

# HiTEM Engineering Inc.

## EMC TEST REPORT FOR

**Wireless Module (LMA)  
Model: HTE 601**

### Tested To The Following Standards:

**FCC Part 15 Subpart C Section(s)  
15.207 & 15.247  
(DTS 2400-2483.5 MHz)**

**Report No.: 97758-8**

**Date of issue: November 30, 2015**



This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of EMC testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

## TABLE OF CONTENTS

Administrative Information .....	3
Test Report Information .....	3
Report Authorization .....	3
Test Facility Information .....	4
Software Versions .....	4
Site Registration & Accreditation Information .....	4
Summary of Results .....	5
Modifications During Testing.....	5
Conditions During Testing.....	5
Equipment Under Test.....	6
FCC Part 15 Subpart C.....	7
15.207 AC Conducted Emissions.....	7
15.247(a)(2) 6dB Bandwidth.....	16
15.247(b)(3) Output Power .....	26
15.247(e) Power Spectral Density .....	37
15.247(d) RF Conducted Emissions & Band Edge .....	46
15.247(d) Radiated Emissions & Band Edge .....	71
Supplemental Information .....	127
Emissions Test Details.....	127

## ADMINISTRATIVE INFORMATION

### Test Report Information

**REPORT PREPARED FOR:**

HiTEM Engineering Inc.  
7420 Carroll Rd  
San Diego, CA 92121

Representative: Seton Kasmir  
Customer Reference Number: 1147

**DATE OF EQUIPMENT RECEIPT:****DATE(S) OF TESTING:****REPORT PREPARED BY:**

Morgan Tramontin / Dianne Dudley  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

Project Number: 97758

October 28, 2015

October 28 - November 10, 2015

### Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

A handwritten signature in black ink, reading "Steve Behm", is written over a horizontal line.

**Steve Behm**  
**Director of Quality Assurance & Engineering Services**  
**CKC Laboratories, Inc.**

## Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):  
CKC Laboratories, Inc.  
110 Olinda Place  
Brea, CA 92823

## Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.02.00
EMITest Immunity	5.02.00

## Site Registration & Accreditation Information

Location	CB #	TAIWAN	CANADA	FCC	JAPAN
Brea A	US0060	SL2-IN-E-1146R	3082D-1	90473	A-0147
Brea D	US0060	SL2-IN-E-1146R	3082D-2	100638	A-0147

## SUMMARY OF RESULTS

### Standard / Specification: FCC Part 15 Subpart C

Test Procedure	Description	Modifications	Results
15.207	AC Conducted Emissions	NA	Pass
15.247(a)(2)	6dB Bandwidth	NA	Pass
15.247(b)(3)	Output Power	NA	Pass
15.247(e)	Power Spectral Density	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	Pass
15.247(d)	Radiated Emissions & Band Edge	NA	Pass

NA = Not applicable

### Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

#### Summary of Conditions

No modifications were made during testing.

**Modifications listed above must be incorporated into all production units.**

### Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

#### Summary of Conditions

None

## EQUIPMENT UNDER TEST (EUT)

During testing numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

### Configuration 1

#### *Equipment Tested:*

Device	Manufacturer	Model #	S/N
Wireless Module (LMA)	HiTEM Engineering Inc.	HTE 601	1

#### *Support Equipment:*

Device	Manufacturer	Model #	S/N
Laptop Computer	Dell Corporation	Inspiron 15	12531160118

### Configuration 2

#### *Equipment Tested:*

Device	Manufacturer	Model #	S/N
Wireless Module (LMA)	HiTEM Engineering Inc.	HTE 601	2

#### *Support Equipment:*

Device	Manufacturer	Model #	S/N
Laptop Computer	Dell Corporation	Inspiron 15	12531160118
DC Power Supply	Xantrex	XTS 30-2X	58738

## FCC PART 15 SUBPART C

### 15.207 AC Conducted Emissions

#### Test Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.207 AC Mains - Average**  
 Work Order #: **97758** Date: 11/3/2015  
 Test Type: **Conducted Emissions** Time: 9:31:45 AM  
 Tested By: S. Yamamoto Sequence#: 13  
 Software: EMITest 5.02.00 120V 60Hz

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

#### Test Conditions / Notes:

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a laptop computer via shielded USB cable. The power to the EUT is provided from an external DC power supply. The EUT antenna port is connected to an external antenna. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

The module is installed on a development board. The antenna port is NOT located on the module, but on the development board.

The EUT is set to the channel and protocol which gave the highest output power (802.11b, Channel 1 2412MHz, MCS 3, 11Mbps). The frequency range of this data sheet is 150kHz to 30MHz. RBW=VBW=9kHz.

Temperature: 21°C

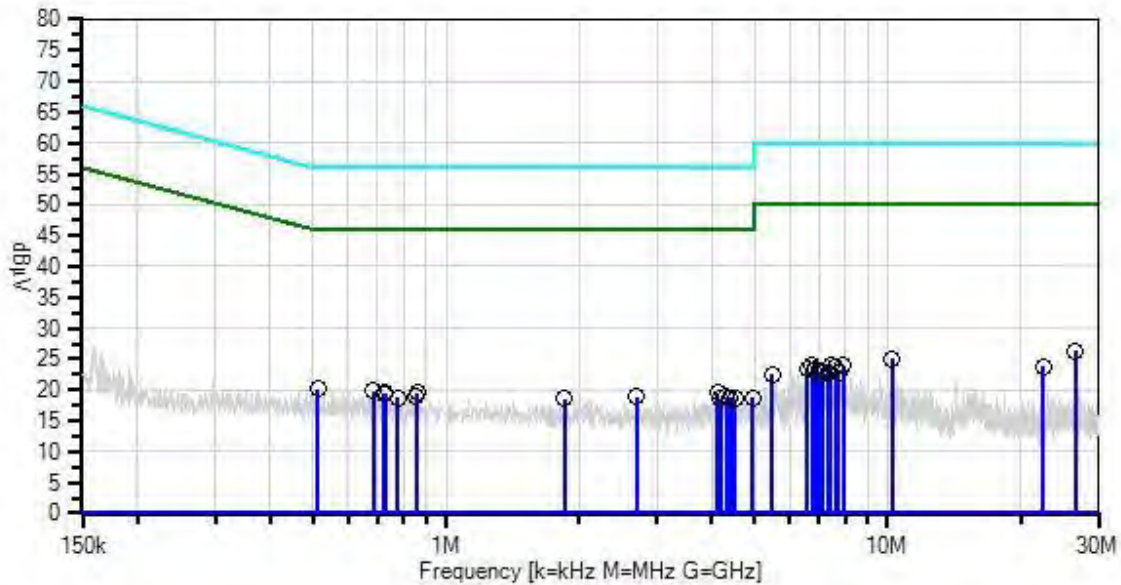
Humidity: 40%,

Pressure: 100kPa

Site A

Test methods: ANSI C63.4 2014

HiTEM Engineering Inc WO#: 97758 Sequence#: 13 Date: 11/3/2015  
15.207 AC Mains - Average Test Lead: 120V 60Hz Line



— Sweep Data	— Readings	○ Peak Readings
x QP Readings	* Average Readings	▼ Ambient
Software Version: 5.02.00	— 1 - 15.207 AC Mains - Average	— 2 - 15.207 AC Mains - Quasi-peak



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T1	AN02343	High Pass Filter	HE9615-150K-50-720B	1/8/2015	1/8/2017
T2	ANP04358	Cable	RG142	3/12/2014	3/12/2016
T3	ANP06084	Attenuator	SA18N10W-06	12/17/2014	12/17/2016
T4	AN00848.1	50uH LISN-Line 1 (L1) (dB)	3816/2nm	3/12/2015	3/12/2016
	AN00848.1	50uH LISN-Line 2 (L2) (dB)	3816/2nm	3/12/2015	3/12/2016

**Measurement Data:**

Reading listed by margin.

Test Lead: Line

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	26.622M	19.4	+0.2	+0.4	+5.7	+0.7	+0.0	26.4	50.0	-23.6	Line
2	10.238M	18.6	+0.1	+0.3	+5.7	+0.3	+0.0	25.0	50.0	-25.0	Line
3	511.421k	14.0	+0.2	+0.1	+5.7	+0.1	+0.0	20.1	46.0	-25.9	Line
4	7.932M	17.7	+0.1	+0.3	+5.7	+0.2	+0.0	24.0	50.0	-26.0	Line
5	685.223k	13.8	+0.2	+0.1	+5.7	+0.1	+0.0	19.9	46.0	-26.1	Line
6	6.734M	17.7	+0.1	+0.2	+5.7	+0.2	+0.0	23.9	50.0	-26.1	Line
7	7.445M	17.6	+0.1	+0.3	+5.7	+0.2	+0.0	23.9	50.0	-26.1	Line
8	22.526M	17.0	+0.2	+0.4	+5.7	+0.5	+0.0	23.8	50.0	-26.2	Line
9	858.298k	13.6	+0.1	+0.1	+5.7	+0.1	+0.0	19.6	46.0	-26.4	Line
10	7.634M	17.3	+0.1	+0.3	+5.7	+0.2	+0.0	23.6	50.0	-26.4	Line
11	728.128k	13.5	+0.1	+0.1	+5.7	+0.1	+0.0	19.5	46.0	-26.5	Line
12	4.122M	13.4	+0.1	+0.2	+5.7	+0.1	+0.0	19.5	46.0	-26.5	Line
13	6.562M	17.4	+0.1	+0.2	+5.7	+0.1	+0.0	23.5	50.0	-26.5	Line
14	722.311k	13.3	+0.1	+0.1	+5.7	+0.1	+0.0	19.3	46.0	-26.7	Line
15	6.860M	17.1	+0.1	+0.2	+5.7	+0.2	+0.0	23.3	50.0	-26.7	Line
16	6.779M	17.0	+0.1	+0.2	+5.7	+0.2	+0.0	23.2	50.0	-26.8	Line
17	854.662k	13.0	+0.1	+0.1	+5.7	+0.1	+0.0	19.0	46.0	-27.0	Line
18	6.986M	16.8	+0.1	+0.2	+5.7	+0.2	+0.0	23.0	50.0	-27.0	Line

19	2.702M	12.8	+0.1	+0.2	+5.7	+0.1	+0.0	18.9	46.0	-27.1	Line
20	4.309M	12.8	+0.1	+0.2	+5.7	+0.1	+0.0	18.9	46.0	-27.1	Line
21	7.148M	16.5	+0.1	+0.3	+5.7	+0.2	+0.0	22.8	50.0	-27.2	Line
22	4.403M	12.7	+0.1	+0.2	+5.7	+0.1	+0.0	18.8	46.0	-27.2	Line
23	7.743M	16.5	+0.1	+0.3	+5.7	+0.2	+0.0	22.8	50.0	-27.2	Line
24	7.346M	16.5	+0.1	+0.3	+5.7	+0.2	+0.0	22.8	50.0	-27.2	Line
25	778.305k	12.7	+0.1	+0.1	+5.7	+0.1	+0.0	18.7	46.0	-27.3	Line
26	4.934M	12.6	+0.1	+0.2	+5.7	+0.1	+0.0	18.7	46.0	-27.3	Line
27	4.177M	12.5	+0.1	+0.2	+5.7	+0.1	+0.0	18.6	46.0	-27.4	Line
28	1.855M	12.6	+0.1	+0.1	+5.7	+0.1	+0.0	18.6	46.0	-27.4	Line
29	5.481M	16.5	+0.1	+0.2	+5.7	+0.1	+0.0	22.6	50.0	-27.4	Line
30	4.509M	12.5	+0.1	+0.2	+5.7	+0.1	+0.0	18.6	46.0	-27.4	Line

Test Location: CKC Laboratories, Inc. • 110 N Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.207 AC Mains - Average**  
 Work Order #: **97758** Date: 11/3/2015  
 Test Type: **Conducted Emissions** Time: 9:35:11 AM  
 Tested By: S. Yamamoto Sequence#: 14  
 Software: EMITest 5.02.00 120V 60Hz

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 2			

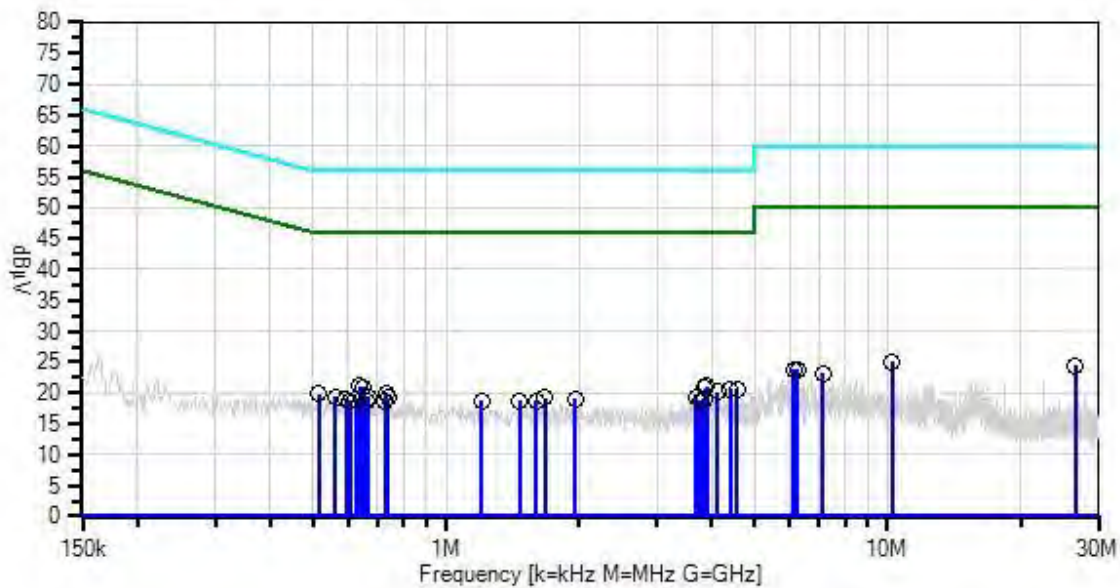
***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 2			

***Test Conditions / Notes:***

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a laptop computer via shielded USB cable. The power to the EUT is provided from an external DC power supply. The EUT antenna port is connected to an external antenna. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.  
 The module is installed on a development board. The antenna port is NOT located on the module, but on the development board.  
 The EUT is set to the channel and protocol which gave the highest output power (802.11b, Channel 1 2412MHz, MCS 3, 11Mbps). The frequency range of this data sheet is 150kHz to 30MHz. RBW=VBW=9kHz.  
 Temperature: 21°C  
 Humidity: 40%,  
 Pressure: 100kPa  
 Site A.  
 Test methods: ANSI C63.4 2014

HiTEM Engineering Inc WO#: 97758 Sequence#: 14 Date: 11/3/2015  
15.207 AC Mains - Average Test Lead: 120V 60Hz Neutral



— Sweep Data  
x QP Readings  
Software Version: 5.02.00  
— Readings  
\* Average Readings  
— 1 - 15.207 AC Mains - Average  
○ Peak Readings  
▼ Ambient  
— 2 - 15.207 AC Mains - Quasi-peak

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T1	AN02343	High Pass Filter	HE9615-150K-50-720B	1/8/2015	1/8/2017
T2	ANP04358	Cable	RG142	3/12/2014	3/12/2016
T3	ANP06084	Attenuator	SA18N10W-06	12/17/2014	12/17/2016
	AN00848.1	50uH LISN-Line 1 (L1) (dB)	3816/2nm	3/12/2015	3/12/2016
T4	AN00848.1	50uH LISN-Line 2 (L2) (dB)	3816/2nm	3/12/2015	3/12/2016

**Measurement Data:**

Reading listed by margin.

Test Lead: Neutral

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	637.955k	15.0	+0.2	+0.1	+5.7	+0.1	+0.0	21.1	46.0	-24.9	Neutr
2	3.892M	15.0	+0.1	+0.2	+5.7	+0.1	+0.0	21.1	46.0	-24.9	Neutr
3	10.238M	18.6	+0.1	+0.3	+5.7	+0.3	+0.0	25.0	50.0	-25.0	Neutr
4	650.317k	14.8	+0.2	+0.1	+5.7	+0.1	+0.0	20.9	46.0	-25.1	Neutr
5	3.850M	14.7	+0.1	+0.2	+5.7	+0.1	+0.0	20.8	46.0	-25.2	Neutr
6	4.411M	14.6	+0.1	+0.2	+5.7	+0.1	+0.0	20.7	46.0	-25.3	Neutr
7	4.560M	14.5	+0.1	+0.2	+5.7	+0.1	+0.0	20.6	46.0	-25.4	Neutr
8	26.622M	17.6	+0.2	+0.4	+5.7	+0.5	+0.0	24.4	50.0	-25.6	Neutr
9	4.118M	14.1	+0.1	+0.2	+5.7	+0.1	+0.0	20.2	46.0	-25.8	Neutr
10	731.764k	13.8	+0.1	+0.1	+5.7	+0.1	+0.0	19.8	46.0	-26.2	Neutr
11	514.330k	13.7	+0.2	+0.1	+5.7	+0.1	+0.0	19.8	46.0	-26.2	Neutr
12	6.265M	17.7	+0.1	+0.2	+5.7	+0.1	+0.0	23.8	50.0	-26.2	Neutr
13	6.130M	17.7	+0.1	+0.2	+5.7	+0.1	+0.0	23.8	50.0	-26.2	Neutr
14	561.598k	13.3	+0.2	+0.1	+5.7	+0.1	+0.0	19.4	46.0	-26.6	Neutr
15	3.675M	13.3	+0.1	+0.2	+5.7	+0.1	+0.0	19.4	46.0	-26.6	Neutr
16	667.770k	13.2	+0.2	+0.1	+5.7	+0.1	+0.0	19.3	46.0	-26.7	Neutr
17	739.764k	13.2	+0.1	+0.1	+5.7	+0.1	+0.0	19.2	46.0	-26.8	Neutr
18	1.677M	13.2	+0.1	+0.1	+5.7	+0.1	+0.0	19.2	46.0	-26.8	Neutr

19	625.592k	13.0	+0.2	+0.1	+5.7	+0.1	+0.0	19.1	46.0	-26.9	Neutr
20	3.829M	13.0	+0.1	+0.2	+5.7	+0.1	+0.0	19.1	46.0	-26.9	Neutr
21	7.148M	16.8	+0.1	+0.3	+5.7	+0.2	+0.0	23.1	50.0	-26.9	Neutr
22	594.322k	12.9	+0.2	+0.1	+5.7	+0.1	+0.0	19.0	46.0	-27.0	Neutr
23	1.962M	13.0	+0.1	+0.1	+5.7	+0.1	+0.0	19.0	46.0	-27.0	Neutr
24	606.685k	12.7	+0.2	+0.1	+5.7	+0.1	+0.0	18.8	46.0	-27.2	Neutr
25	1.600M	12.8	+0.1	+0.1	+5.7	+0.1	+0.0	18.8	46.0	-27.2	Neutr
26	3.756M	12.7	+0.1	+0.2	+5.7	+0.1	+0.0	18.8	46.0	-27.2	Neutr
27	727.401k	12.7	+0.1	+0.1	+5.7	+0.1	+0.0	18.7	46.0	-27.3	Neutr
28	662.680k	12.6	+0.2	+0.1	+5.7	+0.1	+0.0	18.7	46.0	-27.3	Neutr
29	1.468M	12.7	+0.1	+0.1	+5.7	+0.1	+0.0	18.7	46.0	-27.3	Neutr
30	1.200M	12.7	+0.1	+0.1	+5.7	+0.1	+0.0	18.7	46.0	-27.3	Neutr

**Test Setup Photo(s)**



## 15.247(a)(2) 6dB Bandwidth

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. 110 N Olinda Place, Brea CA 92823, 7149936112  
 Customer: HiTEM Engineering Inc.  
 Specification: **15.247(a)(2) 6dB Bandwidth**  
 Work Order #: **97758** Date: 10/28/2015  
 Test Type: **Conducted Emissions**  
 Tested By: S. Yamamoto  
 Software: EMITest 5.02.00

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Test Conditions / Notes:

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to an external antenna. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. Nominal rated EUT voltage is 3.3VDC. • The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11b/g/n 20MHz. The test frequencies are 2422MHz, 2442MHz, and 2462MHz for 802.11n 40MHz. 802.11b, rate MCS3, 11Mbps CH 1, 6, 11. 802.11g, rate MCS7, 54 Mbps, CH 1, 6, 11. 802.11n (20MHz), rate MCS7, 65Mbps, CH 1, 6, 11. 802.11n (40MHz), rate MCS7, 65Mbps, CH 3, 7, 11. Frequency range of measurement, 2412MHz to 2462MHz.

Temperature: 22°C

Humidity: 45%

Pressure: 100kPa

Site A.

Test method: KDB 558074 v03r03 and ANSI C63.10 2013.

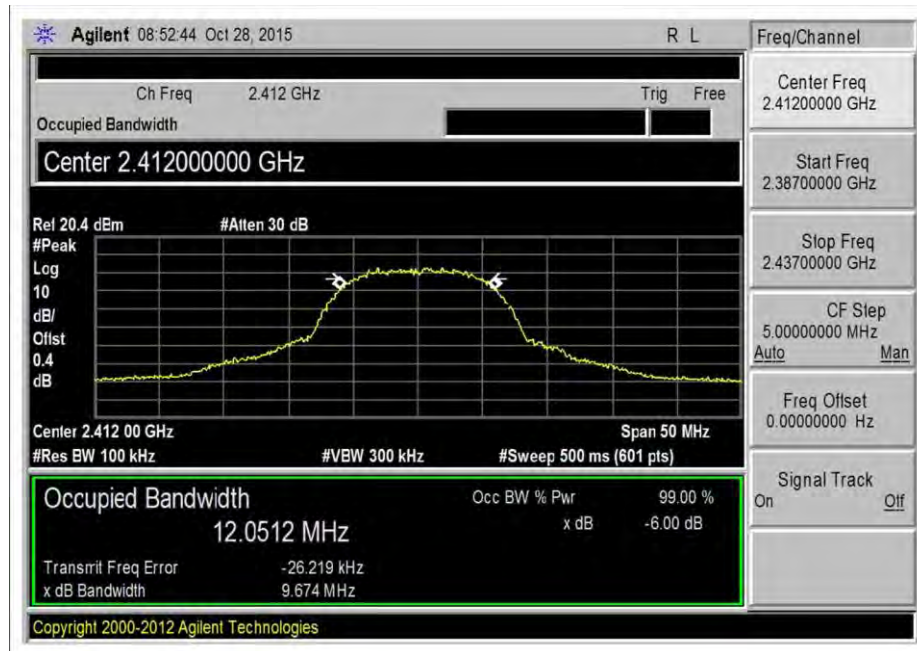
#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
	ANP06661	Cable	LDF1-50	4/15/2014	4/15/2016

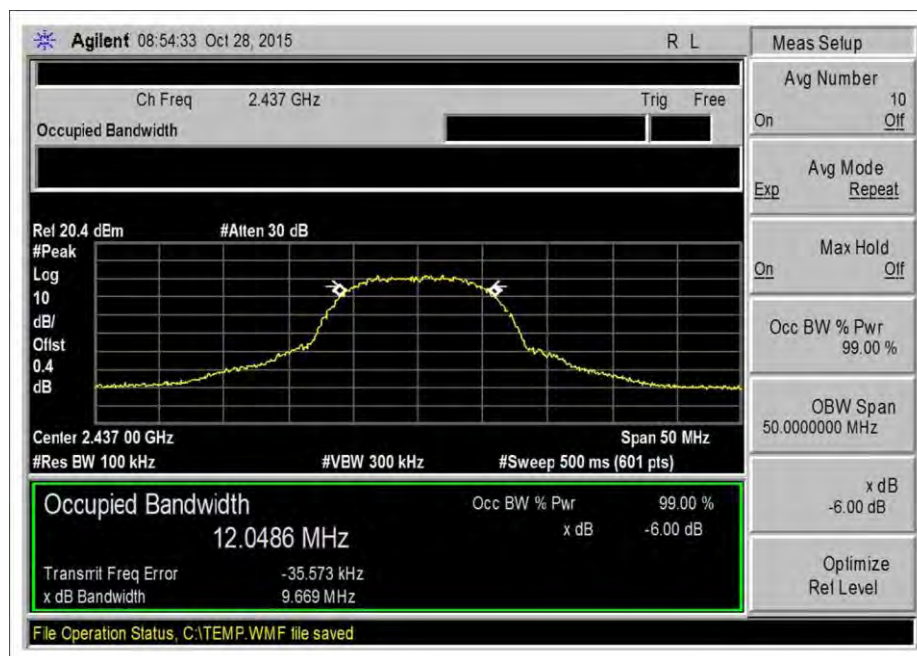


## Plot(s)

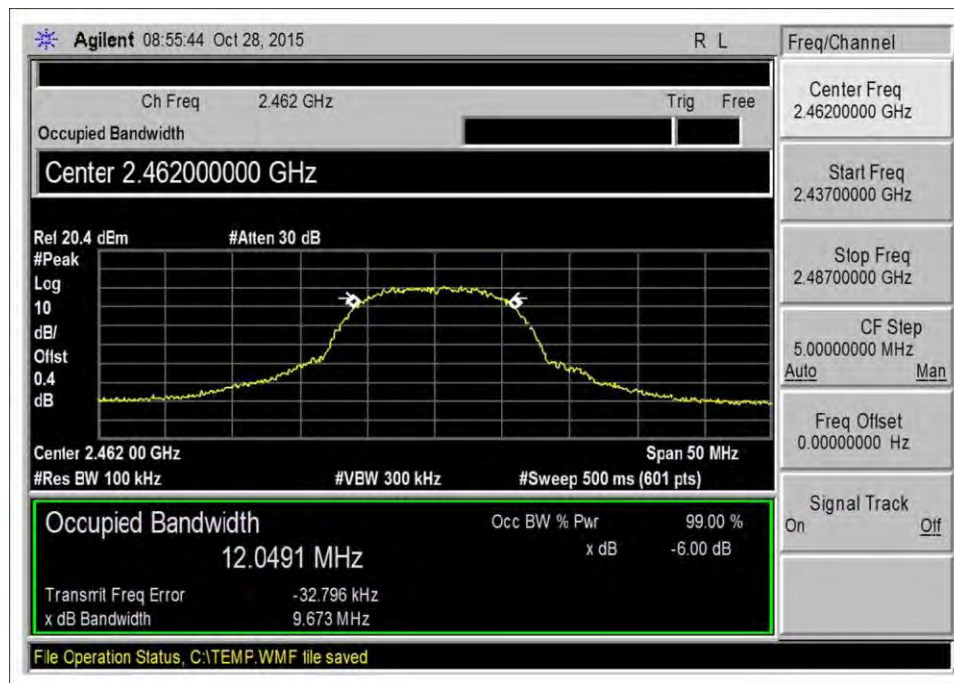
### 802.11b



### Low Channel

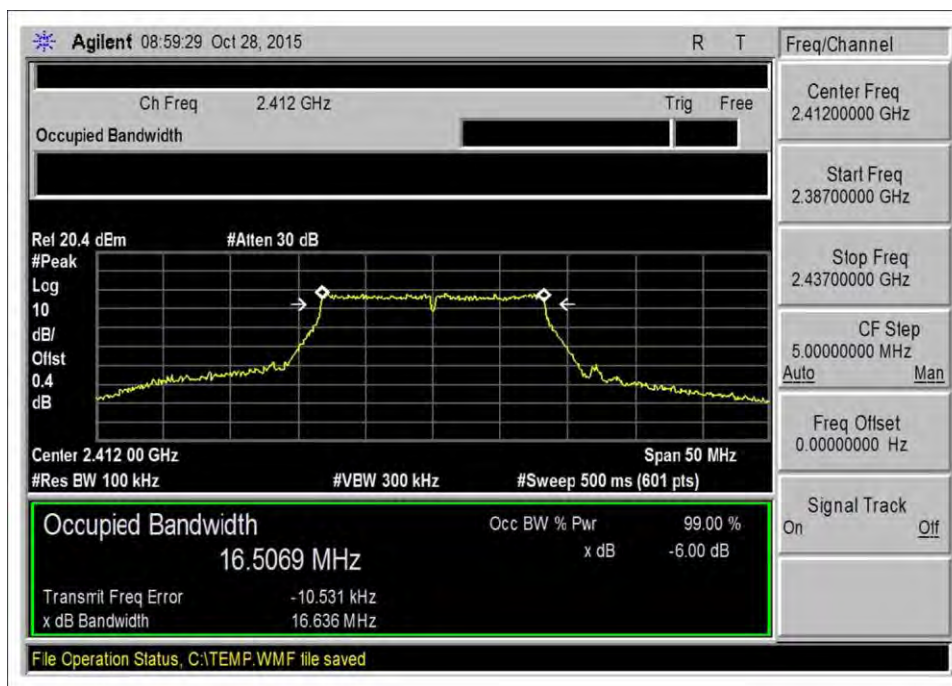


### Middle Channel

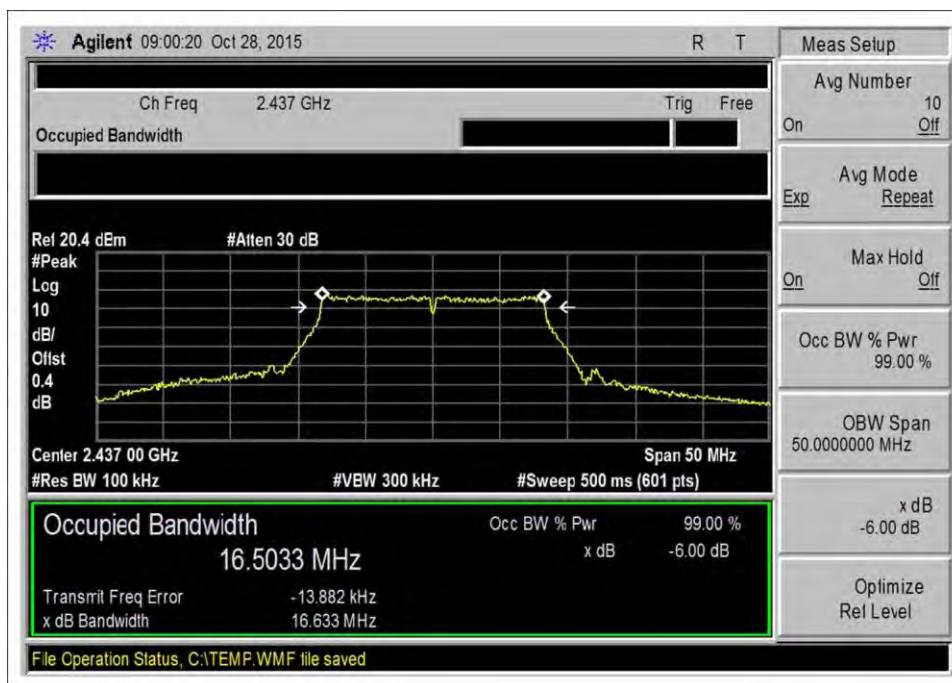


High Channel

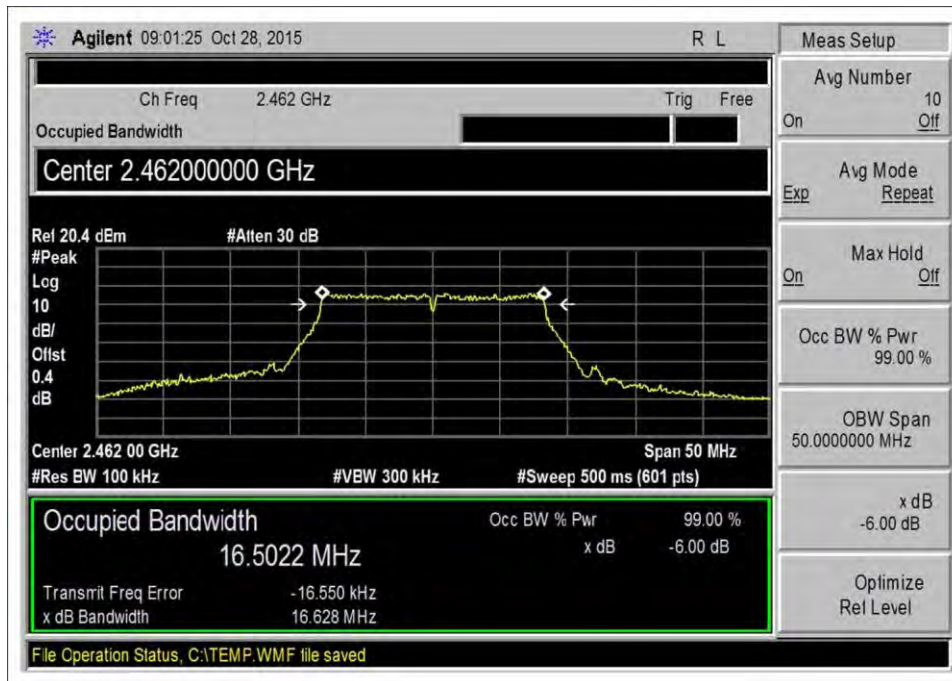
### 802.11g



Low Channel



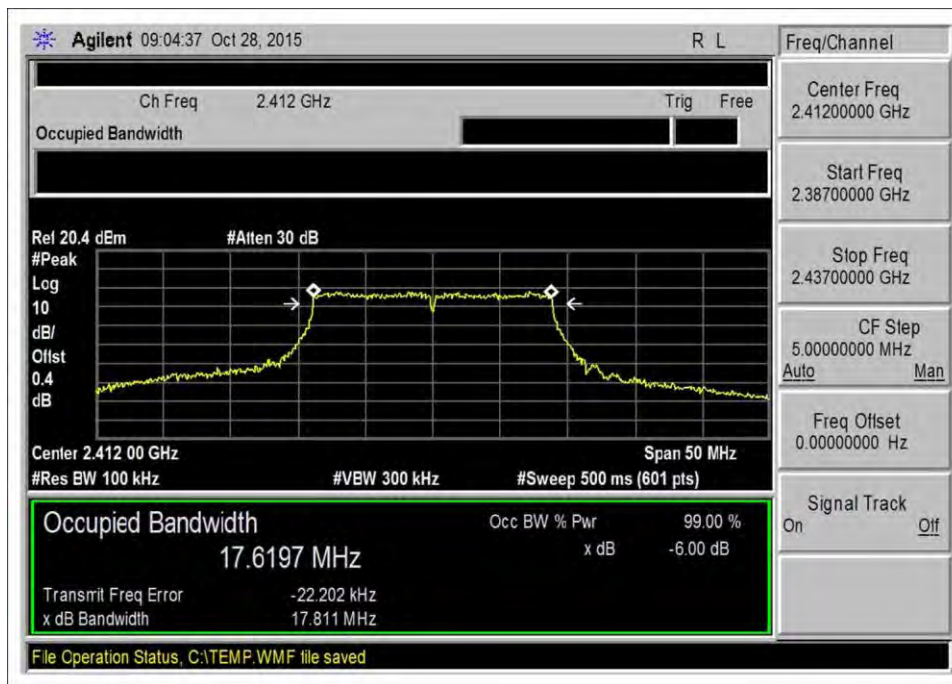
Middle Channel



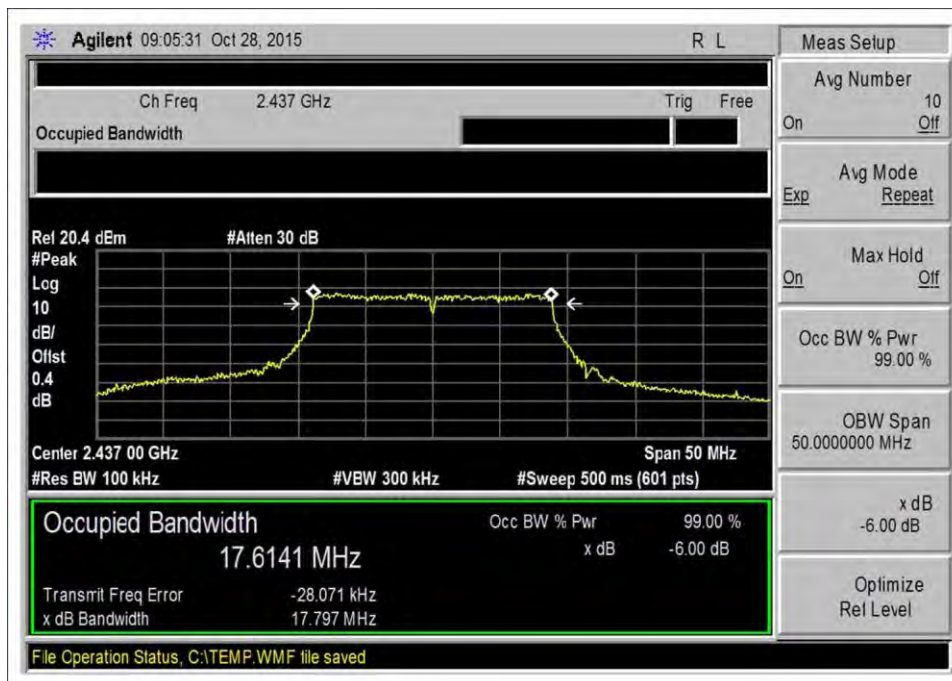
High Channel



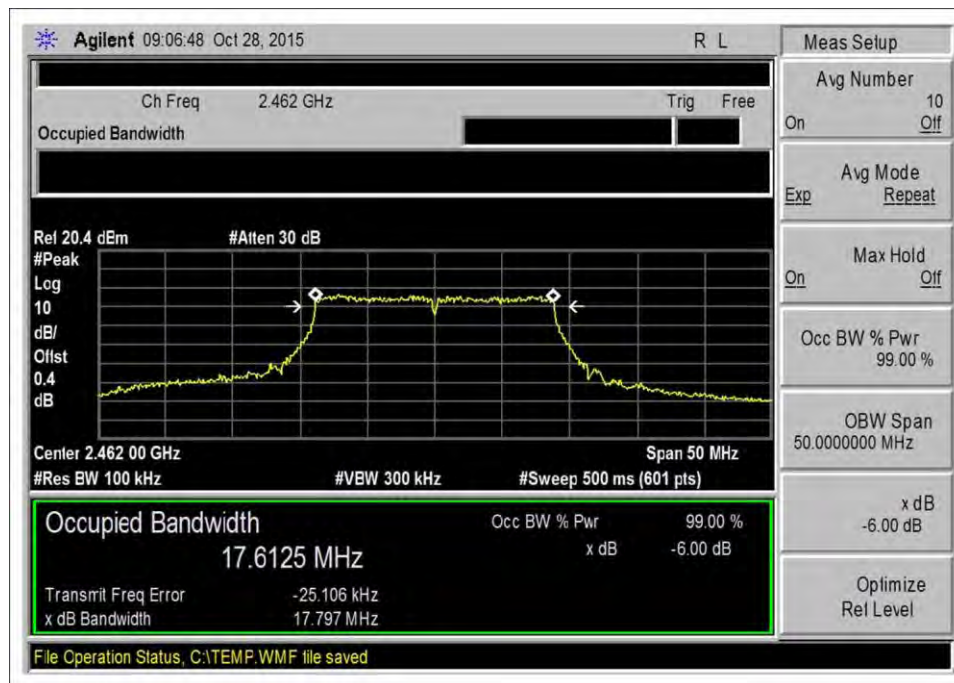
### 802.11n (20MHz)



Low Channel

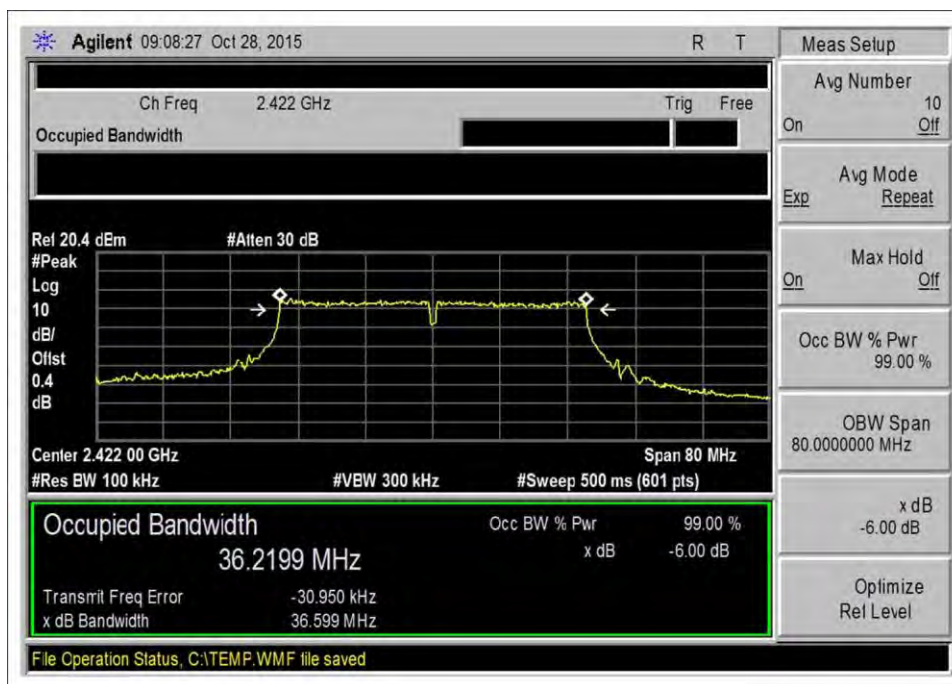


Middle Channel

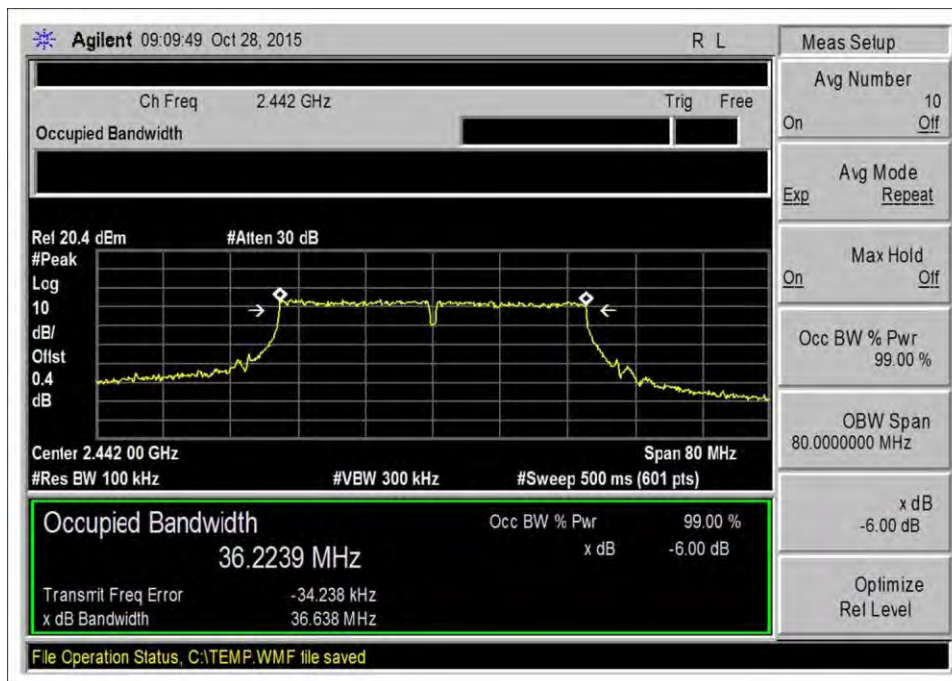


High Channel

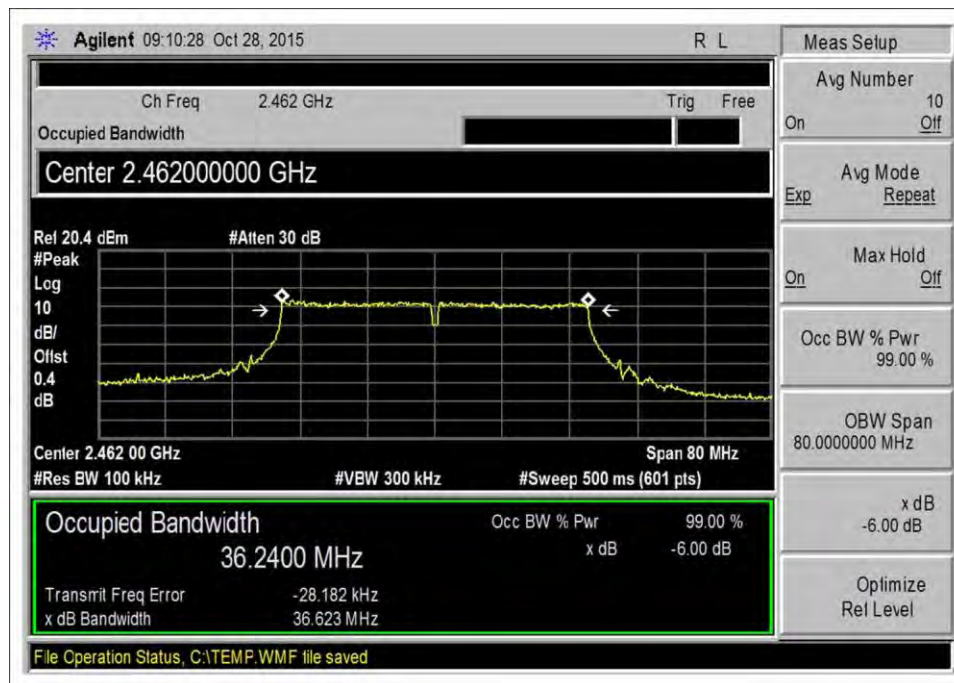
### 802.11n (40MHz)



Low Channel



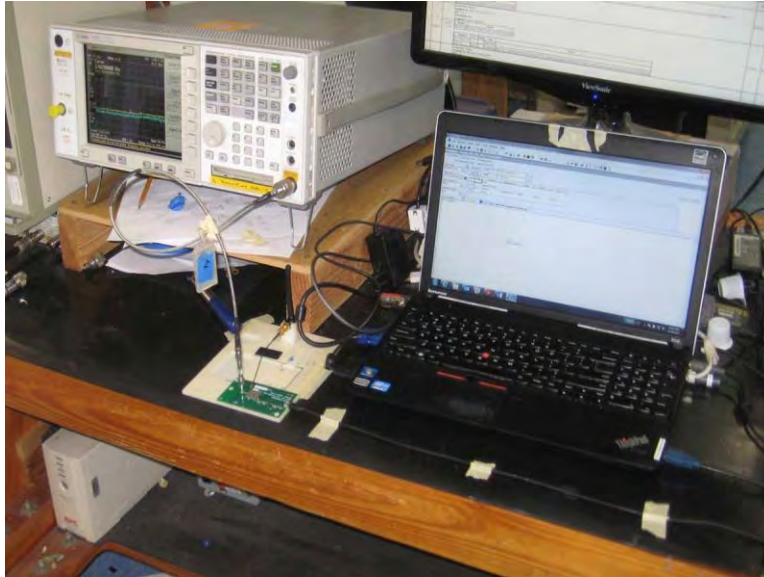
Middle Channel



High Channel



## Test Setup Photo



## 15.247(b)(3) Output Power

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. 110 N Olinda Place, Brea CA 92823, 714-993-6112  
 Customer: HiTEM Engineering Inc.  
 Specification: **15.247(b)(3) Conducted Output Power**  
 Work Order #: **97758** Date: 11/1/2015  
 Test Type: **Conducted Emissions**  
 Tested By: S. Yamamoto  
 Software: EMITest 5.02.00

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Test Conditions / Notes:

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC. The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11b/g/n 20MHz. The test frequencies are 2422MHz, 2442MHz, and 2462MHz for 802.11n 40MHz. 802.11b, rate MCS3, 11Mbps CH 1, 6, 11. 802.11g, rate MCS7, 54 Mbps, CH 1, 6, 11. 802.11n (20MHz), rate MCS7, 65Mbps, CH 1, 6, 11. 802.11n (40MHz), rate MCS7, 65Mbps, CH 3, 7, 11. Frequency range of measurement, 2412MHz to 2462MHz.  
 Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A.  
 Test method: KDB 558074 v03r03 and ANSI C63.10 2013.

#### Test Equipment:

Asset #	Description	Model	Calibration Date	Cal Due Date
02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
P05409	Attenuator	54A-10	9/3/2014	9/3/2016
P06661	Cable	LDF1-50	4/15/2014	4/15/2016

## Test Data Summary - Voltage Variations

Test Location: CKC Laboratories, Inc. 110 N. Olinda Place, Brea, CA 92823, 714-993-6112  
 Customer: HiTEM Engineering Inc.  
 Specification: **15.31(e) Voltage Variation on Power**  
 Work Order #: **97758** Date: 11/03/2015  
 Test Type: **Maximized Emissions**  
 Tested By: S. Yamamoto  
 Software: EMITest 5.02.00

### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

### Test Conditions / Notes:

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT is provided by an external DC power supply. The communications to the EUT is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11b/g/n 20MHz. The test frequencies are 2422MHz, 2442MHz, and 2462MHz for 802.11n 40MHz. Frequency range of measurement, 2400MHz to 2483.5MHz.

Temperature: 21°C  
 Humidity: 40%  
 Pressure: 100kPa  
 Site A

Additional test equipment used: Xantrex model XTS 30-2X DC power supply.

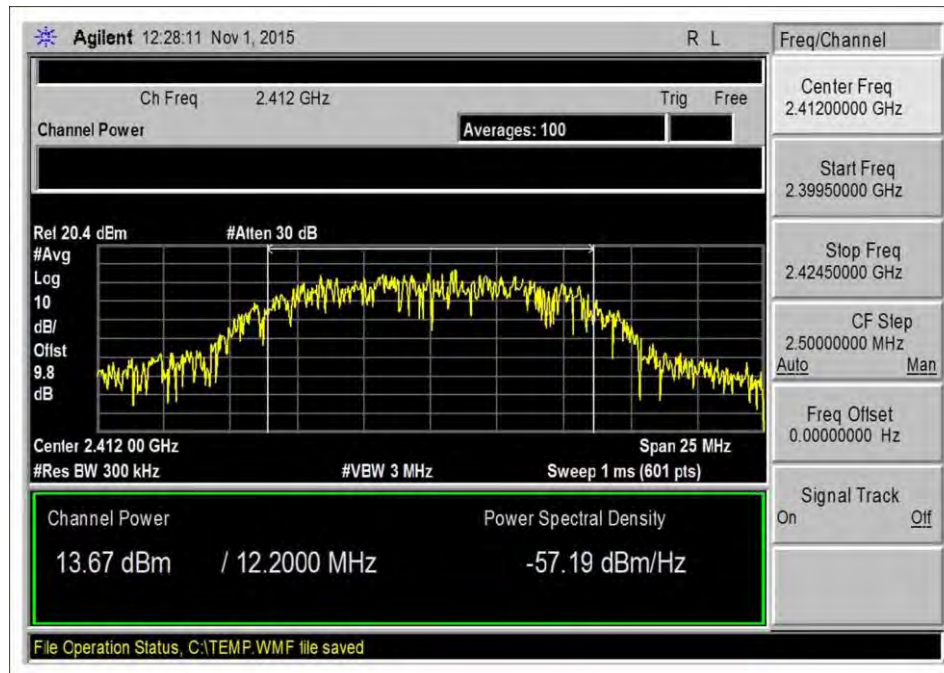
15.31(e) compliance: The supply voltage was varied to 85% and 115% of the nominal rated voltage. For every reading at 85% of the nominal rated voltage, the amplitude was 0.3dB lower than at the nominal rated voltage. For every reading at 115% of the nominal rated voltage, the amplitude was 0.2dB higher than at the nominal rated voltage. The maximum reading at the nominal rated voltage was 13.7dBm. The maximum reading for this section was 13.7dBm + 0.2dB = 13.9dBm. The manufacturers rated output power = 14.0dBm.

### Test Equipment:

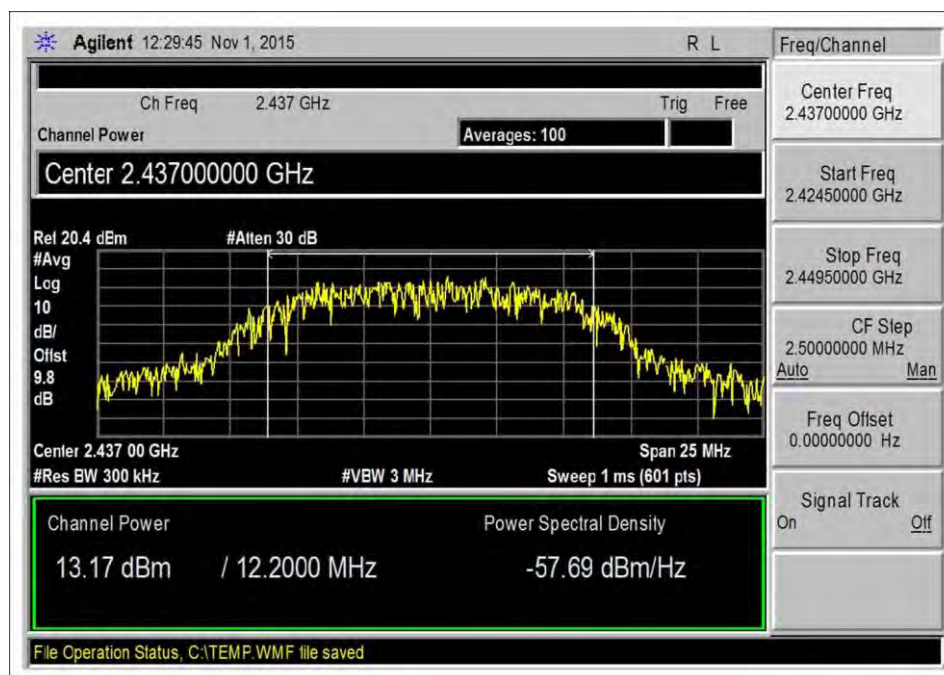
Asset #	Description	Model	Calibration Date	Cal Due Date
P06543	Cable	32022-29094K-29094K-24TC	11/20/2013	11/20/2015
01830	Digital Multimeter	45	2/2/2015	2/2/2017
P06906	DC Power Supply	XTS 30-2X	10/28/15	10/28/17
02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016

## Test Plot(s)

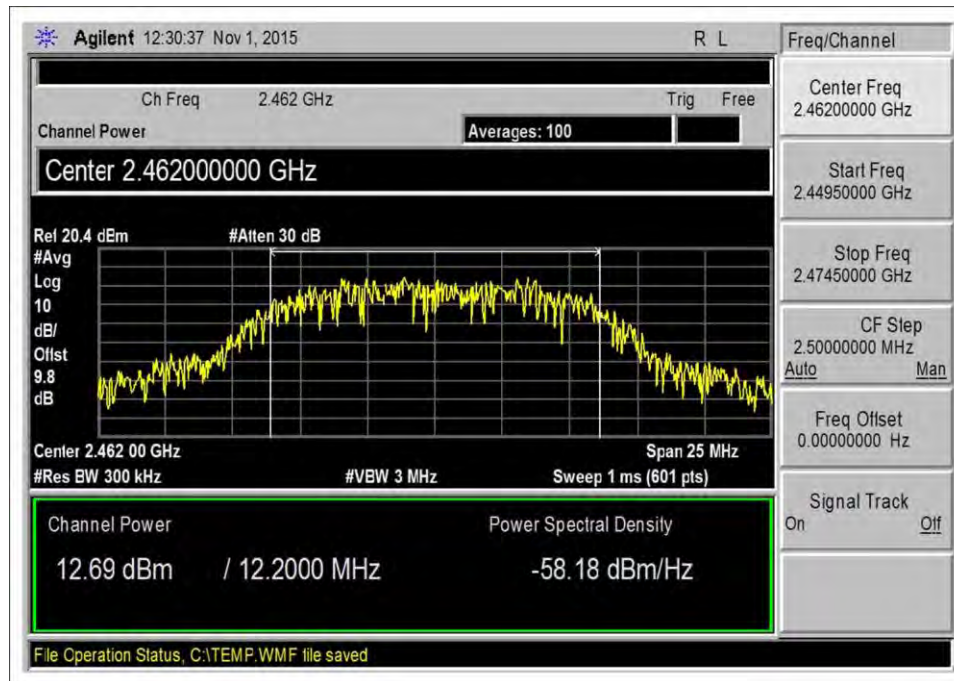
### 802.11b



### Low Channel



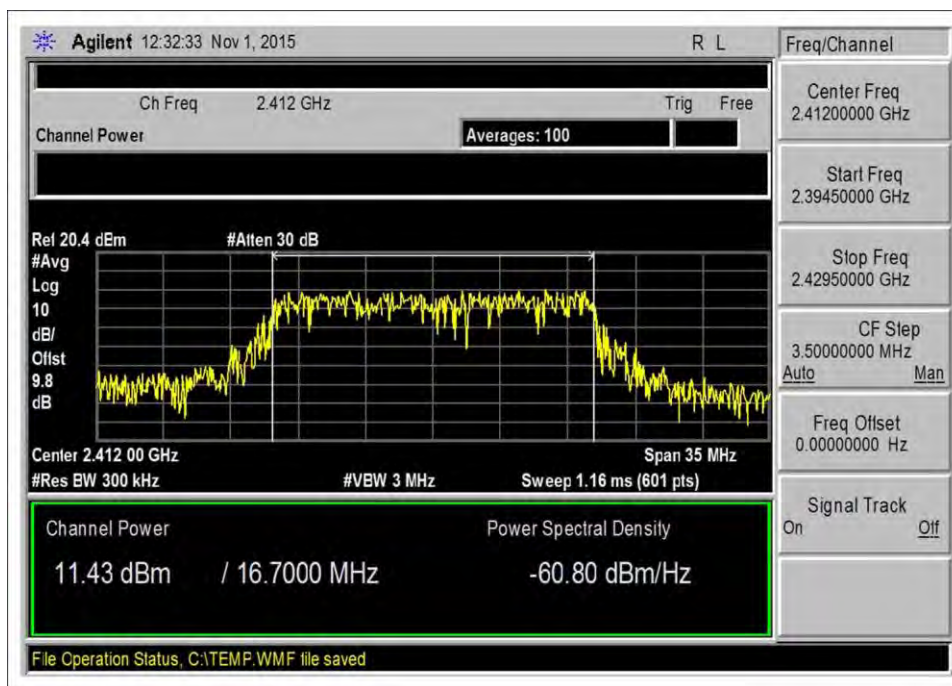
### Middle Channel



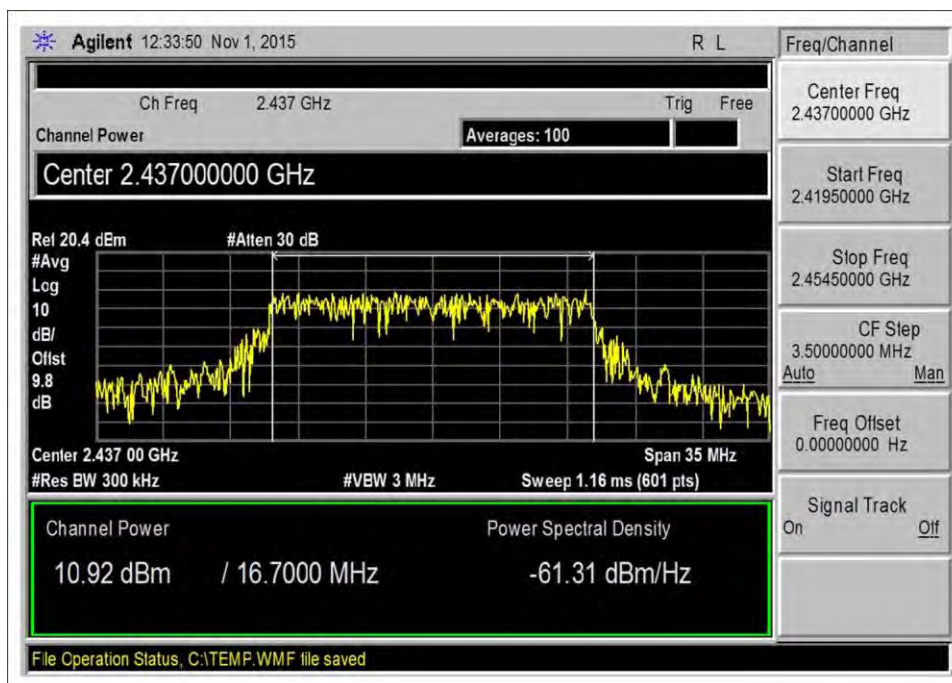
### High Channel



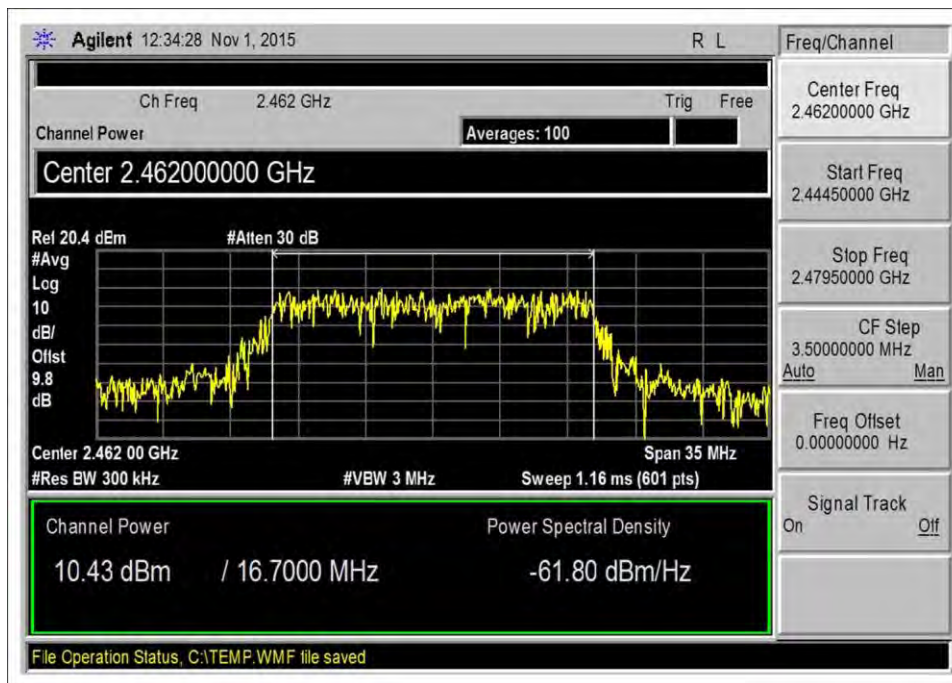
### 802.11g



Low Channel

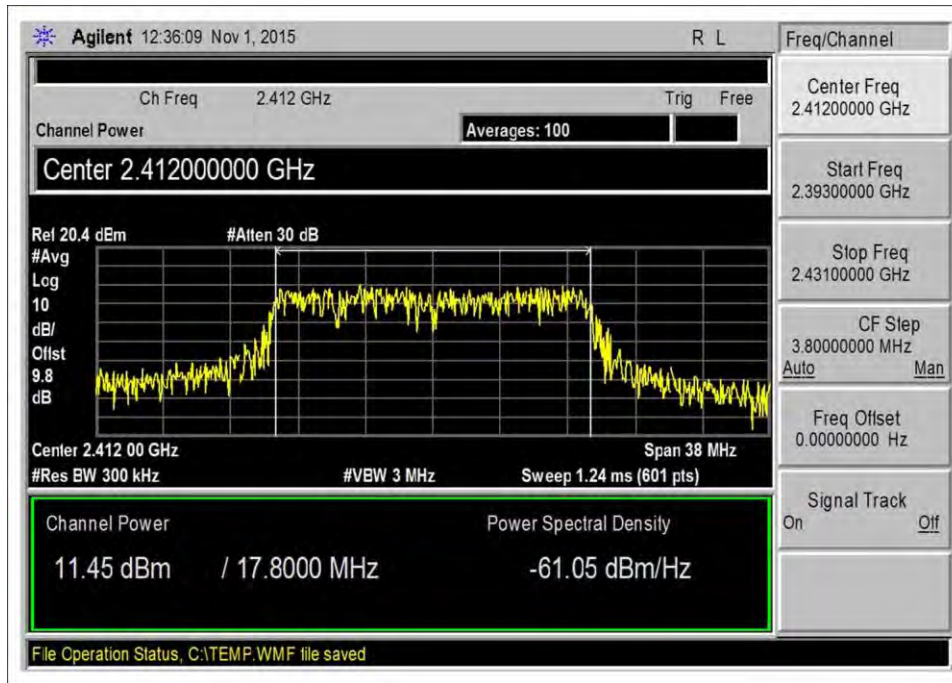


Middle Channel

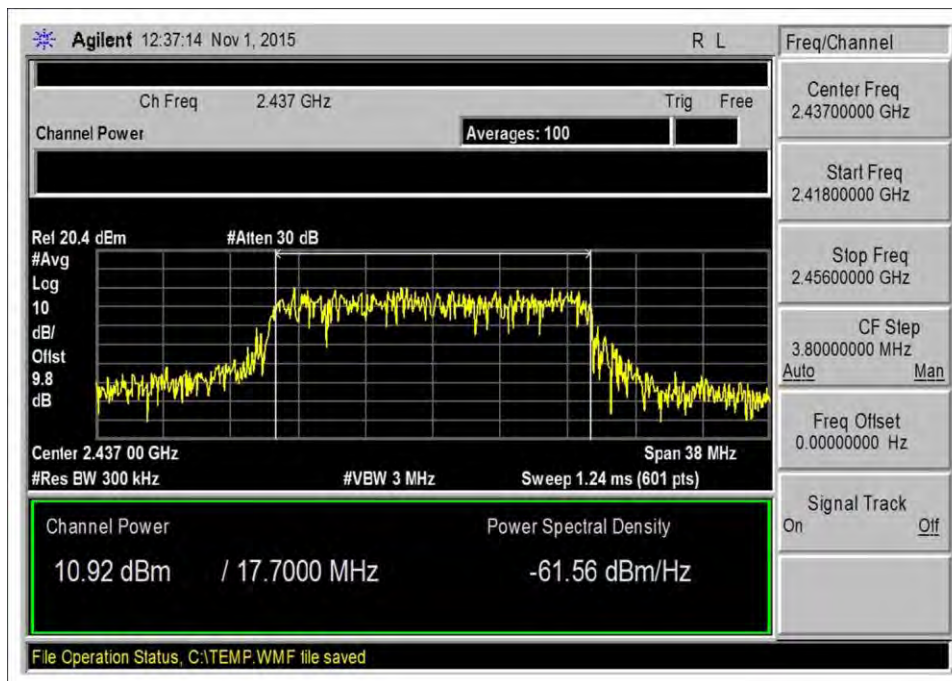


High Channel

### 802.11n (20MHz)

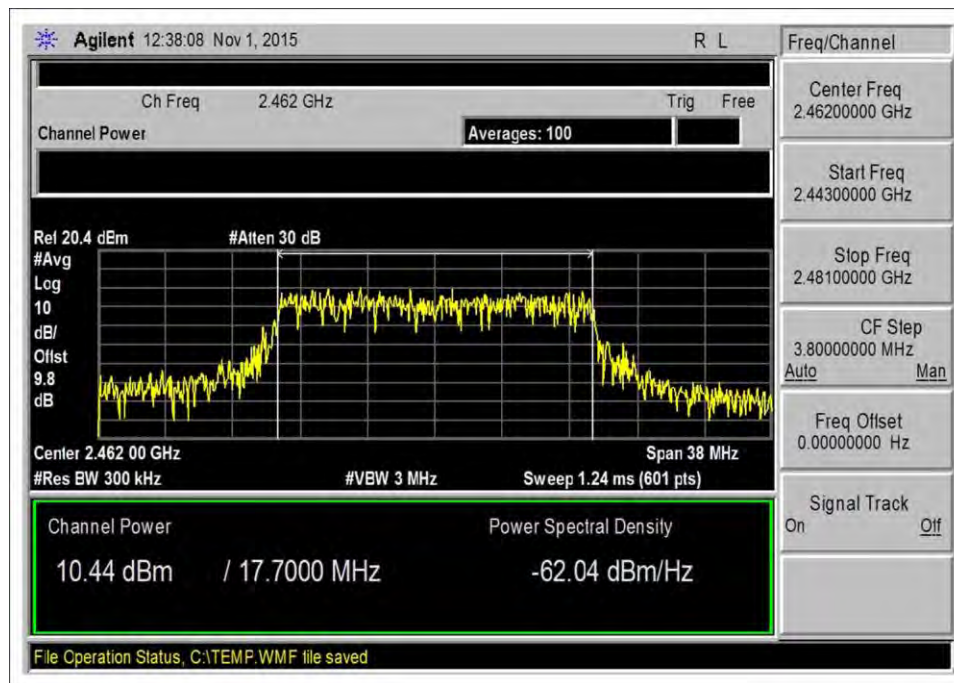


Low Channel



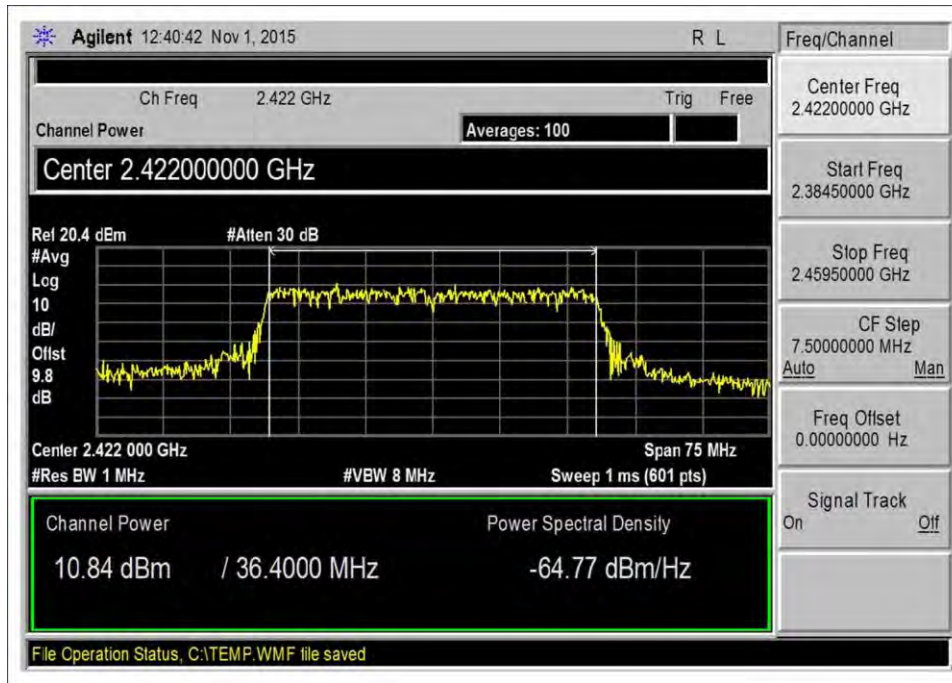
Middle Channel



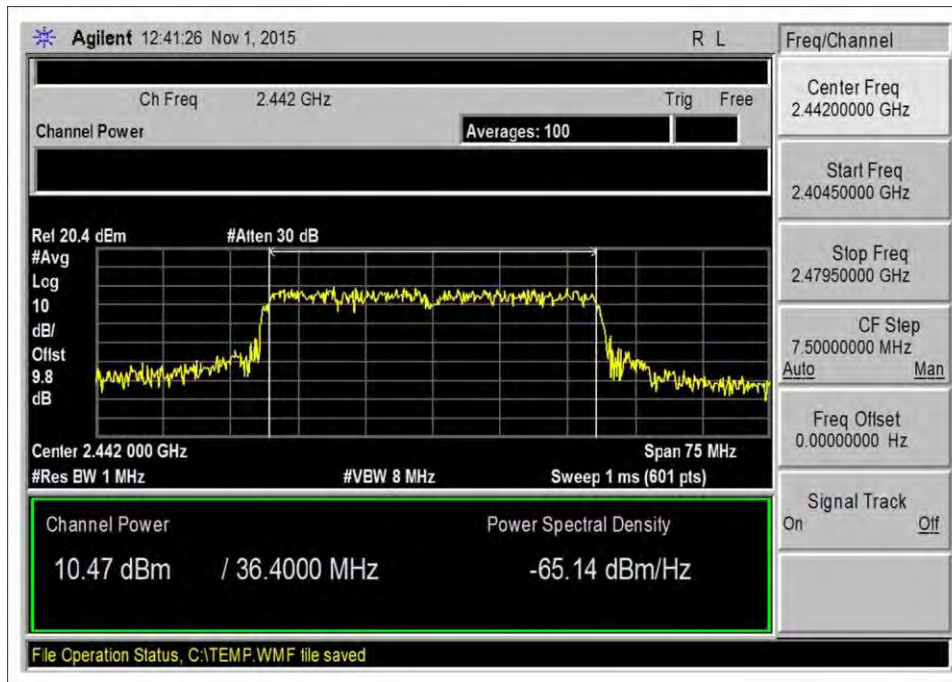


High Channel

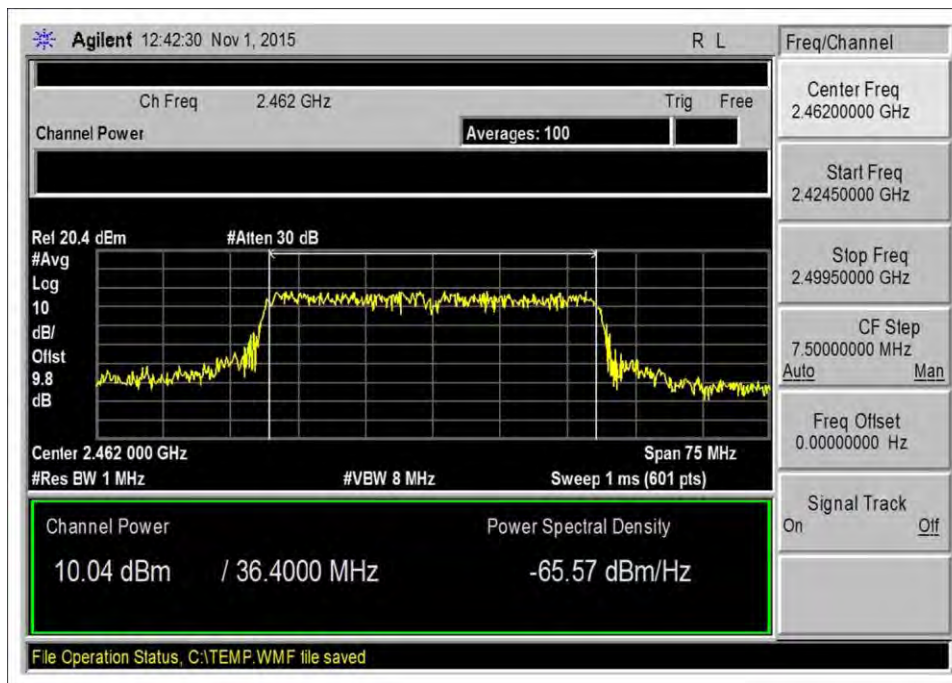
**802.11n (40MHz)**



Low Channel

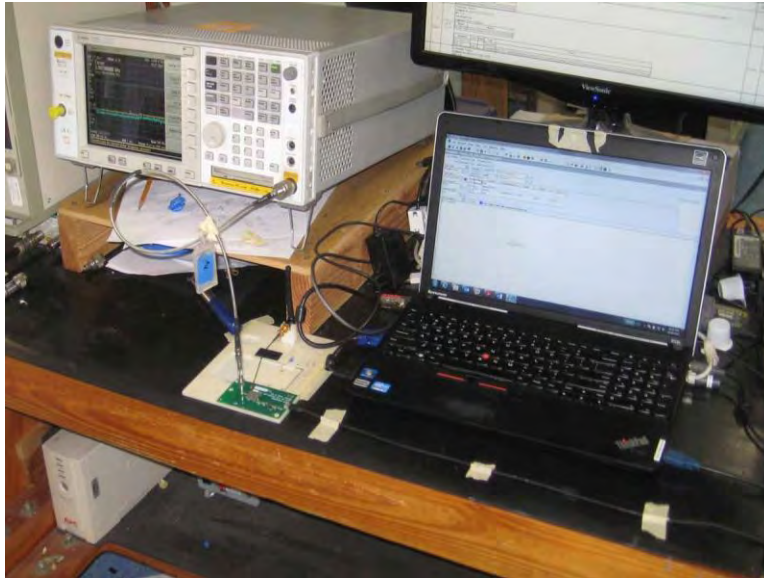


Middle Channel



High Channel

## Test Setup Photo



## 15.247(e) Power Spectral Density

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. 110 N Olinda Place, Brea CA 92823, 714-993-6112  
 Customer: HiTEM Engineering Inc.  
 Specification: **15.247(e) Power Spectral Density**  
 Work Order #: **97758** Date: 10/28/2015  
 Test Type: **Conducted Emissions**  
 Tested By: S. Yamamoto  
 Software: EMITest 5.02.00

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Test Conditions / Notes:

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC. • The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11b/g/n 20MHz. The test frequencies are 2422MHz, 2442MHz, and 2462MHz for 802.11n 40MHz. 802.11b, rate MCS3, 11Mbps CH 1, 6, 11. 802.11g, rate MCS7, 54 Mbps, CH 1, 6, 11. 802.11n (20MHz), rate MCS7, 65Mbps, CH 1, 6, 11. 802.11n (40MHz), rate MCS7, 65Mbps, CH 3, 7, 11. Frequency range of measurement, 2412MHz to 2462MHz.  
 Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A  
 Test method: KDB 558074 v03r03 and ANSI C63.10 2013.

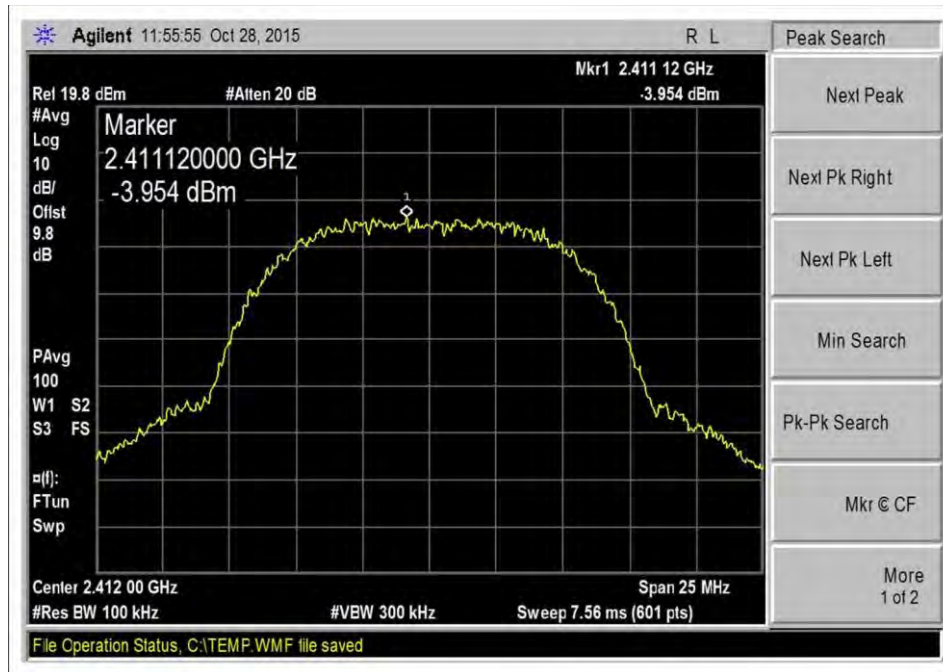
#### Test Equipment:

Asset #	Description	Model	Calibration Date	Cal Due Date
02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
P05409	Attenuator	54A-10	9/3/2014	9/3/2016
P06661	Cable	LDF1-50	4/15/2014	4/15/2016

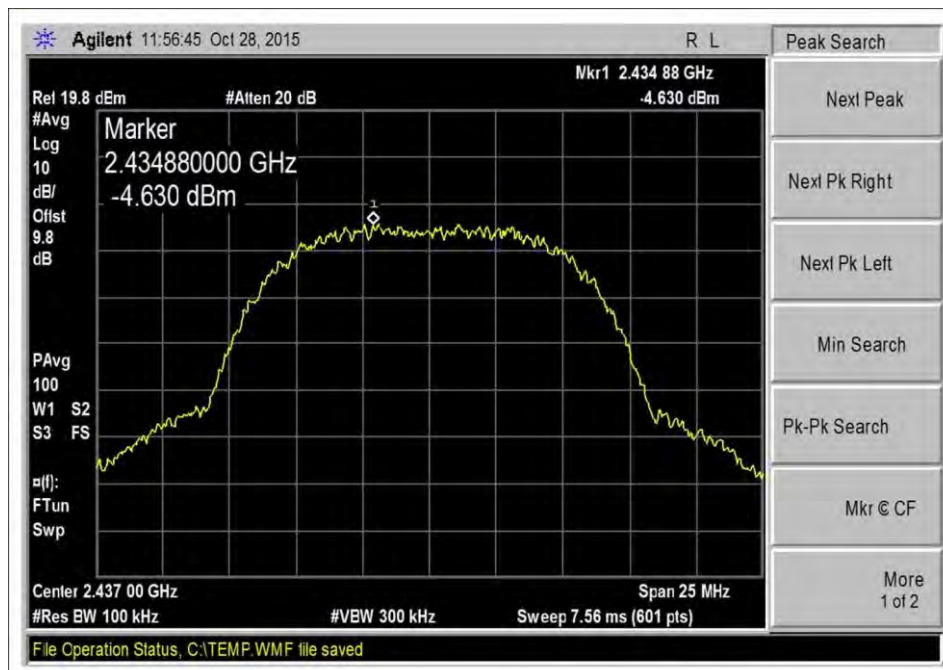


Test Data

802.11b



Low Channel

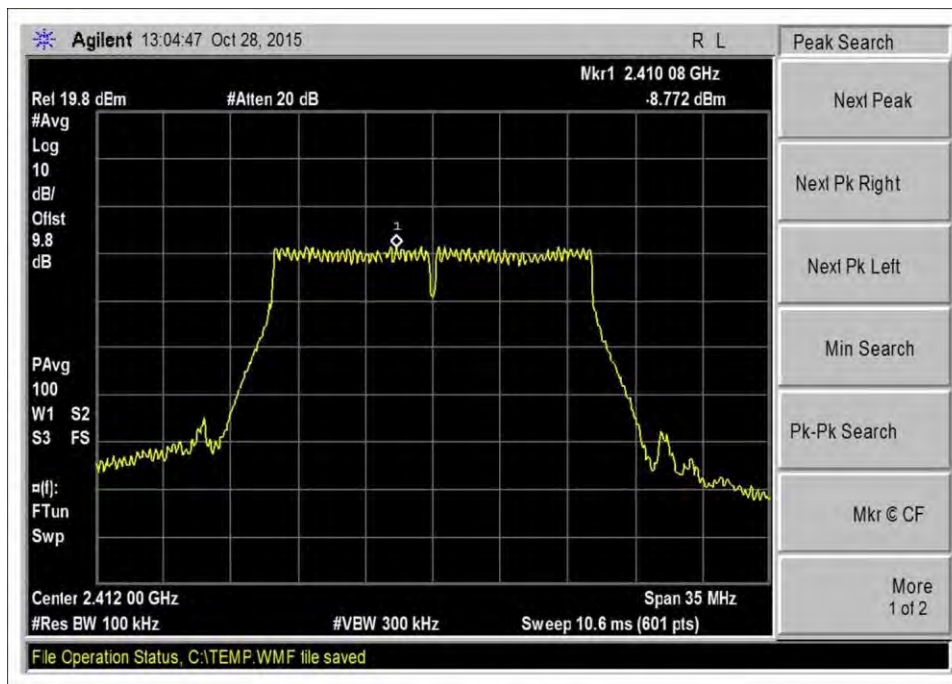


Middle Channel

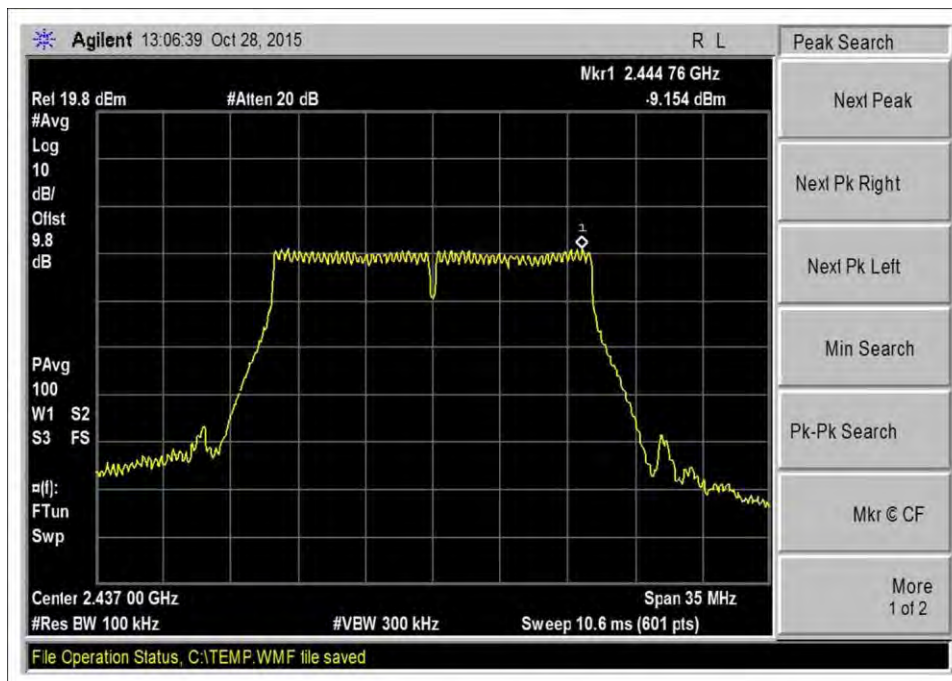


High Channel

### 802.11g

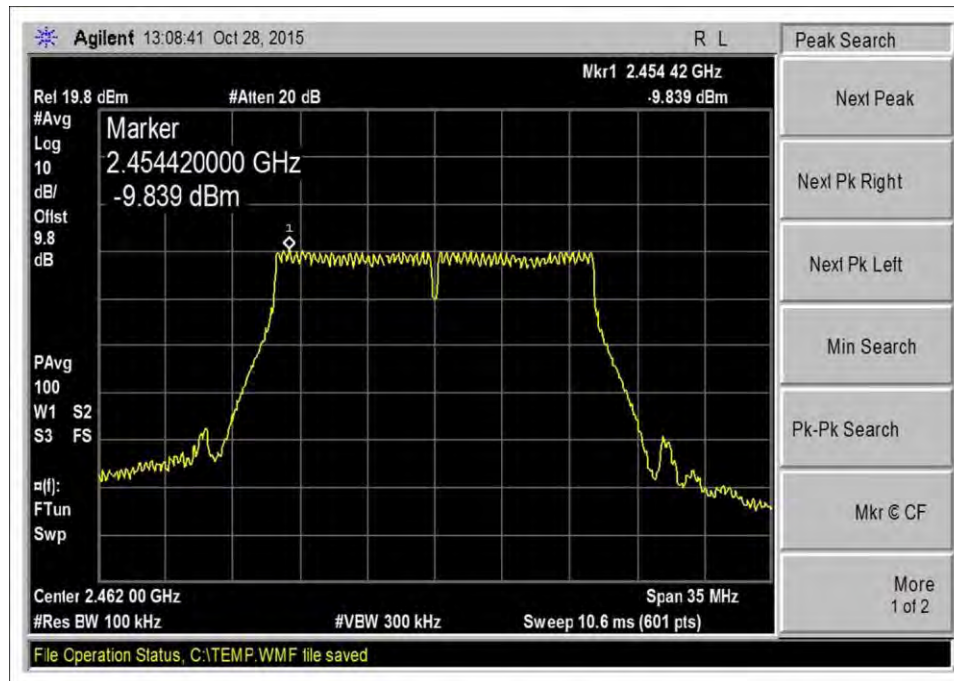


Low Channel



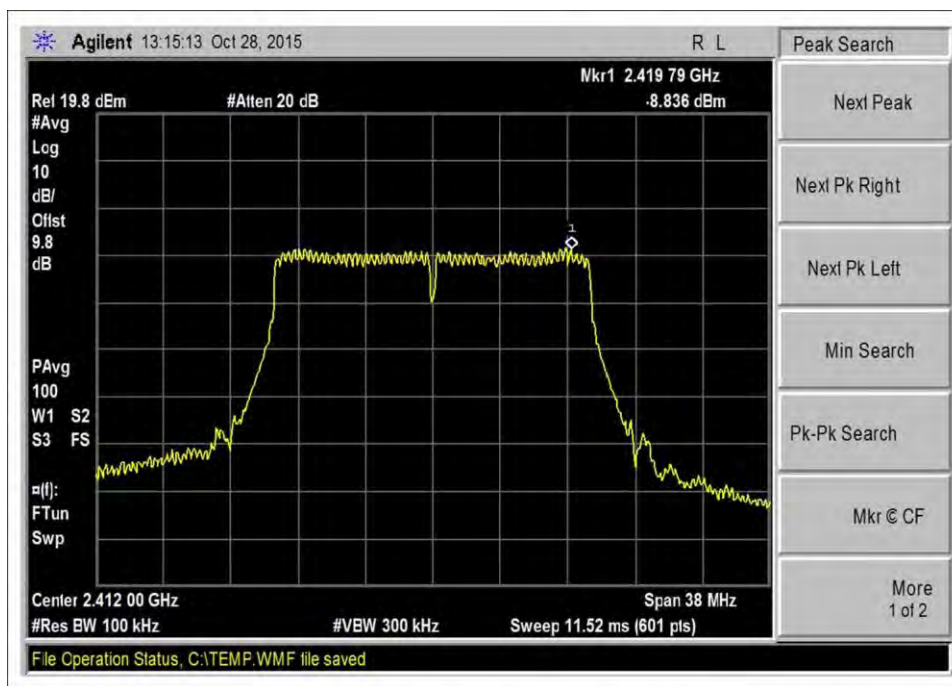
Middle Channel



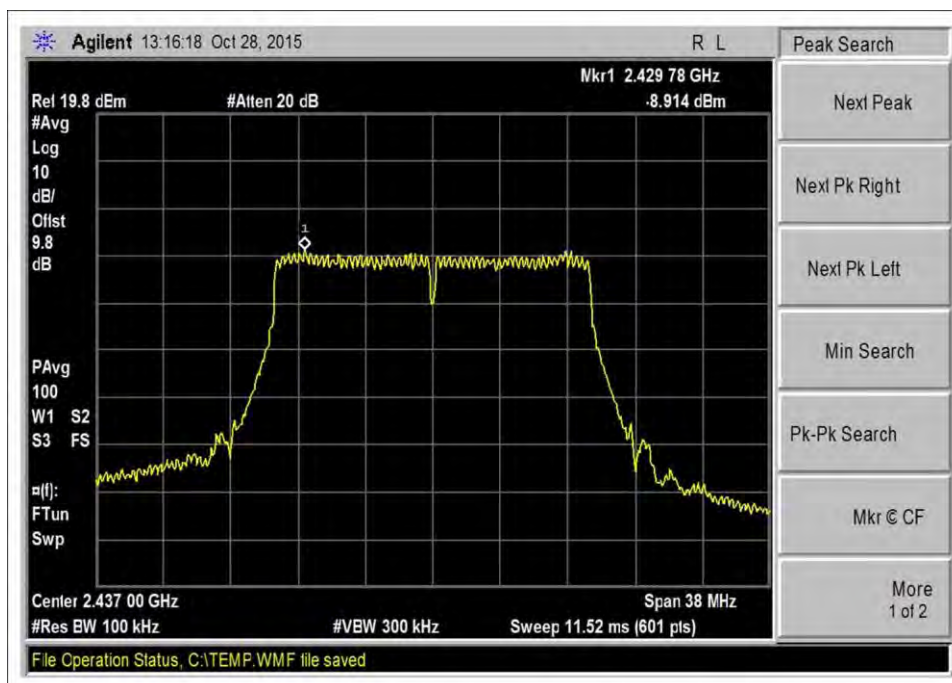


High Channel

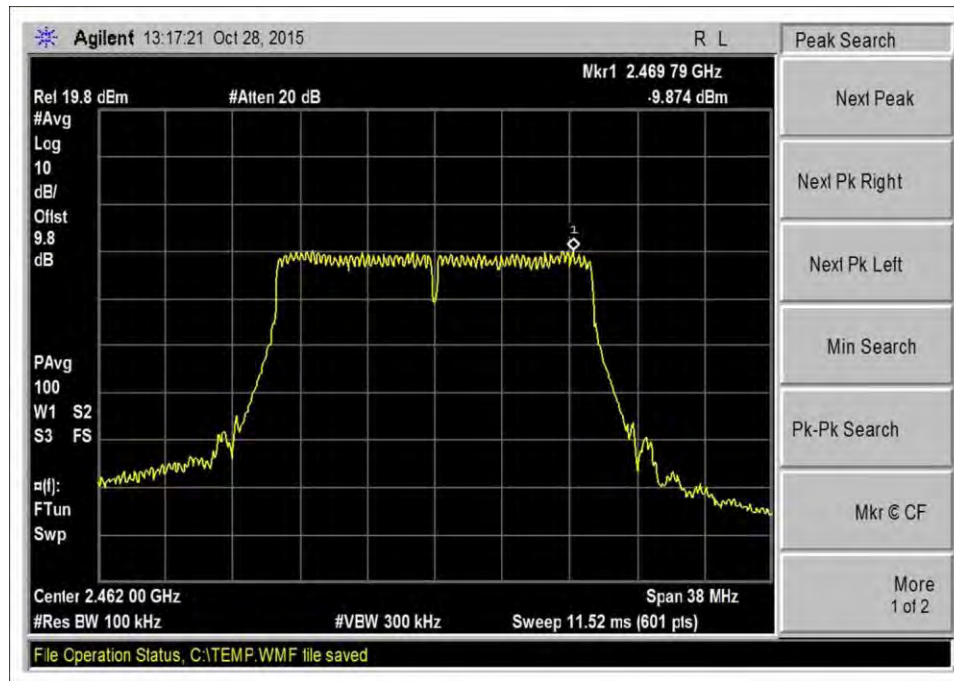
### 802.11n (20MHz)



Low Channel

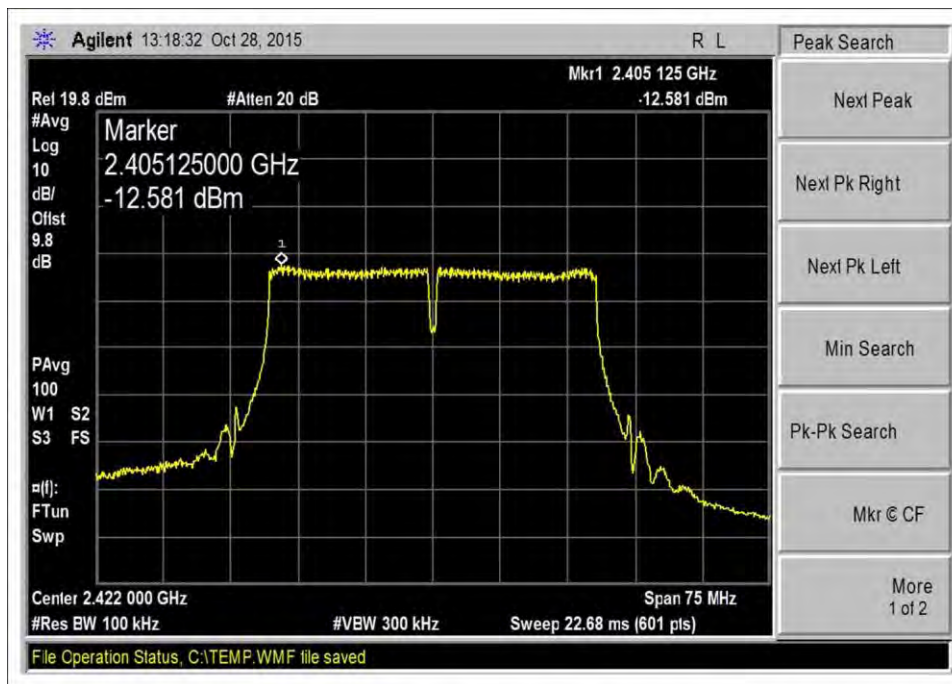


Middle Channel

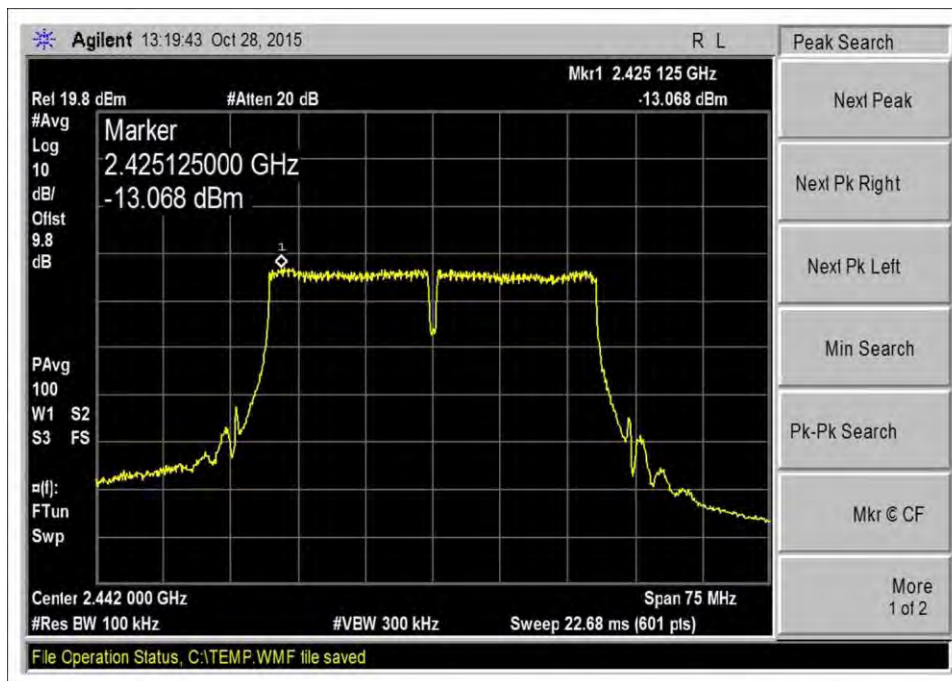


High Channel

### 802.11n (40MHz)



Low Channel



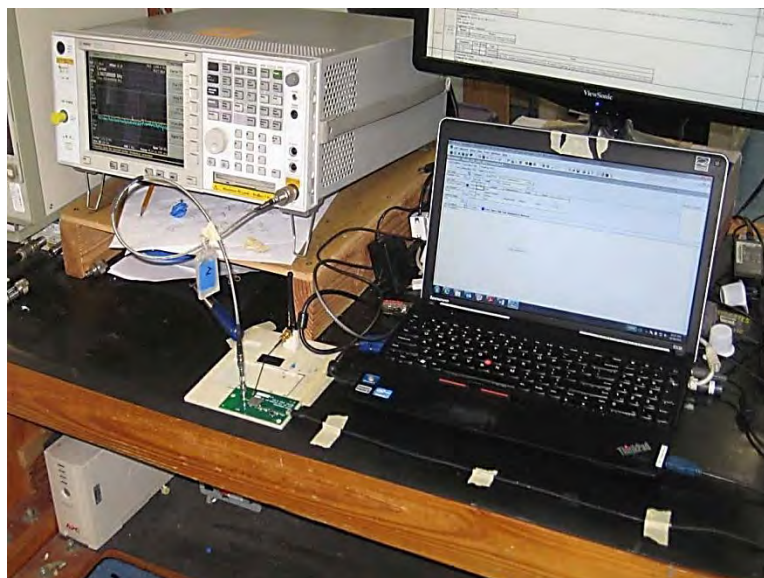
Middle Channel





High Channel

## Test Setup Photo



## 15.247(d) RF Conducted Emissions & Band Edge

### Test Data

Test Location: CKC Laboratories, Inc. • 110 N Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) Conducted Spurious Emissions (30dBc)**  
 Work Order #: **97758** Date: 10/30/2015  
 Test Type: **Conducted Emissions** Time: 09:44:30  
 Tested By: S. Yamamoto Sequence#: 1  
 Software: EMITest 5.02.00 3.3Vdc

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Test Conditions / Notes:

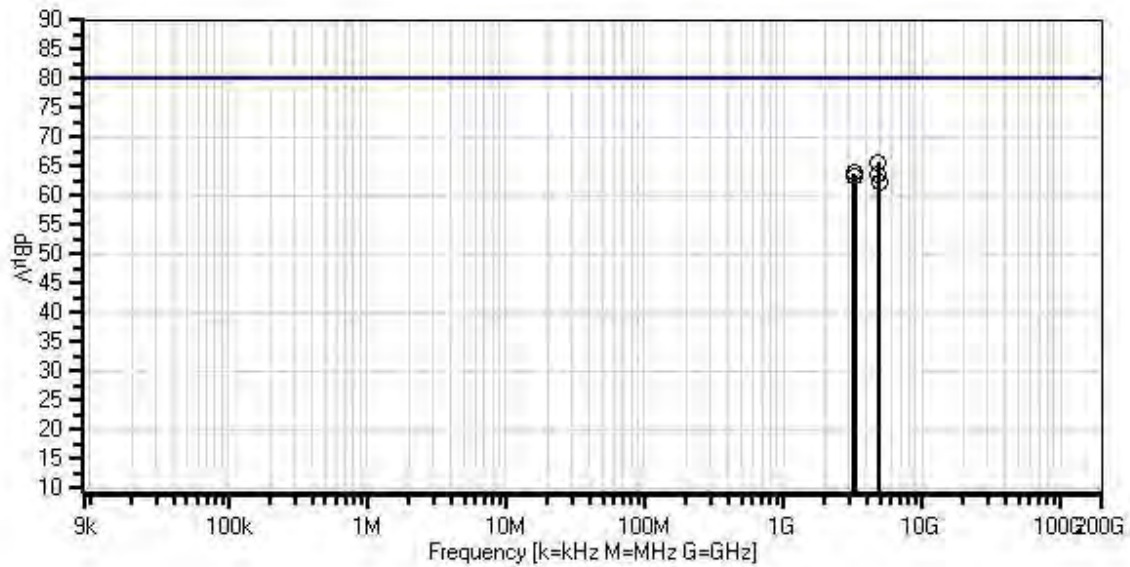
The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11b. 802.11b, rate MCS3, 11Mbps CH 1, 6, 11. Frequency range of measurement, 9kHz to 25GHz. RBW=VBW=100kHz.

Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A.  
 Test method: KDB 558074 v03r03 and ANSI C63.10 2013.



HiTEM Engineering Inc W/O#: 97758 Sequence#: 1 Date: 10/30/2015  
15.247(d) Conducted Spurious Emissions (30dBc) Test Lead: 3.3Vdc Antenna Port



— Readings  
× QP Readings  
▼ Ambient  
1 - 15.247(d) Conducted Spurious Emissions (30dBc)

○ Peak Readings  
\* Average Readings  
Software Version: 5.02.00

**Test Equipment:**

ID	Asset #/Serial #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T1	ANP06543	Cable	32022-29094K- 29094K-24TC	11/20/2013	11/20/2015

**Measurement Data:**

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV	T1 dB				Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	4824.170M	65.2	+0.6				+0.0	65.8	80.1	-14.3	Vert
2	3249.318M	63.5	+0.5				+0.0	64.0	80.1	-16.1	Vert
3	3215.983M	63.3	+0.5				+0.0	63.8	80.1	-16.3	Vert
4	4874.170M	63.2	+0.6				+0.0	63.8	80.1	-16.3	Vert
5	3282.643M	62.9	+0.5				+0.0	63.4	80.1	-16.7	Vert
6	4924.170M	61.9	+0.6				+0.0	62.5	80.1	-17.6	Vert

Test Location: CKC Laboratories, Inc. • 110 N Olinda Pl • Brea, CA 92823 • 7149936112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) Conducted Spurious Emissions (30dBc)**  
 Work Order #: **97758** Date: 10/30/2015  
 Test Type: **Conducted Emissions** Time: 09:57:00  
 Tested By: S. Yamamoto Sequence#: 2  
 Software: EMITest 5.02.00 3.3Vdc

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 1			

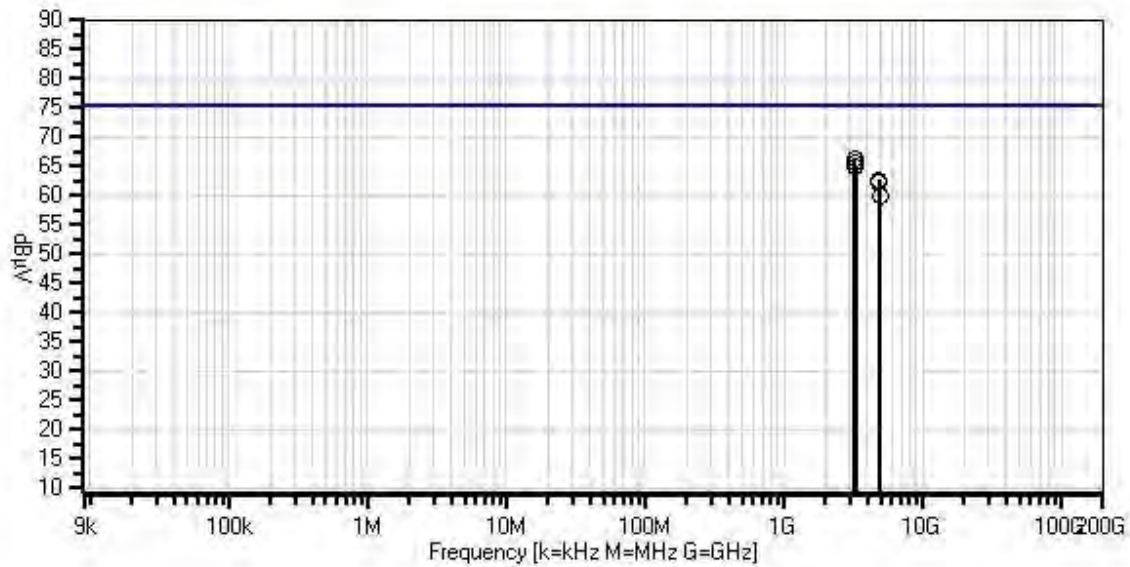
***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Test Conditions / Notes:***

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.  
 The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11g. 802.11g, rate MCS7, 54 Mbps, CH 1, 6, 11. Frequency range of measurement, 9kHz to 25GHz. RBW=VBW=100kHz.  
 Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A.  
 Test method: KDB 558074 v03r03 and ANSI C63.10 2013.

HiTEM Engineering Inc W/O#: 97758 Sequence#: 2 Date: 10/30/2015  
15.247(d) Conducted Spurious Emissions (30dBc) Test Lead: 3.3Vdc Antenna Port



— Readings  
× QP Readings  
▼ Ambient  
— 1 - 15.247(d) Conducted Spurious Emissions (30dBc)

○ Peak Readings  
\* Average Readings  
Software Version: 5.02.00

**Test Equipment:**

ID	Asset #/Serial #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
	ANP06543	Cable	32022-29094K- 29094K-24TC	11/20/2013	11/20/2015

**Measurement Data:**

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV					Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	3215.987M	65.7					+0.0	66.2	75.4	-9.2	Vert
2	3249.310M	65.1					+0.0	65.6	75.4	-9.8	Vert
3	3282.643M	64.4					+0.0	64.9	75.4	-10.5	Vert
4	4826.170M	62.2					+0.0	62.8	75.4	-12.6	Vert
5	4873.330M	61.7					+0.0	62.3	75.4	-13.1	Vert
6	4924.000M	59.5					+0.0	60.1	75.4	-15.3	Vert

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) Conducted Spurious Emissions (30dBc)**  
 Work Order #: **97758** Date: 10/30/2015  
 Test Type: **Conducted Emissions** Time: 10:10:19  
 Tested By: S. Yamamoto Sequence#: 3  
 Software: EMITest 5.02.00 3.3Vdc

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Support Equipment:***

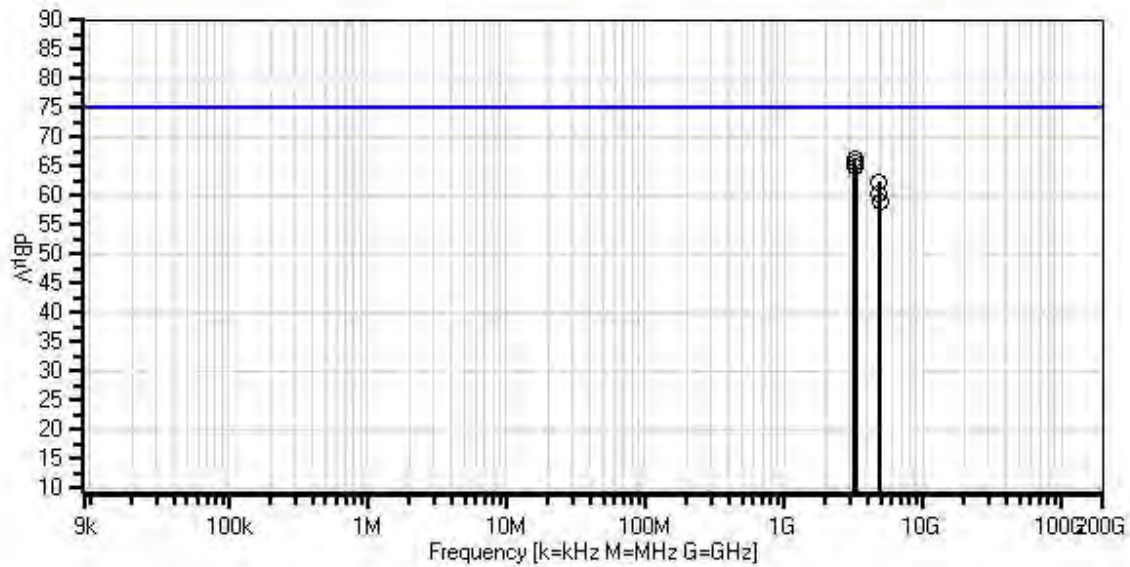
Device	Manufacturer	Model #	S/N
Configuration 1			

***Test Conditions / Notes:***

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.  
 The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11n 20MHz. 802.11n (20MHz), rate MCS7.  
 Frequency range of measurement, 9kHz to 25GHz. RBW=VBW=100kHz.  
 Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A  
 Test method: KDB 558074 v03r03 and ANSI C63.10 2013.



HiTEM Engineering Inc W/O#: 97758 Sequence#: 3 Date: 10/30/2015  
15.247(d) Conducted Spurious Emissions (30dBc) Test Lead: 3.3Vdc Antenna Port



— Readings  
× QP Readings  
▼ Ambient

○ Peak Readings  
\* Average Readings  
Software Version: 5.02.00

1 - 15.247(d) Conducted Spurious Emissions (30dBc)

**Test Equipment:**

ID	Asset #/Serial #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T1	ANP06543	Cable	32022-29094K- 29094K-24TC	11/20/2013	11/20/2015

**Measurement Data:**

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV	T1 dB				Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	3215.985M	65.7	+0.5				+0.0	66.2	75.0	-8.8	Vert
2	3249.307M	65.1	+0.5				+0.0	65.6	75.0	-9.4	Vert
3	3282.646M	64.4	+0.5				+0.0	64.9	75.0	-10.1	Vert
4	4821.750M	61.8	+0.6				+0.0	62.4	75.0	-12.6	Vert
5	4874.920M	59.8	+0.6				+0.0	60.4	75.0	-14.6	Vert
6	4921.500M	58.2	+0.6				+0.0	58.8	75.0	-16.2	Vert

Test Location: CKC Laboratories, Inc. • 110 N Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) Conducted Spurious Emissions (30dBc)**  
 Work Order #: **97758** Date: 10/30/2015  
 Test Type: **Conducted Emissions** Time: 10:24:47  
 Tested By: S. Yamamoto Sequence#: 4  
 Software: EMITest 5.02.00 3.3Vdc

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 1			

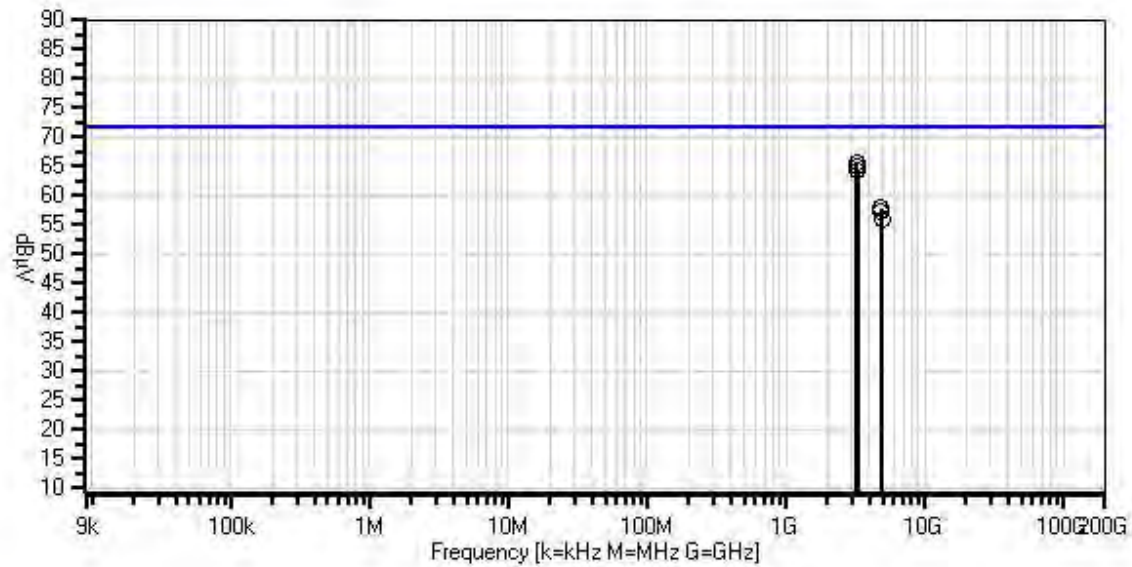
***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Test Conditions / Notes:***

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.  
 The test frequencies are 2422MHz, 2442MHz, and 2462MHz for 802.11n 40MHz. 802.11n (40MHz), rate MCS7, 65Mbps, CH 3, 7, 11. Frequency range of measurement, 9kHz to 25GHz. RBW=VBW=100kHz.  
 Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A  
 Test method: KDB 558074 v03r03 and ANSI C63.10 2013.

HiTEM Engineering Inc W/O#: 97758 Sequence#: 4 Date: 10/30/2015  
 15.247(d) Conducted Spurious Emissions (30dBc) Test Lead: 3.3Vdc Antenna Port



— Readings  
 × QP Readings  
 ▼ Ambient  
 — 1 - 15.247(d) Conducted Spurious Emissions (30dBc)

○ Peak Readings  
 \* Average Readings  
 Software Version: 5.02.00

**Test Equipment:**

ID	Asset #/Serial #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
	ANP06543	Cable	32022-29094K- 29094K-24TC	11/20/2013	11/20/2015

**Measurement Data:**

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV					Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	3229.311M	65.2					+0.0	65.7	71.8	-6.1	Vert
2	3255.983M	64.6					+0.0	65.1	71.8	-6.7	Vert
3	3282.658M	63.9					+0.0	64.4	71.8	-7.4	Vert
4	4847.670M	57.3					+0.0	57.9	71.8	-13.9	Vert
5	4884.330M	56.8					+0.0	57.4	71.8	-14.4	Vert
6	4924.330M	55.5					+0.0	56.1	71.8	-15.7	Vert

## Band Edge Test Conditions / Setup / Test Data

Test Location: CKC Laboratories, Inc. • 110 N Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) Conducted Emissions Band Edge**  
 Work Order #: **97758** Date: 11/10/2015  
 Test Type: **Conducted Emissions** Time: 09:48:38  
 Tested By: S. Yamamoto Sequence#: 15  
 Software: EMITest 5.02.00 3.3Vdc

### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

### Test Conditions / Notes:

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

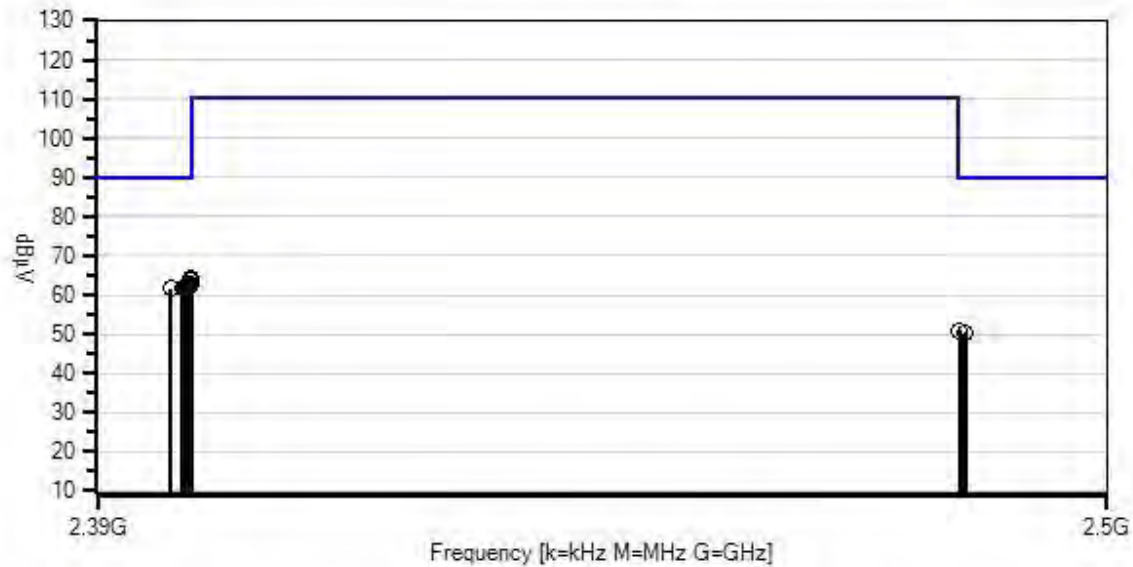
The test frequencies are 2412MHz and 2462MHz for 802.11b. 802.11b, rate MCS3, 11Mbps CH 1, 6, 11. Frequency range of measurement, 2390MHz to 2500MHz. RBW=100kHz, VBW=300kHz.

Temperature: 21°C  
 Humidity: 35%  
 Pressure: 100kPa  
 Site A

Test method: KDB 558074 v03r03 and ANSI C63.10 2013. This data sheet contains the worst case band edge emissions from the EUT in the 2390MHz to 2400MHz and 2483.5MHz to 2500MHz ranges.



HiTEM Engineering Inc WO#: 97758 Sequence#: 15 Date: 11/10/2015  
 15.247(d) Conducted Emissions Band Edge Test Lead: 3.3Vdc Antenna Port



— Readings  
 × QP Readings  
 ▼ Ambient  
 — 1 - 15.247(d) Conducted Emissions Band Edge  
 ○ Peak Readings  
 \* Average Readings  
 Software Version: 5.02.00

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T1	ANP06543	Cable	32022-29094K-29094K-24TC	11/20/2013	11/20/2015

**Measurement Data:**

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV	T1 dB					Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2399.900M	63.8	+0.4					+0.0	64.2	90.1	-25.9	Anten
2	2400.000M	63.4	+0.4					+0.0	63.8	90.1	-26.3	Anten
3	2399.933M	62.4	+0.4					+0.0	62.8	90.1	-27.3	Anten
4	2399.800M	62.2	+0.4					+0.0	62.6	90.1	-27.5	Anten
5	2399.700M	61.9	+0.4					+0.0	62.3	90.1	-27.8	Anten
6	2399.300M	61.6	+0.4					+0.0	62.0	90.1	-28.1	Anten
7	2399.100M	61.4	+0.4					+0.0	61.8	90.1	-28.3	Anten
8	2397.850M	61.3	+0.4					+0.0	61.7	90.1	-28.4	Anten
9	2399.400M	61.3	+0.4					+0.0	61.7	90.1	-28.4	Anten
10	2399.600M	61.2	+0.4					+0.0	61.6	90.1	-28.5	Anten
11	2483.600M	50.5	+0.4					+0.0	50.9	90.1	-39.2	Anten
12	2484.300M	50.0	+0.4					+0.0	50.4	90.1	-39.7	Anten
13	2484.100M	49.9	+0.4					+0.0	50.3	90.1	-39.8	Anten

Test Location: CKC Laboratories, Inc. • 110 N Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) Conducted Emissions Band Edge**  
 Work Order #: **97758** Date: 11/10/2015  
 Test Type: **Conducted Emissions** Time: 09:45:53  
 Tested By: S. Yamamoto Sequence#: 16  
 Software: EMITest 5.02.00 3.3Vdc

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Test Conditions / Notes:***

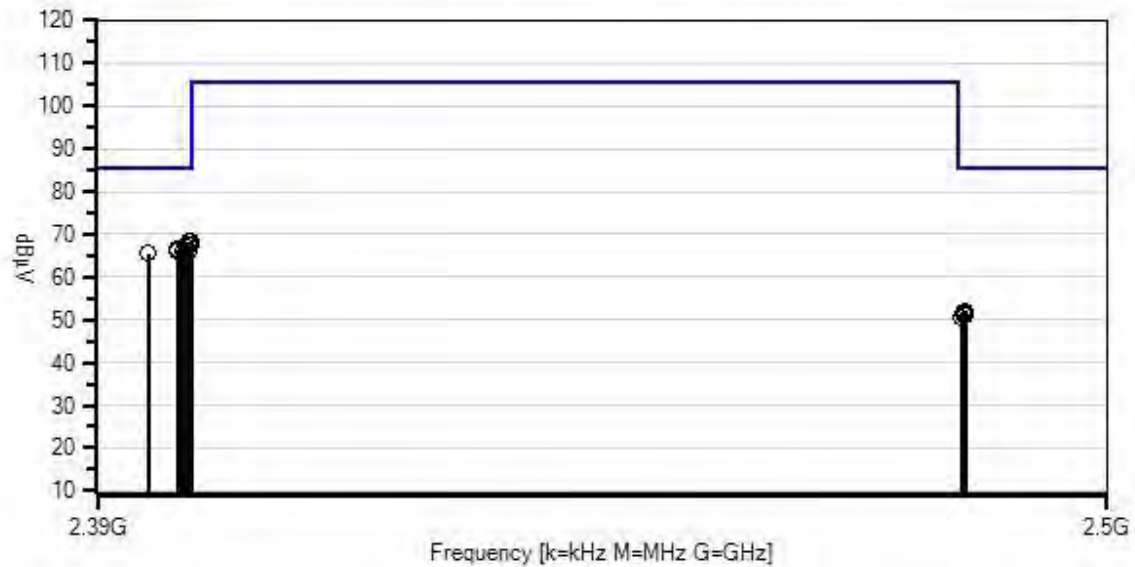
The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

The test frequencies are 2412MHz and 2462MHz for 802.11g. 802.11g, rate MCS7, 54 Mbps, CH 1, 6, 11. Frequency range of measurement, 2390MHz to 2500MHz. RBW=100kHz, VBW=300kHz.

Temperature: 21°C  
 Humidity: 35%  
 Pressure: 100kPa  
 Site A.

Test method: KDB 558074 v03r03 and ANSI C63.10 2013. This data sheet contains the worst case band edge emissions from the EUT in the 2390MHz to 2400MHz and 2483.5MHz to 2500MHz ranges.

HiTEM Engineering Inc WO#: 97758 Sequence#: 16 Date: 11/10/2015  
 15.247(d) Conducted Emissions Band Edge Test Lead: 3.3Vdc Antenna Port



— Readings  
 × QP Readings  
 ▼ Ambient  
 — 1 - 15.247(d) Conducted Emissions Band Edge

○ Peak Readings  
 \* Average Readings  
 Software Version: 5.02.00

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T1	ANP06543	Cable	32022-29094K-29094K-24TC	11/20/2013	11/20/2015

**Measurement Data:**

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV	T1 dB					Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2399.900M	67.9	+0.4					+0.0	68.3	85.4	-17.1	Anten
2	2399.777M	67.9	+0.4					+0.0	68.3	85.4	-17.1	Anten
3	2400.000M	67.2	+0.4					+0.0	67.6	85.4	-17.8	Anten
4	2399.800M	67.1	+0.4					+0.0	67.5	85.4	-17.9	Anten
5	2399.500M	66.6	+0.4					+0.0	67.0	85.4	-18.4	Anten
6	2398.540M	66.1	+0.4					+0.0	66.5	85.4	-18.9	Anten
7	2399.147M	65.8	+0.4					+0.0	66.2	85.4	-19.2	Anten
8	2399.700M	65.8	+0.4					+0.0	66.2	85.4	-19.2	Anten
9	2398.563M	65.6	+0.4					+0.0	66.0	85.4	-19.4	Anten
10	2395.413M	65.1	+0.4					+0.0	65.5	85.4	-19.9	Anten
11	2484.105M	51.6	+0.4					+0.0	52.0	85.4	-33.4	Anten
12	2484.300M	51.2	+0.4					+0.0	51.6	85.4	-33.8	Anten
13	2483.900M	51.1	+0.4					+0.0	51.5	85.4	-33.9	Anten
14	2484.100M	50.9	+0.4					+0.0	51.3	85.4	-34.1	Anten
15	2484.200M	50.8	+0.4					+0.0	51.2	85.4	-34.2	Anten
16	2483.858M	50.2	+0.4					+0.0	50.6	85.4	-34.8	Anten

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) Conducted Emissions Band Edge**  
 Work Order #: **97758** Date: 11/10/2015  
 Test Type: **Conducted Emissions** Time: 09:58:57  
 Tested By: S. Yamamoto Sequence#: 17  
 Software: EMITest 5.02.00 3.3Vdc

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Test Conditions / Notes:***

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

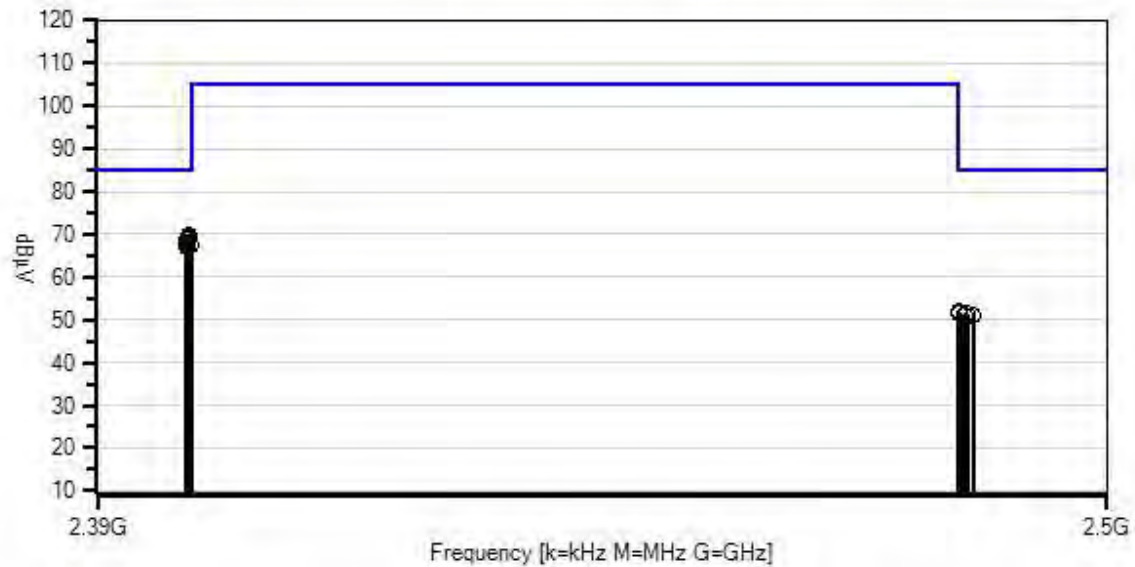
The test frequencies are 2412MHz and 2462MHz for 802.11n 20MHz. 802.11n (20MHz), rate MCS7. Frequency range of measurement, 2390MHz to 2500MHz. RBW=100kHz. VBW=300kHz.

Temperature: 21°C  
 Humidity: 35%  
 Pressure: 100kPa.  
 Site A

Test method: KDB 558074 v03r03 and ANSI C63.10 2013. This data sheet contains the worst case band edge emissions from the EUT in the 2390MHz to 2400MHz and 2483.5MHz to 2500MHz ranges.



HiTEM Engineering Inc WO#: 97758 Sequence#: 17 Date: 11/10/2015  
 15.247(d) Conducted Emissions Band Edge Test Lead: 3.3Vdc Antenna Port



— Readings  
 × QP Readings  
 ▼ Ambient  
 ○ Peak Readings  
 \* Average Readings  
 Software Version: 5.02.00  
 1 - 15.247(d) Conducted Emissions Band Edge

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T1	ANP06543	Cable	32022-29094K-29094K-24TC	11/20/2013	11/20/2015

**Measurement Data:**

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV	T1 dB					Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2399.800M	69.4	+0.4					+0.0	69.8	85.0	-15.2	Anten
2	2399.850M	68.8	+0.4					+0.0	69.2	85.0	-15.8	Anten
3	2399.817M	68.8	+0.4					+0.0	69.2	85.0	-15.8	Anten
4	2399.500M	68.3	+0.4					+0.0	68.7	85.0	-16.3	Anten
5	2399.800M	68.3	+0.4					+0.0	68.7	85.0	-16.3	Anten
6	2399.500M	67.7	+0.4					+0.0	68.1	85.0	-16.9	Anten
7	2399.517M	67.6	+0.4					+0.0	68.0	85.0	-17.0	Anten
8	2399.517M	67.4	+0.4					+0.0	67.8	85.0	-17.2	Anten
9	2399.600M	67.3	+0.4					+0.0	67.7	85.0	-17.3	Anten
10	2399.900M	67.1	+0.4					+0.0	67.5	85.0	-17.5	Anten
11	2400.000M	67.1	+0.4					+0.0	67.5	85.0	-17.5	Anten
12	2399.600M	66.8	+0.4					+0.0	67.2	85.0	-17.8	Anten
13	2483.500M	51.8	+0.4					+0.0	52.2	85.0	-32.8	Anten
14	2483.600M	51.2	+0.4					+0.0	51.6	85.0	-33.4	Anten
15	2484.435M	51.0	+0.4					+0.0	51.4	85.0	-33.6	Anten
16	2485.123M	50.8	+0.4					+0.0	51.2	85.0	-33.8	Anten
17	2484.100M	50.7	+0.4					+0.0	51.1	85.0	-33.9	Anten

Test Location: CKC Laboratories, Inc. • 110 N Olinda Pl • Brea, CA 92823 • 7149936112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) Conducted Emissions Band Edge**  
 Work Order #: **97758** Date: 11/10/2015  
 Test Type: **Conducted Emissions** Time: 10:08:57  
 Tested By: S. Yamamoto Sequence#: 18  
 Software: EMITest 5.02.00 3.3Vdc

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Test Conditions / Notes:***

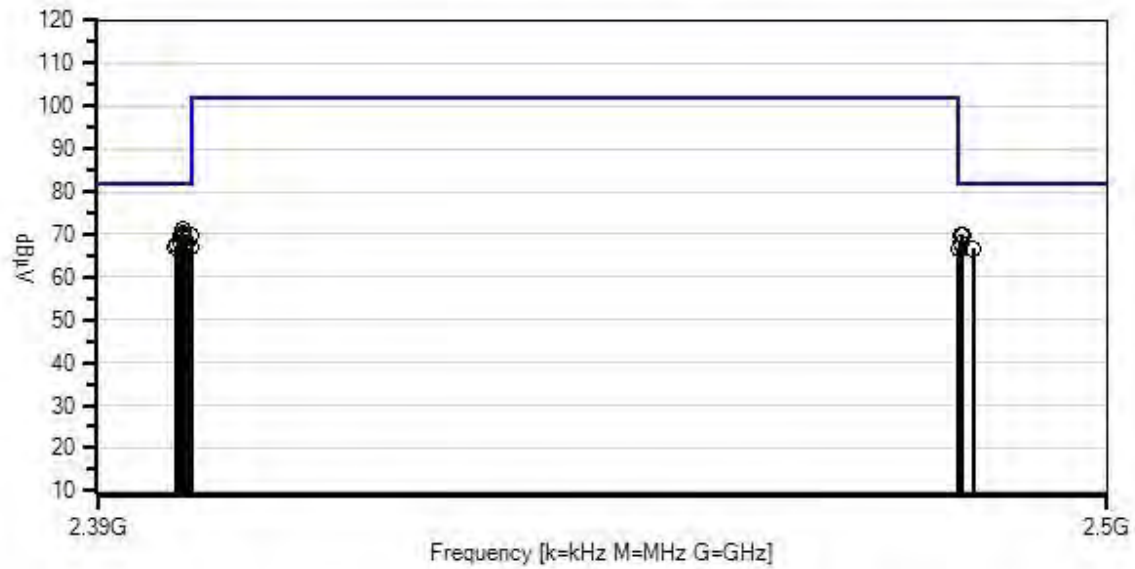
The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the spectrum analyzer. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

The test frequencies are 2422MHz and 2462MHz for 802.11n 40MHz. 802.11n (40MHz), rate MCS7, 65Mbps, CH 3, 7, 11. Frequency range of measurement, 2390MHz to 2500MHz. RBW=100kHz, VBW=300kHz.

Temperature: 21°C  
 Humidity: 35%  
 Pressure: 100kPa  
 Site A.

Test method: KDB 558074 v03r03 and ANSI C63.10 2013. This data sheet contains the worst case band edge emissions from the EUT in the 2390MHz to 2400MHz and 2483.5MHz to 2500MHz ranges.

HiTEM Engineering Inc WO#: 97758 Sequence#: 18 Date: 11/10/2015  
 15.247(d) Conducted Emissions Band Edge Test Lead: 3.3Vdc Antenna Port



— Readings  
 × QP Readings  
 ▼ Ambient  
 — 1 - 15.247(d) Conducted Emissions Band Edge

○ Peak Readings  
 \* Average Readings  
 Software Version: 5.02.00

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T1	ANP06543	Cable	32022-29094K-29094K-24TC	11/20/2013	11/20/2015

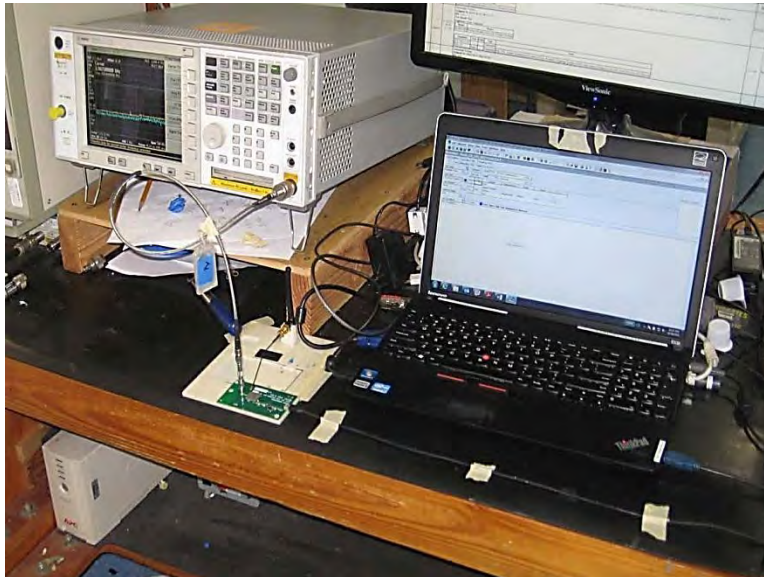
**Measurement Data:**

Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV	T1 dB					Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2399.100M	70.7	+0.4					+0.0	71.1	81.8	-10.7	Anten
2	2399.050M	69.7	+0.4					+0.0	70.1	81.8	-11.7	Anten
3	2399.083M	69.5	+0.4					+0.0	69.9	81.8	-11.9	Anten
4	2398.850M	69.4	+0.4					+0.0	69.8	81.8	-12.0	Anten
5	2483.800M	69.3	+0.4					+0.0	69.7	81.8	-12.1	Anten
6	2483.900M	69.2	+0.4					+0.0	69.6	81.8	-12.2	Anten
7	2400.000M	69.2	+0.4					+0.0	69.6	81.8	-12.2	Anten
8	2483.830M	69.2	+0.4					+0.0	69.6	81.8	-12.2	Anten
9	2399.200M	68.7	+0.4					+0.0	69.1	81.8	-12.7	Anten
10	2483.700M	67.7	+0.4					+0.0	68.1	81.8	-13.7	Anten
11	2399.500M	67.5	+0.4					+0.0	67.9	81.8	-13.9	Anten
12	2399.000M	67.5	+0.4					+0.0	67.9	81.8	-13.9	Anten
13	2399.450M	67.2	+0.4					+0.0	67.6	81.8	-14.2	Anten
14	2398.600M	67.1	+0.4					+0.0	67.5	81.8	-14.3	Anten
15	2399.300M	66.7	+0.4					+0.0	67.1	81.8	-14.7	Anten
16	2398.383M	66.7	+0.4					+0.0	67.1	81.8	-14.7	Anten
17	2399.400M	66.6	+0.4					+0.0	67.0	81.8	-14.8	Anten
18	2399.900M	66.5	+0.4					+0.0	66.9	81.8	-14.9	Anten
19	2483.500M	66.4	+0.4					+0.0	66.8	81.8	-15.0	Anten
20	2485.068M	66.2	+0.4					+0.0	66.6	81.8	-15.2	Anten

## Test Setup Photo





## 15.247(d) Radiated Emissions & Band Edge

### Test Data

Test Location: CKC Laboratories, Inc. • 110 N Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **97758** Date: 11/1/2015  
 Test Type: **Maximized Emissions** Time: 15:57:58  
 Tested By: S. Yamamoto Sequence#: 5  
 Software: EMITest 5.02.00

#### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

#### Test Conditions / Notes:

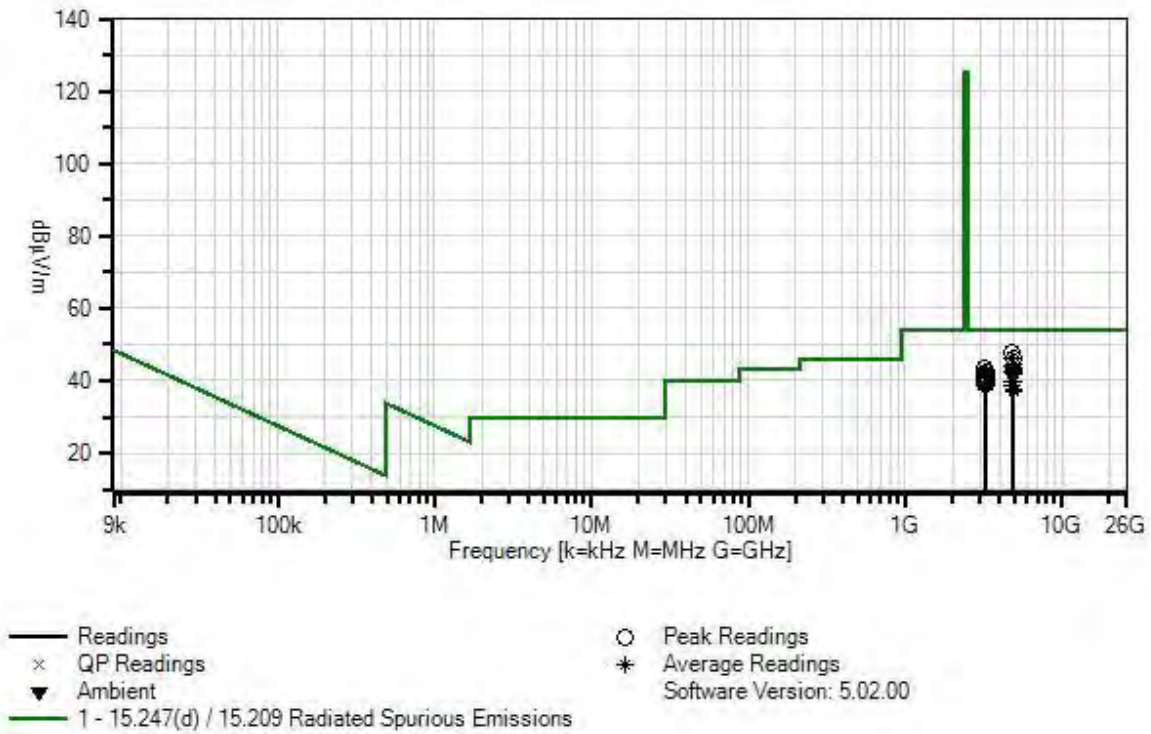
The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the external antenna. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11b. 802.11b, rate MCS3, 11Mbps CH 1, 6, 11. Frequency range of measurement, 9kHz to 25GHz. 9kHz to 150kHz, RBW=VBW=200Hz. 150kHz to 30MHz, RBW=VBW=9kHz. 30MHz to 1000MHz, RBW=VBW=120kHz. 1GHz to 25GHz, RBW=VBW=1MHz.

Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A.

Test method: KDB 558074 v03r03 and ANSI C63.10 2013.

HiTEM Engineering Inc WO#: 97758 Sequence#: 5 Date: 11/1/2015  
 15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T2	ANP06661	Cable	LDF1-50	4/15/2014	4/15/2016
T3	AN00786	Preamp	83017A	4/25/2014	4/25/2016
T4	ANP06543	Cable	32022-29094K-29094K-24TC	11/20/2013	11/20/2015
T5	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/15/2015	6/15/2017
T6	AN00849	Horn Antenna	3115	3/18/2014	3/18/2016
T7	AN01995	Biconilog Antenna	CBL6111C	4/30/2014	4/30/2016
T8	AN00309	Preamp	8447D	3/12/2014	3/12/2016
T9	ANP05198	Cable-Amplitude 15 to 45degC (dB)	8268	12/22/2014	12/22/2016
	AN00314	Loop Antenna	6502	7/2/2014	7/2/2016
	AN01413	Horn Antenna	84125-80008	11/25/2014	11/25/2016
	ANP06554	Cable	32022-29094K-29094K-24TC	3/19/2014	3/19/2016

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
1	4823.700M	48.7	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	47.7	54.0 x axis	-6.3	Horiz
2	4873.700M	47.7	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	46.4	54.0 x axis	-7.6	Horiz
3	4824.017M Ave	47.2	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	46.2	54.0 y axis	-7.8	Horiz
4	4873.973M Ave	45.9	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	44.6	54.0 y axis	-9.4	Horiz
5	4923.980M Ave	45.9	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	44.6	54.0 y axis	-9.4	Horiz
6	4823.967M Ave	45.0	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	44.0	54.0 z axis	-10.0	Horiz
^	4824.017M	62.0	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	61.0	54.0 y axis	+7.0	Horiz
^	4823.967M	59.7	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	58.7	54.0 z axis	+4.7	Horiz

9	3249.381M	48.9	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	43.7	54.0 z axis	-10.3	Horiz
10	3215.993M	48.9	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	43.7	54.0 z axis	-10.3	Horiz
11	3216.037M	48.6	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	43.4	54.0 x axis	-10.6	Vert
12	4923.967M Ave	44.6	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	43.3	54.0 x axis	-10.7	Vert
13	4874.000M Ave	44.3	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	43.0	54.0 z axis	-11.0	Horiz
^	4873.973M	61.0	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	59.7	54.0 y axis	+5.7	Horiz
^	4874.000M	59.0	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	57.7	54.0 z axis	+3.7	Horiz
16	4823.950M Ave	43.6	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	42.6	54.0 x axis	-11.4	Vert
17	4923.888M Ave	43.8	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	42.5	54.0 z axis	-11.5	Horiz
^	4923.980M	60.8	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	59.5	54.0 y axis	+5.5	Horiz
^	4923.888M	58.7	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	57.4	54.0 z axis	+3.4	Horiz
^	4923.883M	48.3	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	47.0	54.0 x axis	-7.0	Horiz
21	3282.589M	47.6	+0.0 +0.5 +0.0	+4.8 +27.9	-38.9 +0.0	+0.5 +0.0	+0.0	42.4	54.0 z axis	-11.6	Horiz
22	4874.002M Ave	43.4	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	42.1	54.0 x axis	-11.9	Vert
23	3215.784M	47.1	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	41.9	54.0 y axis	-12.1	Horiz
24	3249.305M	47.0	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	41.8	54.0 y axis	-12.2	Horiz
25	3282.697M	46.8	+0.0 +0.5 +0.0	+4.8 +27.9	-38.9 +0.0	+0.5 +0.0	+0.0	41.6	54.0 y axis	-12.4	Horiz

26	3249.082M	46.7	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	41.5	54.0 x axis	-12.5	Horiz
27	3249.088M	46.7	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	41.5	54.0 x axis	-12.5	Vert
28	3282.776M	46.5	+0.0 +0.5 +0.0	+4.8 +27.9	-38.9 +0.0	+0.5 +0.0	+0.0	41.3	54.0 x axis	-12.7	Vert
29	3282.718M	46.0	+0.0 +0.5 +0.0	+4.8 +27.9	-38.9 +0.0	+0.5 +0.0	+0.0	40.8	54.0 x axis	-13.2	Horiz
30	3215.821M	45.9	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	40.7	54.0 x axis	-13.3	Horiz
31	3249.251M	45.5	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	40.3	54.0 z axis	-13.7	Vert
32	3282.663M	45.4	+0.0 +0.5 +0.0	+4.8 +27.9	-38.9 +0.0	+0.5 +0.0	+0.0	40.2	54.0 z axis	-13.8	Vert
33	3249.313M	45.2	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	40.0	54.0 y axis	-14.0	Vert
34	4873.992M Ave	41.2	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	39.9	54.0 z axis	-14.1	Vert
35	3249.313M	45.0	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	39.8	54.0 x axis	-14.2	Horiz
36	4824.050M Ave	40.8	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	39.8	54.0 z axis	-14.2	Vert
37	4924.000M Ave	40.9	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	39.6	54.0 z axis	-14.4	Vert
^	4924.000M	55.4	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	54.1	54.0 z axis	+0.1	Vert
39	3216.037M	44.7	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	39.5	54.0 y axis	-14.5	Vert
40	3282.097M	44.5	+0.0 +0.5 +0.0	+4.8 +27.9	-38.9 +0.0	+0.5 +0.0	+0.0	39.3	54.0 y axis	-14.7	Vert
41	3216.071M	44.2	+0.0 +0.5 +0.0	+4.8 +27.8	-38.8 +0.0	+0.5 +0.0	+0.0	39.0	54.0 z axis	-15.0	Vert
42	4823.990M Ave	39.9	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	38.9	54.0 y axis	-15.1	Vert

^ 4823.950M	58.8	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	57.8	54.0 x axis	+3.8	Vert
^ 4823.990M	54.8	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	53.8	54.0 y axis	-0.2	Vert
^ 4824.050M	53.7	+0.0 +0.1 +0.0	+6.1 +30.0	-37.8 +0.0	+0.6 +0.0	+0.0	52.7	54.0 z axis	-1.3	Vert
46 4923.900M Ave	38.8	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	37.5	54.0 y axis	-16.5	Vert
^ 4923.967M	57.7	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	56.4	54.0 x axis	+2.4	Vert
^ 4923.900M	53.6	+0.0 +0.1 +0.0	+6.0 +30.1	-38.1 +0.0	+0.6 +0.0	+0.0	52.3	54.0 y axis	-1.7	Vert
49 4874.013M Ave	38.4	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	37.1	54.0 y axis	-16.9	Vert
^ 4874.002M	58.2	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	56.9	54.0 x axis	+2.9	Vert
^ 4873.992M	56.3	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	55.0	54.0 z axis	+1.0	Vert
^ 4874.013M	53.2	+0.0 +0.1 +0.0	+6.0 +30.0	-38.0 +0.0	+0.6 +0.0	+0.0	51.9	54.0 y axis	-2.1	Vert



Test Location: CKC Laboratories, Inc. • 110 N Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **97758** Date: 11/1/2015  
 Test Type: **Maximized Emissions** Time: 16:27:44  
 Tested By: S. Yamamoto Sequence#: 6  
 Software: EMITest 5.02.00

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 1			

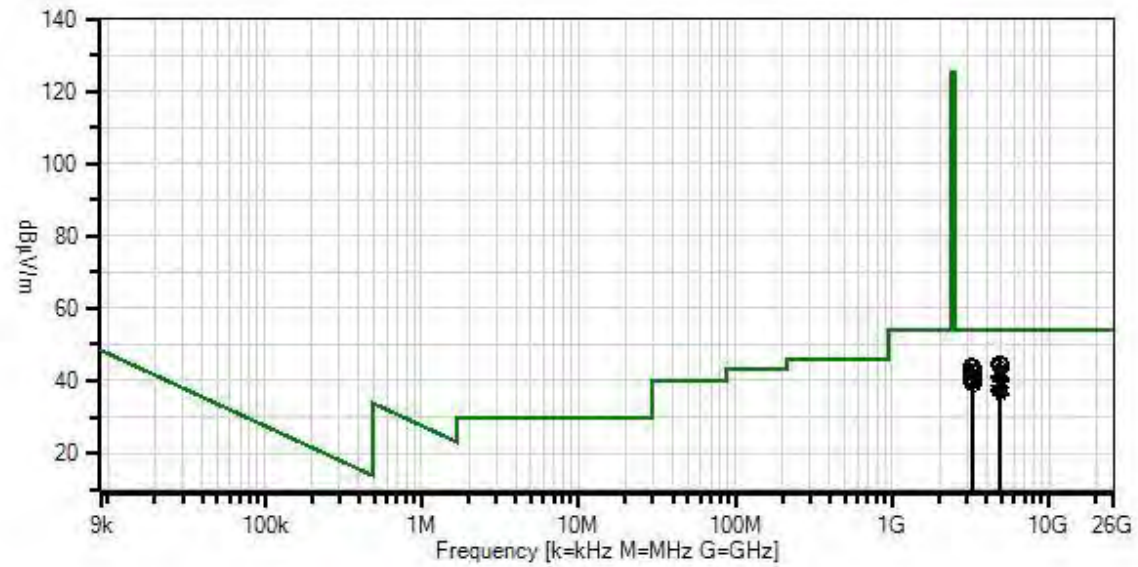
***Test Conditions / Notes:***

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the external antenna. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11g. 802.11g, rate MCS7, 54 Mbps, CH 1, 6, 11. Frequency range of measurement, 9kHz to 25GHz. 9kHz to 150kHz, RBW=VBW=200Hz. 150kHz to 30MHz, RBW=VBW=9kHz. 30MHz to 1000MHz, RBW=VBW=120kHz. 1GHz to 25GHz, RBW=VBW=1MHz.

Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A  
 Test method: KDB 558074 v03r03 and ANSI C63.10 2013.

HiTEM Engineering Inc WO#: 97758 Sequence#: 6 Date: 11/1/2015  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Horiz



— Readings  
× QP Readings  
▼ Ambient  
— 1 - 15.247(d) / 15.209 Radiated Spurious Emissions

○ Peak Readings  
\* Average Readings  
Software Version: 5.02.00

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T2	ANP06661	Cable	LDF1-50	4/15/2014	4/15/2016
T3	AN00786	Preamp	83017A	4/25/2014	4/25/2016
T4	ANP06543	Cable	32022-29094K-29094K-24TC	11/20/2013	11/20/2015
T5	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/15/2015	6/15/2017
T6	AN00849	Horn Antenna	3115	3/18/2014	3/18/2016
	AN00309	Preamp	8447D	3/12/2014	3/12/2016
	AN00314	Loop Antenna	6502	7/2/2014	7/2/2016
	AN01413	Horn Antenna	84125-80008	11/25/2014	11/25/2016
	AN01995	Biconilog Antenna	CBL6111C	4/30/2014	4/30/2016
	ANP05050	Cable	RG223/U	1/15/2015	1/15/2017
	ANP05198	Cable-Amplitude 15 to 45degC (dB)	8268	12/22/2014	12/22/2016
	ANP06554	Cable	32022-29094K-29094K-24TC	3/19/2014	3/19/2016

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	T5 dB	T6 dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
1	4818.330M	45.7	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	44.7	54.0 x axis	-9.3	Horiz
2	4923.330M	45.8	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	44.5	54.0 x axis	-9.5	Horiz
3	4871.030M	45.2	+0.0 +0.1	+6.1 +30.0	-38.0	+0.6	+0.0	44.0	54.0 x axis	-10.0	Horiz
4	3249.250M	49.2	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	44.0	54.0 z axis	-10.0	Horiz
5	3216.067M	49.1	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	43.9	54.0 z axis	-10.1	Horiz
6	4823.713M	44.9	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	43.9	54.0 y axis	-10.1	Horiz
^	4823.713M	58.1	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	57.1	54.0 y axis	+3.1	Horiz
8	4873.600M	44.9	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	43.6	54.0 y axis	-10.4	Horiz
9	3216.025M	48.7	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	43.5	54.0 x axis	-10.5	Vert
10	3215.914M	48.7	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	43.5	54.0 y axis	-10.5	Horiz
11	3282.652M	48.5	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	43.3	54.0 z axis	-10.7	Horiz
12	4923.547M	44.2	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	42.9	54.0 y axis	-11.1	Horiz
^	4923.547M	58.1	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	56.8	54.0 y axis	+2.8	Horiz

14	3282.652M	47.8	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	42.6	54.0 y axis	-11.4	Horiz
15	3249.310M	47.6	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	42.4	54.0 y axis	-11.6	Horiz
16	3249.109M	47.5	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	42.3	54.0 x axis	-11.7	Vert
17	3282.609M	47.3	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	42.1	54.0 x axis	-11.9	Vert
18	4823.583M Ave	42.3	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	41.3	54.0 x axis	-12.7	Vert
^	4823.583M	55.5	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	54.5	54.0 x axis	+0.5	Vert
20	3216.028M	46.4	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	41.2	54.0 x axis	-12.8	Horiz
21	3249.310M	46.2	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	41.0	54.0 x axis	-13.0	Horiz
22	4824.000M Ave	42.0	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	41.0	54.0 z axis	-13.0	Horiz
^	4824.000M	55.3	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	54.3	54.0 z axis	+0.3	Horiz
24	4873.567M Ave	41.9	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	40.6	54.0 z axis	-13.4	Horiz
^	4873.600M	58.5	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	57.2	54.0 y axis	+3.2	Horiz
^	4873.567M	55.3	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	54.0	54.0 z axis	+0.0	Horiz
27	3215.903M	45.7	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	40.5	54.0 y axis	-13.5	Vert
28	3282.725M	45.6	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	40.4	54.0 x axis	-13.6	Horiz
29	4874.000M Ave	41.4	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	40.1	54.0 x axis	-13.9	Vert
30	3249.395M	45.3	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	40.1	54.0 z axis	-13.9	Vert
31	3282.576M	45.3	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	40.1	54.0 z axis	-13.9	Vert
32	3216.153M	45.2	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	40.0	54.0 z axis	-14.0	Vert
33	4922.567M Ave	41.3	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	40.0	54.0 z axis	-14.0	Horiz
^	4922.567M	55.0	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	53.7	54.0 z axis	-0.3	Horiz
35	4923.300M Ave	41.0	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	39.7	54.0 x axis	-14.3	Vert
36	3249.365M	44.8	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	39.6	54.0 y axis	-14.4	Vert
37	3282.755M	44.4	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	39.2	54.0 y axis	-14.8	Vert
38	4817.583M Ave	39.8	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	38.8	54.0 x axis	-15.2	Vert
^	4817.583M	54.6	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	53.6	54.0 x axis	-0.4	Vert

40	4923.908M Ave	39.6	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	38.3	54.0 z axis	-15.7	Vert
^	4923.908M	52.6	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	51.3	54.0 z axis	-2.7	Vert
42	4874.000M Ave	39.2	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	37.9	54.0 z axis	-16.1	Vert
^	4874.000M	54.7	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	53.4	54.0 x axis	-0.6	Vert
^	4874.000M	53.7	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	52.4	54.0 z axis	-1.6	Vert
45	4824.150M Ave	38.8	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	37.8	54.0 z axis	-16.2	Vert
^	4824.150M	52.7	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	51.7	54.0 z axis	-2.3	Vert
47	4823.483M Ave	38.0	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	37.0	54.0 y axis	-17.0	Vert
^	4823.483M	51.1	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	50.1	54.0 y axis	-3.9	Vert
49	4873.533M Ave	37.6	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	36.3	54.0 y axis	-17.7	Vert
^	4873.533M	50.7	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	49.4	54.0 y axis	-4.6	Vert
51	4923.233M Ave	37.0	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	35.7	54.0 y axis	-18.3	Vert
^	4923.300M	54.3	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	53.0	54.0 x axis	-1.0	Vert
^	4923.233M	50.8	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	49.5	54.0 y axis	-4.5	Vert

Test Location: CKC Laboratories, Inc. • 110 N Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **97758** Date: 11/1/2015  
 Test Type: **Maximized Emissions** Time: 16:53:10  
 Tested By: S. Yamamoto Sequence#: 7  
 Software: EMITest 5.02.00

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Test Conditions / Notes:***

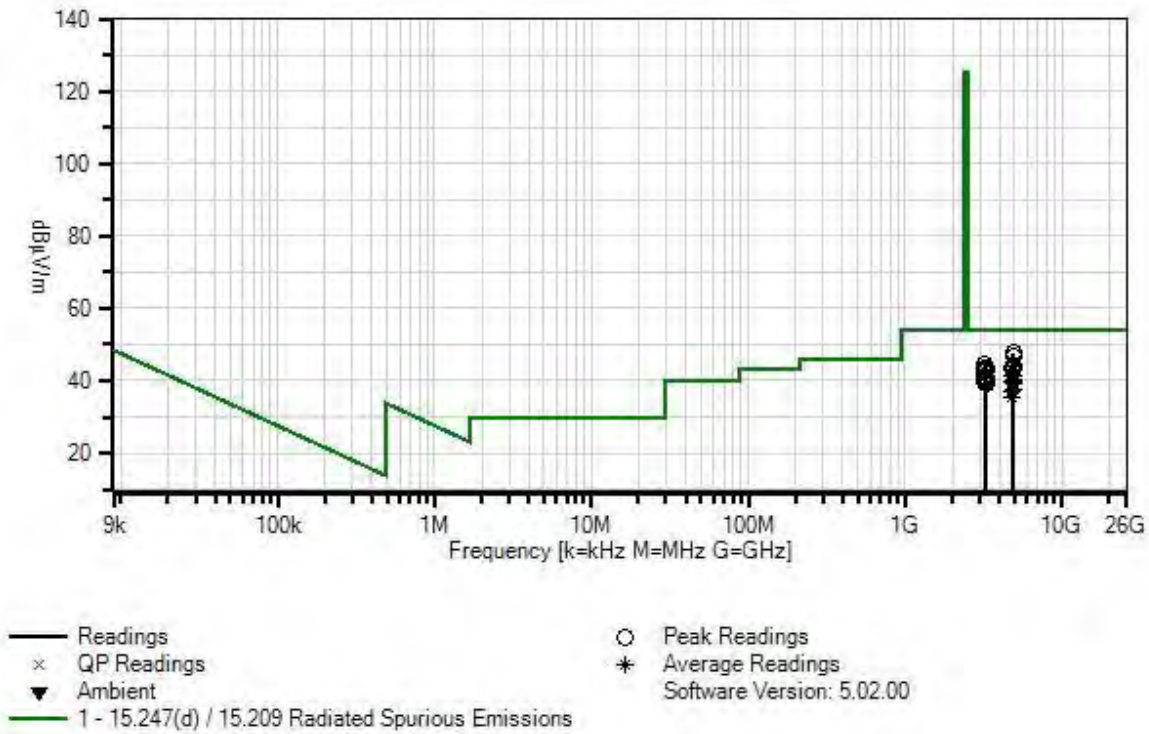
The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the external antenna. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

The test frequencies are 2412MHz, 2437MHz, and 2462MHz for 802.11n 20MHz. 802.11n (20MHz), rate MCS7. Frequency range of measurement, 9kHz to 25GHz. 9kHz to 150kHz, RBW=VBW=200Hz. 150kHz to 30MHz, RBW=VBW=9kHz. 30MHz to 1000MHz, RBW=VBW=120kHz. 1GHz to 25GHz, RBW=VBW=1MHz.

Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A  
 Test method: KDB 558074 v03r03 and ANSI C63.10 2013.



HiTEM Engineering Inc W/O#: 97758 Sequence#: 7 Date: 11/1/2015  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Vert



**Test Equipment:**

ID	Asset #/Serial #	Description	Model	Calibration Date	Cal Due Date
T1	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T2	ANP06661	Cable	LDF1-50	4/15/2014	4/15/2016
T3	AN00786	Preamp	83017A	4/25/2014	4/25/2016
T4	ANP06543	Cable	32022-29094K-29094K-24TC	11/20/2013	11/20/2015
T5	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/15/2015	6/15/2017
T6	AN00849	Horn Antenna	3115	3/18/2014	3/18/2016
	AN00309	Preamp	8447D	3/12/2014	3/12/2016
	AN00314	Loop Antenna	6502	7/2/2014	7/2/2016
	AN01413	Horn Antenna	84125-80008	11/25/2014	11/25/2016
	AN01995	Biconilog Antenna	CBL6111C	4/30/2014	4/30/2016
	ANP05050	Cable	RG223/U	1/15/2015	1/15/2017
	ANP05198	Cable-Amplitude 15 to 45degC (dB)	8268	12/22/2014	12/22/2016
	ANP06554	Cable	32022-29094K-29094K-24TC	3/19/2014	3/19/2016

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	4923.380M	49.0	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	47.7	54.0 y axis	-6.3	Vert
2	4873.793M	48.1	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	46.8	54.0 y axis	-7.2	Vert
3	3215.945M	49.7	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	44.5	54.0 x axis	-9.5	Vert
4	3215.981M	49.6	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	44.4	54.0 z axis	-9.6	Horiz
5	4925.030M	45.5	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	44.2	54.0 x axis	-9.8	Horiz
6	3282.619M	48.8	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	43.6	54.0 z axis	-10.4	Horiz
7	3249.284M	48.7	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	43.5	54.0 y axis	-10.5	Horiz
8	3215.886M	48.7	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	43.5	54.0 y axis	-10.5	Horiz
9	4874.150M	44.7	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	43.4	54.0 x axis	-10.6	Horiz
10	4824.170M	44.3	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	43.3	54.0 x axis	-10.7	Horiz
11	4923.213M Ave	44.2	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	42.9	54.0 y axis	-11.1	Horiz
12	3282.637M	48.0	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	42.8	54.0 y axis	-11.2	Horiz
13	3249.100M	48.0	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	42.8	54.0 z axis	-11.2	Horiz

14	4823.653M Ave	43.8	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	42.8	54.0 y axis	-11.2	Horiz
15	3249.289M	47.6	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	42.4	54.0 x axis	-11.6	Vert
16	4875.027M Ave	42.8	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	41.5	54.0 y axis	-12.5	Horiz
^	4875.027M	56.1	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	54.8	54.0 y axis	+0.8	Horiz
18	3249.387M	46.6	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	41.4	54.0 x axis	-12.6	Horiz
19	4823.617M Ave	42.2	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	41.2	54.0 z axis	-12.8	Horiz
^	4823.653M	57.7	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	56.7	54.0 y axis	+2.7	Horiz
^	4823.617M	55.7	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	54.7	54.0 z axis	+0.7	Horiz
22	3282.594M	46.2	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	41.0	54.0 x axis	-13.0	Horiz
23	3216.006M	46.1	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	40.9	54.0 x axis	-13.1	Horiz
24	3282.617M	46.1	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	40.9	54.0 x axis	-13.1	Vert
25	3215.966M	45.9	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	40.7	54.0 z axis	-13.3	Vert
26	3215.899M	45.9	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	40.7	54.0 y axis	-13.3	Vert
27	3249.353M	45.6	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	40.4	54.0 y axis	-13.6	Vert
28	4923.500M Ave	41.3	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	40.0	54.0 x axis	-14.0	Vert
29	4873.633M Ave	41.3	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	40.0	54.0 z axis	-14.0	Horiz
^	4873.633M	55.4	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	54.1	54.0 z axis	+0.1	Horiz
31	3282.549M	45.1	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	39.9	54.0 z axis	-14.1	Vert
32	3249.003M	45.0	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	39.8	54.0 z axis	-14.2	Vert
33	4874.167M Ave	40.8	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	39.5	54.0 x axis	-14.5	Vert
^	4874.167M	54.4	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	53.1	54.0 x axis	-0.9	Vert
35	4823.477M Ave	40.5	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	39.5	54.0 x axis	-14.5	Vert
^	4823.477M	53.4	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	52.4	54.0 x axis	-1.6	Vert
37	4923.233M Ave	40.4	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	39.1	54.0 z axis	-14.9	Horiz
^	4923.213M	57.2	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	55.9	54.0 y axis	+1.9	Horiz
^	4923.233M	54.2	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	52.9	54.0 z axis	-1.1	Horiz

40	3282.572M	44.2	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	39.0	54.0 y axis	-15.0	Vert
41	4923.550M Ave	39.0	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	37.7	54.0 z axis	-16.3	Vert
^	4923.500M	54.7	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	53.4	54.0 x axis	-0.6	Vert
^	4923.550M	52.4	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	51.1	54.0 z axis	-2.9	Vert
44	4873.680M Ave	38.9	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	37.6	54.0 z axis	-16.4	Vert
^	4873.680M	52.5	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	51.2	54.0 z axis	-2.8	Vert
46	4824.133M Ave	38.0	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	37.0	54.0 z axis	-17.0	Vert
^	4824.133M	51.7	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	50.7	54.0 z axis	-3.3	Vert
48	4823.307M Ave	36.6	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	35.6	54.0 y axis	-18.4	Vert
^	4823.307M	50.6	+0.0 +0.1	+6.1 +30.0	-37.8	+0.6	+0.0	49.6	54.0 y axis	-4.4	Vert

Test Location: CKC Laboratories, Inc. • 110 N Olinda Place • Brea, CA 92823 • 714-993-6112  
 Customer: **HiTEM Engineering Inc.**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **97758** Date: 11/1/2015  
 Test Type: **Maximized Emissions** Time: 17:16:17  
 Tested By: S. Yamamoto Sequence#: 8  
 Software: EMITest 5.02.00

***Equipment Tested:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Support Equipment:***

Device	Manufacturer	Model #	S/N
Configuration 1			

***Test Conditions / Notes:***

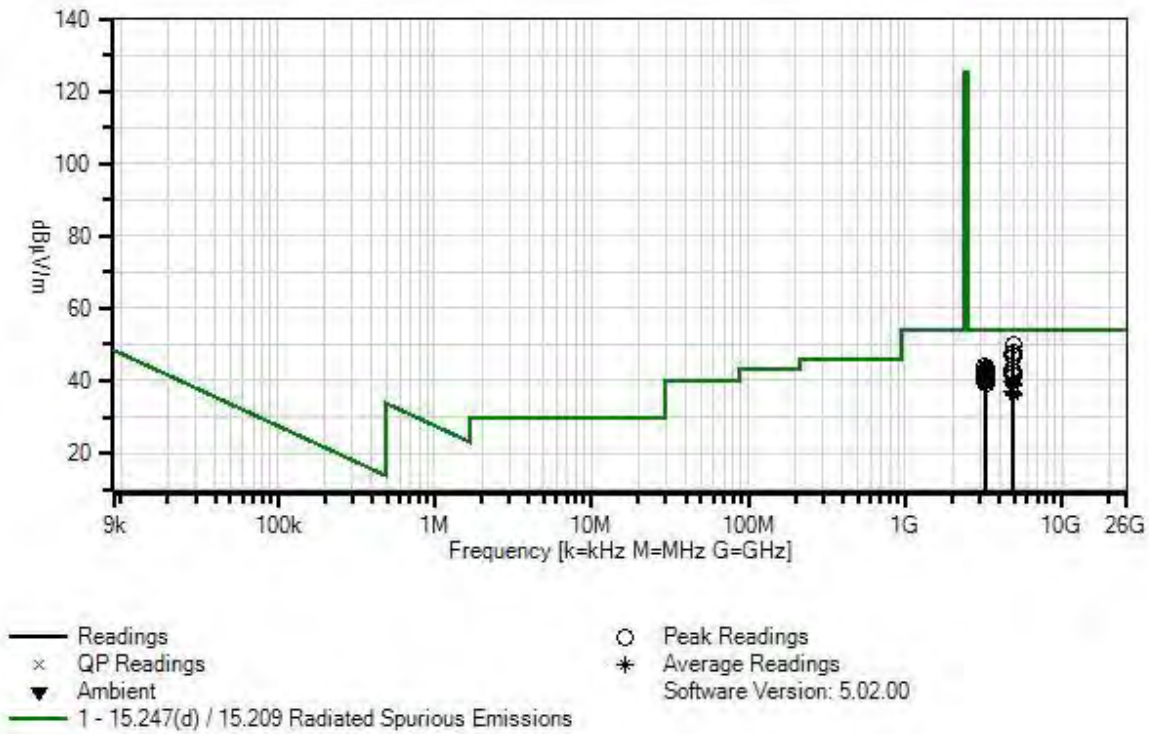
The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to the external antenna. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC.

The test frequencies are 2422MHz, 2442MHz, and 2462MHz for 802.11n 40MHz. 802.11n (40MHz), rate MCS7, 65Mbps, CH 3, 7, 11. Frequency range of measurement, 9kHz to 25GHz. 9kHz to 150kHz, RBW=VBW=200Hz. 150kHz to 30MHz, RBW=VBW=9kHz. 30MHz to 1000MHz, RBW=VBW=120kHz. 1GHz to 25GHz, RBW=VBW=1MHz.

Temperature: 22°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A.

Test method: KDB 558074 v03r03 and ANSI C63.10 2013.

HiTEM Engineering Inc W/O#: 97758 Sequence#: 8 Date: 11/1/2015  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Vert





**Test Equipment:**

ID	Asset #/Serial #	Description	Model	Calibration Date	Cal Due Date
T1	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
T2	ANP06661	Cable	LDF1-50	4/15/2014	4/15/2016
T3	AN00786	Preamp	83017A	4/25/2014	4/25/2016
T4	ANP06543	Cable	32022-29094K-29094K-24TC	11/20/2013	11/20/2015
T5	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/15/2015	6/15/2017
T6	AN00849	Horn Antenna	3115	3/18/2014	3/18/2016
	ANP05198	Cable-Amplitude 15 to 45degC (dB)	8268	12/22/2014	12/22/2016
	ANP06554	Cable	32022-29094K-29094K-24TC	3/19/2014	3/19/2016
	AN00309	Preamp	8447D	3/12/2014	3/12/2016
	AN00314	Loop Antenna	6502	7/2/2014	7/2/2016
	AN01413	Horn Antenna	84125-80008	11/25/2014	11/25/2016
	AN01995	Biconilog Antenna	CBL6111C	4/30/2014	4/30/2016
	ANP05050	Cable	RG223/U	1/15/2015	1/15/2017

**Measurement Data:**

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	4923.500M	51.2	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	49.9	54.0 x axis	-4.1	Vert
2	4883.020M	51.2	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	49.9	54.0 x axis	-4.1	Vert
3	4882.200M	49.3	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	48.0	54.0 z axis	-6.0	Vert
4	4840.117M	48.4	+0.0 +0.1	+6.1 +30.0	-37.9	+0.6	+0.0	47.3	54.0 z axis	-6.7	Vert
5	4914.770M	48.2	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	46.9	54.0 z axis	-7.1	Vert
6	3229.448M	49.4	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	44.2	54.0 z axis	-9.8	Horiz
7	3255.957M	48.8	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	43.6	54.0 x axis	-10.4	Vert
8	3255.767M	48.2	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	43.0	54.0 z axis	-11.0	Horiz
9	3282.870M	48.1	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	42.9	54.0 x axis	-11.1	Vert
10	4838.970M	43.9	+0.0 +0.1	+6.1 +30.0	-37.9	+0.6	+0.0	42.8	54.0 y axis	-11.2	Vert
11	4923.667M	43.9	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	42.6	54.0 y axis	-11.4	Vert
12	3282.659M	47.6	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	42.4	54.0 y axis	-11.6	Horiz
13	3229.389M	47.5	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	42.3	54.0 y axis	-11.7	Horiz

14	3229.341M	47.5	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	42.3	54.0 x axis	-11.7	Vert
15	4886.533M	43.6	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	42.3	54.0 y axis	-11.7	Vert
16	4911.300M	43.5	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	42.2	54.0 x axis	-11.8	Horiz
17	4834.750M	43.2	+0.0 +0.1	+6.1 +30.0	-37.9	+0.6	+0.0	42.1	54.0 x axis	-11.9	Horiz
18	3255.982M	47.3	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	42.1	54.0 y axis	-11.9	Horiz
19	3282.630M	47.1	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	41.9	54.0 z axis	-12.1	Horiz
20	3229.328M	46.9	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	41.7	54.0 x axis	-12.3	Horiz
21	4883.317M	42.7	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	41.4	54.0 x axis	-12.6	Horiz
22	3256.151M	46.4	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	41.2	54.0 x axis	-12.8	Horiz
23	3282.958M	45.9	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	40.7	54.0 x axis	-13.3	Horiz
24	3229.235M	45.7	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	40.5	54.0 y axis	-13.5	Vert
25	3282.662M	45.7	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	40.5	54.0 y axis	-13.5	Vert
26	3256.074M	45.4	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	40.2	54.0 y axis	-13.8	Vert
27	3282.808M	45.4	+0.0 +0.5	+4.8 +27.9	-38.9	+0.5	+0.0	40.2	54.0 z axis	-13.8	Vert
28	3229.338M	45.1	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	39.9	54.0 z axis	-14.1	Vert
29	4840.333M Ave	40.9	+0.0 +0.1	+6.1 +30.0	-37.9	+0.6	+0.0	39.8	54.0 y axis	-14.2	Horiz
^	4840.333M	54.3	+0.0 +0.1	+6.1 +30.0	-37.9	+0.6	+0.0	53.2	54.0 y axis	-0.8	Horiz
31	4920.750M Ave	40.7	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	39.4	54.0 y axis	-14.6	Horiz
^	4920.750M	53.3	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	52.0	54.0 y axis	-2.0	Horiz
33	3255.470M	44.5	+0.0 +0.5	+4.8 +27.8	-38.8	+0.5	+0.0	39.3	54.0 z axis	-14.7	Vert
34	4880.483M Ave	40.1	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	38.8	54.0 y axis	-15.2	Horiz
^	4880.483M	53.5	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	52.2	54.0 y axis	-1.8	Horiz
36	4843.579M Ave	38.4	+0.0 +0.1	+6.1 +30.0	-37.9	+0.6	+0.0	37.3	54.0 x axis	-16.7	Vert
^	4843.580M	51.7	+0.0 +0.1	+6.1 +30.0	-37.9	+0.6	+0.0	50.6	54.0 x axis	-3.4	Vert

38	4837.133M Ave	38.1	+0.0 +0.1	+6.1 +30.0	-37.9	+0.6	+0.0	37.0	54.0 z axis	-17.0	Horiz
^	4837.133M	51.5	+0.0 +0.1	+6.1 +30.0	-37.9	+0.6	+0.0	50.4	54.0 z axis	-3.6	Horiz
40	4880.167M Ave	37.9	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	36.6	54.0 z axis	-17.4	Horiz
^	4880.170M	50.7	+0.0 +0.1	+6.0 +30.0	-38.0	+0.6	+0.0	49.4	54.0 z axis	-4.6	Horiz
42	4920.433M Ave	37.5	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	36.2	54.0 z axis	-17.8	Horiz
^	4920.430M	50.8	+0.0 +0.1	+6.0 +30.1	-38.1	+0.6	+0.0	49.5	54.0 z axis	-4.5	Horiz

## Band Edge Test Conditions / Setup

Test Location: CKC Laboratories, Inc. 110 N Olinda Place, Brea CA 92823, 714-993-6112  
 Customer: HiTEM Engineering Inc.  
 Specification: **15.247(d)/15.209 Radiated Emissions**  
 Work Order #: **97758** Date: 10/28,29/2015  
 Test Type: **Band Edge**  
 Tested By: S. Yamamoto  
 Software: EMITest 5.02.00

### Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

### Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

### Test Conditions / Notes:

The equipment under test (EUT) is 2.4GHz 802.11b/g/n wireless module. The EUT is connected to a remotely located laptop computer via shielded USB cable. The power to the EUT as well as communications is provided from the USB port of the laptop computer. The EUT antenna port is connected to an external antenna. The module is installed on a development board. The antenna port is NOT located on the module, but on the development board. The computer is running Ralink Technology Corporation MT7601 USB QA Test Program V1.0.9.11. This program is used to setup EUT transmitting protocol and EUT transmitting channel. Nominal rated EUT voltage is 3.3VDC. • The test frequencies are 2412MHz and 2462MHz for 802.11b/g/n 20MHz. The test frequencies are 2422MHz and 2462MHz for 802.11n 40MHz. 802.11b, rate MCS3, 11Mbps CH 1, 6, 11. 802.11g, rate MCS7, 54 Mbps, CH 1, 6, 11. 802.11n (20MHz), rate MCS7, 65Mbps, CH 1, 6, 11. 802.11n (40MHz), rate MCS7, 65Mbps, CH 3, 7, 11. Frequency range of measurement, 2310MHz to 2400MHz and 2483.5MHz to 2500MHz.  
 Temperature: 26°C  
 Humidity: 45%  
 Pressure: 100kPa  
 Site A  
 Test method for non-restricted bands: KDB 558074 v03r03 and ANSI C63.10 2013. Test method for restricted bands: ANSI C63.4 2014.

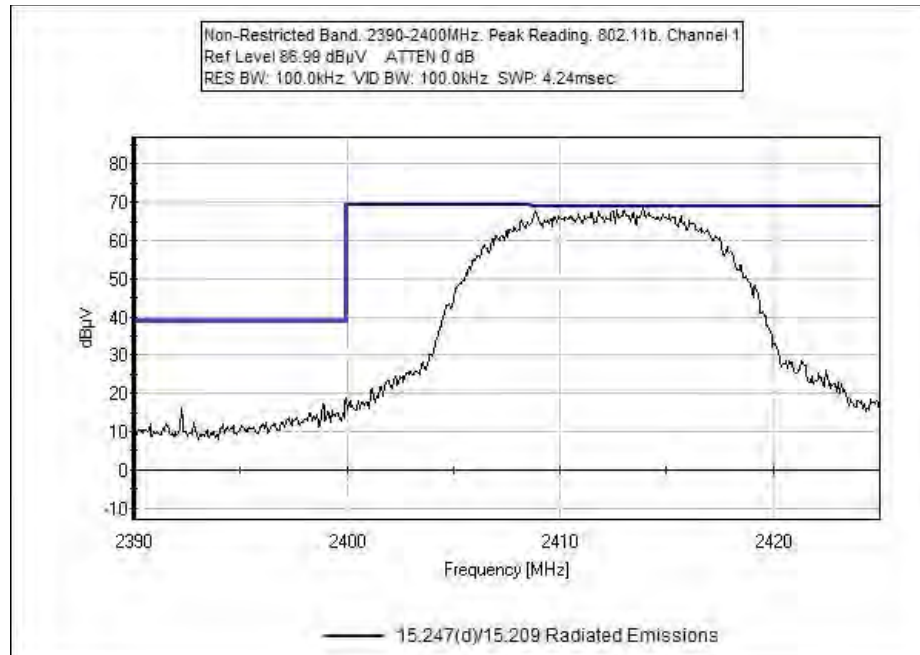
### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/17/2015	7/17/2016
	ANP06661	Cable	LDF1-50	4/15/2014	4/15/2016
	AN00849	Horn Antenna	3115	3/18/2014	3/18/2016

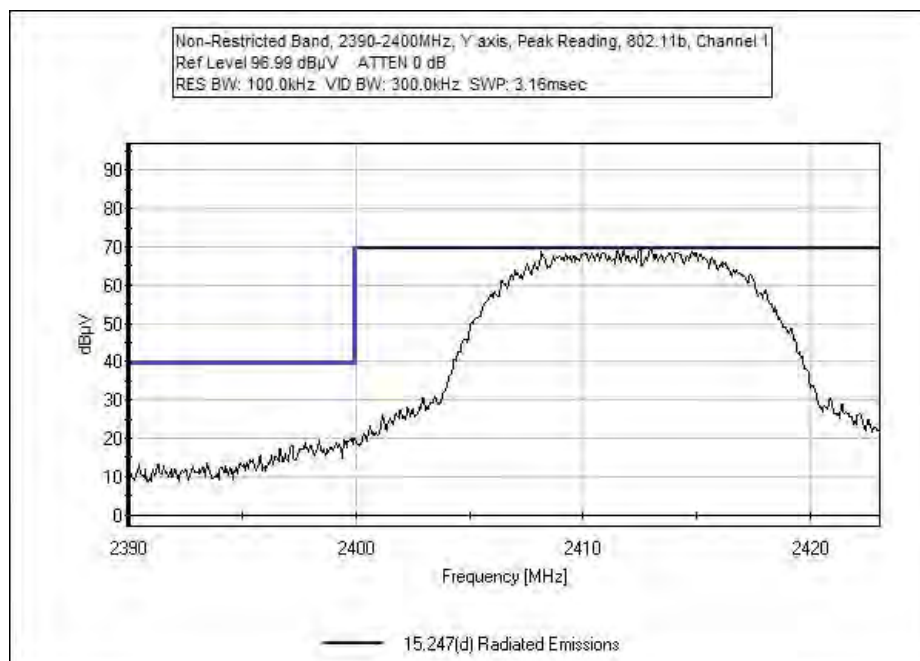
Note: For restricted band data, the limit lines have been corrected to account for the cable and antenna factor loss. The total loss in the measured range starting at 2310MHz and ending at 2500MHz varies between 29.3dB and 29.7dB.

## Band Edge Plots

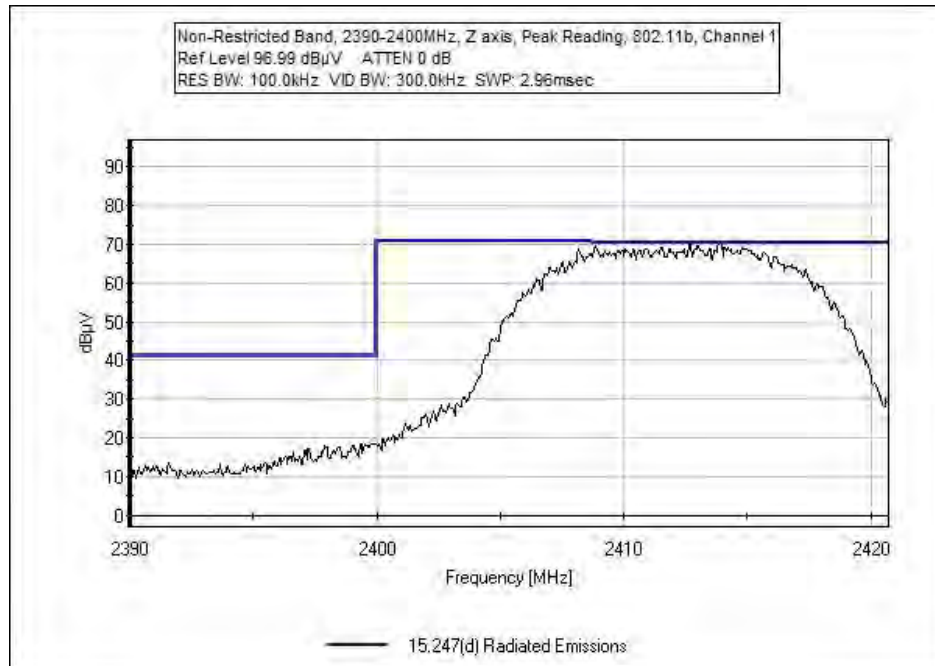
### 802.11b – Non Restricted Band



X Axis

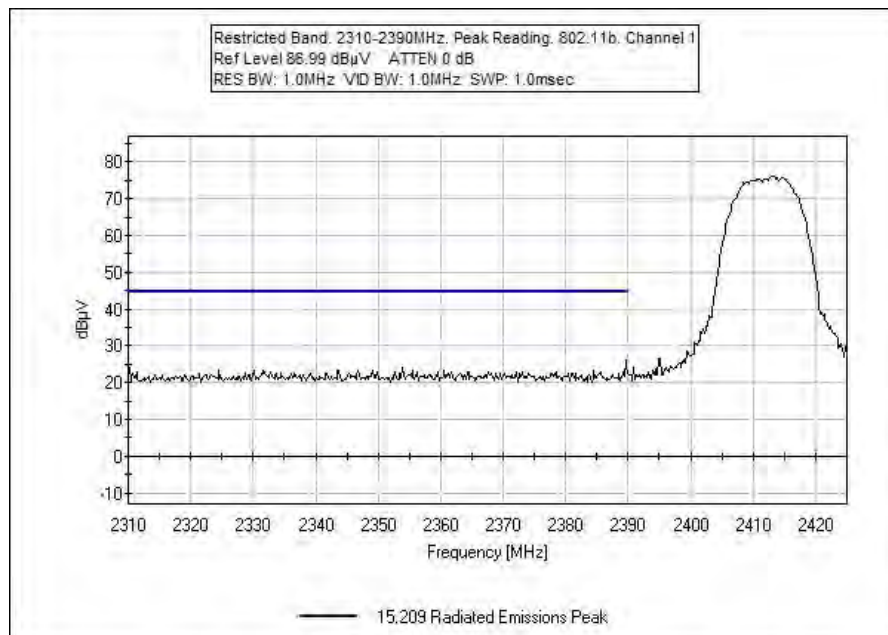


Y Axis

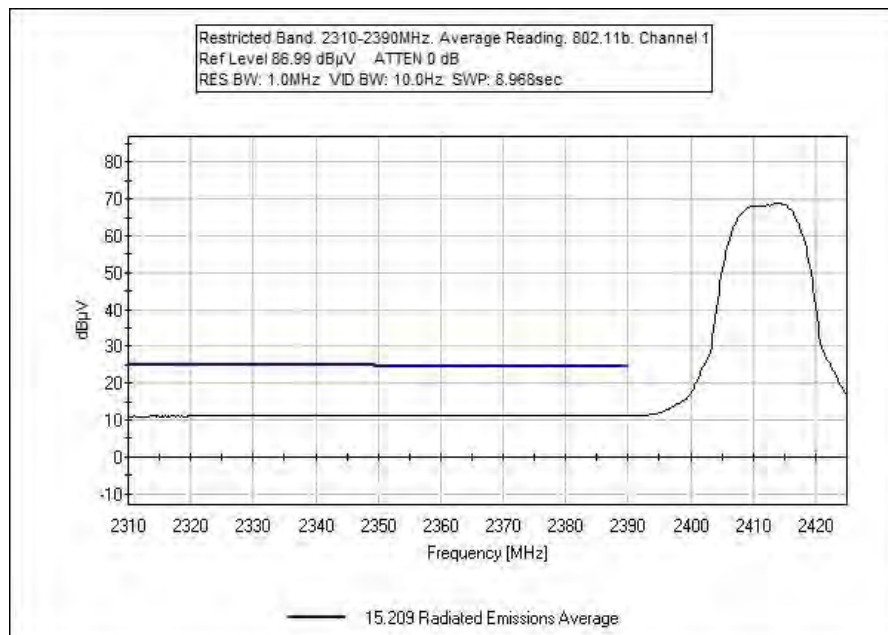


Z Axis

### 802.11b, Restricted Band

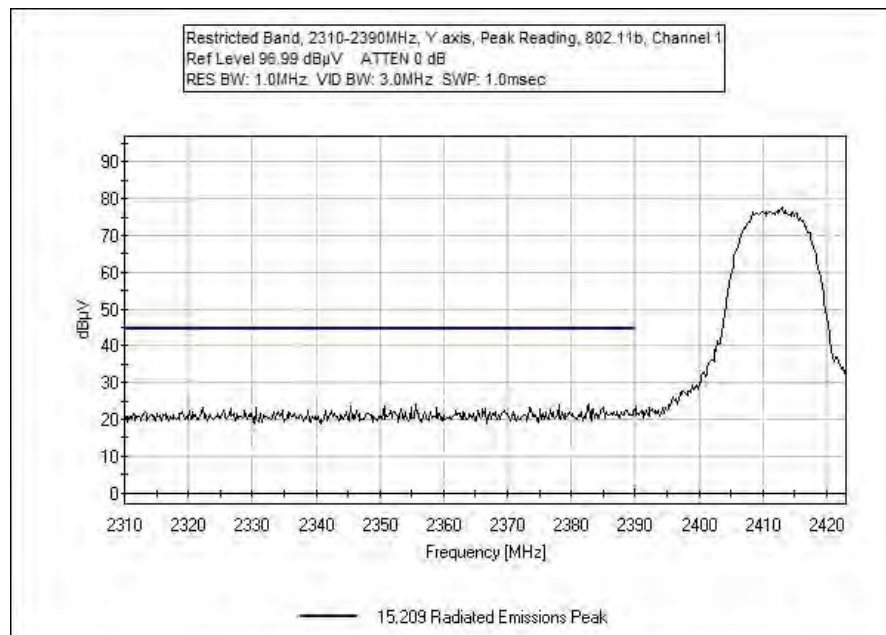


X Axis

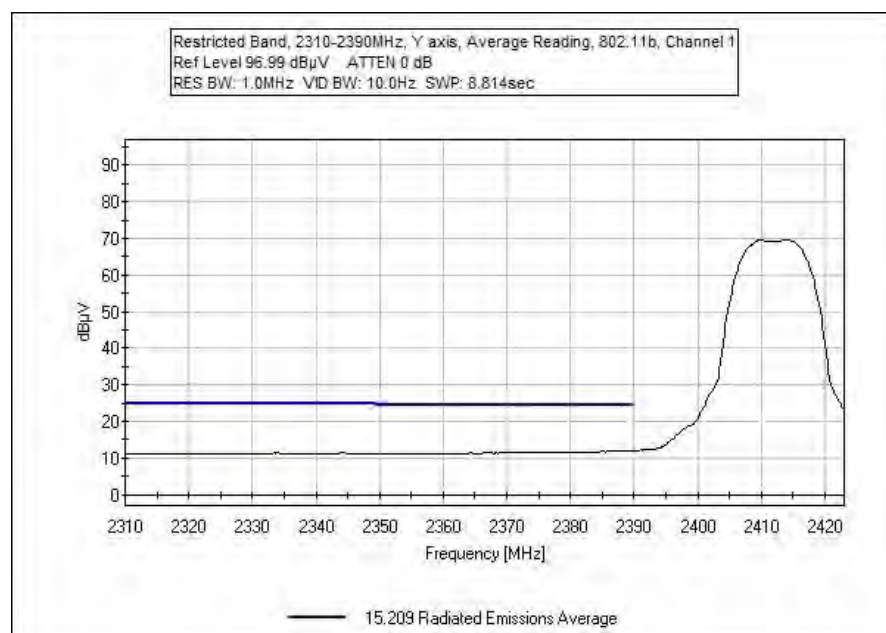


X Axis

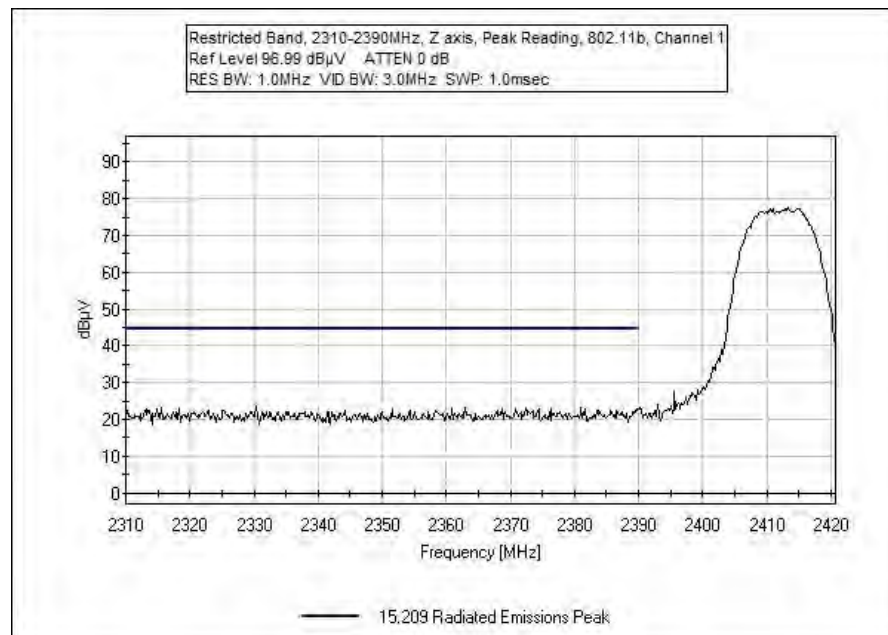




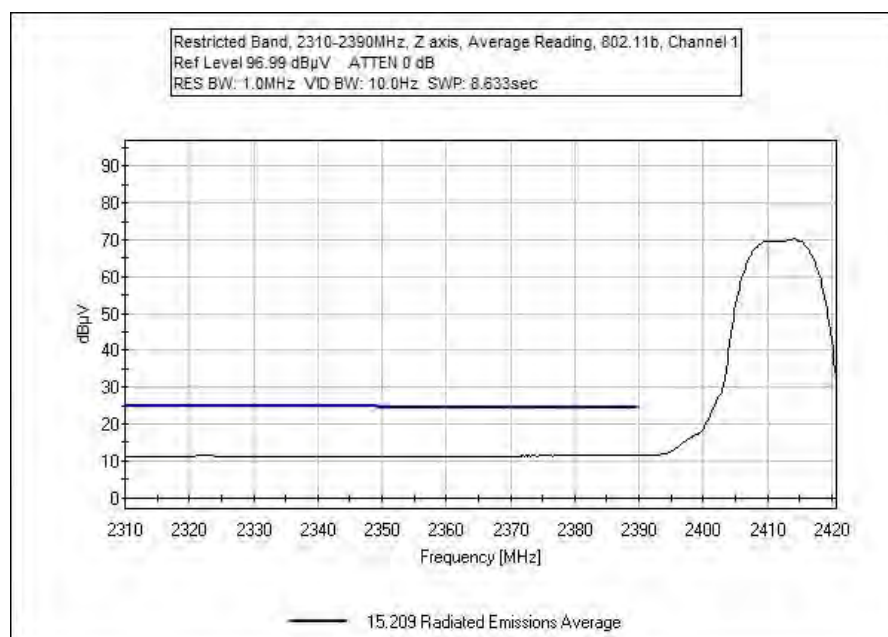
Y Axis



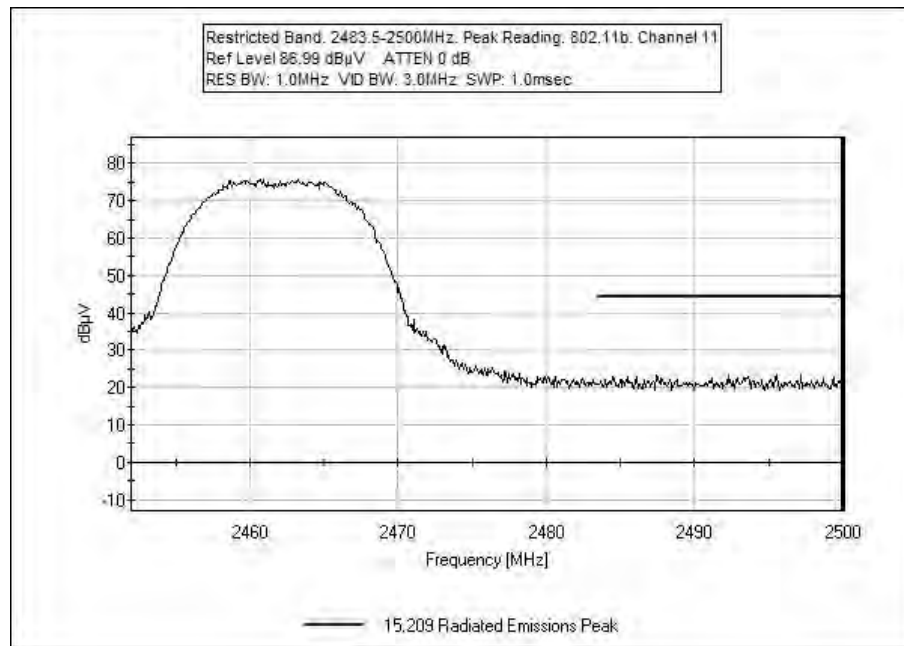
Y Axis



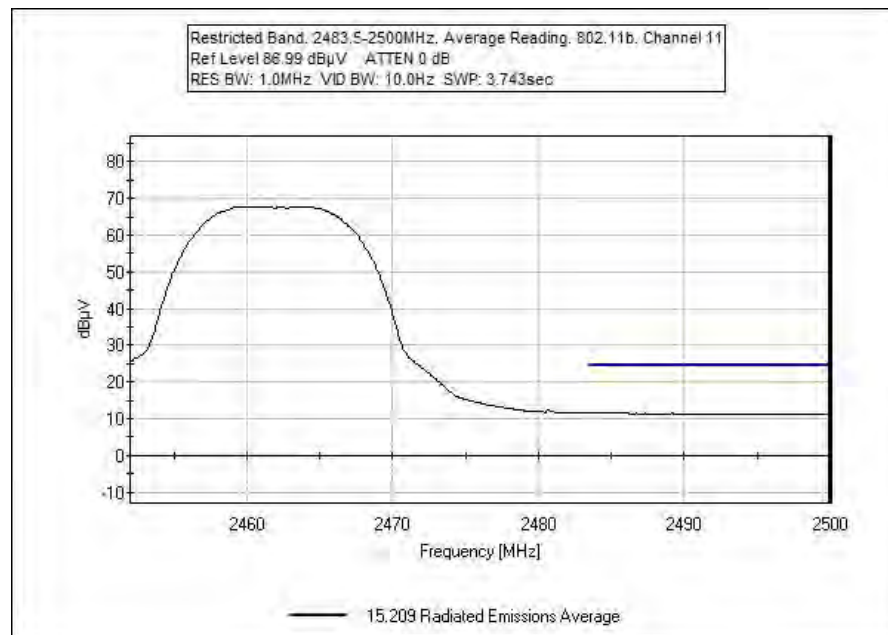
Z Axis



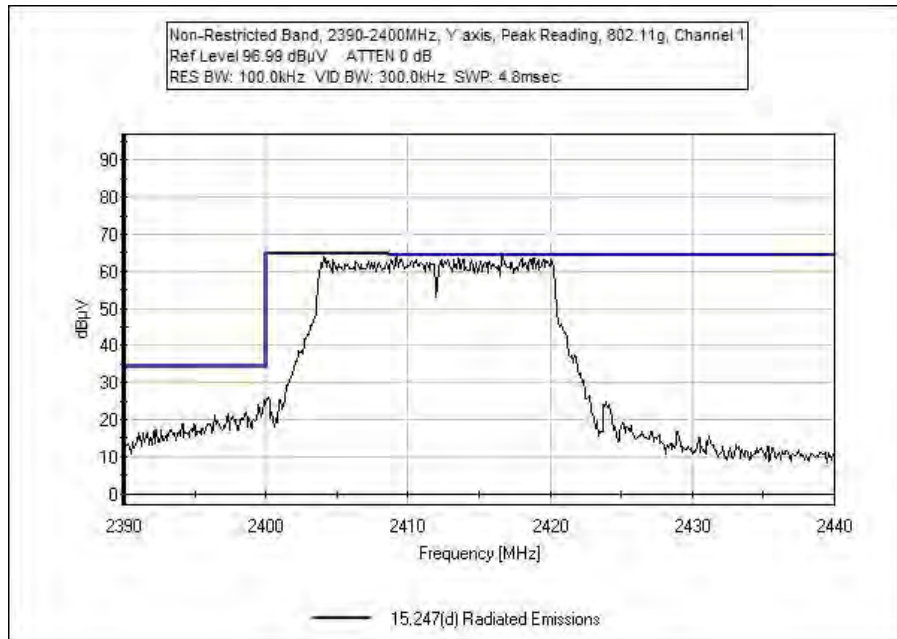
Z Axis



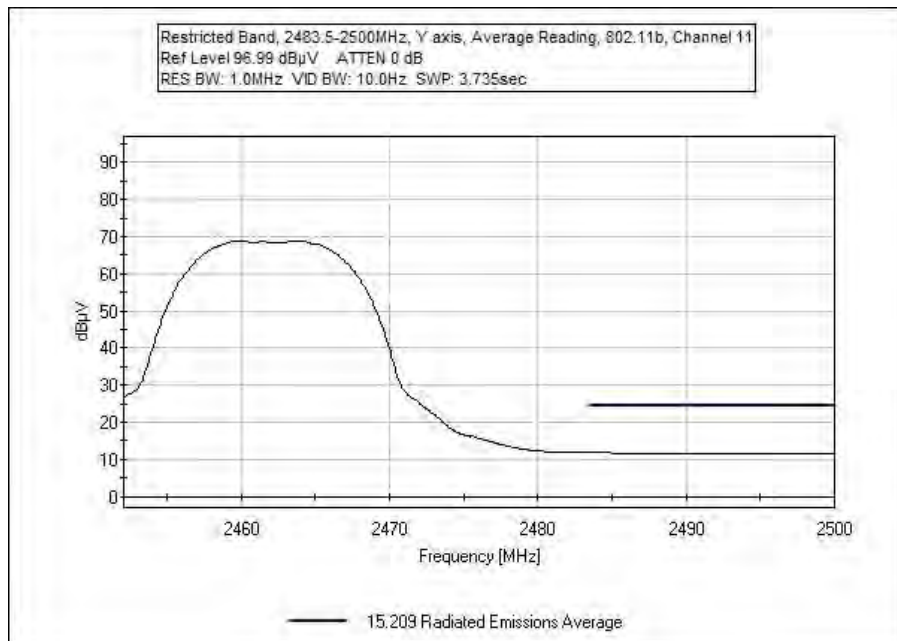
X Axis



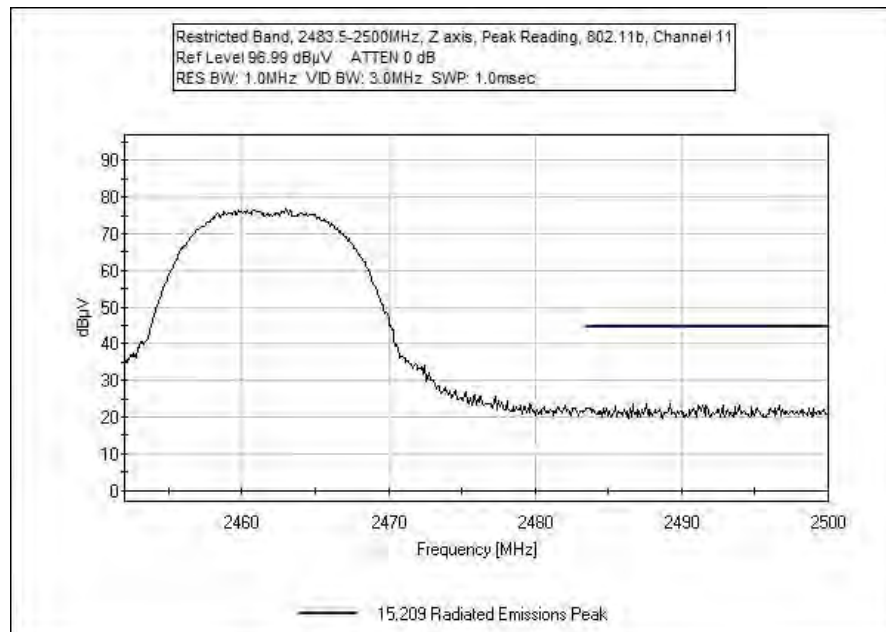
X Axis



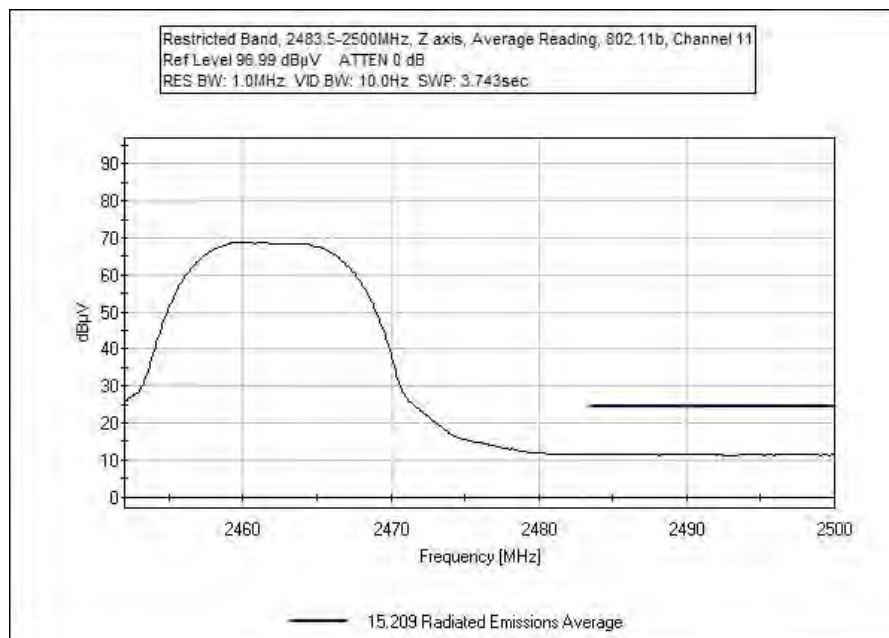
Y Axis



Y Axis

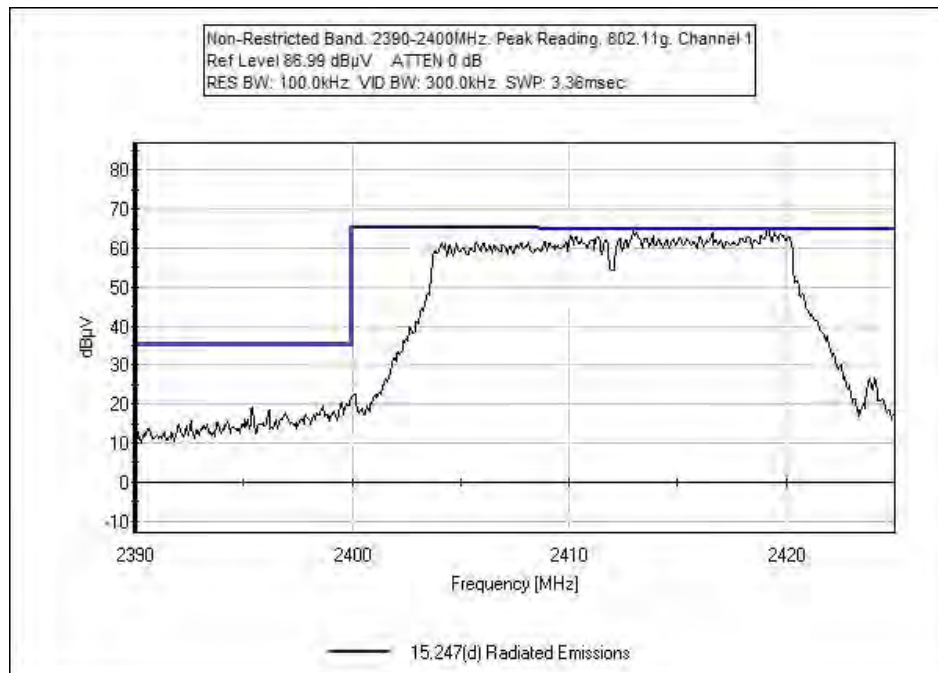


Z Axis

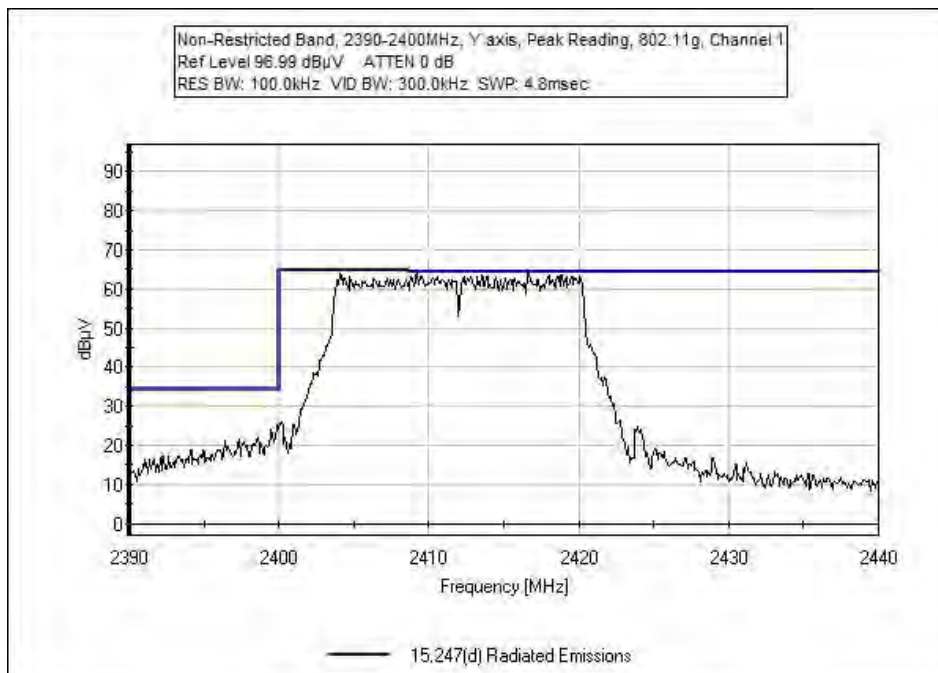


Z Axis

### 802.11g, Non Restricted Bands

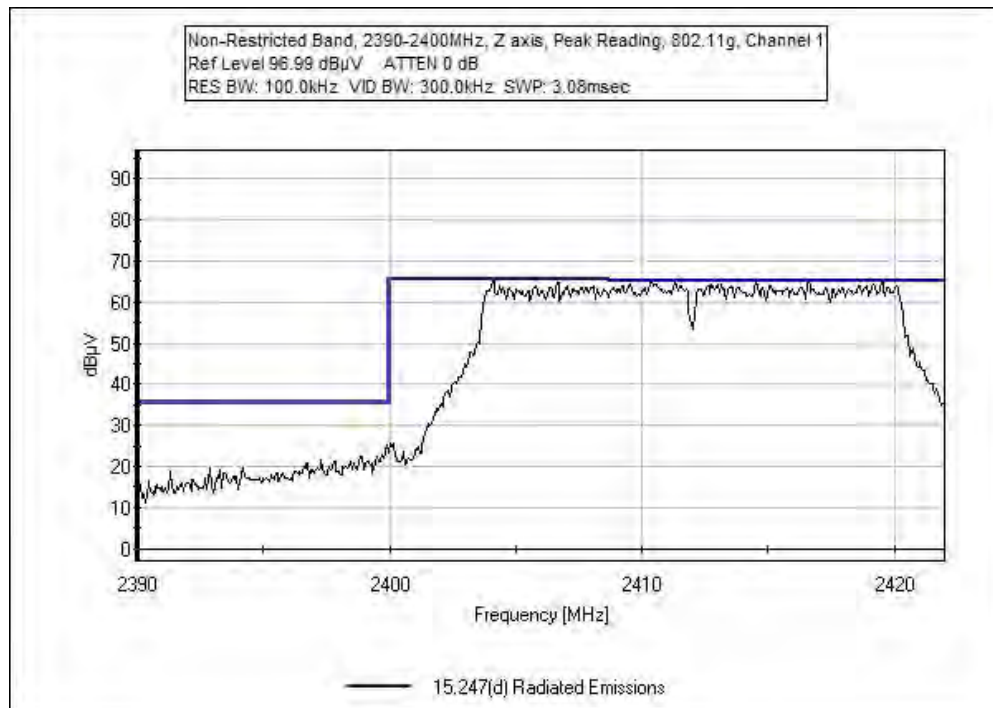


X Axis



Y Axis

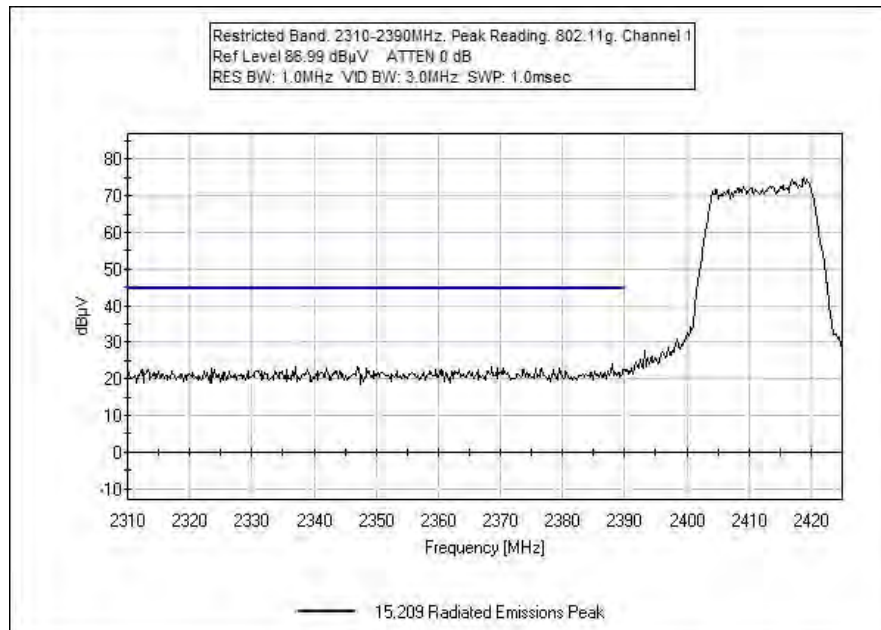




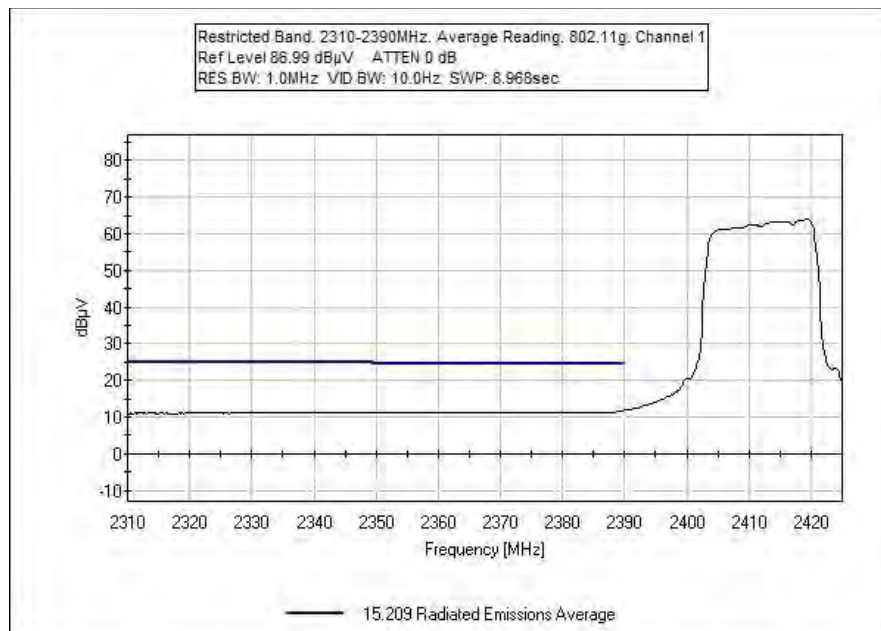
Z Axis



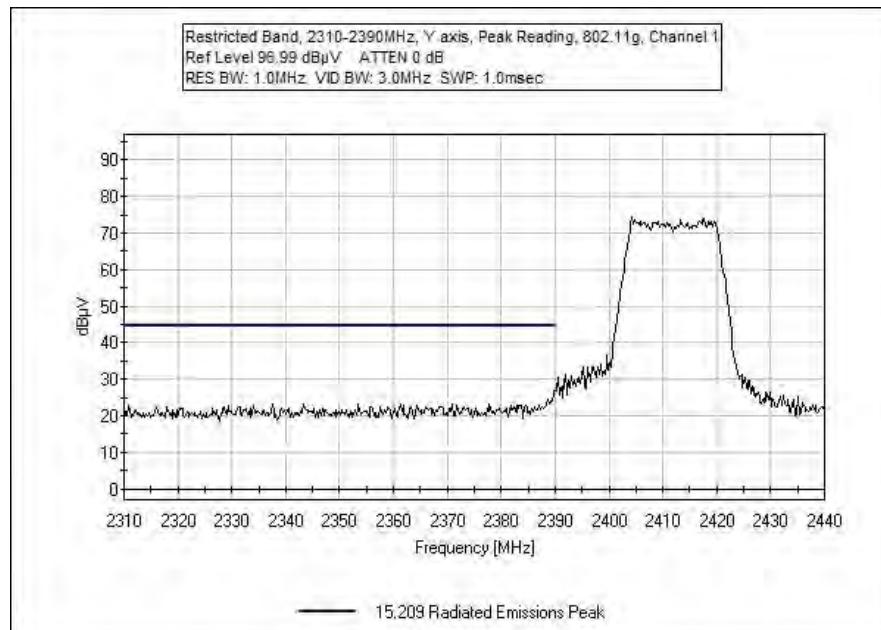
### 802.11g, Restricted Bands



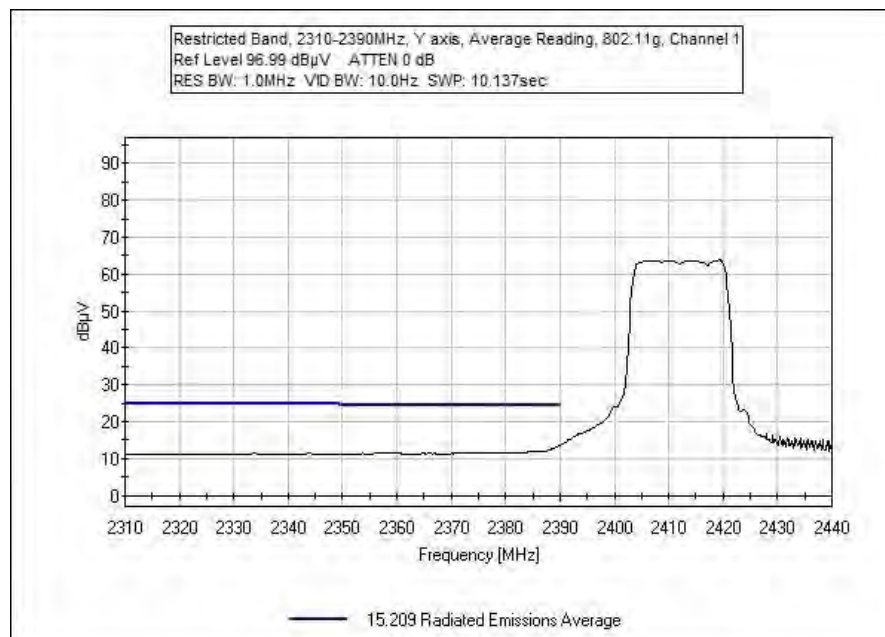
X Axis



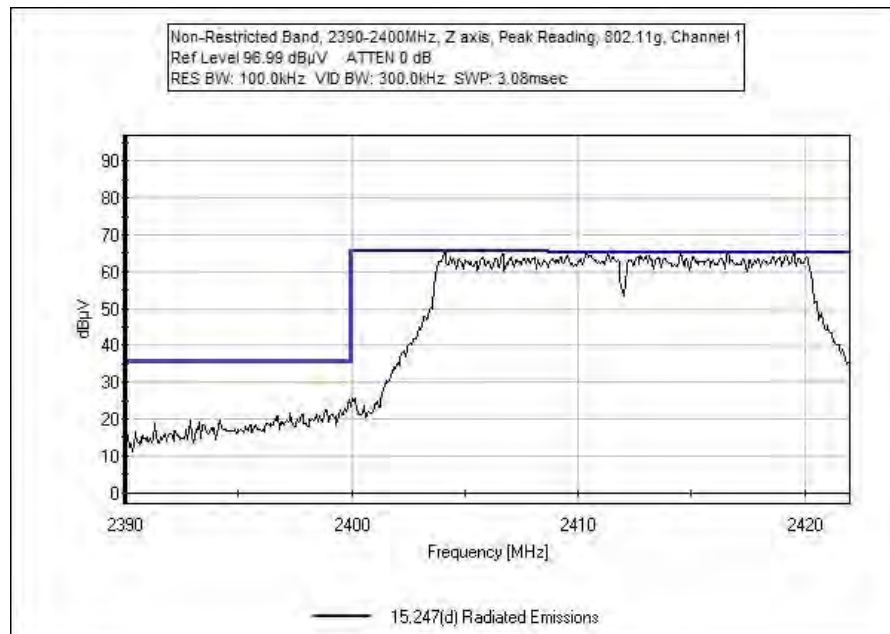
X Axis



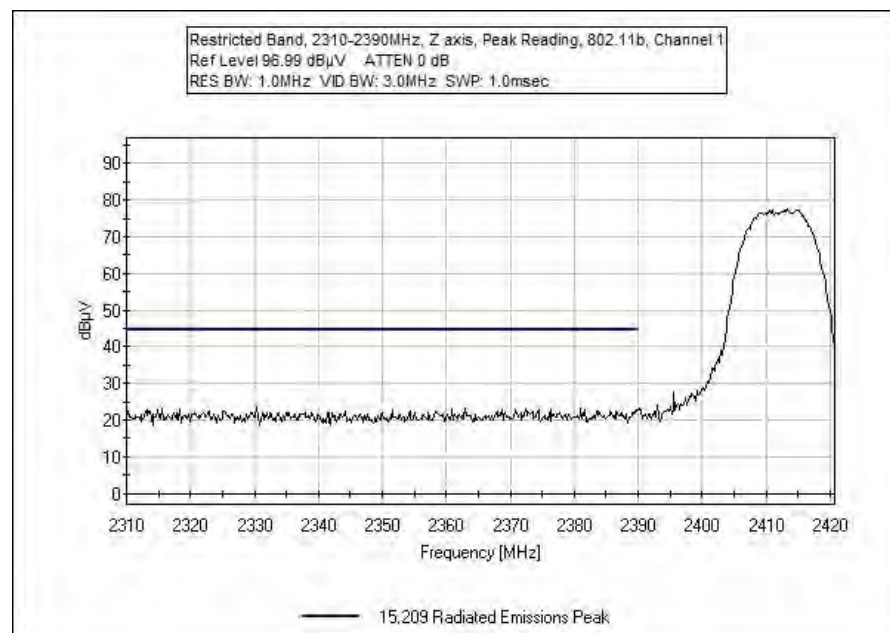
Y Axis



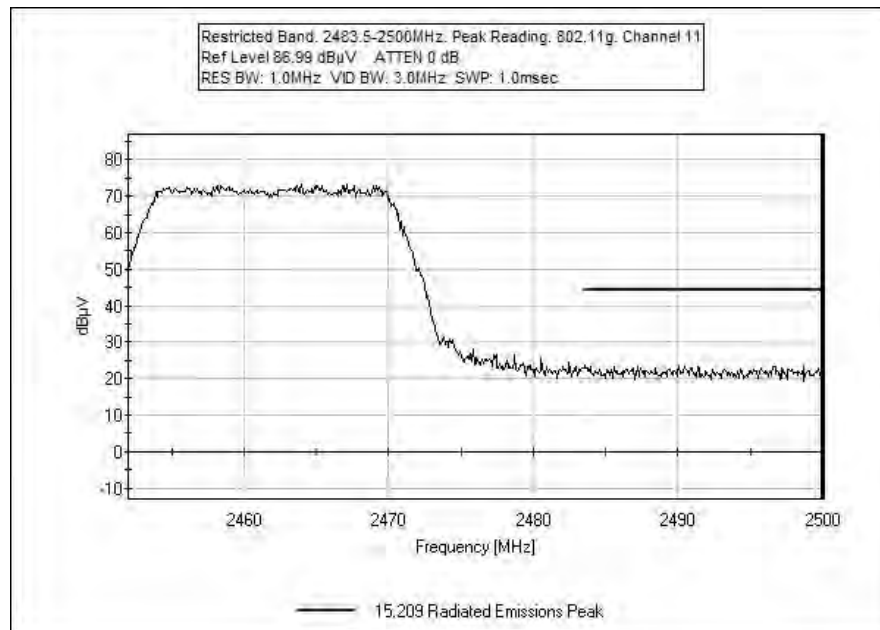
Y Axis



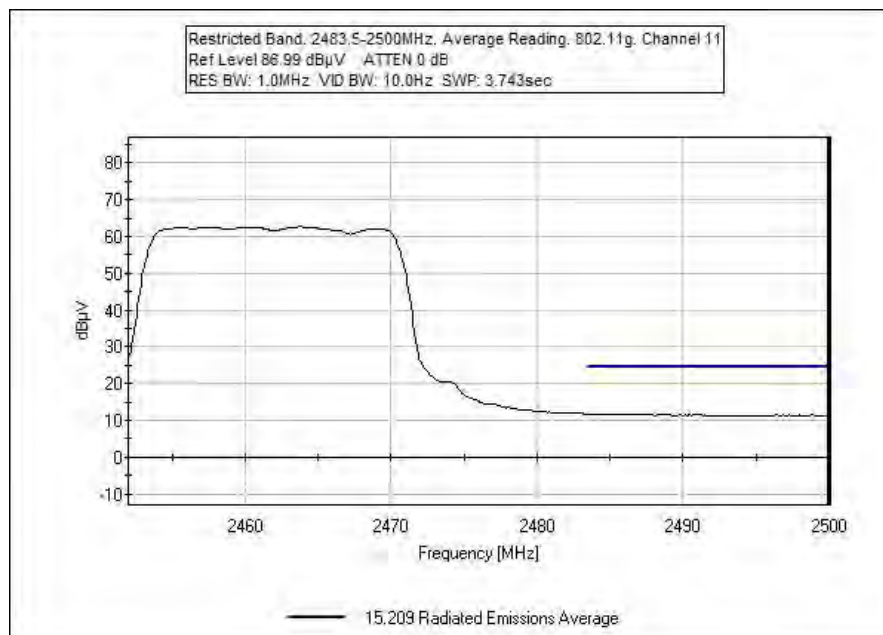
Z Axis



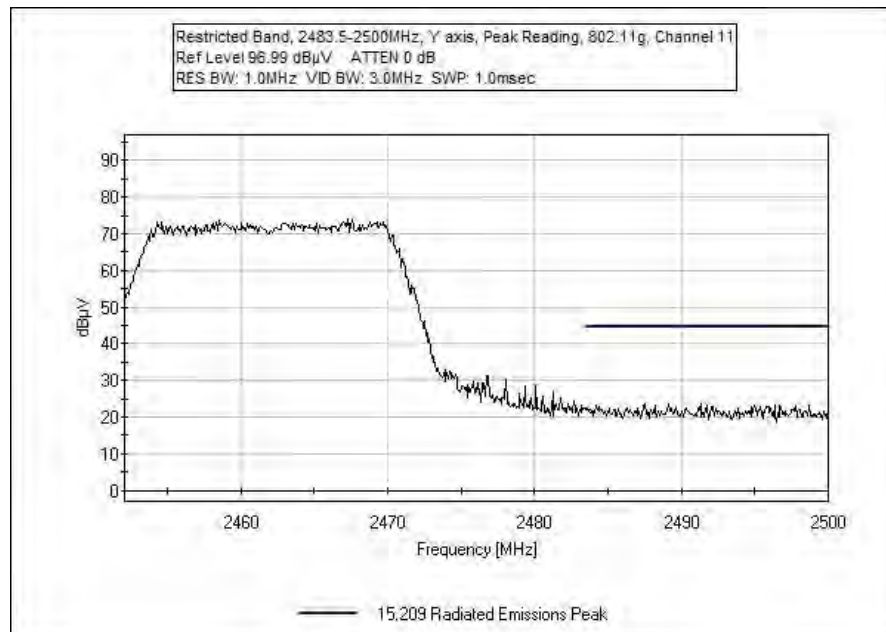
Z Axis



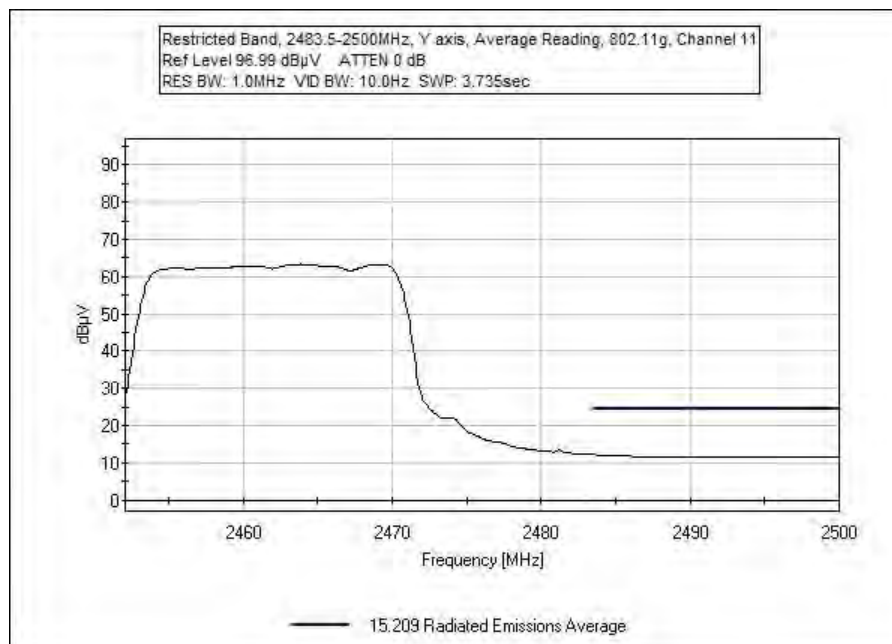
X Axis



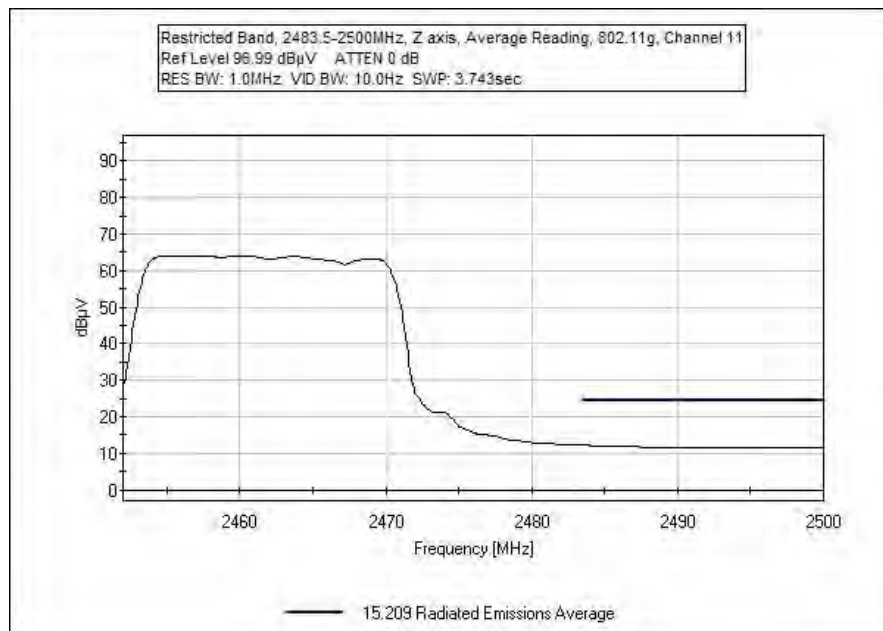
X Axis



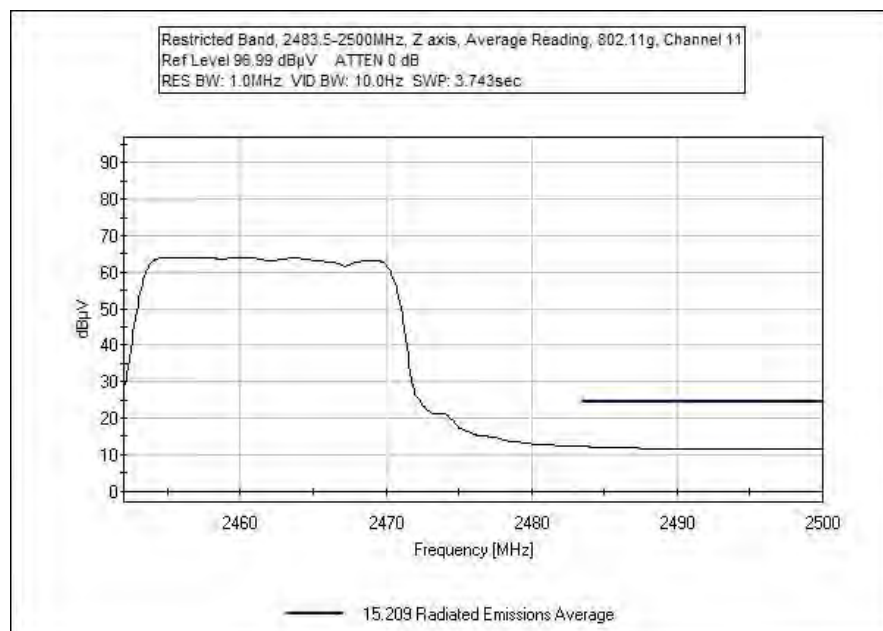
Y Axis



Y Axis



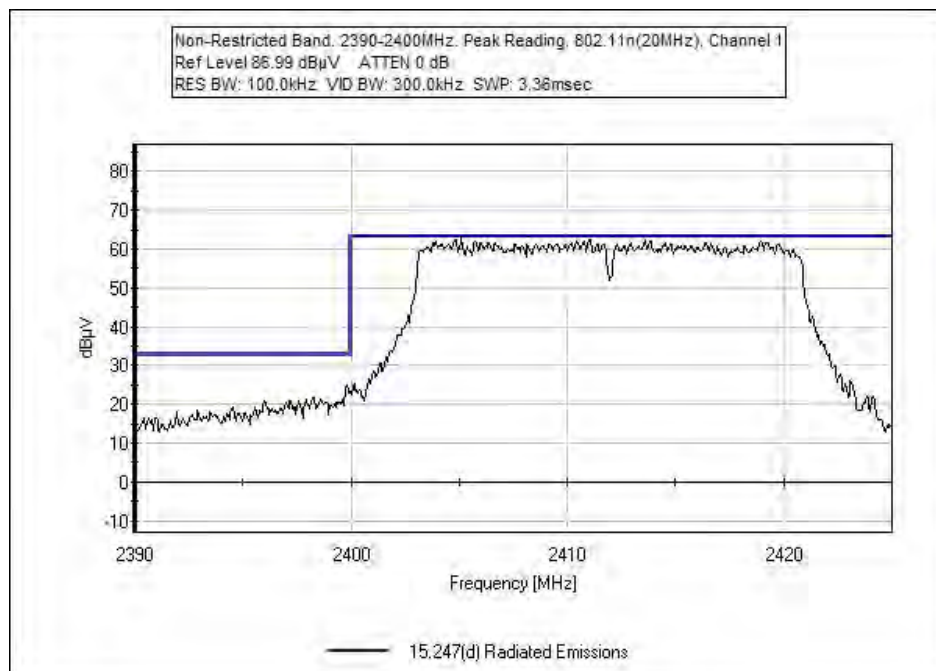
Z Axis



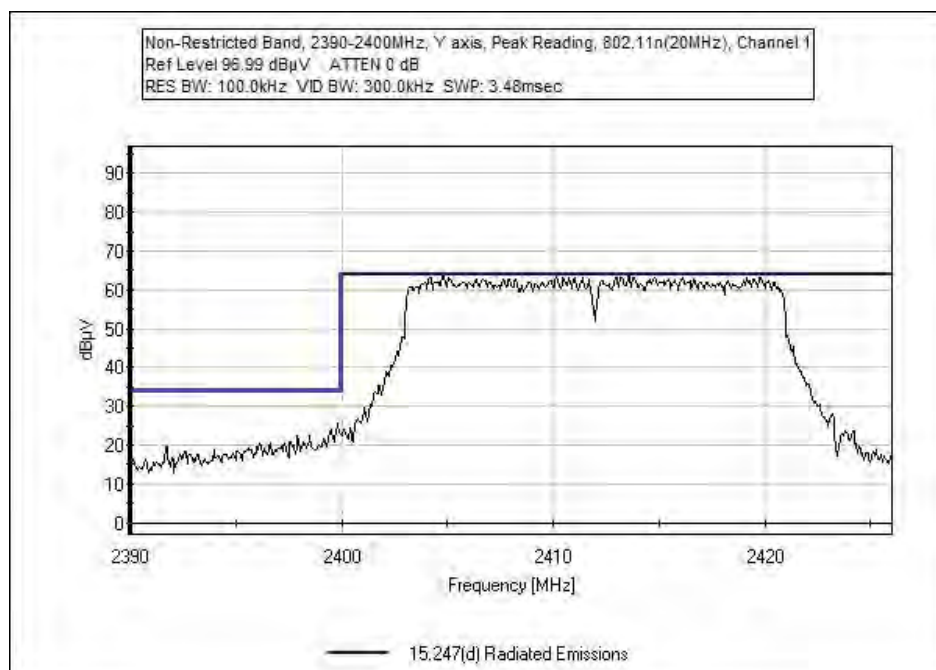
Z Axis



### 802.11n (20MHz), Non Restricted Bands

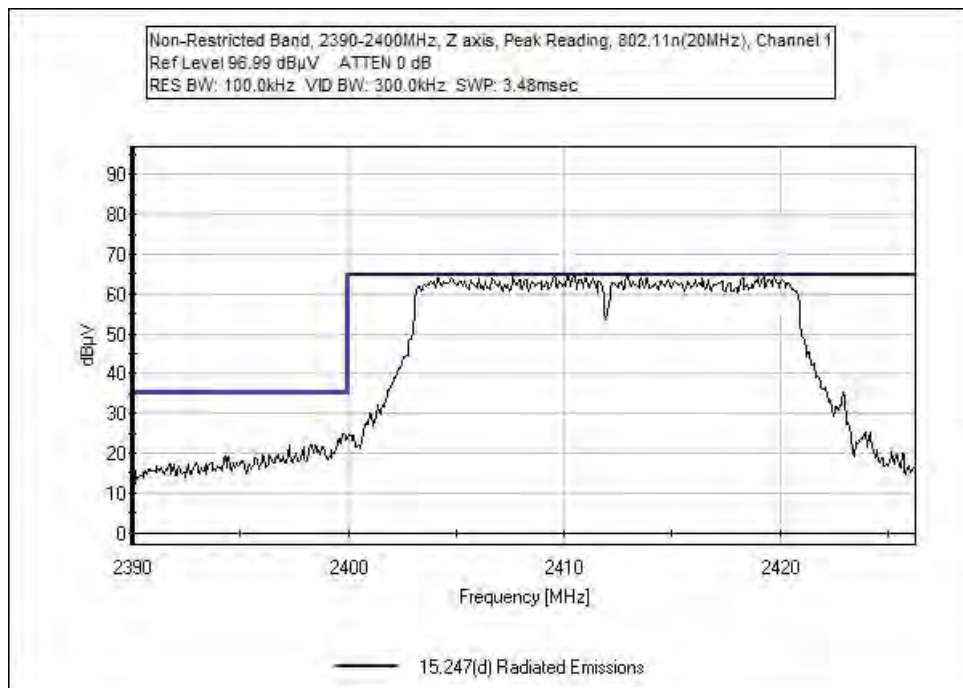


X Axis



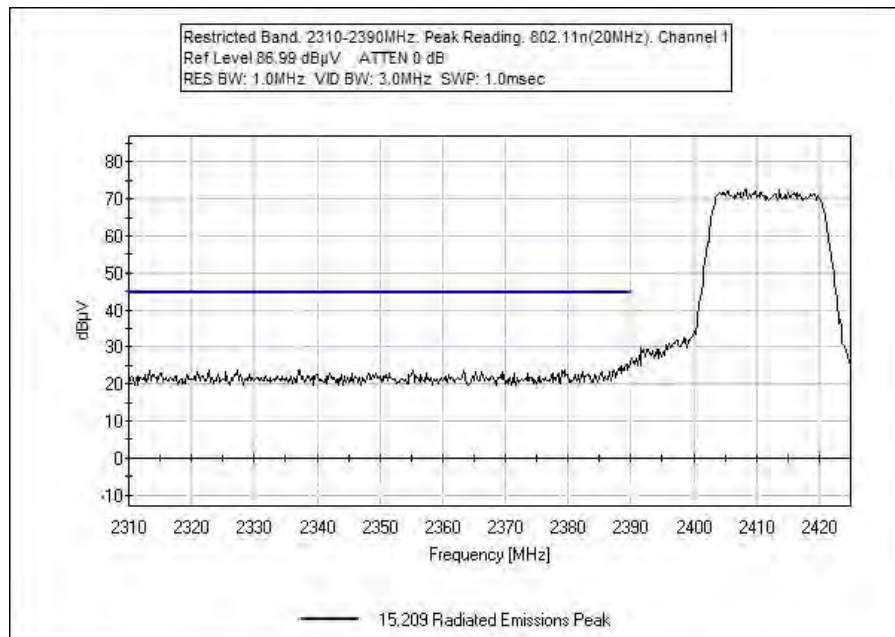
Y Axis



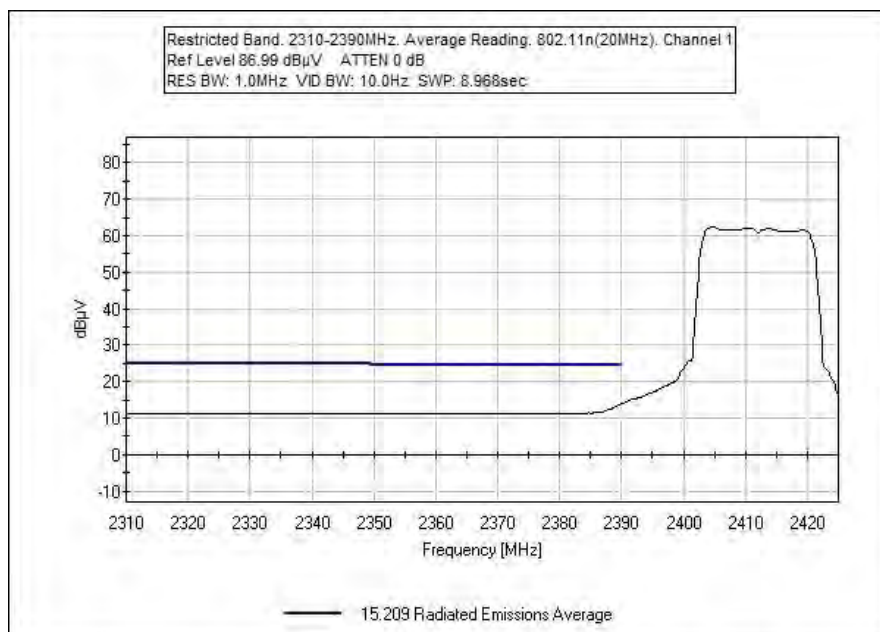


Z Axis

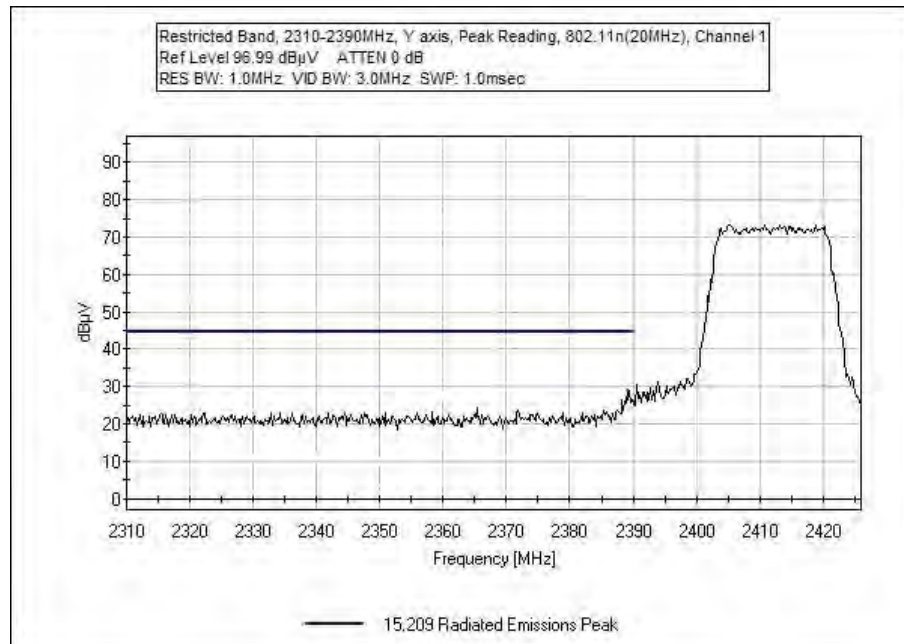
### 802.11n (20MHz), Restricted Bands



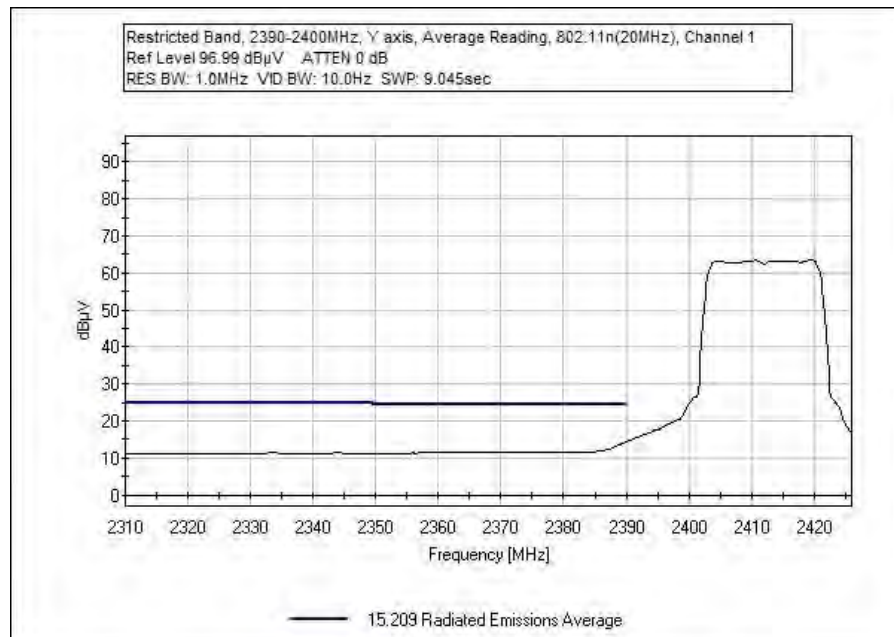
X Axis



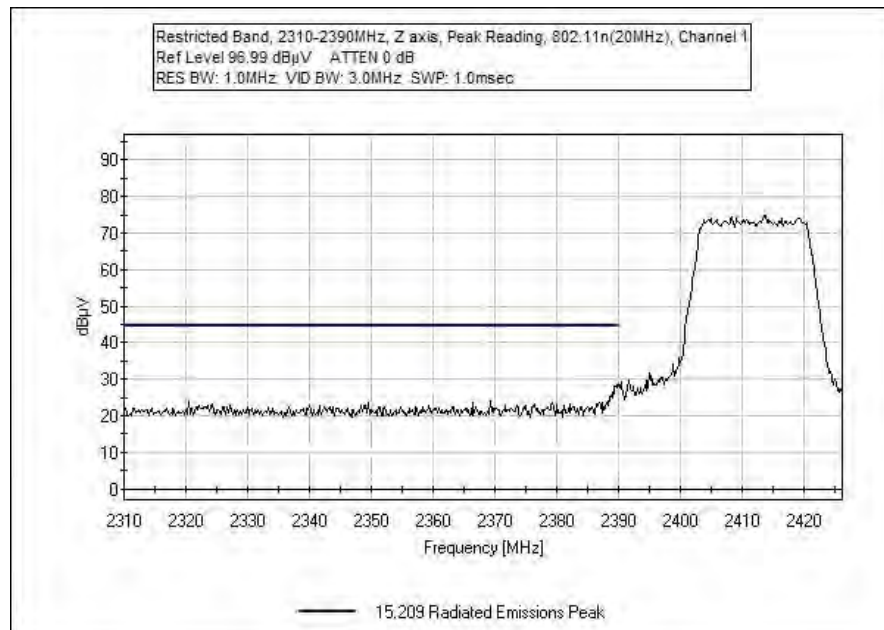
X Axis



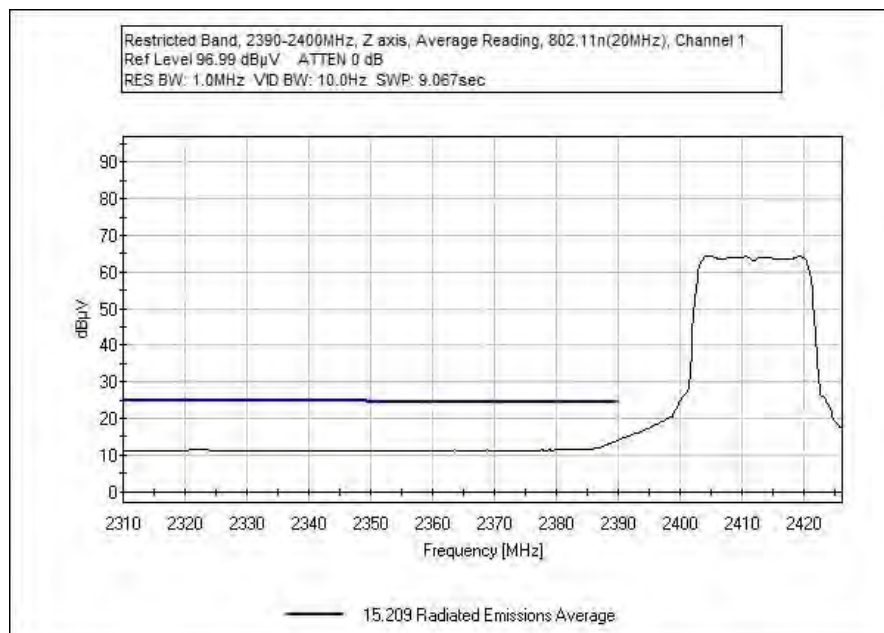
Y Axis



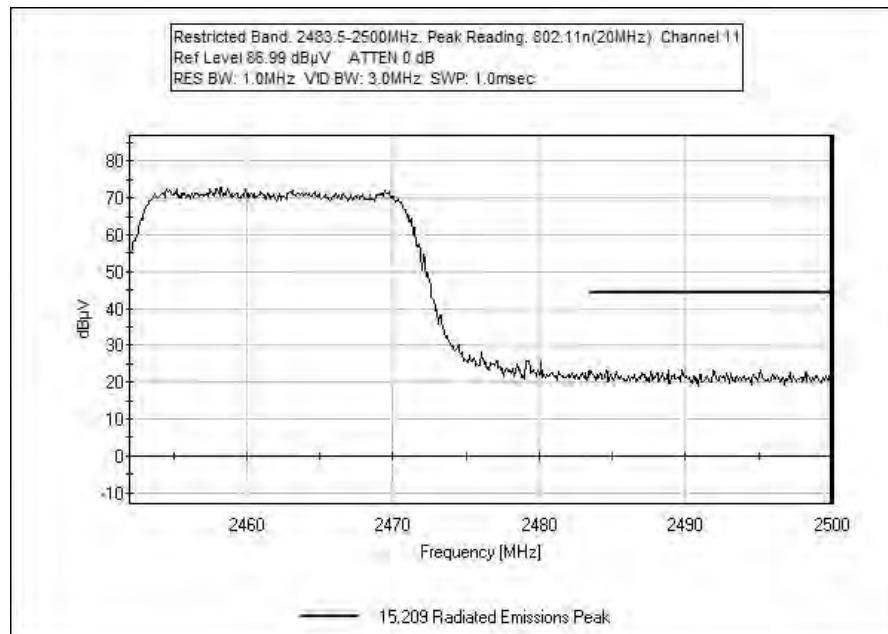
Y Axis



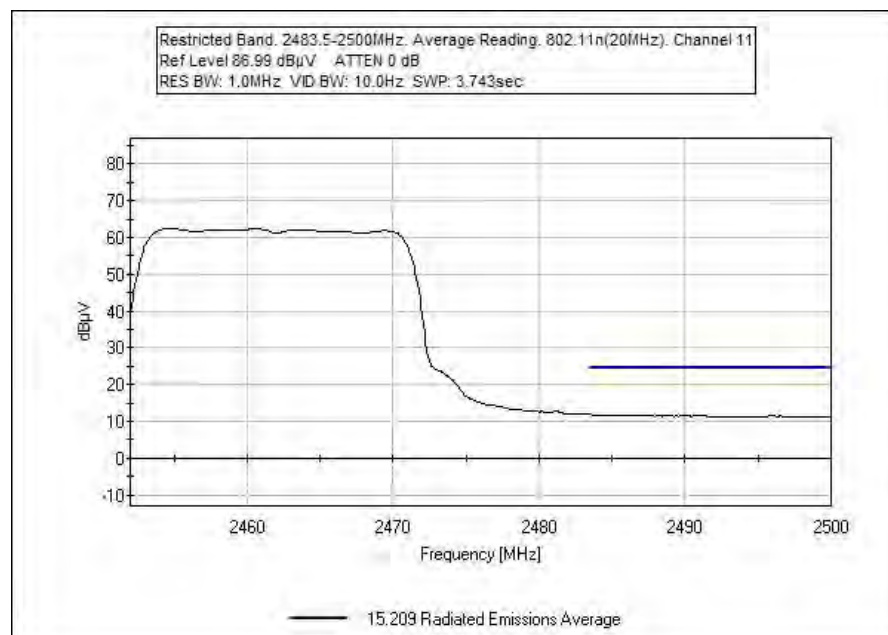
Z Axis



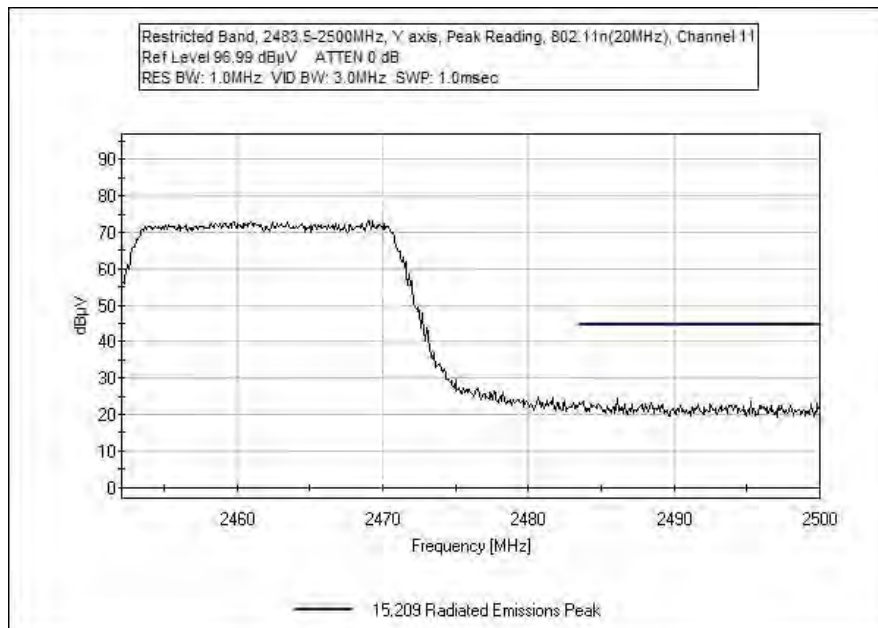
Z Axis



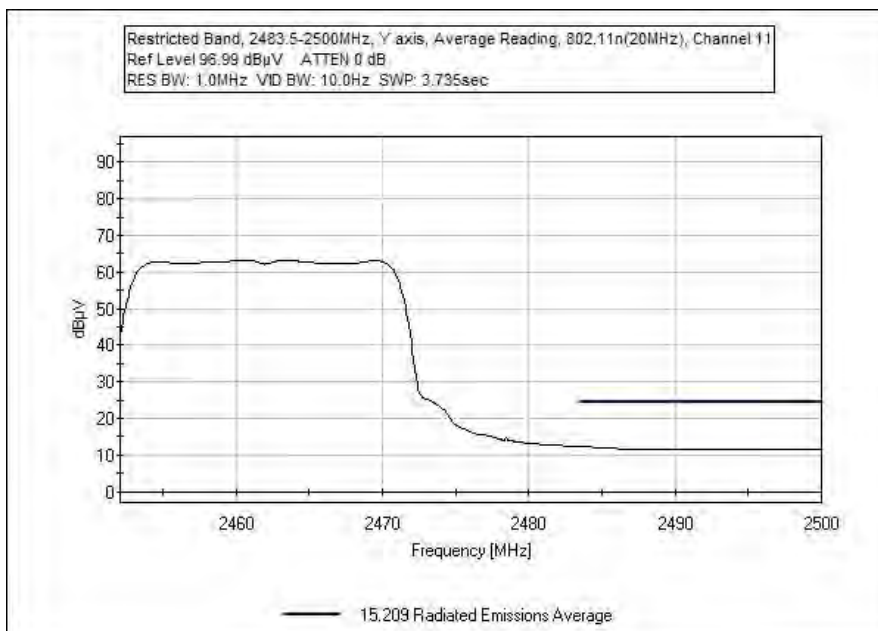
X Axis



X Axis

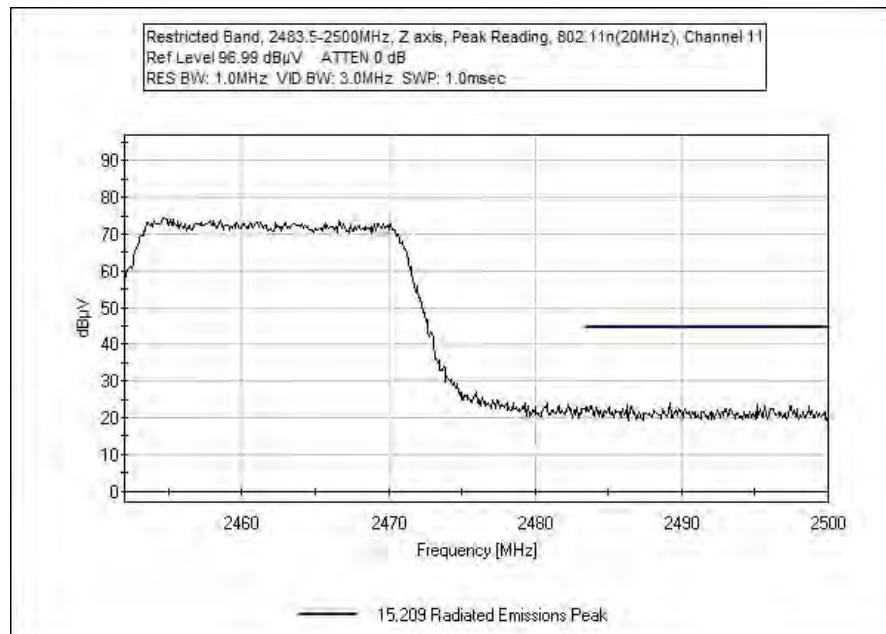


Y Axis

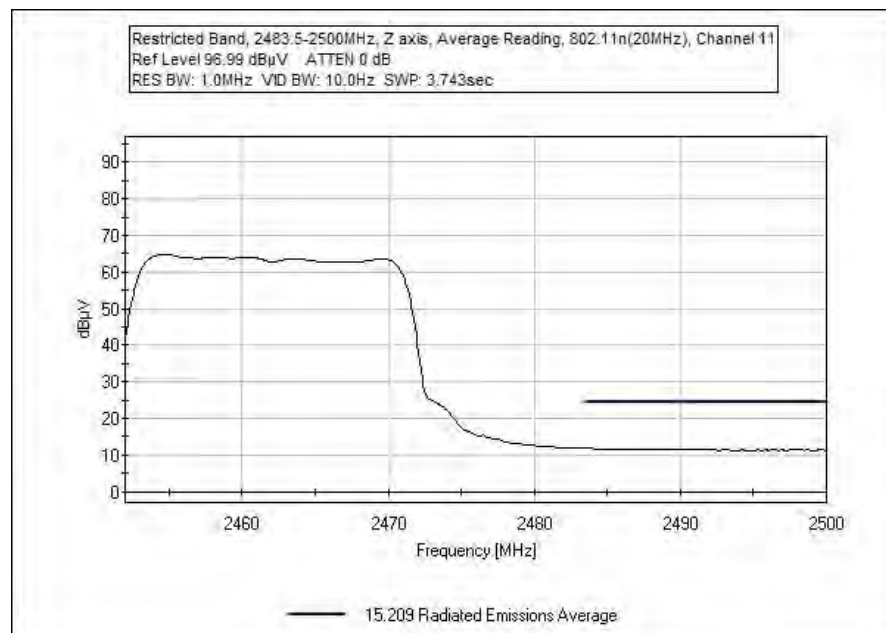


Y Axis





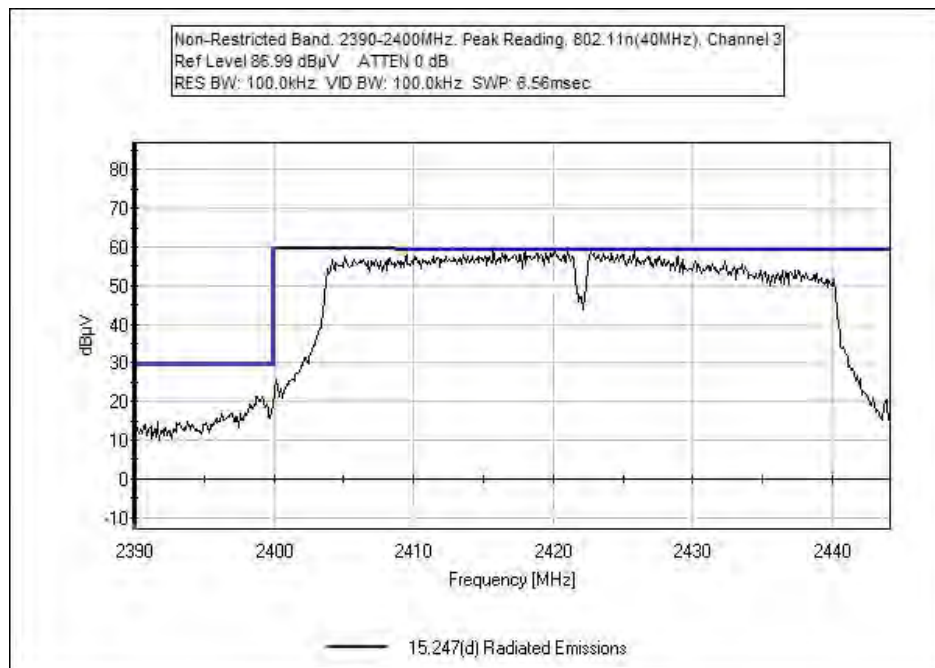
Z Axis



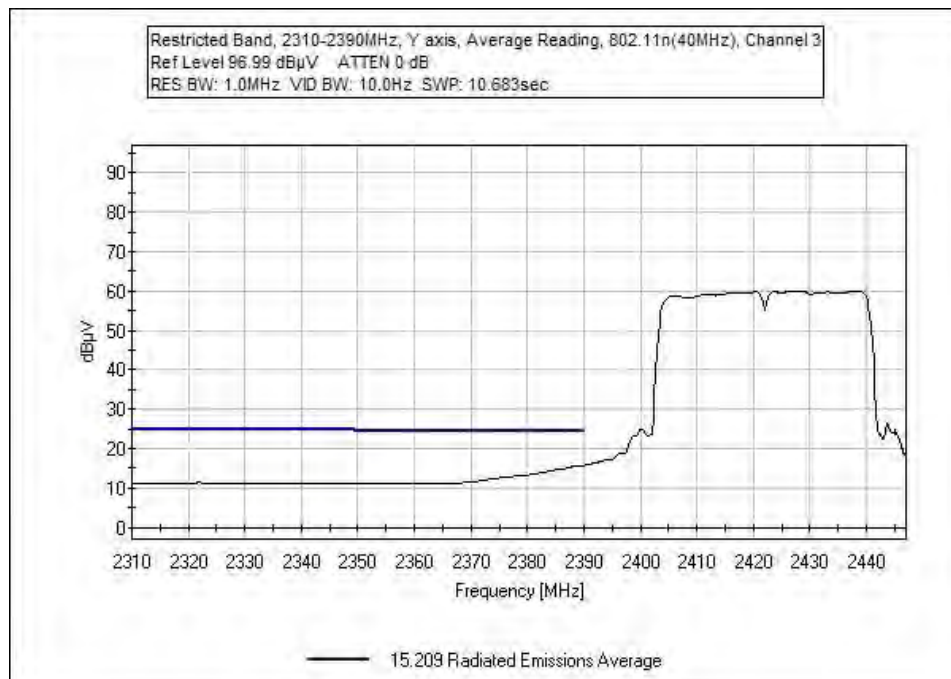
Z Axis



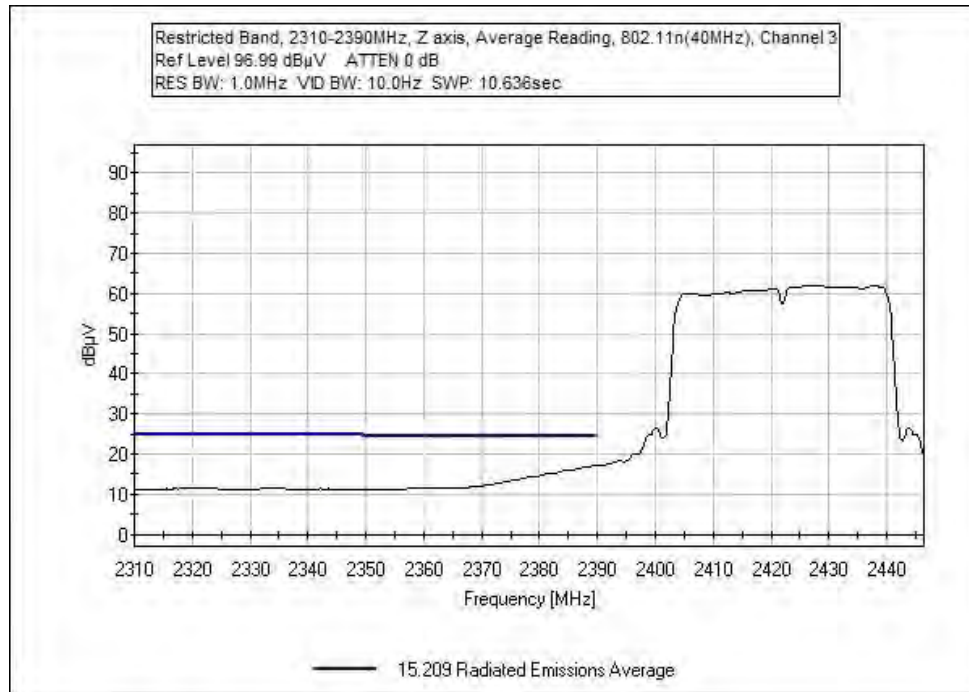
### 802.11n (40MHz), Non Restricted Bands



X Axis

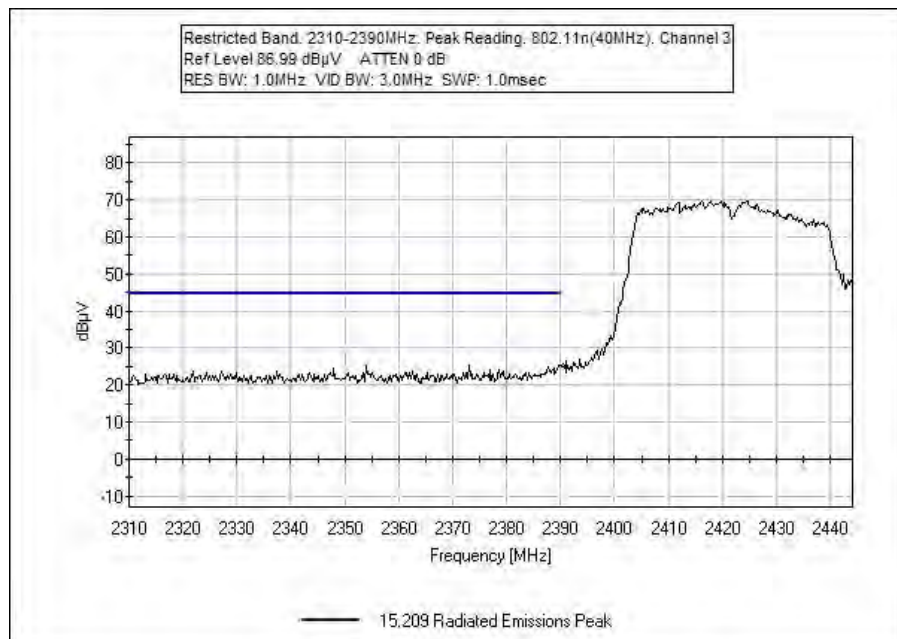


Y Axis

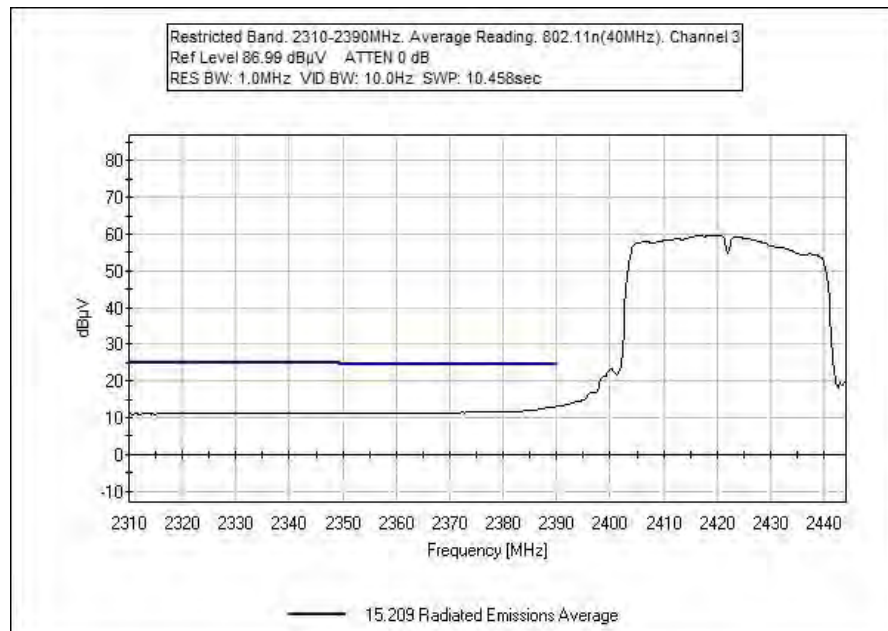


Z Axis

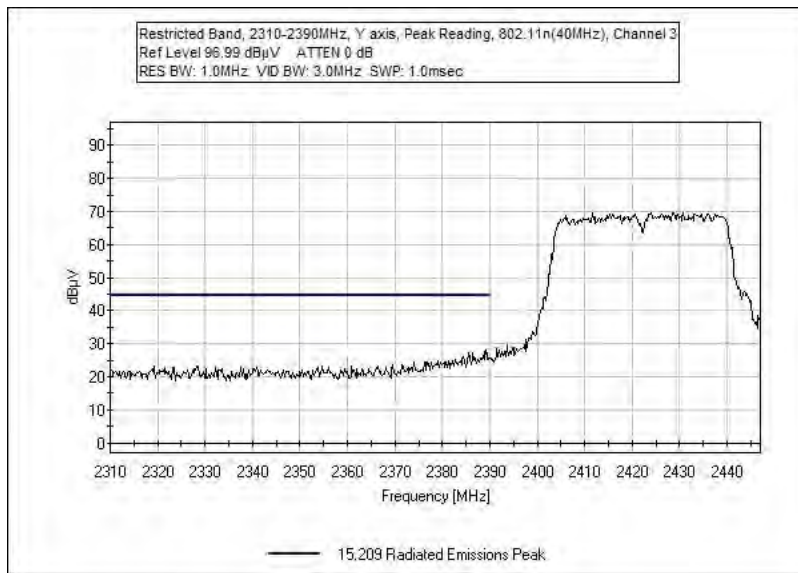
### 802.11n (40MHz), Restricted Bands



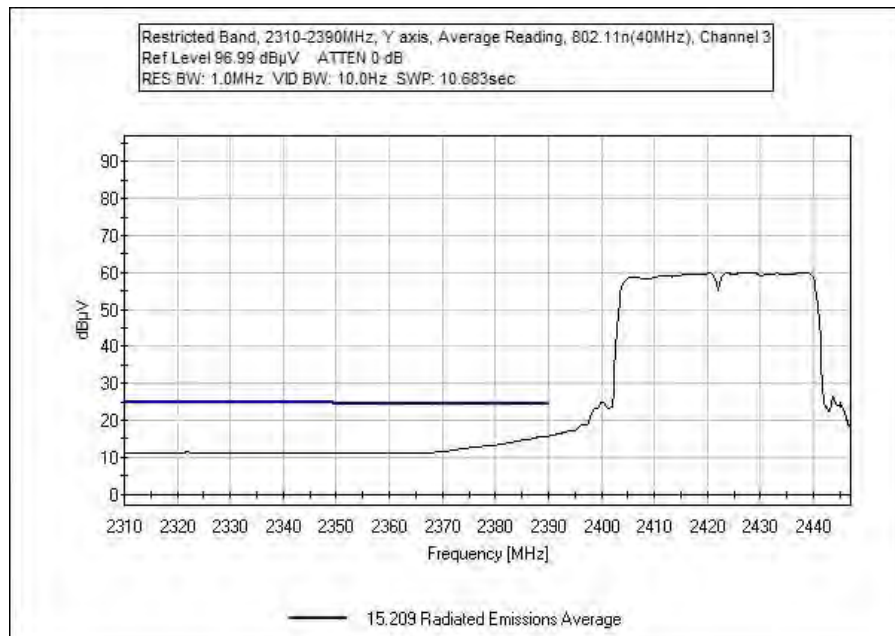
X Axis



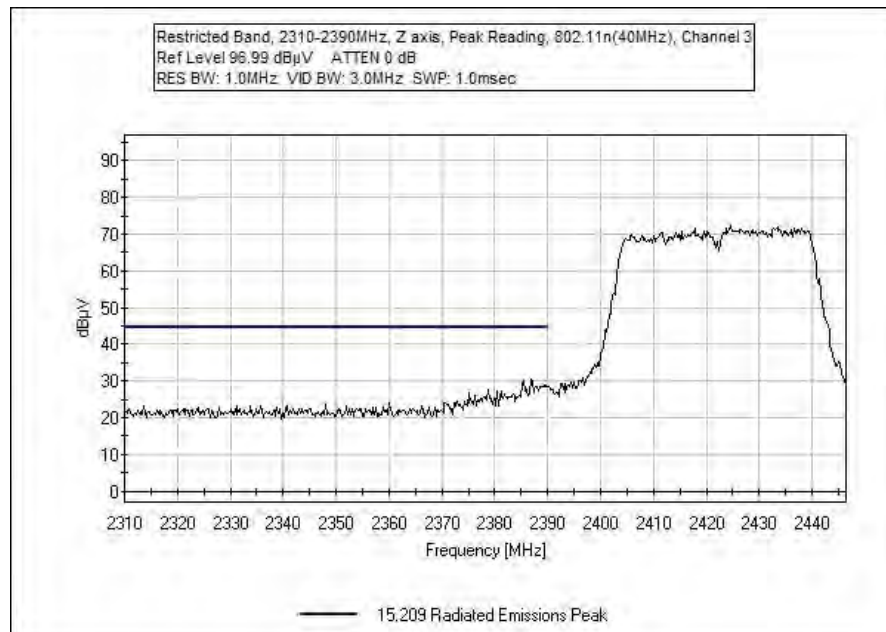
X Axis



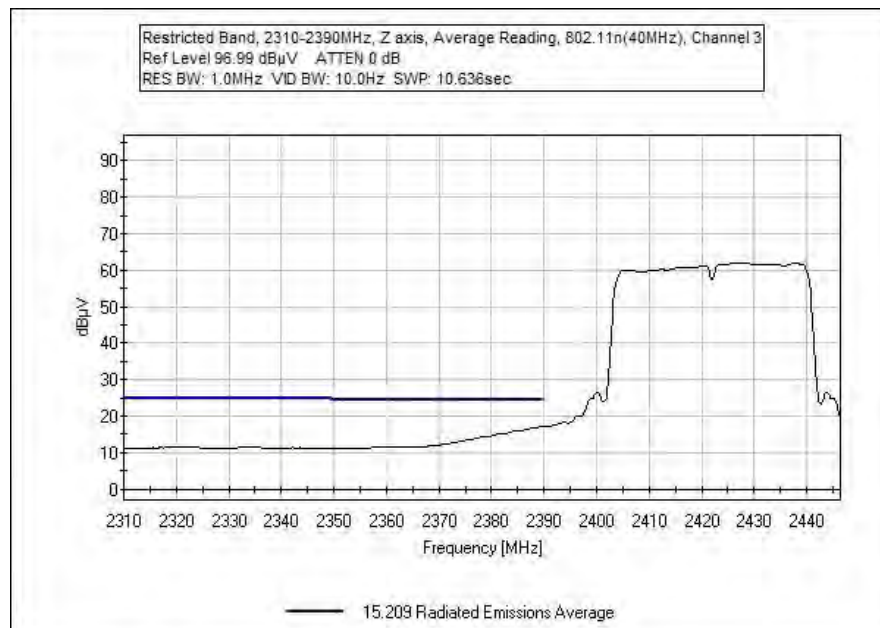
Y Axis



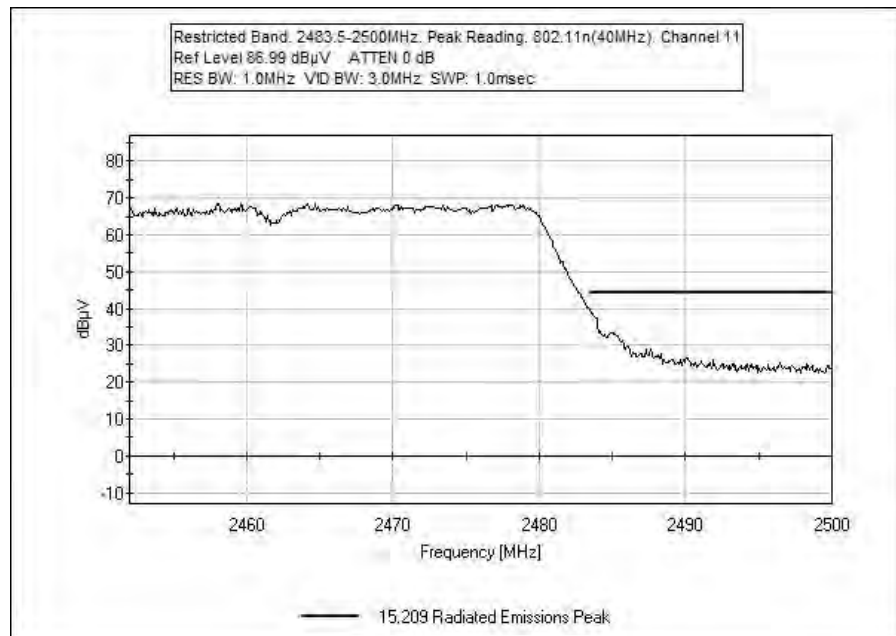
Y Axis



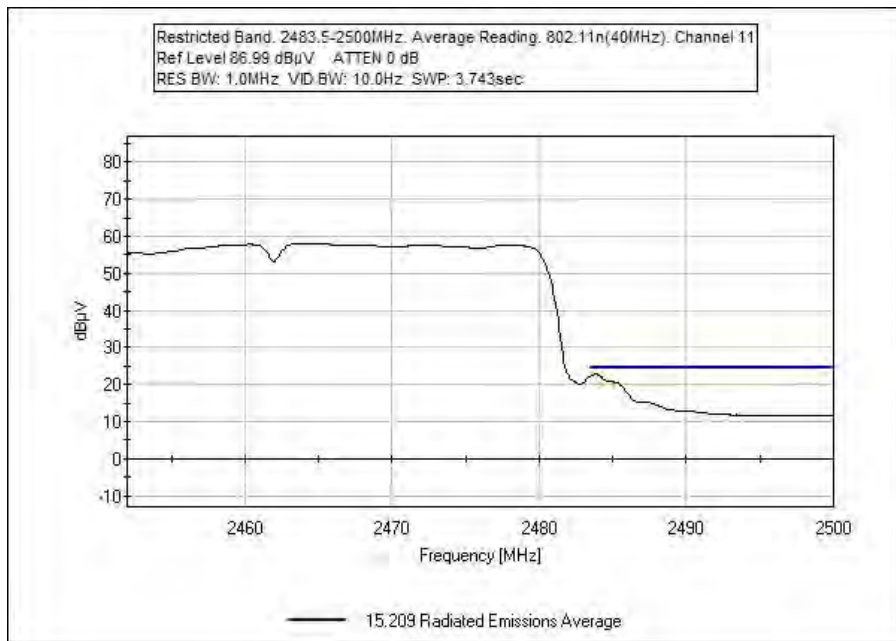
Z Axis



Z Axis

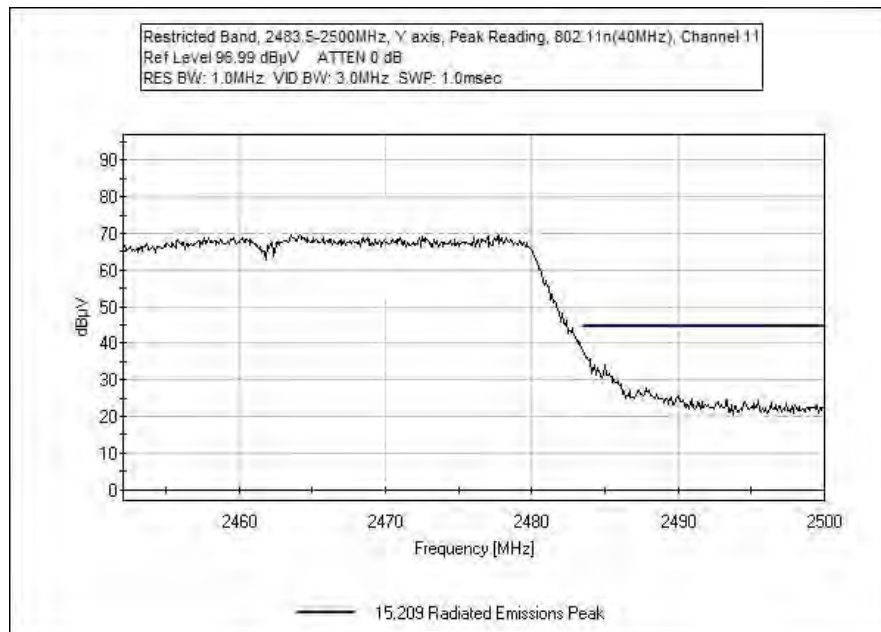


X Axis

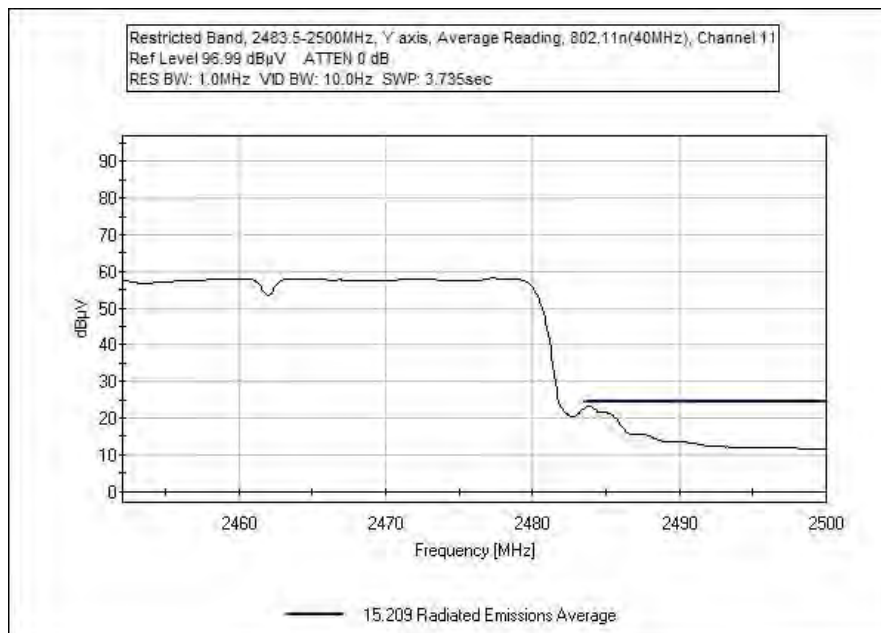


X Axis



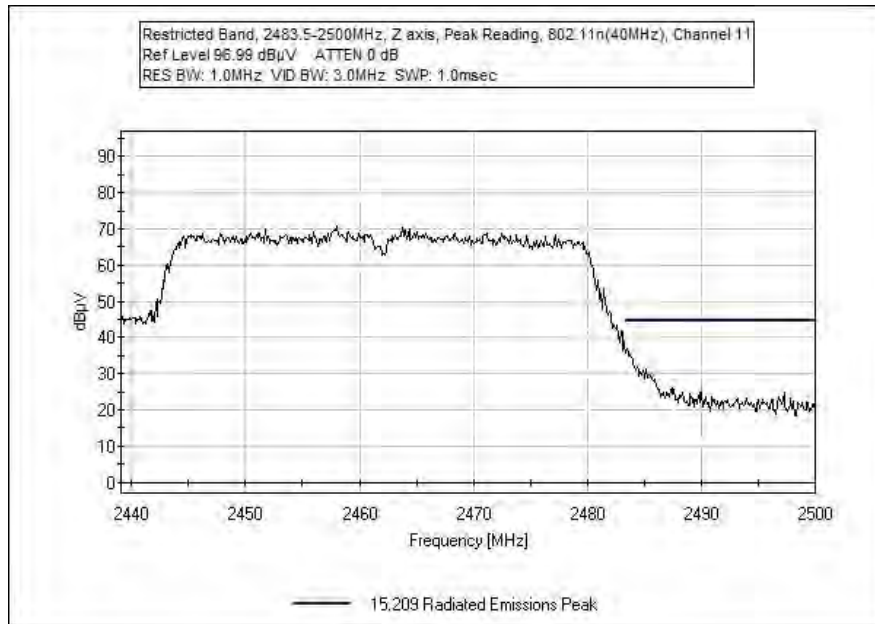


Y Axis

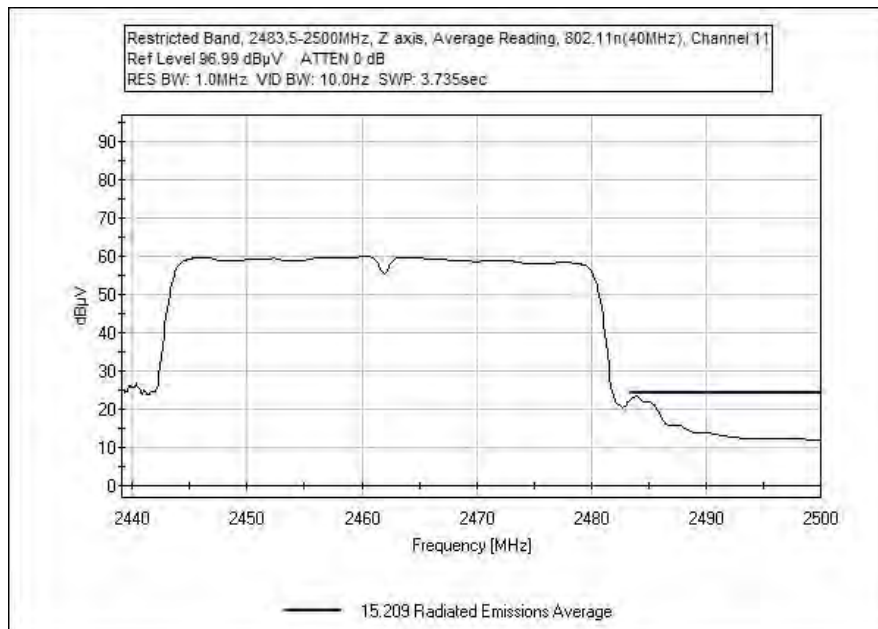


Y Axis





Z Axis



Z Axis

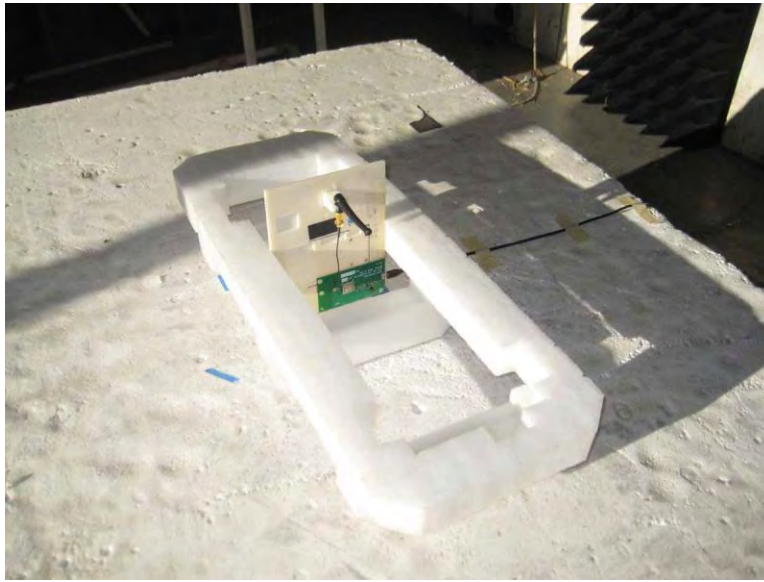
## Test Setup Photo



X Axis



Y Axis



Z Axis

## SUPPLEMENTAL INFORMATION

### Emissions Test Details

#### TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

#### CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dB $\mu$ V/m, the spectrum analyzer reading in dB $\mu$ V was corrected by using the following formula. This reading was then compared to the applicable specification limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBμV)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBμV/m)

#### TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

#### SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or carrot ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

##### Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

##### Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

##### Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.