

# HITEM

## ADDENDUM TO TEST REPORT 95696-19

### 2.4 GHz Transmitter Module Model: Skybell

#### Tested To The Following Standards:

FCC Part 15 Subpart C Section(s)  
15.247

Report No.: 95696-19A

Date of issue: February 9, 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.

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## ADMINISTRATIVE INFORMATION

### Test Report Information

**REPORT PREPARED FOR:**

HITEM  
7420 Carroll Rd  
San Diego, CA 92121

REPRESENTATIVE: Seton Kasmir  
Customer Reference Number: 85

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

Terri Rayle  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

Project Number: 95696

August 29, 2014

August 29 – November 13, 2014

### Revision History

**Original:** Testing of 2.4 GHz Transmitter Module, Model: Skybell to FCC Part 15 Subpart C Section(s), 15.247.

**Addendum A:** To replace the blank data plots in conducted spurious and radiated spurious emission sections (page 29 and 33) and added equipment to the table/list to cover the frequency range tested for radiated spurious emissions (page 31).

### 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.



**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	5.00.14
Immunity	5.00.07

## Site Registration & Accreditation Information

Location	CB #	TAIWAN	CANADA	FCC	JAPAN
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
15.31(e)	Voltage Variation	NA	Pass
15.247(a)(2)	-6dB Occupied Bandwidth	NA	Pass
15.247(b)(3)	RF Power Output	NA	Pass
15.247(d)	Conducted Spurious Emissions	NA	Pass
15.247(d) / 15.209	Radiated Spurious Emissions and Band Edge	NA	Pass
15.247(e)	Power Spectral Density	NA	Pass

NA=Not Applicable

## Modifications\*/Conditions During Testing

This list is a summary of the conditions noted for or 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.**

## EQUIPMENT UNDER TEST (EUT)

### EQUIPMENT UNDER TEST

#### **2.4 GHz Transmitter Module**

Manuf: HITEM

Model: Skybell

Serial: NA

### PERIPHERAL DEVICES

The EUT was tested with the following peripheral device(s):

#### **Laptop**

Manuf: Dell

Model: Averatec

Serial: 00045-436-018

#### **Power Supply**

Manuf: Topward

Model: 6306D

Serial: 988614

## FCC PART 15 SUBPART C

This report contains EMC emissions test results under United States Federal Communications Commission (FCC) CFR 47 Section 15 Subpart C requirements for Intentional Radiators.

### 15.31(e) Voltage Variations

#### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714 993-6112

Customer: **HITEM**

Specification: **15.31(e) Voltage Variation on Power**

Work Order #: **95696**

Date: 9/10/2014

Test Type: **Maximized Emissions**

Equipment: 2.4 GHz transmitter module

Manufacturer: HITEM

Tested By: E. Wong

Model: Skybell

S/N: (none)

#### Test Equipment:

Asset #	Description	Model	Calibration Date	Cal Due Date
00787	Preamp	83017A	5/31/2013	5/31/2015
01646	Horn Antenna	3115	3/18/2014	3/18/2016
02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015
P04382	Cable	LDF-50	7/30/2014	7/30/2016
P06360	Cable	L1-PNMNM-48	7/29/2014	7/29/2016
P06544	Cable	32026-29094K-29094K-36TC	11/20/2013	11/20/2015

#### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz transmitter module*	HITEM	Skybell	(none)

#### Support Devices:

Function	Manufacturer	Model #	S/N
Laptop Computer	Averatec	5100 Series	NA
Power Supply	Jentec Technology Co., LTD.	AF1805-A	LF4R01082201507
Wireless Test Fixture	HITEM	Generic	Generic
Power Supply	LITEON	PA-1600-05	3600324901

***Test Conditions / Notes:***

The equipment under test (EUT) is a wireless module which is installed in the test fixture. The external antenna is connected to an antenna port. The EUT is connected to a remotely located laptop computer via USB cable. The computer is running software Production Test GUI to setup EUT transmitting protocol.

The test frequencies are 2412MHz, 2442MHz, and 2472MHz.

An external DC power adapter is also connected to the wireless test fixture.

Frequency range of measurement, 2400MHz to 2483.5MHz.

Temperature: 21°C

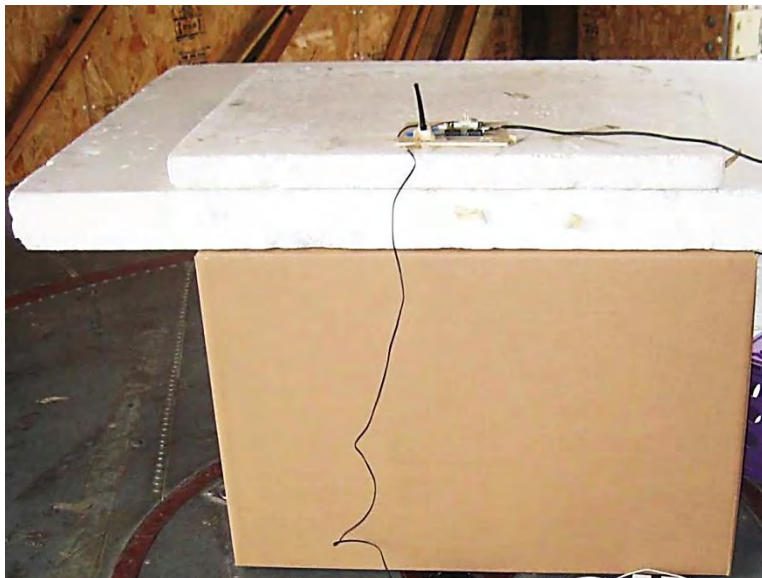
Relative Humidity: 45%

Pressure: 100kPa

Site D

**15.31(e) compliance: the supply voltage was varied between 85% and 115% of the nominal rated supply voltage of the developer board where the device was installed in. The installation does not provide provision of varying DC voltage to the module. No change in the fundamental signal level was observed.**

**Test Photo**





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

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714 993-6112

Customer: **HITEM**

Specification: **15.247(a)(2)**

Work Order #: **95696**

Date: 8/29/2014

Test Type: **Minimum 6dB Bandwidth**

Equipment: 2.4 GHz transmitter module

Manufacturer: HITEM

Tested By: Don Nguyen

Model: Skybell

S/N: (none)

#### Test Equipment:

Asset #	Description	Model	Calibration Date	Cal Due Date
03431	Attenuator	89-20-21	9/5/2013	9/5/2015
P06544	Cable	32026-29094K- 29094K-36TC	11/20/2013	11/20/2015
02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015

#### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz transmitter module*	HITEM	Skybell	(none)

#### Support Devices:

Function	Manufacturer	Model #	S/N
Laptop Computer	Averatec	5100 Series	NA
Power Supply	Jentec Technology Co., LTD.	AF1805-A	LF4R01082201507
Wireless Test Fixture	HITEM	Generic	Generic
Power Supply	LITEON	PA-1600-05	3600324901

#### Test Conditions / Notes:

The equipment under test (EUT) is a wireless module which is installed in the test fixture. The antenna connector port is connected to the spectrum analyzer. The EUT is connected to a support located laptop computer via an USB cable. The computer is running software Production Test GUI to setup EUT transmitting protocol.

The test frequencies are 2412MHz, 2442MHz, and 2472MHz.

An external DC power adapter is also connected to the wireless test fixture.

Frequency range of measurement, 2400MHz to 2483.5MHz.

Temperature: 20°C

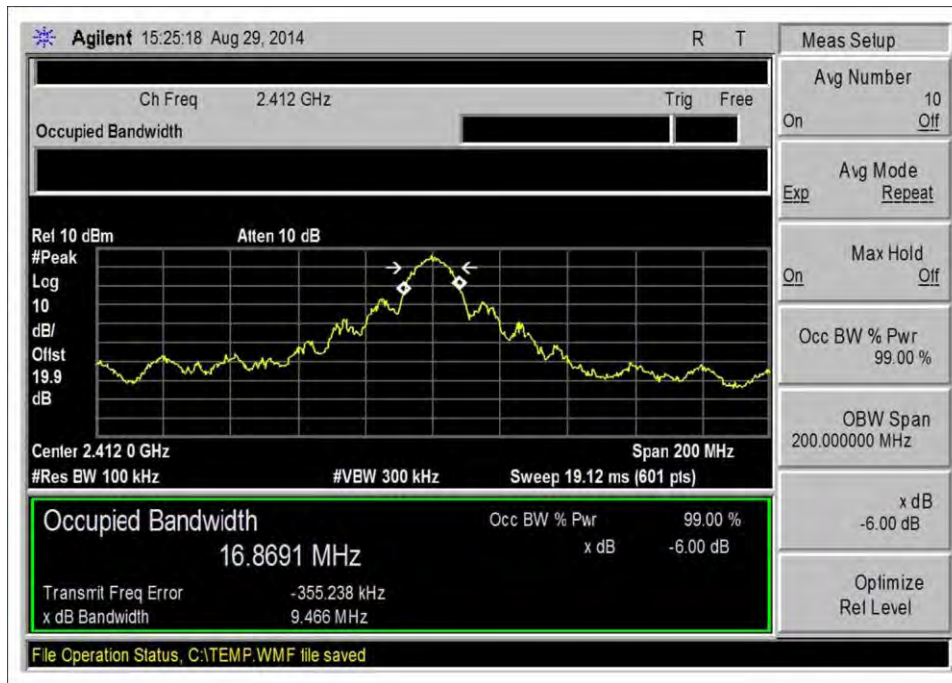
Relative Humidity: 35%

Pressure: 100kPa

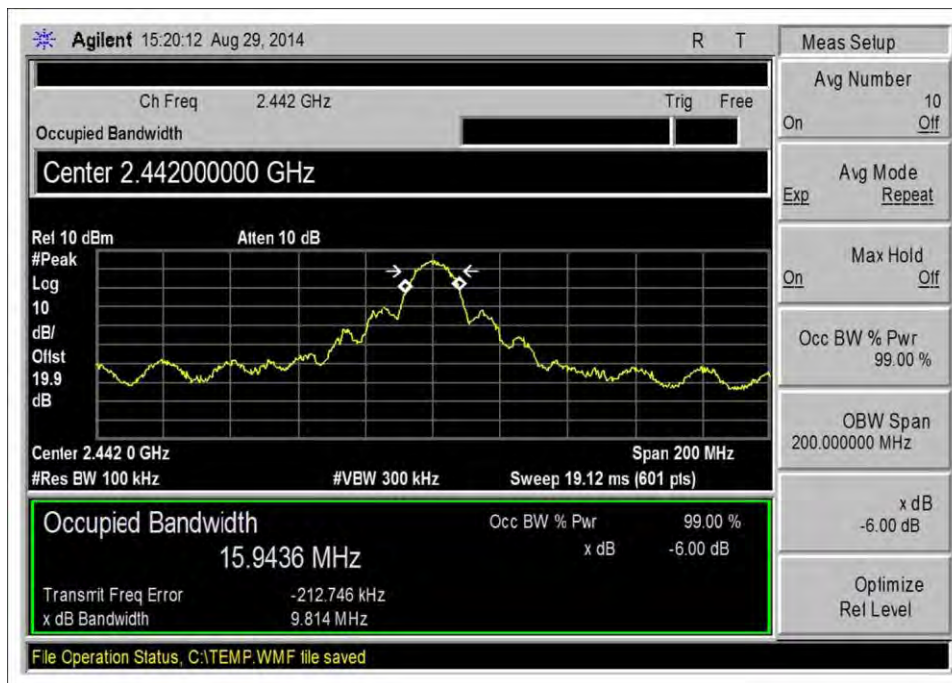
Site D

Minimum 6dB Bandwidth Test Summary			
Frequency (MHz)	Measured 6dB Bandwidth (kHz)	15.247(a)(2) Minimum 6dB bandwidth limit (kHz)	Notes
2412	16869	500	802.11b 11Mbps
2442	15944	500	802.11b 11Mbps
2472	15682	500	802.11b 11Mbps
2412	21696	500	802.11g 54Mbps
2442	17393	500	802.11g 54Mbps
2472	17183	500	802.11g 54Mbps
2412	19034	500	802.11n HT20 MCS3
2442	18173	500	802.11n HT20 MCS3
2472	18132	500	802.11n HT20 MCS3
2412	18272	500	802.11n HT20 MCS7
2442	18081	500	802.11n HT20 MCS7
2472	18015	500	802.11n HT20 MCS7

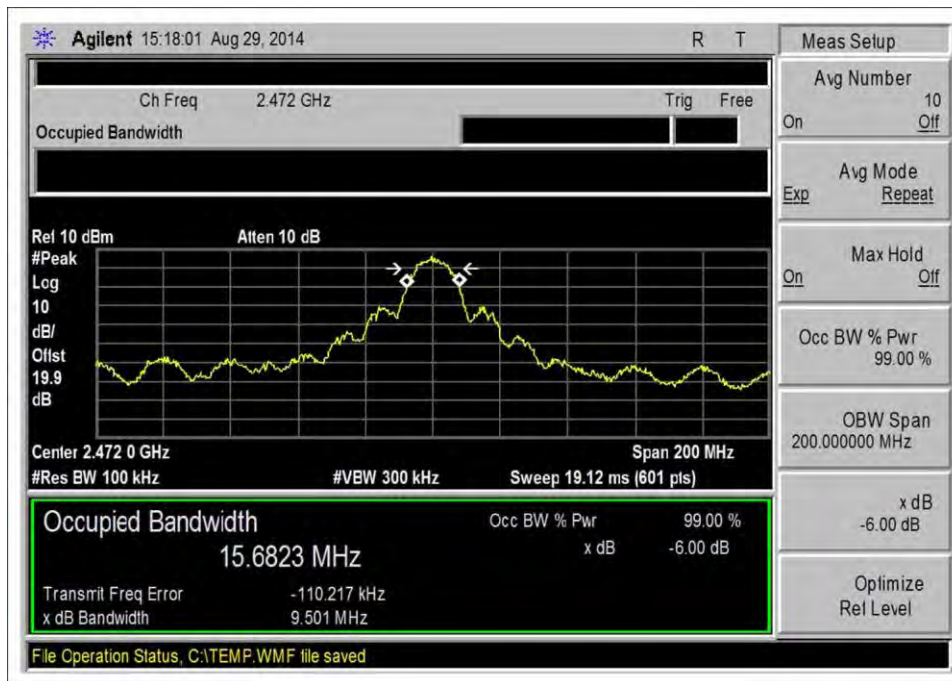
## Test Data



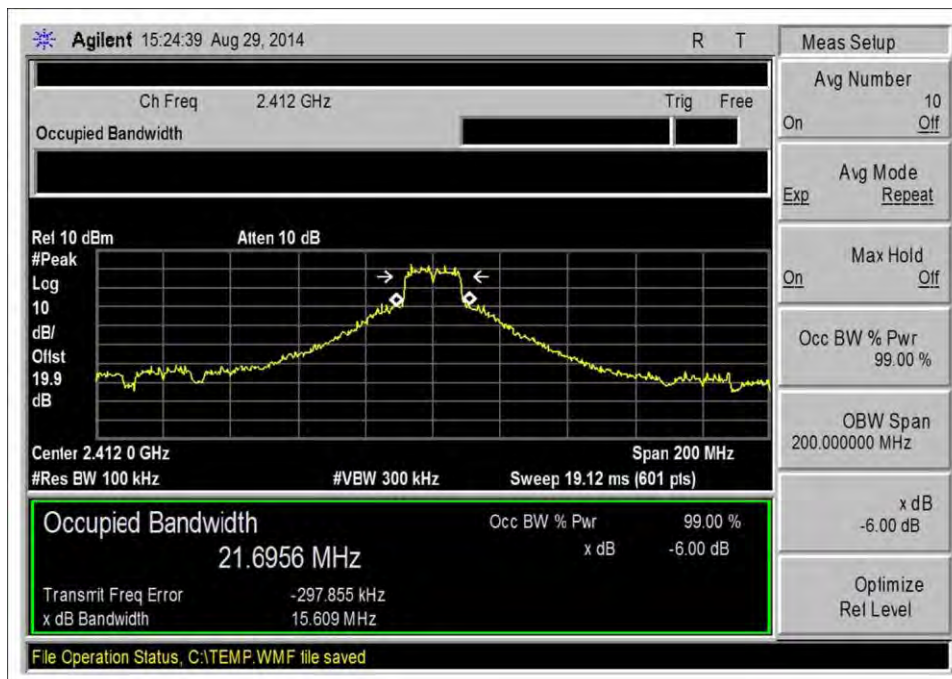
Low Channel, B 11mbps



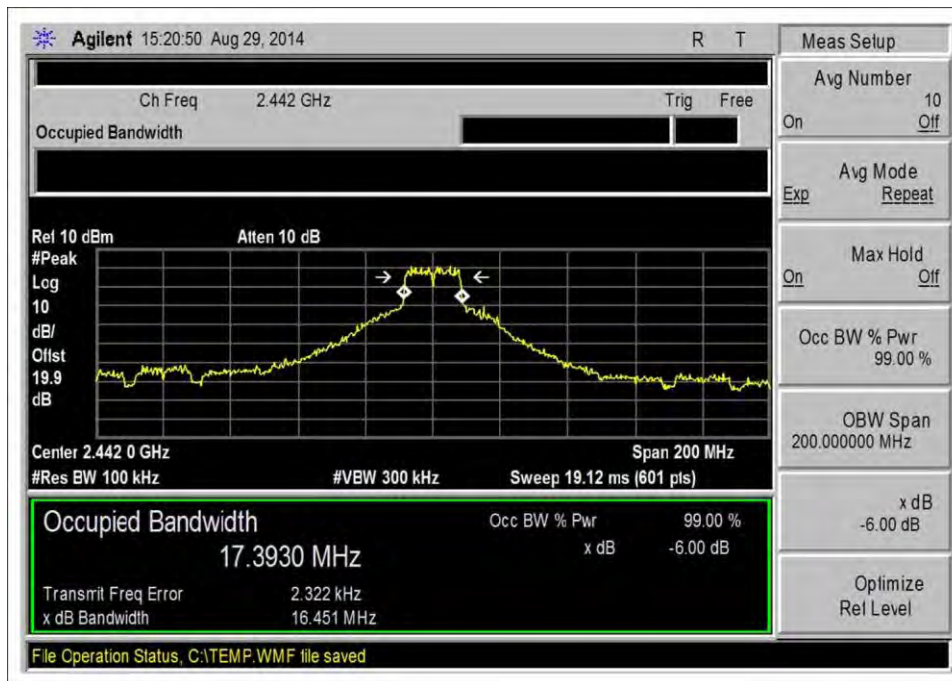
Middle Channel, B 11mbps



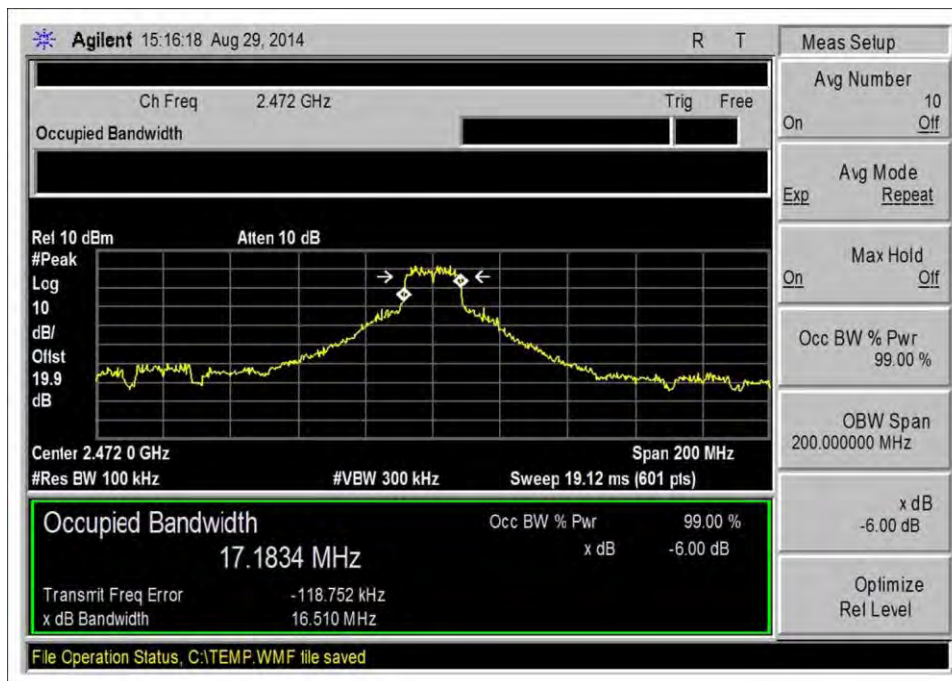
High Channel, B 11mbps



Low Channel, G 54mbps

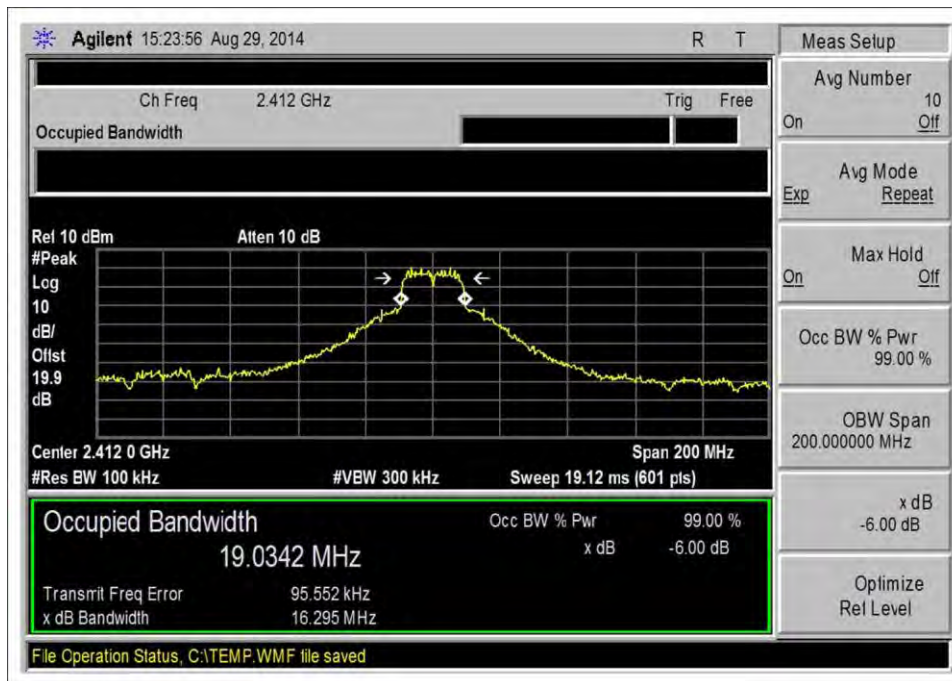


Middle Channel, G 54mbps

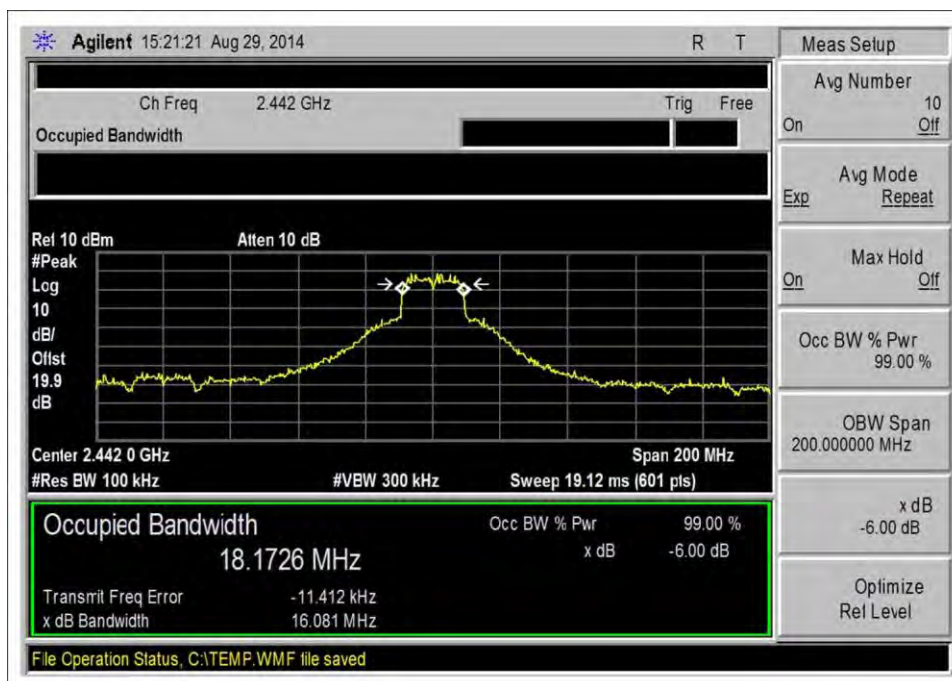


High Channel, G 54mbps

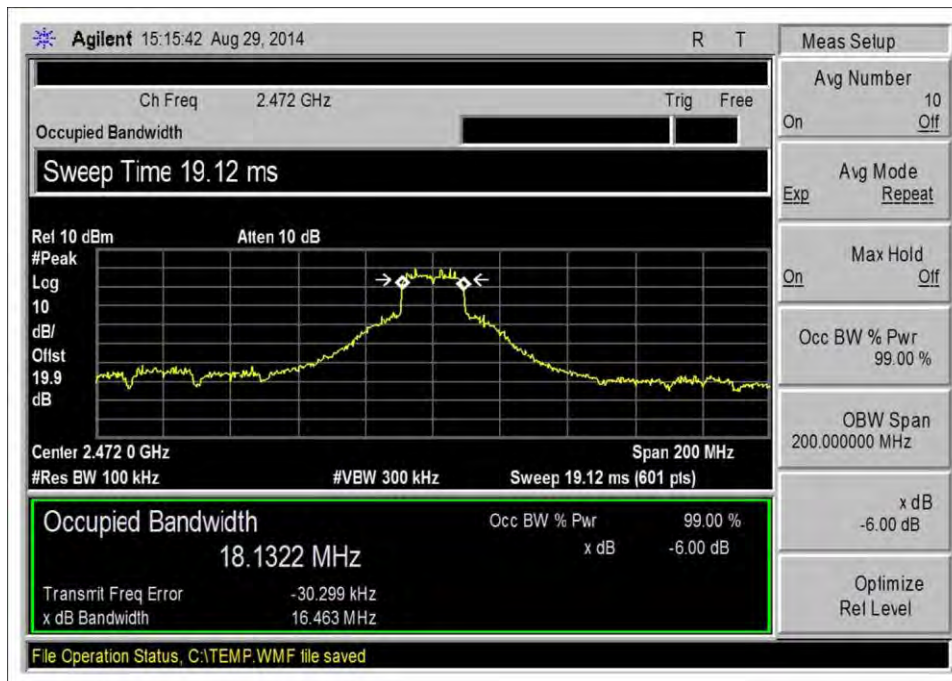




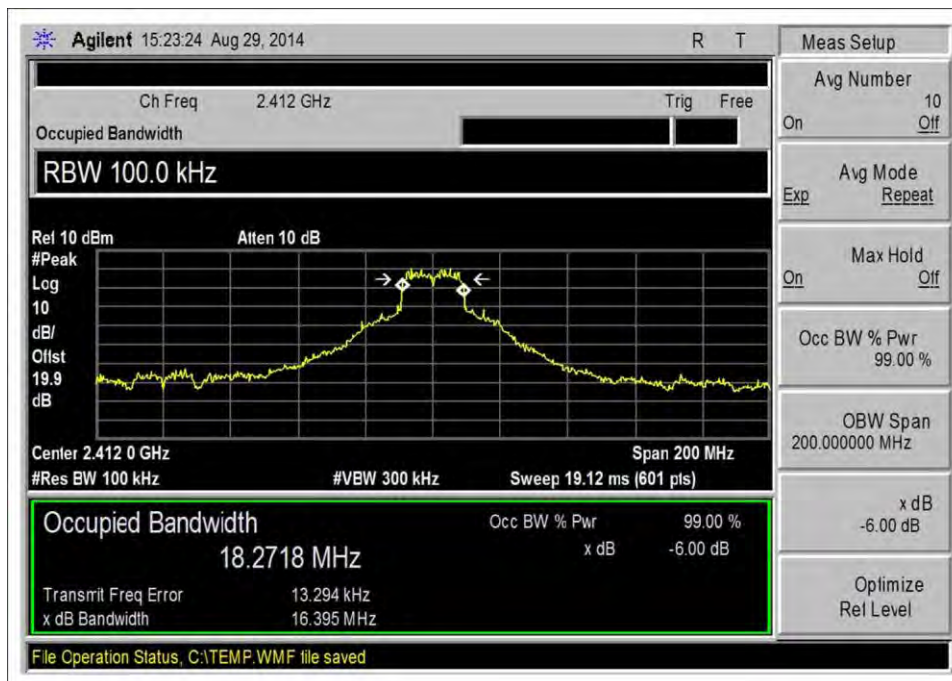
Low Channel, N MCS3



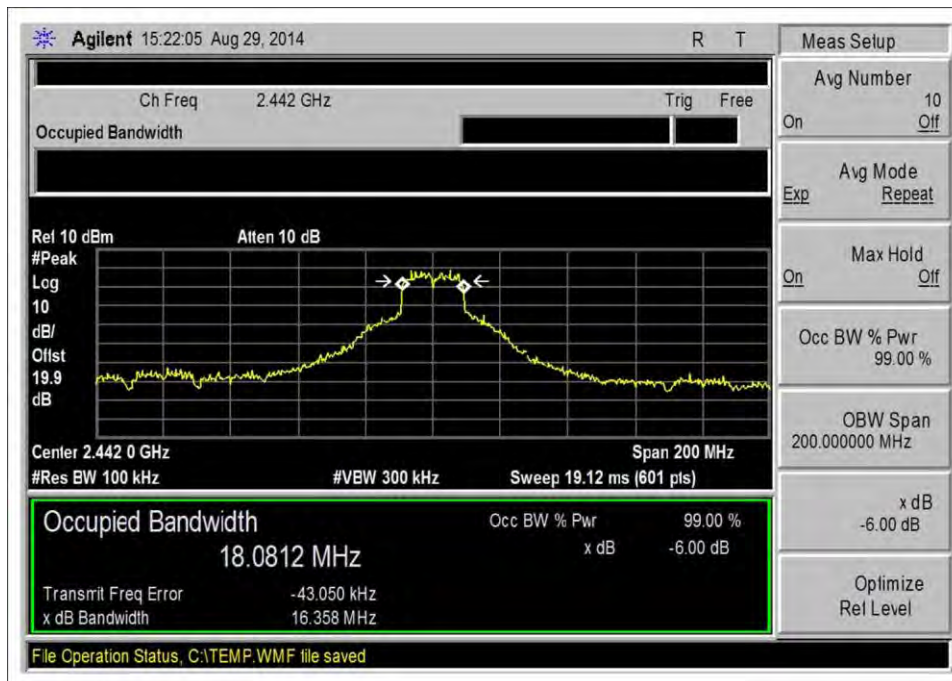
Middle Channel, N MCS3



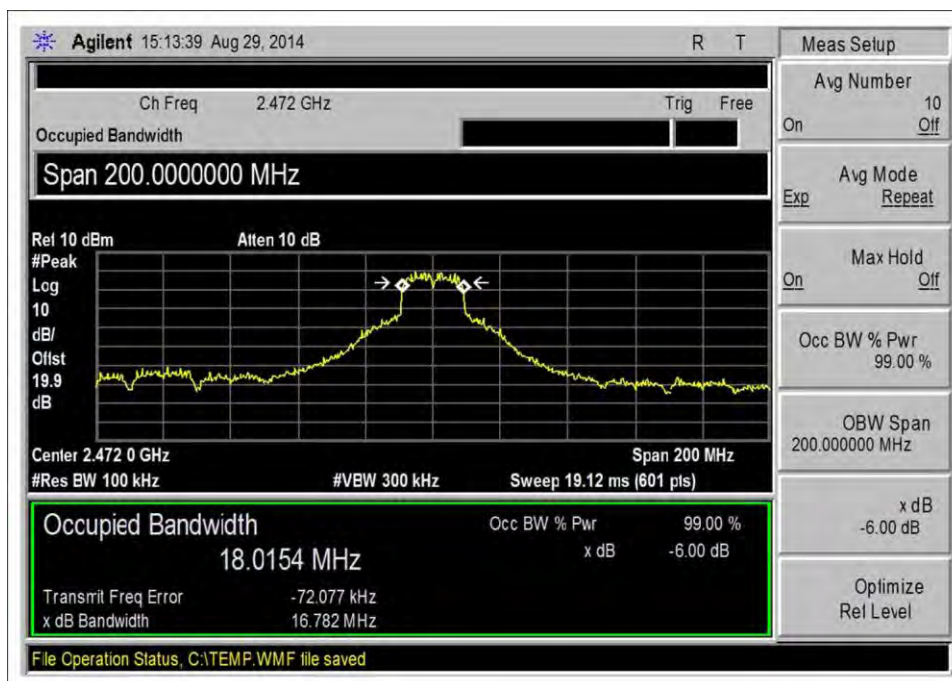
High Channel, N MCS3



Low Channel, N MCS7



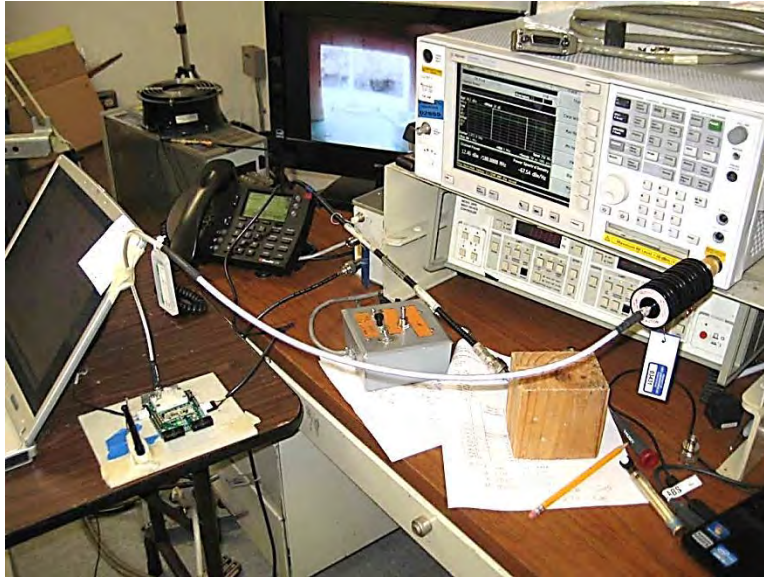
Middle Channel, N MCS7



High Channel, N MCS7



## Test Setup Photo



## 15.247(b)(3) RF Power Output

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714 993-6112

Customer: **HITEM**

Specification: **15.247(b)(3)**

Work Order #: **95696**

Date: 8/29/2014, 11/13/2014

Test Type: **Maximum Peak Conducted Output Power**

Equipment: 2.4 GHz transmitter module

Manufacturer: HITEM

Tested By: Don Nguyen/S. Yamamoto

Model: Skybell

S/N: (none)

#### Test Equipment:

Asset #	Description	Model	Calibration Date	Cal Due Date
03431	Attenuator	89-20-21	9/5/2013	9/5/2015
P06544	Cable	32026-29094K-29094K-36TC	11/20/2013	11/20/2015
02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015

#### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz transmitter module*	HITEM	Skybell	(none)

#### Support Devices:

Function	Manufacturer	Model #	S/N
Laptop Computer	Averatec	5100 Series	NA
Power Supply	Jentec Technology Co., LTD.	AF1805-A	LF4R01082201507
Wireless Test Fixture	HITEM	Generic	Generic
Power Supply	LITEON	PA-1600-05	3600324901

#### Test Conditions / Notes:

The equipment under test (EUT) is a wireless module which is installed in the test fixture. The antenna connector port is connected to the spectrum analyzer. The EUT is connected to a support located laptop computer via USB cable. The computer is running software Production Test GUI to setup EUT transmitting protocol.

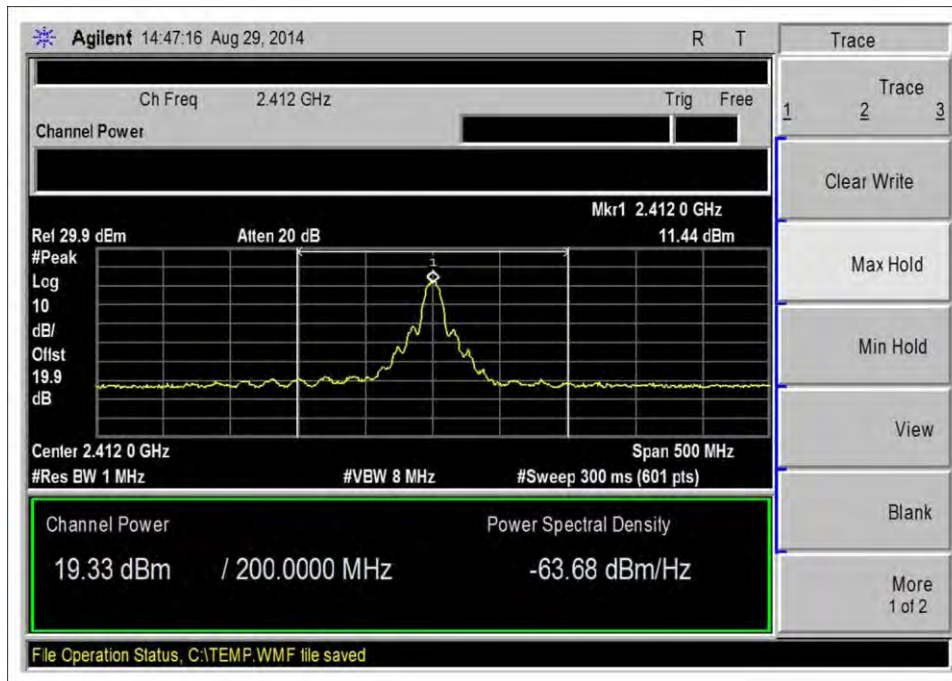
The test frequencies are 2412MHz, 2442MHz, and 2472MHz.  
An external DC power adapter is also connected to the wireless test fixture.  
Frequency range of measurement, 2400MHz to 2483.5MHz.

Temperature: 20°C  
Relative Humidity: 35%  
Pressure: 100kPa

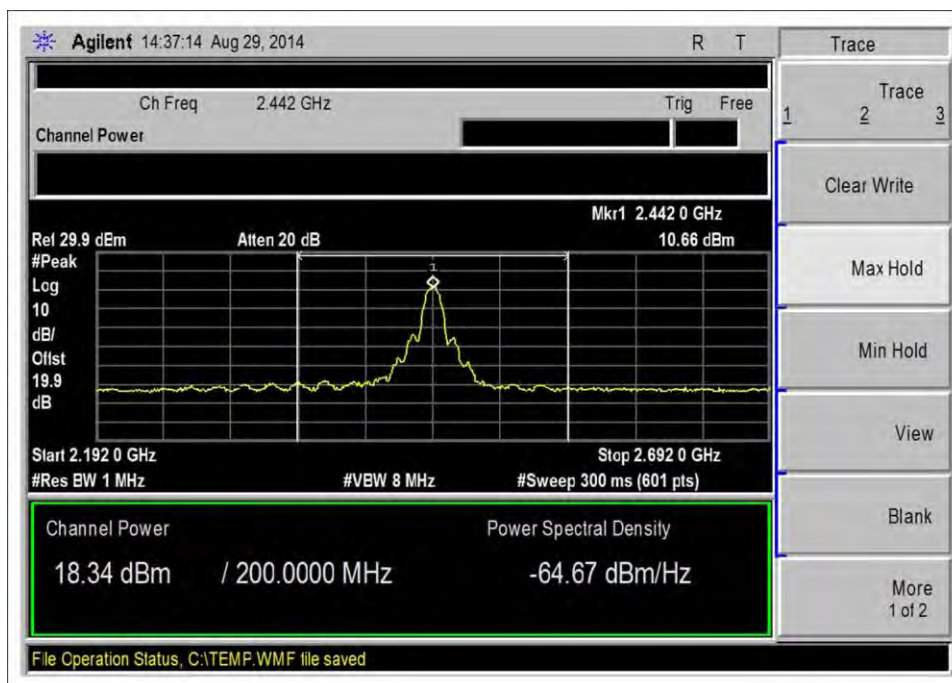
Site D

Maximum Peak Conducted Output Test Summary				
Frequency (MHz)	Measured peak conducted output power (dBm)	Equivalent measured peak conducted output power (W)	15.247(b)(3) Maximum peak output power limit (W)	Notes
2412	19.3	0.085	1	802.11b 11Mbps
2442	18.3	0.068	1	802.11b 11Mbps
2472	17.5	0.056	1	802.11b 11Mbps
2412	18.1	0.065	1	802.11g 54Mbps
2442	16.6	0.046	1	802.11g 54Mbps
2472	12.9	0.019	1	802.11g 54Mbps
2412	16.0	0.040	1	802.11n HT20 MCS3
2442	14.7	0.030	1	802.11n HT20 MCS3
2472	14.7	0.030	1	802.11n HT20 MCS3
2412	15.2	0.033	1	802.11n HT20 MCS7
2442	14.0	0.025	1	802.11n HT20 MCS7
2472	14.2	0.026	1	802.11n HT20 MCS7

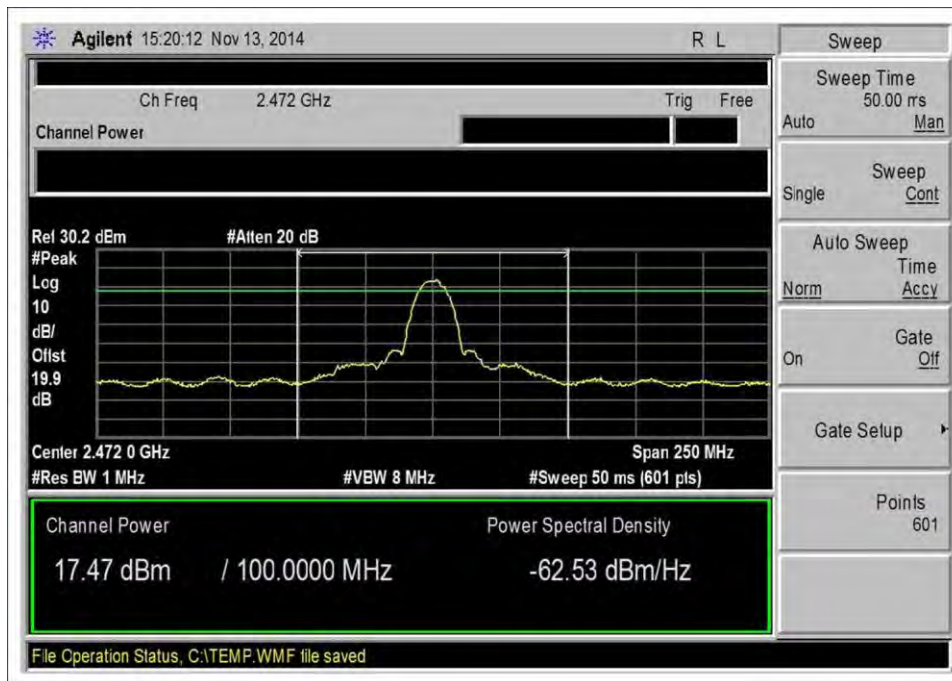
## Test Data



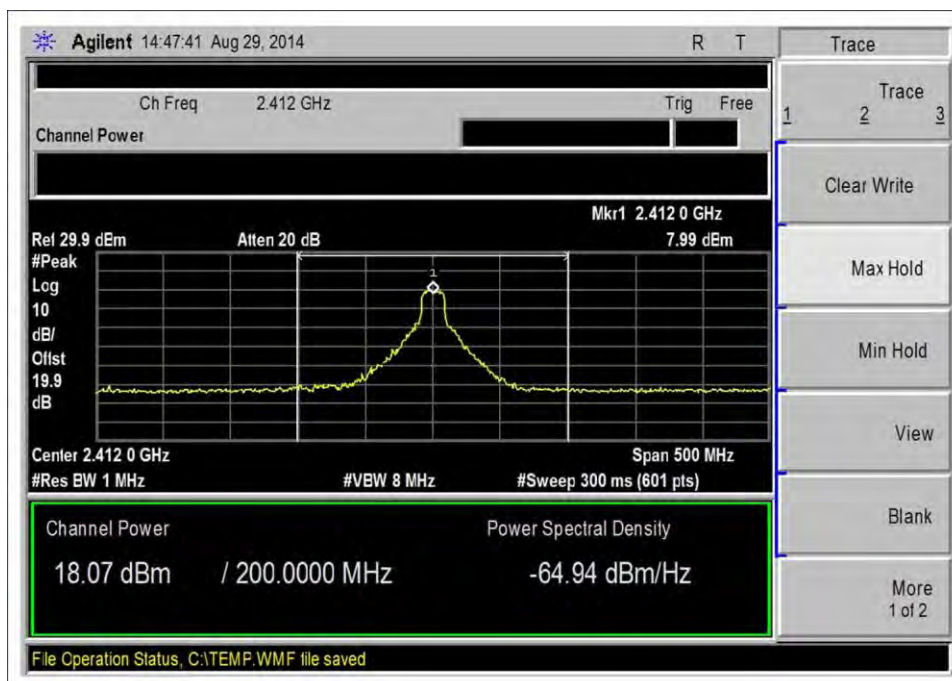
Low Channel, B 11mbps



Middle Channel, B 11mbps

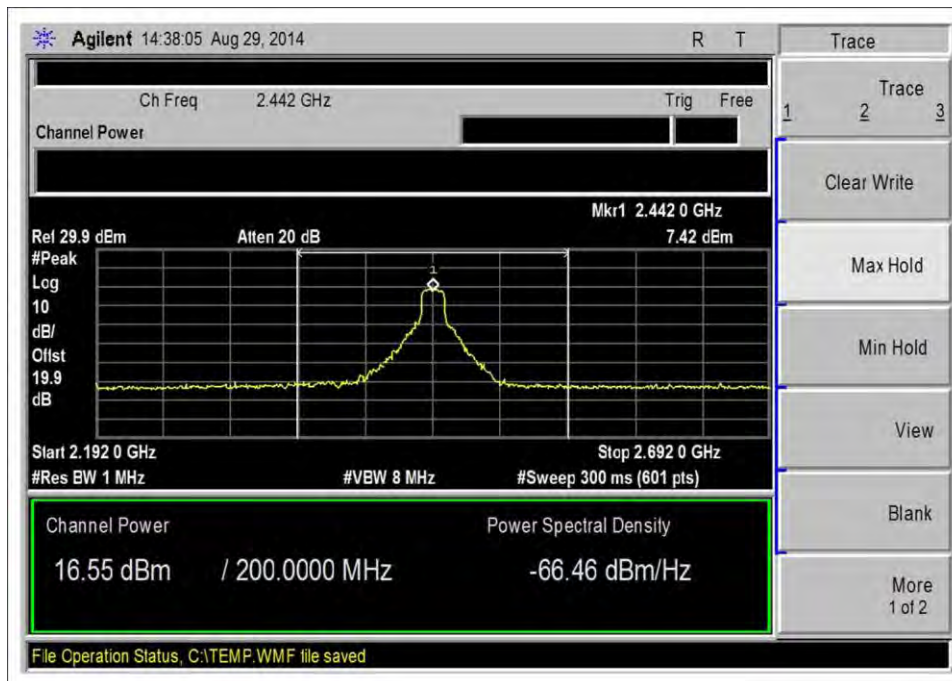


High Channel, B 11mbps

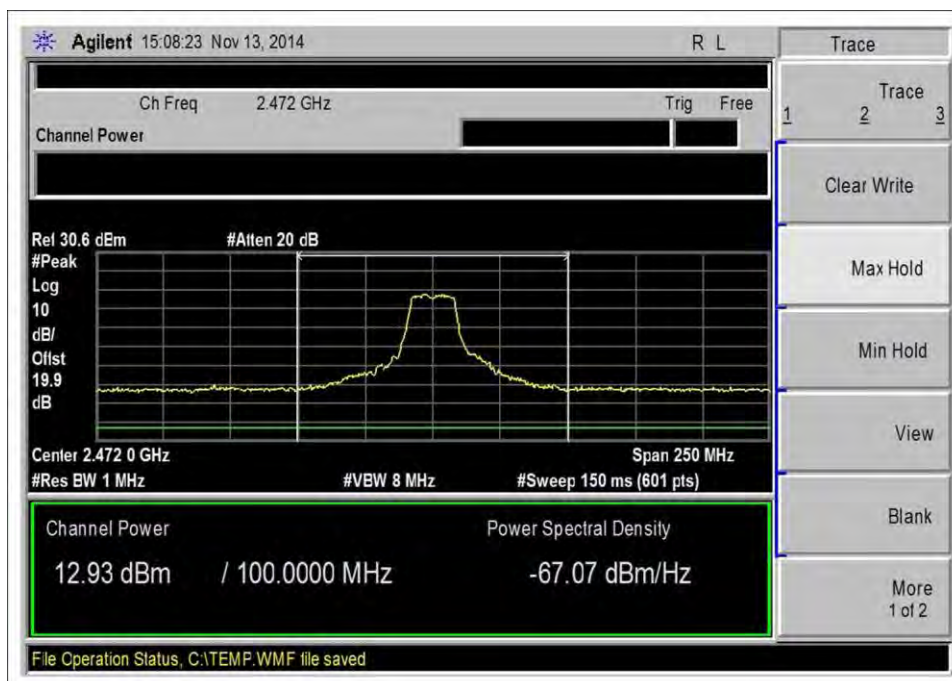


Low Channel, G 54mbps

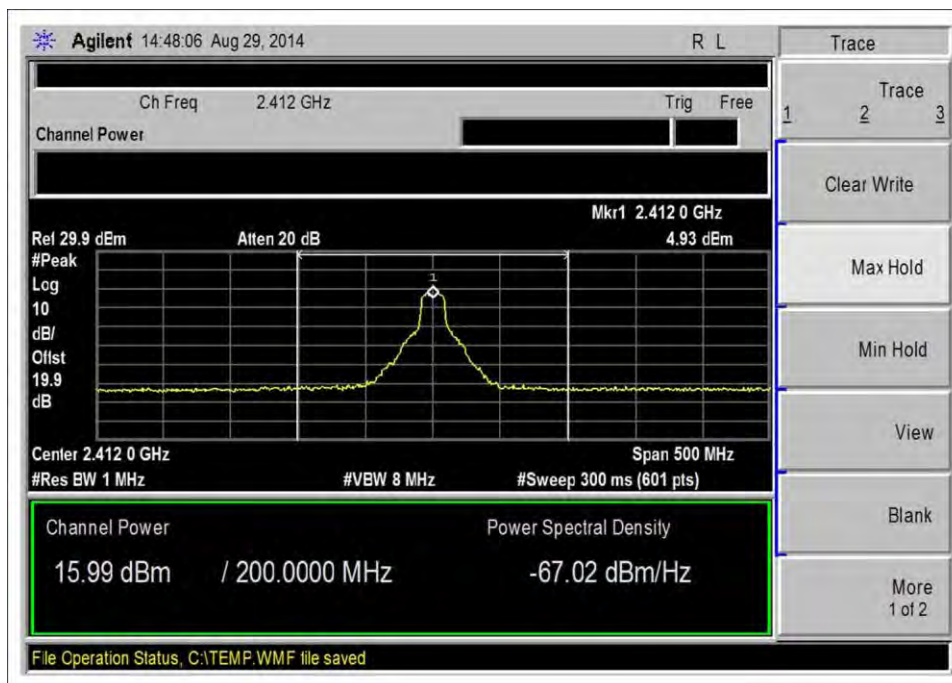




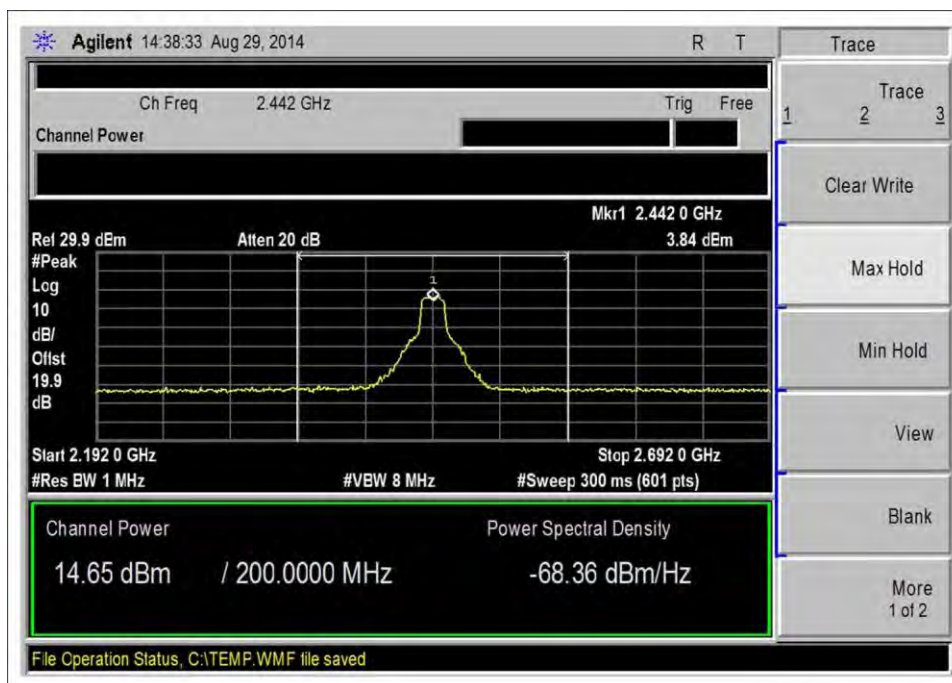
Middle Channel, G 54mbps



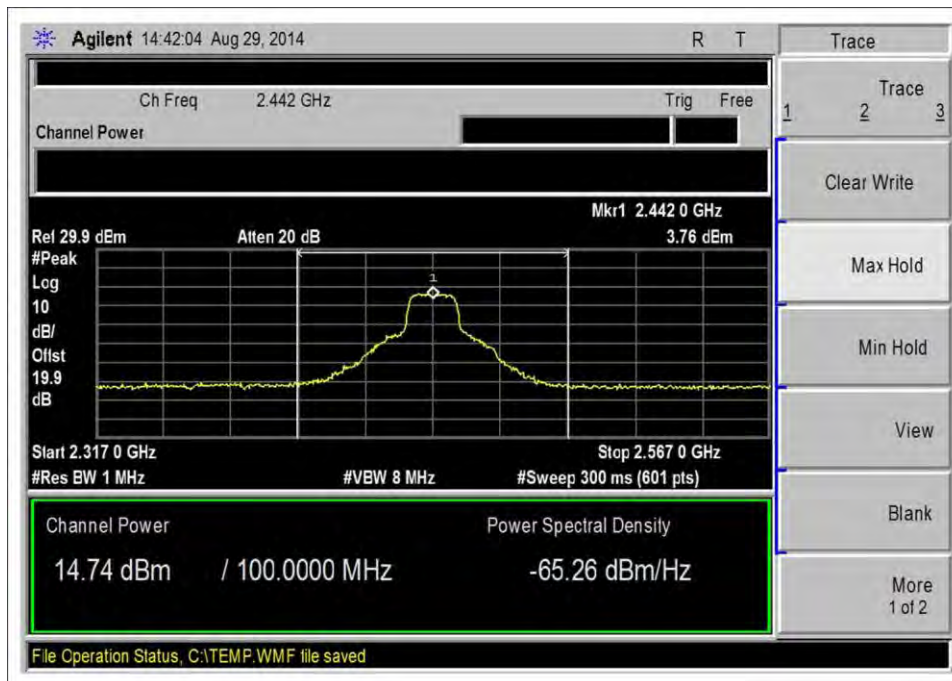
High Channel, G 54mbps



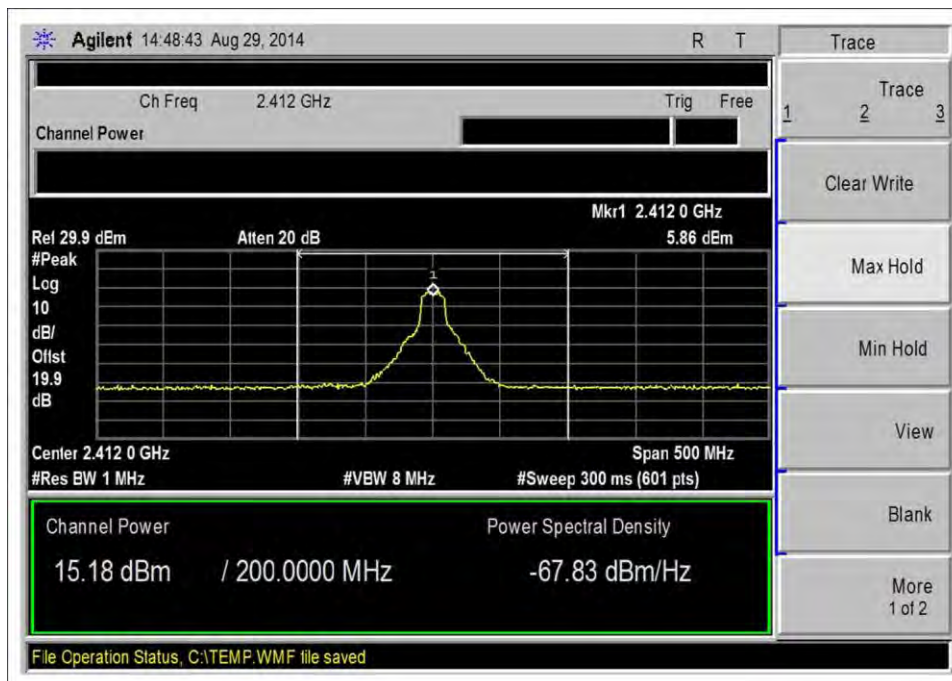
Low Channel, N MCS3



Middle Channel, N MCS3

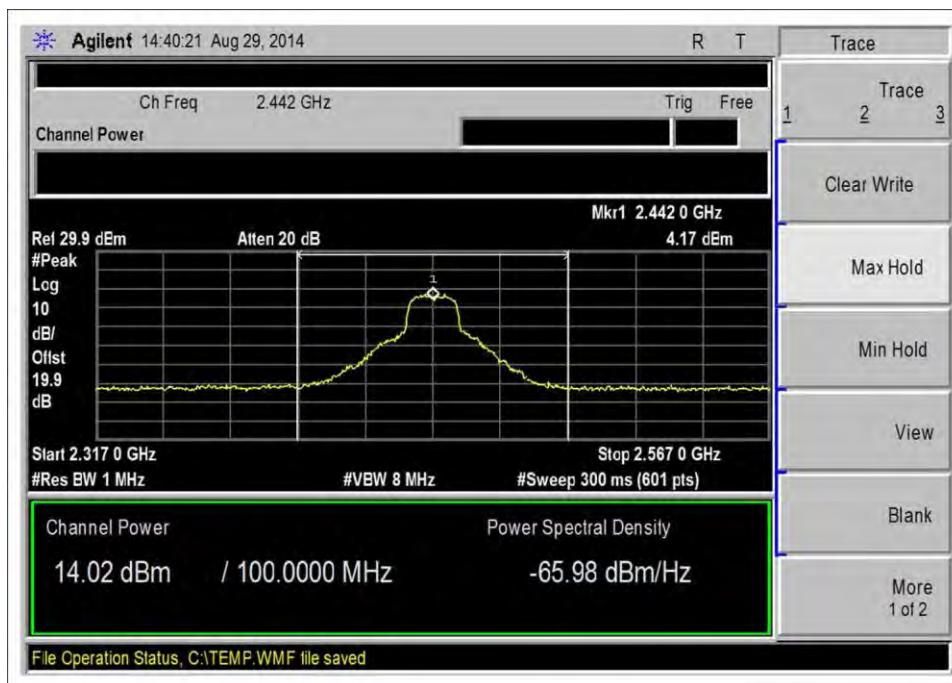


High Channel, N MCS3

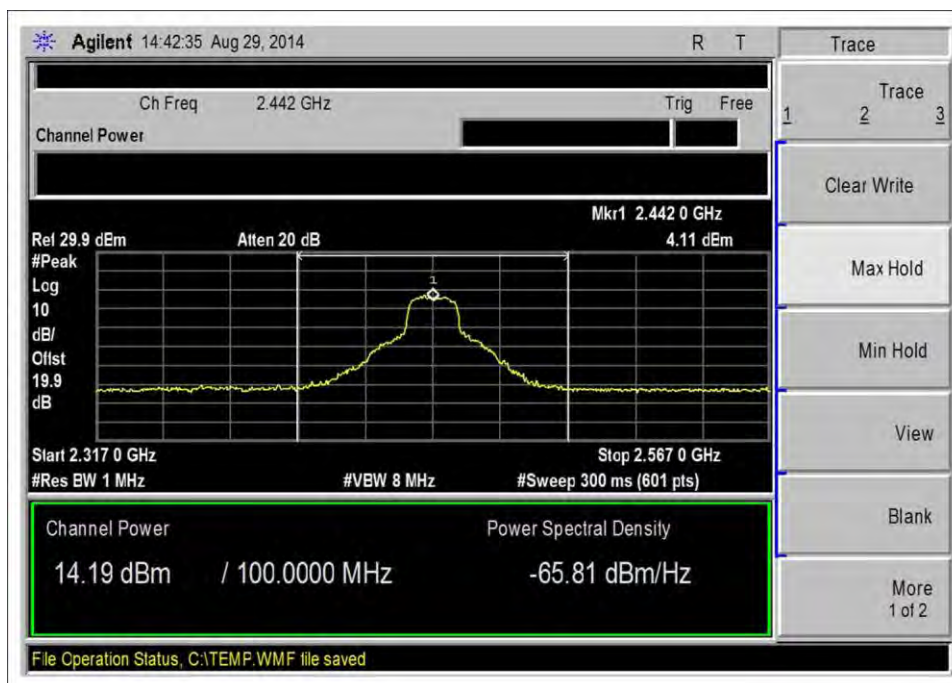


Low Channel, N MCS7



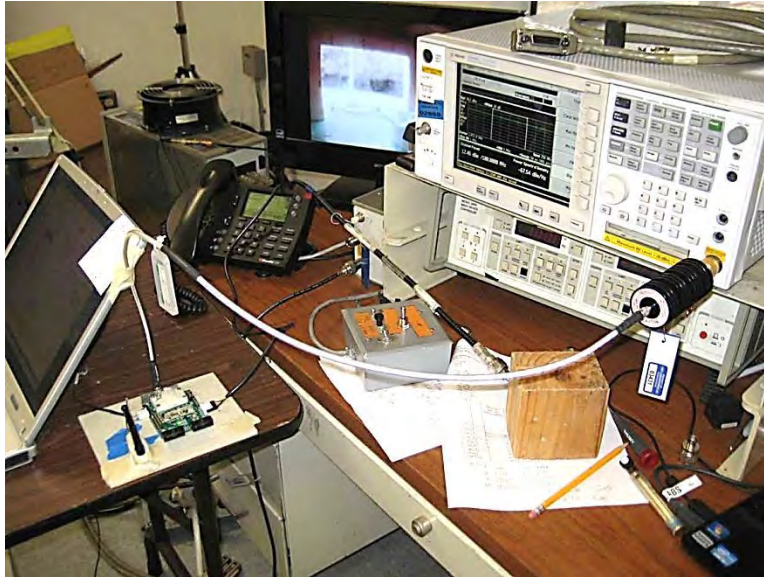


Middle Channel, N MCS7



High Channel, N MCS7

## Test Setup Photo



## 15.247(d) Conducted Spurious Emissions

### Test Conditions / Setup / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714 993 6112

Customer: **HITEM**

Specification: **15.247(d) Conducted Spurious Emissions**

Work Order #: **95696**

Test Type: **Conducted Emissions**

Equipment: **2.4 GHz transmitter module**

Manufacturer: **HITEM**

Model: **Skybell**

S/N: **NA**

Date: 9/9/2014

Time: 14:27:16

Sequence#: 1

Tested By: E. Wong

120V 60Hz

#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015
T1	AN03431	Attenuator	89-20-21	9/5/2013	9/5/2015
T2	ANP06544	Cable	32026-29094K- 29094K-36TC	11/20/2013	11/20/2015
T3	AN03386	High Pass Filter	11SH10- 3000/T10000- O/O	6/5/2013	6/5/2015

#### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz transmitter module*	HITEM	Skybell	NA

#### Support Devices:

Function	Manufacturer	Model #	S/N
Power Supply	Jentec	AF1805-A	NA
Laptop	Dell	Averatec	00045-436-018

**Test Conditions / Notes:**

The EUT seeking Limited Module Approval is installed on a development board and place on the test bench.  
The development board is connected to a support laptop.  
The laptop is running test routine to exercise the intended functionalities of the EUT.

Frequency range : 2400- 2483.5MHz

Frequency : 2412MHz, 2442MHz, 2472MHz..

Protocol: 802.11b, 802.11g, 802.11n20 mcs3, 802.11n20,mcs7.

Test environment conditions:

Temperature 29°C

Relative Humidity: 40%

Pressure: 100kPa

Lowest fundamental emissions measured with 100kHz bandwidth in-band of all four protocols was 105.1dBuV.  
Limit line set at 85.1dBuV.

Ext Attn: 0 dB

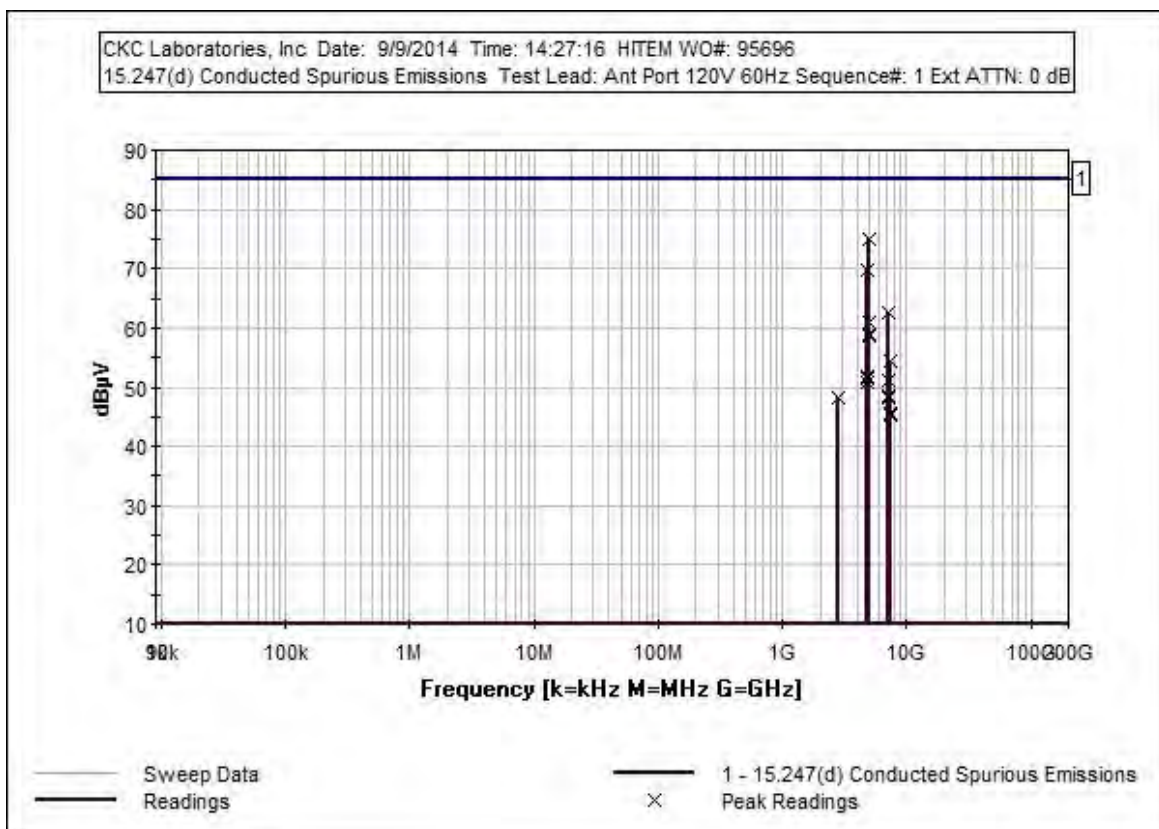
**Measurement Data:**

Reading listed by margin.

Test Lead: Ant Port

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	4944.000M	54.6	+19.1	+0.9	+0.5		+0.0	75.1	85.1 802.11b_H	-10.0	Ant P
2	4823.958M	49.3	+19.2	+0.9	+0.5		+0.0	69.9	85.1 802.11b_L	-15.2	Ant P
3	7236.000M	41.5	+19.7	+1.2	+0.2		+0.0	62.6	85.1 802.11b_L	-22.5	Ant P
4	4945.500M	40.5	+19.1	+0.9	+0.5		+0.0	61.0	85.1 802.11g_H	-24.1	Ant P
5	4943.300M	38.5	+19.1	+0.9	+0.5		+0.0	59.0	85.1 802.11mcs3_H	-26.1	Ant P
6	4949.300M	38.2	+19.1	+0.9	+0.5		+0.0	58.7	85.1 802.11n mcs7_H	-26.4	Ant P
7	7417.450M	33.0	+19.7	+1.2	+0.6		+0.0	54.5	85.1 802.11b_H	-30.6	Ant P
8	4824.300M	31.4	+19.2	+0.9	+0.5		+0.0	52.0	85.1 802.11g_L	-33.1	Ant P
9	4823.170M	30.9	+19.2	+0.9	+0.5		+0.0	51.5	85.1 802.11nmcs3_L	-33.6	Ant P
10	7234.300M	30.2	+19.7	+1.2	+0.2		+0.0	51.3	85.1 802.11g_L	-33.8	Ant P
11	4824.000M	30.1	+19.2	+0.9	+0.5		+0.0	50.7	85.1 802.11nmcs7_L	-34.4	Ant P

12	7232.300M	27.5	+19.7	+1.2	+0.2	+0.0	48.6	85.1	-36.5	Ant P
								802.11n mcs7_L		
13	7236.000M	27.0	+19.7	+1.2	+0.2	+0.0	48.1	85.1	-37.0	Ant P
								802.11n mcs3_L		
14	2792.000M	22.7	+19.3	+0.7	+5.4	+0.0	48.1	85.1	-37.0	Ant P
								802.11n mcs3_L		
15	7416.000M	24.3	+19.7	+1.2	+0.6	+0.0	45.8	85.1	-39.3	Ant P
								802.11g_H		
16	7416.000M	24.0	+19.7	+1.2	+0.6	+0.0	45.5	85.1	-39.6	Ant P
								802.11mcs3_H		
17	7416.000M	23.8	+19.7	+1.2	+0.6	+0.0	45.3	85.1	-39.8	Ant P
								802.11n mcs7_H		



## Test Setup Photo





## 15.247(d) / 15.209 Radiated Spurious Emissions and Band Edge

### Test Conditions / Setup / Data

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92821 • 714 993 6112

Customer: **HITEM**  
 Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**  
 Work Order #: **95696** Date: 9/10/2014 -11/19/2014  
 Test Type: **Radiated Scan** Time: 13:53:38  
 Equipment: **2.4 GHz transmitter module** Sequence#: 8  
 Manufacturer: HITEM Tested By: E. Wong / S. Yamamoto  
 Model: Skybell  
 S/N: NA

#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015
T2	AN01646	Horn Antenna	3115	3/18/2014	3/18/2016
T3	AN00787	Preamplifier	83017A	5/31/2013	5/31/2015
T4	ANP06544	Cable	32026-29094K-29094K-36TC	11/20/2013	11/20/2015
T5	ANP04382	Cable	LDF-50	7/30/2014	7/30/2016
T6	ANP06360	Cable	L1-PNMNM-48	7/29/2014	7/29/2016
	AN03385	High Pass Filter	11SH10-3000/T10000-O/O	6/5/2013	6/5/2015
	AN00314	Loop Antenna	6502	7/2/2014	7/2/2016
	ANP05050	Cable	RG223/U	1/21/2013	1/21/2015
	AN00309	Preamplifier	8447D	3/12/2014	3/12/2016
	ANP05198	Cable	8268	12/11/2012	12/11/2014
	AN01995	Biconilog Antenna	CBL6111C	4/30/2014	4/30/2016
	AN02945	Cable	32022-2-2909K-36TC	10/30/2013	10/30/2015
	AN01413	Horn Antenna	84125-80008	11/9/2012	11/9/2014

Note: The actual date of testing with the above equipment AN01413 was 9/10/2014.

#### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz transmitter module*	HITEM	Skybell	NA

#### Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Dell	Averatec	00045-436-018
Power Supply	Topward	6306D	988614

**Test Conditions / Notes:**

The EUT seeking Limited Module Approval is installed on a development board and place on the Styrofoam surface of 10 cm thickness. The development board is connected to a support laptop. The laptop is running test routine to exercise the intended functionalities of the EUT.

Frequency range of EUT: 2400- 2483.5MHz

Frequencies of EUT during testing: 2412, 2442, 2472MHz

Protocol : 802.11b, 802.11g, 802.11n-mcs3, 802.11n-mcs7

Test environment conditions:

Temperature: 29°C

Relative Humidity: 40%

Pressure: 100kPa

Frequency range of measurement for this data sheet= 9kHz- 25GHz.

9kHz -150kHz;RBW=200Hz,VBW=200Hz;150kHz-30MHz;RBW=9kHz,VBW=9 kHz;30 MHz-1000 MHz;RBW=120kHz,VBW=120kHz,1000 MHz-25000MHz;RBW=1MHz,VBW=1MHz.

Emission profile of the EUT rotated along three orthogonal axes was investigated. Besides the contained band edge emissions, there were no emissions found within 20dB of the limit line in the range of 9kHz to 25GHz.

Ext Attn: 0 dB

**Measurement Data:**

Reading listed by margin.

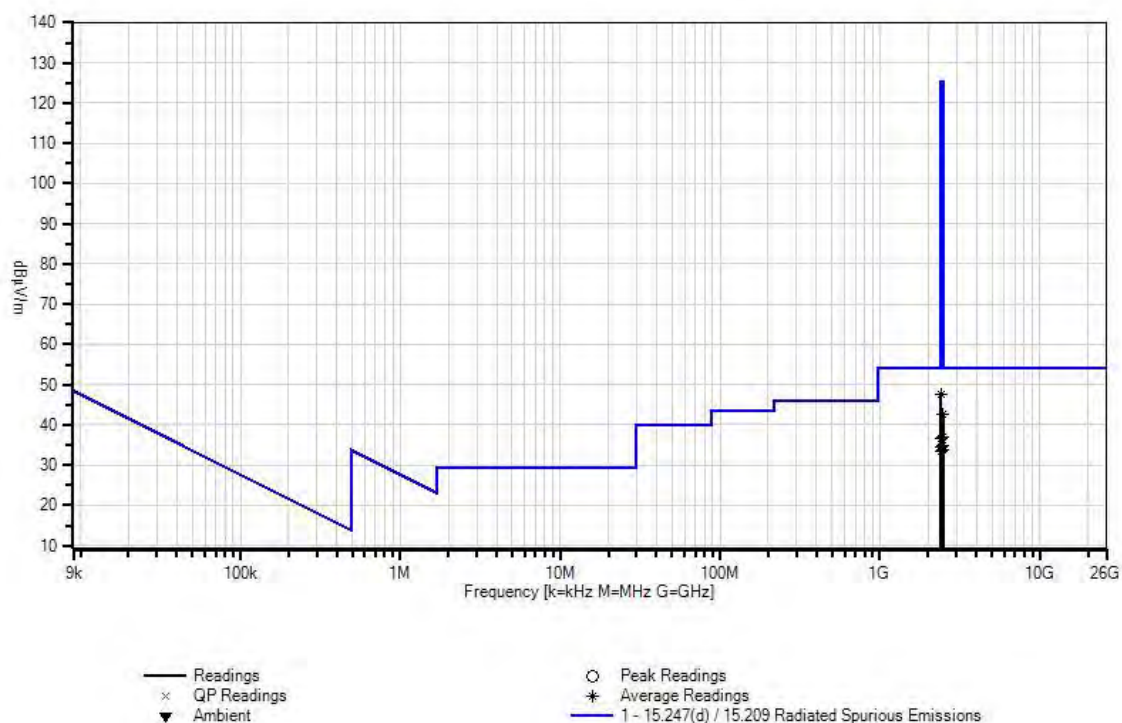
Test Distance: 3 Meters

#	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	2400.000M Ave	51.5	+0.0 +6.5	+25.4 +3.2	-39.7	+0.6	+0.0	47.5	54.0	-6.5	Vert
2	2483.500M Ave	46.4	+0.0 +6.5	+25.5 +3.4	-39.7	+0.7	+0.0	42.8	54.0	-11.2	Vert
3	2483.500M Ave	40.4	+0.0 +6.5	+25.5 +3.4	-39.7	+0.7	+0.0	36.8	54.0	-17.2	Vert
4	2400.000M Ave	40.5	+0.0 +6.5	+25.4 +3.2	-39.7	+0.6	+0.0	36.5	54.0	-17.5	Vert
5	2483.500M Ave	38.4	+0.0 +6.5	+25.5 +3.4	-39.7	+0.7	+0.0	34.8	54.0	-19.2	Vert
6	2400.000M Ave	38.5	+0.0 +6.5	+25.4 +3.2	-39.7	+0.6	+0.0	34.5	54.0	-19.5	Vert
7	2483.500M Ave	37.4	+0.0 +6.5	+25.5 +3.4	-39.7	+0.7	+0.0	33.8	54.0	-20.2	Vert
^	2483.500M	75.6	+0.0 +6.5	+25.5 +3.4	-39.7	+0.7	+0.0	72.0	54.0	+18.0	Vert
^	2483.500M	75.2	+0.0 +6.5	+25.5 +3.4	-39.7	+0.7	+0.0	71.6	54.0	+17.6	Vert
^	2483.500M	74.8	+0.0 +6.5	+25.5 +3.4	-39.7	+0.7	+0.0	71.2	54.0	+17.2	Vert
^	2483.500M	72.6	+0.0 +6.5	+25.5 +3.4	-39.7	+0.7	+0.0	69.0	54.0	+15.0	Vert



12	2400.000M	37.5	+0.0	+25.4	-39.7	+0.6	+0.0	33.5	54.0	-20.5	Vert
	Ave		+6.5	+3.2							
^	2400.000M	72.4	+0.0	+25.4	-39.7	+0.6	+0.0	68.4	54.0	+14.4	Vert
			+6.5	+3.2							
^	2400.000M	69.6	+0.0	+25.4	-39.7	+0.6	+0.0	65.6	54.0	+11.6	Vert
			+6.5	+3.2							
^	2400.000M	61.9	+0.0	+25.4	-39.7	+0.6	+0.0	57.9	54.0	+3.9	Vert
			+6.5	+3.2							

CKC Laboratories, Inc Date: 11/19/2014 Time: 13:53:38 HITEM WO#: 95696  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Sequence#: 8 Ext ATTN: 0 dB



## Band Edge

## Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 110 N. Olinda Place • Brea, CA 92823 • 714 993-6112

Customer: **HITEM**  
 Specification: **ITU-R 55/1**  
 Work Order #: **95696** Date: 11/13/2014  
 Test Type: **Band Edge compliance**  
 Equipment: 2.4 GHz transmitter module  
 Manufacturer: HITEM Tested By: S. Yamamoto  
 Model: Skybell  
 S/N: (none)

### Test Equipment:

Asset #	Description	Model	Calibration Date	Cal Due Date
00787	Preamp	83017A	5/31/2013	5/31/2015
01646	Horn Antenna	3115	3/18/2014	3/18/2016
02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015
P04382	Cable	LDF-50	7/30/2014	7/30/2016
P06360	Cable	L1-PNMNM-48	7/29/2014	7/29/2016
P06544	Cable	32026-29094K-29094K-36TC	11/20/2013	11/20/2015

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz transmitter module*	HITEM	Skybell	(none)

### Support Devices:

Function	Manufacturer	Model #	S/N
Laptop Computer	Averatec	5100 Series	NA
Power Supply	Jentec Technology Co., LTD.	AF1805-A	LF4R01082201507
Wireless Test Fixture	HITEM	Generic	Generic
Power Supply	LITEON	PA-1600-05	3600324901

**Test Conditions / Notes:**

The equipment under test (EUT) is a wireless module which is installed in the test fixture. The external antenna is connected to an antenna port. The EUT is connected to a remotely located laptop computer via a USB cable. The computer is running software Production Test GUI to setup EUT transmitting protocol.

The test frequencies are 2412MHz, 2442MHz, and 2472MHz.

An external DC power adapter is also connected to the wireless test fixture.

Frequency range of measurement, 2400MHz to 2483.5MHz.

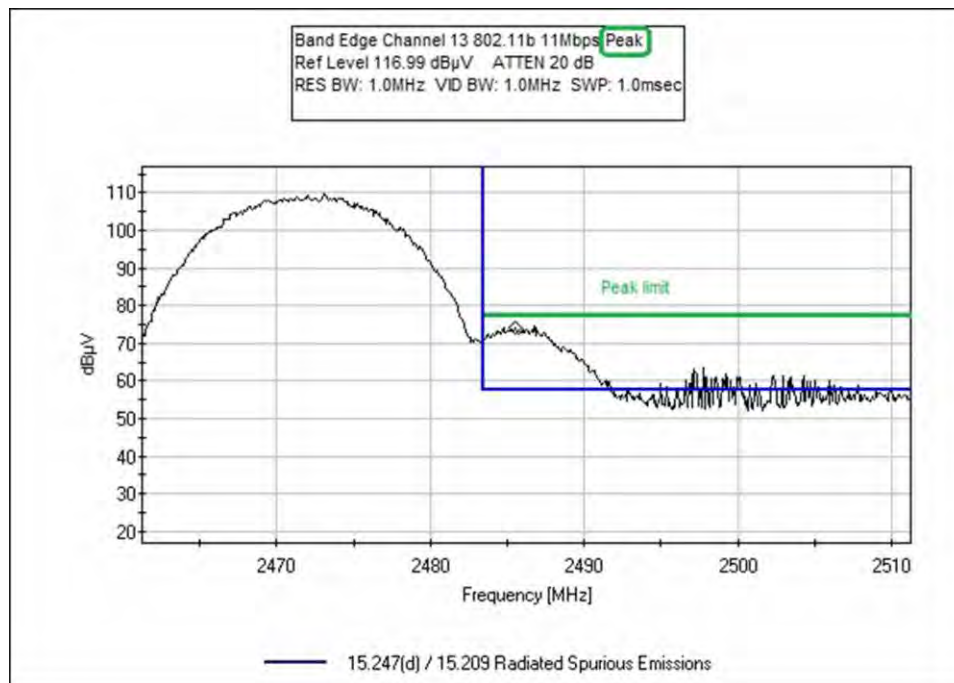
Temperature: 20°C

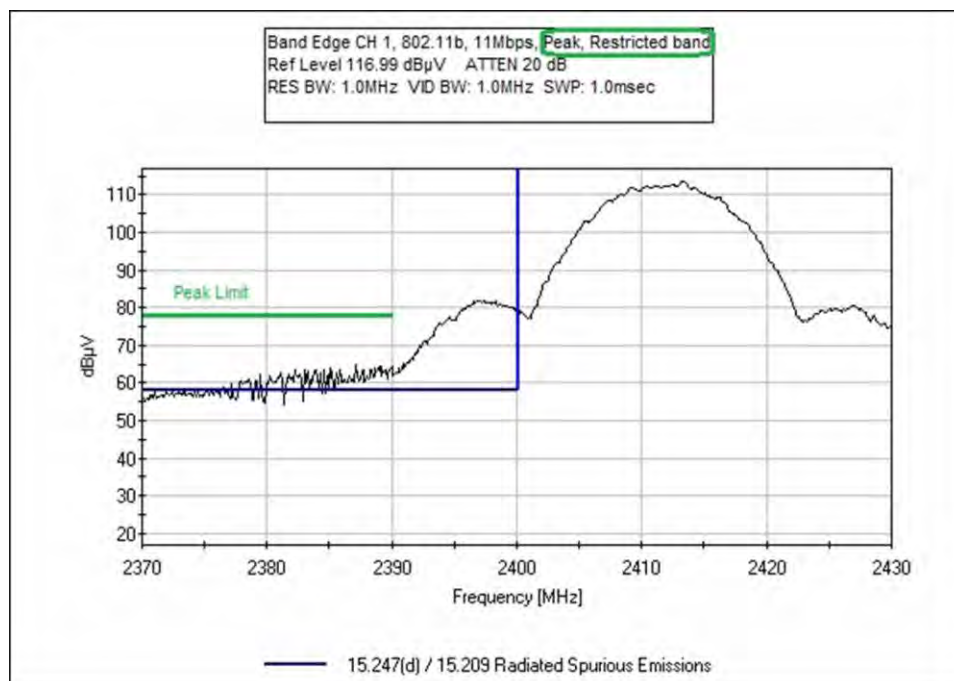
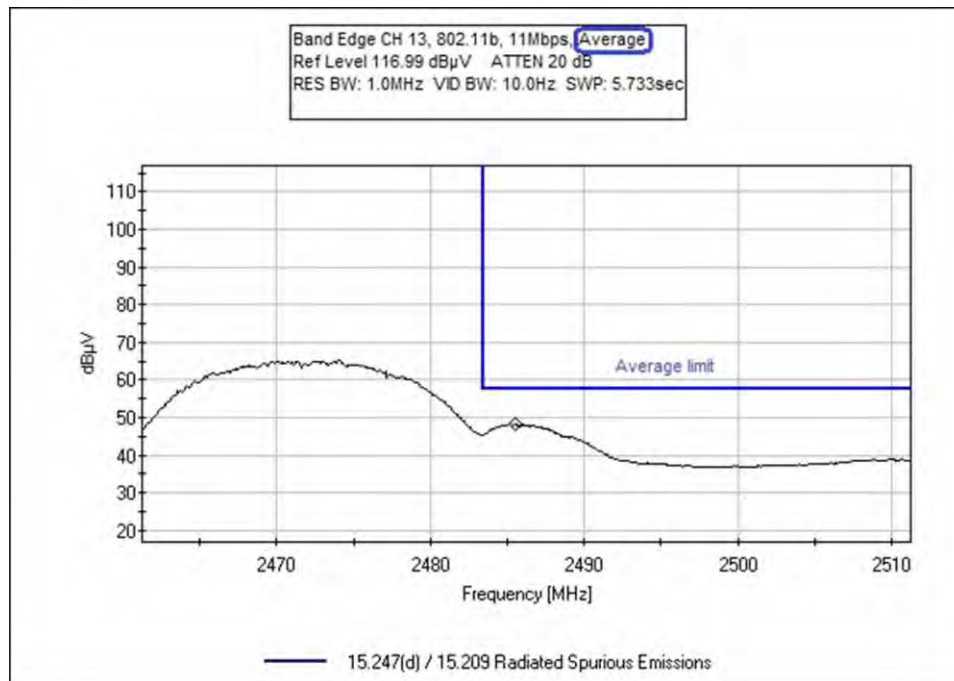
Relative Humidity: 35%

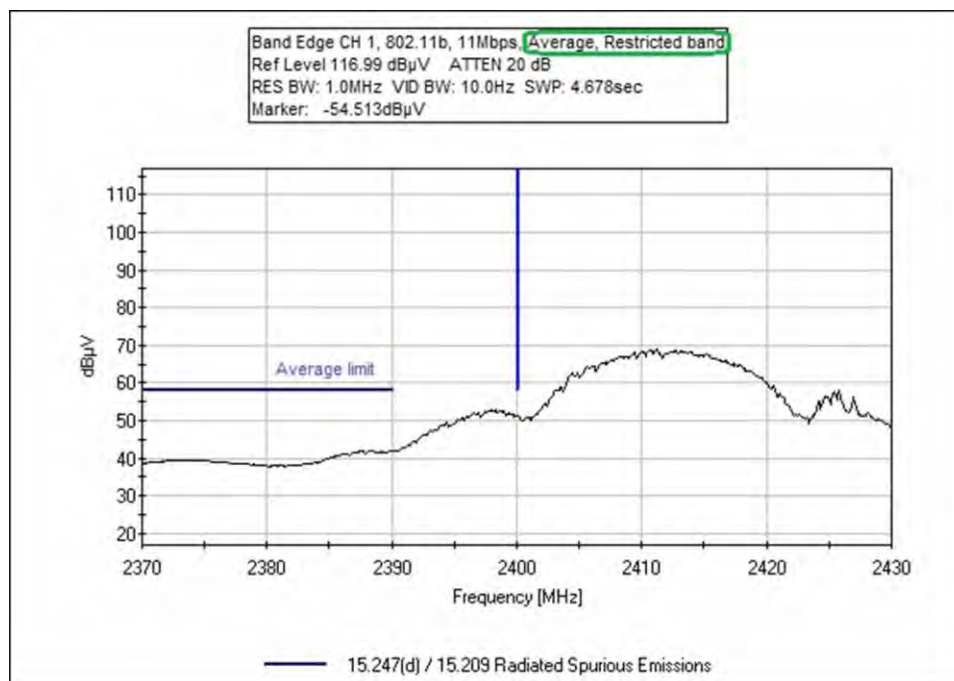
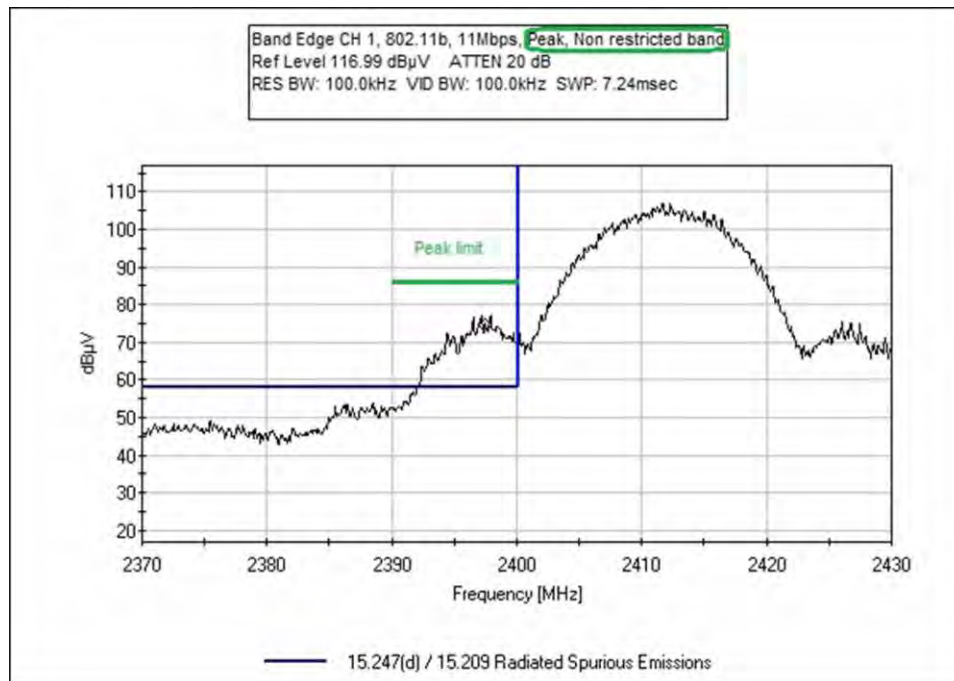
Pressure: 100kPa

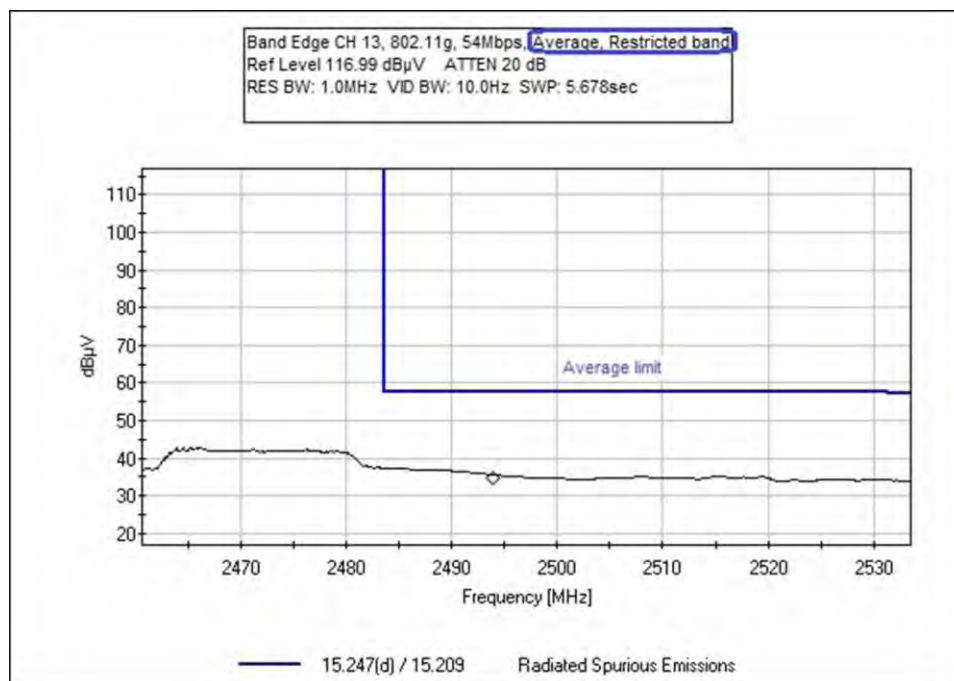
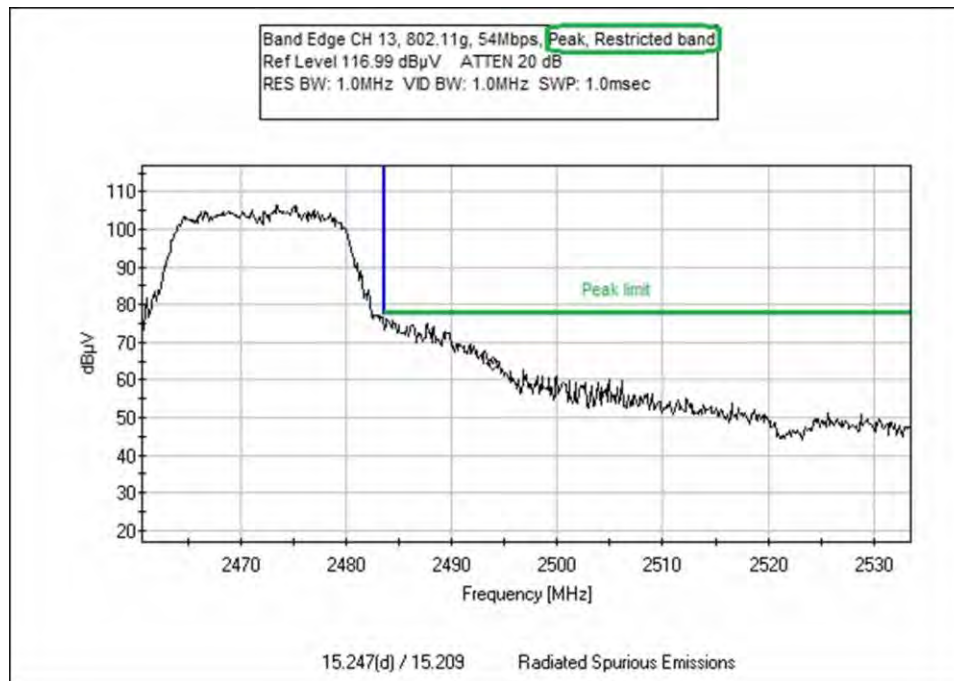
Site D

## Test Data

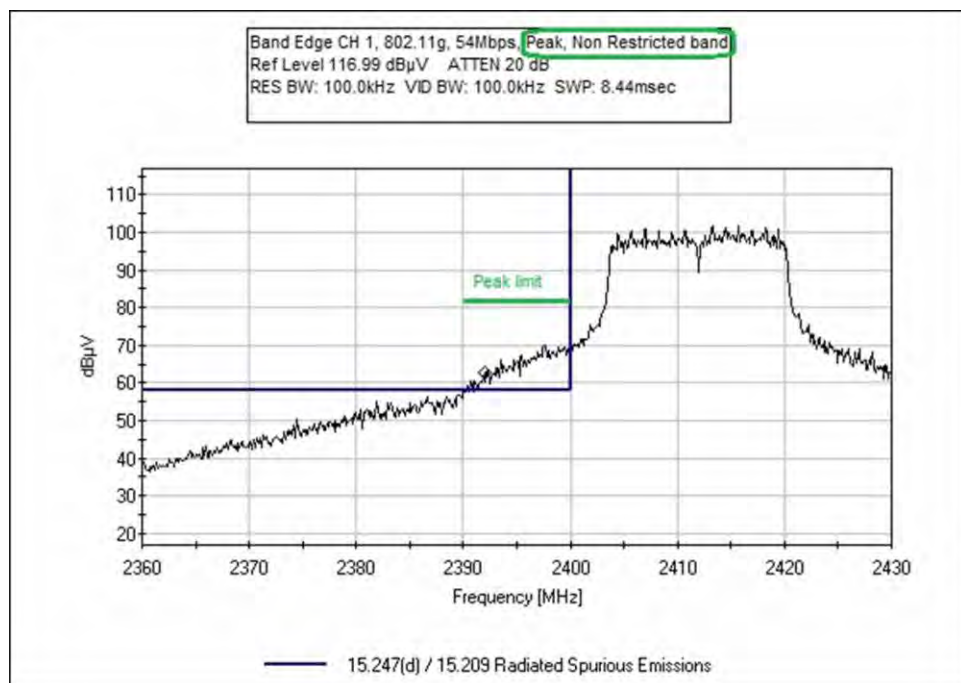
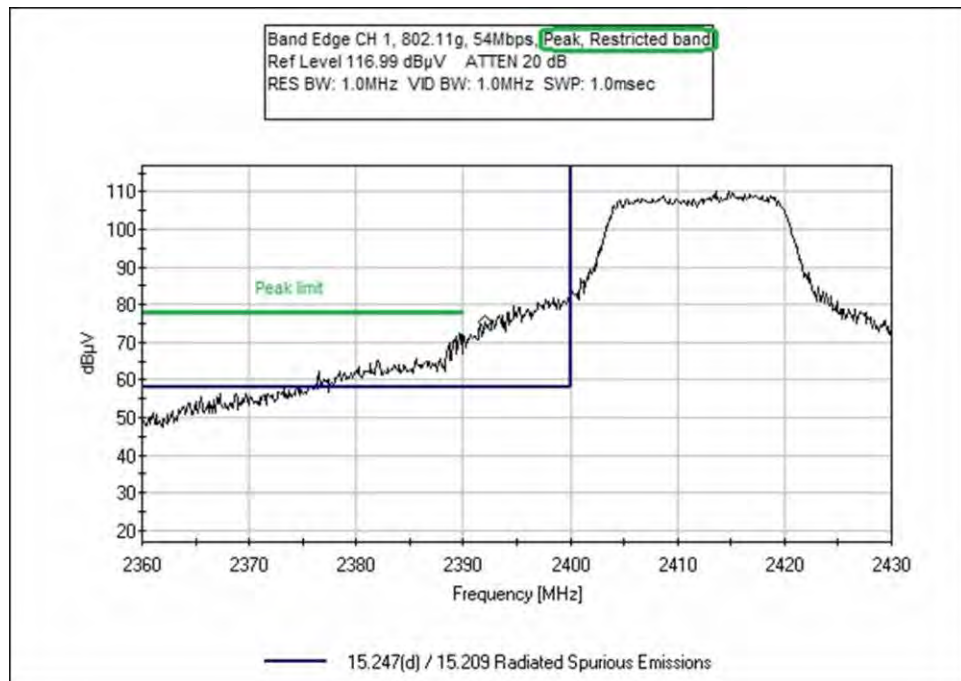


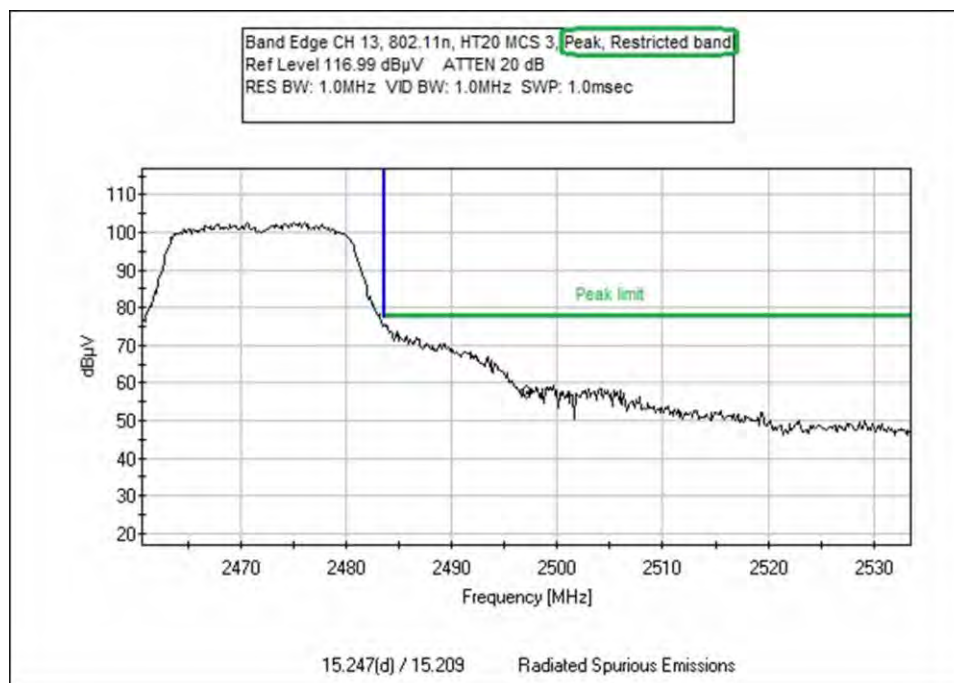
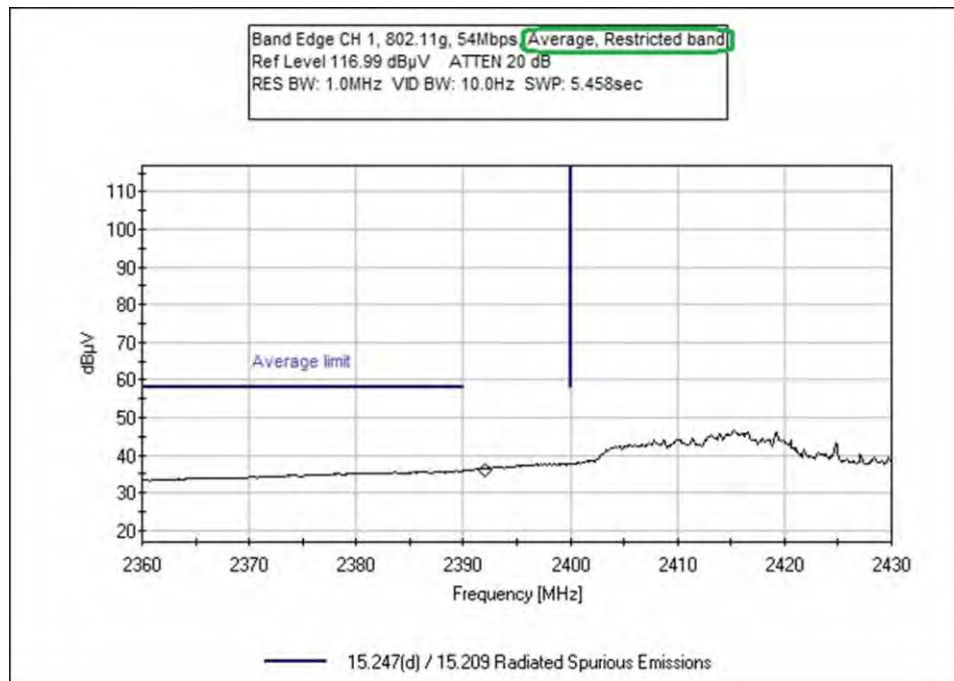




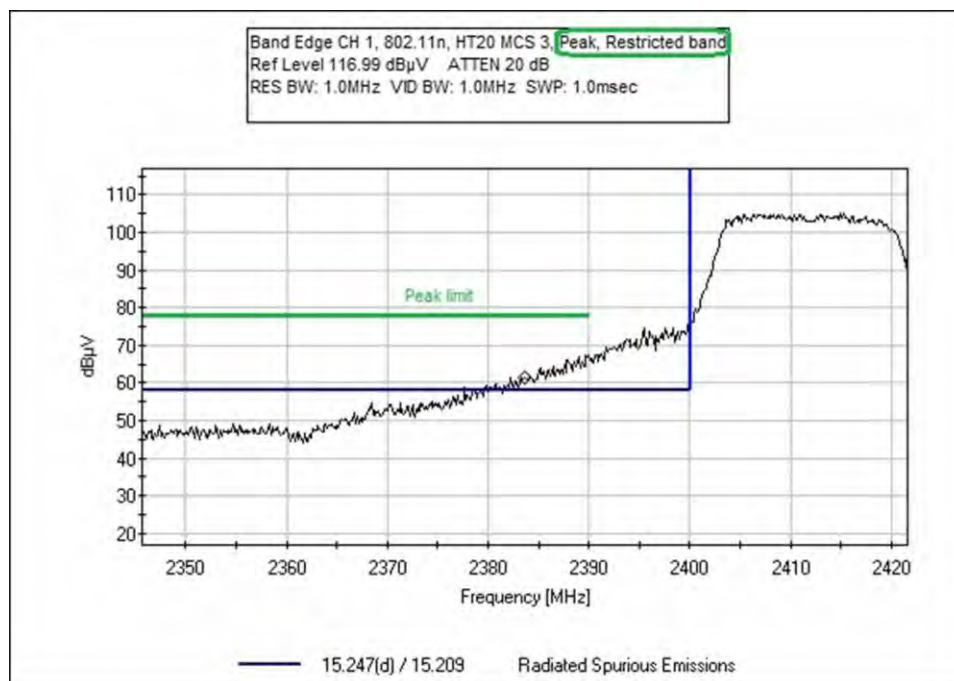
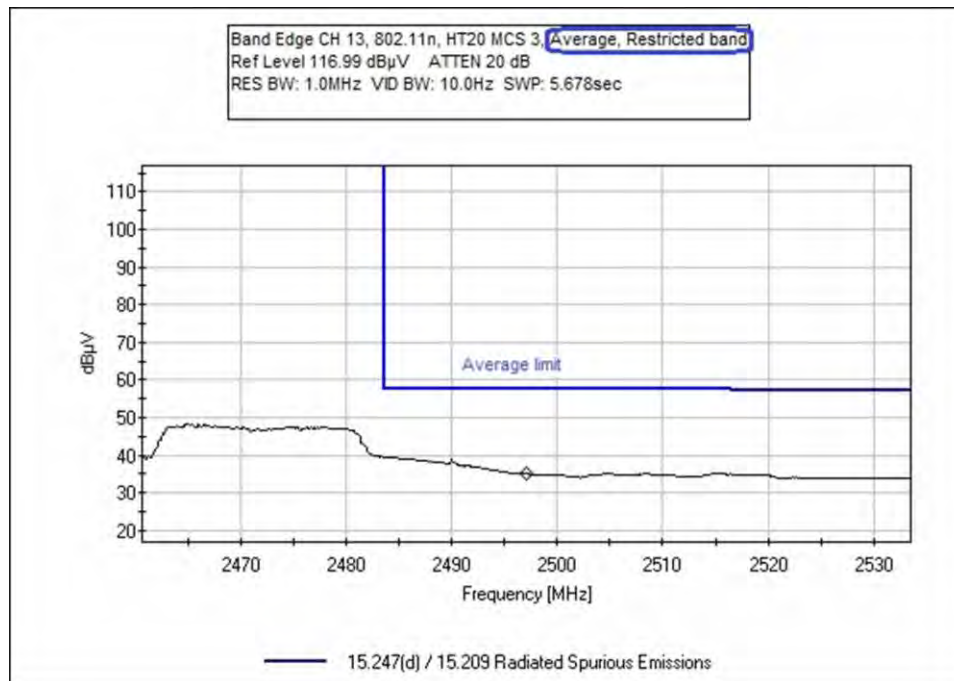


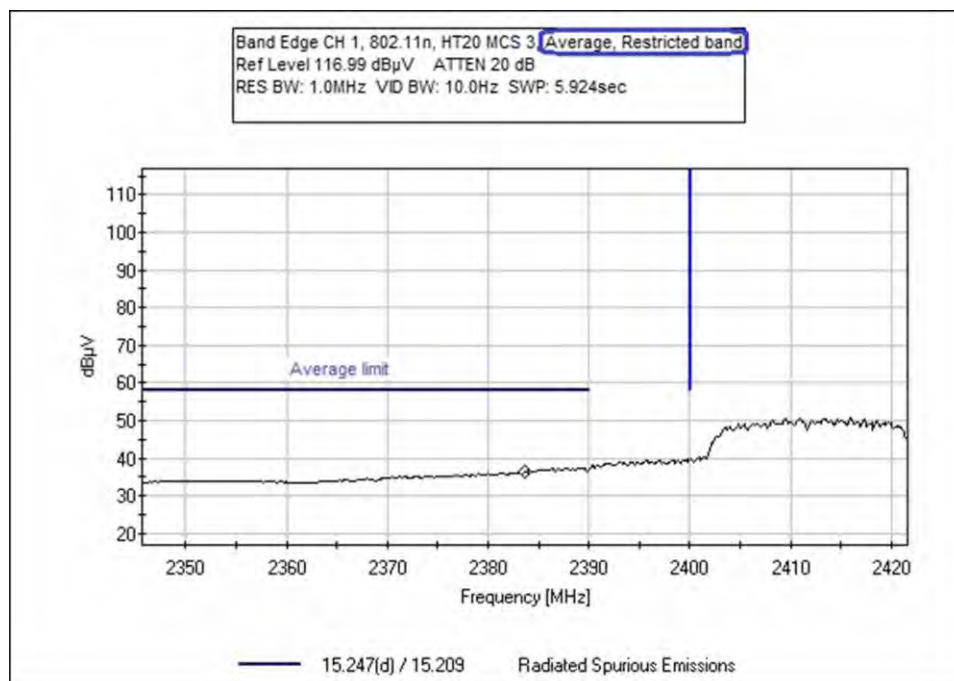
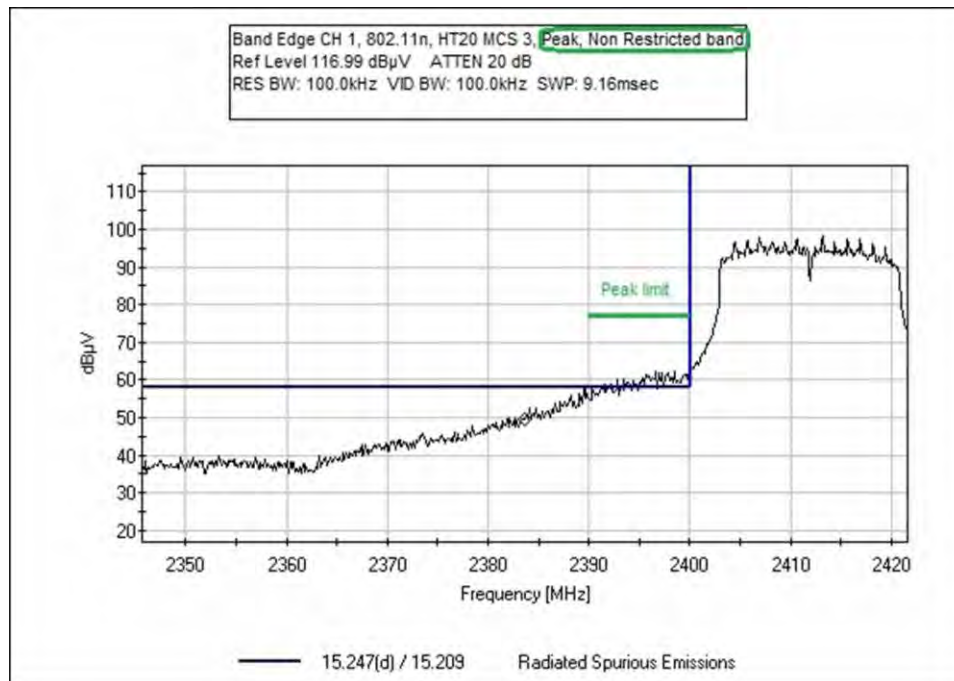


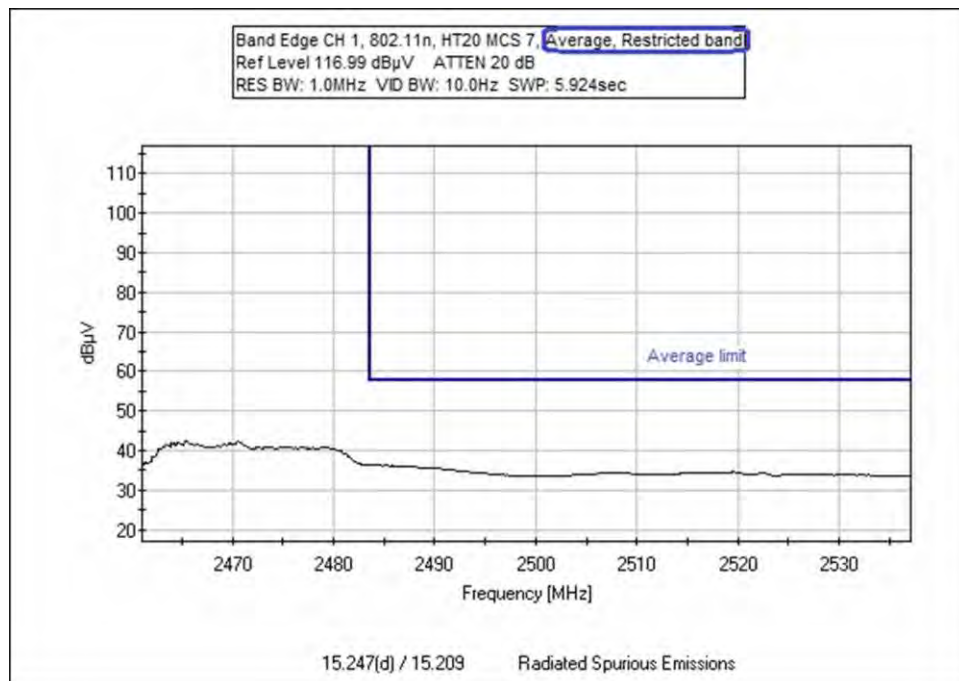
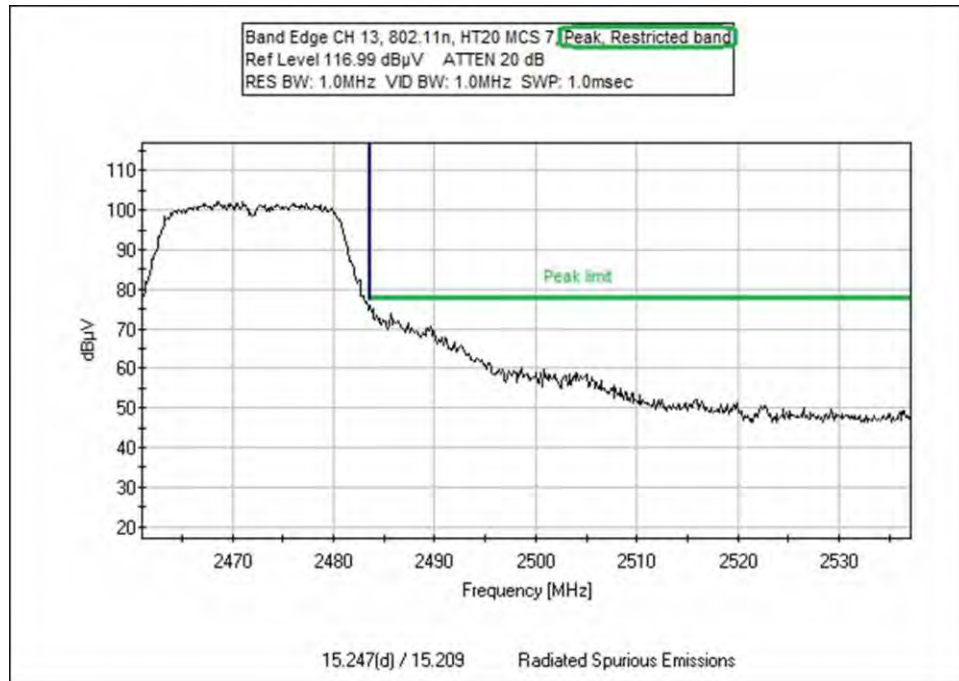


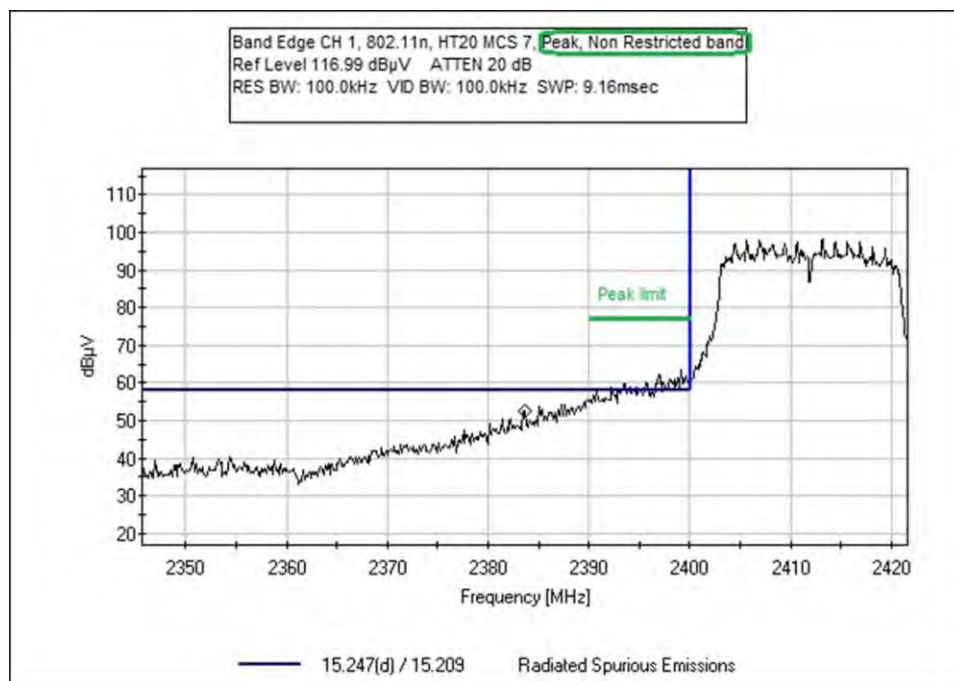
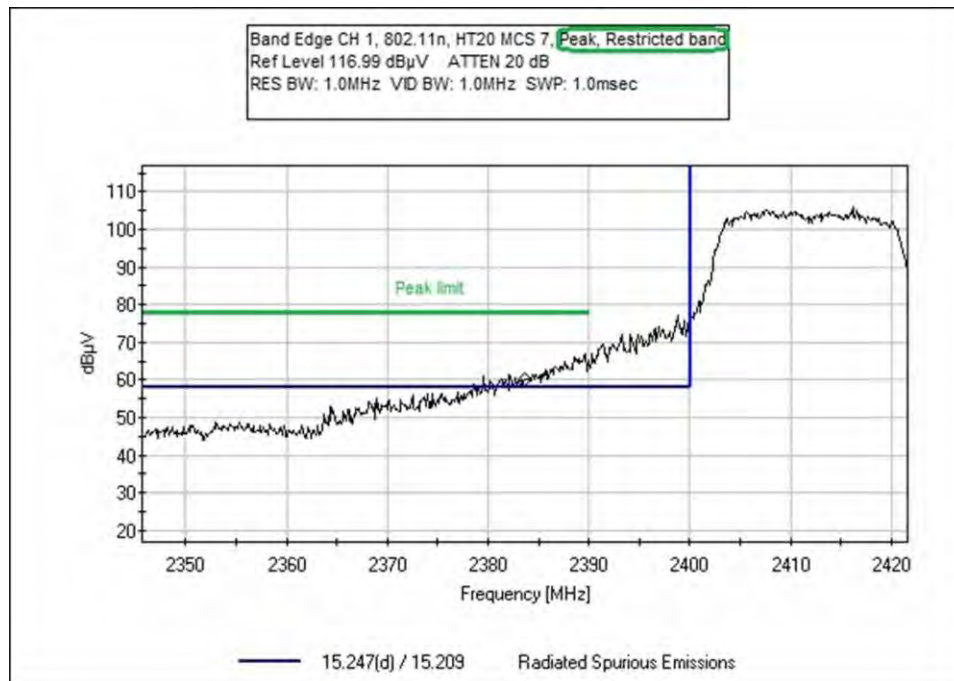


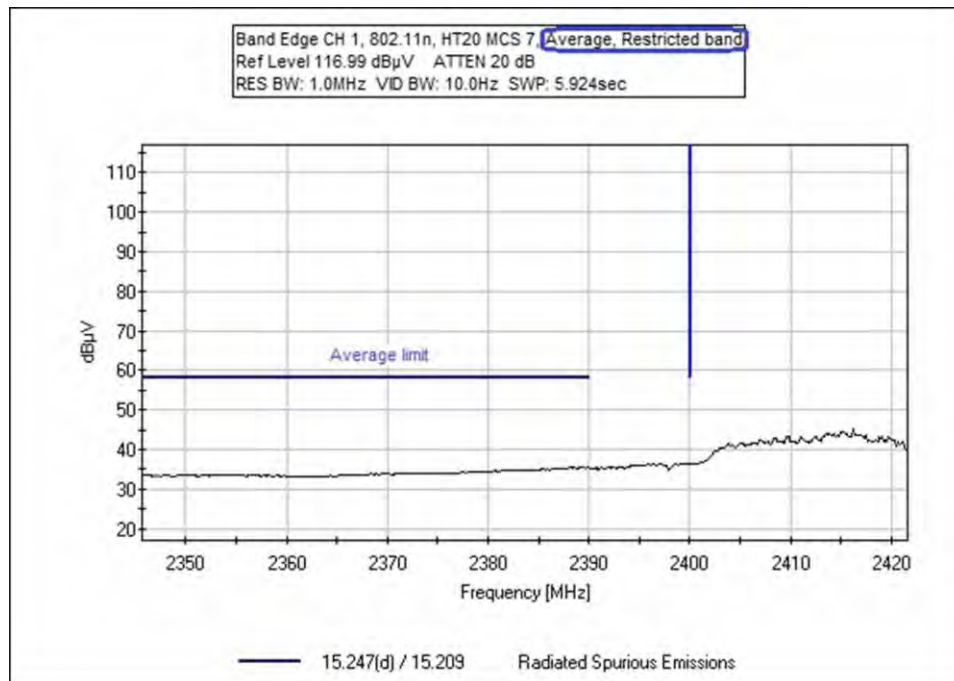




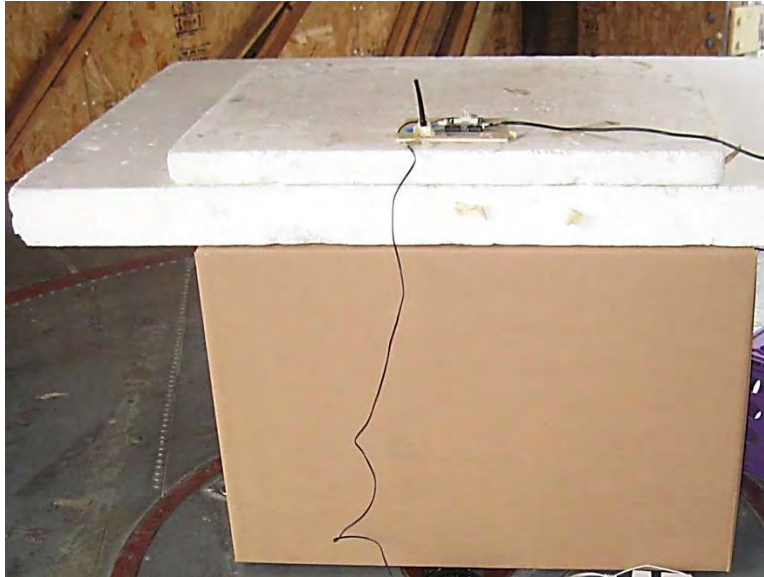








## Test Setup Photo





## 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**

Specification: **15.247(e)**

Work Order #: **95696**

Date: 8/29/2014, 11/13/2014

Test Type: **Conducted Power Spectral Density**

Equipment: 2.4 GHz transmitter module

Manufacturer: HITEM

Tested By: Don Nguyen/S. Yamamoto

Model: Skybell

S/N: (none)

#### Test Equipment:

Asset #	Description	Model	Calibration Date	Cal Due Date
03431	Attenuator	89-20-21	9/5/2013	9/5/2015
P06544	Cable	32026-29094K-29094K-36TC	11/20/2013	11/20/2015
02869	Spectrum Analyzer	E4440A	7/10/2014	7/10/2015

#### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz transmitter module*	HITEM	Skybell	(none)

#### Support Devices:

Function	Manufacturer	Model #	S/N
Laptop Computer	Averatec	5100 Series	NA
Power Supply	Jentec Technology Co., LTD.	AF1805-A	LF4R01082201507
Wireless Test Fixture	HITEM	Generic	Generic
Power Supply	LITEON	PA-1600-05	3600324901

#### Test Conditions / Notes:

The equipment under test (EUT) is a wireless module which is installed in the test fixture. The antenna connector port is connected to the spectrum analyzer. The EUT is connected to a support located laptop computer via an USB cable. The computer is running software Production Test GUI to setup EUT transmitting protocol.

The test frequencies are 2412MHz, 2442MHz, and 2472MHz.

An external DC power adapter is also connected to the wireless test fixture.

Frequency range of measurement, 2400MHz to 2483.5MHz.

Temperature: 20°C

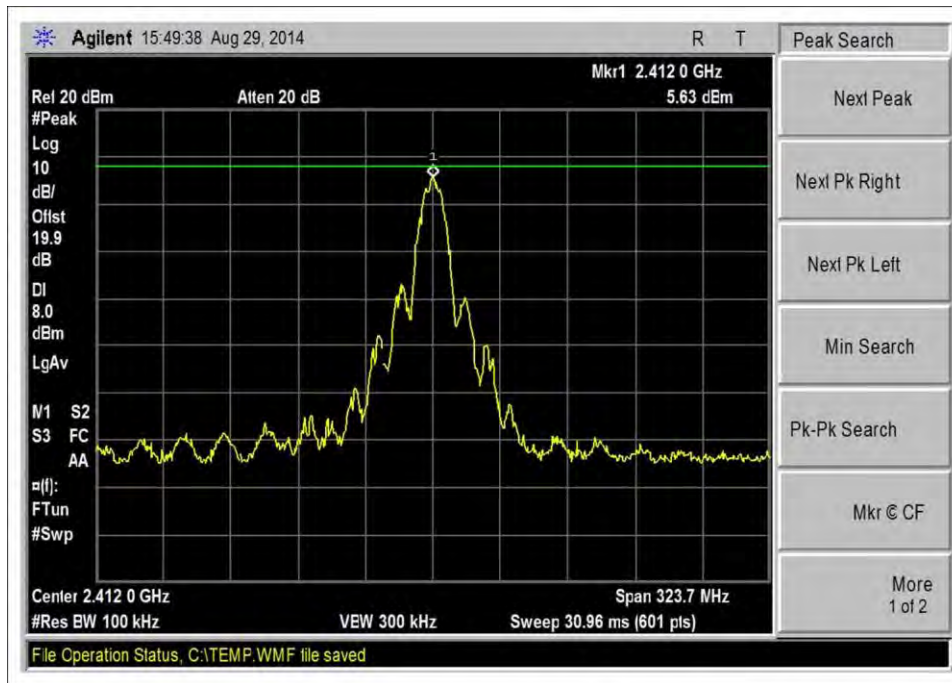
Relative Humidity: 35%

Pressure: 100kPa

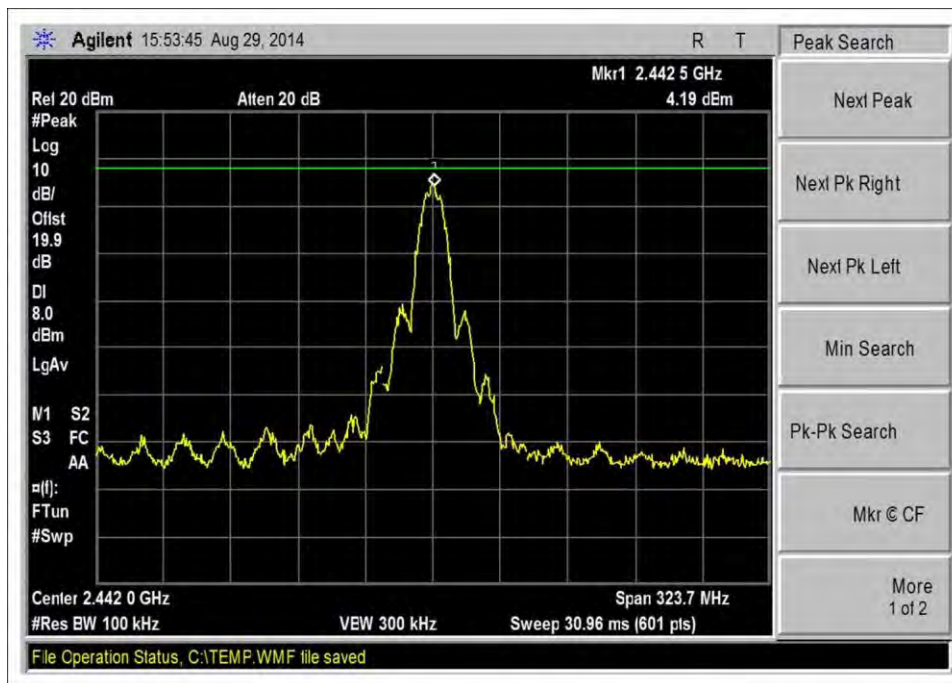
Site D

Conducted Power Spectral Density Test Summary			
Frequency (MHz)	Measured conducted power spectral density (dBm)	15.247(e) Conducted power spectral density limit (dBm)	Notes
2412	5.6	8	802.11b 11Mbps
2442	4.2	8	802.11b 11Mbps
2472	7.3	8	802.11b 11Mbps
2412	1.8	8	802.11g 54Mbps
2442	1.0	8	802.11g 54Mbps
2472	-0.6	8	802.11g 54Mbps
2412	0.0	8	802.11n HT20 MCS3
2442	-1.4	8	802.11n HT20 MCS3
2472	-0.8	8	802.11n HT20 MCS3
2412	-0.1	8	802.11n HT20 MCS7
2442	-1.9	8	802.11n HT20 MCS7
2472	-1.1	8	802.11n HT20 MCS7

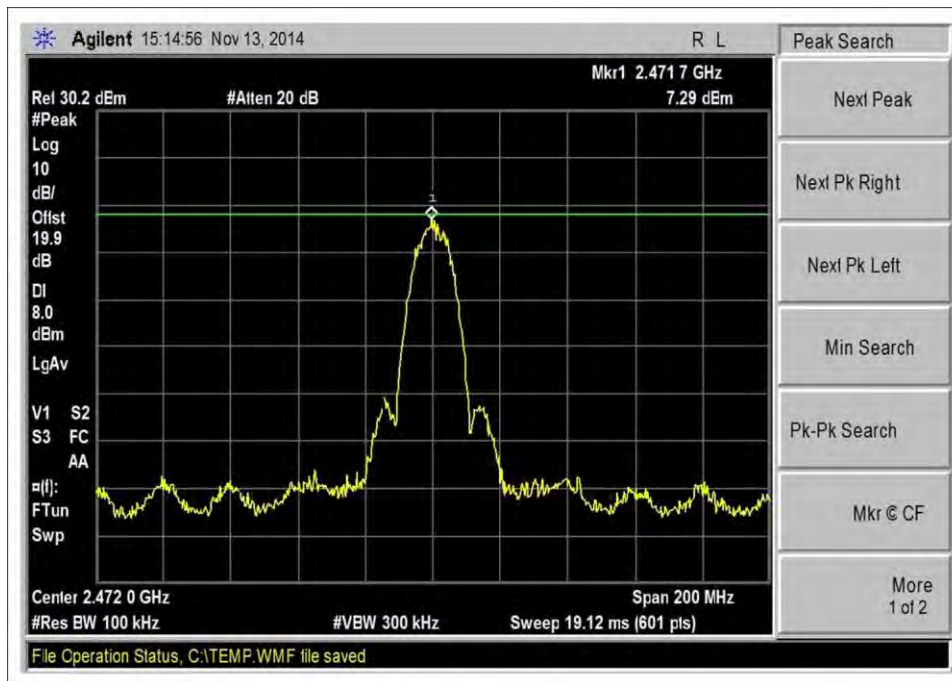
## Test Data



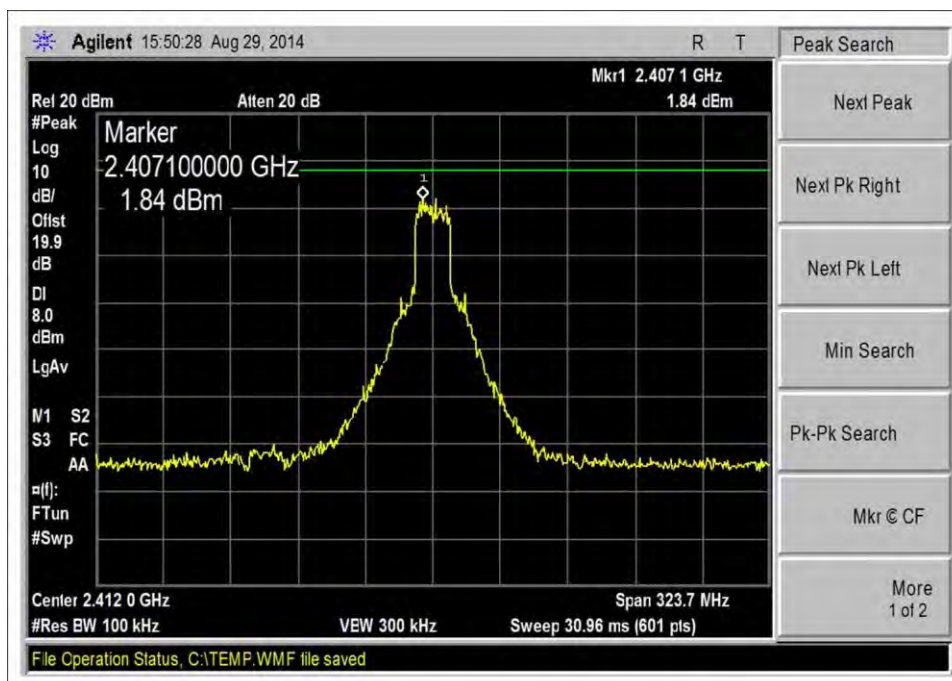
Low Channel, B 11mbps



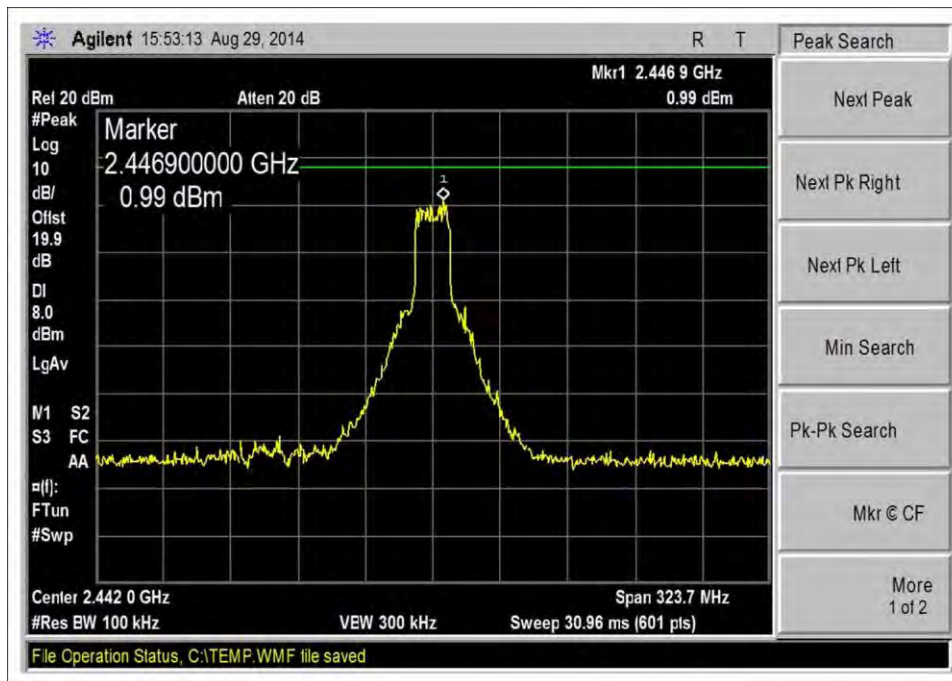
Middle Channel, B 11mbps



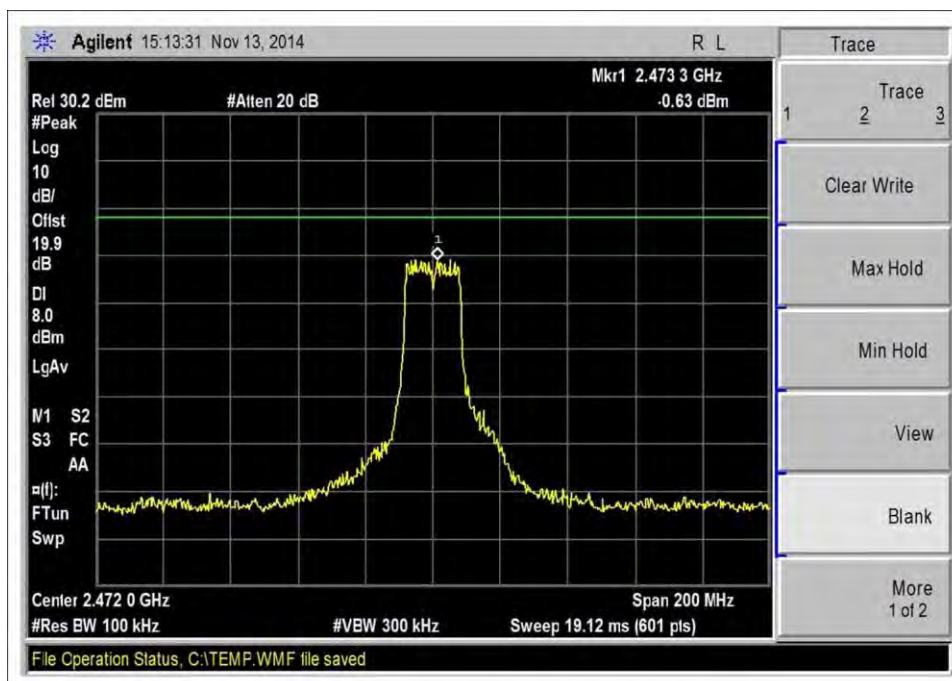
High Channel, B 11mbps



Low Channel, G 54mbps

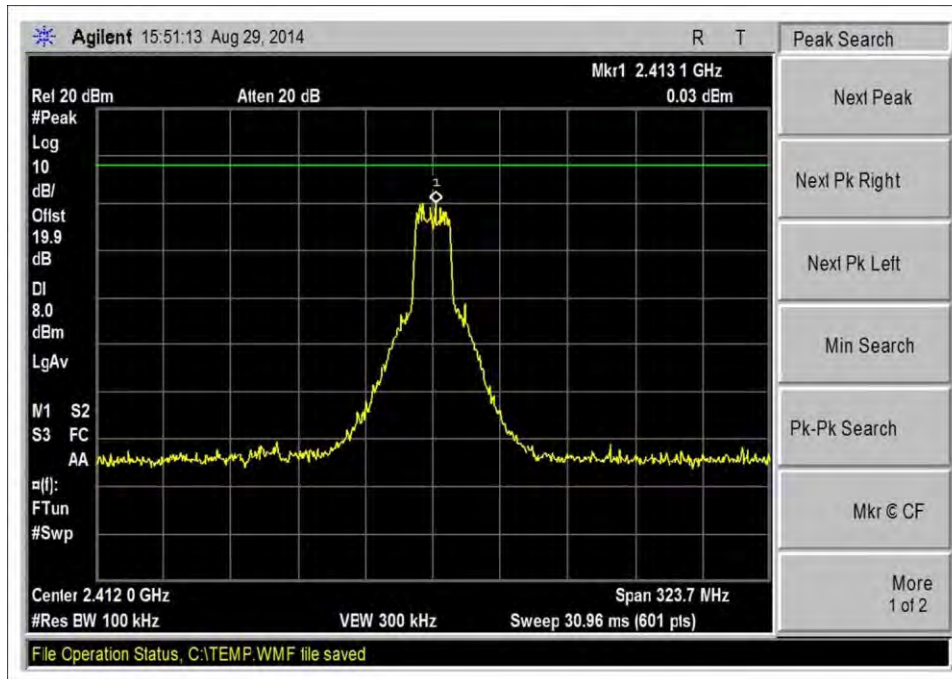


Middle Channel, G 54mbps

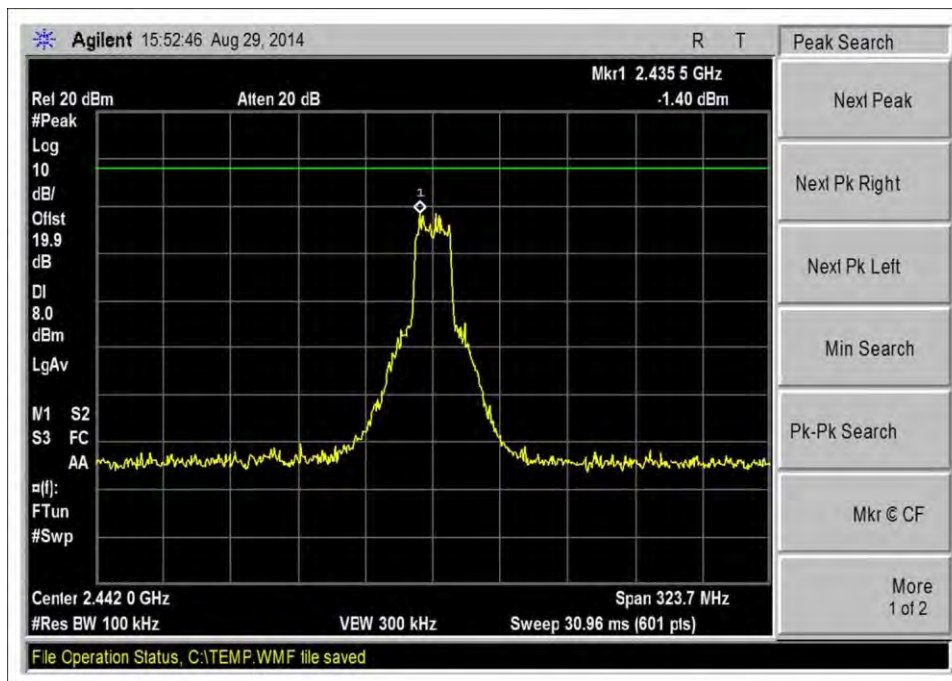


High Channel, G 54mbps

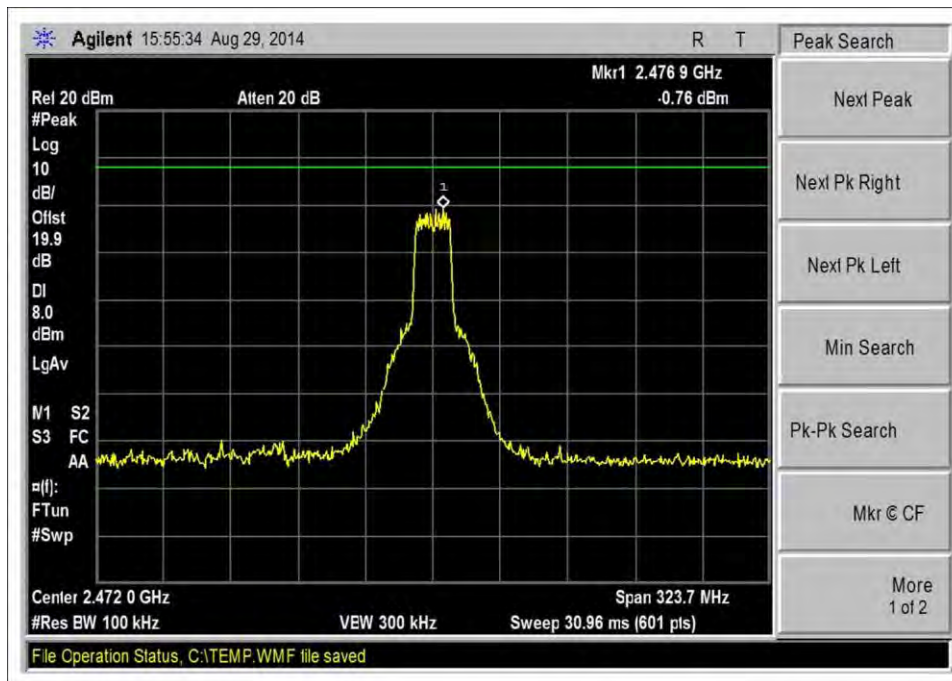




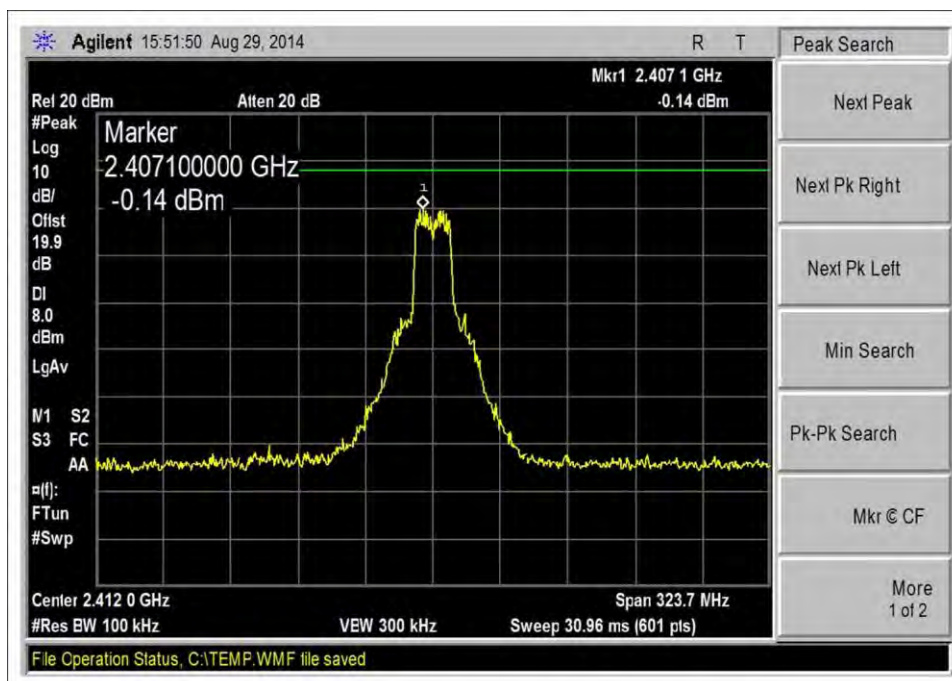
Low Channel, N MCS3



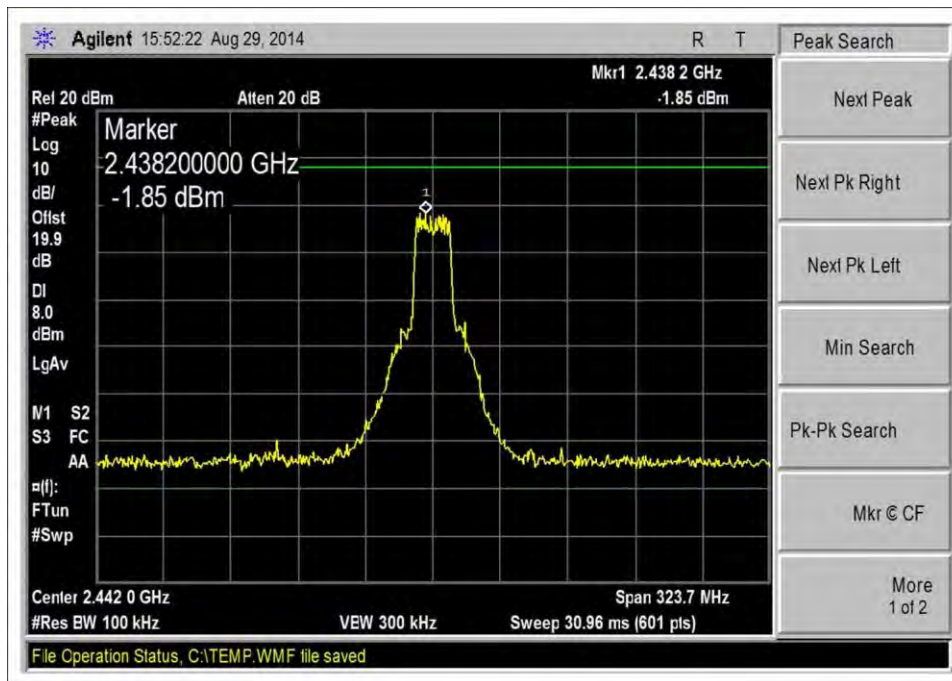
Middle Channel, N MCS3



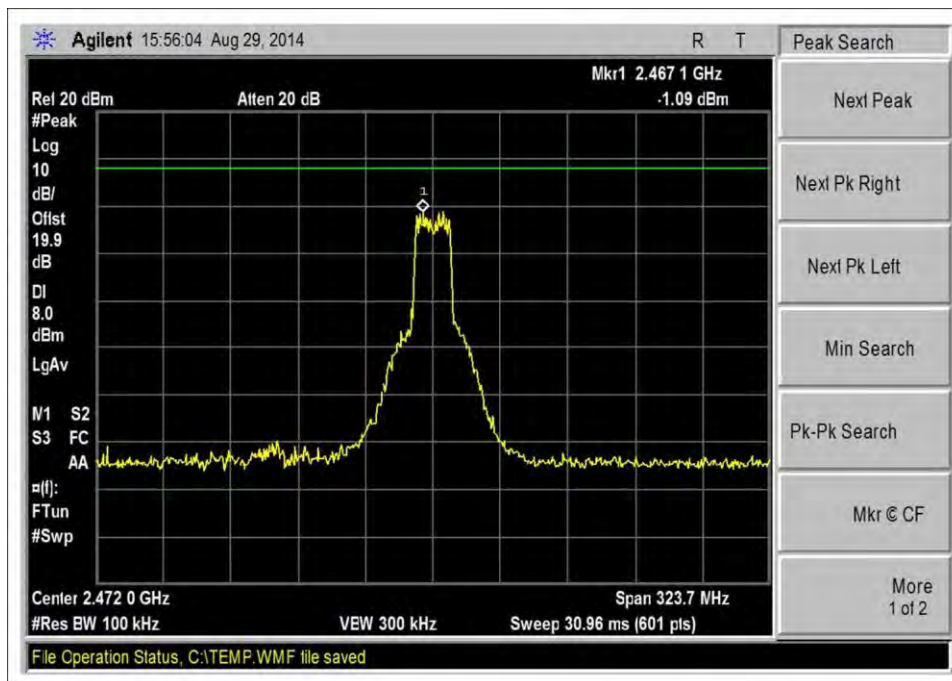
High Channel, N MCS3



Low Channel, N MCS7



Middle Channel, N MCS7



High Channel, N MCS7

## Test Setup Photo





## SUPPLEMENTAL INFORMATION

### Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

### 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  $\text{dB}\mu\text{V}/\text{m}$ , the spectrum analyzer reading in  $\text{dB}\mu\text{V}$  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.