Section 5

Test Report

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5.1 Test Strategy

The Motorola CPEi25100 residential subscriber unit operates in the WiMax mode only. Verification of the performance of the Motorola CPEi25100 IEEE 802.16e WiMax transmitter was accomplished by implementation of the procedures contained within TIA/EIA-603 and FCC requirements. Performance results contained within this Test Report and Appendix documents represent modes that are considered to be representative of a worst case operating condition.

Verification of product performance is presented for three frequencies across the RF bandwidth, two channel bandwidths, seven modulation configurations, eight transmit duty cycles, and 17 or 35 subchannels that are available within IEEE 802.16e standard. This results in possible test combinations exceeding 2 trillion distinct measurements. To reduce the test burden, a series of measurements were performed to observe the variations in the measured parameters. Based on the consistency of these measurements, the information presented in this test report is believed to represent a worst case scenario.

The Motorola CPEi25100 product has been tested with equipment that is generally available in the open market. The primary requirements for the measurement of the CPEi25100 product is that the measurement device, a spectrum analyzer in this case, contain a time gating function, a detector calibrated in terms of rms-equivalent voltage, and a power measurement capability to facilitate the accurate measurement of the channel power and emissions mask. The time gating function is configured to only allow the spectrum analyzer to sweep when the transmitter is active. Measurements performed on the CPEi25100 product were completed with an Agilent E4440A spectrum analyzer with the time gating capability, use of the rms calibrated detector, and power measurement function as necessary. A comparison of channel power measurements with a power meter to channel power measurements with the spectrum analyzer were performed to ensure that the detector response time and limited resolution bandwidth of the spectrum analyzer was not introducing additional errors in the measurement of channel power. The outcome of this comparison indicated that the spectrum analyzer (E4440A) channel power measurement function accurately recorded the power of the emission when compared to a wide bandwidth power meter that also was calibrated in terms of rms-equivalent voltage. As such no additional correction factors needed to be applied to the measurements.

The WiMax system protocol utilizes the ability to transmit on subchannel carriers ranging from 1 to 17 (all) on each 5 MHz transmission burst and 1 to 35 (all) on each 10 MHz transmission burst. To facilitate the product development, a test mode configuration was developed. The test mode allows for the selection of channel frequency, modulation bandwidth, and modulation type (4-QAM, 16-QAM, 64-QAM, + various coding combinations…). Within the test mode, a pseudo random bit sequence is used to generate the transmitted data.

The Motorola, Inc. product described in this test report is based on the IEEE 802.16e standard commonly called Mobile WiMax. The Mobile WiMax system protocol makes use of Time Division Duplex (TDD) / Time Division Multiple Access (TDMA) operation as allowed by the FCC Report and Order and Further Notice of Proposed Rulemaking, FCC 04-135, at 134. Within the BRS and EBS frequency spectrum, channels are allocated in 5.5 MHz and 6.0 MHz single frequency blocks. FCC rules contained in 27.1220 allow for the splitting and combining of channel spectrum when done jointly with other licensees. This would accommodate the 10 MHz emission from a WiMax transmission anywhere within the BRS/EBS spectrum. Additional information is contained in the Technical Description document.

The Motorola, Inc., CPEi25100 product does not contain “smart” antenna technology. The integral antenna contained within the CPEi25100 product is a four-element patch array antenna. This antenna has a fixed gain and radiation pattern. Plots of the antenna performance are shown in the Section 13 Technical Description document.

5.2 Test Equipment List

Test Equipment	Description
DUT	Motorola Residential Subscriber Unit Model No. CPEi25100 Board No. 0612-0300-7220170
Spectrum Analyzer	Agilent E4440A S/N: MY44022791 Calibrated: 05/21/2007 Calibration due: 05/21/2009
Attenuators (All applicable tests except harmonic frequencies)	40 dB, 10W Attenuator MCE/Weinshel Model 23-40-34, S/N. BT 1498 10 dB, 10W Attenuator (low power measurements) MCE/Weinshel Model 23-10-34, S/N. BT 3857 Calibrated by user
Filter/Attenuator Assembly (Harmonic frequency test only)	High Pass Filter 4-18 GHz, P/N H04G18G2, S/N 89099 Microwave Circuits 20 dB, 10W Attenuator, MCE/Weinshel Model 23-20-34, S/N BP4391 Calibrated by user
Laptop Computer (NN1303)	Dell Precision M65 S/N: CRFK 381 Calibration not required
Ethernet Switch	D-Link Model: DSS-5+ 5-port 10/100Mbps S/N: DT8615B009993 Calibration not required
RSU Power Supply	OTE-17-13 13V, 1.3A Rev. Level 3
AC Power Source (Frequency Stability Test Only)	Instek APS-9501 S/N: EF844094 Calibrated with voltmeter listed below.
Digital Voltmeter	HP 34401A S/N: MY45001201 Calibrated: 5-4-2007 / Calibration due: 5-4-2009
Temperature Chamber	Test Equity Model: 1007C S/N: 10294 Temperature verified with thermocouple listed below
Temperature Sensor	Fluke 89 IV True RMS Multimeter S/N 87180024 with K-Type Thermocouple

5.3 RF Power Output

FCC Rules: 2.1046, 27.4, 27.50(h)(2), 27.50(h)(4) 27.50(i)

FCC Requirement: User stations. All user stations are limited to 2.0 watts transmitter output power. (5 MHz or 10 MHz channel BW)

Power Spectral Density (PSD) = [power / 6 MHz] x 100 kHz
PSD (watts) = (2 / 6,000,000) x 100,000
= 0.0333 watts per 100 kHz.

Standard: 47CFR27.50

Test Procedure: **General**

The peak conducted RF output power is measured over an interval of continuous transmission using a spectrum analyzer that has been calibrated in terms of rms-equivalent voltage. The peak power was recorded by utilizing the power measurement function within the spectrum analyzer. The power measurement function of this spectrum analyzer, when using a 100 kHz resolution bandwidth, has been compared against measurements performed with a power meter. The power measurements obtained from the spectrum analyzer and the power meter comparison produced the same value. As such, no additional correction factors were applied to the measured data.

The RF output of the transmitter was measured at J501 which is the RF output of the main board. The antenna board is soldered directly to this connector. This signal is applied to the spectrum analyzer through a coaxial cable and 40 dB attenuator. The spectrum analyzer is time gated by the PA_ON signal at WO505 on the main board so that only RF transmission bursts are captured.

The transmitter is enabled in the test mode and set to the minimum and maximum power level with the host computer. The RF loss of the attenuator and coax was measured and is included in the spectrum analyzer offset level for the maximum and minimum RF power measurements.

Measurements With All Subchannels Enabled

Because of the very large number of combinations of channels, bandwidths, modulation types, subchannels, and time slots available (see Section 5.1), only the following combinations were checked:

Time Slots = 1

- Frequencies = low, mid, and high channels of band
- Bandwidths = 5.0 and 10 MHz
- Modulation Types = QPSK 1/2, QPSK 3/4, 16 QAM 1/2, 16 QAM 3/4, 64 QAM 1/2, 64 QAM 2/3, and 64 QAM 3/4

Time Slots = 2 through 8 (for each)

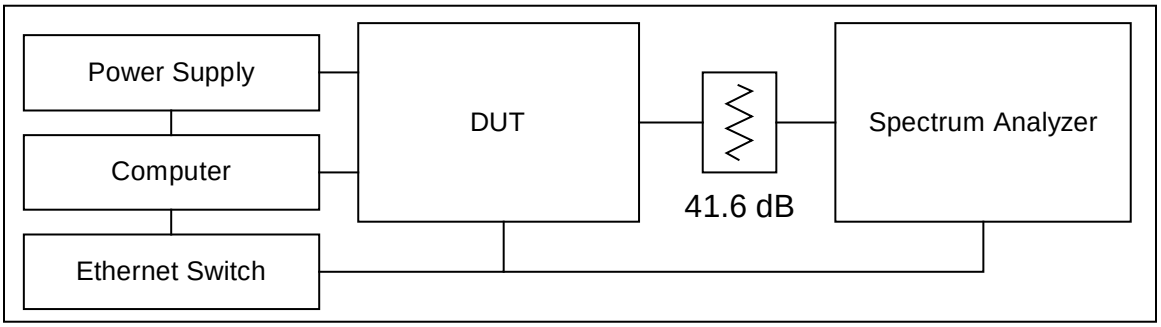
- Bandwidths = 5.0 and 10 MHz
- Channel/modulation type combinations =
  2499 MHz (low)/ 16 QAM 3/4
  2593 MHz (mid)/QPSK 1/2
  2687 MHz (high)/64 QAM 2/3

Measurements With Less Than All Subchannels Enabled

Measurements at a center frequency of 2499 MHz were performed to exhibit compliance to the 27.50(h)(4) requirement when less than all subchannels are enabled. This was done by adjusting the resolution bandwidth of the spectrum analyzer to 10 kHz and setting the span to 5 MHz for a 5 MHz emission and 10 MHz for a 10 MHz emission. The sweep number of points was set to 501 for a 5 MHz emission and 1001 for a 10 MHz emission.

The data points were then extracted from the spectrum analyzer and placed into an Excel spreadsheet. The data points, each representing 10 kHz of spectrum, were converted from their dBm value to the equivalent power in watts for a 50-ohm system. Starting at the first extracted data point, each ten consecutive power values were summed together to achieve the total power in a 100 kHz band. These values were then compared to the emission limit defined in the 27.50(h)(4) requirement.

Test Conditions: **Test Frequencies:** 2499, 2593, 2687 MHz (5.0 and 10 MHz bandwidth)
Temperature: 22°C
Supply Voltage: 120 VAC / 60 Hz nominal to DUT power supply



Conducted RF Power Test Setup

5.3.1. Conducted RF Power Output Test Results

Channel Power – 5.0 MHz Bandwidth, All Subchannels

CPEi25100 Channel Power (5.0 MHz Bandwidth Channels) / RMS detector									
Channel (MHz)	**Modulation**	**Channel Power (dBm)**							
		Time Slots Enabled							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2499	QPSK 1/2	27.71							
	QPSK 3/4	27.69							
	16 QAM 1/2	27.73							
	16 QAM 3/4	27.63	27.65	27.50	27.42	27.42	27.25	27.26	27.13
	64 QAM 1/2	27.66							
	64 QAM 2/3	27.63							
	64 QAM 3/4	27.65							
2593	QPSK 1/2	27.02	27.02	26.91	26.86	26.76	26.71	26.62	26.59
	QPSK 3/4	27.01							
	16 QAM 1/2	27.04							
	16 QAM 3/4	26.93							
	64 QAM 1/2	26.93							
	64 QAM 2/3	26.92							
	64 QAM 3/4	26.99							
2687	QPSK 1/2	27.52							
	QPSK 3/4	27.48							
	16 QAM 1/2	27.37							
	16 QAM 3/4	27.32							
	64 QAM 1/2	27.28							
	64 QAM 2/3	27.29	27.36	27.18	27.14	27.08	26.95	26.96	26.94
	64 QAM 3/4	27.27							

Channel Power – 10 MHz Bandwidth, All Subchannels

CPEi25100 Channel Power (10.0 MHz Bandwidth Channels) / RMS detector									
Channel (MHz)	**Modulation**	**Channel Power (dBm)**							
		Time Slots Enabled							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2499	QPSK 1/2	26.87							
	QPSK 3/4	27.04							
	16 QAM 1/2	27.04							
	16 QAM 3/4	27.07	26.81	26.68	26.62	26.41	26.42	26.05	25.95
	64 QAM 1/2	26.98							
	64 QAM 2/3	26.96							
	64 QAM 3/4	26.93							
2593	QPSK 1/2	27.24	27.15	27.03	26.91	26.78	26.69	26.61	26.51
	QPSK 3/4	27.22							
	16 QAM 1/2	27.21							
	16 QAM 3/4	27.24							
	64 QAM 1/2	27.16							
	64 QAM 2/3	27.11							
	64 QAM 3/4	27.12							
2687	QPSK 1/2	26.55							
	QPSK 3/4	26.56							
	16 QAM 1/2	26.51							
	16 QAM 3/4	26.60							
	64 QAM 1/2	26.50							
	64 QAM 2/3	26.50	26.47	26.41	26.25	26.19	26.13	26.01	25.98
	64 QAM 3/4	26.46							

Minimum Power, All Subchannels

CPEi25100 Channel Power (5.0 MHz Bandwidth Channel)				
Channel (MHz)	**Modulation**	**Minimum Power (dBm)**		
		Time Slots: 8		
2499	16 QAM 3/4		-19.97	
2593	16 QAM 3/4		-20.33	
2687	16 QAM 3/4		-22.38	

CPEi25100 Channel Power (10.0 MHz Bandwidth Channel)				
Channel (MHz)	**Modulation**	**Minimum Power (dBm)**		
		Time Slots: 8		
2499	16 QAM 3/4		-19.76	
2593	16 QAM 3/4		-20.19	
2687	16 QAM 3/4		-19.83	

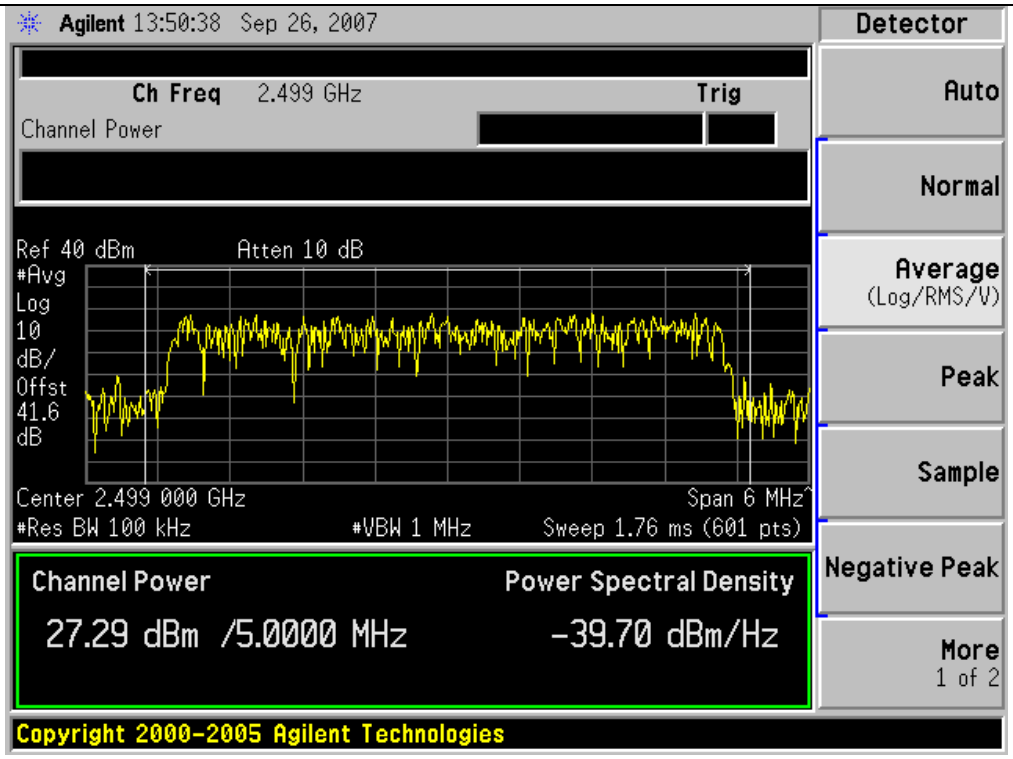
Peak Power Test Results

CPEi25100 RMS / Peak / Average Power Measurements							
Channel (MHz)	**Modulation**	**5 MHz Channels**			**10 MHz Channels**		
		Detector			**Detector**		
		RMS	**Peak**	**Sample**	**RMS**	**Peak**	**Sample**
2499	QPSK 1/2						
	QPSK 3/4						
	16 QAM 1/2	27.29	28.83	27.29	26.96	28.13	26.34
	16 QAM 3/4						
	64 QAM 1/2						
	64 QAM 2/3						
	64 QAM 3/4						
2593	QPSK 1/2	27.03	27.91	26.70	26.72	28.22	27.07
	QPSK 3/4	26.69	28.81	26.79	26.93	28.26	26.95
	16 QAM 1/2	26.65	28.70	27.03	27.12	27.76	27.41
	16 QAM 3/4	26.63	27.95	27.09	26.97	28.43	27.07
	64 QAM 1/2	26.76	28.57	26.92	27.04	28.12	27.08
	64 QAM 2/3	27.06	28.00	27.18	27.01	28.26	27.50
	64 QAM 3/4	27.32	27.58	26.72	27.06	27.96	26.73
2687	QPSK 1/2						
	QPSK 3/4						
	16 QAM 1/2	27.12	28.35	27.20	26.59	27.35	26.45
	16 QAM 3/4						
	64 QAM 1/2						
	64 QAM 2/3						
	64 QAM 3/4						

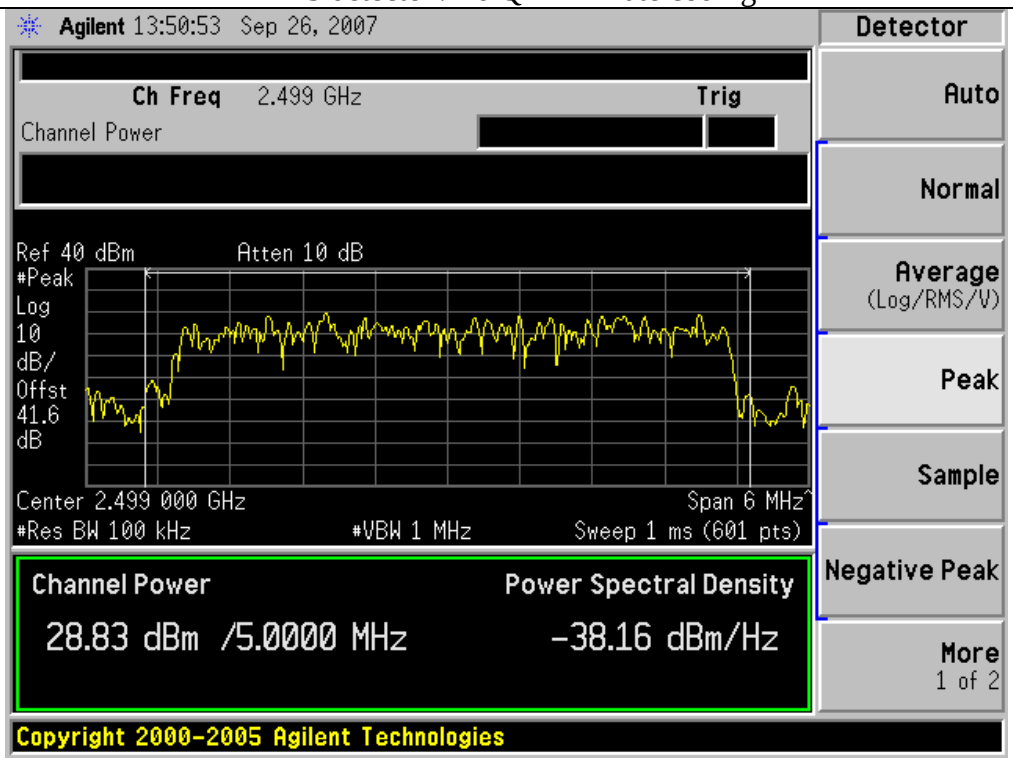
Peak Power Spectrum Analyzer Data

5 MHz channel bandwidth

2499 MHz



RMS detector / 16 QAM ½ rate coding



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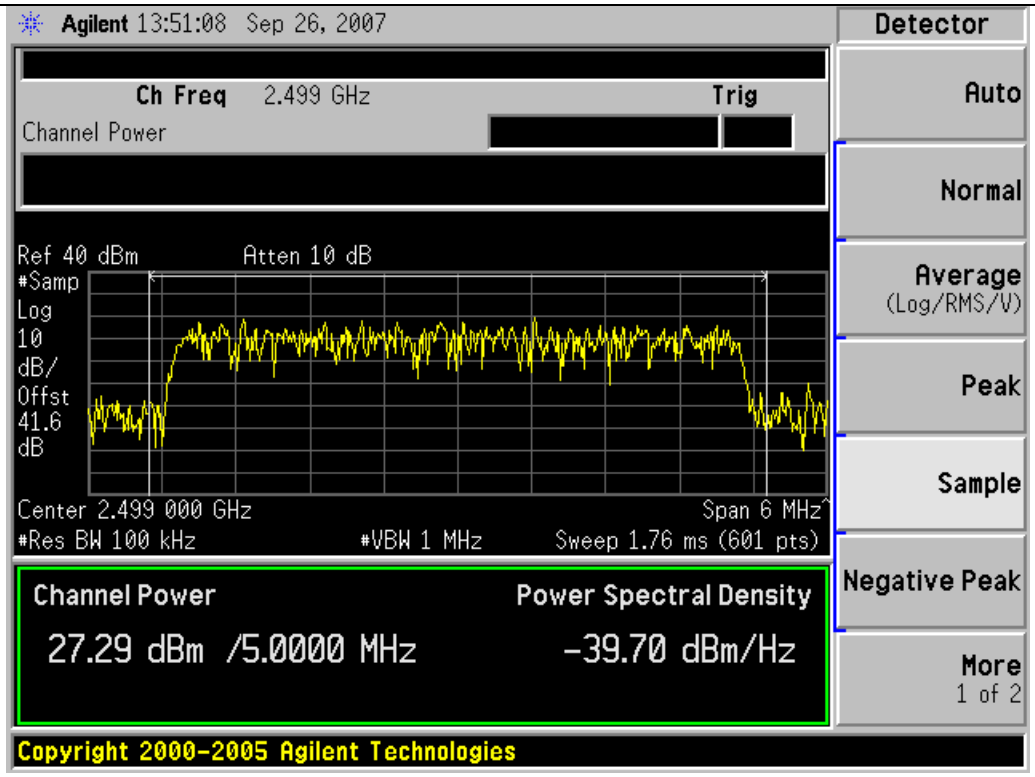
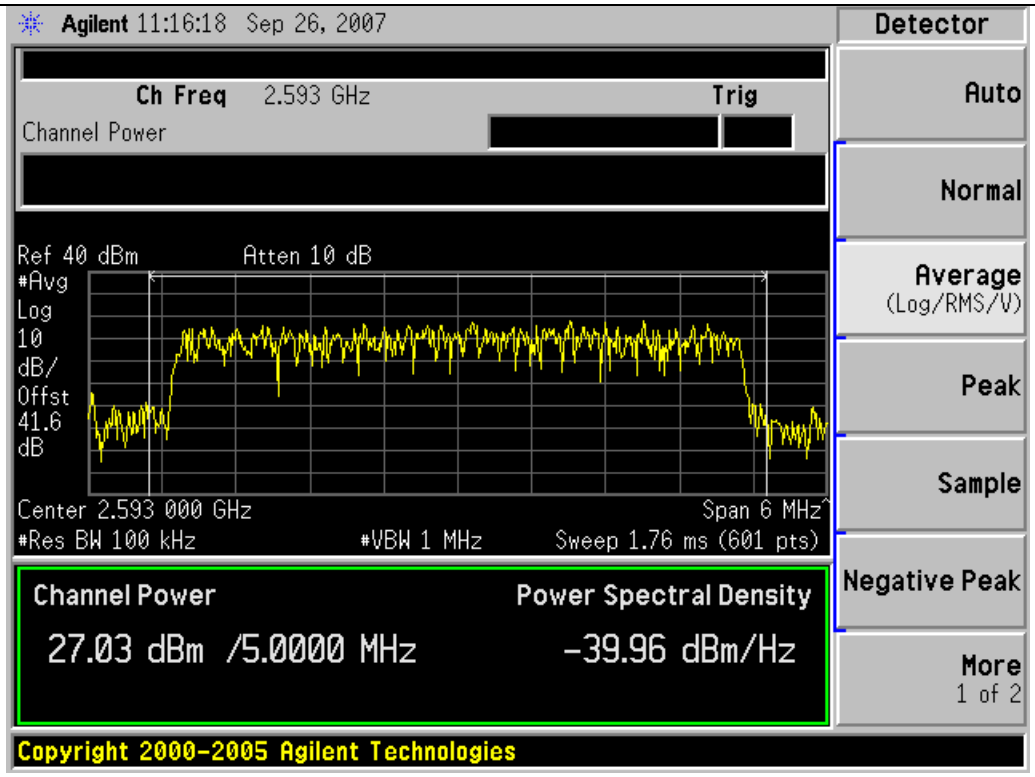


Sample detector / 16 QAM ½ rate coding

2593 MHz



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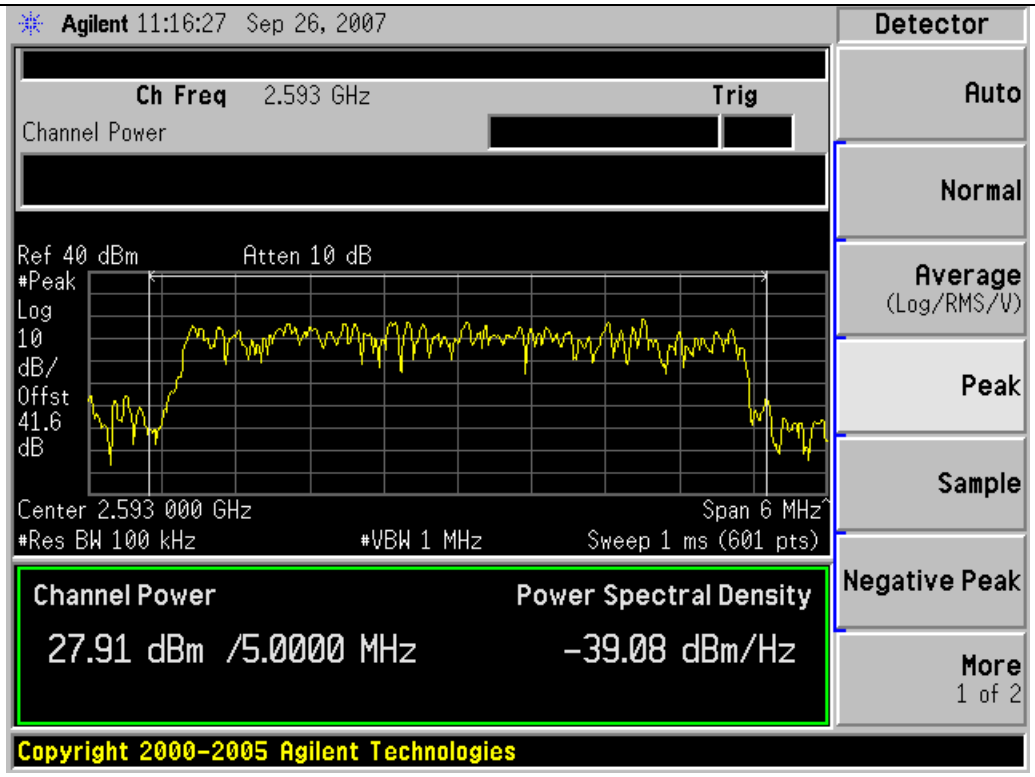

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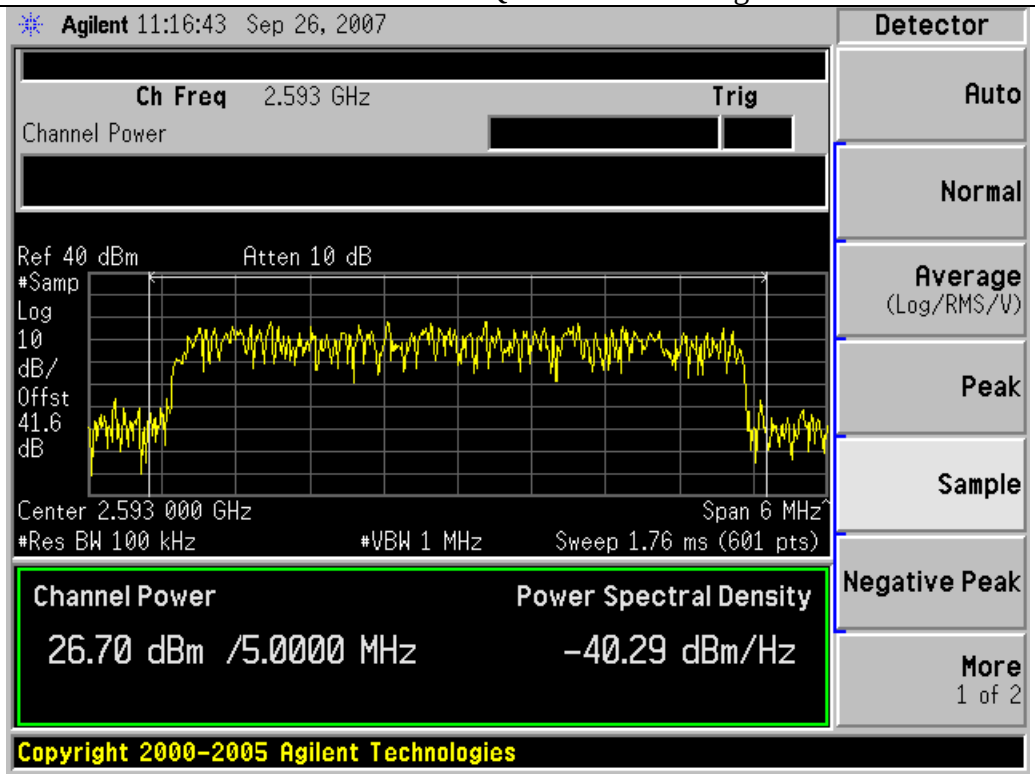

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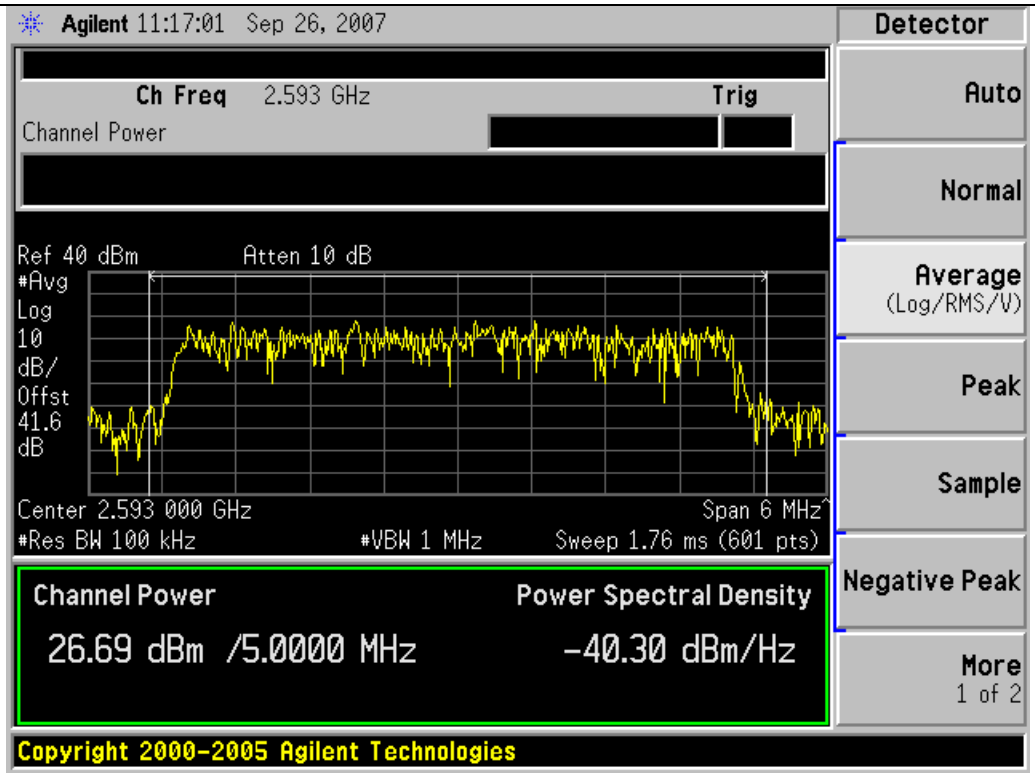
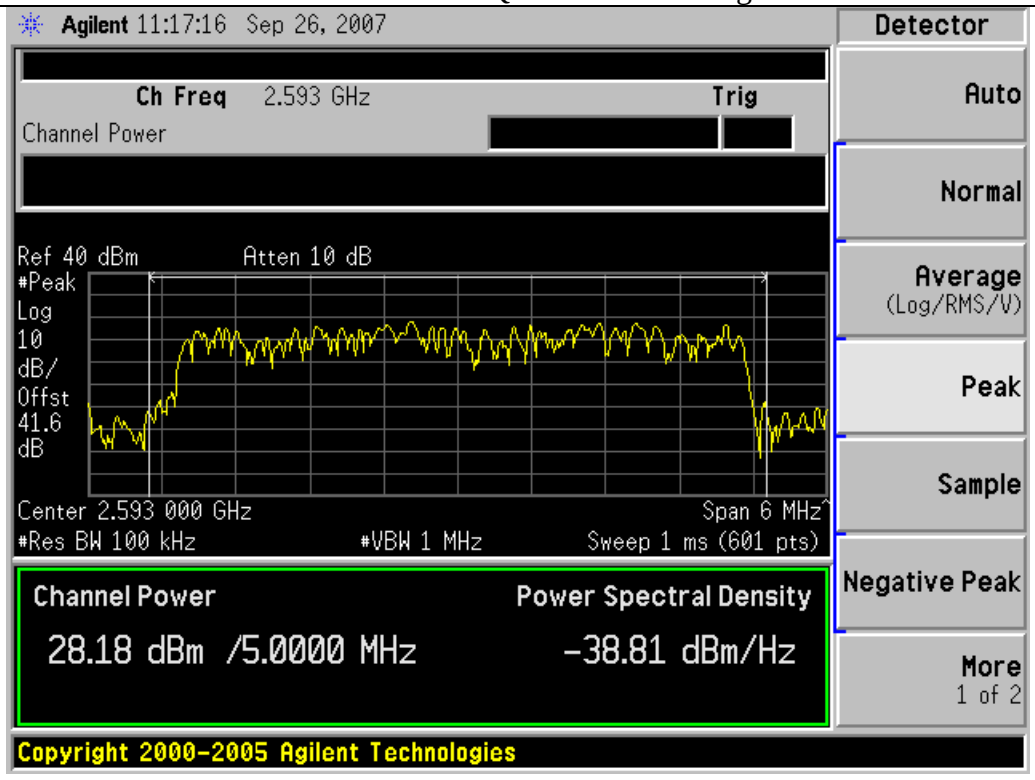


RMS detector / QPSK ¾ rate coding



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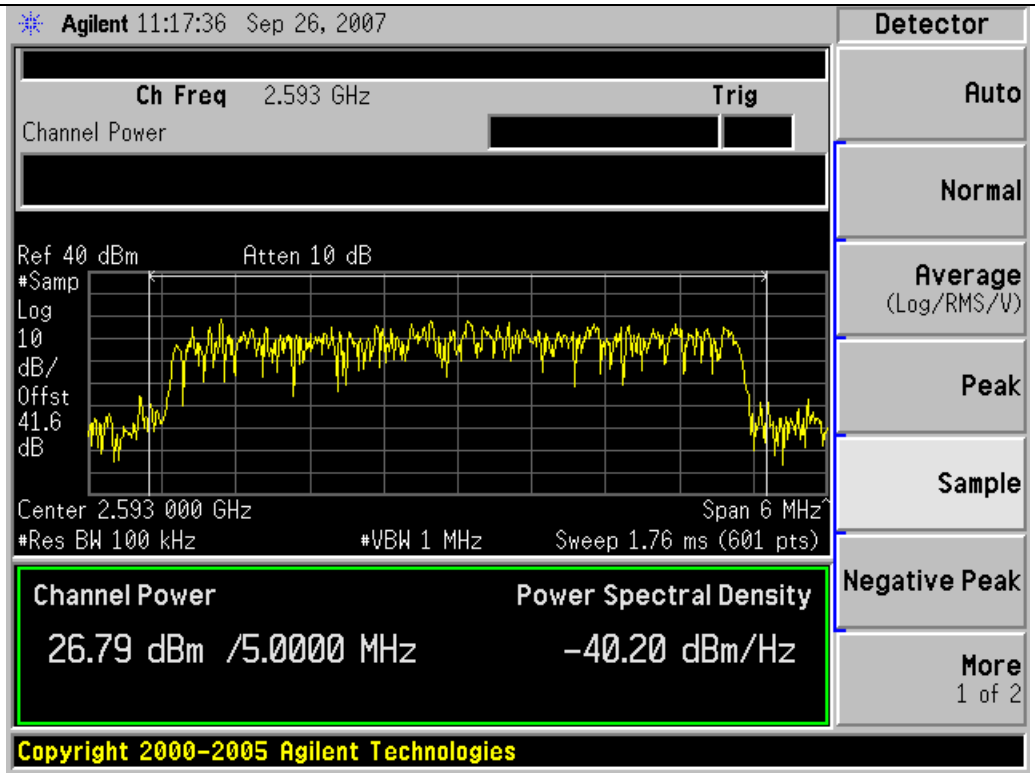

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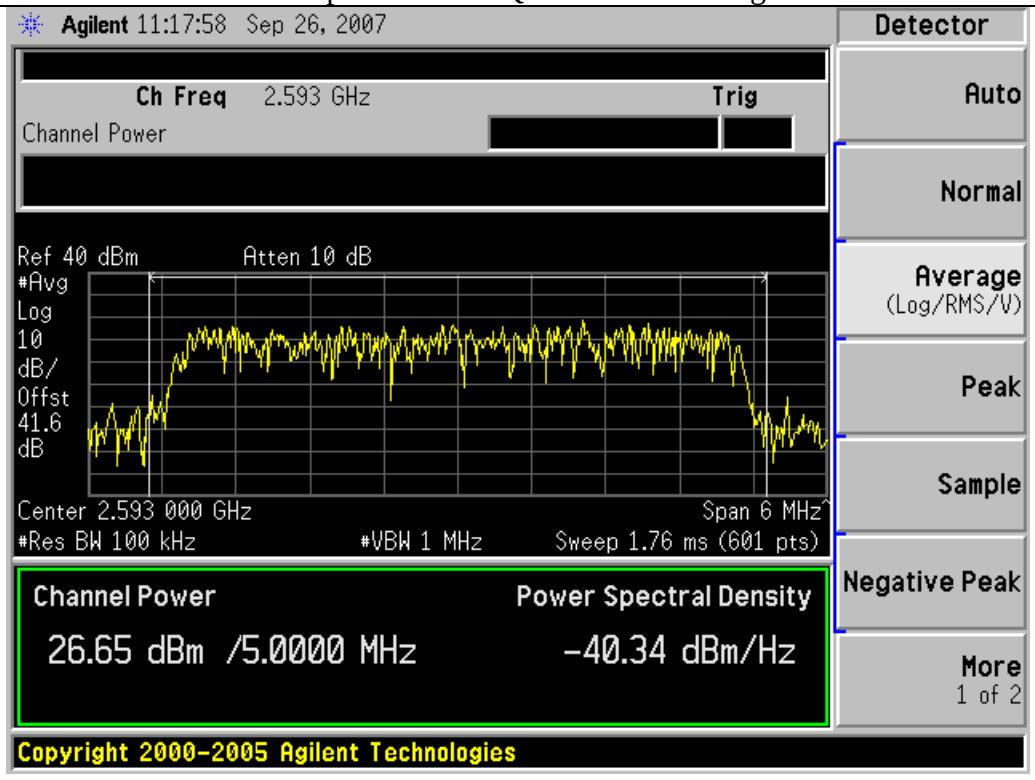

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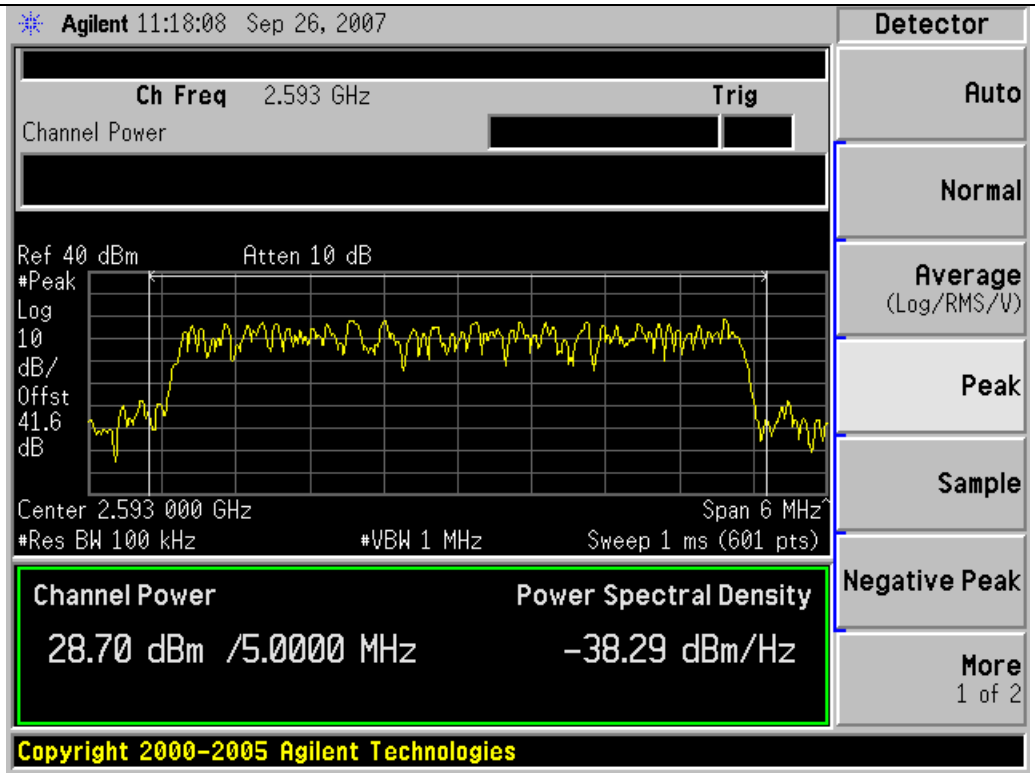

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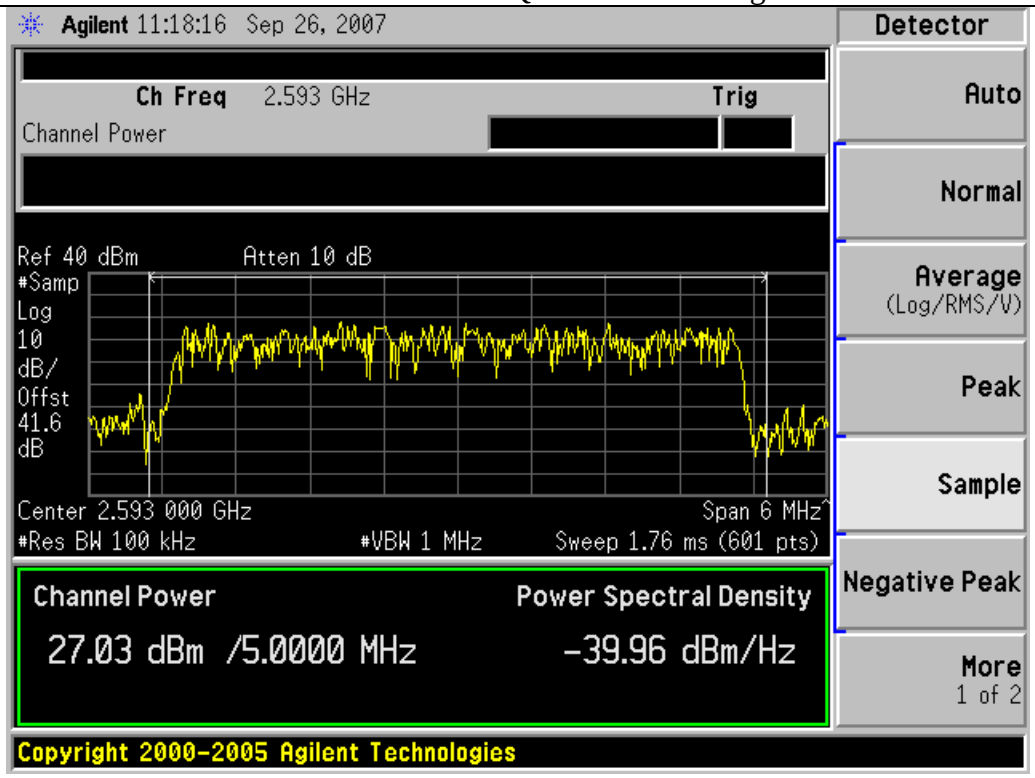

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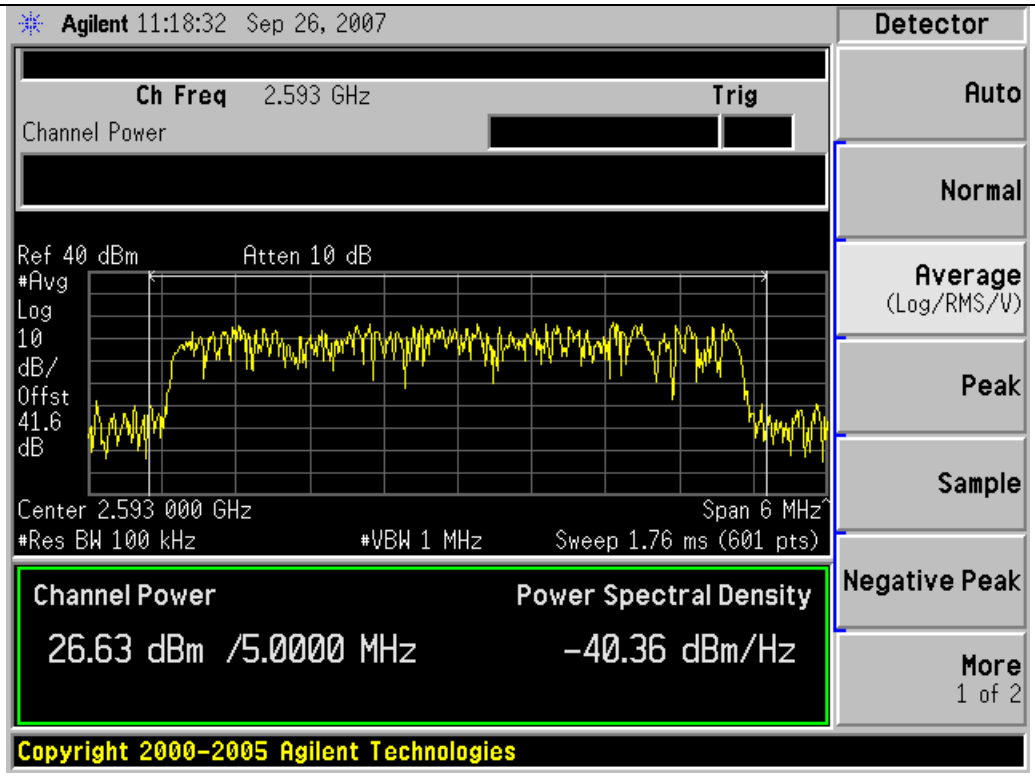

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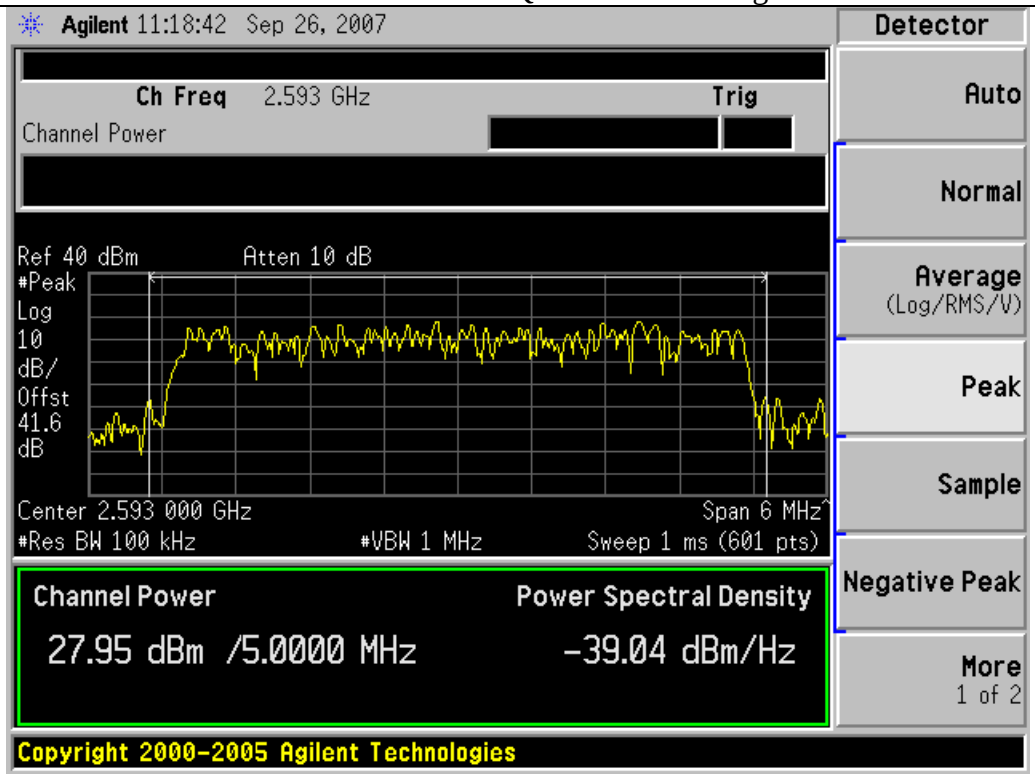
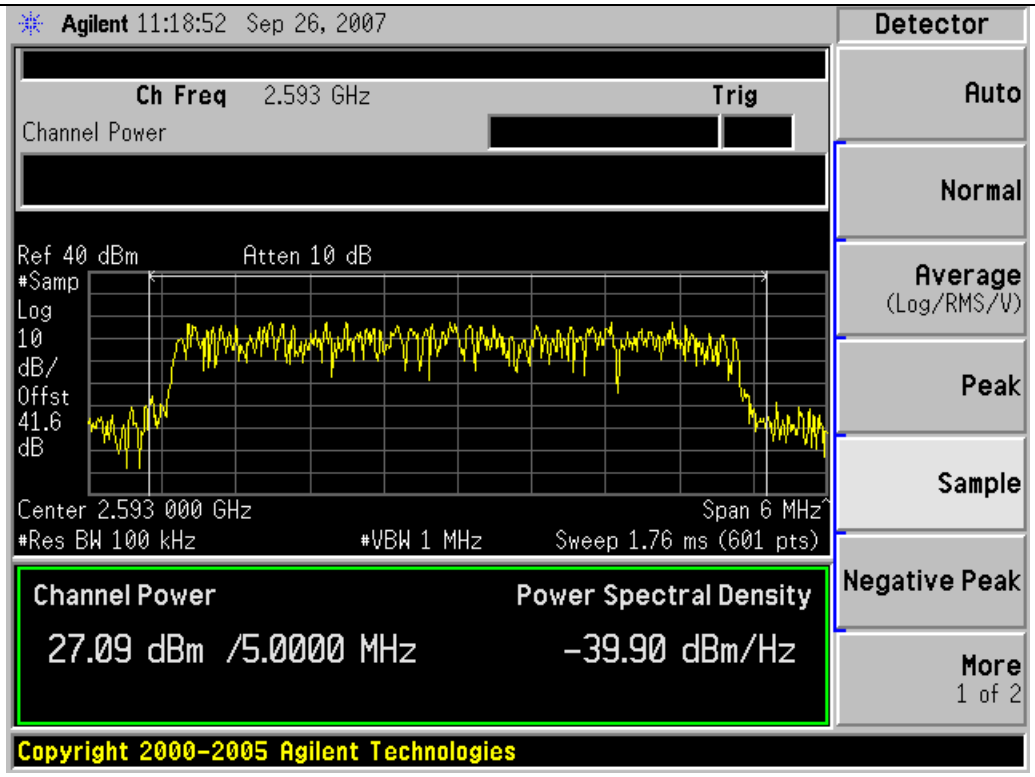


Peak detector / 16 QAM ¾ rate coding



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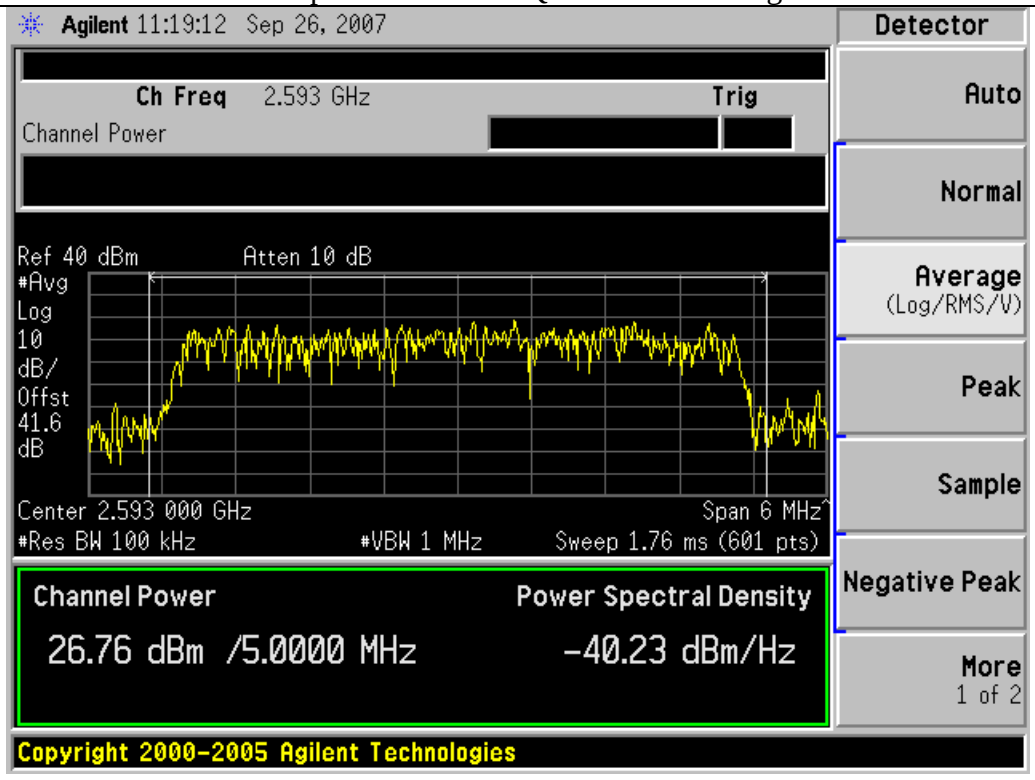

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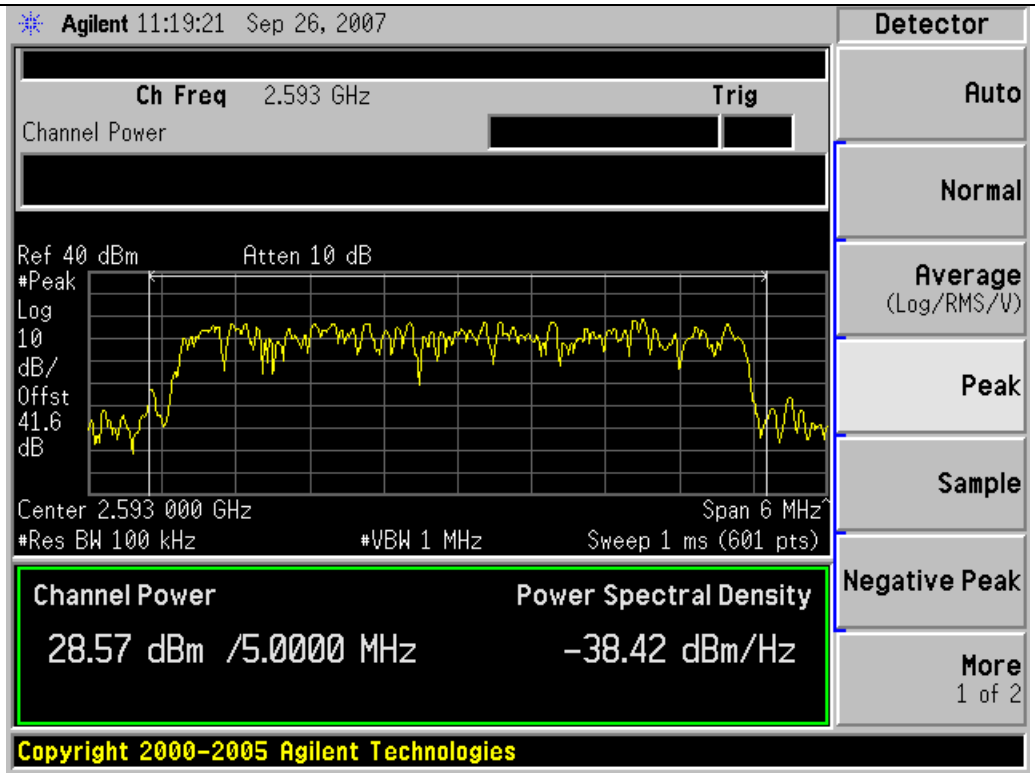

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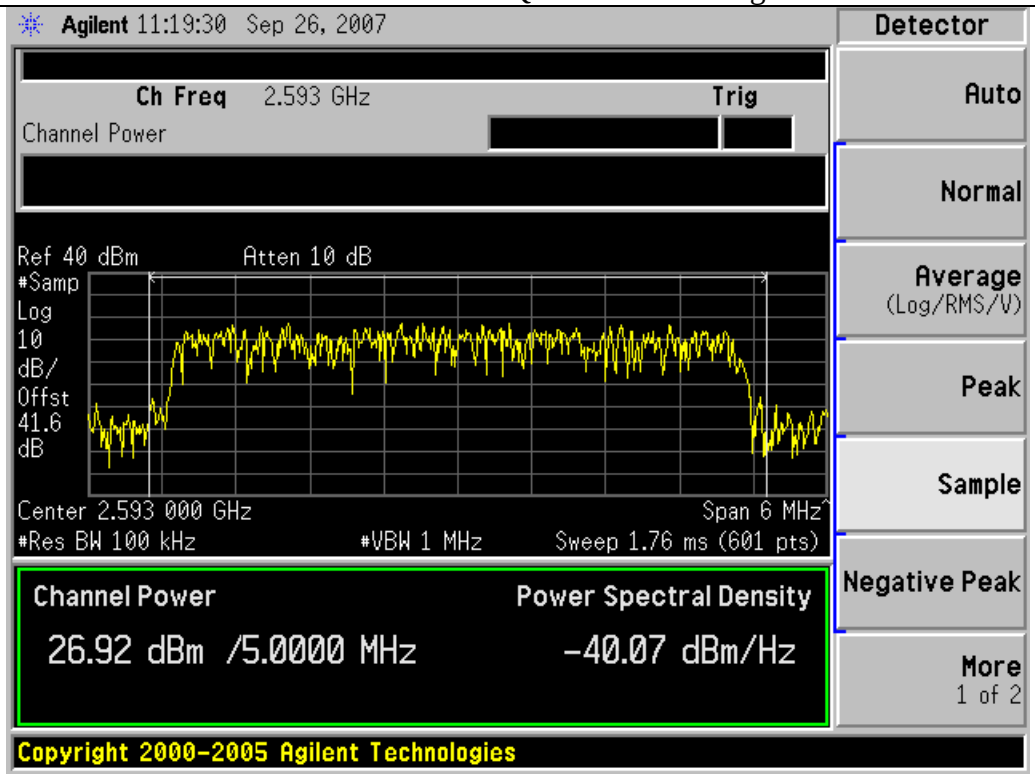

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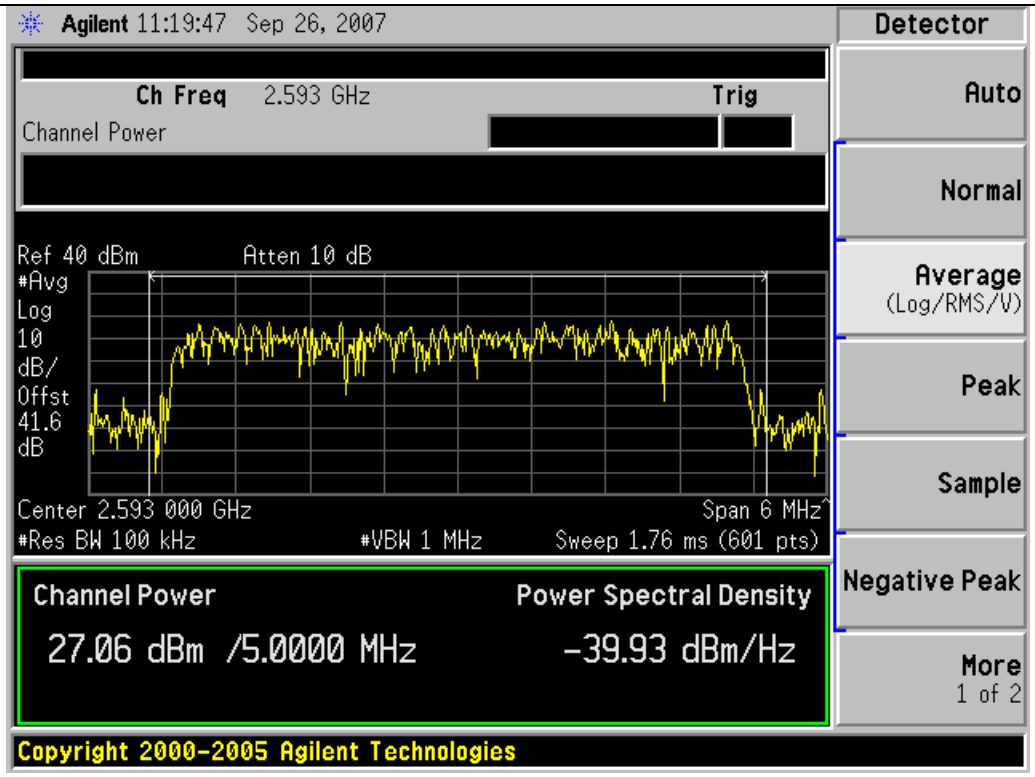
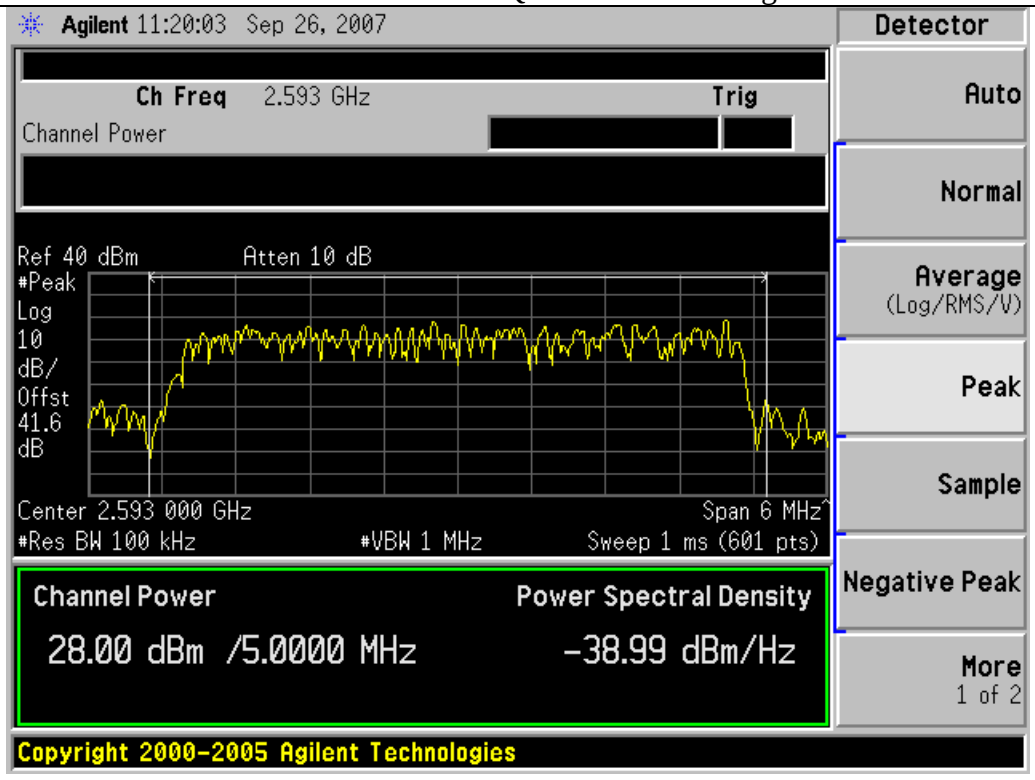
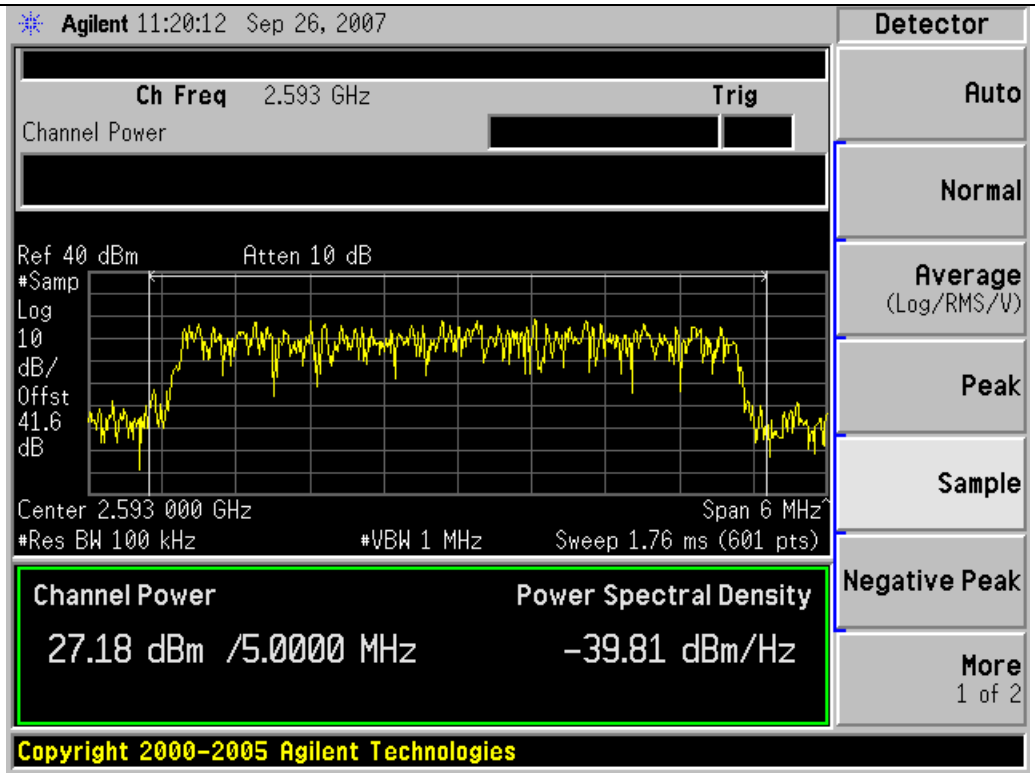


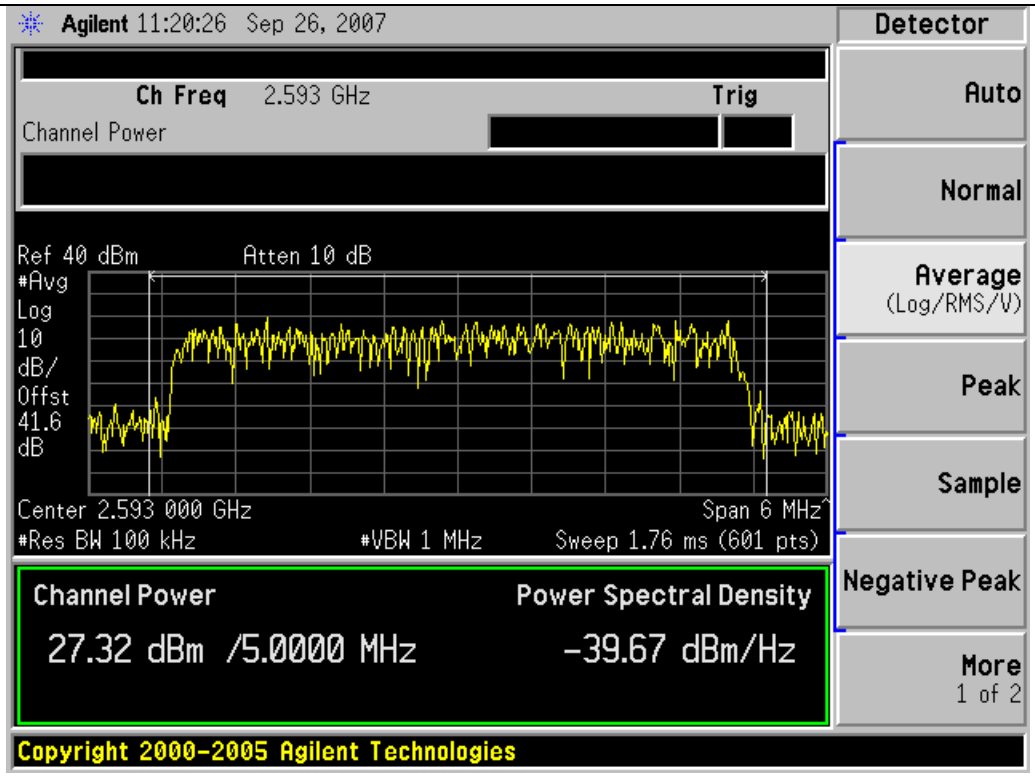
RMS detector / 64 QAM 2/3 rate coding



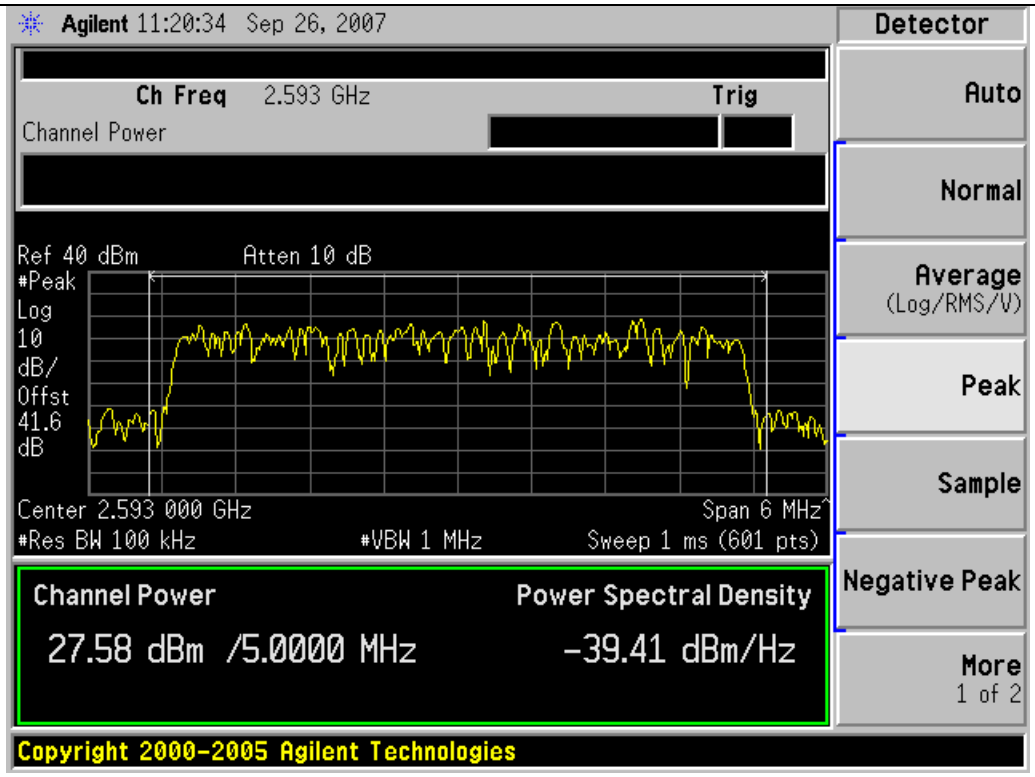
Peak detector / 64 QAM 2/3 rate coding



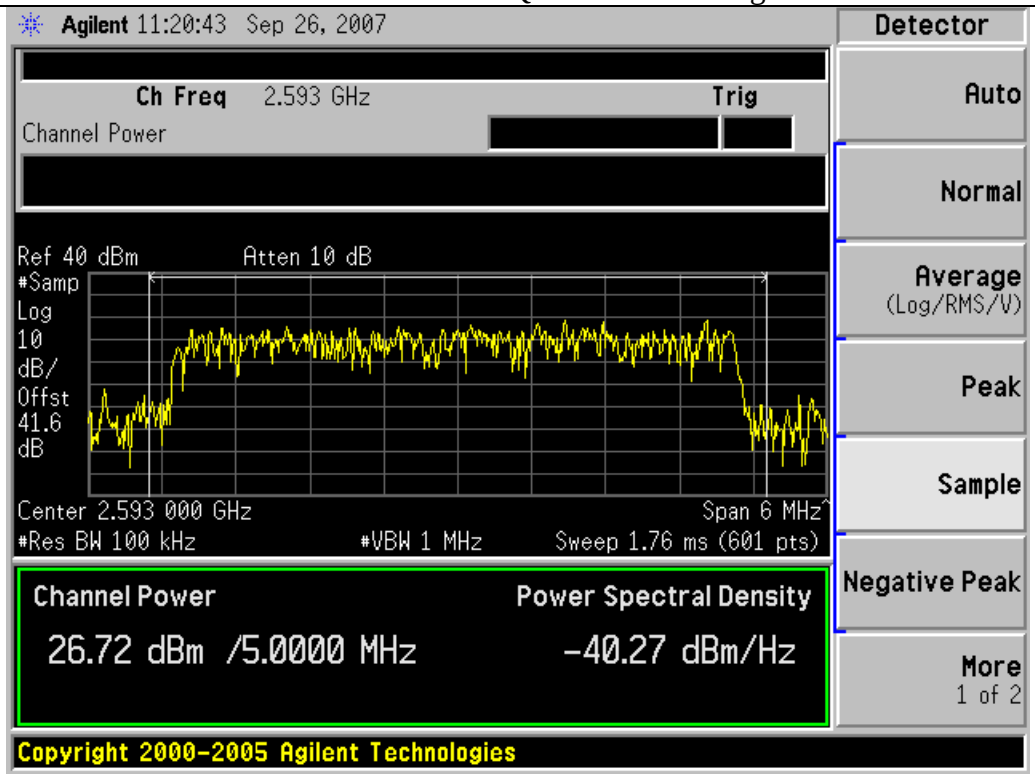
Sample detector / 64 QAM 2/3 rate coding



RMS detector / 64 QAM ¾ rate coding



Peak detector / 64 QAM ¾ rate coding



Sample detector / 64 QAM ¾ rate coding

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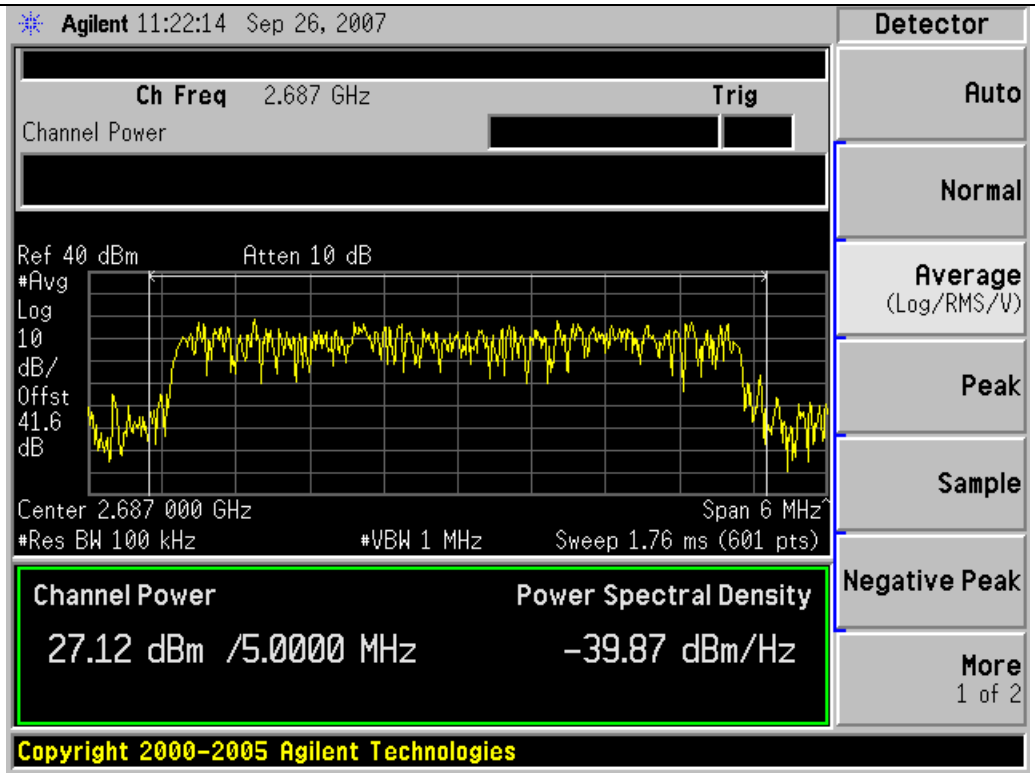
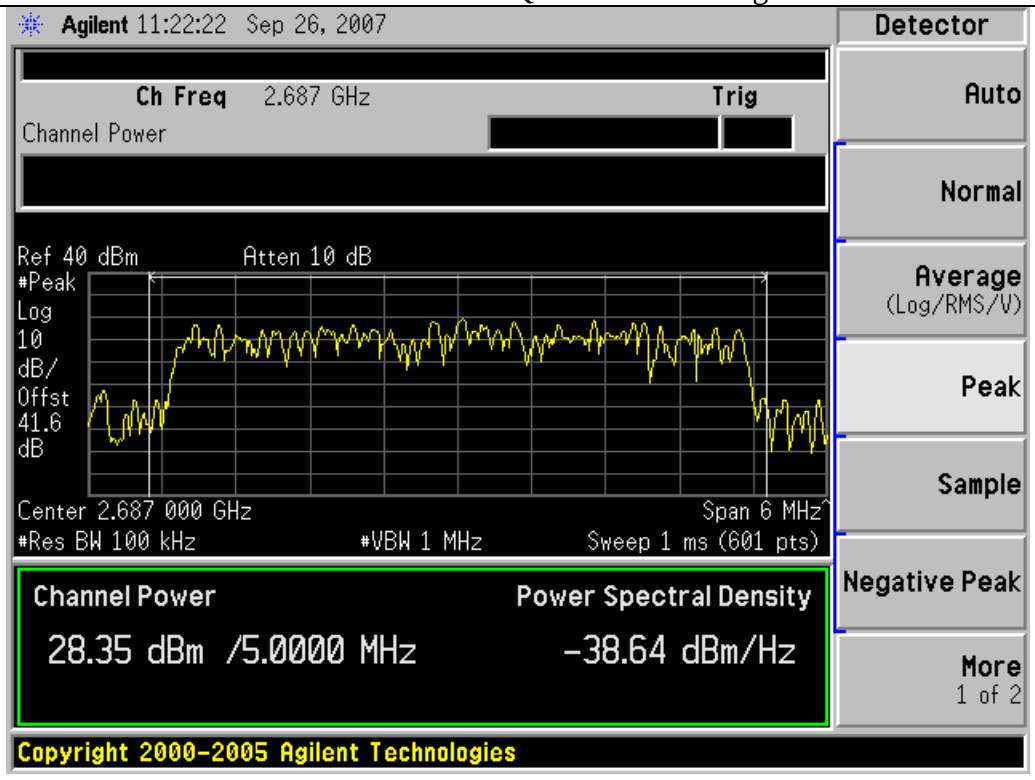
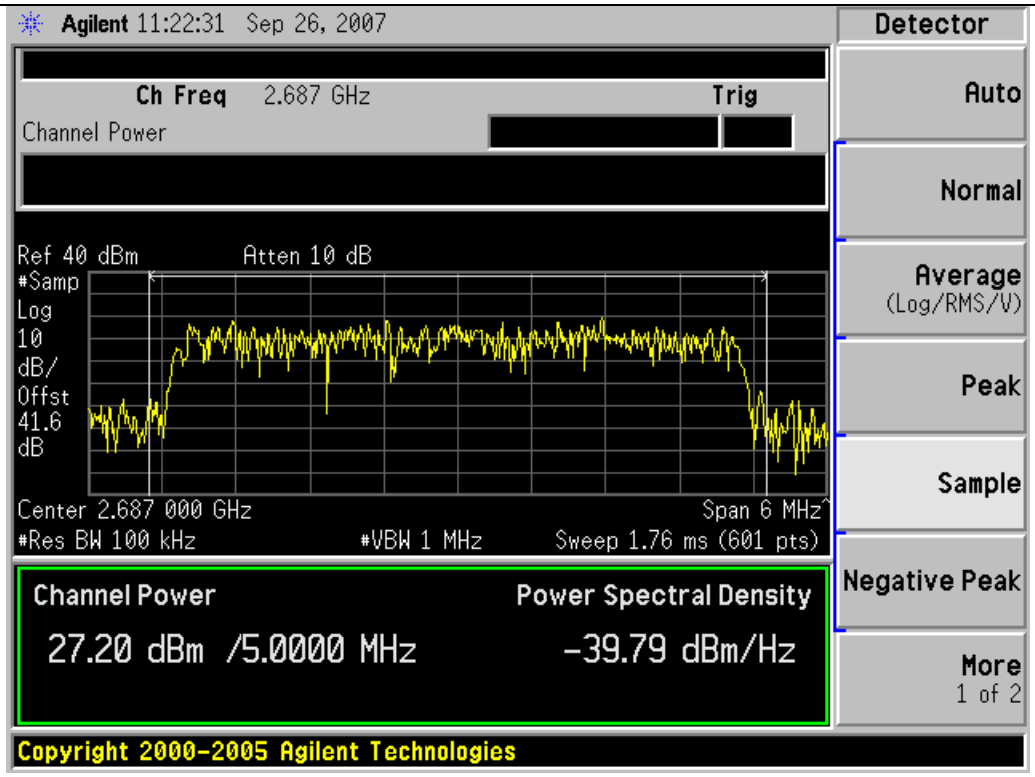


RMS detector / 16 QAM ½ rate coding

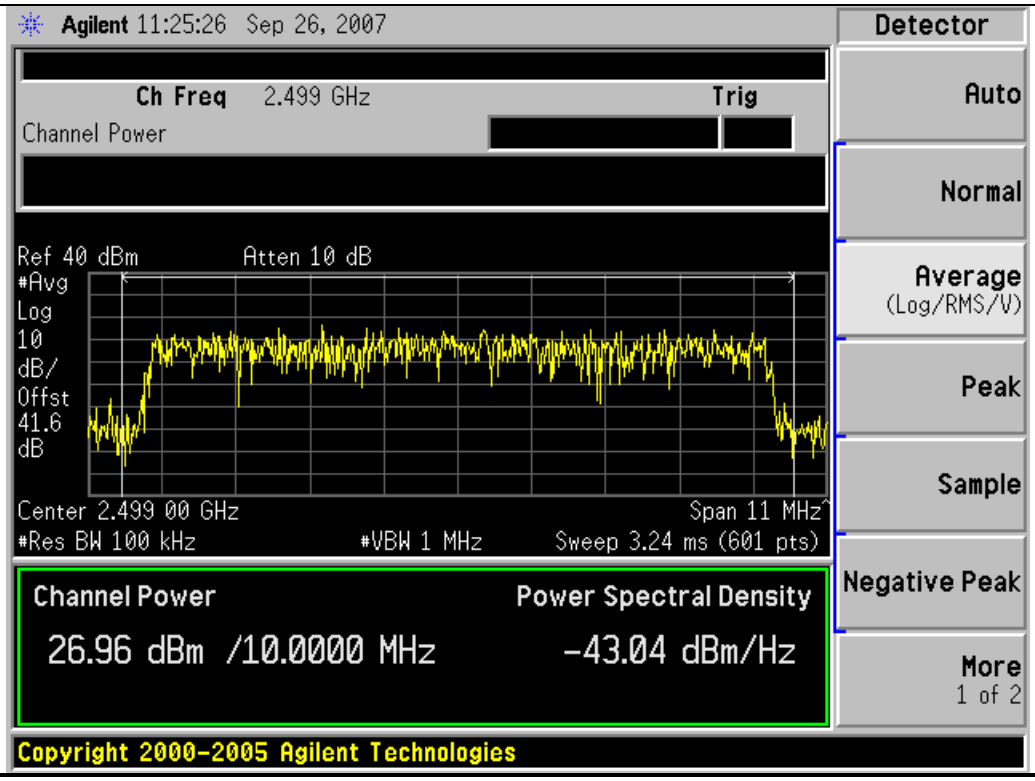


Peak detector / 16 QAM ½ rate coding

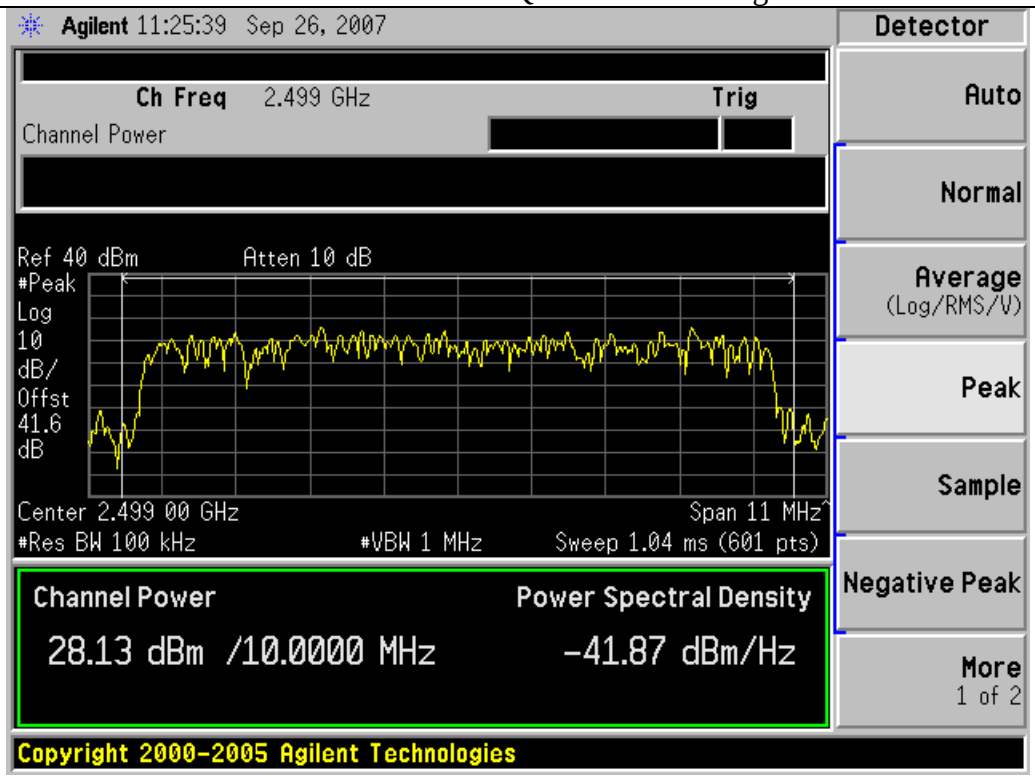


Sample detector / 16 QAM ½ rate coding

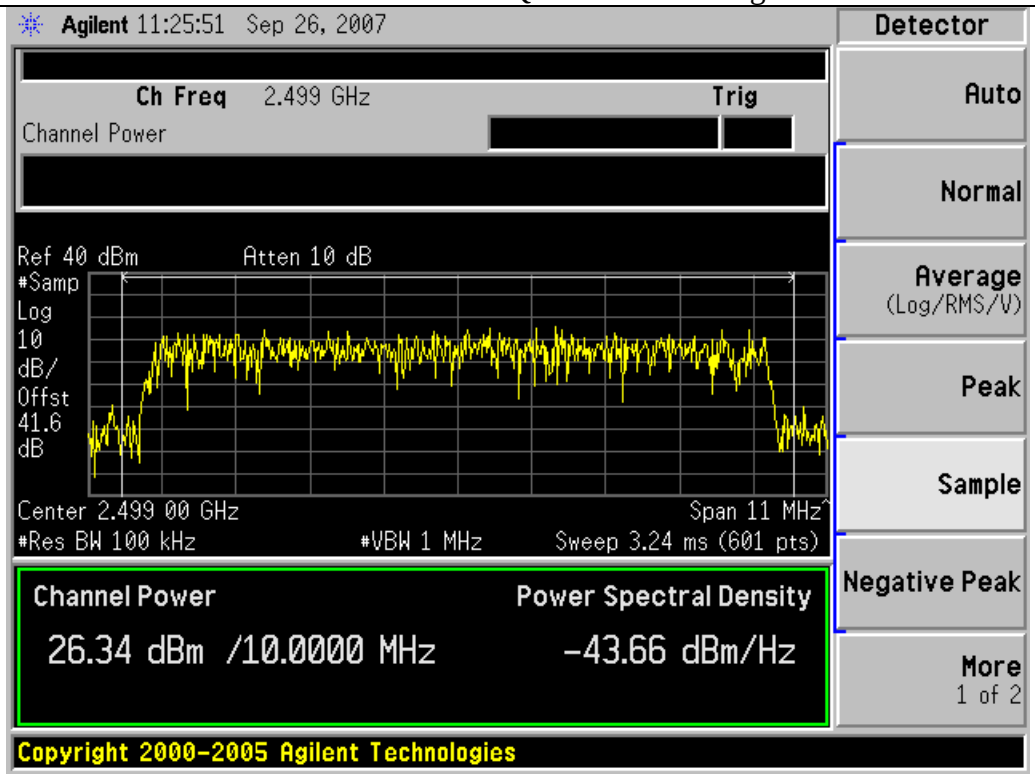
10 MHz channel bandwidth
2499 MHz



RMS detector / 16 QAM ½ rate coding

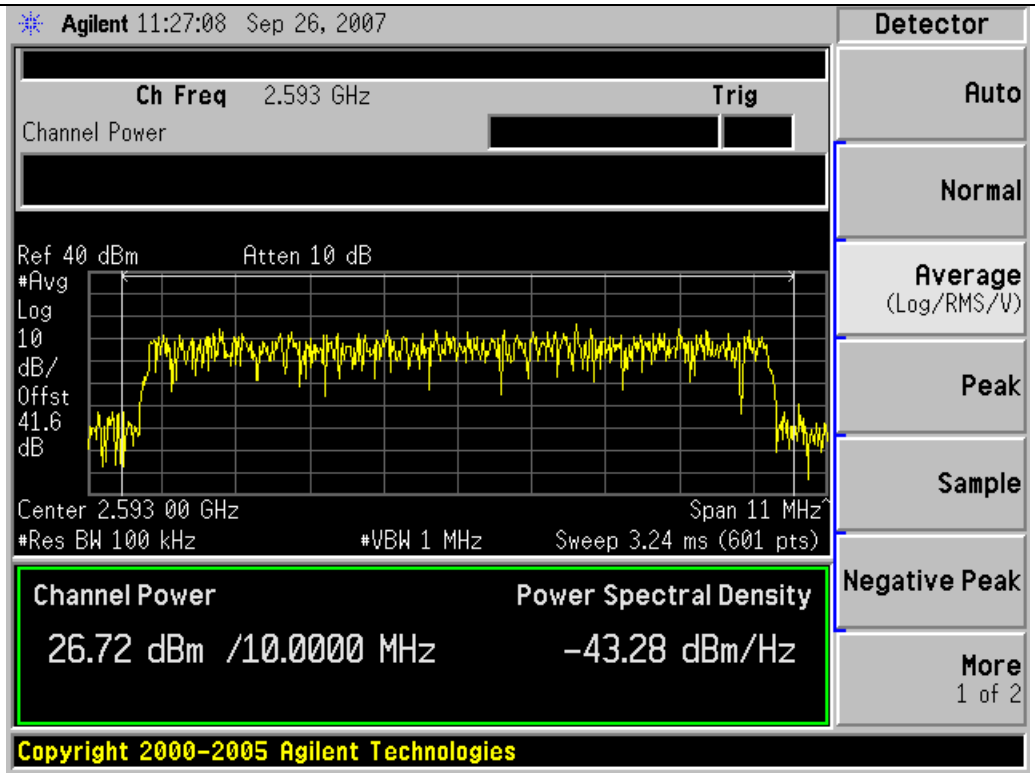


Peak detector / 16 QAM ½ rate coding

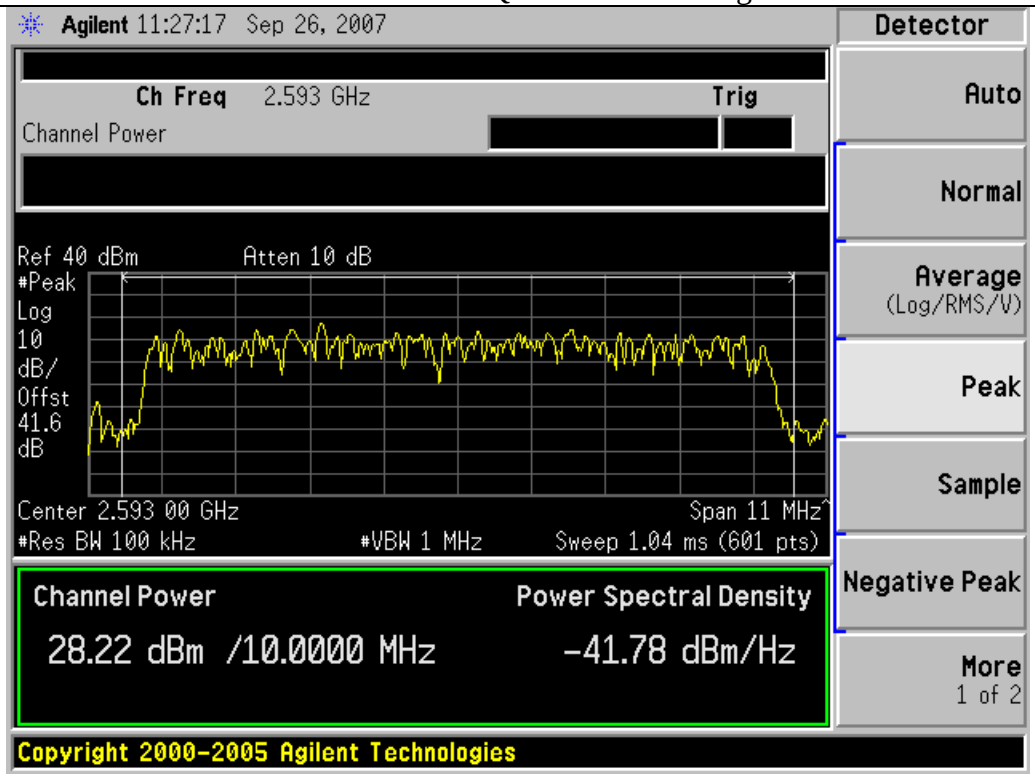


Sample detector / 16 QAM ½ rate coding

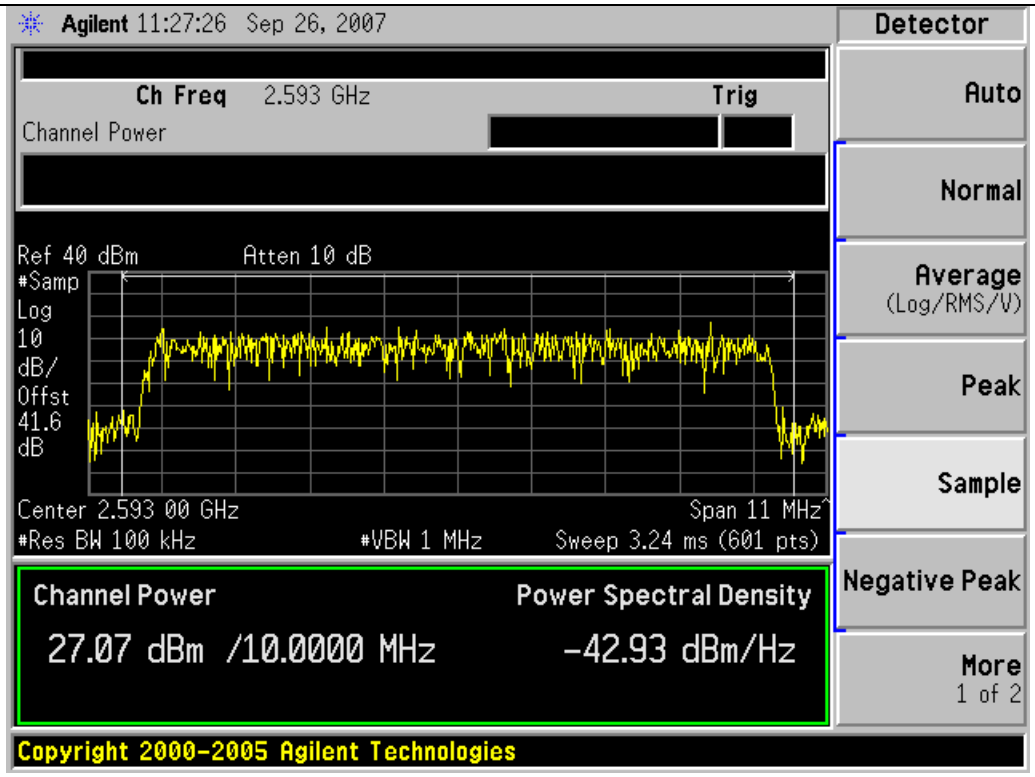
2593 MHz



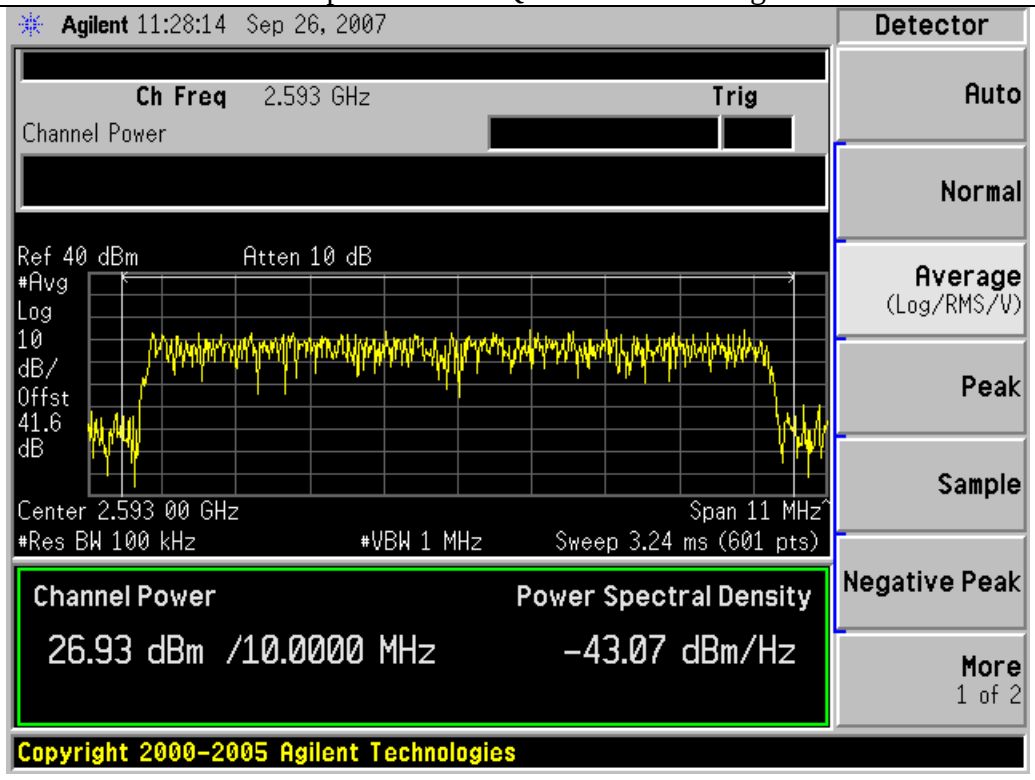
RMS detector / QPSK ½ rate coding



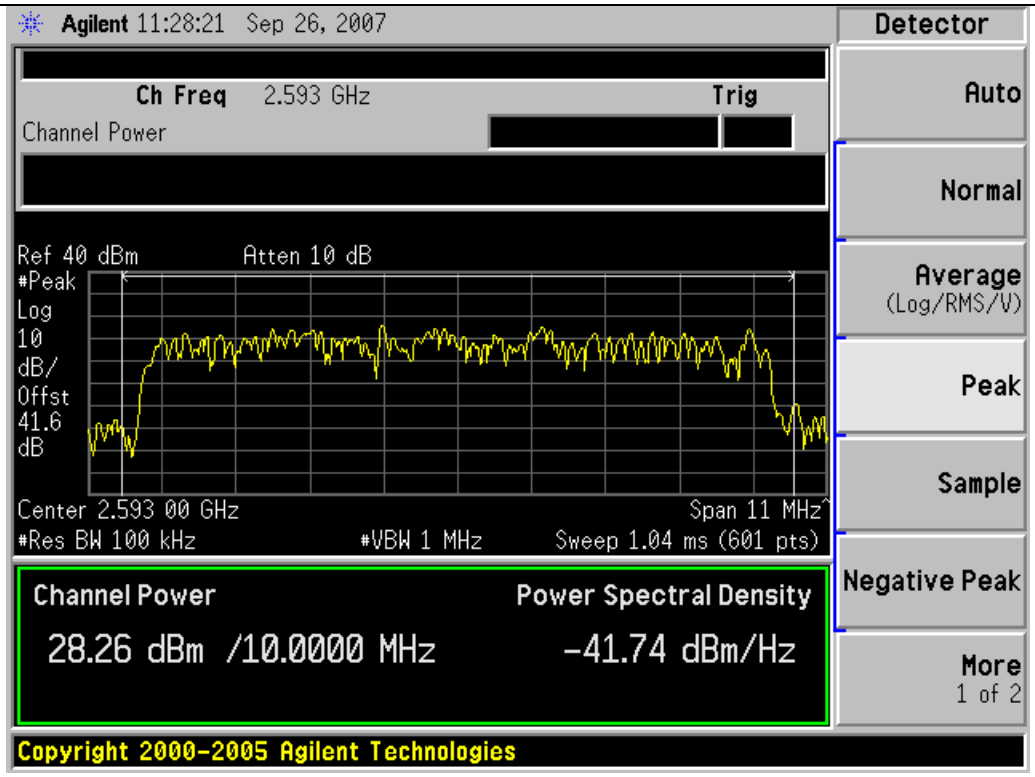
Peak detector / QPSK ½ rate coding



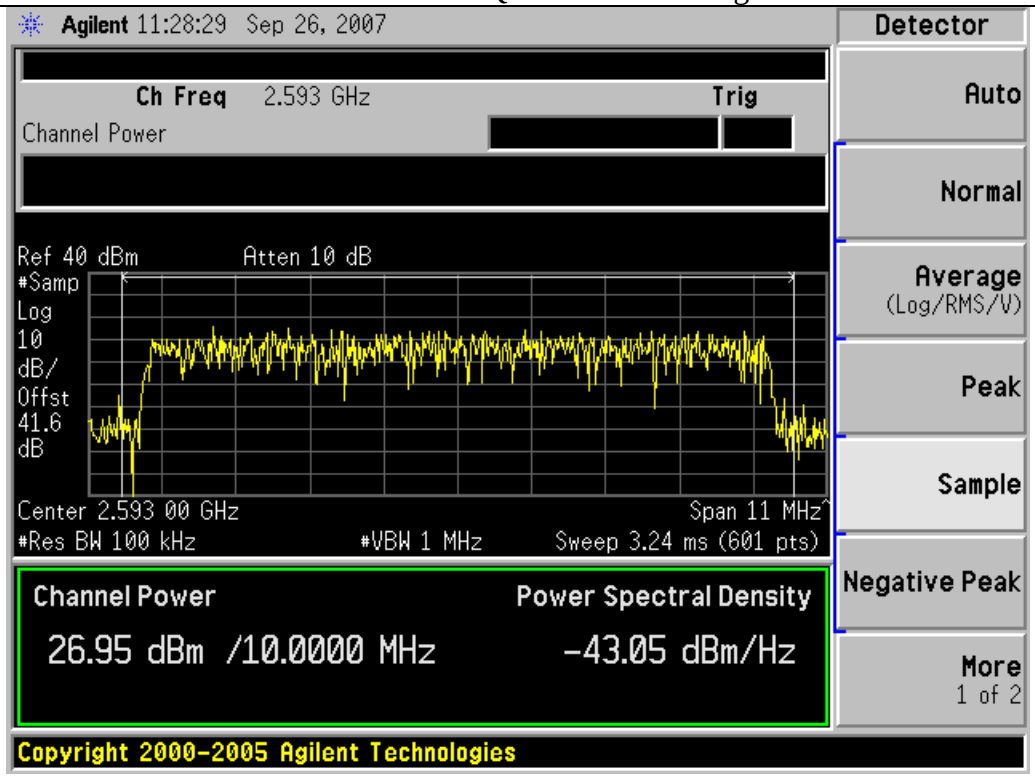
Sample detector / QPSK ½ rate coding



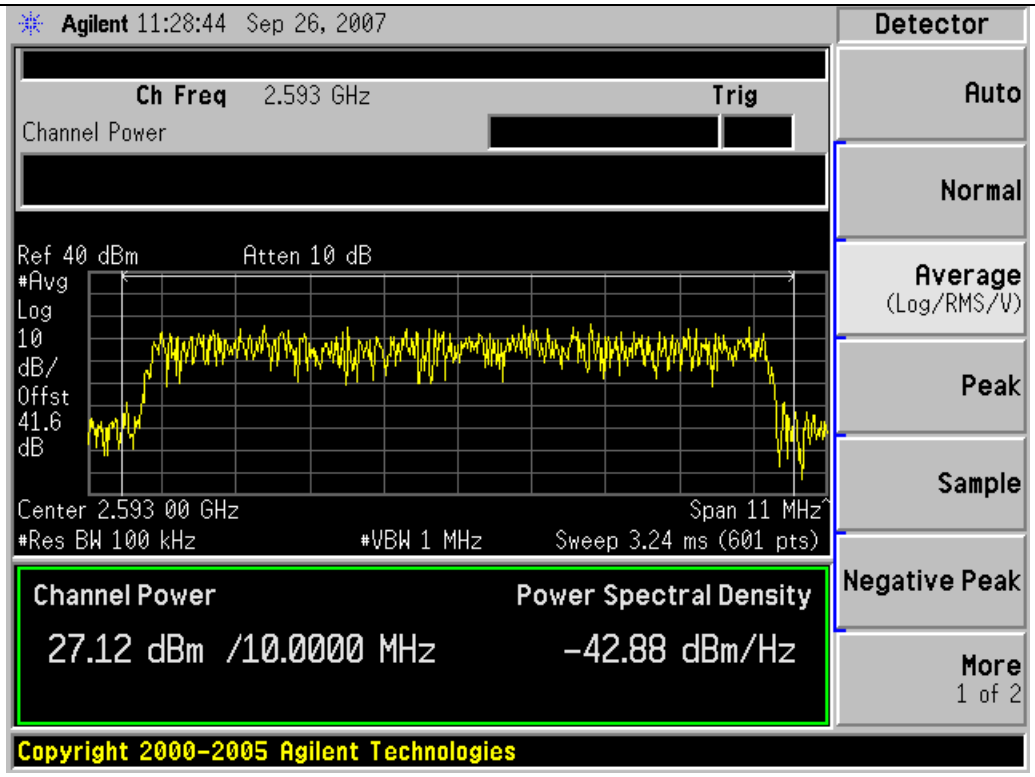
RMS detector / QPSK ¾ rate coding



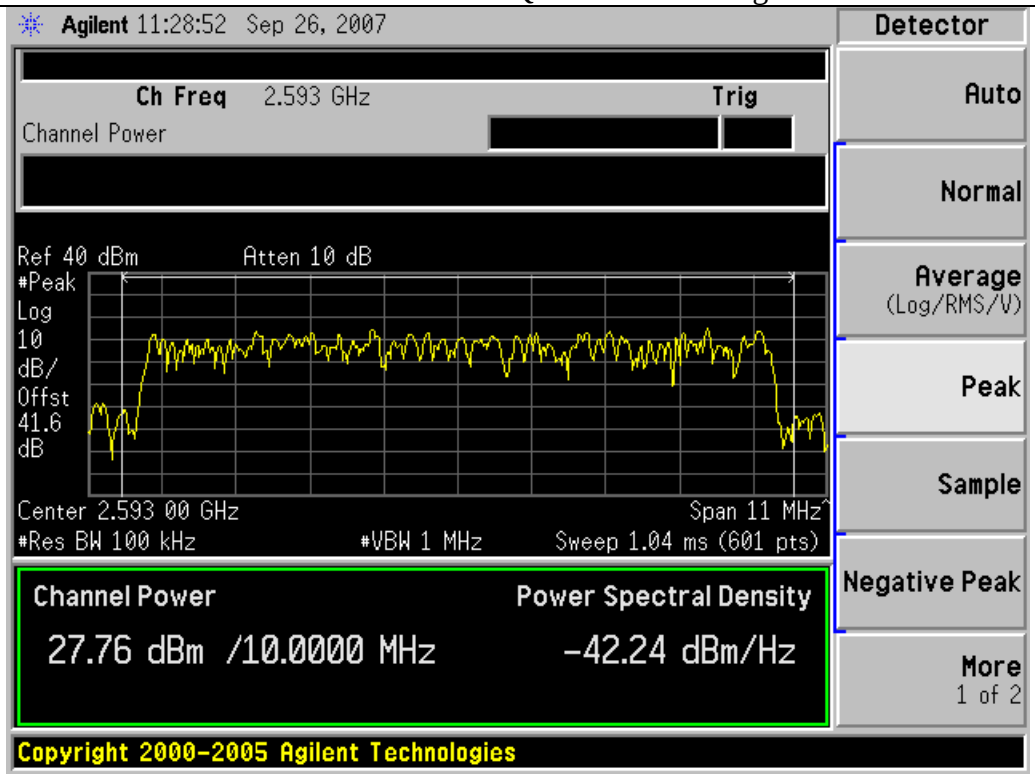
Peak detector / QPSK ¾ rate coding



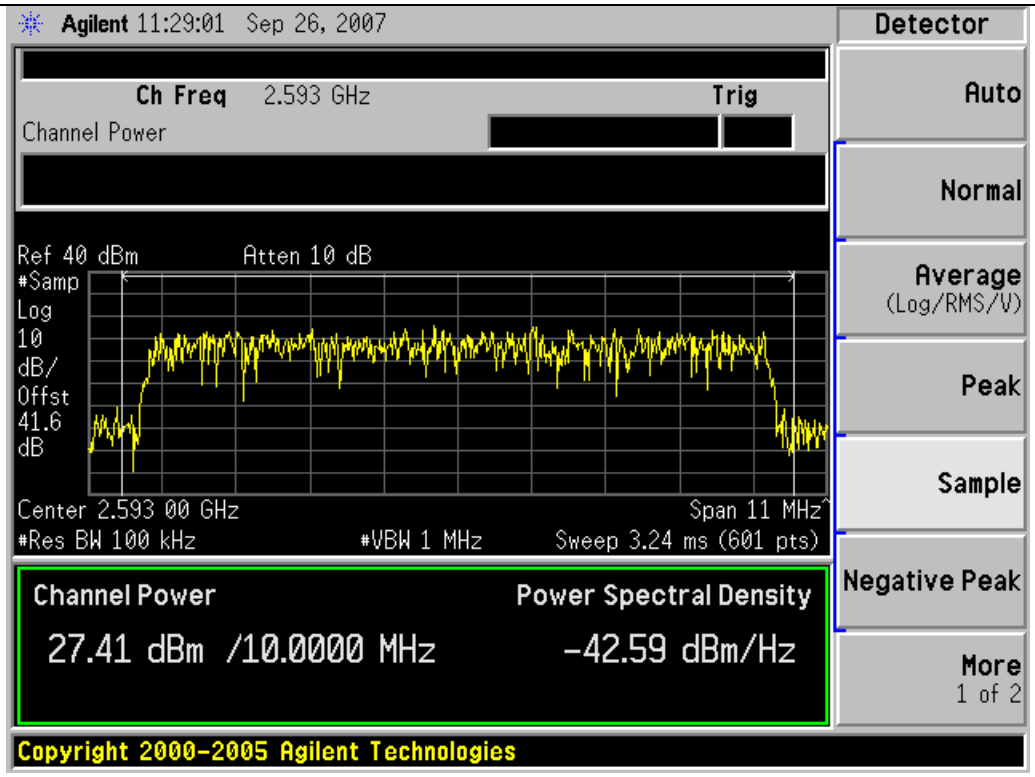
Sample detector / QPSK ¾ rate coding



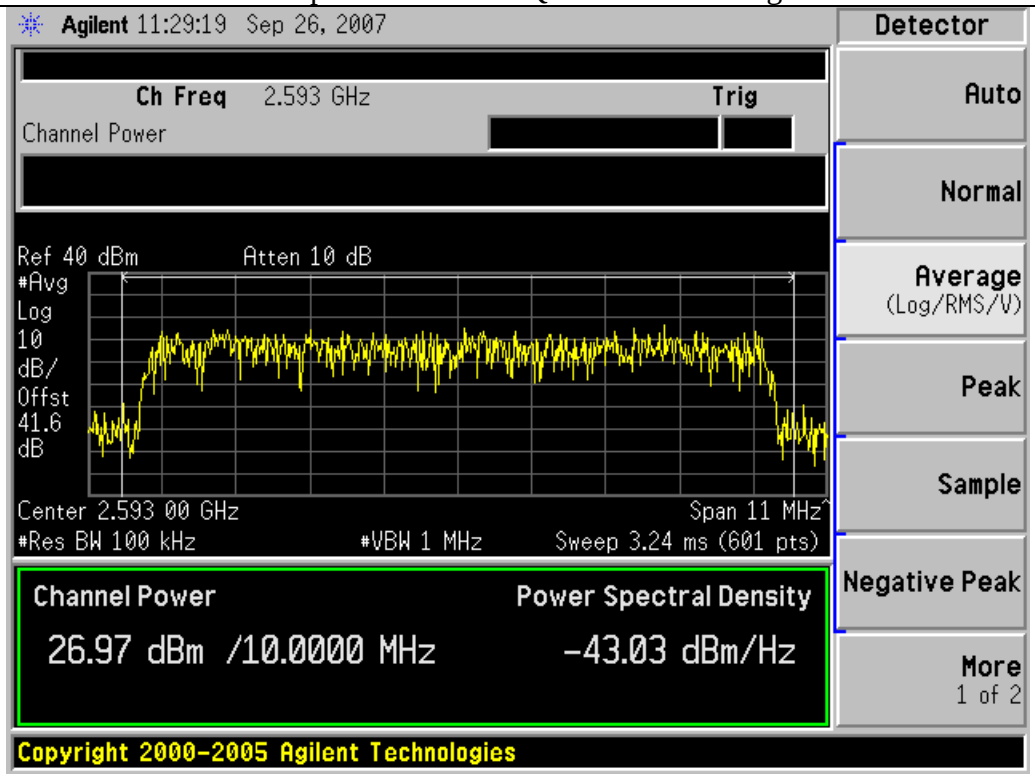
RMS detector / 16 QAM ½ rate coding



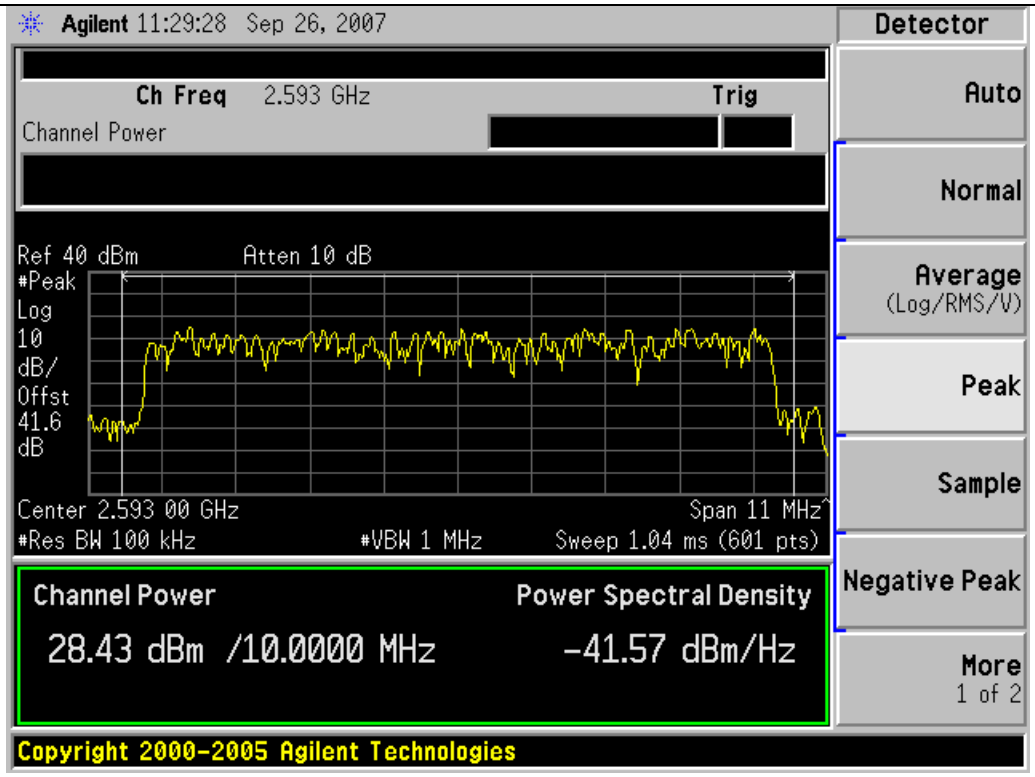
Peak detector / 16 QAM ½ rate coding



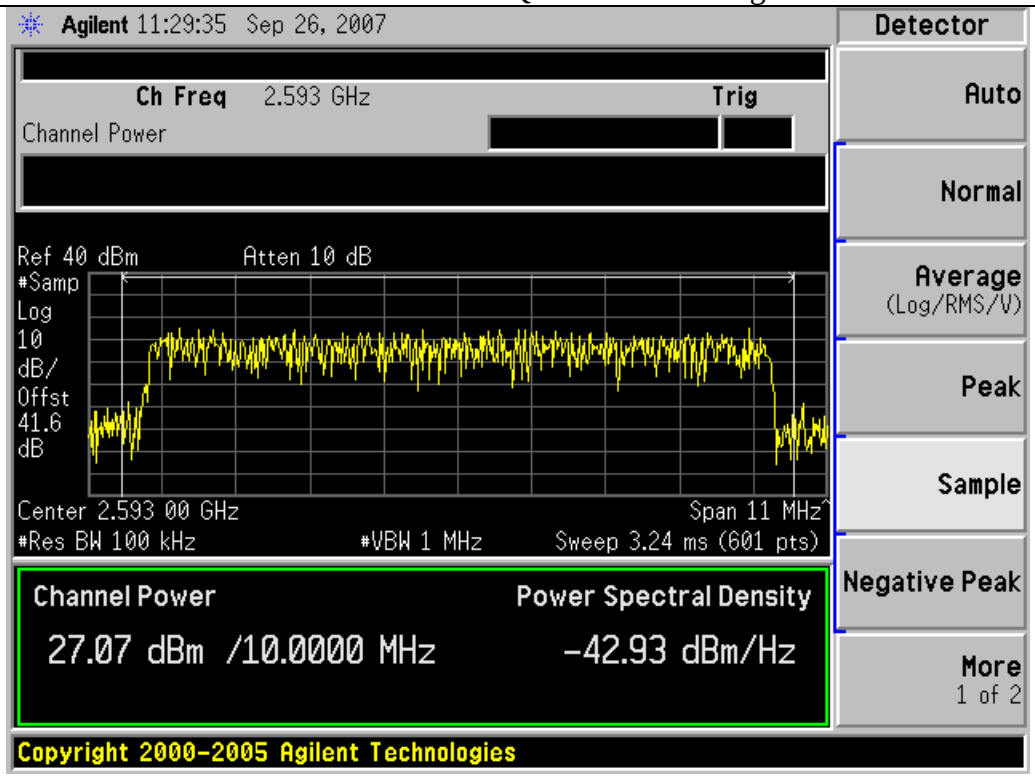
Sample detector / 16 QAM ½ rate coding



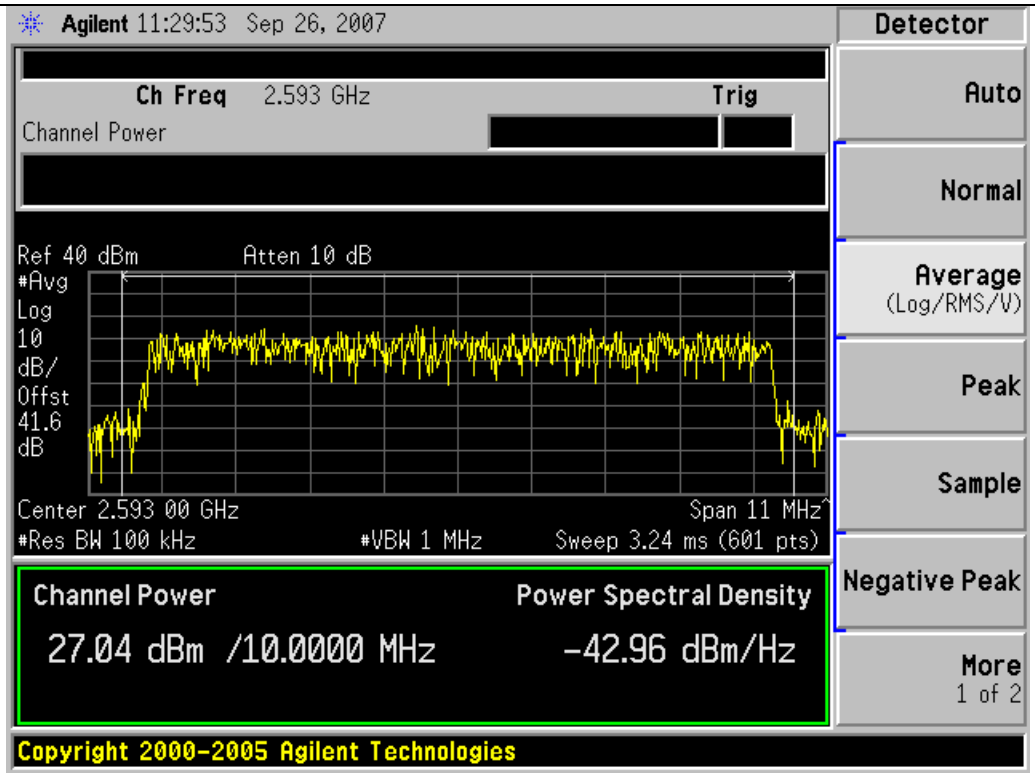
RMS detector / 16 QAM ¾ rate coding



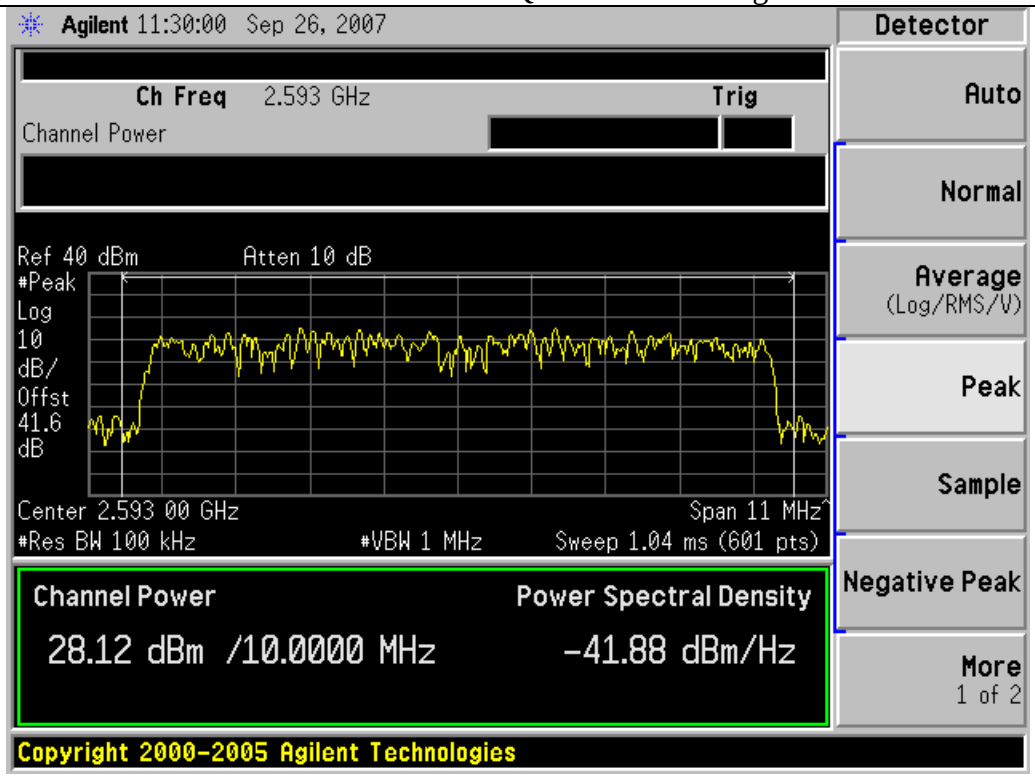
Peak detector / 16 QAM ¾ rate coding



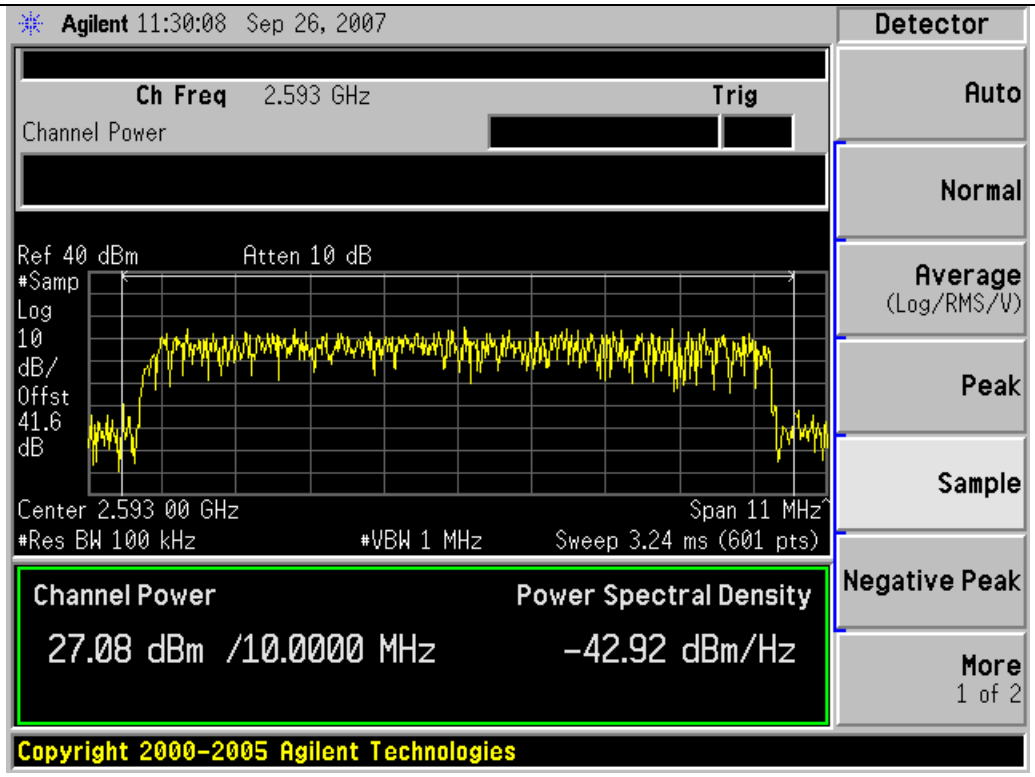
Sample detector / 16 QAM ¾ rate coding



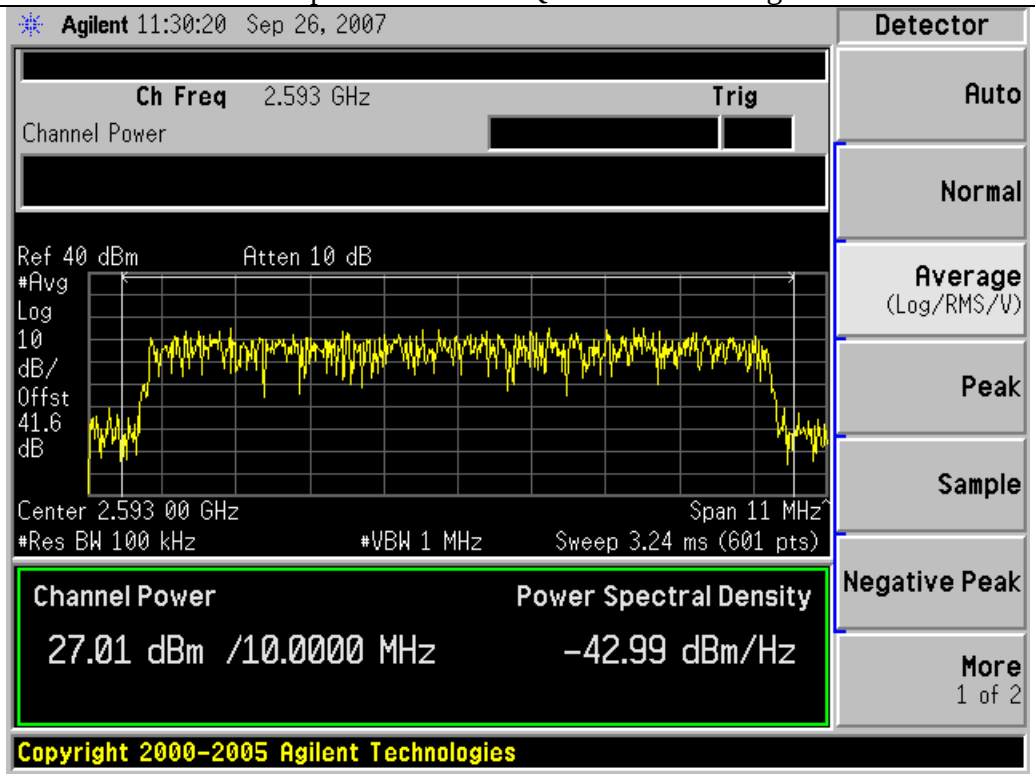
RMS detector / 64 QAM ½ rate coding



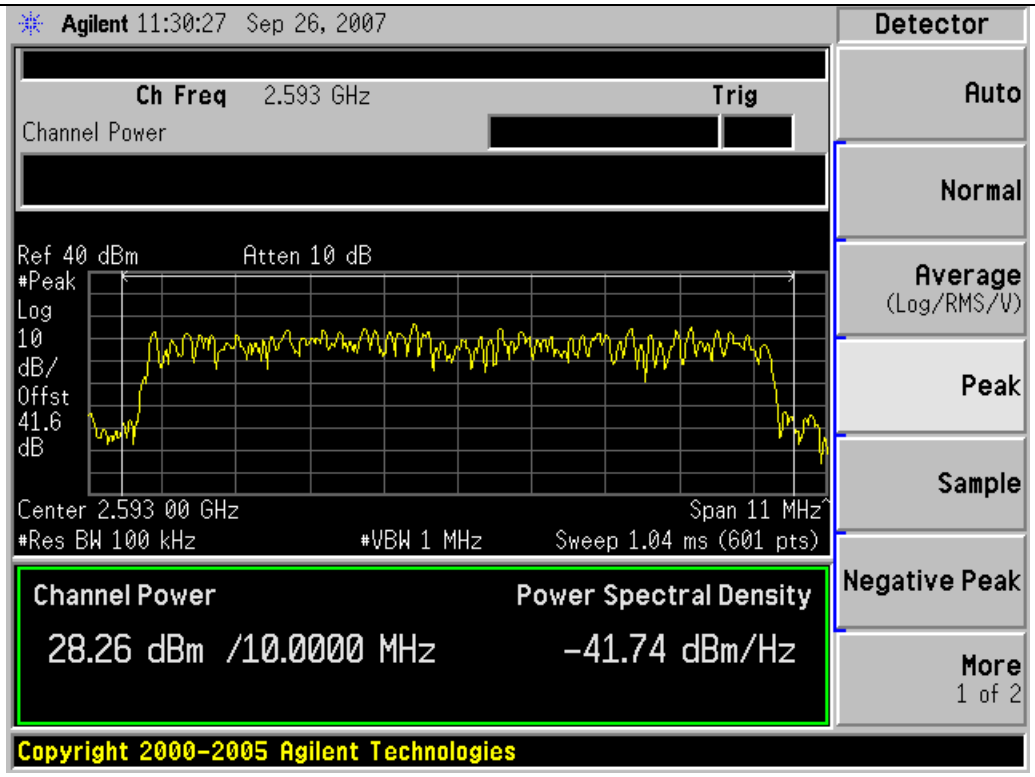
Peak detector / 64 QAM ½ rate coding



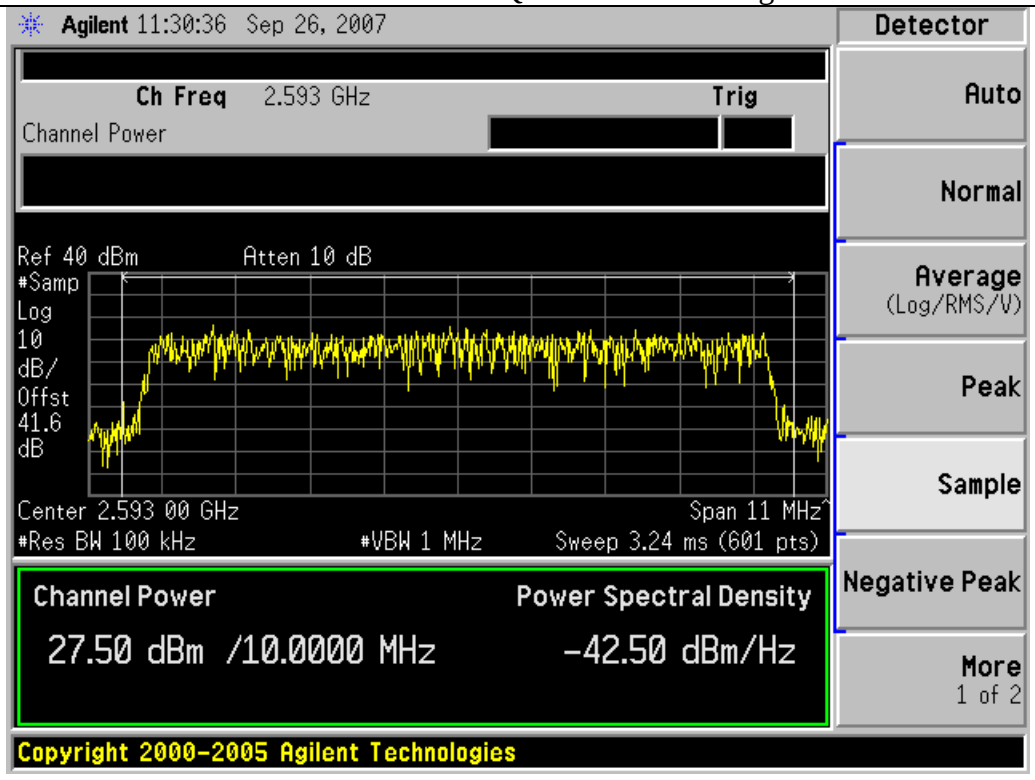
Sample detector / 64 QAM ½ rate coding



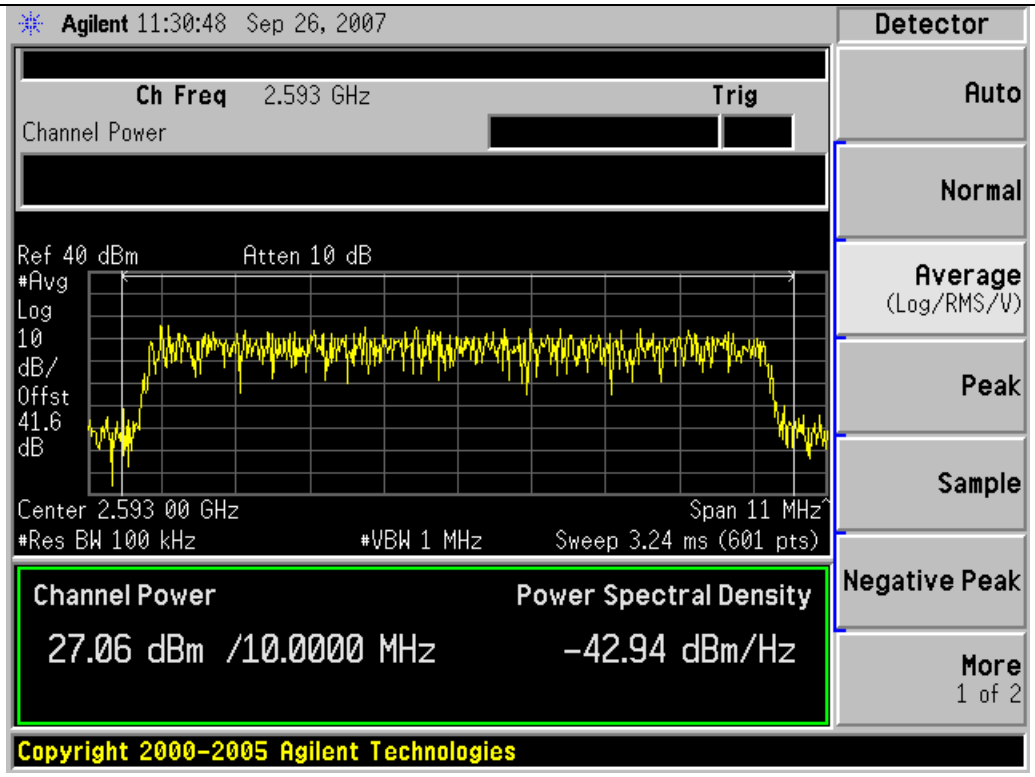
RMS detector / 64 QAM 2/3 rate coding



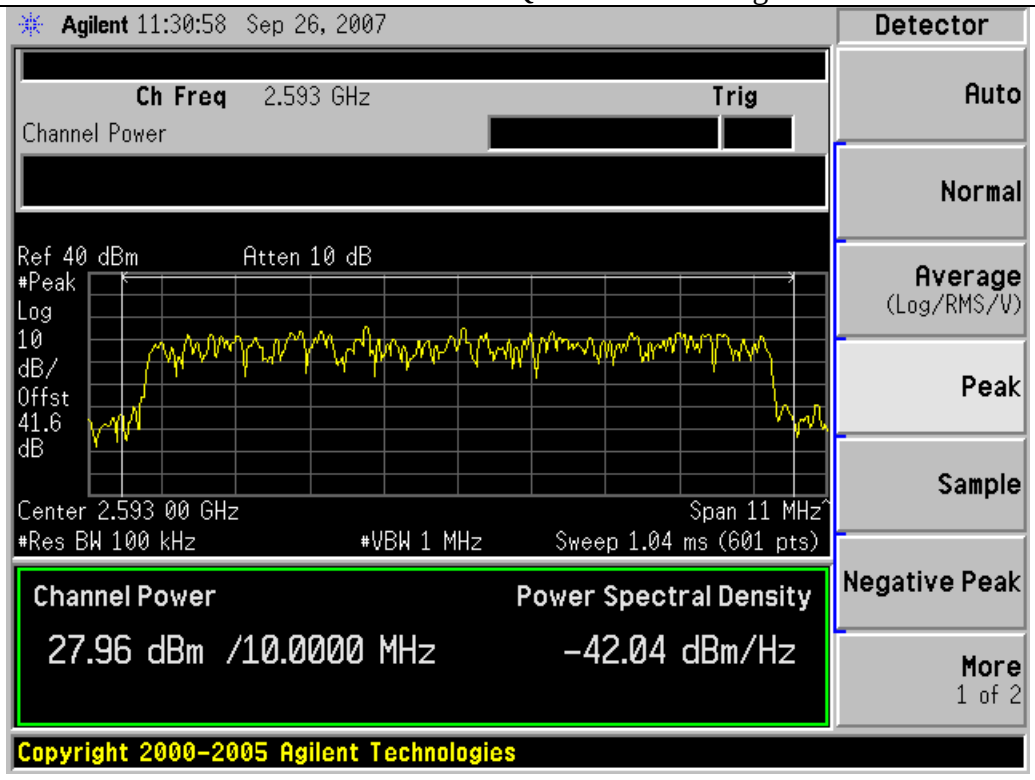
Peak detector / 64 QAM 2/3 rate coding



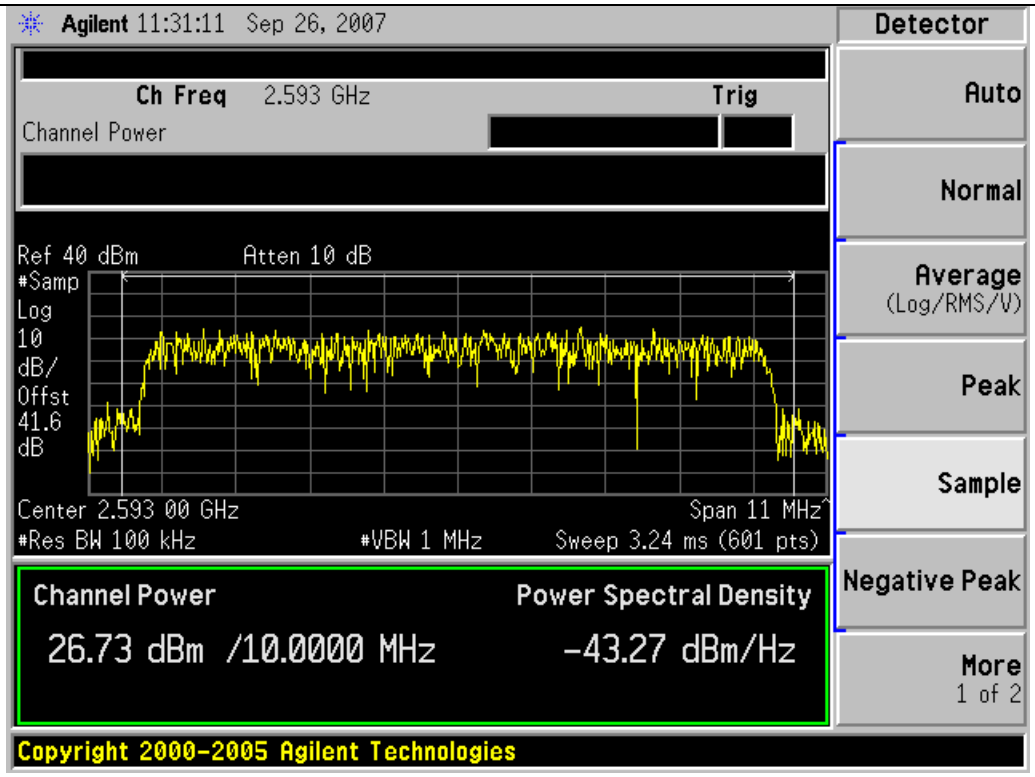
Sample detector / 64 QAM 2/3 rate coding



RMS detector / 64 QAM ¾ rate coding

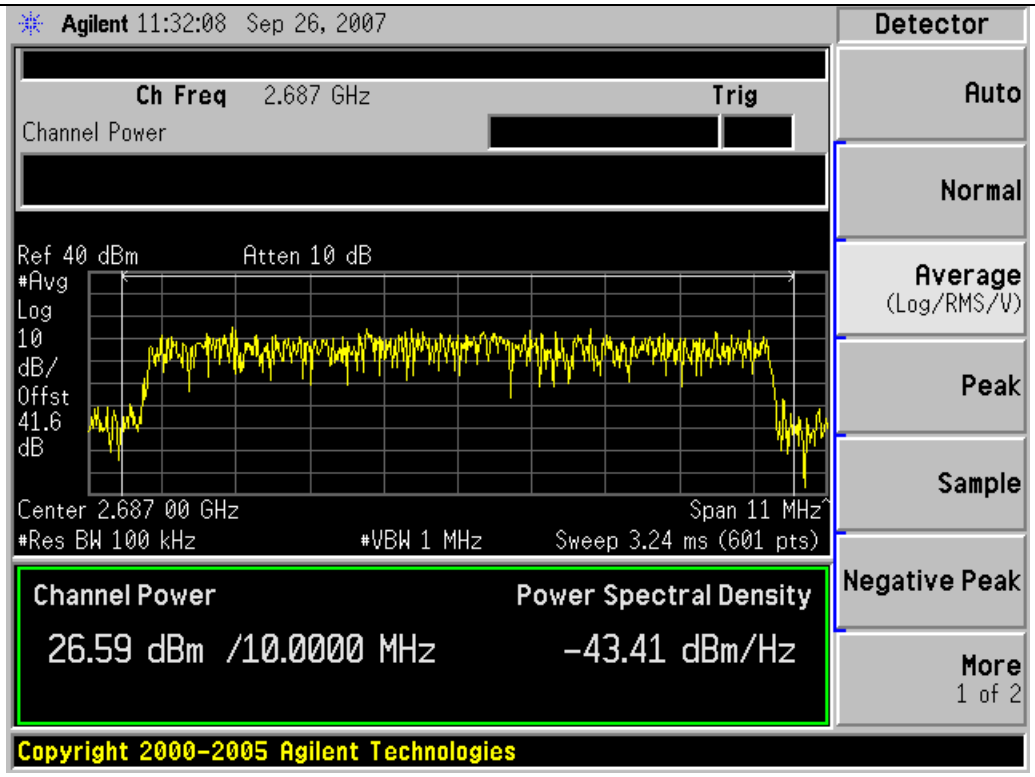


Peak detector / 64 QAM ¾ rate coding

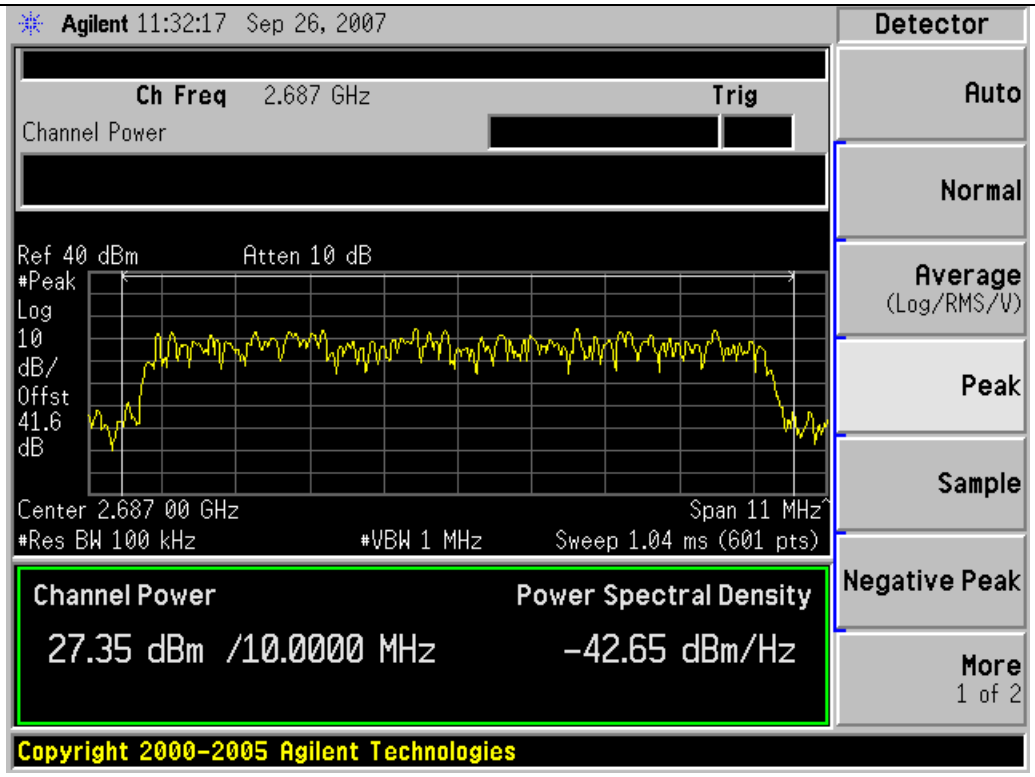


Sample detector / 64 QAM ¾ rate coding

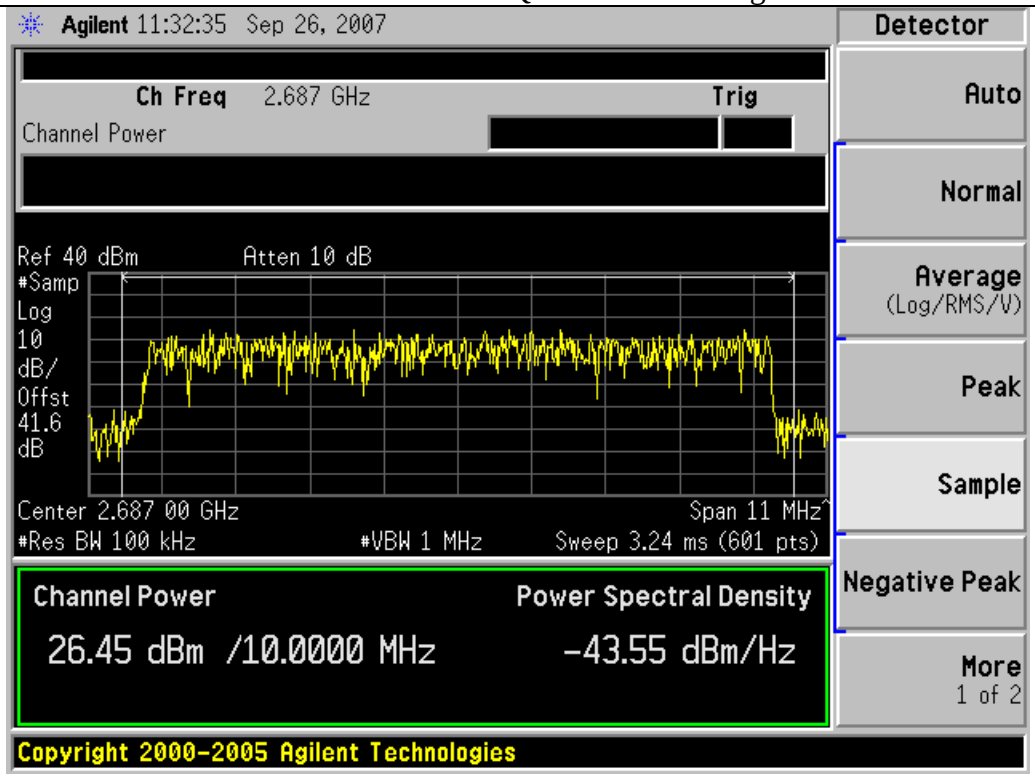
2687 MHz



RMS detector / 16 QAM ½ rate coding



Peak detector / 16 QAM ½ rate coding



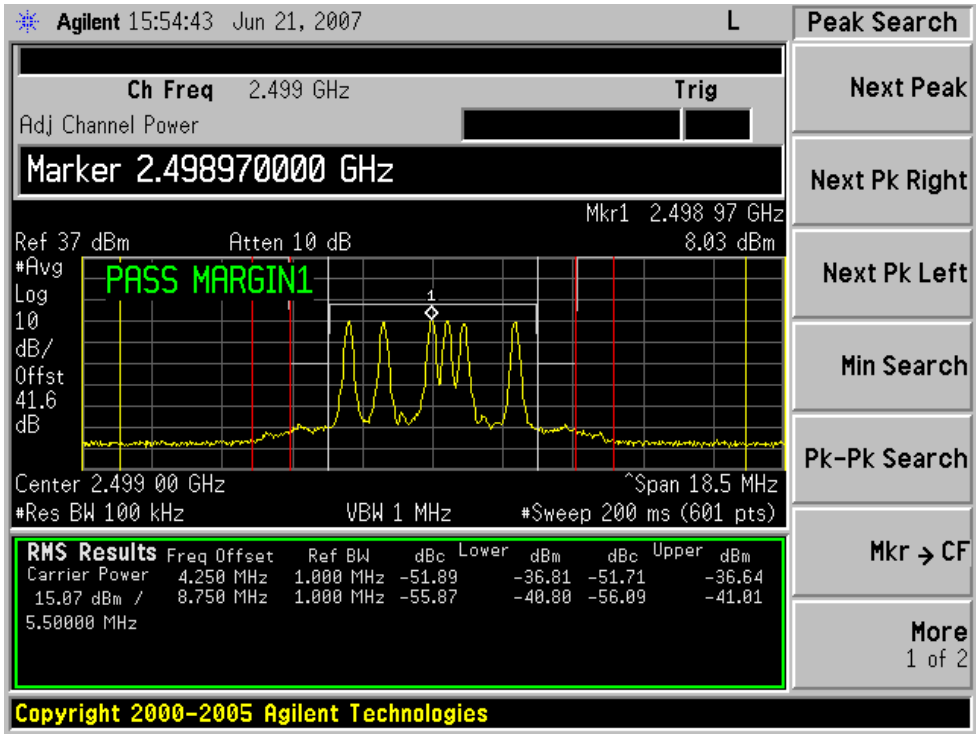
Sample detector / 16 QAM ½ rate coding

100 kHz Power Spectral Density, Various Subchannels Enabled –
Complies to the requirements of 27.50(h)(4).

5.3.2. Conducted RF Power Calculations for 100 kHz PSD

Data point level (dBm) = –47.86 dBm
Data point level (watts) = 0.001 x $10^{(-47.86/10)}$ = 0.0000000163
100 kHz bin 1 (watts) = Summation (Trace points 1 thru 10)
= 16+29+24+23+76+76+108+179+247+196
= 974 nwatts + rounding error = 975 nwatts

Trace Point	Freq (Hz)	Trace1 (dBm)	Trace1 (Watts)		
1	2496500000	-47.86	0.000000016		
2	2496510000	-45.38	0.000000029		
3	2496520000	-46.22	0.000000024		
4	2496530000	-46.31	0.000000023		
5	2496540000	-41.20	0.000000076		
6	2496550000	-41.20	0.000000076		
7	2496560000	-39.65	0.000000108		
8	2496570000	-37.46	0.000000179		
9	2496580000	-36.07	0.000000247	100 kHz bin	Power/100 kHz (W)
10	2496590000	-37.07	0.000000196	1	9.75282E-07
11	2496600000	-35.78	0.000000264	2	1.22339E-06
12	2496610000	-37.15	0.000000193	3	1.38738E-06



Single Subchannel Transmission Example

5.3.3. Conducted RF Power Output Plots

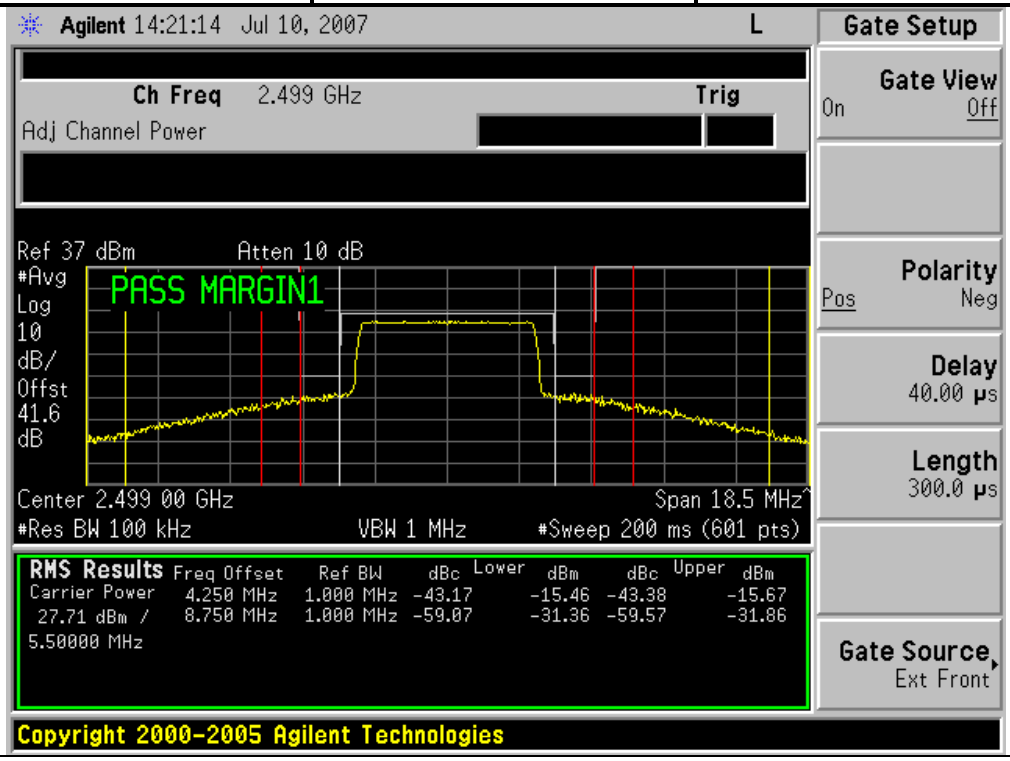
NOTE: All subchannels are enabled for these plots.

Spectrum analyzer plots are shown on the following pages for 2499 MHz, Time Slots = 1 (6.17% duty cycle), both 5.0 and 10 MHz bandwidth (all modulation types). For the minimum power level, plots are displayed for all the data points.

Plots for the Time Slots 2-8 data shown in the tables on pages 7 and 8 are shown in the Appendix (see "Conducted Power and Modulation Characteristics Plots").

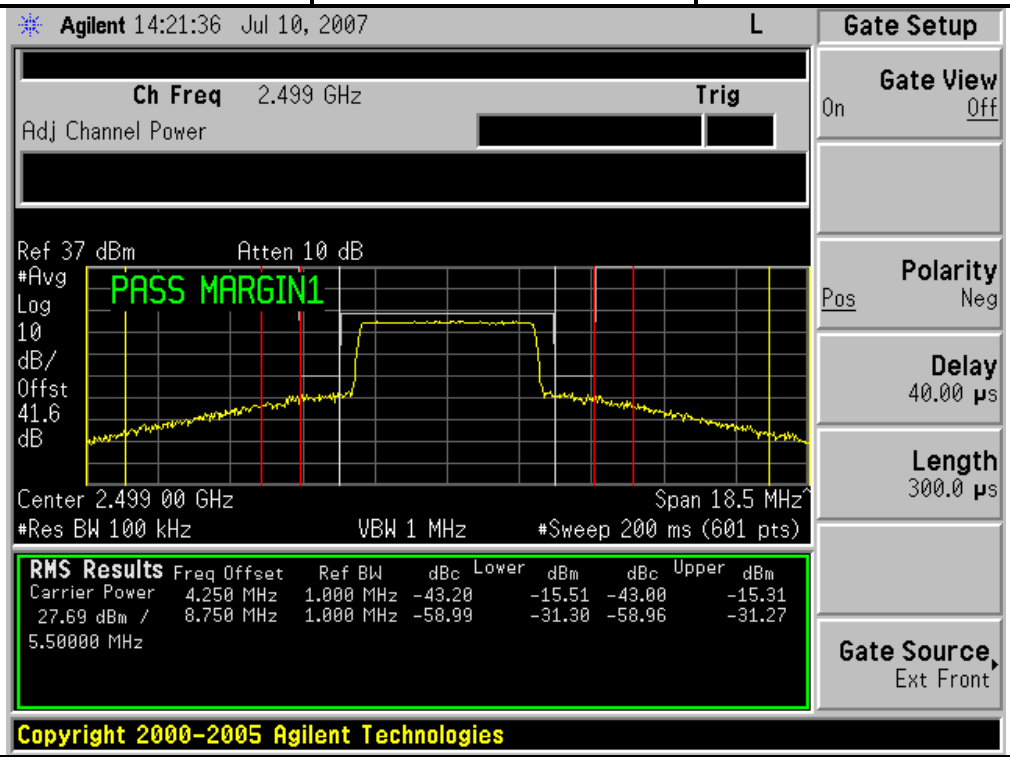
Plots for the other modulation types of 2593 and 2687 MHz, Time Slots = 1, are not shown but are similar.

Time Slots: 1	Bandwidth: 5.0 MHz	Modulation: QPSK 1/2



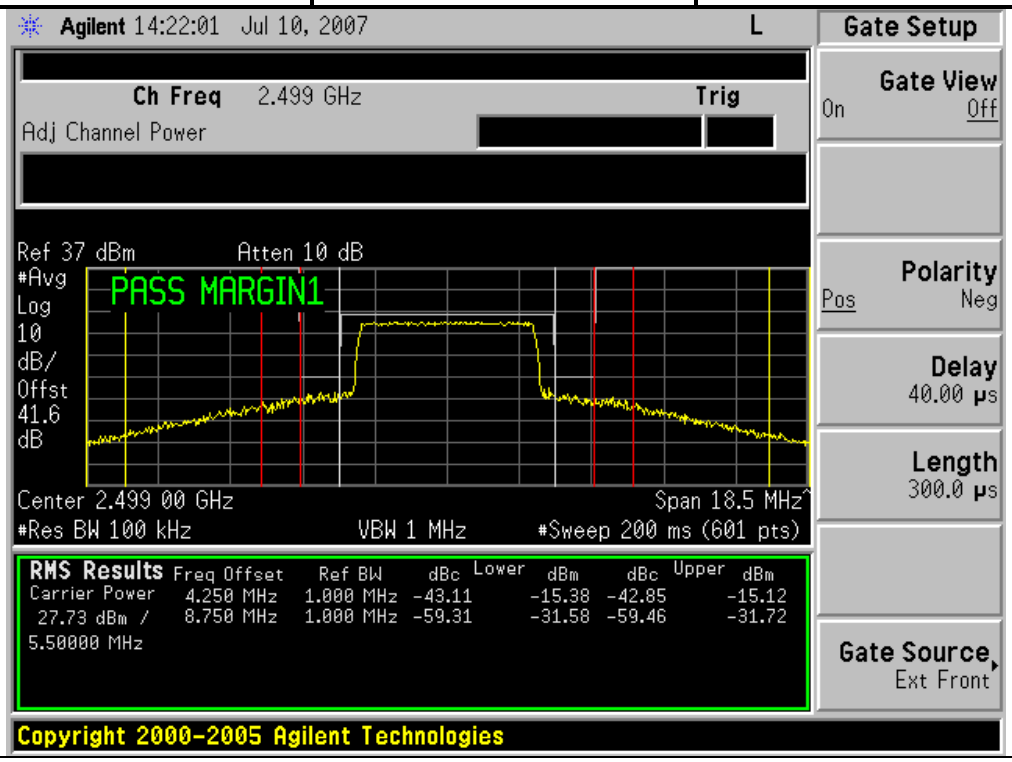
2499 MHz

Time Slots: 1	Bandwidth: 5.0 MHz	Modulation: QPSK 3/4



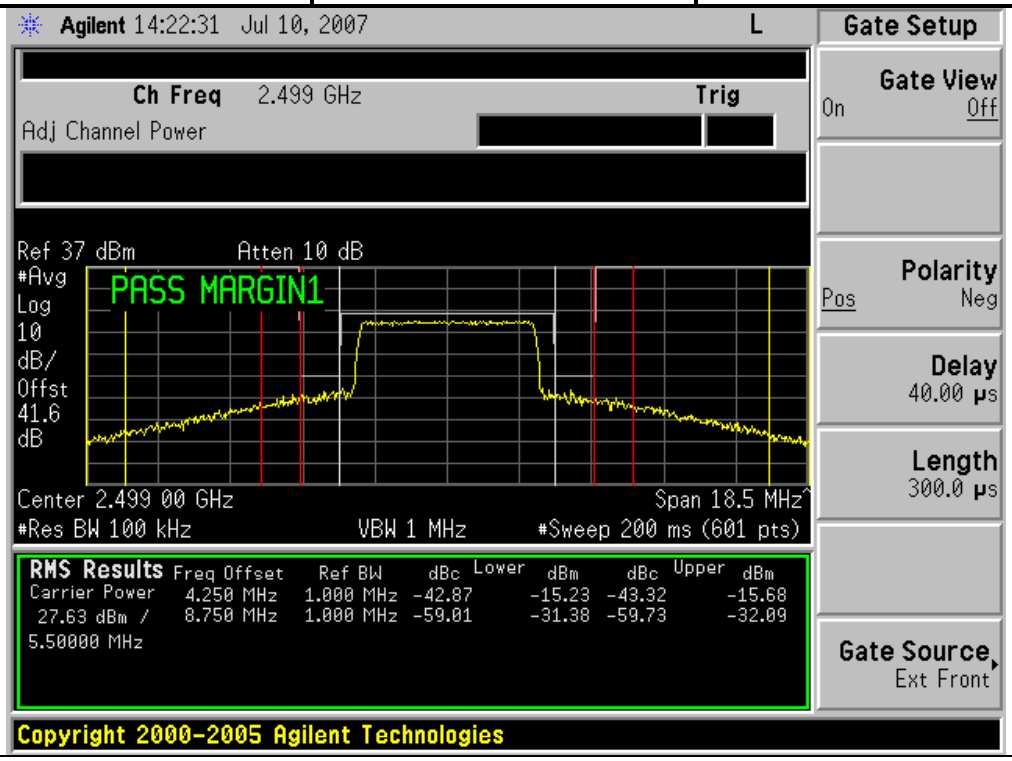
2499 MHz

Time Slots: 1	Bandwidth: 5.0 MHz	Modulation: 16 QAM 1/2



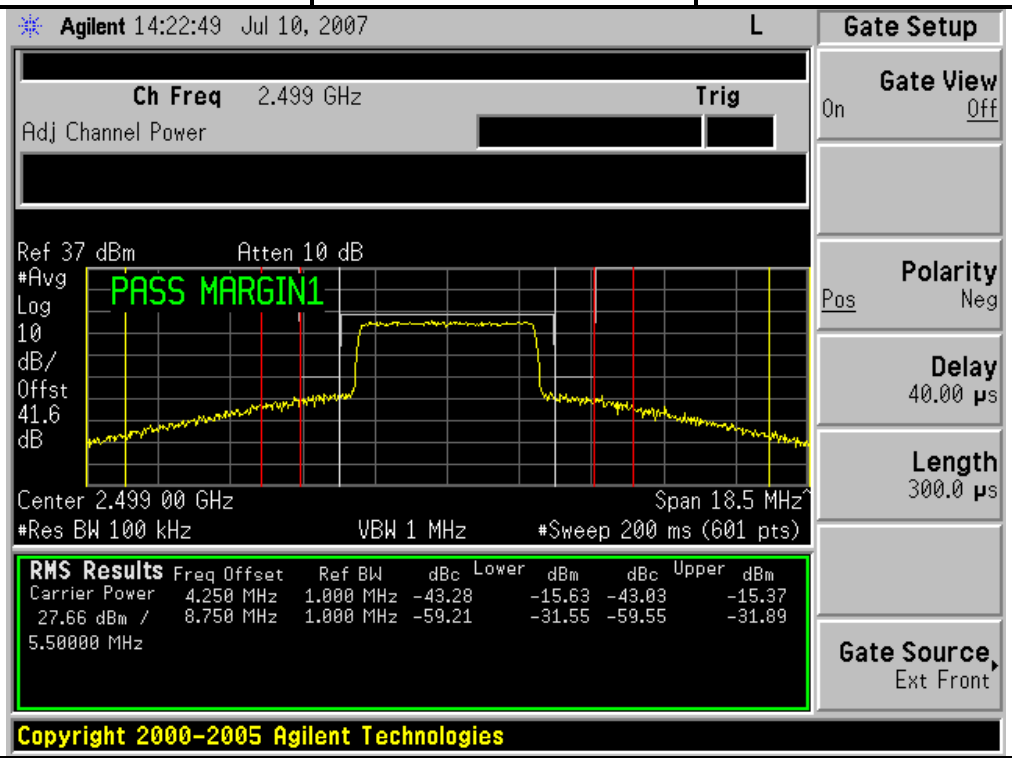
2499 MHz

Time Slots: 1	Bandwidth: 5.0 MHz	Modulation: 16 QAM 3/4



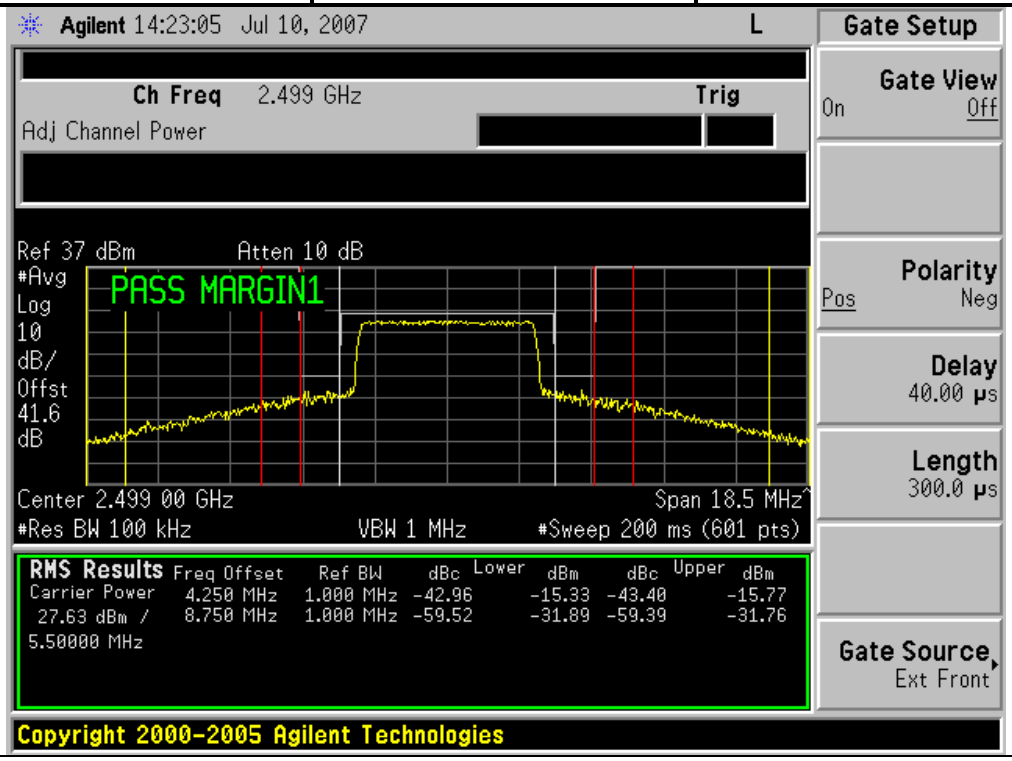
2499 MHz

Time Slots: 1	Bandwidth: 5.0 MHz	Modulation: 64 QAM 1/2



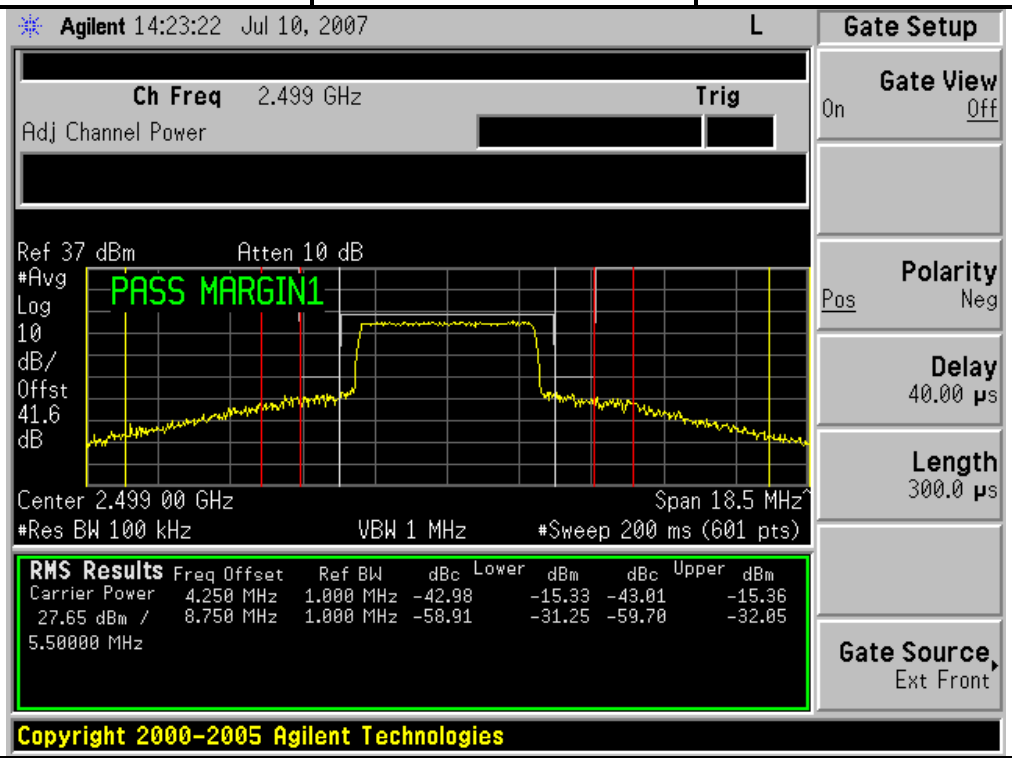
2499 MHz

Time Slots: 1	Bandwidth: 5.0 MHz	Modulation: 64 QAM 2/3



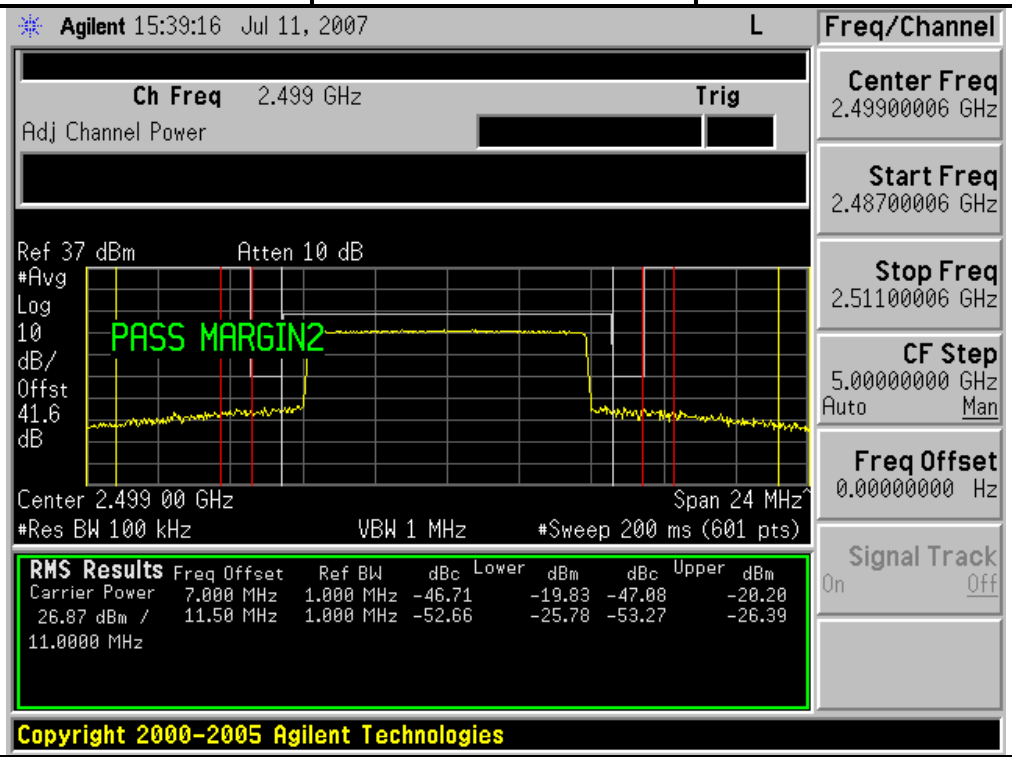
2499 MHz

Time Slots: 1	Bandwidth: 5.0 MHz	Modulation: 64 QAM 3/4



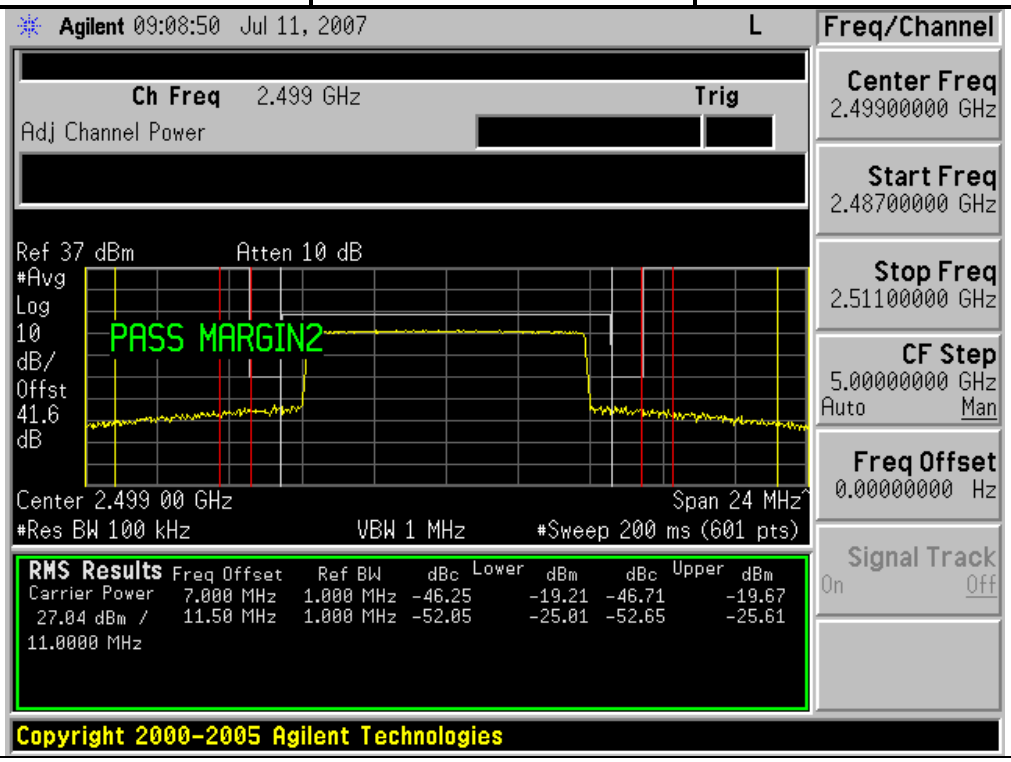
2499 MHz

Time Slots: 1	Bandwidth: 10 MHz	Modulation: QPSK 1/2



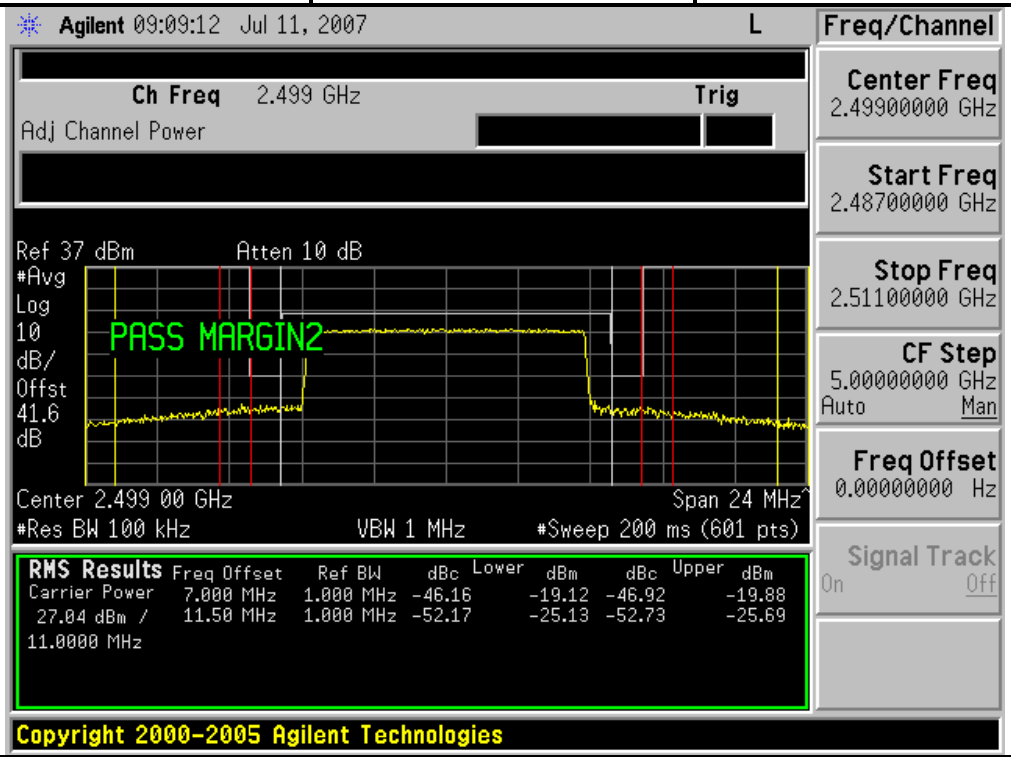
2499 MHz

Time Slots: 1	Bandwidth: 10 MHz	Modulation: QPSK 3/4



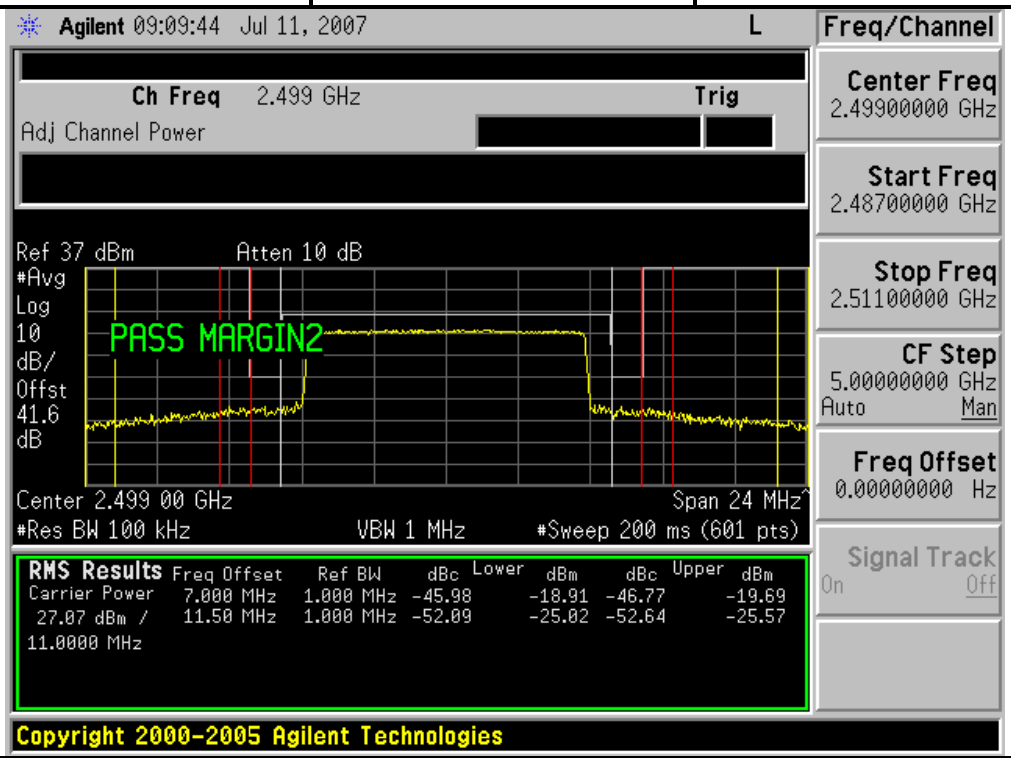
2499 MHz

Time Slots: 1	Bandwidth: 10 MHz	Modulation: 16 QAM 1/2



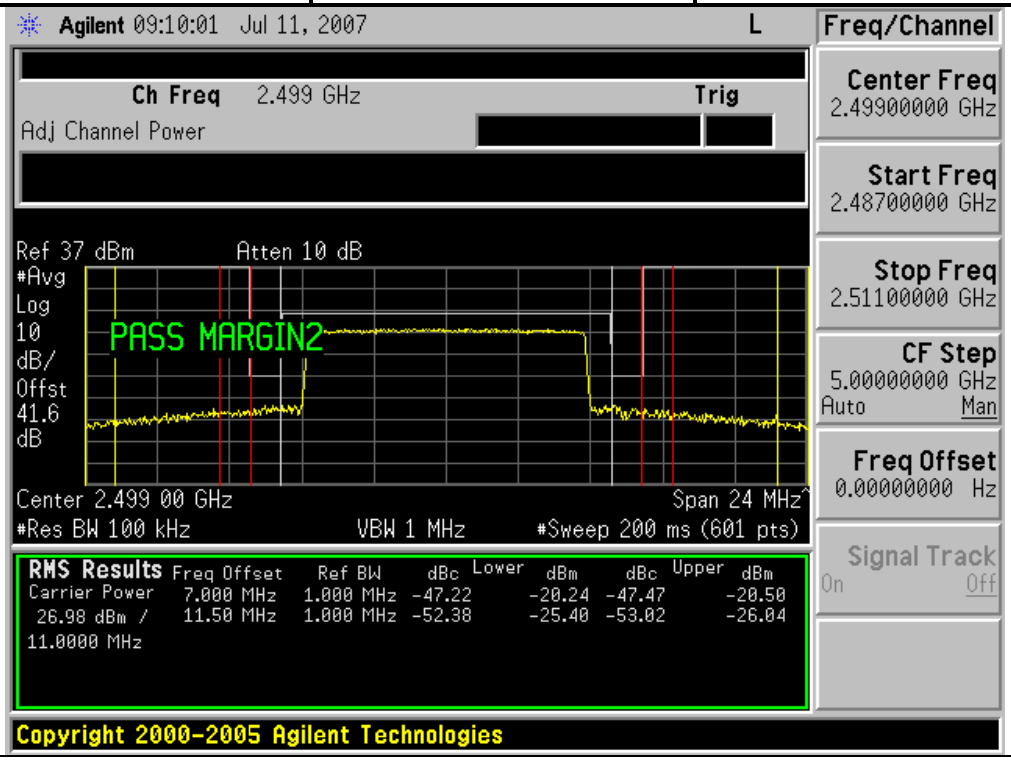
2499 MHz

Time Slots: 1	Bandwidth: 10 MHz	Modulation: 16 QAM 3/4



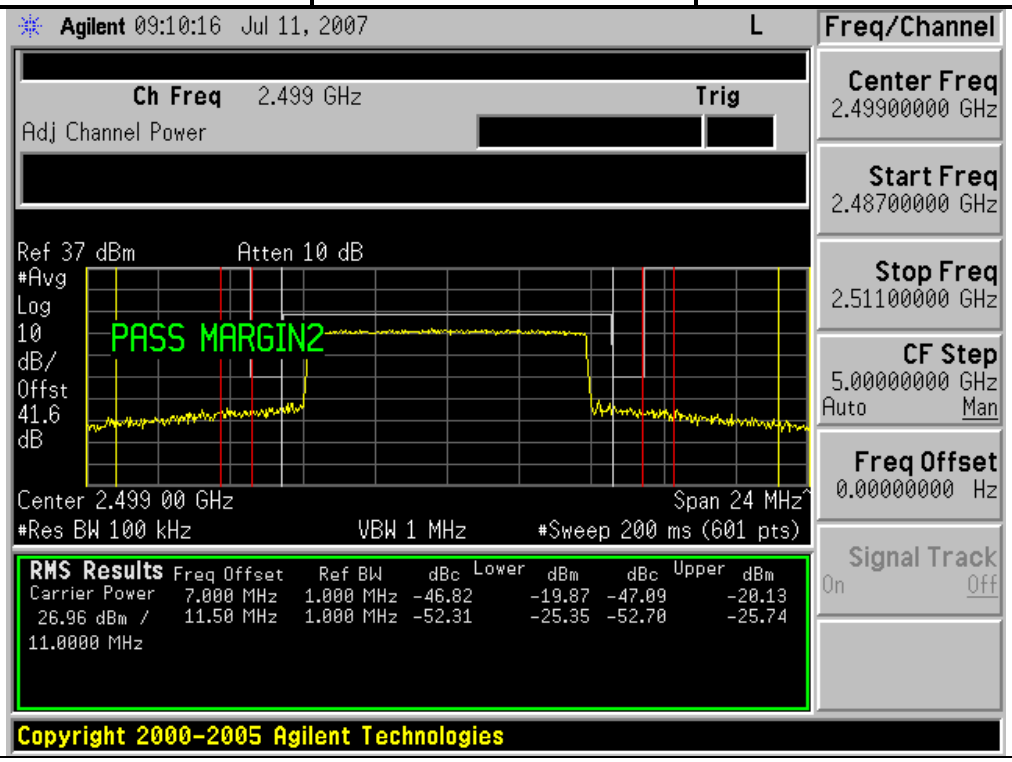
2499 MHz

Time Slots: 1	Bandwidth: 10 MHz	Modulation: 64 QAM 1/2



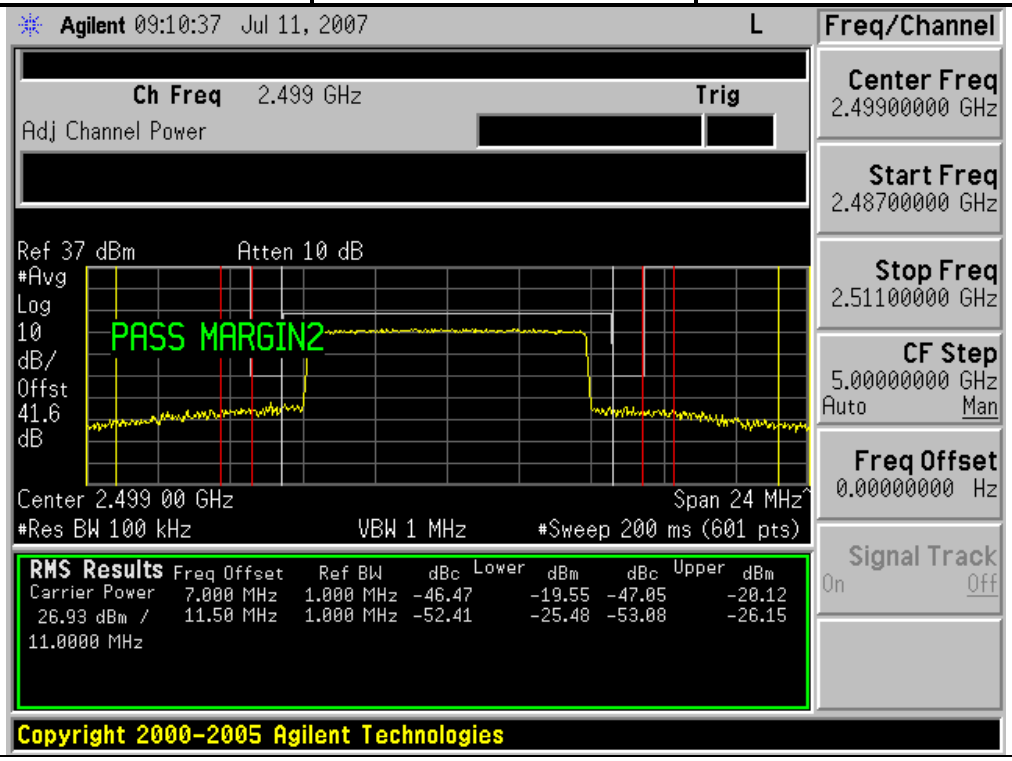
2499 MHz

Time Slots: 1	Bandwidth:10 MHz	Modulation: 64 QAM 2/3



2499 MHz

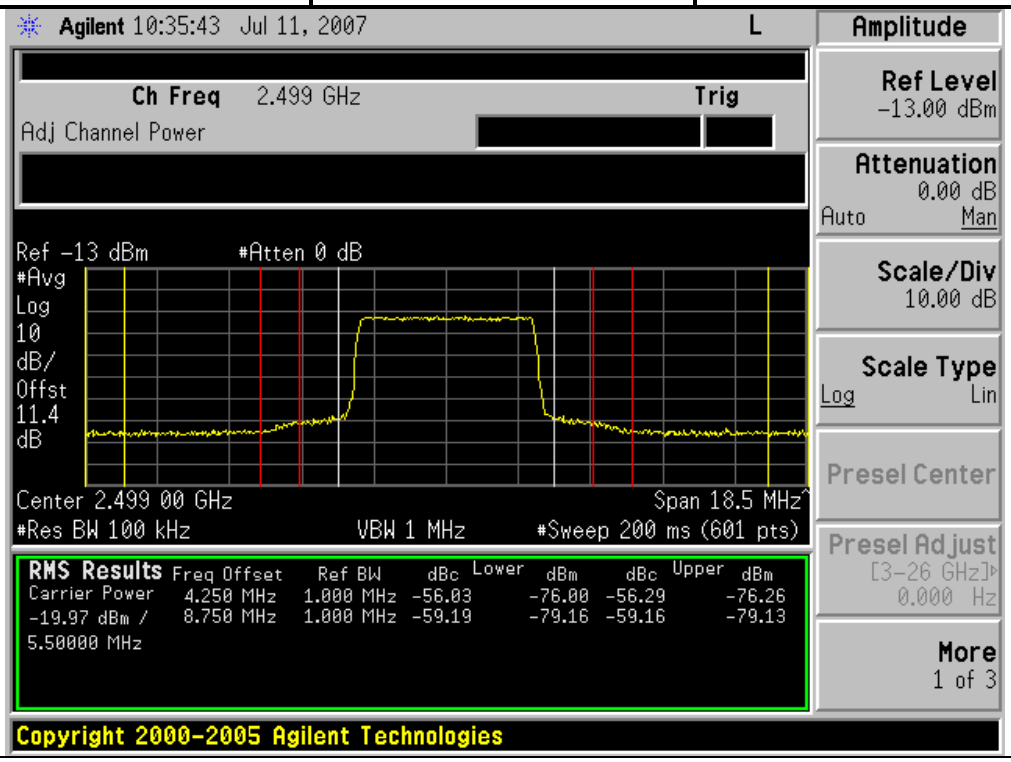
Time Slots: 1	Bandwidth: 10 MHz	Modulation: 64 QAM 3/4



2499 MHz

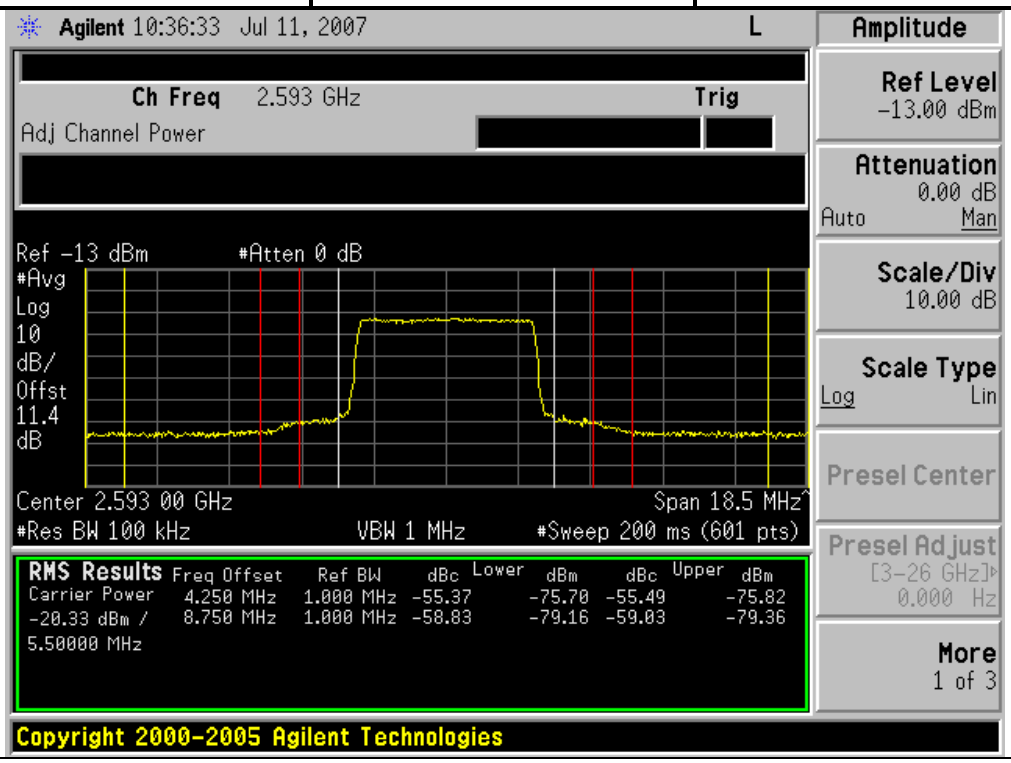
Minimum Power Level Plots

Time Slots: 8	Bandwidth: 5.0 MHz	Modulation: 16 QAM 3/4



2499 MHz

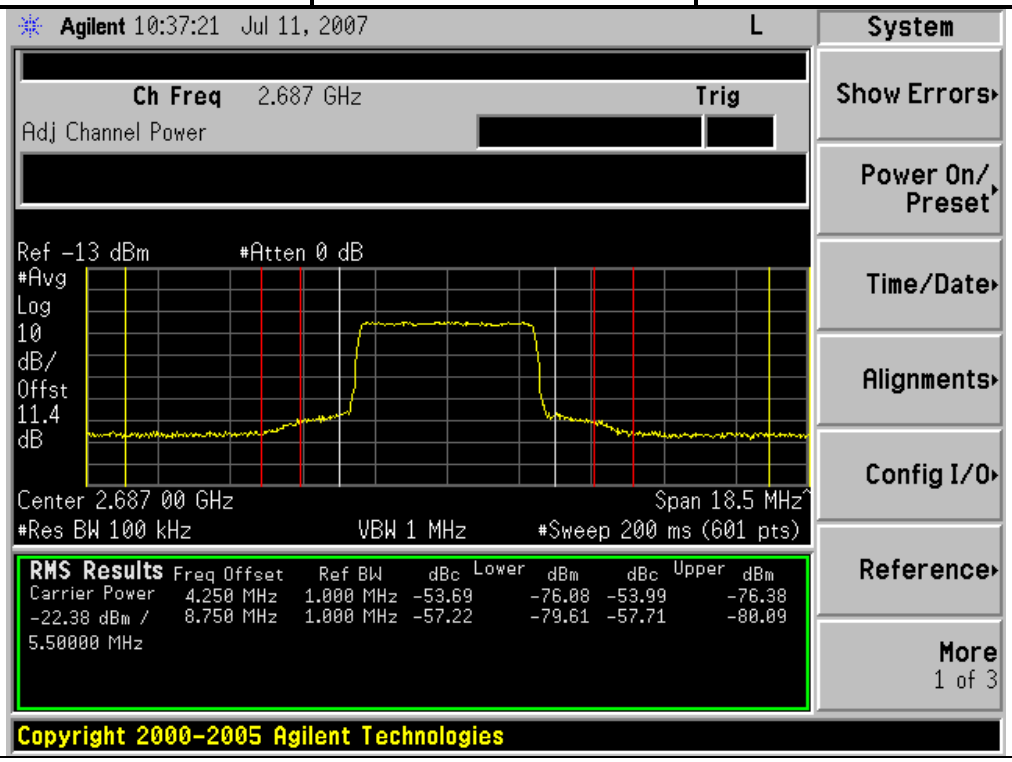
Time Slots: 8	Bandwidth: 5.0 MHz	Modulation: 16 QAM 3/4



2593 MHz

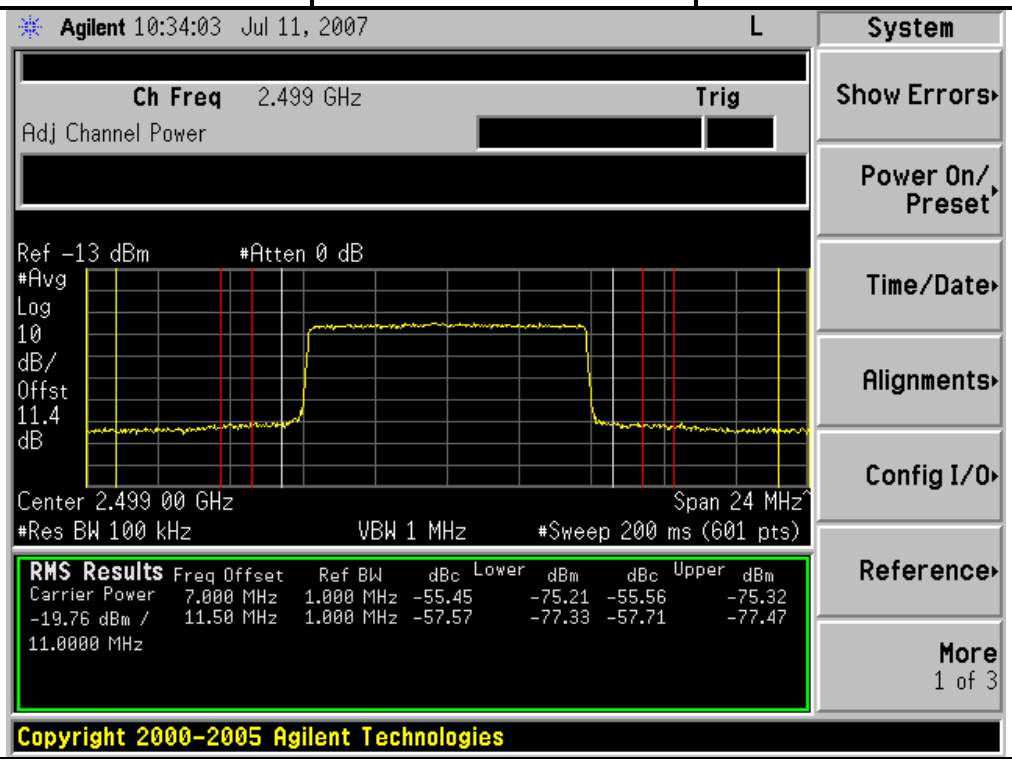
Minimum Power Level Plots (Cont'd)

Time Slots: 8	Bandwidth: 5.0 MHz	Modulation: 16 QAM 3/4



2687 MHz

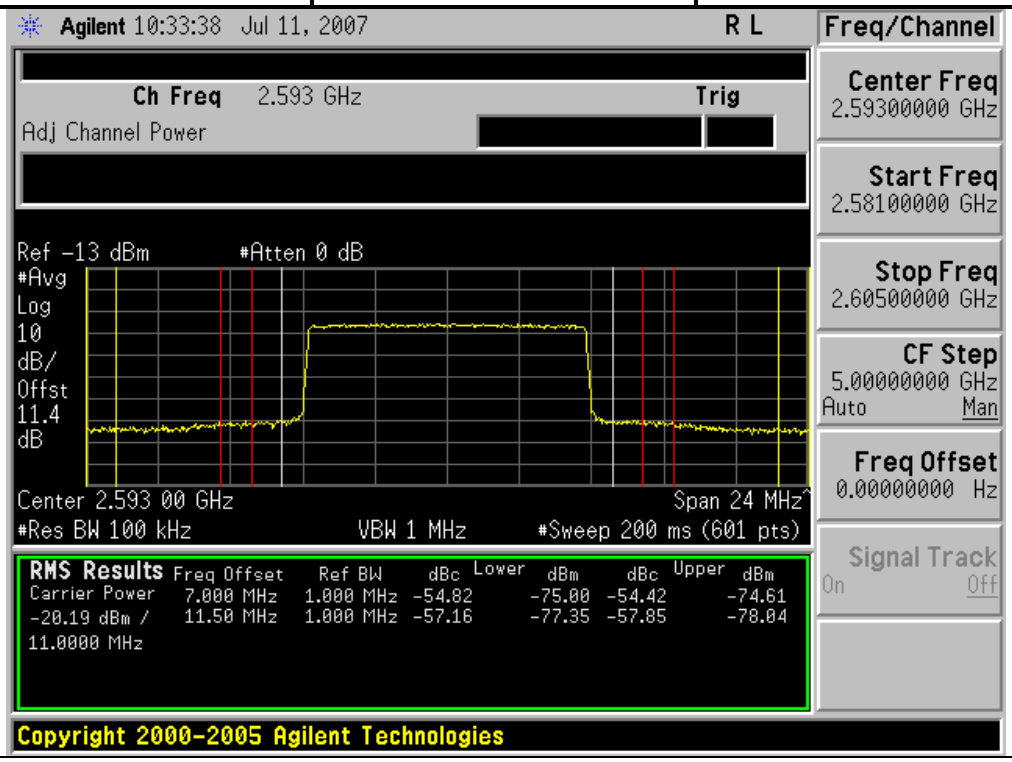
Time Slots: 8	Bandwidth: 10 MHz	Modulation: 16 QAM 3/4



2499 MHz

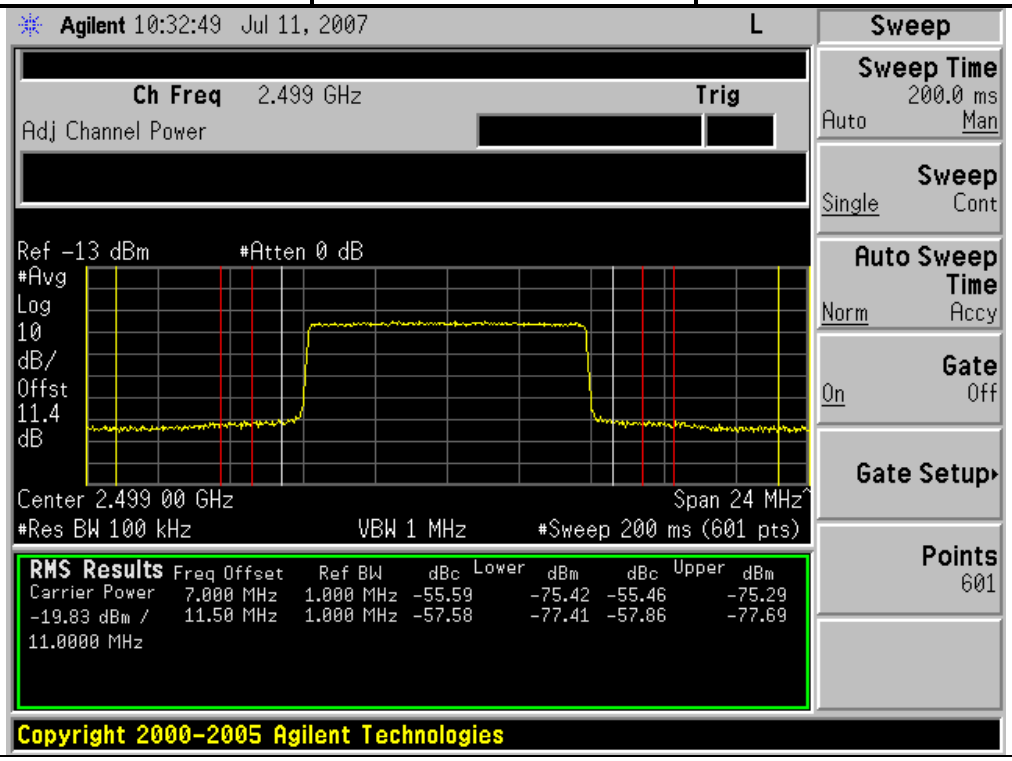
Minimum Power Level Plots (Cont'd)

Time Slots: 8	Bandwidth:10 MHz	Modulation: 16 QAM 3/4



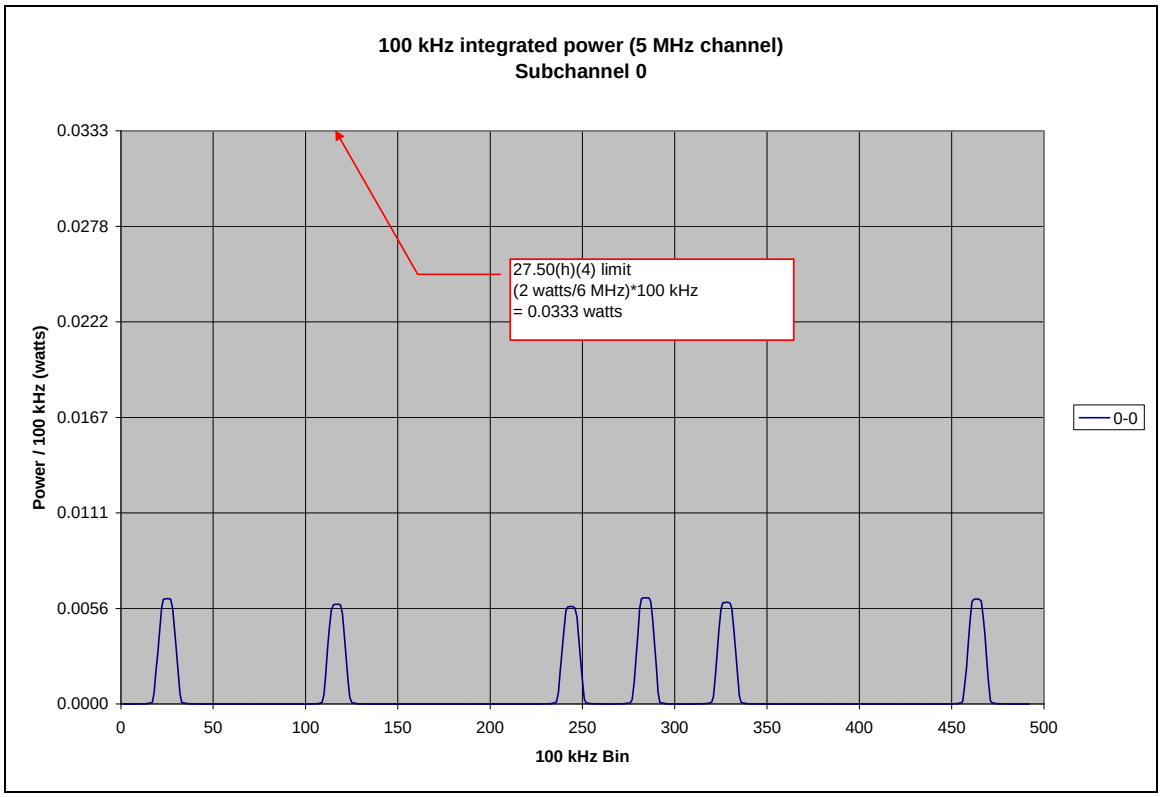
2593 MHz

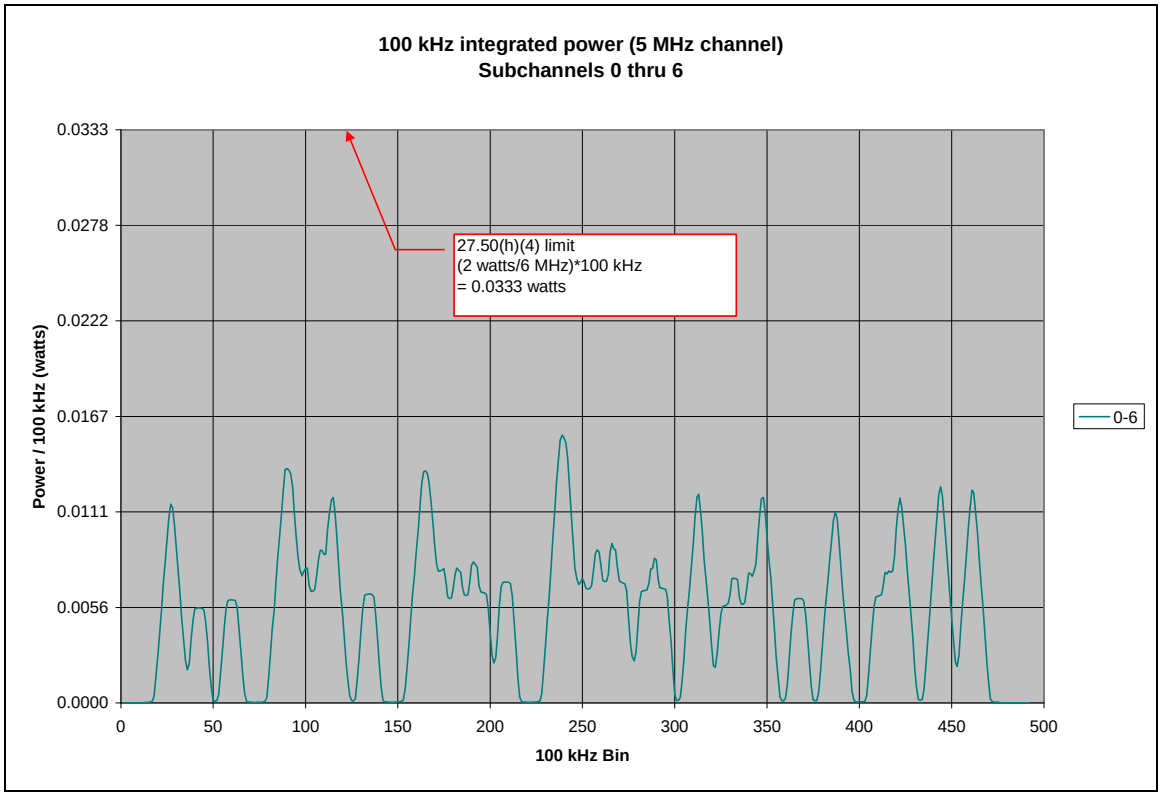
Time Slots: 8	Bandwidth: 5.0 MHz	Modulation: 16 QAM 3/4

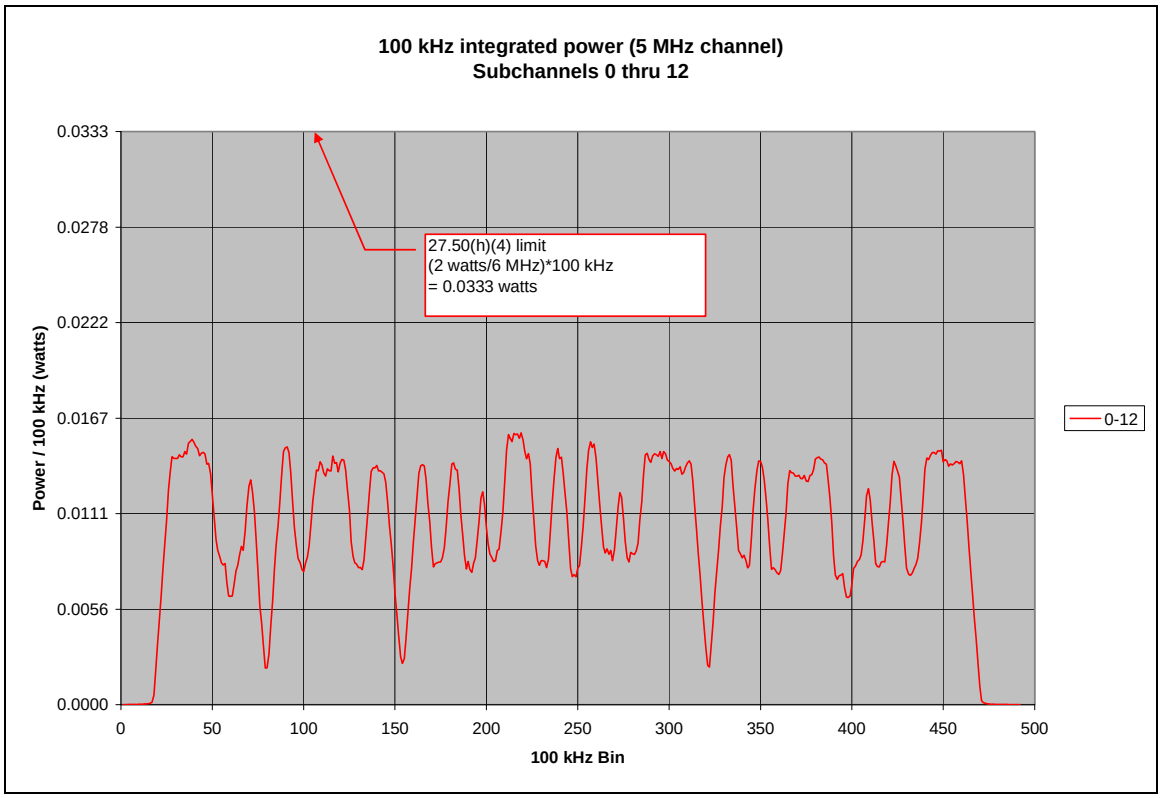


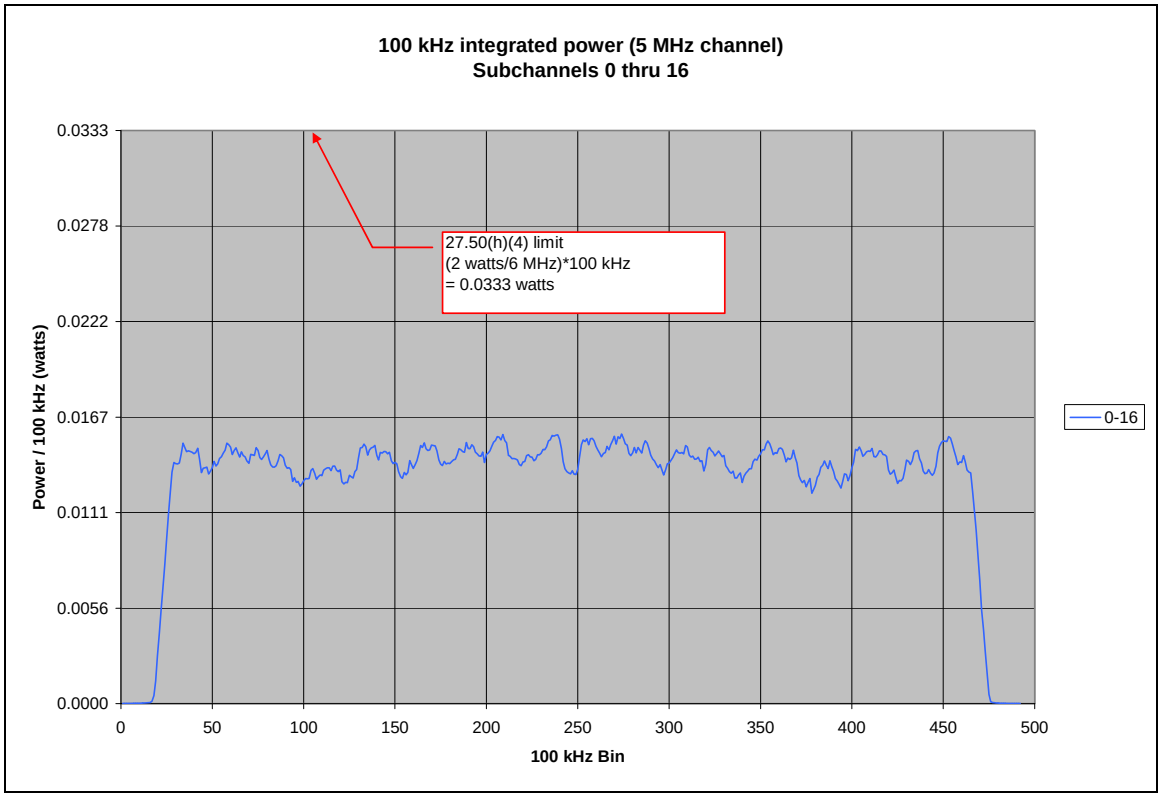
2687 MHz

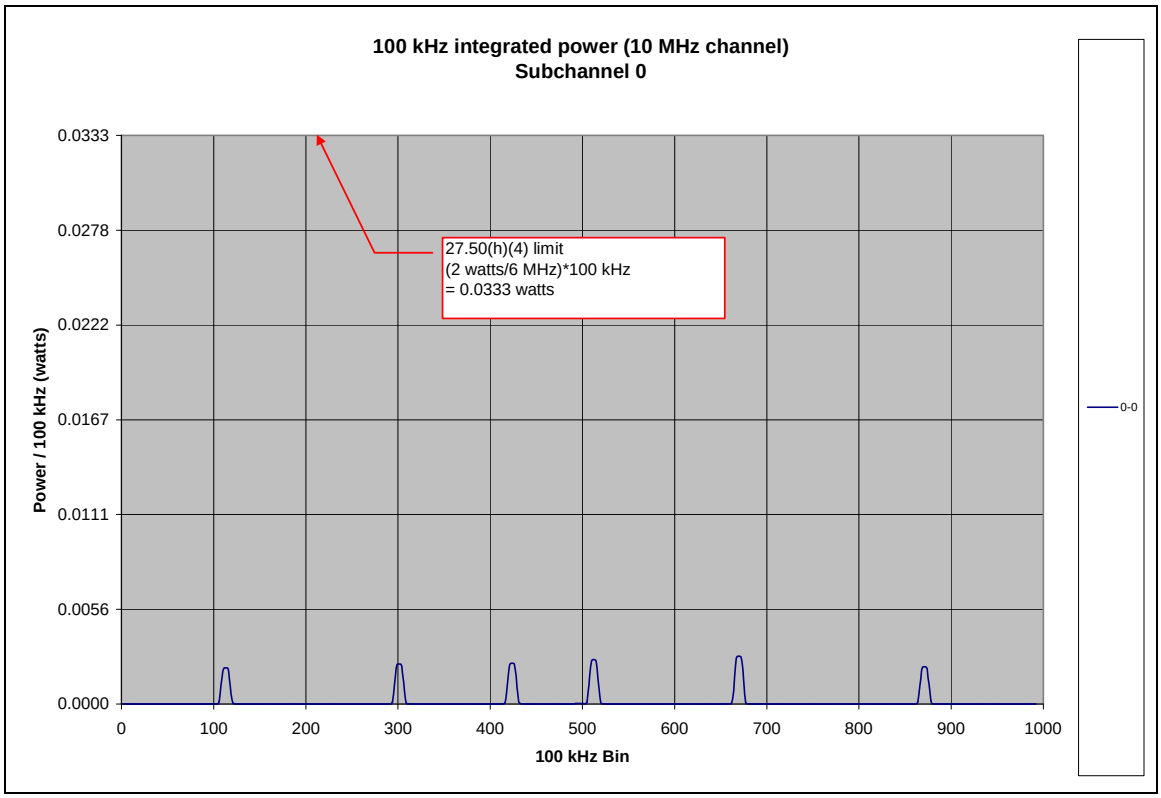
5.3.4. 100 kHz Power Spectral Density Plots

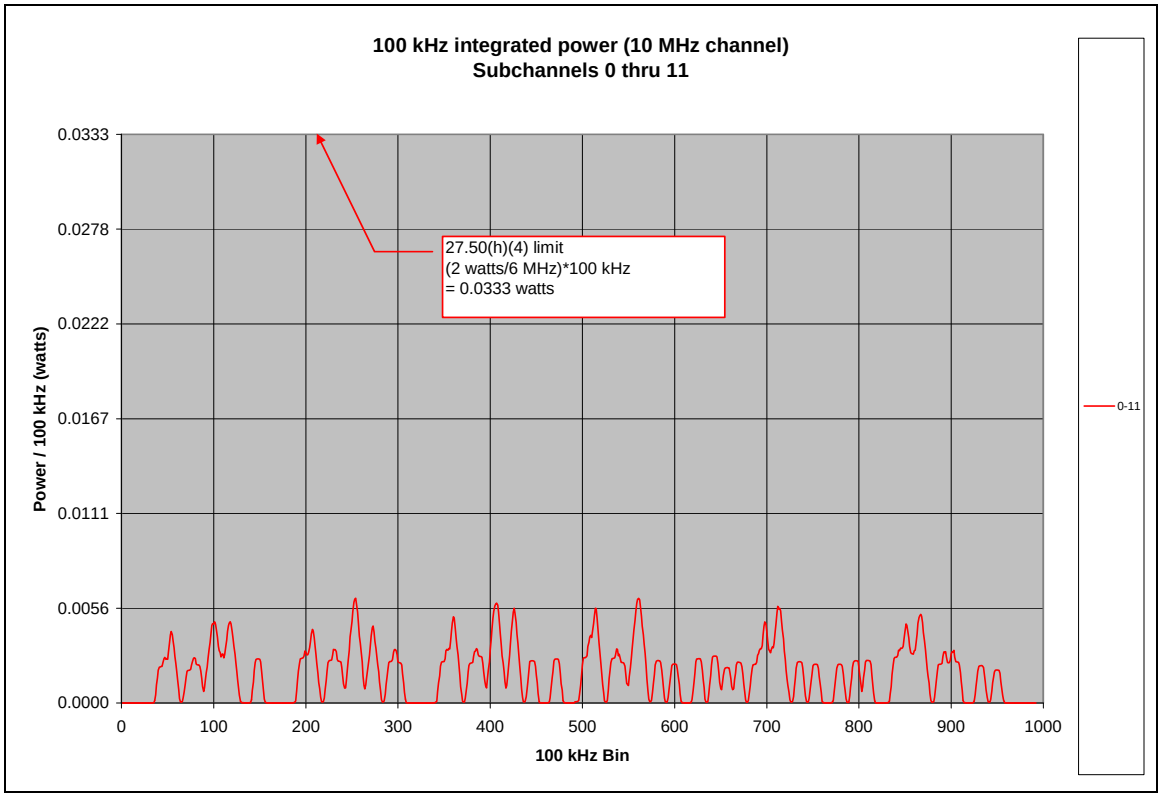


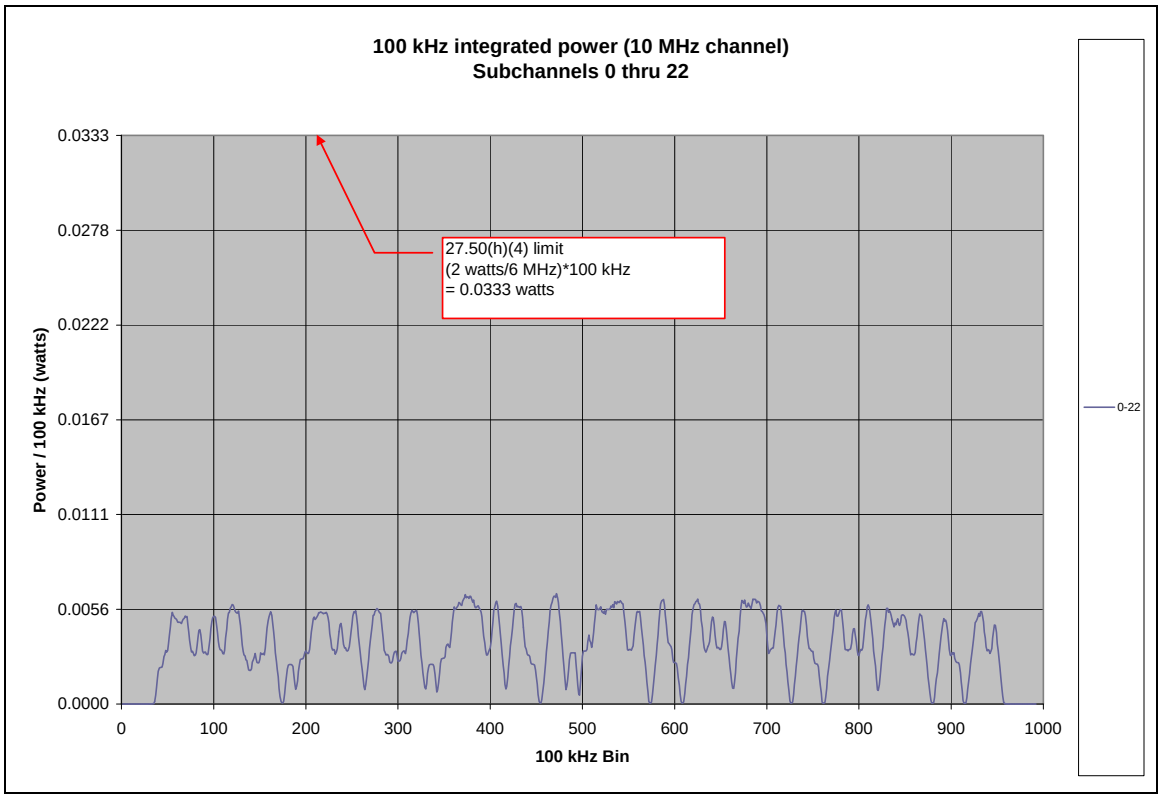


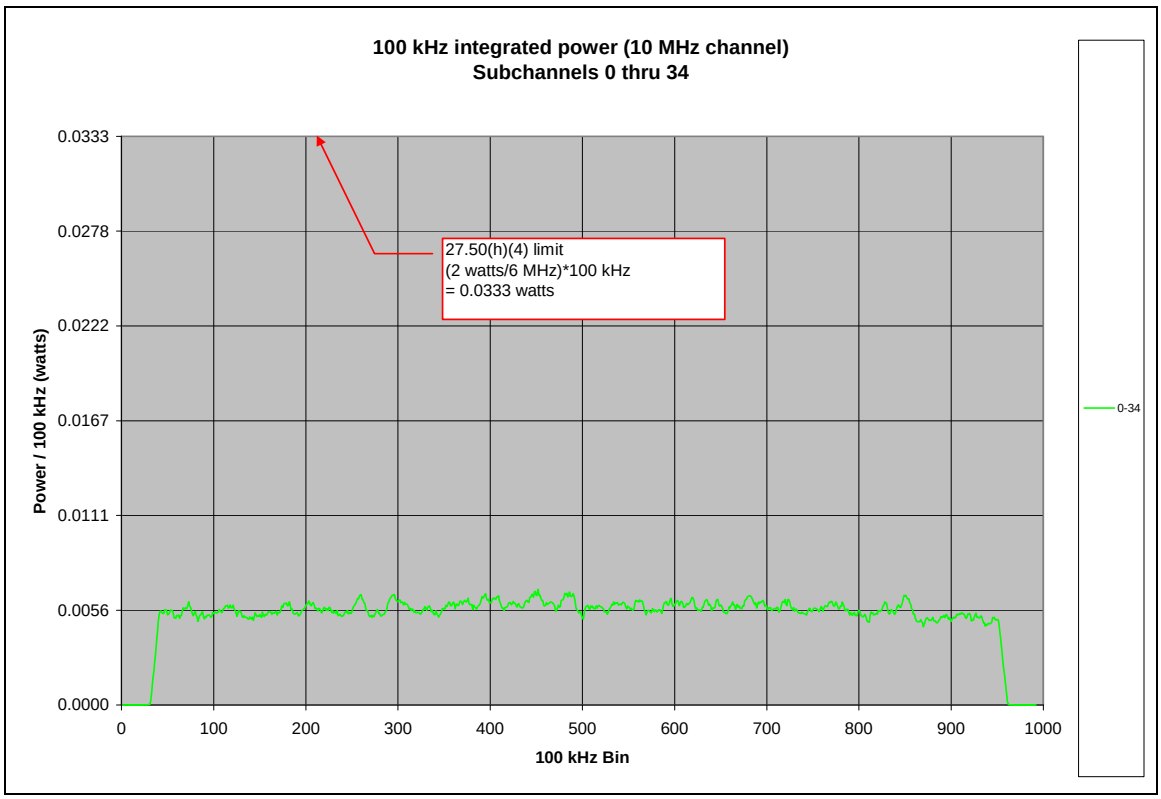

100 kHz integrated power (5 MHz channel)
Subchannels 0 thru 12
27.50(h)(4) limit
(2 watts/6 MHz)*100 kHz
= 0.0333 watts
Power / 100 kHz (watts)
0.0333
0.0278
0.0222
0.0167
0.0111
0.0056
0.0000
0
50
100
150
200
250
300
350
400
450
500
100 kHz Bin
0-12


100 kHz integrated power (5 MHz channel)
Subchannels 0 thru 16
27.50(h)(4) limit
(2 watts/6 MHz)*100 kHz
= 0.0333 watts
Power / 100 kHz (watts)
0.0333
0.0278
0.0222
0.0167
0.0111
0.0056
0.0000
0
50
100
150
200
250
300
350
400
450
500
100 kHz Bin
0-16


100 kHz integrated power (10 MHz channel)
Subchannel 0
0.0333
0.0278
0.0222
0.0167
0.0111
0.0056
0.0000
Power / 100 kHz (watts)
27.50(h)(4) limit
(2 watts/6 MHz)*100 kHz
= 0.0333 watts
0
100
200
300
400
500
600
700
800
900
1000
100 kHz Bin
0-0


100 kHz integrated power (10 MHz channel)
Subchannels 0 thru 11
0.0333
0.0278
0.0222
0.0167
0.0111
0.0056
0.0000
Power / 100 kHz (watts)
27.50(h)(4) limit
(2 watts/6 MHz)*100 kHz
= 0.0333 watts
0
100
200
300
400
500
600
700
800
900
1000
100 kHz Bin
0-11


100 kHz integrated power (10 MHz channel)
Subchannels 0 thru 22
0.0333
0.0278
0.0222
0.0167
0.0111
0.0056
0.0000
Power / 100 kHz (watts)
27.50(h)(4) limit
(2 watts/6 MHz)*100 kHz
= 0.0333 watts
0
100
200
300
400
500
600
700
800
900
1000
100 kHz Bin
0-22


100 kHz integrated power (10 MHz channel)
Subchannels 0 thru 34
0.0333
0.0278
0.0222
0.0167
0.0111
0.0056
0.0000
Power / 100 kHz (watts)
27.50(h)(4) limit
(2 watts/6 MHz)*100 kHz
= 0.0333 watts
0
100
200
300
400
500
600
700
800
900
1000
100 kHz Bin
0-34

5.4 Modulation Characteristics

FCC Rules: 2.1047(d), 27.53(l)(2), 27.53(l)(6)

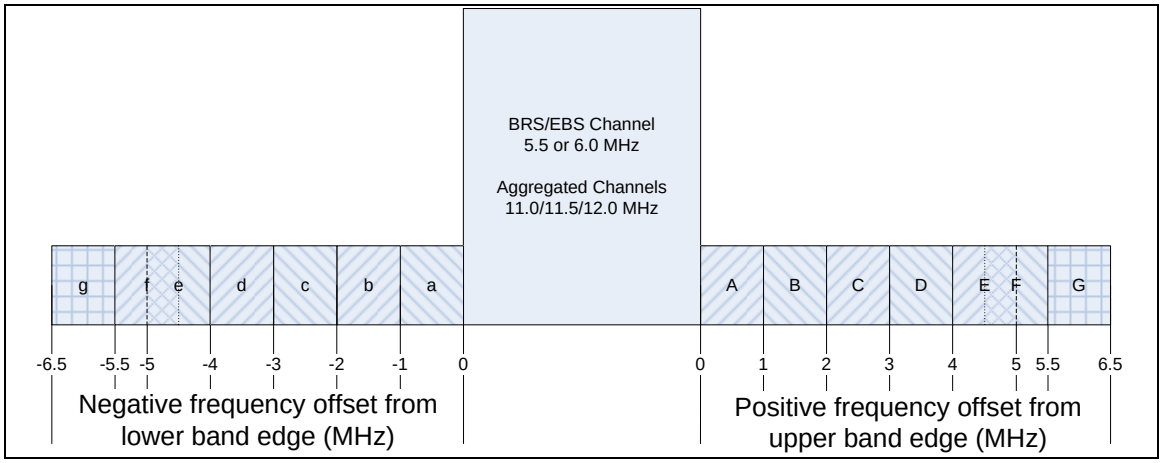
FCC requirement: Temporary Fixed Digital User Station
Attenuation at band edge = 43 + 10*log(P), P= 0.5 watts
Attenuation at band edge = 43 + 10*log(0.5) = 43 + (-3)
Attenuation at band edge = 40 dB (equates to –13 dBm)

Standard: 47CFR27.53(l)

Test Procedure: The Orthogonal Frequency Division Multiple Access (OFDMA) modulated Time Division Duplex (TDD) RF signal from the test unit is applied to a spectrum analyzer. A detector that has been calibrated in terms of rms-equivalent voltage is used to measure the power of the out of band emission. The emissions have been recorded and show compliance to the –13 dBm requirement. As allowed per the FCC rules, a measurement bandwidth of 100 kHz (1% or greater of the emissions bandwidth) was used for the test.

The first 1 MHz of spectral power outside of the channel must be less than –13 dBm when measured with a resolution bandwidth that is at least 1% of the transmitted signal emissions bandwidth. This first 1 MHz of spectrum, designated as bins a/A in the spectral plot shown below, is verified by establishing a limit line at –13 dBm on the spectrum analyzer display. When all emissions in bins a/A are under the –13 dBm limit, a "PASS LIMIT1" (5.0 MHz channel) or "PASS LIMIT2" (10 MHz channel) is displayed. Conversely, a spectral plot with any emissions within bins a/A that are above the –13 dBm limit will produce a "FAIL MARGIN1" or "FAIL MARGIN2" on the display.

All other emissions, shown as bins b/B thru g/G, must be measured with a 1 MHz resolution bandwidth or at least a 1% resolution bandwidth and then integrate the spectral power over a 1 MHz frequency span. The worst case emission for the –13 dBm limit is found at bins b/B. The mobile –25 dBm limit at +/– 5.5 MHz from the channel edge is shown on the plots as bins g/G. The table in section 5.4.1 contains a summary of the plot information for the test configurations.



The CPEi25100 WiMax transmitter is enabled in test mode by the attached computer. The RF loss of the attenuators and coax was measured and is included in the spectrum analyzer amplitude offset and is noted in the block diagram which follows.

Measurements are performed at the same frequencies, bandwidths, modulation types, subchannels, and time slots as used to measure power output. The tested combinations are as follows:

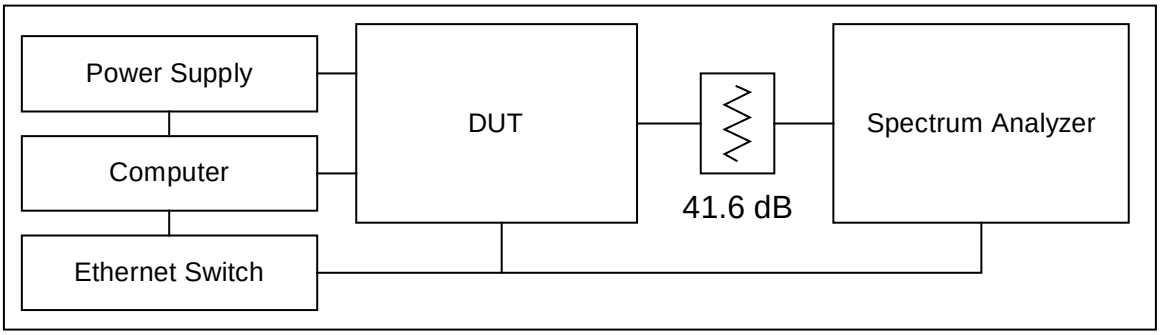
Time Slots = 1

- Subchannels = All
- Frequencies = low, mid, and high channels of band
- Bandwidths = 5.0 and 10 MHz
- Modulation Types = QPSK 1/2, QPSK 3/4, 16 QAM 1/2, 16 QAM 3/4, 64 QAM 1/2, 64 QAM 2/3, and 64 QAM 3/4

Time Slots = 2 through 8 (for each)

- Subchannels = All
- Bandwidths = 5.0 and 10 MHz
- Channel/modulation type combinations =
  2499 MHz (low)/ 16 QAM 3/4
  2593 MHz (mid)/QPSK 1/2
  2687 MHz (high)/64 QAM 2/3

Test Conditions: **Test Frequencies**: 2499, 2593, 2687 MHz (5.0 and 10 MHz bandwidth)
Temperature: 22°C
Supply Voltage: 120 VAC / 60 Hz Nominal to DUT power supply



Modulation Characteristics Test Setup

5.4.1. Modulation Characteristics Test Results Summary

The data for all tested channels, bandwidths, modulation types, and time slots is shown in the tables which follow.

Modulation Characteristics Summary: Time Slots = 1

QPSK 1/2								
Fo (MHz)	Channel BW (MHz)	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	Pass	-15.46	-15.67	2.46	-31.36	-31.86	6.36
2593	5	Pass	-20.52	-20.59	7.52	-35.60	-35.80	10.60
2687	5	Pass	-16.20	-16.16	3.16	-32.38	-32.78	7.38
2499	10	Pass	-19.83	-20.20	6.83	-25.78	-26.39	0.78
2593	10	Pass	-20.32	-20.01	7.01	-26.47	-26.55	1.47
2687	10	Pass	-18.65	-18.41	5.41	-27.14	-26.99	1.99
QPSK 3/4								
Fo (MHz)	Channel BW (MHz)	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	Pass	-15.51	-15.31	2.31	-31.30	-31.27	6.27
2593	5	Pass	-20.64	-20.64	7.64	-35.90	-35.93	10.90
2687	5	Pass	-16.31	-15.90	2.90	-32.15	-32.30	7.15
2499	10	Pass	-19.21	-19.67	6.21	-25.01	-25.61	0.01
2593	10	Pass	-20.74	-20.14	7.14	-26.52	-26.41	1.41
2687	10	Pass	-18.74	-18.61	5.61	-27.01	-26.76	1.76
16 QAM 1/2								
Fo (MHz)	Channel BW (MHz)	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	Pass	-15.38	-15.12	2.12	-31.58	-31.72	6.58
2593	5	Pass	-20.80	-20.77	7.77	-35.59	-35.66	10.59
2687	5	Pass	-16.73	-16.36	3.36	-33.05	-33.05	8.05
2499	10	Pass	-19.12	-19.88	6.12	-25.13	-25.69	0.13
2593	10	Pass	-20.03	-20.18	7.03	-26.38	-26.28	1.28
2687	10	Pass	-18.75	-18.75	5.75	-26.98	-26.68	1.68
16 QAM 3/4								
Fo (MHz)	Channel BW (MHz)	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	Pass	-15.23	-15.68	2.23	-31.38	-32.09	6.38
2593	5	Pass	-20.40	-20.73	7.40	-35.82	-35.50	10.50
2687	5	Pass	-16.52	-16.50	3.50	-33.33	-33.46	8.33
2499	10	Pass	-18.91	-19.69	5.91	-25.02	-25.57	0.02
2593	10	Pass	-20.89	-20.96	7.89	-26.78	-26.67	1.67
2687	10	Pass	-18.21	-18.71	5.21	-28.84	-27.10	2.10
64 QAM 1/2								
Fo (MHz)	Channel BW (MHz)	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	Pass	-15.63	-15.37	2.37	-31.55	-31.89	6.55
2593	5	Pass	-20.54	-20.39	7.39	-35.97	-35.48	10.48
2687	5	Pass	-16.60	-16.86	3.60	-33.09	-33.19	8.09
2499	10	Pass	-20.24	-20.50	7.24	-25.40	-26.04	0.40
2593	10	Pass	-21.18	-20.50	7.50	-26.99	-27.14	1.99
2687	10	Pass	-18.81	-18.89	5.81	-27.12	-27.40	2.12
64 QAM 2/3								
Fo (MHz)	Channel BW (MHz)	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	Pass	-15.33	-15.77	2.33	-31.89	-31.76	6.76
2593	5	Pass	-20.46	-20.50	7.46	-35.22	-35.45	10.22
2687	5	Pass	-16.99	-16.89	3.89	-33.20	-33.45	8.20
2499	10	Pass	-19.87	-20.13	6.87	-25.35	-25.74	0.35
2593	10	Pass	-20.41	-20.30	7.30	-26.84	-27.59	1.84
2687	10	Pass	-19.42	-19.16	6.16	-26.83	-27.06	1.83
64 QAM 3/4								
Fo (MHz)	Channel BW (MHz)	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	Pass	-15.33	-15.36	2.33	-31.25	-32.05	6.25
2593	5	Pass	-21.00	-20.12	7.12	-35.27	-35.58	10.27
2687	5	Pass	-16.85	-16.92	3.85	-33.36	-32.99	7.99
2499	10	Pass	-19.55	-20.12	6.55	-25.48	-26.05	0.48
2593	10	Pass	-20.22	-21.00	7.22	-26.82	-27.04	1.82
2687	10	Pass	-18.71	-19.09	5.71	-26.75	-26.93	1.75

Modulation Characteristics Summary: Time Slots = 2 Through 8

Fo (MHz)	Channel BW (MHz)	Time Slots	Modulation	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	2	16 QAM 3/4	Pass	-15.55	-16.13	2.55	-31.69	-32.35	6.69
2593	5	2	4 QAM 1/2	Pass	-20.24	-20.70	7.24	-35.77	-35.96	10.77
2687	5	2	64 QAM 2/3	Pass	-16.75	-16.94	3.75	-33.21	-33.38	8.21
2499	10	2	16 QAM 3/4	Pass	-20.20	-20.59	7.20	-26.54	-26.55	1.54
2593	10	2	4 QAM 1/2	Pass	-20.91	-20.73	7.73	-26.87	-27.23	1.87
2687	10	2	64 QAM 2/3	Pass	-19.30	-18.67	5.67	-25.83	-27.12	0.83

Fo (MHz)	Channel BW (MHz)	Time Slots	Modulation	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	3	16 QAM 3/4	Pass	-16.15	-16.33	3.15	-32.32	-32.32	7.32
2593	5	3	4 QAM 1/2	Pass	-21.07	-20.90	7.90	-36.27	-36.19	11.19
2687	5	3	64 QAM 2/3	Pass	-16.98	-16.51	3.51	-33.22	-33.29	8.22
2499	10	3	16 QAM 3/4	Pass	-20.76	-21.58	7.76	-26.72	-27.05	1.72
2593	10	3	4 QAM 1/2	Pass	-20.81	-20.72	7.72	-27.48	-27.49	2.48
2687	10	3	64 QAM 2/3	Pass	-18.94	-18.90	5.90	-26.28	-27.50	1.28

Fo (MHz)	Channel BW (MHz)	Time Slots	Modulation	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	4	16 QAM 3/4	Pass	-15.81	-16.11	2.81	-32.76	-33.09	7.76
2593	5	4	4 QAM 1/2	Pass	-21.16	-21.02	8.02	-36.55	-36.66	11.55
2687	5	4	64 QAM 2/3	Pass	-15.18	-16.88	2.18	-33.61	-33.90	8.61
2499	10	4	16 QAM 3/4	Pass	-21.14	-21.29	8.14	-27.10	-27.10	2.10
2593	10	4	4 QAM 1/2	Pass	-21.06	-21.03	8.03	-28.27	-28.26	3.26
2687	10	4	64 QAM 2/3	Pass	-19.67	-19.38	6.38	-27.29	-27.50	2.29

Fo (MHz)	Channel BW (MHz)	Time Slots	Modulation	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	5	16 QAM 3/4	Pass	-16.81	-16.02	3.02	-33.07	-33.19	8.07
2593	5	5	4 QAM 1/2	Pass	-20.98	-21.57	7.98	-36.64	-37.08	11.64
2687	5	5	64 QAM 2/3	Pass	-16.88	-15.75	2.75	-33.14	-34.08	8.14
2499	10	5	16 QAM 3/4	Pass	-21.39	-21.94	8.39	-27.77	-28.22	2.77
2593	10	5	4 QAM 1/2	Pass	-21.74	-21.23	8.23	-28.44	-28.49	3.44
2687	10	5	64 QAM 2/3	Pass	-19.54	-18.88	5.88	-28.32	-28.88	3.32

Fo (MHz)	Channel BW (MHz)	Time Slots	Modulation	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	6	16 QAM 3/4	Pass	-16.02	-16.79	3.02	-32.94	-33.45	7.94
2593	5	6	4 QAM 1/2	Pass	-21.68	-20.77	7.77	-37.01	-37.22	12.01
2687	5	6	64 QAM 2/3	Pass	-17.83	-17.70	4.70	-33.88	-34.35	8.88
2499	10	6	16 QAM 3/4	Pass	-21.91	-21.81	8.81	-28.52	-27.84	2.84
2593	10	6	4 QAM 1/2	Pass	-21.80	-21.81	8.80	-28.82	-28.69	3.69
2687	10	6	64 QAM 2/3	Pass	-19.25	-19.16	6.16	-28.01	-28.04	3.01

Fo (MHz)	Channel BW (MHz)	Time Slots	Modulation	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	7	16 QAM 3/4	Pass	-16.53	-16.81	3.53	-33.45	-33.53	8.45
2593	5	7	4 QAM 1/2	Pass	-21.70	-21.59	8.59	-36.88	-37.38	11.88
2687	5	7	64 QAM 2/3	Pass	-17.18	-17.85	4.18	-34.33	-34.72	9.33
2499	10	7	16 QAM 3/4	Pass	-22.31	-23.20	9.31	-28.38	-29.87	3.38
2593	10	7	4 QAM 1/2	Pass	-22.17	-21.49	8.49	-28.46	-29.13	3.46
2687	10	7	64 QAM 2/3	Pass	-19.59	-19.82	6.59	-28.69	-28.26	3.26

Fo (MHz)	Channel BW (MHz)	Time Slots	Modulation	aA	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
2499	5	8	16 QAM 3/4	Pass	-17.21	-17.44	4.21	-34.12	-33.71	8.71
2593	5	8	4 QAM 1/2	Pass	-22.02	-21.61	8.61	-37.09	-37.73	12.09
2687	5	8	64 QAM 2/3	Pass	-18.30	-16.73	3.73	-35.36	-35.15	10.15
2499	10	8	16 QAM 3/4	Pass	-23.30	-23.21	10.21	-29.50	-29.51	4.50
2593	10	8	4 QAM 1/2	Pass	-22.35	-21.91	8.91	-29.17	-29.34	4.17
2687	10	8	64 QAM 2/3	Pass	-19.95	-19.78	6.78	-28.89	-29.21	3.89

5.4.2. Modulation Characteristics Data Plots

The same spectrum analyzer plots used for RF Power Output (Section 5.3) are also used for these measurements. Therefore, refer to the plots in Section 5.3.3 starting on page 38.

5.5 Occupied and Emission Bandwidth

FCC Rules: 2.1049, 27.53(l)(6)

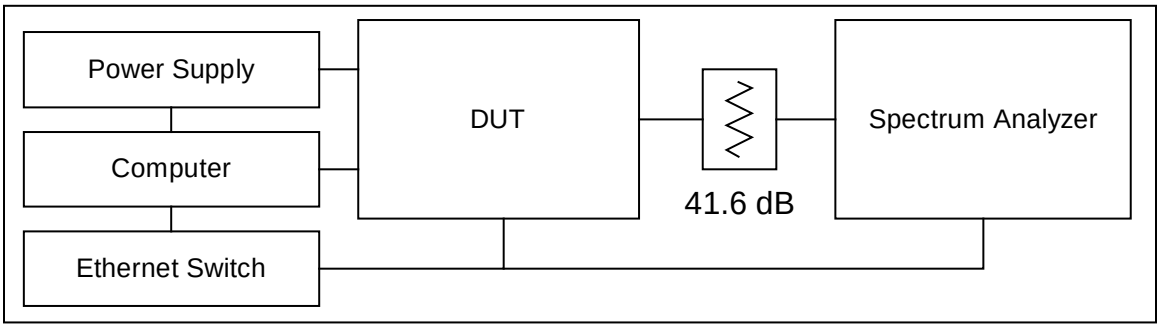
FCC Requirements: Report Results

Standard: ANSI C63.4-2003
American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

Test Procedure: The Orthogonal Frequency Division Multiple Access (OFDMA) modulated Time Division Duplex (TDD) RF signal from the test unit is applied to a spectrum analyzer. The bandwidth of the signal is recorded by measuring the modulation bandwidth with the built in measurement function in the spectrum analyzer. The transmitter is enabled in test mode with the attached computer. The RF loss of the attenuators and coax has been measured and is included in the spectrum analyzer offset level.

Measurements are performed at frequencies at the low, mid, and high points of the band and for each of the modulation formats available (QPSK 1/2, QPSK 3/4, 16 QAM 1/2, 16 QAM 3/4, 64 QAM 1/2, 64 QAM 2/3, and 64QAM 3/4). In addition, measurements were taken for both channel bandwidths (5.0 and 10 MHz). All subchannels (17/35) and time slots (8) were selected.

Test Conditions: **Test Frequencies**: 2499, 2593, 2687 MHz (5.0 and 10 MHz bandwidth)
Temperature: 22°C
Supply Voltage: 120 VAC / 60 Hz nominal to DUT power supply



Occupied/Emission Bandwidth Test Setup

5.5.1. Occupied and Emission Bandwidth Test Results Summary

Occupied Bandwidth (MHz) for 99.0% (-20 dB)								
		Modulation						
Freq (MHz)	Bandwidth (MHz)	QPSK 1/2	QPSK 3/4	16 QAM 1/2	16 QAM 3/4	64 QAM 1/2	64 QAM 2/3	64 QAM 3/4
2499	5.0	4.447	4.447	4.448	4.447	4.446	4.444	4.446
2593	5.0	4.447	4.447	4.445	4.445	4.447	4.444	4.451
2687	5.0	4.447	4.447	4.444	4.449	4.452	4.452	4.450
2499	10.0	9.088	9.089	9.088	9.089	9.093	9.092	9.084
2593	10.0	9.088	9.090	9.087	9.091	9.086	9.086	9.084
2687	10.0	9.089	9.090	9.088	9.087	9.092	9.084	9.089

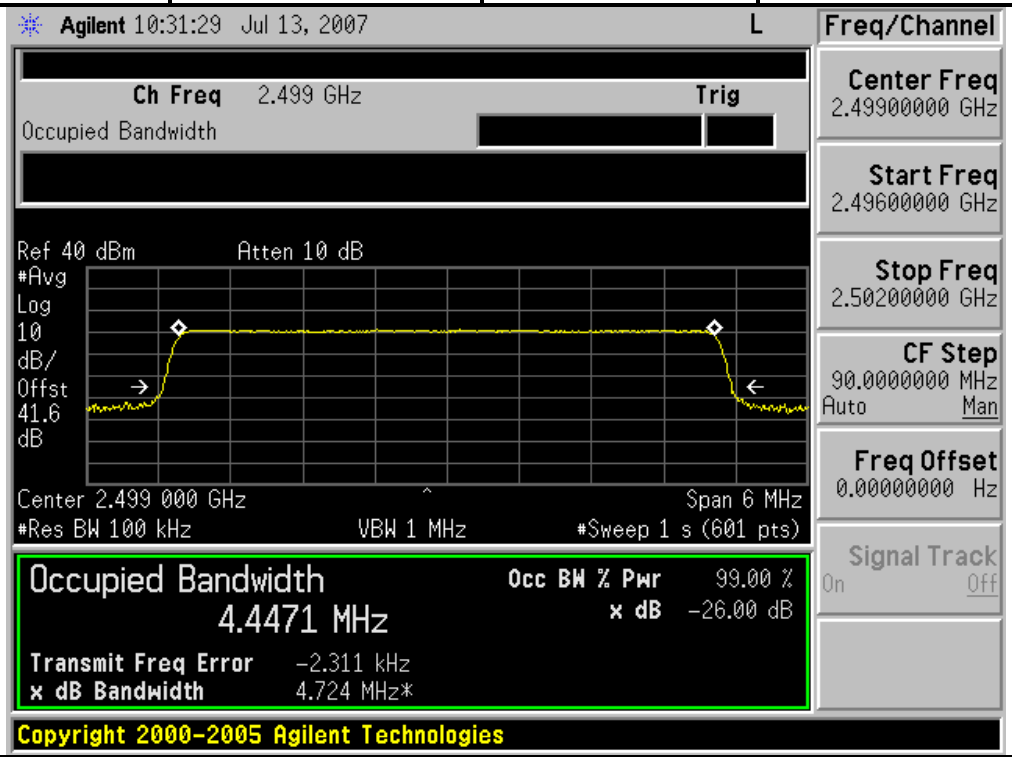
Emission Bandwidth (MHz) for 99.75% (-26 dB)								
		Modulation						
Freq (MHz)	Bandwidth (MHz)	QPSK 1/2	QPSK 3/4	16 QAM 1/2	16 QAM 3/4	64 QAM 1/2	64 QAM 2/3	64 QAM 3/4
2499	5.0	4.731	4.731	4.727	4.724	4.722	4.719	4.716
2593	5.0	4.722	4.720	4.718	4.721	4.720	4.723	4.735
2687	5.0	4.734	4.722	4.726	4.728	4.721	4.719	4.727
2499	10.0	9.446	9.449	9.446	9.442	9.443	9.435	9.439
2593	10.0	9.447	9.450	9.451	9.444	9.445	9.447	9.444
2687	10.0	9.456	9.460	9.447	9.447	9.449	9.453	9.439

5.5.2. Occupied and Emission Bandwidth Spectrum Analyzer Plots

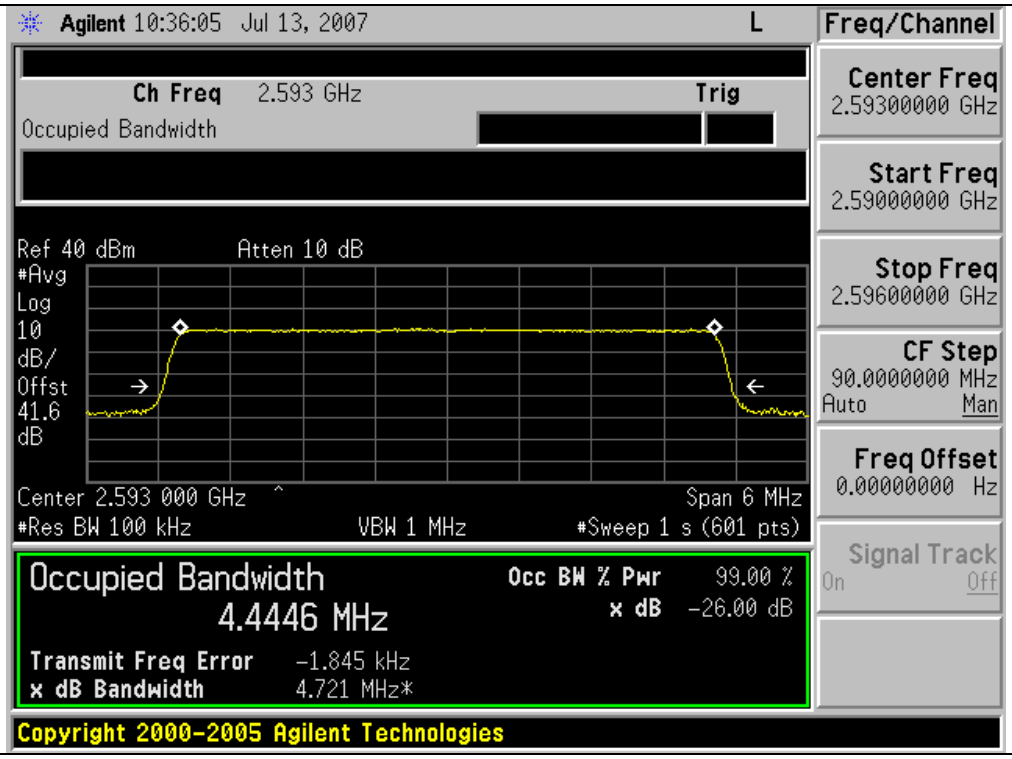
The following are spectrum analyzer plots of the 16 QAM 3/4 data in the preceding tables. The plots for the QPSK 1/2 and 64 QAM 3/4 modulation types are shown in Appendix B (refer to "Occupied/Emission Bandwidth Plots"). The plots for the other modulation types are not shown but are similar

Both Occupied and Emission Bandwidth is shown in the same plot. The 99% Occupied Bandwidth is displayed in large type under "Occupied Bandwidth", and the –26 x dB Emission Bandwidth is displayed in smaller type to the right of "x dB Bandwidth".

Occ/Emiss BW	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4

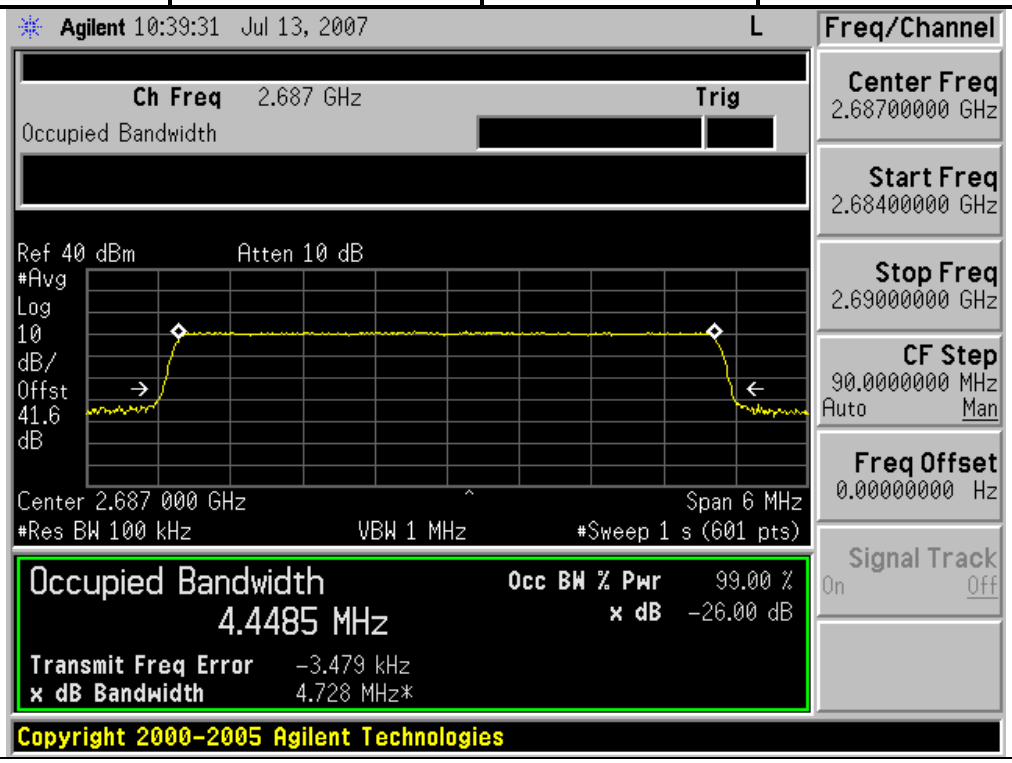


2499 MHz



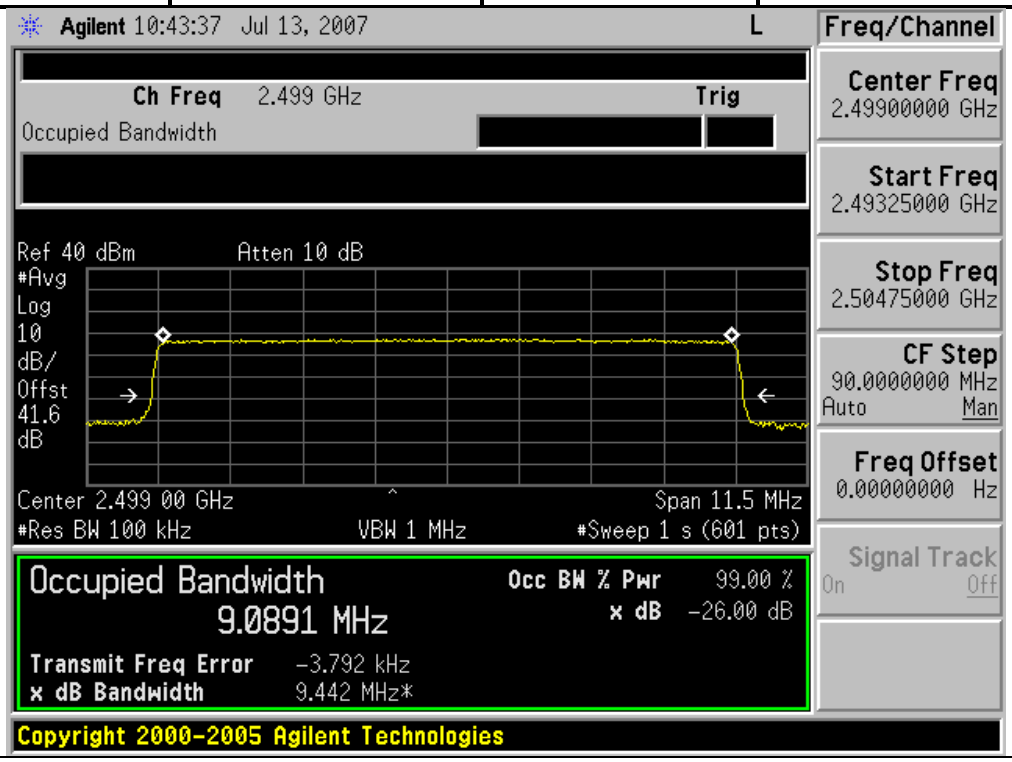
2593 MHz

Occ/Emiss BW	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



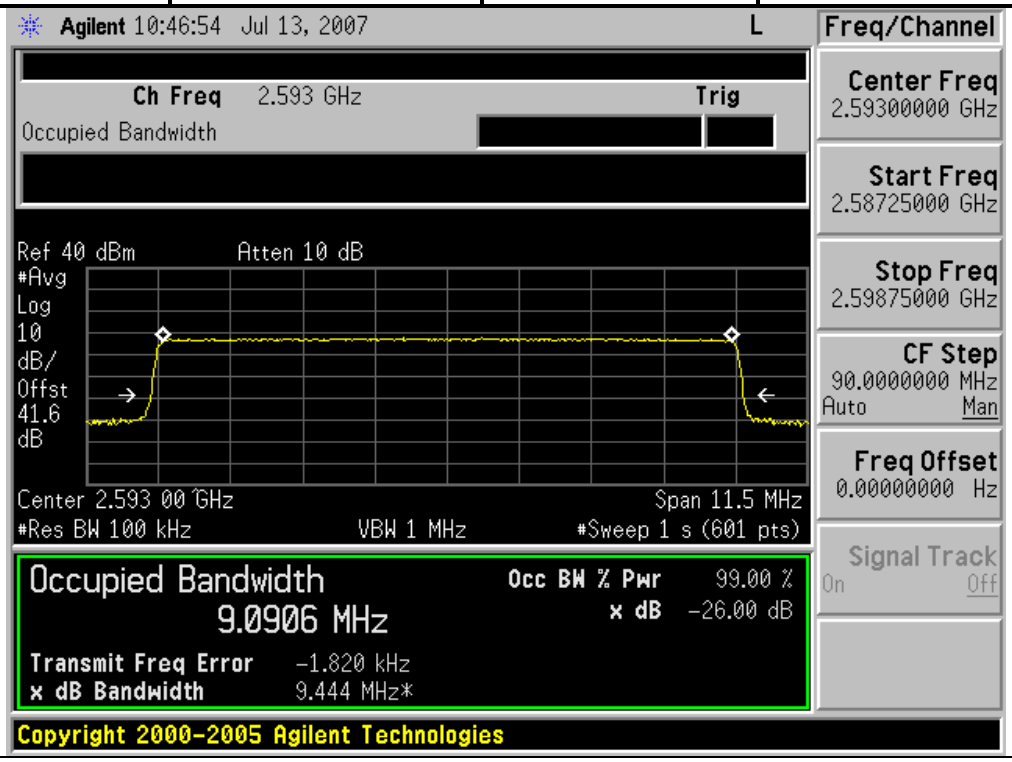
2687 MHz

Occ/Emiss BW	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4

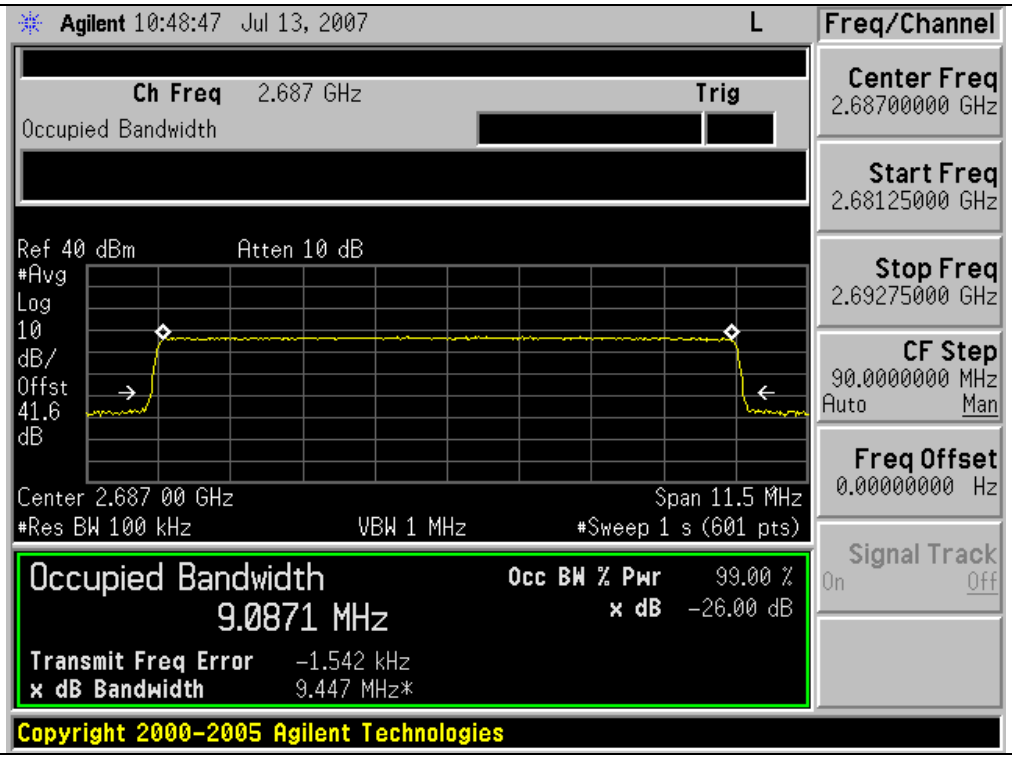


2499 MHz

Occ/Emiss BW	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



2593 MHz



2687 MHz

5.6 Transmitter Spurious Emissions

FCC Rules: 2.1051, 2.1049, 2.1057

Standard: TIA-603-C
TIA Standard, Land Mobile FM or PM Communications Equipment, Measurement and Performance Standards

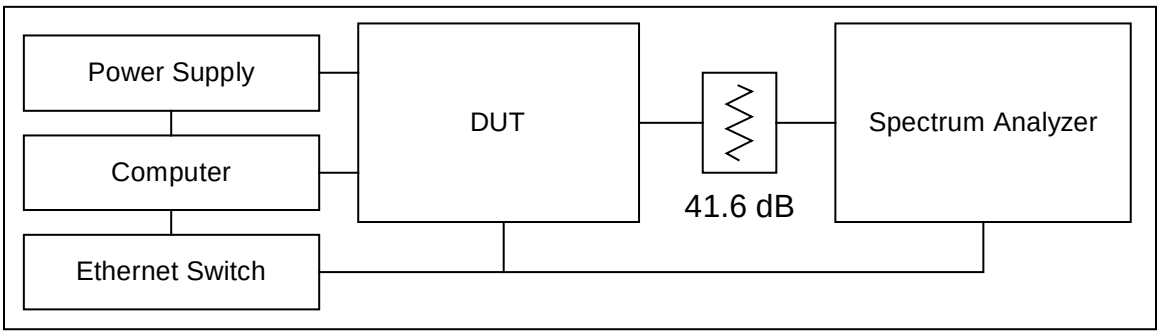
Test Procedure: The Orthogonal Frequency Division Multiple Access (OFDMA) modulated Time Division Duplex (TDD) RF signal from the test unit is applied to a spectrum analyzer thru an attenuator and coax, or, for harmonic measurements, through an attenuator, high pass filter and coax that was calibrated for RF loss at each harmonic frequency being tested. The transmission is recorded from 9 kHz to 26.5 GHz in multiple plots.

The transmitter is enabled in test mode with the attached computer. The RF loss of the attenuator and coax is included in the spectrum analyzer offset level. Measurements are performed at frequencies across the band and both channel bandwidths (5.0 MHz and 10 MHz). A modulation level of 16 QAM 3/4 was used for all measurements with all subchannels enabled and all (8) time slots selected.

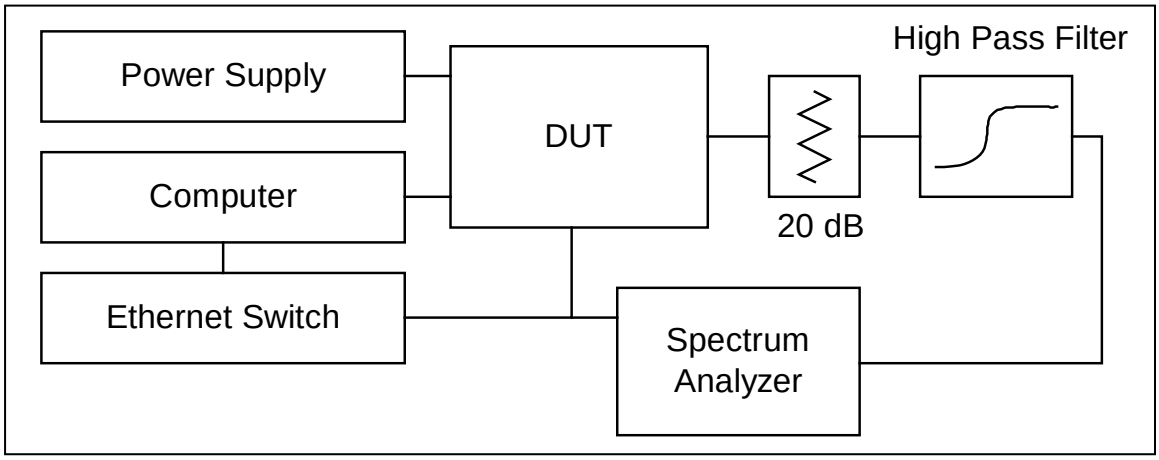
One data plot from each channel bandwidth is included for measurements below the BRS/EBS frequency band (below 2.48 GHz). All other channels measured had similar-looking spectral plots. For tests above the BRS/EBS frequency (2.7-26.5 GHz), plots for all channels are included. For harmonic tests, plots are shown for the second and third harmonic of all test channels.

Test Conditions:
Channels: 2499, 2593, and 2687 MHz (5.0 and 10 MHz bandwidth)
Temperature: 22°C
Supply Voltage: 120 VAC / 60 Hz nominal to the DUT power supply

Test Results: Passes conducted emissions from 9 kHz to 26.86 MHz. All spurious and harmonic emissions are more than 18 dB below the –13 dBm limit.



Spurious Emissions Test Setup

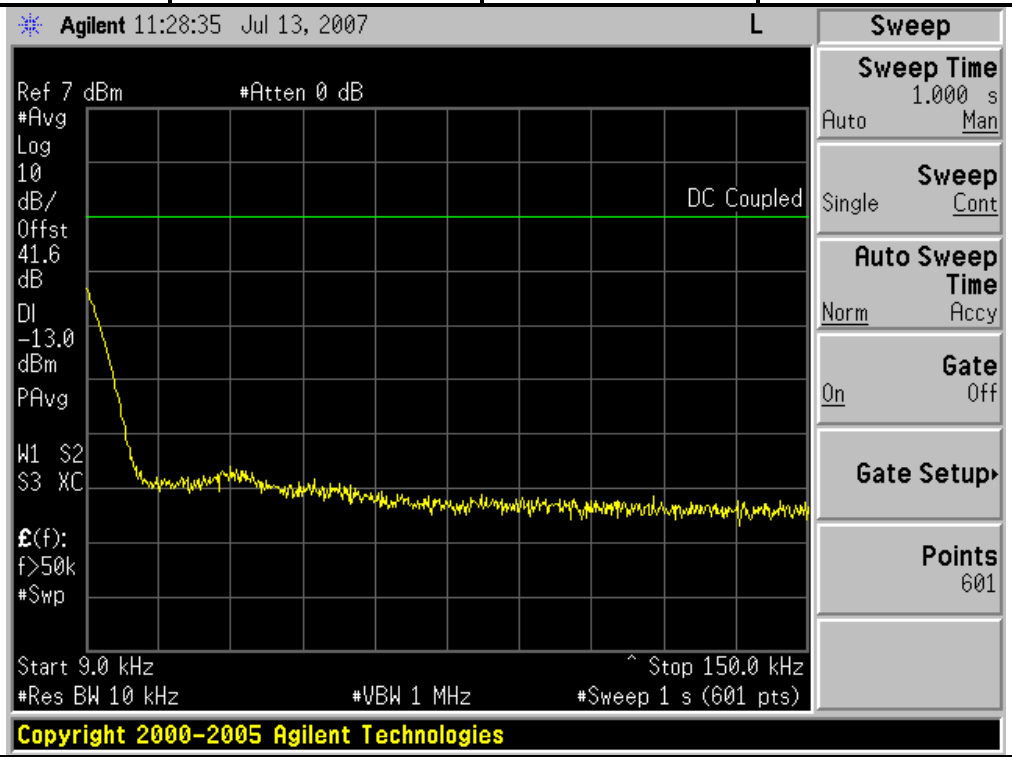


Harmonic Emissions Test Setup

5.6.1. Transmitter Spurious Emissions Plots

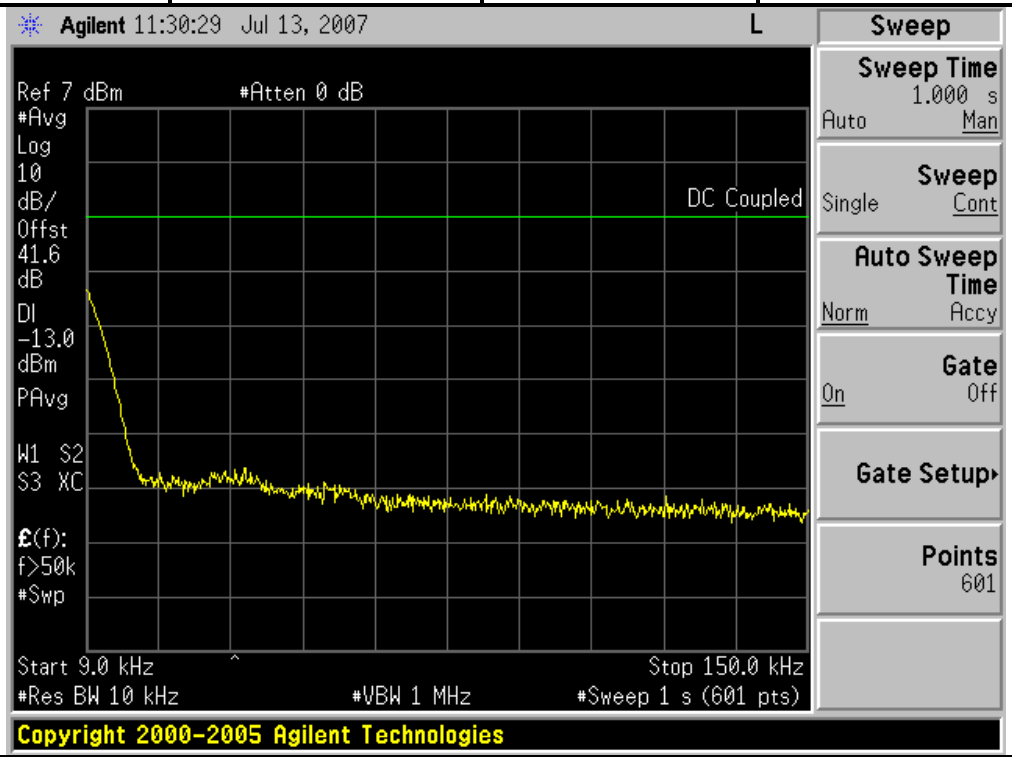
For frequencies below 2.48 GHz, plots for only the 2593 MHz (5.0 and 10 MHz bandwidth) channel are shown on the following pages. The plots for the other channels are similar and are located in the Appendix (see "Transmit Spurious Emissions"). For frequencies above 2.48 GHz, plots for all test channels are shown.

9 – 150 kHz	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



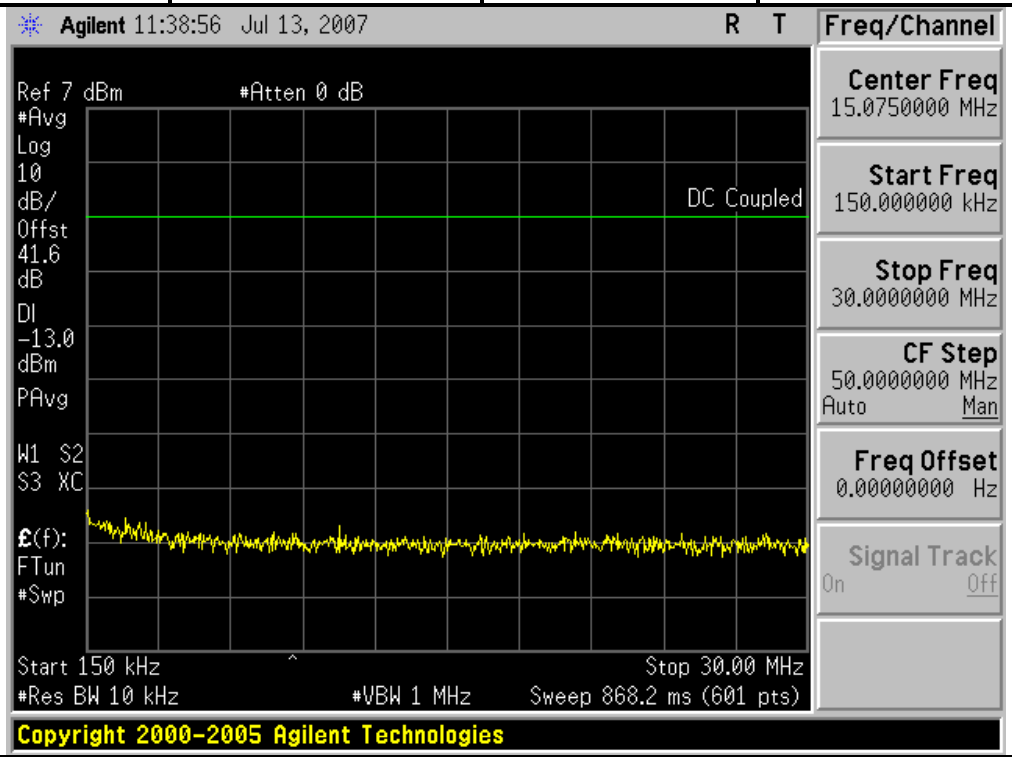
2593 MHz

9 – 150 kHz	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



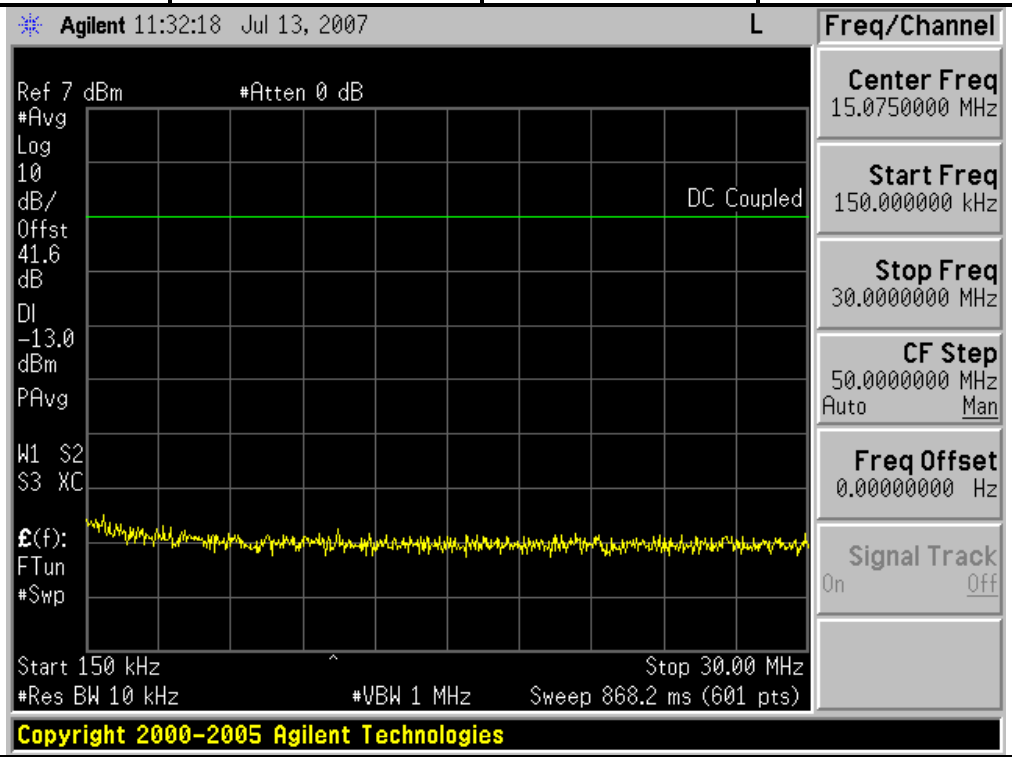
2593 MHz

150 kHz – 30 MHz	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



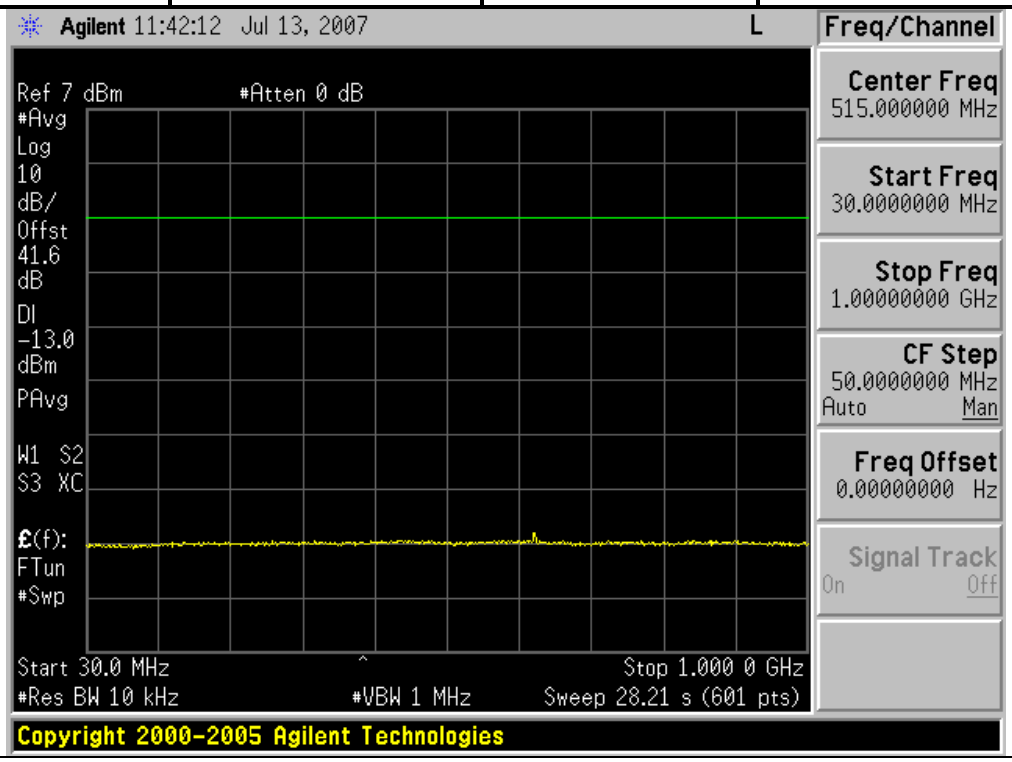
2593 MHz

150 kHz – 30 MHz	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



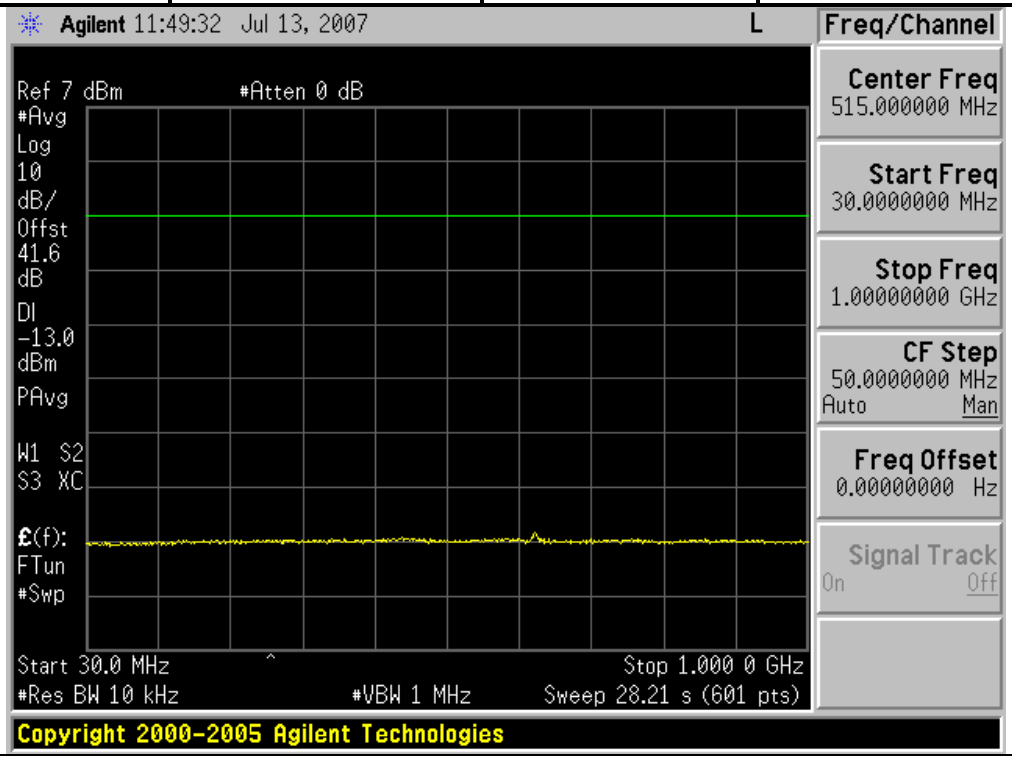
2593 MHz

30 MHz – 1 GHz	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



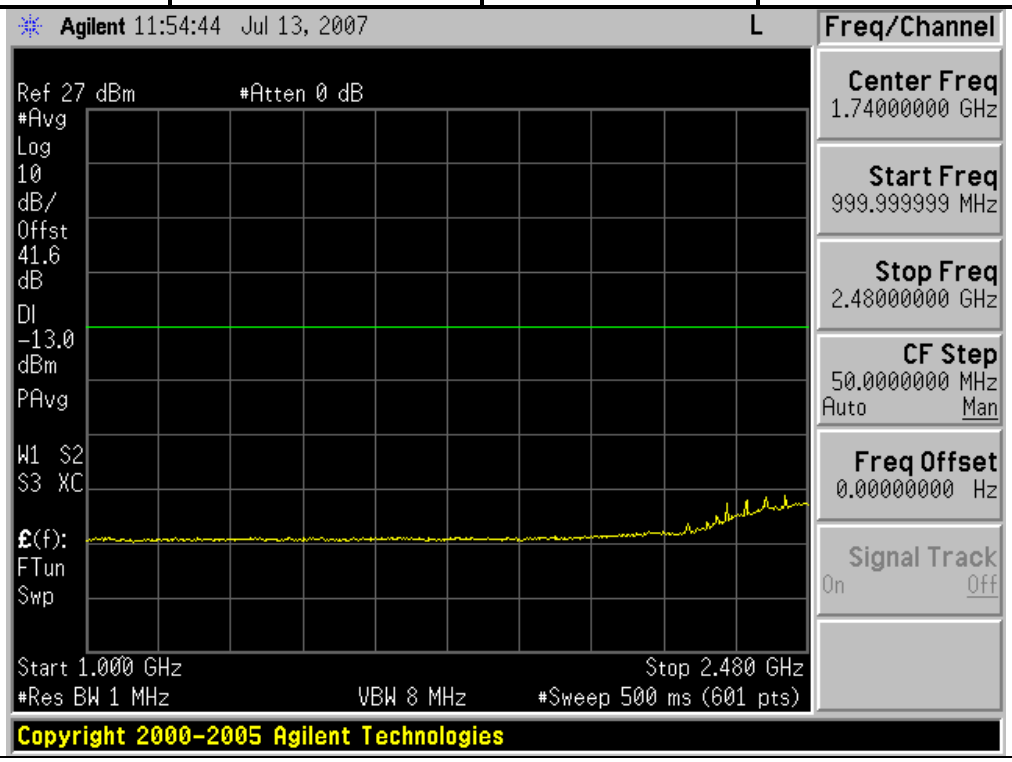
2593 MHz

30 MHz – 1 GHz	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



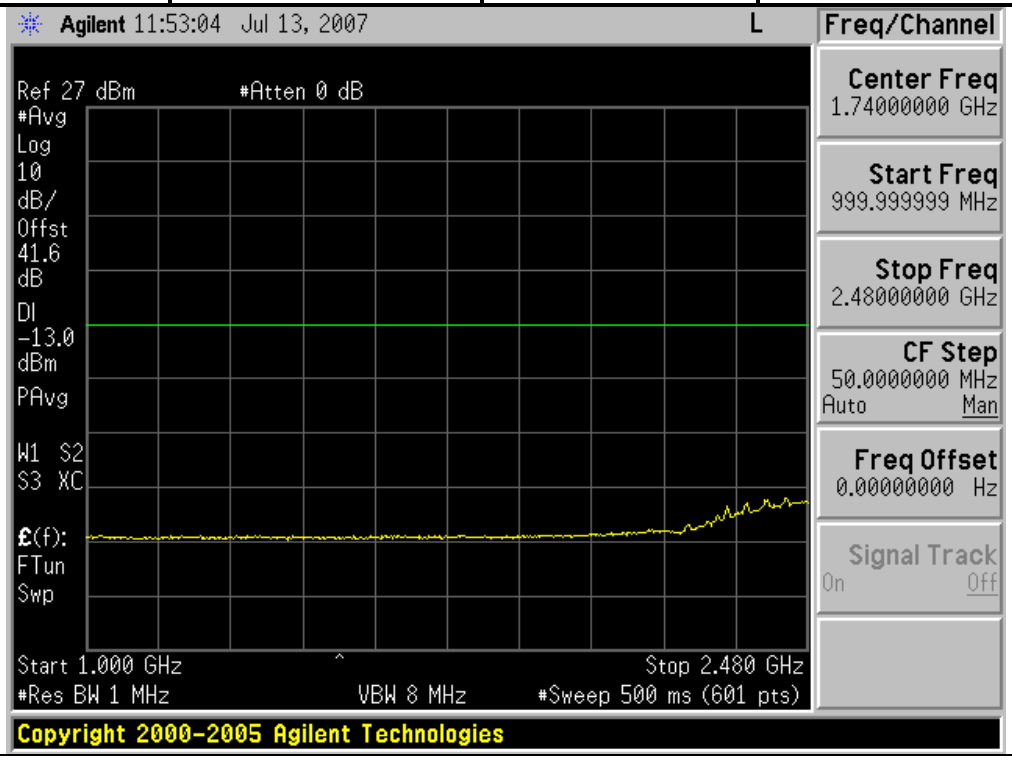
2593 MHz

1 – 2.48 GHz	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



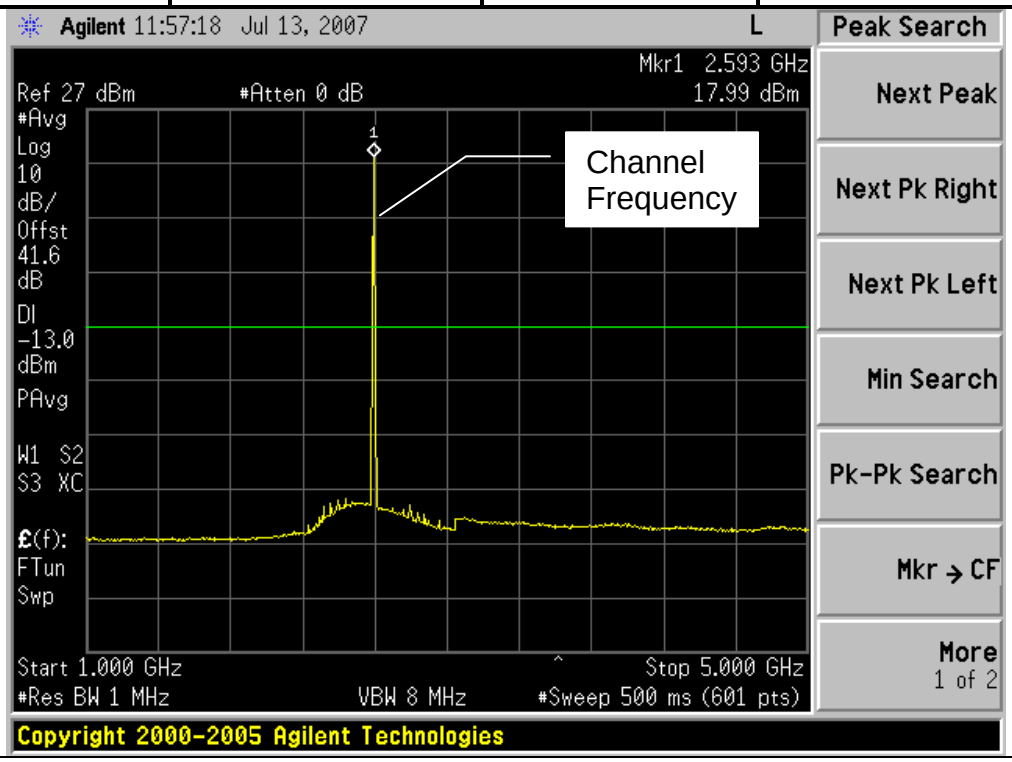
2593 MHz

1 – 2.48 GHz	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



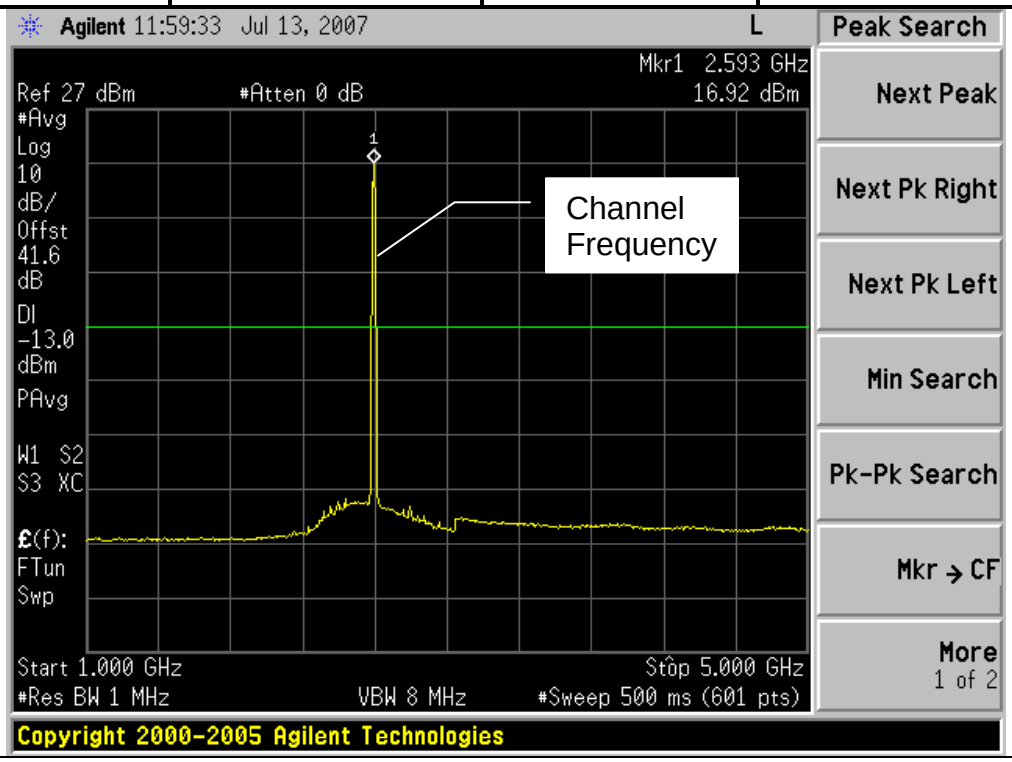
2593 MHz

1 – 5 GHz	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



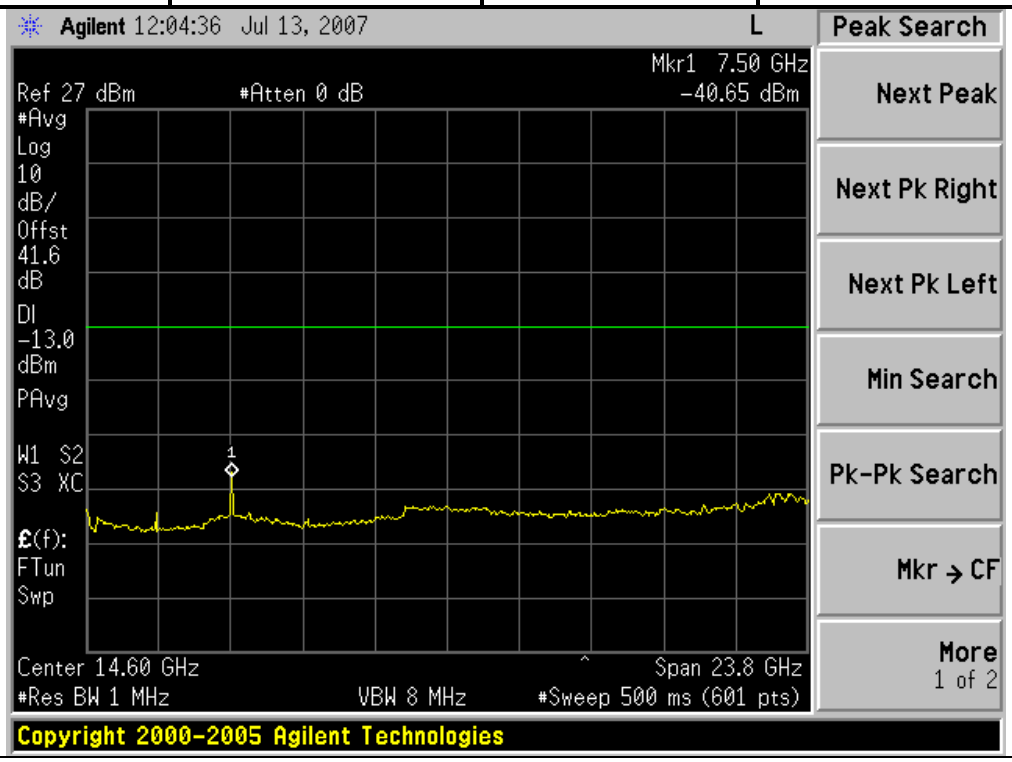
2593 MHz

1 – 5 GHz	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



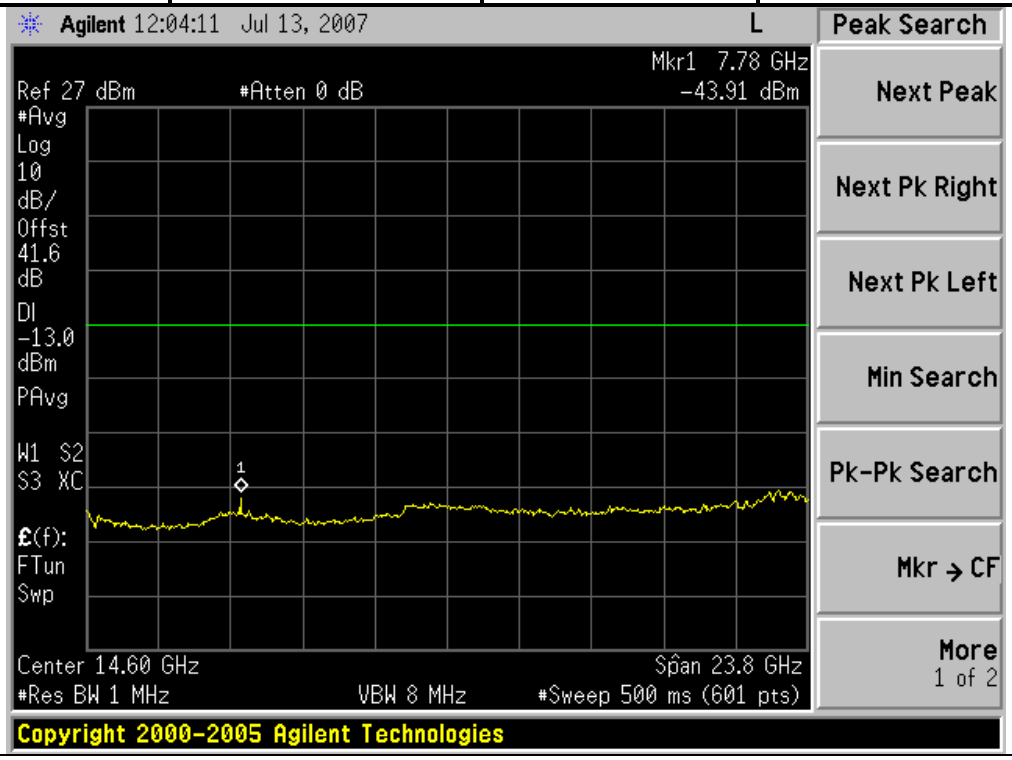
2593 MHz

2.7 – 26.5 GHz	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



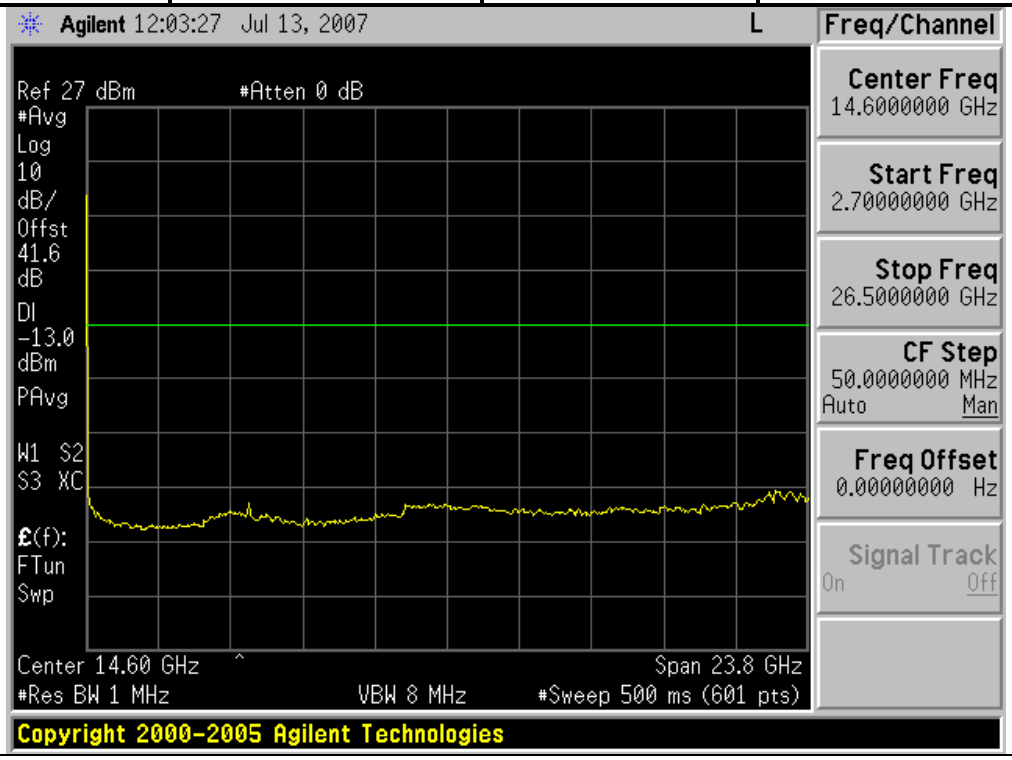
2499 MHz

2.7 – 26.5 GHz	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



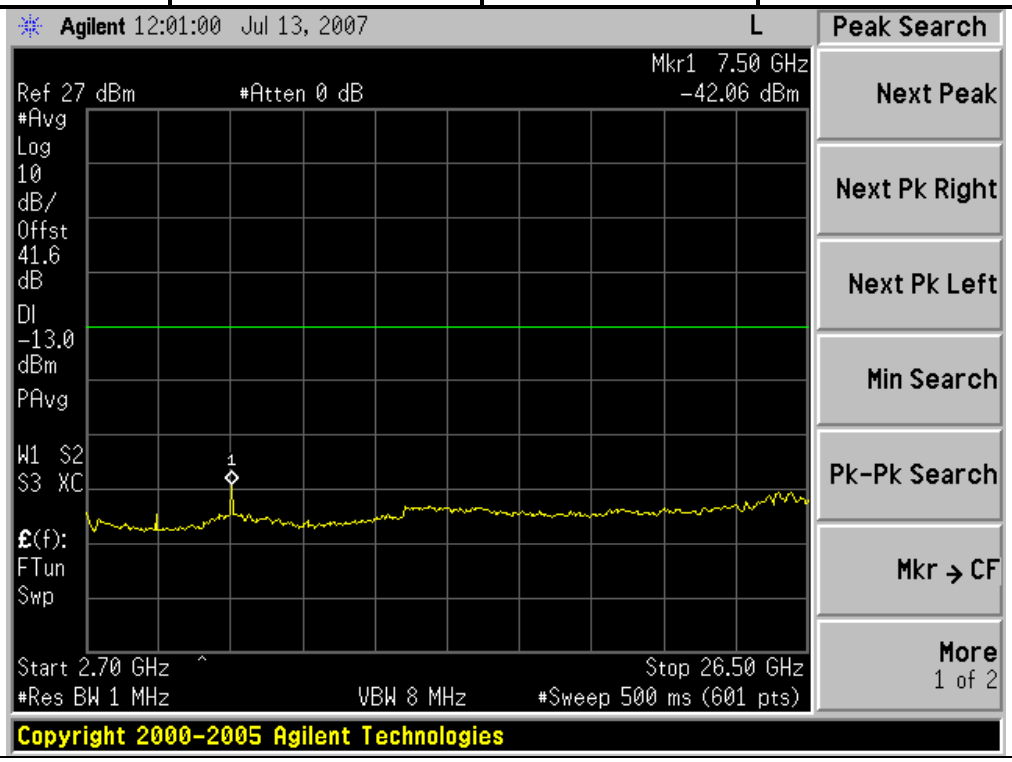
2593 MHz

2.7 – 26.5 GHz	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



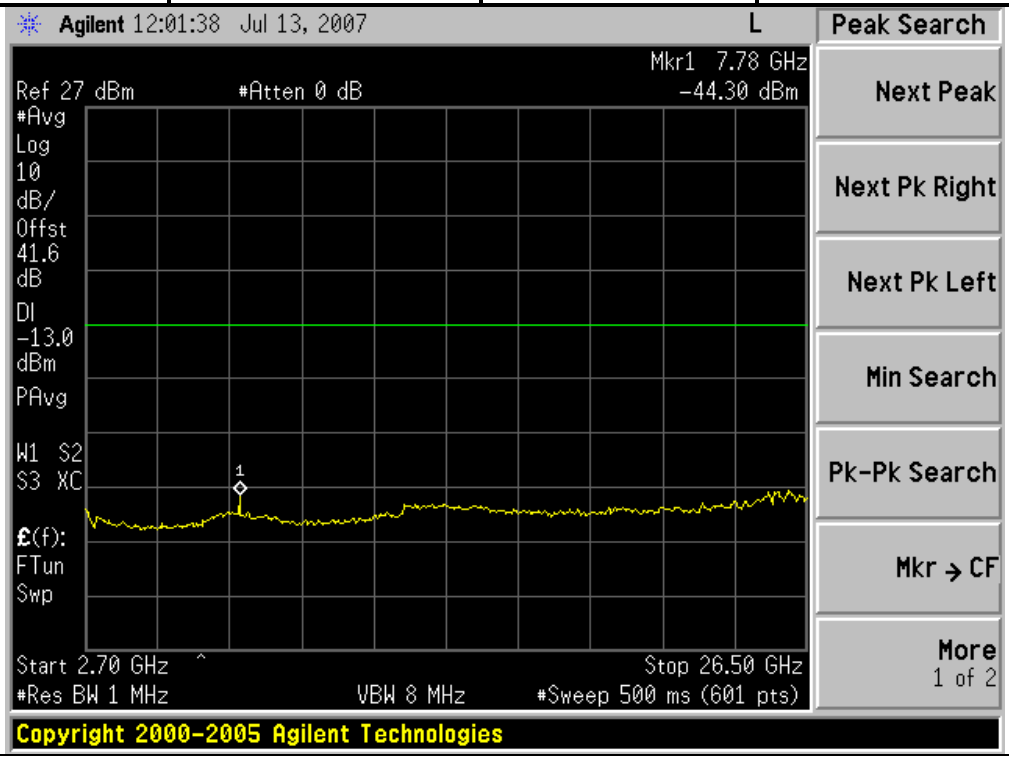
2687 MHz

2.7 – 26.5 GHz	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



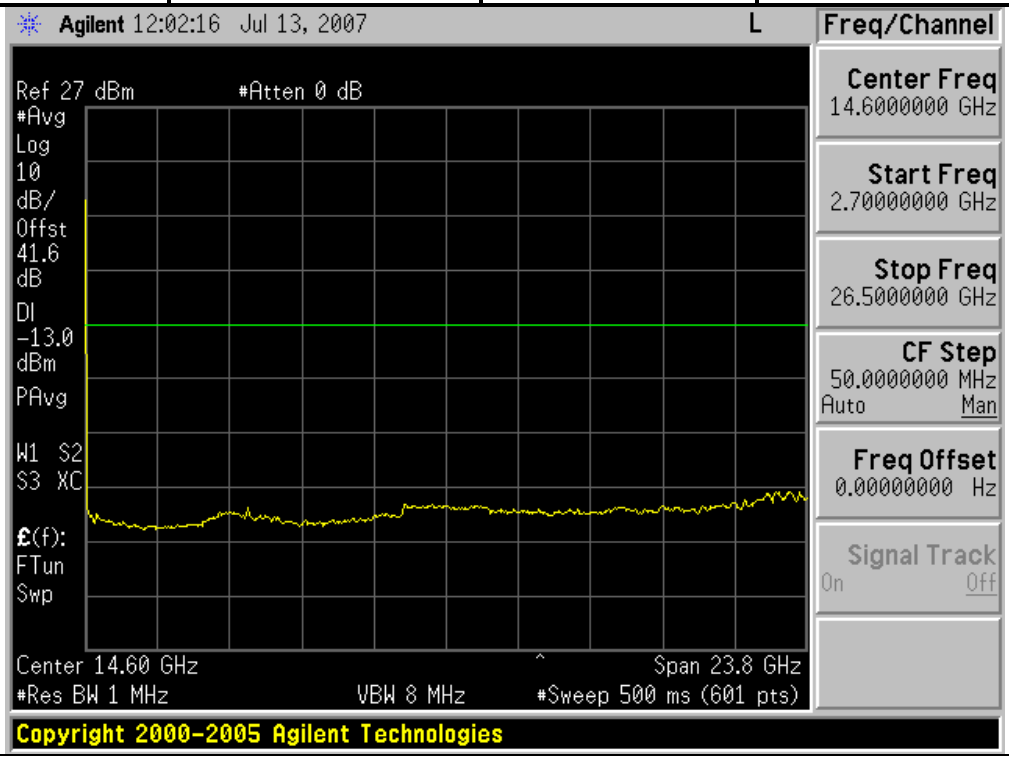
2499 MHz

2.7 – 26.5 GHz	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



2593 MHz

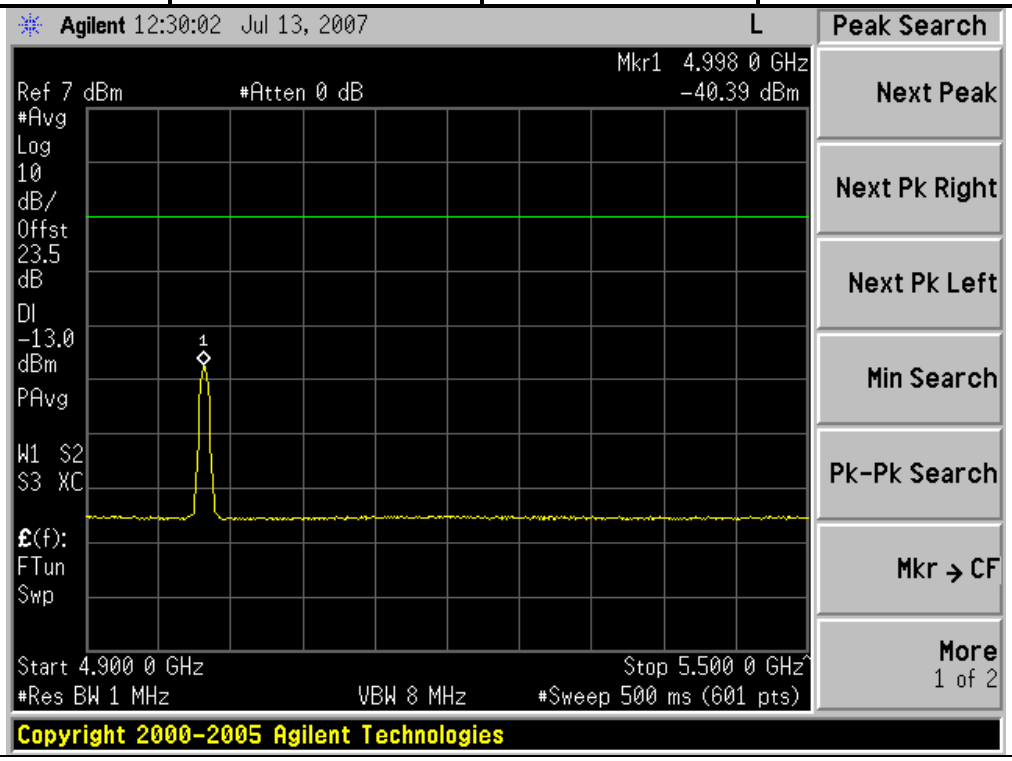
2.7 – 26.5 GHz	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



2687 MHz

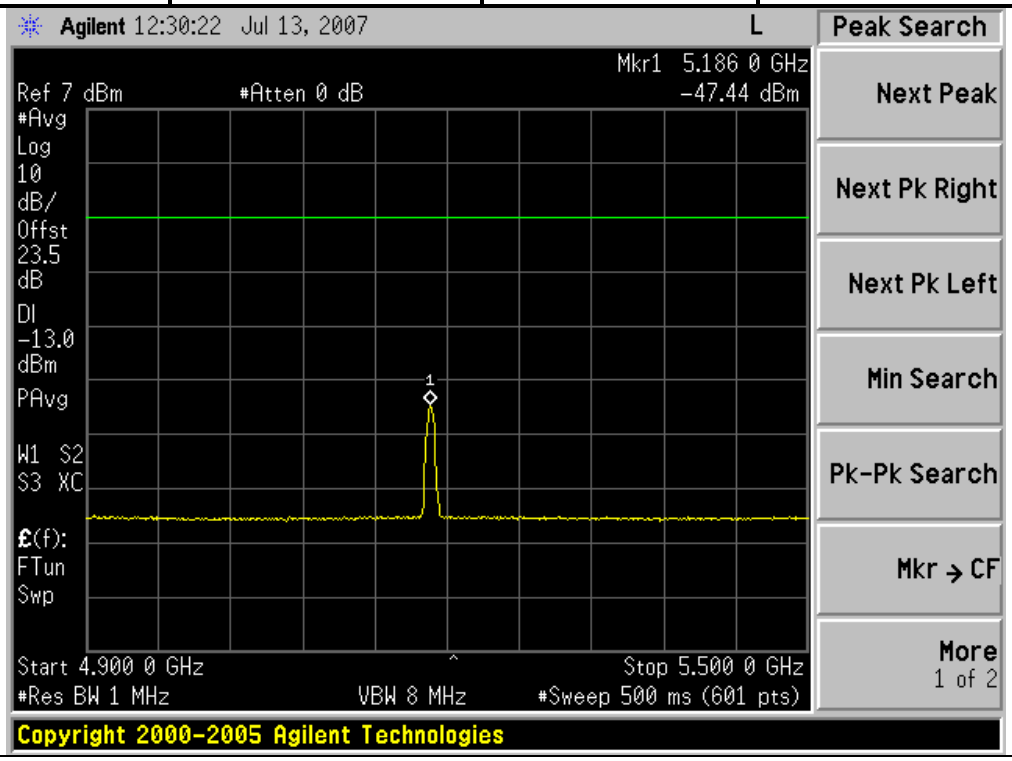
5.6.2. Second Harmonic Emissions Plots

Second Harmonic	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



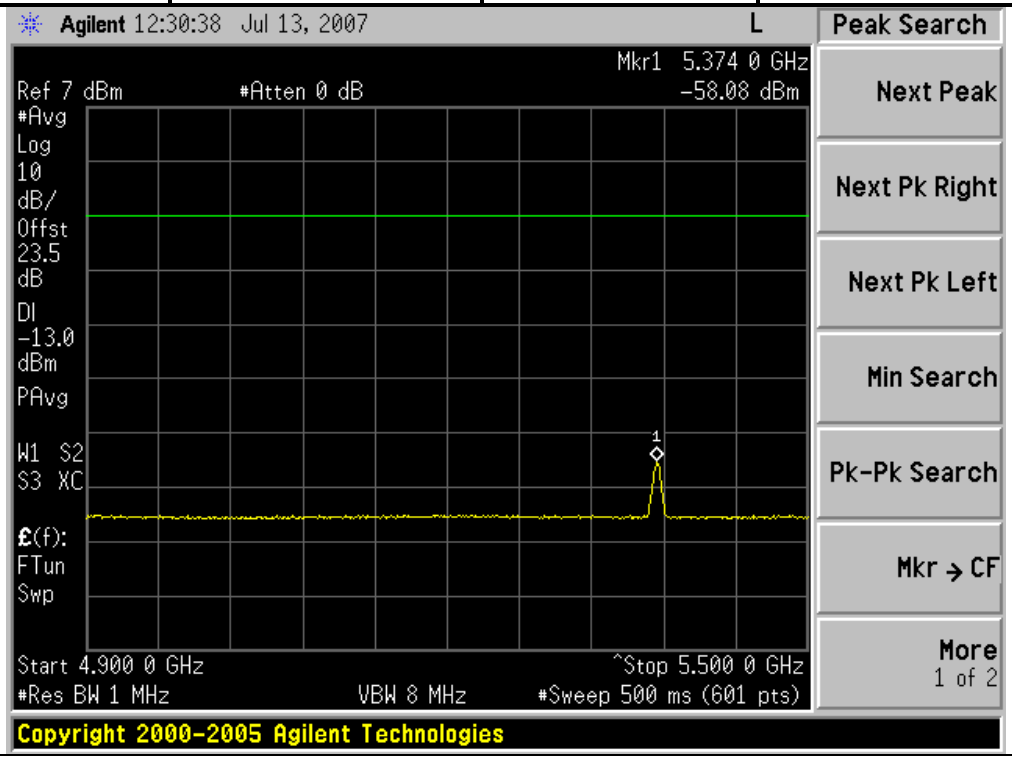
2499 MHz

Second Harmonic	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



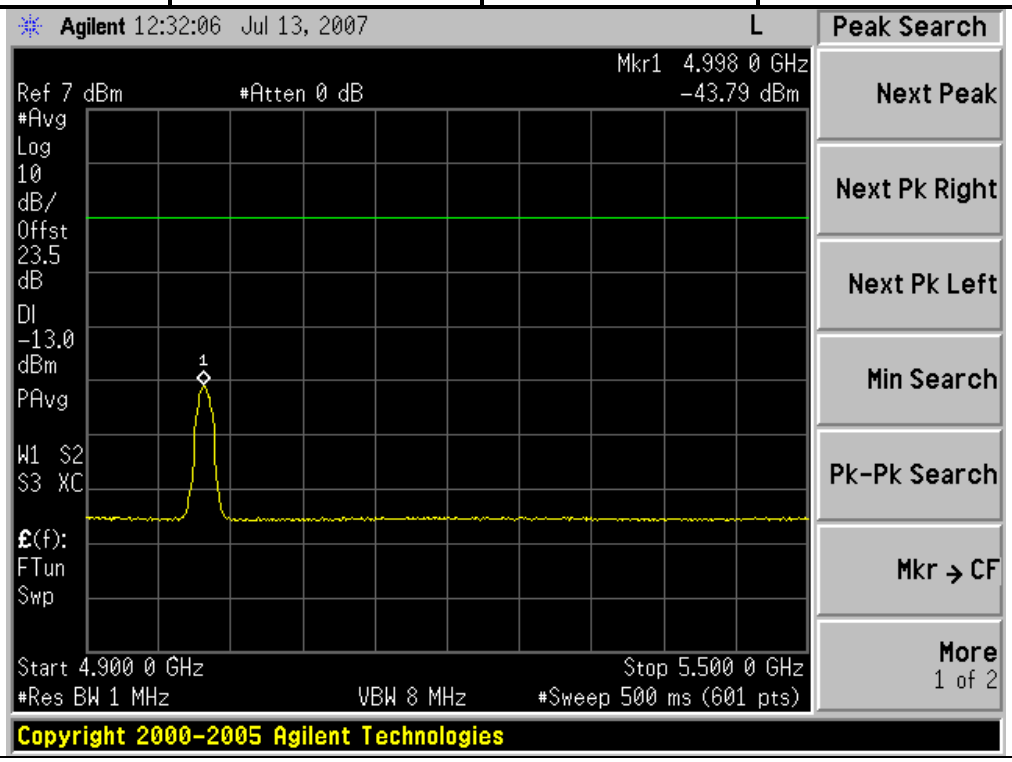
2593 MHz

Second Harmonic	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



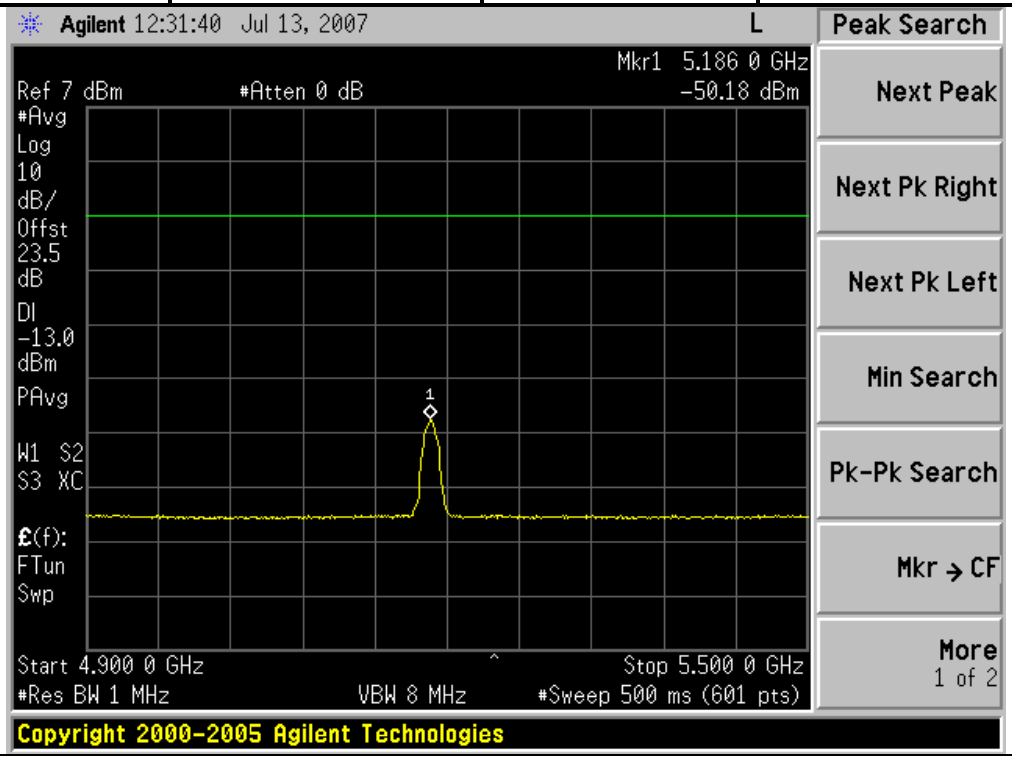
2687 MHz

Second Harmonic	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



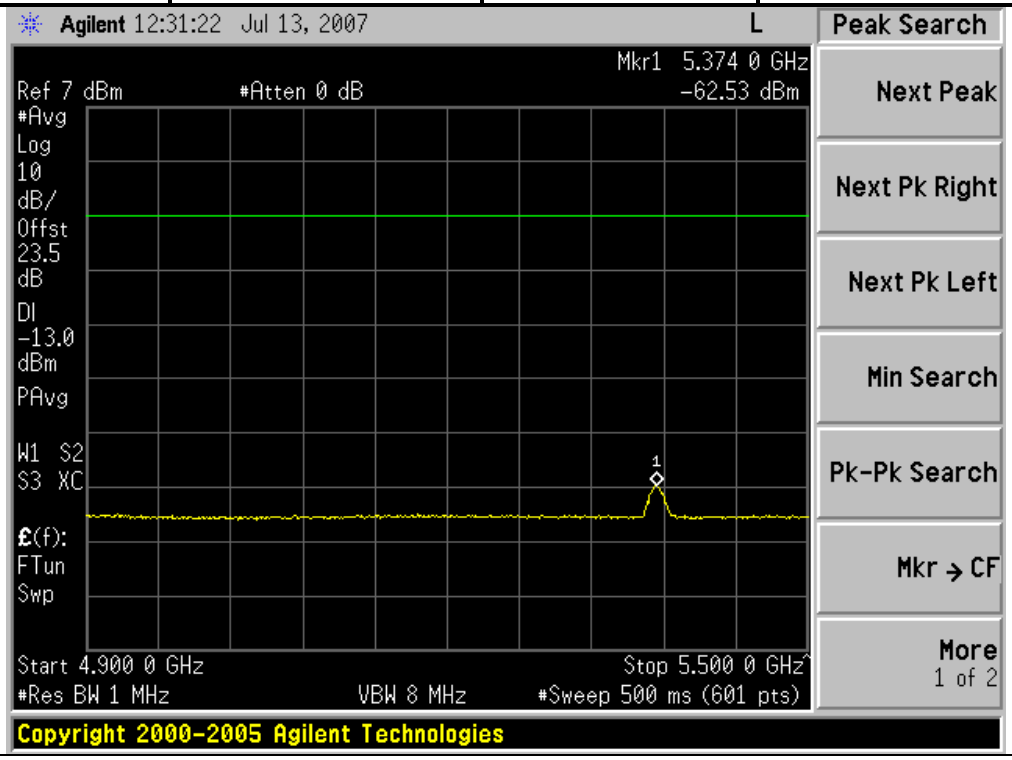
2499 MHz

Second Harmonic	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



2593 MHz

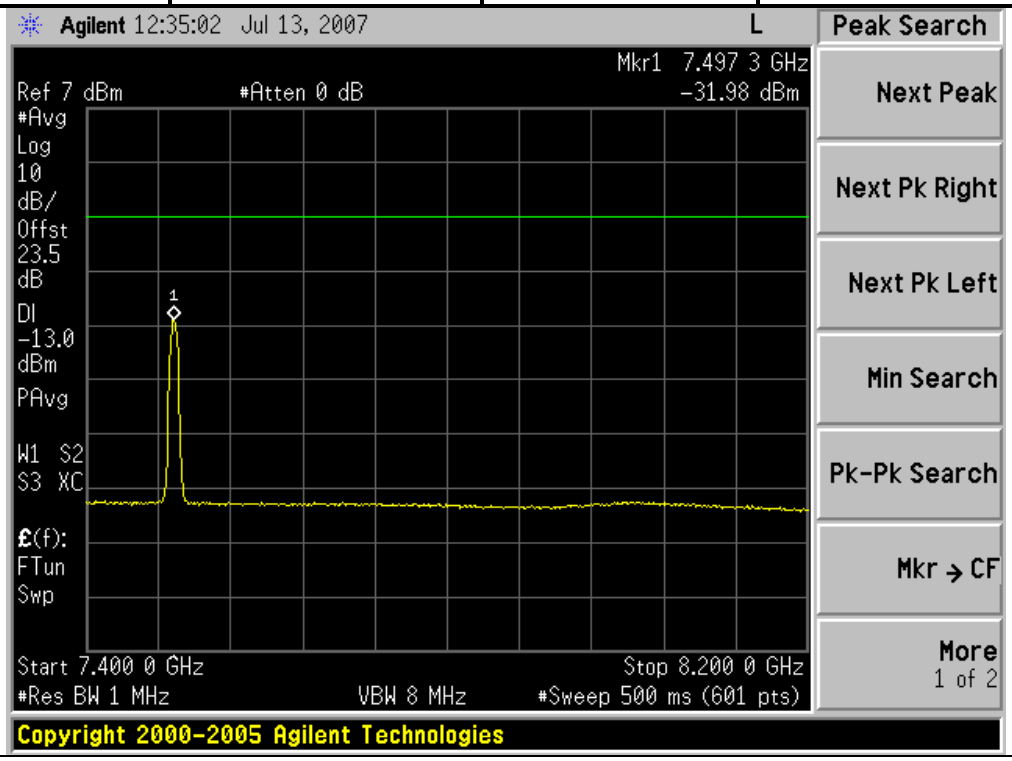
Second Harmonic	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



2687 MHz

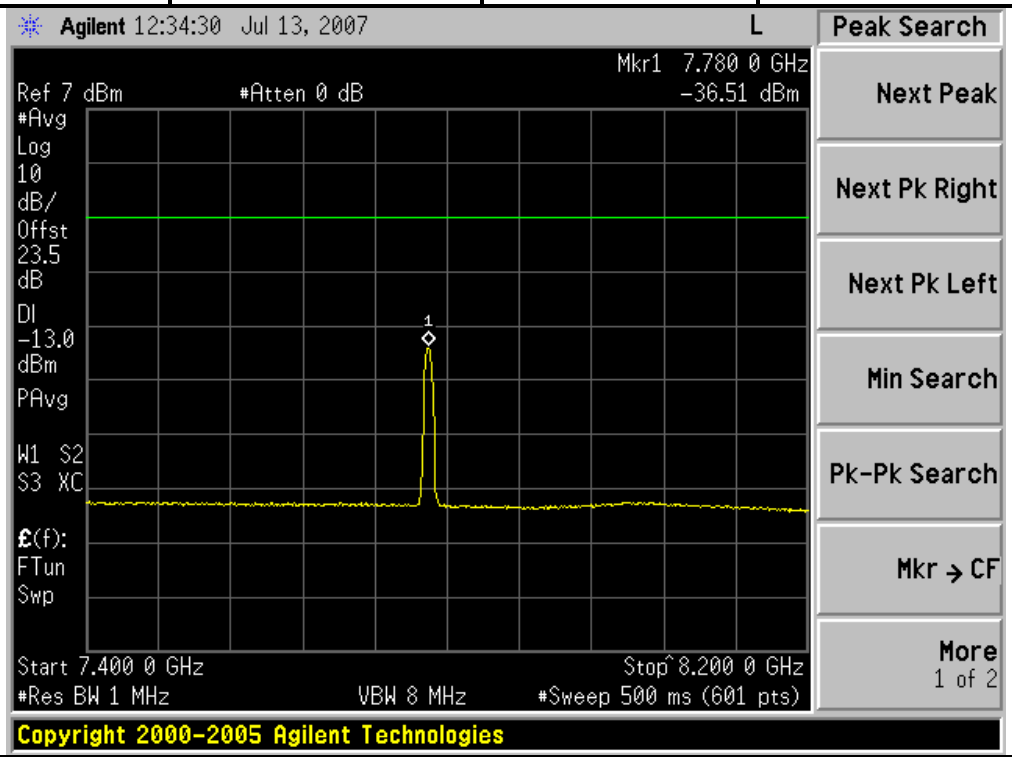
5.6.3. Harmonic 3 Emissions Plots

Third Harmonic	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



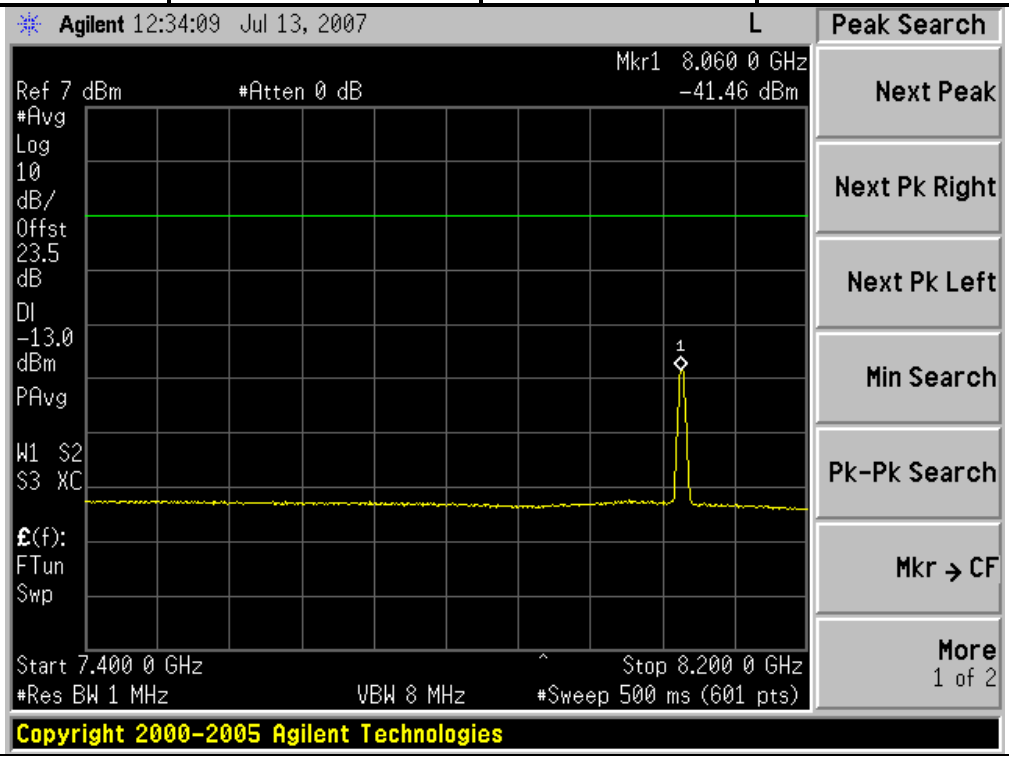
2499 MHz

Third Harmonic	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



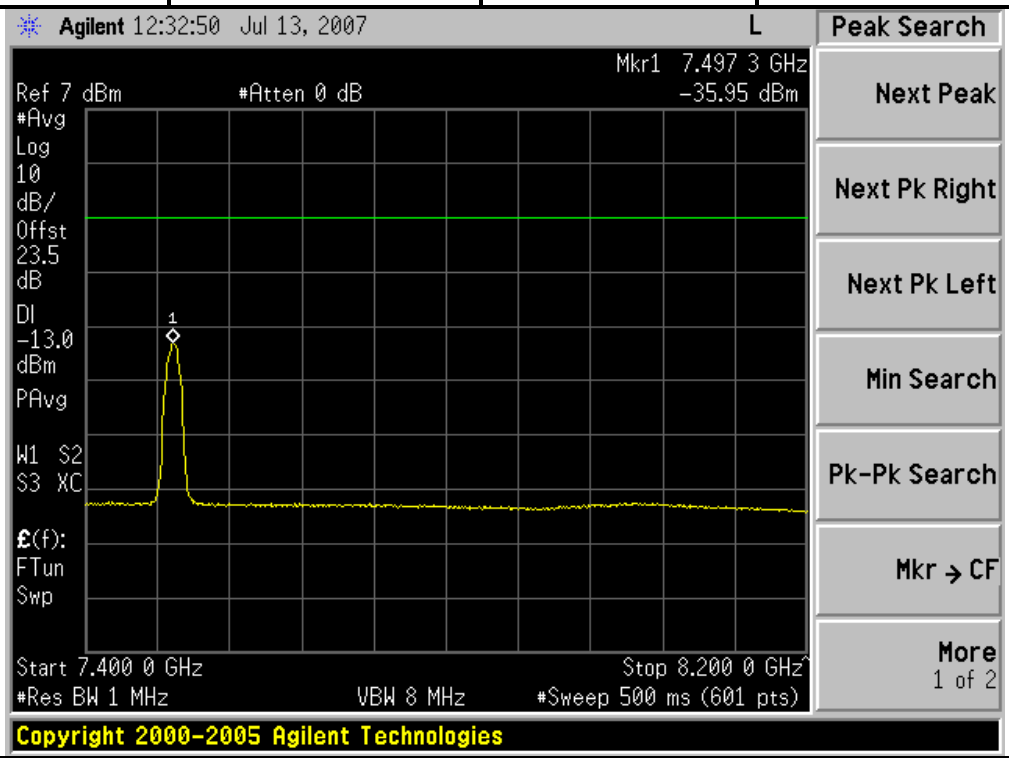
2593 MHz

Third Harmonic	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



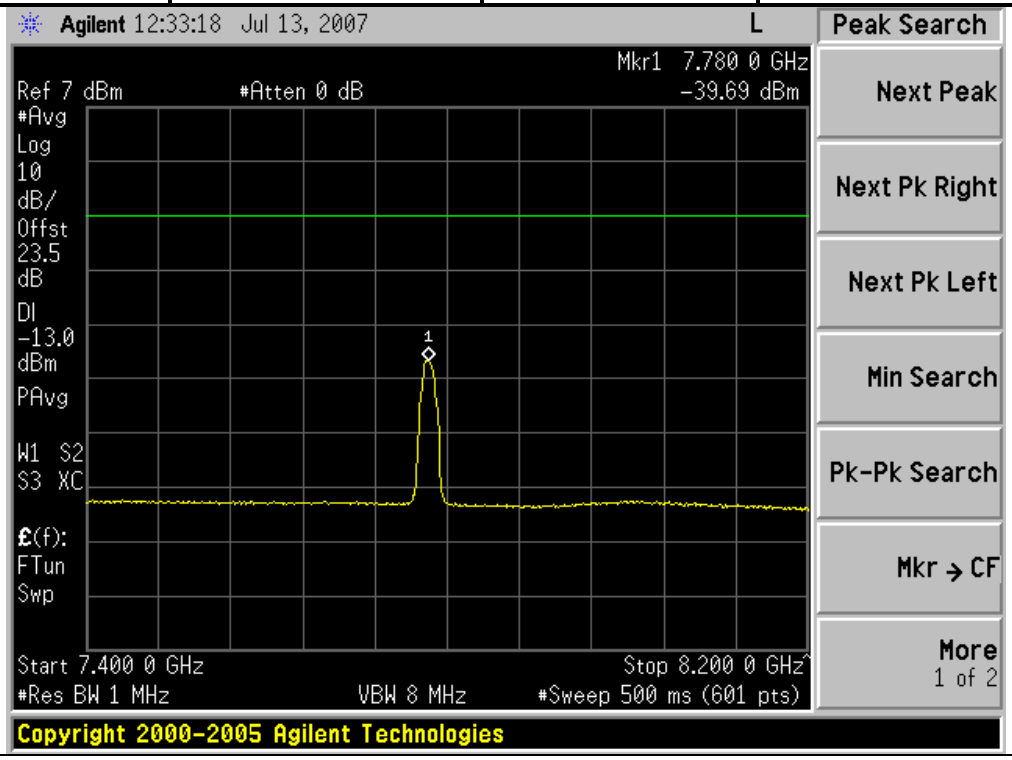
2687 MHz

Third Harmonic	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



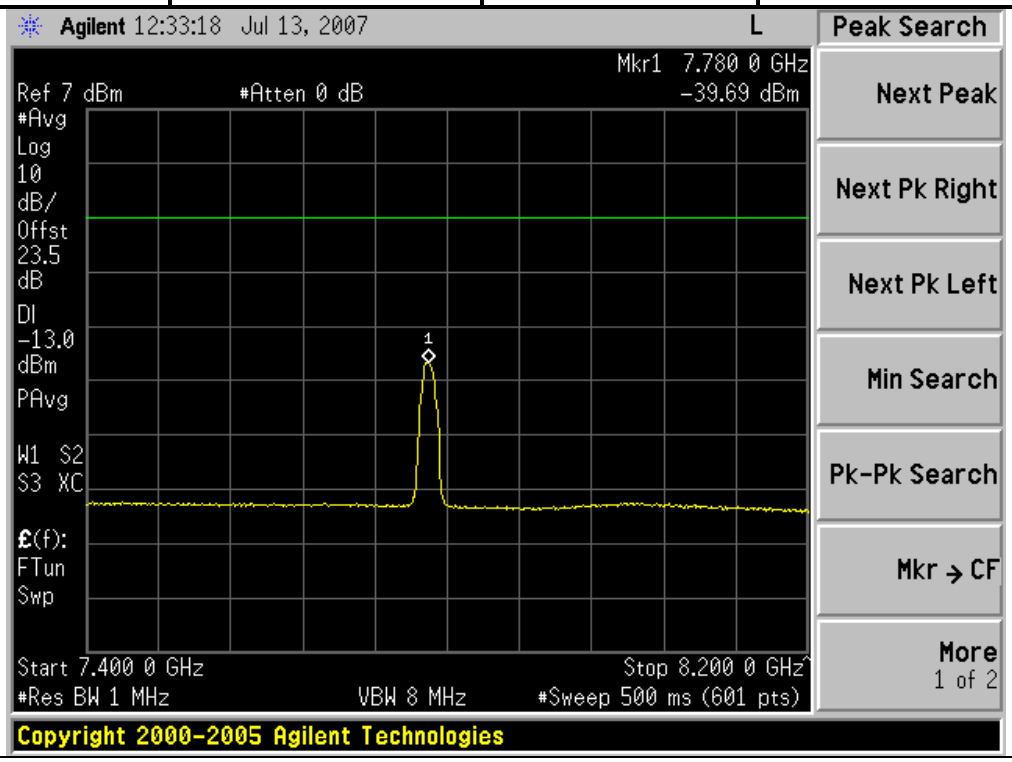
2499 MHz

Third Harmonic	Bandwidth: 10 MHz	Subchannels = All	Modulation: 16 QAM 3/4



2593 MHz

Third Harmonic	Bandwidth: 5.0 MHz	Subchannels = All	Modulation: 16 QAM 3/4



2687 MHz

5.7 Field Strength of Spurious Radiation

FCC Rules:	2.1053, 2.1049, 2.1057
FCC Requirement:	Emissions to be 43+10*log(P) below the channel power or an absolute level of –13 dBm Frequency Range = 30 MHz to 26.86 GHz Case Radiation Attenuation = 43+10logP = -13 dBm maximum
Standards:	TIA-603-C TIA Standard, Land Mobile FM or PM Communications Equipment, Measurement and Performance Standards ANSI C63.4-2001 clause 5.4 Radiated Emissions Tests. American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Test Procedure:	The field strength of spurious radiation was measured at an open area test site with the applicable measurement antennas, low noise amplifiers, and spectrum analyzers. This test was performed with the transmitter/receiver port terminated with its integral antenna(s). Measurements were performed by TUV America located in Taylors Falls, Minnesota on TUV America located in Taylors Falls, Minnesota on July 2nd, 23rd, and 24th of 2007. Spurious signals were maximized for peak level by rotation of the test unit and elevation of the measurement antenna. Verification of compliance to the emissions limit was accomplished by antenna substitution as detailed in the TIA-603-C specification. TUV America-Product Service FCC registration number: 90983
Test Conditions:	**Frequency:** 2499, 2593, 2687 MHz **Channel bandwidths**: 5.0 MHz and 10 MHz **Temperature:** 25°C **Supply Voltage:** 120 VAC / 60 Hz nominal to DUT power supply
Test Results:	Passes Field Strength of Spurious Radiation Refer to attached TUV Test Report: 5B EMC Test Report.pdf

5.8 Frequency Stability Test

FCC Rules: 2.1055, 27.53(l)(4), 27.53(l)(6), 27.54

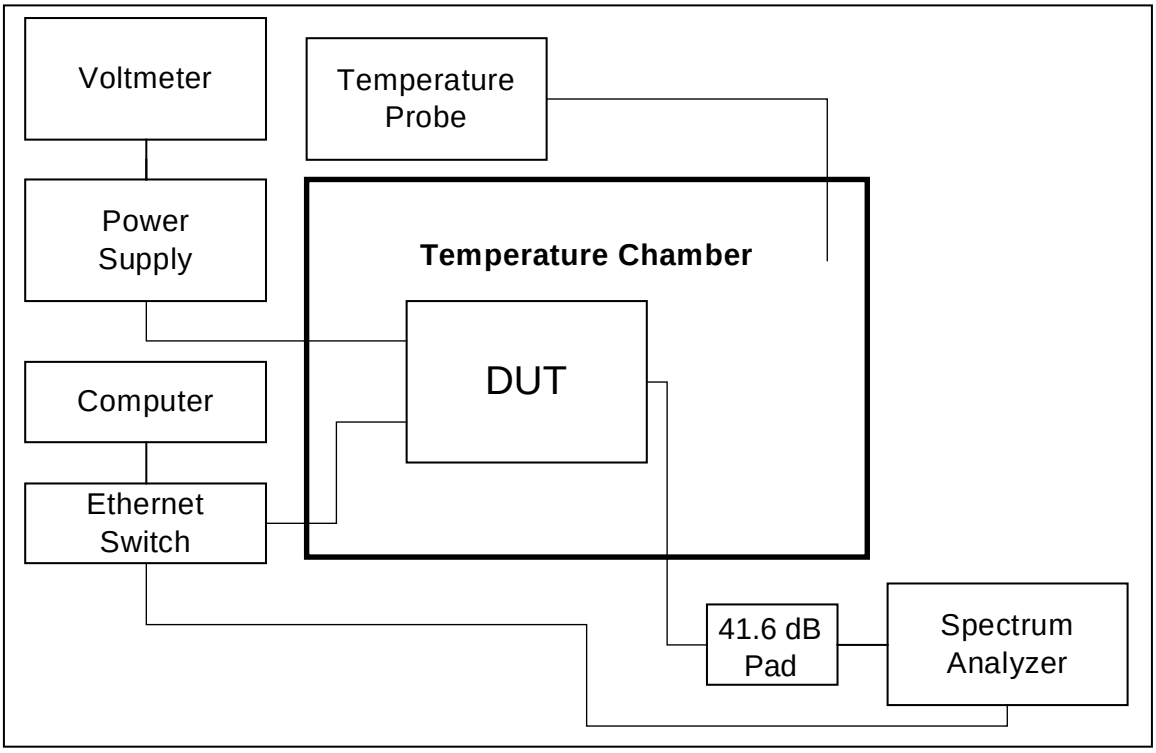
FCC Requirement: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Standard: TIA-603-C

Test Procedure: The frequency stability of the Motorola, Inc. CPEi25100 WiMax fundamental oscillator is derived from the on board 40 MHz TCXO. Since each radio channel operating frequency is synthesized and referenced to the 40 MHz TCXO, only one channel will be reported for frequency stability as all channels will have the same frequency characteristics.

The procedure used for "Modulation Characteristics" (Section 5.4) of this document was repeated to show compliance to the Frequency Stability requirements for the WiMax transmitter of the CPEi25100 product.

Test Set-Up:



Frequency Stability Test Setup

5.8.1. Temperature Variation Test Results

Test Conditions: **Frequency**: 2593 MHz (5.0 and 10 MHz channel bandwidths)
Supply Voltage: 120 VAC / 60 Hz nominal to DUT power supply
Temperature: –30º C to +50º C in 10º C increments

Test Results: Pass Temperature Variation
The tables below summarize the information from the plots contained in this section and in the Appendix.

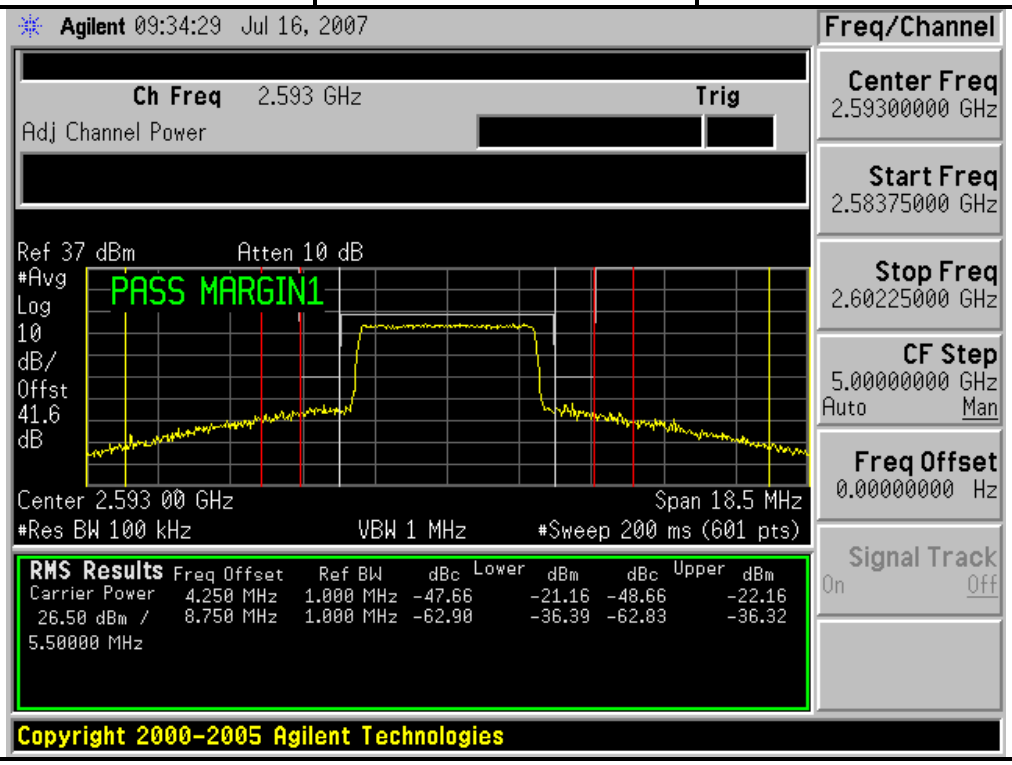
Frequency Stability Emissions 2.593 GHz 5.0 MHz Bandwidth							
Temp °C	**a/A**	**b**	**B**	**Margin to -13 dBm limit**	**g**	**G**	**Margin to -25 dBm limit**
-30	Pass	-21.16	-22.16	8.16	-36.39	-36.32	11.32
-20	Pass	-23.11	-22.98	9.98	-37.11	-38.00	12.11
-10	Pass	-20.18	-19.86	6.86	-35.35	-35.33	10.33
0	Pass	-22.42	-21.99	8.99	-36.99	-36.57	11.57
10	Pass	-19.06	-19.73	6.06	-35.06	-35.78	10.06
20	Pass	-21.46	-21.05	8.05	-37.13	-36.57	11.57
30	Pass	-17.96	-17.33	4.33	-35.19	-35.61	10.19
40	Pass	-19.93	-19.54	6.54	-36.69	-36.38	11.38
50	Pass	-16.38	-17.82	3.38	-34.74	-34.92	9.74

Frequency Stability Emissions 2.593 GHz 10.0 MHz Bandwidth							
Temp °C	**a/A**	**b**	**B**	**Margin to -13 dBm limit**	**g**	**G**	**Margin to -25 dBm limit**
-30	Pass	-22.61	-23.23	9.61	-27.97	-28.48	2.97
-20	Pass	-23.04	-23.12	10.04	-29.33	-29.51	4.33
-10	Pass	-21.02	-20.90	7.90	-27.42	-27.22	2.22
0	Pass	-22.22	-22.04	9.04	-28.43	-28.94	3.43
10	Pass	-19.75	-19.66	6.66	-26.26	-26.07	1.07
20	Pass	-20.23	-20.81	7.23	-28.21	-28.37	3.21
30	Pass	-18.27	-18.11	5.11	-26.16	-25.73	.73
40	Pass	-19.79	-20.41	6.79	-27.80	-28.03	2.80
50	Pass	-18.96	-18.16	5.16	-26.13	-26.51	1.13

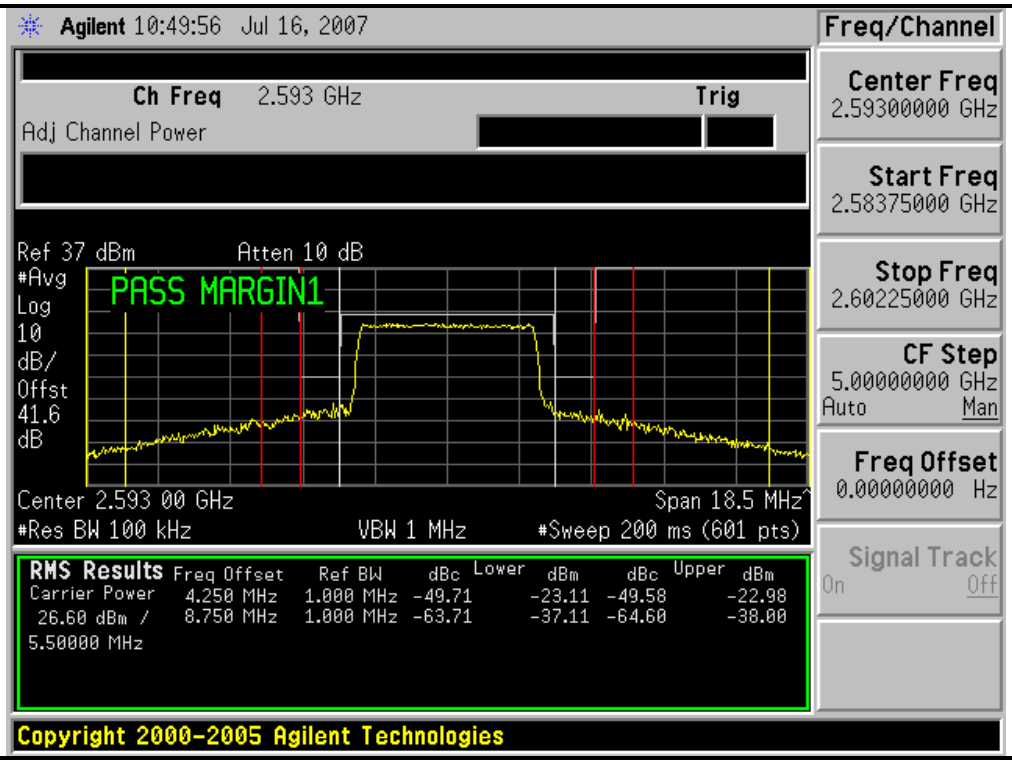
5.8.2. Temperature Variation Spectrum Analyzer Plots

Spectrum analyzer plots of the 5.0 MHz bandwidth measurements follow. The plots for the 10 MHz bandwidth channels are similar and are located in the Appendix.

Bandwidth: 5.0 MHz	Time Slots: 8	Frequency: 2593 MHz

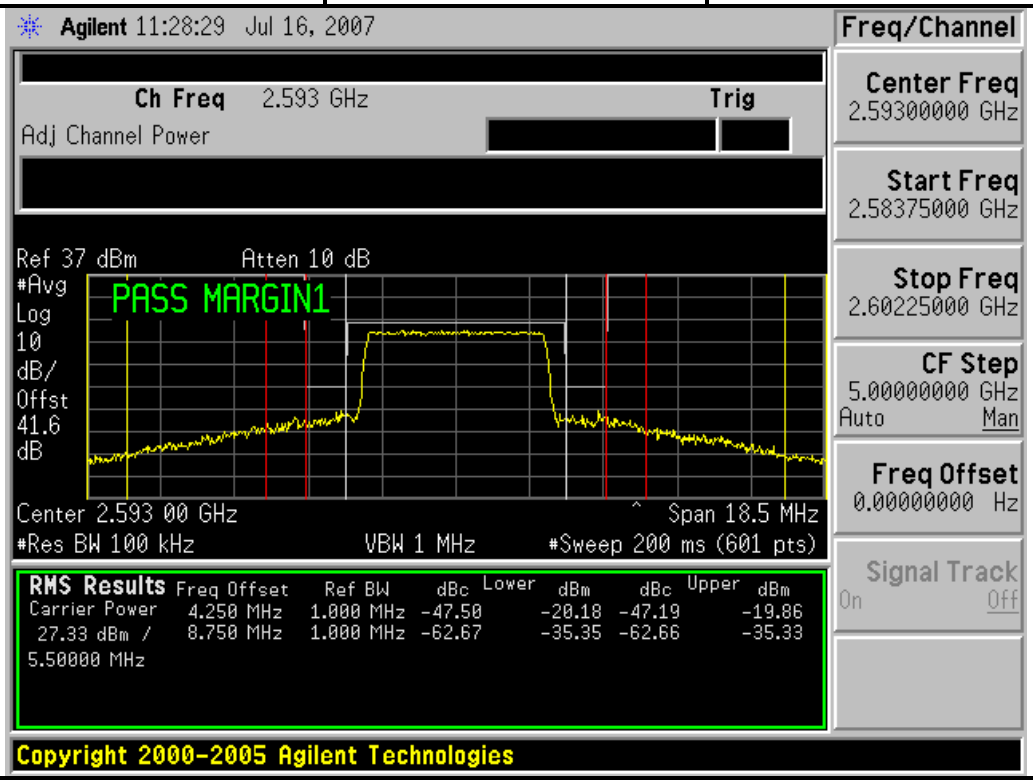


–30° C

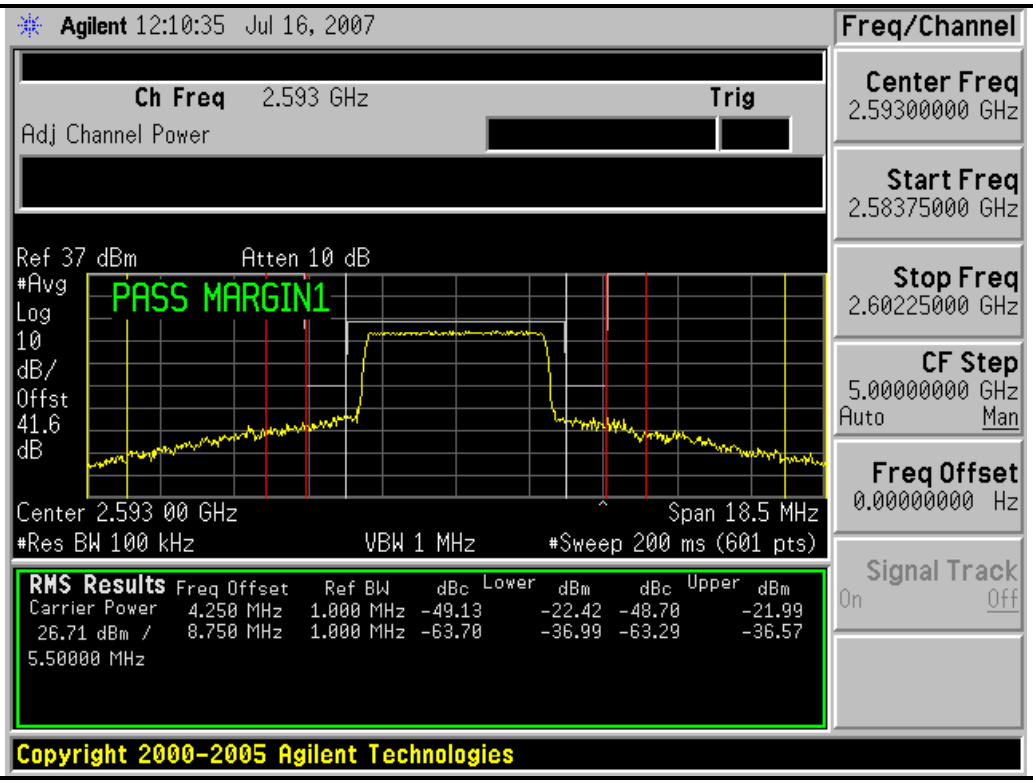


–20° C

Bandwidth: 5.0 MHz	Time Slots: 8	Frequency: 2593 MHz

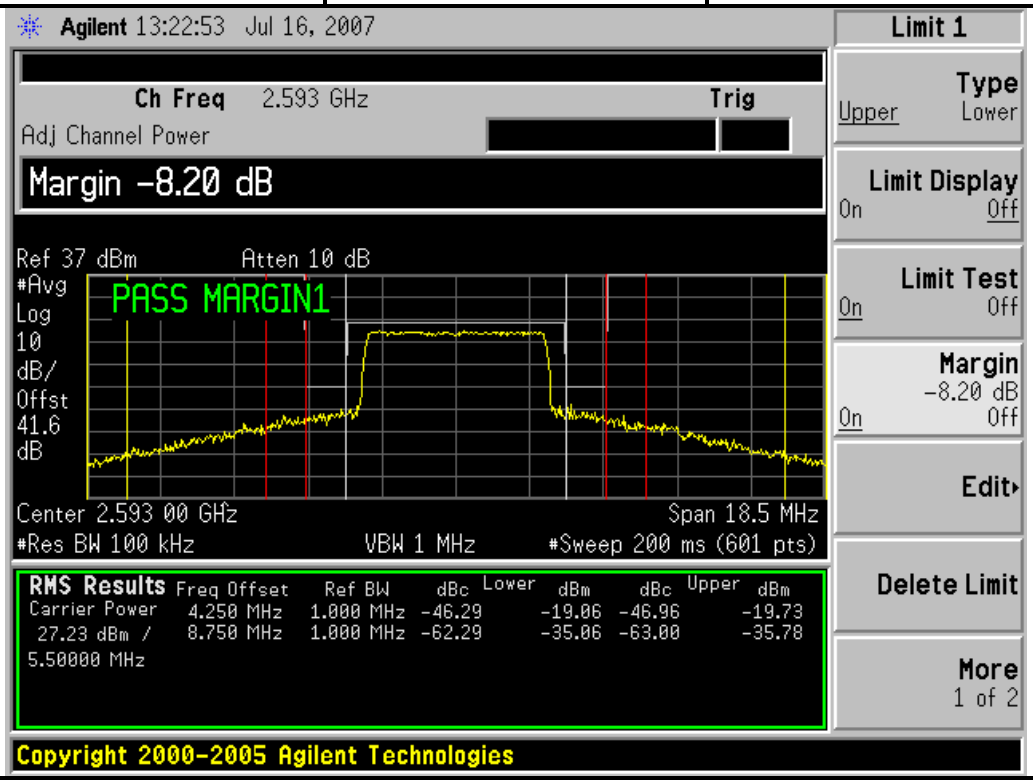


–10° C

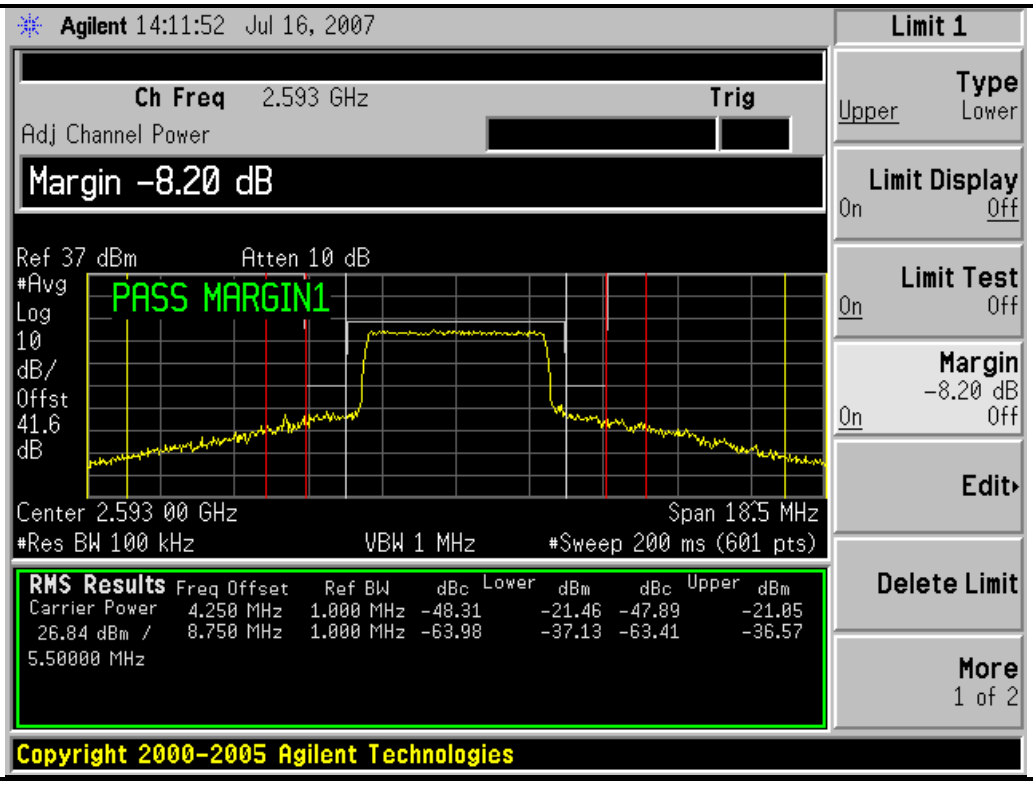


0° C

Bandwidth: 5.0 MHz	Time Slots: 8	Frequency: 2593 MHz

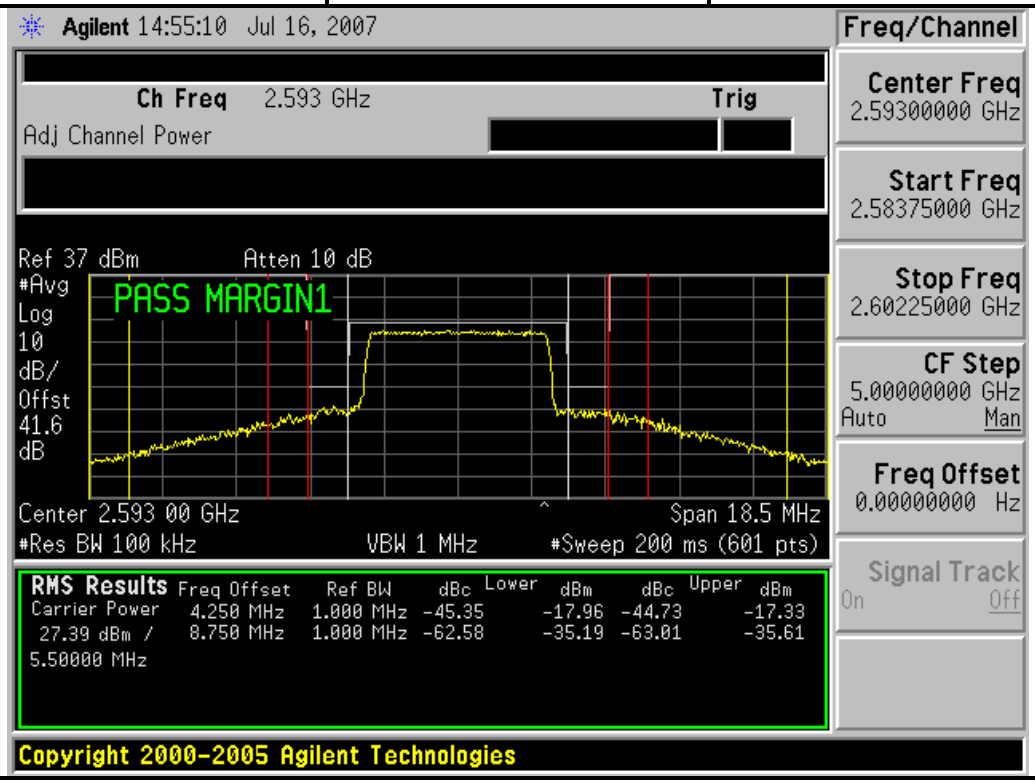


+10° C

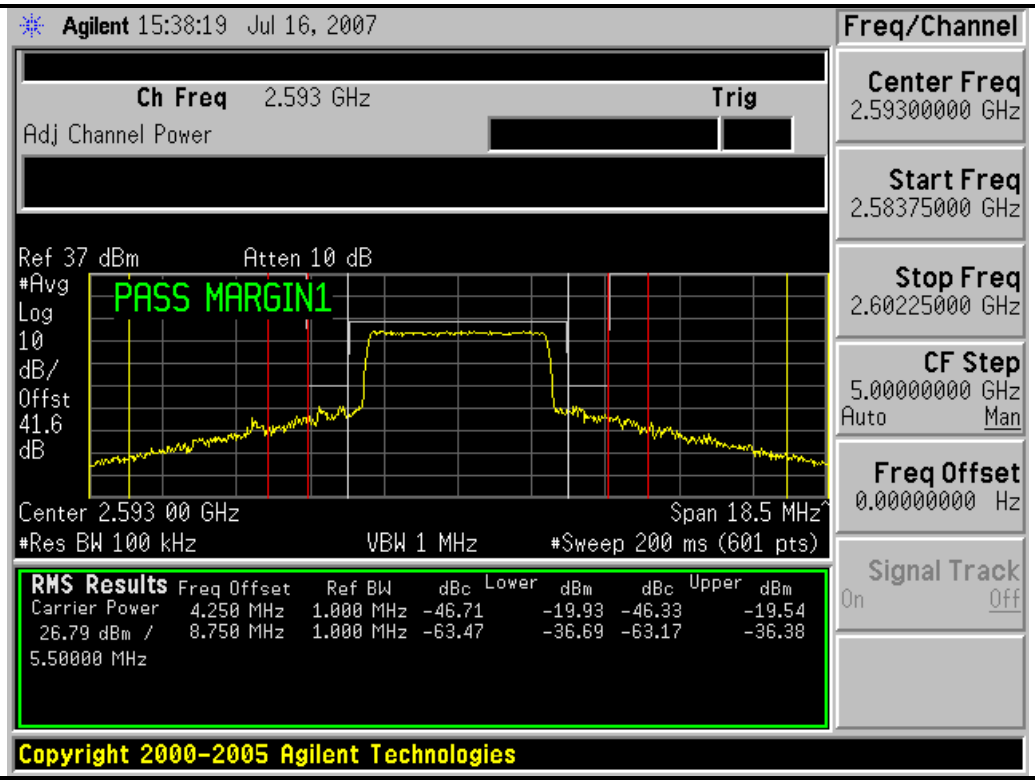


+20° C

Bandwidth: 5.0 MHz	Time Slots: 8	Frequency: 2593 MHz

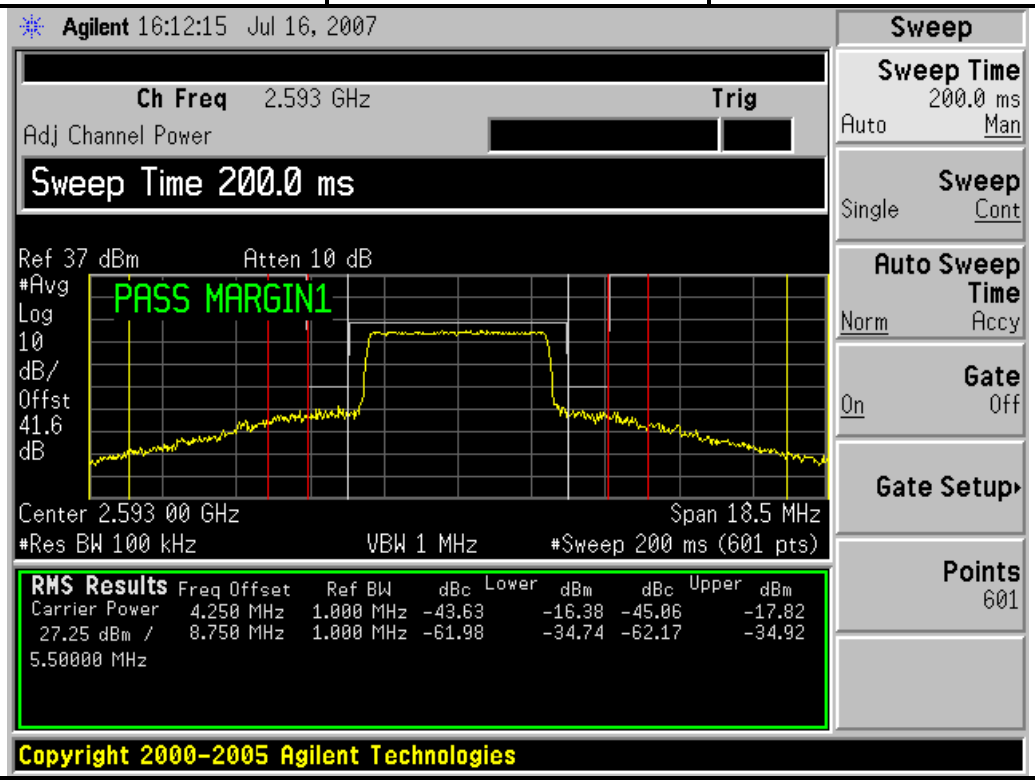


+30° C



+40° C

Bandwidth: 5.0 MHz	Time Slots: 8	Frequency: 2593 MHz



+50° C

5.8.3. Supply Voltage Variation Test Results

Test Conditions: **Frequency:** 2593 MHz
Temperature: 22°C
Source Input Voltage Specification: 120.0 VAC / 60 Hz nominal
Test Voltage Range: 0.85 x 120 = 102 VAC / 60 Hz lower limit
1.15 x 120 = 138 VAC / 60 Hz upper limit

Test Results: Supply Voltage Variation

The tables below summarize the information from the plots contained in this section and in the Appendix.

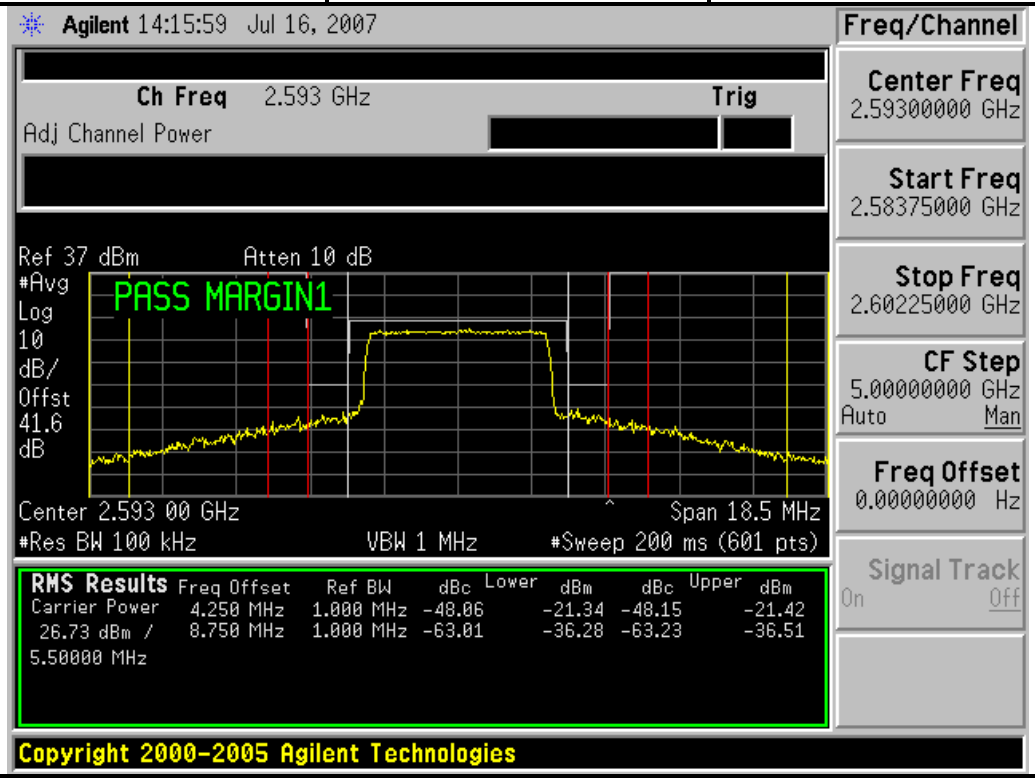
Frequency Stability Emissions 20°C 2.593 GHz 5.0 MHz Bandwidth							
Voltage (Vdc)	**a/A**	**b**	**B**	**Margin to -13 dBm limit**	**g**	**G**	**Margin to -25 dBm limit**
102	Pass	-21.34	-21.42	8.34	-36.28	-36.51	11.28
120	Pass	-21.93	-20.42	7.42	-36.78	-36.55	11.55
138	Pass	-21.11	-21.02	8.02	-36.65	-36.51	11.51

Frequency Stability Emissions 20°C 2.593 GHz 10.0 MHz Bandwidth							
Source Voltage	**a/A**	**b**	**B**	**Margin to -13 dBm limit**	**g**	**G**	**Margin to -25 dBm limit**
102	Pass	-21.00	-21.16	8.00	-28.10	-28.11	3.10
120	Pass	-21.48	-21.08	8.08	-28.13	-27.97	2.97
138	Pass	-20.76	-21.48	7.76	-28.24	-27.24	2.24

5.8.4. Supply Voltage Variation Spectrum Analyzer Plots

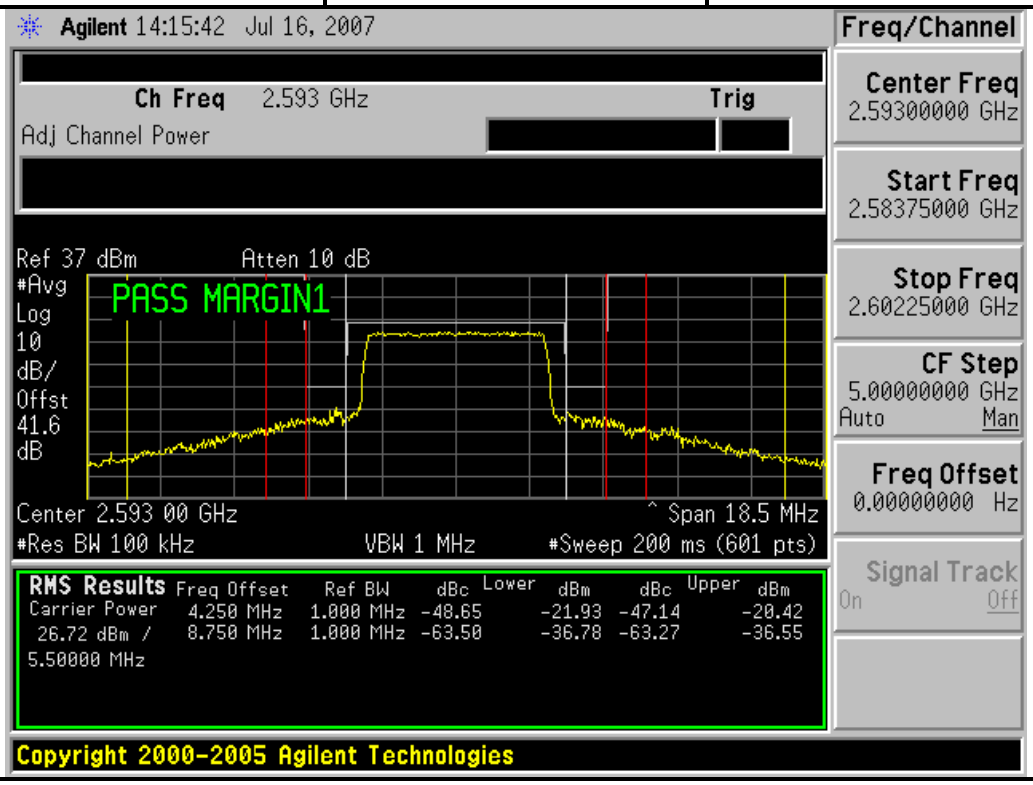
Spectrum analyzer plots of the 5.0 MHz bandwidth measurements follow. The plots for the 10 MHz bandwidth channels are similar and are located in Appendix B.

Bandwidth: 5.0 MHz	Time Slots: 8	Frequency: 2593 MHz

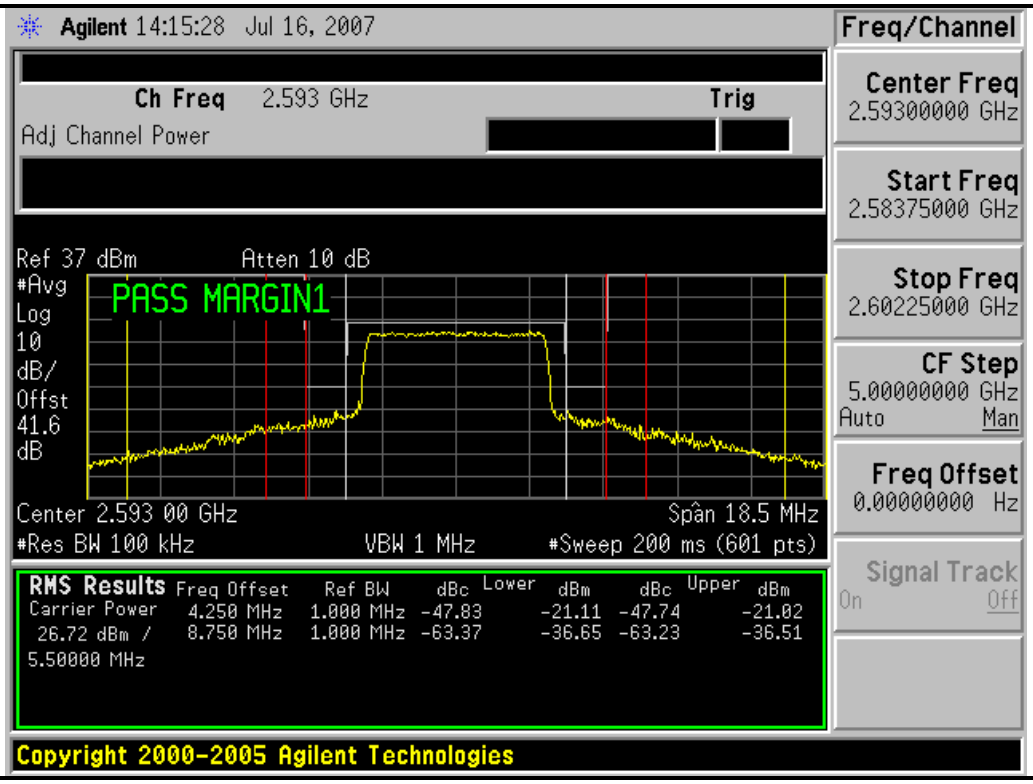


102 VDC / +20° C

Bandwidth: 5.0 MHz	Time Slots: 8	Frequency: 2593 MHz



120 VDC / +20° C



138 VDC / +20° C