Radio Intentional EMC Test Report: EDCS – 1357078

For

CP-DX80

2.4GHz Radio

Against the following Specifications :

47 CFR 15.247

RSS-210

Cisco Systems

EMC Laboratory

170 West Tasman Drive

San Jose, CA 95134

Author: Johanna Knudsen
Approved By: See EDCS
Title: See EDCS

This report replaces any previously entered test report under EDCS - 1357078

This test report has been electronically authorized and archived using the CISCO Engineering Document Control system.

Section 1: Overview

Test Summary

The samples were assessed against the tests detailed in section 3 under the requirements of the following standards:

Emissions:
CFR47 Part 15.247
RSS-210

Notes:

1) Measurements were made in accordance with KDB Publication No. 558074 D01 DTS Meas Guidance v03r01 & measurement method of spurious emission tolerance to the International Telecommunication Union (ITU) Recommendation SM329.

Section 2: Assessment Information

2.1 General

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal Government.

With regard to this assessment, the following points should be noted:

a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results, due to production tolerances and measurement uncertainties.

b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.

c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).

d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%

e) All AC testing was performed at one or more of the following supply voltages:
110V (+/-10%) 60Hz
220V (+/-10%) 50 or 60Hz

f) Cisco Systems, Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). The scope of accreditation, certificate number 1178-01 is referenced in appendix C, along with further details.

2.2 Start Date of Testing

6-FEB-2014

2.3 Report Issue Date

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2.4 Testing facilities

This assessment was performed by:

Testing Laboratory

Cisco Systems, Inc.,
170 West Tasman Drive
San Jose, CA 95134,
USA

Registration Numbers for Industry Canada

Cisco System Site	Site Identifier
Building P, 5m Chamber	Company #: 2461N-1

Test Engineers

Johanna Knudsen, Jose Aguirre

2.5 Equipment Assessed (EUT)

CP-DX80

2.6 EUT Description

The CP-DX80 is a 23 inch HD1080p video capable personal desktop collaboration endpoint that extends the DX series portfolio utilizing Android OS 4.1.1 (EX-60 replacement).

23 inch touch LDF
16 GB eMMC Flash memory (only 8 GB available) & 2 GB RAM
2 Gigabit Ethernet ports (1 for Network Uplink & 1 for Laptop connection)
3 standard A USB ports (2 in the back and 1 on the right side)

1 standard B USB port (with ADB support)
1 micro B USB port
1 HDMI for video out (to external monitor) with a maximum resolution of 1920 x 1200
1 HDMI for video in (from laptop)
1 micro SD card slot
1 Kensington Lock

Wi-Fi (802.11 a/b/g/n) & Bluetooth 3.0
Marvell 88W8787 - Wi-Fi + Bluetooth chip
Murata module LBEH1ZNRZC-TEMP, supports 802.11/a/b/g/n + Bluetooth 3.0 chip
SDIO interface to WLAN – Omap4 SD host controller port 5
PCM (McBSP1) interface to Bluetooth
Single OMAP4470 Architecture, with dual Cortex A9 running at 1.5GHz
Single antenna for 2.4 GHz and 5 GHz bands with diplex inside the module (SISO)
Amphenol SAA CI4671-15-000-R
4.61 dBi peak gain for 2.4 Ghz
7.05 dBi peak gain for 5 GHz
Coexistence between Wi-Fi and Bluetooth (1 antenna utilized)
Supports frequencies/channels 2.412 – 2.472 GHz & 5.180 – 5.825 GHz
Up to 72 Mbps (20 MHz channel), Up to 150 Mbps (40 MHz channel width)
Non- HT20 - 1 to 54 Mbps
HT20 - M0 to M7 (7 to 72 Mbps)
HT40 - M0 to M7 (15 to 150 Mbps)
802.11i security standard (WPA/WPA2)

2.7 Scope of Assessment

Tests have been performed in accordance with the relevant Test and Assessment Plan (TAP), a copy of which is contained in Appendix F of this report, and the relevant Cisco Systems, Inc. radio test procedures (EDCS-420238). This test report may not cover all of the tests highlighted in the test plan.

2.8 Units of Measurement

The units of measurements defined in the appendices are reported in specific terms, which are test dependent. Where radiated measurements are concerned these are defined at a particular distance. Basic voltage measurements are defined in units of [dBuV]

As an example, the basic calculation for all measurements is as follows:

Emission level [dBuV] = Indicated voltage level [dBuV] + Cable Loss [dB] + Other correction factors [dB]

The combinations of correction factors are dependent upon the exact test configurations [see test equipment lists for further details] and may include:-

Antenna Factors, Pre Amplifier Gain, LISN Loss, Pulse Limiter Loss and Filter Insertion Loss..

Note: to convert the results from dBuV/m to uV/m use the following formula:-

Level in uV/m = Common Antilogarithm [(X dBuV/m)/20] = Y uV/m

2.9 Report Template Control No.

EDCS#: 703456

Section 3: Result Summary

3.1 Results Summary Table

Conducted emissions

Basic Standard	Test Details / Comments	Result
Power Spectral Density	15.247: For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. *(RSS-210 A8.2)*	Pass
Peak Output Power	15.247: The maximum conducted output power of the intentional radiator for systems using digital modulation in the 2400-2483.5MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. (*RSS-210 A8.4)*	Pass
6dB Bandwidth	15.247: Systems using digital modulation techniques may operate in the 5725-5850MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz. *(RSS-210 A8.2)*	Pass
Conducted Spurious Emissions	15.247: In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.(*RSS-210 A8.5)*	Pass

Radiated emissions

Basic Standard	Test Details / Comments	Result
Radiated Spurious and Harmonic Emissions	Radiated emissions which fall in the restricted bands, as defined in Sec. 15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a). (*RSS-210 Sec2.7)*	Pass
Restricted Bandedge Measurements	Radiated emissions which fall in the restricted bands, as defined in Sec. 15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a). (*RSS-210 Sec2.7)*	Pass

* SAR measurements to be reported in separate report

4.1 Sample Details

Sample Number	Equipment Details	Serial Number	Part Number
S01	CP-DX80	FOC1801N7WM	CSO 68-00355-01 04 (P2)
S02	CP-DX80	FOC1809N3R2	CSO 68-00355-01 04 (P3A)

The following antennas were evaluated as part of this testing process. The antennas listed reflect the maximum gain allowed for each family type of antenna:

Fixed internal Amphenol Dual Band Antenna at 2.4GHz, Gain: 4.61dBi peak (no external antenna can be used)

4.2 System Details

System #	Description	Samples
1	Radio Test Sample - Manufacturing Image	S01
2	Radio Test Sample – Production Image	S02

4.3 Mode of Operation Details

Mode #	Description	Comments
1	802.11 Test Mode	System is placed in a continuous Tx State at various channels per Test Requirements. 802.11a running at 6Mbps, HT20 running at M0 and HT40 running M0. Manufacturing image used.
2	802.11 Test Mode + Bluetooth for co-location	System is placed in a continuous Tx State at various channels per Test Requirements. 802.11a running at 6Mbps, HT20 running at M0 and HT40 running M0. Production image used.

Section 5: Modifications

5.1 Sample Modifications Performed During Assessment

No modifications were performed during assessment.

Appendix A: Formal Test Results

Target Maximum Channel Power

The following table details the maximum supported Total Channel Power for all operating modes.

	Maximum Channel Power (dBm)		
	Frequency (MHz)		
Operating Mode	2412	2437/2442	2452/2462
802.11b, 1 to 11 Mbps	20	20	20
802.11g, 6 to 54 Mbps	16	16	16
802.11n HT20, M0 to M7	15	15	15
802.11n HT40, M0 to M7	13	13	13

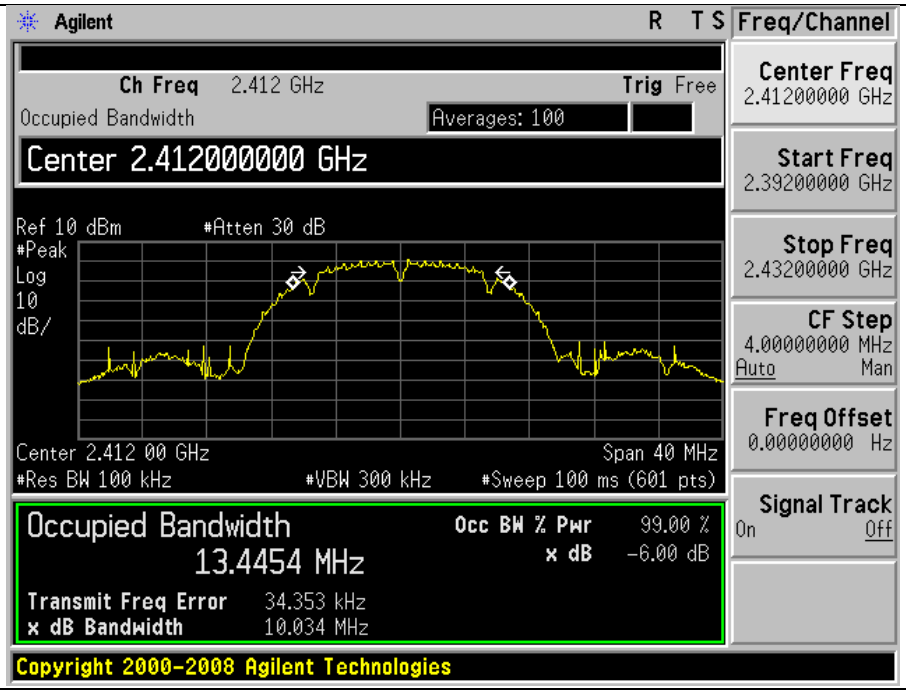
6 dB Bandwidth

15.247 & RSS-210 A8.2:

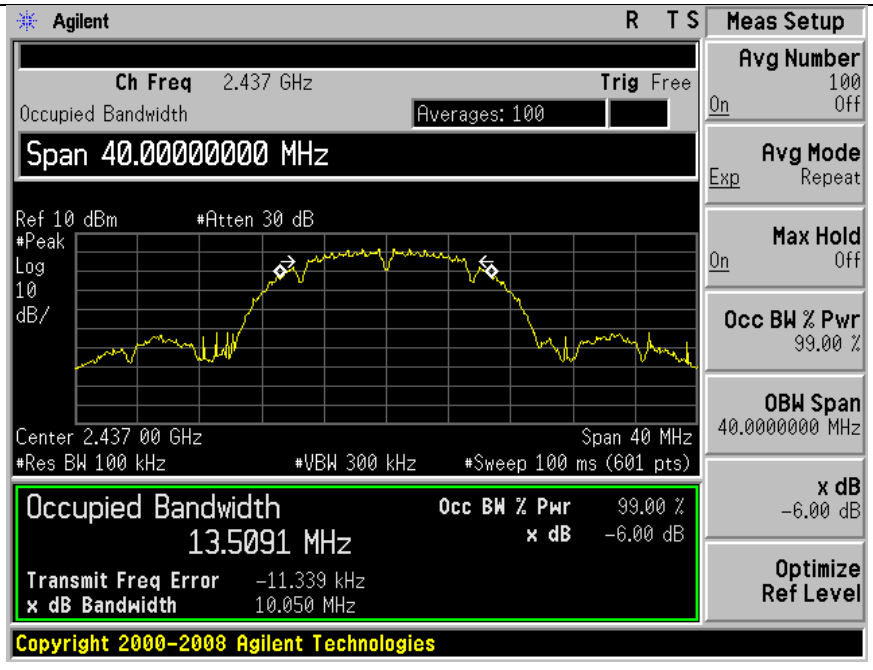
Systems using digital modulation techniques may operate in the 2400-2483.5MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz

Mode	Power Setting (dBm)	Frequency (MHz)	Data Rate	6dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)
802.11b	20	2412	11Mbps	10034	500	-9534
		2437	11Mbps	10050	500	-9550
		2462	11Mbps	10043	500	-9543
802.11g	16	2412	6Mbps	16519	500	-16019
		2437	6Mbps	16528	500	-16028
		2462	6Mbps	16530	500	-16030
802.11n HT20	15	2412	M3	17830	500	-17330
		2437	M3	17824	500	-17324
		2462	M3	17774	500	-17274
802.11n HT40	13	2422	M4	36460	500	-35960
		2442	M4	36467	500	-35967
		2452	M4	36470	500	-35970

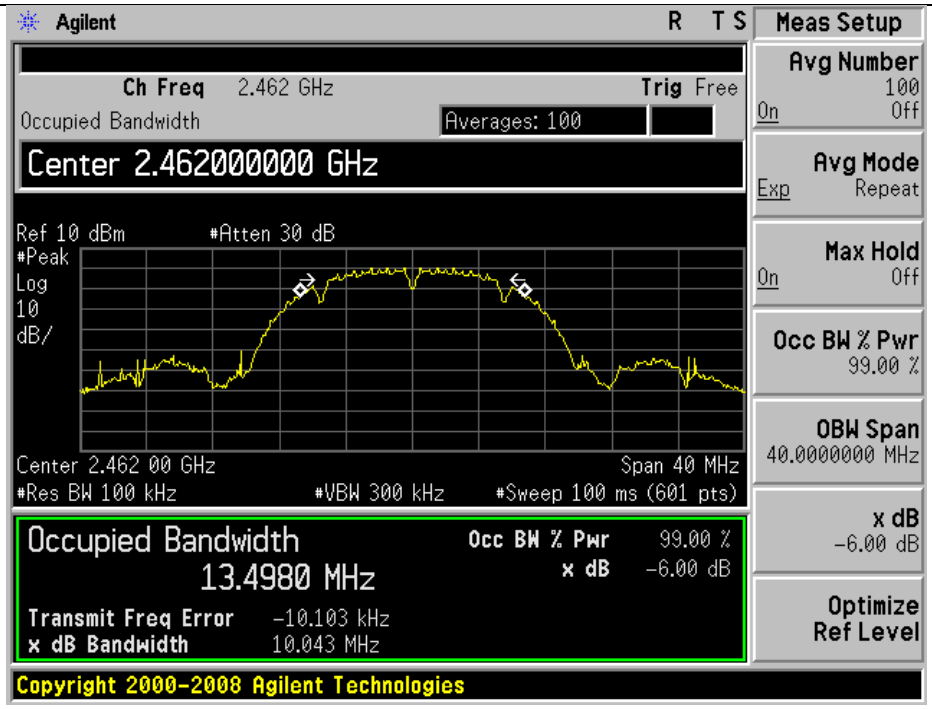
Graphical Test Results for 15.247 (6dB Bandwidth)



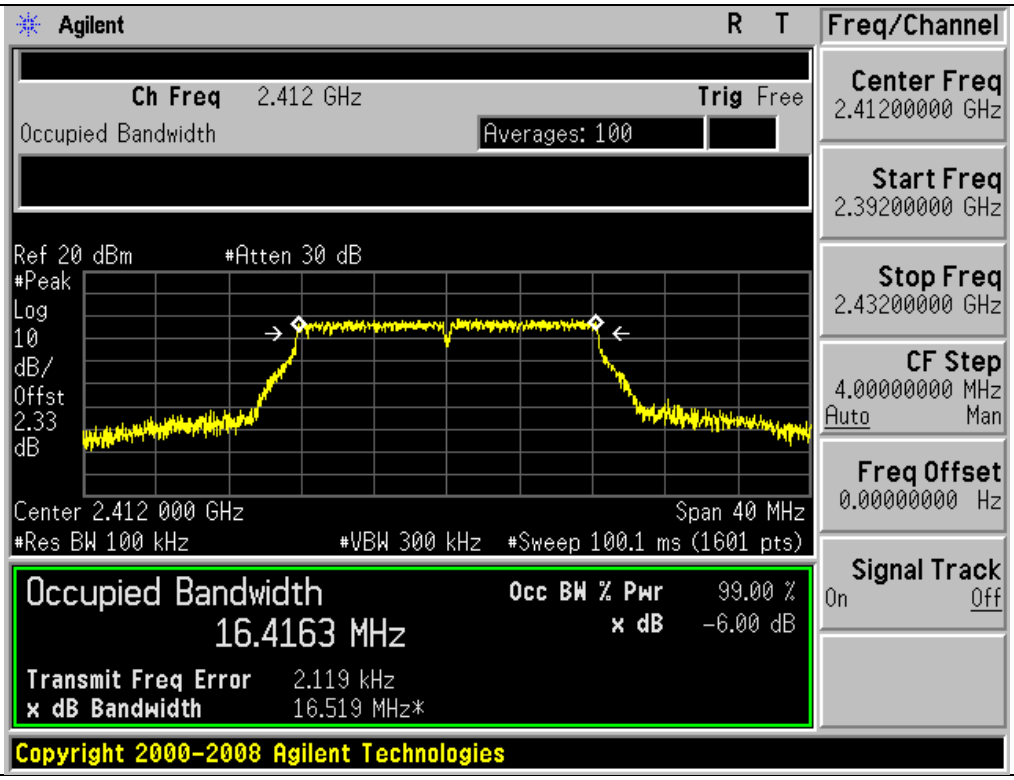
Title: 6dB Bandwidth 2412MHz at 11Mbps (802.11b)



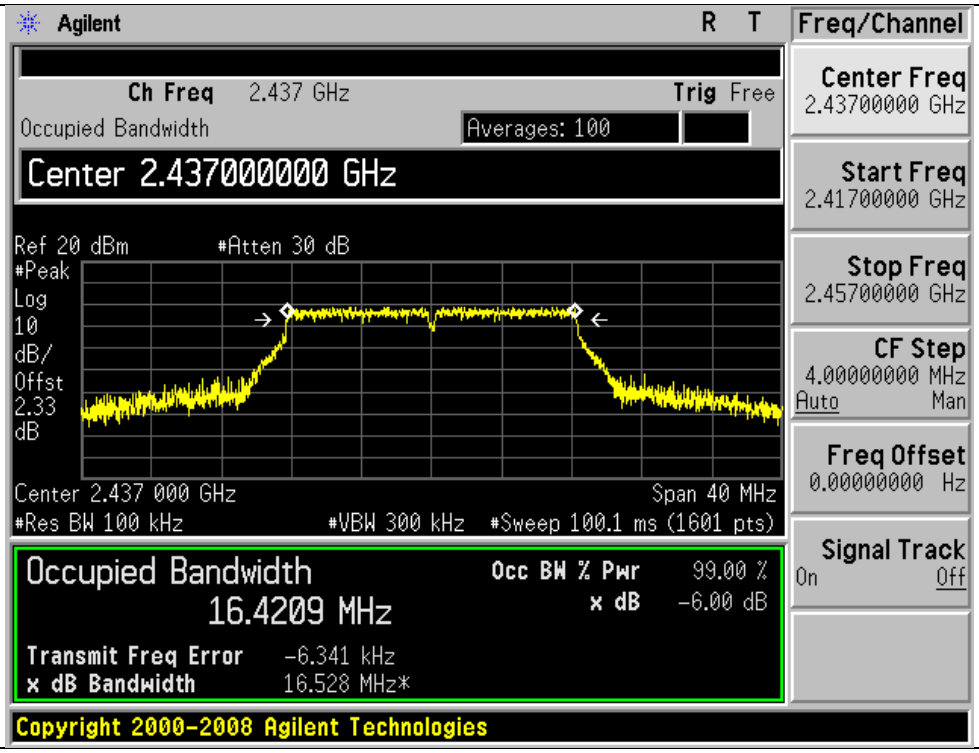
Title: 6dB Bandwidth 2437MHz at 11Mbps (802.11b)



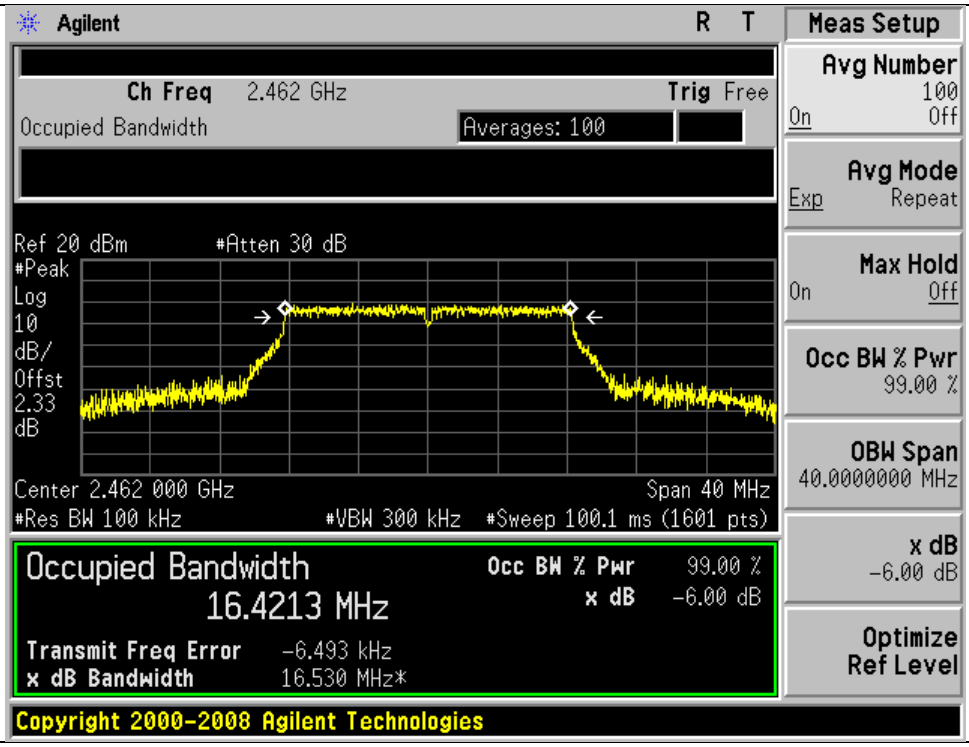
Title: 6dB Bandwidth 2462MHz at 11Mbps (802.11b)



Title: 6dB Bandwidth 2412MHz at 6Mbps (802.11g)



Title: 6dB Bandwidth 2437MHz at 6Mbps (802.11g)



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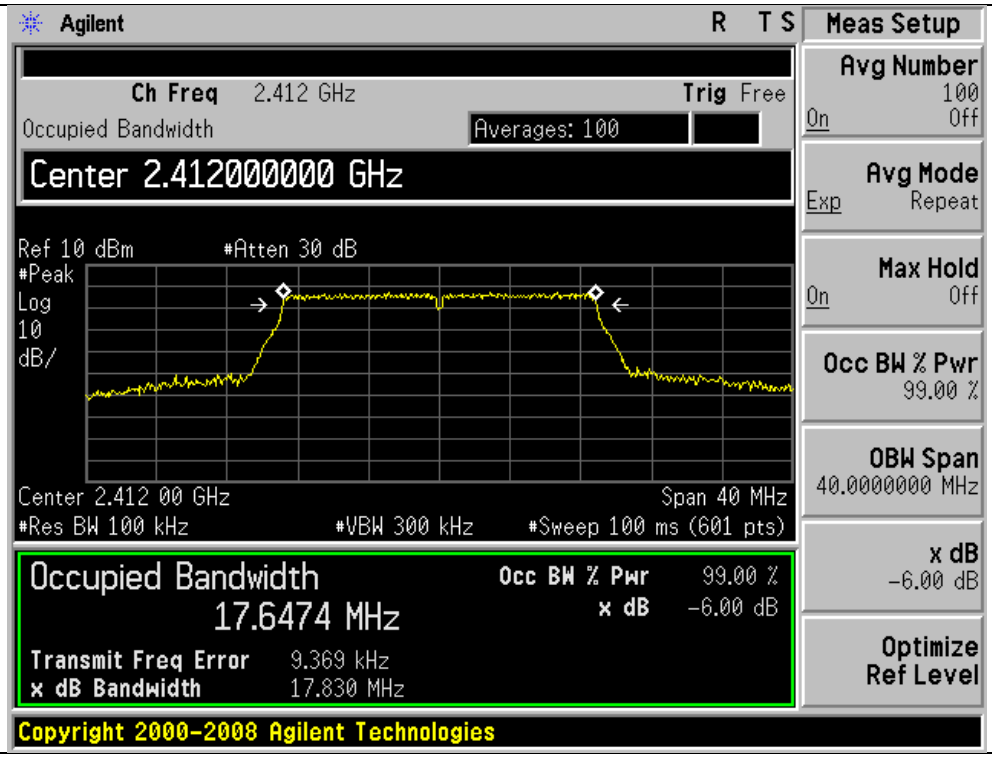
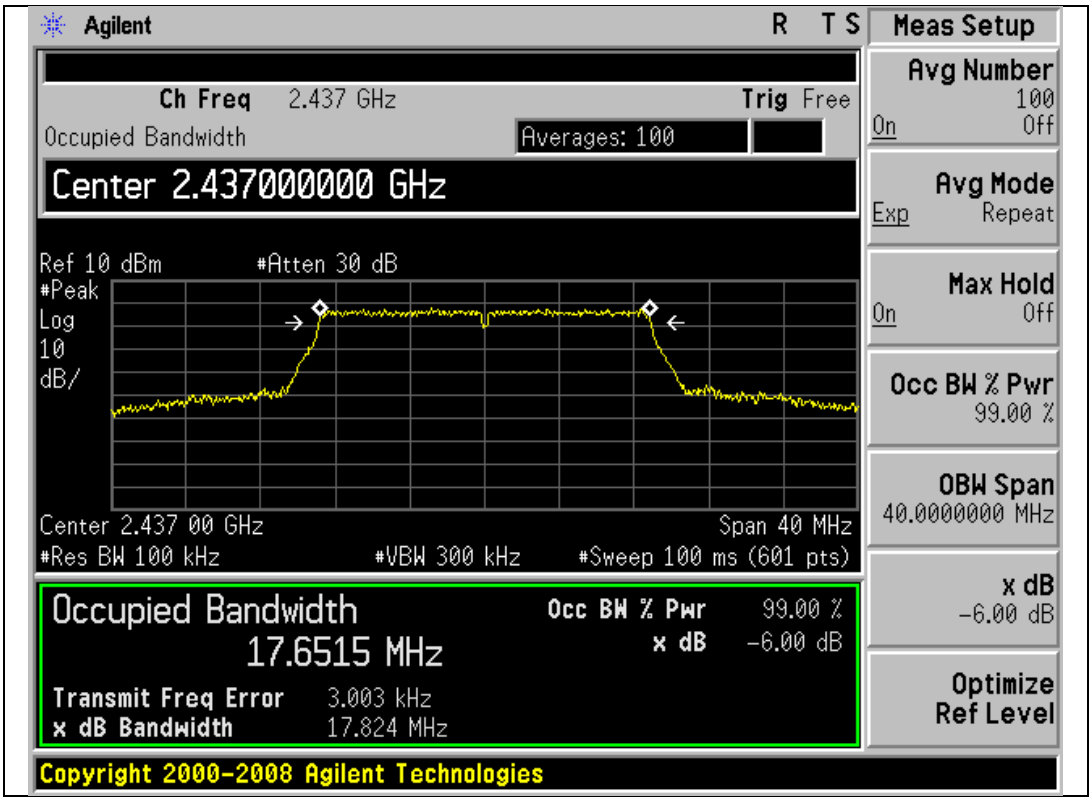


Title: 6dB Bandwidth 2412MHz at 802.11n (HT20 – M3)



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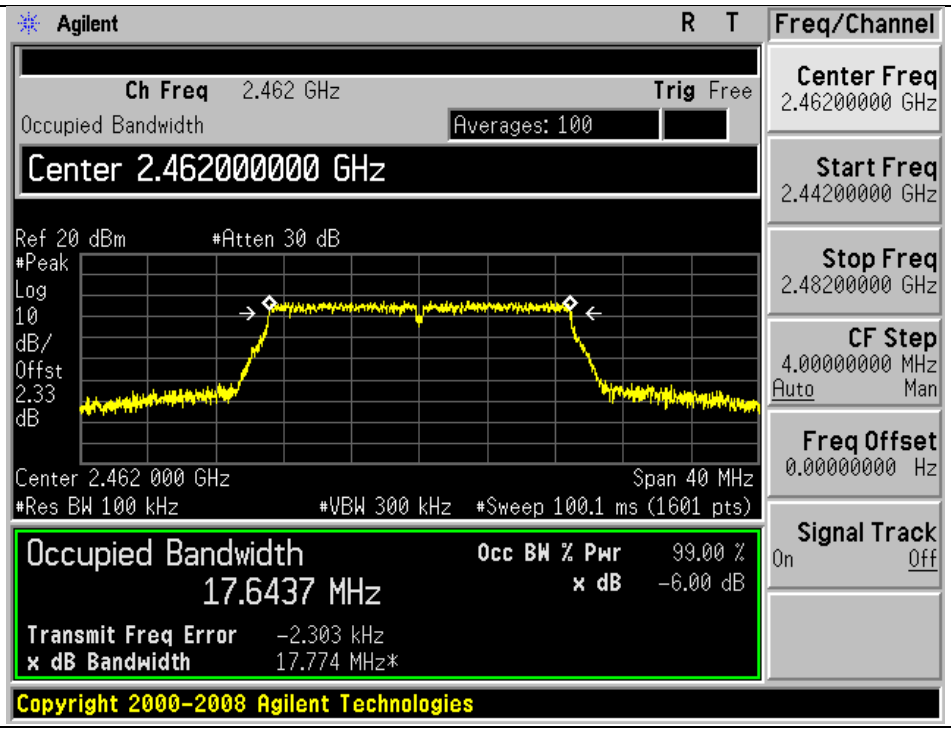
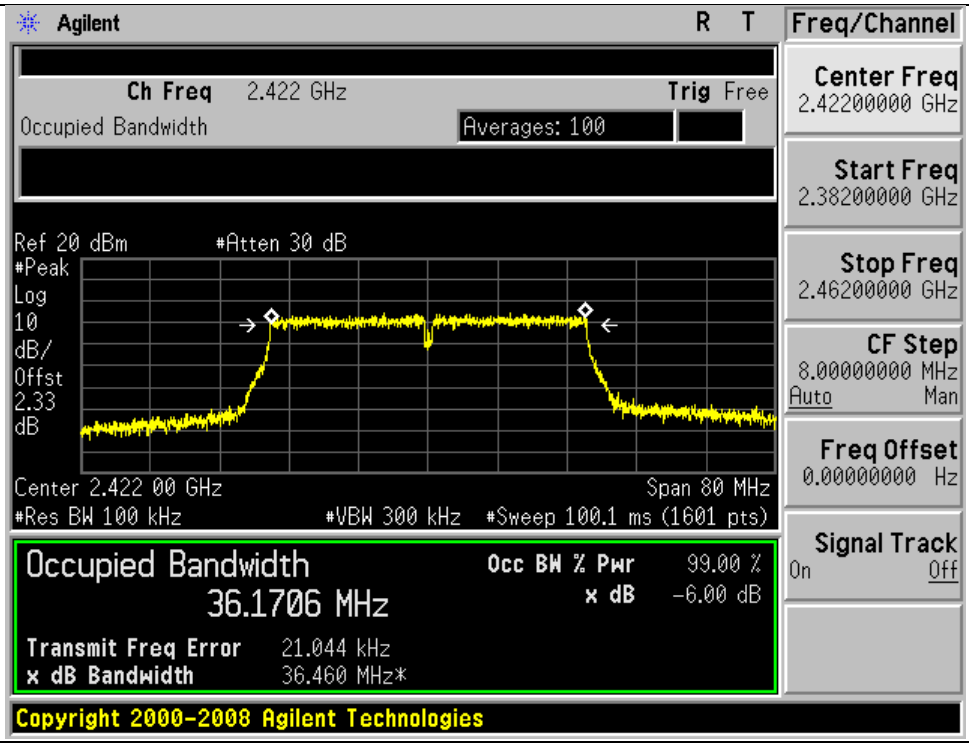
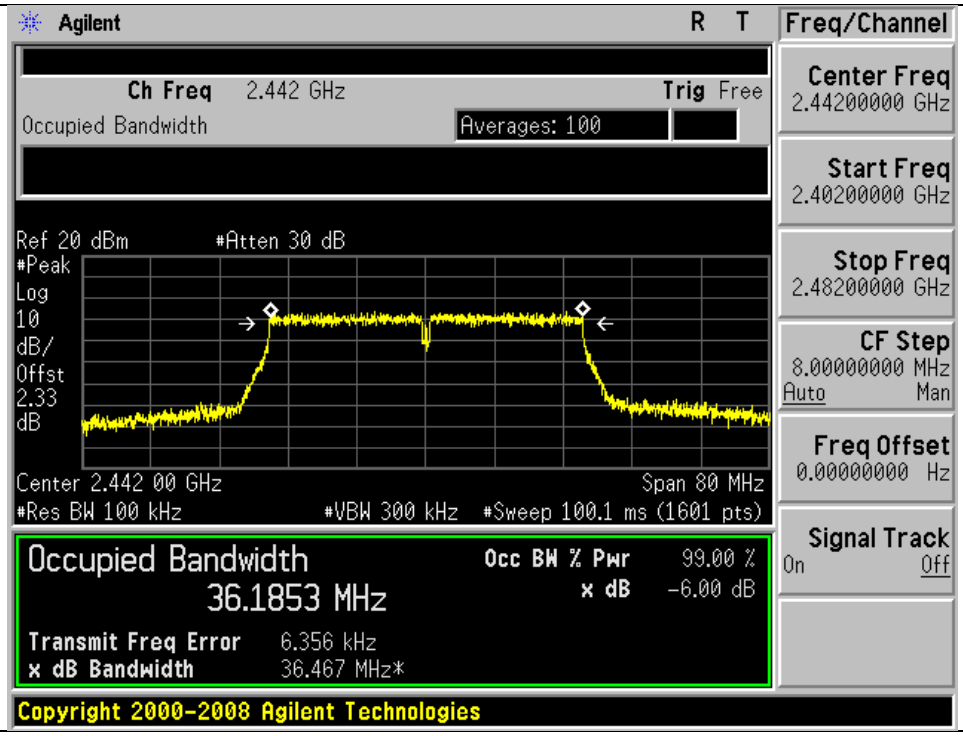


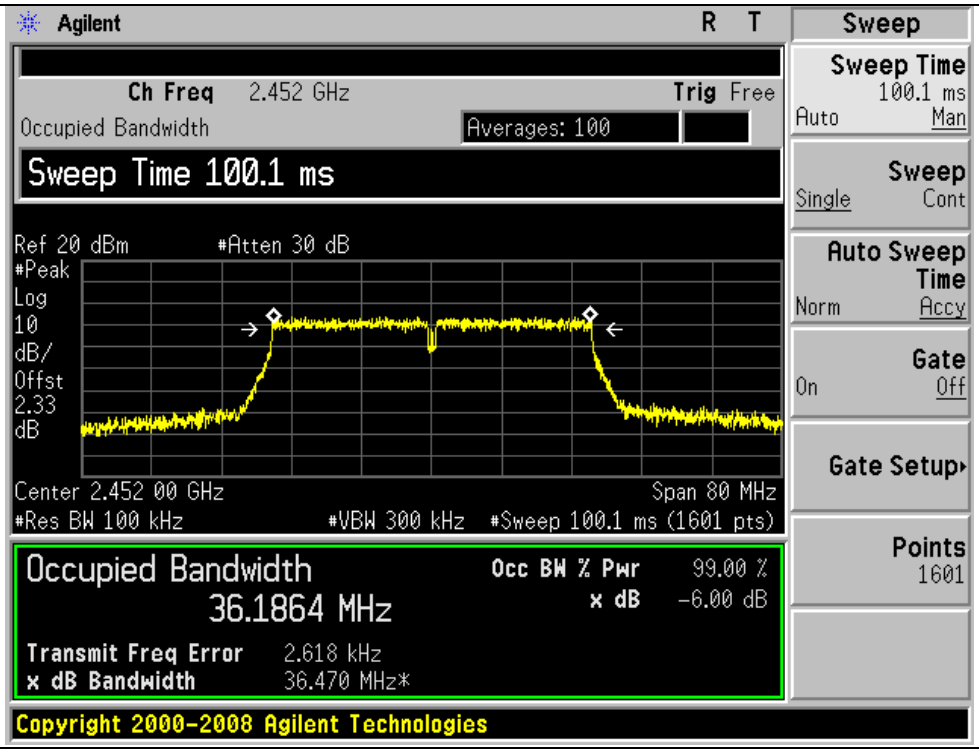
Title: 6dB Bandwidth 2462MHz at 802.11n (HT20 – M3)



Title: 6dB Bandwidth 2422MHz at 802.11n (HT40 – M4)



Title: 6dB Bandwidth 2442MHz at 802.11n (HT40 – M4)

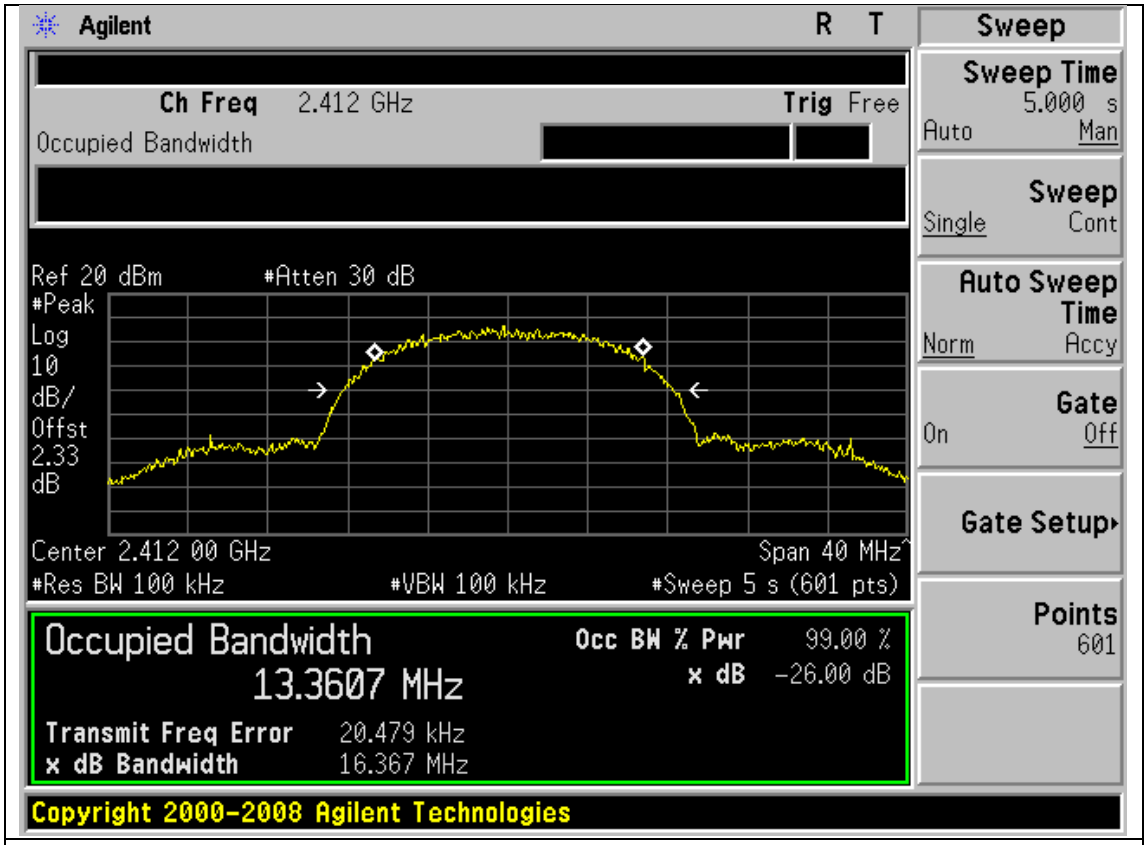


Title: 6dB Bandwidth 2452MHz at 802.11n (HT40 – M4)

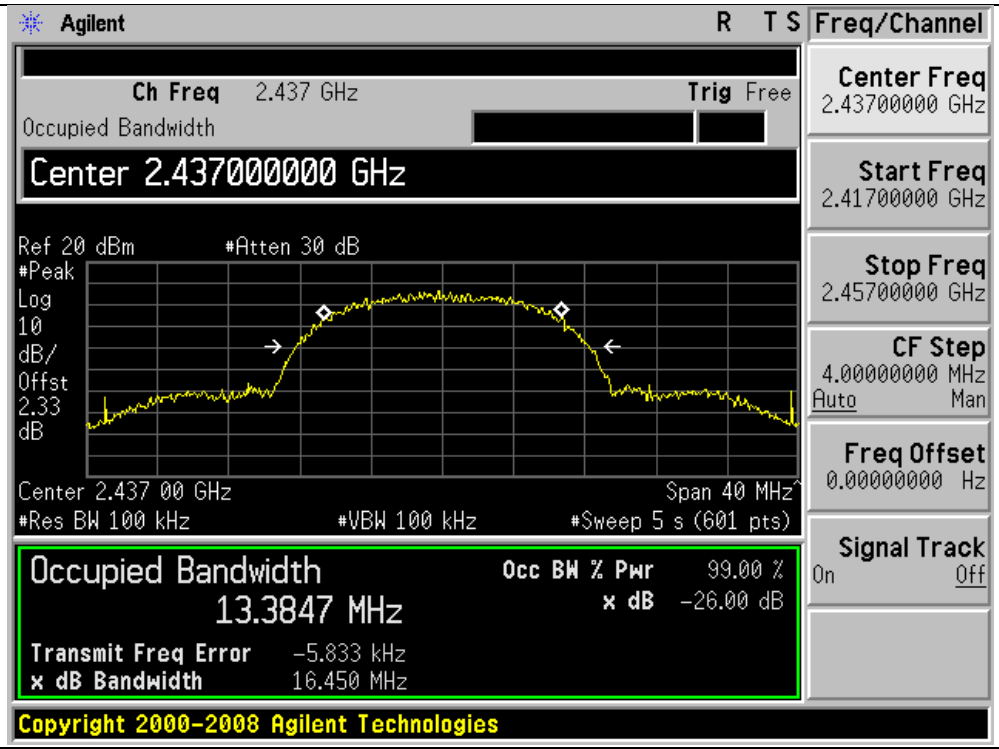
26dB/99% Bandwidth Results

Mode	Power Setting (dBm)	Frequency (MHz)	Data Rate	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
802.11b	20	2412	11Mbps	16.367	13.361
		2437	11Mbps	16.450	13.385
		2462	11Mbps	16.448	13.377
802.11g	16	2412	6Mbps	19.364	16.405
		2437	6Mbps	19.494	16.419
		2462	6Mbps	19.399	16.426
802.11n HT20	15	2412	M3	20.079	17.653
		2437	M3	20.071	17.657
		2462	M3	20.044	17.647
802.11n HT40	13	2422	M4	39.196	36.211
		2442	M4	39.109	36.209
		2452	M4	39.415	36.208

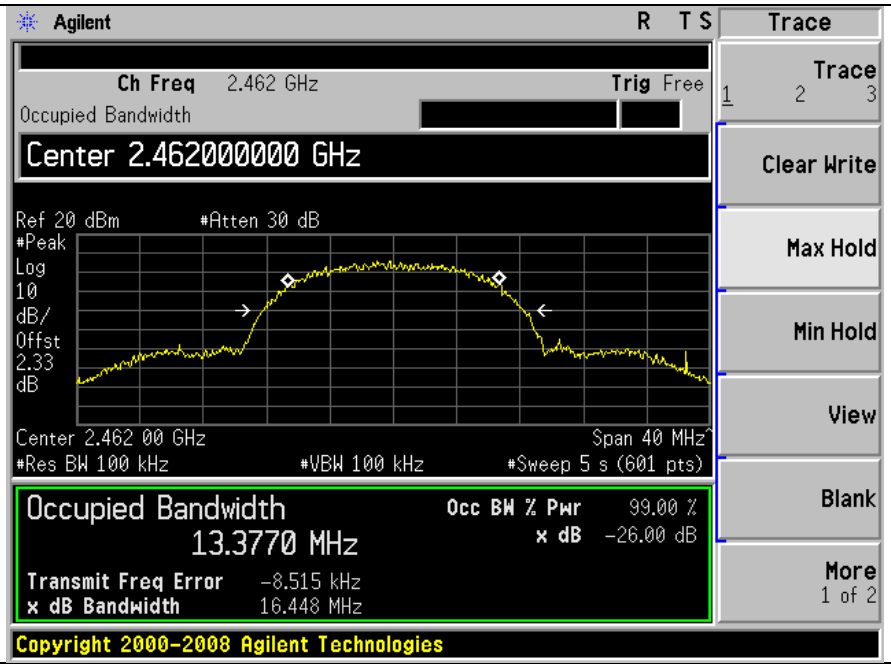
Graphical Test Results RSS210 (Occupied Bandwidth)



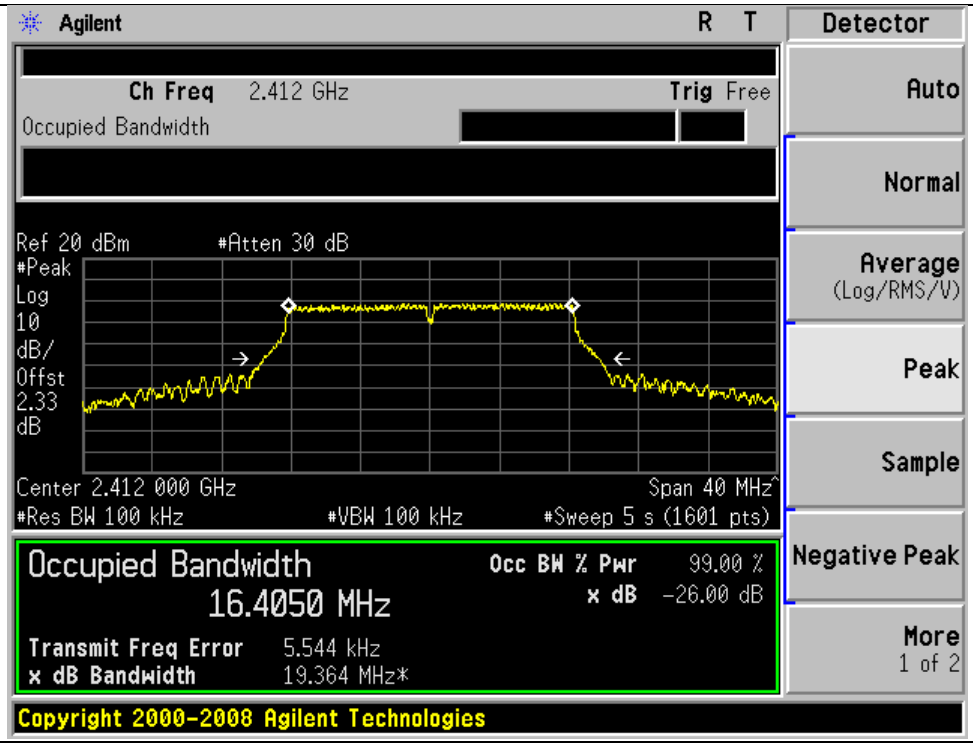
Title: Occupied Bandwidth 2412MHz at 11Mbps (802.11b)



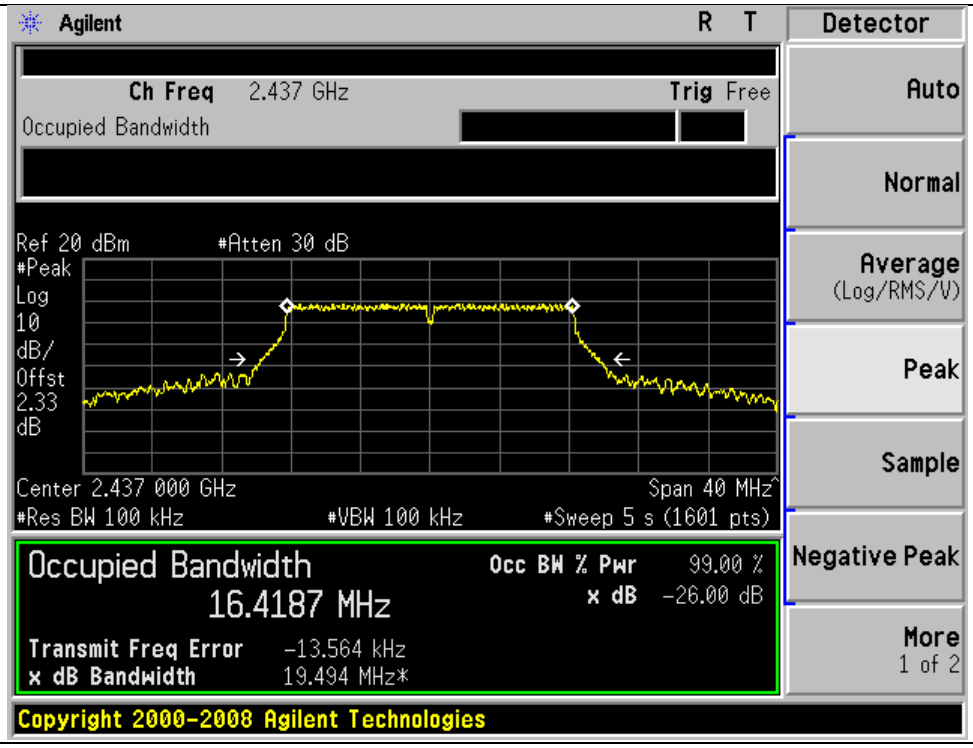
Title: Occupied Bandwidth 2437MHz at 11Mbps (802.11b)



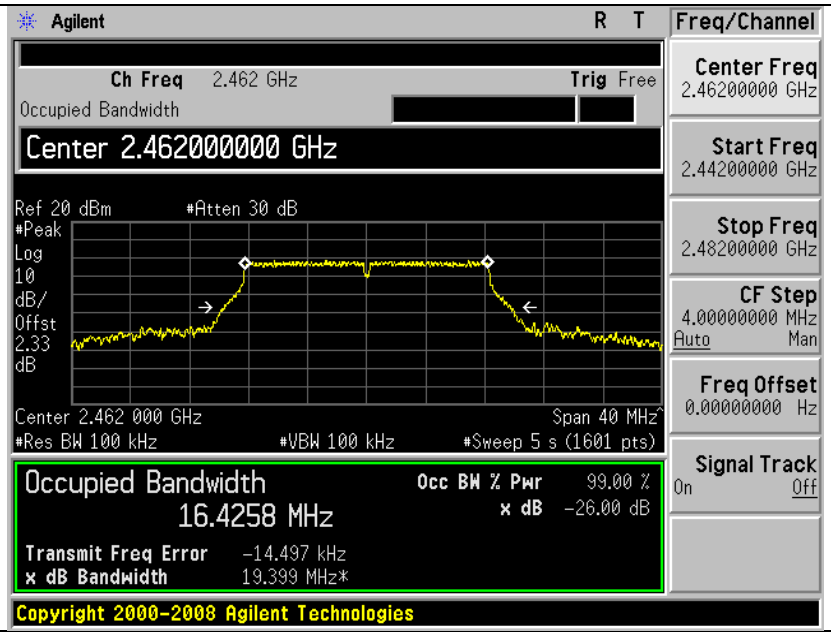
Title: Occupied Bandwidth 2462MHz at 11Mbps (802.11b)



Title: Occupied Bandwidth 2412MHz at 6Mbps (802.11g)



Title: Occupied Bandwidth 2437MHz at 6Mbps (802.11g)



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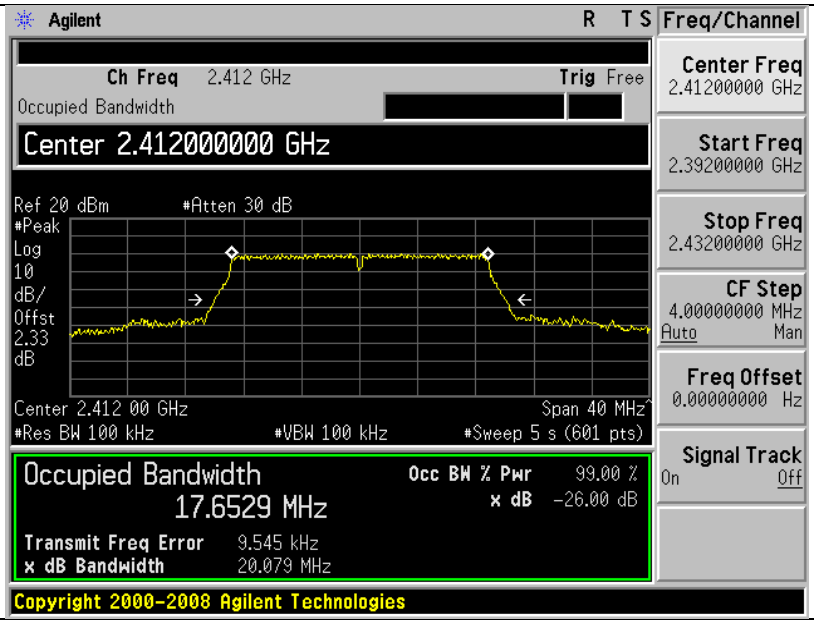
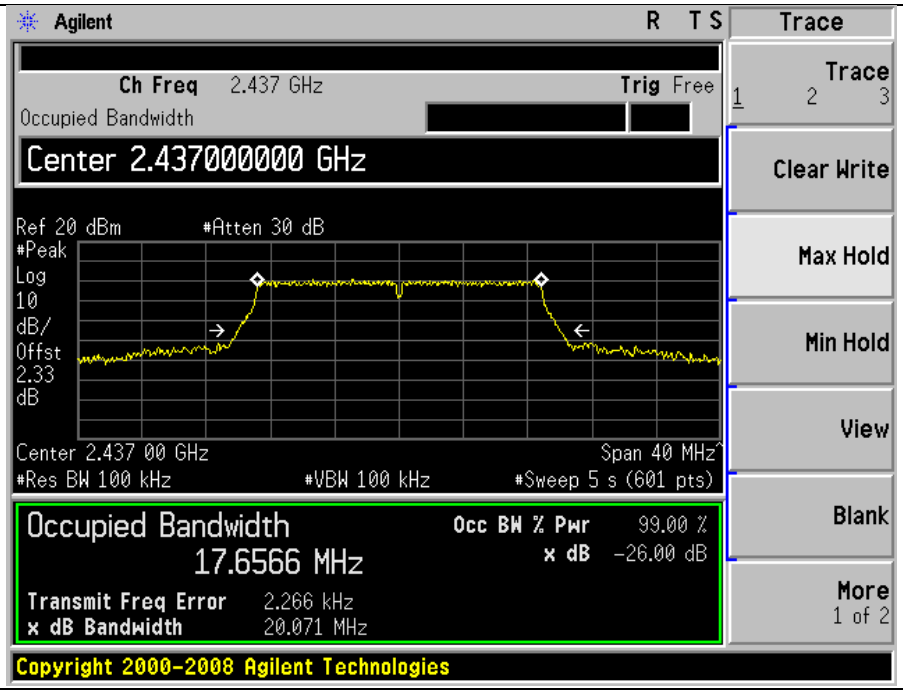


Title: Occupied Bandwidth 2412MHz at M3 (802.11n HT20)



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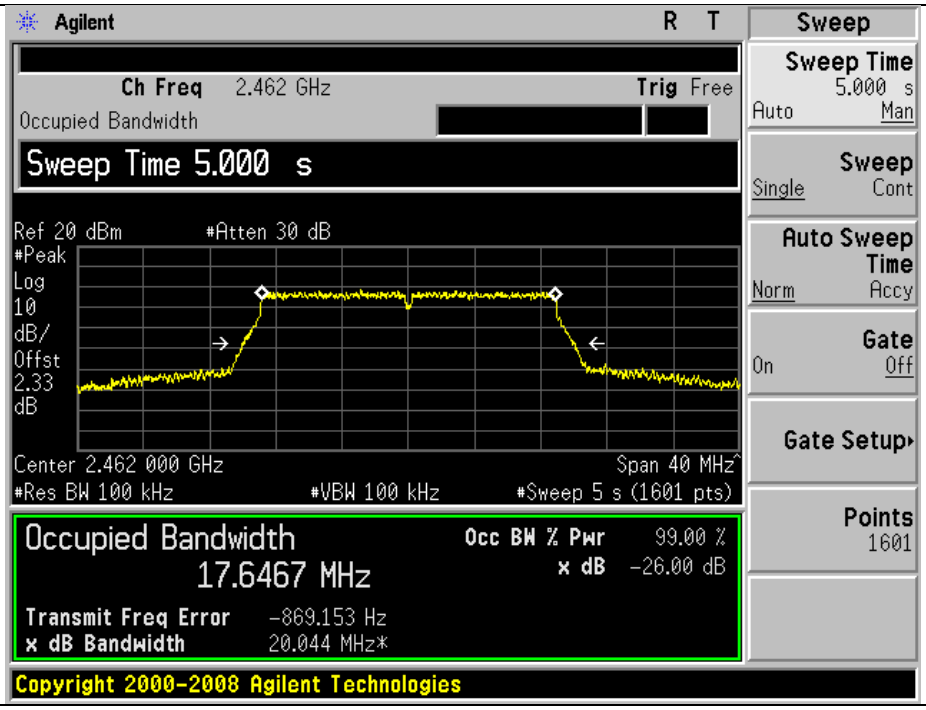

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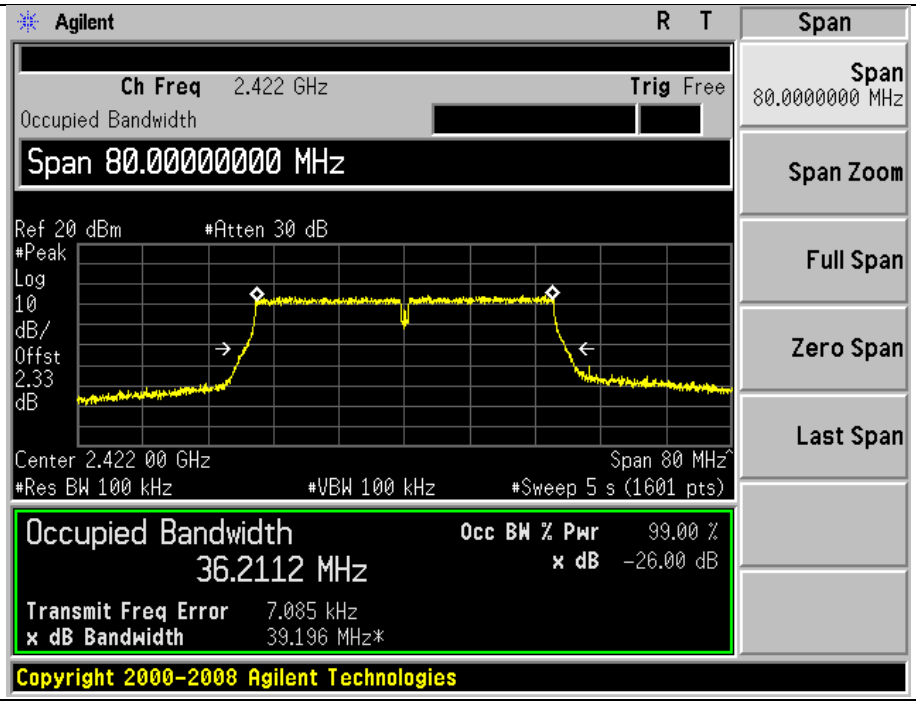
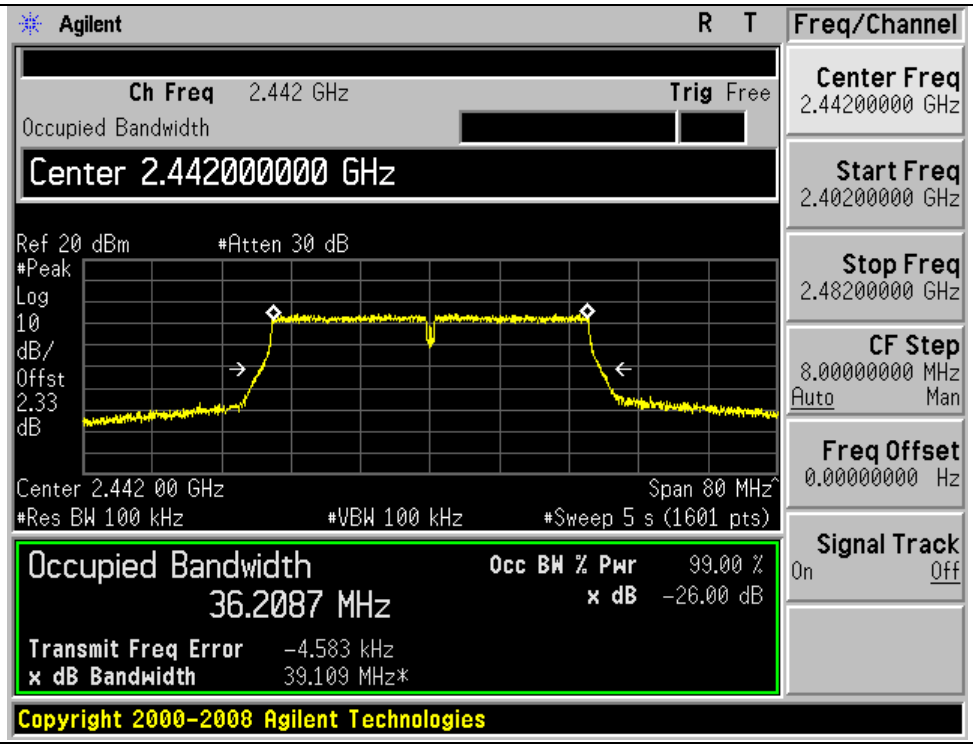
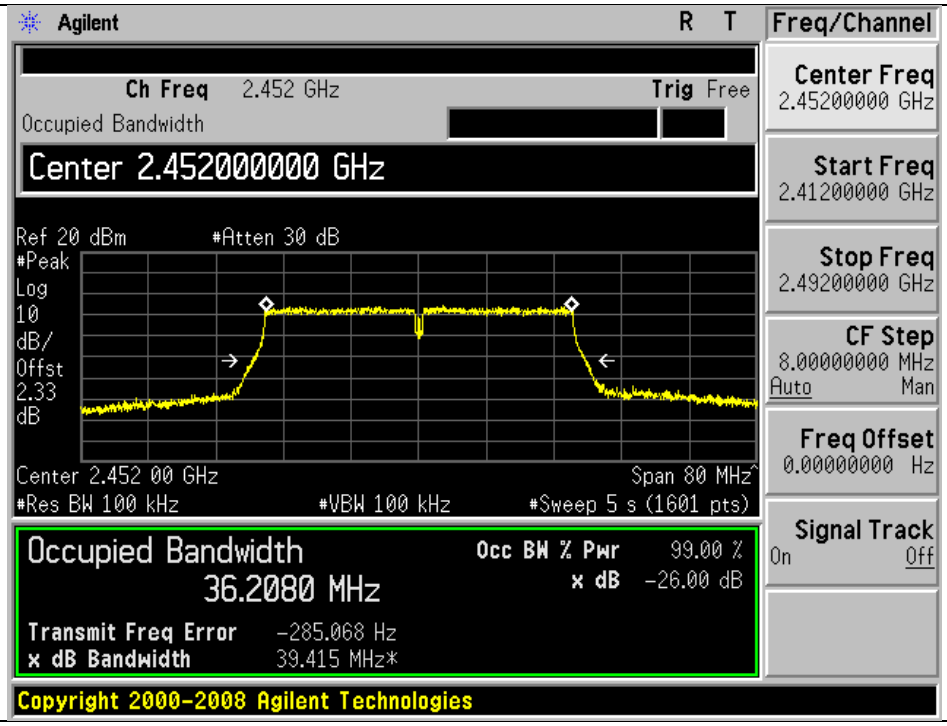


Title: Occupied Bandwidth 2422MHz at M4 (802.11n HT40)



Title: Occupied Bandwidth 2442MHz at M4 (802.11n HT40)



Title: Occupied Bandwidth 2462MHz at M4 (802.11n HT40)

Peak Output Power

15.247 & RSS-210 A8.4:

The maximum conducted output power of the intentional radiator for systems using digital modulation in the 2400-2483.5MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum supported antenna gain is 4.3dBi. The peak correlated gain for each mode is listed in the table below. See the Theory of Operation for details on the correlated gain for each mode.

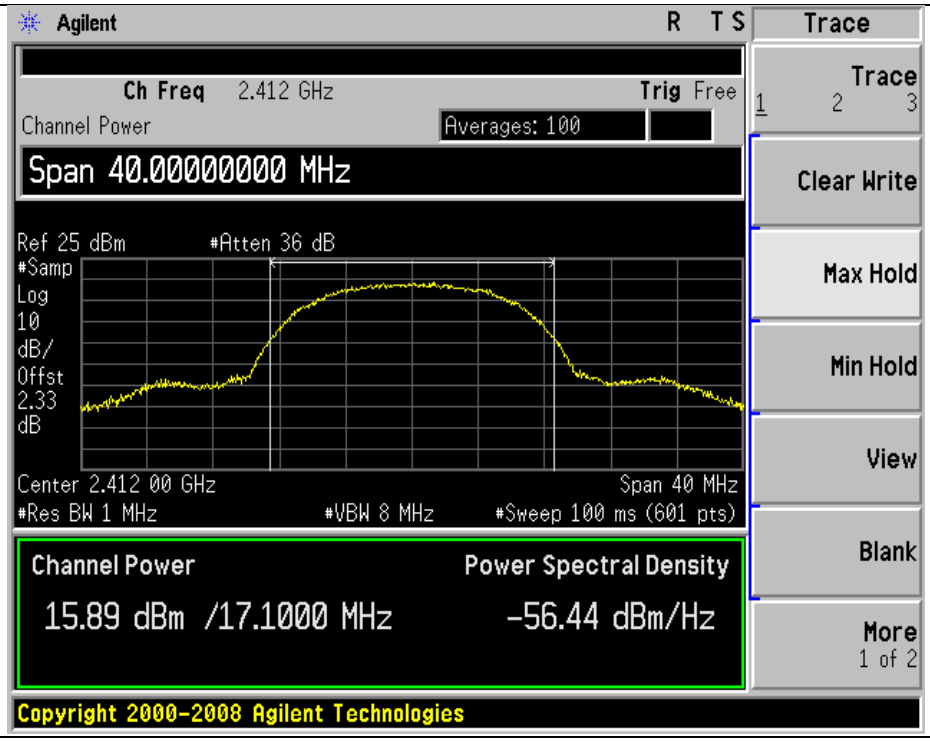
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.

Enable "Channel Power" function of analyzer	
Center Frequency:	Frequency from table below
Span:	20 MHz (must be greater than 26dB bandwidth, adjust as necessary)
Ref Level Offset:	Correct for attenuator and cable loss.
Reference Level:	20 dBm
Attenuation:	20 dB
Sweep Time:	100ms, Single sweep
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector:	Sample
Trace:	Trace Average 100 traces in Power Averaging Mode
Integration BW:	=26 dB BW from 26 dB Bandwidth Data

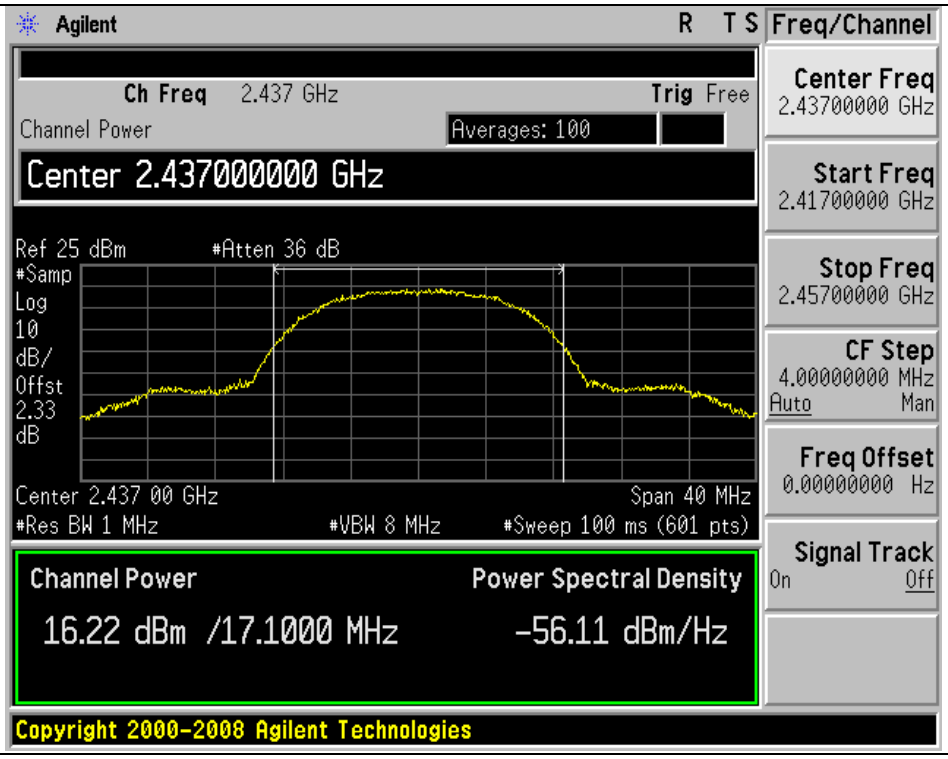
After averaging 100 traces of the transmitter waveform on the spectrum analyzer, record the spectrum analyzer Channel Power.

The “measure-and-sum technique” is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units.

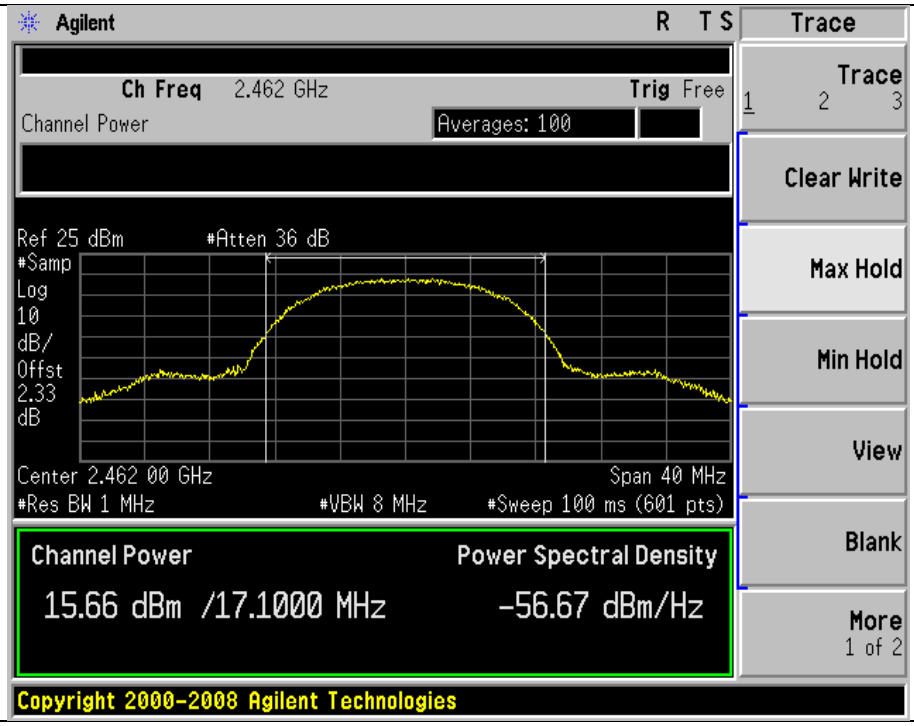
Mode	Power Setting (dBm)	Frequency (MHz)	Data Rate (Mbps)	Peak Output Power (dBm)	Limit (dBm)	Margin (dB)
802.11b	20	2412	11Mbps	15.89	30	14.11
		2437	11Mbps	16.22	30	13.78
		2462	11Mbps	15.64	30	14.36
802.11g	16	2412	6Mbps	13.57	30	16.43
		2437	6Mbps	13.92	30	16.08
		2462	6Mbps	13.48	30	16.52
802.11n HT20	15	2412	M3	12.84	30	17.16
		2437	M3	12.86	30	17.14
		2462	M3	12.56	30	17.44
802.11n HT40	13	2422	M4	10.74	30	19.26
		2442	M4	10.88	30	19.12
		2452	M4	10.95	30	19.05



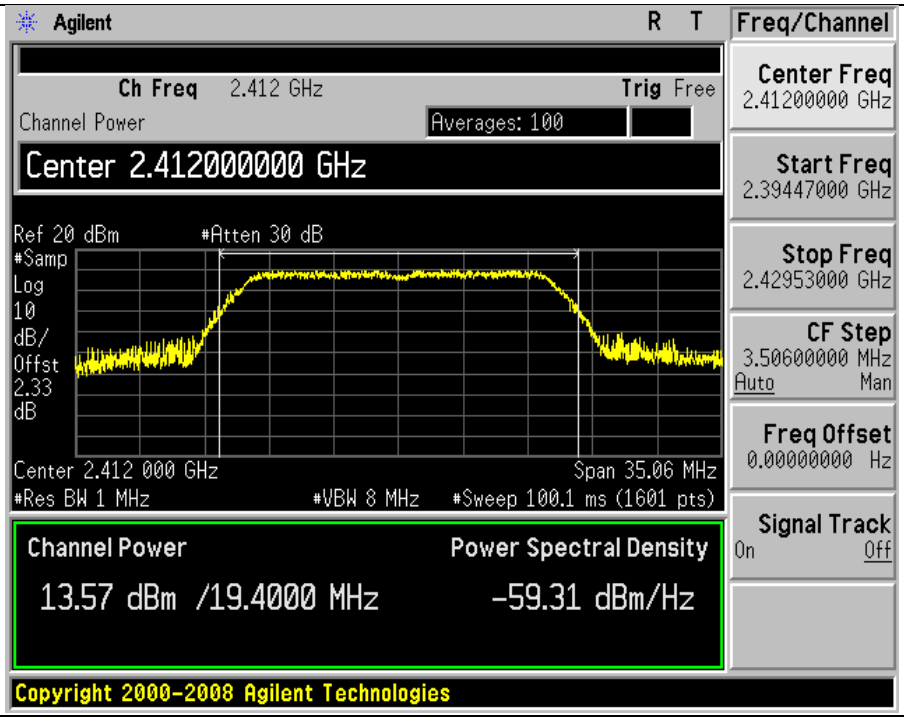
Title: **Peak Output Power 802.11b, 2412 MHz at 11Mbps**



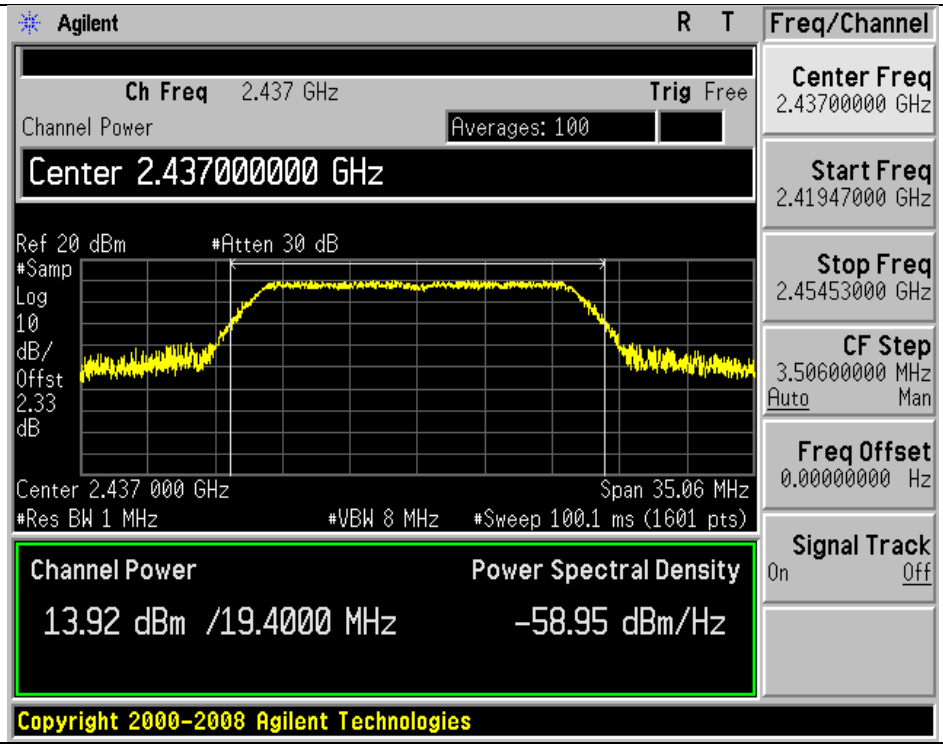
Title: **Peak Output Power 802.11b, 2437 MHz at 11Mbps**



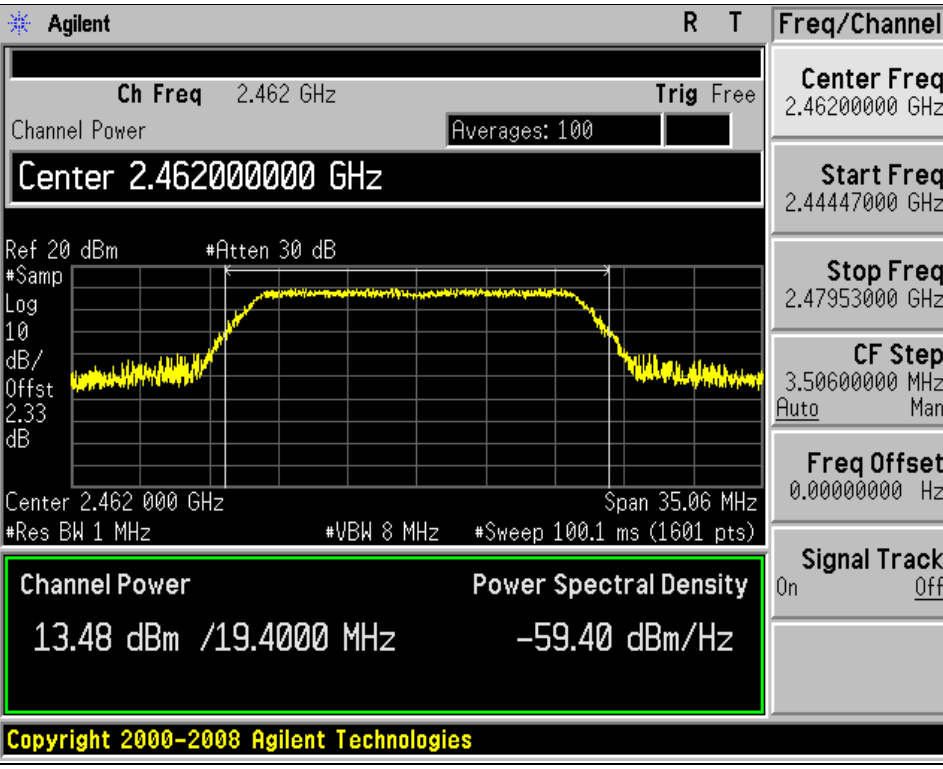
Title: **Peak Output Power 802.11b, 2462 MHz at 11Mbps**



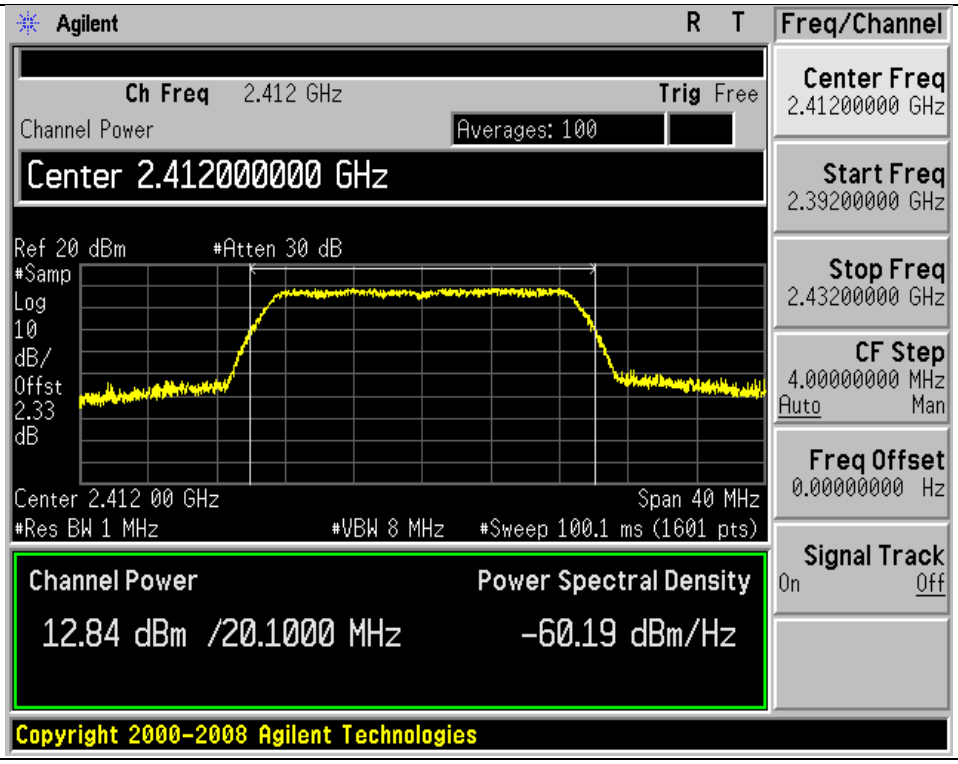
Title: **Peak Output Power 802.11g, 2412 MHz at 6Mbps**



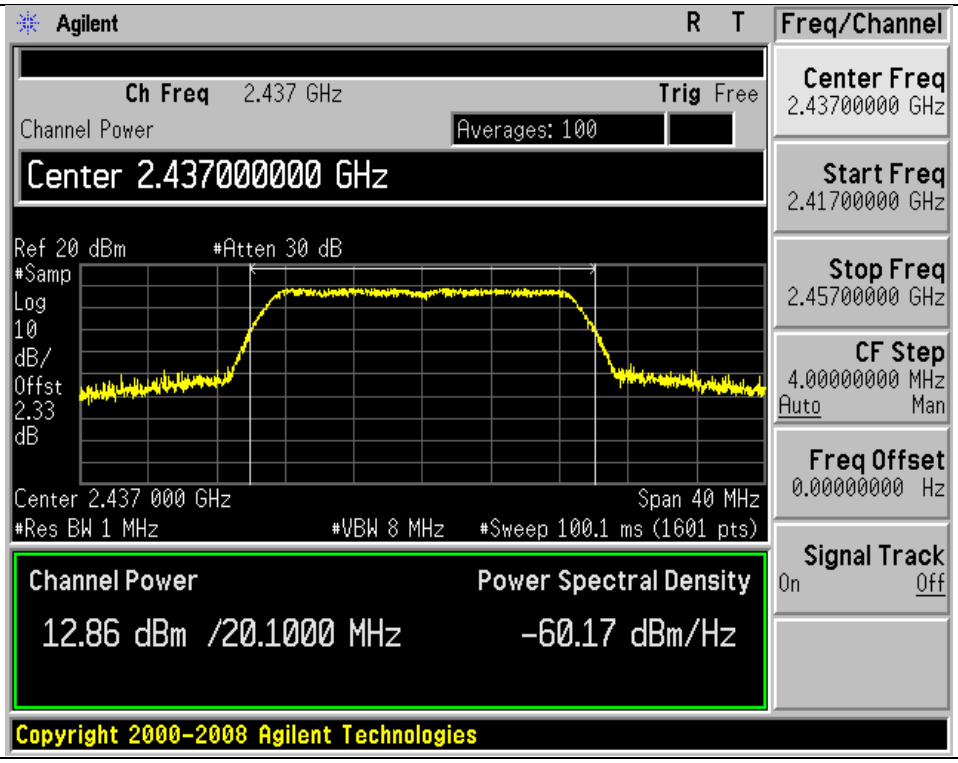
Title: **Peak Output Power 802.11g, 2437 MHz at 6Mbps**



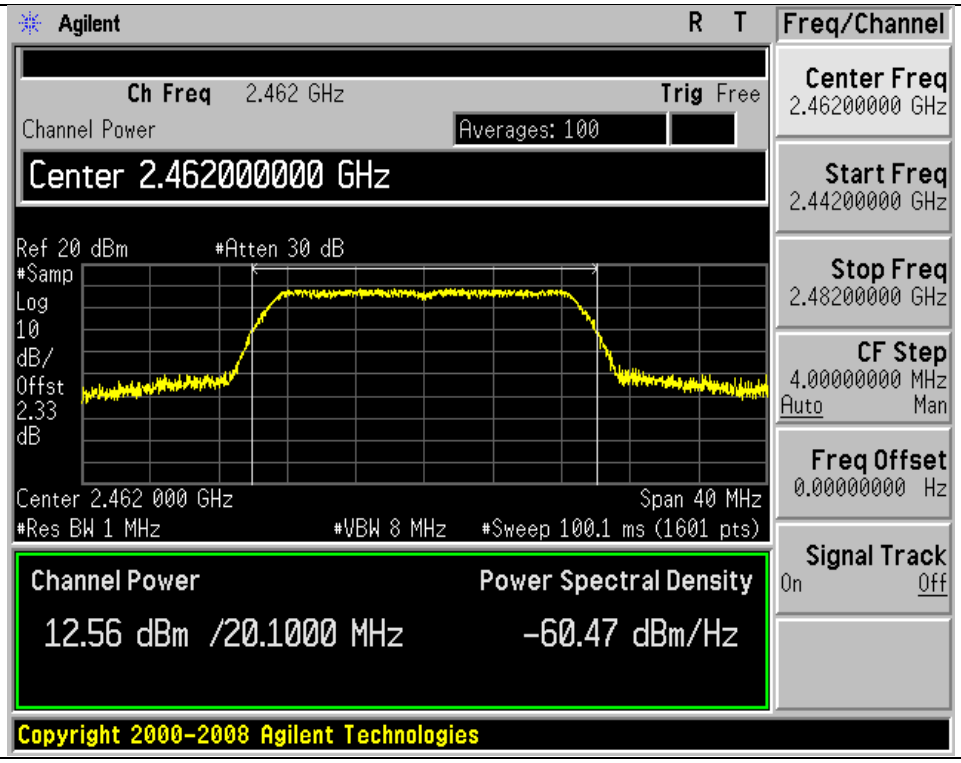
Title: **Peak Output Power 802.11g, 2462 MHz at 6Mbps**



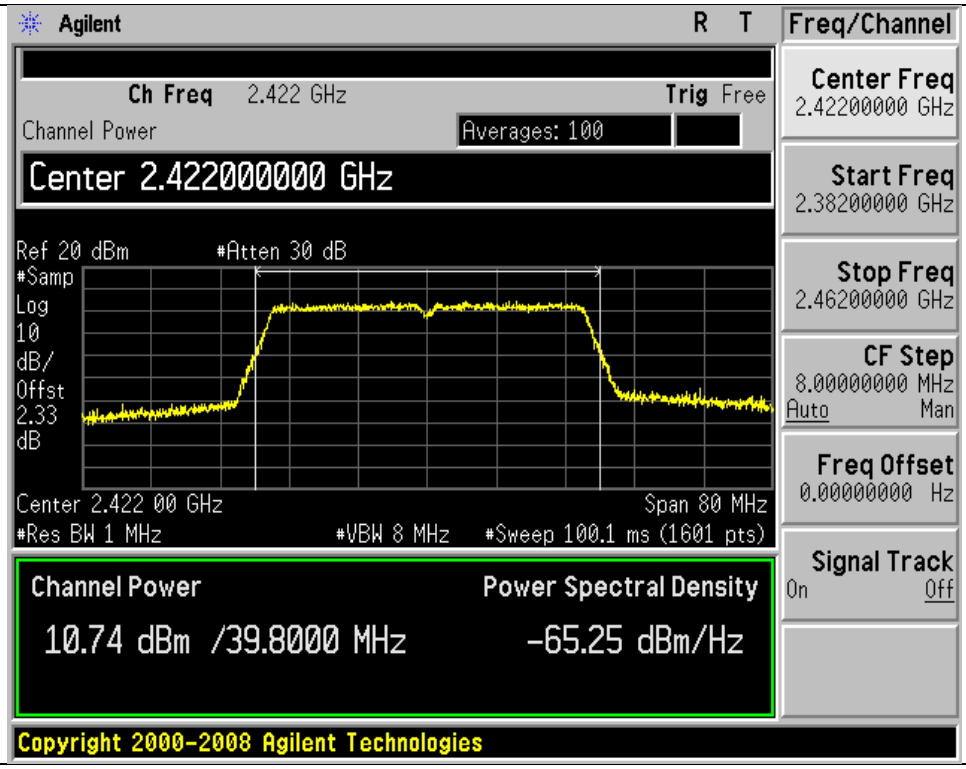
Title: **Peak Output Power 802.11n HT20, 2412 MHz at M3**



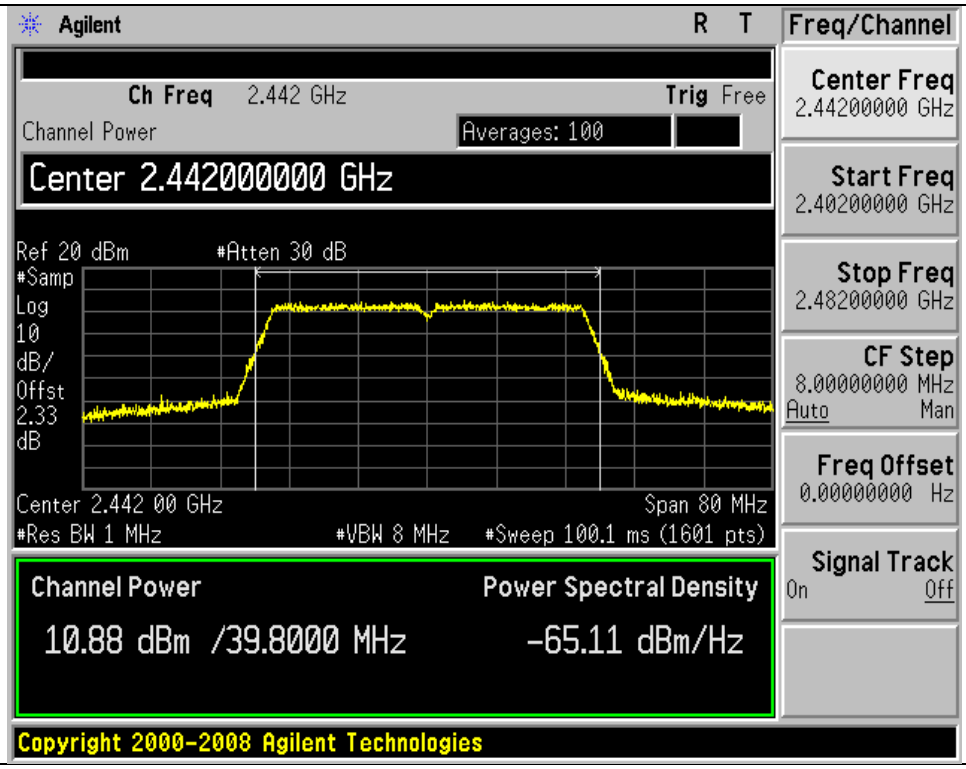
Title: **Peak Output Power 802.11n HT20, 2437 MHz at M3**



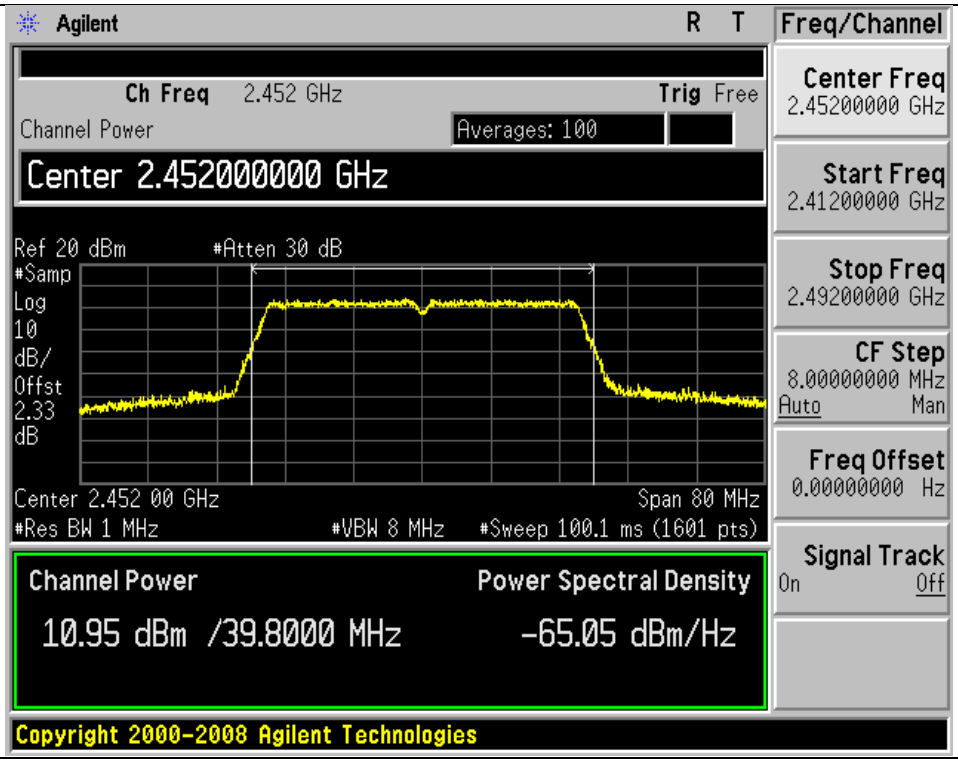
Title: **Peak Output Power 802.11n HT20, 2462 MHz at M3**



Title: **Peak Output Power 802.11n HT40, 2422MHz at M4**



Title: **Peak Output Power 802.11n HT40, 2442 MHz at M4**



Title: **Peak Output Power 802.11n HT40, 2452 MHz at M4**

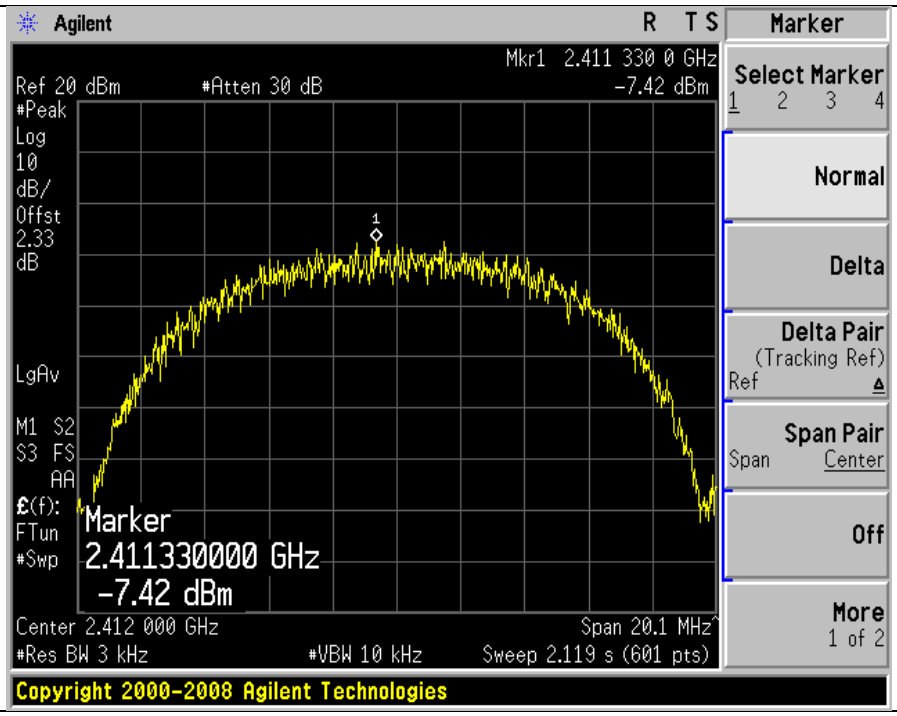
Power Spectral Density

15.247 & RSS-210 A8.2:

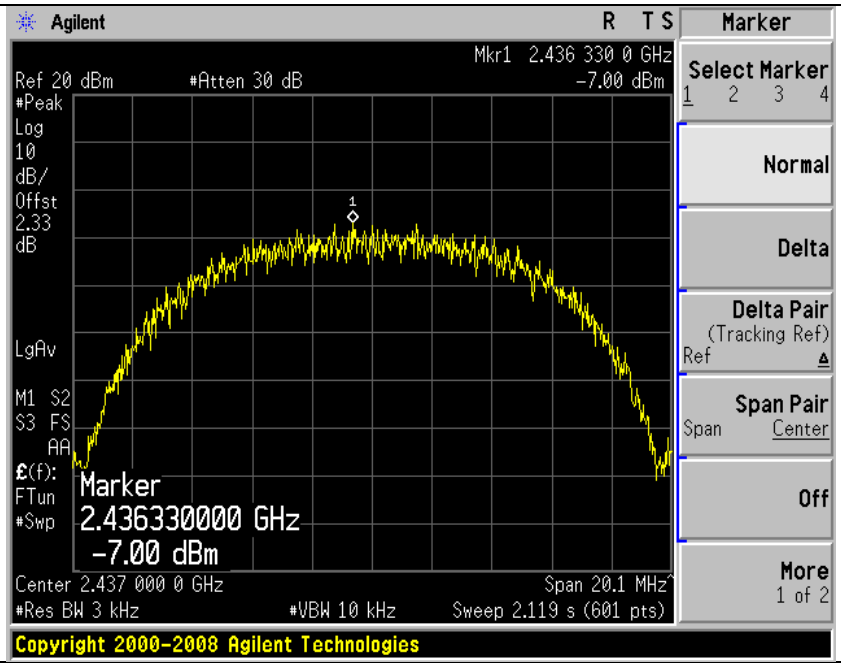
For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

Mode	Power Setting (dBm)	Frequency (MHz)	Data Rate (Mbps)	Peak Power Spectral Density (dBm/3kHz)	Limit (dBm)	Margin (dB)
802.11b	20	2412	11Mbps	-7.42	8	15.42
		2437	11Mbps	-7.00	8	15.00
		2462	11Mbps	-7.47	8	15.47
802.11g	16	2412	6Mbps	-14.57	8	22.57
		2437	6Mbps	-14.91	8	22.91
		2462	6Mbps	-15.50	8	23.50
802.11n HT20	15	2412	M3	-13.31	8	21.31
		2437	M3	-13.15	8	21.15
		2462	M3	-14.97	8	22.97
802.11n HT40	13	2422	M4	-16.05	8	24.05
		2442	M4	-16.11	8	24.11
		2452	M4	-15.39	8	23.39

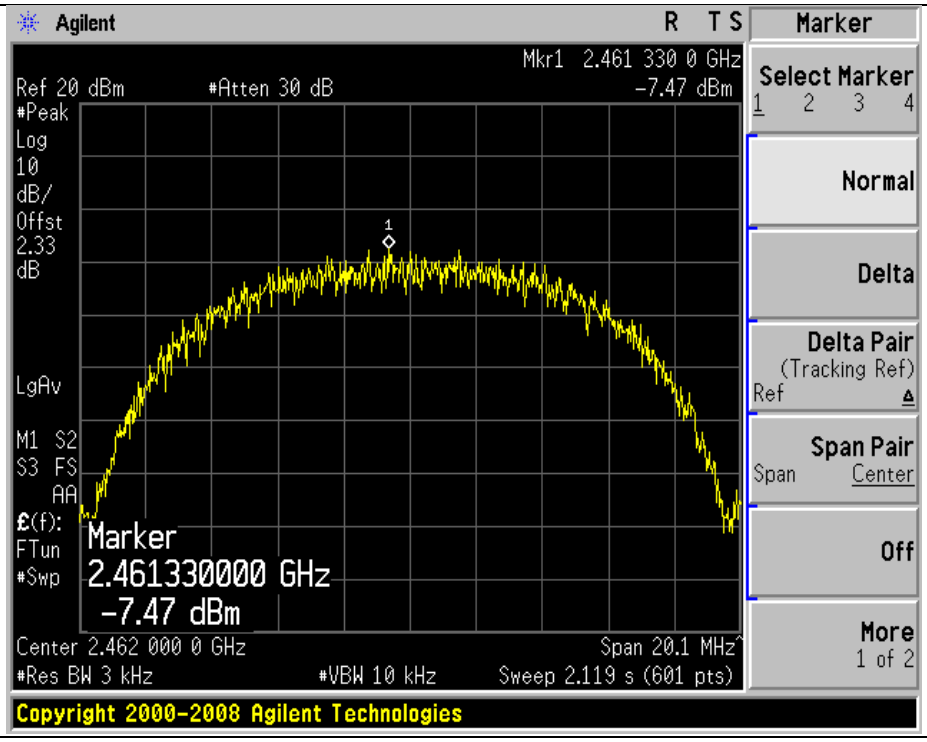
Graphical Test Results



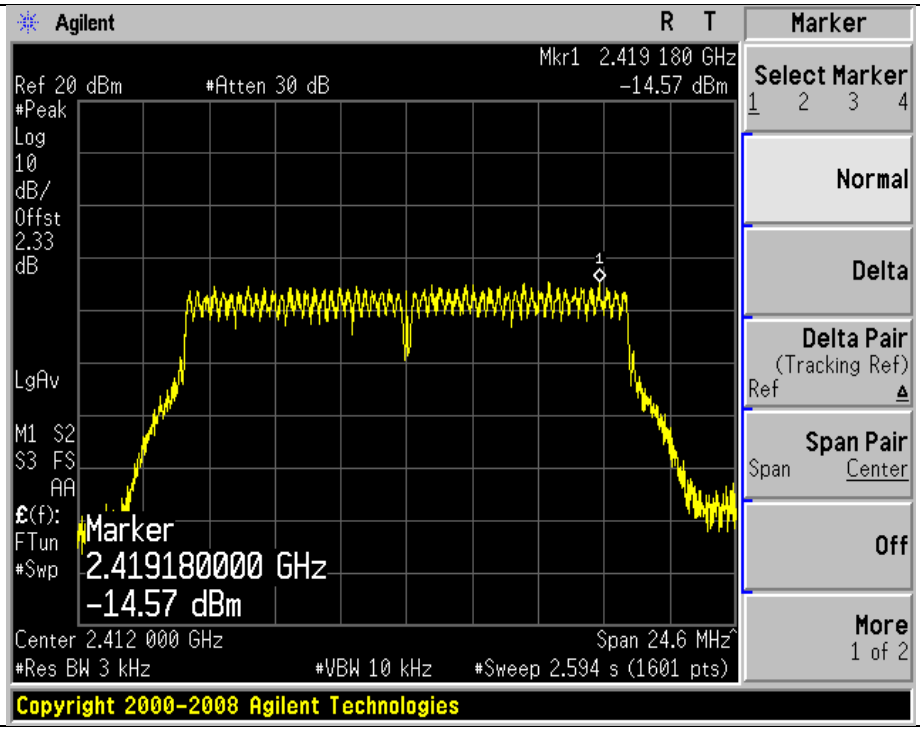
Title: **Power Spectral Density, 2412 MHz, 802.11b at 11Mbps**



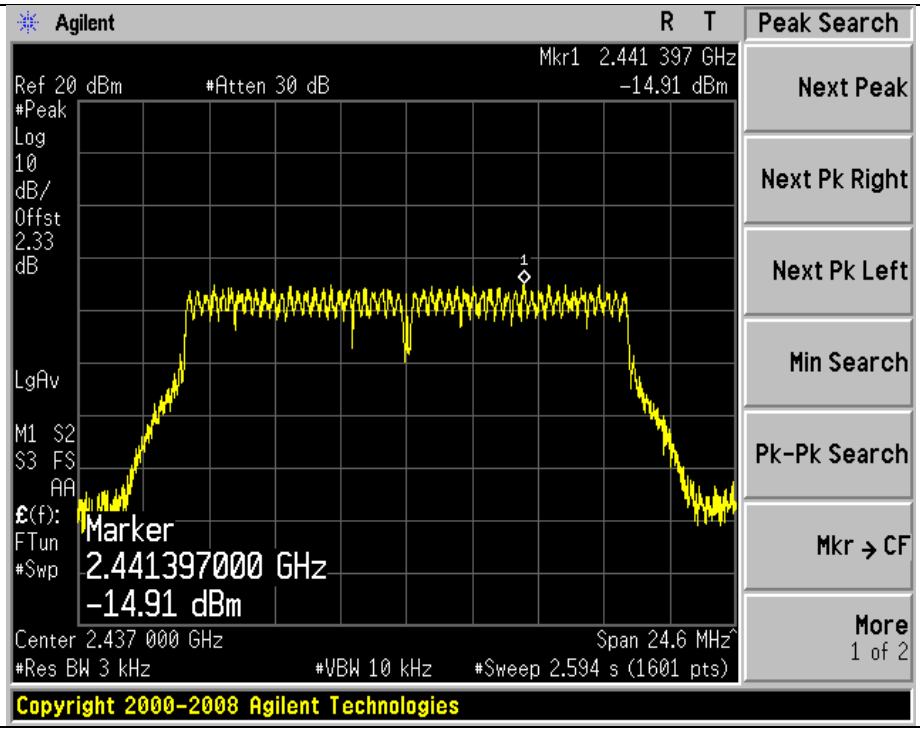
Title: **Power Spectral Density, 2437 MHz, 802.11b at 11Mbps**



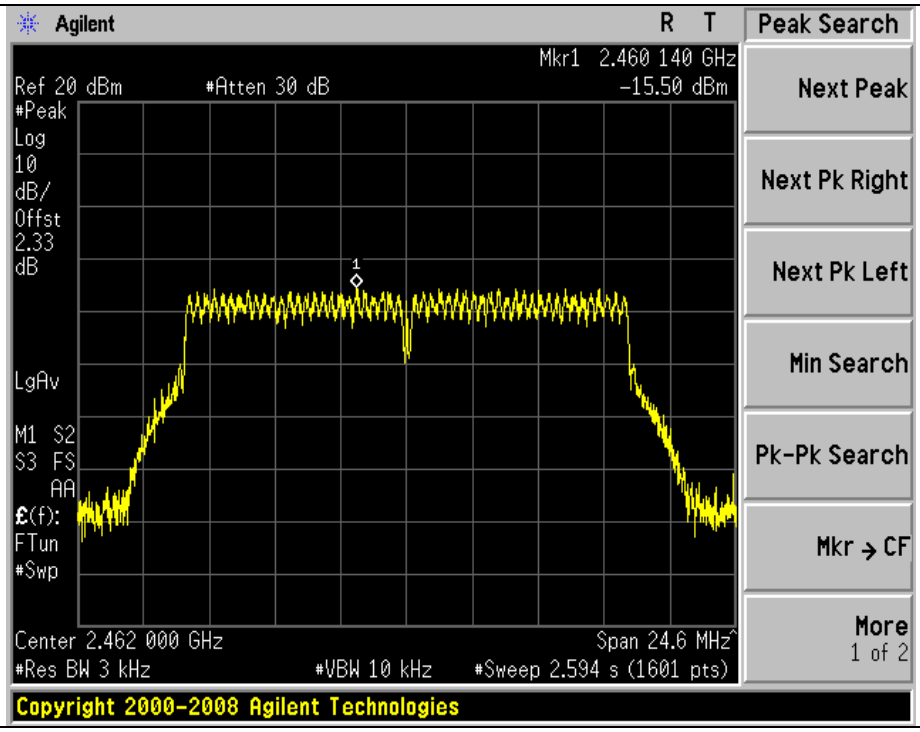
Title: **Power Spectral Density, 2462 MHz, 802.11b at 11Mbps**



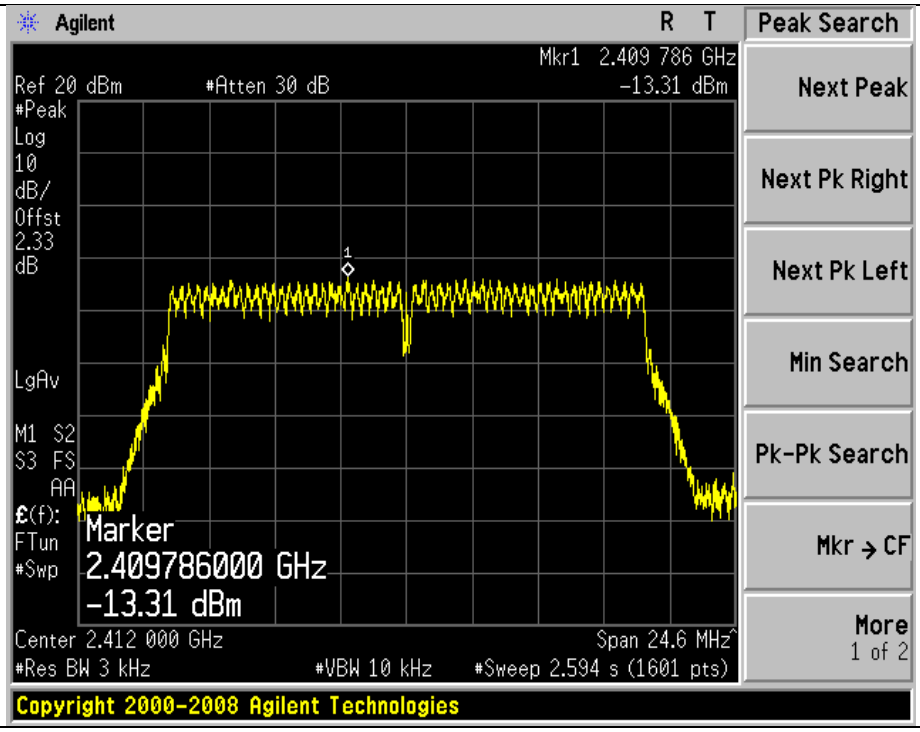
Title: **Power Spectral Density, 2412 MHz, 802.11g at 6Mbps**



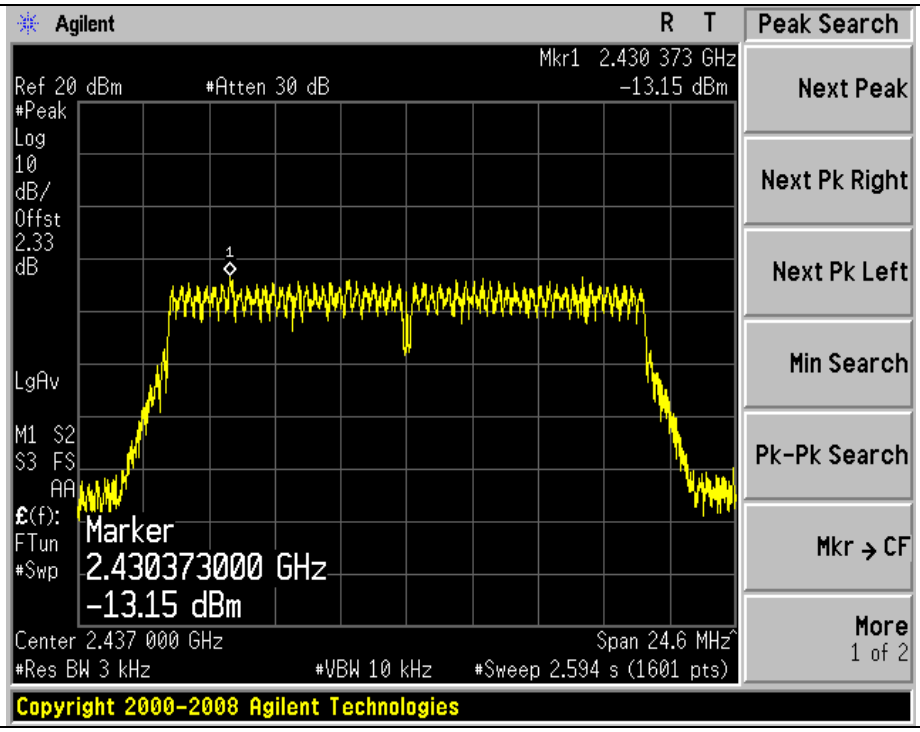
Title: **Power Spectral Density, 2437 MHz, 802.11g at 6Mbps**



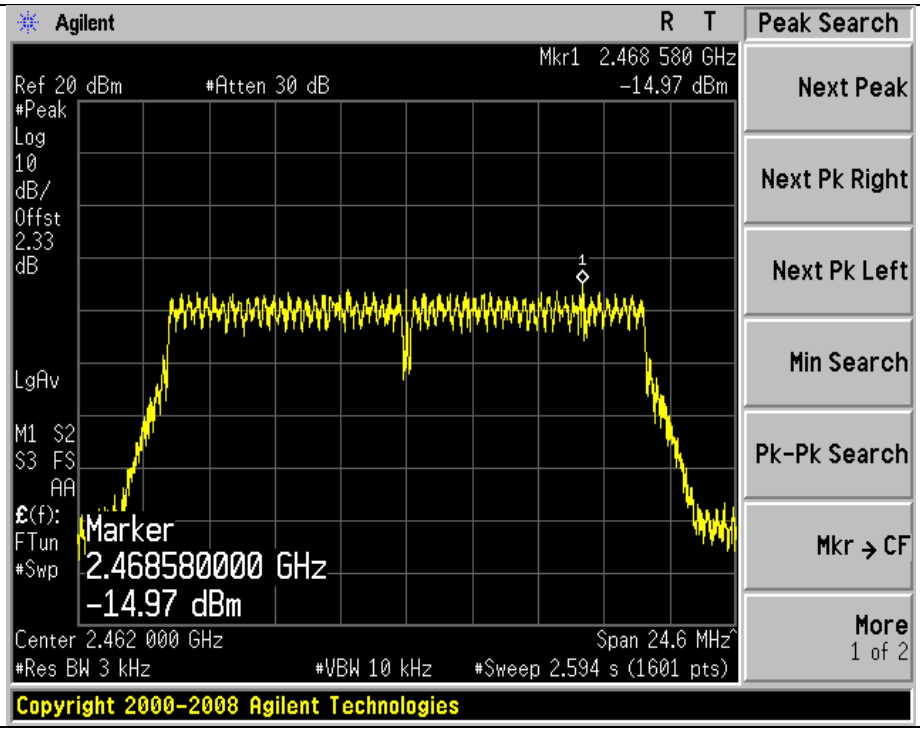
Title: **Power Spectral Density, 2462 MHz, 802.11g at 6Mbps**



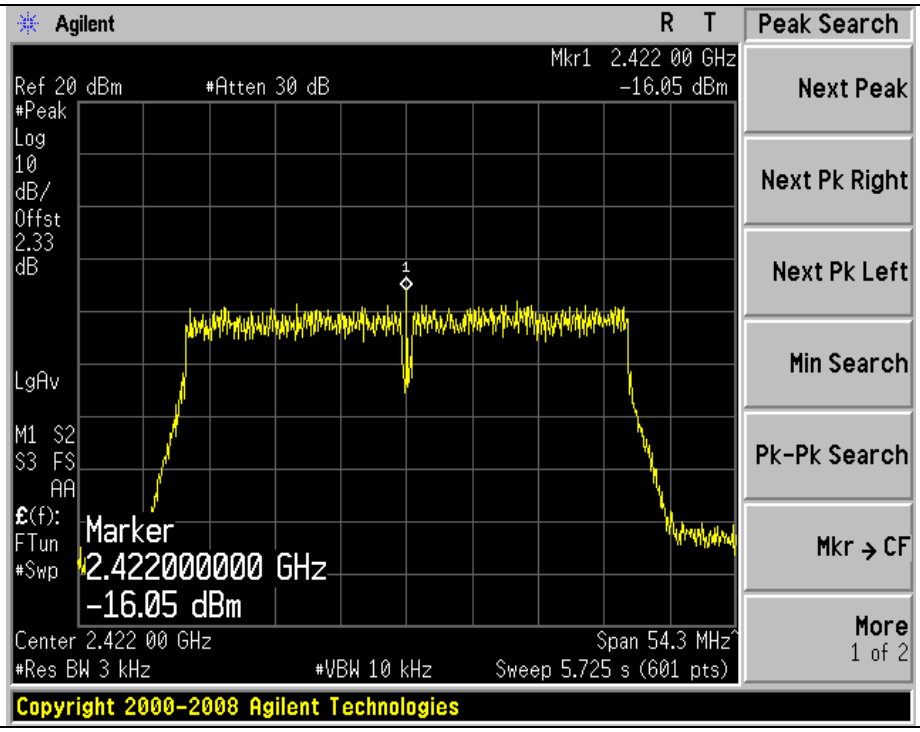
Title: **Power Spectral Density, 2412 MHz, 802.11n HT20 at M3**



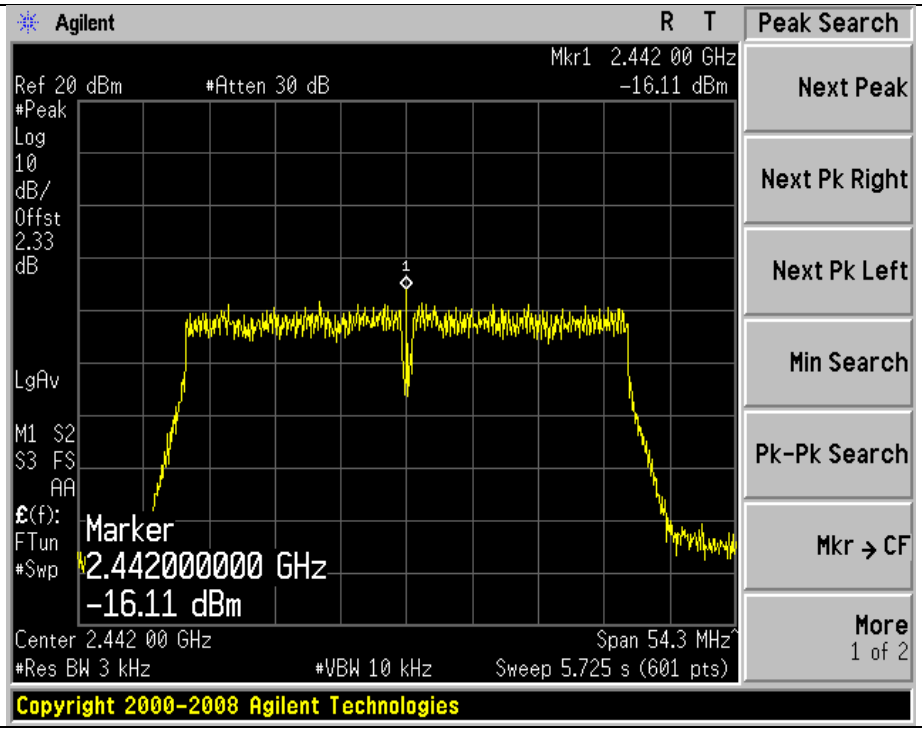
Title: **Power Spectral Density, 2437 MHz, 802.11n HT20 at M3**



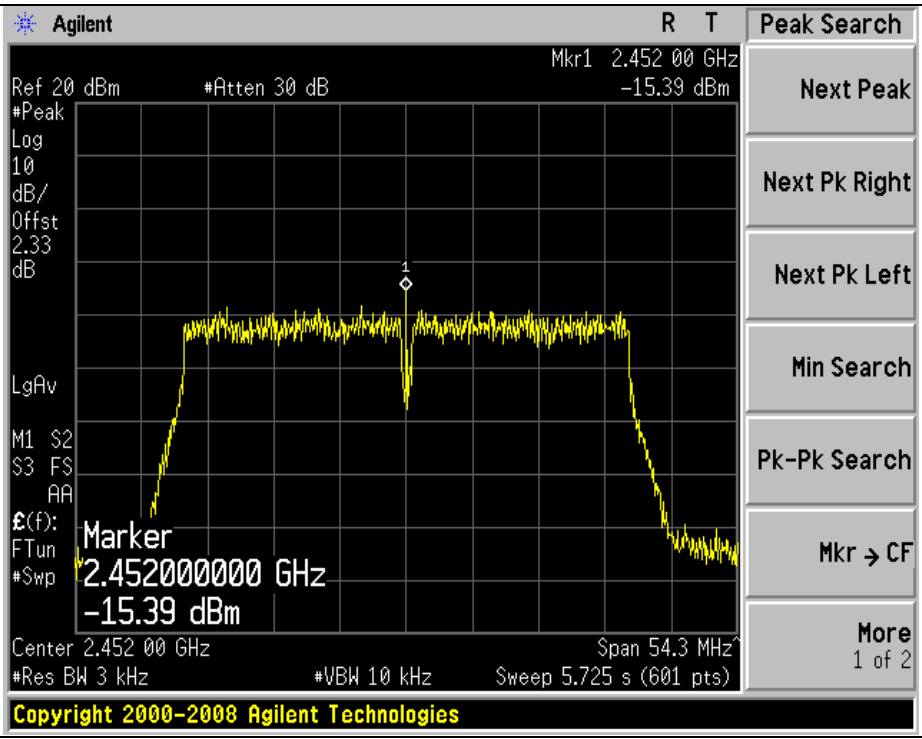
Title: **Power Spectral Density, 2462 MHz, 802.11n HT20 at M3**



Title: **Power Spectral Density, 2422 MHz, 802.11n HT40 at M4**



Title: **Power Spectral Density, 2442 MHz, 802.11n HT40 at M4**



Title: **Power Spectral Density, 2462 MHz, 802.11n HT40 at M4**

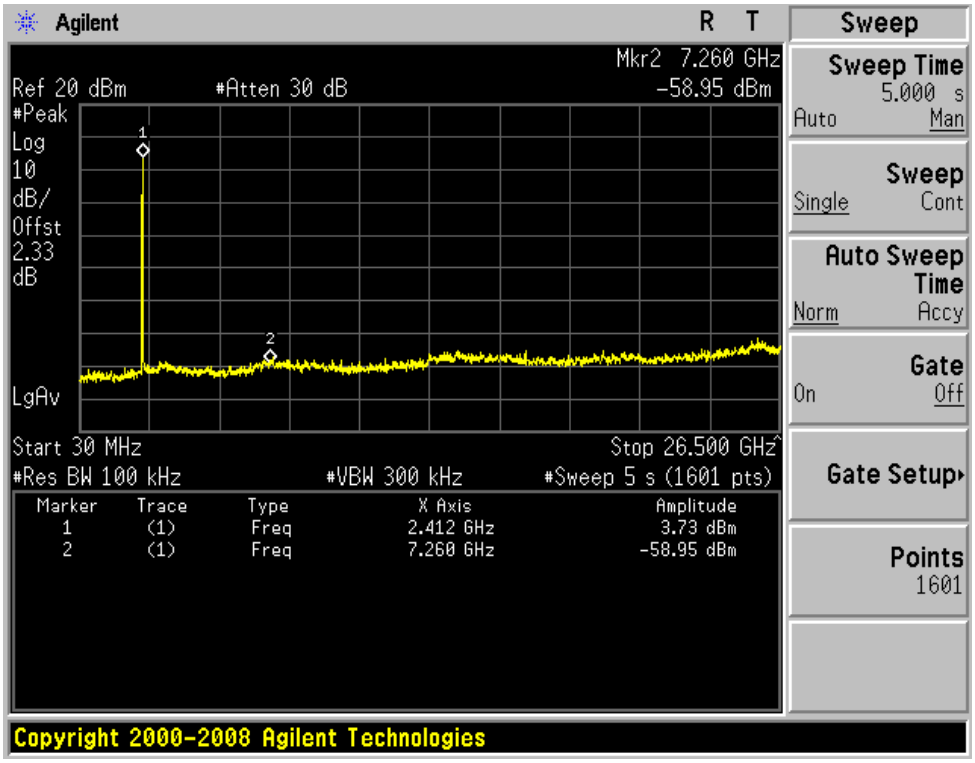
Conducted Spurious Emissions

15.247 & RSS-210 A8.5:

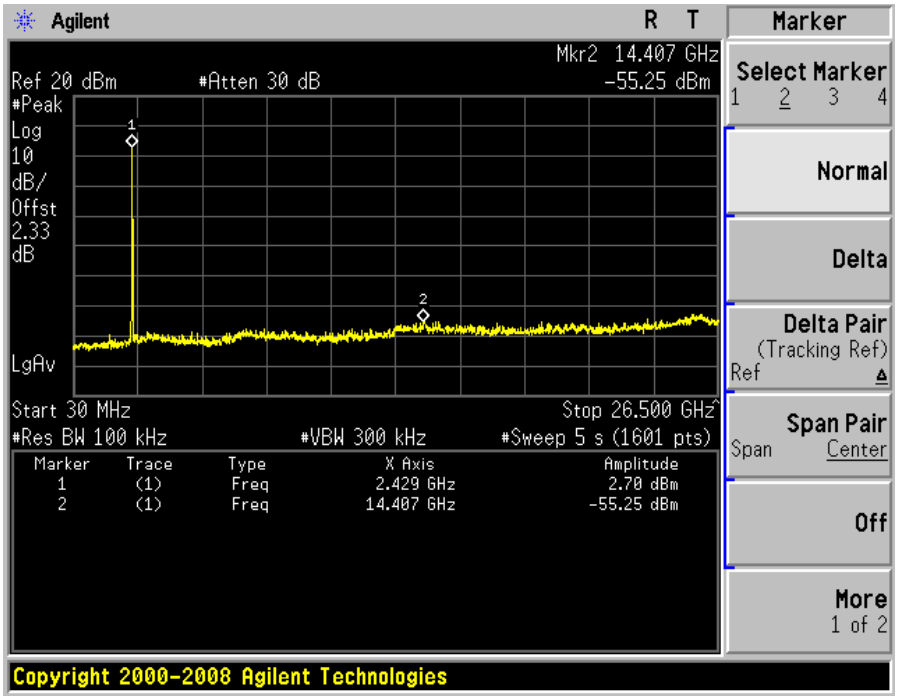
In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

Notes: No significant emissions were observed.

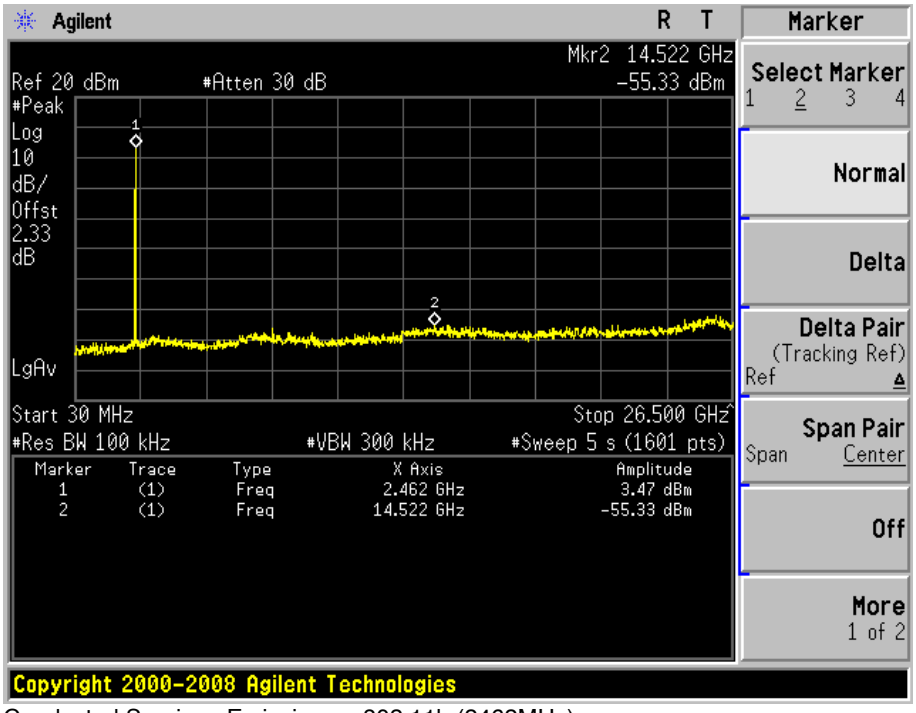
Graphical Test Results



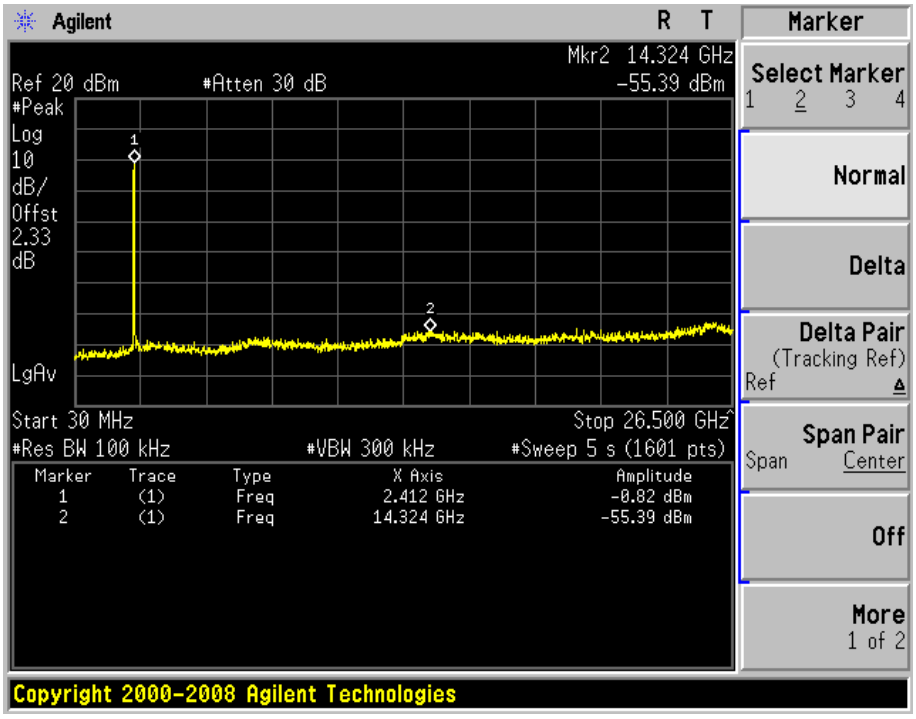
Conducted Spurious Emissions – 802.11b (2412MHz)



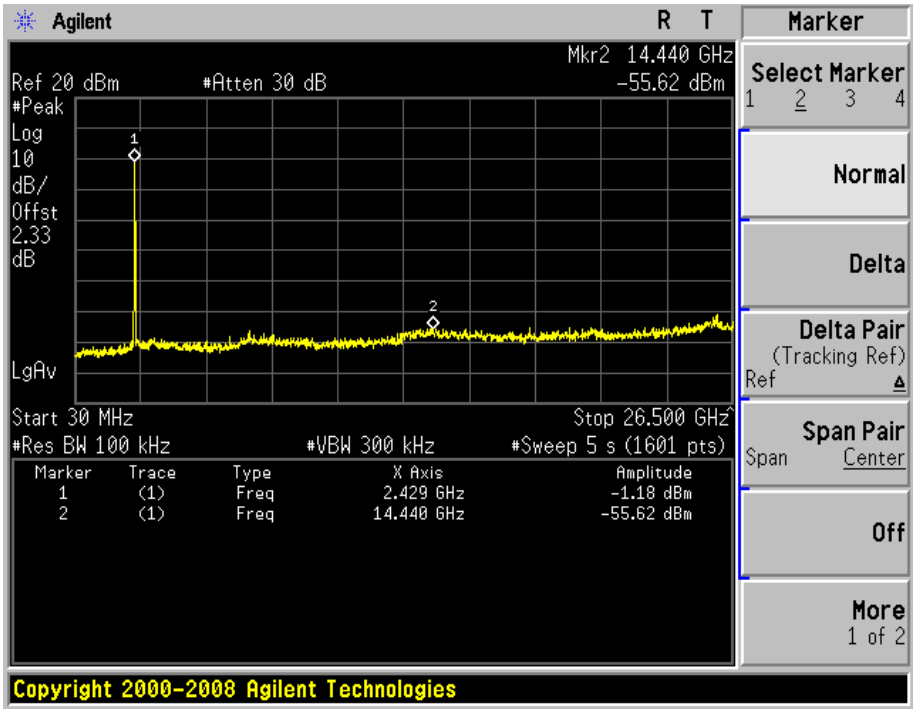
Conducted Spurious Emissions – 802.11b (2437MHz)



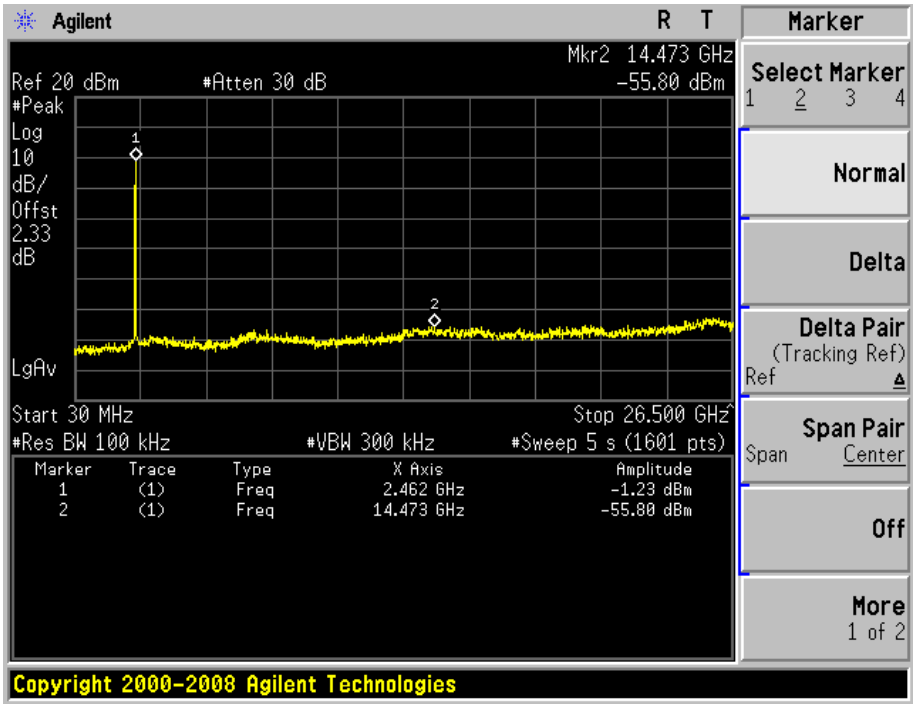
Conducted Spurious Emissions – 802.11b (2462MHz)



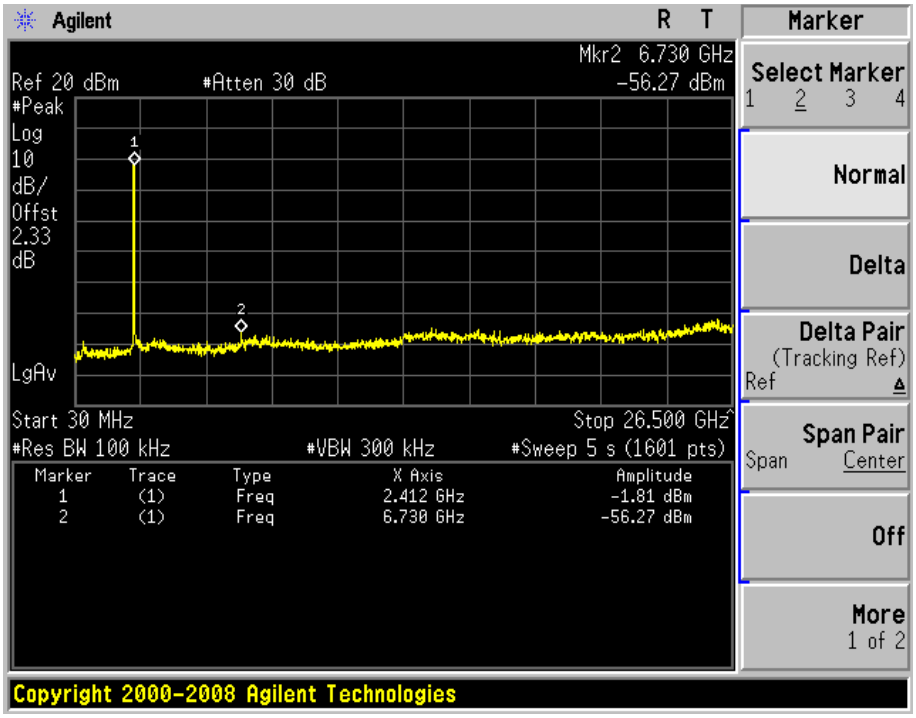
Conducted Spurious Emissions – 802.11g (2412MHz)



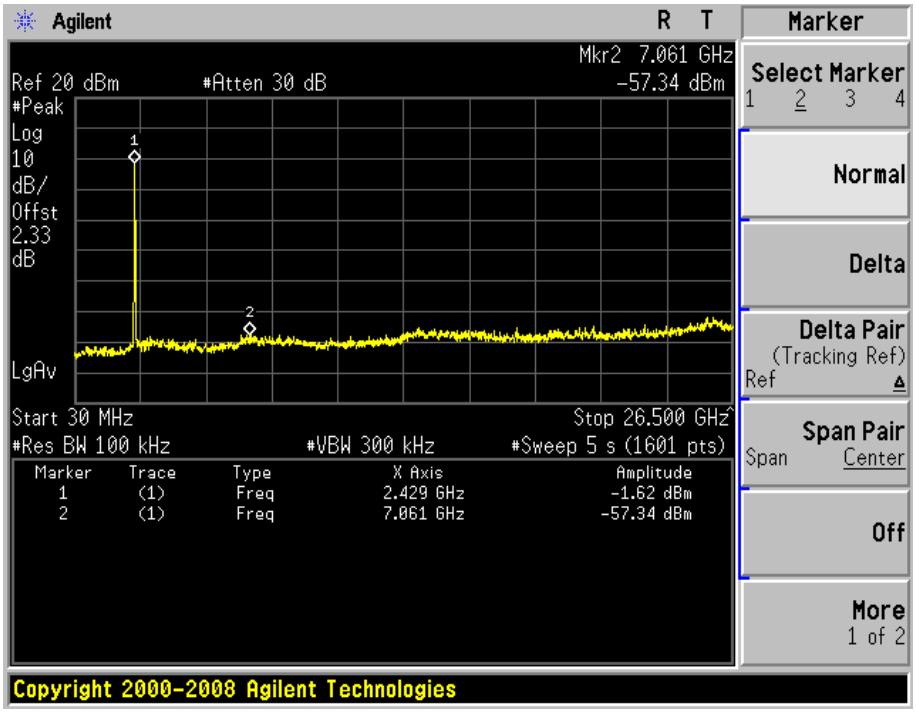
Conducted Spurious Emissions – 802.11g (2437MHz)



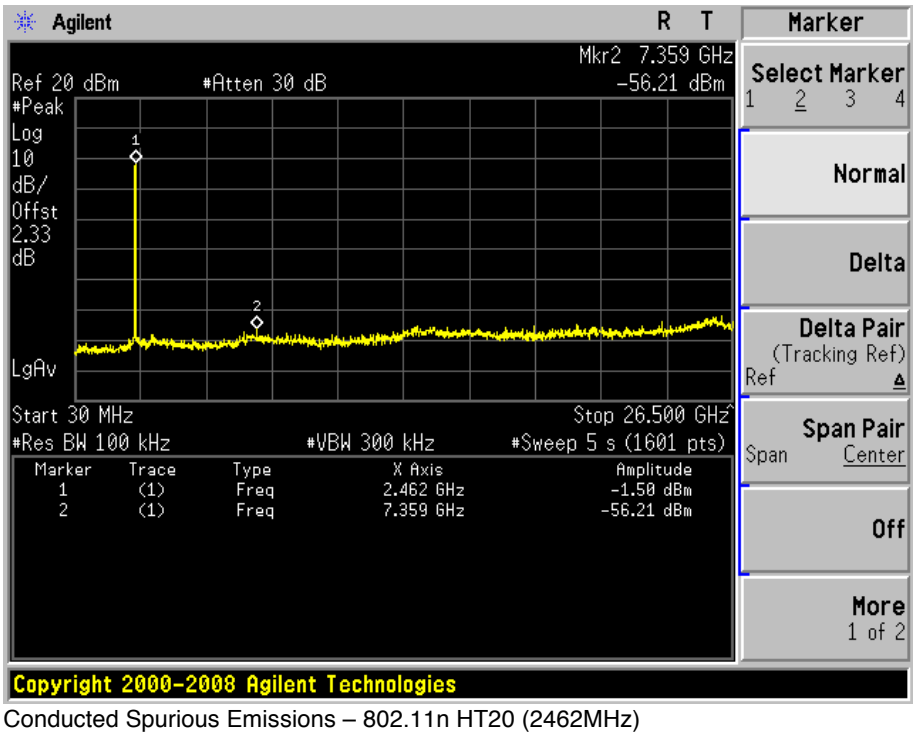
Conducted Spurious Emissions – 802.11g (2462MHz)



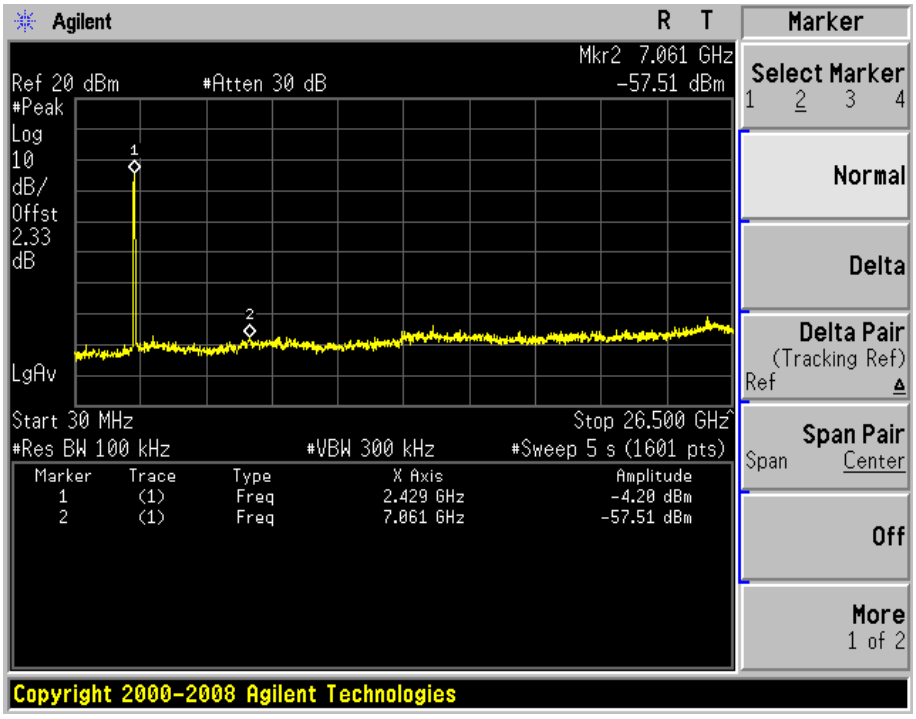
Conducted Spurious Emissions – 802.11n HT20 (2412MHz)



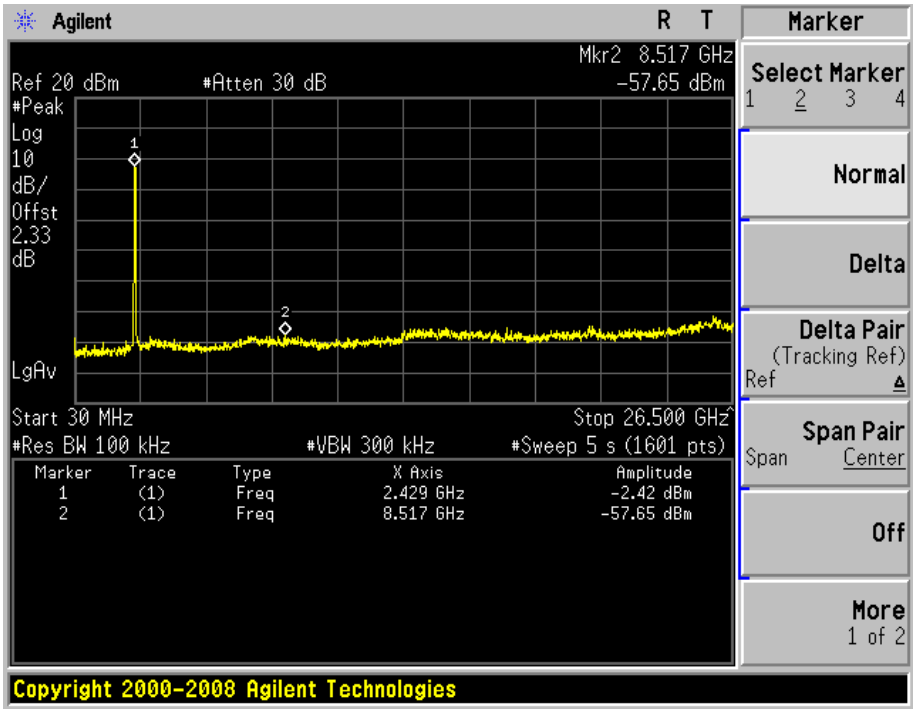
Conducted Spurious Emissions – 802.11n HT20 (2437MHz)



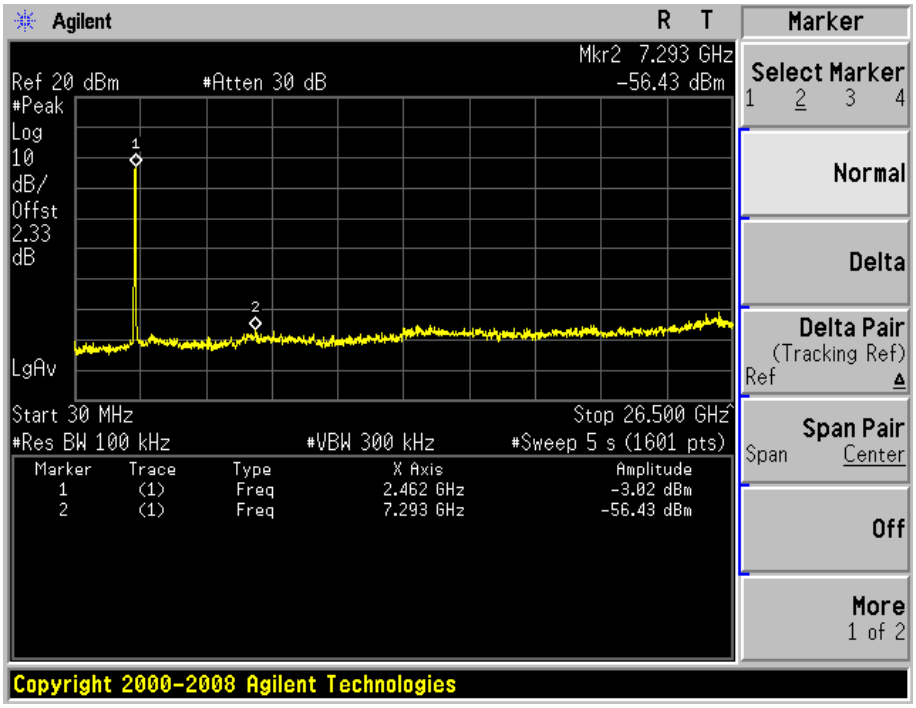
Conducted Spurious Emissions – 802.11n HT20 (2462MHz)



Conducted Spurious Emissions – 802.11n HT40 (2422MHz)

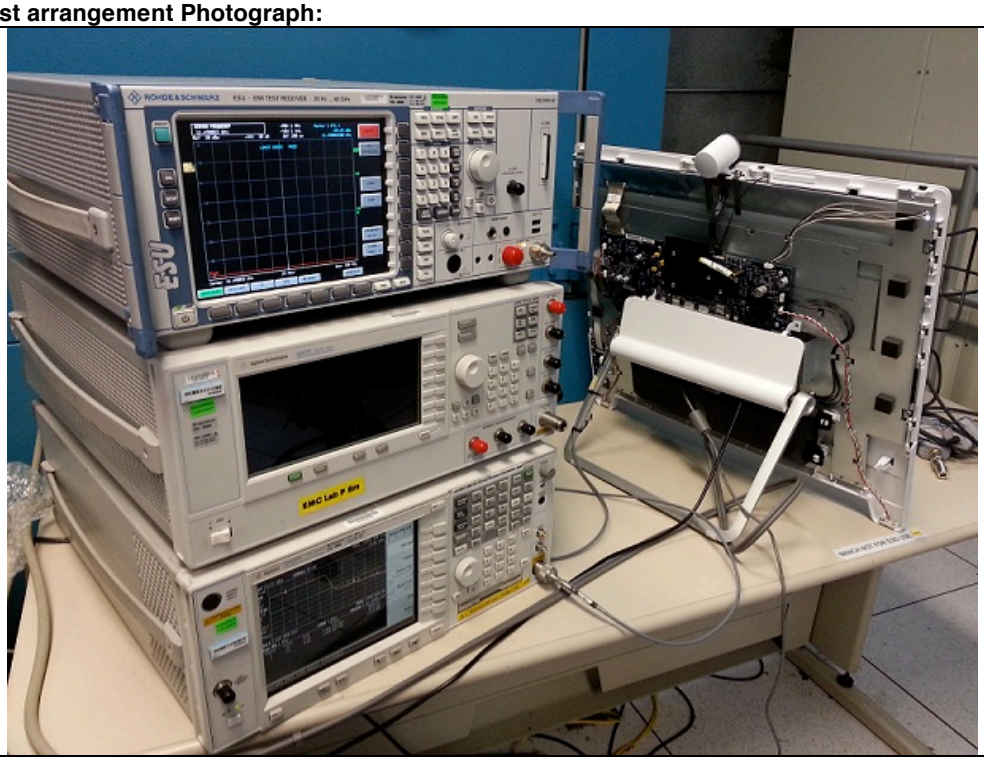


Conducted Spurious Emissions – 802.11n HT40 (2442MHz)



Conducted Spurious Emissions – 802.11n HT40 (2452MHz)

Physical Test arrangement Photograph:



Title: Conducted Spurious Emissions - Test Setup

Conducted Band Edge Measurements

15.205 & RSS-210 sec2.7:

Conducted emissions which fall in the restricted bands, as defined in Sec. 15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a).

Use to substitute conducted measurements in place of radiated measurements.
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode.
Be sure to enter all losses between the transmitter output and the spectrum analyzer.

Reference Level:	20 dBm
Attenuation:	30 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	1 MHz for peak, 100 Hz for average
Detector:	Peak

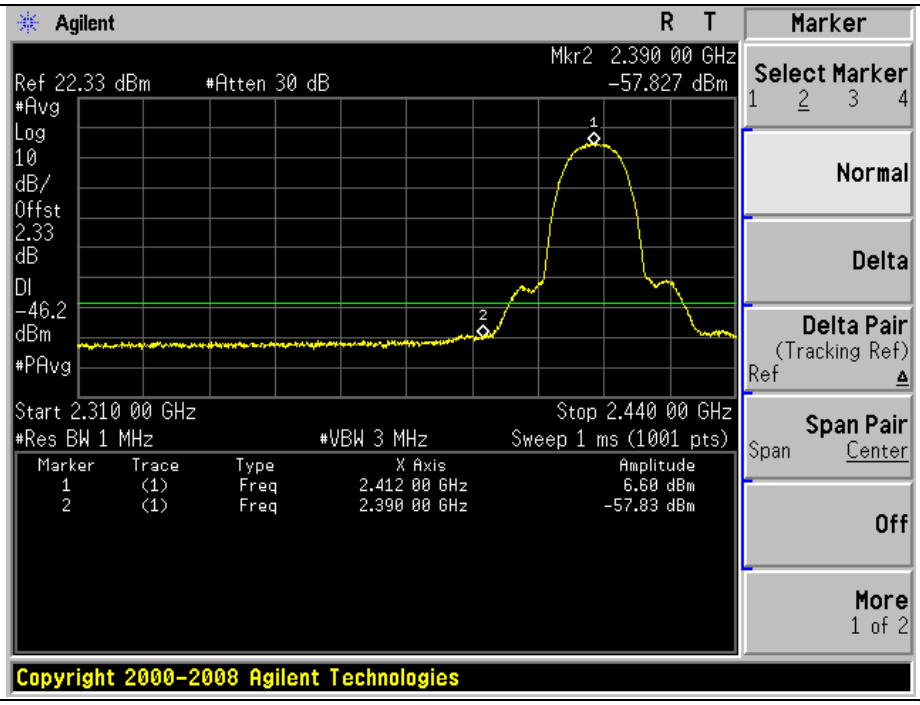
Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= -41.25 dBm eirp (54dBuV/m @3m)
2) Peak plot (Vertical and Horizontal), Limit = -21.25 dBm eirp (74dBuV/m @3m)

Place a marker at the end of the restricted band closest to the transmit frequency to show compliance.
Also measure any emissions in the restricted bands

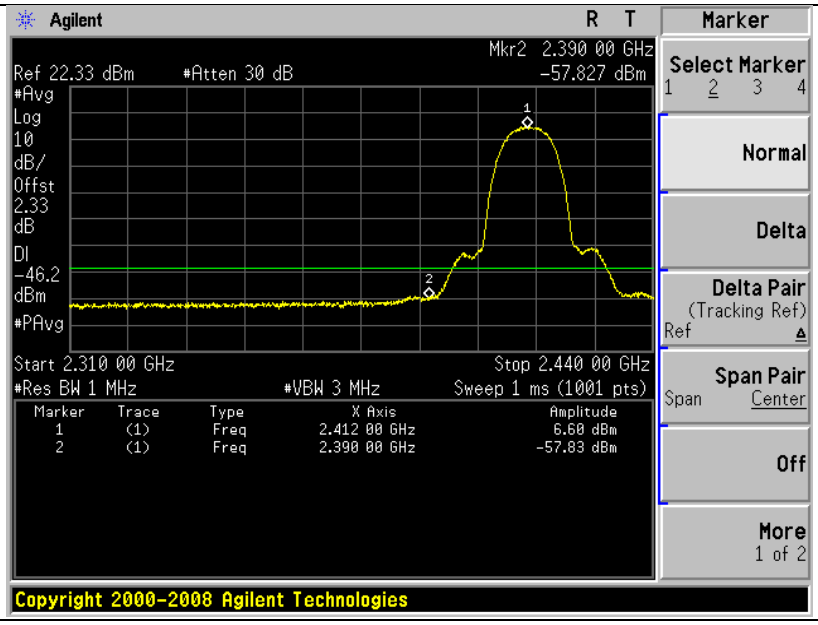
Detector Type	Frequency	Mode	Antenna Gain	Power Setting	Highest Measured Level (dBm)	Limit (dBm)	Limit adjusted for gain (dBm)	Margin
Average	2412	802.11b	5	20	-57.83	-41.25	-46.25	-11.58
Average	2412	802.11g	5	16	-53.01	-41.25	-46.25	-6.76
Average	2412	802.11n HT20	5	15	-53.59	-41.25	-46.25	-7.34
Average	2422	802.11n HT40	5	13	-52.47	-41.25	-46.25	-6.22
Average	2462	802.11b	5	20	-56.16	-41.25	-46.25	-9.91
Average	2462	802.11g	5	16	-49.39	-41.25	-46.25	-3.14
Average	2462	802.11n HT20	5	15	-47.91	-41.25	-46.25	-1.66
Average	2452	802.11n HT40	5	13	-47.37	-41.25	-46.25	-1.12

Detector Type	Frequency	Mode	Antenna Gain	Power Setting	Highest Measured Level (dBm)	Limit (dBm)	Limit adjusted for gain (dBm)	Margin
Peak	2412	802.11b	5	20	-47.97	-21.25	-26.25	-21.72
Peak	2412	802.11g	5	16	-35.01	-21.25	-26.25	-8.76
Peak	2412	802.11n HT20	5	15	-40.60	-21.25	-26.25	-14.35
Peak	2422	802.11n HT40	5	13	-41.04	-21.25	-26.25	-14.79
Peak	2462	802.11b	5	20	-47.99	-21.25	-26.25	-21.74
Peak	2462	802.11g	5	16	-34.16	-21.25	-26.25	-7.91
Peak	2462	802.11n HT20	5	15	-41.16	-21.25	-26.25	-14.91
Peak	2452	802.11n HT40	5	13	-37.1	-21.25	-26.25	-10.85

Graphical Test Results:



Title: Peak Band Edge Measurement for 802.11b (2412MHz at 11Mbps)



Title: Average Band Edge Measurement for 802.11b (2412MHz at 11Mbps)