

# FCC RADIO TEST REPORT

According to  
FCC Part 15 Subpart C § 15.247

**Equipment** : WatchAir OpenArms  
**Model No** : EPUS-LTB  
**Applicant** : EPICT, Inc.  
587-40, Gwahaksaneop 2-ro, Ochang-eup, Cheongwon-gu,  
Chungcheongbuk-do, Korea.  
**Date of reception** : March 6, 2017  
**Date of test** : March 6, 2017 to March 30, 2017  
**Report Number** : BWS-17-RF-0003  
**Report Type** : Original Report  
**Date of issue** : March 30, 2017  
**FCC Rule Part(s)** : FCC Part 15 Subpart C §15.247

The product was received on March 6, 2017 and testing was completed on March 30, 2017. We, BWS TECH Inc. would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of BWS TECH Inc. the test report shall not be reproduced except in full.

(Date) 03/30/2017



Tested by Hyeong-Bae, Lee

(Date) 03/30/2017



Reviewed by Bang-Hyun, Nam

## BWS TECH INC.

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# FCC TEST REPORT

**Scope** – Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)

## 1. General Information

### 1.1 Applicant

● Company Name	EPICT, Inc
● Company Address	587-40, Gwahaksaneop 2-ro, Ochang-eup, Cheongwon-gu, Chungcheongbuk-do, Korea
● Phone/Fax	Tel No. : +82-2-2039-2066 Fax No. : +82-2-2039-2067

### 1.2 Manufacturer

● Company Name	Seers Technology Co., LTD
● Company Address	#1210 Tech Center, SK Technopark, 124, Sagimakgol-ro, Jungwon-gu, Seongnam-si, Gyeonggi-do, South Korea
● Phone/Fax	Tel No. : +82-31-775-3036 Fax No. : +82-31-776-3039

### 1.3 EUT Description

● Equipment	WatchAir OpenArms
● Model(s)	EPUS-LTB, EPUS-LTW
● Operation Frequency	802.11 b/g/n(HT20): 2412MHz-2462MHz 802.11 n(HT40): 2422MHz-2462MHz
● Number of Channels	802.11 b/g/n(HT20): 11 802.11n(HT40): 9
● Modulation Method	802.11 b : DSSS 802.11 g/n(HT20)/n(HT40) : OFDM
● Input Voltage	DC 5 V 2A
● Antenna Peak Gain	3dBi (Part number: 2108517-1)

### 1.4 Other Information

● FCC Rule Part(s)	Part 15 Subpart C §15.247
● FCC ID	2AJKJ-EPUS-LTB
● Test Procedure	ANSI C63.10-2013 KDB 558074 D01 DTS Meas Guidance v03r05 KDB 662911 D01 Multiple Transmitter Output v02r01
● Date of Test	March 6, 2017 to March 30, 2017
● Place of Test	BWS TECH Inc. (FCC Registration Number : 287786) #23, Gokhyeon-ro 480 Beon-gil, Mohyeon-myeon, Cheoin-gu, Yongin-si, Gyeonggi-do 449-853, South Korea TEL: +82-31-333-5997 FAX: +82-31-333-0017

## 2. Description of Test Facility

### Site Description

<b>Test Lab.</b>	:		Accredited by Industry Canada, February 10, 2015 The Certificate Registration Number is 4963A-2.
	:		Accredited by FCC, September 03, 2013 The Certificate Registration Number is 287786.
	:		Accredited by VCCI, September 11, 2015 The Certificate Registration Number is C-4326
	:		Accredited by RRA(EMC,RF, SAR), December 16, 2016 The Certificate Registration Number is KR0017
	:		Accredited by KOLAS(KS Q ISO/IEC 17025), April 08, 2016 The Certificate Registration Number is KT174
<b>Name of Firm</b>	:	BWS TECH Inc.	
<b>Site Location</b>	:	#23, Gokhyeon-ro 480 Beon-gil, Mohyeon-myeon, Cheoin-gu, Yongin-si, Gyeonggi-do 449-853, South Korea	

### 3. Test Methodology

The tests documented in this report were performed in accordance with ANSI C63.10: 2013 and the requirements of FCC Rules Part 15.207, 15.209 and 15.247.

Radio testing was performed according to KDB 558074 D01 DTS Meas Guidance v03r05 and KDB 662911 D01 Multiple Transmitter Output v02r01.

#### 3.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and is operated in a manner that intends to maximize its emission characteristics in a continuous normal application

#### 3.2 EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

#### 3.3 FCC Part 15.205 Restricted Bands of Operations

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	( <sup>2</sup> )
13.36 - 13.41			

1 Until February 1, 1999, this restricted band shall be 0.490-0.510MHz.

2 Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

### 3.4 Description of Test Modes

The EUT has been tested under operating condition.

After verification, all tests were carried out with the worst case test modes as shown below.

Channel Low (2412MHz), Middle (2441MHz) and High (2462MHz) were chosen for full testing.

Worst-case data rates are shown as follows.

Band	Data Rate
802.11b	11 Mbps
802.11g	54 Mbps
802.11n HT20 (MIMO only)	MCS15
802.11n HT40 (MIMO only)	MCS15
The device supports non-beamforming in 802.11n.	

Table 1.

The worst case antenna mode for each of the following tests for 802.11b/g/n is shown as follows.

TEST Description	Antenna 1	Antenna 2	MIMO (2x2)
Peak Output Power	802.11b/g	802.11b/g	802.11n HT20/40
Power Spectral Density	—	802.11b/g	802.11n HT20/40
6dB Bandwidth	—	802.11b/g	802.11n HT20/40 (Test Antenna 2)
Radiated Spurious Emission	—	802.11b/g	802.11n HT20/40
Conducted Spurious Emission	—	802.11b/g	802.11n HT20/40 (Test Antenna 2)
Band Edge Measurement	—	802.11b/g	802.11n HT20/40 (Test Antenna 2)

Table 2.

## 4. Summary of Test Results

Clause	TEST Description	Standard Section	Requirements	Result
5.1	AC Power Line Conducted Emission	§15.207	§15.207(a)	Pass
5.2	Peak Output Power	§15.247(b)(3)	≤30dBm	Pass
5.3	Power Spectral Density	§15.247(e)	≤8dBm/3kHz	Pass
5.4	6dB Bandwidth	§15.247(a)(2)	≥500kHz	Pass
5.5	Radiated Spurious Emission	§15.247(d)	§15.209(a), §15.247(d)	Pass
5.6	Conducted Spurious Emission	§15.247(d)	≥20dBc/100kHz	Pass
5.7	Band Edge Measurement	§15.247(d)	§15.205(a), §15.209(a)	Pass
5.8	Antenna Application	§15.247(b), §15.203	§15.247(b), §15.203	Pass

## 5. Test Data

### 5.1 AC Power Line Conducted Emission

#### 5.1.1 Test Equipment

EQUIPMENT	MODEL	MANUFACTURE	SERIAL NUMBER	Calibration Due date (year/month/date)	Calibration Interval
ISN	CAT3-8158	SCHWARZBECK	79	2017/11/25	1Year
HIGH VOLTAGE PROBE	TK9420	SCHWARZBECK	9420-587	2017/05/15	1Year
CURRENT PROBE	F-16	FCC	63	2018/01/05	1Year
INJECTION PROBE	F-120-9A	FCC	289	2018/01/05	1Year
CDN	CDNS502A	TESEQ	36701	2017/08/31	1Year
MATCHING PAD	UNMP-5075+	MINI-CIRCUITS	15542	2018/01/11	1Year
SPLITTER	ZFRSC-42-S+	MINI-CIRCUITS	23301525S	2018/01/05	1Year
EMI Test Receiver	ESPI	ROHDE & SCHWARZ	100063	2018/01/05	1Year

#### 5.1.2 Test Limit

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

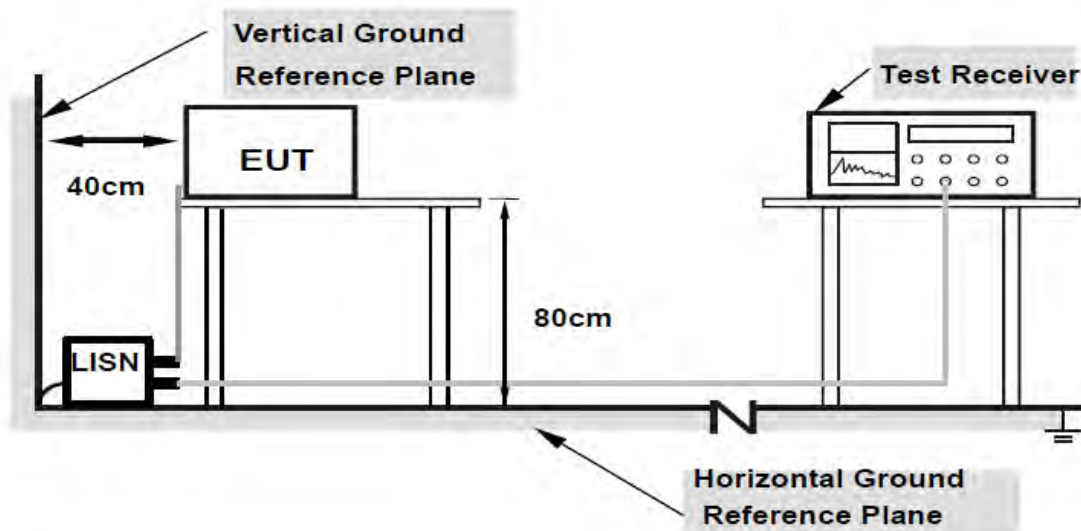
Frequency of emission(MHz)	Conducted limit(dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

#### 5.1.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room and was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network(LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

#### 5.1.4 Block Diagram of Test Setup

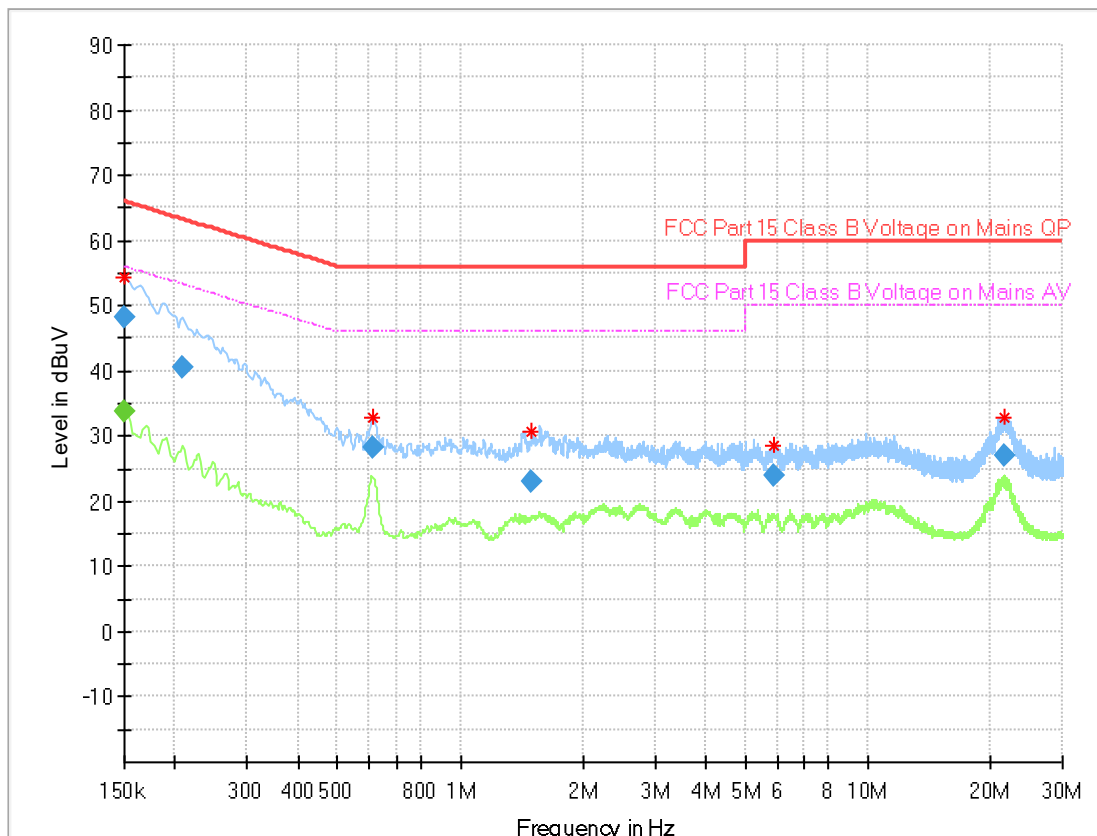


## 5.1.5 Test Result

# Test Report

## Common Information

Test Description: Conducted Emission  
Test Site: Shield Room  
Test Line: L1  
Model Name: EPUS-LTB



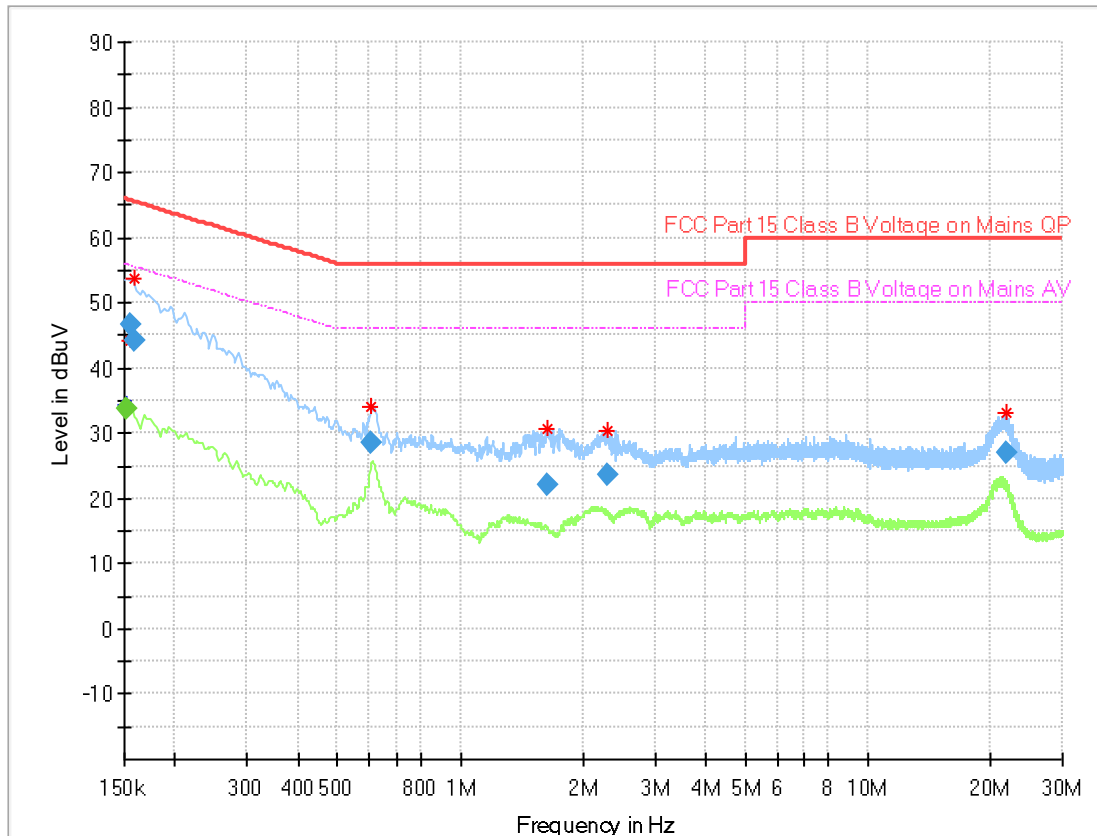
## Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150000	---	33.84	56.00	22.16	1000.0	9.000	L1	GND	7.8
0.150000	48.14	---	66.00	17.86	1000.0	9.000	L1	GND	7.8
0.208500	40.67	---	63.27	22.60	1000.0	9.000	L1	GND	7.7
0.613499	28.19	---	56.00	27.81	1000.0	9.000	L1	GND	7.7
1.499998	23.11	---	56.00	32.89	1000.0	9.000	L1	GND	7.8
5.898745	23.91	---	60.00	36.09	1000.0	9.000	L1	GND	8.1
21.554265	27.08	---	60.00	32.92	1000.0	9.000	L1	GND	8.7

# Test Report

## Common Information

Test Description: Conducted Emission  
Test Site: Shield Room  
Test Line: Neutral  
Model name: EPUS-LTB



## Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.152250	---	33.83	55.88	22.05	1000.0	9.000	N	GND	7.7
0.154500	46.60	---	65.75	19.15	1000.0	9.000	N	GND	7.7
0.159000	44.20	---	65.52	21.32	1000.0	9.000	N	GND	7.7
0.606749	28.42	---	56.00	27.58	1000.0	9.000	N	GND	7.7
1.626000	22.22	---	56.00	33.78	1000.0	9.000	N	GND	7.8
2.289746	23.56	---	56.00	32.44	1000.0	9.000	N	GND	7.9
21.890719	27.07	---	60.00	32.93	1000.0	9.000	N	GND	8.6

## 5.2 Peak Output Power

### 5.2.1 Test Equipment

EQUIPMENT	MODEL	MANUFACTURE	SERIAL NUMBER	Calibration Due date (year/month/date)	Calibration Interval
Power Meter	RPR3006W	D.A.R.E!! Instruments	14I000048S NO09	2017/04/25	1 Year
DC Power Supply	UDP-6015R	Unicorn tech	131007	2017/09/07	1 Year

### 5.2.2 Test Limit

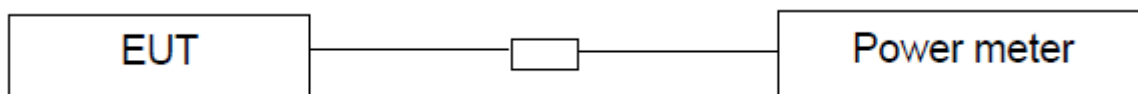
The maximum peak power shall be less than 1 Watt (30dBm).

Note: If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the direction gain of the antenna exceeds 6dBi, In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

### 5.2.3 Measurement Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05 and KDB 662911 D01 Multiple Transmitter Output v02r01.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum output power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.

### 5.2.4 Test SET-UP (Block Diagram of Configuration)



## 5.2.5 Test Result

Test mode: IEEE 802.11b

Channel	Frequency (MHz)	Peak Output Power (dBm)		Limit (dBm)	Result
		Antenna A	Antenna B		
1	2412	12.87	13.47	≤ 30.00	Pass
6	2437	13.23	13.62	≤ 30.00	Pass
11	2462	13.29	13.74	≤ 30.00	Pass

Test mode: IEEE 802.11g

Channel	Frequency (MHz)	Peak Output Power (dBm)		Limit (dBm)	Result
		Antenna A	Antenna B		
1	2412	10.68	12.08	≤ 30.00	Pass
6	2437	10.94	12.23	≤ 30.00	Pass
11	2462	11.09	12.37	≤ 30.00	Pass

Test mode: IEEE 802.11n(20M)

Channel	Frequency (MHz)	Peak Output Power (dBm)		SUM (dBm)	Limit (dBm)	Result
		Antenna A	Antenna B			
1	2412	6.68	6.98	9.64	≤ 30.00	Pass
6	2437	6.83	7.24	10.12	≤ 30.00	Pass
11	2462	7.00	7.40	10.51	≤ 30.00	Pass

Test mode: IEEE 802.11n(40M)

Channel	Frequency (MHz)	Peak Output Power (dBm)		SUM (dBm)	Limit (dBm)	Result
		Antenna A	Antenna B			
3	2422	5.58	5.94	8.77	≤ 30.00	Pass
6	2437	5.65	6.03	7.68	≤ 30.00	Pass
11	2462	5.72	6.15	7.85	≤ 30.00	Pass

## 5.3 Power Spectral Density

### 5.3.1 Test Equipment

EQUIPMENT	MODEL	MANUFACTURE	SERIAL NUMBER	Calibration Due date (year/month/date)	Calibration Interval
Spectrum analyzer	N9020A	Agilent	US46220101	2017/09/07	1 Year
DC Power Supply	UDP-6015R	Unicorn tech	131007	2017/09/07	1 Year

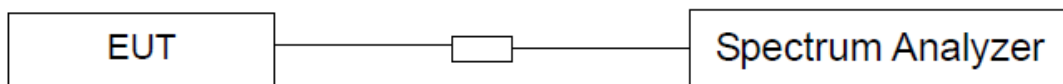
### 5.3.2 Test Limit

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

### 5.3.3 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05 and KDB 662911 D01 Multiple Transmitter Output v02r01.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set (RBW = 3 kHz, VBW = 10 kHz, Detector = Peak, Span = 1.5 times DTS Channel Bandwidth, Trace mode = Max Hold, Sweep = Auto).
5. Measure and record the results in the test report.

### 5.3.4 Block Diagram of Test Setup



### 5.3.5 Test Result

Test mode: IEEE 802.11b

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Result
		Antenna B		
1	2412	-9.14	≤ 30.00	Pass
6	2437	-9.00	≤ 30.00	Pass
11	2462	-8.88	≤ 30.00	Pass

Test mode: IEEE 802.11g

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Result
		Antenna B		
1	2412	-14.41	≤ 30.00	Pass
6	2437	-14.31	≤ 30.00	Pass
11	2462	-14.21	≤ 30.00	Pass

Test mode: IEEE 802.11n(20M)

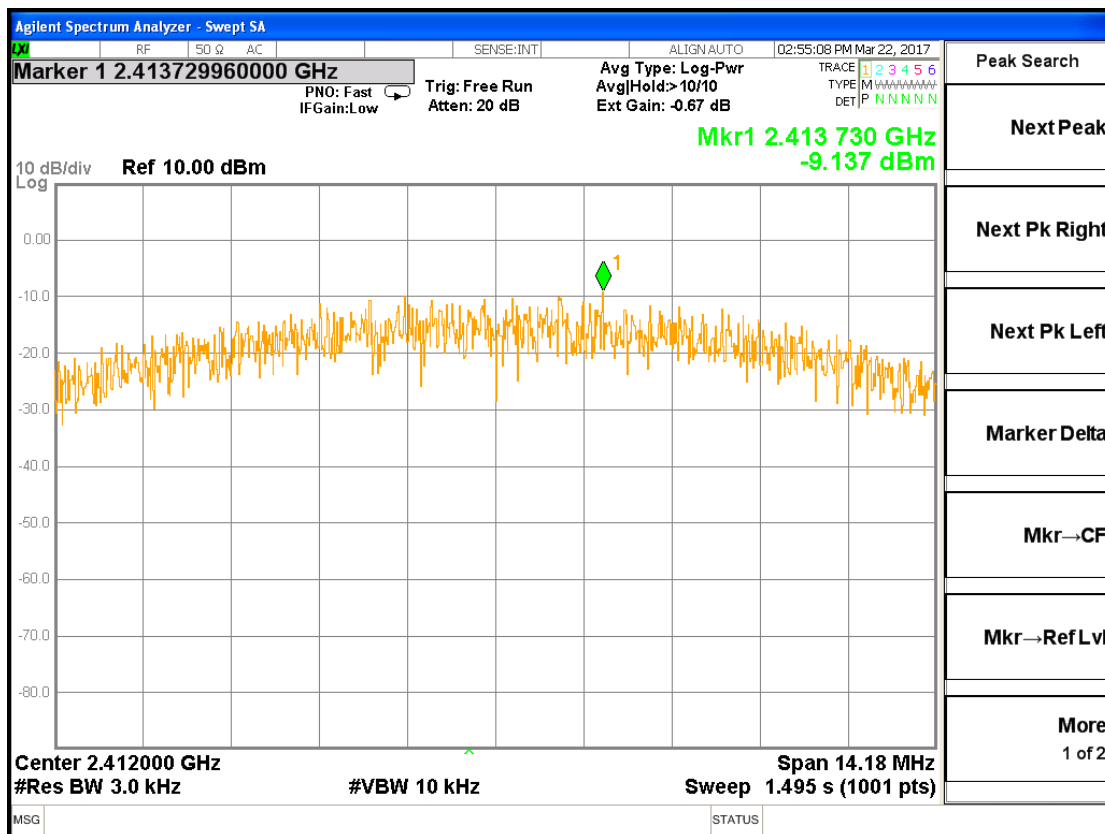
Channel	Frequency (MHz)	Power Spectral Density (dBm)		SUM (dBm)	Limit (dBm)	Result
		Antenna A	Antenna B			
1	2412	-19.71	-18.46	-16.03	≤ 30.00	Pass
6	2437	-19.44	-18.26	-15.80	≤ 30.00	Pass
11	2462	-19.23	-17.43	-15.23	≤ 30.00	Pass

Test mode: IEEE 802.11n(40M)

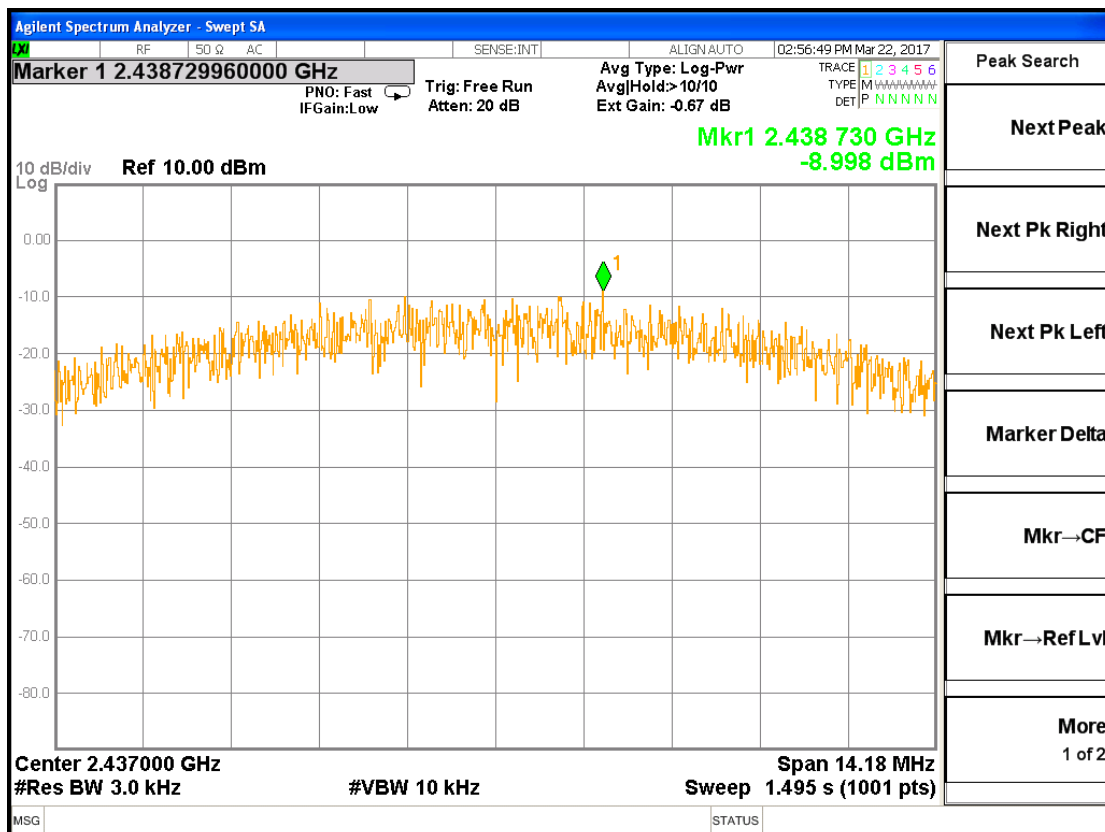
Channel	Frequency (MHz)	Power Spectral Density (dBm)		SUM (dBm)	Limit (dBm)	Result
		Antenna A	Antenna B			
3	2422	-23.27	-22.05	-19.61	≤ 30.00	Pass
6	2437	-22.56	-22.01	-19.27	≤ 30.00	Pass
11	2462	-23.05	-21.85	-19.40	≤ 30.00	Pass

### 5.3.6 Test Plot

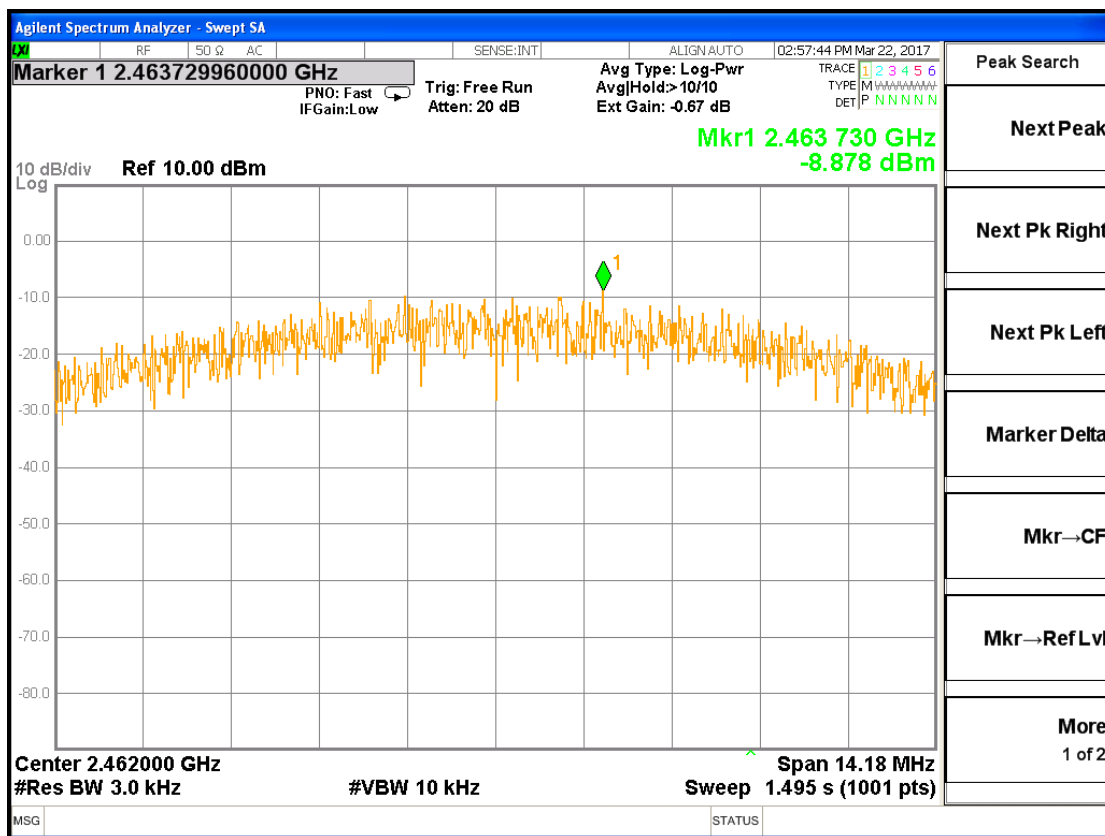
#### Power Spectral Density (802.11b\_CH.1 (2412 MHz))



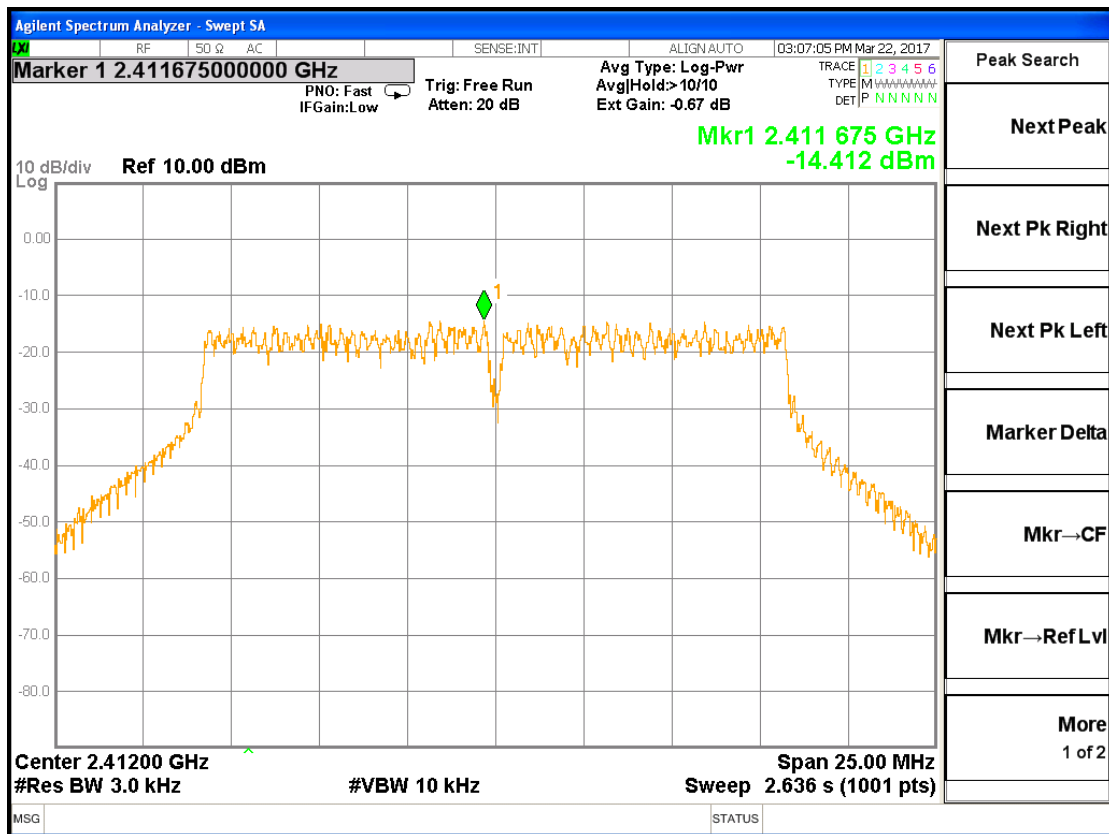
#### Power Spectral Density (802.11b\_CH.6 (2437 MHz))



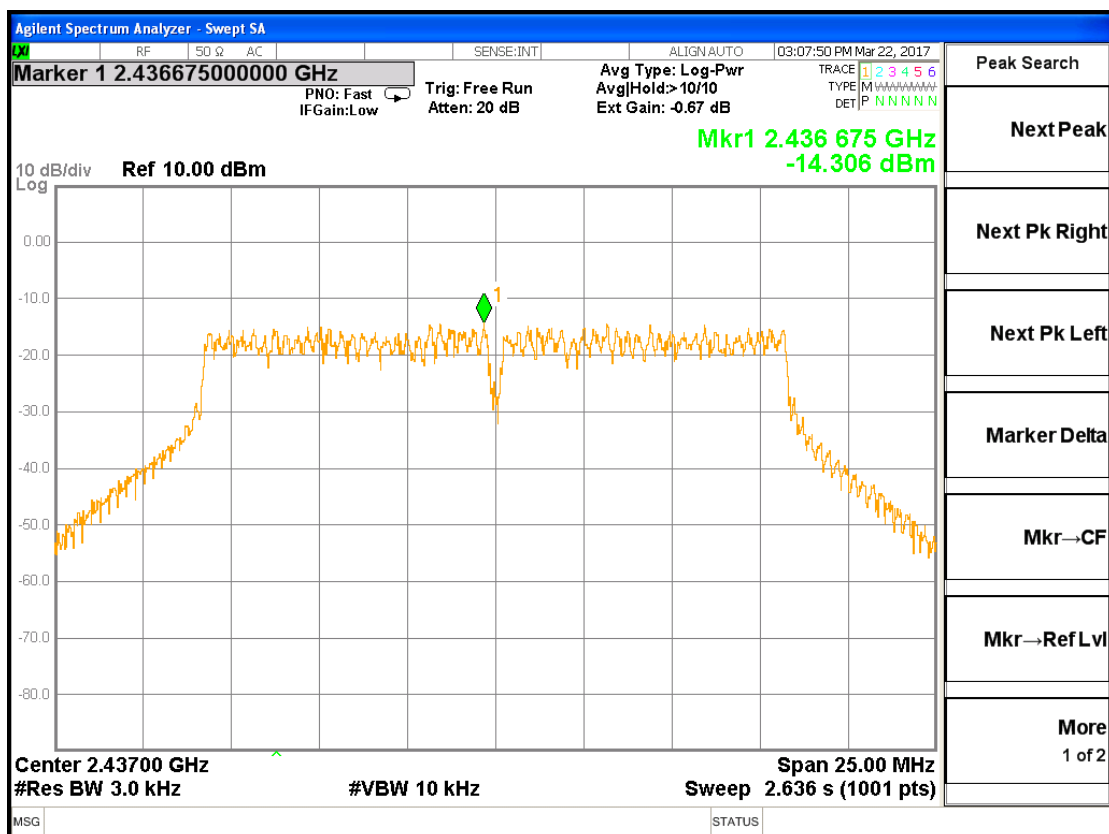
## Power Spectral Density (802.11b\_CH.11 (2462 MHz))



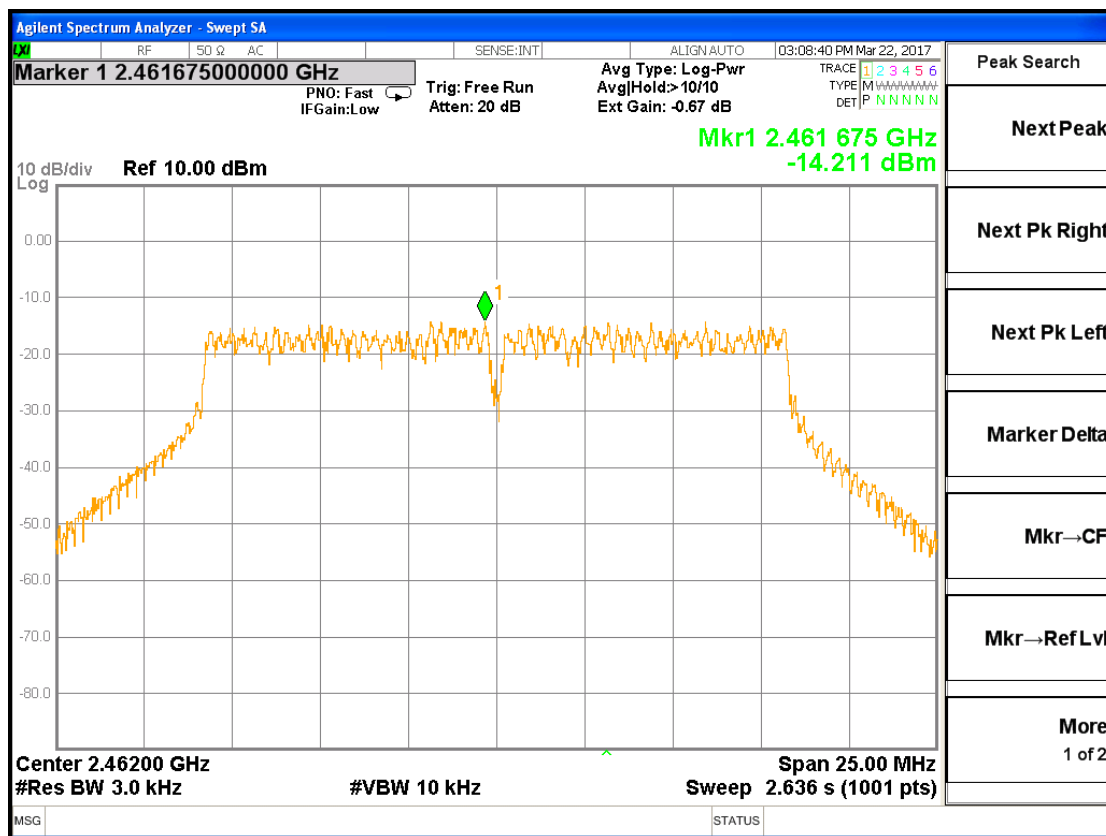
### Power Spectral Density (802.11g\_CH.1 (2412 MHz))



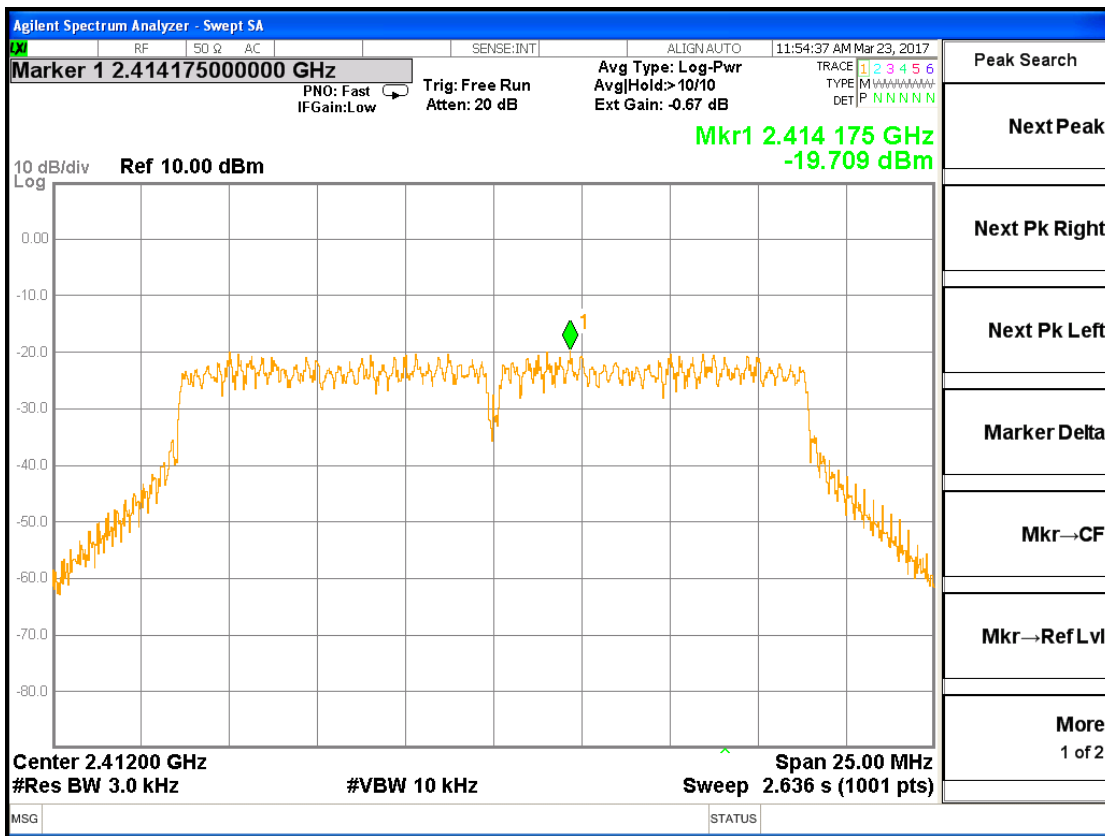
### Power Spectral Density (802.11g\_CH.6 (2437 MHz))



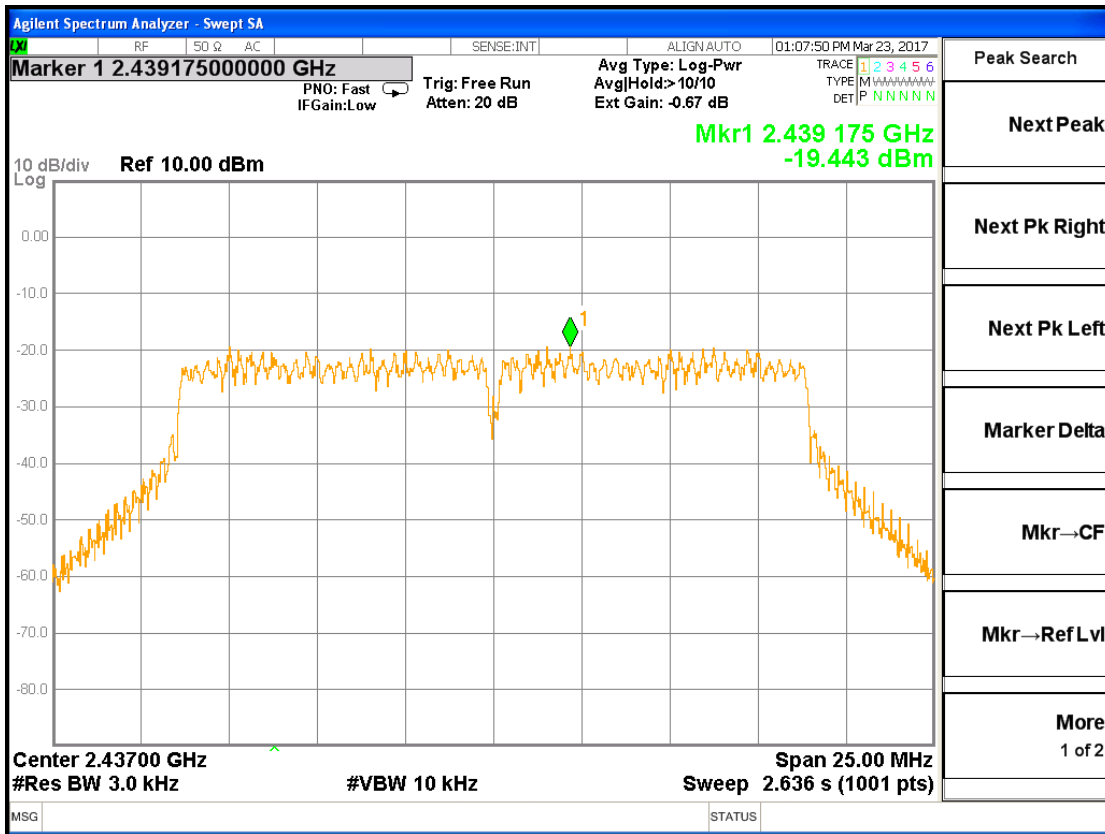
## Power Spectral Density (802.11g\_CH.11 (2462 MHz))



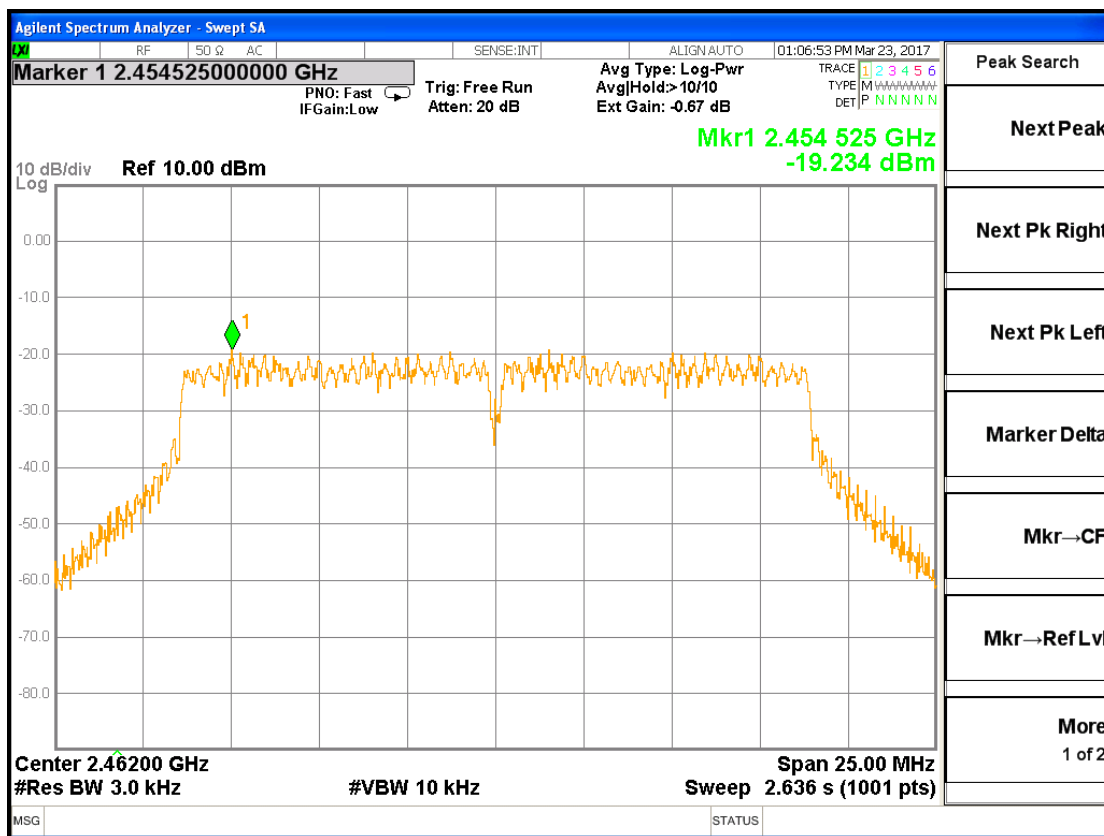
### Power Spectral Density (802.11n(20M)\_CH.1 (2412 MHz)) – Antenna A



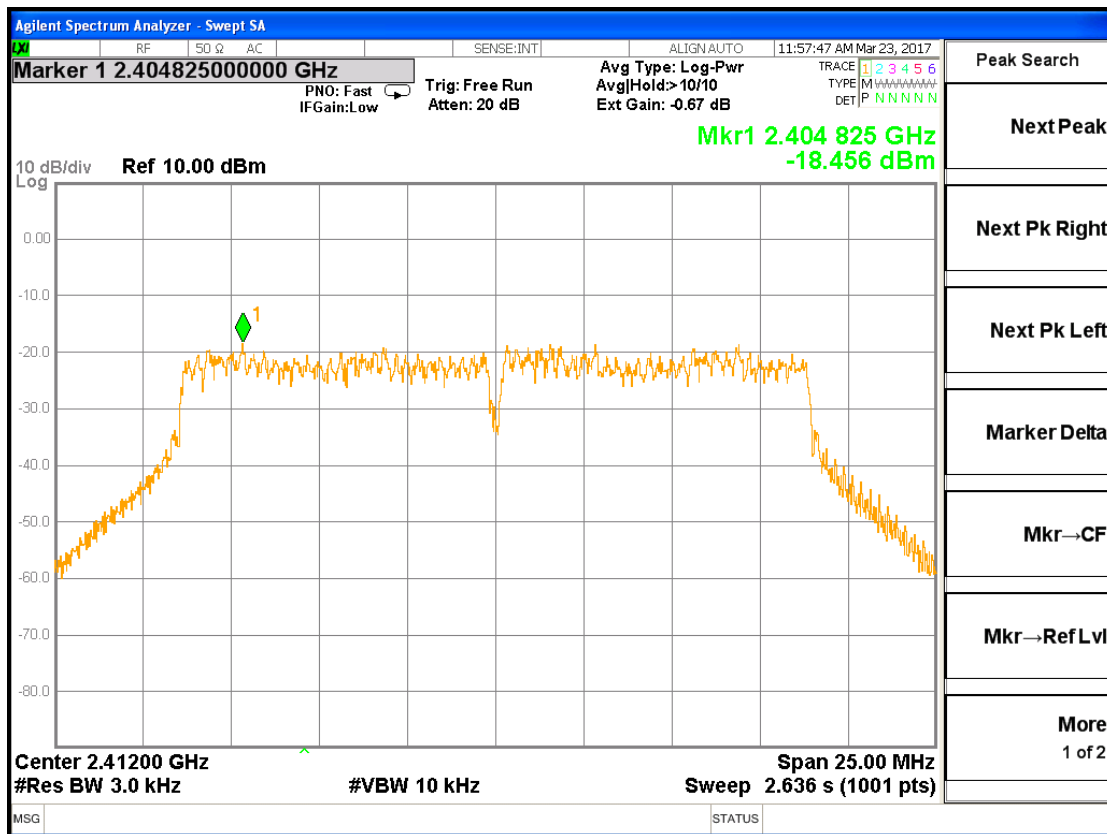
### Power Spectral Density (802.11n(20M)\_CH.6 (2437 MHz)) – Antenna A



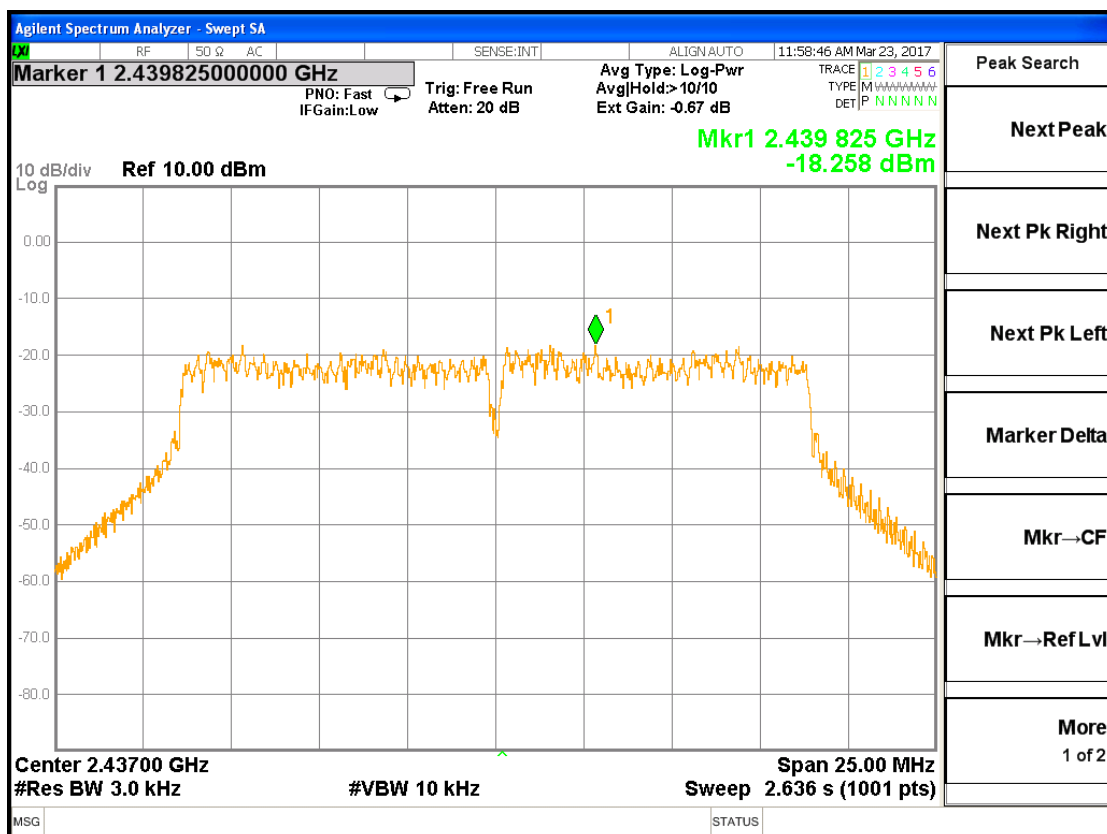
## Power Spectral Density (802.11n(20M)\_CH.11 (2462 MHz)) – Antenna A



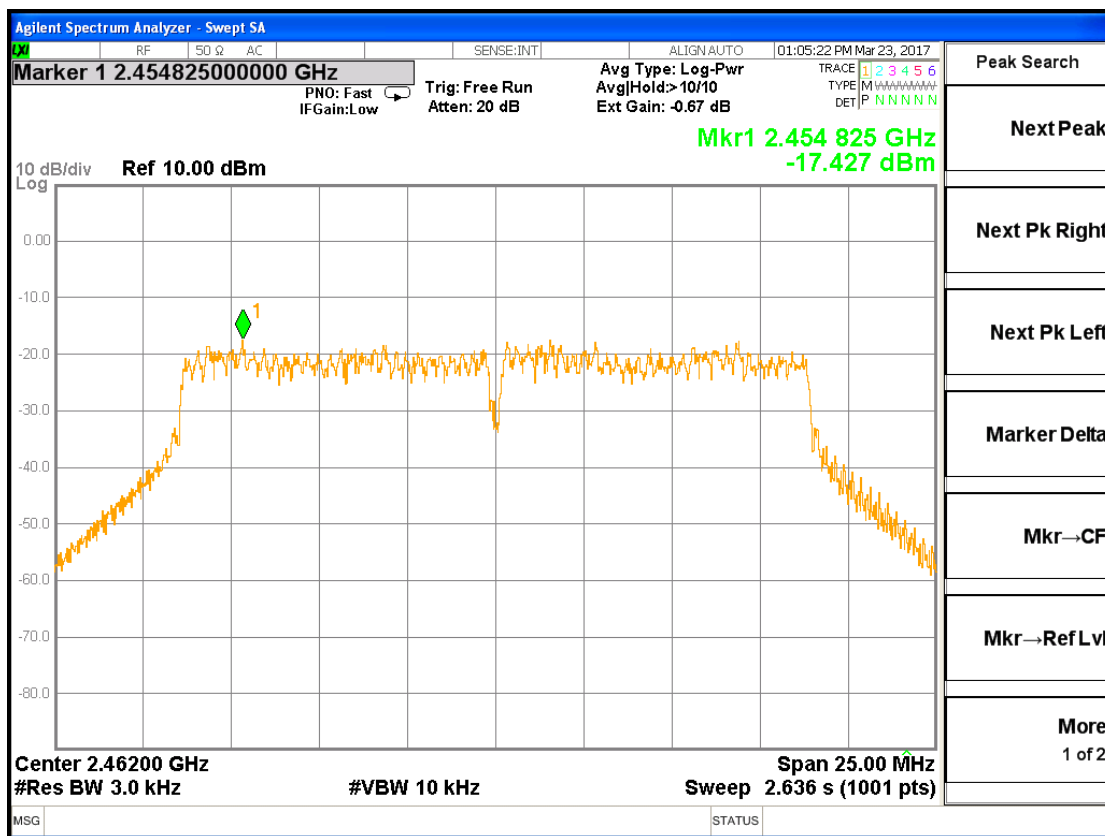
### Power Spectral Density (802.11n(20M)\_CH.1 (2412 MHz)) – Antenna B



### Power Spectral Density (802.11n(20M)\_CH.6 (2437 MHz)) – Antenna B

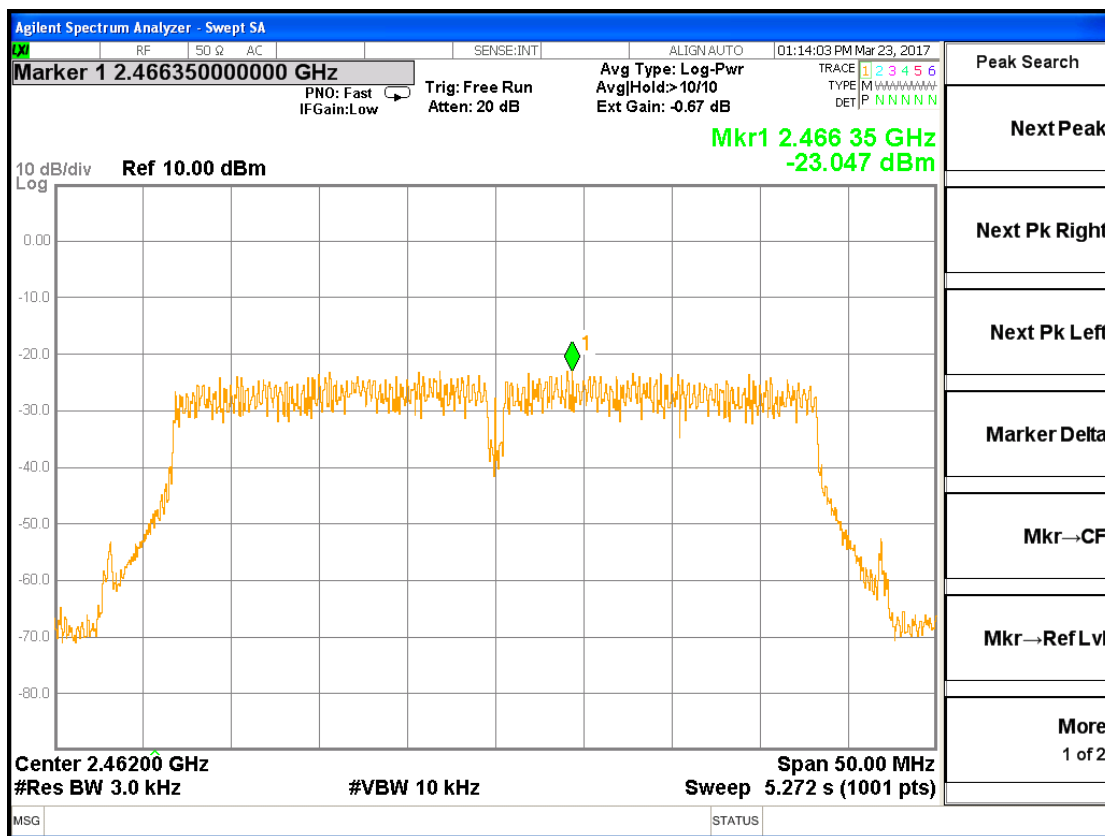


## Power Spectral Density (802.11n(20M)\_CH.11 (2462 MHz)) – Antenna B

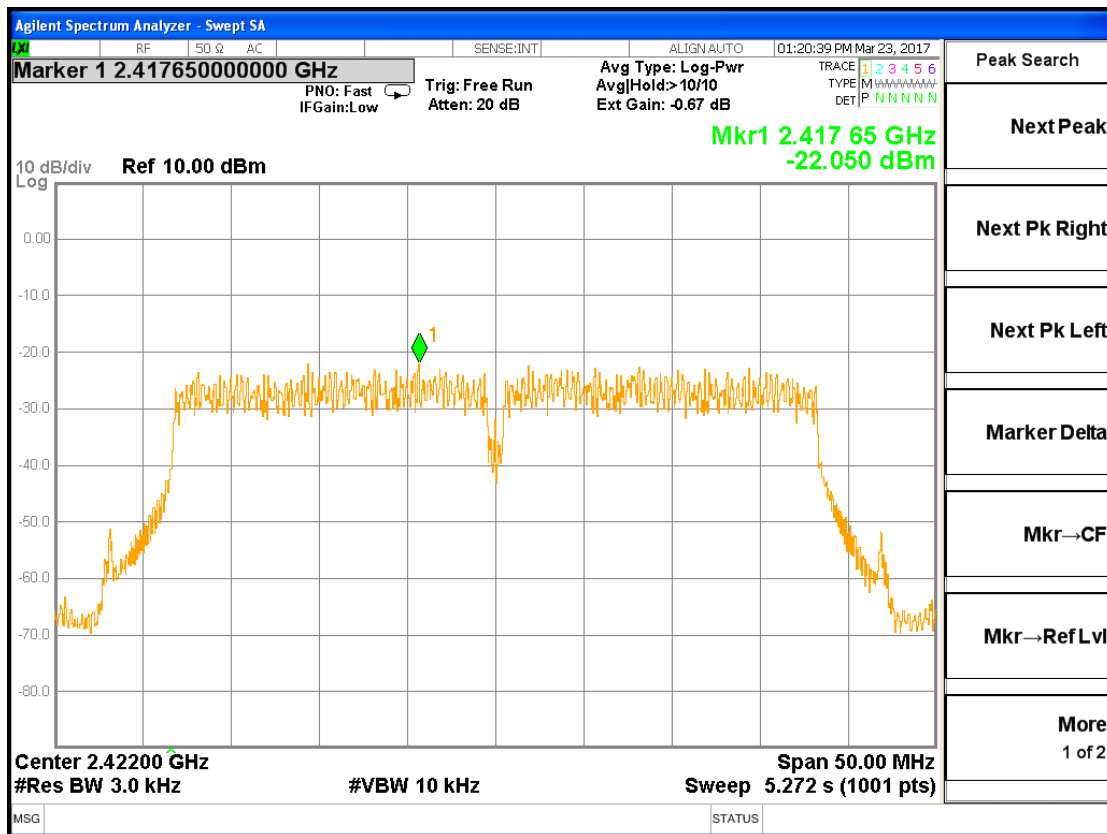




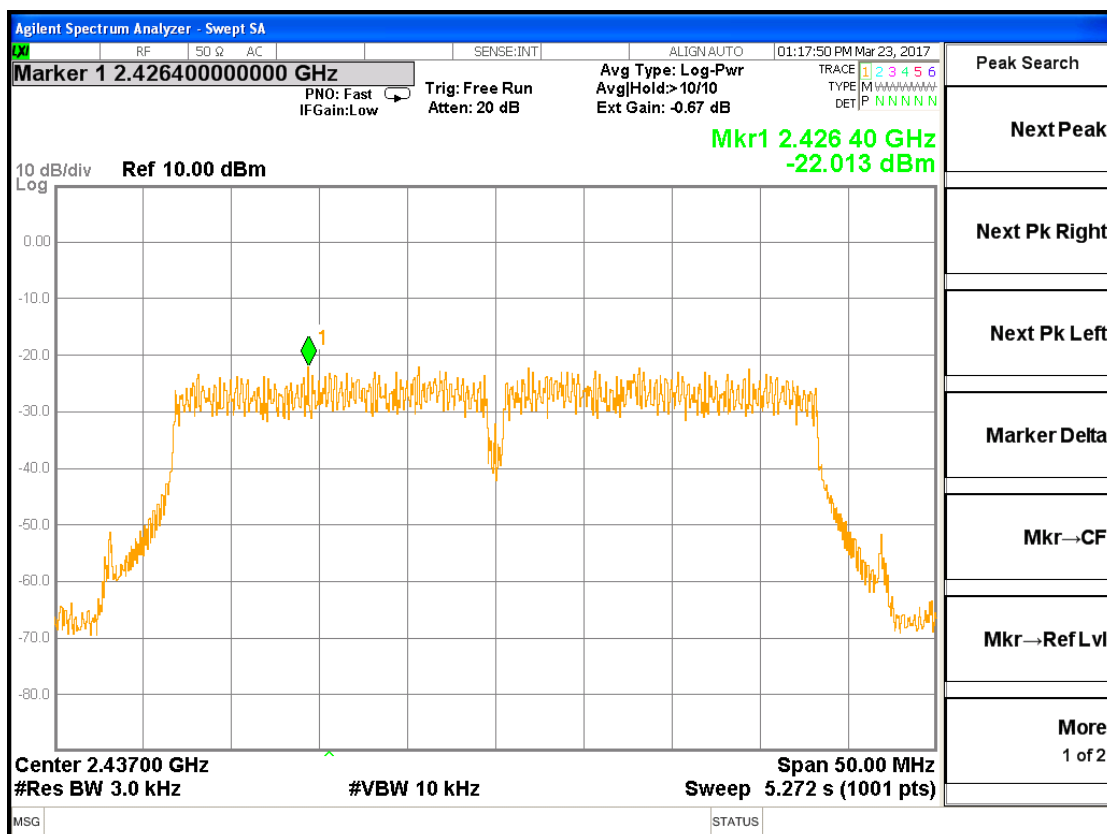
## Power Spectral Density (802.11n(40M)\_CH.11 (2437 MHz)) – Antenna A



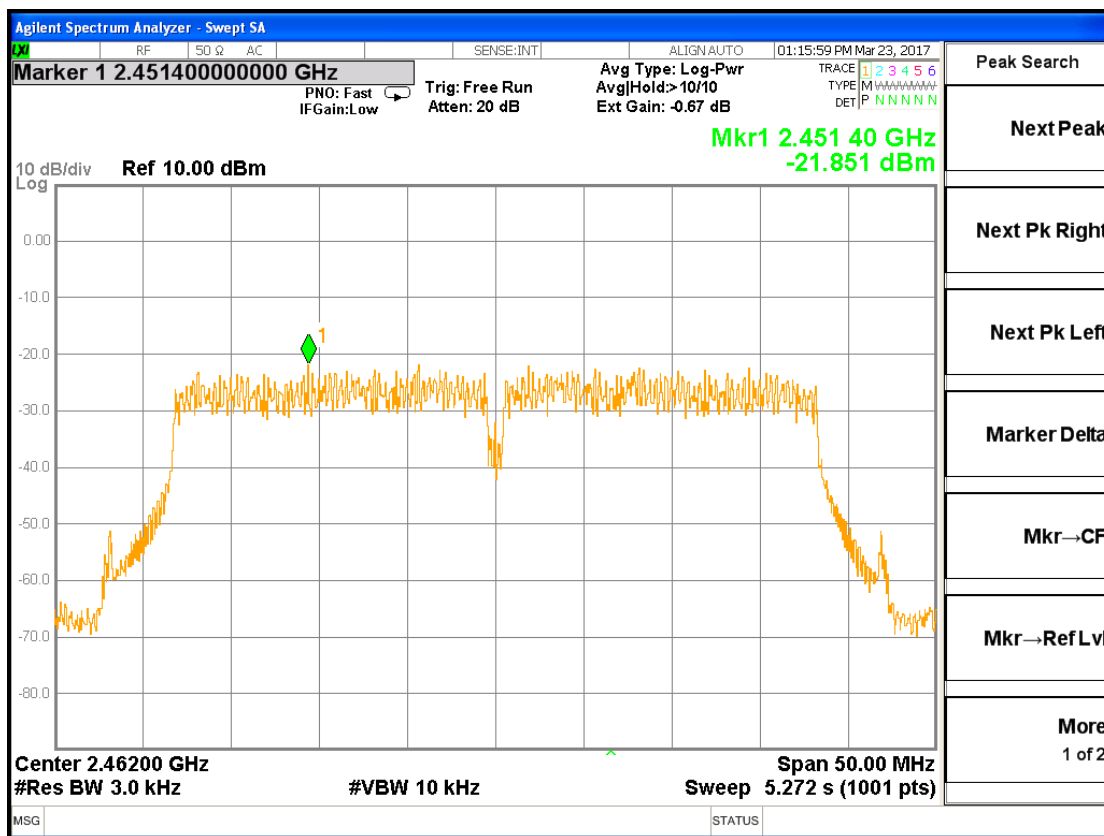
### Power Spectral Density (802.11n(40M)\_CH.1 (2422 MHz)) – Antenna B



### Power Spectral Density (802.11n(40M)\_CH.6 (2437 MHz)) – Antenna B



## Power Spectral Density (802.11n(40M)\_CH.11 (2462 MHz)) – Antenna B



## 5.4 6dB Bandwidth

### 5.4.1 Test Equipment

EQUIPMENT	MODEL	MANUFACTURE	SERIAL NUMBER	Calibration Due date (year/month/date)	Calibration Interval
Spectrum analyzer	N9020A	Agilent	US4622010 1	2017/09/07	1 Year
DC Power Supply	UDP-6015R	Unicorn tech	131007	2017/09/07	1 Year

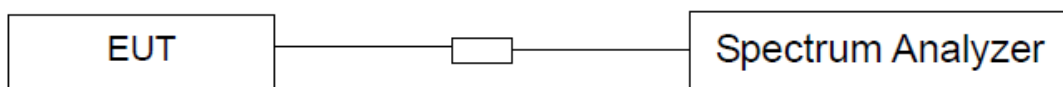
### 5.4.2 Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

### 5.4.3 Measurement Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set (RBW = 100 kHz, VBW = 300 kHz, Detector = Peak, Trace mode = Max Hold, Sweep = Auto).
5. Measure and record the results in the test report.

### 5.4.4 Test SET-UP (Block Diagram of Configuration)



### 5.4.5 Test Result

**Test mode: IEEE 802.11b**

Channel	Frequency (MHz)	6dB Spectrum Bandwidth (MHz)	Limit (MHz)	Result
		Antenna B		
1	2412	8.71	≥ 0.5	Pass
6	2437	8.72	≥ 0.5	Pass
11	2462	8.72	≥ 0.5	Pass

**Test mode: IEEE 802.11g**

Channel	Frequency (MHz)	6dB Spectrum Bandwidth (MHz)	Limit (MHz)	Result
		Antenna B		
1	2412	16.56	≥ 0.5	Pass
6	2437	16.55	≥ 0.5	Pass
11	2462	16.56	≥ 0.5	Pass

**Test mode: IEEE 802.11n(20M)**

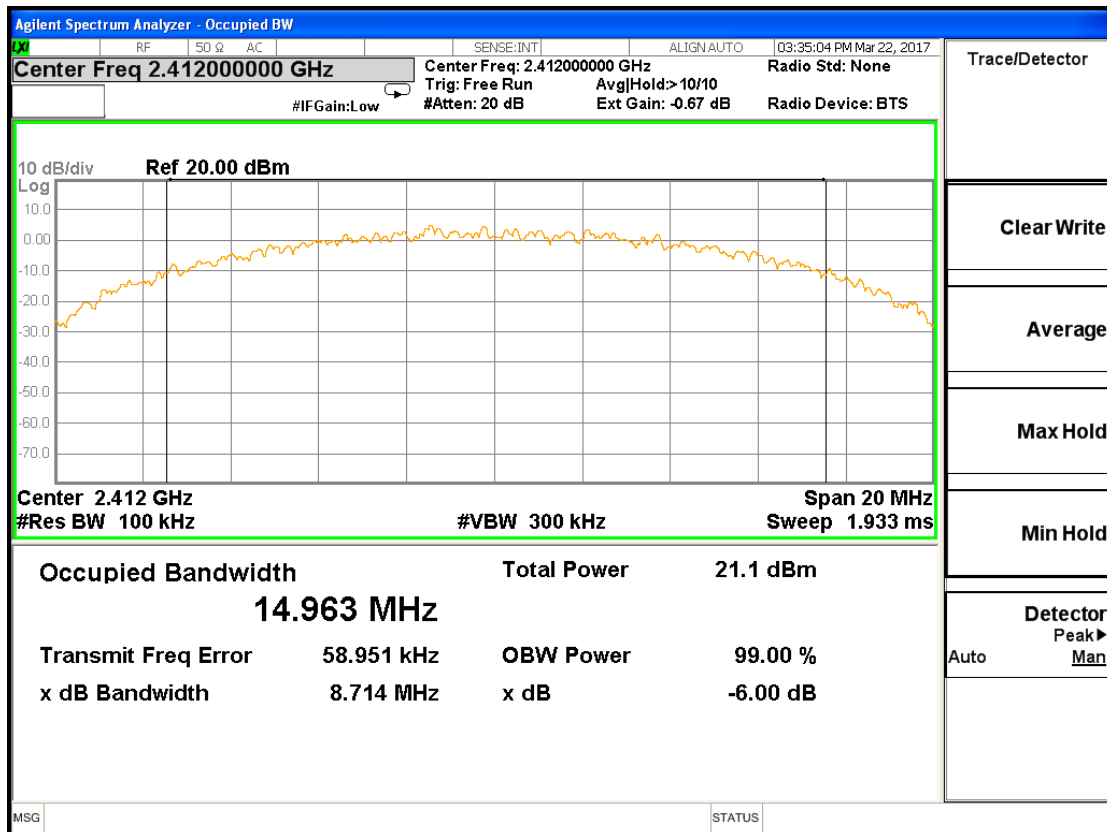
Channel	Frequency (MHz)	6dB Spectrum Bandwidth (MHz)	Limit (MHz)	Result
		Antenna B		
1	2412	17.78	≥ 0.5	Pass
6	2437	17.78	≥ 0.5	Pass
11	2462	17.79	≥ 0.5	Pass

**Test mode: IEEE 802.11n(40M)**

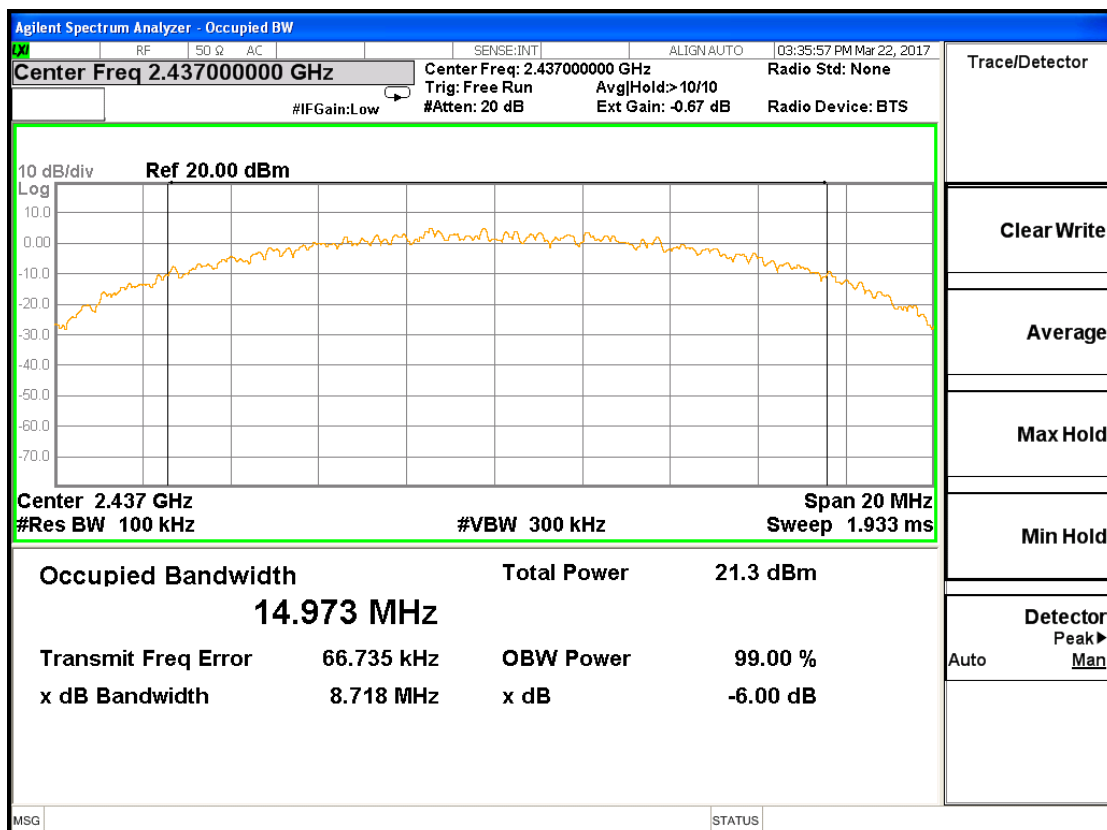
Channel	Frequency (MHz)	6dB Spectrum Bandwidth (MHz)	Limit (MHz)	Result
		Antenna B		
3	2422	36.49	≥ 0.5	Pass
6	2437	36.49	≥ 0.5	Pass
11	2462	36.49	≥ 0.5	Pass

## 5.4.6 Test Plot

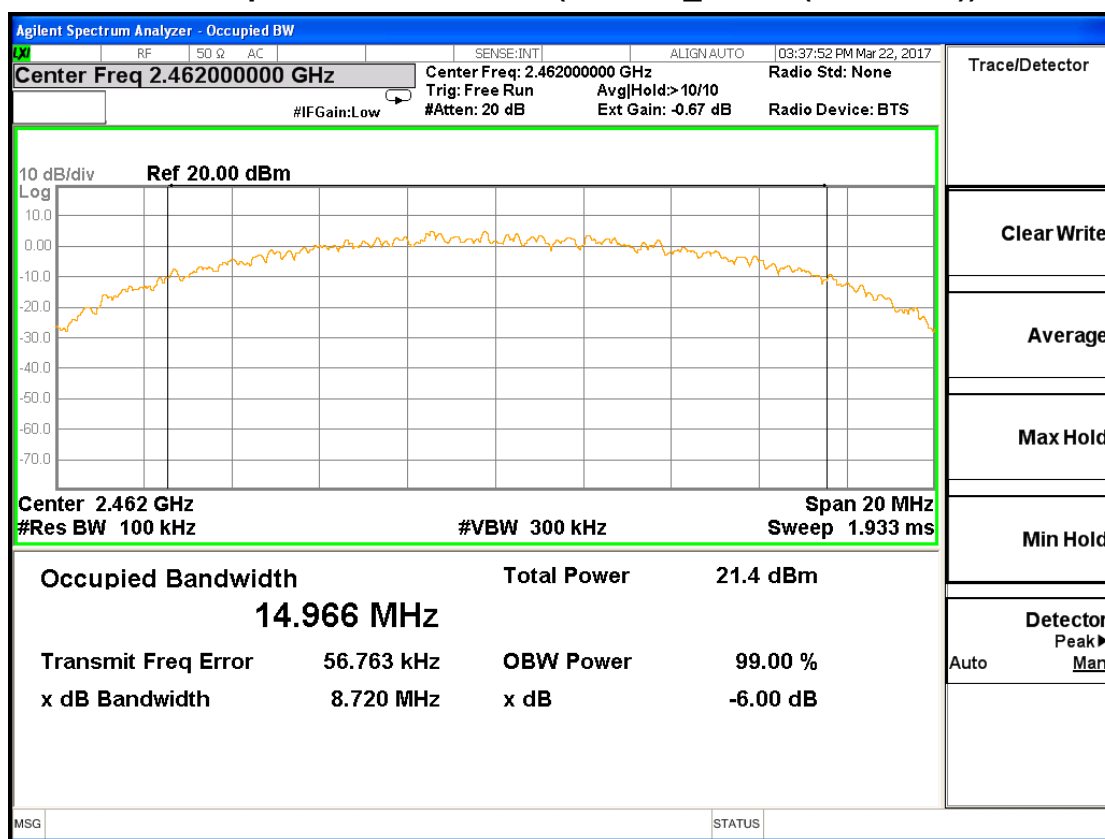
### 6dB Spectrum Bandwidth (802.11b\_CH.1 (2412 MHz))



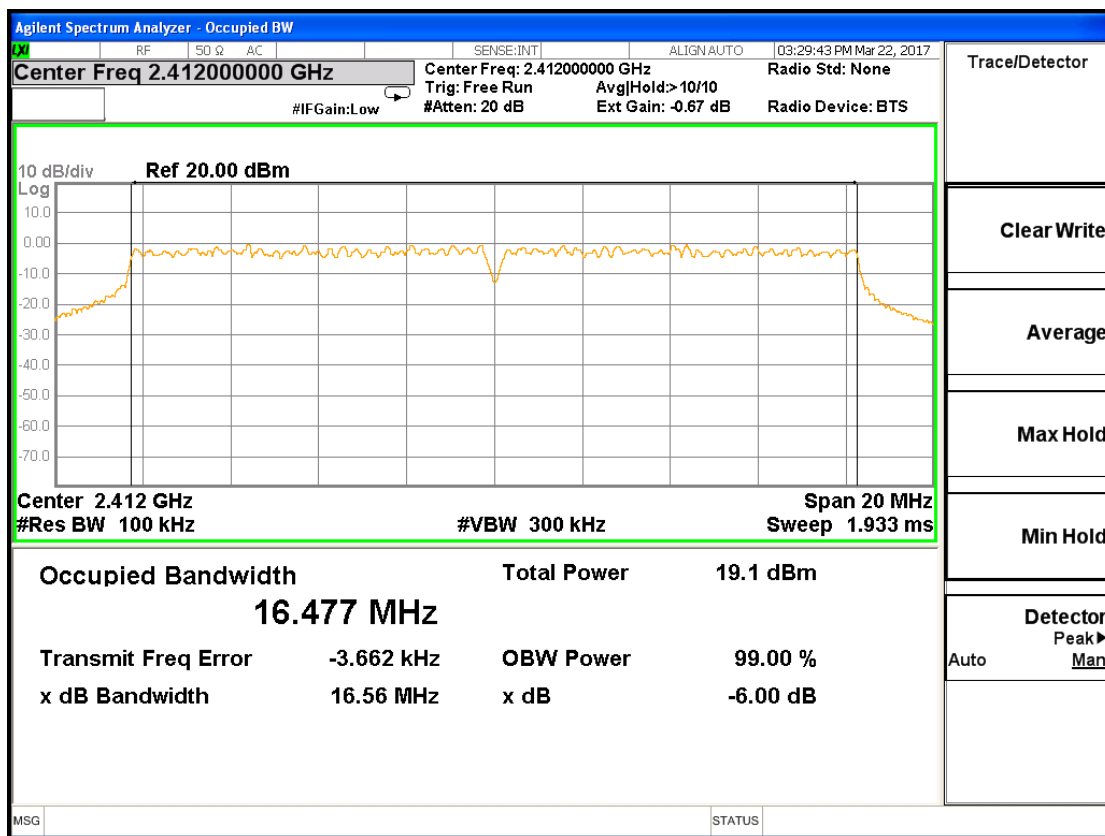
### 6dB Spectrum Bandwidth (802.11b\_CH.6 (2437 MHz))



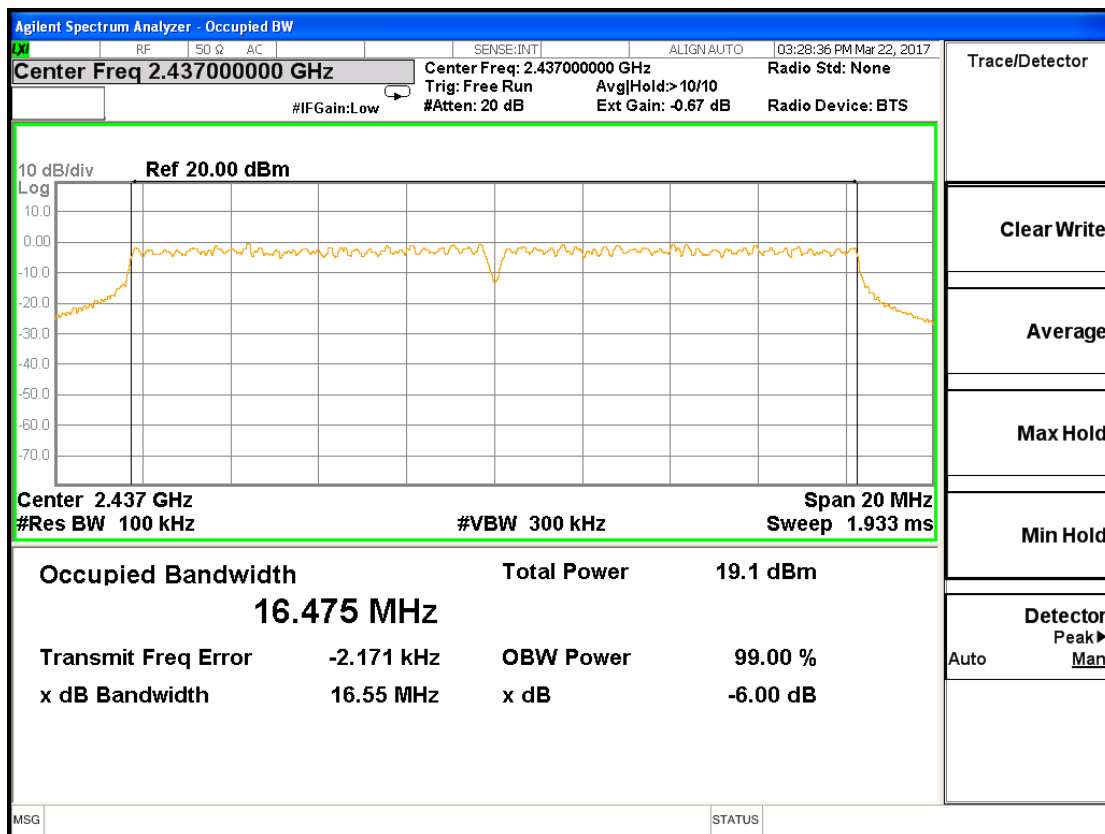
## 6dB Spectrum Bandwidth (802.11b\_CH.11 (2462 MHz))



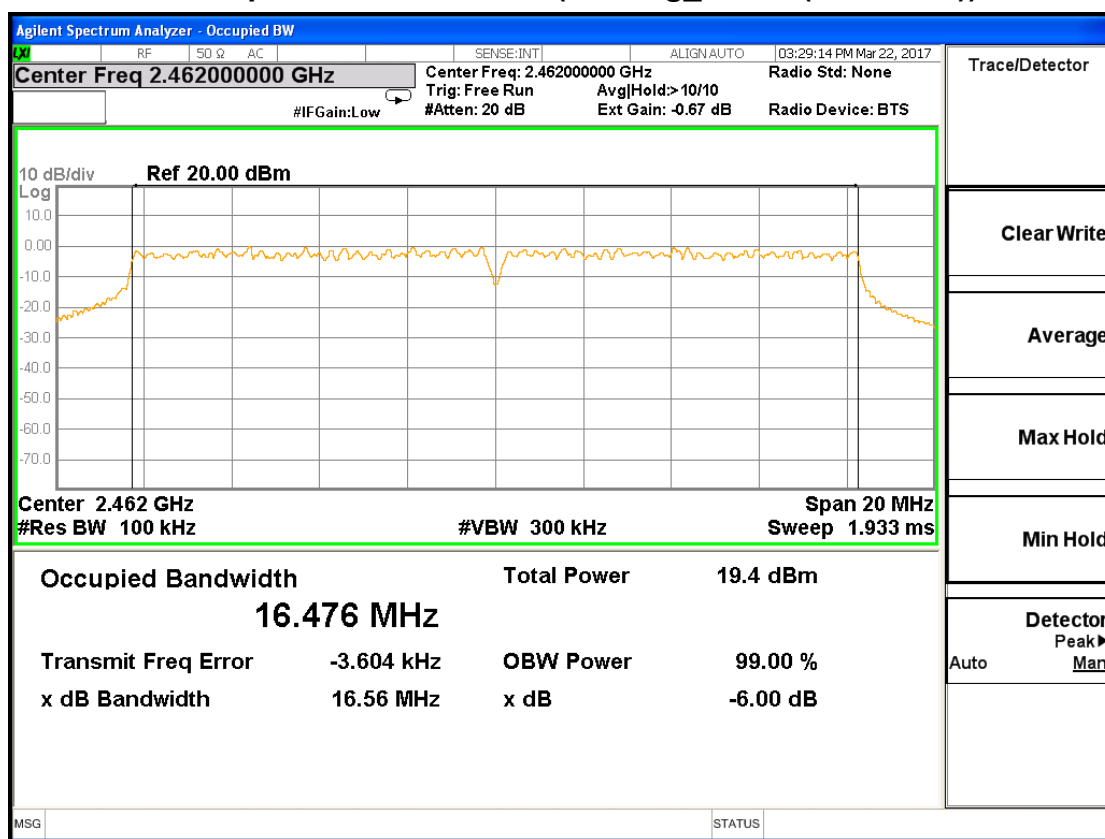
### 6dB Spectrum Bandwidth (802.11g\_CH.1 (2412 MHz))



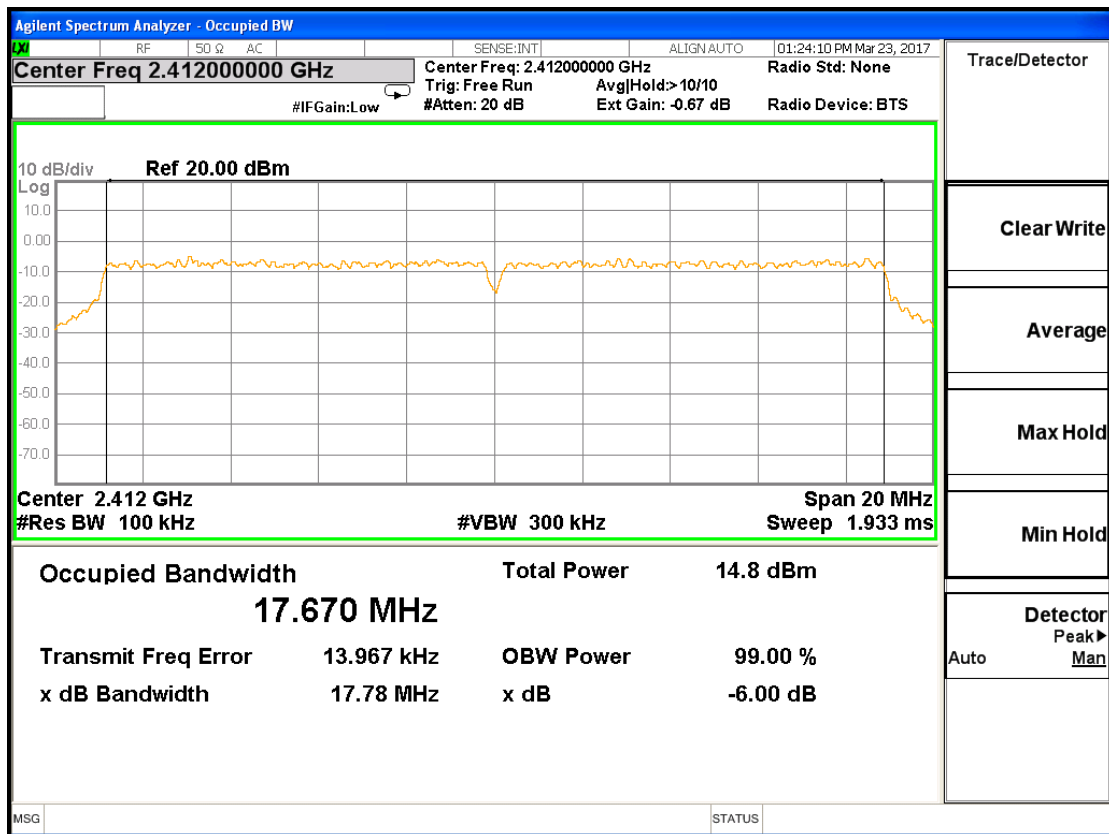
### 6dB Spectrum Bandwidth (802.11g\_CH.6 (2437 MHz))



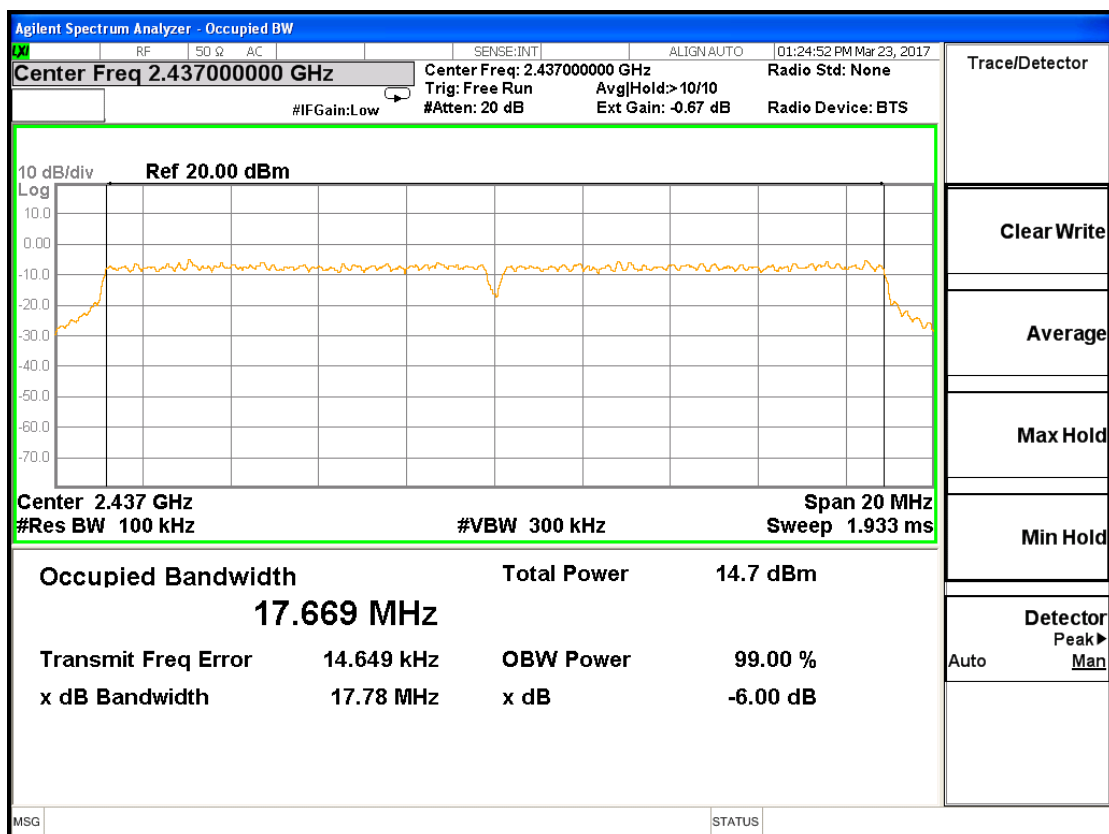
## 6dB Spectrum Bandwidth (802.11g\_CH.11 (2462 MHz))



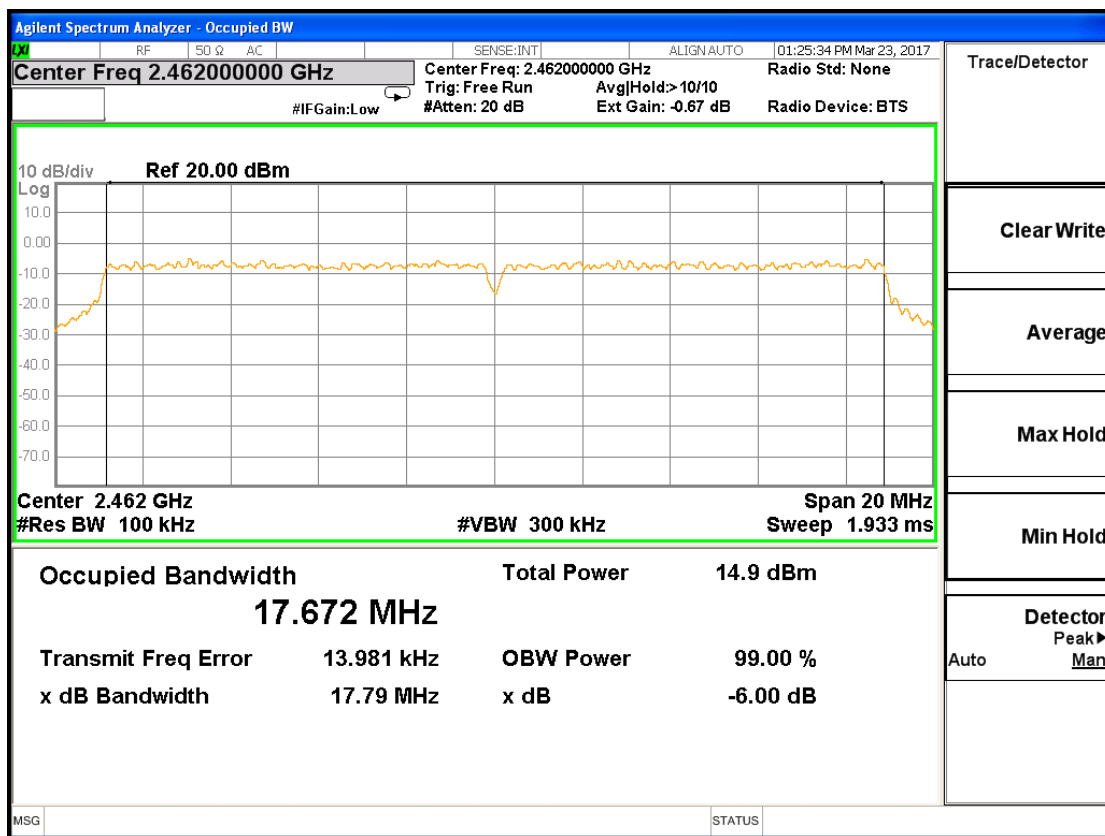
### 6dB Spectrum Bandwidth (802.11n(20M)\_CH.1 (2412 MHz))



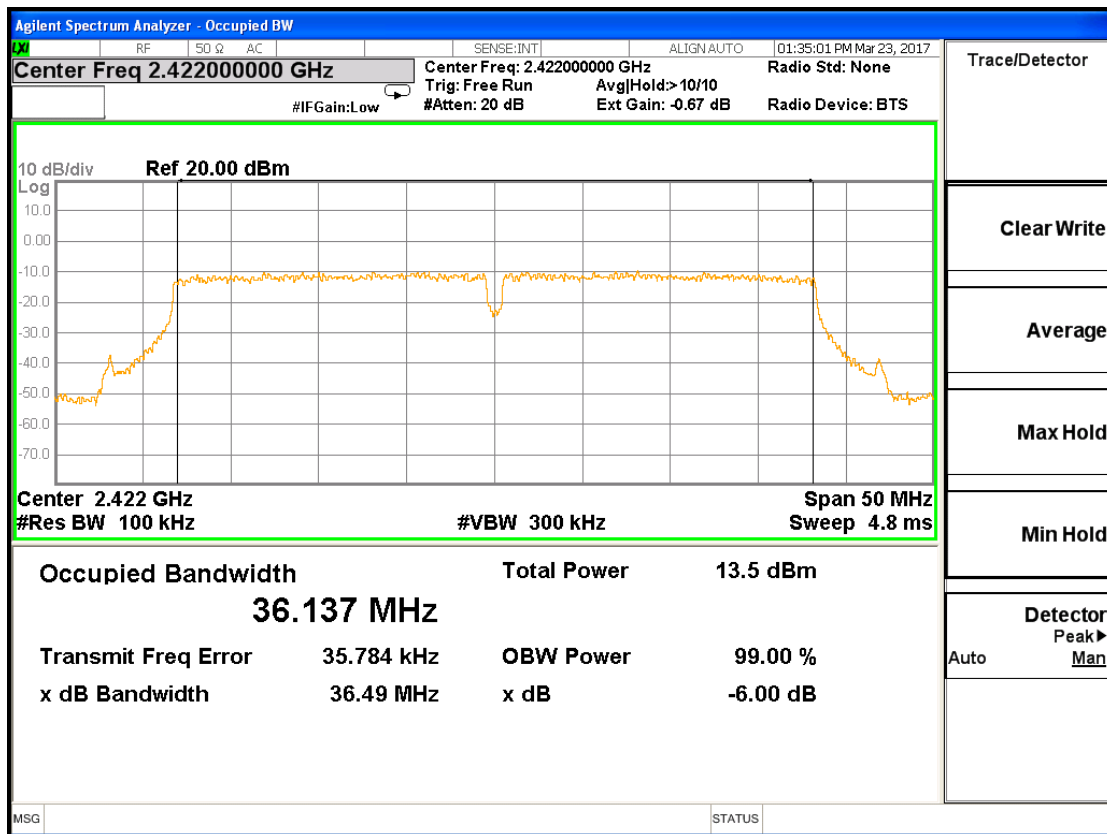
### 6dB Spectrum Bandwidth (802.11n(20M)\_CH.6 (2437 MHz))



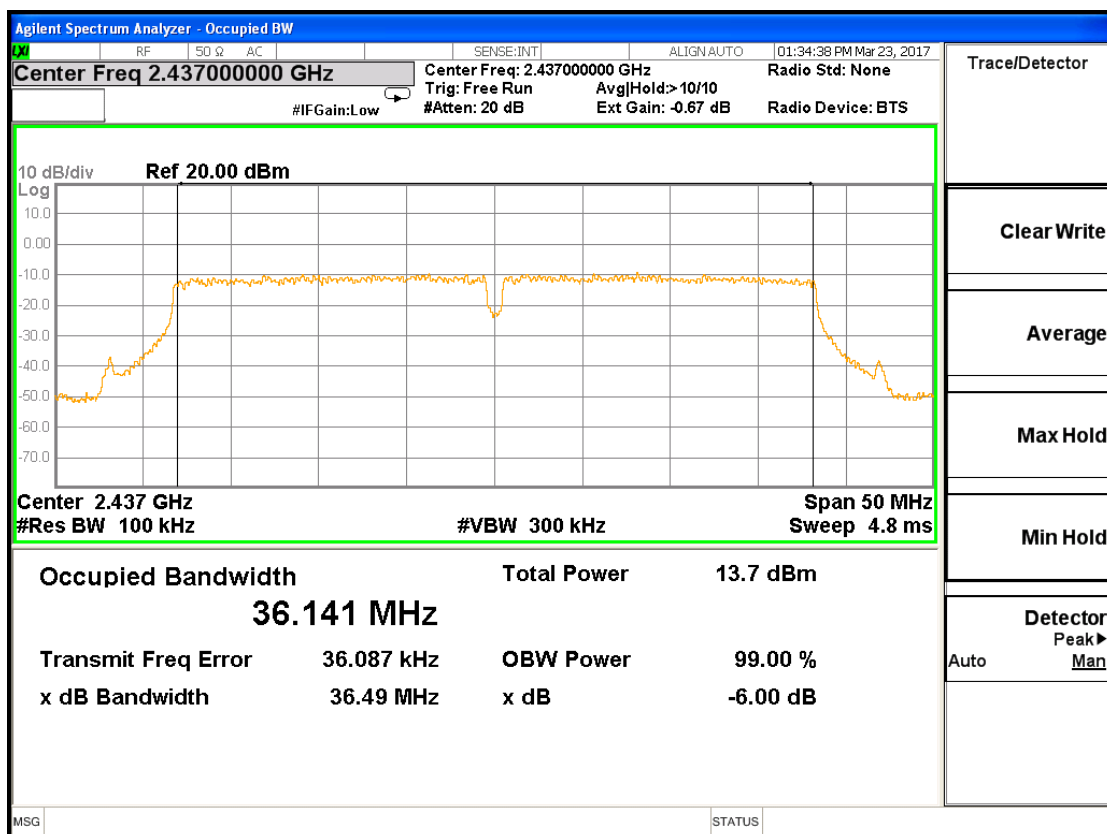
## 6dB Spectrum Bandwidth (802.11n(20M)\_CH.11 (2462 MHz))



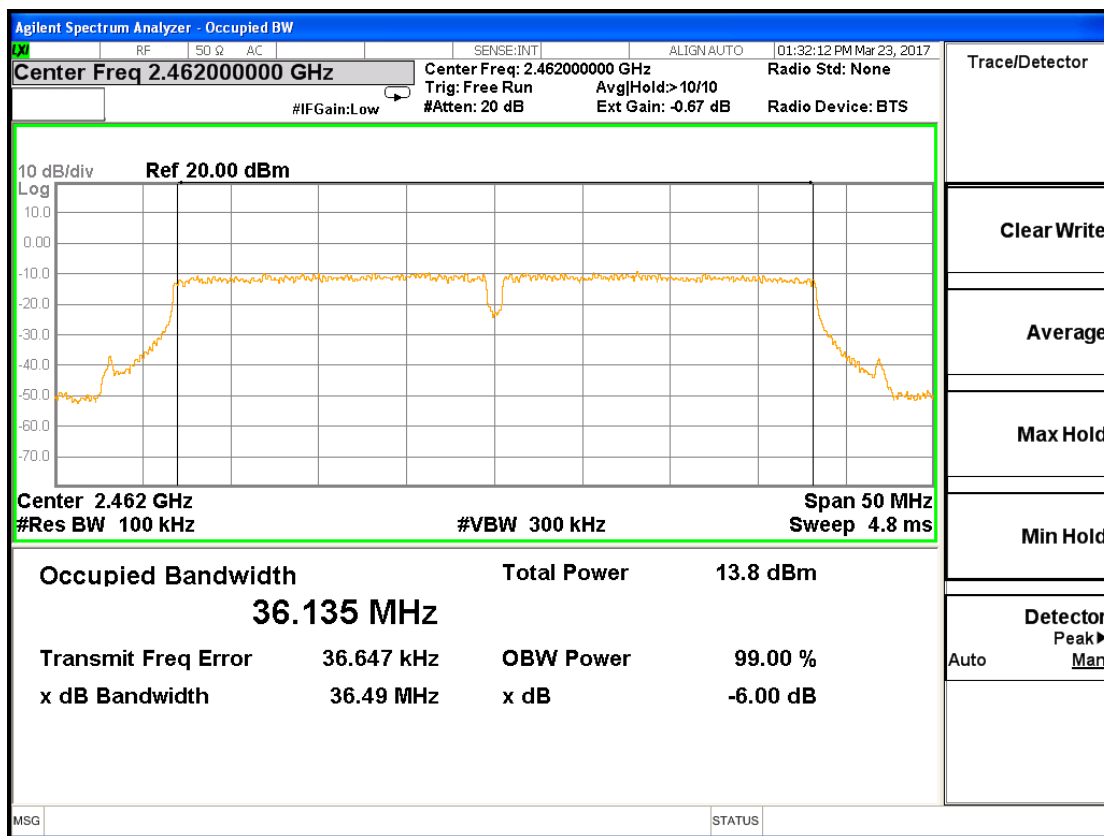
### 6dB Spectrum Bandwidth (802.11n(40M)\_CH.1 (2412 MHz))



### 6dB Spectrum Bandwidth (802.11n(40M)\_CH.6 (2437 MHz))



## 6dB Spectrum Bandwidth (802.11n(40M)\_CH.11 (2462 MHz))



## 5.5 Radiated Spurious Emission

### 5.5.1 Test Equipment

EQUIPMENT	MODEL	MANUFACTURE	SERIAL NUMBER	Calibration Due date (year/month/date)	Calibration Interval
Loop Antenna	FMZB 1519 B	SCHWARZBECK	00025	2018/07/11	2 Year
Bilog Antenna	VULB 9160	SCHWARZBECK	9160-3052	2017/10/06	1 Year
Horn Antenna	BBHA 9120 D	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D 517	2018/10/17	2 Year
Spectrum analyzer	N9020A	Agilent	US46220101	2017/09/07	1 Year
EMI Test Receiver	ESVN30	ROHDE & SCHWARZ	832854/010	2018/01/05	1 Year
RF Amplifier	33711-392-77150-11	AEROFLEX	019	2017/12/08	1 Year
Antenna Master	JAC-3	Daeil EMC	N/A	N/A	-
Antenna Turntable Controller	JAC-2	Daeil EMC	N/A	N/A	-
EMC Analyzer	E7403A	H.P	US39150108	2018/01/05	1 Year
EMI Test Receiver	ESPI	ROHDE & SCHWARZ	100012	2018/01/06	1 Year
Antenna Master	N/A	AUDIX	N/A	N/A	-

### 5.5.2 Test Limit

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

**Note:** Wireless charger configuration was evaluated.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

### 5.5.3 Test Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable. For emissions testing at or below 1 GHz, the table height was 80cm above the reference ground plane. For emission measurements above 1 GHz, the table height was 1.5m.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings and peak emission levels are measured :
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW (9-150kHz: 200Hz, 0.15-30MHz: 9kHz, 30-1000MHz: 120kHz, above 1GHz: 1MHz).
  - (3) VBW  $\geq 3 \times$  RBW ; Sweep = auto; Detector function = peak; Trace = max hold

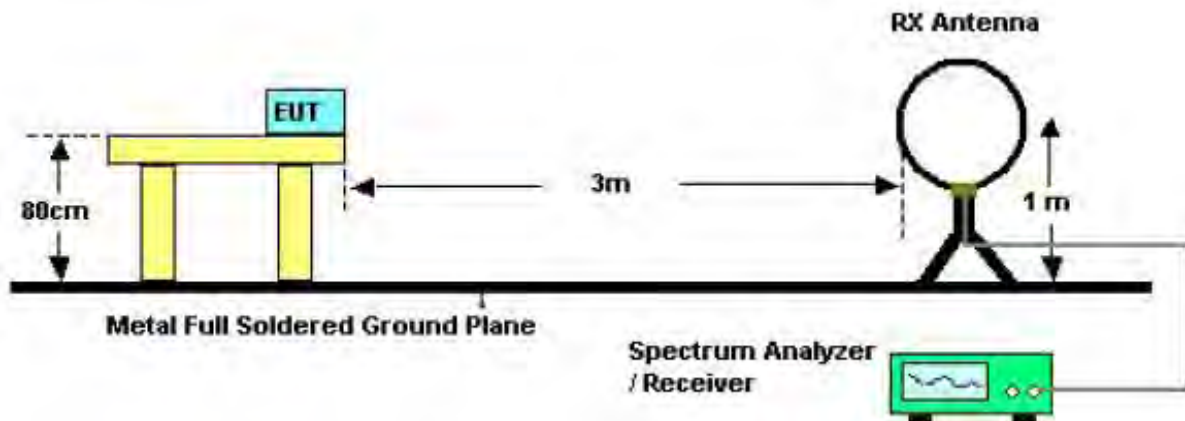
For average measurement:

- VBW = 10 Hz, when duty cycle is no less than 98 percent.
- VBW  $\geq 1/T$ , when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

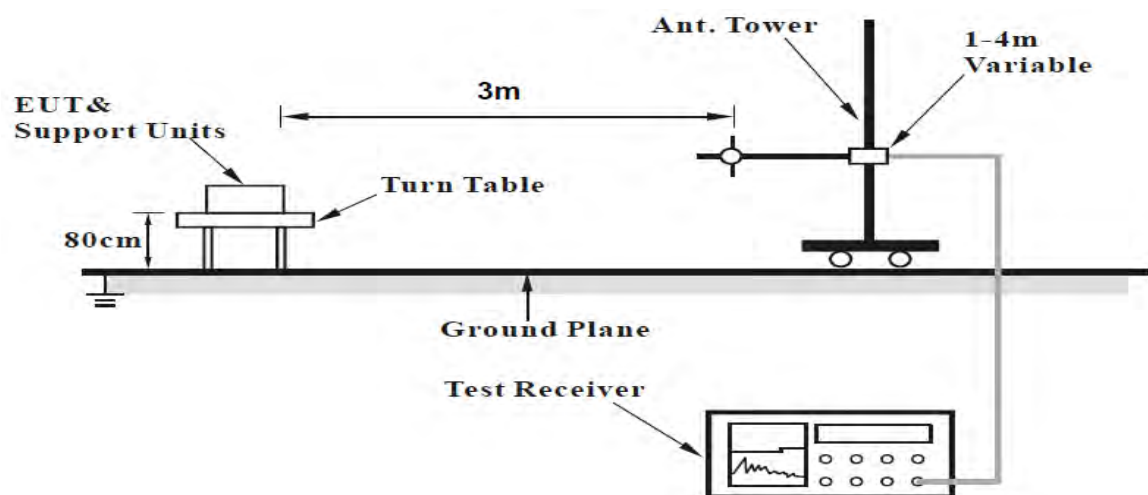
8. Measure and record the results in the test report.

### 5.5.4 Test SET-UP (Block Diagram of Configuration)

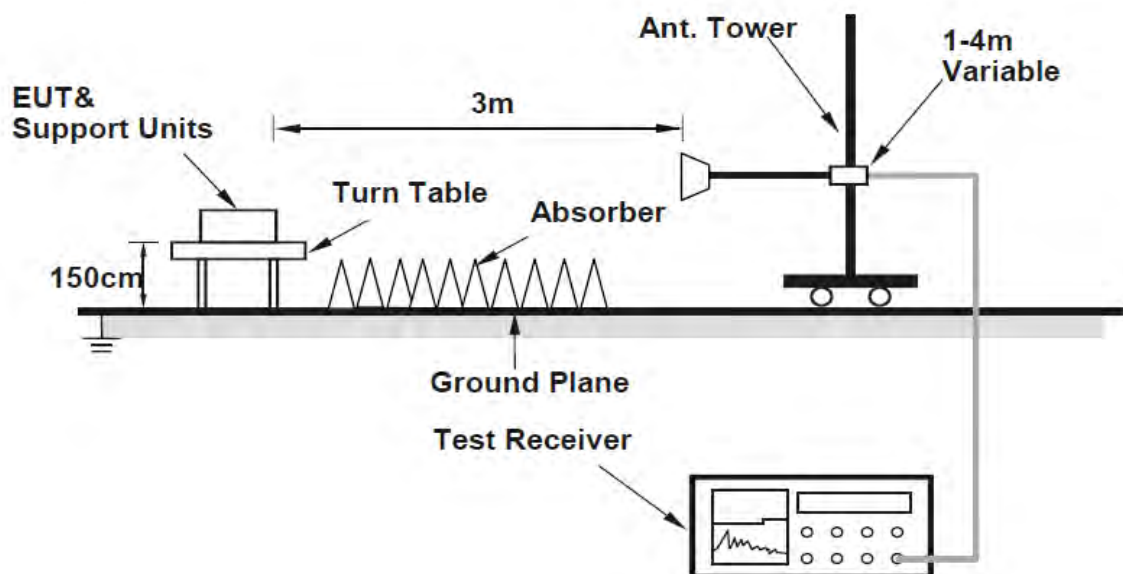
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-Up, Frequency above 1000MHz



## 5.5.5 Test Result

### 5.5.5.1 Frequency Below 30MHz

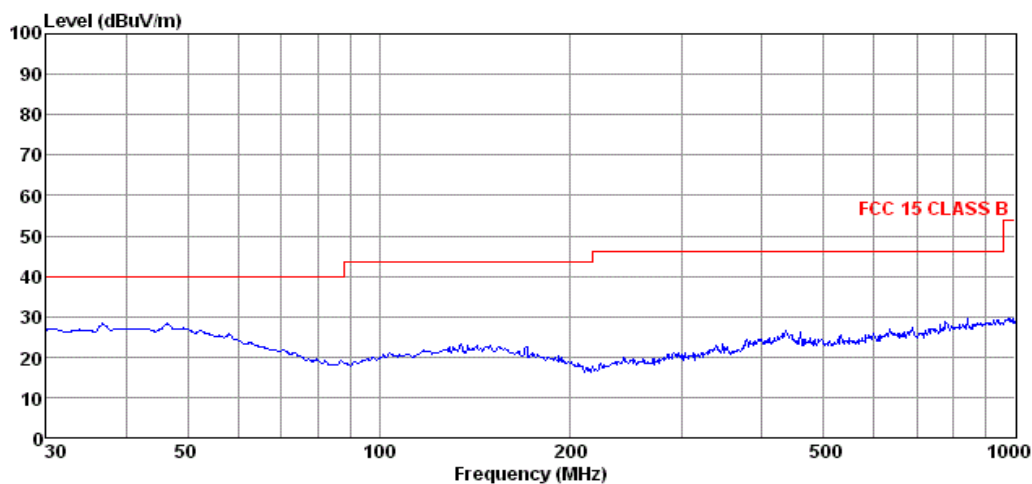
Frequency [MHz]	Reading [dB $\mu$ V]	Polarization [H/V]	Correction Factor [dB]	Result [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	State
-	-	-	-	-	-	-	PASS

Note: §15.31(o)\_The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

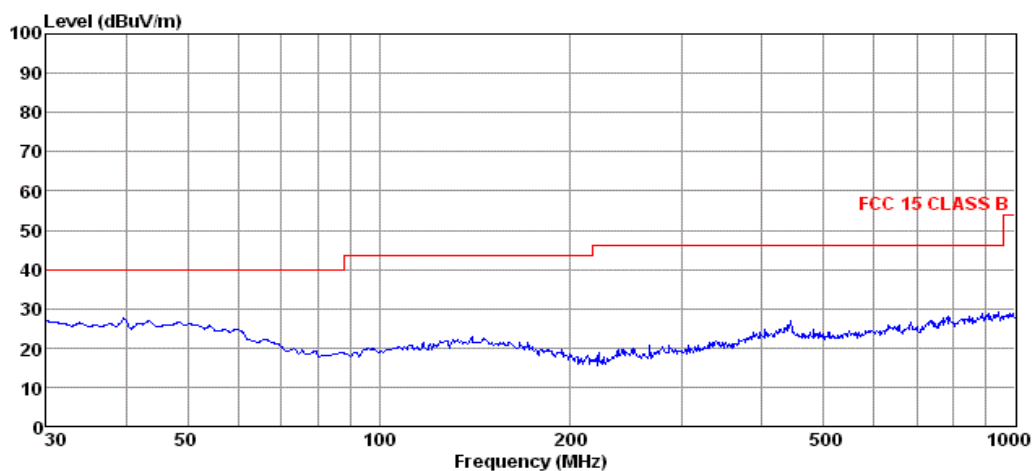
### 5.5.5.2. Frequency Below 1GHz

Test mode: IEEE 802.11b – Antenna B  
2412MHz (Channel 1)

#### 1GHz Below (30 ~ 1000MHz) – Horizontal

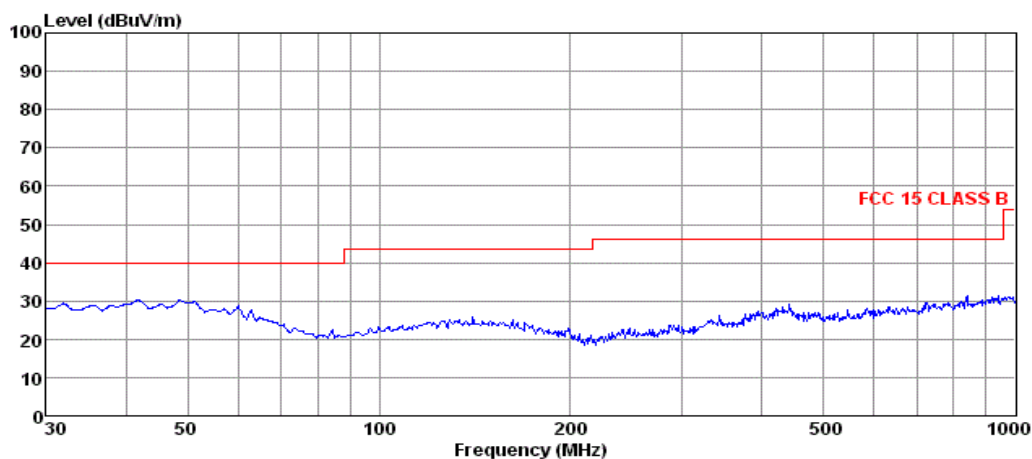


#### 1GHz Below (30 ~ 1000MHz) – Vertical

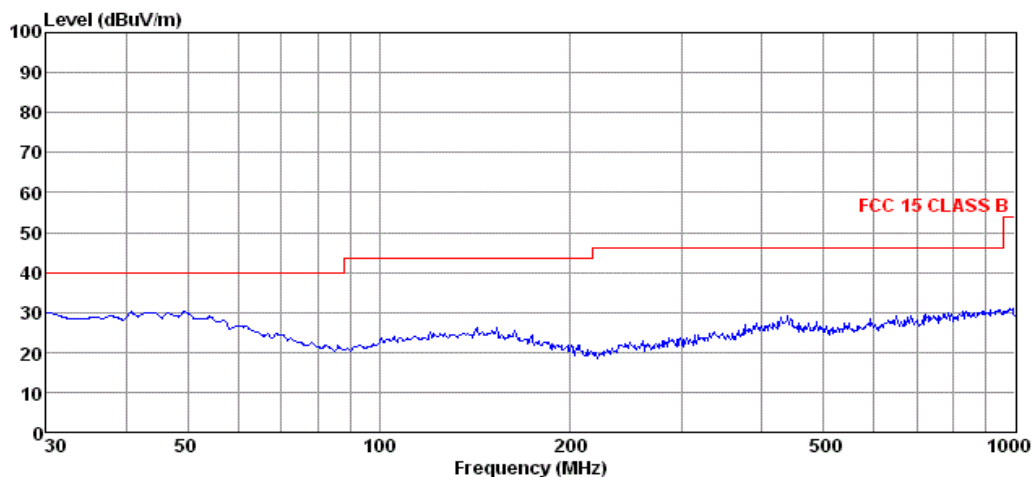


**Test mode: IEEE 802.11b – Antenna B**  
**2437MHz (Channel 6)**

### 1GHz Below (30 ~ 1000MHz) – Horizontal

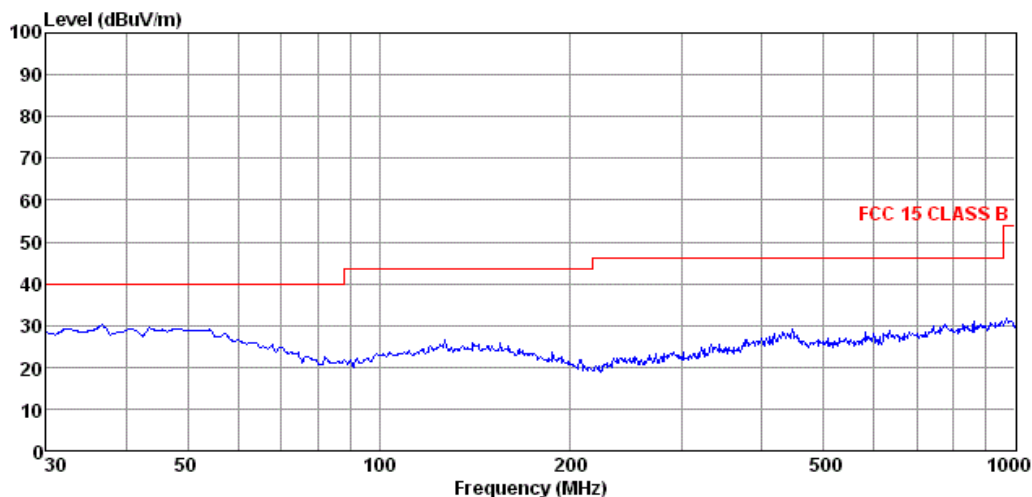


### 1GHz Below (30 ~ 1000MHz) – Vertical

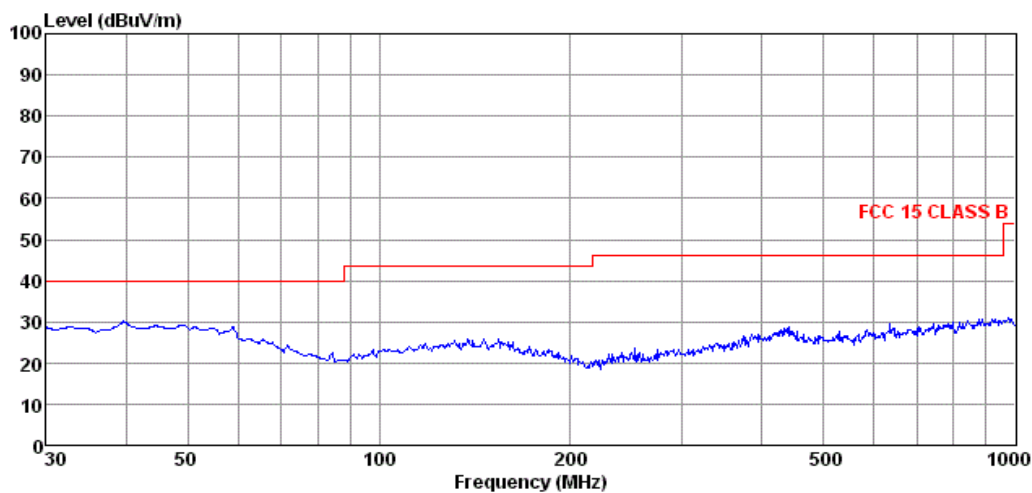


**Test mode: IEEE 802.11b – Antenna B**  
**2462MHz (Channel 11)**

### 1GHz Below (30 ~ 1000MHz) – Horizontal

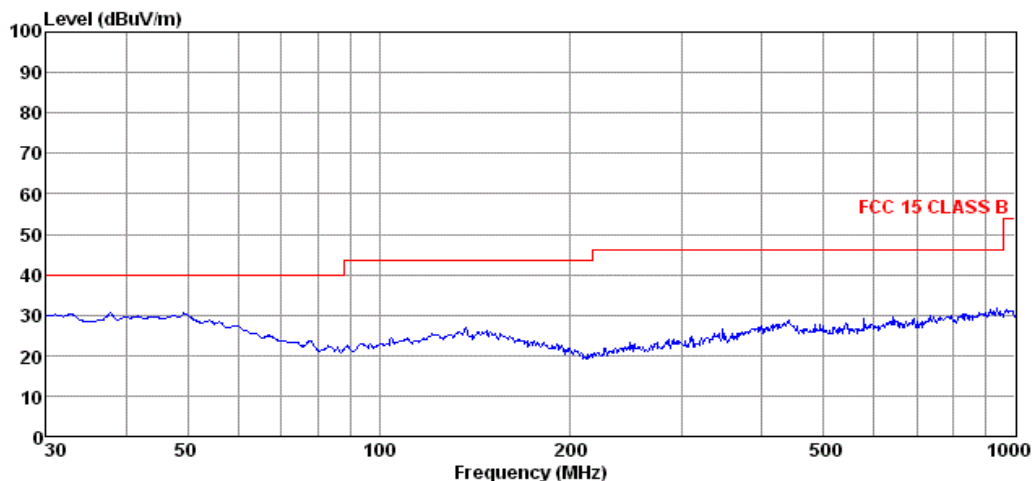


### 1GHz Below (30 ~ 1000MHz) – Vertical

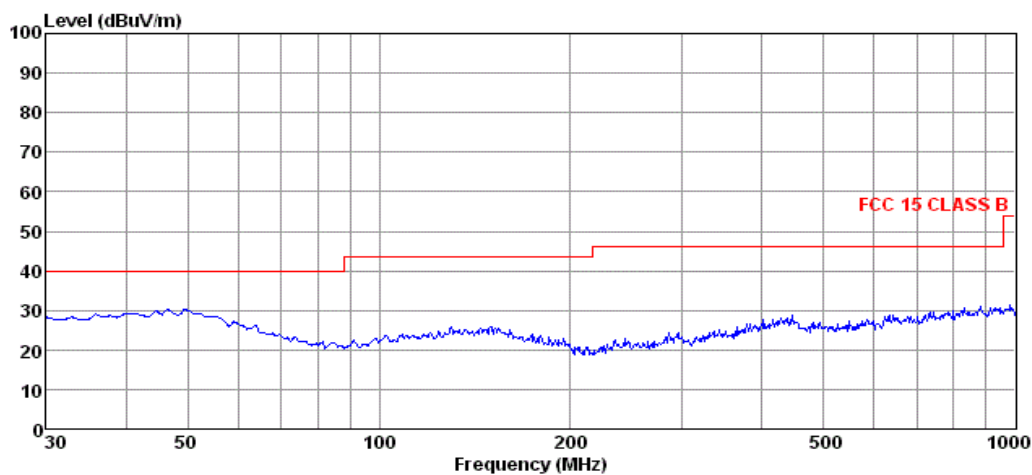


**Test mode: IEEE 802.11g – Antenna B**  
**2412MHz (Channel 1)**

### 1GHz Below (30 ~ 1000MHz) – Horizontal

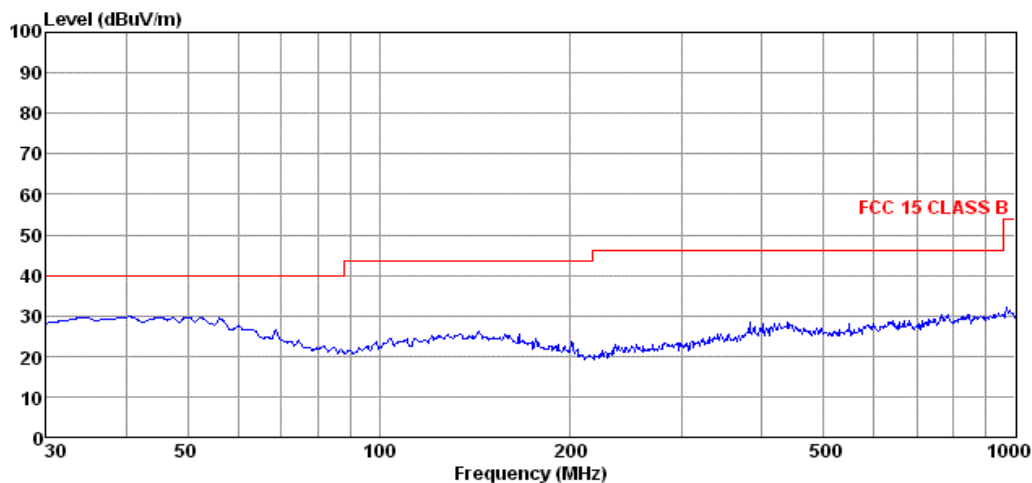


### 1GHz Below (30 ~ 1000MHz) – Vertical

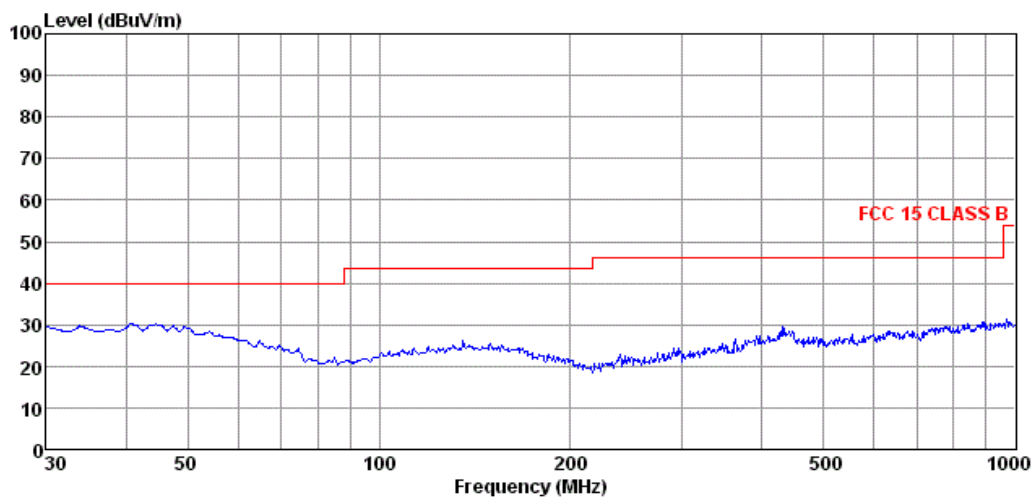


Test mode: IEEE 802.11g – Antenna B  
2437MHz (Channel 6)

### 1GHz Below (30 ~ 1000MHz) – Horizontal

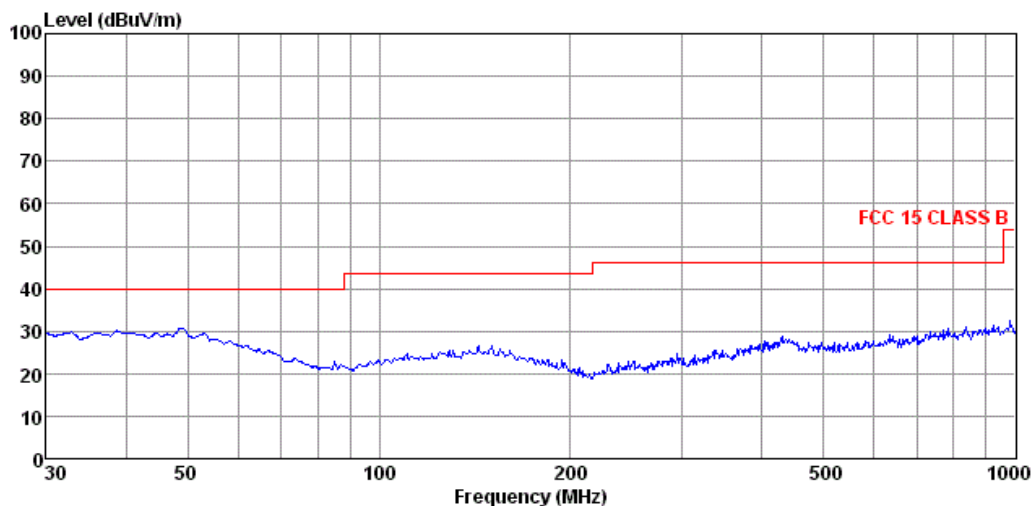


### 1GHz Below (30 ~ 1000MHz) – Vertical

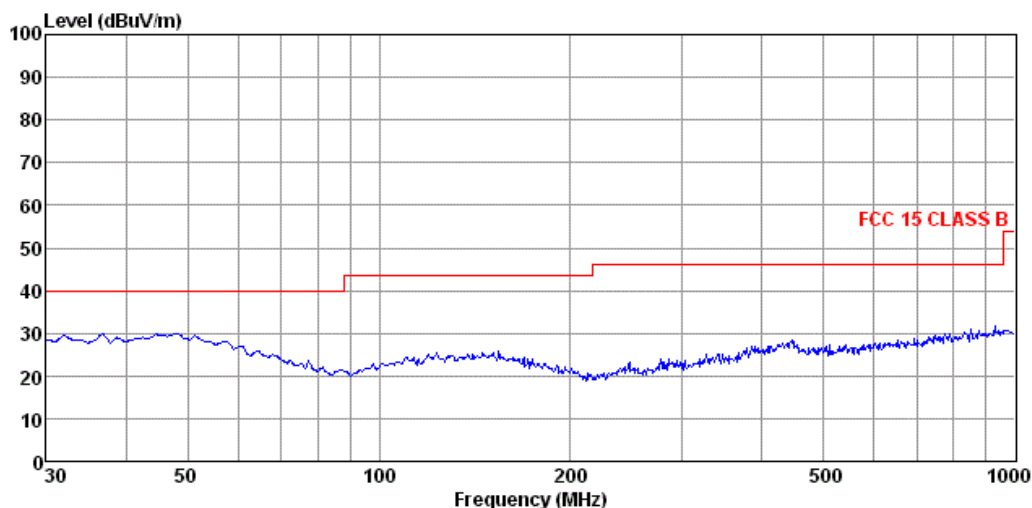


Test mode: IEEE 802.11g – Antenna B  
2462MHz (Channel 11)

### 1GHz Below (30 ~ 1000MHz) – Horizontal

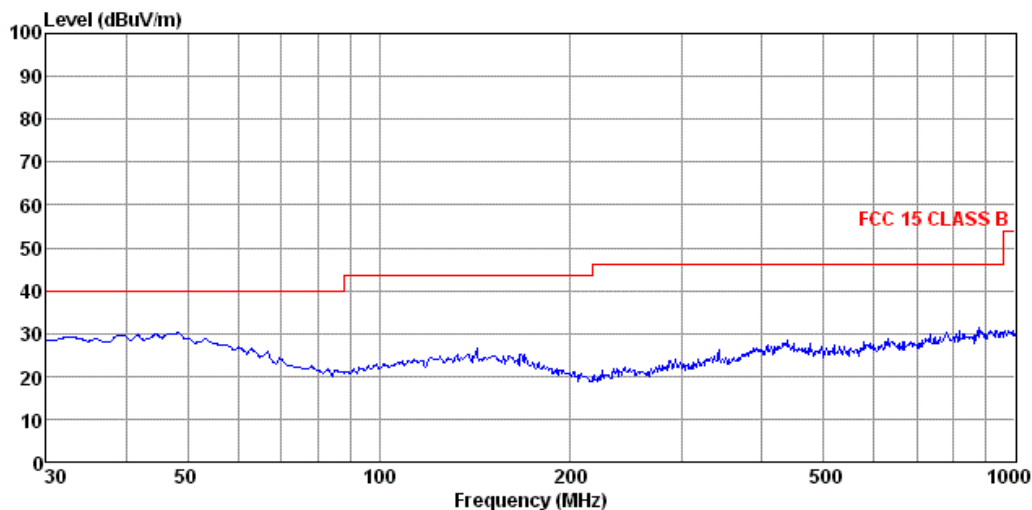


### 1GHz Below (30 ~ 1000MHz) – Vertical

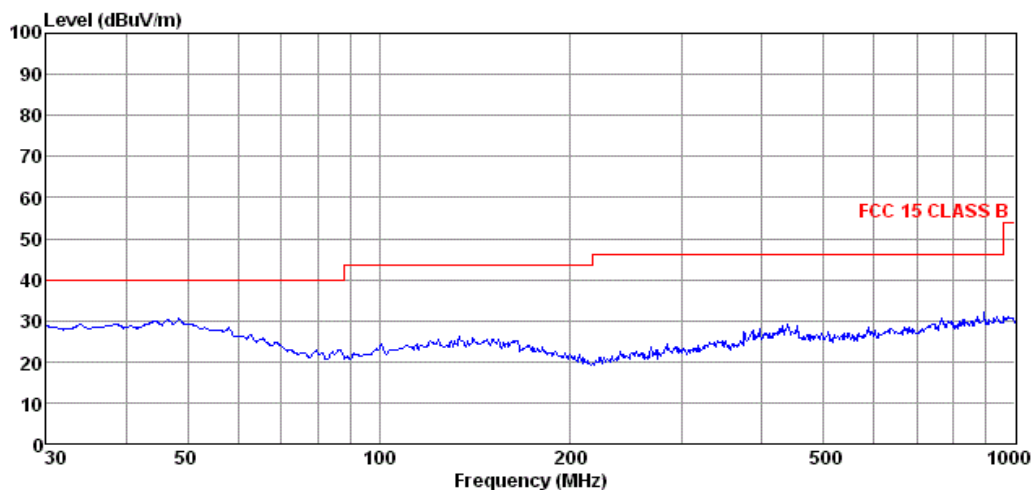


Test mode: IEEE 802.11n(20)  
2412MHz (Channel 1)

### 1GHz Below (30 ~ 1000MHz) – Horizontal

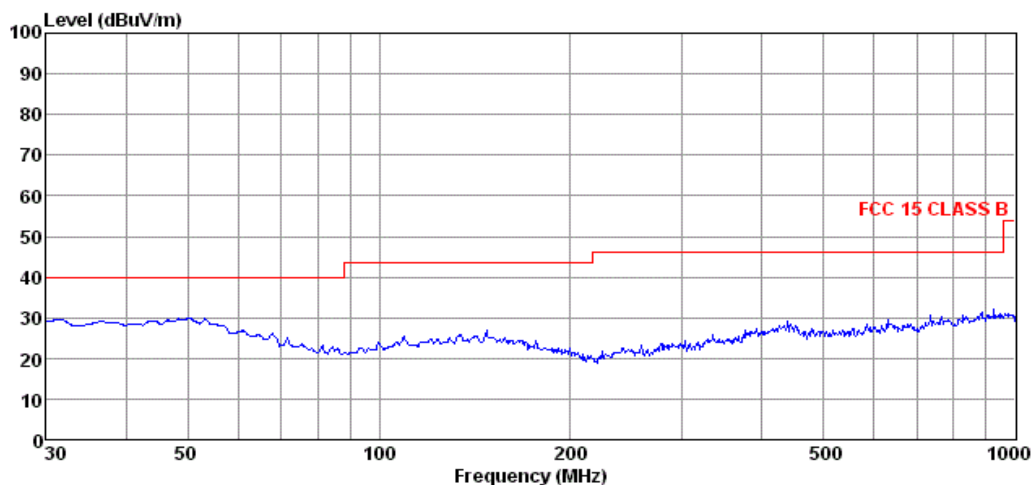


### 1GHz Below (30 ~ 1000MHz) – Vertical

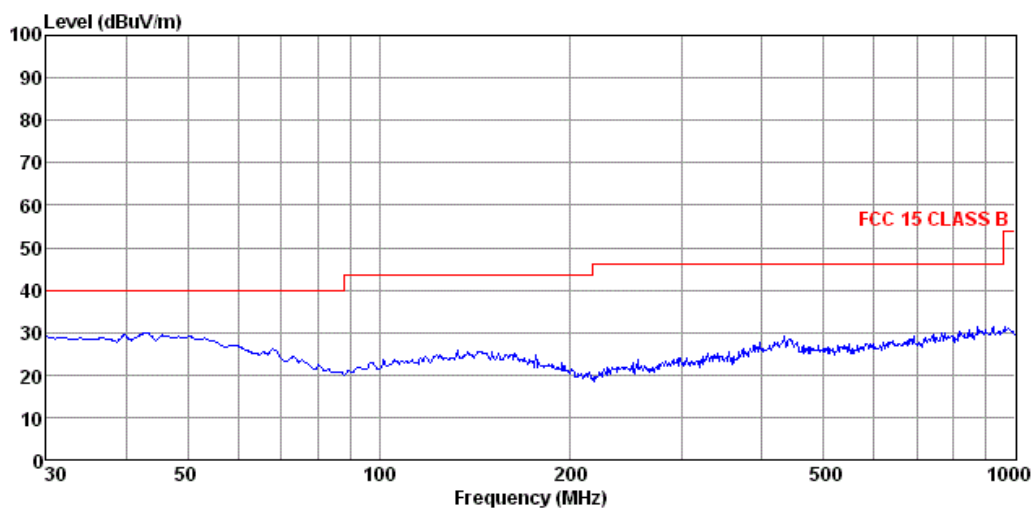


**Test mode: IEEE 802.11n(20)**  
**2437MHz (Channel 6)**

### 1GHz Below (30 ~ 1000MHz) – Horizontal

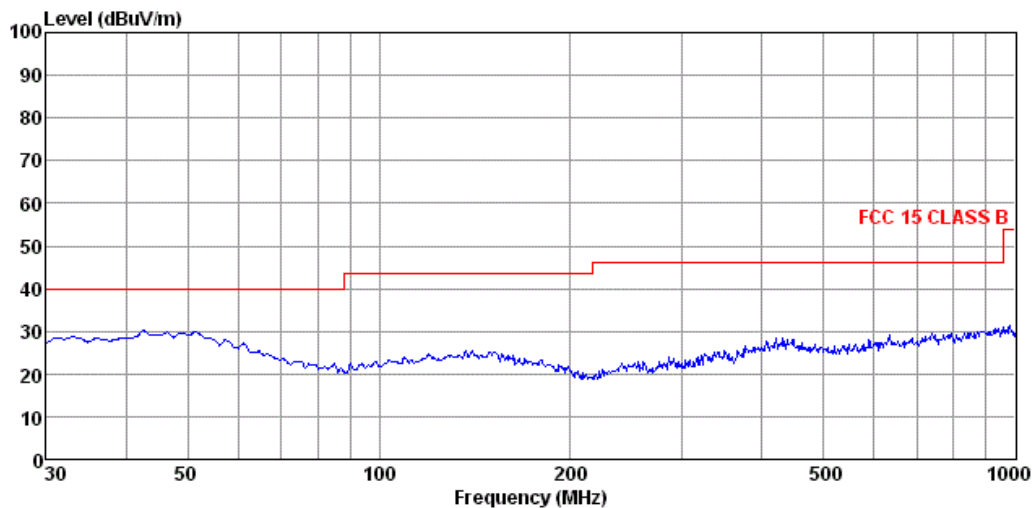


### 1GHz Below (30 ~ 1000MHz) – Vertical

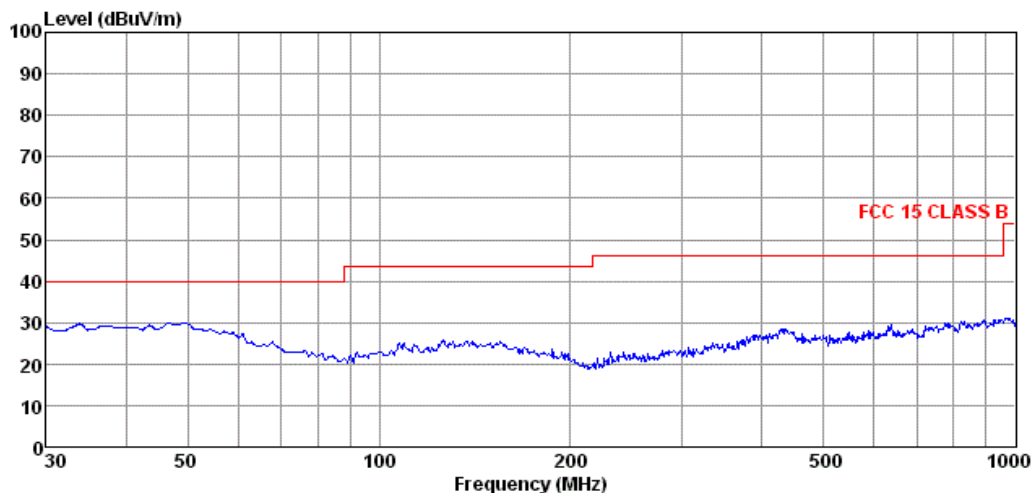


Test mode: IEEE 802.11n(20)  
2462MHz (Channel 11)

### 1GHz Below (30 ~ 1000MHz) – Horizontal



### 1GHz Below (30 ~ 1000MHz) – Vertical

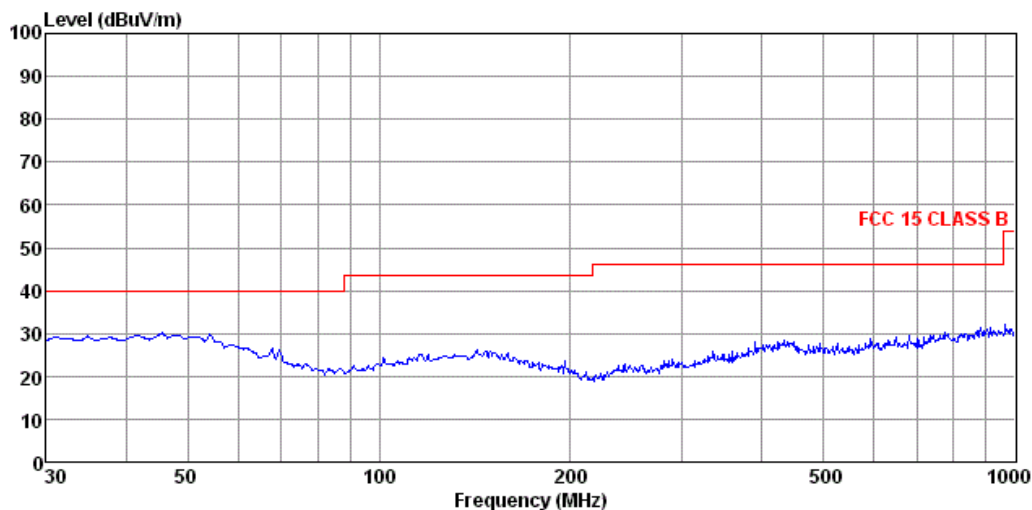


Test mode: IEEE 802.11n(40)  
2422MHz (Channel 3)

### 1GHz Below (30 ~ 1000MHz) – Horizontal



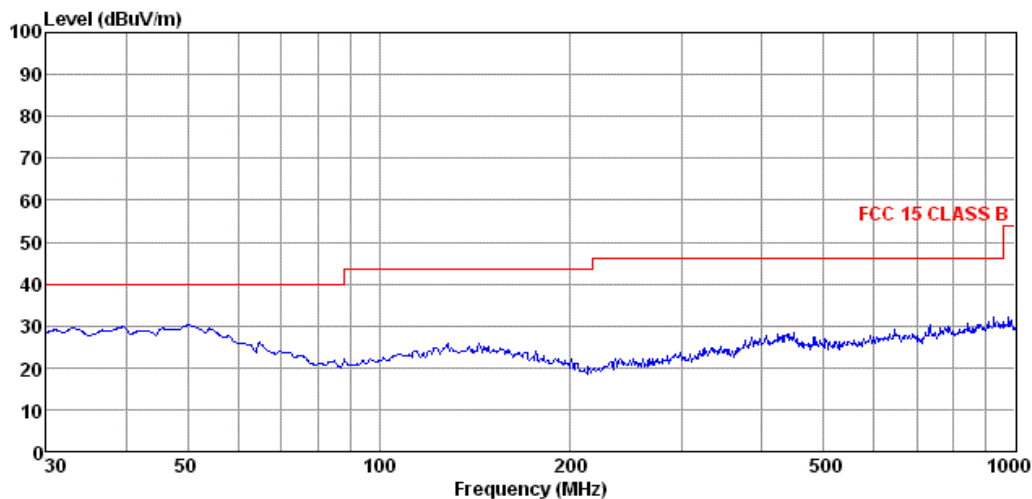
BWS TECH INC.  
3m Full Chamber



### 1GHz Below (30 ~ 1000MHz) – Vertical

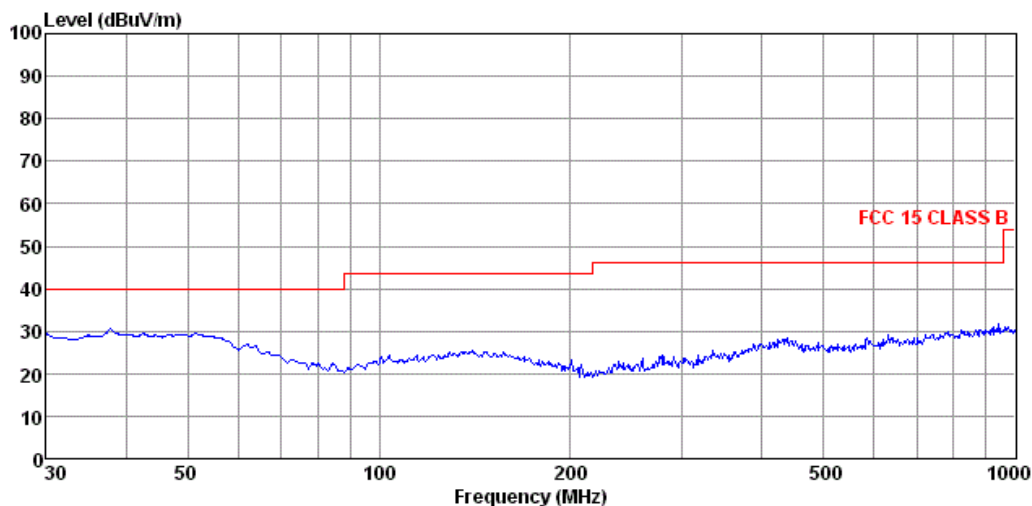


BWS TECH INC.  
3m Full Chamber

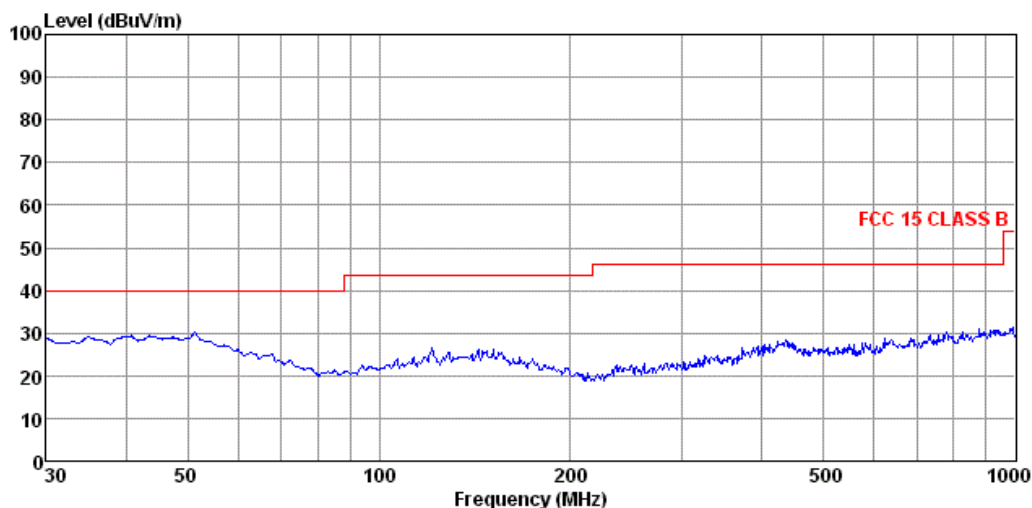


**Test mode: IEEE 802.11n(40)**  
**2437MHz (Channel 6)**

### 1GHz Below (30 ~ 1000MHz) – Horizontal

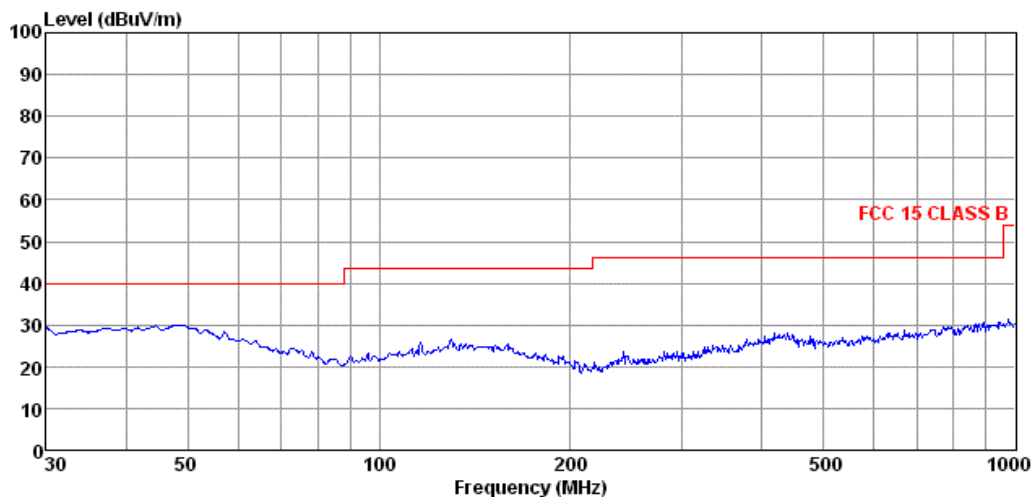


### 1GHz Below (30 ~ 1000MHz) – Vertical

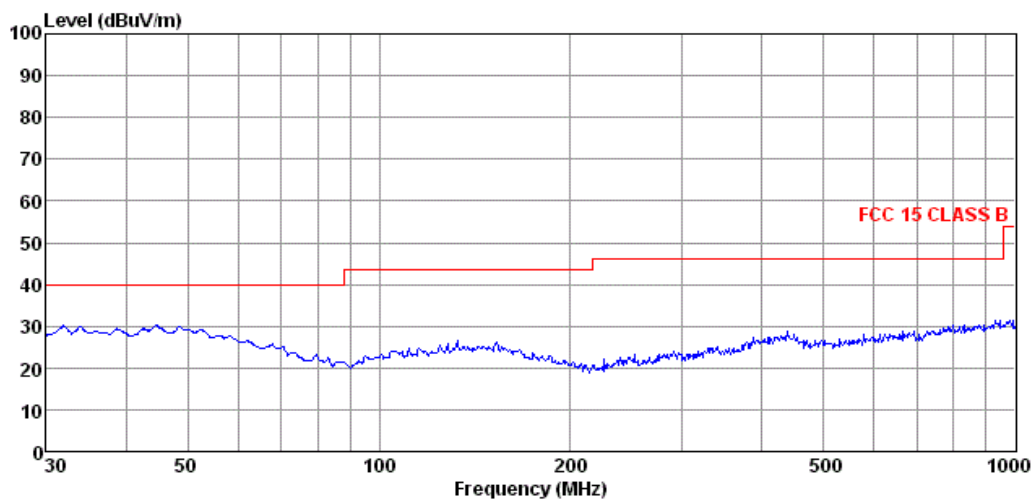


Test mode: IEEE 802.11n(40)  
2462MHz (Channel 11)

### 1GHz Below (30 ~ 1000MHz) – Horizontal



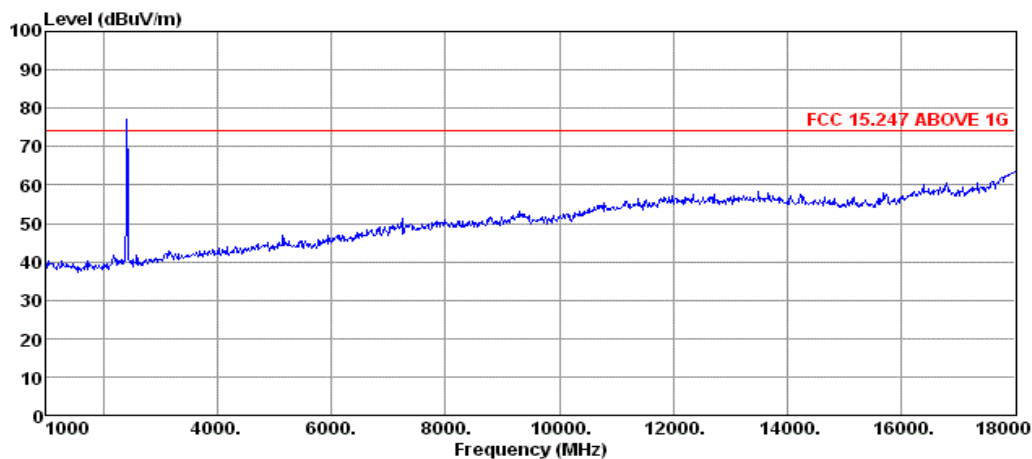
### 1GHz Below (30 ~ 1000MHz) – Vertical



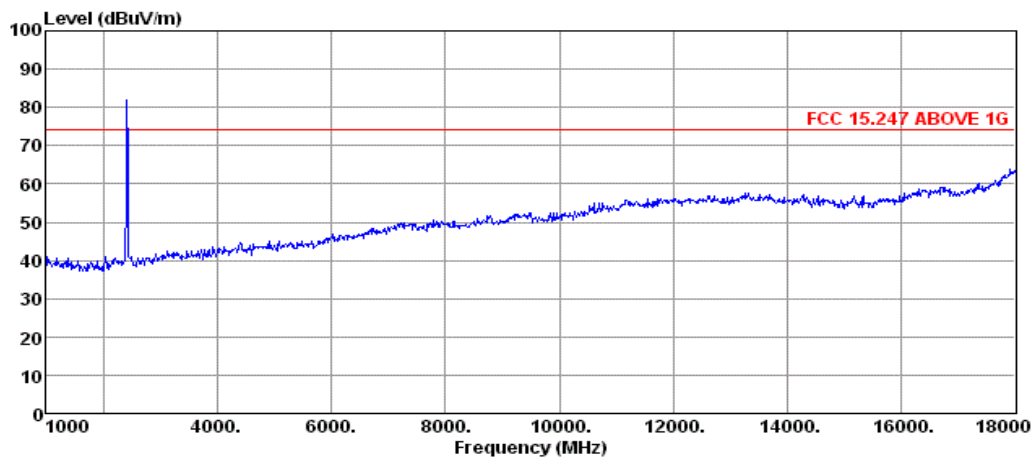
### 5.5.5.3. Frequency Above 1GHz

Test mode: IEEE 802.11b – Antenna B  
2412MHz (Channel 1)

#### 1GHz Above (1 ~ 18GHz) – Horizontal



#### 1GHz Above (1 ~ 18GHz) – Vertical

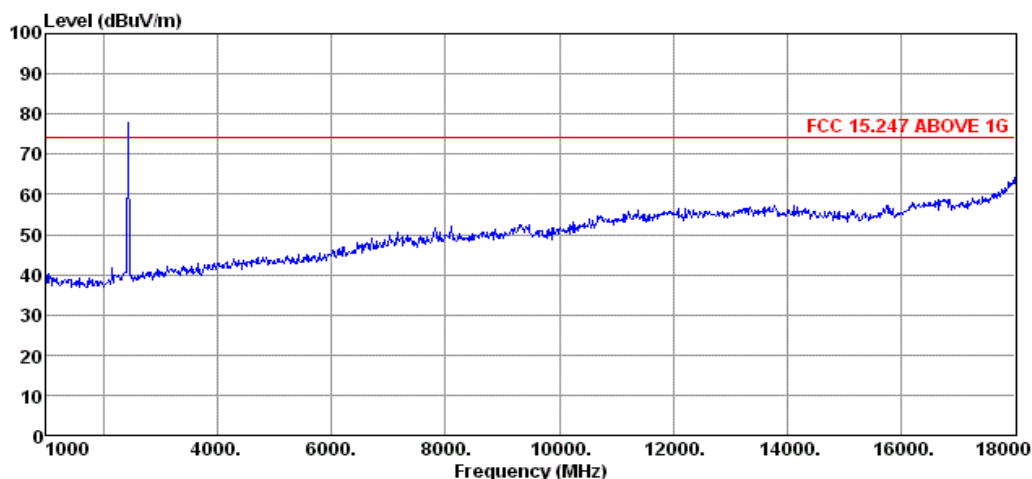


Test mode: IEEE 802.11b – Antenna B  
2437MHz (Channel 6)

## 1GHz Above (1 ~ 18GHz) – Horizontal



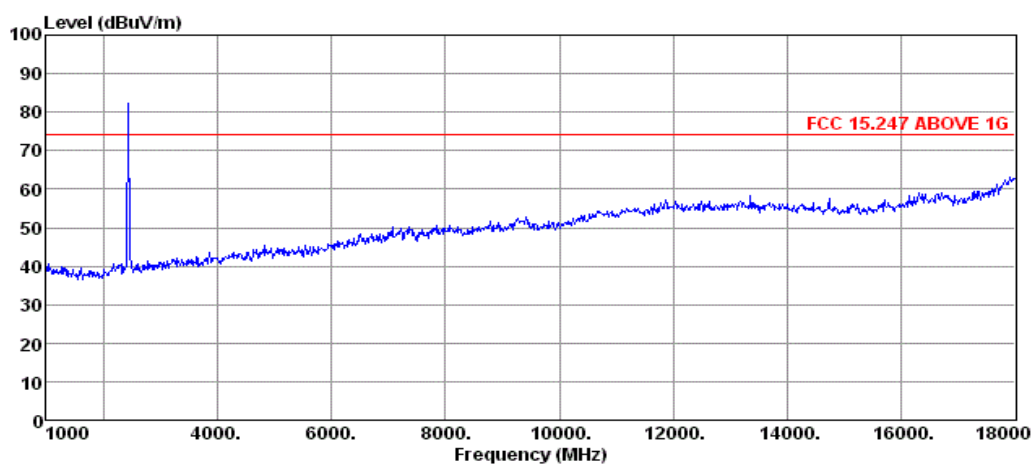
BWS TECH INC.  
3m Full Chamber



## 1GHz Above (1 ~ 18GHz) – Vertical

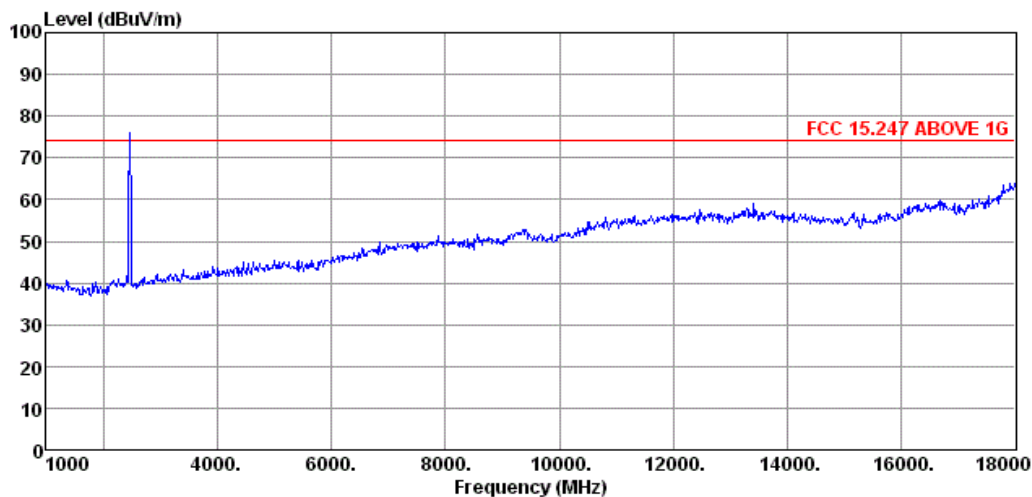


BWS TECH INC.  
3m Full Chamber

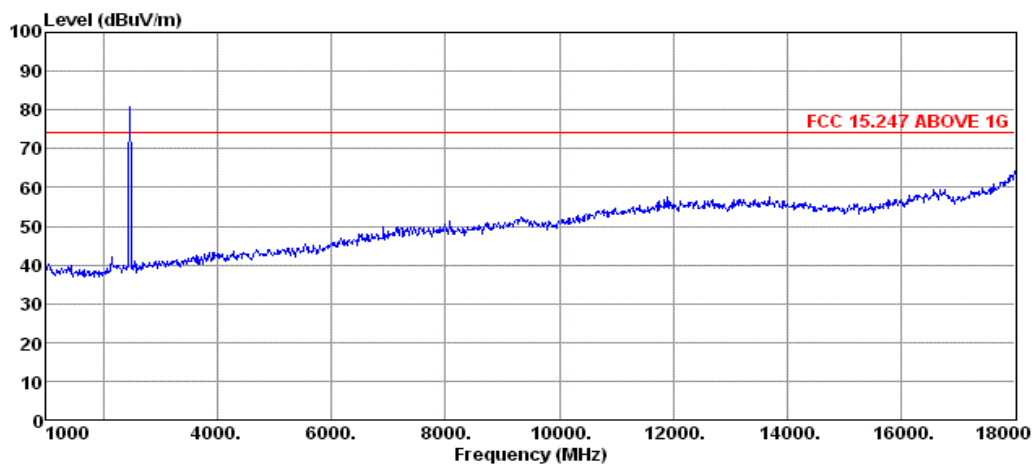


Test mode: IEEE 802.11b – Antenna B  
2462MHz (Channel 11)

### 1GHz Above (1 ~ 18GHz) – Horizontal



### 1GHz Above (1 ~ 18GHz) – Vertical

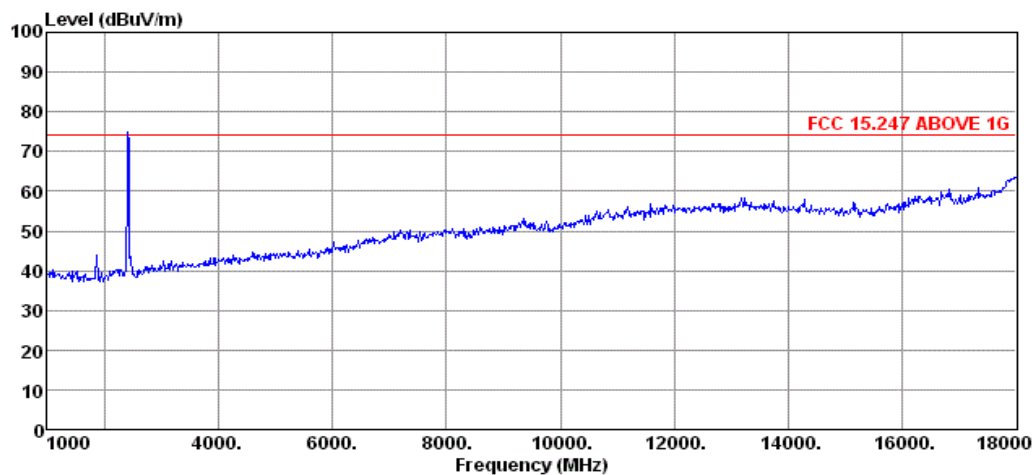


**Test mode: IEEE 802.11g – Antenna B**  
**2412MHz (Channel 1)**

## 1GHz Above (1 ~ 18GHz) – Horizontal



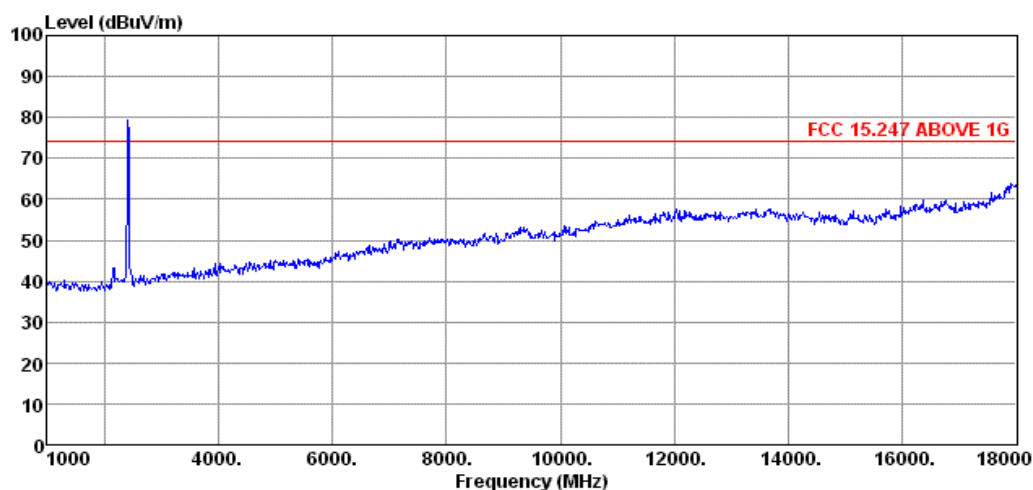
BWS TECH INC.  
3m Full Chamber



## 1GHz Above (1 ~ 18GHz) – Vertical

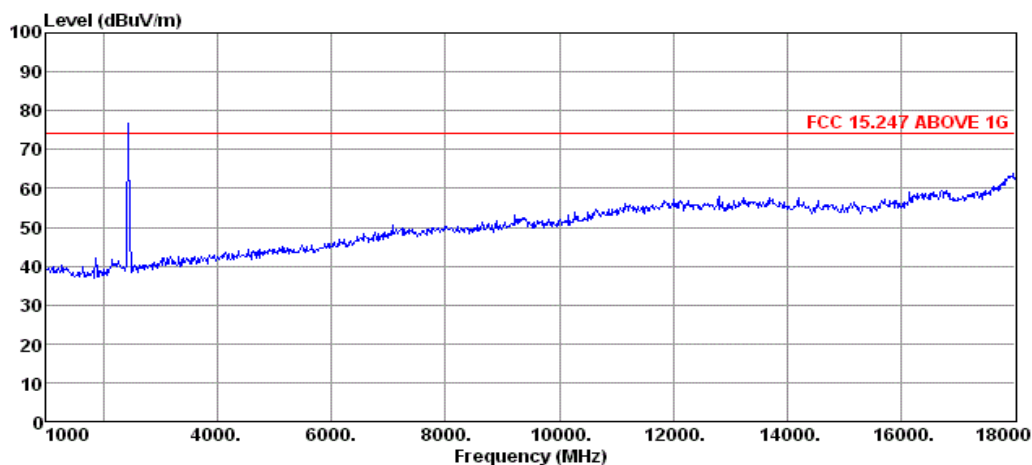


BWS TECH INC.  
3m Full Chamber

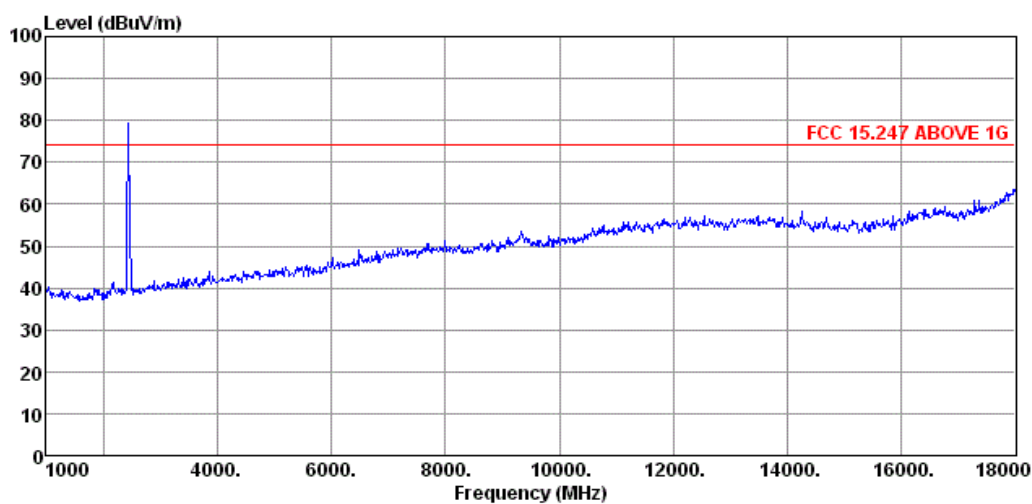


Test mode: IEEE 802.11g – Antenna B  
2437MHz (Channel 6)

### 1GHz Above (1 ~ 18GHz) – Horizontal

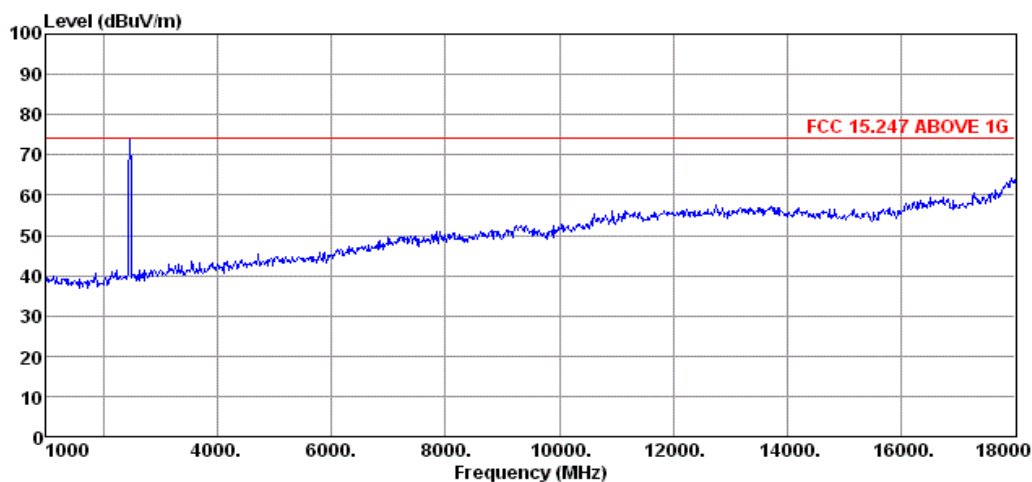


### 1GHz Above (1 ~ 18GHz) – Vertical

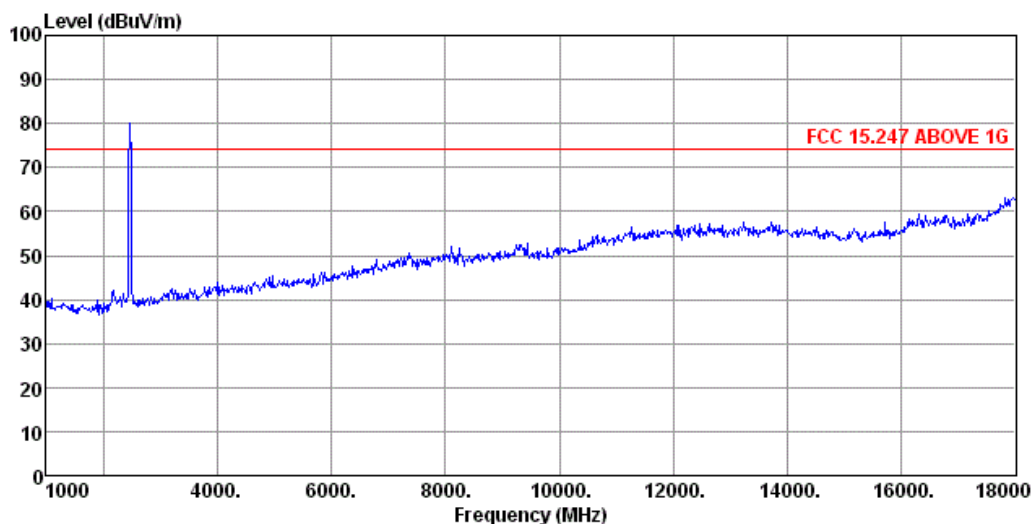


**Test mode: IEEE 802.11g – Antenna B**  
**2462MHz (Channel 11)**

### 1GHz Above (1 ~ 18GHz) – Horizontal

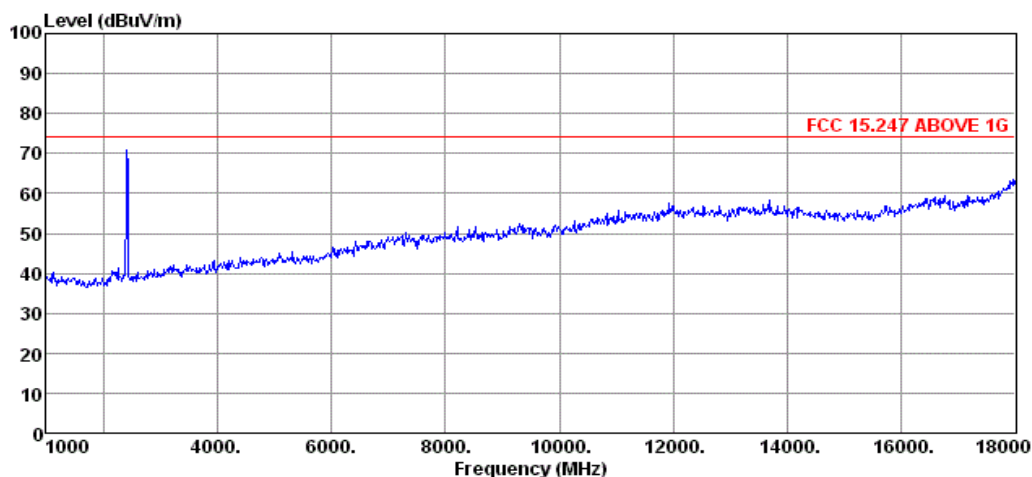


### 1GHz Above (1 ~ 18GHz) – Vertical

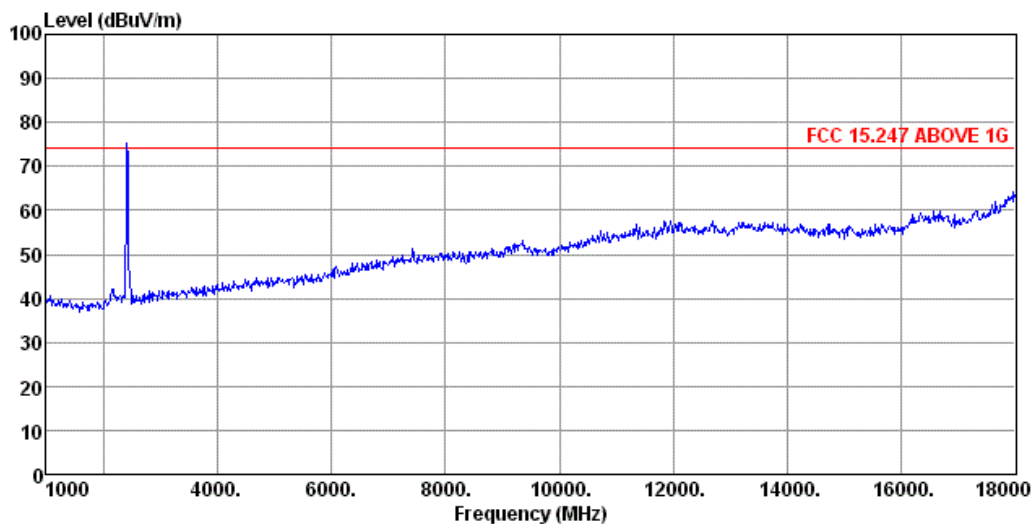


**Test mode: IEEE 802.11n(20)**  
**2412MHz (Channel 1)**

## 1GHz Above (1 ~ 18GHz) – Horizontal

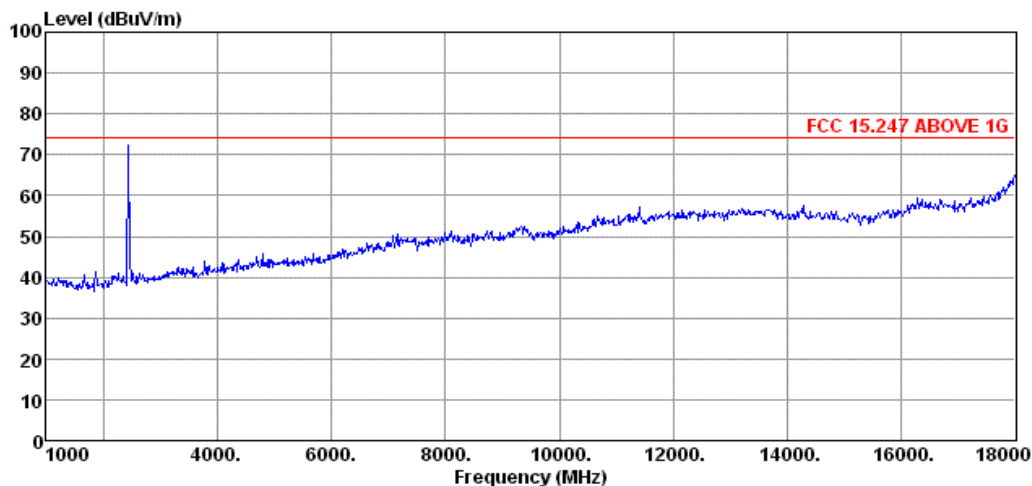


## 1GHz Above (1 ~ 18GHz) – Vertical

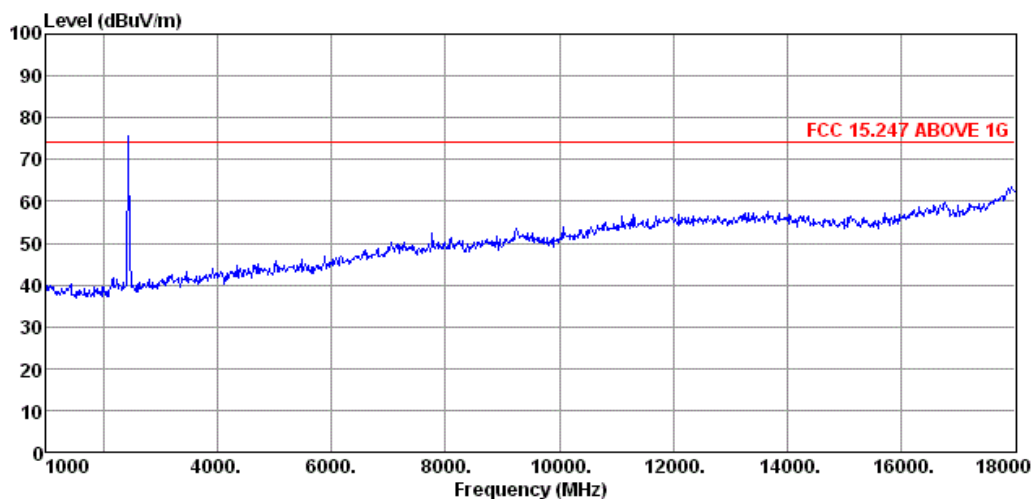


Test mode: IEEE 802.11n(20)  
2437MHz (Channel 6)

### 1GHz Above (1 ~ 18GHz) – Horizontal

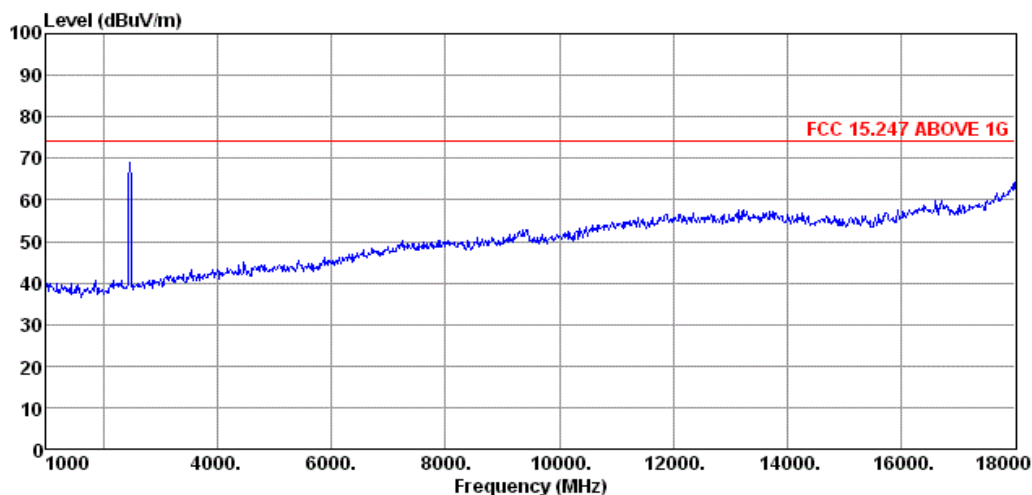


### 1GHz Above (1 ~ 18GHz) – Vertical

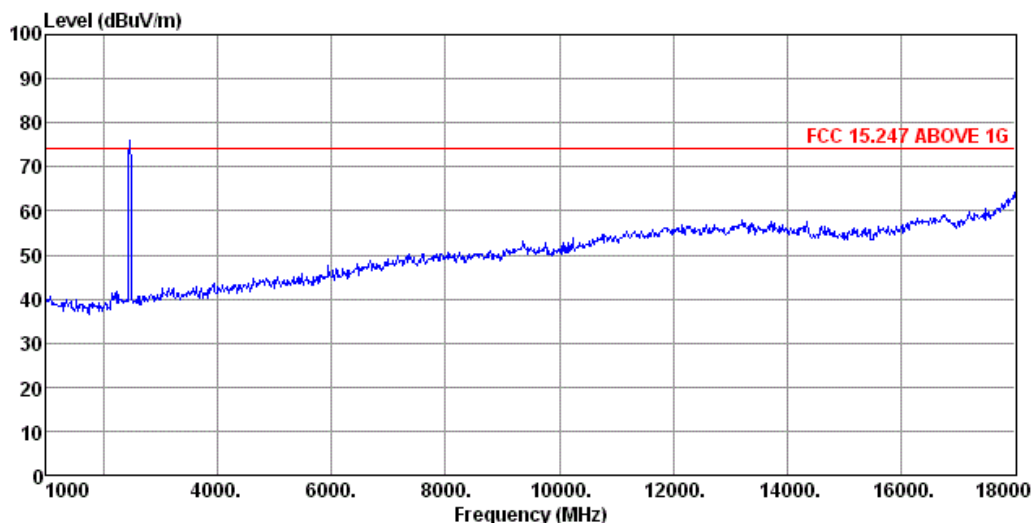


Test mode: IEEE 802.11n(20)  
2462MHz (Channel 11)

## 1GHz Above (1 ~ 18GHz) – Horizontal

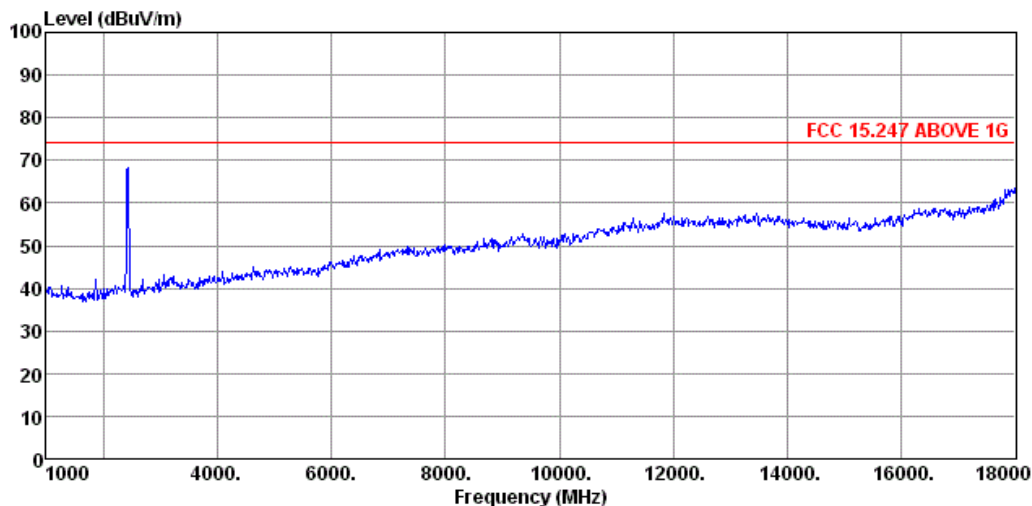


## 1GHz Above (1 ~ 18GHz) – Vertical

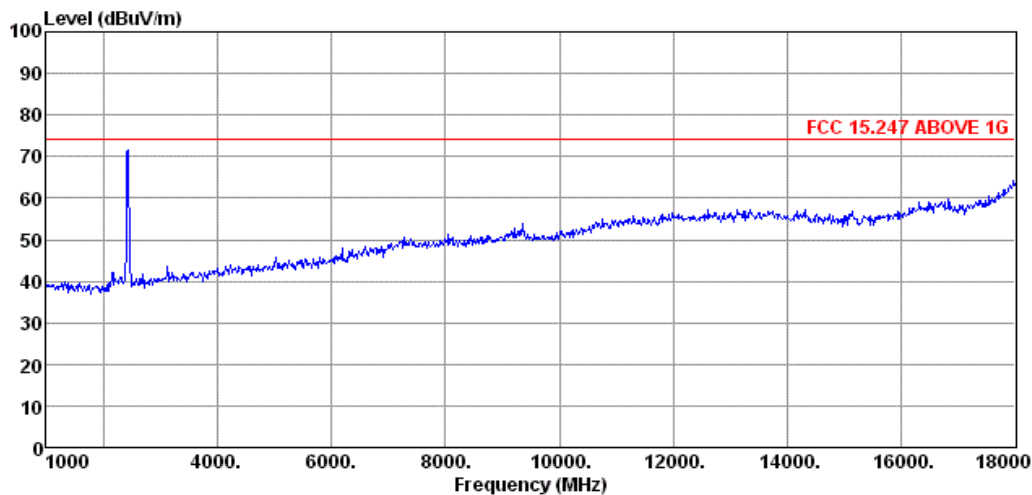


**Test mode: IEEE 802.11n(40)**  
**2462MHz (Channel 1)**

### 1GHz Above (1 ~ 18GHz) – Horizontal



### 1GHz Above (1 ~ 18GHz) – Vertical

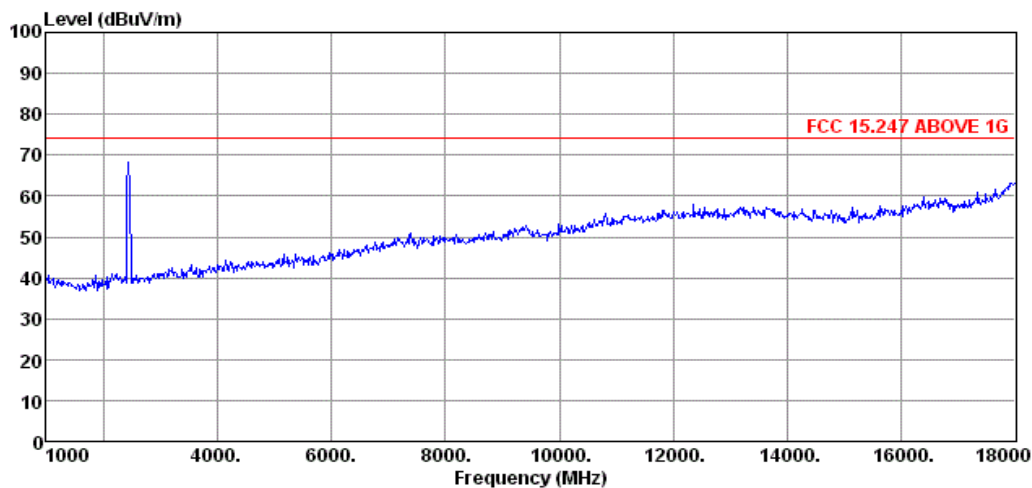


Test mode: IEEE 802.11n(40)  
2437MHz (Channel 6)

### 1GHz Above (1 ~ 18GHz) – Horizontal



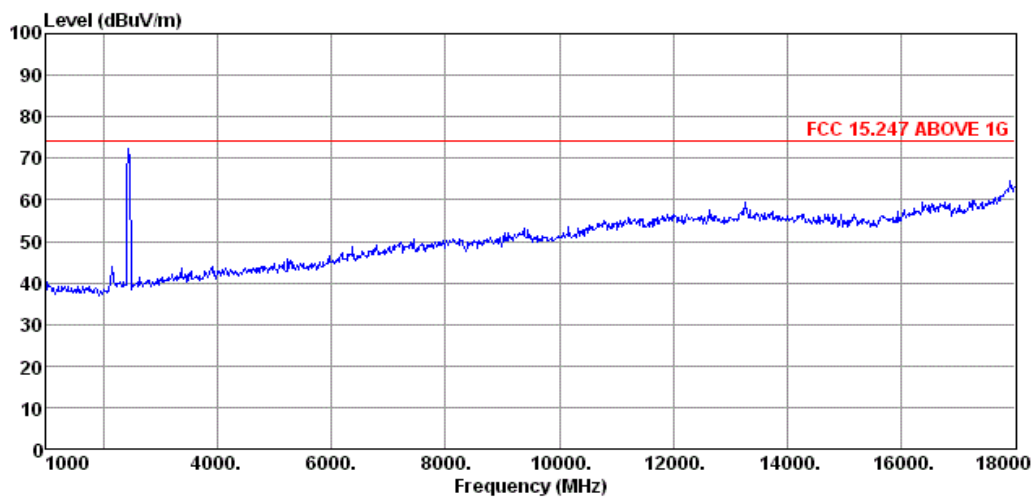
BWS TECH INC.  
3m Full Chamber



### 1GHz Above (1 ~ 18GHz) – Vertical

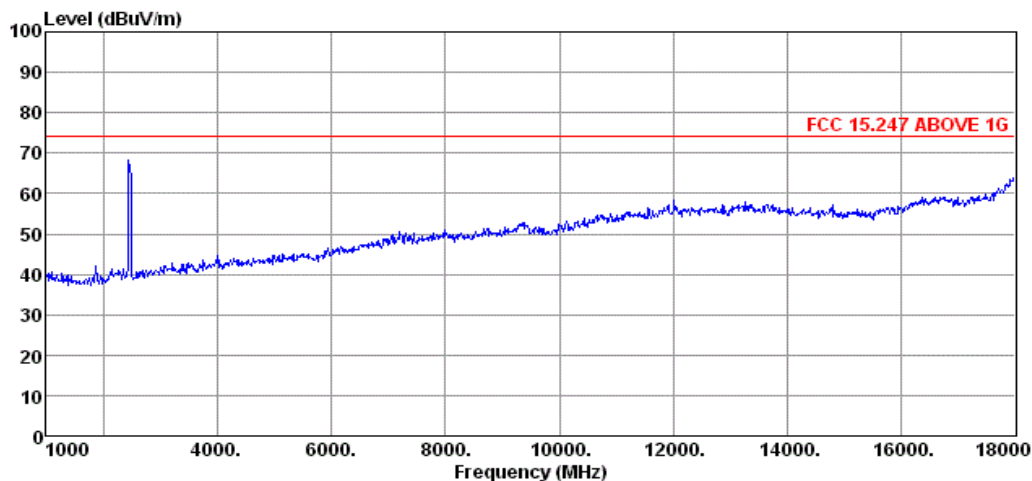


BWS TECH INC.  
3m Full Chamber

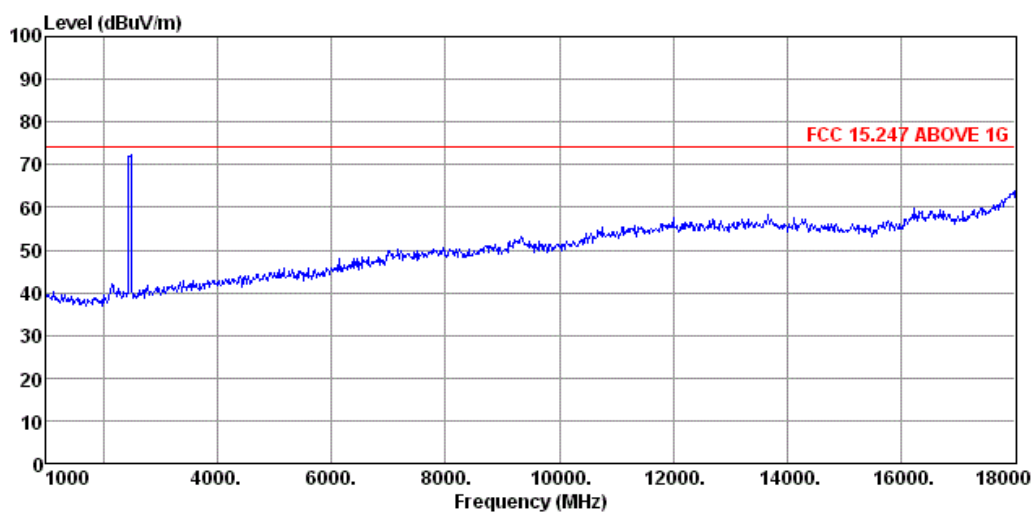


Test mode: IEEE 802.11n(40)  
2462MHz (Channel 11)

### 1GHz Above (1 ~ 18GHz) – Horizontal



### 1GHz Above (1 ~ 18GHz) – Vertical



## 5.6 Conducted Spurious Emission

### 5.6.1 Test Equipment

EQUIPMENT	MODEL	MANUFACTURE	SERIAL NUMBER	Calibration Due date (year/month/date)	Calibration Interval
Spectrum analyzer	N9020A	Agilent	US4622010 1	2017/09/07	1 Year
DC Power Supply	UDP-6015R	Unicorn tech	131007	2017/09/07	1 Year

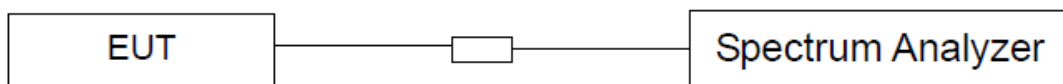
### 5.6.2 Test Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

### 5.6.3 Test Procedure

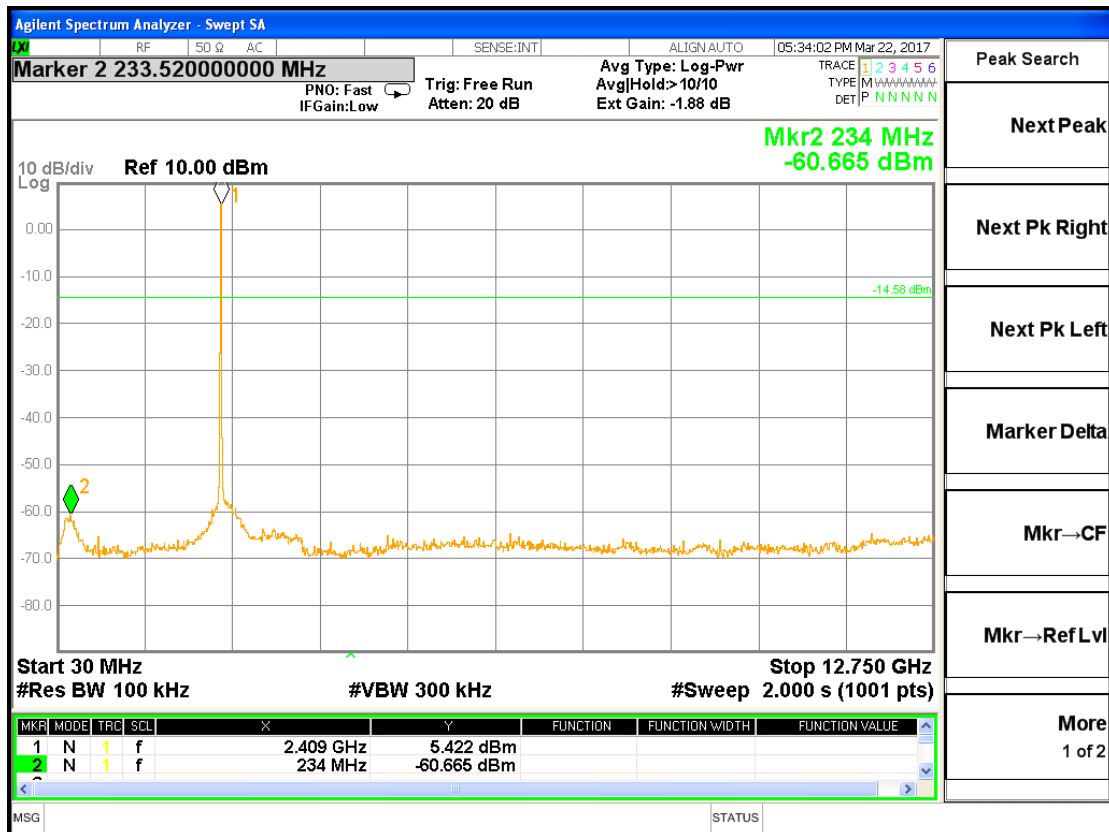
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05 and KDB 662911 D01 Multiple Transmitter Output v02r01.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set (RBW = 100 kHz, VBW = 300 kHz, Detector = Peak, Trace mode = Max Hold, Sweep = Auto).
5. Measure and record the results in the test report.

### 5.6.4 Block Diagram of Test Setup

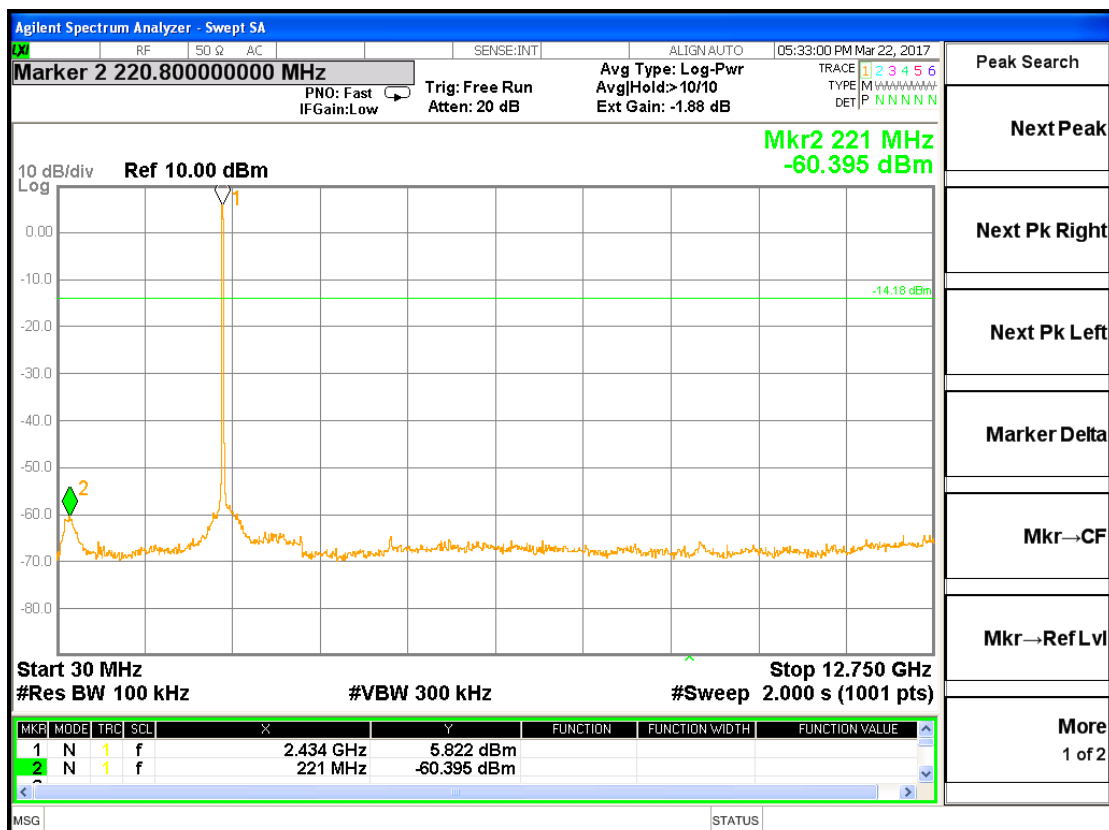


## 5.6.5 Test Result

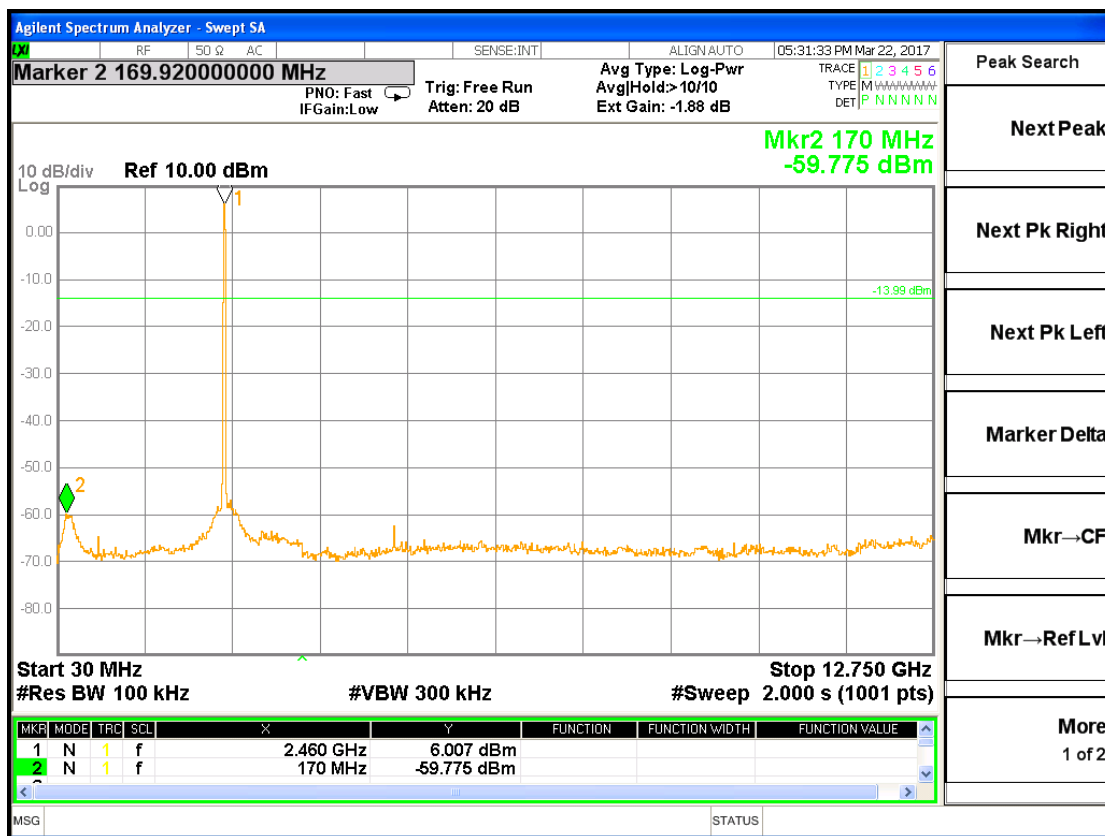
### Conducted Spurious Emission (802.11b\_CH.1 (2412 MHz))



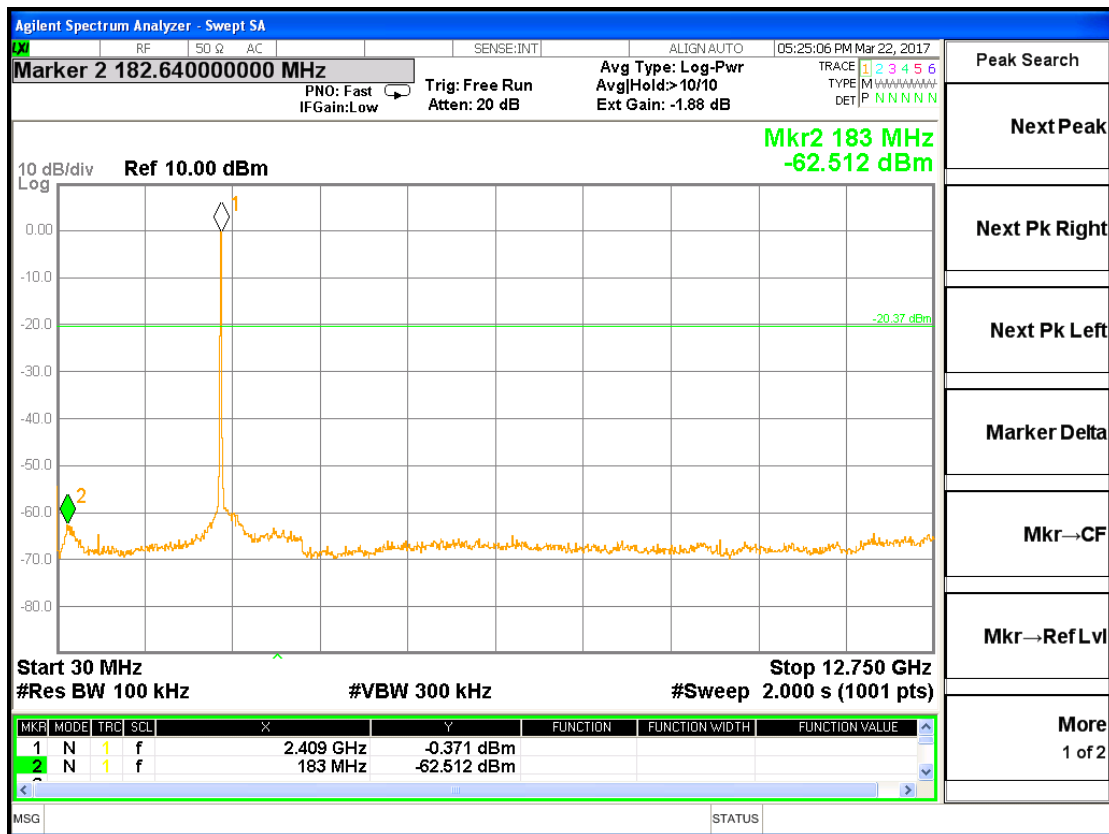
### Conducted Spurious Emission (802.11b\_CH.6 (2437 MHz))



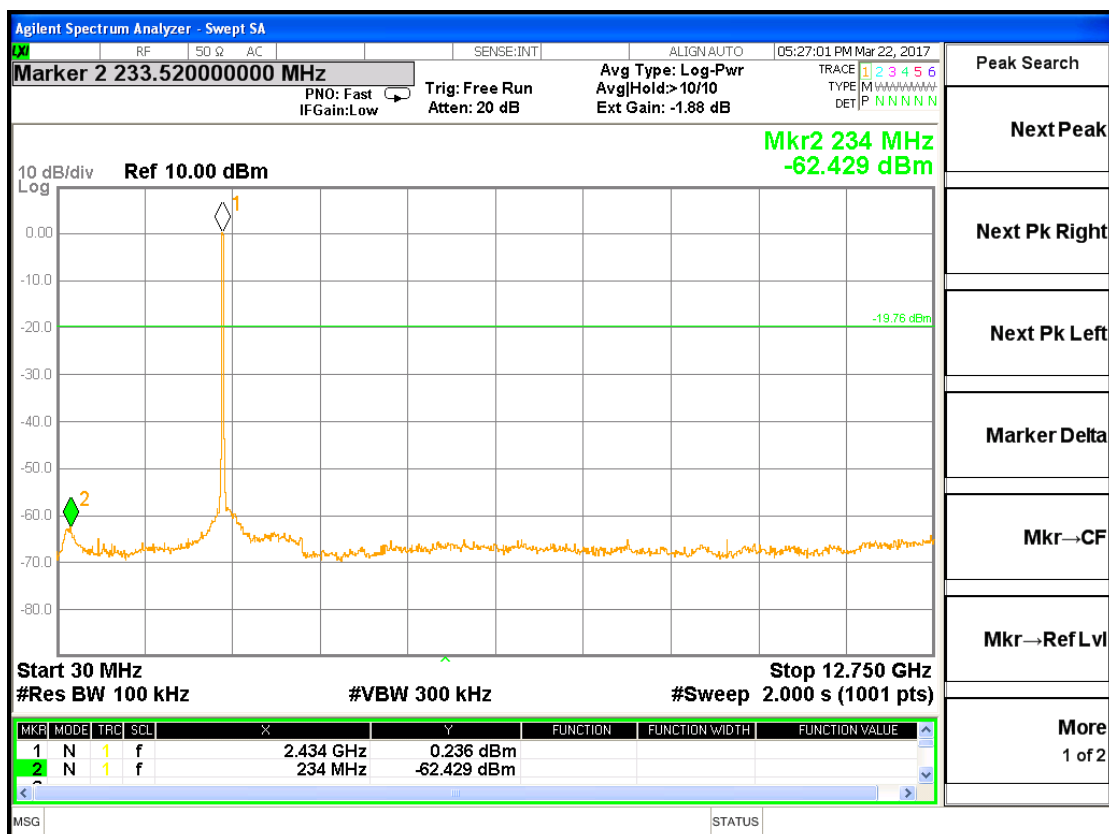
## Conducted Spurious Emission (802.11b\_CH.11 (2462 MHz))



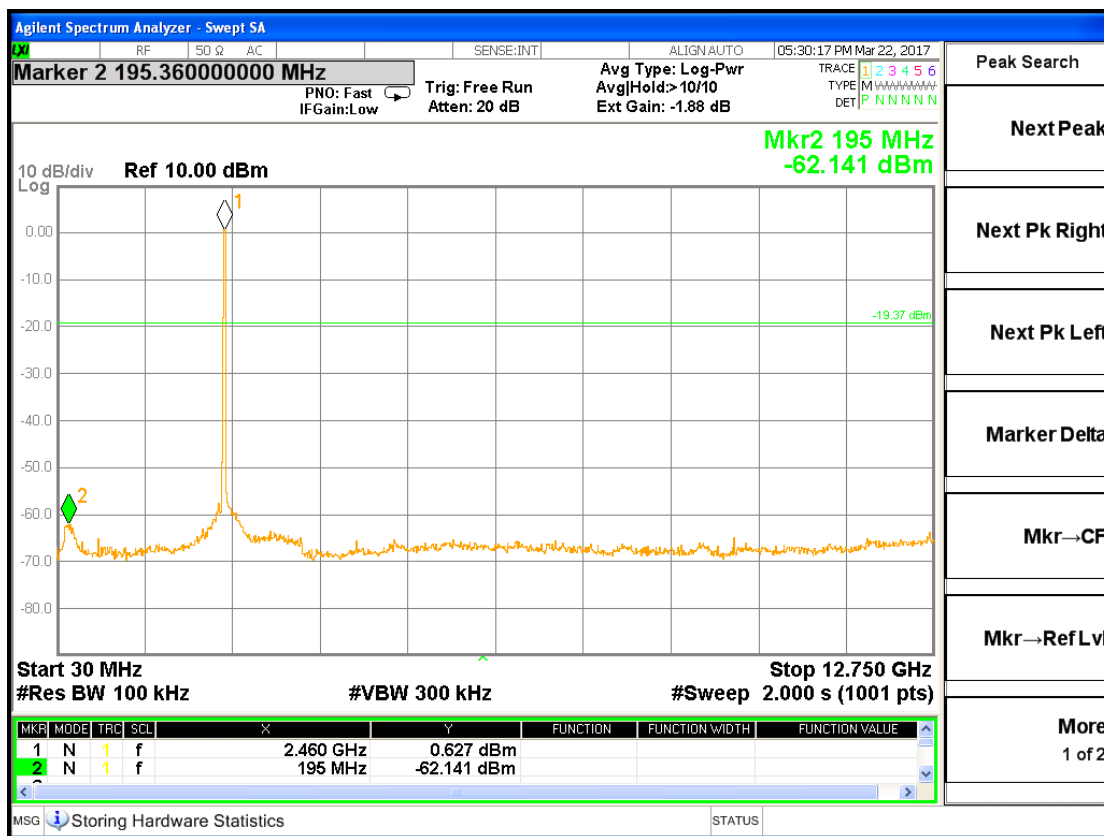
### Conducted Spurious Emission (802.11g\_CH.1 (2412 MHz))



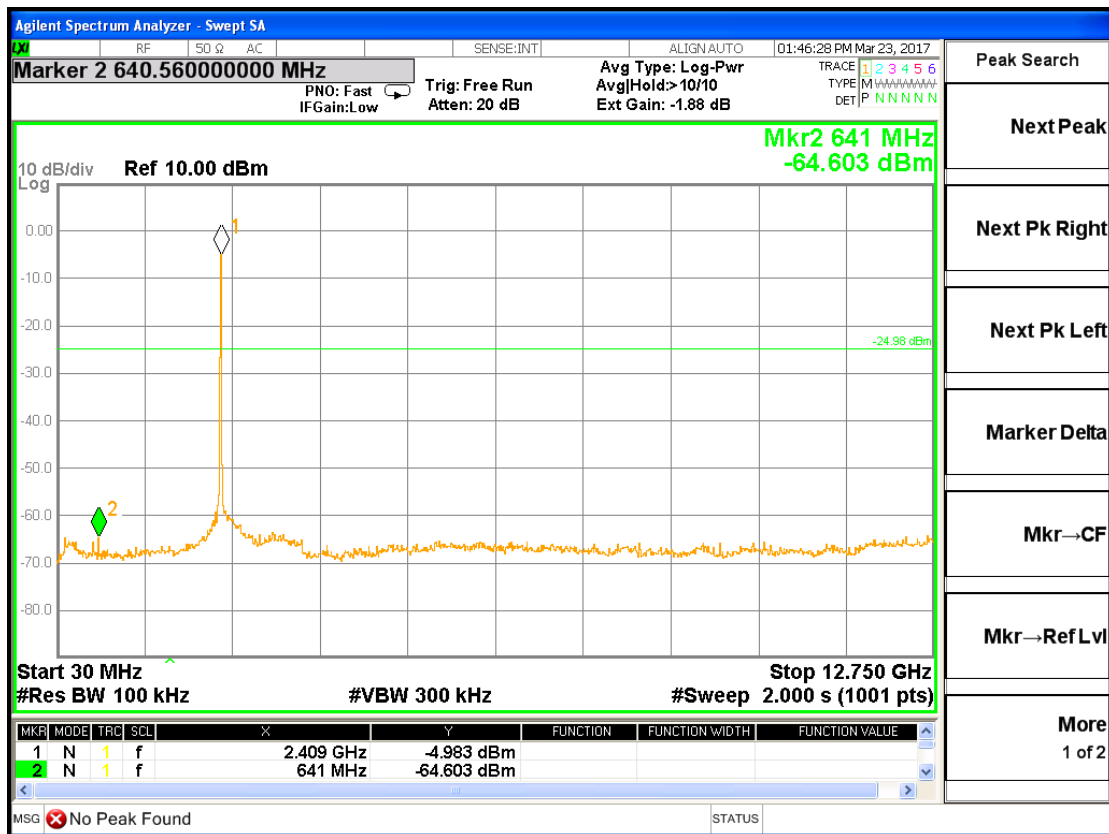
### Conducted Spurious Emission (802.11g\_CH.6 (2437 MHz))



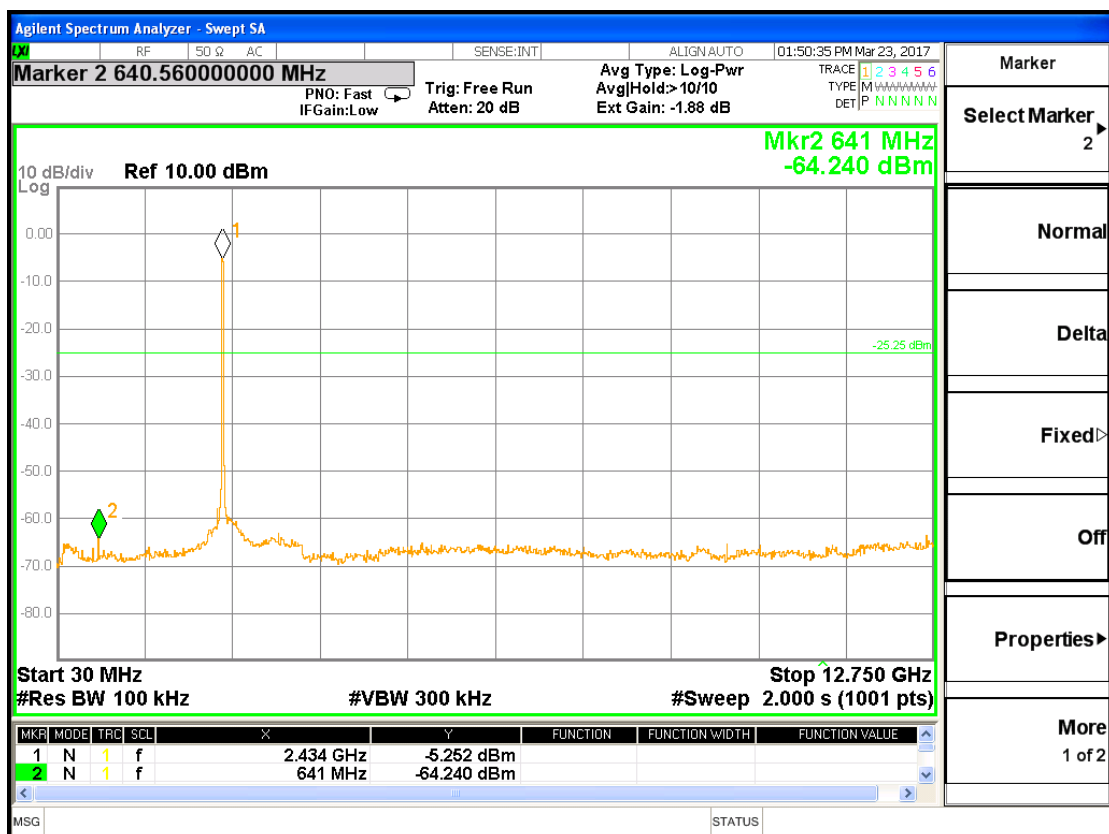
## Conducted Spurious Emission (802.11g\_CH.11 (2462 MHz))



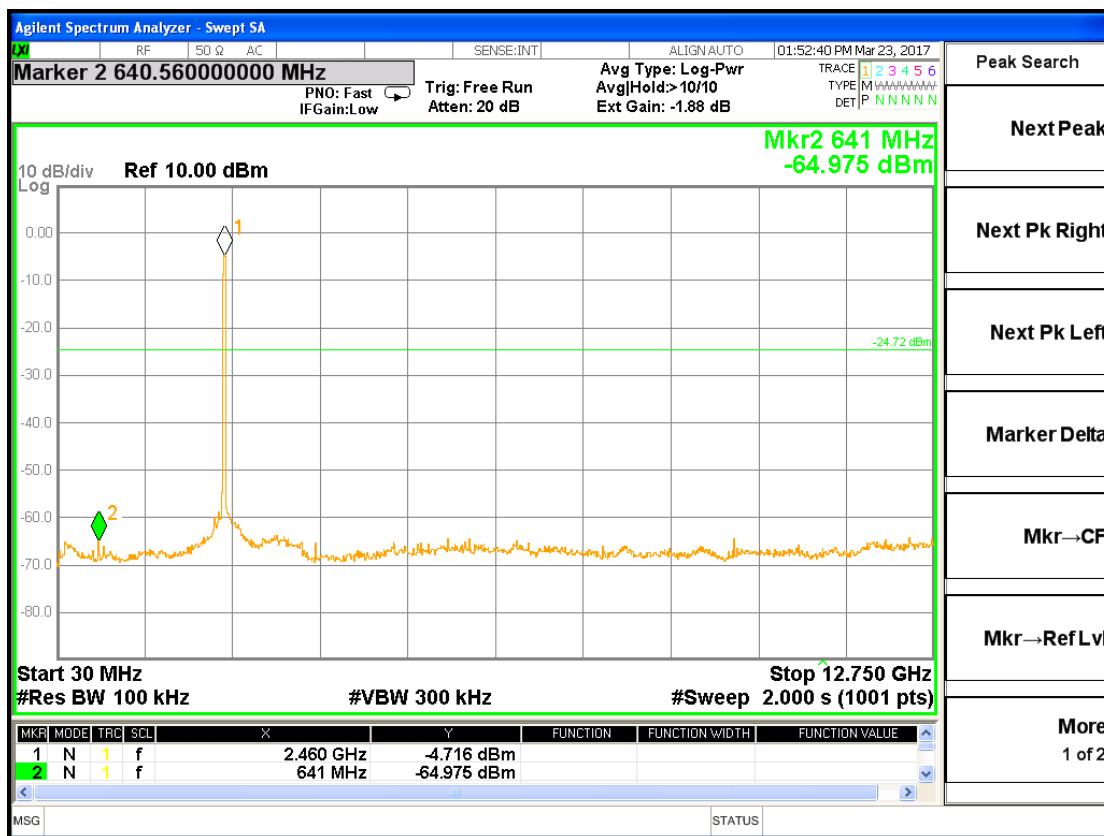
### Conducted Spurious Emission (802.11n(20M)\_CH.1 (2412 MHz))



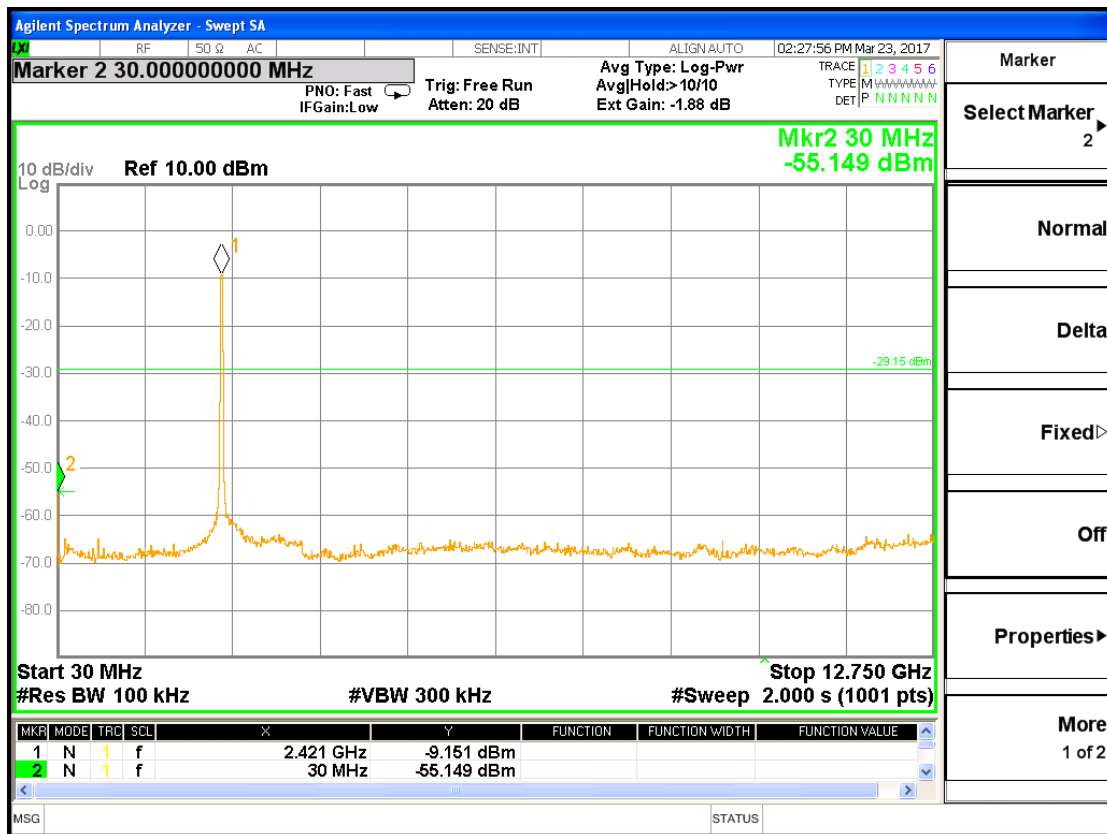
### Conducted Spurious Emission (802.11n(20M)\_CH.6 (2437 MHz))



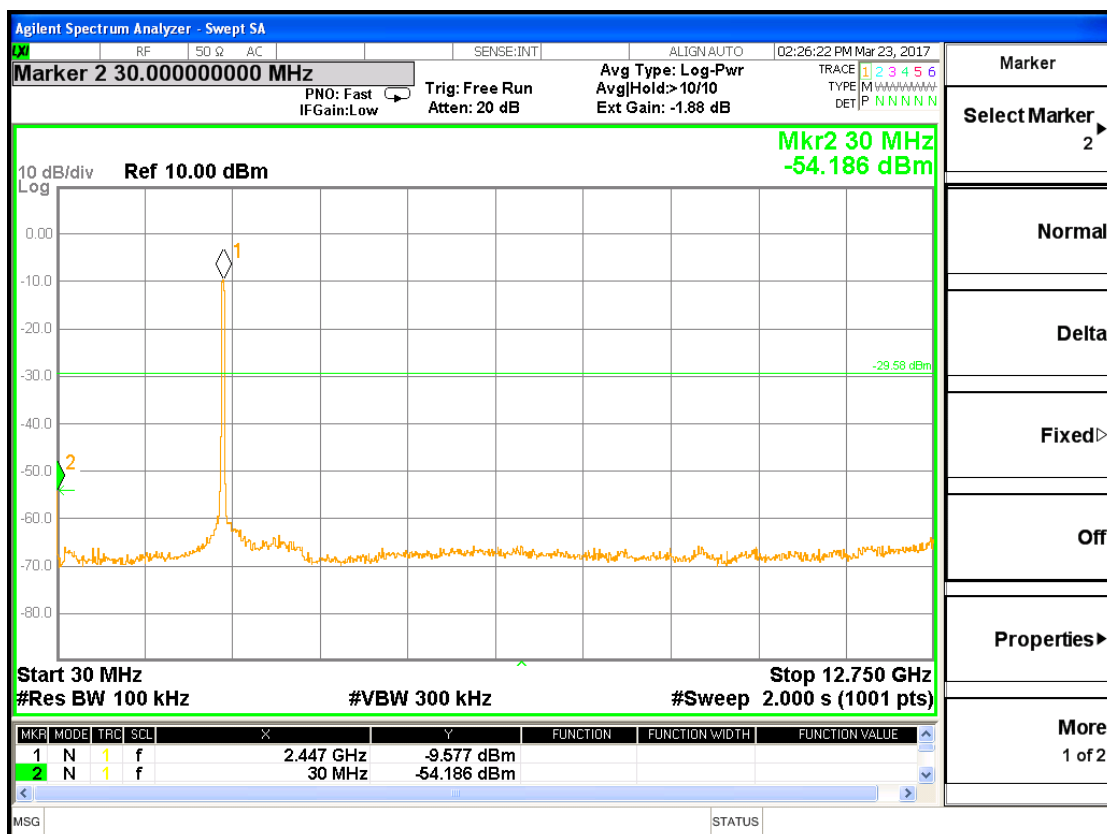
## Conducted Spurious Emission (802.11n(20M)\_CH.11 (2462 MHz))



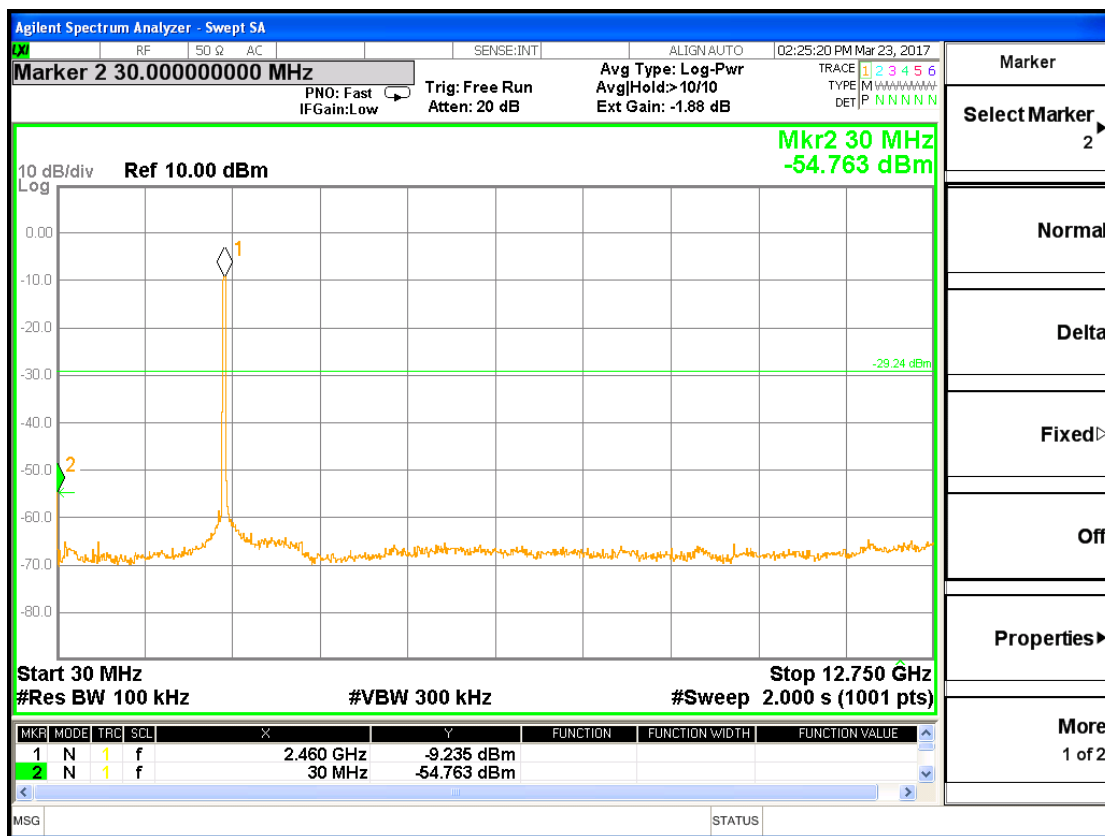
### Conducted Spurious Emission (802.11n(40M)\_CH.1 (2412 MHz))



### Conducted Spurious Emission (802.11n(40M)\_CH.6 (2437 MHz))



## Conducted Spurious Emission (802.11n(40M)\_CH.11 (2462 MHz))



## 5.7 Band Edge Measurement

### 5.7.1 Test Equipment

EQUIPMENT	MODEL	MANUFACTURE	SERIAL NUMBER	Calibration Due date (year/month/date)	Calibration Interval
Loop Antenna	FMZB 1519 B	SCHWARZBECK	00025	2018/07/11	2 Year
Bilog Antenna	VULB 9160	SCHWARZBECK	9160-3052	2017/10/06	1 Year
Horn Antenna	BBHA 9120 D	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D 517	2018/10/17	2 Year
Spectrum analyzer	N9020A	Agilent	US46220101	2017/09/07	1 Year
EMI Test Receiver	ESVN30	ROHDE & SCHWARZ	832854/010	2018/01/05	1 Year
RF Amplifier	33711-392-77150-11	AEROFLEX	019	2017/12/08	1 Year
Antenna Master	JAC-3	Daeil EMC	N/A	N/A	-
Antenna Turntable Controller	JAC-2	Daeil EMC	N/A	N/A	-
EMC Analyzer	E7403A	H.P	US39150108	2018/01/05	1 Year
EMI Test Receiver	ESPI	ROHDE & SCHWARZ	100012	2018/01/06	1 Year
Antenna Master	N/A	AUDIX	N/A	N/A	-

### 5.7.2 Test Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

### 5.7.3 Test Procedure

The EUT is placed on a turntable with 1.5 meter above ground.

The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.

EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.

Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:

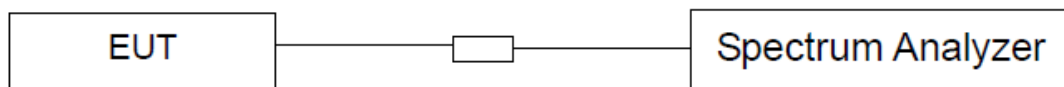
PEAK: RBW=VBW=1MHz / Sweep=AUTO

AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO

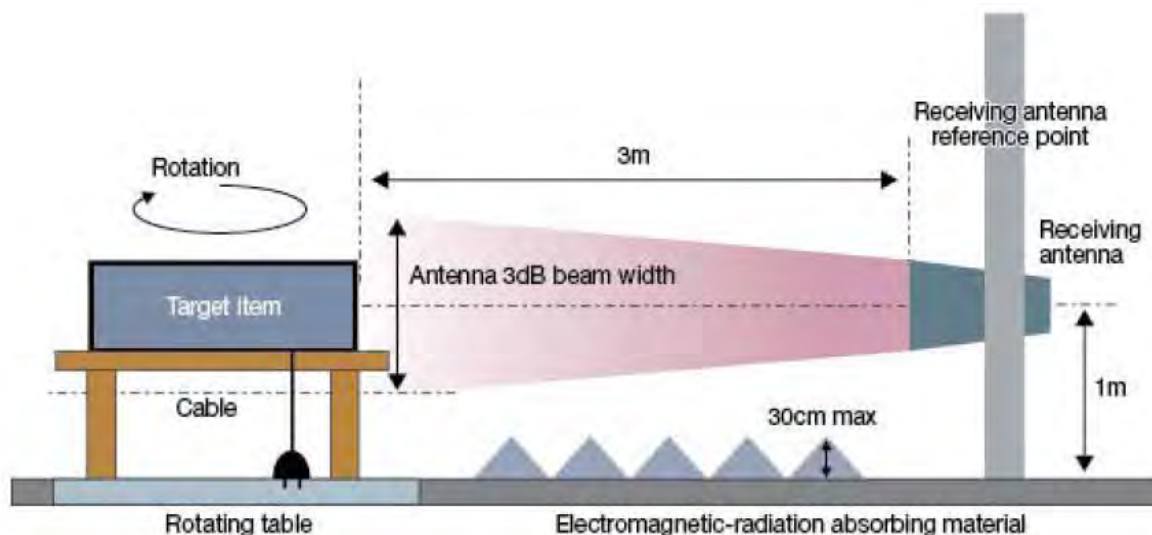
Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

#### 5.7.4 Test SET-UP (Block Diagram of Configuration)

(a) Conducted Emission Test Set-Up, Frequency above 1000MHz



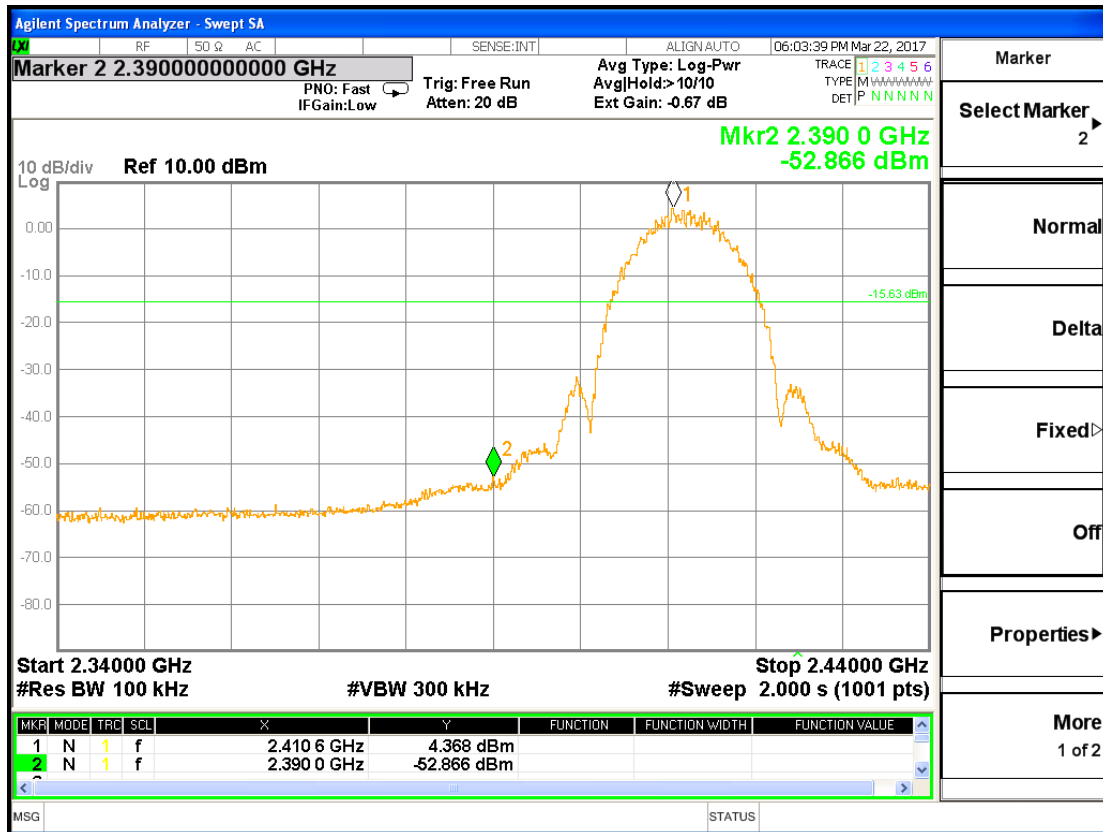
(b) Radiated Emission Test Set-Up, Frequency above 1000MHz



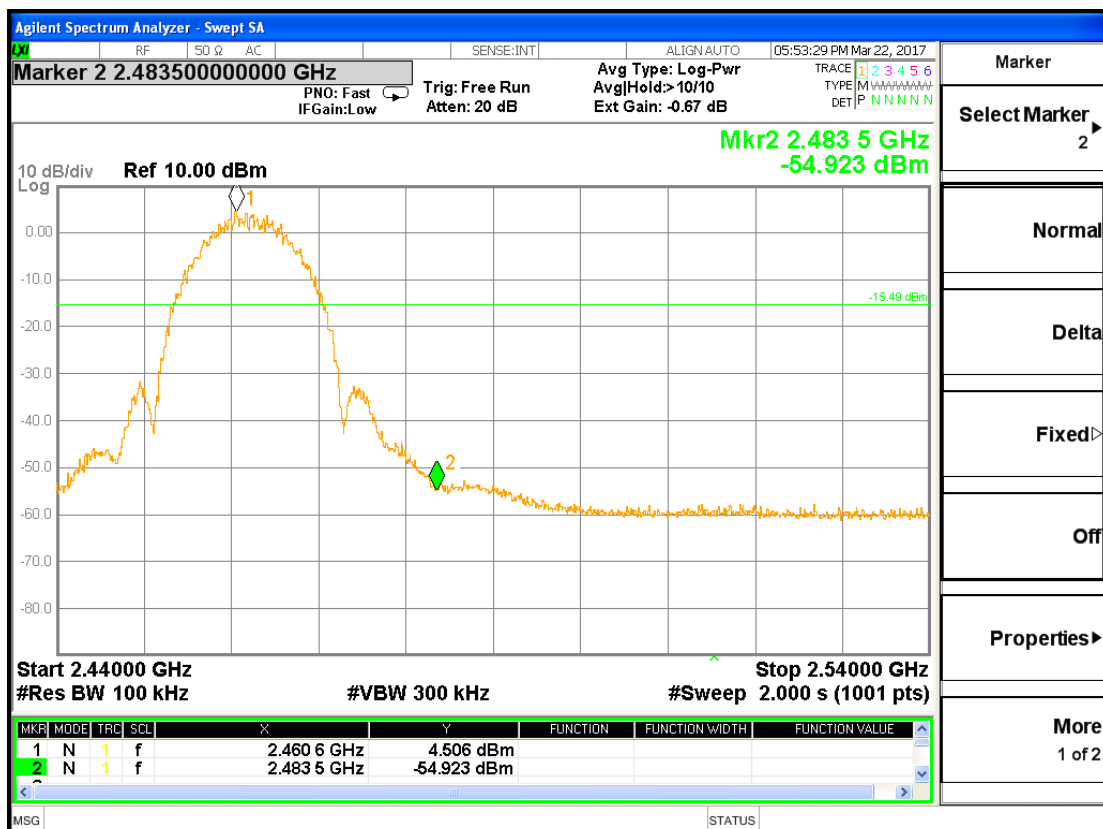
## 5.6.5 Test Result

### 5.6.5.1 Conducted Band Edges

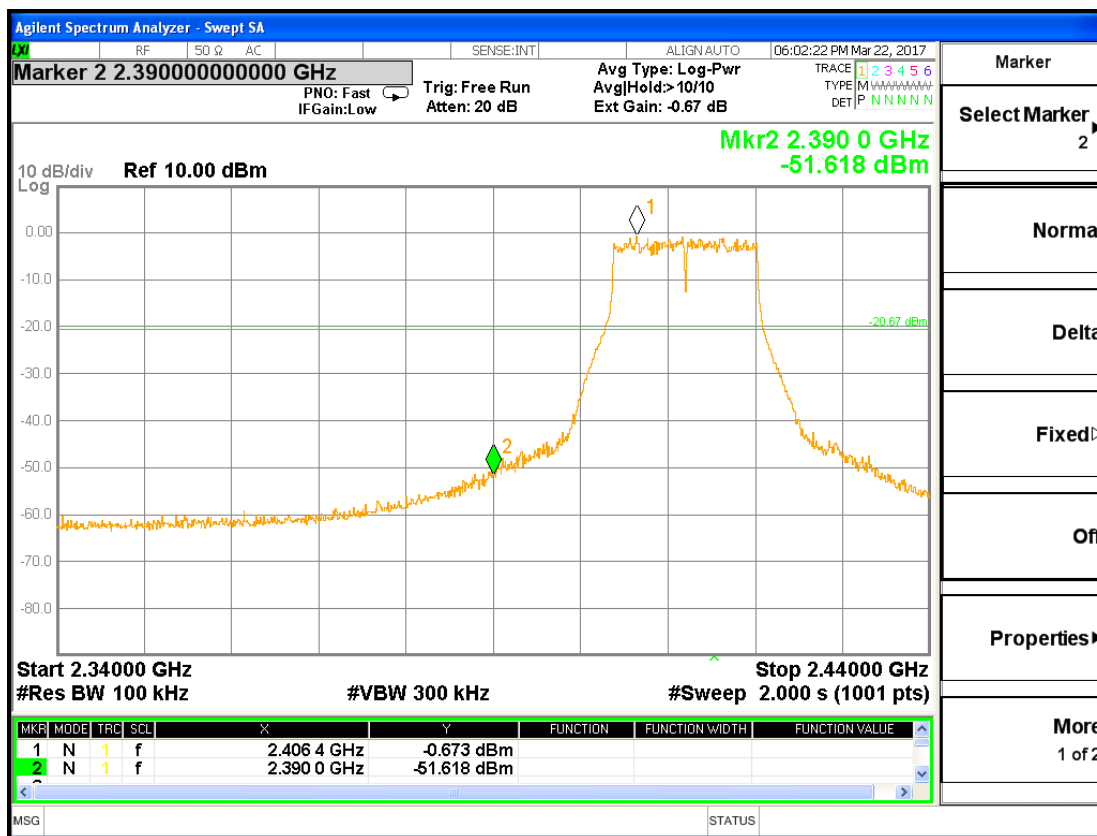
#### Conducted Band Edge Measurement (802.11b\_CH.1 (2412 MHz))



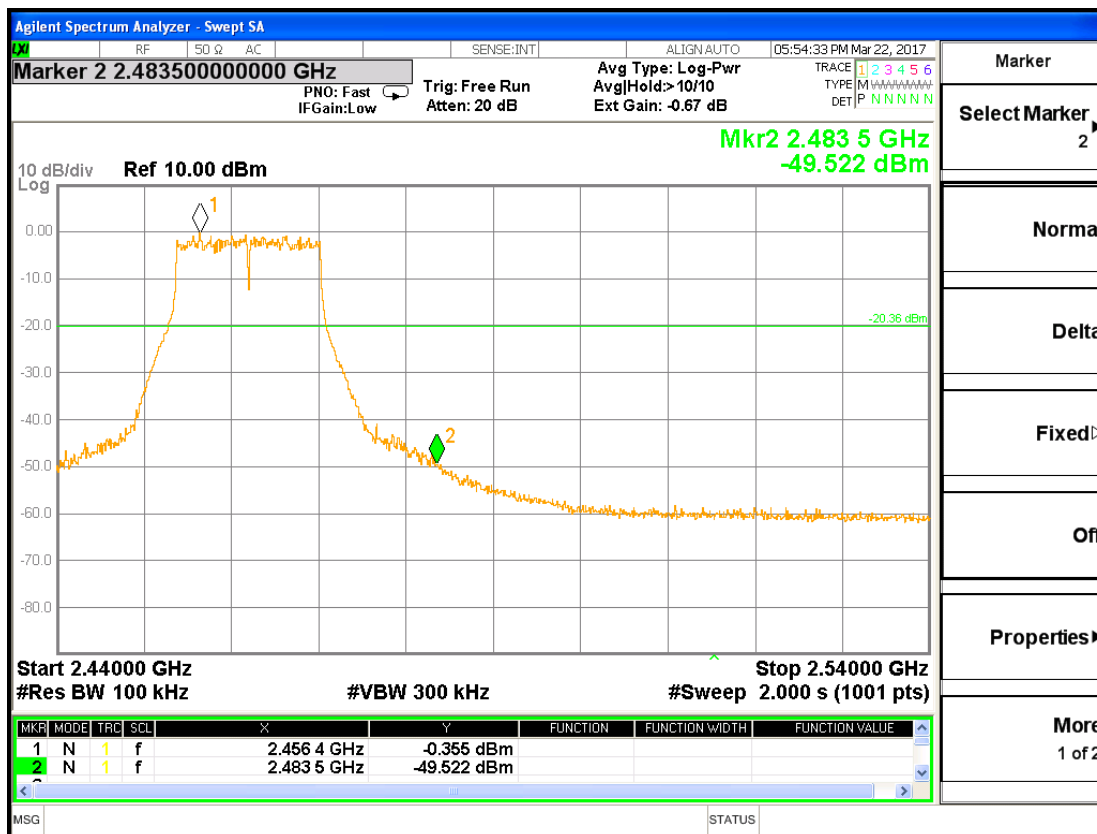
#### Conducted Band Edge Measurement (802.11b\_CH.11 (2462 MHz))



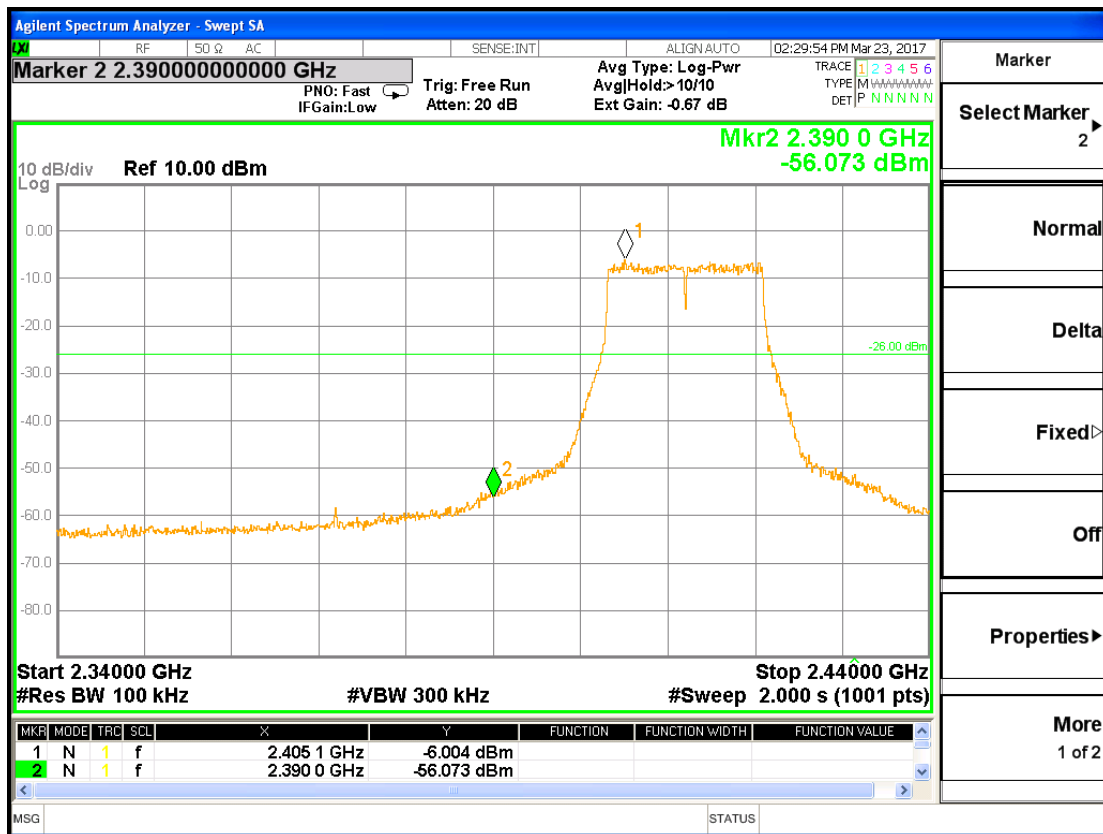
### Conducted Band Edge Measurement (802.11g\_CH.1 (2412 MHz))



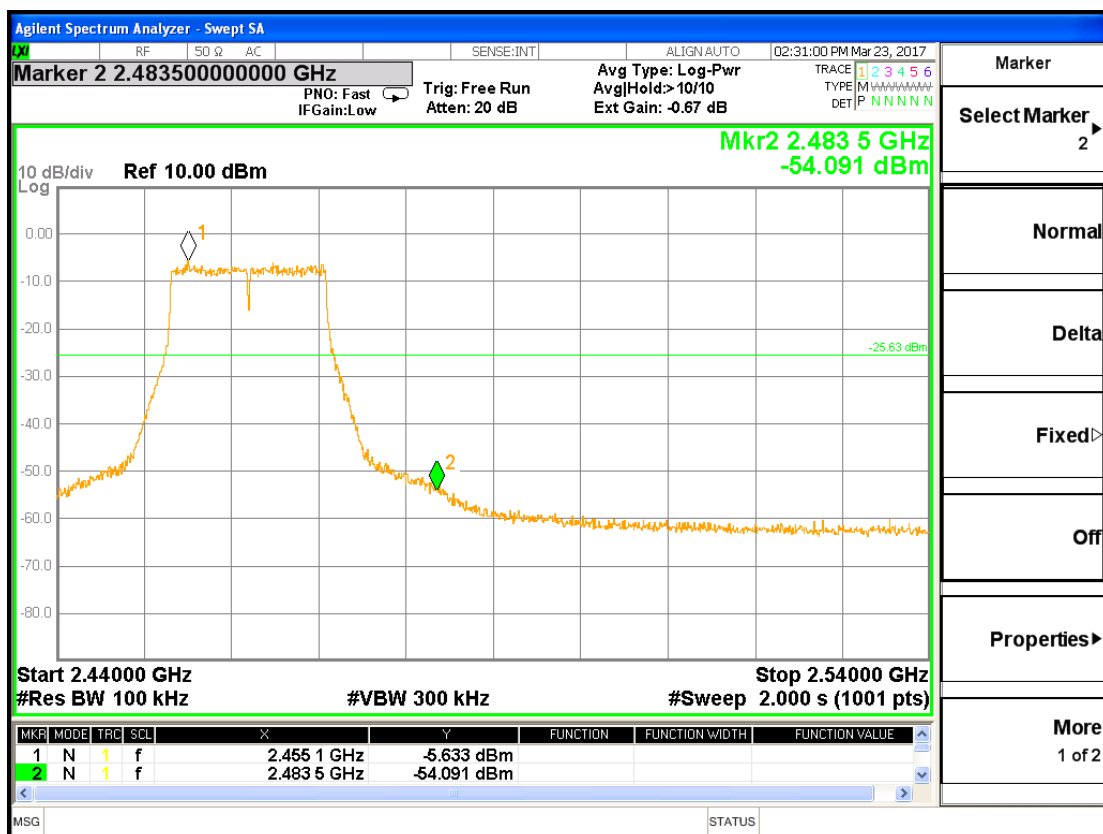
### Conducted Band Edge Measurement (802.11g\_CH.11 (2462 MHz))



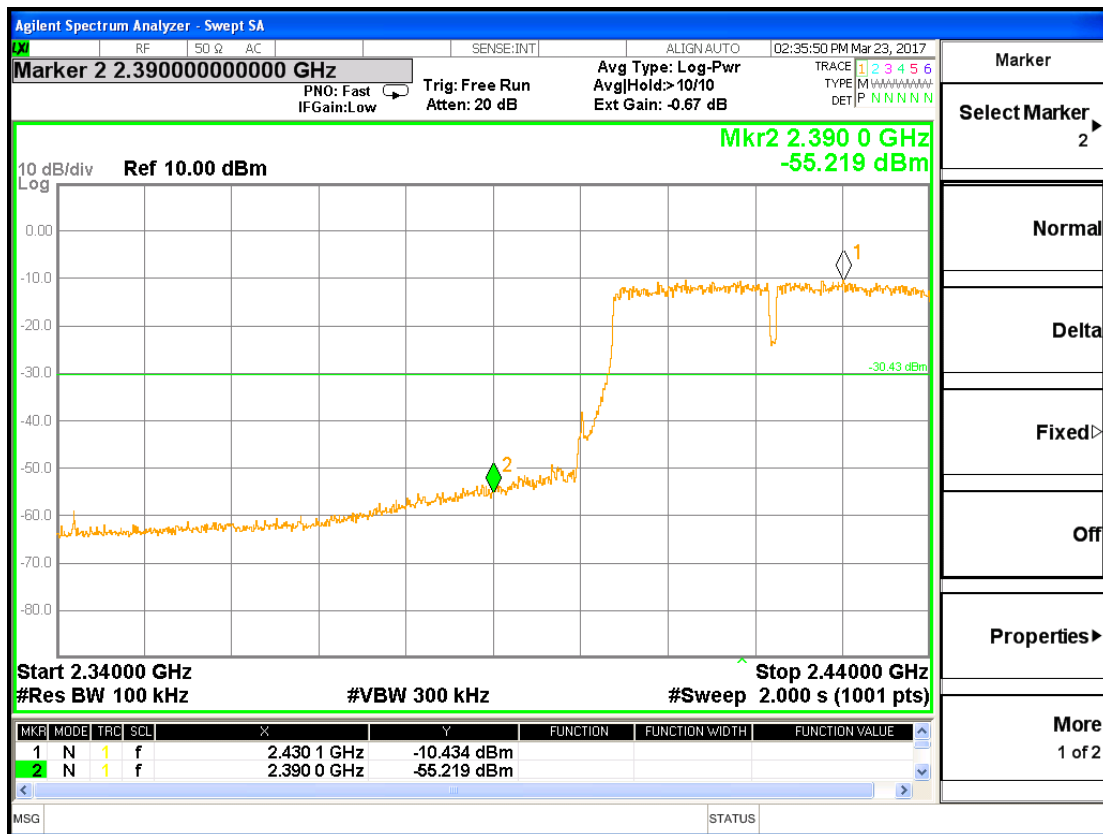
## Conducted Band Edge Measurement (802.11n(20M)\_CH.1 (2412 MHz))



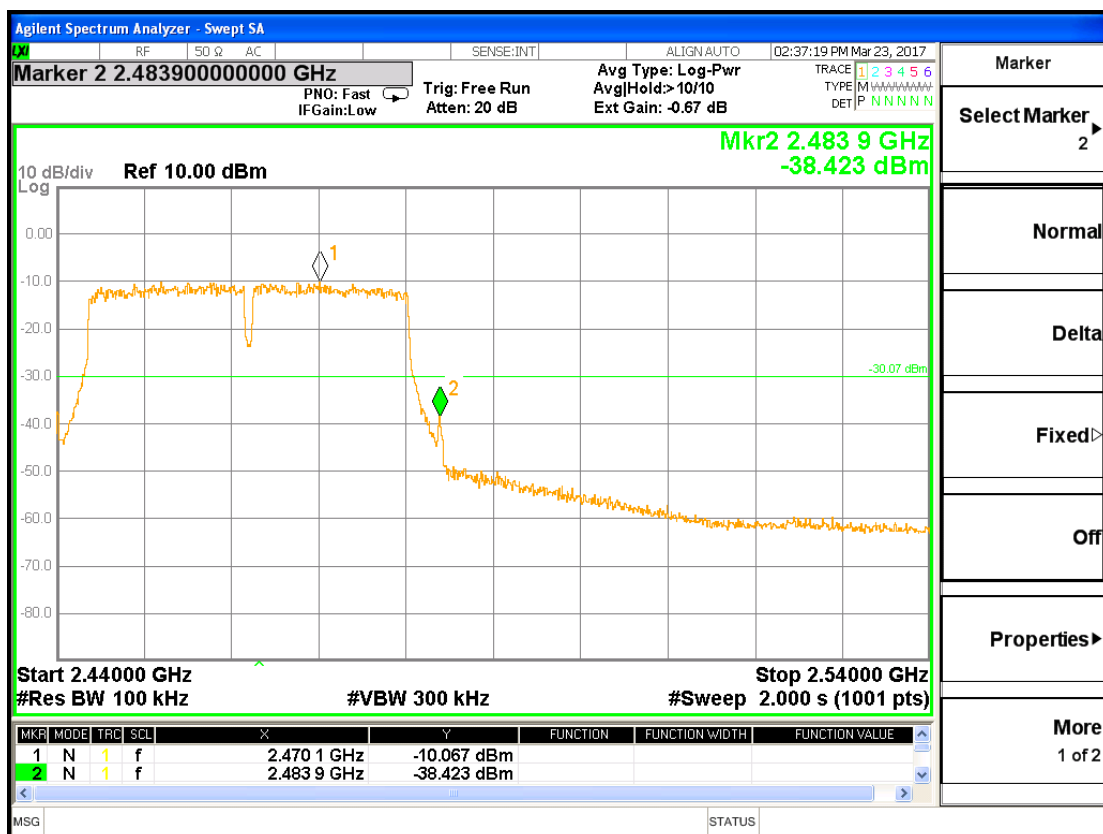
## Conducted Band Edge Measurement (802.11n(20M)\_CH.11 (2462 MHz))



### Conducted Band Edge Measurement (802.11n(40M)\_CH.1 (2412 MHz))



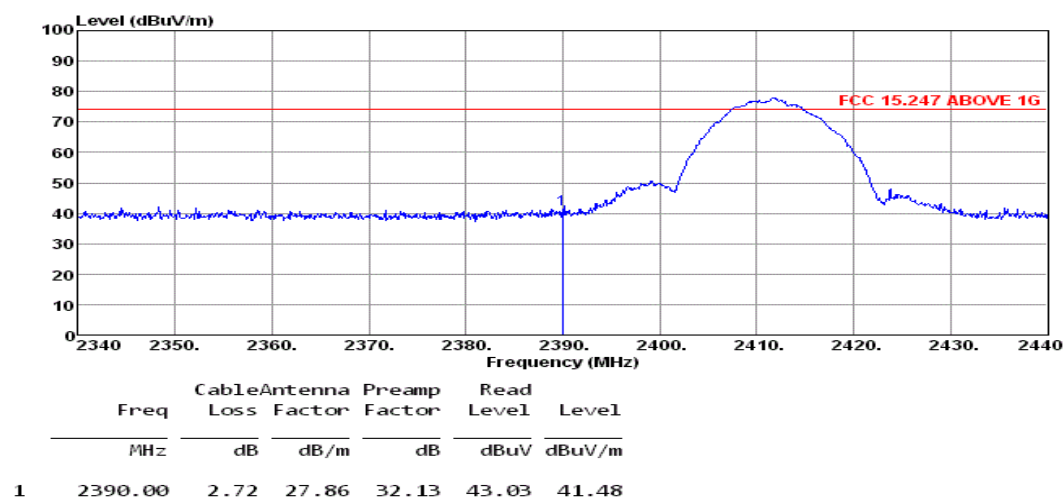
### Conducted Band Edge Measurement (802.11n(40M)\_CH.11 (2462 MHz))



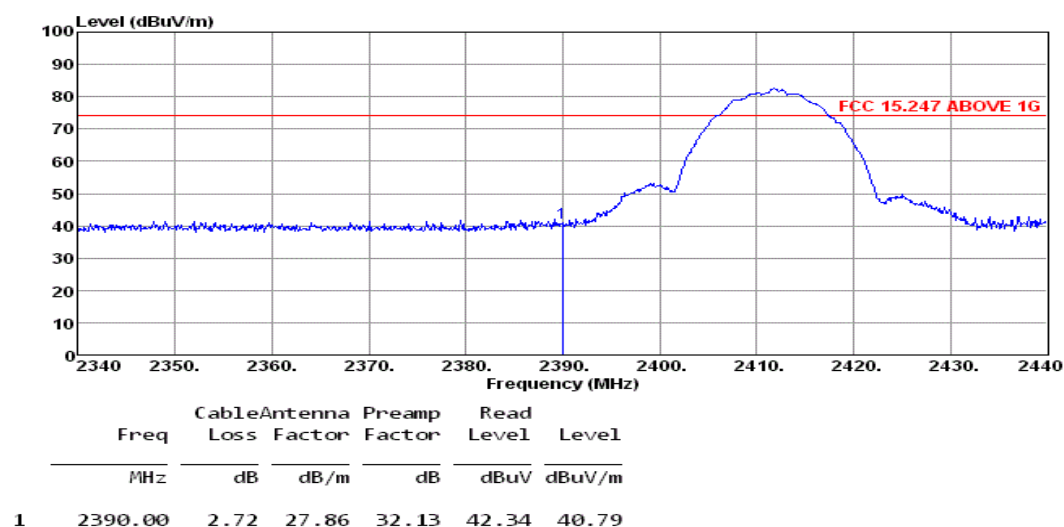
## 5.6.5.2 Radiated Band Edges

Test mode: IEEE 802.11b – Antenna B  
2412MHz (Channel 1)

### Low Band Edge – Horizontal

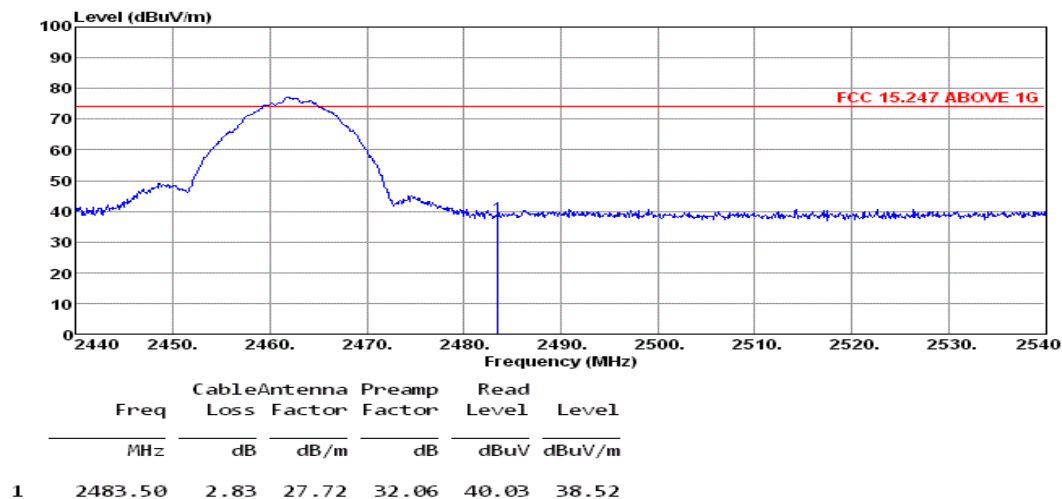


### Low Band Edge – Vertical

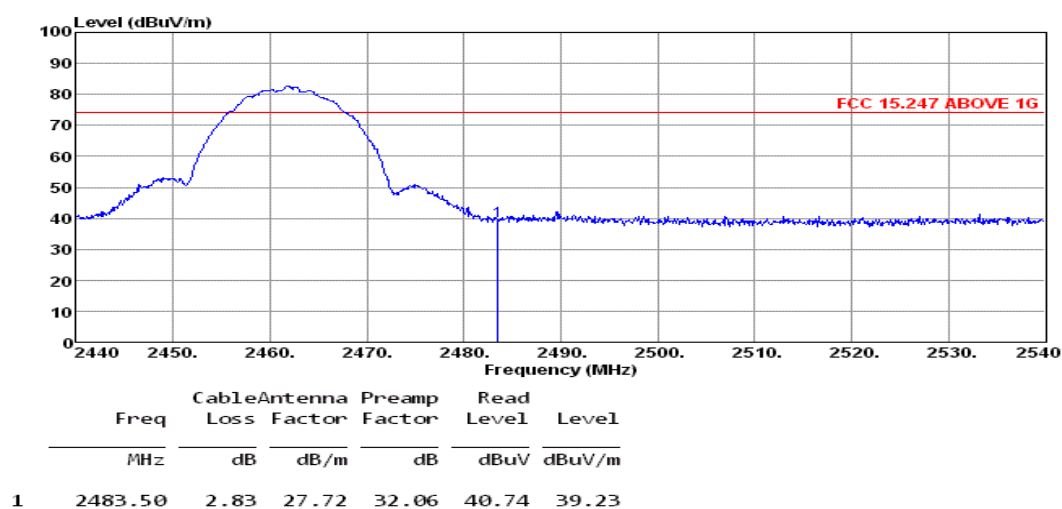


**Test mode: IEEE 802.11b – Antenna B**  
**2462MHz (Channel 11)**

## High Band Edge – Horizontal

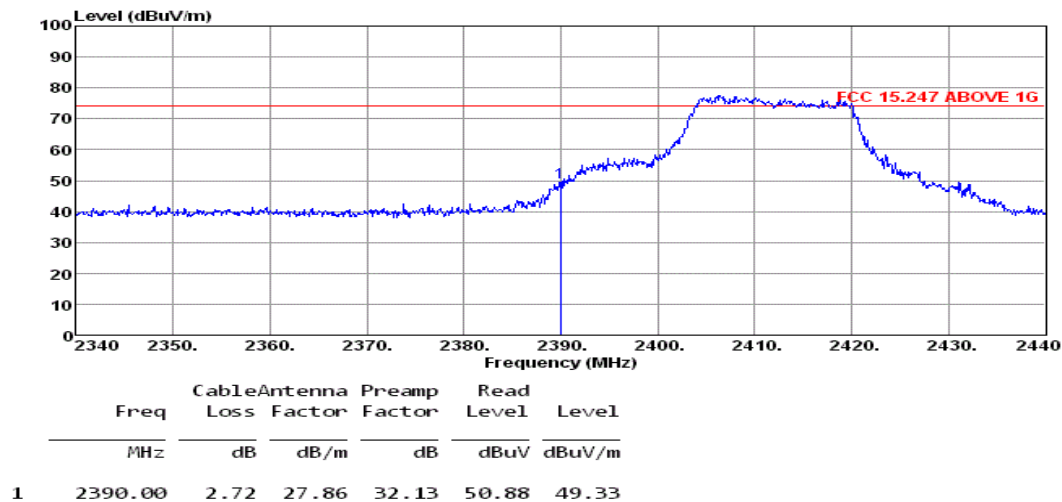


## High Band Edge – Vertical

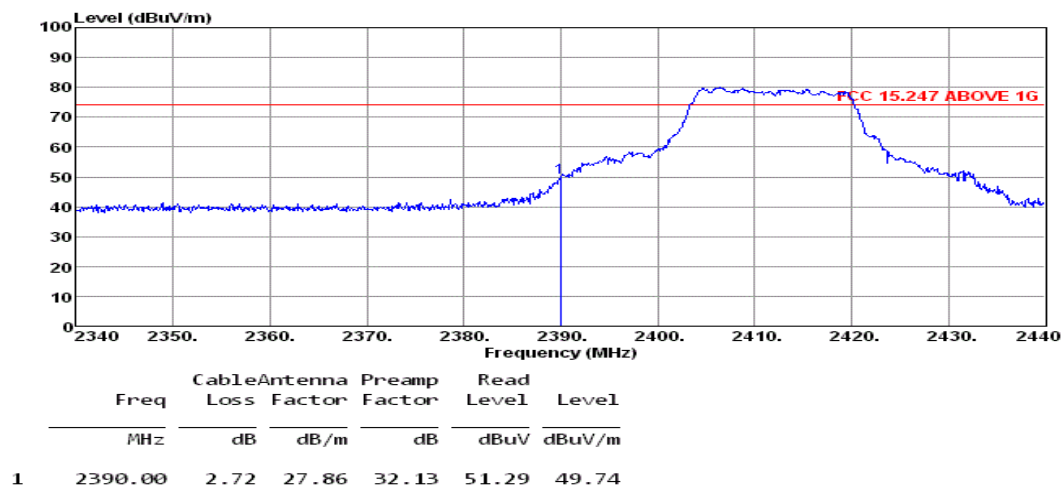


**Test mode: IEEE 802.11g – Antenna B**  
**2412MHz (Channel 1)**

## Low Band Edge – Horizontal

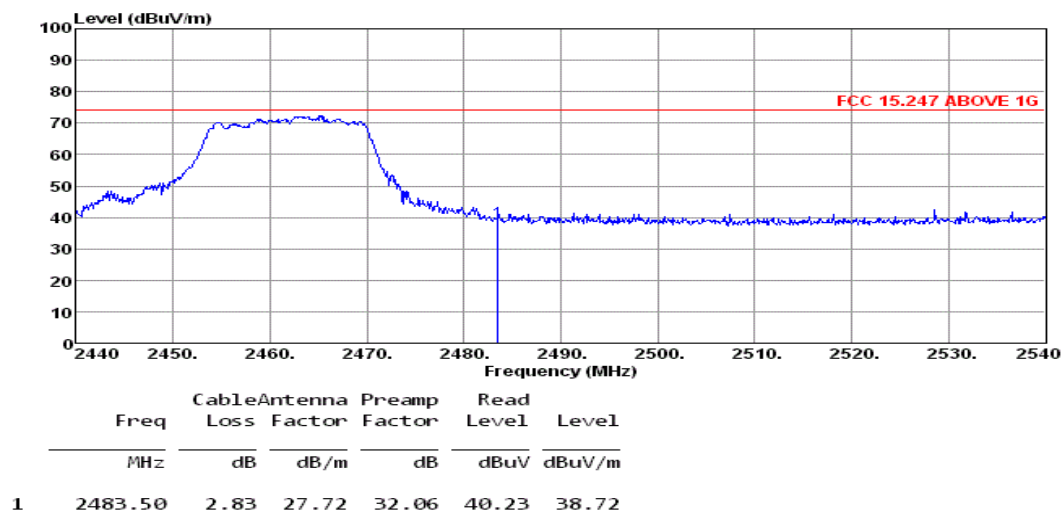


## Low Band Edge – Vertical

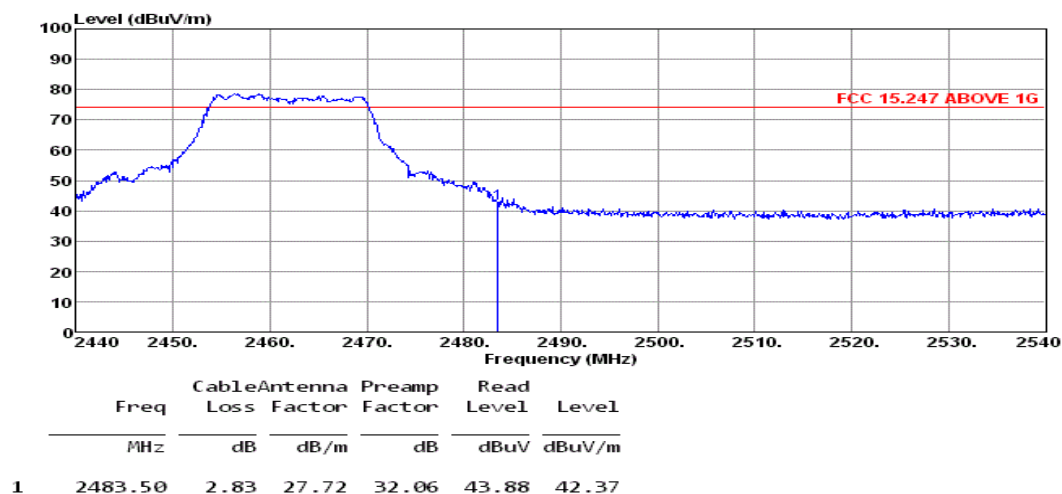


**Test mode: IEEE 802.11g – Antenna B**  
**2462MHz (Channel 11)**

## High Band Edge – Horizontal

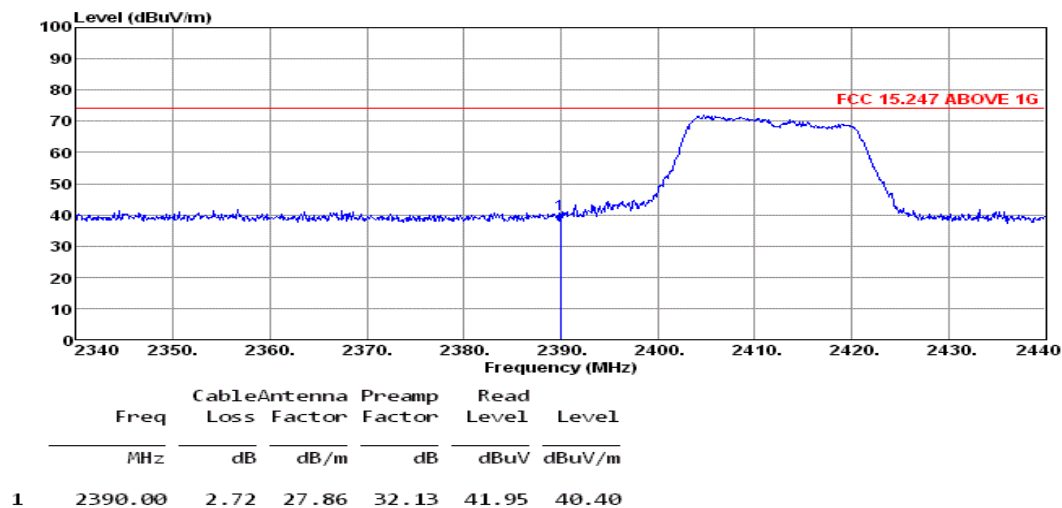


## High Band Edge – Vertical

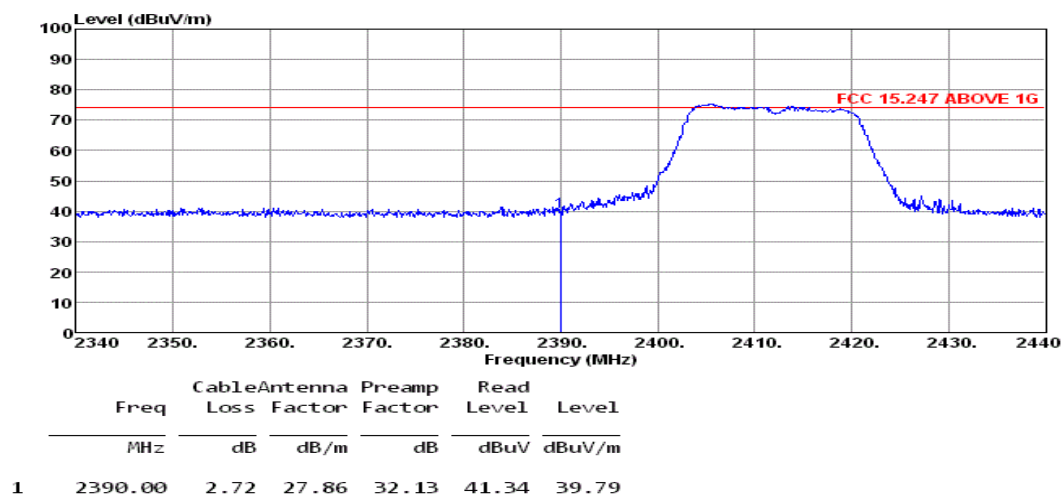


**Test mode: IEEE 802.11n(20)**  
**2412MHz (Channel 1)**

## Low Band Edge – Horizontal

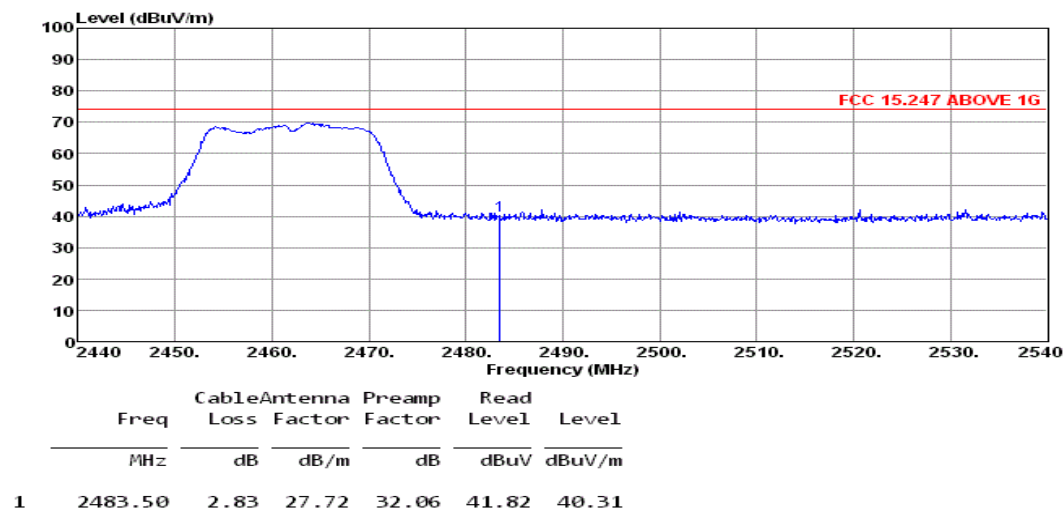


## Low Band Edge – Vertical

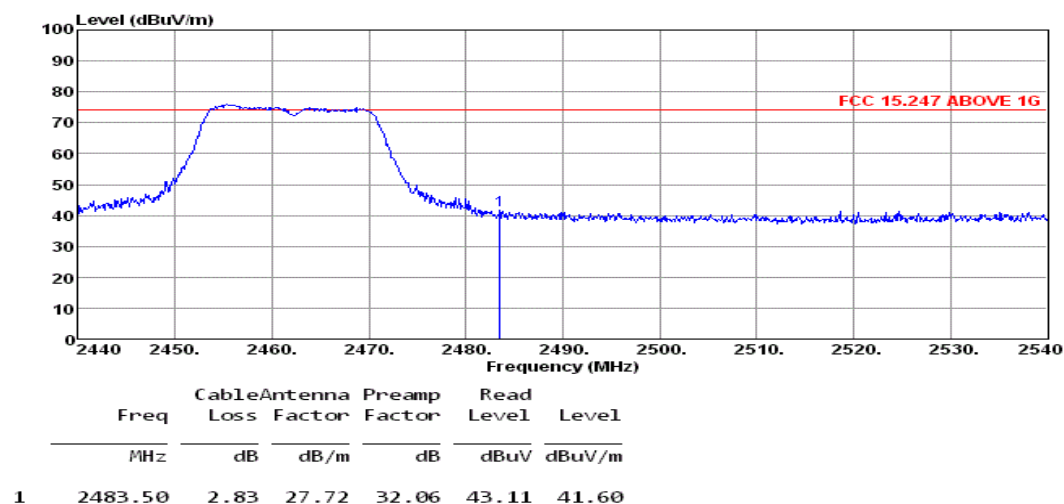


**Test mode: IEEE 802.11n(20)**  
**2462MHz (Channel 11)**

## High Band Edge – Horizontal

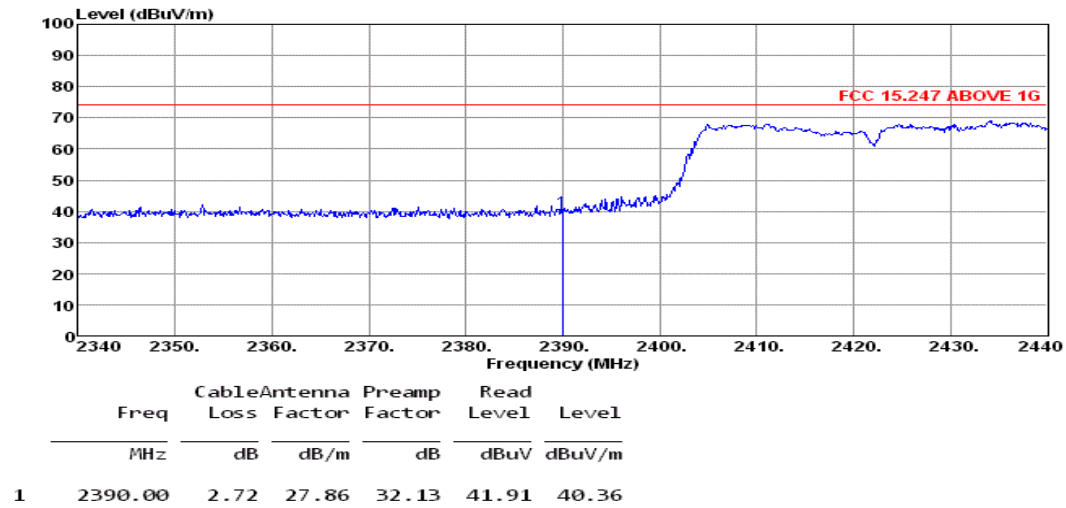


## High Band Edge – Vertical

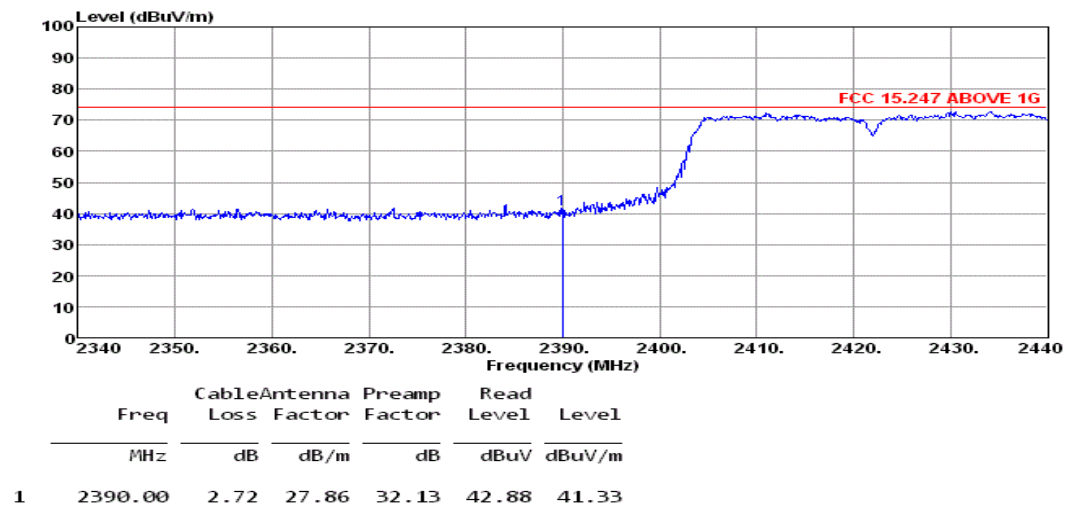


**Test mode: IEEE 802.11(n40)**  
**2422MHz (Channel 3)**

## Low Band Edge – Horizontal

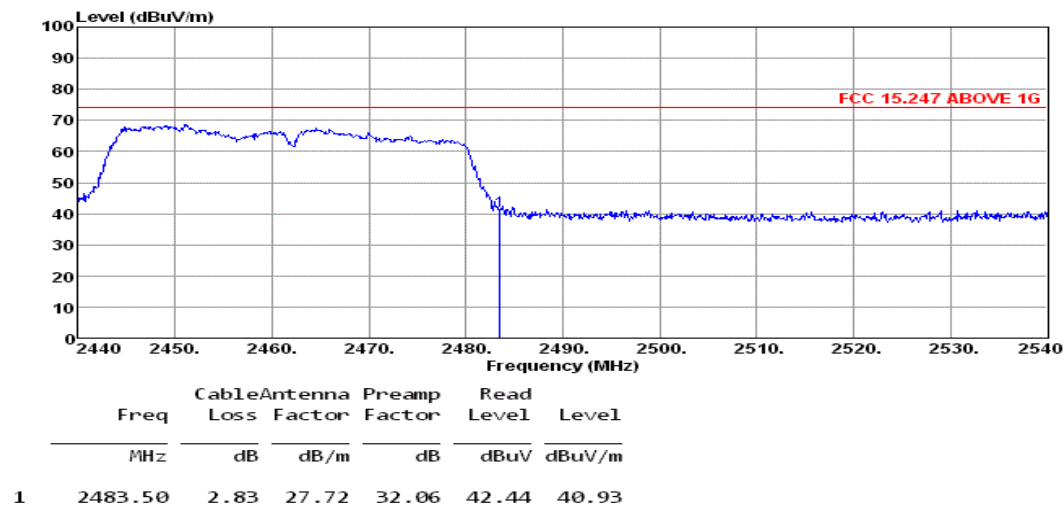


## Low Band Edge – Vertical

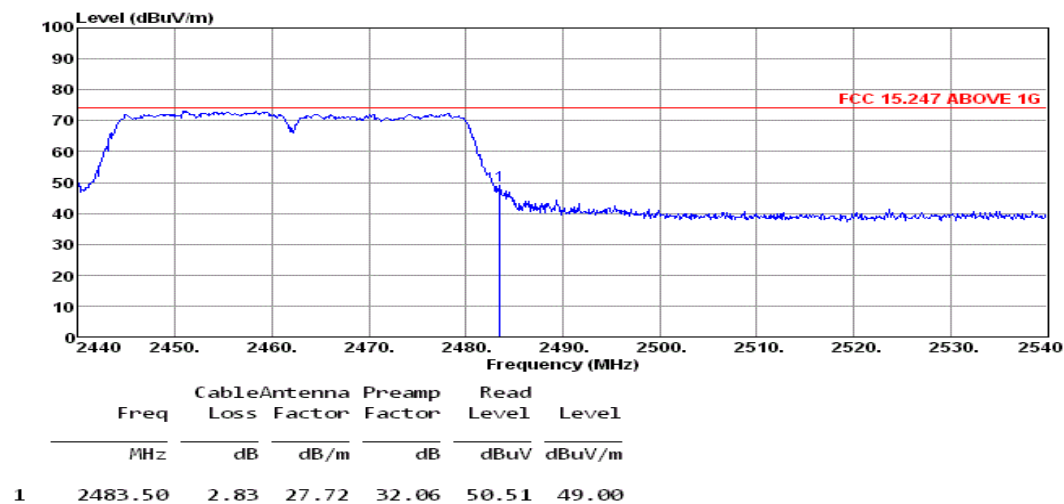


**Test mode: IEEE 802.11(n40)  
2462MHz (Channel 11)**

## High Band Edge – Horizontal



## High Band Edge – Vertical



## 5.7 Antenna Application

### 5.7.1 Antenna Requirement

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to §15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Antenna Type	Frequency	Antenna Gain	Limit
Dual Standard Antenna	2.4GHz	3dBi	≤6dBi

### 5.7.2 Result

PASS