L. S. COMPLIANCE, Inc.

SpectraLink : Appendix D to Report Number 301299-TX. Rev 2

FCC ID: IYGPTB800

Part 15.247 Type Acceptance, Conducted Measurements

Prepared for:

Spectra Link

Revision 2.0

Table of Contents

SpectraLink DS_11MB

I. Project Information

Project: *Spectra Link DS_11MB*

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Report Date: 10/30/01
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Testing By:

August 23, 2001

Thomas T. Lee, EMC engineer — DATE

Prepare By:

August 23, 2001

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Retested:

October 29, 2001

Kenneth L. Boston, EMC Lab Manager — Date

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II. Declaration of Compliance – 15.247 Measurement Summary

Presented below is a compliance matrix showing the test conditions, test indications, test limits and test outcomes associated with the part 15.247 conducted tests performed on the Equipment Under Test: Spectra Link DS_11MB***. (Due to a faulty cable during the test measurements, a retest of conducted parameters was performed on October 23, 2001; and the results updated below)***

A. Part 15.247 (a)(2) Minimum Emission 6 dB Bandwidth

FCC Test Type / EUT Test Conditions	15.247 (a) (2)	15.247 (a) (2)	15.247 (a) (2)
	Limit	Indication	Outcome
Channel 1 (2412 MHz), 11 Mbps	500 kHz, min	10.6 MHz	PASS
Channel 6 (2437 MHz), 1 Mbps	500 kHz, min	7.98 MHz	PASS
Channel 6 (2437 MHz), 5.5 Mbps	500 kHz, min	9.85 MHz	PASS
Channel 6 (2437 MHz), 11 Mbps	500 kHz, min	10.1 MHz	PASS
Channel 11 (2462MHz), 11 Mbps	500 kHz, min	9.35 MHz	PASS

B. Part 15.247 (b) (1) Maximum Conducted Emission Output Power

FCC Test Type / EUT Test Conditions	15.247 (b) (1)	15.247 (b) (1)	15.247 (b) (1)
	Limit	Indication	Outcome
Channel 1 (2412 MHz), 11 Mbps	30 dBm, Max	19.5 dBm	PASS
Channel 6 (2437 MHz), 1 Mbps	30 dBm, Max	18.6 dBm	PASS
Channel 6 (2437 MHz), 5.5 Mbps	30 dBm, Max	19.1 dBm	PASS
Channel 6 (2437 MHz), 11 Mbps	30 dBm, Max	19.2dBm	PASS
Channel 11 (2462MHz), 11 Mbps	30 dBm, Max	19.9 dBm	PASS

C. Part 15.247 (c) Minimum Relative Spurious Power Spectral Density Level

FCC Test Type / EUT Test Conditions	15.247 (c)	15.247 (c)	15.247 (c)
	Limit	Indication	Outcome
Channel 11 (2462 MHz), 11 Mbps, Wide Scan	20 dBc, min	48.1	PASS
Channel 1 (2412 MHz), 1 Mbps, Band Edge	20 dBc, min	43.3 dBc	PASS
Channel 1 (2412 MHz), 5.5 Mbps, Band Edge	20 dBc, min	37.3 dBc	PASS
Channel 1 (2412 MHz), 11 Mbps, Band Edge	20 dBc, min	38.3 dBc	PASS
Channel 11 (2462 MHz), 1 Mbps, Band Edge	20 dBc, min	51.3 dBc	PASS
Channel 11 (2462 MHz), 5.5 Mbps, Band Edge	20 dBc, min	56.0 dBc	PASS
Channel 11 (2462MHz), 11 Mbps, Band Edge	20 dBc, min	53.4dBc	PASS

D. Part 15.247 (d) Maximum Power Spectral Density

FCC Test Type / EUT Test Conditions	15.247 (d)	15.247 (d)	15.247 (d)
	Limit	Indication	Outcome
Channel 1 (2412 MHz), 1Mbps	8 dBm/kHz, Max	-6.5 dBm/3 kHz	PASS
Channel 6 (2437 MHz), 1 Mbps	8 dBm/kHz, Max	-6.0 dBm/3 kHz	PASS
Channel 6 (2437 MHz), 5.5 Mbps	8 dBm/kHz, Max	-9.6 dBm/3 kHz	PASS
Channel 6 (2437 MHz), 11 Mbps	8 dBm/kHz, Max	-9.7 dBm/3 kHz	PASS
Channel 11 (2462MHz), 1 Mbps	8 dBm/kHz, Max	-5.9 dBm/3 kHz	PASS

(Note:) Per FCC Part 15.31 (e) the Conducted Emissions Tests of power output were performed with a fresh fully charged battery pack at Voltage=5.6VDC to 5.7VDC

III. FCC Conducted Measurements

A. Part 15.247

1. 15.247 (a) (2) Emission 6 dB Bandwidth

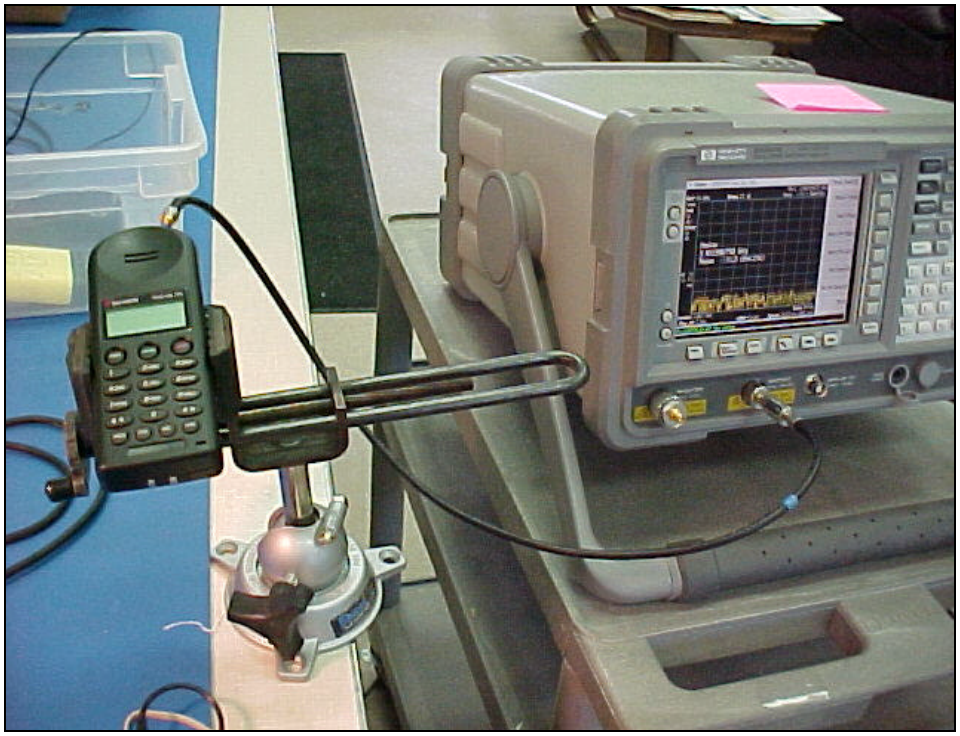
a) Test Requirement

The 6 dB bandwidth of the Equipment emission must be greater than 500 kHz.

$$B_{-6\,dB} > 500\ kHz$$

b) Test Configuration

The test configuration is presented below with the DS 11MB operating on a single 5.0VDC Nickel Metal Hydride Battery. The test sample is connected via a 0.086 Semi-Rigid Coax cable to a 10dB attenuator HP 8493A and the Agilent E4407B Spectrum Analyzer #CC00221C in the test setup below.



c) Test Conditions: Equipment Under Test

The equipment under test is tunable and is set to 3 different channels, one representing the minimum tunable frequency, one representing a midband frequency and one representing the maximum tunable frequency. The frequencies and their channel designators are presented below for reference. Secondly, since the access point is a multi-rate radio, the data (bit) rate test cases are also listed.

Channel 1: 2412 MHz , 11 Mbps

Channel 6: 2437 MHz, 1,5.5,11 Mbps

Channel 11: 2462 MHz , 11 Mbps

Test indications under these six frequency and bit rate conditions are presented.

The output power is fixed to its maximum, worst-case value.

d) Test Conditions: Instrumentation Conditions

The readings indicated on the spectrum analyzer are a result of a marker search function which determines the 6 dB bandwidth of the indicated spectrum. The spectrum analyzer display indicates its conditions as follows:

Center: Center Frequency: 2412, 2437, 2462 MHz

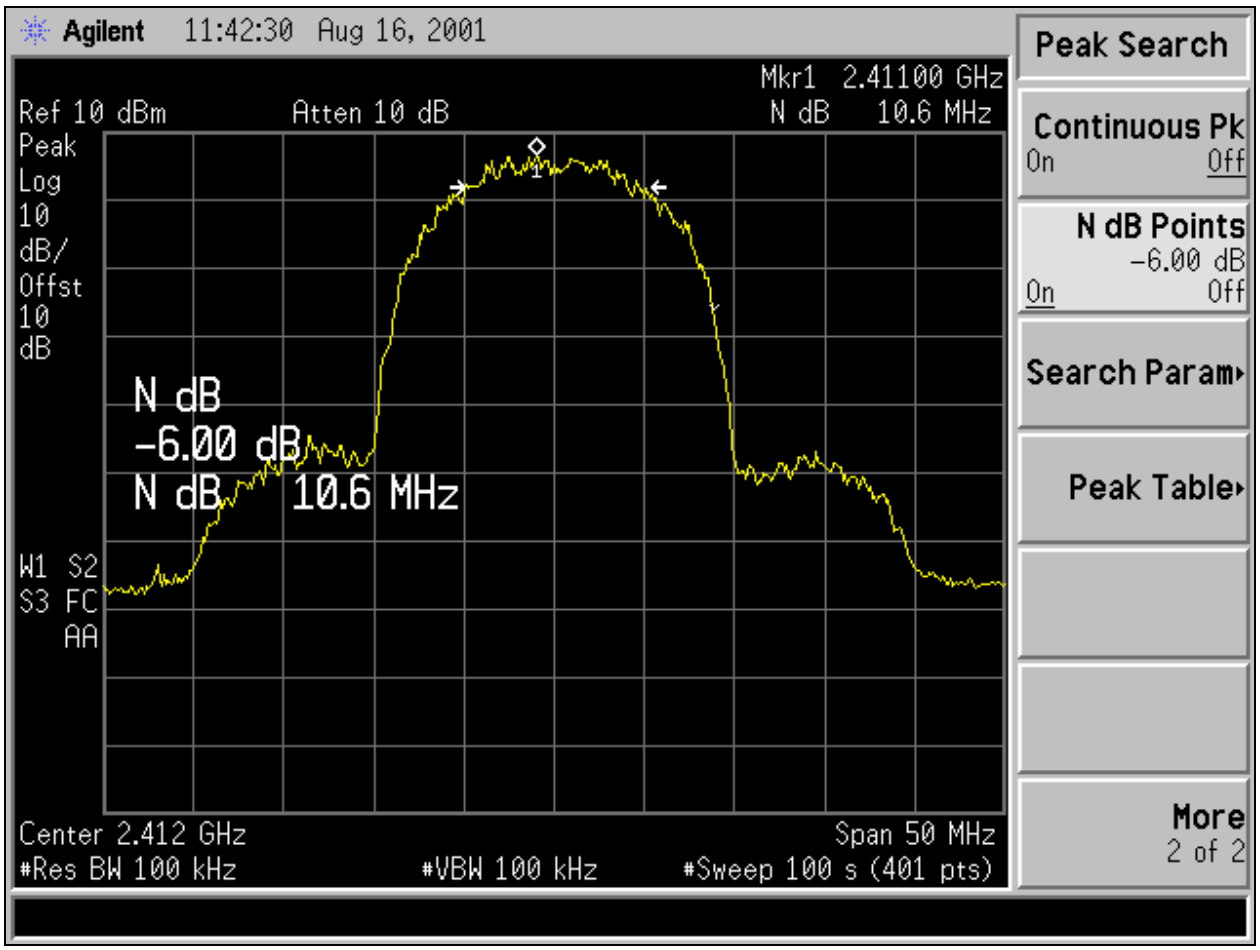
Span: Frequency Span: 50MHz

Res BW: Resolution Bandwidth: 100kHz

VBW: Video (averaging) Bandwidth: 100kHz

Sweep: Frequency Sweep time over indicated frequency Span: 100sec

e) Test Indications

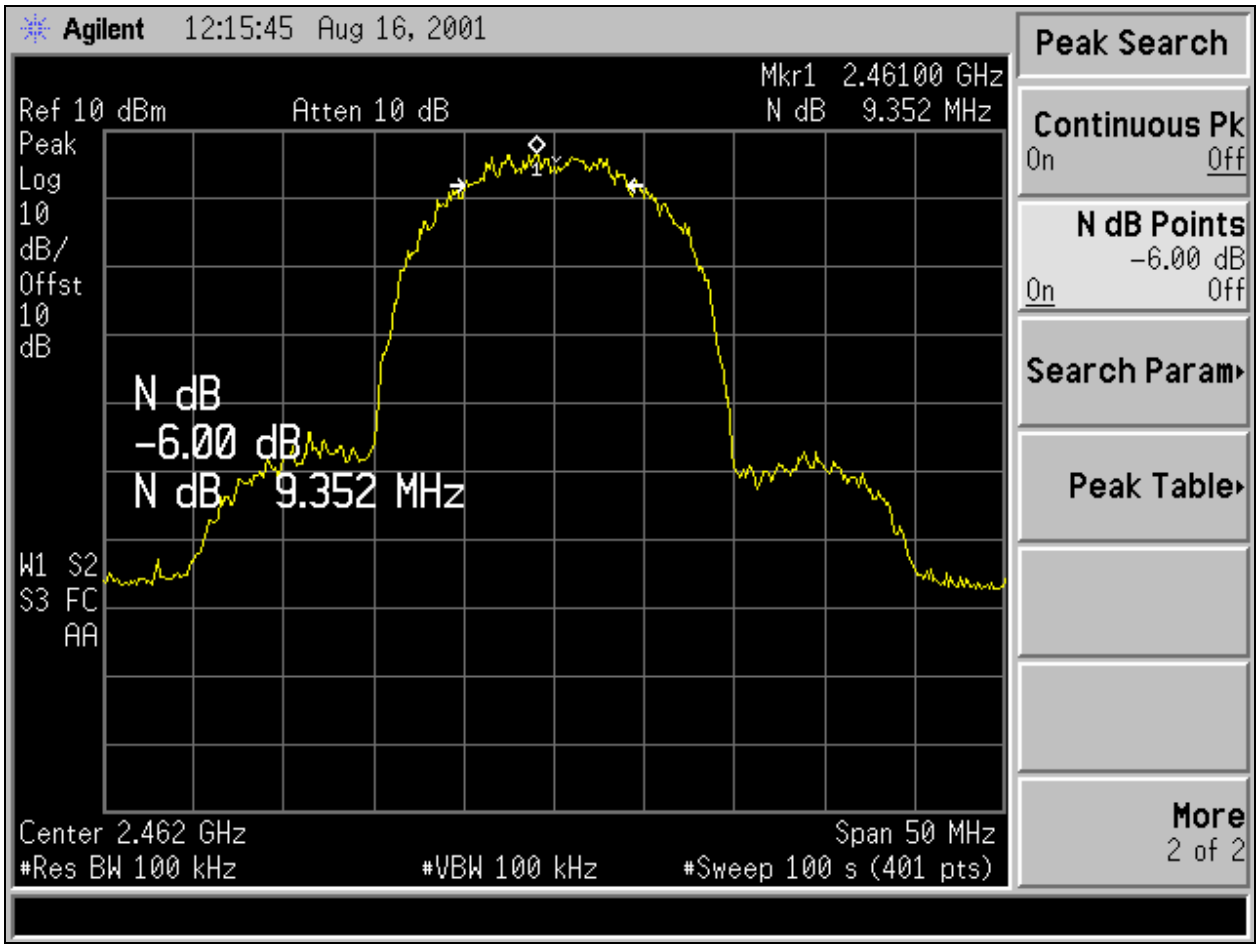


Test Condition: Channel 1: 2412 MHz, 11 Mbps

Test Limit: 500 kHz, minimum.

Test Indication: 10.6 MHz

Test Outcome: 10.6 MHz > 500 kHz →PASS

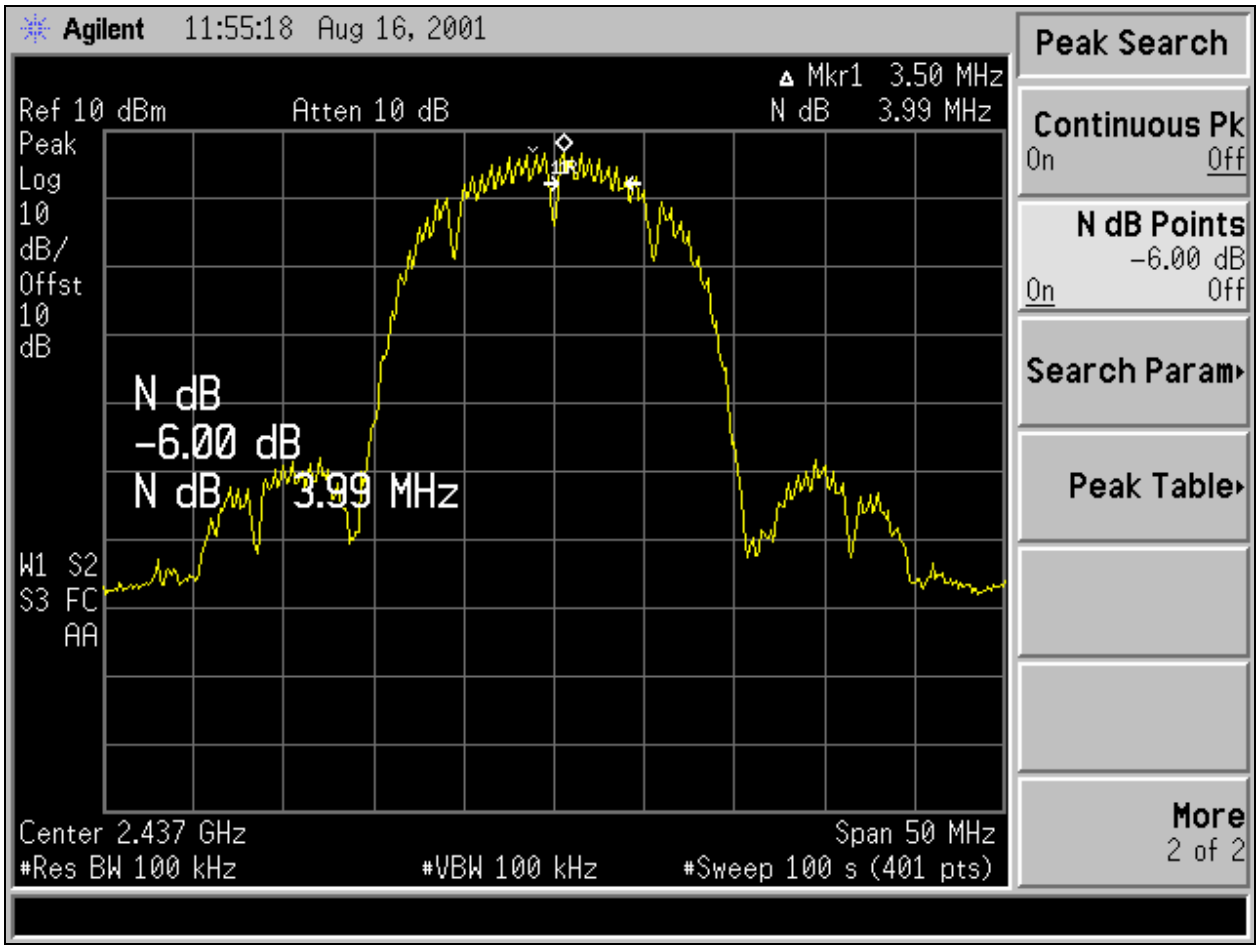


Test Condition: Channel 11: 2462 MHz, 11 Mbps

Test Limit: 500 kHz, minimum.

Test Indication: 9.35 MHz

Test Outcome: 9.35 MHz > 500 kHz →PASS

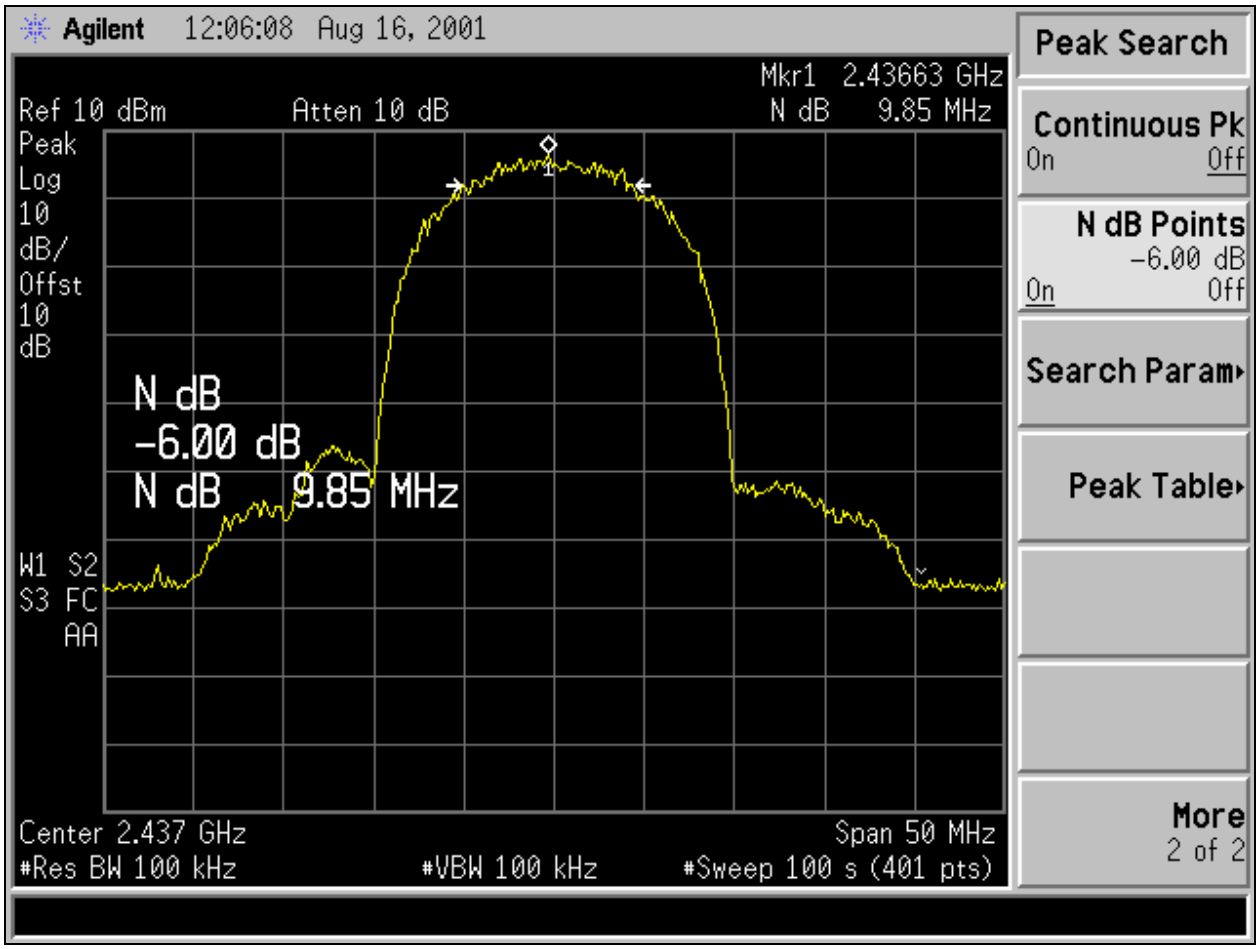


Test Condition: Channel 6: 2437 MHz, 1Mbps

Test Limit: 500 kHz, minimum.

Test Indication: 2x3.99 MHz=7.98 MHz

Test Outcome: 7.98 MHz > 500 kHz → PASS

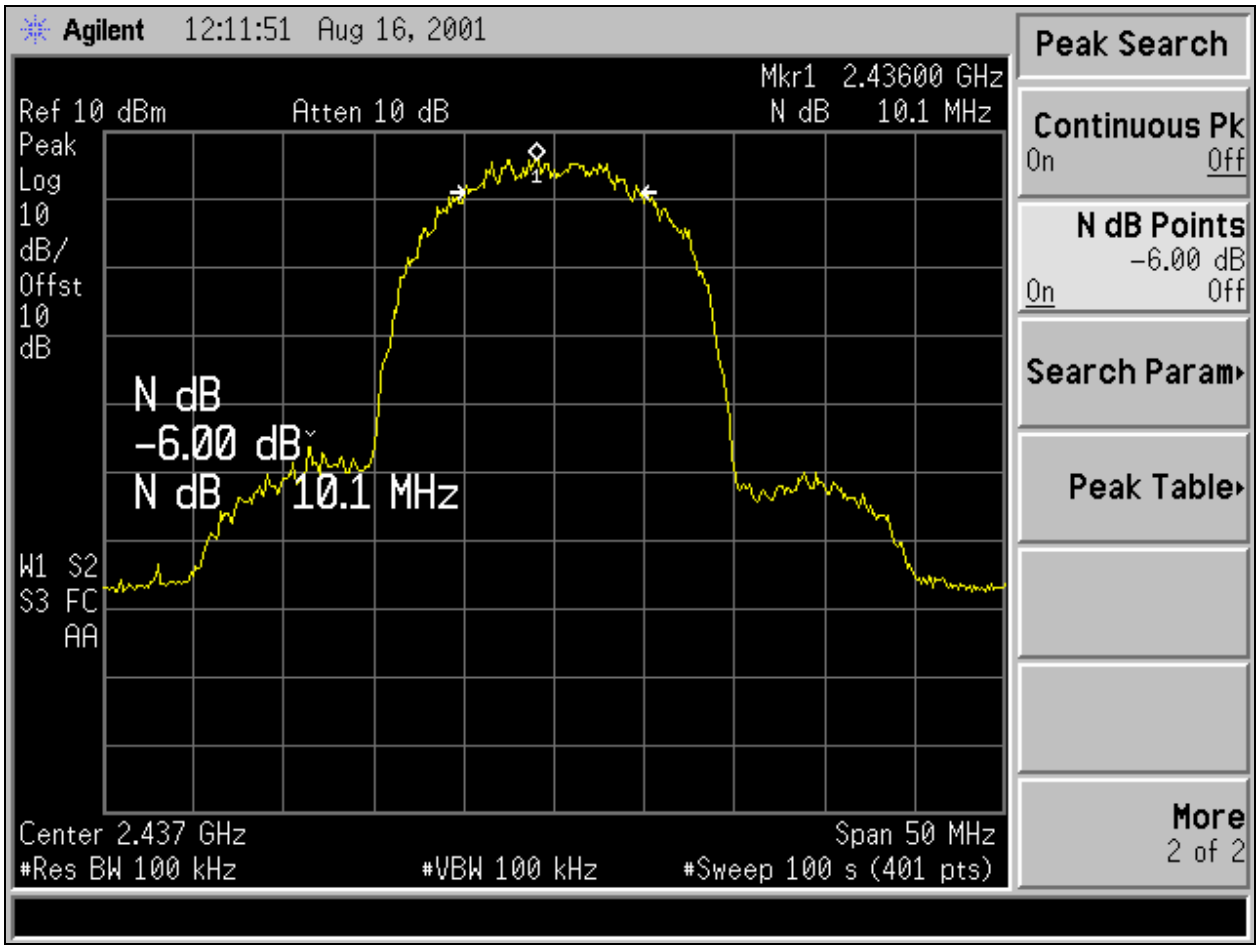


Test Condition: Channel 6: 2437 MHz, 5.5 Mbps

Test Limit: 500 kHz, minimum.

Test Indication: 9.85 MHz

Test Outcome: 9.85 MHz > 500 kHz → PASS



Test Condition: Channel 6: 2437 MHz, 11 Mbps

Test Limit: 500 kHz, minimum.

Test Indication: 10.1 MHz

Test Outcome: 10.1 MHz > 500 kHz → PASS

2. 15.247 (b) (1) Output Power

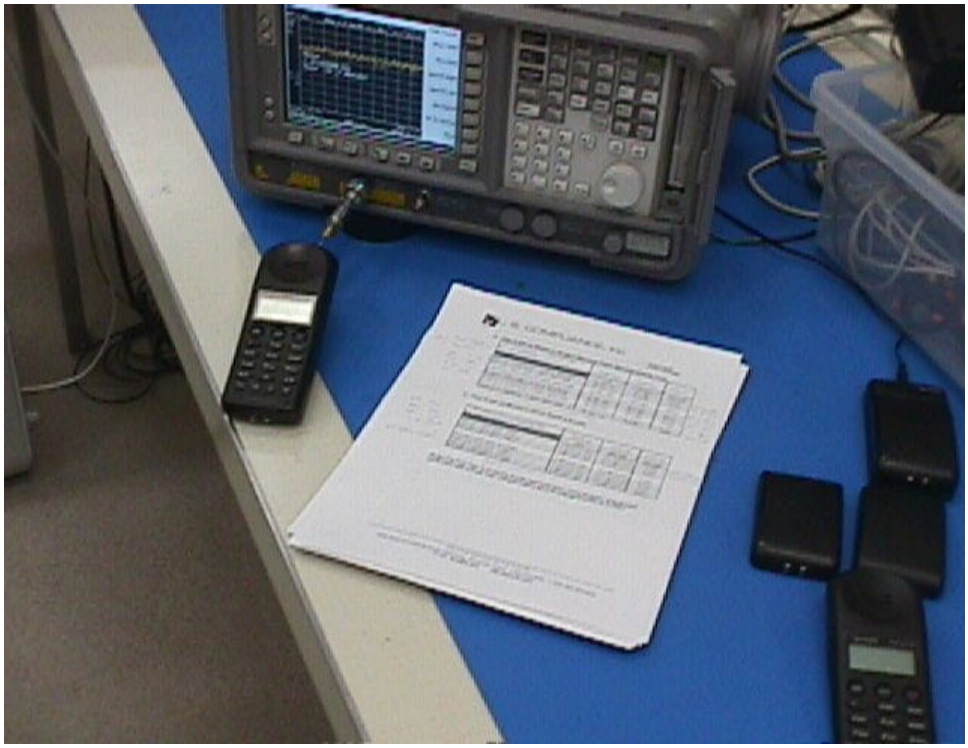
a) Test Requirement

The conducted output power of the Equipment emission must be less than 1 W (30 dBm).

$$P_O < 30\ dBm$$

b) Test Configuration

The test configuration is presented in section II-A-1b. *(RETEST PERFORMED WITH THE FOLLOWING CONFIGURATION, the Spectralink device is connected directly to a 10 dB attenuator, and directly into the analyzer)*



c) Test Conditions: Equipment Under Test

The equipment under test is tunable and is set to 3 different channels, one representing the minimum tunable frequency, one representing a midband frequency and one representing the maximum tunable frequency. The frequencies and their channel designators are presented below for reference. Secondly, since the access point is a multi-rate radio, the data (bit) rate test cases are also listed.

Channel 1: 2412 MHz , 11 Mbps

Channel 6: 2437 MHz, 1,5.5,11 Mbps

Channel 11: 2462 MHz , 11 Mbps

Test indications under these three frequency conditions are presented.

d) Test Conditions: Instrumentation Conditions

The readings indicated on the spectrum analyzer are a result of a direct spectrum analyzer measurement where the indications are a result of a measurement function which detects the integrated channel power between the indicated frequency limits.

Center: Center Frequency: 2412, 2437, 2462 MHz

Span: Frequency Span: 100MHz

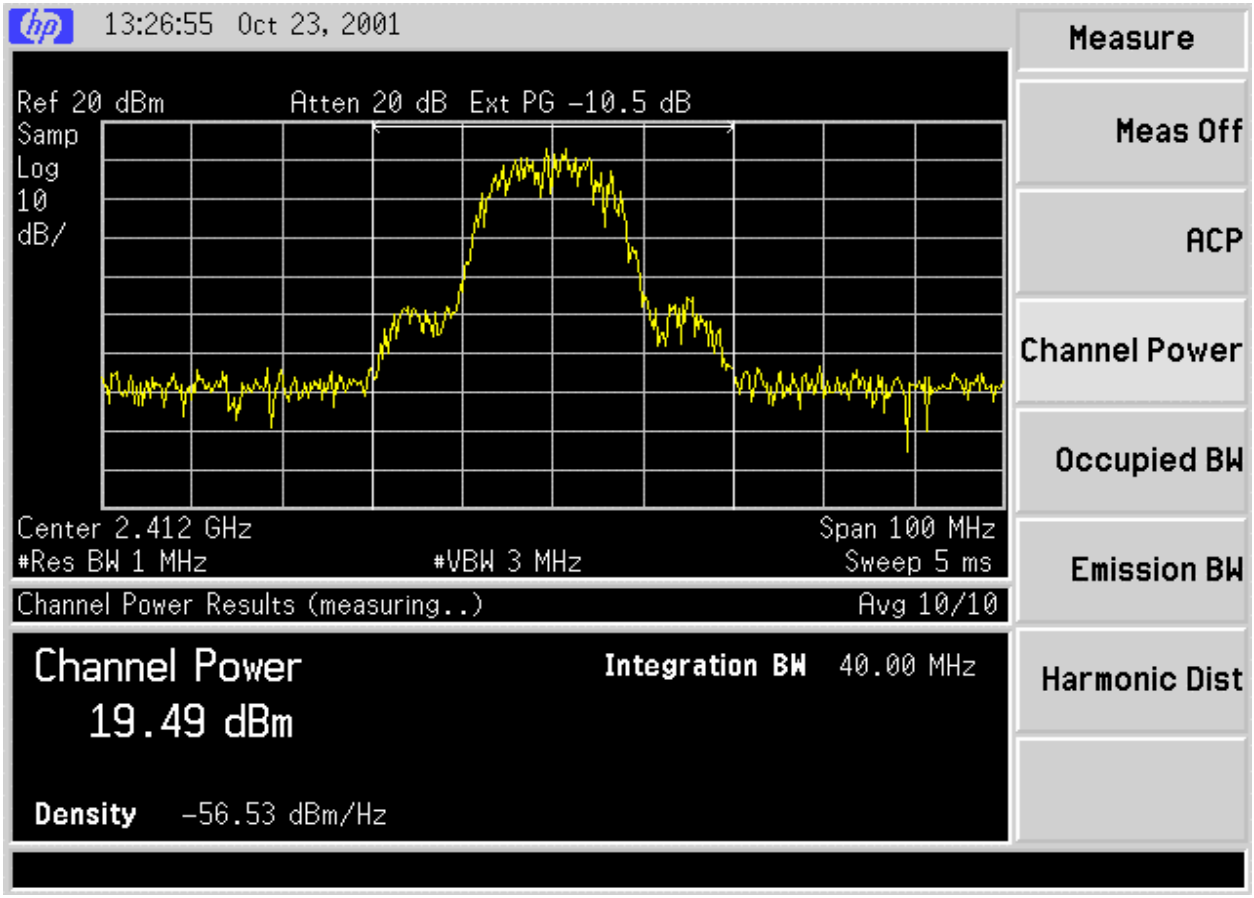
Res BW: Resolution Bandwidth: 1MHz

VBW: Video (averaging) Bandwidth: 3MHz

Sweep: Frequency Sweep time over indicated frequency Span: 4ms, with averaging over 10 sweeps.

Integration BW: Bandwidth over which power spectral density is integrated to determine integrated channel power: 40MHz

e) Test Indications

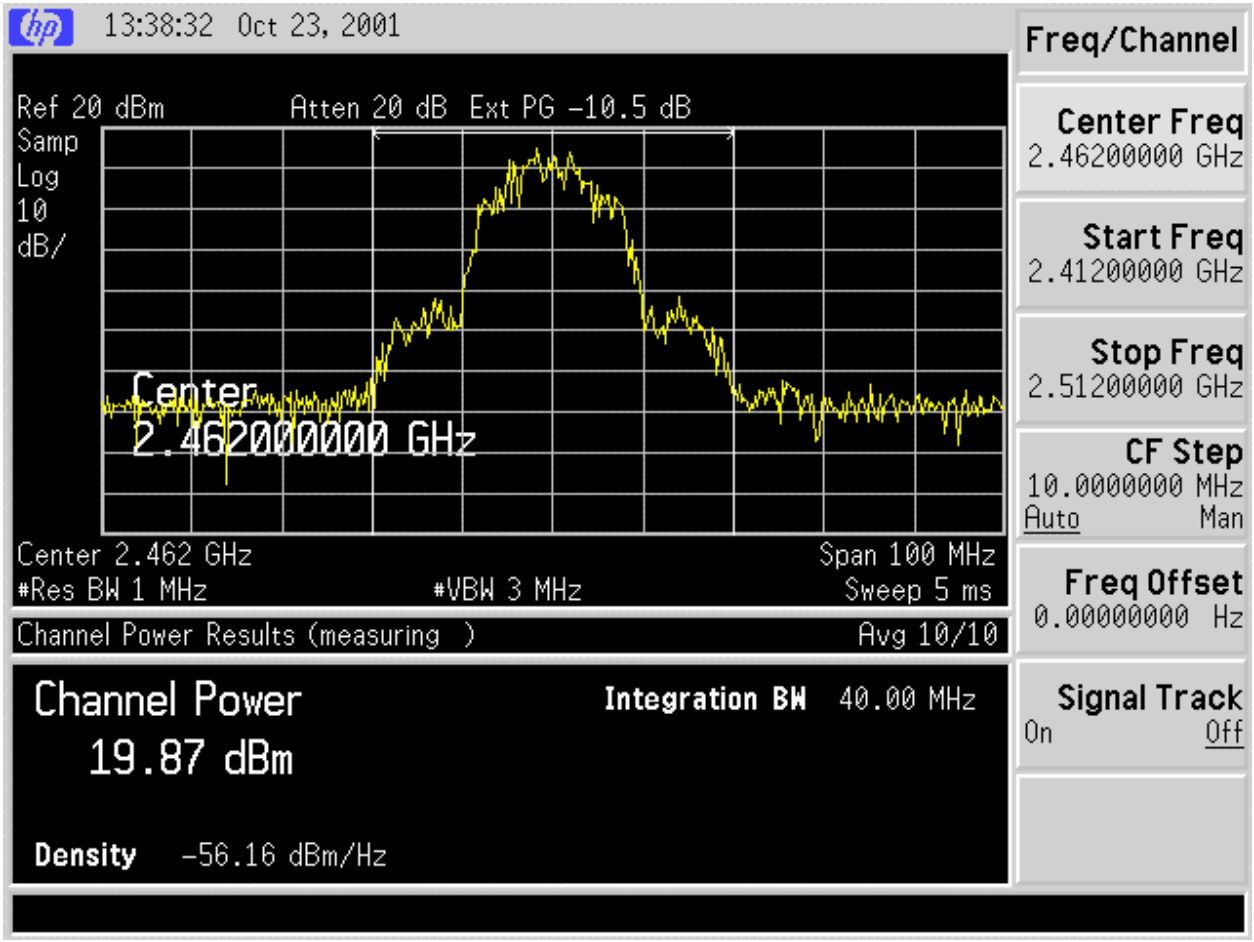


Test Condition: Channel 1: 2412 MHz, 11 Mbps

Test Limit: 30 dBm, Maximum.

Test Indication: 19.49 dBm

Test Outcome: 19.5 dBm < 30 dBm → PASS

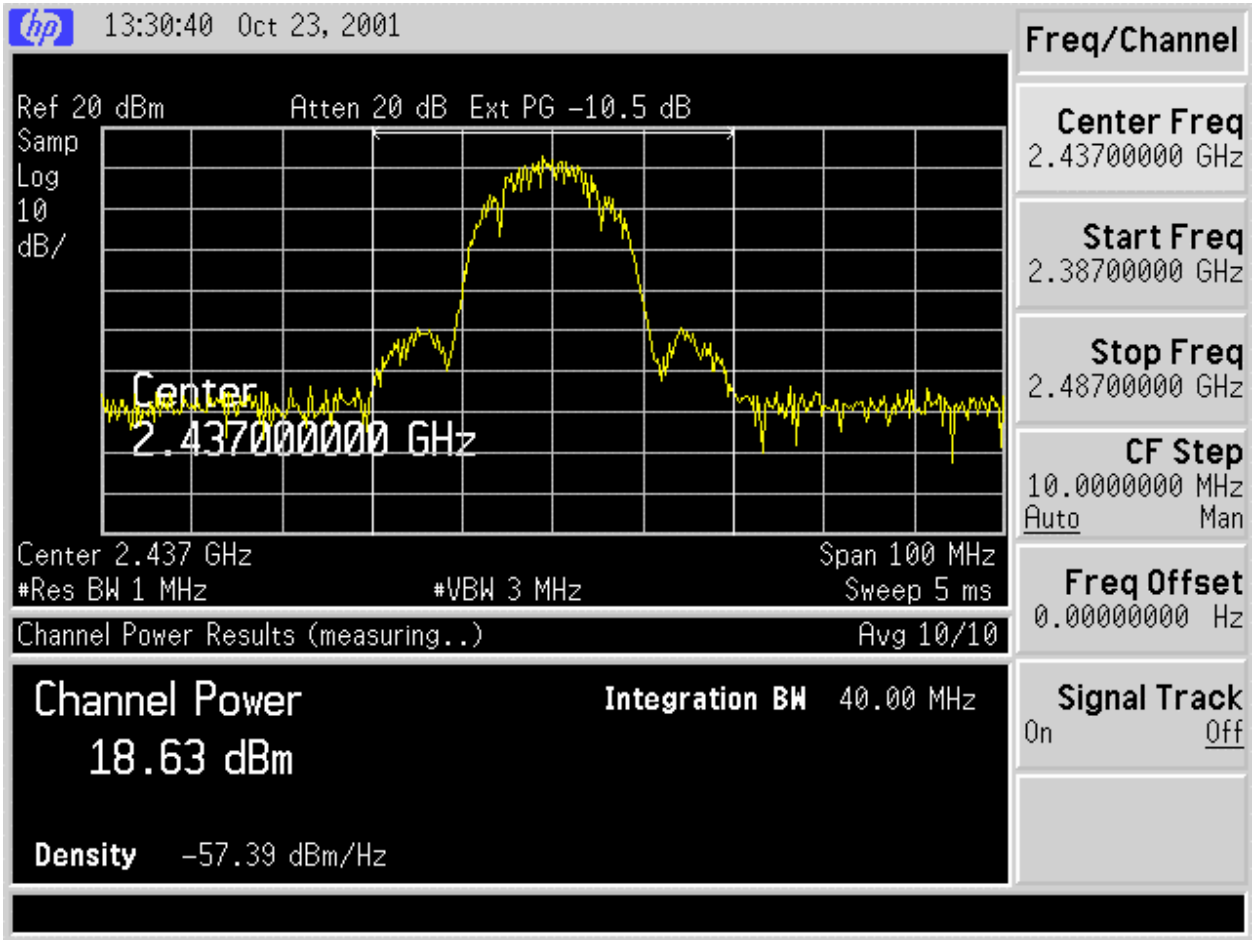


Test Condition: Channel 11: 2462 MHz, 11 Mbps

Test Limit: 30 dBm, Maximum.

Test Indication: 19.87 dBm

Test Outcome: 19.9 dBm < 30 dBm → PASS

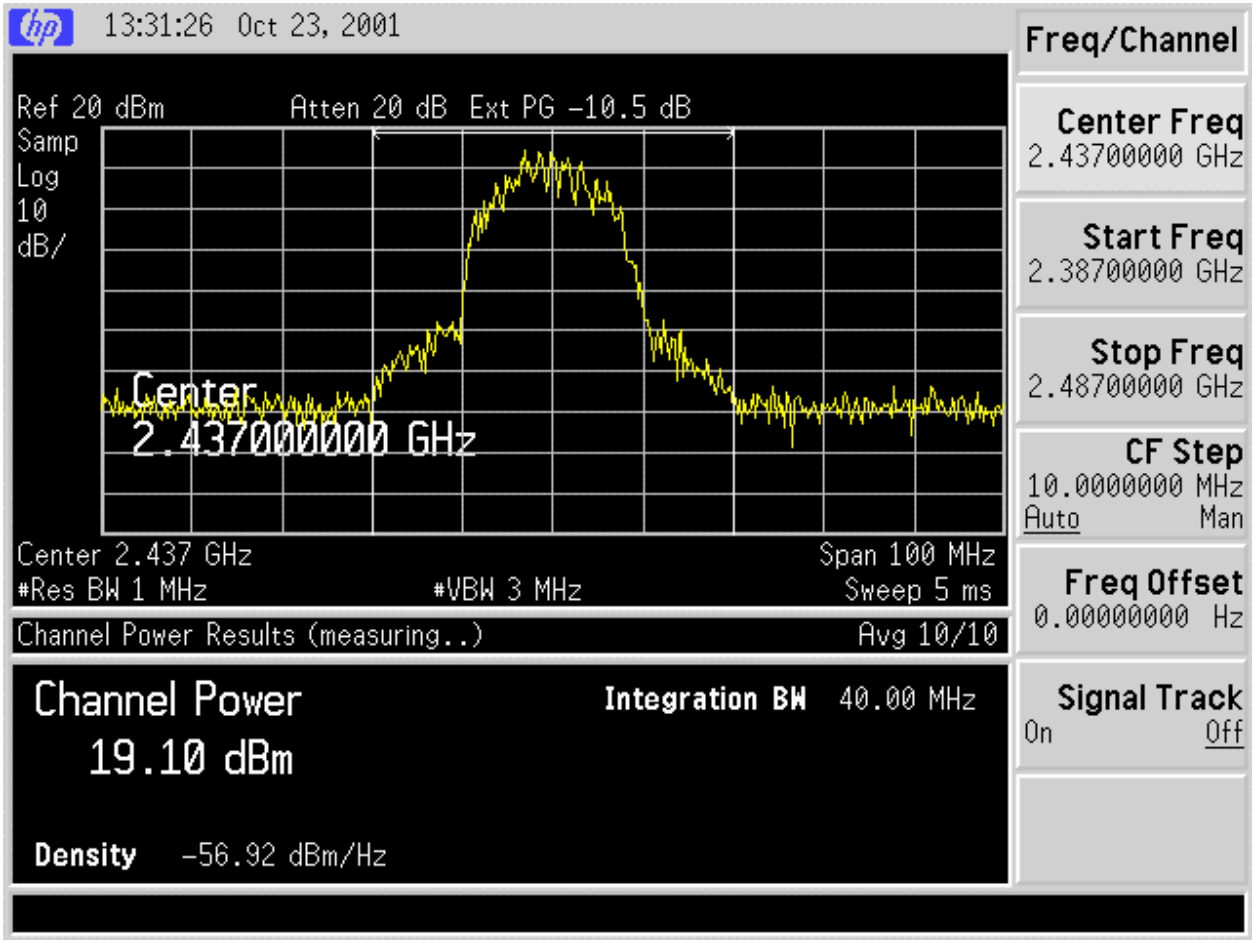


Test Condition: Channel 6: 2437 MHz, 1 Mbps

Test Limit: 30 dBm, Maximum.

Test Indication: 18.63 dBm

Test Outcome: 18.6 dBm < 30 dBm → PASS

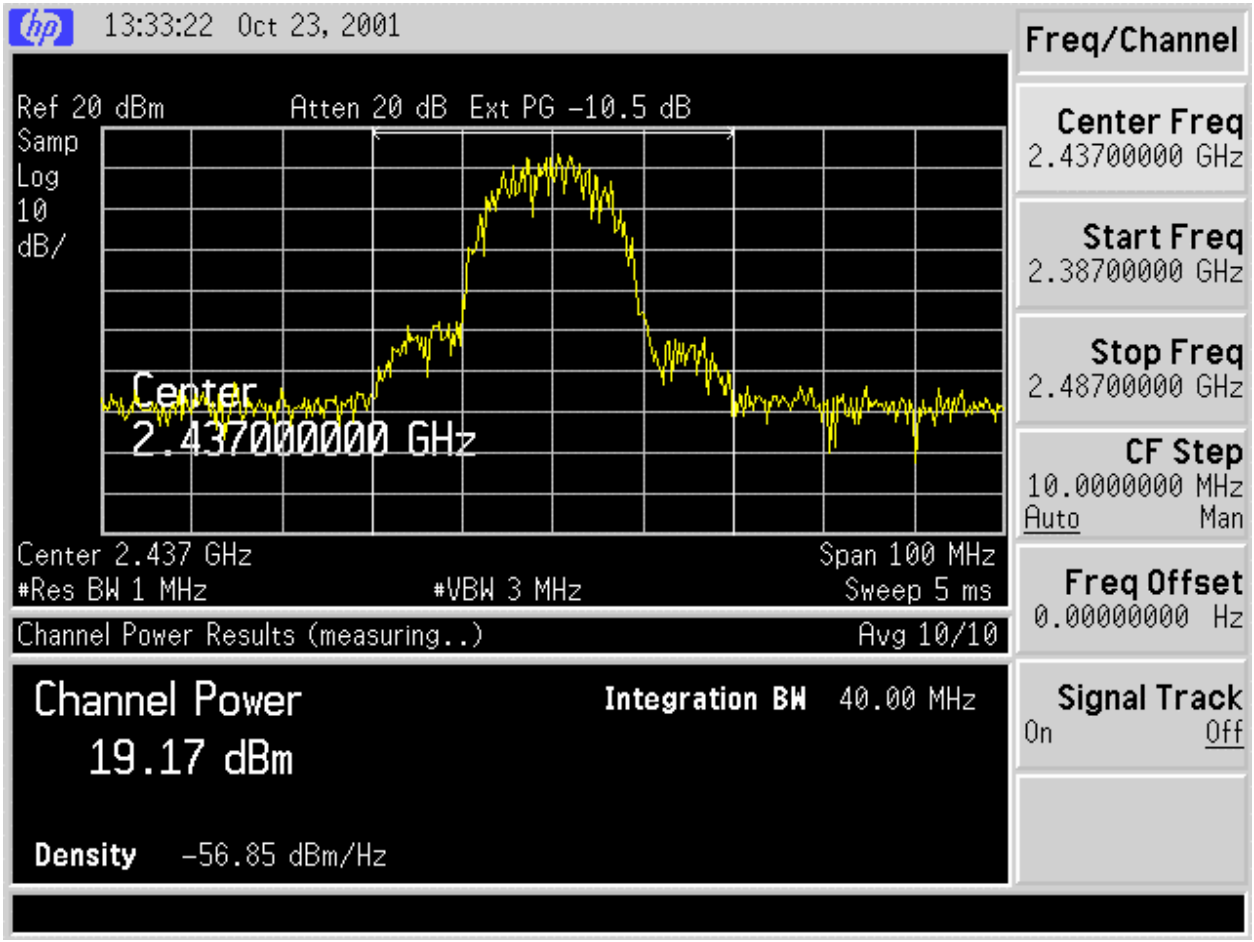


Test Condition: Channel 6: 2437 MHz, 5.5 Mbps

Test Limit: 30 dBm, Maximum.

Test Indication: 19.10 dBm

Test Outcome: 19.10 dBm < 30 dBm → PASS



Test Condition: Channel 6: 2437 MHz, 11 Mbps

Test Limit: 30 dBm, Maximum.

Test Indication: 19.17 dBm

Test Outcome: 19.2 dBm < 30 dBm → PASS

3. 15.247 (b) (3) Effective Radiated Power

The Netlink handheld device utilizes a printed circuit trace as the radiating antenna. It is nominally a quarter wave monopole, with an approximate 0dBi gain. Given the maximum conducted output power noted in the earlier section, and the minimal output power gain of the antenna, the device will comply with the ERP requirement.

4. 15.247 (c) Spurious Modulation Products

a) Test Requirement

The conducted spurious modulation products outside of the authorized band measured within a 100 kHz bandwidth shall be 20 dB below the authorized band peak emission measured within a 100 kHz bandwidth.

$$10\ \log_{10}\left(\frac{P_{Authorized}/100\,kHz}{P_{spurious}/100\,kHz}\right) >\ 20\ dBc$$

b) Test Configuration

The test configuration is presented in section II-A-1b., (*modified for retest, see p 14)*

c) Test Conditions: Equipment Under Test

The equipment under test is tunable and is set to 3 different channels, one representing the minimum tunable frequency, one representing a midband frequency and one representing the maximum tunable frequency. The frequencies and their channel designators are presented below for reference. Secondly, since the access point is a multi-rate radio, the data (bit) rate test cases are also listed. These test conditions are for the test indications which demonstrate compliance at the authorized band-edges.

Channel 1: 2412 MHz; 1,5.5,11 Mbps

Channel 6: 2437 MHz; not shown

Channel 11: 2462 MHz; 1,5.5,11 Mbps

A wideband scan of the harmonic content is presented for channel 11 (2462 MHz) and 11 Mbps rate. This represents the declared worst-case harmonic output of the transmitter.

d) Test Conditions: Instrumentation Conditions

The following conducted spurious emissions are measured for each of the following channel and data rate settings:

Wide-band Scan of Emissions with peak emission table, 9 kHz to 24 GHz in the packet mode transmission. Peak hold mode.

In-band Scan of Emissions showing band-edge compliance in both continuous transmission and in packet mode transmission. Peak Hold Mode.

Center: Center Frequency: N/A

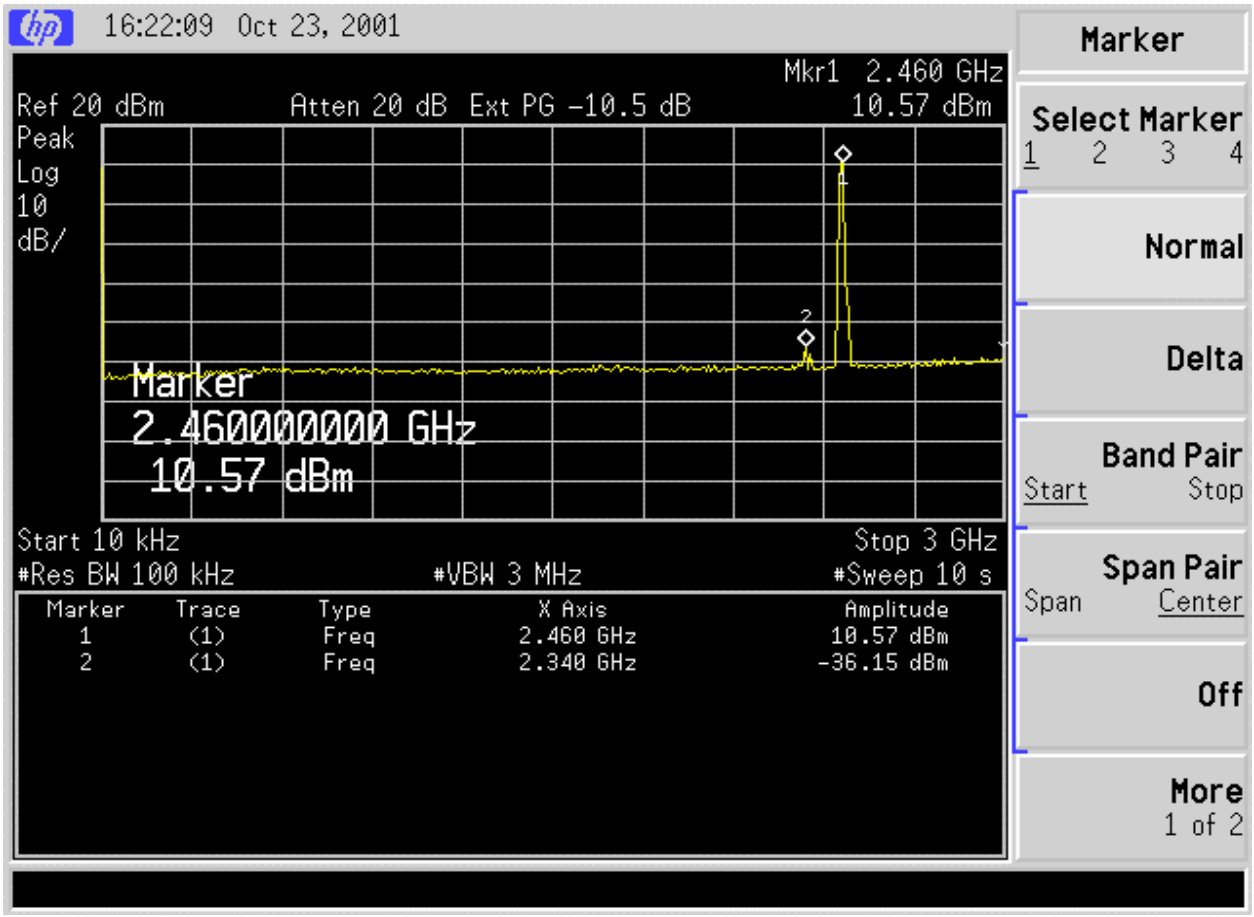
Span: Frequency Span: 9kHz to 24000MHz; 2400-2483MHz

Res BW: Resolution Bandwidth : 100kHz

VBW: Video (averaging) Bandwidth: 3.0MHz

Sweep: Frequency Sweep time over indicated frequency Span: 100sec

e)**Test Indications:**



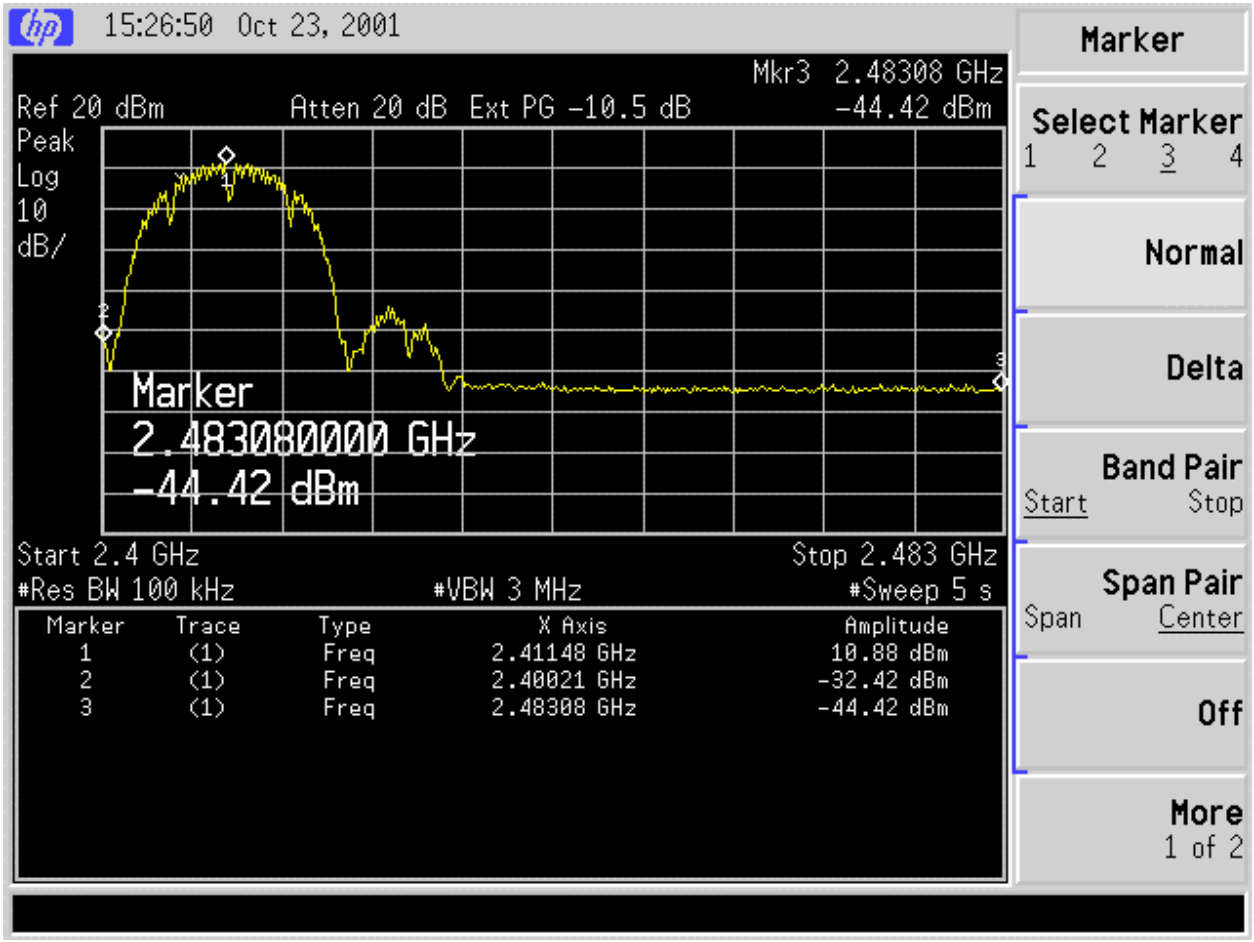
Test Condition: Channel 11: 2462 MHz, 11 Mbps, Wide Scan.
(Selected as "worst case" scenario, no other signals seen out to 24 GHz)

Test Limit: 20 dBc, Minimum.

Test Indication: 8.29 dBm/100 kHz-(-39.83 dBm/100 kHz)

= 48.12 dBc

Test Outcome: 48.12 dBc > 20 dBc → PASS



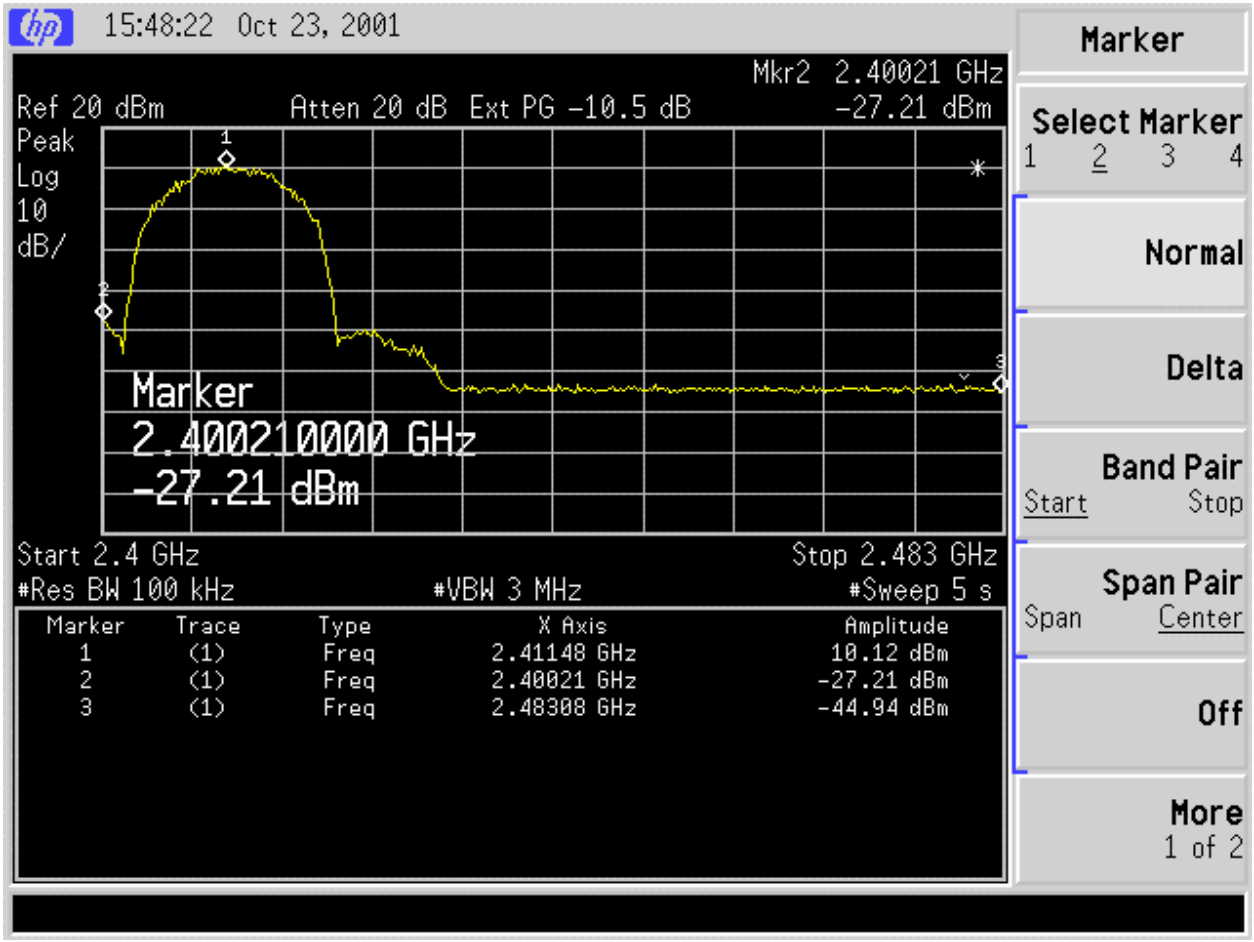
Test Condition: Channel 1: 2412 MHz, 1 Mbps

Test Limit: 20 dBc, Minimum.

Test Indication: 10.88 dBm/100 kHz-(-32.42 dBm/100 kHz)

= 43.3 dBc

Test Outcome: 43.3 dBc > 20 dBc → PASS



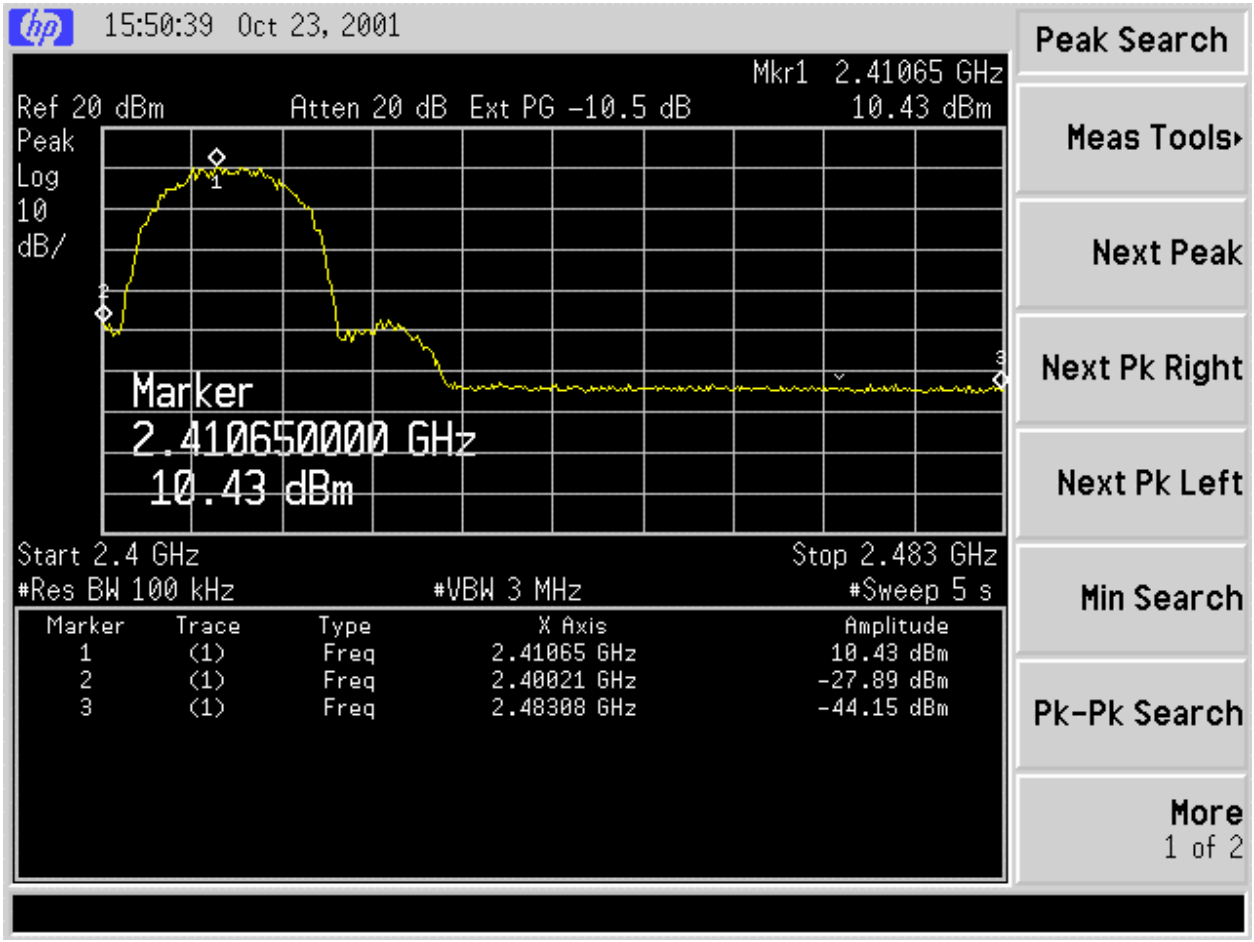
Test Condition: Channel 1: 2412 MHz, 5.5 Mbps

Test Limit: 20 dBc, Minimum.

Test Indication: 10.12 dBm/100 kHz-(-27.21 dBm/100 kHz)

= 37.33 dBc

Test Outcome: 37.3 dBc > 20 dBc → PASS



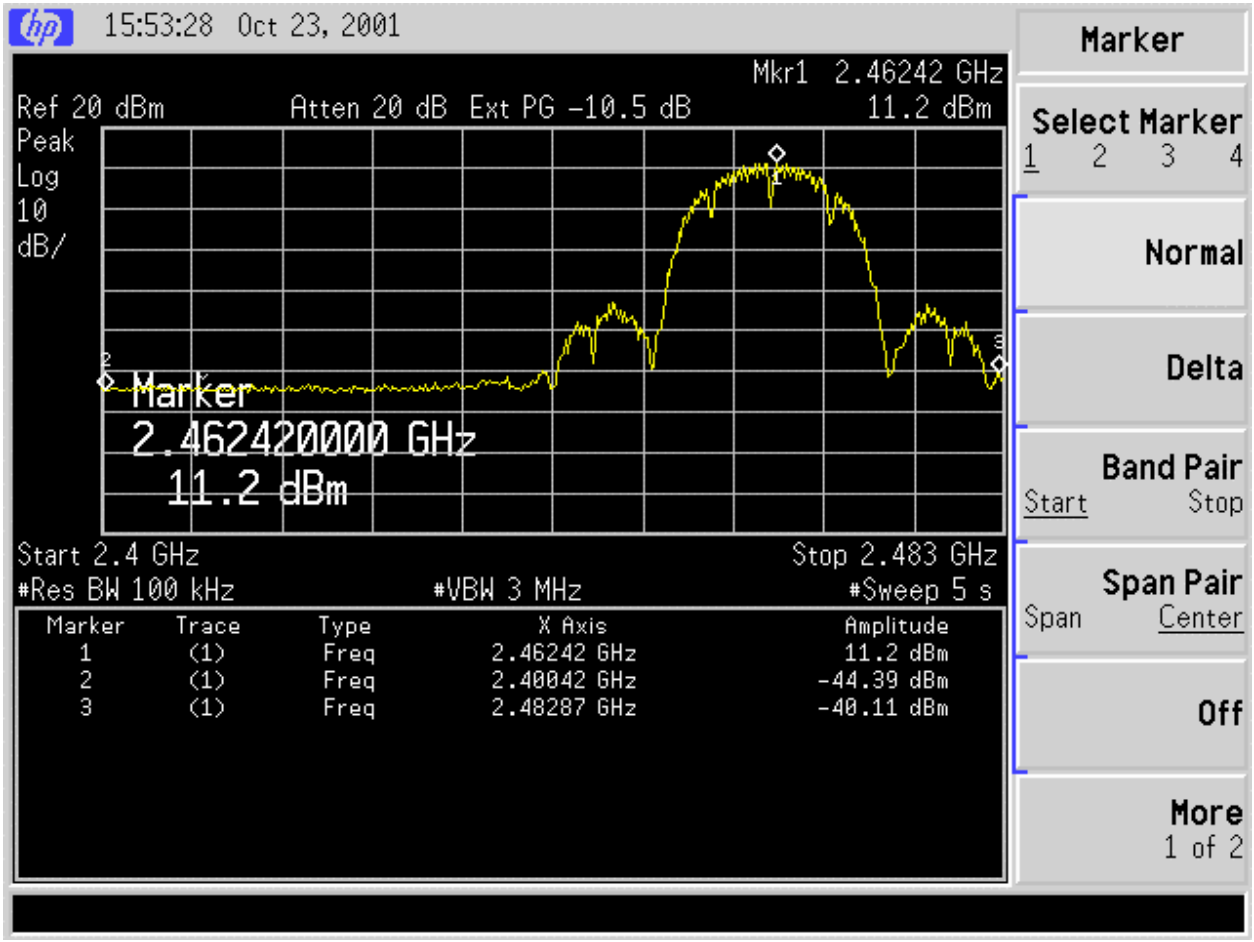
Test Condition: Channel 1: 2412 MHz, 11 Mbps

Test Limit: 20 dBc, Minimum.

Test Indication: 10.43 dBm/100 kHz-(-27.89 dBm/100 kHz)

= 38.32 dBc

Test Outcome: 38.3 dBc > 20 dBc → PASS



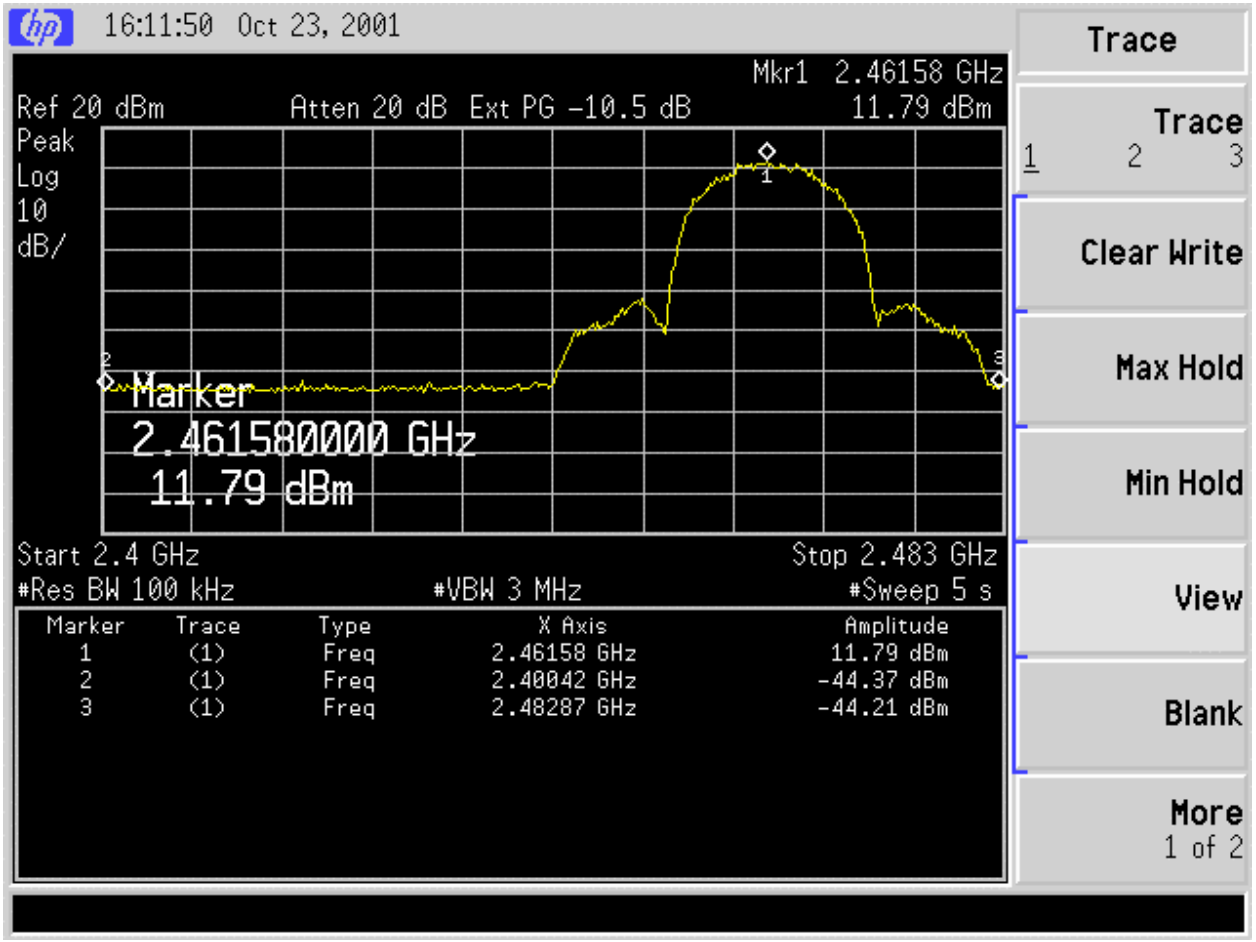
Test Condition: Channel 11: 2462 MHz, 1 Mbps

Test Limit: 20 dBc, Minimum.

Test Indication: 11.2 dBm/100 kHz-(-40.11 dBm/100 kHz)

= 51.31 dBc

Test Outcome: 51.3 dBc > 20 dBc → PASS



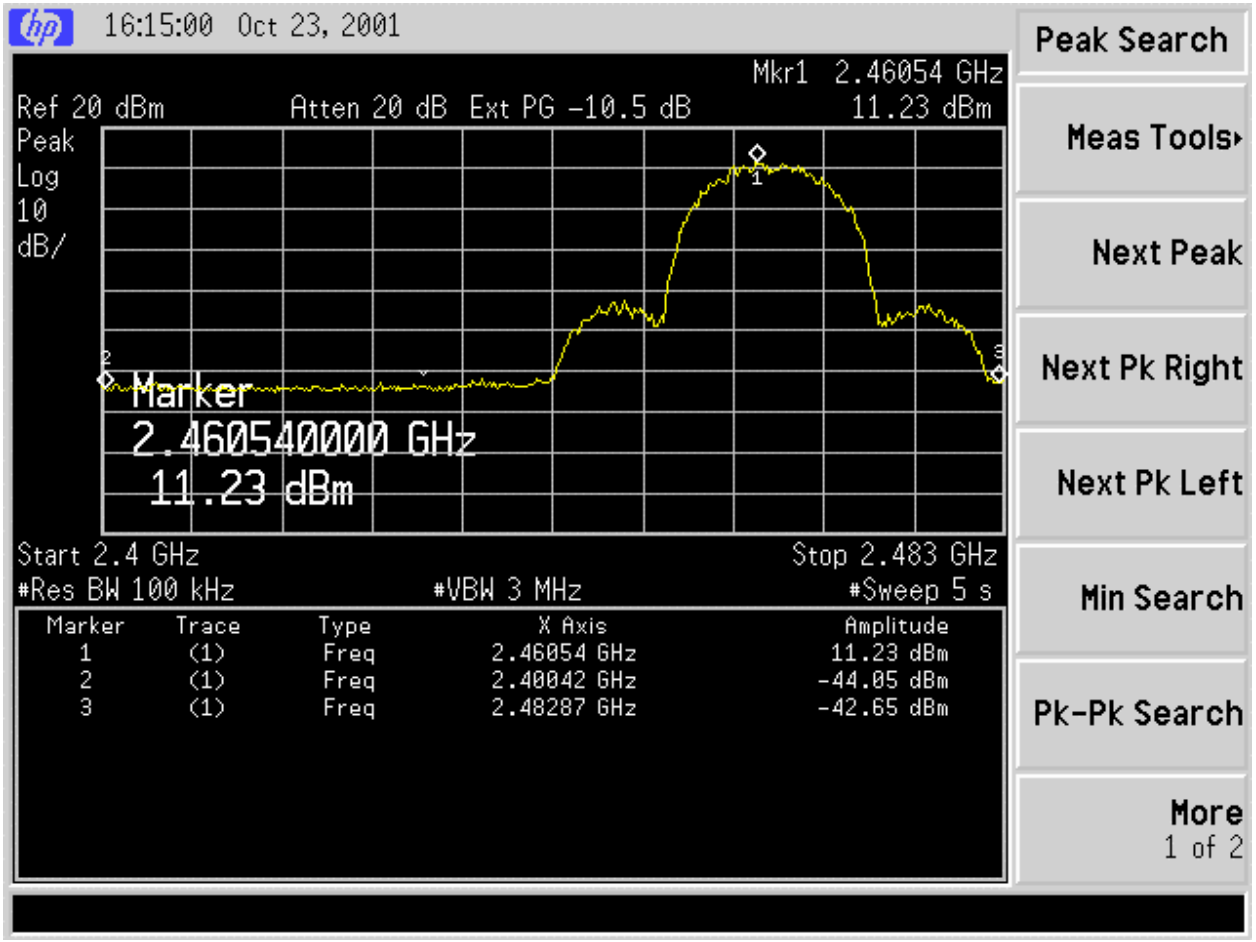
Test Condition: Channel 11: 2462 MHz, 5.5 Mbps

Test Limit: 20 dBc, Minimum.

Test Indication: 11.79 dBm/100 kHz-(-44.21 dBm/100 kHz)

= 56.0 dBc

Test Outcome: 56.0 dBc > 20 dBc → PASS



Test Condition: Channel 11: 2462 MHz, 11 Mbps

Test Limit: 20 dBc, Minimum.

Test Indication: 11.23 dBm/100 kHz-(-42.65 dBm/100 kHz)

= 53.88 dBc

Test Outcome: 53.9 dBc > 20 dBc → PASS

5. 15.247 (d) Power Spectral Density

a) Test Requirement

The maximum power spectral density allowed in the authorized band is 8 dBm/3kHz.

$$P_{authorized} / 3kHz < 8\ dBm / 3kHz$$

b) Test Configuration

The test configuration is presented in section II-A-1b. (*modified for retest, see p 14)*

c) Test Conditions: Equipment Under Test

The equipment under test is tunable and is set to 3 different channels, one representing the minimum tunable frequency, one representing a midband frequency and one representing the maximum tunable frequency. The frequencies and their channel designators are presented below for reference. Secondly, since the access point is a multi-rate radio, the data (bit) rate test cases are also listed.

Channel 1: 2412 MHz , 1 Mbps

Channel 6: 2437 MHz, 1,5.5,11 Mbps

Channel 11: 2462 MHz , 1 Mbps

Test indications under these five frequency and bit rate conditions are presented, as representative of the highest emission cases.

The following conducted power spectral densities are measured for each channel setting:

d) Test Conditions: Instrumentation

The localized peak in the emission spectrum is examined using the noise marker function implemented by the spectrum analyzer. The noise marker method is chosen, since the spectral lines of the emission are not resolvable and have noise-like properties. The power spectral density as indicated is measured in a 1 Hz bandwidth and is corrected for measurement artifacts such as noise bandwidth, and logarithmic amplification weighting. The test indication is then re-normalized to a 3 kHz bandwidth by adding the following correction factor:

$$10 \log_{10}\left(\frac{3\ kHz}{1\ Hz}\right) = 34.8\ dB$$

Center: Center Frequency: 2412, 2437, 2462 MHz

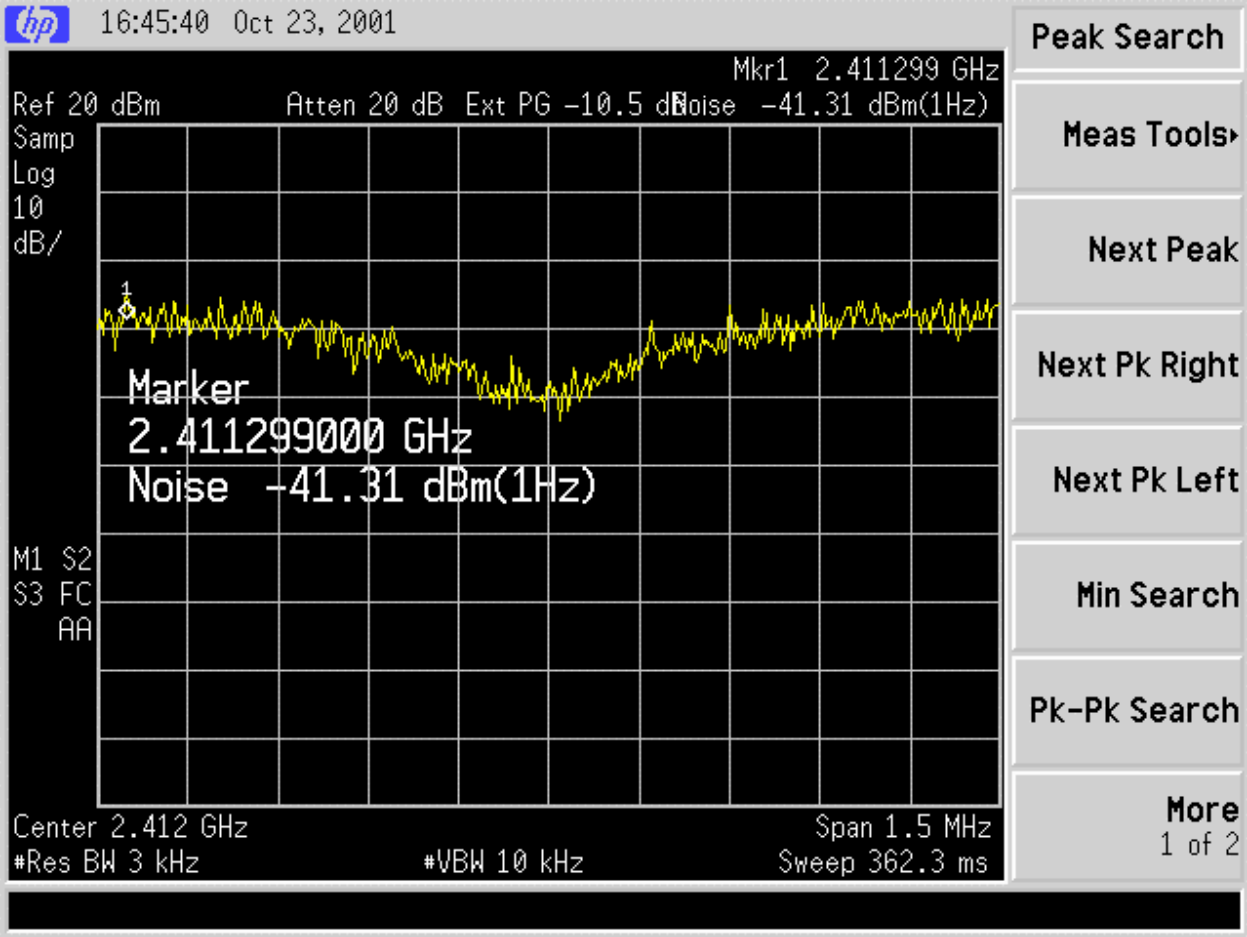
Span: Frequency Span: 50kHz

Res BW: Resolution Bandwidth: 3kHz

VBW: Video (averaging) Bandwidth: 10kHz

Sweep: Frequency Sweep time over indicated frequency Span: 92msec

e) Test Indications

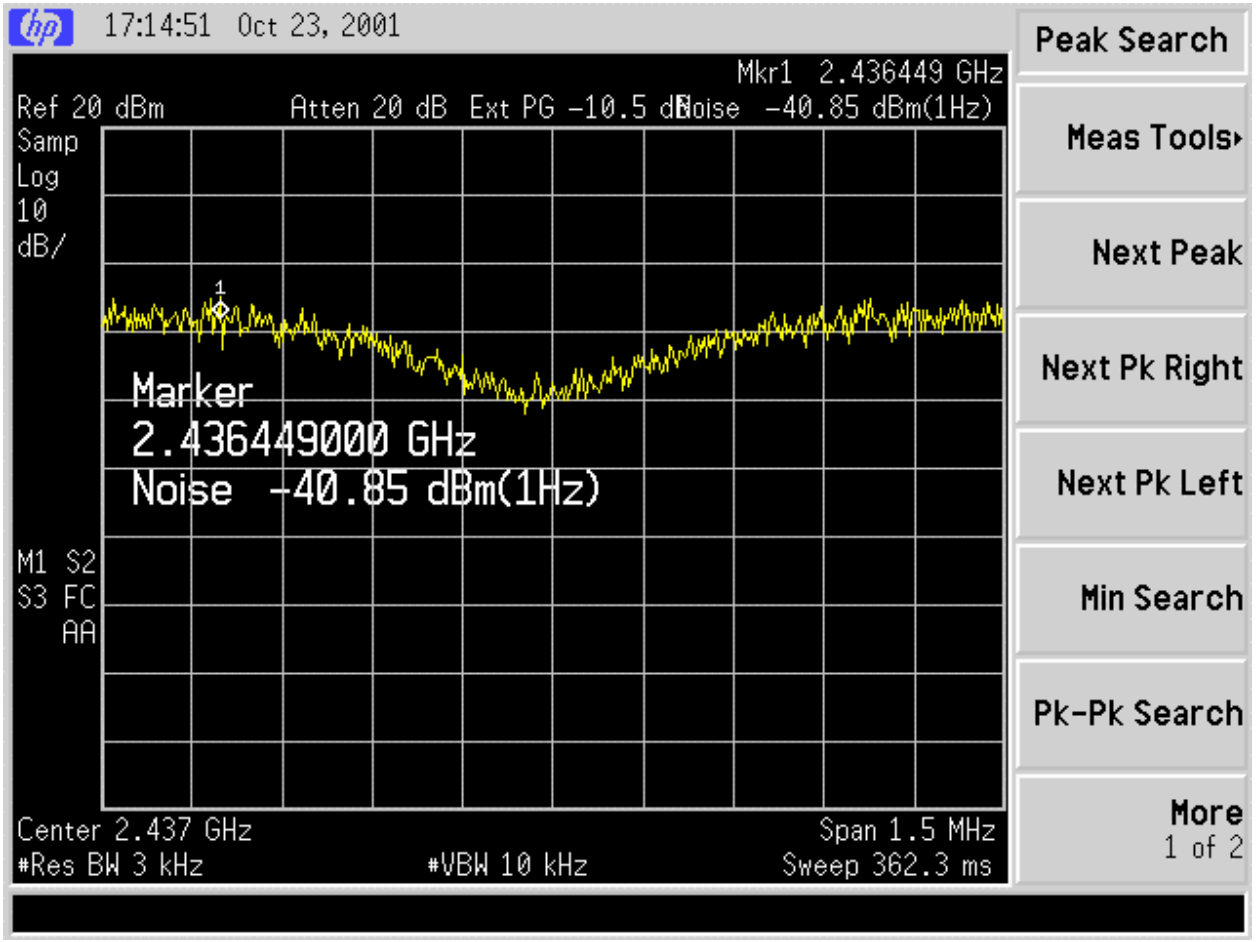


Test Condition: Channel 1: 2412 MHz, 1 Mbps

Test Limit: 8 dBm/3 kHz, Maximum.

Test Indication: -41.31 dBm/Hz + 34.8 dB = -6.51 dBm/3kHz

Test Outcome: -6.5 dBm/3kHz < 8 dBm/3kHz → PASS

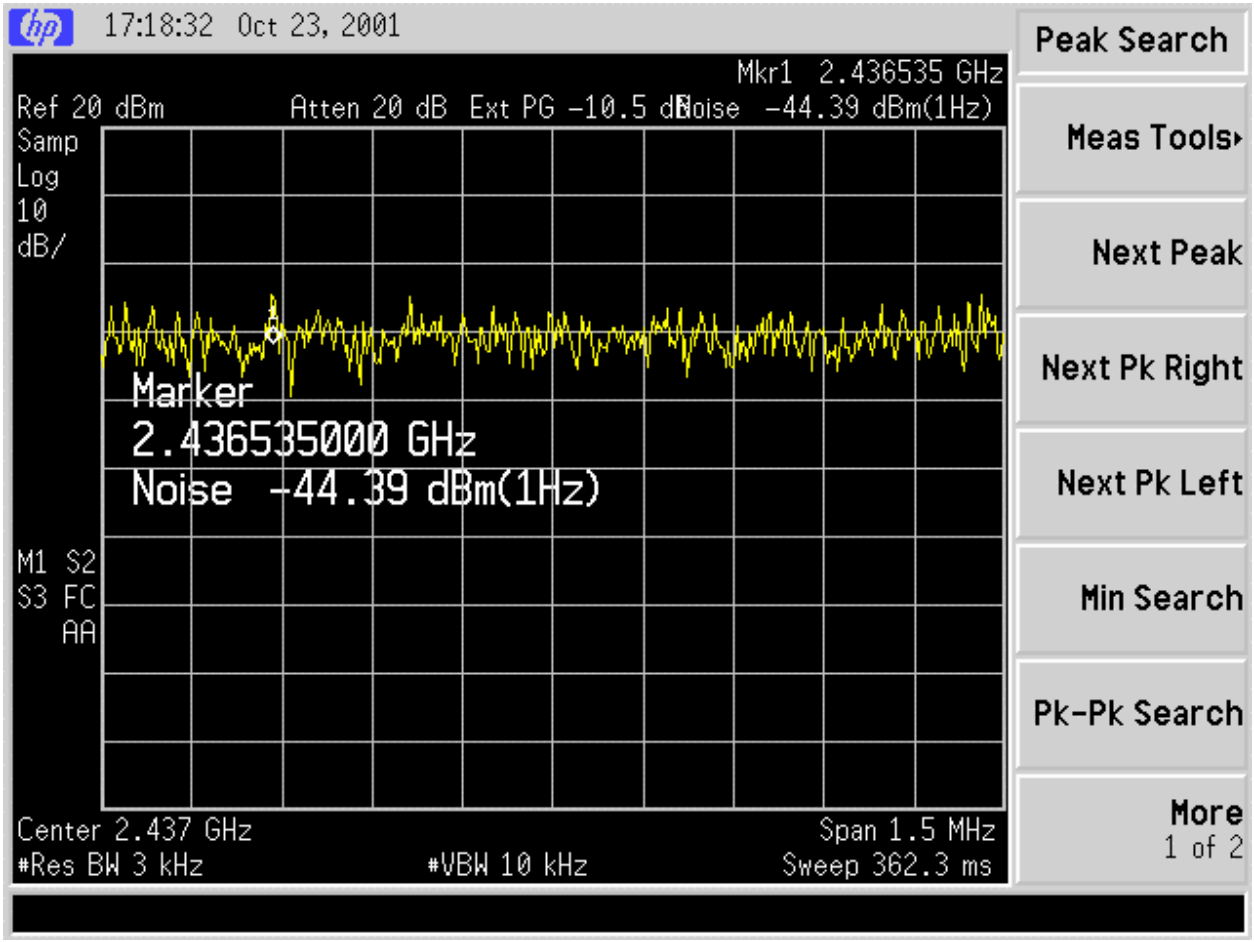


Test Condition: Channel 6: 2437 MHz, 1 Mbps

Test Limit: 8 dBm/3 kHz, Maximum.

Test Indication: -40.85 dBm/Hz + 34.8 dB = -6.05 dBm/3kHz

Test Outcome: -6.0 dBm/3kHz < 8 dBm/3kHz → PASS

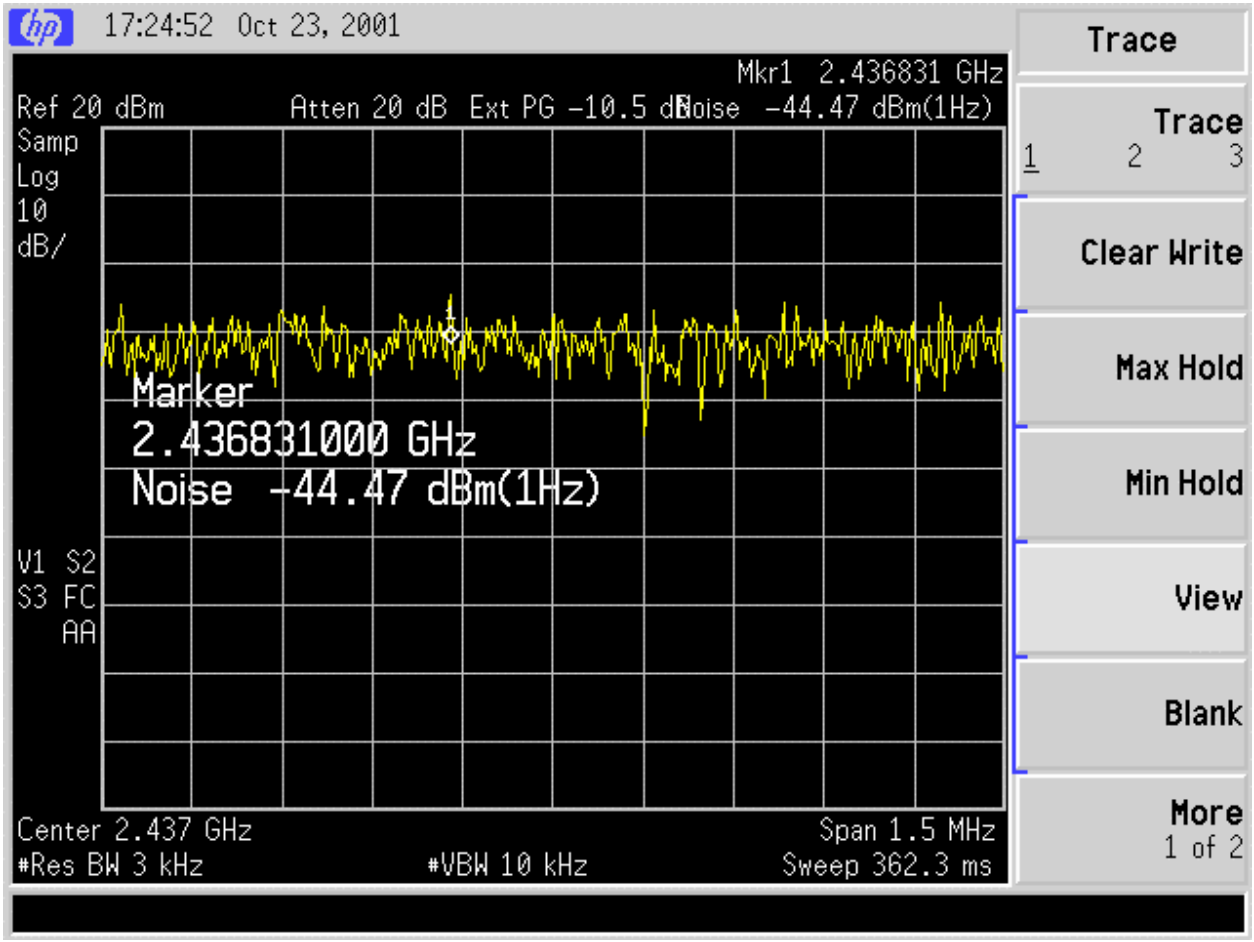


Test Condition: Channel 6: 2437 MHz, 5.5 Mbps

Test Limit: 8 dBm/3 kHz, Maximum.

Test Indication: -44.39 dBm/Hz + 34.8 dB = -9.59 dBm/3kHz

Test Outcome: -9.6 dBm/3kHz < 8 dBm/3kHz → PASS

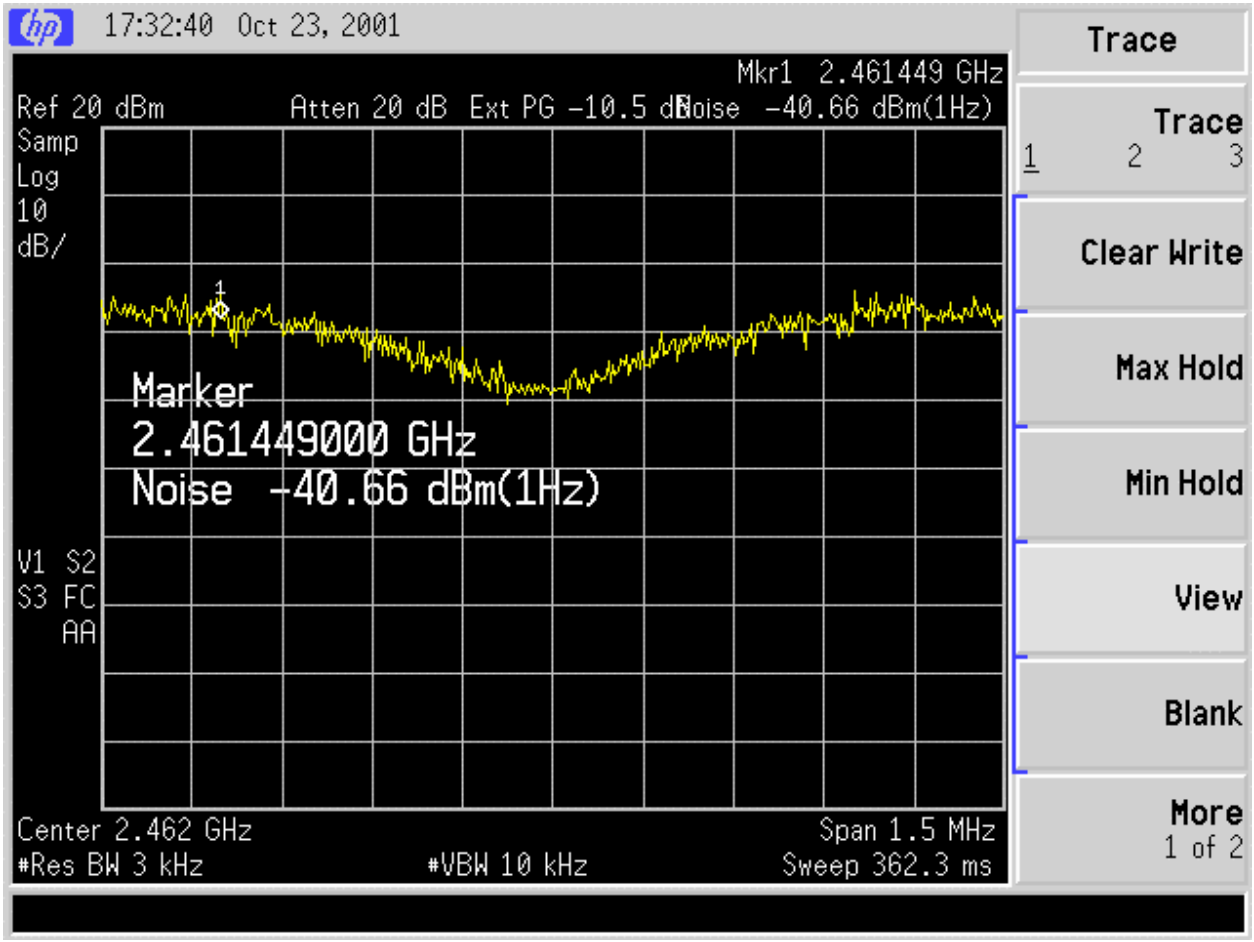


Test Condition: Channel 6: 2437 MHz, 11 Mbps

Test Limit: 8 dBm/3 kHz, Maximum.

Test Indication: -44.47 dBm/Hz + 34.8 dB = -9.67 dBm/3kHz

Test Outcome: -9.7 dBm/3kHz < 8 dBm/3kHz → PASS



Test Condition: Channel 11: 2462 MHz, 1 Mbps

Test Limit: 8 dBm/3 kHz, Maximum.

Test Indication: -40.66 dBm/Hz + 34.8 dB = -5.86 dBm/3kHz

Test Outcome: -5.9 dBm/3kHz < 8 dBm/3kHz → PASS

IV. Critical Equipment List

EQUIPMENT DESCRIPTION	LSR Serial Number	Serial Number	Calibration
Agilent E4402B Spectrum Analyzer	CC00225C	US390102040	4/3/2000
Agilent E4407B Spectrum Analyzer	CC000221C	US39160256	11/8/2000

V. Equipment Uncertainties

Specified Characteristic	Specified Probability Density	Specified Uncertainty
Agilent E4407B Spectrum Analyzer		
Agilent E4402B Spectrum Analyzer		
Total Absolute Amplitude Uncertainty	Uniform	+/-0.35 dB