

**Vyvo 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         |





**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

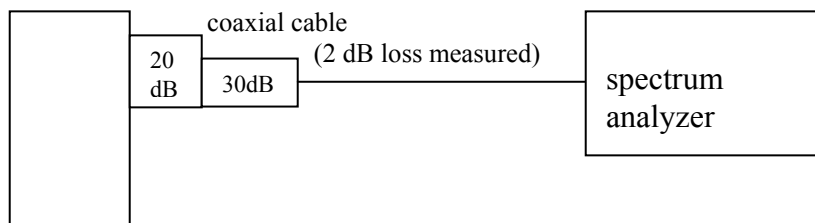
**Test Equipment List**

| 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<br>ELECTRONIC<br>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:

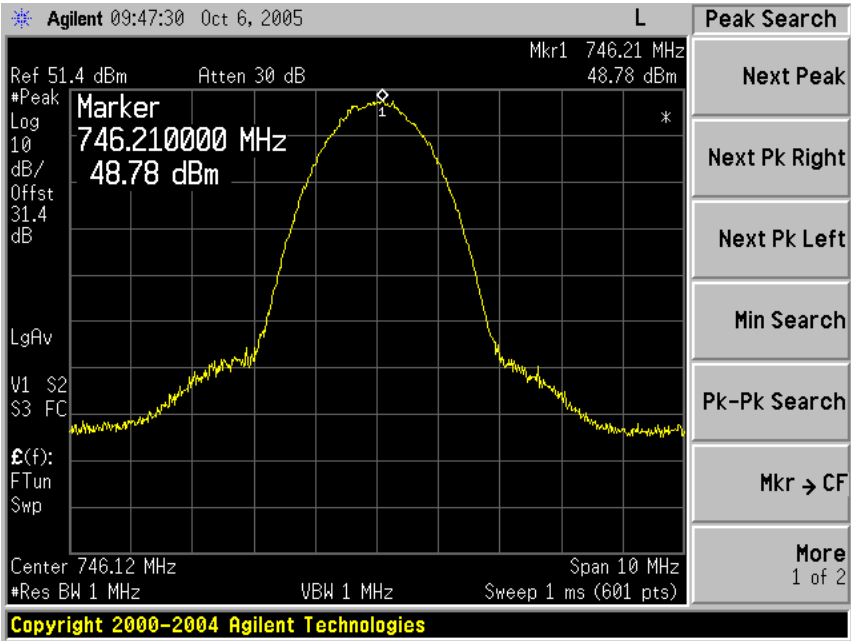
| Modulation | Low Channel | High Channel |
|------------|-------------|--------------|
| QPSK       | 746.1250    | 746.8625     |
| 16AQM      | 746.1375    | 746.8625     |
| 64QAM      | 746.1375    | 746.8500     |

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

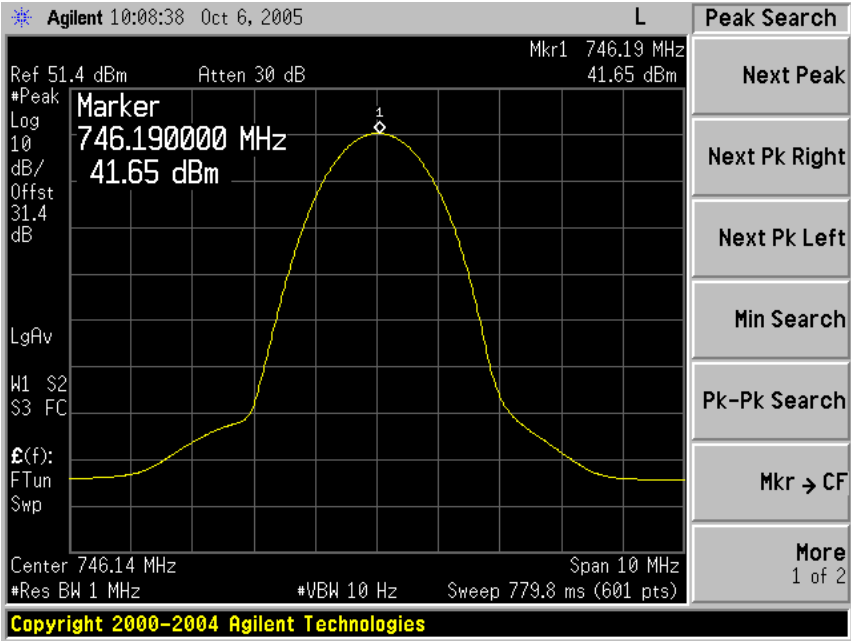
**Test Results**

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

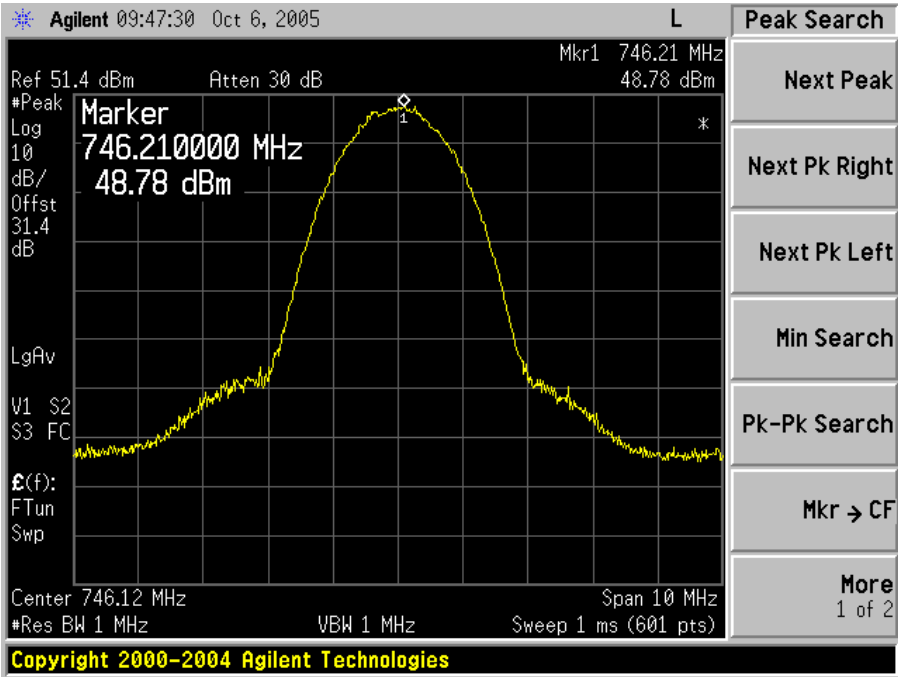
Plot #1 - QPSK PEAK Power Low Channel



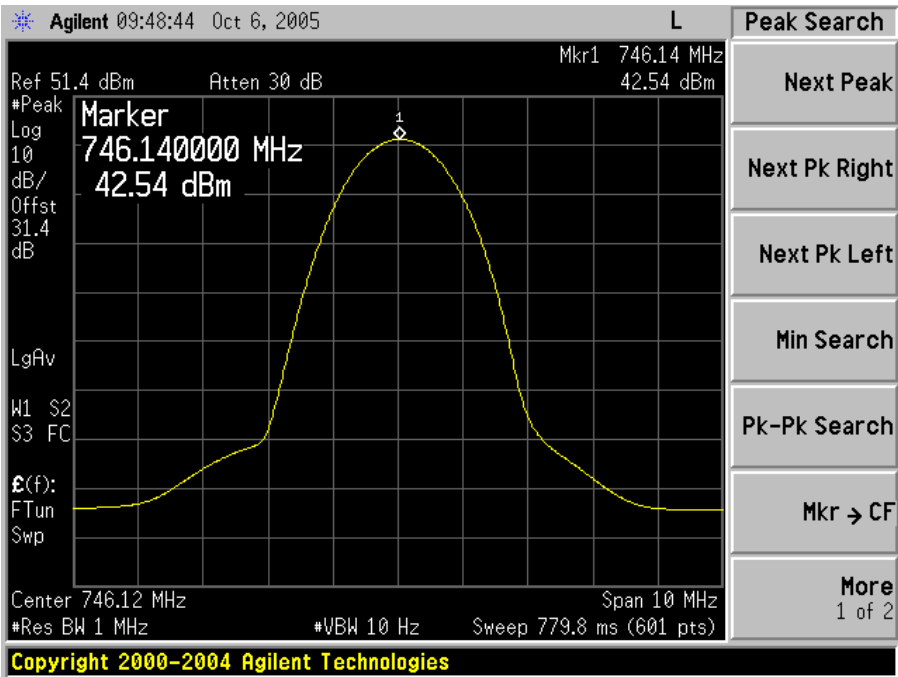
Plot#2 - QPSK AVERAGE Power Low Channel

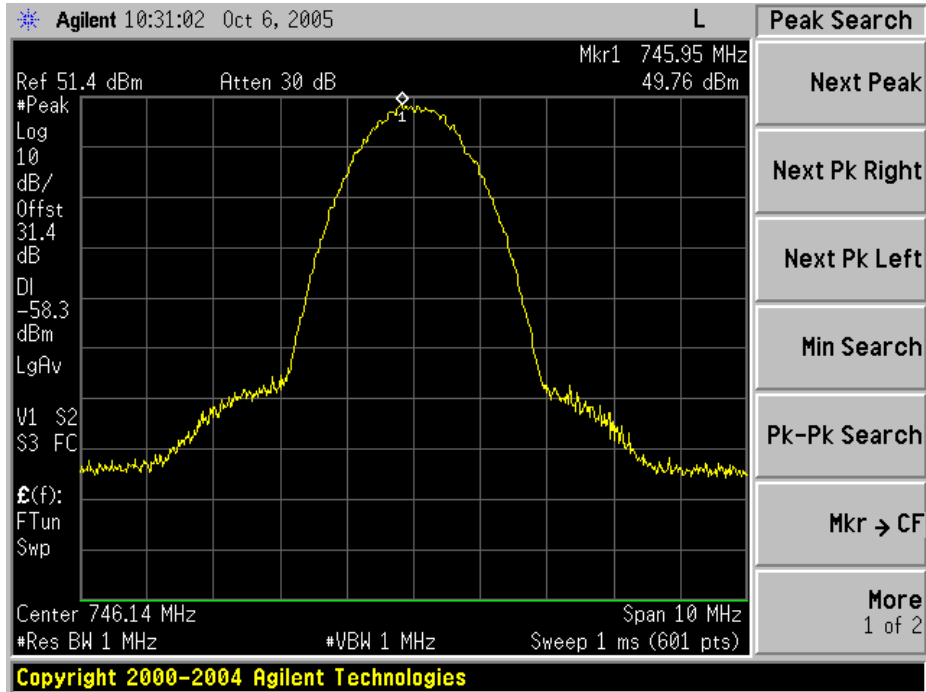
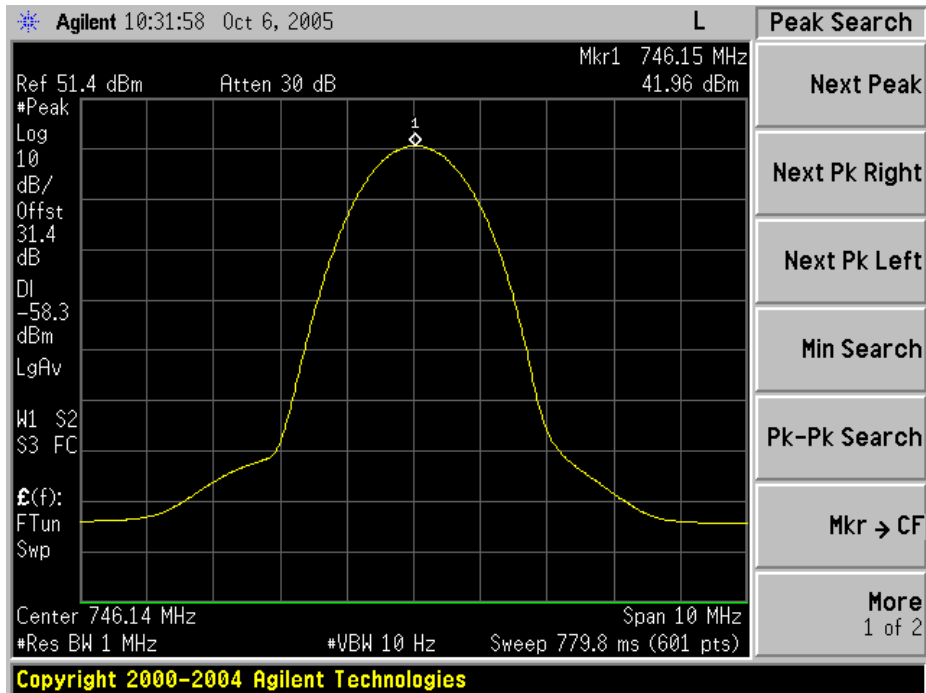


Plot#3 - QPSK PEAK Power High Channel

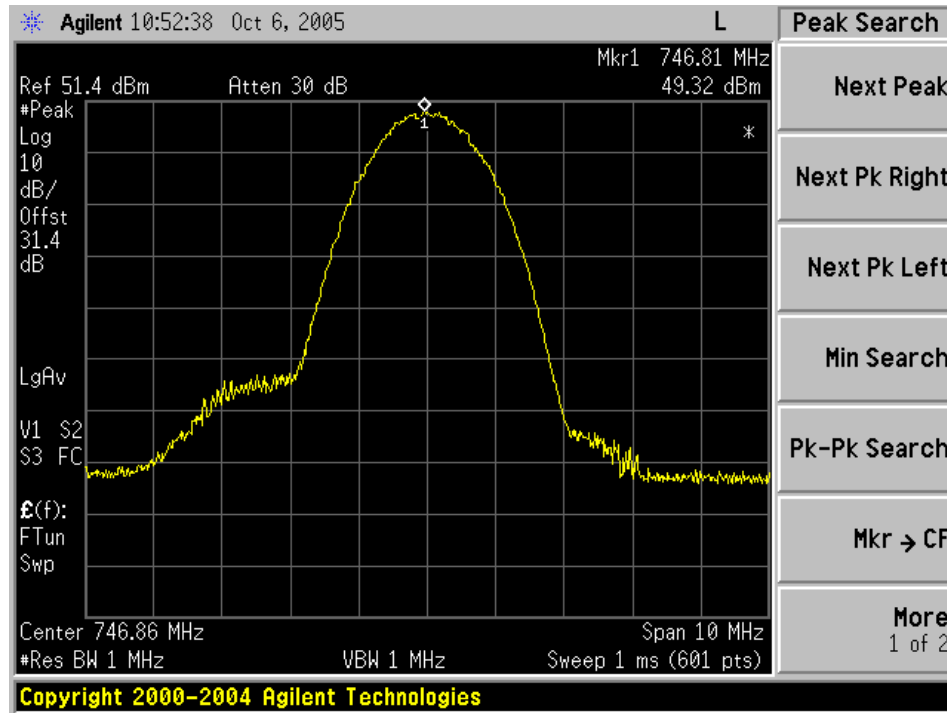


Plot#4 - QPSK AVERAGE Power High Channel

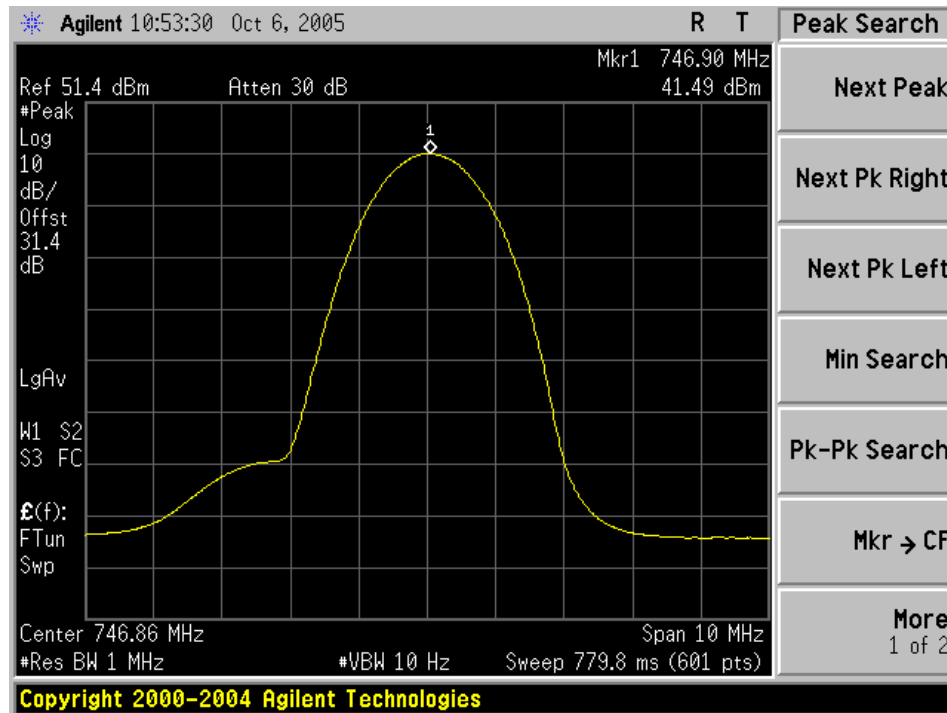


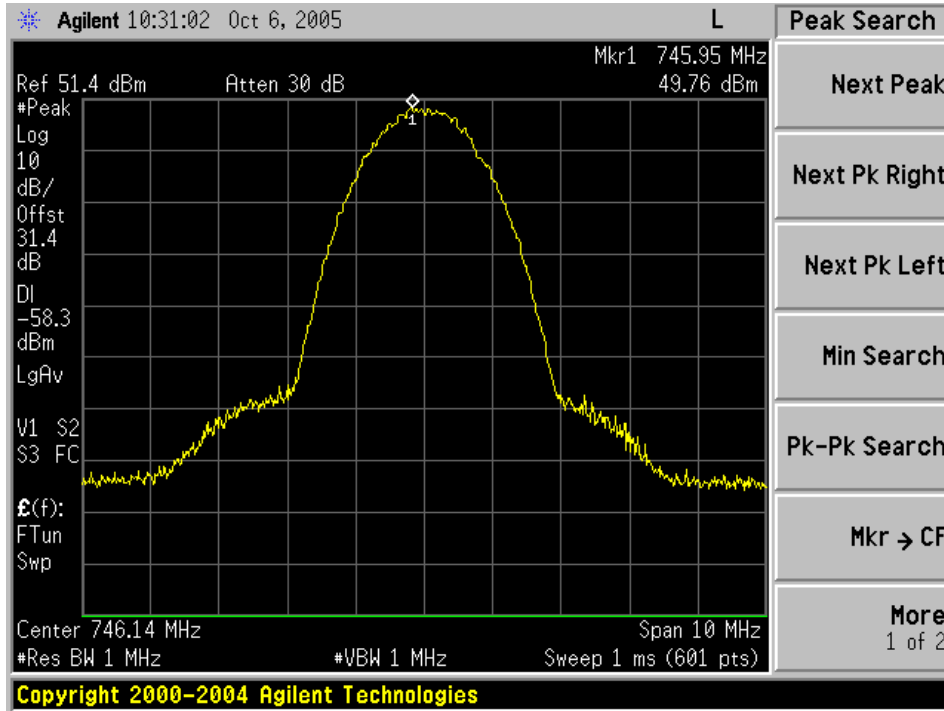
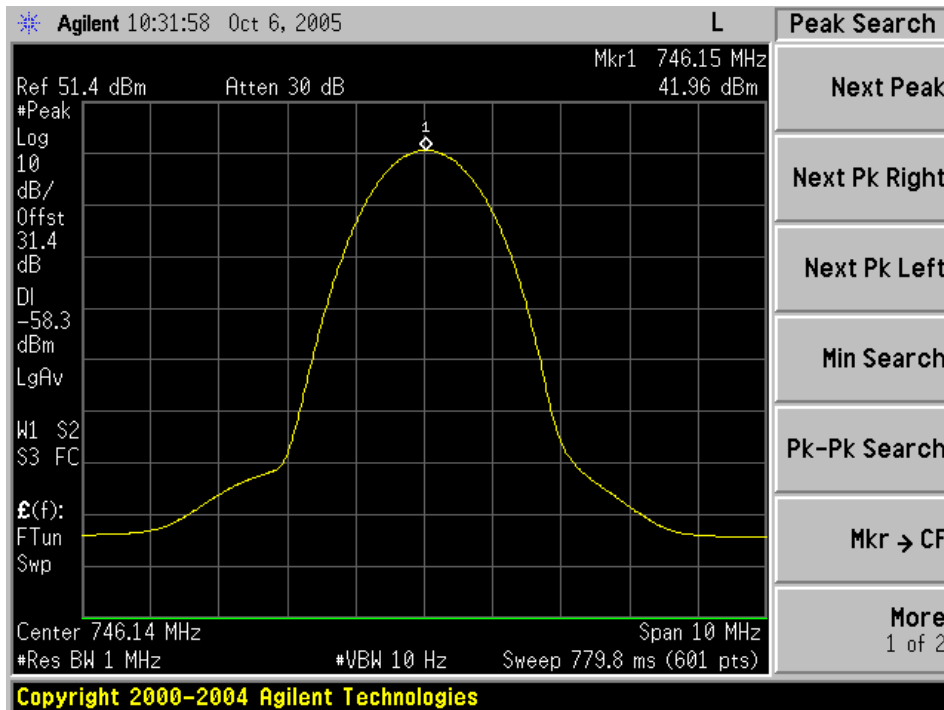
**Plot # 5 - 16QAM PEAK Power Low Channel****Plot # 6 - 16QAM AVERAGE Power Low Channel**

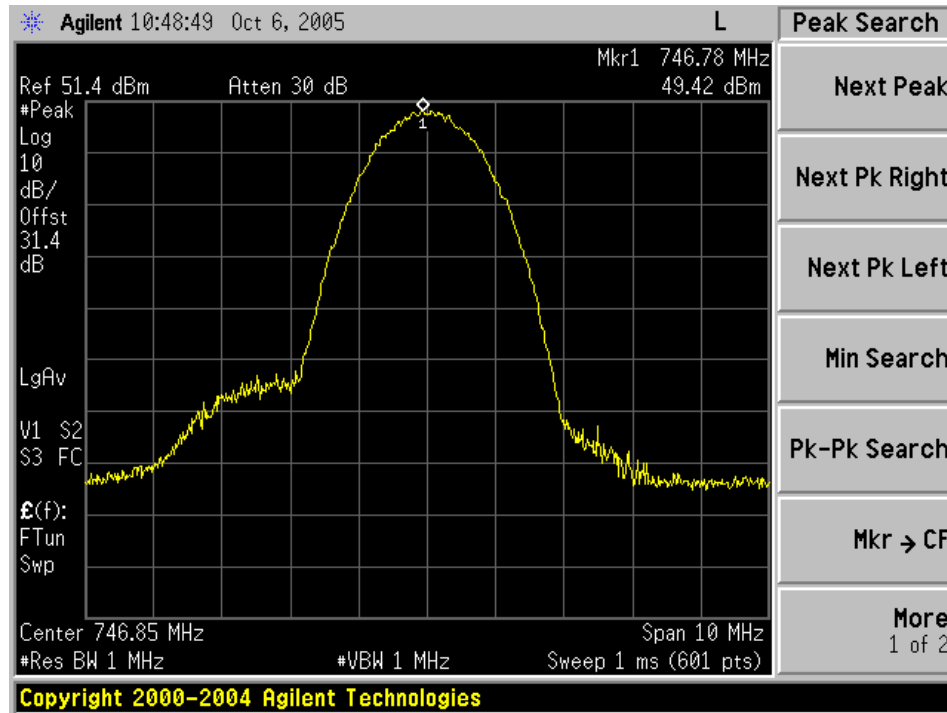
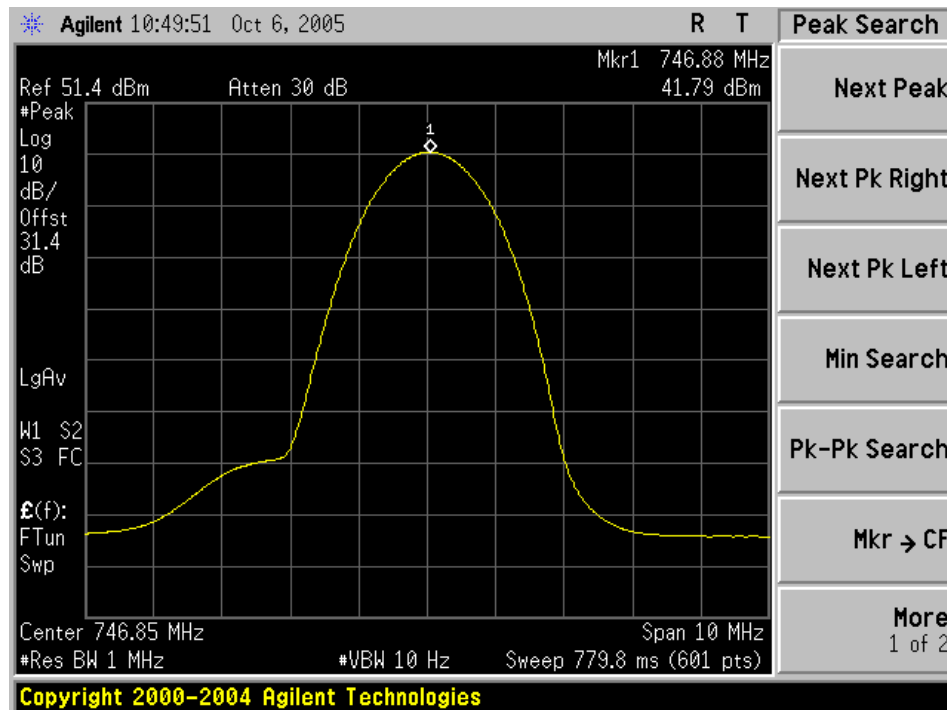
### Plot # 7 - 16QAM PEAK Power HIGH Channel



### 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

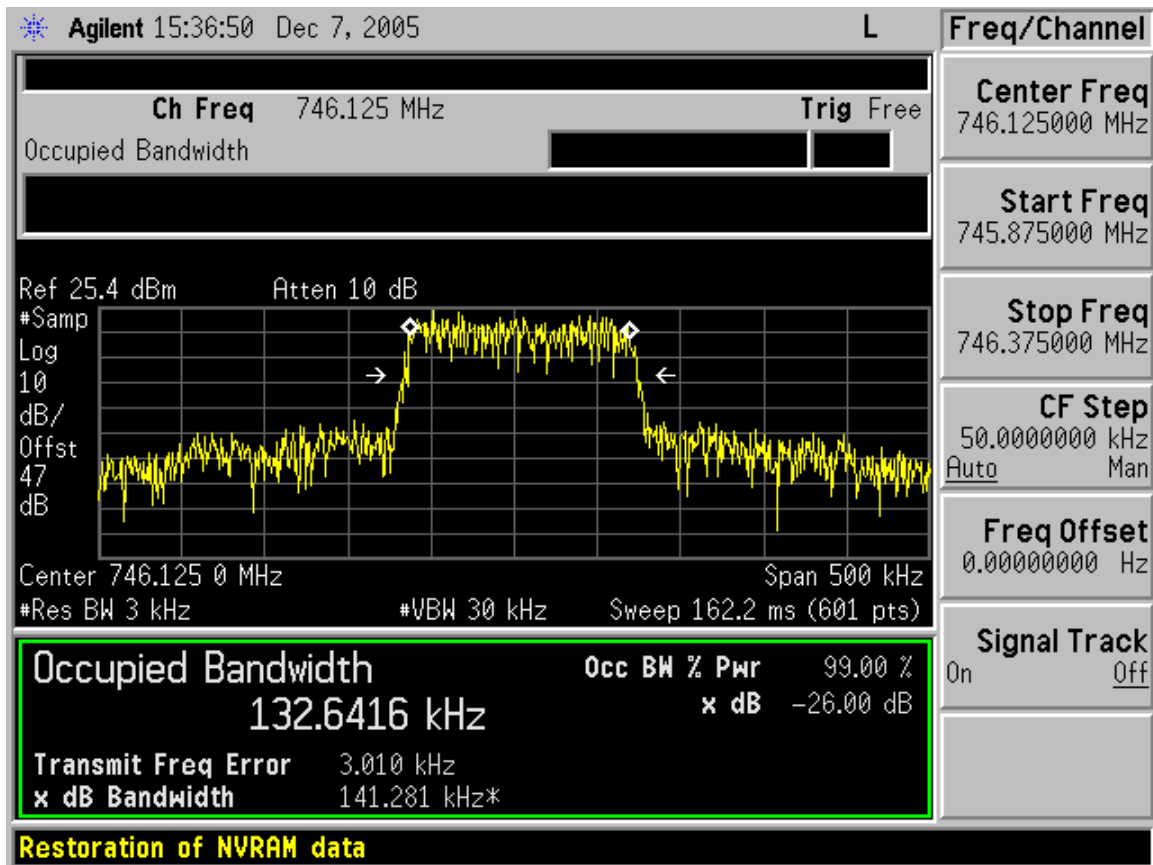
**Test Procedures:**

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.

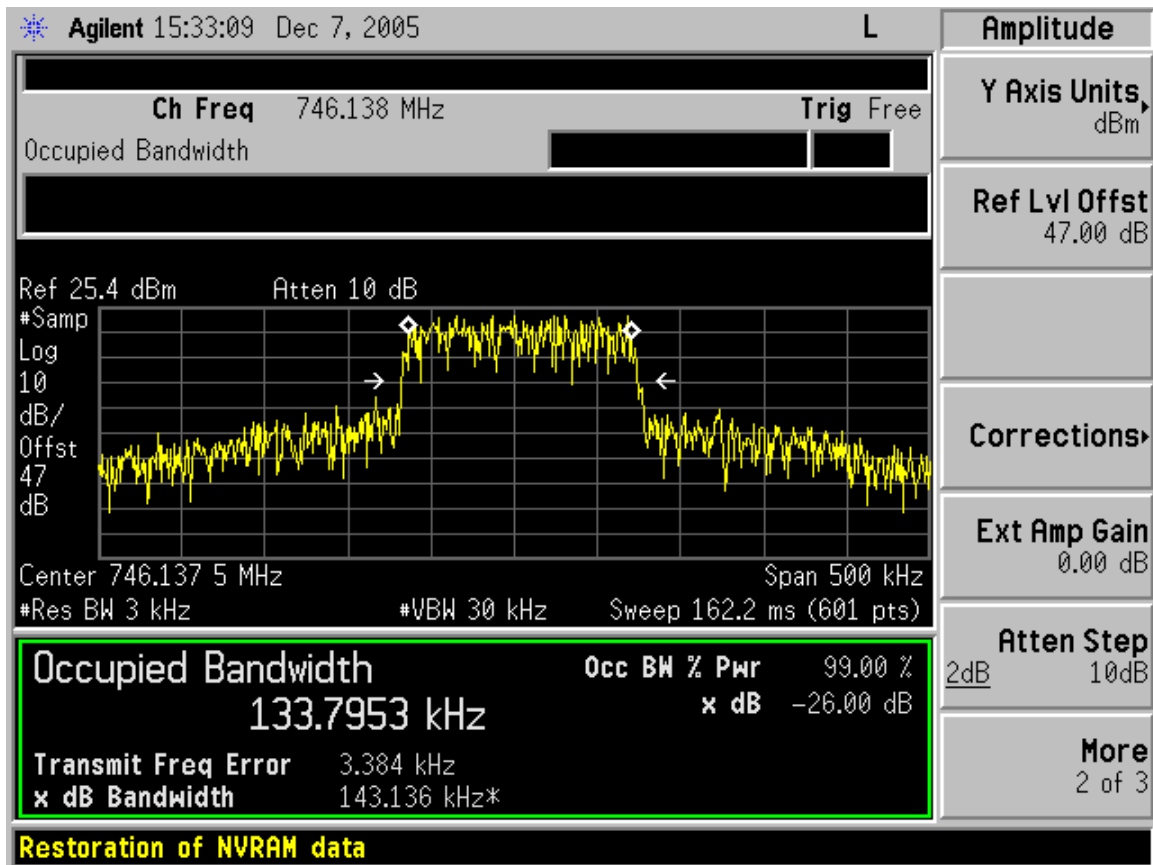
**Test Results:**

Refer to spectrum analyzer displays below.

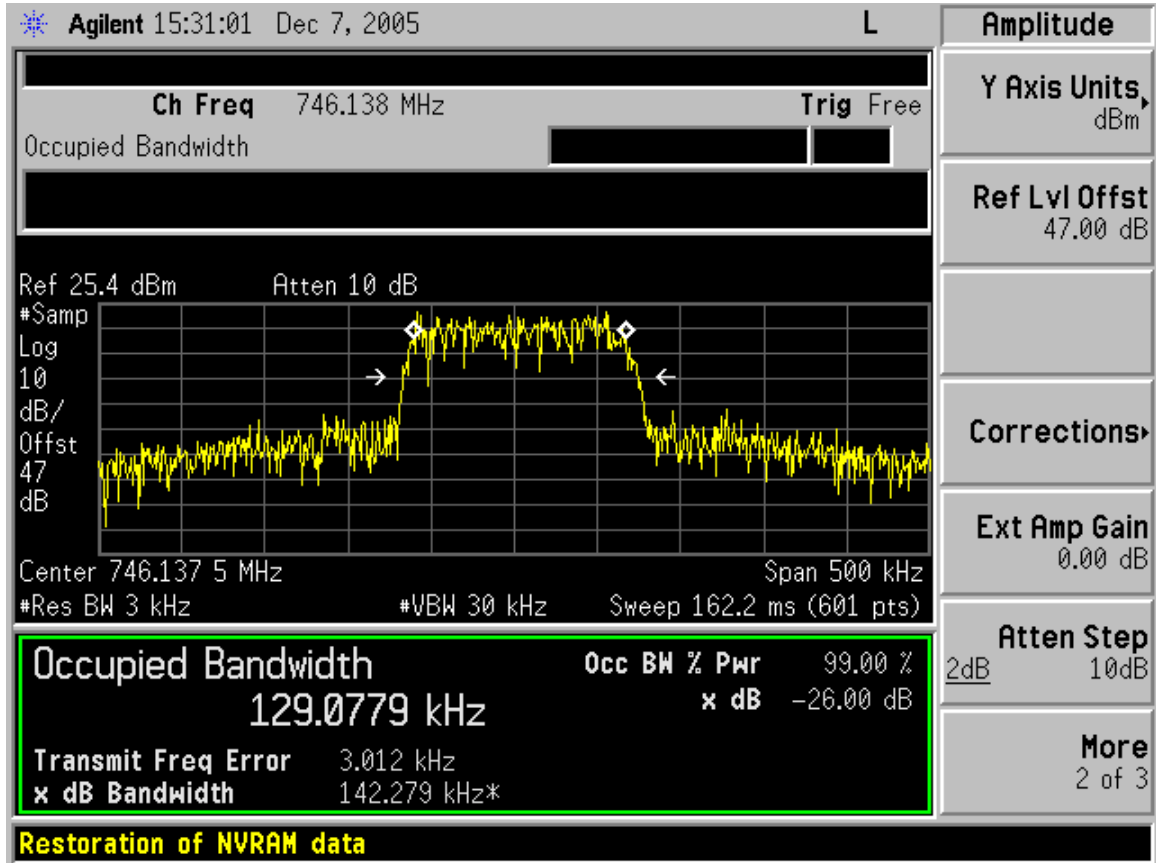
### Plot # 13 - QPSK Occupied Bandwidth



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<br>frequency (kHz) | Measurement<br>bandwidth<br>(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  $\pm$  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

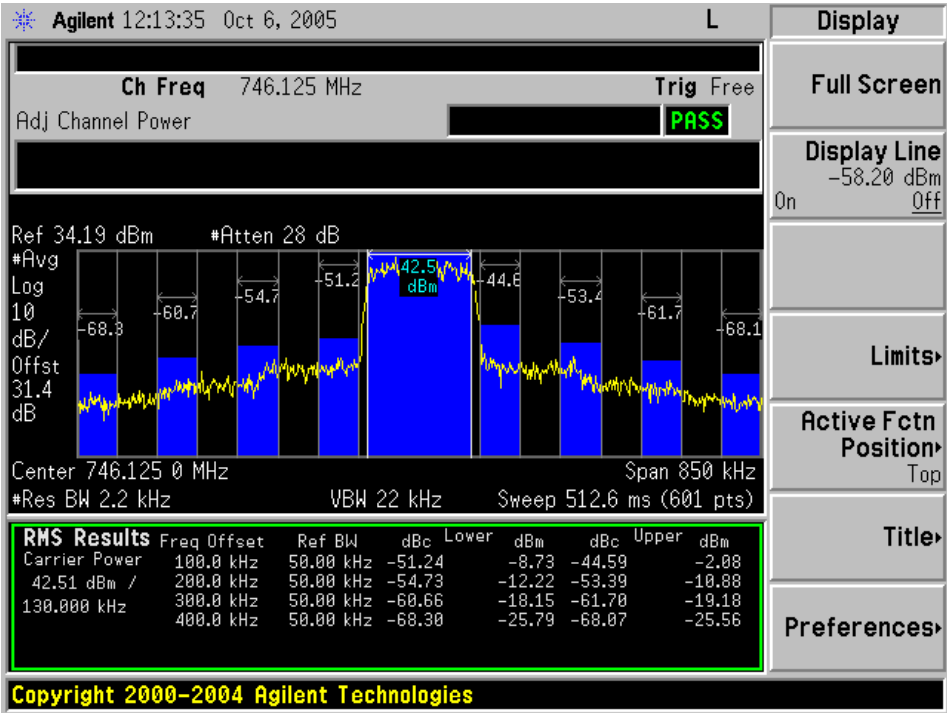
### Test Procedures

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.

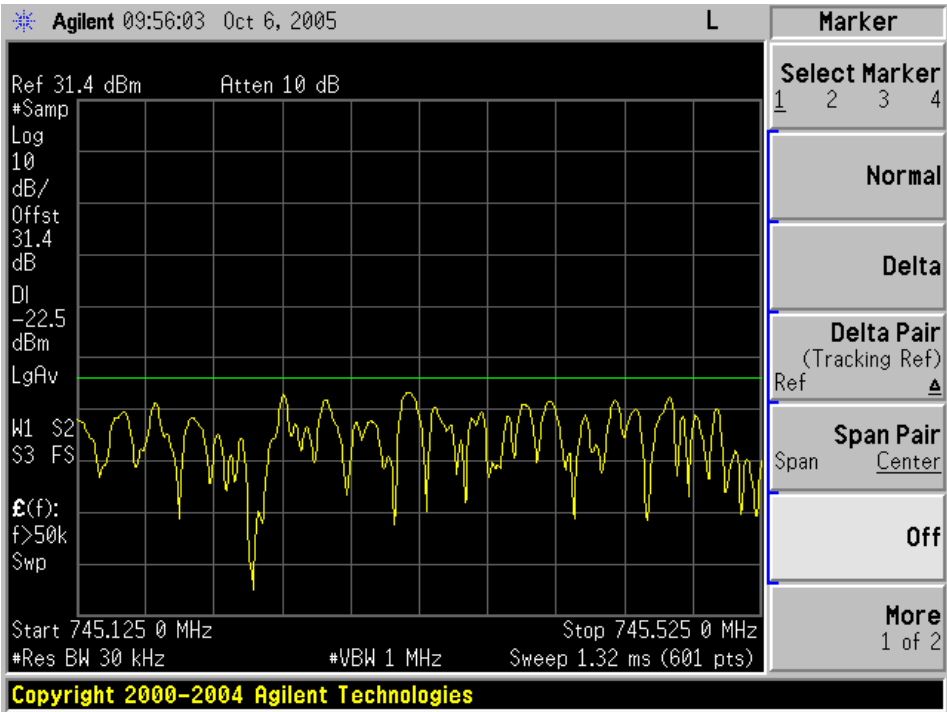
### Test Results

**PASS.** Refer to spectrum analyzer plots below.

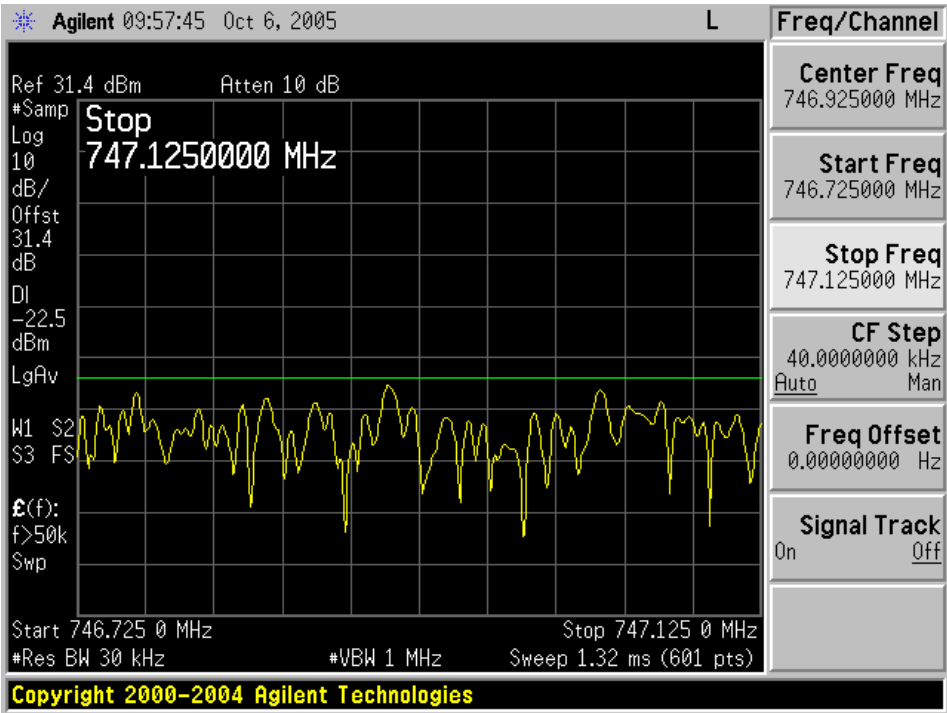
Plot#16 - ACP – QPSK LOW Channel



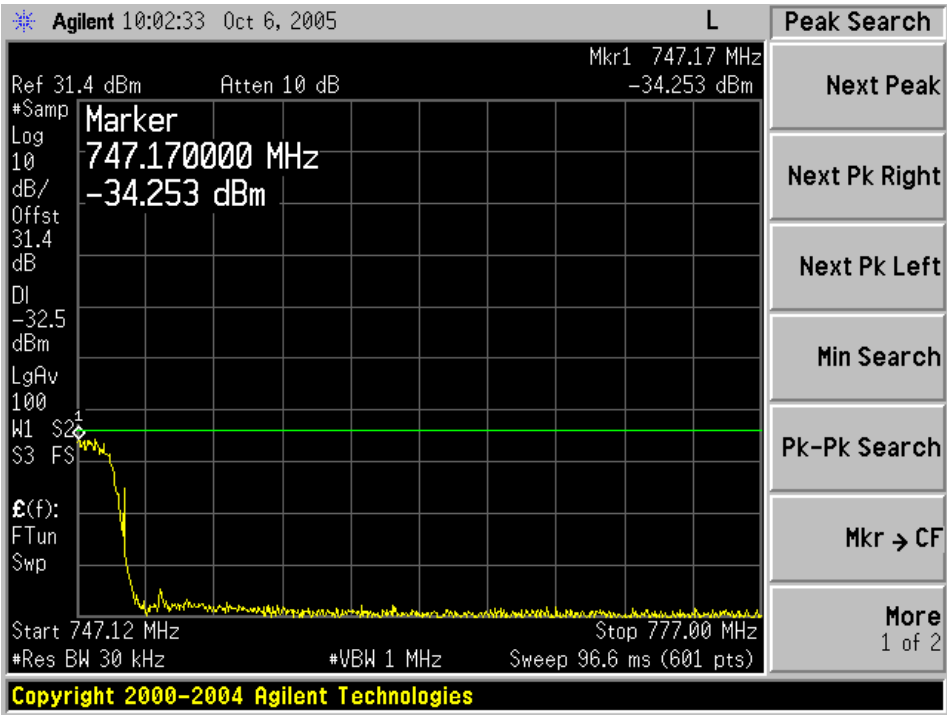
Plot#17 - ACP – QPSK LOW Channel  
600-1000 kHz Below Center Frequency



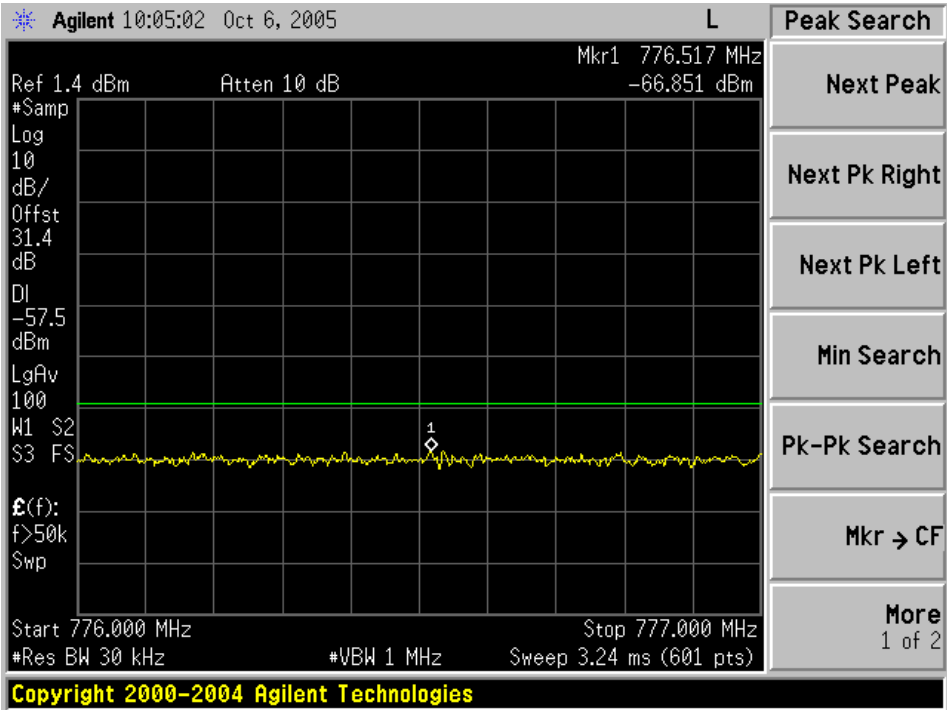
Plot#18 - ACP – QPSK LOW Channel  
600-1000 kHz Above Center Frequency



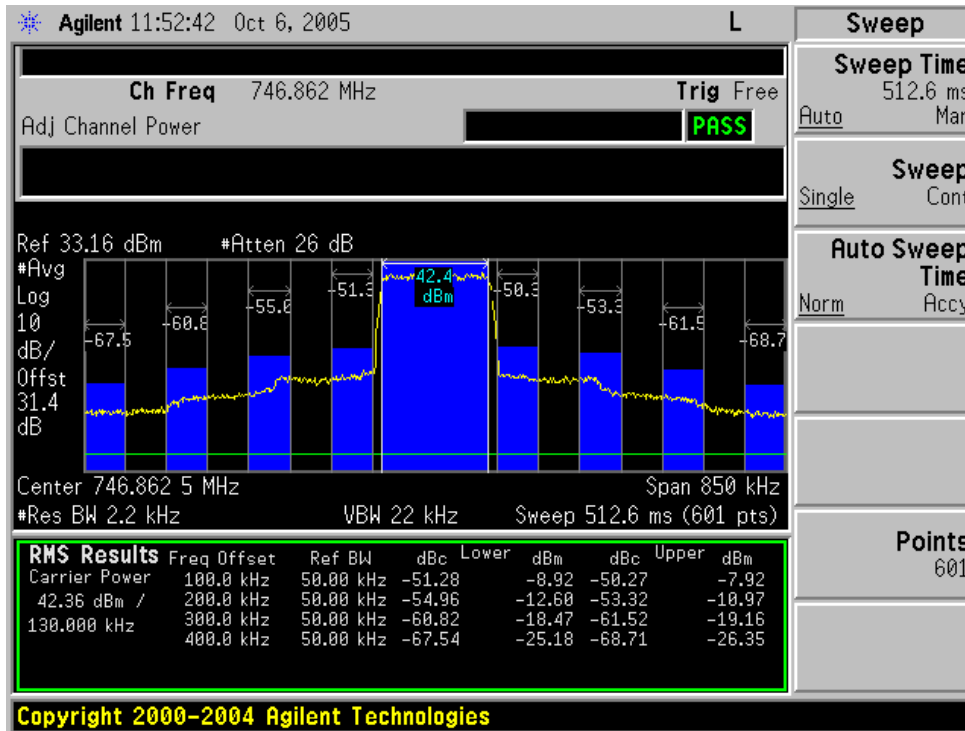
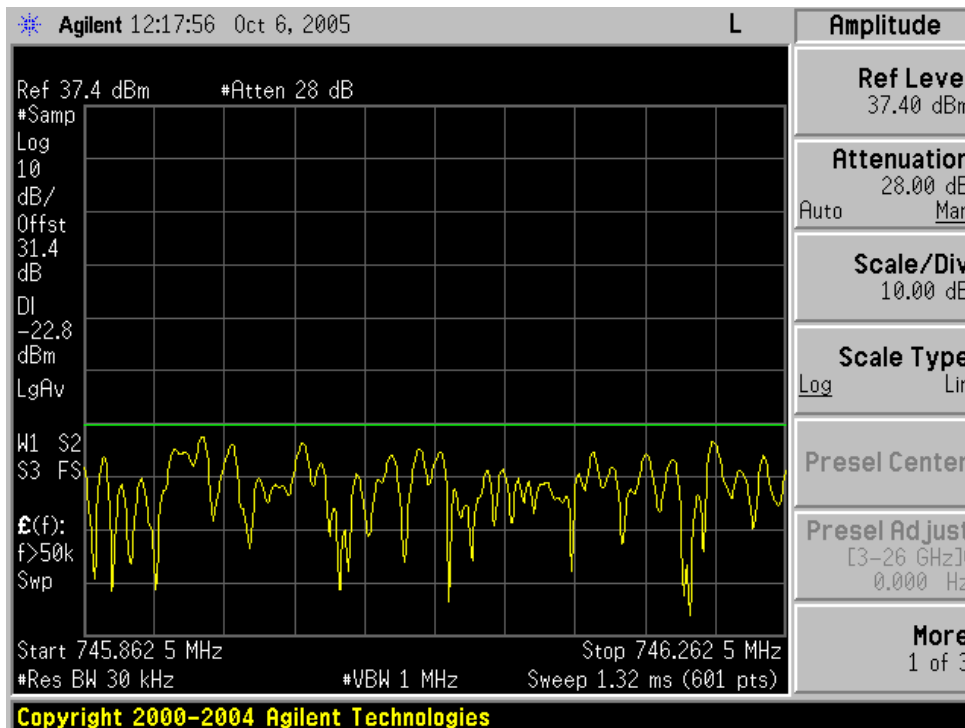
Plot#19 - ACP – QPSK LOW Channel  
1000 kHz – RX Band

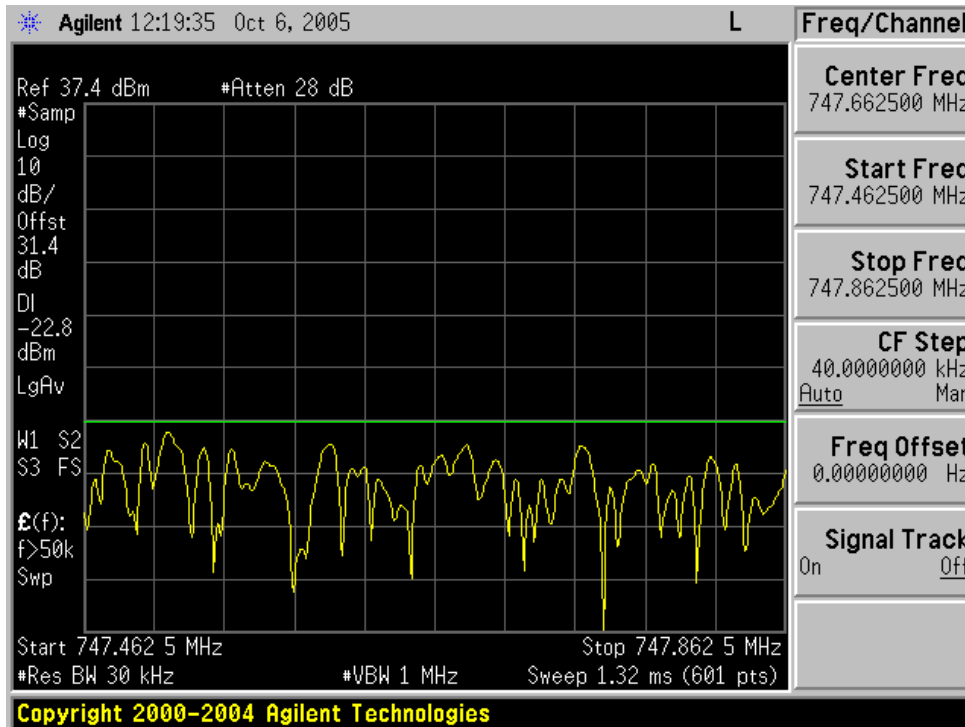
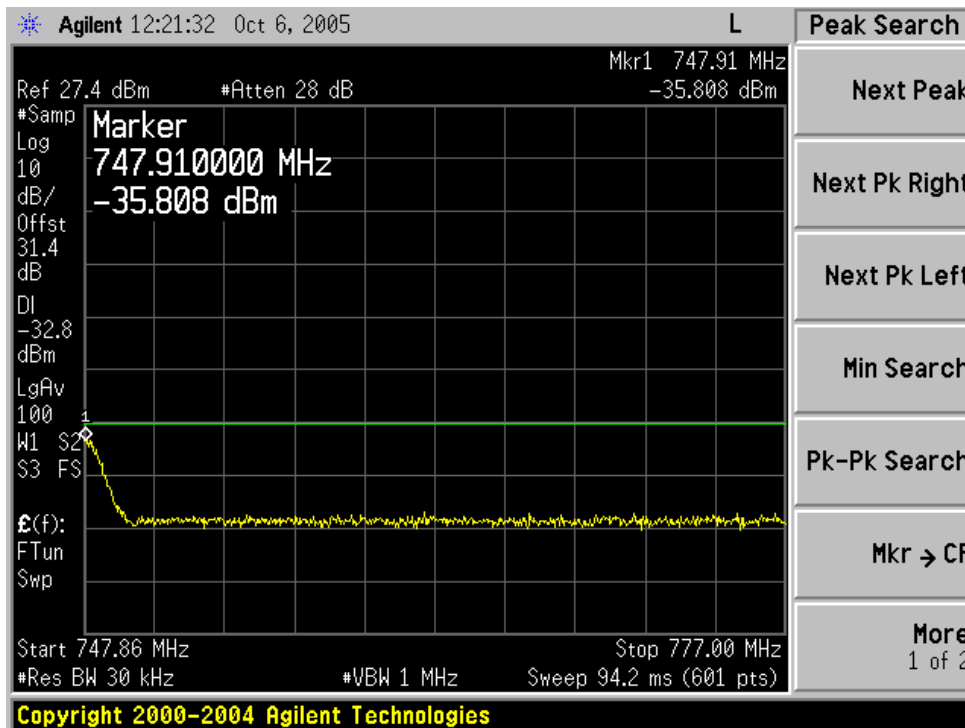


Plot#20 - ACP – QPSK LOW Channel  
In the RX band

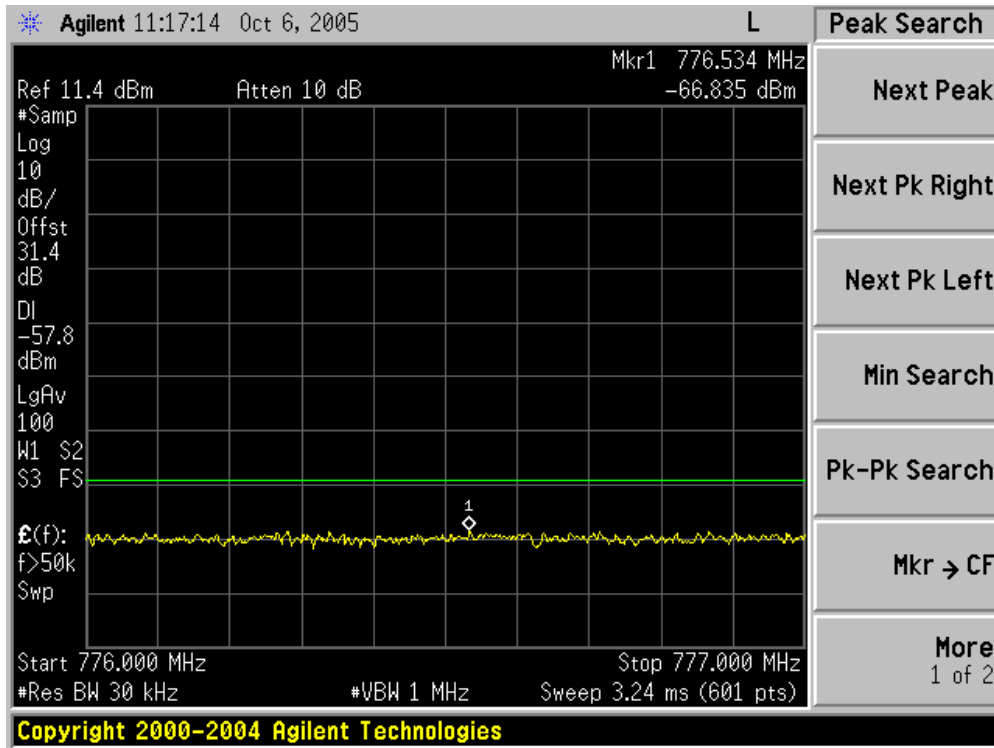


## Plot#21 - ACP – QPSK HIGH Channel

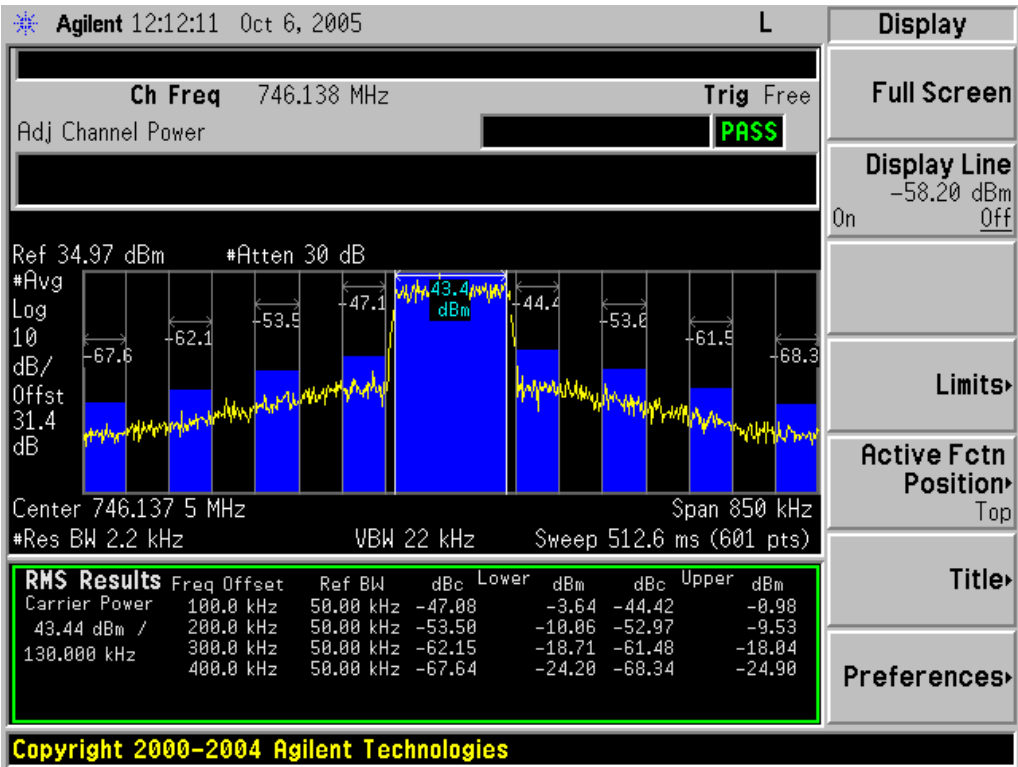
Plot#22 - ACP – QPSK HIGH Channel  
600-1000 kHz Below Center Frequency

**Plot#23 - ACP – QPSK HIGH Channel  
600-1000 kHz Above Center Frequency****Plot#24 - ACP – QPSK HIGH Channel  
1000 kHz – RX Band**

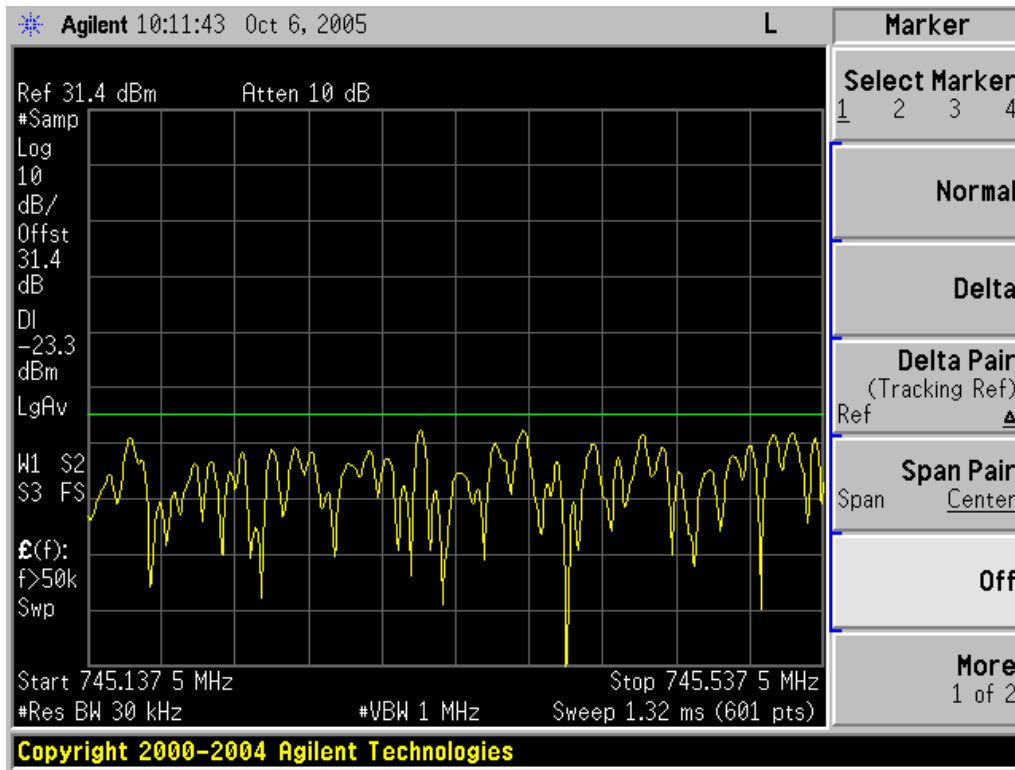
**Plot#25 - ACP – QPSK HIGH Channel  
In the RX Band**

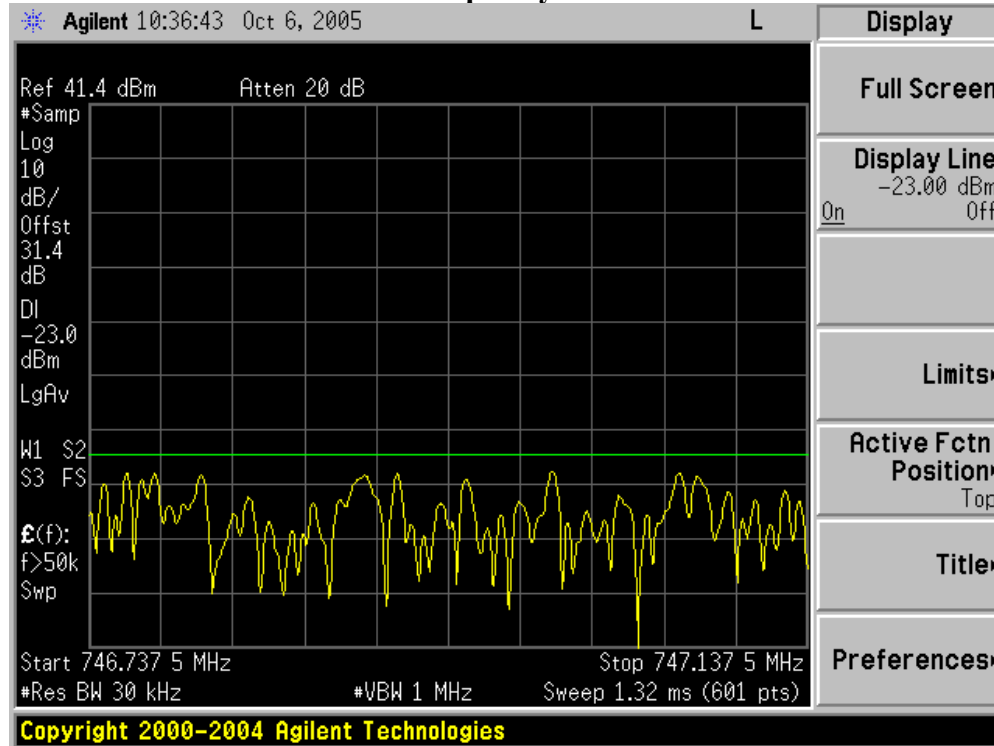
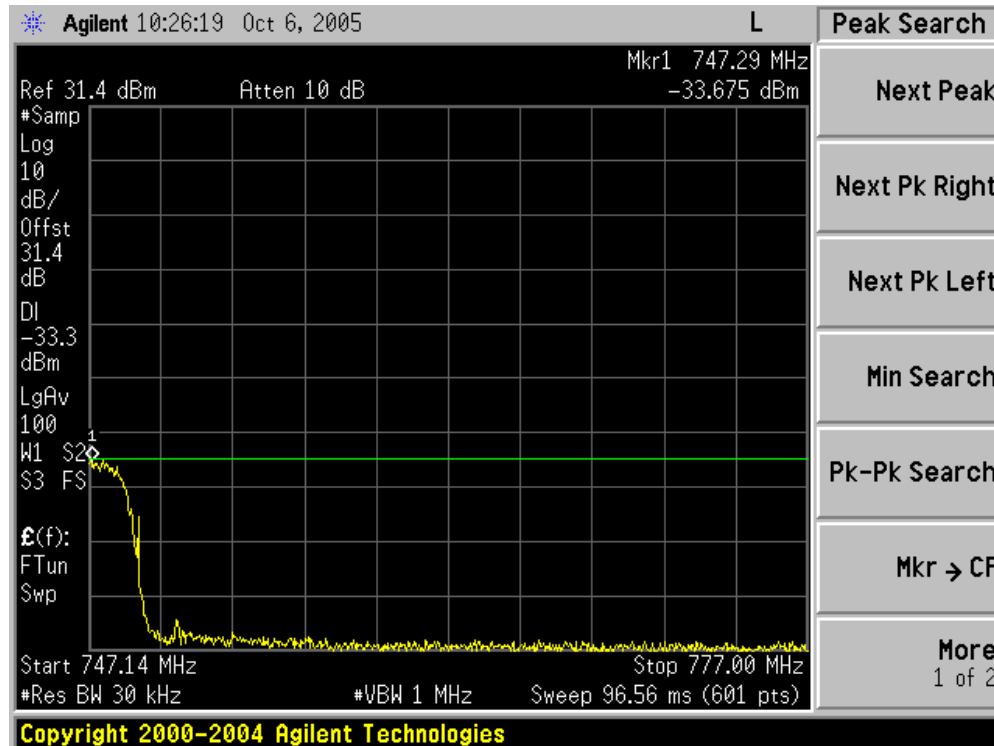


Plot#26 - ACP – 16QAM LOW Channel

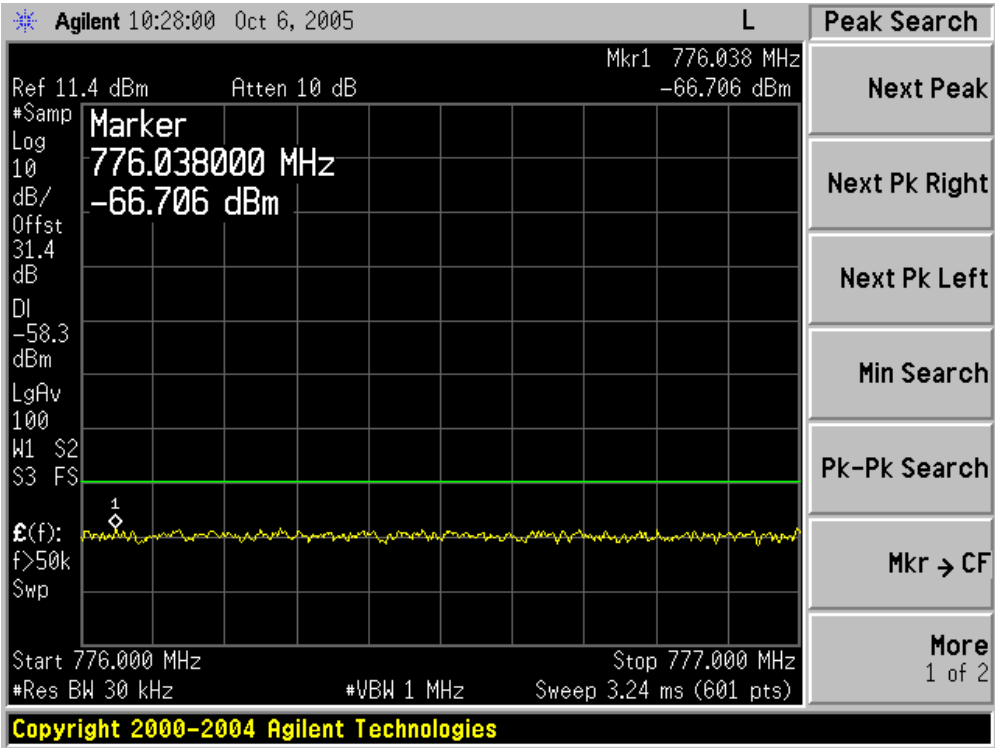


Plot#27 - ACP – 16QAM LOW Channel  
600-1000 KHz Below Center Frequency

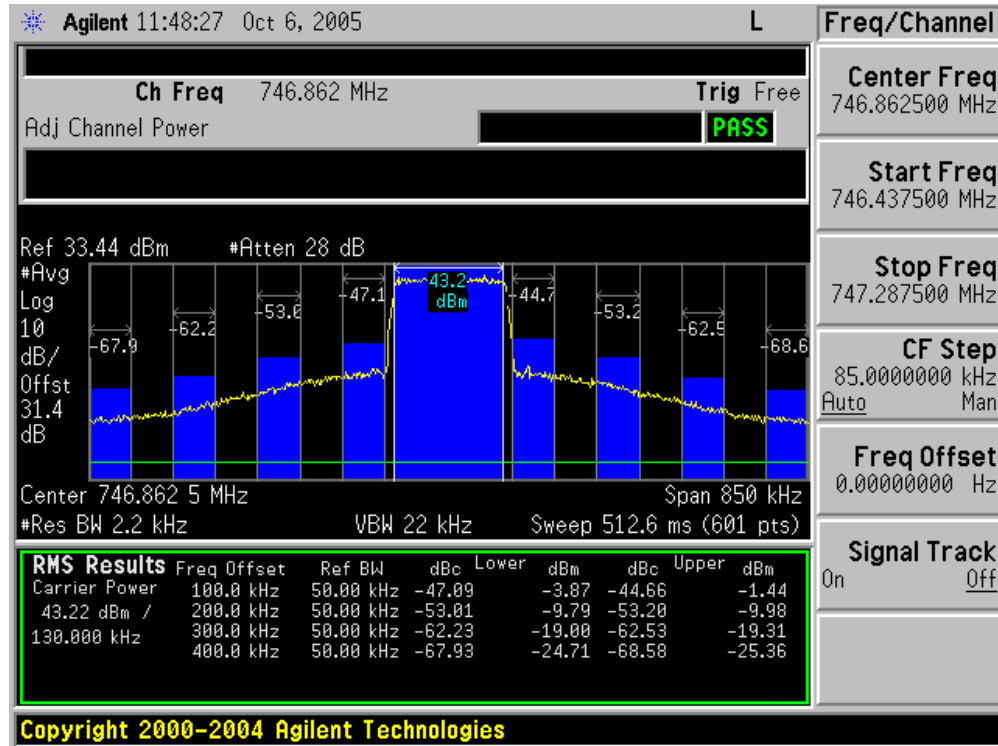
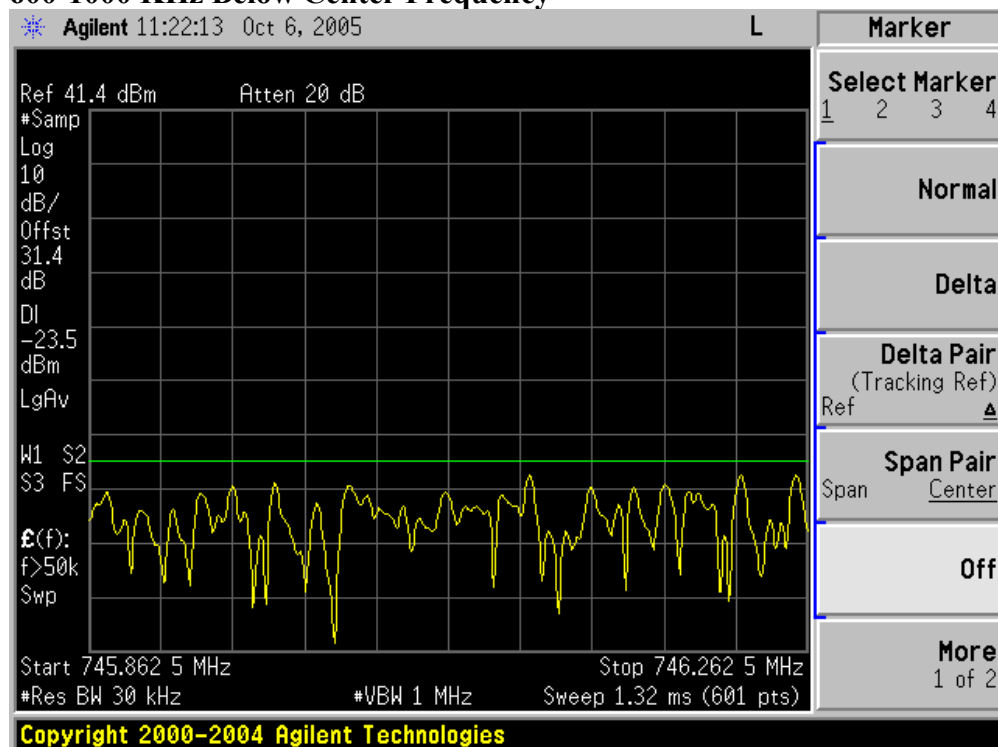


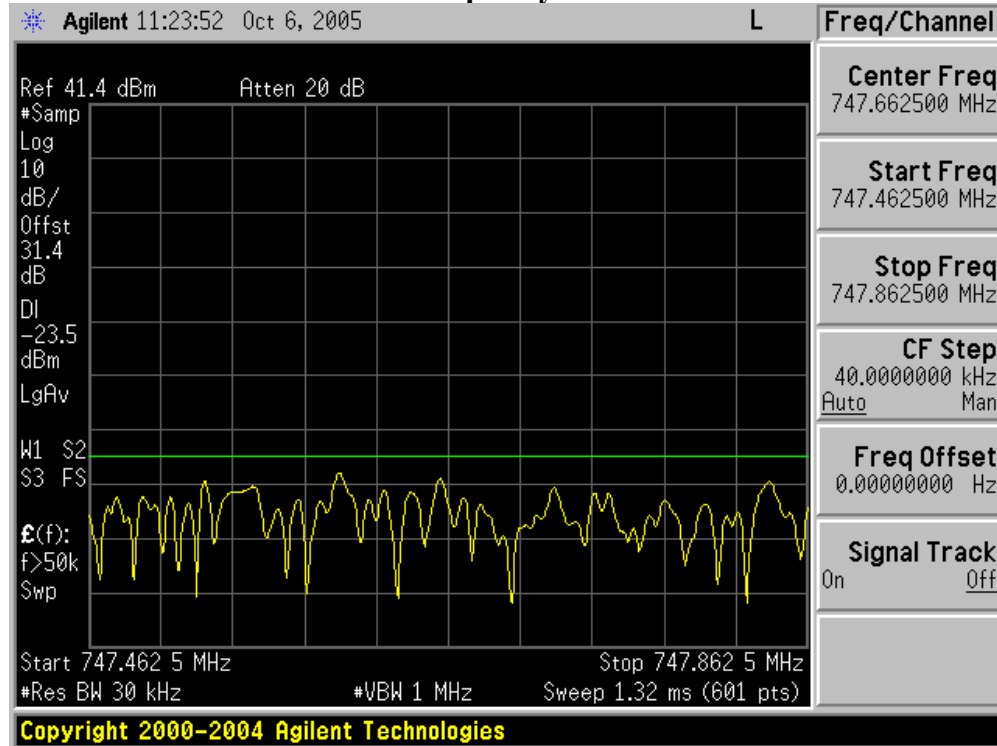
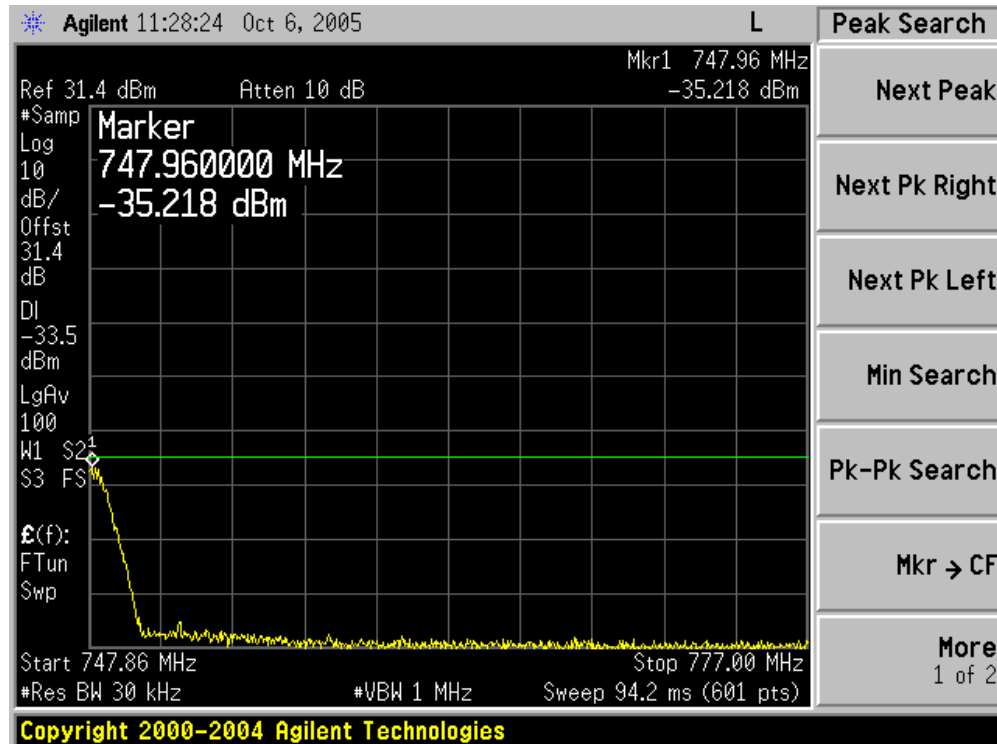
**PLOT#28 - ACP – 16QAM LOW Channel**  
**600-1000 KHz Above Center Frequency****Plot#29 - ACP – 16QAM LOW Channel**  
**1000kHz – RX Band**

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

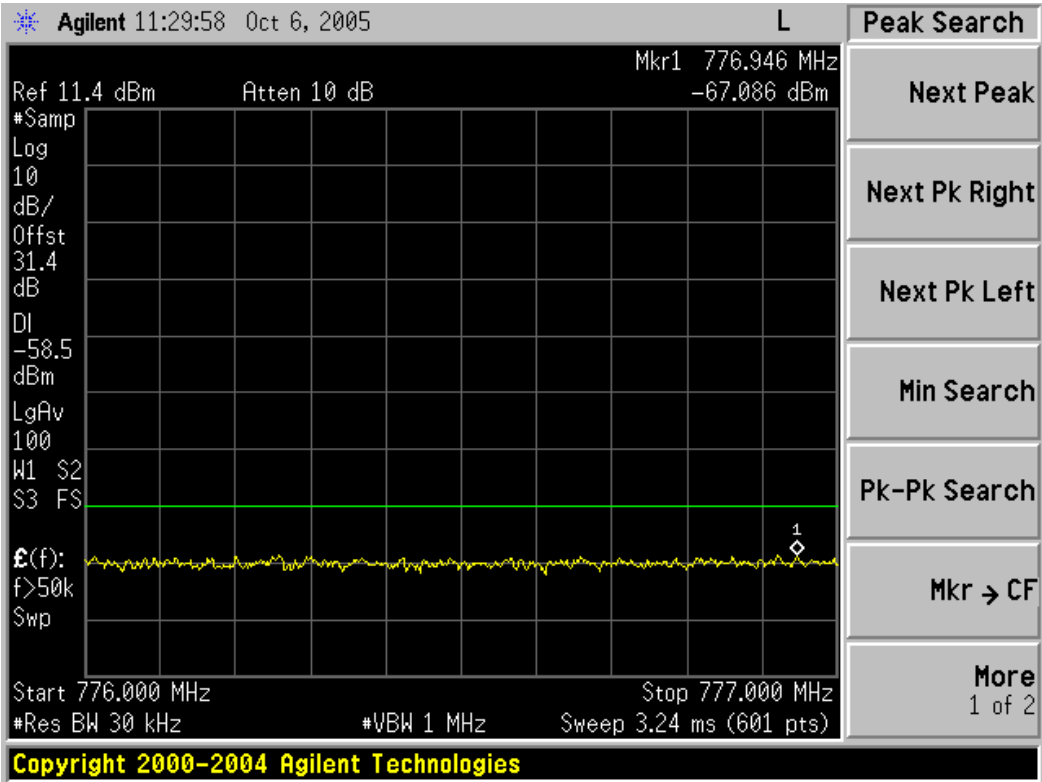


## Plot#31 - ACP – 16QAM HIGH Channel

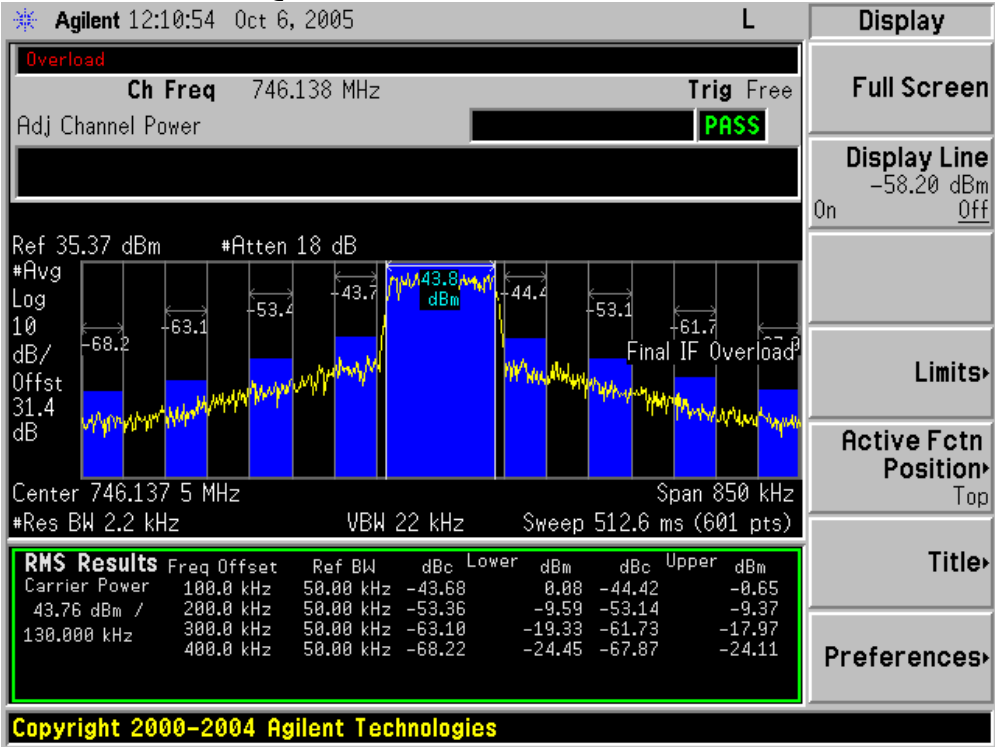
Plot#32 - ACP – 16QAM HIGH Channel  
600-1000 KHz Below Center Frequency

**Plot#33 - ACP – 16QAM HIGH Channel**  
**600-1000 KHz Above Center Frequency****Plot#34 - ACP – 16QAM HIGH Channel**  
**1000kHz – RX Band**

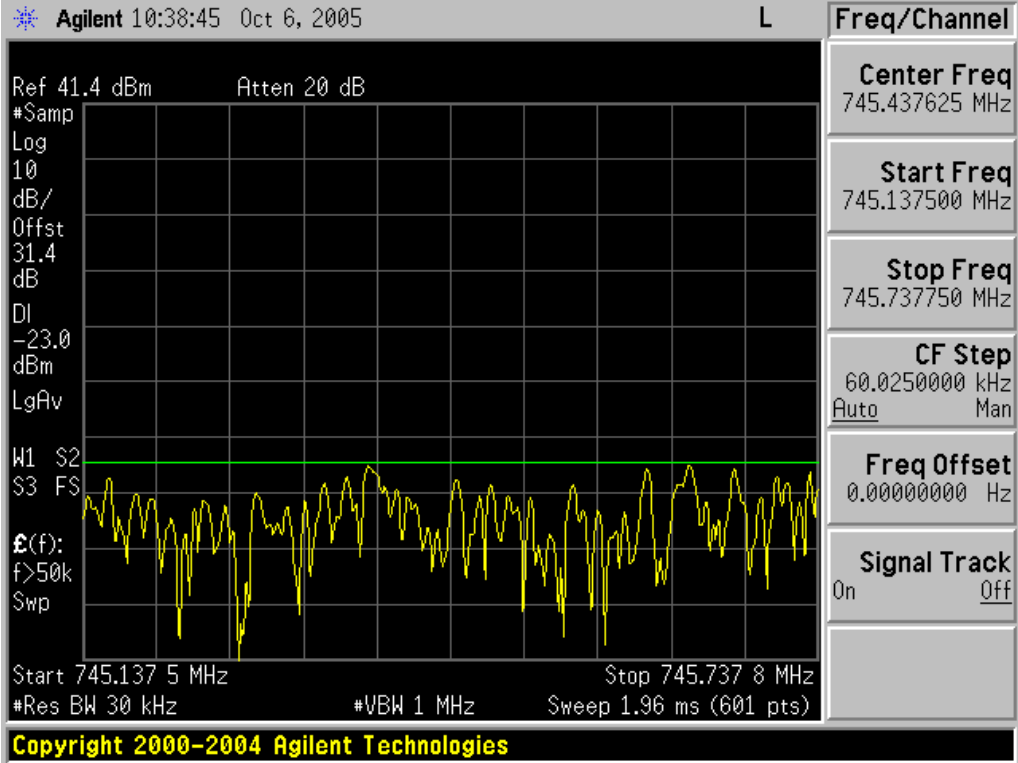
Plot#35 - ACP – 16QAM HIGH Channel  
In the RX Band

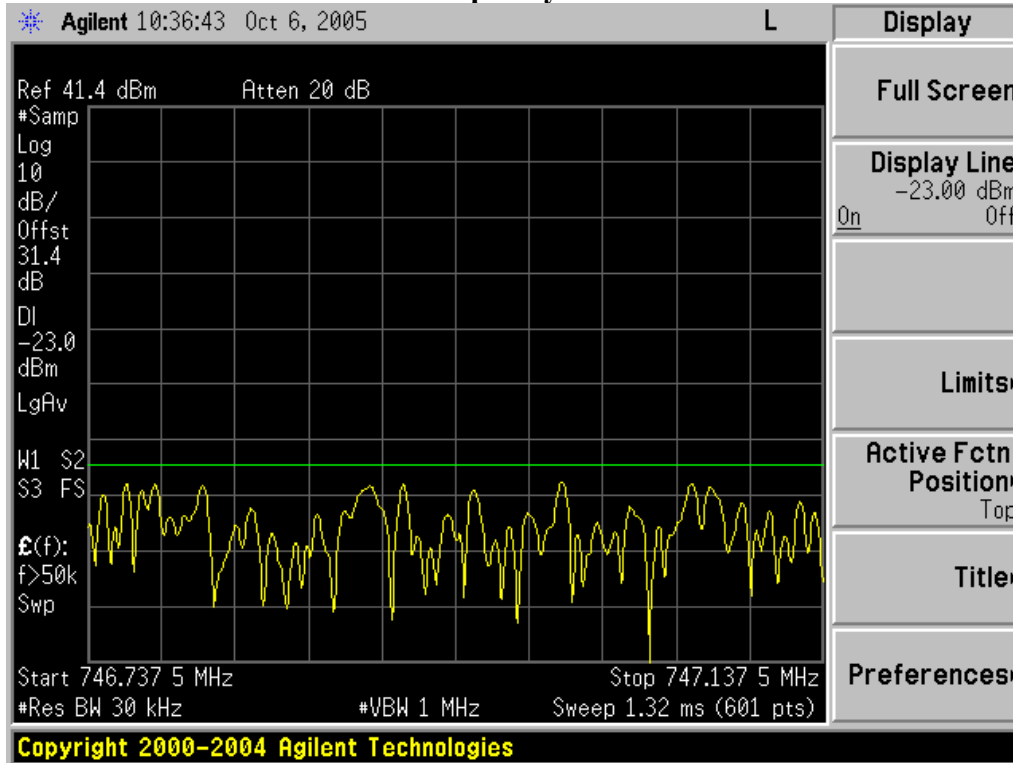
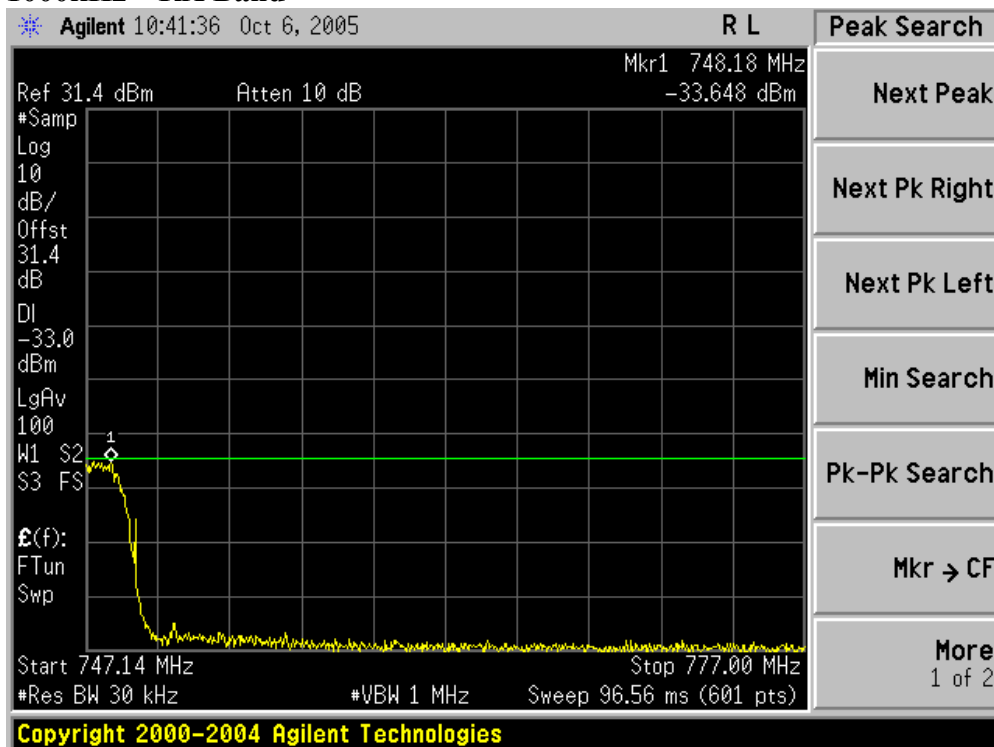


Plot#36 - ACP – 64QAM LOW Channel

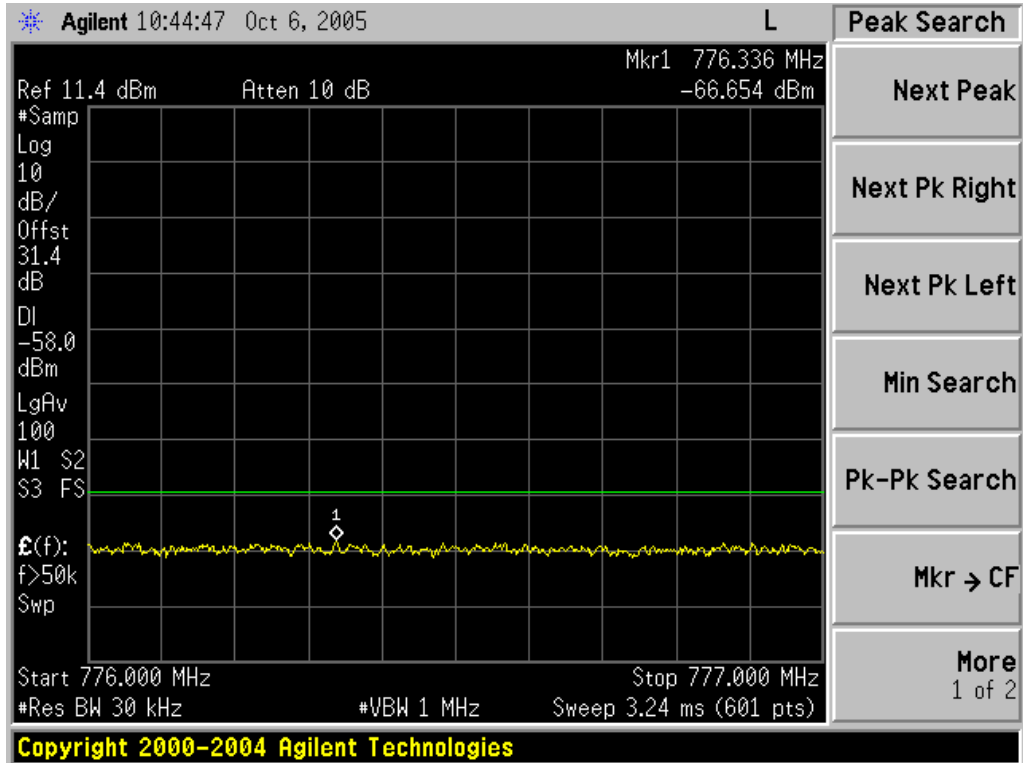


Plot#37 - ACP – 64QAM LOW Channel  
600-1000 KHz Below Center Frequency

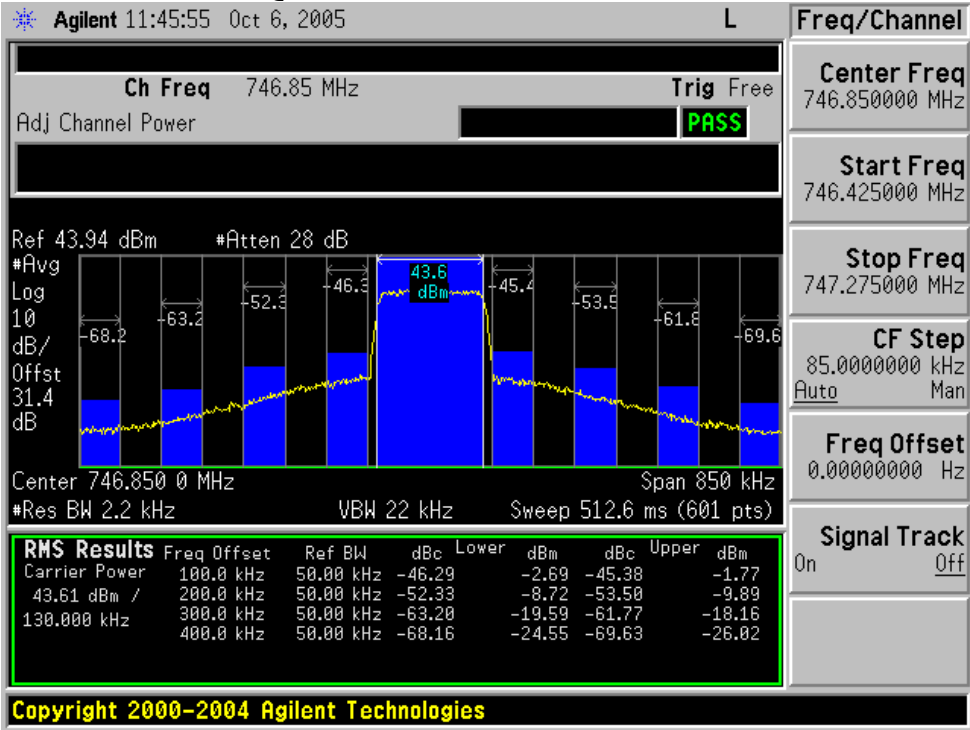


**Plot#38 - ACP – 64QAM LOW Channel  
600-1000 KHz Above Center Frequency****Plot#39 - ACP – 64QAM LOW Channel  
1000kHz – RX Band**

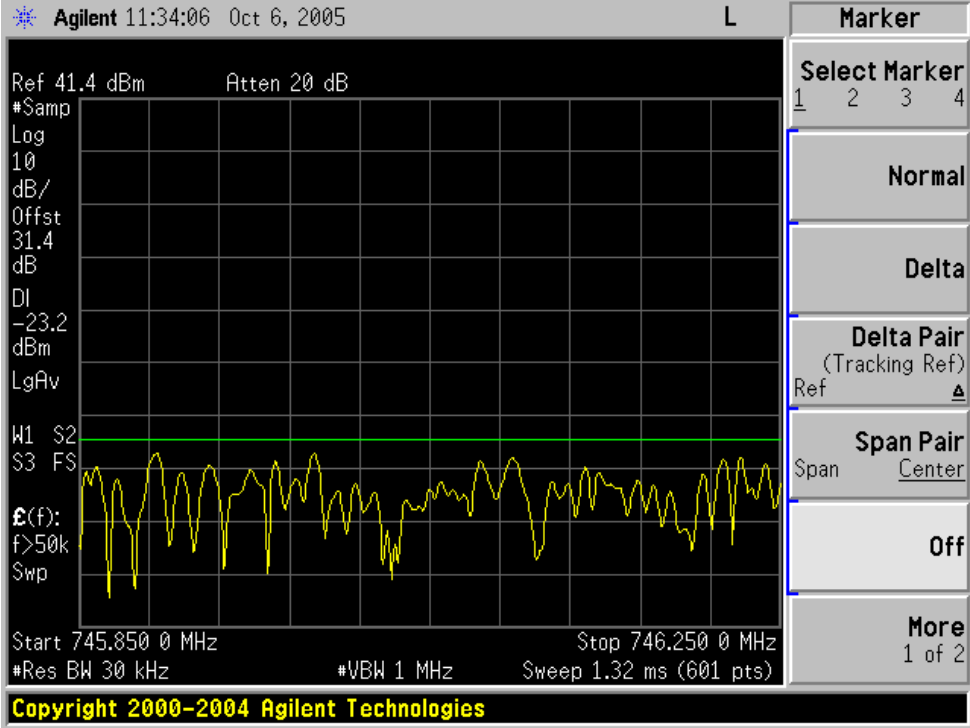
### Plot#40 - ACP – 64QAM LOW Channel In the RX Band

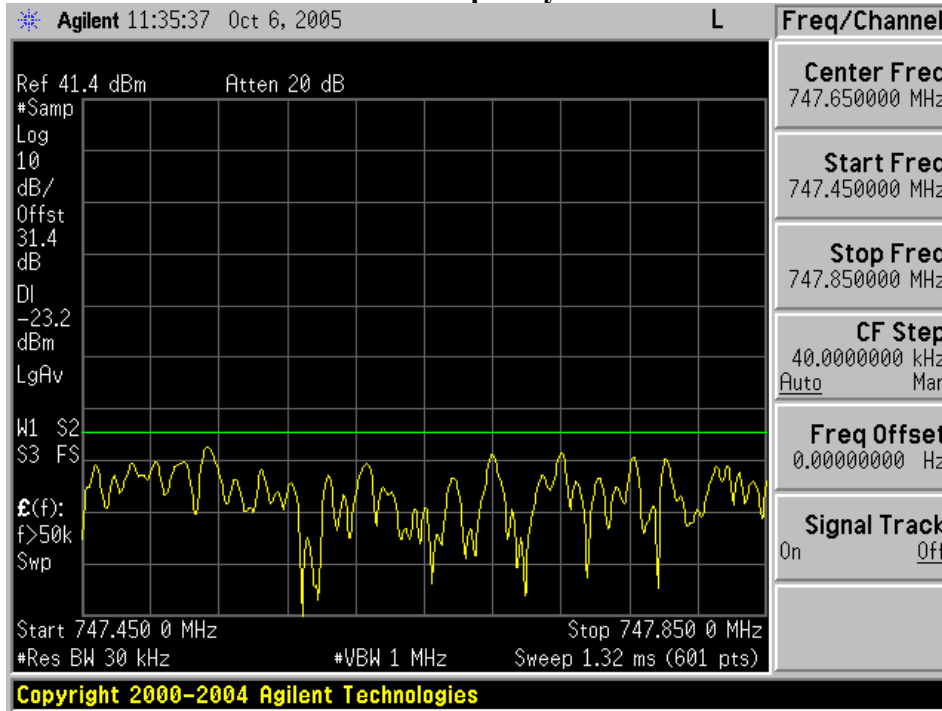
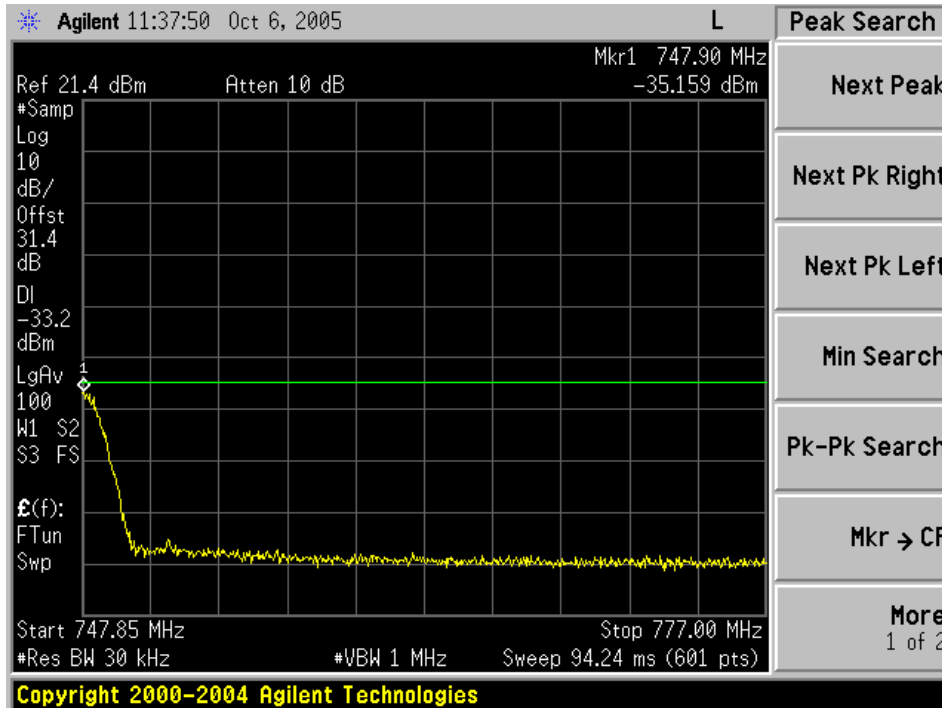


Plot#41 - ACP – 64QAM HIGH Channel

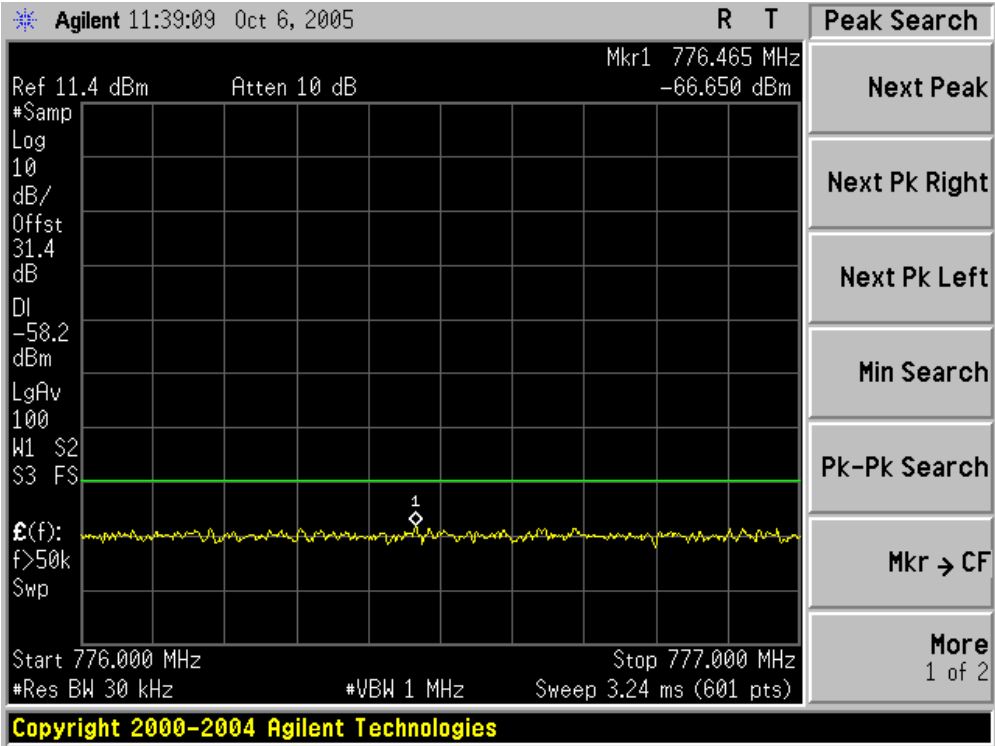


Plot#42 - ACP – 64QAM HIGH Channel  
600-1000 KHz Below Center Frequency



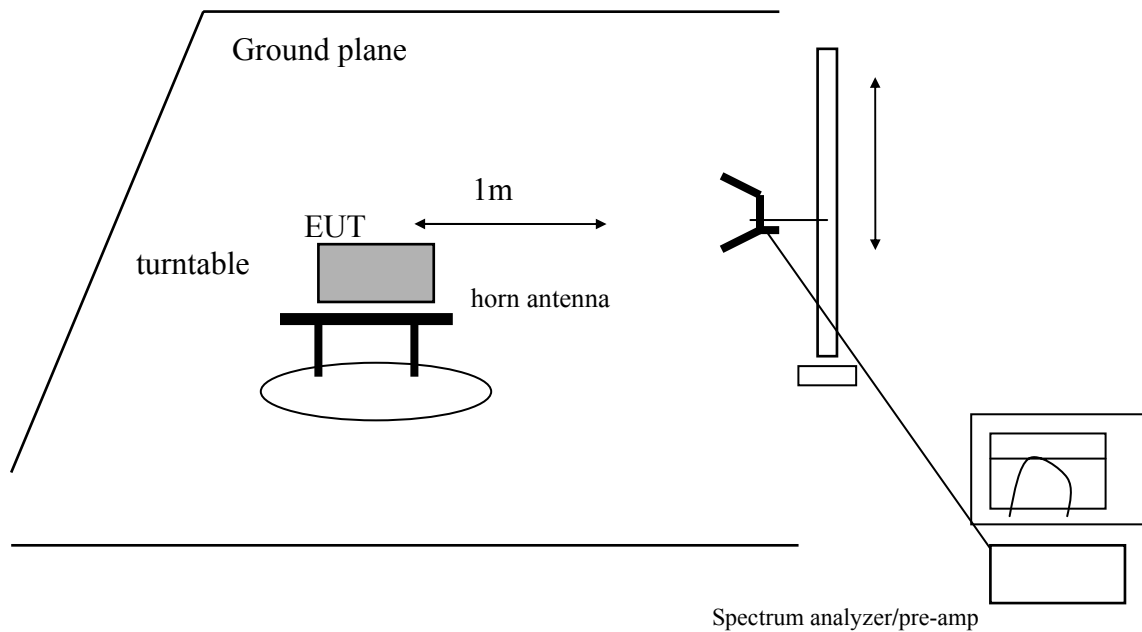
**Plot#43 - ACP – 64QAM HIGH Channel**  
**600-1000 KHz Above Center Frequency****Plot#44 - ACP – 64QAM HIGH Channel**  
**1000kHz – RX Band**

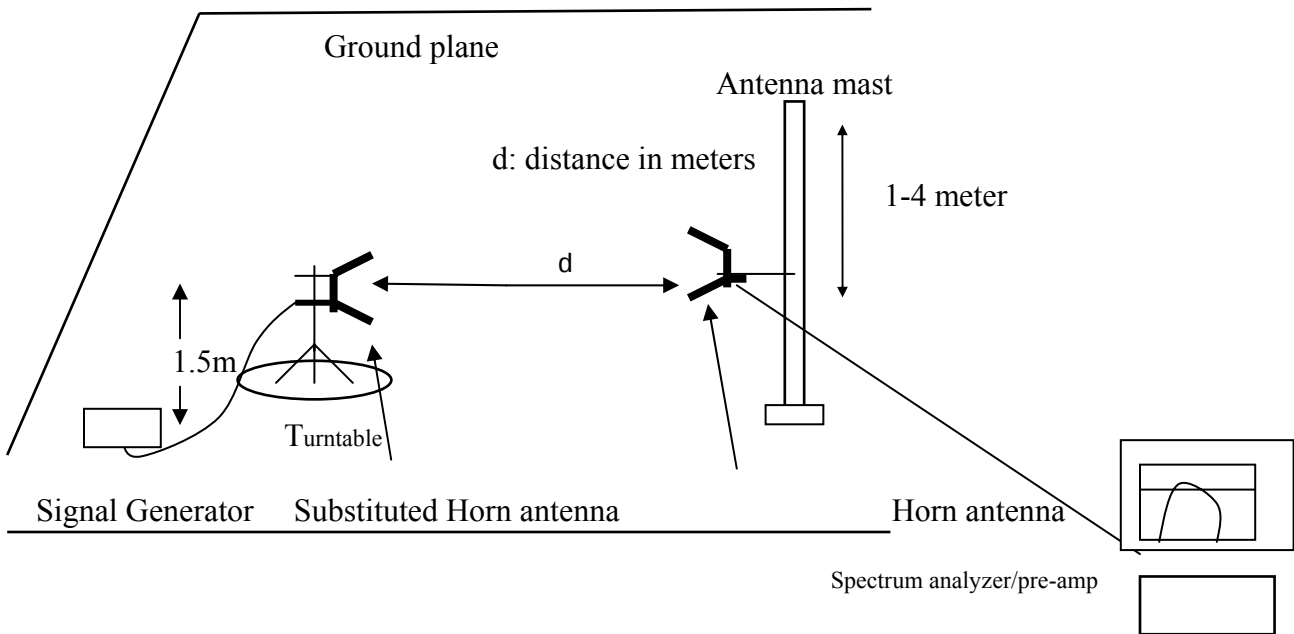
Plot#45 - ACP – 64QAM HIGH Channel  
In the RX Band



**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 / Vyvo  
EUT Descrip.: Base Station  
EUT M/N:  
Test Target: FCC Part 27  
Mode Oper:

## Test Equipment:

|                                                                                                                                                     |                       |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------|
| EMCO Horn 1-18GHz<br>T73; S/N: 6717 @3m                                                                                                             | Horn > 18GHz          | Limit<br>EIRP    |
| Hi Frequency Cables                                                                                                                                 |                       |                  |
| <input type="checkbox"/> (2 ft) <input type="checkbox"/> (2 ~ 3 ft) <input type="checkbox"/> (4 ~ 6 ft) <input checked="" type="checkbox"/> (12 ft) | Pre-amplifier 1-26GHz | Pre-amplifier 20 |

| f<br>GHz                     | SA reading<br>(dBuV/m) | Ant. Pol.<br>(H/V) | SG reading<br>(dBm) | CL<br>(dB) | Gain<br>(dBi) | Gain<br>(dBd) | EIRP<br>(dBm) | Limit<br>(dBm) | Margin<br>(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 Descip.: 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-amplifier 1-26GHz

T63 Miteq 646456

Pre-amplifier 26-4

| f<br>GHz          | SA reading<br>(dBuV/m) | Ant. Pol.<br>(H/V) | SG reading<br>(dBm) | CL<br>(dB) | Gain<br>(dBi) | Gain<br>(dBd) | EIRP<br>(dBm) | Limit<br>(dBm) | Margin<br>(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.

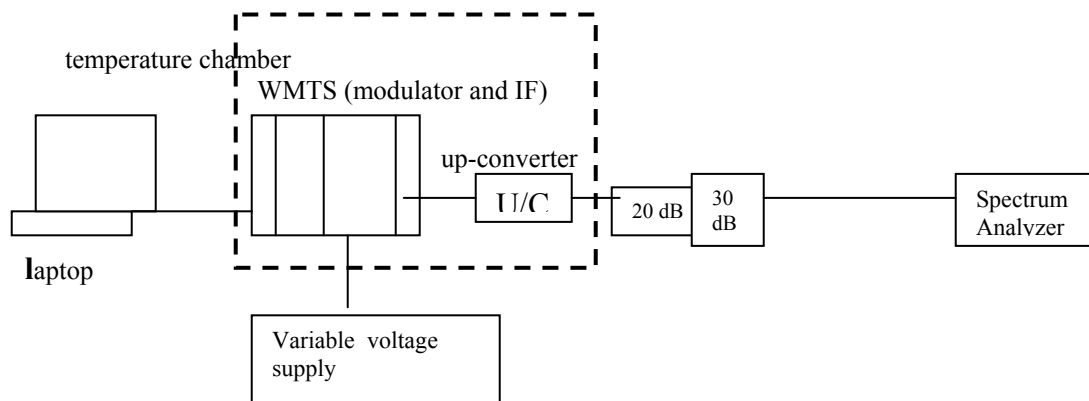
## 2.1055 Frequency Stability

### 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

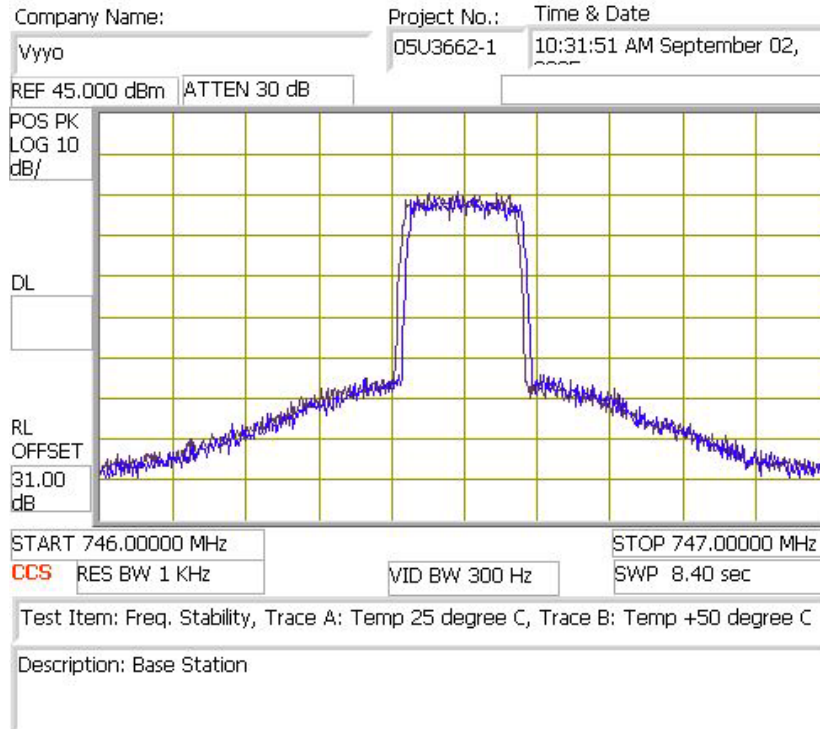
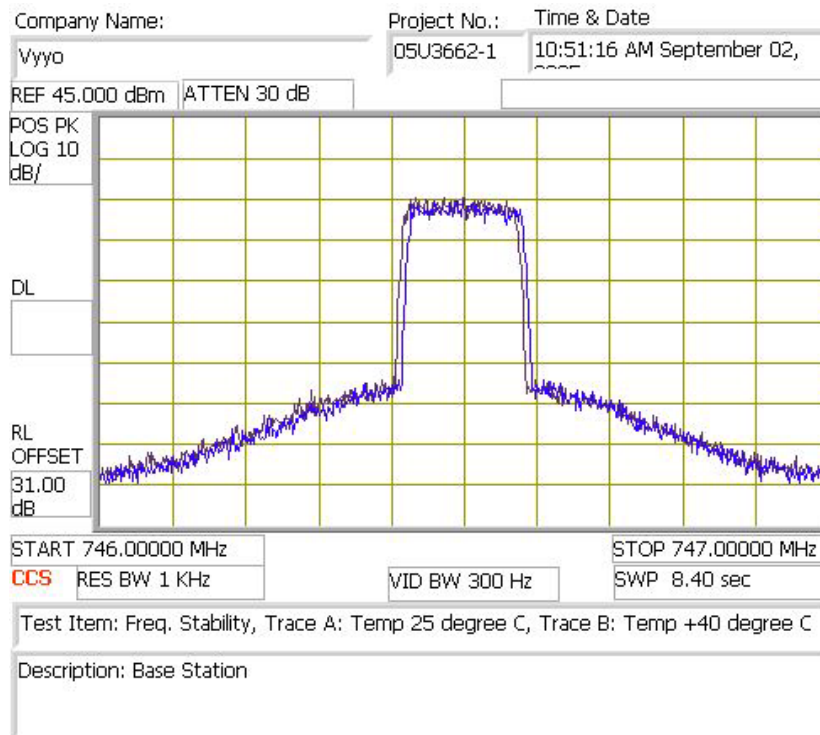
1. The WMTS modulator and the frequency up-converter portions of the transmitter were placed inside the temperature chamber. These are the two subassemblies that determine the operating frequency of the EUT.
2. The output of the U/C was connected to the spectrum analyzer through the same attenuators 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.

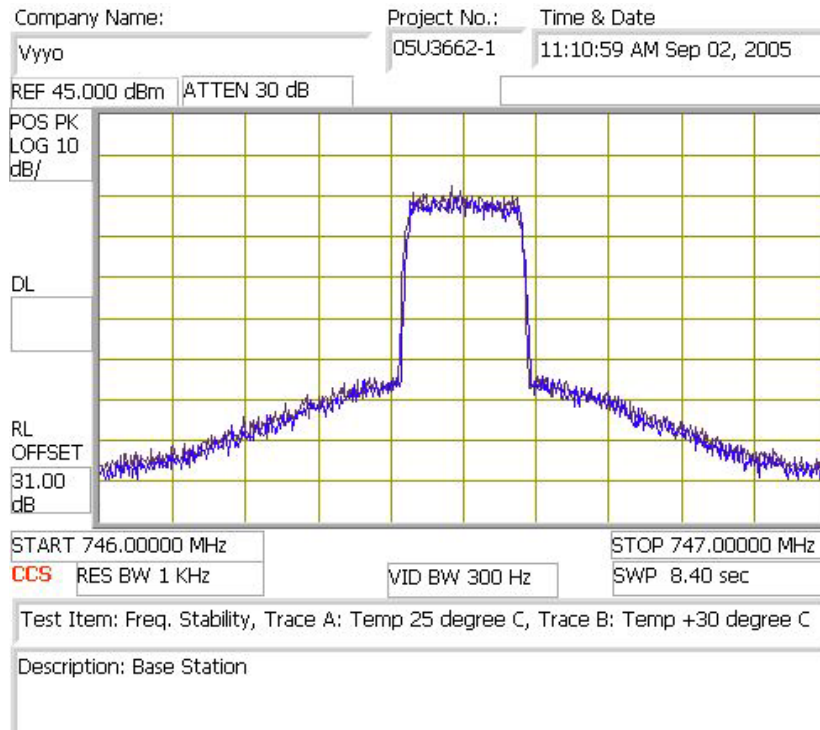
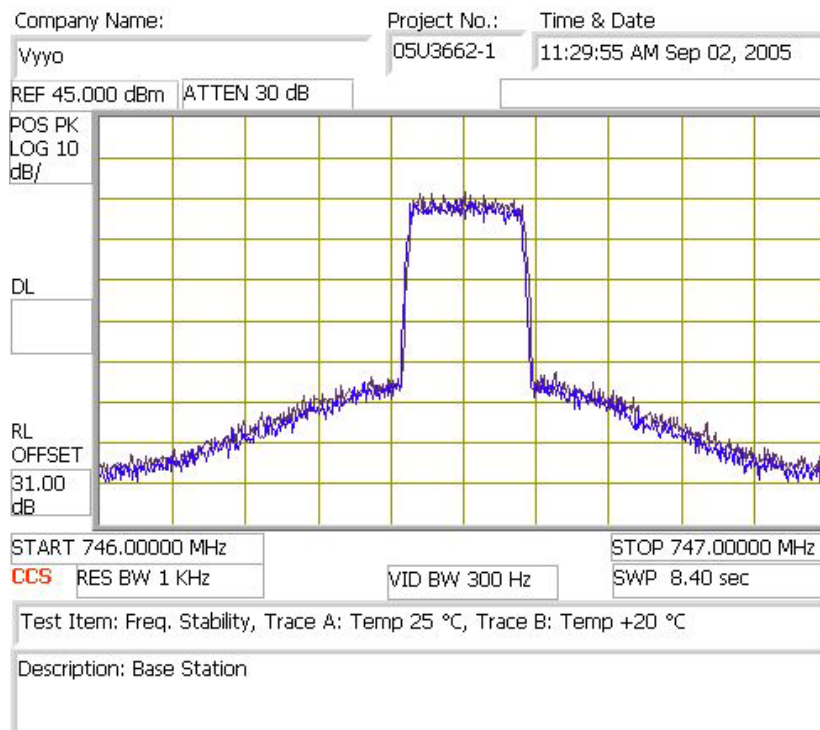
### Test Results

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.

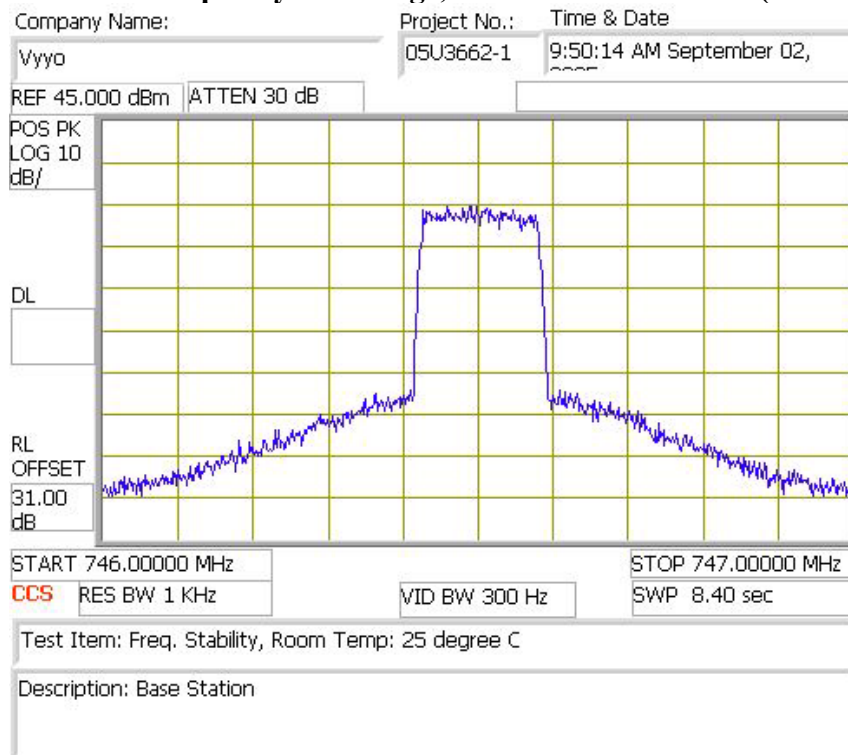
### Test Results

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.

A handwritten signature in blue ink, reading "T.N. Cokenias", with a long horizontal flourish extending to the right.

THOMAS N. COKENIAS  
Consultant, EMC&Radio Type Approvals  
Agent for Vyyo Inc.

T.N. Cokenias Consulting [www.tncokenias.org](http://www.tncokenias.org)  
P.O. Box 1086  
El Granada CA 94018

tel 650 726 1263  
fax 650 726 1252  
cell 650 302 0887