

DATE: 20 August 2008

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

MOTOROLA INC.

Equipment under test:

W24 Wi-Fi Module

W24

Written by:



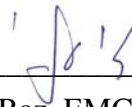
D. Shidlowsky, Documentation

Approved by:



A. Sharabi, Test Engineer

Approved by:



I. Raz, EMC Laboratory Manager

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This report relates only to items tested.

APPLICANT: MOTOROLA INC

FCC ID: IHDP6JF1

Measurement/Technical Report for MOTOROLA INC.

W24 Wi-Fi Module

W24

FCC ID: IHDP6JF1

20 August 2008

This report concerns: Original Grant x Class II change

Class B verification Class A verification Class I change

Equipment type: Direct Sequence Spread Spectrum Transmitter

Request Issue of Grant:

 x Immediately upon completion of review

Limits used:

CISPR 22

Part 15 x

Measurement procedure used is ANSI C63.4-2003.

Application for Certification

prepared by:

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1. General Information

1.1 Administrative Information

Manufacturer: MOTOROLA INC.

Manufacturer's Address: 3 Kremenetski St.
Tel Aviv 67899
Israel
Tel: +972-3-565-8888
Fax: +972-3-565-9692

Manufacturer's Representative: Gil Cahlon

Equipment Under Test (E.U.T): W24 Wi-Fi Module

Equipment Model No.: W24

Equipment Serial No.: UQT00040

Date of Receipt of E.U.T: 01.02.08

Start of Test: 01.02.08

End of Test: 29.02.08; 13.07.08*

Test Laboratory Location: I.T.L (Product Testing) Ltd.
Kfar Bin Nun,
ISRAEL 99780

Test Specifications: See Section 2

* Spurious radiated emission and band edges were re-tested with an antenna connected to the module on 13.07.08.

1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), Registration No. 90715.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-1350, R-1285.
5. Industry Canada (Canada), File No. IC 4025.
6. TUV Product Services, England, ASLLAS No. 97201.
7. Nemko (Norway), Authorization No. ELA 207.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

1.3 *Product Description*

The W24 is a self-contained Wi-Fi module, supporting IEEE 802.11 b/g systems in the 2.4 GHz band.

1.4 *Test Methodology*

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2003. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 *Test Facility*

The radiated emissions tests were performed at I.T.L.'s testing facility at Kfar Bin-Nun, Israel. This site is a FCC listed test laboratory (FCC Registration No. 90715, date of listing August 22, 2006).
I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

1.6 *Measurement Uncertainty*

Radiated Emission

The Open Site complies with the ± 4 dB Normalized Site Attenuation requirements of ANSI C63.4-2003. In accordance with Paragraph 5.4.6.1 of this standard, this tolerance includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies.

2. System Test Configuration

2.1 Justification

Radiated emission screening was performed in 3 orthogonal orientations. The worst case orientation was the horizontal position.

Spurious radiated emission and band edge tests were re-tested with an antenna (3 dBi gain, see antenna data in Section 9 of this report), connected to the E.U.T.

2.2 EUT Exercise Software

Manufacturing software was used for the tests.

2.3 Special Accessories

An access point, M/N AP-5131, FCC ID: H9PAP5131D, manufactured by SYMBOL , was used for testing at the bit rate of 1Mbit/sec.

2.4 Equipment Modifications

Transmit power in the 6Mbps baud rate was increased.

2.5 Configuration of Tested System

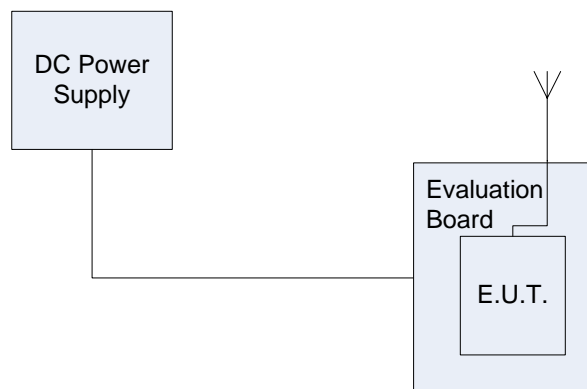


Figure 1. Configuration of Re-tested System

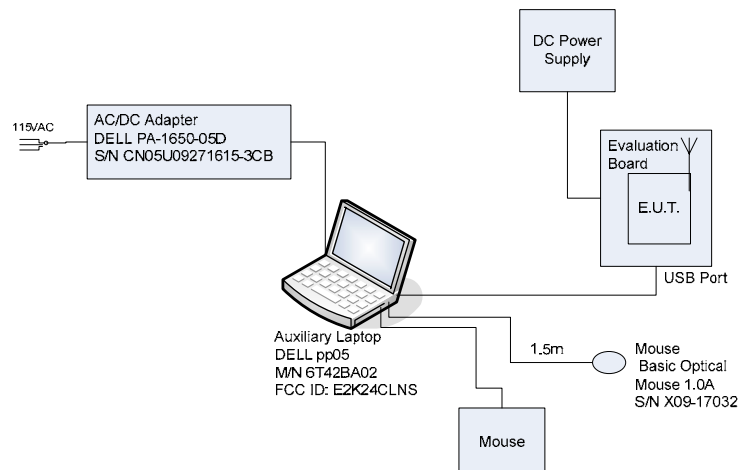


Figure 2. Configuration of System Conducted Emission Test

3. Theory of Operation

The W24 is a self-contained Wi-Fi module, supporting IEEE 802.11 b/g Direct Sequence Spread Spectrum (DSSS) / Orthogonal Frequency Division Multiplexing (OFDM) wireless transceiver systems in the 2.4 GHz band. The W24 enables IP connectivity to any host device. It is ideal for enabling M2M applications to achieve secure, high speed throughput, and access to IP networks via 802.11 b/g wireless LANs or even via cellular network.

4. Set Up Photographs

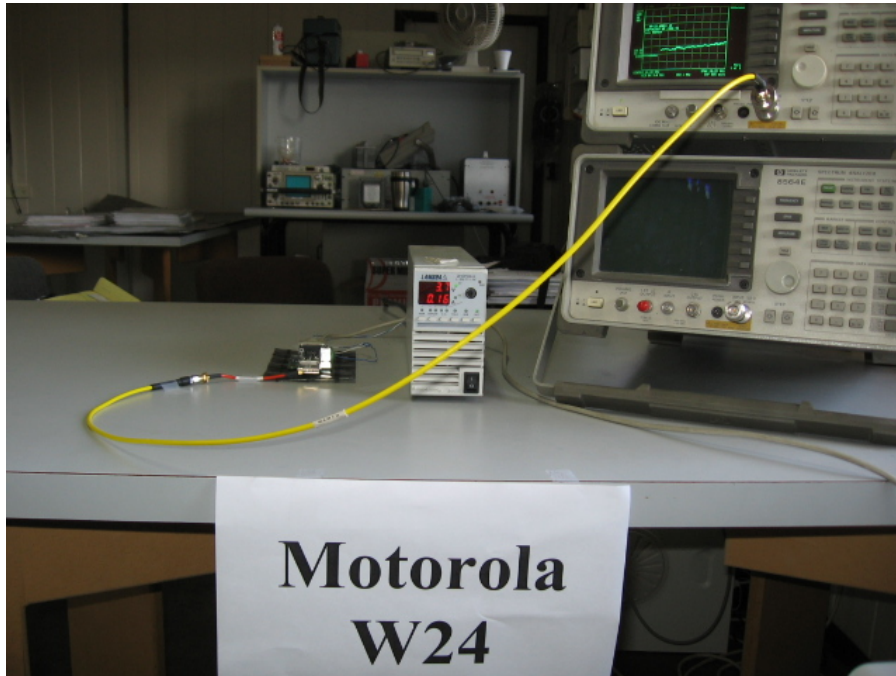


Figure 3. Conducted Emission From Antenna Port



Figure 4. Conducted Emission From AC Mains Test Front



Figure 5. Radiated Emission Re-test

5. Conducted Emission Test Data

5.1 Test Specification

0.15 - 30 MHz, FCC Part 15, Subpart C

5.2 Test Procedure

The E.U.T operation mode and test configuration are as described in Section 4. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room (see Section 3), with the E.U.T placed on an 0.8 meter high wooden table, 0.4 meter from the room's vertical wall. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50 μ Hn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in the photograph, *Figure 4. Conducted Emission From AC Mains Test Front.*

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying to CISPR 16 requirements. The specification limits are loaded to the receiver via a 3.5" floppy disk and are displayed on the receiver's spectrum display.

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

During the conducted emission from AC power lines test, the WLAN transmission was operated.

5.3 Test Data

JUDGEMENT: Passed by 18.2 dB

The E.U.T met the requirements of the FCC Part 15, Subpart C specification.

The details of the highest emissions are given in *Figure 6* to *Figure 9*.

TEST PERSONNEL:

Tester Signature: For/ 

Date: 15.07.08

Typed/Printed Name: A. Sharabi

Notes:

1. Exploratory radiated emission testing was performed in order to determine which configuration (connection via RS232 or USB port) was the “worst” case.
2. Based on the exploratory emission test, the connection via USB port was selected as the “worst” case.

Conducted Emission

E.U.T Description W24 Wi-Fi Module
Type W24
Serial Number: UQT00040

Specification: FCC Part 15, Subpart C

Lead: Phase

Detectors: Peak, Quasi-peak, Average

Signal Number	Frequency (MHz)	Peak (dBuV)	QP (dBuV)	QP Delta L 1 (dB)	Avg (dBuV)	Av Delta L 2 (dB)	Corr (dB)
1	0.151098	56.3	47.7	-18.2	31.4	-24.6	0.0
2	0.287694	37.2	33.4	-27.2	19.0	-31.6	0.0
3	0.353314	34.7	32.5	-26.5	25.4	-23.5	0.0
4	1.441902	34.7	32.5	-23.5	19.5	-26.5	0.0
5	2.235067	32.8	30.5	-25.5	22.5	-23.5	0.0
6	21.084083	28.2	23.7	-36.3	16.8	-33.2	0.0

Figure 6. Detectors: Peak, Quasi-peak, AVERAGE .

Note: QP Delta/Av Delta refer to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Conducted Emission

E.U.T Description W24 Wi-Fi Module
 Type W24
 Serial Number: UQT00040

Specification: FCC Part 15, Subpart C
 Lead: Phase
 Detectors: Peak, Quasi-peak, Average

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ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR 21.23 MHz
 26.64 dBμV

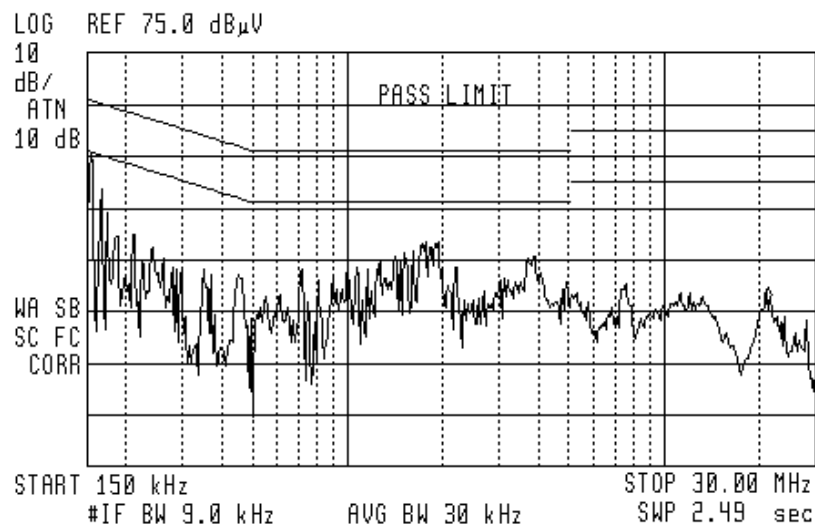


Figure 7. Detectors: Peak, Quasi-peak, Average

Conducted Emission

E.U.T Description W24 Wi-Fi Module
Type W24
Serial Number: UQT00040

Specification: FCC Part 15, Subpart C
Lead: Neutral
Detectors: Peak, Quasi-peak, Average

Signal Number	Frequency (MHz)	Peak (dBuV)	QP (dBuV)	QP Delta L 1 (dB)	Avg (dBuV)	Av Delta L 2 (dB)	Corr (dB)
1	0.170881	53.1	42.0	-23.0	24.7	-30.3	0.0
2	0.244417	38.9	33.6	-28.4	20.4	-31.6	0.0
3	1.519336	37.1	34.6	-21.4	25.9	-20.1	0.0
4	3.405686	32.1	28.1	-27.9	19.8	-26.2	0.0
5	11.887956	27.7	23.8	-36.2	19.8	-30.2	0.0
6	21.543707	28.2	25.0	-35.0	20.7	-29.3	0.0

Figure 8. Detectors: Peak, Quasi-peak, AVERAGE

Note: QP Delta/Av Delta refer to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.


Conducted Emission

E.U.T Description W24 Wi-Fi Module
 Type W24
 Serial Number: UQT00040

Specification: FCC Part 15, Subpart C

Lead: Neutral

Detectors: Peak, Quasi-peak, Average

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ACTV DET: PEAK
 MEAS DET: PEAK QP AVG
 MKR 21.54 MHz
 26.38 dBμV

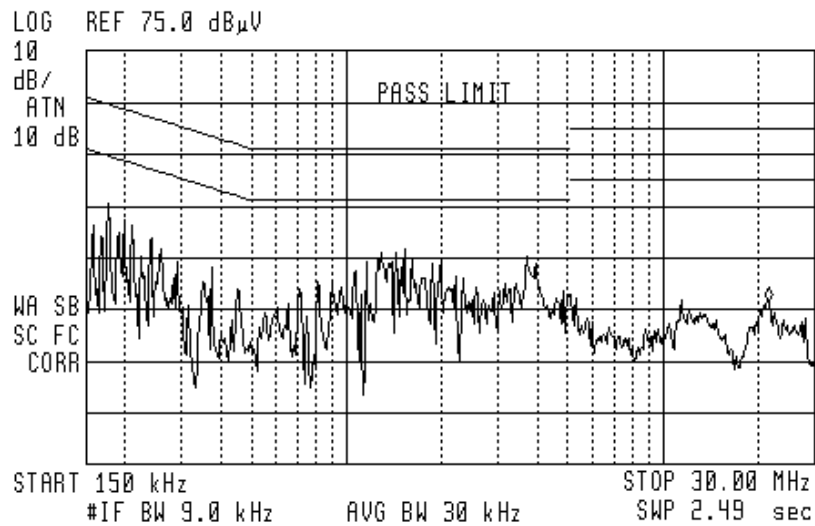


Figure 9 Conducted Emission: NEUTRAL
Detectors: Peak, Quasi-peak, Average

5.4 Test Instrumentation Used, Conducted Measurement

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
LISN	Fischer	FCC-LISN-2A	127	March 8, 2008	1 Year
LISN	Fischer	FCC-LISN-2A	128	March 8, 2008	1 Year
EMI Receiver	HP	85422E	3906A00276	November 12, 2007	1 Year
RF Filter Section	HP	85420E	3705A00248	November 12, 2007	1 Year
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

6. Spurious Radiated Emission Below 1 GHz With Antenna

6.1 Test Specification

9kHz-1000 MHz, F.C.C., Part 15, Subpart C

6.2 Test Procedure

The E.U.T. operation mode and test set-up are as described in Section 3.

See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 3.1.

The frequency range 9 kHz-1000 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 9 kHz-30 MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter.

In the frequency range 30-1000 MHz, the readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Verification of the E.U.T emissions was based on the following methods:

- Turning the E.U.T on and off.

- Using a frequency span less than 10 MHz.

- Observation of the signal level during turntable rotation. Background noise is not affected by the rotation of the E.U.T.

The E.U.T. was tested at the operating frequencies of 2412, 2437, and 2462 MHz using the following modulations: BPSK, QPSK, 16QAM, and 64QAM.

6.3 Test Data

JUDGEMENT: Passed

No signals were found in the frequency range of 9 kHz to 1.0 GHz

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.

The results for all three operating frequencies and modulations were the same.

TEST PERSONNEL:

Tester Signature: For/ 

Date: 15.07.08

Typed/Printed Name: A. Sharabi

6.4 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Period
EMI Receiver	HP	85422E	3411A00102	November 12, 2007	1 year
RF Section	HP	85420E	3427A00103	November 12, 2007	1 year
Antenna Bioconical	ARA	BCD 235/B	1041	March 23, 2008	1 year
Antenna Log Periodic	ARA	LPD-2010/A	1038	November 22, 2007	1 year
Active Loop Antenna	EMCO	6502	9506-2950	October 15, 2007	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

6.5 *Field Strength Calculation*

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$[\text{dB}\mu\text{V/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF}$$

FS: Field Strength [dB μ V/m]
RA: Receiver Amplitude [dB μ V]
AF: Receiving Antenna Correction Factor [dB/m]
CF: Cable Attenuation Factor [dB]

No external pre-amplifiers are used.

7. Spurious Radiated Emission Above 1 GHz With Antenna

7.1 Radiated Emission Above 1 GHz

The E.U.T operation mode and test set-up are as described in Section 3.

See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 3.1.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

In the frequency range 1-2.9 GHz, a computerized EMI receiver complying to CISPR 16 requirements was used.

In the frequency range 2.9-25.0 GHz, a spectrum analyzer including a low noise amplifier was used. During average measurements, the IF bandwidth was 1 MHz and the video bandwidth was 100Hz. During peak measurements, the IF bandwidth was 1 MHz and the video bandwidth was 3 MHz.

The test distance was 3 meters.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

The E.U.T. was tested at the operating frequencies of 2412, 2437, and 2462 MHz using the following modulations: BPSK, QPSK, 16QAM, and 64QAM.

7.2 Test Data

JUDGEMENT: Passed by 8.3 dB

For the operation frequency of 2412 MHz, the margin between the emission level and the specification limit is 8.3 dB in the worst case at the frequency of 2390.00 MHz, vertical polarization.

For the operation frequency of 2437 MHz, the margin between the emission level and the specification limit is 20.9 dB in the worst case at the frequency of 4874.00 MHz, horizontal and vertical polarizations.

For the operation frequency of 2462 MHz, the margin between the emission level and the specification limit is 10.4 dB in the worst case at the frequency of 2483.50 MHz, vertical polarization.

The results for all modulations were the same.

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.

TEST PERSONNEL:

Tester Signature: For/ 

Date: 15.07.08

Typed/Printed Name: A. Sharabi

Radiated Emission Above 1 GHz

E.U.T Description W24 Wi-Fi Module
Type W24
Serial Number: UQT00040

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters Detector: Peak
Operation Frequency: 2412 MHz

Freq.	Polarity	Peak Amp	Peak. Specification	Peak. Margin
(MHz)	(H/V)	(dBμV/m)	(dB μV/m)	(dB)
2390.00	H	56.7*	74.0	-17.3
4824.00	H	45.1**	74.0	-28.9
2390.00	V	65.7*	74.0	-8.3
4824.00	V	47.3**	74.0	-26.7

**Figure 10. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss + Filter Loss- Preamplifier Gain

** “Correction Factor” = Antenna Factor + Cable Loss + Filter Loss

Radiated Emission Above 1 GHz

E.U.T Description W24 Wi-Fi Module
Type W24
Serial Number: UQT00040

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters Detector: Average
Operation Frequency: 2412 MHz

Freq.	Polarity	Average Amp	Average Specification	Average Margin
(MHz)	(H/V)	(dBμV/m)	(dB μV/m)	(dB)
2390.00	H	44.1*	54.0	-9.9
4824.00	H	33.5**	54.0	-20.5
2390.00	V	44.9*	54.0	-9.1
4824.00	V	33.4**	54.0	-20.6

**Figure 11. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Amp” includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss + Filter Loss- Preamplifier Gain

** Correction Factor = Antenna Factor + Cable Loss + Filter Loss

Radiated Emission Above 1 GHz

E.U.T Description W24 Wi-Fi Module
Type W24
Serial Number: UQT00040

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters Detector: Peak
Operation Frequency: 2437 MHz

Freq.	Polarity	Peak Amp	Peak. Specification	Peak. Margin
(MHz)	(H/V)	(dB μ V/m)	(dB μ V/m)	(dB)
4874.00	H	45.3*	74.0	-28.7
4874.00	V	45.5*	74.0	-28.5

**Figure 12. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission Above 1 GHz

E.U.T Description W24 Wi-Fi Module
Type W24
Serial Number: UQT00040

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters Detector: Average
Operation Frequency: 2437 MHz

Freq.	Polarity	Average Amp	Average Specification	Average Margin
(MHz)	(H/V)	(dBμV/m)	(dB μV/m)	(dB)
4874.00	H	33.1*	54.0	-20.9
4874.00	V	33.1*	54.0	-20.9

**Figure 13. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Amp” includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission Above 1 GHz

E.U.T Description W24 Wi-Fi Module
Type W24
Serial Number: UQT00040

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters Detector: Peak
Operation Frequency: 2462 MHz

Freq.	Polarity	Peak Amp	Peak. Specification	Peak. Margin
(MHz)	(H/V)	(dB μ V/m)	(dB μ V/m)	(dB)
2483.50	H	56.4*	74.0	-17.6
4924.00	H	47.3**	74.0	-26.7
2483.50	V	56.8*	74.0	-17.2
4924.00	V	45.3**	74.0	-28.7

**Figure 14. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss + Filter Loss- Preamplifier Gain

** “Correction Factor” = Antenna Factor + Cable Loss + Filter Loss

Radiated Emission Above 1 GHz

E.U.T Description W24 Wi-Fi Module
Type W24
Serial Number: UQT00040

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
Test Distance: 3 meters Detector: Average
Operation Frequency: 2462 MHz

Freq.	Polarity	Average Amp	Average Specification	Average Margin
(MHz)	(H/V)	(dBμV/m)	(dB μV/m)	(dB)
2483.50	H	43.5*	54.0	-10.5
4924.00	H	33.2*	54.0	-20.8
2483.50	V	43.6*	54.0	-10.4
4924.00	V	33.2*	54.0	-20.8

**Figure 15. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Amp” includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss + Filter Loss- Preamplifier Gain

** Correction Factor = Antenna Factor + Cable Loss + Filter Loss

7.3 Test Instrumentation Used, Radiated Measurements Above 1 GHz

Instrument	Manufacturer	Model	Serial Number	Last Calibration Date	Period
Receiver	HP	85422E	3411A00102	November 12, 2007	1 year
RF Section	HP	85420E	3427A00103	November 12, 2007	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A
Antenna-Log Periodic	A.H.System	SAS-200/511	253	February 4, 2007	2 years
Double Ridged Waveguide Horn Antenna	EMCO	3115	29845	March 16, 2008	2 years
Horn Antenna	ARA	SWH-28	1008	December 8, 2006	2 year
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	November 2, 2007	1 year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	January 9, 2008	1 year
Spectrum Analyzer	HP	8593EM	3536A00120	February 26, 2008	1 year
Spectrum Analyzer	HP	8546E	3442A00275	November 14, 2007	1 year
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

8. Antenna Information



2.4 GHz 3 dBi Reverse Polarity-SMA "Rubber Duck" Wireless LAN Antenna - Model: HG2403RD-RSF

Applications and Features

Applications:

- 2.4 GHz ISM Band
- IEEE 802.11b and 802.11g Wireless LAN
- Bluetooth®
- WiFi
- Wireless Video Systems
- Multipoint and Mobile Applications

Features:

- Compact size, only 5.4" long
- Flexible "Rubber Duck" antenna
- Tilt and swivel design
- RP-SMA Connector
- RoHS Compliant
- Optional Magnetic Mount Available



Description

This compact 2.4GHz omnidirectional "rubber-duck" WiFi antenna provides broad coverage and 3 dBi gain. It is a coaxial sleeve design with an omni-directional pattern. It is ideally suited for IEEE 802.11b and 802.11g wireless LANs, Bluetooth® and other WLAN applications.

Only 5.4" long, this flexible antenna features a tilt-and-swivel reverse-polarity SMA plug connector, allowing them to be used vertically, at a right angle, or any angle in-between. It is suitable as a replacement antenna for many access points and radios that are equipped with reverse-polarity SMA connectors including D-Link®, Linksys® WET11 and others (Note: This RF antenna is used as a "replacement" antenna rather than a "range extender" antenna. It should yield similar range to most radio's stock RF antennas)

Application Note: This antenna is not for use with U.S.Robotics® RP-SMA equipped devices.

Specifications

Frequency	2400-2500 MHz
Gain	3 dBi
Impedance	50 Ohm
VSWR	< 2.0
Weight	0.81 oz. (23 g)
Length	5.4" (137 mm)
Diameter	0.5" (13 mm)
Finish	Matte Black
Connector	Reverse Polarity SMA Plug
Operating Temperature	-40° C to 85° C (-40° F to 185° F)
Flame Rating	UL 94HB
Polarization	Vertical
RoHS Compliant	Yes

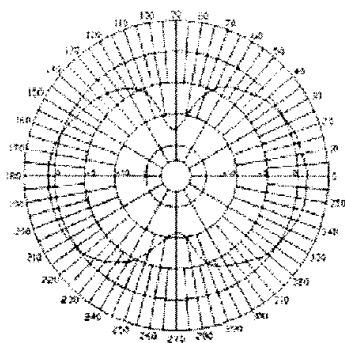


e-mail: sales@hyperlinktech.com • tel: 561-995-2256 • fax: 561-995-2432
web: www.hyperlinktech.com • 1201 Clint Moore Road • Boca Raton FL 33487

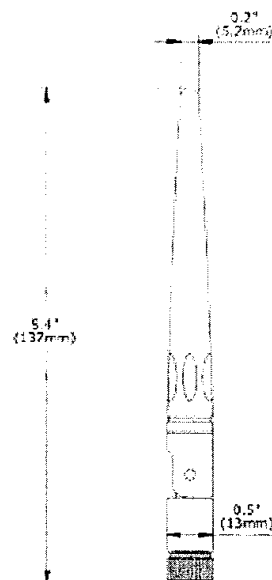


Antenna Gain Pattern

Dimensional Drawing




Vertical



Guaranteed Quality

This product is backed by Hyperlink's Limited Warranty

Magnetic Mount

Model	Description
 HMA6-RSPA10	Reverse-Polarity SMA-Jack (RP-SMA Jack) magnetic mount with 5 ft. high performance low-loss 100 series cable terminated with a Reverse-Polarity SMA Plug (RP-SMA Plug) connector. Custom connectors and cable lengths also available.



e-mail: sales@hyperlinktech.com • tel: 561-995-2256 • fax: 561-995-2432
web: www.hyperlinktech.com • 1201 Clint Moore Road • Boca Raton FL 33487

9. 26 dB Bandwidth 802.11 b/g Signals

9.1 Test procedure

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 kHz resolution BW. The spectrum bandwidth of the E.U.T. was measured and recorded.

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: BPSK (1Mbit/sec), BPSK (6Mbit/sec), QPSK (11Mbit/sec) and 64QAM (54Mbit/sec).

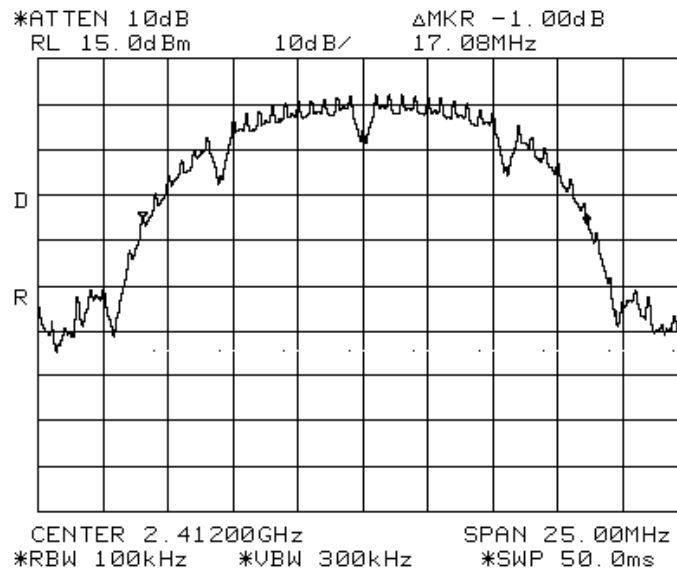


Figure 16 —2412 MHz BPSK (1Mbit/sec)

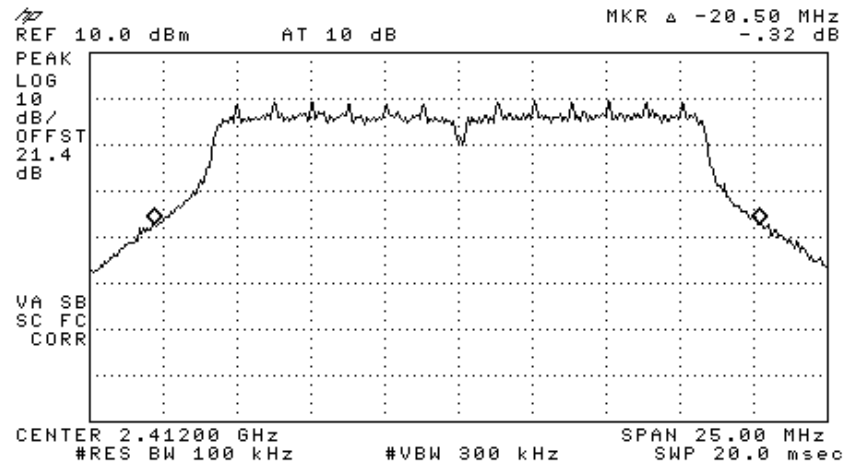


Figure 17 —2412 MHz BPSK (6Mbit/sec)

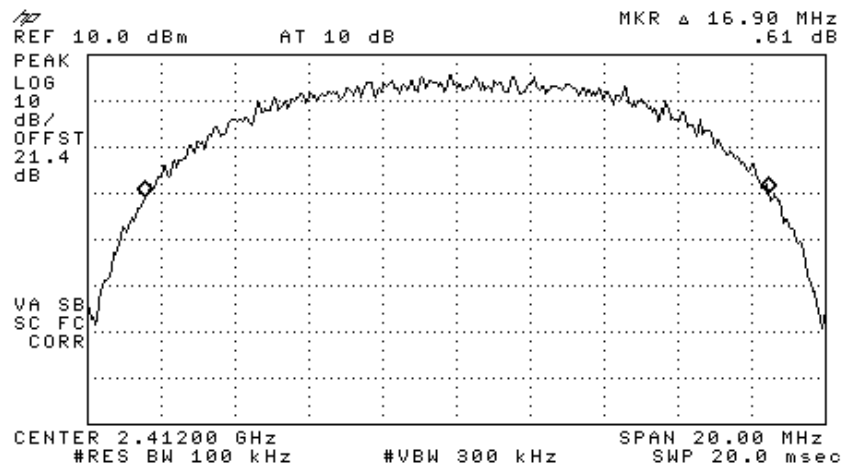


Figure 18 —2412 MHz QPSK (11Mbit/sec)

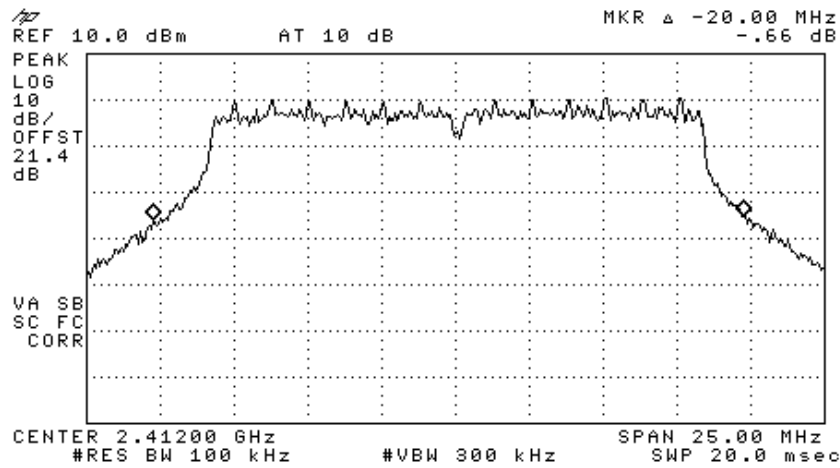


Figure 19 —2412 MHz 64QAM (54Mbit/sec)

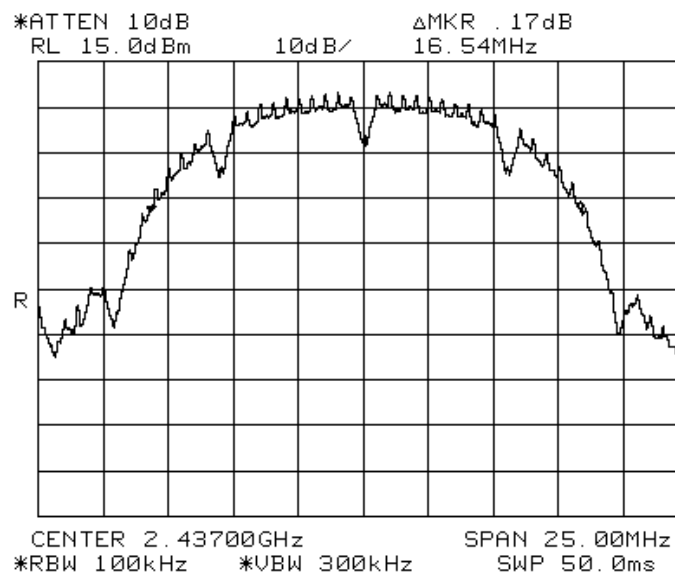


Figure 20 —2437 MHz BPSK (1Mbit/sec)

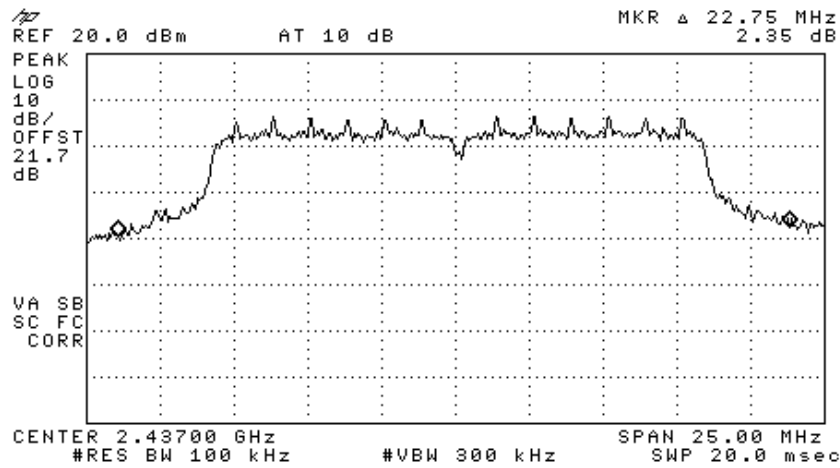


Figure 21 —2437 MHz BPSK (6Mbit/sec)

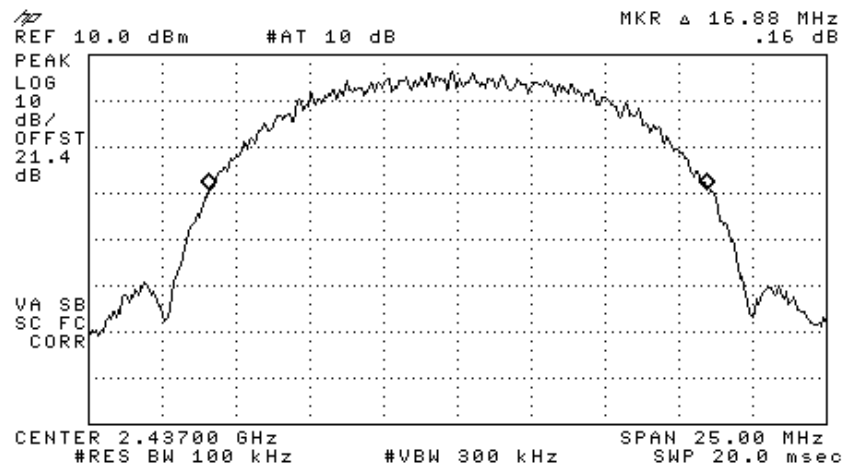


Figure 22 —2437 MHz QPSK (11Mbit/sec)

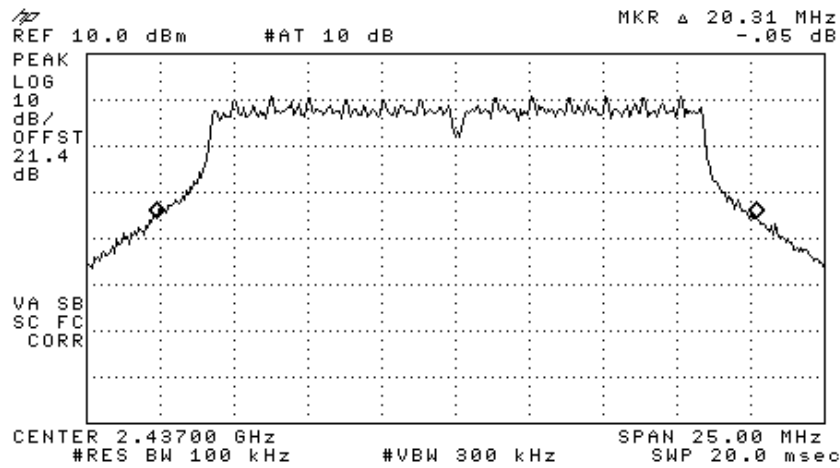


Figure 23 —2437 MHz 64QAM (54Mbit/sec)

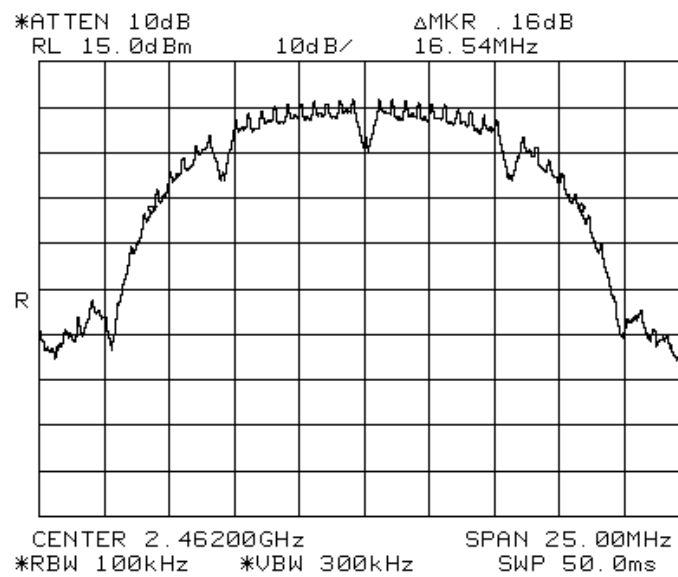


Figure 24 —2462 MHz BPSK (1Mbit/sec)

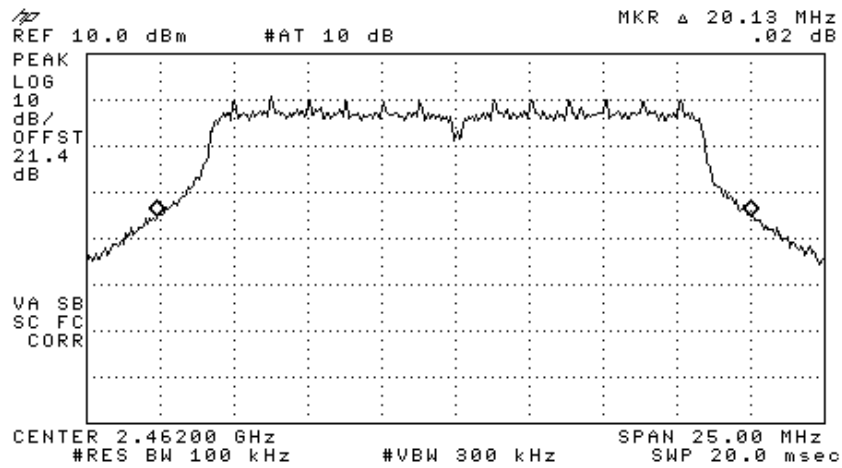


Figure 25 —2462 MHz BPSK (6Mbit/sec)

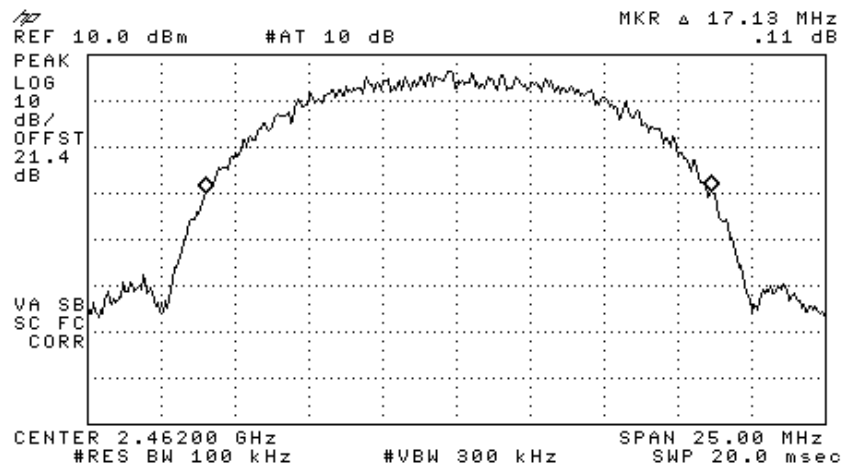


Figure 26 —2462 MHz QPSK (11Mbit/sec)

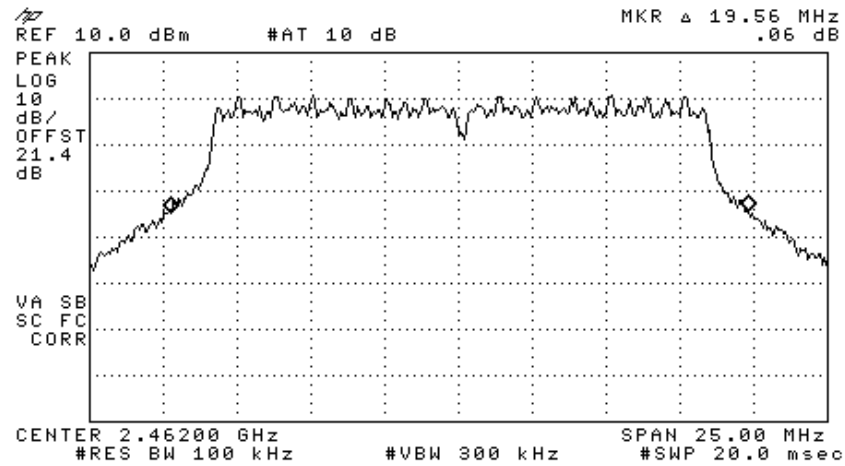


Figure 27 —2462 MHZ 64QAM (54Mbit/sec)

Operation Frequency (MHz)	Modulation	Bit Rate	26 dB Bandwidth (dBm)
2412	BPSK	1 Mbps	17.08
	BPSK	6 Mbps	16.90
	QPSK	11 Mbps	20.50
	64QAM	54 Mbps	20.00
2437	BPSK	1 Mbps	16.54
	BPSK	6 Mbps	16.88
	QPSK	11 Mbps	22.75
	64QAM	54 Mbps	20.31
2462	BPSK	1 Mbps	16.54
	BPSK	6 Mbps	17.13
	QPSK	11 Mbps	20.13
	64QAM	54 Mbps	19.56

TEST PERSONNEL:

Tester Signature: 

Date: 13.04.08

Typed/Printed Name: A. Sharabi

9.2 Test Equipment Used.

26 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	May 9, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

Figure 28 Test Equipment Used

10. Maximum Transmitted Peak Power Output 802.11 b/g Signals

10.1 Test procedure

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The Spectrum Analyzer was set to 1.0 MHz resolution BW. Peak power level was measured at selected operation frequencies.

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: BPSK (1Mbit/sec), BPSK (6Mbit/sec), QPSK (11Mbit/sec) and 64QAM (54Mbit/sec).

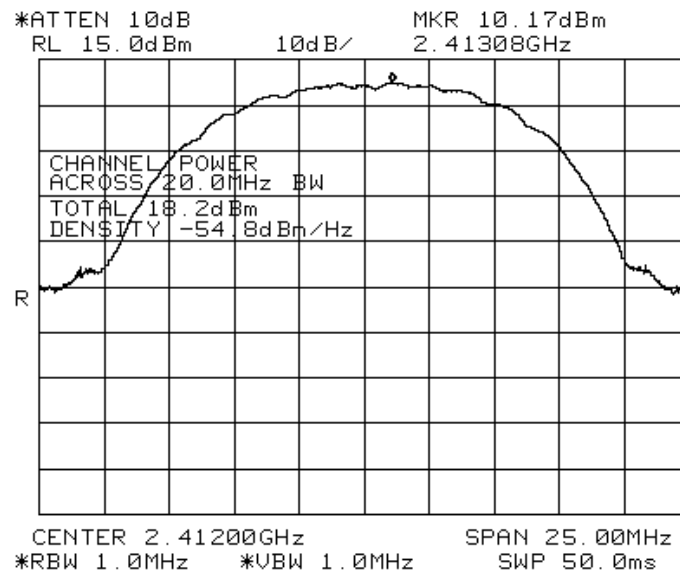


Figure 29 2412 BPSK (1Mbit/sec)

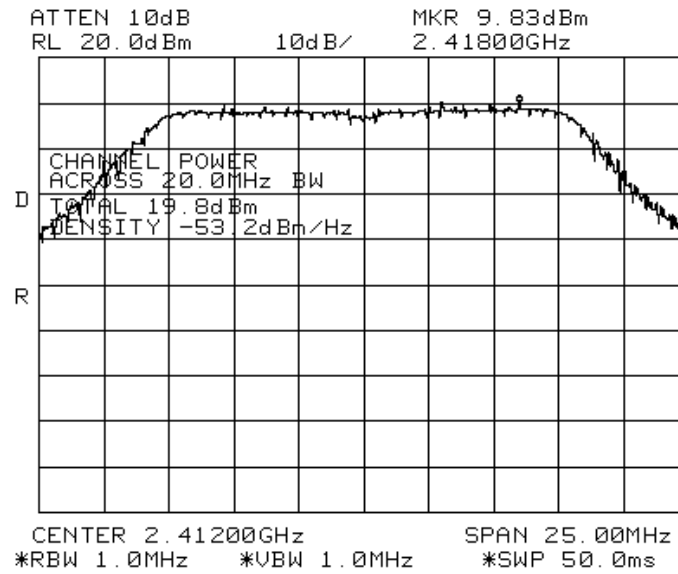


Figure 30 2412 MHz BPSK (6Mbit/sec)

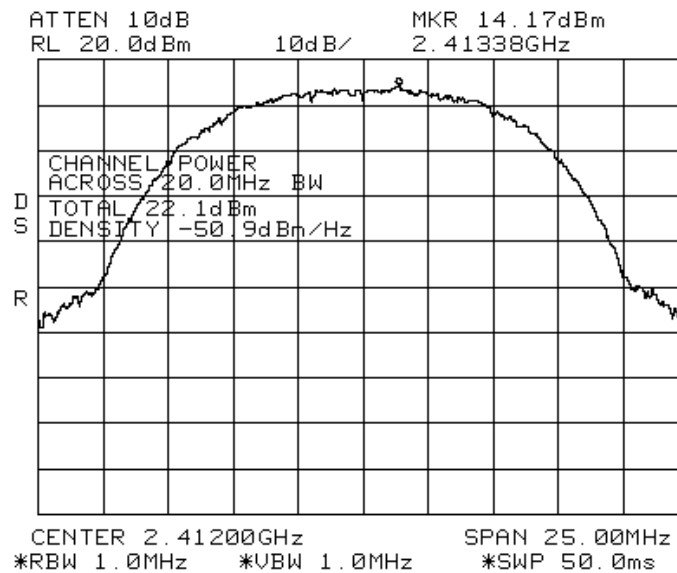


Figure 31 2412 MHz QPSK (11Mbit/sec)

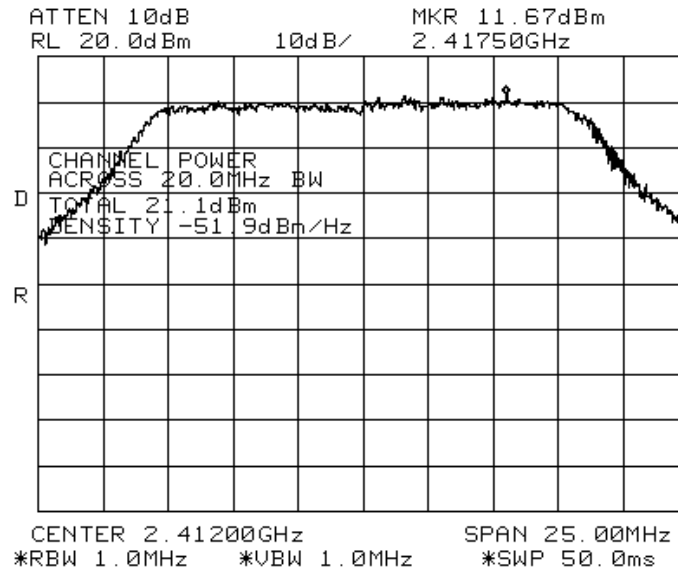


Figure 32 2412 MHz 64QAM (54Mbit/sec)

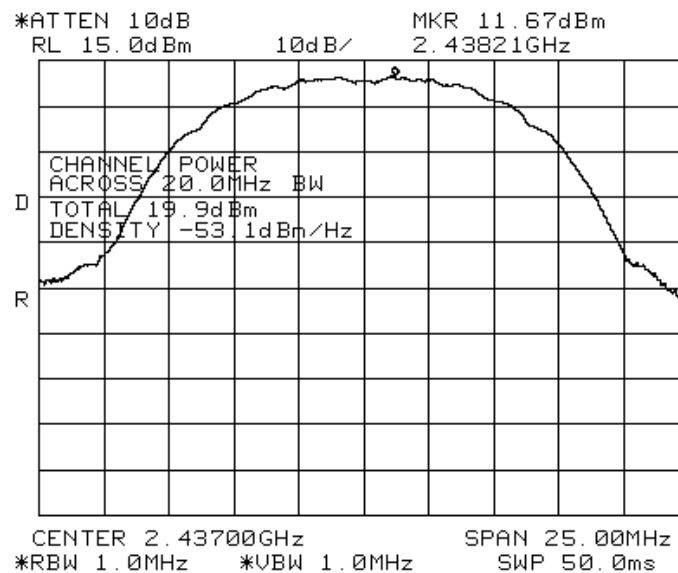


Figure 33 2437 MHz BPSK (1Mbit/sec)

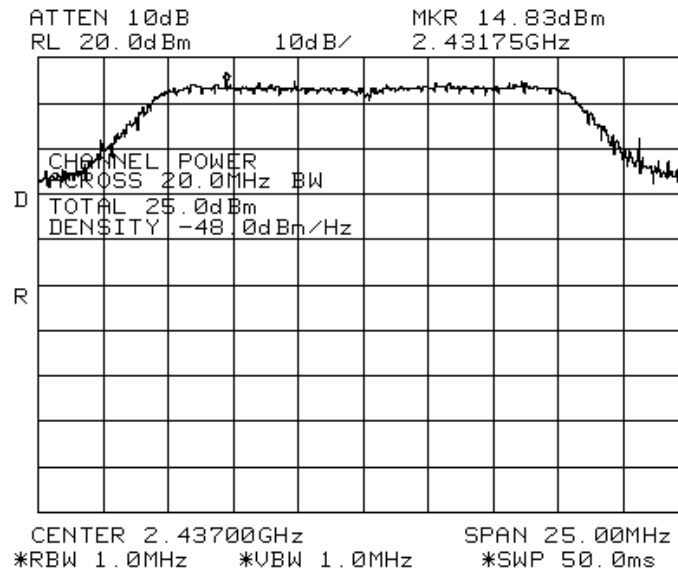


Figure 34 2437 MHz BPSK (6Mbit/sec)

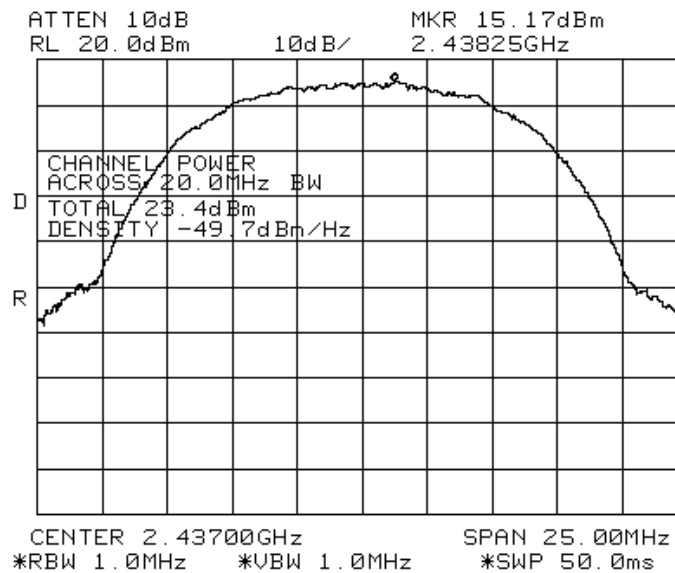


Figure 35 2437 MHz QPSK (11Mbit/sec)

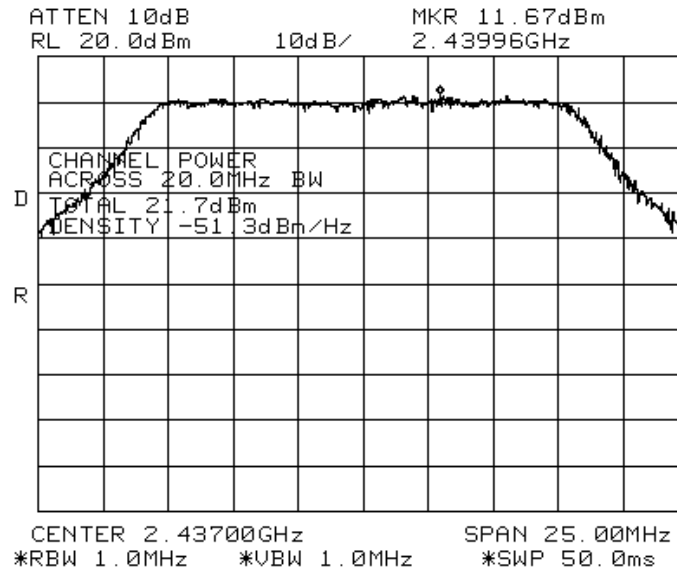


Figure 36 2437 MHz 64QAM (54Mbit/sec)

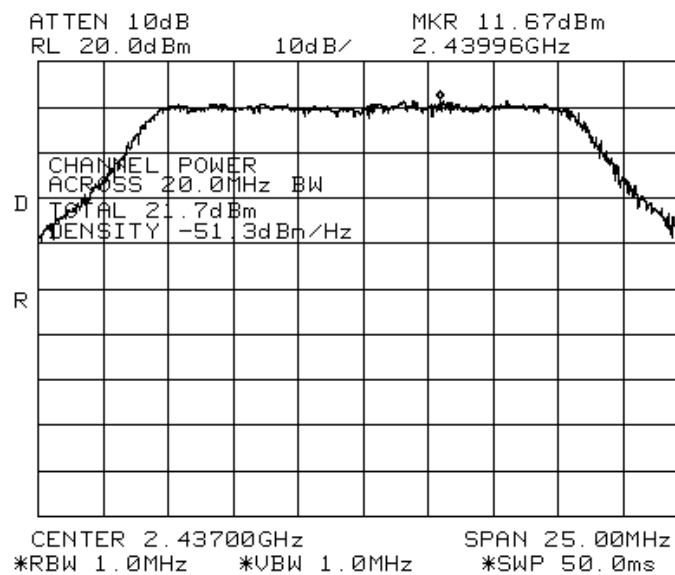


Figure 37 2462 MHz BPSK (1Mbit/sec)

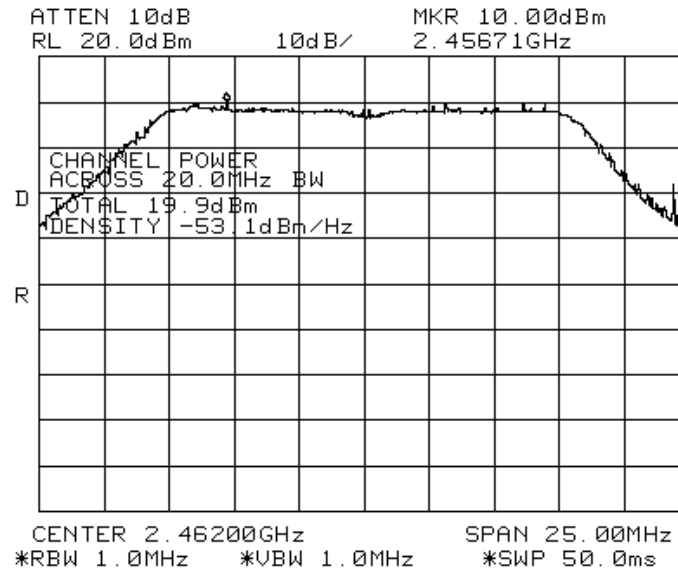


Figure 38 2462 MHz BPSK (6Mbit/sec)

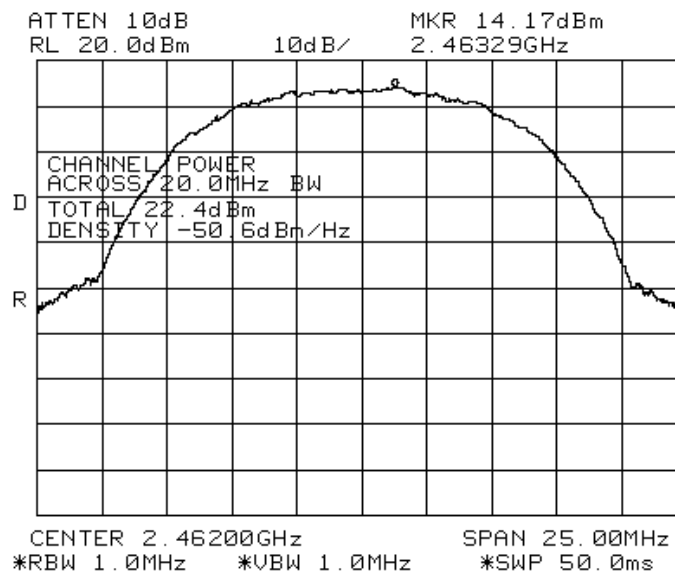


Figure 39 2462 MHz QPSK (11Mbit/sec)

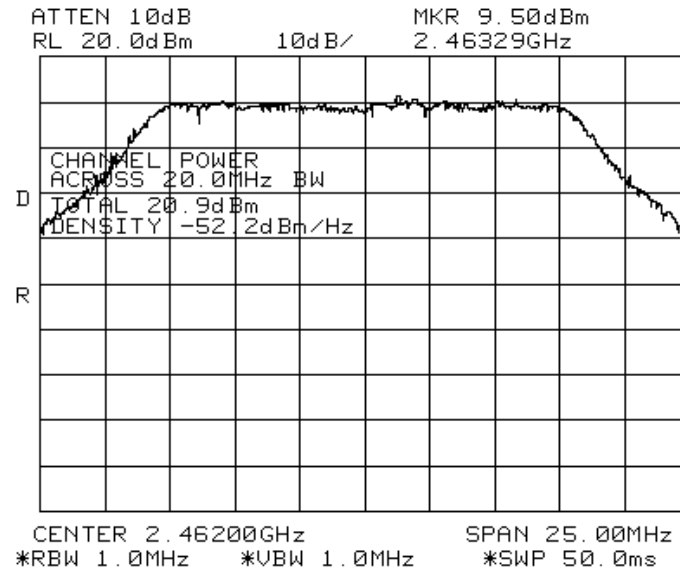


Figure 40 2462 MHz 64QAM (54Mbit/sec)

10.2 Results table

E.U.T. Description: W24 Wi-Fi Module

Model No.: W24

Serial Number: UQT00040

Specification: F.C.C. Part 15, Subpart C

Operation Frequency (MHz)	Modulation	Bit Rate	Power (dBm)	Specification (dBm)	Margin (dB)
2412	BPSK	1 Mbps	18.2	29.0	-10.8
	BPSK	6 Mbps	19.8	29.0	-9.2
	CCK	11 Mbps	22.1	29.0	-6.9
	64QAM	54 Mbps	21.1	29.0	-7.9
2437	BPSK	1 Mbps	19.9	29.0	-9.1
	BPSK	6 Mbps	25.0	29.0	-4.0
	CCK	11 Mbps	23.4	29.0	-5.6
	64QAM	54 Mbps	21.7	29.0	-7.3
2462	BPSK	1 Mbps	18.3	29.0	-10.7
	BPSK	6 Mbps	19.9	29.0	-9.1
	CCK	11 Mbps	22.4	29.0	-6.6
	64QAM	54 Mbps	20.9	29.0	-8.1

Figure 41 Maximum Peak Power Output

Note: Antenna Gain is dBi

JUDGEMENT: Passed by 4.0 dB

TEST PERSONNEL:

Tester Signature: 

Date: 13.04.08

Typed/Printed Name: A. Sharabi

10.3 Test Equipment Used.

Peak Power Output

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	May 9, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

Figure 42 Test Equipment Used

11. Peak Power Output Out of 2400-2483.5 MHz Band 802.11 b/g Signals

11.1 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 kHz resolution BW except for the frequency range

9 kHz-150 kHz where the RBW was set to 1kHz and the frequency range 150 kHz-10 MHz where the RBW was set to 10kHz. The frequency range from 9 kHz to 25 GHz was scanned. Level of spectrum components out of the 2400-2483.5 MHz was measured at the selected operation frequencies.

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: BPSK (1Mbit/sec), BPSK (6Mbit/sec), QPSK (11Mbit/sec) and 64QAM (54Mbit/sec).

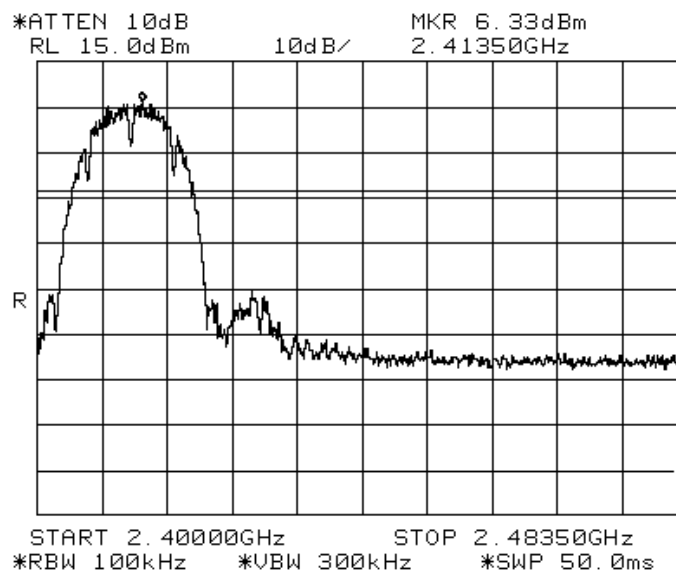


Figure 43 —2412 MHz DBPSK (1Mbit/sec)

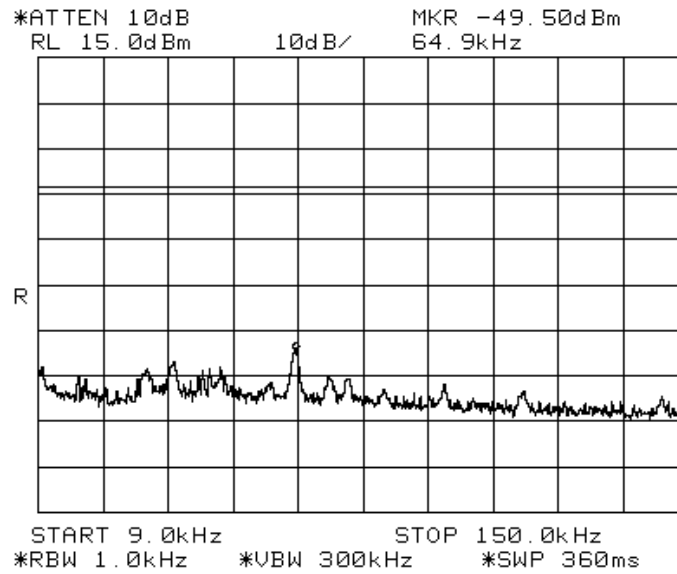


Figure 44 —2412 MHz BPSK (1Mbit/sec)

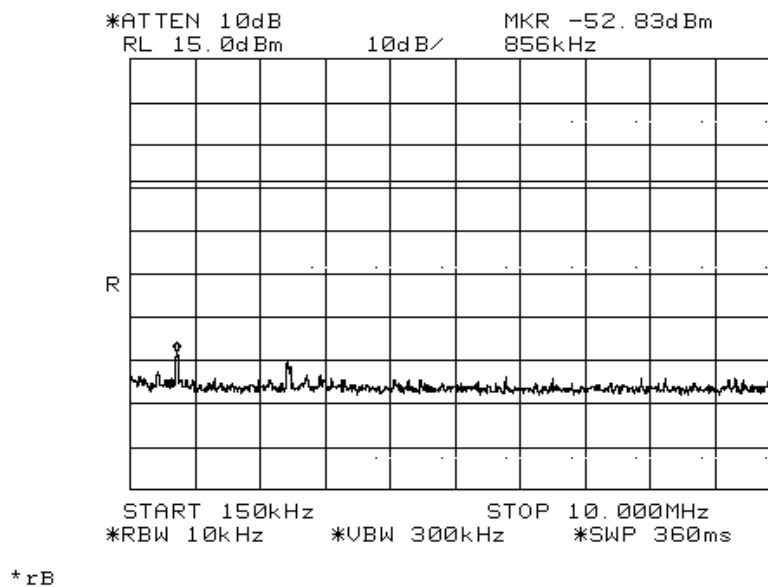


Figure 45 —2412 MHz BPSK (1Mbit/sec)

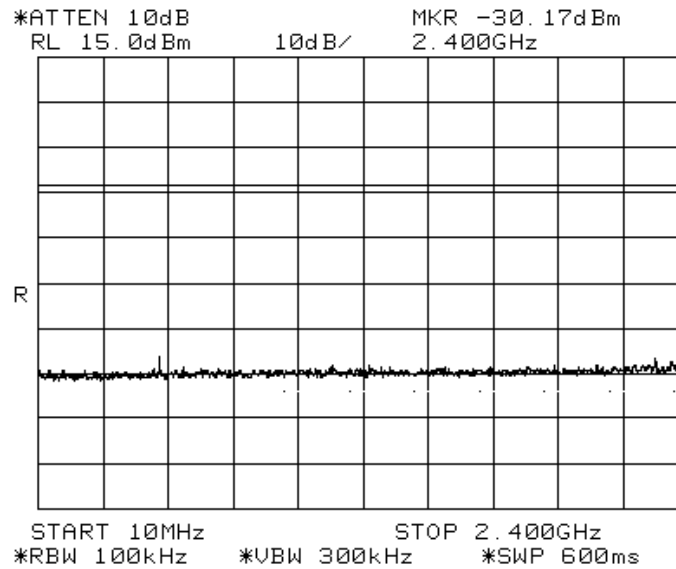


Figure 46 —2412 MHz BPSK (1Mbit/sec)

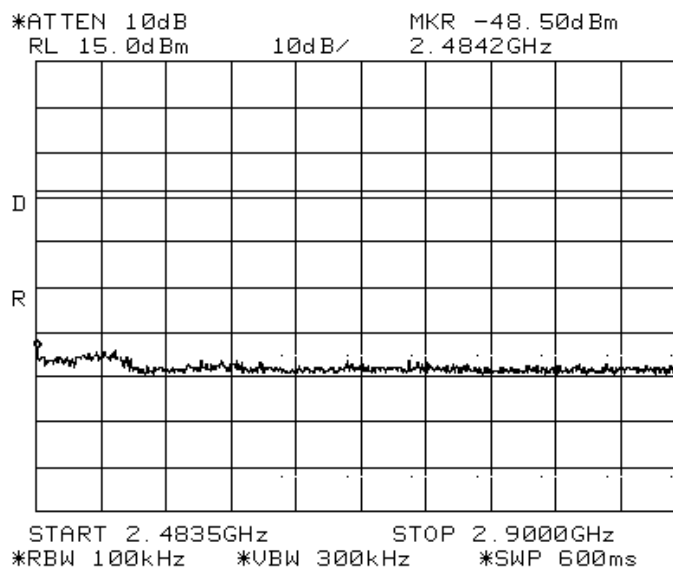


Figure 47 —2412 MHz BPSK (1Mbit/sec)

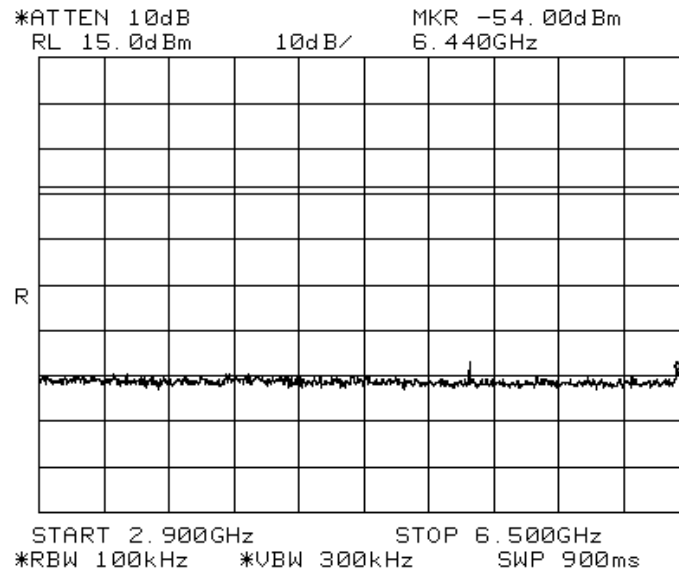


Figure 48 —2412 MHz BPSK (1Mbit/sec)

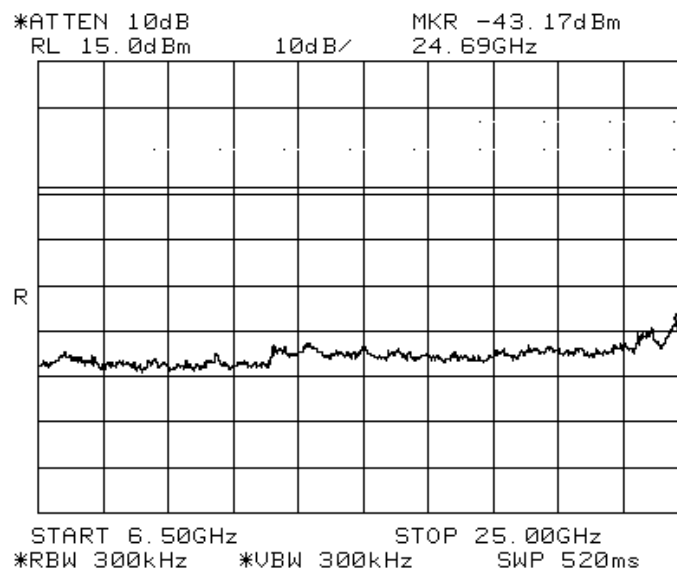


Figure 49 —2412 MHz BPSK (1Mbit/sec)

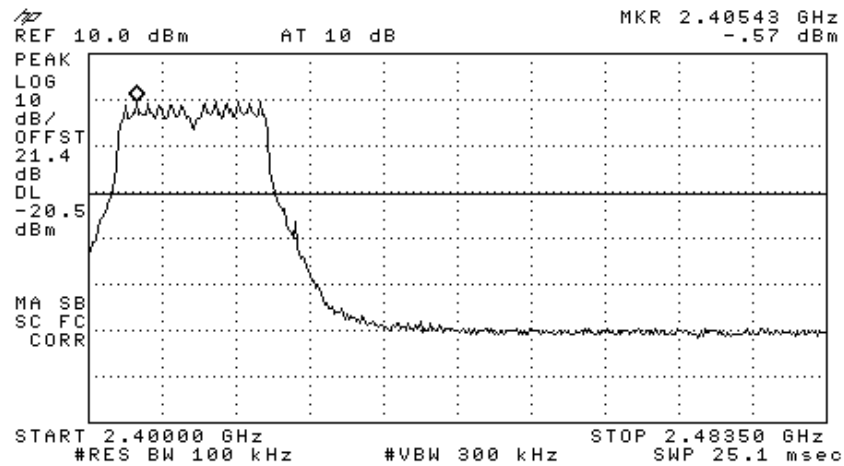


Figure 50 —2412 MHz BPSK (6Mbit/sec)

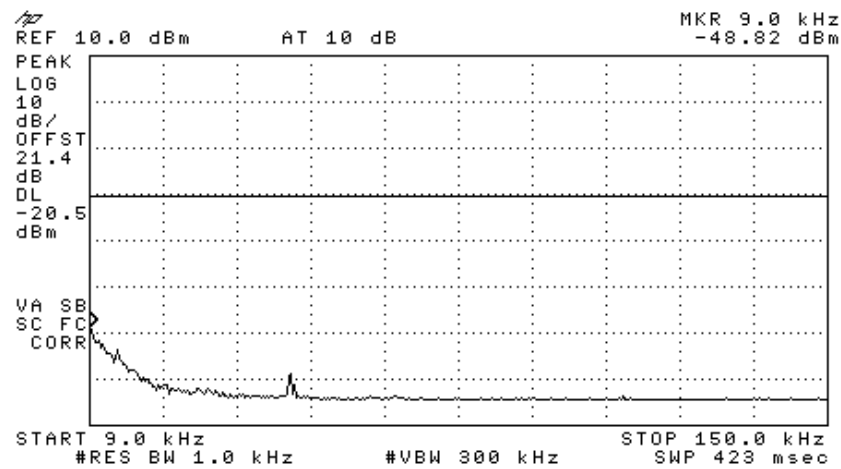


Figure 51 —2412 MHz BPSK (6Mbit/sec)

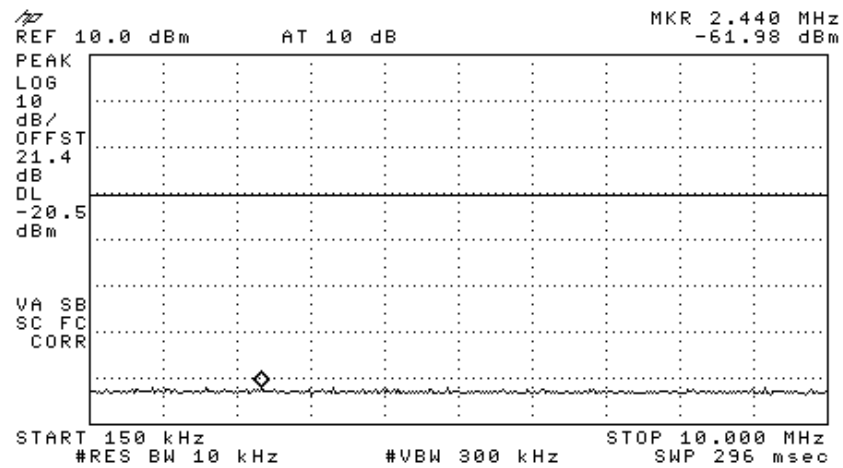


Figure 52 —2412 MHz BPSK (6Mbit/sec)

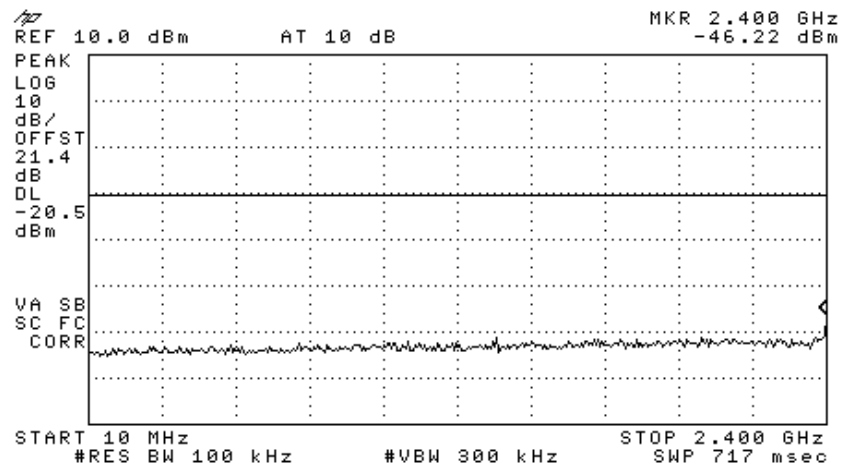


Figure 53 —2412 MHz BPSK (6Mbit/sec)

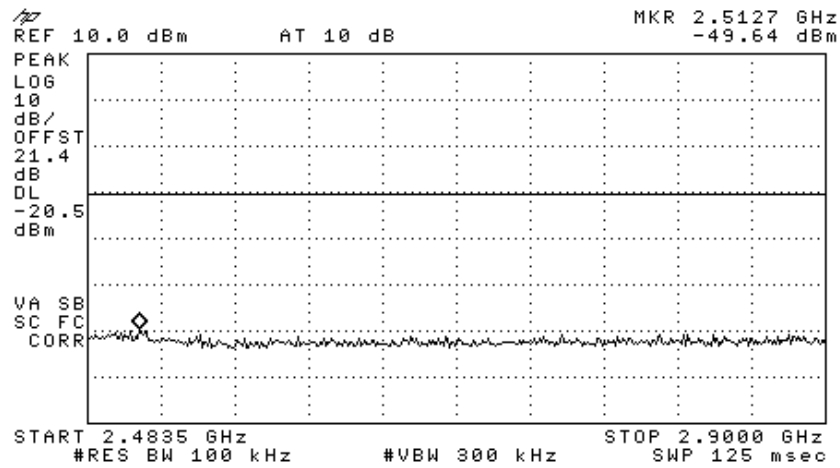


Figure 54 —2412 MHz BPSK (6Mbit/sec)

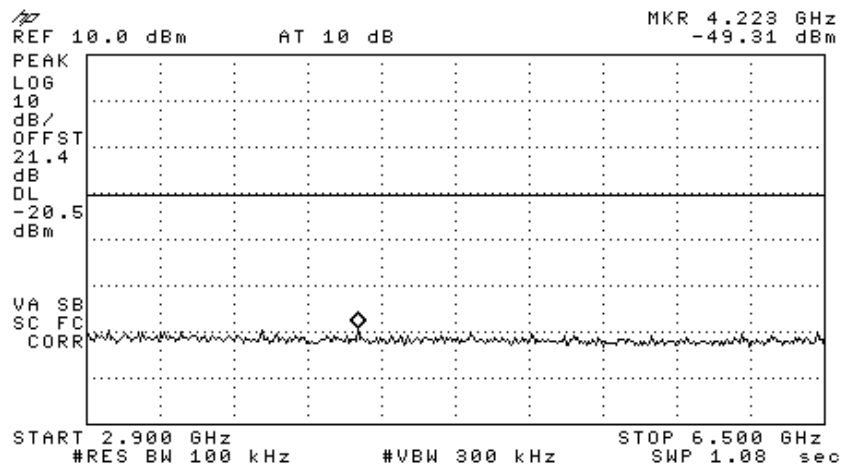


Figure 55 —2412 MHz BPSK (6Mbit/sec)

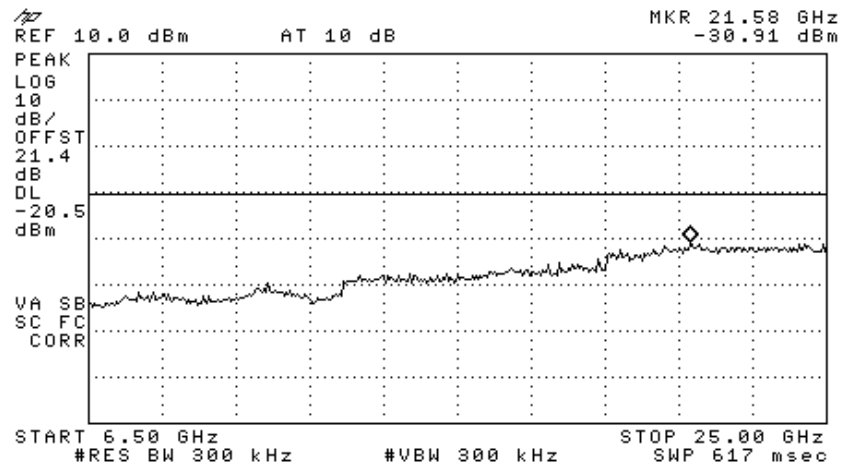


Figure 56 —2412 MHz BPSK (6Mbit/sec)

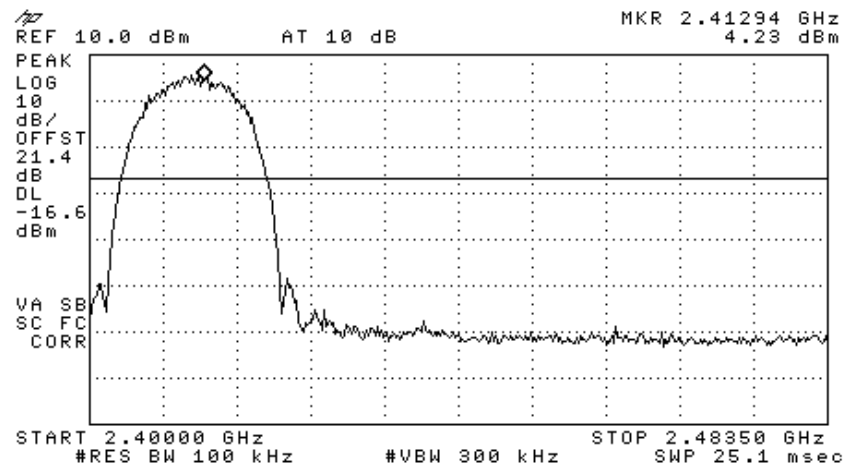


Figure 57 —2412 MHz QPSK (11Mbit/sec)

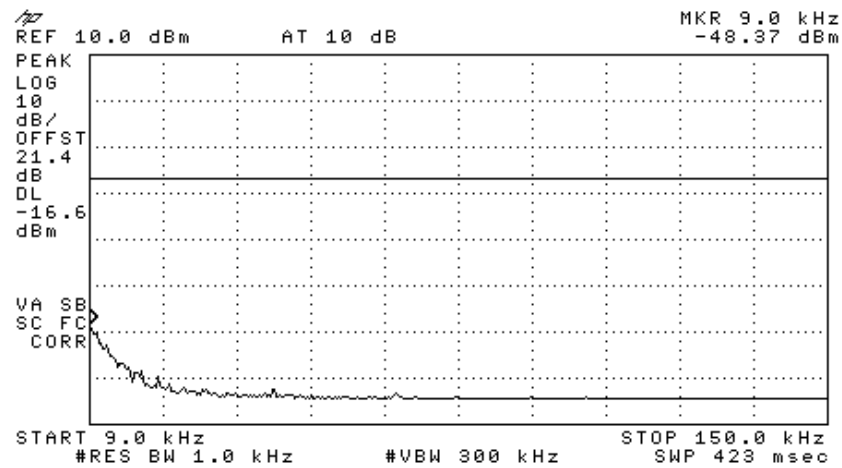


Figure 58 —2412 MHz QPSK (11Mbit/sec)

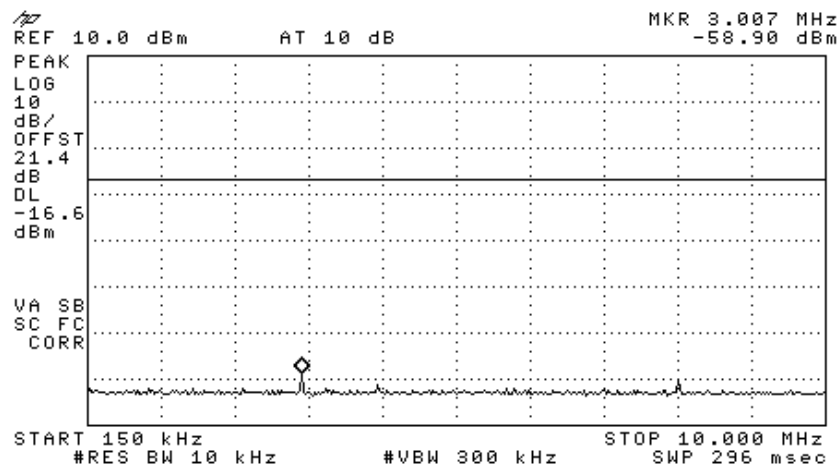


Figure 59 —2412 MHz QPSK (11Mbit/sec)

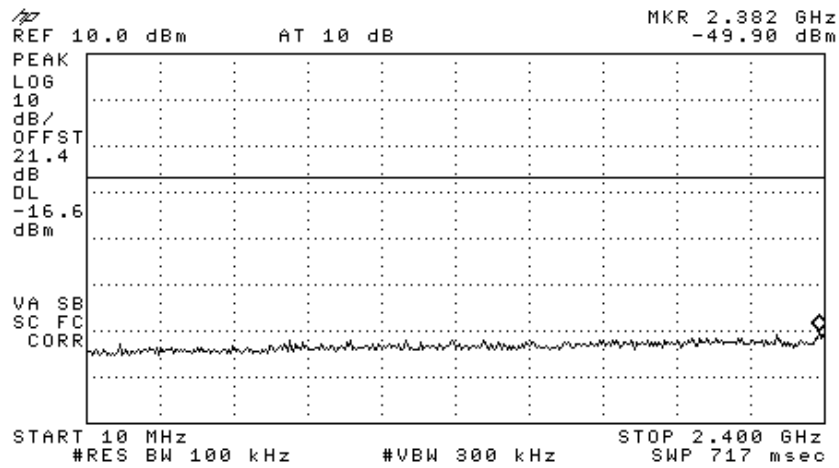


Figure 60 —2412 MHz QPSK (11Mbit/sec)

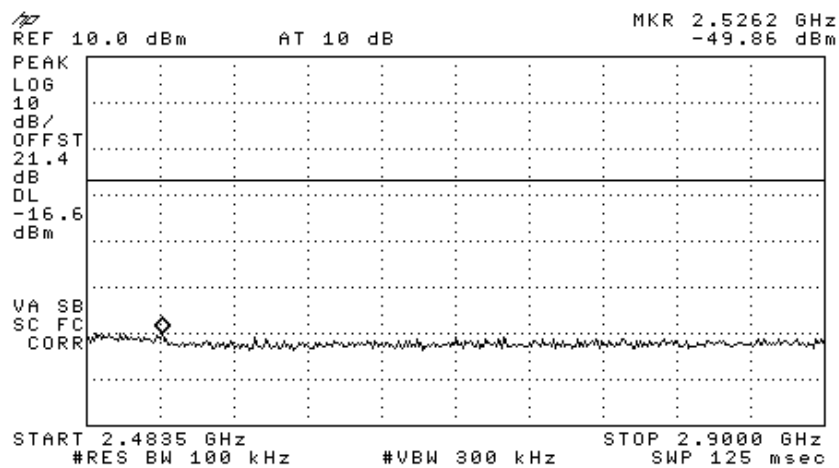


Figure 61 —2412 MHz QPSK (11Mbit/sec)

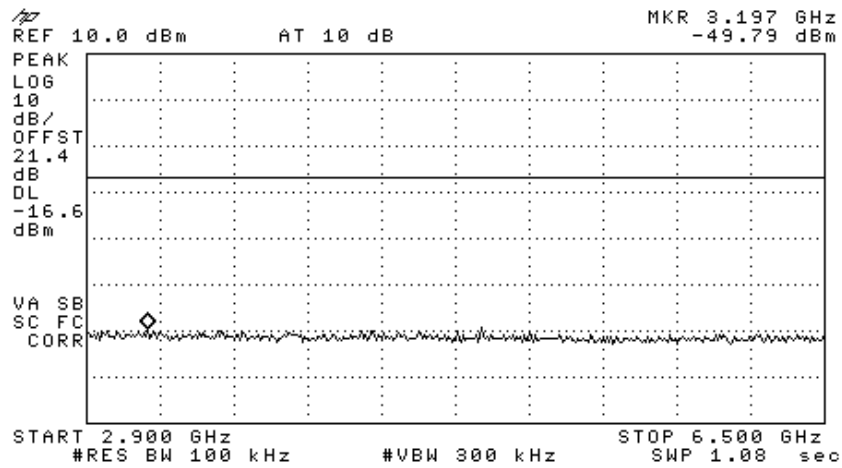


Figure 62 —2412 MHz QPSK (11Mbit/sec)

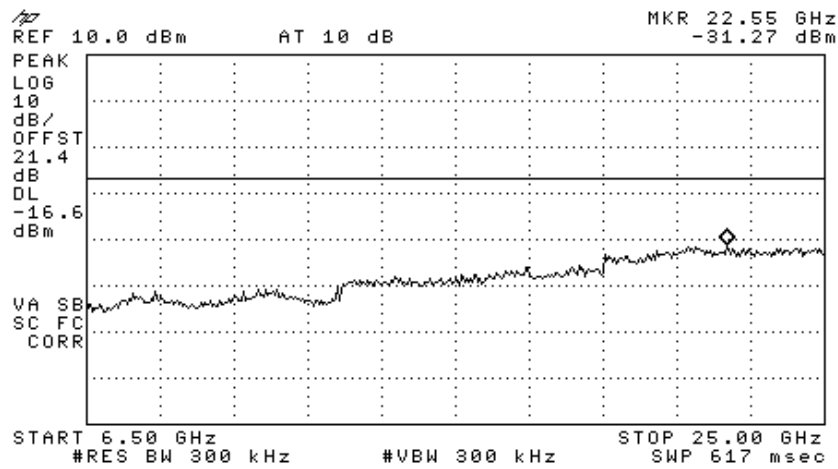


Figure 63 —2412 MHz QPSK (11Mbit/sec)

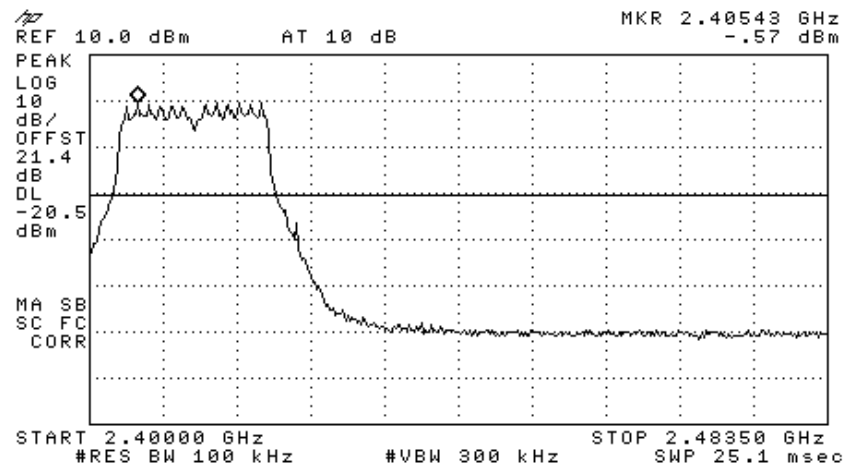


Figure 64 —2412 MHz 64QAM (54Mbit/sec)

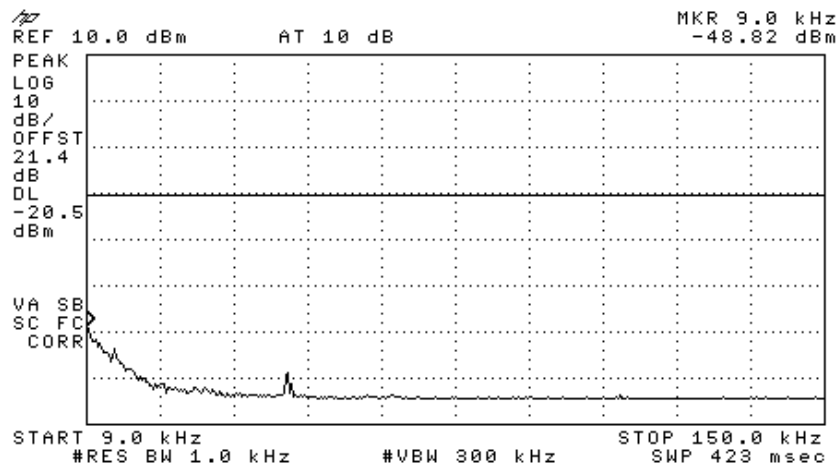


Figure 65 —2412 MHz 64QAM (54Mbit/sec)

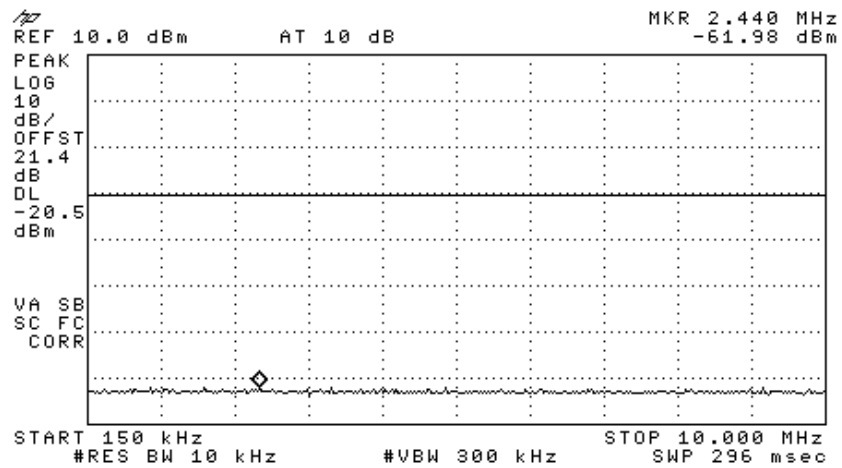


Figure 66 —2412 MHz 64QAM (54Mbit/sec)

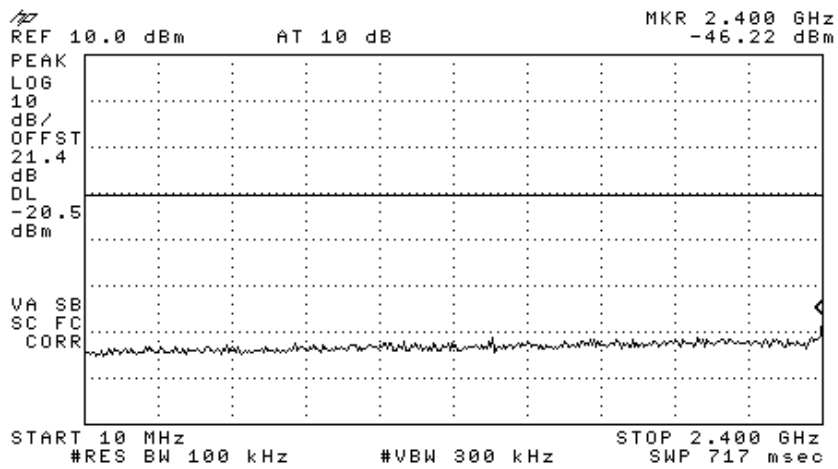


Figure 67 —2412 MHz 64QAM (54Mbit/sec)

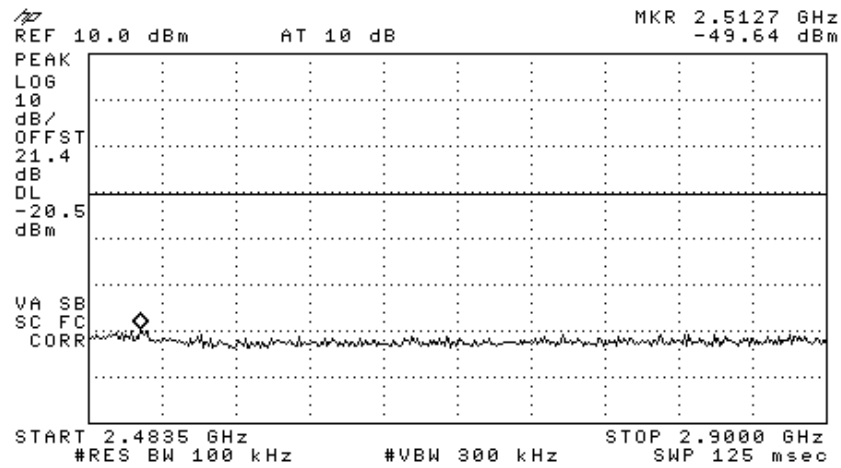


Figure 68 —2412 MHz 64QAM (54Mbit/sec)

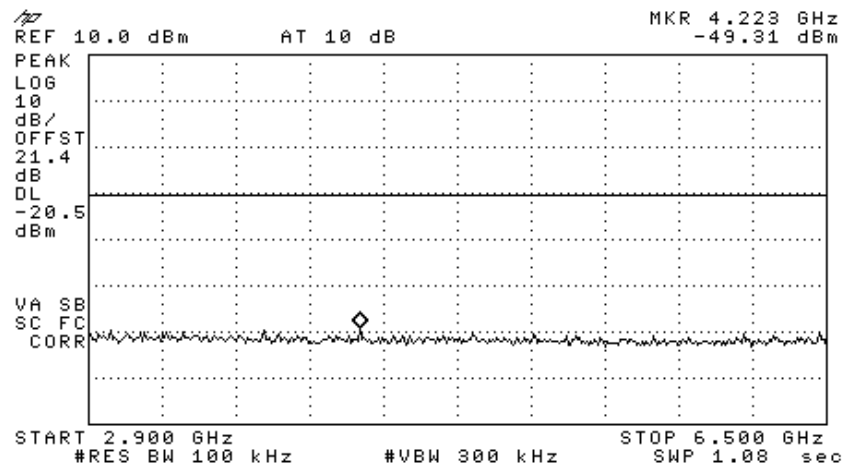


Figure 69 —2412 MHz 64QAM (54Mbit/sec)

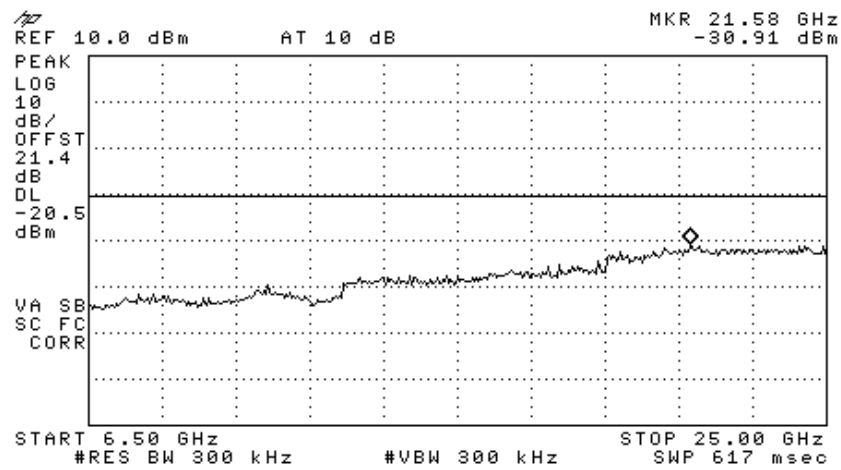


Figure 70 —2412 MHz 64QAM (54Mbit/sec)

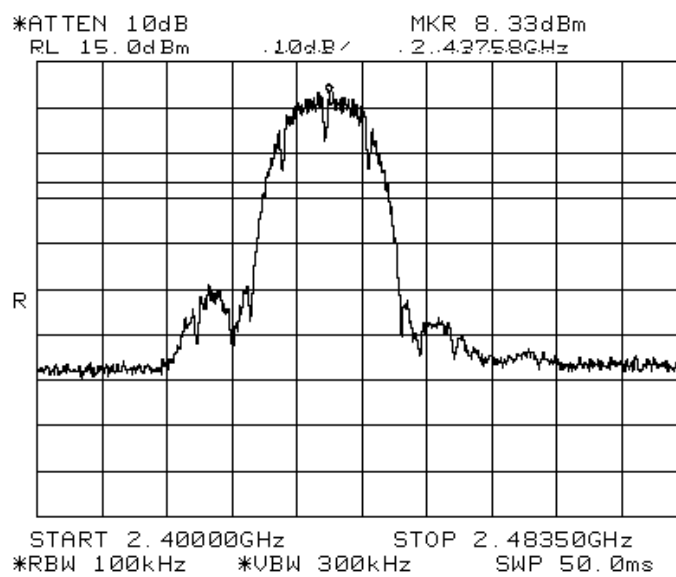


Figure 71 —2437 MHz BPSK (1Mbit/sec)

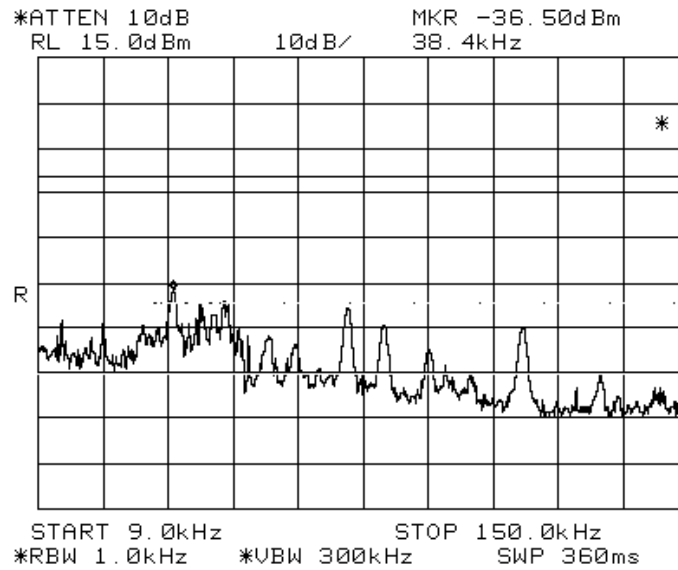


Figure 72 —2437 MHz BPSK (1Mbit/sec)

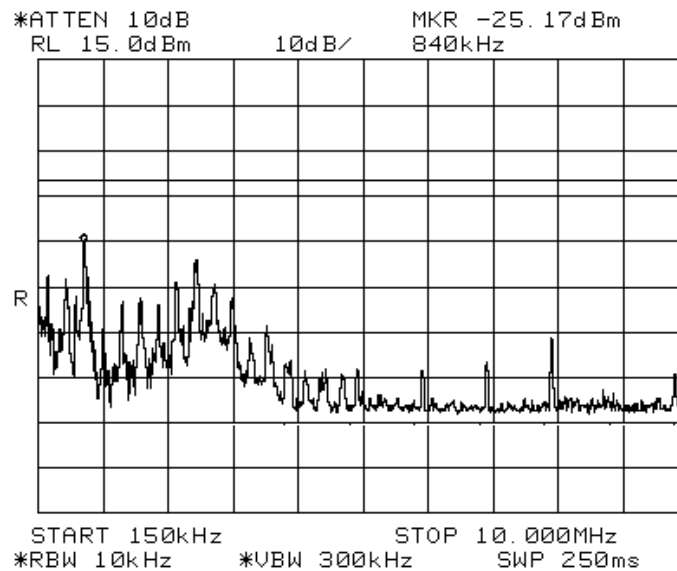


Figure 73 —2437 MHz BPSK (1Mbit/sec)

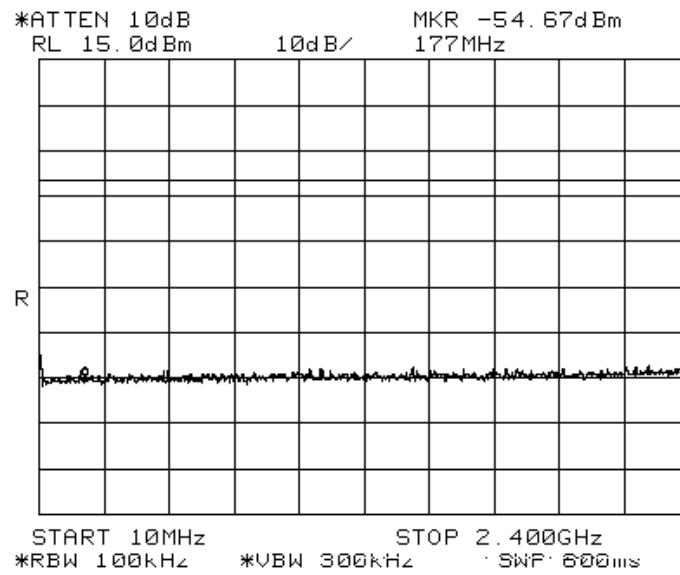


Figure 74 —2437 MHz BPSK (1Mbit/sec)

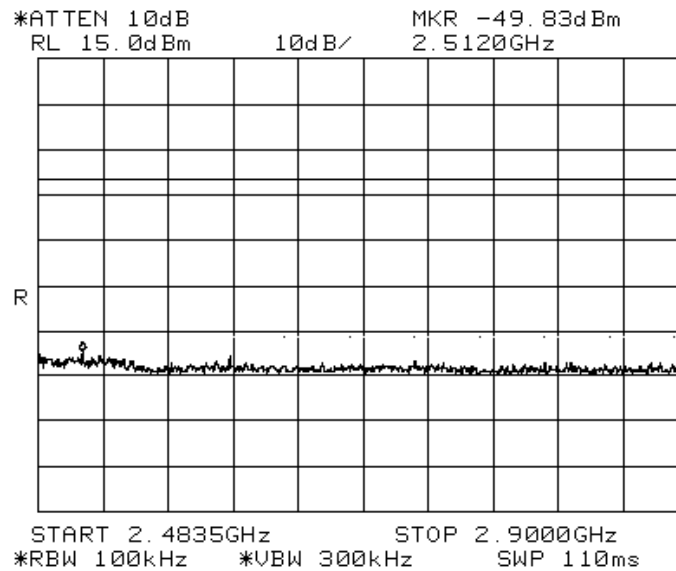


Figure 75 —2437 MHz BPSK (1Mbit/sec)

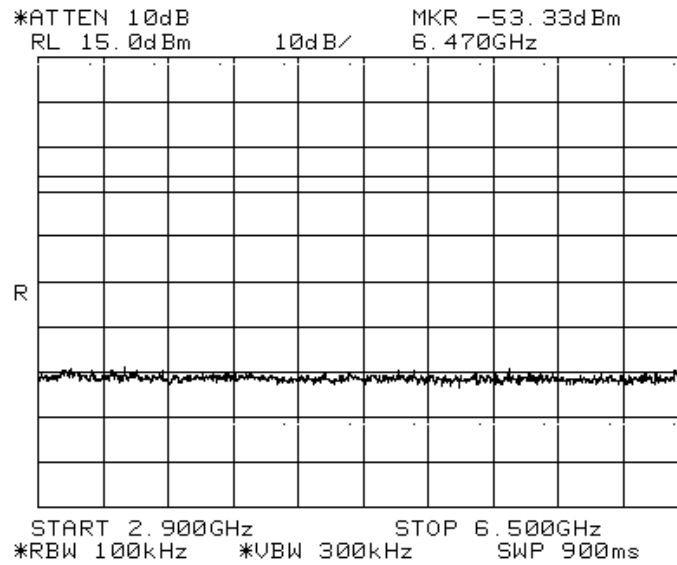


Figure 76 —2437 MHz BPSK (1Mbit/sec)

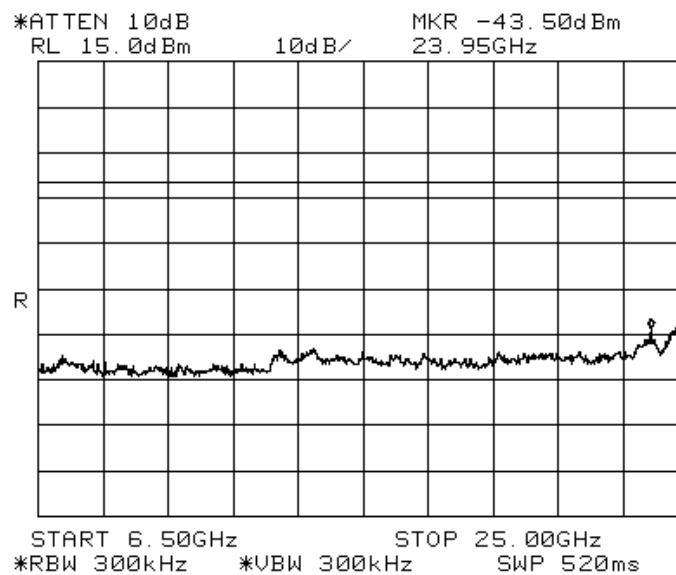


Figure 77 —2437 MHz BPSK (1Mbit/sec)

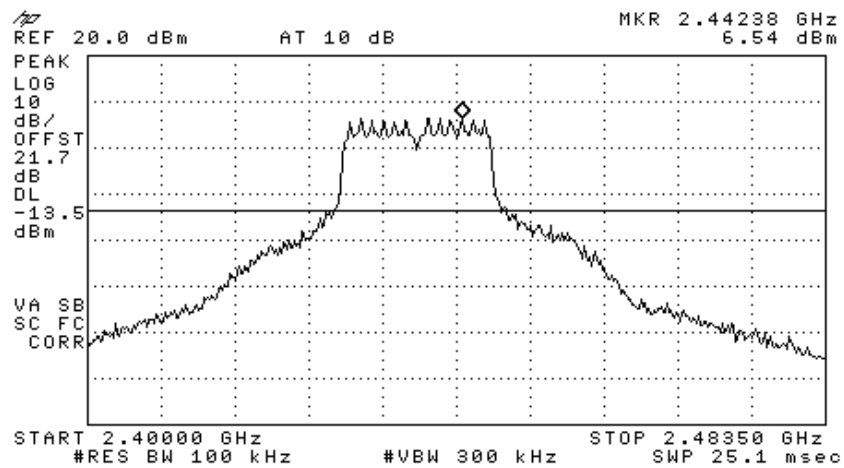


Figure 78 —2437 MHz BPSK (6Mbit/sec)

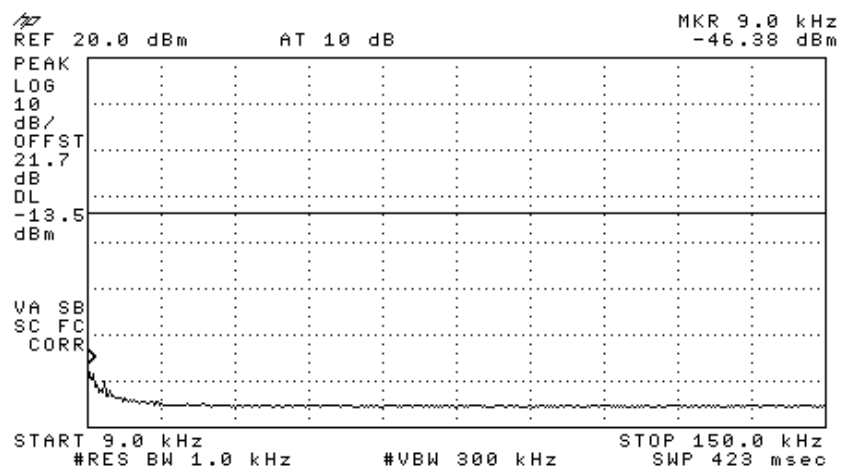


Figure 79 —2437 MHz BPSK (6Mbit/sec)

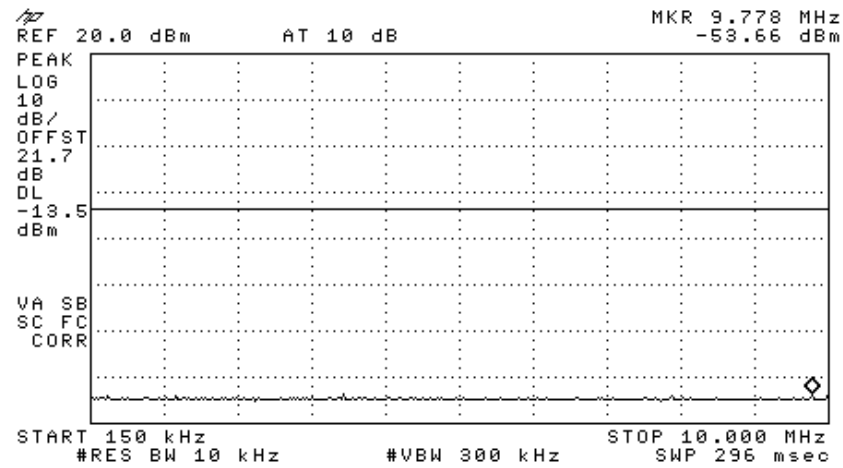


Figure 80 —2437 MHz BPSK (6Mbit/sec)

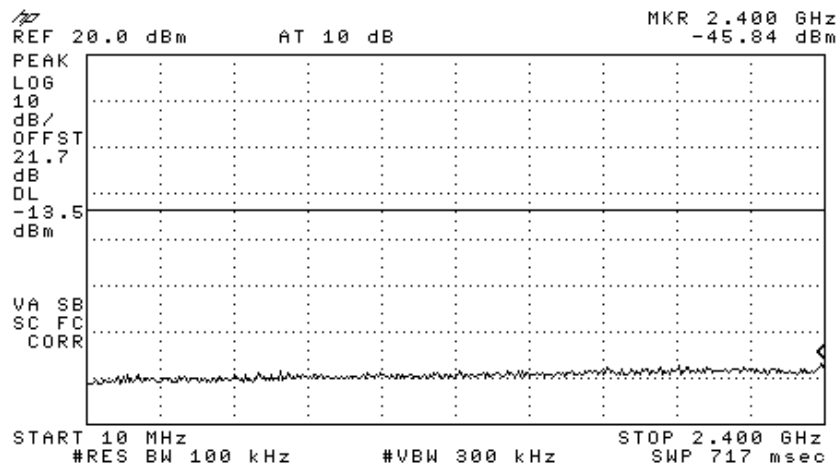


Figure 81 —2437 MHz BPSK (6Mbit/sec)

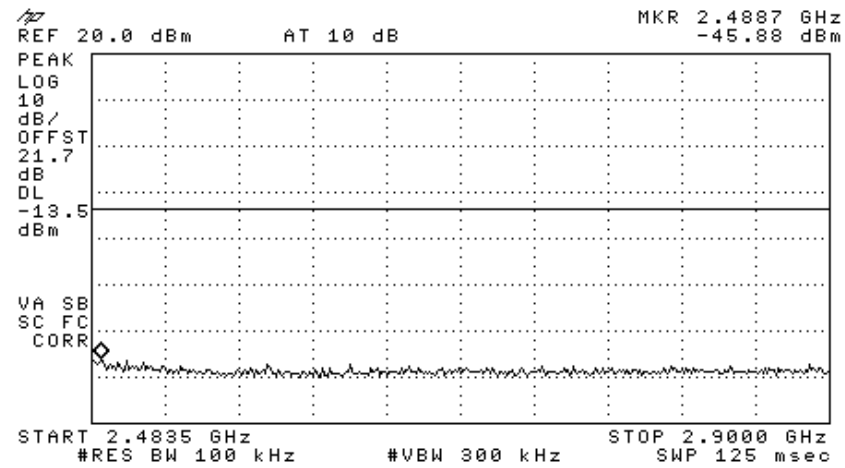


Figure 82 —2437 MHz BPSK (6Mbit/sec)

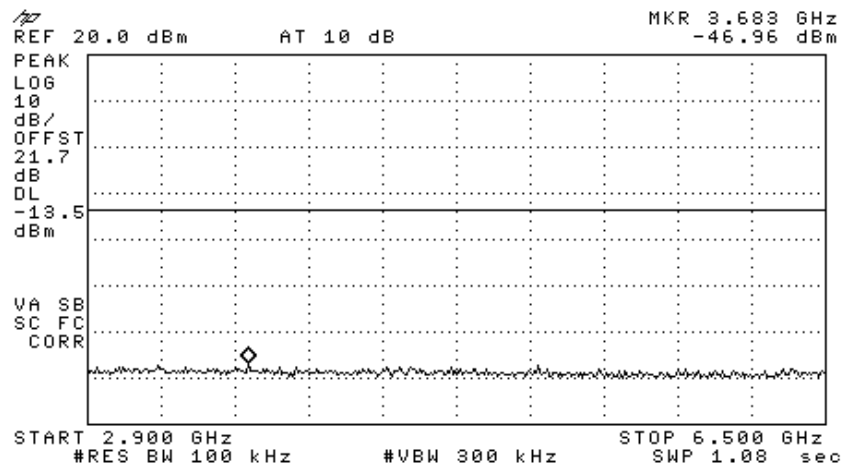


Figure 83 —2437 MHz BPSK (6Mbit/sec)

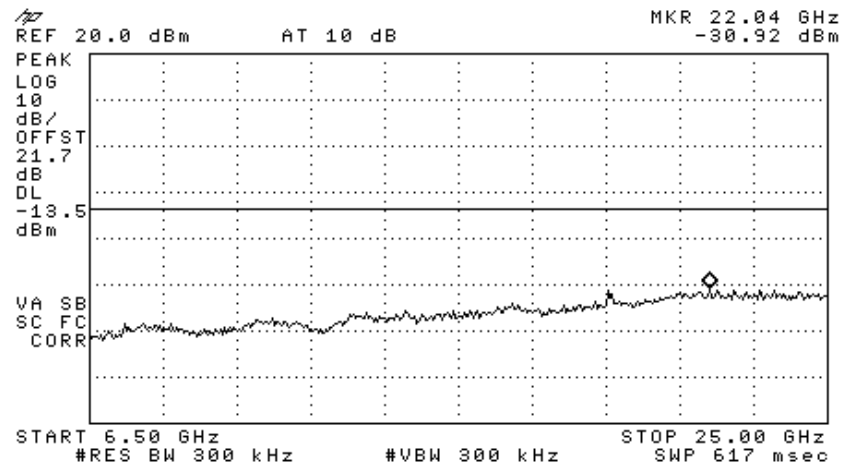


Figure 84 —2437 MHz BPSK (6Mbit/sec)

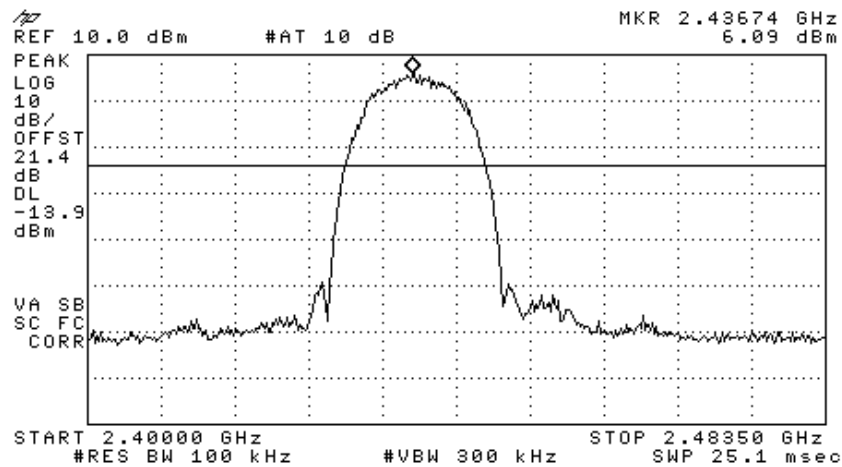


Figure 85 —2437 MHz QPSK (11Mbit/sec)

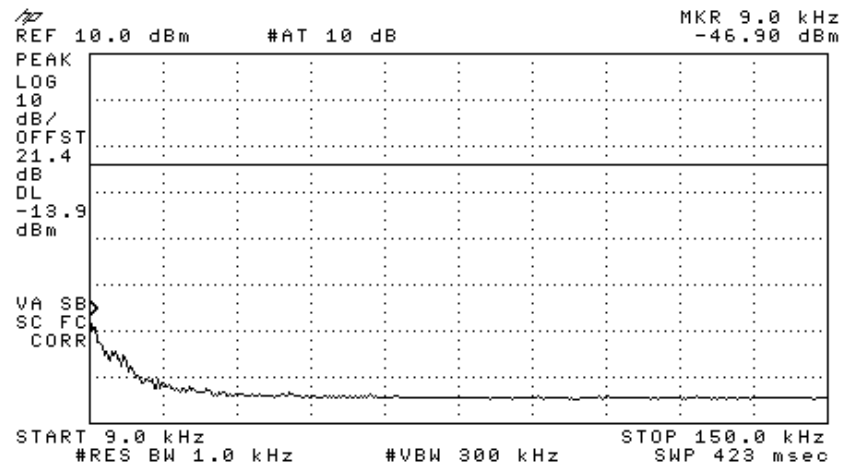


Figure 86 —2437 MHz QPSK (11Mbit/sec)

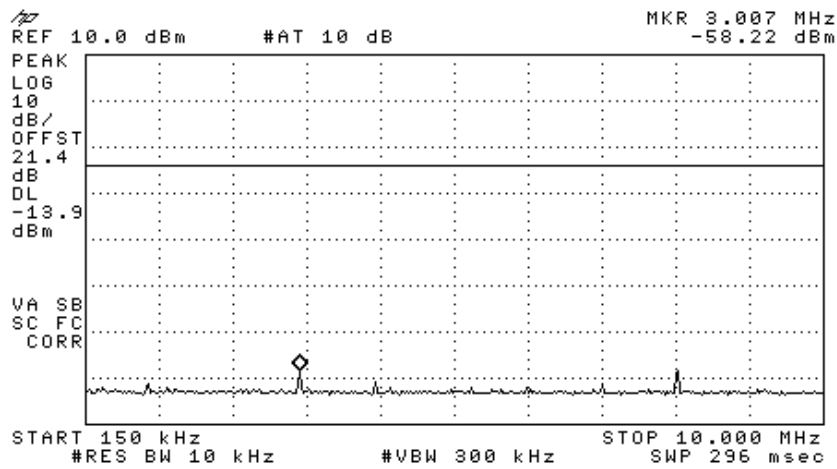


Figure 87 —2437 MHz QPSK (11Mbit/sec)

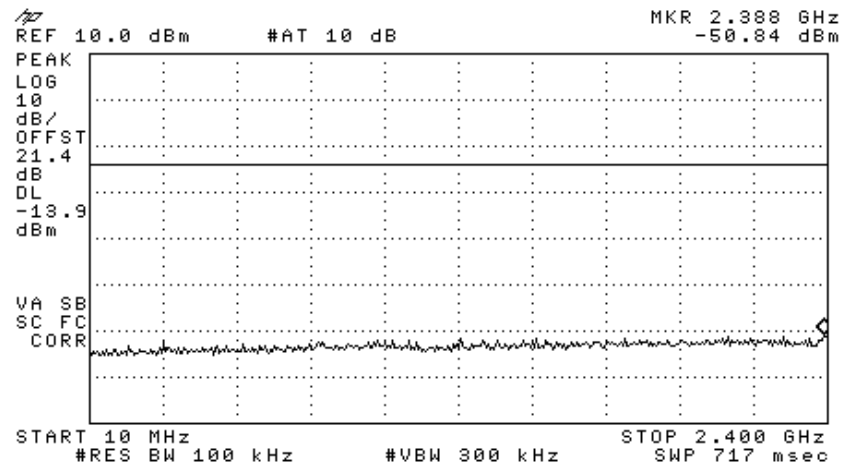


Figure 88 —2437 MHz QPSK (11Mbit/sec)

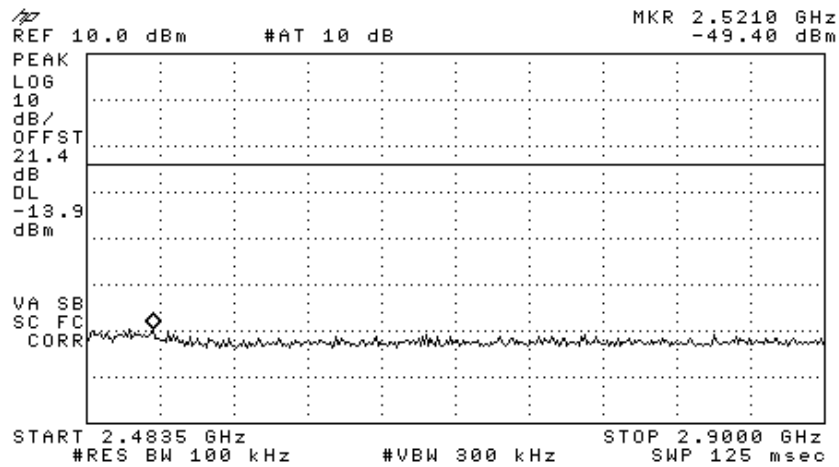


Figure 89 —2437 QPSK (11Mbit/sec)

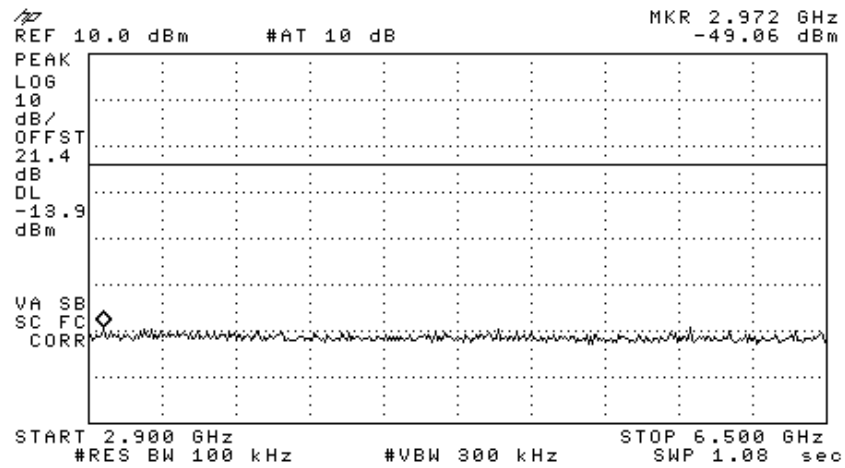


Figure 90 —2437 MHz QPSK (11Mbit/sec)

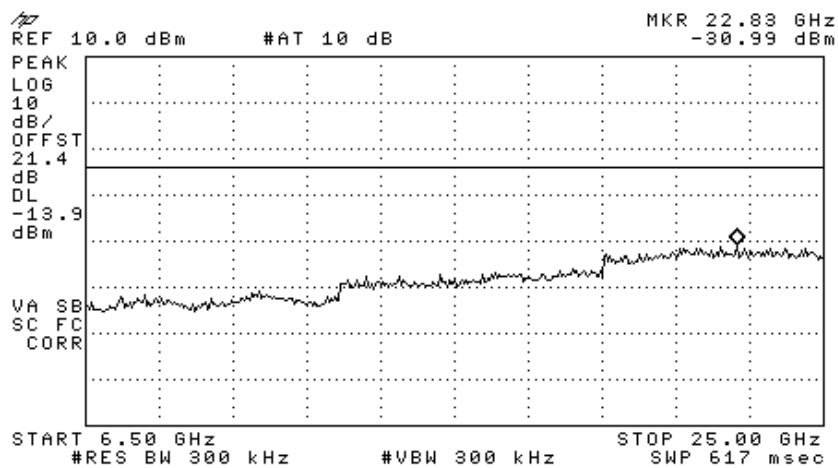


Figure 91 —2437 MHz QPSK (11Mbit/sec)

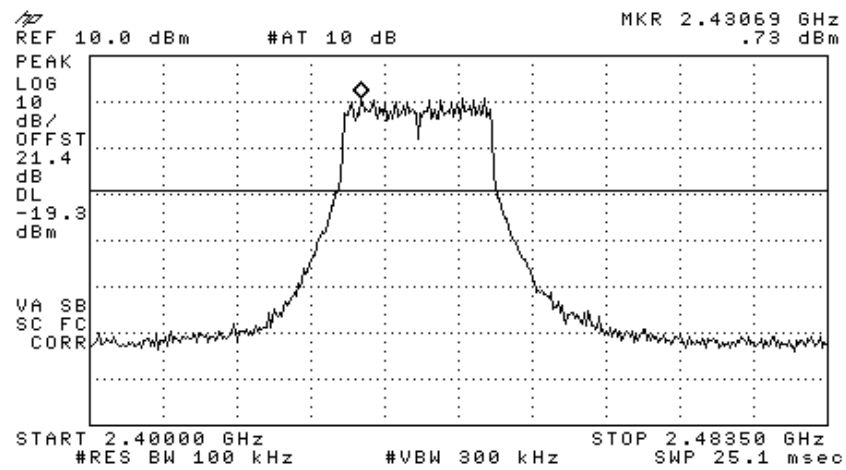


Figure 92 —2437 MHz 64QAM (54Mbit/sec)

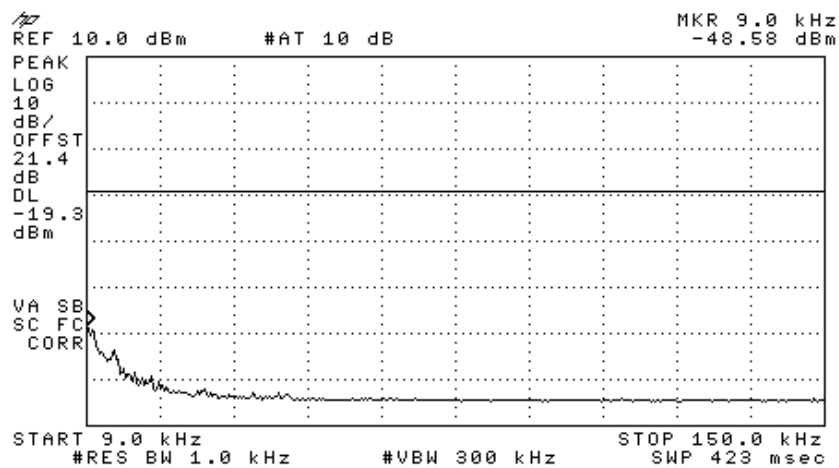


Figure 93 —2437 MHz 64QAM (54Mbit/sec)

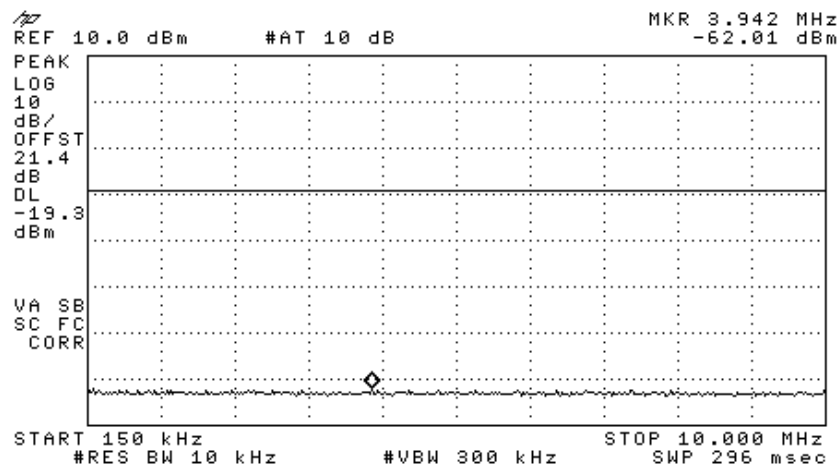


Figure 94 —2437 MHz 64QAM (54Mbit/sec)

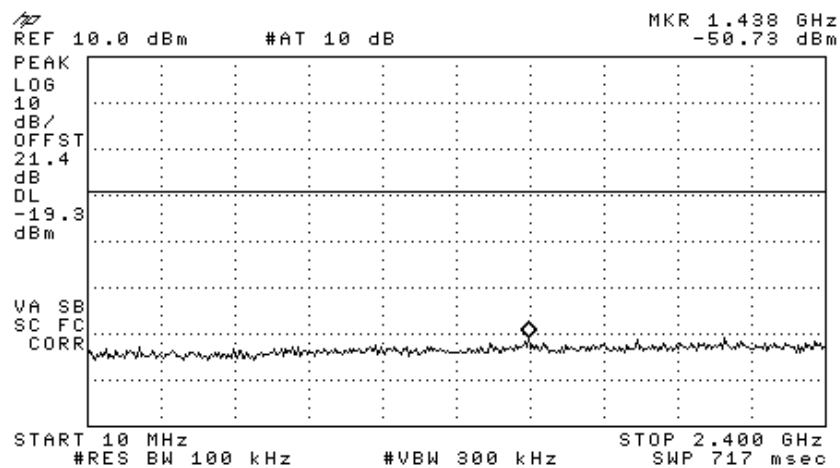


Figure 95 —2437 MHz 64QAM (54Mbit/sec)

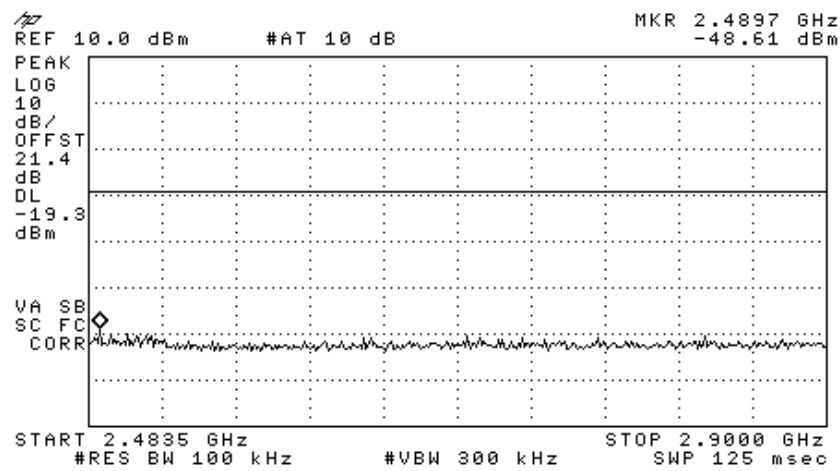


Figure 96 —2437 MHz 64QAM (54Mbit/sec)

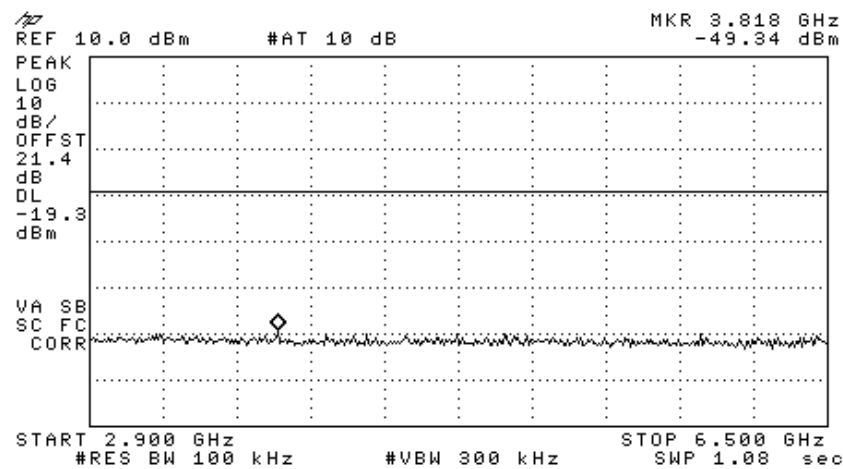


Figure 97 —2437 MHz 64QAM (54Mbit/sec)

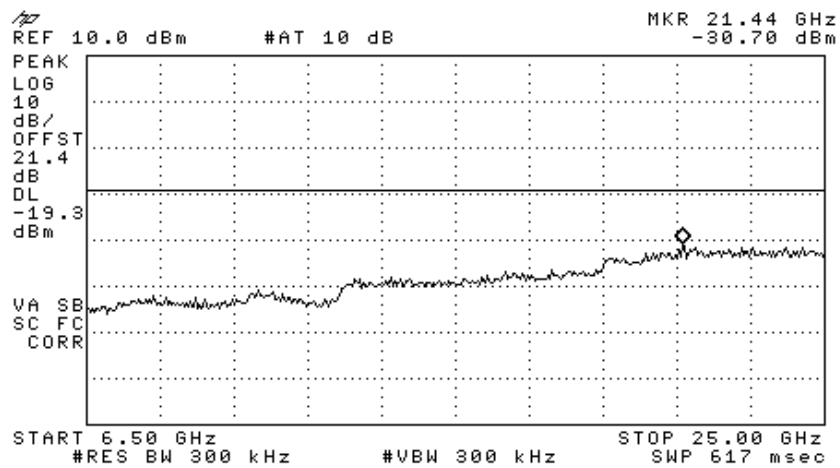


Figure 98 —2437 MHz 64QAM (54Mbit/sec)

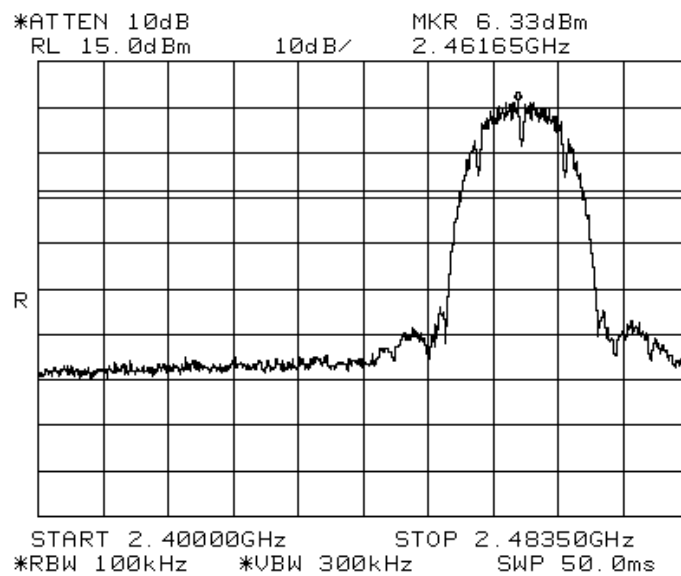


Figure 99 —2462 MHz BPSK (1Mbit/sec)

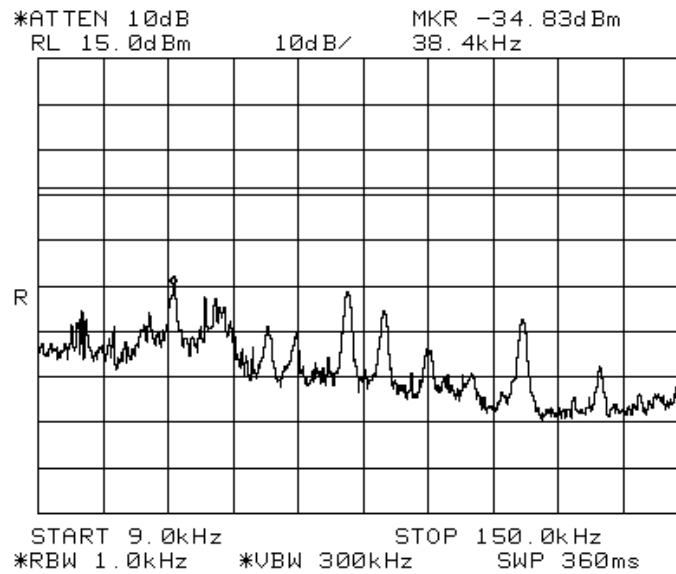


Figure 100 —2462 MHz BPSK (1Mbit/sec)

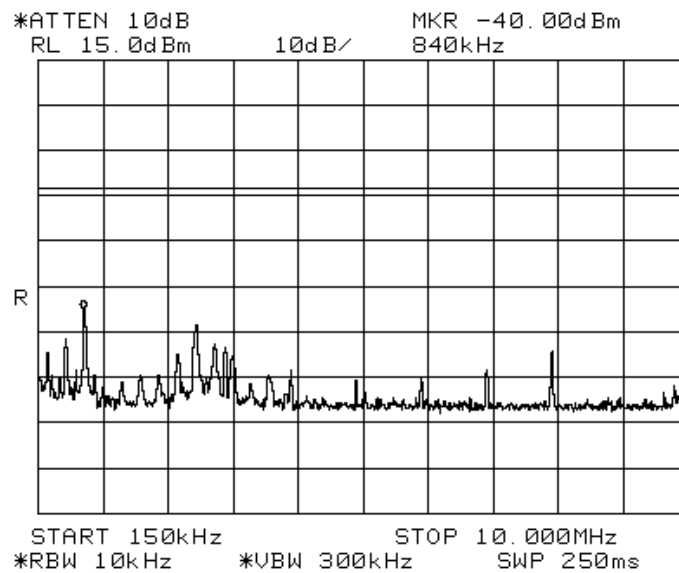


Figure 101 —2462 MHz BPSK (1Mbit/sec)

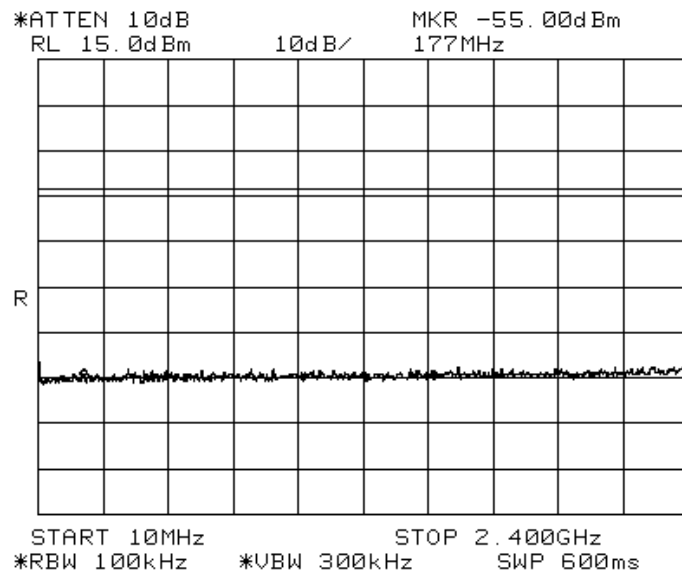


Figure 102 —2462 MHz BPSK (1Mbit/sec)

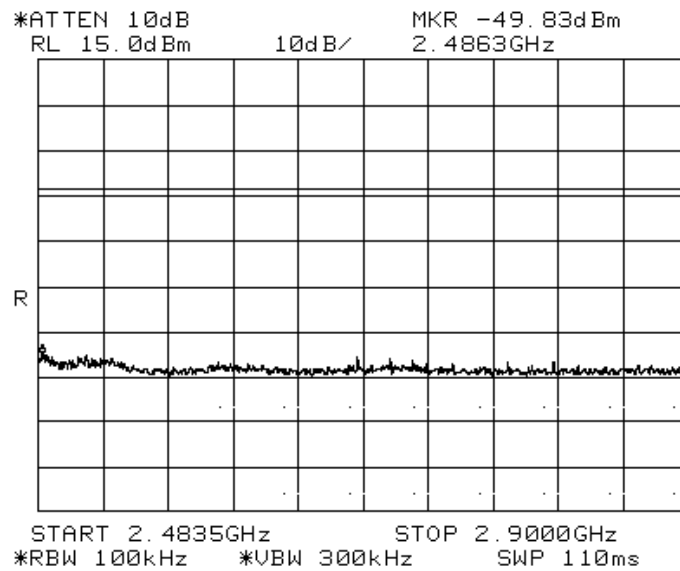


Figure 103 —2462 MHz BPSK (1Mbit/sec)

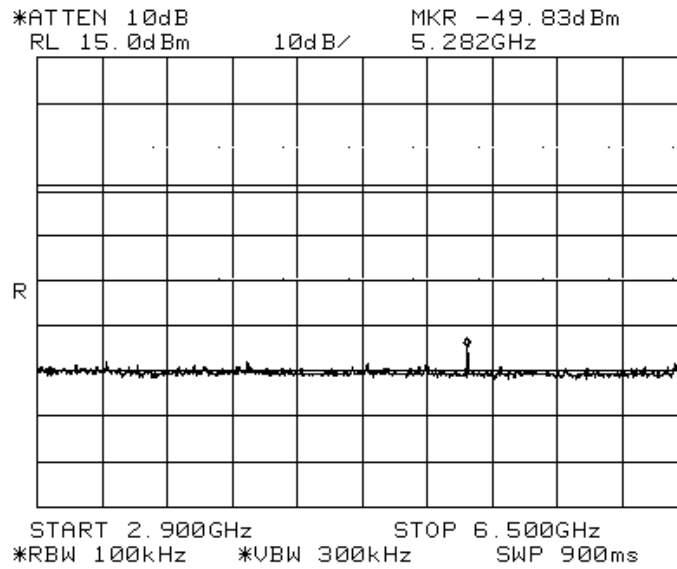


Figure 104 —2462 MHz BPSK (1Mbit/sec)

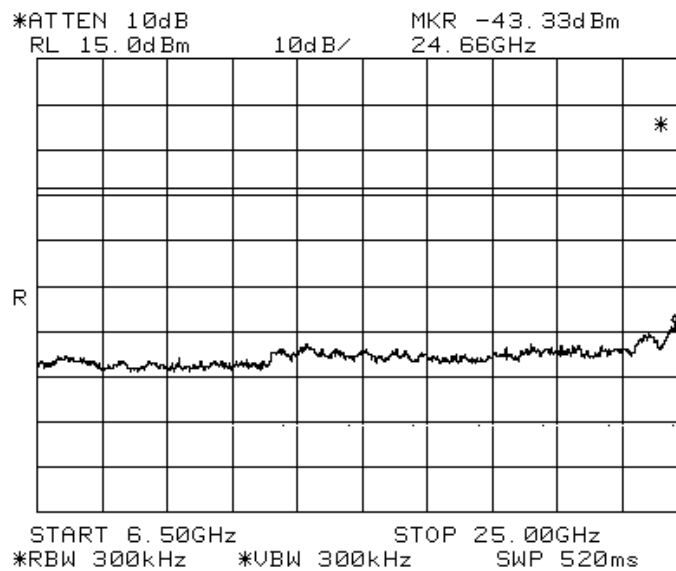


Figure 105 —2462 MHz BPSK (1Mbit/sec)

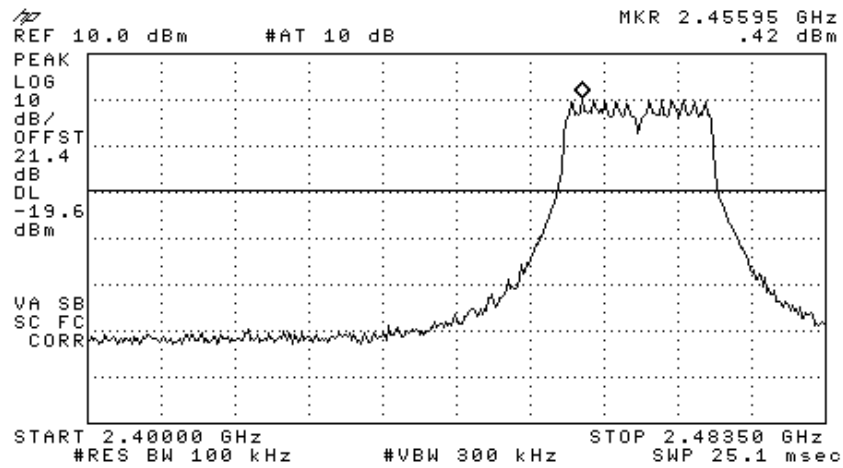


Figure 106 —2462 MHz BPSK (6Mbit/sec)

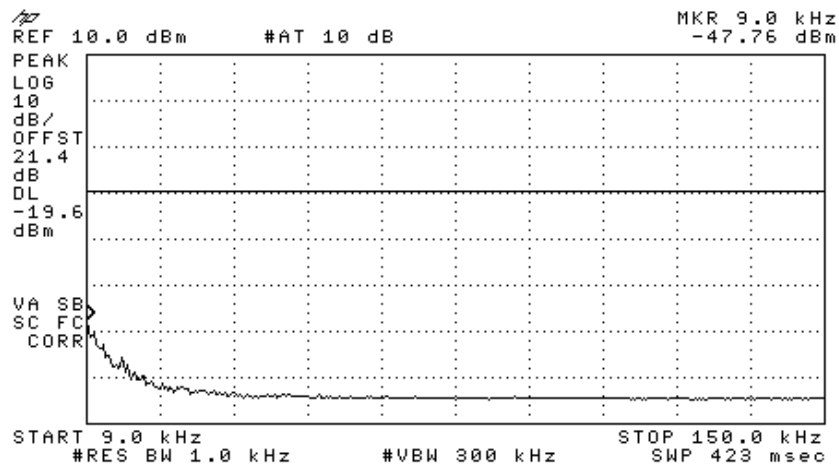


Figure 107 —2462 MHz BPSK (6Mbit/sec)

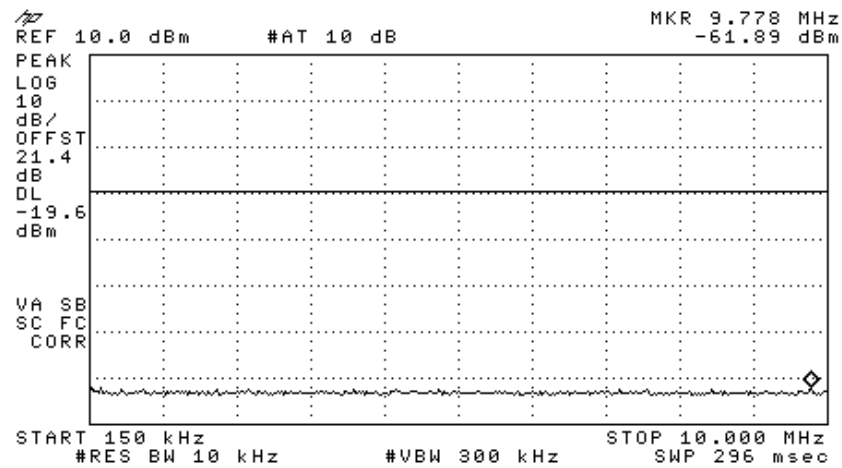


Figure 108 —2462 MHz BPSK (6Mbit/sec)

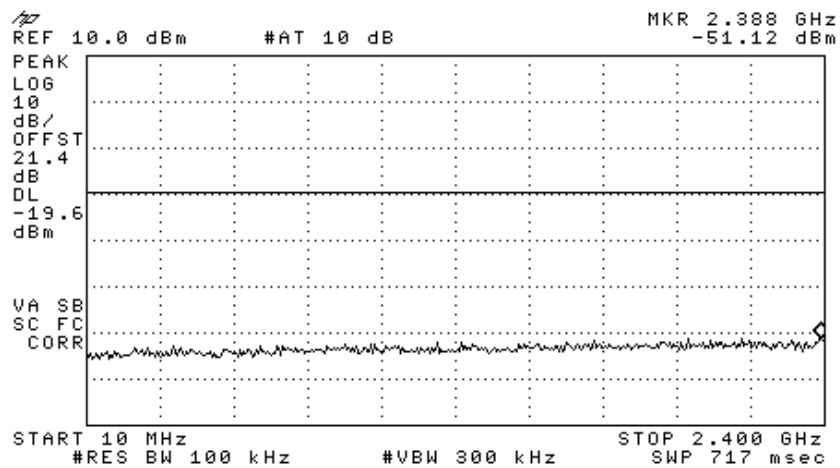


Figure 109 —2462 MHz BPSK (6Mbit/sec)

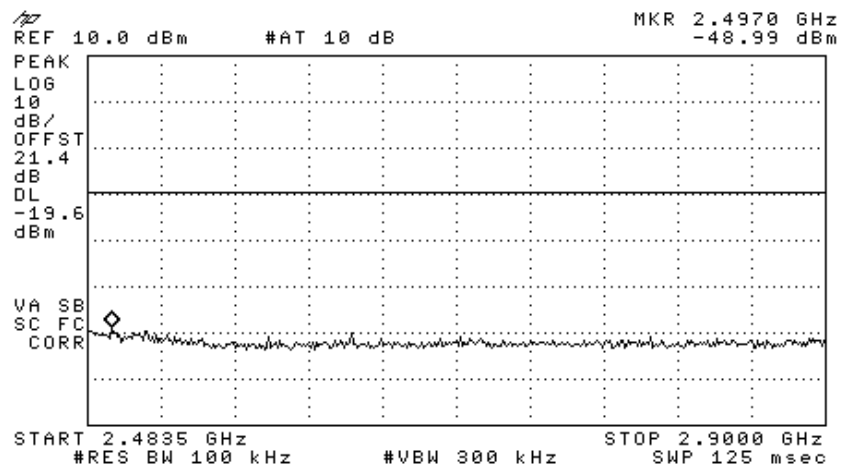


Figure 110 —2462 MHz BPSK(6Mbit/sec)

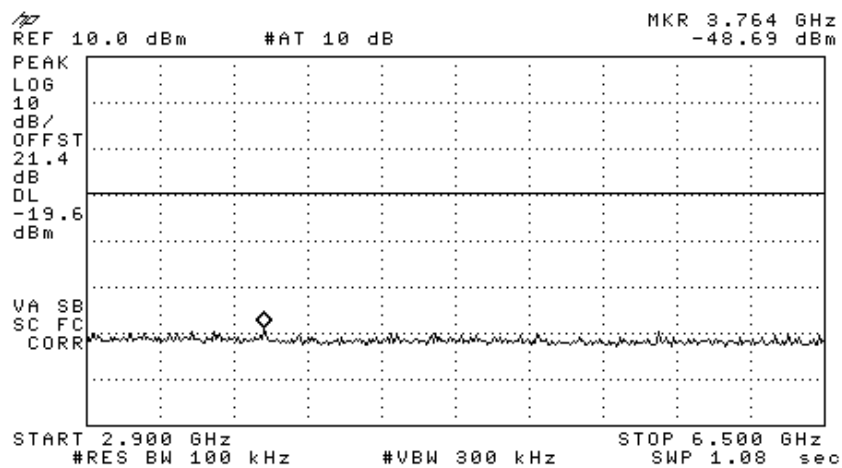


Figure 111 —2462 MHz BPSK (6Mbit/sec)

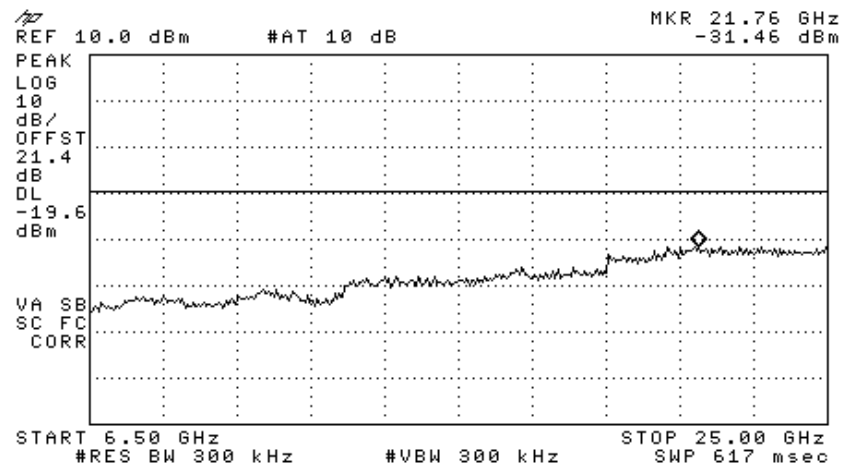


Figure 112 —2462 MHz BPSK (6Mbit/sec)

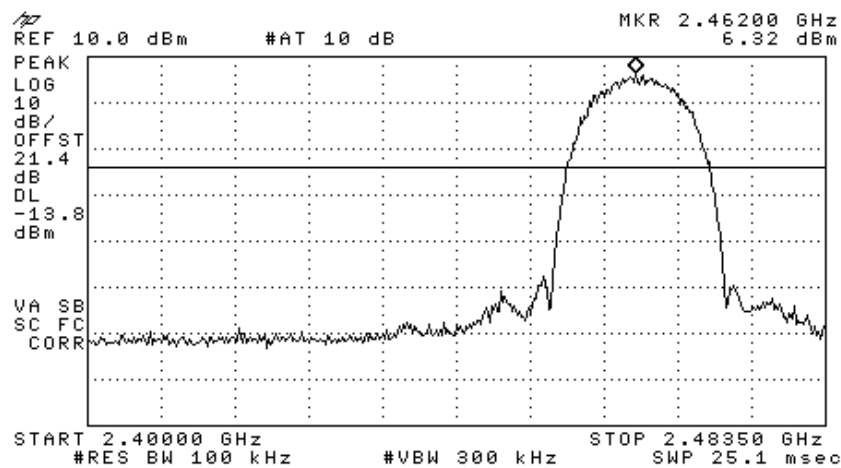


Figure 113 —2462 MHz QPSK (11Mbit/sec)

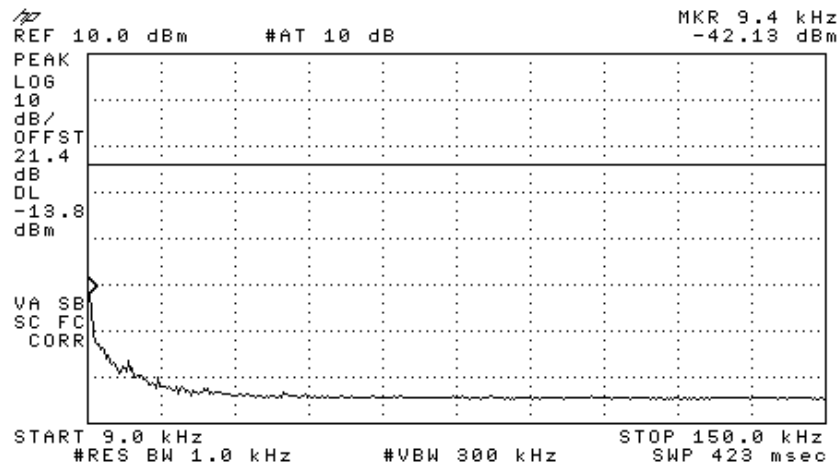


Figure 114 —2462 QPSK (11Mbit/sec)

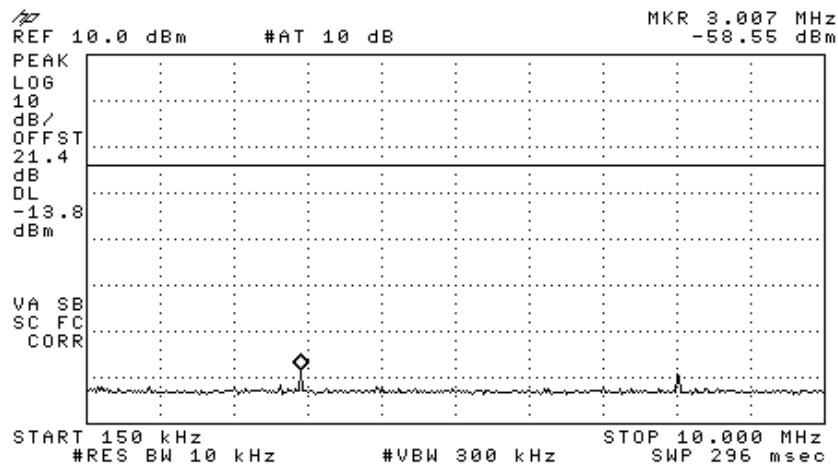


Figure 115 —2462 QPSK (11Mbit/sec)

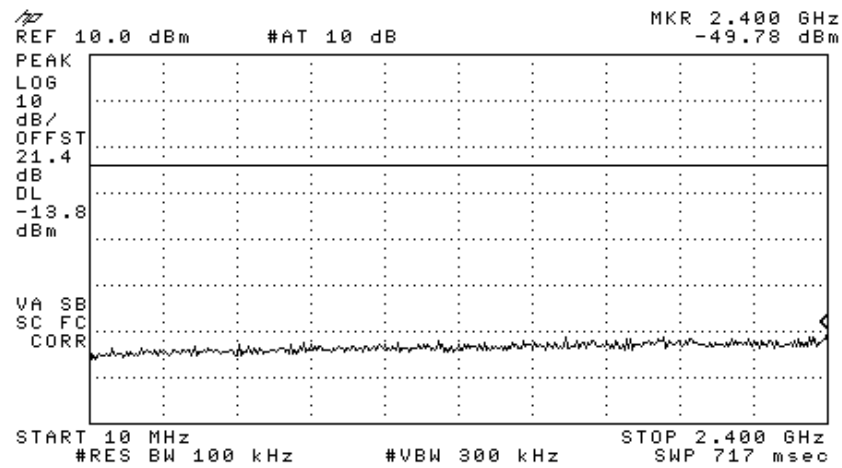


Figure 116 —2462 MHz QPSK (11Mbit/sec)

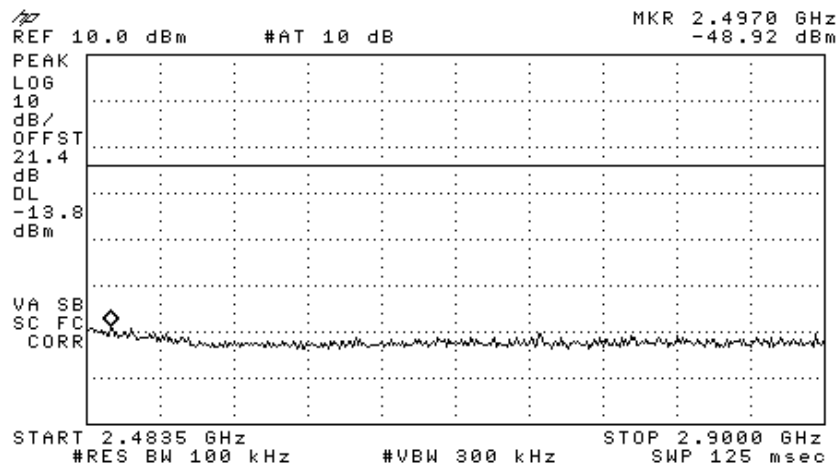


Figure 117 —2462 MHz QPSK (11Mbit/sec)

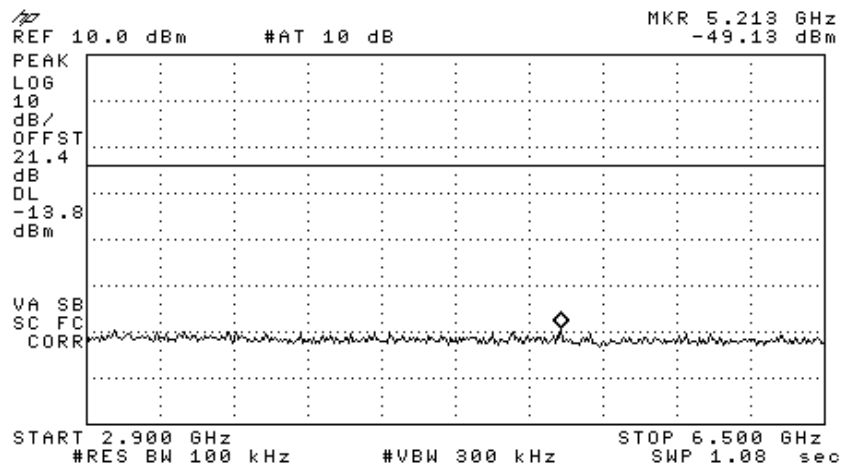


Figure 118 —2462 MHz QPSK (11Mbit/sec)

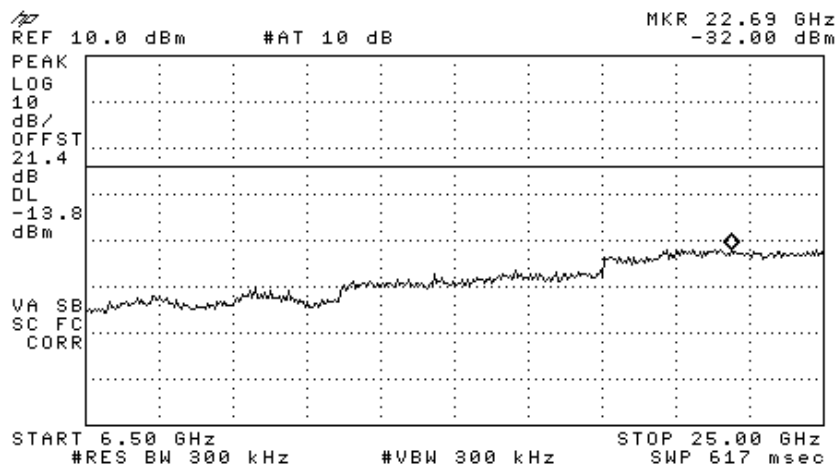


Figure 119 —2462 MHz QPSK (11Mbit/sec)

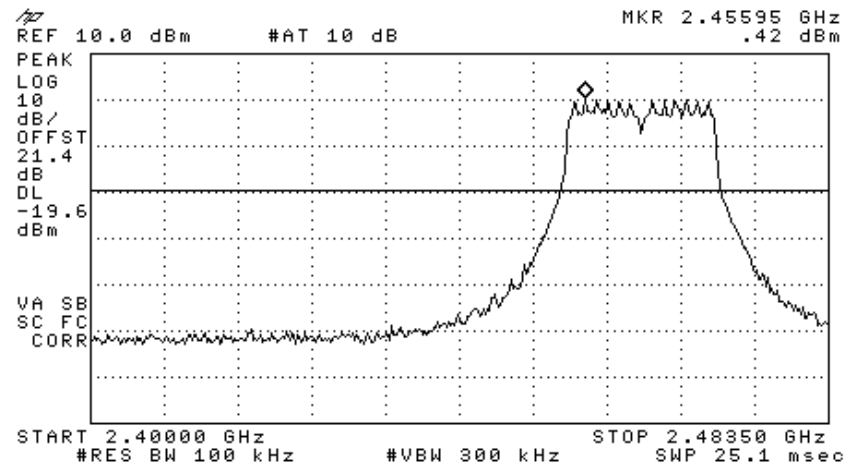


Figure 120 —2462 MHz 64QAM (54Mbit/sec)

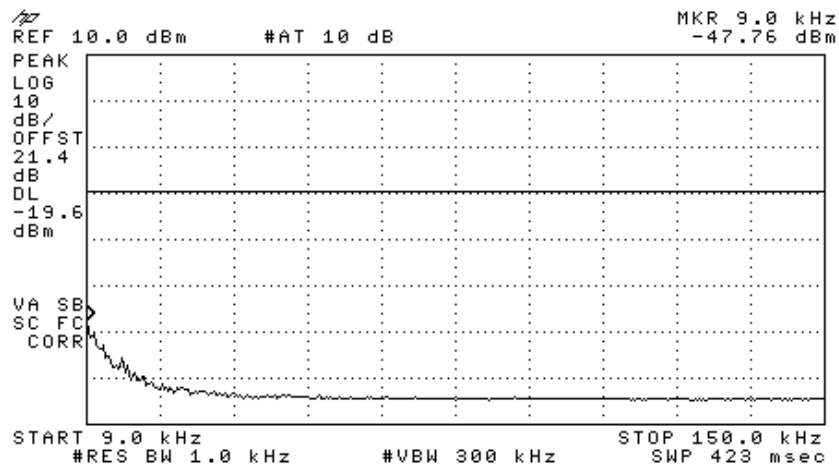


Figure 121 —2462 MHz 64QAM (54Mbit/sec)

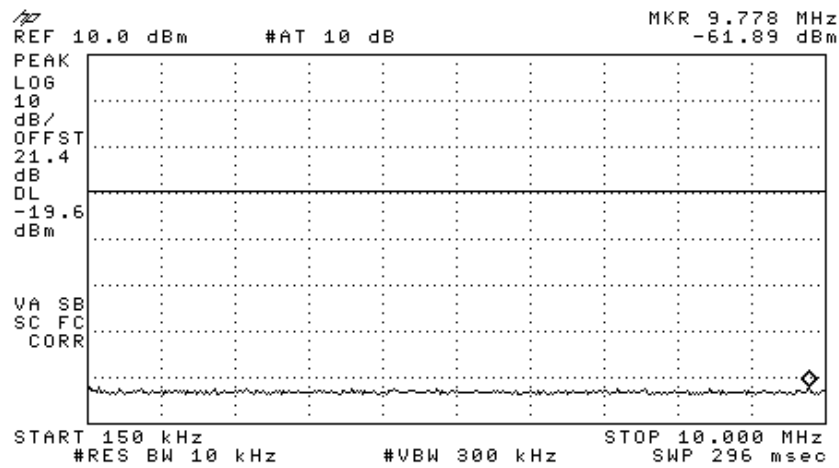


Figure 122 —2462 MHz 64QAM (54Mbit/sec)

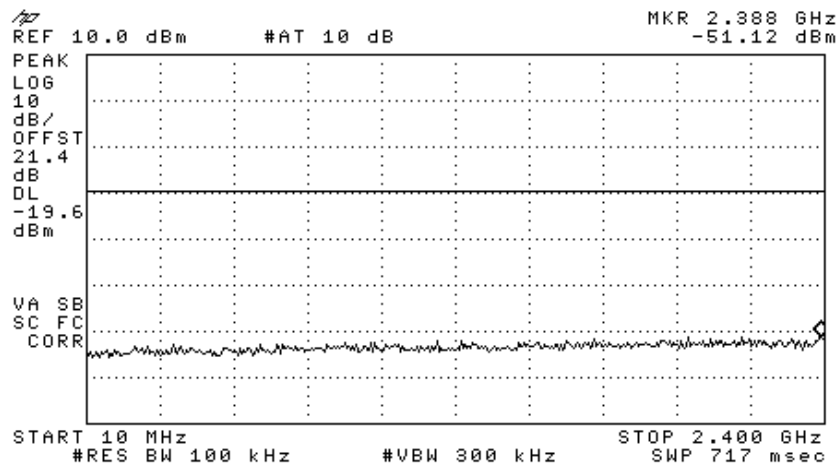


Figure 123 —2462 MHz 64QAM (54Mbit/sec)

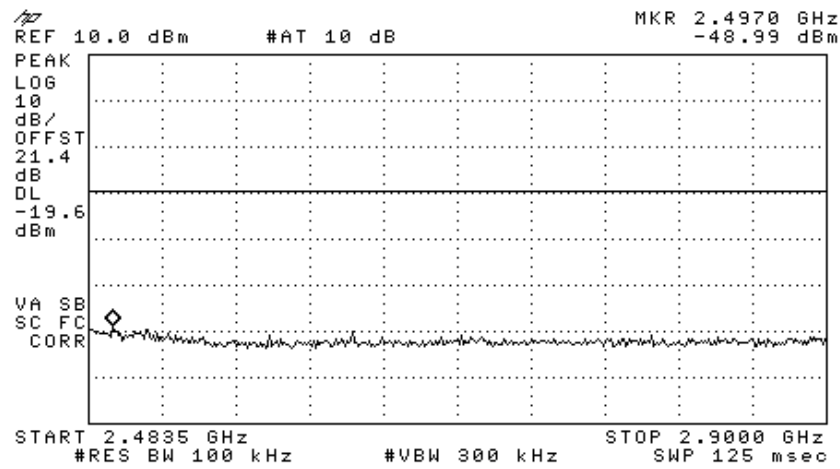


Figure 124 —2462 MHz 64QAM (54Mbit/sec)

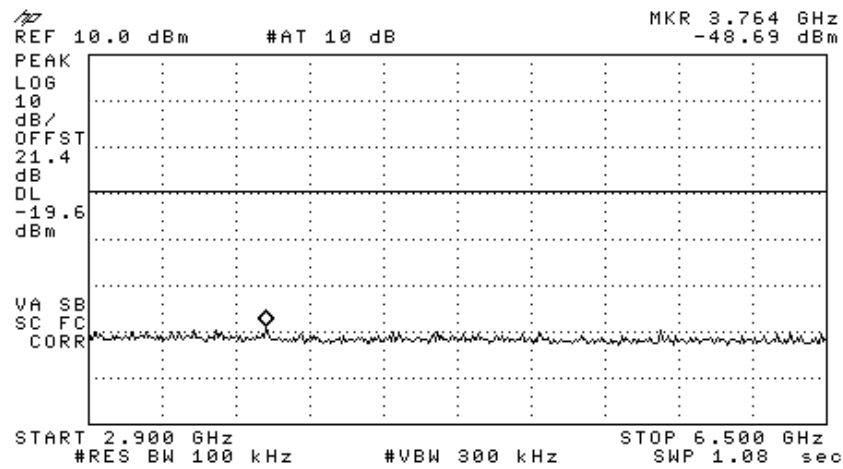


Figure 125 —2462 MHz 64QAM (54Mbit/sec)

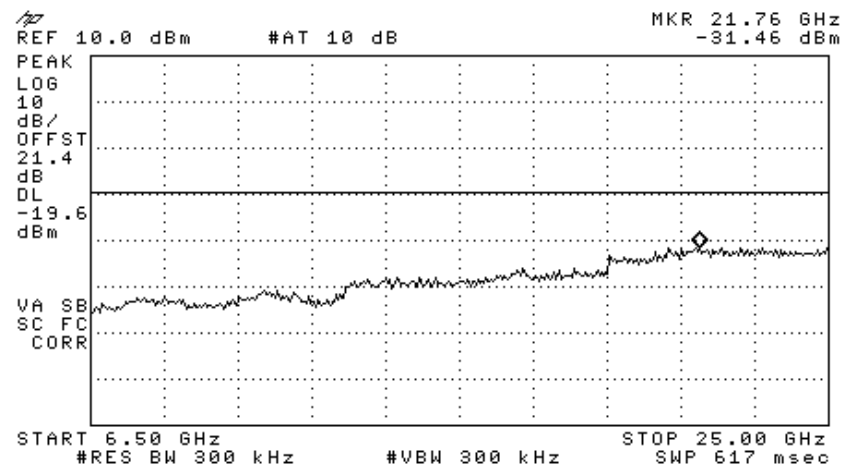


Figure 126 —2462 MHz 64QAM (54Mbit/sec)

11.2 Results table

E.U.T Description: W24 Wi-Fi Module
Model No.: W24
Serial Number: UQT00040
Specification: F.C.C. Part 15, Subpart C (15.247)

Operation Frequency (MHz)	Modulation	Bit Rate	Reading (dBc)	Specification (dBc)	Margin (dB)
2412	BPSK	1 Mbps	30.65	20.0	-10.65
	BPSK	6 Mbps	30.41	20.0	-10.41
	QPSK	11 Mbps	34.67	20.0	-14.67
	64QAM	54 Mbps	31.62	20.0	-11.62
2437	BPSK	1 Mbps	33.50	20.0	-13.50
	BPSK	6 Mbps	37.42	20.0	-17.42
	QPSK	11 Mbps	37.09	20.0	-17.09
	64QAM	54 Mbps	31.40	20.0	-11.40
2462	BPSK	1 Mbps	41.16	20.0	-21.16
	BPSK	6 Mbps	31.86	20.0	-11.86
	QPSK	11 Mbps	38.20	20.0	-18.20
	64QAM	54 Mbps	32.43	20.0	-12.43

Figure 127 Peak Power Output of 2400-2483.5 MHz Band

JUDGEMENT: Passed by 10.41 dB

TEST PERSONNEL:

Tester Signature: 

Date: 13.04.08

Typed/Printed Name: A. Sharabi

11.3 Test Equipment Used.

Peak Power Output of 2400-2438.5 MHz Band

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	May 9, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

Figure 128 Test Equipment Used

12. 6 dB Minimum Bandwidth 802.11b/g Signals

12.1 Test procedure

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 kHz resolution BW. The spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded.

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: BPSK (1Mbit/sec), BPSK (6Mbit/sec), QPSK (11Mbit/sec) and 64QAM (54Mbit/sec).

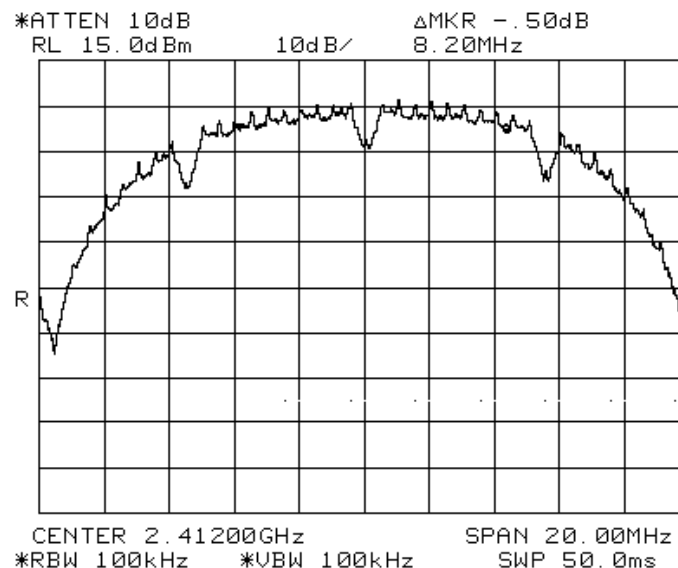


Figure 129 —2412 MHz BPSK (1Mbit/sec)

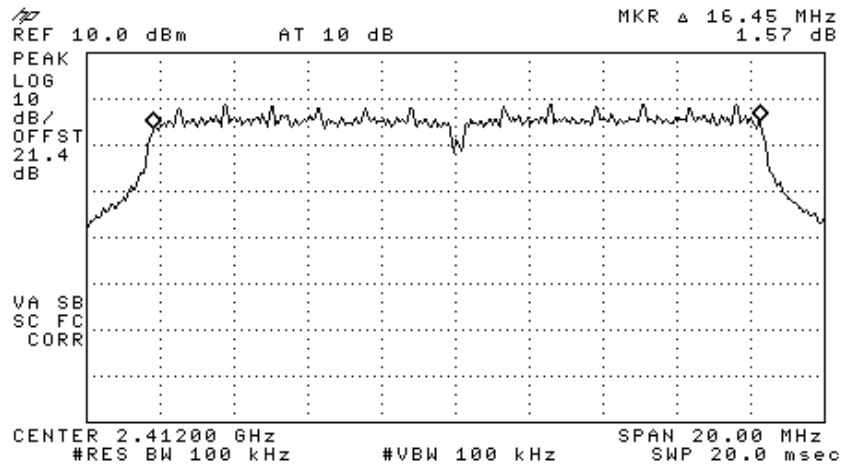


Figure 130 —2412 MHz BPSK (6Mbit/sec)

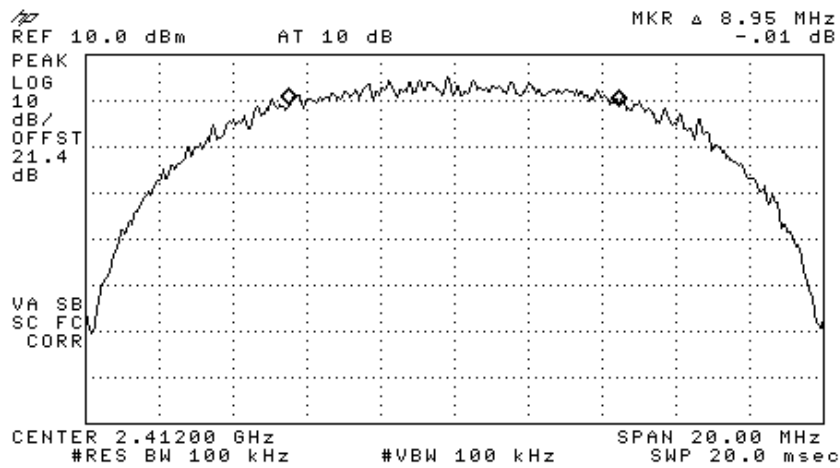


Figure 131 —2412 MHz QPSK (11Mbit/sec)

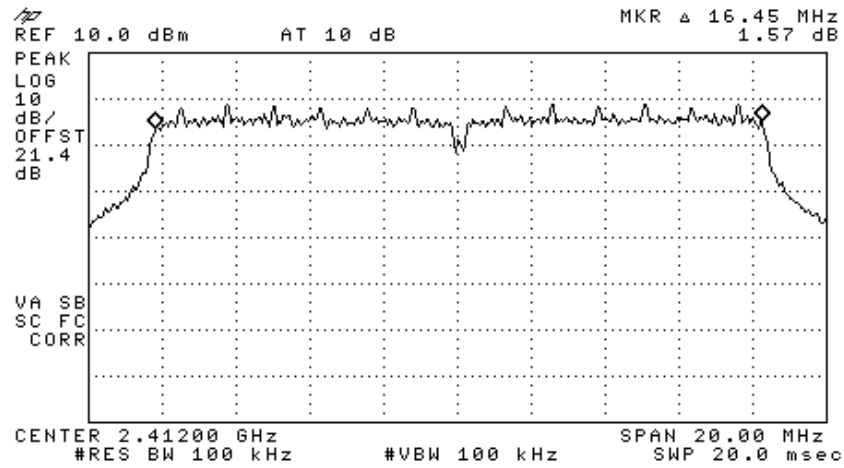


Figure 132 —2412 MHz 64QAM (54Mbit/sec)

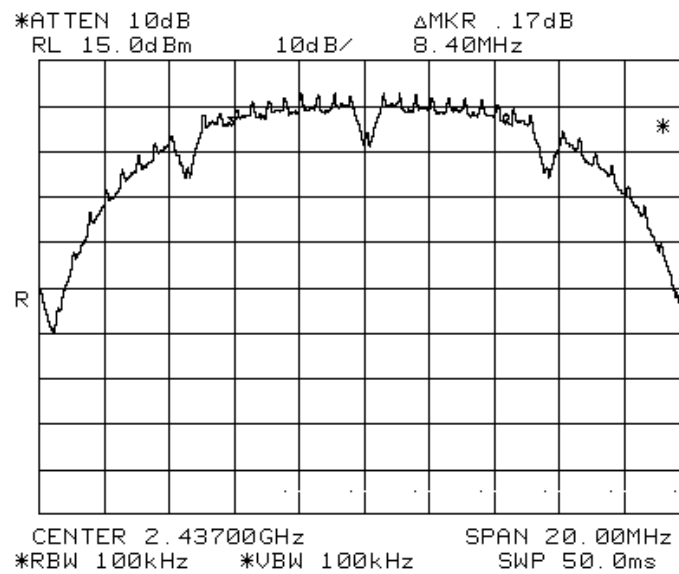


Figure 133 —2437 MHz BPSK (1Mbit/sec)

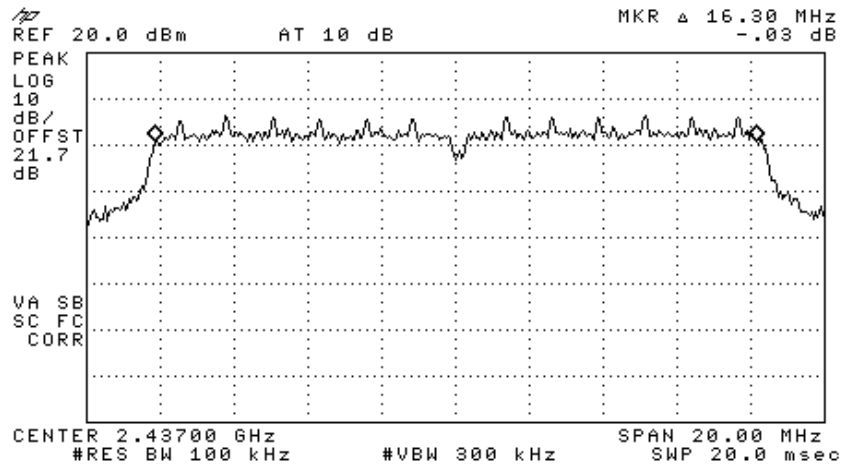


Figure 134 —2437 MHz BPSK (6Mbit/sec)

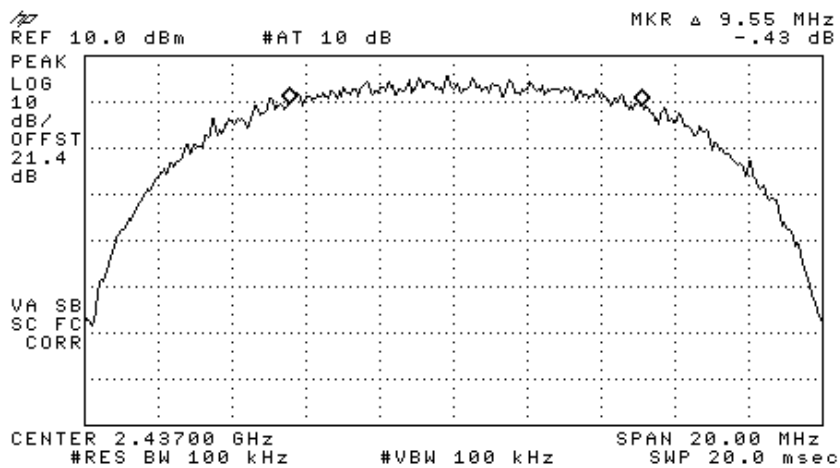


Figure 135 —2437 MHz QPSK (11Mbit/sec)

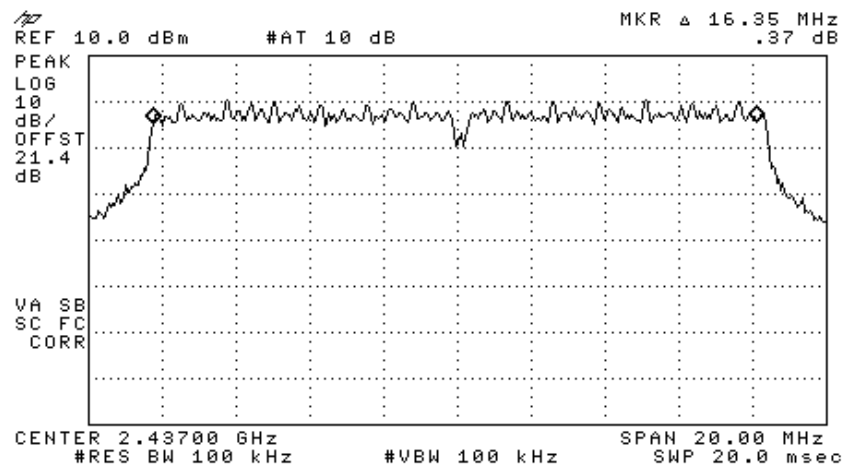


Figure 136 —2437 MHz 64QAM (54Mbit/sec)

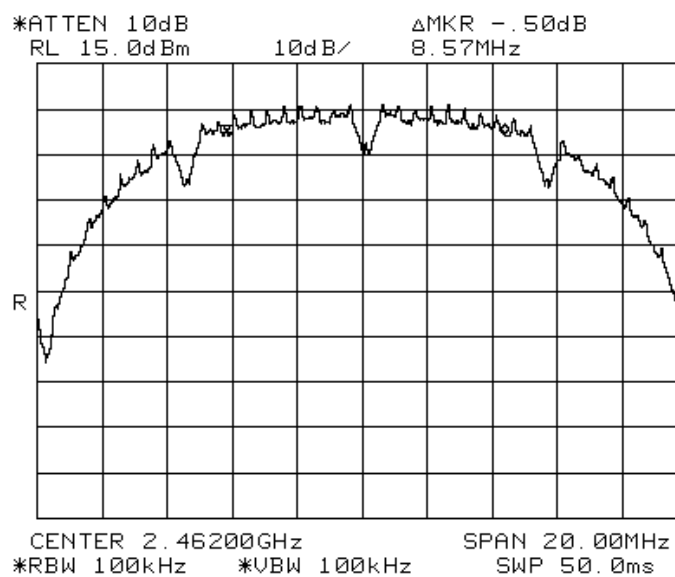


Figure 137 —2462 MHz BPSK (1Mbit/sec)

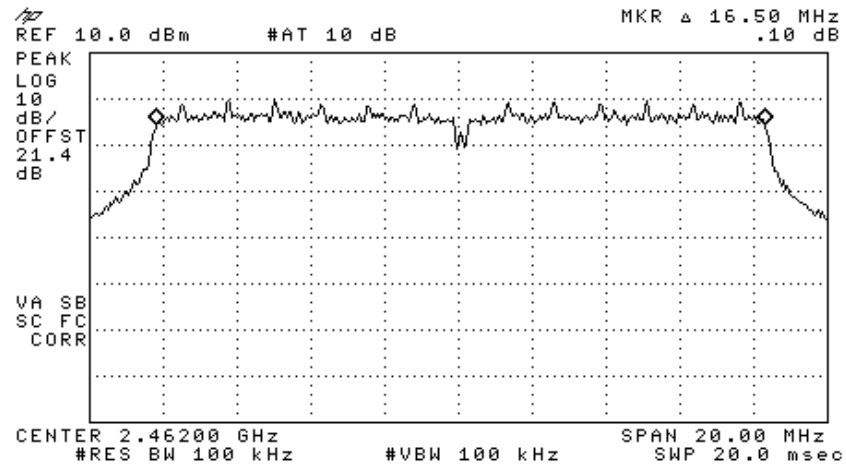


Figure 138 —2462 MHz BPSK (6Mbit/sec)

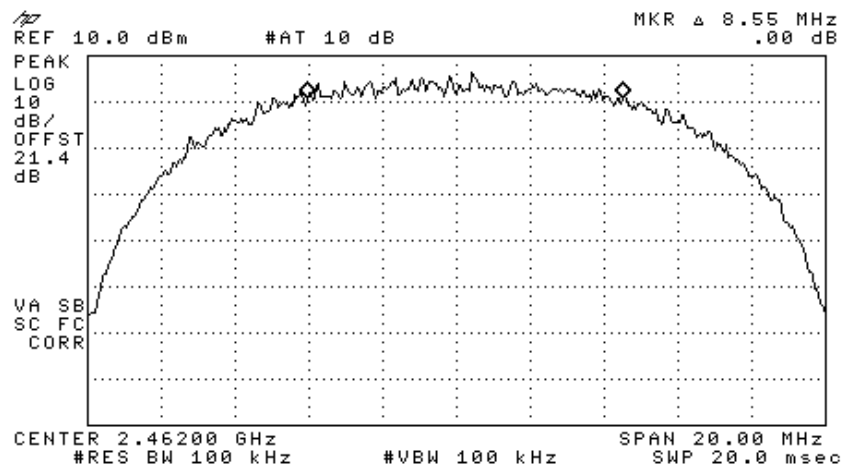


Figure 139 —2642 MHz QPSK (11Mbit/sec)

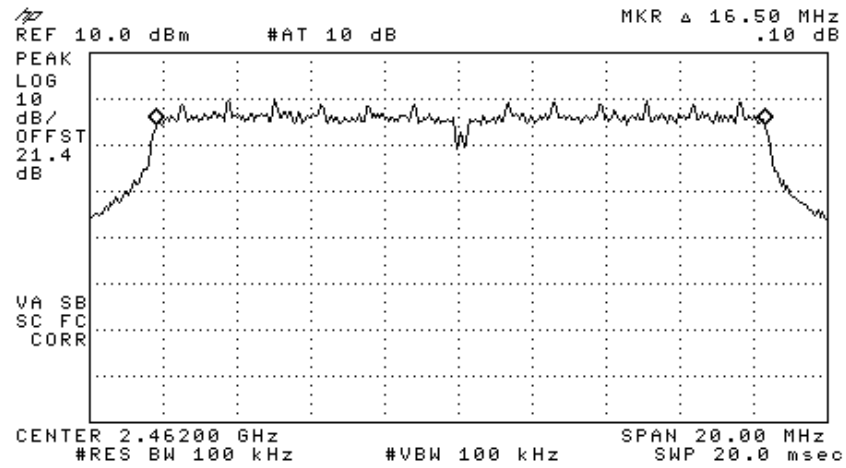


Figure 140 —2462 MHz 64QAM (54Mbit/sec)

12.2 Results table

E.U.T Description: W24 Wi-Fi Module

Model No.: W24

Serial Number: UQT00040

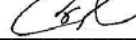
Specification: F.C.C. Part 15, Subpart C: (15.247-a2)

Operation Frequency (MHz)	Modulation	Bit Rate	Reading (MHz)	Specification (MHz)
2412	BPSK	1 Mbps	8.20	0.5
	BPSK	6 Mbps	16.45	0.5
	QPSK	11 Mbps	8.95	0.5
	64QAM	54 Mbps	16.35	0.5
2437	BPSK	1 Mbps	8.40	0.5
	BPSK	6 Mbps	16.30	0.5
	QPSK	11 Mbps	9.55	0.5
	64QAM	54 Mbps	16.35	0.5
2462	BPSK	1 Mbps	8.57	0.5
	BPSK	6 Mbps	16.50	0.5
	QPSK	11 Mbps	8.55	0.5
	64QAM	54 Mbps	16.40	0.5

Figure 141 6 dB Minimum Bandwidth

JUDGEMENT: Passed

TEST PERSONNEL:

Tester Signature: 

Date: 13.04.08

Typed/Printed Name: A. Sharabi

12.3 Test Equipment Used.

6 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	May 9, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

Figure 142 Test Equipment Used

13. Band Edge Spectrum 802.11b/g Signals

[In Accordance with section 15.247(c)]

13.1 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 kHz resolution BW. Maximum power level below 2400 MHz and above 2483.5 MHz was measured relative to power level at 2412 MHz, and 2462 MHz correspondingly.

The E.U.T. was tested using the following modulations: BPSK (1Mbit/sec), BPSK (6Mbit/sec), QPSK (11Mbit/sec) and 64QAM (54Mbit/sec).

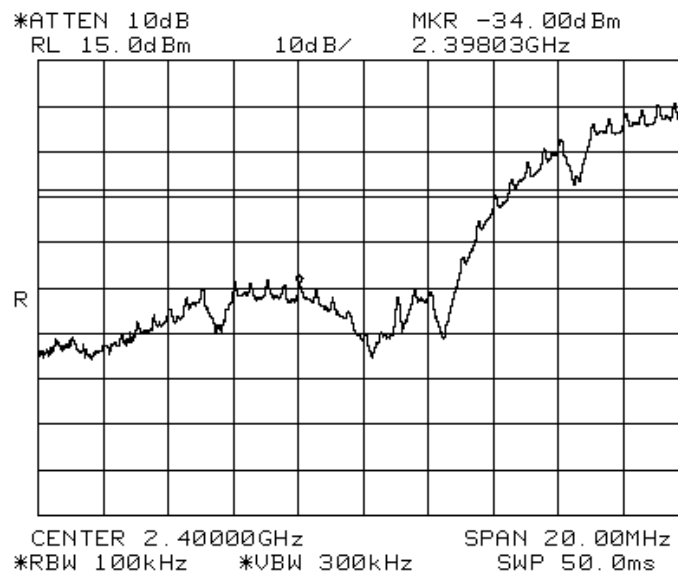


Figure 143 —2412 MHz BPSK (1Mbit/sec)

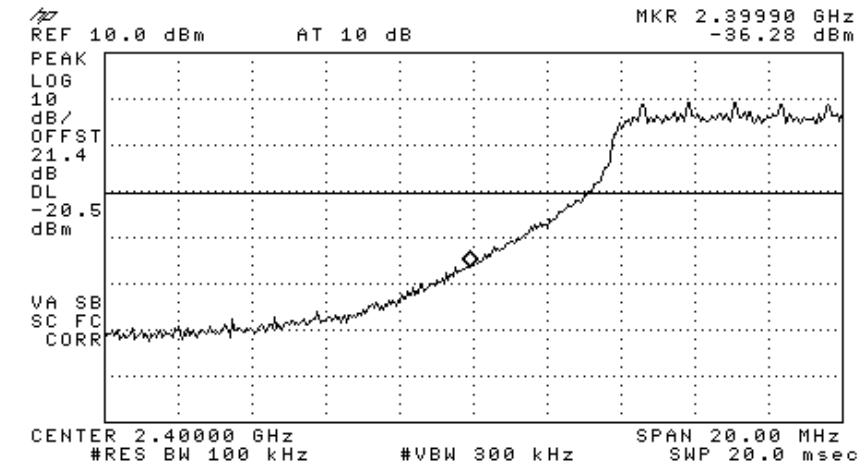


Figure 144 —2412 MHz BPSK (6Mbit/sec)

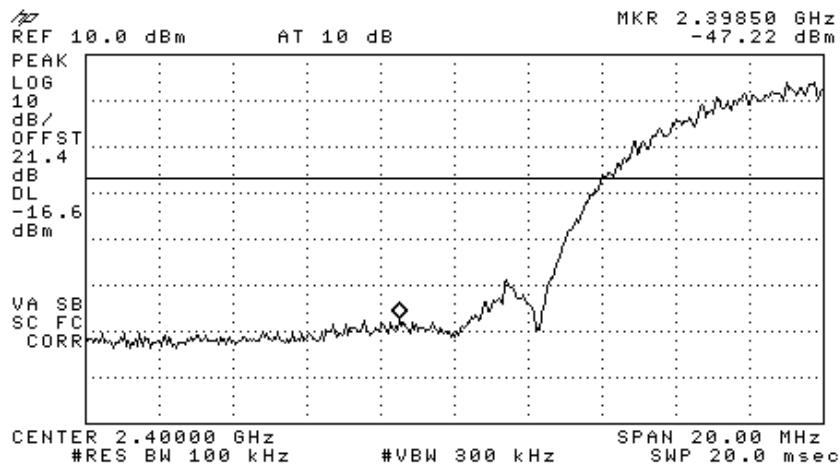


Figure 145 —2412 MHz QPSK (11Mbit/sec)

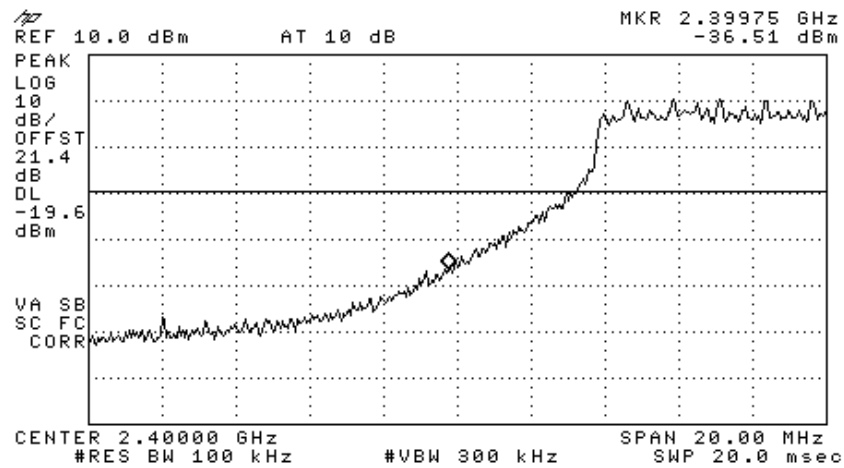


Figure 146 —2412 MHz 64QAM (54Mbit/sec)

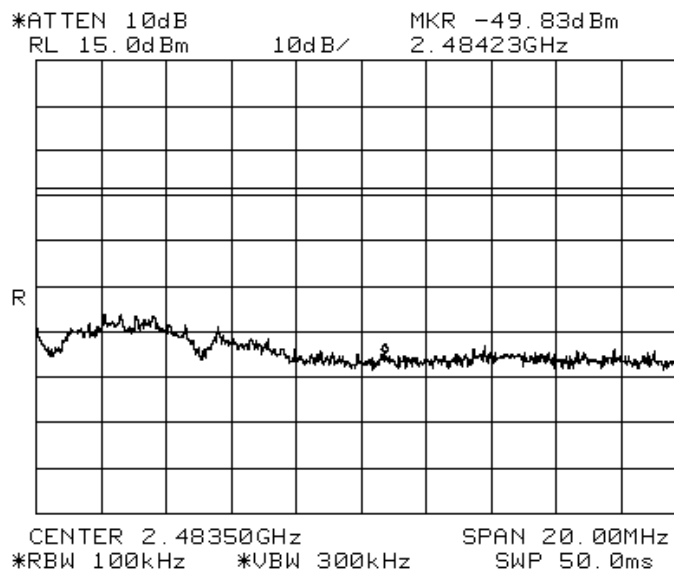


Figure 147 —2462 MHz BPSK (1Mbit/sec)

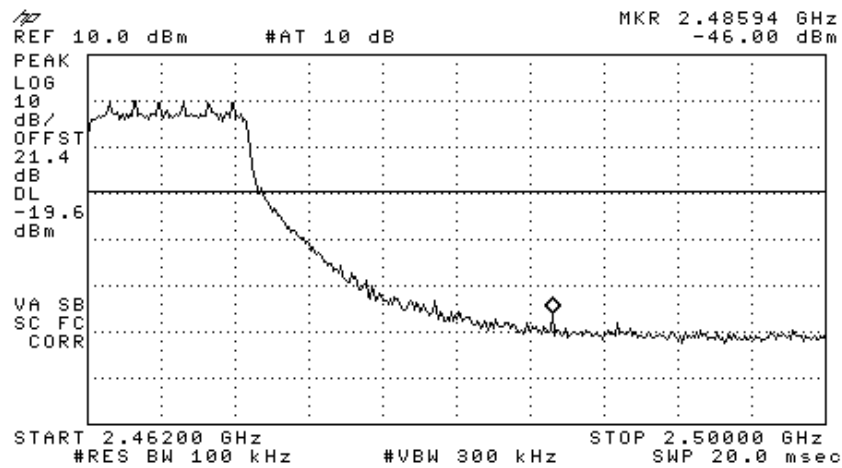


Figure 148 —2462 MHz BPSK (6Mbit/sec)

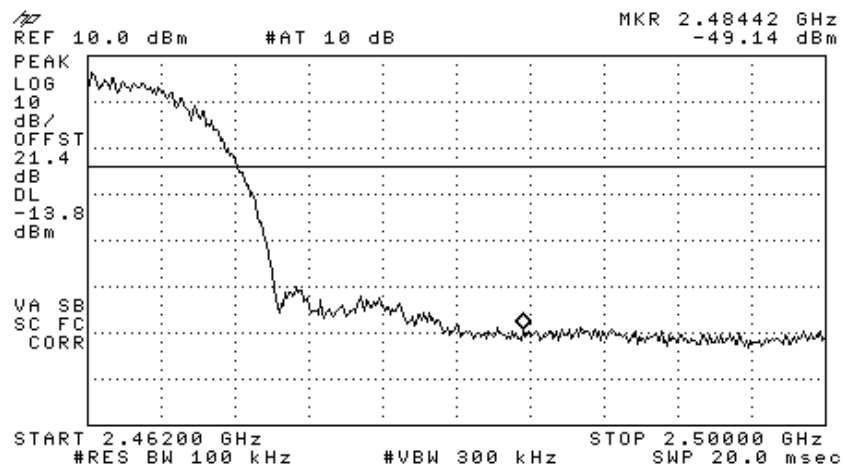


Figure 149 —2462 MHz QPSK (11Mbit/sec)

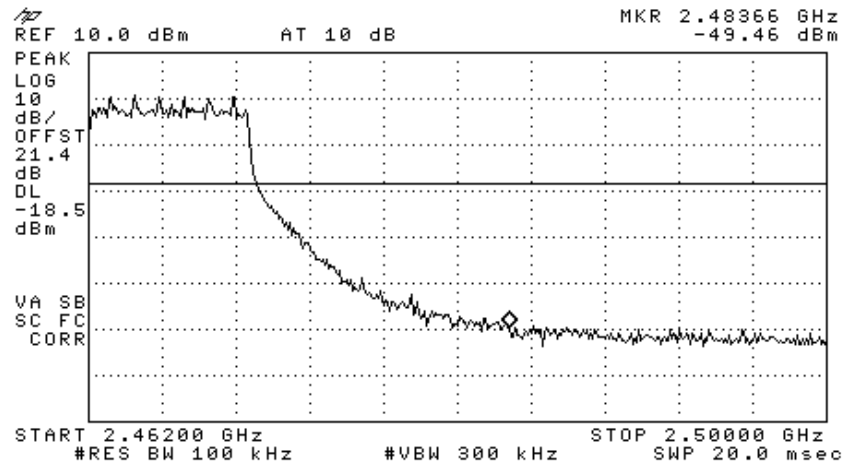


Figure 150 —2462 MHz 64QAM (54Mbit/sec)

13.2 Results table

E.U.T. Description: W24 Wi-Fi Module

Model No.: W24

Serial Number: UQT00040

Specification: F.C.C. Part 15, Subpart C (15.247)

Operation Frequency (MHz)	Modulation	Bit Rate	Band Edge Frequency (MHz)	Spectrum Level (dBc)	Specification (dBc)	Margin (dB)
2412	BPSK	1 Mbps	2398.00	40.33	20.0	-20.33
	BPSK	6 Mbps	2399.90	35.78	20.0	-15.78
	QPSK	11 Mbps	2398.50	50.62	20.0	-30.62
	64QAM	54 Mbps	2399.75	36.91	20.0	-16.91
2462	BPSK	1 Mbps	2484.23	56.16	20.0	-36.16
	BPSK	6 Mbps	2485.94	46.40	20.0	-26.40
	QPSK	11 Mbps	2484.42	55.34	20.0	-35.34
	64QAM	54 Mbps	2483.66	50.96	20.0	-30.96

Figure 151 Band Edge Spectrum

JUDGEMENT: Passed by 15.78 dB

TEST PERSONNEL:

Tester Signature: 

Date: 13.04.08

Typed/Printed Name: A. Sharabi

13.3 Test Equipment Used.

Band edge Spectrum

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	May 9, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

Figure 152 Test Equipment Used

14. Transmitted Power Density 802.11 b/g Signals

[In accordance with section 15.247(d)]

14.1 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 3 kHz resolution BW. and sweep time of 1 second for each 3 kHz “window”. The spectrum peaks were located at each of the 3 operating frequencies.

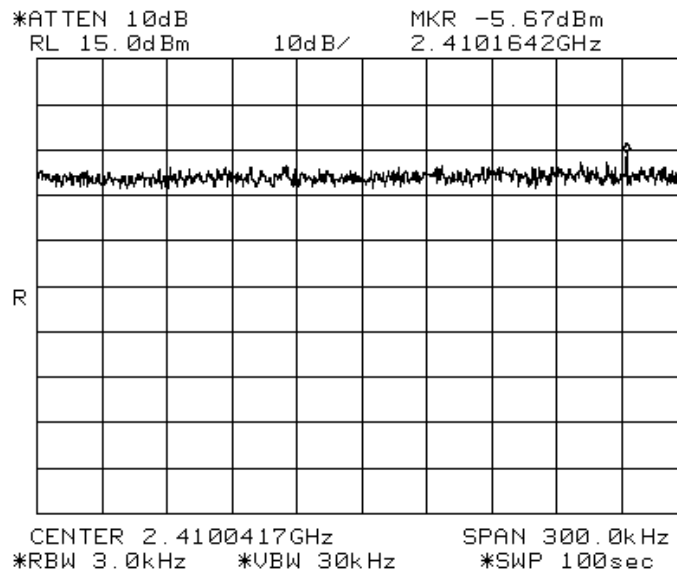


Figure 153 —2412 MHz BPSK (1Mbit/sec)

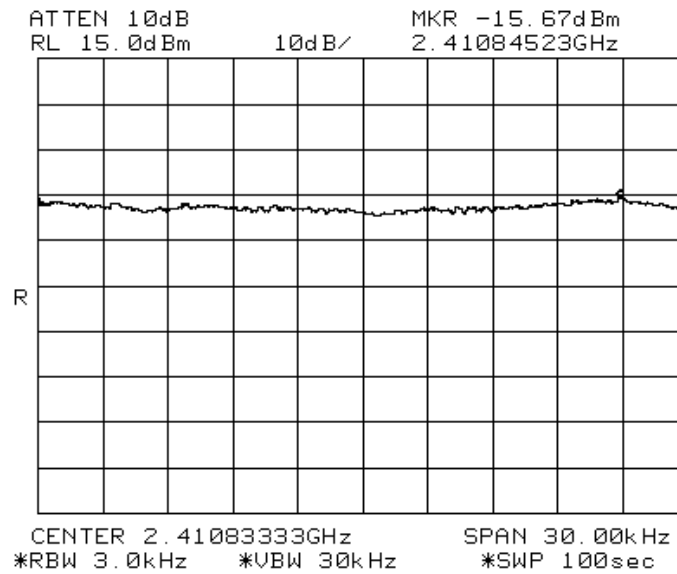


Figure 154 —2412 MHz BPSK (6Mbit/sec)

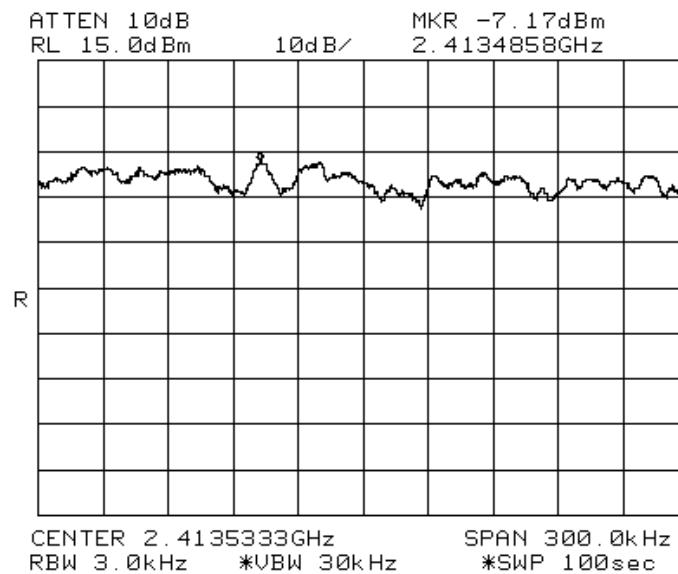


Figure 155 —2412 MHz QPSK (11Mbit/sec)

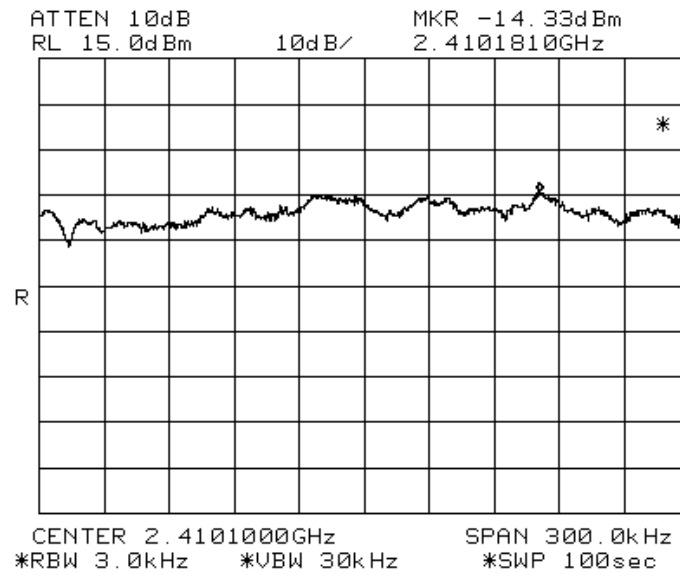


Figure 156 —2412 MHz 64QAM (54Mbit/sec)

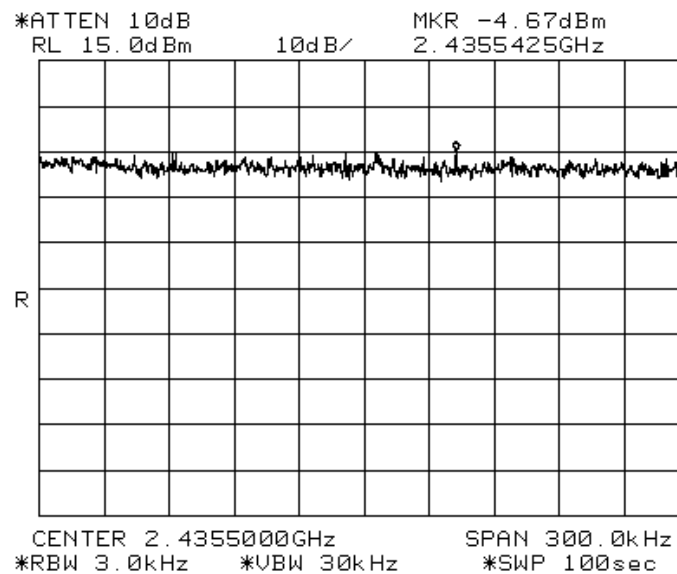


Figure 157 —2437 MHz BPSK (1Mbit/sec)

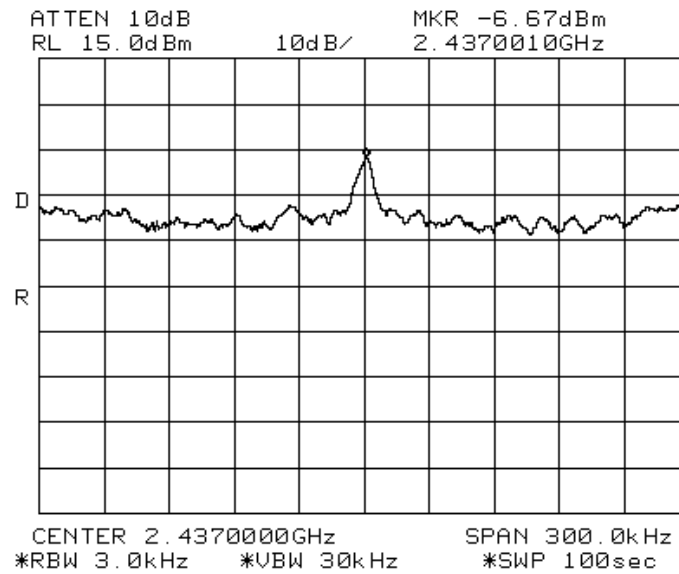


Figure 158 —2437 MHz BPSK (6Mbit/sec)

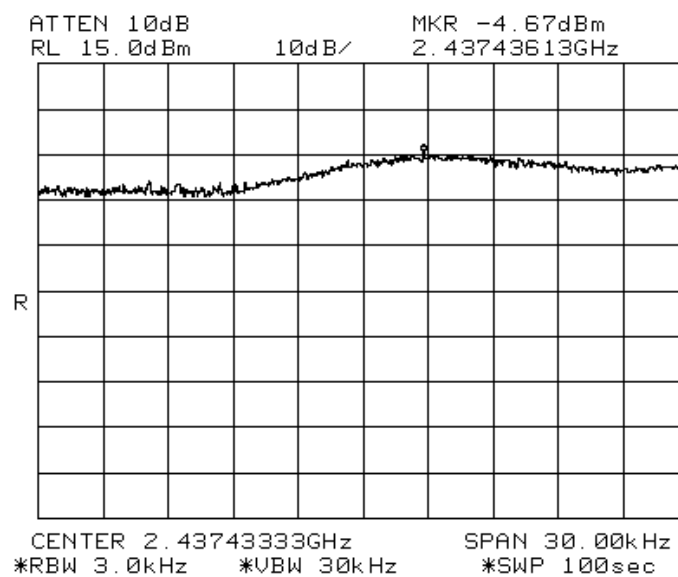


Figure 159 —2437 MHz QPSK (11Mbit/sec)

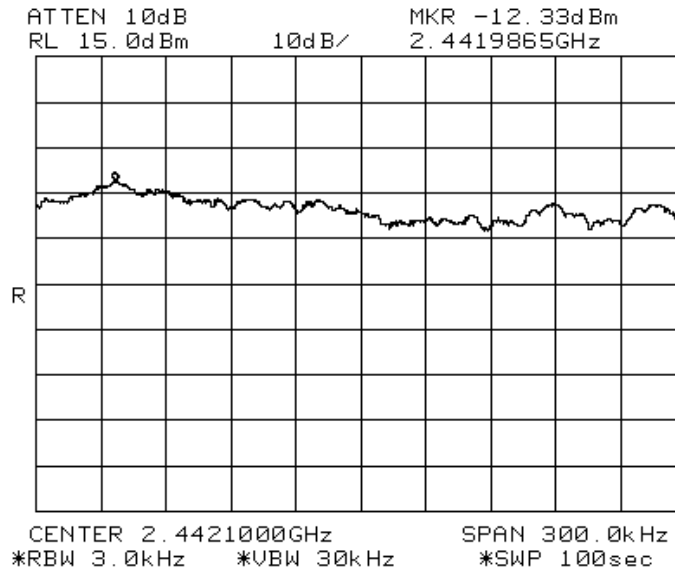


Figure 160 —2437 MHz 64QAM (54Mbit/sec)

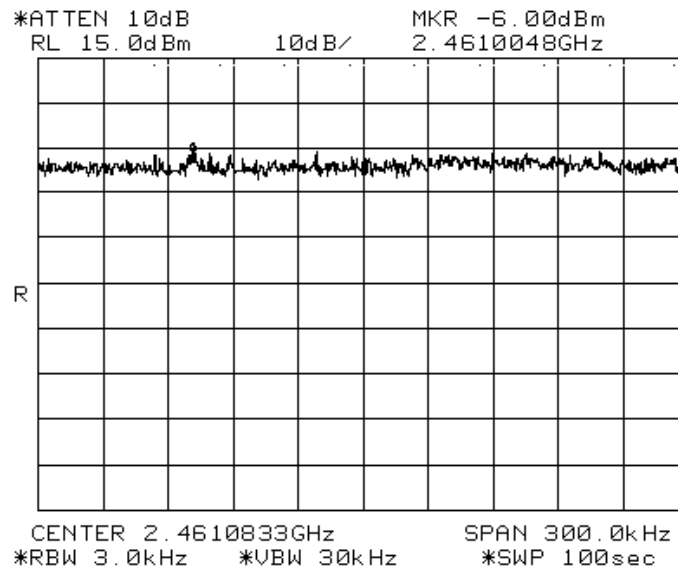


Figure 161 —2462 MHz BPSK (1Mbit/sec)

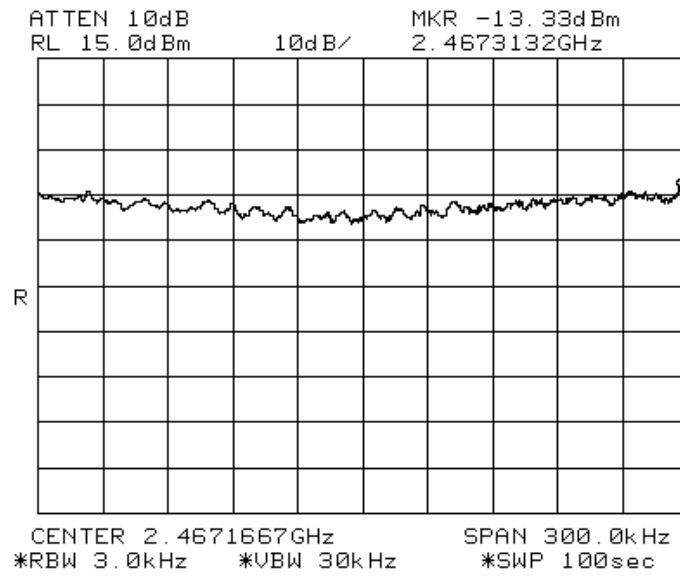


Figure 162 —2462 MHz BPSK (6Mbit/sec)

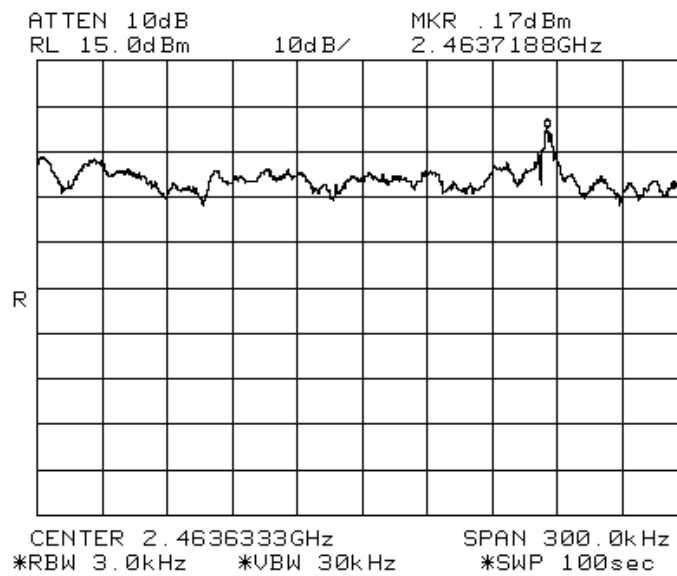


Figure 163 —2462 MHz QPSK (11Mbit/sec)

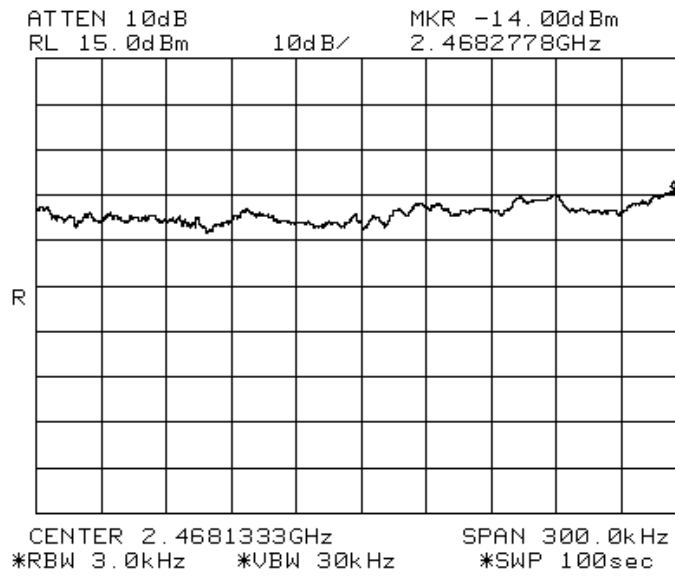


Figure 164 —2462 MHz 64QAM (54Mbit/sec)

14.2 Results table

E.U.T. Description: W24 Wi-Fi Module

Model No.: W24

Serial Number: UQT00040

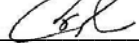
Specification: F.C.C. Part 15, Subpart C (15.247)

Operation Frequency (MHz)	Modulation	Bit Rate	Reading Spectrum Analyzer (dBm)	Specification (dBm)	Margin (dB)
2412	BPSK	1 Mbps	-5.67	8.0	-13.67
2412	BPSK	6 Mbps	-15.67	8.0	-23.67
2412	QPSK	11 Mbps	-7.17	8.0	-15.17
2412	64QAM	54 Mbps	-14.33	8.0	-22.33
2437	BPSK	1 Mbps	-4.67	8.0	-12.67
2437	BPSK	6 Mbps	-6.67	8.0	-14.67
2437	QPSK	11 Mbps	-4.67	8.0	-12.67
2437	64QAM	54 Mbps	-12.33	8.0	-20.33
2462	BPSK	1 Mbps	-6.00	8.0	-14.00
2462	BPSK	6 Mbps	-13.3	8.0	-21.30
2462	QPSK	11 Mbps	-0.17	8.0	-8.17
2462	64QAM	54 Mbps	-14.0	8.0	-22.00

Figure 165 Test Results

JUDGEMENT: Passed by 8.17 dB

TEST PERSONNEL:

Tester Signature: 

Date: 13.04.08

Typed/Printed Name: A. Sharabi

14.3 Test Equipment Used.

Transmitted Power Density

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	HP	8564E	3442A00275	November 14, 2007	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	May 9, 2007	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	February 8, 2008	1 year

Figure 166 Test Equipment Used

15. APPENDIX A - CORRECTION FACTORS

15.1 Correction factors for CABLE from EMI receiver to test antenna at 3 meter range.

FREQUENCY (MHz)	CORRECTION FACTOR (dB)	FREQUENCY (MHz)	CORRECTION FACTOR (dB)
10.0	0.3	1200.0	7.3
20.0	0.6	1400.0	7.8
30.0	0.8	1600.0	8.4
40.0	0.9	1800.0	9.1
50.0	1.1	2000.0	9.9
60.0	1.2	2300.0	11.2
70.0	1.3	2600.0	12.2
80.0	1.4	2900.0	13.0
90.0	1.6		
100.0	1.7		
150.0	2.0		
200.0	2.3		
250.0	2.7		
300.0	3.1		
350.0	3.4		
400.0	3.7		
450.0	4.0		
500.0	4.3		
600.0	4.7		
700.0	5.3		
800.0	5.9		
900.0	6.3		
1000.0	6.7		

NOTES:

1. The cable type is RG-214.
2. The overall length of the cable is 27 meters.
3. The above data is located in file 27MO3MO.CBL on the disk marked "Radiated Emission Tests EMI Receiver".

15.2 Correction factors for CABLE
from EMI receiver
to test antenna
at 3 meter range.

FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.2
2.0	1.6
3.0	2.0
4.0	2.4
5.0	3.0
6.0	3.4
7.0	3.8
8.0	4.2
9.0	4.6
10.0	5.0
12.0	5.8

NOTES:

- 1. The cable type is RG-8.*
- 2. The overall length of the cable is 10 meters.*

15.3 Correction factors for CABLE
from spectrum analyzer
to test antenna above 2.9 GHz

FREQUENCY (GHz)	CORRECTION FACTOR (dB)	FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.9	14.0	9.1
2.0	2.7	15.0	9.5
3.0	3.5	16.0	9.9
4.0	4.2	17.0	10.2
5.0	4.9	18.0	10.4
6.0	5.5	19.0	10.7
7.0	6.0	20.0	10.9
8.0	6.5	21.0	11.2
9.0	7.0	22.0	11.6
10.0	7.5	23.0	11.9
11.0	7.9	24.0	12.3
12.0	8.3	25.0	12.6
13.0	8.7	26.0	13.0

NOTES:

1. The cable type is SUCOFLEX 104 E manufactured by SUHNER.
2. The cable is used for measurements above 2.9 GHz.
3. The overall length of the cable is 10 meters.

15.4 Correction factors for LOG PERIODIC ANTENNA

**Type LPD 2010/A
at 3 and 10 meter ranges.**

Distance of 3 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.1
250.0	10.2
300.0	12.5
400.0	15.4
500.0	16.1
600.0	19.2
700.0	19.4
800.0	19.9
900.0	21.2
1000.0	23.5

Distance of 10 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.0
250.0	10.1
300.0	11.8
400.0	15.3
500.0	15.6
600.0	18.7
700.0	19.1
800.0	20.2
900.0	21.1
1000.0	23.2

NOTES:

1. Antenna serial number is 1038.
2. The above lists are located in file number 38M30.ANT for a 3 meter range,
and file number 38M100.ANT for a 10 meter range.
3. The files mentioned above are located on the disk marked "Radiated Emission
Test EMI Receiver".

15.5 Correction factors for

LOG PERIODIC ANTENNA

**Type SAS-200/511
at 3 meter range.**

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
1.0	24.9
1.5	27.8
2.0	29.9
2.5	31.2
3.0	32.8
3.5	33.6
4.0	34.3
4.5	35.2
5.0	36.2
5.5	36.7
6.0	37.2
6.5	38.1

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
7.0	38.6
7.5	39.2
8.0	39.9
8.5	40.4
9.0	40.8
9.5	41.1
10.0	41.7
10.5	42.4
11.0	42.5
11.5	43.1
12.0	43.4
12.5	44.4
13.0	44.6

NOTES:

1. Antenna serial number is 253.
2. The above lists are located in file number SAS3M0.ANT for a 3 meter range.
3. The files mentioned above are located on the disk marked "Antenna Factors".

**15.6 Correction factors for BICONICAL ANTENNA
Type BCD-235/B,
at 3 meter range**

FREQUENCY (MHz)	AFE (dB/m)
20.0	19.4
30.0	14.8
40.0	11.9
50.0	10.2
60.0	9.1
70.0	8.5
80.0	8.9
90.0	9.6
100.0	10.3
110.0	11.0
120.0	11.5
130.0	11.7
140.0	12.1
150.0	12.6
160.0	12.8
170.0	13.0
180.0	13.5
190.0	14.0
200.0	14.8
210.0	15.3
220.0	15.8
230.0	16.2
240.0	16.6
250.0	17.6
260.0	18.2
270.0	18.4
280.0	18.7
290.0	19.2
300.0	19.9
310	20.7
320	21.9
330	23.4
340	25.1
350	27.0

NOTES:

1. Antenna serial number is 1041.
2. The above list is located in file 19BC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver".

15.7 Correction factors for Double-Ridged Waveguide Horn

**Model: 3115, S/N 29845
at 3 meter range.**

FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENN A Gain (dBi)	FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENNA Gain (dBi)
1.0	24.8	5.4	10.0	38.8	11.4
1.5	26.1	7.6	10.5	38.9	11.8
2.0	28.6	7.7	11.0	39.0	12.1
2.5	29.8	8.4	11.5	39.6	11.8
3.0	31.4	8.4	12.0	39.8	12.0
3.5	32.4	8.7	12.5	39.6	12.5
4.0	33.7	8.6	13.0	40.0	12.5
4.5	33.4	9.9	13.5	39.8	13.0
5.0	34.5	9.7	14.0	40.2	13.0
5.5	35.1	9.9	14.5	40.6	12.9
6.0	35.4	10.4	15.0	41.3	12.4
6.5	35.6	10.8	15.5	39.5	14.6
7.0	36.2	10.9	16.0	38.8	15.5
7.5	37.3	10.4	16.5	40.0	14.6
8.0	37.7	10.6	17.0	41.4	13.4
8.5	38.3	10.5	17.5	44.8	10.3
9.0	38.5	10.8	18.0	47.2	8.1
9.5	38.7	11.1			

15.8 Correction factors for

**Horn Antenna
Model: SWH-28
at 1 meter range.**

FREQUENCY (GHz)	APE (dB /m)	Gain (dBi)
18.0	40.3	16.1
19.0	40.3	16.3
20.0	40.3	16.1
21.0	40.3	16.3
22.0	40.4	16.8
23.0	40.5	16.4
24.0	40.5	16.6
25.0	40.5	16.7
26.0	40.6	16.4

15.9 Correction factors for ACTIVE LOOP ANTENNA

Model 6502
S/N 9506-2950

FREQUENCY	Magnetic Antenna Factor	Electric Antenna Factor
(MHz)	(dB)	(dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2

16. APPENDIX B – FCC/IC (Industry Canada) Cross Correlation Table

Test Spec. Clause	Test Case	Remarks
47 CFR 15.247 (a) (2) RSS-210 Section A8.2 (1)	6 dB Bandwidth	Comply
47 CFR 15.247 (b) (3) & RSS-210 Section A8.4	Maximum Peak Output Power, 2400-2483.5 MHz	Comply
47 CFR 15.247 (e) & RSS-210 Section A8.2 (2)	Peak power spectral density	Comply
47 CFR 15.247 (d) & RSS-210 Section A8.5	Conducted Spurious Emissions	Comply
47 CFR 15.247 (d) & 15.205 & RSS-210 Section A8.5	Spurious Radiated Emissions, Restricted Bands 2310-2390 MHz & 2483.5-2500 MHz	Comply
47 CFR 15.247 (d) & 15.205 & 15.20209 (a)	Spurious Radiated Emissions, Restricted Bands	Comply
47 CFR 15.109/209 & RSS-GEN Section 7.2.3.2	Radiated Emissions, Receive Mode	Comply
47 CFR 15.403 (h)(i) & RSS-210A9.2 (1)	Emission Bandwidth (26dB BW)	Comply