# FCC PART 90Y
# IC RSS-111, ISSUE 4, JANUARY 2012

# TEST AND MEASUREMENT REPORT

For

## Exalt Communications, Inc.

580 Division Street,

Campbell, CA 95008, USA

**FCC ID: TTM-105P25U**
**IC: 6254A-105P25U**

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | 802.11 WLAN Module |

**Prepared By:** Wei Sun

**Report Number:** R1302222-90

**Report Date:** 2013-06-18

**Reviewed By:** Quinn Jiang
Test Engineer

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## DOCUMENT REVISION HISTORY

| Revision Number | Report Number | Description of Revision | Date of Revision |
|---|---|---|---|
| 0 | R1302222-90 | Original Report | 2013-06-18 |

# 1 General Information

## 1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Exalt Communications, Inc*., and their product, FCC: TTM-105P25U and IC: 6254A-105P25U, model: eMIMO, which will henceforth be referred to as the EUT "Equipment Under Test." The EUT is an 802.11 WLAN module and operates on 4940-4990 MHz, 5250-5350 MHz, 5470-5725 MHz, 5725-5825 MHz UNII bands, and 5725-5850 MHz ISM band. 5 and 10 MHz mode of 4940-4990 MHz cannot transmit both chains simultaneously and will not operate on 5725-5825 MHz UNII band.

## 1.2 Mechanical Description of EUT

The EUT measures approximately 12.7 cm (L) x 11.4 cm (W) x 1.6 cm (H) and weighs 102g.

*The test data gathered are from a production sample provided by the manufacturer, Serial Number:PE15139027, assigned by BACL.*

## 1.3 Objective

This type approval report is prepared on behalf of *Exalt Communication, Inc.,* accordance with Part 90 and IC RSS-210 Issue 4, January 2012.

## 1.4 Related Submittal(s)/Grant(s)

FCC Part 15.407 NII with FCC ID: TTM-105P25U; IC: 6254A-105P25U
FCC Part 15.247 DTS with FCC ID: TTM-105P25U; IC: 6254A-105P25U

## 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, as well as the following individual parts:

Part 90Y – Regulations Governing Licensing and Use of Frequencies in the 4940-4990 MHz Band.

Applicable Standards: TIA-603-C

And IC RSS-210 Issue 4 – Broadband Public Safety Equipment Operating in the Band 4940 -4990 MHz.

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

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 test utility used was cart.exe was provided by Exalt Communications, Inc., and was verified Jeffrey Wu to comply with the standard requirements being tested against.

## 2.3 Equipment Modifications

No modification was made to the EUT

## 2.4 Special Equipment

No special equipment was used during testing

## 2.5 Local Support Equipment

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| DELL | Laptop | Latitude E5420 | - |

## 2.6 EUT Internal Configuration Details

N/A, EUT is a module. Please refer to Section 1.2 for the serial number.

## 2.7 External I/O Cabling List and Details

| Cable Descriptions | Length (m) | From | To |
|---|---|---|---|
| RF Cable | <1.0 | Spectrum Analyzer | EUT |
| RJ 45 Cable | <1.0 | LAPTOP | POE |
| RJ 45 Cable | <1.0 | POE | EUT |

# 3 Summary of Test Results

| FCC Rules | Description of Tests | Results |
|---|---|---|
| §90.1217, §2.1091<br>IC RSS-102 | RF Exposure | Compliant |
| §2.1046, §90.1215<br>IC RSS-111 §4.3 | RF Output Power | Compliant |
| §2.1046, §90.1215<br>IC RSS-111 §4.3 | Power Spectral Density | Compliant |
| §2.1049, §90.210<br>IC RSS-111 §5.3, §5.4 | Occupied Bandwidth and Emission Mask | Compliant |
| §2.1051, §90.210<br>IC RSS-111 §4.3, §5.4 | Spurious Emissions at Antenna Terminals | Compliant |
| §90.1215 | Peak Excursion Ratio | Compliant |
| §2.1055, §90.213<br>IC RSS-111 §5.2 | Frequency Stability | Compliant |
| §2.1053, §90.210<br>IC RSS-111 §4.3, §5.4 | Field Strength of Spurious Radiation | Compliant |
| §2.1053, §90.210<br>IC RSS-111 §5.1 | Modulation Characteristics | Note [1] |
| § 90.214 | Transient Frequency Behavior | N/A [1] |

*N/A[1] – Not Applicable to EUT*
Note [1]*: EUT uses digital modulation*

# 4 FCC §2.1046, §90.1215 & IC RSS -111 §5.3 – RF Output Power

## 4.1 Applicable Standards

Per FCC §2.1046, §90.1215

The transmitting power of stations operating in the 4940-4990 MHz band must not exceed the maximum limits in this section.

(a)(1) The maximum conducted output power should not exceed:

| Channel bandwidth (MHz) | Low power maximum conducted output power (dBm) | High power maximum conducted output power (dBm) |
|---|---|---|
| 1 | 7 | 20 |
| 5 | 14 | 27 |
| 10 | 17 | 30 |
| 15 | 18.8 | 31.8 |
| 20 | 20 | 33 |

(b) Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the maximum conducted output power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi.

Per IC RSS-111 §5.3

**Table 1 – Channel Bandwidth and Power Limits**

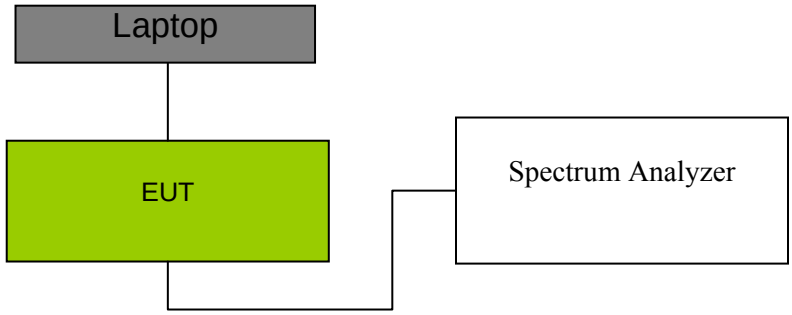
| Channel Bandwidth (MHz) | Transmitter Power, P (dBm) | |
|---|---|---|
| | Low-power Device | High-power Device |
| 1 | $P \leq 7$ | $7 < P \leq 20$ |
| 5 | $P \leq 14$ | $14 < P \leq 27$ |
| 10 | $P \leq 17$ | $17 < P \leq 30$ |
| 15 | $P \leq 18.8$ | $18.8 < P \leq 31.8$ |
| 20 | $P \leq 20$ | $20 < P \leq 33$ |

High- and low-power devices are also limited to a maximum power spectral density of 21 dBm/MHz and 8 dBm/MHz respectively. Devices using channel bandwidths other than those listed in Table 1 are permitted; however, the channel bandwidth shall not exceed 20 MHz and the devices shall comply with the maximum power spectral density limits of 21 dBm/MHz for high-power transmitters and 8 dBm/MHz for low-power transmitters. See SP 4940 MHz for antenna gain limits and operational restrictions for the device.

## 4.2 Test Setup Block Diagram and Procedure

*Conducted:*

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




## 4.3 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates | Calibration Cycle |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2012-09-29 | 1 year |

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

## 4.4 Test Environmental Conditions

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

*The testing was performed by Wei Sun on 2013-05-30 on RF Site.*

## 4.5 Test Results

**5 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 Power (dBm) | Chain 1 Power (dBm) | Highest Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4947.5 | -8.19 | -6.28 | -6.28 | -5* | -1.28 |
| Middle | 4967.5 | -8.31 | -6.17 | -6.17 | -5* | -1.17 |
| High | 4982.5 | -7.66 | -6.03 | -6.03 | -5* | -1.03 |

*Limit: -5 dBm = 14(the limit)–[28(the gain of the low power mode)-9(the limit of the highest gain)]

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 Power (dBm) | Chain 1 Power (dBm) | Highest Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4947.5 | 10.65 | 12.48 | 12.48 | 14 | -1.52 |
| Middle | 4967.5 | 9.87 | 12.24 | 12.24 | 14 | -1.76 |
| High | 4982.5 | 8.94 | 12.14 | 12.14 | 14 | -1.86 |

**10 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 Power (dBm) | Chain 1 Power (dBm) | Highest Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4950 | -5.09 | -3.04 | -3.04 | -2* | -1.04 |
| Middle | 4965 | -4.87 | -3.05 | -3.05 | -2* | -1.05 |
| High | 4980 | -4.69 | -3.02 | -3.02 | -2* | -1.02 |

*Limit: -2 dBm=17(the limit)–[28(the gain of the low power mode)-9(the limit of the highest gain)]

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 Power (dBm) | Chain 1 Power (dBm) | Highest Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4950 | 13.45 | 15.49 | 15.49 | 17 | -1.51 |
| Middle | 4965 | 12.91 | 15.41 | 15.41 | 17 | -1.59 |
| High | 4980 | 13.14 | 15.13 | 15.13 | 17 | -1.87 |

**802.11a Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 Power (dBm) | Chain 1 Power (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4955 | -3.30 | -1.19 | 0.89 | 1 | -0.11 |
| High | 4975 | -3.55 | -1.57 | 0.56 | 1 | -0.44 |

*Limit 1 dBm=20(the limit)–[28(the gain of the low power mode)-9(the limit of the highest gain)]

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 Power (dBm) | Chain 1 Power (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4955 | 15.53 | 15.29 | 18.42 | 20 | -1.58 |
| High | 4975 | 15.85 | 15.64 | 18.76 | 20 | -1.24 |

**802.11n HT20 Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 Power (dBm) | Chain 1 Power (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4955 | -3.05 | -1.77 | 0.65 | 1 | -0.35 |
| High | 4975 | -2.99 | -2.04 | 0.52 | 1 | -0.48 |

*Limit 1 dBm=20(the limit)–[28(the gain of the low power mode)-9(the limit of the highest gain)]

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 Power (dBm) | Chain 1 Power (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4955 | 15.45 | 15.73 | 18.60 | 20 | -1.40 |
| High | 4975 | 14.93 | 15.04 | 18.00 | 20 | -2.00 |

Note: The manufacturer declared that the maximum output power of the radio shall never exceed 20 dBm. So the low-power device limits specified in FCC Part 90Y and IC RSS-111 shall be applied to the device for 5, 10 and 20 MHz channel bandwidth

# 5 FCC §2.1049, §90.210 & IC RSS-111 §5.3 – Occupied Bandwidth & Emission Mask

## 5.1 Applicable Standards

As per FCC §90.210 (l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0-45% of the authorized bandwidth (BW): 0 dB.

(2) On any frequency removed from the assigned frequency between 45-50% of the authorized bandwidth: 219 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50-55% of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55-100% of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100-150% of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.

(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

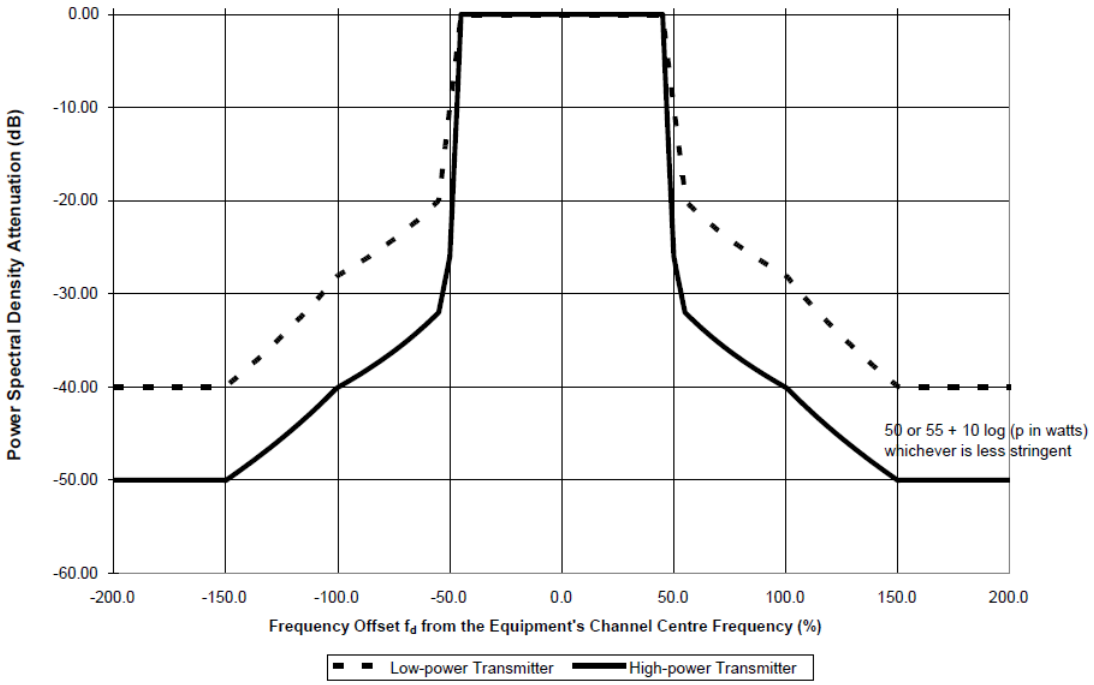
As per IC RSS-111 §5.4, Transmitter Unwanted Emissions,

**Table 2 – Emission Mask for Low- and High-power Transmitters**

| Offset Frequency $f_d$ (% of the Equipment's Channel Bandwidth) | Minimum Attenuation (dB) | |
|---|---|---|
| | Low-power Transmitter | High-power Transmitter |
| $0 < f_d \leq 45$ | 0 | 0 |
| $45 < f_d \leq 50$ | 219 log ($f_d$/45) | 568 log ($f_d$/45) |
| $50 < f_d \leq 55$ | 10 + 242 log ($f_d$/50) | 26 + 145 log ($f_d$/50) |
| $55 < f_d \leq 100$ | 20 + 31 log ($f_d$/55) | 32 + 31 log ($f_d$/55) |
| $100 < f_d \leq 150$ | 28 + 68 log ($f_d$/100) | 40 + 57 log ($f_d$/100) |
| $f_d > 150$ | 40 | whichever is less stringent 50 or 55 + 10 log p |

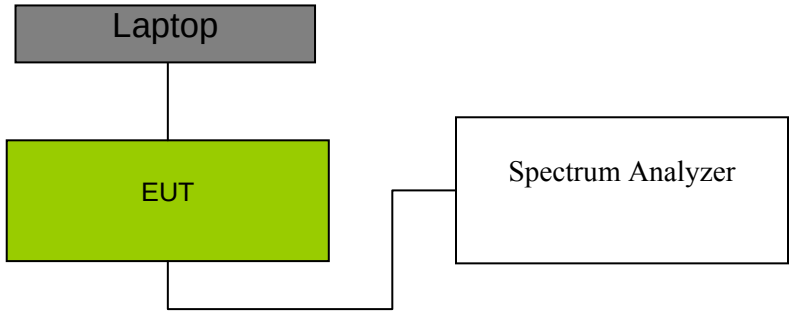
Where: fd (%) = ((f-fc)/channel bandwidth)x100
p: transmitter's output power (in watts), measured as per Section 4.1 of IC RSS-111.

**Figure 1: Unwanted Emission Mask for Low- and High-power Transmitters**




## 5.2 Test Setup Block Diagram and Test Procedure

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




## 5.3 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates | Calibration Cycle |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2012-09-29 | 1 year |

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

## 5.4 Test Environmental Conditions

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

*The testing was performed by Wei Sun on 2013-05-31 on RF Site.*

## 5.5 Test Results

**5 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 (MHz) | Chain 1 (MHz) |
|---|---|---|---|
| Middle | 4967.5 | 4.1219 | 4.1137 |

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 (MHz) | Chain 1 (MHz) |
|---|---|---|---|
| Middle | 4967.5 | 4.1177 | 4.1191 |

**10 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 (MHz) | Chain 1 (MHz) |
|---|---|---|---|
| Middle | 4965 | 8.1664 | 8.1730 |

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 (MHz) | Chain 1 (MHz) |
|---|---|---|---|
| Middle | 4965 | 8.1756 | 8.1760 |

**802.11a Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 (MHz) | Chain 1 (MHz) |
|---|---|---|---|
| Low | 4955 | 16.6442 | 16.5300 |

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 (MHz) | Chain 1 (MHz) |
|---|---|---|---|
| Low | 4955 | 16.6371 | 16.5570 |

**802.11 HT20 Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 (MHz) | Chain 1 (MHz) |
|---|---|---|---|
| Low | 4955 | 17.7568 | 17.7196 |

High Power Setting, Low Gain Antenna (9 dBi)

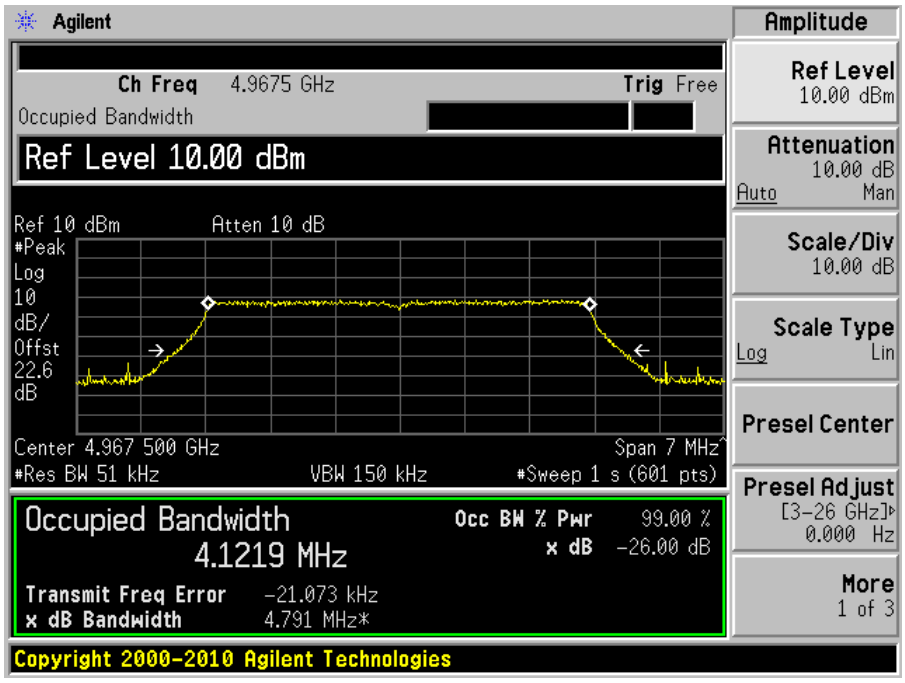
| Channel | Frequency (MHz) | Chain 0 (MHz) | Chain 1 (MHz) |
|---|---|---|---|
| Low | 4955 | 17.7840 | 17.7003 |

Please refer to the following plots.

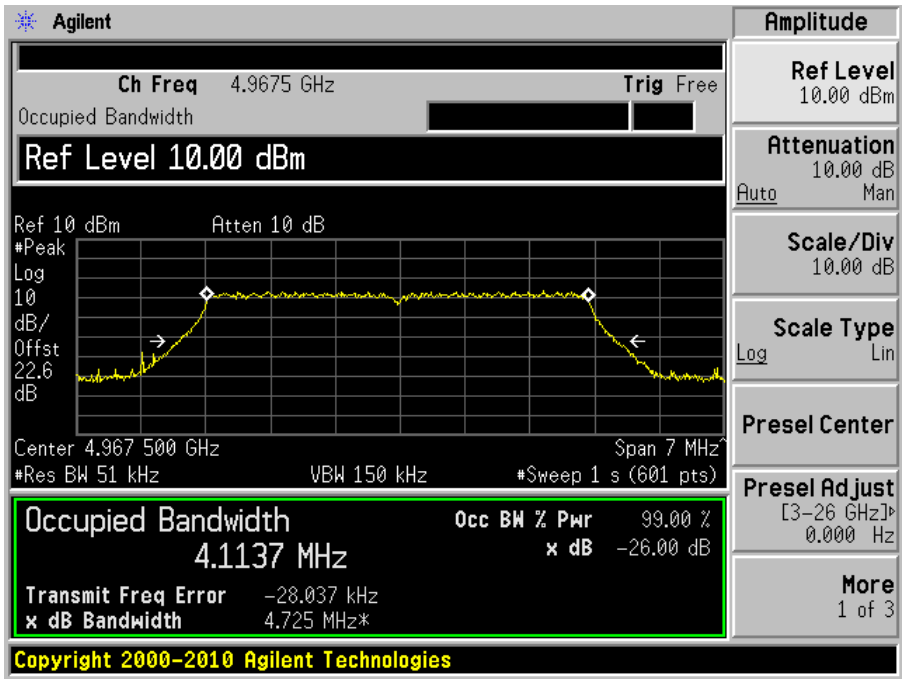
**5 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

Middle Channel Chain 0

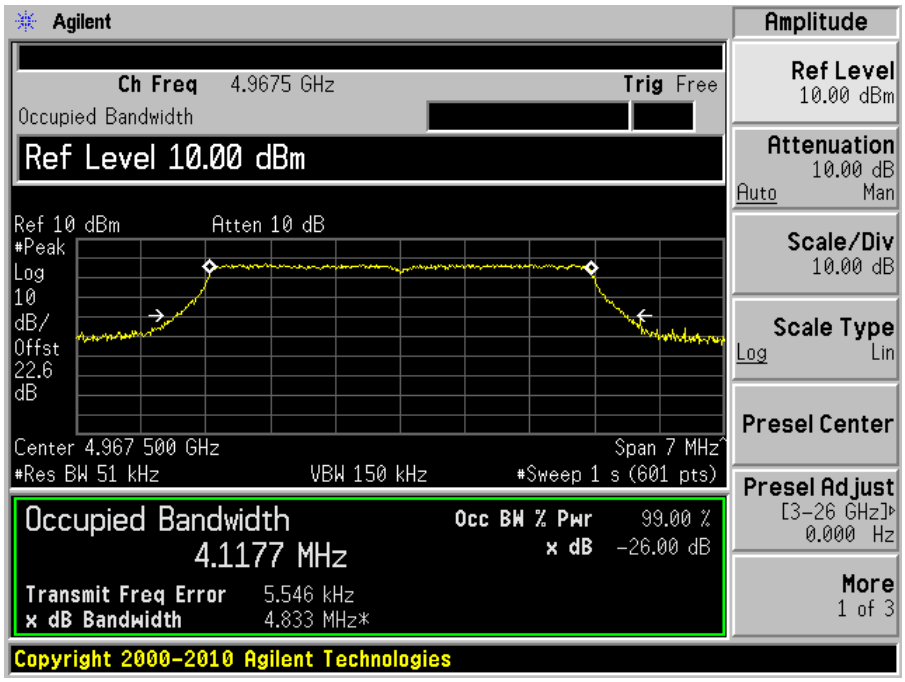



Middle Channel Chain 1

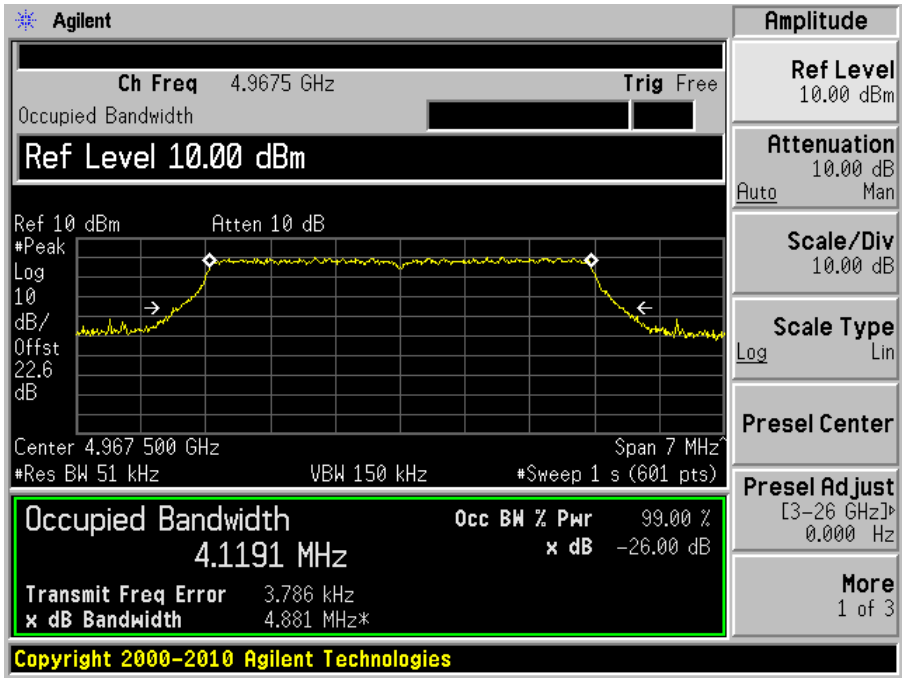


High power, High Gain Antenna (9 dBi)

Middle Channel Chain 0



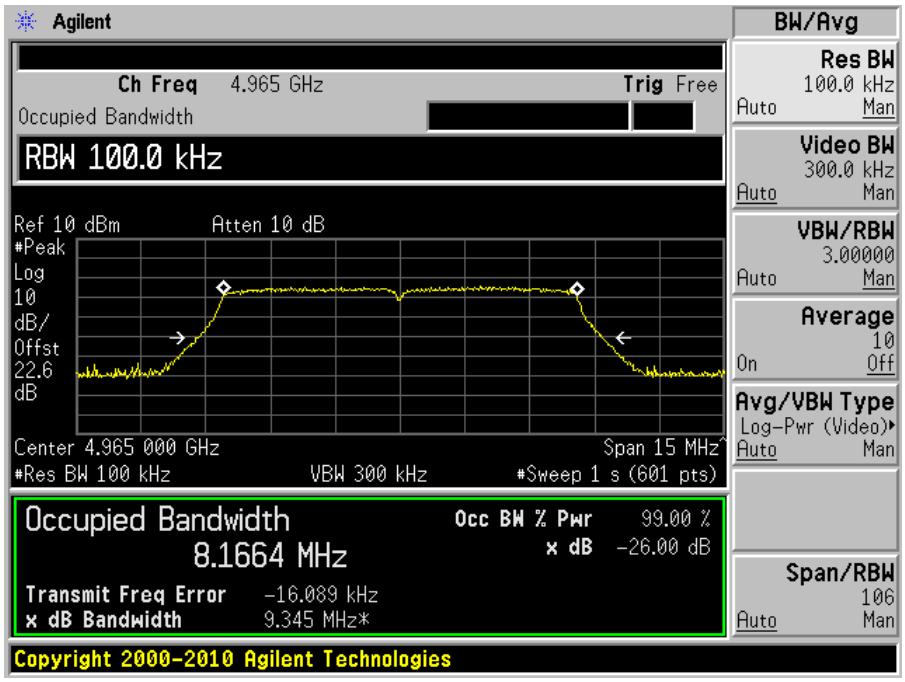

Middle Channel Chain 1



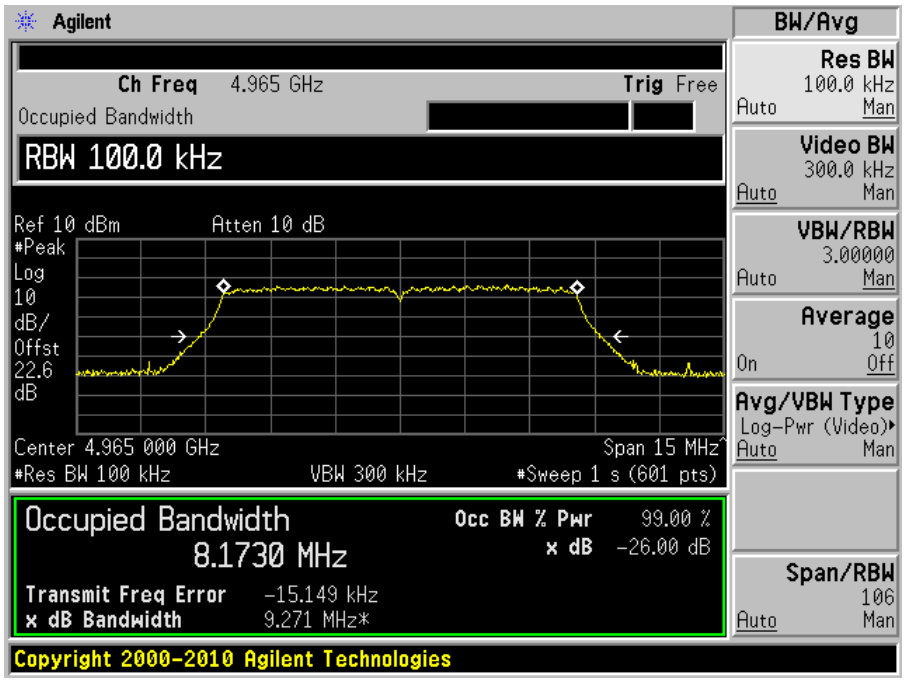
**10 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

Middle Channel Chain 0

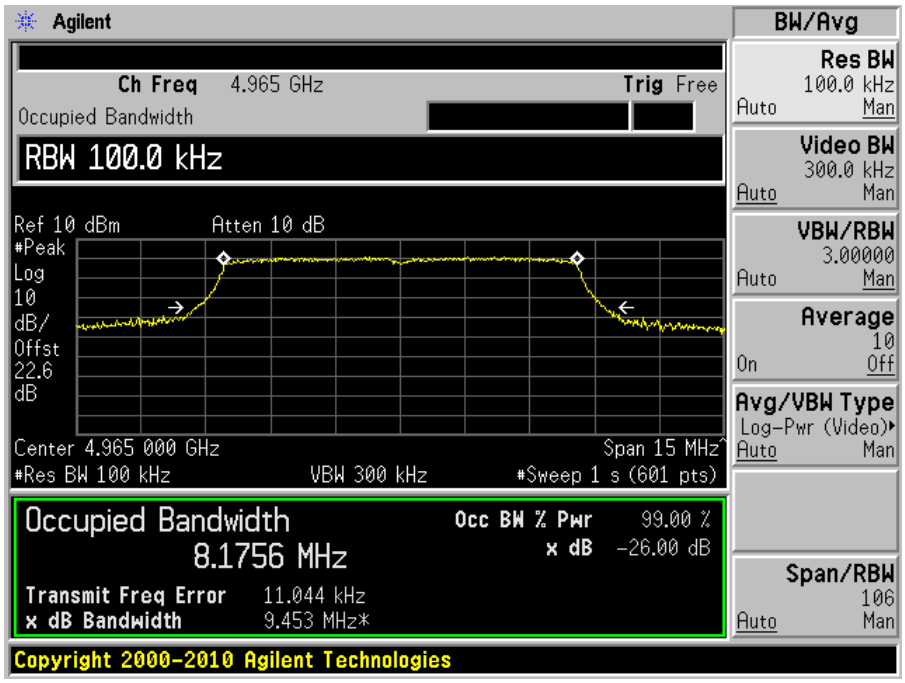



Middle Channel Chain 1

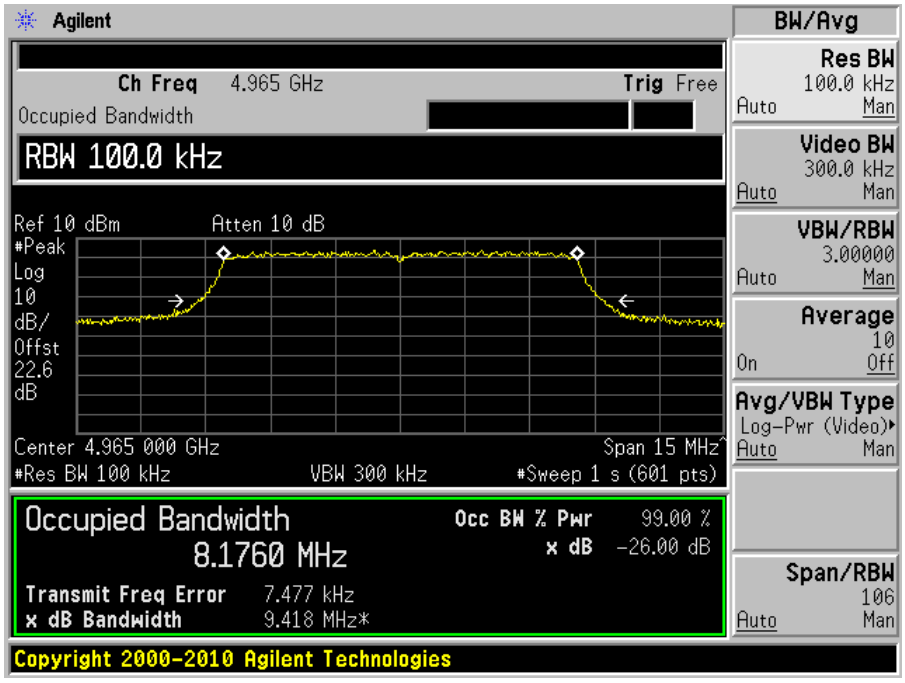


High Power Setting, Low Gain Antenna (9 dBi)

Middle Channel Chain 0



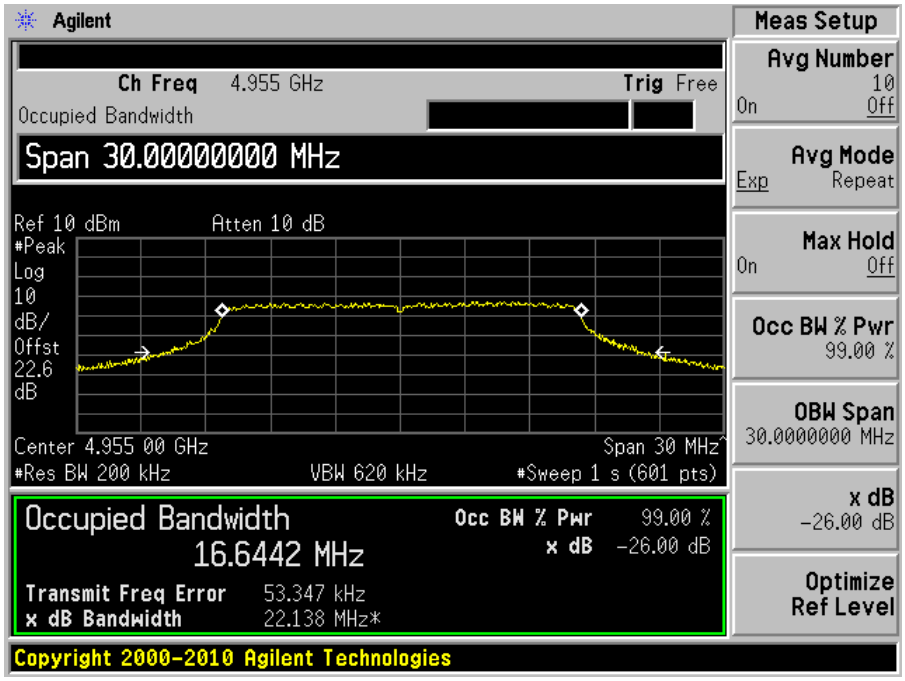

Middle Channel Chain 1



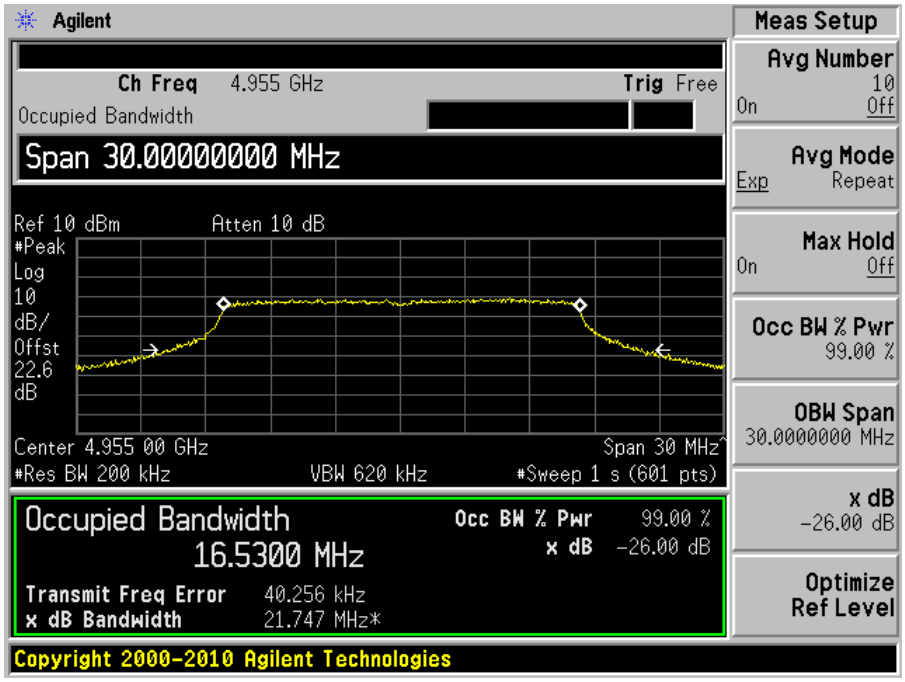
**802.11a mode**

Low Power Setting, High Gain Antenna (28 dBi)

Low Channel Chain 0

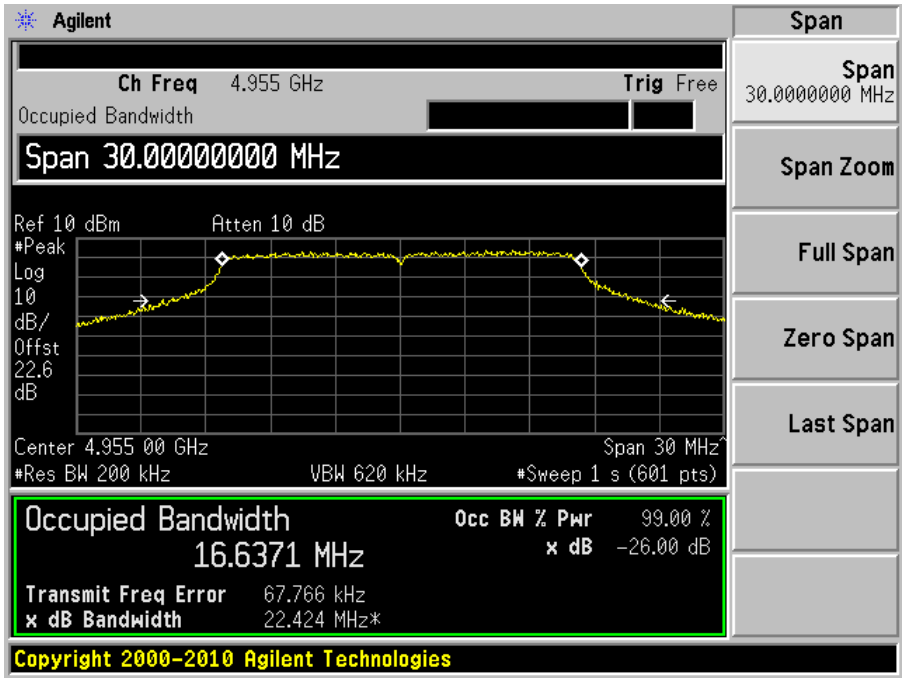



Low Channel Chain 1

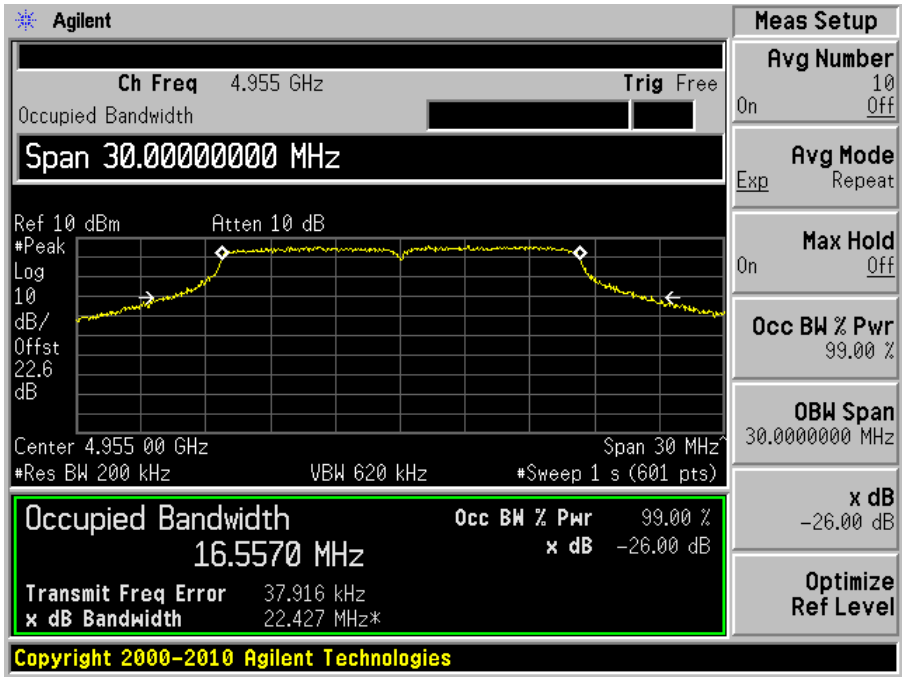


High Power Setting, Low Gain Antenna (9 dBi)

Low Channel Chain 0



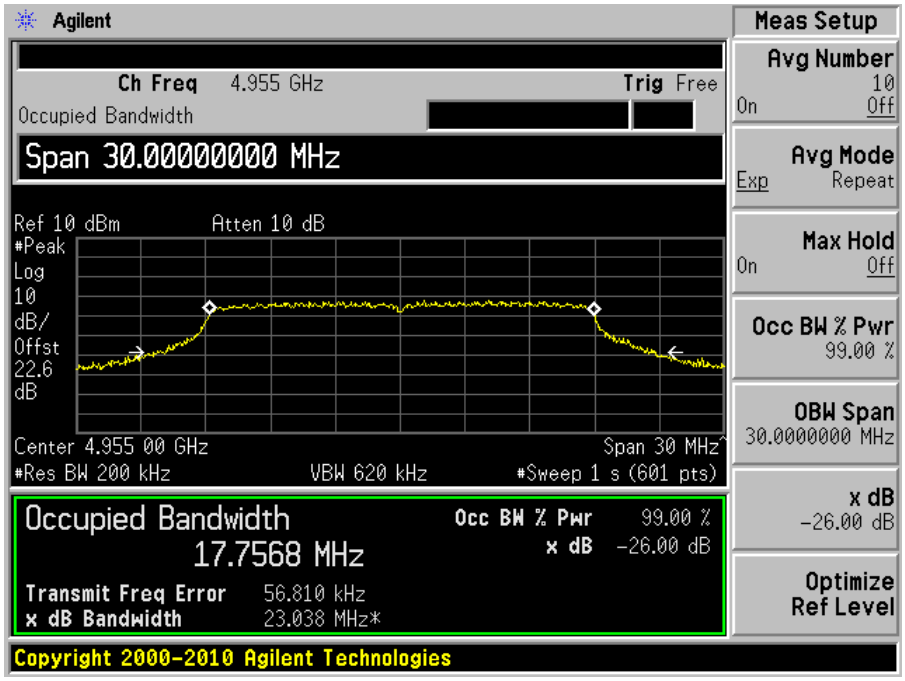

Low Channel Chain 0



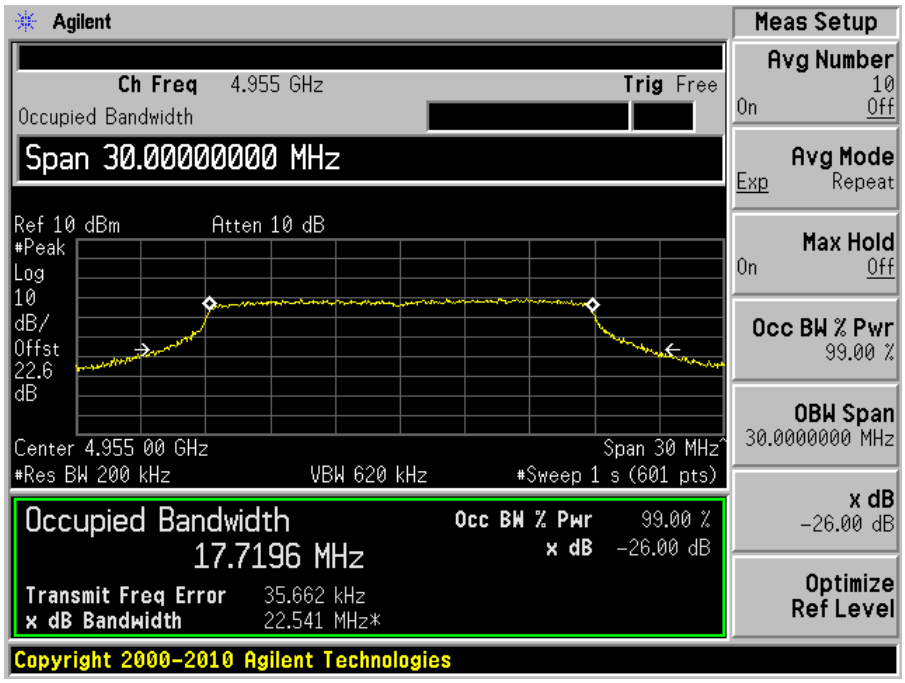
**802.11n HT20 mode**

Low Power Setting, High Gain Antenna (28 dBi)

Low Channel Chain 0

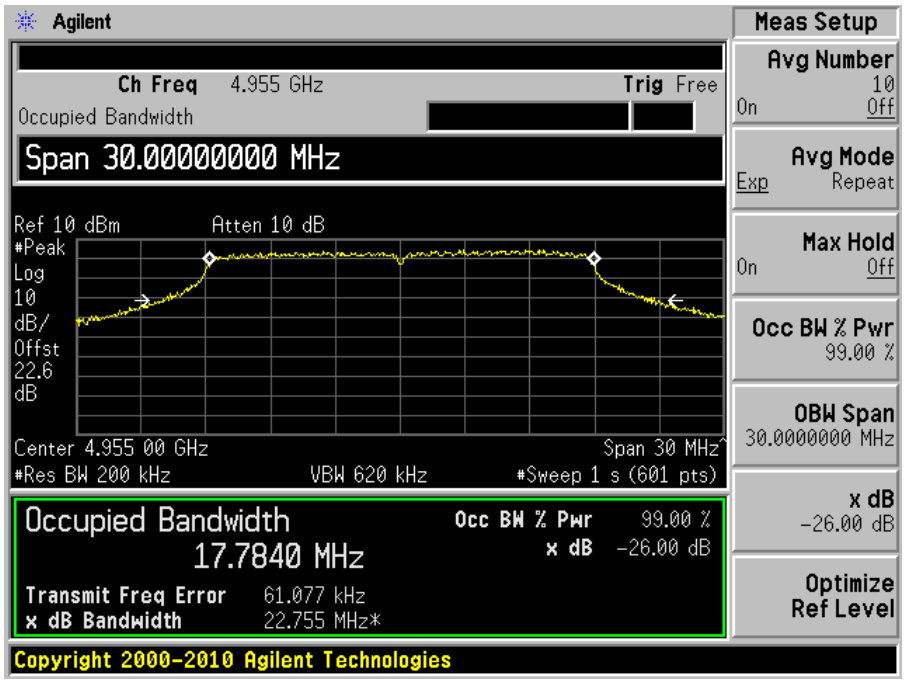



Low Channel Chain 1

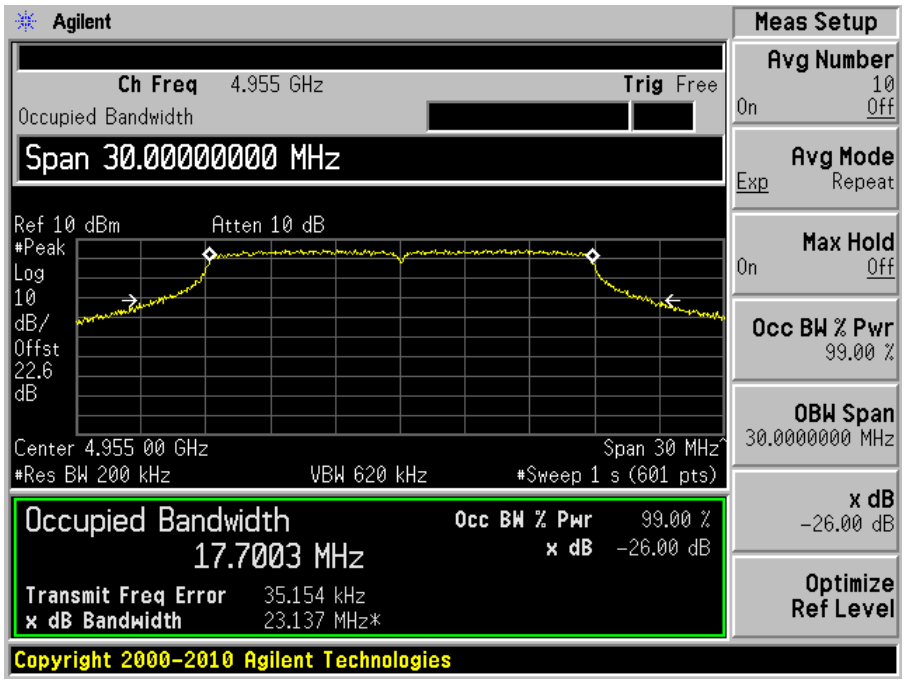


High Power Setting, Low Gain Antenna (9 dBi)

Low Channel Chain 0




Low Channel Chain 1

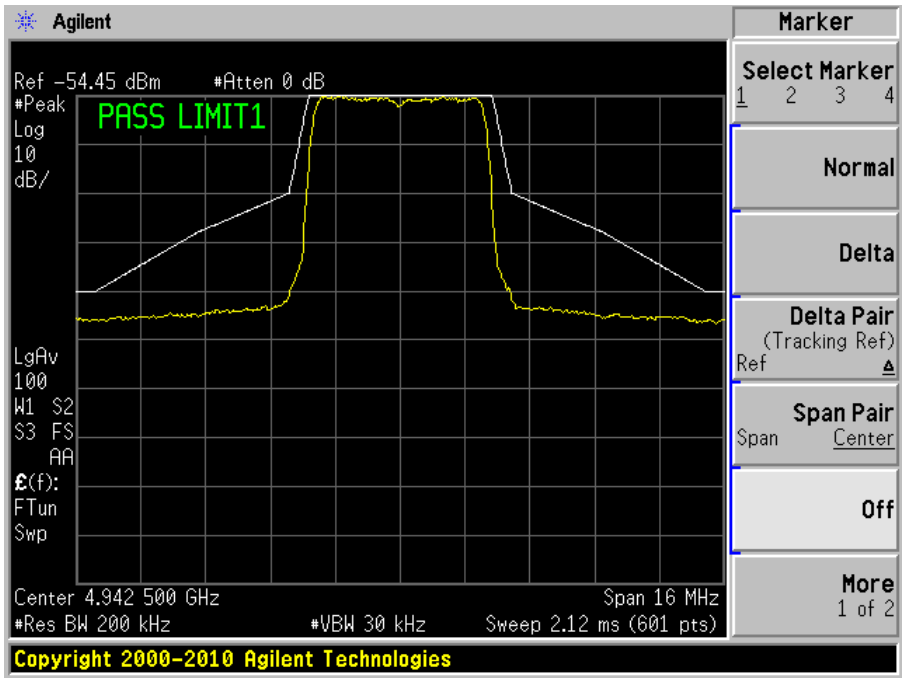


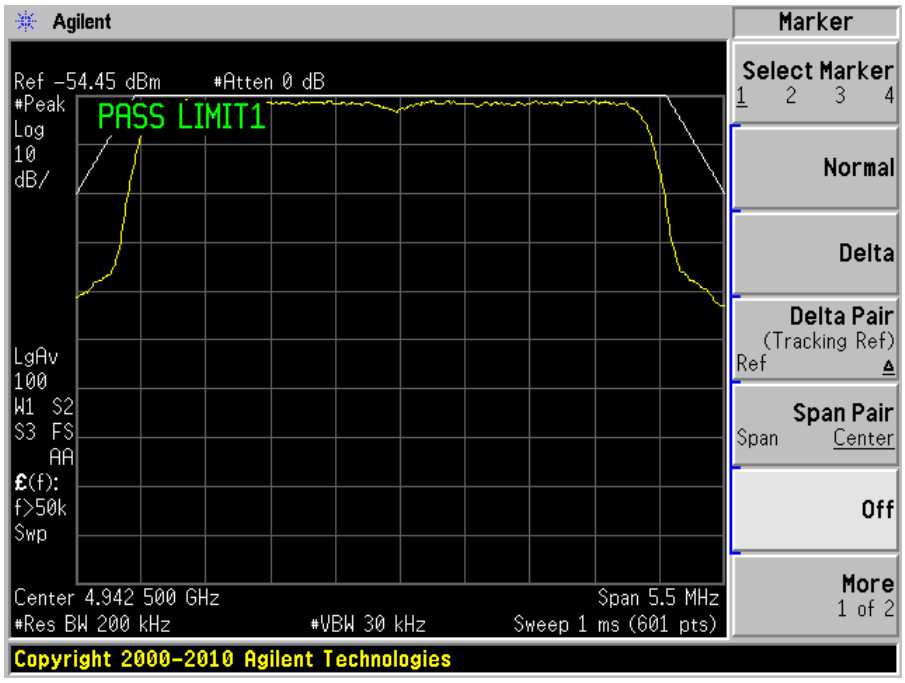
## Emission Mask

### 5 MHz Mode

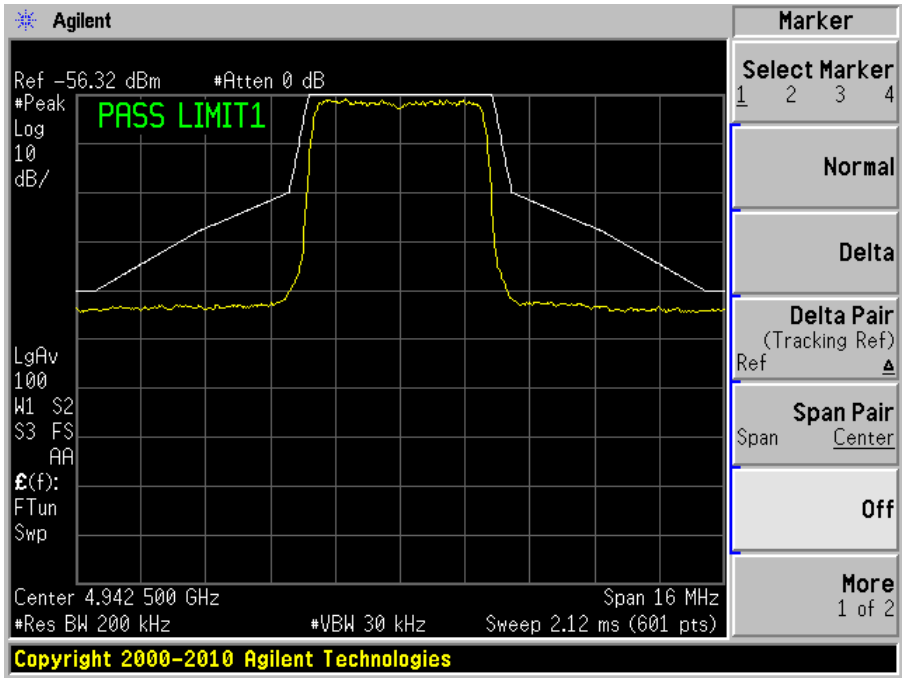
Low Power Setting, High Gain Antenna (28 dBi)

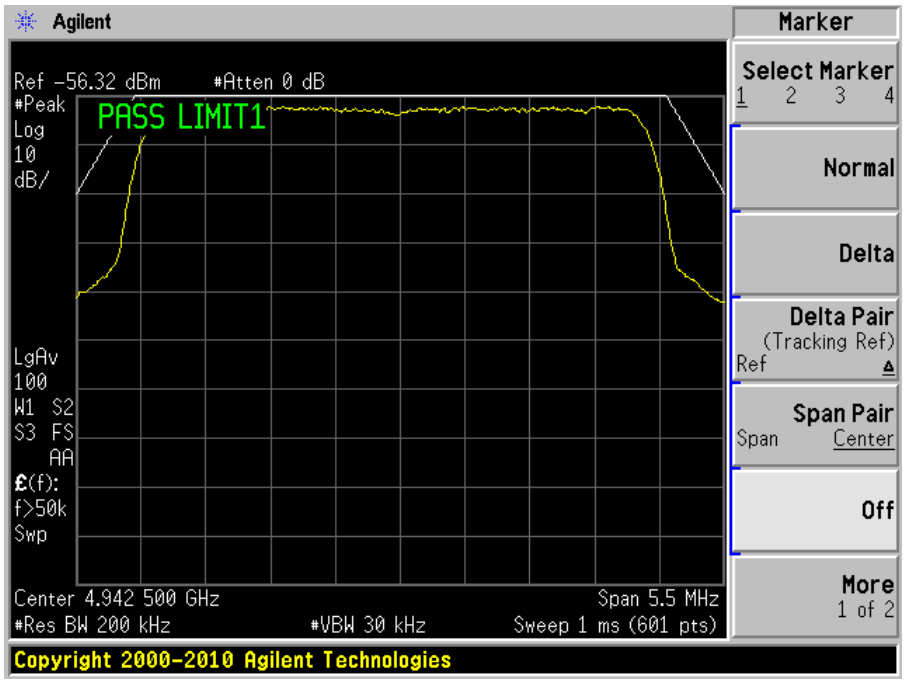
Low Channel 4942.5 MHz, Chain 0



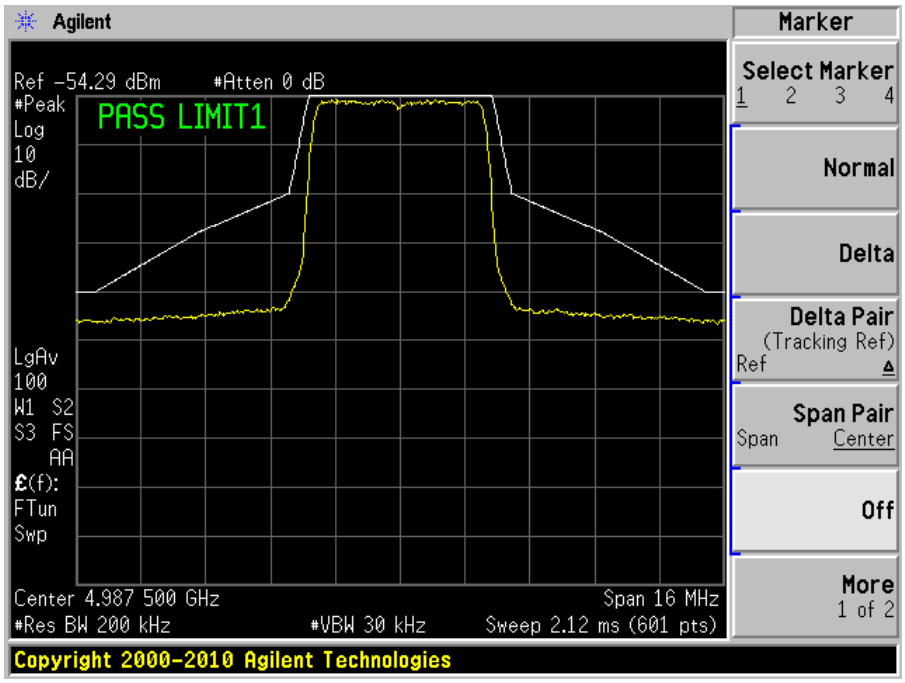



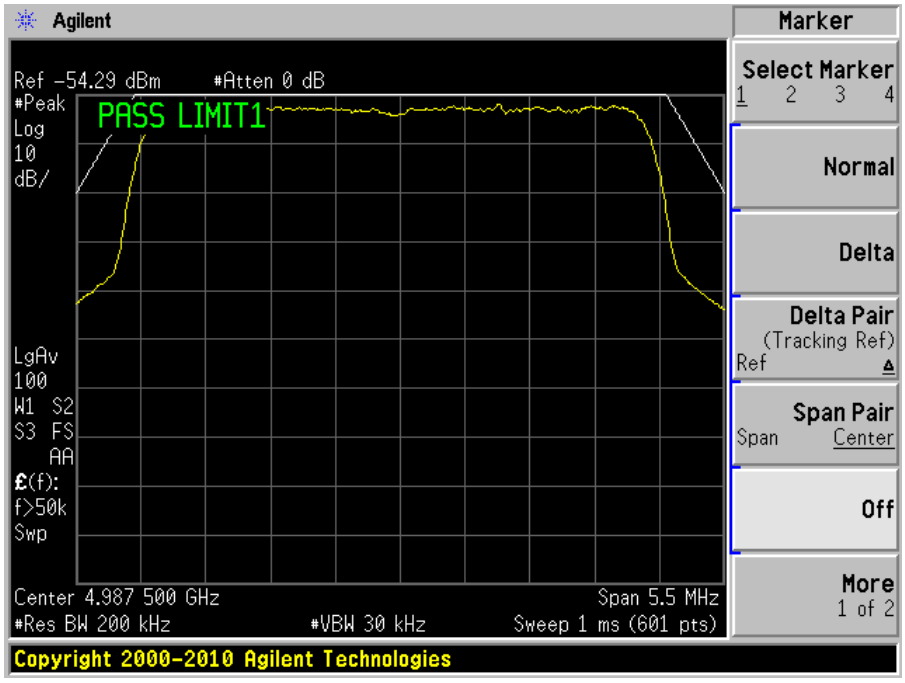
Low Channel 4942.5 MHz, Chain 1



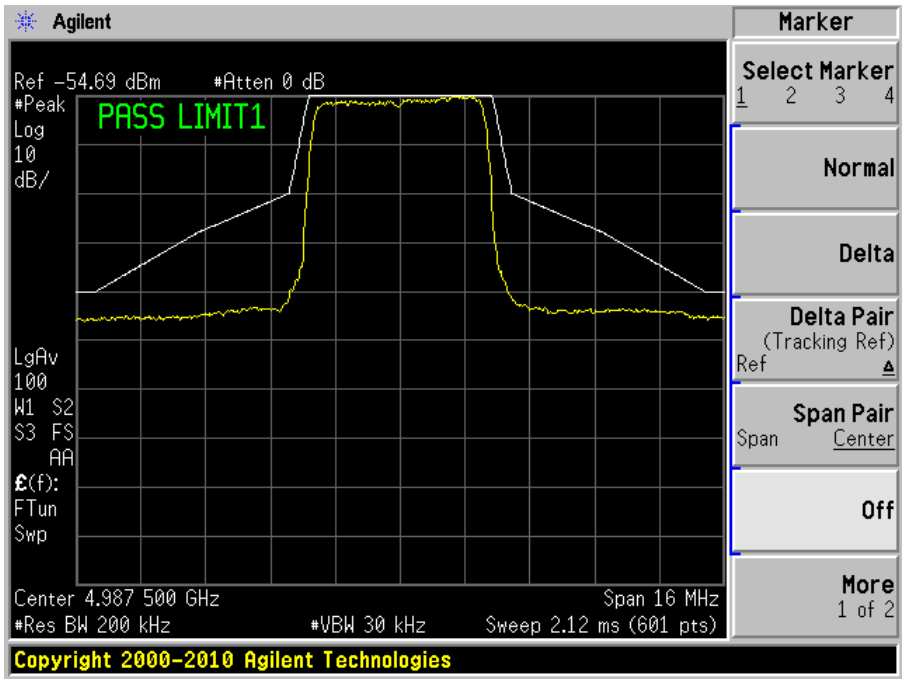



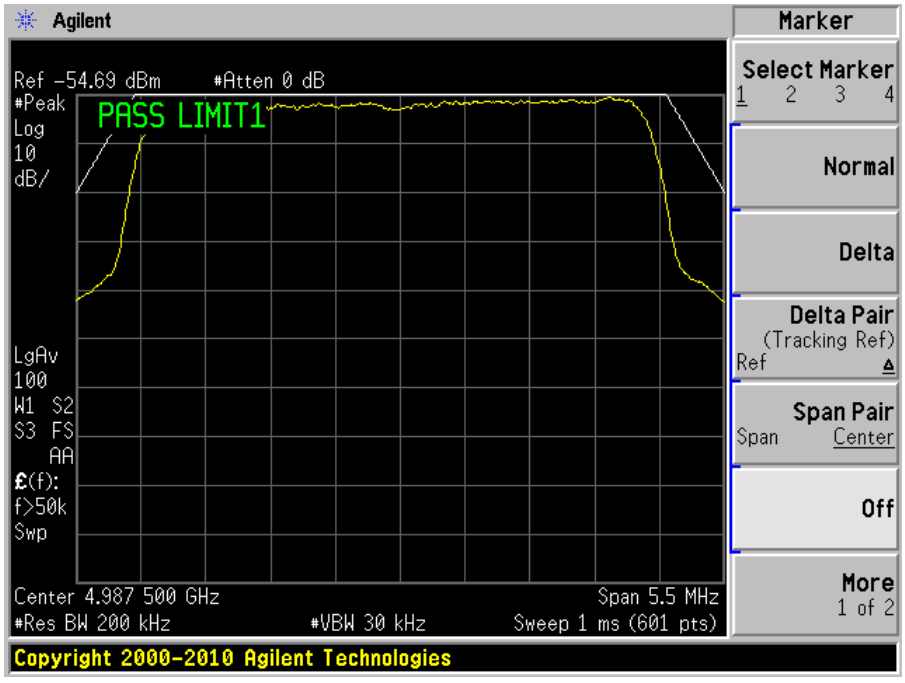
High Channel 4987.5 MHz, Chain 0



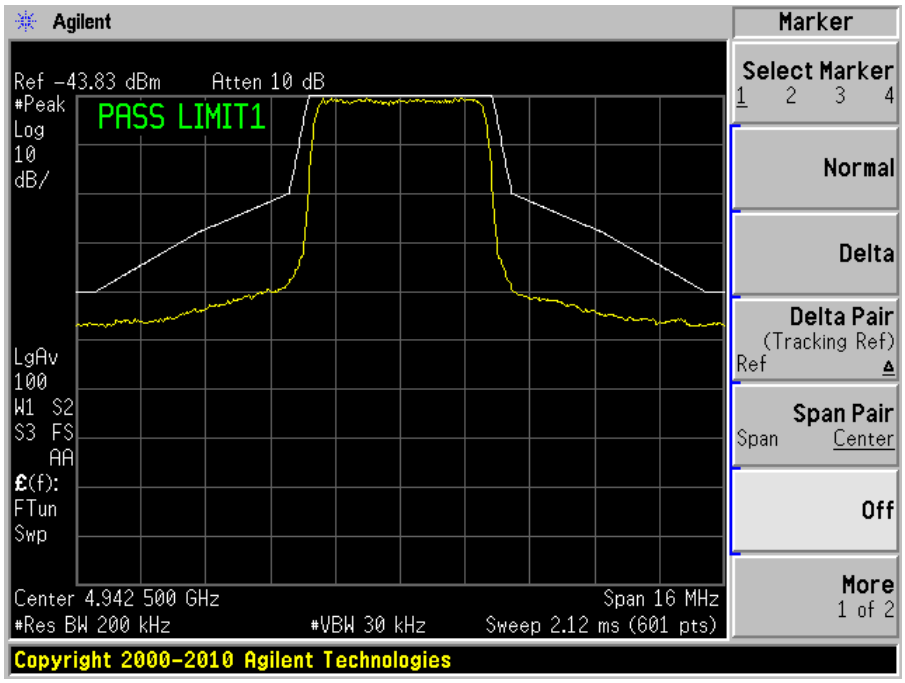
High Channel 4987.5 MHz, Chain 1

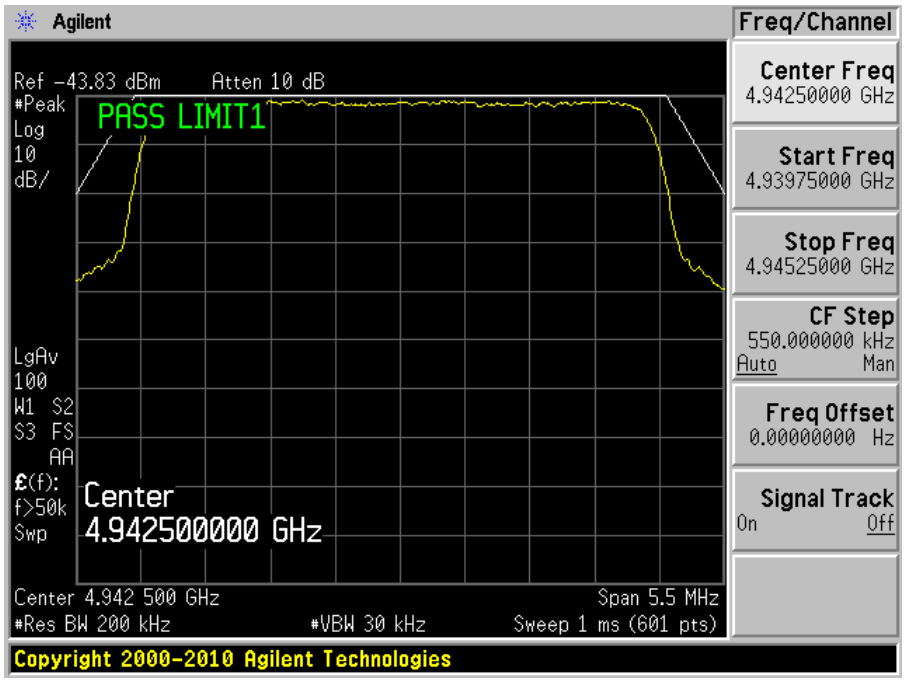


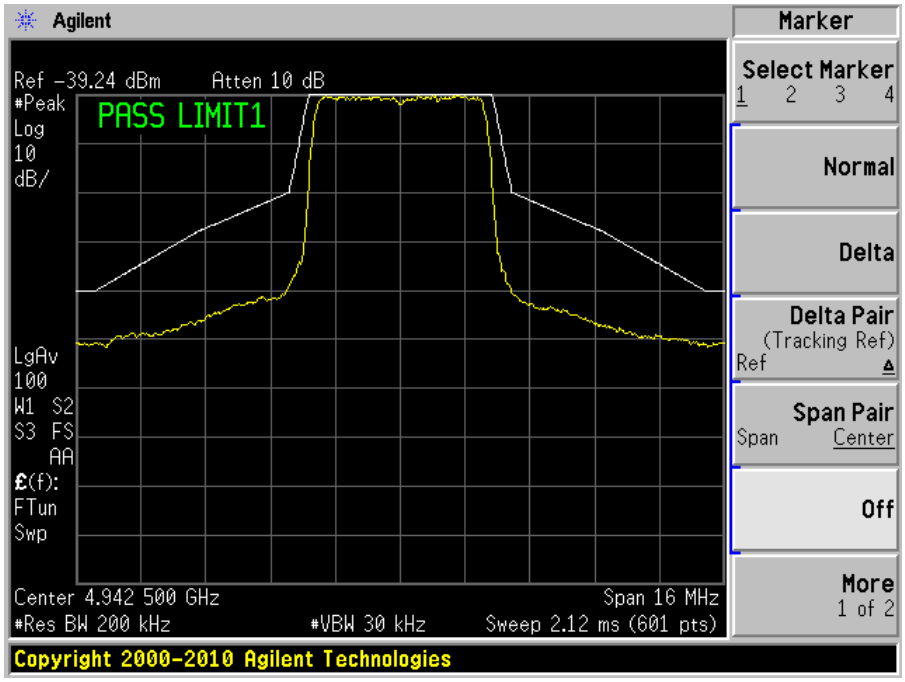
High Power Setting, Low Gain Antenna (9 dBi)

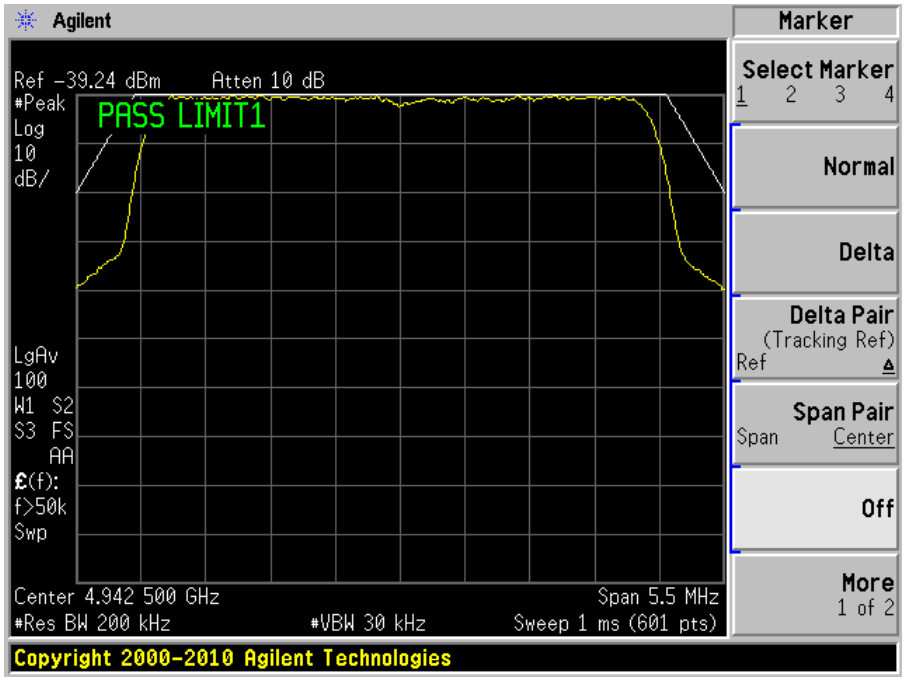
Low Channel 4942.5 MHz, Chain 0



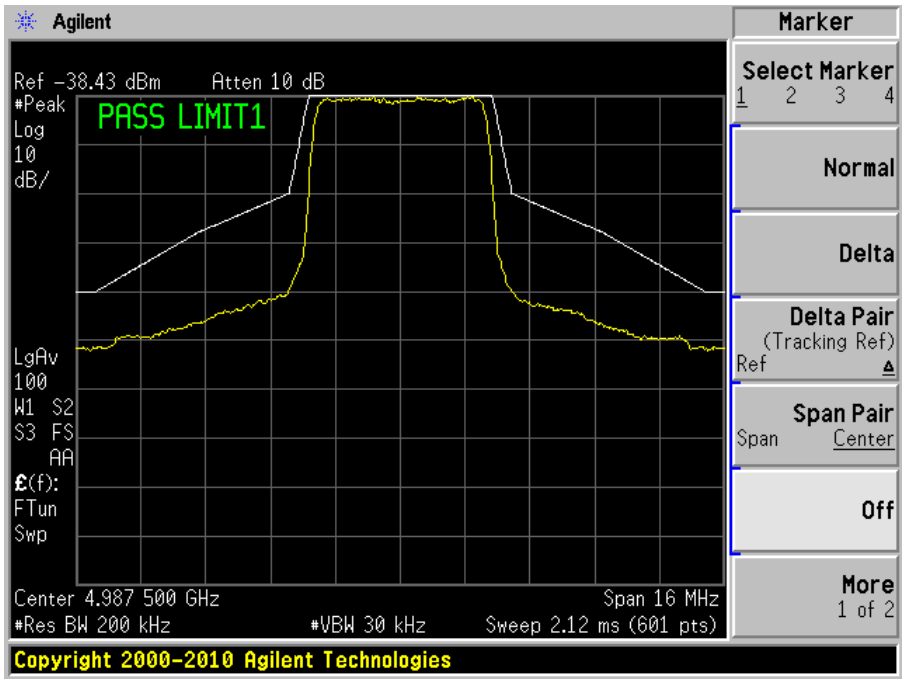



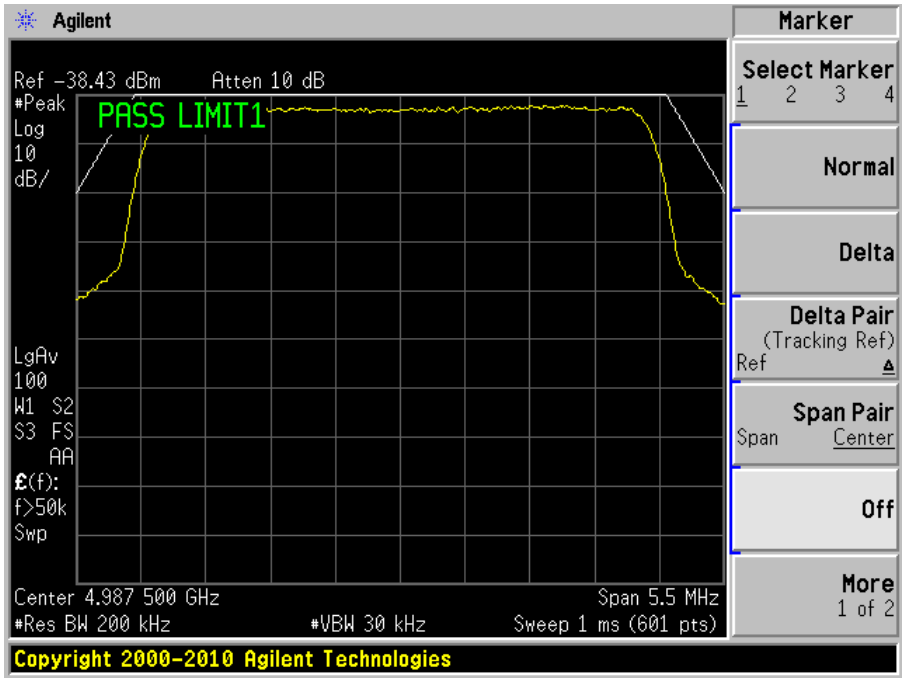
Low Channel 4942.5 MHz, Chain 1



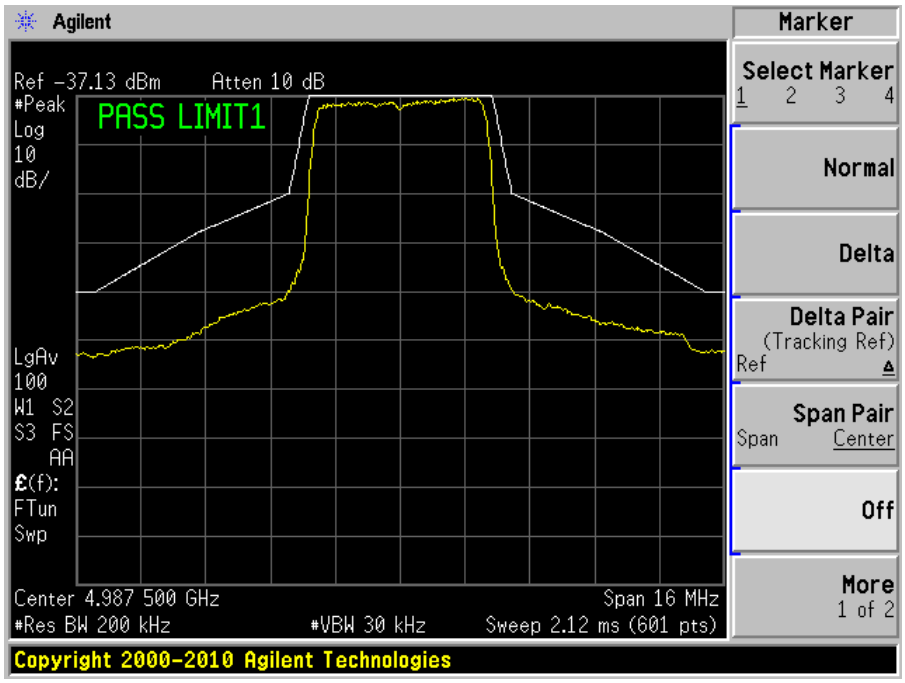



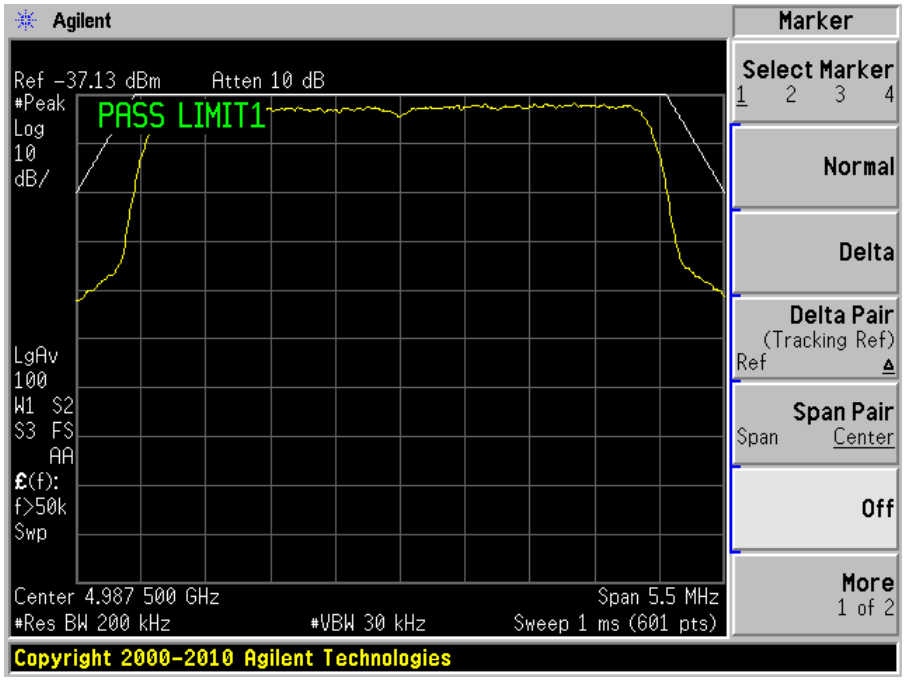
High Channel 4987.5 MHz, Chain 0



High Channel 4987.5 MHz, Chain 1

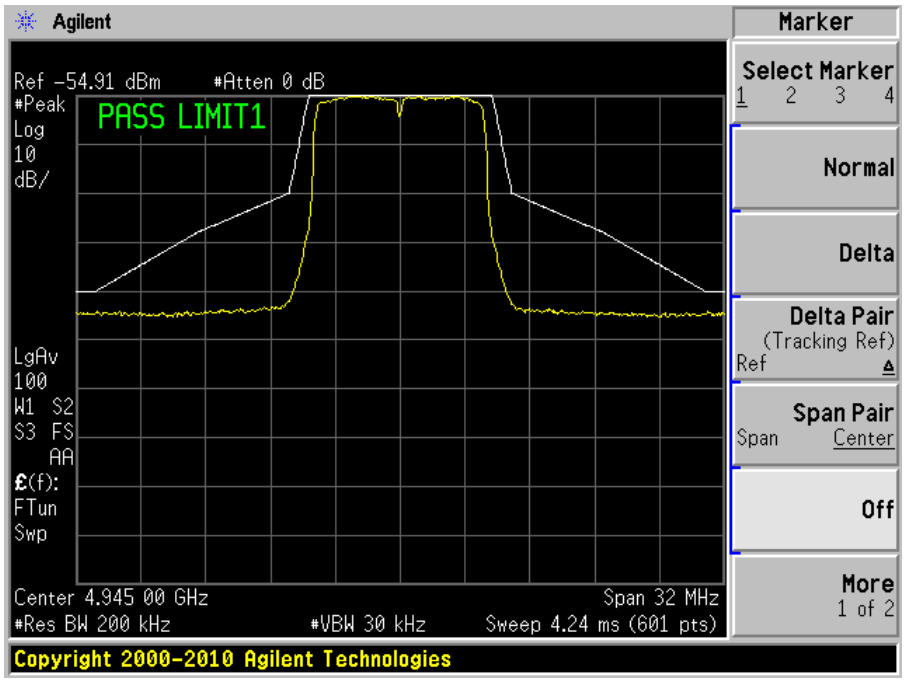


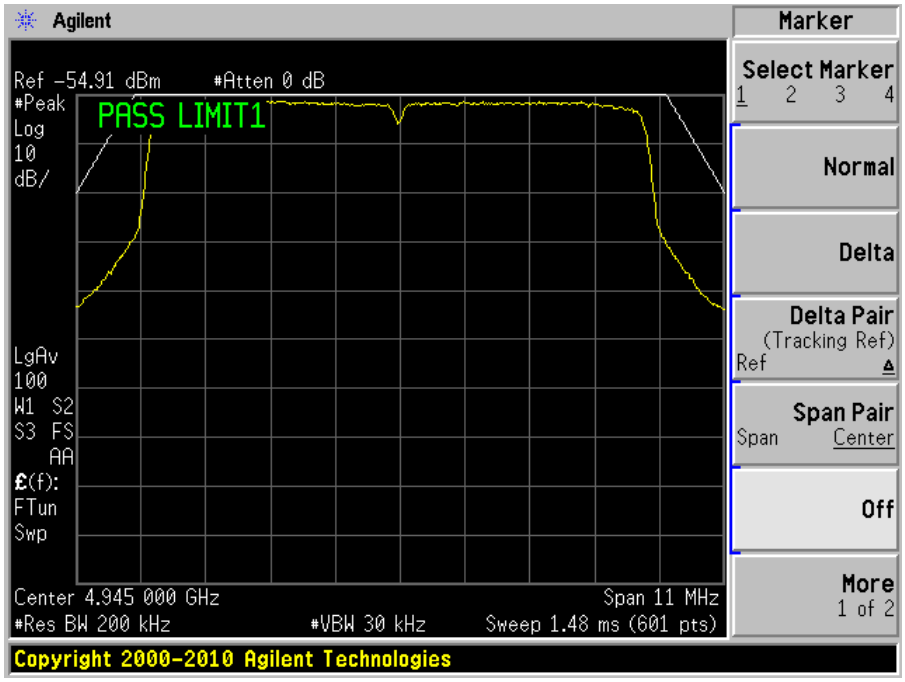



**10 MHz Mode**

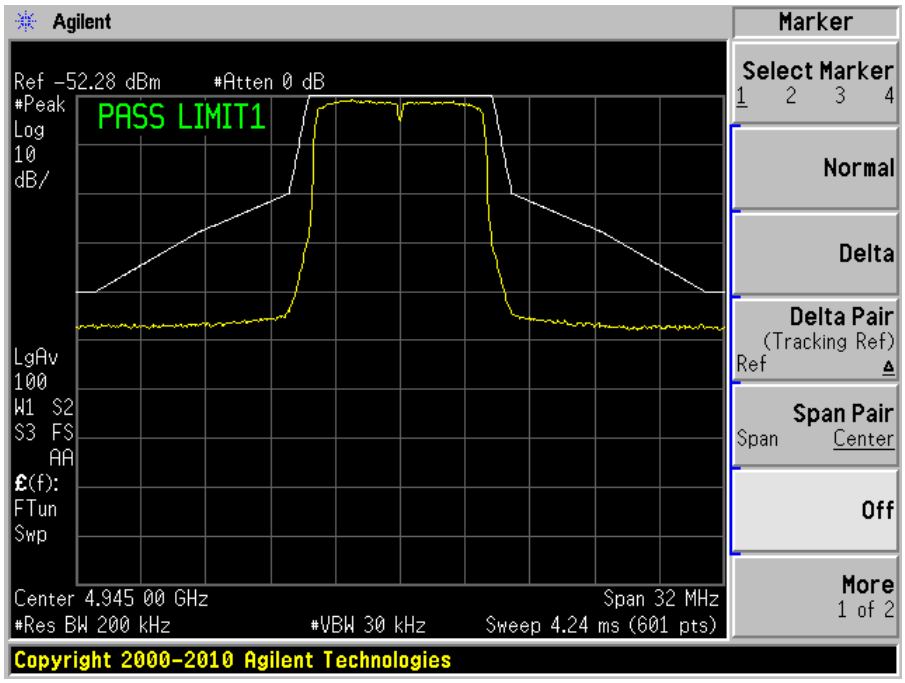
Low Power Setting, High Gain Antenna (28 dBi)

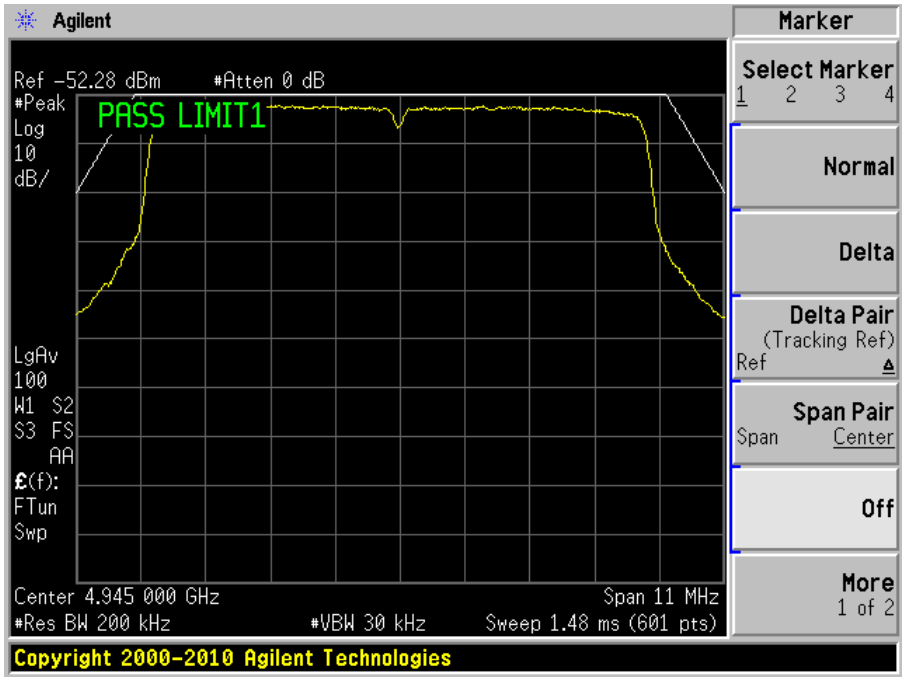
Low Channel 4945 MHz, Chain 0



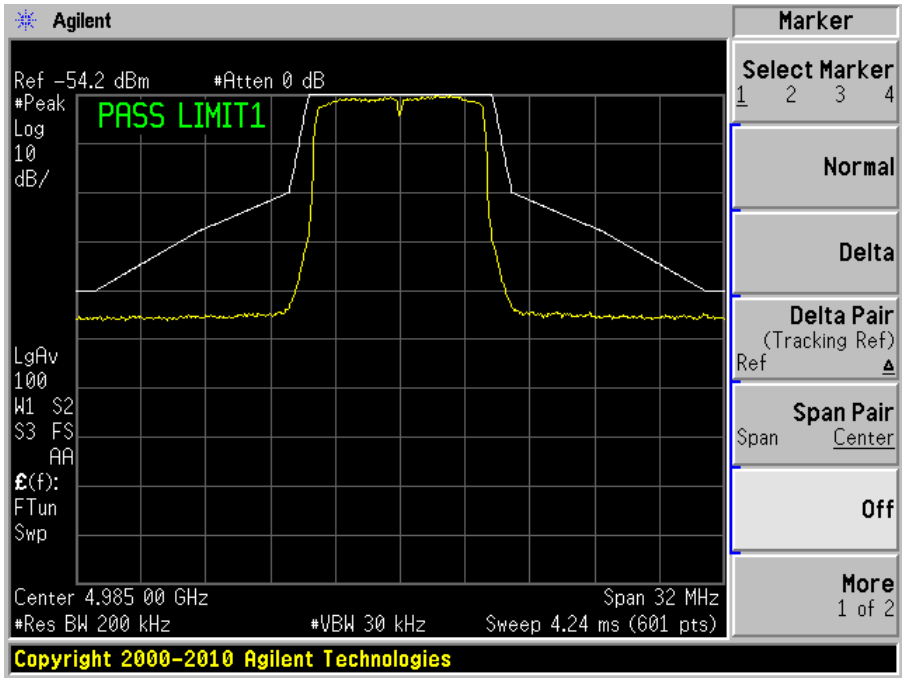



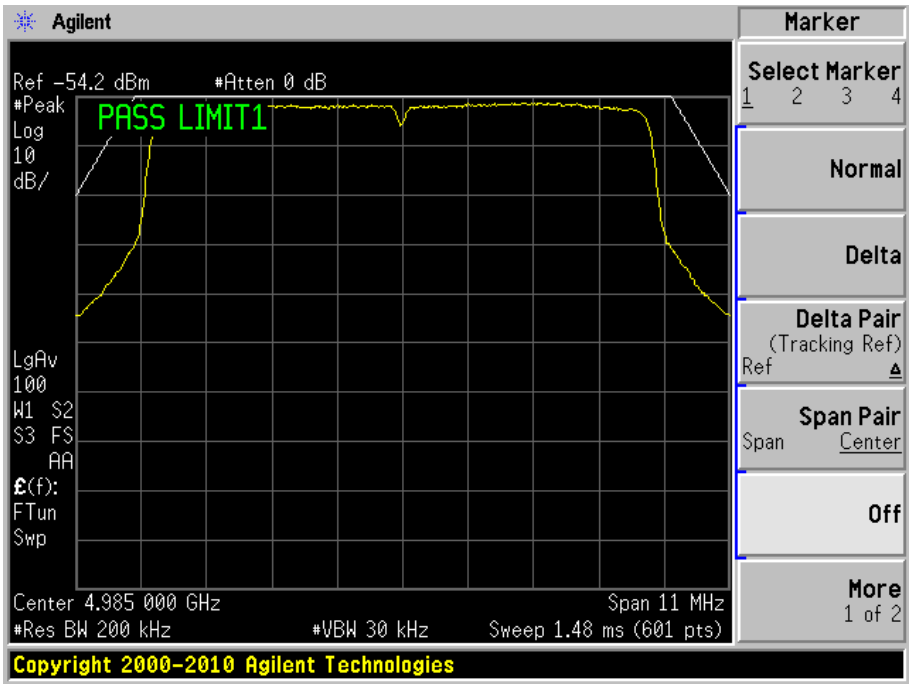
Low Channel 4945 MHz, Chain 1



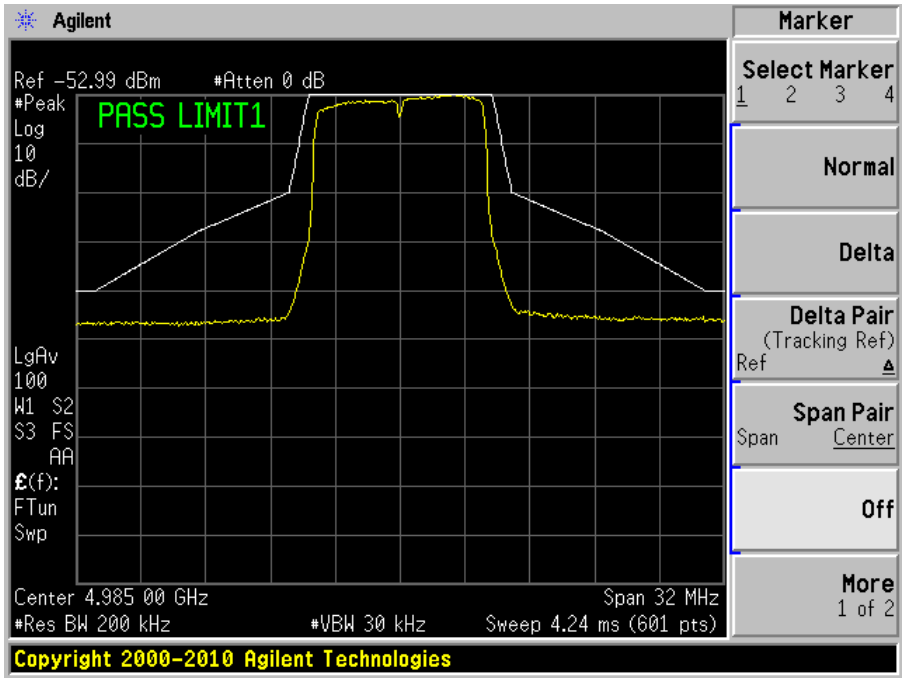



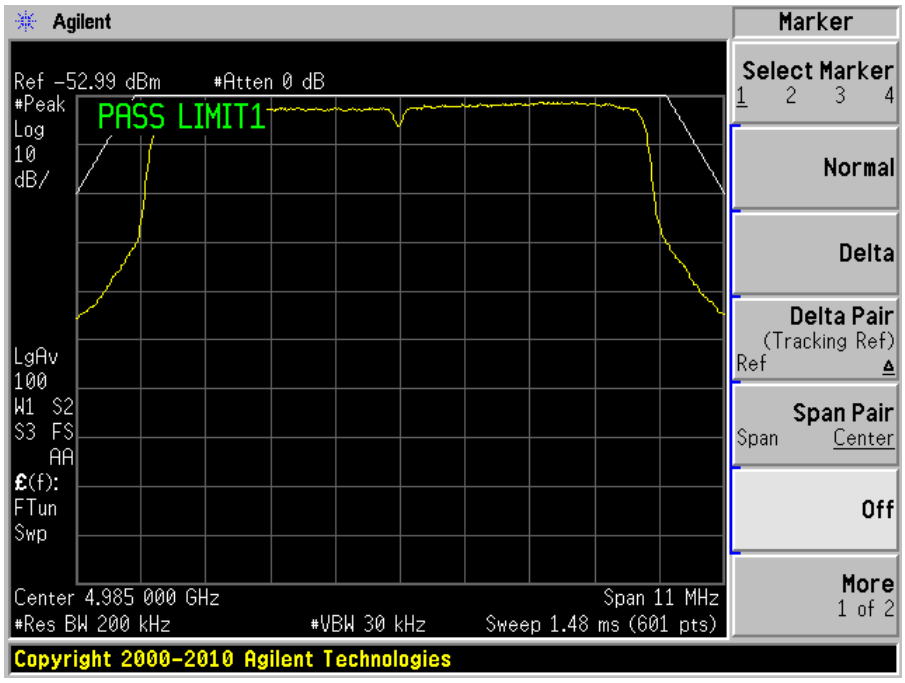
High Channel 4985 MHz, Chain 0



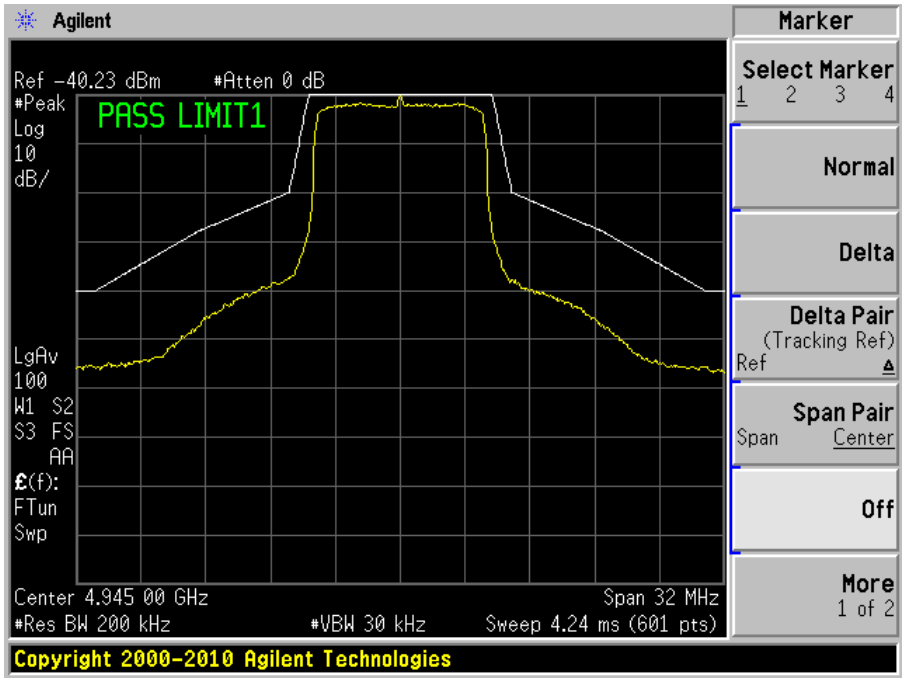
High Channel 4985 MHz, Chain 1

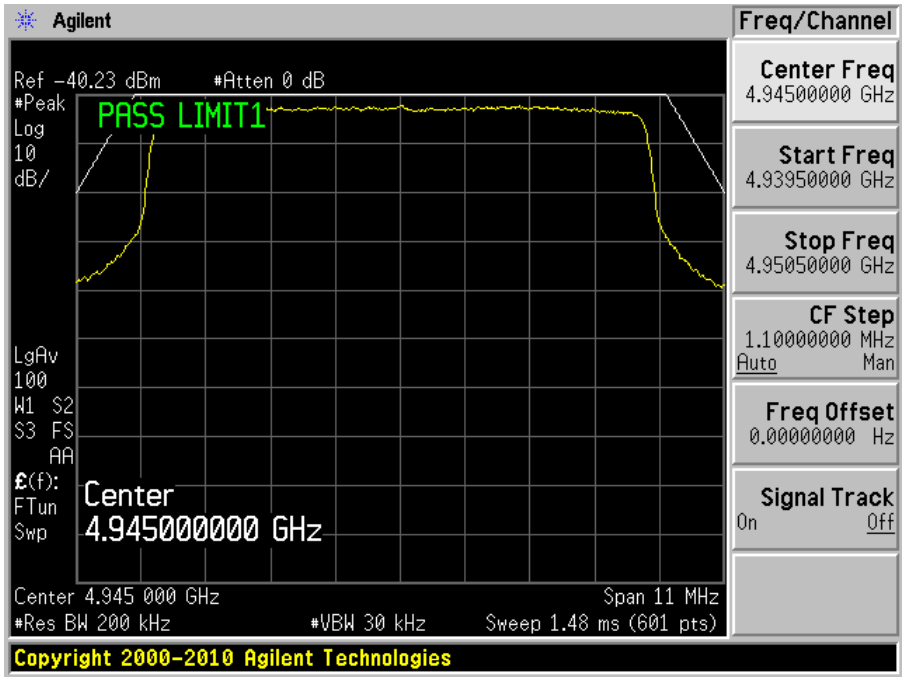


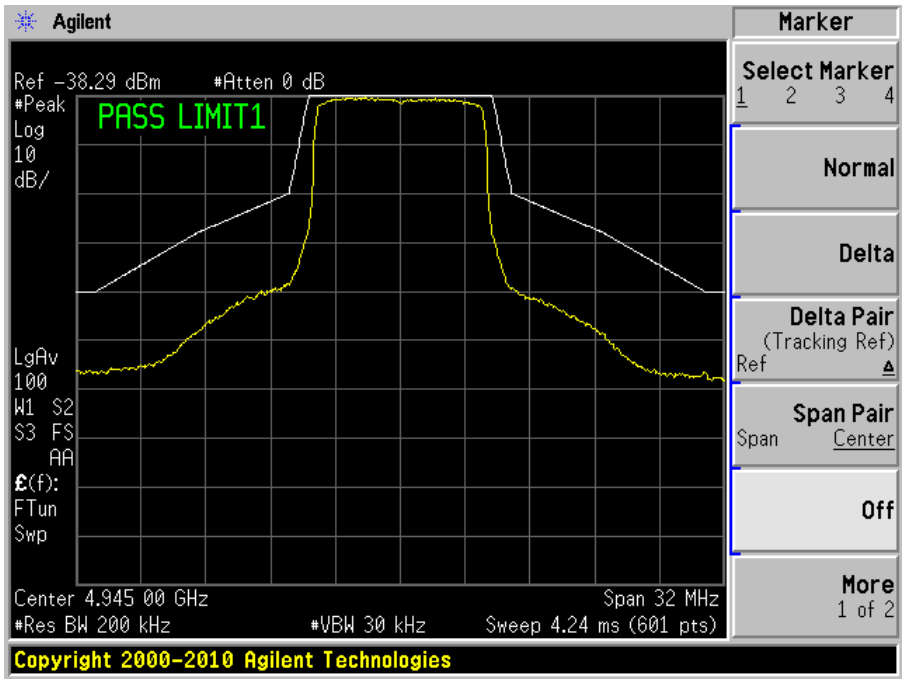
High Power Setting, Low Gain Antenna (9 dBi)

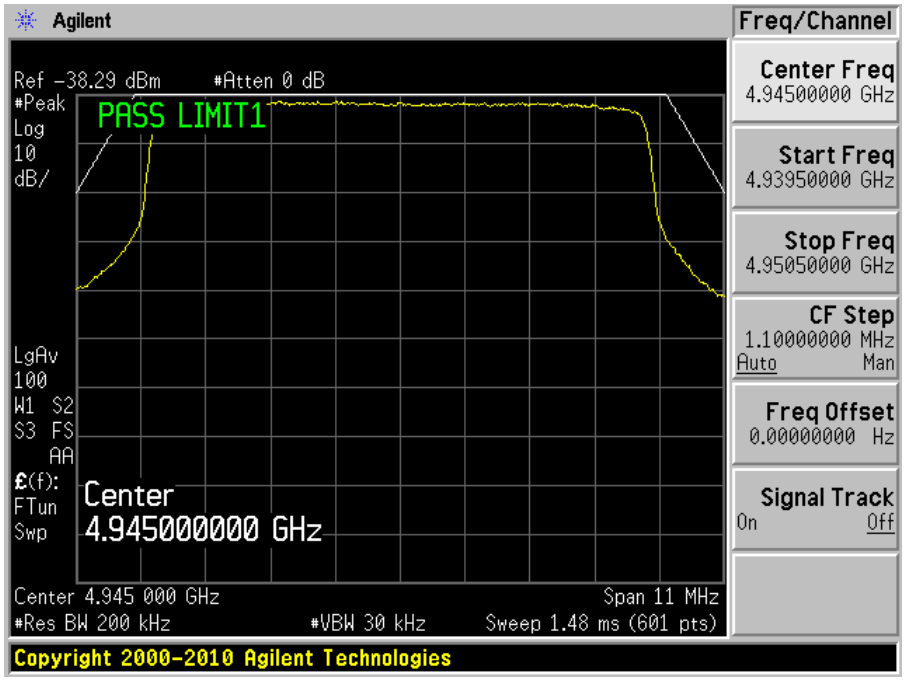
Low Channel 4945 MHz, Chain 0



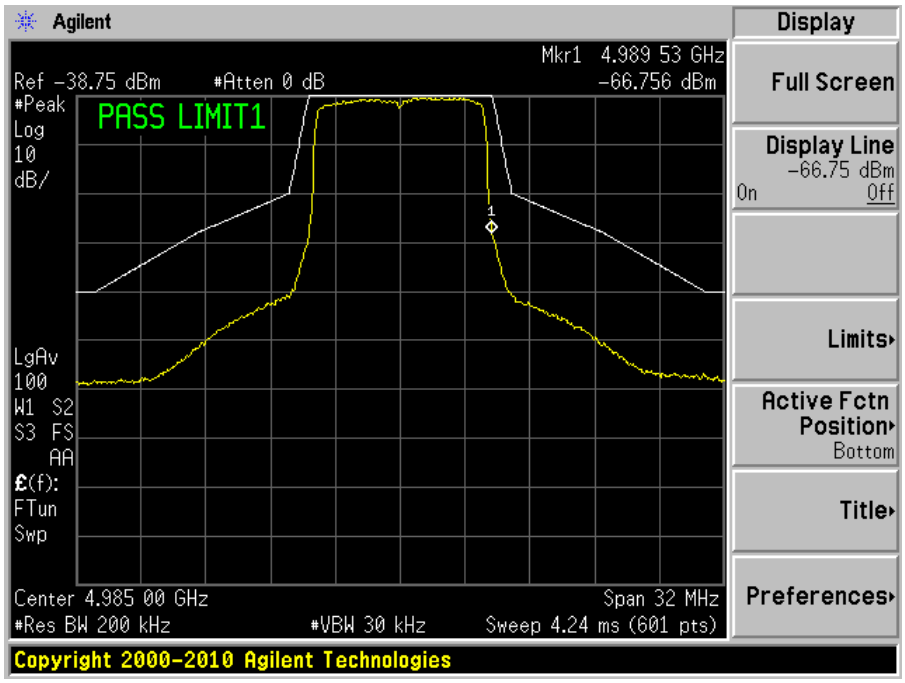



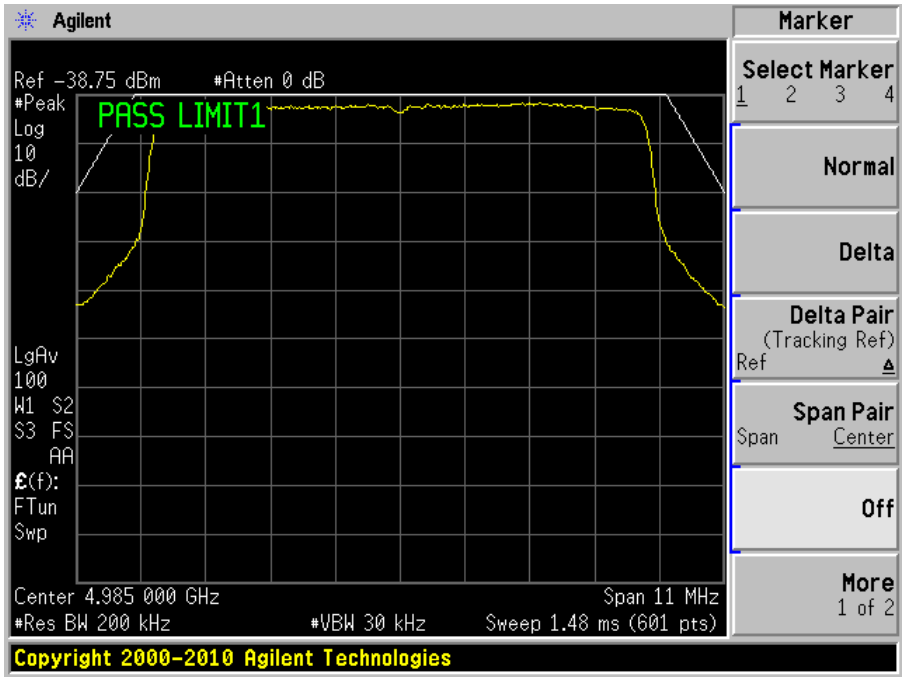
Low Channel 4945 MHz, Chain 1



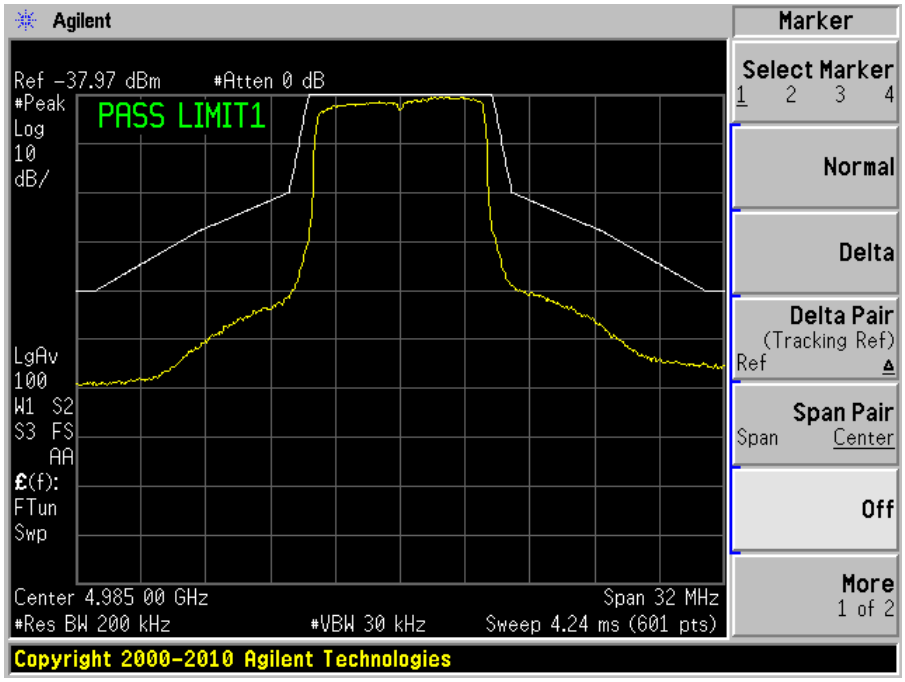



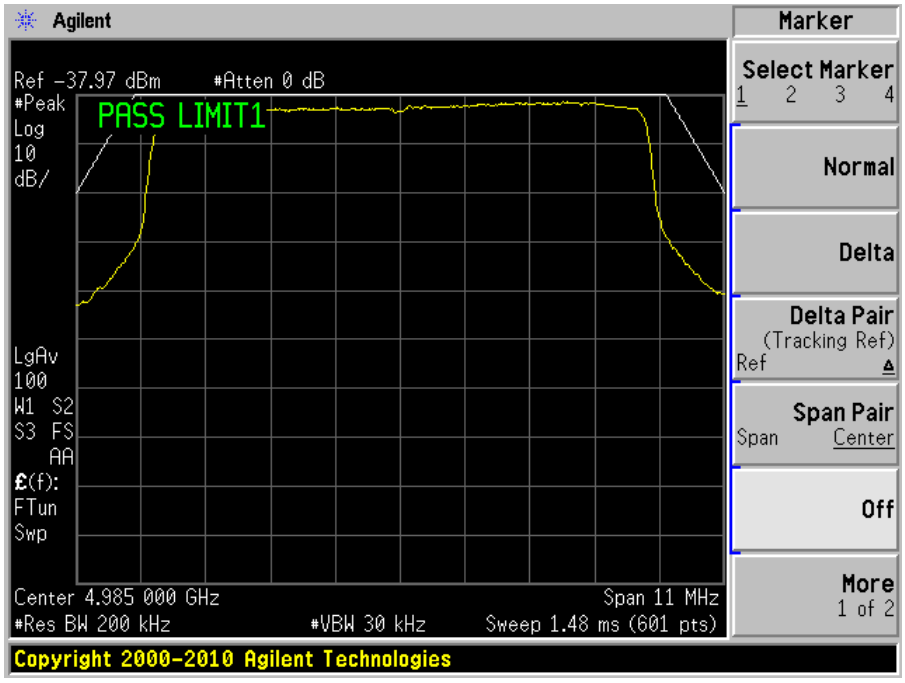
High Channel 4985MHz, Chain 0



High Channel 4985 MHz, Chain 1

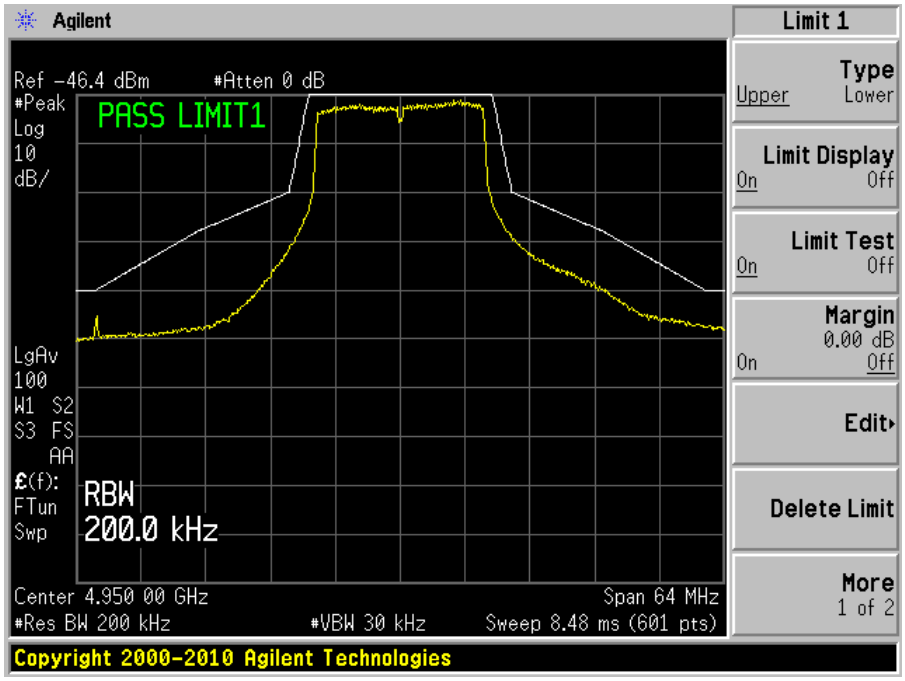


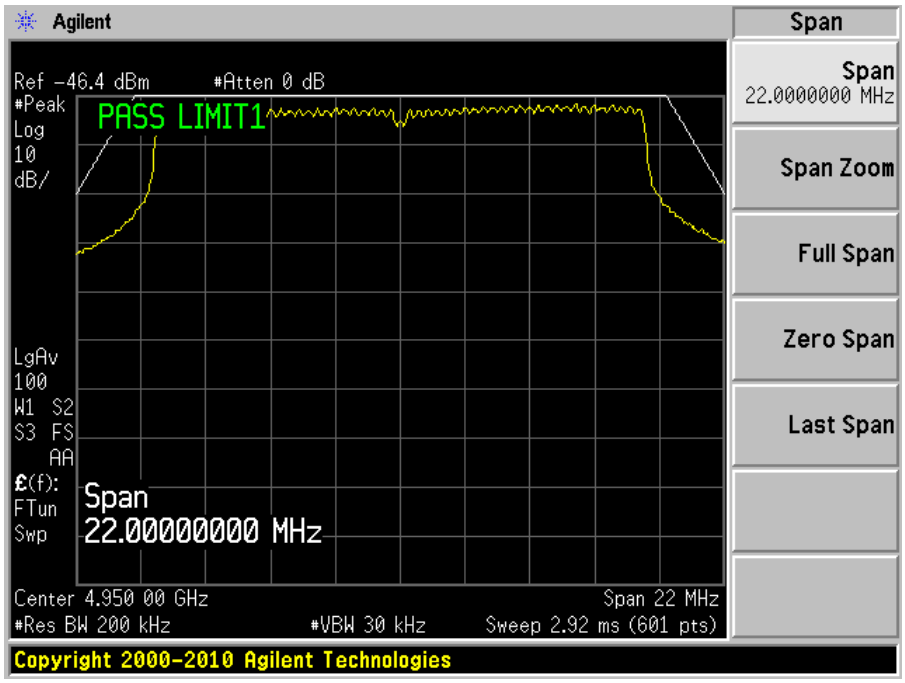



**802.11a Mode**

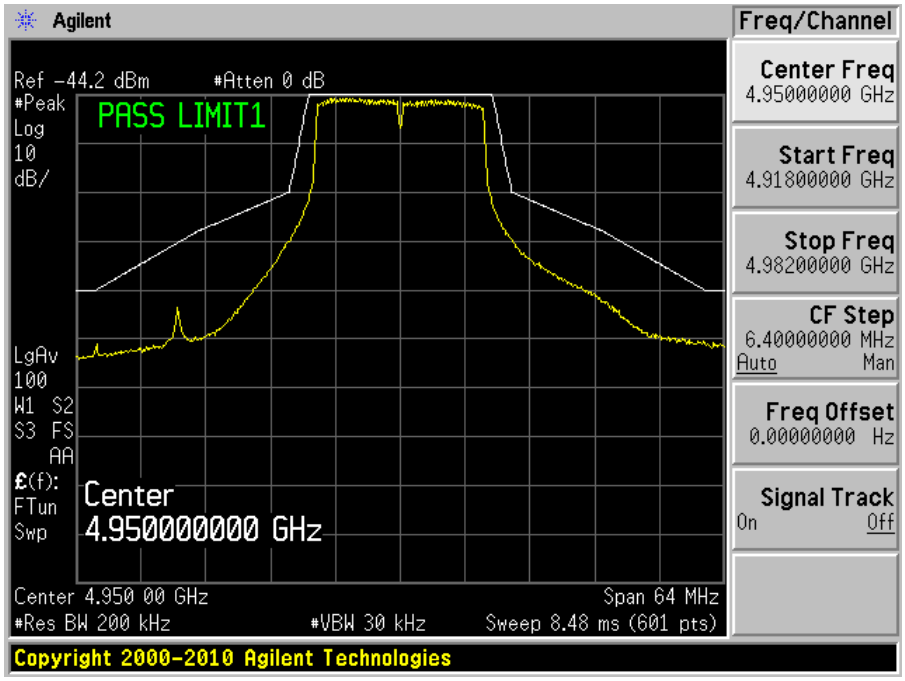
Low Power Setting, High Gain Antenna (28 dBi)

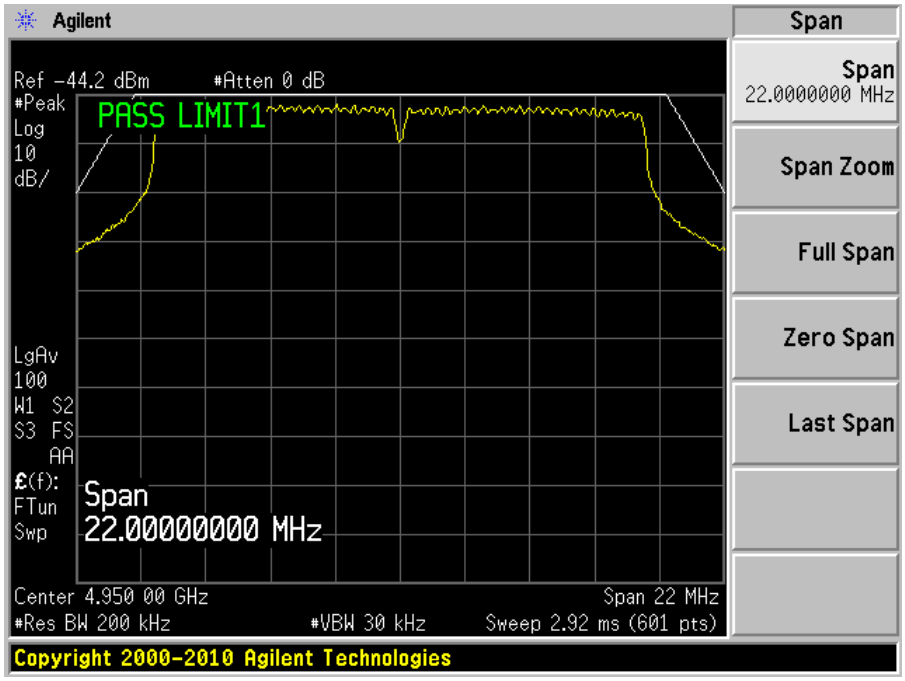
Low Channel 4950 MHz, Chain 0



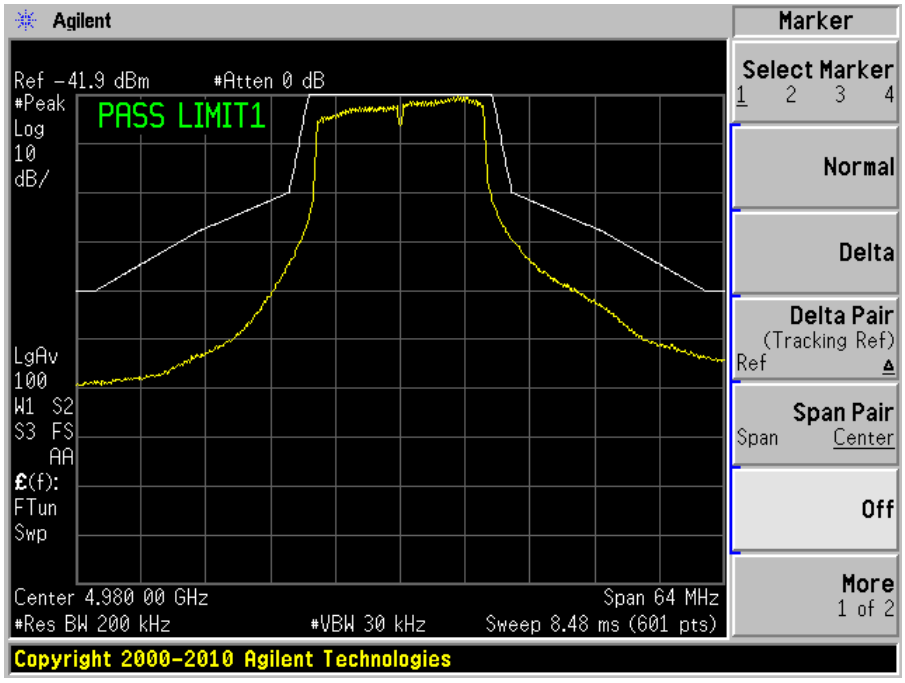



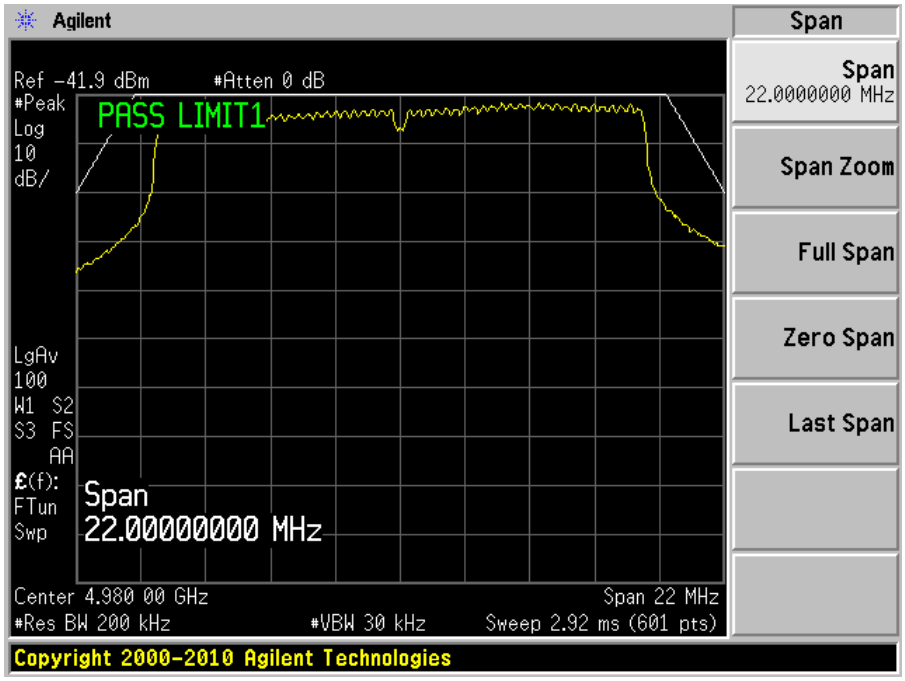
Low Channel 4950 MHz, Chain 1



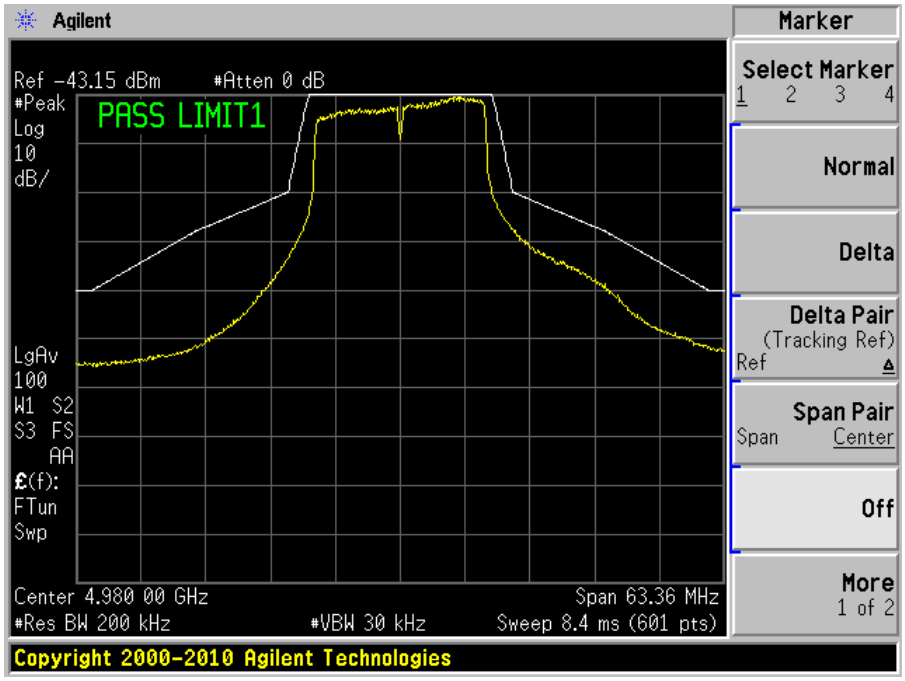



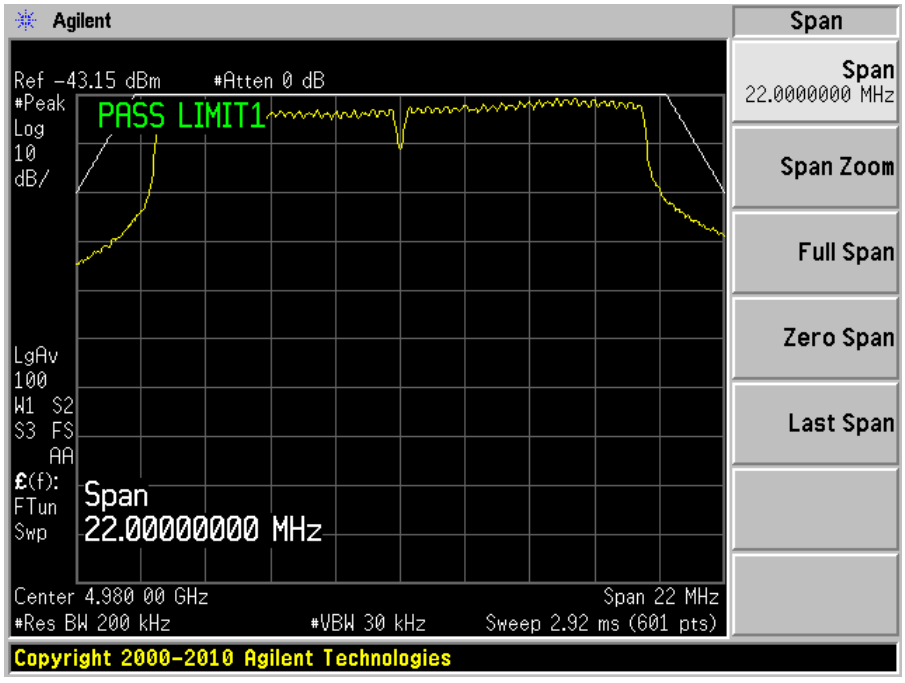
High Channel 4980 MHz, Chain 0



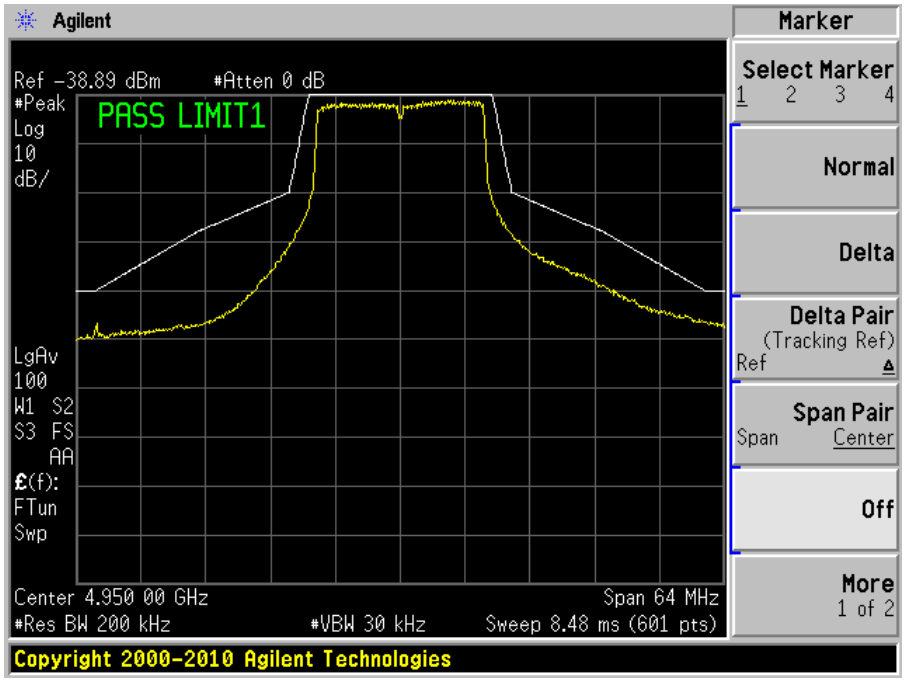
High Channel 4980 MHz, Chain 1

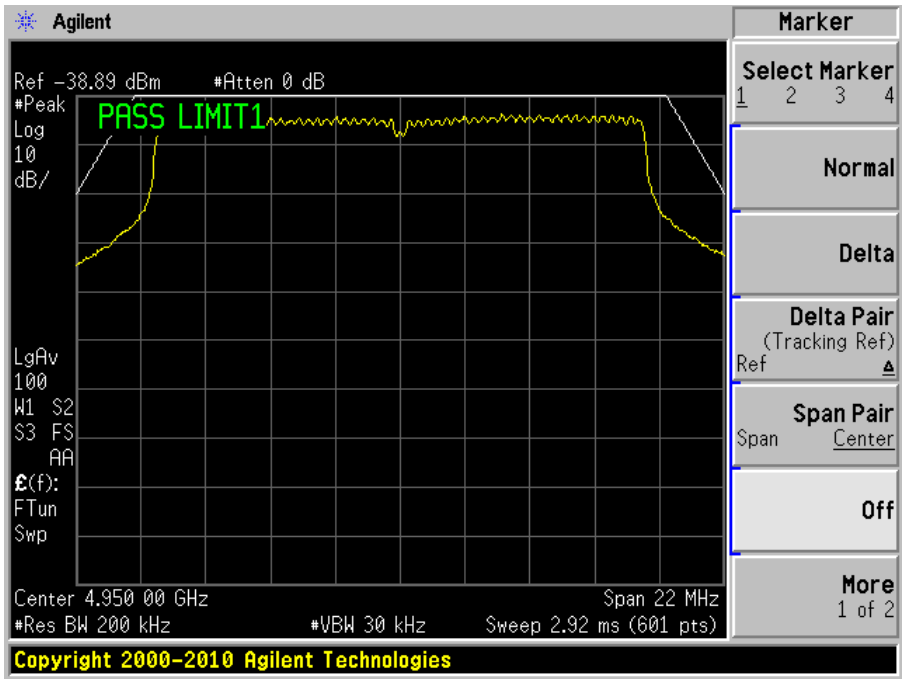


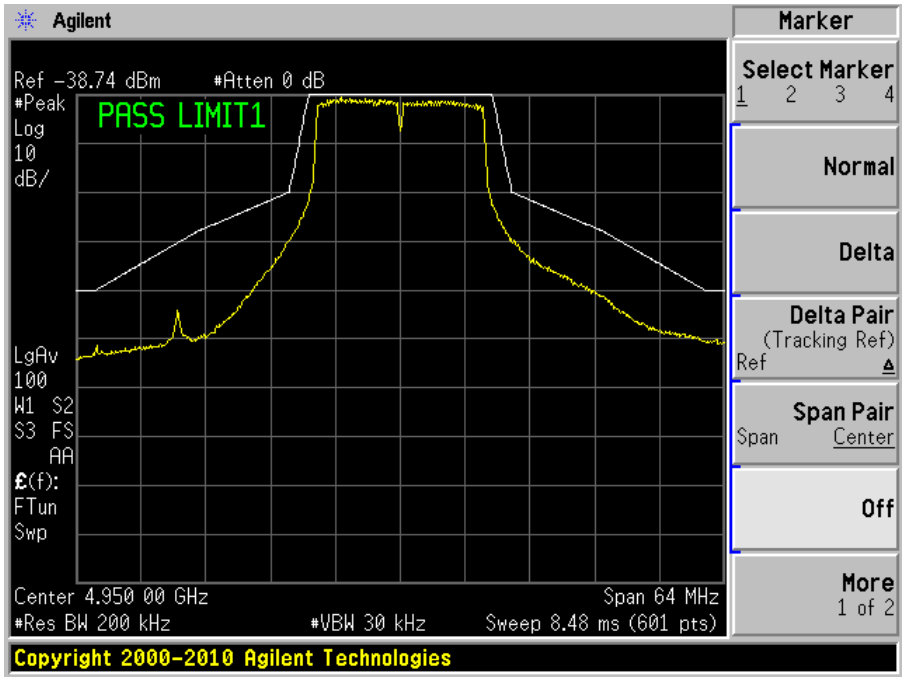
High Power Setting, Low Gain Antenna (9 dBi)

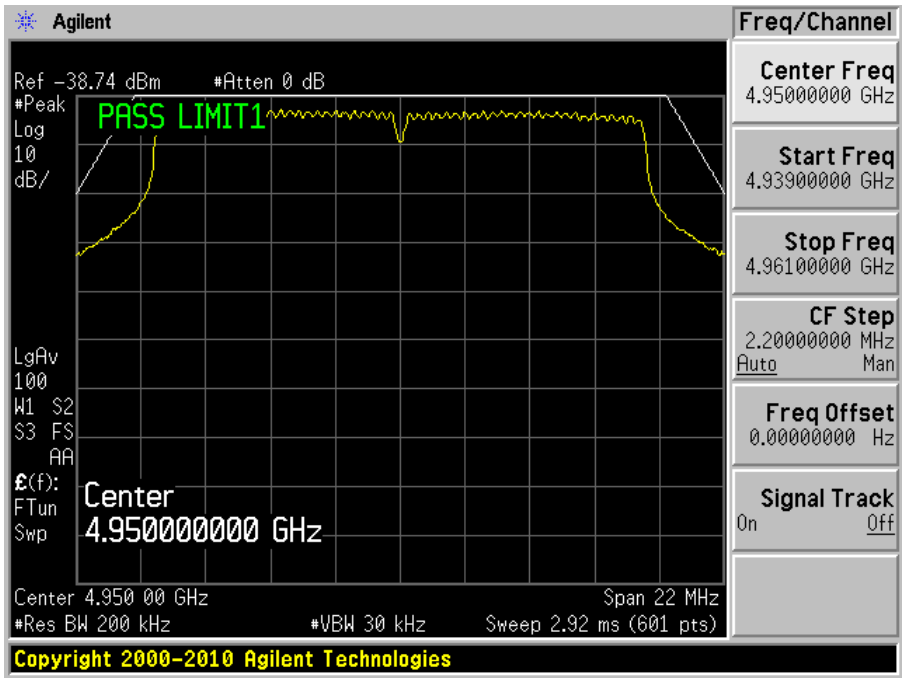
Low Channel 4950 MHz, Chain 0



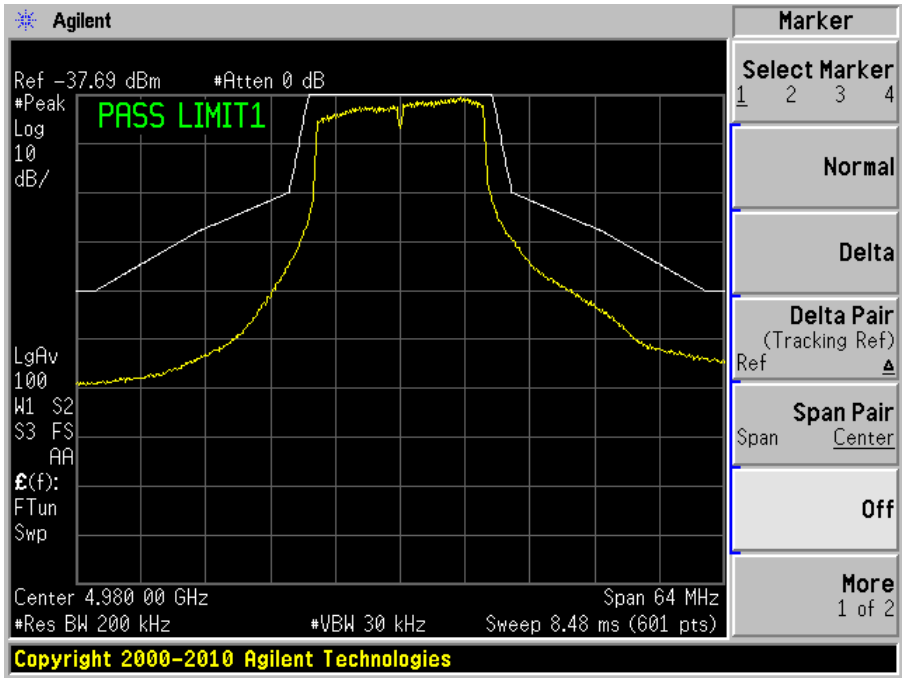



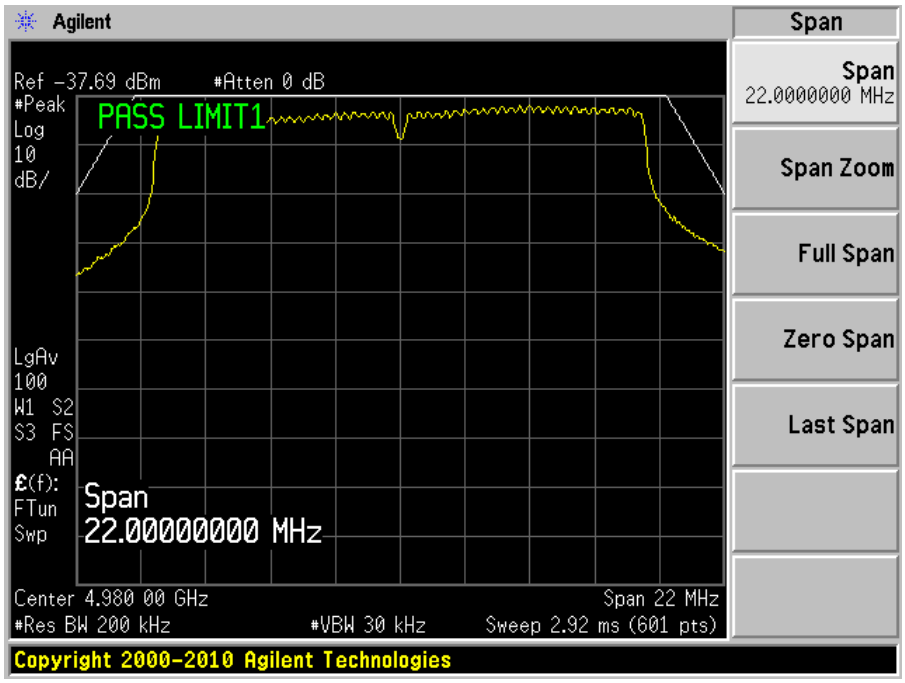
Low Channel 4950 MHz, Chain 0



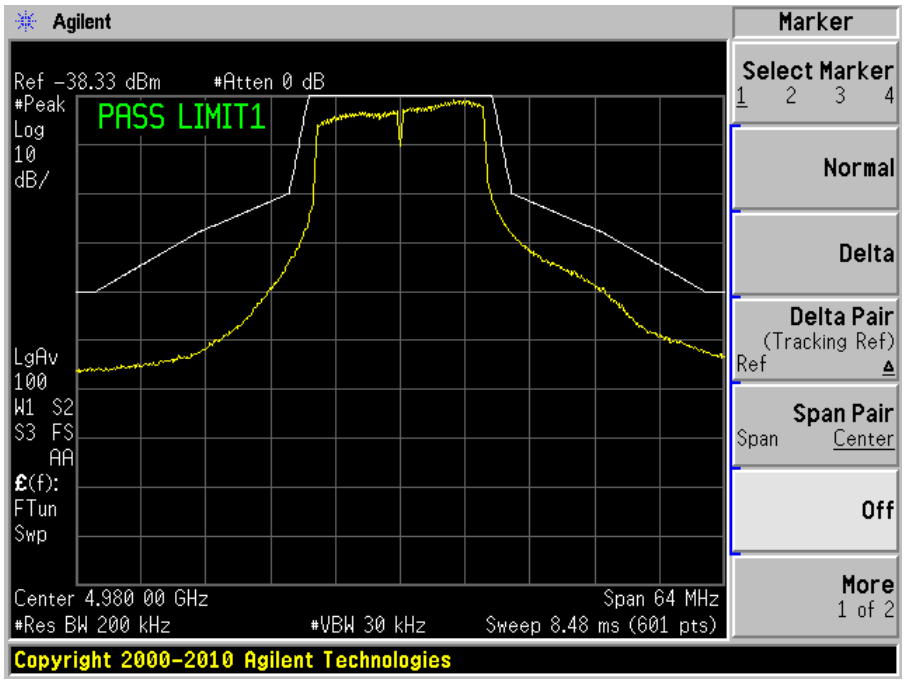



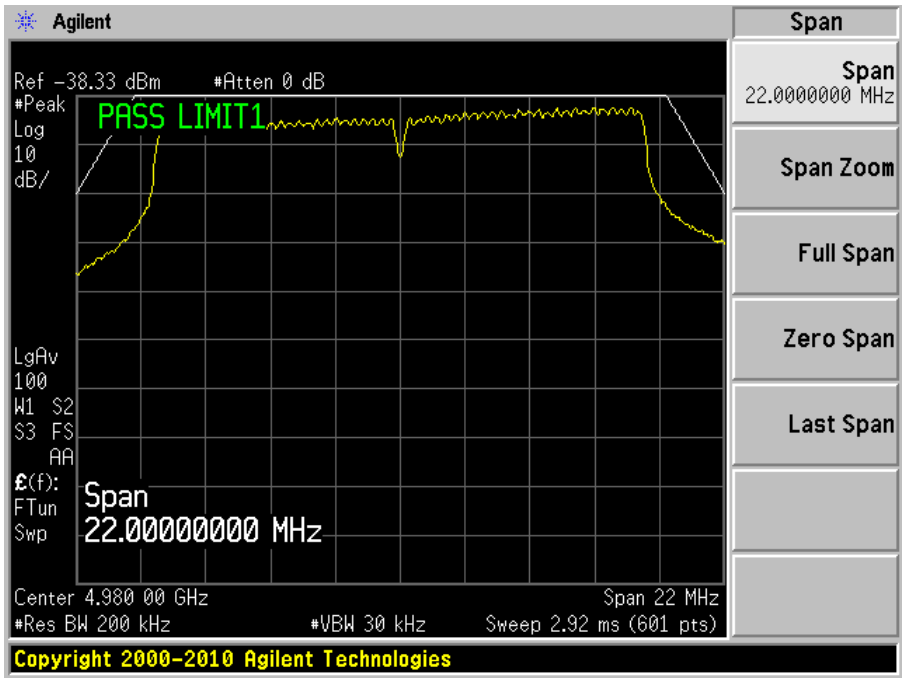
High Channel 4980 MHz, Chain 0



High Channel 4980 MHz, Chain 1

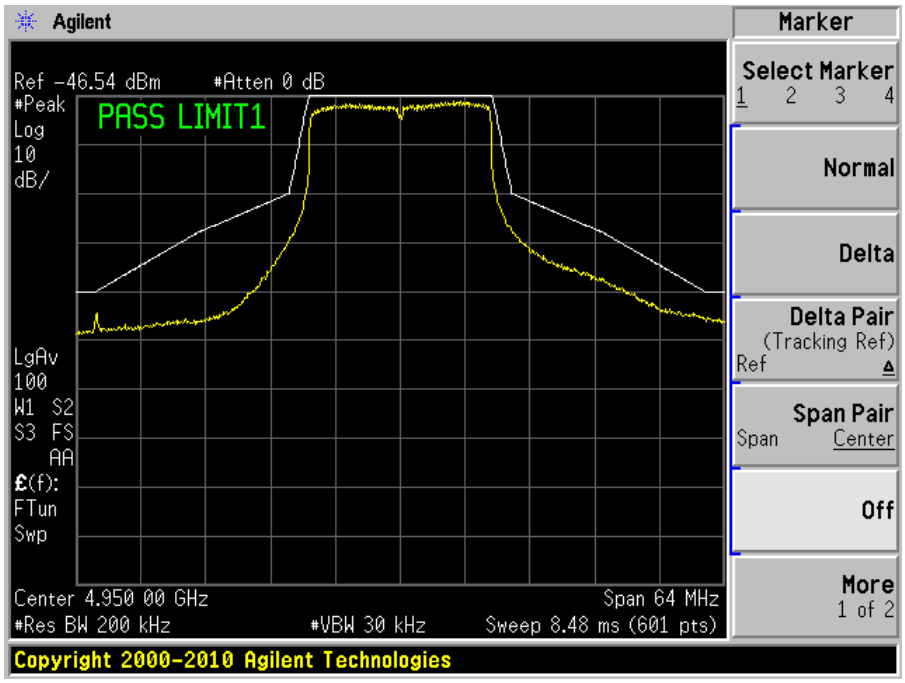


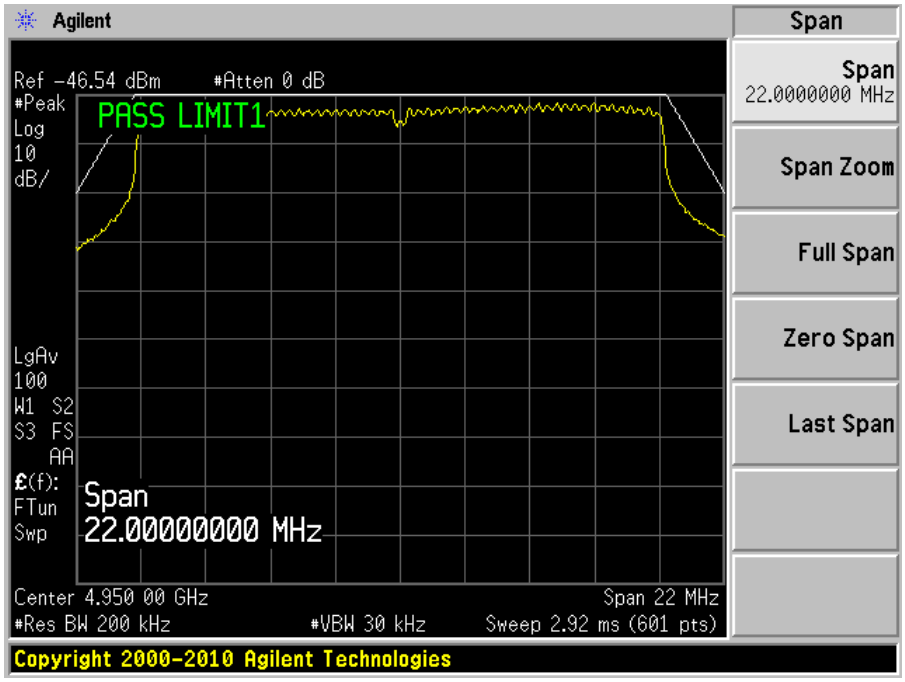



**802.11n HT20 Mode**

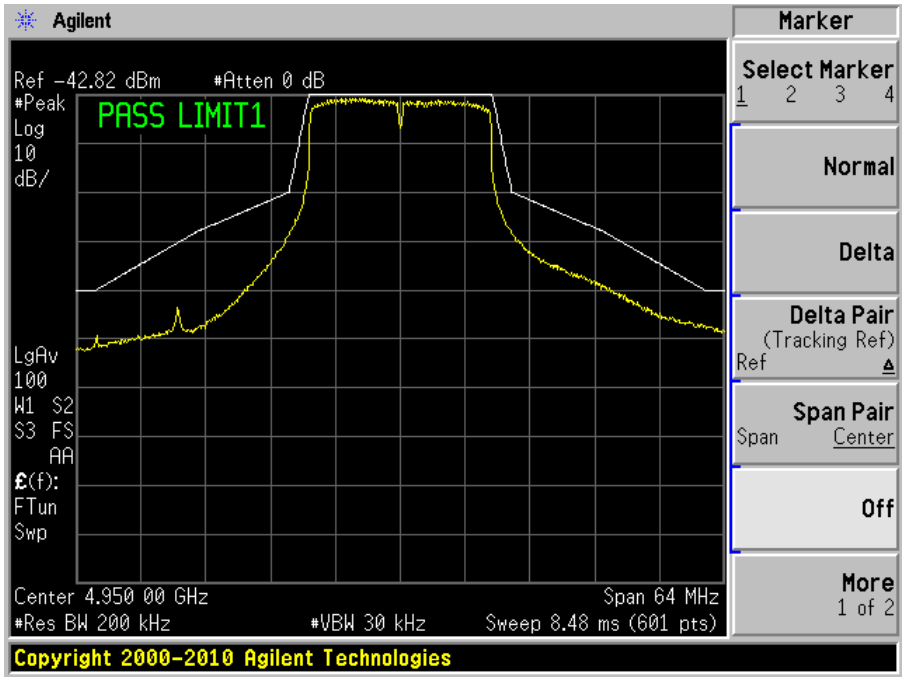
Low Power Setting, High Gain Antenna (28 dBi)

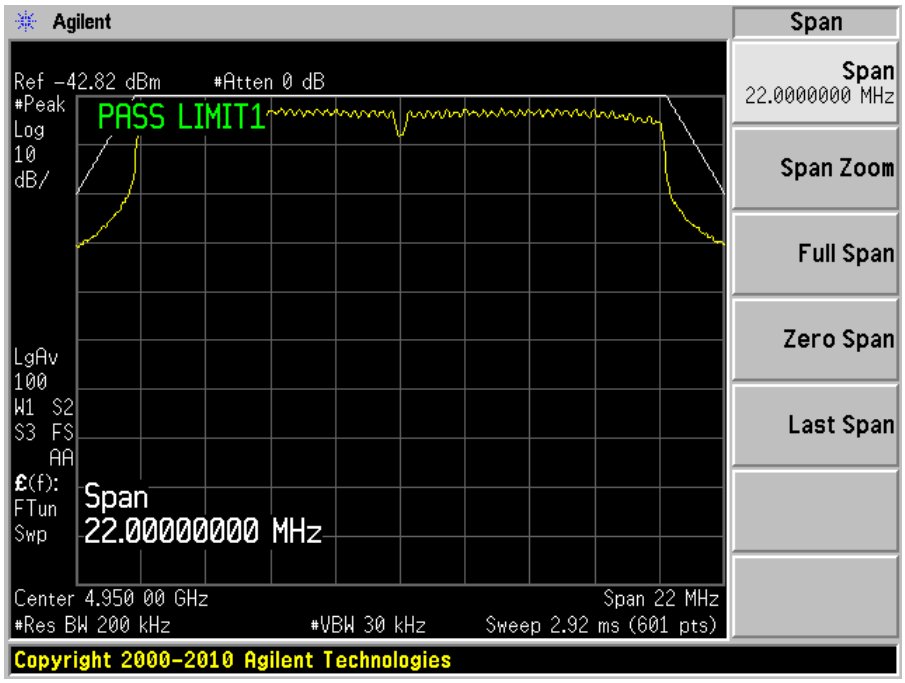
Low Channel 4950 MHz Chain 0



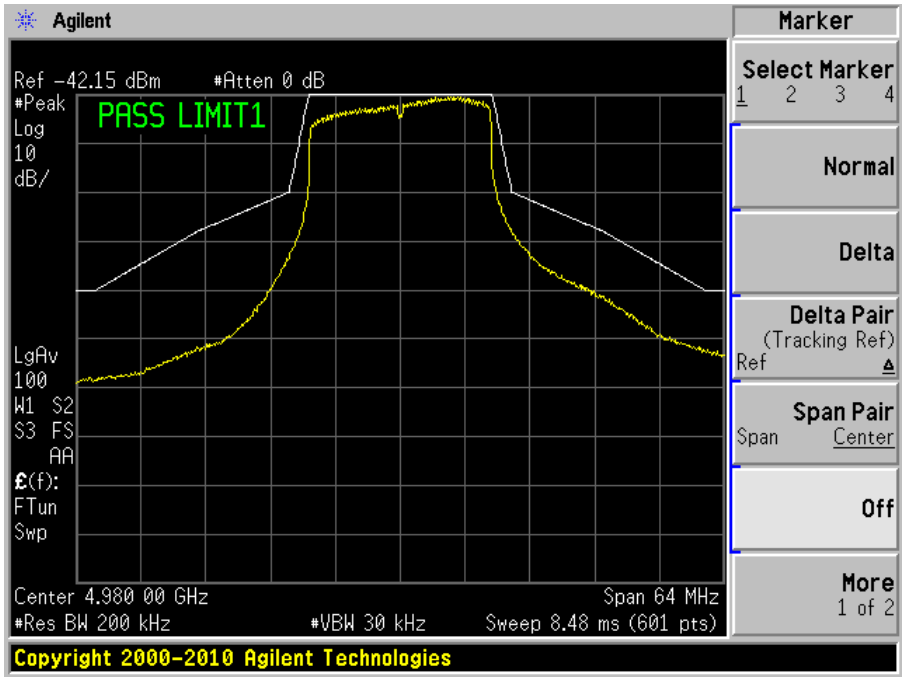



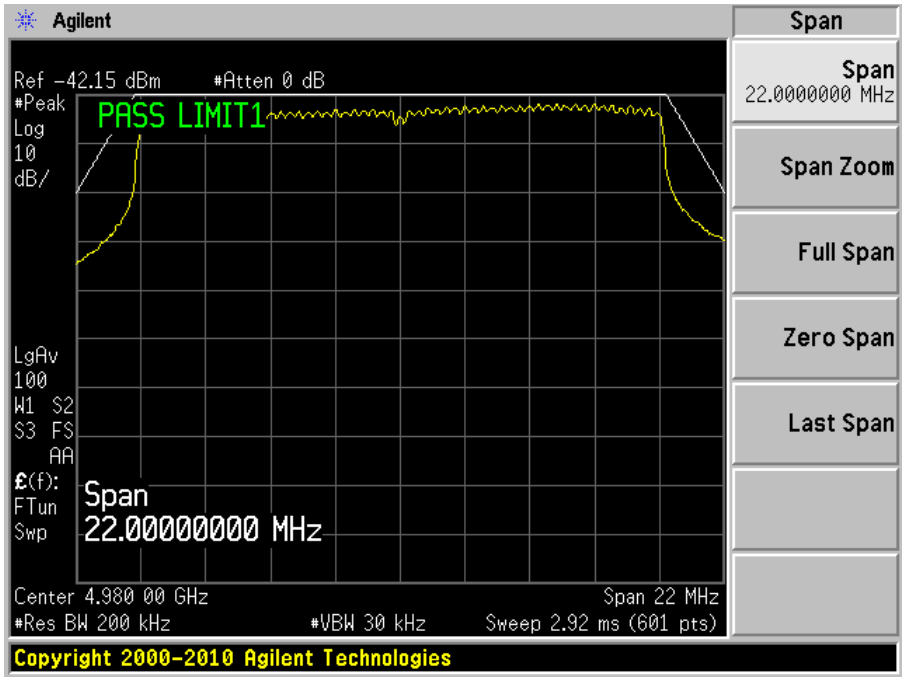
Low Channel 4950 MHz, Chain 1



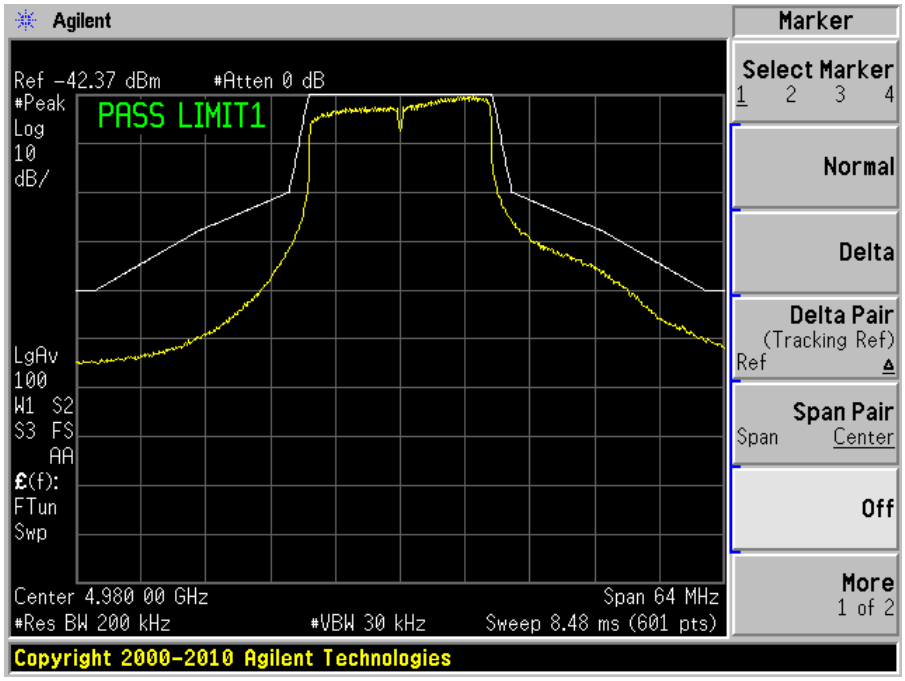



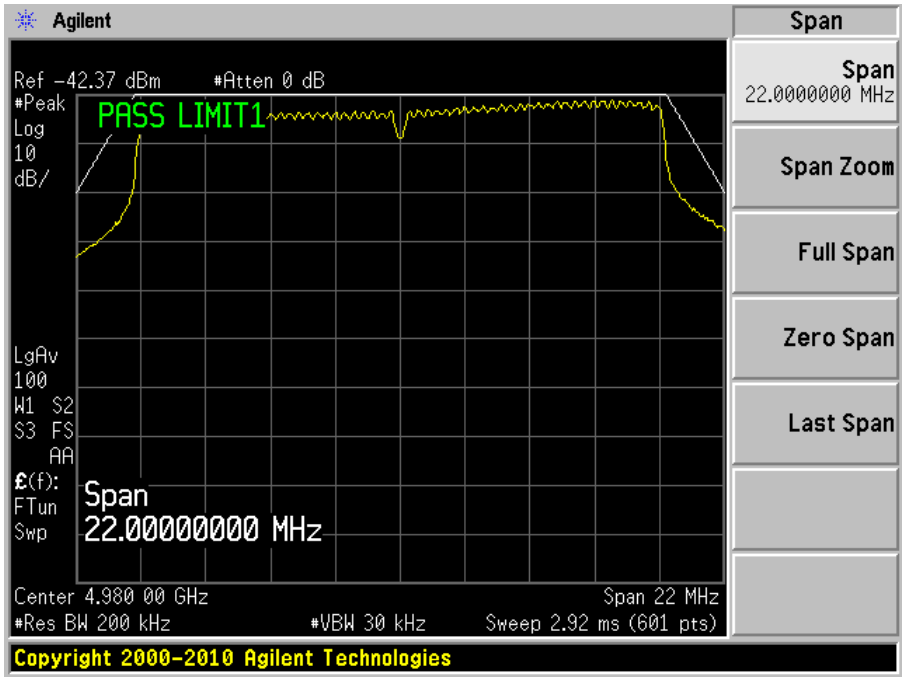
High Channel 4980 MHz, Chain 0



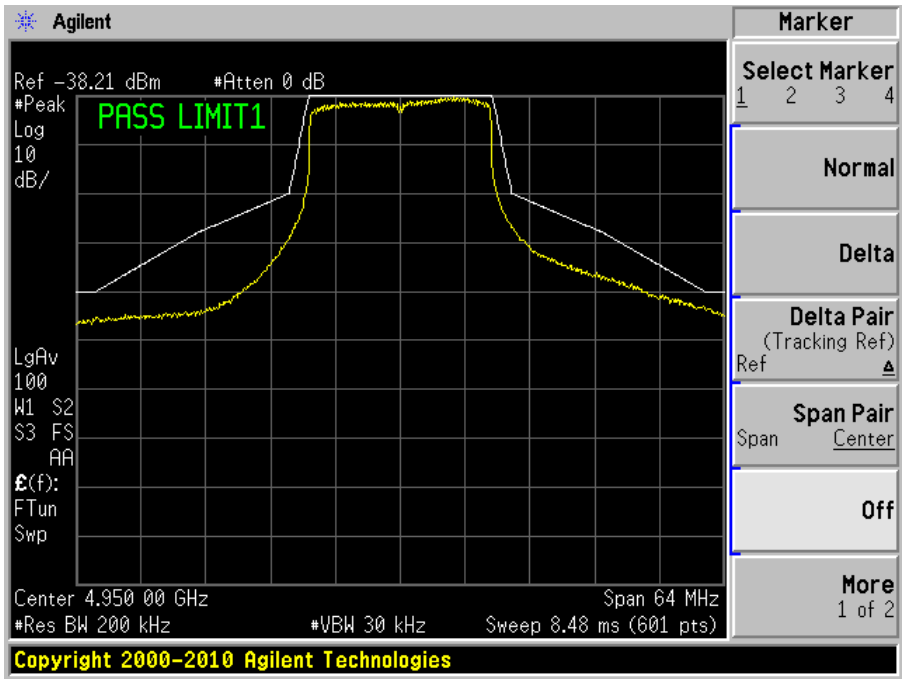
High Channel 4980 MHz, Chain 1

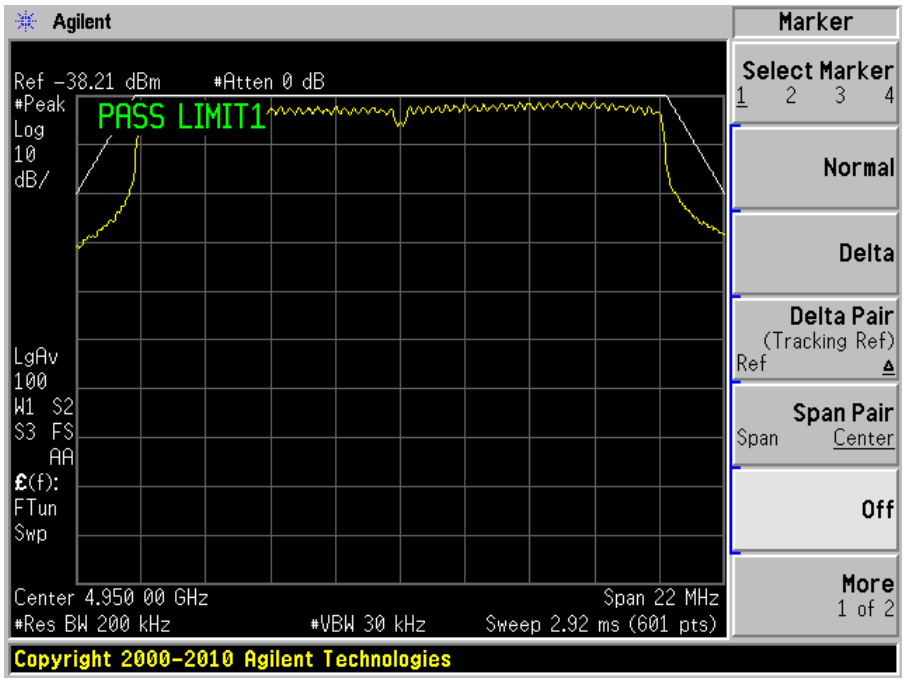


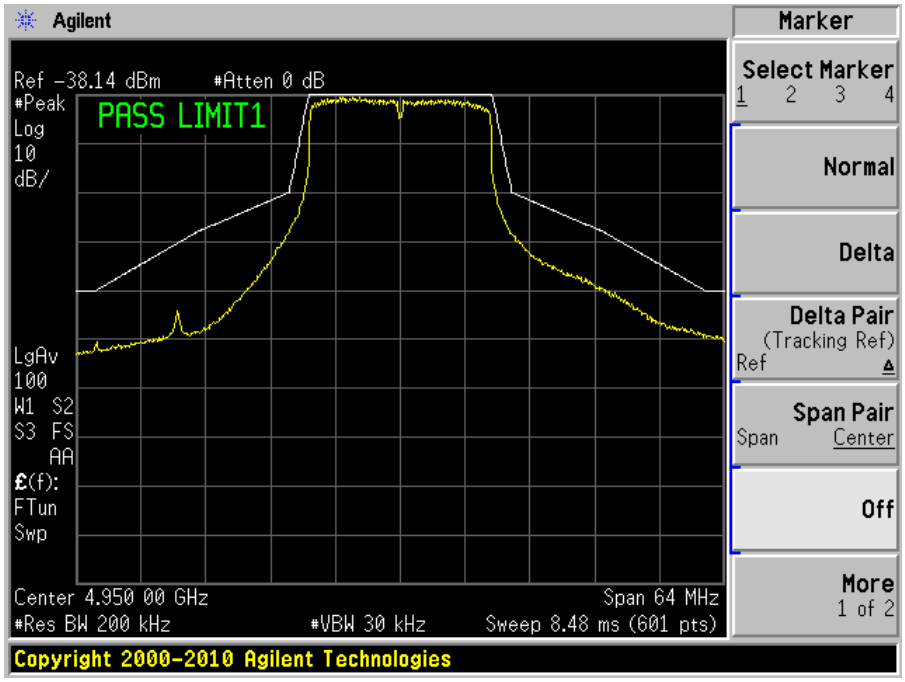
High Power Setting, Low Gain Antenna (9 dBi)

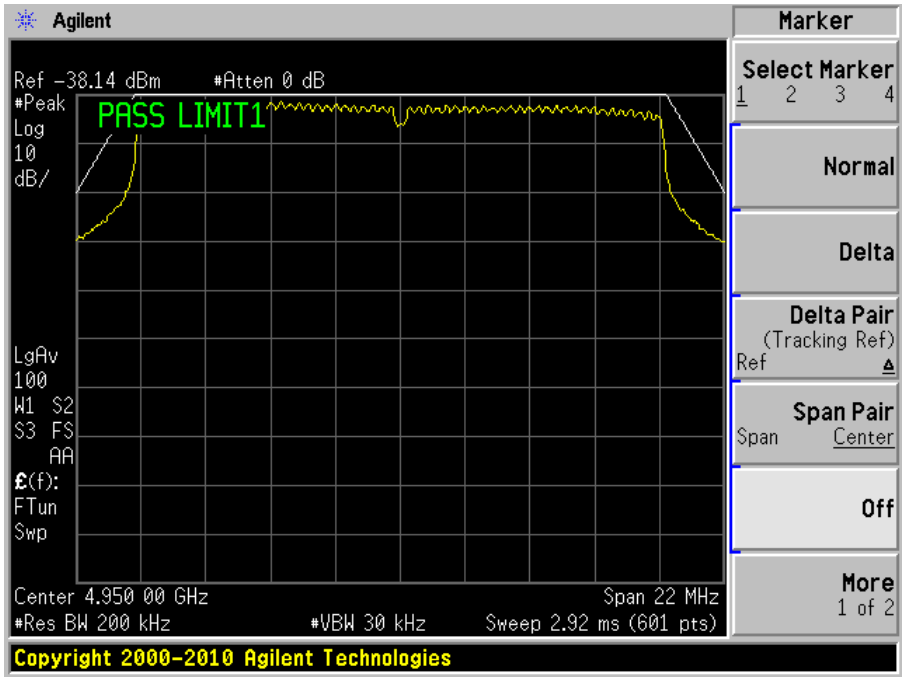
Low Channel 4950 MHz, Chain 0



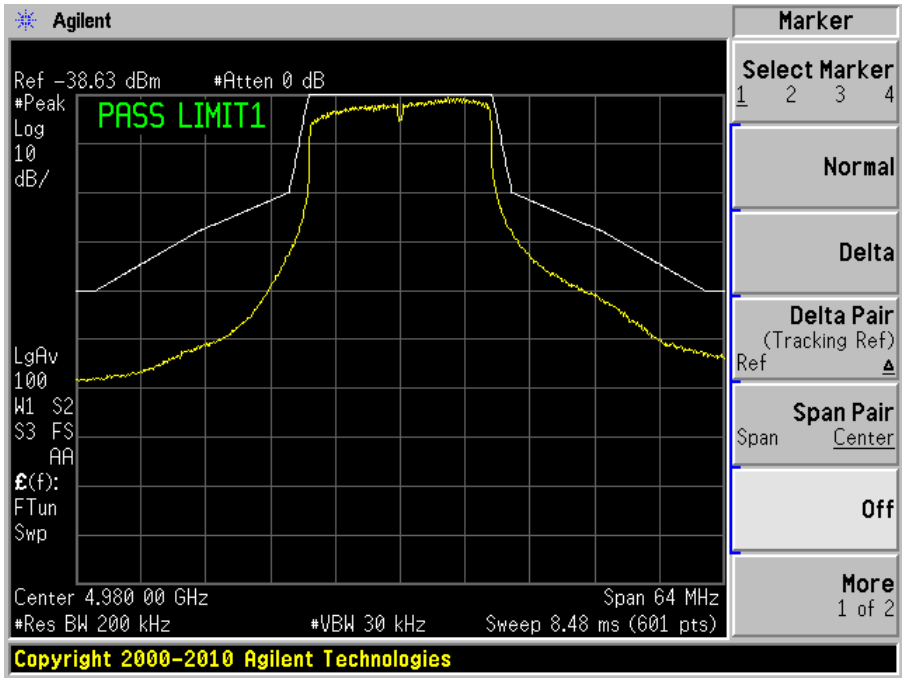



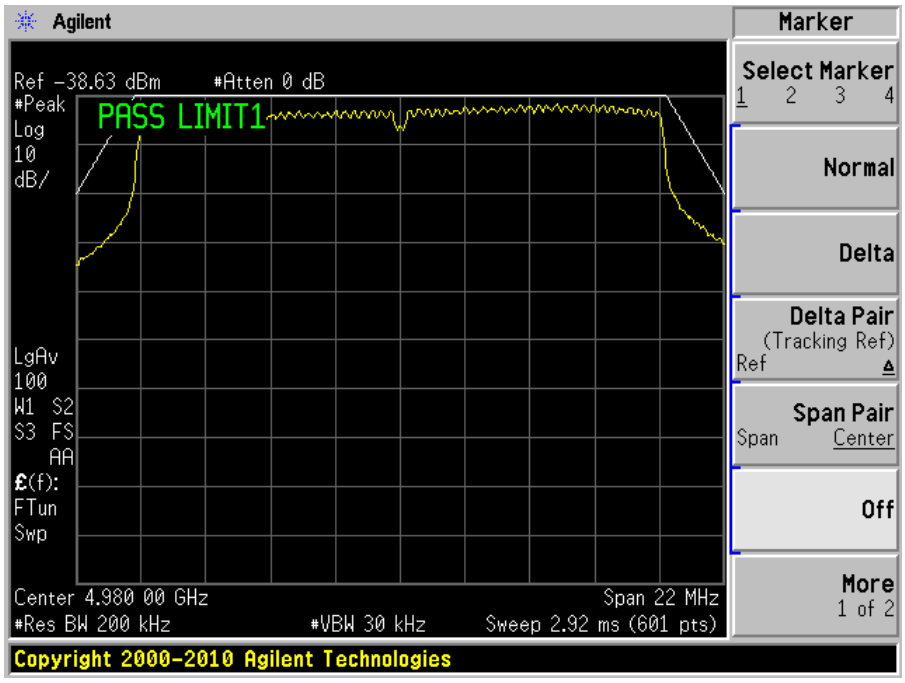
Low Channel 4950 MHz, Chain 1



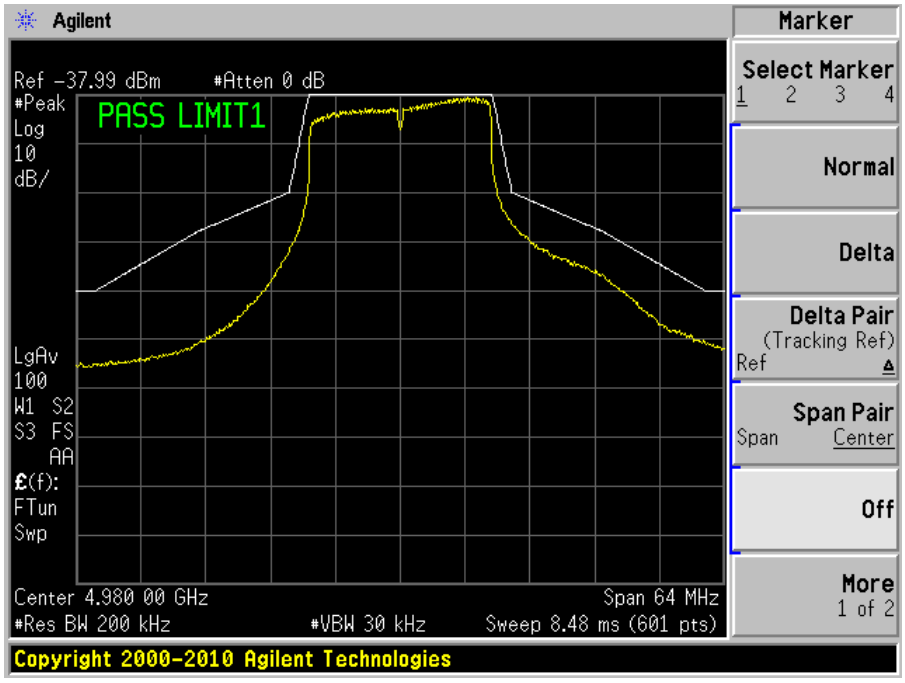



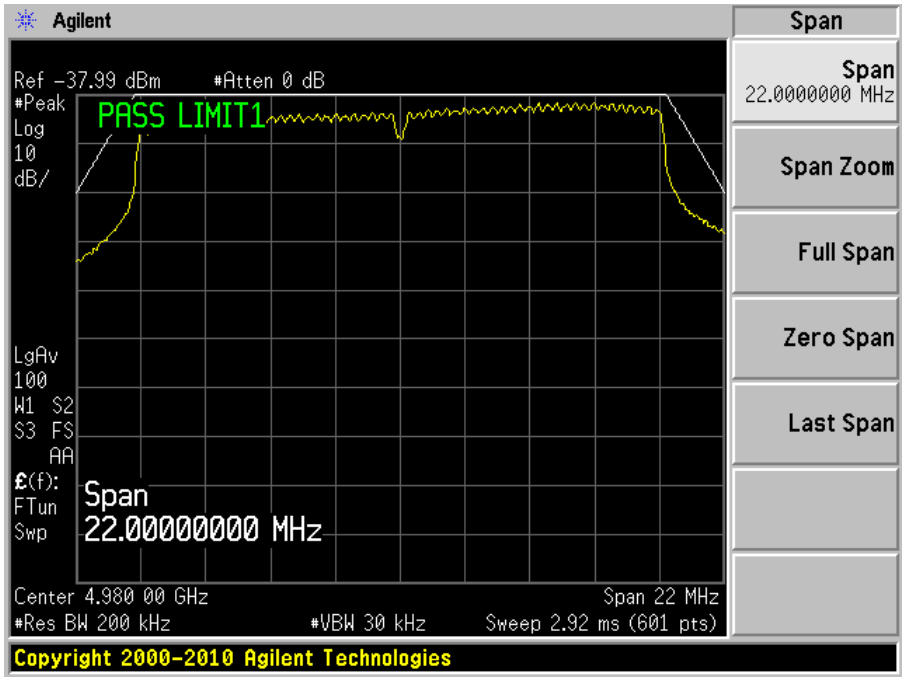
High Channel 4980 MHz, Chain 0



High Channel 4980 MHz, Chain 1



# 6 FCC §2.1051, §90.210 & IC RSS-111 §4.3, §5.4 – Spurious Emissions at Antenna Terminals

## 6.1 Applicable Standards

As per FCC §90.210 (l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0-45% of the authorized bandwidth (BW): 0 dB.

(2) On any frequency removed from the assigned frequency between 45-50% of the authorized bandwidth: 219 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50-55% of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55-100% of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100-150% of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.

(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

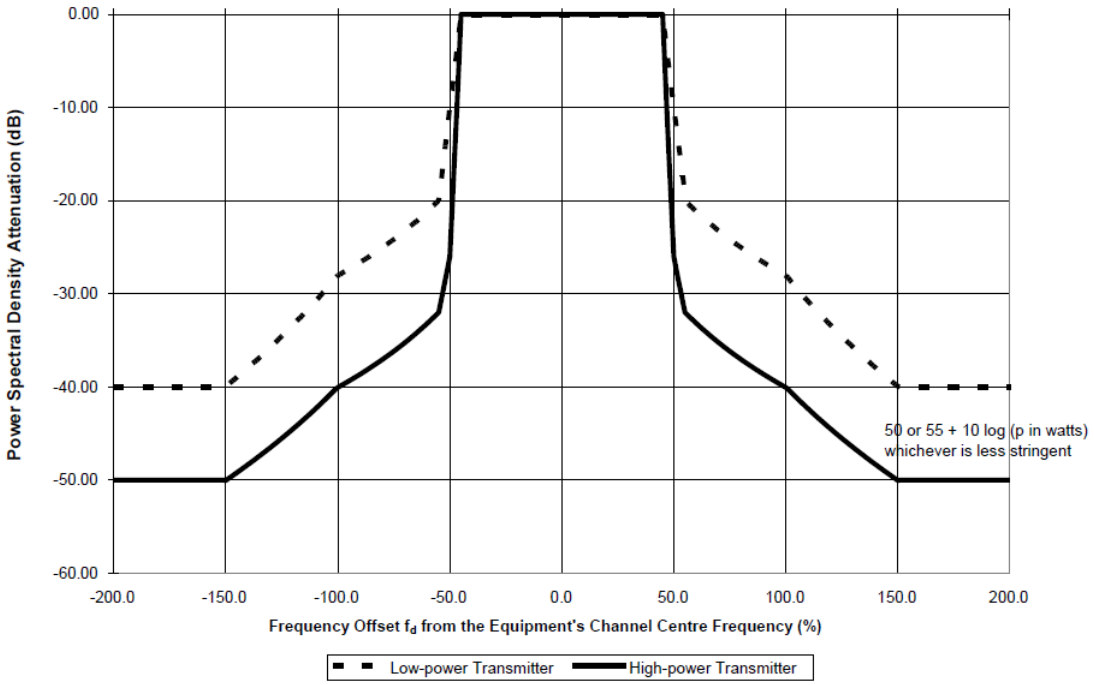
As per IC RSS-111 §5.4, Transmitter Unwanted Emissions,

**Table 2 – Emission Mask for Low- and High-power Transmitters**

| Offset Frequency $f_d$ (% of the Equipment's Channel Bandwidth) | Minimum Attenuation (dB) | |
|---|---|---|
| | Low-power Transmitter | High-power Transmitter |
| $0 < f_d \leq 45$ | 0 | 0 |
| $45 < f_d \leq 50$ | 219 log ($f_d$/45) | 568 log ($f_d$/45) |
| $50 < f_d \leq 55$ | 10 + 242 log ($f_d$/50) | 26 + 145 log ($f_d$/50) |
| $55 < f_d \leq 100$ | 20 + 31 log ($f_d$/55) | 32 + 31 log ($f_d$/55) |
| $100 < f_d \leq 150$ | 28 + 68 log ($f_d$/100) | 40 + 57 log ($f_d$/100) |
| $f_d > 150$ | 40 | whichever is less stringent 50 or 55 + 10 log p |

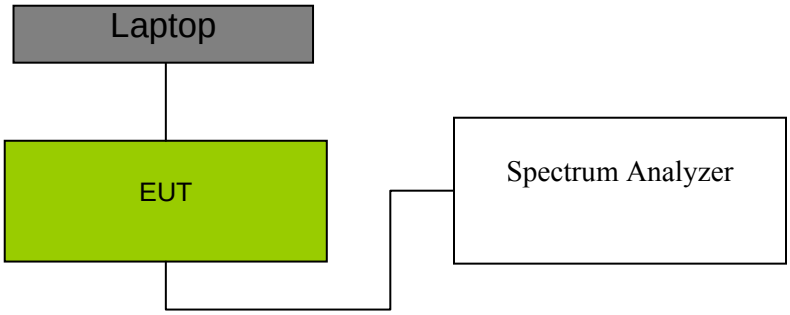
Where: fd (%) = ((f-fc)/channel bandwidth)x100
p: transmitter's output power (in watts), measured as per Section 4.1 of IC RSS-111.

**Figure 1: Unwanted Emission Mask for Low- and High-power Transmitters**




## 6.2 Test Setup Block Diagram and Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz and 1MHz. Sufficient scans were taken to show any out of band emissions up to 10$^{th}$ harmonic.




## 6.3 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates | Calibration Cycle |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2012-09-29 | 1 year |

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

## 6.4 Test Environmental Conditions

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

*The testing was performed by Wei Sun on 2013-06-04 on RF Site.*

## 6.5 Test Results

**5 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)
Worst Case: High Channel

| Channel | Chain | Spur. Emission Reading (dBm) | Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| High | Chain 0 | -51.57 | -7.66 | -47.66 | -3.91 |
| High | Chain 1 | -50.97 | -6.03 | -46.03 | -4.56 |

High Power Setting, Low Gain Antenna (9 dBi)
Worst Case: Low Channel

| Channel | Chain | Spur. Emission Reading (dBm) | Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| Low | Chain 0 | -32.30 | 10.65 | -29.35 | -2.95 |
| Low | Chain 1 | -32.34 | 12.48 | -27.52 | -4.82 |

**10 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)
Worst Case: High Channel

| Channel | Chain | Spur. Emission Reading (dBm) | Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| High | Chain 0 | -50.58 | -4.69 | -44.69 | -5.89 |
| High | Chain 1 | -47.78 | -3.02 | -43.02 | -4.76 |

High Power Setting, Low Gain Antenna (9 dBi)
Worst Case: Low Channel

| Channel | Chain | Spur. Emission Reading (dBm) | Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| Low | Chain 0 | -32.80 | 13.45 | -26.55 | -6.25 |
| Low | Chain 1 | -31.64 | 15.49 | -24.51 | -7.13 |

**802.11a Mode**

Low Power Setting, High Gain Antenna (28 dBi)
Worst Case: Low Channel

| Channel | Chain | Spur. Emission Reading (dBm) | Total Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| Low | Chain 0 | -50.83 | 0.89 | -39.11 | 11.72 |
| Low | Chain 1 | -50.54 | 0.89 | -39.11 | 11.43 |

High Power Setting, Low Gain Antenna (9 dBi)
Worst Case: High Channel

| Channel | Chain | Spur. Emission Reading (dBm) | Total Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| High | Chain 0 | -28.12 | 18.76 | -21.24 | 6.88 |
| High | Chain 1 | -29.15 | 18.76 | -21.24 | 7.91 |

**802.11n HT 20 mode**

Low Power Setting, High Gain Antenna (28 dBi)
Worst Case: Low Channel Chain 0

| Channel | Chain | Spur. Emission Reading (dBm) | Total Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| Low | Chain 0 | -52.24 | 0.65 | -40.65 | 11.59 |
| Low | Chain 1 | -51.67 | 0.65 | -40.65 | 11.02 |

High Power Setting, Low Gain Antenna (9 dBi)
Worst Case: Low Channel

| Channel | Chain | Spur. Emission Reading (dBm) | Output power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| Low | Chain 0 | -30.71 | 18.60 | -21.4 | 9.31 |
| Low | Chain 1 | -30.01 | 18.60 | -21.4 | 8.61 |

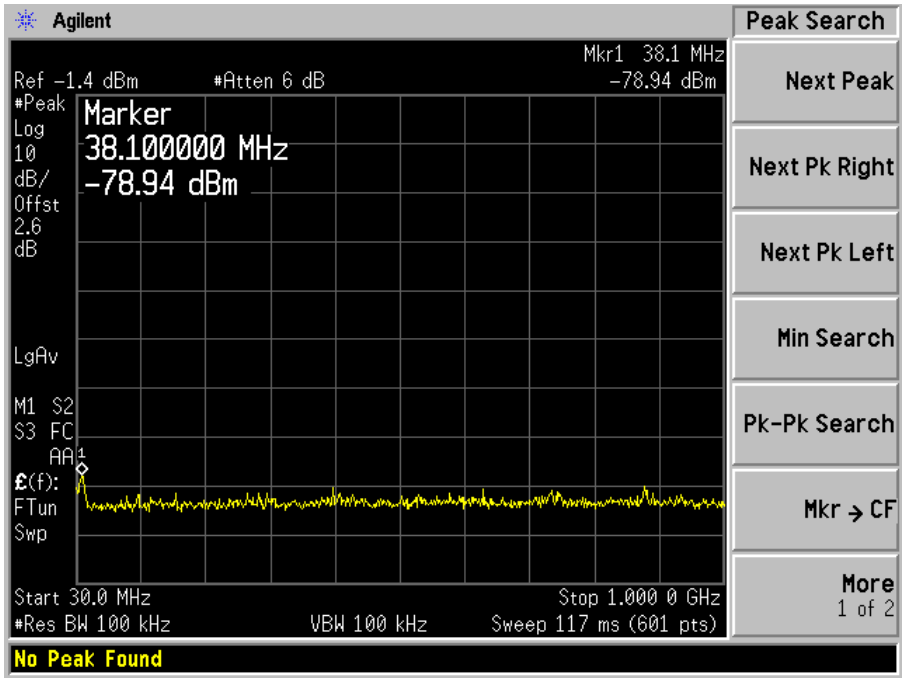
Please refer to the flowing plots.

**5 MHz Mode**

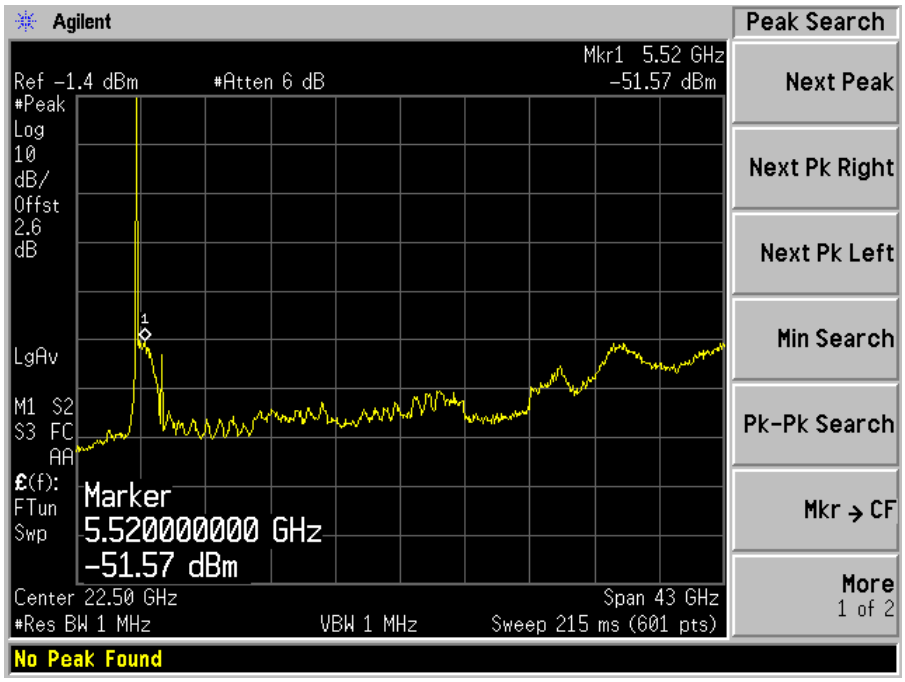
Low Power Setting, High Gain Antenna (28 dBi)

Worst Case: High Channel Chain 0

Below 1 GHz

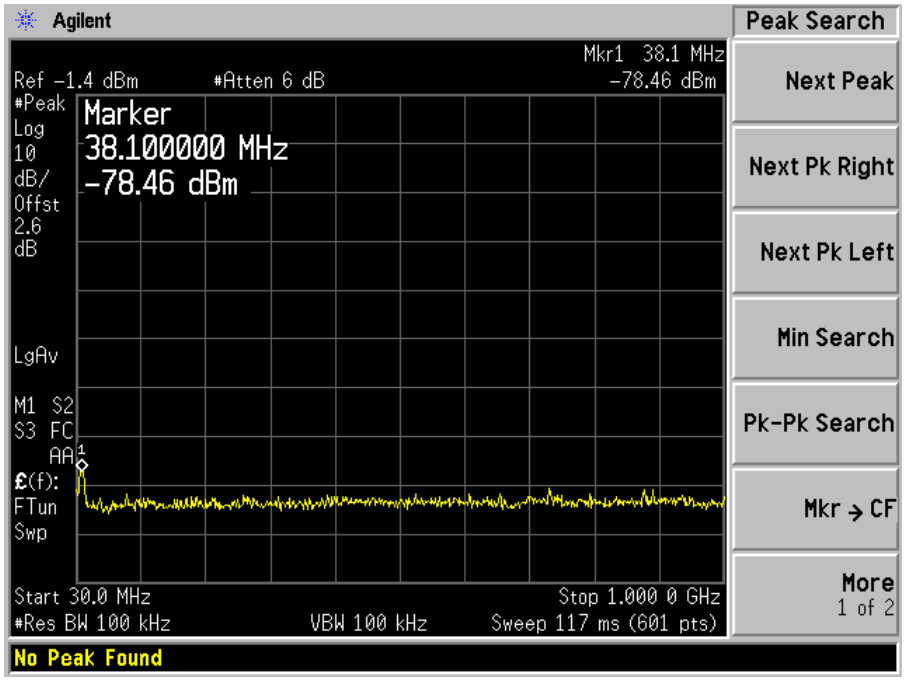



Above 1 GHz

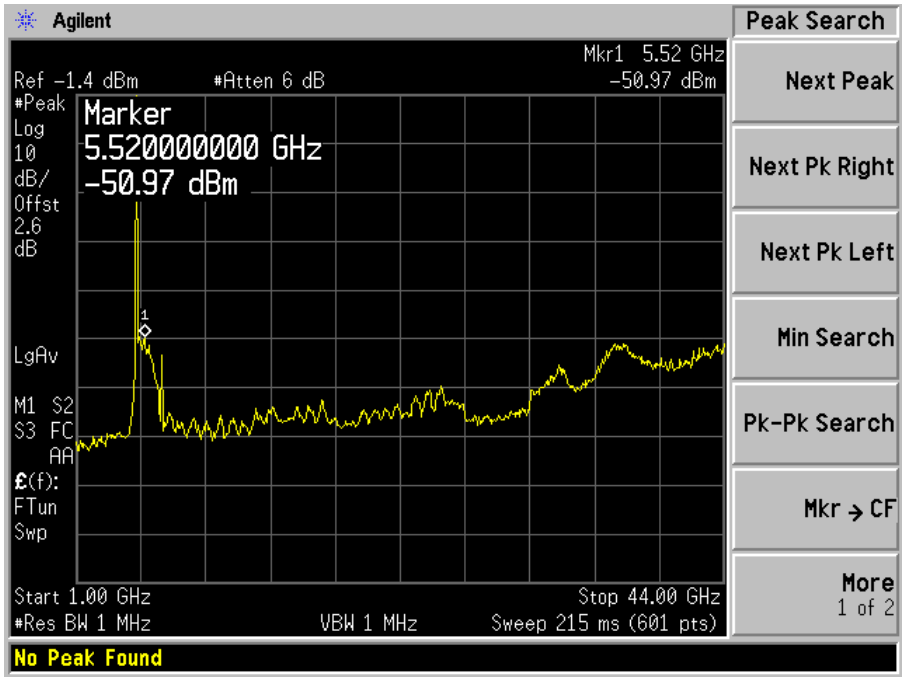


Worst Case: High Channel Chain 1

Below 1 GHz



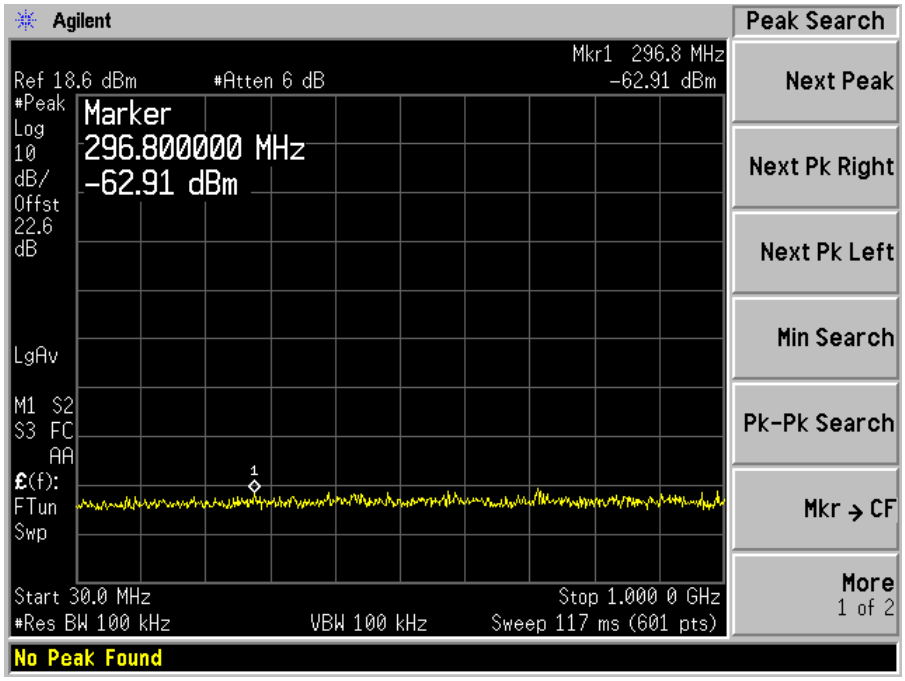

Above 1 GHz



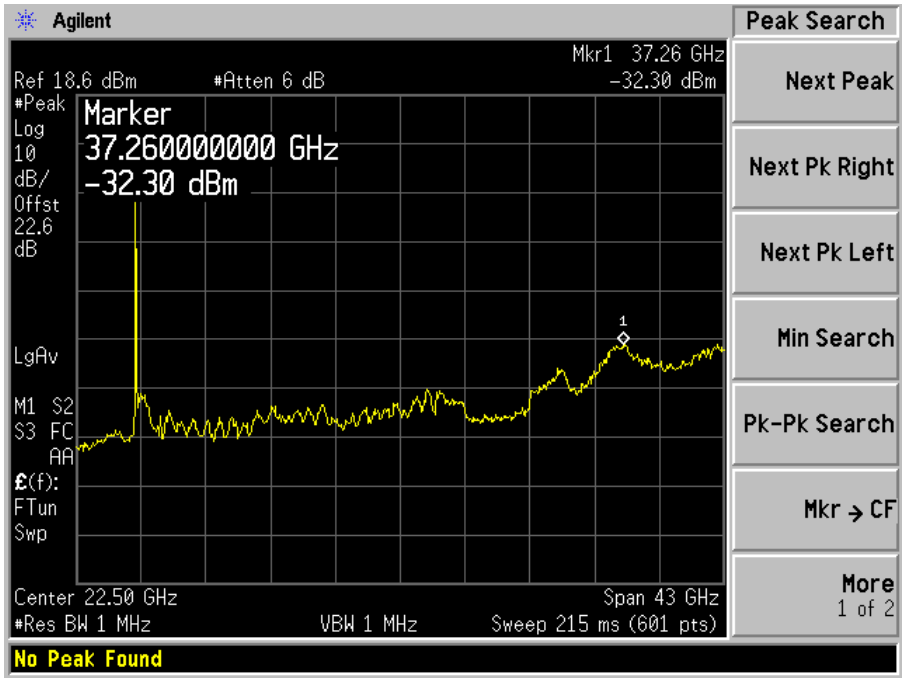
High Power Setting, Low Gain Antenna (9 dBi)

Worst Case: Low Channel Chain 0

Below 1 GHz

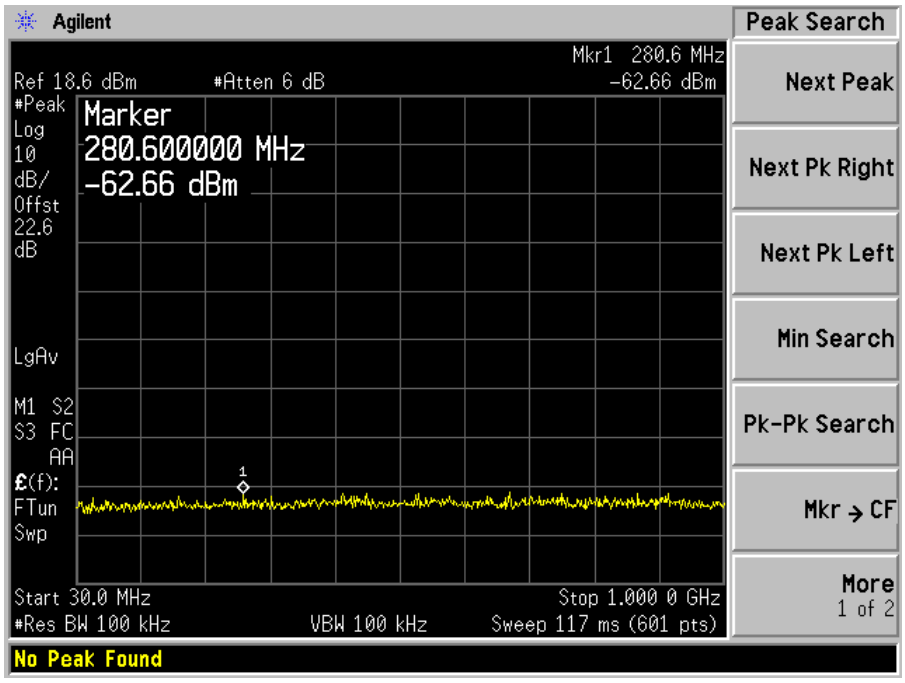



Above 1 GHz

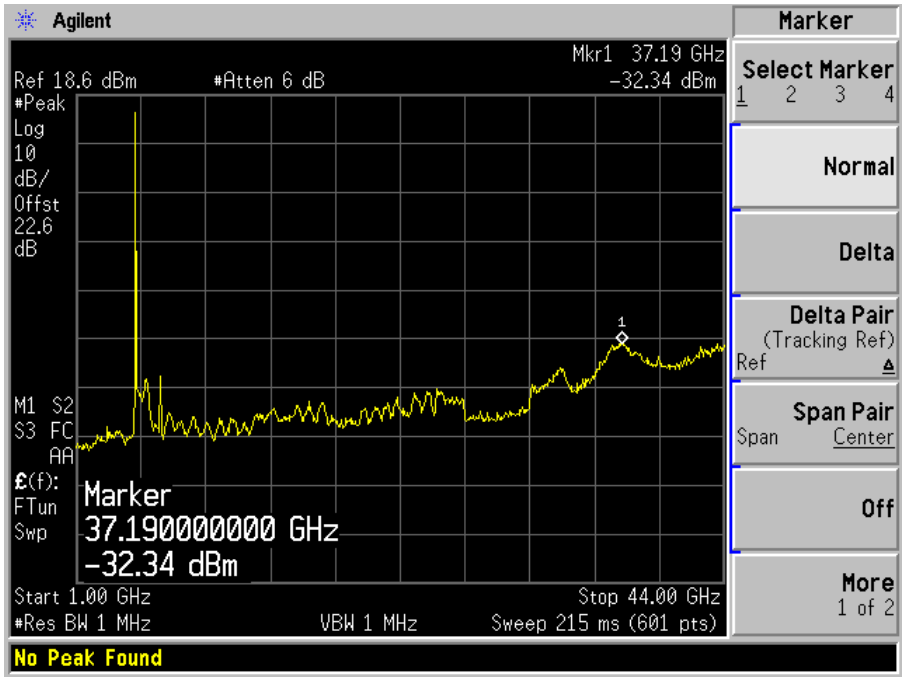


Worst Case: Low Channel Chain 1

Below 1 GHz




Above 1 GHz

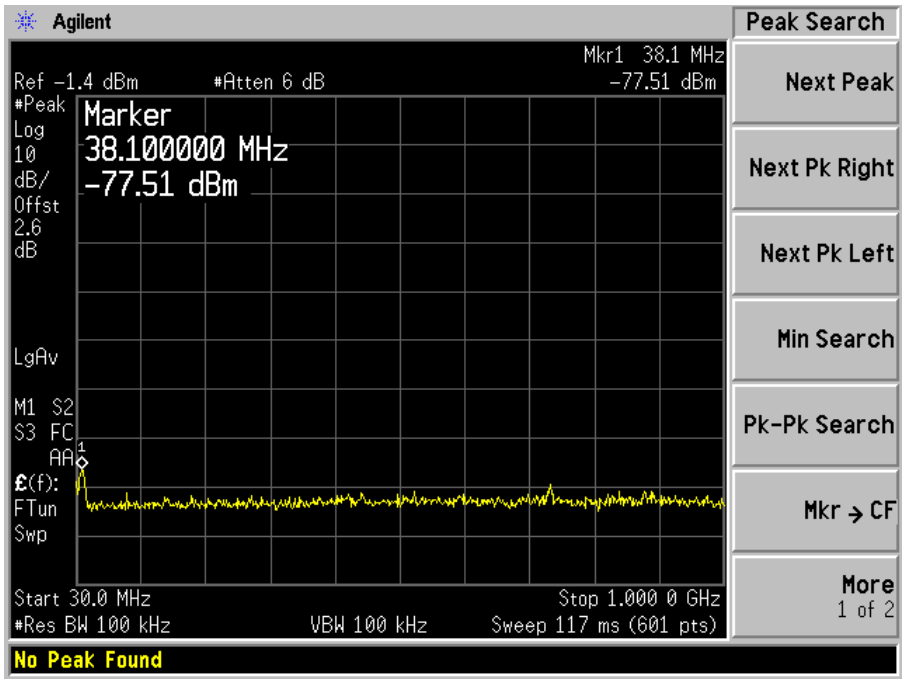


**10 MHz Mode**

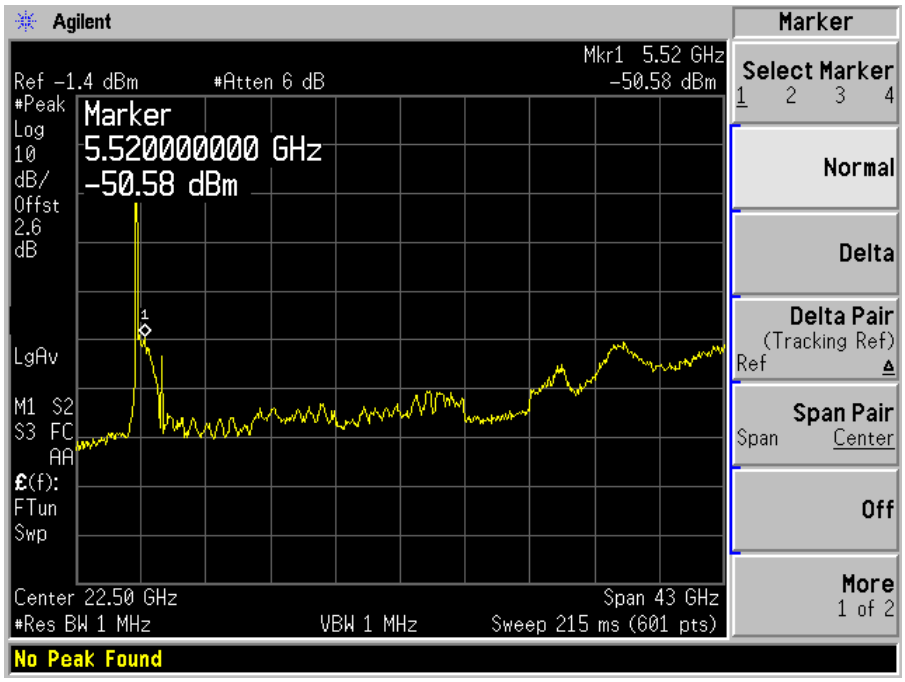
Low Power Setting, High Gain Antenna (28 dBi)

Worst Case: High Channel Chain 0

Below 1 GHz

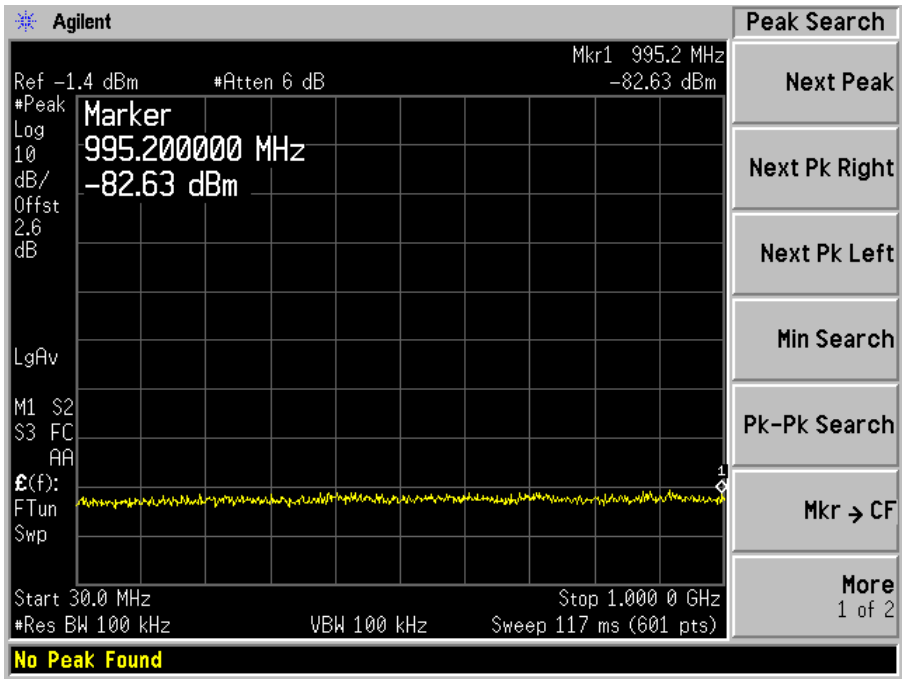



Above 1 GHz

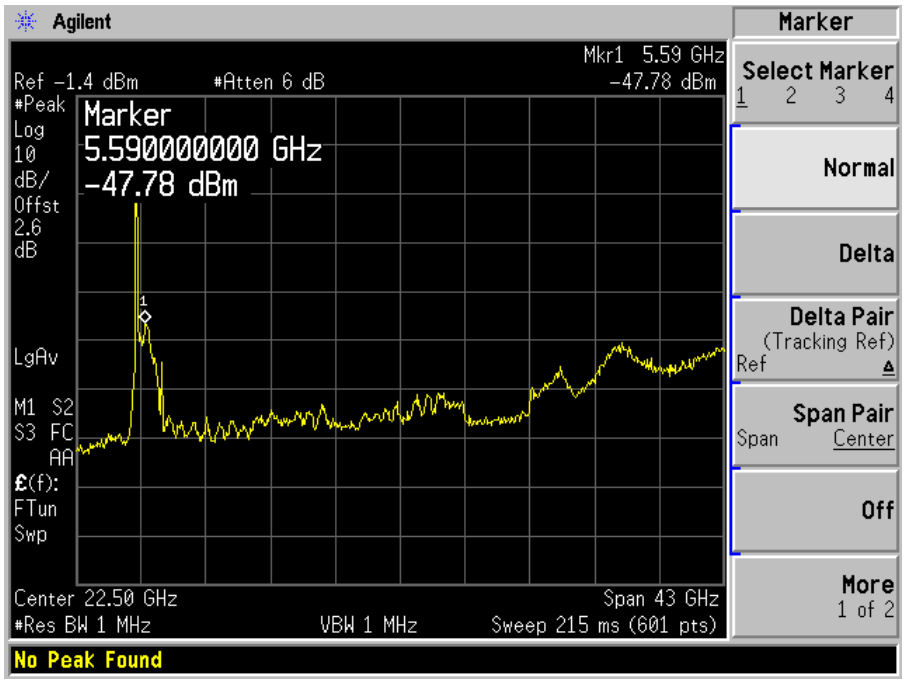


Worst Case: High Channel Chain 1

Below 1 GHz



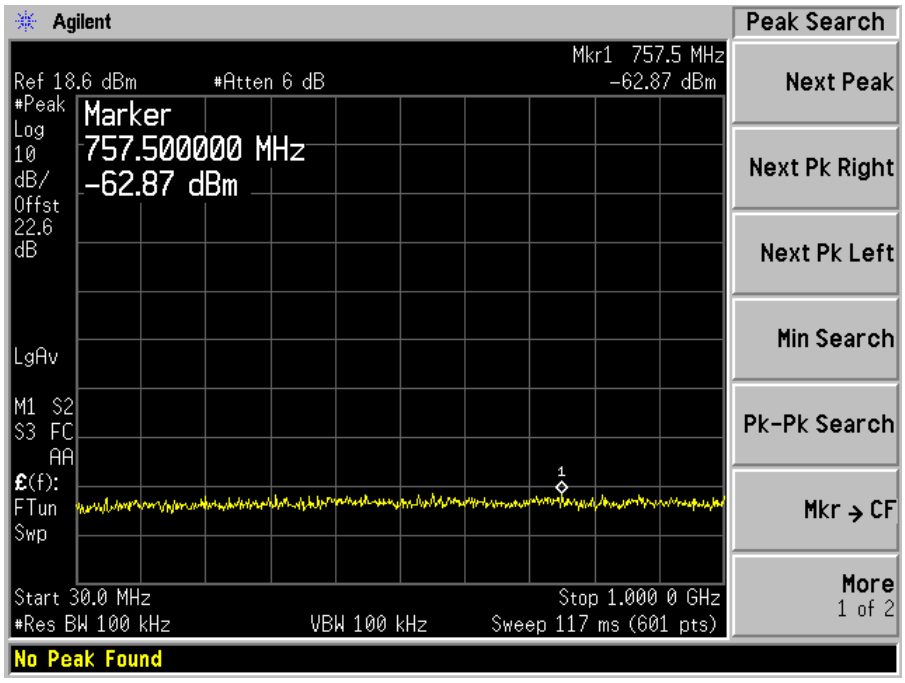

Above 1 GHz



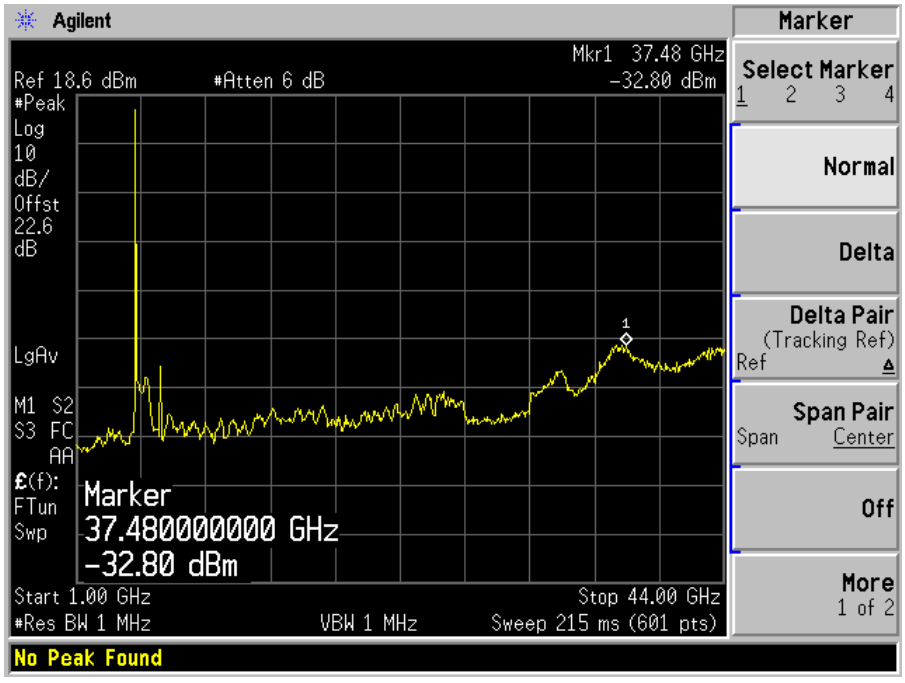
High Power Setting, Low Gain Antenna (9 dBi)

Worst Case: Low Channel Chain 0

Below 1 GHz

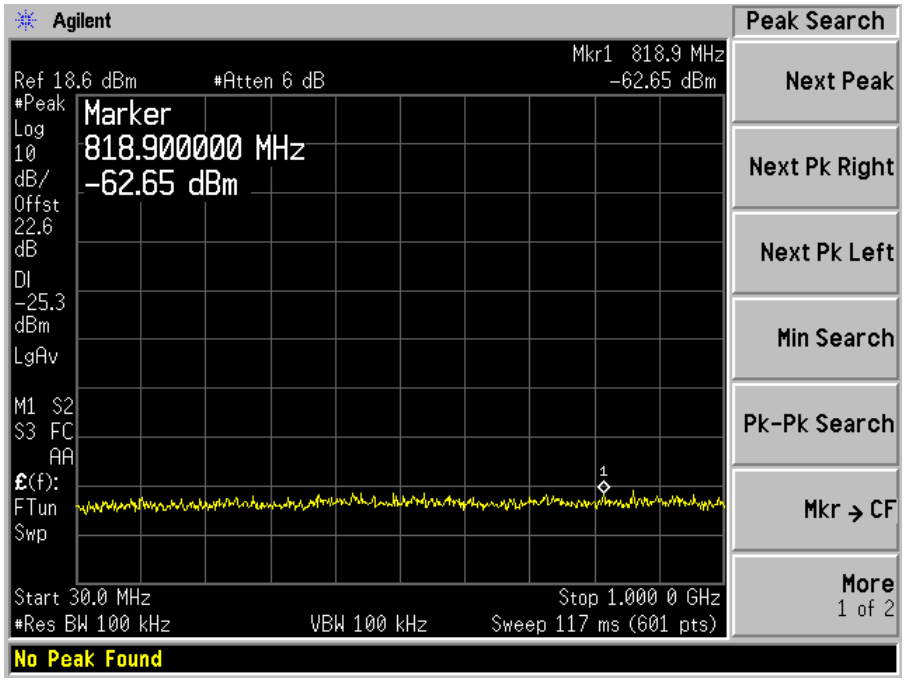



Above 1 GHz

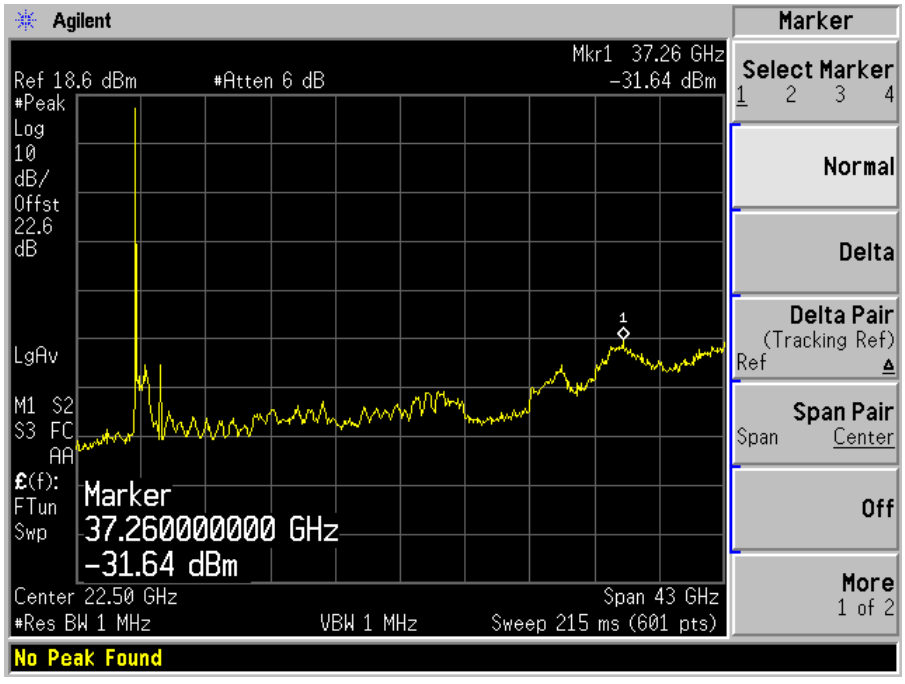


Worst Case: Low Channel Chain 1

Below 1 GHz




Above 1 GHz

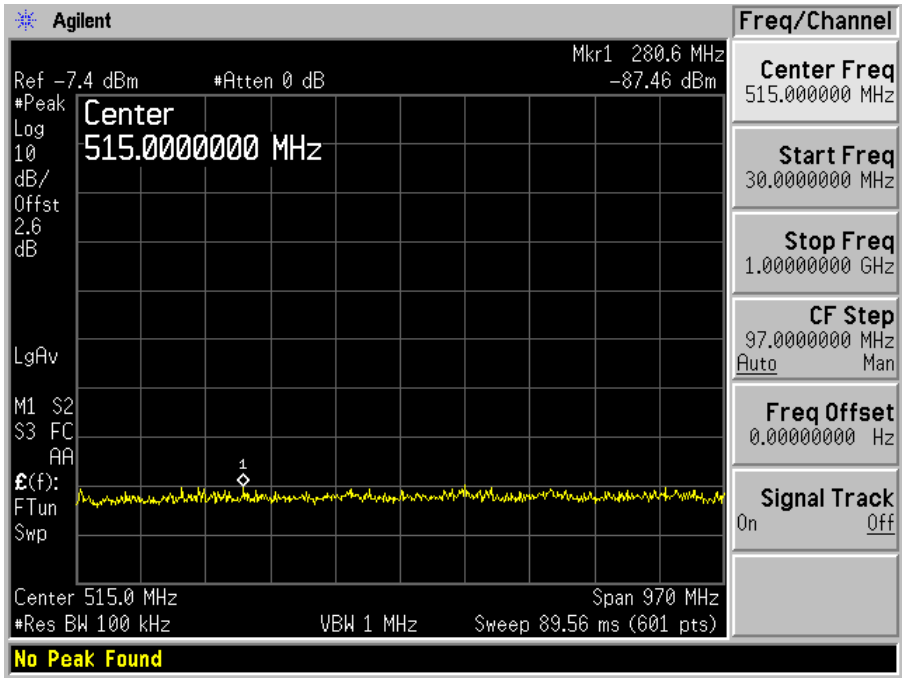


**802.11a Mode**

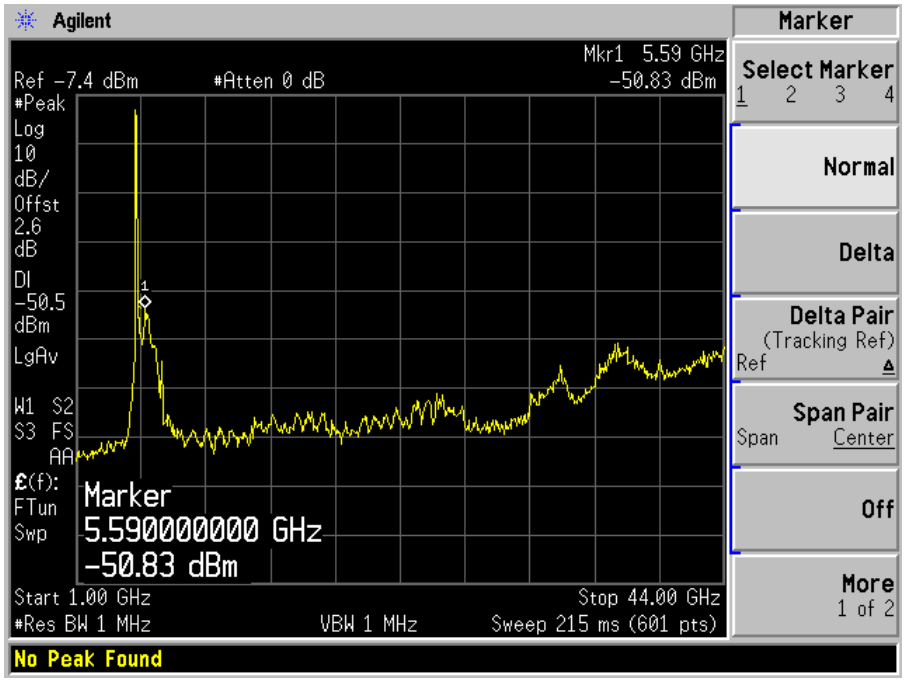
Low Power Setting, High Gain Antenna (28 dBi)

Worst Case: Low Channel Chain 0

Below 1 GHz

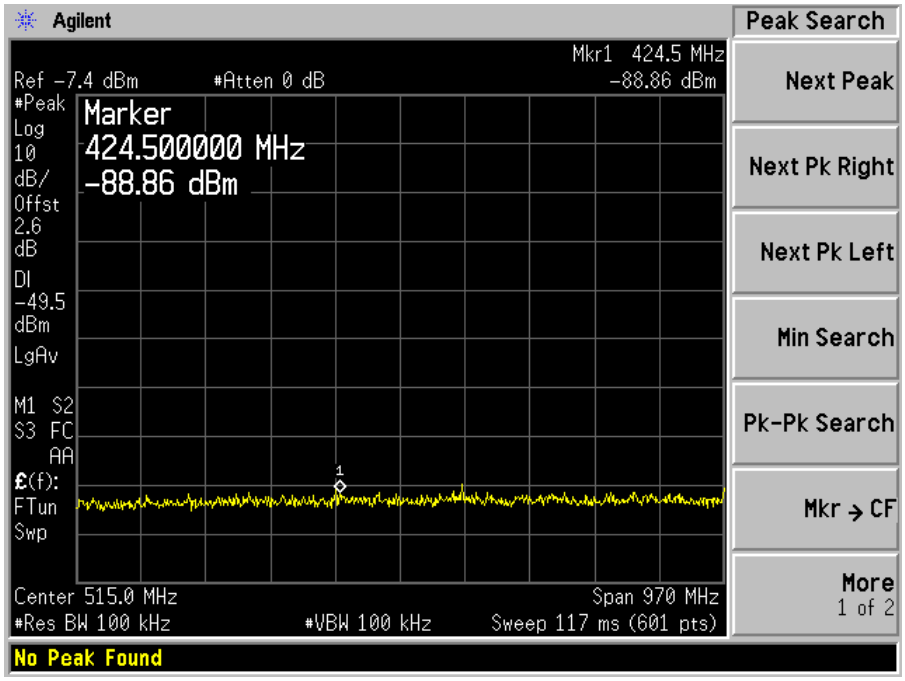



Above 1 GHz

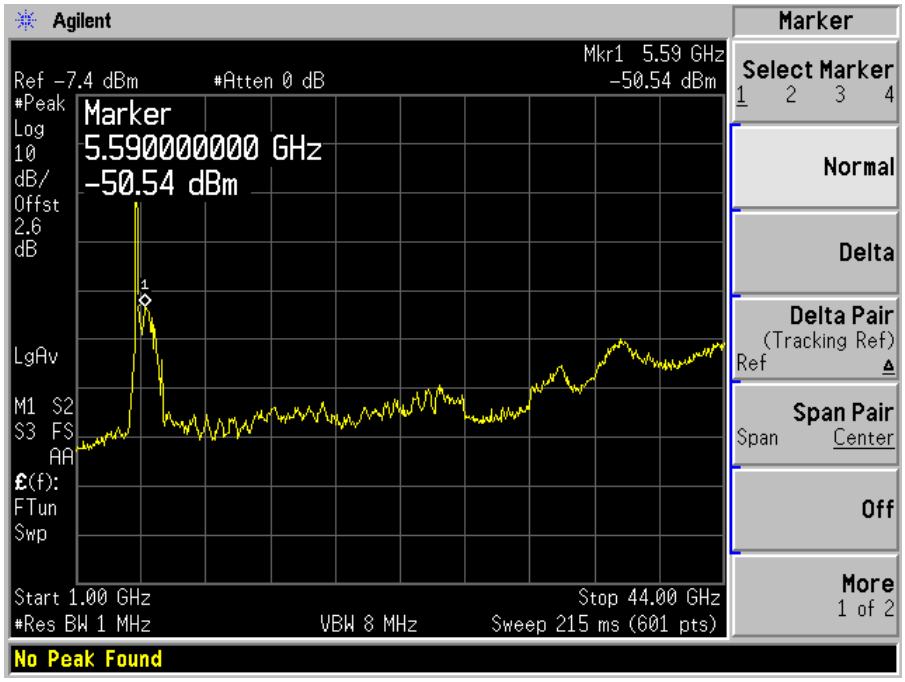


Worst Case: Low Channel Chain 1

Below 1 GHz



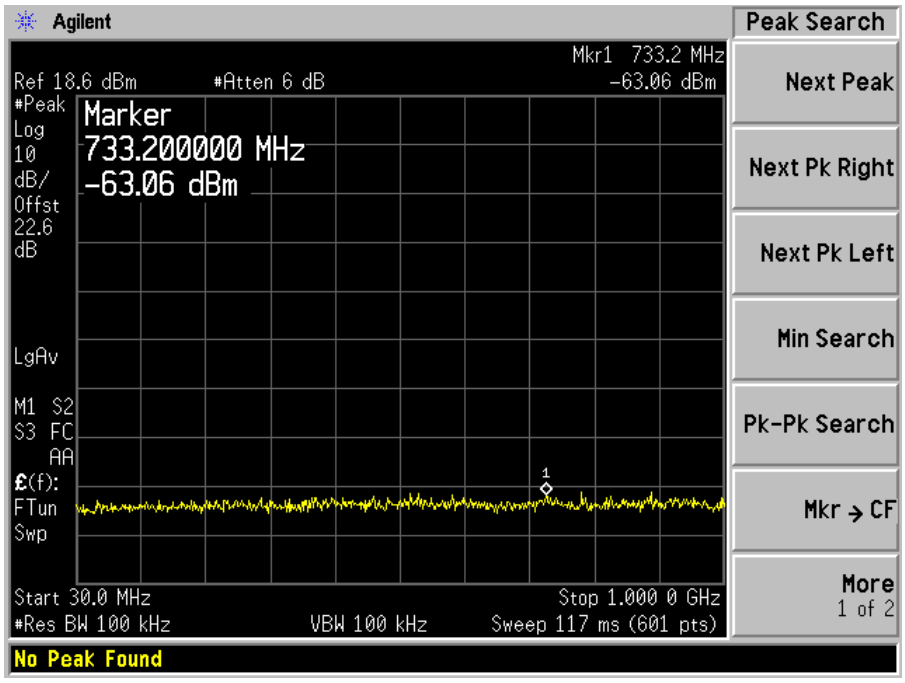

Above 1 GHz



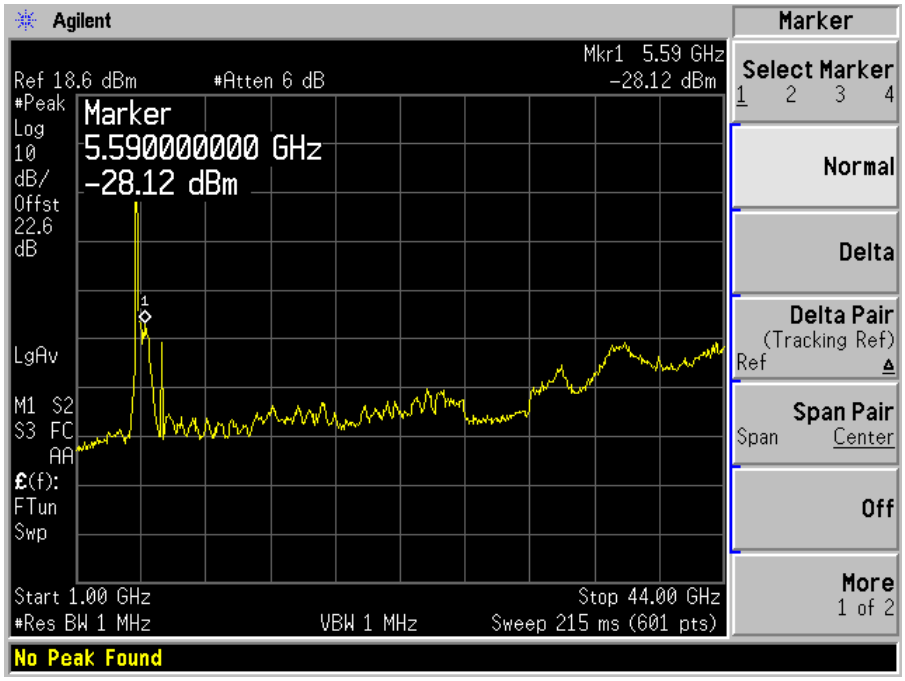
High Power Setting, Low Gain Antenna (9 dBi)

Worst Case: High Channel Chain 0

Below 1 GHz

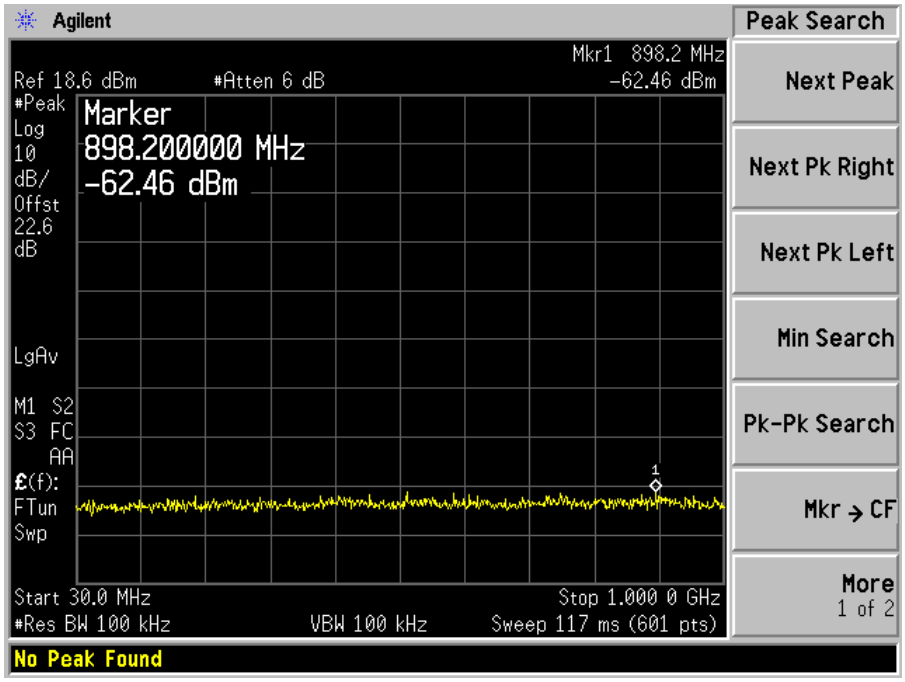



Above 1 GHz

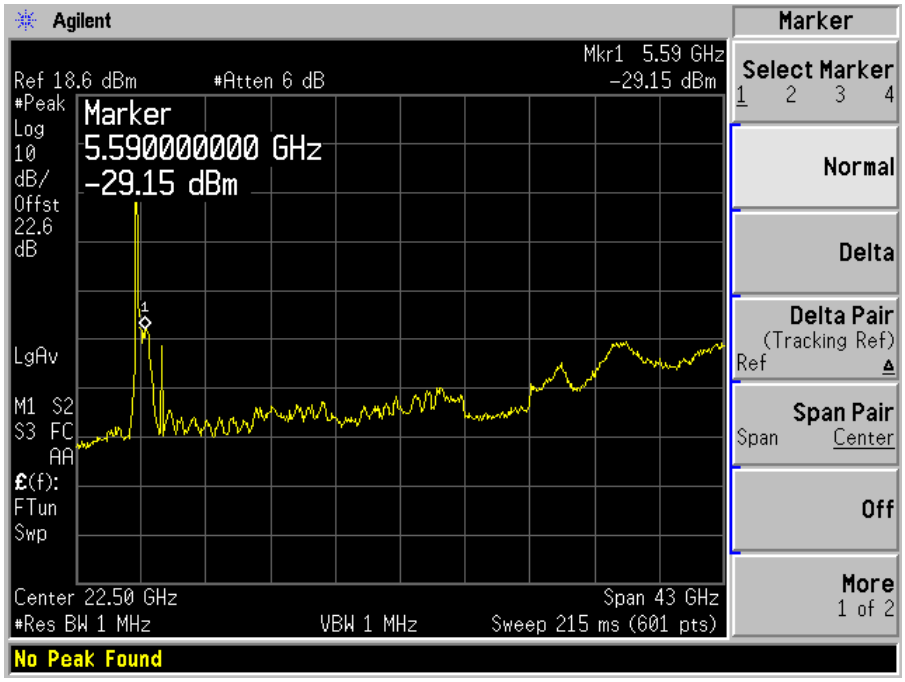


Worst Case: High Channel Chain 1

Below 1 GHz




Above 1 GHz

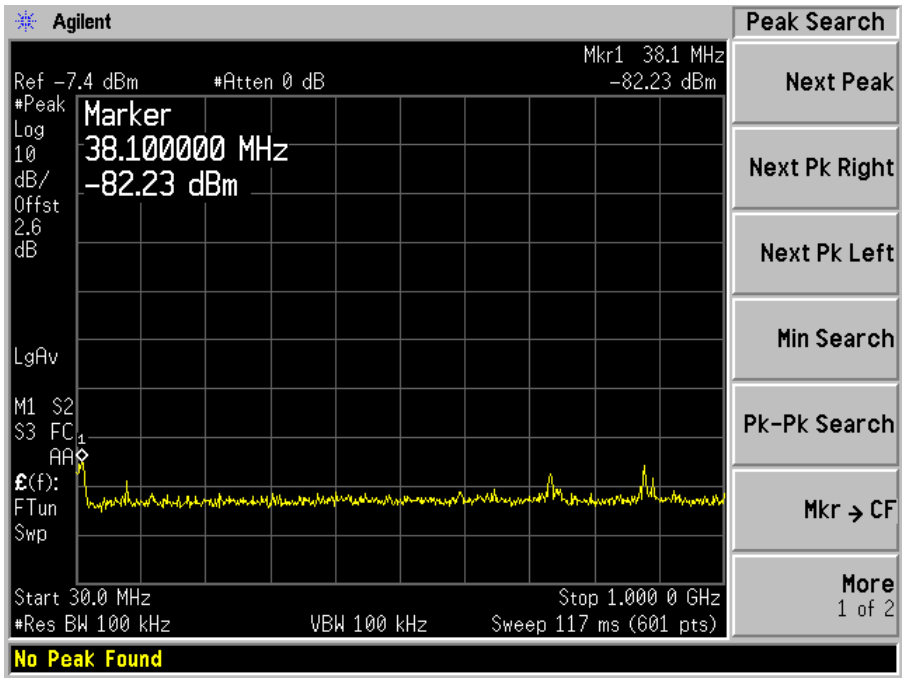


**802.11n HT 20 mode**

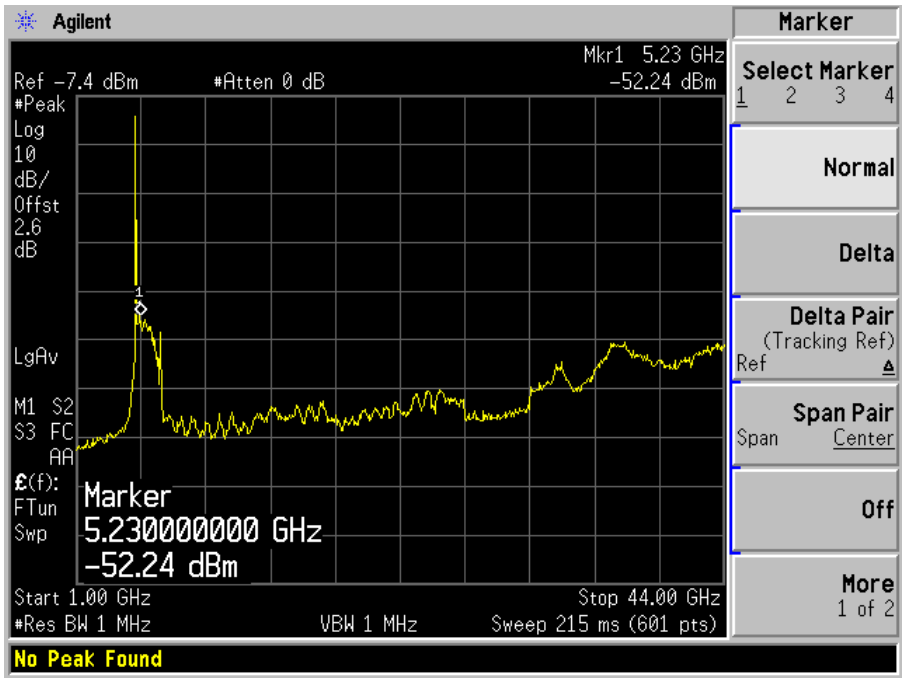
Low Power Setting, High Gain Antenna (28 dBi)

Worst Case: Low Channel Chain 0

Below 1 GHz

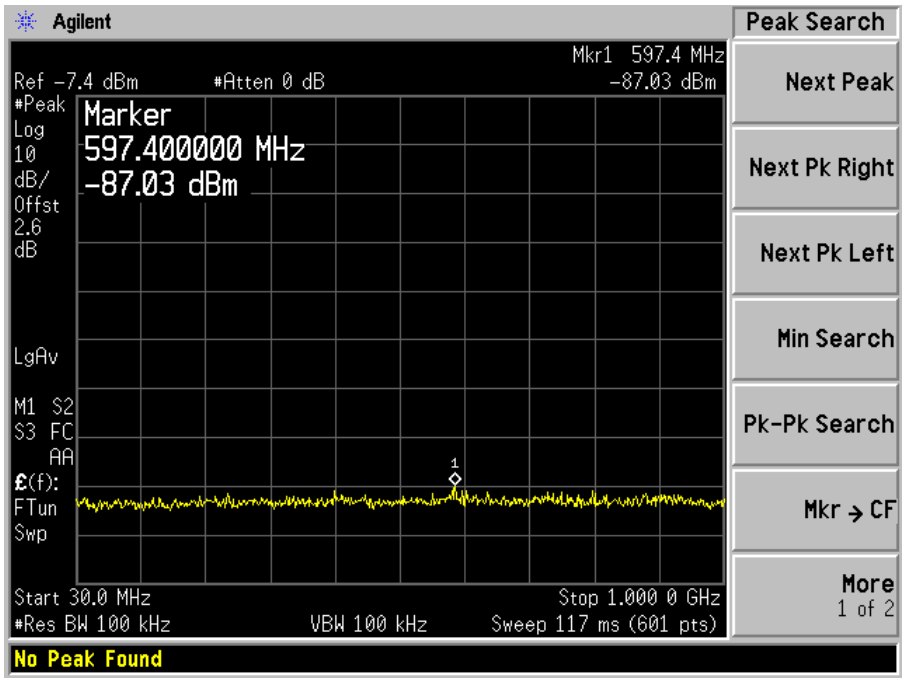



Above 1 GHz

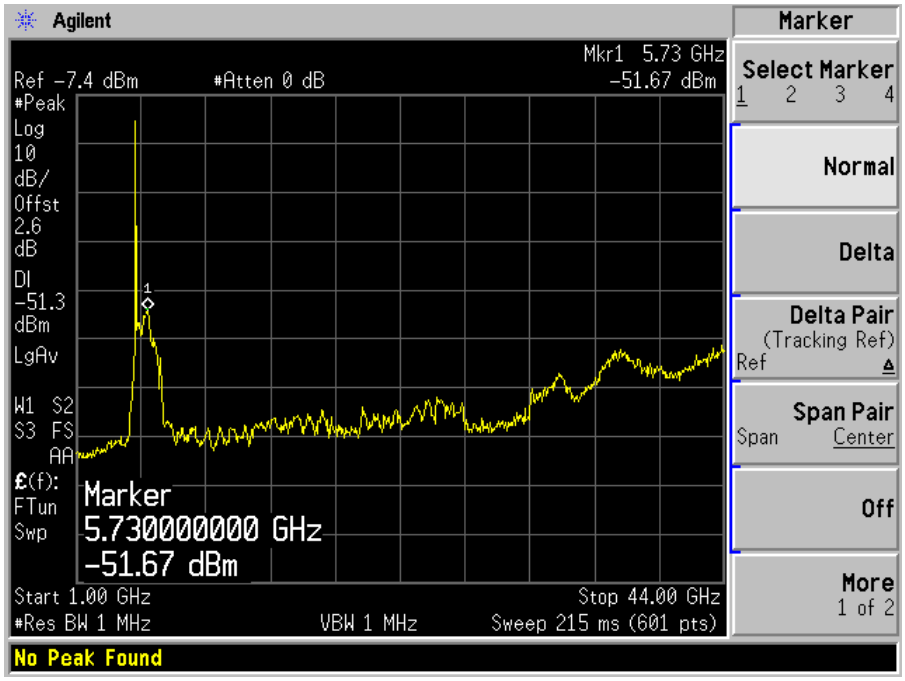


Worst Case: Low Channel Chain 1

Below 1 GHz



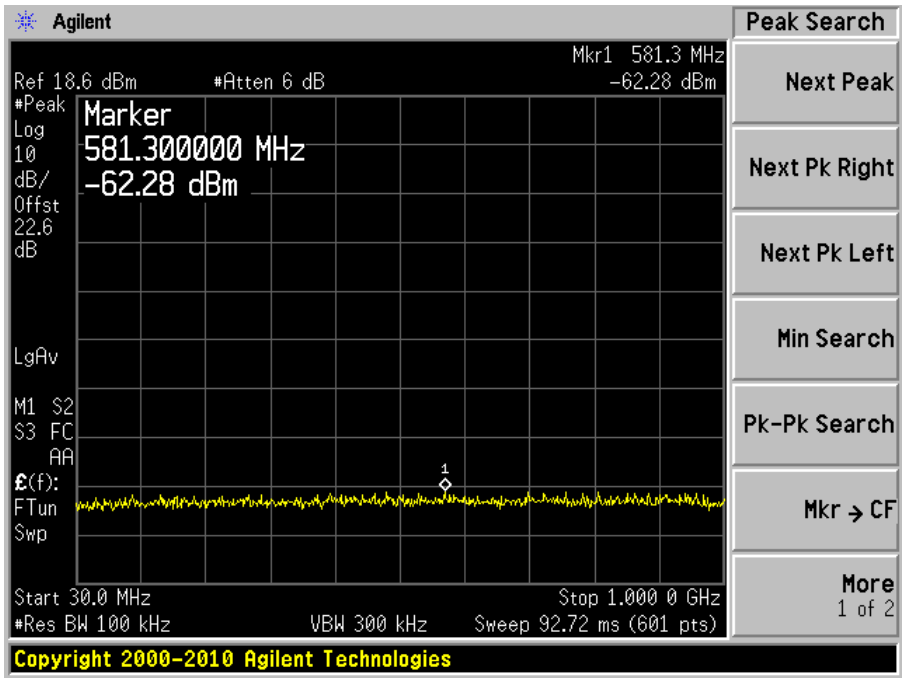

Above 1 GHz



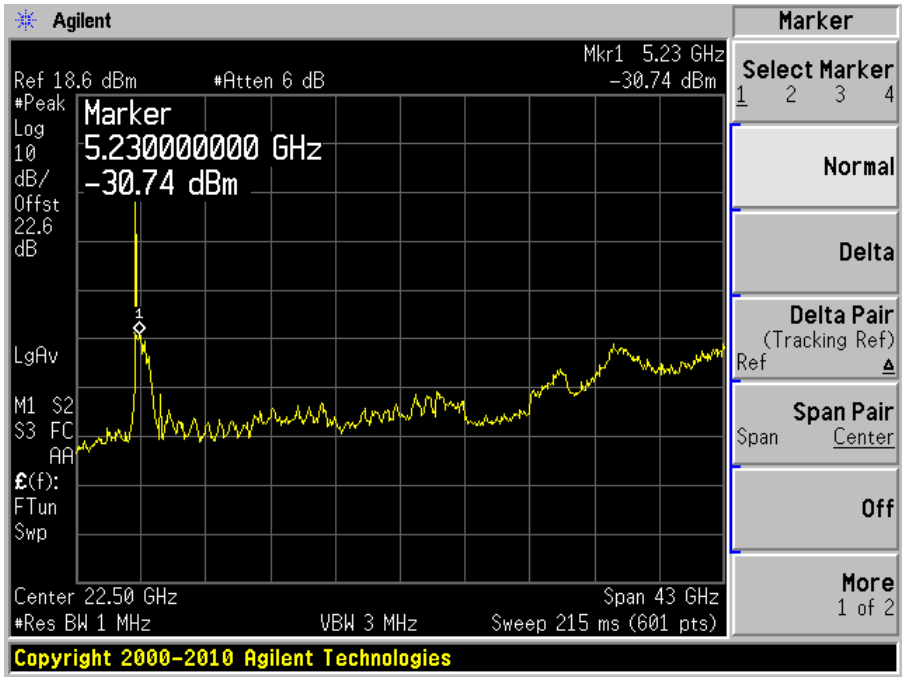
High Power Setting, Low Gain Antenna (9 dBi)

Worst Case: Low Channel Chain 0

Below 1 GHz

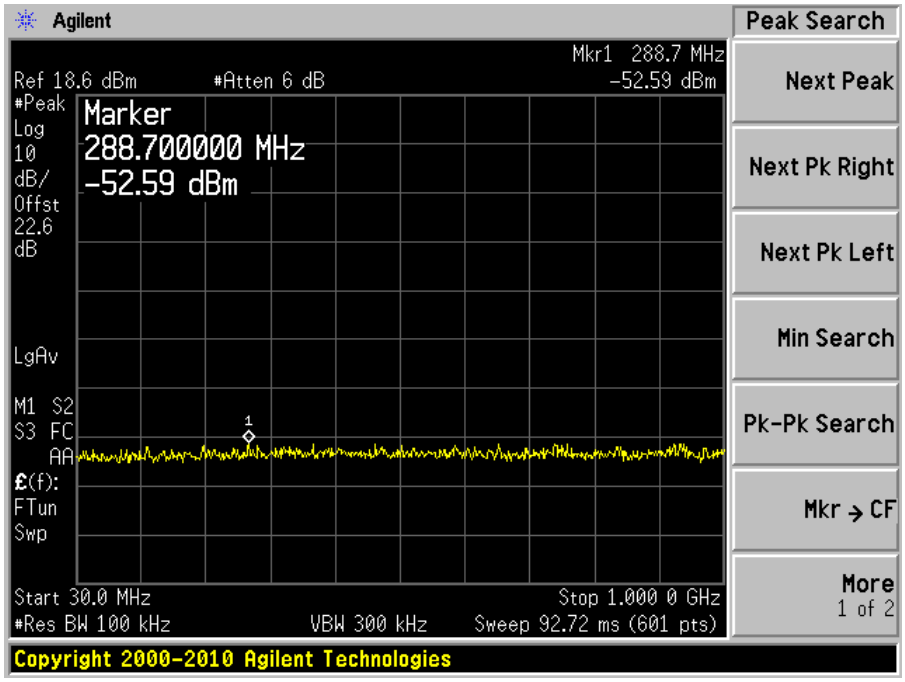



Above 1 GHz

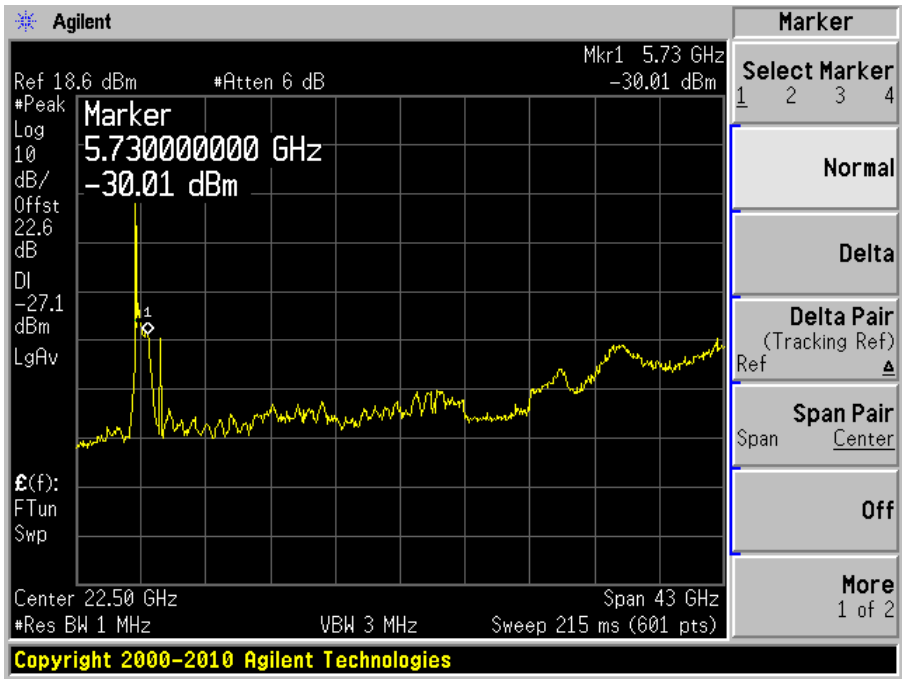


Worst Case: Low Channel Chain 1

Below 1 GHz




Above 1 GHz



# 7 FCC §2.1053, §90.210 & IC RSS-111 §4.3, §5.4 – Field Strength of Spurious Radiations

## 7.1 Applicable Standards

As per FCC §2.1053 (a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. And §90.210(b),(d): Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

As per FCC §90.210 (l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0-45% of the authorized bandwidth (BW): 0 dB.

(2) On any frequency removed from the assigned frequency between 45-50% of the authorized bandwidth: 219 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50-55% of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55-100% of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100-150% of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.

(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

As per IC RSS-111 §5.4, Transmitter Unwanted Emissions,

**Table 2 – Emission Mask for Low- and High-power Transmitters**

| Offset Frequency $f_d$ (% of the Equipment's Channel Bandwidth) | Minimum Attenuation (dB) | |
|---|---|---|
| | Low-power Transmitter | High-power Transmitter |
| $0 < f_d \leq 45$ | 0 | 0 |
| $45 < f_d \leq 50$ | 219 log ($f_d$/45) | 568 log ($f_d$/45) |
| $50 < f_d \leq 55$ | 10 + 242 log ($f_d$/50) | 26 + 145 log ($f_d$/50) |
| $55 < f_d \leq 100$ | 20 + 31 log ($f_d$/55) | 32 + 31 log ($f_d$/55) |
| $100 < f_d \leq 150$ | 28 + 68 log ($f_d$/100) | 40 + 57 log ($f_d$/100) |
| $f_d > 150$ | 40 | whichever is less stringent<br>50 or<br>55 + 10 log p |

Where: fd (%) = ((f-fc)/channel bandwidth)x100
p: transmitter's output power (in watts), measured as per Section 4.1 of IC RSS-111.

## 7.2 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

## 7.3 Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Cycle |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2012-09-29 | 1 year |
| Sunol Science Corp | System Controller | SC99V | 122303-1 | N/R | N/R |
| Sunol Science Corp | Combination Antenna | JB3 | A020106-3 | 2012-06-18 | 1 Year |
| Hewlett Packard | Pre-amplifier | 8447D | 2944A10187 | 2013-03-08 | 1 Year |
| EMCO | Horn antenna | 3115 | 9511-4627 | 2012-10-17 | 1 Year |
| Eaton | Horn antenna | 96001 | 3/1/1907 | 2012-10-17 | 1 Year |
| Mini-Circuits | Pre-amplifier | ZVA-183-S | 570400946 | 2013-05-09 | 1 Year |
| Com-Power | Dipole Antenna | AD-100 | 2226 | 2012-06-18 | 1 Year |

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

## 7.4 Test Environmental Conditions

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

*The testing was performed by Wei Sun on 2013-06-04 in 5 Meter Chamber #2.*

## 7.5 Test Results

**5 MHz Mode**

Worst Case: High Power Setting, Low Gain Antenna (9 dBi), Low Channel

| Indicated | | Turntable Azimuth (degree) | Test Antenna | | Substituted | | | | | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | S.A. Amp. (dBuV) | | Height (cm) | Polarity (H/V) | Frequency (MHz) | Level (dBm) | Ant. Cord. (dB) | Cable Loss (dB) | Absolute Level (dBm) | | |
| 7000 | 30 | 0 | 155 | V | 7000 | -61.28 | 11.11 | 1.41 | -51.58 | -27.52 | -24.06 |
| 7000 | 30 | 0 | 155 | H | 7000 | -61.28 | 11.11 | 1.41 | -51.58 | -27.52 | -24.06 |
| 43.85 | 58.67 | 201 | 157 | V | 43.85 | -57.53 | 0 | 0.1 | -57.63 | -27.52 | -30.11 |
| 43.85 | 38.33 | 317 | 163 | H | 43.85 | -77.87 | 0 | 0.1 | -77.97 | -27.52 | -50.45 |

### 10 MHz Mode

Worst Case: High Power Setting, Low Gain Antenna (9 dBi), Low Channel

| Indicated | | Turntable Azimuth (degree) | Test Antenna | | Substituted | | | | | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | S.A. Amp. (dBuV) | | Height (cm) | Polarity (H/V) | Frequency (MHz) | Level (dBm) | Ant. Cord. (dB) | Cable Loss (dB) | Absolute Level (dBm) | | |
| 7000 | 30 | 0 | 155 | V | 7000 | -61.28 | 11.11 | 1.41 | -51.58 | -24.51 | -27.07 |
| 7000 | 30 | 0 | 155 | H | 7000 | -61.28 | 11.11 | 1.41 | -51.58 | -24.51 | -27.07 |
| 43.85 | 57.91 | 211 | 155 | V | 43.85 | -58.29 | 0 | 0.1 | -58.39 | -24.51 | -33.88 |
| 43.85 | 38.01 | 313 | 169 | H | 43.85 | -78.19 | 0 | 0.1 | -78.29 | -24.51 | -53.78 |

### 802.11a Mode

Worst Case: High Power Setting, Low Gain Antenna (9 dBi), High Channel

| Indicated | | Turntable Azimuth (degree) | Test Antenna | | Substituted | | | | | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | S.A. Amp. (dBuV) | | Height (cm) | Polarity (H/V) | Frequency (MHz) | Level (dBm) | Ant. Cord. (dB) | Cable Loss (dB) | Absolute Level (dBm) | | |
| 7000 | 30 | 0 | 155 | V | 7000 | -61.28 | 11.11 | 1.41 | -51.58 | -21.24 | -30.34 |
| 7000 | 30 | 0 | 155 | H | 7000 | -61.28 | 11.11 | 1.41 | -51.58 | -21.24 | -30.34 |
| 43.85 | 58.55 | 207 | 161 | V | 43.85 | -57.65 | 0 | 0.1 | -57.75 | -21.24 | -36.51 |
| 43.85 | 38.61 | 305 | 167 | H | 43.85 | -77.59 | 0 | 0.1 | -77.69 | -21.24 | -56.45 |

### 802.11n HT20 Mode

Worst Case: High Power Setting, Low Gain Antenna (9 dBi), Low Channel

| Indicated | | Turntable Azimuth (degree) | Test Antenna | | Substituted | | | | | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | S.A. Amp. (dBuV) | | Height (cm) | Polarity (H/V) | Frequency (MHz) | Level (dBm) | Ant. Cord. (dB) | Cable Loss (dB) | Absolute Level (dBm) | | |
| 7000 | 30 | 0 | 155 | V | 7000 | -61.28 | 11.11 | 1.41 | -51.58 | -21.4 | -30.18 |
| 7000 | 30 | 0 | 155 | H | 7000 | -61.28 | 11.11 | 1.41 | -51.58 | -21.4 | -30.18 |
| 43.85 | 58.60 | 215 | 154 | V | 43.85 | -57.6 | 0 | 0.1 | -57.7 | -21.4 | -36.30 |
| 43.85 | 38.17 | 309 | 164 | H | 43.85 | -78.03 | 0 | 0.1 | -78.13 | -21.4 | -56.73 |

Note: On any frequency removed from the assigned frequency above 150% of the authorized bandwidth must be attenuated 40 dB from the fundamental.

# 8 FCC §90.1215 – Peak Excursion Ratio

## 8.1 Applicable Standards

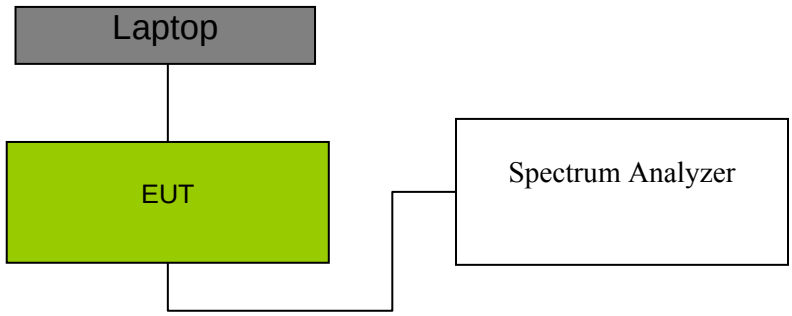
As per FCC §90.1215(e), the ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

## 8.2 Test Setup Block Diagram and Test Procedure

Set the spectrum analyzer span to view the entire emission bandwidth.
The largest difference between the following two traces must be ≤ 13 dB for all frequencies across the emission bandwidth. Submit a plot.

1st Trace:
• Set RBW = 1 MHz, VBW ≥ 3 MHz with peak detector and max-hold settings.

2nd Trace:
• Set RBW = 1 MHz, VBW ≥ 3 MHz with Average detector, 100 average traces and max-hold settings.




## 8.3 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates | Calibration Cycle |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2012-09-29 | 1 year |

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

## 8.4 Test Environmental Conditions

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

*The testing was performed by Wei Sun on 2013-06-03 on RF Site.*

## 8.5 Test Results

**5 MHz Mode**

Worst Case: High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 (dB) | Chain 1 (dB) | Limit (dBm) |
|---|---|---|---|---|
| Low | 4947.5 | 12.723 | 11.881 | 13 |

**10 MHz Mode**

Worst Case: High Power Setting, Low Gain Antenna (9 dBi) Mode

| Channel | Frequency (MHz) | Chain 0 (dB) | Chain 1 (dB) | Limit (dBm) |
|---|---|---|---|---|
| Low | 4950 | 10.541 | 10.642 | 13 |

**802.11a Mode**

Worst Case: High Power Setting, Low Gain Antenna (9 dBi) Mode

| Channel | Frequency (MHz) | Chain 0 (dB) | Chain 1 (dB) | Limit (dBm) |
|---|---|---|---|---|
| High | 4975 | 9.605 | 9.179 | 13 |

**802.11n HT20 mode**

Worst Case: High Power Setting, Low Gain Antenna (9 dBi) Mode

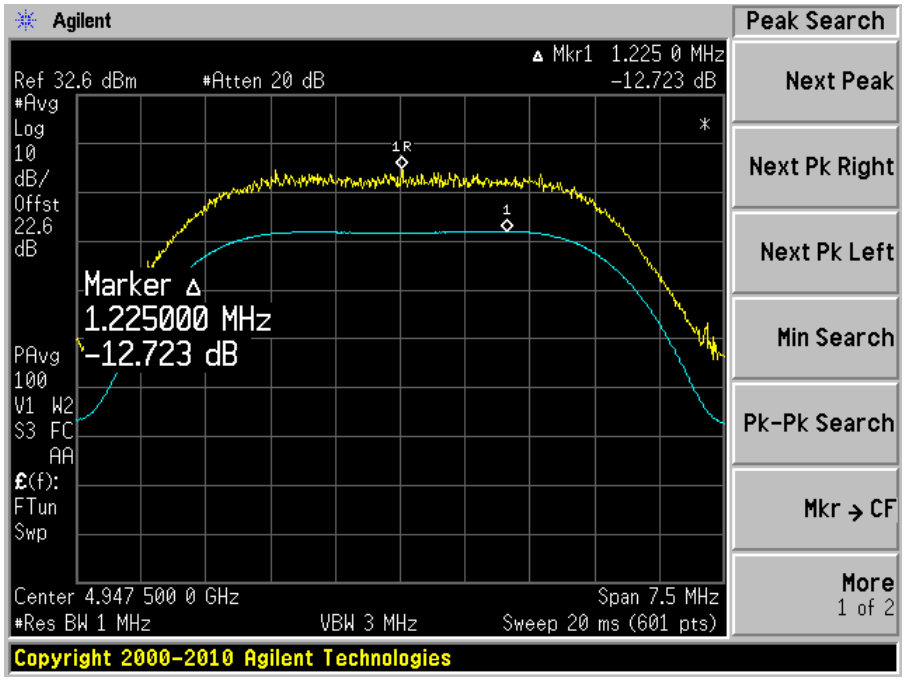
| Channel | Frequency (MHz) | Chain 0 (dB) | Chain 1 (dB) | Limit (dBm) |
|---|---|---|---|---|
| Low | 4955 | 8.697 | 9.141 | 13 |

Please refer to the following plots.

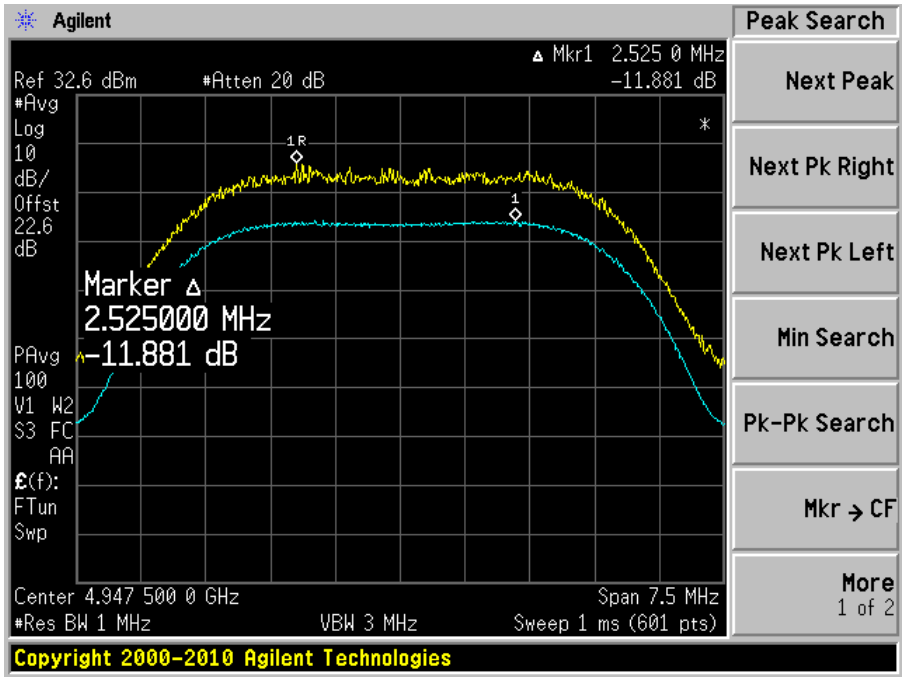
**5 MHz Mode**

High Power Setting, Low Gain Antenna (9 dBi)

Low Channel Chain 0



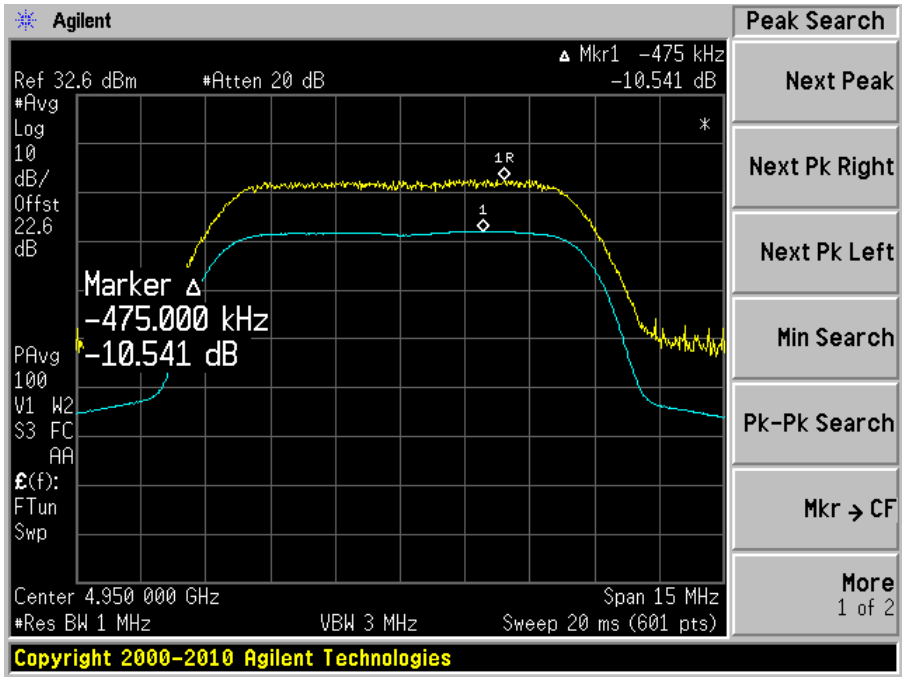

Low Channel Chain 1



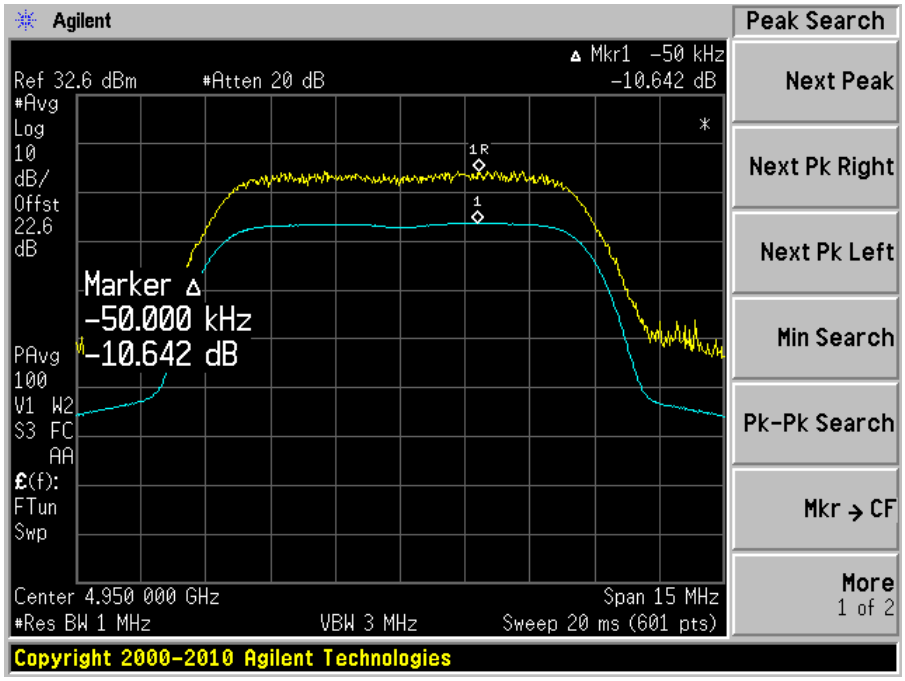
**10 MHz Mode**

High Power Setting, Low Gain Antenna (9 dBi)

Low Channel Chain 0



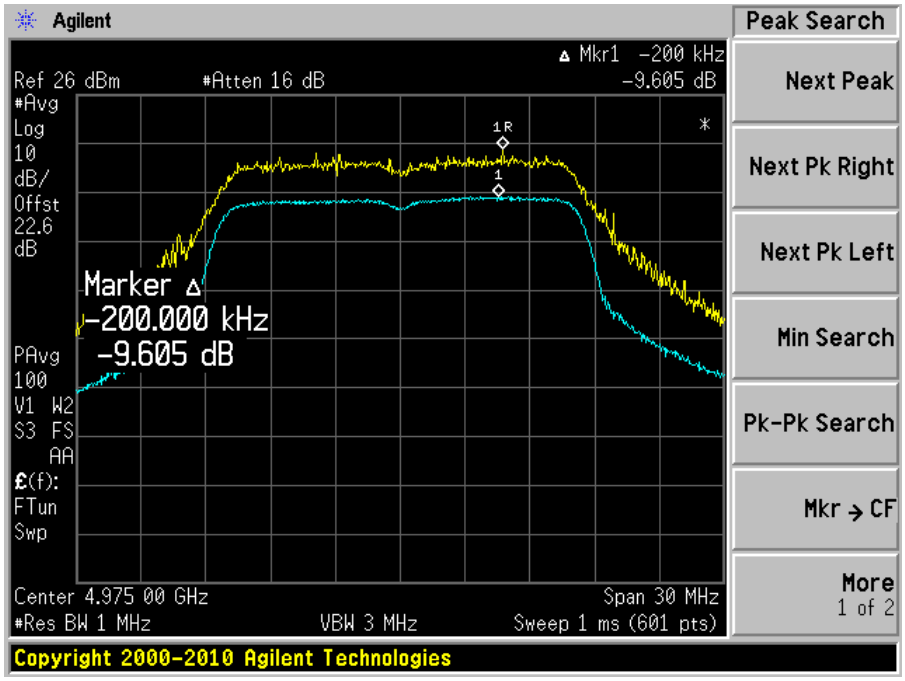

Low Channel Chain 1



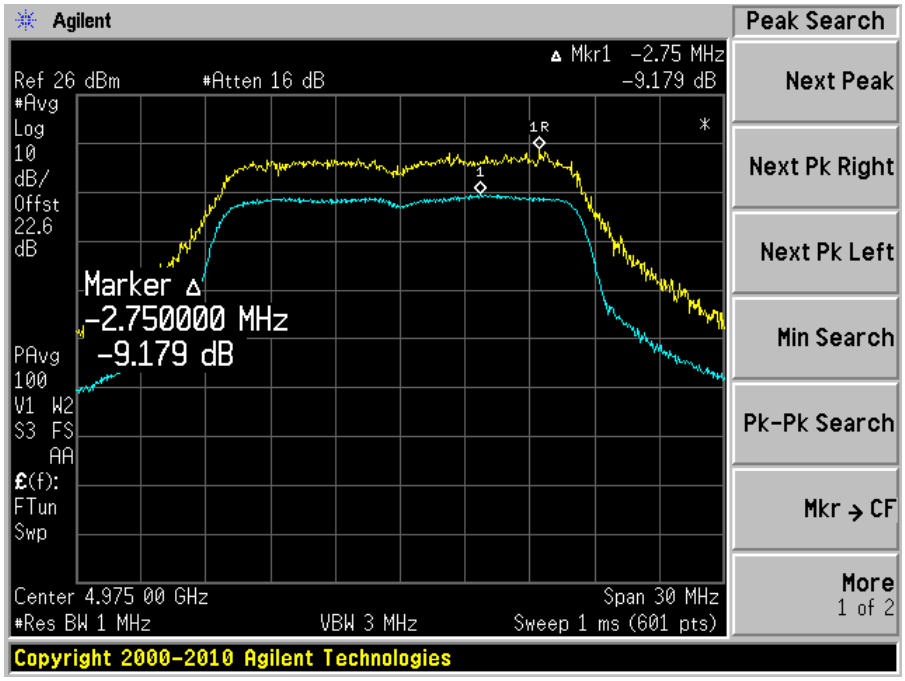
**802.11a Mode**

High Power Setting, Low Gain Antenna (9 dBi)

High Channel Chain 0



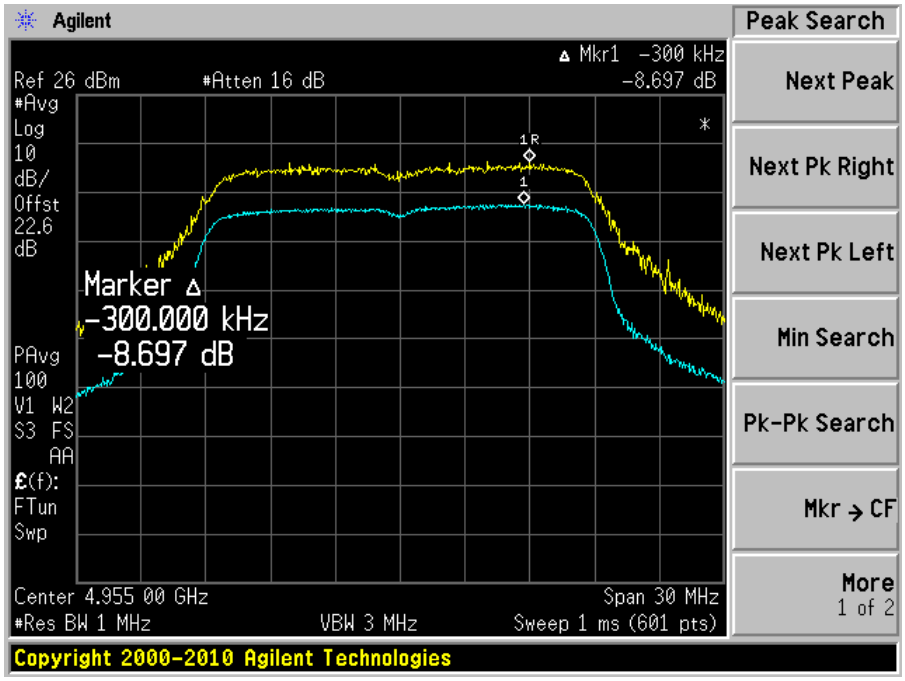

Low Channel Chain 1



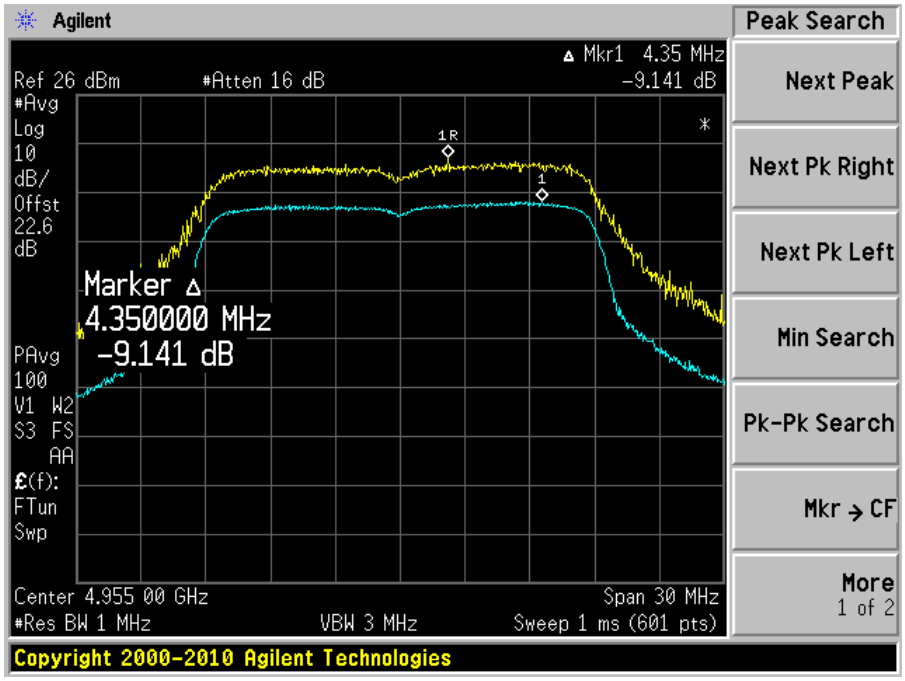
**802.11n HT20 Mode**

High Power Setting, Low Gain Antenna (9 dBi)

Low Channel Chain 0




Low Channel Chain 1



# 9 FCC §2.1055, §90.213 & IC §5.2 – Frequency Stability

## 9.1 Applicable Standards

FCC §90.213

For frequency range above 2450 MHz: Except for DSRCS equipment in the 5850-5925 MHz band, frequency stability is to be specified in the station authorization. Frequency stability for DSRCS equipment in the 5850-5925 MHz band is specified in subpart M of this part

IC RSS-111§5.2

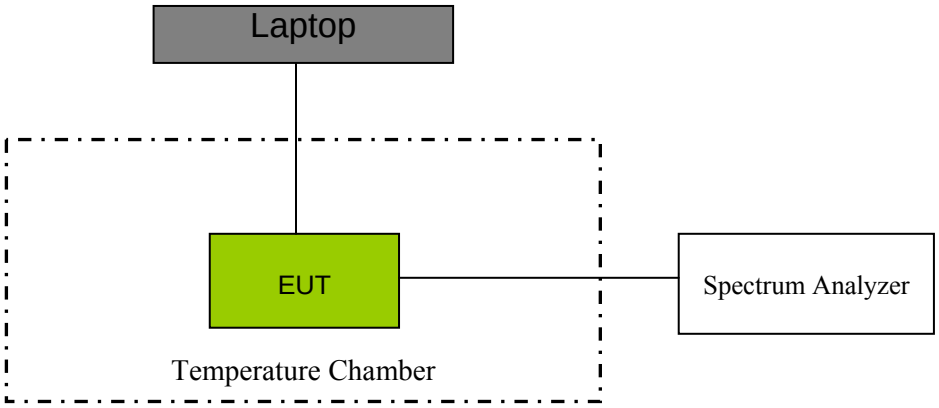
The applicant shall ensure frequency stability by showing that the occupied bandwidth is maintained within the band of operation when tested at the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

## 9.2 Test Setup Block Diagram and 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

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates | Calibration Cycle |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2012-09-29 | 1 year |
| Espec | Temperature Chamber | ESL-4CA | 18010 | 2013-02-07 | 1 Year |

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

## 9.4 Test Environmental Conditions

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

*The testing was performed by Wei Sun on 2013-06-03 on RF Site.*

## 9.5 Test Results

**5 MHz Mode**

Low Channel, 4942.5 MHz Chain 0

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4940.127000 | Pass |
| 120 Vac. -20 °C | 4940.137200 | Pass |
| 120 Vac. -10 °C | 4940.127216 | Pass |
| 120 Vac. 0 °C | 4940.129720 | Pass |
| 120 Vac. 10 °C | 4940.122900 | Pass |
| 120 Vac. 20 °C | 4940.122100 | Pass |
| 120 Vac. 30 °C | 4940.121000 | Pass |
| 120 Vac. 40 °C | 4940.123910 | Pass |
| 120 Vac. 50 °C | 4940.126700 | Pass |
| 102 Vac. 25 °C | 4940.121040 | Pass |
| 138 Vac. 25 °C | 4940.121240 | Pass |

Low Channel, 4942.5 MHz Chain 1

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4940.127100 | Pass |
| 120 Vac. -20 °C | 4940.123120 | Pass |
| 120 Vac. -10 °C | 4940.121250 | Pass |
| 120 Vac. 0 °C | 4940.127210 | Pass |
| 120 Vac. 10 °C | 4940.121088 | Pass |
| 120 Vac. 20 °C | 4940.123720 | Pass |
| 120 Vac. 30 °C | 4940.126700 | Pass |
| 120 Vac. 40 °C | 4940.137200 | Pass |
| 120 Vac. 50 °C | 4940.118800 | Pass |
| 102 Vac. 25 °C | 4940.116200 | Pass |
| 138 Vac. 25 °C | 4940.119600 | Pass |

High Channel, 4987.5 MHz Chain 0

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4989.820000 | Pass |
| 120 Vac. -20 °C | 4989.832000 | Pass |
| 120 Vac. -10 °C | 4989.806200 | Pass |
| 120 Vac. 0 °C | 4989.885000 | Pass |
| 120 Vac. 10 °C | 4989.802330 | Pass |
| 120 Vac. 20 °C | 4989.804710 | Pass |
| 120 Vac. 30 °C | 4989.887100 | Pass |
| 120 Vac. 40 °C | 4989.801080 | Pass |
| 120 Vac. 50 °C | 4989.909200 | Pass |
| 102 Vac. 25 °C | 4989.902620 | Pass |
| 138 Vac. 25 °C | 4989.900500 | Pass |

High Channel, 4987.5 MHz Chain 1

| Environment Condition | Measured Frequency (MHz) | Limit ( <4990 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4989.803880 | Pass |
| 120 Vac. -20 °C | 4989.807100 | Pass |
| 120 Vac. -10 °C | 4989.894600 | Pass |
| 120 Vac. 0 °C | 4989.802900 | Pass |
| 120 Vac. 10 °C | 4989.835400 | Pass |
| 120 Vac. 20 °C | 4989.805250 | Pass |
| 120 Vac. 30 °C | 4989.801540 | Pass |
| 120 Vac. 40 °C | 4989.806750 | Pass |
| 120 Vac. 50 °C | 4989.888000 | Pass |
| 102 Vac. 25 °C | 4989.801420 | Pass |
| 138 Vac. 25 °C | 4989.879200 | Pass |

**10 MHz Mode**

Low Channel, 4945 MHz Chain 0

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4940.470000 | Pass |
| 120 Vac. -20 °C | 4940.596700 | Pass |
| 120 Vac. -10 °C | 4940.404270 | Pass |
| 120 Vac. 0 °C | 4940.499600 | Pass |
| 120 Vac. 10 °C | 4940.488700 | Pass |
| 120 Vac. 20 °C | 4940.472010 | Pass |
| 120 Vac. 30 °C | 4940.421600 | Pass |
| 120 Vac. 40 °C | 4940.481840 | Pass |
| 120 Vac. 50 °C | 4940.491830 | Pass |
| 102 Vac. 25 °C | 4940.478000 | Pass |
| 138 Vac. 25 °C | 4940.482160 | Pass |

Low Channel, 4945 MHz Chain 1

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4940.498800 | Pass |
| 120 Vac. -20 °C | 4940.425600 | Pass |
| 120 Vac. -10 °C | 4940.433800 | Pass |
| 120 Vac. 0 °C | 4940.444900 | Pass |
| 120 Vac. 10 °C | 4940.413000 | Pass |
| 120 Vac. 20 °C | 4940.484500 | Pass |
| 120 Vac. 30 °C | 4940.496070 | Pass |
| 120 Vac. 40 °C | 4940.489800 | Pass |
| 120 Vac. 50 °C | 4940.497310 | Pass |
| 102 Vac. 25 °C | 4940.436100 | Pass |
| 138 Vac. 25 °C | 4940.441510 | Pass |

High Channel, 4985 MHz Chain 0

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4989.530000 | Pass |
| 120 Vac. -20 °C | 4989.544500 | Pass |
| 120 Vac. -10 °C | 4989.544700 | Pass |
| 120 Vac. 0 °C | 4989.470700 | Pass |
| 120 Vac. 10 °C | 4989.500040 | Pass |
| 120 Vac. 20 °C | 4989.488900 | Pass |
| 120 Vac. 30 °C | 4989.504100 | Pass |
| 120 Vac. 40 °C | 4989.499350 | Pass |
| 120 Vac. 50 °C | 4989.481700 | Pass |
| 102 Vac. 25 °C | 4989.433210 | Pass |
| 138 Vac. 25 °C | 4989.485700 | Pass |

High Channel, 4985 MHz Chain 1

| Environment Condition | Measured Frequency (MHz) | Limit ( <4990 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4989.524100 | Pass |
| 120 Vac. -20 °C | 4989.498860 | Pass |
| 120 Vac. -10 °C | 4989.499470 | Pass |
| 120 Vac. 0 °C | 4989.490700 | Pass |
| 120 Vac. 10 °C | 4989.500400 | Pass |
| 120 Vac. 20 °C | 4989.488900 | Pass |
| 120 Vac. 30 °C | 4989.500140 | Pass |
| 120 Vac. 40 °C | 4989.499350 | Pass |
| 120 Vac. 50 °C | 4989.481700 | Pass |
| 102 Vac. 25 °C | 4989.492810 | Pass |
| 138 Vac. 25 °C | 4989.487720 | Pass |

**802.11a Mode**

Low Channel, 4950 MHz Chain 0

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4940.761000 | Pass |
| 120 Vac. -20 °C | 4940.700370 | Pass |
| 120 Vac. -10 °C | 4940.756500 | Pass |
| 120 Vac. 0 °C | 4940.699470 | Pass |
| 120 Vac. 10 °C | 4940.701180 | Pass |
| 120 Vac. 20 °C | 4940.700280 | Pass |
| 120 Vac. 30 °C | 4940.702070 | Pass |
| 120 Vac. 40 °C | 4940.699670 | Pass |
| 120 Vac. 50 °C | 4940.702470 | Pass |
| 102 Vac. 25 °C | 4940.700890 | Pass |
| 138 Vac. 25 °C | 4940.703500 | Pass |

Low Channel, 4950 MHz Chain 1

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4940.704600 | Pass |
| 120 Vac. -20 °C | 4940.709800 | Pass |
| 120 Vac. -10 °C | 4940.695500 | Pass |
| 120 Vac. 0 °C | 4940.722000 | Pass |
| 120 Vac. 10 °C | 4940.704030 | Pass |
| 120 Vac. 20 °C | 4940.708500 | Pass |
| 120 Vac. 30 °C | 4940.699800 | Pass |
| 120 Vac. 40 °C | 4940.696260 | Pass |
| 120 Vac. 50 °C | 4940.701630 | Pass |
| 102 Vac. 25 °C | 4940.702200 | Pass |
| 138 Vac. 25 °C | 4940.703290 | Pass |

High Channel, 4980 MHz Chain 0

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4989.910900 | Pass |
| 120 Vac. -20 °C | 4989.901124 | Pass |
| 120 Vac. -10 °C | 4989.901210 | Pass |
| 120 Vac. 0 °C | 4989.906700 | Pass |
| 120 Vac. 10 °C | 4989.902290 | Pass |
| 120 Vac. 20 °C | 4989.902790 | Pass |
| 120 Vac. 30 °C | 4989.919732 | Pass |
| 120 Vac. 40 °C | 4989.901120 | Pass |
| 120 Vac. 50 °C | 4989.901250 | Pass |
| 102 Vac. 25 °C | 4989.901040 | Pass |
| 138 Vac. 25 °C | 4989.901420 | Pass |

High Channel, 4980 MHz Chain 1

| Environment Condition | Measured Frequency (MHz) | Limit ( <4990 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4989.902710 | Pass |
| 120 Vac. -20 °C | 4989.901960 | Pass |
| 120 Vac. -10 °C | 4989.902670 | Pass |
| 120 Vac. 0 °C | 4989.900880 | Pass |
| 120 Vac. 10 °C | 4989.901080 | Pass |
| 120 Vac. 20 °C | 4989.901670 | Pass |
| 120 Vac. 30 °C | 4989.903120 | Pass |
| 120 Vac. 40 °C | 4989.901620 | Pass |
| 120 Vac. 50 °C | 4989.902380 | Pass |
| 102 Vac. 25 °C | 4989.900420 | Pass |
| 138 Vac. 25 °C | 4989.903920 | Pass |

**802.11n HT20 Mode**

Low Channel 4950 MHz Chain 0

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4940.121000 | Pass |
| 120 Vac. -20 °C | 4940.120321 | Pass |
| 120 Vac. -10 °C | 4940.122330 | Pass |
| 120 Vac. 0 °C | 4940.119871 | Pass |
| 120 Vac. 10 °C | 4940.191200 | Pass |
| 120 Vac. 20 °C | 4940.190050 | Pass |
| 120 Vac. 30 °C | 4940.119850 | Pass |
| 120 Vac. 40 °C | 4940.120620 | Pass |
| 120 Vac. 50 °C | 4940.124710 | Pass |
| 102 Vac. 25 °C | 4940.120108 | Pass |
| 138 Vac. 25 °C | 4940.120262 | Pass |

Low Channel 4950 MHz Chain 1

| Environment Condition | Measured Frequency (MHz) | Limit (> 4940 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4940.120388 | Pass |
| 120 Vac. -20 °C | 4940.120710 | Pass |
| 120 Vac. -10 °C | 4940.119460 | Pass |
| 120 Vac. 0 °C | 4940.129600 | Pass |
| 120 Vac. 10 °C | 4940.120354 | Pass |
| 120 Vac. 20 °C | 4940.125250 | Pass |
| 120 Vac. 30 °C | 4940.120154 | Pass |
| 120 Vac. 40 °C | 4940.123750 | Pass |
| 120 Vac. 50 °C | 4940.198800 | Pass |
| 102 Vac. 25 °C | 4940.120142 | Pass |
| 138 Vac. 25 °C | 4940.197920 | Pass |

High Channel 4980 MHz Chain 0

| Environment Condition | Measured Frequency (MHz) | Limit ( <4990 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4989.109010 | Pass |
| 120 Vac. -20 °C | 4989.104200 | Pass |
| 120 Vac. -10 °C | 4989.109670 | Pass |
| 120 Vac. 0 °C | 4989.099960 | Pass |
| 120 Vac. 10 °C | 4989.108870 | Pass |
| 120 Vac. 20 °C | 4989.101020 | Pass |
| 120 Vac. 30 °C | 4989.102160 | Pass |
| 120 Vac. 40 °C | 4989.101830 | Pass |
| 120 Vac. 50 °C | 4989.102430 | Pass |
| 102 Vac. 25 °C | 4989.098780 | Pass |
| 138 Vac. 25 °C | 4989.103100 | Pass |

High Channel 4980 MHz Chain 1

| Environment Condition | Measured Frequency (MHz) | Limit ( <4990 MHz) |
|---|---|---|
| 120 Vac. -30 °C | 4989.099880 | Pass |
| 120 Vac. -20 °C | 4989.102560 | Pass |
| 120 Vac. -10 °C | 4989.103320 | Pass |
| 120 Vac. 0 °C | 4989.100490 | Pass |
| 120 Vac. 10 °C | 4989.101300 | Pass |
| 120 Vac. 20 °C | 4989.098450 | Pass |
| 120 Vac. 30 °C | 4989.099607 | Pass |
| 120 Vac. 40 °C | 4989.108980 | Pass |
| 120 Vac. 50 °C | 4989.099710 | Pass |
| 102 Vac. 25 °C | 4989.103610 | Pass |
| 138 Vac. 25 °C | 4989.104151 | Pass |

# 10 FCC §2.1046, §90.1215 & IC RSS-111 §5.3 – Power Spectral Density

## 10.1 Applicable Standards

FCC §90.1215

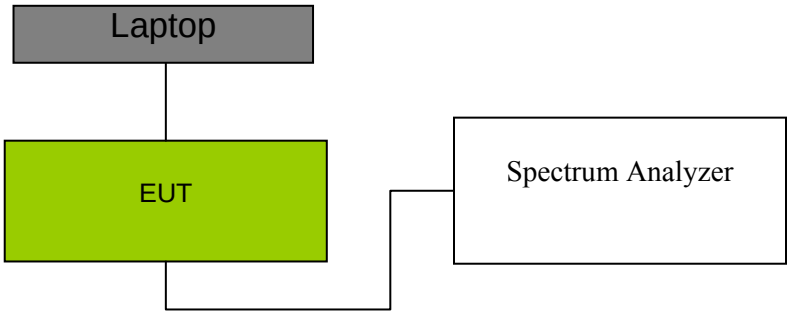
(b) Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the maximum conducted output power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi.

IC RSS-111§5.3

High-and low-power devices are also limited to a maximum power spectral density of 21 dBm/MHz and 8 dBm/MHz respectively. Devices using channel bandwidths other than those listed in Table 1 are permitted; however, the channel bandwidth shall not exceed 20 MHz and the devices shall comply with the maximum power spectral density limits of 21 dBm/MHz for high-power transmitters and 8 dBm/MHz for low-power transmitters. See SP 4940 MHz for antenna gain limits and operational restrictions for the device.

## 10.2 Test Setup Block Diagram and Test Procedure

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




## 10.3 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates | Calibration Cycle |
|---|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2012-09-29 | 1 year |

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

## 10.4 Test Environmental Conditions

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

*The testing was performed by Wei Sun on 2013-06-03 on RF Site.*

## 10.5 Test Results

**5 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 PDS (dBm) | Chain 1 PDS (dBm) | Highest PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4947.5 | -13.86 | -12.02 | -12.02 | -11* | -1.02 |
| Middle | 4967.5 | -14.37 | -12.12 | -12.12 | -11* | -1.12 |
| High | 4982.5 | -13.17 | -11.90 | -11.90 | -11* | -0.90 |

* Limit: -11 dBm=8 dBm(the limit)–[28(the gain of the low power mode)-9(the limit of the highest gain)]

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 PDS (dBm) | Chain 1 PDS (dBm) | Highest PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4947.5 | 4.86 | 7.09 | 7.09 | 8 | -0.91 |
| Middle | 4967.5 | 4.96 | 6.46 | 6.46 | 8 | -1.54 |
| High | 4982.5 | 4.08 | 6.57 | 6.57 | 8 | -1.43 |

**10 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 PDS (dBm) | Chain 1 PDS (dBm) | Highest PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4950 | -14.81 | -12.46 | -12.46 | -11* | -1.46 |
| Middle | 4965 | -14.10 | -12.17 | -12.17 | -11* | -1.17 |
| High | 4980 | -13.57 | -12.10 | -12.10 | -11* | -1.10 |

*Limit -11 dBm=8 dBm(the limit)–[28(the gain of the low power mode)-9(the limit of the highest gain)]

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 PDS (dBm) | Chain 1 PDS (dBm) | Highest PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4950 | 4.76 | 6.55 | 6.55 | 8 | -1.45 |
| Middle | 4965 | 4.22 | 6.52 | 6.52 | 8 | -1.48 |
| High | 4980 | 4.41 | 6.39 | 6.39 | 8 | -1.61 |

**802.11a Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 PDS (dBm) | Chain 1 PDS (dBm) | Total PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4955 | -20.49 | -19.48 | -16.95 | -11 | -5.95 |
| High | 4975 | -20.36 | -18.91 | -16.56 | -11 | -5.56 |

* Limit: -11 dBm=8 dBm(the limit)–[28(the gain of the low power mode)-9(the limit of the highest gain)]

High Power Setting, Low Gain Antenna (9 dBi)

| Channel | Frequency (MHz) | Chain 0 PDS (dBm) | Chain 1 PDS (dBm) | Total PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4955 | 4.82 | 4.98 | 7.91 | 8 | -0.09 |
| High | 4975 | 4.95 | 4.94 | 7.96 | 8 | -0.04 |

**802.11n HT20 Mode**

Low Power Setting, High Gain Antenna (28 dBi)

| Channel | Frequency (MHz) | Chain 0 PDS (dBm) | Chain 1 PDS (dBm) | Total PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4955 | -21.31 | -19.32 | -17.19 | -11 | -6.19 |
| High | 4975 | -19.79 | -18.97 | -16.35 | -11 | -5.35 |

* Limit: -11 dBm=8 dBm(the limit)–[28(the gain of the low power mode)-9(the limit of the highest gain)]

High Power Setting, Low Gain Antenna (9 dBi)

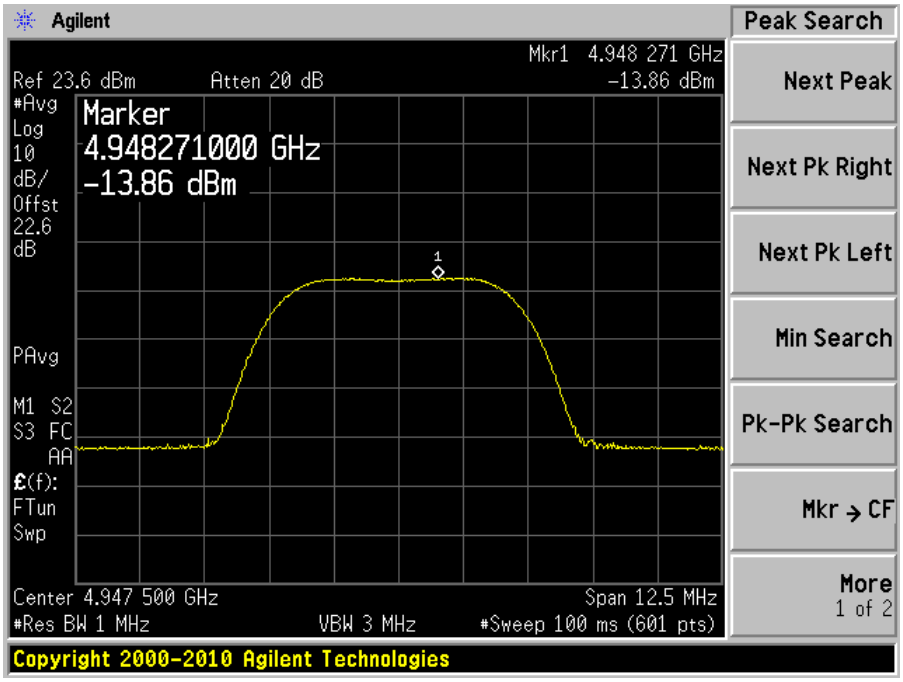
| Channel | Frequency (MHz) | Chain 0 PDS (dBm) | Chain 1 PDS (dBm) | Total PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| Low | 4955 | 4.74 | 4.83 | 7.80 | 8 | -0.20 |
| High | 4975 | 4.85 | 4.47 | 7.67 | 8 | -0.33 |

Please refer to the following plots.

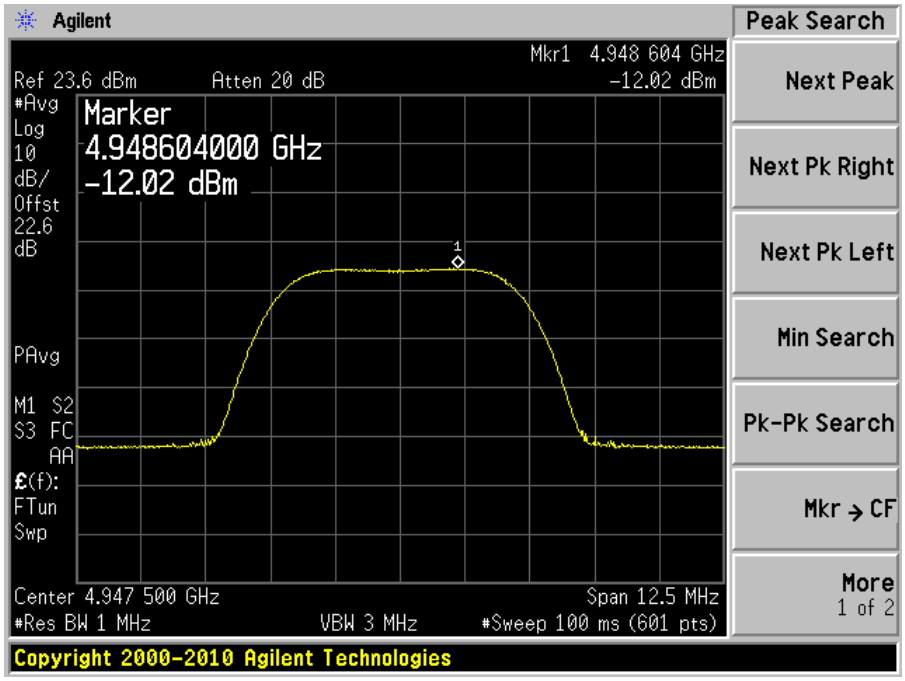
**5 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

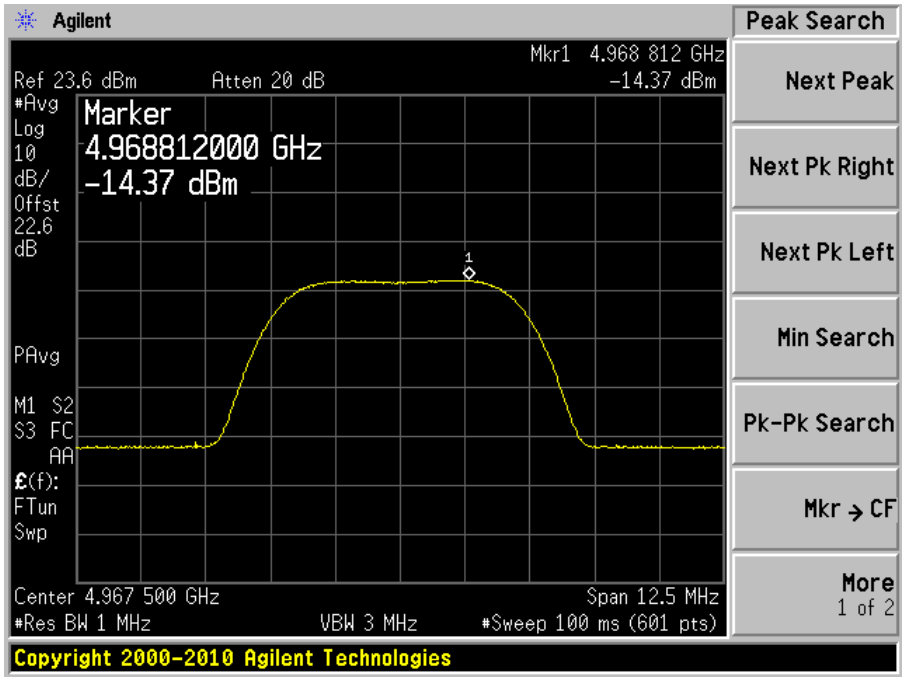
Low Channel, Chain 0



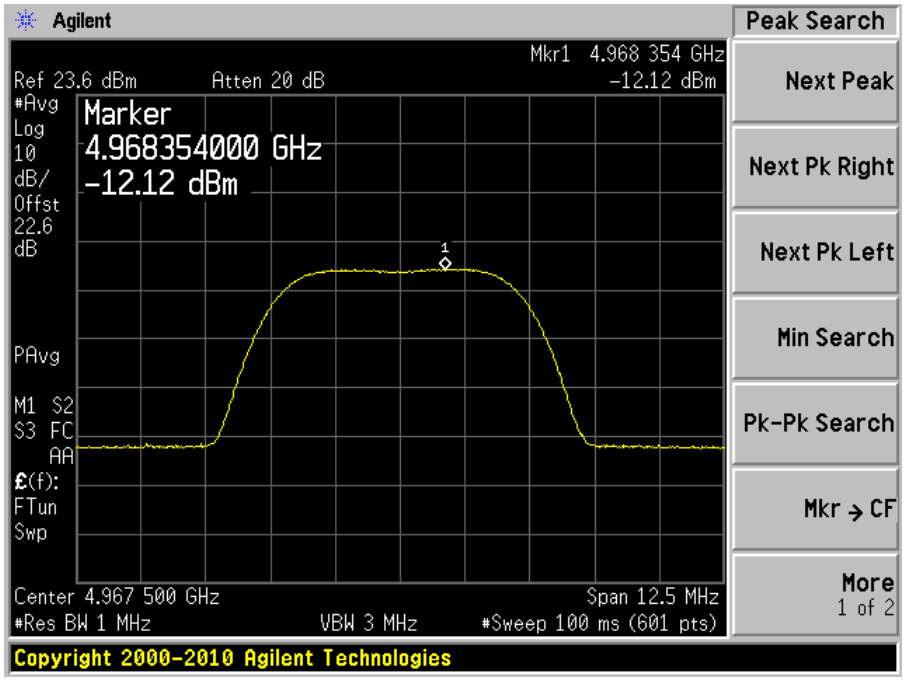

Low Channel, Chain 1



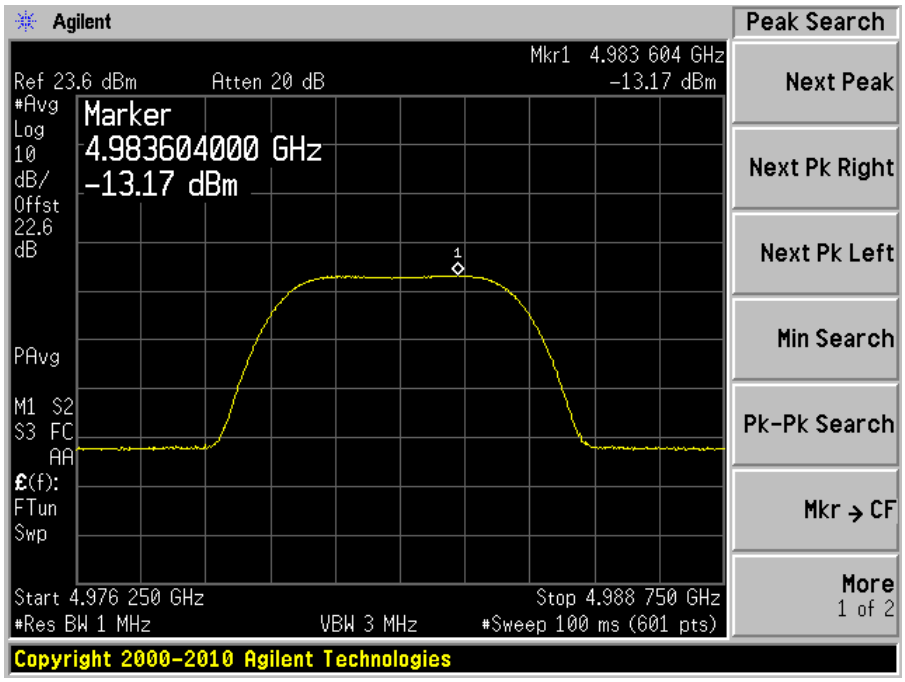
Middle Channel, Chain 0



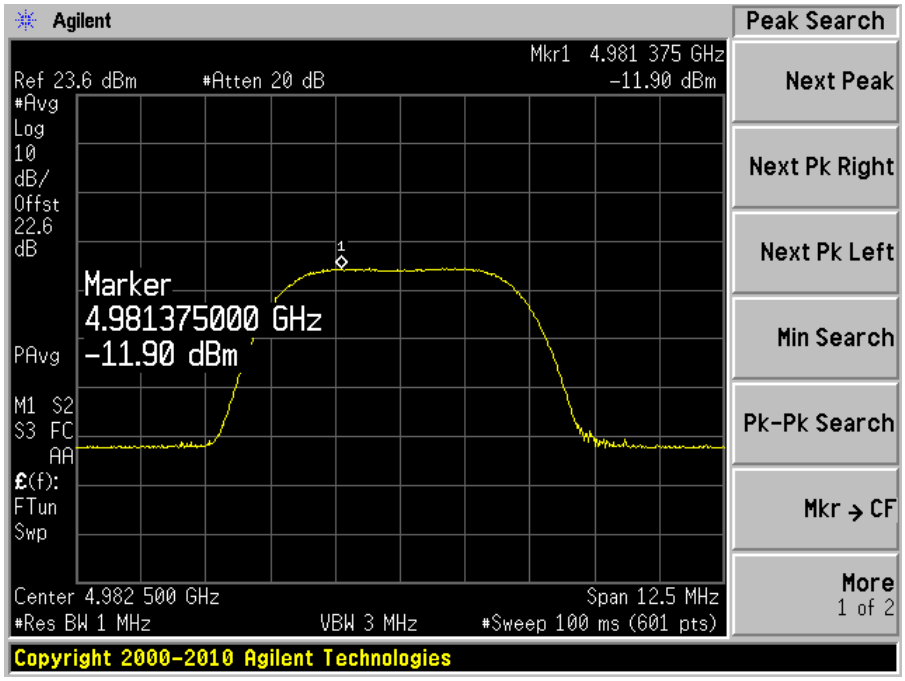

Middle Channel, Chain 1



High Channel, Chain 0

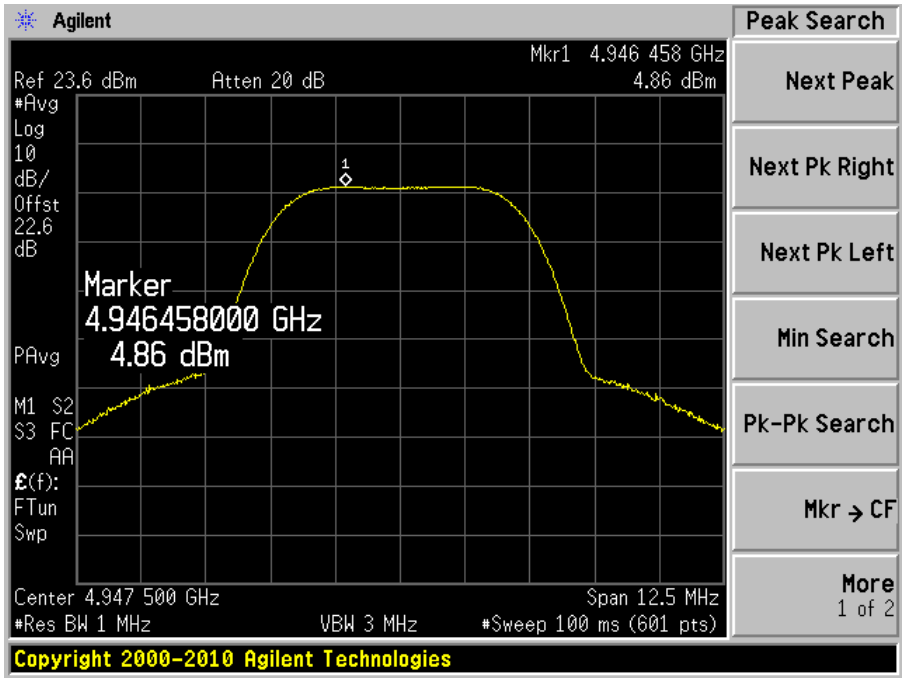



High Channel, Chain 1

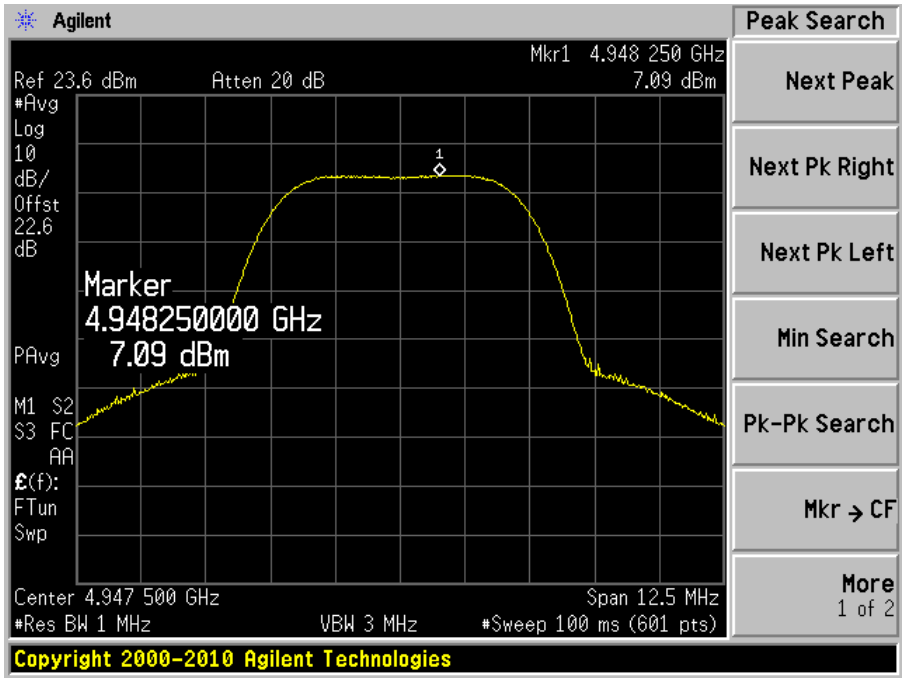


High Power Setting, High Gain Antenna (9 dBi)

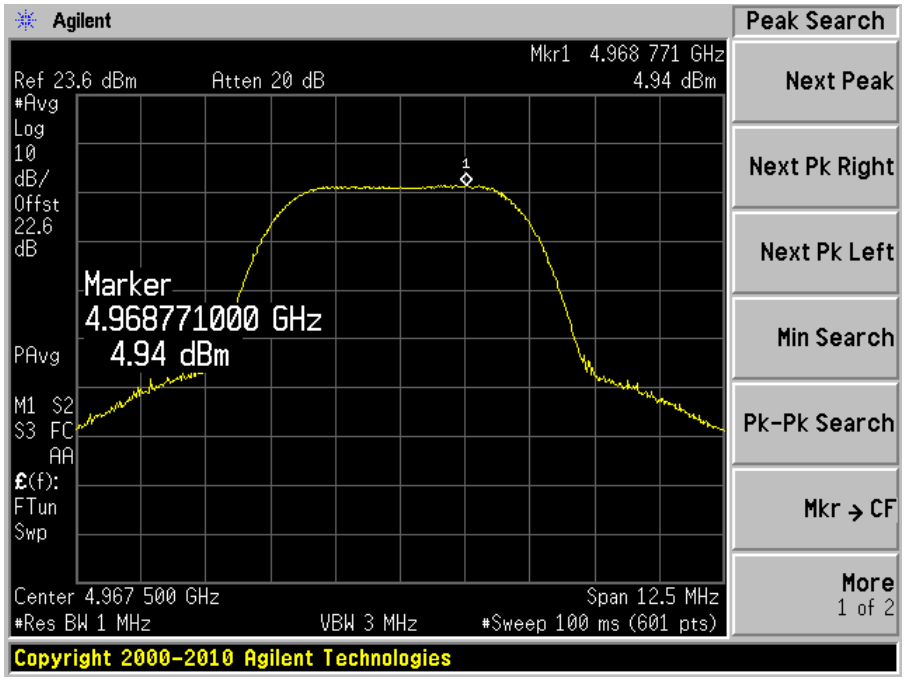
Low Channel, Chain 0



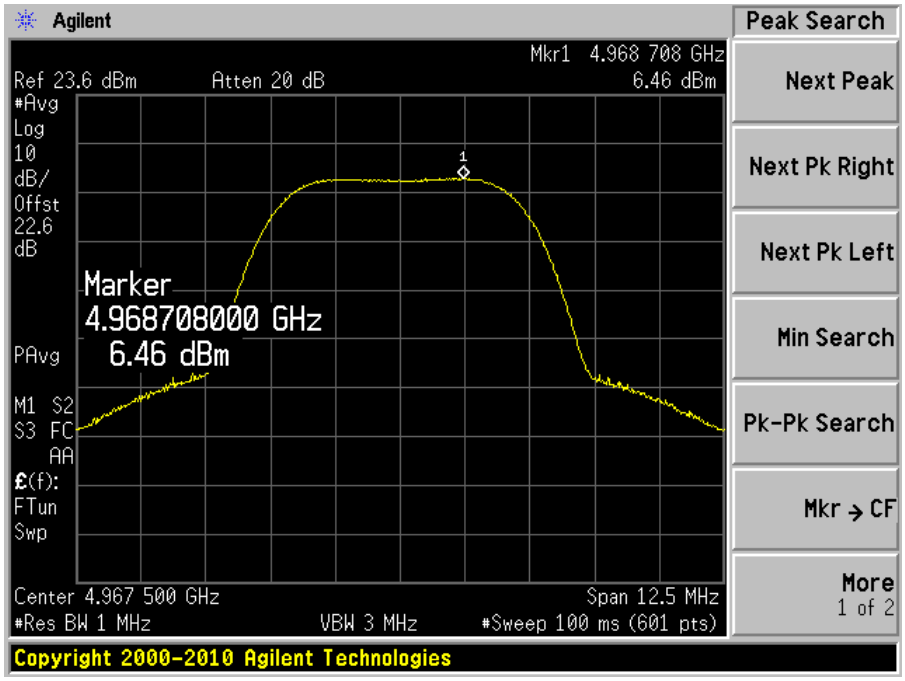

Low Channel, Chain 1



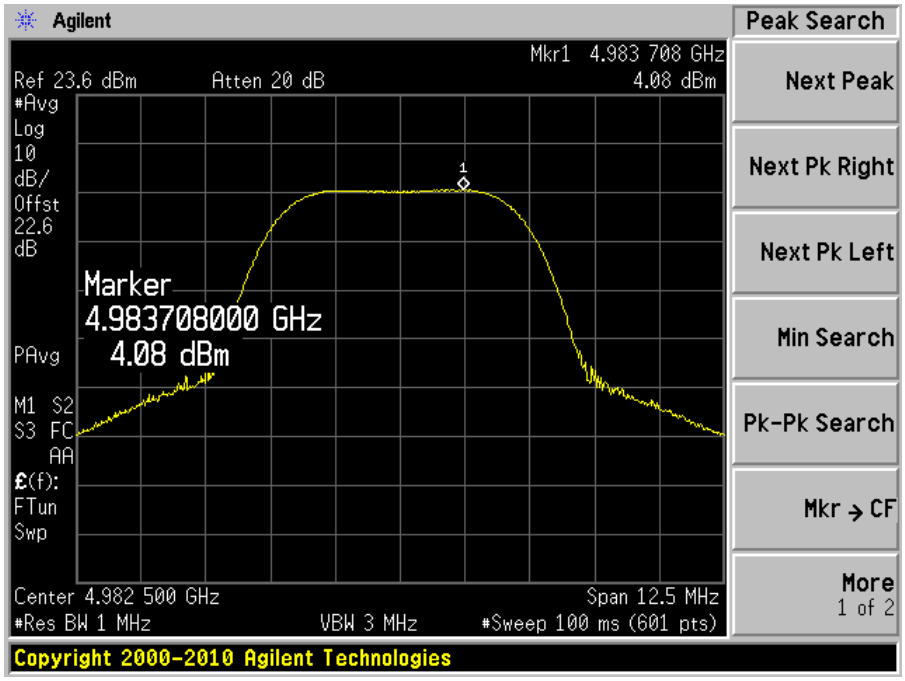
Middle Channel, Chain 0



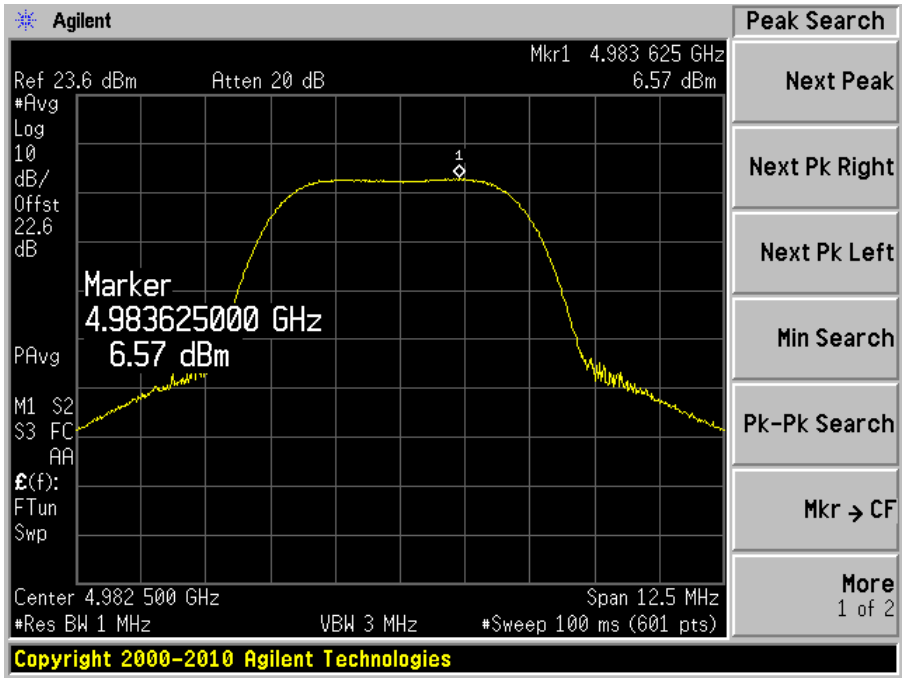

Middle Channel, Chain 1



High Channel, Chain 0



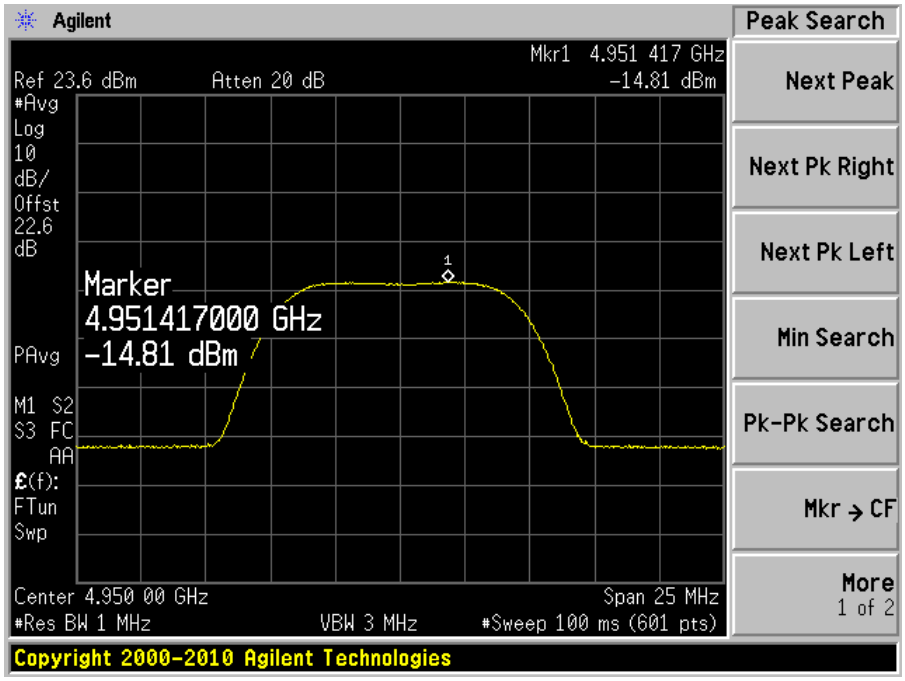

High Channel, Chain 1



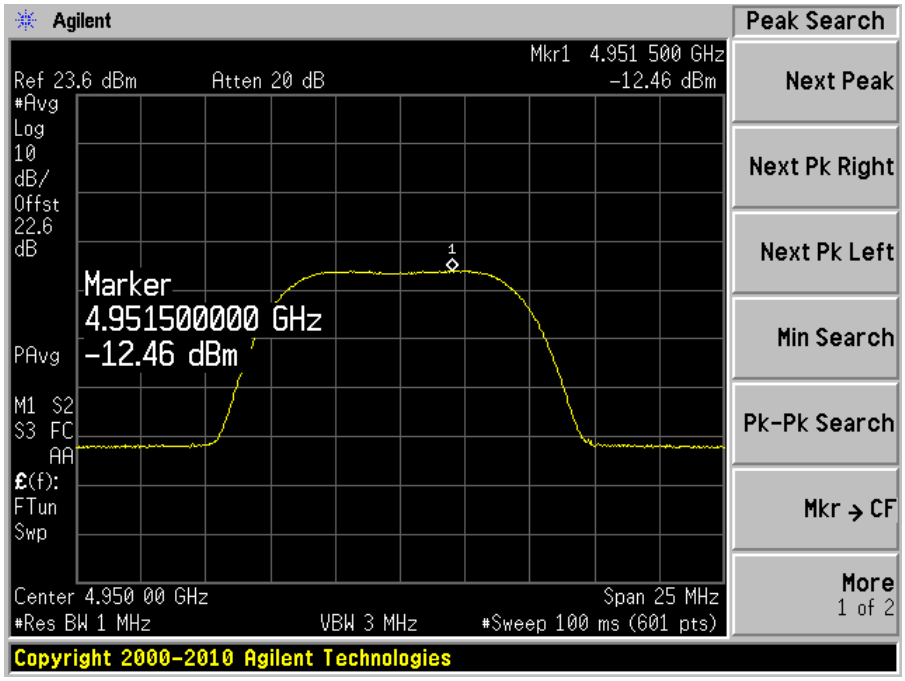
**10 MHz Mode**

Low Power Setting, High Gain Antenna (28 dBi)

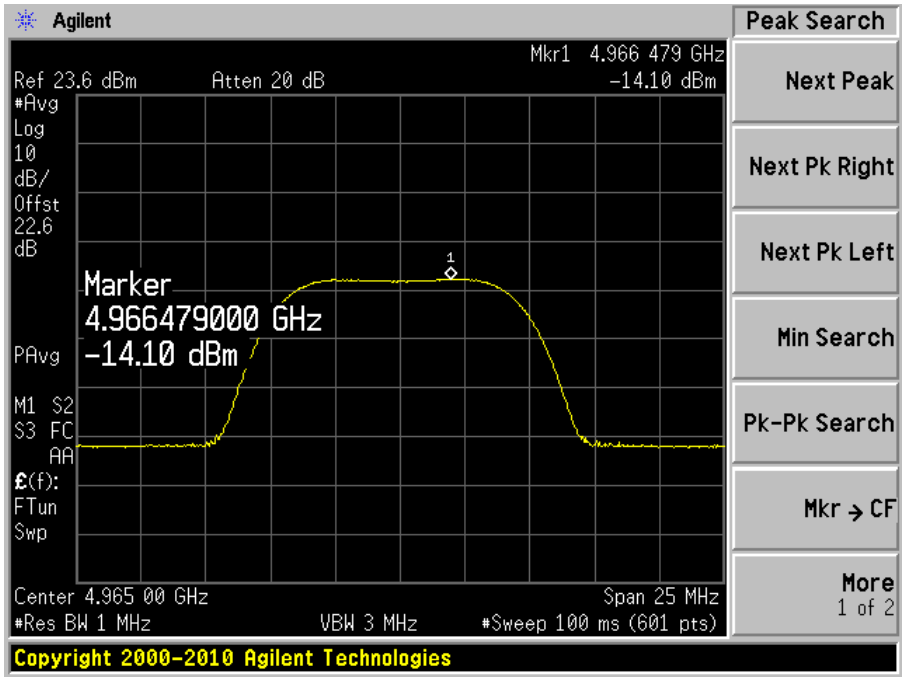
Low Channel, Chain 0



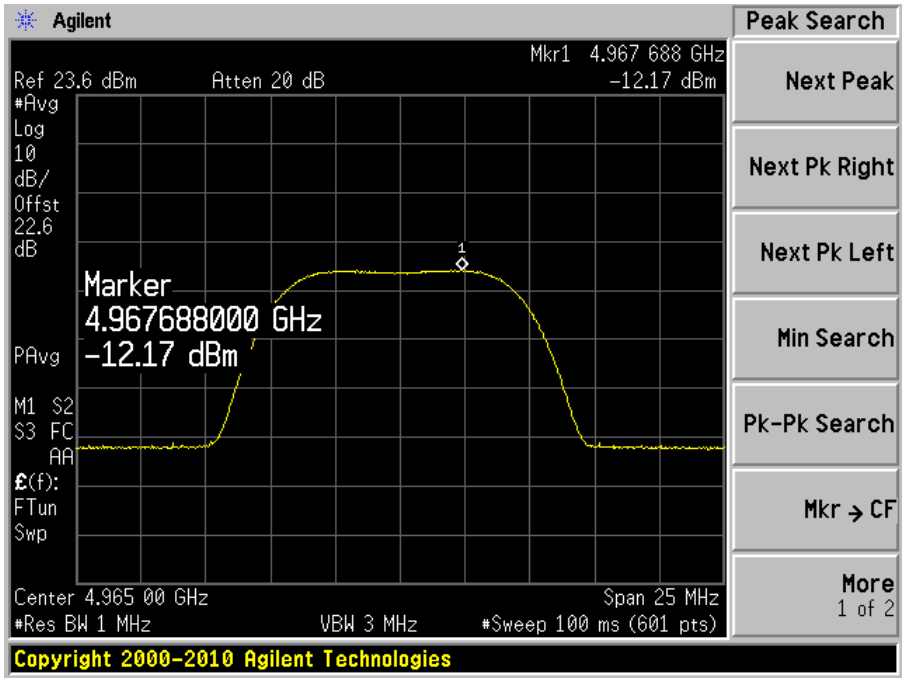

Low Channel, Chain 1



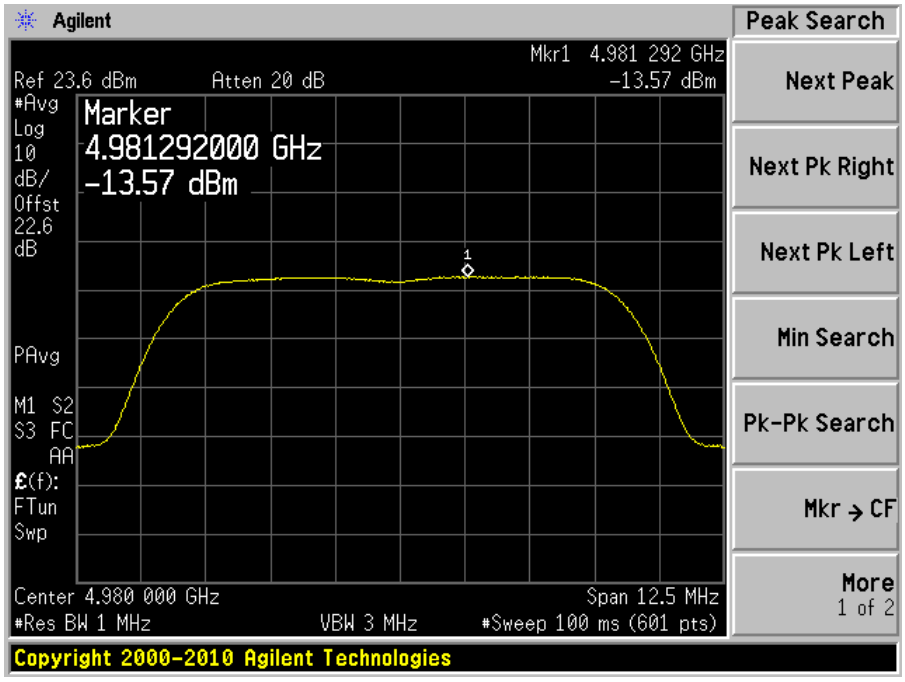
Middle Channel, Chain 0



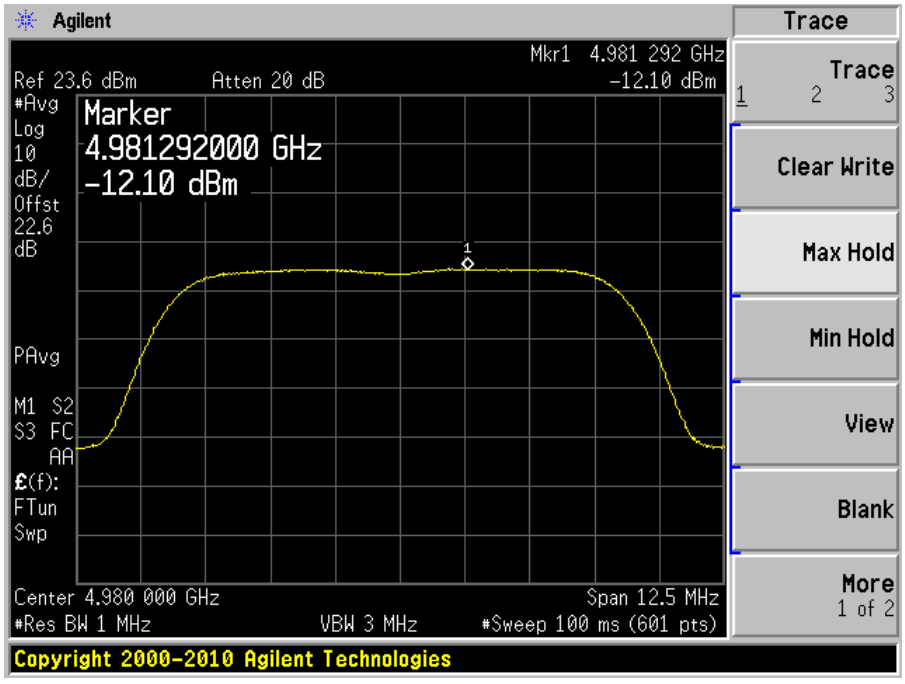

Middle Channel, Chain 1



High Channel, Chain 0

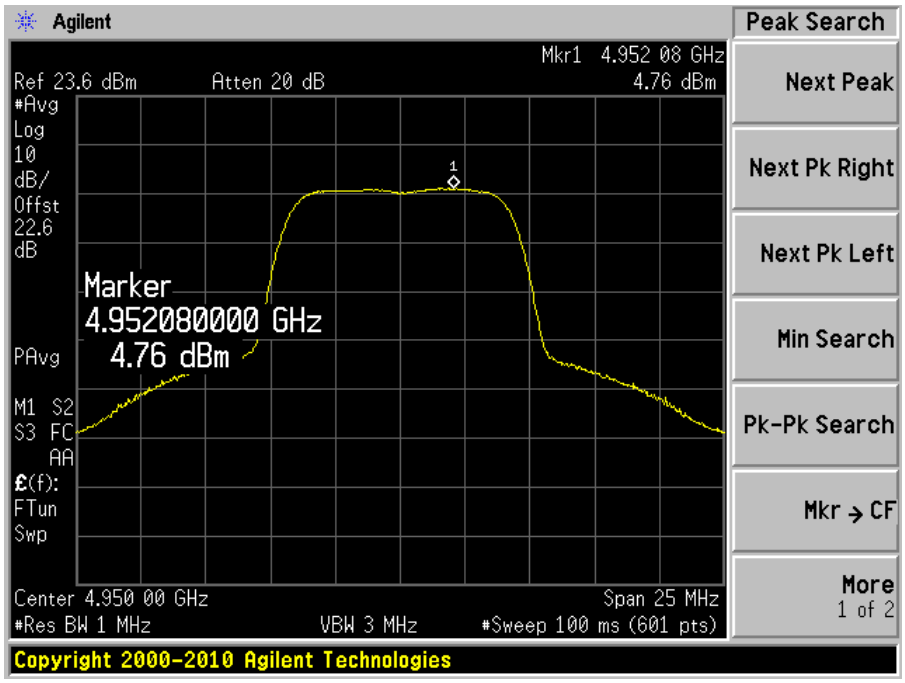



High Channel, Chain 1

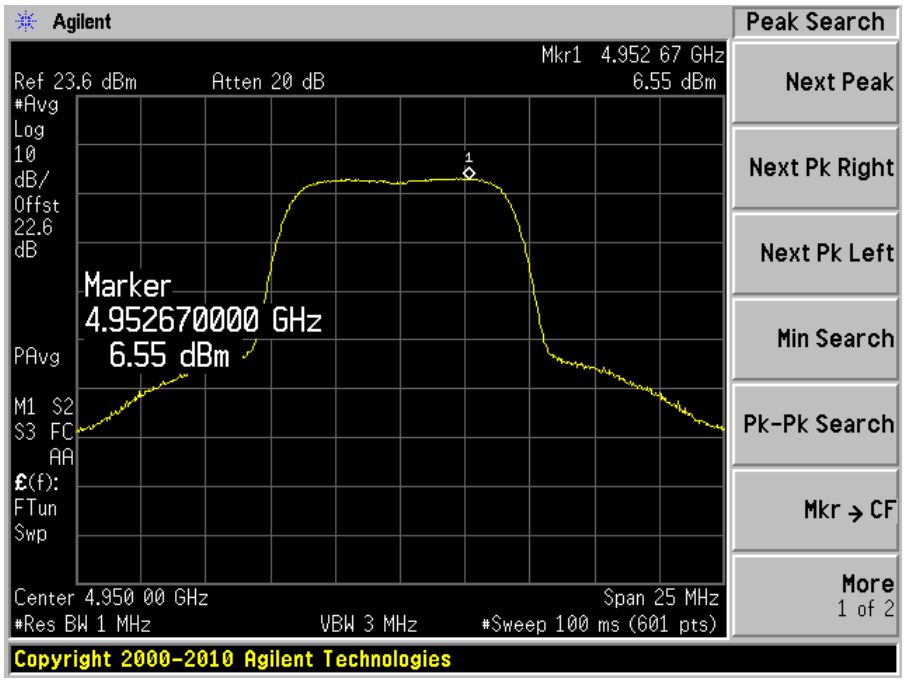


High Power Setting, High Gain Antenna (9 dBi)

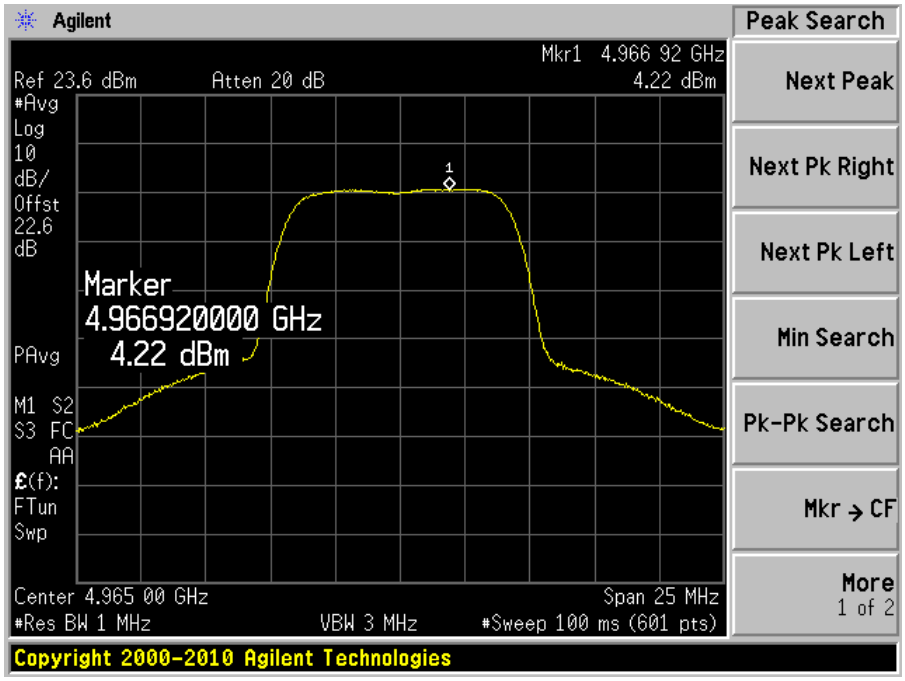
Low Channel, Chain 0



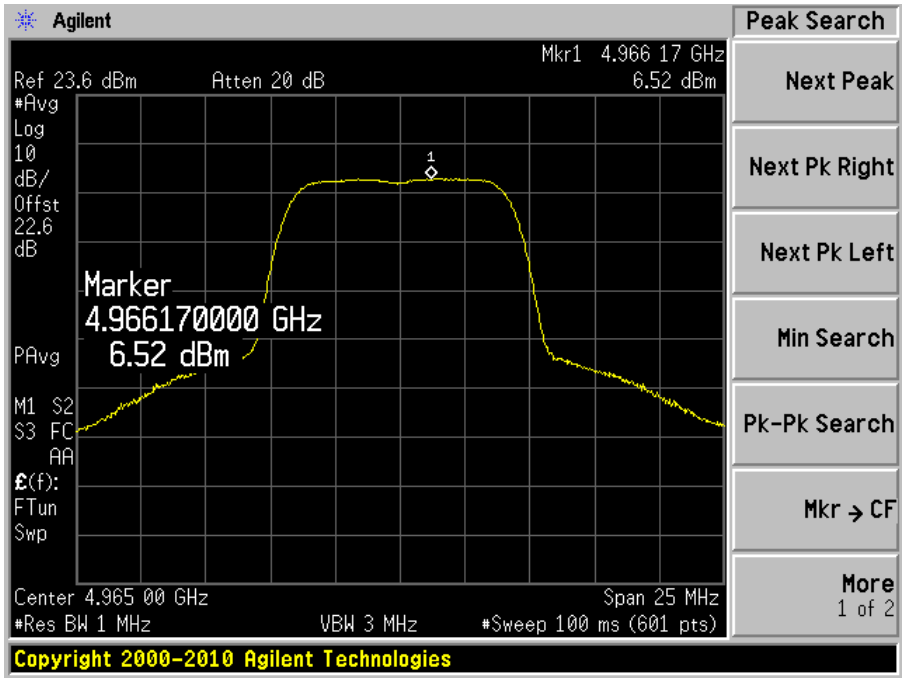

Low Channel, Chain 1



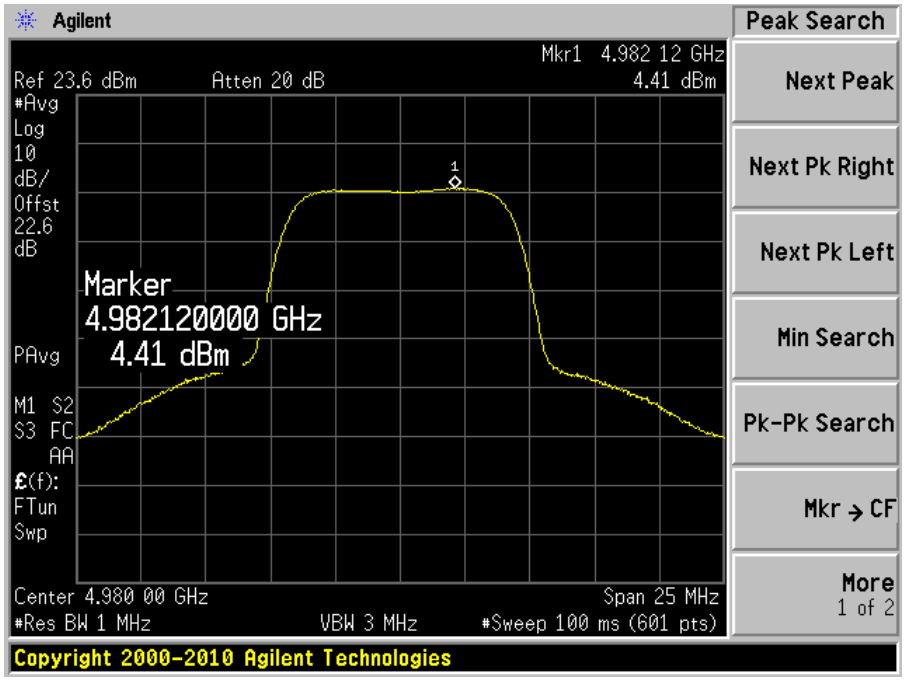
Middle Channel, Chain 0



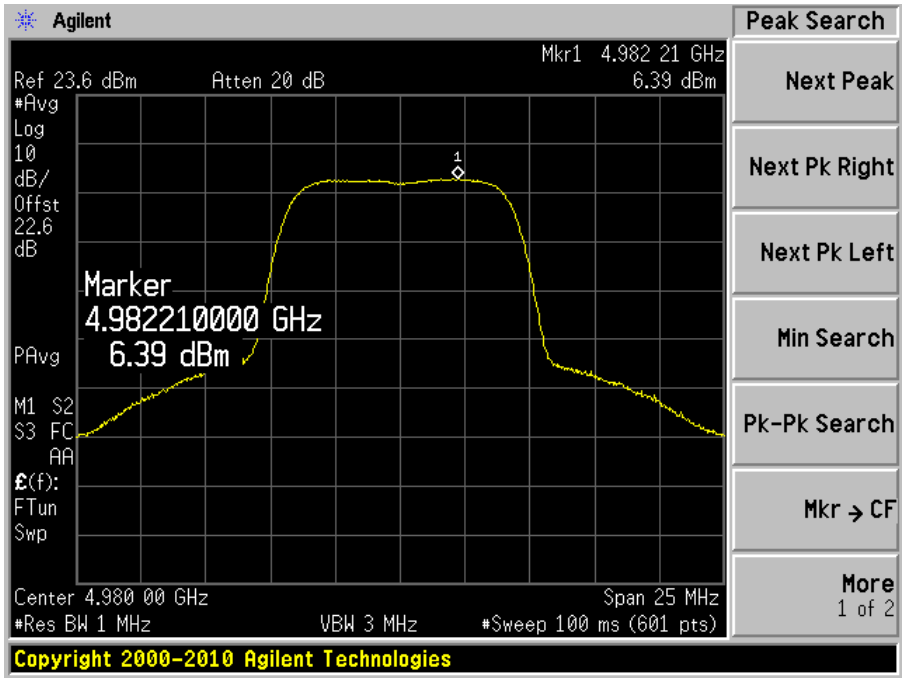

Middle Channel, Chain 1



High Channel, Chain 0



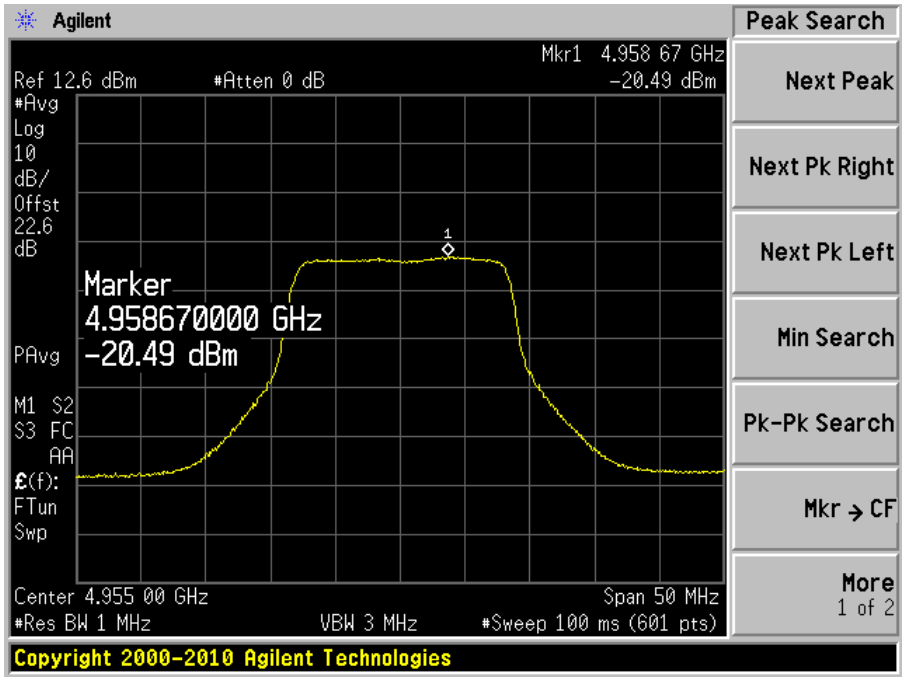

High Channel, Chain 1



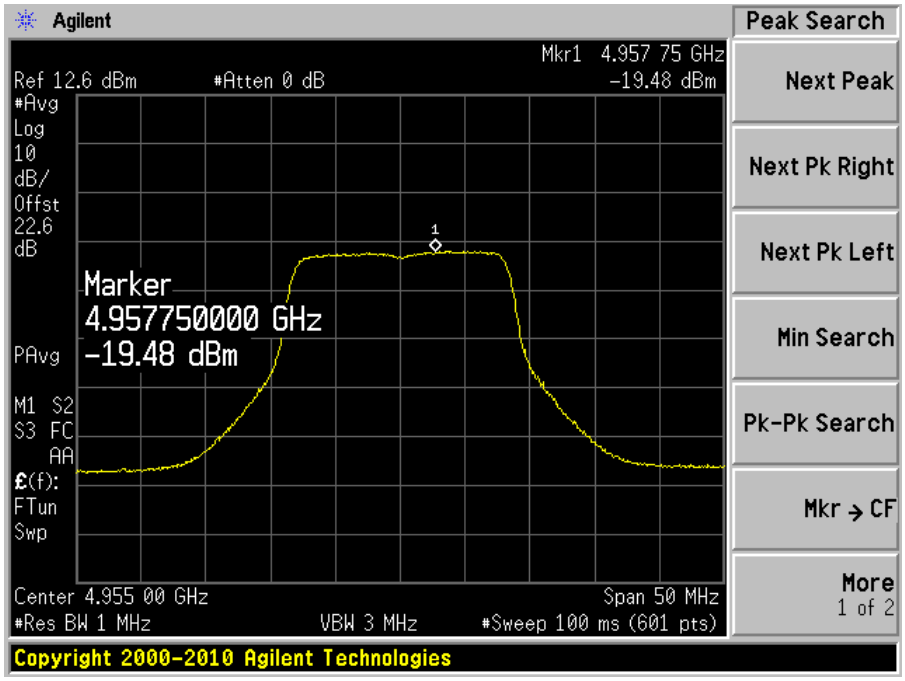
**802.11a Mode**

Low Power Setting, High Gain Antenna (28 dBi)

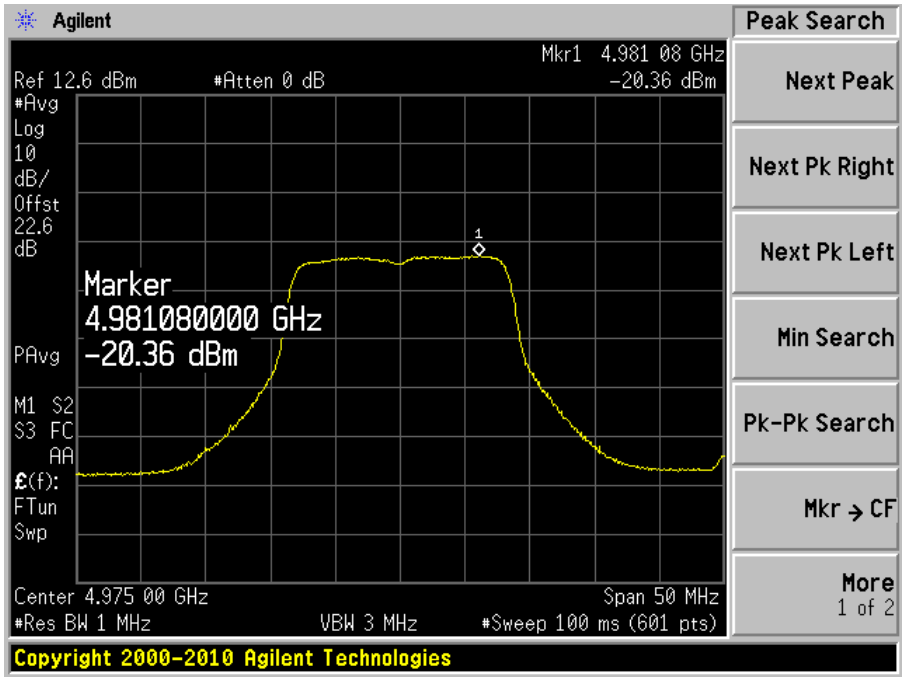
Low Channel, Chain 0



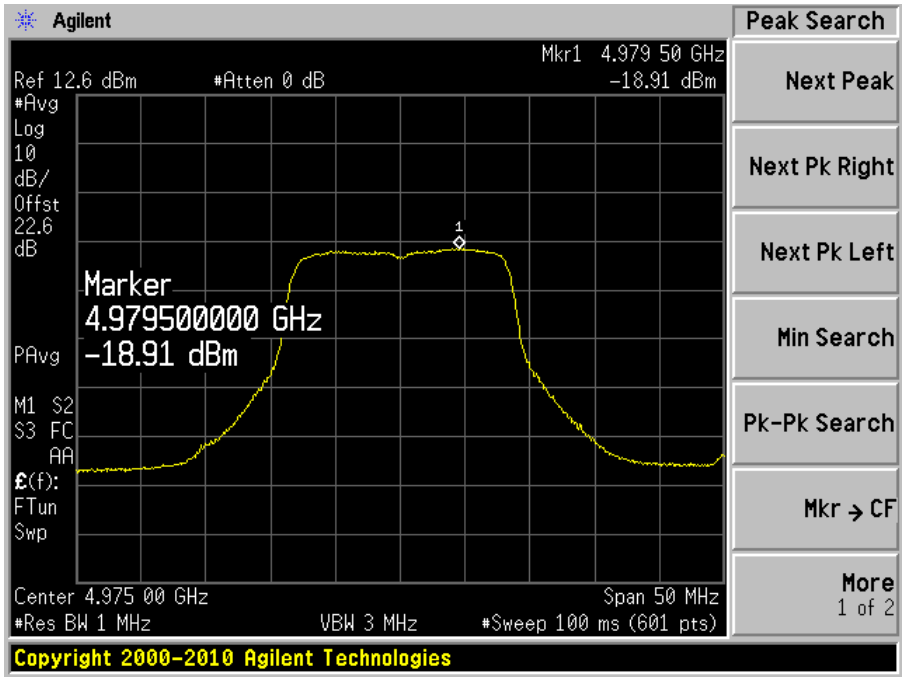

Low Channel, Chain 1



High Channel, Chain 0

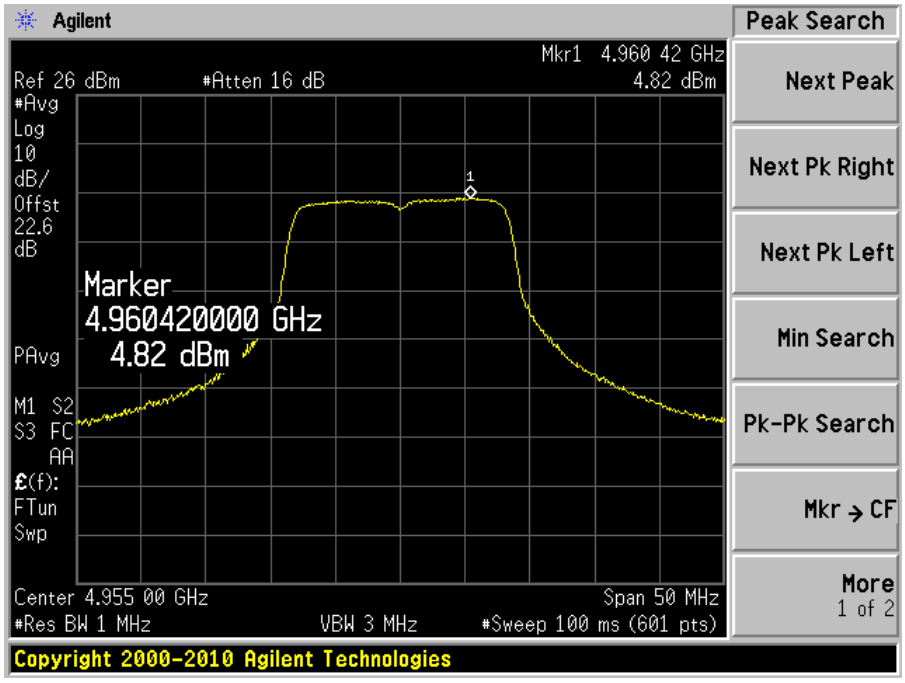



High Channel, Chain 1

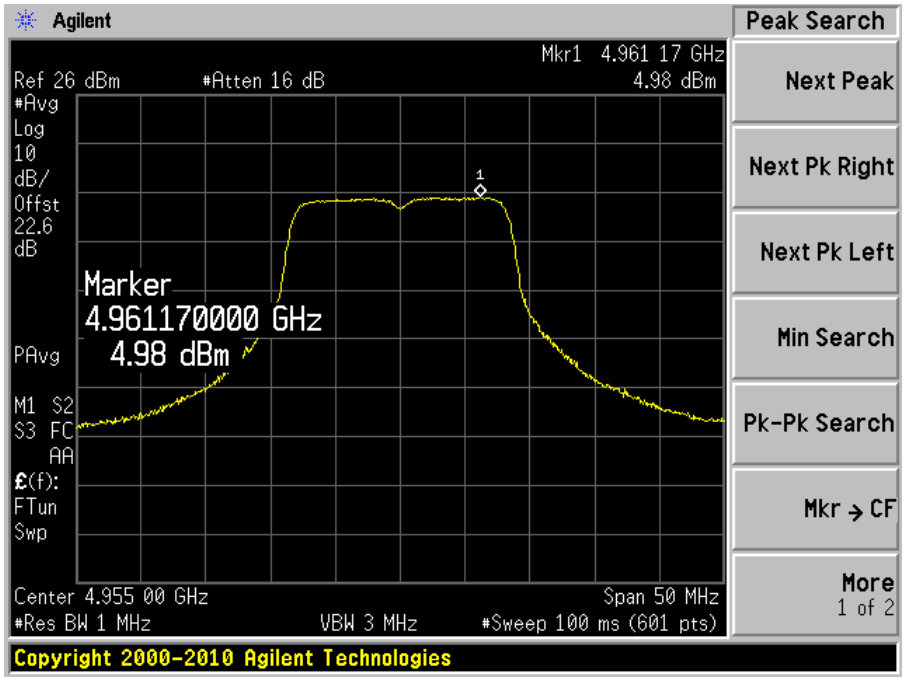


High Power Setting, High Gain Antenna (9 dBi)

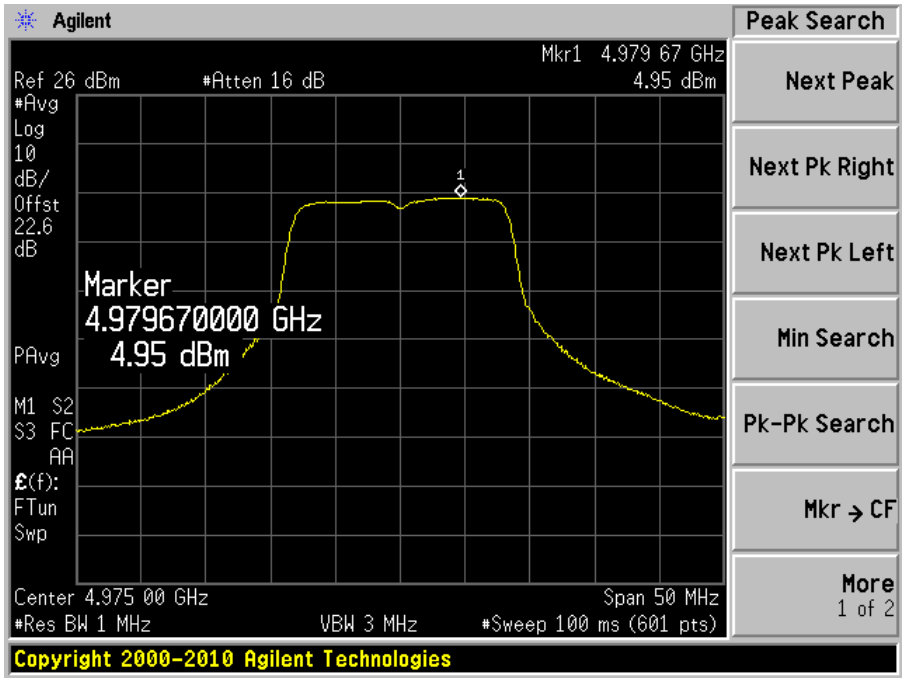
Low Channel, Chain 0



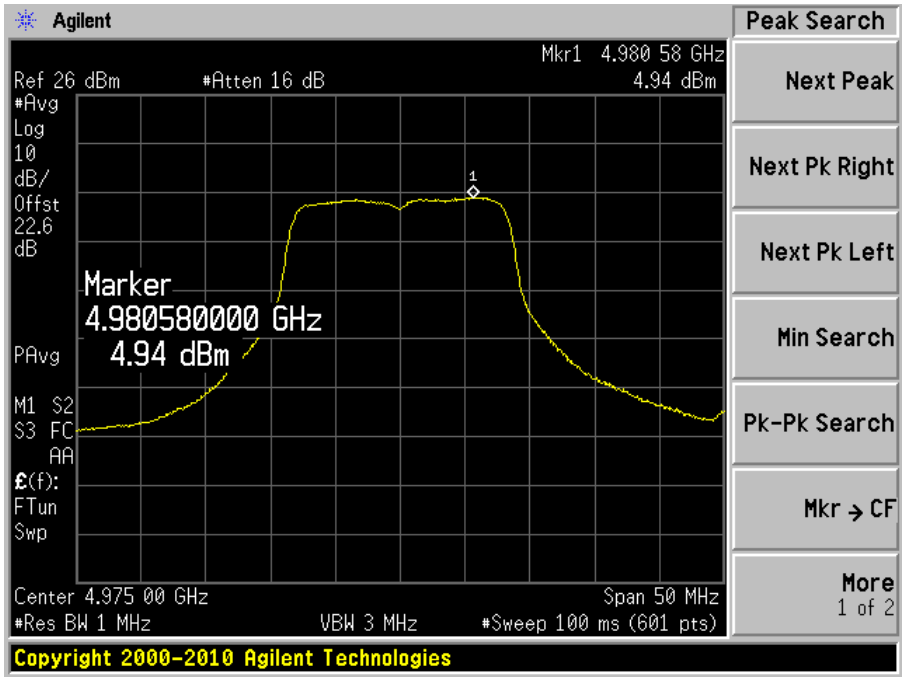

Low Channel, Chain 0



High Channel, Chain 0



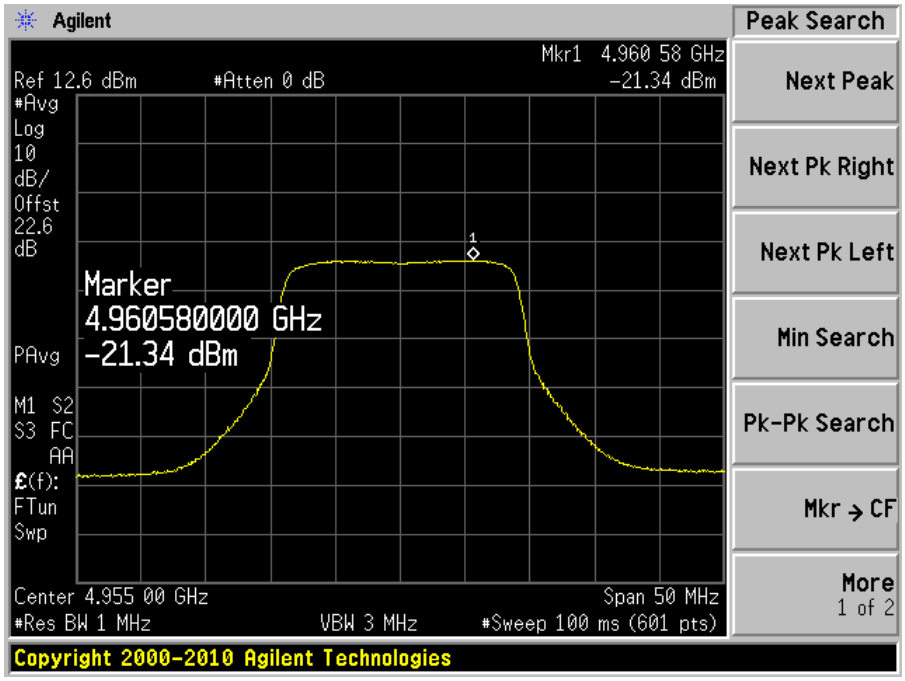

High Channel, Chain 1



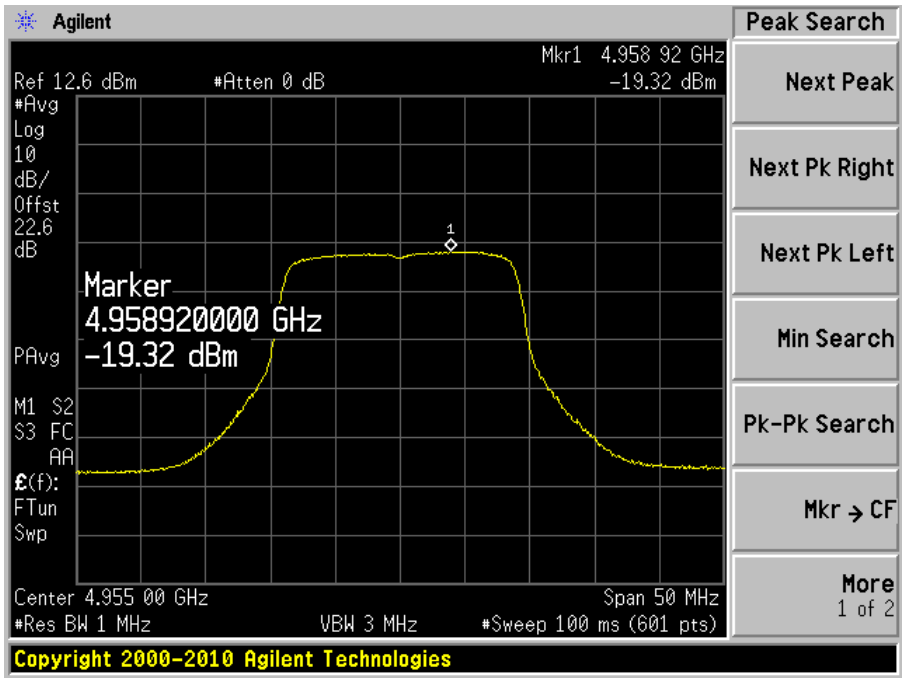
**802.11n HT20 Mode**

Low Power Setting, High Gain Antenna (28 dBi)

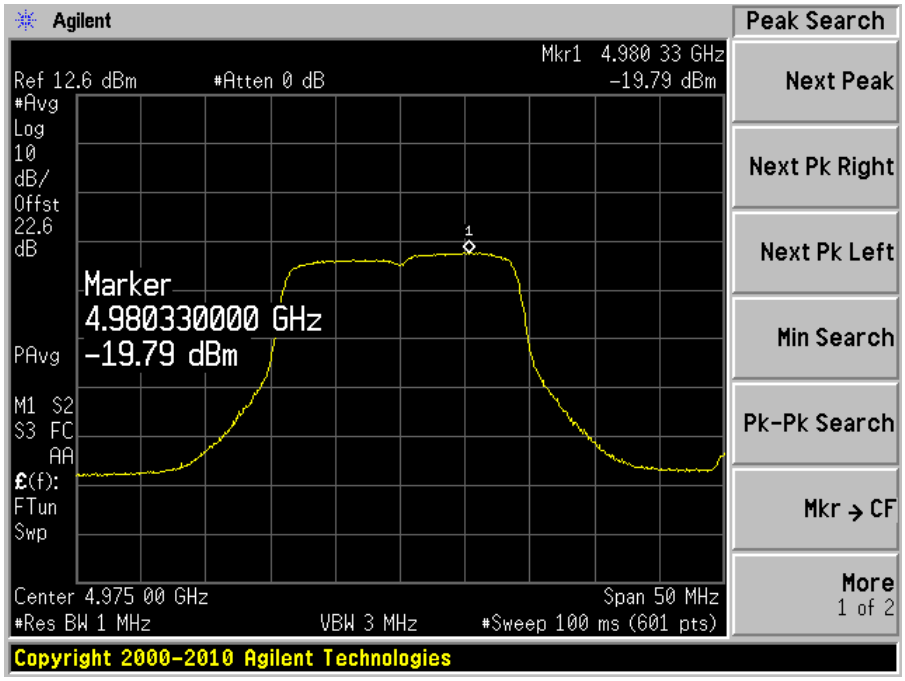
Low Channel, Chain 0



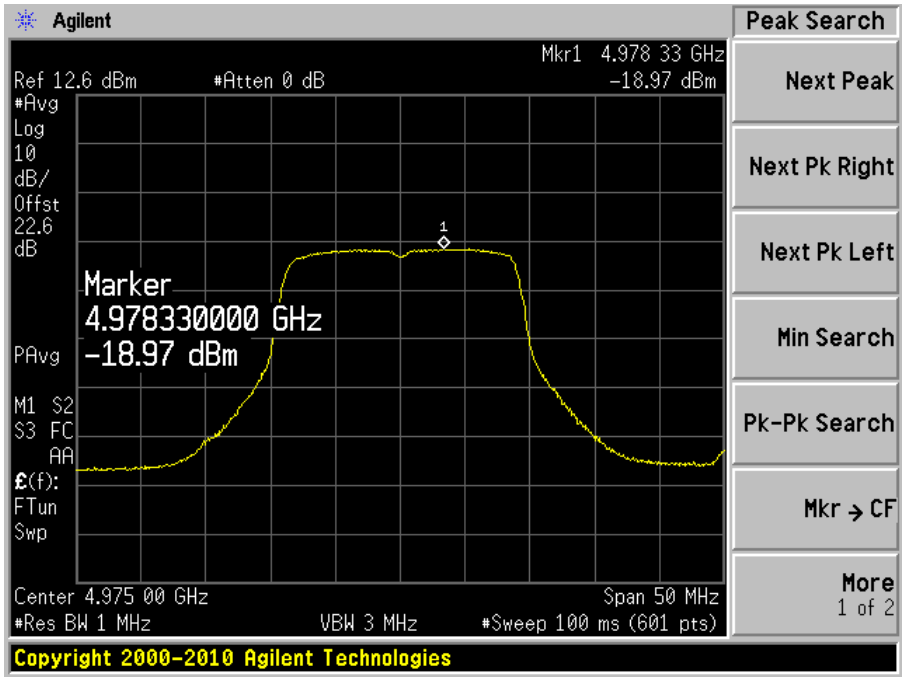

Low Channel, Chain 1



High Channel, Chain 0

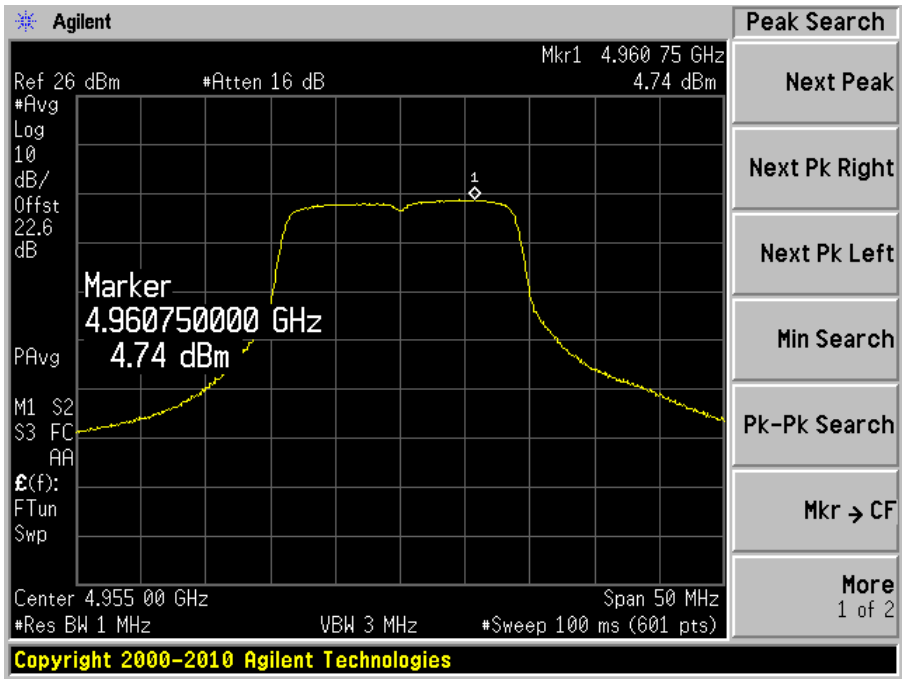



High Channel, Chain 1

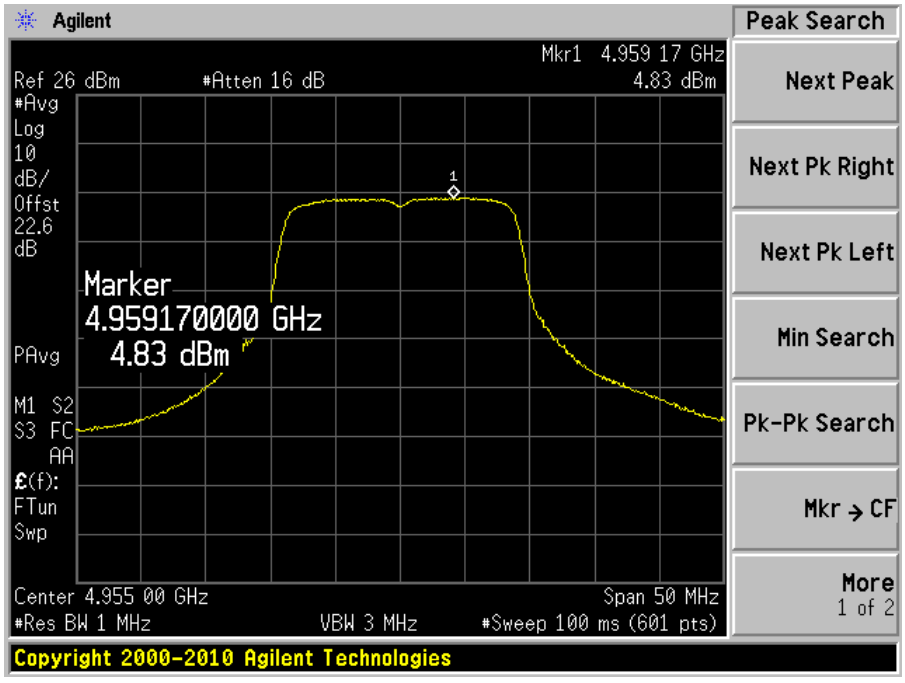


High Power Setting, High Gain Antenna (9 dBi)

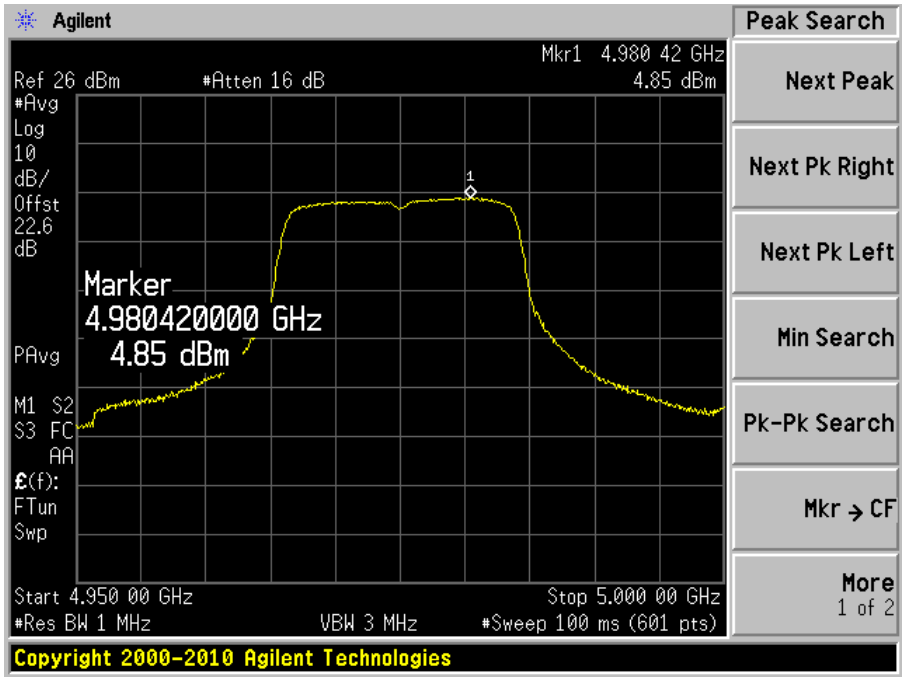
Low Channel, Chain 0



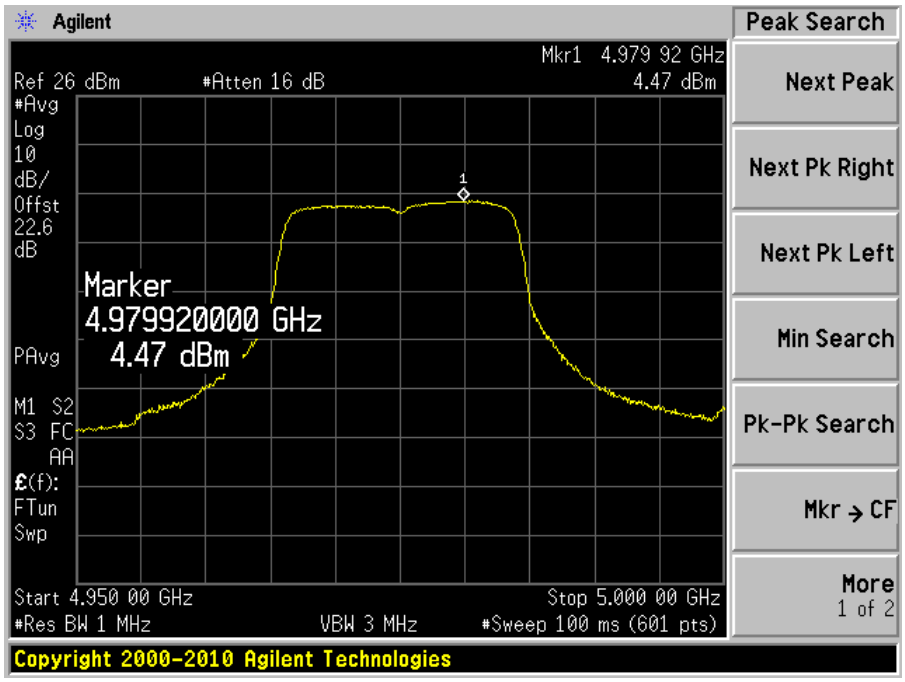

Low Channel, Chain 1



High Channel, Chain 0




High Channel, Chain 1



# 11 IC RSS-111 §5.5 & RSS-Gen §6.1 – Receiver Spurious Radiated Emissions

## 11.1 Applicable Standards

According to IC RSS-Gen §6.1, spurious emissions from receivers shall not exceed the radiated limits shown in the table below.

Table 2: General Field Strength Limits for Transmitters and Receivers at Frequencies above 30 MHz

| Frequency (MHz) | Field Strength Microvolts/m at 3 meters |
|---|---|
| 30-88 | 100 |
| 88-216 | 150 |
| 216-960 | 200 |
| Above 960 | 500 |

## 11.2 EUT Setup

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2009.

## 11.3 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data were recorded in the peak detection mode. Quasi-peak readings was performed only when an emissions was found to be marginal (within -4 dB of specification limits), and are distinguished with a "**QP**" in the data table.

## 11.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + AF + CL + Atten – Ga$$

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

$$Margin = Corrected\ Amplitude - Limit$$

## 11.5 Test Equipment Lists and Details

| Manufacturer | Description | Model No. | Serial No. | Calibration Date | Calibration Interval |
|---|---|---|---|---|---|
| Sunol Science Corp | System Controller | SC99V | 122303-1 | N/R | N/R |
| Sunol Science Corp | Combination Antenna | JB3 | A020106-2 | 2012-08-15 | 1 year |
| Hewlett Packard | Pre-amplifier | 8447D | 2944A06639 | 2012-06-09 | 1 year |
| Mini-Circuits | Pre-amplifier | ZVA-183-S | 570400946 | 2013-05-09 | 1 year |
| Agilent | Spectrum Analyzer | E4440A | MY44303352 | 2012-10-16 | 1 year |
| EMCO | Horn Antenna | 3115 | 9511-4627 | 2012-10-17 | 1 year |
| Rohde & Schwarz | EMI Test Receiver | ESCI 1166.5950K03 | 100338 | 2012-09-19 | 1 year |

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

## 11.6 Test Environmental Conditions

| | |
|---|---|
| **Temperature:** | 18-22 °C |
| **Relative Humidity:** | 45-48 % |
| **ATM Pressure:** | 101-102 kPa |

*The testing was performed by Wei Sun on 2013-05-03 at 5 meters 3.*

## 11.7 Summary of Test Results

According to the test data, the EUT complied with the RSS-210, with the closest margins from the limit listed below:

| **Mode: Receiving** | | | |
|---|---|---|---|
| **Margin (dB)** | **Frequency (MHz)** | **Polarization (Horizontal/Vertical)** | **Range (MHz), Antenna** |
| -3.26 | 30.628 | Vertical | 30-18000 |

## 11.8 Test Results

1) **30-1000 MHz, Measured at 3 meters**

| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dBµV/m) | Margin (dB) | Detector (QP/Ave.) |
|---|---|---|---|---|---|---|---|
| 30.628 | 36.74 | 100 | V | 111 | 40 | -3.26 | QP |
| 43.8055 | 34.09 | 150 | V | 124 | 40 | -5.91 | QP |
| 45.27825 | 28.94 | 109 | V | 112 | 40 | -11.06 | QP |
| 50.4445 | 29.64 | 121 | V | 156 | 40 | -10.36 | QP |
| 66.27875 | 24.72 | 147 | V | 302 | 40 | -15.28 | QP |
| 81.169 | 24.61 | 100 | V | 268 | 40 | -15.39 | QP |

**2) Above 1 GHz Measured at 3 meters**

| Frequency (MHz) | S.A. Reading (dBµV) | Turntable Azimuth (degrees) | Test Antenna | | | Cable Loss (dB) | Pre-Amp. (dB) | Cord. Reading (dBµV/m) | IC | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Height (cm) | Polarity (H/V) | Factor (dB/m) | | | | Limit (dBµV/m) | Margin (dB) | |
| 7440 | 30 | 0 | 100 | V | 36.57 | 5.62 | 27.51 | 44.68 | 74 | -29.32 | Peak |
| 7440 | 30 | 0 | 100 | H | 36.57 | 5.62 | 27.51 | 44.68 | 74 | -29.32 | Peak |
| 7440 | 20 | 0 | 100 | V | 36.57 | 5.62 | 27.51 | 34.68 | 54 | -19.32 | Ave |
| 7440 | 20 | 0 | 100 | H | 36.57 | 5.62 | 27.51 | 34.68 | 54 | -19.32 | Ave |

# 12 FCC §90.1217, §2.1091 & IC RSS-102 - RF Exposure Information

## 12.1 Applicable Standards

According to FCC §90.1217 and §1.1307(b), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density ($mW/cm^2$) | Averaging Time (minutes) |
|---|---|---|---|---|
| Limits for General Population/Uncontrolled Exposure | | | | |
| 0.3-1.34 | 614 | 1.63 | * (100) | 30 |
| 1.34-30 | 824/f | 2.19/f | * ($180/f^2$) | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | / | / | f/1500 | 30 |
| 1500-100,000 | / | / | 1.0 | 30 |

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

According to IC RSS-102 Issue 2 section 4.1, RF limits used for general public will be applied to the EUT.

| Frequency Range (MHz) | Electric Field (V/m rms) | Magnetic Field (A/m rms) | Power Density ($W/m^2$) | Time Averaging (min) |
|---|---|---|---|---|
| 0.003 - 1 | 280 | 2.19 | - | 6 |
| 1 - 10 | 280 / f | 2.19 / f | - | 6 |
| 10 - 30 | 28 | 2.19 / f | - | 6 |
| 30 – 300 | 28 | 0.073 | 2* | 6 |
| 300 – 1 500 | $1.585\ f^{0.5}$ | $0.0042\ f^{0.5}$ | f / 150 | 6 |
| 1 500 – 15 000 | 61.4 | 0.163 | 10 | 6 |
| 15 000 – 150 000 | 61.4 | 0.163 | 10 | $616000 / f^{1.2}$ |
| 150 000- 300 000 | $0.158\ f^{0.5}$ | $4.21 \times 10\ -4\ f^{0.5}$ | $6.67 \times 10^{-5}\ f$ | $616000 / f^{1.2}$ |

**Note:** *f* is frequency in MHz
* = Power density limit is applicable at frequencies greater than 100 MHz

## 12.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

*Where: S = power density*
*P = power input to antenna*
*G = power gain of the antenna in the direction of interest relative to an isotropic radiator*
*R = distance to the center of radiation of the antenna*

For 9 dBi gain antenna (worst case: 20 MHz bandwidth, 802.11 a mode High channel=4975 MHz)

| | |
|---|---|
| Maximum peak output power at antenna input terminal (dBm): | 18.76 |
| Maximum peak output power at antenna input terminal (mW): | 75.16 |
| Prediction distance (cm): | 20 |
| Prediction frequency (MHz): | 4975 |
| Maximum Antenna Gain (dB): | 9 |
| Maximum Antenna Gain (numeric): | 7.94 |
| Power density of prediction frequency at 20 cm ($mW/cm^2$): | 0.12 |
| Power density of prediction frequency at 20 cm ($W/m^2$): | 1.2 |
| MPE limit for uncontrolled exposure at prediction frequency ($mW/cm^2$): | 1.0 |
| MPE limit for uncontrolled exposure at prediction frequency ($mW/cm^2$): | 10 |

For 28 dBi gain antenna (worst case: 20 MHz bandwidth, 802.11 a mode low channel=4955 MHz)

| | |
|---|---|
| Maximum peak output power at antenna input terminal (dBm): | 0.89 |
| Maximum peak output power at antenna input terminal (mW): | 1.23 |
| Prediction distance (cm): | 20 |
| Prediction frequency (MHz): | 4955 |
| Maximum Antenna Gain (dB): | 28 |
| Maximum Antenna Gain (numeric): | 630.96 |
| Power density of prediction frequency at 20 cm ($mW/cm^2$): | 0.15 |
| Power density of prediction frequency at 20 cm ($W/m^2$): | 1.5 |
| MPE limit for uncontrolled exposure at prediction frequency ($mW/cm^2$): | 1.0 |
| MPE limit for uncontrolled exposure at prediction frequency ($mW/cm^2$): | 10 |

## Conclusion

The device complies with the MPE requirements by providing a safe separation distance of at least 20 cm between the antenna with 28 and 9 dBi effective gains, including any radiating structure, and any persons when normally operated.