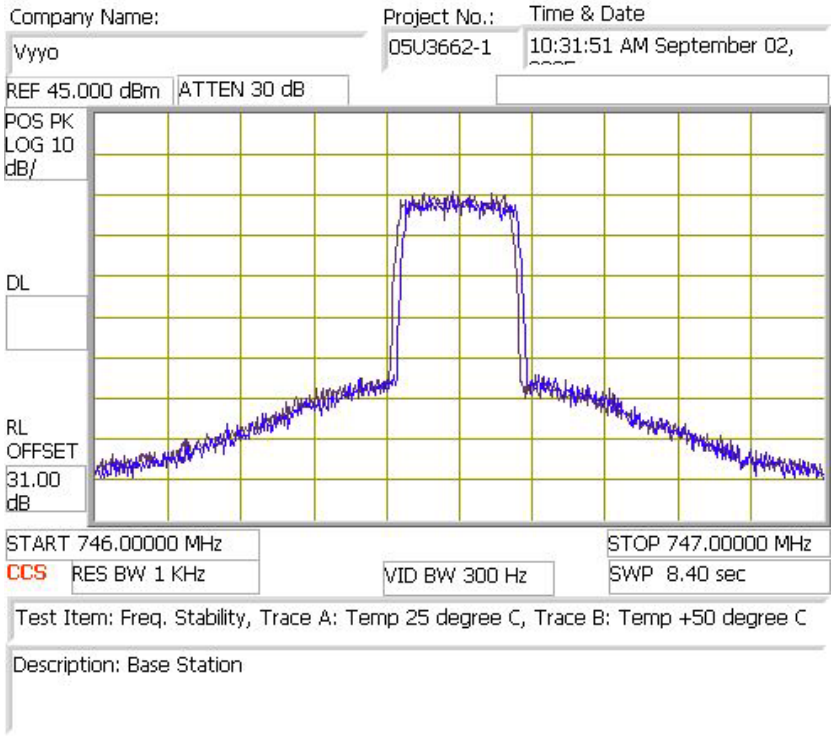
1. The WMTS modulator and the frequency up-converter portions of the transmitter were placed inside the temperature chamber. These are the two subassemblies that determine the operating frequency of the EUT.
2. The output of the U/C was connected to the spectrum analyzer through the same attenuators and coaxial cable used for the other antenna port conducted tests for a total attenuation of 52 dB.
3. The temperature was set to 25C and a plot of the transmitter output mask was recorded (yellow trace) The temperature was allowed to stabilize at every 10 degrees C from –30C to +50C. For each temperature tested a second output mask plot (blue trace) was superimposed on the yellow 25C plot.

Test Results

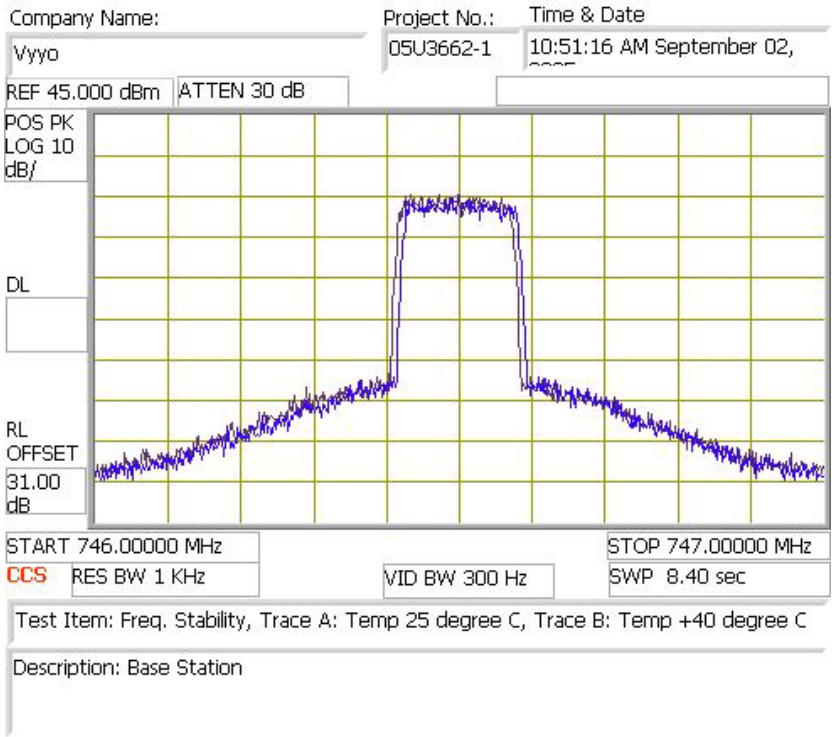
From +10C - +50C the EUT output mask did not vary noticeably from the 25C plot. The EUT is designed for indoor operation in a climate protected room. A temperature sensitive switch turns off the TX power when temperature goes below 10C and there is no TX output.

Refer to attached spectrum analyzer photos.

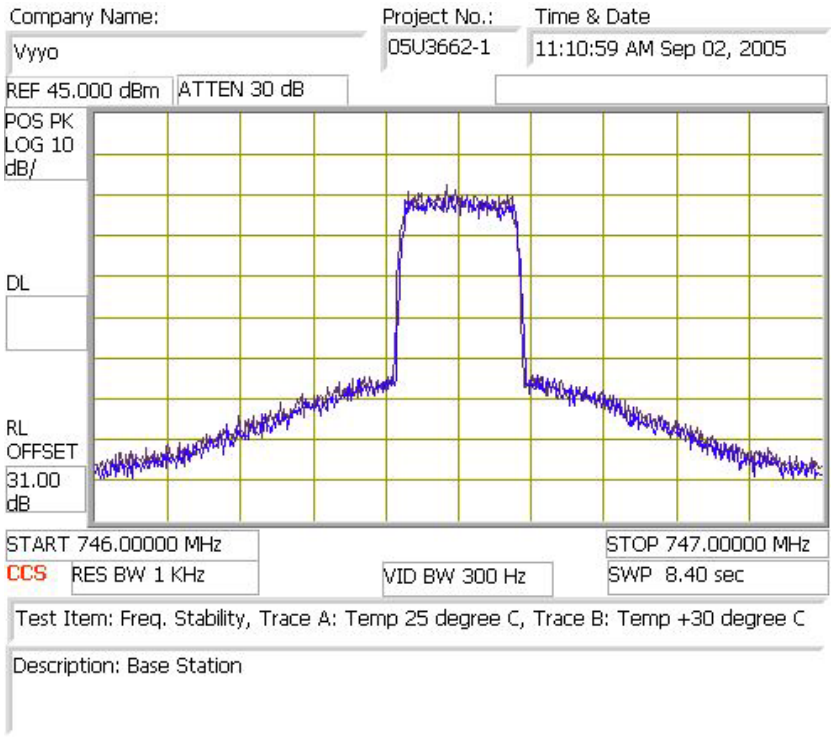
Plot#46 - T = 50°C



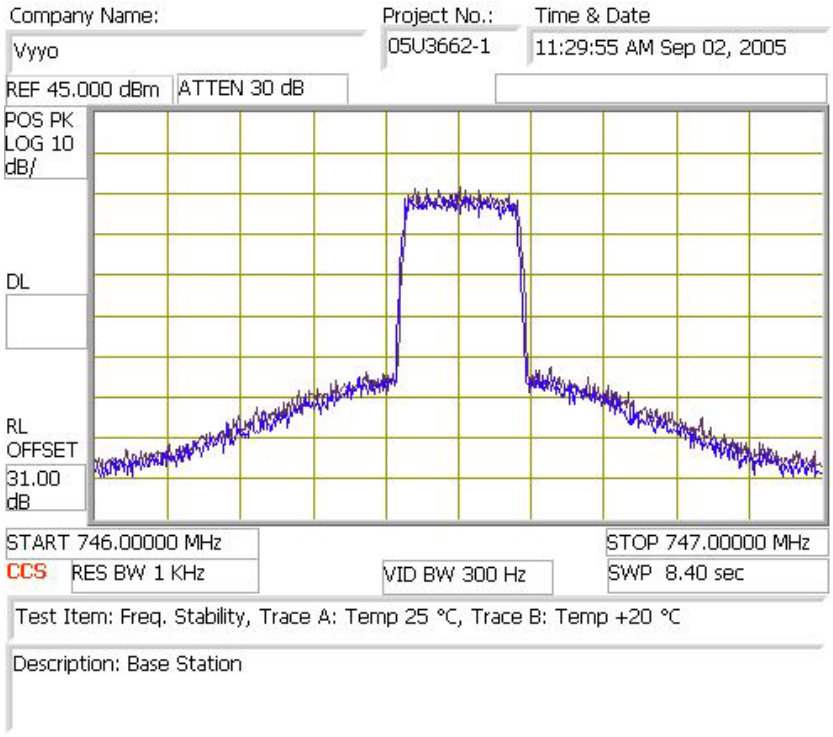
Plot#47 – T=40°C



Plot#48 - T= 30°C



Plot#49 - T= 20°C



Operating Voltage v Frequency

Test Setup
Refer to Figure 3

Test Procedures

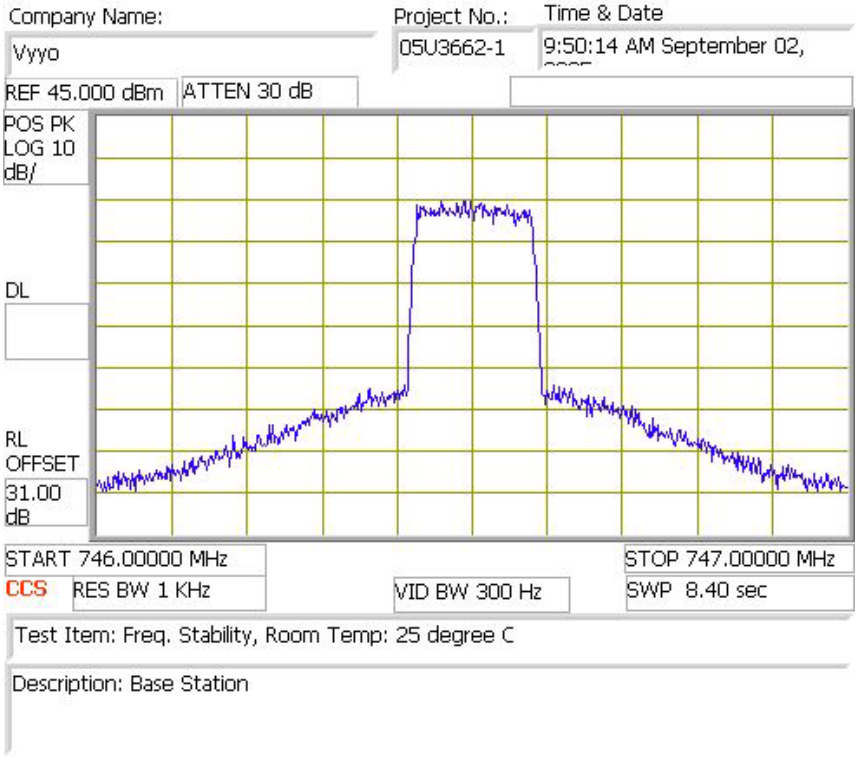
At 25C the power supply voltage was varied between 85% and 115% nominal.

Test Results

No detectable variation. over voltage excursion.

T= 25°C, V = 102 VAC (85% nominal)
T= 25°C, V = 138 VAC (115% nominal)

Plot#50 – Frequency vs Voltage, 85% - 115% Nominal (120 VAC)



Test Site And Test Dates

Test Location: Compliance Certification Services
561 F Monterey Road
Morgan Hill CA 95037

Test Dates: 2 September – 4 October 2005

All testing was performed at Compliance Certification Services either by me or under my supervision. Conducted and radiated emissions were performed using test equipment with calibration traceable to NIST, and following test procedures accepted by the industry.

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